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Authors: Naughton, Ida, Caterino, Michael S., Hanna, Cause, and Holway, David

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CONTRIBUTIONS TO AN ARTHROPOD INVENTORY OF SANTA CRUZ ISLAND, CALIFORNIA

Ida Naughton[1], Michael S. Caterino[2], Cause Hanna[3], and David Holway[4]

ABSTRACT.—Arthropods have been understudied on Santa Cruz Island, resulting in an incomplete understanding of these diverse and ecologically important members of island ecosystems. To enhance the current understanding of Santa Cruz Island biodiversity, we sampled arthropods in 2 native plant habitats: island scrub oak (*Quercus pacifica*) woodland and patches of island morning glory (*Calystegia macrostegia* ssp. *macrostegia*). We used 4 standardized sampling techniques to sample arthropods in 16 *Q. pacifica* woodland plots. We sampled arthropods associated with *C. macrostegia* by pan trapping within 1 m of blooming morning glory individuals. In total, we sampled over 18,000 arthropod specimens, sorted the specimens to morphotypes by order, and had taxonomic specialists identify 10 orders to the narrowest possible identification (n = 458 total species or morphotypes). The taxonomic distribution of our identified specimens is as follows: 1 species of Scorpiones, 5 morphospecies of Pseudoscorpiones, 74 species of Araneae, 4 species of Orthoptera, 10 species of Psocodea, 10 species of Hemiptera, 1 species of Neuroptera, 60 species of Coleoptera, 8 species of Lepidoptera, and 42 species of Hymenoptera (Formicidae and Apoidea). Of these, 62 species represent newly recorded arthropod species on Santa Cruz Island. The diversity of our collections within the *Quercus pacifica* and *Calystegia macrostegia* habitats, the deficiency of current knowledge of Channel Island arthropods, and the fundamental role of arthropods in island ecosystems emphasize the need for a more comprehensive arthropod inventory across the California Channel Islands.

RESUMEN.—Los artrópodos han sido poco estudiados en la Isla Santa Cruz, resultando en un entendimiento incompleto de estos diversos y ecológicamente importantes miembros de los ecosistemas de la isla. Para mejorar la comprensión actual de la biodiversidad de la Isla Santa Cruz, tomamos muestras de artrópodos en dos hábitats de plantas nativas: bosques de robles de la isla (*Quercus pacifica*) y zonas de campanillas de la isla (*Calystegia macrostegia* ssp. *macrostegia*). Usamos cuatro técnicas estándar de recolección de muestras para estudiar artrópodos en 16 terrenos de bosques de *Q. pacifica.* Tomamos muestras de artrópodos asociados con *C. macrostegia* poniendo trampas en un radio de 1 metro de campanillas en flor. En total, tomamos muestras de aproximadamente 18,000 especímenes de artrópodos, clasificamos los especímenes en morfotipos por orden y 10 órdenes fueron identificados por taxónomos especialistas de la forma más específica (n = 458 total de especies o morfotipos). La distribución taxonómica de los especímenes identificados es la siguiente: 1 especie de Scorpiones, 5 morfoespecies de Pseudoscorpiones, 74 especies de Araneae, 4 especies de Orthoptera, 10 especies de Psocodea, 10 especies de Hemiptera, 1 especie de Neuroptera, 60 especies de Coleoptera, 8 especies de Lepidoptera y 42 especies de Hymenoptera (Formicidae y Apoidea). 62 especies de estas representan especies de artrópodos recientemente registradas en la Isla Santa Cruz. La diversidad de nuestras colecciones dentro de los hábitats de *Quercus pacifica* y de *Calystegia macrostegia*, la deficiencia de conocimientos actuales de los artrópodos de las Islas del Canal y el papel fundamental de los artrópodos en los ecosistemas de la isla enfatizan la necesidad de un inventario de artrópodos más completo en todas las Islas del Canal de California.

