Trends in marine crab fishery of India

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Abstract

The overall production of marine crabs in India during 1975-2020 was around 1.61 million tonnes, accounting an average of 9.6% in the total crustacean landings. The overall trend of the fishery indicated an increase at the national level, recording a maximum landing of 57354 tonnes (t) during 2018 and the lowest record of 14202 t during 1978. Bulk of the estimated landings (59%) were from Tamil Nadu and Gujarat with the three portunid crabs *Portunus sanguinolentus, Portunus pelagicus* and *Charybdis feriata* dominating in the fishery during 2007-2020. Status of the marine crab fishery in the different maritime states with landing trends, gear-wise contribution, species composition and bionomics are also presented.

Key words: *Marine crabs, India, maritime states, landings, bionomics*

Introduction

Crabs constitute an important resource in the marine fishery in India and contributed an overall average of 9.6% to the total crustacean landings during 1975-2020. Many species of crabs are exploited along the east and west coasts of India, mainly in trawls as a by-catch and as a targeted resource in gillnet in some regions. While making a comparison between east and west coasts of India, east coast was found more productive contributing 56.7% to the marine crab landings. The overall trend of the fishery showed increase at national level, recording a maximum landing of 57354 tonnes during 2018 and the lowest, 14202 tonnes during 1978. Otherwise, the scenario varied between maritime states, for instance earlier years (2008-2012), state of Gujarat was leading in crab production, later the position was taken over by Tamil Nadu with very clear dominance. It is very evident from the national data on species wise production of marine crabs (2007-2020) and at present in overall production Gujarat is in second position followed by Andhra Pradesh & Kerala. The marine crab landings and effort data used for the analysis were obtained from the National Marine Fishery Resources Data centre (NMFDC) of ICAR-CMFRI (Figs. 1- 3 & Table 1).

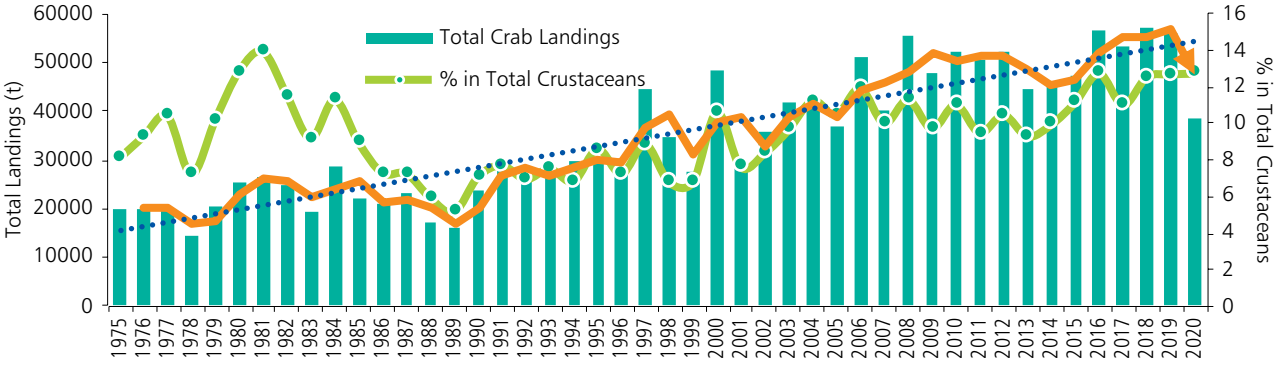

Fig. 1. Marine crab landings in India during 1975–2020.

Table 1. State-wise trend in overall crab landings of India during 2007- 2020

States	Coastal length (km)	Coastal districts	Total (t)	Rank	Percentage	Overall trend
Tamil Nadu	1076	13	233164001	1	33.31	Decreasing
Gujarat	1600	15	179602878	2	25.66	almost steady
Andhra Pradesh	974	9	76795955	3	11.00	Decreasing
Kerala	590	9	51622213	4	7.37	Increasing
Karnataka	300	3	41839864	5	6.00	Increasing
Odisha	480	6	36941425	6	5.28	Increasing
West Bengal	158	4	36762107	7	5.25	Decreasing
Maharashtra	720	7	15153865	8	2.16	Increasing
Puducherry	45	4	12953456	9	1.85	Increasing
Daman & Diu	21	2	10496116	10	1.50	Decreasing
Goa	104	2	4681290	11	0.67	Increasing

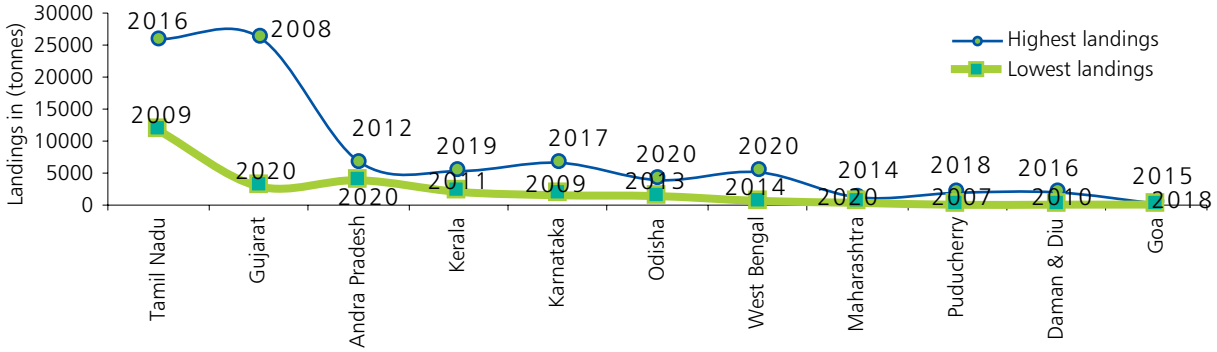

Fig.2. Statewise trend of highs and lows in annual crab landings (2007-2020)

Species composition

Edible crabs landed in India belong to the family Portunidae and around 61% of the landings were recorded by three species of marine crabs *Portunus sanguinolentus* (28.2%), *Portunus pelagicus* (25%) and *Charybdis feriata* (7.7%). Major species recorded in different states during 2007-2020 and their fishery trends are presented (Table 2, Figs. 4 – 6). In Gujarat, *P. sanguinolentus* has recently emerged as the dominant species followed by *P. pelagicus*, pushing down *C. feriata* to the third position. Similarly in Tamil Nadu, the hitherto dominating species *Portunus pelagicus* (30.7%) has been overtaken by *P. sanguinolentus* (33.3%) with a marginal increase registered in the landings. The other important edible species included in the fishery in appreciable quantities were *Charybdis lucifera*, *Charybdis*

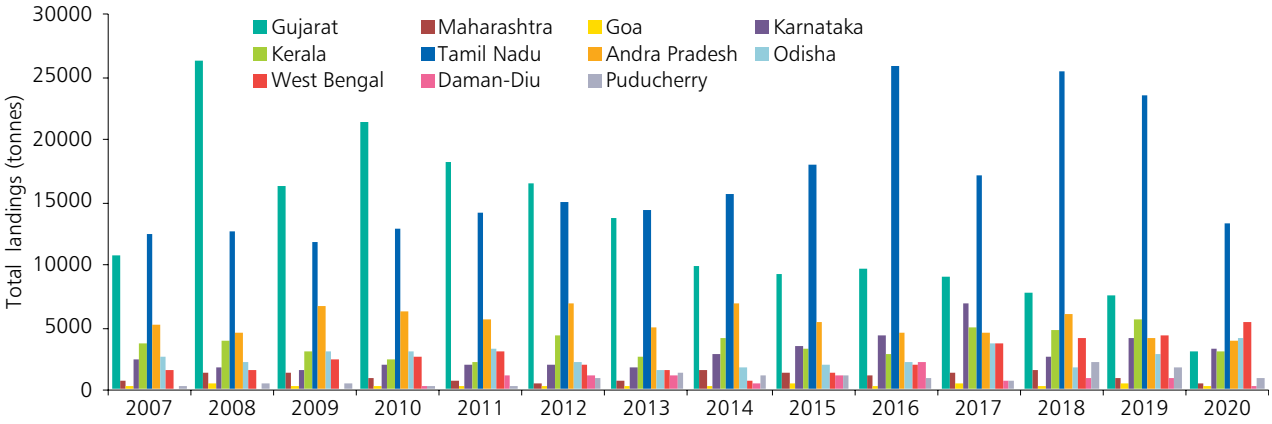

Fig. 3. State-wise estimates of marine crab landings during 2007-2020

Table 2. Major species recorded in the marine crab landings of different maritime states during 2007-2020

