A REPRINT FROM

ENTOMOLOGY

OF THE

CALIFORNIA

CHANNEL ISLANDS

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INTRODUCTION

The California Channel Islands are a group of 8 islands located off of the coast of southern California (fig. 1). These islands lie in a geologically complex region known as the California Continental Borderland, which extends northwest to Point Arguello, southeast to Cedros Island and west to the Patton Escarpment and Cedros Deep (Vedder and Howell 1980). To avoid confusion, the name California Channel Islands is preferred; many authors use "California Islands" to include the islands along the Pacific coast of Baja California and those near San Francisco, and "Channel Islands" is preoccupied by the British Channel Islands. The California Channel Islands are "fringing islands" because they are distributed along the edge of a continent, rather than an "archipelago" (Carlquist 1974).

Interest in the California Islands, particularly the Channel Islands, has intensified in the last 25 years among scientists and the public. Since 1965 two multidisciplinary symposia on the California Islands have been held (Philbrick 1967, Power 1980), and the number of publications dealing with these islands has increased. There also has been a resurgence of interest among entomologists during the last 15 years.

In this introductory paper, I present an overview of island geology, climate, human impact, and give a synopsis of the flora and fauna, emphasizing insects. General information for each island is presented, and an appendix lists the known endemic terrestrial arthropod species.

GEOLOGY

The present adjacent mainland topography is dominated by the east–west trending Transverse Ranges which transect the northwest trending Coast and Peninsular Ranges. The four northern islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) appear to form a westward continuation of the Transverse Ranges but the islands and mainland mountains are not a homogenous structural unit (Wenner and Johnson 1980). The four southern islands (Santa Barbara, Santa Catalina, San Nicolas, and San Clemente) are scattered to the southeast of the northern islands (fig. 1).

The geologic history of the California Continental Borderland over the past 100 million years (MY) is quite poorly understood due to the complicated structure and stratigraphy (reviewed by Howell 1976 and Vedder and Howell 1980). It is important to note that current geologic knowledge shows that much of the earlier literature is incorrect and oversimplified. The complex basin and ridge structure (the higher ridges being islands) of the Continental Borderland occurs because the area lies at the intersection of the Pacific and North American lithospheric plates. In the late Oligocene, some 30 MY ago, the regional tectonic regime shifted from convergence to transform faulting when the almost complete subduction of the Farallon Plate brought the Pacific and North American Plates into contact and created the San Andreas fault system (Atwater 1970).

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Figure 1. Map showing location of California Channel Islands.
During the Miocene, the basin and ridge configuration was developed by the right-shear stress field and widespread volcanism, the latter occurring about 24 to 10 MY ago. In latest Miocene and Pliocene times the volcanism diminished and sedimentation of the basins accelerated. The Pleistocene Epoch, beginning about 2 MY ago, is characterized by major fluctuations in eustatic sea levels (due to global climatic changes) and both regional and local tectonic changes. The wave-cut terraces common on the islands and mainland record the massive fluctuations in former shoreline locations, but in analyzing these it is very difficult to separate the eustatic and tectonic components (Muhs 1983).

The geological questions most important entomologically are the dates of last submergence of the islands, since the modern fauna consists only of those species which have become established since the last emergence of dry land suitable for colonization. Unfortunately these dates are not well documented. Terraces apparently hold the best clues, but the mixing of eustatic and tectonic causes and limited accuracy of dating techniques have, so far, limited their use. During the Middle Pleistocene, most of the islands were submerged (fig. 2), and perhaps only Santa Catalina and the higher parts of Santa Cruz and Santa Rosa Islands remained above water (Johnson 1978, 1983). During the Late Pleistocene, eustatically lowered sea levels united the northern islands into one large island named Santarosae by Orr (1968) (fig. 3). Thus, the biotas of most of the islands have arisen since Middle Pleistocene times.

Recent reevaluation has shown that neither geological nor biological evidence support the previously popular idea of a Late Pleistocene land bridge between the eastern end of the northern superland and the present Oxnard area on the mainland (Johnson 1978, Junger and Johnson 1980, Wenner and Johnson 1980). Geologic evidence suggests "that at no time during the Quaternary was the water depth between the islands and the mainland less than 100 m" (Junger and Johnson 1980). However, the lowering of sea level by about 130 m during the last glaciation narrowed the channel between the superland and the mainland to about 6 km. The depauperatness and composition of the biota of the Channel Islands indicates "sweepstakes" dispersal rather than a land bridge (Wenner and Johnson 1980). The land bridge has been invoked primarily to explain the island presence of fossil dwarf mammoths, but elephants are good swimmers (Johnson 1980b). These studies (e.g. Wenner and Johnson 1980) have pointed out the importance of other means of dispersal to the Channel Islands, such as aerial dispersal (Guilmette et al. 1970), rafting (e.g. Prescott 1959, VanBlaricom and Jameson 1982) and intentional or accidental movement of organisms by Amerindians (e.g. Walker 1980).

