The food composition of Halmahera walking shark

(*Hemiscyllium halmahera*)

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**Abstract.** Halmahera walking shark or Halmahera epaulette shark (*Hemiscyllium halmahera*) is known as a shallow endemic shark species of the Halmahera island of Indonesia. This research was conducted with the aim to know the composition of *H. halmahera* food, as part of the parental domestication effort for cultivation and conservation of endemic species. Six individual of *H. halmahera* were obtained by simple random sampling in waters of Kao Bay threshold, North Maluku in October 2017. The result of gastric contents analysis using frequency occurrence method showed that *H. halmahera* is classified as benthic coral reef population with varied food composition consisted of small fish scales (96.6%), Annelida (2.1%), fish larvae (0.3%), *Mysis* (0.2%), *Eucalanus sp* (0.2%), *Pseudophausia* (0.2%), *Hyperia sp*, *Acrocalanus sp*, *Copilia sp*, and fish bone respectively (0.1%). Type of food that is always present in all stomach samples, namely the Annelida which contains a lot of proteins, vitamins and minerals even iodium that are useful for growth and the immune system.

1. **Introduction**

As the largest archipelagic country in the world with 17,508 islands and coastline along the 81,000 km with an area of ocean reaching 6 million km\(^2\) and has a wealth of natural resources and environmental services which are very potential, geo-strategically, Indonesia plays an essential role in economic development and contribute to the preservation of environmental ecosystems globally [1]. In addition to demographic bonuses, Indonesia is the largest country in Southeast Asia that plays an essential role in enhancing global fisheries productivity. Until now Indonesia has been the largest shark-producing country among the other 20 countries over the last three decades with production volume significant even exceeding the number of 100 thousand tons per year [2, 3]. Sharks are predatory animals in coral reefs and oceans and are at the top levels of food chains that play a role in determining the balance and control of complex food webs [4].

One of the potentials of Indonesia's endemic shark resources found in the shallow reef ecosystem of Halmahera island in the province of North Maluku is the Halmahera walking shark (*Hemiscyllium halmahera*). It is a shark with unique color patterns and stripes of military uniform, so it is called as Halmahera Epaulette Shark. It has high selling value, and it is often traded alive for the benefit of public aquariums in some countries [5]. Indonesian Shark diving according to Ichsan *et al.* (2016) [6] have a potential economic value of a reef shark on the island of Morotai, North Maluku is 8,518 USD. Moreover, if the sharks are left alive and protected, they will have a value 568 times higher than those sold in dead condition. Conservation efforts need to be supported with sufficient information on the
characteristics of conservation target species regarding natural history, biology and population status and dynamics [7].

Until now, the availability of scientific data and information, especially biological aspects of shark is lacking. This is confirmed by Faizah et al. (2012) [8] that data and information from the cartilaginous fish group (Chondrichthyans) such as sharks in Indonesia still lack in number when compared to biological data from Teleostei or bony fish species. Therefore, research on the composition of food in *H. halmahera* needs to be done as information in the management of species conservation and as a restocking effort in nature through cultivation activities beginning with parent domestication.

2. Materials and methods

2.1. Study area

This research was started by sampling on 24-25 October 2017 with the location of the *H. halmahera* fish sampling on the verge of Kao Bay, precisely around the coral reef area of the Doro coastal village, Bobale Island and Hatetabako village, North Maluku Province, Indonesia (Figure 1).

![Figure 1. Map of sampling sites](image)

2.2. Sampling methods

*H. halmahera* is an organism that actively searches for food in the night and has slow movements and is sometimes encountered in silence (*immobile organism*) in the coral reef area, so the sampling process in this organism is more appropriate by using simple random sampling technique [9]. Sampling was done randomly by night dive, and fish were caught by hand as many as 6 specimens.

