Survey of Shore-crabs and their population in some selected coastal wetlands of Nagappattinam district, Tamil Nadu, Southern India

S. Asokan, R. Nagarajan, G. Srinivasan, T. Saravanan, T. Sakthi and C. Senthil Kumar

Article History
Received: 06.07.2021
Revised and Accepted : 24.10.2021
Published: 23.03.2022

https://doi.org/10.56343/STET.116.015.003.008
www.stetjournals.com

Abstract

A survey of shore crabs, variation in their population and soil characteristic factors influencing the crab population was carried out in the four coastal wetlands of Chinnangudi, Tranquebar, Pazhayar and Thirumullaivasal of Ngapattinam, Tamilnadu between December 2001 and February 2002. Three species of shore crabs viz. *Ocypoda platytaris, Ocypoda macrocera* and *Uca lactea annulipes* were recorded. Population of the shore crabs in three different habitats namely seashore, estuary and riverine and different locations within the habitat were also evaluated to understand their population fluctuations and habitat preference. There was no significant difference in the shore crab population among the study areas and between the locations. There was a significant difference in the crab population among habitats. A multiple regression analysis showed that the riverine habitat had significantly higher population of shore crabs than the seashore and estuarine habitat. Furthermore, it was inferred that the shore-crab density was influenced by the soil Electric Conductivity (EC) and potassium. The potassium had significant positive influence on the crab population. The soil electric conductivity had a non-linear relationship with the shore-crab density, which indicated that certain level of electric conductivity influenced the density of shore-crab. However, the threshold of the EC could not be predicted.

Key words: Crab, Density, Population, EC, Potassium, Seashore, Estuary, Riverine

INTRODUCTION

Crustaceans are economically important organisms, which influence considerably the blue revolution of the globe. Such crustaceans are classified into three groups *viz.*, non-penaeid prawns (crabs and lobsters) penaeid prawns (shrimps) and other crustaceans (Kurian and Sabastian, 1986). Since they are nutritious and delicious, they become important diet, not only for man but also to other animals such as aquatic mammals and birds (Prater, 1971; Ali and Ripley 1983).

The crabs, belong to order decapoda, play an important role in aquatic ecosystem by acting as a predator as well as prey to maintain the natural balance. They are voracious feeders on various aquatic benthic organisms especially on molluscs (Warner, 1977; Ayyar and Ananthakrishnan, 1985). On the other hand a variety of crabs are acting as a vital prey for many aquatic birds in the aquatic ecosystems (Ali and Ripley 1983).

Ocypodan crabs are usually found in the sandy shores of tropical and subtropical regions inhabiting mostly in the inter-tidal zones. The shore-crab is a semi terrestrial species found in the seashore especially at the estuary. A perusal of literature shows a paucity of information on several aspects of these crabs in India. Although Alcock (1896-1990) contributed comprehensive information on the taxonomy and geographic distribution of most of Indian crabs, not much information is available on shore crab distribution and quantification in the coastal wetlands of the east cost of India.

The Coromandel (East coast) coast of India, especially the Tamilnadu region is important to shorebirds as many important wetlands such as Pichavaram mangroves, Point Calimere swamps, Udyamarthandapuram waterbird sanctuary, Vaduvoor lake etc, are situated here (Sampath and Krishinamoorthy, 1990; Thiyagesan and Nagarajan 1995; Nagarajan and Thiyagesan, 1996; Nagarajan and Thiyagesan 1998). These coastal wetland are especially important in the context that they serve as a wintering area for birds as appreciable number of many species of birds annually migrate from Arctic Siberia to wintering grounds in India enroute passage to Australia (Sampath and Krishnamurthy, 1990).