Santa Cruz Island has a total area of 249 km^2 and is the largest and most topographically and ecologically diverse of the California Channel Islands. The island was formed on an active fault zone, yielding a central valley defined by 2 steep ridges that rise to a maximum elevation of 753 m at Mount Diablo. Anacapa Island lies 7 km to the east, Santa Rosa Island 9 km to the west, and the coast of mainland Santa Barbara County 30 km to the north (Junak et al. 1995). During the ranching period (1857–1939), the terrestrial ecosystems of Santa Cruz Island suffered severe impacts, as the presence of cattle, sheep, and pigs resulted in overgrazing, declines in some native fauna, and the eventual proliferation of nonnative species. After ranching ended in 1939, feral pigs and sheep remained, to the detriment of the island's ecosystems, until the last of the sheep were eradicated in 2001 and the last of the pigs were eradicated in 2007 (Junak et al 1995). Today, 10 plant community

[1]University of California Berkeley, 7 Gauss Way, Berkeley, CA 94704. E-mail: naughton.ida@gmail.com
[2]School of Agricultural, Forest, and Environmental Sciences, Clemson University, Clemson, SC 29634.
[3]California State University Channel Islands, 1 University Dr., Camarillo, CA 93012.
[4]University of California San Diego, 9500 Gilman Dr., San Diego, CA 92093.

types are recognized on Santa Cruz Island; these ecosystems support the island's 8 endemic plant species, including *Lotus argophyllus* var. *niveus*, *Arcostaphylos insularis*, and *Malacothamnus fasciculatus* var. *nesioticus* (Junak et al 1995). The island has 6 known endemic vertebrates, including the Island Scrub Jay (*Aphelocoma insularis*), the Santa Cruz Island fox (*Urocyon littoralis santacruzae*), and the Santa Cruz Island deer mouse (*Peromyscus maniculatus santacruzae*). Compared to the vertebrates of Santa Cruz Island, which are relatively well studied and the focus of long-term research programs, the island's invertebrates remain incompletely studied.

The invertebrate phylum Arthropoda is among the most species-rich phyla of organisms on earth, with over one million described species (Foottit and Adler 2009). As a whole, arthropods provide key ecological services (Losey and Vaughan 2006). Over 65% of the world's known angiosperm species require insects for pollination (Axelrod 1960). Insects recycle nutrients by decomposing plant and animal matter (Daily et al. 1997, Losey and Vaughan 2006), and many arthropod groups serve as important prey for a wide variety of vertebrates, especially birds, small mammals, and lizards (Cowie and Hinsley 1988, Fellers and Drost 1991).

Substantial documentation exists for Santa Cruz Island, but due to the ecological variance of the island and high arthropod diversity, these efforts have fallen far short of describing the island's arthropods comprehensively. Throughout the early 1900s, several independent entomologists, such as R.V. Chamberlin, H.C. Davis, J.S. Garth, W. Hovanitz, C.H. Kennedy, F.C. Winters, E.P. Van Duzee, and T.A. Cockerell, collected and recorded arthropods on Santa Cruz Island (Miller 1985). A concentrated effort to gain entomological information on the island was made by the Los Angeles Museum–Channel Islands Biological Survey between 1939 and 1941. In 1966, the University of California research station was opened, initiating a new era of invertebrate sampling for the island. Researchers visited from the California Academy of Sciences, Natural History Museum of Los Angeles County, Santa Barbara Museum of Natural History, California Department of Food and Agriculture, U.S. Department of Agriculture, Yale University, University of California at Berkeley, and University of California at Davis (Miller 1985). In 1985, an Entomology of the California Channel Islands symposium (Menke and Miller 1985) presented many new findings for Santa Cruz Island, especially with respect to Orthoptera (Weissman 1976), Lepidoptera (Powell 1985), and Apoidea (Rust et al. 1985). While some invertebrate surveys have continued on Santa Cruz Island in more recent years, only a few of these have made it into the published literature (e.g., ants: Wetterer et al. 2000; Lepidoptera: Powell 1994; aquatic insects: Furlong and Wenner 2002). Important collections of Coleoptera and Lepidoptera are held at the Santa Barbara Natural History Museum and the Essig Museum of Entomology, respectively; but many arthropod groups from Santa Cruz Island are underrepresented in museum collections.

