

BIBLIOGRAPHY

BATTAD, ANDRE S. APRIL 2012. Insects Fauna of Bengaongao Cave, Tublay, Benguet. Benguet State University, La Trinidad, Benguet.

Adviser: Dr. Lita M. Colting Ph. D.

ABSTRACT

The study was conducted at Bengaongao Cave, Barangay Ambongdolan, Tublay, Benguet from November 2010 to September 2011 to determine and identify the cave fauna particularly insects and other arthropods, to determine their ecological importance, and to prepare a poster for tourists.

There were 24 arthropods, 19 insects from the orders Coleoptera, Dermaptera, Diptera, Hemiptera, Hymenoptera, Isoptera, Neuroptera, Odonata, Orthoptera and Plecoptera and five arachnids from the orders Araneae, Amblyphigi, Opilliones. The insects living in the caves belong to Order Coleoptera (Family Carabidae, Dytiscidae, Gyrinidae, Scarabeidae, and Lampyridae), Order Dermaptera (Family Forficulidae), Order Diptera (Family Culicidae, Ceratopogonidae, Nycteribiidae, and Streblidae), Order Hemiptera (Family Corixidae), Order Hymenoptera (Family Formicidae), Order Isoptera with two families (Termitidae and Rhinotermitidae), Neuroptera (Family Myrmeleontidae), Order Odonata (Family Corduliidae), Order Orthoptera (Family Raphidophoridae) and Order Plecoptera (Family Perlidae). Apart from insects there were presence of other arachnids and bats. There were five arachnids represented by the Order Araneae (Family Pholsidae, Pisauridae and Salticidae), Order Amblyphigi (Family Charontidae) and Order Opilliones (Family Stylocellidae).



The most numerous were Order Coleoptera with five families, followed by Order Diptera with four families and Order Isoptera with two families. The others were represented with only one family. In the arachnids, the most numerous is Order Araneae with three families; the others were only represented by one family.

Fifteen of the arthropods were decomposers or predators may contribute to the cleanliness and in managing of the population of insects and arthropods within the cave. Families under Order Diptera are known as ecto-parasites, two are associated with bats and the remaining two are associated known to cause annoyance or injuries to human beings. This information may contribute to the growing eco-tourism industry, for people to understand the significance and importance of the fauna that are found within the cave.



RESULTS AND DISCUSSION

Collected Specimens

Entrance Zone

The Insect Fauna that were found at the Entrance Zone belongs to the Orders the Coleoptera (Families, Carabidae, Dytiscidae, Gyrinidae, Scarabeidae, and Lampyridae), Dermaptera (Family Forficulidae), Diptera (Families Culicidae and Ceratopogonidae), Hemiptera (Family Corixidae), Hymenoptera (Family Formicidae), Isoptera (Families Termitidae, and Rhinotermitidae), Odonata (Family Corduliidae), and Order Plecoptera (Family Perlidae). Arachnids were also found in the Entrance Zone belonging to the Order Araneae (Families Pholcidae and Salticidae).

Twilight Zone

The Insect Fauna that were found in the Twilight Zone belonged to the Orders Diptera (Family Nycteribiidae), Isoptera (Family Termitidae), Neuroptera (Family Myrmeleontidae) and Orthoptera (Family Raphidophoridae). Arachnids were also found in the Twilight Zone belonging to the Order Araneae (Family Pholcidae and Pisauridae).

Dark Zone

The Insect Fauna that were found in the Dark Zone belonged to the Orders Diptera (Families Nycteribiidae, and Streblidae), Orthoptera (Family Raphidophoridae), and Plecoptera (Family Perlidae). Arachnids were also found in the Dark Zone belonging to the Orders Araneae (Family Pisauridae), Order Amblyphigi (Family Charontidae), and Order Opilliones (Family Stylocellidae).



The Insect Orders Coleoptera (Families Dytiscidae and Gyrinidae) Hemiptera (Family Corixidae), Plecoptera (Family Perlidae) were also found in the Bengaongao Cave in comparison to the insects found by (Horsskott et. *al.*, 2010) and (Fisher, 1988) in the Caves of Indonesia. While Orders Coleoptera (Families Carabidae and Scarabaeidae) found in the Caves of Bicol by (Jackson et. *al.* 1998) were also found within the Bengaongao Cave. Parasitic Diptera (Families Streblidae and Nycteriidae) feeding on fruit bats were also present in Bengaongao Cave in comparison to the insects found by (Thu-cao and Bae, 2007) in the Caves of Vietnam and Thailand. Insect Orders Hymenoptera (Family Formicidae), Isoptera (Families Termitidae and Rhinotermitidae) and Orthoptera (Family Raphidophoridae) were also present in comparison to the studies of (Rust and Andersen 1999) in the Moreneo Caves of Brazil.

The insect Orders Archeognatha, Collembolla, Blattodea, Ephemeroptera, Lepidoptera, Mantodea and Trichoptera. And the Other Arthropods which belongs to the Orders, Psuedoscorpionida, Scorpionida, Chilopoda and Diplopoda, which were found by (Urban, 2009) in the Kabayan Cave Mummies were not present in the Bengaongao Cave probably due to the difference of environment with in the two caves.

The insect Orders Coleoptera (Family Lampyridae), Dermaptera (Family Forficulidae), Diptera (Families Ceratopogonidae and Culicidae), Neuroptera (Family Myrmeleontidae), and Odonata (Family Corduliidae) were collected at the Entrance Zone of the Cave and are classified only as visitors of the caves.

Other Arthropods belonging to the Orders Araneae (Families Pholcidae, Pisauridae and Salticidae), Order Amblyphigi (Family Charontidae) and Order Opilliones (Family



Stylocellidae) were also present within the Bengaongao Cave, the same with the findings of (Adis and Harvey, 2000) in the caves of “Gruta Cana Brava”, Brazil.

Identification and Ecological Importance

Order Coleoptera

The Order Coleoptera was represented by five families, the Family *Carabidae* (Figure 4) is one of the major beetle families and commonly known as ground beetles. The specimen was found under a rock, 18 millimeters in body length, recognizable by the flattened body shape and ridged elytra. It has long legs and prominent mandibles. Their appearance is similar to the sun beetles with a thinner pro-thorax and a metallic black coloring. Carabids are classified as scavengers and predator, depending on the scarcity of food (Beutel 1991).

