

Terrestrial invertebrate survey within the provinces of Guanacaste and San Jose, Costa Rica

Bekka S. Brodie¹ and Pilar G. Conde¹

INTRODUCTION

In January 2002, arthropod communities were sampled from 4 sites in the provinces of San Jose and Guanacaste, Costa Rica. Costa Rica, in Central America, is bordered by the Caribbean Sea on the east, the Pacific Ocean on the west, Nicaragua on the north and Panama to the south (Figure 1). In the province of Guanacaste, collecting was conducted at two sites in the village of El Guayabal, and one site in the coastal village of Playa Junquillal. In the province of San Jose, collecting was done at one site in the village of Tibas. The climate in the study area is tropical to neotropical and has two distinct seasons, rainy and dry. Differences in arthropod communities are believed to be affected by climatic and environmental changes.

STUDY SITE DESCRIPTION

Guanacaste is located in a tropical dry rainforest in the coastal lowlands bordering the Pacific Ocean (Figure 2). Guanacaste has greater extremes in precipitation, in relation to rainy and dry seasons than San Jose. Temperatures range from 19 to 32 Centigrade. Both provinces experience a distinct rainy season from May to November and a dry season from December to April (Anonymous, 2001.)

Two of the Guanacaste sites are in the village of El Guayabal. The first, "La Finca" (meaning "The Farm"), is a site composed of an abandoned woodlot of about half a hectare, the majority of which floods to become a swamp-like area every rainy season. Evidence of the most recent flooding a month previous to this study was still evidenced by downed trees and debris heaps. The second El Guayabal site, "La Otra Finca" ("The Other Farm") is a recently abandoned citrus orchard of about 1.2 hectares in size at a higher elevation than La Finca. The Other Farm does not receive a yearly inundation by water. The third site in Guanacaste is a beach-side plot at Playa Junquillal. Playa Junquillal is an environmentally protected beach (Conde, 2002.) Strict regulations concerning building codes and land use are enforced, minimizing the amount of disturbance made to the environment (Conde, 2002).

Tibas is located in a valley within the Cordillera Central Mountains of Costa Rica (Figure 3). The climate of this central upland region is wetter and cooler than the drier coastal lowlands. Average temperatures in January are 14 to 27 degrees Centigrade. There usually is occasional light rainfall during the dry season (Anonymous, 2001.) The site studied in Tibas was known as "El Caffetal" ("The Coffee Patch"). The Coffee Patch is essentially maintained as a hedgerow in a suburban yard. The collections were done in the surrounding yard as well.

¹ Report to satisfy a Biol. 399 directed research project.

The purpose of this survey is to sample the arthropod community from several sites within the provinces of San Jose and Guanacaste. This survey was intended to document differences in communities which presumably is reflective of variant climate change and land use.

METHODS

Insects were collected using aerial nets, pit fall traps, and a malaise trap. Aerial nets were brushed over small vegetation and grasses along the perimeters of the collecting sites. Pit fall traps are a hole in the ground with bait (canine feces) and a solution of detergent at the bottom to collect the specimens. Pit fall traps were placed approximately in the center of each collecting site. A malaise trap is a large net that is set up with out bait. Insects using the area as a flyway would encounter the trap and be directed upward into the collecting chamber (Brodie, 2002). Placement of the malaise trap was selected primarily on available open space in the collection sites. Specimens captured were fixed in a freezer (-20°C) and then preserved in a 70% alcohol mixture. Lepidoptera specimens however, were specially handled by freezing and placing them in a paper envelope for safekeeping. When we returned to the U.S. they were re-hydrated using a phenol and water solution for pinning. Insects were classified at least to family following Borrer *et al.* (1998), Brues *et al.* (1954), Stehr (1991), the web-based resources of the National Biodiversity Institute of Costa Rica (InBio) (2002), and the Tree of Life Project (2001). Arachnid samples were identified with the use of Borer *et al.* (1954), Levi (1990), and InBio (2002). Permits for the collection and exportation of the preserved specimens were obtained.

These sites were arbitrarily selected. This research is not intended to be quantitative based on methods of collection.