Assessment of the insect fauna of the Channel Islands has progressed little since the Entomology of the Channel Islands Symposium, which established that approximately 100 arthropod species were known to be endemic to the Channel Islands and that 40 of these taxa were endemic only to Santa Cruz Island (Miller 1985). To augment the documentation of Santa Cruz Island arthropod diversity, we sampled arthropods within 2 unique habitats: island scrub oak (*Quercus pacifica*) woodland and island morning glory (*Calystegia macrostegia*) patches within riparian and grassland ecosystems. Both of these plant habitats are restricted to the California Channel Islands and thus might support distinctive arthropod assemblages. Obtaining a comprehensive inventory of organisms that function within an ecosystem is a preliminary step to making informed management decisions (Dubois 2003). The results of our collection efforts are intended to further delineate the arthropod fauna of Santa Cruz Island and to inform the conservation goals of The Nature Conservancy and the National Park Service.

METHODS

Arthropod sampling took place between 3 June and 13 June 2011 and between 2 September and 12 September 2011. We collected arthropods within 16 circular plots (10-m radius) in *Quercus pacifica* woodland (Fig. 1). Each plot supported >5 mature *Q. pacifica* individuals; other perennial plants present

included *Rhus integrifolia, Heteromeles arbutifolia, Quercus agrifolia, Toxicodendron diversilobum,* and *Cercocarpus betuloides.* Further collections were made within patches of the endemic plant *Calystegia macrostegia.* Plots for collection in *C. macrostegia* were defined by the placement of patch growth within riparian and coastal sage scrub habitat. Arthropods were collected either on or within 1 m of a patch.

To sample arthropods at each *Q. pacifica* plot, we employed 4 standardized sampling techniques with comparable levels of effort during each of the 2 sampling rounds. (1) We beat 3 separate *Q. pacifica* branches onto a 1 × 1-m beating sheet and aspirated arthropods off of the sheet. (2) We overturned 3 rocks settled into the soil at each site and scoured for the presence of arthropods (Cole et al. 1992); arthropods detected were aspirated. During the June collection round, we impressed 3 bricks into the ground throughout each site in order to standardize the "rocks" used in the September sampling round. (3) We collected leaf litter under mature *Q. pacifica* individuals from 3 discrete areas at each plot. After mixing leaf litter together, we subsampled 1 L of leaf litter and placed it in a Winkler extractor for 24 h. (4) We set out 5 pitfall traps throughout each plot. Pitfall traps consisted of 50-mL centrifuge tubes filled with soapy water. Traps were buried so that the open rim of each tube was level with the ground, and then the traps were left out for 48 h. To sample arthropods associated with *C. macrostegia,* we filled bowl traps (one yellow, one white, and one blue) with soapy water and placed a set within 1 m of 10 patches of *C. macrostegia* for 6 h. All collected specimens were preserved in 90% ethanol immediately after collection.

We sorted specimens to order and then to morphotype before sending them to taxonomic specialists to obtain genus and species identifications. Identification priority was placed on the orders Araneae, Scorpiones, Coleoptera (Staphylinidae and Carabidae), honeydew-producing Hemiptera, Psocodea, Orthoptera, Formicidae, and Apoidea. The acquisition of genus-level or species-level identifications is beneficial for biological monitoring and is especially important in studies aimed at examining subtle differences in faunal presence among sites or over time and for recognizing areas that support rare species and high biodiversity (Lenat and Resh 2001). Our collection data will be entered into an All Taxa Biodiversity Inventory (ATBI) conducted by The Nature Conservancy and the National Park Service.