CLIMATE

The California Channel Islands have a Mediterranean Climate, with mild temperatures year round, dry summers and winter rains ranging from 15 to 50 cm (Johnson 1978, Weissman and Rentz 1977). Strong winds and heavy fog predominate the weather patterns, especially on the smaller islands.

Historically, the apparent low seasonality of the climate in coastal southern California during the Late Pleistocene, probably with mild winters similar to those of today, and summers which were cooler and more moist than they are now, allowed establishment of communities differing from those of today. Closed-cone pine forest and contiguous communities lined much of coastal California, and these occurred on at least several islands (e.g. Axelrod 1980, Chaney and Mason 1930, Johnson 1977, 1978, Miller and Peck 1979). With post Pleistocene development of summer drought conditions and resultant increase in seasonality, many mesic plants and animals retreated to areas which retained sufficient moisture, while many xeric plants and animals expanded their ranges (e.g. Axelrod 1978, 1981, Martin and Neuner 1978).

MAN AND HIS IMPACT ON THE ISLANDS

Man has had a significant impact on the biota of the California Channel Islands since long before historical records. Radiocarbon dating of charcoal from a suspected mammoth barbecue pit on Santa Rosa Island suggests the presence of man over 40,000 years ago, but this needs confirmation (Berger 1980, Orr 1968). However the presence of
Figure 2. Map showing maximum extent of sea level rise during the last 500,000 years (Pleistocene) (modified from Vedder and Howell, 1980). Diagonal shading indicates island and mainland shorelines at that time. Dashed lines indicate contemporary island and mainland shorelines. Note that San Miguel, Anacapa, San Nicolas and Santa Barbara were submerged.
Figure 3. Map showing approximate shorelines of California Channel Islands and adjacent coast 18,000 years ago (Pleistocene) (modified from Vedder and Howell, 1980). Note super island Santarosae.
Amerindians on the islands by 8000 to 7000 radiocarbon years ago is well documented (Glassow 1980). These people lived at various times on all 8 islands and travelled by canoe among them and to the mainland (Glassow 1980, Hudson et al. 1978).

The islands were first visited by European man in 1542 (Juan Rodriguez Cabrillo), followed eventually by Spanish colonization of California. The early 1800's saw the decline of the island Indians due to various factors, but the activities of marine mammal hunters and Indian relocation programs of the Spanish missions were major causes. Domestic livestock (pigs, goats, sheep) left on the islands by early voyagers and later by ranchers became feral and proliferated on the islands. The problems caused by feral animals, such as overgrazing and the decline of the native flora, were exacerbated by domestic stock held by ranchers. Agricultural operations became established in the mid 1800's, resulting in more livestock, the introduction of new kinds of animals such as domestic cats, and the introduction of European weedy plants. Massive vegetation stripping and landscape modification ensued on several of the islands due to overgrazing coupled with drought. This induced changes in plant communities and, especially on San Miguel Island, allowed massive erosion and expansion of sand dune areas (Coblentz 1980, Hobbs 1980, Johnson 1980a, Minnich 1980). However, as documented by Johnson (1980a), episodic vegetation stripping may have a long history, due first to natural fires, then overgrazing by mammoths, followed by Indian fires, and finally sheep and other grazers.

Over 20 species of mammals and a few birds have been introduced to the islands through the years, but most of these have now been extirpated. The present major feral animal problems are: sheep (Santa Cruz Island), goats (Santa Catalina and San Clemente Islands), cats (Santa Catalina, San Nicolas and San Clemente Islands), and black rats (San Miguel, Anacapa, and Santa Catalina Islands); efforts are underway to control or eliminate most of these. The various feral animals impact island ecosystems in different ways: some overgraze, destroying native plants and promoting erosion (sheep, goats, and others), some uproot vegetation (pigs), while others (especially cats) decimate populations of native animals, especially nesting sea birds. Without predators to control them, the feral animals are able to reproduce very rapidly and out-compete native island animals. Because most partial control programs actually increase the rate of population growth, "total removal of goats [and other feral herbivores] is an absolute prerequisite to habitat recovery" (Coblentz 1982).

In the early 1900's most of the islands were used primarily for grazing and limited farming. In 1938, Anacapa and Santa Barbara Islands were designated as Channel Islands National Monument. During World War II most of the islands were occupied by the military and three (San Miguel, San Nicolas, and San Clemente Islands) have remained under military control. Under, for the most part, increasingly better management through the years, most of the islands have started to recover from early abuses. In recent years, important progress has been made toward preserving these islands. In 1980, Congress created the Channel Islands National Park, consisting of the northern four islands plus Santa Barbara Island (Public Law 96-199), although Santa Cruz and Santa Rosa Islands remain in private ownership at present. Preceding the park, the Santa Catalina Island Conservancy was established and the Nature Conservancy purchased part of Santa Cruz Island. At this time, management of the islands is as follows (more details in the island treatments): National Park Service (San Miguel, Anacapa and Santa Barbara Islands), Nature Conservancy (part of Santa Cruz Island), U.S. Navy (San Clemente and San Nicolas Islands), Santa Catalina Island Conservancy (Santa Catalina Island), and private (Santa Rosa Island and part of Santa Cruz Island). The only large human population on the islands is at Avalon on Santa Catalina Island.

