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Author: Douglass R. Miller

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SELECTED SCALE INSECT GROUPS (HEMIPTERA: COCCOIDEA) IN THE SOUTHERN REGION OF THE UNITED STATES

DOUGLASS R. MILLER
Systematic Entomology Laboratory, PSI, Agricultural Research Service, U.S. Department of Agriculture
Room 137, Building 005, BARC-West, 10300 Baltimore Avenue, Beltsville, MD 20705

ABSTRACT
This publication includes general discussions on the Conchaspididae, Diaspididae, Eriococcidae, Ortheziidae, Pseudococcidae, and Putoidae. Keys are presented for genera in the families Eriococcidae, Ortheziidae, and Pseudococcidae. Material for each family include introduction, field appearance, diagnosis, life history, important references, illustration of a slide-mounted adult female, and a checklist of the species occurring in the Southern Region of the United States and their distribution by state.

Key Words: scales, identification, southeastern United States

RESUMEN
Esta publicación incluye un discusión general de los Conchaspididae, Diaspididae, Eriococcidae, Ortheziidae, Pseudococcidae, y Putoidae. Las secciones para cada familia incluye una introducción, su apariencia en el campo, su diagnosis, la tabla de vida, referencias importantes, una ilustración de la hembra adulta montada en laminas de microscopio, una lista de las especies que ocurren en la Región sureste de los Estados Unidos y su distribución en cada Estado. Se incluye claves para los Eriococcidae, Ortheziidae, y Pseudococcidae.

Scale insects are phytophagous, feeding by sucking plant juices through a set of stylets. Individual species infest one or more or leaves, fruit, branches, main stems, trunks, or roots. They are widely distributed throughout the world with the exception of the cold extremes of the Arctic and Antarctic. They are found on a wide diversity or vascular plants, but only a few species are found on ferns and mosses. There is some debate about their rank in the classification system but they are considered by many authors to be part of the Order Hemiptera, Suborder Sternorrhyncha, Superfamily Coccoidea (Gullan 2001). The group includes about 7,300 species, 1,050 genera (Ben-Dov et al. 2002), and 20 or more families (especially if the margarodoids are divided into separate family units).

Scale insects are generally small, cryptic creatures that cause major problems in agricultural and ornamental ecosystems. They are commonly transported on plant materials and because of their small size and habit of feeding in concealed areas are frequent invasive species (Miller et al. 2005) causing billions of dollars in damage annually (Kosztarab 1990).

Scales are characterized by having a single claw, neotenic adult females, winged but non-feeding adult males, and an unusual form of metamorphosis that normally includes a prepupa and pupa in the adult male (Miller & Kosztarab 1979). Generally there are 3 or 4 instars in the female and 5 instars in the male. Most scale insects produce some kind of wax covering that may entail a mealy substance over the body or elaborate waxy structures that are attached to the body of the insect or are formed as domicile-like structures.

A list of families that occur in the Southern Region of the United States is given below. This, the splitters view of the Coccoidea, is becoming increasingly accepted in the discipline (Koteja 1974). Distribution records are those listed in ScaleNet (Ben-Dov et al. 2005) and have been supplemented with data from the Florida State Collection of Arthropods, Gainesville, FL and National Museum of Natural History, Beltsville, MD. Distribution records include established outdoor and greenhouse infestations, but do not include records of material taken in quarantine and destroyed.

1. Aclerididae (Flat grass scales)—small-sized family, worldwide 57 species
2. Asterolecaniidae (Pit scales)—moderate-sized family, worldwide 223 species
3. Cerococcidae (Ornate pit scales)—moderate-sized family, worldwide 72 species
4. Coccidae (Soft scales)—large-sized family, worldwide 1,130 species
5. Conchaspididae (False armored scales)—small-sized family, worldwide 29 species
6. Dactylopiidae (Cochineal scales)—small-sized family, native to new world 10 species
7. Diaspididae (Armored scales)—largest-scale family, worldwide 2,300 species

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8. Eriococcidae (Felt scales)—large-sized family, rare in the Oriental and Afrotropical areas 556 species
9. Kermesidae (Gall-like scales)—moderate-sized family, primarily from the northern hemisphere 90 species
10. Kerriidae (Lac scales)—moderate-sized family, worldwide 97 species
11. Kuwaniidae—small-sized margarodoid family, occurring under bark of hosts 8 species
12. Lecanodiaspididae (False pit scales)—moderate-sized family, worldwide 78 species
13. Margarodidae (Ground pearls)—moderate-sized margarodoid family, worldwide 108 species
14. Matsucoccidae (Pine bast scales)—small-sized margarodoid family on pines from Australia and the northern hemisphere 46 species
15. Monophlebidae (Giant scales)—moderate-sized margarodoid family, worldwide 255 species
16. Ortheziidae (Ensign scales)—moderate-sized family, worldwide 196 species
17. Pseudococcidae (Mealybugs)—large-sized family, worldwide 1,989 species
18. Putoidae (Giant mealybugs)—small-sized family, in all regions but Australasian and Afro-tropical areas 57 species
19. Xylococcidae—small-sized margarodoid family occurring in northern hemisphere and neotropics 11 species

Conchaspididae or False Armored Scales (Fig. 1)

False armored scales occur in all zoogeographic regions but probably are introduced in the Australasian and Palearctic regions. Madagascar seems to have the greatest diversity of species. There are 29 species in 4 genera worldwide; in the United States and in the Southern Region there are 3 species in 2 genera (Ben-Dov et al. 2002). Conchaspis angraeci Cockerell is widespread and may be introduced into the US, but Asceloconchaspis milleri Williams appears to be native to southern Florida.

Field Characters: Body hidden under thick wax cover similar to armored scale cover except exuviae not incorporated. Cover not attached to body, often volcano shaped with ridges radiating from scale apex; round or oval in outline. Some covers without conical top, but usually with ridges. Cover of most species white or dirty white. Female body usually white (Mamet 1954) deep red or purple in Conchaspis cordiae (F. William Howard, pers. comm., May 2005).

Diagnosis: Posterior abdominal segments coalesced into pygidium; legs present in all but 1 species; trochanter and femur fused; tibia and tarsus fused; antennae 3- to 5-segmented; ocellar spot on head; 2 genera with metathoracic sclerotizations near hind coxae.

Hosts: Conchaspidids are frequently collected on trees and woody perennials, but they also are found on orchids, euphorbias, and palms.

Life History: False armored scales have 4 female instars and 5 in the male (Miller 1991b). First instars settle on the host but do not produce a cover until the first molt. They usually settle on the leaves or branches of the host.

Important references: Ben-Dov (1974); Ben-Dov (1981); Mamet (1954); Mamet (1959); Williams (1985a); Williams (1992).

Checklist of false armored scales of the Southern Region (asterisk signifies a commonly collected species)

*Asceloconchaspis milleri Williams  FL

*Conchaspis angraeci Cockerell  FL, PR

Conchaspis cordiae Mamet FL, PR.

