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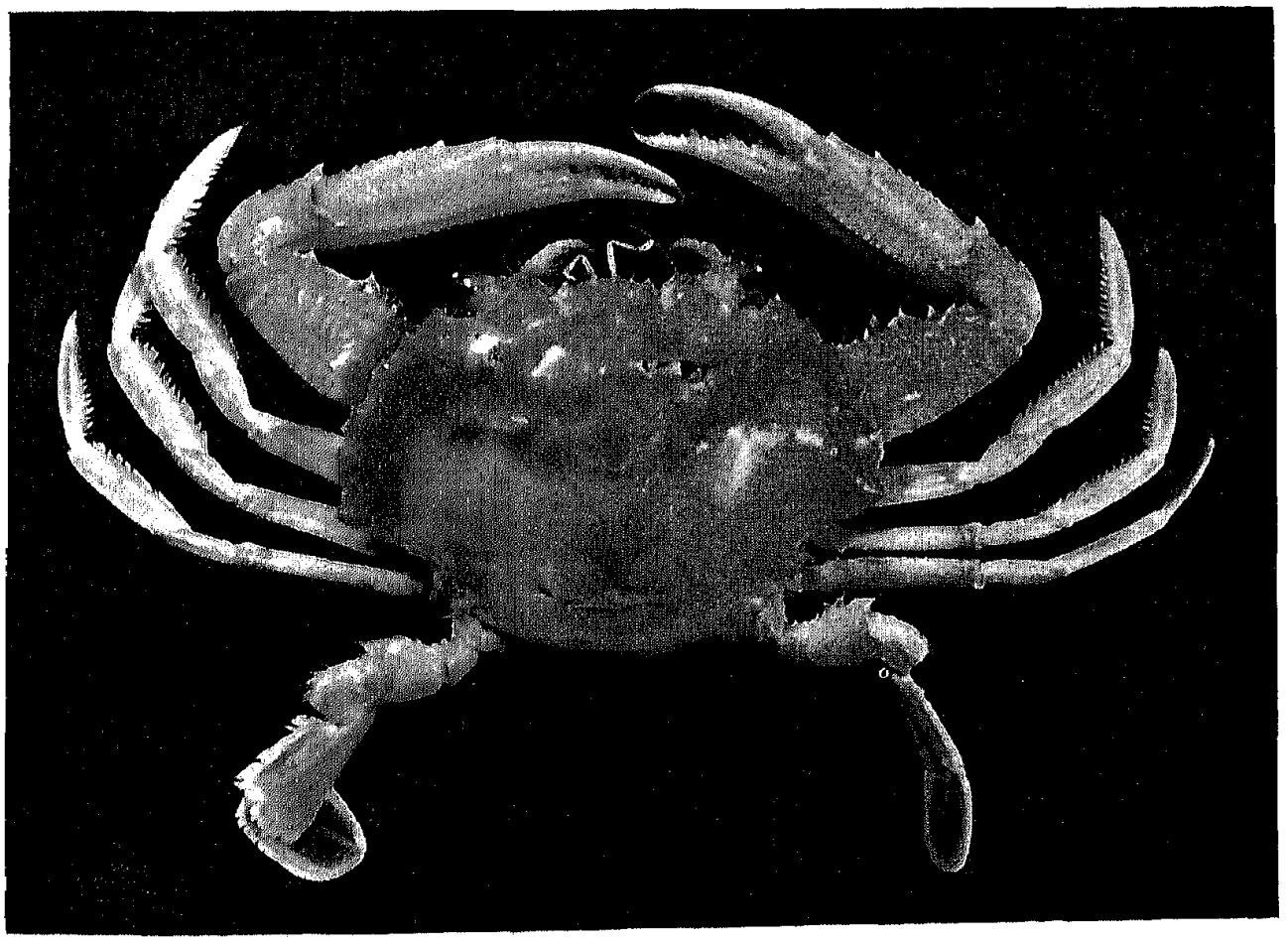
Notes on the portunid crab *Charybdis edwardsi* Leene & Buitendijk, 1949, from the Western Indian Ocean

