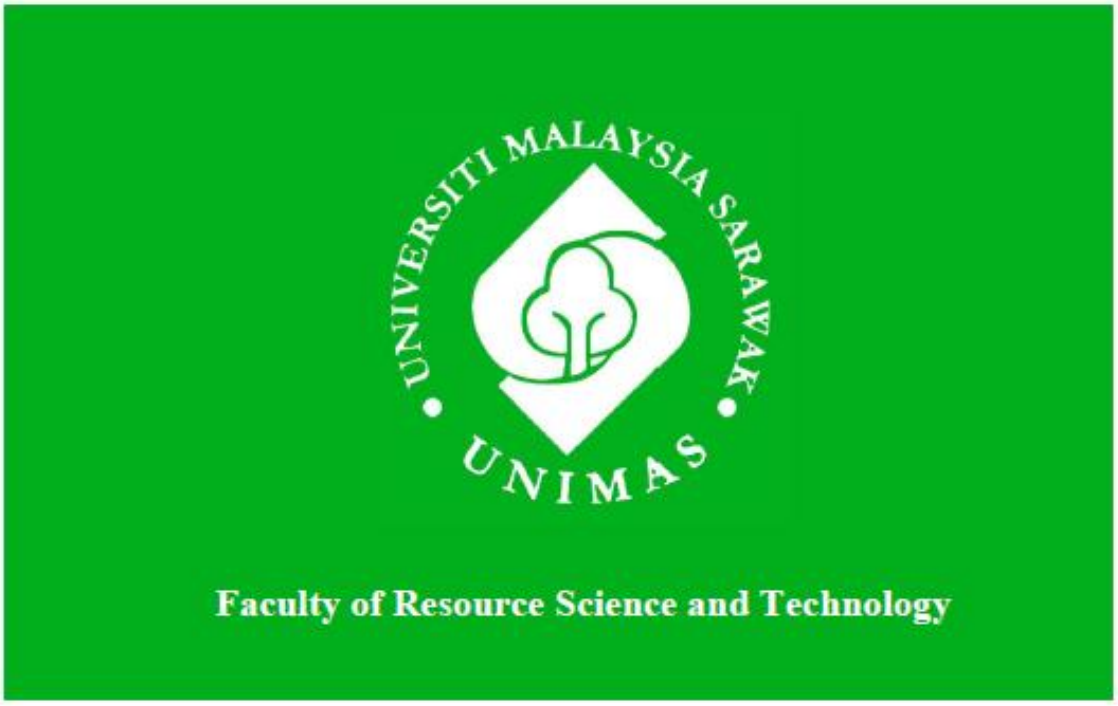

THE ECOLOGY OF SAND BUBBLER CRAB AT PUGU BEACH, LUNDU, SARAWAK

Haleeda Natasya binti Ahmad Zawawi

(36167)

Bachelor of Science with Honours
(Aquatic Resource Science and Management)
2015

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The Ecology of Sand Bubbler Crab at Pugu Beach, Lundu, Sarawak

Haleeda Natasya binti Ahmad Zawawi (36167)

This project report is submitted in partial fulfillment of the requirements for the Degree of Bachelor of Science with Honours
(Aquatic Resource Science and Management)

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DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. No portion of the work referred to in this dissertation has been submitted in support of an application for another degree qualification of this or any other university or institution of higher learning.

.....

Haleeda Natasya binti Ahmad Zawawi

Aquatic Resource Science and Management

Department of Aquatic Science

Faculty of Resource Science and Technology

University Malaysia Sarawak

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List of Abbreviations

cm	-	Centimeter
mm	-	Micrometer
TOM	-	Total organic matter
PSA	-	Particle size analysis
µ	-	Micrometer
SPSS	-	Statistical Process for Social Science

THE ECOLOGY OF SAND BUBBLER CRAB AT PUGU BEACH, LUNDU, SARAWAK

Haleeda Natasya binti Ahmad Zawawi

Aquatic Resource Science and Management Programme
Faculty of Resource Science and Technology
Universiti Malaysia Sarawak

