DIET OF SELECTED SPECIES OF BABBLERS (FAMILY: TIMALIIDAE) AT KAMPUNG SERASOT AND KAMPUNG BUNG JAGOI, GUNUNG JAGOI, BAU, SARAWAK (BORNEO)

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DECLARATION

I hereby declare that no portion of the work referred to in this dissertation have been submitted in support of an application for another degree or qualification to this university or any other institution of higher learning.

_____________________________
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# Table of Contents

Acknowledgment .................................................................................................................. I

Declaration .......................................................................................................................... II

Table of Contents ............................................................................................................... III

List of Tables and Figures ................................................................................................. IV

List of Figures .................................................................................................................... V

List of Appendices ........................................................................................................... VI

Abstract ............................................................................................................................ 1

Introduction ....................................................................................................................... 2
  1.1 Problem Statement ............................................................................................... 3
  1.2 Objectives ............................................................................................................. 3

Literature Review ............................................................................................................... 4
  2.1 Description of species ......................................................................................... 4
  2.2 Diet of species in family Timaliidae ................................................................. 5
  2.3 Resource partitioning ......................................................................................... 6
  2.4 Techniques for analyzing diet ........................................................................... 8
  2.5 Insect abundance, ecology and roles in ecosystem ........................................... 11

Materials and Method ...................................................................................................... 13
  3.1 Study area ........................................................................................................... 13
  3.2 Field work sampling .......................................................................................... 14
  3.3 Laboratory technique ......................................................................................... 15
  3.4 Statistical analysis .............................................................................................. 17

Results ............................................................................................................................... 20
  4.1 Species of babblers and collection samples ..................................................... 20
  4.2 Diet composition of babblers ........................................................................... 24
  4.3 Prey availability in the diet of babblers and the environment comparison
      between Kampung Serasot and Kampung Bung Jagoi ........................................ 27
  4.4 Data Analysis ...................................................................................................... 31

Discussion ......................................................................................................................... 37
  5.1 Diet selection of family Timaliidae ................................................................. 36
  5.2 Analysis of the insect parts ................................................................................. 40
  5.3 Comparison between stomach content, regurgitated item and faeces sample .... 42
  5.4 Challenges ............................................................................................................ 44

Conclusion ......................................................................................................................... 45

References ......................................................................................................................... 46

Appendix ............................................................................................................................ 50
List of Tables

Table 1: Description of babblers ................................................................. 4
Table 2: Food preference of family Timaliidae in Borneo .............................. 5
Table 3: Samples collected at Kampung Serasot (site A) .............................. 19
Table 4: Samples collected Kampung Bung Jagoi (Site B) ............................. 21
Table 5: Total individual of babbler species at Kampung Serasot and Kampung Bung Jagoi ................................................................. 22
Table 6: Frequency of occurrence of insect prey in the diet of babblers at Kampung Serasot and Kampung Bung Jagoi ................................................................. 25
Table 7: Measure of electivity of insect order between the prey item in the diet and habitat ................................................................................................................. 33
Table 8: Standard length of babblers and insect prey .................................... 34
List of Figure

Figure 1: Sampling sites at Gunung Jagoi, Bau, Sarawak, Malaysia ...................... 13
Figure 2: Faeces sample and regurgitated sample in PVC container ..................... 14
Figure 3: Examples of the measurements taken on the arthropod bodies .............. 16
Figure 4: Total frequency of occurrence of prey items in the diet of babblers at Kampung Serasot (Site A) and Kampung Bung Jagoi (Site B) ................. 23
Figure 5: Percentage of insect found in the diet of babblers at Kampung Serasot (Site A) and Kampung Bung Jagoi (Site B) ............................................. 27
Figure 6: Percentage of insect found in the environment at Kampung Serasot (Site A) and Kampung Bung Jagoi (Site B) ...................................................... 27
Figure 7: Cumulative frequency of prey availability in the diet of babbler at Kampung Serasot (Site A) ............................................................................. 29
Figure 8: Cumulative frequency of prey availability in the diet of babbler at Kampung Bung Jagoi (Site B) ........................................................................... 29
Figure 9: Fitted Line Plot between insect order in diet (C1) versus insect prey in habitat (C2) at Site A ................................................................. 31
Figure 10: Fitted Line Plot between insect order in diet (C1) versus insect prey in habitat (C2) at Site B ................................................................. 31
Figure 11: Relationship between mean insect prey and predator size (standard length) in mm ................................................................. 35
Appendix 1: Mann-Whitney U-test on insect prey in diet of babblers between Site A and Site B ................................................................. 44

