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

(August 2024-April 2025, Phase VIII)

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Contents

1. Introduction

The red swimming crab (*Monomia haani*) belongs to the Family Portunidae and is 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 on 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 (Zhang, 1997). The

species can be caught year-round and mainly comes from bottom trawlers, baited crab traps, and gill nets. The estimated annual capture volumes of *M. haanii* were 30,000-35,000 t in Minnan-Taiwan Bank fishing grounds in the 1990s, contributing to 16-23% of the total capture volume in bottom trawl fishery (Zhang, 1997). In 2009-2018, the estimated annual capture volumes were 30,000-40,000 t, contributing to 60-70% of the annual crab catch in Fujian Province (Ocean Outcomes, 2018; OFBFJ, 2010-2018). Based on the previous results of this project (in progress reports of 2018-2022), the monthly CPUE and average size of *M. haani* collected from Minnan-Taiwan Bank fishing grounds 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. The processed products of *M. haani* and other crabs from Dongshan County for export are mainly as canned lump crab meat, frozen crab body, and frozen raw claw meat, to about 20 countries and areas (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) launched together a long-term fishery improvement project (FIP) in 2018 in Dongshan County:

(1) Phase I in August-December 2018: the project focused on 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.

(2) Phase II in January-April 2019: the project 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.

(3) Phase III in August-December 2019: 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).

Based on the Phases I-III, five publications (four in English and one in Chinese) were completed, with the details followed below:

(a) Lin, B.-a., Boenish, R., Kritzer, J.P., Jiang, Y., Wang, S.-l., Liu, M. (2021). Reproductive dynamics of a swimming crab (*Monomia haanii*) in the world's crab basket. *Fisheries Research* 236, 105828.

(b) Boenish, R., Lin, B.-a., Kritzer, J.P, Wilberg, M., Shen, C.-c., Jiang, J., Liu, M. (2021). A bioeconomic approach towards improved fishery management of *Monomia*

haanii in the southern Taiwan Strait, China. *Fisheries Research* 240, 105969.

(c) Lin, B.-a, Jiang, Y., Boenish, R., Xu, Q., Liu, M. (2021). Population, reproductive and fishery dynamics of spotted box crab (*Calappa philargius*), a new claw-only fishery species, in the southern Taiwan Strait, China. *Frontiers in Marine Science* 8, 751790.

(d) Lin, B.-a, Jiang, Y., Liu, M. (2023). Population structure and reproductive dynamics of the ridged swimming crab *Charybdis natator* in the southern Taiwan Strait of China: significant changes within 25 years. *Frontiers in Marine Science* 10, 1056640.

(e) Liu, C.-l, Zhang, X., Fan, E.-y, Wang, S.-l, Jiang, Y., Lin, B.-a, Fang, L., Li, Y.-q, Liu, L.-b, Liu, M. (2024). Species diversity and ecological characteristics of seahorses (genus *Hippocampus*) in China's waters and their conservation measures. *Biodiversity Science* 32(1), 23282, 1-17. (in Chinese with English abstract)

(4) Phase IV in August-December 2020: the project (no data available in January-April 2020) 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.

(5) In January-April 2021: the landing port surveys on the *M. haani* trawl fishery in Dongshan County were conducted without financial support to keep long term dataset available.

(6) Phase V in October 2021-April 2022: 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 trawl vessels were conducted, including the capture volumes of *M. haani*, sea horses and endangered species, and latitude and longitude data for the fishing grounds.

(7) Phase VI in August 2022-April 2023: 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 from trawl vessels continued, including the capture volumes of *M. haani* and bycatch volumes of seahorses, with latitude and longitude recorded.

(8) Phase VII in August 2023-April 2024: the project continued the surveys on the trawl fishery of *M. haani* in Dongshan County. Information on catch volumes, species composition, and proportions of main economic species and "feed fishes" were collected. Species compositions of "feed fishes" were examined. The biological study of *M. haanii* and *P. sanguinolentus* was further conducted to determine size classes, sex ratio, the number of females carrying eggs, and spawning peaks. For the first time, logbook data from baited crab trap vessels were collected in Dongshan County to provide baseline information on the trap fishery. In addition, major and minor secondary species were identified based on cumulative catch data from 2019–2023.

(9) Phase VIII in August 2024-April 2025: 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. Species compositions of "feed fishes" were examined. The biological study of *M. haani* and *P. sanguinolentus* continued. In this phase, the logbook data were collected from two trawl vessels and three trap vessels in Dongshan County.

Based on the phases V-VIII, two publications (one in English and one in Chinese) were prepared, with the details followed below:

(a) Liu, C.-l., Lin, B.-a., Jiang, Y., Fang, L., Wang, S.-l., Wang, J., Chen, Z.-z., Jiang, C.-r., Guan, S.-y., Yang, G.-h., Liu, M. (under review). Status of seahorse catches in bottom trawl fishery of the southern Taiwan Strait, China. *Fisheries Research.*

(b) Gao, W.-x., Guan, S.-y., Liu, C.-l., Fang, L., Wang, S.-l., Wang, J., Liu, M. (in preparation). Changes of *Portunus sanguinolentus* population in the southern Taiwan Strait within 30 years (1994-1996 vs 2022-2024).

In August 2024-April 2025, the specific objectives of Phase VIII 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 trawl vessels and trap vessels through the logbook collection monthly to understand the trawl and trap fishery patterns; and

(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.

2. Materials and Methods

2.1 Survey periods for trawl vessels and trap vessels

Trawl surveys were conducted at Gongqian Landing Port monthly in August 2024-April 2025 in Dongshan County, Zhangzhou City, Fujian Province; meanwhile, crab samples of *M. haanii* and *P. sanguinolentus* were randomly purchased at the landing port; approximate 20 kg per month (Table 2-1; Fig. 2-1).

In addition, logbook surveys of trawl and trap vessels were also conducted from Tongling District in August 2024-April 2025 (Fig. 2-1).

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

No.	Dates	Items
1	August 22th-27th, 2024	Trawler survey and crab sample collection
2	September 18th-22th,2024	Trawler survey and crab sample collection
3	October 9st-13th, 2024	Trawler survey and crab sample collection
4	November 4th-8th, 2024	Trawler survey and crab sample collection
5	December 7th-12th, 2024	Trawler survey and crab sample collection
6	January 9nd-13th, 2025	Trawler survey and crab sample collection
7	February 6th-9th, 2025	Trawler survey and crab sample collection
8	March 3th-7th, 2025	Trawler survey and crab sample collection
9	April 18th-22th, 2025	Trawler survey and crab sample collection

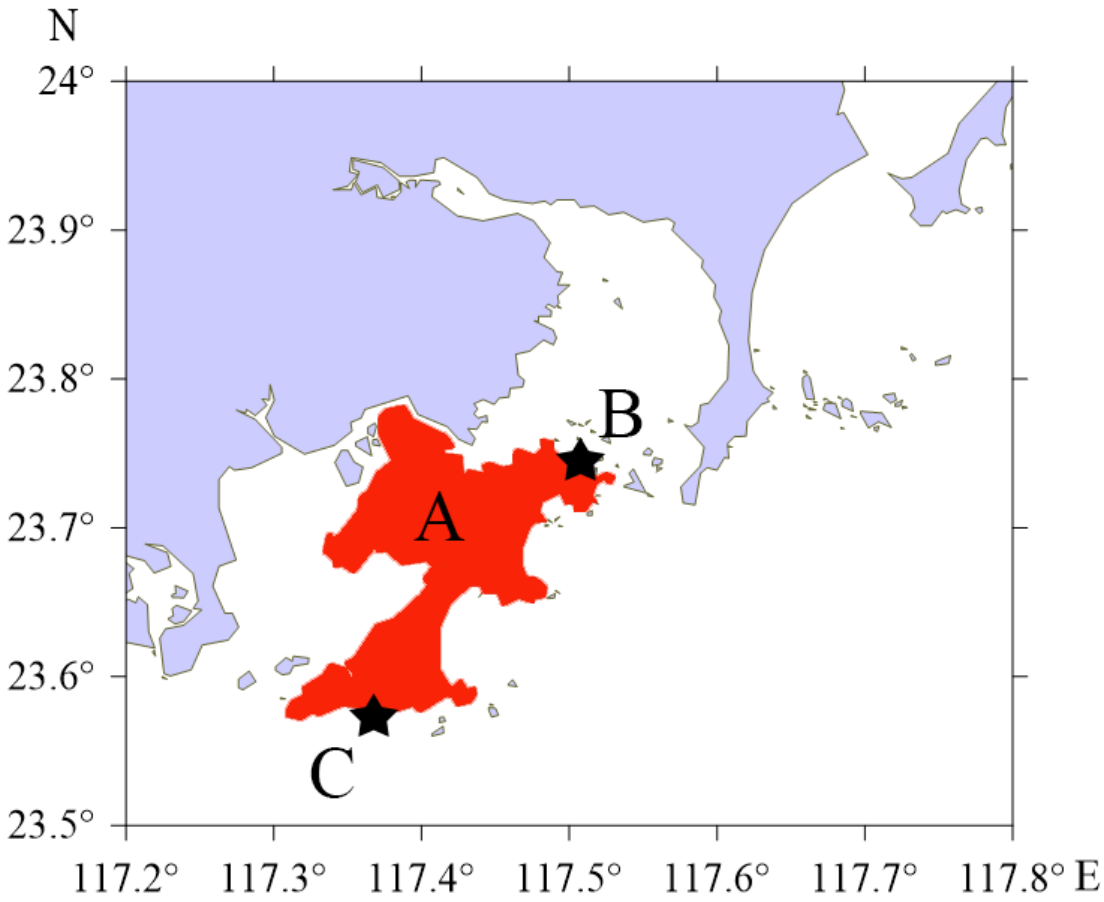

Fig. 2-1. Locations of the landing ports surveyed in Dongshan County (A). B: Tongling Landing Port; C: Gongqian Landing Port.

2.2 Fishing vessel information collection

In Dongshan County, about 424 trawl vessels were registered in 2023 and about 65 trap vessels were estimated based on the records from Fishery Society of Dongshan County. The numbers of vessels were used for further estimation on the total annual capture volumes in Dongshan County (see section 3.5).

In August 2024-April 2025, at least 10 trawl vessels were surveyed each month at Gongqian Landing Port of Dongshan County (Figs. 2-1 & 2-2). 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.

Fig. 3-2. Survey at Gongqian Landing Port in Dongshan County.

For each trawl and trap vessel surveyed through logbook, information on GPS locations (Fig. 2-3) were collected whenever possible. The information on the number of days per trip and per month at sea, the number of traps per line, and the number of trap lines towed per day were noted to further understand the operation modes of trawl and trap vessels.

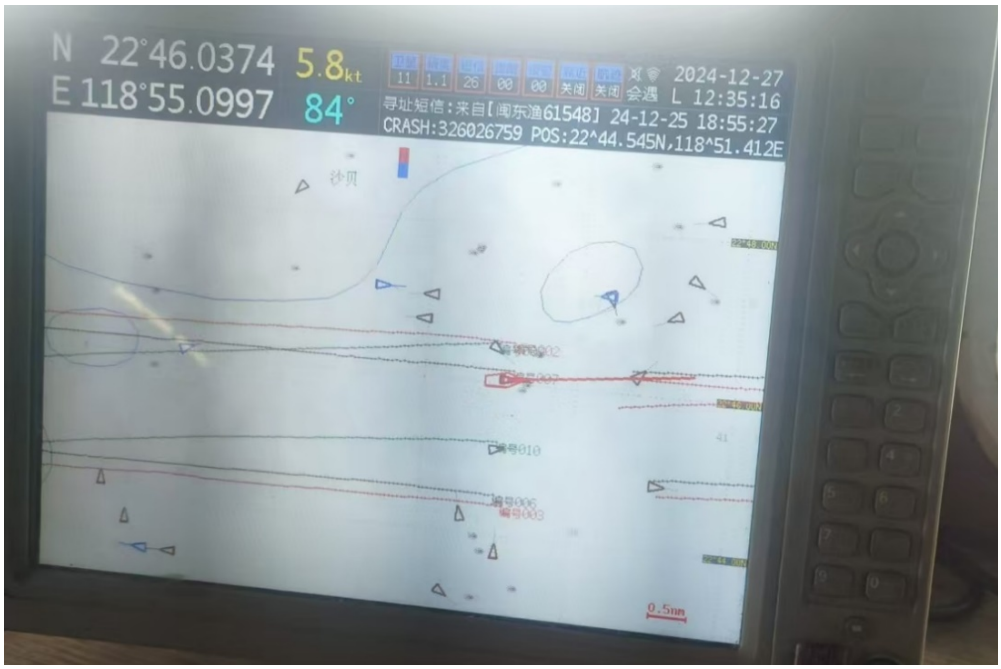

Fig. 2-3. Location of the fishing area recorded from a trap vessel surveyed through logbook.

2.3 Capture volume data collection

For each trawl vessel surveyed at Gongqian Landing Port, 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 based on observation, estimation and interview. The capture per unit effort (CPUE) of each vessel was subsequently calculated.

For each trawl vessel (N = 2) and trap vessel (N = 3) from logbook survey, the trade statements with species or species group and volume were collected (Fig. 2-4). The capture per unit effort (CPUE) of each trawl and trap vessel was subsequently calculated.

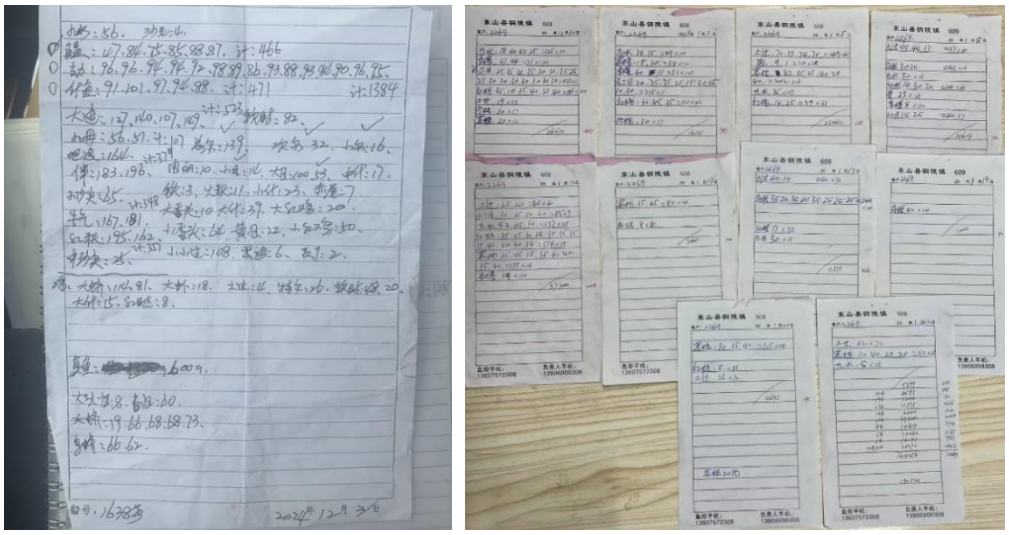

Fig. 2-4. Trade statements from the captains of the trawl (left) and trap (right) vessels surveyed through logbook in Dongshan County.

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 sorted by species in catch landings in trawl fishery.

In August 2024-April 2025, *M. haani* and *P. sanguinolentus*, about one basket (about 20 kg) each species, were collected randomly and monthly for measurement and examination during trawl vessels surveys (Figs. 2-5 & 2-6). Baskets are the uniform containers hold catches by local fishermen on board in Dongshan County.

Red swimming carb *Monomia haani*

Three-spot swimming crab *Portunus sanguinolentus*

Fig. 2-5. Two crab species sampled for biological examination.

Fig. 2-6. *Monomia haani* (up) and *Portunus sanguinolentus* (down) landings at Gongqian Landing Port of Dongshan County.

2.5 Feed fish sampling

At least 1 kg feed fishes were randomly collected monthly in August 2024-April 2025 from the trawl vessels surveyed at Gongqian Landing Port for further species identification, proportions of different species, and size measurement (Fig. 2-7).

Small *M. haani* and *P. sanguinolentus* individuals were also found in feed fish samples; their size and sex data were integrated into further biological analyses for the two species (see sections 3.7 & 3.8).

Fig. 2-7. Feed fish landings at Gongqian Landing Port of Dongshan County.

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 small size and poor 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. 2-8).

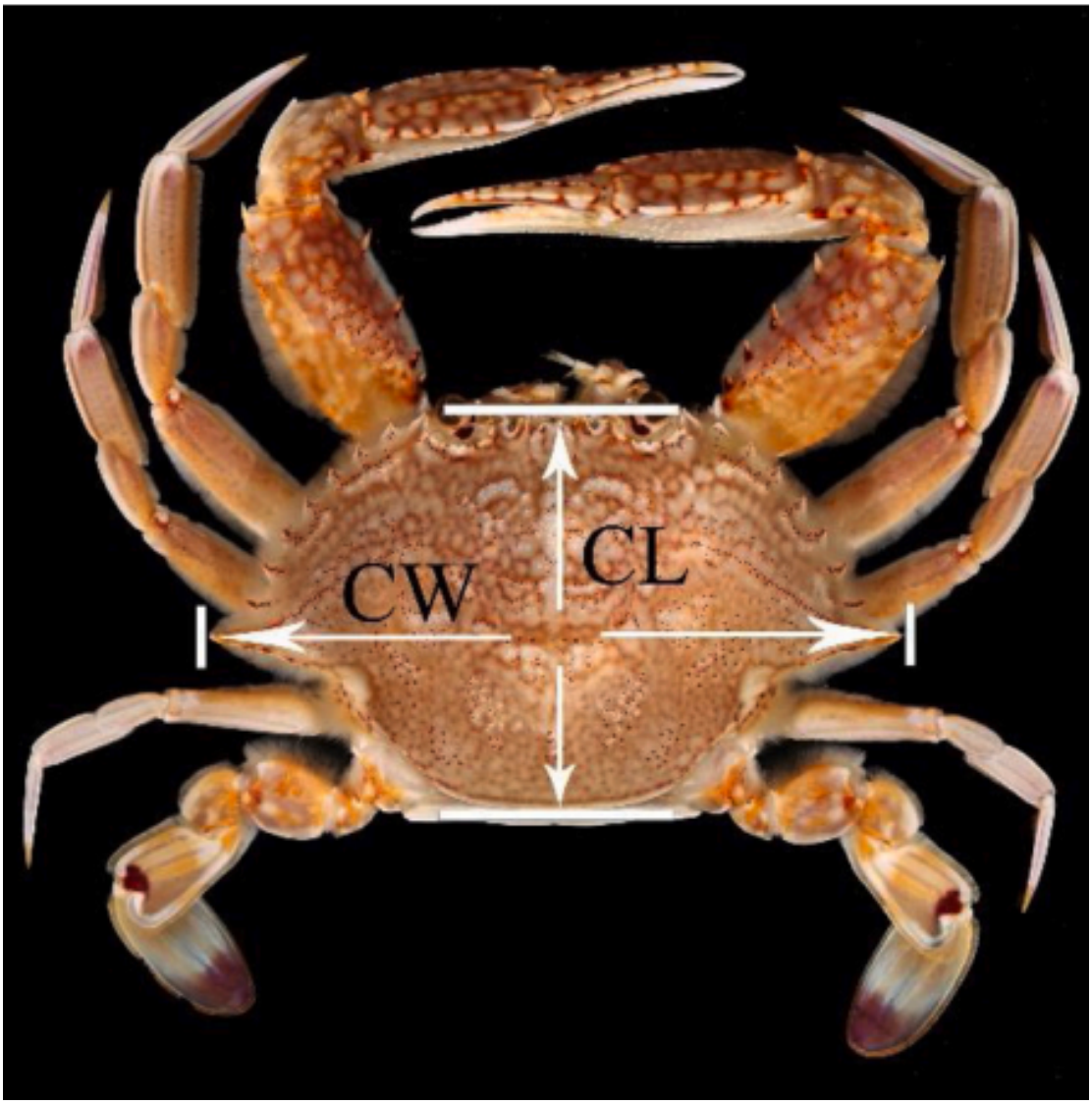

Fig. 2-8. Crab size measurement.
CL: carapace length; CW: carapace width.

2.8 Crab sex determination

Crab sex was determined based on the morphology of abdomen (Fig. 2-9). The spawning season of crabs is determined by the high proportions of the females bearing eggs by month (Fig. 2-10). 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 water.

Fig. 2-9. Sex determination for crabs.

Fig. 2-10. A female crab bearing eggs.

3. Results

3.1 Number of vessels surveyed

A total of 98 trawl vessels were surveyed at Gongqian Landing Port of Dongshan County in August 2024-April 2025 (Fig. 2-1; Table 3-1).

In addition, the catch volume records (trade statement) of three baited trap vessels (N = 3) and two trawl vessels (N = 2) from Tongling District were collected in August 2024-April 2025 (Fig. 2-1).

Table 3-1. Number of trawl vessels surveyed in August 2024-April 2025 at Gongqian Landing Port of Dongshan County.

Month	Number of vessels surveyed
August 2024	10
September 2024	11
October 2024	13
November 2024	11
December 2024	10
January 2025	11
February 2025	11
March 2025	10
April 2025	11
Total	98

3.2 Species diversity from trawl and trap fishery

3.2.1 Species composition

A total of 523 species (at species, genus or family level) were identified cumulatively from trawl fishery catches from August 2018 to April 2025 (Phases I-VIII) at the landing ports of Dongshan County, including 403 fishes (77.06%), 96 crustaceans (18.36%) and 24 cephalopods (4.58%) (Table 3-2). Fishes came from 23 orders and 108 families, with almost half of the species from the order Perciformes. Crustaceans came from 2 orders and 25 families, and cephalopods came from 4 orders and 6 families. Among 523 species, 76 species were found in both food and feed fishes, including 56

fishes, 11 crustaceans and 9 cephalopods; 200 species were only found in feed fishes, including 134 fishes, 59 crustaceans and 7 cephalopods.

In logbook surveys of trawl vessels (N= 2), catches were sorted as crabs (by species), shrimps (by species or species group or size), fishes (by species or species group), cuttlefishes (by species or species group or size), squids (by species or species group or size) and octopus (by species or species group or size). Crabs included *M. haanii*, *P. sanguinolentus*, *P. trituberculatus*, *Charybdis feriatus*, *C. natator*, and *Calappa philargius*. Trade of trawl vessles included mainly fresh with minor alive.

In logbook surveys of trap vessels (N = 3), catches were sorted as crabs (by species or size), fishes (by species or species group), cuttlefishes (by species or species group or size), squids (by species or species group or size) and octopus (b by species or species group or size); no shrimps in catches. Crabs also included *M. haanii*, *P. sanguinolentus*, *P. trituberculatus*, *Charybdis feriatus*, *C. natator*, and *Calappa philargius*. 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* and *Sebastiscus marmoratus*. Fishes were mainly recorded as species group, such as eels, bamboo sharks, Synodontidae spp., Sillaginidae spp., Tetraodontidae spp. and Mullidae spp.. Becides these, the remained fishes were recorded as mixed fishes. Trade of trap vessels included both fresh and alive.