G. F. LOSSE

Department of Fisheries, F.A.O., Rome *

Introduction

Among the species of swimming crabs (Portunidae) which occur in East African waters and the Gulf of Aden, only *Charybdis edwardsi* has been found in any numbers offshore beyond the continental shelf, leading a truly pelagic swimming existence. The oceanic swarming habit of the species in the Western Indian Ocean was only recently recorded by Della Croce & Holthuis (1965). Other reports of oceanic crab swarms have been made by merchant ships and fishermen, but as these reports were not accompanied by specimens the identity of the crabs in question remains uncertain.



Charybdis edwardsi Leene and Buitendijk. Female from the Zanzibar Channel, East Africa.

* Formerly East African Marine Fisheries Research Organization, Zanzibar.

During the author's fishery work for the East African Marine Fisheries Research Organization (Zanzibar) in 1964–65 off East Africa, and more recently (1966/67) for a Fishery Development Project in the Gulf of Aden, sponsored by the United Nations Development Programme (Special Fund), several collections of specimens and observations of the species were made. The collections were deposited at the laboratories of the Organization in Zanzibar (East African material) and the Project in Aden (Gulf of Aden material).

The preliminary data indicate that *C. edwardsi* occurs in the surface waters of the extreme Western Indian Ocean (including the Arabian Sea and Gulf of Aden) often in very large numbers, or swarms, principally during the south-east/north-east inter-monsoon and early north-east monsoon period (October to December). Due to this extreme abundance *C. edwardsi* may be of considerable importance in any appreciation of the biology and fishery of this vast area in these seasons.

Recently, Stephenson & Rees (1967) placed *C. edwardsi* in the synonymy of *C. smithii* McLeay, as a result of examining the type of *C. smithii* in the museum of the University of Sydney. For the purpose of the present study the name *C. edwardsi* has been retained as the identification of East African and Gulf of Aden material was based on comparison with the type of *C. edwardsi* in the British Museum.

Distribution

The species has been recorded previously with certainty only from the Malabar coast of India, locality of the lectotype * (a male, British Museum Reg. No. BMNH 1951.4.3.1) and off the Comores and Eastern Coast of Africa (Positions: 09° 45′ S–43° 39′ E, 07° 03′ S 42° 34′ E, 05° 14′ S 41° 40′ E) by Della Croce & Holthuis (1965). New records established from East Africa and the Gulf of Aden are shown in table 1.

Additional observations made by the author when the crabs were being collected are given in the Appendix.

Specimens were collected on the surface of the sea in depths ranging from 8–10 m close inshore, to more than 2000 m far from the land. The species therefore cannot be considered entirely oceanic in habit, but the general indications are that the large swarms observed on the surface of the sea only occur offshore in the deeper waters.

Observations of crab swarms which may have been this species (no specimens were collected) were recorded in the logs of M/V *Herefordshire* on 21. x. 1963, in 10° 43′ N–59° 26′ E (cited by Della Croce & Holthuis) and M/V *Shropshire* on 26. xii. 1960, 02.30–04.30 G.M.T., in 17° 33′ N–56° 10′ E (Gordon, *in litt.*) in the Arabian Sea. A record of a large crab swarm occurring off the east coast of Somalia was made by the British ship SS. *City of New York* on 22. x. 1966, from 12.15 G.M.T. in 03° 36′ N–48° 17′ E, to 14.40 G.M.T. in 04° 18′ N–48° 30′ E (Appendix). Large numbers of crabs offshore were also reported in 1962/63 from the Gulf of Aden (Anon., 1964). Japanese longline fishermen speak of a 'crab current' in the Western Indian Ocean, between 45° and 55° E (probably the Equatorial Counter Current) during the north-east monsoon (T. Ochi, personal communication).

* Leene & Buitendijk (1949) quote 'East Indies'.

