

Florida Department of Agriculture and Consumer Services Division of Plant Industry

***Chionaspis pinifoliae* (Fitch) (Diaspididae: Coccoomorpha: Hemiptera), pine needle scale, a potential pest of Florida pines and the Christmas tree industry, but not established in Florida**

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INTRODUCTION

Chionaspis pinifoliae (Fitch), pine needle scale, is a common pest of conifers, especially in urban environments and Christmas tree farms. This insect is considered one of the most serious pests of ornamental pines in the U.S., especially mugo pine and Scotch pine (Johnson and Lyon, 1991; Miller and Davidson, 2005). In Québec, *C. pinifoliae* is an emerging pest of Christmas trees, but is not known to cause significant damage. Although not generally monitored by growers, *C. pinifoliae* can be an obstacle for export (Doherty et al., 2018). Morphological and biological similarities between *C. pinifoliae* and a closely related species, pine scale, *C. heterophyllae* Cooley, have led to taxonomic confusion. For example, there is a historical case of misidentification where a research program focusing on *C. pinifoliae* was found to have actually worked with *C. heterophyllae* when voucher specimens were reexamined (Nielsen and Johnson, 1973).

For the past two years, many *Abies fraseri* (Pursh) Poir (Pinaceae) and *Pinus strobus* L. (Pinaceae) Christmas trees were rejected for sale in Florida because of contamination with *C. pinifoliae*. Rejected plant shipments were from North Carolina (FDACS-DPI sample numbers E2017-4458, E2017-4501, E2017-4688, E2018-6007, E2018-6128) and Canada (E2017-4743). These regulatory actions raised questions from Christmas tree producers and state Extension faculty at North Carolina State University (NC State) and the University of Florida. Shipments were rejected because of contamination with *C. pinifoliae* but literature indicated the species had been recorded in Florida since 1899 (Cooley, 1899; Merrill and Chaffin, 1923; Wilson, 1917; Dekle, 1976; Liu et al., 1989; Miller and Davidson, 2005). Each of these publications were based on records from the Florida Department of Agriculture and Consumer Services (FDACS) Division of Plant Industry (DPI) or the Florida State Collection of Arthropods (FSCA). Recently all of the DPI records and FSCA specimen slides reported as *C. heterophyllae* and *C. pinifoliae* were reexamined. All previous records of *C. pinifoliae* from Florida are either interceptions from other states or countries, or misidentifications of *C. heterophyllae*. In addition, only *C. heterophyllae* was found in a recent collection survey performed by Jerrold Moody (NC State) from *Pinus* sp. in the field in Lake County (E2018-278). Our findings provide strong evidence that *C. pinifoliae* does not occur in Florida.

Chionaspis heterophyllae is apparently native to North America including Florida (Miller and Davidson, 2005). *Chionaspis pinifoliae* has a relatively broad host range (reported on three host plant families: Cupressaceae, Pinaceae, Taxaceae) compared to *C. heterophyllae*, which is reported on only one host plant family (Pinaceae). Gwiazdowski et al. (2011) studied specimens from 320 North American localities including seven from Florida and 51 host species within the Pinaceae and found 10 cryptic species similar to *C. heterophyllae* and *C. pinifoliae* using morphological and molecular tools. In support of our conclusion, they also found only *C. heterophyllae* in Florida. Therefore, it is likely that quarantine activities carried out by DPI over recent years have helped prevent the establishment of *C. pinifoliae* in Florida.

FSCA COLLECTION OF CHIONASPIS SPECIES

There are 214 records of *C. pinifoliae* either in the FSCA collection, DPI database or in the form of archived physical identification slips dating back to the 1910s. Of these, 138 lack supporting voucher slides, but the remaining records were associated with 176 slides deposited in the FSCA collection. All slides were recently reexamined to confirm their identities. All of these were found to be either interception records from other states or misidentifications. In several cases the slide labels indicated the collection