We report new species records for the California Channel Islands based on comparisons with available published and unpublished sources. The primary sources for species lists for the islands are Menke and Miller (1985) and papers cited within that symposium proceedings. Additional and more recent sources for Santa Cruz Island records include published surveys for Formicidae (Wetterer et al. 2000), Lepidoptera (Powell 1994), and aquatic insects (Furlong and Wenner 2002). Although we cannot account for undocumented collections, the species that we collected and determined to be new findings for Santa Cruz Island are taxa not mentioned in the sources in our bibliography.

RESULTS

Within our identified specimens, 60 species (or morphospecies) of Coleoptera were identified within 19 families, 74 species (or morphospecies) of Araneae were identified within 23 families, 10 species of Psocodea within 6 families, and 3 species and 1 morphospecies of Orthoptera within 4 families. The taxonomic distribution of newly recorded species for Santa Cruz Island is as follows: 4 species of Coleoptera, 5 species of Apoidea, 1 species of Formicidae, 34 species of Araneae, and 10 species of Psocodea. We also collected 5 endemic species during our *Q. pacifica* habitat sampling: *Rualena cruzana* and *Zelotes cruz* (Araneae), *Scymnus falli* and *Eleodes inculta* (Coleoptera), and *Pseudouroctonus minimus thompsoni* (Scorpiones). In addition to the species listed in the appendix, we collected and sorted to order 72 morphotypes of Hemiptera, 116 morphotypes of Hymenoptera, and 55 morphotypes of Diptera that have not yet been reviewed by taxonomic specialists to validate identifications. Our identified specimens and collection information are listed in the appendix.

DISCUSSION

Previous entomological work (Menke and Miller 1985) has collated knowledge about several arthropod groups on Santa Cruz Island, but a practical understanding of the

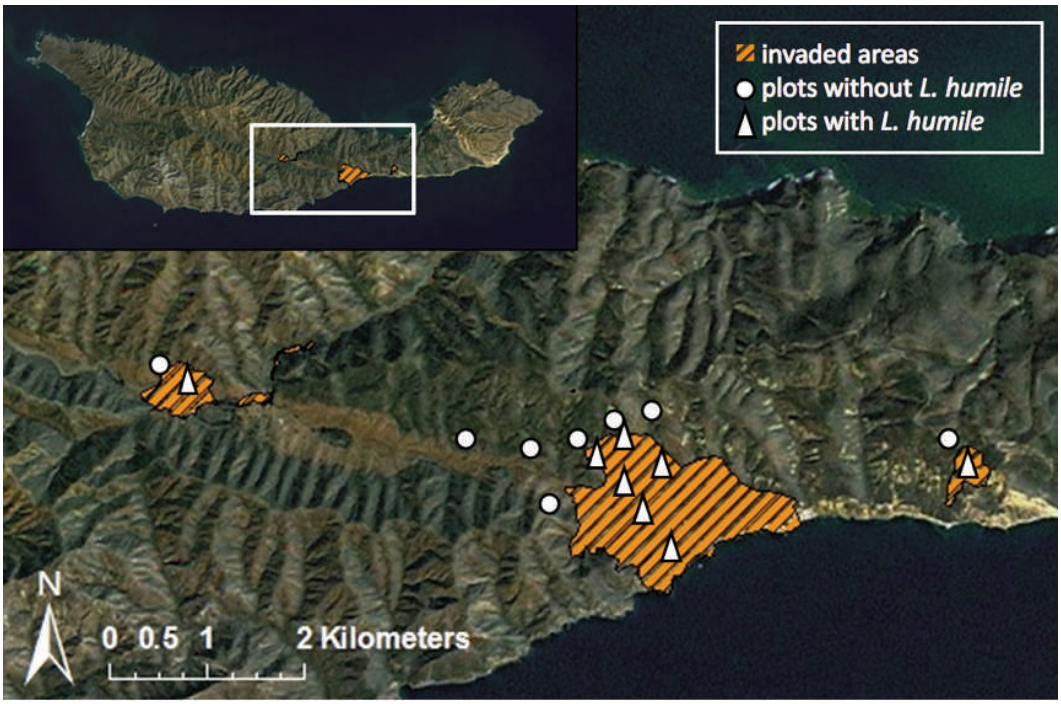

Fig. 1. Santa Cruz Island sampling sites. △ = *Linepithema humile* present, ○ = *Linepithema humile* absent. Shading indicates area invaded by *Linepithema humile*.

