Feeding habit of *Strombus canarium* in Tanjung Sebauk Bintan Island, Indonesia

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**Abstract.** Several species of marine gastropod mollusk used by the community as economical food commodities, including the *Strombus canarium* was found in the Tanjung Sebauk, Bintan Island. The *S. canarium* diet as a deposit feeder significantly affects the consumption of the biota food varieties. Until now, there was limited information related to the classification of food consumed by *S. canarium*. Environmental factors affect *S. canarium* habitat substantially by providing a food source that is absorbed and influences the growth of *S. canarium*. Resettlement and restaurant activities in coastal areas affect changes in environmental conditions and modify the habitat and food variations of the organism. The Swept Area Sampling (SAS) method was applied to sweep and collecting *S. canarium* at a bed-ground area of 1500 m² in Tanjung Sebauk. The shell splitting and surgery completion of *S. canarium* were handled in the laboratory. *S. canarium* samples were immersed with 10% formalin to serve and protect the gastric sample and prevent it from rupturing, including providing the possibility to observe the various food components from *S. canarium*. Each species of organism found in an *S. canarium* stomach sample was photographed and counted and measured three times. Photographs of the gastric sample obtained from observations in a microscope were analyzed and identified comprehensively to find the composition of food varieties from the *S. canarium*. The varieties of food composition obtained were distinguished by class and group of biota and analyzed using the Preponderance Index. The varieties of food composition in gastric samples from *S. Canarium* shown eight species with the majority composition from plankton groups (phytoplankton and zooplankton), and one species was the copepod class. The following species of biota found in the stomach *S. canarium* based on the Preponderance Index consisted of *Thalassionema sp.* (42.59%) as primary food, followed by *Nocticula sp.* and *Coscinodiscus sp.* as additional food with a percentage of 37.45% and 12.35%, respectively. In comparison, the variety of complementary food from *S. canarium* consisted of *Entomoneis sp.* (2.47%), *Cymbella sp.* (1.23%), *Cochlodinium sp.* (1.23%), *Calanus sp.* (1.85%), and *Boreadinium sp.* (0.82%).

**Keywords:** Bintan Island; composition; diversity; food; *Strombus canarium*
1. Introduction

The local community in Bintan Island generally use several species of gastropod conch as food and economic commodity. The famous gastropod conch in Bintan Island is "dog conch" which is found in the coastal area of Tanjung Sebauk, Bintan Island. The dog conch has an essential ecological role in their habitat [1]. The high economic value of conch as a fishery commodity leads to overexploitation of this species [2]. The Dog conch belongs to the phylum mollusk under the family Strombidae, an economically important species in the Indo-West Pacific [3]. At the level of an adult, individuals have yellowish-brown or gold and grey shell color. In addition, the conch also has characteristics with a shell cover which is crescent-shaped, the mouth shell (aperture) grows outward, the stromboid incision is located to the right of the anterior shell, the outer edge of the shell (outer lip) is thickened, the layer of the shell thickened with the maximum length of the shell nearly to 100 mm, but generally measures in size 65 mm [4].

The growth of mollusk shells is very underdeveloped due to the influence of shell-forming materials, such as macro elements, including Calcium Carbonate, Magnesium Carbonate, Silicates, Phosphates, Amino Acids, and microelements such as Aspheric Acid, Serine, Alanine [5]. According to Muzahar et al. [6], the species of gastropods consumed by the people of the Riau Islands from the genus Strombus are the Strombus canarium (Linnaeus, 1758) and S. urceus (Linnaeus, 1758). Based on Irawan and Falmi research results [7] on the eastern coast of Bintan Island found three species of Dog conch were used by the coastal community, including S. urceus, S. canarium, and S. turturella. The research from Cob et al. [4] and Muzahar et al. [6] presented the species of gastropod conch consumed by the people of the Riau Islands from the Strombus family is S. canarium. The majority of the local community in Bintan Island exploits the Dog conch has high economic value due to the portion of delicious and nutritious food. Dog Conch is one of the foods that are very popular with local people and also domestic and foreign tourists. Several foreign tourists from Singapore and Malay also consume the Dog conch when visiting Bintan Island. The Gastropod Conch s generally live in tidal areas known as the littoral zone [8]. The Dog conch, also known as live in various types of habitat. Supratman [2] states that the Dog Conch habitat is generally a sandy mud substrate with overgrown benthic plants such as seagrass and macroalgae. The majority of the species live from the lowest low tide to six meters of water depth. The suitable habitat conditions will significantly support the life of Dog Conch naturally. According to Cob et al. [9], the Dog Conch diet consists of algae, plankton, detritus. Cob et al. [1] stated that the food source of conch comes from various components, including detritus and epiphyte.

