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## Whitefly fauna of Clark County, Nevada.

John W. Dooley III  
*San Jose State University*

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WHITEFLY FAUNA OF CLARK COUNTY, NEVADA

A Thesis

Presented to

The Faculty of the Department of Biological Sciences

San Jose State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

John W. Dooley III

December, 2009

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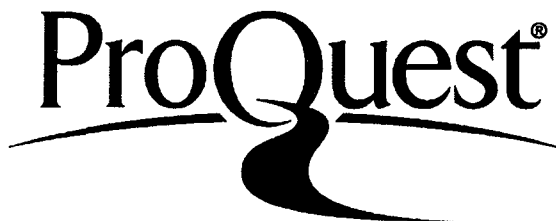
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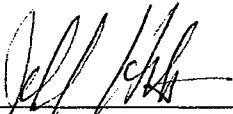
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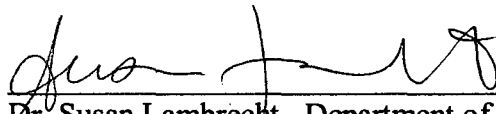
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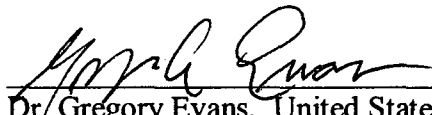
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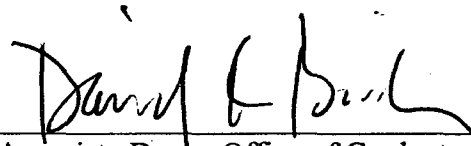
APPROVED FOR THE DEPARTMENT OF BIOLOGICAL SCIENCES

  
\_\_\_\_\_  
Dr. Jeff Honda, Department of Biological Sciences 10/11/09  
Date

  
\_\_\_\_\_  
Dr. Susan Lambrecht, Department of Biological Sciences 9/30/09  
Date

  
\_\_\_\_\_  
Dr. Gregory Evans, United States Department Agriculture 10/5/09  
Date

APPROVED FOR THE UNIVERSITY

  
\_\_\_\_\_  
Associate Dean, Office of Graduate Studies and Research 12/3/09  
Date

## ABSTRACT

### WHITEFLY FAUNA OF CLARK COUNTY, NEVADA

by

John William Dooley

The research presented here documents the whitefly fauna within the Las Vegas area in Clark County, Nevada, with information on the geology, host and plant communities in the area where the whiteflies were collected. Only specimens of the immature fourth stage (puparium) were observed and collected at Red Rock Canyon, Mount Charleston, and the Mojave Desert surrounding Las Vegas.

Prior to 2003, ten whitefly species had been recorded as being established in Nevada: *Aleuroglandulus subtilis* Bondar, *Aleuroplatus berbericolus* Quaintance & Baker, *Aleyrodes spiraeoides* Quaintance, *Bemisia tabaci* (Gennadius), *Dialeurodes citri* (Ashmead), *Siphoninus phillyreae* (Haliday), *Tetrалеurodes mori* (Quaintance), *Trialeurodes abutiloneus* (Haldeman), *T. packardi* (Morrill), and *T. vaporariorum* (Westwood). Since then, seven more species have been recorded in Nevada: *Aleuoparadoxus arctostaphyli* Russell, *Aleuroplatus gelatinosus* (Cockerell), *Aleuropleurocelus ceanothi* (Sampson), *Aleuropleurocelus nigrans* (Bemis), *Tetrалеurodes quercifolia* Nakahara, *Trialeurodes corollis* (Penny), and *Trialeurodes glacialis* (Bemis). All known established species and three undescribed species in Clark county are described and illustrated in this research. The three undescribed species are *Aleuropleurocelus* sp.#1; *Tetrалеurodes* sp., and *Trialeurodes* sp.

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## Abbreviations and Acronyms

APHIS	Animal & Plant Health Inspection Service (USDA)
ARS	Agricultural Research Service (USDA)
BLM	Bureau of Land Management (USDOI)
NCA	National Conservation Area (Red Rock Canyon)
NHM	Natural History Museum, London
PPQ	Plant Protection & Quarantine (USDA-APHIS)
RRC	Red Rock Canyon NCA (USDOI-BLM)
RRCIA	Red Rock Canyon Interpretive Association
SSQ	Sand Stone Quarry (USDOI-BLM- RRC)
SEL	Systematic Entomology Lab
USDA	United States Department of Agriculture
USDOI	United States Department of the Interior
USNM	United States Natural History Museum

## Introduction

Whiteflies are phytophagous causing injury and destruction to a wide variety of plants. Some, known to be vectors of plant diseases, cause major economic damage presenting a serious threat to Nevada's agricultural and ornamental resources. Some species, such as *Trialeurodes vaporariorum* (Westwood), are vectors of Gemini viruses (Brown 2000, 23). Biotype Q of *Bemisia tabaci* (Gennadius) was first discovered in Spain in 1991 (Simon *et al* 1999, 25) and now occurs in Arizona. Biotype Q has developed resistance to several pesticides leading to mass explosions in its populations in some countries and is known to occur in Arizona. Sorenson's 1991 publication on the ash whitefly, *Siphoninus phillyreae* (Haliday), is the only known publication describing a whitefly of Nevada affecting pomegranate and other nursery commodities. At the same time, the ash whitefly was reported to be established in the Red Rock Canyon NCA at Calico Basin and as a pest in Pahrump, more than 40 miles away (Sorenson 1991, 1 ). For this reason it is imperative to study the biological and environmental impacts of the already established whiteflies on the desert environment and the environmental effects of the desert on these organisms.

Whiteflies were collected from 1959 to 1991 sporadically by state and university entomologists in eight counties throughout Nevada and California. Results from these collections documented the establishment of whiteflies in Nevada.

Besides affecting their desert ecosystems of plants serving as nutrients for the desert animals, whiteflies impact their local agricultural resources (Nevada County ERC)

including onions, potatoes, wheat, greenhouse and nursery products. Whiteflies also interact with their allelopathic host plants, such as manzanita, which inhibit the growth of other plants species. The objective of this project is to identify and document the whitefly species that occur in the Las Vegas area and to determine their biogeographical and host range. Two species, *Aleuroglandulus subtilis* Bondar and *Tetraleurodes mori* (Quaintance), were found in temperate regions at higher elevations of Mount Charleston and not within the desert areas.

Whiteflies were collected by John Dooley in Clark County, Nevada from 2003 within the arid Mohave Desert surrounding Las Vegas including Red Rock Canyon National Conservation Area (197,000 acres). In 2006, Dr. Jeff Knight (State Entomologist for Nevada), Robert Little (Nevada Dept of Agriculture) and John Dooley jointly collected whiteflies in the Mohave Desert and on Mount Charleston. Dr. Lambrecht provided identification, training, and support for desert and other plant communities.

The geology of Red Rock Canyon NCA (BLM, Red Rock Canyon NCA Geological History) provides a window into the adverse climatic and weather conditions of the Mohave Desert affecting the diversity of the plant and animal life. The various whitefly species and their hosts have become established and survived having been impacted by temperature, climate, and soil. The Canyon was formed from an ancient deep ocean basin extending from Nevada to Utah. Approximately 225 million years ago this basin slowly rose with marine organisms depositing limestone on the ocean bottom creating the niche for creosote, manzanita, and oak becoming established on many of the rocky cliffs.

About 180 million years ago the area was completely arid with a giant dune ecosystem stretching into Colorado. As the wind shifted the sands back and forth, old dunes were leveled and new ones were raised leaving curved, angled lines in the sand. These shifting sands were buried by other sediments, and eventually cemented into sandstone by iron oxide with calcium carbonate. The exposure of the sediments to the elements caused mineral oxidation formation (layers of orange and red colored rocks), known as Aztec sandstone (Figure 1).

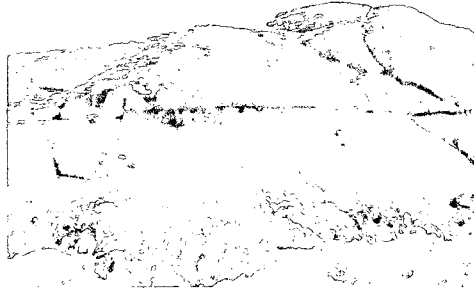


Figure 1. Aztec sandstone

The most significant geologic feature of Red Rock Canyon is the Keystone Thrust Fault that formed around 65 million years ago. A thrust fault is a fracture in the earth's crust resulting from the compression forces causing the overlapping of one crustal plate over another. The oldest rocks on the bottom of the upper plate lay directly above the youngest rocks of the lower plate. At Red Rock Canyon, the gray carbonate rocks of the ancient ocean have been thrust over the tan and red rock layers. The Keystone Thrust Fault extends from the Cottonwood Fault along State Route 160 north for 21 kilometers along the crest of the Red Rock escarpment. It then curves east along the base of La



Madre Mountain before it is obscured by very complex faulting north of the Calico Hills (BLM, Red Rock Canyon NCA Geological History).

## **Plant Communities**

More than 1500 species of desert shrubs (figure 2) dominate the biogeography of Clark County with 200 species that are endemic to the Mohave Desert and not found in the warmer, Southern Sonoran Desert or the cooler, Northern Great Basin Desert (Red Rock Canyon Interpretive Association).



Figure 2. Desert shrubs (Mojave)

Some plants have become established as solitary plants on these red and orange cliffs including creosote, manzanita, and oak.

The plant communities where whiteflies were collected include 1) the deciduous woodlands on Mount Charleston, 2) oak shrub, 3) manzanita with co-dominant oak, and 4) the desert scrub (chaparral) with the latter three occurring within the Red Rock Canyon National Conservation Area (RRCNCA). Whiteflies were collected in two geographical areas: Mount Charleston and the RRCNCA. A plant community is an area associated with various vegetation, with one or more dominant or co-dominant species, and is

named after the dominant or most abundant species. The Red Rock Canyon Interpretive Association (RRCIA) lists nine plant communities. Only those from which whiteflies were collected are addressed.

Desert scrub community is found generally to the east of the sandstone escarpment with an annual precipitation from 5 to 8 inches and soils generally shallow to very shallow. In the desert scrub community, mesic (moist) years produce an exceptional growth of annual plants. The wide variety of small flowering plants includes buckwheat, desert poppy and mallow. Blackbrush, bursage, catclaw, cheesebush, cholla cactus, creosote, dalea, desert almond, Mormon tea, Spanish bayonet, spiny menodora, sagebrush, turpentine bush, big galleta grass, needle grass, and sand dropseed are commonly found in this community.

Manzanita grows from parent rock (cliffs) and along the trails in the bajadas. In the scrub it is associated with juniper, *Ceanothus*, oaks, pinyon pine, and yerba santa.

Oakbrush occurs from 4,000 to 6,000 feet in the RRCNCA. Soils are moderately deep to deep. Precipitation is usually between 8 and 10 inches (Red Rock Canyon Interpretive Association). Sagebrush, manzanita, snowberry and rabbitbrush are some of the scrub species that also occur in this community in varying amounts. Nevada bluegrass, Indian ricegrass, big galleta, several annual grasses and forbs also occur in this community. Soil variability and soil moisture, as affected by slope and aspect (e. g. north slope compared to the south slope), may account for the occurrence of oakbrush.

See the following list of scientific and approved common names (Table 1) for the plants that are established within the area of this research.

Table 1 Common and Scientific Names of Plants  
(USDA, ARS. Germplasm Resources Information Network)

Bursage	<i>Ambrosia</i>	spp.	Asteraceae
Catclaw	<i>Acacia</i>	<i>greggii</i>	Fabaceae
Ceanothus	<i>Ceanothus</i>	<i>greggii</i>	Rhamnaceae
Cheesebush	<i>Ambrosia</i>	<i>salsola</i>	Asteraceae
Cholla cactus	<i>Opuntia</i>	spp.	Cactaceae
Cotton	<i>Gossypium</i>	<i>hirsutum</i>	Malvaceae
Creeping Barberry	<i>Berberis</i>	<i>repens</i>	Berberidaceae
Creosote bush	<i>Larrea</i>	<i>tridentata</i>	Zygophyllaceae
Currants	<i>Ribes</i>	spp	Grassulariaceae
Dalea	<i>Dalea</i>	spp	Fabaceae
Desert almond	<i>Prunus</i>	<i>fasciculata</i>	Rosaceae
Desert-willow	<i>Chilopsis</i>	<i>linearis</i>	Bignoniaceae
Euphorbia	<i>Euphorbia</i>	sp.	Euphorbiaceae
Fuschsia	<i>Fuschsia</i>	<i>hybrida</i>	Onagraceae
Gambel's oak	<i>Quercus</i>	<i>gambelii</i>	Fagaceae
Holly	<i>Ilex</i>	sp.	Aquifoliaceae
Holly barberry	<i>Berberis</i>	<i>aquifolium</i>	Berberidaceae
Joshua tree	<i>Yucca</i>	<i>brevifolia</i>	Agavaceae
Juniper	<i>Juniperus</i>		Cupressaceae
Kumquat	<i>Fortunella</i>	sp.	Rutaceae
Manzanita	<i>Arctostaphylos</i>	sp.	Ericaceae
Mohave yucca	<i>Yucca</i>	<i>schidigera</i>	Agavaceae
Mormon-tea	<i>Ephedra</i>	spp.	Ephredaceae
Mulberry	<i>Morus</i>	sp.	Moraceae
Needle grass	various		Poaceae
Oak	<i>Quercus</i>	spp.	Fagaceae
Pinyon pine	<i>Pinus</i>	<i>monophylla</i>	Pinaceae
Pomegranate	<i>Punica</i>	<i>granatum</i>	Lythraceae
Ponderosa pine	<i>Pinus</i>	<i>ponderosa</i>	Pinaceae
Prickly pear	<i>Opuntia</i>	<i>charlestonensis</i>	Cactaceae
Sagebrush	<i>Artemesia</i>	<i>tridentata</i>	Asteraceae
Serviceberry	<i>Amelanchier</i>	sp.	Rosaceae
Single-leaf Ash	<i>Fraxinus</i>	<i>anomala</i>	Oleaceae
Snowberry	<i>Symphoricarpus</i>	<i>albus</i>	caprifoliaceae
Spanish bayonet	<i>Yucca</i>	spp	Agavaceae
Velvet ash	<i>Fraxinus</i>	<i>velutina</i>	Oleaceae
Willow	<i>Salix</i>	spp.	Salicaceae
Yerba santa	<i>Eriodictyon</i>	spp.	Boraginaceae

## Whiteflies of Southern Nevada in Clark County

Whiteflies (Aleyrodidae, Hemiptera, Sternorrhyncha) comprise a monophyletic group, with over 1400 species in one fossil subfamily (Bernaeinae) and historically into three extant (current) subfamilies that have been consolidated into two subfamilies, the Aleurodicinae and Aleyrodinae (Martin and Mound 2007). The earliest known fossil Aleyrodids were found in early Cretaceous amber from Lebanon (Grimaldi & Engle 2005). All the current genera found in Nevada belong within the Aleyrodinae subfamily. The Aleurodicinae are not known to occur in Nevada.

Prior to 2003, ten whitefly species had been recorded as being established in Nevada by the Nevada Department of Agriculture (Table 2): *Aleuroglandulus subtilis* Bondar, *Aleuroplatus berbericolus* Quaintance & Baker, *Aleyrodes spiraeoides* Quaintance, *Bemisia tabaci* (Gennadius), *Dialeurodes citri* (Ashmead), *Siphoninus phillyreae* (Haliday), *Tetraleurodes mori* (Quaintance), *Trialeurodes abutiloneus* (Haldeman), *T. packardi* (Morrill), and *T. vaporariorum* (Westwood).

Table 2: Intercepted species in Nevada (1959-1991)  
(Courtesy, Dr. Jeff Knight, Nevada State Entomologist)

Genus	Species	Hosts	Locality	Date
<i>Aleuroglandulus</i>	<i>subtilis</i>	<i>Berberis repens</i>	Kyle Canyon; Spring Mts.	05/06/77
<i>Aleuroplatus</i>	<i>berbericolus</i>	<i>Mahonia aquifolium</i>	Fallon	10/21/60
<i>Aleuroplatus</i>	<i>berbericolus</i>	<i>Mahonia aquifolium</i>	Reno	10/21/60
<i>Aleuroplatus</i>	<i>berbericolus</i>	Oregongrape	Minden	10/28/75
<i>Aleuroplatus</i>	<i>berbericolus</i>	<i>Berberis repens</i>	Kyle Canyon; Spring Mts.	05/06/77
<i>Aleyrodes</i>	<i>spiraeoides</i>	<i>Solanum tuberosum</i>	Panaca	08/30/61
		<i>Euphorbia</i> sp.		
<i>Bemisia</i>	<i>tabaci</i>	( <i>poinsettia</i> )	Las Vegas	02/14/91
<i>Dialeurodes</i>	<i>citri</i>	<i>Kumquat</i>	Las Vegas	03/16/59
<i>Siphoninus</i>	<i>phillyreae</i>	<i>Punica granatum</i>	Las Vegas	09/18/90
		<i>Fraxinus velutina</i>		
<i>Siphoninus</i>	<i>phillyreae</i>	<i>glabra</i> 'Modesto'	Las Vegas	09/27/90
		<i>Fraxinus velutina</i>		
<i>Siphoninus</i>	<i>phillyreae</i>	<i>coriacea</i>	Calico Basin	10/21/90
<i>Siphoninus</i>	<i>phillyreae</i>	<i>Fraxinus anomala</i>	Calico Basin	10/21/90
<i>Siphoninus</i>	<i>phillyreae</i>	<i>Pyrus communis</i>	Pahrump	11/15/90
<i>Siphoninus</i>	<i>phillyreae</i>	<i>Fraxinus</i> sp.	Reno	08/21/91
<i>Tetraleurodes</i>	<i>mori</i>	<i>Morus</i>	Las Vegas	09/21/64
<i>Tetraleurodes</i>	<i>mori</i>	<i>Berberis repens</i>	Virgin Mts.	05/03/77
<i>Trialeurodes</i>	<i>abutilonea</i>	<i>Gossypium hirsutum</i>	Pahrump	07/19/60
<i>Trialeurodes</i>	<i>abutilonea</i>	<i>Medicago sativa</i>	Overton	08/04/61
<i>Trialeurodes</i>	<i>packardi</i>	Not recorded	Not recorded	unknown
<i>Trialeurodes</i>	<i>vaporariorum</i>	<i>Calendula officinalis</i>	Reno	09/30/74
<i>Trialeurodes</i>	<i>vaporariorum</i>	<i>Fuchsia hybrida</i>	Reno	02/23/73
<i>Trialeurodes</i>	<i>vaporariorum</i>	<i>Solanum melongena</i>	Reno	10/02/74
<i>Trialeurodes</i>	<i>vaporariorum</i>	Not recorded	Elko	11/03/76

From 2003 seven more species have been collected by John Dooley, Dr. Jeff Knight, and Robert Little increasing the geographic range of the whitefly fauna into Nevada: *Aleuoparadoxus arctostaphyli* Russell, *Aleuroplatus gelatinosus* (Cockerell), *Aleuropleurocelus ceanothi* (Sampson), *A. nigrans* (Bemis), *Tetraleurodes quercifolia* Nakahara, *Trialeurodes corollis* (Penny), *Trialeurodes glacialis* (Bemis) and possibly

undescribed species: *Aleuropleurocelus* sp.#1, *Tetraleurodes* sp., and *Trialeurodes* sp.#1.

Other undescribed and doubtful species that require more research are placed in

Appendix B with descriptions for comparisons: *Aleuropleurocelus* sp. #2,

*Aleuropleurocelus* sp. #3, and *Trialeurodes* sp. #2. All new records were validated by

Dr. Greg Evans at the Systematic Entomology Lab (USDA, ARS) in Beltsville. Table 3

shows the data for all the species collected.