R. Nagarajan
email: *oystercatcher@rediffmail.com*

PG and Research Department of Zoology and Wildlife Biology, A.V.C. College (Autonomous), Mannampandal - 609 305, Mayiladuthurai, Southern India

P - ISSN 0973 - 9157
E - ISSN 2393 - 9249

Furthermore, these wetlands are being used as stopover sites by birds both during inward and outward migration (Sampath and Krishinamoorthy, 1990; Thiyagesan and Nagarajan 1995; Nagarajan and Thiyagesan, 1996; Nagarajan and Thiyagesan 1998; Pandian, 2000). Myers (1983) also suggested that such areas are critical continuance of migration and ultimately for the survival of many shorebirds. van Vessem (1992) had also stated "most waterbird species are migratory, traveling long distances and crossing many borders in order to complete their annual cycle". Throughout their range they are dependent on networks of wetlands and specific habitats for breeding, wintering and staging areas". Velasquez and Hockey (1991) had also stated that intertidal mudbanks are the most important foraging habitat for migrant waders. The mudflats and sand flats of the east coast of Tamilnadu had been shown to harbour a great variety of shore birds (Sampath and Krishnamurthy, 1990; Nagarajan and Thiagesan, 1996; Pandian, 1999; 2000). However, the information on the prey spectrum is scanty and sporadic especially on the macro-invertebrates. But information in relation to shore-crab fauna, which is the main diet for birds such as curlew, whimbrel, great sand plover, terns and gulls in the east coast region of India (Pandian, 1999; 2000) is yet to be recorded.

So, the present investigation is planned to carry out in four different coastal wetlands *viz.*, Chinnangudi, Tranquebar, Pazhayar and Thirumullaivasal of Nagapattinam district, Tamilnadu, which are important wintering and migratory path of waterbirds.

Population estimation of shore-crabs in the study areas in order to answer the following questions.

a. Does the population differ among the study areas?

b. Is there any significant difference in the crab population among the various habitats? If so, which habitat supports high population of crabs?

c. Is there any significant difference in the crab population between the locations?

d. What are the soil characteristic factors influenced the crab population?

MATERIALS AND METHODS

STUDY AREA

The present study was conducted in the coastal regions of Nagapattinam District, Tamilnadu, southern India. The map of the study area is shown in the figure 1. Four coastal wetlands *viz.*, Chinnangudi, Tranquebar, Pazhayar and Thirumullaivasal spread over the entire stretch of Coramandel coastline of Nagapattinam District constituted the study area of the present investigation.

Chinnangudi

Chinnagudi is fishing coastal village, which is located 25km east of Mayiladuthurai. The sea is separated from the village by a sand bar. The seashore is sandy in nature. The river Uppanar estuary makes the estuary in this area and has a wide diversity of coastal wetlands.

Tranquebar

The marine zone on the east coast of Tranquebar is located at about 25 km east of Mayiladuthurai. The beach is steep and sandy with scattered masses of brickwork and buildings from the ruins of an old 17th Century Fort, the seaward face of which is now damaged and submerged due to encroachment by the sea. Large isolated Brick-blocks and portion of fort walls lie buried in the beach. It facilitates as the substratum for many algae, crustacean, gastropods, bivalves, sea anemone and other rocky shore fauna. The Uppanar estuary is to some extent, a bar built estuary and sand bar is shifted depending upon the strength of the flow of freshwater due to monsoonal rains. The estuarine biotype is greatly influenced by the discharges of irrigation channels, backwaters and tidal water. The width of estuary is not altered from time to time by any erosion like often and it is measured about 50 meters in diameter and 1000m in length. The average depth of the estuary is about 1.5 meter.

Pazhaiyar

Pazhaiyar is one of the important fishing landing sites of the east coast. The river Collidam mixes with sea in Pazhaiyar and makes a wide estuary. This area is located 20km east of Sirkazhi. The estuary is separated by a wide sand bar. This estuary makes a wide variety of coastal wetlands in this area. The major source of income for this village is fishing. The area has several mechanized boats for fishing.