The Dog conch feed on deposit feeder characteristic [1, 9] by filtering the remaining organic matter at the bottom of the substrate as feed. The habit consumption of Dog conch dramatically affects the type of feed and there is limited information regarding the type of food contained in these conch s. The Dog conch are scattered in several areas of Bintan Island, including in the Tanjung Sebauk as a coastal area located in the Kampung Bugis village, Bintan Island. The coastal area in Tanjung Sebauk is the primary habitat of a species of Dog Conch known as S. canarium. The several seagrass species from Enhalus acoroides and Thalassia hemprichii cover the coastal area in Tanjung Sebauk as the primary habitat for Dog conch. The Tanjung Sebauk coastal area also has several population activities, including; settlements and restaurant activities. The activities have an impact on the condition of the surrounding ecosystem, including the Dog conch and their habitat. The alterations in coastal activities around the Tanjung Sebauk affect the habitat of Dog conch and the composition of organic matter remaining in the substrate. The anthropogenic activity can have dangerous parasitic biota around the conch habitat and be used Dog conch as food.

The Activities around Tanjung Sebauk will impact on Strombus species habitat and will disturb the development of marine biota, then absorbed by the Dog Conch as food consumption. Residential and restaurant activities affect changes in environmental conditions and affect the type of Dog conch habitat. The comprehensive research for feeding habits from Dog conch was limited. The objective of this research to giving necessary information about the feeding habit of Dog conch, especially in the Strombus canarium species.
2. Materials and methods

2.1. Research location
The research was conducted from March to June 2019 in Tanjung Sebauk, Bintan Island. Tanjung Sebauk is a coastal residential village with several local restaurants occupied by coastal communities. The majority of the people in Tanjung Sebauk are fishermen, mostly seagrass fishermen, use gill-net as fishing gear and collect *S. canarium* in the seagrass and mangrove ecosystems. Another fishing activity of the coastal communities in Tanjung Sebauk is catching small crabs using crab traps called *Bento*. The activities of catching Dog conch by the community during low tide conditions in the seagrass area. The local community depends on the commodity *S. canarium* because it has economic value and is easy to distribute and sell to the nearest restaurant or sell it to collectors who come directly to the location. The sampling for *S. canarium* using the Swap Area Method (SAM) by sweeping the bed-ground area of 1500 m² at the location where the local community caught *S. canarium* in Tanjung Sebauk.

![Figure 1. The Sampling area location of *Strombus canarium* in Tanjung Sebauk Bintan Island.](image)

The study location in figure 1 is an area sampling location of *S. Canarium* and also the fishing ground area to catch the *S. Canarium* for the coastal community. Ten samples were collected for the shell splitting. Surgery completion of *S. canarium* was handled in the Marine Biology Laboratory, Faculty of Marine Science and Fisheries, Maritime Raja Ali Haji University for further analysis. Each *S. canarium* sample is inserted into the plastic and labeled sequentially according to the sample number. For preservation, the *S. canarium* samples were immersed with 10% formalin solution and mixed with a little seawater [3] to serve and protect the gastric sample and prevent rupturing, and provide the possibility to observe the various food components from *S. canarium*.

