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Steps for the dissection of male *Spodoptera* moths (Lepidoptera: Noctuidae) and notes on distinguishing *S. litura* and *S. littoralis* from native *Spodoptera* species

Introduction

The purpose of this handout is to guide you in the dissection, screening, and identification of moths collected in *Spodoptera* surveys. These instructions will help you distinguish *Spodoptera litura* and *littoralis*, the targets of our surveys, from various native species, some of which are strongly attracted to the lures.

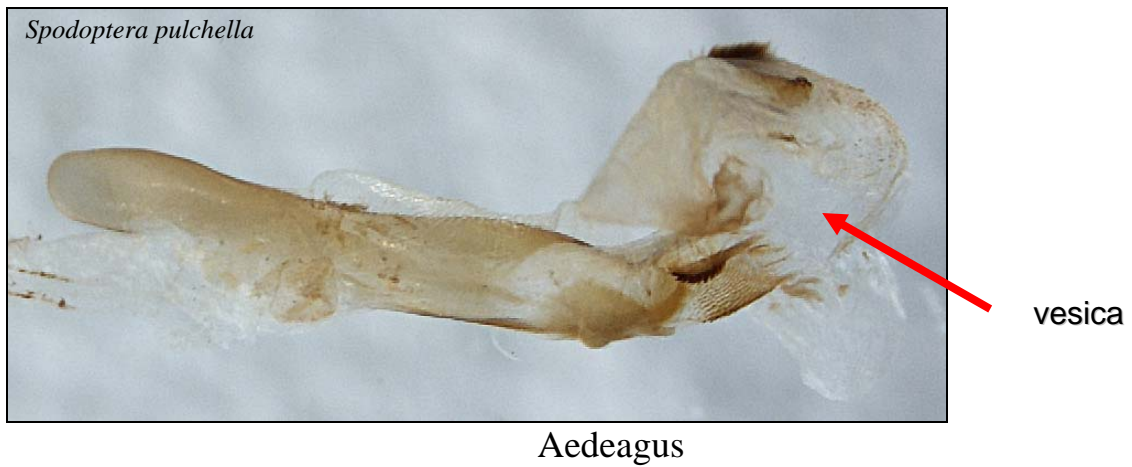
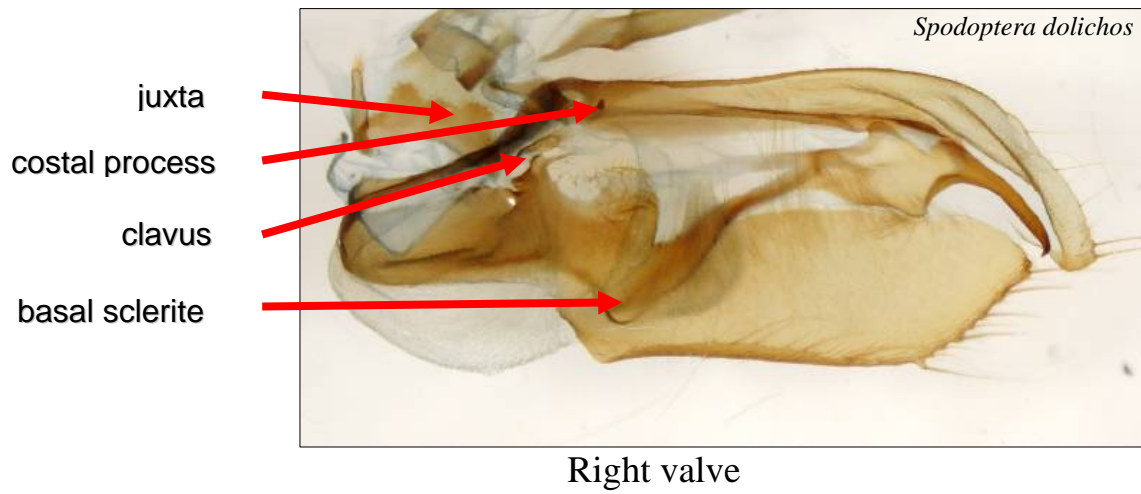
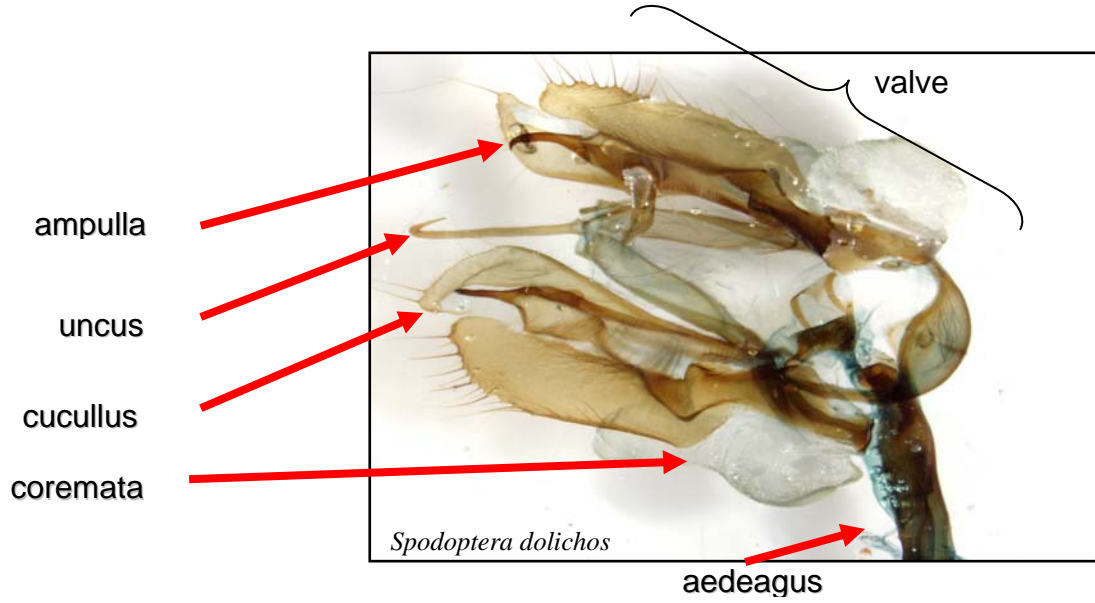
Part 1 introduces some genitalic terminology.