Order: Coleoptera
Family: Carabidae
Subfamily: Harpalinae
Tribe: Harpalini
Subtribe: Ditoma
Genus: *Bottchrus*
Common Name: Ground Beetle
Location Found: Entrance
Ecological Importance: Predator
Figures

4a: Posterior view magnified 3x

4b: Specimen found on a twig

Magnified 1x

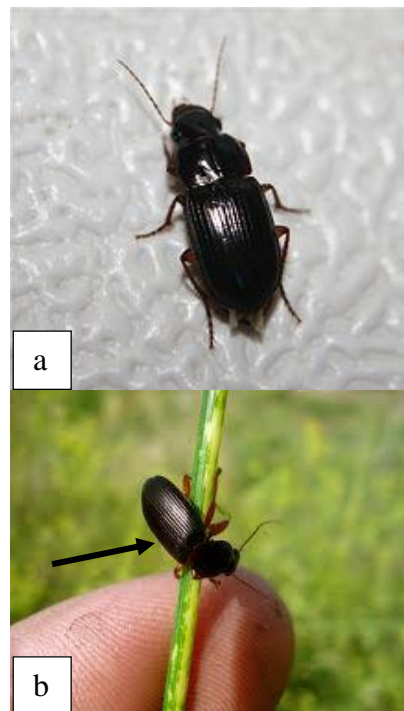


Figure 4. Carabidae

The Family *Dytiscidae* also known as predaceous water beetles are one of the largest and most commonly encountered aquatic beetles (Figure 5.). The specimen was found at a water puddle at the entrance. The specimen is eight millimeters long, hard, smooth, oval body, without a ventral spine, flattened hind legs and with a fringe of hairs. The adults and larvae attack animals much larger than themselves, and have been known to feed on other insects, crustaceans, worms, leeches, mollusks, tadpoles and small fish (Bailey et.al. 2002).

Order: Coleoptera
 Family: Dytiscidae
 Subfamily: Agabinae
 Tribe: Agabini
 Genus: *Ilybiosoma*
 Common name: Dytiscid Beetle
 Location found: Entrance
 Ecological Importance: Predator
 Figures
 5a: Specimen posterior view 1x
 5b: Lateral view magnified 2x

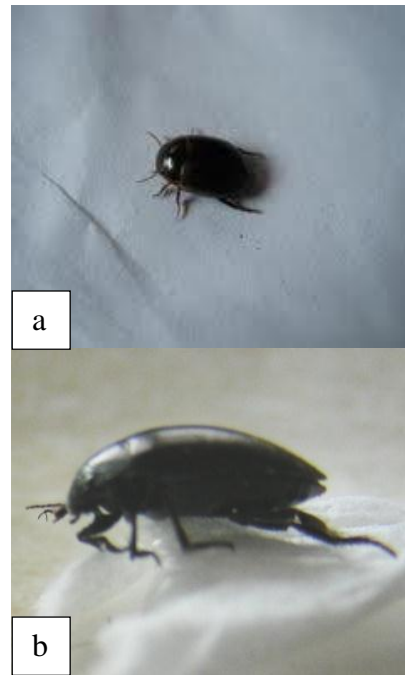


Figure 5. Dytiscidae

The Family *Gyrinidae* is called whirligig beetles they are aquatic and mainly thrive on the water surface (Figure 6). One specimen was located on the surface of a water puddle, it has very short and compact antennae, mid and hind legs are also short, flattened and paddle-like, with fringes of swimming hairs; fore legs long and slender, with expanded tarsi.

Order: Coleoptera
Family: Gyrinidae
Subfamily: Gyrininae
Tribe: Gyrinini
Genus: Gyrinus
Common Name: Whirlygig Beetle
Location found: Entrance
Ecological Importance: Scavenger

Figure

6a: Specimen posterior view
magnified 5x

6b: Specimen anterior view

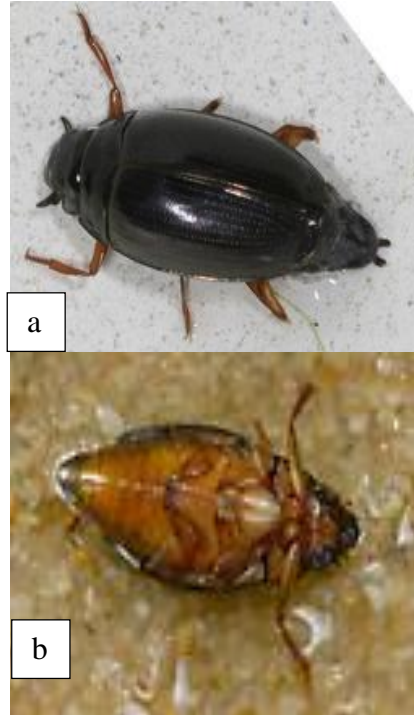


Figure 6: Gyrinidae

The Family Lampyridae is soft bodied winged beetles that are commonly known as fireflies or lightning bugs for adults and glow worms for larvae (Figure 7). One specimen was found on a leaf at the Entrance Zone, having a yellow blunt head, measuring 10 millimeters and emits a green colored light below the abdomen. Adults and larvae are carnivorous; they feed on a wide variety of insects and other small invertebrates, and other species of fireflies (Naumann, 1993).

Order: Coleoptera
Family: Lampyridae
Subfamily: Luciolinae
Genus: Luciola
Common name: Firefly
Location found: Entrance
Ecological Importance: Predator
Figure
7a: Specimen posterior view magnified 2x
7b: Specimen anterior view magnified 3x



Figure 7. Lampyridae

The Family Scarabaeidae are stout-bodied beetles, with dark metallic colors, clubbed antennae and broad front legs and adapted for digging (Figure 8). One specimen was found under rocks and leaf debris. Many species of this family are scavengers that recycle dung, carrion, or decaying plant material (Coca-abia, 2007) and (Bezděk, and Hájek, 2010).

Order: Coleoptera
 Family: Scarabaeidae
 Subfamily: Melolonthinae
 Genus: Phyllophaga
 Common Name: May or June beetle
 Location Found: Entrance
 Ecological Importance: Scavenger
 Figure
 8a: Specimen magnified 3x
 8b: Specimen found on soil
 Magnified 2x

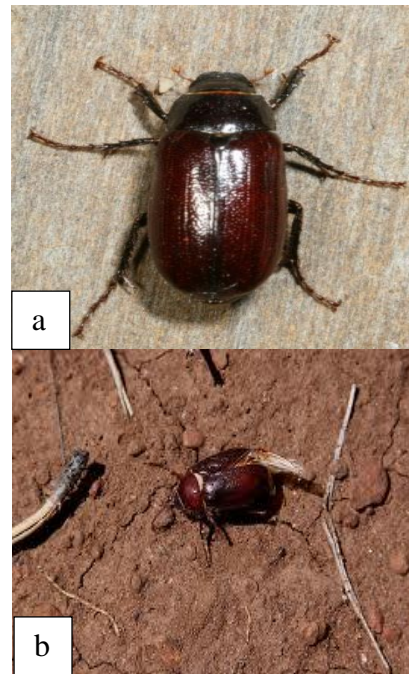


Figure 8. Scarabaeidae

Order Diptera

The Order Diptera is represented by the four Families: Culicidae, Ceratopogonidae, Nycteribiidae, and Streblidae (Figure 9). The Family Culicidae is known to be one of the most abundant groups of mosquitoes. One specimen was located at the Entrance Zone. It has black slender long-legs with long proboscis and the presence of scales on most parts of the body.