was from a location in Florida, but when we examined the archived identification slips it was clear the host plant originated from outside of Florida, usually on imported Christmas trees. For example, based on the archived identification slip (see Fig. 1), undigitized sample #H-567, the 1965 collection from Osceola County on *Pinus sylvestris* L. was an interception from Washington state. We also found three specimens from 1993 (E1993-2352) labelled as *C. heterophyllae*, but they were actually *C. pinifoliae*. They were labelled as being from *Pinus* sp. in Hillsborough County but archived identification slips stated they were intercepted from Washington, D.C. There were eight records collected from within Florida identified as *C. pinifoliae* that are misidentifications of *C. heterophyllae*. Five were collected in 1919 (undigitized sample #5459) from *P. palustris* Mill. in Miami-Dade County, one was collected in 2006 (E2006-9146) from *P. sylvestris* in Osceola County, and two were collected in 1991 (E1991-00438) from *Pinus* sp. in Alachua County.

INTERCEPTION RECORDS

Chionaspis pinifoliae has been intercepted in 36 Florida counties (Alachua, Baker, Bay, Bradford, Brevard, Broward, Collier, Columbia, Duval, Escambia, Flagler, Hernando, Highlands, Hillsborough, Jefferson, Lake, Lee, Leon, Manatee, Marion, Martin, Miami-Dade, Okeechobee, Orange, Osceola, Palm Beach, Pasco, Pinellas, Polk, Putnam, Sarasota, Seminole, St. Lucie, Suwannee, Taylor and Volusia) Alabama, Canada, California, Colorado, Massachusetts, Mexico, Michigan, Montana, North Carolina, Pennsylvania, South Carolina, Virginia, Washington D.C., and Washington on the following two hosts plant families: Pinaceae including *Abies* sp. (*A. balsamea*, *A. fraseri*); *Cedrus* sp. (*C. deodara*); *Picea* sp. (*P. pungens*, *P. thunbergiana*); *Pinus* sp. (*P. caribea*, *P. clausa*, *P. densa*, *P. densiflora*, *P. elliotii*, *P. glabra*, *P. palustris*, *P. pinea*, *P. strobus*, *P. sylvestris*, *P. thunbergia*); *Pseudotsuga menziesii* and *Tsuga canadensis*; and Cupressaceae including *Juniperus* sp. (*J. virginiana*).

GEOGRAPHICAL RANGE

Chionaspis pinifoliae has been reported in Canada, Chile, Cuba, El Salvador, Germany, Honduras, Libya, Mexico, the U.K. and the U.S. (in 42 states including Alabama, Arizona, California, Colorado, Connecticut, Washington D.C., Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin and Wyoming).

Pine scale, *Chionaspis heterophyllae* is an indigenous species in Florida first reported in the state in 1897 (Cooley, 1897) and has been reported in 29 other U.S. states (García et al., 2016).

HOST PLANTS

Chionaspis pinifoliae has been reported from three host plant families including Cupressaceae (*Cupressus* sp., *Juniperus* sp., *J. virginiana*), Pinaceae (*Abies alba*, *A. balsamea*, *A. concolor*, *A. fraseri*, *A. grandis*, *Cedrus* sp., *Larix laricina*, *Picea abies*, *P. engelmannii*, *P. glauca*, *P. orientalis*, *P. orientalis*, *Pinus caribaea*, *P. cembra*, *P. densiflora*, *P. echinata*, *P. flexilis*, *P. halepensis*, *P. mugo*, *P. nigra*, *P. palustris*, *P. ponderosa*, *P. radiata*, *P. resinosa*, *P. rigida*, *P. strobus*, *P. sylvestris*, *P. tropicalis*, *P. virginiana*, *P. wallichiana*, *Pseudotsuga menziesii* and *Tsuga canadensis*) and Taxaceae (*Taxus* sp., *Torreya* sp.).

Chionaspis heterophyllae is only reported from the plant family Pinaceae (*Abies alba*, *A. balsamea*, *A. fraseri*, *Picea* sp., *Pinus caribaea*, *P. clausa*, *P. echinata*, *P. elliotii*, *P. resinosa*, *P. rigida*, *P. sylvestris*, *P. taeda* and *P. virginiana*) (García et al., 2016).

