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Insects associated with endangered plants in the Galápagos Islands, Ecuador

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Abstract

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Few studies on insects and host plant associations have been undertaken in the Galápagos Islands. Since endemism in the Galápagos is high, and those species of endemic plants that are critically endangered will consequently also have an equally endangered insect fauna associated with them, it is important to know the endemic species of insects that have an association with those plants and their degree of dependence. Insect interactions with 19 species of endangered plant were observed and collections made between April 2001 and August 2002. One hundred and eight insect species were found to have some degree of interaction, using plants for refuge and/or as a food source. Eighty two of these could be identified to species. Most of the identified insects (76,8%) are endemic or native and several generalist feeders. They do not appear to have a restricted feeding range or distinct host plant preference.

Additional Key words: Endangered plants, Galápagos Islands, insect interaction.

Resumen

Boada R. 2005. Insectos asociados con plantas amenzadas en las Islas Galápagos, Ecuador. Entomotropica 20(2): 77-88.

Pocos estudios acerca de insectos asociados a plantas se han realizado en las Islas Galápagos. Tomando en cuenta el alto grado de endemismo en Galápagos, unido al hecho que especies de plantas que están en peligro de extinción consecuentemente también tendrán entomofauna asociada igualmente en peligro, es importante conocer qué especies de insectos usan estas plantas y su grado de dependencia. Durante el periodo comprendido entre abril 2001 y agosto 2002 se observaron y colectaron manualmente insectos que interactúan con 19 especies de plantas en peligro. Ciento ocho especies de insectos fueron observados usando las plantas como refugio y/o fuente de alimento. Ochenta y dos insectos fueron identificados. La mayoría de los insectos identificados observados (76,8%) son endémicos o nativos y de estos varias especies son generalistas ya que aparentemente no tienen un rango restringido de alimentación ni ninguna preferencia por la planta hospedera.

Palabras clave adicionales: Interacción insectos, Islas Galápagos, plantas en peligro de extinción.

Introduction

Few studies on insects and plant relationships have been undertaken in the Galápagos Islands, and those were focused on flower visitation in non-endemic and endemic species of plants such as *Darwiniothamnus tenuifolius* (Hook. f.) Harling (Asteraceae) and *Plumbago scandens* L. (Plumbaginaceae) on Pinta and Santa Cruz Islands (McMullen & Viderman 1994) and *Scalesia baurii* ssp. *hopkinsii* (B. L. Rob.) (Asteraceae) on Pinta Island (McMullen & Naranjo 1994). Investigations were made on pollinator availability in *Justicia galapagana* Lindau (Acanthaceae) (McMullen 1994). Observations on the relationships of the Galápagos carpenter bee (*Xylocopa darwini*) and other insect visitors to flowering plants were also made (McMullen 1985, 1993; Linsley et al.

1966). Currently, studies on Lepidoptera species, their distribution, and their host plants are being conducted (Roque-Albelo & Landry 2001).

Some endemic plant populations are being reduced due the presence of introduced organisms such as feral goats and donkeys, and weedy or invasive plants (Jaramillo 2000). Consequently, it is important to focus studies on endangered plant species and the insects associated with them. This will bring about a better understanding of the insect-host plant interactions and their mutual dependencies and will provide information on the interactions of those insects that are endemic, native or introduced.

Species endemism in the Galápagos is high**.** Those species of endemic plants that are critically endangered may also have an endangered insect fauna associated with them. The objective of this study is to investigate relationships between insects and endangered Galapagos plant species. This paper presents new information on 82 insect species (53 endemic, 10 native, 19 introduced), associated with 19 endangered plant species.

Materials and Methods

Study sites

This study was conducted in the Galápagos Islands, Ecuador, from April 2001 to August 2002. Several islands on which the plants are naturally found were used as study sites.

Collecting methods

Visits to the localities were made during the warm/humid season (from December to June) and during the cool/dry season (from July to November). The number of individual insects were recorded, their behavior (feeding, mating, ovipositing, resting), the part of the plant where the insect was found, and the time of day and the weather conditions. Insects were located by visual inspection of the plants, and collected using forceps, fine brushes and an aspirator. The entire plant was searched; including stems, leaves, fruits and flowers. When possible, roots were checked as well. The insects were killed using ethyl acetate or 75% ethyl alcohol. Larvae and juveniles were reared under laboratory conditions in the Containment Facility at the Charles Darwin Foundation. Voucher specimens are deposited in the Terrestrial Invertebrate Reference Collection of the Charles Darwin Research Station (IC CDRS), Santa Cruz Island.

Insect identification

Insects were identified using keys and compared with those specimens preserved in the Invertebrates collection of Charles Darwin Research Station CDRS Reference Collection. All the specimens were sent to specialists for identification or confirmation.