island's arthropod assemblages and their habitats remains incomplete. Our results contribute to the existing knowledge of Santa Cruz Island arthropods by recording new species and collection localities of arthropods associated with native *Q. pacifica* and *C. macrostegia* habitats and by illustrating the diversity of arthropods living within specific habitat types. Our 215 species and morphospecies records increase the island's biodiversity documentation, especially for groups such as Psocodea, for which no previous records have been found (Miller 1985).

In addition to the deposition of our collections at the Santa Barbara Museum of Natural History and San Diego Natural History Museum, identification and locality collection data for each of our specimens will be added to an All Taxa Biodiversity Inventory (ATBI) compiled by the National Park Service and The Nature Conservancy. We hope that the accessibility and flexibility of the ATBI database will efficiently facilitate the use of our archived collection data in future conservation and research efforts (Ponder et al. 2001).

Our effort to inventory Santa Cruz Island arthropods has been partly motivated by the potential threat of invasive species, such as the Argentine ant (*Linepithema humile*), to the island's habitats (Wetterer et al. 2000). Argentine ant invasions have been known to negatively impact Araneae, Psocodea, and Coleoptera populations on Hawaii (Krushelnycky and Gillespie 2008, 2010); and research on the effects of the Argentine ant on Santa Cruz Island is currently in progress. Half of our sampling plots were located in areas of Argentine ant infestation. These infested areas pose a potential threat to the diversity we encountered and create an urgency to better understand the island's arthropod assemblages. Even with our best sampling efforts, it is probable that due to the high vagility and rarity of certain arthropods and the small seasonal range of our sampling, we have not detected every arthropod associated with the habitats sampled. The integral role of arthropods in community structure, the taxonomic diversity of arthropods associated with individual plant communities, and the threats to extant biodiversity emphasize the need of further arthropod sampling on Santa Cruz Island and across the California Channel Islands. A comprehensive

inventory is the basis for accurate monitoring and understanding of these unique and remarkable ecosystems.

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Appendix on page 302.

APPENDIX. Arthropod inventory of Santa Cruz Island: number of individuals by month and by collection habitat and method. Key: BT = *Quercus pacifica* branch beating, UR = under rock survey, LL = *Q. pacifica* leaf litter sample, PF = pitfall trap, PN = *Calystegia macrostegia* pan trap, * = previously unrecorded, + = endemic.

