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Review of *Nealyda* Dietz (Lepidoptera: Gelechiidae:
Apatetrinae) with description of a new species
from the Florida Keys

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Review of *Nealyda* Dietz (Lepidoptera: Gelechiidae: Apatetrinae) with description of a new species from the Florida Keys

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Abstract. *Nealyda grandipinella* Bennett and Hayden, **new species**, is described from Big Pine Key, Florida, USA. Photographs of the adult and of male and female genitalia are provided for *N. grandipinella* and its congeners within the state of Florida. *Nealyda* Dietz (Lepidoptera: Gelechiidae) is provisionally transferred from Anomologinae to Apatetrinae based on characters of the genitalia. The homology and terminology of the processes arising from the vinculum of gelechiid genitalia are explored. The potential host plant of the new species is discussed, along with other undescribed species of *Nealyda*.

Key words. Caribbean Region, Caryophyllales, sacculus, vinculum.

ZooBank registration. urn:lsid:zoobank.org:pub:3A1AD0AF-0026-470A-8D9B-1C70B9CF3B37

Introduction

Nealyda Dietz was proposed in Elachistidae with the type species *N. bifidella* Dietz, 1900. Later in the same year, Busck (1900) moved the genus to Gelechiidae and described two new species, *N. kinzelella* Busck and *N. pisoniae* Busck. The genus has been previously placed in Anomologinae based on its reduced uncus and gnathos (Bidzilya and Karsholt 2008; Lee and Landry 2023). We provisionally place *Nealyda* in Apatetrinae based on the similarity of the genitalia to those of *Chrysoesthia* Hübner (Karsholt and Moreno 2014) and particularly *Metanarsia* Staudinger (Bidzilya 2005, 2008; Karsholt et al. 2013).

Currently, nine species of *Nealyda* are described worldwide (Hobern et al. 2024). The genus is restricted to the New World. *Nealyda bifidella* is the only species described from the Western Nearctic, but several potential undescribed species have been noted from California (Gates et al. 2002), Texas (Eiseman 2021) and Mexico (Powell and Opler 2009). Three species of *Nealyda* are recorded from Florida: *Nealyda kinzelella*, *N. pisoniae*, and *N. phytolaccae* Clarke (Heppner 2007). No new species have been described since the mid-20th Century (Hering 1955).

The Asian species *Apatetris panchromatica* (Meyrick), which Clarke (1969) had transferred from *Aristotelia* Hübner to *Nealyda*, was transferred to *Apatetris* Staudinger by Sakamaki (2000), although the author had reservations because of severe damage to the type specimen. The presence of iridescent scales on the forewing, which Western species lack, and the similarity of *A. panchromatica* to *A. elaeagnella* Sakamaki lead us to agree with the placement of *A. panchromatica* in *Apatetris*.

Nealyda species are oligophagous leaf-miners on Caryophyllales. Other Gelechiidae that share that habit are *Chrysoesthia* and several genera of more distantly related Gnorimoschemini and other Gelechiinae (Eiseman 2021; Bidzilya pers. comm. 2024). *Nealyda* larvae feed on Nyctaginaceae or Phytolaccaceae (Busck 1903; Clarke 1946; Eiseman 2021). In the Florida Keys, *Nealyda* specimens have been recorded from *Pisonia* L. and *Guapira* Aubl. (Nyctaginaceae) (Busck 1900; Clarke 1946; GBIF Secretariat 2023).

Materials and Methods

The first specimens were collected with an ultraviolet light trap in an agricultural pest survey on Big Pine Key by the Cooperative Agricultural Pest Survey (CAPS), a division of the Florida Department of Agriculture and Consumer Services (FDACS). A subsequent Malaise trap in 2019 provided more specimens. The type specimens are deposited in the Florida State Collection of Arthropods (FSCA) and housed in the McGuire Center for Lepidoptera and Biodiversity (Gainesville, Florida). Specimens of related species in the FSCA were examined, including *N. bifidella* Dietz, *N. pisoniae* Busck, *N. kinzelella* Busck, and *N. phytolaccae* Clarke, as well as specimens of undescribed species of *Nealyda* (see *additional material examined*). In addition to the figures below, cataloged specimens and genitalia images are available through the Lepidoptera Specify database of the Florida Museum of Natural History (Florida Museum 2024). The FLMNH-MGCL specimen numbers stated below are the “Alt Cat Number” = “MGCL nnnnnn,” or else they can be found under Genus = *Nealyda*.

The genitalia were dissected by maceration in 10% aqueous KOH, stained with Chlorazol black in 50% ethanol, Eosin Y, or Orange G (Robinson 1976), and slide-mounted in Euparal. Morphological terms follow Huemer and Karsholt (2010). The authors use both “vincular processes” and “lateromedial projections” to refer to the paired lobes between the valvae. The term vincular processes is used here because they are attached to the vinculum.

Photographs of habitus were taken using a JVC digital camera and Leica Z16APO lens with Auto-montage Pro 5.01 (Synoptics Ltd.). High-resolution photographs of genitalia were taken with a Leica DM6 compound microscope with a Leica DMC6200 camera, and slices were stacked with Zerene Stacker Version 1.04. The stacked images were postprocessed with Adobe Photoshop 23.5.1. Habitus illustrations were edited with Adobe Photoshop 11 (Adobe Systems 2012) and stacked with Helicon Focus 8.2.2 if necessary (Kozub et al. 2000). Figures were assembled with GIMP 2.10.36 (GNU Image Manipulation Program 2023) and Artweaver Free 7 (Boris Eyrych Software 2023). The map was created using SimpleMappr (Shorthouse 2010) using data from the FSCA. Erroneous localities, such as coordinates that corresponded to a body of water, were excluded from the map.

DNA was sequenced by the FDACS-DPI Molecular Diagnostics Laboratory. Dry legs were removed from a paratype, and the standard mtDNA “barcode” region was sequenced by standard methods (Hebert et al. 2004). COI sequences of congeners were downloaded from the Barcode of Life Data System (Ratnasingham and Hebert 2007). The Process ID numbers are: LNAUX180-18, MNAB1535-18, MNAB1536-18, BBLOB1332-11, MNAB1531-18, MNAB1526-18, MNAB1527-18, MNAB1525-18, MNAB1528-18, LNAUX002-18, GONA176-10, LNAUX182-18, LNAUX183-18, SCBMF029-19, LNAUX001-18. The sequences were aligned with Muscle (Madeira et al. 2024). Extensive missing data in the other sequences precluded meaningful calculation of percentage differences by distance methods. Diagnostic sites were pinpointed by analysis with implied-weights parsimony with TNT 1.5 (Goloboff and Catalano 2016) with the commands: *hold 1000; piwe=10; mu=hold 10 repl 10; best; apo [-.].*

Abbreviations of institutions.

FSCA Florida State Collection of Arthropods, Gainesville, FL
MEM Mississippi Entomological Museum, Mississippi State, MS
MGCL McGuire Center for Lepidoptera and Biodiversity, Gainesville, FL
NMNH US National Museum of Natural History, Washington D.C.

Results

Nealyda Dietz, 1900

(Fig. 1–5)

Nealyda Dietz, 1900. Type species: *Nealyda bifidella* Dietz, 1900, by monotypy.