Plant selection

The list of endangered plant species considered for this study was compiled using the International Union for Conservation of Nature and Natural Resources (IUCN) criteria, (IUCN 2000). The categories are: critically endangered, where the species has an extremely high risk of extinction in the wild in the immediate future; endangered, where the species is not now critically endangered but has a very high risk of extinction in the wild in the near future; and vulnerable, where the species is not now critically endangered or endangered but has a high risk of extinction in the wild in the future (Valencia et al. 2000, Tye 2002). From a total of 1359 species registered in the Herbarium of the Charles Darwin Station, 238 are endemic. From this number 190 have been evaluated to establish their category having that: 24 species, which corresponds to 13%, are critically endangered, 29 species (15%) are endangered and, 62 species (32%) are vulnerable (Herbarium CDS Data Base 2006).

Characteristics of each species of plant are given according to McMullen (1999) and Wiggins & Porter (1971).

For insect collecting and data recording from plants with large populations (>50 individuals), 10 x 10 m quadrants were used. For species of plants with small populations, each accessible individual was checked. Others species of plants found within the area were also checked to record the specificity and feeding range of the insects

Results

One hundred and eight insects were found to have some association with the 19 species of endangered

Table 1. Number and status of insects collected from 19 species of threatened plant species in Galapagos between April 2001-August 2002. Some insect species were recorded visiting more than one plant species.

Family	Plant species	Number of species of insects				
		Endemic	Native	Introduced	Undetermined	Total
Asteraceae	*Darwiniothamnus lancifolius*	3				3
	Darwiniothamnus tenuifolius			1		1
	Lecocarpus darwinii	2		1	1	4
	Lecocarpus lecocarpoides		1		1	2
	Lecocarpus pinnatifidus	2			1	3
	Scalesia atractyloides	4	1	1	1	7
	Scalesia cordata	2	2	1		5
	Scalesia gordilloi	9	1	7	1	18
	Scalesia microcephala	1	1			2
	Scalesia pedunculata	11	3	5	8	27
	Scalesia retroflexa	7	4		1	12
Cactaceae	*Opuntia echios*	1			1	2
	Opuntia megasperma var. orientalis	4			1	5
Cyatheaceae	*Cyathea weatherbyana*	7			3	10
Ericaceae	*Pernettya howellii*	2		1		3
Euphorbiaceae	*Acalipha wigginsi*	2		1	1	4
Melastomataceae	*Miconia robinsoniana*	5	1	1	4	11
Portulacaceae	*Calandrina galapagosa*	2		3	3	8
Scrophulariaceae	*Galvezia leucantha* var. *porphirantha*				1	1

plants that were studied. From this number of insect species, eighty-two were identified to species level and their status determined. Accordingly, 53 species (64.6%) are endemic, ten are native (12.2%), and nineteen are introduced species (23.2%). Twenty six species could not be identified to species level and their origin is unknown. Insects visited the plants searching either for nectar and pollen or were observed feeding on leaves, flowers or fruit. Insects mainly used the plants for refuge and as a food source. Taller plants were found to shelter a higher number of insects (Table 1).

Plants and insects are listed below alphabetically by family and genus. Following the species name is the status of the insect (endemic, native, introduced), the part of the plant where it was observed, the island it was collected from, the month collected, and any additional information reported by other authors.

Family: Asteraceae

***Darwiniothamnus lancifolius* (Hooker f.)** [Critically endangered]

Bushy-branched shrub to 3 m tall with flowers in radiate heads. Distributed in Fernandina, Isabela (Alcedo, Cerro Azul, Darwin, Ecuador, Sierra Negra).

Campiglossa crockeri Curran 1934 (Diptera: Tephritidae). Endemic fruit fly. Found resting on flowers. Isabela (Sierra Negra). July. Also reported on Baltra, Fernandina, Floreana, Isabela, Pinzón, Rábida, and Santiago (Sinclair and Peck 2002).

Dyseuaresta bilineata Foote, 1982 (Diptera: Tephritidae). Endemic. Found resting on flowers. Isabela (Sierra Negra). July. Also reported on Fernandina and Santa Cruz (Sinclair and Peck 2002).

Toxomerus crockeri Curran, 1934 (Diptera: Syrphidae). Endemic. Found feeding on nectar. Isabela (Sierra Negra). July.

***Darwiniothamnus tenuifolius* (Hooker f.) 1962** Cronquist & Stuessy [Near threatened]

Bushy shrub to 3.5 m tall with flowers in radiate heads. Found on Fernandina, Floreana, Isabela (Alcedo, Cerro Azul, Darwin, Ecuador, Sierra Negra), Pinta, Pinzón, Santa Cruz and Santiago.

Icerya purchasi (Hemiptera: Margarodidae). Introduced cottony cushion scale. Found sucking sap of leaves and stems. Isabela (Alcedo). April. Also reported on Baltra, El Edén, Genovesa, Fernadina, Floreana, Marchena, Pinta, Pinzón, Rábida, San Cristóbal, Santa Cruz, Santa Fé, Santiago (Lincango 2003).

***Lecocarpus darwinii* Adsersen 1980** [Endangered]

Shrub to 1.5 m tall, freely branched upward with flowers in radiate heads. Known only from San Cristóbal.

Melanogromyza sp. (Diptera: Agromyzidae). Endemic. Observed visiting flowers. San Cristóbal (Cerro Colorado). April.

Spodoptera sp. (Lepidoptera: Noctuidae). Native armyworm. Observed feeding on leaves. San Cristóbal (Cerro Colorado). May.

