SCREENING KEY FOR CAPS TARGET LEPIDOPTERA IN THE EASTERN AND MIDWESTERN UNITED STATES (MALES)

LAB MANUAL FOR THE LEPIDOPTERA IDENTIFICATION WORKSHOP
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DISCLAIMER: species and characters included in this key were selected based on the author's experience and may not reflect current CAPS funding priorities or policies or may not reflect the opinion or views of the USDA or CAPS
This key is dedicated to Lloyd Knutson and Mary Lacy-Theisen for their efforts in developing a program to distribute pest insect specimens.

Thanks to them, exotic pest reference specimens are common in many institutional collections with red PKNTO or INKTO labels.

Their understanding of the importance of a reference specimen to pest detection was years ahead of its time. To this day no one yet knows how to solve this problem, in spite of the fact everyone knows it is an issue. It not rocket science but ....

Most species encountered in the Cooperative Agricultural Pest Survey (CAPS) program can be divided into four categories: CAPS targets (pests approved and funded for survey); suggested targets (exotic pests with a pathway that merit consideration for funding); low risk targets (exotic pests with no or improbable pathways into the US) and non-targets (native US species encountered in the survey). Non-targets may ("look-alikes") or may not resemble the target pest.

This key emphasizes CAPS targets and their similar native non-targets (named by association with the pest they resemble). Some suggested targets are included because they may be CAPS targets in the future. Low risk targets, while interesting, are usually ignored. Very few common non-targets are included in this key to keep it relatively short. Screening aids for a single CAPS target usually discuss non-target identification in more detail. The intended value of this key rests on the fact that almost no North American collection has all these species represented and the web rarely if ever illustrates genitalia. Thus, a diagnostic lab usually cannot rapidly screen samples for the worst pests, and if they have a suspect, illustrations of the genitalia are usually not easily available.

The accuracy of any specialized or simplified key depends on the context in which the key is utilized. This key is designed to help diagnostic labs recognize suspects more rapidly in USDA pheromone traps. It is not designed for use in non-agricultural settings. Being a screening aid, this key does not contain sufficient detail or cover enough taxa to allow for final identifications. New US records or quarantine significant finds of extreme importance need to be first sent to the appropriate APHIS specialist, then passed on to the Systematic Entomology Lab (SEL) for final confirmation. At least one voucher specimen of any newly established exotic pest should be deposited in the USNM collection at Washington, D.C.

Besides exotic agricultural pests, diagnostic labs need to be aware of potential escapes from butterfly houses and the likely future increase of trade in illegal CITES species. A few couplets include CITES or other protected taxa, but this is only a very small portion of the total number. Should APHIS ever expand the Smuggling Interdiction and Trade Compliance (SITC) program, or their internet surveillance, the number of CITES related issues would no doubt increase proportionately.

The following key only applies only to males and relies heavily on genitalia. While female genitalia are often distinctive and useful, most CAPS target pests are easier to identify as males, and most CAPS sticky traps are designed to capture males. There are several ways to sex moths: the antennae, shape of the abdomen, presence of lobed valves and the frenulum bristles. The males of some species differ from females in having bipectinatae antennae. Males often have thin pointed abdomens whereas female abdomens are thicker (being filled with eggs) with a rounded tip. The male valves often do not overlap completely, this results in slit sometimes being visible. Similarly, the female genitalia may have the ovipositor lobes partially visible as two "hairy pads". Although there are exceptions (e.g. some pyraloids), if a frenulum is present, one bristle signifies a male and multiple bristles indicate a female.

Terminology has been kept to a minimum and issues of homology between structures in different families are not addressed. Neutral terms like clasper or basal process are used. Comparison of the unknown with pictures of the target is critical to the accurate use of this key.
The characters used in the key reflect the state of the art. In some cases, one character will allow undisputed recognition (hindwing of *Thaumatotibia leucotreta*). The other extreme is that the pest is poorly defined morphologically and host data is needed (*Phylllocnistis citrella* traps need to be associated with a citrus grove).

Specimens that do not fit the couplets in either direction will likely represent taxa not covered by the key. In a few larger families there is a pathway in the key for discarding miscellaneous samples that are not targets or non-targets for the CAPS program.

Characters used in this key were taken from the Internet, published taxonomic literature, various unpublished APHIS documents and my personal experience. This key is a draft which needs to be tested with a large series of actual specimens and evaluated by members of CAPS.

Consult the reference lists and individual presentations in this workshop for information on female genital characters, distribution, and hosts. In some cases molecular diagnostics are an option for identification. Bucket traps or lightly coated tanglefoot traps can also be used. These can be evaluated on a case by case basis depending on the target.

Julieta Brambila (USDA/APHIS/PPQ), Richard Brown (Mississippi State University) and Marc Epstein (CDFA) provided useful comments on the key. John Brown (USDA/ARS) helped by reading and proofing the tortricid section. Thanks to Todd Gilligan (Colorado State University) for information on laws relating to protected Lepidoptera and E. LaGasa (WSDA) for modifying the target categories.

SCREENING KEY FOR CAPS TARGET LEPIDOPTERA IN THE EASTERN AND MIDWESTERN UNITED STATES (MALES)

1. Antenna gradually thickened or clubbed at tip
   1'. Antenna variable, but not thickened or clubbed at tip

2. Forewing and hindwing with large clear areas; hindwing with a row of small curved spines on the inner margin; thorax and abdomen with red markings
   2'. Forewing and hindwing without large clear areas; hindwing without a row of small curved spines on the inner margin; thorax and abdomen without red markings

3. Labial palpi all black; base of valve with a simple ridge; saccus rounded at tip (apple clearwing moth) *Synanthedon myopaeformis*
   3'. Labial palpi black with the inner surface reddish yellow; base of valve with a rounded lobe; saccus truncate at the tip (non-target exotic for eastern US, large red belted clearwing moth) *Synanthedon culiciformis*

4. Underside of forewing bright red; hindwing bright orange with a series of white spots on a dark background (South American palm borer) *Paysandisia archon*
   4'. Underside of forewing not bright red; hindwing not bright orange with a series of white spots on a dark background
5. Forewing with second anal vein reaching the wing margin and a "spur" present on the
discal cell near the base; hindwing tail absent

5'. Forewing lacking both the second anal vein and "spur" on the discal cell near the base;
rarely a hindwing tail is present

6. Valve with a marginal process; large usually orange, green, black and yellow
butterflies (more rarely blue) lacking eyespots (birdwings, some CITES
protected) Troides, Ornithoptera, etc.

