EDIBLE INSECTS FROM HLEGU AND TAIKKYI TOWNSHIPS, YANGON REGION

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ABSTRACT

A total of 17 species from seven order and 11 families were recorded with different population abundance and different seasonal occurrence of edible insects species during the study period. The study sites were conducted in Hlegu and Taikkyi townships in Yangon Region. Study period lasted from June 2012 to May 2016. Insects were collected from the bare ground, bushes, muddy soil, paddy fields, trees, natural ponds, channels and streams. *Heliocopris bucephalus, Apis florea, Oecophylla smaragdina* and *Macrotermes darwiniensis* were collected in dry season. *Acilius sulcatus*, *Lethocerus indicus*, and *Anax junius* were collected in wet season and *Acheta domesticus, Gryllus assimilis, Oxya hyla, Gryllotalpa orientalis, Omphisa fuscidentalis, Attacus atlas, Metanastria hyrtaca, Helicoverpa zea, Rhynchophorus ferrugineus*, and *Apogonia glabripennis* were collected in cool season. According to this study, six species were observed as the terrestrial type, three species were aquatic type and eight species were arboreal types in 17 species of edible insects in both study sites. The number of edible insects was found to be 7441 insects, 4197 insects and 5847 insects as terrestrial, aquatic and arboreal types, respectively. Population status of edible insects was also studied by using SPSS methods. *Acheta domesticus*, *Gryllus assimilis*, *Omphisa fuscidentalis*, *Lethocerus indicus*, *Rhynchophorus ferrugineus*, *Oxya hyla*, *Anax junius*, *Acilius sulcatus*, *Heliocopris bucephalus*, and *Oecophylla smaragdina* were found as the popular edible insects and consumed by rural people in my study. Five kinds of nutritional values were recorded from the collected edible insect species. Of all these values, the maximum content of protein was observed in *Anax junius* was 52 g, that of carbohydrate in *Anax junius* and *Attacus atlas* as nine g and that of fat in *Acheta domesticus* and *Omphisa fuscidentalis* as 61 g. Moreover, the maximum amount of energy was recorded in *Acheta domesticus* and *Omphisa fuscidentalis* as 649 kcal and 641 kcal, respectively, while that of fiber was recorded as 60.72% and 60.96% in *Acheta domesticus* and *Omphisa fuscidentalis,* respectively.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLE

CHAPTER 1

INTRODUCTION

In Myanmar, the tradition of eating insects was popular in some places. Recently a large number of insects have become available for domestic consumption in Myanmar. Increase in the world population will require the production of vast amount of foods in the latter half of the twenty-first century. It will be difficult to increase productivity to a level that satisfies food demand, mainly because of limited availability of new farm land. This will lead to shortages of food, especially animal protein. When total food resources are insufficient, it is unwise to feed livestock with grain and other foodstuffs, which can be consumed directly by humans. Therefore, it becomes necessary to look for new sources of animal protein such as insects, which are rich in nutrients. Expanding populations and increasing purchasing power are placing ever-increasing demands on food production system throughout the world. FAO estimates that global food production will need to expand by at least 60 percent from current levels to meet global food requirements in 2050. There is a tendency to think of traditional habits and customs as outdated or primitive. Experience across numerous fields has highlighted the value and benefits to be gained from combining customary knowledge and approaches with modern science and understanding. Such is the case with edible forest insects (Ramos Elorduy, 2005).

Aside from their nutritional and environmental benefits, experts see considerable opportunity for edible insects to provide income and jobs for rural people who capture, rear, process, and transport and market insects as food. These prospects can be enhanced through promotion and adoption of modern food technology standards to ensure that the insects are safe and attractive for human consumption (FAO, 2014).

In Myanmar, there are a lot of foods, fish, and vegetables to have for our livings because it has a good weather condition and good geographical zone in Southeast Asia. But preparation is the best for the uncertain future. Most people know that there will be a big problem between insufficient food supply and increasing of world population in coming three decades. This problem will undoubtly be faced by all humans. So which insects can get from where and how much nutritional value can get should be known. Moreover, the available season and means of getting these insects should be understood.

Some of the major edible insects, such as grasshoppers and borers mostly eat fresh plant leaves or wood and therefore cleaner and more hygienic than crabs or lobsters, which eat carrion. Possibly more than 2000 species of insects, mostly forest-based and often classify as pests, have been serving as human food for subsistence and in commerce. Traditionally, most edible insects have been harvested from natural forests, but surprisingly little is known about the life cycles, population dynamics, commercial and management potential of most edible forest insects. Insects represent a significant biological resource that is still not fully utilized around the world (Ramos Elorduy, 2005).

Wherever forest insects are part of the human diet, they have generally been collected from the wild. The most commonly eaten insect forms are larvae and pupae, usually with little or no processing of the insects before they are consumed. The forest and its products are of vital importance to the rural population. These include various vegetables and fruits, mushrooms, edible insects, honey etc. Non-timber forest products are important for food security, health, social and economic welfare of rural communities. Considering the popularity of edible insects, it is not surprising that scores of species are prominent items of commerce in town as and village markets of the world (Latham, 2002).

Archaeological evidence suggests that entomophagy has been practiced since humans first appear; today insects still remain an important food source. Insects are commonly used and consumed in variety of ways: (1) as part of regular diets; (2) as famine or survival foods; (3) for medicine purposes; (4) for ritual purposes; and (5) as novelties (Sutton, 1995). In hunter-gather societies, insects are recognized as food. In modern agricultural societies, insects are generally viewed negatively. But in many cultures in Africa, Asia and Oceania and Latin America, peats such as locusts and grasshoppers are important food items (Defoliart, 1999). Eating insects is not simply the result of poverty or protein deficiency. In many parts of the world eating insects is a matter of preference and tradition (Jach, 2003; Pemberton, 1999). Worldwide, insects have been formed part of the cuisine of 113 entomophagous countries, with almost 1500 known species of edible insects being consumed by over 3000 different ethnic groups (MacEvilly, 2000). In Thailand, approximately 163 species are edible (Lewvanich, *et al*., 2000) and over 50 species are commonly eaten (Watanabe, 1984).

Insects have always surrounded us, but now they are becoming increasingly present in our culture. Hlegu and Taikkyi townships are chosen as the study sites to conduct this research. These two townships are largely rural and not far from Yangon just 30 km and 40 km from Yangon. It takes an hour or half and an hour to get these two townships. These two townships have the good habitations for insects. Some people in these townships earn in finding the seasonal edible insects. They search and collect the insects in different ways and send them to the collectors who come from Myawadi. Not only edible insects but also eels, frogs and crabs are collected. The collected insects are frozen and then sent from Myawadi to Thailand.

While entomophagy remains a significant component of humanity's diet, research indicates that the eating of insects may well be declining in many part of the world, including within societies that have long embraced edible insects as part of their diets. Though a great many people enjoy the low prices and other conveniences of our modern world, progress has been causing ever greater threats to our future. One reason that the mass production of cows, pigs, horses and other animals involves particularly catastrophic environmental impacts is that they are inherent wasteful in their consumption of grain, water and other resources (Paoletti and Dreon, 2005).

While many of us enjoy eating beef or pork, we may well sense that the days of consuming these animals are numbered. As global population continues to rise, and climate and economics continue to change, the demands of food production and resource use will have a major effect on how we feed ourselves. It is distinctly possible that the large animal food sources that we have taken for granted for so long will be impractical to produce. This will make micro-livestock, particularly insects, a desirable choice compared to other paradigms (Defoliart, 1995).

Recent volatility in food prices, anxiety over rising food insecurity and increasing concerns related to climate change and the large contributions of the agriculture sector to greenhouse gas emissions are motivating many experts to reassess diets and various approaches for food production, especially protein production. This has led to more serious consideration of the potential for edible insects to contribute to food security and prospects for commercial farming, or rearing, of insects for food (Pawlick, 1989).

In many parts of the world where insect eating has been a common element of traditional culture, the practice is warning due to modernization and changing attitudes. Our neighboring countries such as Thailand, Lao, Cambodia, Vietnam and China have earned by selling the variety of edible insects in good packaging to the international markets. In some places of Myanmar the tradition of eating insects has significant potential to improve rural livelihoods, enhance nutrition and contribute to sustainable management of insect habitats.

As researchers have discovered that local people consume edible forest insects not because they are environmentally-friendly or nutritious but they are cheap compared to meat or poultry that are widely available. Rather they choose to eat insects simply because the insects are good in taste (DeFoliart, 1995).

The popular edible insects which the dealers collect in those areas are *Acheta domesticus, Oxya hyla*, *Heliocopris bucephalus, Omphisa fuscidentalis,* *Attacus atlas, Rhynchophorus ferrugineus, Acilius sulcatus,* beebrood of *Apis florea, Oecophylla smaragdina, Lethocerus indicus* and *Anax junius.*

The eating of insects appears to be culturally universal, only varying with location, insect population and ethnic group. Insects, edible and non-edible alike, are key life forms in forest ecosystems, functioning as pollinators, aiding in the decomposition of dead plants and animals and aerating soil through their burrowing (Defoliart, 1999). Recently, more sophisticated and wide-reaching marketing and commercialization of edible forest insects have been advanced, including attractive packaging and advertising. Some advocates believe that creating a wider market for food insects could provide an economic incentive for conserving insect habitats. Published research thus has paid little attention to the subject of marketing and commercialization of edible forest insects in Asia and the Pacific (Bukkens, 2005).

The absence of economic data represents a serious constraint to the commercial development of edible insects. Existing practices to gather forest insects for local subsistence purpose must not be impacted negatively by commercialization. The key will be in fostering understanding and respect for insect eating and raising awareness of the potential contributions that edible insects can make to the environment, nutrition and livelihoods (Bodenheimer, 1951).

Wherever forest insects are part of the human diet, they have generally been collected from the wild. The most commonly eaten insect forms are larvae and pupae, usually with little or no processing of the insects before they are eaten. As an academic discipline, entomophagy (the human consumption of insects) is necessarily inter-disciplinary, with relationships to several different recognized fields of scientific study (Balinga, 2004). The lack of any one institution in the world with a strong research focus on edible insects is an impediment to conducting research on the subject. Relevant information is scattered far and wide among a variety of books and articles from different university departments and research facilities. For instances, where insects are traditional food among a certain group, this fact can serve as an avenue to commercial development. Rural people who move to the city bring with them their traditional food preferences and represent a strong initial potential market. The same is true of individuals who have immigrated to foreign countries. The ethnic restaurants and markets that such groups establish provide a source of what some have called nostalgia food, which brings back fond memories of the homeland. Patrons experimenting with new and different ethnic foods have an opportunity to try such dishes. The issue that would be most beneficial to commercializing edible forest insects that are sold live, dried, smoked, roasted, or in some other form. Benefits would accrue from the local to the international markets (Defoliart, 1991).

This study was conducted with the following objectives:

- to record and identify the edible insects in Hlegu and Taikkyi townships, Yangon Region
- to observe the seasonal occurrence of edible insects in the study areas
- to assess the microhabitats and population status of recorded edible insects
- to investigate the nutritional values of the edible insects and compare with those of six common food sources

CHAPTER 2
REVIEWOF LITERATURE

2.1 Entomophagy research

Meyer-Rochow, (1979) recommended that the value of insects as food item is undisputed. In many locations insects are abundant and can be cultivated easily, requiring minimal space. In contrast to larger domestic food animals, whose bones, blood and offal are almost unusable as foods the entire insect can be used or processed into food. Insects are generally rich in protein and they contain lipids of easily digestible fatty acid composition, moderate amount of carbohydrates and a balanced and valuable admixture of minerals. Few insect species are poisonous and some survival books, for example the consumption of insects rather than the uptake of unknown plants.

DeFoliart, (1989) reported that on the other hand, it is obvious that neighboring cultures share insect food practices through interchange of ideas, intermarriage and trade links when examine entomophagy in South and Southeast Asian regions. Although evidence for some of the interaction postulated is strong. Thus, there is a call for more research, especially incorporating interdisciplinary approaches. If insects farming proceeds, insect diseases and insect pests need to be addressed, not only in view of the acceptability of the insect product by human consumers, but also in regard to the economic viability of such insect-breeding facilities. The economic situation of the collectors of food and medicinal arthropods and that of the vendors, intermediaries and consumers of commercially valuable insects and other arthropods should be investigated. An ethnological approach would require comparisons of the usage of insects and other arthropods between different ethnic groups.

DeFoliart, (2005) stated that the western media had a heyday reporting on these novel developments, which may have helped to gradually diminish some or the prejudice in that part of the world. Powerful arguments in support of entomophagy include nutritional benefits, poverty reduction through food security and the potential for income generation. Incentives for pesticide avoidance and conservation of bio-and cultural diversity are also frequently cited as motives to promote this practice. The most compelling argument in flavor of insects as food is their nutritional value and thus the potential to bolster food security and balanced diet for better health Food caterpillars and forest bees in particular are important for generating income, especially in Africa where their value often exceeds that of common agricultural crops.

2.2 Setting the table for a more crowded earth

Sene (2000) stated that the earth population is expected to exceed well over 9 billion by 2050, and will the people need to meet humanity's need for food, feed, fuel, fiber, and shelter, with a minimal ecological footprint. The "Nine Billion Problem" has implications for how to grow and view food now and in the future. Insects have served as a food source for humanity since the first bipedal human ancestor came down from the trees and started walking the Savannahs. Interestingly, however, to say, insect eating or rare in the western world, but remains a significant source of food for people in other cultures. According to the FAO, 1900 species of insects are consumed by more than 80 countries across Asia, Africa, and the Americas. There are many advantages to insects as food. Insects contain more protein and are lower in fat then traditional meats, along with having a better feed efficiency rate. Insects save a substantial amount of energy and natural resources by their high metabolic rates. Because insects require less space and food, the ecological footprint of insects as food is smaller than that of traditional livestock. Finally, their reproduction rate is significantly higher, making them much easier to rise.

Costa Neto, (2000) recommended that United States Department of Agriculture's National Institute of Food and Agriculture (NIFA) focuses in research, education and outreach that aligns with the grand global challenges, including food security and food safety, nutrition, sustainable energy, water and climate change. Additionally in relation to insects as human food, we need to understand a number of issues, such as biology of species that can be consumed, biotic and abiotic constraints to insect livestock production, health and environmental risks, food safety and regulatory implications, human behavior and attitudes to consumption of insects, production challenges, and infrastructure needs. Edible insects are eaten as immature (eggs, larvae, pupae, and nymphs) in some cases also as adults.

Nickle, (1996) stated that many insects are consumed not only as food but also as medicine, and this provides a relevant contribution to the phenomenon of zoo-therapy, as well as opening new prospects for the economic and cultural valorization of animals traditionally regarded as useless. The ingestion of a varied of edible species contributes to the nutrition of indigenous, traditional peoples, as well as those individuals who live in urban areas that use this kind of food resource, in accordance with their abundance during several seasons of the year when they are available.

Considering the nutritional qualities, Yen, (2005) pointed out that insects should be considered as renewable resources available for sustainable exploitation aiming at reducing the protein of malnutrition and hunger in many parts of the world. Edible insects are sourced by three main strategies: wild harvesting, semi-domestication of insects in the wild, and farming. The degree to which each of these contributes varies regionally. While entomophagy has decreased in westernised societies, the demand for edible insects has apparently in Asia in association with increases standards of living.

Wild harvesting is still the main source of edible insects in much of the region. While some insects collected in the wild are pests, others occupy different trophic levels and provide important ecosystem services. The increased in demand for edible insects puts pressure on the source populations of insects because new technologies are now used to collect insects and to store them safety for long periods, facilitating the collection of the greater amounts of insects. This, in combination with either loss of natural habitats or changes to the environment, puts even more pressure on natural insect populations. Hence, this study was conducted to investigate, identify and access nutritional values of selected edible insects. Traditionally, insects for human consumption have been collected from the wild. In the past, most insects were collected from non-commercial home consumption, but insects are now increasingly sold in local markets and to dealers as a source of cash income (Meyer-Rochow, 2005).

2.3 Safety of insects for animal feed

DeFoliart, (1989) reported that increasing demand for food, particularly meat, fish and eggs, has led to an urgent need for new supplies of protein from sustainable sources. Invertebrates contribute to the natural diet of wild fish and mono-gastric livestock across the world and offer the potential to be used effectively as an alternative to animal and soya based proteins in animal feed. With a change in meat consumption habits towards pork and chicken and to an increase of fish in the diet, insects and insect protein could provide a low-cost and sustainable source of high-protein feed. Insects thrive on waste products from various source, they efficiently convert nitrogen from agricultural waste into valuable protein whilst requiring fewer valuable resources such as land and water per unit protein than protein crops. Farms processing insects for feed are likely to become a realistic prospect and projects and also set up pilot scale production facilities to investigate the exploitation of insects as a source of animal feed.

Hardouin, (1995) explained that the persistence of chemical residues, such as antibiotics and pesticides through the food chain is of particular concern where for example manure or anaerobic digested is used as feedstock. Food security is a global challenge and insect farming offers the potential to provide a sustainable source of protein for animal feed. Some scholars believe that the number of species and volume of insects consumed by people in the developing world is likely to have been overlooked or systematically underestimated. They contend that insect species are not always merely a food of last resort consumed to stave off hunger in times of food shortage-but seasonally available foods, often prized asdelicacies, that are integrated routinely into the diet. In some countries edible insects are widely traded commodities.

Van Huis *et al*., (2013) revealed that the nutritional composition of edible insect species varies, but in general insects are found to be good sources of protein, some fat and some fiber. The proportion of protein per 100g of various insect species compares favorably with from mammals, reptiles and fish. In term of protein quality, edible insects can supply a range of essential amino acids, sometimes providing a vital supplement for the amino acid deficiencies of local staple foods. Some insect species contain considerable quantities of healthy unsaturated fats and essential fatty acids. Insects generally also contain high quantities of important micronutrients, such as iron and zinc, for example, while some also contain useful amounts of certain vitamins.

CHAPTER 3

MATERIALS AND METHODS

3.1 Study sites

Hlegu and Taikkyi Townships of Yangon Region were chosen as study sites. Hlegu Township is located between 17° 14′ 0″ N 96° 14′ 0″ E and Taikkyi township is located between 17° 30′ 0″ N 96° 2 ′ 0″ E in Yangon Region (Fig 3.1 A, B and C).

3.2 Study period

Study period lasted from June 2012 to May 2016.

3.3 Materials

Materials used in collection were

a. Pruning knife
b. Hoe, Spade and Hand trowel
c. Nymph seine net
d. Torch light
e. Plastic Boxes
f. Paper boxes (51 cm × 31 cm ×46 cm)
g. Ice box
h. Cannon EOS 60D
i. Frying pan (Plate 3.1)

A. Map of Taikkyi and Hlegu Townships, Yangon Region

B. Study Site in Hlegu (Site 1)

C. Study site in Taikkyi (Site 2)

Fig. 3.1 Map of study sites

Source: Google Maps

A. Pruning knife

B. Hoe, Spade and Hand trowel

C. Nymph seine net

D. Torch light

E. Plastic Boxes

F. Paper boxes

Plate 3.1 Materials

G. Ice box

H. Cannon EOS 60D

H. Frying pan

Plate 3.1 Continued

3.4 Collecting of specimens

Collection was carried out monthly in both study sites. For burrowing terrestrial animals such as *Acheta domesticus, Gryllus assimilis, Omphisa fuscidentalis, Rhynchophorus ferrugineus, Attacus atlas, Oxya hyla, Apogonia glabripennis, Heliocopris bucephalus, Gryllotalpa orientalis, Macrotermes darwiniensis, Metanastria hyrtaca* and *Helicoverpa zea* were collected by hand, by digging with spade or hand trowel or by using with pruning knife. In order to extract the bamboo worms, the internode of bamboo was cut by the pruning knife. For arboreal insects, particularly the nest of bees *Apis florea,* the beehives were collected by smoking the bees away and red ants *Oecophylla smaragdina,* were collected by shaking the branches of the tree. Aquatic insects such as *Lethocerus indicus, Anax junius* and *Acilius sulcatus* were collected by trawling the seine net. Collected insects were put into various sizes of plastic boxes and paper boxes of (51 cm × 31 cm ×46 cm) for further identification. The boxes were labeled with date of collection, locality and fresh color of the specimens. The plastic boxes that contain the larvae were placed into the ice. The collected insects were brought back to the laboratory for identification and further observation. (Plate 3.2 and 3.3).

3.5 Collection size of the specimens

Collection sizes were randomly selected to observe and record the popular edible insects. At each time of collection, abundance or few were recorded base on above or below of 50 specimens of edible insects per day or night.

3.6 Identification of the collected specimens

The collected species were identified followed after Borror and Delong (1963), Imms (1976), Morris and Waterhouse (2001).

3.7 Laboratory analysis report

Nutritive values of collected edible insects were analyzed in Food Industries Development Supporting Laboratory (FIDSL), the Union of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI) Yangon. Moreover, the nutritive values of commonly consumed meats such as chicken, pork, beef, mutton, fish and prawn were also analyzed there (Appendices IV).

3.8 Keeping the collected specimens

The collected specimens were kept in different ways according to their behaviors (Plates 3.4).

3.9 Data analysis

The normal tests, ANOVA and T-test were done on the data for population of edible insect species monthly, seasonally and annually. Correlation between individual numbers and weather parameters consisting rainfall, humidity and temperature were analyzed by Pearson method at $P<0.05$ and $P<0.01$. All analysis of data was conducted by using Statistical Package for Social Science (SPSS) version 16 and graphical presentations.

A. Searching the dung beetle

B. Digging the larvae of *H.bucephalus*

C. Searching crickets

D. Searching the borer by scrapping the bark

E. Searching for the borer

F. Searching for mole cricket

Plate 3.2 Collection of terrestrial and arboreal edible insects

G. Collection borers from the dead tree

H. Collection beehive by smoking

I.Collection of grub

J. Collection red ants and eggs

Plate 3.2 Continued

A. Making small seine Net

B. Collection of giant water beetles

C. Collection of small aquatic edible insects

Plate 3.3 Collection of aquatic insects

A. Keeping the grub in the original host plant

B. Keeping the dung ball in the dung

C. Keeping the crickets in the paper boxes

Plates 3.4 keeping the collected specimens

CHAPTER 4
RESULTS

4.1 Species composition of the edible insects

A total of 17 species from seven orders and 16 families were recorded with different population abundance and different categorize edible insects species according to the survey results (Fig 4.1, 4.2 and Table 4.1).

4.1.1 The classification of edible insects

The classification of edible insects was done according to the Borror and Delong (1963), Imms (1976), Morris and Waterhouse (2001).

Phylum	-	Arthropoda
Class	-	Insecta
(1) Order	-	Orthoptera
Family	-	Gryllidae
Genus	-	*Acheta*
Species	-	*Acheta domesticus* Linnaeus, 1758
Common name	-	House cricket
Local name	-	Payit
Length	-	50.8 - 76.2 mm

Genus	-	*Gryllus*
Species	-	*Gryllus assimilis* (Fabricius, 1775)
Common name	-	House cricket
Local name	-	Payit
Length	-	40 – 55 mm
Family	-	Acrididae

Genus	-	*Oxya*
Species	-	*Oxya hyla* (Serville, 1831)
Common name	-	Grasshopper
Local name	-	Hnan
Length	-	70-75 mm

Family	-	Scarabaidae
Genus	-	*Heliocopris*
Species	-	*Heliocopris bucephalus* Fabricius, 1775
Common name	-	Dung beetle
Local name	-	Delone/Ecode
Length	-	65-75 mm

Family	-	Gryllotalpidae
Genus	-	*Gryllotalpa*
Species	-	*Gryllotalpa orientalis* Burmeister, 1838
Common name	-	Mole cricket
Local name	-	Khawylay payit
Length	-	42-53mm

(2) Order	-	Lepidoptera
Family	-	Pyralidae
Genus	-	*Omphisa*
Species	-	*Omphisa fuscidentalis* (Hampson, 1896)

Common name	-	Bamboo worm
Local name	-	War-poe
Length	-	30-40mm

Family	-	Saturriidae
Genus	-	*Attacus*
Species	-	*Attacus atlas* (Linnaeus, 1758)
Common name	-	Atlas moth
Local name	-	Tha-yet-poe
Length	-	20-25mm

Family	-	Lasiocampidae
Genus	-	*Metanastria*
Species	-	*Metanastria hyrtaca* Cramer, 1782
Common name	-	Wood borer
Local name	-	Borer
Length	-	25-30 mm

Family	-	Noctuidae
Genus	-	*Helicoverpa*
Species	-	*Helicoverpa zea* Boddie, 1850
Common name	-	Wood borer
Local name	-	Borer
Length	-	25-30 mm

(3) Order	-	Coleoptera
Family	-	Currulionidae
Genus	-	*Rhynchophorus*
Species	-	*Rhynchophorus ferruhineus* (Olivier, 1790)
Common name	-	Grub
Local name	-	Thinpound Poe
Length	-	30-40mm
Family	-	Dytiscidae
Genus	-	*Acilius*
Species	-	*Acilius sulcatus* (Linnaeus, 1758)
Common name	-	Water beetle
Local name	-	Yae Poe
Length	-	20-30 mm
Family	-	Cerambycidae
Genus	-	*Apogonia*
Species	-	*Apogonia glabripennis* LeConte, 1856
Common name	-	Moth larvae
Local name	-	Borer
Length	-	20-30 mm
(4)Order	-	Hymenoptera
Family	-	Apidae
Genus	-	*Apis*

Species	-	*Apis florea* Fabricius, 1787
Common name	-	Bee brood
Local name	-	Pyartalat
Length	-	180-200 mm

Family	-	Formicidae
Genus	-	*Oecophylla*
Species	-	*Oecophylla smaragdina* (Fabricius, 1775)
Common name	-	Weaver ants
Local name	-	Red ants
Length	-	10-15mm

(5)Order	-	Hemiptera
Family	-	Belostomatidae
Genus	-	*Lethocerus*
Species	-	*Lethocerus indicus* (Lepeietier & Serville, 1825)
Common name	-	Giant water bug
Local name	-	Palima
Length	-	30-40 mm

(6)Order	-	Odonata
Family	-	Aeshnidae
Genus	-	*Anax*
Species	-	*Anax junius* (Drury, 1773)
Common name	-	Green darnar
Local name	-	Darnar
Length	-	20-25 mm

(7)Order	-	Isoptera
Family	-	Termitidae
Genus	-	*Maacrotermes*
Species	-	*Maacrotermes darwiniensis* Kemner, 1934
Common name	-	Termite
Local name	-	Palu
Length	-	10-15 mm (Fig. 4.1, 4.2 and Table 4.1)

4.1.2 Occurrence of recorded edible insects

1. *Acheta domesticus* (Linnaeus, 1758)

The insect, *Acheta domesticus* was mostly isolated on the bare ground and 50.8-76.2 mm in length. The adults were lived in loose soil and collected by digging with small spade and also can by hand under the light trap on the bare ground. Most of them can be found in October to February (cool season) and comsumed by frying. At each collection, 50 to 80 insects were collected per night for one person.

2. *Gryllus assimilis* (Fabricius, 1775)

The body was 15-31 mm long and dark in color. *Gryllus assimilis* has the same habitat with *Acheta domesticus*. The insect was collected by light trap in cool season. The adults are eaten by frying. At each collection, 30 to 50 were collected per night by one person.

3. *Oxya hyla* (Serville, 1831)

In rural places of Myanmar, the adults of fried *Oxya hyla* were eaten as snack with sticky rice. Grasshoppers were collected by groups in the paddy fields especially when the crops are harvested in cool season. Hand nets were used in collection. The length is 70-75 mm and eaten by frying. The females are larger than males and eaten by baking as delicacy. At each collection, 60 to 80 insects were collected per day by one person.

4. *Heliocopris bucephalus* Fabricius, 1775

Dung beetles *Heliocopris bucephalus* were extricated with the help of a spade at the depth of approximately 20 centimeters. The collection was done with care in order not to kill them. Live in cluster and one dunghill generally contains four to ten beetles. The length was 65-75 mm. Dung beetles were found in dunghills created by buffalos or cows in paddy fields in dry season. Thus, the quantity of collection depends in the number of dunghills available. Dung beetles were expansive and consumed with gravy as a delicious food.

5. *Gryllotalpa orientalis* Burmeister, 1838

The head is large distinct and the body was 30-32 mm in length. They were mostly found in cool and dry season. Isolated insects were found in dry and muddy soil. Collectiion was done by digging a shallow depth with spade. The crickets are rare and hardly to be found. At each time of collection, 10 to 20 insects were collected per day by one person.

6. *Omphisa fuscidentalis* (Hampson, 1896)

The body of the worm was white, 38-40 mm long and found in clusters and inhabit in bamboo internodes. Bamboo worms were collected by cutting down the bamboo and picked up by hand from October to January. The bamboo worms were more expansive and popular in Myanmar and can be consumed by frying. At each time of collection, 40 to 50 worms were collected inside the internode of a bamboo.

7. *Attacus atlas* (Linnaeus, 1758)

The length is about 20-23 mm. Their cocoons were made in cluster on the surface of the mango leaves. The larvae of the moths can be picked up easily by hand in early cool season when the cocoons are abundant and can be consumed by frying. At each time of collection, 30 to 80 cocoons were collected per day by one person.

8. *Metanastria hyrtaca* Cramer, 1782

The length was about 30-35 mm and cream in color. As they live inside the stem of the tree they are also called borers. Collection was difficult as they were collected by cutting down the dead stem and splitting them out with force. At each time of collection, 30 to 50 borers were collected in each stem.

