Field Notes on the Terrestrial Crabs

By C. A. GIBSON-HILL

(Plate III).

Andrews collected specimens of five species of land crustacea during his stay on Christmas Island in 1897–98, of which four had been previously recorded by J. J. Lister. Of the five, four are the subject of short notices below; in the case of the fifth, *Coenobita clypeata* Latr., I can add nothing to the brief note which Andrews included in the Monograph. These five species, as he said, are a very important factor in the fauna of the island. With the exception of *Cardisoma hirtipes* Dana. they work as the principal scavengers, destroying both vegetable refuse and carrion, while the red crab, *Gecarcoidea humei natalis* (Pocock), which is abundant, to a large extent takes the place of the earth-worm.

In addition to the above species there is another scavenger, a second *Geograpsus, G. grayi* (Milne-Edwards) not recorded by Andrews.[1] This, like *Geograpsus crinipes* (Dana), occurs all along the shore terrace, and is particularily common on the east coast in the region of the beaches, and on the west coast round the Dales. On Dolly Beach and at Flying Fish Cove both can be found on the foreshore, especially at night.

Another small species, *Sesarma jacksoni* Balss, was taken by Dr. J. W. Harms in 1933 in the neighbourhood of Grimes's Cave.[2] I have since taken several specimens on the shore terrace

1. It seems likely that the note on habits published by Andrews under *Ocypoda ceratopthalma* really applies to this species: if that is so it accounts for his apparent failure to record *Geograpsus grayi*, which he must have seen if it were present at the time of his visit. His comment on the crab which he identifies as *O. ceratopthalma* is, "This crab is rather common on the shore platform at Flying Fish Cove, where it lives under the blocks of stone, which are strewn at the foot of the cliff" (Monograph, p. 164). This is definitely the habitat of *Geograpsus grayi* and not suitable for *Ocypoda ceratopthalma*. The latter was found only on the two sandy beaches (Dolly and Greta Beaches) on the east coast of the island, on both of which it was plentiful in company with *O. kuhli* and *O. cordimana*. Its food there included young turtles which it intercepted on their way to the sea.

2. Harms gives the type locality as Grimes's Cave, which is most misleading. The cave is a sea cave, at the foot of the coastal cliff, while the normal habitat of the crab is certainly the shore terrace above the cliff.

near Rocky Point, and found it again on the east coast in the vicinity of Greta Beach. These crabs move about principally at night, and seem to travel to the sea to spawn during the first two months of the year. Yet another species, *Sesarma obtusifrons* Dana, is fairly plentiful in the pock-marks and crevices at the top of the sea cliff. It is particularly common in Flying Fish Cove and behind Greta and West White Beaches. It also occurs up on the shore terrace proper, at the base of the inland cliff, and during the rainy season can occasionally be found in the open. Females with spawn (a crab with a carapace width of 18 mm. carrying about 5,500 eggs) are most frequent from January to April. The spawn is taken to the sea and deposited, at low tide, on the edges of the rock pools on the uncovered portions of the fringing reef.

There is only one truly fresh-water crab, *Ptychognathus pusillus* Heller, which was first described from the island by de Man in 1905, from specimens obtained by Dr. Hanitsch in the previous year from the stream above Panchoran Bay[1]. It is still common there, although the nature of the spring has changed. It turns up again in most of the streams down the east coast of the island, but I have not been able to find it in the neighbourhood of the Dales on the west side. At Dolly Beach it follows the water down to the beginning of the sand. One other small species, *Metasesarma rousseauxi* H.M.-Edw. can also be found there, hiding under the rotting coconut husks in the mud which borders the landward edge of the beach, (Plate III, below). I have taken this again from a fairly similar habitat on Isabel Beach, on the north coast. It is very variable in colour, ranging from black with orange-brown markings and the legs mottled with dark umber and fawn-umber, to a very pale green-white with black markings and the legs pink-brown, mottled with dull nigger-brown.

Two species of hermit crab, *Coenobita perlatus* M.-Edw. and *C. rugosus* M.-Edw., are very plentiful on all the beaches, except Flying Fish Cove where the latter, at least, is fairly rare. The largest specimens seem to be on Greta Beach. These crabs belong more strictly to the marine fauna, but they occasionally stray away from the sea, and may be found on the shore terrace.

I am much indebted to Mr. M. W. F. Tweedie for the determination of a number of the species mentioned above.