2.2. The gastric surgery process for *S. canarium*.
The *S. canarium* samples were surgically performed in undamaged/broken condition. After the breaking process of the shell, the sample of the stomach contents from *S. canarium* was analyzed carefully. The stomach content of the *S. canarium* was reserved and put in a small petri dish that has been labeled. The sample was given a little distilled water and then observed under a microscope by placing the prey items on a slide and closed with a cover glass. Each species of organism found in the stomach sample was
photographed and counted. For each sample, the replicate process examination was taken three times. Photos of prey items collected from microscopic observations were then identified to determine the quality and quantity of food. For diets, prey items from the zooplankton and phytoplankton groups referred to the guidelines for identifying "Marine and Freshwater Plankton" by Davis (1977). As for other invertebrates, refers to the identification guidelines on the official biota identification website from marine species. The type of particular food obtained was distinguished based on the biota class and group to classify the feeding habit of S. canarium. The preponderance index (PI) proposed by Natarajan and Jhingran (1961) was used to analyze the feeding habit of S. canarium with counted the volume of the particular food item ($Vi$) and occurrence frequency of the particular food item ($Oi$). The equation for the preponderance index was given below:

$$\text{preponderance index} = \frac{V_i \times O_i \times 100}{\sum V_i \times O_i}$$

3. Results and discussion

3.1. The classification of food items

The food items of S. canarium were classified or grouped according to class, order, family, and species refer to the existing identification book. The results of classification and grouping in S. canarium stomach samples are presented in table 1.

| Class          | Order     | Family          | Species            |
|----------------|-----------|-----------------|--------------------|
| Copepod        | Calanoid  | Calanidae       | Calanus sp.        |
| Diatom         | Biddulphiales | Coscinodiscaceae | Coscinodiscus sp.  |
|                | Cymbellales | Cymbellaceae    | Cymbella sp.       |
|                | Rhopalodiales | Entomoneidae    | Entomoneis sp.     |
|                | Bacillariales | Thalassionemataceae | Thalassionema sp. |
| Dinoflagellate | Gymnodiniales | Gymnodiniaceae  | Boreadinium sp.    |
|                | Noctilucae  | Noctilucae      | Cochlodinium sp.   |

There are eight species of food items found in the S. canarium stomach, and all of the prey components are plankton groups (phytoplankton and zooplankton). From eight species found, the S. canarium prey item is grouped into three classes, including copepods (zooplankton), diatoms, and dinoflagellates (phytoplankton). In the copepod class or known as shrimp larvae, only one species was found, Calanus sp. The diatom class was the most dominant food item than another class with four species of food components consisting of Coscinodiscus sp., Cymbella sp., Entomoneis sp., and Thalassionema sp. the Dinoflagellate class were found in three species including; Boreadinium sp., Cochlodinium sp., and Nocticula sp. All food items in the stomach of S. canarium were identified in the plankton group and indicated the main food of S. canarium is plankton. Following the research conducted by Nasution et al. [10], the diet of S. canarium consists of algae, plankton, detritus. Whereas Cob et al. [1] affirmed that the food source of S. canarium comes from various components, particularly detritus and epiphyte organisms. Several of the food item found in the S. canarium stomach samples were also epiphytic (e.g., plankton attached on seagrass leaves).
The Species of *Thalassionema* sp., known as the epiphyte group was found in the seagrass leaves of *Enhalus acorumides*, *Thalassia hemprichii*, and *Halodule pinifolia* [11]. The species of seagrass from *Enhalus acorumides* and *Thalassia hemprichii* are the most common seagrass species found in Tanjung Sebauk as *S. canarium* habitat. The result of the study shown the *S. canarium* also use epiphytes attached to the surface of the seagrass leaves as food. Another species of epiphyte found in the *S. canarium* stomach was *Cymbella* sp. According to the research from Borowitzka et al. [12] and Azkab [13] shown the *Cymbella* sp. is a species of epiphyte that lives as a microalga and attaches itself to the seagrass as a host. The *Cymbella* sp. is also including in the epiphytic flora group and is used as a food source for herbivorous animals. Thus, our study proves the *S. canarium* used are *Cymbella* sp. as food and act as herbivorous. The results of research conducted by Aryawati et al. [14] shown the plankton species from *Coscinodiscus* sp. and *Nocticula* sp. is a species of phytoplankton that live in ocean waters to rivers. However, both species conclude in a group of algae with characteristics that store toxins in its body (HABs) and endangered for humans if consumed. A previous study from Tungka et al. [15] stated that HABs describe the condition of algae bloom and are exacerbated by the presence of several phytoplankton species that contain toxins in their bodies and are known as Harmful Algae Blooms (HABs). For this reason, in consuming *S. canarium* for human need more pay attention to the health aspects before consuming the *S. canarium*.