State	Major species in Overall landings (2007-2020)	Dominant species (2018-2020)
Gujarat	*C. feriata, P. sanguinolentus & P. pelagicus*	*P. sanguinolentus*
Maharashtra	*P. sanguinolentus, C. feriata & P. pelagicus*	*P. sanguinolentus*
Goa	*P. sanguinolentus, P. pelagicus & C. feriata*	*P. sanguinolentus*
Karnataka	*P. pelagicus, P. sanguinolentus & C. feriata*	*P. pelagicus*
Kerala	*P. sanguinolentus, C. feriata & P. pelagicus*	*P. sanguinolentus*
Tamil Nadu	*P. pelagicus, P. sanguinolentus & C. natator*	*P. sanguinolentus*
Andhra Pradesh	*P. sanguinolentus & P. pelagicus*	*P. sanguinolentus*
Odisha	*P. sanguinolentus, P. pelagicus & C. feriata*	*P. sanguinolentus*
West Bengal	*P. sanguinolentus, P. pelagicus & C. feriata*	*P. sanguinolentus*
Daman-Diu	*C. feriata, & P. sanguinolentus*	*C. feriata*
Puducherry	*P. sanguinolentus & P. pelagicus*	*P. sanguinolentus*

**Note: Species names are provided as following the World Register of Marine Species (WoRMS).*

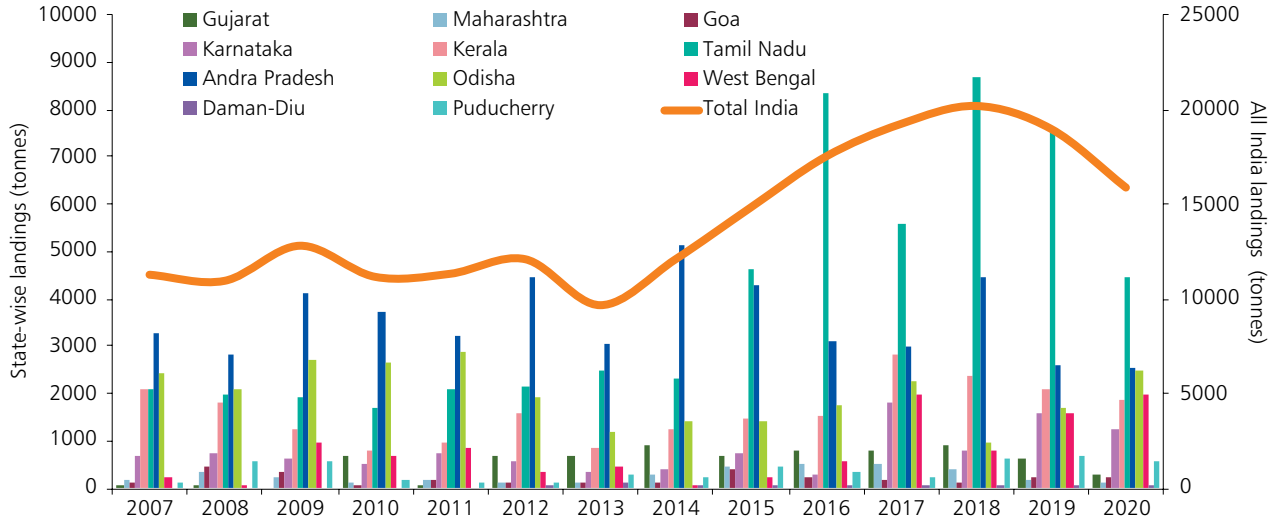

Fig 4. State-wise *Portunus sanguinolentus* landings in India (2007-2020)

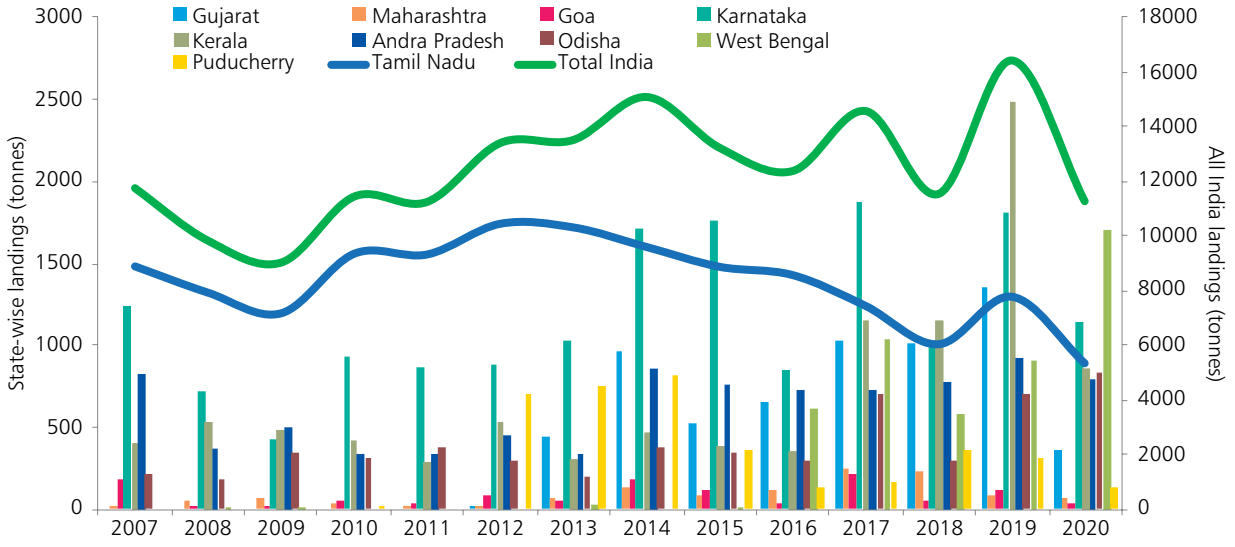

Fig 5. State-wise *Portunus pelagicus* landings in India (2007-2020)

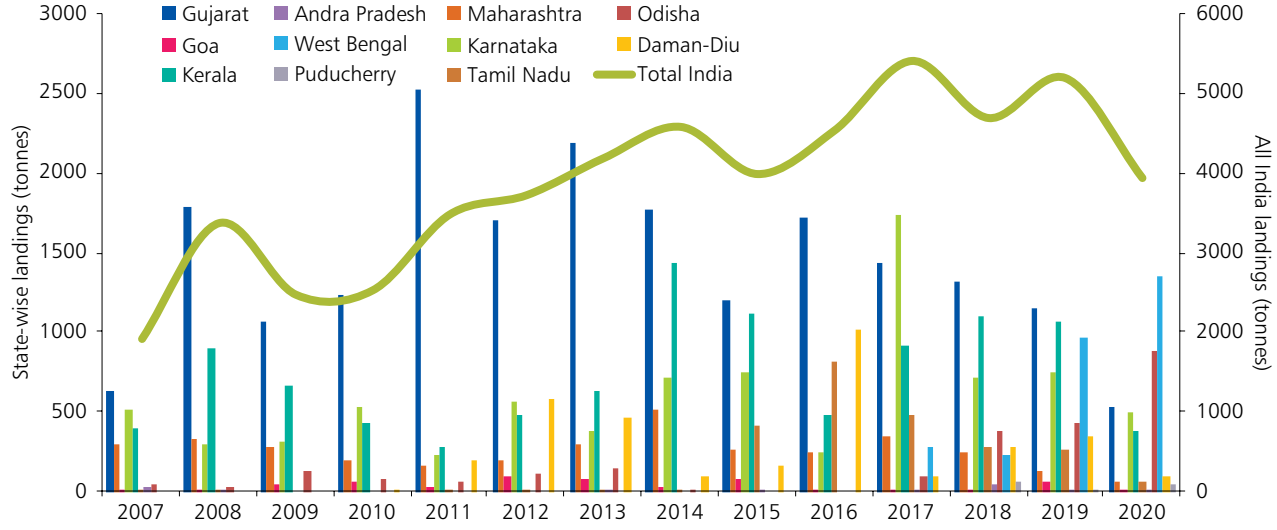

Fig. 6. State-wise *Charybdis feriata* landings in India (2007-2020)

natator, *Charybdis smithii*, *Charybdis annulata*, *Portunus gladiator* (revised as *Monomia gladiator*), *Podophthalmus vigil*, *Scylla serrata* and *Scylla olivacea*.