IDENTIFICATION

The female scale cover of *C. pinifoliae* is elongate oval (2.5-3 mm long), almost parallel-sided on spruce, usually broader on pine, convex and snow white. First instar exuviae are almost colorless, second instar exuviae are orange-yellow. The male scale cover of *C. pinifoliae* is elongate oval (1 mm long, 0.4 mm wide), slightly broadened posteriorly, tricarinate, white and the exuviae are pale yellow (Kosztarab, 1963) (Fig. 2). *Chionaspis pinifoliae* and *C. heterophyllae* overlap broadly in geographical distribution and somewhat in host range. Unfortunately, these species are so similar morphologically that they can be distinguished only by a few subtle morphological characteristics pertaining to the adult females. A large mitochondrial sequence difference confirms the structural differences of the pygidial lobes on adult females are a reliable and convenient character for distinguishing *C. pinifoliae* from *C. heterophyllae* (Philpott et al., 2009; Gwiazdowski et al., 2011). Gwiazdowski et al. (2011) provided the following criteria for distinguishing between these two species based on pygidial structure (Fig. 2):

1. In *C. pinifoliae* the median lobes are strongly protruding, their medial margins are parallel or convergent and lateral notches are absent (median lobes slightly protruding, medial margins strongly divergent and lateral notches present in *C. heterophyllae*)
2. In *C. pinifoliae* the third lobes are protruding and are generally round without notches (third lobes recessed and less visible and notches are present especially on the lateral lobule in *C. heterophyllae*)
3. In *C. pinifoliae* the gland spines on the last three abdominal segments are of the same length or shorter than the median lobes (gland spines longer than median lobes in *C. heterophyllae*)

BIOLOGY

Chionaspis pinifoliae overwinters in the egg stage except in some cases as gravid adult females depending on geographical locations (Luck and Dahlstein, 1974). It has one to two generations per year depending on the location (Kosztarab, 1963). A generalized life history based on populations on *Pinus jeffreyi* Balf. in California is as follows: egg laying starts in late May, first instars appear in mid-June and persist until August, second instars are present from late July through September, adult males are present in September and adult females appear in early September (Luck and Dahlstein, 1974).

DAMAGE

In some cases, pine needle scale can build to large populations causing the needles of infested trees to appear gray from a distance. In heavy infestations, needles turn yellow and eventually drop. The lower branches usually die first and entire trees may be killed (Miller and Davidson, 2005). Damage from this insect is uncommon on Christmas trees, but has been shown to reach damaging levels on pines along roadsides or other impervious surfaces (Tooker and Hanks, 2000).

MANAGEMENT

The timing of crawler emergence is critical for managing armored scale insects because the crawler stage is the most vulnerable to insecticides. Accurate identification is critical to effectively predict when crawlers will emerge.

