Uttar Pradesh Journal of Zoology

Volume 45, Issue 17, Page 391-403, 2024; Article no.UPJOZ.3888
ISSN: 0256-971X (P)

Comparative Analysis of Gear Efficiency for *Portunus sanguinolentus* Fishing along the Ramanathapuram Coast of Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration among all authors. Author AV did the investigation, formal analysis, and writing of the original manuscript draft. Author JL did the manuscript editing, formal analysis. Author NC did the formal analysis. Author PD did the formal analysis. Author DK did the formal analysis. Author NSS did the review correction. Author BKP did the manuscript review. Author Bhooleshwari did the manuscript review. Author SK did the formal analysis. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/upjoz/2024/v45i174383

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers,peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/3888

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Cite as: *Vaishnav, Anand, Jham Lal, Nayan Chouhan, Payel Debbarma, Deepika Kurre, Nongthongbam Sureshchandra Singh, Bikas Kumar Pati, Bhooleshwari, Shailendra Kumar, and Adipta Chakraborty. 2024. "Comparative Analysis of Gear Efficiency for Portunus Sanguinolentus Fishing Along the Ramanathapuram Coast of Tamil Nadu, India". UTTAR PRADESH JOURNAL OF ZOOLOGY 45 (17):391-403. https://doi.org/10.56557/upjoz/2024/v45i174383.*

Original Research Article

Received: 02/06/2024
Accepted: 05/08/2024
Published: 23/08/2024

ABSTRACT

This study, which was conducted along the Ramanathapuram coast of Tamil Nadu, India, investigated the capture composition of a three-spot swimming crab (*Portunus sanguinolentus*) across various fishing gear from November 2019 to October 2020. The fishermen employed bottom-set gillnets, trammel nets, and trawl nets in 29 different fishing areas within a range of 1-50 nautical miles. The fishing vessels used included wooden boats, known as 'Vallam,' equipped with inboard engines, and FRP boats with outboard engines. Bottom-set gillnets, with mesh sizes of 80--100 mm, predominantly caught crabs, whereas trammel and trawl nets were primarily used to capture fish and cephalopods, with crabs being caught as bycatch. The size distribution of the collected *P. sanguinolentus* ranged from 26 to 87 mm in carapace length and 61 to 189 mm in carapace width. The mean size fell between 115 and 125 mm in width and 45 to 60 mm in length. Catch per unit effort analysis revealed that bottom-set gillnets contributed 82.77% of the catch, followed by 3.69% from trammel nets and 13.53% from trawl nets.

Keywords: Sustainable fisheries; gear efficiency; trawl net; trammel net; catch; vallam; mean size.

1. INTRODUCTION

The marine water crab *Portunus sanguinolentus is* also known as the three-spotted swimming crab [1]. Its common name is derived from the three distinct red-to-maroon spots located on the posterior part of its carapace. This species is widely distributed across the Indo-Pacific region, from the east coast of South Africa to Hawaiian waters [2] (Apel and Spiridonov, 1998). It typically inhabits sandy oceanic environments at depths reaching up to 30 m [3,4]. The Ramanathapuram coast of Tamil Nadu, encompassing the ecologically significant Gulf of Mannar, is a very important region for marine biodiversity and fisheries [5]. The blue swimming crab, *Portunus sanguinolentus*, is a commercially valuable species that is extensively harvested in these waters. *Portunus sanguinolentus* plays a vital role in marine ecosystems as both a predator and prey, contributing to the trophic dynamics of coastal waters. This species is found in a variety of habitats, including sandy and muddy substrates, which provide rich feeding grounds [6]. The burrowing behaviour of crabs enhances sediment turnover and nutrient cycling, benefiting the broader ecological community [7]. Therefore, understanding their capture patterns is important not only for fisheries but also for maintaining the ecological balance. This study explored the catch composition of *P. sanguinolentus* using different fishing gear along the Ramanathapuram coast, specifically bottom-set gillnets, trammel nets, and trawl nets. Each of these gears has distinct characteristics and efficiencies, influencing their effectiveness in crab capture. Bottom-set gillnets, known for their selectivity, are widely used because of their high efficiency in catching larger crabs. Trammel nets and trawl nets, though less selective, are important for capturing a diverse range of species, including bycatch [8].