				Collection habitat and method				
		Month		*Q. pacifica* woodland				*C. macrostegia* visitors
Order/family	Species	Jun	Sep	BT	UR	LL	PF	PN
ARANEAE								
Agelenidae	*Hololena* sp.*	1					1	
	Rualena cruzana +*	4	1		3	1	1	
	Rualena spp.*	1			1			
Anyphaenidae	*Anyphaena* sp.*	33	65	93	2	1	1	1
	Lupettiana mordax	1		1				
Araneidae	*Araneus* sp.*	10	35	42	3			
	*Araneus montereyensis**	1	1	1	1			
	*Araniella displicata**		1	1				
	Eustela sp.*		2	1			1	
	Metepeira sp.*	2	1	3				
	*Metepeira grinnelli**		1	1				
	unidentified Araneidae*	9	3	11			1	
Clubionidae	unidentified Clubionidae*	1	1			1	1	
	Clubiona sp.*	11	2	11	1	1		
Corrinidae	*Castianeira occidens**	1			1			
	*Meriola arcifera**	1			1			
	*Meriola californica**		1	1				
	Scotinella sp.*	5	24	3		22	4	
	unidentified Corinnidae*	1			1			
Cyrtaucheniidae	*Aptostichus* sp.*	2			2			
Dictynidae	*Blabomma* sp.*	1				1		
	Mallos sp.*		1		1			
	*Yorima angelica**	5	12		1	11	5	
	unidentified Dictynidae*	10	42	26	19	5	2	
Filistatidae	*Filistatinella* sp.	2	2			4		
Gnaphosidae	*Drassyllus insularis**	4	4		3		5	
	Zelotes cruz +*	1			1			
	Zelotes sp.	1			1			
	unidentified Gnaphosidae	16	10		4	15	7	
Leptonetidae	*Archoleptoneta schusteri**		1			1		
Linyphiidae	*Frontinella communis**		1				1	
	*Frontinella pyramitela**		11	9	2			
	Linyphantes sp.*	3			2		1	
	Neriene sp.*		2	2				
	*Wubana drassoides**		1				1	
	unidentified Linyphiidae *	57	67	16	3	105		
Lycosidae	*Alopecosa kochi* *	4			2	2	2	
	unidentified Lycosidae	4			2		2	
Miturgidae	*Cheiracanthium inclusum**		6	4	2			
	Cheiracanthium sp.*	1		1				
	unidentified Miturgidae	1					1	
Oecobiidae	*Oecobius navus**	1	1			1	1	
Oxyopidae	*Oxyopes salticus**		1	1				
	Oxyopus sp.*		3	1				2
Philodromidae	*Philodromus spectabilis**	3	3					
	Philodromus sp.*	6	25	24	2	2	3	
Plectreuridae	*Plectreurys castanea**		1		1			
Salticidae	*Habronattus californicus**		4					4
	Habronattus oregonus	1					1	
	*Metacyrba taeniola**	1				1		
	*Peckhamia scorpionia**	1	1	2				
	*Pelegrina aeneola**	35	49	78	6			
	Pelegrina sp.*	28	3	29			2	
	*Phanias harfordi**	2		2				
	*Sassacus vitis**	3	5	8				
	unidentified Salticidae	13	13	16	1	4	1	4

APPENDIX. Continued.