9. *Helicoverpa zea* Boddie, 1850

The length was about 30-40 mm in length and pale in color. The edible stage is the larvae. The larvae contain high in fiber as they eat cellulose of the plant. Live in single in each narrow hollow of the stem and can be collected by splitting the stem in cool season. At each time of collection, 20 to 30 larvae were collected from the tree.

10. *Rhynchophorus ferrugineus* (Oliver, 1790)

The palm weevil is a species of beetle that is 25-55 mm in length. Larvae lived inside the stem and were collected by splitting the stems to open. Only one was observed in each pupa house. The worms are most expansive and popular of all the recorded edible insects. Before frying, the weevils were immersed in milk. At each time of collection, 30 to 50 worms were collected per day by one person.

11. *Acilius sulcatus* (Linnaeus, 1758)

They are found mostly in the wet season while the paddy fields and small channel are full of water. Wings are hard and dark in color. The length was 20-30 mm. They were consumed by frying and cooking with gravy. At each time of collection, 60 to 100 insects were collected per day by one person.

12. *Apogonia glabripennis* LeConte 1856

The larva of long horn beetle is pale in color and also called woodborer. The length was about 25-28 mm. The color and taste were similar to those of bamboo worms. Collection was the same as that of the *Metanastria hyrtaca* and *Helicoverpa zea*. At each time of collection, 10 to 20 worms were collected per day by one person.

13. *Apis florea* Fabricius, 1787

The nests of *Apis florea* were found in branches of the trees. The size of beehive was 180-200 mm. The hive was smoked to open it. Then the comb was removed one by one with care. The nest of *Apis florea* was collected in cool and dry seasons. At each time of collection, one to two combs were collected per day by one person.

14. *Oecophylla smaragdina* (Fabricius, 1775)

The weaver ant was an aggressive and territorial insect that builds different shaped of nests with woven leaves of various tree species. Their nests were made in different trees, such as jackfruit and mango, etc. The larvae and pupae were collected from the nest by shaking the branches of the tree. At each time of collection, three to five nests were collected per day by one person. The larvae were abundantly found in hot season and can be consumed with gravy.

15. *Lethocerus indicus* (Lepeietier & Serville, 1825)

Well develop skeletal appendages and large wings are present. Nocturnal in nature and most individuals lived under submerged aquatic plants. Catching of them can be easily done by hand or light trap at night in wet season. The length was about 45-50 mm. Females were more expansive and can be consumed by frying. At each time of collection, 50 to 80 insects were collected per day by one person.

16. *Anax junius* Drury, 1773

The immature stages are aquatic and the nymphs were not resemble to the adults. Dragonfly nymphs were rarely sought specifically and 20-25 mm in length. All the nymph stages were mainly found in still water and also in rivers. Collection of them was done by trawling the seine net in wet season. At each time of collection, 20 to 40 insects were collected per day by one person.

17. *Macrotermes darwiniensis* Kemner, 1934

Termites were one of the edible insects and collected in groups during the hot season. Collection of them was done easily by the help of light at night. The length was about 10-15 mm and reddish brown in color. A each time of collection, 80 to 120 insects were collected per day by one person. Before frying, Wings were removed.

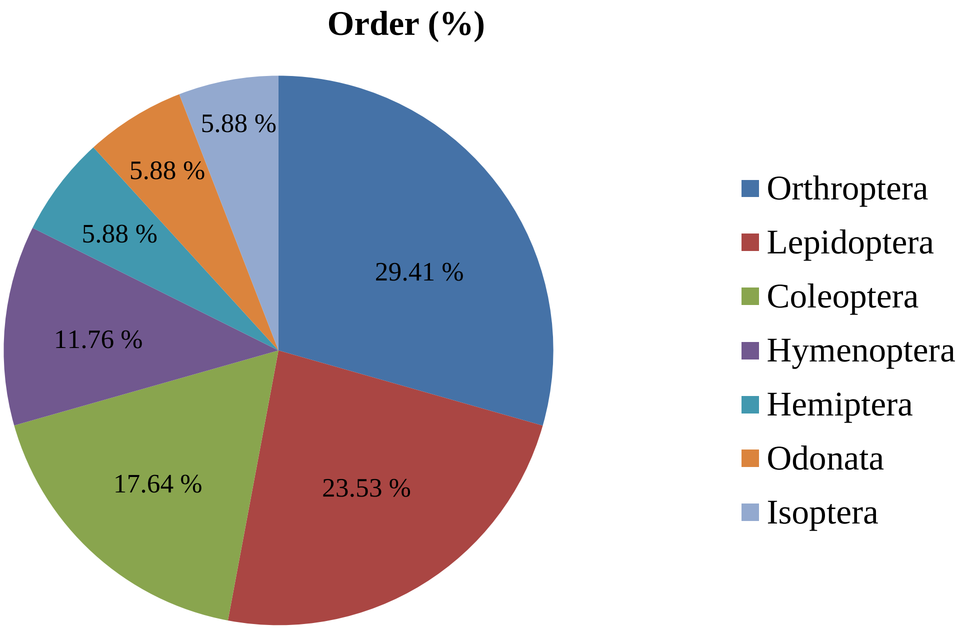


Fig. 4.1 Different orders of selected edible insects

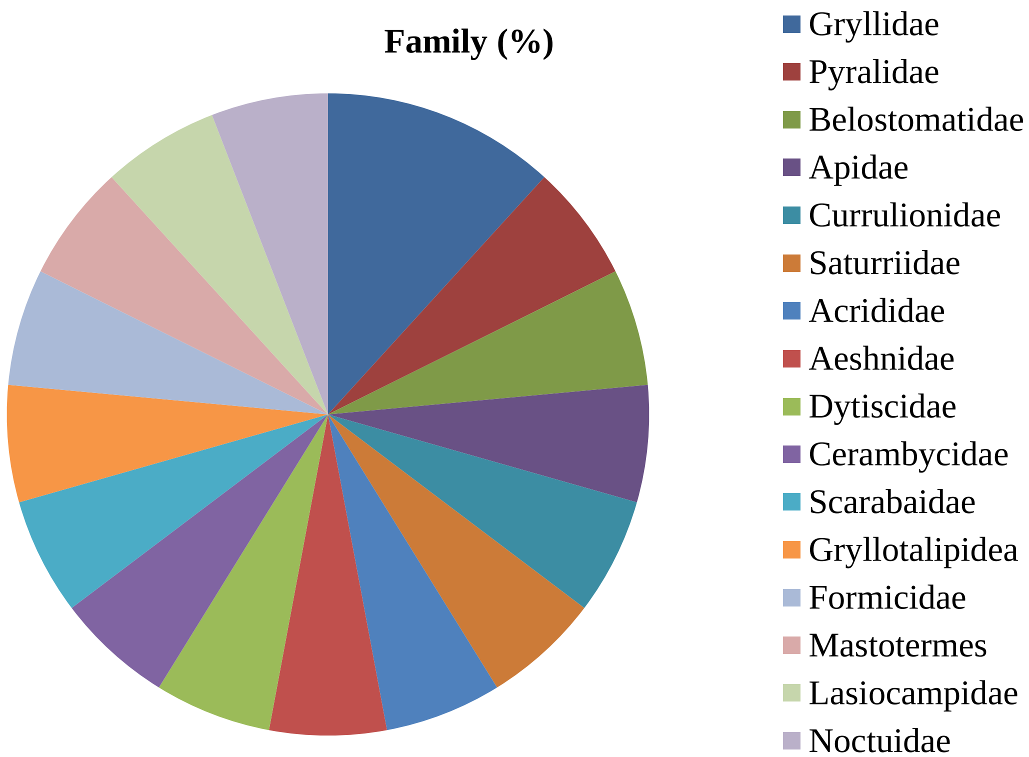


Fig. 4.2 Different families of selected edible insects

Table 4.1 Different orders and families of selected edible insects

No.	Order	Family	Genus	Species
1.	Orthroptera	Gryllidae	*Acheta*	*Acheta domesticus*
			Gryllus	*Gryllus assimilis*
		Acrididae	*Oxya*	*Oxya hyla*
		Scarabaidae	*Heliocopris*	*Heliocopris bucephalus*
		Gryllotalpidae	*Gryllotalpa*	*Gryllotalpa orientalis*
2.	Lepidoptera	Pyralidae	*Omphisa*	*Omphisa fuscidentalis*
		Saturriidae	*Attacus*	*Attacus atlas*
		Lasiocampidae	*Metanastria*	*Metanastria hyrtaca*
		Noctuidae	*Helicoverpa*	*Helicoverpa zea*
3.	Coleoptera	Currulionidae	*Rhynchophorus*	*Rhynchophorus ferrugineus*
		Dytiscidae	*Acilius*	*Acilius sulcatus*
		Cerambycidae	*Apogonia*	*Apogonia glabripennis*
4.	Hymenoptera	Apidae	*Apis*	*Apis florea*
		Formicidae	*Oecophylla*	*Oecophylla smaragdina*
5.	Hemiptera	Belostomatidae	*Lethocerus*	*Lethocerus indicus*
6.	Odonata	Aeshnidae	*Anax*	*Anax junius*
7.	Isoptera	Termitidae	*Macrotermes*	*Macrotermes darwiniensis*

4.1.3 The abundance of recorded edible insects in two study sites

In study site 1(Hlegu), 258 numbers of *Acheta domesticus*, 205 numbers of *Gryllus assimilis*, 268 numbers of *Oxya hyla*, 84 numbers of *Heliocopris bucephalus,* 76 numbers of *Gryllotalpa orientalis,*175 numbers of *Omphisa fuscidentalis,* 253 numbers of *Attacus atlas,*174 numbers of *Metanastria hyrtaca*, 113 numbers of *Helicoverpa zea*, 165 numbers of *Rhynchophorus ferrugineus,* 288 numbers of *Acilius sulcatus,*71 numbers of *Apogonia glabripennis*, 21 numbers of *Apis florea,* 36 numbers of *Oecophylla smaragdina,* 266 numbers of *Lethocerus indicus,* 113 numbers of *Anax junius* and 380 numbers of *Macrotermes darwiniens* were found in the year 2012-2013 and there were 240 numbers of *Acheta domesticus*, 170 numbers of *Gryllus assimilis,* 270 numbers of *Oxya hyla*, 26 numbers of *Heliocopris bucephalus*, 64 numbers of *Gryllotalpa orientalis*, 185 numbers of *Omphisa fuscidentalis*, 219 numbers of *Attacus atlas*, 180 numbers of *Metanastria hyrtaca*, 105 numbers of *Helicoverpa zea*, 170 numbers of *Rhynchophorus ferrugineus,* 270 numbers of *Acilius sulcatus,* 68 numbers of *Apogonia glabripennis,* 18 numbers of *Apis florea,* 45 numbers of *Oecophylla smaragdina*, 244 numbers of *Lethocerus indicus*, 143 numbers of *Anax junius* and 400 numbers of *Macrotermes darwiniens* were found in the year 2013 - 2014 and then there were 293 of *Acheta domesticus*, 197 numbers of *Gryllus assimilis,* 310 numbers of *Oxya hyla*, 24 numbers of *Heliocopris bucephalus*, 64 numbers of *Gryllotalpa orientalis,* 179 numbers of *Omphisa fuscidentalis,* 279 numbers of *Attacus atlas*, 178 numbers of *Metanastria hyrtaca*, 104 numbers of *Helicoverpa zea,* 143 numbers of *Rhynchophorus ferrugineus,* 345 numbers of *Acilius sulcatus,* 63 numbers of *Apogonia glabripennis,* 18 numbers of *Apis florea*, 48 numbers of *Oecophylla smaragdina,* 295 numbers of *Lethocerus indicus,* 140 numbers of *Anax junius* and 420 numbers of *Macrotermes darwiniens* were found in the year 2014 -2015. A total number of 8863 belonging to17 species of edible insects were collected in the study site 1 (Hlegu) (Fig. 4.3, 4.4, 4.5 and 4.6).

In study site 2 (Taikkyi), 305 numbers of *Acheta domesticus*, 193 numbers of *Gryllus assimilis*, 167 numbers of *Oxya hyla*, 20 numbers of *Heliocopris bucephalus,* 76 numbers of *Gryllotalpa orientalis,* 166 numbers of *Omphisa fuscidentalis,* 299 numbers of *Attacus atlas,* 127 numbers of *Metanastria hyrtaca,* 88 numbers of *Helicoverpa zea,* 140 numbers of *Rhynchophorus ferrugineus,* 276 numbers of *Acilius sulcatus,* 58 numbers of *Apogonia glabripennis,* 15 numbers of *Apis florea*, 25 numbers of *Oecophylla smaragdina,* 292 numbers of *Lethocerus indicus,* 194 numbers of *Anax junius* and 439 numbers of *Macrotermes darwiniens* were found in the year 2012 - 2013 and there were 278 numbers of *Acheta domesticus*, 198 numbers of *Gryllus assimilis,* 259 numbers of *Oxyahyla,* 20 numbers of *Heliocopris bucephalus,* 73 numbers of *Gryllotalpa orientalis,* 171 numbers of *Omphisa fuscidentalis*, 206 numbers of *Attacus atlas*, 200 numbers of *Metanastria hyrtaca*, 98 numbers of *Helicoverpa zea*, 140 numbers of *Rhynchophorus ferrugineus,* 271 of *Acilius sulcatus,* 60 of *Apogonia glabripennis,* 18 numbers of *Apis florea*, 18 numbers of *Oecophylla smaragdina*, 258 numbers of *Lethocerus indicus*, 138 numbers of *Anax junius* and 378 numbers of *Macrotermes darwiniens* were found in the year 2013 -2014 and then 266 numbers of *Acheta domesticus*, 215 numbers of *Gryllus assimilis,* 274 numbers of *Oxya hyla*, 80 numbers of *Heliocopris bucephalus*, 110 numbers of *Gryllotalpa orientalis,* 176 numbers of *Omphisa fuscidentalis,* 240 numbers of *Attacus atlas,* 192 numbers of *Metanastria hyrtaca,* 132 numbers of *Helicoverpa zea,* 150 numbers of *Rhynchophorus ferrugineus,* 267 numbers of *Acilius sulcatus*, 72 numbers of *Apogonia glabripennis*, 18 numbers of *Apis florea,* 28 numbers of *Oecophylla smaragdina*, 254 numbers of *Lethocerus indicus*,116 numbers of *Anax junius* and 368 numbers of *Macrotermes darwiniens* were found in the year 2014-2015. A total number of 8622 belonging to 17 species of edible insects were collected in the study site 2 (Taikkyi) (Fig. 4.7, 4.8, 4.9 and 4.10).

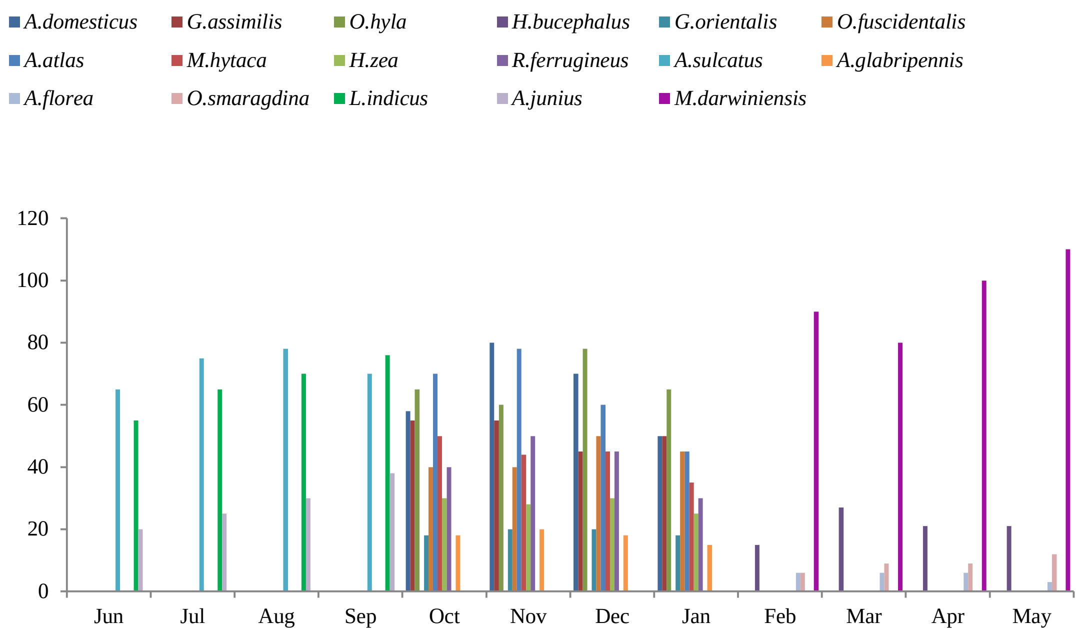


Fig. 4.3 Recorded edible insects June 2012-May 2013 from Hlegu (Site 1)

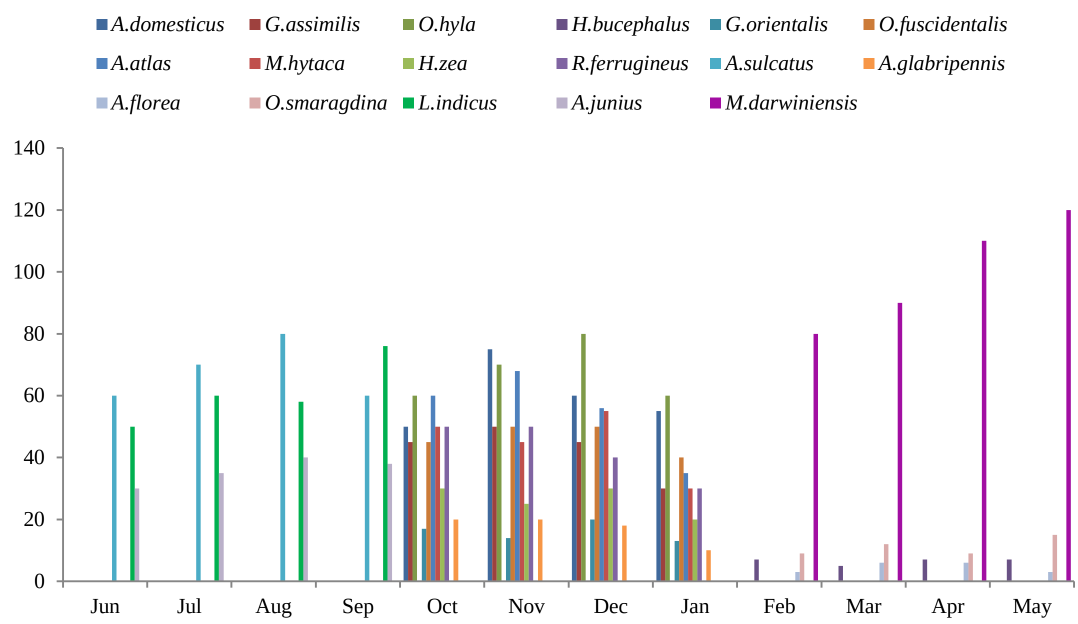


Fig. 4.4 Recorded edible insects June 2013-May 2014 from Hlegu (Site 1)

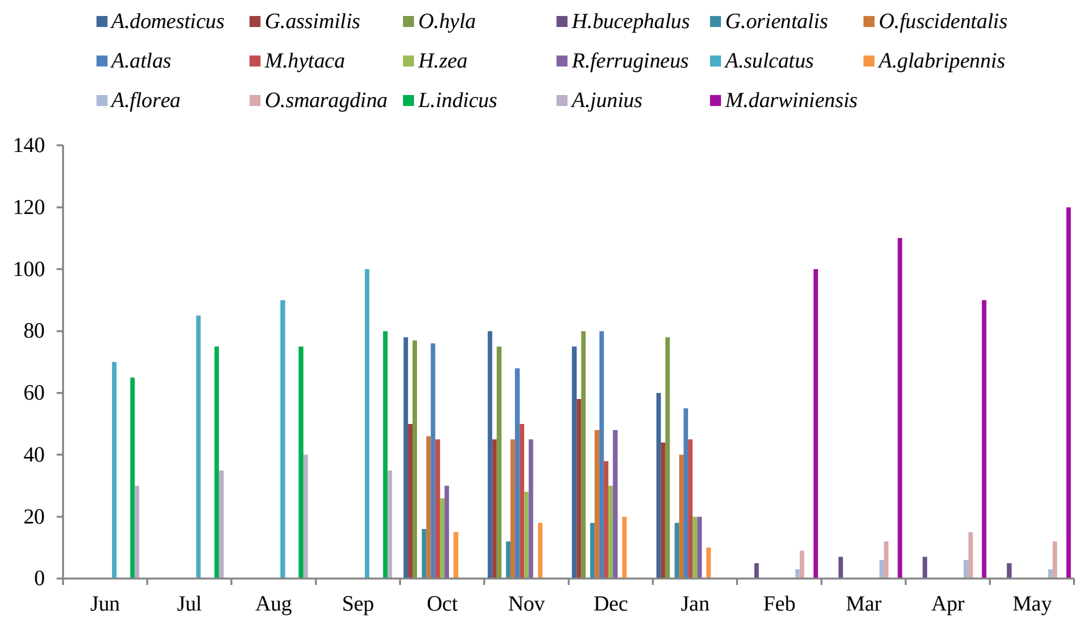


Fig. 4.5 Recorded edible insects June 2014-May 2015 from Hlegu (Site 1)

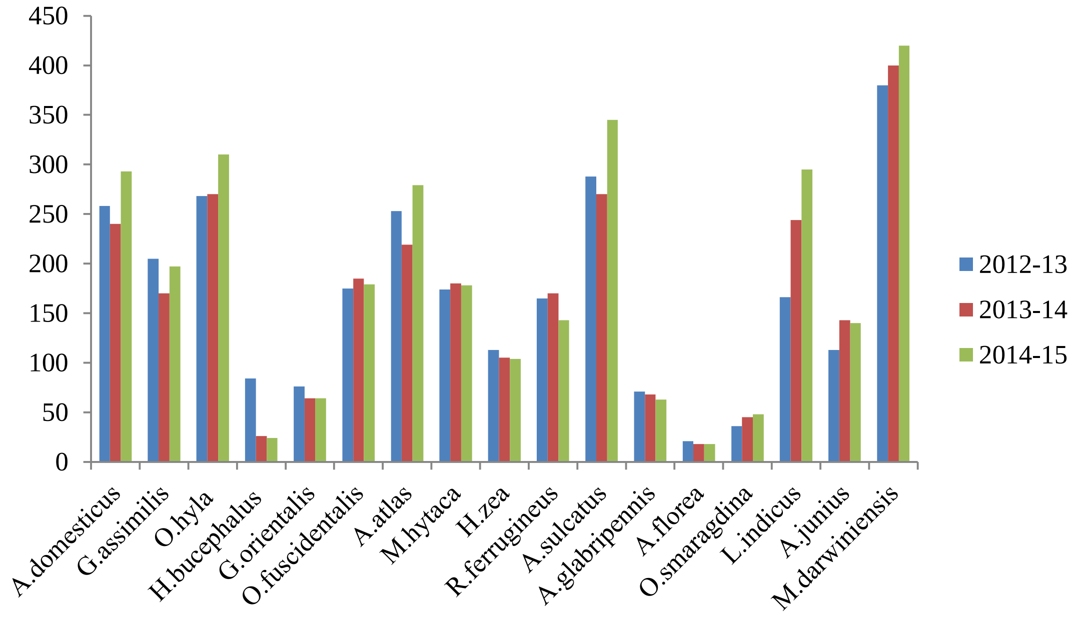


Fig.4.6 Total recorded insects June 2012-May 2015 from Hlegu (Site1)

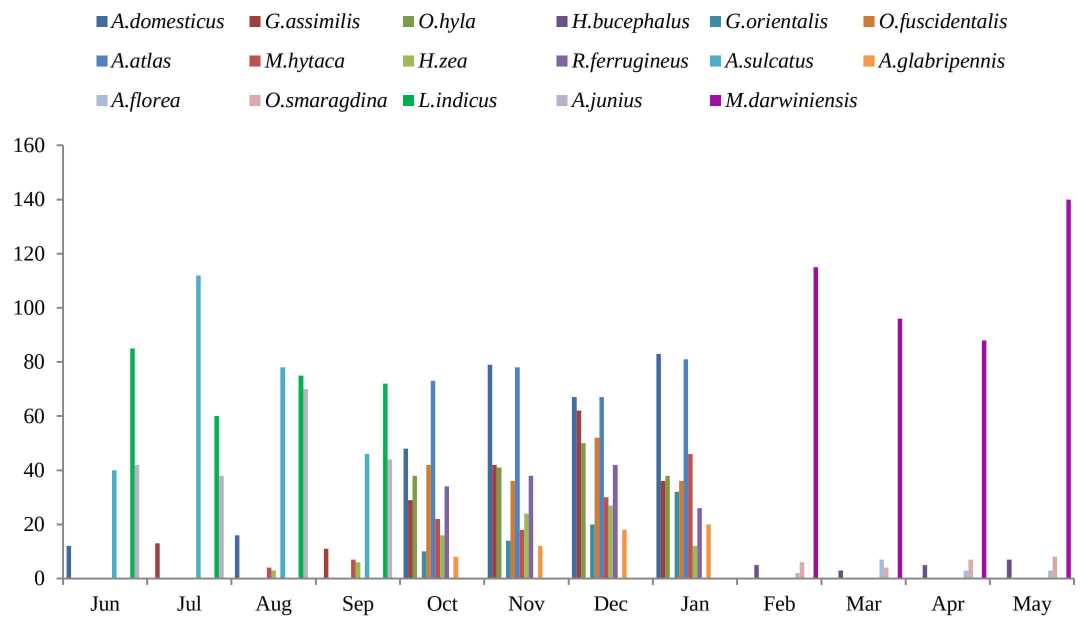


Fig. 4.7 Recorded edible insects June 2012-May 2013 from Taikkyi (Site 2)

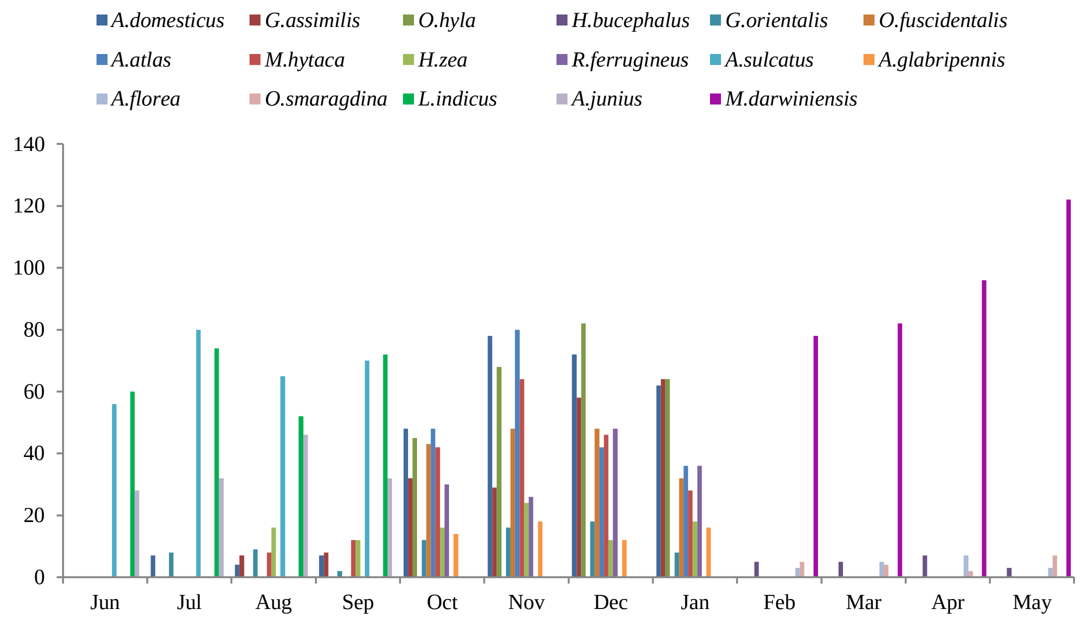


Fig. 4.8 Recorded edible insects June 2013-May 2014 from Taikkyi (Site 2)

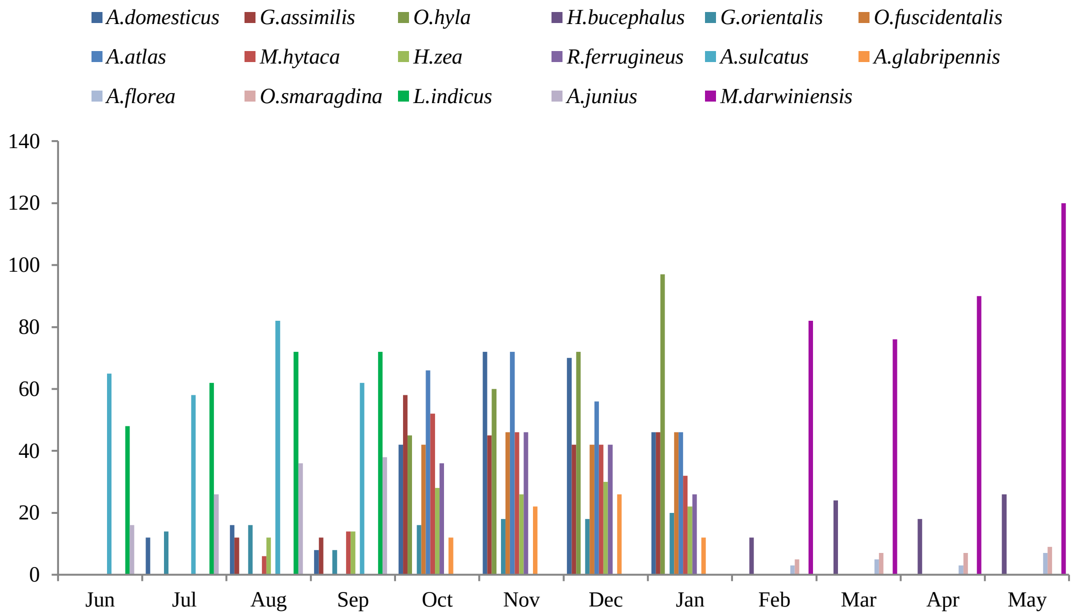


Fig. 4.9 Recorded edible insects June 2014-May 2015 from Taikkyi (Site 2)