RESULTS

Tables 1- 4 list the arthropods collected, including a taxonomic overview and a quantitative assessment for each location. The families found most frequently in the San Jose study site were Membracidae (Homoptera) and Gryllidae (Orthoptera). In El Guayabal, Membracidae (Homoptera) and Pieridae (Lepidoptera) were most frequently found in the orchard; in the woodlot Tipulidae (Diptera) and Cicadellidae (Homoptera) were mostly represented. Due to high winds at the Playa Junquillal site, the malaise trap failed to operate properly. Therefore, the results obtained were not a true representation of the common taxa at this site (Table 4).



Figure 1. The country of Costa Rica and its provinces, note the provinces of Guanacaste and San Jose on the western coast (Costa Rica, Ecosystems, 2000.)



Figure 2. Province of Guanacaste: The village of El Guayabal was where the two sampling sites, La Finca and La Otra Finca were located. One site was at Playa Junquillal (Costa Rica, Ecosystems, 2000.)

Class	Order	Family	Subfamily	Genus species	Quantity
Arachnida	Araneae	Amouribidae			1
Arachnida	Araneae	Araneidae		<i>Gasteracantha cacriformis</i>	1
Arachnida	Araneae	Lycosidae			2
Insecta	Orthoptera	Acrididae			2
Insecta	Orthoptera	Gryllidae			5
Insecta	Orthoptera	Phasmatidae			1
Insecta	Blattaria	Blattellidae			2
Insecta	Blattaria	Blattidae			3
Insecta	Dermaptera	Carcinophoridae			4
Insecta	Hemiptera	Lygaeidae			1
Insecta	Hemiptera	Miridae			4
Insecta	Hemiptera	Rhopalidae			1
Insecta	Homoptera	Cicadellidae			2
Insecta	Homoptera	Membracidae			6
Insecta	Neuroptera	Chrysopidae			3
Insecta	Coleoptera	Scarabaeidae	Acanthocerinae		1
Insecta	Diptera	Muscidae			1
Insecta	Diptera	Tabanidae			1
Insecta	Lepidoptera	Arctiinae			1
Insecta	Lepidoptera	Pieridae			1
Insecta	Lepidoptera	Unknown			1
Insecta	Hymenoptera	Ichneuemonidae			1

Table 1. Listing of arthropods collected at "The Coffee Patch" in Tibas, winter 2002.

Class	Order	Family	Subfamily	Genus species	Quantity
Arachnida	Araneae	Salticidae			2
Insecta	Orthoptera	Gyrillacridae			1
Insecta	Orthoptera	Acrididae			5
Insecta	Blattaria	Blattellidae			1
Insecta	Hemiptera	Pentatomidae			2
Insecta	Homoptera	Cicadellidae			1
Insecta	Homoptera	Membracidae			6
Insecta	Coleoptera	Scarabidae			3
Insecta	Diptera	Dolichopodidae			1
Insecta	Diptera	Tabanidae			1
Insecta	Lepidoptera	Pieridae		<i>Philea</i>	1
Insecta	Lepidoptera	Saturniidae			1
Insecta	Lepidoptera	Nymphalidae	Limenitidae		1
Insecta	Lepidoptera	Gelechiidae			2
Insecta	Lepidoptera	Pieridae			4
Insecta	Lepidoptera	Nymphalidae	Agrynninae		5
Insecta	Hymenoptera	Xyelidae			1
Insecta	Hymenoptera	Apinae			2
Insecta	Hymenoptera	Formicidae			7

Table 2. Listing of arthropods collected at "The Other Farm" in Guanacaste, winter 2002.