Appendix 2: Mann-Whitney U-test on insect prey in environment between Site A and Site B .............................................................................. 45

Appendix 3: Linear correlation and regression of insect order between the diet and insect survey at Site A ........................................................................ 46

Appendix 4: Linear correlation and regression of insect order between the diet and insect survey at Site B ........................................................................ 47

Appendix 5: The diet analysis of insect found in regurgitate, stomach and fecal sample in babbler ........................................................................ 48

Appendix 6: Insect survey on the forest floor at Site A......................................................... 53

Appendix 7: Insect survey on the forest floor at Site B......................................................... 55

Appendix 8: Data analysis of insect found in crop, stomach and fecal sample in babbler .............................................................................. 46

Appendix 9: Birds inventory data sheet at Kampung Serasot (site A) and Kampung Bung Jagoi (site B)........................................................................ 57
The diet of 23 individuals of family Timaliidae consisting of seven species of babblers namely, \textit{(Stachyris poliocephala)}, Chestnut-winged babbler \textit{(Stachyris erythroptera)}, Rufous-crowned babbler \textit{(Malacopteron magnirostre)}, Scaly-crowned babbler \textit{(Malacopteron cinnereum)}, Moustached babbler \textit{(Malacopteron magnoirostre)}, Horsfield’s babbler \textit{(Malacocincla sepiaria)}, and Short-tailed babbler \textit{(Malacocincla malaccensis)} was studied. Birds were captured at Kampung Serasot and Kampung Bung Jagoi, Bau District, Sarawak, Borneo on 8-12 November 2011 and 2-5 February 2012, respectively. About 0.2 ml of 1.5% potassium antimony tartrate were given to babblers so that they regurgitated the food items inside their crop. The regurgitated items, stomach contents and faecal samples of the same bird were all analyzed. The regurgitated item, digestive system and faeces of babblers were preserved using 70% alcohol in the field and examination of the stomach content was conducted at the Parasitology Laboratory at External Laboratory (EL), Universiti Malaysia Sarawak (UNIMAS). The insect parts used as main identification of insect order are body, head, mandibles, wings, elytra and legs. The study showed that the diet of babblers contains six insect orders that is, Coleoptera (40%), Hymenoptera (18.67%), Orthoptera (13.33%), Arachnida (9.33%), Diptera (8%), and unidentified order (10.67%).

\textbf{Keywords:} diet, regurgitated items, stomach content, fecal sample, potassium antimony tartrate, 70% alcohol, insect parts

Diet of selected species of babblers (Family Timaliidae) at Kampung Serasot and Kampung Bung Jagoi, Gunung Jagoi, Bau, Sarawak (Borneo)