![Figure 2](image_url)

**Figure 2.** The prey composition in *S. canarium* gastric content. The species from top left to the bottom right, *Boreadinium* sp., *Calanus* sp., *Cochlodinium* sp., *Coscinodiscus* sp., *Cymbella* sp., *Entomoneis* sp., *Nocticula* sp., and *Thalassionema* sp..

The zooplankton group used as prey by *S. canarium* is *Calanus* sp. from the copepod class. In the seawater, zooplankton from the Copepod group is a species that has a high abundance [16]. According to Nugraha et al. [17], the *Calanus* sp. plays an essential role in the food chain in the sea because of their abundance and equally distribution, thus delivering this species as the primary food chain for marine animals. The species of *Calanus* sp. have a habit of living as meiofauna with tiny size and spend their entire life in sediments or cycle of meiobenthic. *Calanus* sp. as meiofauna is used and absorbed by *S. canarium* as food from the bed substrate. After an overall analysis, the feed contained in the stomach of *S. canarium* consisted of zooplankton and phytoplankton groups, but dominant in the phytoplankton group. The condition indicates that *S. canarium* is generally a herbivorous animal, although in several cases, it also consumes food from other animal groups. Our result study accordance with research from Nugraha et al. [17], the *S. canarium* is a herbivorous animal, and Cob et al. [4] affirm that *S. canarium*
mainly feeds on phytoplankton. The results of the study by Cob et al. [9] also showed that the composition in the stomach contents of the *Laevisstrombus canarium* conch consists of several components, precisely; diatoms, detritus, foraminifera, seagrass, algae fragments, sand particles, and several dominant in the epiphytic group of organisms including diatoms.

### 3.2. *The composition of food items*

The composition of the prey component of gastric content in *S. canarium* for each species was different, including *Boreadinium sp.* with a composition of 2.63%, *Calanus sp.* (3.95%), *Cochlodinium sp.* (3.95%), *Coscinodiscus sp.* (15.79%), *Cymbella sp.* (3.95%), *Entomoneis sp.* (5.26%), *Nocticula sp.* (34.21%), and *Thalassionema sp.* (30.26%). The composition of the *S. canarium* of prey composition is presented in figure 3.

![Diagram of prey composition in S. canarium gastric content](image)

**Figure 3.** The prey composition in *S. canarium* gastric content.

Figure 3 shows the composition of the highest gastric content of *S. canarium* was of *Nocticula sp.* species with 26 individuals/10 conch samples, followed by *Thalassionema sp.* and *Coscinodiscus sp.* with the composition were 23 individuals/10 conch samples and 12 individuals/10 conch samples, respectively. The highest composition in the gastric content of *S. canarium* was *Nocticula sp.* species because this species is an alga belonging to the Dinoflagellate class. According to Sediadi (1999), Dinoflagellates can be found in all tropical seawaters globally and give a severe threat to the conditions of marine life and other marine benthic animals. The population explosion of this poisonous Dinoflagellate group causes mortality in other marine organisms. It even results in human death due to the contents of the accumulation of toxins in this species. This is concerning because *S. canarium* is an economical consumption marine biota that is consumed by humans.