State-wise landings

Gujarat contributed 25.7 % of the overall crab landings in India, recording highest and lowest landings in 2008 and 2020 respectively (Fig. 7). January to March is the most productive period for the landings of crabs, and contributed 37.8 to 47.8% of annual crab landings during 2018-2020. Till recently, the dominant species recorded was *Charybdis feriata.* However, during 2018-2020 *P. sanguinolentus* emerged as the most dominant species followed by *P. pelagicus* and pushing down *C. feriata* to the third position. Another important observation was that the non-edible crab, *Charybdis hoplites* landed in enormous quantities encompassing bulk of the *Charybdis* spp. (50.4%) in total landings. Crabs were mainly landed in trawls (Multi-day 81% & Single-day 4%) followed by mechanised dol nets (6%). In multi-day trawls the catch per unit effort (CPUE) varied between 31-374 kg and the catch per hour (CPH) between 0.3- 6.0 Kg (Figs. 8 & 9).

During 2007-2020 period the overall trend of total crab landings in Maharashtra was stable and contributed 2.2

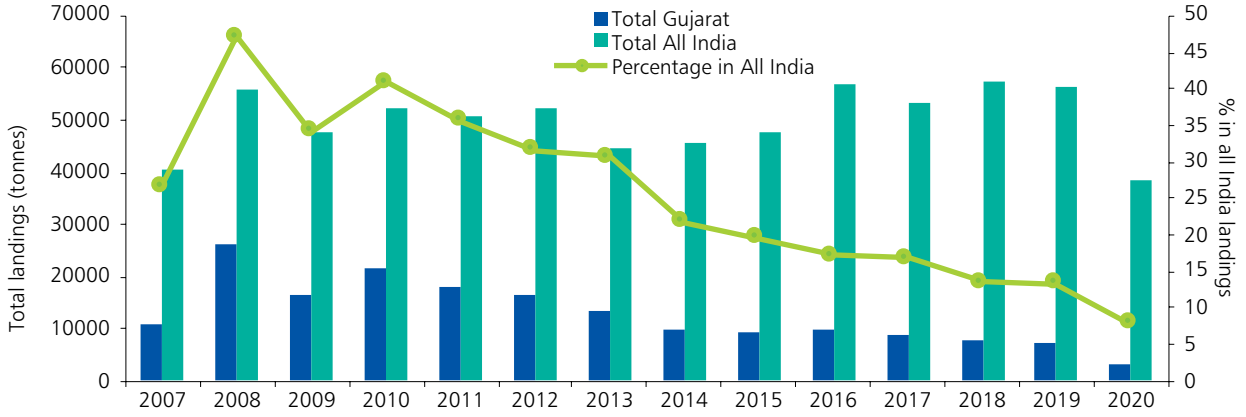

Fig. 7. Annual marine crab landings in Gujarat (2007-2020)

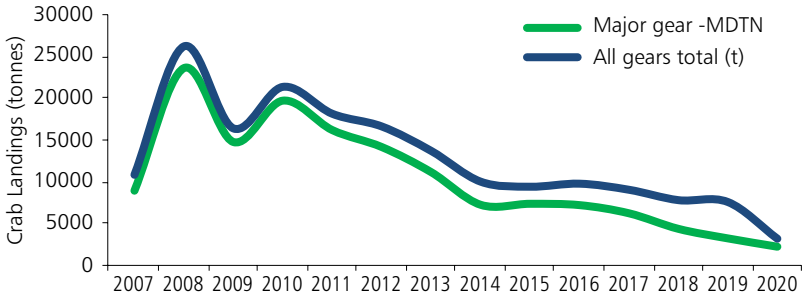

Fig. 8. Gear-wise contribution of marine crab landings in Gujarat (2007-2020)

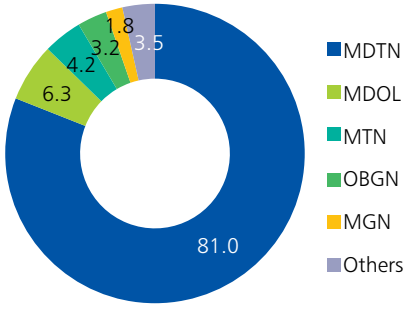

Fig. 9. Percentage contribution of different gears to marine crab landings in Gujarat (2007-2020)

% of the overall crab landings in India, with the highest and lowest landings in 2014 and 2020 respectively. *P. sanguinolentus* was the dominant species throughout the period (Fig.10). 71% of the crab landing of the state was recorded in trawls (Multiday-60% & Single day 11%) and mechanised dol nets (17%). In multi-day trawls the CPUE varied between 5.0-17.0 kg and the CPH between 0.1-0.21 kg (Figs. 11&12)

The share of Goa in overall crab landings during 2007-2020 was very meagre and status of the fishery recorded a slightly declining trend over the period. The highest and lowest landings were noted in 2015 and 2018 respectively and the bulk of the landing was contributed by *P. sanguinolentus* in all years (Fig.13). Maximum crabs were landed in Multiday trawls (44.3%) and Single day (40.2%) trawls followed by the gillnets (10.5%) (Figs. 14 & 15).

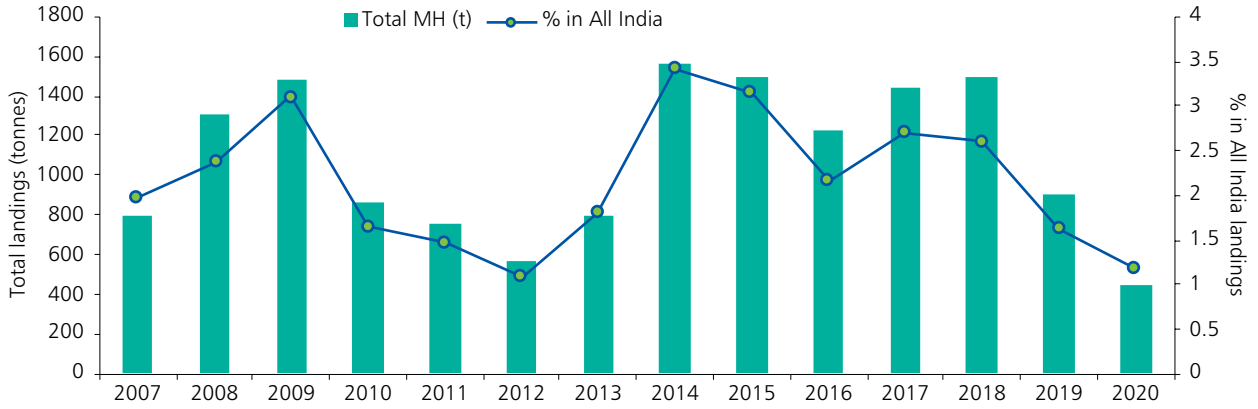

Fig. 10. Annual marine crab landings in Maharashtra (2007-2020).

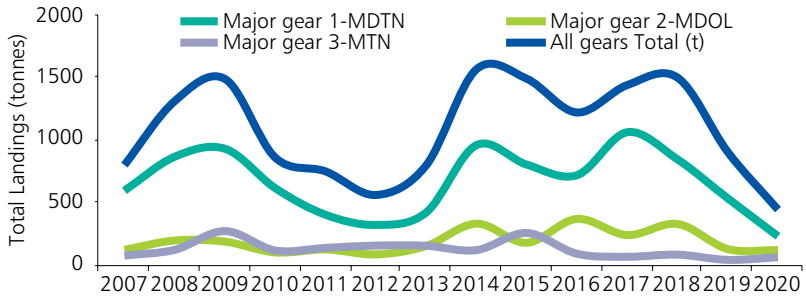

Fig. 11. Contribution of major gears to marine crab landings in Maharashtra (2007-2020).