<i>Class</i>	<i>Order</i>	<i>Family</i>	<i>Subfamily</i>	<i>Genus species</i>	<i>Quantity</i>
Arachnida	Acari				22
Arachnida	Araneae	Amouribidae			3
Arachnida	Araneae	Ctenidae			1
Arachnida	Araneae	Oecobidae			1
Arachnida	Araneae	Oxyopidae			1
Arachnida	Araneae	Salticidae			3
Arachnida	Araneae	Sparassidae		<i>Heteropoda</i>	1
Arachnida	Araneae	Therididae		<i>Micrathena</i>	1
Arachnida	Araneae	Therididae		<i>Argiopes argentata</i>	1
Arachnida	Araneae	Thomisidae		<i>Misumenops</i>	2
Insecta	Orthoptera	Acrididae			9
Insecta	Orthoptera	Tettigoniidae			2
Insecta	Hemiptera	Alydidae			1
Insecta	Hemiptera	Berytidae			3
Insecta	Hemiptera	Coreidae			2
Insecta	Hemiptera	Lygaeidae			4
Insecta	Hemiptera	Lygaeidae			1
Insecta	Hemiptera	Pentatomidae			4
Insecta	Hemiptera	Pentatomidae	Pentatominae		1
Insecta	Hemiptera	Pyrrhocoridae			1
Insecta	Hemiptera	Rhopalidae			7
Insecta	Homoptera	Membracidae			1
Insecta	Homoptera	Cicadellidae			35
Insecta	Homoptera	Achilidae			1
Insecta	Homoptera	Fulgoridae			1
Insecta	Homoptera	*Unknown			2
Insecta	Neuroptera	Hemerobiidae			1
Insecta	Neuroptera	Myrmeleontidae			3
Insecta	Coleoptera	Chelonariidae			1
Insecta	Coleoptera	Curculionidae			2
Insecta	Coleoptera	Lycidae			2
Insecta	Coleoptera	Nitidulidae			1
Insecta	Coleoptera	Scarabaeidae			2
Insecta	Coleoptera	*Unknown			1
Insecta	Diptera	Asilidae			3
Insecta	Diptera	Bombyliidae			1
Insecta	Diptera	Calliphoridae			3
Insecta	Diptera	Coelopidae			1
Insecta	Diptera	Culicidae			34
Insecta	Diptera	Dolchopodidae	Dolchopodinae		4
Insecta	Diptera	Dolchopodidae		<i>Condylostylus</i>	23
Insecta	Diptera	Dolchopodidae			3
Insecta	Diptera	Pipunculidae			1
Insecta	Diptera	Scenopinidae			2
Insecta	Diptera	Sepsidae			1
Insecta	Diptera	Tabanidae			1
Insecta	Diptera	Tachinidae			1
Insecta	Diptera	Tipulidae			40
Insecta	Trichoptera				24
Insecta	Lepidoptera	Arctiidae			1

Table 3. Listing of arthropods collected at "The Farm" in Guanacaste, winter 2002.

Insecta	Lepidoptera	Hesperidae			3
Insecta	Lepidoptera	Nymphalidae	Argynninae		1
Insecta	Lepidoptera	Nymphalidae	Limenitidae		1
Insecta	Lepidoptera	Nymphalidae		<i>Anartia fatima</i>	2
Insecta	Lepidoptera	Pieridae			3
Insecta	Hymenoptera	Bradynobaenidae			1
Insecta	Hymenoptera	Cephalidae			3
Insecta	Hymenoptera	Chacidae			1
Insecta	Hymenoptera	Embolemidae			1
Insecta	Hymenoptera	Eucoilidae			3
Insecta	Hymenoptera	Evanidae			1
Insecta	Hymenoptera	Formicidae			6
Insecta	Hymenoptera	Ichneumidae		<i>Megarhyssa</i>	1
Insecta	Hymenoptera	Monomachidae			1
Insecta	Hymenoptera	Mutillidae			2
Insecta	Hymenoptera	Pompilidae			3
Insecta	Hymenoptera	Scoliidae			1
Insecta	Hymenoptera	Sphecidae			8
Insecta	Hymenoptera	Vespidae	Masurinae		1
Insecta	Hymenoptera	Vespidae			2

Table 3 (cont.). Listing of arthropods collected at "The Farm" in Guanacaste, winter 2002.

<i>Class</i>	<i>Order</i>	<i>Family</i>	<i>Subfamily</i>	<i>Genus species</i>	<i>Quantity</i>
Insecta	Orthoptera	Acrididae			1
Insecta	Diptera	Theveridae			1
Insecta	Lepidoptera	Satyridae			1
Insecta	Hymenoptera	Anaxyelidae			1
Insecta	Hymenoptera	Vespidae			2

Table 4. Listing of arthropods collected at "Playa Junquial" in Guanacaste, winter 2002.