Table 3-2. Species recorded (N = 523) in trawl fishery in August 2018-April 2025 (Phase I-VIII) 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 = 403)					
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	Lesser moray	*#Gymnothorax minor*	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	Indian anchovy	**Stolephorus indicus*	LC
		78	Bloch's gizzard shad	*Nematalosa nasus*	LC
	Engraulidae	79	Commerson's anchovy	**Stolephorus commersonnii*	LC
		80	Japanese anchovy	**Engraulis japonicus*	LC
		81	Kammal thryssa	**Thryssa kammalensis*	DD
		82	Moustached thryssa	*Thryssa mystax*	LC
		83	Orangemouth anchovy	*Thryssa vitrirostris*	LC
		84	Hamilton's thryssa	*Thryssa hamiltonii*	LC
		85	Dussumier's thryssa	**Thryssa dussumieri*	LC
		86	Common hairfin anchovy	**Setipinna tenuifilis*	DD
	Prisigasteridae	87	Elongate ilisha	*Ilisha elongata*	LC
		88	Buccaneer anchovy	**Encrasicholina punctifer*	LC
Gonorhynchiformes	Gonoruchidae	89	beaked salmon	**Gonorynchus abbreviatus*	NE
Siluriformes	Plotosidae	90	Striped eel catfish	*Plotosus lineatus*	NE

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

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

		139	Weedy stingfish	*Scorpaenopsis cirrosa*	NE
		140	Scorpionfish	*#Scorpaena miostoma*	NE
		141	Korean rockfish	*Sebastes schlegelii*	NE
		142	Dwarf stingfish	**Minous pusillus*	NE
		143	Grey stingfish	**Minous monodactylus*	LC
	Aploactinidae	144	Dusky velvetfish	**Aploactis aspera*	NE
	Triglidae	145	Oriental flying gurnard	*Dactyloptena orientalis*	LC
		146	Spiny red gurnard	*#Chelidonichthys spinosus*	LC
		147	Redwing searobin	**Lepidotrigla microptera*	NE
		148	Forksnout searobin	**Lepidotrigla alata*	NE
		149	Searobin	**Lepidotrigla japonica*	NE
	Platycephalidae	150	Midget flathead	**Onigocia spinosa*	LC
		151	Rough flathead	*Grammoplites scaber*	NE
		152	Tuberculated flathead	**Sorsogona tuberculata*	LC
		153	Bartail flathead	*Platycephalus indicus*	DD
		154	Olive-tailed flathead	**Rogadius asper*	LC
		155	Celebes flathead	**Thysanophrys celebica*	LC
		156	Large-spined flathead	**Suggrundus macracanthus*	LC
		157	Japanese flathead	**Inegocia japonica*	LC
		158	Spotted flathead	**Inegocia guttata*	NE
		159	Crocodile flathead	*Cociella crocodila*	LC
		160	Flathead	*Platycephalidae sp.	
Perciformes	Moronidae	161	Japanese seabass	*Lateolabrax japonicus*	NE
	Serranidae	162	Barred soapfish	*Diploprion bifasciatum*	LC

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

		186	Luminous cardinalfish	**Rhabdamia gracilis*	LC
	Sillaginidae	187	Japanese sillago	*Sillago japonica*	LC
		188	Bay sillago	*#Sillago ingenuua*	NE
	Coryphaenidae	189	Common dolphinfish	*Coryphaena hippurus*	LC
	Rachycentridae	190	Cobia	*Rachycentron canadum*	LC
	Echeneidae	191	Shark sucker	*Remora remora*	LC
	Carangidae	192	African pompano	*Alectis ciliaris*	LC
		193	Bigeye scad	*Selar crmenophthalmus*	LC
		194	Torpedo scad	*Megalaspis cordyla*	LC
		195	Yellowstripe scad	*#Selaroides leptolepis*	LC
		196	Black pomfret	*Parastromateus niger*	LC
		197	Whitefin trevally	**Carangoides equula*	LC
		198	Razorbelly scad	*Alepes kleinii*	LC
		199	Japanese scad	*#Decapterus maruadsi*	LC
		200	Shortfin scad	*Decapterus macrosoma*	LC
		201	Japanese jack mackerel	*#Trachurus japonicus*	NT
		202	Snubnose pompano	*Trachinotus blochii*	LC
		203	Needlescaled queenfish	*Scomberoides tol*	LC
		204	Yellowtail amberjack	*Seriola dumerili*	LC
		205	Yellowtail amberjack	*Seriola aureovittata*	LC
		206	Blackbanded trevally	*Seriolina nigrofasciata*	LC
		207	Jack	*Carangidae sp.	
	Menidae	208	Moonfish	*Mene maculata*	NE
	Leiognathidae	209	Deep pugnose ponyfish	**Secutor ruconius*	NE

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

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

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

		281	Slender wrasse	**Suezichthys gracilis*	LC
		282	Rosed razorfish	*Iniistius verrens*	LC
		283	Blackspot razorfish	*Iniistius dea*	LC
		284	Redblotch razorfish	*Xyrichtys twistii*	LC
		285	Masuda's hogfish	*Bodianus masudai*	LC
		286	Blackstripe wrasse	*Coris musume*	LC
		287	Red naped wrasse	*Pseudolabrus eoethinus*	LC
	Scaridae	288	Blue-barred parrotfish	*Scarus ghobban*	LC
	Champsodontidae	289	Crocodile toothfish	**Champsodon atridorsalis*	NE
		290	Günther's gaper	**Champsodon guentheri*	NE
		291	Snyder's gaper	**Champsodon snyderi*	NE
	Pinguipedidae	292	Harlequin sandsmelt	*#Parapercis pulchella*	LC
		293	Sandperch	**Parapercis ommatura*	NE
		294	Grub fish	*Parapercis sexfasciata*	NE
		295		**Parapercis* sp.	
		296		*Pinguipedidae sp.	
	Callionymidae	297	Dragonet	*#Callionymus huguenini*	NE
		298	Japanese longtail dragonet	*Calliurichthys japonicus*	LC
		299	Japanese filamentous dragonet	*Callionymus doryssus*	NE
		300	Eightspot dragonet	*#Callionymus octostigmatus*	NE
		301	Horn dragonet	**Callionymus curvicornis*	NE
		302	Izu ruddertail dragonet	*Callionymus curvispinis*	NE
		303	Dragonet	**Callionymus* sp.	

		304	Izu dragonet	*Calliurichthys izuensis*	NE
		305	Kai Island deepwater dragonet	*Bathycallionymus kaianus*	NE
	Percophidae	306	Duckbill	*Acanthaphritis barbata*	NE
		307	Duckbill	*Percophidae sp.	
	Trichonotidae	308	Black-spot sand-diver	*#Trichonotus filamentosus*	LC
		309	Spotted sand-diver	*#Trichonotus setiger*	LC
	Ammodytidae	310	Sand lance	*#Bleekeria viridianguilla*	NE
		311	Sand lance	*#Bleekria mitsukurii*	NE
	Uranoscopidae	312	Naked-nape stargazer	*Uranoscopus oligolepis*	LC
		313	Chinese stargazer	**Uranoscopus bicinctus*	NE
		314	Japanese stargazer	*#Uranoscopus japonicus*	LC
		315	Chinese stargazer	**Uranoscopus chinensis*	NE
		316	Longnosed stargazer	**Ichthyscopus lebeck*	NE
		317	Oriental fringe stargazer	**Ichthyscopus pollicaris*	NE
		318		*Uranoscopidae sp.	
	Gobiidae	319	Burrowing goby	*Trypauchen vagina*	LC
		320	Maned goby	**Oxyurichthys microlepis*	LC
		321	Pinkgray goby	**Amblychaeturichthys hexanema*	NE
		322	Goby	*Gobiidae sp.1	
		323	Goby	*Gobiidae sp.2	
	Eleotridae	324	Ward's sleeper	**Valenciennea wardi*	LC
		325	Immaculate glidergoby	**Valenciennea immaculata*	LC
	Ptereleotridae	326	Blue hana goby	**Ptereleotris hanae*	LC

	Ephippidae	327	Longfin batfish	*Platax teria*	LC
	Siganidae	328	Mottled spinefoot	*#Siganus fuscescens*	LC
	Sphyraenidae	329	Seapike	*Sphyraena jello*	NE
		330	Red barracuda	*Sphyraena pinguis*	NE
		331	Yellowtail barracuda	*Sphyraena flavicauda*	NE
		332	Japanese barracuda	*Sphyraena japonica*	NE
		333	Seapike	*Sphyraena sp.*	
	Acanthuridae	334	Scalpel sawtail	*Prionurus scalprum*	DD
	Trichiuridae	335	Largehead hairtail	*#Trichiurus lepturus*	LC
		336	Japanese hairtail	**Trichiurus japonicus*	NE
		337	Chinese short-tailed hairtail	**Trichiurus brevis*	NE
		338	Hairtail	**Trichiurus sp.*	
	Scombridae	339	Chub mackerel	*#Scomber japonicus*	LC
		340	Japanese Spanish mackerel	*Scomberomorus niphonius*	DD
		341	Narrow-barred Spanish mackerel	*Scomberomorus commerson*	NT
		342	Indo-Pacific king mackerel	*Scomberomorus guttatus*	DD
		343	Bullet mackerel	*Auxis thazard*	LC
		344	Bonito	*Euthynnus affinis*	LC
		345	Striped bonito	*Sarda orientalis*	LC
	Istiophorus	346	Indo-Pacific sailfish	*Istiophorus platypterus*	NE
	Centrolophidae	347	Pacific rudderfish	*#Psenopsis anomala*	LC
	Stromateidae	348	Butterflyfish	*Pampus argenteus*	NE
		349	Chinese silver pomfret	*Pampus chinensis*	NE

Pleuronectiformes	Paralichthyidae	350	Cinnamon flounder	*Pseudorhombus cinnamoneus*	LC
		351	Largetooth flounder	*Pseudorhombus arsius*	NE
		352	Taiwan-ganzôbirame	*Pseudorhombus levisquamis*	LC
		353	Roughscale flounder	*Pseudorhombus oligodon*	LC
		354	Large-tooth flounder	**Tarphops oligolepis*	LC
		355	Bastard halibut	*Paralichthys olivaceus*	NE
	Bothidae	356	Lefteye flounder	**Psettina tosana*	LC
		357	Flounder	**Psettina* sp.	
		358	Largescale flounder	**Engyprosopon grandisquama*	LC
		359	Lefteye flounder	**Engyprosopon maldivensis*	DD
		360	Lefteye flounder	**Engyprosopon multisquama*	LC
		361	Largescale dwarf flounder	**Engyprosopon macrolepis*	LC
		362	Blue flounder	**Crossorhombus azureus*	LC
		363	Flounder	**Crossorhombus* sp.	
		364	Indo-Pacific oval flounder	**Bothus myriaster*	LC
		365	Many-spotted lefteye flounder	**Arnoglossus polyspilus*	LC
		366	Large-crested lefteye flounder	**Arnoglossus macrolophus*	LC
		367	Dwarf lefteye flounder	**Arnoglossus tenuis*	LC
		368	Lefteye flounder	**Arnoglossus* sp.	
		369	Flounder	*Bothidae sp.	
	Pleuronectidae	370	Ridged-eye flounder	#*Pleurinichthys cornutus*	NE
	Samaridae	371	Crested flounder	**Samaris cristatus*	LC

	Soleidae	372	Ovate sole	**Solea ovata*	LC
		373	Unicorn sole	*Aesopia cornuta*	LC
		374	Zebra sole	*Zebrias zebra*	NE
		375	Flounder	**Zebrias crossolepis*	DD
		376	Wavyband sole	**Pseudaesopia japonica*	LC
		377	Flounder	*Soleidae sp.	
		378	Blackspotted sole	*#Liachirus melanospilos*	LC
	Cynoglossidae	379	Red tonguesole	**Cynoglossus joyneri*	NE
		380	Speckled tougue sole	**Cynoglossus puncticeps*	LC
		381	Speckled tongue sole	**Cynoglossus itinus*	LC
		382	Genko sole	**Cynoglossus interruptus*	LC
		383	Three-lined tongue sole	*Cynoglossus abbreviatus*	DD
		384	Tongue sole	**Cynoglossus oligolepis*	DD
		385	Tongue sole	**Cynoglossus* sp.	
		386	Black cow-tongue	*Paraplagusia japonica*	LC
Tetraodontiformes	Monacanthidae	387	Unicorn leatherjacket filefish	*Aluterus monoceros*	LC
		388	Threadsail filefish	*#Stephanolepis cirrhifer*	LC
		389	Hairfinned leatherjacket	**Paramonacanthus japonicus*	LC
		390	Mudbank filefish	*#Paramonacanthus sulcatus*	LC
		391	Faintstripe filefish	*#Paramonacanthus pusillus*	LC
		392	Prickly leatherjacket	*Chaetodermis peniciligera*	LC
	Tetraodontidae	393	Blowfish	*#Lagocephalus wheeleri*	NE
		394	Smooth blaasop	*Lagocephalus inermis*	LC

		395	Lattice blaasop	*Takifugu oblongus*	LC
		396	Pufferfish	*Takifugu poecilonotus*	LC
		397	Yellowfin puffer	*Takifugu xanthopterus*	LC
		398	Guineafowl puffer	*Arothron meleagris*	LC
		399	Stellate puffer	*Arothron stellatus*	LC
		400	Puffer	*Torquigener pallimaculatus*	LC
	Diodontidae	401	Longspined porcupinefish	*Diodon holocanthus*	LC
	Balistidae	402	Starry triggerfish	*Abalistes stellaris*	LC
		403	Masked triggerfish	*Sufflamen fraenatum*	LC
Crustacean (N = 96)					
Stomatopoda	Squillidae	404	Japanese squillid mantis shrimp	**Oratosquilla fabricii*	NE
		405	Mantis shrimp	**Oratosquilla kempi*	NE
		406	Mantis shrimp	**Lophosquilla costata*	NE
		407	Mantis shrimp	**Lophosquilla* sp.	
		408	Robber harpiosquillid mantis shrimp	*Harpiosquilla harpax*	NE
		409	Smooth squillid mantis shrimp	**Erugosquilla woodmasoni*	NE
		410	Mantis shrimp	**Carinosquilla multicarinata*	NE
		411	Mantis shrimp	**Oratosquillina interrupta*	NE
		412	Mantis shrimp	#*Odontodactylus japonicus*	NE
		413	Mantis shrimp	*Squillidae sp.	
Decapoda	Sicyoniidae	414	Shrimp	**Sicyonia japonica*	NE

		415	Shrimp	**Sicyonia cristata*	NE
		416	Shrimp	**Sicyonia* sp.	
	Palaemonidae	417	Shrimp	*Palaemonidae sp.	
	Solenoceridae	418	Udang merah	*#Solenocera crassicornis*	NE
	Penaeidae	419	Kuruma shrimp	*Penaeus japonicus*	NE
		420	Chinese white prawn	*Penaeus merguiensis*	NE
		421	Western king prawn	*Penaeus latisulcatus*	NE
		422	Green tiger prawn	*Penaeus semisulcatus*	NE
		423	Witch prawn	*Penaeus canaliculatus*	NE
		424	Redspot king prawn	*Penaeus longistylus*	NE
		425	Giant tiger prawn	*Penaeus monodon*	NE
		426	Periscope shrimp	**Atypopenaeus stenodactylus*	NE
		427	Southern rough shrimp	*#Trachysalambria curvirostris*	NE
		428	Rough shrimp	**Trachysalambria longipes*	NE
		429	Spear shrimp	*#Parapenaeopsis hardwickii*	NE
		430	Coral shrimp	*#Kishinouyepenaeopsis cornuta*	NE
		431	Shrimp	**Mierspenaeopsis cultrirostris*	NE
		432	Smoothshell shrimp	**Batepenaeopsis tenella*	NE
		433	Flamingo shrimp	**Parapenaeus longipes*	NE
		434	Whiskered velvet shrimp	*#Metapenaeopsis barbata*	NE
		435	Kishi velvet shrimp	**Metapenaeopsis dalei*	NE
		436	Humpback prawn	*Metapenaeopsis lamellata*	NE
		437	Southern velvet shrimp	**Metapenaeopsis palmensis*	NE
		438	Mogi velvet shrimp	**Metapenaeopsis mogiensis*	NE

		439	Velvet shrimp	**Metapenaeopsis* sp.1	
		440	Velvet shrimp	**Metapenaeopsis* sp.2	
		441	Shrimp	**Penaeidae* sp.1	
		442	Shrimp	**Penaeidae* sp.2	
	Pasiphaeidae	443	Lesser glass shrimp	**Leptochela gracilis*	NE
	Thoridae	444	Shrimp	**Birulia kishinouyei*	NE
	Scyllaridae	445	Slipper lobster	**Chelarctus cultrifer*	LC
	Palinura	446	Chinese spiny lobster	*Panulirus stimpsoni*	DD
		447	Ornate spiny lobster	*Panulirus ornatus*	LC
		448	Smooth fan lobster	*Ibacus novemdentatus*	LC
	Albuneidae	449	Sand crab	**Albunea* sp.	
	Raninidae	450	Red frog crab	*Ranina ranina*	NE
		451	Crab	**Cosmonotus grayii*	NE
	Dromiidae	452	Japanese sponge crab	**Lauridromia dehaani*	NE
		453	Crab	**Conchoecetes artificiosus*	NE
	Dorippidae	454	Granulated mask crab	**Paradorippe granulata*	NE
	Majidae	455	Kelp crab	**Pugettia* sp.	
		456	Crab	*Majidae sp.	
	Leucosiidae	457	Pebble crab	*Leucosia craniolaris*	NE
		458	Painted pebble crab	*Leucosia anatum*	NE
		459	Fleeting purse crab	**Myra fugax*	NE
		460	Crab	**Myra* sp.	NE
		461	Crab	*Leucosiidae sp.	
	Calappidae	462	Box crab	*#Calappa philargius*	NE

		463	Spotted box crab	*Calappa lophos*	NE
		464	Reef box crab	**Calappa hepatica*	NE
		465	Crab	**Cycloes granulosa*	NE
	Epialtidae	466	Crab	**Phalangipus* sp.	
	Parthenopidae	467	Strong elbow crab	**Enoplolambrus validus*	NE
	Corystidae	468	Crab	*Jonas distincta*	NE
	Matutiodea	469	Spotted moon crab	**Matuta planipes*	NE
		470	Yellow moon crab	**Ashtoret lunaris*	NE
	Portunidae	471	Mud crab	*Scylla paramamosain*	NE
		472	Swimming crab	**Portunus hastatoides*	NE
		473	Japanese blue crab	#*Portunus trituberculatus*	NE
		474	Swimming crab	**Portunus gracilimanus*	NE
		475	Three-spot swimming crab	#*Portunus sanguinolentus*	NE
		476	Swimming crab	**Portunus argentatus*	NE
		477	Flower crab	*Portunus pelagicus*	NE
		478	Red swimming crab	#*Monomia haani*	NE
		479	Swimming crab	**Charybdis bimaculata*	NE
		480	Swimming crab	**Charybdis acuta*	NE
		481	Banded-legged swimming crab	**Charybdis annulata*	NE
		482	Swimming crab	**Charybdis brevispinosa*	NE
		483	Crucifix crab	*Charybdis feriatus*	NE
		484	Swimming crab	**Charybdis hongkongensis*	NE
		485	Rock crab	#*Charybdis natator*	NE

		486	Swimming crab	**Charybdis variegata*	NE
		487	Soldier swimming crab	*Charybdis miles*	NE
		488	Swimming crab	*Charybdis sagamiensis*	NE
		489	Swimming crab	*Charybdis amboinensis*	NE
		490	Swimming crab	*Charybdis hellerii*	NE
		491	Swimming crab	*Charybdis granulata*	NE
		492	Swimming crab	**Charybdis japonica*	NE
		493	Swimming crab	**Charybdis* sp.	
	Porcellanidae	494	Crab	**Porcellana pulchra*	NE
		495	Crab	*Porcellanidae sp.	
		496	Crab	**Raphidopus ciliatus*	NE
	Polybiidae	497	Crab	**Polybius corrugatus*	NE
	Xanthidae	498	Mosaic reef crab	*Lophozozymus pictor*	NE
	Pilumnidae	499	Crab	**Heteropilumnus* sp.	
Cephalopods (N= 24)					
Sepiida	Sepiidae	500	Spineless cuttlefish	*#Sepiella maindroni*	DD
		501	Golden cuttlefish	*#Sepia esculenta*	DD
		502	Kisslip cuttlefish	*Sepia lycidas*	DD
		503	Pharaoh cuttlefish	*Sepia pharaonis*	DD
		504	Bigfin reef squid	*Sepioteuthis lessoniana*	DD
		505	Cuttlefish	#Sepiidae sp.	
	Sepiolidae	506	Squid	**Sepiola* sp.	
	Sepiadariidae	507	Koch's bottletail squid	**Sepiadarium kochii*	LC
		508	Double-ear bobtail	**Euprymna berryi*	DD

Teuthida	Loliginidae	509	Squid	*Loligo japonicus*	DD
		510	Indian squid	*Loligo oshimai*	DD
		511	Spear squid	*Loligo bleekeri*	LC
		512	Squid	*Uroteuthis duvaucelii*	DD
		513	Southern dumpling squid	*Uroteuthis chinensis*	DD
		514	Swordtip squid	**Uroteuthis edulis*	DD
		515	Little squid	*#Loliolus uyii*	DD
		516	Squid	*Loliginidae sp.	
Oegopsida	Ommastrephidae	517	Squid	**Todarodes pacificus*	LC
Octopoda	Octopodidae	518	Whiparm octopus	*#Octopus variabilis*	DD
		519	Webfoot octopus	*#Octopus ocellatus*	LC
		520	Octopus	*#Amphioctopus aegina*	LC
		521	Stareye octopus	*#Amphioctopus kagoshimensis*	LC
		522	Greater blue-ringed octopus	**Hapalochlaena lunulata*	LC
		523	Octopus	#Octopodidae sp.	

3.2.2 Endangered, threatened and protected species

Endangered, threatened and protected (ETP) species observed at the landing ports of Dongshan County were mainly Elasmobranchii speices. All Carcharhinidae species were listed in CITES Appendix II in 2022, and three of them (*Scoliodon macrorhynchos*, *Carcharhinus macloti*, and *Galeocerdo cuvier*) were recorded at the landing ports of Dongshan County according to the surveys from August 2024 to April 2025 (Fig. 3-1). *S. macrorhynchos* was the most common species of Carcharhinidae species that was spotted in September 2024, October 2024, December 2024 and January 2025, with a total of 88 individuals. Their size range was about 35 cm to 85 cm total length (TL). The other two species had low occurrence during landing port surveys. One *C. macloti* individual was recorded in March 2025 and its size was about 65 cm TL. Two *G. cuvier* were recorded in August 2024 and their sizes were about 100 cm and 150 cm TL.

Sphyrna lewini (Shpyrnidae) was listed as CITES Appendix II in 2014. *S. lewini* had a low occurrence at the landing ports of Dongshan County according to the surveys from August 2024 to April 2025 (Fig. 3-2), with one individual recorded in October 2024, one in November 2024, and one in February 2025. Their sizes were approximately 60-95 cm TL.

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 2024 to April 2025 (Fig. 3-3). One individual was spotted in March 2025, with a size of about 70 cm TL.

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. During the surveys from August 2024 to April 2025, only *H. trimaculatus* was found at the landing ports of Dongshan County with low numbers.

Scoliodon macrorhynchos

Carcharhinus macloti

Galeocerdo cuvier

Fig. 3-1 *Scoliodon macrorhynchos*, *Carcharhinus macloti* and *Galeocerdo cuvier* found in trawl catches at the landing ports in Dongshan County.

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.

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 2025 (Phase I-VIII).

Among the 523 species identified aforementioned in Dongshan County from August 2018 to April 2025, 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 and areas remained unchanged during the surveys from August 2018 to April 2025. Based on the captain and crew interviews, and logbooks of trawl and trap vessels surveyed from Dongshan County, the vessels mainly operated in Minnan Fishing Ground, Taiwan Bank Fishing Ground, Yuedong Fishing Ground, Dongsha Fishing Ground and Southern Taiwan Fishing Ground (Lin et al., 2021) (Fig. 3-4).

Based on the GPS locations on board collected from logbook data of trawl vessels (Phase VI), logbook data of trap vessels (Phase VII), and logbook data of trap and trawl vessels (Phase VIII), the fishing grounds were further specified; trawl vessels mainly operated in Minnan Fishing Ground, and trap vessels mainly operated in Taiwan Bank Fishing Ground (Fig. 3-5).