Order: Diptera
Family: Culicidae
Subfamily: Culicinae
Genus: Culex
Common Name: Culex mosquito
Location Found: Entrance
Ecological Importance:
Ecto -Parasite
Figure
11a: Specimen top view magnified 2x
11b: Area where specimen was found

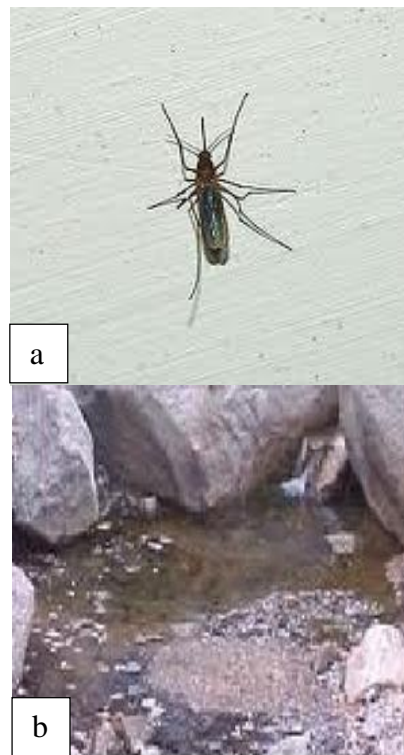


Figure 9. Culicidae

The family Ceratopogonidae this is commonly known as biting midges. They mostly feed on animal blood and rarely feed on human blood. One specimen was found at the Entrance Zone of the cave. Biting midges have smaller bodies than Mosquitoes; the legs are smaller than their antennae, with wings folded on top of each wing along the abdomen. They are found in almost any aquatic or semiaquatic habitat throughout the world, the blood-sucking

species are known to be vectors of disease-causing viruses, protozoa, and filarial worms (Bertone *et al.* 2008).

Order: Diptera
Family: Ceratopogonidae
Subfamily: Ceratopogonidae
Tribe: Culicoidini
Genus: Culicoides
Location Found: Entrance
Ecological Importance:
Ecto- Parasite
Figure
10a: Specimen on skin magnified 2x
10b: Specimen magnified 4x

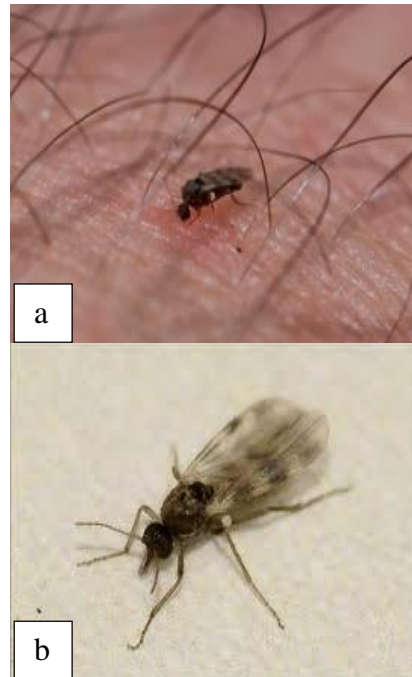


Figure 10. Ceratopogonidae

The Family Streblidae, they are known collectively as bat flies (Figure 11). Together with the family Nycteribiidae, they are pupiparous and parasitic exclusively on bats (Thu-cao and Bae, 2007). One specimen was collected parasitizing on a bat in the Dark Zone, it has a flea-like body structure, wings present and not longer than the body, legs and head arise from the sides. The wings are almost always fully developed, rarely reduced and non-functional (Graciolli, 2006).

Order: Diptera
Family: Streblidae
Subfamily: Streblinae
Tribe: Trichobiini
Genus: Trichobius
Location Found: Dark Zone
Ecological Importance:
Endo Parasite

Figure

11a: Specimen top view magnified 4x

11b: Host Harpy Fruit bat (*Harpyionycteris*)

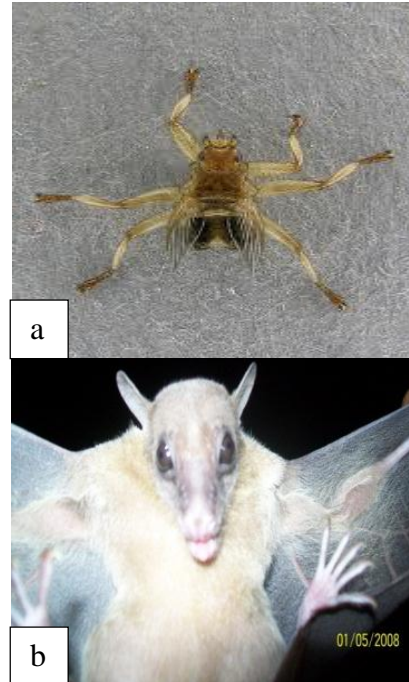


Figure 11. Streblidae

The Family Nycteribiidae, they are also known as bat flies, together with their close relatives the Streblidae. One specimen was found on a fruit bat in the Dark Zone, the specimen has a flattened body, spider-like appearance, the head is closely attached to the head, eyes, antennae and wings are absent, and mouthparts are modified specialized for sucking. Nycteribids are seldom encountered on the soil or the bat roosts, as they almost never leave the bodies of their hosts. Both males and females are hematophagic (Dittmara, 2009).

Family: Nycteribiidae
Subfamily: Nycteribinae
Genus: Phthiridium
Location Found: Dark zone
Ecological Importance:
Ecto-Parasite
Figure
12a: Specimen posterior view
Magnified x5



12b: Woolly Bat (kerivoula) where Specimen is located on it's Stomach



Figure 12. Nycteribiidae

Order Dermaptera

The Family Forficulidae under the suborder Forficulina is the most common earwigs found in the world, the specimen was found at the Entrance Zone (Figure 13). The specimen is black in color, has a pair of leathery forewings covering a few segments of the abdomen and the membranous hind wings, which have the tips protruding. Most of the species are commonly feed on plants, insects, invertebrates and decaying plant or animal matter (Guillet and Vancassel. 2001).

Order: Dermaptera
Family: Forficulidae
Subfamily: Forficulinae
Genus: Forficula
Location Found: Entrance
Ecological Importance: Scavenger/
Predator
Figure
13a: Specimen posterior view
Magnified 3x
13b: Specimen lateral view
Magnified 3x



Figure 13. Forficulidae

Order Hemiptera

The Order Hemiptera was represented by one Family, the Family Corixidae, commonly known as “water boatmen”. One specimen was located on a puddle along the entrance zone. The specimen had a tear drop shaped body with hairy paddle-shaped legs, black in color and with yellow striations along the body. Water boatmen are scavengers which feed on decaying matter and were also known to eat algae and planktons (Donovan, *et. al*, 2000).