Thirumullaivasal

Thirumullaivasal is a fishing coastal village which is located 25km east of Sirkazhi. The sea is separated from the village by a sand bar, amidst the river Uppanar mixes with the Bay of Bengal. The seashore is sandy shore in nature. The estuary makes many coastal wetlands and some of them are wide open water areas which has many muddy islets. The islets are exposed during low tide and supports a wide variety of benthic organisms. The accessibility for human to this islets is difficult and so there is no disturbance on these areas. The area has a patchy distribution of mangrove vegetation and *Acacia* and *Prosopis* vegetation.

Selection of habitat and location

Within the study area the habitat would have had an influence on the shore-crab distribution and

population. Hence, the collection and survey were made in three different habitats *viz.*, seashore area, estuary area and 1 km upward from the estuary (hereafter this area is referred to as "riverine habitat"). In each habitat the collections were made in two different locations *viz.* on the margin of shore area during low tide (hereafter this area is referred to as "immediate") and another location, which is one meter away from the earlier location towards the shore (hereafter this location is referred to as "1 meter away").

Study period

The data collection on the population of shore crabs were conducted between December 2001 and March 2002.

Collection and preservation of shore-crabs

Shore-crabs are generally found in the burrows on the shore areas of sea and estuary. Extensive surveys were conducted in all tidal and coastal areas of seashore by walk and the shore-crabs were collected. The collected animals were brought to the laboratory, cleaned and preserved in 10% formalin. Later they were identified up to species level.

Population counts

Each burrow is occupied by a single crab, hence the number of burrows counted was considered as crab population. 1m X 1m quadrat was randomly laid in different locations and the crab burrows were counted and recorded. The quadrates were laid in different locations (immediate and 1 meter away) of different habitats (seashore, estuary and riverine) in all the four study areas during low tide period.

Soil Characters

The soil electrical conductivity was measured using electrical conductivity bridge, pH was measured using pH digital meter, and level of potassium was estimated using flame photometer. The soil nitrogen and phosphorous was also estimated using standard procedures.

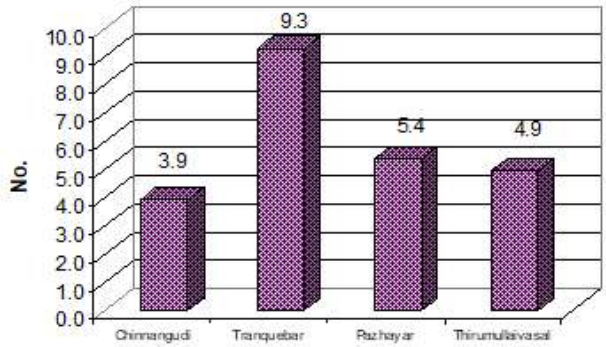

Fig. 1. Shore-crab density in different areas of the study areas during the study period.

Table 1: Shore-crab density per meter square in different location of various habitats in the study areas.

Habitat	Location	Chinnangudi	Tranquebar	Pazhaiyar	Thirumullaivasal	Overall
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Seashore	Immediate	4.3±1.86	4.3±0.58	4±1	4.3±1.53	4.3±1.34
	1m away	3.5±2.51	3.7±2.89	3.7±1.53	2±1	3.3±2.09
	Overall	3.9±2.15	4±1.9	3.8±1.17	3.2±1.72	3.8±1.79
Estuary	Immediate	-	2.7±0.58	4.7±0.58	3±1	3.4±1.13
	1m away	-	3.7±0.58	4.3±1.53	2.7±1.16	3.6±1.24
	Overall	-	3.2±0.75	4.5±1.05	2.8±0.98	3.5±1.15
Riverine	Immediate	-	45±--	8±--	18±--	23.7±19.14
	1m away	-	25.5±7.78	17±--	15±--	20.8±7.14
	Overall	-	32±12.53	12.5±6.36	16.5±2.12	22±12.25

Statistical analysis

Simple arithmetic mean and standard deviation were calculated for the respective study areas, habitat and location. The multiple regression equation was used to determine the variations in the crab population