Diagnosis. The maculation of *Nealyda* species (Fig. 1) is yellowish tan, brown, gray, and/or black. The labial palps (Fig. 2) are slightly rounded and stout with banding. The forewings typically have a single medial fascia darker than surrounding scales, but Caribbean species have two fasciae (*N. neopisoniae* Clarke) or none (*N. bicolor*



Figure 1. Habitus of *Nealyda* species present in Florida, USA and the Bahamas. **A)** *N. grandipinella*, holotype. **B)** *N. kinzelella*. **C)** *N. pisoniae* (Florida). **D)** *N. phytolaccae*. Scale bars = 1 mm.

Walsingham). The apex of the wing is darkly irrorated. The hindwings have a medial cleft, whereby the tornus is extended similarly to the apex. The metathoracic legs have a medial inner tibial spur greater than two times the length of the outer spur. In the male genitalia (Fig. 3), the valvae have sparse microtrichia apically. The saccular processes (or sacculi) are large, often strongly sclerotized, and mesally connected to each other. The vincular processes of the phytolaccae group are large lobed structures, while in the pisoniae group, they are weakly sclerotized bumps with microtrichia. The uncus is globular to conical. The gnathos is strongly reduced to a ring around the base of the uncus. The tegumen is trapezoidal with sparse microtrichia. The phallus is ankylosed to the vinculum. In the female genitalia (Fig. 4), the papillae anales are large, heavily sclerotized, and extremely setose. The ductus bursae and corpus bursae are unsclerotized. The signum is a small hook, spine, or granular patch. The larvae feed in leaf mines in Caryophyllales.

***Nealyda grandipinella* Bennett and Hayden, new species**

(Fig. 1A, 2A, 3A, 4A, 5)

Diagnosis. *Nealyda grandipinella* differs from its congeners by the presence of silvery-gray scales throughout the forewing and a lack of brown pigmentation. The habitus is nearly indistinguishable from *N. pisoniae* specimens collected in the Bahamas, but it lacks the thick, dark gray band on the outer side of the first labial palpomere that is present in *N. pisoniae*. In the male genitalia, the most obvious difference is the arrangement of setae on the sacculus: they are thick and parallel in a comb-like row, twelve to fourteen in number, whereas the most similar species have a few thin setae (*N. kinzelella*, *N. pisoniae*) or numerous rough, irregularly disposed setae (*N. bifidella*). *Nealyda grandipinella* also differs by the conical shape of the uncus that terminates in circular scales, a straight, broad phallus with four terminal teeth, and valvae that are medially constricted, with the distal half broad, laterally curved, and lemon shaped. In related species, the uncus is truncate, the phallus is narrow and curved without teeth, and the terminal expansion of the valva is narrower and not distinctly bent laterad. In the female genitalia, the ductus bursae is 33% longer than the corpus bursae, and the signum is curved, hook-shaped, and $\frac{1}{5}$ as long as the corpus bursae. Congeners have the ductus bursae and corpus bursae subequal in length. In most other species, the central spine of the signum is $\frac{1}{7}$ or less the length of the corpus bursae. *Nealyda bifidella* has a spine $\frac{1}{3}$ the length of the corpus bursae and distinct lateral granular arms of the signum, but the ductus bursae has a distinct membranous swelling halfway along its length.

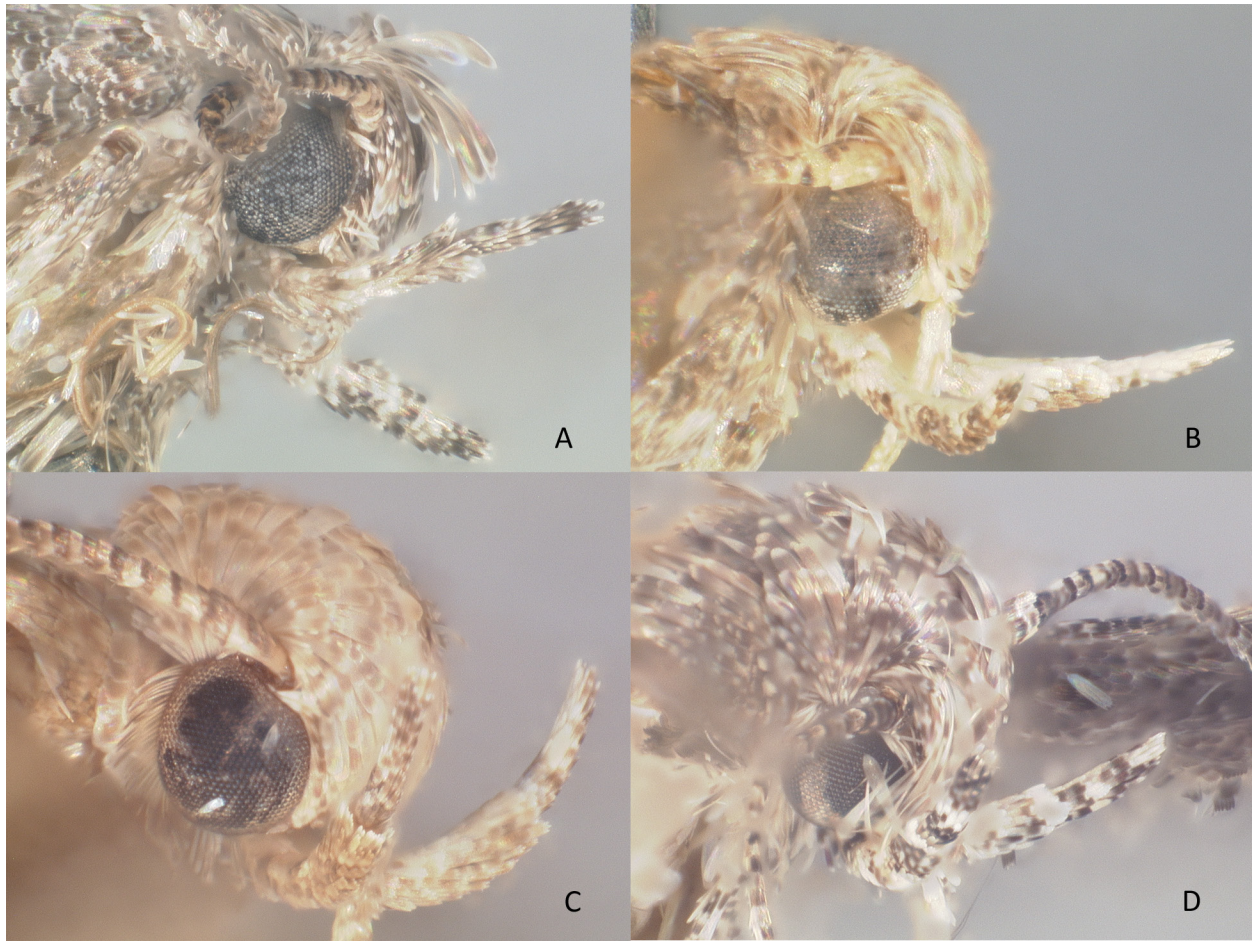


Figure 2. Heads of *Nealyda* species. **A)** *N. grandipinella*. **B)** *N. kinzelella*. **C)** *N. pisoniae*. **D)** *N. phytolaccae*.