6'. Valve lacks a marginal process; two eyespots present on the hindwing (lime
swallowtail) Papilio demoleus (or the almost identical P. demodecus)

7. Tympanum present on either metathorax or abdomen

7'. Tympanum absent on metathorax and abdomen

8. Metathoracic tympanum present, not opening downward; HW with Sc and R1 veins
widely separated beyond discal cell

8'. Abdominal tympanum present, often opening downward; HW with Sc and R1 veins
fused or barely touching beyond discal cell see Pyraloidea key

9. Ocelli present; antenna without spinules at the end of each branch; proboscis well
developed; orbicular and/or reniform spot usually circular or oval see Noctuidae key

9'. Ocelli absent; antenna with spinules at the end of each branch; proboscis poorly
developed; orbicular spot absent and reniform spot usually c or v-shaped

10. Tegumen with a digitate process; dorsal arm of valve bifurcate; forewing slightly
pointed (pink gypsy moth) Lymantria mathura

10'. Tegumen without a digitate process; dorsal arm of valve fingerlike; forewing
rounded at the apex

11. Costal process as long as valve; basal process present; forewing white with black
zigzag lines, sometime black or gray in melanic forms (nun moth) Lymantria monacha

11'. Costal process longer than valve; basal process absent; forewing light brown to dark
red brown

12. Forewing length 14-22 mm (European gypsy moth) Lymantria dispar dispar

12'. Forewing length greater than 22 mm; (Asian gypsy moth, Japanese gypsy
moth) Lymantria dispar asiatica, Lymantria dispar japonica

13. Proboscis scaled and well developed; hindwing produced to a point at the apex;
gnathos tonguelike or rounded

13'. Proboscis naked, reduced or absent; hindwing without a point at the apex; gnathos
rarely tonguelike or rounded
14. Antennal scape lacks pecten; uncus rounded, not spined; valve slender and curved apically; aedeagus with a distal spine (South American tomato moth) *Tuta absoluta*

14'. Antennal scape with pecten; uncus pointed, spined; valve rounded with deciduous spines and not bent apically; aedeagus lacking a distal spine

15. Valve with broad and long deciduous spines arising beneath a membrane (non-target, pink bollworm) *Pectinophora gossypiella*

15'. Valve with thin short deciduous spines not arising beneath a membrane (pink spotted bollworm) *Pectinophora scutigera*

16. Proboscis reduced; frenulum absent

16'. Proboscis usually well developed, sometimes absent; frenulum present

17. Wings blue green with veins outlined in red brown; a small eyespot present on the forewing and hindwing; long tails present on the hindwing (Spanish moon moth, IUCN Red List species) *Graellsia isabellae*

17'. Wings gray to brown without veins outlined in red brown; no eyespot present on the forewing or hindwing; long tails absent on the hindwing

18. Valve with two projections, the smaller one either 1/5 or 3/4 as long as the larger one (European pine moth, Siberian silk moth) *Dendrolimus pini* and *Dendrolimus "superans-sibiricus complex"

18'. Valve with a single projection (*Dendrolimus* non-target) *Gloveria, etc*

19. Chaetosemata present; antenna filiform; costal fold present or absent

19'. Chaetosemata absent; antenna filiform or bipectinate; costal fold always absent

20. Forewing white with rows of black dots; uncus bifid and pointed; valve somewhat oval and apically expanded; saccus long and tubular

20'. Forewing not white with rows of black dots; uncus not bifid and pointed; valve not oval and expanded apically; saccus not long and tubular

21. Forewing with four rows of black spots and white cilia; anal area of hindwing and cilia white; not associated with apple (apple ermine moth non-target) *Yponomeuta multipunctella*

21'. Forewing with three rows of black spots and mostly gray cilia; anal area of hindwing and cilia mostly gray; reared from or collected near *Malus* (apple ermine moth) *Yponomeuta malinellus*

22. Very tiny (less than 2 mm) moths with mostly white wings

22'. Larger moths (more than 2 mm); wings not mostly white
23. Eyecap absent; forewing with a faint y-shaped marking; reared from or associated with citrus and related Rutaceae (citrus leafminer) *Phyllocnistis citrella*

23'. Eyecap present; forewing lacks a faint y-shaped marking; not reared or associated with citrus

24. Head smoothly scaled; valve oval, dorsal lobes rounded (pear leaf blister moth) *Leucoptera malifoliella*

24'. Head roughly scaled; valve not oval, dorsal lobes pointed (pear leaf blister moth non-target) *Proleucoptera smilaciella*

25. Palpi upturned; forewing with a large white patch

25'. Palpi upturned or porrect; forewing lacking a large white patch

26. Valve slightly swollen at tip, not boot-shaped; saccus abruptly narrowed, parallel sided, total length of the vinculum and saccus approximately two times that of the valve (leek moth) *Acrolepiopsis assectella*

26'. Valve clubbed at tip, almost boot shaped; saccus gradually tapering, total length of the vinculum and saccus less than two times that of the valve (leek moth non-target) *Acrolepiopsis incertella*

27. Antenna bipectinate to the tip

27'. Antenna not bipectinate to the tip a species not in the key

28. Forewing with at least a single slanted vertical line from the costa to the inner margin; valve not squared shaped with two patches of stout spines

28'. Forewing without a single slanted vertical line from the costa to the inner margin; valve roughly squared shaped with two patches of stout spines

29. Forewing with a vertical subterminal line (*Darna* non-target) *Natada nasoni*

29'. Forewing without a subterminal line (nettle caterpillar) *Darna pallivitta*

30. Hindwing dirty white, the apex rounded (butterworm) *Chilecomadia moorei*

30'. Hindwing brown, the apex pointed (teboworm) *Chilecomadia valdiviana*
Appendix 1. Synanthedon species male genitalic identification characters.
Fig. 58. Male and female genitalia of *Troides (Troides) priamus* (L.). For scale length and key to structures refer to figure 20.
Fig. 13. Male genitalia
A. Lateral (rl. valva removed) and

ANATOMY OF THE COMMON LEMON BUTTERFLY
Papilio demelissa
PLATE 19. MALE GENITALIA. *lymantria (Nyctria) mathura*. Fig. 1. Genital capsule, Taiwan, genitalia slide USNM 59200. Fig 2. Genital capsule, Russia, Siberia, Kongaus, genitalia slide USNM 58862. Fig. 3. Aedoeagus, genitalia slide USNM 59200.
PLATE 14. MALE GENITALIA. Fig. 1. Lymantria (Lymantria) monacha, genital capsule, No data, genitalia slide USNM 59108. Fig. 2. Lymantria (Lymantria) monacha, valve, Sweden, genitalia slide USNM 58968. Fig. 3. Lymantria (Lymantria) monacha, aedoeagus, genitalia slide USNM 58968. Fig. 4. Lymantria (Lymantria) pulverea, genital capsule, Taiwan, Tayuling, genitalia slide DCF 1647 (PWS). Fig. 5. Lymantria (Lymantria) pulverea, valve, genitalia slide DCF 1647 (PWS). Fig. 6. Lymantria (Lymantria) pulverea, aedoeagus, genitalia slide DCF 1647 (PWS).
PLATE 7. MALE GENITALIA. 

Lymantria (Porthetria) dispar dispar. Fig. 1. Genital capsule, USA, Maryland, Montgomery Co., genitalia slide USNM 59088. Fig. 2. Aedeagus genitalia slide USNM 59088. Fig. 3. Valve, France, genitalia slide USNM 57648. Fig. 4. Valve, Sardinia, genitalia slide USNM 59165. Fig. 5. Genital capsule, USA, New Hampshire, Portsmouth, genitalia slide USNM 59097. Fig. 6. Aedeagus genitalia slide USNM 59097. Fig. 7. Valve, Russia, genitalia slide USNM 59150. Fig. 8. Valve, Baskin, Kazakhstan, Altai Territory, genitalia slide USNM 59193.
FIGURA 94
Genitales: (A) Symmtrischema plasiosm, macho; (B) Phthorimaea opercularia, macho; (C) P. opercularia, hembra; (D) Keiferia lycopersicella, p.f., proceso falciforme; (E) Scrobipalpula absoluta; p.e., proceso espiniforme.
Tuta absoluta
Pectinophora species, male genitalia, left valva, mesal view.