Part 2 describes and illustrates how to obtain the genitalia from specimens prepared with potassium hydroxide.

Part 3 examines genitalic characters of the target species.

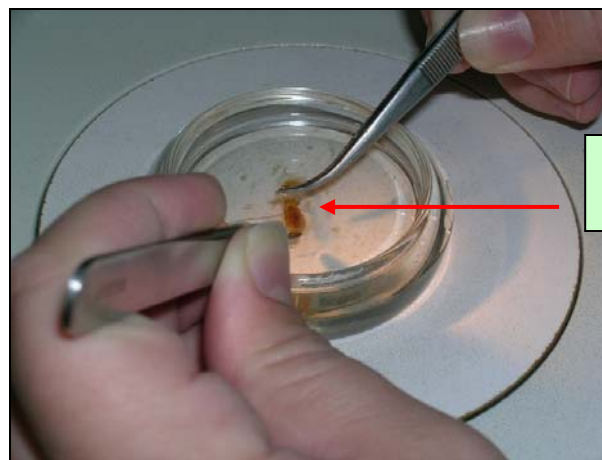
Part 4 illustrates the genitalia of native species.

Part 1: Genital terminology



Part 2: How to obtain genitalia from processed specimens

- 1. Place abdomens in dish.** Place one abdomen at a time into a glass (or plastic) dish with alcohol for microscope examination. In time, you can place 10 or more specimens in one dish, occasionally replacing the alcohol when it becomes cloudy with scales.
- 2. Obtaining the genitalia.** Hold the abdomen at the base with straight forceps and press it gently with the round end of curved-tipped forceps from base to apex to extrude the entire genitalia, being very careful not to damage the aedeagus by pressing too hard. A small hair brush can be used instead of forceps. If the genitalia do not exit though the apex, gently grab both valves and pull slowly. If the abdomen is inflexible, return it to KOH for further clearing. If the genitalia are obtained, but are not flexible, place the genitalia in the warm KOH solution for 5 or 10 more minutes.