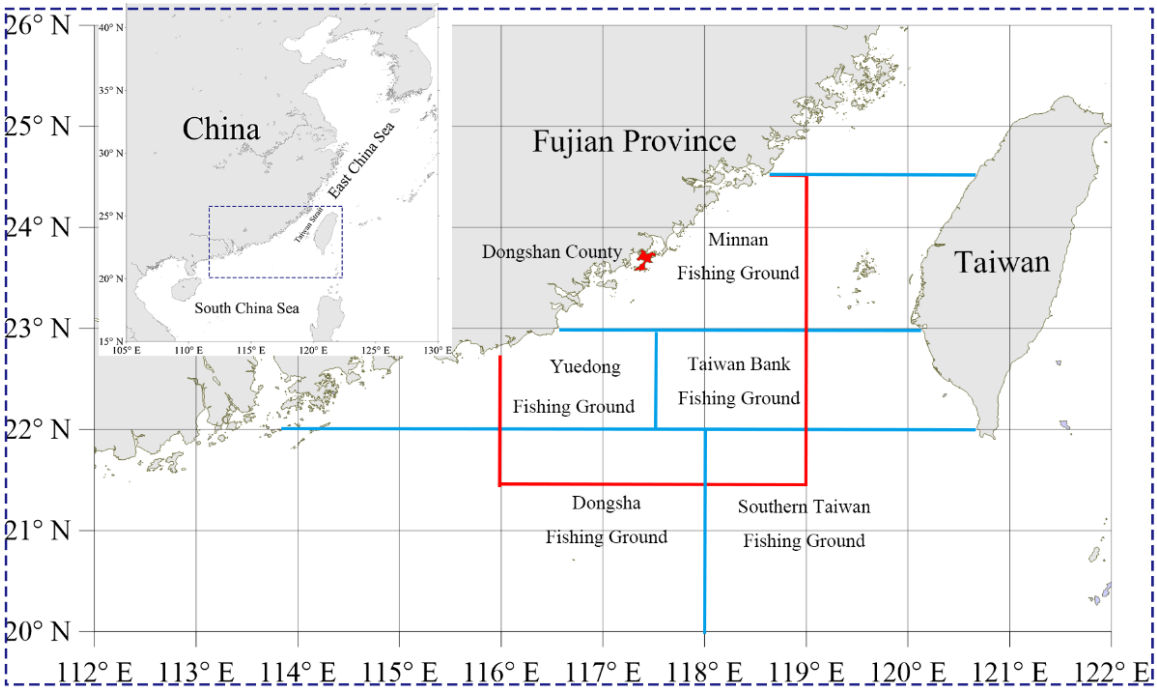

Fig. 3-4. Fishing areas (within red line) of trawl vessels from Dongshan County (red area), covering five fishing grounds of southern Taiwan Strait.

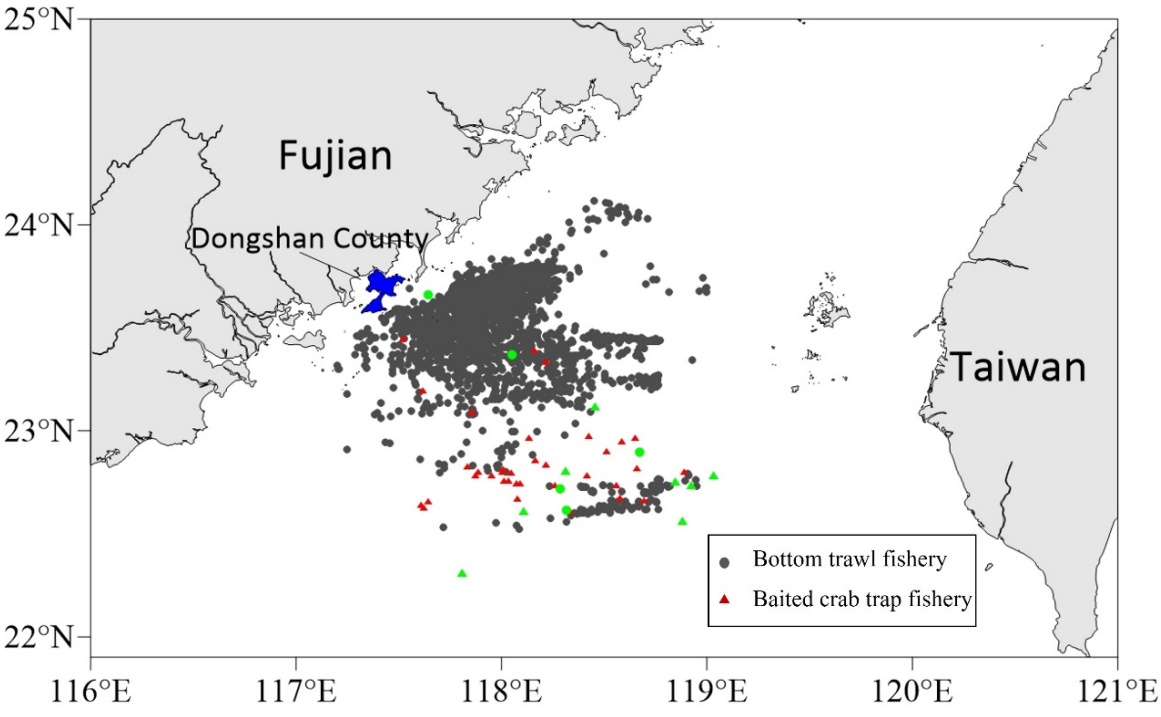

Fig. 3-5. The locations of trawl and trap fisheries based on logbook surveys from Dongshan County
(dark grey circles: Phase VI from trawl vessels; red triangles: Phase VII from trap vessels; green circles: Phase VIII from trawl vessels; green triangles: Phase VIII from trap vessels).

3.4 Fishery operation patterns of trawl and trap vessels

Based on 98 trawl vessels surveyed at Gongqian Landing Port of Dongshan County during the surveys from August 2024 to April 2025, they generally spent 1-12 days/trip at sea (mean = 6.12, N = 98) (Table 3-3). Over 60% of trawl vessels surveyed spent more than 5 days/trip at sea. The variation of fishing days at sea highly depended on the weather conditions. The trawl fishery operation days are similar with the findings in August 2018-April 2025 surveys (in Phases I- VIII), 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 in August 2018-April 2025 at 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)
August 2024-April 2025	6.12 (1-12) (N=98)

Based on the logbook surveyed in Dongshan County form August 2024 to April 2025, the two trawl vessels (N = 2) had 101.5 days and 105.5 days at sea (average of 103.5 days), with both having 15 trips and range of 2-13.5 days/trip at sea (average of 6.90 days/trip). Over 90% of the trawl trips were more than 5 days/trip at sea (Fig. 3-6). The results were similar with the trawl surveys at Gongqian Landing Port during the same period, August 2024-April 2025 (Table 3-3).

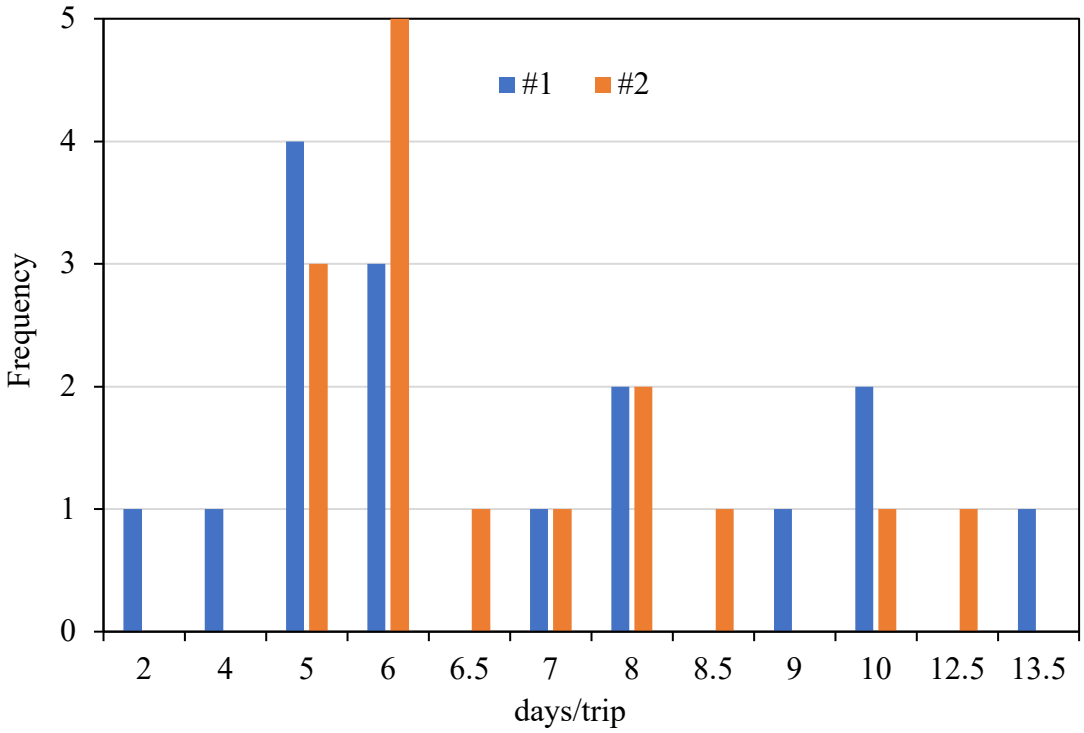

Fig. 3-6. Fishing days per trip of tralw vessels surveyed through logbook (N = 2) in August 2024-April 2025 from Dongshan County.

Based on the logbook surveyed in Dongshan County form August 2024 to April 2025, the three trap vessels (N = 3) did not return except bad weather (i.e. the cases those government called back all vessels) and holidays (e.g. Chinese New Year, January-Feburary 2025). The average annual fishing days of the trap vessels (N = 3) were 182 days in August 2024-April 2025, ranged from 160 days to 208 days (8 or 9 trips) (Table 3-4). The average fishing days per trip were 21 days/trip, ranged from 3 days/trip to 46 days/trip. Over 73% of trips spent more than 10 days/trip at sea, and over 30% of trips spent more than 30 days/trip at sea. The fishing days per trip of trap vessels were longer than those of trawl vessels aforementioned.

Compared to the logbook surveyed of the three trap vessels (N = 3) in Dongshan County form August 2023 to April 2024, the results of the two phases were similar (Table 3-4). In April 2023 and April 2024, when the catches declined significantly, two trap vessels surveyed stopped fishing, which was one month earlier before the national summer fishing moratorium (Table 3-4).

Table 3-4. Fishing days of trap vessels surveyed (N = 3) in August 2023-April 2024 and August 2024-April 2025 from Dongshan County.

Vessels	Aug 2024	Sept 2024	Oct 2024	Nov 2024	Dec 2024	Jan 2025	Feb 2025	Mar 2025	Apr 2025	Total
#1	15	24	18	14	28	25	27	9	0	160
#2	15	23	20	21	30	24	25	28	22	208
#3	15	23	21	20	30	16	26	26	0	177
Average	15	23	20	18	29	22	26	18	7	182
Vessels	**Aug 2023**	**Sept 2023**	**Oct 2023**	**Nov 2023**	**Dec 2023**	**Jan 2024**	**Feb 2024**	**Mar 2024**	**Apr 2024**	**Total**
#1	13	25	23	28	24	28	21	22	0	184
#2	11	24	24	25	29	28	24	21	14	200
#3	13	25	24	27	23	28	20	21	0	181
Average	12	25	24	27	25	28	22	21	5	188

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 = 98) at Gongqian Landing Port of Dongshan County from August 2024 to April 2025, the average total capture volume was about 7885.99 kg/vessel/trip, and the average capture volumes and proportions of different taxonomic groups were calculated (Table 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 74.17% (average of 5849.14 kg/vessel/trip) of the total capture volume (average of 7885.99 kg/vessel/trip).

(2) The average food fish capture volume was 3952.97 kg/vessel/trip, contributed to 50.13% of the total capture volume.

(3) The average feed fish capture volume was 1896.17 kg/vessel/trip, contributed to 24.04% of the total capture volume.

(4) The average total crustacean capture volume was 1070.20 kg/vessel/trip, contributed to 13.57% of the total capture volume, with the estimated average volumes

of 810.42 kg/vessel/trip for crabs and 259.78 kg/vessel/trip for shrimps.

(5) The average total cephalopod capture volume was 966.64 kg/vessel/trip, contributed to 12.26% of the total capture volume.

Table 3-5. Capture volumes and proportions from trawl vessels surveyed (N = 98) in August 2024-April 2025 at Gongqian Landing Port of Dongshan County.

Parameters	**Mean (N = 98)**	
Fishing days per trip	6.12 days/trip	
Average total capture volume per trip	7885.99 kg/vessel/trip	
Average total crustacean capture volume per trip	1070.20 kg/vessel/trip	
	Shrimps: 259.78 kg/vessel/trip	Crabs: 810.42 kg/vessel/trip
Total crustacean volume/total capture volume	13.57%	
	Shrimps: 3.29%	Crabs: 10.28%
Average total fish capture volume per trip	5849.13 kg/vessel/trip	
Total fish volume/total capture volume	74.17%	
Average total food fish capture volume per trip	3952.97 kg/vessel/trip	
Total food fish volume/total capture volume	50.13%	
Average total feed fish capture volume per trip	1896.17 kg/vessel/trip	
Total feed fish volume/total capture volume	24.04%	
Average total cephalopod capture volume per trip	966.64 kg/vessel/trip	

Parameters	Mean (N = 98)
Total cephalopod volume/total capture volume	12.26%

Based on the average CPUE (kg/vessel/day, N = 98) of the surveyed trawl vessels at Gongqian Landing Port in August 2024-April 2025, the latest number of registered trawl vessels in Dongshan County in 2023 (N = 424), and the average annual fishing days (103.5 days obtained from logbook of the two trawlers above in Phase VIII, see section 3.4), the estimated annual capture volume of trawl fishery in Dongshan County was 53891.31 t (Table 3-6).

Table 3-6. Estimated annual capture volume of trawl fishery in August 2024-April 2025 in Dongshan County based on the trawl vessels surveyed (N = 98) at Gongqian Landing Port.

Species group	CPUE (kg/vessel/day)	Number of vessels	Fishing days (day)	Estimated capture volume (t)
Food fish	645.65	424	103.5	28333.70
Feed fish	309.71			13591.31
Crustacean	174.80			7670.92
Cephalopod	157.89			6928.84
Total	1228.04			53891.31

Based on the logbook of the two trawl vessels surveyed (N = 2) from Dongshan County from August 2024 to April 2025, the average total capture volume was about 5642.88 kg/vessel/trip, and the average capture volumes and proportions of different taxonomic groups were calculated (Table 3-7). The findings were summarized as below:

(1) The most dominant capture taxonomic group was the fishes (including food fish and feed fish), contributed to 79.15% (average of 4466.62 kg/vessel/trip) of the total capture volume (average of 5642.88 kg/vessel/trip).

(2) The average total food fish capture volume was 3642.05 kg/vessel/trip, which

contributed to 64.54% of the total capture volume.

(3) The average total feed fish capture volume was 824.57 kg/vessel/trip, which contributed to 14.61% of the total capture volume.

(4) The average total crustacean capture volume was 528.78 kg/vessel/trip, which contributed to 9.37% of the total capture volume, with the estimated average volumes of 437.16 kg/vessel/trip for crabs and 91.62 kg/vessel/trip for shrimps.

(5) The average total cephalopod capture volume was 647.48 kg/vessel/trip, which contributed to 11.47% of the total capture volume.

Table 3-7. Capture volumes and proportions from the logbook of the two trawl vessels surveyed (N = 2) in August 2024-April 2025 in Dongshan County.

Parameters	**Mean (N = 2)**	
Fishing days per trip	6.90 days/trip	
Average total capture volume per trip	5642.88 kg/vessel/trip	
Average total crustacean capture volume per trip	528.78 kg/vessel/trip	
	Shrimps: 91.62 kg/vessel/trip	Crabs: 437.16 kg/vessel/trip
Total crustacean volume/total capture volume	9.37%	
	Shrimps: 1.62%	Crabs: 7.75%
Average total fish capture volume per trip	4466.62 kg/vessel/trip	
Total fish volume/total capture volume	79.15%	
Average total food fish capture volume per trip	3642.05 kg/vessel/trip	
Total food fish volume/total capture volume	64.54%	
Average total feed fish capture volume per trip	824.57 kg/vessel/trip	

Parameters	Mean (N = 2)
Total feed fish volume/total capture volume	14.61%
Average total cephalopod capture volume per trip	647.48 kg/vessel/trip
Total cephalopod volume/total capture volume	11.47%

Based on the average CPUE (kg/vessel/day) of the two surveyed trawl vessels in August 2024-April 2025, the latest number of registered trawl vessels in Dongshan County in 2023 (N = 424), and the average annual fishing days (103.5 days), the estimated annual capture volume of trawl fishery in Dongshan County was 37433.49 t (Table 3-8).

Table 3-8. Estimated annual capture volume of trawl fishery in August 2024-April 2025 in Dongshan County based on the two trawl vessels surveyed (N = 2) through logbook.

Species group	CPUE (kg/vessel/day)	Number of vessels	Average annual fishing days (day)	Estimated capture volume (t)
Food fish	549.10	424	103.5	24096.70
Feed fish	126.53			5552.64
Crustacean	84.86			3724.00
Cephalopod	92.53			4060.59
Total	853.01			37433.49

3.5.2 Crabs

The average crustacean capture volume was 1070.20 kg/vessel/trip based on the surveys at Gongqian Landing Port of Dongshan County from August 2024 to April

2025, with the average proportion of 13.57% of the tatal capture volumes (Table 3-5). The crab capture volume proportions in the total capture volumes of trawl fishery (N = 98) were further analyzed (Table 3-9; 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 3.97% in April 2025 to 16.14% in August 2024, including four main crab species, *M. haani*, *P. sanguinolentus*, *C. natator* and *C. philargius*.

(2) Among the total crab capture volume of 810.42 kg/vessel/trip, *M. haani* was 528.96 kg/vessel/trip, *P. sanguinolentus* was 190.77 kg/vessel/trip, *C. natator* was 14.55 kg/vessel/trip and *C. philargius* was 75.60 kg/vessel/trip, contributing to 6.71%, 2.42%, 0.18% and 0.96% of the total capture volume, respectively.

(3) The dominant crab species in trawl fishery was *M. haani*, contributing around 65.27% of the total crab production. The proportions of *M. haani* varied monthly, ranging from 2.32% in April 2025 (148.75 kg/vessel/trip) to 12.93% in August 2024 (1631.88 kg/vessel/trip).

(4) Based on the average fishing days at sea per trip, the average CPUE of *M. haani* ranged from 18.18 kg/vessel/day in April 2024 to 233.13 kg/vessel/day in August 2025 (mean = 86.40 kg/vessel/day).

(5) Based on the average fishing days at sea per trip, the average CPUE of *P. sanguinolentus* ranged from 3.85 kg/vessel/day in April 2024 to 52.19 kg/vessel/day in January 2025 (mean = 31.16 kg/vessel/day).

Table 3-9. Average capture volumes (kg/vessel/trip) and proportions (%) of four main crab species in the total capture volumes from trawl vessels surveyed (N = 98) in August 2024-April 2025 at Gongqian Landing Port of Dongshan County.

Crab species	**Average volume (kg/vessel/trip)**	**Proportion (%)**
Monomia haani	528.96	6.71%
Portunus sanguinolentus	190.77	2.42%
Charybdis natator	14.55	0.18%
Calappa philargius	75.60	0.96%

Other crabs	0.54	0.01%
Total	810.42	10.28%

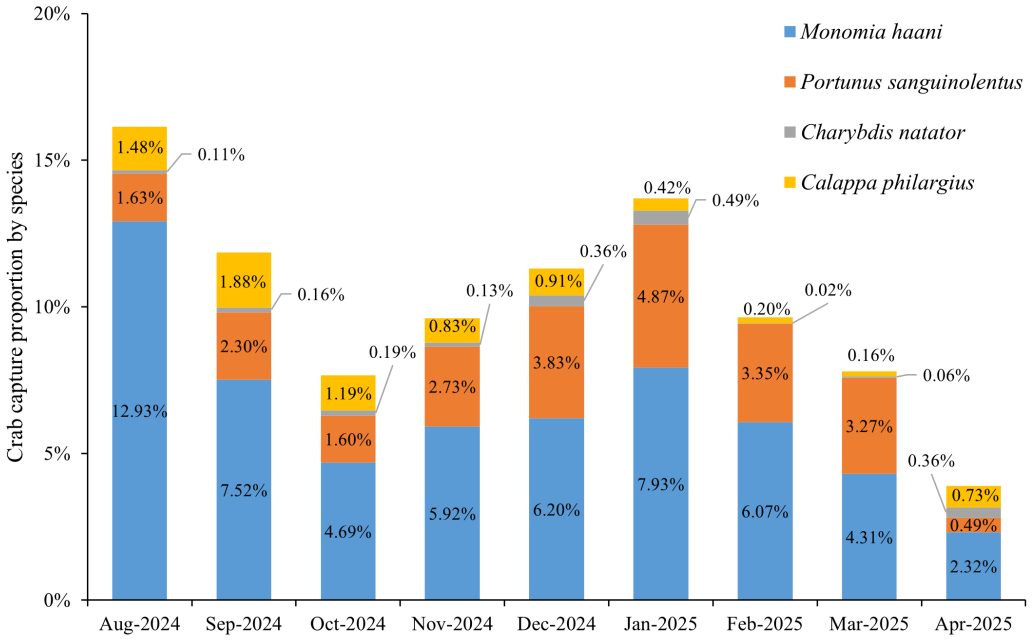

Fig. 3-7. Crab proportions (%) in the total capture volumes by species from trawl vessels surveyed in August 2024-April 2025 at Gongqian Landing Port of Dongshan County.

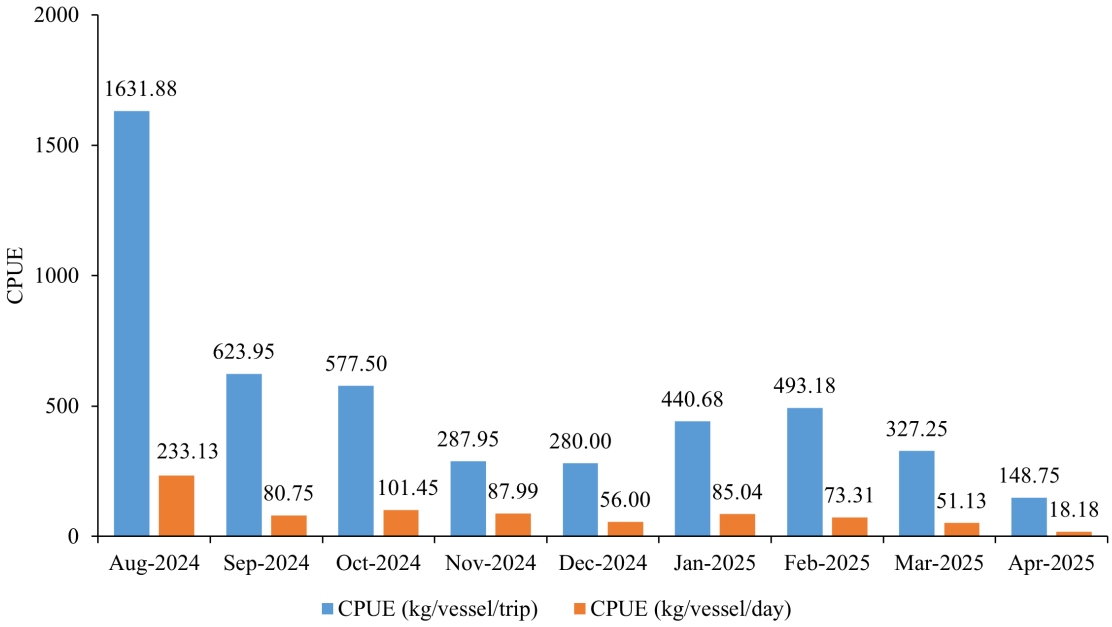

Fig. 3-8. Monthly average CPUE (kg/vessel/trip and kg/vessel/day) of *Monomia haani*, surveyed in August 2024-April 2025 at Gongqian Landing Port of Dongshan County.