1. A fresh-water shrimp, *Palaemon lar*, was described at the same time. *Palaemon* occurs only in this small stream running into Panchoran Bay, and in the water-storage tank which is supplied from it. Specimens from the latter locality are colourless. The stream also contains a few individuals of a species of Goby.

Gecarcoidea humei natalis Pocock.

This, by far the commonest crab on the island, occurs abundantly throughout the jungle, wherever the surface is covered with soil. In parts, the ground is so honey-combed with its holes, which are not deep enough for their roofs to bear much weight, that one sinks in up to the ankle with every third or fourth step. These burrows, which vary from six to twenty-four inches in length and, after an initial descent, run fairly close to the surface, are used principally as a retreat in danger, since the crab spends most of its time, except in very dry weather, in the open. The burrows are always constructed where the soil is soft, and not too damp, and may be dug and abandoned relatively quickly.

The usual diet of this crab, in the jungle, is fallen, slightly rotting, leaves, which are frequently taken into the burrow to be eaten. The species is not, however, by any means purely vegetarian, and it also takes any form of carrion; it will even eat the dead bodies of its fellows if the shell has been crushed. It will drink readily from standing water, spooning a small drop up on the tip of the chela. Both claws are used alternately in regular rotation.

The normal colour of the adult shell, when clean, is a bright red with black and white markings on the carapace, but in a few individuals it is an orange-red or even yellowish-orange. In paler specimens only the white markings are present. In the young stages the carapace is duller and darker, almost black, and frequently devoid of markings.

Once a year these crabs migrate, in mass, to the sea to spawn. In the jungle itself the movement takes place during the cooler hours of the day, and at night. In the more open places it is restricted to evening, night and early morning, as any individual caught without shade by the full sun soon dies of dehydration. The line taken is that of the natural descent of the ground, modified, apparently, by the line of their own first ascent. This path is followed blindly over all obstacles, but it does, for the most part, result in the crabs arriving down only at those portions of the coast which are protected by a fringing reef. As the sea cliff in the uncovered stretches drops fairly straight into the water, without rock-pools or ledges, it seems reasonable to suppose that spawn laid there has a poor chance of survival, and thus sends up very few young crabs. This is obviously a more powerful influence in determining the line of the adult's descent than the nature of the obstacles to be overcome, since it is the number of crabs which come up, not which get down, which is important. If the spawn is washed

away, or all the youngsters are drowned trying to obtain a foothold on the base of the sea cliff, there will, in later years, be no crabs to return there to breed. On the other hand if only one fertilised female in an hundred reaches a place from which the young can climb up easily the balance is maintained. On the north side of the island, where a strip of the shore terrace, flanked by a fringing reef, has been cleared for a coconut plantation, the crabs continue to make their way to the sea across the now open ground in spite of the very heavy mortality. A mile and a half further on, where the terrace is still well protected by jungle, but the fringing reef is absent, few adults attempt to descend. Similarly, very few crabs cross the southern six miles of the railway, which would take them towards Smithson Bight where there is relatively little reef; while uncountable numbers make their way over the northern four miles, towards the north coast, in spite of the fact that, at a rough estimate, over an hundred thousand die of exhaustion every year while climbing the metalled lines.

The adults begin to move during the last days of the dry season, and usually reach the shore terrace in November, or the first week of December, in time for the first burst of rainy weather. The majority of the earliest arrivals are males: they make their way straight to the sea to wash and then retreat to the back of the shore terrace, or even as far as the top of the inland cliff. There they dig themselves in and wait. As soon as a suitable female passes she is seized and dragged half into the burrow, where copulation takes place. Normally this occurs at night, or at least during damp or rainy weather. After copulation the male may remain, or return to the centre of the island, while the female continues her way to the sea. She usually appears on the shore terrace with spawn from nineteen to twenty-three days after the arrival of the first males (*see* table).[1] The eggs are laid among the stones and boulders in the shallow water inside the reef. Their presence attracts numbers of sea-eels, *Muraena* sp., who fight viciously for any fragments of crab which they can tear off. After depositing their spawn the females slowly make their way back to the inland plateau.

1. A few individuals follow a minority time-table. Thus in 1917 there were two waves of females with spawn, one in mid-November and the second on 7–8th December; as the young crabs were first seen on 5th January, 1918, apparently only the second group was successful. A second small batch of fertilised females arriving about a month after the first was also recorded in 1932 and 1938–39, and I saw a few south of North-East Point in January, 1940.