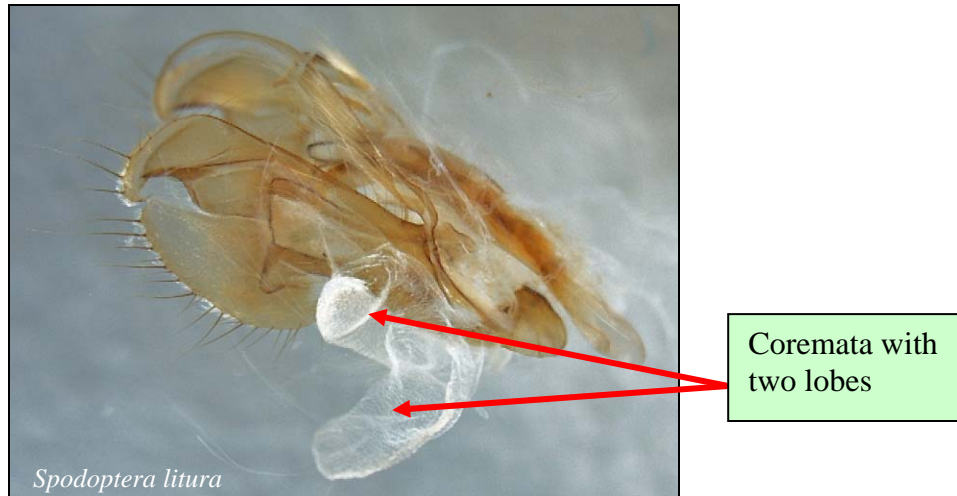


Use round forceps to press on the abdomen



Genitalia extracted from the abdomen

- 3. Examining the coremata (an external structure), optional.** With the left straight forceps hold the genitalia, and with the back of curved-tipped forceps or using a brush remove some of the hairs on the outside of the valve to examine the coremata (=membranous lobes). Pull gently on the bottom and then on the top of the coremata to see if it has one or two lobes. If it only has one lobe, the specimen is neither *S. litura* nor *S. littoralis*. You may skip this step, but it is useful during screening.



- 4. Opening the valves.** Grasp each valve on its side with forceps and gently open them, tugging a little so that they stay open. It may be helpful to remove entirely one valve so that it lies on its back without having to hold the other valve open.



5. Examining inner genitalic structures. Several structures need to be examined to screen the target species or to identify which *Spodoptera* species is at hand. They need to be examined from different angles. Refer to the terminology at the beginning of this section.



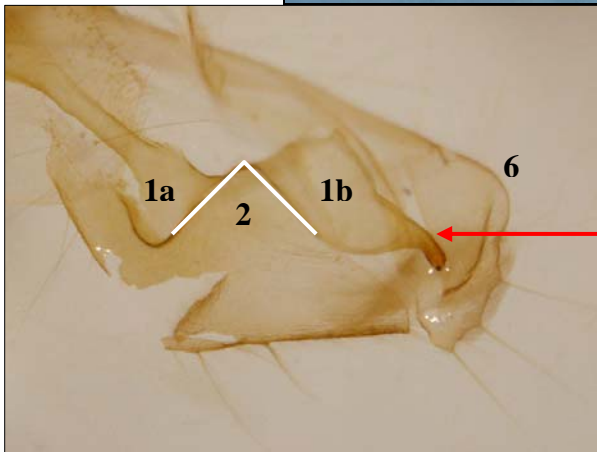
Right valve removed

Part 3: Genitalic characters of the target species

Spodoptera litura

Spodoptera litura can be identified by the shape of the structures on the inner surface of the valve. The most important character to notice is a set of two “windows” separated by a right angle.

1. Two “windows”, one triangular (1a) and one rectangular (1b).
2. Right angle in the center of the valve.
3. Clavus small.
4. Costal process small, elongate, narrow, and curved.
5. Ampulla slightly curved.
6. Cucullus truncate (nearly square-edged).
7. Juxta triangular with a narrow base and a pointed process.
8. Coremata with two lobes.