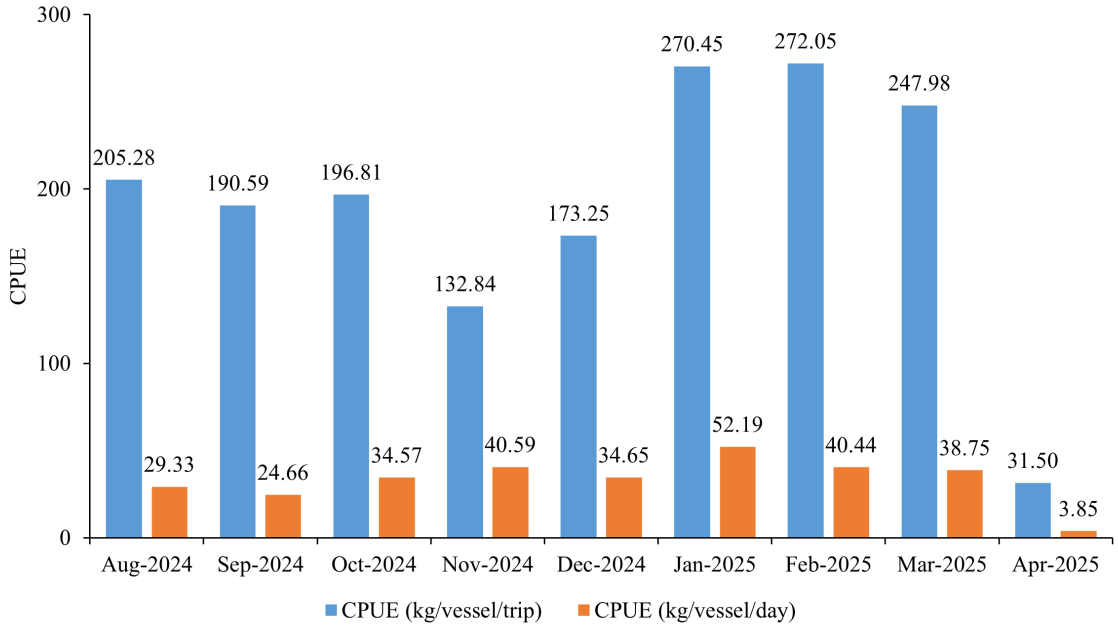

Fig. 3-9. Monthly average CPUE of *Portunus sanguinolentus* by kg/vessel/trip and kg/vessel/day, surveyed in August 2024-April 2025 at Gongqian Landing Port of Dongshan County.

Based on the two logbook surveys in Dongshan County from August 2024 to April 2025, the average crustacean capture volume was 528.78 kg/vessel/trip, with the average proportion of 9.37% of the tatal capture volume (Table 3-7). The crab capture volume proportions were further analyzed (Table 3-10). *M. haani* is the dominant species in crab catches, same to the results from landing port surveys.

Table 3-10. Average capture volumes (kg/vessel/trip) and proportions (%) of three main crab species in the total capture volumes from the two trawl vessels surveyed in August 2024-April 2025 in Dongshan County.

Crab species	**Average volume (kg/vessel/trip)**	**Proportion (%)**
Monomia haani	385.38	6.83%
Portunus sanguinolentus	7.67	0.14%
Charybdis natator	40.27	0.71%
Other crabs	3.84	0.07%
Total	437.16	7.75%

3.5.3 Food fishes

In August 2024-April 2025, 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*). The food fish species or species groups were similar to the previous phases.

Based on the 98 trawl vessels surveyed at Gongqian Landing Port of Dongshan County in August 2024-April 2025, the average food fish capture volume was 3952.97 kg/vessel/trip, with the average proportion 50.13% of the tatal capture volumes (Table 3-5). The food fish capture volume proportions in the total capture volumes showed monthly variation, from 22.19% (March 2025) to 73.24% (September 2024) (Table 3-11; Fig. 3-10).

Based on the two trawl vessels surveyed (N = 2) through logbook in Dongshan County in August 2024-April 2025, the average food fish capture volume was 3642.05 kg/vessel/trip, with the average proportion 64.54% of the total capture volumes (Table 3-7). The food fish capture volume proportions in the total capture volumes showed variation per trip, ranged from 35.31% to 83.80%.

Table 3-11. Proportions (%) of dominant food fish species or species group in trawl fishery from August 2024 to April 2025 at Gongqian Landing Port of Dongshan County. (red: the top three)

Fish species/Groups	**Aug-2024**	**Sep-2024**	**Oct-2024**	**Nov-2024**	**Dec-2024**	**Jan-2025**	**Feb-2025**	**Mar-2025**	**Apr-2025**
Total food fish	67.21%	73.24%	61.38%	48.45%	44.60%	39.47%	27.00%	22.19%	37.48%
Synodontidae spp	10.66%	15.35%	8.64%	4.51%	7.25%	9.44%	11.94%	3.83%	8.28%
Evynnis cardinalis	23.09%	18.55%	10.36%	1.92%	4.67%	2.41%	0.03%	0.20%	0.89%
Sillaginidae spp.	0.14%	0.81%	2.50%	2.62%	2.57%	4.45%	0.52%	3.90%	4.30%
Decapterus maruadsi & *Trachurus japonicus*	10.16%	12.79%	12.94%	13.69%	12.52%	9.57%	0.14%	0.00%	13.07%
Mullidae spp.	5.27%	2.96%	1.11%	0.64%	2.17%	1.24%	1.14%	0.47%	1.45%
Trichiuridae spp.	0.50%	0.59%	0.16%	0.12%	0.57%	1.53%	0.03%	0.00%	0.04%
Siganus fuscescens	0.02%	0.14%	0.25%	0.09%	0.00%	0.18%	0.00%	0.02%	0.55%
Ammodytidae spp.	0.00%	4.68%	7.30%	4.63%	3.54%	2.09%	7.25%	10.67%	5.65%
Callionymidae spp.	0.45%	0.33%	0.00%	0.00%	0.00%	0.00%	0.03%	0.44%	0.11%
Monacanthidae spp.	4.49%	8.27%	5.98%	6.02%	0.90%	0.64%	1.21%	0.44%	0.85%
Tetraodontidae spp.	8.42%	4.87%	4.50%	9.18%	6.09%	3.27%	2.32%	0.87%	0.43%

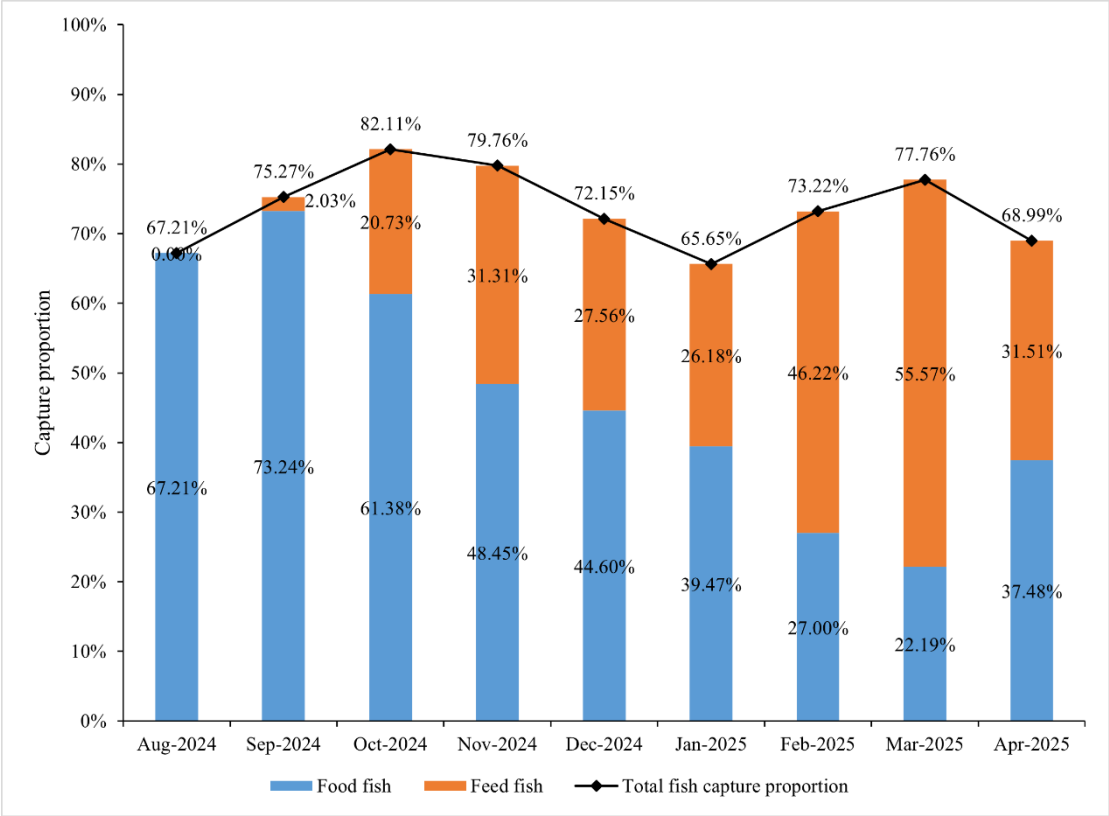

Fig. 3-10. Food and feed fish capture proportions (%) in the total capture volumes from trawl vessels surveyed in August 2024-April 2025 at Gongqian Landing Port of Dongshan County.

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 (Zhang et al., 2018), mentioned by the captains of the trawl vessels surveyed.

Based on the 98 trawl vessels surveyed at Gongqian Landing Port of Dongshan County in August 2024-April 2025, the average feed fish capture volume was 1896.17 kg/vessel/trip, with the average proportion 24.04% of the total capture volumes (Table 3-5). The feed fish capture proportions in the total capture volumes showed monthly variation, from 0.00% (August 2024)-55.57% (March 2025) of the total capture volumes (Fig. 3-10). The reason without feed fish in August 2024 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.

Based on the two trawl vessels surveyed (N = 2) through logbook in Dongshan County in August 2024-April 2025, the average feed fish capture volume was 824.57 kg/vessel/trip, with the average proportion 14.61% of the total capture volumes (Table 3-7). The food fish capture volume proportions in the total capture volumes showed variation per trip, ranged from 0.00% to 41.00%.

3.5.4.2 Species diversity in feed fishes

Based on the monthly and randomly samplings of feed fishes (mean = 1.52 kg, ranging from 0.85 kg to 2.42 kg) at Gongqian Landing Port of Dongshan County from September 2024 to April 2025 (no feed fish landing in August 2024), 134 species with 91 fishes, 36 crustaceans and 7 cephalopods were identified (Table 3-12). There were 10 species dominated in feed fishes including fishes, crabs and squids, and some were juveniles of commercially important species.

Table 3-12. Species diversity, size range (standard length for fishes and cephalopods, carapace width for crabs) and proportions in feed fishes of trawl catches in September 2024-April 2025 at Gongqian Landing Port in Dongshan County.
(*species only found in feed fishes) (red: the top three dominant species or species group each month)

No.	Species name	Sep-2024		Oct-2024		Nov-2024		Dec-2024		Jan-2025		Feb-2025		Mar-2025		Apr-2025	
		%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)	%	Size (cm)
1	*Gymnothorax minor*	-	-	0.00%	-	2.30%	31	2.90%	31.5	-	-	-	-	-	-	-	-
2	*Pisodonophis cancrivorus*	-	-	2.10%	44.5	-	-	-	-	0.00%	-	-	-	2.90%	42.4	2.60%	35
3	*Callechelys kuro*	-	-	0.50%	36.9	0.60%	27.6	-	-	0.10%	13	0.70%	37.8	0.50%	25.2	-	-
4	**Ichthyapus vulturis*	-	-	-	-	-	-	-	-	-	-	2.00%	43.7	-	-	-	-
5	**Ophichthidae* sp.	-	-	-	-	0.70%	17.3-25.2	-	-	0.70%	23.9	-	-	0.10%	9.1	-	-
6	*Oxyconger leptognathus*	1.80%	18.5-24.1	3.10%	22.6-30.0	7.30%	20.0-25.4	-	-	1.00%	23.5	-	-	-	-	-	-
7	*Gnathophis heterognathos*	5.90%	11.6-19	-	-	0.10%	10	0.10%	8.7	-	-	-	-	-	-	-	-
8	*Conger myriaster*	2.20%	20.8-24.5	1.40%	12.5-18.6	-	-	-	-	-	-	-	-	-	-	-	-
9	**Saurenchelys fierasfer*	-	-	-	-	-	-	-	-	0.20%	23.6	-	-	-	-	-	-
10	*Anguilliformes* sp.	0.00%	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	**Stolephorus indicus*	-	-	-	-	-	-	-	-	-	-	0.10%	4.6-6.4	0.40%	5.8	-	-
12	**Setipinna tenuifilis*	-	-	-	-	0.70%	9.8	-	-	-	-	-	-	-	-	-	-

13	*Clupeiformes* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10%	4.1
14	**Gonorynchus abbreviatus*	-	-	-	-	-	-	-	-	-	-	-	-	0.30%	7.0-7.9	-	-
15	*Plotosus lineatus*	-	-	-	-	2.90%	17.3	-	-	-	-	-	-	-	-	-	-
16	*Alepocephalidae sp.	-	-	-	-	-	-	-	-	0.20%	6	-	-	-	-	-	-
17	*Trachinocephalus myops*	4.70%	10.2-12.2	1.60%	9.7-12.5	2.80%	6.5-12.0	2.00%	5.5-12.5	-	-	4.70%	8.1-12.1	1.70%	5.9-12.4	-	-
18	*Synodus fuscus*	0.70%	6.5-10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	*Saurida elongata*	-	-	0.10%	4.2-7.4	-	-	-	-	0.70%	9.4	0.20%	8.5	-	-	-	-
20	*Saurida tumbil*	-	-	-	-	1.30%	7.9-11.6	1.20%	8.2-8.8	7.00%	10.2-13.0	2.30%	14.1-14.5	-	-	1.90%	9.7-10.0
21	*Saurida undosquamis*	-	-	2.60%	8.1-11.6	-	-	-	-	-	-	-	-	-	-	-	-
22	**Bregmaceros* sp.	0.00%	4.4	0.10%	4.3-6.0	0.70%	4.3-7.3	0.50%	4.6-6.8	0.70%	4.5-6.0	0.20%	6.6-6.7	0.60%	4.0-7.2	0.20%	4.5-6.5
23	**Ophidion muraenolepis*	1.10%	11.7-12.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	Mugilidae sp.	-	-	-	-	0.00%	2.9	-	-	-	-	-	-	-	-	-	-
25	**Pegasus laternarius*	0.30%	4.6-5.5	0.10%	4.1	-	-	0.20%	5.5	-	-	-	-	-	-	-	-
26	**Apistus carinatus*	1.70%	3.7-10.9	1.10%	9.3	3.40%	3.1-8.8	3.50%	4.1-10.0	1.70%	2.2-8.7	1.10%	3.7-7.7	2.80%	3.7-8.4	2.20%	9.4
27	*Minous pusillus*	-	-	-	-	0.30%	1.9-4.2	-	-	0.20%	4.5	0.20%	5.1	-	-	-	-

28	*Chelidonichthys spinosus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.80%	11.5
29	**Lepidotrigla alata*	-	-	-	-	-	-	2.20%	9.9	-	-	-	-	-	-	-	-
30	**Onigocia spinosa*	0.30%	7.1	0.50%	1.8-7.0	1.80%	4.7-11.1	-	-	1.80%	6.5-9.1	3.90%	6.2-7.3	1.10%	7.1-7.5	2.80%	7.5-9.1
31	**Inegocia japonica*	-	-	3.00%	17.4	-	-	-	-	-	-	-	-	-	-	-	-
32	**Inegocia guttata*	2.70%	4.0-10.9	-	-	-	-	-	-	-	-	-	-	0.20%	5.6	-	-
33	**Ostorhinchus kiensis*	0.40%	3.7-4.2	0.00%	3.8	-	-	-	-	-	-	-	-	-	-	-	-
34	**Ostorhinchus semilineatus*	-	-	-	-	0.80%	5.0-6.7	-	-	0.30%	5.6	-	-	-	-	-	-
35	*Ostorhinchus fasciatus*	-	-	0.60%	7.4	0.60%	3.3-6.7	-	-	0.40%	5.7	-	-	-	-	-	-
36	**Apogonichthyoides niger*	-	-	0.80%	3.2-5.9	0.20%	2.7-3.0	0.50%	3.6-4.8	4.10%	3.8-5.8	1.30%	4.6-5.7	0.60%	6.6	-	-
37	**Jaydia striata*	0.00%	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	**Rhabdamia gracilis*	0.20%	5.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	*Sillago ingenuua*	3.60%	6.1-7.9	17.40 %	5.9-11.5	6.20%	4.0-10.6	2.50%	4.1-10.2	4.80%	5.1-9.5	6.30%	5.2-10.0	-	-	0.50%	7.2
40	*Selaroides leptolepis*	-	-	1.80%	12.2	-	-	-	-	-	-	-	-	-	-	-	-
41	*Decapterus maruadsi*	-	-	-	-	-	-	-	-	-	-	-	-	3.90%	3.5-6.6	-	-

42	*Carangidae sp.	-	-	0.10%	3.0-4.4	-	-	-	-	-	-	-	-	-	-	-	-
43	*Secutor ruconius*	-	-	-	-	-	-	0.50%	5.2	-	-	-	-	-	-	-	-
44	*Equulites rivulatus*	-	-	0.70%	2.6-6.5	-	-	0.20%	4.0-4.1	3.00%	4.1-6.2	2.30%	4.7-6.5	-	-	-	-
45	*Hapalogenys analis*	-	-	-	-	0.00%	2.3	-	-	-	-	-	-	-	-	-	-
46	*Evynnis cardinalis*	-	-	-	-	-	-	-	-	-	-	1.10%	2.8-3.9	11.40 %	3.2-4.7	36.70 %	3.8-6.8
47	*Polydactylus sextarius*	-	-	-	-	-	-	2.20%	7.6-8.5	-	-	-	-	-	-	-	-
48	*Johnius trewavasae*	-	-	-	-	0.80%	5.1-8.0	-	-	-	-	-	-	-	-	-	-
49	*Pennahia macrocephalus*	-	-	-	-	4.70%	4.1-8.4	3.10%	3.3-8.2	-	-	-	-	-	-	-	-
50	*Pennahia argentata*	-	-	-	-	1.10%	3.3-7.6	1.20%	3.9-7.5	-	-	-	-	-	-	-	-
51	*Upeneus japonicus*	0.00%	2.7	1.10%	3.3-8.5	2.10%	4.9-9.7	2.60%	4.4-9.0	2.50%	5.0-9.1	1.20%	8.1-10.2	-	-	-	-
52	*Teixeirichthys jordani*	9.80%	5.7-8.1	2.40%	5.8-7.7	1.90%	9	1.30%	7.6	-	-	4.50%	8.2-9.7	-	-	-	-
53	*Suezichthys gracilis*	0.20%	6.1	1.40%	12.1	0.80%	9	-	-	-	-	-	-	-	-	-	-
54	*Champsodon atridorsalis*	0.10%	6.1	0.20%	5.3-6.8	-	-	-	-	-	-	-	-	-	-	-	-
55	*Champsodon snyderi*	0.80%	3.1-6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	*Parapercis ommatura*	-	-	0.20%	4.5-5.8	0.20%	3.4-5.6	-	-	-	-	-	-	-	-	1.80%	7.8-8.2
57	*Parapercis* sp.	-	-	-	-	-	-	-	-	-	-	0.00%	4.1	0.00%	4	-	-

58	*Pinguipedidae sp.	-	-	-	-	-	-	0.00%	3.6	-	-	-	-	-	-	0.20%	4.7-5.4
59	*Parapercis pulchella*	4.50%	3.8-12.4	2.10%	5.1-9.6	4.20%	5.1-13.1	5.20%	5.6-11.0	5.60%	5.5-9.9	8.50%	3.7-13.0	10.20%	3.1-11.0	5.00%	3.9-10.9
60	**Callionymus curvicornis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.80%	7.3-8.8
61	**Callionymus octostigmatus*	0.80%	9.5	-	-	0.50%	9	0.50%	3.6-8.6	0.20%	3.5-4.7	2.40%	4.4-7.8	7.90%	5.1-8.5	-	-
62	*Percophidae sp.	-	-	-	-	-	-	-	-	0.00%	3	0.10%	4.5-5.2	0.40%	3.4-5.1	-	-
63	**Trichonotus elegans*	4.10%	5.9-9.7	1.90%	6.8-12.0	2.60%	6.5-10.4	3.70%	6.3-18.6	4.50%	4.5-12.5	2.70%	5.9-10.8	5.50%	6.1-10.6	1.70%	6.2-8.6
64	*Trichonotus filamentosus*	1.00%	5.9-8.6	0.30%	10.0-10.2	0.20%	8.5-8.9	0.40%	7.7-8.8	0.50%	7.2-8.5	0.10%	6.9-8.5	0.30%	6.4-9.3	0.30%	7.5-8.4
65	*Trichonotus setiger*	2.20%	10.3-14.5	0.60%	11.8-12.0	2.40%	11.5-13.3	0.40%	11.6	4.60%	9.0-13.1	4.30%	5.2-13.0	4.90%	7.2-12.5	2.00%	10.5-13.0
66	*Bleekeria viridianguilla*	12.10%	9.0-13.0	29.80%	6.8-13.0	8.90%	7.0-12.0	13.10%	5.8-12.2	13.10%	7.5-12.0	13.50%	7.9-12.0	9.30%	7.9-11.9	6.40%	6.6-10.5
67	*Bleekria mitsukurii*	7.30%	8.2-11.6	6.50%	8.3-11.1	3.70%	7.0-10.9	6.10%	7.1-10.7	2.10%	8.8-10.5	4.80%	7.7-12.1	2.30%	10.4-11.5	0.50%	8.5
68	**Uranoscopus bicinctus*	0.30%	5.7	-	-	-	-	1.30%	7.7	-	-	-	-	-	-	-	-
69	**Uranoscopus chinensis*	-	-	1.30%	9.2	1.60%	3.3-8.8	0.60%	6	0.40%	3.4-4.2	3.80%	13.2	1.30%	8.2	1.20%	6.4
70	*Ichthyscopus lebeck*	2.30%	10.1	-	-	-	-	0.10%	2.7	-	-	-	-	-	-	-	-
71	*Uranoscopidae sp.	0.00%	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-

72	**Valenciennea wardi*	0.50%	8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
73	*Siganus fuscescens*	-	-	2.30%	10.3-11.1	-	-	-	-	-	-	-	-	-	-	-	-
74	*Trichiurus lepturus*	-	-	-	-	-	-	5.10%	43.0-44.8	-	-	-	-	-	-	-	-
75	*Scomber japonicus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.50%	14.5
76	**Psettina tosana*	-	-	0.70%	4.7-6.1	-	-	-	-	-	-	-	-	-	-	-	-
77	**Engyprosopon multisquama*	3.60%	3.8-9.0	0.70%	6.2-72	0.80%	8.7	-	-	-	-	-	-	-	-	-	-
78	**Crossorhombus azureus*	1.60%	4.3-7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	**Arnoglossus* sp.	1.90%	3.7-7.2	-	-	1.40%	4.8-6.8	-	-	-	-	2.10%	5.5-8.5	6.10%	6.9-8.7	-	-
80	**Bothidae sp.*	-	-	0.40%	6.3-7.0	-	-	-	-	-	-	-	-	-	-	-	-
81	**Solea ovata*	-	-	-	-	-	-	-	-	-	-	1.10%	6.7-10.4	-	-	-	-
82	**Zebrias crossolepis*	-	-	-	-	-	-	-	-	2.10%	11.5	1.80%	12.4	-	-	-	-
83	*Liachirus melanospilos*	1.20%	6.5-8.5	-	-	0.60%	5.8-6.0	-	-	-	-	-	-	-	-	2.70%	10.1
84	**Cynoglossus puncticeps*	2.30%	9.0-12.7	-	-	-	-	-	-	-	-	-	-	2.20%	7.5-12.7	-	-
85	**Cynoglossus itinus*	-	-	0.60%	11.7	-	-	-	-	-	-	-	-	-	-	-	-
86	**Cynoglossus* sp.	-	-	-	-	-	-	-	-	2.10%	4.5-11.7	0.30%	7.8	-	-	-	-
87	*Stephanolepis cirrhifer*	-	-	0.10%	1.8-2.5	-	-	-	-	-	-	-	-	-	-	-	-