9. *P. scutigera*, showing exposed, deciduous setae.
10. *P. gossypiella*, showing deciduous setae arising beneath membrane (From Holdaway 1929a).

**Females.** Pectinophora have paired hooklike siga (Figs. 11, 12). Both *P. scutigera* (Fig. 12) and *P. gossypiella* (Fig. 11) have the apophyses posteriores longer than the ductus bursae; and *P. scutigera* (Fig. 12) has strongly curved, somewhat slender siga. *P. gossypiella* (Fig. 11) has stout, slightly curved siga. *P. endema* (Fig. 13) has the ductus bursae longer than the apophyses posteriores.

**EGGS.** Length 0.53–0.64 mm; width 0.30–0.33 mm. White to pale cream, becoming pink, blotched. Surface sculptured with longitudinal ridges joined by oblique lines.
Both the pheromone and the dispensers were manufactured by the Institute of Chemical Means for Plant Protection in Moscow. Five different mixtures of attractant (Table 1) were tested in 10 replicates. The traps were placed in a line 150 m apart in 1-2-3-4-5-1-2 etc. sequence in a park type pine forest. For a period of 40 days traps were checked twice—23 males of *D. pini* and 17 males of *D. superans* were caught. The distribution of catches demonstrated that 1:1 and 1:0.5 mixtures had equal attractivity to both species. The 1:0.1 mixture was not attractive for Siberian moth males and the aldehyde did not attract either species.

The experiment demonstrated the similarity of sex attractants of Siberian moth and pine moth. Possibly the pheromones of these species, in addition to the main components, contain some minor ones which determine the specificity of the communication signal. Males of the two species are morphologically very similar, the only real difference can be found in male genitalia. The lower branch of the valvae of Siberian moth is much longer and thinner than that of the pine moth (Fig. 1).

<table>
<thead>
<tr>
<th>Attractant components mkg per lure Z5E7DDDAL:Z5E7DDDOL</th>
<th>% of the total males caught</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Dendrolimus pini</em></td>
</tr>
<tr>
<td>1 1000 : 1000</td>
<td>30.4</td>
</tr>
<tr>
<td>2 1000 : 500</td>
<td>39.1</td>
</tr>
<tr>
<td>3 1000 : 250</td>
<td>8.7</td>
</tr>
<tr>
<td>4 1000 : 100</td>
<td>21.8</td>
</tr>
<tr>
<td>5 1000 : 0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Total** 100 100

Figure 1. Part of genitalia (valvae) of *Dendrolimus pini* (A) and *D. superans sibiricus* (B) males; AB—upper branch, LB—lower branch of valvae.
In the male genitalia the most obvious difference is the extent of the teeth or serrations on the apical extension of the aedoeagus; in *gargamelle* the teeth extend from the apex to the opening, and in *medusa* they extend for only half the distance from the apex to the opening.

The larva has been described by Comstock (1960: 178). The following description is, in part, from his summary. The head is gray-brown with the adfrontal and epicranial sutures light brown. The middorsal white stripe on the thoracic and abdominal segments is bisected by a black line, and it is bordered a darker shade on each side. There is a paler subdorsal line and a lateral line composed of a series of short black and white stripes. The spiracular area is mottled with dull white, brown, and black. The host plants are recorded as *Eriogonum fasciculatum* Benth., *Ceanothus verrucosus* Nutt., and *Pinus* species. I wonder if this last could be an error in which the larva of *arizonensis* was mistaken for this species.

The moth is known from the coastal areas of southern California, and it has a summer flight period.
Fig. 30a-h. a, b, *Yponomeuta orientalis* Zag. (after Zagulajev, 1969). a, ♂ genitalia; b, ♀ genitalia. c-e, *Yponomeuta osakae* Mrt. (after Moriuti, 1977). c, ♂ genitalia without aedeagus, ventral view; d, aedeagus; e, sacculus. f-h, *Yponomeuta padellus* (L.). f, ♂ genitalia without aedeagus, lateral view; g, aedeagus; h, ♀ genitalia.


Type: LSL. Distribution: Imago: V–VI. Host plant: L most of these pl 1974; Sherniyaz

*Yponomeuta pal* Gershenson, 1979, I

Holotype: IZ! Material exar nia, Khosrov (Shcherbak). Distribution: Imago: IX.

*Yponomeuta pal* Holotype: MI Material exa 12–4–1934. R. I Distribution: Imago: IV. Description: ♀. 21mm. The the other *Ypono* with silvery-fus thorax with five arranged in four the same colour
As treated here - in a broad concept - the taxon Yponomeutidae is a heterogeneous family group comprising the subfamilies Acrolepiinae, Argyresthiinae, Plutellinae and Yponomeutinae. These subfamilies differ markedly, especially the Argyresthiinae and Acrolepiinae, and are sometimes separated as families. In general, yponomeutid adults are small to medium-sized narrow-winged micro-moths, often brightly coloured, with a few larger moderately broad-winged species, notably in the Yponomeutinae. Larval feeding habits differ according to the subfamily, some feed exposed (Plutella, Plutellinae), some live gregariously in a communal webbing or nest (Yponomeuta, Yponomeutinae), some are concealed-feeders, tunnelling in fruit and shoots (Argyresthia, Argyresthiinae), or living between the leaves (Acrolepiopsis, Acrolepiinae).

The structure of the male genitalia varies greatly with the different subfamilies: tegumen usually narrow, weak; uncus usually reduced, often indefinite; socii strongly developed, prominent and setose, often erect (Yponomeutinae), sometimes with specialised scales on internal surface (Argyresthiinae); gnathos usually present, tongue-like (Yponomeutinae), or recurved and with spines at tip (Argyresthiinae), or absent (Acrolepiinae); anellus present as sclerotised ring (Plutellinae), or membranous; vinculum narrowly rounded, or rectangular, usually with slender saccus, or W-shaped or nearly so in ventral aspect (Argyresthiinae); sternite 8 sometimes in form of V- or Y-shaped plate (Argyresthiinae), or entire segment 8 sometimes divided, forming two lobes enclosing genitalia (Yponomeutinae, Zelleria).

Structural differences between the subfamilies are less marked in the female genitalia than in the male: ovipositor sometimes partially extensile, lobes short or reduced; sternite 8 often with spinulose pads on either side of ostium; signum single or absent; coremata sometimes present.

ADULTS (Fig. 1) - Overall shiny metallic gray. Vertex of head with tuft of hair; antenna long and filiform, scape forms eye-cap, antennal segments 28-32 in female, 28-30 in male. Female wingspan 7-8 mm, body length 2.6-3.0 mm; male wingspan 5.5-6.0 mm, maximum body length 2.0-2.3 mm (Ferro 1961). Forewing lanceolate; outer and posterior margin fringed; at rest, apex pointed, upturned in lateral view, divergent outwards in dorsal view (Emmet 1981); fringe with 4 radiating black lines: 2 toward costa, 3d horizontal, 4th directed posteriorly about 45° from long axis of wing; apical half, orange, enclosing 2 white, dark-edged costal spots and post tornal pale violet-golden spot strongly black-margined on both sides (Meyrick 1928, Stainton 1855). Hind wing narrowly lanceolate, evenly leaden gray, fringe longer than width of wing (Réal 1966). Wing venation (Fig. 2). Male genitalia (Fig. 3). Female ovipositor (Fig. 4).