ABSTRACT

A study on ecology of sand bubbler crab was conducted at Pugu Beach, Lundu, Sarawak (22thNovember 2014 and 3rdFebruary 2015). The objectives of this study were to document the community structure of sand bubbler crabs, to study the distribution of sand bubbler crabs across intertidal area and to investigate the influence of salinity, temperature, pH, total organic matter and sediment particle size analysis on the distribution of these crab across the intertidal. The sampling was done using line transect and quadrate (1m x 1m) methods and the crabs were collected using PVC corer (3.6 cm). From this research, only one species of sand bubbler crab was found namely *Dotilla intermedia*. In total, about 230 individuals of *D. intermedia* were collected from Pugu Beach, Lundu, Sarawak. Pore water salinity ($r = 0.623$, $p = 0.013$) and sediment temperature ($r = 0.564$, $p = 0.029$) showed significant correlation with the density of *D. intermedia*. Thus, further study can be done to investigate the relationship of the others parameter on the density of *D. intermedia*.

Key words: Ecology, sand bubbler crab, *Dotilla*, density.

ABSTRAK

Kajian tentang ekologi ‘ketam pasir’ telah dijalankan di Pantai Pugu, Lundu, Sarawak (22thNovember 2014 and 3rdFebruary 2015). Tujuan kajian ini dijalankan adalah untuk mendokumentasikan struktur komuniti ‘ketam pasir’, mengkaji taburan ‘ketam pasir’ melintangi kawasan intertidal dan mengkaji hubungan antara parameter air liang dan parameter tanah terhadap taburan ‘ketam pasir’ melintangi kawasan intertidal. Kaedah yang digunakan adalah garisan pintas dan kuadrat dan ketam dikutip menggunakan PVC korer (3.6 cm). Hasil kajian mendapati hanya satu spesies’ketam pasir’ telah ditemui. Jumlah ketam yang dijumpai di Pantai Pugu, Lundu, Sarawak adalah 230 individu. Parameter air liang ($r = 0.623$, $p = 0.013$) dan suhu tanah ($r = 0.564$, $p = 0.029$) menunjukkan hubungan signifikan terhadap kepadatan ketam. Oleh itu, kajian harus dipanjangkan untuk mengkaji hubungan parameter lain terhadap ‘ketam pasir’.

Kata kunci: Ekologi, ‘ketam pasir’, *Dotilla*, kepadatan.

1.0 INTRODUCTION

Sand bubbler crab, from the family of Ocypodidae comprises a number of very small crabs with carapace size around 1 cm and can be found in sandy shore of tropical and subtropical region (McLachlan and Brown, 2006). This crab feeds on the organic materials contained in the sediment surface by sorting it using its mouth parts and leaves a distinctive pattern of sand pellets of sorted sediment radiating around its burrow (McLachlan and Brown, 2006).

Sandy shore becomes a dynamic environment where the physical structure of the marine habitat is influenced by the interaction among sand, waves and tides (McLachlan and Brown, 2006). It has a great socio-economic value as recreational resources, thus severely impacted by anthropogenic activity (McLachlan and Brown, 2010). Besides, sandy shore is one of the most resilient dynamic coastlines due to their ability in absorbing the wave energy that is driven by surf-zone water movement, thus carries sand offshore during storm and move it back onshore during calms (McLachlan and Brown, 2006).

Some keys adaptations of invertebrates that inhabit sandy beaches are mobile, able to burrow and rhythmic behaviours where they tend to react immediately with the changing in the environment condition during tidal, semi-lunar, lunar and seasonal. These adaptations are needed in order to survive with rapidly changed condition. These can be seen in sand bubbler crab population as they will descent into the burrow as it is an obvious method of escaping high temperature and undergo evaporative cooling process by entering the burrow to maintain the water in the branchial cavity (McLachlan and Brown, 2010).