**FLORA AND FAUNA**

The plants of the California Channel Islands are fairly well known. Detailed floras are available for Santa Barbara (Philbrick 1972), Santa Catalina (Thorne 1967), and San Clemente (Raven 1963) Islands, as well as more limited treatments for San Nicolas Island (Foreman 1967) and the northern islands (Smith 1976). Additional work on the northern islands is underway at the Santa Barbara Botanic Garden. Philbrick (1980) and Thorne (1969a) present general discussions of island plants and their unique features. The following island plant communities are recognized (Philbrick and Haller 1977): 1) southern
beach and dune, 2) coastal bluff, 3) coastal sage scrub, 4) maritime cactus scrub, 5) island chaparral, 6) valley and foothill grassland, 7) southern coastal oak woodland, 8) island woodland, 9) southern riparian woodland, 10) Bishop pine forest, 11) Torrey pine forest, and 12) coastal marsh. Only a few of these communities are present on the smaller islands, but most are present on the larger islands of Santa Cruz, Santa Rosa, and Santa Catalina. At present, almost nothing has been published on ecological relationships between island insects and plants.

The terrestrial vertebrates are also fairly well known on these islands. There are no comprehensive faunal papers, but summaries are available for reptiles and amphibians (Savage 1967), mammals (von Bloeker 1967), and birds (Power 1976, Diamond and Jones 1980). Channel Islands vertebrates provide habitats for insects and relatives which have been little explored. The only serious attempts to survey vertebrate ectoparasites have been by the "Los Angeles Museum—Channel Islands Biological Survey" from 1939 to 1941 (Augustson 1939, 1941, 1942, 1943) and in recent years the Santa Barbara Museum of Natural History (Lane et al. 1983). A few studies (e.g. Collins et al. ms, Doyen 1974, Knowlton 1949a, b, Schwenkmeyer 1949) have addressed predation on insects by foxes and lizards.

The non-arthropod terrestrial invertebrates of the California Islands are very poorly known, although some (e.g. snails and isopods) are presently under study. Almost nothing is known of interactions between island insects and other invertebrates.

INSECT FAUNA

Among the insects, arachnids, centipedes, and millipedes, the Miller and Menke (1981) bibliography demonstrates how little is really known. The only insect order that has been treated systematically for all the Channel Islands is the Orthoptera (Rentz and Weissman 1982). Many minor references to other insect groups have been published, but most are descriptive and do not contain identification aids. Insect names in most of the older literature cannot be trusted; in fact, some of the old literature can be more misleading than enlightening. Meaningful studies of island ecology, evolution, and biogeography must be preceded by taxonomic studies of the insects (e.g. Fosberg 1977, Powell 1981) and subsequent publications that provide identification keys. In this regard, entomologists are far behind most other biologists in understanding the fauna of these islands.

Knowledge of island insects is further hindered by the poor overall taxonomic condition of most insect groups (e.g. Hodges 1976, Danks 1979). Many groups of insects have not been taxonomically revised since the 1800's and, in many cases, species are not recognizable from available keys and descriptions. Thus, only specialists with complete collections of literature and reference specimens can identify even mainland insects. The problems are worse than normal with island specimens, which often vary slightly in color, sculpture, or size from conspecific mainland specimens.

Little is known about the ecology, evolution, and biogeography of the island entomofaunas. A very few papers have included ecology, behavior, and biological control applications (Gall 1981, Goeden et al. 1967, Opler 1974, and Weissman and French 1981). Only a few morphometric studies have been made (Ball and Negre 1972, Hovanitz 1941, LeGare and Hovanitz 1952, and Rentz and Weissman 1982); more study is needed to more thoroughly explain why many island insect populations tend to be larger and darker than their mainland counterparts.

Chromosomes of Orthoptera (Weissman 1976, Rentz and Weissman 1982) and Drosophila (Anderson et al. 1975, Dobzhansky and Epling 1944, and Harshman and Taylor 1978) have been studied. Allozyme and karyotype frequencies of the fly Drosophila pseudoobscura from the Channel Islands do not differ much from those of mainland populations. Likewise, Gill (1980) has found that the Channel Island mice Peromyscus maniculatus have undergone comparatively more morphological divergence than genetic divergence from mainland populations. However, chromosomes of the grasshopper Trimerotropis pseudofasciata on the islands do vary from those of mainland populations (Weissman 1976). Gill stresses that "holistic studies using a diversity of methods are important to an understanding of the variation found in natural populations".