88	*Paramonacanthus sulcatus*	-	-	-	-	-	-	1.60%	9.1	-	-	-	-	-	-	-	-
89	**Paramonacanthus japonicus*	3.30%	7.2-9.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	**Lophosquilla costata*	0.30%	1.1-1.2	0.40%	1.3-1.5	-	-	0.10%	0.9	-	-	-	-	-	-	-	-
91	**Oratosquillina interrupta*	-	-	0.30%	1.1-1.5	0.30%	1.0-1.4	0.10%	1.2	1.90%	1.3-1.9	0.40%	1.4-1.9	-	-	-	-
92	*Squillidae sp.	0.30%	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
93	**Sicyonia lancifer*	-	-	-	-	0.20%	1.7	-	-	-	-	-	-	-	-	-	-
94	*Trachysalambria curvirostris*	1.80%	1.1-2.2	1.60%	1.1-2.5	2.70%	2.0-3.4	0.60%	1.9-2.1	-	-	-	-	-	-	-	-
95	*Metapenaeus affinis*	-	-	-	-	-	-	-	-	0.80%	2	-	-	-	-	-	-
96	*Parapenaeopsis hardwickii*	0.20%	1.9	-	-	-	-	0.10%	1.4	-	-	-	-	-	-	-	-
97	*Kishinouyepenaeopsis cornuta*	-	-	-	-	0.50%	3	0.60%	1.4-1.8	3.70%	1.4-3.1	3.20%	1.9-3.4	1.70%	2.0-3.1	-	-
98	**Batepenaeopsis tenella*	0.20%	0.4-0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
99	*Metapenaeopsis barbata*	-	-	-	-	4.90%	1.1-6.9	4.60%	0.9-1.7	11.60%	1.2-2.3	8.80%	1.5-2.7	10.40%	1.0-2.6	3.60%	1.3-2.1
100	**Metapenaeopsis* sp.2	1.30%	1.0-1.5	2.30%	1.5-1.9	-	-	-	-	-	-	-	-	-	-	-	-
101	**Metapenaeopsis* sp.1	0.50%	0.5-1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

102	**Birulia kishinouyei*	0.00%	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
103	**Biarctus vitiensis*	-	-	0.00%	0.9	-	-	-	-	-	-	-	-	-	-	-	-
104	*shrimp sp.1	-	-	-	-	0.00%	1	-	-	0.10%	1.0-1.5	-	-	0.00%	1	-	-
105	*shrimp sp.2	-	-	-	-	-	-	-	-	0.00%	2.5	-	-	0.00%	0.5	-	-
106	**Conchoecetes artificiosus*	0.10%	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107	**Raphidopus ciliatus*	-	-	-	-	-	-	0.00%	1.1	-	-	-	-	-	-	-	-
108	*Leucosia craniolaris*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10%	1.3
109	*Leucosiidae sp.	0.10%	2	-	-	-	-	-	-	0.10%	1.1-1.2	-	-	0.10%	1	-	-
110	*Calappa philargius*	0.50%	1.2-1.9	0.50%	1.5-3.4	1.00%	1.9-3.6	0.20%	2.2	0.30%	1.9-2.1	-	-	-	-	-	-
111	**Cycloes granulosa*	-	-	-	-	-	-	-	-	0.30%	1.5-1.6	-	-	0.10%	1.5	-	-
112	**Phalangipus* sp.	0.10%	0.8-1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
113	**Enoplolambrus validus*	0.00%	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
114	*Parthenope sinensis*	0.00%	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
115	**Matuta planipes*	-	-	-	-	-	-	0.00%	1.5	0.40%	1.8-2.6	0.10%	2.8	0.40%	1.6-2.5	0.70%	8.7-9.8
116	**Polybius corrugatus*	-	-	-	-	-	-	-	-	-	-	-	-	0.10%	1.7	1.80%	1.8-2.4
117	**Portunus hastatoides*	-	-	-	-	0.10%	3.3	1.10%	3.6-4.1	-	-	-	-	-	-	-	-
118	**Portunus gracilimanus*	0.30%	1.7-3.0	0.20%	1.4-2.0	1.30%	2.0-4.1	-	-	-	-	-	-	-	-	-	-
119	*Portunus*	0.20%	2.1-3.5	0.00%	2.2	1.30%	3.2-5.0	0.20%	3.5	0.10%	3.2	0.80%	2.6-6.9	-	-	-	-

	sanguinolentus																
120	**Portunus argentatus*	0.20%	1.8-2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
121	*Monomia haani*	3.50%	1.6-7.0	1.70%	1.2-4.6	13.60 %	2.5-5.7	21.00 %	2.6-6.6	6.00%	2.1-5.8	7.60%	2.0-5.6	-	-	1.20%	2.4-3.6
122	**Charybdis annulata*	0.20%	1.5-1.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
123	**Charybdis bimaculata*	-	-	-	-	-	-	0.50%	2.0-2.4	-	-	-	-	-	-	0.80%	2.1-2.6
124	**Charybdis brevispinosa*	-	-	-	-	0.60%	2.0-2.3	-	-	-	-	-	-	-	-	-	-
125	*Charybdis feriatus*	-	-	-	-	-	-	2.70%	5.9	-	-	-	-	-	-	-	-
126	**Charybdis hongkongensis*	-	-	-	-	0.60%	3.5	-	-	-	-	-	-	-	-	-	-
127	**Charybdis variegata*	-	-	0.90%	0.9-2.6	-	-	-	-	-	-	0.20%	1.3-2.9	-	-	1.70%	3.0-3.5
128	**Sepiola* sp.	3.10%	2.1-5.5	0.50%	3.1	-	-	-	-	-	-	-	-	-	-	-	-
129	**Sepiadarium kochii*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.30%	2.5
130	**Euprymna berryi*	-	-	-	-	2.00%	2.1-3.0	1.80%	1.9-3.0	7.00%	1.5-3.2	0.90%	1.6-2.5	3.30%	1.3-2.1	3.10%	2.0-3.0
131	**Loliginidae* sp.	-	-	0.90%	3.2-4.5	-	-	1.20%	2.5-5.0	2.90%	2.2-5.0	0.40%	6.4	1.30%	2.8-5.0	-	-
132	*Amphioctopus aegina*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.60%	2.7
133	*Octopus ocellatus*	1.40%	4	0.00%	-	-	-	-	-	-	-	-	-	-	-	1.00%	2.9
134	*Octopus variabilis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.50%	4.9

135	*Gymnothorax minor*	-	-	0.00%	-	2.30%	31	2.90%	31.5	-	-	-	-	-	-	-	-

3.5.4.3 *Monomia haani* in feed fishes

M. haani was one of the ten dominate species found in feed fish samples from trawl catches in Dongshan County and contributed to 1.20%-21.00% of the total feed fish volumes in September 2024-April 2025 (Table 3-12).

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 = 162) of *M. haani* were juveniles in feed fishes, and the juvenile proportions were from 94.7% to 100% in September 2024-April 2025. The smallest size of *M. haani* in feed fishes was 1.2 cm CW, caught in October 2024 (Table 3-13).

Based on the feed fish samples in Phases II-VIII, 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 3-13).

Table 3-13. Smallest *Monomia haani* individuals in feed fish samples in Phases II-VIII (January 2019-April 2025) 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
October 2024	1.2

3.5.5 Average capture proportions from 2018 to 2025 (Phases I-VIII)

Based on the trawl vessels surveyed at the landing ports of Dongshan County from August 2018 to April 2025 (Phases I-VIII), 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 3-14). The largest proportion of total capture volume was fish, over 70% in each phase, followed by crustacean, then by cephalopod.

Table 3-14. Average capture volumes (kg/vessel/trip) and proportions from trawl vessels surveyed from 2018 to 2025 (in Phase I-VIII) at the landing ports of Dongshan County.

Phase		**VIII**	**VII**	**VI**	**V**	**IV**	**II-III**	**I**
Survey period		2024.8-2025.4	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		98	107	101	79	54	79	61
Average fishing days (days/trip)		6.12	7.48	6.22	6.34	6.48	7.16	7.67
Average total capture volume (kg/vessel/trip)		7885.99	10592.08	8179.9	8751.28	10813.89	8153.79	7855.00
Crustacean	Volume	1070.20	1803.07	1489.73	1132.84	1621.48	1202.46	-
	Proportion%	13.57%	17.02%	18.21%	12.94%	14.99%	14.75%	-
Shrimp	Volume	259.78	258.05	239.83	360.31	212.38	271.49	-
	Proportion%	3.29%	2.44%	2.93%	4.12%	1.96%	3.46%	-
Crab	Volume	810.42	1545.01	1249.90	772.71	1409.09	920.33	1603.00
	Proportion%	10.28%	14.59%	15.28%	8.83%	13.03%	11.29%	20.41%
Fish	Volume	5849.13	7534.34	5875.85	6731.53	8290.82	5805.80	-

	Proportion%	74.17%	71.13%	71.83%	76.92%	76.67%	71.20%	-
Food fish	Volume	3952.97	4975.37	3802.60	4039.44	7128.06	4435.31	-
	Proportion%	50.13%	46.97%	46.49%	46.16%	65.92%	54.39%	-
Feed fish	Volume	1896.17	2558.97	2073.25	2692.09	1162.76	1370.49	-
	Proportion%	24.04%	24.16%	25.35%	30.76%	10.75%	16.81%	-
Cephalopods	Volume	966.64	1254.67	814.32	886.91	901.00	1145.54	-
	Proportion%	12.26%	11.85%	9.96%	10.13%	8.33%	14.05%	-

3.6 Capture volumes and proportions by trap vessels

3.6.1 Capture volumes per unit

Based on the logbook data collected from the three trap vessels surveyed (N = 3) in Dongshan County from August 2024 to April 2025, and the number of fishing days at sea monthly (see Table 3-4 in section 3.4), the average daily capture volumes (kg/day) were between 114.89 kg/day in March 2025 and 1141.23 kg/day in January 2025 (Table 3-15; Fig. 3-11), with the average of 547.98 kg/vessel/day. Because of low catches in March 2025, two trap vessels stopped fishing in April 2025, i.e., one month earlier than the initial of the national summer fishing moratorium.

Monthly variation of the average daily capture volumes (kg/day) was high, both in August 2024 to April 2025 (Fig. 3-11), and in October 2023-April 2024 (Fig. 3-12). However, same trends were noted during the two survey periods, i.e., the average daily capture volumes (kg/ day) were low in March and April, just before the initial of the national summer fishing moratorium.

Table 3-15. Average daily total capture volumes (kg/day) of the three trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

Vessels	**Aug 2024**	**Sept 2024**	**Oct 2024**	**Nov 2024**	**Dec 2024**	**Jan 2025**	**Feb 2025**	**Mar 2025**	**Apr 2025**
#1	881.93	756.77	594.19	560.57	692.36	592.14	459.67	144.89	-
#2	375.00	418.63	387.10	533.24	611.97	679.15	372.74	311.29	335.36
#3	479.90	445.07	338.19	850.73	831.87	1141.23	440.33	465.17	-
Average	578.94	540.16	439.83	648.18	712.07	804.17	424.25	307.12	

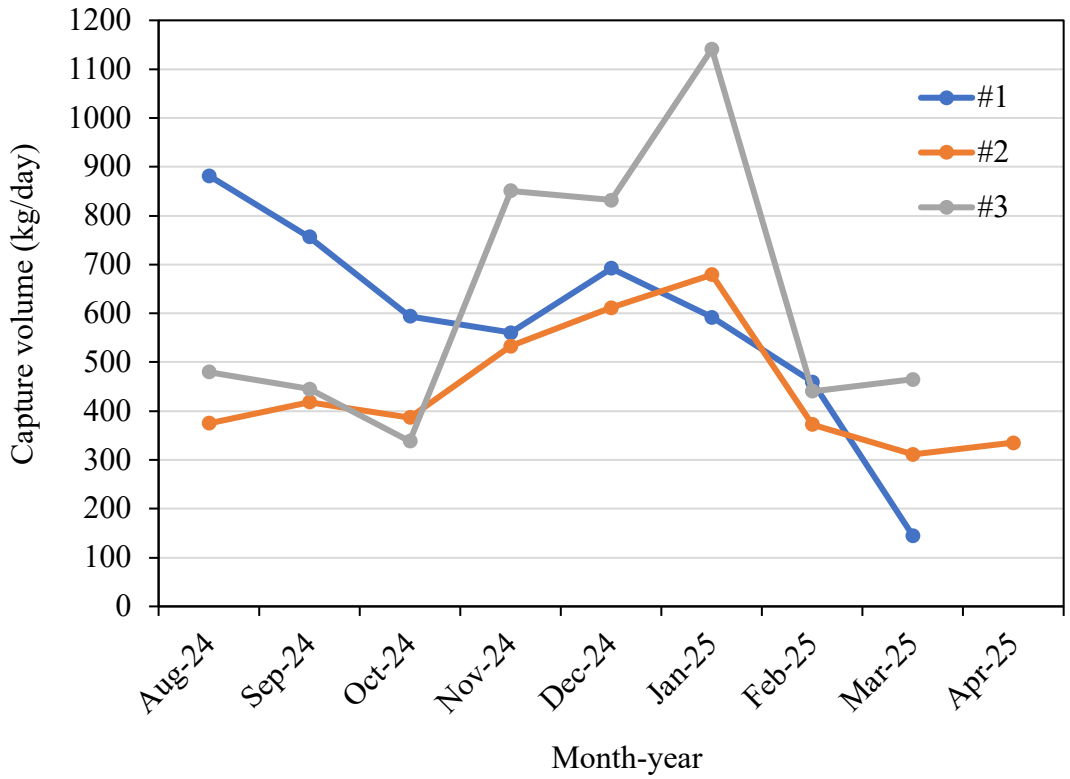

Fig. 3-11. Average daily capture volumes (kg/day) of trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

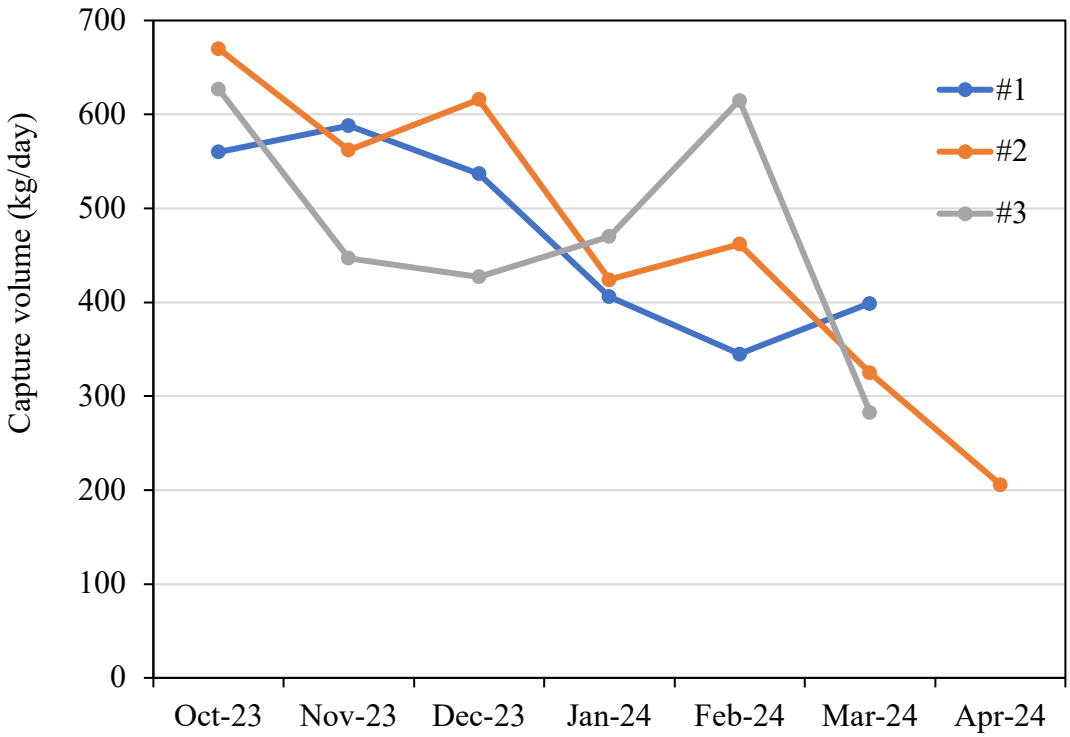

Fig. 3-12. Average daily capture volumes (kg/day) of trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

Based on the logbook data collected from the three trap vessels surveyed (N = 3) in Dongshan County from August 2024 to April 2025, the average daily capture volumes (kg/day) (Table 3-16), the average daily number of trap lines towed was 6 lines/day (ranged 4-7 lines/day), the average CPUE (kg/line) was 91.33 kg/line, ranged 24.15-190.21 kg/line (Table 3.16).

Table 3-16. CPUE (kg/line) of the total capture volumes of the three trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

Vessels	Aug 2024	Sept 2024	Oct 2024	Nov 2024	Dec 2024	Jan 2025	Feb 2025	Mar 2025	Apr 2025
#1	146.99	126.13	99.03	93.43	115.39	98.69	76.61	24.15	
#2	62.50	69.77	64.52	88.87	102.00	113.19	62.12	51.88	55.89
#3	79.98	74.18	56.37	141.79	138.65	190.21	73.39	77.53	
Average	96.49	90.03	73.30	108.03	118.68	134.03	70.71	51.19	

3.6.2 Capture volumes and proportions of different taxonomic groups

Based on the logbook data collected from three trap vessels surveyed (N = 3) in Dongshan County from August 2024 to April 2025, the average daily capture volumes (kg/day) by taxonomic group were estimated (Table 3-17). The most dominant capture taxonomic group was crab in trap fishery, contributed to over 75% (average of 385.75 kg/day, N= 3) of the total capture volume; the average fish capture volume was 151.95 kg/day, contributing approximate 23% of the total capture volume; the average cephalopod capture volume was 14.48 kg/day, contributing approximate 1.5% of the total capture volume (Table 3-17).

Table 3-17. Average daily capture volume (kg/day) by taxonomic group and its proportion (%) from trap vessels surveyed (N = 3) from August 2024 to April 2025 in Dongshan County.

	#1		#2		#3		Average	
	kg/day	%	kg/day	%	kg/day	%	kg/day	%
Crab	462.05	78.94	323.36	72.31	371.85	59.59	385.75	75.63
Fish	117.94	20.15	114.33	25.57	223.58	35.83	151.95	22.86
Cephalopod	5.32	0.91	9.48	2.12	28.63	4.59	14.48	1.52
Total	585.32	100.00	447.16	100.00	624.06	100.00	552.18	100.00

Based on the average annual fishing days of the three trap vessels in August 2024-April 2025 (182 days/vessel/year, N = 3) (Table 3-4), 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 3-17), the estimated annual capture volume of trap fishery in Dongshan County was 6532.29 t (Table 3-18).

Table 3-18. Estimated annual capture volume of trawl fishery in Dongshan County.

	Average daily capture volume (kg/day)	**Number of vessels**	**Average annual fishing days (d)**	**Estimated capture volume (t)**
Crab	385.75	65	182	4563.42
Fish	151.95			1797.57
Cephalopod	14.48			171.30
Total	552.18			6532.29

3.6.3 Crabs

As the dominant taxonomic group in trap fishery, crabs were recorded at the species level, including six species, *M. haani*, *P. sanguinolentus*, *P. trituberculatus*, *C. feriatus*, *C. natator* and *C. philargius*, with *M. haani*, *P. sanguinolentus* and *C. natator* had high catches.

For *M. haani*, monthly variation in CPUE (kg/line) was noted in two periods, August 2024-April 2025 and October 2023-April 2024, with CPUE was generally high in August 2024-April 2025 (Table 3-19; Figs. 3-13 & 3-14). The average CPUE was 38.59 kg/line in August 2024-April 2025. High average CPUE were noted in December 2024 and January 2025, and low CPUE were noted in October 2024. *M. haani* was mainly traded fresh. Only large sized individuals were sold alive for higher price.

Table 3-19. CPUE (kg/line) of *Monomia haani* in the trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

Vessels	**Aug 2024**	**Sept 2024**	**Oct 2024**	**Nov 2024**	**Dec 2024**	**Jan 2025**	**Feb 2025**	**Mar 2025**	**Apr 2025**
#1	77.69	81.28	29.75	52.54	57.21	41.83	50.76	20.40	-

#2	6.58	19.66	10.86	17.65	33.29	49.09	30.20	27.12	26.05
#3	10.24	24.44	4.75	19.75	68.43	107.46	45.60	52.01	-
Average	31.50	41.79	15.12	29.98	52.98	66.13	42.19	33.18	

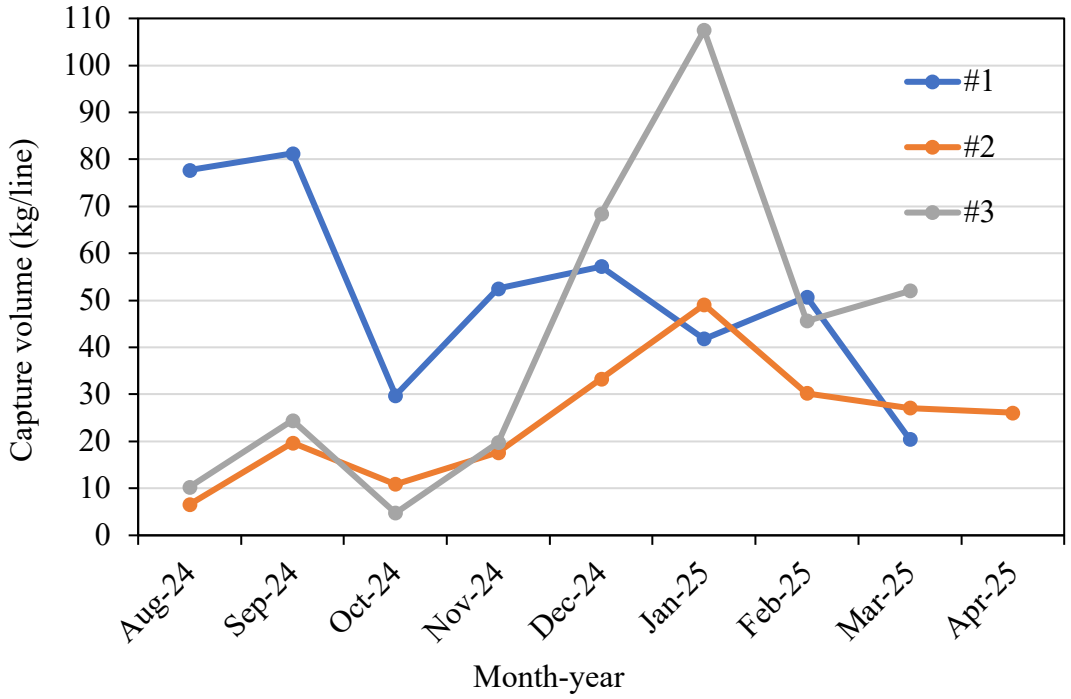

Fig. 3-13. CPUE (kg/line) of *Monomia haani* in the trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

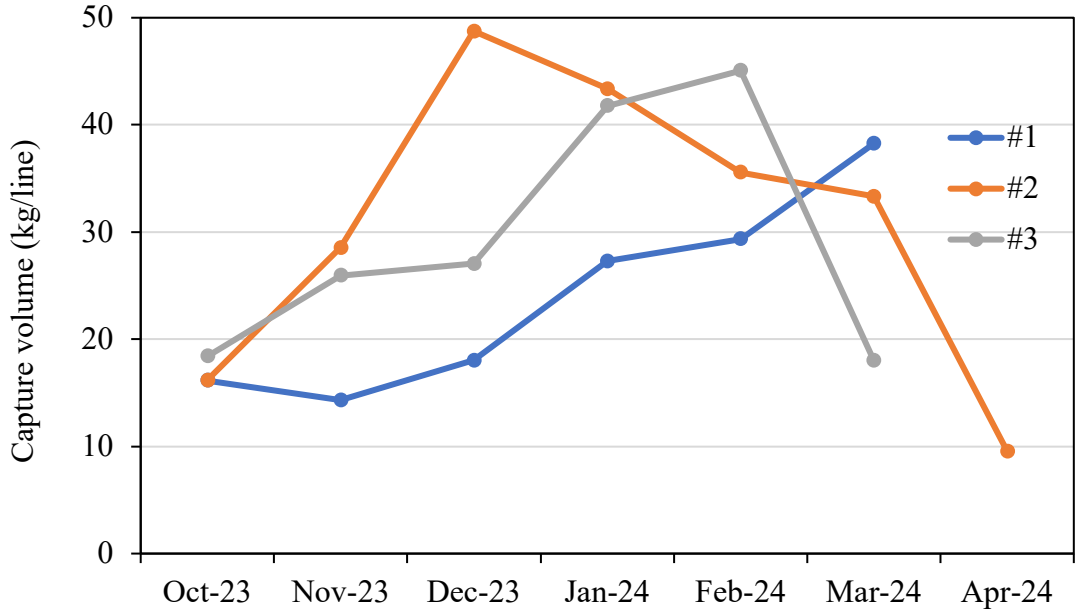

Fig. 3-14. CPUE (kg/line) of *Monomia haani* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

For *P. sanguinolentus*, monthly variation in CPUE (kg/line) was noted in two periods, August 2024-April 2025 and October 2023-April 2024, with CPUE was generally low in August 2024-April 2025, all < 30 kg/line (Table 3-20; Figs. 3-15 & 3-16). The average CPUE was 7.48 kg/line in August 2024-April 2025. *P. sanguinolentus* was traded both fresh and alive.