Sandy beaches are inhabited by both micro and macro organisms and one of them are sand bubbler crabs. Most of them will move up over the beach from the surf zone when the tide comes, and move down onto the beach from the dunes on the falling tide (McLachlan

and Brown, 2006). This behaviour also can be seen in sand bubbler crab population as they are diurnally active during low tide (Clayton and Al-Kindi, 1998) and remained buried at night (McLachlan and Brown, 2006). During low tide, they will come out from their burrow for feeding, fighting, courtship and copulation (Koga and Murai, 1997).

Previous studies had focused on their life history (Suzuki, 1983), microhabitat movement (Koga, 1995), distribution and recruitment of pelagic larvae (Suzuki and Kikuchi, 1990), mating behaviours (Koga and Murai, 1997), burrow defence behaviour (Takahashi et al., 2001), wandering behaviour (Gherardi et al., 2002) and population biology (Litulo et al., 2005).

For the worldwide distribution, sand bubbler crab can be found in Japan (Takahashi et al., 2001; Suzuki and Kikuchi, 1990; Koga and Murai, 1997; Suzuki, 1983; Wong et al., 2010), Afrika (Gherardi et al., 2002; Litulo et al., 2005), China (Wong at al., 2011), Philippines (Wong at al., 2011), Taiwan (Wong et al., 2010), Singapore (Wong et al., 2010), Hong Kong (Wong et al., 2010) and Thailand (Allen et al., 2011), but in Malaysia there is no publish report about sand bubbler crab yet.

Therefore, this study was conducted in order to (1) document community structure of sand bubbler crabs that inhabit Pugu Beach, (2) study the distribution of sand bubbler crabs across intertidal area and (3) investigate the influence of salinity, temperature, pH, total organic matter and sediment particle size analysis on the distribution of these crab across the intertidal.

2.0 LITERATURE REVIEW

2.1 Taxonomy Classification of Sand Bubbler Crab

Sand bubbler crab, small crab with carapce size around 1 cm consist of two genus, *Scopimera* and *Dotilla* (Kemp, 1919). Sand bubbler crab from the genus *Dotilla* sometimes replaced the population of ghost crab (genus *Ocypode*) in some sandy shore areas (McLachlan and Brown, 2006).

Kingdom: Animalia

Phylum: Arthropoda

Class: Crustacea

Order: Decapoda

Family: Ocypodidae

Subfamily: Scopimerinae

Genus: *Scopimera*

Genus: *Dotilla* Stimpson (1858)

2.2 Recent Status

In World Register of Marine Species (WoRMS) website, a total of 17 species of sand bubbler crab under the genus *Scopimera* (Table 1) and 12 species under the genus *Dotilla* (Table 2) had been discovered recently.

Table 1: List of known species of sand bubbler crabs under the genus *Scopimera*. (Source: WoRMS)

Species Name	The Founder
Scopimera bitympana	Shen, 1930
S. crabicauda	Alcock, 1900
S. curtelsoma	Shen, 1936
S. globosa	De Haan, 1835
S. gordonae	Serene and Moosa, 1981
S. inflate	A. Milne – Edwards, 1873
S. intermedia	Balss, 1934
S. investigatoris	Alcock, 1900
S. kochi	Roux, 1917
S. longidactyla	Shen, 1932
S. philippiensis	Wong, Shih and Chan, 2011
S. pilula	Kemp, 1919
S. proxima	Kemp, 1919
S. ryukyuensis	Wong, Shih and Chan, 2010
S. sheni	Wong, Shih and Chan, 2011
S. sigillorum	Rathbun, 1914
S. tuberculata	Stimpson, 1858

Table 2: List of known species of sand bubbler crabs under the genus *Dotilla*. (Source: WoRMS)

Species Name	The Founder
Dotilla sulcata	Forskal, 1775
D. blanfordi	Alcock, 1900
D. brevitarsis	de Man, 1888
D. intermedia	de Man, 1888
D. fenestrate	Hilgendorf, 1869
D. malabarica	Nobili, 1903
D. pertinax	Kemp, 1915
D. profuga	Nobili, 1903
D. sigillorum	Rathbun, 1914
D. wichmanni	de Man, 1892
D. affinis	Alcock, 1900
D. clepsydrodactyla	Alcock, 1900

2.3 Habitat Influences

The constant exchange of sand, organic matter and nutrients availability that occur at beach influence the distribution and growth of organisms that inhabit beach area (McLachlan and Brown, 2006). Besides, the physical processes such as the action of waves and tides can alter the community structure of the macroinfauna. It is because, they have to adapt to life in the sand to ensure that the supply of oxygen and food are sufficient even when they are not protected from wave action during high tide. Desiccation is another problem that organisms have to face especially when the tide is low (Ahmad et al., 2011).