Table 3: Species Collected with Host and Geographical Area

Genus	Species	Host Plant	Location
<i>Aleuroglandulus</i>	<i>subtilis</i> (Bondar)	<i>Berberis repens</i>	Spring Mountain
<i>Aleuoparadoxus</i>	<i>arctostaphyli</i> Russell	<i>Ceanothus</i> sp.	Sandstone Quarry
<i>Aleuoplatus</i>	<i>gelatinosus</i> (Cockerell)	<i>Eriodictyon</i> sp.	Sandstone Quarry
<i>Aleuoplatus</i>	<i>gelatinosus</i> (Cockerell)	<i>Quercus</i> sp.	Pine Creek Canyon
<i>Aleuoplatus</i>	<i>gelatinosus</i> (Cockerell)	<i>Quercus</i> sp.	Sandstone Quarry
<i>Aleuopleurocelus</i>	<i>ceanothi</i> Sampson	<i>Arctostaphylos</i>	Sandstone Quarry
<i>Aleuopleurocelus</i>	<i>ceanothi</i> Sampson	<i>Ceanothus?</i> sp.	Boy Scout Area
<i>Aleuopleurocelus</i>	<i>ceanothi</i> Sampson	<i>Eriodictyon</i> sp.	Lee Canyon
<i>Aleuopleurocelus</i>	<i>ceanothi</i> Sampson	<i>Eriodictyon</i> sp.	Pine Creek Canyon
<i>Aleuopleurocelus</i>	<i>ceanothi</i> Sampson	<i>Eriodictyon</i> sp.	Sandstone Quarry
<i>Aleuopleurocelus</i>	<i>ceanothi</i> Sampson	<i>Larrea</i> sp.	Sandstone Quarry
<i>Aleuopleurocelus</i>	<i>ceanothi</i> Sampson	<i>Quercus</i> sp.	Pine Creek Canyon
<i>Aleuopleurocelus</i>	<i>ceanothi</i> Sampson	<i>Eriodictyon</i> sp.	Willow Springs
<i>Aleuopleurocelus</i>	<i>nigrans</i> Sampson	<i>Arctostaphylos</i>	Sandstone Quarry
<i>Aleuopleurocelus</i>	<i>nigrans</i> Sampson	<i>Ceanothus</i> sp.	Sandstone Quarry
<i>Aleuopleurocelus</i>	<i>nigrans</i> Sampson	Indet. Plant	Sandstone Quarry
<i>Aleuopleurocelus</i>	<i>nigrans</i> Sampson	<i>Quercus</i> sp.	Pine Creek Canyon
<i>Aleuopleurocelus</i>	sp.	<i>Arctostaphylos</i>	Sandstone Quarry
<i>Aleuopleurocelus</i>	sp.	<i>Eriodictyon</i> sp.	Sandstone Quarry
<i>Aleuopleurocelus</i>	sp.	<i>Larrea</i> sp.	Blue Diamond
<i>Aleuopleurocelus</i>	sp.	<i>Quercus</i> sp.	Pine Creek Canyon; Sandstone Quarry
<i>Tetraleurodes</i>	<i>mori</i> Quaintance	<i>Penstemon</i> sp.	Lee Canyon
<i>Tetraleurodes</i>	<i>quercicola</i> Nakahara	<i>Quercus</i> sp.	Pine Creek Canyon
<i>Tetraleurodes</i>	sp.	<i>Quercus</i> sp.	Pine Creek Canyon; Sandstone Quarry
<i>Trialeurodes</i>	<i>corollis</i> (Penny)	<i>Arctostaphylos</i>	Sandstone Quarry
<i>Trialeurodes</i>	<i>glacialis</i> (Bemis)	<i>Quercus</i> sp.	Sandstone Quarry
<i>Trialeurodes</i>	sp. nr <i>notata</i>	<i>Ribes</i>	Mahogany grove
<i>Trialeurodes</i>	sp.	<i>Quercus</i> sp.	Sandstone Quarry

The plant species associated with whiteflies in the Mohave Desert and in the temperate areas of Mount Charleston include beard tongue, manzanita, trailing currant, ceanothus, yerba santa, euphorbia, kumquat, single leaf ash, velvet ash, fuchsia, cotton, creosote, alfalfa, mulberry, pomegranate, oak, and currants. A large degree of

hybridization occurs in both the oak and Manzanita populations making it difficult to determine the identity of the oak and manzanita species that serve as whitefly hosts.

## **Materials and Methods**

In this study, collections of whitefly puparia (stage 4) were made around the Las Vegas, Nevada area during the spring, summer and winter months from 2003 to 2008. John Dooley collected whiteflies in the following geographical locations within Red Rock Canyon NCA: Sandstone Quarry (Figure 3), Lost Creek Canyon, Pine Creek Canyon, and Willow Springs.

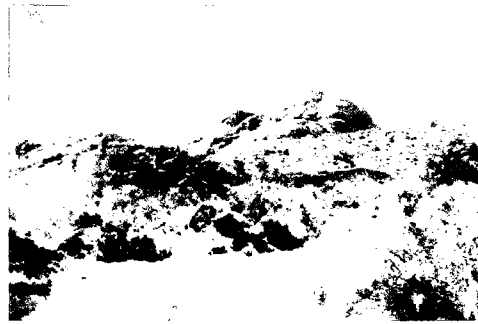


Figure. 3 Sandstone Quarry

Whenever possible, the geographical coordinate locations (Table 4) were recorded using a GPS Magellan Sportrak Pro.



Table 4: GPS Coordinates of Species Collected

North	West	Genus	Species	Author	Host plant
35°58.524N	115°22.308W	<i>Tetraleurodes</i>	<i>mori</i>	Quaintance	<i>Pemstemon</i> sp.
35°58.528N	115°22.307W	<i>Aleuropleurocelus</i>	<i>ceanothi</i>	Sampson	<i>Eriodictyon</i> sp.
35°59.245N	115°31.637W	<i>Aleuropleurocelus</i>	<i>ceanothi</i>	Sampson	<i>Ceanothus?</i>
36°00.707N	115°25'.777W	<i>Aleuroglandulus</i>	<i>subtilis</i>	(Bondar)	<i>Berberis repens</i>
36°07.462N	115°28.853W	<i>Aleuropleurocelus</i>	sp.		<i>Quercus</i> sp.
36°07.514N	115°28.738W	<i>Aleuropleurocelus</i>	<i>ceanothi</i>	Sampson	<i>Eriodictyon</i> sp.
36°07.514N	115°28.738W	<i>Aleuropleurocelus</i>	<i>ceanothi</i>	Sampson	<i>Quercus</i> sp.
36°07.514N	115°28.738W	<i>Aleuropleurocelus</i>	<i>nigrans</i>	Sampson	<i>Quercus</i> sp.
36°07.577N	115°28.474W	<i>Aleuroplatus</i>	<i>gelatinosus</i>	(Cockerell)	<i>Quercus</i> sp.
36°07.577N	115°28.474W	<i>Aleuropleurocelus</i>	sp.		<i>Quercus</i> sp.
36°07.577N	115°28.474W	<i>Tetraleurodes</i>	<i>quercicola</i>	Nakahara	<i>Quercus</i> sp.
36°07.577N	115°28.474W	<i>Tetraleurodes</i>	sp.		<i>Quercus</i> sp.
36°07.698N	115°28.439W	<i>Aleuropleurocelus</i>	<i>acaudatus ?</i>	Sampson	<i>Larrea</i> sp.
36°08.879N	115°29.187W	<i>Aleuroplatus</i>	<i>gelatinosus</i>	(Cockerell)	<i>Quercus</i> sp.
36°09.715N	115°26.998W	<i>Aleuroplatus</i>	<i>gelatinosus</i>	(Cockerell)	<i>Quercus</i> sp.
36°09.715N	115°26.998W	<i>Aleuropleurocelus</i>	<i>ceanothi</i>	Sampson	<i>Larrea</i> sp.
36°09.715N	115°26.998W	<i>Aleuropleurocelus</i>	sp.		<i>Quercus</i> sp.
36°09.715N	115°26.998W	<i>Tetraleurodes</i>	sp.		<i>Quercus</i> sp.
36°09.715N	115°26.998W	<i>Trialeurodes</i>	sp.		<i>Quercus</i> sp.
36°09.781N	115°26.011W	<i>Aleuroplatus</i>	<i>gelatinosus</i>	(Cockerell)	<i>Quercus</i> sp.
36°09.781N	115°26.011W	<i>Aleuropleurocelus</i>	<i>ceanothi</i>	Sampson	<i>Eriodictyon</i> sp.
36°09.781N	115°26.011W	<i>Aleuropleurocelus</i>	<i>nigrans</i>	Sampson	<i>Arctostaphylos</i>
36°09.781N	115°26.011W	<i>Aleuropleurocelus</i>	sp.		<i>Arctostaphylos</i>
36°09.781N	115°26.011W	<i>Aleuropleurocelus</i>	sp.		<i>Quercus</i> sp.
36°09.781N	115°26.011W	<i>Trialeurodes</i>	<i>corollis</i>	(Penny)	<i>Arctostaphylos</i>
36°09.781N	115°26.011W	<i>Trialeurodes</i>	<i>glacialis</i>	(Bemis)	<i>Quercus</i> sp.
36°09.787N	115°27.012W	<i>Aleuroplatus</i>	<i>gelatinosus</i>	(Cockerell)	<i>Quercus</i> sp.
36°09.795N	115°27.006W	<i>Trialeurodes</i>	sp.		<i>Quercus</i> sp.
36°09.816N	115°27.027W	<i>Aleuroplatus</i>	<i>gelatinosus</i>	(Cockerell)	<i>Eriodictyon</i> sp.
36°09.816N	115°27.027W	<i>Aleuropleurocelus</i>	<i>ceanothi</i>	Sampson	<i>Eriodictyon</i> sp.
36°09.829N	115°27.049W	<i>Aleuroplatus</i>	<i>gelatinosus</i>	(Cockerell)	<i>Quercus</i> sp.
36°09.829N	115°27.049W	<i>Aleuropleurocelus</i>	sp.		<i>Quercus</i> sp.
36°09.829N	115°27.049W	<i>Tetraleurodes</i>	sp.		<i>Quercus</i> sp.
36°09.829N	115°27.049W	<i>Trialeurodes</i>	sp.		<i>Quercus</i> sp.
36°18.722N	115°37.098W	<i>Trialeurodes</i>	sp	nr notata	<i>Ribes</i>

Nevada State Department of Agriculture Entomologist, Dr. Jeff Knight, Botanists Dr. Susan Lambrecht (SJSU) and Mr. Tim Torbett (PPQ, San Francisco), and John Dooley (PPQ, San Francisco) identified the plants.

The puparia were dried and pressed in preparation for mounting on slides. Dr. Jessie Newhouse (PPQ) conducted various experiments to determine the best mounting method to be used to prepare slides from available methods devised by Gill (personal communication, 2008), and Martin (1999, 124-125). The preparation method utilized the following chemicals: 5% potassium hydroxide (KOH), water, ammonia & hydrogen peroxide solution (for those specimens requiring bleaching), 70% and 90 % ethanol, clove oil, and balsam or euparal mounting medium. The puparia were placed into microcentrifuge tubes containing KOH and heated by floating the tubes in a bubbling hot water bath for 15 minutes (modified technique by Newhouse). The puparia were removed from the water bath. If too opaque, they were placed in a solution of ammonia and hydrogen peroxide (8 drops of ammonia in a small crucible filled with peroxide) and slowly heated and monitored for 10 to 15 minutes. The specimens were then washed in water to remove excess ammonia and peroxide. Pale specimens such as *Aleuroglandulus*, *Aleyrodes*, and some *Trialeurodes*, were soaked in essigs aphid fluid with the addition of two drops of double stain for 10-15 minutes. The stain was not added for dark colored pupa (*Aleuoparadoxus*, *Aleuoplatus*, *Aleuopleurocelis*, *Tetraeurodes* and some *Trialeurodes*). Stained or dark specimens were placed in 70% alcohol for 15 minutes and then transferred into 90% alcohol for 15 minutes. Specimens were transferred into clove oil to dehydrate for 15 minutes, then slide mounted in Canadian balsam or euparal and

deposited in the reference collections in San Francisco, Ca (PPQ) and Beltsville, Md (ARS, Systematic Entomology Laboratory).

## **Whitefly Morphology and Terminology**

The family Aleyrodidae (Hemiptera, Sternorrhyncha) is comprised of the Aleurodicinae and Aleyrodinae subfamilies. Only the Aleyrodinae is known to occur in Nevada. It is important to separate the two subfamilies should the Aleurodicine become established. Both families can be separated easily in both the adult and pupal stages. The 4<sup>th</sup> stage (puparium) is the most commonly used to identify species because the puparium has many more diagnostic structures than the adult and prepupal immature stages. The adults can be identified to subfamily easily by the wing venation, the number of antennal segments, and the number of ventral abdominal wax plates in the females and males. Adult males and females of all the Aleurodicinae have the R-1 vein of the fore wing forked (except the genus *Paraleyrodes*). The genus *Paraleyrodes* (Aleurodicinae) and the Aleyrodinae have the R-1 vein of the fore wing simple (not forked). The following abbreviations are used: A<sub>1</sub>-A<sub>8</sub> (abdominal segments 1 through 8), C<sub>1</sub> (cephalon) T<sub>1</sub> (prothorax = thoracic segment 1), T<sub>2</sub> (mesothorax = thoracic segment 2), T<sub>3</sub> (metathorax = thoracic segment 3).

### **Pupal Key to Separating the Subfamilies (Aleyrodidae):**

- A Lingula, operculum and vasiform orifice present; leg with single terminal claw or adhesive pad usually oriented toward the median (puparia) or toward the margin (prepupal immature stages) ..... B
- A' Puparium lacking lingula, operculum and vasiform orifice; legs otherwise ..... not Aleyrodidae

- B Terminal claw present ..... Aleurodicinae (not in Nevada)  
 B' Adhesive pad present ..... Aleyrodinae

Pupal Key to the Genera of the Aleyrodinae in Nevada

1. Puparium clear to yellowish in color ..... 2  
 1' Puparium dark brown to black ..... 6
- 2 Puparium with large pair of glands on the dorsum of the metathorax; thoracic and caudal clefts dentate ..... *Aleuroglandulus* Bondar  
 2' Large prothoracic glands absent; tracheal clefts not dentate ..... 3
- 3 Dorsum with elongate dorsal siphon tubes ..... *Siphoninus* Silvestri  
 3' Dorsum without elongate siphon tubes ..... 4
- 4 Submarginal row of papillae present, lingula usually visible and trilobed .....  
 ..... *Trialeurodes* Cockerell  
 4' Submarginal row of papillae absent; if present, papillae does not occur in rows ... 5
- 5 Cranial suture present; caudal and thoracic tracheal clefts and furrows present; lingula reduced or mostly obscured by operculum ..... *Dialeurodes* Cockerell  
 5' Cranial suture absent; Clefts rudimentary or absent; lingula lance-shaped and exposed ..... *Bemisia* Quaintance & Baker
- 6 Dorsal row of flat, elongate papillae present in the submargin and median areas; reniform papillae present ..... *Aleuoparadoxus* Russell  
 6' Dorsal elongate and reniform papillae absent; if present, then cone, bullet, or rod shaped ..... 7
- 7 Papillae present in submarginal rows, with or without dorsal clusters of papillae; lingula tri-lobed ..... *Trialeurodes* Cockerell  
 7' Papillae absent; lingula if visible not tri-lobed ..... 8
- 8 Lateral margin deflexed, body boat-shaped or oval; most species with protuberance at the posterior apex of puparium ..... *Aleuropleurocelus*  
 8' Lateral margin not deflexed: not boat-shaped ..... 9
- 9 Subdorsal fold and submarginal transverse bands present . *Tetraeurodes* Cockerell  
 9' Subdorsal fold and transverse bands absent ..... *Aleuoplatus* Quaintance & Baker

## GENUS *Aleuroglandulus* Bondar

*Aleuroglandulus* Bondar 1923: 121.

DIAGNOSIS (Bondar 1923, 121; Russell 1944, 5; Martin 2005, 67). PUPARIUM:

*Habitus* (in nature). Ovoid to elliptical in shape; bright yellow to pale cuticle; flat to slightly convex dorsally; ventral surface with a thin waxy layer with thickened edges.

*Margin*. Smooth except with dentate tracheal thoracic and caudal clefts that are comprised of a comb of teeth. *Dorsum*. Subdorsal fold absent; thoracic & caudal tracheal folds evident. Dorsum with at least one pair of large round glands, longitudinal molting suture terminates at margin; transverse molting suture slightly caudad from its midpoint, its ends slightly recurved and terminating in subdorsal area just anterior to the thoracic abdominal suture. Segmental sutures terminated at the subdorsum; first and second abdominal sutures curved cephalad toward the apex; 3rd and 4th abdominal sutures almost straight; fifth and sixth curved caudad from submedian area. *Vasiform orifice*. Subcordate, lateral side of orifice vertically ridged and posteriorly rugose. Operculum occupying about two-thirds of orifice, nearly as long as wide, its posterior margin curved; its dorsal surface somewhat sculptured. Lingula inserted (contained within the vasiform orifice), spinulose, elongate, with 2 or 3 pairs of lateral lobes and an unpaired terminal one. *Venter*. Antennae terminate at the T<sub>1</sub> position with the apical end narrowed and fingerlike; leg stout with or without spine. *Chaetotaxy*. Anterior and posterior marginal setae present; 7 minute cephalothoracic and 8 abdominal setal pairs present on margin. A pair of submedian setae present on cephalic, first and eighth abdominal segments; a median or submedian caudal pair present at the body margin.

COMMENTS: This genus is comprised of four species, with only *Aleuroglandulus subtilis* Bondar known to occur in Nevada. Martin (2005, 15) synonymized *A. emmae* with *A. subtilis*. Descriptions were taken from Russell (1944, 5) or observed on slide and field specimens.

***Aleuroglandulus subtilis* Bondar**

*Aleuroglandulus subtilis* Bondar 1923: 121-122

*Aleuroglandulus emmae* Russell 1944: 5 (synonymized by Martin 2005, 15)

*Aleuroglandulus malangae* Russell 1944: 5 (synonymized by Martin 2005, 15)

DISTRIBUTION (Bondar 1923, 122; Russell 1944, 1; Martin 2005, 67). Nearctic Region: USA (FL, NV, TX, UT). Bahamas, Brazil, Colombia, Costa Rica, Cuba, Domenica, El Salvador, Guatemala, Guadeloupe, Haiti, Honduras, Jamaica, Mexico, Panama, Peru, Puerto Rico, Venezuela.

Location in Southern Nevada-Spring Mountain

36°00.707N by 115°25.777W.

DIAGNOSIS (Bondar 1923, 122; Russell 1944, 1; Martin 2005, 67). PUPARIUM (Figure 4): *Habitus* (in nature). Often found in scattered to dense populations on the underside of leaf. Pupa light clear to yellow in color, oval; well developed prothoracic glands visible with hand lens. The large pairs of glands secrete strands of pale to yellowish wax bundles that form above the puparium. Posterior end of body is truncate.