REFERENCES

- Cooley, R.A. (1899).** The coccid genera *Chionaspis* and *Hemichionaspis*. *Special Bulletin of the Hatch Experiment Station of the Massachusetts Agricultural College* 1–57.
- Cooley, R.A. (1897).** New species of *Chionaspis*. *Canadian Entomologist* 29: 278–282
- Dekle, G.W. (1976).** Florida armored scale insects. *Arthropods of Florida and Neighboring Land Areas* 3: 1–345.
- Doherty, J. F., Guay, J.F., and Cloutier, C. (2018).** Novel temperature-dependent development rate models for postdiapause egg eclosion of three important arthropod pests found in commercial Christmas tree plantations of southern Québec. *Canada Environmental Entomology* 47(3): 715–724.
- García, M., Denno, B., Miller, D., Miller, G., Ben-Dov, Y., and Hardy, N. (2016).** ScaleNet: A literature-based model of scale insect biology and systematics. *Database*. doi: 10.1093/database/bav118. <http://scalenet.info>. Accessed on October 24, 2019.
- Gwiazdowski, R.A., Vea, I.M., Andersen, J.C., and Normark, B.B. (2011).** Discovery of cryptic species among North American pine-feeding *Chionaspis* scale insects (Hemiptera: Diaspididae). *Biological Journal of the Linnean Society* 104:47–62.
- Johnson, W.T. and Lyon, H.H. (1991).** Insects that feed on trees and shrubs. *Comstock Publisher, Associates, Ithaca, N.Y.* 560 pp.
- Kosztarab, M.P. (1963).** The armored scale insects of Ohio (Homoptera: Coccoidea: Diaspididae). *Bulletin of the Ohio Biological Survey* 2 (new series): 120 pp.
- Liu, T., Kosztarab, M.P., and Rhoades, M. (1989).** Biosystematics of the adult females of the genus *Chionaspis* (Homoptera: Coccoidea: Diaspididae) of North America, with emphasis on polymorphism. *Studies on the Morphology and Systematics of Scale Insects No. 15 (Contribution No. 2 to a National Biological Survey)*. Virginia Agricultural Experiment Station, Blacksburg, VA, *Bulletin* 88-2.
- Luck, R.F., and Dahlstein, D.L. (1974).** Bionomics of the pine needle scale, *Chionaspis pinifoliae*, and its natural enemies at South Lake Tahoe, California. *Annals of the Entomological Society of America* 67: 309-316.
- Merrill, G.B., and Chaffin, J. (1923).** Scale Insects of Florida. *Quarterly Bulletin of the Florida State Plant Board* 7: 177-298.
- Miller, D.R., and Davidson, J.A. (2005).** Armored scale insect pests of trees and shrubs. Cornell University, Press Ithaca, NY 442 pp
- Nielsen, D.G., and Johnson, N.E. (1973).** Contribution to the life history and dynamics of the pine needle scale, *Phenacaspis pinifoliae* in Central New York. *Annals of the Entomological Society of America* 66: 34-43.
- Philpott, D., Berlocher, S.H., Mitchell, R.F., and Hanks, L.M. (2009).** Molecular validation of a morphological character for distinguishing between the armored scale insects *Chionaspis pinifoliae* and *Chionaspis heterophyllae* (Hemiptera: Diaspididae). *Annals of the Entomological Society of America* 102(3): 381-385.
- Tooker, J. F., and Hanks, L. M. (2000).** Influence of plant community structure on natural enemies of pine needle scale (Homoptera: Diaspididae) in urban landscapes. *Environmental Entomology* 29: 1305–1311.
- Wilson, C.E. (1917).** Some Florida scale-insects. *Quarterly Bulletin of the Florida State Plant Board* 2: 2-65.

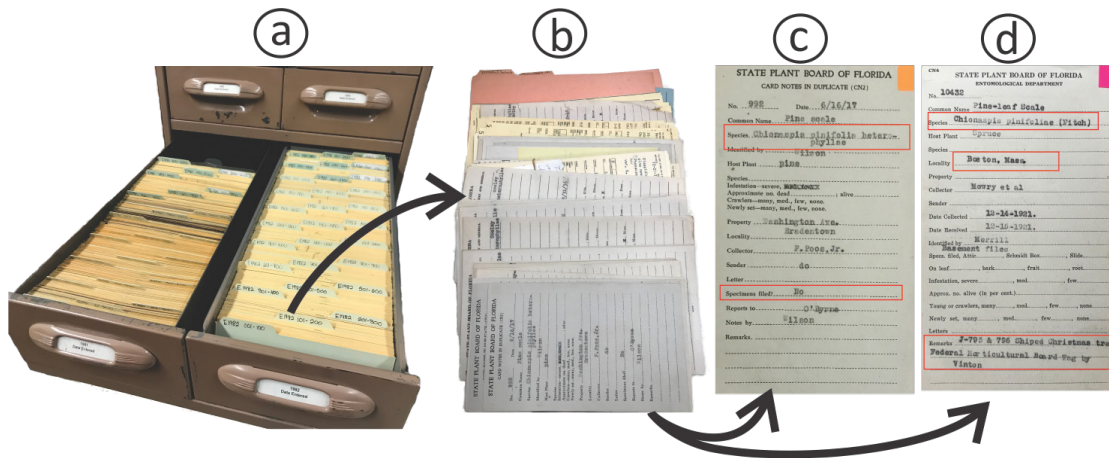


Figure 1. (a) Library of DPI archived paper identification slips. (b) Archived paper identification slips of *Chionaspis pinifoliae* and *Chionaspis heterophyllae*. (c) Slip showing a record identified as *C. pinifoliae heterophyllae* (= *C. heterophyllae*) in 1917 from Bradenton, Florida without a voucher reference. (d) Slip showing a record of *C. pinifoliae* intercepted from imported Christmas trees in Florida in 1921. Photo by Muhammad Z. 'Zee' Ahmed, FDACS-DPI.