(Figs. 2-3)

Leucoptera malifoliella. 2. Female wing venation. 3. Male genitalia, ventral view (2 from Ferro 1961; 3 from Zangheri and Ravelli 1957).

Pear leaf blister moth,

Leucoptera malifoliella - 3
Fig. 63–74. Outlines of male valvae of Acrolepiopsis species, apex directed rightwards, all at same scale. 63, A. assectella, slide MIC 5172, specimen CNCLEP00006906; 64, A. sapporensis, slide USNM 15937, specimen CNCLEP00018264; 65, A. californica (holotype of A. liliivora), slide USNM 91630; 66, A. californica, paratype, slide USNM 91617; 67, A. californica, holotype, slide USNM 91616; 68, A. californica, ex Lilium pardalinum, slide JFL 1645, specimen CNCLEP00020303; 69, A. californica, slide JFL 1600, specimen CNCLEP0002217; 71, A. leucoscia, slide USNM 15934, specimen CNCLEP0002747; 72, A. heppneri, slide MIC 5170, specimen CNCLEP00014105; 73, A. reticulosa, holotype, slide Gaedike 2556; 74. A. incertella, slide MIC 5171, specimen CNCLEP00002208. Scale bar = 0.1 mm.

Acrolepia dorsimaculella; Walsingham 1882: 172.

Diagnosis

Although A. incertella is superficially distinguished from A. heppneri, it is readily separable by its genitalia. The male genitalia (Fig. 53) have an elongated saccus that is barely longer than the valvae; stubby valvae have a slightly concave dorsal and ventrally rounded apical margin. The aedeagus is shorter and less curved. Female genitalia are distinguishable from that of A. heppneri, and are variably curved. The plane of the sterigmata is smooth and situated in part of the corpus bursae. The female genitalia are distinguished by the presence of the ductus bursae and the ostium sterigmatis.

**Distribution**

Widely distributed across North America from South Dakota and Mississippi in the west to the Atlantic in the east. The species is found in several scattered locations.

**Life history**

Larvae feed on young leaves and have been reared from Smilax herbacea. The account again was provided by Terry Harrison (personal communication). The larva is known as 'Spirit', and feeds as a skeletonizer on S. tamnoides. It appears once per year, early in May. The larva is easy to spot. Each larva gains of one of the green terminal leaves, looks something like a silkworm, and is about 2 cm in length (Fig. 125). The larval damage is seen on the external sides of the terminal leaves, which appear to be eaten away.
Explanation of Plate IV

Fig. 1 *Chilecomadia valdiviana* Phil. Male genitalia: vinculum cut on one side and structures opened out; only one valve shown; ventral surface of dorsal structures and mesal face of valve shown; penis directly below.

Fig. 2 *Chilecomadia moorei* S. Fig. Male genitalia: as in figure 1.

Fig. 3 *Rhizocossus* n. gen., *munroei* n. sp. Male genitalia: as in figure 1.

Fig. 4 *Chilecomadia moorei* S. Fig. Female genitalia: A, dorsal view; B, ventral view of region about ostium.
SCREENING KEY FOR CAPS TARGET TORTRICIDAE IN THE EASTERN AND MIDWESTERN UNITED STATES (MALES)

1. Bottom edge of hindwing with circular patch of black scent scales; tibia of hindleg heavily tufted (false codling moth) *Thaumatotibia leucotreta*
   1'. Bottom edge of hindwing lacking circular patch of black scent scales; tibia of hindleg not heavily tufted 2

2. Uncus elongate or spatulate 3
   2'. Uncus absent or bifid 8

3. Membranous lobe present at apex of valve 4
   3'. Membranous lobe absent at apex of valve 5

4. Costal fold lobed and conspicuous (light brown apple moth) *Epiphyas postvittana*
   4'. Costal fold vestigial and narrow, or absent (light brown apple moth non-target) *Clepsis* spp.

5. Uncus spatulate; transtilla with stout spinelike setae; costal fold lobed and conspicuous 6
   5'. Uncus elongate or spatulate; transtilla lacks stout setae; costal fold present or absent 7

6. Uncus two to three times longer than wide; valve with small pointed lobe at apex (summer fruit tortrix) *Adoxophyes orana*
   6'. Uncus with length equal to width; valve rounded without small pointed lobe at apex (summer fruit tortrix non-target) *Adoxophyes furcatana*

7. Valve with spine at apex of sacculus; antenna not notched native and exotic *Archips* spp.
   7'. Valve lacks spine at apex of sacculus; base of antenna notched native and exotic *Pandemis* spp.

8. Forewing uniformly green, even when worn; valve with two small lobes at apex (green oak tortrix) *Tortrix viridana*
   8'. Forewing not uniformly green; valve lacks two small lobes at apex 9

9. Uncus and socii absent; ventral margin of valve indented to form a "neck" 10
   9'. Uncus or socii present; ventral margin of valve does not form a "neck" 12

10. Neck strongly constricted so that valve appears bilobed ventrally (bean moth) *Cydia fabivora*
   10'. Valve does not appear bilobed ventrally 11
11. Valve with a thornlike projection; apex of aedeagus sclerotized and concave, one long thin cornutus present (plume fruit moth)  
   Grapholita funebrana
11'. Valve lacks a thornlike projection; apex of aedeagus not sclerotized and concave, several long thin cornuti present (non-target, Oriental fruit moth)  
   Grapholita molesta

12. Aedeagus massive, almost as wide and long as the valve, with a thin long cornutus, a patch of cornuti and a circle of cornuti; European grape berry moth  
   Eupoecilia ambiguella
12'. Aedeagus not as wide or long as the valve, without three groups of cornuti  
   13

13. Black sex scaling on hindwing, abdomen and hindleg; valve broad and quadrate at base, curved upward distally (bean shoot moth)  
   Crocidosema aporema
13'. Black sex scales absent on hindwing, abdomen and hindleg; valve not quadrate at base and curved upward distally  
   14

14. Uncus absent; valve long, thin and notched on the ventral margin, the apex evenly rounded with relatively short and sparse setae; aedeagus without cornuti (grape vine moth)  
   Lobesia botrana
14'. Uncus and cornuti present or absent; if valve long and thin then apex with dense setae and ventral notch absent  
   Tortricidae (not in the key)
Fruit Tree Tortrix (continued)

Archips podanus (Scopoli)
Tortricidae: Tortricinae: Archipini

Archips podanus

Archips crateageanus

Archips magnolianus (male)

Archips pupuranus (female)
Eupoecilia ambiguella

Lobesia botrana

Crocidosembla aporema
SCREENING KEY FOR CAPS TARGET PYRALOIDEA IN THE EASTERN AND MIDWESTERN UNITED STATES (MALES)

1. Chaetosemata absent, if present then moth straw colored; preacinctorium present but may be hard to find; a slide mounted cleared abdomen shows open tympanal cavities medially (Crambidae) 3

1'. Chaetosemata present, moths always brown and gray; preacinctorium absent; a slide mounted cleared abdomen shows closed tympanal cavities medially (Phycitinae) 2

2. Forewings narrow and mostly brown; scale and setal tufts present near base of sacculus; apical portion of gnathos hooked; mesotibia without an oblique black dash (honeydew moth) . Cryptoblabes gnidiella