Slide & Image by PPQ,  
San Francisco (J.Dooley)



Mexico  
Brosimon alicastrum  
22-vii-2003  
Coll: G. Gracia  
Det. J.Dooley  
Los Indios 041110 Tx



Figure 4. *Aleuroglandulus subtilis* Bondar

*Margin.* Prothorax with tracheal pore area dentate with teeth from large and strongly acute to short and rounded; 7-15 teeth at each thoracic pore, 12-29 teeth at caudal tracheal pore. *Dorsum* with a well-defined pair of large prothoracic glands: 120-160  $\mu\text{m}$  long and 100-140  $\mu\text{m}$  wide extending from cephalothoracic to mesothoracic suture with axes parallel to axis of body. Smaller pair of subcircular glands absent or, if present, only on  $A_3$ : 50-70  $\mu\text{m}$  long and 50-80  $\mu\text{m}$  wide on abdominal segment 3, their axes diagonal to, and their posterior ends directed towards the median line of body. Distal part of pro-mesothoracic suture curved around gland. *Vasiform orifice.* Cordate, rather narrow posteriorly, 65-80  $\mu\text{m}$  long and 56-66  $\mu\text{m}$  wide, its posterior end about the length of the orifice from the posterior margin of the puparium; a well-defined, anterior end of orifice bordered by a flat rim 12  $\mu\text{m}$  long across; posterior end of orifice with notch and a tooth opposite the notch. Operculum 36-48  $\mu\text{m}$  long and 40"-52  $\mu\text{m}$  wide. Lingula is 44-60  $\mu\text{m}$  long and 24-32  $\mu\text{m}$  wide, with 3 pairs of lateral lobes, its long subapical setae 36-40  $\mu\text{m}$ . *Venter.* Each leg with a stout basal spine 12-16  $\mu\text{m}$  long on inner basal area of each leg and one about 6  $\mu\text{m}$  sometimes present on middle legs. *Pores.* Pairs of disk pores

and associated porettes arranged as follows: one submedian pair of pores each on cephalic, mesothoracic, and third and fourth abdominal segments; one subdorsal pair of pores each on thoracic segment and on each of abdominal segments 5-7. *Chaetotaxy*. Anterior and posterior marginal, cephalic, and A<sub>1</sub> setae pairs present, each about 12 µm long; A<sub>8</sub> setal pair present about 16 µm each, caudal setal pair present about 40-80 µm; bases of dorsal setae slightly tuberculate.

HOSTS. (Bondar 1923,122; Russell 1944, 1). Araceae: *Alocasia* sp., *Caladium bicolor*, *Caladium x hortulanum*, *Caladium* sp., *Colocasia antiquorum*, *C. esculenta*, *Xanthosoma* sp., *X. sagittifolium*, *X. undipes*; Arecaceae: *Chamaedorea wendlandiana*, *Synechanthus warscewizianus*; Berberidaceae: *Berberis repens* (Nevada); Euphorbiaceae: *Euphorbia heterophylla*, *Jatropha* sp.; Fabaceae: *Clitoria laurifolia*, *Galactia acapulcensis*; Lauraceae: *Persea americana*, *P. borbonia*; Myrtaceae: *Psidium guajava*; Rhamnaceae: *Gouania lupuloides*; Rubiaceae: *Chomelia oligantha*, *Gardenia* sp..

MATERIAL EXAMINED (5 puparia). Spring Mountain, Nevada at 36°00.707 N by 115°25.777W on *Berberis repens*, 6-viii-2002.

COMMENTS: This species was collected only on *Berberis* in the Mount Charleston area (temperate) of Nevada. This species is easily separated from others with the presence of differentiated submedian pair of large glands on the prothoracic and abdominal III; vasiform orifice inset from the posterior margin equal to or less than its own length.



GENUS *Aleuoparadoxus* Quaintance and Baker

*Aleuoparadoxus* Quaintance & Baker. 1914: 105.

DIAGNOSIS (Quaintance & Baker 1914, 105; Russell 1947, 4-5). PUPARIUM (Figure 5): *Habitus* (in nature). Black, subcircular to elliptical with ventral surface nearly flat. *Margin*. Dentate with a submarginal row of flat papillae. *Dorsum*. Flat and reniform (kidney-shaped) papillae (Figure 5) distributed throughout the body.

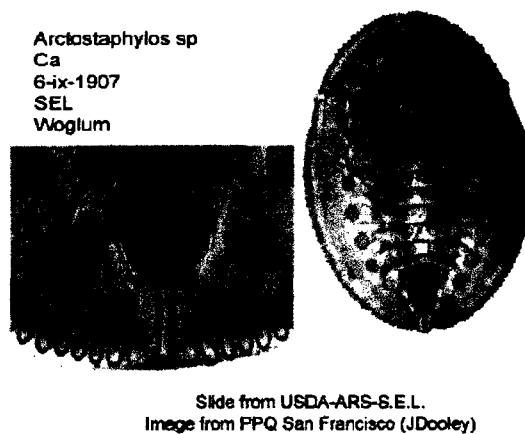


Figure 5. *Aleuoparadoxus* Quaintance & Baker

Tracheal folds well-developed. *Vasiform orifice*. Somewhat cordate, with the rim prominent and its sides vertically ridged. Operculum similar in shape to, and almost or completely filling the orifice; lingula elongate, usually with 3 pairs of lateral lobes and an unpaired terminal one; with a pair of small setae at base of posterior lateral lobes, and an elongate pair arising ventrally at base of terminal lobe. Pairs of submedian depressions arranged as follows: one or two mesocephalad and 2 mesad of setae on cephalic segment, one in or adjoining posteriorly each cephalothoracic suture and one well separated from the suture on each segment of thorax, one in or posterior to thoracic-abdominal and on each abdominal suture. *Pores*. The dorsum with pores and porettes; submarginal

porettes present next to or at the inner ends of papillae; disk pores nearly contiguous to, and much larger than porettes. *Chaetotaxy*. One pair of anterior and posterior marginal setae present; 7 pairs of submarginal setae on cephalothorax and 8 pairs of submarginal setae on abdomen. Submarginal setae present with seven cephalothoracic pairs and eight abdominal pairs. Descriptions taken from Russell (1947) or observed on slide and field specimens. See Quaintance & Baker 1914 and Martin 2005 for further taxonomic information.

COMMENTS: this genus is only known to occur in the Americas; only one species is known to occur in Nevada.

***Aleuoparadoxus arctostaphyli* Russell**

*Aleuoparadoxus arctostaphyli* Russel 1944: 15-18

DISTRIBUTION (Russell 1947, 16). Nearctic Region: USA (CA, NV).

Location in Southern Nevada-

Red Rock Canyon NCA

Sandstone Quarry (GPS coordinates unknown).

DIAGNOSIS (Russell 1947, 15-16). PUPARIUM: *Habitus* (in nature). Light dark brown to black in color; elliptical to subcircular in shape; with waxy glassy rods extending from submarginal and dorsal papillae. *Margin*. Thoracic tracheal pore area indicated by 2-4 marginal, widened teeth and submarginal ridges; abdominal tracheal

pore area less distinct. *Dorsum*. Submarginal papillae 32-56  $\mu\text{m}$  (usually 40-50  $\mu\text{m}$ ) long and 16-18  $\mu\text{m}$  wide, not contiguous, the majority separated from each other by a distance of about 1/5 the width of a papilla apart. Tracheal folds present terminating at the dentate margin; submarginal row of noncontiguous flat elongate papillae present with 2 to 3 pairs of cephalic subdorsal modified papillae and 0 to one central subdorsal pair on prothorax; each papillae ranged from 20 to 64  $\mu\text{m}$ . Four pairs of scattered reniform papillae present on the cephalon. *Vasiform orifice*. Rather broad posteriorly, 68-88  $\mu\text{m}$  long and 60-80  $\mu\text{m}$  wide. Operculum 64-80  $\mu\text{m}$  m long and 56-72  $\mu\text{m}$  wide. *Venter*. Antennae terminate at the T<sub>1</sub> position, abruptly tapered, short fingerlike at apex. Each anterior leg with 1-3 poorly to well developed, blunt spines present along the anterior margin of the coxa just mesad of the rugose band; middle and posterior legs each with a seta apparently about 20  $\mu\text{m}$  long located in the rugose band. *Pores*. Thoracic tracheal pore absent. *Chaetotaxy*. Cephalic, A<sub>1</sub> and A<sub>8</sub> abdominal setae, each 24-32  $\mu\text{m}$  long; caudal setae 10-30  $\mu\text{m}$ . Ventral abdominal setae 35-40  $\mu\text{m}$  long.

HOSTS (Russell 1947, 16). Ericaceae: *Arbutus menziesii*, *Arctostaphylos* sp., *A. manzanita*, *A. tomentosa*, *A. virgata*, *A. viscida*; \*Rhamnaceae: *Ceanothus* sp.

MATERIAL EXAMINED. Two puparia collected by John Dooley at Red Rock Canyon NCA, NV (Sandstone Quarry) on *Ceanothus* sp. on 12-ix-2003.

COMMENTS. New state record for Nevada and the only species in this genus found in Nevada. Found on *Ceanothus* sp. on 12-ix-2003. Validated by Dr. Greg Evans at SEL.

GENUS *Aleuroplatus* Quaintance and Baker

*Aleuroplatus* Quaintance and Baker. 1914: 98

DIAGNOSIS (Quaintance and Baker 1914, 98). PUPARIUM: *Habitus* (in nature).

Black or brownish, sometimes pale; shape elliptical, oval, or subcircular. *Margin*.

Dentate, or if crenulate then modified as teeth or comb at the caudal & thoracic tracheal

margins; thoracic and caudal tracheal folds present. *Dorsum*. Subdorsal suture and

papillae absent; transverse molting suture terminating at the margin. *Vasiform orifice*.

Elevated, subcircular to subcordate with an operculum covering most of orifice obscuring

the lingula. *Venter*. Often heavily stippled. *Pores*. No prominent pores observed.

*Chaetotaxy*. A<sub>1</sub> setal absent. Cephalothoracic and abdominal setae variable.

COMMENTS. Two species are established in Nevada but only *A. gelatinosus* was collected and observed. Descriptions taken from observing slide and field specimens.

Pupal key to the *Aleuroplatus* in Nevada:

- 1 Transverse suture curving straight up at submargin; vasiform orifice lacking a posterior tooth; cephalic setae with widened base ..... *Aleuroplatus berbericolus* (Quaintance & Baker)
- 1' Transverse suture not as above; vasiform orifice with a posterior tooth, directed inward; cephalic setae with normal base ..... *Aleuroplatus gelatinosus* (Cockerell)

***Aleuroplatus berbericolus* Quaintance & Baker**

*Aleuroplatus berbericolus* Quaintance & Baker. 1917: 383-384

DISTRIBUTION (Quaintance and Baker 1917, 384). Nearctic Region: Canada, Mexico, USA (AZ, CA, CO, NM, NV, OR, UT, WA, TX).

Location in Nevada Counties: Churchill, Washoe, Douglas, Clark.

DIAGNOSIS (Quaintance and Baker 1917, 383-384). PUPARIUM: *Habitus* (in nature). From 880  $\mu\text{m}$  in length to 656  $\mu\text{m}$  in width; chestnut brown in color; oval to elliptical in shape. *Margin*. Dentate with truncate teeth; thoracic tracheal comb composed of three or four rather prominent tooth with serrate margins; caudal comb similar to tracheal comb; tracheal area differentiated from rest of the margin. *Dorsum*. Transverse molting suture not curved-up abruptly at submargin. *Vasiform orifice*. Margin thickened lacking posterior inward projecting tooth; operculum subtriangular in shape, broad and rounded at the apex filling 50% of the orifice. *Venter*. Variably ornamented to smooth. *Pores*. Submarginal pores in multiple rows; subdorsum with irregularly scattered minute pore-like structures. *Chaetotaxy*. Cephalic setae not widened at base;  $A_8$  setae slender and shorter than vasiform orifice.

HOSTS (Quaintance and Baker 1917). Aquifoliaceae: *Ilex* sp.; Berberidaceae: *Berberis repens*, *Berberis (Mahonia) aquifolium*.

COMMENTS. No Nevada specimen found and therefore not examined.

***Aleuroplatus gelatinosus* (Cockerell)**

*Aleuroplatus gelatinosus* (Cockerell). 1898: 264

DISTRIBUTION (Cockerell 1898, 264; Quaintance & Baker 1917, 98). Nearctic Region: Mexico, USA (AZ, CA, GA, NM, NV, TX, UT, WA); Neotropical: Cuba.

Locations in Southern Nevada (Red Rock Canyon NCA):

Pine Creek Canyon

36°07'577N by 115°28'474W (elev.3935 ft.)

36°08'879N by 115°29'187W (elev.4286 ft.)

Sandstone Quarry

36°09.715N by 115°27.998W

36°09.781N by 115°27.011W

36°09.787N by 115°37.012W

36°09.802N by 115°27.013W

36°09.816N by 115°27.027W

36°09.829N by 115°27.049W

DIAGNOSIS (Cockerell 1898, 264; Quaintance & Baker 1917, 98). PUPARIUM

(Figure 6): *Habitus* (in nature). Black in color; sometimes in clusters to solitary, oval to subcircular with heavy to light waxy concentrations dorsally and well beyond margin.

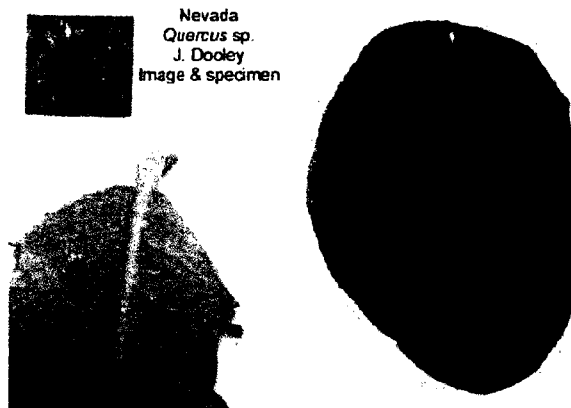


Figure 6. *Aleuroplatus gelatinosus* Cockerell

*Margin.* Tracheal area differentiated from rest of margin with obvious fold and tracheal cleft bidentate. *Dorsum.* Transverse molting suture curving up at submargin. *Vasiform orifice.* Lacks posterior inward projecting tooth; subcircular in outline with the margin thickened. The operculum covers half the orifice obscuring the lingula. *Venter.* Legs unarmed (without spines) but with setae. *Pores.* Submarginal pores in multiple rows; dorsal pores scattered over the dorsal and submedial regions. *Chaetotaxy.* C1 setae present with widened base; A<sub>1</sub> setae absent; A<sub>8</sub> setae present and longer than vasiform orifice.

HOSTS (Cockerell 1898, 264; Bemis 1904, 504; Penny 1922, 22; Quaintance & Baker 1917, 98). Fagaceae: *Quercus agrifolia*, *Q. arizonica*, *Quercus* sp.; Rhamnaceae: *Rhamnus californica*; Rubiaceae: *Casasia calophyla*.

MATERIAL EXAMINED (52 puparia) at Rock Canyon NCA, NV. Pine Creek Canyon: 36°07.577N by 115°28.474W (elev. 3935') on *Quercus* sp. 23-xii-2007: 3 puparia; 36°08.879N by 115°29.187W (elev. 4286') on *Quercus* sp., 23-xii-2007: 3 puparia. Sandstone Quarry: 36°09.816N by 115°27.027W) on *Eriodictyon* sp. 24-viii-2008: one puparium; on *Quercus* sp. 07-iii-2006: 7 puparia; 36°09.787N by 115°27.012W on *Quercus* sp. 24-viii-2008: 20 puparia; 36°09.829N by 115°27.049W) on *Quercus* sp. 24-viii-2008: 6 puparia; 36°09.715N by 115°26.998W on *Quercus* sp. 27-iii-2008: 4 puparia; 36°09.781N by 115°26.011W on *Quercus* sp. 27-iii-2008: 6 puparia; on *Quercus* sp. 27-iii-2008: one puparium; 36°09.802N by 115°27.013W) on *Quercus* sp. 19-vii-2008: 1 puparium.

COMMENTS: New state record (03-vii-2006) for Nevada and validated by Dr. Greg Evans (PPQ) at the Systematic Entomology Lab (Beltsville, Md). Most common and abundant whitefly found on *Quercus* in all locations that were sampled. The wax is unusually prolific causing the black puparia to appear steeped in the wax. Description taken from specimen observations and from Quaintance & Baker (1917, 98).

## GENUS *Aleuropleurocelus* Drews and Sampson

*Aleuropleurocelus* Drews and Sampson 1956: 282

DIAGNOSIS (Drews and Sampson 1956, 282). PUPARIUM: *Habitus* (in nature).

Black; pupal case rotund to elongate shape boat-like with or without waxy deposits.



*Margin.* Apparent margin (outermost, visible) slightly irregular but not dentate; true margin dentate and always deflexed dorsally. *Dorsum.* Puparia usually covered with granules or imbrications; posterior protuberance present, reduced or absent. Transverse molting suture terminates at the apparent margin or well before the true margin, depending on the species; longitudinal molting suture terminates at anterior margin. *Vasiform orifice.* Surrounded by a narrow or broad ring with inner margin of vasiform orifice smooth or dentate; lingula usually obscured by subcordate operculum. *Venter.* Median abdominal depressions present or absent. Antennae terminate at the T<sub>1</sub> pair of legs. *Pores.* Pores and porettes absent or present; disc pores from solitary and randomly dispersed to forming clusters dorsally on the cephalothorax and the abdomen. *Chaetotaxy.* Cephalic, A<sub>8</sub>, and apical pair of caudal setae present. A<sub>1</sub> setae absent.

COMMENTS. In Nevada this genus appears to be limited to plants of the arid or semi-arid areas of the chaparral community, such as *Eriodictyon* (Yerba Santa) in Nevada. Of twelve described species, two described (and possibly three undescribed) species occur in Nevada. Drews and Sampson (1956, 281) distinguished *Aleuropleurocelus* from *Tetralicia*. This difference may prove to be insufficient to justify maintaining this as a separate genus. Martin (2005, 19-20) proposed that *Aleuropleurocelus* be considered New world species while *Tetralicia* be considered Old World species.

Pupal key to the *Aleuropleurocelus* in Nevada

- 1 Puparium boat shaped with a relatively wide deflexed margin; caudal protuberance developed ..... 3
- 1' Puparium oval shape with slight or narrow deflexed margin; caudal protuberance absent ..... 2
  
- 1 Eyespot linear, slit-like ..... *Aleuropleurocelus* #1 or #3
- 2' Eyespot oval ..... *Aleuropleurocelus* sp. #2
  
- 3 Transverse suture reaching margin; median abdominal depressions not strongly sclerotized ..... *Aleuropleurocelus ceanothi* (Sampson)
- 3' Transverse suture not reaching margin; median abdominal depressions strongly sclerotized ..... *Aleuropleurocelus nigrans* (Bemis)

***Aleuropleurocelus ceanothi* (Sampson)**

*Aleuropleurocelus ceanothi* (Sampson). 1945: 59-60

DISTRIBUTION (Sampson 1945, 60). Nearctic Region: USA (CA, NV).

Location in Southern Nevada:

Boy Scout Area: 35°59.245N by 115°31.637W

Lee Canyon: 35°58.528N by 115°22.307W

Red Rock Canyon NCA :

Pine Creek Canyon: 36°07.462N by 115°28.853W

36°07.514N by 115°28.738W (elev. 3971')

36°07.577N by 115°28.474W

Sandstone Quarry: 36°09.438N by 115°37.649W; 36°09.748N by

115°27.010W, 36°09.795N by 115°37.098W, 36°09.816N by 115°27.027W,

36°09.715N by 115°26.998W, 36°09'781N by 115°26.011W.

Willow Springs: 36°09'400N by 115°37.748W (elev. 4467')

DIAGNOSIS (Sampson 1945, 59-60). PUPARIUM (Figure 7): *Habitus* (in nature).

Black in color; boat shaped (elliptical).