Table 3-20. CPUE (kg/line) of *Portunus sanguinolentus* in the trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

Vessels	**Aug 2024**	**Sept 2024**	**Oct 2024**	**Nov 2024**	**Dec 2024**	**Jan 2025**	**Feb 2025**	**Mar 2025**	**Apr 2025**
#1	28.61	7.81	4.97	10.04	13.39	8.14	8.34	0.00	-
#2	5.18	5.68	0.84	9.04	6.55	2.43	5.39	6.72	1.36
#3	4.77	12.04	15.47	24.03	3.33	1.22	1.03	0.63	-
Average	12.85	8.51	7.09	14.37	7.76	3.93	4.92	2.45	

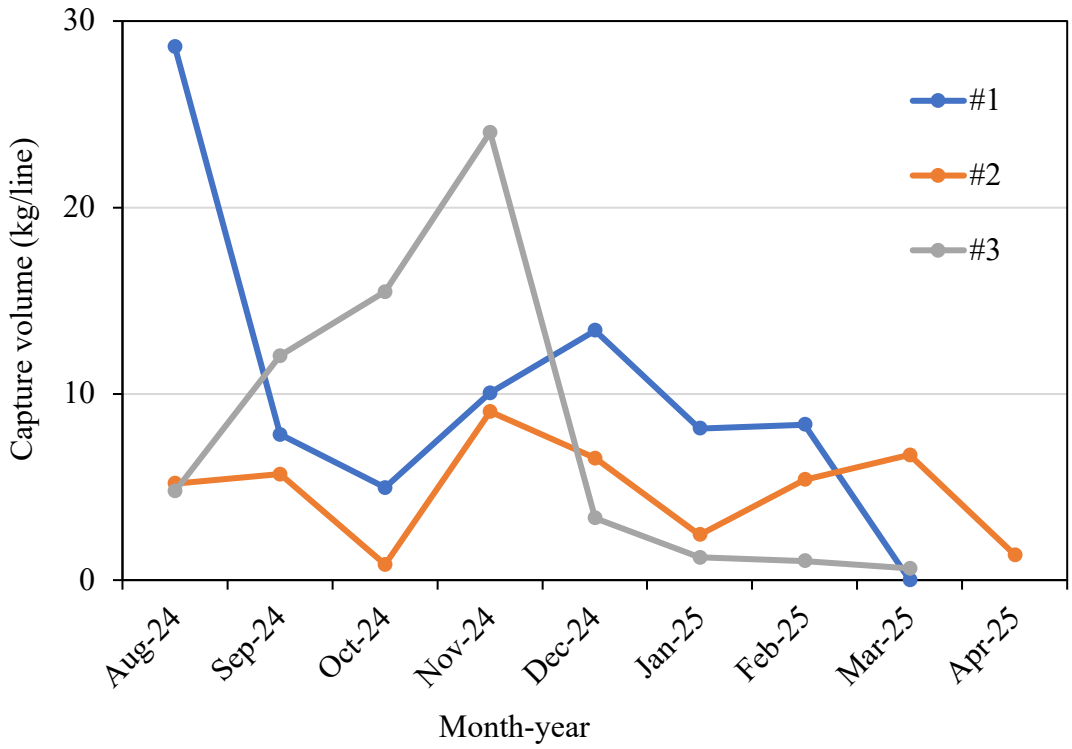

Fig. 3-15. CPUE (kg/line) of *Portunus sanguinolentus* in the trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

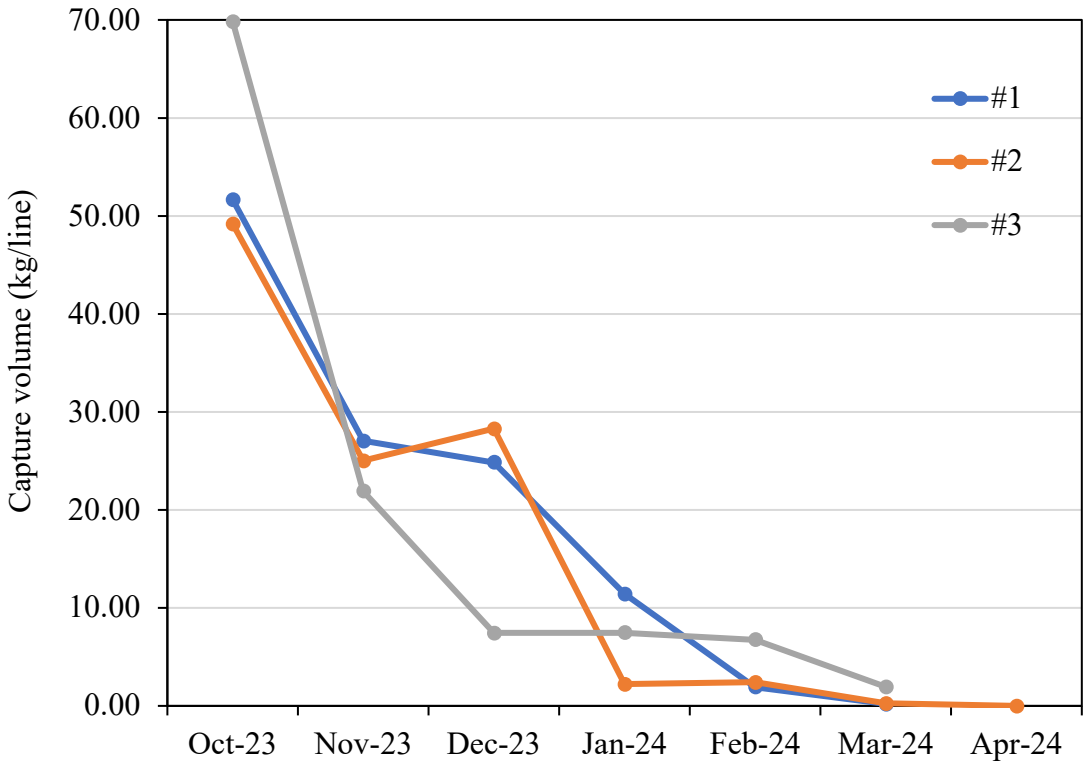

Fig. 3-16. CPUE (kg/line) of *Portunus sanguinolentus* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

For *C. natator*, monthly variation in CPUE (kg/line) was noted in two periods, August 2024-April 2025 and October 2023-April 2024 (Table 3-21; Figs. 3-17 & 3-18). The average CPUE was 12.21 kg/line in August 2024-April 2025. *C. natator* was traded alive only.

Table 3-21. CPUE (kg/line) of *Charybdis natator* in the trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

Vessels	**Aug 2024**	**Sept 2024**	**Oct 2024**	**Nov 2024**	**Dec 2024**	**Jan 2025**	**Feb 2025**	**Mar 2025**	**Apr 2025**
#1	11.58	11.63	17.71	4.40	3.63	2.70	3.67	0.00	-
#2	20.22	23.68	30.19	35.72	32.85	30.06	7.97	6.72	12.56
#3	4.96	2.03	5.10	11.09	16.91	4.96	0.64	4.18	-
Average	12.25	12.45	17.67	17.07	17.80	12.57	4.09	3.63	

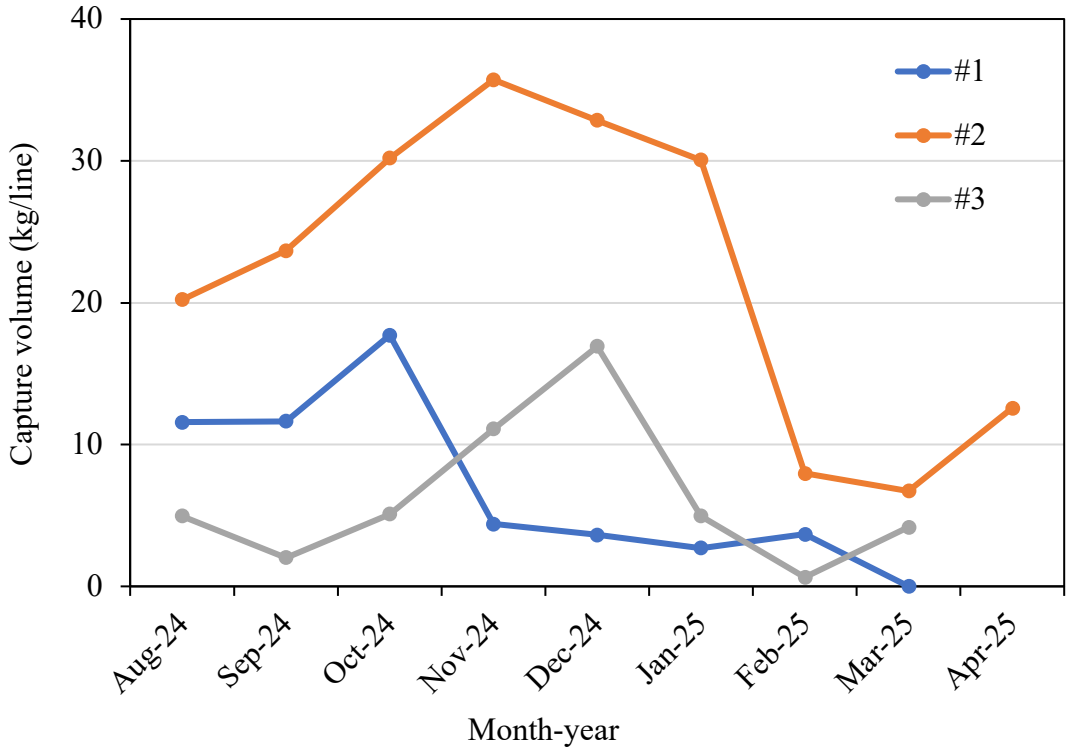

Fig. 3-17. CPUE (kg/line) of *Charybdis natator* in the trap vessels surveyed (N = 3) in August 2024-April 2025 from Dongshan County.

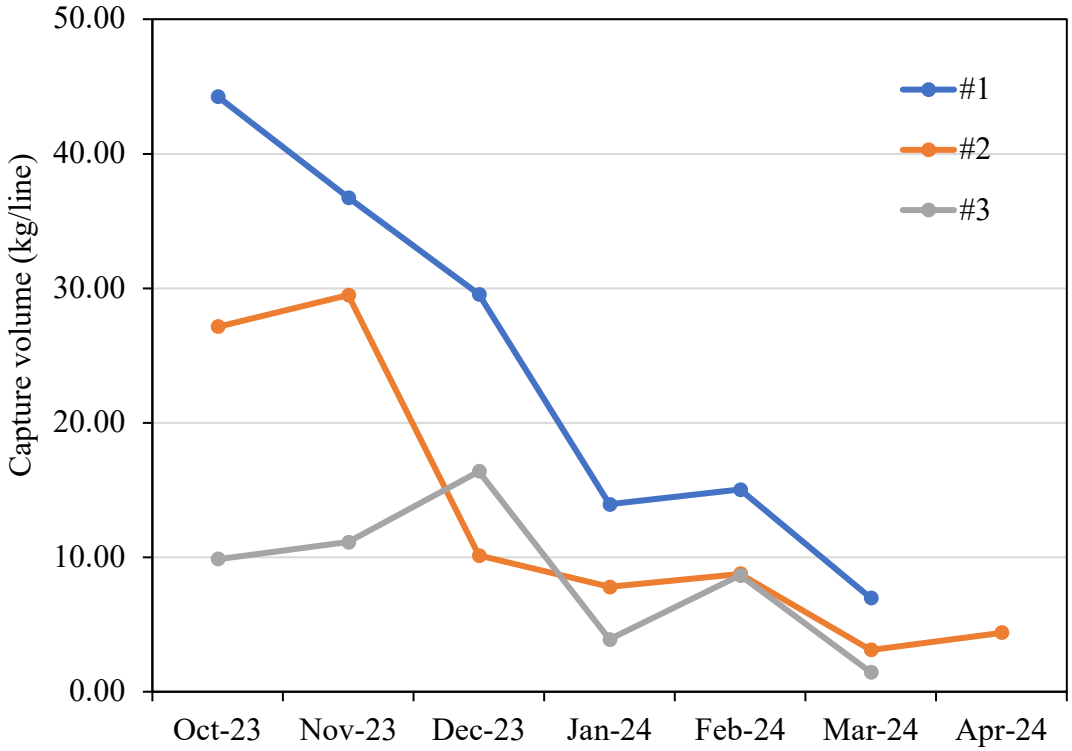

Fig. 3-18. CPUE (kg/line) of *Charybdis natator* in the trap vessels surveyed (N = 3) in October 2023-April 2024 from Dongshan County.

3.6.4 Fishes

Based on the three trap vessels surveyed (N = 3) in Dongshan County from August 2024 to April 2025, only a few species with high price or high volume were recorded at the species level, including 石斑鱼 *Epiniphelus awoara* (only minor *Epiniphelus akarra*), 二长棘鲷 *Evynnis cardinalis* and 褐昌鲉 *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. Groupers, eels and rockfishes were sold alive, and other fishes sold as fresh.

3.7 Biology of *Monomia haani*

Monomia hanni samplings were conducted randomly from trawl catches at Gongqian Landing Port of Dongshan County monthly from August 2024 to April 2025. A total of 2,219 individuals were collected and measured, including smaller individuals in feed fish samples.

3.7.1 Size variation by month

Sizes (carapace width, CW in cm) of *M. haani* ranged from 1.2 cm to 11.9 cm CW, and monthly average sizes ranged from 6.4 cm CW in April 2025 to 8.6 cm CW in December 2024 (Table 3-22).

The dominant size classes of *M. haani* in August 2024-April 2025 showed monthly variation (Fig. 3-19):

(1) Proportions of larger sizes (>10.0 cm CW) were highest in December 2024 (37.18%), followed by January 2025, March 2025, November 2024, October 2024, and August 2024 with moderate levels around 10%–25%. In other months, proportions of larger sizes (>10.0 cm CW) were generally low (<10%), and lowest in April 2025 (0.33%) and September 2024 (1.26%).

(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; >80% was recorded in February 2025 (80.00%) and April 2025 (83.39%), >60% in January 2025 (63.22%) and November 2024 (60.65%), >50% in September 2024 (51.88%) and March 2025 (50.67%). Proportions were relatively low in August 2024 (47.86%) and October 2024 (36.50%). The lowest proportion was recorded in December 2024

(31.41%).

(3) Sizes < 6.0 cm CW (around the size at 50% sexual maturity) were found in all months. The proportions were >30% in November 2024 (47.1%) and April 2025 (44.3%), and the proportions were <10% in August 2024 (1.2%), September 2024 (8.8%) and October 2024 (9.0%).

Table 3-22. Number of samples and sizes (carapace width, CW, cm) of *Monomia haani* from trawl fishery in Dongshan County in August 2024-April 2025.

Month	**Number**	**Range of CW (cm)**	**Average CW (cm)**
Aug-2024	257	5.8-11	8.2
Sep-2024	239	1.6-10.8	7.5
Oct-2024	200	1.2-11.8	8.2
Nov-2024	310	2.5-11.6	6.9
Dec-2024	156	2.6-11.5	8.6
Jan-2025	242	2.1-6.8	7.7
Feb-2025	285	2.0-11.0	7.0
Mar-2025	223	2.2-11.9	7.7
Apr-2025	307	2.4-10.7	6.4
Total	2219	1.2-11.9	7.4

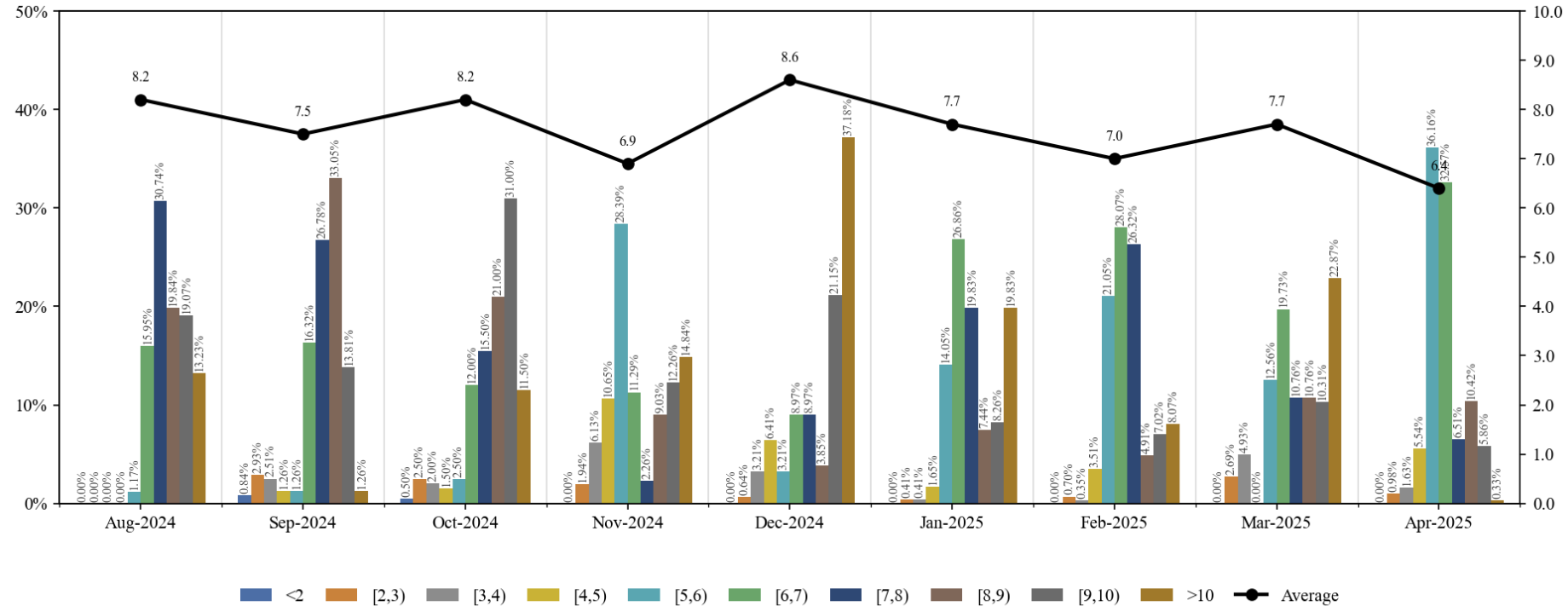

Fig. 3-19. Proportions (%) of different size classes (cm in carapace width) of *Monomia haani* (left Y-axis) and the trends of the monthly average sizes (right Y-axis) in trawl catches of Dongshan County from August 2024 to April 2025.

3.7.2 Size variation by sex

The sex of 35 small individuals in feed fish samples cannot be determined due to poor condition, therefore, only 2184 individuals were used for further analyses.

The sizes ranged from 1.9 cm to 11.0 cm CW for females (mean = 6.4 cm CW, SD = 1.2, N = 781), and from 1.2 cm to 11.9 cm CW for males (mean = 8.0 cm CW, SD = 2.1, N = 1403) (Fig. 3-20). Males were significantly larger than females in CW (W = 278, 046, $p < 0.01$). 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. 3-20. Size (carapace width, CW) frequency (%) of *Monomia haani* males (N = 1403) and females (N = 781), collected from August 2024 to April 2025. 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 2,184 individuals randomly sampled, the overall sex ratio of *M. haani* was 1.80:1 (male: female, N = 1403 for males, N = 781 for females), showing a significant male-bias (p <0.05). Significant male-biased ratios were observed in all months except February 2025 (p = 0.76) and March 2025 (p = 0.54) (Fig. 3-21).

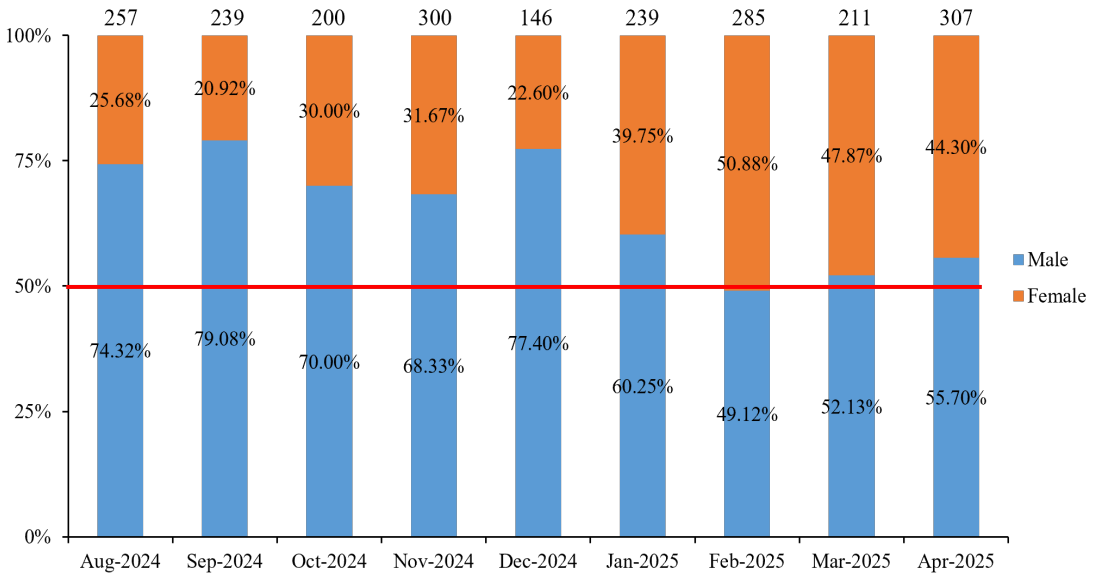

Fig. 3-21. Proportions (%) of males and females of *Monomia haani* (N = 2184) in trawl catches of Dongshan County in August 2024-April 2025.
(Number of samples showed at the top of the bars)

3.7.4 Spawning season

M. haani females carrying eggs were found in most of sampling months except November and December 2024. The spawning peak was in February, March and April 2025, determining by the high proportions (%) of number of females carrying eggs/number of females (Fig. 3-22).