Table 1

Collections of *Charybdis edwardsi* from East African waters and the Gulf of Aden

Date	Time G.M.T.	Position Lat.	Position Long.	Sounding fms	Surface water T°C	Number of specimens	Method of capture
16. ix. 1964	Night	4 mls N.W. of Pemba Island (Tanzania)		4–5	—	13	Bucket under lamp
22. x. 1964	—	05° 08′ S	40° 43′ E	1025	—	15	Isaacs/Kidd trawl
26. x. 1965	17·00	02° 32′ S	41° 01′ E	50	26·7	6	Handnet under lamp
4. xi. 1965	21·15	05° 59′ S	38° 55′ E	21	26·4	2	Handnet under lamp
6. xi. 1965	01·00	06° 05′ S	39° 11′ E	8	26·3	4	Stick-held dipnet (*bouke-ami*)
19. x. 1966	03·10	13° 25′ N	47° 32′ E	900	27·4	1	Handnet under lamp
19. x. 1966	16·30	12° 49′ N	46° 48′ E	950	27·2	14	Handnet under lamp
8. xi. 1966	12·10	12° 21′ N	48° 00′ E	960	27·8	1	Handnet under lamp
8. xi. 1966	20·00	12° 00′ N	48° 30′ E	1240	27·7	1	Handnet under lamp
9. xi. 1966	18·45	11° 51′ N	50° 08′ E	1005	27·5	24	Stomach contents of striped marlin
23. xi. 1966	02·30	11° 53′ N	44° 20′ E	350	27·2	1	Isaacs/Kidd trawl
24. xi. 1966	19·00	12° 03′ N	43° 44′ E	250	27·1	4	Handnet under lamp
5. iii. 1967	21·25	14° 18′ N	49° 42′ E	800	25·5	1	Handnet under lamp
6. iii. 1967	00·30	14° 32′ N	49° 50′ E	280	25·0	2	Handnet under lamp

Observations on stomach contents of longline caught yellowfin, bigeye tuna and striped marlin from the equatorial Western Indian Ocean area, during the north-east monsoon, demonstrated that many of these larger pelagic fish had gorged on the crabs during this period (personal observation). *C. edwardsi* may therefore be an important seasonal food item in the diet of large oceanic fishes.

Surface observations of crabs indicated that the general activity of the species was high, and when swarms occurred the individuals were often paddling vigorously when disturbed by the ship. At night at anchor, or at drift, crabs were often seen motionless on the surface; but when bright lights were switched on specimens often increased in activity and swam rapidly to the source of light. Generally activity of the larger males was higher than that of females. The latter were often motionless even under a lamp at night; this lesser activity of females may be the reason why males were predominant in the samples collected (mainly under lamps at night). The feeding behaviour of the species has been noted above.

Effect on fishery

Extensive longline bait loss and damage has been recorded during the north-east monsoon in the Western Indian Ocean and the Gulf of Aden. During exploratory longline fishing off East Africa by the Kenya Government vessel R/V *Menika II* and the research vessel of the East African Marine Fisheries Research Organization, F.R.V. *Manihine*, in 1964/65, the effect of bait scavenging on the success of fishing operations during the north-east monsoon was marked. Off Mombasa in December 1964 baits were so rapidly removed or damaged that catches were very small or none were made; bait damage was severe until February.

During longline surveys in the Gulf of Aden in 1962/63 (Anon., 1964) and 1966/67 (Losse, 1967), assumed crab damage was again severe in the north-east monsoon period, often affecting successful fishing operations. During the 1966/67 survey, notes on longline bait loss were kept. Although the total immersion time of hooks was short, bait loss occurred on up to 98% of the total hooks shot (Losse, 1967). Loss of bait over short periods may be up to 30% (personal observation), depending on the type and condition of bait used. Very heavy losses could not be attributed to natural means, i.e. deterioration of bait and falling off the hook during the hauling operations. During October/November 1966 the loss of bait was very great but varied with the areas fished. In the eastern Gulf (east of 47° E) the thermocline was very shallow (less than 31 m) and bait loss was below 40%. In the western Gulf (west of 47° E), the thermocline was slightly deeper (up to 55 m) and maximum bait losses were encountered. That the crab was abundant in the entire area was indicated by surface sightings. The differential bait loss may have been due to a greater proportion of hooks fishing below the thermocline (? crabs absent) in the east than in the west. Long, medium and short buoy lines were used (respectively 22, 15 and 5 m in length) and therefore hooks fished at variable depths. Although no detailed observations were made there was a general indication that the short and medium length buoy-line basket hooks suffered the greatest bait loss. In March 1967 very few crabs were observed in the Gulf and only relatively minor losses of bait were evident.