Xyonysius naso (Van Duzee) 1933 (Hemiptera: Lygaeidae). Endemic bug. Found feeding on leaves and flowers. San Cristóbal. May. Also reported on Floreana, Isabela, Pinzón, Santa Cruz, and Santa Fe (Peck, 2001).

Sp. 1 (Hemiptera: Lygaeidae). Status? Found feeding on leaves and flowers. Santa Cruz (Cerro Colorado). April.

***Lecocarpus lecocarpoides* (B.L. Robinson & Greenam) 1970** [Vulnerable]

Shrub to 1 m tall. Freely branched upwards with flowers in radiate heads. Distributed in Española and associated islets.

Loxomorpha sp. prob. *cambogiales* (Guenée) (Lepidoptera: Pyralidae). Native? moth. Found boring on flowers and fruits. Gardner (near Española). August .

Sp. 1 (Hemiptera: Coccidae). Status? Feeding on leaves. Sapsucker. Española (Sarifa Islet). August.

***Lecocarpus pinnatifidus* Decne. 1846** [Endangered].

Shrub to 2 m tall. Freely branched upward with flowers in radiate heads. Known only from Floreana.

Estola insularis nigrescens Linsley & Chemsak 1966 (Coleoptera: Cerambycidae). Endemic long-horned beetle. Found feeding on dead stems. Floreana. August.

Ptitnus sp. (Coleoptera: Ptinidae). Status? Spider beetle. Found feeding on dead stems. Floreana. August. Genus also reported from Española, Pinta, Santa Cruz, and Santa Fe (Peck 1999).

Tricodesma denticolis Blair 1928 (Coleoptera: Anobiidae) Endemic. Found feeding on dead stems. Floreana. August. Also reported on Isabela, Santa Cruz, Santiago and Seymour (Peck 1999). Woodborer.

***Scalesia atractyloides* Arnott var. *atractyloides* 1836** [Critically endangered].

Small tree grows up to 3 m tall with flowers in discoid heads. This species is known only from Santiago.

Corythaica cytharina (Butler) 1877 (Hemiptera: Tingidae). Endemic lace bug. Found feeding on stems and flowers. Santiago (Zona D). April. Also reported on 16 islands and to have a variety of host plants (Peck 2001).

Camponotus planus Smith 1877 (Hymenoptera: Formicidae). Endemic ant. Found tending mealy bugs on stems. Santiago (Cabo Nepean) April. Also found on other islands.

Tapinoma melanocephalum (Fabricius 1723) (Hymenoptera: Formicidae). Introduced ant. Found visiting flowers. Santiago (Cabo Nepean), Santa Cruz. April.

Fulrada carpasella (Schaus 1923) (Lepidoptera: Pyralidae). Endemic moth. Found boring flowers. Santiago. April.

Xylocopa darwini Cockerell 1926 (Hymenoptera: Anthophoridae). Endemic carpenter bee. Found visiting flowers. Santiago. April. Also reported on Isabela, Santiago, Pinzón, San Cristóbal, Santa Cruz, Baltra, San Cristóbal, Floreana, Gardner, Fernandina (McMullen 1985, 1993, 1994).

Zagrammosoma buselus (Hymenoptera: Eulophidae) Native? Found on leaves, parasitoid of leaf-miners. Santiago (Cabo Nepean). April.

Sp. 1 (Hemiptera: Pseudococcidae) Status? Mealy bug. Found feeding on shoots. Santiago. April.

***Scalesia cordata* A. Steward 1911** [Endangered].

Tree growing to over 10 m tall with flowers in discoid heads. Known only from Isabela (Cerro Azul, Sierra Negra).

Adaina scalesiae (Murtfeldt 1880) (Lepidoptera: Pterophoridae). Native moth. Found feeding on leaves. Isabela (Sierra Negra). July.

Estoloides galapagoensis Blair 1933 (Coleoptera: Cerambycidae). Endemic long-horned beetle. Found resting on leaves. Isabela (Puerto Villamil). July. Also reported on Baltra, Fernandina, Santa Cruz, Santa Fe, Santiago, Seymour Norte. Scavenger; arid to humid forest zone (Peck 1999).

Podisus sordidus (Stål) 1859 (Hemiptera: Pentatomidae). Native? stink bug. Found resting on shoots and leaves. Isabela (Puerto Villamil). July. Also reported on Española, Fernandina, Floreana, Marchena, Pinta, Pinzón, San Cristóbal, Santa Cruz, Santiago, Seymour. Predator on insects? (Peck 2001).

Orthezia insignis Browne 1887 (Hemiptera: Ortheziidae). Introduced. Found feeding on shoots. Isabela (Puerto Villamil).

Repipta annulipes Barber 1925 (Hemiptera: Reduviidae). Endemic. Predator found on leaves. Isabela, Puerto Villamil. July. Also reported on Fernandina and Santa Cruz (Peck 2002).

***Scalesia gordilloi* Hamann & Wium-Anderson 1998** [Vulnerable]

Shrub growing up to 1.5 m tall with flowers in discoid heads. Distributed only on San Cristóbal.