This research aims to evaluate the efficiency and catch composition of *P. sanguinolentus* across different fishing gear employed along the Ramanathapuram coast. The study was conducted from November 2019 to October 2020, covering 25 fishing areas within 1 to 50 nautical miles off the coast. The diversity of fishing boats, comprising motorized wooden boats, motorized FRP boats, and trawlers, adds to the complexity of the study. Detailed data on capture per unit effort (CPUE), design features of gear and crafts, mean length and width of carapace, and total catch were recorded. The findings of this study are crucial for developing integrated management strategies to ensure the sustainable exploitation of *P. sanguinolentus*. The dominance of bottom-set gillnets in terms of catch composition highlights their importance but also raises concerns about overfishing and resource depletion. By comparing the efficiency of various types of fishing gear, this research provides insights that can inform regulatory policies and promote the use of more sustainable fishing practices. Therefore, the aim of this study

was to underscore the importance of adaptive management approaches in maintaining the health of marine ecosystems and supporting the livelihoods of local fishing communities.

2. MATERIALS AND METHODS

2.1 Study Area

This research was conducted along the Ramanathapuram coast in the Gulf of Mannar from November 2019 to October 2020. The Ramanathapuram coast features a 141 km shoreline along the Gulf of Mannar, which is located between latitudes 9°05' and 9°50' N and longitudes 78°10' and 79°27' E [9,8]. Four landing centers, Keelakarai, Periyapattinam, Muthupettai, and Vedhalai, which are situated along the Palk Bay coast in the Ramanathapuram district, were randomly chosen as primary sampling locations (Fig. 1). Data collection involved weekly visits to these fish landing centers, where observations were made, and fishermen were interviewed via a structured questionnaire. Crab fishing operations occur for approximately 20 days each month at these landing centers [10,11]. To monitor fishing activities, data were gathered twice a month over the year-long period from November 2019 to October 2020. A stratified random sampling method was employed to reduce data variability by dividing the population into homogeneous subgroups on the basis of factors such as water depth, mesh size, and gear type [12]. The data collected included catch records, total operational units, catch per unit effort (CPUE), and catch compositions from various gear types.