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\textbf{ABSTRACT}

The diet of 23 individuals of family Timaliidae consisting of seven species of babblers namely, \textit{(Stachyris poliocephala)}, Chestnut-winged babbler \textit{(Stachyris erythroptera)}, Rufous-crowned babbler \textit{(Malacopteron magnirostre)}, Scaly-crowned babbler \textit{(Malacopteron cinnereum)}, Moustached babbler \textit{(Malacopteron magnirostre)}, Horsfield’s babbler \textit{(Malacocincla sepiaria)}, and Short-tailed babbler \textit{(Malacocincla malaccensis)} was studied. Birds were captured at Kampung Serasot and Kampung Bung Jagoi, Bau District, Sarawak, Borneo on 8-12 November 2011 and 2-5 February 2012, respectively. About 0.2 ml of 1.5% potassium antimony tartrate were given to babblers so that they regurgitated the food items inside their crop. The regurgitated items, stomach contents and faecal samples of the same bird were all analyzed. The regurgitated item, digestive system and faeces of babblers were preserved using 70% alcohol in the field and examination of the stomach content was conducted at the Parasitology Laboratory at External Laboratory (EL), Universiti Malaysia Sarawak (UNIMAS). The insect parts used as main identification of insect order are body, head, mandibles, wings, elytra and legs. The study showed that the diet of babblers contains six insect orders that is, Coleoptera (40%), Hymenoptera (18.67%), Orthoptera (13.33%), Arachnida (9.33%), Diptera (8%), and unidentified order (10.67%).

\textbf{Keywords:} diet, regurgitated items, stomach content, fecal sample, potassium antimony tartrate, 70% alcohol, insect parts

\textbf{ABSTRAK}

Diet 23 ekor burung dari famili Timaliidae merangkumi tujuh spesis babbler iaitu \textit{(Stachyris poliocephala)}, Chestnut-winged babbler \textit{(Stachyris erythroptera)}, Rufous-crowned babbler \textit{(Malacopteron magnirostre)}, Scaly-crowned babbler \textit{(Malacopteron cinnereum)}, Moustached babbler \textit{(Malacopteron magnirostre)}, Horsfield’s babbler \textit{(Malacocincla sepiaria)}, dan Short-tailed babbler \textit{(Malacocincla malaccensis)} telah dikaji. Burung tersebut telah ditangkap di Kampung Serasot dan Kampung Duyuh Daerah Bau, Sarawak, Borneo pada 8 - 12 November 2011 dan 2 - 5 Februari 2012, masing-masing. Kira-kira 0.2 ml dari 1.5% potassium antimony tartrat diberikan kepada burung supaya setiap makanan di dalam tembolok dikumuhkan. Bahan kumuhan, isi perut dan sampel najis dari burung yang sama disimpan dalam larutan 70% alkohol di lapangan dan analisis isi perut dilakukan di Makmal Parasitologi di External Laboratory (EL), Universiti Malaysia Sarawak (UNIMAS). Bahagian serangga yang digunakan sebagai petanda order serangga adalah badan, kepala, mandibel, kepak, elytra dan kaki. Kajian ini menunjukkan bahawa diet babbler mengandungi tujuh order serangga iaitu Coleoptera (40%), Hymenoptera (18.67%), Orthoptera (13.33%), Arachnida (9.33%), Diptera (8%), dan Order tidak diketahui (10.67%).

\textbf{Kata kunci:} diet, bahan kumuhan, isi perut, sampel najis, 0.2 ml dari 1.5% potassium antimony tartrat, 70% alkohol, bahagian serangga
1.0 Introduction

Based on King et al. (1993), there are 268 species of Family Timaliidae in the world, of which 139 species occur in South-East Asia. They form a diverse family of small passerines, with some 27 endemic species in the Sundaic lowlands (Lambert & Collar, 2002). According to Smythies (1981), there are 36 species of babblers on Borneo and four species are endemic: Black - Browed Babbler (*Malacocincla perspicillatum*), Bornean Wren Babbler (*Ptilocichla leucogrammica*), Black - Throated Wren Babbler (*Napothera atrigularis*) and Mountain Wren Babbler (*Napothera crassa*). Generally, babblers are mainly inhabitants of virgin and secondary jungle (Madoc, 1976).

Most babbler species are terrestrial and forage on the forest undergrowth and lower branches of tall trees. They spend a great deal of time foraging from ground level and frequently up to 50 feet height. They are fond of working their way up on large creeper-covered trees, feeding on insects and berries. Babblers always hunt in a flock of small parties in tangled thickets or bushes searching for food and alert to the predators above them (Smythies, 1981).