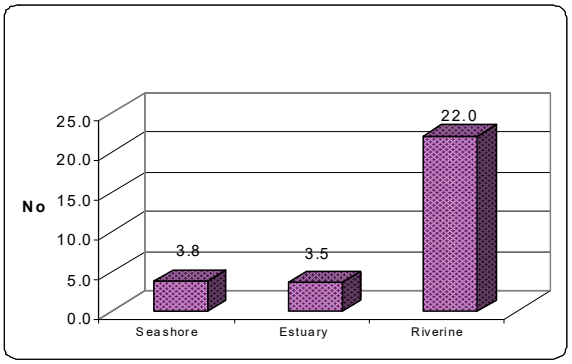

Figure 2. Shore-crab density in different habitats of the study areas during the study period.

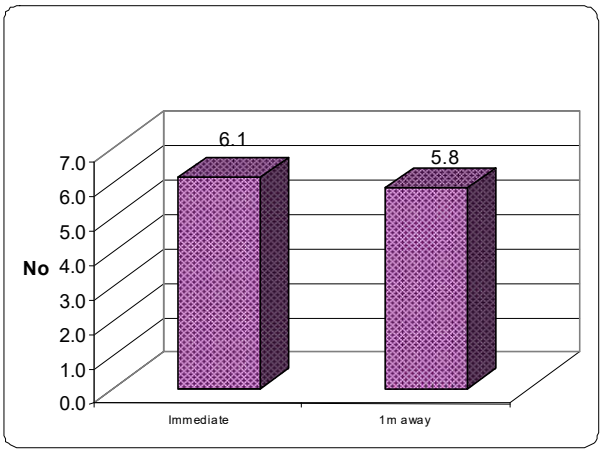

Fig. 3. Overall shore crab density in two different locations.

m²). The density was lowest 3.9/m² in Chinnangudi (Fig. 1). However, the variation in the density in different areas did not differ significantly (p>0.05)

Population counts of shore-crabs

The shore-crab density in different locations of various habitats in all study areas is given in table. 1. In Chinangudi area, the study was carried out only in the seashore habitat.

Seashore

The overall crab population of seashore habitat was 3.7±1.79 per m² (n=30) (Fig. 2). The seashore habitat of Tranquebar had the maximum population of 4.0±1.90/ m² (n=6) and the Pazhaiyar had the minimum of 3.8±1.17/ m² (n=6) (Table 1).

Table 2: Multiple regression equation showing the relative importance of soil characteristics on crab population in the study area.

Predictor	Coefficient	SD	't	P	F, P & R^2
Constant	8.645	2.981	2.9	0.006	80.71
Seashore	-10.712	1.812	-5.91	0.01	0.001
Estuarine	-10.879	1.81	-6.01	0.01	89.90%
Electrical conductivity	12.421	2.753	4.51	0.01	
Electrical conductivity^2	-10.013	1.695	-5.91	0.01	
Electrical conductivity^3	1.9305	0.2666	7.24	0.01	
Potassium	0.09589	0.02913	3.29	0.002	

Table 2a: Analysis of Variance (ANOVA) to the show thesignificance of the above multiple regression equation.

Source	DF	SS	MS	F	P
Regression	6	2793.14	465.52	80.71	0
Error	48	276.86	5.77		
Total	54	3070			

among the study areas and habitats and between the locations and also the factors influencing the crab population. All the statistical inferences were made by following Sokal and Rohlf (1987).

RESULTS

During the study period, three different shore-crab species were observed in all the study areas. They were 1. *Ocypoda platytaris,* 2. *Ocypoda macrocera* and 3. *Uca lactea annulipes*.

Shore-crab density in the study areas

The mean densities of shore-crab (per m²) in different study areas indicated that the Tranquebar area had highest shore-crab density of 9.3/m² followed by Pazhaiyar (5.4/m²) and the Thirumullaivasal (4.9/

Estuary

The overall density of shore-crabs was 3.5±1.15/m² (n=18) in the estuarine habitat (Fig. 2). The density was highest in Pazhaiyar (4.5±1.05/m²; n=6) and lowest in Thirumullaivasal (2.8±0.98 m²; n=6).