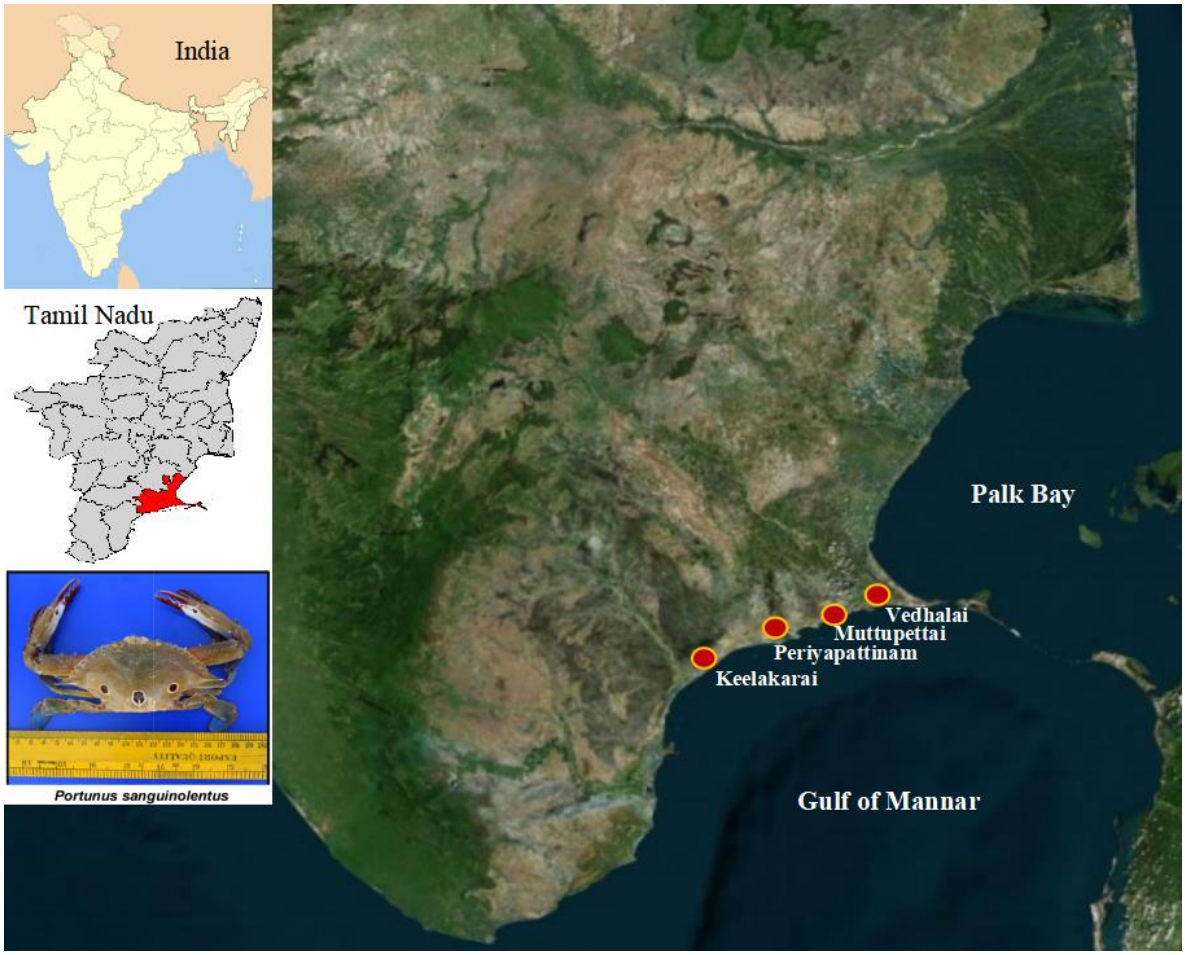

Fig. 1. Map of the study area along the Ramanathapuram coast

2.2 Technical Details and Design Specifications of the Fishing Crafts and Gears Involved in Crab Fishing

The fishing crafts utilized along the Gulf of Mannar coast include wooden boats known as "Vallam" and fibre-reinforced plastic (FRP) boats. Information regarding the design and technical specifications of these crafts was obtained through direct measurements at selected landing centers, following the guidelines of the FAO Catalogue. Detailed information on the design and technical specifications of the fishing gear used for crab fishing along the Ramanathapuram coast was also gathered through direct measurements and face-to-face interviews with fishermen at the landing centers. These data were compiled and presented in accordance with the FAO Catalogue on Fishing Gear Design [13,14]. The operational details of the fishing gear involved in crab fishing were collected through direct interviews with fishermen during sampling. Additional information, such as the distance to fishing grounds, the number of fishing trips per month, the depth of operations, the duration of fishing trips, the nature of the operations, the fishing season, and the equipment used, was also collected.

2.3 Estimation of Catch and Effort for Various Types of Fishing Gear

To estimate the catch and effort data for *Portunus sanguinolentus*, data were collected for the period of one year from November 2019--October 2020) because of the availability of these data throughout the year along the chosen landing centers on the Ramanathapuram coast. The catch data, recorded in terms of numbers and weights, were randomly collected on each sampling day. The daily catch estimate was determined by multiplying the catch data by the number of boats engaged in fishing on the sampling day. To calculate the monthly catch, the average daily catch estimates were multiplied by the number of fishing days in that month. The total fishing effort was represented by the number of boat days per month. The catch per unit effort (CPUE) was calculated for one fishing day across all types of gear and crafts [15].

3. RESULTS AND DISCUSSION

3.1 Crab Fishing Grounds along the Ramanathapuram Coast

Fishermen in the Gulf of Mannar were observed using fishing nets from coastal waters to the deep sea. GPS data collected from these fishermen revealed 29 distinct fishing grounds along the Ramanathapuram coast in the Gulf of Mannar (Table 1). These fishing grounds were scattered within a distance range of 1--50 nautical miles, where bottom-set gillnets, trammel nets, and trawl nets were employed by the fishermen. The fishing grounds of fishermen along the Ramanathapuram coast have expanded from nearshore to deep waters to target crabs. Josileen et al. [11] noted that fishermen in Pak Bay utilize bottom-set gillnets at distances of up to 10–12 km from the shore, within a depth range of 4–5 meters. Similarly, Vidhya et al. [16] reported that fishermen along the Gulf of Mannar coast harvest crabs at distances ranging from 8 to 15 nautical miles offshore, with depths between 10 and 15 meters.

3.2 Crafts and Gear Involved in Crab Fishing along the Ramanathapuram Coast

In the Gulf of Mannar waters, two types of fishing crafts are used for crab fishing: wooden boats known as Vallam with inboard engines and fibre-reinforced plastic (FRP) boats equipped with outboard motors (OBMs). Both boats were powered by engines ranging from 9.9--20 horsepower. The technical details of these crab fishing methods are provided in Table 2.