Anthidium sp. (Hymenoptera: Megachilidae). Introduced bee. Observed pollinating flowers. San Cristóbal. April.

Bicyrtes sp. (Hymenoptera: Sphecidae). Introduced? wasp. Observed visiting flowers. San Cristóbal. April. Also reported on Floreana, Isabela, Santa Cruz.

Camponotus macilentus Smith 1877 (Hymenoptera: Formicidae). Endemic ant. Found tending Coccidae on trunk and stems. Santa Cruz. April.

Camponotus planus Smith 1877 (Hymenoptera: Formicidae). Endemic ant. Observed tending Coccidae on trunk and stems. Santa Cruz. April.

Cycloneda sanguinea (Linneus) 1763 (Coleoptera: Coccinelidae). Native ladybug. Predator found on flowers. San Cristóbal. April.

Chrysopa sp. (Megaloptera: Chrysopidae). Status? Predator found on stems. San Cristóbal. April.

Galapaganus sp. cf. *galapagoensis* (Linell) (Coleoptera: Curculionidae). Endemic snout beetle. Found feeding on leaves. San Cristóbal. April. Also reported on Santa Cruz (Peck 1999).

Galapagomyia inoa Walker 1849 (Diptera: Sarcophagidae). Endemic fleshfly. Found visiting flowers. San Cristóbal. Also reported on Baltra, Bartolomé, Darwin, Española, Fernandina, Floreana, Isabela, Santa Cruz, Santa Fé, Seymour (Peck 1999).

Heliodines galapagensis Heppner & Landry 1994 (Lepidoptera: Heliodinidae). Endemic moth. Observed visiting flowers. San Cristóbal. April. Also reported on Santa Cruz.

Hemiargus ramon (Dognin 1887) (Lepidoptera: Lycaenidae). Introduced moth. Observed feeding on flowers (pollen or nectar). San Cristóbal. April.

Monomorium floricola (Jerdon 1851) (Hymenoptera: Formicidae). Introduced ant. Observed feeding on nectar. Santa Cruz. May.

Polistes versicolor (Oliver 1791) (Hymenoptera: Vespidae). Introduced wasp. Observed visiting flowers. San Cristóbal. April. Also reported on most islands (Causton, et. al. 2004)

Pseudopentarthrum cunicollis (Coleoptera: Curculionidae). Endemic . Observed visiting flowers. San Cristóbal. March. Also reported on Isabela, Pinzón, Santa Cruz and Santa Fe (Peck 1999).

Pseudoplusia includens (Walker[1858] 1857) (Lepidoptera:Noctuidae). Introduced moth. Observed feeding on flowers. San Cristóbal. April.

Schistocerca literosa (Walker) 1870 (Orthoptera: Acrididae). Endemic short grasshopper. Found on flowers. San Cristóbal. April. Also reported on Española, Floreana, Gardner near Española, and Genovesa (Peck, 2001).

Solenopsis geminata (Fabricius 1804) (Hymenoptera: Formicidae). Introduced ant. Observed on stems and trunk. San Cristóbal. May.

Urbanus dorantes galapagensis (Williams 1911) (Lepidoptera: Hespiridae). Endemic skipper. Observed visiting flowers. San Cristóbal. May.

Xylocopa darwini (Hymenoptera: Anthophoridae). Endemic carpenter bee. Observed pollinating flowers. Santa Cristóbal. April. Also reported on Isabela, Santiago, Pinzón, Santa Cruz, Baltra, San Cristóbal, Floreana, Gardner, Fernandina Fernandina (McMullen 1985, 1993, 1994).

***Scalesia microcephala* B. L. Robinson 1902** [Endangered]

Shrub or small tree typically 1.5-4 m tall. Distributed in Fernandina, Isabela (Alcedo, Darwin, Ecuador, Wolf), and Wolf.

Adaina scalesiae (Lepidoptera: Pterophoridae). Native moth. Caterpillar observed feeding on leaves. Isabela (Wolf). October.

Eupithecia galapagosata Landry & Rindge, 1995 (Lepidoptera: Geometridae). Endemic. Observed feeding on leaves. Isabela (Alcedo). October.

***Scalesia pedunculata* Hooker 1847** [Endangered]

Tree growing up to 20 m tall with flowers in discoid heads. Distributed in Santa Cruz, San Cristóbal, Floreana and Santiago.

Adaina scalesiae Landry, Roque-Albelo & Mattheus 2004 (Lepidoptera: Pterophoridae). Native moth. Observed feeding on leaves. Santa Cruz. January, June.

Agallia sp. (Homoptera: Cicadellidae). Status? Leaves. Santa Cruz. June.

Cycloneda sanguinea (Linn.) (Coleoptera: Coccinellidae). Native ladybug. Predator observed resting on flowers. Santa Cruz. April. Also reported on Española, Fernandina, Floreana, Genovesa, Isabela, Marchena, Pinta, Pinzón, Rábida, San Cristóbal, Santiago, and Wolf (Peck 1999).