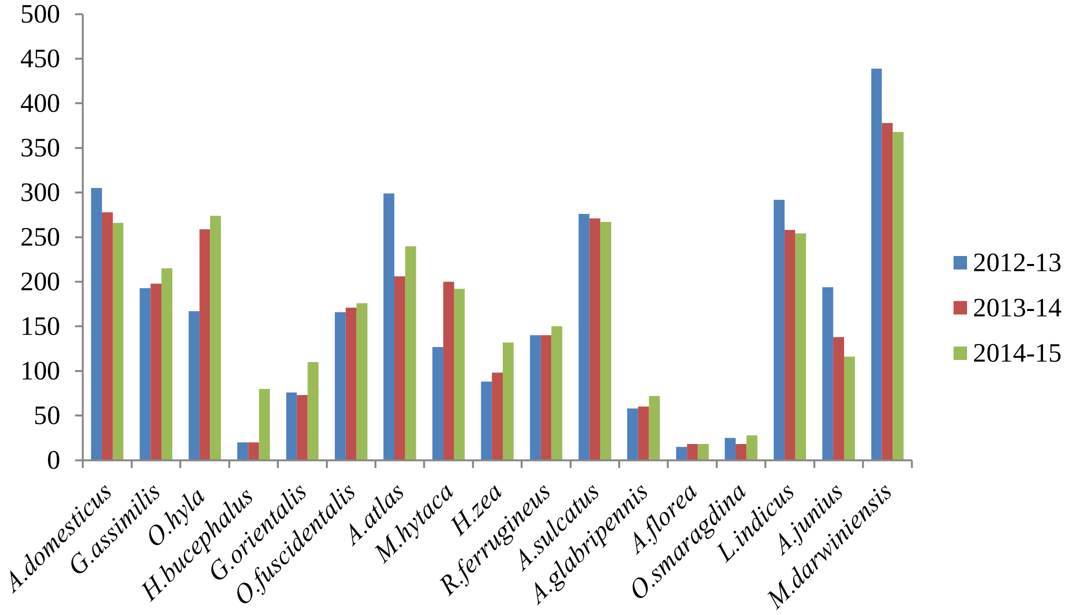


Fig. 4.10 Total recorded insects from June 2012-May 2015 in Hlegu (Site1)

4.2 Different types of habitat of the recorded edible insects

Two types of habitats were recorded that 17 species of edible insects by terrestrial and aquatic types in the study fields. *Acheta domesticus*, *Gryllus assimilis*, *Omphisa fuscidentalis, Lethocerus indicus*, *Apis florea, Rhynchophorus ferrugineus*, *Attacus atlas*, *Oxya hyla*, *Anax junius*, *Acilius sulcatus*, *Apogonia glabripennis*, *Heliocopris bucephalus*, *Gryllotalpa orientalis*, *Oecophylla smaragdina*, *Macrotermes darwiniensis*, *Metanastria hyrtaca* and *Helicoverpa zea.* The spices of*Acheta domesticus*, *Gryllus assimilis*, *Omphisa fuscidentalis*, *Apis florea*, *Rhynchophorus ferrugineus, Attacus atlas, Oxya hyla*, *Apogonia glabripennis, Heliocopris bucephalus*, *Gryllotalpa orientalis*, *Oecophylla smaragdina*, *Macrotermes darwiniensis*, *Metanastria hyrtaca* and *Helicoverpa zea* were investigated that the terrestrial habitat types and *Lethocerus indicus*, *Anax junius* and *Attacus atlas* were recorded that the aquatic habitat types. Edible insects were sourced by three main strategies as wild harvesting, semi-domestication of insects in the wild, and farming. Local people have eaten the different stages and soft body parts on the edible insects (Plate 4.1).

Most edible insects were collected from natural habitats, mainly in the wild of rural areas. Edible insect harvesting was mostly undertaken by individuals and families for non-commercial household consumption. Insect harvesting was undertaken by man and women equally and sometimes even by children.

The time of insect collection depends on the insect’s behavior and life cycles. Some insects, such as grasshoppers are less active and thus easier to capture at low temperatures- mostly in early morning or at night time. Other species such as crickets were found by their stridulating sound. Aquatic insects were collected all year round but peak collection is generally in the rainy season. Night flyer such as the giant water bug and beetles were attracted by light and caught with nets and traps.

A. *Acheta domesticus*

B. *Gryllus assimilis*

C. *Oxya hyla*

D. *Heliocopris bucephalus*

E. *Gryllotalpa orientalis*

F. *Omphisa fuscidentalis*

Plate 4.1 Collection of edible insects

G. *Atlas atlas*

H. *Metanastria hyrtaca*

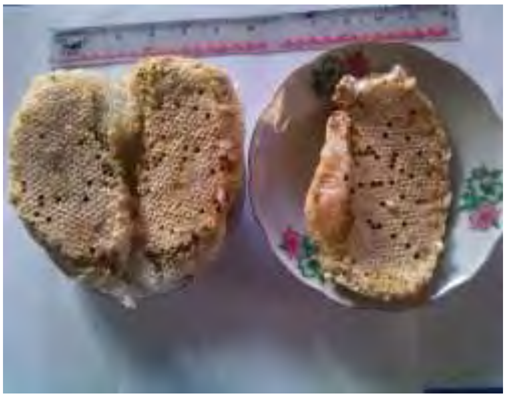
I. *Helicoverpa zea*

J. *Rhynchophorus ferrugineus*

K. *Acilius sulcatus*

L. *Apogonia glabripennis*

Plate 4.1 Continued



M. Bee brood of *Apis florea*

N. *Oecophylla smaragdina*

O. *Lethocerus indicus*

P. *Anax junius*

Q. *Macrotermes darwininesis*

Plate 4.1 Continued

A. Habitat of *Acheta domesticus*

B. Habitat of *Gryllus assimilis*

C. Habitat of *Oxya hyla*

D. Habitat of *H.bucephalus*

E. Habitat of *Gryllotalpa orientalis*

F.Habitat of *O. fuscidentalis*

Plate 4.2 Habitat of collected edible insects

G. Habitat of *Atlas atlas*

H. Habitat of *Metanastria hyrtaca*

I. Habitat of *Helicoverpa zea*

J. Habitat of *Rhynchophorus ferrugineus*

K. Habitat of *Acilius sulcatus*

L. Habitat of *Apogonia glabripennis*

Plate 4.2 Continued

M. Habitat of *Apis florea*

N. Habitat of *Oecophylla smaragdina*

O. Habitat of *Lethocerus indicus*

P. Habitat of *Anax junius*

Q. Habitat of *Macrotermes darwiniensis*

Plate 4.2 Continued

4.3 Seasonal occurrence of edible insects from June 2012 –May 2015

Insects were collected from paddy fields, upland and forested areas, natural ponds and streams. Seasonal availability of edible insects were recorded that terrestrial and aquatic types in Hlegu and Taikkyi townships. *Acheta domesticus*, *Gryllus assimilis*, *Oxya hyla*, *Gryllotalpa orientalis*, *Omphisa fuscidentalis*, *Attacus atlas*, *Metanastria hyrtaca*, *Helicoverpa zea*, *Rhynchophorus ferrugineus*, and *Apogonia glabripennis* were collected by groups in cool season. *Acilius sulcatus*, *Lethocerus indicus* and *Anax junius* were collected much abundance in wet season. *Acheta domesticus*, *Gryllus assimilis*, *Gryllotalpa orientalis*, *Metanastriahyrtaca* and *Helicoverpa zea*, were also collected in wet seasons. *Heliocopris bucephalus*, *Apis florea*, *Oecophylla smaragdina* and *Macrotermes darwiniensis* were recorded by groups in dry season.

In Hlegu the total numbers of individual recorded were 734 in wet season, 1691 in cool season and 521 in dry season in June 2012- May 2013. The total numbers of insects collected were 729 in wet season, 1599 in cool season and 489 in dry season in June 2013-May 2014. Finally 862 insects were collected in wet season, 1728 in cool season and 510 in dry season of June 2014- May 2015. The number of insects collected in wet seasons, in cool seasons and in dry seasons were 2325, 5018 and 1520, respectively during the study period in Hlegu.

In Taikkyi the total numbers of individuals were 834 in wet season, 1547 in cool season and 499 in dry season in June 2012- May 2013. And then 767 insects were collected in wet season, 1583 in cool season and 434 in dry season in June 2013- May 2014. Also 781 insects were collected in wet season, 1683 in cool season and 494 in dry season in June 2014-May 2015. And 2382 insects were recorded in wet seasons, 4813 insects in cool seasons and 1427 insects were collected in dry seasons during the study period in Taikkyi. In addition, 8863 of edible insects were collected in Hlegu and 8862 of edible insects were collected in Taikkyi (Fig.4.11, 4.12).

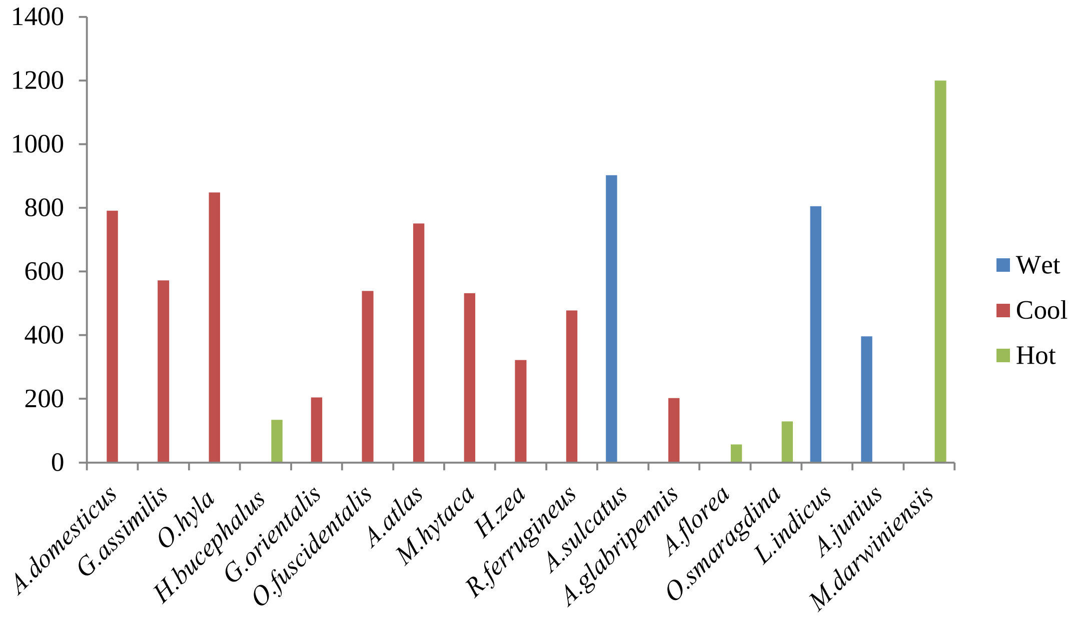


Fig. 4.11 Seasonal occurrence of edible insects from June 2012 to May 2015 in Hlegu (Site 1)

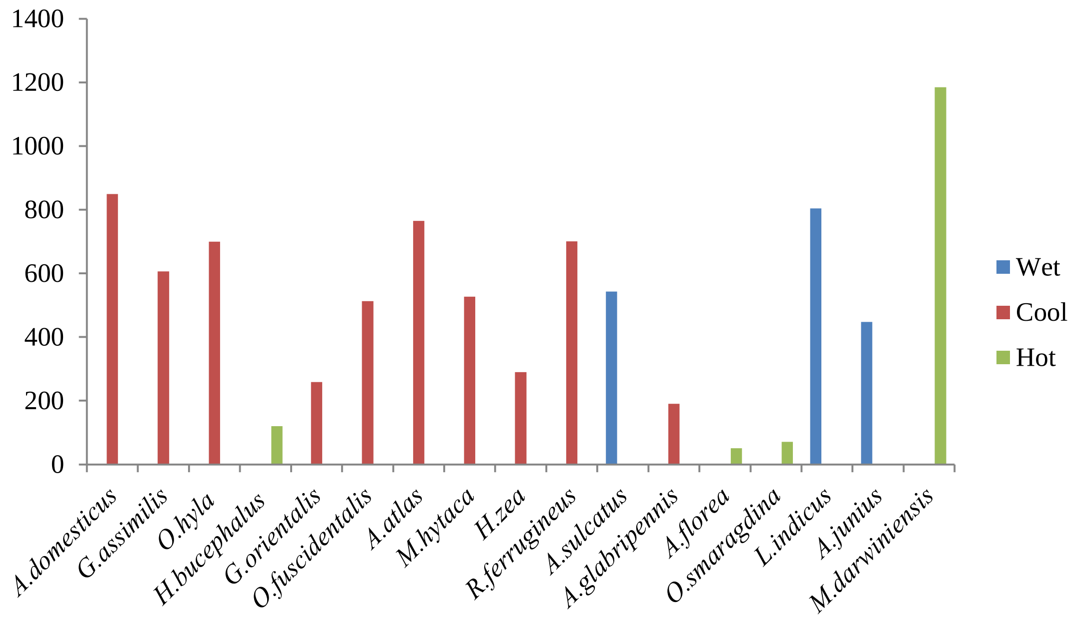


Fig. 4.12 Seasonal occurrence of edible insect from June 2012 to May 2015 in Taikkyi (Site 2)

4.4 Microhabitats of collected edible insects in the study sites

Insects live in various habitats. Terrestrial insects live on bare ground, around bushes, by burrowing, in paddy fields and muddy soil. Aquatic insects live in the ponds, stream and in the fields during the wet season. And arboreal insects live in the stems, by nesting on the trees and by making pupae cases on the surface of the leaves. 722 individuals were collected on bare ground, 448 individuals in bushes, 1434 individuals in burrowing, 48 individuals in muddy soil and 1097 individuals in the paddy fields of terrestrial types. Regarding aquatic type, 781 insects in ponds, 625 insects in small channels and 698 insects were collected in the paddy fields during wet seasons. As the arboreal types, 57 insects on the branches of the tree, 2073 insects in the stem of the tree and 880 insects on the leaves were collected in Hlegu (Site1). The largest composition number of 1434 insects were found to be burrows then followed by 1097 insects in the paddy fields, 722 insects on the bare ground, 448 insects in the bushes and the least 48 insects in muddy soil as terrestrial types. The largest number of 781 insects in ponds, the second largest number of 698 insects in the paddy fields and the least composition number of 625 insects in small channels as aquatic types. A total of 3749 insects as terrestrial types, 2104 insects as aquatic types and 3010 insects as arboreal types were observed during the study period (Fig. 4.13, Table 4.2).

The aquatic insects of 775 individuals in the pounds, 529 individuals in small channels and 762 individuals in the paddy fields were collected. The arboreal insects of 51 insects on the branches of the trees, 1970 insects in the stem of the tree and 816 insects on the surface of the leaves were collected in Taikkyi (Site2). The terrestrial insects collected were 948, 432, 1402, 24 and 913 on the bare ground, around bushes, in burrows, in muddy soil and in paddy field, respectively. A total of 3692 insects as terrestrial types, 2093 insects as aquatic types and 2837 insects as arboreal types were observed during the syudy period (Fig. 4.14 and 4.15,Table 4.3).

Table 4.2 Microhabitat of collected edible insects Hlegu (site1)

No	Scientific names	Terrestrial Habitat					Aquatic habitat			Arboreal habitat		
		Bare ground	**Bushes**	**Burrowing**	**Muddy**	**Fields**	**Pounds**	**Channel**	**Fields**	**Branches**	**Stem**	**On Leaves**
1.	*Acheta domesticus*	266	148	86	0	291	0	0	0	0	0	0
2.	*Gryllus assimilis*	236	142	74	0	120	0	0	0	0	0	0
3.	*Oxya hyla*	126	95	0	0	627	0	0	0	0	0	0
4.	*Heliocopris bucephalus*	22	0	62	24	26	0	0	0	0	0	0
5.	*Gryllotalpa orientalis*	72	63	12	24	33	0	0	0	0	0	0
6.	*Omphisa fuscidentalis*	0	0	0	0	0	0	0	0	0	539	0
7.	*Attacus atlas*	0	0	0	0	0	0	0	0	0	0	751
8.	*Metanastria hytaca*	0	0	0	0	0	0	0	0	0	532	0
9.	*Helicoverpa zea*	0	0	0	0	0	0	0	0	0	322	0
10.	*Rhynchophorus ferrugineus*	0	0	0	0	0	0	0	0	0	478	0
11.	*Acilius sulcatus*	0	0	0	0	0	236	340	327	0	0	0
12.	*Apogonia glabripennis*	0	0	0	0	0	0	0	0	0	202	0
13.	*Apis florea*	0	0	0	0	0	0	0	0	57	0	0
14.	*Oecophylla smaragdina*	0	0	0	0	0	0	0	0	0	0	129
15.	*Lethocerus indicus*	0	0	0	0	0	367	160	278	0	0	0
16.	*Anax junius*	0	0	0	0	0	178	125	93	0	0	0
17.	*Macrotermes darwiniensis*	0	0	1200	0	0	0	0	0	0	0	0

Table 4.3 Microhabitat of collected edible insects Taikkyi (site 2)

No	Scientific names	Terrestrial Habitat					Aquatic habitat			Arboreal habitat		
		Bare ground	Bushes	Burrowing	Muddy	Fields	Pounds	Channel	Fields	Branches	Stem	On Leaves
1.	*Acheta domesticus*	345	148	63	0	293	0	0	0	0	0	0
2.	*Gryllus assimilis*	292	138	55	0	121	0	0	0	0	0	0
3.	*Oxya hyla*	187	83	0	0	430	0	0	0	0	0	0
4.	*Heliocopris bucephalus*	22	0	62	0	36	0	0	0	0	0	0
5.	*Gryllotalpa orientalis*	102	63	37	24	33	0	0	0	0	0	0
6.	*Omphisa fuscidentalis*	0	0	0	0	0	0	0	0	0	513	0
7.	*Attacus atlas*	0	0	0	0	0	0	0	0	0	0	745
8.	*Metanastria hytaca*	0	0	0	0	0	0	0	0	0	519	0
9.	*Helicoverpa zea*	0	0	0	0	0	0	0	0	0	318	0
10.	*Rhynchophorus ferrugineus*	0	0	0	0	0	0	0	0	0	430	0
11.	*Acilius sulcatus*	0	0	0	0	0	198	235	381	0	0	0
12.	*Apogonia glabripennis*	0	0	0	0	0	0	0	0	0	190	0
13.	*Apis florea*	0	0	0	0	0	0	0	0	51	0	0
14.	*Oecophylla smaragdina*	0	0	0	0	0	0	0	0	0	0	71
15.	*Lethocerus indicus*	0	0	0	0	0	388	137	279	0	0	0
16.	*Anax junius*	0	0	0	0	0	189	157	102	0	0	0
17.	*Macrotermes darwiniensis*	0	0	1185	0	0	0	0	0	0	0	0

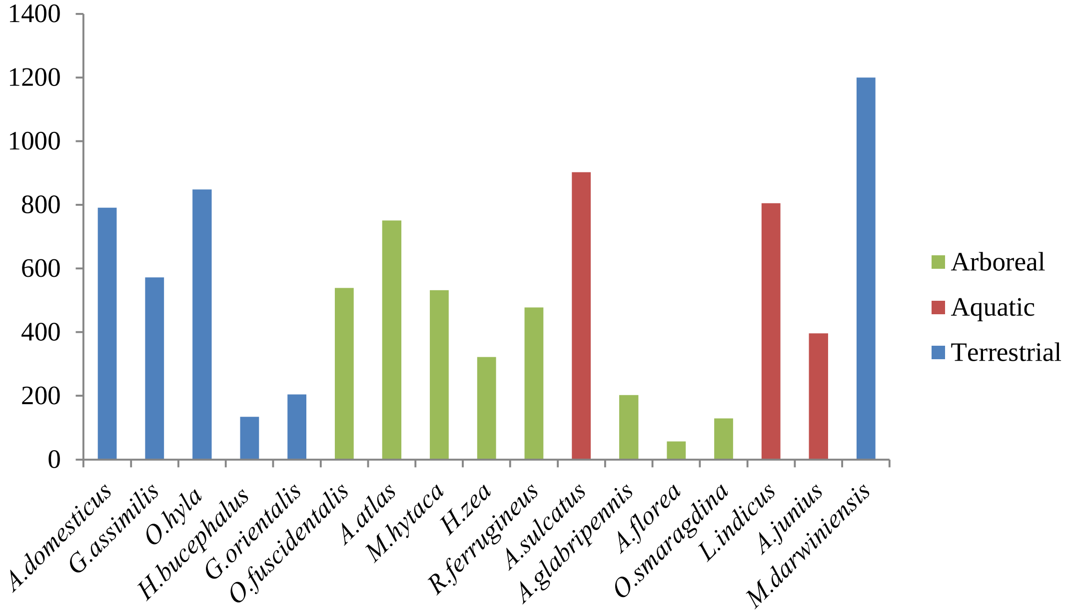


Fig. 4.13 Microhabitats of selected edible insects in Hlegu (Site 1)

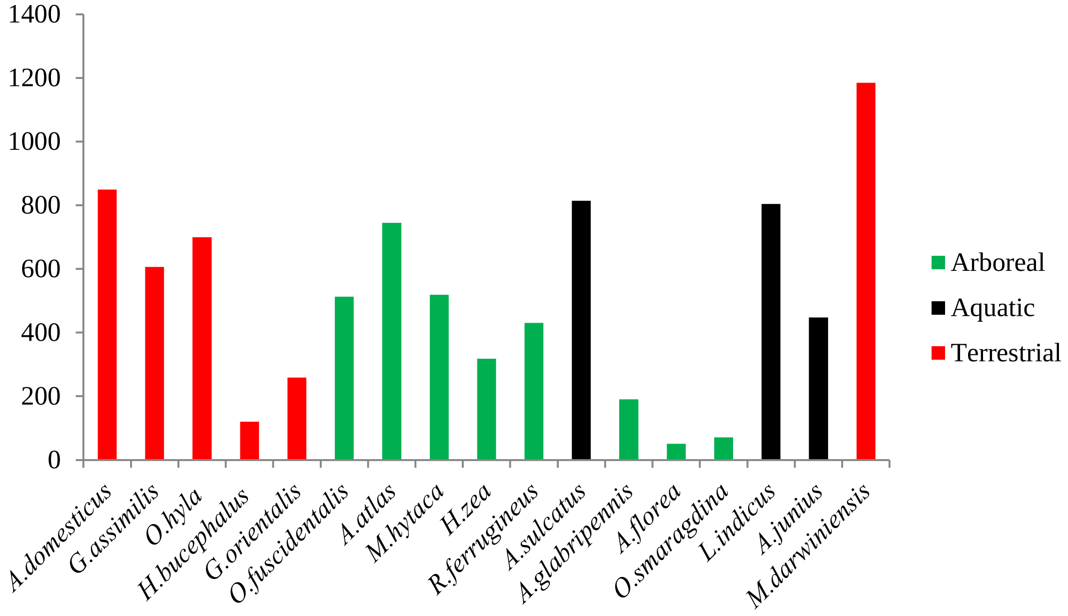


Fig. 4.14 Microhabitats of selected edible insects in Taikkyi (Site 2)

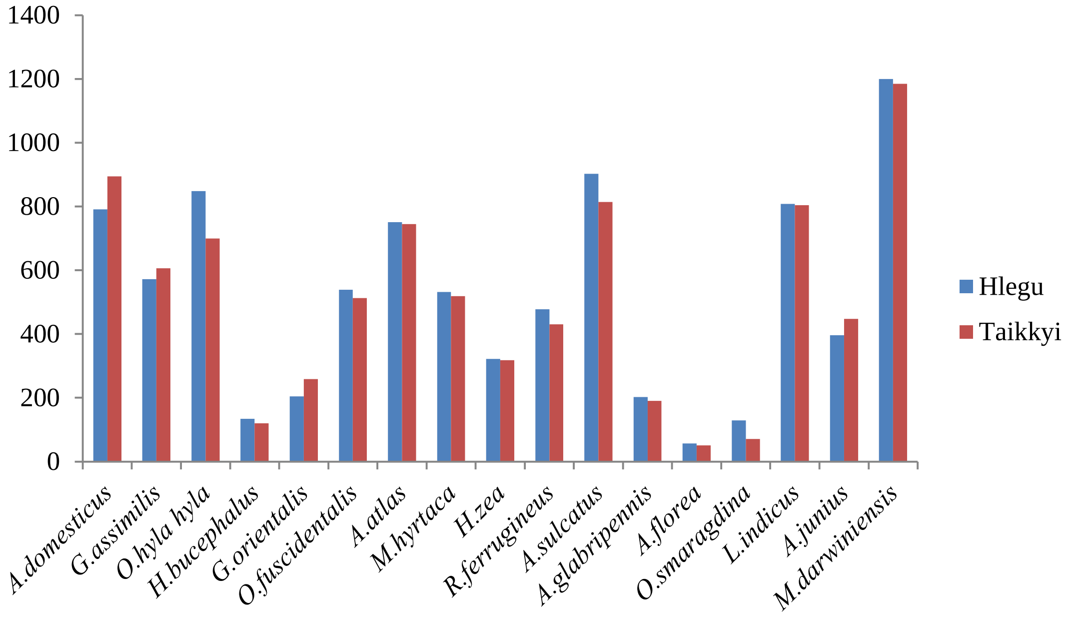


Fig. 4.15 Total recorded edible insects in both study sites from June 2012-May 2015

4.5 Population status of edible insects in the study period

The results revealed that no significant differences observed among monthly and annual population in both study sites during the study period June-2012 to May-2015. But significant difference was observed among seasonal populations.

The terrestrial habitat of edible insects in Hlegu *Acheta domesticus, Gryllus assimilis, Oxya hyla, Heliocopris bucephalus, Gryllotalpa orientalis* and *Macrotermes darwiniensis* were (F=0.095, F=0.074, F=0.038, F=2.182,F= 0.055 and F= 0.013, P>0.05) respectively. These species in Taikkyi were also showed (F=0.034, F=0.022, F=0.302, F=2.47, F=0.457, and F=0.049, P>0.05) respectively. No significant difference was observed both study sites.

The aquatic habitat of edible insects in Hlugu *Acilius sulcatus, Lethocerus indicus* and *Anax junius* were (F=0.09, F=0.049 and F=0.083 P>0.05) respectively. These species in Taikkyi were (F=0.001, F=0.032 and F=0.552, P>0.05) respectively. No significant difference was observed in both study sites.

And the arboreal habitat of edible insects in Hlegu *Omphisa fuscidentalis, Attacus atlas, Metanastria hyrtaca, Helicoverpa zea, Rhynchophorus ferrugineus, Apogonia glabripennis, Apis florea* and *Oecophylla smaragdina* were (F=0.004, F=0.075, F=0.002, F=0.011, F=0.041, F=0.019, F=0.04 and F=0.107, P>0.05) and these species in Taikkyi were (F=0.005, F=0.183, F=0.34, F=0.394, F=0.008, F=0.069, F=0.045 and F=0.227, P>0.05). Those species of both study sites were found no significant differences in the study period (Appendix I)

4.6 Population status of recorded edible insects in both study sites

The total mean population numbers of terrestrial species were *Acheta domesticus* (23.58±30.35, n=36 and 21.97±24.56, n=36), *Gryllus assimilis* (16.83±21.92, n=36 and 15.88±18.97, n=36), *Oxya hyla* (19.44±29.83, n=36 and 23.55±34.09, n=36), *Heliocopris* bucephalus (3.33±6.62, n=36 and

3.72±6.88, n=36), *Gryllotalpa orientalis* (7.19±8.64, n=36 and 5.66±8.27, n =36) and *Macrotermes darwiniensis* (32.91±48.60, n=36 and) in both study sites. No significant difference was found in both study sites (df=70, t = 0.248, t=0.195, t=-0.544, t=-0.244, t=0.766 and t=-0.036, P>0.05).

The total population numbers of aquatic species were *Acilius sulcatus* (22.61±34.12, n=36 and 25.08±36.60, n=36) *Lethocerus indicus* (22.33±32.58, n=36 and 22.36±32.53, n=36) and *Anax junius* (11.88±18.86, n=36 and 11.00±16.15, n=36) in both study sites. No significant difference was found in both study sites (df=70, t=-0.0296, t=-0.004 and t=0.215, P>0.05).