				Collection habitat and method					
		Month		*Q. pacifica* woodland				*C. macrostegia* visitors	
Order/family	Species	Jun	Sep	BT	UR	LL	PF	PN	
Segestriidae	*Ariadna fidicina**	1		1					
	Segestria cruzana	3	1	3	1				
Tetragnathidae	*Tetragnatha versicolor**	1	46	35	4		8		
	Tetragnatha sp.*	25	8	32	1				
Theridiidae	*Euryopis spinigera**	2	1		1	2			
	*Theridion murarium**	1	38	36	3				
	*Theridion punctipes**	2	34	36					
	Theridion sp.*	3	50	27	16		7		
	*Wamba crispulus**	8	41	45	4				
	Theridiidae sp.*	2	10	12					
Thomsidae	*Coriarachne utahensis**		11	9	2				
	*Mecaphesa importuna**	1		1					
	Mecaphesa sp.*	7	5	10			2		
	*Tmarus angulatus**	3	28	28	3				
	Xysticus sp.	6		6					
	unidentified Thomsidae	1		1					
Uloboridae	*Hyptiotes gertschi**		4	3	1				
	unidentified Uloboridae	1					1		
COLEOPTERA									
Anobiidae	*Ptinus* sp.	1					1		
	Tricorynus sp.		3	2	1				
Brentidae	Apioninae sp.	11	1	9	1	2			
	Gen. sp.		1				1		
Byturidae	*Xerasia grisescens*		1	1					
Cantharidae	*Cultellunguis hatchi*	2		2					
	Frostia sp.	2		2					
Carabidae	*Calathus ruficollis*	2		1	1				
	Notiophilus sp.		1			1			
	Pterostichus sp.	3			3				
Cerambycidae	*Ipochus faciatus*	2		2					
Chrysomelidae	*Diachus auratus*	3	5	6	2				
	Epitrix sp.	6	1	5			2		
Cleridae	*Phyllobaenus* sp.	5		5					
Coccinellidae	*Cycloneda polita*	3	6	9					
	Delphastus catalinae		2	2					
	Hyperaspis lateralis		1	1					
	Hyperaspis nr. *annexa*	10	4	1	12	1			
	Hyperaspis taeniata	1		1					
	Hyperaspis sp.		1		1				
	Psyllobora vigintimaculata	4	9	10	3				
	*Rhyzobius forestieri**	1	1	1			1		
	Scymnus falli +	2	2	1	2				
	Scymnus pallens	1	1	2				2	
	Scymnus sp.	4	3	7					
Curculionidae	*Curculio uniformis*	7	4	10	1				
	Curculio sp.		1	1					
	Dendrocranulus californicus	4		4					
	Geodercodes latipennis	5	3			7	1		
	Nemocestes sp.	4	2			6			
Erotylidae	*Dacne californica*		1			1			
Latridiidae	*Corticarina* sp.	2	10	10	1	1			
	Fuchsina sp.	68	61			129			
	Melanophthalmus sp.	1	4	5					
	Metophthalmus haigi	1				1			
	Metophthalmus rudis	3				3			
	Metophthalmus trux	3				3			
	Metophthalmus sp.		5		1	4			
Melyridae	Subfamily Dasytinae sp. 1		1					1	
	Subfamily Dasytinae sp. 2		7					7	
	unidentified Melyridae	16		1				15	

APPENDIX. Continued.

				Collection habitat and method					
		Month		*Q. pacifica* woodland				*C. macrostegia* visitors	
Order/family	Species	Jun	Sep	BT	UR	LL	PF	PN	
Mordellidae	*Mordellistena* sp.	1	1	2					
	Mordella hubbsi	22						22	
Mycteridae	*Lacconotus pinicola*	1		1					
Nitidulidae	*Cryptarcha gila**	1	1						
Phalacridae	*Phalacrus* sp.	3	1	4					
Staphylinidae	*Brachycepsis* sp.		1			1			
	*Bryoporus rufescens**	8	2			9	1		
	Falagriota occidua	3	3			5	1		
	Heterothops conformis	2				2			
	*Linohesperus borealis**	3				3			
	Medon sp. 1	3	2			3	2		
	Medon sp. 2	2				2			
	Pseudopsis sp.	1				1			
	Quedius sp.	1	1						
	Aleocharinae sp.	10	18			27	1		
	Aleocharinae sp. 1	2	2			4			
Tenebrionidae	*Coniontis* sp.	2			2				
	Eleodes inculta +	19	24		1	38	4		
	Hymenorus sp.	1				1			
HEMIPTERA									
Aphididae	*Aphis* sp.	2						2	
	Capitophorus elaeagni	3	1	1				3	
	Cavariella aegopodii	1	2					3	
	Dysaphis sp.	3						3	
	Myzocallis agrifolicola		1	1					
	Rhopalosiphoninus sp.	1						1	
	Sipha sp.		1	1					
	Tuberculatus pallidus	6		5				1	
	Tuberculatus pallidus nymphus	1	3	4					
	Uroleucon sp.	1				1			
LEPIDOPTERA									
Blastobasidae	*Holcocerina* sp.	2	2	4					
Depressariidae	unidentified Depressariidae	1		1					
Gelechiidae	*Telphusa sedulitella*	2		2					
	unidentified Gelechiidae	1		1					
Hesperiidae	*Pyrgus communis*		1	1					
	Ochlodes sylvanoides	1						1	
Tortricidae	*Epinotia emarginana*	1		1					
	Henricus umbrabasanus		1		1				
NEUROPTERA									
Hemerobiidae	*Hemerobius pacificus*		1	1					
ORTHOPTERA									
Acrididae	unidentified Acrididae	3		1				2	
Anostostomatidae	*Cnemotettix* sp.	4	1		1		4		
Stenopelmatidae	*Stenopelmatus* sp.	2	5		3	2	2		
Tettigonidae	*Scudderia* sp.	1		1					
PSEUDOSCORPIONES									
Cheliferidae	unidentified Cheliferidae	6	3			8	1		
Chemitidae	unidentified Chemitidae	1		1					
Chthoniidae	unidentified Chthoniidae	2	18			20			
Olpiidae	*Oreolpium* sp.	1							
	unidentified Olpiidae		1			1			
SCORPIONES									
Vaejovidae	*Pseudouroctonus minimus thompsoni* +	15	6		14	2	5		