Conotelus sp. (Coleoptera: Nitidulidae). Introduced sap beetle. Found on shoots. Santa Cruz (Los Gemelos). September. Also reported on Isabela and San Cristóbal (Datura flowers) (Peck, 1999).

Creontiades castaneum Van Duzee 1933 (Hemiptera: Miridae). Endemic. Found feeding on leaves and shoots. Santa Cruz. January. Also reported on Floreana, Isabela, and San Cristóbal (Peck 2001).

Cyrtopeltis sp. (Hemiptera: Miridae). Endemic stinkbug. Found feeding on leaves. Santa Cruz. September.

Eupithecia perryvriesi Herbulot, 1971 (Lepidoptera: Geometridae). Endemic moth. Larvae found feeding on shoots and leaves. Santa Cruz. January.

Galapaganus howdenae (Coleoptera: Curculionidae). Introduced snout beetle. Found feeding on leaves. Santa Cruz. September, April, and June.

Leptobrysa decora Drake (Hemiptera: Tingidae). Introduced. Found feeding on stems. San Cristóbal. March.

Loewinyia fasciata Forrest & Wheeler 2002 (Diptera: Asteiidae). Endemic. Found on leaves in decomposition. Santa Cruz (Los Gemelos). January.

Nacaeus galapagensis (Coffait) (Coleoptera: Staphylinidae). Endemic. Found on leaves decomposition and stems. Santa Cruz (Los Gemelos). January.

Neortholomus usingeri (Ashlock) 1972 (Hemiptera: Lygaeidae). Endemic. Found feeding on leaves. Santa Cruz. September. Also reported on Fernandina, Floreana, Isabela, Pinzón, Rábida, San Cristóbal (Peck 2001).

Orthezia insignis Browne (Homoptera: Ortheziidae). Introduced sapsucker. Found feeding on shoots. Santa Cruz. September and June. Also reported on San Cristóbal (Peck 2001).

Pagiocerus frontalis (Fabricius) 1801 (Coleóptera: Scolytidae). Introduced bark beetle. Found on leaves. Santa Cruz (Los Gemelos). September.

Paratrechina fulva (Wheeler 1924) (Hymenoptera: Formicidae). Introduced ant. Found tending aphids on shoots and leaves. Santa Cruz. June.

Philatis sp. (Hemiptera: Issidae). Endemic planthopper. Found feeding on leaves. Santa Cruz. June.

Phalacrus darwini C. Waterhouse 1877 (Coleoptera: Phalacridae). Endemic. Found resting on shoots and leaves. Santa Cruz (Los Gemelos). Also reported on Fernandina, Floreana, Isabela, Marchena, Pinta, San Cristóbal, and Santiago. September. Fungivore? (Peck 1999).

Shafferiessa galapagoensis Landry & Neunzig, 1997 (Lepidoptra: Pyralidae). Endemic moth. Found feeding on shoots. Santa Cruz.

Thyrinteina umbrosa Herbulot 1971 (Lepidoptera: Geometridae). Endemic. Found feeding on leaves. Santa Cruz. January.

Astrotishcheria scalesiaella sp. nov. (Lepidoptera: Tischeridae). Endemic leaf miner. Found feeding on leaves. Santa Cruz. June.

Sp. 1 (Coleoptera: Staphylinidae). Status? Santa Cruz. January.

Sp. 1 (Diptera: Drosophilidae). Status? Santa Cruz. September

Sp. 1 (Hemiptera: Cicadellidae). Status? Found feeding on leaves. Santa Cruz. January.

Sp. 2 (Hemiptera: Cicadellidae). Status? Found feeding on leaves. Santa Cruz. September.

Sp. 3 (Hemiptera: Cicadellidae). Status? Found feeding on leaves. Santa Cruz. May.

Sp. 2 (Hemiptera: Lygaeidae). Status? Found feeding on leaves. Santa Cruz. January

Sp. 1 (Coleoptera: Curculionidae). Status? Found feeding on leaves. Santa Cruz. September.

***Scalesia retroflexa* Hemsley 1901** [Critically endangered]

Shrub growing up to 2 m tall with white flowers commonly in discoid heads. Found only in the southeastern part of Santa Cruz.

Acanthoscelides sp. (Coleoptera: Bruchidae). Status? Found on dry leaves. Santa Cruz. January.

Adaina scalesiae (Lepidoptera: Pterophoridae). Native moth. Leaves. Santa Cruz. July.

Eburia lanigera Linell 1898 (Coleoptera: Cerambicydae). Endemic long-horned beetle. Found resting on stems. Santa Cruz. January. Also reported on Baltra, Champion, Española, Fernandina, Floreana, Gardner (Española), Genovesa. (Peck 1999). Wood borer.

Heliodines galapagensis Heppner & Landry, 1994 (Lepidoptera: Heliodinidae). Endemic moth. Observed visiting flowers. Santa Cruz. July. Also reported on San Cristóbal.

Hypasclera collenettei Blair 1928 (Coleoptera: Oedemeridae). Endemic. Found on dead stems. Santa Cruz. January. Also reported on Baltra, Bartolomé, Darwin, Ferandina, Floreana, Genovesa, Isabela, Marchena, Pinta, Rábida, San Cristóbal, Santiago, Santa Cruz, Santa Fé, and Wolf (Peck 1999).