Three types of fishing gear are employed for crab fishing in the Gulf of Mannar waters of the Ramanathapuram coast: bottom-set gillnets (Nandu valai), trammel nets (Kanava valai), and trawl nets. Among these, only the bottom-set gillnets specifically targeted crabs. The fishermen used bottom-set gillnets with mesh sizes between 80 and 100 mm to catch crabs in coastal waters. These fishermen typically engage in single-day fishing trips. The peak fishing season for bottom-set gillnets occurs during the southwest monsoon, from September to January. Trawl nets were operated only at the Keelakari landing center, where crabs are caught as bycatch. Previous studies have also documented the use of these gears and crafts by fishermen on the Ramanathapuram coast for crab fishing [11]. Rajamani and Palanichamy [17] confirmed similar findings and reported that crab resources along the coast of the Gulf of Mannar were landed using trawlers, wooden Vallams, FRP boats, and sail-operated Vathais. Josileen and Menon [18] reported that Ramanathapuram coastal fisherman catches crabs year-round via trawlers, which are generally 28–32 m in length

and are equipped with 48--58 hp engines. In the Gulf of Mannar, fishermen employ Vallams, Vathais, and FRP boats for operating bottom-set gillnets (Vidhya, 2016).

Ameer Hamsa [19] reported that crabs were captured primarily via gillnets and trawl nets throughout the year in Palk Bay and the Gulf of Mannar. Sukumaran and Neelkanthan (1996) reported that *Portunus* crabs were exploited by trawl nets, mini trawls, shore seines, Jebbubale, and Kanthabale along the Karnataka coast. Kizhakudan [20] studied the blue swimming crab fishery in the Gulf of Kutch and reported that it was supported mainly by trawl nets and gillnets. Josileen and Menon [18] noted that crab resources in Palk Bay were exploited via a traditional bottom-set crab gillnet known as Nanduvalai. Rajamani and Palanichamy [17] reported that traditional set gillnets, also known as Nanduvalai, were used in many fishing villages of Palk Bay and the Gulf of Mannar.

3.3 Design Features of Fishing Gear Involved in Crab Fishing

The bottom-set gillnets used across Vedhalai, Muttupettai, Periyapattinam, and Keelakarai were constructed with PA mono twines, with diameters ranging from 0.3 to 0.6 mm. The mesh sizes vary from 80 to 110 mm, and the number of meshes along the head rope ranges from 1080 to 6600, depending on the landing center. These nets were operated with head ropes and foot ropes made from PE, with lengths ranging from 60 to 300 meters and diameters between 2.5 and 3.5 mm. Cylindrical sinkers, weighing between 6 and 10 grams, were placed at intervals of 0.6 to 1 meter to maintain the position of the net on the seabed. The horizontal (0.4 to 0.6) and vertical (0.6 to 0.7) hanging coefficients ensure optimal deployment and operation of the nets (Table 3).

Table 1. Fishing ground for *P. sanguinolentus* fishing along the coast of Ramanathapuram

Sl. No.	Fishing grounds Position latitude	longitude	Distance from shore (Nm)	Depth of operation (m)	Nature of bottom
1.	9.08 N	78.44 E	7	4 - 6	Muddy
2.	9.10 N	78.46 E	3	2 - 5	Sand and mud
3.	9.11 N	78.45 E	4	3 - 5	Sand and mud
4.	9.09 N	78.50 E	6	4 - 6	Muddy
5.	9.11 N	78 .52 E	5	3 - 6	Muddy
6.	9.08 N	78.56 E	6	4 - 6	Sandy
7.	9.12 N	78.54 E	3	3 - 6	Muddy
8.	9.13 N	78.57E	4	3 - 6	Sandy
9.	9.12 N	78.59E	6	4 - 6	Sandy
10.	9.12 N	79.02E	5	4 - 6	Sandy
11.	9.10 N	79.04E	7	4 - 6	Sandy
12.	9.14 N	79.05E	2	3 - 6	Sandy
13.	9.11 N	79.08E	6	4 - 6	Sandy
14.	9.14 N	79.09E	4	3 - 6	Muddy
15.	9.12 N	79.12E	7	4 - 7	muddy
16.	9.06 N	78.42E	10	5 - 8	muddy
17.	9.07 N	78.56E	8	4 - 6	Sandy
18.	9.07 N	79.04E	9	6 -9	Sandy
19.	9.10 N	79.11E	8	5 - 9	Sandy
20.	9.09 N	79.01E	9	5 - 10	Sandy
21.	8.50 N	78.30E	29	30 - 40	Sandy
22.	9.08 N	78.41E	24	30 - 40	Muddy
23.	8.58 N	78.31E	22	20 - 35	Sandy
24.	9.05 N	78.43E	9	15 - 25	Sandy
25.	8.45 N	78.32E	32	25-30	Sandy
26.	9.06 N	79.16E	29	20 - 35	Sandy
27.	9.08 N	78.55E	9	25 - 35	Sandy
28.	9.10 N	78.45E	4	10 - 20	Sand and Mud
29.	8.46 N	79.01E	30	35 - 40	Sandy