Diaspididae or Armored Scale Insects (Figs. 2, 3)

Armored scales are the most speciose family of scale insects including about 2,369 species in 380 genera (Ben-Dov et al. 2002). Although there are several classifications of the Diaspididae, there are two groups that contain a majority of the species and are relatively easy to recognize. They often are used as informal groups and are referred to as diaspidines and aspidiotines; they are based on two of the major subfamilies of armored scales, the Diaspidinae and Aspidiotinae (Ferris 1942). There are no obvious characters that separate these groups all of the time, but most species are consistent with the following combination of characters. Diaspidines produce an elongate scale cover and have two-barred macroducts, more than one seta on each antenna, gland spines between the pygidial lobes, bilobed second lobes, and pores near the spiracles. Aspidiotines produce an oval or round cover and have one-barred macroducts, one seta on each antenna, plates between the pygidial lobes, simple second lobes, and no pores near the spiracles.

Field Characters: Wax covering domicile-like, not attached to body; wax covering with exuviae of 1 or 2 immature instars incorporated and usually visible; cover formed of wax manipulated by pygidium, of solid consistency, not filamentous or powdery; often with ventral cover; body elongate or oval; body color white, yellow, purple, red, or orange; occurring on nearly any part of plant, rare on roots and rootlets; some species become buried under plant epidermis.

Diagnosis: Posterior abdominal segments coalesced into wax-forming structure called pygidium; generally with lobes and plates or gland spines on pygidium; legs absent or represented by small sclerotized area; antennae represented by unsegmented knob; labium 1-segmented.
Host plants: Armored scales occur on a variety of host plants encompassing more than 1,380 plant genera in 182 plant families (compiled from Borchsenius 1966). The most prevalent host families are: Fabaceae with about 230 species of armored scales, Poaceae with about 150 species, and

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Fig. 1. *Conchaspis angraeci* Cockerell: Illustration from Gill (1993).
Euphorbiaceae with 145 species. Armored scales usually are pests on plants that survive for more than a single year including fruit and nut crops, forest trees, and ornamentals such as landscape perennials, shrubs, shade trees, and greenhouse plants. Miller and Davidson (1990) compiled a list of 199 species that are considered pests in at least some part of the world. This figure is only about 8% of the total number of described species and their economic impact is quite significant.

Life History: Diaspidids have 3 female instars and 5 male instars (Miller 1991b) Life histories are quite diverse; there can be from 1 to 6 or more generations each year and overwintering can be in any instar except the third, fourth, or adult male. Second instars and mated adult females are probably the most common. In many species, the number of generations and overwintering stages can vary depending on the climate. Eggs or first instars (=crawlers) are laid under the scale cover and a small slit is present at the posterior end of the cover that allows the crawlers egress to the outside. Scale cover formation is an interesting process that usually involves the incorporation of the crawler and second-instar exuviae. Several groups are pupillarial, i.e., the adult female remains inside of the hardened second instar exuviae. Dispersal is undertaken by the first-instar crawler either passively by air movement or actively by crawling. The first instar is the only life stage that has legs with the exception of the third, fourth, and adult male. Males only incorporate the shed skin of the crawler into their cover; the exuviae of the other instars are kicked posteriorly in the cover (Miller & Davidson 2005).

Important references: Balachowsky (1948, 1950, 1951, 1953, 1954); Ben-Dov & German (2003); Borchsenius (1966); Danzig (1993); Ferris (1937, 1938, 1941, 1942); Howard & Oliver (1985); Miller & Davidson (2005); Miller & Gimpel (2005); Tang (1986).

Checklist of Armored Scales of the Southern Region (asterisk signifies a frequently collected species)