Figure 3. Province of San Jose: Study site Tibias was located at # 1 (Costa Rica, Ecosystems, 2000.)

DISCUSSION

Vegetation plays a primary role in determining the neotropical insect fauna in each physiographic area (Hogue, 1993.) The country's vegetation varies from near desert conditions to lush tropical forests. Environmental disturbances affect the vegetation, and in turn, the invertebrate community. Human contributions to these disturbances include activities such as deforestation, cattle ranching and agriculture (Putz and Holbrook, 1988; Hogue, 1993). Insects often thrive in disturbed soils, due to the lush herbaceous flora that invades the disrupted area (Hogue, 1993). During the transitional periods as these areas regenerate, the arthropod communities will often diversify and/or re-establish themselves from year to year (Hogue, 1993).

Difference in arthropod communities between collection sites is substantial and is believed to be a reflection of variability of the climate and land use. Though they are small differences in the organisms found at different sites in this research, they can lead to tremendous differences in similar results due to the diversity of this country.

Interactions between vascular plants and the arthropod community in a given area might cause species sorting. For example, a seasonal dry forest hosts a different mix of flora, some of which only flower during the rainy season, supporting a different mix of pollinating birds and insects (Putz and Holbrook, 1988) than a wet rainforest. In spite of its small size, Costa Rica features greater biodiversity than all of Europe or North America. This is due to a number of factors, including:

- The country's location between North and South America, enabling plants and animals from both continents and the Antilles (Caribbean islands) to establish themselves there.

- Costa Rica's tropical climate and geographical makeup includes a range of habitats, from lowland rainforest to cloud forests, to tropical lakes and rivers.
- The nation's ecological policy, which has protected a significant percentage of its natural territory.
- Increased plant biodiversity through agricultural practices provide flowering and aromatic ornamental plants that attract beneficial insects.

There is now a national inventory project being conducted by the National Biodiversity Institute of Costa Rica (InBio) to record and help protect the flora and fauna of the Country (InBio, 2002). The Area de Conservación Guanacaste (A.C.G.) was established in order to restore an entire ecosystem of dry forest, found adjacent to a rain forest and a cloud forest. This large protected area would help insure the survival of the region's biodiversity in the future.

REFERENCES

- Brodie, B. S. 2002. A survey of arthropods along the Marcy-South Power Line at Greenwoods Conservancy. *In* 34th Ann. Rept. (2001). SUNY Oneonta Biol. Fld. Sta., SUUNY Oneonta.
- Borror, D. J., C. A. Triplehorn and N. F. Johnson. 1989. *Insects*, 6th Edition. Saunders College Publishing. Ft. Worth, Texas.
- Brues, *et. al.* 1954. *Bulletin of the Museum of Comparative Zoology at Harvard College*. Vol. 108. Cambridge, Mass.
- Conde, R.J.J. 2002. Personal Communication.
- Anonymous. 2000. Costa Rica Ecosystems. Photo.net. Retrieved March 5th, 2002. <http://www.photo.net/cr/moon/ecosystems.html>.
- Anonymous. 2001. Costa Rica Climate. Centralamerica. Retrieved 5 Feb. 2003. <http://www.centralamerica.com/cr/info/climate.htm>.
- Hogue, C. L. 1993. *Latin American Insects and Entomology*. University of California Press. Berkely and Los Angeles, California and Oxford, England.
- InBio. 2002. Retrieved May 8, 2002. El Instituto Nacional de Biodiversidad (de Costa Rica) <http://www.inbio.ac.cr/>
- Levi, H. W., and L. R. Levi. 1991. *Spiders and their Kin*. Golden Books. New York.
- Putz, F.E. and N.M. Holbrook. 1988. Strangler fig rooting habits and nutrient relations in the llanos of Venezuela. *American Journal Botany* 76, 781-788.
- Stehr, F. W. 1991. *Immature Insects*. Kendal/Hunt Publishing Company. Dubuque, Iowa.