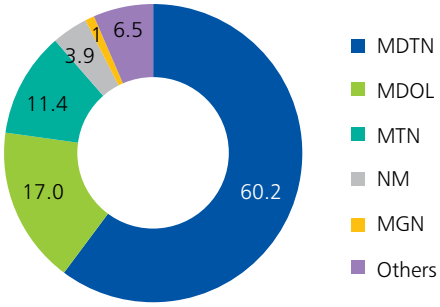

Fig. 12. Percentage contribution of different gears to marine crab landings in Maharashtra (2007-2020).

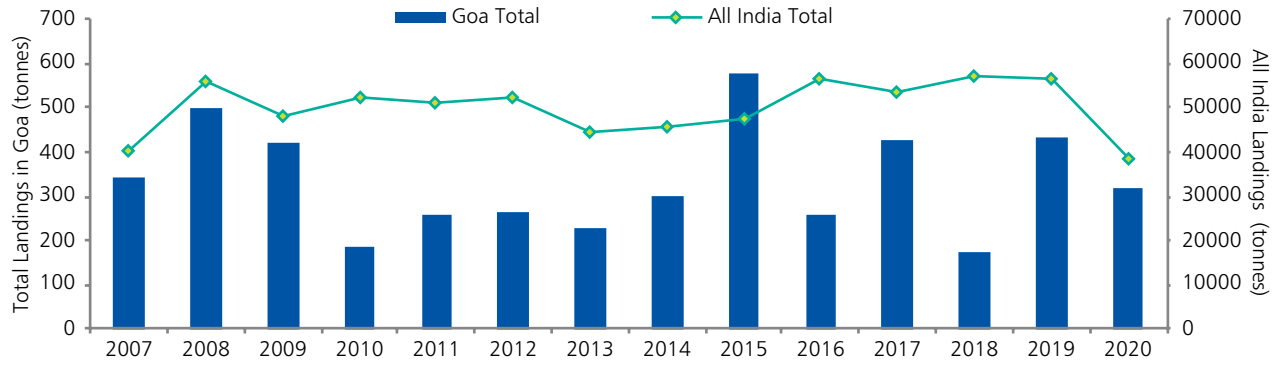

Fig. 13. Annual marine crab landings in Goa (2007-2020)

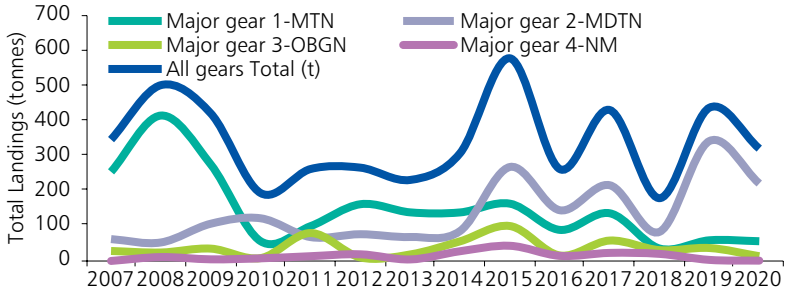

Fig. 14. Gear-wise contribution of marine crab landings in Goa (2007-2020)

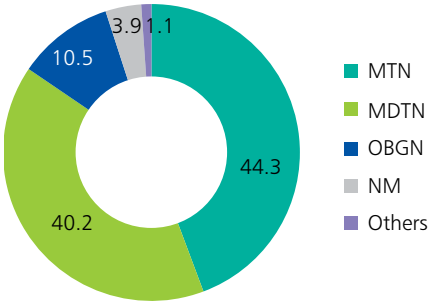

Fig. 15. Percentage contribution of different gears to marine crab landings in Goa (2007-2020)

Karnataka contributed 6% of the overall crab landings in India, recording highest and lowest landings in 2017 and 2009 respectively. The state ranked 5th in overall landings and *Portunus pelagicus* was the dominant species throughout the reporting period. The overall trend showed a steady increase (Fig. 16). Bulk of the crab landings in the state were contributed by Multi-day trawls (60%) Single-day trawls (30%) and the rest by other gears. Annual CPUE and CPH in multiday trawls varied between 17.6–187.3 kg and 0.2–1.8 kg and in single day trawls between 8.0–21.8 and 1.1- 3.5 kg respectively (Figs. 17 & 18).

In Kerala the overall trend of total crab landings during 2007-2020, recorded increase and contributed 7.4 % of the overall crab landings in India, with the highest and lowest landings in 2019 and 2011 respectively. *P. sanguinolentus* (46.6%) was the dominant species (Fig. 19) with major contribution by trawls (Multi-day 52% & Single-day 27.3%) accounting for nearly 80% of the crab landing of the state. Annual CPUE and CPH in multiday trawls varied between 8.1–43.3 kg and 0.3–5.5 kg and in single day trawls between 6.1 – 17.5 & 1.0- 11.8 kg respectively (Figs. 20 & 21).

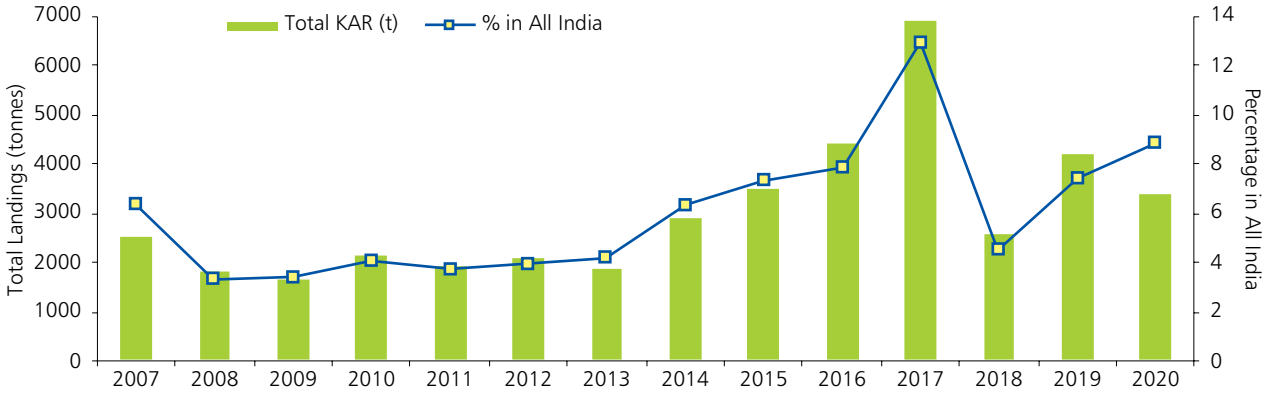

Fig. 16. Annual marine crab landings in Karnataka (2007-2020).

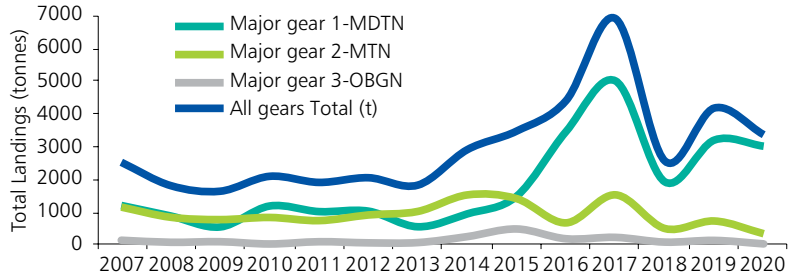

Fig. 17. Gear-wise contribution of marine crab landings in Karnataka (2007-2020)

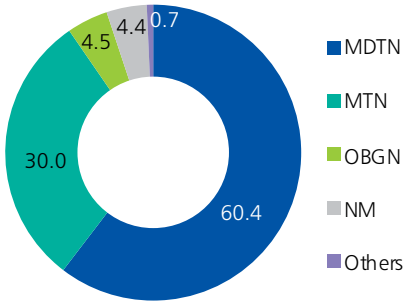

Fig. 18. Percentage contribution of different gears to marine crab landings in Karnataka (2007-2020)