Sandy shores intertidal organisms are usually burrowers in order to adapt in sandy beach area. Their burrowing ability are affected by several factors like size of body, sediment particle size and the temperature of water. On the other hand, the composition of intertidal organisms at the sandy shore increase when going down to lower tide zone but the diversity of organisms is higher at the middle tide zone (Ahmad et al., 2011).

2.4 Behavior of Sand Bubbler Crab

The burrowing cycle of this ocypodid is differ with soft-bodied animals, such as worms and mollusks as their body are able to elongate but take more times for digging compared to sand-burrowing arthropods. Sand bubbler crab with fixed body shape covered by exoskeleton do burrows using it jointed appendages, thus enable them to burrow rapidly into dry or moist sand, whereas worms and mollusks only can burrow into moist sand. Besides, sand bubbler crab burrows permanently and in sideway form (McLachlan and Brown, 2006).

Allen et al. (2011) stated that sand bubbler crabs feed on organic matters in sediment surface using their chelipeds to scrape sediment the sediment into their mouth where the organic matterial will be separated from the inorganic material by floatation mechanism. The inorganic material then will be rejected from the base of their mouth as feeding pellets, thus will be pinched off by chela and passed through the leg. The movement pattern of these crabs during feeding are in radial form.

2.5 Species Identification

According to Wong et al. (2010), carapace is using to differentiate between species under genus *Scopimera* (Figure 1). Their carapace is slightly broader than long with inflated (*S. globosa and S. ryukyuensis*) and convex shape (*S. intermedia*). Besides, the surface of carapace covered by tubercles. Besides, they also can be distinguish by observing the formation of tooth of dactylus (Figure 2). The species of *Dotilla* species can be differentiate by observing the groove pattern of the carapace (Figure 3).