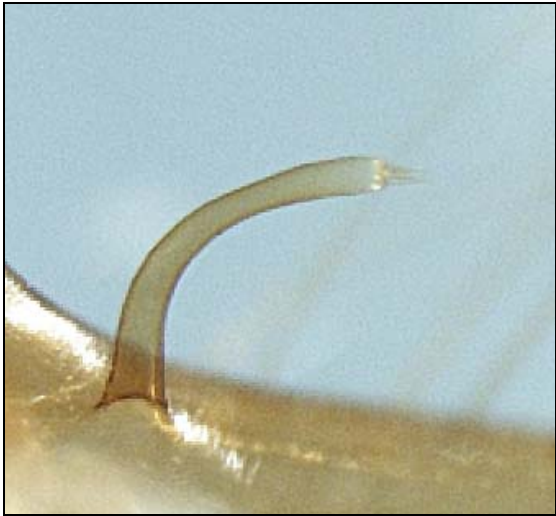
ampulla slightly curved (5)



Clavus (3)



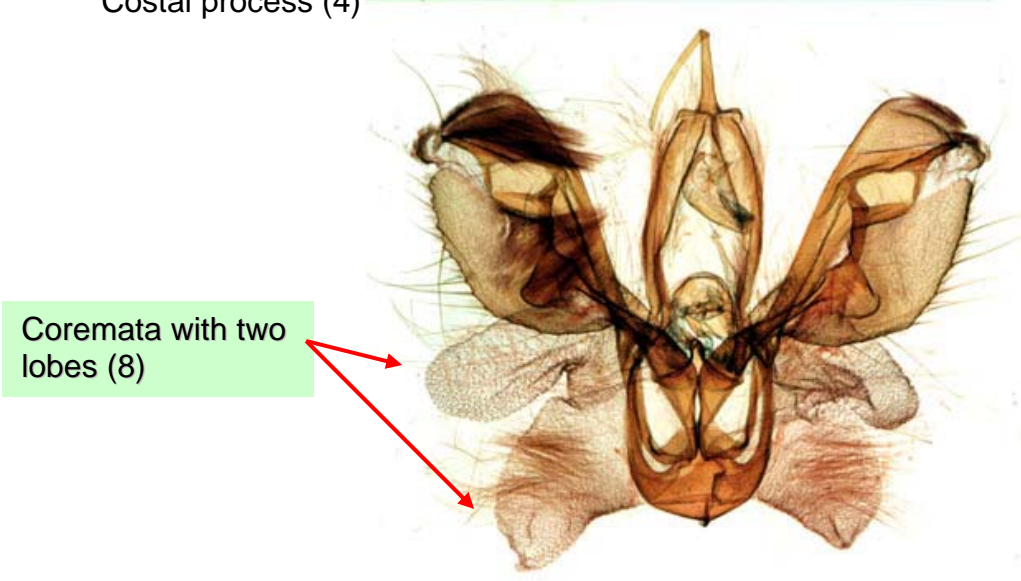
Juxta (7)



Costal process (4)



Aedeagus



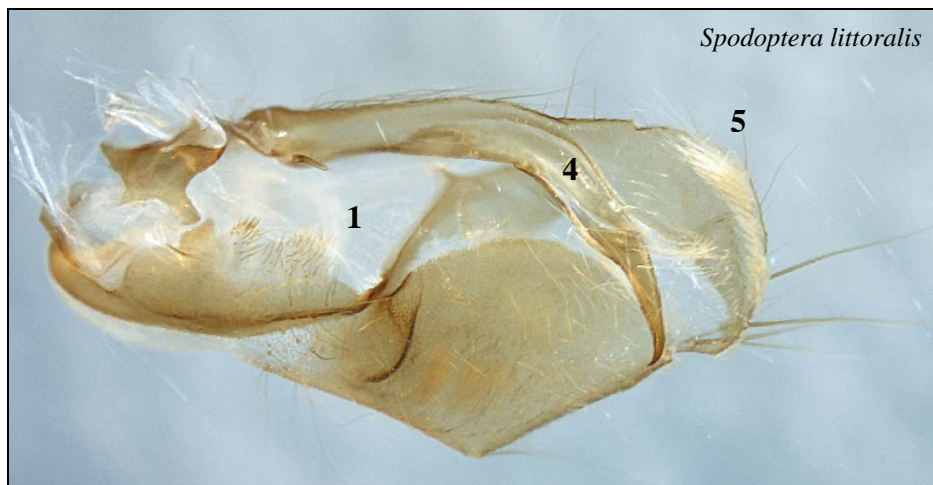
Coremata with two lobes (8)