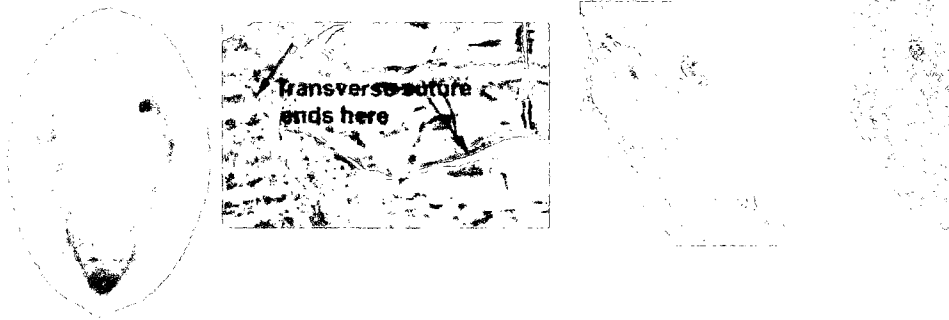


Figure 7. *Aleuropleurocelus ceanothi* Sampson

*Margin.* convex; outer lateral margin deflexed with imbricated marginal band; true margin is dentate and a slightly thin wax layer. *Dorsum.* The transverse molting suture reaches the third thoracic suture; median abdominal depressions weakly or not prominently sclerotized. *Vasiform orifice.* Raised and surrounded by a sclerotized ring; lingula concealed by cordate shaped operculum; posterior protuberance present. *Pores.* Absent. *Chaetotaxy;* anterior and posterior setae, cephalic, and A<sub>8</sub> setae present.

HOSTS (Sampson 1945, 60). Rhamnaceae: *Ceanothus cuneatus*; Boraginaceae:

*Eriodictyon* sp.; Fagaceae: *Quercus* sp.

MATERIAL EXAMINED (75 puparia). “Boy Scout Area”, NV 35°59.254N by 115°31.637W on *Ceanothus?* sp., 23-viii-06: 3 puparia. Lee Canyon, NV 35°58.528N by 115°22.307W *Eriodictyon* sp., 23-viii-06: 4 puparia. Red Rock Canyon NCA, NV: Pine Creek Canyon at 36°07.514N by 115°28.738W ( elev.3971’ ) on *Eriodictyon* sp., 23-xii-

2007: 5 puparia; 36°07.514N by 115°28.738W (elev.3971') on *Quercus* sp., 23-xii-2007: 2 puparia. Sandstone Quarry on *Arctostaphylos* sp., 28-iii-2008: 2 puparia and 19-viii-2008: 3 puparia; Sandstone Quarry on *Arctostaphylos* sp., 19-viii-2008: 2 puparia; at 36°09.802N by 115°27.9013W and 36°09.709N by 115°26.982W on *Arctostaphylos* sp., 19-viii-2008: 2 puparia; at 36°09.709N by 115°26.782W on *Eriodictyon* sp. 19-viii-2008: 1 puparium; at 36°09.788N by 115°27.010W on *Eriodictyon* sp. 19-viii-2008: 7 puparia; at 36°09.709N by 115°26.782W on *Eriodictyon* sp. 19-viii-2008: 2 puparia; at 36°09.802N by 115°27.013W on *Eriodictyon* sp. 19-viii-2008: 6 puparia; on *Eriodictyon* sp. 03-vii-2006: 13 puparia, 28-iii-2008: 3 puparia, 19-8-2008: 3 puparia; 36°09.816N by 115°27.027W, 24-viii-2006: 3 puparia, 28-iii-2008: 7 puparia; at 36°09.715N by 115°26.998W on *Larrea* sp., 28-iii-2008: 6 puparia and 19—viii-2008: 1 puparium; on *Quercus* sp., 03-vii-2006: 4 puparia. Willow Springs) on *Eriodictyon* sp. 22-vi-2007: 3 puparia.

COMMENTS: New state record collected by John Dooley (2005) for Nevada. Validated by Dr. Greg Evans at SEL.

### ***Aleuropleurocelus nigrans* (Sampson)**

*Aleuropleurocelus nigrans* (Bemis) 1904

DISTRIBUTION (Bemis 1904, 524) Sampson 1945, 60).

Nearctic Region: Mexico, USA (AZ, CA, NV).

Locations in Southern Nevada at Red Rock Canyon NCA:

Lost Creek Canyon

Pine Creek Canyon

36°07.514N by 115°28.738W (elev. 3971').

Sandstone Quarry

36°09'438N by 115°29.649W

36°09'781N by 115°26.011W.

DIAGNOSIS (Bemis 1904, 522-524; Sampson 1945, 59-60). PUPARIUM (Figure 8):

*Habitus* (in nature). Black in color. boat shaped (elliptical);

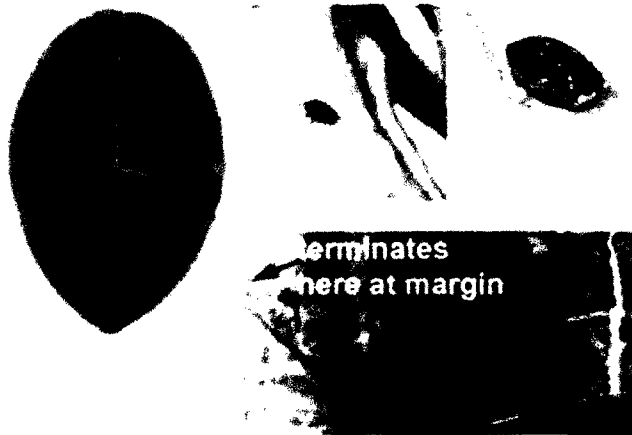


Figure 8. *Aleuroleurocelus nigrans* (Sampson)

*Margin.* Lateral margin convex; outer margin deflexed with imbricated marginal band; true margin is dentate and slight thin wax layer. *Dorsum.* Transverse molting suture terminates before the third thoracic suture; median abdominal depressions strongly sclerotized. *Vasiform orifice.* Raised and surrounded by a sclerotized ring; lingula concealed by cordate shaped operculum; posterior protuberance present. *Pores.* Each abdominal segment (except A<sub>2</sub>) with one or two pairs of porettes near the sclerotized

median depressions. *Chaetotaxy*. Anterior and posterior setae present; cephalic and A<sub>8</sub> setae present.

HOSTS (Sampson 1945, 60). Caprifoliaceae: *Lonicera involucrate*, *Symphoricarpus racemosus*; Ericaceae: *Arbutus enziesii*, *Arctostaphylos* sp., Fagaceae: *Quercus densiflora*, *Quercus* sp.; Hydrophyllaceae: *Eriodyction* sp., Lamiaceae: *Salvia opiana*; Lauraceae: *Umbellularia californica*; Ranunculaceae: *Clematis ligusticifolia*; Rhamnaceae: *Ceanothus californicus*, *Ceanothus cuneatus*, *Ceanothus* sp., *Rhamnus californicus*; Rosaceae: *Heteromeles arbutifolia*, *Prunus ilicifolia* Rhamnaceae: *Ceanothus cuneatus*. Host plants in Southern Nevada- Rhamnaceae: *Ceanothus* sp.

MATERIAL EXAMINED (15 puparia). Red Rock Canyon NCA, NV. Lost Creek Canyon on indeterminate host 19-viii-2008: 1 puparium; Pine Creek Canyon at 36°07.514N by 115°28.738W (elev. 3971') on *Quercus* sp. 23-xii-2007: 5 puparia. Sandstone Quarry at 36°09.781N by 115°26.011W on *Arctostaphylos* sp. 27-iii-2008 & 28-iii-2008: 2 puparia; 36°09.781N by 115°26.011W) on *Ceanothus* sp. 16-xii-2003, 03-vii-2006, and 05-vii-2006: 7 puparia; 36°09.781N by 115°26.011W on *Ceanothus* sp. 19-viii-2008: 4 puparia.

COMMENTS: New state record for Nevada on *Arctostaphylos* sp. on 28-iii-2008 and with *Quercus* sp. on 23-xii-2007 and validated by Dr. Greg Evans (PPQ) at Systematic Entomology Lab (ARS).

*Aleuropleurocelus* sp.#1

DIAGNOSIS. PUPARIUM (Figure 9): *Habitus* (in nature). Black in color; oval to rotund; usually solitary on upper or lower side of leaf without noticeable wax formation. Puparium 673  $\mu\text{m}$  long and 539.9  $\mu\text{m}$  wide.



Figure 9. *Aleuropleurocelus* sp. #1

*Margin.* Deflexed margin oriented towards median appearing as two separate dentate margins that are separated by a 28-37  $\mu\text{m}$  distance. The physical margin is tuberculate with irregularly-shaped structures. The true inner dentate margin forms a fold-like inner concentric ring with the teeth pointing toward the margin. Inner dentate margin with basal row of submarginal glands that are rectangular-elongated and divided. *Dorsum.* The entire dorsum is patterned with multiple rows and clusters of various sized granules from the cephalon to the caudal areas and from the subdorsum (deflexed inner margin) to the submedian area. The median area is weakly sculptured. Longitudinal molting suture terminates at margin and is 298  $\mu\text{m}$  long. The suture has a single row of granules on each side extending from the transverse suture to 2/3 the distance toward the anterior margin giving a zippered appearance. The transverse suture extends out and curves anterior and terminates at the true inner margin at the level of the T<sub>2</sub> suture. A pair of narrowed and transverse eyespots present each with a robust and thick lower Margin. *Venter.*

Antennae terminate at the T<sub>1</sub> pair of legs. Thoracic cuticle with a moderate spinulose band present transversing the basal areas of the legs while a broad spinulose area occurs lateral to the mouth parts; abdominal cuticle weakly granulated from the margin to the submargin and smoother toward the median. *Vasiform orifice*. Widely cordate, 55.6 µm long and 68.4 µm wide, with a moderate to broad lateral and posterior margin; anterior margin not defined. Operculum is 26.3 µm long and 35.5 µm wide; completely covers the lingula and most of the vasiform orifice. Caudal protuberance absent or greatly reduced, widely separating the caudal pair of setae. *Pores*. Scarce, on cephalon, thorax and abdomen (submedian to subdorsum). *Chaetotaxy*. Thoracic and abdominal segment 1 setae absent; A<sub>8</sub> pair of setae present (38.5-48.6 µm long), each arising from a tubercle base on the anterior-lateral margin of the vasiform orifice. Caudal setae pair is broken off or missing.

MATERIAL EXAMINED (36 puparia). Red Rock Canyon NCA, NV. Sandstone Quarry on *Quercus* sp.: 00-iv-2004, validated by Dr. Greg Evans (PPQ) at Systematic Entomology Lab (ARS). Pine Creek Canyon at 36°07.577N by 115°28.474W (elev.3935') on *Quercus* sp., 23-xii-2007: 2 puparia; 36°07.462N by 115°28.853W (elev. 3976') on *Quercus* sp., 23-xii-2007: 1 puparium. Sandstone Quarry at 36°09.781N by 115°26.011W) on *Arctostaphylos* sp., 27-iii-2008: 3 puparia; on *Eriodictyon* sp., 28-iii-2008: 1 puparium; 36°09.829N by 115°27.049W) on *Quercus* sp., 24-viii-2006: 2 puparia; on *Quercus* sp.: 7-vii-2006, 1 puparium; at 36°09.715N by 115°26.998W) on *Quercus* sp., 27-iii-2008: 8 puparia; Sandstone Quarry at 36°09.781N by 115°26.011W)



on *Quercus* sp. On 27-vi-2007: 1 puparium, on 27-iii-2008: 13 puparia, and on 27-vi-2008: 4 puparia.

HOSTS. Ericaceae: *Arctostaphylos* sp., Fagaceae: *Quercus* sp., Zygophyllaceae: *Larrea* sp.

COMMENTS: This undescribed species was validated on 3/19/2008 by Dr. Greg Evans (PPQ) at Systematic Entomology Lab (ARS). Its broadly oval shape differs from *A. ceanothi* and *A. nigrans* which are boat-shaped, not broadly oval shape. It is most similar in shape to *Aleuropleurocelus abnormis* Quaintance not known to occur in Nevada but differs from the latter by lacking a wide, curving sclerotized area along the anterior margin.

This species differs from *Aleuropleurocelus* sp #2 (Appendix B with only a few slides available for examination) by the following characters: longer distance of 47 $\mu$ m between true and physical margin (37 maximum for sp #2); true margin obviously dentate (unlike sp #2 with a smooth to slightly sinuate margin); longitudinal suture has adjacent row of granules giving the suture a zippered look (weak granules not resembling a zippered appearance in sp #2); pair of eyespots present but are narrowly transverse with thickened margins in shape (not oval and notched as in sp.2); the vasiform orifice is much longer and wider as 55.6  $\mu$ m X 68.4  $\mu$ m (compared to 41.6  $\mu$ m X 46.9  $\mu$ m in sp.#2); operculum is 26.3  $\mu$ m x 35.5  $\mu$ m (28.3  $\mu$ m x 30  $\mu$ m for sp.#2); A<sub>8</sub> setae much longer (38.5-48.6  $\mu$ m, compared to 22-24  $\mu$ m in sp.#2); bands of minute pores absent but with

few scattered pores (bands present from cephalon to abdomen from subdorsum to median area in sp. #2).

It also differs from *Aleuropleurocelus* sp #3 (Appendix B with only a few slides available for examination) by the following characters: shorter distance of 47  $\mu\text{m}$  between true and physical margin (60 maximum for sp #3); true margin obviously dentate (unlike sp. #3 with a smooth to slightly sinuate margin); longitudinal suture has adjacent row of granules giving the suture a zippered look (weak granules not resembling a zippered appearance in sp. #3); pair of eyespots present but are narrowly transverse with thickened margins in shape (not suboval and notched as in sp.3); vasiform orifice longer and wider (55.6  $\mu\text{m}$  X 68.4  $\mu\text{m}$ ) than SP #3 (33  $\mu\text{m}$  X 35  $\mu\text{m}$ ); operculum is 26.3  $\mu\text{m}$  x 35.5  $\mu\text{m}$  (24  $\mu\text{m}$  x 30  $\mu\text{m}$  for sp. #3);  $A_8$  setae much longer (38.5-48.6  $\mu\text{m}$ ) than SP. #3 (22-24  $\mu\text{m}$ ); bands of minute pores absent but with few scattered pores (bands present from cephalon to abdomen from subdorsum to median area in sp. #3).

## GENUS *Aleyrodes* Latreille

*Aleyrodes* Linnaeus 1758, 537-38

DIAGNOSIS (Linnaeus 1758, 537-38; Latreille 1796, 93). PUPARIUM: *Habitus* (in nature). Pupal case of the Nevada species normally pale with little dorsal sculpturing. *Margin*. Crenulated with thoracic cleft undefined. *Dorsum*. Transverse molting suture not reaching submargin and terminating posterior to  $T_2$  and  $T_3$  thoracic sutures. A concentric dorsal suture-like fold or furrow absent.  $A_7$  segment not significantly reduced with 8 subequal abdominal segments clearly visible between transverse molting suture

and vasiform orifice. *Vasiform orifice*. Elongate-cordate to rounded-triangular to cordate with a clearly defined posterior lateral margin; a spinulose inserted lingula present within the vasiform orifice with one pair of apical setae, and completely exposed with a trapezoidal operculum covering only the anterior half of the vasiform orifice. *Venter*. Smooth not ornamented. Antennae terminate at the T<sub>1</sub> pair of legs, rarely terminating beyond T<sub>3</sub> pair of legs; smooth with caudal furrow not or slightly marked. Median abdominal tubercles present or absent. Chaetotaxy. C<sub>1</sub>, A<sub>1</sub>, A<sub>8</sub>, and caudal pairs of setae present.

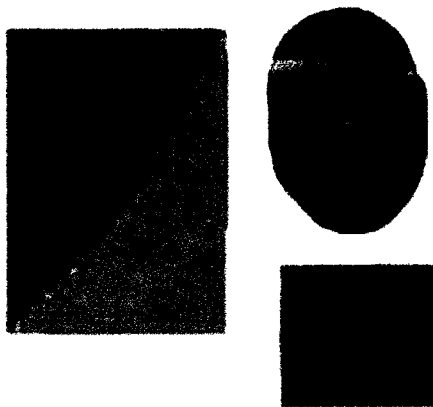
COMMENTS: this genus is comprised of 33 species, of which only *Aleyrodes spiraeoides* Quaintance is known to occur in Nevada, but has not been found in Clark County, NV to date.

### ***Aleyrodes spiraeoides* Quaintance**

*Aleyrodes spiraeoides* Quaintance 1900: 36-38

DISTRIBUTION (Quaintance & Baker 1900, 38): Nearctic Region: Mexico, USA (AZ, CA, CO, DC, FL, ID, IL, LA, NV, OR, TX, UT, WA).

DIAGNOSIS (Quaintance & Baker 1900, 37-38). PUPARIUM (Figure 10). *Habitus* (in the field). Very large (1115 µm in length by 830 µm in width), yellow, round to elliptical in shape, dorsum and surrounding surface often dusted with powdery white wax.



Slide from C.D.F.A  
 Images from J. Dooley (PPQ)

Figure 10. *Aleyrodes spiraeoides* (Quaintance)

*Margin.* Crenulate and tracheal area undifferentiated. *Dorsum.* Large dark brown central area absent. Papillae and tracheal folds not observed;  $A_7$  medial area as wide as that of  $A_6$ . *Vasiform orifice.* Orifice subcordate to triangular in shape with operculum covering half the vasiform orifice with lingula exposed and conical in shape. *Venter.* Smooth with caudal furrow faintly evident. *Pores.* Indistinct or absent. *Chaetotaxy.* Caudal setae minute to fairly long.

HOSTS (Quaintance & Baker 1900, 38; Penny 1922, 25): Asteraceae: *Sonchus oleraceus*, *Troximon* sp.; Asclepiadaceae: *Asclepias* sp.; Caprifoliaceae: *Lonicera involucrata*; Convolvulaceae: *Convolvulus occidentalis*, *C. sepium*; Ericaceae: *Gaultheria shallon*; Guttiferae: *Hypericum androsamum*; Hippocastanaceae: *Aesculus californica* Iridaceae: *Gladiolus* sp. (CDFA slide, R. Gill), *Iris* sp.; Musaceae: *Musa* sp. (Watson 2008)

Myrtaceae: *Melaleuca hypericifolia*; Onagraceae: *Fuchsia* sp.; Plantaginaceae: *Plantago major*; Rosaceae: *Fragaria* sp., *Fragaria x ananassa*, *Opulaster capitatus*; Saururaceae: *Anemopsis californica*; Solanaceae: *Nicotiana glauca*, *Solanum douglasii*.

COMMENTS: No Nevada specimen found and therefore not examined. This species was collected in Nevada (Lincoln County) at Panaca on 08/30/61 by R. C. Bechtel.

### GENUS *Bemisia* Quaintance & Baker

*Bemisia* Quaintance & Baker. 1914: 99-100

DIAGNOSIS (Quaintance & Baker 1914, 99-100; Martin 1999, 54-55; Martin 2000, 32-33). PUPARIUM: *Habitus* (in nature). Pupa usually pale to yellow sometimes with brown pigment, varying from elliptical to oval, broad to parallel across the thorax. *Margin*. Irregularly crenulate with tracheal thoracic and caudal clefts varying from slightly to moderately differentiated. *Dorsum*. Transverse molting suture not reaching margin; subdorsal fold and furrow absent. Vasiform orifice is acute-triangular in shape terminating into a pronounced caudal furrow; operculum occupying anterior half of orifice exposing the inserted lingula (contained within the vasiform orifice) that is spinulose and elongate triangular in shape. *Venter*. Tracheal furrow well developed and stippled. *Pores*. Absent to poorly developed. Tracheal furrow well developed from the caudal marginal cleft; thoracic tracheal furrows moderately developed from marginal tracheal cleft. *Chaetotaxy*. Highly variable among species

COMMENTS: No Nevada specimen found and therefore not examined. The physical characteristics of the host plant cause a high degree of variation in the size and shape tubercles, chaetotaxy, and cuticle sculpturing in this genus.