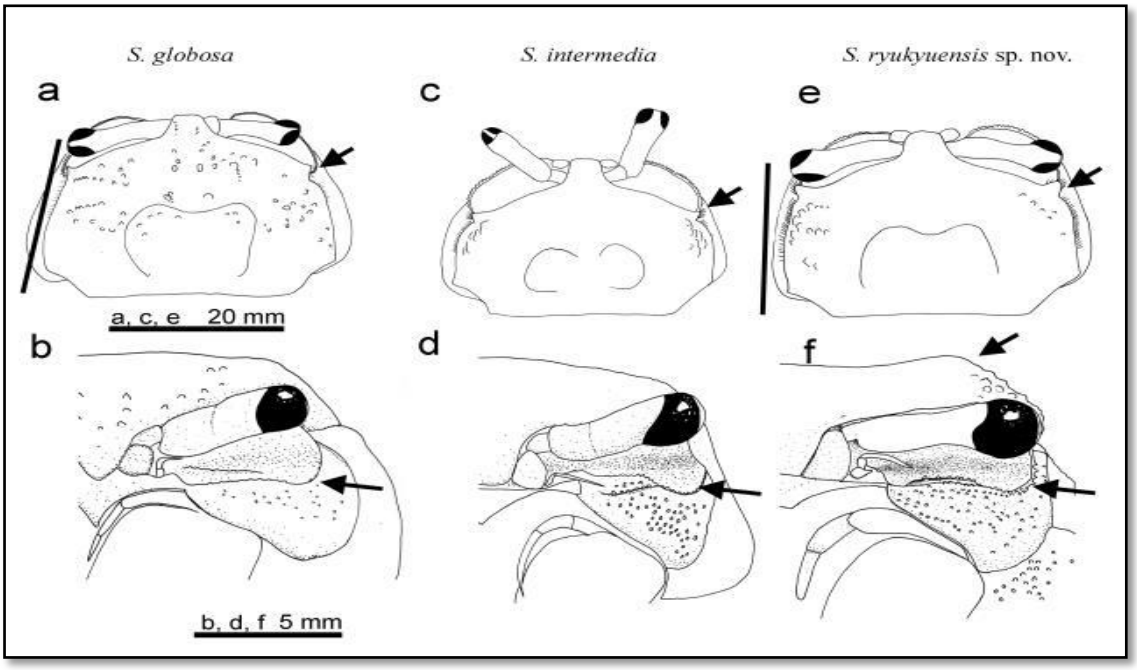

Figure 1: The varies shape of carapace posses by different species under genus *Scopimera* (a,b.c). (Adopted from Wong et al., 2010).

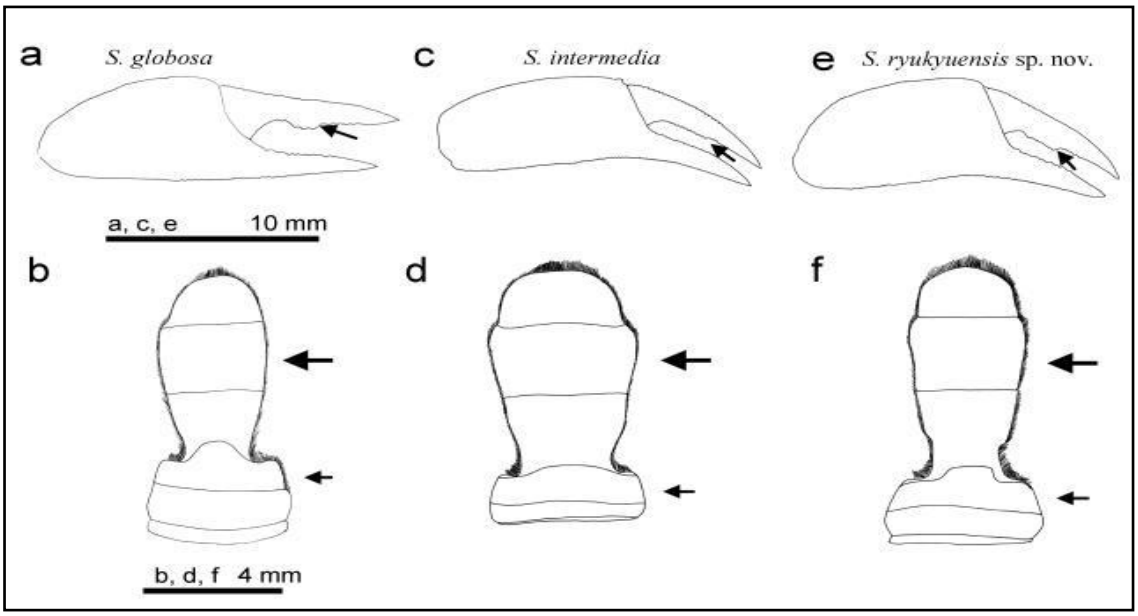

Figure 2: The varies formation of tooth at the middle of dactyl possess by different species under genus *Scopimera* (a, c, e). (Adopted from Wong et al., 2010).

Based on Allen et al. (2011), carapace of the species under genus *Dotilla* also broader than long. But, its surface sculptured with groove rather than tubercles. Besides, the formation of distinct tooth can be seen at the middle of dactylus.