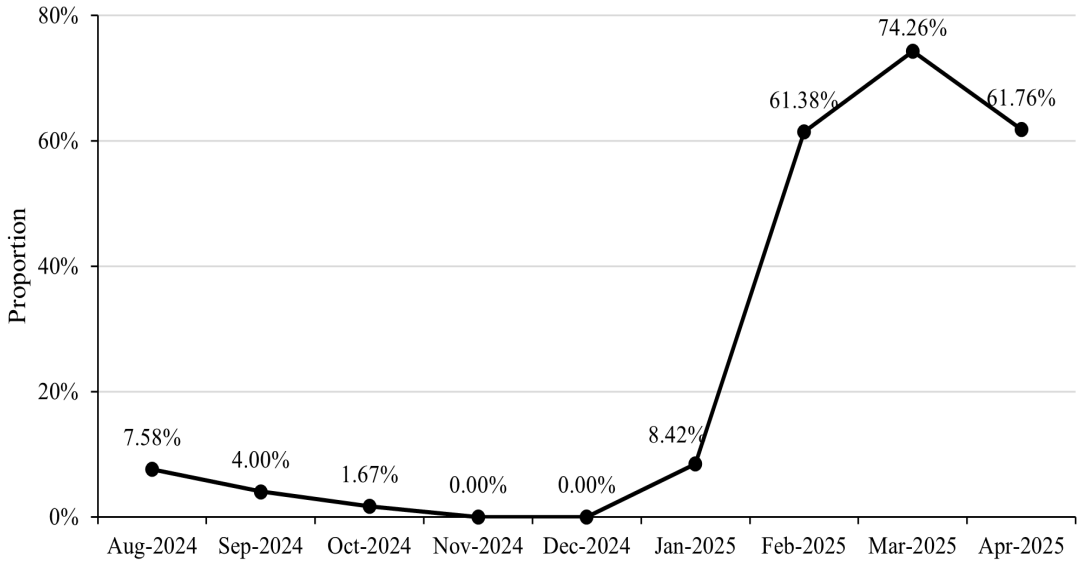

Fig. 3-22. Proportions (%) of *Monomia haani* females carrying eggs in trawl catches of Dongshan County in August 2024-April 2025.

3.7.5 Spawning season determined from 2022 to 2025 (Phases V-VIII)

According to the surveys from 2018 to 2025 (Phases I-VIII), *M. haani* females carrying eggs were found in most of sampling months, indicating the species can spawn year-round.

The proportions of individuals carrying eggs were particularly high from February to April in 2022-2025, indicating the consistent spawning peak of *M. haani* (Fig. 3-23). Because of the lack of samples in May-July, it is unknown whether the peak spawning season (February-April) determined could extend longer.

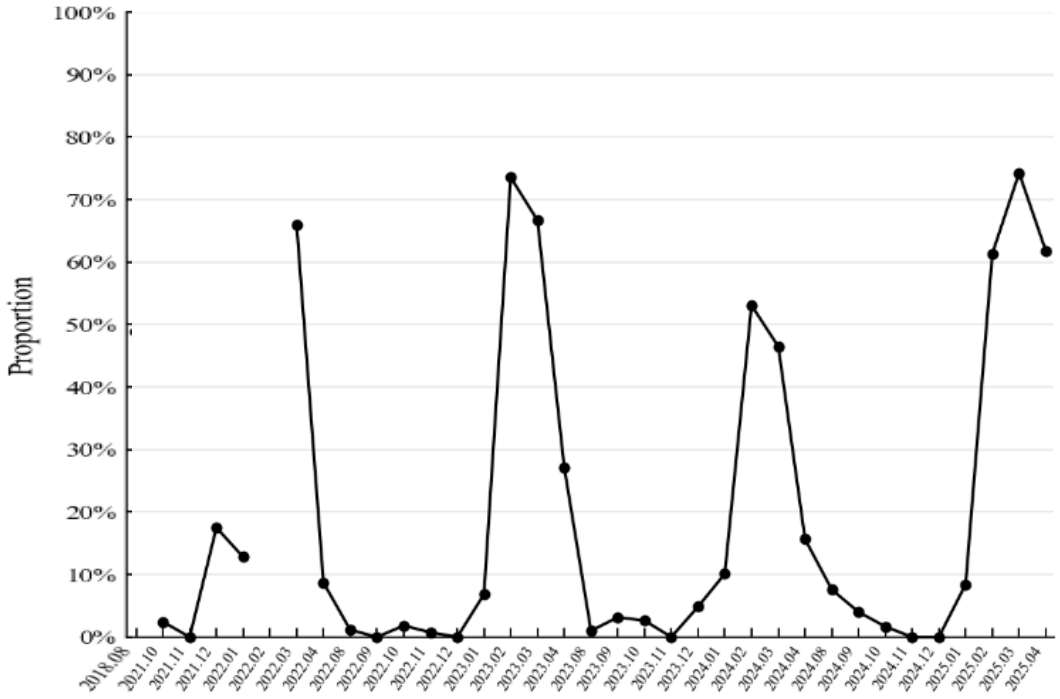

Fig. 3-23. Proportions (%) of *Monomia haani* females carrying eggs in trawl fishery in Dongshan County from 2022 to 2025 (Phases V-VIII).

3.7.6 Sizes for female maturity

The minimum size for female carrying eggs was 3.3 cm CW, caught in April 2025.

Females collected in February, March and April 2025 (the spawning peak) were used to calculate the size at 50% female maturity (CW_{50}), and the estimated CW_{50} was 5.3 cm CW (Fig. 3-24), smaller than 6.3 cm CW estimated from 2019 samples (Lin et al., 2021).

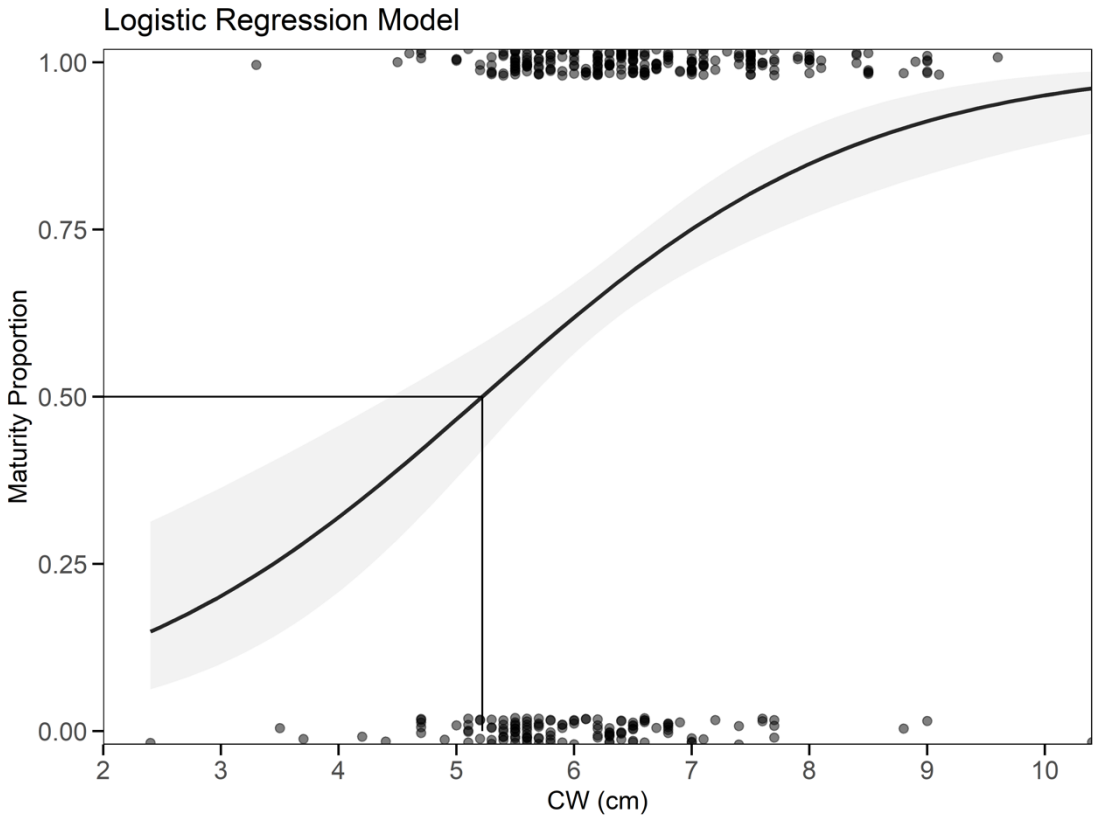

Fig. 3-24. Size (carapace width, CW) at 50% female maturity of *Monomia haani* based on all females sampled in the spawning peak determined, i.e. February, March and April 2025 (N = 382). The fitting curve was suggested by the black solid line with 95% CI. The circle represented the individuals that 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: $BW = 0.0732 \times CW^{3.2273}$ ($R^2 = 0.9645$; N = 2184); $BW = 0.0727 \times CW^{3.2609}$ ($R^2 = 0.9343$; N = 781) for females; $BW = 0.0641 \times CW^{3.2773}$ ($R^2 = 0.9604$; N = 1403) for males (Fig. 3-25).

The relationship of carapace length (CL)-carapace width (CW) for *M. haani* was: $CL = 0.5651 \times CW + 0.0604$ ($R^2 = 0.973$; N = 2183); $CL = 0.5619 \times CW + 0.1029$ ($R^2 = 0.94$; N = 781) for females; $CL = 0.57 \times CW + 0.0091$ ($R^2 = 0.9749$; N = 1403) for males (Fig. 3-26).

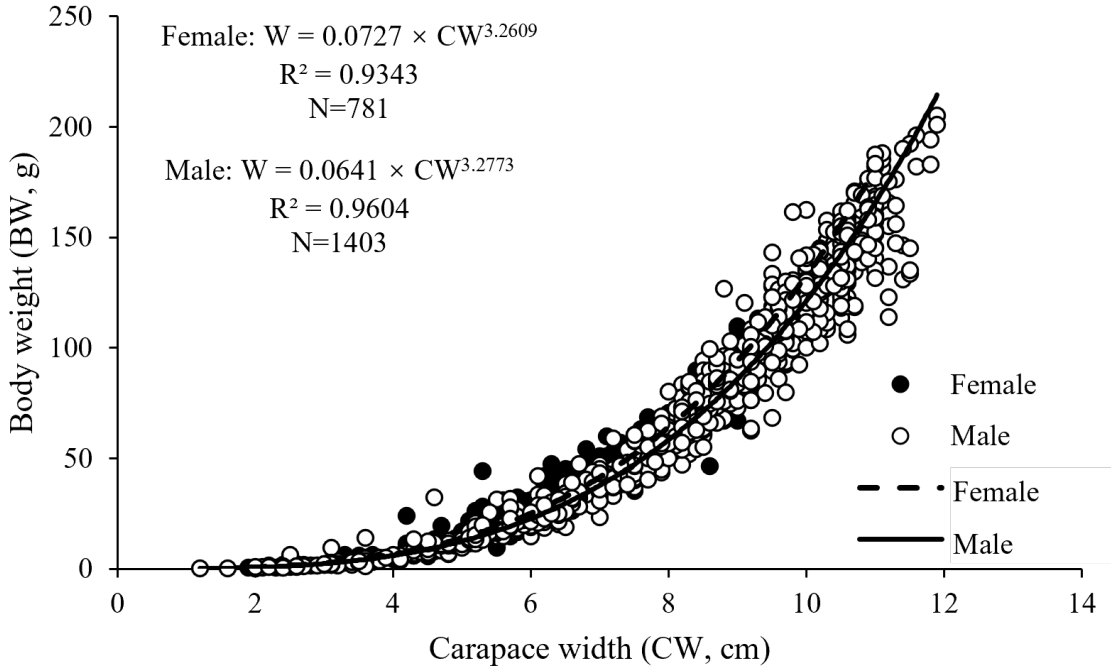

Fig. 3-25. Size (carapace width, CW)-weight (whole body weight, BW) relationship of *Monomia haani* in August 2024-April 2025.

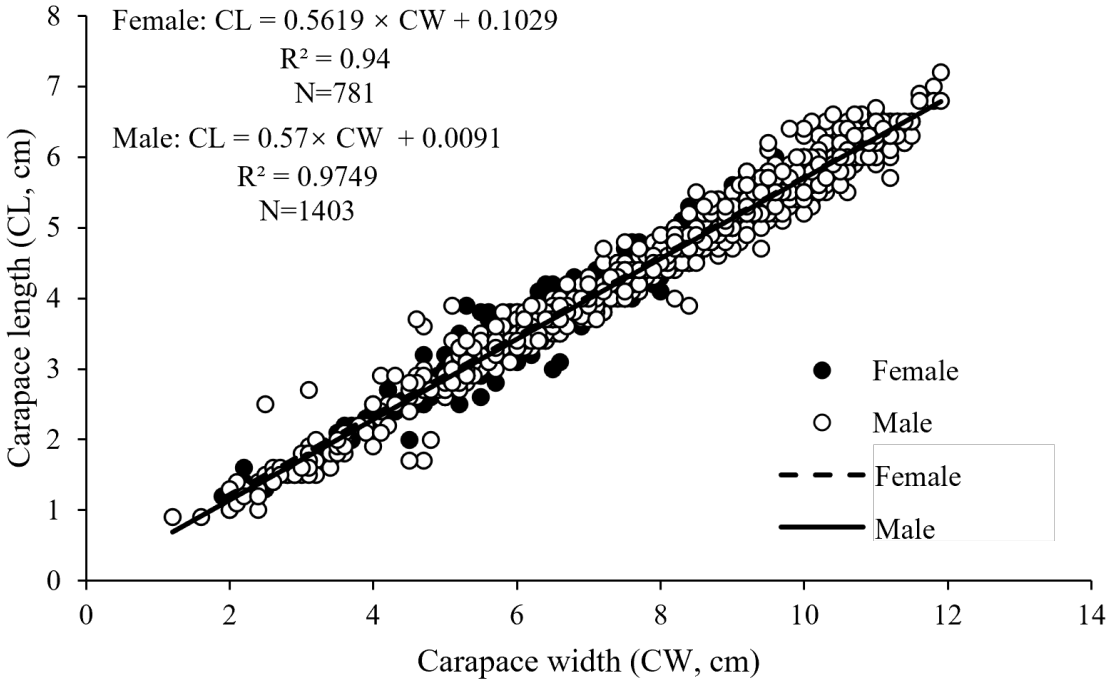

Fig. 3-26. Carapace length (CL)-carapace width (CW) relationship of *Monomia haani* in August 2024-April 2025.

3.8 Biology of *Portunus sanguinolentus*

P. sanguinolentus samplings were conducted randomly from trawl catches at Gongqian Landing Port of Dongshan County monthly from August 2024 to April 2025. A total of 996 individuals were collected and measured, including smaller individuals in feed fish samples.3.8.1 Size variation by month

Sizes (carapace width, CW in cm) of *P. sanguinolentus* ranged from 2.1 cm to 19.3 cm CW, and monthly average sizes ranged from 10.4 cm CW in March 2025 to 14.3 cm CW in October 2024 (Table 3-23, Fig. 3-27). The minimum size individual (2.1 cm CW) was found in September 2024.

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

(1) Proportions (%) of larger sizes (≥ 15.0 cm CW) were high in October 2024 and August 2024, accounting for 38.98% and 20.27%, respectively, and were less than 10% in December 2024, and January-March 2025.

(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 November 2024 (66.20%), February 2025 (62.57%), March 2025 (78.82%) and April 2025 (54.64%), around 40-45% in December 2024 (40.91%).

Table 3-23. Number of samples and sizes (carapace width, CW, cm) of *Portunus sanguinolentus* from trawl fishery in Dongshan County in August 2024-April 2025.

Month	Number	Range of CW (cm)	Average CW (cm)
Aug-2024	74	10.9-16.3	13.7
Sep-2024	89	2.1-17.0	12.9
Oct-2024	59	2.2-18.5	14.3
Nov-2024	142	3.2-17.3	11.0
Dec-2024	110	3.5-16.0	12.2
Jan-2025	84	3.2-16.6	13.4
Feb-2025	171	2.6-16.0	11.4
Mar-2025	170	7.5-17.0	10.4
Apr-2025	97	7.1-19.3	11.4
Total	996	2.1-19.3	11.9

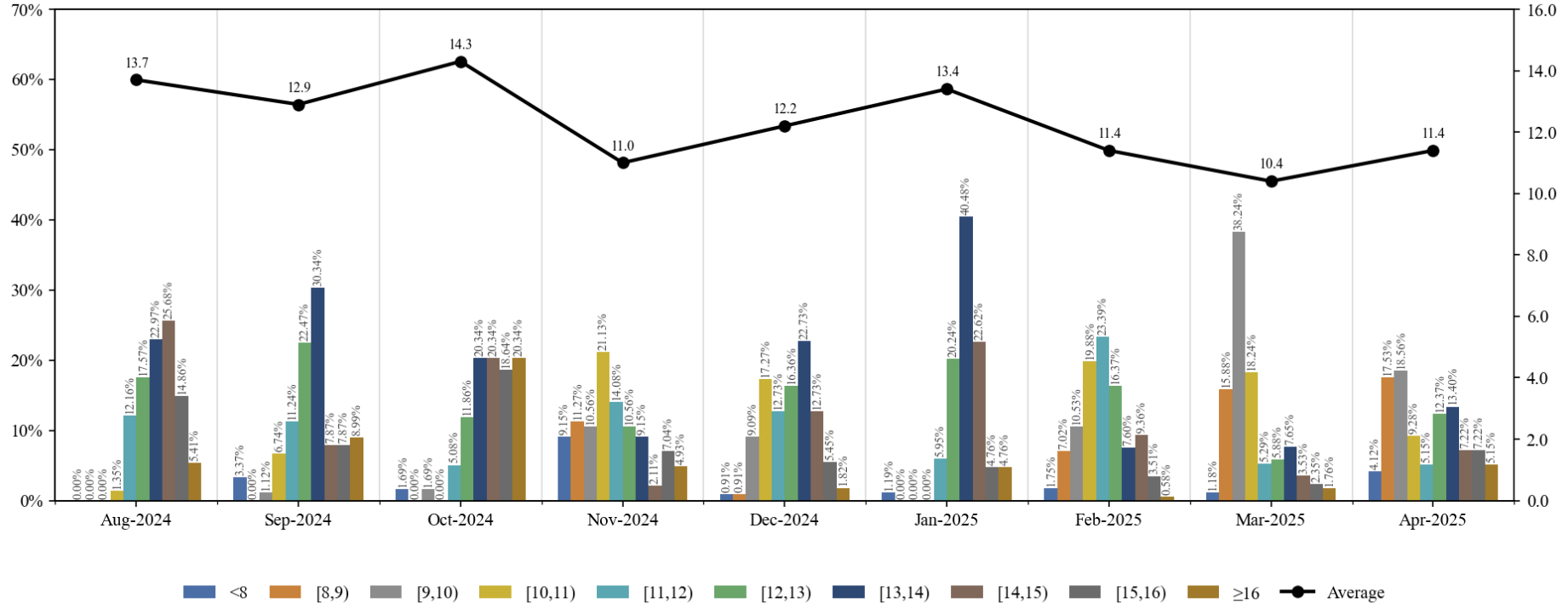

Fig. 3-27. Proportions (%) of different size classes (cm in carapace width) of *Portunus sanguinolentus* (left Y-axis) and the trends of the monthly average sizes (right Y-axis) in trawl catches of Dongshan County from August 2024 to April 2025.

3.8.2 Size variation by sex

The sizes ranged from 3.5 cm to 17.4 cm CW for females (mean = 11.9, SD = 2.1, N = 541), and from 2.1 cm to 19.3 cm CW for males (mean = 12.0, SD = 2.1, N = 455) (Fig. 3-25). There was no significantly difference in CW between males and females (W = 231947, $p > 0.05$).

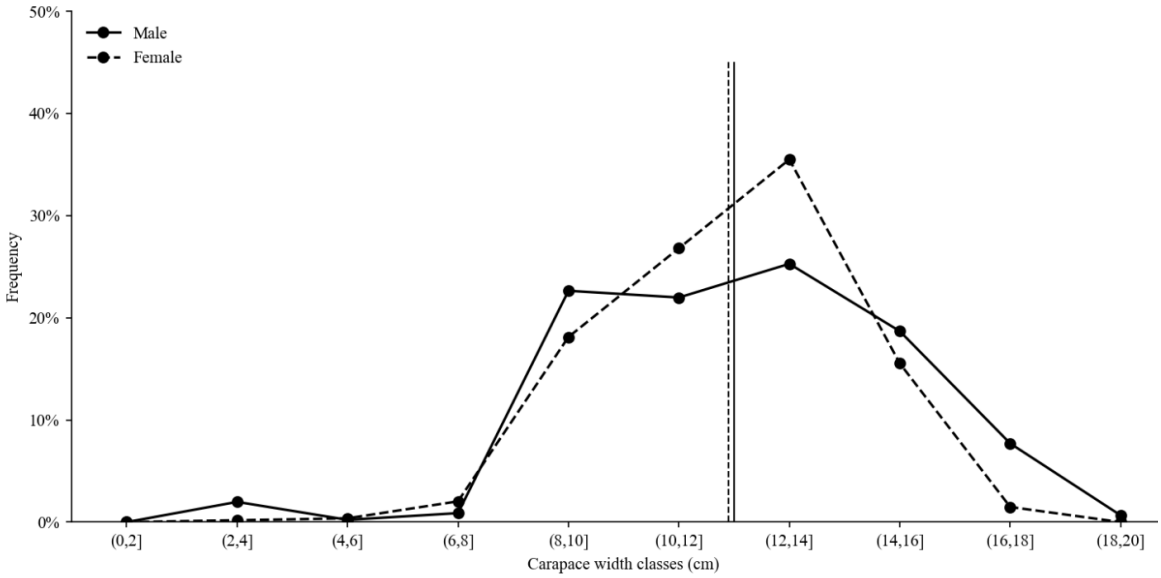

Fig. 3-25. Size (carapace width, CW) frequency (%) of *Portunus anguinolentus* males (N = 455) and females (N = 541), collected from August 2024 to April 2025. Vertical lines indicate the average sizes of males and females.

3.8.3 Sex ratio

Sex ratios of *P. sanguinolentus* showed monthly variation. From the 996 individuals randomly sampled, the overall sex ratio of *P. sanguinolentus* was 1: 1.19 (male: female, N = 455 for males, N = 541 for females), showing a significant female-bias ($p < 0.05$). Female-bias was significant in January and February 2025 ($p < 0.05$), and male-bias was signicant in April 2025 ($p < 0.05$). No significant sex bias from August to December 2024 and March 2025 ($p > 0.05$) (Fig. 3-26).

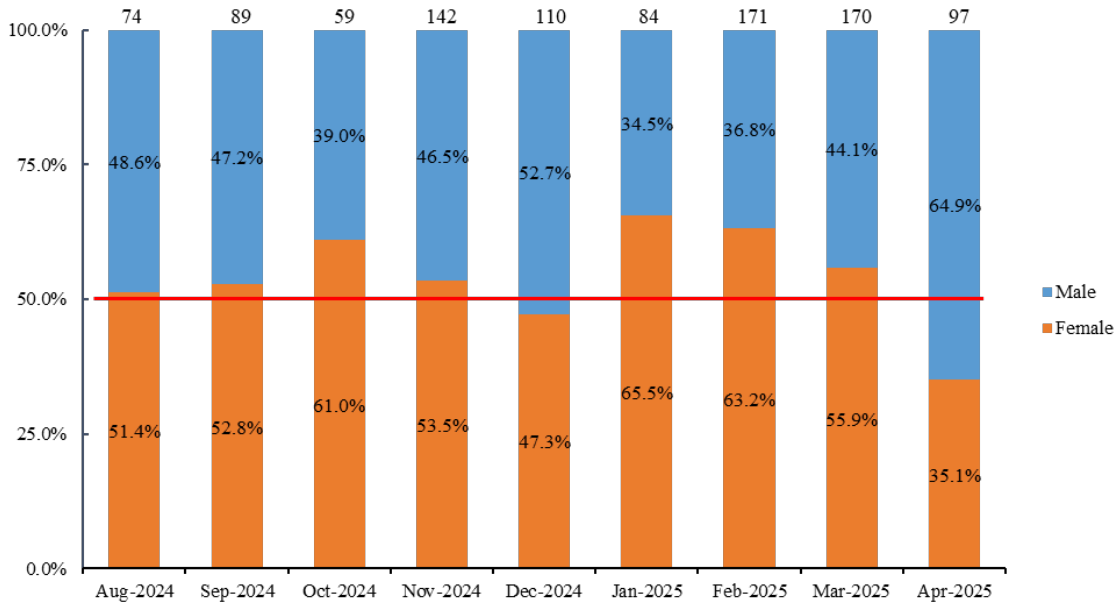

Fig. 3-26. Proportions of males and females of *Portunus sanguinolentus* (N = 996) in trawl fishery in Dongshan County in August 2024-April 2025.
(Number of samples showed at the top of the bars)

3.8.4 Spawning season

P. sanguinolentus females carrying eggs were found in six sampling months except December 2024 and January 2025 (Fig. 3-27). The spawning peaks were in August 2024, in February 2025, and in April 2024, determining by the proportions (%) of number of females carrying eggs/number of females.