Description, Adult. Head (Fig. 2A). Labial palps slightly rounded and stout. Outer side light gray, with dark gray banding at apex, base of third segment, and distal end of second segment. Inner side with suffusion of white scales proximal to the frons and dark gray scales on opposite side. Vertex with broad, rounded scales that widen towards apex, smaller and more linear anteriorly; scales dark gray subapically, only reaching the margin in more linear scales, pale gray on margin. Antennal scape light gray with black band at apex. Basal third of antenna with alternating gray and dark gray flagellomeres, becoming completely gray in distal two-thirds. Eyes light gray. Variation in intensity of irroration, nearly absent in some specimens. Silver or whitish ocelli.

Thorax. Dorsal surface of thorax with broad light gray scales with thin white band at apex.

Wings (Fig. 1A). Basal half of forewing with gray scales with rounded white apex. Antemedial fascia wide, black, followed by thin white fascia. Medial area with gray and white scales similar to those of basal half of wing. Postmedial fascia diffuse black, with lateral pointed projection of black scales near costa. Elongate, lateral patch of black scales near inner margin. White irroration near apex, diffusing into linear, dark gray scales with white apex. Terminal fringe dark gray. Hindwings with medial cleft extended less than a third of the wing's length. Light gray, infuscated at apex.

Pregenital abdomen. Scales similar to those on thorax. Tuft of yellow-white setae extending beyond final tergite to cover genital opening and valvae.

Legs. Coxa and femur of prothoracic legs with scales light gray with dark gray suffusion on anterior surface. Scales on posterior side yellow white. Tibia light gray with three dark-gray bands on distal side; epiphysis present. First tarsomere long, light gray with two black bands on distal side. Other tarsomeres dark gray at base and

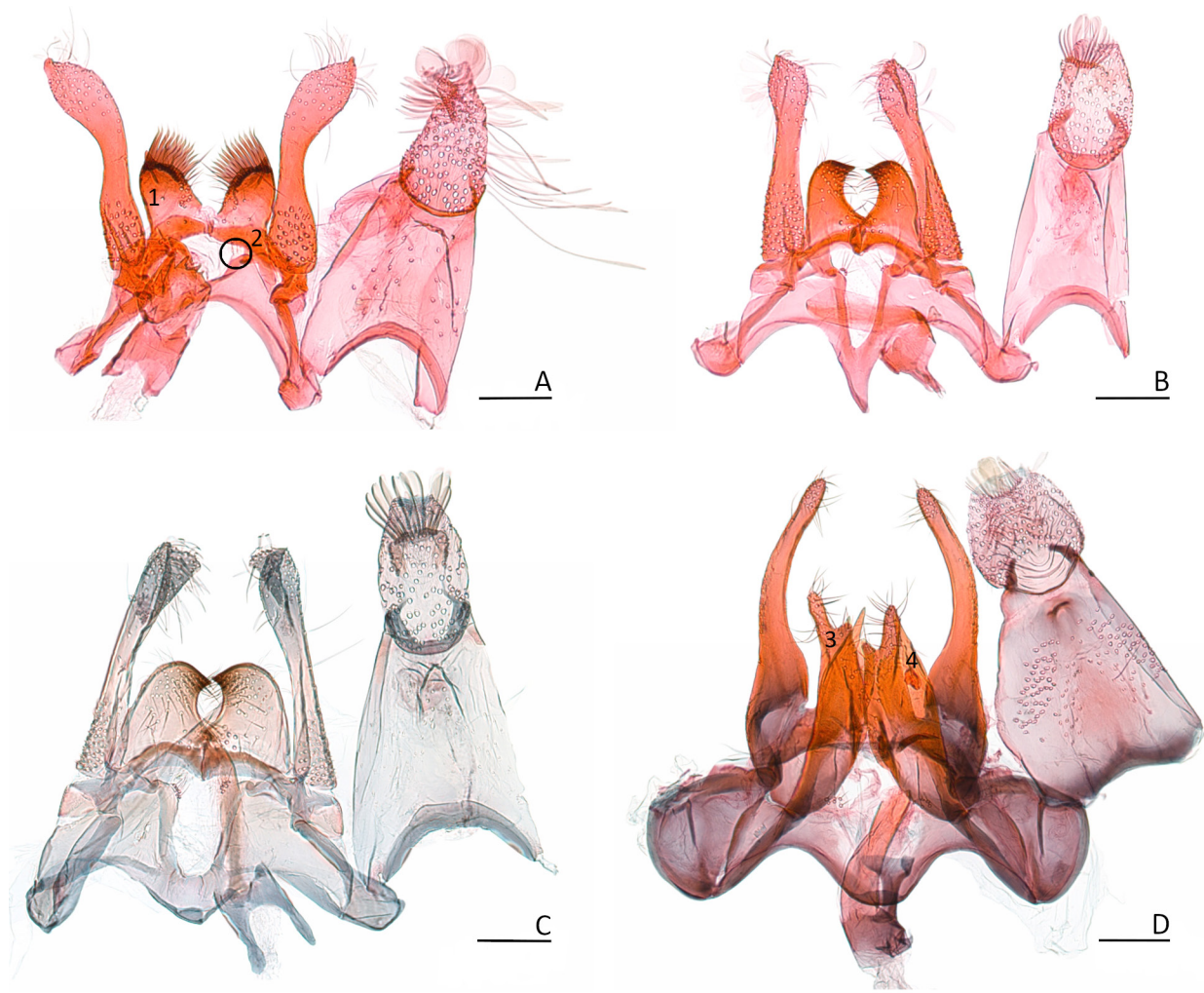


Figure 3. Male genitalia of *Nealyda* species present in Florida. **A)** *N. grandipinella*, MGCL slide 4702. 1) Saccular processes, 2) Vincular processes. **B)** *N. kinzelella*, MGCL slide 4703. **C)** *N. pisoniae*, MGCL slide 4113. **D)** *N. phytolaccae*, MGCL slide 4551. 3) Saccular processes, 4) Vincular processes. Terms from Huemer and Karsholt 2010. Scale bars = 0.1 mm.

becoming light gray at apex. Mesothoracic legs with coxa cream colored, pattern otherwise similar to front legs except banding indistinct. Two lateral spurs arising one slightly above the other near distal end of tibia. Metathoracic legs with coxa and femur yellow grayish white with large, diffuse, light-gray spots. Tibia light gray near base, distally dark gray with four lateral spurs. Medial pair with inner spur more than 2 times the length of outer spur, extended to distal end of tibia in both sexes, becoming slightly broader at apex. Second pair of spurs subequal in length, slightly shorter than shorter medial spur, at distal end of tibia. First tarsomere dark gray with two yellow-white bands, one at base and one at apex; other tarsomeres dark gray.

Male genitalia (Fig. 3A). Valvae slightly bulbous at base, with many microtrichia, becoming constricted medially and expanding to lemon shape with slight upturned point at corona. Cucullus with microtrichia, most dense at corona. Sacculus bluntly rounded, about half the length of valvae, with strongly sclerotized apex and small blunted projection. Apex of sacculus with thick, comb-like setae. Vinculum band shaped, terminating shortly before tegumen. Uncus broadly conical, with many long microtrichia. Four large, circular scales at apex about 0.25x size of uncus, extending to about the same length as the valvae. Tegumen trapezoidal with few microtrichia, extending slightly longer than length of uncus. Gnathos thin, semicircular. Phallus ~0.25 mm, ankylosed, spinose.