Several studies have approached evolutionary questions (Darlington 1943, Rentz and Weissman 1973, 1982) but much more work is needed. A few zoogeographic questions
have been discussed (Miller 1984, Powell 1981, Weissman and Rentz 1976, and several papers in this volume), but more work is needed here as well.

INSECT ENDEMISM

Over 100 taxa are presently considered endemic to the California Channel Islands (see appendix), but it would be premature to draw conclusions from these data because 1) many of these supposed endemics may eventually prove not to be, and 2) some endemics have not been described and others have probably not yet been collected or recognized in collections. The comparative importance of autochthonous endemism versus mainland relicualism is not yet clear, but both are involved.

In general, the development of autochthonous endemism has been limited by the high vagility of many species and the geologically short duration of isolation. The time since initial colonization (which may have taken place anytime since the last submergence which was Middle Pleistocene or earlier for most islands) probably has not been long enough to allow significant divergence in most insects. This agrees with analysis of Quaternary insect fossils, primarily beetles, from various Holarctic localities which indicate great morphological stability of species from the Pleistocene through the present (Ashworth 1979, Coope 1979, Miller 1983). The fact that many endemics on the northern Channel Islands occur on more than one island in the group agrees with both their present closeness and their Late Pleistocene history of being united into one superisland (Johnson 1978).

Quaternary climatic changes in California (discussed above) have caused many species to shift ranges and undergo local extinctions, providing many opportunities for development of relict populations on the islands.

ISLAND INSECT SURVEYS

The following history of entomological collecting on the Channel Islands is derived from Miller and Menke (1981). In the last half of the 1800's, naturalists pursuing other studies occasionally collected insects, which were noted in various publications from museums in the eastern United States. It was not until the 1890's that the first serious entomological collections were made (see Fall 1897).

During the early 1900's over a dozen professional and amateur entomologists (including C. F. Baker, J. T. Carlson, A. N. Caudell, H. G. Dyar, M. Hebard, W. A. Hilton, C. H. Ingham, H. O. Marsh, O. C. Poling, P. H. Timberlake) visited Santa Catalina Island. Up to about 1940, a few entomologists (including R. V. Chamberlain, H. C. Davis, J. S. Garth, W. Hovanitz, C. H. Kennedy, F. C. Winters, and E. P. Van Duzee) independently collected on Santa Cruz and other islands. During the early 1900's the most important collections, mostly Lepidoptera, were made by Don C. Meadows while a resident of Santa Catalina Island from 1927 to 1934.

From 1939 to 1939, Theodore D. A. Cockerell undertook a study of insects, especially bees, of the Channel Islands. Although he tried to make this a major survey, it did not gain much momentum and remained basically a one man operation.

From 1939 through 1941, the "Los Angeles Museum-Channel Islands Biological Survey" undertook the first major sampling of this fauna. All the islands were visited during 13 trips. Although World War II aborted the field work and much of the laboratory research, this collection remains a very important data source. Almost no further island entomological collecting took place until the mid 1960's.

The establishment of the University of California field station on Santa Cruz Island in 1966 opened a new era for island entomology. During the next 15 years, many entomologists representing the California Academy of Sciences, California Department of Food and Agriculture, Natural History Museum of Los Angeles County, Santa Barbara Museum of Natural History, U.S. Department of Agriculture, University of California at Berkeley and Davis, Yale University and other institutions have visited the islands, especially Santa Cruz. In spite of these efforts, there is still a strong need for more collecting during all seasons over a period of years. In order to facilitate retrieval of Channel Island insects from large, general collections, several institutions dye the locality labels yellow (Miller and Menke, 1981).
THE ISLANDS

The following treatments are intended only to give the most important features of each island. Permits are required for collecting on all islands, and permission is required to visit most of them. Average rainfall figures are from Weissman and Rentz (1977). Selected references are provided at the end of each paragraph (see also Thorne 1969a, Remington 1971).

San Miguel Island
Area: 37 km²; Maximum elevation: 253 m; Rainfall: 35 cm. The island's topographic and biotic diversities are low, with large portions of the island dominated by sand and caliche (calcium carbonate root castings). The weather is harsh; wind and fog are especially intense. Presently open to the public on a limited basis as part of Channel Islands National Park whose administrative office is in the city of Ventura. See Bremner 1933, Johnson 1972, Miller 1973.

Santa Rosa Island
Area: 217 km²; Maximum elevation: 475 m; Rainfall: 31 cm. The island is dominated by rolling hills and flat terraces covered with annual grassland accented with trees and shrubs. Many other communities are scattered among the steeper slopes and canyons. Santa Rosa is a privately owned cattle ranch (Vail & Vickers Co., Santa Barbara), although it is within the boundaries of Channel Islands National Park. See Orr 1968.