Lepidantrax tinctus Thomson 1869 (Diptera: Bombyliidae). Native? Found visiting flowers. Santa Cruz. January.

Nemotelus albiventris Thomson 1869 (Diptera: Stratiomydae). Endemic. Observed visiting flowers. Santa Cruz. July and January.

Pelonium longfieldae Blair 1928 (Coleoptera: Cleridae). Endemic soldier beetle. Predator found on dead stems. Santa Cruz (Punta Núñez). January. Also reported on Champion, Floreana, Isabela, Marchena, Pinta, Rabida, San Cristóbal, Santa Cruz, Santiago, Seymour (Peck 1999).

Scutobruchus ceratioborus (Philippi) 1859 (Coleoptera: Bruchidae). Native wood borer. Found on dead stems. Santa Cruz. January. Also reported in Argentina, Chile, Española, and Pinzon (Peck 1999).

Shafferiessa galapagoensis Landry & Neunzig 1997 (Lepidoptera: Pyralidae). Endemic moth. Santa Cruz.

Xylocopa darwini (Hymenoptera: Anthophoridae). Endemic carpenter bee. Observed visiting flowers. Santa Cruz. January and July. Also reported on Isabela, Santiago, Pinzón, Santa Cruz, Baltra, San Cristóbal, Floreana, Gardner, and Fernandina Fernandina (McMullen 1985, 1993, 1994).

Pachodynerus galapagensis Williams 1926 (Hymenoptera: Vespidae). Native wasp. Observed visiting flowers. Santa Cruz. July and January.

Family: Cactaceae

***Opuntia echios* J.T. Howell 1933** [Vulnerable]

Mainly arboreal, 12 m tall with solitary flowers. Distributed in Baltra, Daphne, Isabela (SN), Santa Cruz, Santa Fe, Seymour, and Islets.

Ammophorus sp. (Coleoptera: Tenebrionidae). Endemic darkling beetle. Found resting on dead stems. Santa Cruz (Garrapatero). April.

Chrysochlorina fasciata Thomson 1869 (Diptera: Stratiomydae). Endemic. Found feeding on dead stems. Santa Cruz. August. Also reported on Baltra, Española, Floreana, Isabela, Rábida, San Cristóbal, Santa Fe, Santiago, and Seymour (Sinclair and Peck 2002).

***Opuntia megasperma* var. *orientalis* J. T. Howell 1933** [Vulnerable].

Plant generally arboreal, with dense rounded crown, to 6 m tall; trunk to 60 cm across; solitary flowers. Distributed in Española and its islets, San Cristóbal.

Nesoecia sp. (Orthoptera: Tettigonidae). Endemic. Male and female found resting on trunk. Gardner (near Española). August.

Creantiades sp. (Hemiptera: Miridae). Status? Española (Gardner), July.

Ormiscus variegatus G.R. Waterhouse 1845 (Coleoptera: Anthribidae). Endemic. Observed walking on stem. Islet Tortuga (near Española). August. Also reported on Baltra, Española, Floreana, Gardner at Española, Genovesa, Isabela, Pinta, Pinzón, Rábida, San Cristóbal, Santa Fe, Santiago, S. Plazas, Santa Cruz, and Wolf (Peck 1999).

Diomus galapagoensis (Waterhouse) (Coleoptera: Coccinelidae). Endemic ladybug. Predator found resting on stems. Gardner (near Española). August.

Pseudopentarthum sp. (Coleoptera: Curculionidae). Endemic snout beetle. Observed on stem. Gardner (near Española). August.

Family: Cyatheaceae

***Cyathea weatherbyana* (Morton) 1969**
[Endangered]

Tree fern, with fronds 2-3 m long supported on a trunk approximately 25-30 cm in diameter and up to 6 m tall. Distributed on Isabela (Sierra Negra, Alcedo), San Cristóbal, Santa Cruz, and Santiago.

Allograpta splendens Thomson 1897 (Diptera: Syrphidae). Endemic fly. Found resting on leaves. Santa Cruz. March. Also reported on Española, Floreana, Isabela, Pinta, San Cristóbal, and Santiago (Sinclair and Peck 2002).

Amblypsilopus depilis Bickel & Sinclair 1997 (Diptera: Dolichopodidae). Endemic fly. Found resting on leaves. Santa Cruz. March. Also found on Fernandina and Isabela (Sierra Negra) (Sinclair and Peck 2002).

Dipropus puberulus (Boheman) 1858 (Coleoptera: Elateridae). Endemic click beetle.

Found resting on leaves and trunk. Santa Cruz. March. Herbivore (Peck 1999).

Galapaganus howdenae (Coleoptera: Curculionidae). Introduced snout beetle. Found feeding on leaves. Santa Cruz. March.

Scaptomyza sp. (Diptera: Drosophilidae). Endemic. Found resting on leaves. Santa Cruz (Cerro Crocker). March

Sp 1. (Coleoptera: Staphylinidae: Aleocharinae). Status?.Found resting on leaves. Santa Cruz (Cerro Crocker). March.

