Gut content analysis of cattle egrets (*Bubulcus ibis*) in Asam Kumbang Crocodile Park, North Sumatra

E Jumilawaty, N Namira, A Anggelicha and A Hartanto
Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan, North Sumatra 20155, Indonesia

*E-mail: erni1@usu.ac.id

**Abstract.** Cattle egret (*Bubulcus ibis*) is a widespread avian species inhabiting a variety of natural and artificial sites. Asam Kumbang Crocodile Park is one of establishments that occupied some portions of *B. ibis* habitat with no recent information on the food resource and prey availability for the viability of *B. ibis*. To this aim, we collected 10 random individuals of *B. ibis* to be sacrificed for gut content analysis of prey species. A total of 19 taxa was found as prey items in the gut of *B. ibis* with the dominant group from insects (Orthoptera, Scolopendromorpha). The diversity of prey species was categorized as moderate with intraspecific diet variation which formed four guilds that fed on specific taxa namely Group 1 (Haplotaxida, Lepidoptera, Anurans), Group 2 (Blattodea, Coleoptera, Araneae), Group 3 (Orthoptera, Scolopendromorpha); and Group 4 (Dermaptera, Squamata). *Oxya chinensis* and *Oxya velox* are important rice grasshopper pests that were also found in the gut of *B. ibis* reflecting their potential function as biological control agent.

1. **Introduction**

Alteration of ecosystems by human has an impact on the biological and ecological aspect of animal species [1]. Until now, the habitable area for animal is decreasing due to the habitat fragmentation for the development of urban area, agricultural, livestock, and industrial sectors. As a consequence, foraging habitat and food resources may also decline that influence the habitat selection by animals including birds [2]. For a cosmopolitan species like cattle egrets (*Bubulcus ibis*), they need to adapt by selecting the most abundant prey for their breeding success in the human-altered ecosystems [3].

*Bubulcus ibis* (Pelecaniformes, Ardeidae) is one of the most successful ardeids to inhabit the terrestrial area by showing a dietary plasticity [4,5]. Owing to the biological feature, the birds show a great versatility in habitat selection especially the foraging area such as in agroecosystems, grasslands, municipal wastes in urban area and water bodies [6-8]. Furthermore, the diet composition of cattle egrets may vary depending on the season, prey availability and abundance, and may be spatially and temporally constrained [9,10].

Asam Kumbang Crocodile Park is one of tourist destinations in Medan City, North Sumatra. The park is known as the largest crocodile breeding area for saltwater crocodile (*Crocodylus porosus*) in Indonesia with an area of 2 ha and a total population of ±2,000 crocodiles. The establishment of the park has altered a portion of wetland areas and agricultural fields which are now becoming the habitats of cattle egrets. Cattle egrets may become a potential biological control agents to important insect pests and urban pests in the area. This study then investigated the diet composition of cattle egrets
occupying the area of Asam Kumbang Crocodile Park to provide an insight on their role in the new ecosystem.

2. Materials and method

2.1. Study site
The study was conducted from November to December 2018 at Asam Kumbang Crocodile Park with the administrative location at Bunga Raya II Road, Medan Selayang District, Medan City, North Sumatra, Indonesia (Figure 1). The bird specimen was collected from a lake (1 ha) in the park with a dominant vegetation composed by river tamarind (Leucaena leucocephala) stands utilized by B. ibis as nesting and breeding sites.

Figure 1. Lake in the Asam Kumbang Crocodile Park as a habitat of Bubulcus ibis.

2.2. Bird collection
The cattle egrets were collected by manual capture using a bird net during the day from 10:00 to 12:00 AM. Ten random birds were caught and each of them was killed with an injection of 10 mL chloroform per body weight. The bird specimens were immediately dissected on the field while the gut content or gizzard of each bird was preserved in 95% EtOH, labelled and then transported to the laboratory for manual inspection. Prey items recorded from each gut were identified to the species taxonomy level using identification guides [11-15].

2.3. Data analysis
The data were analyzed descriptively using Excel software. The relationship between prey taxa among B. ibis individuals was analysed using a Bray-Curtis dissimilarity method. Ecological parameters such as taxa richness (S), Shannon’s diversity index ($H'$), and equitability index ($E$) were analyzed using PAST software.
3. Results and discussion

Based on the gut content analysis of 10 random individuals, it was revealed that insects were the most consumed preys by *B. ibis* (Table 1). Insects within the Orthoptera order or grasshoppers (6 species) were documented as the most speciose taxa followed by Coleoptera (4 species) and Arachnids (2 species). A total of 288 prey items were recovered during the gut examination and were identified to its possible species.

The diversity of prey taxa based on Shannon’s diversity index \( (H') \) was categorized into moderate level of biodiversity with an equitability index \( (E) \) of 0.75. The results may also indicated the abundance of prey diversity especially insects in the area inhabited by *B. ibis*. Based on the relative abundance of each prey item, Orthoptera (53%) was documented as the most abundant in the gut of *B. ibis*, followed by Scolopendromorpha (24%) and Coleoptera (7%) (Figure 2).