Santa Cruz Island
Area: 249 km²; Maximum elevation: 753 m; Rainfall: 51 cm (in central valley). This is the largest and most topographically and ecologically diverse of the California Channel Islands. Generally, the island consists of two ridges parallel to its long axis with a long, central valley. This is the only Channel Island with a central valley, which provides a unique climatic setting. The Nature Conservancy owns most of the island, with an option to purchase most of the remainder. Much of the island is presently used for cattle grazing. A research field station, administered by the University of California, Santa Barbara, is located in the central valley. Efforts are underway to eliminate feral sheep, which have recently been considered to "heavily" impact over one third of the island (Van Vuren 1981). See Bremner 1932, Miller 1971.

Anacapa Island
Area: 2.9 km²; Maximum elevation: 283 m; Rainfall: 17 cm. Anacapa actually consists of three islets. East and Middle Islets are basically flat on top with perpendicular sea cliffs, while West Islet is much higher and cut by deep canyons which yield greater topographic and biotic diversity. East and Middle Anacapa are presently open to the public, but West Anacapa is a "research natural area" closed to the public. Anacapa is part of Channel Islands National Park whose administrative office is in Ventura, California. See Dunkle 1942, Valentine and Lipps 1963.

Santa Barbara Island
Area: 2.6 km²; Maximum elevation: 194 m; Rainfall: 30 cm. The undulating surface of this island, the smallest of the Channel Islands, is dominated by annual grassland, with scattered patches of other plants (e.g. Coreopsis). Man's farming, feral animals, and fires have had a deleterious effect on the vegetation. Santa Barbara 1. is part of Channel Islands National Park and is open to the public on a limited basis. See Lipps et al. 1968, Philbrick 1972.
Santa Catalina Island

Area: 194 km\(^2\); Maximum elevation: 632 m; Rainfall: 29 cm. This island is very rugged with ridges and peaks along its length. Originally developed as a resort (the city of Avalon) and ranch, most of the island is now part of an easement open to the public for recreational use under joint management of the Santa Catalina Island Conservancy (headquarters in Avalon) and the Los Angeles County Department of Parks and Recreation. Feral goats have "severely impacted" vegetation and complete removal has been recommended (Coblentz 1980, 1982). See Meadows 1937, Thorne 1967, 1969b.

San Nicolas Island

Area: 58 km\(^2\); Maximum elevation: 277 m; Rainfall: 19 cm. This island is a mesa whose margins are dissected by steep gulches. Sand dunes and badlands topography fringe much of the island. Overgrazing and subsequent erosion have taken their toll, but grasses and shrubs are slowly revegetating it. Presently San Nicolas is part of the Pacific Missile Test Range, headquartered at Point Mugu. See Foreman 1967, Winslow 1960, Vedder and Norris 1963.

San Clemente Island

Area: 145 km\(^2\); Maximum elevation: 599 m; Rainfall: about 15 cm. This southernmost Channel Island is dominated by a grass and herb covered plateau with an elevation of 240 to 450 m. and a gently sloping west side. However, the east side of the plateau drops precipitously to the sea. The island is a U.S. Navy base. Short-sighted animal protectionist groups have repeatedly thwarted almost successful attempts by the Navy to remove feral goats from the island (Laycock 1984). A research field station on San Clemente is administered by North Island Naval Air Station, San Diego. See Kasaty 1978, Miller 1974, Olmsted 1958, Raven 1963, 1965, Thorne 1969b.

EPILOGUE: THE FUTURE

The comments of Fall (1897) on the subject of island entomology are still appropriate, although originally written 87 years ago: "To eastern collectors it may seem a matter for wonderment that so interesting a field should so long remain, entomologically speaking, practically unexplored... Mountain and desert and valley offer opportunities without number; he [eastern man] takes the goods the gods provide and troubles not himself about possibilities in lands hull down in the Pacific." The accelerating accumulation of specimens and data in recent years has brought Channel Islands entomology to the point where substantial contributions to science can now be made in some insect groups.

Numbers of insect species recorded from the islands in the literature and studies in progress range from about 250 (Santa Barbara I.) to 1000 (Santa Cruz I.) (Miller unpubl. data). However, estimates of the total species on each island range up to 4000 for Santa Cruz (Powell 1981, Miller unpubl. data). It is obvious that our knowledge is far from complete.

This is an especially important time for an entomological understanding of these islands, since most of the administrative agencies involved are presently developing management plans. With the diverse threats now facing the islands (including recreational use, feral animals, oil and gas development, oil and liquid natural gas tanker routes, harvest of marine resources, space shuttle program, and military uses), it is important that the insect components of the island ecosystems are understood in order to properly protect them.

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APPENDIX

TERRESTRIAL ARTHROPOD SPECIES CONSIDERED ENDEMIC TO THE CALIFORNIA CHANNEL ISLANDS

The terrestrial arthropod taxa listed here are derived only from published sources. Unpublished new taxa are not included. Distributions are derived from published and unpublished sources. The many questionable weevil taxa in Trigonoscuta described by Pierce (1975) are not included. Under distribution, the island listed first is the type locality. An asterisk (*) denotes taxa in need of taxonomic review, many of which will probably prove to be not endemic. The sections on Lepidoptera and Apoidea were contributed by Jerry A. Powell and Richard W. Rust, respectively.