Sp. 2 (Coleoptera: Staphylinidae). Status? Found feeding on decaying leaves. Santa Cruz (Cerro Crocker). March.

Sp. 3 (Coleoptera: Staphylinidae). Status? Found feeding on decaying leaves. Santa Cruz (Cerro Crocker). March.

Philatis sp. 1 (Hemiptera: Issidae). Endemic plant hopper. Found feeding on leaves. Santa Cruz (Cerro Crocker). March.

Philatis sp. 2 (Hemiptera: Issidae). Endemic plant hopper. Found feeding on leaves. Santa Cruz (Cerro Crocker). March.

Family: Ericaceae

***Pernettya howellii* Sleumer 1935** [Endangered]

Low branched shrub to 30 cm tall with solitary campanulate flowers. Distributed in Isabela (Sierra Negra, Cerro Azul, Alcedo), and Santa Cruz.

Siphona sp. (Diptera: Tachinidae). Endemic. Observed visiting flowers. Santa Cruz. July.

Spodoptera sp. (Lepidoptera: Noctuidae). Native. Found feeding leaves. Santa Cruz. July.

Toxomerus crockeri (Diptera: Syrphidae). Endemic. Found visiting flowers. Santa Cruz. July and March. Also reported on Floreana, Isabela, Pinta, San Cristobal, and Santiago (Sinclair and Peck 2002).

Family: Euphorbiaceae

***Acalipha wigginsi* Webster 1970** [Vulnerable]

Erect herb 20-50 cm tall with inflorescences in axillary spikes. This species is known only from the central region of Santa Cruz, in the humid zone.

Galapaganus howdenae Lanteri (Coleoptera: Curculionidae). Introduced snout beetle. Found feeding on leaves. Santa Cruz. March-April.

Nezara viridula (Linnaeus) (Hemiptera: Pentatomidae). Introduced stinkbug. Found resting on stem**.** Santa Cruz (Cerro Crocker). March.

Toxomerus crockeri Curran 1934 (Diptera: Syrphidae). Endemic flower fly. Found feeding on nectar. Santa Cruz. March. Also reported on Floreana, Isabela, Pinta, San Cristóbal and Santiago. (Sinclair and Peck 2002)

Sp. (Hemiptera: Cicadellidae). Status? Leafhopper. Found resting on flowers. Santa Cruz. March.

Family: Melastomataceae

***Miconia robinsoniana* Cogn. 1902** [Endangered]

Shrub 2-5 m tall with flowers in terminal panicles. Distributed in San Cristóbal and Santa Cruz.

Anchonus (Coleoptera: Curculionidae). Endemic snout beetle. Found feeding on leaves and flowers. Santa Cruz. March. Genus also reported on Floreana, Isabela, Pinzón, San Cristobal, Santiago (Peck 1999).

Ascogaster venus ? (Hymenoptera: Chelonidae). Native? Parasitic wasp. Observed visiting flowers. Santa Cruz (Media Luna). March.

Baeocera galapagoensis Lobl 1977 (Coleoptera: Scaphidiidae). Endemic. Found visiting flowers. Santa Cruz (Media Luna). March. Also reported on Bartolome, Española, Fernandina, Floreana, Gardner (near Española) Genovesa, Isabela, Marchena, San Cristóbal, Santa Fé, South Plaza, and Wolf (Peck 1999).

Bracon sp. (Hymenoptera: Braconidae). Status? Parasitic wasp. Found visiting flowers. Santa Cruz (Media Luna). March.

Mordellistena galapagoensis Van Dyke 1953 (Coleoptera: Mordellidae). Endemic tumbling flower beetle. Found visiting flowers. Santa

Cruz (Media Luna). March. Also reported on Floreana, Fernandina, Genovesa, Isabela, Pinzón, Santa Cruz, Santiago. Found in different blooming plants. Larva is a scavenger (Peck 1999).

Xanthandrus agonis Walker 1849 (Diptera: Syrphidae). Endemic flower fly. Found visiting flowers Santa Cruz (Media Luna). March. Also reported on Floreana, Isabela, and Pinta (Sinclair and Peck 2002).

Siphona sp. (Diptera: Tachinidae). Endemic? fly. Found visiting flowers. Santa Cruz (Media Luna). March.

Toxomerus sp. (Diptera: Syrphidae). Endemic. Found visiting flowers. Santa Cruz (Media Luna). March.

Wasmannia auropunctata Roger 1863 (Hymenoptera: Formicidae). Introduced fire ant. Found on stems. Santa Cruz (Media Luna). March. Also on Albany, Cousin, Champion, Española, Floreana, Isabela, Mao, Marchena, Pinzón, San Cristóbal, Santa Fé, Santiago, Seymour Norte (H. Herrera, 2005)

Sp. 1 (Coleoptera: Staphilinidae: Aleocharinae). Status? Found resting on flowers. Santa Cruz (Media Luna). March.

Sp. 1 (Diptera: Tipulidae). Status? Found visiting leaves and flowers. Santa Cruz (Media Luna). March.