APPENDIX. Continued.

				Collection habitat and method					
		Month		*Q. pacifica* woodland				*C. macrostegia* visitors	
Order/family	Species	Jun	Sep	BT	UR	LL	PF	PN	
PSOCODEA									
Stenopsocidae	*Graphopsocus cruciatus**	5		5					
Ectopsocidae	*Ectopsocus californicus**	5		5					
	*Ectopsocus vachoni**								
Psocidae	*Loensia maculose**	4		4					
	*Amphigerontia bifasciata**	4		4					
Elipsocidae	*Elipsocus* sp.*	1		1					
	*Elipsocus hyalinus**	5	1	6					
Dasydemellidae	*Teliapsocus conterminas**		3	3					
	Teliopsocus sp.*		1	1					
Myopsocidae	*Myopsocus* sp.*		1	1					
HYMENOPTERA									
Apidae	*Bombus vosnesenskii**		7					7	
	Ceratina acantha		12					12	
	*Ceratina arizonensis**		1					1	
	Diadasia rinconis		1					1	
	Melissodes nr. *lustra*		2						
Colletidae	*Colletes* sp. 1	2						2	
	Colletes sp. 2	1	1					2	
Encyrtidae	*Aphycaspis* sp.		1	1					
	Copidosoma capsicum		1		1				
	Ooencyrtus sp.	1		1					
	unidentified Encyrtidae		1	1					
Formicidae	*Camponotus semitestaceus*		306				306		
	Camponotus hyatti	1	1	1	1				
	Camponotus maritimus	60	71	14	30		87		
	Crematogaster marioni	49	14	51	8	2	2		
	Formica moki	151	138	37	49	10	193		
	Linepithema humile	725	795	173	157	173	1017		
	Monomorium ergatogyna	47	40	8	27	6	46		
	Pheidole hyatti	91	117	31	23	11	143		
	Prenolepis imparis	4		3		1			
	Solenopsis molesta	196	120	83	1	192	40		
	Stenamma diecki	1				1			
	Stenamma snellingi	2				2			
	Tapinoma sessile		1				1		
	Temnothorax andrei	186	201	2	13	284	88		
	*Temnothorax nitens**	2				2			
Halictidae	*Halictus farinosus**	1	3					4	
	*Halictus ligatus**		1					1	
	*Halictus tripartitus**	1	50					51	
	Lasioglossum (little Evylaeus)	22	10					32	
	Lasioglossum sp.	9	18					27	
	Lasioglossum sp. 2	1						1	
	Lasioglossum sp. 3	1	1					2	
	Lasioglossum sp. 4		14					14	
	Lasioglossum sp. 5		1					1	
	Lasioglossum sp. 6		1					1	
	Lasioglossum sp. 7		1					1	
	Lasioglossum CF *imbrex*	34	3					37	
	*Lasioglossum incompletum**	3	118					121	
	Lasioglossum nr. *imbrex**	1	2					3	
Megachilidae	*Megachile* sp. 1		3					3	
	Megachile sp. 2		3					3	