DETAILS OF THE ANNUAL BREEDING MIGRATION OF *Gecarcoidea humei natalis*.

Crabs first descended to shore terrace	Female crabs first seen with spawn	Young crabs began to leave Flying-fish beach
21 November, 1919	14 December, 1919	16 January, 1920
13 November, 1920	3 December, 1920	3 January, 1921
1 November, 1921	22 November, 1921	None observed
? 22 November, 1922	9 December, 1922	6 January, 1923
13 December, 1923	1 January, 1923	None observed
No record 1924	19 November, 1924	22 December, 1924
No record 1925	11 December, 1925	11 January, 1926
3 December, 1926	25 December, 1926	25 January, 1927
21 November, 1927	No record 1927	19 January, 1928
22 November, 1928	3 January, 1929	2 January and 1 February, 1929
1 November, 1929	No record 1929	None observed
23 November, 1930	5 December, 1930	None observed
9 November, 1931	2 December, 1931	2 January, 1932
5 November, 1932	? 23 November, 1932	30 December, 1932
8 November, 1933	? 8 December, 1933	No record
9 November, 1934	30 November, 1934	3 January, 1935
1 November, 1935	21 November, 1935	30 December, 1935
14 November, 1936	6 December, 1936	None observed
3 December, 1937	25 December, 1937	None observed
25 November, 1938	15 December, 1938	18 January, 1939
10 November, 1939	2 December, 1939	None observed

These figures, which are taken from notes made by the chemist of the Christmas Island Phosphate Co., refer to the narrow strip of shore-terrace which borders Flying Fish Cove.

If the weather has been favourable the young crabs generally begin to leave the water between thirty and thirty-four days after the first spawn was laid. On eight occasions in the last twenty-one years so few have survived that they have escaped detection. The crabs are usually apparent in the rock-pools for some days before they attempt to move on to the land. At this stage they are pinkish, about 5 mm. broad and with the abdomen still protruding posteriorly. They swim fast and appear superficially not unlike *Corixa*. By the time that they come to leave the water they are some 8 mm. broad, definitely canceriform in shape and stronger in colour. Their first move is to the shelter

of the rocks beyond the high-tide mark, and they do not reach the road above the beach until the second or third day. Like the adults they travel mostly in the evening, night and early morning, and seek, where possible, shade and damp places. If the season has been a good one they come up from the water in hundreds of millions. In January, 1939, the surface of the road through the coconut plantation was bright red with them for a distance of over two hundred yards, and there was a constant murmur from the grass along the sides of the road as they pushed their way past the stems. They seem to take about six days to climb the inland cliff behind Flying Fish Cove, and another four to reach the railway line above Smith Point. By then they have travelled about three-quarters of a mile, and risen six hundred feet. The mortality is very high, and further increased by some of the adults who take up their position in the line of a stream of young crabs and scoop them into their mouths with both claws.

Apart from losses due to death the onward wave of young crabs is continually being depleted by individuals who settle down where they are. Shortly after it passes the lip of the inland cliff the wave becomes so spread out that it is practically impossible to follow its progress. The width of the carapace, which is still about 6·5 mm. becomes very variable. It is, however, certain that subsequent growth must be fairly slow as the smallest crab found in November, then presumably about nine to eleven months old, measured only 19·5 mm. across the carapace, and the smallest females with spawn 33 mm.

Cardisoma hirtipes Dana.

This species has a very limited distribution on the island, and as a result, though plentiful, was not found by some of the previous investigators. It occurs only in the immediate neighbourhood of fresh-water. It is thus abundant on the west coast between Hugh's Dale and Sydney's Dale, and on the east side of the island, in the vicinity of Harrison's, Henderson's and Hewan's springs. There is also a smaller colony further down the same coast, along the streams which drain into the sea around Dolly Beach, and another in the north behind Panchoran Bay. This latter group is of some interest. When Andrews was on the island in 1897–98 there was a waterfall and stream running down onto the beach, and he described the crab as "especially common". About five years' after his visit the course of the water was slightly modified, and it now oozes straight out into a small catchment pit, from which it is pumped into storage

tanks; with the result that *Cardisoma* is at present much less plentiful there than in any of the other places enumerated above.[1]

Normally, this crab digs large burrows in the soft dark mud along the sides of the streams, in which it spends much of its time, usually emerging only from dusk or in dull rainy weather. These holes, which are about twenty to thirty inches long and with their floors from twelve to eighteen inches down, frequently contain water. This is particularly so in the neighbourhood of the slight marsh at Anderson Dale, (Plate III, above) where many of the entrances are level with the surface of the pool. If, as over most of the slope at Panchoran Bay, the ground is too hard to allow of the excavation of a large hollow the crabs generally scratch a short tunnel under a tree-root.