Table 1. Taxonomic information and number of prey items in the gut of *Bubulcus ibis* \((N = 10\) ind.)

| Order         | Family           | Species                          | Number of prey items |
|---------------|------------------|----------------------------------|----------------------|
| Anura         | Dicroglossidae   | Fejervarya cancrivora            | 2                    |
| Araneae       | Lycosidae        | Lycosa chaperi                   | 6                    |
| Blattodea     | Ectobiidae       | Supella longipalpa               | 11                   |
| Coleoptera    | Coccinellidae    | Cheiloclomenes septempunctata     | 2                    |
|               |                  | Cheiloclomenes sexmaculata       | 1                    |
|               |                  | Cheiloclomenes sulphurea         | 3                    |
| Dermaptera    | Forficulidae     | Forficula auricularia            | 3                    |
| Haplotaxida   | Megascoleciadia  | Pheretima darleiensis            | 4                    |
| Lepidoptera   | Noctuidae        | Spodoptera litura                | 7                    |
| Orthoptera    | Acrididae        | Dissosteira carolina             | 8                    |
|               |                  | Oxya chinensis                   | 44                   |
|               |                  | Oxya velox                      | 5                    |
|               |                  | Valanga nigricornis             | 5                    |
| Gryllida      |                  | Gryllus bimaculatus              | 38                   |
|               |                  | Gryllus texensis                 | 62                   |
| Scolopendromorpha | Scolopendridae | Scolopendra gigantea            | 69                   |
| Squamata      | Scincidae        | Eutropis multifasciata           | 1                    |
| Unidentified  | -                | -                                | 3                    |
| **Total**     |                  |                                   | 288                  |
| **Taxonomic richness (S)** |                  |                                   | 19                   |
| **Shannon’s diversity (H’)** |                  |                                   | 2.25                 |
| **Equitability (E)**     |                  |                                   | 0.75                 |
Figure 2. Relative abundance of prey taxa in the gut of *B. ibis*

In the wetland areas and agricultural fields around Asam Kumbang Crocodile Park, many terrestrial animals may become potential preys to *B. ibis* including some grasshoppers as found in this study. Based on the clustering analysis using Bray-Curtis dissimilarity index (Figure 3), there were four groups of intraspecific diets among *B. ibis* individuals namely Group 1 that fed on Haplotaxida, Lepidopterans and Anurans; Group 2 (Blattodea, Coleoptera, Araneae), Group 3 (Orthoptera, Scolopendromorpha); and Group 4 (Dermaptera, Squamata).

Figure 3. Bray-Curtis dissimilarity between preys

These feeding guilds may reflect their strategy or preference towards specific food resources present in the habitat. *Gryllus texensis* (Orthoptera: Gryllidae) was found as the most abundant prey
species in the gut of *B. ibis* yet reflecting their high abundance in the grassland areas. In addition, *Oxya chinensis* and *Oxya velox* (Orthoptera: Acrididae) were considered as important rice pests in Indonesia [16]. The presence of *Oxya* in the diet of *B. ibis* may thus reflect their involvement in the biological control of these pests. The second most preyed species was centipedes from *Scolopendra gigantea*. The finding of *S. gigantea* as prey items of *B. ibis* is still limited and may due to its striking appearance in the wild which attracted *B. ibis* on hunting them. The successful utilization of a particular habitat by an animal species was a function between food abundance and accessibility. Cattle egrets then demonstrated their persistence in the wetland areas due to the ease of forage as a characteristic feature of insectivorous species [17]. *Bubulcus ibis* may also behave as an opportunistic predator which explained their accidental predation to *Fejervarya cancrivora* and *Eutropis multifasciata* in our study. However, other study reported cattle egrets may also hunt vertebrate especially when the number of insects were declining due to seasonal issue [9]. A study on cattle egrets at the grassy habitat of the University of Ghana also reported a small portion of amphibians in their diet yet supporting their behaviors as opportunistic foragers in the urban area [8]. In any case, the diet of *B. ibis* varies greatly depending on prey availability and diversity. As a result, insect biodiversity must be preserved in order to maintain the food resources for the long-term viability of these key agricultural auxiliary.

4. Conclusion
Cattle egrets (*Bubulcus ibis*) in Asam Kumbang Crocodile Park consumed a variety of prey species, dominantly from insects such as grasshoppers (Orthoptera) and centipedes (Scolopendromorpha). Some grasshoppers namely *Oxya chinensis* and *Oxya velox* in the Acrididae family were also found in the gut of *B. ibis* yet may reflect their function as biological control agent in the agricultural fields. The establishment of crocodile park inside the grassland and wetland habitat of *B. ibis* still preserved the insect biodiversity for the diet of the flocks.

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