Order: Hemiptera
Family: Corixidae
Subfamily: Corixinae
Tribe: Hesperocorixini
Genus: Hesperocorixa
Common Name: Water Boatman
Location Found: Entrance
Ecological Importance: Scavenger
Figure

14a: Specimen top view magnified x4

14b: Specimen found on rock
Magnified 2x



Figure 14. Corixidae

Order Hymenoptera

The Order Hymenoptera was represented by one Family Formicidae, the Family Formicidae commonly known as ants; ants are found on most parts of the world. Ants have distinct morphology, having elbowed antennae, metapleural glands, and a strong constriction of their second abdominal segment into a node-like petiole.

The subfamily Myrmicinae known as fire ants, named for the burning sensation felt when stung or bitten by the insects (Figure 15). One specimen was found at the Entrance Zone, the specimen was slender bodied with bright red color and large mandibles. Fire ants are known to be omnivorous although they are also known for their voracious appetites (Rust and Andersen, 1999).

Order: Hymenoptera

Family: Formicidae

Subfamily: Myrmicinae

Genus: *Myrmica*

Common Name: Fire ant

Location Found: Entrance

Ecological Importance:

Predator/Scavenger

Figure

15a: Specimen frontal view

Magnified 4x

15b: Specimen preying on other ants

Magnified 3x

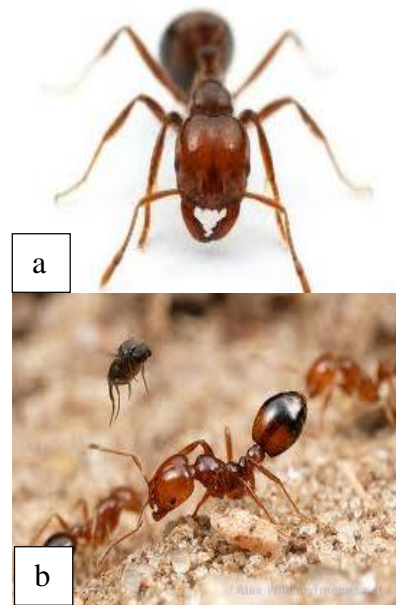


Figure 15 Formicidae

The subfamily Formicinae commonly known as black ants, one specimen was found at the Entrance Zone (Figure 16). The specimen is pure metallic black color, with small sized body and reduced mandibles. Black ants are scavenger ants, they feed on decaying plant matter, and some species are known to have a mutual relationship with aphids and scales (Naumann, 1993).

Order: Hymenoptera
Family: Formicidae
Subfamily: Formicinae
Tribe: Lasini
Genus: Lasius
Common Name: Black ant
Location Found: Entrance
Ecological Importance:
Predator and Scavenger
Figure
16a: Specimen magnified 3 xs
16b Specimen found on leaf
Magnified 2x



Figure 16. Formicidae

Order Isoptera

The Order Isoptera was represented by two Families: Rhinotermitidae and Termitidae. Family Rhinotermitidae, is a family of subterranean termites, one specimen was found at the Entrance Zone and Twilight Zone of the cave (Figure 17). The specimen had stout white colored abdomen, with yellow colored head, and reduced mandibles. The family Rhinotermitidae termites prefer feeding on decaying wood than trees (Donovan, et. al, 2000).

Order: Isoptera
Family: Rhinotermitidae
Subfamily: Captotermitinae
Genus: Captotermes
Common Name: Milk Termite
Location Found: Entrance
Ecological Importance: Scavenger
Figure



- 17a: Tunnels found on the walls of the cave magnified 3x
 17b: Tunnels found at the cave wall

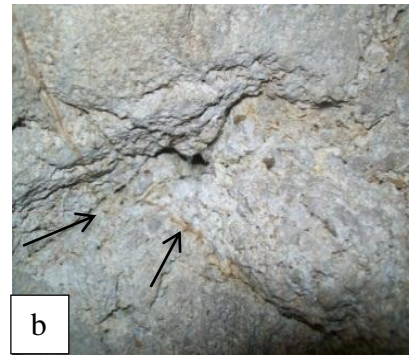


Figure 17. Rhinotermitidae

The Family Termitidae, is a family of mound- building termites, the specimen was found at the entrance of the cave (Figure 18). The specimen has slender bodies with a distinguishable pointed black head and with a brown abdomen. The family is known for their invasive pattern of colonization and feeding, and considered as detritivores. They prefer leaf litter and decaying wood. (Donovan, et. *al.* 2000).

- Order: Isoptera
 Family: Termitidae
 Subfamily: Nasutitermitinae
 Genus: Nasutitermes
 Common Name: Pin Termites
 Location Found: Entrance
 Ecological Importance: Scavenger
 Figure
 18a: Specimen on wood magnified 4x
 18b: Tunnels found on the ceiling of the cave

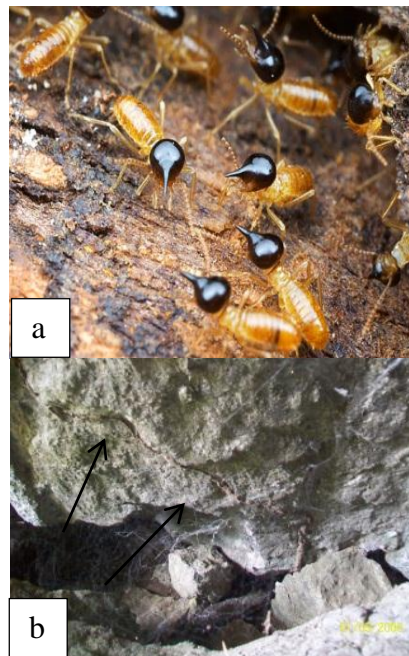


Figure 18. Termitidae

Order Neuroptera

The Order Neuroptera was represented by one family, the Family Myrmeleontidae, this family is referred to as ant lions. One specimen was found at the Entrance Zone (Figure 19). The specimen had long jaws, reduced legs, enlarged abdomen which is hump-like in appearance and thorax is retracted to the abdomen. Ant lion larvae are carnivorous unlike the adults it feeds on small insects that fall into their trap (Haring and Aspöck. 2004).