***Bemisia tabaci* (Gennadius)**

*Bemisia tabaci* Gennadius 1889:1-3

DISTRIBUTION (Gennadius 1889, 3). Worldwide distribution; in Nevada recorded only from Clark County on 14-ii-1991

DIAGNOSIS (Gennadius 1889, 1-2). PUPARIUM (Figure 11): *Habitus* (in nature), Ovoid and usually pale to yellow with little to no wax visible.

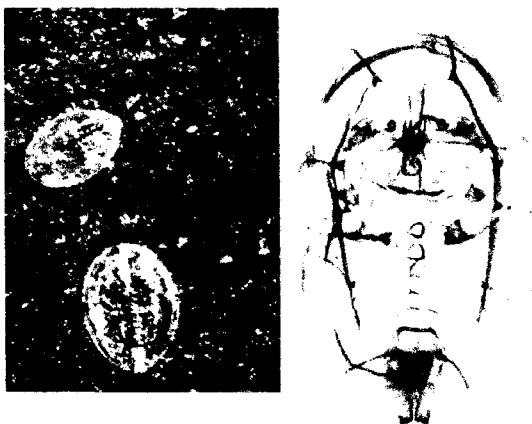


Figure 11. *Bemisia tabaci* (Gennadius)

*Margin.* Smooth to crenulate with faint tracheal cleft. *Dorsum.* Entire without longitudinal subdorsal folds or furrows. Thoracic tracheal furrows moderately developed from marginal tracheal cleft extending at most half way to spiracle; caudal furrow well

developed extending from the vasiform orifice to the caudal marginal cleft. Papillae present or absent. *Vasiform orifice*. Acute-triangular in shape terminating into a pronounced caudal furrow (shorter than orifice); operculum occupying anterior half of orifice exposing the inserted spinulose lingula that is elongate triangular in shape.

*Venter*. Antennae terminate at the T<sub>1</sub> pair of legs; base of legs with minute setae but without large spines. Tracheal furrow well developed and stippled. *Pores*. Pores and porettes distributed on the dorsum. *Chaetotaxy*. Caudal setae long and robust on tubercles (Figure 11). Dorsal setae highly variable, short to long, with acute apices.

HOSTS. Polyphagous and found on Euphorbiaceae: *Euphorbia* (Poinsettia) in Nevada, but not collected.

COMMENTS: Easily separated from other Nevada whiteflies by combination of characters given above.

## GENUS *Dialeurodes* Cockerell

*Aleyrodes (Dialeurodes)* Cockerell, 1902: 283.

*Dialeurodes* Quaintance and Baker 1914: 97

DIAGNOSIS (Cockerell 1902, 283; Quaintance and Baker 1914, 97; Jensen 2001, 285-286 ): PUPARIUM: *Habitus* (in nature). Oval and flat; cuticle usually pale and semi-translucent, sometimes with pigmentation and rarely dark colored. *Margin*. Smooth or crenulate; caudal and thoracic tracheal folds usually terminating at the margin as a pore

(internally smooth to dentate). *Dorsum*. Submargin not separated by fold or furrow; transverse molting suture terminates well before margin; thoracic and caudal tracheal furrows defined and may be marked by stippling. *Vasiform orifice*. Orifice broadly elliptical or subcircular; operculum covers almost all of orifice obscuring most of lingula. *Venter*. Antennae terminate at the T<sub>1</sub> pair of legs. *Chaetotaxy*. Cephalic, A<sub>8</sub> and caudal setae present; A<sub>1</sub> setae absent or present; subdorsum with 14 pairs of setae (7 on the cephalothorax and 7 on the abdomen).

COMMENTS: No Nevada specimen found and therefore not examined. This genus was recently reviewed by Jensen (2001) who split *Dialeurodes* into *Dialeurodes*, *Massilieurodes*, and *Singhiella* based on the presence or absence of the cranial suture, stippling present or absent in the tracheal and caudal regions, and the setal position of A<sub>14</sub> either adjacent to or distant from the caudal furrow ridge.

### ***Dialeurodes citri* (Ashmead)**

*Aleyrodes citri* (Ashmead) Ashmead 1885: 704

*Dialeurodes* Quaintance & Baker 1914: 97

*Aleyrodes* (*Dialeurodes*) Cockerell 1902: 283

DISTRIBUTION. Worldwide.

DIAGNOSIS (Ashmead 1885, 704; Cockerell 1902, 283, Quaintance & Baker 1914, 97).

PUPARIUM (Figure 12): *Habitus* (in nature). Oval and flat; cuticle usually pale and semi-translucent.





Figure 12 *Dialeurodes citri* (Ashmead)

*Margin.* Smooth or crenulate; caudal and thoracic tracheal folds usually terminating at the margin as a pore, internally smooth. *Dorsum.* Submargin not separated by fold or furrow; transverse molting suture terminates well before margin; subdorsal tubercles present; A<sub>1</sub> to A<sub>6</sub> segments subequal in length; thoracic and caudal tracheal furrows stippled with micro spines (Figure 12); vasiform orifice broadly elliptical or subcircular; operculum covers almost all of orifice obscuring most of lingula. *Venter.* Antennae terminate at the T<sub>1</sub> pair of legs. *Chaetotaxy.* Cephalic, A<sub>8</sub> (located anterior to the widest diameter of the vasiform orifice) and caudal setae present; A<sub>1</sub> setae absent; submargin with 12 pairs of setae.

HOSTS (Cockerell 1902: 283; Quaintance & Baker 1914: 97). Polyphagous and found on *Fortunella* (Rutaceae) in Nevada.

COMMENTS: Not collected since 1959 in Clark County, NV.

## GENUS *Siphoninus* Silvestri

*Siphoninus* Silvestri 1915: 245-247

DIAGNOSIS (Silvestri 1915, 245-246, Martin *et al.* 2000, 434-436). PUPARIUM:

*Habitus* (in nature). Oval-shaped, pale with shaded submedian regions of various degrees. *Margin*. Smooth or crenulated, not deflexed. Thoracic tracheal margins not differentiated; caudal tracheal comb present *Dorsum*. Dorsal disc covered with siphon-like glands of various lengths, unevenly distributed, usually apically rounded and distributed dorsally. *Vasiform orifice*. Not elevated, orifice floor sculptured. Operculum often short covering less than half the vasiform orifice exposing the inserted lingula. *Chaetotaxy*. Cephalic A<sub>1</sub> and A<sub>8</sub> setal pairs present and usually longer than vasiform orifice.

COMMENTS: Numerous long siphon tubes on the dorsum will separate this genus from other North American species: This genus comprised of three species of which only *S. phillyreae* is known to occur in Nevada.

### *Siphoninus phillyreae* (Haliday)

*Aleyrodes phillyreae* Haliday 1835: 119-120

DISTRIBUTION (Haliday 1835, 119; Mound 1966, 419 *et al.*). Afrotropical:

Cameroons, Eritrea, Sudan; Australasia: Australia, Hawaii, New Zealand; Oriental:

Nearctic: US (CA,GA,NC,NV,VA); Neotropical: Mexico; Oriental: India, Pakistan;

Palaeartic: Austria, Austria, Corsica, Cyprus, Czech Republic, France, Germany,

Hungary, India, Ireland, Iran, Italy, Libya, Morocco, Pakistan; Romania, Russia: Saudi Arabia, Spain, Syria, United Kingdom, Yugoslavia.

DIAGNOSIS (Haliday 1835, 119-120; Silvestri 1915, 245-247, Martin *et al* 2000, 434-436). PUPARIUM (Figure 13): *Habitus* (in nature). Normally oval-shaped, pale with central submedian waxy bundles.

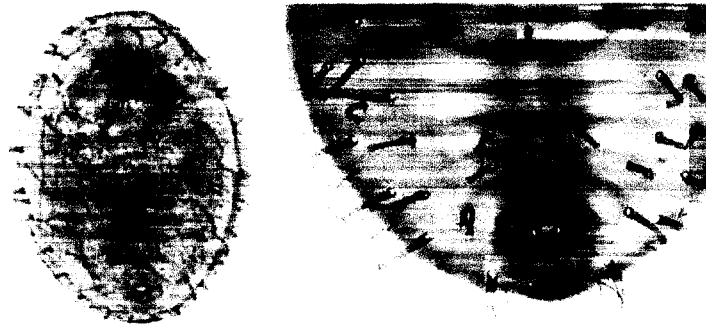


Figure 13. *Siphoninus phillyreae* Haliday

*Margin.* Crenulated with caudal tracheal cleft dentate with 12-13 teeth. *Dorsum.*

Transverse molting suture terminates well before the margin curving up slightly at the apex but does not meet the T<sub>3</sub> segmental suture. Covered with siphon-like tubes of varying lengths (Figure 13). Brown stripe medially from the cephalothorax past the vasiform orifice. *Venter.* Caudal cleft is differentiated into a series of 14 fleshy, fingerlike projects. Legs unarmed lacking. *Pores.* None observed; not reported in literature. *Chaetotaxy.* Cephalic, A<sub>1</sub>, A<sub>8</sub> (anterior to the vasiform orifice) and caudal setal pairs present and long. Submargin with a series of flagellate setae from the cephalothorax to the cauda.

HOSTS. Fabaceae: *Azalia* sp.; Oleaceae: *Fraxinus anomala*, *F. excelsior*, *F. syriaca*, *F. velutina*, *Olea chrysophylla*, *O. europea*, *Phillyrea latifolia*; Puniaceae: *Punica granatum*; Rhamnaceae: *Rhamnus alaternus*, *Zyzyphus* sp; Rosaceae: *Crataegus mollis*, *C. monogyna*, *C. oxyacantha*, *Cydonia oblonga*, *Mespilus* sp., *Prunus persica*, *Pyrus communis*, *P. malus*, *P. sativa*; Rutaceae: *Citrus* sp.

COMMENTS. No Nevada specimen found and therefore not examined. The official common name is the Ash Whitefly. This species was collected in Nevada: Clark County in 1990, Nye County in 1990 (Pahrump), and Washoe County (Reno) in 1991. The Ash Whitefly has ability to reproduce explosively and develop high reproductive potential. Its direct feeding interferes with the flow of nutrients through the phloem of the plants causing defoliation. They secrete copious amounts of honeydew (excrement) discoloring the leaves and nearby surfaces. This honeydew causes sooty molds to form negatively affecting the marketability and appearance of the plants (Sorenson 1991).

GENUS *Tetraleurodes* Cockerell

*Aleyrodes* (*Tetraleurodes*) Cockerell: 1902: 283.

*Tetraleurodes* Quaintance & Baker 1914: 107-108

DIAGNOSIS (Cockerell 1902, 283; Quaintance & Baker 1914, 108; Nakahara 1995, 106). PUPARIUM: *Habitus* (in nature). Black in most species, rarely pale; suboval to broadly oval, often heavily sclerotized. *Margin*. Dentate in most species, sometimes crenulated, not deflexed. Pale glandular areas, from V to round or rectangular in shape, present at base of marginal teeth; thoracic and caudal tracheal margins not differentiated

from the rest of the margin marginal teeth or crenulations are more evenly spaced and subequal. *Dorsum*. Longitudinal molting suture meeting dorsal fold or Margin; transverse molting suture terminates before or at the submarginal fold. Large submarginal row of tubercles present or absent. Tracheal furrows absent. Submarginal fold present with transverse tuberculate bands with furrow and ridges between submargin and fold. *Vasiform orifice*. Subcordate, elevated and sometimes overlapping subdorsal fold; operculum subcordate almost filling entire orifice, obscuring the lingula. *Venter* Antennae terminate at the T<sub>1</sub> pair of legs; legs with or without spinulose bands, the latter may be narrow to broad when present. Caudal and thoracic furrows may have a slight pattern (stippled to smooth). *Pores*. In a single row or irregular rows within or outside of the transverse bands; disc pores associated with porettes absent or present. *Chaetotaxy*. Anterior and posterior marginal setae present; caudal setae present. Submedian thoracic setae present or absent; A<sub>1</sub> setae absent; A<sub>8</sub> setae present.

COMMENTS. This is a large and widespread genus with 69 described species. Two described and one undescribed species are known to occur in Nevada.

#### Pupal key to the *Tetraleurodes* in Nevada

- 1 Three pairs of minute submedian cephalothoracic setae present; submargin to subdorsum cuticle rugose ..... *Tetraleurodes* sp.
- 1' Two pairs of submedian cephalothoracic setae present or absent (T<sub>2</sub>, T<sub>3</sub>); cuticle otherwise ..... 2
- 2 3 to 8 disc pore subdorsal cluster present on A<sub>4</sub> .. *Tetraleurodes mori* (Quaintance)
- 2' Cephalothoracic setae absent; 3-8 disc pore cluster absent on A<sub>4</sub> .....  
..... *Tetraleurodes quercifolia* Nakahara

***Tetraleurodes mori* Quaintance & Baker**

*Tetraleurodes mori* (Quaintance) Quaintance and Baker 1914: 108

DISTRIBUTION. Nearctic Region: USA; Neotropical Region: Belize, Costa Rica, Jamaica, Nicaragua, Panama, Puerto Rico, Trinidad and Tobago, Venezuela. Oriental: Taiwan, Thailand, Vietnam.

Location in Southern Nevada (Clark County) – Latest collection:

Lee Canyon at 35°58.524N by 115°22.308W collected on 23/08/06 by Dr. Knight, Robert Little, and John Dooley.

DIAGNOSIS (Quaintance 1899, 1-4; Cockerell 1902, 206; Quaintance & Baker 1914, 108). PUPARIUM (Figure 14): *Habitus* (in nature). Puparium oval sclerotized, and black; wax scarce or absent.

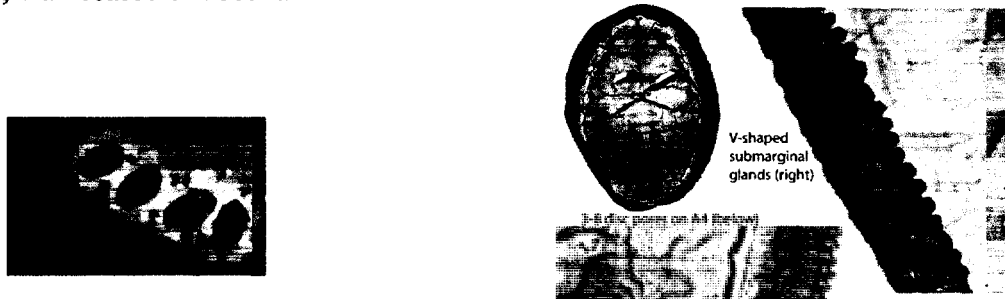


Figure 14. *Tetraleurodes mori* Quaintance

*Margin.* Margin dentate with tracheal clefts that are undifferentiated from rest of Margin.

Submargin with V to U-shaped glands (Figure 14) associated with marginal teeth.

*Dorsum.* Concentric fold separates subdorsum from submargin, roughened area from submargin to submedian area absent; submarginal tubercles absent; tracheal furrows

absent; abdomen lacking submedian depressions; operculum without median notch.

*Venter*. Cuticle smooth and legs unarmed. *Pores*. 3-8 minute disc pores (Figure 14) present on each side of A<sub>4</sub>. *Chaetotaxy*. T<sub>2</sub>, T<sub>3</sub>, and A<sub>8</sub> setae present; cephalic setae absent.

HOSTS. Aceraceae: *Acer negundo*, *A. pseudoplatanus*, *Acer* sp.; Aquifoliaceae: *Ilex opaca*; Betulaceae: *Betula* sp.; *Carpinus* sp., *Corylus* sp.; Bignoniaceae: *Catalpa* sp., *Stizophyllum* sp.; Cornaceae: *Cornus florida*, *C. sanguineus*, *Cornus* sp.; Ebenaceae: *Diospyros* sp.; Ericaceae: *Kalmia latifolia*; Hamamelidaceae: *Liquidambar styraciflua*; Lauraceae: *Persea carolina*; Magnoliaceae: *Magnolia* sp.; Moraceae: ?*Eugenia* sp., *Morus rubra*, *Morus* sp.; Myrtaceae: *Psidium* sp.; Oleraceae: *Forsythia* sp., *Fraxinus* sp.; Papaveraceae: *Argemone mexicana*; Plantaginaceae: *Penstemon* sp.; Rutaceae: *Citrus sinensis*, *Citrus* spp.; Tiliaceae: *Tilia americana*, *Tilia* sp.; Ulmaceae: *Celtis* sp.; Verbenaceae: *Callicarpa Americana*.

MATERIAL EXAMINED (18 puparia). Lee Canyon, NV (35°58. 524N by 115°22. 308W) on Plantaginaceae: *Penstemon* sp., 23-viii-2006.

COMMENTS: Widespread in the Americas. This species was easily distinguished from other species in the genus by the presence of a cluster of 3-8 disc pores on A<sub>4</sub>.

***Tetraleurodes quercicola* Nakahara**

*Tetraleurodes quercicola* Nakahara 1995: 131-134

DISTRIBUTION (Nakahara 1995, 134). Nearctic Region: Mexico; USA (AZ, CA, NV, UT); Neotropical: Puerto Rico. Nevada record: Pine Creek Canyon in Red Rock Canyon NCA at 36°07.577N by 115°28.474W (elev. 3935').

DIAGNOSIS (Nakahara 1995, 131-133). PUPARIUM (Figure 16): *Habitus* (in nature).

Oval sclerotized and black; wax not observed.

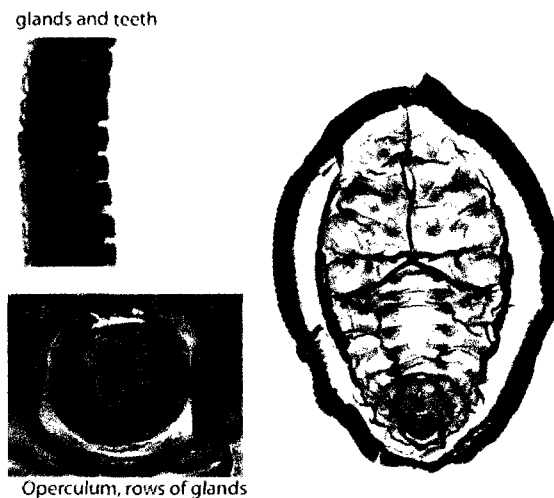


Figure 16. *Tetraleurodes quercicola* Nakahara

*Margin.* Margin dentate, teeth wider than long and apically truncate to subtruncate; small, oval glandular areas at base of marginal teeth; submargin with transverse ridges and furrows terminating at, or close, to base of marginal teeth; band of microtubercles present extending from the pale glandular areas on the ridges. *Dorsum.* Submargin



differentiated from dorsal disk by submarginal fold. Eyespots diffuse. Longitudinal molting suture terminates at the anterior margin; transverse molting suture diagonally extends to subdorsal ridge curving anterior to the level of the meso-metathoracic suture. *Venter*. Smooth without distinct sculpture or pattern. Thoracic and tracheal folds evident. *Vasiform orifice*. Subcordate located on a raised area of A<sub>8</sub>; small tubercle with pale gland on posterolateral part of rim; orifice margin (Figure 16) with two rows of cell like structures (inner row with 4 cells laterally and outer row with 15-16 cells laterally and caudally). Operculum subcordate and subequal to orifice size completely covering the lingula. *Pores*. Disk pores, 4-5 µm in diameter, with associated porettes in median row around submargin; pores 3 µm in diameter, with associated porettes present on cephalothorax and abdomen subdorsally and submedially. *Chaetotaxy*. Cephalothoracic submedian and A<sub>8</sub> setae absent; caudal setae short, thin about 5 µm long.