Birds favour the most suitable feeding sites and select prey size that maximize their energy profit. When they are very hungry, birds are more willing to risk starvation by spending time searching for an area with a high concentration of food. The amount of daily foraging time reflects a bird’s energy needs. Birds usually maintain small to moderate fat reserves and so must balance their expenditures with new intakes on a daily basis. When food is not available, birds will use fat and glycogen reserves and then other body tissues for energy (Gill, 1990).
Studies on diet analysis are necessary to understand the ecology of most organism. According to Borror et al. (1989), insects are dominant on the earth today and they live in almost every type of habitats. Insects range in size from about 0.25 to 330 mm in length and have various skeletal structures on the outside of the body. Many insects have their own ecological function, some of them are pest and some of them also serve as food for many birds especially insectivorous birds.

1.1 Problem Statement
There is no study done on the diet and nutrition of babblers in Sarawak. The babblers forage in flocks, but we still do not know whether they share the same resource or practice resource partitioning, or whether their diet reflect the abundance of prey present in the environment.

1.2 Objectives

1. To determine the diet of Family Timaliidae through regurgitated item, stomach content and fecal analysis.

2. To determine the abundance of insect in the forest floor of Mount Jagoi, Sarawak (Borneo).

3. To determine the relationship between the diet of family Timaliidae and the abundance of insect on the forest floor of Gunung Jagoi, Sarawak (Borneo).
2.0 Literature review

2.1 Description of species

The members of family Timaliidae are termed “babblers” because they make odd sounds and chattering noises. These sounds are commonly heard coming from dense thickets or the undergrowth of the jungle. Babblers are poor flyers, have short and rounded wings, and spend much of their time on or near the ground, often in small parties. They eat insects, and the young ones are never spotted. They can be grouped into a number of subfamilies with rather different habits (Smythies, 1981).

According to the Smythies (1981), there are five subfamilies of babblers in Borneo, which is summarized into the table below:

Table 1: Description of babblers

<table>
<thead>
<tr>
<th>Subfamily</th>
<th>Region</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subfamily Cinclosomatinae (Ground babblers)</td>
<td>Australo-Papuan region.</td>
<td>A group of primitive insect-eater.</td>
</tr>
<tr>
<td>Subfamily Pellorneinae (Jungle babblers)</td>
<td>Africa and South East Asia.</td>
<td>Consist of three species: i) Pellorneum species in Borneo has a long tail, long legs and very short and inconspicuous rictal bristles ii) Malacopteron has short wings, short tail, long legs; iii) Trichastoma has long wings and short tail and legs. - All species are terrestrial and arboreal in habits.</td>
</tr>
<tr>
<td>Subfamily Pomatorhinae (Scimitar babblers and wren-babblers)</td>
<td>South East Asia and Australia.</td>
<td>Consist of two species: i) Scimitar babblers is rather long scimitar-shaped bills, best developed in Himalayas and only one species can be found in Borneo. ii) Wren babblers are terrestrial in habits, feeding on the ground on insects and their larvae. - Both species shy and difficult to observe.</td>
</tr>
<tr>
<td>Subfamily</td>
<td>Region</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Timaliinae (Babblers)</td>
<td>South East Asia and Madagascar.</td>
<td>1) Habits in forest undergrowth, sometimes ascending up into the trees, rarely descending to the ground. 2) They share habitat with the jungle babblers. 3) Mixed parties comprising several different species of babblers and jungle babblers are often encountered working through the forest.</td>
</tr>
<tr>
<td>Turdoidinae (Song babblers)</td>
<td>Africa, Arabia, Asia Minor and South East Asia. Most genera being in the Himalayas and other mountain ranges of South East Asia.</td>
<td>1) In Borneo, they are seven species associated with the relict montane fauna which has strong Himalayan affinities. 2) Five are montane and the other two are submontane. 3) Food choice is usually insects and berries.</td>
</tr>
</tbody>
</table>