Table 2. Technical specifications of the crafts involved in crab fishing along the Gulf of Mannar

Sl. No.	Particulars	Technical specification of crafts		
1.	Type of fishing vessel	Motorized vallam	FRP withOBM	Trawler
2.	Material	Wooden	FRP	Wooden and steel
3.	Dimension			
	a. Length (m)	7.5 - 8.5	7.3 – 8.2	15 - 20
	b. Breadth (m)	1.5 – 1.75	1.6 – 1.8	5.52 – 6.53
	c. Depth (m)	1.5 - 2	1.06 – 1.2	4.54 – 6.50
	d. Draught (m)	1 – 1.5	0.8 – 0.9	2.53 – 3.85
4.	Engine power (hp)	8 - 10	8 - 10	110 - 200
5.	Make of engine	Kirlosker	Yamaha, Suzuki, Kirlosker	Caterpillar and Chinese
6.	Speed (in knots)			
	Maximum speed	6 - 8	9- 11	7.5 - 11
	Fishing speed	3 - 5	5 - 6	3 - 5
7.	Total no. of craft operated	85	42	70
8.	No. of craft targeted/bycatch involved in crab fishing	79 (Main catch)	42 (Main catch)	35 (Bycatch)
9.	Navigational aid	GPS	GPS	GPS, Compass, Echosounder and VHF

Table 3. Design features of the bottom set crab gill net of the Gulf of Mannar

Sl No.	Particulars	Landing centers			
		Vedhalai	**Muttupettai**	**Periyapattinam**	**Keelakarai**
1.	Common name	Crab net	Crab net	Crab net	Crab net
2.	Local name	Nandu valai	Nandu valai	Nandu valai	Nandu valai
3.	Main webbing				
	Mesh size	80 - 110	90 - 110	90 - 100	80 - 110
	No. of meshes along head rope per unit	1080 - 4400	1800 - 4300	1900 - 4300	1080 - 6600
	No. of meshes in depth	10 - 18	12 - 18	12 - 18	10 - 20
	Twine type	PA mono	PA mono	PA mono	PA mono
	Twine diameter (mm)	0.3 -0.6	0.3 - 0.4	0.3 -0.4	0.3 - 0.6
	Colour of webbing	White, Blue & Green	White & Yellow	White & Yellow	White, Blue, Green & Yellow
4.	Head rope				
	Length (m)	60 - 200	100 - 200	100 - 200	60 - 300
	Diameter(mm)	3	2.5 - 3	2.5 - 3	3 – 3.5
	Material	PE	PE	PE	PE
5.	Foot rope				
	Length (m)	60 - 200	100 - 200	100 - 200	60 - 300
	Diameter (mm)	2.5	2 – 2.5	2 – 2.5	2 – 2.5
	Material	PE	PE	PE	PE
6.	Floats	-	-	-	-
7.	Sinkers				
	Shape	Cylindrical	Cylindrical	Cylindrical	Cylindrical
	Diameter (mm)	0.8 – 1	0.8 – 1	0.8 – 1	0.8 – 1
	Weight (gms)	6 & 10	6 & 10	6 & 10	6 & 10
	Material	Pb	Pb	Pb	Pb
	Gap between two consecutive sinker (m)	0.6 - 1	0.6 - 1	0.6 - 1	0.6 - 1

Sl No.	Particulars	Landing centers			
		Vedhalai	Muttupettai	Periyapattinam	Keelakarai
8.	Horizontal hanging coefficient	0.4 – 0.6	0.4 – 0.6	0.4 – 0.6	0.4 – 0.6
9.	Vertical hanging coefficient	0.6 – 0.7	0.6 – 0.7	0.6 – 0.7	0.6 – 0.7
10.	Presence of stapling rope	Yes	Yes	Yes	Yes
11.	Time and duration of fishing	5 pm – 10 am, 17 hrs	4 pm – 8 am, 16 hrs	4 pm – 8 am 16 hrs	4 pm – 9 am 17 hrs
12.	Units operated per trip	10 - 25	15 - 30	15 - 30	15 - 35

Crab fishing with bottom-set gillnets was typically a single-day operation, with fishing trips lasting from the late afternoon to the following morning, spanning 16--17 hours. The peak season for crab fishing using these nets was during the southwest monsoon, from January to June. The number of units operated per trip ranges from 10--35, varying by landing center. The operational details, including the time and duration of fishing and the number of units operated, highlight the intensive nature of crab fishing in this region and its dependence on seasonal variations [15].