The total population numbers of arboreal species were *Omphisa fuscidentalis* (14.25±20.69, n=36 and 14.97±21.59, n=36) *Attacus atlas* (20.69±30.98 n=36 and 20.86±30.86, n=36) *Metanastria hyrtaca* (14.41±19.43, n=36 and 14.77±21.55, n=36) *Helicoverpa zea* (8.83±10.45, n=36 and 8.94±12.99, n=36) *Rhynchophorus ferrugineus* (11.94±17.67, n=36 and 13.27±19.86, n=36), *Apogonia glabripennis* (5.27±8.10, n=36 and 5.61±8.30, n=36), *Apis florea* (1.41±2.28, n=36 and 1.58±2.43, n=36) and *Oecophylla smaragdina* (1.97±3.03, n=36 and 3.58±5.35, n=36) in both study sites. No significant difference was found in both study sites (df=70, t=-0.145, t=-0.023, t=-0.075, t=-0.04, t=-0.301, t=-0.172, t=-0.3 and t=-1.569, P>0.05) (Appendix II).

4.7 Correlation between recorded edible insect and weather parameters

In the study site 1 (Hlegu), The negative correlation and highly significance were found between the species *Acheta domesticus, Gryllus assimilis, Oxya hyla, Gryllotalpa orientalis, Omphisa fuscidentalis, Metanastria hyrtaca, Helicoverpa zea,* and temperature (P<0.01).

The negative correlation and significant were found between the species *Attacus atlas, Rhynchophorus ferrugineus, Apogonia glabripennis* and temperature (P<0.05). The positive correlation and highly significant were found between the species *Helicoverpa zea, Apis florea, Oecophylla* *smaragdina*, *Macrotermes darwiniensis* and temperature (P<0.01). No correlation significant was observed between the aquatic species *Acilius sulcatus, Lethocerus indicus, Anax junius* and temperature.

The negative correlation but highly significance were found between the species *Helicoverpa zea, Apis florea, Oecophylla smaragdina*, *Macrotermes darwiniensis* and humidity (P<0.01). The positive correlation and highly significant were found between the aquatic species *Acilius sulcatus*, *Anax junius* , *Lethocerus indicus, Anax junius* and humidity (P<0.01). The rest of ten species *Acheta domesticus, Gryllus assimilis, Oxya hyla, Gryllotalpa orientalis, Omphisa fuscidentalis*, *Attacus atlas*, *Metanastria hyrtaca*, *Helicoverpa zea, Rhynchophorus ferrugineus* and *Apogonia glabripennis* were not significantly correlated with humidity.

Finally the negative correlation and highly significant were found between the species *Apis florea* and rainfall (P<0.01). The negative correlation and significant were found between the species *Oxya hyla*, *Heliocopris* bucephalus, *Gryllotalpa orientalis, Omphisa fuscidentalis, Attacus atlas, Metanastria hyrtaca*, *Helicoverpa zea, Rhynchophorus ferrugineus, Apogonia glabripennis*, *Oecophylla smaragdina, Macrotermes darwiniensis* and rainfall (P<0.05). The positive correlation and highly significant were found between the aquatic species *Acilius sulcatus*, *Anax junius*, *Lethocerus indicus, Anax junius* and rainfall (P<0.01). The rest of two species *Acheta domesticus, Gryllus assimilis* were not significantly correlated with rainfall.

In the study site 2 (Taikkyi), Pearson test showed that the negative correlation and highly significance were found between the species *Acheta domesticus*, *Gryllus assimilis*, *Oxya hyla*, *Gryllotalpa orientalis*, *Omphisa fuscidentalis, Metanastria hyrtaca*, *Helicoverpa zea*, *Rhynchophorus ferrugineus, Apogonia glabripennis* and temperature (P<0.01). The negative correlation and significance were found between the species *Attacus atlas,* and temperature (P<0.05). The positive correlation and highly significance were found between the species *Helicoverpa zea, Apis florea, Oecophylla* *smaragdina*, *Macrotermes darwiniensis* and temperature ($P<0.01$). No correlation significance was observed between the aquatic species *Acilius sulcatus, Lethocerus indicus, Anax junius* and temperature.

The negative correlation but highly significance were found between the species *Helicoverpa zea, Apis florea, Oecophylla smaragdina*, *Macrotermes darwiniensis* and humidity ($P<0.01$). The positive correlation and highly significance were found between the aquatic species *Acilius sulcatus*, *Anax junius, Lethocerus indicus, Anax junius* and humidity ($P<0.01$). The rest of ten species; *Acheta domesticus, Gryllus assimilis, Oxya hyla, Gryllotalpa orientalis, Omphisa fuscidentalis, Attacus atlas, Metanastria hyrtaca, Helicoverpa zea, Rhynchophorus ferrugineus* and *Apogonia glabripennis* were not significantly correlated with humidity.

Finally The negative correlation and significance were found between the species *Acheta domesticus*, *Gryllus assimilis, Oxya hyla, Omphisa fuscidentalis, Attacus atlas, Metanastria hyrtaca, Rhynchophorus ferrugineus, Apis florea, Apogonia glabripennis, Oecophylla smaragdina, Macrotermes darwiniensis* and rainfall ($P<0.05$). The positive correlation and highly significance were found between the aquatic species *Acilius sulcatus, Anax junius*, *Lethocerus indicus, Anax junius* and rainfall ($P<0.01$). No correlation significance was observed between the rest three species *Helicoverpa zea, Gryllotalpa orientalis, Helicoverpa zea* and rainfall (Table 4.4, 4.5) and (Fig. 4.14 to 4.30) (Appendix III).

Table 4.4 Correlation between recorded edible insects and weather parameter in Hlegu (Site 1)

Species	Temperature r value	Humidity r value	Rainfall r value
Acheta domesticus	-.453(**)	0.272	-0.256
Gryllus assimilis	-.495(**)	0.18	-0.31
Oxya hyla	-.514(**)	0.043	-.421(*)
Heliocopris bucephalus	.494(**)	-.627(**)	-.340(*)
Gryllotalpa orientalis	-.491(**)	0.044	-.419(*)
Omphisa fuscidentalis	-.505(**)	0.05	-.418(*)
Attacus atlas	-.384(*)	0.114	-.391(*)
Metanastria hytaca	-.463(**)	0.086	-.390(*)
Helicoverpa zea	-.461(**)	0.082	-.397(*)
Rhynchophorus ferrugineus	-.408(*)	0.104	-.380(*)
Acilius sulcatus	-0.044	.719(**)	.828(**)
Apogonia glabripennis	-.413(*)	0.105	-.386(*)
Apis florea	.574(**)	-.797(**)	-.455(**)
Oecophylla smaragdina	.592(**)	-.693(**)	-.384(*)
Lethocerus indicus	-0.038	.722(**)	.819(**)
Anax junius	-0.066	.719(**)	.840(**)
Macrotermes darwiniensis	.583(**)	-.726(**)	-.402(*)

*Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 4.5 Correlation between recorded edible insects and weather parameters in Taikkyi (Site 2)

Species	Temperature r value	Humidity r value	Rainfall r value
Acheta domesticus	-.555(**)	0.101	-.359(*)
Gryllus assimilis	-.583(**)	0.08	-.340(*)
Oxya hyla	-.572(**)	-0.015	-.420(*)
Heliocopris bucephalus	.470(**)	-.499(**)	-0.272
Gryllotalpa orientalis	-.607(**)	0.189	-0.137
Omphisa fuscidentalis	-.490(**)	0.061	-.408(*)
Attacus atlas	-.400(*)	0.088	-.393(*)
Metanastria hytaca	-.497(**)	0.134	-.329(*)
Helicoverpa zea	-.440(**)	0.258	-0.216
Rhynchophorus ferrugineus	-.508(**)	0.057	-.404(*)
Acilius sulcatus	-0.055	.697(**)	.876(**)
Apogonia glabripennis	-.521(**)	0.011	-.405(*)
Apis florea	.577(**)	-.690(**)	-.377(*)
Oecophylla smaragdina	.561(**)	-.647(**)	-.349(*)
Lethocerus indicus	-0.032	.715(**)	.797(**)
Anax junius	-0.021	.666(**)	.751(**)
Macrotermes darwiniensis	.581(**)	-.691(**)	-.378(*)

*Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

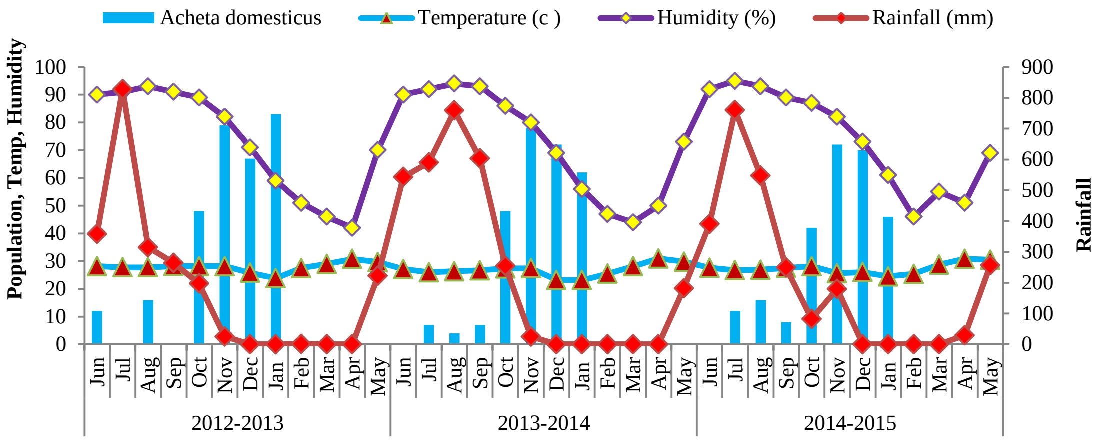


Fig. 4.16 Relation between *Acheta domesticus* and weather parameter in Takkyi

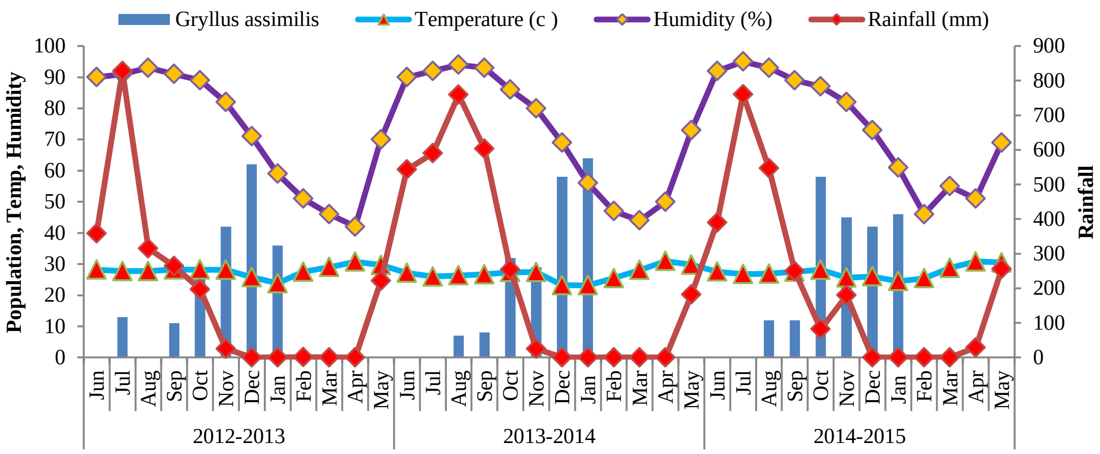


Fig. 4.17 Relation between *Gryllus assimilis* and weather parameter in Taikkyi

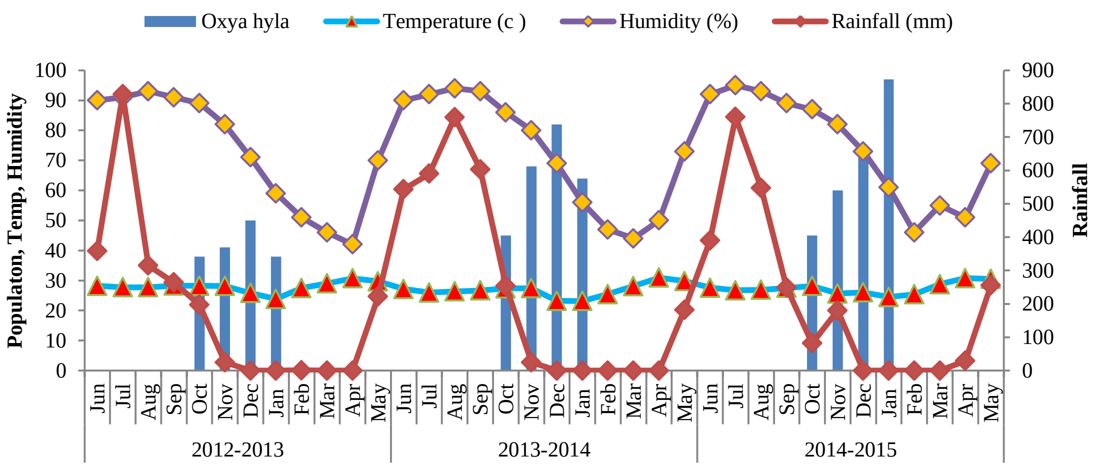


Fig. 4.18 Relation between *Oxya hyla* and weather parameter in Taikkyi

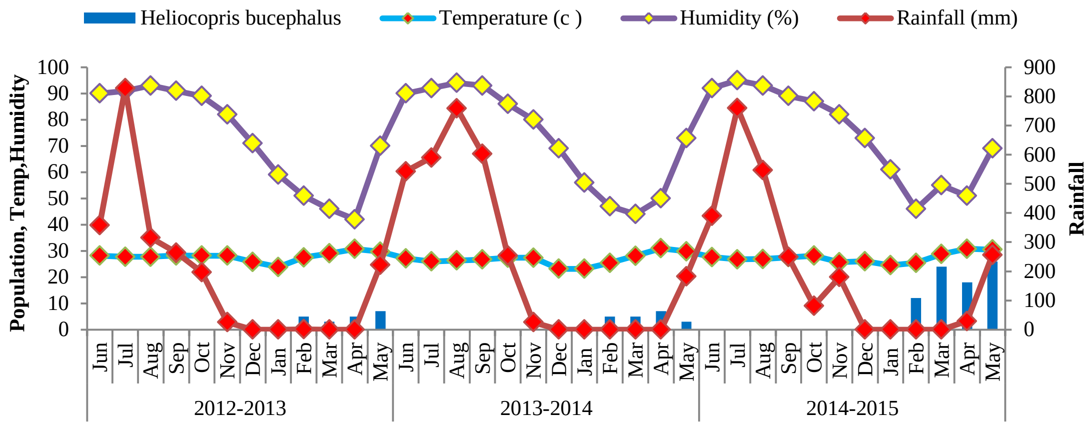


Fig. 4.19 Relation between *Heliocopris bucephalus* and weather parameter in Taikkyi

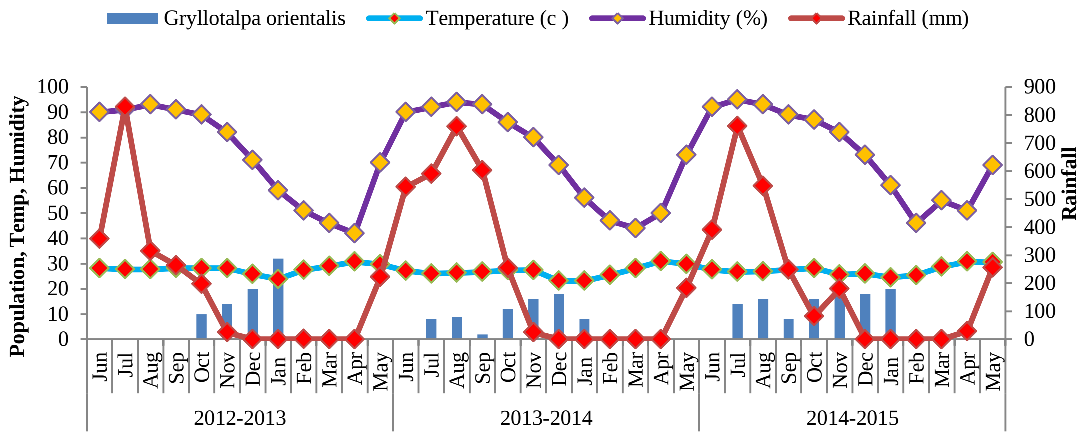


Fig. 4.20 Relation between *Gryllotalpa orientalis* and weather parameter in Taikkyi

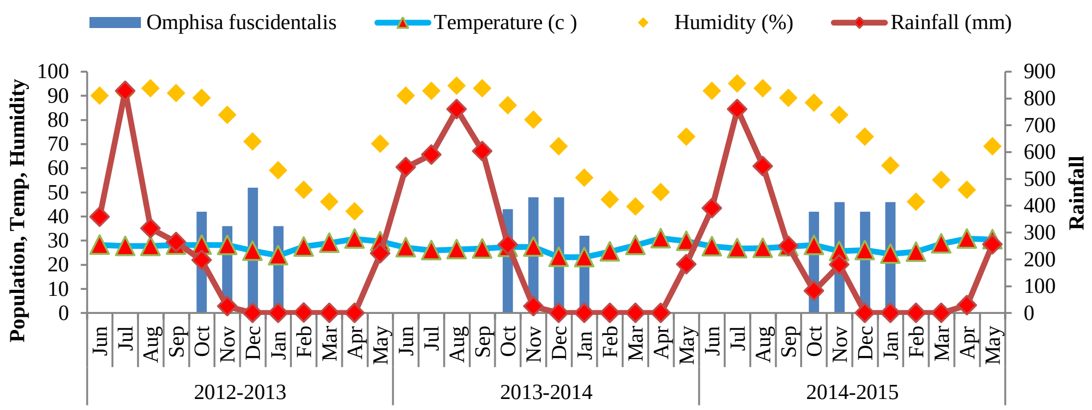


Fig. 4.21 Relation between *Omphisa fuscidentalis* and weather parameter in Taikkyi

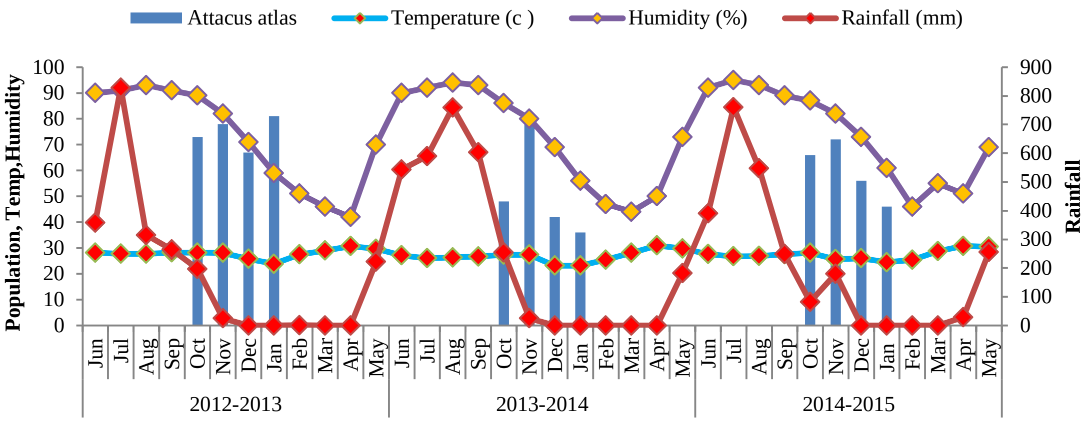


Fig. 4.22 Relation between *Attacus atlas* and weather parameter in Taikkyi

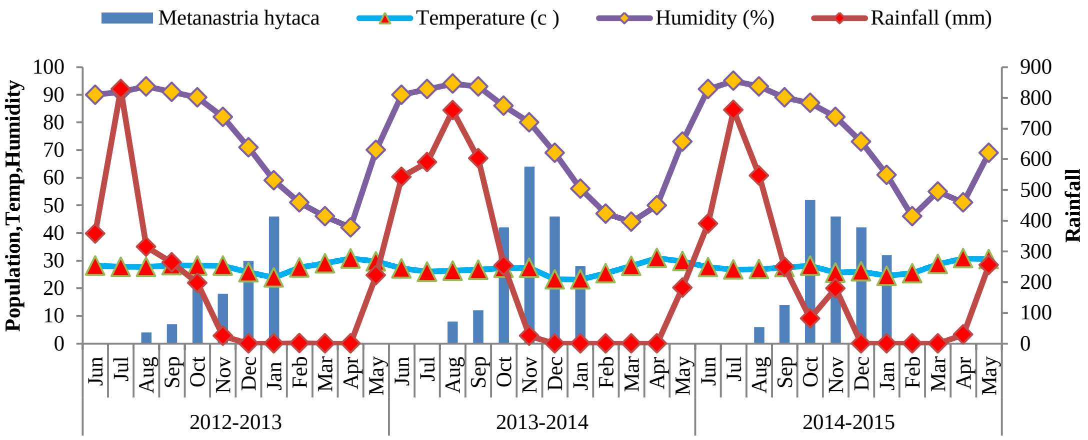


Fig. 4.23 Relation between *Metanastria hyrtaca* and weather parameter in Taikkyi

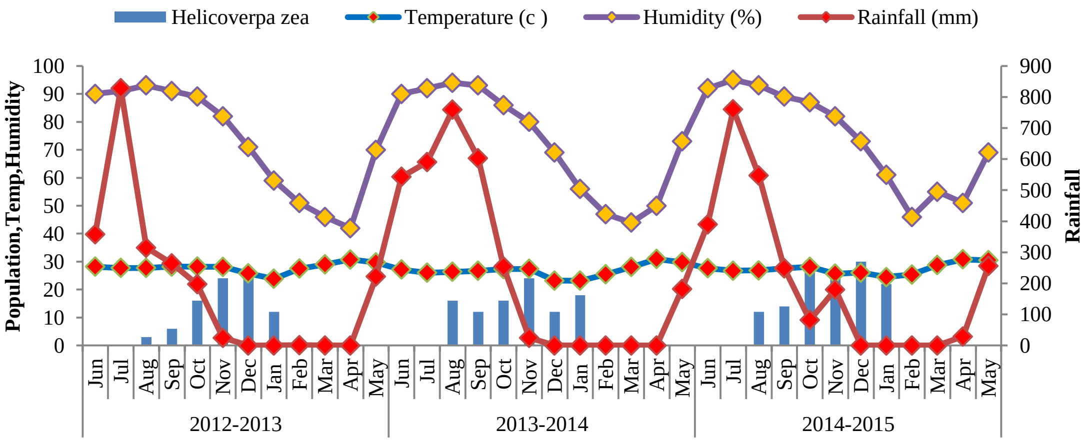


Fig. 4.24 Relation between *Helicoverpa zea* and weather parameter in Taikkyi

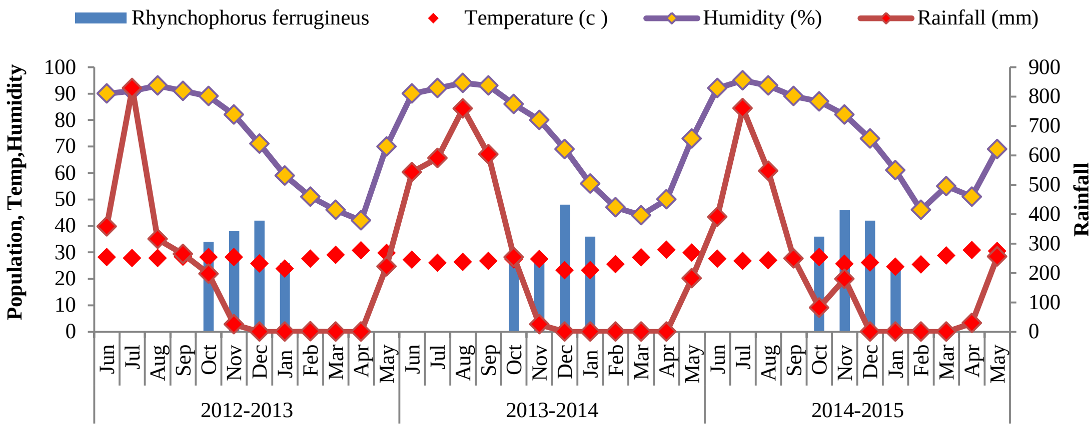


Fig. 4.25 Relation between *Rhynchophorus ferrugineus* and weather parameter in Taikkyi

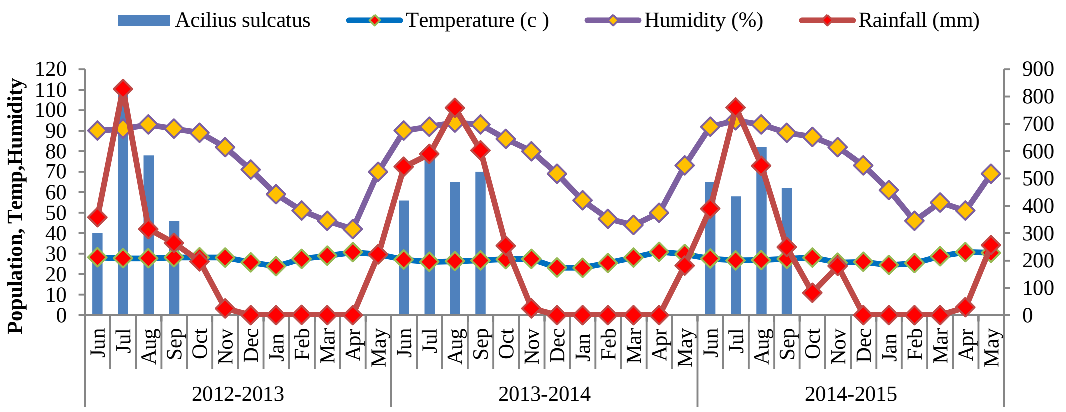


Fig. 4.26 Relation between *Acilius sulcatus* and weather parameter in Taikkyi

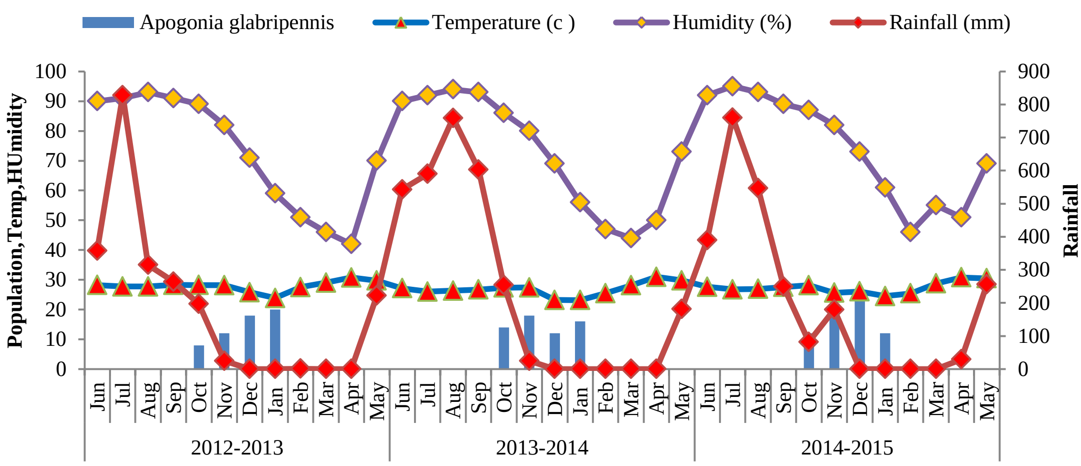


Fig. 4.27 Relation between *Apogonia glabripennis* and weather parameter in Taikkyi

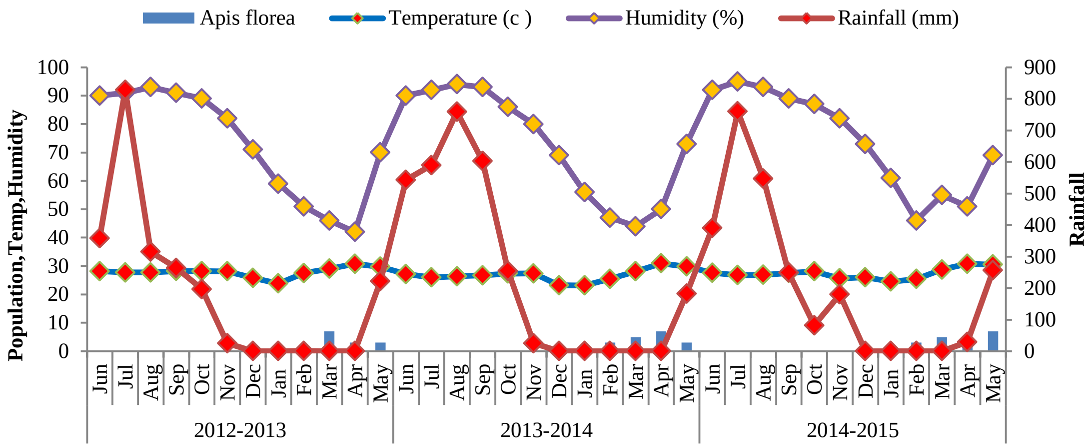


Fig. 4.28 The relation between *Apis florea* and weather parameter in Taikkyi

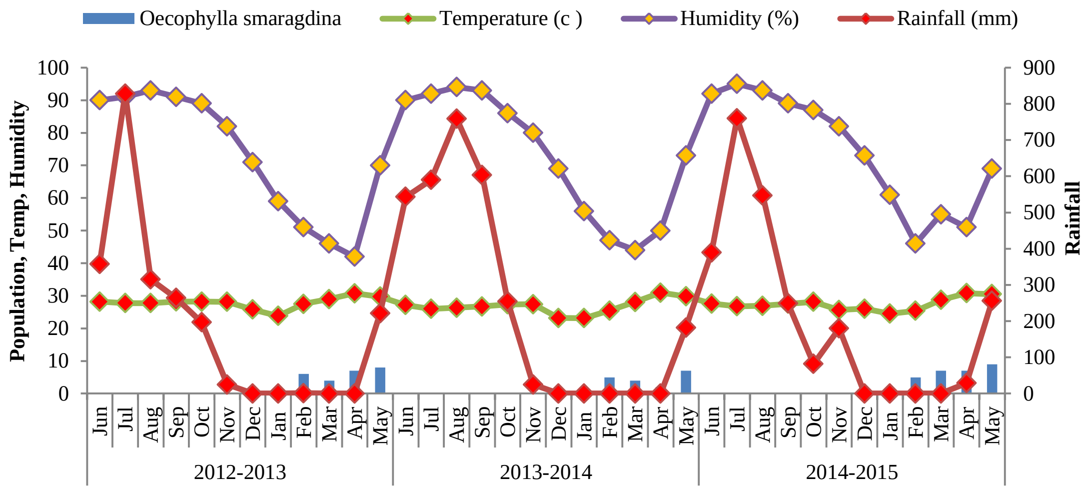


Fig. 4.29 The relation between *Oecophylla smaragdina* and weather parameter in Taikkyi