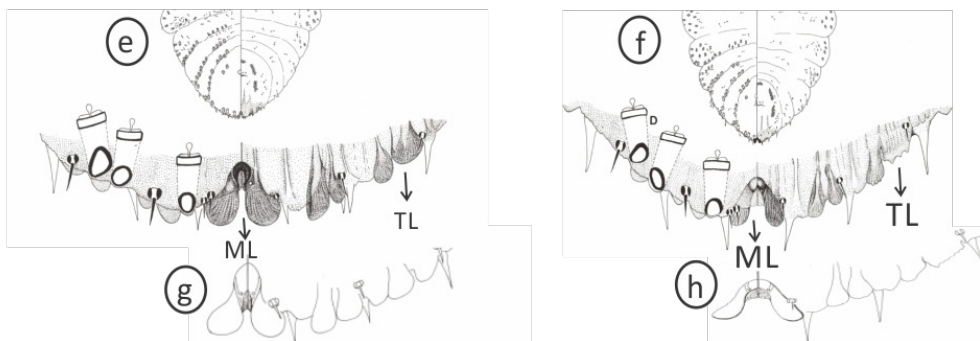
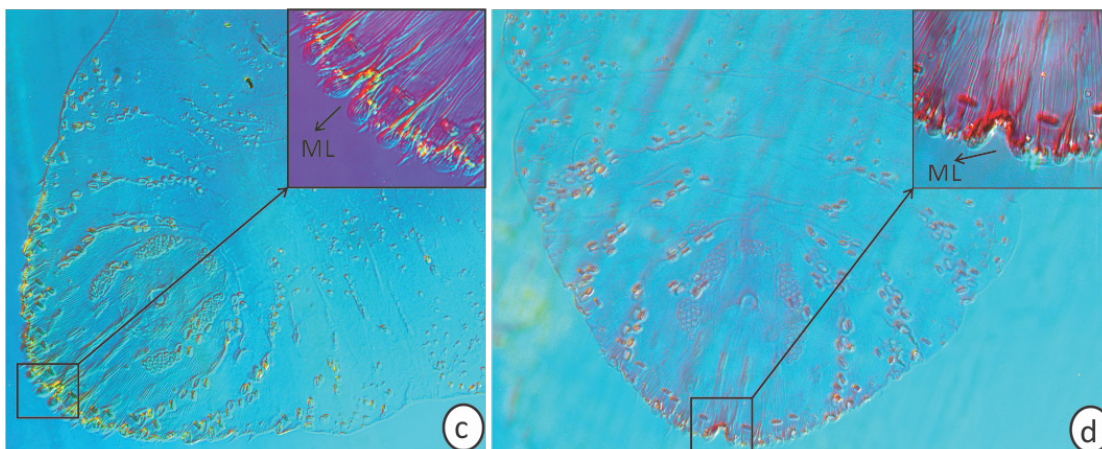
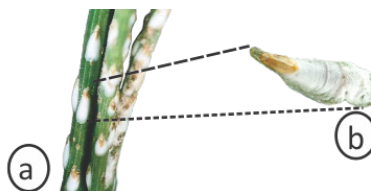


Figure 2. Pine needle scale, *Chionaspis pinifoliae* and pine scale, *Chionaspis heterophyllae*. (a) Infestation of pine needle scale on pine needles. (b) Close-up of adult female. (c, e, g) Slide-mounted view of adult female of *C. pinifoliae*. (d, f, h) Slide-mounted view of adult female of *C. heterophyllae*. ML: median lobes, TL: third lobes, counting; rows of macro-tubular ducts. Photo by Muhammad Z. 'Zee' Ahmed, FDACS-DPI. Illustration from Liu et al. (1989).