These crabs are vegetable feeders, and unlike most of the other species on the island will not seriously attack each other even in captivity.

According to the Chinese woodcutters, who catch *Cardisoma* for food, the females generally appear with spawn in January or February, about six to eight weeks after the beginning of the rainy season. This agrees with my records. I found gravid crabs on 25th January, 4th February, and 19th February and on 17th February, was shown a female which had developed eggs while in captivity.

Geograpsus grayi M.-Edw.

This species, which is practically confined to the shore terrace, occurs all round the island. It is most plentiful along the strip of the north coast between Steep Point and the region of Margaret Beaches; within these limits it is very common. It favours dryish situations, and is frequently found out in the open. It does not dig a proper burrow, but lives instead under the rocks and boulders which have fallen from the inland cliff. It is active during the day, and most pugnacious when molested, not retreating straight to shelter, but rearing itself up on its walking-legs, so that the body is almost vertical, and holding its chelae out in a wide semi-circle. When it moves it travels, almost backwards, in a series of short, quick, jerky shuffles. It is a scavenger, mostly of animal refuse.

1. These four areas, in all of which the species occurs in considerable numbers, are the only places where there are obvious streams of fresh-water, but occasional specimens can sometimes be found at other points along the shore terrace. When these places are examined one always discovers that the ground is dampish, and usually that there is a small outcrop of volcanic rock in the immediate vicinity. It would thus appear that even if there is no patent spring present, there is at least a seepage of water near the surface and that this, though not favourable for the growth of a large colony, enables a few individuals to exist.

The breeding season is fairly definite, though wide. Females laden with spawn, on their way to the sea, can be found from October to the end of January, with a few even as late as March, a crab with a carapace width of about 27 mm. carries some 20,000 eggs. It thus begins earlier than the other species, and in many cases copulation must take place during the dry weather. The species is not sufficiently plentiful for it to be easy to detect the young forms in, or leaving, the water. But individuals flattened and with a carapace width of only about 7 mm. can be found on the shore terrace from the end of December until February. In the latter month specimens up to 9·5 or 10 mm. are fairly common. These youngsters differ slightly from the adults in habits and in general appearance. They move more at night and in damper weather, and they can often be found climbing walls and buildings (the full-grown crabs never attempt sheer, vertical surfaces). In appearance the young crabs are flattened, with the carapace roughly square; the colour of the latter is mid purplish-brown, often with faint, browner transverse striations, and with the limbs much paler. They resemble, superficially, small forms of *Sesarma jacksoni*, also active about the same time, but they can easily be distinguished by the limbs. In *Sesarma* the limbs and the carapace are the same purplish red-brown, and in shape they are longer and slimmer than in *Geograpsus*, with the chelae relatively smaller and more finely pointed. These young specimens cease their wanderings in March, and from then onwards can only be found with great and increasing difficulty, until the end of April when they seem to disappear entirely.

Birgus latro, Linn.

The robber-crab, which seems to have been first recorded from Christmas Island by Dampier in 1688, occurs abundantly and equally all over the island. It is even plentiful on the hills of the inland plateau where, in some cases, it is separated from the sea by three or four miles of jagged limestone pinnacles. In spite of their cannabilistic tendencies they frequently collect together in groups of a dozen or more. Probably they are drawn by food, or even the sound of each other's movements. They are very sensitive to presence in the jungle and, as Andrews noted, one has only to sit down in an empty area and wait for fifteen to thirty minutes before one or two will appear, advancing cautiously to investigate. At such moments they wave their antennae continuously, with an up and down movement, raising first one and then the other.

These crabs are equally active by day and night and, as a result of their inquisitive and foraging habits, may be a nuisance to people camping in the jungle. It is interesting to note that

when Andrews first visited the island in 1897, and the rat *Mus macleari* was abundant, the crabs never moved about after dusk, except in strong moonlight or in the glow from a fire. At the time of his second stay, ten years later, when the rat was already much less common, the crabs had begun to wander more by night. On most other inhabited islands they are purely nocturnal.