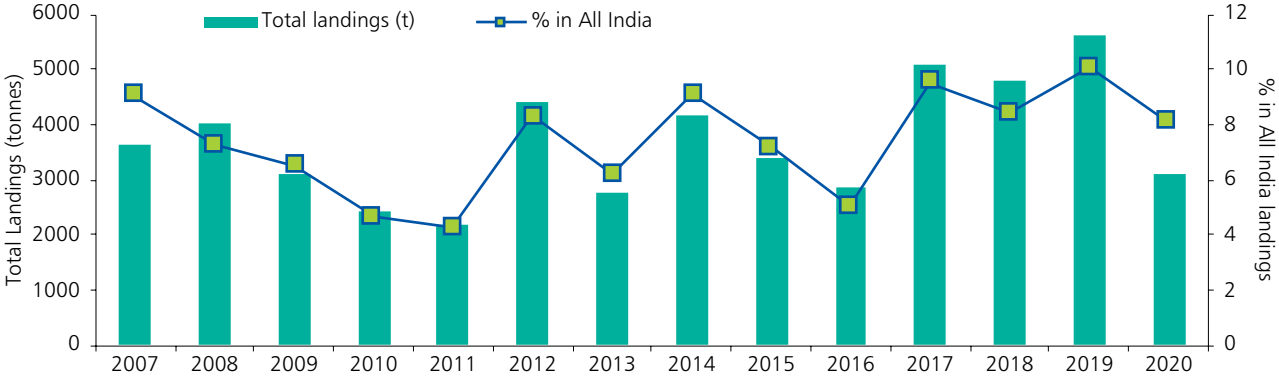

Fig. 19. Annual marine crab landings in Kerala (2007-2020)

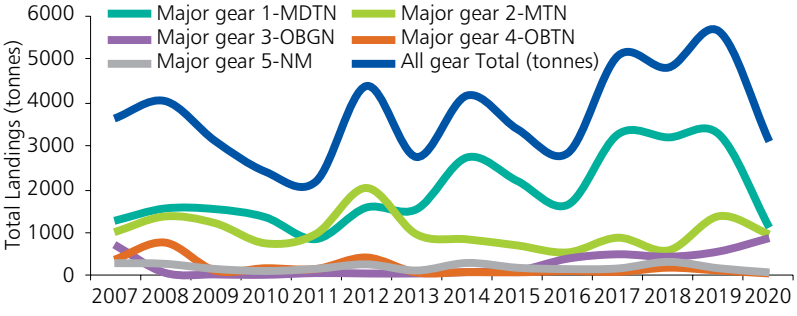

Fig. 20. Gear-wise contribution of marine crab landings in Kerala (2007-2020)

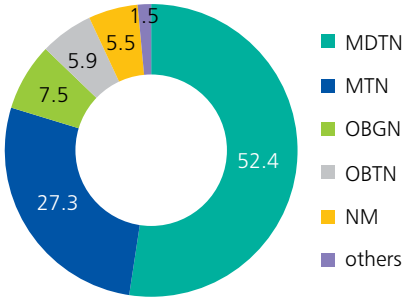

Fig. 21. Percentage contribution of different gears to marine crab landings in Kerala (2007-2020)

During 2007-2020, Tamil Nadu ranked first in the country contributing 33.3% in overall marine crab landings, recording an increasing trend over the period. The state registered the highest and lowest landings in 2016 and 2009 respectively. *P. pelagicus* was the dominant species in overall landings, however, in recent years *P. sanguinolentus* has shown dominance (Fig. 22). Unlike in other maritime states, crabs were mainly landed in gillnets (44%), single-day trawls (34.6%) and multi-day trawls (15.6%). The annual CPUE in gillnets, single-day and multi-day trawls varied between 2.5–8.1 kg, 7.6–51.9 kg and 18.3–279.5 kg respectively with CPH between 0.53–1.1 kg, 0.71–4.4 kg and 0.77–3.1kg respectively (Figs. 23 & 24).

Andhra Pradesh was contributing 11% of the total crab production with overall status showing a declining trend and the highest and lowest landings recorded in 2012 and 2020 respectively. (Fig. 25). The major species in the landing was *P. sanguinolentus* in all the years and was recorded in multi-day trawls (62%) and gillnets (19%). The annual CPUE in multi-day trawls and gillnets recorded between 58.1- 134.4 kg and 0.93- 5.6 kg respectively while annual CPH was

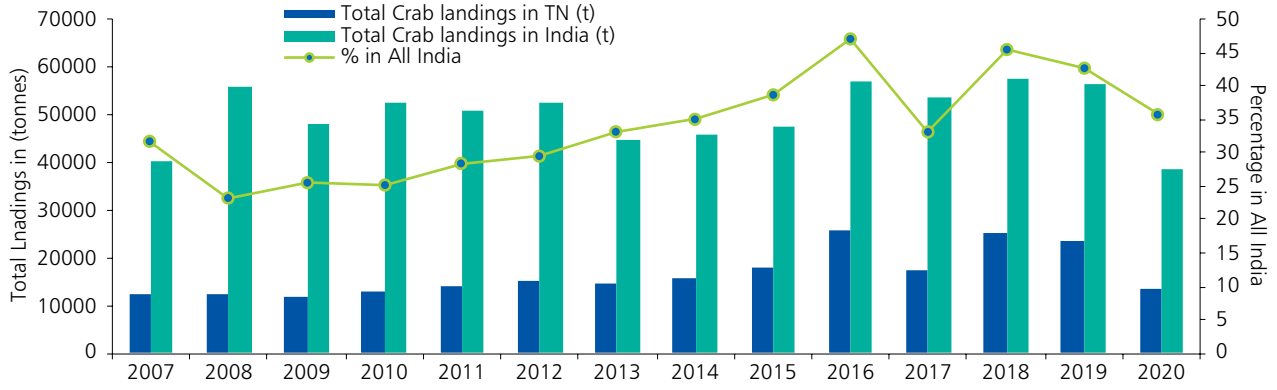

Fig. 22. Annual marine crab landings in Tamil Nadu (2007-2020)

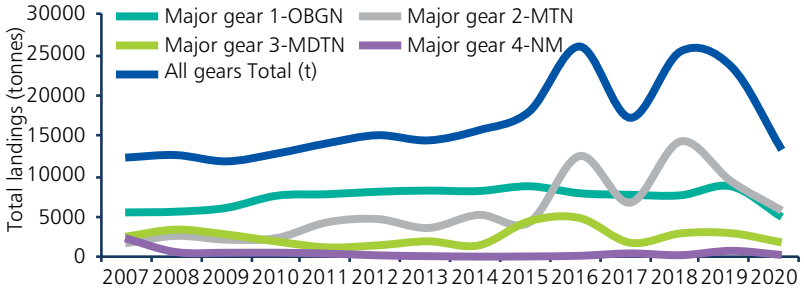

Fig. 23. Gear-wise contribution of marine crab landings in Tamil Nadu (2007-2020)

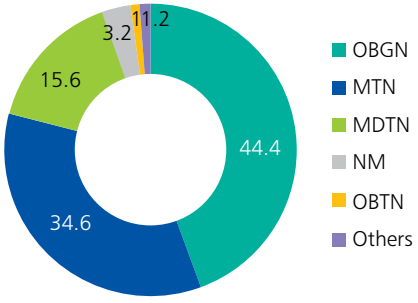

Fig. 24. Percentage contribution of different gears to marine crab landings in Tamil Nadu (2007-2020)

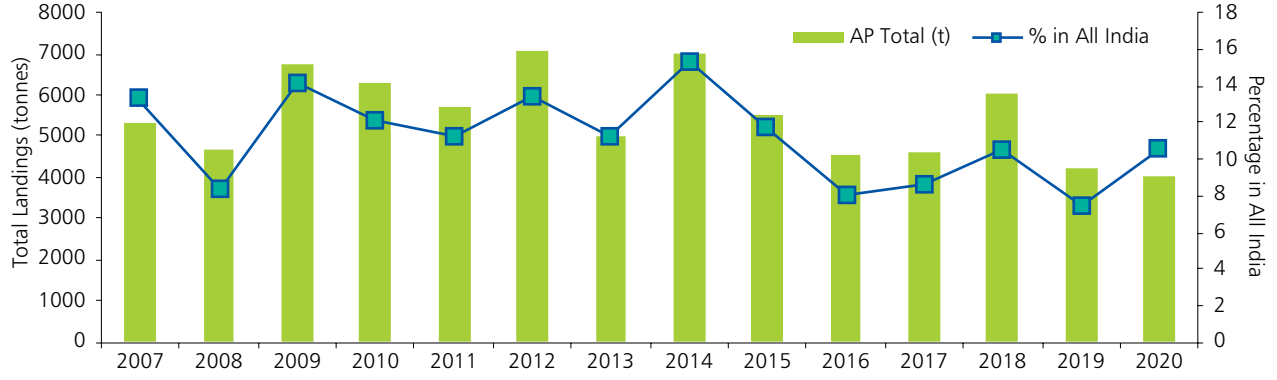

Fig. 25. Annual marine crab landings in Andhra Pradesh (2007-2020)

between 0.69–1.3 kg and 0.22–1.2 kg respectively (Figs. 26 & 27).