Order: Neuroptera

Subfamily: Myrmeleontidae

Tribe: Myrmeleontini

Genus: Myrmeleon

Common Name: Ant Lion

Location Found:

Ecological Importance:

Figure

19a: Specimen magnified 3x

19b: Ant lion found under sand pit
Magnified 3x

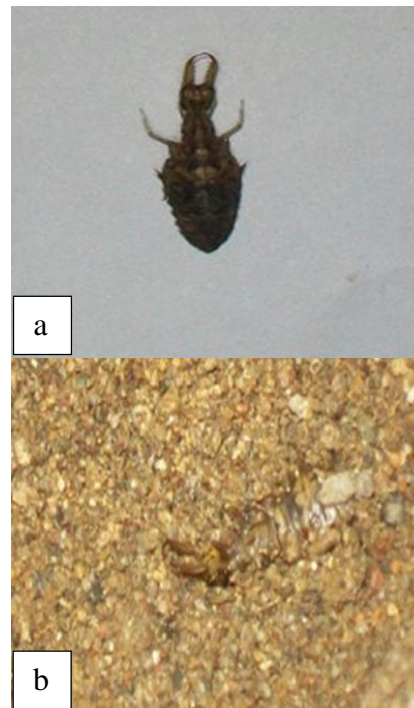


Figure 19. Myrmeleontidae

Order Odonata

The Order Odonata was represented by one family the Family Corduliidae commonly known as basket tailed Dragonflies. The family Corduliidae adults are black with areas of metallic green, and have large, emerald-green eyes. The larvae are black, hairy, and aquatic. Larvae (Figure 20) feed on a wide variety of aquatic insects, such as mosquito

larvae, other aquatic fly larvae, may fly larvae, and freshwater shrimp (Hamid and Rawi 2010).

Order: Odonata
Family: Corduliidae
Genus: Epitheca
Common Name: Dragonfly Niad
Location Found: Entrance
Ecological Importance: Predator
Figure
20a: Specimen posterior view
Magnified 3x
20b: Specimen labium magnified
5x



Figure 20. Corduliidae

Order Orthoptera

The Order Orthoptera is represented by one Family: Raphidophoridae, the Family Raphidophoridae under the suborder Ensifera referred to as moon hoppers or cave crickets (Figure 21). Two specimens were found in the Twilight Zone and Dark Zone of the cave. The specimen had large hind legs with "drumstick-shaped" femora and long, slender antennae, greyish color with black pigments found along the body color, humpbacked in appearance and wingless. Cave crickets feed on decaying matter; mainly they are described as scavengers (Russo, et al. 2007).

Order: Orthoptera
Family: Raphidophoridae
Subfamily: Raphidophorinae/
Troglophilinae
Genus: Troglophylus
Common Name: Cave Cricket
Location Found: Dark Zone
Ecological Importance: Scavenger

Figure

21a: Specimen anterior view
Magnified 2x

21b: Specimen found on rock
Magnified 1x

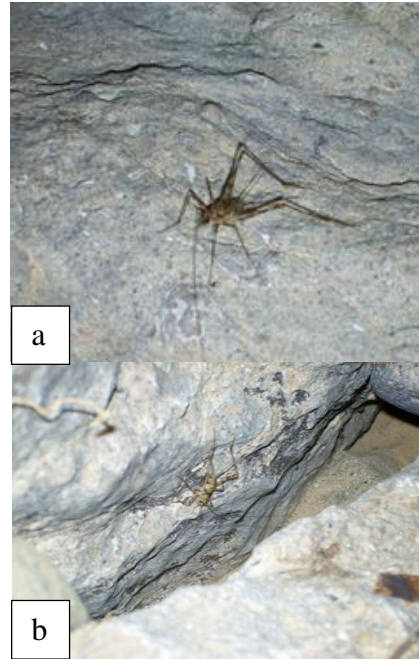


Figure 21. Raphidophoridae

Order Plecoptera

The Order Plecoptera was represented by one Family: Perlidae commonly known as Stone flies (Figure 22). One specimen were found at the Entrance Zone and the Dark Zone, the specimen had chewing mandibles, long, large compound eyes, and two ocelli, the legs are robust, with each ending in two claws and relatively soft abdomen. The Family Perlidae is known to be scavengers feeding on floating organic material like leaf litter (Hamid and Rawi 2010).

Order: Plecoptera
Family: Perlidae
Subfamily: Perlinae
Genus: Neoperla
Common Name: Stone fly
Location Found: Entrance and Dark Zone
Ecological Importance: Scavenger
Figure

22a: Specimen found on rock
Magnified 3x

22b: Area in the dark zone where
the specimen is found

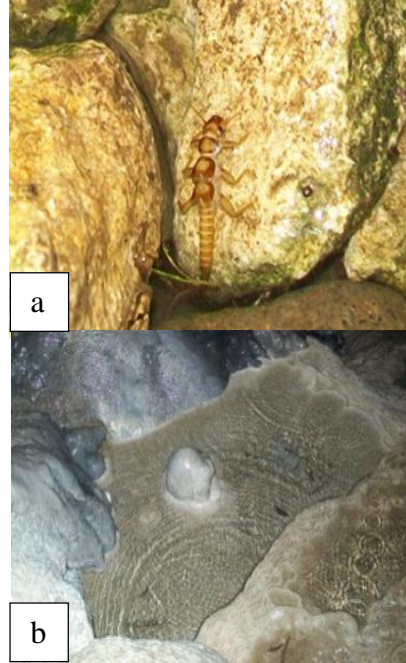


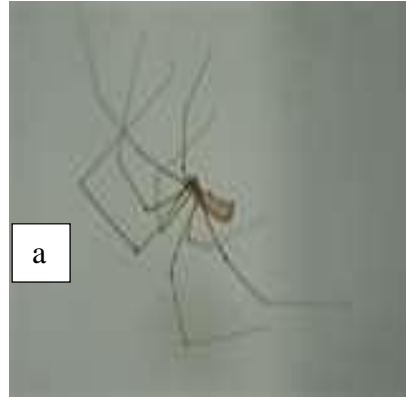
Figure 22. Perlidae

Identification and Ecological Importance of Other Arthropods

Order Araneae

The Order Araneae was represented by three Families: Pholcidae, Pisauridae, and Salticidae. The Family Pholcidae, commonly known as “daddy-long-legs” (Figure 23). One specimen was found at the Entrance Zone and Twilight Zone of the Cave. It has extremely long thin legs, and a skull shaped thorax, with cylindrical and elongate abdomen. Pholcids are araneomorphs, meaning they kill and digest their prey with venom, in caves they feed primarily on cave crickets and other spiders (Mađarić, et. al. 2005).

Order: Araneae
Suborder: Araneomorphae
Superfamily: Pholcoidea
Family: Pholcidae
Genus: *Pholcus*Walckenaer
Common Name: Daddy Long Legs
Location found: Entrance and
Twilight zone
Ecological Importance: Predator
Figure



23a: Specimen lateral view
magnified 3x

23b: Area where the specimen
was found



Figure 23. Pholcidae

The Family Salticidae also known as the jumping spiders. One specimen was found at the Entrance Zone of the Cave (Figure 24). It has eight eyes, three eyes on each side of the head positioned horizontally and two eyes in the middle, with enlarged mandibles and broad hind legs. The Family Salticidae are predatory spider like most arachnids they feed on insects and other small prey (Framenau,et.al. 2010).

