Food preferences of anuran species in horticultural lands, Doulu village, Karo regency, North Sumatera

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Abstract. Anura is an amphibian group of species with potential as natural pest predator. Data on food preferences and potential anuran species as pest control in horticultural lands at Doulu Village, Karo Regency, North Sumatera has not yet been reported. The aims of this study were to determine the type of food through stomach dissection and to evaluate the role of anuran species as a pest control by calculating percentage of insect pests as their preferred food. The results of this study found four species namely Duttaphrynus melanostictus, Phrynoidis juxtaspera, Fejervarya cancrivora and Hylarana erythraea. The results from stomach dissection found that 25 insect species belonging to 14 orders were preyed by the anuran species. Based on the percentage of insect pests as preferred food, species D. melanostictus was the most potential followed by H. erythraea, F. cancrivora and P. juxtaspera. It can be concluded that all anuran species found in this study acted as pest control in the habitat with different proportions.

1. Introduction

Indonesia is a country with a high level of diversity of Anura (frogs and toads) constituting 450 species of Anura or representing 11 percents of the total world species [1]. Anurans have important aspects in scope of economy and ecology. Economically, certain species of frogs were harvested or captive-bred for flesh consumption. According to data from previous research, Indonesia is the largest exporter of frozen frog meat in the world. Each year, an average of 4 million tons of frog meat is exported to worldwide, with 80% of the amount being captured from the wild [2]. Ecologically speaking, anurans played significant role in the food chain as secondary consumers. All anurans are well known as carnivores. The most common of food or prey is arthropods and worms. Bigger frogs or toads are known to also consume smaller fish, crustaceans, molluscs, juvenile organisms from lizards, snakes and even their relatives [1, 3]. Anurans may act as stabilizing predator when it comes to population of insects pests. The main diet of anurans is insect group that plays a role in maintaining the balance of the ecosystem, especially controlling the population of insect pests [4].

Natural habitat of anurans is quite diverse depending on the microhabitat specialty. Most anurans inhabited primary and secondary forests. According to previous research, there are also several species of anurans that have associated habitats close to humans ranging from urban to rural areas and land used by human for agriculture and horticulture purposes [1]. Frogs of genus Rana and other members are known to favor areas of rice fields, swamps and riverbanks of secondary forest [5].
The diversity of anuran habitats makes study on their feeding habits important as an indicator to evaluate each species strategy to survive in habitat. By studying feeding habits or diet composition, we can also examine their ecological function in the habitat. Doulu village is located in Berastagi district, Karo regency, North Sumatra is a village with extensive horticultural activities. The study then revealed the ecological importance of having anurans in horticultural field to act as potential pest predator.

2. Materials and Methods

2.1. Study site
Doulu village was chosen as study site with extensive horticultural activity, located in Berastagi district, Karo Regency, North Sumatera, Indonesia (Figure 1). The horticultural field is planted with crops such as cabbage and chili in traditional ways by local communities. The area is located at altitude of ± 1,000 masl with annual rainfall of 2,000 mm year⁻¹. The village can be reached ± 2 hr using land transportation from capital city of North Sumatera, Medan.

Figure 1. Map location of study site

2.2. Specimens handling
Anuran samples were collected by exploring the entire horticultural field. Five individuals of each species were hand-captured during night between 20:00 to 23:30 pm. All anurans were identified using standard identification guide Iskandar, Mistar, Van Kampen and euthanized by injecting 70% alcohol prior dissection. Specimens were dissected for its abdomen and stomach contents were removed and stored in bottle cap filled with 70% alcohol. Duration of collecting anurans and dissecting should be no more than 5 hour [7].

2.3. Stomach content identification
Stomach contents were identified to lowest taxonomy identity with standard insect identification guide [8] and counted for each species. Calculation of the number of preys were done by examining insect
parts such as heads, wings, elytra following conditions stated by previous research [9]. Data of the number of preys were analyzed descriptively for each anurans found in this study.