### 2.2 Diet of species in family Timaliidae

According to Smythies (1981) and Davison (1992), the diet of family Timaliidae can be summarized below:

**Table 2: Food preference of family Timaliidae in Borneo**

<table>
<thead>
<tr>
<th>Subfamily</th>
<th>Food choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subfamily Cinclosomatinae (Ground babblers)</td>
<td>Cicadas, spiders and hard black beetles.</td>
</tr>
<tr>
<td>Subfamily Pellorneinae (Jungle babblers)</td>
<td>Ants, caterpillar, grasshoppers, locustids, black beetles, spiders, fruits, grubs and insects</td>
</tr>
<tr>
<td>Subfamily Pomatorhinae (Scimitar babblers and wren babblers)</td>
<td>Grubs, grasshoppers, locustids, beetles, crickets, earwigs, caterpillar, ginger seeds, flower pods, berries, tiny snails and insects</td>
</tr>
<tr>
<td>Subfamily Timaliinae (Babblers)</td>
<td>Ants, caterpillars, small locustids, spiders, beetles, flies, fruits and insects.</td>
</tr>
<tr>
<td>Subfamily Turdoidinae (Song babblers)</td>
<td>Ants, crickets, caterpillars, grasshoppers, locustids, small snails, earwigs, beetles, seeds, berries, fruits and insects.</td>
</tr>
</tbody>
</table>
2.3 Resource partitioning

Based on Krebs (1978) and Krebs et al. (1983), birds forage and seek for foods in such a way that they get maximum energy in return. Birds make decisions on what types of food to eat, where to forage, types of searching path to take, and time spent feeding in a particular spot. Optimal Foraging Theory concerns how bird makes these foraging decisions.

In the tropical Andean forests, Vuilleumier (1972) found that interspecific feeding flocks are mostly composed of brightly colored, insectivorous passerines. In Krebs and Davies (1993), explains four possible advantages of flock feeding: protection against predators, cooperative food-finding, duplicate effort in food capturing, and satisfaction of social tendencies. A research study conducted by Schoener (1974), determines the major purpose of resource partitioning is to analyze the limits of interspecific competition place on the number of species that can stably coexist.

Rakotoarisoa (1995) studied habitat use and feeding behaviours of Black-loodered babbler (Turdoides sharpie) and Arrow-marked babbler (Turdoides jardeneii) near Lake Naivasha, India for ten consecutive days. Significant differences were recorded in perch characteristics and the feeding site characteristics. Black-loodered babblers are found in a wider-range of habitats, from open Acacia woodland with more open ground to shrubby woodland, and tend to perch on small trees and shrubs; whereas Arrow-marked babblers are more restricted to Acacia woodland with thick herbaceous cover vegetation, and tend to perch on larger trees with dense canopy cover. Distinct niche differentiation was therefore concluded in both species. No territorial overlap was recorded on neighboring groups of both species. The two species tend to tolerate a certain degree of coexistence.
where boundaries are defined by habitat characteristics rather than territorial behaviors of both species.

Hsieh and Chen (2011), studied foraging niche overlap between mixed-species flocks may cause competition. Flocking and foraging behaviours of flocks led by Grey-cheeked Fulvetta (Alcippe morrisonia) were studied in northeastern Taiwan for two consecutive non-breeding seasons from 1998 to 2000. The foraging height spectrum increased with increasing the group size of fulvettas. The number of species and number of individuals of canopy fulvettas in a flock, increased more rapidly than understorey fulvettas as the group size increased. The more foraging height of canopy species overlapped with that of the understorey species, the lower its departure rate. These observations indicate that foraging niche overlap between canopy species and the understorey species may facilitate the formation of mixed-species bird flocks. It is therefore important to incorporate the role of positive interactions when trying to understand the formation and maintenance of biological communities.
2.4 Techniques for analyzing diet

Insects have a hardened exoskeleton which is tough to digest and easy to do qualitative analysis such as recognizing body, elytra, wing, mandible and other insect parts and quantitative analysis such as counting the head of insect as individuals (Hyslop, 1980).