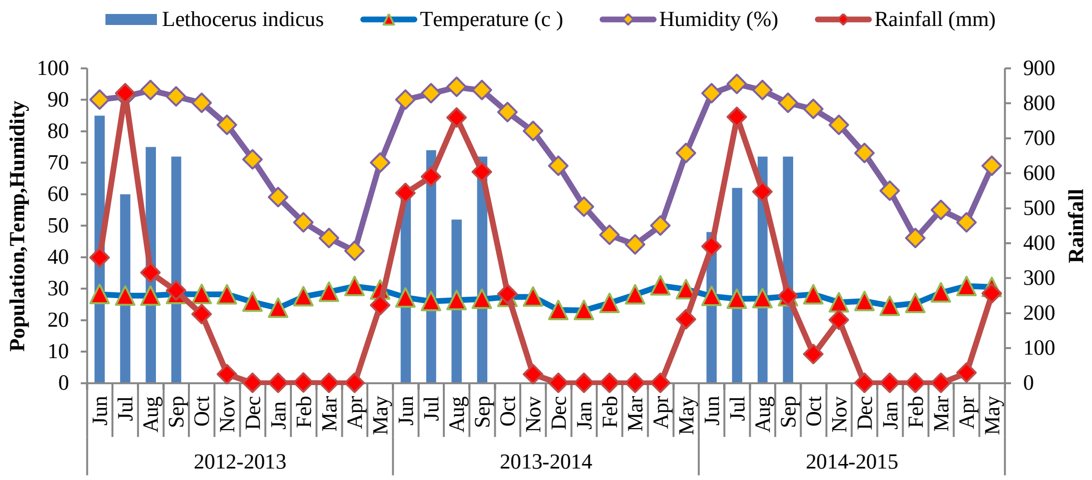


Fig. 4.30 The relation between *Lethocerus indicus* and weather parameter in Taikkyi

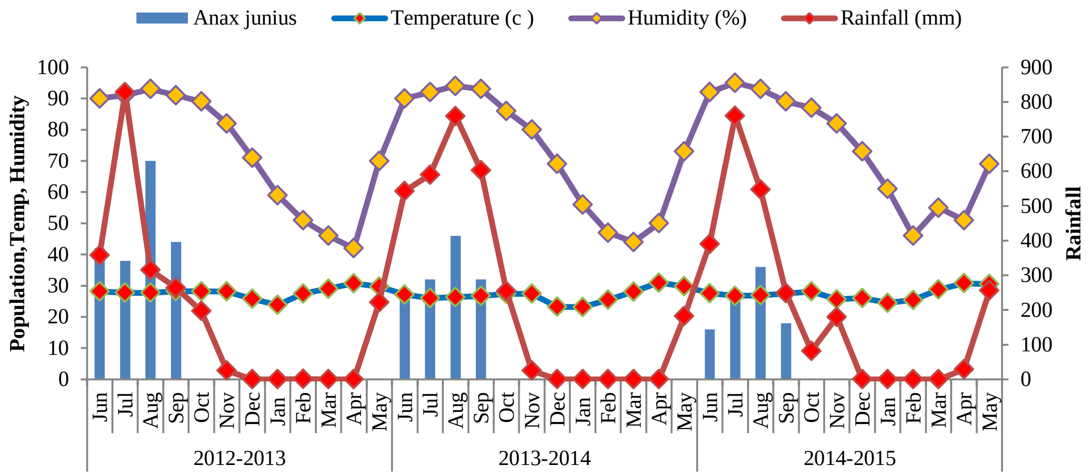


Fig. 4.31 The relation between *Anax junius* and weather parameter in Taikkyi

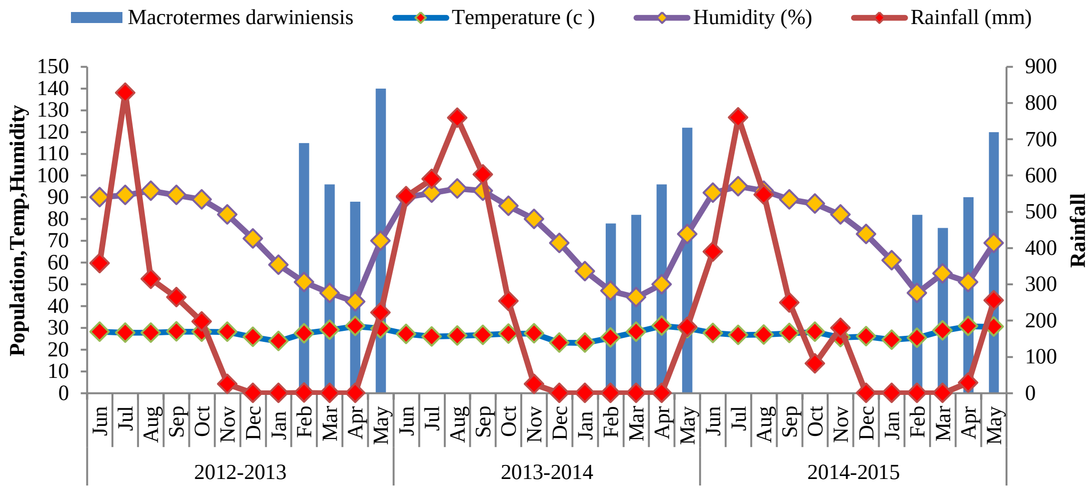


Fig. 4.32 The relation between *Macrotermes darwiniensis* and weather parameter in Taikkyi

4.8 Popular edible insects and local cooking styles of rural people

A wide range of insects were consumed at various stages of their life cycles. Aquatic insects like dragonflies, predaceous diving beetles and water scavenger beetles were eaten at the nymph stage. Weaver ants have been consumed at the stages of egg, pupa and adult. *Acheta domesticus*, *Gryllus assimilis*, *Oxya hyla*, *Omphisa fuscidentalis*, *Lethocerus indicus*, *Rhynchophorus ferrugineus*, *Anax junius*, *Acilius sulcatus*, *Heliocopris bucephalus*, and *Oecophylla smaragdina* were cooked as the popular edible insects by rural people. Ways of cooking and comsuming styles are different. Local people have used their traditional knowledge to cook each insect species in a different way either as the deep fried form or fried with spices and consumed with rice or sticky rice (Table 4.6).

Table 4.6 Popular insects and eaten parts on the selected edible insects

No.	Scientific name	Common names	Popular	Eaten part	Cooking style
1.	*Acheta domesticus*	Cricket	✓	Whole	Fried
2.	*Gryllus assimilis*	Black cricket	✓	Whole	Fried
3.	*Oxya hyla*	Grasshopper	✓	Soft parts	Fried
4.	*Heliocopris bucephalus*	Dung beetle	-	Whole	Fried
5.	*Gryllotalpa orientalis*	Mole cricket	-	Whole	Fried
6.	*Omphisa fuscidentalis*	Bamboo worm	✓	Whole	Fried
7.	*Attacus atlas*	Saturnalia	-	Whole	Fried
8.	*Metanastria hyrtaca*	Borer	✓	Whole	Fried
9.	*Helicoverpa zea*	Borer	✓	Whole	Fried
10.	*Rhynchophorus ferrugineus*	Grub	✓	Whole	Fried
11.	*Acilius sulcatus*	Water beetle	-	Soft parts	Fried
12.	*Apogonia glabripennis*	Borer	✓	Whole	Fried
13.	*Apis florea*	Bee brood	-	Pupa	Raw
14.	*Oecophylla smaragdina*	Ant and eggs	✓	Whole	Fried
15.	*Lethocerus indicus*	Water bug	-	Soft parts	Fried
16.	*Anax junius*	Dragonflies	-	Whole	Fried
17.	*Macrotermes darwiniensis*	Palu	-	Whole	Fried

4.9 Nutritional values of selected edible insects

Five kinds of nutritional values were recorded on the collected edible insects from the study areas. The highest content of protein 52 g and the second highest 39 g were recorded that in the edible insects, *Anax junius* and *Attacus atlas*, respectively.The highest content of carbohydrate 9 g was observed in *Acilius sulcatus* and *Attacus atlas*. The second highest content of carbohydrate, 8 g was found in *Apis florea*, *Rhynchophorus ferrugineus* in this study.The highest content of fat, 61g was observed in *Acheta domesticus* and *Omphisa fuscidentalis* species and the second highest 52 g was observed in *Gryllotalpa orientalis* species. Regarding energy, the maximum amount was found 649 kcal in *Acheta domesticus* followed by 641kcal, 556 kcal and 543 kcal in *Omphisa fuscidentalis, Gryllotalpa orientalis* and *Attacus atlas,* respectively. As for fiber, the maximum content was analysed as 60.72% in *Acheta domesticus* followed by 60.96%, 39.41% and 39.09% in *Omphisa fuscidentalis, Gryllus assimilis* and *Attacus atlas* (Table 4.7) and this study also investigated the other extracts such as moisture and ash content of edible insects (Table 4.8), (Fig. 4.33 to 4.40) (Appendix IV).

Table 4.7 Nutritional values content in selected edible insects on g/100g

No.	Scientific name	Protein (g)	Carbohydrate (g)	Fat (g)	Energy (kcal)	Fiber (%)
1.	*Acheta domesticus*	24	1	61	649	60.72
2.	*Gryllus assimilis*	19	1	39	431	39.09
3.	*Oxya hyla hyla*	25	3	30	382	30.03
4.	*Heliocopris bucephalus*	6	2	2	50	1.76
5.	*Gryllotalpa orientalis*	22	0.1	52	556	3.93
6.	*Omphisa fuscidentalis*	20	3	61	641	60.96
7.	*Attacus atlas*	39	9	39	543	39.41
8.	*Metanastria hyrtaca*	14	0.4	22	256	3.47
9.	*Helicoverpa zea*	20	0	17	233	8.95
10.	*Rhynchophorus ferrugineus*	12	8	23	279	22.7
11.	*Acilius sulcatus*	25	0.3	5	146	4.63
12.	*Apogonia glabripennis*	10	6	6	118	5.53
13.	*Apis florea*	9	8	7	131	7.08
14.	*Oecophylla smaragdina*	10	2	13	165	2.53
15.	*Lethocerus indicus*	22	3	8	172	8.22
16.	*Anax junius*	52	9	13	361	13.03
17.	*Macrotermes darwiniensis*	26	0	45	509	3.98

Table 4.8 Moisture and ash content of selected edible insects on g/100g

No.	Scientific name	Common names	Moisture(%)	Ash(%)
1.	*Acheta domesticus*	Cricket	7.46	2.65
2.	*Gryllus assimilis*	Black cricket	37.31	1.20
3.	*Oxya hyla*	Grasshopper	37.07	0.90
4.	*Heliocopris bucephalus*	Dung beetle	81.93	6.93
5.	*Gryllotalpa orientalis*	Mole cricket	20.44	1.63
6.	*Omphisa fuscidentalis*	Bamboo worm	11.84	0.94
7.	*Attacus atlas*	Saturnalia	4.74	5.10
8.	*Metanastria hyrtaca*	Borer	58.77	0.96
9.	*Helicoverpa zea*	Borer	58.08	1.46
10.	*Rhynchophorus ferrugineus*	Grub	58.01	0.54
11.	*Acilius sulcatus*	Water beetle	61.03	1.64
12.	*Apogonia glabripennis*	Borer	74.72	1.81
13.	*Apis florea*	Bee brood	75.63	0.82
14.	*Oecophylla smaragdina*	Ant and eggs	65.73	6.69
15.	*Lethocerus indicus*	Water bug	61.23	1.03
16.	*Anax junius*	Dragonflies	14.16	4.22
17.	*Macrotermes darwiniensis*	Palu	27.77	1.54

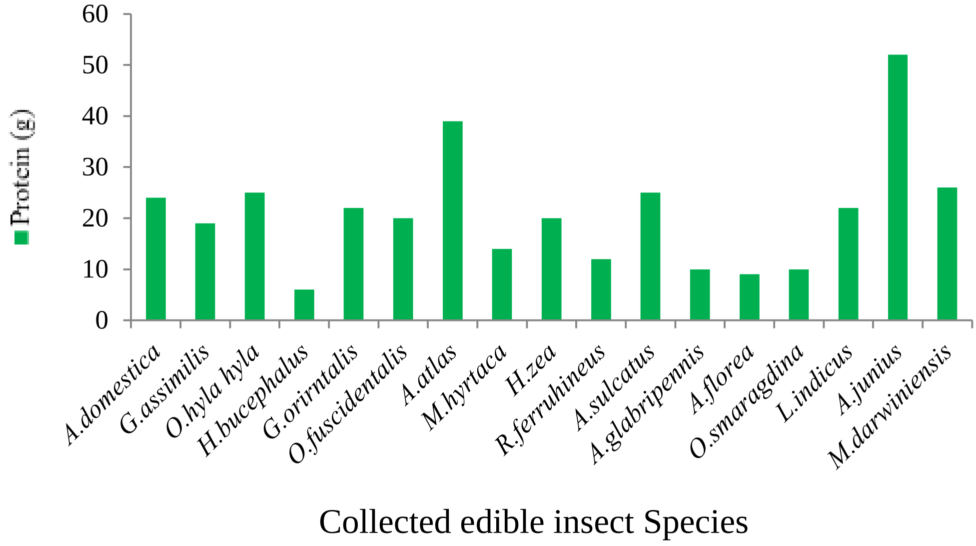


Fig. 4.33 Protein content of selected edible insects on g/100g

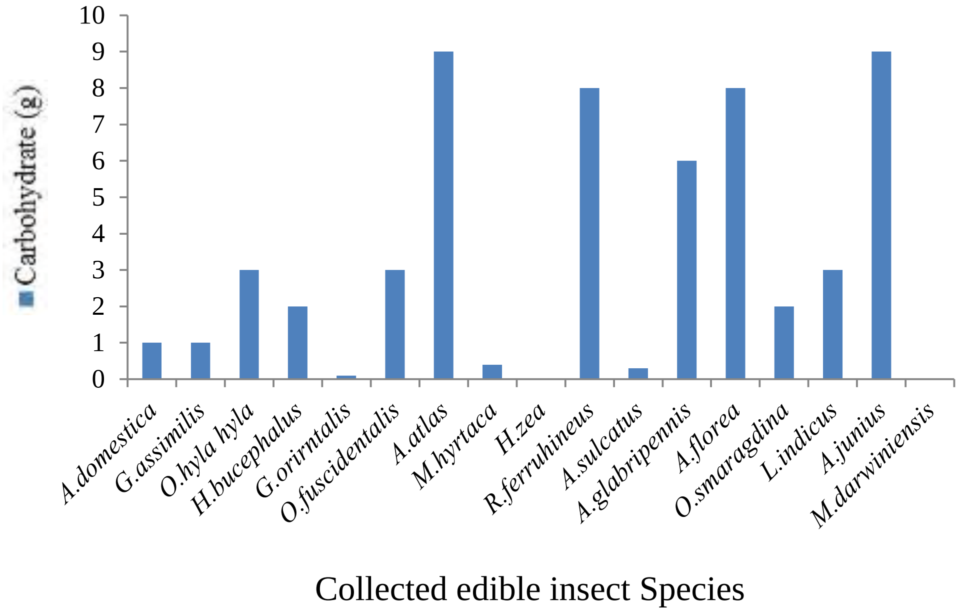


Fig. 4.34 Carbohydrate content of selected edible insect on g/100g

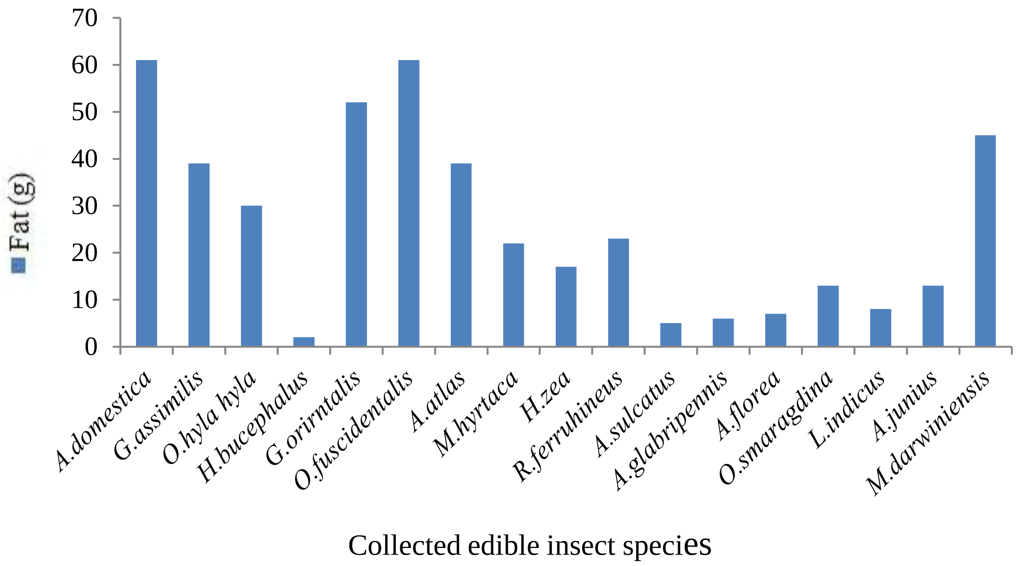


Fig. 4.35 Fat content of selected edible insect on g/100g

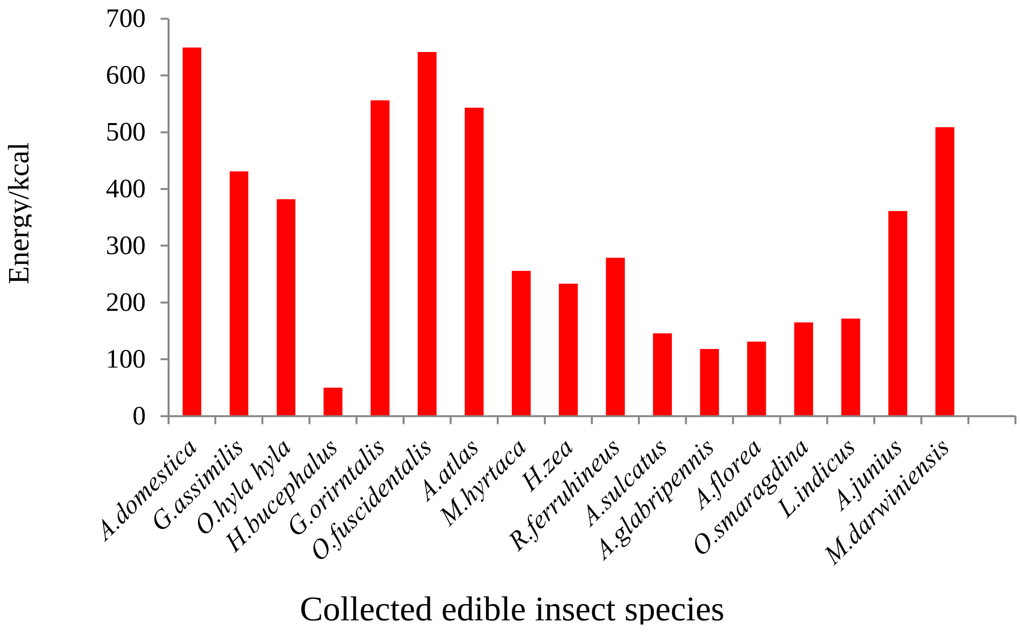


Fig. 4.36 Energy content of selected edible insects on g/100g

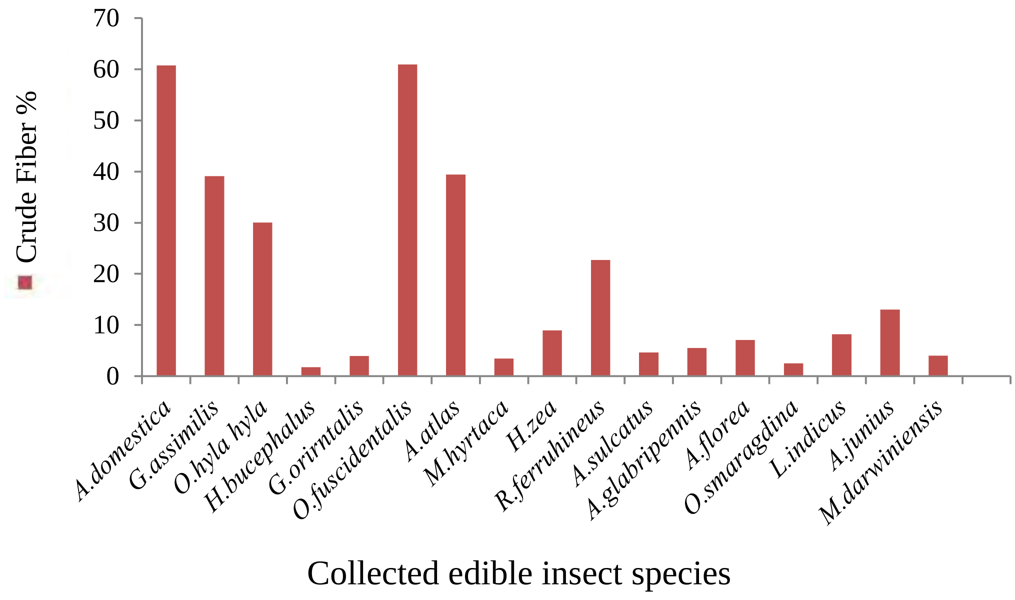


Fig. 4.37 Fibre content of selected edible insects on g/100g

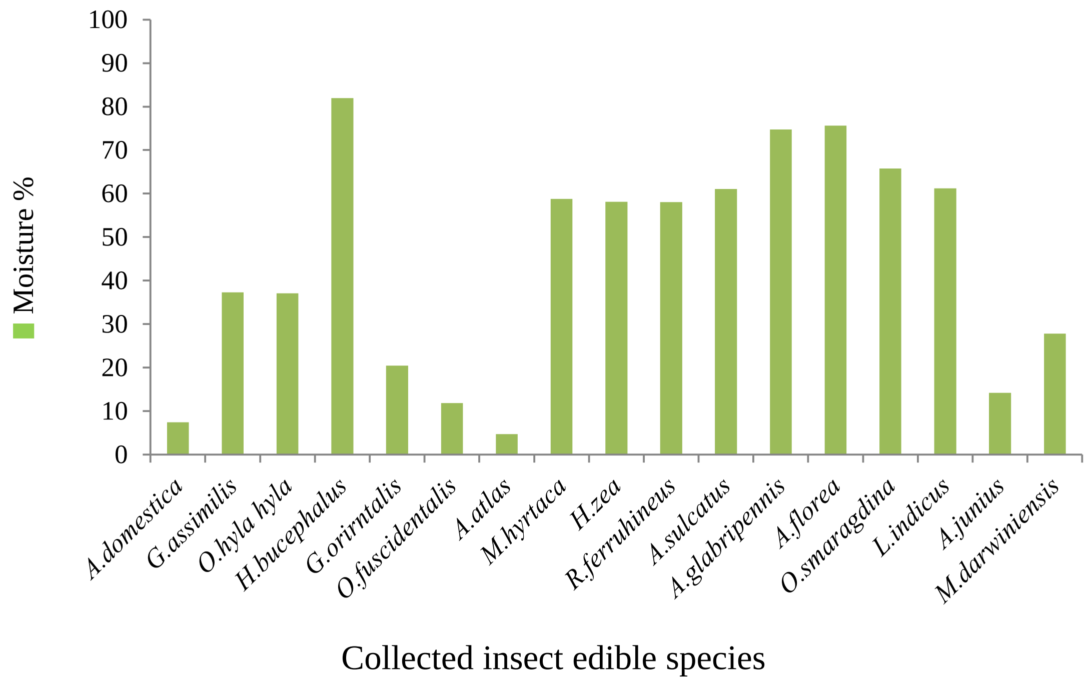


Fig. 4.38 Moisture content of selected edible insects on g/100g

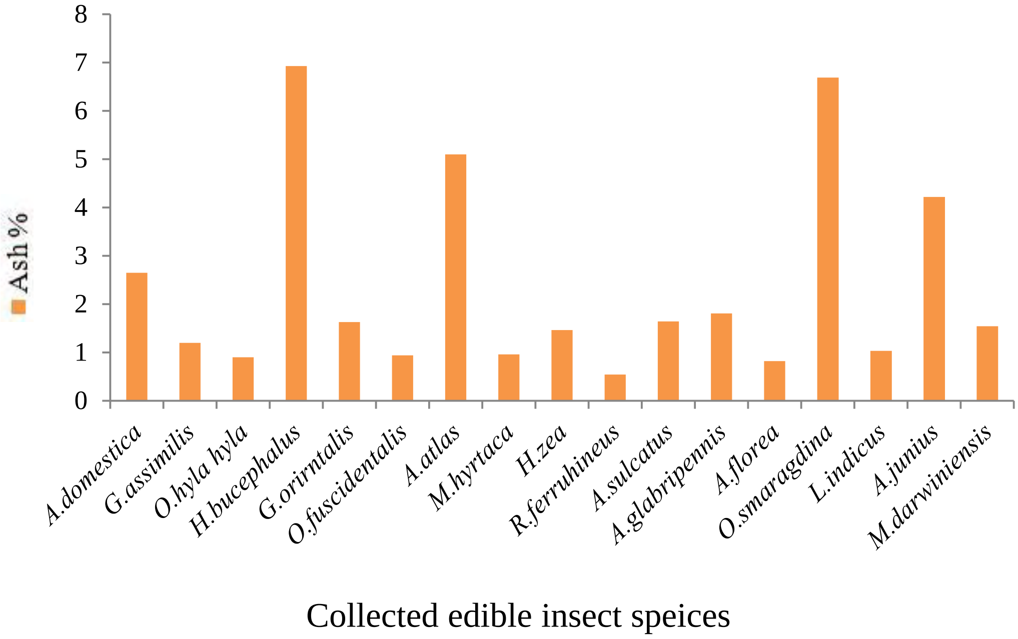


Fig. 4.39 Ash content of selcted edible insects on g/100g

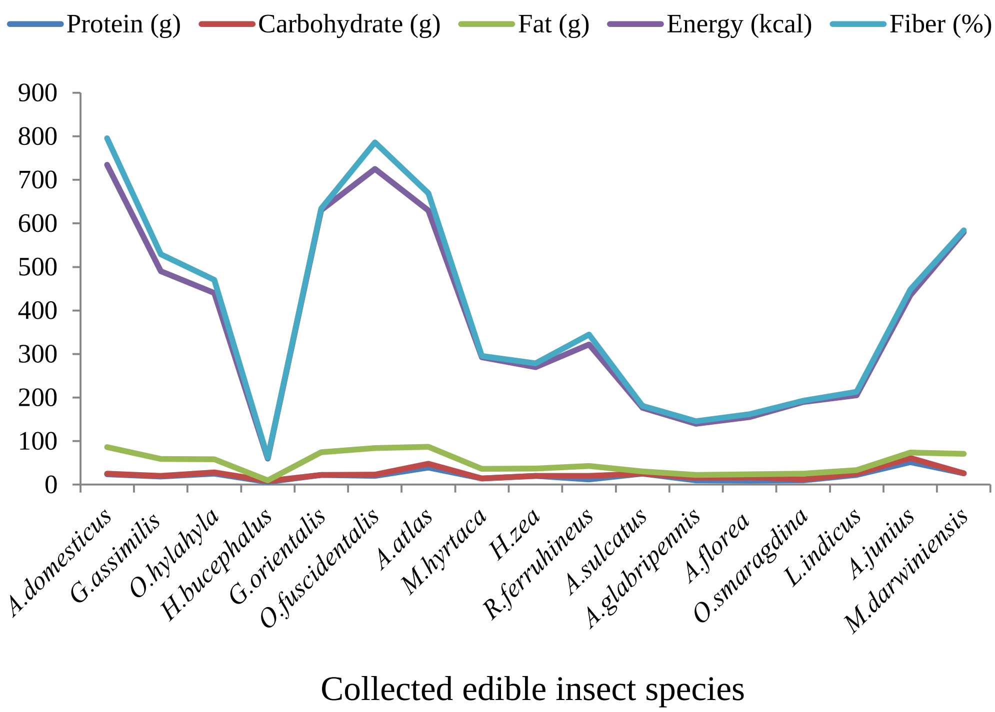


Fig. 4.40 Nutritional values content in selected edible insects on g/100g

4.10 Nutritional values content in six different food sources

Out of the six common meats, the highest energy value was analysed as 414 kcal in pork and followed by 264 kcal 247 kcal 245 kcal, 216 kcal and 185 kcal in mutton, beef, fish, prawn and chicken, respectively. As for fat, the maximum content was found as 36 gin pock and followed by 13 g 12 g , 11 g, 7 g and 5 g in fish, prawn, mutton, beef and chicken, respectively. Regarding carbohydrate 36 g was found to be highest in pork but the least in mutton as 0.3 g, while fish and prawn contain only 2 g. No carbohydrate was observed in chicken and beef. The maximum fiber content was analysed in prawn as 0.53%, while in pork, chicken, fish, beef and mutton as 0.48%, 0.19%, 0.18%, 0.5% and 0.4%, respectively (Table. 4.9, 4.10 and Figure 4.41, 4.42).