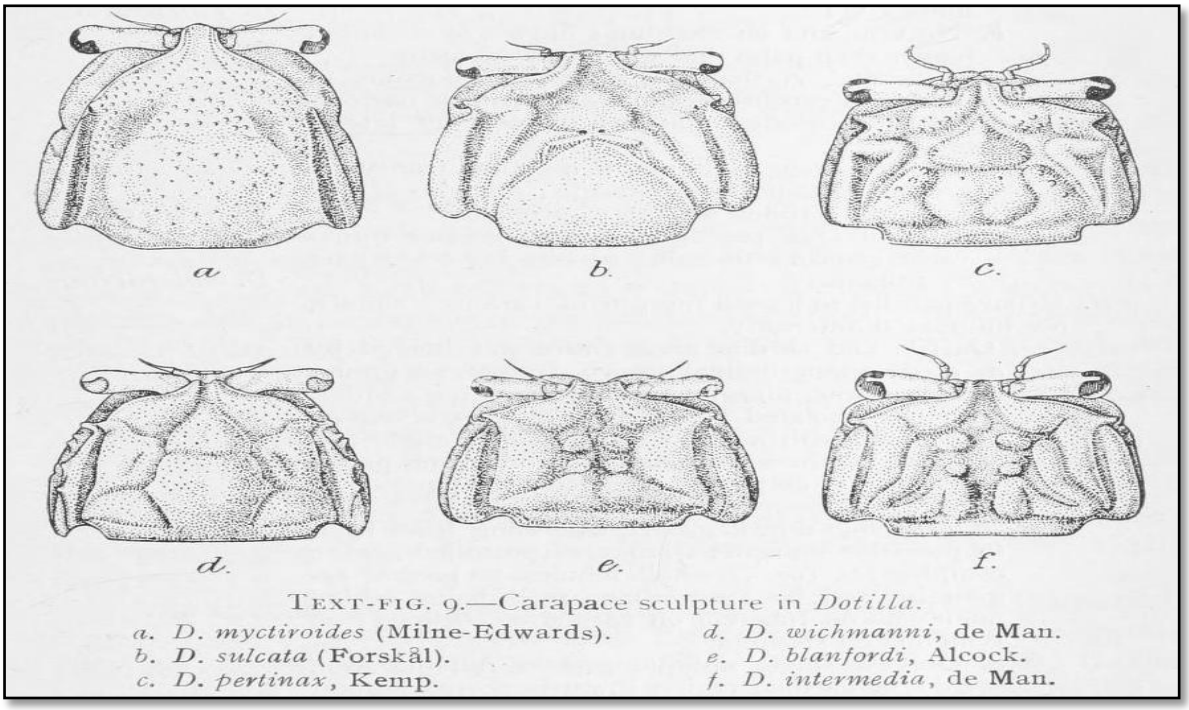

Figure 3: Varies groove pattern of carapace posses by the species under genus *Dotilla*. (Adopted from Kemp, 1919)

2.6 Habitats Preferance

Sand bubbler crab can be found on sandy or muddy estuaries and tidal flat where they dig burrows to hide from predator and avoid from high tide (Takahashi et al., 2001). Based on Macnae (1968), *Scopimera* and *Dotilla* prefer sandy shore except for *D. fenestrata* which was found in mangrove swamps. However, this crab sometimes can be found in both areas with a preference well-drained area (Dray and Paula, 1998).

There were several studies conducted in intertidal area of East African sandy shore which dominated by sand bubbler crab *D. fenestrata* (Litulo et al., 2005). On sandy beach of Red Sea, *D. sulcata* was found at the lower parts of the intertidal zone which forming large population (Fishelson, 1983). Based on Hilgendorf (1869), *D. fenestrata* be the most and dominant brachyuran of may East African sandy shore where they were found abundantly at intertidal area (Litulo et al., 2005).

Clayton and Al-Kindi (1998) mentioned that genus *Scopimera* is found further east than *Dotilla*. In Thailand, two species from genus *Dotilla*, *D. intermedia* and *D. wichmanni* have been discovered at sandy shore area (Wong et al., 2010). In sandy shore of Japan, *S. globosa* was found inhabit the upper littoral zone of Tomioka Bay (Suzuki and Kikuchi, 1990; Suzuki, 1983) and intertidal sandy-muddy flat of Wajiro Beach, Fukuoka (Koga, 1995; Koga and Murai, 1997).

2.7 Importants to the Ecosystem

Sand bubbler crab plays a major role in the ecology of sandy shore, presenting locally patches of high density and contribute for the consumption of organic matter availability in the superficial layer of the sediment (Dray and Paula, 1998). Besides, their burrowing activities enhance the oxidation process in the anaerobic layers (Fishelson, 1983).