2'. Forewings with pale costal area and black distal dot; apical portion of gnathos bilobed; mesotibia with oblique black dash (cactus moth) Cactoblastis cactorum

3. Gnathos and uncus joined like a pincer; middle of hindwing with a row of scales at base of Cu vein 4

3'. Gnathos and uncus not joined like a pincer; middle of hindwing lacking row of scales at base of Cu vein 6

4. Ocelli absent; costal process of valve large and flattened apically Diatraea considerata

4'. Ocelli present; costal process of valve, if present, blunt and triangular 5

5. Frons with upper and lower ridge; triangular costal process of valve absent (Asiatic rice stem borer) Chilo suppressalis

5'. Frons with single upper ridge; triangular costal process of valve present (spotted stalk borer) Chilo partellus

6. Forewing with scale tuft near base of costa; gnathos toothed dorsally Crocidolomia pavonana (binotalis)

6'. Forewing lacks scale tuft near base of costa; gnathos not toothed dorsally 7

7. Wings white with a thick straight contrasting brown band at the margins 8

7'. Wings lack a thick contrasting brown band at the margins 9

8. Brown band at forewing costal margin encloses one to two pale spots (box tree pyralid) Diaphania perspectalis

8'. Brown band at costal margin solid, without a pale spots 9

9. White lateral margins of frontal area not reaching antennal base; dark band of forewing widens at anal angle; hindtibia not flattened; dorsum of A5-6 dark, the rest white; anal tuft no wider than two times the abdomen (pumpkin caterpillar; established in S. Fla, exotic in rest of US) Diaphania indica
9'. White lateral margins of frontal area reaching antennal base; dark band of forewing not widened at the anal angle; hind tibia flattened; dorsum of A1-5 white, A6-7 either dark or white; anal tuft 2-3 times wider than the abdomen (non-target, melonworm)  

   *Diaphania hyalinata*

10. Wings and abdomen orange with black dots; uncus elongate, the tip rounded and slightly spatulate, with a small row of spines (yellow peach moth complex)  

   "*Conogethes* spp."

10'. Wings and abdomen not orange with black dots; uncus not elongate and slightly spatulate  

11

11. Uncus trilobed; valve with mesal spiny patch and comblike spines on sacculus  

   12

11'. Uncus not trilobed; valve lacks mesal spiny patch and comblike spines on sacculus  

   13

12. Forewing light yellow tan; spined zone of sacculus longer than spineless basal area (Asian corn borer)  

   *Ostrinia furnacalis*

12'. Forewing brown to tan with a slight reddish tint; spined zone of sacculus shorter than spineless basal area (non-target, European corn borer)  

   *Ostrinia nubilalis*

13. Forewing with 2-3 white patches, the largest one elongate and open at the costal margin; dark border of hindwing irregular, never straight; (lima bean pod borer)  

   *Maruca vitrata (testulalis)*

13'. Forewing without 2-3 white patches and a large one open at the costal margin; dark border of hindwing absent  

14

14. Tip of uncus clubbed; tegumen with a sharp notch at apex; forewing with a large oval spot bisected by a pointed spike (pattern may be faded)  

   *Glyphodes onychinalis*

14'. Tip of uncus not clubbed; tegumen lacks a sharp notch at apex; forewing without a large oval spot bisected by a pointed spike  

15

15. Postmedial line with a medial finger like lobe; aedeaegus without cornuti  

   *Duponchelia fovealis*

15'. Postmedial line lacks a medial finger like lobe; aedeaegus with or without cornuti  

16

16. Forewing white with an irregular red brown lobed spot at the middle of the inner margin; aedeaegus with a single thin cornutus  

   17

16'. Forewing not white with an irregular red brown lobed spot at the middle of the inner margin; aedeaegus with or without a single thin cornutus  

   Crambidae not in the key

17. Tegumen membranous (New World origins)  

   *Neoleucinodes elegantalis*

17'. Tegumen sclerotized (Old World origins)  

   *Leucinodes orbinalis*
FIGURE 1: CRYPTOBLABES GNIDIELLA
a. Male forewing and hindwing; b. Male genitalia (left valva, aedoeagus and some scales and setae of tufts near base of sacculus omitted); c. Aedoeagus; d. Female genitalia.
FIGURE 31: VENATION AND GENITALIA OF *CACTOBLASTIS CACTORUM*

*a.* Male forewing and hindwing.  
*b.* Male genitalia (most of left valva and aedoeagus omitted) (HHN 3141).  
*c.* Aedoeagus.  
*d.* Corpus bursae, ductus bursae, and part of ductus seminalis (HHN 3142).
medial line, extending from the costa to vein 3, black-brown; both wings with the postmedial line indistinct.

_Hab._ Khäsia; Nágas. _Exp._ 22 millim.

5030. _Glyphodes hermasalis_, _Wlk._ _Cat._ xviii, p. 516.


♀. Pale yellow; palpi except at base, frons, antennæ, and stripes on shoulders and vertex of thorax black; thorax below with a ridge of large leaden-coloured scales near mid legs; abdomen with the distal half black. Fore wing with the costal area black, with three spots in cell conjoined to it; an outwardly-oblique nearly straight postmedial line with the area beyond it black. Hind wing with postmedial line curved from costa to anal angle, the area beyond it black.

_Hab._ Sikkim; Khäsia; Borneo. _Exp._ 35 millim.


_Phacellura advenalis_, Lec. _Wien._ ent. _Mon._ 1863, pp. 401, 473, pl. 13, fig. 17.

Head fuscous; palpi white below; thorax and abdomen white and fuscous. Fore wing fuscous, with white spot in cell and discocellular lunule; a broad white fascia below the cell from base to marginal area and fasciae in the interspaces beyond the cell, the two between veins 2–5 short. Hind wing white, with broad fuscous marginal band narrowing to anal angle.

_Hab._ Japan; China; Dharmsál. _Exp._ 50–54 millim.

5032. _Glyphodes pulverulentalis_, _n._ _sp._

♀. Differs from _negataulis_ (p. 347) in being thickly irrorated and striated with black; abdomen with oblique lateral stripes; the anal tuft black with brown middle. Fore wing with all the markings obscured by the spots and striae; the antemedial, medial, and postmedial bands broader and less irregular, the 1st dentate inwards on vein 2, the 2nd without discocellular spot on it, the 3rd with series of pale specks on its outer edge from vein 4 to inner margin; the dentate submarginal line replaced by a series of diffused black patches in the interspaces. Hind wing thickly irrorated and striated; oblique black-edged brown postmedial and submarginal bands almost meeting at a point near anal angle; cilia of both wings fuscous, with fulvous and brown lines at base.

_Hab._ Nágas; Tenasserim (Doherty). _Exp._ 30 millim. Type in coll. Elwes.

5033. _Glyphodes dysallactalis_, _n._ _sp._

♂. Differs from _negatalis_ in being paler. Fore wing with the

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Figura 5. Adultos de *Diaphania Hyalinata* (1X).

Figura 6. Tibia posterior izquierda de *Diaphania Hyalinata* (1X).


Figura 8. Vista ventral del borde anterior de *Diaphania Hyalinata* mostrando las modificaciones de las escamas (25X).


Morphology of Yellow Peach Moth

Fig. 2. Selected morphometric characters of the two types of yellow peach moth. 1: Valva of male genitalia, 2: Tegumen of male genitalia, 3: Ovipositor of female. For abbreviations, see text.

kV under a model SE-430 (Hitachi, Tokyo) scanning electron microscope.