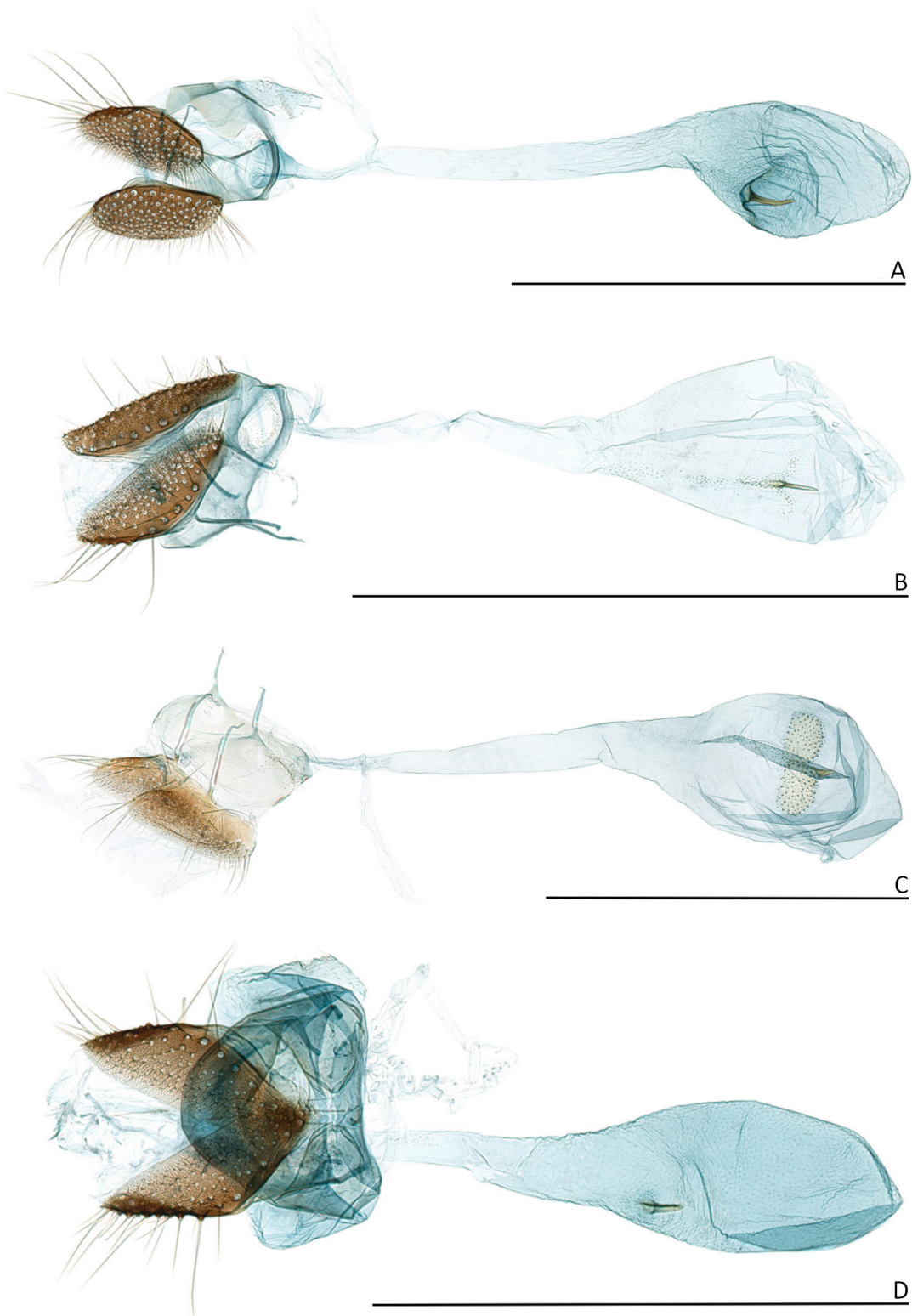


Figure 4. Female genitalia of *Nealyda* species present in Florida. A) *N. grandipinella*, MGCL slide 5021. B) *N. kinzelella*, MGCL slide 4984. C) *N. pisoniae*, MGCL slide 5058. D) *N. phytolaccae*, MGCL slide 4985. Scale bars = 1 mm.

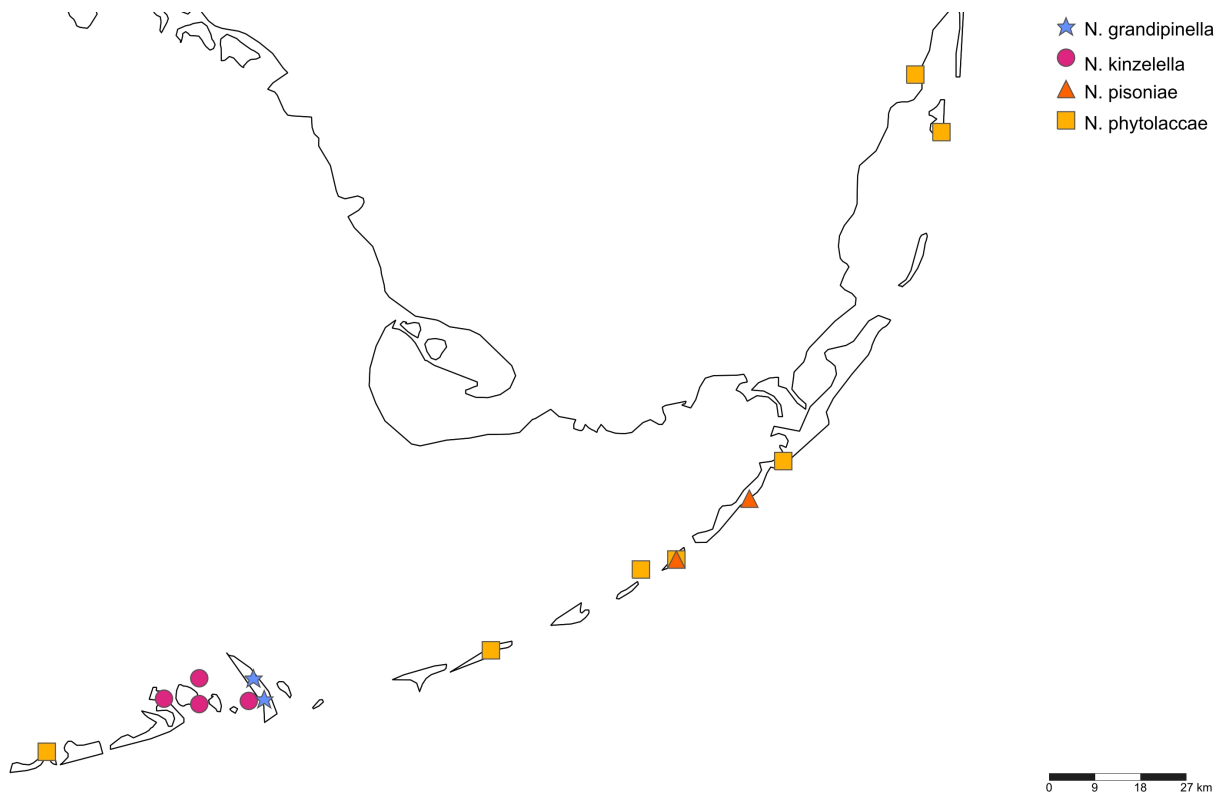


Figure 5. Map of *Nealyda* specimens from South Florida in the FSCA.