2.3. Sample handling process

Stages of handling the process starts from the study site and then done in coolbox storage during the trip. After that, shark abdominal surgery was performed in the next day by taking the abdominal organ as expressed in Figure 2. It was then stored in containers that have been labeled then steered by preservation by using 10% of formalin solution to maintain the freshness and wholeness of the morphological body parts of the organism or sample [10, 11].
2.4. *Abdominal contents analysis*

The Composition, dominance and shared habits of *H. halmahera* can be known by performing an analysis of the abdominal contents. Analysis of gastric contents on *H. halmahera* uses the method of number and frequency of occurrences by counting all types of individual organisms as well as other objects present in abdominal contents and then calculated one by one per species [11]. The process of abdominal analyzes was conducted at the laboratory of the Center for In-Sea Research-LIPI Ambon, using Nikon SMZ 654 microscopy and the documentation used Nikon 50i camera. Furthermore, the identification process is based on guidelines according to Hutabarat and Evans (1986) [12], Nontji (2008) [13] and Yamaji (1996) [14].

3. Results and Discussion

The results of the microscopic observation and identification regarding the contents of *H. halmahera* abdominal obtained from the sampling showed that there are 10 types of food. Whereas, in the 1000 frequency findings of the six samples of Halmahera abdominal were found out to have a varied food composition consisting of small fish scales (96.6%), Annelida (2.1%), fish larvae (0.3%), Mysis (0.2%), Eucalanus sp (0.2%), Pseudeuphausia (0.2%), Hyperia sp, Acrocalanus sp, Copilia sp, and fishbone respectively 0.1%. The type of food and its number in abdominal samples of *H. halmahera* can be seen in Table 1.

**Table 1.** The amount of Frequency and Percentage of Food Type Composition of *H. halmahera*.

| No. | Food types    | The amount of food | Percentage (%) |
|-----|---------------|--------------------|----------------|
| 1.  | Small fish scales | 966                | 96.6           |
| 2.  | Annelida      | 21                 | 2.1            |
| 3.  | Fish larvae   | 3                  | 0.3            |
| 4.  | Mysis         | 2                  | 0.2            |
| 5.  | Eucalanussp   | 2                  | 0.2            |
| 6.  | Pseudeuphausia| 2                  | 0.2            |
| 7.  | Hyperiasp     | 1                  | 0.1            |
| 8.  | Acrocalanussp | 1                  | 0.1            |
| 9.  | Copiliasp     | 1                  | 0.1            |
| 10. | Fish bone     | 1                  | 0.1            |
|     | **Total**     | **1000**           | **100**        |
Based on the analysis of the type and the amount of food composition in Table 1, walking shark Halmahera is classified as benthic carnivore with a fairly diverse variety of foods and consists of coral reef organisms dominated by small fish, annelids, copepods, benthic crustacean, and zooplankton. It has been previously reported by Allen et al., (2013) [15] that the main types of food favored by H. halmahera are small fish and crustaceans such as crabs and shrimp and molluscs. The same thing has also been reported that shark food from the Hemiscyllidae family is not as well known, but generally sharks are known as common because bamboo sharks are classified as benthic sharks with food such as small fish and benthic invertebrates [16]. The form of food types found in the H. halmahera abdominal in this study can be seen in Figure 3.

![Figure 3. The result of documentation of food type in H. halmahera abdominal contents. a. Fish scale, b. Annelida; c. Mysis; d. Eucalanus sp; e. Pseudeuphausia; f. Hyperia sp; g. Acrocalanus sp; h. Copilia sp; i. Fish bone](image)

From the observation regarding the composition of abdominal contents in 6 individuals, there is a type of food that is always present in all H. halmahera's stomach samples, namely the Annelida or sea worm species similar to Polychaeta or known locally as "laor". This type of "laor" worm contains many proteins, vitamins and minerals even iodium that are useful for growth and the immune system [17, 18]. In addition to visual observation during sampling, H. halmahera is a group of sharks that have a main habitat on the bottom of the waters with a big dependence on coral reef ecosystem and has an important role in regulating the balance of coral reef ecosystems in the Halmahera islands. Thus, the threat of degradation of coral reefs do not only affect the population of H. halmahera, but also influence the food chain system on the coral reef community structure.

4. Conclusion
H. halmahera belongs to the "benthic carnivore" which has the habit of eating small fish species, annelids, mollusks, crustaceans, and zooplankton. Besides playing an essential role in regulating the ecosystem balance of coral reefs H. halmahera can also be used as a species indicator in the health monitoring of coral reefs. In addition to the high trade of these sharks, fishing activities using bombs cause the degradation of coral habitat is another threat to the presence of H. halmahera populations. Hence the results of this study can be recommended that this species should be conserved and there is a need for stock recovery through cultivation.
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