HOSTS. Fagaceae: *Quercus gambelii* and *Q. turbinella*.

MATERIAL EXAMINED (one puparium). Red Rock Canyon NCA, NV. Pine Creek Canyon at 36°07.577N by 115°28.474W (elev.3935') on *Quercus* sp., collected on 23-xii-2007 by John Dooley.

COMMENTS: New Nevada state record validated by Greg Evans (PPQ) at Systematic Entomology Lab (ARS) at Beltsville, Md.

***Tetraleurodes* sp.**

DIAGNOSIS. PUPARIUM (Figure 17): *Habitus* (in nature). Oval sclerotized and black; wax scarce (forms a thin marginal ring) or absent; usually solitary on upper or lower part of leaf.

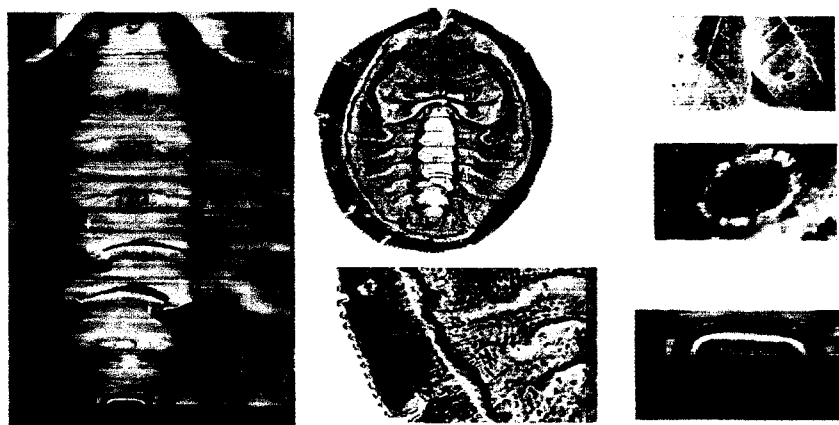


Figure 17. *Tetraleurodes* sp.

*Margin.* Ovoid Length and width vary from 730-1270  $\mu\text{m}$  long; 560-960  $\mu\text{m}$  wide.

Dentate, not differentiated at thoracic or caudal tracheal openings, with 6 to 8 teeth per 100 mm.; submarginal, pale glandular areas vary from thimble-shaped to distorted (not U or V-shaped). *Dorsum.* Longitudinal suture terminates close to the margin. Transverse suture terminates on or before the subdorsal fold. Cuticle rugose from submargin to subdorsum being smooth in the median region. Eyespot absent. Submedian abdominal depressions well-defined from A<sub>1</sub> to A<sub>7</sub>. Median tubercles well-defined from A<sub>2</sub> to A<sub>7</sub>.

*Vasiform orifice.* Orifice and operculum subcordate; operculum with dorsum rugose completely obscuring the lingula. Posterior notch absent on both the vasiform orifice and

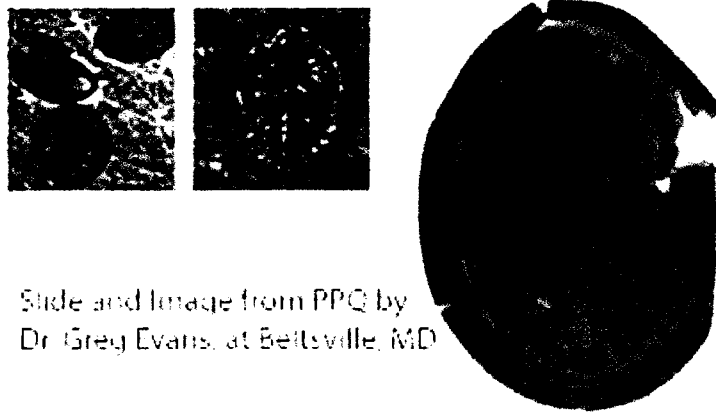
operculum. *Pores.* Tubercle-like small pores present in a single irregular row in the transverse band between the dorsal fold and microtuberculate band averaging from 60-80 pores combined for both sides. Each pore about 57  $\mu\text{m}$  in diameter. Numerous pores each associated with a porette present on dorsum on the subdorsum to the submedian areas: cephalic from 0-1 submedian and 0 to 2 subdorsum pores;  $T_2$  with 0-2 submedian and 0 to 3 subdorsal pores;  $T_3$  with 1-3 subdorsum pores only;  $A_1$  pores absent or with 1 submedian or 1 subdorsal pore present;  $A_2$  with 0-1 submedian pore present;  $A_3$  with 0-1 submedian pores present;  $A_4$  with 0-1 subdorsal and 1-2 submedian pores present;  $A_5$  with 1-2 submedian and 0-2 subdorsal pores present;  $A_6$  with 0-1 submedian and from 1-2 subdorsal pores present;  $A_6$  with 0-1 submedian and 1-2 subdorsal pores present;  $A_7$  from 0-1 submedian and 0-2 subdorsal pores present; and  $A_8$  1-3 submedian present and no subdorsum pores. *Chaetotaxy.* Submarginal, thoracic and abdominal setae present; cephalic setae 15  $\mu\text{m}$  long,  $T_2$  setae 10-30  $\mu\text{m}$  long;  $T_3$  setae 15 to 25  $\mu\text{m}$  long;  $A_1$  setae absent; and  $A_8$  setae 5 to 16  $\mu\text{m}$  long. Submarginal setae at irregular pattern with 6-8 setae on transverse ridge between tubercle-like pores and microtuberculate band.

MATERIAL EXAMINED (17 pupae). One slide, one puparium (pre-emergence) deposited in the Systematic Entomology Lab, ARS, USDA on *Quercus* sp., Red Rock Canyon NAS at Sandstone Quarry (one puparium), 05-vii-2006 (#1 from Sandstone Quarry, Red Rock Canyon NCA). 10 paratypes on *Quercus* sp.: Red Rock Canyon NCA (Pine Creek Canyon at 36°07.577N by 115°28.474W at 3935 foot elev.), 23-xii-2007 (1 puparium); Red Rock Canyon NCA (Sandstone Quarry at 36°09'829N by 115°27'049W),

24-viii-2006 (2 puparia); 36°09.715N x 115°26.998W, 27-iii-2008 (4 puparia); Red Rock Canyon NCA (Sandstone Quarry): 00-ix-2004 (1 puparium), 08-ix-2005 (2 puparia), 03-viii-2006 (2 puparia), 05-vii-2006 (5 puparia).

COMMENTS. This species is usually found solitary or few in small numbers on the upper side of the oak leaf. The puparium sometimes has a thin marginal wax ring or is totally devoid of wax. No dried or fresh specimens were available for field comparisons. The main problem in examination is the loss of the submedian setae which breaks off during the mounting process. The cephalothoracic setae are very small. *T. perileuca* (Cockerell) and *Tetraleurodes* sp., not officially recorded in Nevada, have been found only associated with *Quercus*.

This species fits well within the *Tetraleurodes* genus and is closest to the species *T. perileuca* (Cockerell) which is not known to occur in Nevada (Figure 15). A comparison was made to the four specimens of *T. perileuca* (Cockerell) deposited at the Systematic Entomology Lab, Beltsville, MD. *Tetraleurodes* sp. differs from *T. perileuca* (Cockerell) by the absence of an eyespot; a greater number of tubercle like pores in a single row on the inner margin between the microtuberculate band and the dorsal fold (from 70 to 80 pores verses 49 to 58 in *T. perileuca*); the distribution and pattern of the pores (each associated with a porette) on the cephalothorax and abdomen: more numerous, especially on A<sub>8</sub> and T<sub>2</sub>, and distributed differently from *T. perileuca* (Cockerell).



Slide and Image from PPQ by  
Dr. Greg Evans, at Beltsville, MD

Figure 15. *Tetraleurodes perileuca* (Cockerell)

*Tetraleurodes* sp. differs from *T. mori* (Quaintance) by the presence of numerous pores and associated porettes (absent in *T. mori*); the rugose cuticle (smooth in *T. mori*); absence of v-shaped submarginal glands and the single, submarginal row of tubercle-like pores; the absence of a cluster of 3-8 disc pores on A<sub>4</sub>; and the absence of a row of spinules at the base of the legs. In addition *T. mori* is not known to occur on oaks.

#### GENUS *Trialeurodes* Cockerell

*Aleyrodes* (*Trialeurodes*) Cockerell: 1902: 283.

*Trialeurodes* Cockerell Quaintance & Baker, 1915: xi

DIAGNOSIS (Quaintance 1900, 31-32, Cockerell 1902, 283; Russell 1947, 1-85).

PUPARIUM: *Habitus* (in nature). Normally oval shaped, most species pale with a few species dark brown or having a pale or dark brown form; about 100 species are described. More abundant on the underside of the leaf and less dense on the upper surface. *Margin*. Crenulate (crenulations from small to large, uniform or of varying widths), somewhat weak, and sometimes modified at the thoracic tracheal openings and showing some

stippling in the thoracic furrow. *Dorsum*. A submarginal row of variously shaped papillae (cylindrical, bullet, conical apically rounded or acute) well or poorly developed; if well developed, then separated, closely appressed; such papillae may also occur on the dorsal disc. Seven or 8 abdominal segments apparent in median region of abdomen: A<sub>7</sub> in most species reduced with the median length no more than one-third the length of A<sub>6</sub>. Vasiform orifice. Cordate shaped, defined, enclosing a posteriorly lobed lingula that is contained within the vasiform orifice. The lingula has 3 paired lobes and one apical lobe that is usually partially, but may be totally covered by the operculum. The operculum, cordate to subcordate, covers at least half the vasiform orifice. *Venter*. Antennae usually terminate at the T<sub>1</sub> position. Legs with spines on inner portion of leg or such spines absent. Thoracic tracheal folds usually present and unmarked. *Pores*. Submarginal disc pores and porettes present while distribution and location varies and may be associated with papillae. *Chaetotaxy*. Cephalic, A<sub>8</sub> (not anterior to anterior margin of vasiform orifice), and caudal pairs of submedian setae present; A<sub>1</sub> setae present or absent.

COMMENTS: Physical characteristics of the host plant leaves sometimes cause a high degree of variation in the shape and pattern of the papillae, and cuticle sculpturing of species in this genus. Of 67 described species, five species are known to occur in Nevada along with one undescribed species.

Pupal Key to the *Trialeurodes* in Nevada

- 1 Marginal crenulations narrow, 20 or more per 100 mm; puparium light ..... 2
- 1' Marginal crenulations wide, less than 20 per 100 mm; puparium light to dark ..... 3
- 2 Posterior part of the vasiform orifice with a distinct, peglike, median tooth; leg spines absent ..... *Trialeurodes abutiloneus* (Haldeman)
- 2' Median peglike tooth of the vasiform orifice absent; each leg with a robust spine, the spine on T<sub>2</sub> leg slightly larger ..... *Trialeurodes packardi* (Morrill)
- 3 Puparium dark brown to black in color ..... 4
- 3' Puparium light in color ..... 5
- 4 Submarginal papillae aligned closely together; 3 pairs of median reniform papillae clusters ..... *Trialeurodes corollis* (Penny)
- 4' Submarginal papillae in 2-3 irregular rows, clusters absent ..... *Trialeurodes glacialis* (Bemis)
- 5 Submarginal row of well separated papillae less than 100; submedian papillae absent or if present few; median abdominal row of papillae absent ..... *Trialeurodes vaporariorum* (Westwood)
- 5' Characters otherwise ..... 6
- 6 Submarginal single row of papillae adjacent, oriented toward the margin with more than 100 papillae; submedian papillae present and numerous; median abdominal row of papillae present ..... *Trialeurodes* sp.
- 6' Submarginal papillae in 2-3 irregular rows, clusters absent; submedian tubercles of irregular shape present and numerous in groups; median abdominal row of papillae absent ..... *Trialeurodes glacialis* (Bemis)

***Trialeurodes abutiloneus* (Haldeman)**

*Aleurodes abutilonea* Haldeman

*Trialeurodes abutiloneus* (Haldeman) Quaintance & Baker 1915: 105

DISTRIBUTION (Quaintance & Baker 1915, 105; Russell 1948, 74-75). Nearctic:

Mexico, USA (AL, CA, CO, FL, MS, NY, MI, NV, PA, TX, VA, WA, WI); Neotropical:

Cuba, Jamaica, Puerto Rico, Trinidad.

DIAGNOSIS (Quaintance & Baker 1914, Russell 1948, 71-74). PUPARIUM. *Habitus* (in nature). Colorless to pale yellow and sometimes with a median brown strip. Mounted specimens from 600-900  $\mu\text{m}$  long and 450-600  $\mu\text{m}$  wide. *Margin*. With narrow crenulations, 20 or more per 100  $\mu\text{m}$ . Submarginal row of papillae in a single irregular row or a regular close-set row numbering 44-112. *Vasiform orifice*. Orifice elongate-cordate with a tooth arising from the posterior margin. Operculum covers up to 75 percent with the lobed tip of the lingual exposed. *Venter*. Microsetae present on each leg but lack spines. See Russell, 1947:73-74 for complete description.

HOSTS. Polyphagous. Found in Nevada on *Medicago sativa* (Fabaceae) and *Gossypium hirsutum* (Malvaceae).

COMMENTS: Not found and therefore not examined. Nevada record: in Southern Nevada collected on 07/19/60 in Pahrump, Nye County, by R. C. Bechtel and on 08/04/61 by F. D. Parker and R. C. Bechtel in Overton, Clark County.

### ***Trialeurodes corollis* (Penny)**

*Asterochiton corollis* Penny, 1922: 26-28

*Trialeurodes corollis* (Penny) Russell 1947: 36-38

DISTRIBUTION. Nearctic Region: USA (CA, NV). New Nevada record.

Location in Southern Nevada



Red Rock Canyon NCA

Sandstone Quarry 39°09.781 by 115°26.011W (elev.4294').

DIAGNOSIS (Penny 1922, 26-27; Russell 1948, 36-37). PUPARIUM (Figure 18):

*Habitus* (in nature). Dark brown, oval in shape. Dorsum with a continuous marginal fringe of wax. Pupal disk rests on a layer of fringe wax (Russell, 1948).

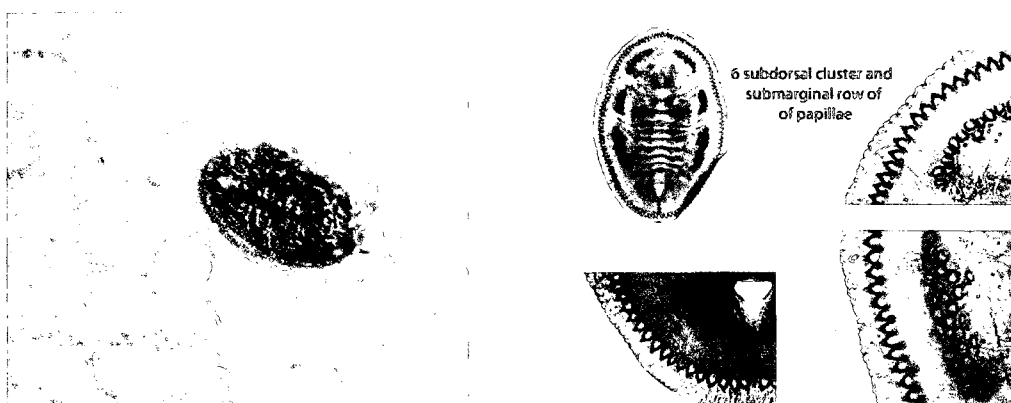


Figure 18. *Trialeurodes corollis* (Penny)

*Margin.* Smooth or crenulate, not dentate; marginal crenulations large with less than 20 crenulations per 100 mm; tracheal combs slightly differentiated from rest of margin.

*Dorsum.* Transverse molting suture reaching submarginal papillae; with irregular submarginal row and 3 pairs of submedian papillae clusters. See Russell, 1947:37-38 for complete description.

HOSTS (Penny 1922, Russell 1947). *Arctostaphylos* sp.

MATERIAL EXAMINED (2 puparia) Red Rock Canyon NCA, NV. Sandstone Quarry at 36°09.781N by 115°26.011W (elev.4294') on *Arctostaphalos* sp., collected on 28-iii-2008 by John Dooley.

COMMENTS: New Nevada record validated by Dr. Greg Evans (PPQ) at Systematic Entomology Lab (ARS) at Beltsville, Md. It can be separated from other *Trialeurodes* puparia by the three pairs of papillae clusters on the submedian area.

***Trialeurodes glacialis* (Bemis)**

*Aleyrodes glacialis* Bemis, 1904: 518-519

*Asterochiton glacialis*, Quaintance & Baker, 1914: 105

*Trialeurodes glacialis* (Bemis), Quaintance & Baker 1915: xi

DISTRIBUTION (Bemis 1904, Quaintance & Baker 1914, Russell 1947). Nearctic Region: USA (CA, NV). New Nevada record.

Location in Southern Nevada-Sandstone Quarry at Red Rock Canyon NCA.

39°09. 781 by 115°26.011W (elev. 4294').

DIAGNOSIS (Bemis 1904, 518; Quaintance & Baker 1914, 105; Russell 1948, 51-52).

PUPARIUM (Figure 19): *Habitus* (in nature). Dark brown, oval in shape. Tufts of white setae projecting from margin and sparsely distributed on dorsum.

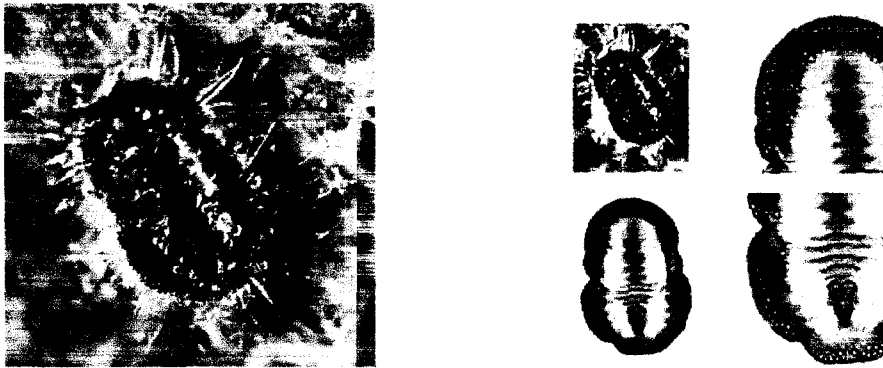


Figure 19. *Trialeurodes glacialis* Bemis

*Margin.* Thoracic pore and furrow usually undifferentiated; thoracic tracheal margin somewhat differentiated by a slight indentation of 2-3 crenulations. *Dorsum.*

Submarginal papillae numbering 115-175 and arranged in an irregular single to triple row; papillae apically pointed and oriented towards the margin. *Venter.* No taxonomic significance observed by John Dooley or addressed by Russell; legs unarmed (lacking spine). *Pores.* Marginal discoidal pores proximal to the outer papillae for the most part while lateral to the inner submarginal papillae. See Russell, 1947:37-38 for complete description.

HOSTS (Bemis 1904, Quaintance & Baker 1914, Russell 1947). Fagaceae: *Quercus* sp.

MATERIAL EXAMINED (1 puparium). Red Rock Canyon NCA, NV (Sandstone Quarry at 36°09.781N by 115°26.011W) on *Arctostaphalos* sp., 28-iii-2008.

COMMENTS: New Nevada state record validated by Dr. Greg Evans) at Systematic Entomology Lab (ARS) at Beltsville, Md.