Discussion

There is little doubt that *C. edwardsi* is widespread in the Western Indian Ocean, often occurring in large swarms on the surface of the sea between October and December, principally at night. The seasons of maximum occurrence appear to be in the period of the south-east to north-east inter-monsoon and in the early months of the north-east monsoon. During this period the species may be of considerable biological and fishery importance due to the voracious predatory habits. The effects of predation by large numbers of these crabs must be considerable, but the extent of this cannot be estimated at present. The crab also formed at times a considerable portion of the food items of some large, economically valuable, oceanic pelagic fishes, mainly Scombroids, and it may therefore play an important role in the diet of these forms during the season of crab abundance.

In the longline fishery extensive bait removal and damage has severely affected the efficiency of fishing operations when crabs were abundant. This indicated that large sub-surface crab stocks occurred in the area.

The pelagic swarming appears to be a seasonal phenomenon, but the factors which govern the distribution, abundance and pelagic occurrence are not known. It is possible that the abundant appearance of the species is due to an active, voracious feeding phase, perhaps following a spawning period, but some other factor may be involved and reproductive activity cannot be ruled out.

Attempts to harvest this species could be made, but the specimens were rather small for direct human consumption. Reduction to meal would perhaps be feasible and valuable if large quantities can be economically caught.

Acknowledgments

I would like to thank Dr. Isabella Gordon, Crustacea Section, British Museum (Natural History), London, for kindly identifying specimens of *C. edwardsi* collected off East Africa in 1965 and Mr. T. Ochi, FAO/TA Masterfisherman, Mombasa, Kenya, for discussions on crab observations made by Japanese longline fishermen in the Western Indian Ocean; also for arranging a visit to a Japanese longline vessel in Mombasa.

Appendix

Surface observations of swimming crabs from East Africa and the Gulf of Aden

The following observations were made of swimming crabs occurring on the surface of the sea. In most cases specimens were collected which are listed in table 1.

26. x. 1965.	17.00–20.00 G.M.T., in 02° 32′ S–41° 01′ E, sounding 50 fms, temperature 26·7°c. A small number of crabs appeared on the surface under lamps while the ship was drifting. The specimens started feeding voraciously on small (juvenile) *Coryphaena hippurus* collected under the lamps.
4–5. xi. 1965.	21.15–01.00 G.M.T., in 05° 59′ S–38° 55′ E, sounding 21 fms, temperature 26·4°c. Small number of crabs were feeding on small shoaling fishes collected under lamps; the activity of specimens was high.
6–7. xi. 1965.	16.00–02.00 G.M.T., in 06° 05′ S–39° 11′ E, sounding 8 fms, temperature 26·3°c. Small number of crabs appeared on the surface shortly after dusk and collected in the vicinity of lamps. Later specimens started feeding voraciously on small mackerel (*Rastrelliger*) and sardines (*Sardinella*) which were shoaling under the lamps.

18–19. x. 1966. 23.10 G.M.T., in 13° 38′ N–47° 57′ E, sounding 780 fms, temperature 27·4°c; 03.10 G.M.T., in 13° 25′ N–47° 32′ E, sounding 900 fms, temperature 27·4°c; 16.00 G.M.T., in 12° 49′ N–46° 48′ E, sounding 950 fms, temperature 27·1°c. Very large numbers of crabs were seen on the surface at all three positions paddling quickly. They collected quickly around lamps at stations and started feeding on any small fishes disorientated by the lamps. These included myctophiids and juvenile dorado (*Coryphaena hippurus*).