3. Results and Discussions

The results showed that horticultural fields in Doulu village was inhabited by four anuran species namely, *Duttaphrynus melanostictus* (Bufonidae), *Phrynoidis juxtaspera* (Bufonidae), *Fejervarya cancrivora* (Dicroglossidae) and *Hylarana erythraea* (Ranidae). The results from insect parts identification showed that at least 25 distinguishable taxa, belonging to 14 orders can be found (Table 1). Five of them were recognized as important pest in agricultural and horticultural fields, especially to cabbage and chili (Table 2).

### Table 1. Food preferences arranged by insect orders

| Orders            | *Duttaphrynus melanostictus* | *Phrynoidis juxtaspera* | *Hylarana erythraea* | *Fejervarya cancrivora* |
|-------------------|-------------------------------|-------------------------|----------------------|-------------------------|
| Stylommathophora  | N: 11, %: 36.6                | N: 1, %: 0.8            | N: 1, %: 11.1        | N: 4, %: 33.3           |
| Orthoptera        | 2                             | 2                       |                      |                         |
| Blattodeae        | 1                             | 3                       | 3.4                  | -                       |
| Polydesmida       | 5                             | 45                      | 36.2                 | 5                       |
| Araneae           | 1                             | 3                       | 2.2                  | 1                       |
| Diptera           | -                             | -                       | -                    | 2                       |
| Hemiptera         | -                             | -                       | 10                   | -                       |
| Lepidoptera       | 2                             | 6.6                     | 3.4                  | -                       |
| Coleoptera        | 4                             | 13.3                    | 18                   | 14.5                    |
| Dermaptera        | 1                             | 3.3                     | 1.8                  | 1                       |
| Mesogastropoda    | 1                             | 3                       | -                    | -                       |
| Hymenoptera       | 2                             | 6.6                     | 39                   | 31.4                    |
| Decapoda          | -                             | -                       | -                    | 4                       |
| Odonata           | -                             | -                       | -                    | 4                       |

The results showed that four orders belonging to Stylommathophora, Polydesmida, Coleoptera and Hymenoptera were the most commonly found as preyed insects. Order Polydesmida was found in three anuran species, indicating as general diet to them. Pest insect, *P. pupilaris* was found in stomach content from all anuran species collected. It may be indicated that *P. pupilaris* was populous and common in both fields as pests. Both *C. binotalis* and *S. Litura* were known to be only preyed by *H. erythraea* and *P. aspera*. Insect pests like *C. binotalis* and *G. orientalis* were specific and important pests in cabbage fields [10]. *Spodoptera litura* and *A. epsilon* were also considered as important pest in chili plantation [11]. *Phrynoidis juxtaspera* was anuran species with most diverse diet in this study.
The anuran preyed on four species of insect pests followed by *D. Melanostictus* which preyed upon three species.

Percentage of insect pests preferred by anuran species in this study was calculated (Table 3). Differences in the percentage were divided based on habitat, cabbage and chili plantation. Species *D. melanostictus* showed the highest food preference upon in this study reaching 77.77% of total insect pests in cabbage field followed by *H. erythraea* in chili plantation. It can be seen from their feeding habits, that anuran species found in this study especially *D. melanostictus* was prominent as pest control.

| Anuran species      | Percentage (%) |
|---------------------|----------------|
| Cabbage field       | Chili plantation |
| *Duttaphrynus melanostictus* | 77.77 % | 15.38 % |
| *Fejervarya cancrivora* | 21.05 % | - |
| *Hylarana erythraea* | - | 33.33 % |
| *Phrynoidis juxtaspera* | 6.25 % | 1.40 % |

Members of Bufonidae have been known as potential pest control and natural predator. One key determinant in their successful hunt, was also affected by their survivability and populous number of individuals in the habitat. Members of Bufonidae possessed natural toxin secreted from parathyroid glands, which rendering them unfavoured to predation. Anuran also tend to consume greedily until their stomach is full of food when food is abundant in their habitats to anticipate food shortages or when prey is rare [12]. These behavior benefits the anuran inhabiting the farmland with fluctuating population of insect pests. In addition to these traits, the opportunistic nature of Anura is also favorable the main diet of anuran species can be altered flexibly according to the natural abundance of prey so that shifting prey species is highly likeable [13]. Although this study did not measure the prey abundance in habitat, but the number of important prey as insect pests showed that anuran species in this study are categorized as both generalist and opportunist predator.

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