Female genitalia (Fig. 4A). Corpus bursae broadly ovular. Signum a slightly curved hook, about 0.25x length of corpus bursae. Ductus bursae relatively narrow and straight, ~1 mm, lacking any sclerotization. Ductus semina-lis arising from posterior portion of ductus bursae. Ostium bursae funnel shaped. Papillae anales large, elliptical, heavily sclerotized, ~0.33 mm, with many long microtrichia, some extending the length of papillae anales.

Immature stages. Unknown.

DNA barcode. The DNA COI barcode sequence is as follows (diagnostic sites in bold italics):

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CTTTATATTTTATTTTGGTATTTGAGCAGGTATAGTTGGAACCTCTCTAAGCTTATTAATTCGAGCTGAATTAGGAACCTCCTGGTCTCTTAAT
TGGAGATGATCAAATTTATAACTATTTGTAACAGCTCATGCTTTTATTATAATTTTATAGTTATACCTATTATAATTGGAGGGTTTGGA
AATTGATTAGTACCTTTAATATTGGGAGCCCCGTATATAGCTTTCCCCGAATAAATAATATAAGATTTTGATTATTACCCCTCTCTTAACCTT
TACTAATTTCTAGAAGTATCGTAGAAAATGGAGCAGGTACAGGATGAACAGTTTACCCCTCTTCTCTCTAATATTGCTCATGGAGGTACTTC
AGTGTATTTAGCAATTTTCTCTCTTCATTTAGCAGGTATTTTCATCAATTTTAGGAGCTATCAATTTTATTACAACCTATTATTAATATAAAAT
AATGGCTATCTTTTGATCAAATACCACTTTTGTGAGCAGTAGGTATCACAGCTTTACTTCTCTTTTATCTTTACCTGTATTAGCAGGAGC
AATTACAATACTTTTAACAGATCGTAATTTAAATACATCATTTTGTGA
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The most closely related available COI sequence is GONA176-10, sample ID SL0379, an undetermined *Nealyda* specimen collected in Puerto Rico, deposited in the MEM.

Host. Unknown. Predicted to be *Guapira* or *Pisonia* (Nyctaginaceae).

Distribution (Fig. 5). Big Pine Key, Monroe County, Florida, USA.

Type specimens. Holotype: 1 ♂ “USA, FL, Mon. Co. Big Pine Key, Key Deer Blvd. Trailhead. 24.7096, -81.3826, UVL [trap], 12-13-IV-2018, P. Corogin, B. Danner, J. Farnum, J. Hayden, J. Stanley, E. Talamas, L. Whilby. E18-1830; J.E. Hayden photo index 424, FLMNH-MGCL Slide 07061; FLMNH-MGCL Specimen 164645”. Deposited in the FSCA.

Paratypes (9): USA, Florida: 4 ♂ “USA, FL, Mon. Co. Big Pine Key, Key Deer Blvd. Trailhead. 24.7096, -81.3826, UVL [trap], 12-13-IV-2018, P. Corogin, B. Danner, J. Farnum, J. Hayden, J. Stanley, E. Talamas, L. Whilby. E18-1830”; one “FLMNH-MGCL Slide 04702 | FLMNH-MGCL Specimen 164644”; one “DNA JEH-2019-0122B

| FLMNH-MGCL Specimen 164646”; others FLMNH-MGCL Specimens 164647, 164648. 1 ♂ “USA, FL, Mon. Co. Big Pine Key, Palmetto Ave. 24.6726, -81.3634 CAPS malaise 26-XII-2018–8-I-’19 J. Farnum E19-94 | FLMNH-MGCL Specimen 164649”; 1 ♀ same locality label as previous, “MGCL Slide 05021 | FLMNH-MGCL Specimen 164653”; 1 ♂ “USA, FL, Mon. Co. Big Pine Key, Palmetto Ave. 24.67261, -81.36339 M.T. 16–28-V-2019 CAPS, J. Farnum E19-3054 | FLMNH-MGCL Specimen 164650”; 1 ♀ “USA, FL, Mon. Co. Big Pine Key, Palmetto Ave. 24.67261, -81.36339 CAPS malaise trap 23-VII–7-VIII-2019 J. Farnum E19-4439 | FLMNH-MGCL Specimen 164651”; 1 ♂ “USA, FL, Mon Co. Big Pine Key, Key Deer Refuge, Manillo Trail 24.70969, -81.38266 CAPS malaise trap, 27-I–11-II-2020 J. Farnum E20-547 | FLMNH-MGCL Specimen 164652”. Deposited in the FSCA.

Etymology. The species is named for Big Pine Key, Monroe County, Florida. It is a feminine Latin adjective.

Additional material examined. *Nealyda bifidella*: 1 ♂ “TEXAS: Cottle Co. Matador WMA 17-V-85 leg. E. Knudson | MGCL Ascension #2016-40 E.C. Knudson, Knudson/Bordelon | FLMNH-MGCL Slide 05097”; 1 ♀ “TX: Jeff Davis Co. TNC-Davis Mts. Pr. Bridge Gap 7300, 11-V-00/B/K | FLMNH-MGCL Slide 05098”; 1 ♂ “13 May 1996 black light trap leg J.S. Nordin COLORADO: Mesa Co. T13S R99W Sect. 5, 3.4 m. SW of Whitewater via Hwy 141, East Creek, El. 4780 ft | MGCL Accession #2018-3 J. Nordin | FLMNH-MGCL Slide ♂ 07066 | FLMNH-MGCL Specimen 164622”.

Nealyda kinzelella: 1 ♂, 2 ♀ “USA, FL, Monroe Co. Cudjoe Key, Rte 1 & Cutthroat Dr. 24.66385, -81.47875. UVL 12-13-IV-2018 J. Hayden, P. Corogin, B. Danner, J. Farnum, E. Talamas, J. Stanley, L. Whilby. E18-1829”, of which ♂ “FLMNH-MGCL Slide 04703”, first ♀ “FLMNH-MGCL Slide 04984”, second ♀ “J.E. Hayden photo index 419”; 1 ♂ “USA, FL, Monroe Co. Sugarloaf Key, 24.67338, -81.5130 Ex mine *Guapira obtusata* 22-III-2018 J. Farnum E18-1873 | FLMNH-MGCL Slide 04696”.

Nealyda phytolaccae: 1 ♂, 2 ♀ “USA, FL, M.-Dade Co. Miami, 601 NW 7th St. Rd. 25.779384, -80.207936 CAPS survey, ex *Guapira discolor* 5-I-2018 P. Perez E18-59;” of which ♂ “Ecl. 10-I-2018; FLMNH-MGCL Slide 04551;” first ♀ “Ecl. 8-I-2018; FLMNH-MGCL Slide 04549;” second ♀ “Ecl. 8-I-2018; J.E. Hayden photo index 420”. 1 ♀ “USA, FL, Mon Co. Key Largo 99540 Overseas Hwy. In *Guapira discolor* leaves 25.094424, -80.442358. 23-I-2018 O. Garcia E18-233. Ecl. 25-I-2018; FLMNH-MGCL Slide 04985;” 1 ♀ “USA, FL, Monroe Co. Islamorada, Lignumvitae Key St. Pk. 24.90231, -80.8949 ex *Guapira discolor* 31-X-2018 J.M. Farnum E18-6146; FLMNH-MGCL Slide 04983;” 1 ♀ “FLORIDA: Monroe Co. 1 mi SW. Islamorada, Upper Matecumbe Key 23-VI-1974; AT (UV) BLACKLIGHT; J.B. Heppner collector; FLMNH-MGCL Slide 05059;” 2 ♂ “USA, FL, Miami-Dade Co. Key Biscayne, Bill Baggs St. Pk. 25.67746, -80.16155 reared ex *Guapira discolor* lvs 31-I-2019 J. Farnum, L. Golden E19-547”, one “FLMNH-MGCL Slide 05099”, one “FLMNH-MGCL Slide 07065; FLMNH-MGCL Specimen 164621”.