Order: Araneae
Family: Salticidae
Genus: Unknown
Common Name: Jumping spider
Location Found: Entrance
Ecological Importance: Predator
Figure
24a: Specimen magnified 3x
24b: Specimen anterior view of
Ocelli magnified 5x

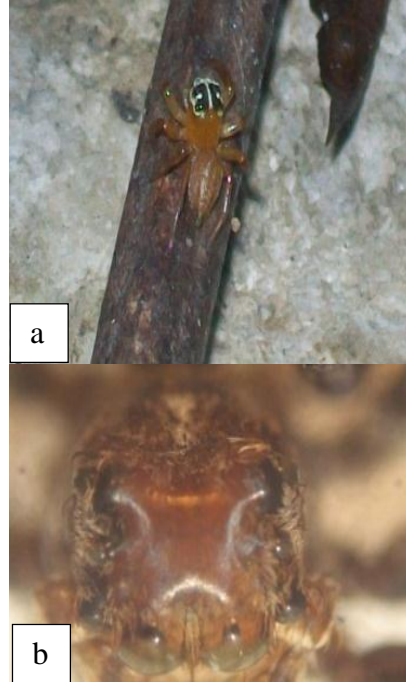


Figure 24. Salticidae

The Family Pisauridae or commonly known as Nursery Web spiders. One specimen was found at the Dark Zone (Figure 25). It has a distinct vertical lining found throughout the head and abdomen, with long slender legs and a medium sized body. In caves or most subterranean species, they feed on insects, other arthropods and even small vertebrates like cave fish, and pack rats. (Sierwald, 1997).

Order: Araneae
Family: Pisauridae
Genus: Tinus
Common Name: Nursing Spider
Location Found: Entrance
Ecological Importance: Predator

Figure

25a: Specimen top view
Magnified 2x

25b: Distinct stripe on thorax magnified
5x

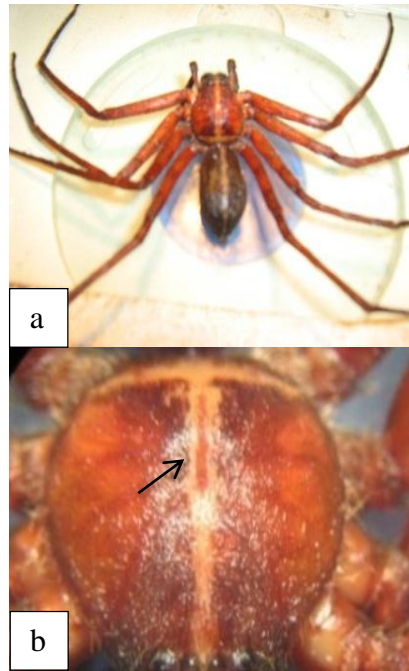


Figure 25. Pisauridae

Order Amblyphigi

The Order Amblyphigi was represented by one Family. The Family Charontidae commonly known as False Whip Scorpions (Figure 26). One specimen was found in the Dark Zone, the specimen has a heart-shaped cephalothorax, pedipalps not exceeding the length of the “whip”, and the carapace, pedipalps and legs are reddish-brown in color and has a sideward manner of moving. The Family Charontidae is primarily known as scavengers although some species are carnivorous depending on the presence of food (Harvey, 2002).

Order: Amblypygi, Thorell
Family: Charontidae
Genus: Charon
Common Name: Tailless Whip Scorpion
Location Found: Dark Zone
Ecological Importance: Predator
Figure
26a: Specimen top view magnified 4x
26b: Specimen found on cave floor

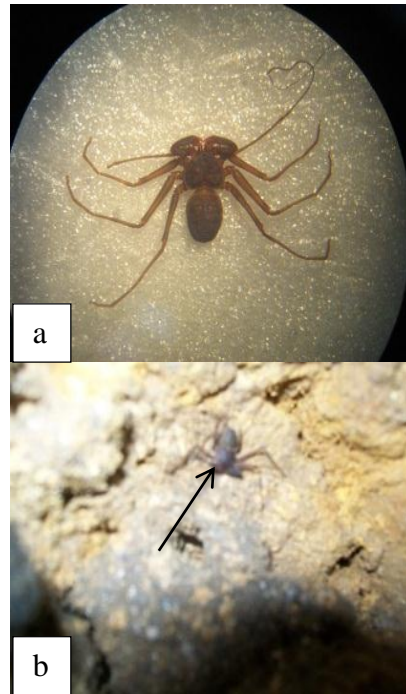


Figure 26. Charontidae

Order Opilliones

The Order Opilliones was represented by one Family. The order *Opilliones* formerly known as *Phalangida* is an order of arachnids commonly known as “harvestmen” or “grand-daddy-long-legs” (Figure 27). The Family Stylocellidae also known as Armored Harvestmen. One specimen was found at the Dark Zone, the specimen had an armored carapace, long legs, with two distinct body regions abdomen and cephalothorax, and spinnerets absent. Harvestmen are omnivorous, and feed on a wide variety of small insects, plant materials, and fungi: some are scavengers feeding upon dead organisms, bird dung, and other fecal material (Madaric, et.al.2005).

Order: Opilliones
Suborder: Cyphophthalmi
Superfamily: Stylocelloidea, Hansen and
Sorensen 1904
Family: Stylocellidae
Hansen & Sørensen, 1904
Genus: Stylocellus
Common Name: Armored Harvestman
Location Found: Dark Zone
Ecological Importance: Scavenger
27a: Top view magnified 4x
27b: Anterior view of ocelli magnified
5x

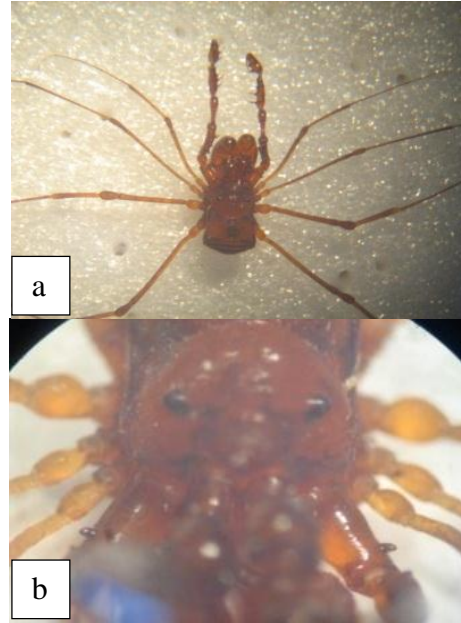


Figure 27. Stylocellidae

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to determine the ecological importance of insects and other arthropods associated with Bengaongao cave in Tublay, Benguet.