Abgrallaspis colorata (Cockerell) FL, NC, SC, TX
*Abgrallaspis cyanophylli (Signoreti) FL, GA, LA, MS, PR, TX
Abgrallaspis iihacae (Ferris) GA, TN, VA
Abgrallaspis liriodendri Miller and Howard LA
Abgrallaspis perseae Davidson GA, TX
Acutaspis agavis (Townsend and Cockerell) FL, TX
Acutaspis albopicta (Cockerell) TX
Acutaspis aliena (Newstead) FL, PR
*Acutaspis morrisonorum Kosztarab AL, AR, FL, GA, LA, NC, PR, TN, VA
Acutaspis perseae (Comstock) AL, FL, GA, LA, MS, SC, TN, TX
Acutaspis scutiformis (Cockerell) TX
Aneceaspis tridentata (Ferris) TX
Andaspsis hawaiensis (Maskell) FL
Andaspsis mackieana (McKenzie) FL
Andaspsis puniceas (Laing) FL
Annulaspsis polygona Ferris TX
Aonidia atlantica Ferris AL, FL, GA
Aonidia shastae (Coleman) TX
*Aonidiella auranti (Maskell) FL, LA, MS, PR, TX
*Aonidiella citrina (Coquillett) FL, TX
Aonidiella comperei McKenzie PR
Aonidiella inornata McKenzie PR, TX
Aonidiella orientalis (Newstead) FL, PR
*Aonidiella taxus Leonard FL, GA, LA
*Aonidomytilus albus (Cockerell) FL, PR
Aonidomytilus concolor (Cockerell) TX
Aonidomytilus crooki (Ferris) FL, GA, VA
*Aonidomytilus hyperici Ferris FL, GA, LA, MS, NC, VA
Aonidomytilus peniangularis (Ferris) TX
Aonidomytilus sabatius Tippins AL, GA
*Aonidomytilus solidaginis (Hoke) AL, FL, GA, LA, MS, SC, TN, VA
Aspidiaspis gainesi McDaniel TX
Aspidiella hartii (Cockerell) PR
*Aspidiella sacchari (Cockerell) FL, PR, TX
Aspidiotus destructor (Signoret) FL, GA, PR
Aspidiotus excisus Green FL, PR
Aspidiotus marisci AL, FL, GA
*Aspidiotus neri Bouche AL, FL, GA, LA, MS, PR, TX
*Aulacaspsis rosea Bouche FL, GA, LA, PR, SC, VA
*Aulacaspsis tuberculatus Newstead FL, PR
*Aulacaspsis yasumatsui Takagi FL, PR
*Carulaspsis juniperi Bouche GA, VA
*Carulaspsis minima (Signoreti) AL, FL, GA, LA, NC, TN, TX, VA
Chioniaspis acericolor Hohlender GA, NC, TX
*Chioniaspis americana Johnson FL, GA, LA, MS, TN, TX, VA
Chioniaspis carvae Cooley FL, LA, NC, VA
Chioniaspis corni Cooley LA, VA
Chioniaspis etrusca Leonardi TX
*Chioniaspis floridensis Takagi FL
*Chioniaspis furfura (Fitch) FL, GA, KY, LA, MS, NC, TN, TX, VA
*Chioniaspis gleditsiae Sanders FL, LA, MS, NC, TN, TX, VA
Chioniaspis hamoni Liu and Kosztarab FL
*Chioniaspis heterophyllae Cooley AL, FL, GA, LA, MS, NC, TN
*Chioniaspis kosztarabii Takagi and Kawai FL, GA, MS, NC, TN, VA
Chioniaspis linteri Comstock FL, LA, TX
Chioniaspis longiloba Cooley AL, AR, FL, LA, TX
Chioniaspis nyssae Comstock AL, FL, GA, LA, MS, NC, SC, TX, VA
*Chioniaspis pinifoliae (Fitch) AL, FL, GA, LA, TN, TX, VA
Chioniaspis platani Cooley LA, NC, TX, VA
*Chioniaspis saliscis (Linnaeus) AL, AR, FL, LA, MS, NC, TN, TX, VA
Chioniaspis styracis Liu and Kosztarab FL
Chioniaspis triformis Tippins and Beshar FL, GA
Chortinaspsis chattos McDaniel TX
Chortinaspsis divaricata Ferris FL, GA
Chortinaspsis frankliniana Ferris TX
Chortinaspsis graminella (Cockerell) FL, GA, TX
*Chrysomphalus aonidum (Linnaeus) AL, FL, GA, LA, MS, PR, TX
*Chrysomphalus bifasciulatus Ferris AL, GA, LA, NC, SC, TX, VA
*Chrysomphalus dictyospermi (Morgan) FL, GA, LA, MS, PR, TX
Fig. 2. Diaspidinae—*Lepidosaphes pallida* (Maskell): Unpublished illustration by Davidson.
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Circulaspis fistulata (Ferris) TX
Circulaspis fistulella Ferris FL, GA, TX
Clavaspidas barbigera Ferris FL
Clavaspidas crypta Howell and Tippins GA
Clavaspidas courtsiae (Marlatt) FL, TX
Clavaspidas coullae (Ferris) TX
*Clavaspidas herculanea (Cockerell and Hadden) FL, PR, TX
Clavaspidas mori (Herrick) TX
Clavaspidas pedianthi (Ferris) TX
Clavaspidas subaeminus (Cockerell) TX
Clavaspidas texana Ferris TX
*Clavaspidas ulmi (Johnson) GA, LA, MS, SC, TX, VA
*Comstockiella sabalis (Comstock) FL, GA, LA, MS, NC, SC, TX
Crenulaspis dicitron Miller and Davidson PR
Crenulaspis dicrotensis (Lindinger) PR
Cupidaspidas cupressi (Coleman) TX
Dactylaspidas crotonis (Cockerell) PR
Dactylaspidas lobata Ferris TX
Diaspidiota aequulis (Johnson) TX
*Diaspidiota ancyulus (Putnam) AL, FL, GA, KY, LA, MS, NC, SC, TN, TX, VA
*Diaspidiota juglanisregiae (Comstock) AL, FL, GA, LA, MS, SC, TN, TX, VA
*Diaspidiota liquidambaris (Kotinsky) AL, FL, GA, LA, MS, NC, SC, TN, TX, VA
*Diaspidiota mcmobri McKenzie AL, FL, GA, LA, MS, NC, SC, VA
*Diaspidiota osborni (Newell and Cockerell) AL, FL, GA, KY, LA, MS, NC, SC, TN, TX, VA
*Diaspidiota perniciosus (Comstock) AL, AR, FL, GA, KY, LA, MS, SC, TN, TX, VA
Diaspidiota piceus (Sanders) TN
Diaspidiota socialis (Hoke) GA, MS, TX
Diaspidiota taxdii (Ferris) FL, GA, LA, TX
*Diaspidiota uvae (Comstock) AL, AR, FL, GA, KY, MS, NC, TN, TX, VA
*Diaspis boisduvali (Bouché) FL, GA, LA, PR, TN, TX
*Diaspis bromeliae (Kerner) FL, LA, PR
*Diaspis coccois Lichtenstein FL
*Diaspis cognata Hoke FL, MS
*Diaspis diospyri Ferris TX
*Diaspis echnoaceti (Bouché) FL, GA, LA, PR, TN, TX, VA
Diaspis radicicola Ferris TX
Diaspis texensis (Cockerell) TX
Diaspis toumeyi Cockerell TX
Dicirculaspis bhursa (Ferris) TX
Duplachionaspis diversgens (Green) FL
Duplachionaspis claviger (Cockerell) FL
Duplachionaspis fosor (Newstead) PR
Duplachionaspis tesseratus (Grandpre and Charmoy) FL, PR
Dynaspis abietis (Schrank) FL, GA, MS
Dynaspis britannicus (Newstead) LA
Dynaspis californicus (Coleman) GA, LA, TX
Epidiaspis tillandsiae Takagi and Tippins FL, GA
Ferrisidea magnae (Ferris) TX
Ferrisidea externa Ferris GA, VA
*Fiorinia floriae (Targioni Tozzetti) AL, FL, LA, GA, PR
Fiorinia japonica Kuwana VA
Fiorinia pinicola Maskell GA
*Fiorinia theae Green AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, TX, VA
Fissuraspis ulmi (Hoke) AR, FL, GA, MS, TX
*Froggattiella penicillata (Green) AL, FL, GA, LA, MS, PR, TX
Furcaspis biiformis (Cockerell) FL, PR
Geodiaspis arundinariae Tippins and Howell GA
Gymnaspis aechmeae Newstead AL, FL, LA, PR
Haliaspis arcibo Howell PR
Haliaspis asymmetrica (Ferris) FL, GA, NC
Haliaspis litoralis (Ferris) TX
Haliaspis maczeniae (McDaniel) TX
Haliaspis nakaharai Howell PR
Haliaspis pennisarius Howell FL
*Haliaspis spartinae (Comstock) FL, GA, SC, TX, VA
Haliaspis texana Liu and Howell TX
Haliaspis unioleae Takagi FL, GA, LA, SC
*Hemiberlesia lataniae (Signoret) AL, FL, GA, LA, MS, NC, PR, TX, VA
Hemiberlesia musae Takagi and Yamamoto PR
*Hemiberlesia neodiffinis Miller and Davidson AL, AR, FL, GA, LA, MS, NC, SC, TN, TX
Hemiberlesia palmae (Cockerell) FL
*Hemiberlesia populare (Marlatt) TX
*Hemiberlesia rapax (Comstock) AL, FL, GA, LA, MS, PR, SC, TX, VA
Hemigymnaspis eugeniae (Lindinger) PR
Houndria bicalvis (Comstock) LA, PR
*Ischnaspis longirostris (Signoret) FL, GA, LA, PR
Kuwanspis hokoni (Kuwana) FL, GA
Kuwanspis houndri (Cooley) FL, GA, LA
Kuwanspis linearis (Green) PR
*Kuwanspis pseudoleucaspis (Kuwana) AL, FL, GA, LA, SC
Kuwanspis verniformis (Takahashi) FL
Lapazia obscura Howell and Beeshar TX
*Leptidosaphes becki (Newman) FL, GA, LA, MS, PR, TN, TX
Lepidosaphes boguschi McDaniel TX
*Leptidosaphes camelliae Hoke FL, GA, LA, MS, SC, TX, VA
Lepidosaphes conchiformis (Gmelin) PR
*Leptidosaphes conchiformis (Gmelin) PR
Lepidosaphes crotonis (Cockerell) FL
Lepidosaphes elaeagni (Packard) AL, FL, LA, MS, PR, SC, TX
Lepidosaphes lasianthei (Green) PR
Lepidosaphes neusteadii (Sulc) FL, MS
*Leptidosaphes pallida (Maskell) FL, GA, LA, MS, VA
Lepidosaphes pinnaeformis (Bouché) FL
Lepidosaphes rubrouttata Cockerell PR
Lepidosaphes tokionis (Kuwana) MS, PR
*Leptidosaphes ulmi (Linnaeus) FL, GA, LA, NC, TN, VA
Lepidosaphes vermiculus Mamet PR
Lepidosaphes yanagica Kuwana GA, TN, VA
Lopholeucaspis cockerelli (Grandpre and Charmoy) FL, PR
Lingdingiaspis floridana Ferris FL
Lopholeucaspis japonica (Cockerell) VA
Melanaspis arundinariae Deitz and Davidson SC
Melanaspis bromilae (Leonardi) FL, PR
Melanaspis coccoloba Ferris FL, PR
Melanaspis dekleri Deitz and Davidson FL, GA
Melanaspis delicata Ferris TX
Melanaspis deliquescent Ferris TX
Melanaspis elegani McKenzie LA, TX
Melanaspis jamacana (Ferris) TX
Melanaspis latipygna Ferris TX
Melanaspis lilacina (Cockerell) TX
Melanaspis marlatti (Parrott) FL, GA, TX
Melanaspis mimosaes (Comstock) FL
Melanaspis nigropunctata (Cockerell) PR, TX, VA
*Melanaspis obscura (Comstock) AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, TX, VA
Melanaspis odontoglossi (Cockerell) FL, PR
Melanaspis pseudoponderosa Deitz and Davidson FL, TX
Melanaspis smalisics (Comstock) FL, GA, LA, MS, NC, SC, TX, VA
Melanaspis tenax McKenzie FL, PR
*Melanaspis tenebricosa (Comstock) AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, TX, VA
*Morganella ceroenosis (Cockerell) FL, GA, LA, MS, SC, TX
Morganella longispina (Morgan) FL, PR
Myctetus apiaca (Newstead) TX
Myctetus defectopus Ferris FL, TX
Myctetus personata (Comstock) FL, PR
Myctetus sphaerioides (Cockerell) LA
Neopinnaspis harperi McKenzie FL, GA
Niveaspis ilicis (Hoike) GA, MS, TX
Oceanaspis triductus (Adachi and Fullaway) FL, PR
*Oceanaspis spinosus (Comstock) AL, FL, GA, LA, MS, PR, TX
Odonaspis benardi Balachowsky TX
Odonaspis floridana Ben-Dov FL, PR
Odonaspis litorosa Ferris TX
Odonaspis minima Howell and Tippins GA
*Odonaspis ruthae Kotinsky AL, AR, FL, GA, LA, MS, NC, PR, SC, TX
Odonaspis saccharaecis (Zehntner) AL, FL, PR, TX
Odonaspis secreta (Cockerell) LA
Odonaspis texana Ben-Dov TX
Opuntiaspis carinata (Cockerell) FL
Opuntiaspis javanensis Green FL
Palinaspis quohogiformis (Merrill) FL, PR
Parlatoropsis chinesis (Marlatt) FL
*Parlatoria camelliae Comstock AL, FL, GA, LA, MS, NC, SC, TX, VA
Parlatoria cineria Hadden PR
Parlatoria crotonis Douglas FL, LA, PR
*Parlatoria pergandii Comstock AL, FL, GA, LA, MS, NC, PR, SC, TX, VA
*Parlatoria proteus (Curtis) FL, GA, LA, MS, PR, TN, TX
Parlatoria pseudopodidiotus Lindinger FL, PR, TN
Parlatoria theae Cockerell GA, NC, TX, VA
Parlatoria ziziphy (Lucas) FL, PR
Pellucaspis celsis McDaniel TX
*Pinaspis arbuscula (Signoret) AL, AR, FL, GA, KY, LA, MS, NC, PR, SC, TN, TX, VA
Pinaspis buxi (Bouché) FL, PR
*Pinaspis strachani (Cooley) AL, FL, GA, LA, MS, PR, TX
Praecocaspis diversa Ferris FL
Protodiaspis emoryi Ferris TX
Protodiaspis lobata Ferris TX
Protodiaspis varia Hoike AR, MS, TN, TX
*Pseudaonidia duplex (Cockerell) AL, FL, GA, LA, MS, NC, SC, TX, VA
*Pseudaonidia paeniae (Cockerell) AL, AR, FL, GA, LA, MS, NC, SC, TX, VA
Pseudaonidia triploleberis (Green) FL, PR
*Pseudaonidia cockerelli (Cooley) AL, FL, GA, LA, MS, PR, SC, TN, TX, VA
*Pseudaonidia pentagona (Targioni Tozzetti) AL, FL, GA, LA, MS, NC, PR, SC, TN, TX, VA
*Pseudaonidia prunolica (Maskell) AL, FL, GA, LA, MS, NC, VA