According to Martin and Hockey (1993), the stomach flushing of bird diets has been shown to be efficient as a non-destructive method of sampling gut content. In this technique, a length of plastic tubing, 4 mm in external diameter was passed down the oesophagus and into the stomach. The end of the tube was partially heat-sealed and rounded to prevent abrasion. Several small holes were made in the distal 15 mm of the tube. The other end of the tube was attached to a 60 ml syringe. Sufficient water was forced from the syringe to fill the bird’s stomach while the bird was turned upside down and the regurgitated content was collected in a large beaker. All samples were stored in 5 % buffered formalin until analyzed. The technique used on 14 wader species up to size of Eurasian Curlew (Numenius arquata) and African Black Oystercatcher (Haematopus moquini). A 3mm diameter tube would have been better for birds as small as Little Stint (Calidris minuta). Between 24% and 71% (median = 58%) of the gut contents from both Eurasian Curlew (Numenius arquata) and African Black Oystercatcher (Haematopus moquini) were recovered with a single application of pump. The range in the proportions of each prey types in the pump samples were overall similar to the proportions remaining in the guts, although there was considerable variation within prey types.

Chou et al. (1998) had investigated the diet analysis of the Grey-cheeked Fulvetta (Alcippe morrisonia) based on gut contents and investigate the seasonal variation in diet composition using stomach flushing technique. When the bird was caught using mist-nets, the bird’s was processed for
flushing with a warm 1% saline solution. One person held the bird and positioned the receptacle under the cloaca, and the other opened the bird’s mouth, inserted the Vaseline-coated plastic tubing, and flushed saline solution into the bird’s stomach. It usually took 3 - 5 pushes to respond and it needed only 1 - 2 minutes to finish the entire process. All gut contents were then collected and stored in a bottle with 75% alcohol solution. The diet of this species is based on 626 flushing gut contents from birds captured from July 1994 to April 1997. The diet of the Gray-cheeked Fulvetta is described through frequency of occurrence, relative volume and a standardized index. Within the 18 orders of insect identified, Hymenoptera and Coleoptera contributed most in the diet of Grey-cheeked Fulvetta. The high demand of arthropod food for nestlings in the breeding season might account for the abundance in the seasonal change of the environment.

Mallet-Rodrifues (2001) studied the diet composition of the Black-capped Foliage-gleaner (Philydor atricapillus) using chemical emetics; antimony potassium tartrate (tartar emetics) as a forced regurgitation method. The birds received 0.2 cm³ of a 1% solution of antimony potassium tartrate, given orally through a 2.8 mm diameter flexible plastic tubes attached to a syringe and inserted gently into the bill as far as the lower oesophagus. After treatment, the bird was placed in plastic PVC container for 10 - 15 minutes. The regurgitated food items were preserved in 70% ethanol. Each regurgitated sample was placed in 10-cm Petri dish and carefully separated and classified to the lowest taxonomic level possible under a dissecting microscope in laboratory. The number of individuals prey ingested was estimated by counting the number of heads, mandibles, legs or wings and dividing by the number found in a whole arthropod. The diet was dominated by beetles and spiders, but considering the prey available, the birds showed stronger preference for oothecans and moths. Ants were largely avoided. Thus, in their principal foraging substrate, birds showed preference for some prey categories, avoiding other prey in proportion to their availability.
Asokan et al. (2009) studied the diet of three insectivorous birds namely White-breasted Kingfishers (*Halcyon smyrnensis*), Small Bee-eaters (*Merops orientalis*) and Black Drongos (*Dicrurus macrocercus*) in Nagapattinam District, Tamil Nadu, India using non-lethal potassium antimony tartrate. The collected pellets were bagged, labeled and dried in hot air oven at 60°C for identification of prey remains. The prey fragments were identified according to lowest taxa level by observing the insect parts collected in the regurgitated pellet. In this study, these three species consumed almost similar proportions of Coleopterans, Hemipterans, Hymenopterans and Orthopterans. They were predominantly found in agricultural lands and the above insect prey formed principal food items due to their greater availability.