Riverine

The reverine habitat had the highest shore-crab density in all the study areas (Fig. 2). The overall density was 22.0±12.25/m² (n=7). The highest density of 32.0±12.53/m² was observed in Tranquebar and the lowest density of 12.5±6.36/m² (n=3) was in Pazhaiyar.

A multiple regression was developed to investigate the difference among the habitats in the crab density, in which the density of shore crabs was regressed against habitat. The habitat is entered as dummy variable with seashore as 1, estuary as 2 and rivererine as 3. The multiple regression analysis showed (Table 2) that the riverine habitat had significantly higher population of shore crabs than the seashore and estuarine habitat.

Shore-crab density in different locations

The overall shore-crab density in two different locations *viz.,* immediate to low tide level and 1 meter

away from the low tide level was shown in figure 3. The overall shore-crab's density in the location of immediate to the low tide level was 6.1/m^2 recorded and 5.8/m^2 for 1meter away from the low tide level. The difference in the shore-crab density between two locations (*i.e.,* immediate to low tide level and 1 meter away from the low tide level) was not statistically significant ($p>0.05$).

Factors influencing the shore-crab population

In order to investigate the factors that influence the shore-crab density a multiple regression equation (Table 2 and 2a) was developed by the crab density against the soil characteristics such as the pH, Electric Conductivity (EC), nitrogen, phosphorous and potassium (Table 2). Regression analysis explained 89.9% of the total variation in the shore crab population. It showed that the shore-crab density was influenced by the soil Electrical Conductivity (EC) and potassium. The potassium had significant positive influence on the crab population. The soil electric conductivity had a non-linear relationship with the shore-crab density, which indicated that certain level of electric conductivity influenced the density of shore-crab. The threshold of the electric conductivity was unable to predict. The other factors namely pH, nitrogen and phosphorous did not show any significant influence on the shore-crab density.

DISCUSSION

In the present study, three species of shore crabs viz. *Ocypoda platytaris, Ocypoda macrocera* and *Uca lactea annulipes* were collected. Ayyar and Ananthakrishnan (1985) observed nine different species of shore crabs in the Madras coast. Joel *et al.* (1986) collected 29 different species of crabs from Pulicat lake, but in which only five species were restricted to sub-terrestrial habitat. The present study was a one time collection between December 2001 and March 2002. So, a long term study covering all seasons of a year should be taken in future to enlist fully the shore crab diversity of the east coast.

It was noticed that there was a strong habitat preference among the crab species. It was very well established that the crab show a strong vertical zonation in distribution (eg. Joel *et al.,* 1986). A review of the literature on the vertical distribution of brachyuran fauna from different parts of the world clearly indicates that each species prefers a specific moisture content in the substratum, on the basis of the physiological ability to withstand varying degrees of drying of the gills in the atmospheric air. Hence this habitat preference could be well associated with the vertical distribution pattern of the crabs (e.g. Sethuramalingam and Ajmalkhan, 1991).

In the present study it was found that the riverine habitat was generally dominated by *Uca lactea.* We noticed several juveniles and immature animals during the data collection, which could be due to the post-breeding season. Therefore the population was remarkably high.

It was noticed that the soil Electrical conductivity (EC) influenced the crab population in non-linear fashion. Electrical conductivity is a measure of the ionic composition of the medium and as such it plays a vital role in the release of the nutrients as well as their uptake by the plants. Barke and Smart (1980) observed the electrical conductivity in the sediments of the North American lakes to influence the macrophyte growth in them. Nagarajan and Thiyagesan (1996) also found the electrical conductivity in the Pichavaram wetlands to have significant influence on their waterbird population structure.

Results of the present study showed that the coastal wetlands studied is rich in shore-crab diversity and density. This could be the reason to attract many wintering bird to this areas. Hence a study should be undertaken to understand the prey (crab) and predators (migratory waterbirds) interactions of these coastal lands.