Family: Portulacaceae

***Calandrinia galapagosa* St. John 1937** [Critically Endangered]

Perennial succulent herb to 1.8 m tall with inflorescences in terminal cymes. Found only on San Cristóbal.

Bradisya sp. (Diptera: Sciaridae). Endemic? Found feeding on nectar. San Cristóbal. April.

Euxesta sp. nov. (Diptera: Ulidiidae). Endemic. Found feeding on rotten stems. San Cristóbal. October, March, April. Stem borer?

Icerya purchasi Maskell 1878 (Hemiptera: Coccidae). Introduced cottony cushion scale. Found sucking sap of leaves and stems. San Cristóbal. Also distributed on Baltra, El Edén, Genovesa, Fernadina, Floreana, Marchena, Pinta, Pinzón, Rábida, San Cristóbal, Santa Cruz, Santa Fé, Santiago (Lincango 2003).

Pseudopentarthrum cunicollis Van Dyke 1953 (Coleoptera: Curculionidae). Endemic. Found feeding on leaves. San Cristóbal (Cerro Colorado). Also reported on Isabela, Pinzón, Santa Cruz and Santa Fe (Peck 1999). April and October.

Spodoptera eridanea (Stool, 1782) (Lepidoptera: Noctuidae). Native armyworm. Found feeding on leaves. San Cristóbal (Cerro Colorado). May . Also found on Isabela, San Cristóbal, Santa Cruz, Santiago (Roque-Albelo 2005).

Sp.1 (Diptera: Sciaridae). Status? Found feeding on nectar. San Cristóbal. April.

Paratrechina sp. (Hymenoptera: Formicidae). Introduced ant. Found resting on leaves and stems. San Cristóbal (Cerro Colorado). May.

Sp. 1 (Hemiptera: Aphidae). Status? Found feeding on shoots. San Cristóbal (Cerro Colorado). April.

Family: Scrophulariaceae

***Galvezia leucantha* Wiggins var. *porphiranta* Tye & Jäger** [Critically endangered]

Branched shrub to 1.5 m tall with axillary flowers. Distributed only in Santiago.

Ceroplastes sp. (Hemiptera: Coccidae). Status? Found sucking on leaves and stems. Santiago (Zona D). April.

Discussion

One hundred and eight insects were found to have some association with the species of endangered plants that were studied. This is a small number when compared with the entomofauna existing on Galapagos Islands. The total number of insects that actually occur on the islands is not yet known but Peck (2001) estimated 1862+ species.

Most of the identified insects, 63 (76.8 %) were endemic or native. Thirty seven of the 63 species found do not have a restricted distribution and are

found on more than one island. This shows that many species do not have a restricted feeding range or host plant preference as was expected. In general, the different species of insects have different feeding habits, and they are found on distinct parts of the plants. Becker (1975) and Peck (2001) state that islands support more generalist feeders (scavengers and saprophages) and fewer specialist feeders (phytophages) than do continents. Peck himself observed very little evidence for host specificity for plant-feeding insects when he studied the Galápagos entomofauna (Peck 2001).

Some species such as the dipterans, *T. crockeri*, *N. albiventris, D. bilineata, L. tinctus, N. albiventris*, an adult lepidopteran, *U. galapagensis*, and the coleopterans, *B. galapagoensis* and *M. galapagoensis*, visited flowers feeding on pollen or nectar. The carpenter bee X. darwini was observed visiting different plant species while searching for nectar. This bee is considered the principal pollinator of 70 different plants in Galapagos (Linsley et al., 1966, McMullen, 1994).

The coleopterans, *G. howdenae*, *G.* sp., larvae of lepidopterans *A. scalesiae, E. galapagosata, T. ummbrosa*, and *D. galapagensis*, and orthopterans feed principally on leaves and shoots. Coleopterans *E. lanigera*, *T. denticolis* and *E. insularis* feed on woody stems. The hemipterans *X. naso*, *C. cytharina* and *Cyrtopeltis* sp. were observed feeding on seeds and fruit as well as being sapsuckers.

Predator species such as *Repipta* sp., *P. longfieldae* and *D. galapagensis* were also observed on plants because these are sites where their prey can be found.

Introduced Hemiptera species such as the sapsucker *I. purchasi* and *O. insignis* as well as the lepidopterans *S. eridanea* and *P. includens* larva feed on leaves and flowers. The introduced wasp *P. versicolor* may compete for nectar and pollen with endemic and native species (Parent 2000).

Within the group of plants studied there exists a range of different plant sizes, from large to small, and even the number of individuals per plant species differs. This makes it difficult to compare and analyze if there is any pattern of plant utilization, but it was clear to see that taller plants such as the giant fern *C. weatherbyana*, *M. robinsoniana*, the Asteraceae *S. gordilloi*, *S. retroflexa* and *S. pedunculata* (Table 1) possessed a greater number of insects since they offer more "niches" (see Peck 2001) .

More information is needed in order to define insect distribution, behavior and feeding range, and to understand the insect-plant interactions on the Galápagos Islands.

Due to the lack of funding, this study is not finished yet and more data will be necessary to be taken to complete observations for both the cold and warm seasons and include more species of endangered plants.

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