Nine quantitative characters (7 linear and 2 angular) were morphometrically evaluated on the male genitalia and the female ovipositor (Fig. 2). As supplementary characters, structure of the hind tibia and the hind 1st-tarsus of the male moth, papilla analis of the female moth, epipharynx, mandible, labrum and pinacular of the larva and cremaster of the pupa were selected for comparisons between the two types. Some parts of these morphological characters were also compared with those of the cardamom shoot borer, C. punctiferalis from India. All morphometrical characters were also compared on photographs.

RESULTS

Male genitalia

There were definite differences in three characters of the male genitalia between FFT and PFT although the specimens from various host plants and localities showed a little individual variation. The first discriminating character between the males of the two types was the angle of mesal projection of valva (APV) against costa (Fig. 2). As shown in Table 1, APV was distinctly larger in PFT than in FFT but no difference in this trait was observed among the populations from various host plants in each type.

The second discriminating character on the genitalia was the overall shape of valva,
Pros. 97-99. *Ostrinia furnacalis* (Guenée), sacculus of male genitalia. 97, Vinogradovka, Ussuri, Slide LM 11 AM; 98, Yokohama, Japan, Slide 572 C, AM; 99, Yakovlevka Spas., Ussuri, Slide LM 10 AM; 100, Yokohama, Japan, Slide 572 E, AM; 101, Yokohama, Japan, Slide 572 A, AM; 102, Yokohama, Japan, Slide 572 H, AM; 103, Yokohama, Japan, Slide 572 G, AM; 104, Yokohama, Japan, Slide 572 F, AM; 105, Yokohama, Japan, Slide 572 D, AM; 106, Yokohama, Japan, Slide 572 I, AM; 107, Tai-shan, Shantung, China, Slide 570 C, AM; 108, Tai-shan, Shantung, China, Slide 570 A, AM; 109, Tai-shan, Shantung, China, Slide 570 D, AM; 110, Tai-shan, Shantung, China, Slide 570 G, AM; 111, Bangalore, India, reared from *Polygonum* stems, Slide 1353 AM; 112, Kukjail, U.P., India, reared from *Polygonum* stems, Slide 1354 AM; 113, Kukjail, U.P., India, reared from *Polygonum* stems, Slide 1335 AM; 115, Amboina, Slide BM 50 AM; 116, Malay Peninsula, Slide BM 47 AM; 117, Amboina, Slide BM 49 AM; 118, Puttalam, Ceylon, Slide Pyr. 2540; 119, Malay Peninsula, Slide BM 48 AM.
FIGURE 37.—Maruca testulalis (Geyer): a, ventral view of male genitalia with left harpe and aedeagus removed; b, aedeagus; c, ventral view of female genitalia.
Cladistic Analysis of Glyphodes Group

(1) ciliate.

4. Antemedial line of forewing: (1) absent; (1) present, outwardly oblique at 45°; (2) present, outwardly oblique at more than 45°.

5. Triangular marking at middle of forewing costa: (0) absent; (1) present.

6. Torus of hindwing: (0) without any spots; (1) with two small spots, surrounded by metallic marking; (2) with a small, triangular dark spot.

7. Transparent spot at middle of forewing: (0) absent; (1) two, different size; (2) two, nearly the same size.

8. Sixth abdominal segment of male: (0) without scale tufts; (1) with prominent scale tufts on each side.

9. Hair pencils on lateral margin of male sixth tergum (T6): (0) absent; (1) present on each lateral side.

10. Bundle of long hairs on lateral margin of male T8: (0) without any bundle of long hairs; (1) with a bundle of long hairs on each side.

11. Sclerotized part of male T8: (0) absent; (1) inverted Y-shaped, with posterior portion forming two adjacent, parallel rods (Fig. 3); (2) inverted Y-shaped, with posterior portion forming two outwardly curved rods (Fig. 2); (3) paired longitudinal rods, parallel and widely distant anteriorly then briefly curved towards each other and again parallel and less distant in posterior half (Fig. 4); (4) inverted M-shaped like, strongly sclerotized also between arms (Fig. 1).

12. Anterior edge of male eighth sternum (S8): (0) rounded (Fig. 6); (1) angled (Fig. 5); (2) sinuate (Fig. 7).

Figs. 12-18. Uncus and tegumen. 12, Glyphodes doleschalii; 13, G. caesalis; 14, Metallarcha diplochrysa; 15, G. ophiopila; 16, G. conjunctalis; 17, Agriglypta iysalis; 18, G. onychinalis. hd: head of uncus; tg: tegumen; tr: transtilla.


Figs. 23-26. Vinculum of male genitalia. 23, Glyphodes doleschalii; 24, G. cosmarcha; 25, Metallarcha eurychrysa; 26, Dysallacta megalopa. jx: juxta; vc: vinculum.
Fig. III
Duponchelia fovealis (Zeller). Apparato genitale maschile di lato (1); dal dorso (2); dal ventre (3); particolare della culcita (4); pene (5).

ae=aeagus; am=ampulla; cl=clasper; co=costa; cu=cucullos; du.ej=ductus ejaculatorius; p=penis; sa=saccus; tg=tegumen; un=uncus; va=valvae.

Ciascuna valva presenta flessioni sclerificate, dall'aspe nella parte ventrale, al di sc estroflessione digitiforme sin
Il penis (p) è allungato e drico con il coecum penis più due espansioni del tipo rostr.

Apparato genitale femminile

Fig. IV
Duponchelia fovealis (Zeller). Apparato genitale femminile.
antr=antrum; apo.ant=apophys teriotes; apo.po=apophyses posteriore =bursa copulatrix; du.bu=ductus b o=ostium bursae; pap.a=papillae

Eighty-eight male and female genitalic preparations (50% males, 50% females) were made from different species feeding on different host plants. The abdomen of the adult was removed, cleared in 10% KOH, transferred to 15% ethanol, and brushed to remove scales. Then they were stained with chlorazol black and the excess color removed. Before slide mount the clove oil was

Observations were made using a Laborlux-S compound microscope, and female genital length, and labial size and length, was measured using a Heerbrugg Swiss camera lucida. The abdomen of the third labial adults, and its labia, were measured from the anterior end to the apex, and the labial length was measured from the anterior margin of the labial to the apex. The following apparatus were used: National Museum of Natural History, Washington, D.C.; National Museum of Natural Science, Brussels; National Museum of Natural History, Paris; Field Museum of Natural History, Chicago; and the American Museum of Natural History, New York.

The diagnosis of this species includes only derivate morphological characters. The following apparatus were used: National Museum of Natural History, Washington, D.C.; National Museum of Natural History, Brussels; National Museum of Natural History, Paris; Field Museum of Natural History, Chicago; and the American Museum of Natural History, New York.

The following apparatus were used: National Museum of Natural History, Washington, D.C.; National Museum of Natural History, Brussels; National Museum of Natural History, Paris; Field Museum of Natural History, Chicago; and the American Museum of Natural History, New York.