CLASS INSECTA
Order Orthoptera

Family Eumastacidae

Morsea californica islandica Rentz & Weissman 1982
Santa Cruz, Santa Rosa Is.
Morsea californica catalinae Rentz & Weissman 1982
Santa Catalina I.

Family Acrididae

Microtes nicola Rentz & Weissman 1982
San Nicolas I.

Scirtetica clementina Rentz & Weissman 1982
San Clemente I.

Trimerotropis santabarbara Rentz & Weissman 1982
Santa Barbara I.

Family Tettigonidae

Neduba morsel islandica Rentz & Weissman 1982
Anacapa, Santa Rosa Is.

Neduba morsel santacruzae Rentz & Weissman 1982
Santa Cruz I.

Neduba propstl Rentz & Weissman 1982
Santa Catalina I.

Family Stenopelmatidae

Cnemotettix caudulus Rentz & Weissman 1973
Santa Rosa, San Miguel, Santa Cruz Is.

Cnemotettix pulvillifer Caudell 1916
San Clemente I.

Cnemotettix spinulus Rentz & Weissman 1973
San Nicolas, Santa Rosa, Santa Cruz, Anacapa Is.

Family Phasmatidae

Pseudosermyle catalinae Rentz & Weissman 1982
Santa Catalina I.

Order Hemiptera

Family Miridae

*Lopidea nigridea hirta* Van Duzee 1921
San Miguel I.

Family Lygaeidae

*Melanopleurus fuscusus* Brailovsky 1977
Santa Cruz I.

Order Homoptera

Family Cicadidae

Okanagana hirsuta Davis 1915
Santa Rosa, Santa Cruz, Anacapa Is.
Okanagana catalina Davis 1936 (elevated from subspecies of O. hirsuta. REVISED STATUS by R. J. Gill)
Santa Catalina I.

Family Cicadellidae

Tiaa cruzensis Gill & Oman 1983
Santa Cruz I.

Tiaa insula Sawbridge 1975
Santa Barbara I.

Family Pseudococcidae

Heliococcus clemente Miller 1974
San Clemente I.

Order Coleoptera

Family Carabidae

*Amara clementina (Casey) 1918
San Clemente I.

*Amara insularis Horn 1875
San Clemente I. (published records from other islands cannot be trusted)

*Pterostichus gliscans Casey 1913
San Clemente I.

Family Staphylinidae

*Strigota seclusa Casey 1911
Santa Catalina I.

Family Scarabaeidae

Coenonycha clementina Casey 1909
San Clemente I.

Coenonycha clypeata McClay 1943
Santa Catalina I.

Coenonycha fulva McClay 1943
Santa Catalina I.

Phobetus ciliatus Barrett 1935
Santa Catalina I.

Phobetus testaceus LeConte 1861
Santa Cruz I.

Serica catalina Dawson 1947
Santa Catalina I.

Serica cruzi Saylor 1939
Santa Cruz I.
Family Anobiidae

Euvrilletta catalinae (Fall) 1905
Santa Catalina I.

Xarifa insularis Fall 1905
Santa Catalina, San Clemente Is.

Family Melyridae

"Amecocerus anacapensis" (Blaisdell) 1924
Anacapa I.

"Attalus transmarinus" Fall 1898 (replacement name for A. subfasciatus Fall 1897, not Gorham 1886)
San Clemente I.

Collops crusoe Fall 1910
San Nicolas, Santa Rosa, Santa Cruz Is.

"Dasytastes catalinae" (LeConte) 1866
Santa Catalina I.

"Dasytastes insularis" Fall 1901
Santa Catalina I.

"Dasytes clemente" Fall 1901
San Clemente I.

"Trichochrous calcaratus" Fall 1934
Santa Cruz, Santa Rosa, Anacapa Is.

"Trichochorus pedalus" (LeConte) 1866
Santa Catalina, San Clemente, Guadalupe Is.

Family Coccinellidae

Scymnus falli Gordon 1976
Santa Cruz, Santa Rosa, Santa Barbara Is.

Family Lathridiidae

"Melanophthalma insularis" Fall 1899
San Clemente I.

Family Tenebrionidae

Apsena grossa (LeConte) 1866
San Clemente, Santa Barbara, San Nicolas, Santa Catalina Is.

Clbdelis bachei LeConte 1861
"Santa Barbara I.", Santa Cruz, Santa Catalina Is.

Coniontis lata LeConte 1866
San Clemente, San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Barbara Is.

"Coniontis santarosae" Blaisdell 1921
Santa Rosa, San Miguel Is.
Eleodes incultus LeConte 1865 (E. incultus affinis Blaisdell 1918, is a NEW SYNONYM; synonymy by R. E. Somerby)
"Santa Barbara I., San Miguel (and Prince), Santa Rosa, Santa Cruz, Anacapa Is.