In Odisha the overall trend of total crab landings showed increase and the state contributed 5.28% of the overall crab landings in India, with highest and lowest landings in 2020 and 2014 respectively (Fig. 28). *P. sanguinolentus* was the dominant species throughout the period. Crabs were mainly landed in multi-day trawls (67%), gillnets (12%) and single-day trawls (11.8%). The annual CPUE in multi-day trawls, gillnets and single-day trawls ranged between 45.6 – 127.5 kg, 0.8-3.7 kg and 18.2 – 91.4 kg respectively and annual CPH between 0.7–1.3 kg, 0.16–0.6 kg and 0.94 – 14.4 kg respectively (Figs. 29 & 30).

West Bengal contributed 5.25% of the overall crab landings in India, recording highest and lowest landings in 2020 and 2014 respectively. The overall trend showed a steady increase (Fig. 31). *P. sanguinolentus* was the dominant species throughout the period and mainly landed in multi-day trawls (51%), followed by motorised and mechanised bag nets contributing 26% and 15.2% respectively. The annual CPUE in multi-day trawls, motorised and mechanised bagnets ranged between 6.3-157.6 kg,

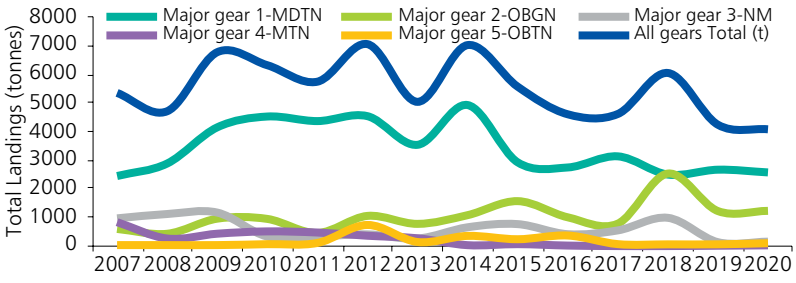

Fig. 26. Gear-wise contribution of marine crab landings in Andhra Pradesh (2007-2020)

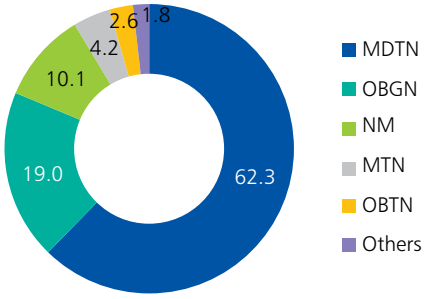

Fig. 27. Percentage contribution of different gears to marine crab landings in Andhra Pradesh (2007-2020).

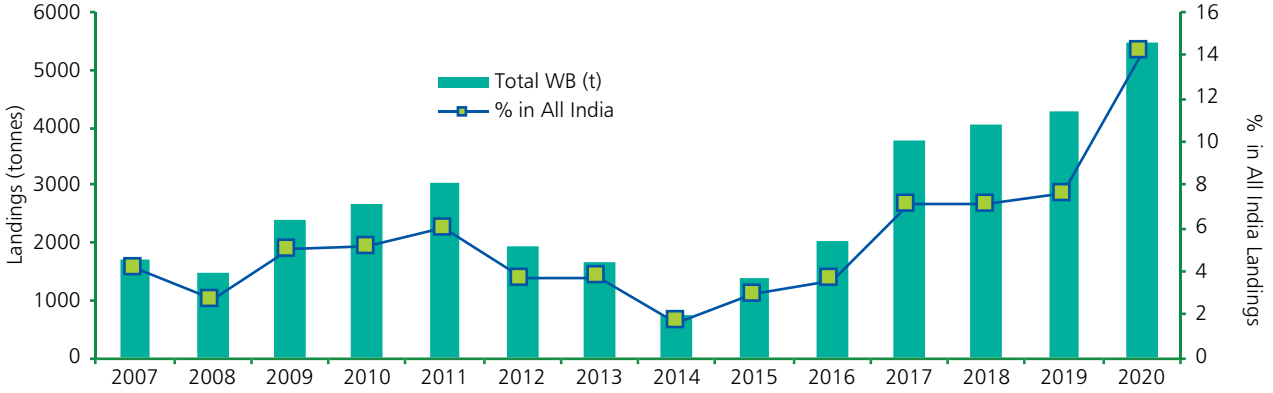

Fig. 28. Annual marine crab landings in Odisha (2007-2020)

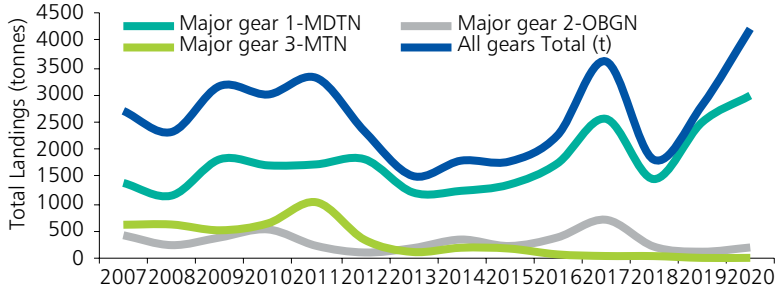

Fig. 29. Gear-wise contribution of marine crab landings in Odisha (2007-2020)

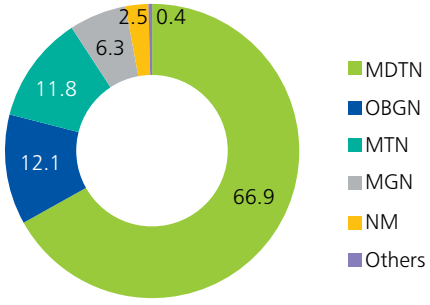

Fig. 30. Percentage contribution of different gears to marine crab landings in Odisha (2007-2020)

3.3 -16.7 kg ans 7.4 -107.4 kg respectively and CPH between 0.10–1.3 kg, 0.51 – 2.5 kg and 0.61 – 4.6 kg respectively (Figs. 32 & 33).

Union Territory of Puducherry contributed 1.85% of the overall crab landings in India, recording highest and lowest crab landings in 2018 and 2007 respectively (Fig. 34). The dominant species was *P. sanguinolentus* and gear-wise landings indicated dominance of multi-day trawls (Multiday-60%, gillnets-16% and Single day 14%) similar to other maritime states. The annual CPUE in multi-day trawls, gillnets and single-day trawls ranged between 9.5-124.3 kg, 0.3-11.8 kg and 2.7-116.5 kg respectively and annual CPH between 0.44- 2.7 kg, 0.11–3.9 kg and 0.3-10.4 kg respectively (Figs. 35 & 36).