There were 24 arthropods associated in the cave comprised of 19 insects, and five Arachnids. The insects belonged to Orders: Coleoptera (Families Carabidae, Dytiscidae, Gyrinidae, Scarabeidae, and Lampyridae), Dermaptera (Family Forficulidae), Diptera (Families Culicidae, Ceratopogonidae, Nycteribiidae, and Streblidae), Hemiptera (Family Corixidae), Hymenoptera (Family Formicidae), Isoptera (Families Termitidae, Rhinotermitidae) Neuroptera (Family Myrmeleontidae), Odonata (Family Corduliidae), Orthoptera (Family Raphidophoridae) and Plecoptera (Family Perlidae).

Most of the insects are scavengers, these belonged to the Order Dermaptera (Family Forficulidae), Hemiptera (Family Corixidae), Hymenoptera (Family Formicidae), Isoptera (Families Termitidae, Rhinotermitidae), Coleoptera (Families Gyrinidae, Scarabeidae).

The predatory insects belonged to the Orders Coleoptera (Families Carabidae, Dytiscidae, Scarabeidae, and Lampyridae), and Order, Odonata (Corduliidae).

While the insects belonging to the Order Diptera (Families Nycteribiidae, and Streblidae) are parasites of bats living in the cave while (Families Culicidae and Ceratopogonidae) are parasitic to animals and man.

The Arachnids associated with Bengaongao cave belongs to the order Araneae (Families Pholcidae, Pisauridae, Salticidae), Order Amblyphigi (Family Charontidae) and Order Opilliones (Family Stylocellidae). All arachnids identified were predators to other arthropods and none were known to be harmful to man.



Conclusion

Fifteen of the insects and Arachnids associated with Bengaongao cave were beneficial arthropods that help maintain the ecology of the cave, except for the visitor insects of the Order Dipteral Family Culicidae (mosquitoes) and Ceratopogonidae (biting midges). These Dipteran insects are known parasites of animals and man (Soulsby, 1982).

The arachnids associated with the cave are predators of other arthropods and may help maintain the balance of the population of arthropods inside the cave. None of which were poisonous or known to be harmful to man.

Recommendation

These insects and arachnids that were collected are beneficial arthropods and should be conserved so that they will not become endangered and shall continue to contribute in the pristine quality of the cave. It is also recommended to study the effect of the frequency of the visitors and disturbance to the cave on the population of the arthropods.



LITERATURE CITED

ADIS, J. and HARVEY, M. S. 2000. "How many Arachnida and Myriapoda are there worldwide and in Amazonia?". *Studies on Neotropical Fauna and Environment* 35 (2): 139–141. doi:10.1076/0165-0521(200008)35:2;1-9;FT139 Retrieved September 14, 2011 from http://www.americanarachnology.org/JoA_free/JoA_v30_n3/ arac-30-03-470.pdf

ANNONYMOUS. 2011. Beautiful Sites and Places of Benguet. Retrieved September 13, 2011 http://www.benguet.gov.ph/index2.php?option=com_content&do_pdf=1&id=216.

BAILEY, P., P. BOON, & K. MORRIS, (2002) Australian Biodiversity Salt Sensitivity Database. Land & Water Australia. Retrieved September 22, 2011 at <http://www.rivers.gov.au/research/contaminants/saltsen.htm>

BEUTEL, R. G. 1991. Larval head structures of Omophron and their implications for the relationships of Omophronini (Coleoptera: Carabidae). *Entomologica Scandinavica* 22(1): 55-67. Retrieved September 12, 2011 from <http://www.arthropod-systematics.de/contents>.

BEZDĚK, A. and HÁJEK, J. 2010: Catalogue of type specimens of beetles (Coleoptera) deposited in the National Museum, Prague, Czech Republic. Scarabaeidae: Dynamopodinae, Dynastinae, Melolonthinae and Rutelinae. *Acta Entomologica Musei Nationalis Pragae*, 50: 279-320. ISSN: 0374-1036 PDF, September 12, 2011 from <http://www.arthropod-systematics.de/contents>.

BERTONE, M. A., G. W. COURTNEY, and B. M. WIEGMANN, 2008. Phylogenetics and temporal diversification of the earliest true flies (Insecta: Diptera) based on multiple nuclear genes. *Systematic Entomology journal* 33: Pp.668-687. Retrieved September 6, 2011 from <http://tolweb.org/Diptera>.

BUCRHAM, J. 2009. "Learning about caves; how caves are formed". Journey into amazing caves Pp.524-529. Retrieved February 26 2011 http://www.amazingcaves.com/learn_formed.html.

COCA-ABIA, M. 2007. Phylogenetic relationships of the subfamily Melolonthinae (Coleoptera, Scarabaeidae). *Insect systematics & evolution*, 38: 447-472. Retrieved September 13, 2011 from <http://tolweb.org/Coleoptera>.

DENR, 1998. Guidelines Ecotourism Development in the Philippines (DENR-DOT) Retrieved March 6, 2012 from <http://www.denr.gov.ph/section-policies/laws.php?filter=type&filterID=4>.

DITTMARA K.B. 2009. Pupal Deposition and Ecology of Bat Flies (Diptera:



Streblidae): *Trichobius* sp. in a Mexican Cave Habitat. *Journal of Parasitology*, Retrieved September 3, 2011 from <http://www.bioone.org/doi/abs/10.1645/GE-1664.1?journalCode=para>.

DONOVAN, S. E., D. T. JONES, W. A. SANDS, and P. EGGLETON 2000. Morphological phylogenetics of termites (Isoptera). *Biological Journal of the Linnean Society* 70/3:467–513. Retrieved September 11, 2011 from <http://www.bioone.org/doi/abs/10.1206/651.1>.

DUCKECK, C. and LANA, F. 2004. *Biospeleology* Pp.1 Retrieved at February 26, 2011 <http://www.uwec.edu/jolhm/cave/biospe2.html>.

FRAMENAU, V. W., DUPÉRRÉ, N., BLACKLEDGE, T. A. and VINK, C. J. 2010. Systematics of the new Australasian orb-weaving spider genus *Backbourkia* (Araneae:Araneidae: Araneinae). *Arthropod Systematics & Phylogeny*, 68 (1): 79-111. pdf 2865 kb. Retrieved September 12, 2011 from <http://www.arthropod-systematics.de/contents.html>.

FISHER, R.C. 1988. An inordinate fondness for beetles. *Biological Journal of the Linnean Society*, 35:313-319. Retrieved: September 6, 2011 from <http://tolweb.org/coleoptera>

FOREST MANAGEMENT SERVICES-DENR. 1999. Re-assessment of Crystal cave for It's possible rehabilitation for tourism purposes retrieved October 12, 2011 at http://www.benguet.gov.ph/index2.php?option=com_content&do_pdf=22id=217.