Eriococcidae or Felt Scales (Fig. 4)

Felt scales occur in all zoogeographic regions but have very poor representation in the Afrotropical and Oriental regions and are very abundant in New Zealand and Australia. There are 542 species in 69 genera; in the United States there are 80 species in 10 genera; in the Southern Region including Puerto Rico there are 49 species in 7 genera (Ben-Dov et al. 2002). Several species are occasional pests in the Southern Region including Eriococcus azaleae on azaleas, E. coccineus on cactus especially Mammillaria, E. quercus on oaks, and E. spurius on elms.

Field Characters: Felt scales are very diverse and comprise a number of apparently unrelated groups (Cook et al. 2002). The most common eriococcids in the U.S. are those of the Eriococcus type. They produce a white, gray, or yellowish ovisac that encloses the pyriform body of the adult female. Body color varies from pink or red to purple, green, or brown. The posterior end of the sac has a small opening that allows the first instars to escape. Other eriococcids occur under the bark of the host, produce little or no ovisac secretion and often are pink or red. Many species produce galls including one of the most interesting genera Apiomorphe which induces very ornate structures on various species of eucalyptus (Cook & Gullan 2002).

Diagnosis: Because of the great diversity and lack of monophyly of this family (Cook et al. 2002) there is no single diagnostic character. Characters that often are present on felt scales include: microtubular ducts; strongly protruding anal lobes; conical setae; cruciform pores; translucent pores on hind legs (Miller & McKenzie 1967).
Hosts: Eriococcids occur on a wide diversity of hosts including trees, shrubs, and even grasses. They are found on all parts of the host with the possible exception of small diameter rootlets. The greatest diversity in the southern hemisphere is on older families such as the Myrtaceae whereas
in the northern hemisphere they are most diverse on more advanced plant groups such as the Asteraceae (Hoy 1962; Miller 1969).

Life History: Felt scales have 3 instars in the female and 5 in the male (Miller 1991b). Most eriococcus-type species have 1 or 2 generations each.
year. The overwintering stage usually is the adult female or egg in the ovisac. First instars appear in early spring and settling often occurs within hours of emergence from the ovisac. Second-instar males feed for a short period then produce a narrow felt sac that encloses the body. Development of the prepupa, pupa, and adult male occurs within this sac. Soon after molting, the adult female mates and produces the ovisac several days later. Usually 50 to 100 eggs are laid. Some eriococcids have very unusual life histories. One example is the gall-inducing genus Apiomorpha which can have females that live for a year or more and produce separate male galls that often are induced on the gall of the female (Cook 2001; Cook & Gullan 2002).

Important references: Cook (2001); Cook et al. (2002); Ferris (1955); Gill (1993); Gullan (1984); Hoy (1962, 1963); Miller & Gimpel (2000).