From a permanent mount.
Modified from M. Pogue (2002).

Spodoptera littoralis

Spodoptera littoralis can be distinguished from native species by a combination of valve characters. It can easily be separated from *S. litura* by the absence of the two “windows” in the inner surface of the valves.

1. Large opening at the base of valve (similar to *S. frugiperda*).
2. Clavus in the shape of small bump.
3. Costal process small, elongate, narrow, and curved.
4. Ampulla elongate and curved.
5. Cucullus truncate (nearly square-edged).
6. Juxta quadrate (=squarish) with two ventrolateral projections. This is the most important character, but is difficult to see if it is folded or torn.
7. Coremata with two lobes.

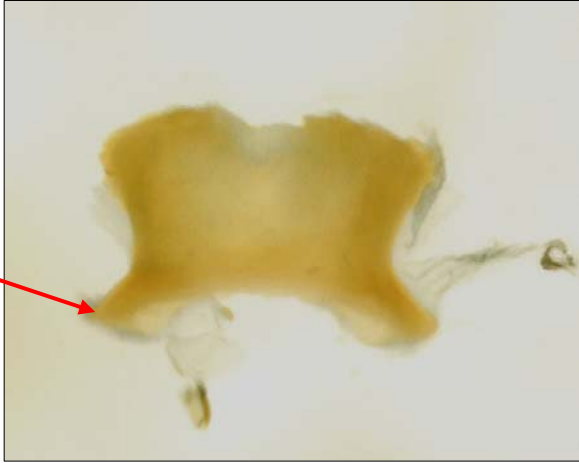


Clavus (2)



Costal process (3)

Ventrolateral projection



Juxta (6)



Aedeagus

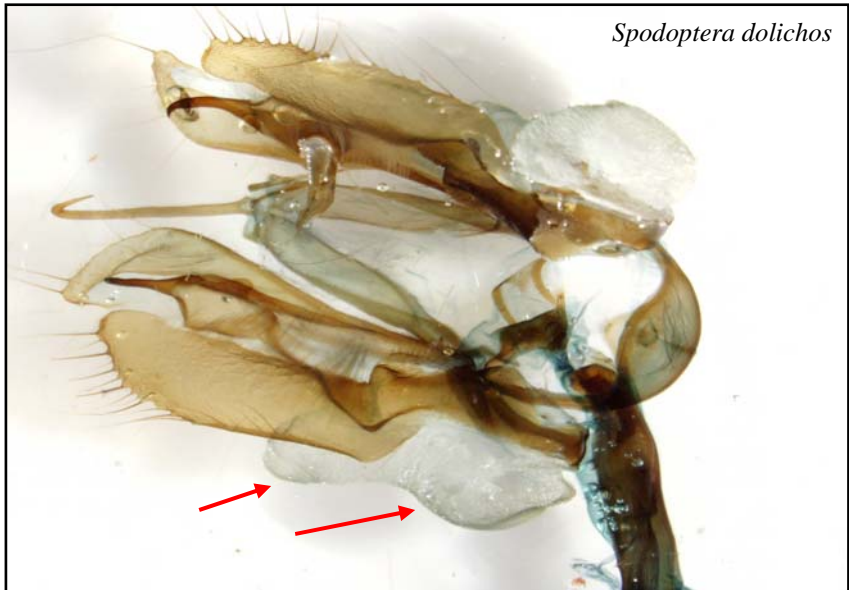
Part 4: Genitalic characters of native species