Table 4.9 Energy content in six common meats on g/100g

No.	Meat g/100g	Energy (kcal)	Protein (g)	Carbohydrate (g)	Fat (g)	Fibre (%)
1.	Chicken	185	35	0	5	0.19
2.	Pork	414	22	36	36	0.48
3.	Beef	247	46	0	7	0.05
4.	Mutton	264	41	0.3	11	0.04
5.	Fish	245	30	2	13	0.18
6.	Prawn	216	2 5	2	12	0.53

Table 4.10 Ash and Moisture content in six common meats on g/100g

No.	Meat	Ash(%)	Moisture(%)
1.	Chicken	1.61	59.10
2.	Pork	0.47	40.95
3.	Beef	1.66	46.18
4.	Mutton	1.56	45.70
5.	Fish	1.82	52.40
6.	Prawn	3.09	57.26

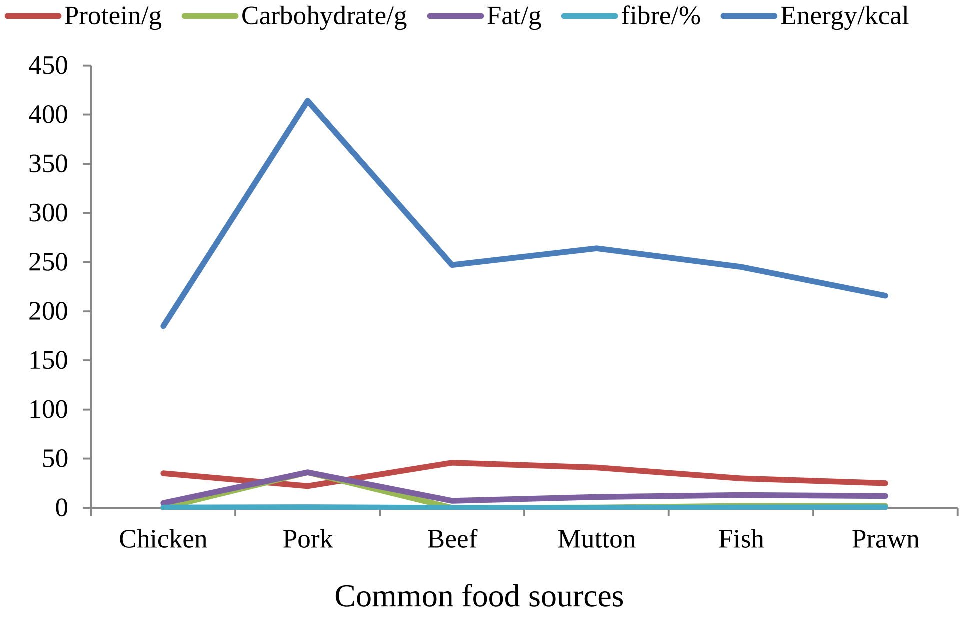


Fig. 4.41 Nutritional vlues content in six common food source

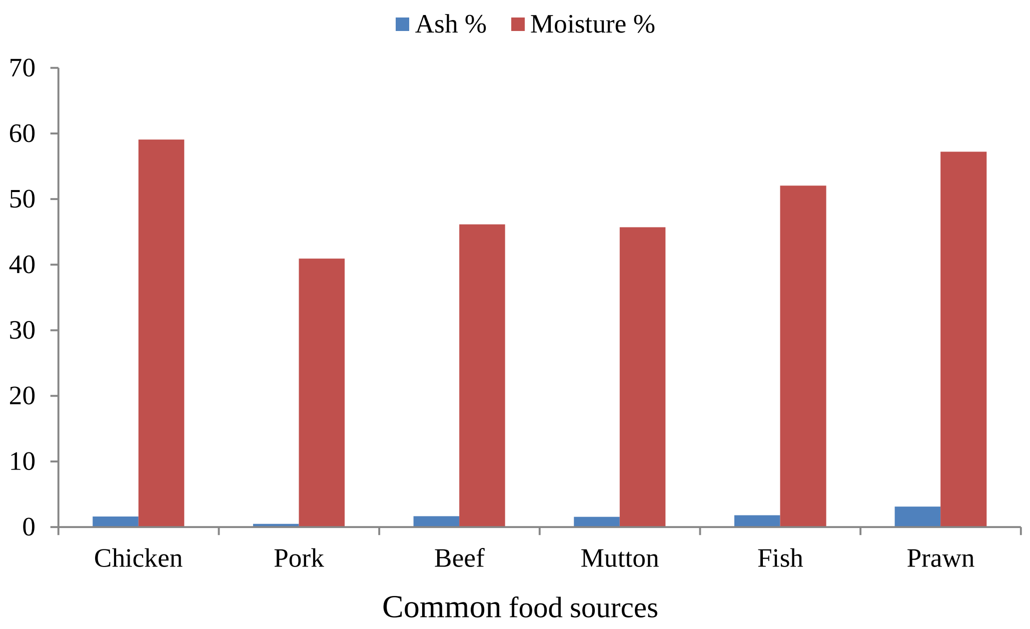


Fig. 4.42 The ash and moisture content in six common food source

4.11 Comparison of the nutritional values in edible insects with different food sources

By comparing six common meats, chicken, pork, beef, mutton, fish and prawn with 17 recorded edible insects, the amount of energy was found to be more in *Acheta domesticus* (649 kcal), *Omphisa fuscidentalis* (641 kcal), *Gryllotalpa orientalis* (556 kcal), *Attacus atlas* (543 kcal), *Macrotermes darwiniensis* (509 kcal) than that in pork (414 kcal). As for protein, *Anax junius* (52g) was found to be more protein than that in beef (46g). The carbohydrate that contains only in 15 recorded insects. Out of these insects, *Helicoverpa zea* and *Macrotermes darwiniensis* contain no carbohydrate. The maximum content (9g) was found in *Attacus atlas*, which was very much less than the content found in pork (36g). Regarding fiber content, all recorded 17 insects contain more than that in six analysed meat.

Table 4.11 Comparison of nutritional values in edible insects with food sources

No.	Scientific names	Protein (g)	Carbohydrate (g)	Fat (g)	Energy (kcal)	Fiber (%)
1.	*A.domesticus*	24	1	61	649	60.72
2.	*G.assimilis*	19	1	39	431	39.09
3.	*O.hyla hyla*	25	3	30	382	30.03
4.	*H.bucephalus*	6	2	2	50	1.76
5.	*G.orientalis*	22	0.1	52	556	3.93
6.	*O.fuscidentalis*	20	3	61	641	60.96
7.	*A.atlas*	39	9	39	543	39.41
8.	*M.hyrtaca*	14	0.4	22	256	3.47
9.	*H.zea*	20	0	17	233	8.95
10.	*R.ferrugineus*	12	8	23	279	22.7
11.	*A.sulcatus*	25	0.3	5	146	4.63
12.	*A.glabripennis*	10	6	6	118	5.53
13.	*Apis florea*	9	8	7	131	7.08
14.	*O.smaragdina*	10	2	13	165	2.53
15.	*L.indicus*	22	3	8	172	8.22
16.	*A.junius*	52	9	13	361	13.03
17.	*M.darwiniensis*	26	0	45	509	3.98
18.	Chicken	35	0	5	185	0.19
19.	Pork	22	36	36	414	0.48
20.	Beef	46	0	7	247	0.05
21.	Mutton	41	0.3	11	264	0.04
22.	Fish	30	2	13	245	0.18
23.	Prawn	25	2	12	216	0.53

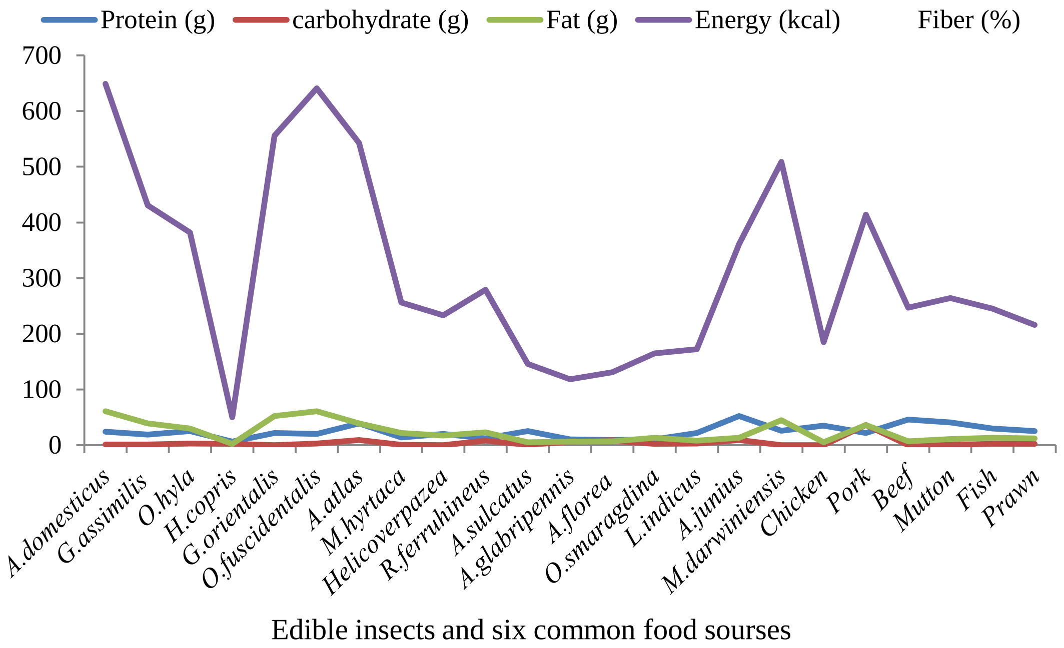


Fig. 4.43 Comparison of selected edible insects with food source

CHAPTER 5

DISCUSSION

Over 1000 species of insects are known to be eaten in 80% of the world nations. The total number of ethnic groups recorded to practice entomophagy is around 3000. FAO (2014) has registered some 1900 edible insect species and estimates there were in 2005 two billion insect consumers world-wide. In the present study, 17 species from seven order and 16 families were recorded with different population abundance and different categorize edible insects species during study period in the rural area of Hlegu and Taikkyi Townships, Yangon Region. In Myanmar, the main regions producing edible insects are Insein, Bogalay, Thein Zayet and Taung Gyi. Mandalay division is famous for its fresh crickets. These are Myanmar's favorite edible. Mon and Shan state are hotspots for border trade and exporting insects to Thailand, who import over 1.3 million USD worth of insects ever year from Myanmar, Cambodia and China. Deep fried bamboo caterpillars and palm weevil larvae are a common snack found in food stalls on the streets of Yangon. Burmese, Shan, Kayin and Chin peoples have long included insects as part of their traditional diets.

In many parts of the world where entomophagy was well established, such as tropics, communication strategies need to promote and preserve edible insects as valuable sources of nutrition in order to counter the growing of diets. In areas where food security was fragile, edible insects need to be promoted as key foods and feeds for nutritional, cultural and economic reasons. Considering the popularity of the edible insects, it was not surprising that scores of species have been and are prominent item of commerce in the town and villages of tropical and sub-tropical regions of the world (DeFoliart, 1989).

Occurrence of edible insects was recorded yearly in both study sites. Many insects were edible; however, consumption focuses on larger insects that could be collected and eaten without the use of special equipment. When the maximum temperature was 39.2 °C in April and the minimum temperature was 14.9°C in January, the humidity was 94% in August and the rainfall was

759 mm in August, the total numbers of 17 species collected were 2946 of insects in Hlegu, 2958 of insects in Taikkyi from June 2012-May 2013. When the maximum temperature was 37.8°C in April and the minimum temperature was 14.4°C in January, the humidity was 95% in August and the rainfall was 760 mm in July, 2817of insects in Hlegu, 2784 of insects were collected in Taikkyi from June 2013-May 2014. And when the maximum temperature was 38°C in April and the minimum temperature was 16.3°C, the humidity was 93% in August and 828 mm in July, 3100 of insects in Hlegu, 2880 of inssects in Taikkyi were collected from June 2014-May 2015.

Insects were occurred seasonally *Acheta domesticus, Gryllus assimilis, Oxyahyla*, *Gryllotalpa orientalis, Omphisa fuscidentalis, Attacus atlas, Metanastria hyrtaca*, *Helicoverpa zea*, *Rhynchophorus ferrugineus* and *Apogonia glabripennis* were collected by groups in cool season. *Acilius sulcatus, Lethocerus indicus* and *Anax junius* were collected abundantly in wet season. *Heliocopris bucephalus, Apis florea, Oecophylla smaragdina* and *Macrotermes darwiniensis* were recorded by groups in dry season. Among them ten species of edible insects were found in cool season abundantly. Three species of edible insects were recorded in both study sites in wet season. Four kind species of edible insects were recorded dry season. There was the total of 2104 of 17 species in Hlegu, 2382 of insects in Taikkyi in wet seasons. There was the total of 5439 of 17 species in Hlegu, 4813 of insects in Taikkyi in cool seasons. And there was the total of 1520 of 17 species in Hlegu, 1427 of insects in Taikkyi in dry seasons of the whole study period. According to the results, seasonal distribution of edible insects was the maximum in cool season may be due to availability of suitable food sources and good weather conditions in cool season.

Although a number of insect was available throughout the year, some could only be obtained for a short season, dependent either on weather or other natural circumstances (Banjo *et al*., 2006). The capturing, processing, transporting and marketing of edible forest insects provided interesting income and livelihood opportunities for several of people around the study sites. Considerable challenges and barriers remained, forest insects as human food is more widely promoted. Various stages of insects are collected for food: eggs, larvae or nymphs, pupae or adults. Insect products, such as honey and pollen, are sought after as nutritional food. Local people also used certain insects and insect products as medicine because it was difficult to find treatment from a doctor in very remote areas. Insects were often collected for food when they were abundant and easily obtainable in the field. The methods for preparing the insects as food were highlighted (Sutton, 1995). The finding of the present study is agreeable with what Sutton mentioned.

In the present study, three types of habitats: terrestrial, aquatic and arboreal were considered for the habitats of edible insects. According to survey results, six species were observed as the terrestrial, three were recorded as aquatic and the remaining eight were arboreal type. *Acheta domesticus*, *Gryllus assimilis*, *Oxya hyla, Heliocopris bucephalus*, *Gryllotalpa orientalis* and *Macrotermes darwiniensis* were terrestrial types. *Acilius sulcatus*, *Lethocerus indicus* and *Anax junius* were aquatic types and *Omphisa fuscidentalis*, *Attacus atlas*, *Metanastria hyrtaca*, *Helicoverpa zea*, *Rhynchophorus ferrugineus*, *Apogonia glabripennis*, *Apis florea* and *Oecophylla smaragdina* were arboreal types. And this study also studied microhabitats of edible insects most terrestrial type were collected from the bare ground, bushes, burrows, muddy soil and the fields. The three aquatic species were collected from the ponds, small channels and fields. And the arboreal insects were collected from the stem, branches and the surface of the leaves.

The increased or decreased in the population of insects could be affected by the local climate condition directly or indirectly. In the present study the correlation between collected 17 species and three key environmental factors such as temperature, humidity and rainfall showed some significant correlations. According to the results, for the temperature, the aquatic insects such as *Acilius sulcatus*, *Lethocerus indicus* and *Anax junius* showed no correlation to the temperature. Because freshwater habitats were narrower than in most terrestrial habitats. Among the 17 edible species, only seven of them such as *Heliocopris bucephalus*, *Acilius sulcatus*, *Apis florea*, *Oecophylla smaragdina, Lethocerus indicus, Anax junius,* and *Macrotermes darwiniensis* were correlated and highly significant with humidity. The rest ten species such as *Achetadomesticus*, *Gryllus assimilis*, *Oxya hyla*, *Gryllotalpa orientalis, Omphisa fuscidentalis*, *Attacus atlas*, *Metanastria hyrtaca*, *Helicoverpa zea*, *Rhynchophorus ferrugineus*, were not correlated significantly with humidity. From the observation in this study only the three aquatic species, *Acilius sulcatus, Lethocerus indicus, Anax junius* showed positively correlated and highly significant with the rainfall. *Achetadomesticus* and *Gryllus assimilis* were no correlated in Hlegu but *Heliocopris bucephalus*, *Gryllotalpa orientalis* and *Helicoverpa zea* were no correlated and significant with the rainfall in Taikkyi.

Insects offered particular benefits to those who wanted to reduce their environmental footprint, because they were exceptionally efficient in converting what they eat into tissue that can be consumed by others-about twice as efficient as chickens and pigs, and more than five times as efficient as beef cattle. As a food source, insects were highly nutritious. Edible insects provided essential macronutrients, such as energy, protein, carbohydrates, fat and fiber that could help to daily diets. Based on the study of the nutritive values of insect species, they are eaten selectively (Bodenheimer, 1951; Paoletti, 2005). Their findings are more or less agreeable to those of this study.

Edible insects are a food source that continues to be tapped extensively by populations in the Third World (DeFoliart, 1991, 1989). Considering the population of the edible insects, it is not surprising that scores of species have been and are prominent items of commerce in the town and village markets. It is important to note that insects are high in protein, energy and vitamins and minerals World (DeFoliart, 1989). The quantity and quality of proteins, lipids, vitamins, minerals and calories present in edible caterpillars are comparable to those of beef, fish, pork, chicken, milk and eggs (DeFoliart, 1991). Due to the wide diversity and origin of insects, especially those harvested from the wild, in general it was difficult to get them all in one time. The present work recorded the total of edible were 8863 in Hlegu and 8622 in Taikkyi in the study period. Edible insects were sold using spoons, milk tin or just placed in heaps with prices depending on the unit measure. A wide range of insects is consumed at various stages of their life cycles. They can be cooked in various ways and served as side or main dishes. Insects that were edible in a raw state or that require minimal cooking were preferred. The people in those areas consumed the edible insects mostly by frying. The results of this study have shown that edible insects are prominent items of commerce in some places of Yangon Region.

And finally this study investigated the nutritional qualities of 17 selected edible insects in the both sites. Proximate analyses were carried out to determine the nutritive values (dry matter, crude protein, crude fiber and ash of selected edible insects in the study sites. Five kinds of nutritional values recorded on the collected edible insects from the study area. Many insect species contained as much - or more - protein as meat or fish. Some insects, especially in the larval stage, are also rich in fat. Insects that are collected from forest areas are generally clean and free of chemicals, and in some areas are even considered to be health foods. The highest content of protein 52 g in *Anax junius* and the second highest content of protein 39 g in *Attacus atlas* were recorded. The edible insect, *Anax junius* was more protein than in beef. In carbohydrate, the highest content by 9 g was observed in *Anax junius* and *Attacus atlas* were more carbohydrate than in fish and prawn. Similarly the highest consistent of fat was also observed in *Acheta domesticus* and *Omphisa fuscidentalis* species were more than in pork. The highest fiber content in edible insect was observed more than in prawn. In the present study, the fiber content in edible insects ranged from 1.76% to 60.96%. Similarly, the content of energy in edible insects was recorded more than in pork in this research. In the above comparison, insects were prominently contained of high nutritional values than in common food sources.

SUMMARY

1. In the present study, 17 species from seven order and 16 families were recorded with different population abundance and different categorize edible insects species during the study period in the rural area of Hlegu and Taikkyi townships in Yangon Region.
2. The total number of edible insects was 8863 individuals in Hlegu and 8622 individuals in Taikkyi collected in the study period.
3. Regading seasonal occurrence, the population of *Heliocopris bucephalus, Apis florea, Oecophylla smaragdina* and *Macrotermes darwiniensis* were collected more in dry season whereas the population of *Lethocerus indicus*, *Acilius sulcatus*, and *Anax junius* were collected more in wet season. The population of *Acheta domesticus, Gryllus assimilis, Omphisa fuscidentalis, Rhynchophorus ferrugineus, Attacus atlas, Oxya hyla*, *Apogonia glabripennis*, *Gryllotalpa orientalis, Metanastria hyrtaca* and *Helicoverpa zea* were collected more in cool season.
4. Three types of habitats were recorded that terrestrial and aquatic and arboreal types in the study areas. According to survey results, six species were observed as the terrestrial species and three species of aquatic species and eight species were arboreal types.
5. *Acheta domesticus, Gryllus assimilis, Omphisa fuscidentalis, Lethocerus indicus*, *Rhynchophorus ferrugineus*, *Oxya hyla*, *Anax junius*, *Acilius sulcatus*, *Heliocopris bucephalus*, and *Oecophylla smaragdina* were cooked as the popular edible insects of rural people. Local rural people have consumed by selecting the different stages and soft body parts on the selected edible insects.
6. According to the results, the aquatic insects, such as *Acilius sulcatus, Lethocerus indicus* and *Anax junius,* showed no correlation with the temperature. Among the 17 edible species, only seven of them such as *Heliocopris bucephalus, Acilius sulcatus, Apis florea, Oecophylla smaragdina, Lethocerus indicus, Anax junius,* and *Macrotermes*

darwiniensis were correlated and significant with humidity. The rest ten species were not correlated with humidity. In accordance with rainfall, *Achetadomesticus* and *Gryllus assimilis* were no correlated in Hlegu but *Heliocopris bucephalus, Gryllotalpa orientalis* and *Helicoverpa zea* were no correlated in Taikkyi.

7. Five kinds of nutritional values were recorded on the collected edible insects from the study area. The highest content of protein 52 g and the second highest content of protein 39 g were recorded that in the edible insects, *Anax junius* and *Attacus atlas*, receptively. For carbohydrate, highest content of 9 g was observed in *Anax junius* and *Attacus atlas*. The second highest content of carbohydrate, 8 g was found in *Apis florea, Rhynchophorus ferrugineus* in this study.

8. Similarly the highest consist of fat, 61g was also observed in *Acheta domesticus* and *Omphisa fuscidentalis* species and the second highest amount of fat, 52g was observed in *Gryllotalpa orientalis* species. But, the highest amount of energy, 649 kcal and 641kcal as well as fiber, 60.72% and 60. 96% *Acheta domesticus* and *Omphisa fuscidentalis* were recorded in study site. Similar to the third and fourth highest number of energy, 556 kcal and 543kcal in *Gryllotalpa orientalis* and *Attacus atlas* were investigated, respectively. The third and fourth highest number of fiber, 39.09% and 39.41% in *Gryllus assimilis* and *Attacus atlas* were investigated, respectively.

9. *Anax junius* contains more protein than in beef. As for carbohydrate, the highest content by 9 g was observed in *Anax junius* and *Attacus atlas*is in which more carbohydrate than in fish and prawn. Similarly the highest content of fat was also observed in *Acheta domesticus* and *Omphisa fuscidentalis* species which was more than in pork. The highest content of fiber in edible insect was observed more than that in prawn. Moreover, the amount of energy in edible insects was recorded more than that in pork in this research.

SUGGESTIONS FOR FUTURE WORKS

1. Identification of edible insects should be carried out based on molecular analysis.
2. Seasonal changes of edible insect population in various areas of Myanmar should be conducted.
3. Ecological aspects of edible insects should be studied in Myanmar.

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APPENDICES

APPENDIX I

Hlegu

Descriptives

1. *Acheta domesticus*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	21.5000	24.57086	7.09300	5.8884	37.1116	.00	72.00
2013-2014	12	20.0000	22.25064	6.42321	5.8626	34.1374	.00	63.00
2014-2015	12	24.4167	28.45557	8.21442	6.3369	42.4965	.00	68.00
Total	36	21.9722	24.56186	4.09364	13.6617	30.2828	.00	72.00

ANOVA

Acheta domesticus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	121.056	2	60.528	.095	.909
Within Groups	20993.917	33	636.179		
Total	21114.972	35			

Descriptives

2.*Gryllus assimilis*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	17.0833	22.66137	6.54178	2.6850	31.4817	.00	50.00
2013-2014	12	14.1667	16.81359	4.85367	3.4838	24.8495	.00	42.00
2014-2015	12	16.4167	18.54458	5.35336	4.6340	28.1993	.00	44.00
Total	36	15.8889	18.97183	3.16197	9.4697	22.3080	.00	50.00

ANOVA

Gryllus assimilis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	56.056	2	28.028	.074	.929
Within Groups	12541.500	33	380.045		
Total	12597.556	35			

Descriptives

3.Oxya hyla

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	22.3333	33.23288	9.59351	1.2182	43.4485	.00	78.00
2013-2014	12	22.5000	33.60871	9.70200	1.1460	43.8540	.00	80.00
2014-2015	12	25.8333	38.17384	11.01984	1.5788	50.0878	.00	80.00
Total	36	23.5556	34.09939	5.68323	12.0180	35.0931	.00	80.00

ANOVA

Oxya hyla

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	93.556	2	46.778	.038	.963
Within Groups	40603.333	33	1230.404		
Total	40696.889	35			

Descriptives

4. *Heliocopris bucephalus*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	7.0000	10.65150	3.07482	.2324	13.7676	.00	27.00
2013-2014	12	2.1667	3.24271	.93609	.1063	4.2270	.00	7.00
2014-2015	12	2.0000	3.01511	.87039	.0843	3.9157	.00	7.00
Total	36	3.7222	6.88108	1.14685	1.3940	6.0504	.00	27.00

ANOVA

Heliocopris bucephalus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	193.556	2	96.778	2.182	.129
Within Groups	1463.667	33	44.354		
Total	1657.222	35			

Descriptives

5. *Gryllotalpa orientalis*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	6.3333	9.37437	2.70615	.3771	12.2895	.00	20.00
2013-2014	12	5.3333	8.04909	2.32357	.2192	10.4475	.00	20.00
2014-2015	12	5.3333	8.01514	2.31377	.2408	10.4259	.00	18.00
Total	36	5.6667	8.27043	1.37840	2.8684	8.4650	.00	20.00

ANOVA

Gryllotalpa orientalis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.000	2	4.000	.055	.946
Within Groups	2386.000	33	72.303		
Total	2394.000	35			

Descriptives

6. *Omphisa fuscidentalis*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	14.5833	21.68560	6.26009	.8050	28.3617	.00	50.00
2013-2014	12	15.4167	22.90875	6.61319	.8611	29.9722	.00	50.00
2014-2015	12	14.9167	22.10495	6.38115	.8719	28.9615	.00	48.00
Total	36	14.9722	21.59694	3.59949	7.6649	22.2796	.00	50.00

ANOVA

Omphisa fuscidentalis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.222	2	2.111	.004	.996
Within Groups	16320.750	33	494.568		
Total	16324.972	35			

7 *Attacus atlas*

Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	21.0833	32.01550	9.24208	.7417	41.4250	.00	78.00
2013-2014	12	18.2500	27.94190	8.06613	.4966	36.0034	.00	68.00
2014-2015	12	23.2500	34.82195	10.05223	1.1252	45.3748	.00	80.00
Total	36	20.8611	30.86945	5.14491	10.4164	31.3058	.00	80.00

ANOVA

Attacus atlas

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	150.889	2	75.444	.075	.928
Within Groups	33201.417	33	1006.104		
Total	33352.306	35			

Descriptives

8. *Metanastria hytaca*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	14.5000	21.66480	6.25409	.7348	28.2652	.00	50.00
2013-2014	12	15.0000	22.86323	6.60005	.4734	29.5266	.00	55.00
2014-2015	12	14.8333	22.06121	6.36852	.8163	28.8504	.00	50.00
Total	36	14.7778	21.55937	3.59323	7.4831	22.0724	.00	55.00

ANOVA

Metanastria hytaca

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.556	2	.778	.002	.998
Within Groups	16266.667	33	492.929		
Total	16268.222	35			

9. *Helicoverpa zea*

Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	9.4167	13.96397	4.03105	.5444	18.2889	.00	30.00
2013-2014	12	8.7500	13.16417	3.80017	.3859	17.1141	.00	30.00
2014-2015	12	8.6667	12.99883	3.75244	.4076	16.9257	.00	30.00
Total	36	8.9444	12.99878	2.16646	4.5463	13.3426	.00	30.00

ANOVA

Helicoverpa zea

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.056	2	2.028	.011	.989
Within Groups	5909.833	33	179.086		
Total	5913.889	35			