Nealyda pisoniae: 1 ♀ “FL: Monroe Co. Upper Matecumbe Key, Islamorada 31-VII-1992 W. Lee Adair, Jr. | W.L. Adair Collection – 2003 | J.E. Hayden photo index 423”; 1 ♀ “FL: Monroe Co. Upper Matecumbe Key, Islamorada 5-IX-1992 W. Lee Adair, Jr. | W.L. Adair Collection – 2003 | FLMNH-MGCL Slide 05058”; 1 ♂ “FL: Monroe Co. Upper Matecumbe Key, Islamorada 5-IX-1992 W. Lee Adair, Jr. | W.L. Adair Collection – 2003 | FLMNH-MGCL Slide 04113”; 1 ♂ “BAHAMAS: Great Inagua 0.95 mi. SE of lighthouse 20.92694, -73.661111, 26.vii.2014 M.J. Simon & G. Goss | Bahamas Survey MGCL Accession No. 2014-21 | FLMNH-MGCL Slide 05056 | MGCL 238208”; 1 ♀ same locality and accession data as above, one “MGCL-FLMNH Slide 05057 | MGCL 238211”, one “MGCL 238209”.

Nealyda sp.: 5 leafmines “E14-3392, USA, FL, M-Dade Co. Key Biscayne, Bill Baggs Cape St. Pk. Crandon Blvd. *Guapira discolor*. 14-V-2014 L. Whilby, M. DaCosta et al. CAPS-IMS”.

Nealyda sp.: 1 ♀ “Bexar Co. Texas, San Antonio, Leg. E.C. Knudson, 29-VII-84 | MGCL Ascension #2016-40, E.C. Knudson, Knudson/Bordelon | FLMNH-MGCL slide 07018”; 1 ♀ “TX: Val Verde Co. 15 mi. W. Del Rio, 19-VIII-95 leg/E. Knudson | MGCL Accession #2016-40, E.C. Knudson, Knudson/Bordelon”.

Nealyda sp.: 1 ♂ “PERU: Dept. Junin, Pampa Hermosa Lodge nr. San Ramon, 1220 m, 6-7 Nov 2009 J. Heppner | FLMNH-MGCL slide 07048 | FLMNH-MGCL Specimen 164606”; 1 ♂ “PERU: Dept. of Junin, Pampa Hermosa Lodge Nr. San Ramon, 1220 m, 2-6 Apr 2011 J.B. Heppner & C. Carrera”.

Key to *Nealyda* Dietz in the United States and Caribbean based on external features

1. Forewing proximal half pale brown to dark ochereous brown 2
- Forewing proximal half gray, with or without brown irroration 5
- 2(1). Forewing divided by a single medial fascia 3
- Forewing not divided by a single medial fascia or multiple fasciae present 7
- 3(2). Forewing proximal half ochereous brown to dark brown; apex of wing deeply infuscated; midwestern and southwestern United States *N. bifidella* Dietz
- Forewing proximal half tan to pale yellowish brown; apex of wing slightly infuscated with patchy black scales; Florida, United States 4
- 4(3). Forewing distal half gray, distinctly contrasted with proximal half along fascia; hindwing light gray ...
..... *N. kinzelella* Busck
- Forewing distal half tan brown, concolorous with proximal half; hindwing light brown
..... *N. pisoniae* Busck (in part)
- 5(1). Forewing dark gray, brown irroration present; hindwing deeply infuscated at apex
..... *N. phytolaccae* Clarke
- Forewing pale gray, sometimes slightly metallic, without brown irroration; hindwing slightly infuscated at apex 6
- 6(5). Bahamas *N. pisoniae* Busck (in part)
- Big Pine Key, Florida *N. grandipinella* Bennett and Hayden
- 7(2). Proximal half of forewing brown, distal half gray; margins of colors distinct but without medial fascia; hindwing pale gray; West Indies *N. bicolor* (Walsingham)
- Forewing pale brown, divided into thirds by two thick dark ochereous brown fasciae; hindwing dark brownish gray; Cuba *N. neopisoniae* Clarke

Key to described *Nealyda* species in the United States based on male genitalia

1. Vincular processes longer than wide; saccular processes triangular **phytolaccae group, 2**
- Vincular processes extremely small, weakly sclerotized bumps bearing few setae directly below saccular processes; saccular processes ovate in outline with cuspidate or hooked apex ... **pisoniae group, 3**
- 2(1). Vincular processes long, with pointed apex and with few setae; saccular processes large and mitten-shaped, extending slightly beyond length of saccular processes; phallus slightly curved
..... *N. phytolaccae* Clarke
- Vincular processes small, digitiform, rounded projections not extending beyond apex of vinculum; saccular processes with blunted apex and many setae; phallus sharply curved *N. bifidella* Dietz
- 3(1). Saccular processes with strongly sclerotized apical hook; phallus narrow, bent to curved with no spines 4
- Saccular processes bluntly rounded with small apical spine and many apical setae; phallus broad and spinose *N. grandipinella* Bennett and Hayden
- 4(3). Apices of valvae slightly pointed; saccus sharply pointed; phallus bent at 90° angle
..... *N. kinzelella* Busck
- Apices of valvae rounded; saccus rounded to weakly pointed; phallus slightly curved
..... *N. pisoniae* Busck

Key to described *Nealyda* species in the United States based on female genitalia

1. Signum consisting of a large, visible spine and faint lines of dissociated granules extended laterad and posteriad of the spine 2
- Spine of signum small; signum dominated by oval, continuously sclerotized granular lateral areas *N. pisoniae* Busck
- 2(1). Signum a curved spine 3
- Signum a straight spine 4
- 3(2). Ductus bursae with broad swollen area halfway; papillae anales slightly rectangular .. *N. bifidella* Dietz
- Ductus bursae evenly membranous, without swollen area; papillae anales elliptical *N. grandipinella* Bennett and Hayden
- 4(2). Papillae anales fused basally, nearly the size of corpus bursae *N. phytolaccae* Clarke
- Papillae anales separate, smaller than corpus bursae *N. kinzelella* Busck

Discussion

Issues with identification. Clarke (1946) and Hering (1955) both included keys in their descriptions that do not provide sufficient detail to properly identify specimens to species. Clarke's key uses subjective adjectives to describe the habitus, such as light and dark, and does not discuss genitalia. Both keys start with banding on the labial palpi, but our observations find that the maculation is inaccurately described by Clarke. Clarke and Hering do not effectively divide *Nealyda* into species groups. We provide keys for habitus and for male and female genitalia, and we restrict them to the Nearctic and Caribbean species for which we have reliable information.