***Trialeurodes packardi* (Morrill)**

*Aleyrodes packardi* Morrill, 1903:25-35

*Asterochitin packardi* (Morrill), Quaintance and Baker, 1914:105

*Trialeurodes packardi* (Morrill), Quaintance and Baker, 1915: XI

DISTRIBUTION (Morrill 1903, 25-35; Quaintance and Baker 1914, 105; Quaintance and Baker 1915, XI; Russell 1948, 59-63). Australasia: Hawaii (USA); Nearctic Region: Canada, Mexico, USA (AZ, CA, CT, DC, FL, GA, IN, IO, KS, MA, MD, ME, MI, MN, MO, NC, NJ, NV, NY, OH, OR, PA, RI, TN, TX, UT, VA, WA, WI)); Oriental: S. Korea; Palaearctic: Hungary.

Location in Southern Nevada- unknown without collection data provided by Nevada State Department of Agriculture.

DIAGNOSIS (Morrill 1903, 25-35; Quaintance and Baker 1914, 105; Quaintance and Baker 1915: XI; Russell 1948, 59-62). PUPARIUM (Figure 20): *Habitus* (in nature). Colorless or pale yellow, oval.

Strawberry  
Davis, Ca  
24 August 1977  
Coll: L.E. Ehler



Figure 20. *Trialeurodes packardi* Morrill

*Margin.* Smooth or crenulate, not dentate; narrow crenulations (20 to 22 or more per 100 mm); tracheal combs slightly differentiated from the rest of lateral margin. *Dorsum.* Transverse molting suture reaching the margin; submarginal papillae as long as broad, submedian and median row absent; median area of A<sub>8</sub> suture does not extend past the A<sub>7</sub> suture giving the appearance of 8 abdominal segments. *Venter.* Each leg with spine that of leg 2 with spine larger than others. *Pores.* Submarginal row of dorsal disc pores present. *Chaetotaxy.* C<sub>1</sub>, A<sub>1</sub> and A<sub>8</sub> setal pairs present. See Russell, 1947:37-38 for complete description.

HOSTS (Morrill 1903,25-35; Quaintance and Baker 1914,105; Quaintance and Baker 1915, XI; Russell 1948: 63). Polyphagous

COMMENTS: Not found and therefore not examined.

### ***Trialeurodes* sp.#1**

DIAGNOSIS. PUPARIUM (Figure 21): *Habitus* (in nature). Oval to elongate, bright yellow with thoracic furrows forming a Y shape pattern. Dense dorsal transparent wax secretions are present causing significant problems when removing the wax during the mounting process. Found solitary usually on the upper leaf surface near margin. Body 1090 µm in length and 760 µm in width.

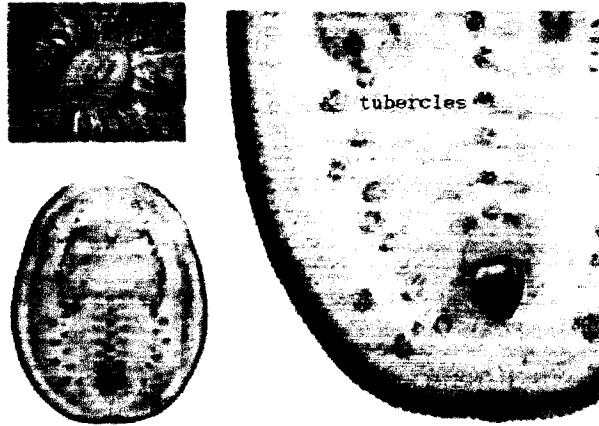


Figure 21. *Trialeurodes* sp #1

*Margin* crenulate with 10 irregular, crenulations per 100  $\mu\text{m}$ . *Dorsum*. Longitudinal and transverse sutures terminate at the submarginal papillae. Dorsal disk with abdominal segments slightly differentiated only from the median to the subdorsum and less defined in the cephalothorax.  $A_6$  segment more than twice the width of  $A_7$  medially. Submedian abdominal depressions faint. Submargin with a continuous row of 102-105 cone-shaped papillae, each being 19-26  $\mu\text{m}$  in length, oriented toward but not reaching the margin.  $A_1$  through  $A_6$  with median abdominal papillae or tubercles subequal in size ranging from 24 - 39  $\mu\text{m}$  in diameter. Subdorsum with irregular row of poorly defined tubercles of various sizes: on the cephalothorax consisting of one row and from  $A_1$  to  $A_8$  in two irregular rows. *Vasiform orifice*. Orifice is cordate in shape 166. 23  $\mu\text{m}$  in length and 150.5  $\mu\text{m}$  in width; operculum shield-like covering almost the entire lingula exposing only the tip. *Venter*. Legs unarmed with microsetae but lacking spines. Antennae terminate at the  $T_1$  pair of legs. *Pores*. Each marginal papillae with a central, basal disc pore, some with two; also present at base between submarginal papillae. *Chaetotaxy*.

Submedian setal pair present are on the cephalon each 23-26  $\mu\text{m}$  in length,  $A_1$  setae each 17.7  $\mu\text{m}$  in length,  $A_8$  setae 15-19  $\mu\text{m}$  in length, and caudal setae each 10-13.4  $\mu\text{m}$  in length.

MATERIAL EXAMINED (17 puparia collected by John Dooley). One puparium slide deposited at the Systematic Entomology Lab, ARS, USDA) as pre-emergence on *Quercus* sp., Red Rock Canyon NCA at Sandstone Quarry (one puparium), viii-24-2006; 18 paratype slides on *Quercus* sp.. Red Rock Canyon NCA, NV, Sandstone Quarry: at 36°09'829N by 115°27'049W, 24-viii-2006 (6 puparium) and 36°09.795N X 115°27.006W, 24-viii-2006 (1 puparium); and at 36°09.829N X 115°27.049W, 27-iii-2008 (3 puparium); Red Rock Canyon NCA, NV, Sandstone Quarry: 00-ix-2004 (1 puparium), 24-vii-2006 (5 puparia), 07-iii-2006 (1 puparium), 24-vii-2007 (1 puparium).

HOSTS. Fagaceae: *Quercus* spp.

COMMENTS. Differs from its closest relative, *Trialeurodes oblongifolia* Russell, not known to occur in Nevada, by the presence of a median row of dorsal papillae from  $A_1$  thru  $A_6$  and the total number of marginal papillae from 204 to 212. In *T. oblongifolia* the median tubercles are absent and the marginal papillae number from 282-368 (Russell, 1947).

***Trialeurodes vaporariorum* (Westwood)**

*Aleyrodes vaporariorum* Westwood, 1856: 282

*Asterochitin vaporariorum* (Westwood), Quaintance & Baker, 1914:104-105

*Trialeurodes vaporariorum* (Westwood), Quaintance & Baker, 1915: 645

DISTRIBUTION . Afrotropical: Ethiopia, Kenya, South Africa, Zimbabwe;  
Australasian: Australia, Hawaii, Indonesia, New Guinea, New Zealand, Philippines,  
Reunion; Nearctic: Canada, Mexico, USA (AK, AL, AZ, CA, CO, CT, DC, DE, FL, GA,  
HI, ID, IN, IL, IO,KS, MA, MD, MI, MO, MS, NC, NE, NJ, NM, NY; OH, OR, PA, RI,  
SC, SD, TX, UT, VA, WA, WI,WV); Neotropical: Argentina, Bermuda, Brazil, Chile,  
Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guadeloupe,  
Guatemala, Honduras, Jamaica, Mexico, Peru, Puerto Rico, Venezuela; Palaearctic:  
Azores, Austria, Belgium, Bangladesh, Bulgaria, Canary Islands, Denmark,  
France,Germany, Greece, Hungary, India, Iran, Ireland, Italy, Israel, Jordan, Netherlands,  
Norway, Poland, Portugal, Spain, Turkey,United Kingdom; Oriental: Hong Kong, Japan,  
Korea, Sri Lanka.

DIAGNOSIS (Westwood 1856, 282; Quaintance & Baker 1914,104-105; Quaintance &  
Baker 1915, 645, Russell 1948, 43-48). PUPARIUM (Figure 22): *Habitus* (in nature).  
Normally oval shaped, pale to yellow in color. Fresh specimens relatively thick with  
waxy patches dorsally and marginally.



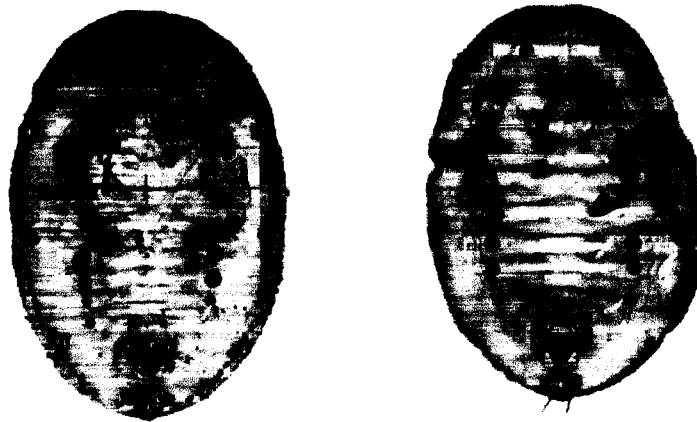


Figure 22. *Trialeurodes vaporariorum* (Westwood)

*Margin.* Crenulations large (from 9- 12 per 100 mm) and subequal in width. Submargin with variously shaped papillae (bullet, cylindrical, conical apically rounded or acute), numbering 64 to 140, well to poorly developed and from small to large usually oriented to the margin; if well developed, then well-separated to closely appressed; marginal clefts slightly modified at the openings or not at all. *Dorsum.* Papillae present or absent on the subdorsal and submedian areas. Longitudinal suture present from the margin to the transverse suture that terminates before or at the submargin. Eight abdominal segments apparent in median region of abdomen with the median length of abdominal segment VII reduced to no more than one-third the length of  $A_6$ . *Vasiform orifice.* The cordate-shaped vasiform orifice contains the lingula, usually with 3 paired lobes and one apical lobe; operculum cordate-shaped covering half the vasiform orifice. *Venter.* Antennae terminate at the  $T_1$  pair of legs; legs with setae present but lacking spines on inner portion. Thoracic tracheal clefts and folds absent. *Pores.* Submarginal disc pores and porettes present, distribution and location variable; pores may be associated with papillae.

*Chaetotaxy*. Cephalic and abdominal segments with or without a pair of setae; A<sub>8</sub> and caudal pair of setae present. See Russell, 1947:37-38 for complete description.

HOSTS (Westwood 1856, 282; Quaintance & Baker 1914, 104-105; Quaintance & Baker 1915, 645; Russell 1948, 48-49). Polyphagous. In Nevada found on Onagraceae: *Fuchsia hybrida*; Asteraceae: *Calendula Officinalis*, and Solanaceae: *Solanum meloena*.

COMMENTS. Not found and therefore not examined. Characters vary greatly in specimens collected on plants with hairy to glabrous leaves. Nevada record: Southern Nevada (collected on by 2/23/73, 9/30/74 and 10/2/74 by F. A. Hilbig at Reno (Walshoe County), and 11/03/76 by S. D. Peters. This species was not observed nor collected.

## References

- Ashmead, William H. 1885. The Orange *Aleurodes* (*Aleurodes citri* n. sp. ) *Florida Dispatch* 2: 704.
- Bemis, Florence E. 1904. The Aleyrodids or mealy-winged flies of California with reference to other American species. *Proceedings of the United States National Museum* 27: 514-522.
- Bondar, Gregorio. 1923. Aleyrodideos do Brasil. *Bahia* 183 pp.
- Brown Judy K. 2000. Molecular markers for the identification and global tracking of whitefly vector-Begomovirus complexes. *Virus Res.* 71: 233-260.
- Cockerell, Theodore D. 1896. New species of insects taken on a trip from the Mesilla Valley to the Sacramento mountains, New Mexico. *Aleurodidae Journal of the New York Entomological Society* 4: 207.
- Cockerell, Theodore D. 1898. A new *Aleurodes* on oak *Canadian Entomologist* 30: 264.
- Cockerell, Theodore D. 1902. The classification of the Aleyrodidae. *Proceedings of the Academy of Natural Sciences of Philadelphia*.
- Dooley, John W. 2006. Whitefly Fauna of the World on Lucid Central. <http://www.lucidcentral.org/keys/v3/whitefly/INTRODUCTION%20TO%20THE%20ALEYRODIDAE>. Htm. Last accessed December 2009.
- Drews, E. A and Woodrow W. Sampson 1956. California Aleyrodids of the genus *Aleuropleurocelus*. *Annals of the Entomological Society of America* 51: 120-125.
- Evans, Gregory A. 2005. Whitefly Taxonomic and Ecological Website USDA-ARS-SEL [http://www.sel.barc.usda.gov:591/1WF/whitefly\\_catalog.htm](http://www.sel.barc.usda.gov:591/1WF/whitefly_catalog.htm). Last accessed December 2009).
- Evans, Gregory A. 2008. The Whiteflies (Hemiptera: Aleyrodidae) of the World and Their Host Plants and Natural Enemies. USDA/Animal Plant Health Inspection Service (APHIS). Version 2008-09-23 (unpublished).
- Gennadius, P. 1889. Disease of tobacco plantations in the Trikonía. The Aleurodid of tobacco [In Greek] *Ellenike Georgia* 5: 1-3.
- Gill, Ray. 2008. Personal communication by email: slide mounting techniques.

- Grimaldi, David & Michael Engel. 2005. *Evolution of the Insects*. Cambridge University Press. Cambridge (United Kingdom).
- Haliday. A. H. 1835. *Aleyrodes phillyreae* *Entomological Magazine* 2: 119.
- Jensen, Andrew. 2001. A cladistic analysis of Dialeurodes, Massilieurodes and Singhiella, with notes and keys to the Nearctic species and descriptions of four new Massilieurodes species (Homoptera: Aleyrodidae). *Systematic Entomology*: 26: 279-310.
- Linnaeus, Carolus. 1758 *Systema Naturae*.
- Martin, Jon. 1999. Whitefly fauna of Australia *CSIRO Tech Paper No. 38*.
- Martin, Jon *et al.* 2000. Whiteflies of the mediterranean Basin *CABI Publishing Bulletin of Entomological Research* 90: 407-448.
- Martin, Jon. 2005. Whiteflies of Belize (Hemiptera, Aleyrodidae) Part 2-Introduction and account of the Subfamily Aleyrodinae Westwood *Zootaxa* 1098: 1-116.
- Morrill, A. W. 1903. Notes on some Aleyrodes from Massachusetts, with description of new species. *Psyche*, Cambridge: 10: 80-85
- Mound, Laurence A. and S. H. Halsey. 1978. Whitefly of the World. A systematic catalog of the Aleyrodidae (Homoptera) with HOSTS plant and natural enemy data. British Museum (Natural History)/John Wiley & Sons, Chichester
- Nakahara, Steve. 1995. Taxonomic studies of the genus *Tetraleurodes* (Homoptera: Aleyrodidae). *Insecta Mundi* 9: 105-150.
- Nevada County Economic Resource Council (ERC). Timber. <http://www.ncerc.org/industryagriculture.php>. Last accessed December 2009.
- Penny, D. D. A catalog of the California Aleyrodidae and the description of four new species. *J. Ent. Zool.*:14:21-35.
- Quaintance, Altus L. 1899. New or little known Aleurodididae (sic) I. *Canadian Entomologist* 31: 1.
- Quaintance, Altus L. and A. C. Baker. 1900. Contributions towards a monograph of the American Aleurodididae. *Tech. Ser. Bur. Ent. U.S.* 8: 9-64.
- Quaintance, Altus L. and A. C. Baker. 1914. Classification of the Aleyrodidae. Part II. *Technical Service Bur. Ent. U. S.* 27 (1914): 95-109.

- Quaintance, Altus L. and A. C. Baker. 1915. A new genus and species of Aleyrodidae from British Guiana. *Ann. Ent. Soc. Am.* 8: 369-371.
- Quaintance, Altus L. and A. C. Baker. 1916. Aleurodidae or whiteflies attacking the orange with descriptions of three new species of economic importance. *Journal of Agricultural Research* 6: 469.
- Quaintance, Altus L. A. L. and A. C. Baker. 1917. A contribution to our knowledge of the whiteflies of the subfamily Aleurodicinae (Aleyrodidae). *Proceedings of the U. S. National Museum* 51: 335-445.
- Red Rock Canyon Interpretive Association. 2008. last accessed December 2009 at <http://www.redrockcanyonlv.org/>.
- Riley, Charles V. & Howard, L. O. 1893. The orange *Aleyrodes* (*Aleyrodes citri* n. sp.). *Insect Life* 5: 219-226.
- Russell, Louise. 1944. A taxonomic study of the genus *Aleuroglandulus* Bondar (Homoptera: Aleyrodidae). *Proceedings of the Entomological Society of Washington* 46: 1-9.
- Russell, Louise. 1948. A classification of the whiteflies of the new tribe Trialeurodini (Homoptera: Aleyrodidae). *Revista de Entomologia, Rio de Janeiro* 18: 1-85.
- Sampson, Woodrow. W. 1945. Five new species of Aleyrodidae from California (Homoptera). *Pan-Pacific Entomologist* 21: 59.
- Silvestri, Filippo. 1915. Contributo all conoscenza degli insetti dell'olivo dell'Eritrea e dell'Africa meridionale. (in Italian). *Bollettino del Laboratorio di Zoologia Generale e Agraria della R. Scuola Superiore d'Agricoltura, Portici*: 9:240-334.
- Simon, Belen. et al. 1999. Variación genética de poblaciones de *Bemisia tabaci* (Gennadius) en la Cuenca Mediterránea occidental. Proc. 7th Spanish Nat'l. Cong., Aguadulce, Almeria: 25-33.
- Sorenson, Carl. E. 1991. The ash whitefly: A new pest of ornamental plants and fruit trees in Nevada. Nevada Cooperative Extension, University of Nevada, Reno; fact sheet 91-16 Systematic Entomology Lab, ARS, USDA.
- Takahashi, R. 1936. Three species of Aleyrodidae from China (Homoptera). *Lingnan Science Journal* 15: 453-455.

USDA, ARS. Germplasm Resources Information Network. 2007. <http://www.ars-grin.gov/cgi-bin/npgs/html/taxecon>. Last accessed December, 2009.

Watson, Gillian (CDFA). 2008. Personal communication by email.

## Appendix A: Glossary of Puparium Morphology & Structures

The following is a generalized illustration of an Aleyrodine puparium (copyright protected) followed by a list of scientific terms.