Eleodes laticollis apprimus Blaisdell 1921
San Nicolas, San Miguel (and Prince), Santa Rosa, Santa Cruz, Anacapa, Santa Barbara, San Clemente Is.

Eleodes subvestitus (Blaisdell) 1939
San Nicolas I.

Eusattus robustus LeConte 1866
San Clemente I.

Eusattus politus Horn 1883 (E. vanduzeei Blaisdell 1921 is a synonym)
Prince, San Miguel, Santa Rosa Is. (Stated type locality of politus, "Santa Barbara", is incorrect)

Coelus pacificus Fall 1897
San Nicolas, San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, San Clemente Is.

*Metoponium insulare Casey 1907
Santa Catalina I.

Family Cantharidae

Cantharis hatchi dorthyae Fender 1968
Santa Catalina I.

Family Chrysomelidae

*Colaspidea subvittata Fall 1897
Santa Catalina, San Clemente Is.

Family Curculionidae

*Sciophites insularis Van Dyke 1935
San Clemente I.

Sitona cockerelli Blaisdell 1938
San Miguel I.

*Trigonoscuta species. Pierce (1975) described many "endemic" species and subspecies from the Channel Islands. Due to his tendency toward extreme taxonomic splitting, the validity of most of these taxa is questionable.

Various islands

Order Trichoptera

Family Psychomyiidae

Tinodes schusteri Denning 1983
Santa Cruz I.
Order Lepidoptera
(Jerry A. Powell)

Family Pieridae

*Anthocharis cethura catalina* Meadows 1937
Santa Catalina I.

Family Nymphalidae

*Euphydryas editha insularis* Emmel & Emmel 1975
Santa Rosa I.

Family Lycaenidae

*Strymon avalona* (Wright) 1905
Santa Catalina I.

Family Hesperiidae

*Ochlodes sylvanoides santacruza* Scott 1981
Santa Cruz, Santa Rosa Is.

Family Arctiidae

*Arachnis picta insularis* Clarke 1940
Anacapa I.

*Arachnis picta meadowsi* Comstock 1942
Santa Catalina I.

*Lophocampa indistincta* (Barnes & McDunnough) 1910
Santa Catalina, Santa Rosa, Santa Cruz, Anacapa Is.

Family Noctuidae

*Feralia meadowsi* Buckett 1968
Santa Catalina, Santa Cruz Is.

*Zosteropoda clementea* Meadows 1942
San Clemente, Santa Rosa, Santa Cruz Is.

Family Geometridae

*Pterotaea crinigera* Rindge 1970
San Clemente I.

Family Pyralidae

*Everestis angustalis catalinae* Munroe 1973
Santa Catalina I.

*Rhodophaea cruz* Opler 1977
Santa Cruz I.

Family Tortricidae

*Argyrotaenia franciscana Insulana* Powell 1964
Anacapa, San Miguel, Santa Rosa, Santa Cruz, San Nicolas Is.
Arovrotaenia isotallimna Powell 1964
Santa Barbara I.

Family Oecophoridae

Agonopteryx toega Hodges 1974
San Clemente I.

Family Blastobasidae

*Holcocera phenacocci* Braun 1927
Santa Catalina I.

Family Plutellidae

Ypsolophra lyonothamnae (Powell) 1967
Santa Cruz, San Clemente Is.

Family Gracillariidae

Acrocercops insulariella Opler 1971
Santa Cruz I.

Order Diptera

Family Tipulidae

Tipula hastingsae diperona Alexander 1973
Santa Cruz I.

Tipula santaecruzae Alexander 1973
Santa Cruz I.

Family Asilidae

Cophura hennei Wilcox & Martin 1945
San Nicolas I.

Efferia anacapai (Wilcox & Martin) 1945
Anacapa, Santa Barbara Is.

Efferia clementi (Wilcox & Martin) 1945
San Clemente I.

Stanopogon neojubatus Wilcox & Martin 1945
Santa Rosa, San Miguel, Santa Cruz, Anacapa, Santa Barbara Is.

Family Agromyzidae

*Amauromyza insularis* Spencer 1981
Santa Catalina I.

Order Hymenoptera

Family Formicidae

Aphaenoqaster oatruelis Forel 1886
Guadalupe, Santa Barbara, San Nicolas, Santa Catalina, San Clemente Is.
Camponotus bakeri Wheeler 1904 (elevated from subspecies of C. hyatti, REVISED STATUS by R. R. Snelling)
Santa Catalina, Santa Rosa, Santa Barbara, San Clemente Is.

Family Sphecidae

Ammophila azteca clemente Menke 1967
San Clemente I.

Bembix americana hamata C. Fox 1923
San Miguel, Santa Rosa, Santa Cruz Is.

Bembix americana nicolai Cockerell 1938
San Nicolas I.

Bembix americana dug Menke 1984
San Clemente I.