Birgus spends most of its time in the open, and individuals seem to move over fairly wide areas. They may hide under rocks or fallen trees, and they occasionally usurp the holes of *Gecardoidea*, or possibly *Cardisoma*, but I have never found them making any serious attempt to dig burrows for themselves. When molested they shuffle backwards with a series of awkward jerks until they can push their inadequately armoured abdomen into the shelter of a fallen trunk or a rock crevice. They defend themselves principally with the first pair of walking-legs, which are raised and waved over the back, and then tapped viciously on the ground at their fullest extent; the latter movement is accompanied by the usual low, chittering sound. The chelae are brandished rather ineffectively in front, and the claws may even be kept closed. The crab seems to rely more on the threat of what it might do than what it actually does, and a determined attack by anything capable of getting in under the legs would be rapidly fatal. Their defense is undoubtedly most effective against each other, and two hungry specimens may spar for hours until one elects, and and is able, to retreat.

Fairly frequently, when disturbed, they climb some four to five feet up the trunk of a tree. Usually they choose the island sago-palm, *Arenga listeri*, which they also ascend for fruit. It is not uncommon to find them resting in this position, but the manoeuvre seems to be one of doubtful utility as they often have the greatest difficulty in getting down again. They climb by holding, almost embracing, the trunk with the first and second pair of walking-legs, which terminate in long, sharp spikes, and hitching themselves upwards in a series of short jerks by means of the third pair. When resting the latter take most of the weight. Descent in this manner is difficult, and they can easily lower themselves too far and lose balance. When molested they usually continue to climb upwards, or fall down. Left to themselves they generally descend from a height of a few feet by traversing either round the trunk, or backwards and forwards in a zigzag. If they once reach the top of the tree they seem to prefer to clamber down head foremost. Rock faces are always negotiated this way, however steep they may be.

The diet is varied. They are very fond of the fruit of *Arenga listeri*, and if one crab is at the top of the tree feeding a number of others soon collect underneath for the berries which

fall down. They also eat the pith of the same tree and of the *Pandanus*, and the fruit of *Terminalia catappa*, *Barringtonia racemosa* and, if it drops, *Artocarpus integrifolia*. They will dehusk fallen coconuts, but I have found no evidence to suggest that they ascend the palm in search of them. Once they have partially dehusked a coconut they seem to have no better idea than to steady the nut with one chela and hit it with the other, or to scrape at its surface with the great claw. If the shell is already cracked the former may enable them to slit it sufficiently to insert the tip of the chela, but the leverage seems to be too short for the crab to hammer through an intact nut. Neither method appears to be very successful. A large specimen of *Birgus*, which I kept for three weeks with nothing but water and whole coconuts, failed completely to open a nut and thus went without food.[1] It made no attempt to apply the peculiar gimlet-technique described by Harms, and I am strongly of the opinion that *Birgus* only eats coconuts if it finds them already damaged.

In addition to vegetable food these crabs will take all forms of carrion, the dried fish from rat-traps, and even their fellows when these are injured. They are good scavengers but, as they frequently drag substances some considerable distance before determining whether or not they are really edible, a definite nuisance. I have seen sandals, sticks, cooking-tins and even knives and forks stolen from jungle camps and abandoned, and I once found a pair of crabs fighting over a silver wrist-watch, taken from a pile of clothes fifteen yards away.

Females laden with spawn can be seen on their way to the sea from the middle of November to the end of February. As they can be found high on the plateau, it would appear that fertilisation must take place in the jungle itself and that the males do not migrate. The subsequent development of the young crab has been described by Harms. He records that up to the end of the ninth month they live, like most other Pagurids, in *Trochus* shells. The smallest free forms, which are common in the jungle during the first three months of the year, are thus about twelve months old. They are said to reach maturity in their fourth year, after the eighth moult.

1. This experiment was repeated again in November and December, 1940; on this occasion two large crabs were without food for six weeks, as a result of their failure to open the coconuts provided for them. I tried twice more on the Cocos-Keeling Islands, in 1941, with medium-sized crabs. The first died after seven and a half weeks without removing even a portion of the husk. The second was given three partially dehusked nuts and two with the husk removed completely: it concentrated on the former and tore off several fragments, but finally died, after four weeks, without opening them. In all experiments the crabs spent more time trying to get out of the box in which they were confined than in working on the coconuts, in which they showed little interest.