The following apparatus were used: National Museum of Natural History, Washington, D.C.; National Museum of Natural History, Brussels; National Museum of Natural History, Paris; Field Museum of Natural History, Chicago; and the American Museum of Natural History, New York.
subventral setae SV thorax and metathoracic ventral seta, SV1. A seta on pinaculum of the male. Seta SD2 preservable on pigmented to spiracle (Fig. 19). in same pinaculum position in relation D2, D1, SD1 and highly sclerotized p L3 present, L1 and on prolegs of A6 mesally; an incomple outwardly on lateral

Biology.—Neoleucinodes reared on a wild so
num lanceifolium Ja
gato" in Spanish b (Figs. 24–25). One one larva of N. silruits have a scar the oviposition site, and exit hole before pup N. silvaniae are pai soma sp. (Hymenop

Distribution.—Cc
Cundinamarca.

Type material.—]
lombia, Cundinama. Bajo, Finca Villa 74°37'6.41"W, 1,64 Ex. Solanum Solanu Collected by A.E. ] Diaz) [UNAB]. Pars same data as holoty

Etymology.—The niae is the name Silvania, where it wa

Species comparis silvaniae appears ide lis, but it can be disti third labial palpal se males of N. silvan labial palpi in N. eli dimorphic, the fema labial palpal segment shorter (Figs. 4,6). T in the females of N.
SCREENING KEY FOR CAPS TARGET NOCTUIDAE IN THE EASTERN AND MIDWESTERN UNITED STATES (MALES)

1. Eyes appear hairy under low power (30x)  
1'. Eyes not hairy under low power

2. Foretibia with a single large curved claw; subterminal line of forewing, if present, thin and white without a w-shaped marking; genitalia symmetrical (cabbage moth) \textit{Mamestra brassicae}
   2'. Foretibia lacking a single large curved claw; subterminal line of forewing with a w-shaped marking; genitalia asymmetrical (cabbage moth non-target) \textit{Dicestra trifoli}

3. Thorax and/or abdomen with scale tufts; forewing with a silver marking often shaped like a "y,v, solid dot or boot"  
3'. Scale tufts on thorax and abdomen present or absent; forewing lacks a silver shaped marking

4. Forewing with two solid silver spots; valve without clasper or clavus; saccus longer than valve; A8 with arrow shaped sclerite, toothed apically (golden twin spot) \textit{Chrysodeixis chalcites}
   4'. If forewing has two solid silver spots, then valve with a clasper or clavus; saccus shorter than valve and A8 without an arrow shaped sclerite

5. Forewing with a boot shaped spot connected to a curved line reaching the inner margin; clavus long and thin; hindtibia spined (Essex Y moth) \textit{Cornutiplusia circumflexa}
   5'. Forewing with a y-shaped spot and no curved line reaching the inner margin; clavus absent; hindtibia without spines

6. Valve with a fingerlike projection on the inner surface; aedoeagus with one curved spine at the base of the vesica and a long curved apical cornutus (silver y moth) \textit{Autographa gamma}
   6'. Valve lacks a fingerlike projection on the inner surface; aedoeagus without a basal spine and with several apical cornuti in a cluster (silver y moth non-target) \textit{Rachiplusia ou}

7. Eyes lashed; foreleg tarsus with several strong curved spines; orbicular spot contrasting, round or slightly oval; apex of valve pointed \textit{Copitarsia} spp.  
7'. If eyes are lashed, the foreleg tarsus has several strong curved spines, and the orbicular spot is round or slightly oval, then valve apex is not pointed

8. Hindwing with 1-2 pale spots within a dark border  
8'. Hindwing without spots within a dark border
9. Outer surface of foretibia with at least three stout spines; vesica with a large basal spine and other cornuti in a more or less complete row; South American bollworm *Helicoverpa gelotopoeon*

9'. Outer surface of foretibia with a single apical spine; vesica lacks a large basal spine and the cornuti are separated into groups

10. Ventral margin of 8th sternite truncate; 11-14 cornuti present; vesica with one lobe (requires everting the vesica) (Old World bollworm) *Helicoverpa armigera*

10'. Ventral margin of 8th sternite evenly rounded; more than 15 cornuti present; vesica with 3 lobes (requires everting the vesica) (non-target corn earworm) *Helicoverpa zea*

11. Forewing with a highlighted M vein (marking like a silver fork having 3 unequal prongs) which may be partially covered by a white band; apex of forewing with a white marking; hindwing shiny white; cornuti in a dense patch; apex of valve split or notched

11'. Forewing lacks a highlighted M vein; apex of forewing with or without a white marking; hindwing shiny white or gray; cornuti sometimes in dense patch; apex of valve not split or notched

12. Thorax with two dark black parallel longitudinal lines; (non-target) *Spodoptera dolichos*

12'. Thorax lacking two dark black parallel longitudinal lines

13. Apex of valve flattened (non-targets) *Spodoptera ornithogalli* (yellow striped armyworm) and *Spodoptera pulchella*

13'. Apex of valve rounded

14. Valve appearing to have two "windows": one is an upside down equilateral triangle with a large lobe at the apex and the other a more poorly defined small rectangle (rice cutworm) *Spodoptera litura*

14'. Valve does not have both a triangle and rectangular "window"

15. Clasper very thick and curved (non-target) *Spodoptera latifascia*

15'. Clasper forming a triangle with two sides equal and angled about 30 degrees at the base (Egyptian cottonworm) *Spodoptera littoralis*
HELP NOTES TO 'SEPARATE MAMESTRA BRASSICAE, THE CABBAGE MOTH, FROM DISCESTRA TRIFOLII
THE CLOVER CUTWORM

The following guide will help separate M. brassicae from the most common non-target in NER sticky traps, D. trifolii. Characters to distinguish exotic from non-target Mamestra spp. were sent to NER OIC's in the 1992 Trapping Guidelines last spring. Both species have "hairy eyes", visible with high magnification.

Eyes hairy and elements of wing pattern in a typical noctuid (figs. from Hodges, 1971).

Mamestra brassicae L.

Mamestra brassicae has only a weak W-shaped forewing marking, a white orbicular spot and no process on the valva of the male genitalia. Other important general features of M. brassicae include the strong foreleg tibial claw, thoracic dorsal scale tufts and abdominal hair pencils (figs. from Pest Detection Manual, Covell (1984), drawings are original). Note that several other native noctuids also have an obvious white orbicular spot (see Covell, 1984).

Discestria trifolii has a strong obvious W-shaped forewing marking, a weak white orbicular spot and a long process on the valva of the male genitalia which is asymmetrical on the right and left side (figs. from Smith, 1891 and Covell, 1984).
Figure 44.—Chrysodeixis chalcites (Esper): a, ventral view of male genitalia with left harpe and aedeagus removed; b, aedeagus; c, ventral view of female genitalia.
be exempt from displaying such differences. However, there is a persistent conviction among many lepidopterists (Scoble, 1986) that the genitalia are somehow 'special' and that any morphological differences observed must

\[ \text{Cornutiplusia genitalia 455} \]

**FIGS. 12–15.** Male eighth tergites. 12, Noctuid slide no. 11884, South Africa: Transvaal, 20.xi.1896, A. Ross. 13, Noctuid slide no. 11885, Canary Islands: near Puerto de la Cruz, Tenerife, 20.iii.–4.iv.1962, Dr Kettlewell. 14, Noctuid slide no. 11865, India: Niligiris, Hampson Coll. 15, Noctuid slide no. 11868, India: Mahabaleshwar, 17.v.1930, Maxwell Coll. Posterior edges uppermost. Note that the two arms are broadly fused in the South African and Canary Islands specimens, while they are either separate (Fig. 15) or joined by a narrow band of weak sclerotization (Fig. 14) in the Indian specimens. Scale bar=1 mm.

and is discontinuous basally with the saccular margin, while the clavus is shorter and broader. The arms of tergite 8 are separate (Fig. 15) or joined by a narrow band of weak sclerotization (Fig. 14). This form is restricted to southern India (Fig. 7).