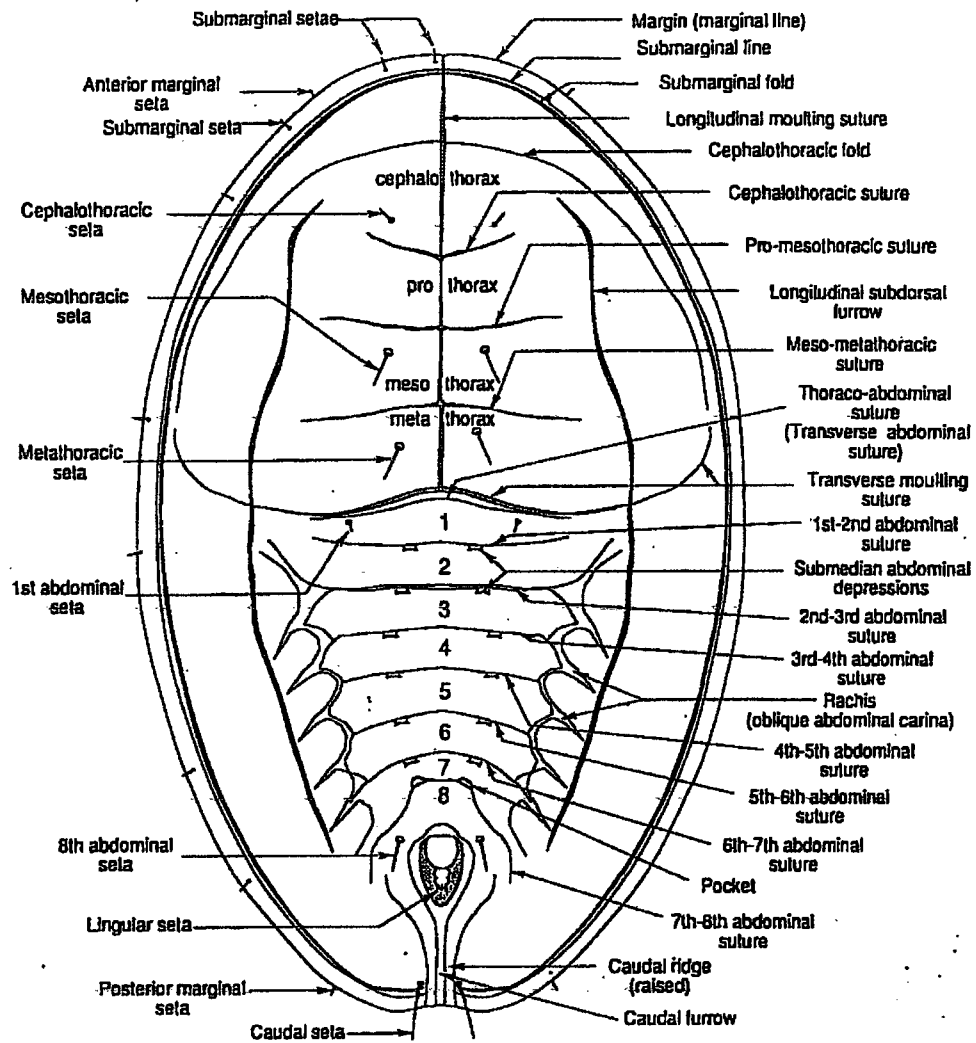


Illustration: Pupal form

(courtesy Dan Gerling, TelAviv University & Ray Gill, CDFA-retired)

**Abdominal segments (Figure 23).** 7-8 visible segments below the third pair of legs and the transverse molting suture.



Figure 23 Abdominal segments

**Cephalothorax with cranial suture (Figure 24).** Cephalothorax is the area from the anterior margin of the body (cephalon, C<sub>1</sub>) to the transverse suture (thorax, T<sub>1</sub> to T<sub>3</sub>). The cranial suture is a pair of sclerotized but sometimes weak lines (seams) extending from the median to the submedian area on the cephalon anterior to first pair of legs.

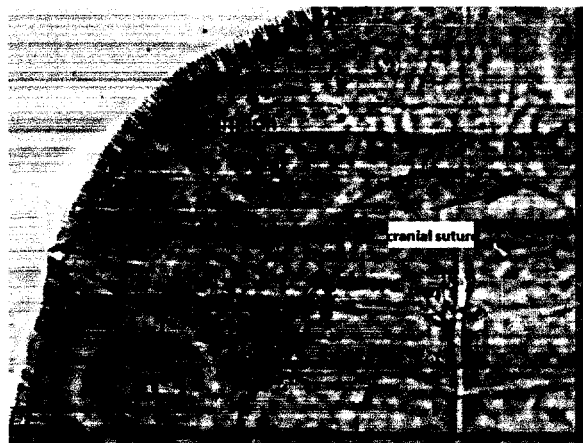


Figure 24 Cephalon



**Lateral margin** (Figure 25). Outermost puparial region that is toothed (dentate), crenulate (plate-like) or smooth. In species that have the lateral margin reflexed or deflexed, the true margin is folded, dorsally or ventrally, appearing to be in the submedian area of the body, and the submargin appears to be the false lateral margin.

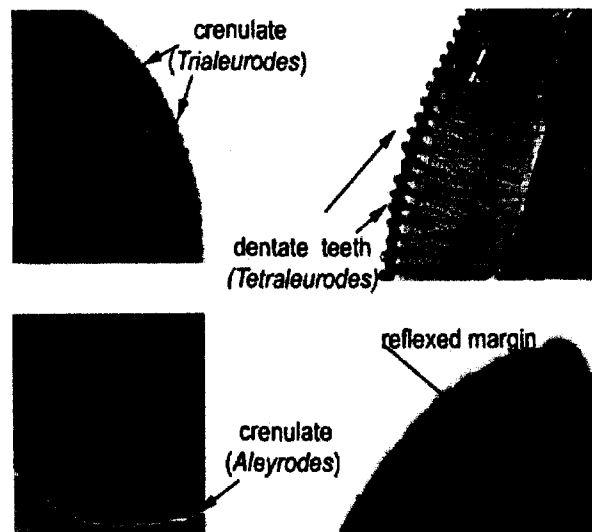


Figure 25. Lateral puparial margin

**Leg appendages** (Figure 26). Normally 2-segmented structures (except from Africa); oriented down or toward the median axis; terminal appendage of leg is either either a pad (Aleyrodinae) or claw (Aleurodicinae).

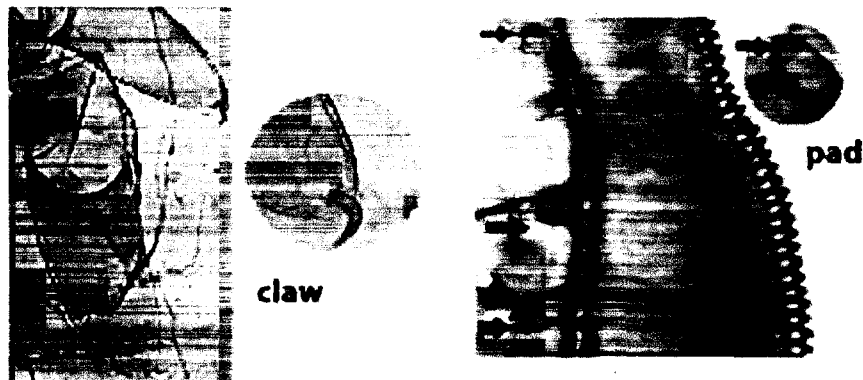


Figure 26. Claw or pad

**Lingula** (Figure 27). Various-shaped dorsal organ in the vasiform orifice, used to remove fecal material, inserted (within the vasiform orifice) or exerted (extending beyond the vasiform orifice), and partially or completely covered by the operculum.



Figure 27. Lingula obscured      partly exposed      exposed

**Median and submedian areas** (Figure 29). Median refers to the area along the center axis for the puparium; submedian refers to the area adjacent to the median areas

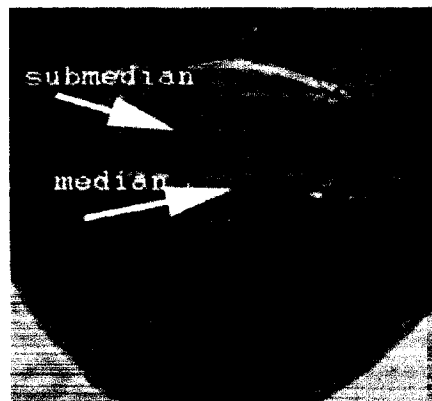


Figure 29. Median and submedian areas

**Molting suture** (Figure 28). Longitudinal molting suture extends from the anterior apex of the margin to the transverse molting suture. Transverse molting suture terminated at or well before the margin and is a transverse, curved line separating the thorax from the abdomen.

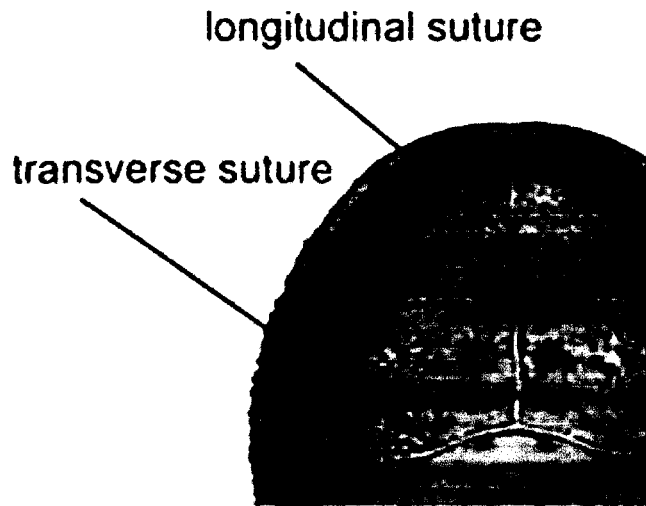


Figure 28. Molting sutures

**Operculum** (Figure 30). Plate like structure that partially or completely covers the vasiform orifice (images, see lingula)

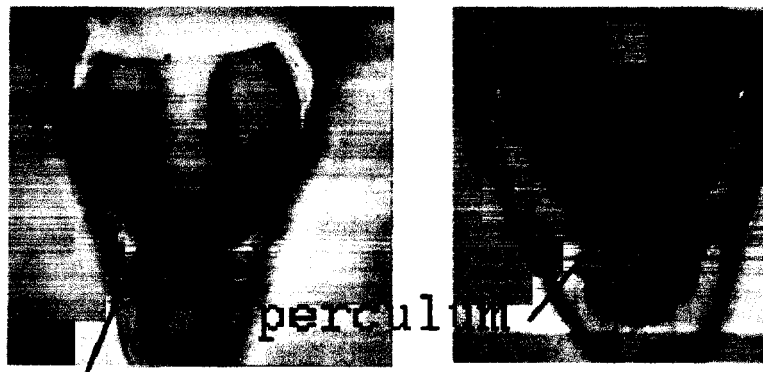


Figure 30. Operculum

**Papillae** (Figure 31). Bullet, rod or reniform shaped structures often found in the submarginal rows dorsally from the cephalon to the cauda.

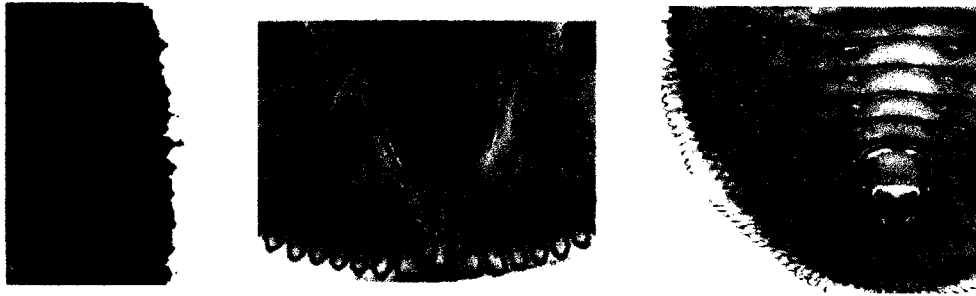


Figure 31. Papillae variable

**Subdorsal and submarginal areas** . Subdorsal area falls between the submedian and the submarginal area; the submarginal area falls between the subdorsal area and the margin.

**Tracheal or caudal clefts** (Figure 32). Differentiated marginal areas opposite the spiracles and the vasiform orifice. May be smooth or plate, pore or comb shaped.

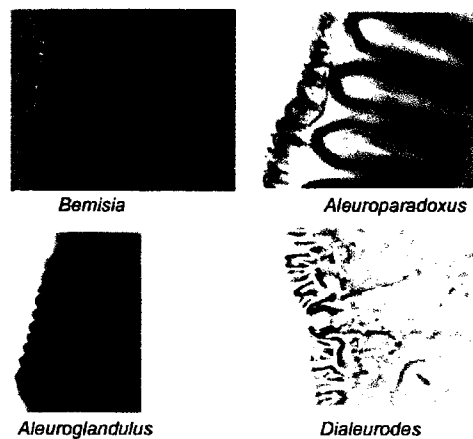


Figure 32. Tracheal and caudal cleft

**Tubercles** (Figure 33). Papillae are bullet, rod or reniform shaped structures often found in the submarginal rows dorsally from the cephalon to the cauda. Tubercles are raised, rounded or, amorphic structures found in submarginal rows or scattered over the dorsum.

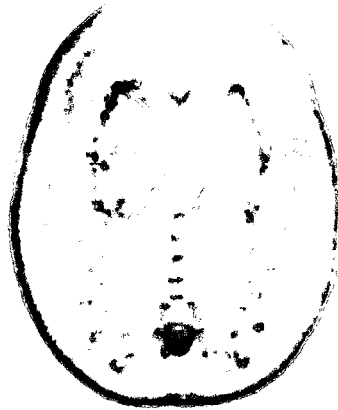
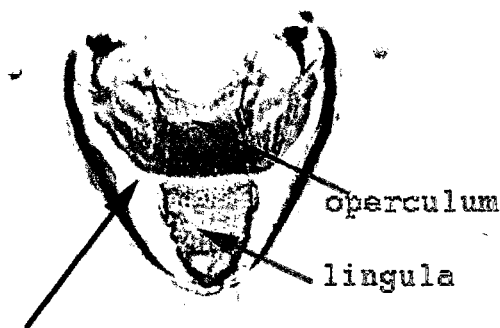


Figure 33. Tubercles

**Vasiform orifice** (Figure 34). Various shaped structure (cordate, subcordate, rectangular, quadrate or triangular) located medially on  $A_8$  containing a lingula and partially or entirely covered by an operculum.



vasiform orifice

Figure 34. Vasiform orifice

## Appendix B: other undescribed species

### *Aleuropleurocelus* sp. #2

DIAGNOSIS. PUPARIUM: *Habitus* (in nature). Oval, black in color; puparia usually solitary and found on the upper or lower side of the leaf. Wax formation not noticeable. Puparium 871. 1  $\mu\text{m}$  long and 576.2  $\mu\text{m}$  wide. *Margin*. Deflexed (inside) margin smooth to slightly sinuate. The physical margin is tuberculate with irregular-shaped structures. True and apparent lateral outside margin separated by a distance of 47  $\mu\text{m}$  distance. *Dorsum*. The entire dorsal cuticle is patterned with multiple rows and clusters of various sized granules from the cephalon to the caudal areas and from the subdorsum (deflexed inner margin) to the submedian area. The median area is weakly sculptured. Longitudinal molting suture terminates at margin and is 319.9  $\mu\text{m}$  long. The suture has an adjacent single row of weak granules on each side of varying sizes extending from the longitudinal suture to the inner margin, but not giving a zippered appearance. The transverse suture extends out curving anteriorly terminating at outermost inner margin anterior to the level of the thoracic suture. Eyespot present, suboval in shape with outer margin notched and bounded by a moderately thick rim. *Venter*. The ventral cuticle has a moderate to weakly granulated appearance except for a smooth median area; the legs and antennae are obscured by a very opaque pupal case so that they are poorly visible. *Vasiform orifice*. Orifice is widely cordate (41.6  $\mu\text{m}$  long and 46.9  $\mu\text{m}$  wide) with a moderate to broad lateral and posterior margin forming a partial ventral ring with anterior margin weakly defined. Operculum is 28.3  $\mu\text{m}$  long to 30  $\mu\text{m}$  wide; completely covers the lingula and at least 2/3 of the orifice. Caudal protuberance reduced with the caudal

pair of setae widely separated. *Pores*. Dorsal cluster of minute thoracic pores are adjacent to and radiating from the longitudinal suture; a band of minute pores forming a lunate pattern near the anterior inner margin on the cephalon and extending laterally; most ventral abdominal segments with bands of minute pores from the subdorsum to the median area. *Chaetotaxy*. Thoracic and A<sub>1</sub> submedian setae absent; caudal pair of setae present (22 µm to 24 µm long).

MATERIAL EXAMINED (3 slides). One slide with one puparium is deposited at the Systematic Entomology Lab, ARS, USDA: collected at Sandstone Quarry (Red Rock Canyon NCA) at 36<sup>o</sup>09.829N by 115<sup>o</sup>27.049 24-viii-2006 collected on *Quercus* sp. (collected by Dr. Knight and Robert Little); Sand Stone Quarry 22-vi-2007: 1 puparium. Sand Stone Quarry 36<sup>o</sup>09.781N by 115<sup>o</sup>27.011, 27-iii-2008: 1 puparium collected on *Quercus* sp. Collected by John Dooley.

HOSTS. Fagaceae: *Quercus* sp.

COMMENTS: This undescribed species was validated on 3/19/2008 by Dr. Greg Evans at Systematic Entomology Lab at Beltsville, Md. For differences, see *Aleuropleurocelus* sp#1. Although this organism displays unique character traits that differ from *Aleuropleurocelus* sp. #1 and #3, more specimens need to be collected before determining if this is a new species.

*Aleuropleurocelus* sp. #3

DIAGNOSIS. PUPARIUM: *Habitus* (in nature). Oval, black in color requiring bleaching before slide mounting. Puparium, 798. 9  $\mu\text{m}$  long and 558.3  $\mu\text{m}$  wide, usually solitary on upper or lower side of leaf. Wax formation not noticeable. *Margin*. Deflexed (inside) margin smooth to slightly sinuate. The outside margin tuberculate with irregular-shaped structures. True and outside margin separated by a distance of 60  $\mu\text{m}$  distance from outer to inner Margin. *Dorsum*. The entire dorsal cuticle is patterned with multiple rows and clusters of various sized granules from the cephalon to the caudal areas and from the subdorsum (deflexed inner margin) to the submedian area. The median area is weakly sculptured. Longitudinal molting suture, 358. 8  $\mu\text{m}$  long, terminates at the margin; with an adjacent single row of weak granules on each of its sides, of varying sizes, extending from the transverse suture to the inner margin, but not giving a zippered appearance. The transverse suture extends out and curves anterior terminating at the outermost margin anterior to the level of the thoracic suture. Eyespot present, suboval in shape without outer notched margin and bounded by a moderately thick rim. *Venter*. The ventral cuticle has a moderate to weakly granulated appearance except being smooth in the median area; the legs and antennae are poorly visible due to the very opaque pupal case. *Vasiform orifice*. Orifice is widely cordate, 33  $\mu\text{m}$  long and 35  $\mu\text{m}$  wide, with a moderate to broad lateral and posterior margin forming a partial ventral ring with anterior margin weakly defined. Operculum is 24  $\mu\text{m}$  long to 30  $\mu\text{m}$  wide; completely covers the lingula and at least 2/3 of the orifice. Caudal protuberance reduced with the caudal pair of setae widely separated. *Pores*. Dorsal cluster of minute thoracic pores absent but



solitary pores present: cephalothorax with 3 pairs of submedian pores. Most abdominal segments with 1-2 minute submedian and one minute subdorsal pairs of pores.

*Chaetotaxy.* Thoracic and A<sub>1</sub> setae absent; caudal pair of setae present, 34-38 μm long.

MATERIAL EXAMINED (one slide). One Puparium collected at the Sand Stone Quarry (Red Rock Canyon NCA), 3-vii-2006 on *Quercus* sp. by John Dooley; deposited at and validated by Dr. Greg Evans (PPQ) at Systematic Entomology Lab (ARS).

HOSTS. Fagaceae: *Quercus* sp.

COMMENTS: This undescribed species was validated on 3/19/2008 by Dr. Greg Evans (PPQ) at Systematic Entomology Lab (ARS)) at Systematic Entomology Lab at Beltsville, Md. Although this organism displays unique character traits that differ from *Aleuropleurocelus* sp. #1 and #2, more specimens need to be collected before determining if this is a new species.

***Trialeurodes* sp. #2**

DIAGNOSIS. Field characteristics unknown, except puparium very dark and closely resembles *T. notata* as validated by Dr. Greg Evans (PPQ) at Systematic Entomology Lab (ARS).

COMMENTS: Two puparia collected (one slide poor) on *Ribes* sp. at Mahogany Grove in the temperate biogeographical area of Mount Charleston at 36°18.722N by 115°37.098W. More specimens need to be collected before determining if this is a new species