Previous diagnoses of *Nealyda* did not include information about genitalia. Busck (1903) included *Nealyda* in a key to Nearctic gelechiid genera and diagnosed it by the shape of the palpi, vestiture, and venation, which was adequate for a time when knowledge about genitalia was almost nil, but it should have been improved by the mid-20th Century. The most recent diagnosis (Hering 1955) has further shortcomings. The cleft hindwing and open hindwing cell were cited as defining characters, but these are homoplastic in Gelechiidae, including *Apatetrtris* (*Apatetrini*) (Sakamaki 2000). Hering (1955) apparently did not know about Clarke's (1946) publication and claimed that *Nealyda* species feed solely on Nyctaginaceae. However, the type specimen of *N. phytolaccae* was reared on *Phytolacca americana* L. (Phytolaccaceae) (Clarke 1946). The more general statement that the species feed on Caryophyllales, which includes both Nyctaginaceae and Phytolaccaceae, is a convincing synapomorphy for *Nealyda*.

Specimens of the putatively new species mentioned in Gates et al. (2002), Powell and Opler (2009), and Eiseman (2021) should be thoroughly examined and dissected. The species reported from California and Mexico are noted to be similar to *Nealyda bifidella* but are darker in color (Powell and Opler 2009). Some specimens tentatively identified as *N. bifidella* on iNaturalist from the same region have a similarly darkened region on the proximal half of the forewings (GBIF Secretariat 2023). However, color variation in the wings is not sufficient to delineate two species of *Nealyda*. Specimens of *N. pisoniae* collected from the Florida Keys are tan to brown in color, while specimens of *N. pisoniae* from the Bahamas are silvery like *N. grandipinella*. Dissections of these western specimens are required to determine if they are truly distinct from *N. bifidella*.

At this time, COI barcode sequences on the Barcode of Life Data System are available for only a few species: *N. bifidella*, *N. phytolaccae*, *N. neopisoniae*, and undetermined specimens from the Florida Keys, Puerto Rico, and Southwestern United States. The new species matches none of them.

Host plants. The host plant of *Nealyda grandipinella* is unknown, but it may be a *Guapira* or *Pisonia* species, as are the documented host plants for congeneric *Nealyda* species in the Florida Keys. Two species of *Guapira* are reported from the region: *G. obtusata* (Jacq.) Little and *G. discolor* (Spreng.) Little (Wunderlin et al. 2024); *N. kinzelella* has been reared from *G. obtusata*, and *N. phytolaccae* has been reared from *G. discolor* (Busck 1900; FDACS-DPI unpublished data). Two species of *Pisonia* are also reported from Big Pine Key (GBIF Secretariat 2023), *P. aculeata* L. and *P. rotundata* Griseb., of which *P. aculeata* has been recorded as a host plant for *N. pisoniae*.

in Florida and *N. neopisoniae* in Cuba (Busck 1900; Clarke 1946). No *Nealyda* species have been formally reared on *P. rotundata*.

Pisonia rotundata occurs in the Florida Keys, Cuba and the Bahamas (GBIF Secretariat 2023), and it is considered endangered by the state of Florida (Wunderlin et al. 2024). The highest density of observations on iNaturalist is concentrated around Big Pine Key, where several *Nealyda* mines have been observed on *P. rotundata* (GBIF Secretariat 2023). These observations have been identified as *N. pisoniae*; however, the mines match neither the species description (Busck 1903) nor other observations of *N. pisoniae* on its known host plant, *P. aculeata*. This unique damage appears somewhat like the irregular, trumpet-shape mines of *N. pisoniae*, but it is broader and more circuitous, curving back in towards the leaf midrib (Frade 2021; Ringer 2022). The rarity of *N. grandipinella* and *P. rotundata*, their overlapping ranges and the presence of unusual damage suggest *P. rotundata* may be a host plant of *N. grandipinella*. Rearing more specimens from Big Pine Key is required.

Homology of vincular processes. The vinculum of many gelechiids has two pairs of processes: one mesal pair and one pair near the base of the valvae. The terms for these in the literature are variable, even within the same publication; for example, Huemer and Karsholt (2010) label the mesal pair “vincular process” in their Fig. 4 but “lateromedial projection” in Fig. 5. Using the former term for the mesal processes is preferable because they are attached to the vinculum but not to the anellus (cf. Huemer and Karsholt [2010] Fig. 6), and “lateromedial” is ambiguous. The process nearer the base of the valva can be homologized with the sacculus because of its position, and naming it the “sacculus” or “saccular process” has much precedent in the literature (Bidzilya 2005; Huemer and Karsholt 2010; Landry et al. 2017; Corro Chang and Metz 2021).

The variation of these projections in *Nealyda* makes them especially difficult to describe and homologize among the species. At first sight, *N. grandipinella*, *N. pisoniae*, *N. kinzelella*, and *N. bifidella* appear to have a single pair of processes in this area, while *N. phytolaccae* and *N. neopisoniae* have two pairs. Our first assumption was that these projections were vincular processes; however, this does not explain why some species have more processes than others. Closer inspection of *Nealyda grandipinella*, *N. pisoniae* and *N. kinzelella* reveals extremely small, weakly sclerotized paired bumps on the apices of the vinculum below the valvae. Since these bumps arise directly from the vinculum, we homologize them with the vincular processes. The large projections connected laterally to the bases of the valvae are therefore the saccular processes. However, the processes are peculiar in that their bases are connected to each other mesally in a conformation that resembles a transtilla, thereby arching over the vinculum. In *N. phytolaccae* and *N. neopisoniae*, the vincular processes are very long and lanceolate or aciculate, with few or no setae. The sacculus has a mitten-shaped apex in *N. phytolaccae* and is simple and elongate in *N. neopisoniae*; Clarke (1946) refers to the sacculus as the “ventral lobe” of the harpe (= valva) in both species. Nevertheless, Clarke’s incomplete and unlabeled illustrations make it difficult to determine what he meant with *N. neopisoniae*. The sacculus in *Chrysoesthia* and especially *Metanarsia* is broad and simple, like in the pisoniae group, so that shape may be plesiomorphic, whereas the narrow, bifid shape in the phytolaccae group may be apomorphic.

Nealyda bifidella shows an intermediate state between the pisoniae and phytolaccae groups. The saccular processes are triangular as in *N. phytolaccae*, but they are more strongly sclerotized as in the pisoniae group and bear numerous mesally directed setae as in *N. grandipinella*. Furthermore, *N. bifidella* has lobe-like vincular processes as in the phytolaccae group, but the processes are much smaller and do not extend up to the valvae. Based on the size and sclerotization of the vincular processes, *N. bifidella* appears to be more closely related to the phytolaccae group than to the pisoniae group. These characters may provide some insight into the species’ relationships.