Checklist of Felt Scales of the Southern Region
(asterisk signifies a frequently collected species)

**Eriococcus idastes** Ferris TX
**Cornoculus cornutus** Ferris TX
**Cryptococcus fugisuga** Lindinger TN, VA
**Cryptococcus williamsi** Kostarab VA
**Eriococcus actius** (Miller and Miller) FL, GA
*Eriococcus aracuarensis* Maskell FL, TX, PR
**Eriococcus arenariae** (Miller and Miller) SC
**Eriococcus arenosus** Cockerell TX
*Eriococcus azaleae* Comstock AL, AR, FL, GA, LA, MS, NC, SC, TN, TX, VA
**Eriococcus besheareae** (Miller and Miller) FL, GA, SC
**Eriococcus boguschi** McDaniel TX
**Eriococcus caroliniae** Williams NC, VA
**Eriococcus chilos** (Miller and Miller) VA
*Eriococcus coccineus* Cockerell FL, TX, VA
**Eriococcus cryptus** Cockerell TX
**Eriococcus davidsoni** (Miller and Miller) FL
**Eriococcus densus** (Miller and Miller) AL, FL, GA, SC, VA
*Eriococcus drusae** (Miller, Liu, and Howell) FL, GA
*Eriococcus dubius* Cockerell AL, TX
**Eriococcus erigoni** Ehrhorn FL
**Eriococcus euphoria** Ferris TX
**Eriococcus gerberi** McDaniel TX
**Eriococcus howelli** (Miller and Miller) FL, GA, SC, VA
**Eriococcus hoyi** (Miller and Miller) TX
**Eriococcus kemptoni** Parrott AL, GA, MS, TX, VA
**Eriococcus laeves** Parrott and Cockerell TX
**Eriococcus leptoporus** (Miller and Miller) GA
**Eriococcus megaporus** (Miller and Miller) FL, GA, SC, VA
**Eriococcus mesotrichus** (Miller and Miller) FL, GA, LA, SC
**Eriococcus microtrichus** (Miller and Miller) TX
**Eriococcus missouri** Hollinger GA, LA, MS, VA
**Eriococcus monotrichus** (Miller and Miller) FL, GA
**Eriococcus nudulus** (Ferris) TX

**Eriococcus oligotrichus** (Miller and Miller) GA
**Eriococcus ophius** (Miller and Miller) FL, GA
*Eriococcus quercus* (Comstock) AL, FL, GA, LA, MS, TX, VA
**Eriococcus smithi** Lobbell FL, GA, LA, MS, SC, TX
**Eriococcus spurius** (Modeer) AL, AR, LA, TN, TX, VA
**Eriococcus stellatus** McDaniel TX, VA
**Eriococcus texanus** King TX
**Eriococcus tinsleyi** TX
**Eriococcus tosotrichus** (Miller and Miller) GA
**Hypericoccus hyperici** (Ferris) AL, FL, GA, TN
**Oregmopyga neglecta** (Cockerell) TX
**Oregmopyga parvispina** (Chaffin) FL, TX
**Oregmopyga strongyla** Miller and Miller GA
**Oregmopyga tippinsi** Miller and Miller AL, FL, GA, MS
**Ovaticoccus adoxus** Miller and Miller TX
*Ovaticoccus agavium* (Douglas) TX

Ortheziidae or Ensign Scales (Fig. 5)

Ensign scales occur in all zoogeographic regions of the world. There are 198 species and 20 genera worldwide; in the United States there are about 30 species in 7 genera; and in the Southern Region there are 17 species in 6 genera (Ben-Dov et al. 2002).

Field Characters: Adult females with a thick wax ovisac that is attached to the abdomen and not the host; body adorned with patches of thick wax giving an ornate, elegant appearance; legs and antennae large and dark (Kozár 2004).

Diagnosis: Anal ring on dermal surface, with pores and setae; apex of antenna with thick terminal seta; abdominal spiracles present; eyes stalked; predominant pore type quadrirocular; usually with ovisac band around perimeter of ventral abdomen (Kozár 2004).
Hosts: Ortheziids occur on a broad diversity of host plants ranging from mosses and fungi to grasses and woody shrubs, even on small herbaceous plants (Morrison 1925, 1952).

Life History: Ensign scales have 4 instars in the female and most likely 5 instars in the male (Miller 1991b). It is unknown if the prepupa is mobile like most margarodoid groups or is seden-
tary like other scale insects. The life history of these scales is not well described. In the greenhouse on coleus, Orthezia insignis (Browne) could complete a complete life cycle in 30 days and reproduction was strictly parthenogenetic. Offspring were deposited over 24 days and from 80-102 nymphs were produced per female (Shivakumar & Lakshmikantha 2001). Normally feeding on the foliage of the host.

Important References: Kozár (2004); Miller et al. (2005); Morrison (1925, 1952).

Notes: In 2004, a book was completed on the Ortheziidae of the world by Ferenc Kozár. Many new genera and species are included from most areas of the world. The Orthezia species groups used by Morrison (1952) are now treated as genera, e.g., the graminis species group is now Graminorthezia, so the number of described genera has nearly doubled.

**KEY TO ENSIGN SCALE GENERA IN THE SOUTHERN REGION**

1. Tibiae and tarsi separate ................................................................. 3
   Tibiae and tarsi fused ................................................................. 2

2(1). Antennae 3- or 4-segmented; first 2 segments smaller or equal to other segments ....... Nipponorthezia
   Antennae 6- or 7-segmented; first 2 segments largest ................................... Newsteadia

3(1). With rows of setae inside of ovisac band ........................................... 4
   Without rows of setae inside of ovisac band. .............................................. Insignorthezia

4(3). Head without dorsal sclerotized plates .............................................. 5
   Head with dorsal sclerotized plates ....................................................... Praelongorthezia

5(4). 7 or fewer pairs of abdominal spiracles ........................................... Graminorthezia
   8 pairs of abdominal spiracles. ......................................................... Orthezia

**Pseudococcidae or Mealybugs (Fig. 6)**

Mealybugs occur in all zoogeographic regions of the world and are abundant in most ecosystems. There are 1,989 species and 271 genera worldwide; in the United States there are 351 species in 48 genera; and in the Southern Region there are 155 species and 37 genera (Ben-Dov et al. 2002).

Field Characters: Adult females are often characterized by a white, mealy or powdery secretion that covers the body. Species that occur in concealed habitats such as grass sheaths either lack this secretion or have only small amounts of it. Frequently marginal areas of the body have a series of protruding lateral wax filaments. These filaments may be absent, confined to the posterior 1 or 2 abdominal segments, or occur around the entire body perimeter. A filamentous secretion often is produced that encloses the eggs and at least part of the body (McKenzie 1967).

Diagnosis: Look for the following combination of characters; none are present in all species. With ostioles; cerarii, when present, usually present at least on anal lobe; 1 or more circuli; swirled-type trilocular pores; translucent pores on hind legs; 2 pores on each surface of trochanter; without basal denticle on claw. Other characters to consider are: trochanter pores parallel to front edge of femur, not oriented transversely; 3 labial segments; usually 3 pairs of anal-ring setae; more than 4 setae on tibia; tubular ducts without invagination (Williams 2004; Miller et al. 2005).

Notes: No single character can be used to determine a specimen as a pseudococcid. Mealybugs are a large and diverse group and exceptions occur for every character. There are species without ostioles, cerarii, circuli, trilocular pores, and translucent pores. Although the family is distinct, the only way that it can be diagnosed is by using a combination of characters (Danzig 1986).