On the other hand, the dominant biota in *S. canarium* gastric content was Dinoflagellate group. According to Sediadi [18], Dinoflagellates have distinctive characteristics. The dynamics of these organisms' growth can reproduce rapidly in a relatively short time, grow with high density and abundance, and have a wide distribution and population explosion (blooming) known as Harmful Algae Blooms (HABs) [14]. Thus, it is possible that this species is more dominant in the seawaters of Tanjung Sebauk and consumed by *S. canarium*. However, it requires awareness from Dinoflagellates with toxic potential and can be dangerous if consumed by humans with disproportionate levels. *Thalassionema sp.*
species also seen dominant with a relatively high percentage of species component compared to several other prey species in *S. canarium* gastric content. *Thalassionema sp.* is a phytoplankton group from the Diatom class of the order Bacillariophyceae. According to Sari *et al.* [19], phytoplankton from Bacillariophyceae is found in different types of seawaters' condition. Bacillariophyceae are more able to adapt to existing environmental conditions. This class is cosmopolitan and has high tolerance and adaptability. However, *Thalassionema sp.* is a species of phytoplankton that has no potential to be toxic in seawaters and has no toxic effect on marine biota or humans.

![Figure 4. The total individual per species in *S. canarium* gastric content.](image)

![Figure 5. The Preponderance index in *S. canarium* gastric content.](image)

The Food Index or Preponderance index is essential for determining a specific organism's diet and food consumption. The Preponderance index has a function to analyze and determine the percentage composition of species in samples of stomach contents, including primary, supplementary, or complimentary food categories in an organism's diet. After going through the calculations, the results of this food index analysis are presented in figure 5. Based on figure 5 shown *Thalassionema sp.* was
the highest Preponderance index composition value with 42.59% (primary food), followed by Nocticula sp. with a percentage of composition Preponderance index was 37.45% (supplementary food) and followed by Coscinodiscus sp. of 12.35% (complimentary food), Entomoneis sp. of 2.47% (complimentary food), Cymbella sp. of 1.23% (complimentary food), Cochlodinium sp. with of 1.23% (complimentary food), Calanus sp. of 1.85% (complimentary food), and the species of Boreadinium sp. of 0.82% (complimentary food).

Figure 5 explains that the Preponderance index explains the variations in each food item in *S. Canarium* gastric content. Thalassionema sp. was recorded as the primary food of *S. canarium*, while Nocticula sp. and Coscinodiscus sp. were regarded as a supplementary diet from *S. canarium*. Several species from Boreadinium sp., Calanus sp., Cochlodinium sp., Cymbella sp., and Entomoneis sp. is a variety of complementary food for *S. canarium*. Figure 5 also shown that Thalassionema sp. as the main diet consumed by *S. canarium*, and this biota was confirming as herbivorous organisms that prey on various species of phytoplankton that live as epiphytes in seagrass. A previous study from Husna *et al.* [20] also mentioned the high feed composition in seagrass leaves was Thalassionema spp. and *S. canarium* consumes 46.67% food consumption from the epiphytic group that lives in the seagrass ecosystem. Meanwhile, our study shows the Preponderance index for Thalassionema sp. of 42.59%, which is almost the equivalent as the results of the literature from Husna *et al.* [20] with Thalassionema spp. is a species of epiphyte that lives in the seagrass ecosystem.

### 4. Conclusion

Inside the *S. canarium* stomach sample, there were eight species of food items, and all species in plankton groups (phytoplankton and zooplankton), including Calanus sp. Coscinodiscus sp., Cymbella sp., Entomoneis sp., Thalassionema sp. Boreadinium sp., Cochlodinium sp., Nocticula sp., and the largest Preponderance index was Nocticula sp.

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