No males were available from Sri Lanka or The Gambia and the form of the male genitalia of these populations remains unknown. No consistent differences were found between any of the populations in the structure of the aedeagus, vesica or sternal hairpencils.

**Discussion**

Intraspecific variation in genitalia has been recognized frequently and, to be sure, there is no intrinsic reason why these structures should
FIGS. 8-11. Male genitalia: right valves, inner view. 8, Noctuid slide no. 11884, South Africa: Transvaal, 20.xi.1896, A. Ross. 9, Noctuid slide no. 11877, Ethiopia: Addis Ababa, c. 8100 ft, 2.x.1948, H. Scott. 10, Noctuid slide no. 11865, India: Niligiris, Hampson Coll. 11, Noctuid slide no. 11868, India: Mahabaleshwar, 17.v.1930. Maxwell Coll. Note that the harpes of the Indian specimens are shorter, the sacculus edges basal to the harpes are not continuous with the bases of the clavi, and that the clavi themselves are shorter and broader. Scale bar=1 mm.

out the Middle East and down the African Rift Valley as far as Kenya and Uganda (Fig. 6).

The sole specimen available from Sri Lanka shows a different form of corpus bursae (Fig. 4). The fundus is evenly curved and tapers distally to a blunt point. The apex is much shorter and is rarely recurved.

The South African form (Fig. 5) is markedly different from either the Palaearctic or the Sri Lankan form. The fundus is relatively short and broadens distally. The apex, however, is expanded and reflexed anteriorly to form a pouch-like structure, while the origin of the ductus seminalis has moved to a more proximal position, near the base of the pouch. Finally, the ductus bursae opens into the corpus bursae posteriorly, rather than dorsally, as in the other two forms. In addition to South Africa and Namibia, this form of female genitalia also occurs on Grand Comoro (although Dufay (1982) did not record C. circumflexa from that island) and, perhaps surprisingly, in the Gambia (Fig. 6).

Male genitalia

Two types of male genitalic structure were found, but they are not as distinctive as those of the females. The vast majority of specimens conformed to the Palaearctic type, which occurs across almost all of the known range of the species from the Canary Islands to Iran and throughout Africa, including Grand Comoro (Fig. 7). In specimens from these areas (Figs. 8, 9), the harpe (terminology of Kitching, 1987) is usually quite long, often exceeding the costal margin of the valve (Fig. 8), while it is continuous basally with the saccular margin and the base of the clavus. The clavus itself is relatively long and slender. In addition, the two arms of tergite 8 (Figs. 12, 13) are broadly fused, with a small posterior, central projection, giving a somewhat starfish-like appearance.

In contrast, in the other form of the male genitalia (Figs. 10, 11), the harpe is shorter, never exceeds the costal margin of the valve and is discontinuous basally, margin, while the clavus broader. The arms of t (Fig. 15) or joined by a sclerotization (Fig. 14) in the S to southern India (Fig. 7).

No males were available from these populations and is consistent differences were found between the populations in the aedeagus, vesica or sternum.

Discussion

Intraspecific variation in recognized frequently and no intrinsic reason why th
SIMPLIFIED SCREENING AID FOR AUTOGRAPHA GAMMA IN APHIS STICKY TRAPS

*Autothopa gamma* is a common APHIS target pest. Identification of this pest is complicated for non-specialists. The first problem is that line drawings of the genitalia in the PKNTO series do not provide the user with enough detail to recognize *A. gamma*. There is also a lack of information on which non-target Plusiinae are likely to be found in sticky trap samples.

This document illustrates the genitalia of *A. gamma* and compares it to *A. californica* and *Rachiplusia ou* which are sometimes collected in APHIS traps. Both of these species are similar enough to *A. gamma* in wing color to cause concern. Only males are discussed because females are usually not found in trap samples. The genital terminology and characters used to identify these species follows Poole and LaFontaine (1991). Consult Miller et al. (1993) for a procedure on how to prepare genitalia of Lepidoptera from sticky traps.

*Autothopa gamma*, when viewed under low power (20x), has a simple valve with a thin process and two tufts of scent hairs (Fig. 1). The aedoeagus was removed for clarity.

![Fig. 1. Male genitalia of *Autothopa gamma* (20x).](image-url)
The aedoeagus of *A. gamma* has two spines, one curved spine at the base of the vesica (Fig. 2), and another longer curved spine called the apical comutus (Fig. 3).

![Curved apical spine on the aedoeagus of *A. gamma* (200x).](image)

Fig. 2. Curved apical spine on the aedoeagus of *A. gamma* (200x).

![Apical comutus of *A. gamma* (200x).](image)

Fig. 3. Apical comutus of *A. gamma* (200x).

A portion of the vesica of the aedoeagus in *A. gamma* is set with pigmented pointed granules (Fig. 4), stained red in this photograph for clarity. These granules surround the apical comutus (Fig. 3).
In the eastern United States, *A. gamma* is most likely to be confused with *Rachiplusia ou*. This species has been found in *A. gamma* sticky traps from Michigan and South Carolina. The valve of *R. ou* lacks a fingerlike projection on the inner surface (Fig. 5) which is present in *A. gamma* (Fig. 1).
The aedeagus of *R. ou* has several apical cornuti in a cluster, again stained red for clarity (Fig. 6). Only one is present in *A. gamma* (Fig. 3).

![Fig. 6. Apical cornuti of *R. ou* (Rheinburg illumination, 100x).](image)

In the western USA, *A. gamma* is easily confused with *Autographa californica*. The most obvious difference is the shape of the apical cornutus. In *A. californica* the cornutus has a broad flange on one side (Fig. 7) whereas the cornutus of *A. gamma* is shaped like Fig 3. Otherwise the genitalia are almost identical to a non-specialist. *Autographa californica* has been found in traps from Oregon.

![Fig. 7. The cornutus of *Autographa californica*.](image)

*Autographa ampla* and *Anagapha falcifera* are also found in *A. gamma* traps but their wing color is unlike *A. gamma* (see the color plates in LaFontaine and Poole 1991).
48 are phylogenetically informative. In the majority of the informative characters are found in third parsimony trees, it is not supported by likelihood methods (Fig. 3). This result is likely because o-
Figs. 13-17. *Helicoverpa gelotopoeon* (Dyar). 13, 14, Male genitalia; 15, female genitalia; 16, lumen surface of appendix bursae (at greater magnification than other figures); 17, right foreleg.

Figs. 18-22. *Helicoverpa* 21, lumen surface of append foreleg.
Figs. 38-42. *Helicoverpa armigera* (Hübner). 38, 39, Male genitalia; 40, female genitalia; 41, lumen surface of appendix bursae (at greater magnification than other figures); 42, right foreleg.
Figs. 50-54. *Helicoverpa zea* (Boddie). 50, 51, Male genitalia; 52, female genitalia; 53, lumen surface of appendix bursae (at greater magnification than other figures); 54, right foreleg.