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Literature Cited

- Adobe Systems. 2012.** Adobe Photoshop Elements 11.0.
- Bidzilya O. 2005.** A review of the genus *Metanarsia* Staudinger, 1871 (Gelechiidae). *Nota Lepidopterologica* 27(4): 273–297.
- Bidzilya O. 2008.** New species and new records of the genus *Metanarsia* Staudinger, 1871 (Lepidoptera: Gelechiidae). *SHILAP Revista de Lepidopterología* 36(144): 531–538.
- Bidzilya O, Karsholt O. 2008.** New data on Anomologini from Palaearctic Asia (Gelechiidae). *Nota Lepidopterologica* 31(2): 199–213.
- Boris Eyrych Software. 2023.** Artweaver Free 7. Available at <https://www.artweaver.de/en/help/217> (Last accessed 11 Oct 2024.)
- Busck A. 1900.** New species of moths of the Superfamily Tineina from Florida. *Proceedings of the United States National Museum* 23(1208): 225–254, pl. 1.
- Busck A. 1903.** A revision of the American moths of the family Gelechiidae, with descriptions of new species. *Proceedings of the United States National Museum* 25(1304): 767–930, pl. 28–32.
- Clarke JFG. 1946.** Synopsis of the genus *Nealyda* Dietz, with descriptions of new species (Gelechiidae: Lepidoptera). *Journal of the Washington Academy of Sciences* 36(12): 425–427.
- Clarke JFG. 1969.** Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick. Vol. 7, Gelechiidae (D–Z). Trustees of the British Museum (Natural History); London. 531 p.
- Corro Chang PE, Metz MA. 2021.** Classification of *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae: Gelechiinae: Gnorimoschemini) based on cladistic analysis of morphology. *Proceedings of the Entomological Society of Washington* 123(1): 41–54. DOI: 10.4289/0013–8797.123.1.41
- Dietz WG. 1900.** Some new genera and species of N.A. Tineina. *Entomological News and Proceedings of the Entomological Section* 11(2): 349–353, pl. 1.
- Eiseman C. 2021.** Caryophyllales. p. 1477–1552. In: Eiseman C. *Leafminers of North America*. Second edition. Published by the author.
- Florida Museum. 2024.** Lepidoptera Collection. Hosted by the University of Florida, Florida Museum of Natural History. Available at <https://specifyportal.floridamuseum.ufl.edu/leps/> (Last accessed 7 Oct 2024.)
- Frade N. 2021.** iNaturalist observation. Available at <https://www.inaturalist.org/observations/102633671>. (Last accessed 11 April 2024.)
- Gates MW, Heraty JM, Schauff ME, Wagner DL, Whitfield JB, Wahl DB. 2002.** Survey of the parasitic Hymenoptera on leafminers in California. *Journal of Hymenoptera Research* 11(2): 213–270.
- GBIF Secretariat. 2023.** GBIF Backbone Taxonomy. Checklist dataset <https://doi.org/10.15468/39omei> Accessed via GBIF.org on 11 April 2024.
- GNU Image Manipulation Program. 2023.** GIMP 2.10.36. Available at: www.gimp.org (Last accessed 11 October 2024.)
- Goloboff PA, Catalano SA. 2016.** TNT version 1.5. including a full implementation of phylogenetic morphometrics. *Cladistics* 32: 221–283. DOI:10.1111/cla.12160
- Hebert PD, Penton EH, Burns JM, Janzen DH, Hallwachs W. 2004.** Ten species in one: DNA barcoding reveals cryptic species in the neotropical skipper butterfly *Astraptes fulgerator*. *Proceedings of the National Academy of Sciences* 101: 14812–14817.
- Heppner JB. 2007.** Lepidoptera of Florida, Part 1: Introduction and Catalog. *Arthropods of Florida and Neighboring Land Areas* 17: 276–277.
- Hering EM. 1955.** Eine neue *Nealyda* von Argentinien (Lep. Gelech.). *Deutsche Entomologische Zeitschrift* 2(5): 322–325.
- Hobern D, Sattler K, Lee S. 2024.** Catalogue of World Gelechiidae (version 1.1.24.136 (15 May 2024)). In: Bánki O., Roskov Y, Döring M, Ower G, Hernández Robles DR, Plata Corredor CA, Stjernegaard Jeppesen T, Örn A, Vandepitte L, Hobern D, Schalk P, DeWalt RE, Ma K, Miller J, Orrell T, Aalbu R, Abbott J, Adlard R, Aedo C, et al. *Catalogue of Life (Annual Checklist 2024)*. Catalogue of Life, Amsterdam, Netherlands. <https://doi.org/10.48580/dg6lk-4th>. (Last accessed 9 July 2024.)
- Huemer P, Karsholt O. 2010.** Gelechiidae II (Gelechiinae: Gnorimoschemini). In: Huemer P, Karsholt O, Nuss M (eds.). *Microlepidoptera of Europe*, Vol. 6. Apollo Books; Stenstrup. 586 p.

- Karsholt O, Mutanen M, Lee S, Kaila L. 2013.** A molecular analysis of the Gelechiidae (Lepidoptera, Gelechioidea) with an interpretative grouping of its taxa. *Systematic Entomology* 38: 334–348. <https://doi.org/10.1111/syen.12006>
- Karsholt O, Vives Moreno A. 2014.** Two new Gelechiidae for the Iberian Peninsula (Lepidoptera: Gelechiidae). *SHILAP Revista de Lepidopterología* 42(168): 649–653.
- Kozub D, Shapoval J, Yatsenko S, Starikh V, Dobarskyi A. 2000.** Helicon Focus 8.2.2. Helicon Soft Ltd. Available at www.heliconsoft.com. (Last accessed 28 October 2024.)
- Landry JF, Nazari V, Bidzilya O, Huemer P, Karsholt O. 2017.** Review of the genus *Agonochoetia* Povolný (Lepidoptera, Gelechiidae), and description of a new genus and species from the Canary Islands. *Zootaxa* 4300(4): 451–485. <https://doi.org/10.11646/zootaxa.4300.4.1>
- Lee S, Landry JF. 2023.** Family Gelechiidae Stainton, 1854 (twirler moths and allies). p. 137–152. In: Pohl GR, Nanz SR (eds.). *Annotated Taxonomic Checklist of the Lepidoptera of North America, North of Mexico*. Wedge Entomological Research Foundation; Bakersfield, California. xiv+580 p.
- Madeira F, Madhusoodanan N, Lee J, Eusebi A, Niewielska A, Tivey ARN, Lopez R, Butcher S. 2024.** Muscle: Multiple Sequence Alignment (MSA). The EMBL-EBI Job Dispatcher sequence analysis tools framework in 2024. *Nucleic Acids Research* 52(W1): W521–W525. Available at <https://www.ebi.ac.uk/jdispatcher/msa/muscle>. (Last accessed 11 July 2024.)
- Powell JA, Opler PA. 2009.** *Moths of Western North America*. University of California Press; Berkeley, California. xiii+369 p.
- Ratnasingham S, Hebert PDN. 2007.** BOLD: The Barcode of Life Data System (www.barcodinglife.org). *Molecular Ecology Notes* 7: 355–364. Available at www.boldsystems.org. (Last accessed 11 July 2024.)
- Ringer DJ. 2022.** iNaturalist observation. Available at <https://www.inaturalist.org/observations/116224535>. (Last accessed 11 April 2024.)
- Robinson GS. 1976.** Preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. *Entomologist's Gazette* 27(2): 127–132.
- Sakamaki Y. 2000.** Japanese species of the genus *Apatetris* (Lepidoptera, Gelechiidae). *Tijdschrift Voor Entomologie* 143: 211–220.
- Shorthouse DP. 2010.** SimpleMappr. Available at: <https://www.simplemappr.net>. (Last accessed 23 April 2024.)
- Wunderlin RP, Hansen BF, Franck AR, Essig FB. 2024.** *Atlas of Florida Plants*. [Landry SM, Campbell KN (application development), USF Water Institute.] Institute for Systematic Botany, University of South Florida, Tampa. Available at: <http://florida.plantatlas.usf.edu/>. (Last accessed 30 May 2024.)

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