Palmodes insularis Bohart & Menke 1961
San Clemente, San Miguel, Santa Rosa, Santa Cruz, Anacapa Is.

Family Andrenidae

Perdita layiae layiae Cockerell 1938
San Miguel, Santa Cruz Is.

Family Halictidae

Dialictus cabrilli (Cockerell) 1937
San Miguel I.

Dialictus megastictus (Cockerell) 1937
San Miguel I.

Dialictus pilosicaudus (Cockerell) 1937
San Miguel I.

Dialictus punctiferellus (Cockerell) 1937
San Miguel I.

*Evylaeus avalonensis (Cockerell) 1938
Santa Catalina, San Clemente Is.

Evylaeus hammondi (Cockerell) 1938
San Miguel I.

Sphecodes nigricans miquelensis Timberlake 1940
San Miguel I.

Family Anthophoridae

*Anthophora californica erysimi Cockerell 1937
San Miguel I.

*Anthophora urbana catalinae Cockerell 1901
Santa Catalina I.
*Anthophora urbana clementina* Cockerell 1939
San Clemente I.

*Anthophora urbana nicolai* Cockerell 1939
San Nicolas I.

Exomalopsis cockerelli Timberlake 1980
Santa Catalina I.

Nomada avalonica Cockerell 1938
Santa Catalina I.

Melissodes scotti Cockerell 1939
Santa Catalina I.

**CLASS ARACHNIDA**

Order Scorpionida

Veiovis "minimus" thompsoni Gertsch & Soleglad 1972
Anacapa, Santa Rosa, Santa Cruz Is.

Family Phalangiidae

Protolophus cockerelli Goodnight & Goodnight 1942
San Clemente I.

Order Phalangida

Family Erythraeidae

*Rhynchoiophus angustipes* Banks 1907 (replacement name for *R. gracillipes* Banks 1904, not Kramer 1897)
Santa Rosa I.

Family Ixodidae

Ixodes peromysci Augustson 1940
Santa Barbara, Anacapa, San Clemente Is.

Family Parasitidae

*Poecilochirus pilosula* (Banks) 1904, NEW COMBINATION by D. E. Johnston. Transferred from *Laelaps* (Laelapidae), where it was incorrectly placed by Banks (1904). The classification of *Poecilochirus*, species of which are phoretic on *Nicrophorus* (Silphidae) and other Coleoptera, needs revision. The types were probably taken from *Nicrophorus nigrita* Mannerheim, which was collected by the collector of the types on Santa Rosa I. (Fall 1897) and is the only *Nicrophorus* known from the Island (Miller and Peck 1979).
Santa Rosa I.

Order Araneida

Family Zodariidae

Lutica clementea Gertsch 1961
San Clemente I.

Lutica nicolasia Gertsch 1961
San Nicolas I.
Family Dysderidae

*Sesoestria cruzana* Chamberlin & Ivie 1935
Santa Cruz I.

Family Agelenidae

*Rualena alleni* Chamberlin & Ivie 1942
San Nicolas I.

*Rualena cockerelli* Chamberlin & Ivie 1942
San Miguel I.

*Rualena cruzana* Chamberlin & Ivie 1942
Santa Cruz I.

Family Gnaphosidae

*Drassyllus barbus* Platnick 1984
Santa Barbara I.

*Zelotes cruz* Platnick & Shadab 1983
Santa Cruz, Anacapa, Santa Barbara Is.

CLASS DIPLOPODA
Order Julida

Family Parajulidae

*Bollmaniulus catalinae* (Chamberlin) 1940
Santa Catalina I.

Order Spirostreptida

Family Cambalidae

*Nannolene catalina* Chamberlin 1941
Santa Catalina I.

*Tigolene clementius* Chamberlin 1941
San Clemente I.

CLASS CHILOPODA
Order Geophilomorpha

Family Geophilidae

*Geophilus nicolanus* Chamberlin 1940
San Nicolas I.

Family Schendylidae

*Pectiniunguis catalinensis* Chamberlin 1941
Santa Catalina I.

Order Lithobiomorpha

Family Lithobiidae

*Nothembius insulae* Chamberlin 1916
Santa Cruz I.
CLASS PAUROPODA
Order Heterognatha

Family Pauropodidae

*Pauropus santus* Hilton 1930
Santa Cruz I.

CLASS SYMPHYLA
Order Cephalostigmata

Family Scolopendrellidae

*Symphylella santa* Hilton 1931
Santa Cruz I.

SUMMARY OF TAXONOMIC CHANGES

Homoptera: Cicadidae
*Okanagana catalina* Davis 1936 (revised status)

Coleoptera: Tenebrionidae
*Eleodes incultus affinis* Blaisdell 1918 (= *E. incultus* LeConte 1865)

Hymenoptera: Formicidae
*Camponotus bakeri* Wheeler 1904 (revised status)

Acari: Parasitidae
*Poecilochirus pilosula* (Banks) 1904 (new combination)