Spodoptera dolichos

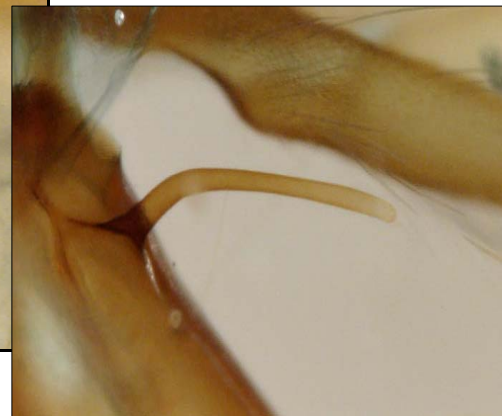
The male genitalia of *Spodoptera dolichos* are most easily distinguished by the shape of the clavus, which is similar to a bent thumb, and the shape of the basal sclerite.

1. Clavus shaped as a thumb.
2. Costal process small, elongate, narrow, and bent.
3. Ampulla elongate and curved.
4. Basal sclerite angular.
5. Juxta broad, base concave.
6. Coremata with two lobes.

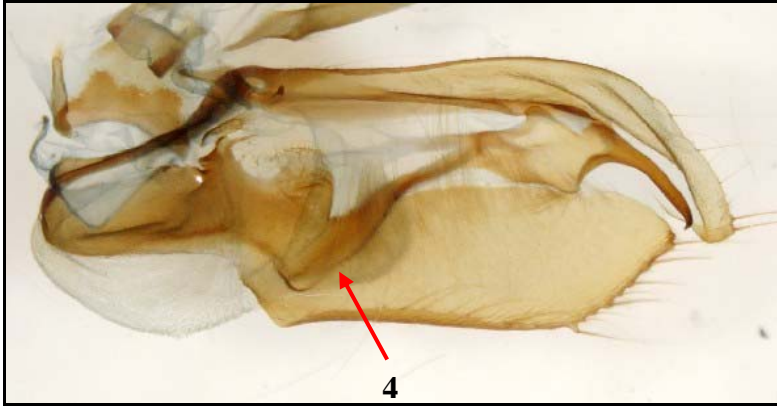
Coremata with two lobes (6)



Clavus (1)



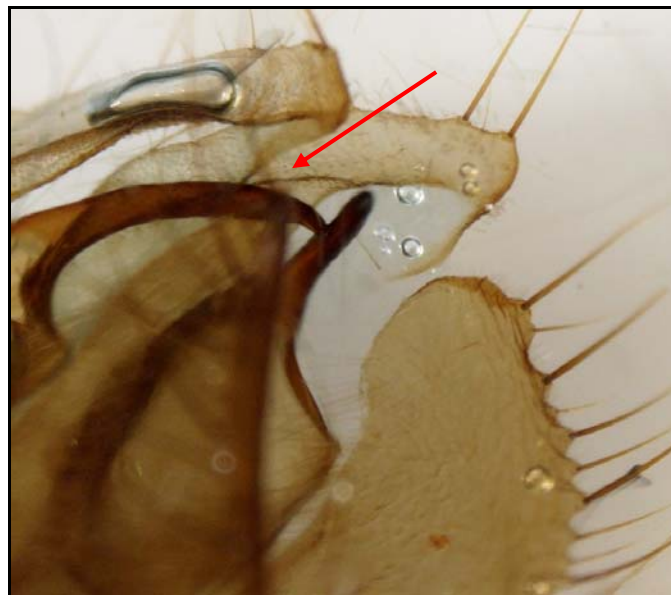
Costal process (2)



Juxta (5)