During the 2010-2020, the overall crab landings in Daman & Diu exhibited a slightly declining trend and contributed 1.5% of the overall crab landings in India with highest and lowest landings recorded in 2016 and

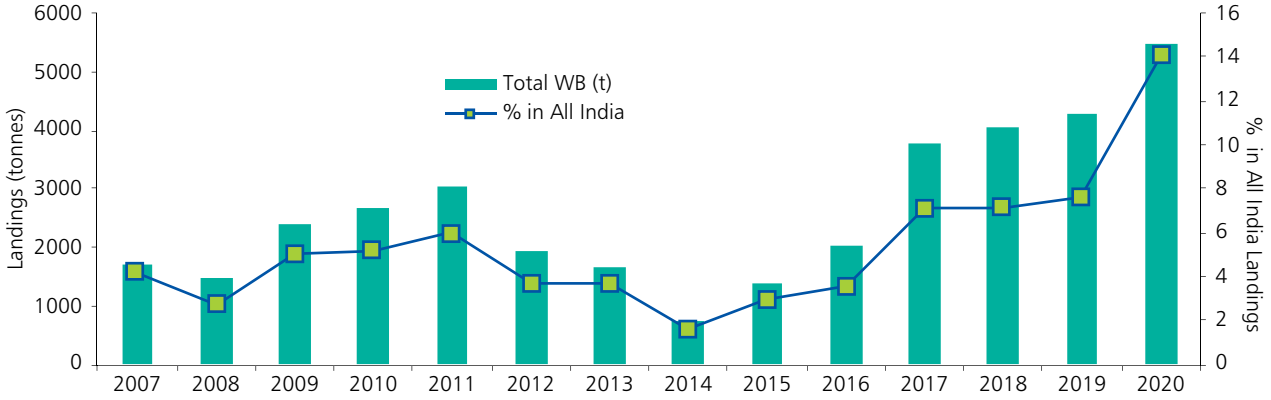

Fig. 31. Annual marine crab landings in West Bengal (2007-2020).

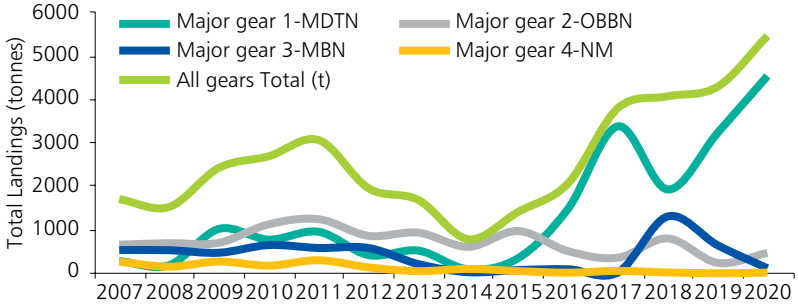

Fig. 32. Gear-wise contribution of marine crab landings in West Bengal (2007-2020)

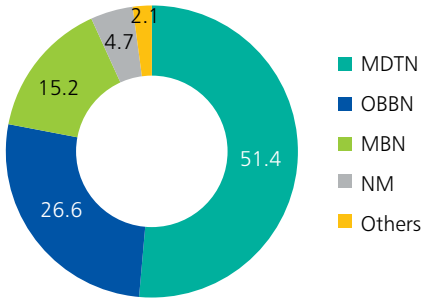

Fig. 33. Percentage contribution of different gears to marine crab landings in West Bengal (2007-2020)

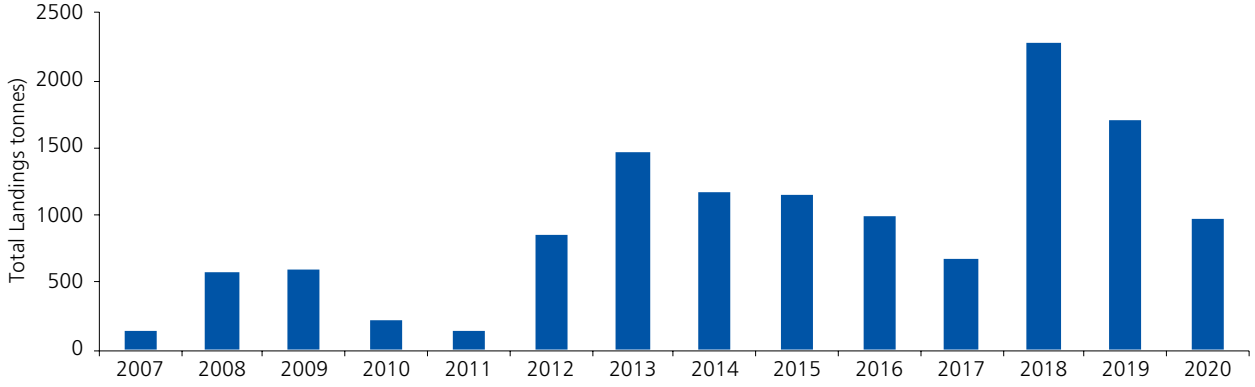

Fig. 34. Annual marine crab landings in Puducherry during 2007-2020

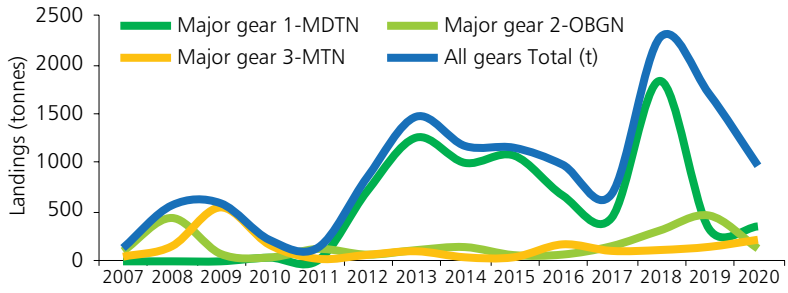

Fig. 35. Gear-wise contribution of marine crab landings in Puducherry (2007-2020)

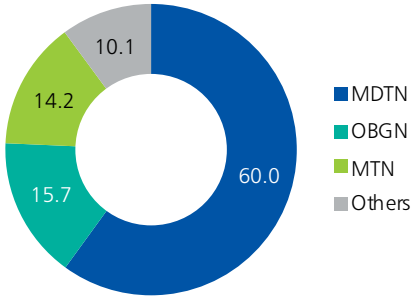

Fig. 36. Percentage contribution of different gears to marine crab landings in Puducherry (2007-2020)

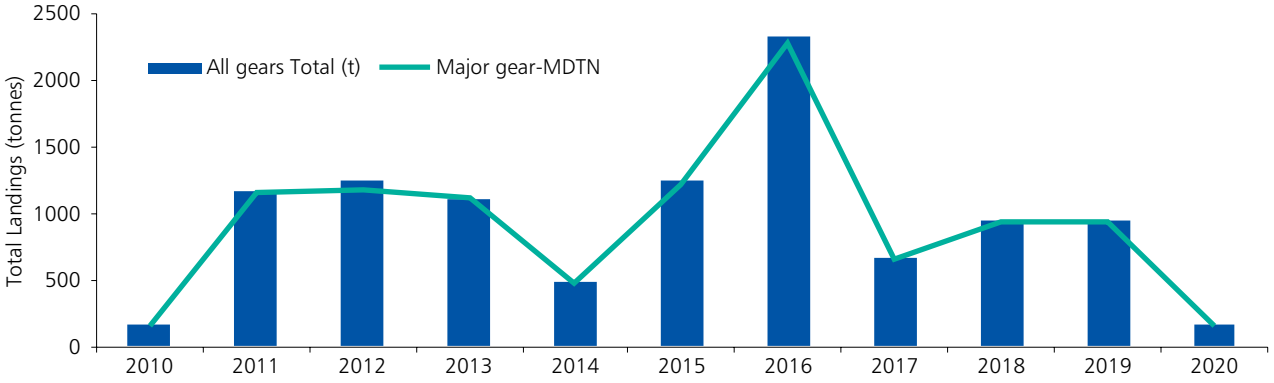

Fig. 37. Annual marine crab landing and gear-wise contribution in Daman-Diu (2007-2020)

2010 respectively. *C. feriata* was the dominant species in overall landings and the bulk of the crab landing was contributed by multi-day trawls (98%) during the period. The annual CPUE and CPH in multi-day trawls ranged between 24.8-360.0 kg and 0.2- 2.72 kg respectively (Fig.37).