Trammel nets, known locally as Kanava valai nets, were also utilized for crab fishing at Vedhalai and Keelakarai. These nets consist of an inner layer with mesh sizes between 35 mm and 70 mm and an outer layer with mesh sizes between 140 mm and 300 mm. The head ropes and foot ropes were made from PE, with lengths ranging from 40 to 100 meters. The nets were supported by circular plastic floats and cylindrical lead sinkers, ensuring stability and effective operation. Fishing trips via trammel nets typically last 11--12 hours, with the number of units operating per trip ranging from 5--20 (Table 4). Trawl nets, used primarily in Keelakari, capture crabs as bycatch. These nets have head ropes measuring 100 to 140 meters in length and foot ropes between 110 and 150 meters in length. The wings of the trawl nets had mesh sizes between 300 mm and 600 mm, whereas the belly panels had mesh sizes ranging from 30 mm to 600 mm. The cod end of the trawl nets has a mesh size of 20 mm (Table 5), ensuring the retention of smaller crabs and other bycatch species. The use of trawl nets was less targeted towards crabs but contributed significantly to the overall catch composition in these areas.

The technical specifications and operational details of the fishing crafts and gears employed along the Ramanathapuram coast demonstrate the diverse and specialized methods used in crab fishing. The predominant use of bottom-set gillnets, with their specific design features and seasonal peak usage, indicates a targeted approach towards *Portunus sanguinolentus*. Trammel nets and trawl nets, while not exclusively aimed at crabs, play crucial roles in the overall fishing strategy. A detailed understanding of these gear designs and usage patterns provides valuable insights into fishing practices in the Gulf of Mannar, aiding in the development of sustainable management strategies for a region's crab fisheries 11m [19,17,15].

3.4 Size Range and Mean Size

Three-spot swimming crabs (*P. sanguinolentus*) were landed with bottom-set gillnets, trammel nets, and trawl nets along the Gulf of Mannar. The carapace length (CL) ranged from 26 to 87 mm, whereas the carapace width (CW) ranged from 61 to 189 mm. The peak sizes recorded in the total catch were 45 to 60 mm CL and 115 to 125 mm CW. Wimalasiri et al. [21] estimated the size at first sexual maturity for *P. sanguinolentus* at 9.75 cm CW for males and 9.40 cm CW for females in the Palk Bay region of Shrilanka. Compared with the present study, the recorded peak carapace width (115--125 mm) exceeds the size at first sexual maturity, indicating that the majority of the catch comprises sexually mature individuals. Vidhya et al. [22] studied the stock characteristics, growth, and mortality parameters of *P. sanguinolentus* in the Gulf of Mannar, reporting carapace widths ranging from 3.9 cm to 19.10 cm and carapace lengths ranging from 1.9 cm to 10.3 cm for both males and females. The size ranges observed in the current study (26--87 mm CL and 61--189 mm CW) align well with Vidhya et al.'s findings, indicating consistency in the size distribution of the crab population in the region. Pillai and Thirumilu [23] reported that the carapace width of female P. sanguinolentus ranged from 4.0 to 15.8 cm, and for males, it ranged from 4.4 to 15.2 cm at the Chennai coast. Similarly, Dineshbabu et al. [24] reported that the carapace width of P. sanguinolentus ranged from 5.6 to 16.0 cm for females and from 6.1 to 17.0

cm for males along the Karnataka coast. Compared with these previous studies, it was concluded that larger-sized *P. sanguinolentus* were caught from the Gulf of Mannar coast. This observation was also confirmed by Vidhya (2016). At the Gulf of Suez, Sallam & Gab-Alla [25] documented a size range between 4.7 and 14.85 cm CW for C. natator in the trawl fishery. The differences in size could be attributed to the fishing gear employed or spatial variation. Seasonal effects on crab abundance and catch composition, which are influenced by fluctuations in temperature, rainfall, and varying climate conditions, were also noted.