Hosts: Based on an analysis of the host information in the mealybug catalogue by Ben-Dov (1994), mealybugs occur on species in about 250 families of host plants. The most common host family is Poaceae with 585 species. The Asteraceae is a distant second with 250 species. The top ten most common host families are Fabaceae 225; Rosaceae 116; Rubiaceae 101; Euphorbiaceae 97; Myrtaceae 94; Labiatae 85; Moraceae 82; Cyperaceae 75. It is interesting that grasses and composites are such

**Checklist of Ensign Scales (Ortheziidae) of the Southern Region (asterisk signifies a commonly collected species)**

*Graminorthezia pseudograminis* (Morrison) TX
*Graminorthezia tillandsiae* (Morrison) FL, GA, LA, VA
*Insignorthezia cactiologia* (Morrison) TX
*Insignorthezia insignis* (Browne) FL, PR, TN, VA
*Insignorthezia pseudinsignis* Morrison LA, TX
*Newsteadia americana* Morrison SC, VA
*Newsteadia floridensis* Kozár and Koncze Benedicty FL
*Newsteadia minima* Morrison FL, GA, NC, VA
*Newsteadia trisegmentalis* Howell FL, GA
*Nipponorthezia obscura* Morrison FL, SC, TX, VA
*Orthezia ambrosiola* Morrison TX
*Orthezia annae* Cockrell TX
*Orthezia graminicola* Morrison GA, MS
*Orthezia solidaginis* Sanders GA, VA
*Praelongorthezia chisosi* Morrison TX
*Praelongorthezia gymnolomiae* (Morrison) TX
*Praelongorthezia praelonga* Douglas PR
important hosts of mealybugs, but are far less common as hosts of armored scales. This might be explained by the tendency for mealybugs to occur on herbaceous plants rather than woody plants. There are surprisingly few mealybugs on families such as Salicaceae, Pinaceae, and Betulaceae.

Fig. 6. *Pseudococcus maritimus* (Ehrhorn): Illustration from Miller, Gill, and Williams (1984).
KEY TO SLIDE-MOUNTED ADULT FEMALE MEALYBUG GENERA IN THE SOUTHERN REGION

1. Trilocular pores abundant .......................................................... 6
   ...Trilocular pores absent or rare ............................................... 2

2(1). Quinquelocular pores present ................................................. 3
   Quinquelocular pores absent .................................................. 4

3(2). With a few trilocular pores near spiracles ............................... Brevennia
   ...Without trilocular pores ...................................................... Heterococcus

4(2). Posterodorsal setae filamentous, not enlarged ........................... 5
   Some posterodorsal setae enlarged, similar in shape to cerarian setae  
   Hypoecoccus

5(4). Pores in spiracular atria ...................................................... Miscanthicoccus
   ...Pores absent from spiracular atria ....................................... Syrmeccocus

6(1). Legs present ................................................................. 9
   Legs absent ................................................................. 7

7(6). Small pores or ducts in cluster posterior of hind spiracle ........... 8
   ...Small pores absent from area posterior of hind spiracle ............ Antonina

8(7). Anal ring at end of invaginated tube; anal ring setae longer than diameter of anal ring  
   Chaetococcus
   ...Anal ring on dorsal surface, not in a tube; anal ring setae shorter than diameter of ring  
   Paludicoccus

9(6). Antennae not geniculate or elbowed; normally not on rootlets of host  
   ...Antennae geniculate; usually on rootlets of host ...................... 10

10(9). Apex of body with 2 spines; head also with 2 spines ............... Geococcus
   ...Apex of body and head without spines ................................ Rhizoecus

11(9). Legs well developed, longer that clypeolabral shield plus labium  
   ...Legs small; front legs about same length or shorter than clypeolabral shield plus labium  
   Humococcus

12(11). Without circuli ............................................................. 13
   With circuli ........................................................................... Radicoccus

13(12). Hind coxae not enlarged, without translucent pores ................ 14
   Hind coxae greatly enlarged, with numerous translucent pores ....... Pseudantonina

14(13). Anal ring without pores ..................................................... Ehrhornia
   ...Anal ring with many pores ................................................ Antoninoides

15(11). Anal ring with pores .......................................................... 16
   ...Anal ring without pores ....................................................... Humococcus

16(15). Claw without a denticle ...................................................... 20
   Claw with a denticle ................................................................... 17

17(16). Dorsal tubular ducts without a sclerotized orifice .................... 18
   Some dorsal tubular ducts protruding and with sclerotized orifices .... Heliococcus

18(17). Dorsal setae conical or filamentous ..................................... 19
   Some dorsal setae enlarged, often truncate, with cluster of basal trilocular pores  
   Stemmatomerinx
Fig. 7. _Puto kosztarabi_ Miller and Miller: Illustration from Miller and Miller (1993).
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
<th>Taxon</th>
</tr>
</thead>
<tbody>
<tr>
<td>19(18).</td>
<td>Dorsal tubular ducts without clusters of multilocular pores surrounding orifice.</td>
<td>Phenacoccus</td>
</tr>
<tr>
<td>20(16).</td>
<td>Without oral-rim tubular ducts</td>
<td>( \text{or} ) ( \	ext{with} ) oral-rim tubular ducts</td>
</tr>
<tr>
<td>21(20).</td>
<td>With multilocular pores at least near vulva</td>
<td>( \text{or} ) ( \	ext{without} ) multilocular pores</td>
</tr>
<tr>
<td>22(21).</td>
<td>With more than 6 pairs of cerarii</td>
<td>( \text{or} ) ( \	ext{with} ) 6 or fewer pairs of cerarii</td>
</tr>
<tr>
<td>23(22).</td>
<td>Oral-rim tubular ducts without associated setae, usually without sclerotization around rim</td>
<td>( \text{or} ) ( \	ext{with} ) oral-rim tubular ducts with associated setae and heavy sclerotization around rim</td>
</tr>
<tr>
<td>24(23).</td>
<td>Anal bar present; dorsal setae nearly as long as ventral setae</td>
<td>( \text{or} ) ( \	ext{with} ) anal bar absent; dorsal setae conspicuously shorter than ventral setae</td>
</tr>
<tr>
<td>25(22).</td>
<td>Anal bar present</td>
<td>( \text{or} ) ( \	ext{with} ) anal bar absent</td>
</tr>
<tr>
<td>26(25).</td>
<td>18 pairs of cerarii</td>
<td>( \text{or} ) ( \	ext{with} ) 17 or fewer pairs of cerarii</td>
</tr>
<tr>
<td>27(25).</td>
<td>Auxiliary setae present in cerarii other than anal-lobe pair</td>
<td>( \text{or} ) ( \	ext{with} ) auxiliary setae absent from cerarii other than anal-lobe pair</td>
</tr>
<tr>
<td>28(20).</td>
<td>Small discoidal pores absent from derm near hind coxae</td>
<td>( \text{or} ) ( \	ext{with} ) small discoidal pores present on derm near hind coxae</td>
</tr>
<tr>
<td>29(28).</td>
<td>Anal lobe cerarius with more than 3 conical setae; without unusually long marginal setae on each of posterior 4 abdominal segments</td>
<td>( \text{or} ) ( \	ext{with} ) anal lobe cerarius with 2 conical setae; with unusually long marginal setae on each of posterior 4 abdominal segments</td>
</tr>
<tr>
<td>30(28).</td>
<td>6 or fewer pairs of cerarii</td>
<td>( \text{or} ) ( \	ext{with} ) more than 6 pairs of cerarii</td>
</tr>
<tr>
<td>31(30).</td>
<td>Cerarii anterior of anal lobe pair without auxiliary setae</td>
<td>( \text{or} ) ( \	ext{with} ) cerarii anterior of anal lobe pair with auxiliary setae</td>
</tr>
<tr>
<td>32(31).</td>
<td>Antennae 9-segmented; legs unusually long, extending beyond posterior apex of body</td>
<td>( \text{or} ) ( \	ext{with} ) antennae with fewer than 9 segments; legs not usually extending beyond posterior apex of body</td>
</tr>
<tr>
<td>33(31).</td>
<td>Dorsal setae not conical, differently shaped than cerarian setae</td>
<td>( \text{or} ) ( \	ext{with} ) some dorsal setae conical, same shape as cerarian setae</td>
</tr>
<tr>
<td>34(33).</td>
<td>Cerarii with 3 or fewer conical setae</td>
<td>( \text{or} ) ( \	ext{with} ) cerarii with more than 3 conical setae</td>
</tr>
<tr>
<td>35(34).</td>
<td>With more than 10 pairs of cerarii; with an anal bar</td>
<td>( \text{or} ) ( \	ext{with} ) with fewer that 10 pairs of cerarii; without an anal bar</td>
</tr>
<tr>
<td>36(30).</td>
<td>Dorsal tubular ducts absent or without associated setae, usually without sclerotization around orifice</td>
<td>( \text{or} ) ( \	ext{with} ) dorsal tubular ducts with associated setae and sclerotization around rim</td>
</tr>
<tr>
<td>37(36).</td>
<td>Multilocular pores present, at least near vulva</td>
<td>( \text{or} ) ( \	ext{with} ) multilocular pores absent</td>
</tr>
<tr>
<td>38(37).</td>
<td>Without or with 1 circulus</td>
<td>( \text{or} ) ( \	ext{with} ) with more than 1 circulus</td>
</tr>
<tr>
<td>39(38).</td>
<td>Cerarii numbering more than 1 pair</td>
<td>( \text{or} ) ( \	ext{with} ) cerarii absent or restricted to anal lobe</td>
</tr>
<tr>
<td>40(39).</td>
<td>On pines; body rotund</td>
<td>( \text{or} ) ( \	ext{with} ) on grasses; normally slender, elongate</td>
</tr>
<tr>
<td>41(39).</td>
<td>Not on grasses; body round or broadly oval</td>
<td>( \text{or} ) ( \	ext{with} ) occurring on grasses; body often elongate or elongate oval</td>
</tr>
</tbody>
</table>
Checklist of Mealybugs of the Southern Region
(asterisk signifies a frequently collected species)