3.0 MATERIALS AND METHODS

3.1 Study Site

The samplings were done on 22th November 2014 and 3rd April 2015 at sandy beach of Pugu Beach, Lundu (N 01°46'01.5'', E 109°51'29.8''). The coordinate was recorded using Global Positioning System (GARMIN, GPSmap 60CSx).

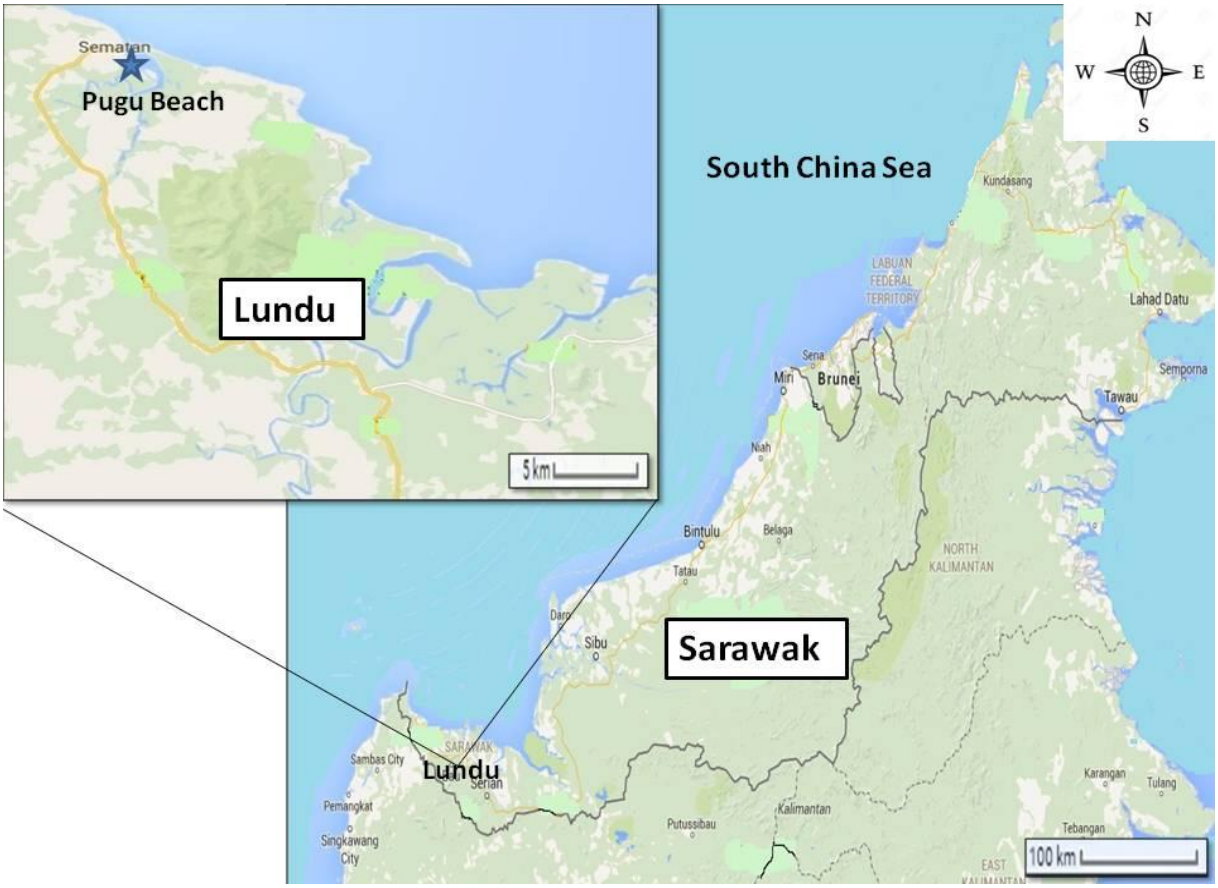

Figure 4: The map showing the location of the sampling site.