8. xi. 1966. 12.10 G.M.T., in 12° 21′ N–48° 00′ E, sounding 960 fms, temperature 27·8°c; 15.50 G.M.T., in 12° 27′ N–48° 31′ E, sounding 1100 fms, temperature 27·7°c; 20.00 G.M.T., in 12° 00′ N–48° 30′ E, sounding 1240 fms, temperature 27·7°c. Large swarms of crabs were seen on the surface at all three positions and also during the entire passage from 12.10 G.M.T. to 20.00 G.M.T. When the ship stopped at stations large numbers rapidly swarmed to the illuminated areas feeding on small fishes collected there. The crabs were apparently abundant over a very great area.

9. xi. 1966. 16.45–17.30 G.M.T., in 11° 51′ N–50° 08′ E, sounding 1005 fms, temperature 27·5°c. Very large numbers of crabs collected around lamps while the ship was at drift. These were again feeding on small fishes and garbage thrown from the ship.

24. xi. 1966. 14.00–19.00 G.M.T., in approx. 12° 03′ N 43° 44′ E, soundings 148–323 fms, temperature 27·1°c. Small numbers of crabs appeared on the surface at 14.00 G.M.T. but abundance increased at dusk, after which they were seen inactive on the surface at intervals of 20–30 metres.

Through the kindness of Dr. A. L. Rice, British Museum (Natural History), the author received the following log record, made by the British ship SS. *City of New York*:

"22nd October 1966 at 12.15 GMT in 03° 36′ N, 48° 17′ E, numerous small brown crabs were sighted swimming at the sea surface. They continued to be visible all round the vessel as far as the eye could discern, either directly or by associated ripples, to a distance of at least one mile. The crabs varied in size from about 1½ inches to about 3½ inches across the shell and had an average separation, one from the other, of about 3–4 feet. So far as could be determined there was a general movement of the whole body (of crabs) towards the south or south-west. They were still visible in all directions at the same density until darkness prevented further observations at 14.40 in 4° 18′ N, 48° 30′ E." SS. *City of New York* (20542), Mombasa towards Djibouti.

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All specimens examined were collected between September (1964) and March (1967); but offshore samples were not taken until October, and I can find no records of crab swarms before this period. General indications are that the crabs leave the inshore waters at the end of the south-east monsoon period in September/October and gather in large numbers in the surface waters offshore during the inter-monsoon period and the early north-east monsoon. After February few crabs have been seen or caught. Whether a mass migration of the populations occurs, or whether a feeding or breeding cycle is involved, is not known.

Surface water temperature records when collections were made ranged from 25·0°C to 27·8°C; the greater number of specimens were taken when the temperature was 26·4°C to 27·8°C. Thus, offshore records from East Africa were confined to the periods when the water begins to become warmer after the cold (winter) south-east monsoon (Newell, 1957), and in the Gulf of Aden when the waters cool after the warmer (summer) south-west monsoon period. It is therefore very likely that the swarming habit of the crabs may be dependent on a fairly limited temperature range.

Most specimens were collected in the late afternoon, at dusk or during the night under lamps, while surface observations were made during the same periods. During the bright daylight hours no crabs were generally seen on the water surface. Evidence of the species occurring at depth may be gained from the predation of longline baits (see below) and the occurrence of crabs in stomachs of typically deep-swimming forms (e.g. bigeye tuna).

The pattern of vertical migration of the species, if indeed it occurs on a cyclic basis, is not known. However, in the Gulf of Aden the greatest numbers occurred on the surface of the sea during the darkest nights.

Biology

The size range (breadth of carapace) of males and females measured by Della Croce & Holthuis (loc. cit.) was 51 to 65 mm and 48 to 61 mm respectively. Specimens from East Africa and the Gulf of Aden were measured with dial calipers (extreme carapace breadth, including spines) to the nearest 0·1 mm (table 2). The size of 56 males ranged from 45·8 to 71·3 mm and that of 21 females from 43·7 to 59·0 mm; the range in mean size, of samples of males and females, was 52·0 to 70·5 mm and 49·9 to 55·1 mm respectively.