Bionomics

The bionomics such as size range, dominant size groups, mean size and sex ratio of three major commercial species viz. *P. sanguinolentus, P. pelagicus* and *C. feriata* in the fishery of different maritime states of the country are presented in Table 3. *P. sanguinolentus* was represented by a size range of 31-203 mm CW (carapace width), *P. pelagicus* 46-230 mm CW and *C. feriata* 31-165 mm CW in overall crab landings in India during 2017-2020. Sizes bigger than the above mentioned were also recorded occasionally in the landings. Landings of *P. pelagicus* from Palk Bay have recorded a maximum size of 250 mm CW, which is very rare with sizes above 200 mm CW forming only 0.24% and 0.3% among male and female crabs respectively. Similarly, in December 2018, a large female *P. sanguinolentus* with 213 mm CW was recorded from Visakhapatnam landing centre. The overall dominant size group in *P. sanguinolentus* ranged between 86-121 mm, in *P. pelagicus* 61-180 mm CW and *C. feriata* 61-115 mm CW. Similarly, the mean sizes of these species also shown wide-range; it varied between 92.3-123.1 mm in *P. sanguinolentus*, 81.2-156.7 mm in *P. pelagicus* and 71.9-101.4 mm in *C. feriata*. Among *P. sanguinolentus,* bigger crabs were landed in Andhra Pradesh and the mean size in males and females were recorded as 126.9 and 122.4 mm CW respectively. Bigger *P. pelagicus* were fished from Palk Bay, Tamil Nadu, recording a mean size of 149.6 mm CW in males and 156.7 mm CW in females. C. *feriata* bigger sized crabs were landed in Gujarat, registering a mean size of 111.4 mm CW in males and 118.7 CW in females. Males of *P. sanguinolentus* were dominating in landings, in all the states. In *P. pelagicus*, females were dominating except in Andhra Pradesh and Chennai region of Tamil Nadu. *C. feriata* landings of east coast recorded a clear domination of females whereas, crab landings along west coast in, Kerala and Karnataka, showed domination of males.

Table 3. Size distribution and sex ratio of major three crab species from different maritime states of India

	Size Range (mm)		Dominant size (mm)		Mean size (mm)		Sex Ratio (%)	
Species/State	Male	Female	Male	Female	Male	Female	Male	Female
Portunus sanguinolentus								
Gujarat	35-175	50-185	95-135	100-145	113.2	117.46	44	56
Maharashtra	78-173	83-163						
Karnataka	51-160	46-145	91-95	91-95	96.5	92.3	47	53
Kerala	46-171	42-152	106-115	96-110	113	107.9	45	55
Tamil Nadu	36-190	31-180	86-121	86-111	95.9	102.9	46	54
Andhra Pradesh	58-203	68-193	108-128	103-123	126.9	122.4	43	57
Odisha	51-186	45-178	126-135	116-125	117	126	44	56
West Bengal	48-189	44-179	121-130	116-120	118	123	41	59
Portunus pelagicus								
Gujarat	85-175	95-185	125-140	135-155	133.5	142.4	42	58
Maharashtra								
Karnataka	46-160	46-160	66-70	61-65	81.2	89.1	44	56
Kerala	55-172	62-182	101-125	101-110	109.4	110.3	40	60
Tamil Nadu (Chennai)	51-170	56-175	81-115	86-115	87.1	96.9	62	38
Tamil Nadu (Palk Bay)	70-230	60-220	141-170	141-180	149.6	156.7	40	60
Andhra Pradesh	83-178	53-163	108-113	113-138	133.5	135.4	56	44
Odisha	61-201	58-194	131-140	121-130	139	122	44	56
West Bengal	62-196	55-191	126-135	116-125	134	127	43	57
Charybdis feriata								
Gujarat	75-165	85-165	100-120	110-125	111.4	118.7	44	56
Maharashtra	63-168	58-138						
Karnataka	36-135	31-135	61-65	61-65	75.5	71.9	52	48
Kerala	42-158	33-130	81-100	66-95	85.7	77.1	55	45
Tamil Nadu	46-150	51-135	86-115	66-100	90.9	84.7	46	54
Andhra Pradesh	63-148	58-138	98-118	88-108	103.6	98.5	35	65
Odisha	61-150	53-147	106-115	101-110	107	101	45	55
West Bengal	65-154	51-141	106-115	96-105	105	99	46	54

Fishing and spawning season

Marine crabs are fished throughout the year in India except in the ban period pertinent with respective states. However, considerable variations were observed in peak fishing season between the states/region during the reporting period. During the past five years, it is more evident due to climate change as happening elsewhere in the world. In spawning season also, similar differences were noticed between the states and among the major three species. All the species are capable of breeding continuously throughout the year and it is difficult to predict the peak annual spawning season very precisely. Earlier studies have also clearly showed inconsistencies in the seasonal timings of spawning of these crabs, not following a similar or a uniform pattern. All these crabs carry the spawned eggs in their abdomen, attached to the pleopods till hatching. This egg mass is known as 'berry' and according to the stage of embryonic development the colour changes from bright yellow/orange colour to deep grey. These changes take usually 8-10 days depending on the species, size of the mother crab, and water temperature. By recording the prevalence of berried crabs in regular sampling the spawning season of respective species can be assessed. Over the years,

Table 4. Spawning season recorded for three major species from different maritime states of India

State	*P. sanguinolentus*	*P. pelagicus*	*C. feriata*
Gujarat	Sept* & Nov-Feb**	-	-
Karnataka	Aug-Nov* & Feb-Mar**	Sept* & Feb*	Aug-Nov*
Kerala	Apr-May* & Sept**	March-April*	Nov-Dec*
Tamil Nadu	July-Aug*& Dec-Feb**	July-Aug* & Jan*	Jun-Aug* & Dec**
Tamil Nadu (Palk Bay)	Jan-Mar* & Sep-Nov**	Jan-Mar* & Sep-Nov**	-
Andhra Pradesh	Oct-Nov* & Jan-Feb**	Sep-Nov* & Jan- Feb**	Feb-Mar* & Jul-Aug**
Odisha	Oct-Nov* & Jan- Feb**	Nov-Dec* & Feb-Mar**	Oct-Nov* & Feb-Mar**
West Bengal	Oct-Nov* & Jan- Feb**	Nov-Dec* & Feb-Mar**	Oct-Nov* & Feb-Mar**

*Major spawning season; **Minor spawning season

significant variations were found in the occurrence of berried crabs in the fishery of different states and hence it is difficult to forecast the exact peak spawning season for these crabs, usually following a major and a minor peak. Based on the studies conducted on these aspects during 2017-2020 at different centres, spawning seasons (major & minor respectively) of three commercial species are presented in (Table 4).

Conclusion

While closely tracking the marine crab fishery of India for the past fifty years, it is evident that the status of this resource is shifting from by-catch to targeted fishery, at least for a few species. The continuous monitoring and studies carried out by ICAR-CMFRI clearly delineate the status of the stocks in different regions. The overall trend of the fishery showed increase, however, in most of the fishing areas species are less abundant or in the rebuilding state clearly indicating need for ensuring sustainability through proper fisheries management plans. Most of the commercial crabs in India are highly resilient; short-lived and their life span is around 2.5-3 years. These fast growing species breed throughout the year and recorded fairly high fecundity rates. In 2014, Minimum Legal Size (MLS) was implemented for 58 species in Kerala (Mohamed *et al*., 2014), which included the three major species of crabs reported here. Our landing records showed that the percentage of crabs below MLS was considerably low thereafter. All states/regions should follow regulatory measures concurrently otherwise intended result will not be attained. In the case of these crabs an important measure that can be implemented is the prevention of landing and trade of berried females, which alone can create a positive impact on the fishery. ICAR-CMFRI has recommended Fishery Management Plan (FMP) for a few species in certain maritime states, which were prepared based on the inferences evolved through several years consistent studies. The Fishery management for Palk Bay Blue Swimming Crab (BSC), suggests the rules and regulations to be followed for the BSC fishery in Palk Bay (Josileen *et. al,* 2019). Collaboration among the stakeholders is required to achieve the objective of sustainability and rejuvenation of the crab fishery resources in India. This may take considerable time depending on the life cycle of the species and prevailing situation of the ecosystem. There is a general notion that solving issues associated with marine fisheries are impractical or a herculean task, considering the complexity of the In spite of this, by following mandatory regulatory measures we can progress through these conditions. Enforcement of rules and regulations by Central and State governments in areas of their respective jurisdiction and adoption of systematic and precautionary approaches by all the stakeholders from fishers to traders is therefore highly desirable.

References

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