*Antonina nakaharai* Williams and Miller (misidentification of *A. crawii*) LA
*Antonina grammis* (Maskell) AL, FL, GA, LA, MS, PR, SC, TX
*Antonina pretiosa* Ferris FL, GA, LA
Antoninoides bouteilouae (Parrott) TX
Antoninoides nortoni (Parrott and Cockerell) FL, GA, NC, TX
Antoninoides parrotti (Cockerell) FL, MS, TX
Brevennia rehi (Lindinger) FL, PR, TX
*Chaeococcus bambusae* (Maskell) FL, PR
Chnaurococcus trifolii (Forbes) VA
Chorizococcus dentatus (Lobdell) MS, VA
Chorizeococcus graysonii Brachman and Kosztarab VA
Chorizococcus nakaharai Williams and Granara de Willink PR
Chorizococcus psoraleae McKenzie TN
Chorizococcus rostellum (Lindinger) LA, MS, VA
Chorizococcus shaferi (Hollinger) MS
Distichlicoccus taxodii Kosztarab FL, GA, VA
Distichlicoccus alkalinus (Cockerell) TX
Distichlicoccus digitariae Williams and Granara de Willink PR
Dysmicoccus biginosus Beardsey PR
*Dysmicoccus bonisinsi* (Kuwana) VA, GA, LA, MS, PR, SC, TX
*Dysmicoccus brevipes* (Cockerell) FL, LA, PR
Dysmicoccus difficilis (Lobdell) MS, VA
Dysmicoccus diomdium (McConnell) MS, SC, VA
*Dysmicoccus grasseti* (Leonardi) PR
*Dysmicoccus juncus* (McConnell) VA
*Dysmicoccus lassii* (Cockerell) FL, VA
*Dysmicoccus merrilli* (Ferris) FL
*Dysmicoccus milleri* Kosztarab AL, FL, GA, VA
*Dysmicoccus morrisoni* (Hollinger) AL, GA, LA, MS, VA
*Dysmicoccus neobrevipes* Beardsley FL, PR
*Dysmicoccus obsesus* (Lobdell) AL, AR, GA, LA, MS, NC, VA
Dysmicoccus texensis (Tinsley) TX
Dysmicoccus Vaccini Miller and Polavarapu NC
Dysmicoccus wistariae (Green) VA
Euryecoccus blanchardii (King and Cockerell) TX
Euryecoccus campbellii Kosztarab VA
Euryecoccus capillinae Ferris FL
Euryecoccus yucae Ferris TX
Ferrisia claviseta (Lobdell) MS
Ferrisia floridana (Ferris) FL
Ferrisia quinquandci (Tinsley) TX
*Ferrisias malvastra* (McDaniel) TX
*Ferrisias virgata* (Cockerell) FL, LA, PR, TX, VA
Geococcus coffeae Green FL, PR
Helioecoccus deserticola Miller TX
Helioecoccus insignis (Lobdell) LA, MS
Helioecoccus osborni (Sanders) LA, TX, VA
Helioecoccus stachyos (Ehrhorn) VA
Helioecoccus wheeleri (King) TX
Heterococcus nudus (Green) VA
Heterococcus ratti Miller SC
Humococcus atriplicis Ferris TX
Humococcus dasycladse (Ferris) TX
Humococcus hilariae (Ferris) TX
Hypogeococcus barbarae Rau VA
Hypogeococcus hamonii Miller FL
Hypogeococcus margaretae Miller FL
Hypogeococcus spinosus Ferris TX
*Macconellicoccus hirsutus* (Green) FL, PR
*Miscenthococcus miscanthi* (Takahashi) VA
*Nipaecoccus nipae* (Maskell) FL, LA, PR
*Orcella acuta* (Lobdell) FL, GA, KY, LA, MS, NC, SC, TX, VA
Palmicoccus brouni Williams and Watson FL
*Palmicoccus palmarum* (Ehrhorn) FL
*Palmicoccus lumparensis* (Takahashi) FL
Paludicoccus distichium (Kuwana) TX
Paracoccus juniperti (Ehrhorn) TX
*Paracoccus marginatus* Williams and Granara de Willink FL
Paracoccus townsendi (Cockerell) TX
Paradoxococcus medanieli McKenzie AL, FL, GA, MS, SC, TX, VA
Paraput lovedum (Cockerell) (=Cataenococcus oliva- ceus) FL, TX
Pelioecoccus flaveolus (Cockerell) VA
Pelioecoccus serratus (Ferris) TN, VA
Phenacoccus acericola King KY, TN, VA
Phenacoccus coelestrae Ehrhorn FL, PR
Phenacoccus dearnessi King TX, VA
Phenacoccus gosspji (Townsend and Cockerell FL
Phenacoccus helianthi (Cockerell) TX
Phenacoccus horotonarum Bachman and Kosztarab VA
Phenacoccus hordi McKenzie TX
*Phenacoccus madeinensis* Green AL, FL, LA, MS, NC, PR, TX, VA
Phenacoccus minimus Tinsley VA
Phenacoccus parvus Morrison FL, PR
Phenacoccus rubivorus Cockerell NC, VA
*Phenacoccus solani* Ferris FL, LA, PR, TX, VA
*Phenacoccus solenopsis* Tinsley FL, MS, TX, VA
*Planococcus citri* (Risso) AL, AR, FL, GA, KY, LA, MS, NC, PR
SC, TN, TX, VA
*Planococcus ficus* (Signoret) AL, FL, GA, NC, SC, TX
Planococcus eugeniae Miller and Denno FL
*Pseudantonina arundinariae* McConnell SC
*Pseudantonina gigantococa* (Lindberg) FL, GA
*Pseudantonina nakaharai* Kosztarab VA
Pseudantonina wilkeyi Kosztarab VA
*Pseudococcus bryberia* Ferris TX
*Pseudococcus bryberia* Gimpel and Miller FL, GA, VA
*Pseudococcus constocki* (Kuwana) GA, LA, SC, VA
*Pseudococcus dasyliriae* Gimpel and Miller TX
*Pseudococcus dolichomelos* Gimpel and Miller FL, NC, SC, TX
*Pseudococcus donrileyi* Gimpel and Miller TX
*Pseudococcus elisae* Borchsenius FL
*Pseudococcus importatus* McKenzie FL
*Pseudococcus jackbeardsleyi* Gimpel and Miller FL, PR, TX
*Pseudococcus longispinus* (Targioni Tozzetti) AL, FL, NC, PR, TX
*Pseudococcus maritimus* (Ehrhorn) AR, FL, GA, TN, TX, VA
*Pseudococcus microcirculus* McKenzie FL
*Pseudococcus nakaharai* Gimpel and Miller FL, TX