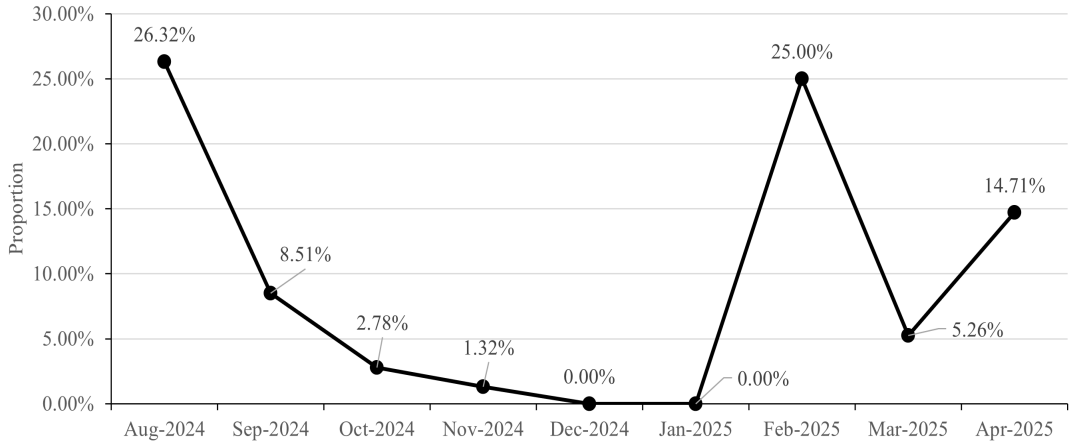

Fig. 3-27. Proportions (%) of *Portunus sanguinolentus* females carrying eggs from trawl fishery of Dongshan County in August 2024-April 2025.

3.8.5 Spawning season determined from 2022 to 2025 (Phases V-VIII)

According to the surveys from 2022 to 2025 (Phases V-VIII), the proportions of individuals carrying eggs were high in February-April, indicating the consistent spawning peak of *P. sanguinolentus*. In addition, there was another spawning peak in August; it is unknown whether the summer spawning peak could start earlier in June and July (Fig. 3-28).

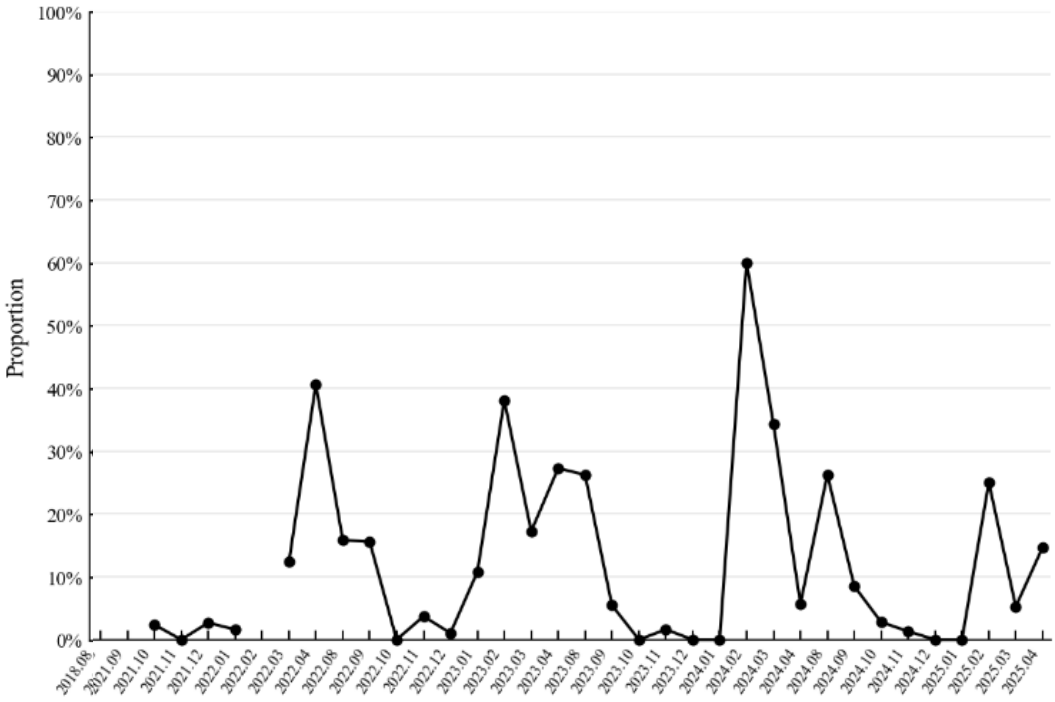

Fig. 3-28. Proportions (%) of *Portunus sanguinolentus* females carrying eggs in trawl fishery in Dongshan County from 2022 to 2025 (Phases V-VIII).

3.8.6 Sizes for female maturity

The minimum size for female carrying eggs was 9.6 cm CW for *P. sanguinolentus*, caught in March 2025, which was smaller than 10.2 cm CW in February 2024 and 10.7 cm CW in January 2023 obtained from the previous phases.

Females collected in August 2024, February 2025 and April 2025 (the spawning peaks) were used to calculate the size at 50% female maturity (CW_{50}), and the estimated CW_{50} was 11.2 cm CW (Fig. 3-29).

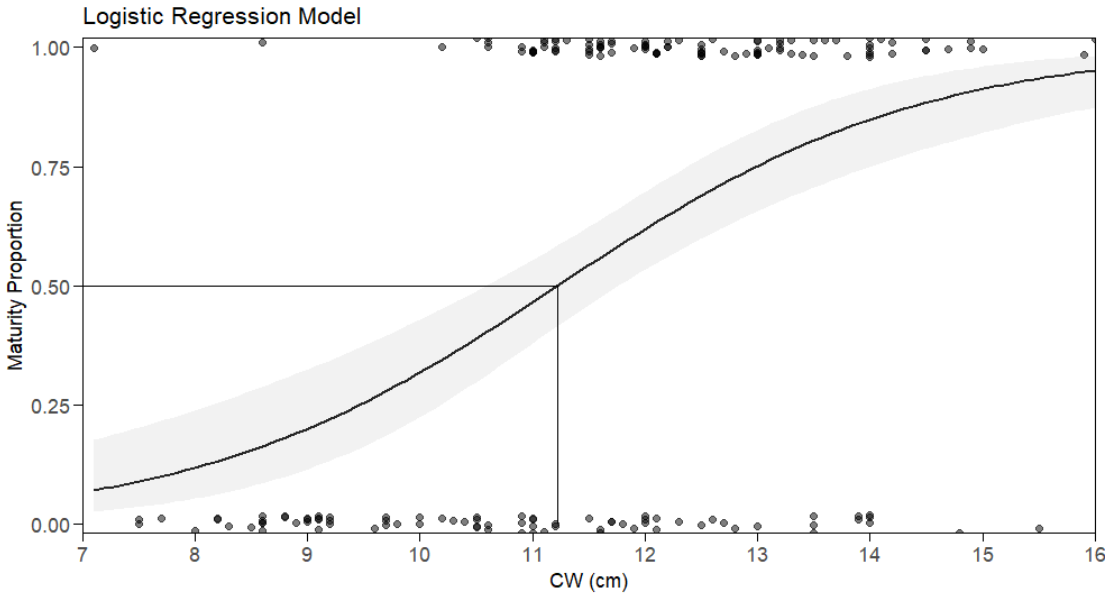

Fig. 3-29. Size (carapace width, CW) at 50% female maturity of *Portunus sanguinolentus* based on all females sampled in spawning peaks determined, i.e. August 2024, February 2025 and April 2025 (N = 180). The fitting curve was suggested by the black solid line with 95% CI. The circle represented the 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: $BW = 0.0486 \times CW^{3.1016}$ ($R^2 = 0.9139$; N = 996); $BW = 0.0734 \times CW^{2.9313}$ ($R^2 = 0.8728$; N = 541) for females; $BW = 0.0393 \times CW^{3.1907}$ ($R^2 = 0.938$; N = 455) for males (Fig. 3-30).

The relationship of carapace length (CL)-carapace width (CW) for *P. sanguinolentus* was: $CL = 0.4419 \times CW + 0.1042$ ($R^2 = 0.9500$; N = 996); $CL = 0.4357 \times CW + 0.1883$ ($R^2 = 0.9214$; N = 541) for females; $CL = 0.4461 \times CW + 0.0419$ ($R^2 = 0.9687$; N =455) for males (Fig. 3-31).

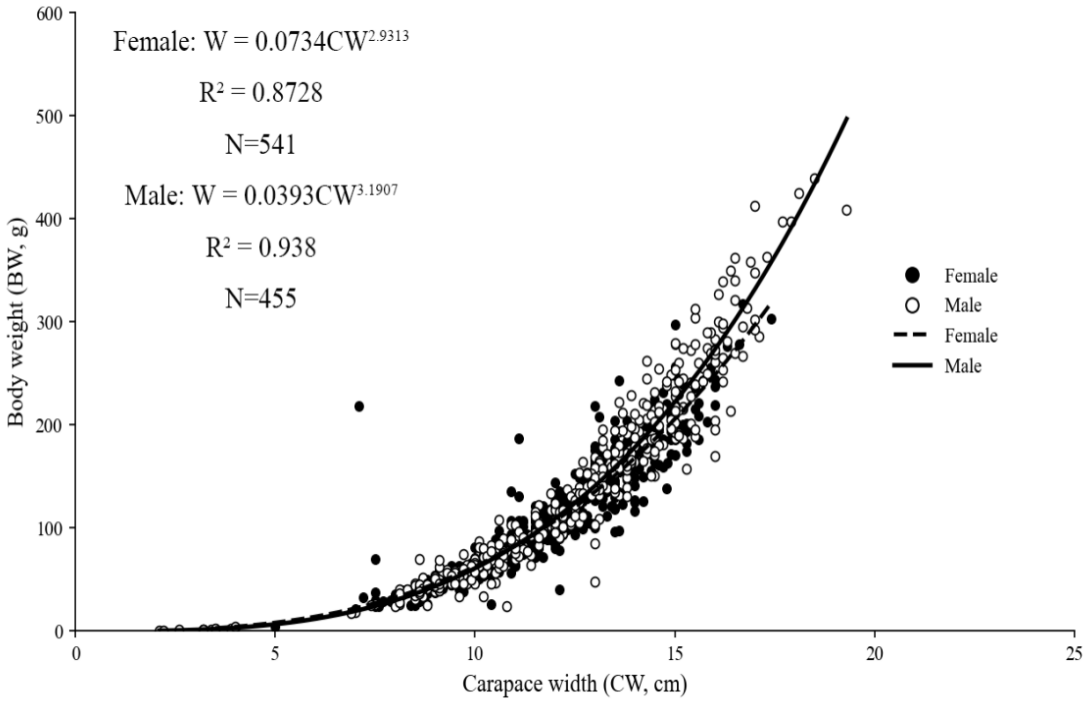

Fig. 3-30. Size (carapace width, CW)-weight (whole body weight, BW) relationship of *Portunus sanguinolentus* in August 2024-April 2025.

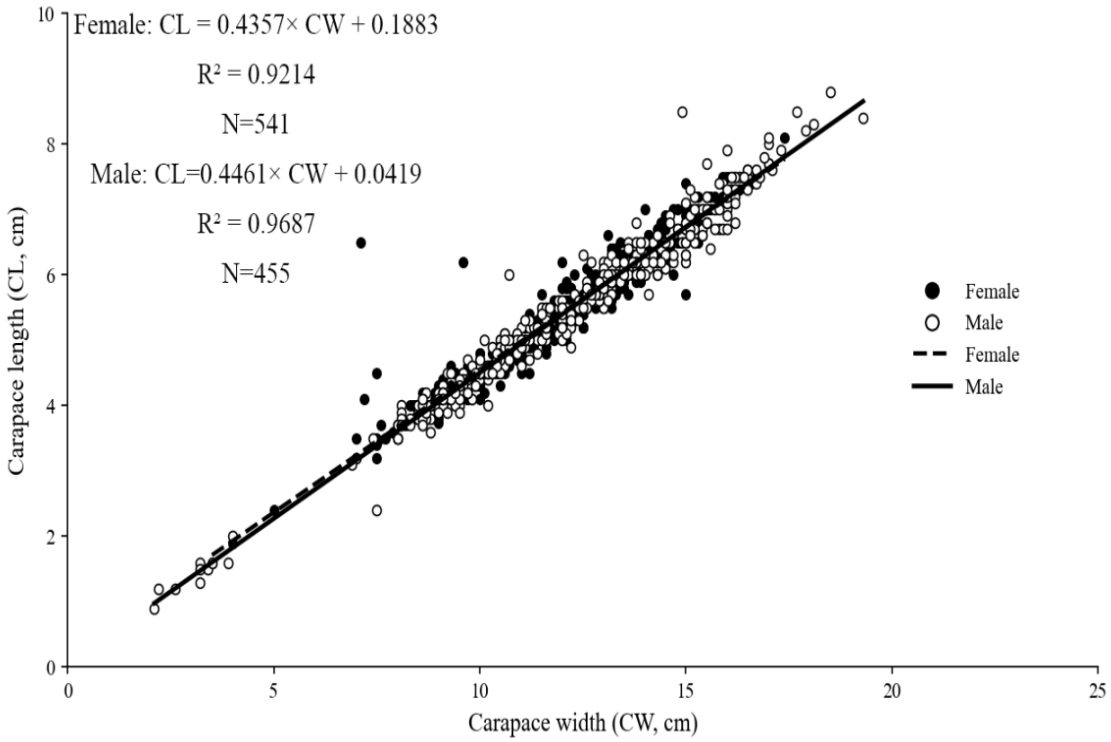

Fig. 3-31. Carapace length (CL)-carapace width (CW) relationship of *Portunus sanguinolentus* in August 2024-April 2025.

4. Significant findings

(1) The species diversity in the southern Taiwan Strait is high. A total of 523 species (at species, genus or family level) were identified cumulatively from trawl fishery catches from August 2018 to April 2025 (in Phases I-VIII) at the landing ports of Dongshan County, including 403 fishes (77.06%), 96 crustaceans (18.36%) and 24 cephalopods (4.58%).

(2) The species in feed fishes is diverse. A total of 134 species with 91 fishes, 36 crustaceans and 7 cephalopods were identified from September 2024 to April 2025. Among these species, 78 species were only found in feed fishes including 47 fishes, 27 crustaceans and 4 cephalopods.

(3) The most dominant species group in trawl fishery surveyed at Gongqian Landing Port was food fish, accounting for approximately 50% of the total capture volumes. Same pattern was found through logbook surveys of the two trawl vessels; the food fish contributed to over 60% of the total capture volumes.

(4) The most dominant species group in trap fishery based on the three trap vessels surveyed was crabs, which accounted for approximate 75% of the total capture volumes.

(5) Based on the number of registered trawl and trap vessels in Dongshan County, the annual fishing days, and the average CPUE, the estimated annual capture volumes were about 53891 t for trawl fishery and 6532 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.

(6) Based on the three trap vessels surveyed, the 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.

(7) 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, Epinephelus* spp., eels and rockfishes

(8) The CPUE for *M. haani* in trawl fishery based at Gongqian Landing Port

surveys in Dongshan County was high in August 2024 (> 1500 kg/vessel/trip and > 200 kg/vessel/day), and showed a decline trend with time, and reached to the lowest volues in April 2025 (< 150 kg/vessel/trip and < 20 kg/vessel/day). The trends were the same in 2018-2025, high in August, the first fishing month after the termination of the national summer fishing moratorium; high CPUE could last till November, but the declines were observed from December to April, giving the lowest CPUE in April (Figs. 4-1 & 4-2).

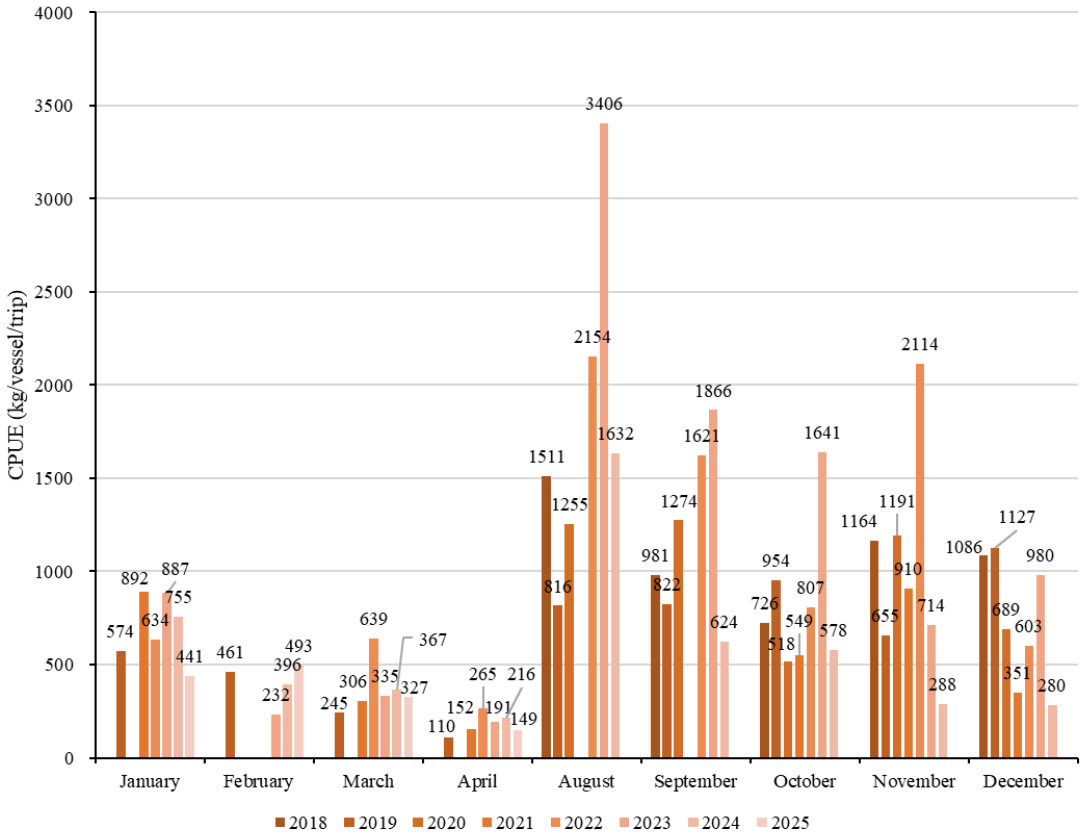

Fig. 4-1. Monthly average CPUE (kg/vessel/trip) of *Monomia haani* (values shown at the tops of the bars), surveyed at the landing ports of Dongshan County from 2018 to 2025 (Phases I-VIII).

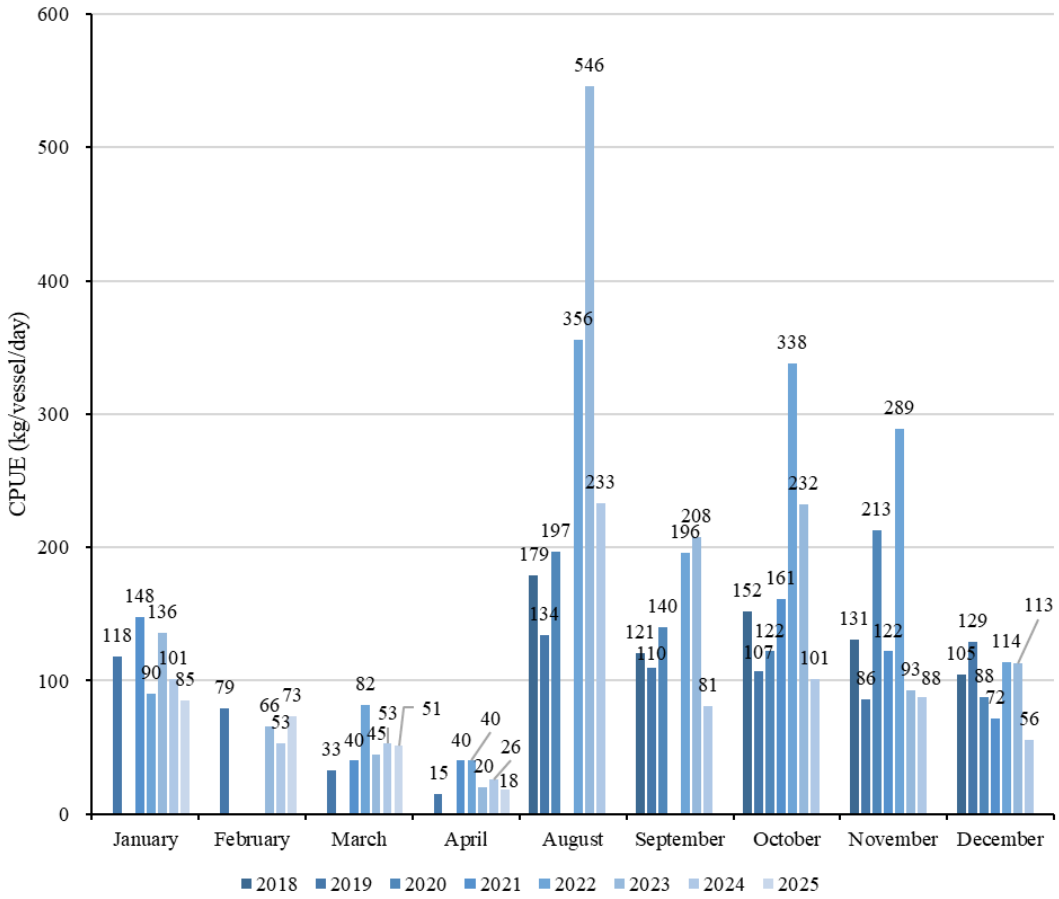

Fig. 4-2. Monthly average CPUE (kg/vessel/day) of *Monomia haani* (values shown at the tops of the bars), surveyed at the landing ports of Dongshan County from 2018-2025 (Phases I-VIII).

(9) 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.

(10) Based on the monthly sampling from 2022 to 2025, one spawning peak before the national summer fishing moratorium was identified and relatively consistent for *M. haani* and *P. sanguinolentus*; in February-April for *M. haani* and *P. sanguinolentus*.

(11) 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 approximate 2400 t/year (6 t, 65 vessels, 6 months fishing (182 day)/year).

(12) The minimum sizes and the sizes at 50% female maturity of *M. haani* and *P. sanguinolentus* in 2018-2025 showed annual variations (Table 4-1). The minimum sizes

for female bearing eggs and the size at 50% female maturity all showed a decline for both species.

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
2025	3.3	5.3	9.6	11.2

-: no data

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

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

(13) In Phase VIII, we conducted logbook survey on both trap vessels and trawl vessels. The results are informative. Due to the short of budget, we only collect trade statements of three trap vessels and two trawl vessels.

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