Descriptives

10. *Rhynchophorus ferrugineus*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	13.7500	20.79390	6.00268	.5382	26.9618	.00	50.00
2013-2014	12	14.1667	21.51462	6.21074	.4969	27.8364	.00	50.00
2014-2015	12	11.9167	18.88943	5.45291	-.0851	23.9184	.00	48.00
Total	36	13.2778	19.86182	3.31030	6.5575	19.9981	.00	50.00

ANOVA

Rhynchophorus ferrugineus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	34.389	2	17.194	.041	.960
Within Groups	13772.833	33	417.359		
Total	13807.222	35			

Descriptives

11. *Acilius sulcatus*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	24.0000	35.57578	10.26984	1.3962	46.6038	.00	78.00
2013-2014	12	22.5000	33.60871	9.70200	1.1460	43.8540	.00	80.00
2014-2015	12	28.7500	42.96537	12.40303	1.4511	56.0489	.00	100.00
Total	36	25.0833	36.60943	6.10157	12.6965	37.4702	.00	100.00

ANOVA

Acilius sulcatus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	255.500	2	127.750	.090	.914
Within Groups	46653.250	33	1413.735		
Total	46908.750	35			

Descriptives

12. *Apogonia glabripennis*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	5.9167	8.80556	2.54195	.3219	11.5115	.00	20.00
2013-2014	12	5.6667	8.73169	2.52062	.1188	11.2145	.00	20.00
2014-2015	12	5.2500	8.08056	2.33266	.1159	10.3841	.00	20.00
Total	36	5.6111	8.30242	1.38374	2.8020	8.4202	.00	20.00

ANOVA

Apogonia glabripennis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.722	2	1.361	.019	.982
Within Groups	2409.833	33	73.025		
Total	2412.556	35			

Descriptives

13. *Apis florea*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	1.7500	2.70101	.77971	.0339	3.4661	.00	6.00
2013-2014	12	1.5000	2.39317	.69085	-.0205	3.0205	.00	6.00
2014-2015	12	1.5000	2.39317	.69085	-.0205	3.0205	.00	6.00
Total	36	1.5833	2.43046	.40508	.7610	2.4057	.00	6.00

ANOVA

Apis florea

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.500	2	.250	.040	.961
Within Groups	206.250	33	6.250		
Total	206.750	35			

Descriptives

14. *Oecophylla smaragdina*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	3.0000	4.61224	1.33144	.0695	5.9305	.00	12.00
2013-2014	12	3.7500	5.73863	1.65660	.1039	7.3961	.00	15.00
2014-2015	12	4.0000	6.04528	1.74512	.1590	7.8410	.00	15.00
Total	36	3.5833	5.35790	.89298	1.7705	5.3962	.00	15.00

ANOVA

Oecophylla smaragdina

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.500	2	3.250	.107	.898
Within Groups	998.250	33	30.250		
Total	1004.750	35			

Descriptives

15.*Lethocerus indicus*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	22.1667	33.06972	9.54640	1.1552	43.1782	.00	76.00
2013-2014	12	20.3333	30.56835	8.82432	.9111	39.7555	.00	76.00
2014-2015	12	24.5833	36.46034	10.52519	1.4175	47.7491	.00	80.00
Total	36	22.3611	32.53144	5.42191	11.3541	33.3682	.00	80.00

ANOVA

Lethocerus indicus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	109.056	2	54.528	.049	.953
Within Groups	36931.250	33	1119.129		
Total	37040.306	35			

Descriptives

16. *Anax junius*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	9.4167	14.47542	4.17869	.2194	18.6139	.00	38.00
2013-2014	12	11.9167	17.74803	5.12341	.6401	23.1932	.00	40.00
2014-2015	12	11.6667	17.36419	5.01261	.6340	22.6993	.00	40.00
Total	36	11.0000	16.15284	2.69214	5.5347	16.4653	.00	40.00

ANOVA

Anax junius

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	45.500	2	22.750	.083	.921
Within Groups	9086.500	33	275.348		
Total	9132.000	35			

17. *Macrotermes darwiniensis* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	31.6667	47.25816	13.64225	1.6403	61.6931	.00	110.00
2013-2014	12	33.3333	50.15129	14.47743	1.4687	65.1979	.00	120.00
2014-2015	12	35.0000	52.13619	15.05042	1.8742	68.1258	.00	120.00
Total	36	33.3333	48.46206	8.07701	16.9361	49.7305	.00	120.00

ANOVA

Macrotermes darwiniensis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	66.667	2	33.333	.013	.987
Within Groups	82133.333	33	2488.889		
Total	82200.000	35			

Taikgyi

Descriptives

1. *Acheta domesticus*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	25.4167	33.80548	9.75880	3.9377	46.8956	.00	83.00
2013-2014	12	23.1667	31.75140	9.16584	2.9928	43.3405	.00	78.00
2014-2015	12	22.1667	27.84970	8.03952	4.4718	39.8615	.00	72.00
Total	36	23.5833	30.35916	5.05986	13.3113	33.8554	.00	83.00

ANOVA

Acheta domesticus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	66.500	2	33.250	.034	.967
Within Groups	32192.250	33	975.523		
Total	32258.750	35			

Descriptives

2.*Gryllus assimilis*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	16.0833	21.17227	6.11191	2.6311	29.5356	.00	62.00
2013-2014	12	16.5000	23.68544	6.83740	1.4510	31.5490	.00	64.00
2014-2015	12	17.9167	22.77342	6.57412	3.4471	32.3862	.00	58.00
Total	36	16.8333	21.92780	3.65463	9.4140	24.2526	.00	64.00

ANOVA

Gryllus assimilis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22.167	2	11.083	.022	.978
Within Groups	16806.833	33	509.298		
Total	16829.000	35			

Descriptives

3. *Oxya hyla*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	13.9167	20.76911	5.99553	.7206	27.1127	.00	50.00
2013-2014	12	21.5833	32.86186	9.48640	.7039	42.4628	.00	82.00
2014-2015	12	22.8333	35.62643	10.28446	.1974	45.4693	.00	97.00
Total	36	19.4444	29.83042	4.97174	9.3513	29.5376	.00	97.00

ANOVA

Oxya hyla

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	559.389	2	279.694	.302	.742
Within Groups	30585.500	33	926.833		
Total	31144.889	35			

Descriptives

4. *Heliocopris bucephalus*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	1.6667	2.60536	.75210	.0113	3.3220	.00	7.00
2013-2014	12	1.6667	2.60536	.75210	.0113	3.3220	.00	7.00
2014-2015	12	6.6667	10.38647	2.99832	.0674	13.2659	.00	26.00
Total	36	3.3333	6.62463	1.10410	1.0919	5.5748	.00	26.00

ANOVA

Heliocopris bucephalus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	200.000	2	100.000	2.470	.100
Within Groups	1336.000	33	40.485		
Total	1536.000	35			

Descriptives

5 *Gryllotalpa orientalis*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	6.3333	10.61160	3.06331	-.4090	13.0756	.00	32.00
2013-2014	12	6.0833	6.69407	1.93241	1.8301	10.3365	.00	18.00
2014-2015	12	9.1667	8.58999	2.47972	3.7088	14.6245	.00	20.00
Total	36	7.1944	8.64149	1.44025	4.2706	10.1183	.00	32.00

ANOVA

Gryllotalpa orientalis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	70.389	2	35.194	.457	.637
Within Groups	2543.250	33	77.068		
Total	2613.639	35			

Descriptives

6.*Omphisa fuscidentalis*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	13.8333	20.81011	6.00736	.6112	27.0554	.00	52.00
2013-2014	12	14.2500	21.41421	6.18175	.6441	27.8559	.00	48.00
2014-2015	12	14.6667	21.69765	6.26357	.8806	28.4527	.00	46.00
Total	36	14.2500	20.69558	3.44926	7.2476	21.2524	.00	52.00

ANOVA

Omphisa fuscidentalis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.167	2	2.083	.005	.995
Within Groups	14986.583	33	454.139		
Total	14990.750	35			

Descriptives

7. *Attacus atlas*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	24.9167	36.94334	10.66462	1.4440	48.3893	.00	81.00
2013-2014	12	17.1667	27.34903	7.89499	-.2101	34.5434	.00	80.00
2014-2015	12	20.0000	30.13907	8.70040	.8505	39.1495	.00	72.00
Total	36	20.6944	30.98462	5.16410	10.2108	31.1781	.00	81.00

ANOVA

Attacus atlas

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	369.056	2	184.528	.183	.833
Within Groups	33232.583	33	1007.048		
Total	33601.639	35			

8. *Metanastria hytaca* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	10.5833	15.21039	4.39086	.9191	20.2476	.00	46.00
2013-2014	12	16.6667	22.63277	6.53352	2.2865	31.0468	.00	64.00
2014-2015	12	16.0000	20.81957	6.01009	2.7719	29.2281	.00	52.00
Total	36	14.4167	19.43101	3.23850	7.8422	20.9912	.00	64.00

ANOVA

Metanastria hytaca

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	267.167	2	133.583	.340	.714
Within Groups	12947.583	33	392.351		
Total	13214.750	35			

Descriptives

9. *Helicoverpa zea*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	7.3333	10.02119	2.89287	.9662	13.7005	.00	27.00
2013-2014	12	8.1667	9.04367	2.61068	2.4206	13.9127	.00	24.00
2014-2015	12	11.0000	12.54809	3.62232	3.0273	18.9727	.00	30.00
Total	36	8.8333	10.45398	1.74233	5.2962	12.3705	.00	30.00

ANOVA

Helicoverpa zea

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	88.667	2	44.333	.392	.679
Within Groups	3736.333	33	113.222		
Total	3825.000	35			

10. *Rhynchophorus ferrugineus* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	11.6667	17.59821	5.08017	.4853	22.8480	.00	42.00
2013-2014	12	11.6667	17.94605	5.18058	.2643	23.0690	.00	48.00
2014-2015	12	12.5000	19.01435	5.48897	.4189	24.5811	.00	46.00
Total	36	11.9444	17.67313	2.94552	5.9647	17.9242	.00	48.00

ANOVA

Rhynchophorus ferrugineus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.556	2	2.778	.008	.992
Within Groups	10926.333	33	331.101		
Total	10931.889	35			

11. *Acilius sulcatus* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	23.0000	38.13374	11.00826	-1.2290	47.2290	.00	112.00
2013-2014	12	22.5833	33.76512	9.74715	1.1300	44.0367	.00	80.00
2014-2015	12	22.2500	33.32519	9.62015	1.0762	43.4238	.00	82.00
Total	36	22.6111	34.12438	5.68740	11.0651	34.1571	.00	112.00

ANOVA

Acilius sulcatus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.389	2	1.694	.001	.999
Within Groups	40753.167	33	1234.944		
Total	40756.556	35			

12 *Apogonia glabripennis* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	4.8333	7.69691	2.22191	-.0570	9.7237	.00	20.00
2013-2014	12	5.0000	7.50757	2.16725	.2299	9.7701	.00	18.00
2014-2015	12	6.0000	9.61060	2.77434	-.1063	12.1063	.00	26.00
Total	36	5.2778	8.10154	1.35026	2.5366	8.0189	.00	26.00

ANOVA

Apogonia glabripennis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.556	2	4.778	.069	.934
Within Groups	2287.667	33	69.323		
Total	2297.222	35			

13 *Apis florea* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	1.2500	2.17945	.62915	-.1348	2.6348	.00	7.00
2013-2014	12	1.5000	2.43086	.70173	-.0445	3.0445	.00	7.00
2014-2015	12	1.5000	2.43086	.70173	-.0445	3.0445	.00	7.00
Total	36	1.4167	2.28504	.38084	.6435	2.1898	.00	7.00

ANOVA

Apis florea

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.500	2	.250	.045	.956
Within Groups	182.250	33	5.523		
Total	182.750	35			

14. *Oecophylla smaragdina* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	2.0833	3.20393	.92489	.0477	4.1190	.00	8.00
2013-2014	12	1.5000	2.46798	.71244	-.0681	3.0681	.00	7.00
2014-2015	12	2.3333	3.55050	1.02494	.0775	4.5892	.00	9.00
Total	36	1.9722	3.03773	.50629	.9444	3.0000	.00	9.00

ANOVA

Oecophylla smaragdina

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.389	2	2.194	.227	.798
Within Groups	318.583	33	9.654		
Total	322.972	35			

15. *Lethocerus indicus* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	24.3333	36.34265	10.49122	1.2423	47.4243	.00	85.00
2013-2014	12	21.5000	32.21660	9.30013	1.0306	41.9694	.00	74.00
2014-2015	12	21.1667	31.82290	9.18648	.9474	41.3860	.00	72.00
Total	36	22.3333	32.58308	5.43051	11.3088	33.3579	.00	85.00

ANOVA

Lethocerus indicus

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	72.667	2	36.333	.032	.968
Within Groups	37085.333	33	1123.798		
Total	37158.000	35			

16. *Anax junius* **Descriptives**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	16.1667	25.05932	7.23400	.2447	32.0886	.00	70.00
2013-2014	12	11.5000	17.47986	5.04600	.3938	22.6062	.00	46.00
2014-2015	12	8.0000	12.73506	3.67630	-.0915	16.0915	.00	36.00
Total	36	11.8889	18.86460	3.14410	5.5060	18.2718	.00	70.00

ANOVA

Anax junius

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	402.889	2	201.444	.552	.581
Within Groups	12052.667	33	365.232		
Total	12455.556	35			

Descriptives

17. *Macrotermes darwiniensis*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2012-2013	12	36.5833	55.37058	15.98411	1.4025	71.7641	.00	140.00
2013-2014	12	31.5000	47.67408	13.76232	1.2093	61.7907	.00	122.00
2014-2015	12	30.6667	46.43144	13.40360	1.1655	60.1678	.00	120.00
Total	36	32.9167	48.60533	8.10089	16.4710	49.3623	.00	140.00

ANOVA

Macrotermes darwiniensis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	246.167	2	123.083	.049	.952
Within Groups	82440.583	33	2498.199		
Total	82686.750	35			

APPENDIX II

T-Test

Group Statistics

Acheta domesticus	Site	N	Mean	Std. Deviation	Std. Error Mean
	Taikkyi	36	23.5833	30.35916	5.05986
	Hlegu	36	21.9722	24.56186	4.09364

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Acheta domesticus	Equal variances assumed	3.577	.063	.248	70	.805	1.6111	6.50846	-11.36961	14.59183
	Equal variances not assumed			.248	67.076	.805	1.6111	6.50846	-11.37957	14.60179

Group Statistics

Gryllus assimilis	Site	N	Mean	Std. Deviation	Std. Error Mean
	Taikkyi	36	16.8333	21.92780	3.65463
	Hlegu	36	15.8889	18.97183	3.16197

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Gryllus assimilis	Equal variances assumed	.837	.363	.195	70	.846	.9444	4.83264	-8.69395	10.58284
	Equal variances not assumed			.195	68.582	.846	.9444	4.83264	-8.69746	10.58635

Group Statistics

Oxya hyla	Site	N	Mean	Std. Deviation	Std. Error Mean
	Taikkyi	36	19.4444	29.83042	4.97174
	Hlegu	36	23.5556	34.09939	5.68323

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Oxya hyla	Equal variances assumed	3.120	.082	-.544	70	.588	-4.1111	7.55098	-19.17106	10.94884
	Equal variances not assumed			-.544	68.784	.588	-4.1111	7.55098	-19.17575	10.95352

Group Statistics

Heliocopris bucephalus	Site	N	Mean	Std. Deviation	Std. Error Mean
	Taikkyi	36	3.3333	6.62463	1.10410
	Hlegu	36	3.7222	6.88108	1.14685

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Heliocopris bucephalus	Equal variances assumed	.184	.669	-.244	70	.808	-.3889	1.59195	-3.56393	2.78615
	Equal variances not assumed			-.244	69.899	.808	-.3889	1.59195	-3.56401	2.78623

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Gryllotalpa orientalis	Taikkyi	36	7.1944	8.64149	1.44025
	Hlegu	36	5.6667	8.27043	1.37840

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Gryllotalpa orientalis	Equal variances assumed	.007	.933	.766	70	.446	1.5278	1.99357	-2.44827	5.50383
	Equal variances not assumed			.766	69.866	.446	1.5278	1.99357	-2.44840	5.50396

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Omphisa fuscidentalis	Taikkyi	36	14.2500	20.69558	3.44926
	Hlegu	36	14.9722	21.59694	3.59949

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Omphisa fuscidentalis	Equal variances assumed	.294	.589	-.145	70	.885	-.7222	4.98535	-10.66520	9.22075
	Equal variances not assumed			-.145	69.873	.885	-.7222	4.98535	-10.66551	9.22107

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Attacus atlas	Taikkyi	36	20.6944	30.98462	5.16410
	Hlegu	36	20.8611	30.86945	5.14491

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Attacus atlas	Equal variances assumed	.005	.942	-.023	70	.982	-.1667	7.28959	-14.70529	14.37195
	Equal variances not assumed			-.023	69.999	.982	-.1667	7.28959	-14.70529	14.37196

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Metanastria hytaca	Taikkyi	36	14.4167	19.43101	3.23850
	Hlegu	36	14.7778	21.55937	3.59323

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Metanastria hytaca	Equal variances assumed	2.372	.128	-.075	70	.941	-.3611	4.83727	-10.00874	9.28652
	Equal variances not assumed			-.075	69.257	.941	-.3611	4.83727	-10.01056	9.28834

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Helicoverpa zea	Taikkyi	36	8.8333	10.45398	1.74233
	Hlegu	36	8.9444	12.99878	2.16646

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Helicoverpa zea	Equal variances assumed	5.746	.019	-.040	70	.968	-.1111	2.78016	-5.65596	5.43374
	Equal variances not assumed			-.040	66.921	.968	-.1111	2.78016	-5.66045	5.43823

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Rhynchophorus ferrugineus	Taikkyi	36	11.9444	17.67313	2.94552
	Hlegu	36	13.2778	19.86182	3.31030

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Rhynchophorus ferrugineus	Equal variances assumed	.921	.341	-.301	70	.764	-1.3333	4.43105	-10.17079	7.50412
	Equal variances not assumed			-.301	69.067	.764	-1.3333	4.43105	-10.17289	7.50622

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Acilius sulcatus	Taikkyi	36	22.6111	34.12438	5.68740
	Hlegu	36	25.0833	36.60943	6.10157

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Acilius sulcatus	Equal variances assumed	.933	.337	-.296	70	.768	-2.4722	8.34120	-19.10822	14.16378
	Equal variances not assumed			-.296	69.657	.768	-2.4722	8.34120	-19.10966	14.16522

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Apogonia glabripennis	Taikkyi	36	5.2778	8.10154	1.35026
	Hlegu	36	5.6111	8.30242	1.38374

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Apogonia glabripennis	Equal variances assumed	.273	.603	-.172	70	.864	-.3333	1.93337	-4.18932	3.52265
	Equal variances not assumed			-.172	69.958	.864	-.3333	1.93337	-4.18936	3.52269

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Apis florea	Taikkyi	36	1.4167	2.28504	.38084
	Hlegu	36	1.5833	2.43046	.40508

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Apis florea	Equal variances assumed	.618	.434	-.300	70	.765	-.1667	.55599	-1.27556	.94222
	Equal variances not assumed			-.300	69.735	.765	-.1667	.55599	-1.27563	.94230

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Oecophylla smaragdina	Taikkyi	36	1.9722	3.03773	.50629
	Hlegu	36	3.5833	5.35790	.89298

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2taile)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Oecophylla smaragdina	Equal variances assumed	22.623	.000	-1.569	70	.121	-1.6111	1.02652	-3.65845	.43622
	Equal variances not assumed			-1.569	55.394	.122	-1.6111	1.02652	-3.66798	.44576

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Lethocerus indicus	Taikkyi	36	22.3333	32.58308	5.43051
	Hlegu	36	22.3611	32.53144	5.42191

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Lethocerus indicus	Equal variances assumed	.000	.990	-.004	70	.997	-.0278	7.67382	-15.33273	15.27718
	Equal variances not assumed			-.004	70.000	.997	-.0278	7.67382	-15.33273	15.27718

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Anax junius	Taikkyi	36	11.8889	18.86460	3.14410
	Hlegu	36	11.0000	16.15284	2.69214

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Anax junius	Equal variances assumed	.369	.546	.215	70	.831	.8889	4.13920	-7.36649	9.14426
	Equal variances not assumed			.215	68.379	.831	.8889	4.13920	-7.36993	9.14771

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
Macrotermes darwiniensis	Taikkyi	36	32.9167	48.60533	8.10089
	Hlegu	36	33.3333	48.46206	8.07701

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Macrotermes darwiniensis	Equal variances assumed	.016	.900	-.036	70	.971	-.4167	11.43951	-23.23206	22.39873
	Equal variances not assumed			-.036	69.999	.971	-.4167	11.43951	-23.23206	22.39873

Group Statistics

	Site	N	Mean	Std. Deviation	Std. Error Mean
individual	Taikkyi	36	245.5833	136.54458	22.75743
	Hlegu	36	251.7500	129.89652	21.64942

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
individual	Equal variances assumed	.025	.874	-.196	70	.845	-6.1667	31.41016	-68.81225	56.47892
	Equal variances not assumed			-.196	69.826	.845	-6.1667	31.41016	-68.81499	56.48166

APPENDIX III

Hlegu

Correlations

1		*Acheta domesticus*	Rainfall	Temperature	Humidity
Acheta domesticus	Pearson Correlation	*1*	-.256	-.453(**)	.272
	Sig. (2-tailed)	.	.131	.006	.109
	N	36	36	36	36
Rainfall	Pearson Correlation	-.256	1	.006	.755(**)
	Sig. (2-tailed)	.131	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.453(**)	.006	1	-.092
	Sig. (2-tailed)	.006	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.272	.755(**)	-.092	1
	Sig. (2-tailed)	.109	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

2		*Gryllus assimilis*	Rainfall	Temperature	Humidity
Gryllusassiis	Pearson Correlation	1	-.310	-.495(**)	.180
	Sig. (2-tailed)	.	.066	.002	.294
	N	36	36	36	36
Rainfall	Pearson Correlation	-.310	1	.006	.755(**)
	Sig. (2-tailed)	.066	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.495(**)	.006	1	-.092
	Sig. (2-tailed)	.002	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.180	.755(**)	-.092	1
	Sig. (2-tailed)	.294	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

3		*Oxya hyla*	Rainfall	Temperature	Humidity
Oxya hyla	Pearson Correlation	1	-.421(*)	-.514(**)	.043
	Sig. (2-tailed)	.	.011	.001	.804
	N	36	36	36	36
Rainfall	Pearson Correlation	-.421(*)	1	.006	.755(**)
	Sig. (2-tailed)	.011	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.514(**)	.006	1	-.092
	Sig. (2-tailed)	.001	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.043	.755(**)	-.092	1
	Sig. (2-tailed)	.804	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

4		*Heliocopris bucephalus*	Rainfall	Temperature	Humidity
Heliocopris bucephalus	Pearson Correlation	1	-.340(*)	.494(**)	-.627(**)
	Sig. (2-tailed)	.	.043	.002	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	-.340(*)	1	.006	.755(**)
	Sig. (2-tailed)	.043	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	.494(**)	.006	1	-.092
	Sig. (2-tailed)	.002	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.627(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

5		*Gryllotalpa orientalis*	Rainfall	Temperature	Humidity
Gryllotalpa orientalis	Pearson Correlation	1	-.419(*)	-.491(**)	.044
	Sig. (2-tailed)	.	.011	.002	.800
	N	36	36	36	36
Rainfall	Pearson Correlation	-.419(*)	1	.006	.755(**)
	Sig. (2-tailed)	.011	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.491(**)	.006	1	-.092
	Sig. (2-tailed)	.002	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.044	.755(**)	-.092	1
	Sig. (2-tailed)	.800	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

6		*Omphisa fuscidentalis*	Rainfall	Temperature	Humidity
Omphisa fuscidentalis	Pearson Correlation	1	-.418(*)	-.505(**)	.050
	Sig. (2-tailed)	.	.011	.002	.773
	N	36	36	36	36
Rainfall	Pearson Correlation	-.418(*)	1	.006	.755(**)
	Sig. (2-tailed)	.011	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.505(**)	.006	1	-.092
	Sig. (2-tailed)	.002	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.050	.755(**)	-.092	1
	Sig. (2-tailed)	.773	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

7		*Attacus atlas*	Rainfall	Temperature	Humidity
Attacus atlas	Pearson Correlation	1	-.391(*)	-.384(*)	.114
	Sig. (2-tailed)	.	.019	.021	.509
	N	36	36	36	36
Rainfall	Pearson Correlation	-.391(*)	1	.006	.755(**)
	Sig. (2-tailed)	.019	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.384(*)	.006	1	-.092
	Sig. (2-tailed)	.021	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.114	.755(**)	-.092	1
	Sig. (2-tailed)	.509	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

8		*Metanastria hytaca*	Rainfall	Temperature	Humidity
Metanastria hytaca	Pearson Correlation	1	-.390(*)	-.463(**)	.086
	Sig. (2-tailed)	.	.019	.004	.617
	N	36	36	36	36
Rainfall	Pearson Correlation	-.390(*)	1	.006	.755(**)
	Sig. (2-tailed)	.019	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.463(**)	.006	1	-.092
	Sig. (2-tailed)	.004	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.086	.755(**)	-.092	1
	Sig. (2-tailed)	.617	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

9		*Helicoverpa zea*	Rainfall	Temperature	Humidity
Helicoverpa zea	Pearson Correlation	1	-.397(*)	-.461(**)	.082
	Sig. (2-tailed)	.	.017	.005	.635
	N	36	36	36	36
Rainfall	Pearson Correlation	-.397(*)	1	.006	.755(**)
	Sig. (2-tailed)	.017	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.461(**)	.006	1	-.092
	Sig. (2-tailed)	.005	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.082	.755(**)	-.092	1
	Sig. (2-tailed)	.635	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

10		*Rhynchophorus ferrugineus*	Rainfall	Temperature	Humidity
Rhynchophorus ferrugineus	Pearson Correlation	1	-.380(*)	-.408(*)	.104
	Sig. (2-tailed)	.	.022	.013	.548
	N	36	36	36	36
Rainfall	Pearson Correlation	-.380(*)	1	.006	.755(**)
	Sig. (2-tailed)	.022	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.408(*)	.006	1	-.092
	Sig. (2-tailed)	.013	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.104	.755(**)	-.092	1
	Sig. (2-tailed)	.548	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).