Table 2.
Size in millimetres (carapace breadth) of *C. edwardsi* samples

Date	Males			Females		
	No.	Size range	Mean	No.	Size range	Mean
16. ix. 1964	6	45·8–56·8	52·0	7	43·7–55·5	49·9
22. x. 1964	9	51·2–60·1	54·9	6	48·1–55·3	52·1
19. x. 1966	1	52·5	52·5	—	—	—
19. x. 1966	11	47·0–60·1	—	3	52·2–59·0	—
8. xi. 1966	2	60·9–66·2	63·5	—	—	—
9. xi. 1966	21	52·9–68·1	61·8	3	50·0–55·0	52·0
23. xi. 1966	—	—	—	1	55·1	55·1
24. xi. 1966	3	56·0–70·0	62·6	1	55·0	55·0
5–6. iii. 1967	3	69·3–71·3	70·5	—	—	—

The samples are too small and isolated in time to draw conclusions about the growth of the species. It is, however, of interest to note that in the 1964 samples a mean size difference in males and females was evident from September to October, the latter sample representing the larger specimens. During 1966/67 the smaller specimens were collected in October and the larger in November, while the largest males recorded were collected in March. The general indications were that the smallest specimens appeared at the beginning of the season of the species' abundance in the surface waters (September/October) and that during this season rapid growth resulted.

The overall sex ratio of males to females was 2·6 : 1, and males were generally predominant in the individual samples. No ovigerous specimens were observed and nothing is known of the reproductive cycle of this species.

On several occasions *C. edwardsi* was observed feeding, in a most voracious manner, on small pelagic fishes collected under lamps at night. In October 1965, on the North Kenya banks, crabs were feeding heavily on juvenile dorado, *Coryphaena hippurus* (nine specimens caught measured 43·0–99·7 mm S.L.), which were then abundant under lamps at night. These juveniles formed an easy prey to the crabs, apparently due to their disorientation by the light. Off Zanzibar, in November 1965, a small number of crabs was actively catching sardines (*Sardinella gibbosa*) and mackerel (*Rastrelliger kanagurta*) which ranged from about 90 to 140 mm in length.

In the Gulf of Aden during October/November 1966, the species was again observed feeding on juvenile dorade, mackerel, sardines and myctophiids, which were collected under lamps at night. Four crabs caught in an Isaacs/Kidd trawl were found to be devouring the catch consisting of myctophiids, *Chauliodus* and *Stomias*.

Fast swimming fish were quickly caught and securely held by the chelipeds, and then rapidly devoured. When hunting, the crabs move into the vicinity of a fish shoal, or into the centre of it, then extend the chelipeds fully and rapidly swim in a circular path snapping vigorously at any fish which come near the chelipeds. By such means even small mackerel are securely caught. These observations demonstrated that *C. edwardsi* can be a voracious and agile predator. A species of similar habits is *Polybius henslowi* Leach, in which the oceanic swarming habit is also known, which often attacks sardines and is therefore considered a severe pest by sardine fishermen in other seas (Della Croce & Holthuis, 1965).

During longline fishing operations in the Gulf of Aden in the season of crab abundance, a high percentage of baits were removed or partially destroyed; this was assumed to be due to the scavenging habits of the species at depth, during the hours of daylight. The 'messy' appearance of baits pointed to activity of crabs rather than squid, as the latter produce crater-like holes in bait. Longline baits removed or attacked included sardines (*Sardinella*) and scad (*Selar*); shark fillet and *Tilapia* baits suffered little damage during fishing operations.

Known predators are yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), marlin and shark (Merrett, 1967). A striped marlin (*Tetrapterus audax*) caught in the Gulf of Aden on 23. xi. 1966 contained a live *C. edwardsi* in the stomach; a tiger shark (*Galeocerdo cuvier*), caught in the same locality on the previous day also contained a fresh specimen.