Table 4. Design features of trammel nets in the Gulf of Mannar

Sl. No.	Particulars	Landing centers	
		Vedhalai	Keelakarai
1.	Common name	Trammel net	Trammel net
2.	Local name	Kanava valai	Kanava valai
3.	Main webbing		
	Inner layer		
	Mesh size	35 - 70	35 – 70
	No. of meshes in head rope per unit	1520 - 2280	1520 - 3800
	No. of meshes in depth	50 - 60	50 - 60
	Twine type	PA mono	PA mono
	Twine diameter (mm)	0.1 - 0.2	0.1 -0.2
	Colour of webbing	white	white
	Hanging coefficient	0.5 – 0.6	0.5 – 0.6
	Outer layer		
	Mesh size	180 – 300	140– 300
	No. of meshes along head rope per unit	260 - 318	272-
	No. of meshes in depth	7 - 15	7 – 15
	Twine type	PA mono	PA mono
	Twine diameter (mm)	0.3 – 0.4	0.3 – 0.4
	Colour of webbing	White & Blue	White & Blue
	Hanging coefficient	0.5 – 0.7	0.7 – 0.8
3.	Head rope		
	Length (m)	60 - 100	40 – 100
	Diameter(mm)	3 - 4	3 – 4
	Material	PE	PE
4.	Foot rope		
	Length (m)	60 - 100	40 – 100
	Diameter (mm)	3 - 4	3 – 4
	Material	PE	PE
5.	Floats		
	Shape	Circular	Circular
	Diameter (cm)	12 - 15	12 – 15
	Thickness (cm)	1.2 – 1.5	1.2 – 1.5
	Material	Plastic	Plastic
	Number per unit	15 - 40	15 – 40
6.	Sinkers		
	Shape	Cylindrical	Cylindrical
	Diameter (mm)	0.8 – 1	0.8 – 1
	Weight (gms)	10 & 20	10 & 20
	Material	Pb	Pb
	Gap between two sinker (m)	0.6 – 1.2	0.6 – 1.2
7.	Presence of stapling rope	Yes	Yes
8.	Time and duration of fishing	6 am – 5 pm 11 hrs	5 am – 5 am 12 hrs
9.	Units operated per trip	5 - 20	8 – 20

Table 5. Design features of the trawl net along the Keelakarai landing center of the Gulf of Mannar

Sl. No.	Particulars	Trawl net
1.	Head rope	
	Length (m)	100 - 140
	Diameter(mm)	16 - 18
	Material	PE
2.	Foot rope	
	Length (m)	110 - 150
	Diameter (mm)	10 - 12
	Material	PE
3.	Wing	
	No. of meshes	90 - 100
	Stretched mesh size (mm)	300 - 600
	Twine diameter (mm)	1.5
	Material	PE
4.	Belly	
	Number of panel	5 - 8
	Mesh size (mm)	30 - 600
	Height (m)	3 - 8
	Cutting rate	1N2B
	Twine diameter (mm)	1.25
	Material	PE
5.	Cod end	
	Mesh size (mm)	20
	No. of meshes in depth	400 - 600
	Twine diameter	1.5
	material	PE

3.5 Catch, Effort and CPUE of P. Pelagicus from Different Fishing Gear

The monthly average catch and catch per unit effort (CPUE) of *Portunus sanguinolentus* were analysed via three different fishing methods, namely, bottom set gillnet (Nandu Valai), trammel net (Kanava Valai), and trawl net at the Gulf of Mannar, from November 2019 to October 2020 (Table 6). The data revealed significant variations in the total catch and CPUE among the different fishing methods and across different months.

For the bottom set gillnet, the highest total catch was observed in September, with 4621 kg, yielding a CPUE of 1.59 kg/day, followed closely by October, with a catch of 4424 kg and a CPUE of 1.49 kg/day. The lowest catches were recorded in April and May, with total catches of 693 kg and 1731 kg, respectively, and corresponding CPUE values of 0.59 kg/day and 0.67 kg/day, respectively. This variation in catch could be attributed to seasonal changes in crab abundance, as well as fishing efforts and environmental conditions. The trammel net resulted in a consistent but lower yield than did the bottom set gillnet. The highest total catch using the trammel net was observed in October, with a value of 266 kg, resulting in a CPUE of 0.42 kg/day. The lowest catch occurred in May, with a total catch of 32 kg and a CPUE of 0.05 kg/day. Compared with that of the bottom-set gillnet, the performance of the trammel net highlights its limited efficiency in capturing *P. sanguinolentus*, potentially due to differences in gear selectivity and operational methods. The trawl net demonstrated varying success, with the highest total catch in October at 1218 kg and a CPUE of 2.07 kg/day, indicating the highest efficiency among the three methods. Conversely, during the months of April and May, trawl nets were not used, resulting in zero catches. The seasonal absence of trawl net operations could be due to regulatory measures, gear restrictions, or unfavourable fishing conditions during these months. Overall, the relatively high CPUE of trawl nets during peak months suggests that it is a highly effective method for catching *P. sanguinolentus*, although its usage might be limited by operational constraints or environmental regulations. Compared with trammel nets, bottom set gillnets and trawl nets were more effective at capturing

Table 6. Monthly average catch and CPUE of *P. sanguinolentus* from bottom set gillnet, trammel net and trawl net at Gulf of Mannar