42(4). Anal lobe cerarii with large concentration of basal trilocular pores, 2 conical setae ........... Chnaurococcus
Anal lobe cerarii without a concentration of basal trilocular pores, often without conical setae ............................................. Euryecoccus

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Pseudococcus odermatti Gimpel and Miller FL
Pseudococcus pithecellobii Gimpel and Miller TX
Pseudococcus puertoricensis Gimpel and Miller PR
Pseudococcus sorghiellus (Forbes) AR, FL, GA, LA, NC, SC, TN, VA
Pseudococcus spanocera Gimpel and Miller AR, FL, GA
*Pseudococcus viburni* (Signoret) AL, FL, GA, NC, SC, VA
Rhizoecus americanus (Hambleton) FL, PR
Rhizoecus apizacus Hambleton TX
Rhizoecus caucicus (Hambleton) FL
Rhizoecus dianichi Green FL
Rhizoecus bicirculus McKenzie TX
Rhizoecus brevirostris Hambleton TX
Rhizoecus bituberculatus McKenzie NC
Rhizoecus distinctus (Hambleton) TN, VA
Rhizoecus falcifer Kunckel d’Herculais FL
Rhizoecus flavianus Hambleton FL, GA
Rhizoecus gracilis McKenzie TX, VA
Rhizoecus hibisci Kuwana and Takagi FL, PR
Rhizoecus kelloggi (Ehrhorn and Cockerell) FL, TX
Rhizoecus keyensis Hambleton FL
Rhizoecus ladaniae Hambleton FL
Rhizoecus leucosomus (Cockerell) FL, TX, VA
Rhizoecus martimimus (Cockerell) FL
Rhizoecus mexicanus (Hambleton) FL
Rhizoecus palestinez (Hambleton) FL
Rhizoecus pseudoacatis Gimpel and Miller FL
Rhizoecus simplex (Hambleton) FL
Rhizoecus spicatus Hambleton FL
Rhizoecus solani (Hambleton) TX
Rhizoecus spinipes (Hambleton) AR, FL, GA
Saccharicoccus sacchari (Cockerell) PR
Spilococcus erioanti (Ehrhorn) TX
Spilococcus gutierreziae (Cockerell) TX
Spilococcus prosopidis (Cockerell) TX
Spilococcus steili (Cockrell and Townsends) TX
Stemmatomerinx acicula Howell and Miller FL
Stemmatomerinx adenticulata Howell and Miller GA
Stemmatomerinx aristida Howell and Miller GA
Stemmatomerinx besheareae Howell and Miller GA
Stemmatomerinx decorata Ferris TX
Syrnococcus spirapuncta (Lobdell) FL, MS
Syrnococcus pecosensis Ferris TX
Tridiscus matildae Kosztarab SC
Trionymus americanus (Cockerell) MS
Trionymus cariciis McConnell FL, GA, SC, TN, VA
Trionymus clandestinis McConnell VA
Trionymus louryi Brachman and Kosztarab VA
Trionymus mori Lobdell MS
Trionymus radicicola (Morrison) PR
Trionymus smithii (Essig) VA

**Putoideae** or giant Mealybugs (Fig. 7)

Giant mealybugs occur in the Nearctic, Neotropical, Oriental, and Palearctic regions. They are absent from the Afrotropical and Australasian regions. There are 57 species and 1 or 2 genera worldwide; in the United States there are 23 species in 1 genus; and in the Southern Region there are 5 species and 1 genus (Ben-Dov et al. 2002).

**Diagnosis:** Body large and rotund; claw with basal denticle in addition to subapical denticle; cerarii large and conspicuous; trochanter with 3 or 4 pores on each surface; with trilocular pores, ostioles, translucent pores on hind legs, and usually with a circulus (Williams 2004; Miller 1991a).

**Notes:** Giant mealybugs are quite uniform in their morphological characteristics. The family most likely includes only 1 or 2 genera: *Macroceoccus* (which often is treated as a synonym of *Puto*) and *Puto*. *Ceroputo* clearly is a pseudococcid and not a putoid. Putoids have only recently been removed from the Pseudococcidae, based primarily on their chromosome system.

**Life History:** Giant mealybugs have 4 instars in the female and 5 in the male. Most species have a single generation each year, although *Puto sandini* Washburn requires 4 years to complete a generation (Washburn 1965). *Puto antennatus* (Signoret) has a single generation each year and feeds on conifers in the high elevations of the Varian Alps. Overwintering occurs in the immature stages under the bark of the host. In early spring the nymphs move to the bases of needles, enlarge, and appear as adults in early May. Adult males are common. Eggs are laid in July (Sampo & Olmi 1979). *Macroceoccus superbus* Leonardi has essentially the same life history. There is a single generation each year, adults appear in May, and ovipsotion occurs in July. Mating is necessary for reproduction. First instars are the overwintering stage (Marotta 1992).

Important references: Ben-Dov (1994); Ben-Dov & German (2005); Danzig (1986, 1999); Kosztarab & Kozár (1988); McKenzie (1967); Miller & Miller (1993a); Williams (2004).

**Giant Mealybugs (Putoideae) of the Southern Region** (asterisk signifies a frequently collected species)

*Puto barberi* (Cockrell) PR
Puto kostzarabi Miller and Miller VA
Puto lasiorum (Cockrell) TX
Puto mexicanus (Cockrell) TX
*Puto yuccae* (Coquillett) TX

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