REFERENCES

Alcock, A. 1990. Materials for a Carcinological Fauna of India; No.6, The Brachyura Catometopa, or Grapsoidea; *J. As. Soc. Bengal*, 69: 279-456.

Alcock, A.1899a. The Brachyara Cyelometopa; Part II. A revision of the Cyclometopa with an account the families Portunidae, Cancridae and Corystidae; *J. As. Soc. Bengal,* 68: 1-104.

Alcock, A.1899b. Natural history notes from the R.I.M. Survey ship 'Investigator': Ser III No3, On some notable new and rare species of Crustacea; *J. As. Soc. Bengal,* 68: 111-119.

Alcock, A.1899c. Materials for Carcinological Fauna of India; No.5, The Brachyura Primigenia or Dromiacea: *J. As. Soc. Benga,l* 68: 123-169.
https://doi.org/10.5962/bhl.title.15343

Ali, S. and Ripley, S.D. 1983. Handbook of the birds of India and Pakistan Oxford University Press, Delhi.

Barke, W.J. and Smart, R.M. 1986. Sediment – related mechanism of growth limitation in submerged macrophytes. *Ecology*, 67(5): 1328-1340.
https://doi.org/10.2307/1938689

Kurian, C.V. and Sabastian, V.O. 1986. Prawn and prawn fisheries of India. 3rd ed. Hindustan Publishing Corporation, Delhi. P 297.

Myers, J.P. 1983. Conservation of migrating shore birds: staging areas, geographic bottle necks, and regional movement. *Am. Birds.,* 37:23-25.

Nagarajan, R. and Thiyagesan, K. 1996. Waterbird population and substrate quality of the Pichavaram wetlands, southern India. *IBIS*,138 (4): 710-721.
https://doi.org/10.1111/j.1474-919X.1996.tb04773.x

Nagarajan, R., and Thiyagesan, K. 1998. Significance of adjacent croplands in attracting waterbirds to the Pichavaram mangrove forests. *In*: 172-181; Dhinsa, M.S., P.S. Rao and B.M. Parasharya (Eds.) *Proc. Birds in Agricultural Ecosystem. Society for Applied Ornithology* (India).

Pandian, J. 1999. Studies on the waterbird use of unprotected mudflats of Nagapattinam, coast, Tamilnadu, South India. *M.Sc., Dissertation submitted to Division of Post graduate studies in Wildlife biology, A.V.C. College, Mannampandal.*

Pandian, J. 2000. Factors influencing waterbird use of coastal sandflats and mud flats of Nagapattinam District, Tamilnadu, Southern India. *M.Phil., dissertation, AVC College, Mannampandal, India.*

Prater, S.H. 1971. The book of Indian animals. Bombay Natural History Society Press, Bombay. 207p.

Sampath and Krishnamoorthy, K. 1990. Shorebirds (Charadriiformes) of the Pichavaram mangroves, Tamilnadu, India. *Wader Study Group Bull.* 58:24-27.

Sethuramalingam, S. and Ajmalkhan, S. 1991. Brachyuran crabs of Parangipettai coast. CAS in Marine Biology, Annamalai University, Parangipettai. 92p.

Sokal R.H. and Rohlf, F.J. 1987. Biometry. W.H. Freeman and Company, New York.

Thiyagesan, K. and Nagarajan, R. 1995. Impacts of developmental projects on the wetlands in two coastal districts of Tamilnadu, Southern India. *Asian Wetland News (Malaysia)* 8(1): 8.

Warner, C.F. 1977. The biology of crabs. Pawl Elek (Scientific books) Ltd., London. 202p.

Van Vessem, J. 1992. Migratory waterfowl conservation: The need for international co-operation. *Wader study group Bull.*, 64:19.

Velasquez, C.R. and Hockey, P.A.R. 1991. The importance of supratidal foraging habitats for waders at a south temperate estuary. *Ardea.* 80(2): 243-253.