In the study by Roadway and Cooke (2002) faecal analysis was used to determine seasonal changes in the diet of wintering Harlequin Ducks at a herring spawning site. The fecal analysis provides a non-intrusive method commonly used to investigate the diet of mammal and many bird species. Such analysis can accurately determine the frequency of occurrence of prey types and diet diversity if there are identifiable, undigested remains of all prey types. Collected faeces were dried or frozen until they could be analyzed. Faeces were mixed and carefully rinsed with water to separate prey fragments, which were then examined under stereoscopic microscope. The measured frequency of occurrence and relative abundance by volume of prey remains in 202 fecal samples collected during four date periods in 1998 and 1999. These two measures were highly correlated. The principal prey items were snails, crabs, limpets and chitons. The study recommends using faecal analyses to determine frequency of prey occurrence in the diet of other sea-ducks are known to feed on hard-shelled molluscs and crustaceans.
Another study conducted by Parrish (1994), describes that a new method which allows safe non-invasive collection of faecal samples from mist-netted birds and rapid storage for later analysis. The technique involves holding and transporting birds in specially adapted socks in plastic collection and storage bags are attached. Faeces samples fall into plastic bags for later removal, labeling, storage and analysis. The faecal collection bags were plastic zipper-lock sandwich bags which were attached to the bottom of the sock with safety pins. During a portion of the 1993 autumnal migration season, 347 of 482 birds banded (71.99%) produced fecal samples with little time or effort required on part of the researchers to collect them. The technique proves especially feasible for assimilating diet data from constant-effort banding stations during migration.

2.5 Insect abundance, ecology and roles in ecosystem

Some insectivorous birds are beneficial depend upon various insect in vegetation areas (Asokan et al., 2009). They can be beneficial when they act as biological pest control to reduce or eliminate the pest population. Ecological conditions govern the insect distribution. The density of insects in a region depends on the abundance of the greenery as it provides more food to them. This is probably the reason for high density of insect population in tropics (Saxena, 1992).

According to Hill & Abang (2010), the order Coleoptera are the largest and most successful group of insects in the world. The main factor contributing to their success is the modification of the forewings into the sclerotized hard elytra, functioning as protective covers for the large folded hind wings when not in use. Their role in ecosystem can be beneficial or pest to other organism. In benefits, they can act by controlling the population of other pest such as Dung beetles (Coleoptera, Scarabidae) have been successfully used to reduce the population of pestilent flies and parasitic
worms that breed in cattle dung (Brown et al., 2010). However, they can also become pest at both larval and adult stages such as Colorado potato beetle, \textit{(Leptinotarsa decemlineata)} which is a notorious pest of potato plants (Alyokhin et al., 2008).

Based on Brian (1983), the most abundant insect that can be found in the mixed-dipterocarp forest and lowland hill forest is primitive ants and social wasps. They act as predators to other arthropods and worms including termites. They play a major part in decomposing dead trees in the tropics such as leaf litter, wood, dung, seeds and herbage. They produce many other products useful to humans and are harnessed by humans, for example, all living species of \textit{Apis} have had their honey collected for consumption and other commercial purposes (Winston, 1987). Besides that, they can also act as pollinators for a large variety of plant (Oz et al., 2009). Insects dominate most terrestrial ecosystems, for their diversity, sheer abundance and biomass.
3.0 Materials and Method

3.1 Study area

The first site is located near Kampung Serasot (Site A) at the foot of Gunung Jagoi, Bau, Sarawak. Field sampling was done between 8th - 12th November 2011. The GPS reading for this site is N 01°21.938' and E 110°02.395' elevation 103 m. It is a lowland hill mixed dipterocarp forest. Near the site, there was a paddy farm, durian orchard and rubber tree vegetation, a habitat suitable for babblers to prey on insect.