Month	Bottom set gillnet (Nandu Valai)				Trammel Net (Kanava Valai)				Trawl net			
	Average no. of boat landed per day	Average no. of boat days per month	Total catch per month (kg)	CPUE	Average no. of boat days per day	Average no. of boat days per month	Total catch per month (kg)	CPUE (kg/day)	Average no. of boat days per day	Average no. of boat days per month	Total catch per month (kg)	CPUE
November' 19	144	2739	4000	1.46	56	1088	134	0.25	18	324	610	1.88
December	145	2535	2455	0.96	54	954	110	0.23	22	352	162	0.46
January' 20	135	2540	3218	1.26	50	1030	43	0.08	26	494	455	0.92
February	131	2490	3332	1.33	51	1137	131	0.2	20	420	584	1.39
March	146	2124	1490	0.70	51	759	77	0.19	24	336	306	0.91
April	125	1165	693	0.59	60	525	71	0.23	00	00	00	00
May	128	2563	1731	0.67	56	1204	32	0.05	00	00	00	00
June	111	2176	2107	0.96	54	1074	184	0.34	28	504	479	0.95
July	124	2362	2852	1.20	61	1192	108	0.18	33	660	845	1.28
August	145	2993	4093	1.36	59	1300	143	0.23	22	484	359	0.74
September	149	2893	4621	1.59	59	1307	262	0.41	25	475	708	1.49
October	164	2956	4424	1.49	65	1245	266	0.42	28	588	1218	2.07

P. sanguinolentus in the Gulf of Mannar. The peak catch periods varied across the methods, with significant catches occurring in September and October for the bottom-set gillnets and trawl nets.

Josileen et al. [26] reported that *P. sanguinolentus* constitutes 28.2% of the edible crab landings in India, emphasizing its importance in the country's crab fishery. The findings in the Gulf of Mannar align with this national trend, highlighting the prominence of *P. sanguinolentus* in local fisheries. In states such as Tamil Nadu, *P. sanguinolentus* has overtaken *Portunus pelagicus* as the dominant species, reflecting a shift in species composition. Das et al. [27] further provided insights into the fishery and stock characteristics of *P. sanguinolentus* from Veraval waters from 2009--2010. The study reported an average annual landing of 322 tons, accounting for approximately 40% of the total edible crab landings at Veraval. Pillai and Thirumilu [23] reported annual landing of *P. sanguinolentus,* with an average catch of 765.8 tonnes by trawlers on the Chennai coast. Samuel and Soundarapandian (2009) reported that the total catch of *P. sanguinolentus,* along with ovigerous females, was estimated at 31.875 tons from February 2004 to December 2004 and 26.58 tons from May 2005 to January 2006 at the Parangipettai coast, South East coast of India. These findings emphasize the importance of selecting appropriate fishing gear and timing to maximize catch efficiency while considering environmental sustainability and regulatory compliance.

4. CONCLUSION

A study along the Ramanathapuram coast demonstrated that bottom-set gillnets are significantly more effective at capturing *Portunus sanguinolentus* than trammel and trawl nets are. The analysis revealed that bottom-set gillnets, with mesh sizes ranging from 80 to 100 mm, accounted for the majority of the catch (82.77%), whereas trammel nets and trawl nets contributed only 3.69% and 13.53%, respectively. The size range of the crabs collected indicated a healthy population, with carapace lengths between 26 and 87 mm and widths between 61 and 189 mm, and the mean sizes recorded were 45 to 60 mm in length and 115 to 125 mm in width. The findings highlight the efficiency of bottom-set gillnets in targeting *P. sanguinolentus*, suggesting that this gear type is optimal for sustainable crab fisheries in the region. However, the research faced limitations, including potential biases due to environmental conditions, seasonal variations, and data collection methods, which may have influenced the results. To promote sustainable fisheries practices, policies that regulate mesh size and gear deployment, establish marine protected areas, and enforce seasonal fishing bansare recommended. Educating fishermen on sustainable practices and ensuring compliance through monitoring are crucial steps. A healthy crab population is vital for maintaining ecosystem balance and can serve as an indicator of a well-functioning marine environment. It also supports local economies and food security, underscoring the importance of sustainable management practices for the long-term viability of fisheries and the overall health of the marine ecosystem.

FURTHER RESEARCH

The author may suggest a future course of action/research.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ACKNOWLEDGEMENTS

The authors would like to extend their sincere gratitude to the Dean, ‘FC&RI, Thoothukudi, TNJFU’, for graciously providing the essential research facilities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/3888