GRACIOLLI, G. 2006. A faunal survey of nycteribiid flies (Diptera: Nycteribiidae) associated with bats in Paraguay. *Journal of Parasitology Zootaxa* 1220: 35-46. Retrieved Spetember 2, 2011 from http://fm1.fieldmuseum.org/aa/Files/cdick/Graciolli_et_al_2006_Zootaxa.pdf.

GUILLET, S. AND VANCASSEL M. 2001. Dermapteran life-history evolution and phylogeny with special reference to the Forficulidae family. *Evolutionary Ecology Research* 3(4): 441-447.

HALLAN, J. 2005. "Synopsis of the described Araneae of the world", *Journal of arthropods, systematics and phylogeny*, 105: Pp. 356- 368. pdf 706 kb. Retrieved September 12, 2011 from <http://www.arthropod-systematics.de/contents.html>.

HAMID, .S.A. and RAWI C. S. 2010. Stoneflies (Insecta: Plecoptera) in Malaysian



tropical rivers: Diversity and seasonality School of Biological Sciences, Universiti Sains Malaysia. *Journal of Entomology and Nematology* Vol. 3(2), pp. 030-036, Retrieved September 19, 2011 from <http://www.academicjournals.org/JEN/PDF/Pdf2011/February/Suhaila%20and%20Salma%20h.pdf>.

HARING, E. AND ASPÖCK, U. 2004. Phylogeny of the Neuropterida: a first molecular approach. *Systematic Entomology journal* 29:415–430 Retrieved September 11, 2011 from <http://tolweb.org/Neuroptera>.

HARVEY, M.S. 2002. The First Old World Species of Phrynidae (Amblypygi): *Phrynus exsul* from Indonesia, Department of Terrestrial Invertebrates, Western Australia 6000, Australia. 2002. *The Journal of Arachnology* 30:470–474. Retrieved September 14, 2011 from http://www.americanarachnology.org/JoA_free/JoA_v30_n3/ arac-30-03-470.pdf.

HOLSINGER, J. R. 1985. Speciation in Cave Faunas. Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23508. Retrieved April 16, 2011 www.jstor.org/pss/2097051.

HONEY M. 2008. *Ecotourism and Sustainable Development: Who Owns Paradise?* Second Ed. Washington, DC: Island Press. p.33. retrieved March 28 2011 at <http://en.wikipedia.org/wiki/Ecotourism>.

HORSTKOTTET, J, R. RIESCH, M. PLATH, and P. JAGER, 2010 Predation by three species of spiders on a cave fish in a Mexican sulphur cave, *Bull. Br. arachnol. Soc.* 2010 15 (2), 55- 58. Retrieved September 12, 2011 from <http://www.repository.naturalis.nl/document/149018>.

JACKSON R., D. LI, N. FIJN, and A. BARRION, 1998. Predator–Prey Interactions Between Aggressive-Mimic Jumping Spiders (Salticidae) and Araneophagic Spitting Spiders (Scytodidae) from the Philippines. *Journal of Insect Behavior* 11 (3), Pp. 319-342. Retrieved September 12, 2011 from <http://tolweb.org/coleoptera>.

MAĐARIĆ B.B., B. A. HUBER, A. STEINACHER, and G. PASS, 2005. Phylogeny of pholcid spiders (Araneae: Pholcidae): Combined analysis using morphology and molecules. *Journal Molecular Phylogenetics and Evolution* 37, Pp. 661-673 Retrieved September 17, 2011 from http://resolver.scholarsportal.info/resolve/10557903/v37i0003/661_pospcaumam

MILLER, C.M. 1992. Biodiversity Reconnaissance in the Chiquibul Forest Reserve and



TheChiquibul National Park, Cuevis and Puente Natural: The WCI Chiquibul Expedition, A Preliminary Reconnaissance- July 13-19, 1992. Technical Report. Retrieved April 15 2011 at <http://eprints.eriub.org/705/>.

NATIONAL CAVING ASSOCIATION. 1997. Protect our caves. Retrieved October 9 2011, at <http://www.caveinfo.org.uk/uca/protect.htm>.

NG .M.. 1997. Importance of Eco-tourism to Asia . Retrieved October 9 2011, at <http://www.AsiaTourinfo.org.htm>.

NAUMANN, I.1993. Common and Scientific names for insects and allied organisms of economic and environmental importance. Journal of arthropods, systematics and phylogeny, 68: Pp. 51- 71. Retrieved September 12, 2011 from <http://www.arthropod-systematics.de/contents>.

PHILIPPINE DEPARTMENT OF TOURISM. 2009. R.A No. 9593 otherwise known as Tourism Act of 2009 and its Implementing Rules and Regulations. Pp. 1-8

PHILIPPINE DAILY INQUIRER, 2007. Philippine “Green Honey” Adulterated, article by R. Valencia and S. Bismark last 7/21/2007. Retrieved March 7. 2012 at <http://apitherapy.blogspot.com/2007/07/philippine-green-honey-adulterated.html>.

RUSSO, C. D., M, RAMPINI, and I. LANDECK, 2007. The cave crickets of northeast Turkey and transCaucasian regions, with descriptions of two new species of the genera Dolichopoda and Troglophilus (Orthoptera, Rhaphidophoridae). Journal of Orthoptera Research June 2007 : Vol. 16, Issue 1 Jun 2007, Pp: 67-76. Retrieved September 11, 2011 from <http://www.bioone.org/action/doSearch>.

RUST, J. and ANDERSEN, N. M. 1999. Giant ants from the Paleogene of Denmark with a discussion of the fossil history and early evolution of ants (Hymenoptera: Formicidae). Zoological Journal of the Linnean Society 125: Pp 331-348. Retrieved August 28, 2011 from <http://tolweb.org/Hymenoptera>.

SIERWALD, P. 1997. Phylogenetic analysis of Pisaurine nursery web spiders, with revisions of Tetragnophthalma and Perenethis (Araneae, Lycosidae, Pisauridae). The Journal of Arachnology 25:361-407 retrieved September 12, 2011 from Americanarachnology.org

THU CAO, T.K. and BAE, Y. J. 2007. Vietnamese Stonefly Species of the Genus Tyloperla(Plecoptera: Perlidae) Journal of Asia-Pacific Entomology 10, Pp. 329-334 Retrieved September 19, 2011 from http://journals2.scholarsportal.info/details.xqy?uri=/12268615/v10i004/329_vssotgtp.xml

URBAN, S. 2009. Monitoring and classification of insects and related arthropods associated with mummy caves in Kabayan, Benguet. Undergraduate Thesis, Benguet State University, La Trinidad, Benguet.Pp. 20- 22