The second site is located near Kampung Bung Jagoi (Site B) at the top of Gunung Jagoi, Bau, Sarawak. Field sampling on this site was done on 2nd to 5th February 2012. The GPS reading for this site is N 01°21.551' and E 110°02.277' elevation 340 m. It is a primary forest, many fruit trees such as durian, rambutan, cempedak and other tropical fruit trees are found along the jungle trail and near the village.

Figure 1: Sampling sites at Gunung Jagoi, Bau, Sarawak, Malaysia.
3.2 Field work sampling

Twenty mist-nets were set up at each site. Each mist-net was deployed above ground by using two aluminium poles. The mist-nets were opened at 0600 to 1800 hours and checked at every two hours interval because the birds are very active during the day and constantly searching for food and water. The babblers were measured using the digital caliper (± 0.01mm) and they were weighed using the pesola spring scale of 50 g. The measurement taken were from tail to anus to measure the total body size of babblers. All babblers caught were kept inside a cloth bag with A4 paper as a filter to collect the feces for one to two hours. Then, these birds were given 0.2 ml of 1.5% potassium antimony tartrate and held inside a large PVC container as a place for them to vomit and collect the regurgitate item. The time taken to hold the babblers in PVC container is 15 to 25 minutes. At least, three individual per species caught are sacrificed for stomach analysis. The digestive system were extracted to examine the stomach content later in the laboratory. The faecal samples, regurgitated samples and stomach contents were preserved in 70% ethanol for further analysis. Figure below shows the faeces and regurgitated sample taken on site.

![Figure 2: Faeces and regurgitated sample in PVC container](image-url)
Besides that, the insect was searched along 350 m transect line within a range of 10 m from mist nets. Every newly-found insect encounter were sprayed using insecticide to be compared later with insect found in babblers. Individual or a colony of insect in the environment were also recorded.

**3.3 Laboratory technique**

The laboratory work done was classifying the insect parts from the faecal, stomach and regurgitated items. Comparison of the insect parts according to order level is done by four methods. The samples are compared with the preserve sample of insects in the UNIMAS Museum, cross-reference with insect found on site, using a well-illustrated entomology texts (e.g. Borror *et al.*, 1989) and as well as with the help of entomologist. The common insect parts detected are head, mouthparts, elytra, mandibles, body structures, legs and wings.

The insect parts were observed using a compound microscope at Parasitology Laboratory, External Laboratory, East Campus, UNIMAS. Motic Images Plus Version 2.0 software and camera from the Motic China Group, CO. Ltd. (Copyright 1999-2006) was used to capture images of insect parts. The resolution used was 1600 x 1200 pixels. The magnification lens was adjusted between the range of 2.0 - 7.5. First, the sample with 70% alcohol was placed on a petri dish and the microscope lens was adjusted at meniscus level for clear observation. Then, two fine needles were used to separate the insect parts accordingly. The microscope is also equipped with measuring scale device to measure the size of insect parts. Figure 3 shows the measurement in the arthropods body (Hodar, 1997). Finally, the insect parts were classified, photographed and recorded (refer to Appendix 13).
**Figure 3:** Examples of the measurements taken on the arthropod bodies. Arthropods are represented without legs for simplicity: 1. Scorpionida; 2. Soliphuga chelicera; 3. Araneae; 4. Araneae chelicera; 5. Lepidoptera larva mandible; 6. Dermaptera; 7. Coleoptera; B. Body length; P. Pronotum or prosoma width; Q. Chelicerae; F. Forceps or caudal appendages; H. Head width; E. Elytrum length; M. Mandible.

Source of diagram:

Hodar, 1997