Correlation

11		*Acilius sulcatus*	Rainfall	Temperature	Humidity
Acilius sulcatus	Pearson Correlation	1	.828(**)	-.044	.719(**)
	Sig. (2-tailed)	.	.000	.800	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	.828(**)	1	.006	.755(**)
	Sig. (2-tailed)	.000	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.044	.006	1	-.092
	Sig. (2-tailed)	.800	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.719(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

12		*Apogonia glabripennis*	Rainfall	Temperature	Humidity
Apogonia glabripennis	Pearson Correlation	1	-.386(*)	-.413(*)	.105
	Sig. (2-tailed)	.	.020	.012	.543
	N	36	36	36	36
Rainfall	Pearson Correlation	-.386(*)	1	.006	.755(**)
	Sig. (2-tailed)	.020	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.413(*)	.006	1	-.092
	Sig. (2-tailed)	.012	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.105	.755(**)	-.092	1
	Sig. (2-tailed)	.543	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

13		*Apis florea*	Rainfall	Temperature	Humidity
Apis florea	Pearson Correlation	1	-.455(**)	.574(**)	-.797(**)
	Sig. (2-tailed)	.	.005	.000	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	-.455(**)	1	.006	.755(**)
	Sig. (2-tailed)	.005	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	.574(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.797(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

14		*Oecophylla smaragdina*	Rainfall	Temperature	Humidity
Oecophylla smaragdina	Pearson Correlation	1	-.384(*)	.592(**)	-.693(**)
	Sig. (2-tailed)	.	.021	.000	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	-.384(*)	1	.006	.755(**)
	Sig. (2-tailed)	.021	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	.592(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.693(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

15		*Lethocerus indicus*	Rainfall	Temperature	Humidity
Lethocerus indicus	Pearson Correlation	1	.819(**)	-.038	.722(**)
	Sig. (2-tailed)	.	.000	.825	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	.819(**)	1	.006	.755(**)
	Sig. (2-tailed)	.000	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.038	.006	1	-.092
	Sig. (2-tailed)	.825	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.722(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

16		*Anax junius*	Rainfall	Temperature	Humidity
Anax junius	Pearson Correlation	1	.840(**)	-.066	.719(**)
	Sig. (2-tailed)	.	.000	.702	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	.840(**)	1	.006	.755(**)
	Sig. (2-tailed)	.000	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.066	.006	1	-.092
	Sig. (2-tailed)	.702	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.719(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

17		*Macrotermes darwiniensis*	Rainfall	Temperature	Humidity
Macrotermes darwiniensis	Pearson Correlation	1	-.402(*)	.583(**)	-.726(**)
	Sig. (2-tailed)	.	.015	.000	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	-.402(*)	1	.006	.755(**)
	Sig. (2-tailed)	.015	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	.583(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.726(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Taikkyi

Correlations

1		*Acheta domesticus*	Rainfall	Temperature	Humidity
Acheta domesticus	Pearson Correlation	1	-.359(*)	-.555(**)	.101
	Sig. (2-tailed)	.	.032	.000	.557
	N	36	36	36	36
Rainfall	Pearson Correlation	-.359(*)	1	.006	.755(**)
	Sig. (2-tailed)	.032	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.555(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.101	.755(**)	-.092	1
	Sig. (2-tailed)	.557	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

2		*Gryllus assimilis*	Rainfall	Temperature	Humidity
Gryllus assimilis	Pearson Correlation	1	-.340(*)	-.583(**)	.080
	Sig. (2-tailed)	.	.043	.000	.644
	N	36	36	36	36
Rainfall	Pearson Correlation	-.340(*)	1	.006	.755(**)
	Sig. (2-tailed)	.043	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.583(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.080	.755(**)	-.092	1
	Sig. (2-tailed)	.644	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlation

3		*Oxya hyla*	Rainfall	Temperature	Humidity
Oxya hyla	Pearson Correlation	1	-.420(*)	-.572(**)	-.015
	Sig. (2-tailed)	.	.011	.000	.933
	N	36	36	36	36
Rainfall	Pearson Correlation	-.420(*)	1	.006	.755(**)
	Sig. (2-tailed)	.011	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.572(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.015	.755(**)	-.092	1
	Sig. (2-tailed)	.933	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

4		*Heliocopris bucephalus*	Rainfall	Temperature	Humidity
Heliocopris bucephalus	Pearson Correlation	1	-.272	.470(**)	-.499(**)
	Sig. (2-tailed)	.	.108	.004	.002
	N	36	36	36	36
Rainfall	Pearson Correlation	-.272	1	.006	.755(**)
	Sig. (2-tailed)	.108	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	.470(**)	.006	1	-.092
	Sig. (2-tailed)	.004	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.499(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.002	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

5		*Gryllotalpa orientalis*	Rainfall	Temperature	Humidity
Gryllotalpa orientalis	Pearson Correlation	1	-.137	-.607(**)	.189
	Sig. (2-tailed)	.	.427	.000	.270
	N	36	36	36	36
Rainfall	Pearson Correlation	-.137	1	.006	.755(**)
	Sig. (2-tailed)	.427	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.607(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.189	.755(**)	-.092	1
	Sig. (2-tailed)	.270	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

6		*Omphisa fuscidentalis*	Rainfall	Temperature	Humidity
Omphisa fuscidentalis	Pearson Correlation	1	-.408(*)	-.490(**)	.061
	Sig. (2-tailed)	.	.013	.002	.726
	N	36	36	36	36
Rainfall	Pearson Correlation	-.408(*)	1	.006	.755(**)
	Sig. (2-tailed)	.013	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.490(**)	.006	1	-.092
	Sig. (2-tailed)	.002	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.061	.755(**)	-.092	1
	Sig. (2-tailed)	.726	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

7		*Attacus atlas*	Rainfall	Temperature	Humidity
Attacus atlas	Pearson Correlation	1	-.393(*)	-.400(*)	.088
	Sig. (2-tailed)	.	.018	.016	.610
	N	36	36	36	36
Rainfall	Pearson Correlation	-.393(*)	1	.006	.755(**)
	Sig. (2-tailed)	.018	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.400(*)	.006	1	-.092
	Sig. (2-tailed)	.016	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.088	.755(**)	-.092	1
	Sig. (2-tailed)	.610	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

8		*Metanastria hytaca*	Rainfall	Temperature	Humidity
Metanastria hytaca	Pearson Correlation	1	-.329(*)	-.497(**)	.134
	Sig. (2-tailed)	.	.050	.002	.436
	N	36	36	36	36
Rainfall	Pearson Correlation	-.329(*)	1	.006	.755(**)
	Sig. (2-tailed)	.050	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.497(**)	.006	1	-.092
	Sig. (2-tailed)	.002	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.134	.755(**)	-.092	1
	Sig. (2-tailed)	.436	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

9		*Helicoverpa zea*	Rainfall	Temperature	Humidity
Helicoverpa zea	Pearson Correlation	1	-.216	-.440(**)	.258
	Sig. (2-tailed)	.	.207	.007	.129
	N	36	36	36	36
Rainfall	Pearson Correlation	-.216	1	.006	.755(**)
	Sig. (2-tailed)	.207	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.440(**)	.006	1	-.092
	Sig. (2-tailed)	.007	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.258	.755(**)	-.092	1
	Sig. (2-tailed)	.129	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlation

10		*Rhynchophorus ferrugineus*	Rainfall	Temperature	Humidity
Rhynchophorus ferrugineus	Pearson Correlation	1	-.404(*)	-.508(**)	.057
	Sig. (2-tailed)	.	.015	.002	.740
	N	36	36	36	36
Rainfall	Pearson Correlation	-.404(*)	1	.006	.755(**)
	Sig. (2-tailed)	.015	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.508(**)	.006	1	-.092
	Sig. (2-tailed)	.002	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.057	.755(**)	-.092	1
	Sig. (2-tailed)	.740	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

11		*Acilius sulcatus*	Rainfall	Temperature	Humidity
Acilius sulcatus	Pearson Correlation	1	.876(**)	-.055	.697(**)
	Sig. (2-tailed)	.	.000	.748	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	.876(**)	1	.006	.755(**)
	Sig. (2-tailed)	.000	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.055	.006	1	-.092
	Sig. (2-tailed)	.748	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.697(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

12		*Apogonia glabripennis*	Rainfall	Temperature	Humidity
Apogonia glabripennis	Pearson Correlation	1	-.405(*)	-.521(**)	.011
	Sig. (2-tailed)	.	.014	.001	.950
	N	36	36	36	36
Rainfall	Pearson Correlation	-.405(*)	1	.006	.755(**)
	Sig. (2-tailed)	.014	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.521(**)	.006	1	-.092
	Sig. (2-tailed)	.001	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.011	.755(**)	-.092	1
	Sig. (2-tailed)	.950	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

13		*Apis florea*	Rainfall	Temperature	Humidity
Apis florea	Pearson Correlation	1	-.377(*)	.577(**)	-.690(**)
	Sig. (2-tailed)	.	.024	.000	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	-.377(*)	1	.006	.755(**)
	Sig. (2-tailed)	.024	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	.577(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.690(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

14		*Oecophylla smaragdina*	Rainfall	Temperature	Humidity
Oecophylla smaragdina	Pearson Correlation	1	-.349(*)	.561(**)	-.647(**)
	Sig. (2-tailed)	.	.037	.000	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	-.349(*)	1	.006	.755(**)
	Sig. (2-tailed)	.037	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	.561(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.647(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Correlations

15		*Lethocerus indicus*	Rainfall	Temperature	Humidity
Lethocerus indicus	Pearson Correlation	1	.797(**)	-.032	.715(**)
	Sig. (2-tailed)	.	.000	.851	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	.797(**)	1	.006	.755(**)
	Sig. (2-tailed)	.000	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.032	.006	1	-.092
	Sig. (2-tailed)	.851	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.715(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

**Correlation is significant at the 0.01 level (2-tailed).

Correlations

16		*Anax junius*	Rainfall	Temperature	Humidity
Anax junius	Pearson Correlation	1	.751(**)	-.021	.666(**)
	Sig. (2-tailed)	.	.000	.905	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	.751(**)	1	.006	.755(**)
	Sig. (2-tailed)	.000	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	-.021	.006	1	-.092
	Sig. (2-tailed)	.905	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	.666(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

**Correlation is significant at the 0.01 level (2-tailed).

Correlations

17		*Macrotermes darwiniensis*	Rainfall	Temperature	Humidity
Macrotermes darwiniensis	Pearson Correlation	1	-.378(*)	.581(**)	-.691(**)
	Sig. (2-tailed)	.	.023	.000	.000
	N	36	36	36	36
Rainfall	Pearson Correlation	-.378(*)	1	.006	.755(**)
	Sig. (2-tailed)	.023	.	.973	.000
	N	36	36	36	36
Temperature	Pearson Correlation	.581(**)	.006	1	-.092
	Sig. (2-tailed)	.000	.973	.	.596
	N	36	36	36	36
Humidity	Pearson Correlation	-.691(**)	.755(**)	-.092	1
	Sig. (2-tailed)	.000	.000	.596	.
	N	36	36	36	36

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

APPENDIX IV

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

UMFCCI Tower, 7th Floor, Room No.(4),No.(29), Minye Kyawswa Road,

Lanmadaw Township, Yangon, Myanmar

FIDSL

LABORATORY ANALYSIS REPORT

FIDSL - 06 -1445/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-250080866
4	Date Received	: 25.7.2014
5	Sample Number	: 1391/14
6	Product Name	: Cricket
7	Type of Test	: Nutrition Package
8	Date of Issue	: 31.7.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	7.46%
2	Ash	AOAC-2000 (942.05)	2.65%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	24.48%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	4.09%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	60.72%
6	Carbohydrate	By Difference	0.60%
7	Energy Value (Kcal / 100 g)		649

Remarks ***: Edible portion (after removing wings) constitutes 84% of the whole sample.***
Analysis was done on edible portion only.

Nutrition Facts (100 gm)		
Energy	649	Kcal
Protein	24	gm
Fat	61	gm
Carbohydrate	1	gm

Dr. Aye Kyaw 31/7/14
Manager
FIDSL (MFPEA)

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Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

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Lanmadaw Township, Yangon, Myanmar

FIDSL

LABORATORY ANALYSIS REPORT

FIDSL - 06 -2338/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 17.11.2014
5	Sample Number	: 2181/14
6	Product Name	: Black Cricket
7	Type of Test	: Nutrition Package
8	Date of Issue	: 25.11.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	37.31%
2	Ash	AOAC-2000 (942.05)	1.20%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	19.11%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	2.36%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	39.09%
6	Carbohydrate	By Difference	0.93%
7	Energy Value (Kcal / 100 g)		431

Remarks

Nutrition Facts (100 gm)		
Energy	431	Kcal
Protein	19	gm
Fat	39	gm
Carbohydrate	1	gm

Dr. Aye Kyaw
Manager
FIDSL (MFPEA)

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

UMFCCI Tower, 7th Floor, Room No.(4),No.(29), Minye Kyawswa Road,

Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06 -2336/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 17.11.2014
5	Sample Number	: 2179/14
6	Product Name	: Grass Hopper
7	Type of Test	: Nutrition Package
8	Date of Issue	: 25.11.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	37.07%
2	Ash	AOAC-2000 (942.05)	0.90%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	24.80%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	4.63%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	30.00%
6	Carbohydrate	By Difference	2.60%
7	Energy Value (Kcal / 100 g)		382

Remarks

Nutrition Facts (100 gm)		
Energy	382	Kcal
Protein	25	gm
Fat	30	gm
Carbohydrate	3	gm

Dr. Aye Kyaw 28/11/14
Manager
FIDSL (MFPEA)

Myanmar Food Processors and Exporters Association (MFPEA)

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Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06 - 487/15
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 24.2.2015
5	Sample Number	: 395/15
6	Product Name	: Larvae of Dung Beetle
7	Type of Test	: Nutrition Package
8	Date of Issue	: 6.3.2015
9	Results	

(The Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr.No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	81.93%
2	Ash	AOAC-2000(942.05)	6.93%
3	Protein	AOAC-2000(920.152) (Kjeldahl Method)	5.79%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	1.76%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	1.64%
6	Carbohydrate	By Difference	1.95%
7	Energy Value(Kcal/100g)		50

Nutrition Facts (100g)		
Energy	50	Kcal
Protein	6	gm
Fat	2	gm
Carbohydrate	2	gm

Dr.Aye Kyaw 6/3/15
Manager
FIDSL(MFPEA)

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Myanmar Food Processors and Exporters Association (MFPEA)

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Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06 - 287/15
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 26.1.2015
5	Sample Number	: 195/15
6	Product Name	: Mole Crickets
7	Type of Test	: Nutrition Package
8	Date of Issue	: 6.2.2015
9	Results	

(The Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr.No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	20.44%
2	Ash	AOAC-2000(942.05)	1.63%
3	Protein	AOAC-2000(920.152) (Kjeldahl Method)	22.24%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	3.93%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	51.69%
6	Carbohydrate	By Difference	0.07%
7	Energy Value(Kcal/100g)		556

Nutrition Facts (100g)		
Energy	556	Kcal
Protein	22	gm
Fat	52	gm
Carbohydrate	0.1	gm

Dr.Aye Kyaw 6/2/15
Manager
FIDSL(MFPEA)

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

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Lanmadaw Township, Yangon, Myanmar

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LABORATORY ANALYSIS REPORT

FIDSL - 06 -2337/14
Page 1/1

1 Company's Name : Daw Ni Ni Khin
2 Address : University of Yangon
3 Phone No. : 09-73131884
4 Date Received : 17.11.2014
5 Sample Number : 2180/14
6 Product Name : Bamboo Worm
7 Type of Test : Nutrition Package .
8 Date of Issue : 25.11.2014
9 Results

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	11.84%
2	Ash	AOAC-2000 (942.05)	0.94%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	20.37%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	2.53%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	60.96%
6	Carbohydrate	By Difference	3.36%
7	Energy Value (Kcal / 100 g)		641

Remarks

Nutrition Facts (100 gm)		
Energy	641	Kcal
Protein	20	gm
Fat	61	gm
Carbohydrate	3	gm

Dr. Aye Kyaw
Manager
FIDSL (MFPEA)
25/11/14

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

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LABORATORY ANALYSIS REPORT

FIDSL - 06-2013/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-250080866
4	Date Received	: 13.10.2014
5	Sample Number	: 1902/14
6	Product Name	: A.atlas
7	Type of Test	: Nutrition Package
8	Date of Issue	: 22.10.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	4.74%
2	Ash	AOAC-2000 (942.05)	5.10%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	38.84%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	2.59%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	39.41%
6	Carbohydrate	By Difference	9.32%
7	Energy Value (Kcal / 100 g)		543

Nutrition Facts (100 gm)		
Energy	543	Kcal
Protein	39	gm
Fat	39	gm
Carbohydrate	9	gm

Dr. Aye Kyaw 22.10.14
Manager
FIDSL (MFPEA)

Myanmar Food Processors and Exporters Association (MFPEA)

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LABORATORY ANALYSIS REPORT

FIDSL - 06- 2009/15
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: Yangon University
3	Phone No.	: 09-73131884
4	Date Received	: 20.8.2015
5	Sample Number	: 1750/15
6	Product Name	: Borer
7	Type of Test	: Nutrition Package
8	Date of Issue	: 4.9.2015
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. o	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	58.77%
2	Ash	AOAC-2000(942.05)	1.96%
3	Crude Protein	AOAC-2000(920.103) (Kjeldahl Method)	13.78%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	3.47%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	21.62%
6	Carbohydrate	By Difference	0.40%
7	Energy Value (Kcal / 100 g)		256

Remarks

Nutrition Facts (100 gm)		
Energy	256	Kcal
Protein	14	gm
Fat	22	gm
Carbohydrate	0.4	gm

Tin Naing Win
Manager
FIDSL

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Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06- 1706/15
Page 1/1

1	Company's Name	: Ma Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 13.7.2015
5	Sample Number	: 1526/15
6	Product Name	: Corn Leaf Beetle
7	Type of Test	: Nutrition Package
8	Date of Issue	: 24.7.2015
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC (2000) 934.01	58.08%
2	Ash	AOAC (2000) 942.05	1.46%
3	Crude Protein	AOAC (2000) 920.152 (Kjeldahl method)	20.45%
4	Crude Fiber	AOAC (2000) 978.10 Fiber Cap Method	8.93%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	17.34%
6	Carbohydrate	By difference	0.00%
7	Energy Value (Kcal / 100 g)		233

Remarks

Nutrition Facts (100 gm)		
Energy	233	Kcal
Protein	20	gm
Fat	17	gm
Carbohydrate	0	gm

for Sein Thaung Oo
Chairman
Management Committee
FIDSL

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

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Lanmadaw Township, Yangon, Myanmar

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LABORATORY ANALYSIS REPORT

FIDSL - 06-0974/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: Yangon University
3	Phone No.	: 09-250080866
4	Date Received	: 7.5.2014
5	Sample Number	: 963/14
6	Product Name	: Grub
7	Type of Test	: Nutrition Package
8	Date of Issue	: 16.5.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	58.01%
2	Ash	AOAC-2000 (942.05)	0.54%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	11.58%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	0.81%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	22.70%
6	Carbohydrate	By Difference	6.36%
7	Energy Value (Kcal / 100 g)		279

Remark

Nutrition Facts (100 gm)		
Energy	279	Kcal
Protein	12	gm
Fat	23	gm
Carbohydrate	6	gm

Dr. Aye Kyaw
Manager
FIDSL (MFPEA)

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

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Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06-1222/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: Yangon University
3	Phone No.	: 09-250080866
4	Date Received	: 15.6.2014
5	Sample Number	: *1191/14*
6	Product Name	: Yee Poe
7	Type of Test	: Nutrition Package
8	Date of Issue	: 19.6.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	61.03%
2	Ash	AOAC-2000 (942.05)	1.64%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	24.83%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	7.61%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	4.63%
6	Carbohydrate	*By Difference*	0.26%
7	Energy Value (Kcal / 100 g)		146

Remark

Nutrition Facts (100 gm)		
Energy	146	Kcal
Protein	25	gm
Fat	5	gm
Carbohydrate	0.3	gm

Dr. Aye Kyaw 19/6/14
Manager
FIDSL (MFPEA)

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LABORATORY ANALYSIS REPORT

FIDSL - 06-1164/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: Yangon University
3	Phone No.	: 09-250080866
4	Date Received	: 2.6.2014
5	Sample Number	: 1117/14
6	Product Name	: Borers
7	Type of Test	: Nutrition Package
8	Date of Issue	: 11.6.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	74.72%
2	Ash	AOAC-2000 (942.05)	1.81%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	9.82%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	2.31%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	5.83%
6	Carbohydrate	By Difference	5.51%
7	Energy Value (Kcal / 100 g)		118

Remark

Nutrition Facts (100 gm)		
Energy	118	Kcal
Protein	10	gm
Fat	6	gm
Carbohydrate	6	gm

Dr. Aye Kyaw 11.6.14
Manager
FIDSL (MFPEA)

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

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FIDSL

LABORATORY ANALYSIS REPORT

FIDSL - 06 -2496/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 1.12.2014
5	Sample Number	: 2317/14
6	Product Name	: Bee Brood
7	Type of Test	: Nutrition Package
8	Date of Issue	: 19.12.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	75.63%
2	Ash	AOAC-2000 (942.05)	0.82%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	8.51%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	0.41%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	7.08%
6	Carbohydrate	By Difference	7.55%
7	Energy Value (Kcal / 100 g)		131

Remarks

Nutrition Facts (100 gm)		
Energy	131	Kcal
Protein	9	gm
Fat	7	gm
Carbohydrate	8	gm

Dr. Aye Kyaw 19/12/14
Manager
FIDSL (MFPEA)

Myanmar Food Processors and Exporters Association (MFPEA)

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LABORATORY ANALYSIS REPORT

FIDSL - 06- 1705/15
Page 1/1

1	Company's Name	: Ma Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 13.7.2015
5	Sample Number	: 1525/15
6	Product Name	: Ants and their eggs
7	Type of Test	: Nutrition Package
8	Date of Issue	: 17.7.2015
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC (2000) 934.01	65.73%
2	Ash	AOAC (2000) 942.05	6.69%
3	Crude Protein	AOAC (2000) 920.152 (Kjeldahl method)	10.21%
4	Crude Fiber	AOAC (2000) 978.10 Fiber Cap Method	2.53%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	13.19%
6	Carbohydrate	By difference	1.65%
7	Energy Value (Kcal / 100 g)		165

Remarks

Nutrition F cts (100 gm)		
Energy	165	Kcal
Protein	10	gm
Fat	13	gm
Carbohydrate	2	gm

17/7/2015

Sein Thaung Oo
Chairman
Management Committee
FIDSL

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

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Lanmadaw Township, Yangon, Myanmar

FIDSL

LABORATORY ANALYSIS REPORT

FIDSL - 06-1013/14
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: Yangon University
3	Phone No.	: 09-250080866
4	Date Received	: 12.5.2014
5	Sample Number	: 987/14
6	Product Name	: Palima
7	Type of Test	: Nutrition Package
8	Date of Issue	: 21.5.2014
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	61.25%
2	Ash	AOAC-2000 (934.05)	1.03%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	21.88%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	4.97%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	8.22%
6	Carbohydrate	By Difference	2.65%
7	Energy Value (Kcal / 100 g)		172

Remark

Nutrition Facts (100 gm)		
Energy	172	Kcal
Protein	22	gm
Fat	8	gm
Carbohydrate	3	gm

Dr. Aye Kyaw 21/5/14
Manager
FIDSL (MFPEA)

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Food Industries Development Supporting Laboratory (FIDSL)

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FIDSL

LABORATORY ANALYSIS REPORT

FIDSL - 06-2012/14
Page 1/1

1 Company's Name : Daw Ni Ni Khin
2 Address : University of Yangon
3 Phone No. : 09-250080866
4 Date Received : 13.10.2014
5 Sample Number : 1901/14
6 Product Name : A.junius Drury, 1773
7 Type of Test : Nutrition Package
8 Date of Issue : 22.10.2014
9 Results

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000 (934.01)	14.16%
2	Ash	AOAC-2000 (942.05)	4.22%
3	Protein	AOAC-2000 (920.152) (Kjeldahl method)	51.75%
4	Crude Fiber	AOAC(2000) 978.10 Fiber Cap Method	8.03%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	13.03%
6	Carbohydrate	By Difference	8.81%
7	Energy Value (Kcal / 100 g)		361

Nutrition Facts (100 gm)		
Energy	361	Kcal
Protein	52	gm
Fat	13	gm
Carbohydrate	9	gm

Dr. Aye Kyaw
Manager
FIDSL (MFPEA)

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Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

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Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06- 1791/15
Page 1/1

1	Company's Name	: Ma Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 24.7.2015
5	Sample Number	: 1595/15
6	Product Name	: Pa Lu (Local Name)
7	Type of Test	: Nutrition Package
8	Date of Issue	: 3.8.2015
9	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC (2000) 934.01	27.77%
2	Ash	AOAC (2000) 942.05	1.54%
3	Crude Protein	AOAC (2000) 920.152 (Kjeldahl method)	25.58%
4	Crude Fiber	AOAC (2000) 978.10 Fiber Cap Method	2.98%
5	Ether Extract (Crude Fat)	AOAC (Buchi Soxhlet Method)	44.54%
6	Carbohydrate	*By difference*	*0.00%*
7	Energy Value (Kcal / 100 g)		509

Remarks

Nutrition Facts (100 gm)		
Energy	509	Kcal
Protein	26	gm
Fat	45	gm
Carbohydrate	0	gm

Sein Thaung Oo
Chairman
Management Committee
FIDSL

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APPENDIX V

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

UMFCCI Tower, 7th Floor, Room No.(4),No.(29), Minye Kyawswa Road,

Lanmadaw Township, Yangon, Myanmar

FIDSL

LABORATORY ANALYSIS REPORT

FIDSL - 06- 2816/15
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 10.12.2015
5	Sample Number	: 2465/15
6	Product Name	: Chicken
7	Type of Test	: Nutrition Package
8	Date of Issue	: 24.12.2015
9	Results	

This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	59.10%
2	Ash	AOAC-2000(942.05)	1.61%
3	Protein	AOAC-2000(920.103) (Kjeldahl Method)	35.10%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	0.19%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	4.52%
6	Carbohydrate	*By Difference*	*0.00%*
7	Energy Value (Kcal / 100 g)		185

Remarks

Nutrition Facts (100 gm)		
Energy	185	Kcal
Protein	35	gm
Fat	5	gm
Carbohydrate	0	gm

Tin Naing Win
Manager
FIDSL

Myanmar Food Processors and Exporters Association (MFPEA)

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LABORATORY ANALYSIS REPORT

FIDSL - 06- 2815/15
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 10.12.2015
5	Sample Number	: 2464/15
6	Product Name	: Pork with Fat
7	Type of Test	: Nutrition Package
8	Date of Issue	: 24.12.2015
9	Results	

This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	40.95%
2	Ash	AOAC-2000(942.05)	0.47%
3	Protein	AOAC-2000(920.103) (Kjeldahl Method)	21.90%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	0.48%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	35.72%
6	Carbohydrate	By Difference	0.48%
7	Energy Value (Kcal / 100 g)		414

Remarks

Nutrition Facts (100 gm)		
Energy	414	Kcal
Protein	22	gm
Fat	36	gm
Carbohydrate	0.5	gm

Tin Naing Win
Manager
FIDSL

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Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06- 2818/15
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 10.12.2015
5	Sample Number	: 2467/15
6	Product Name	: Beef
7	Type of Test	: Nutrition Package
8	Date of Issue	: 24.12.2015
9	Results	

This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	46.18%
2	Ash	AOAC-2000(942.05)	1.66%
3	Protein	AOAC-2000(920.103) (Kjeldahl Method)	45.88%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	0.05%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	6.51%
6	Carbohydrate	By Difference	0.00%
7	Energy Value (Kcal / 100 g)		247

Remarks

Nutrition Facts (100 gm)		
Energy	247	Kcal
Protein	46	gm
Fat	7	gm
Carbohydrate	0	gm

Tin Naing Win
Manager
FIDSL

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Food Industries Development Supporting Laboratory (FIDSL)

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LABORATORY ANALYSIS REPORT

FIDSL - 06- 2819/15
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 10.12.2015
5	Sample Number	: 2468/15
6	Product Name	: Mutton
7	Type of Test	: Nutrition Package
8	Date of Issue	: 24.12.2015
9	Results	

This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	45.70%
2	Ash	AOAC-2000(942.05)	1.56%
3	Protein	AOAC-2000(920.103) (Kjeldahl Method)	40.93%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	0.04%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	11.48%
6	Carbohydrate	By Difference	0.29%
7	Energy Value (Kcal / 100 g)		264

Remarks

Nutrition Facts (100 gm)		
Energy	264	Kcal
Protein	41	gm
Fat	11	gm
Carbohydrate	0.3	gm

Tin Naing Win
Manager
FIDSL

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LABORATORY ANALYSIS REPORT

FIDSL - 06- 2817/15
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 10.12.2015
5	Sample Number	: 2466/15
6	Product Name	: Fish (Ca-ca-dit)
7	Type of Test	: Nutrition Package
8	Date of Issue	: 24.12.2015
9	Results	

This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	52.40%
2	Ash	AOAC-2000(942.05)	1.82%
3	Protein	AOAC-2000(920.103) (Kjeldahl Method)	30.24%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	0.18%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	13.47%
6	Carbohydrate	By Difference	1.89%
7	Energy Value (Kcal / 100 g)		245

Remarks

Nutrition Facts (100 gm)		
Energy	245	Kcal
Protein	30	gm
Fat	13	gm
Carbohydrate	2	gm

Tin Naing Win
Manager
FIDSL

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

UMFCCI Tower, 7th Floor, Room No.(4),No.(29), Minye Kyawswa Road,

Lanmadaw Township, Yangon, Myanmar

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LABORATORY ANALYSIS REPORT

FIDSL - 06- 2820/1
Page 1/1

1	Company's Name	: Daw Ni Ni Khin
2	Address	: University of Yangon
3	Phone No.	: 09-73131884
4	Date Received	: 10.12.2015
5	Sample Number	: 2469/15
6	Product Name	: Prawn
7	Type of Test	: Nutrition Package
8	Date of Issue	: 24.12.2015
9	Results	

This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Moisture	AOAC-2000(934.01)	57.26%
2	Ash	AOAC-2000(942.05)	3.09%
3	Protein	AOAC-2000(920.103) (Kjeldahl Method)	25.31%
4	Crude Fiber	AOAC-2000 (978.10) Fiber Cap Method	0.53%
5	Ether Extract (Crude Fat)	AOAC(Buchi Soxhlet Method)	12.03%
6	Carbohydrate	By Difference	1.78%
7	Energy Value (Kcal / 100 g)		216

Remarks

Nutrition Facts (100 gm)		
Energy	216	Kcal
Protein	25	gm
Fat	12	gm
Carbohydrate	2	gm

Tin Naing Win
Manager
FIDSL

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TO WHOM IT MAY CONCERN

External's Report: Ni Ni Khin's PhD thesis

Date: 15-8-2016

The candidate observed the edible insects from Hlegu and Taikkyi Townships, Yangon Region.

She classified 17 species of edible insects from Hlegu and Taikkyi Townships. She investigated the edible insect species occurrence from microhabitats and she also correlated the population of edible insects with weather parameters. The data analyzed and presented are quite satisfactory and the implication from this work are surely of economic value.

I am satisfied with the effort she has put in regarding her work. I recommend that she should be awarded the doctoral degree.

Yours faithfully,

Professor Dr Daw Khin Aye
Head (Retired)
Department of Zoology
Pyay University

TO WHOM IT MAY CONCERN

Referee's Report: Ni Ni Khin's PhD thesis

Date: 15-8-2016

The candidate carried out the occurrence of edible insects in three different seasons at Hlegu and Taikkyi Townships, Yangon Region. She assessed the microhabitats and population status of the recorded insects.

She also pointed out the nutritional values of the recorded edible insects and made the comparison with those of six common food sources.

The literature is well reviewed. The chapter on material and method is precisely expressed. The data are well organized and statistically analyzed.

The candidate's work is of economic value.

I am satisfied with her effort and recommend that she should be awarded the doctoral degree.

Yours faithfully,

Dr Thynn Thynn Naing
Professor and Head (Retired)
Department of Zoology
West Yangon University