Aedeagus

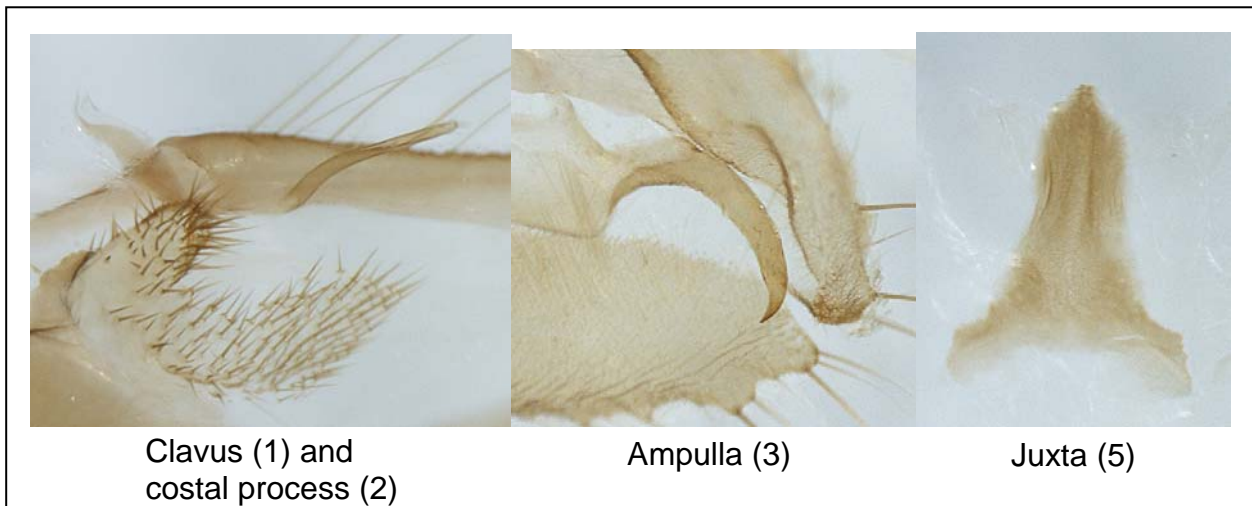
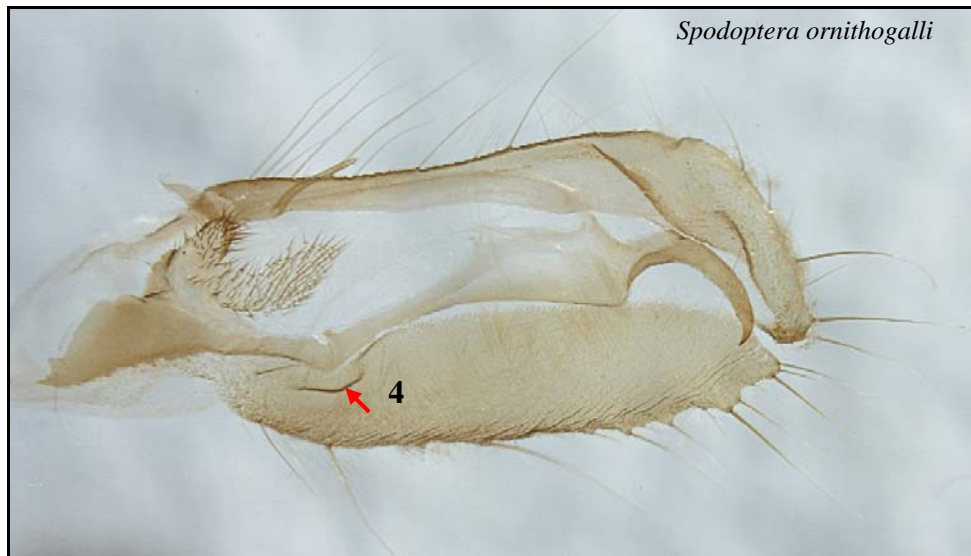


Ampulla (3)

Spodoptera ornithogalli

The genitalia of *Spodoptera ornithogalli* are most easily distinguished by the shape of the clavus, which resembles a hairy toe. It is nearly identical to the genitalia of *S. pulchella*; notice that the coremata are of unequal size.

1. Clavus shaped as a hairy toe.
2. Costal process small, elongate, narrow, and slightly curved.
3. Ampulla elongate and curved.
4. Basal sclerite rounded.
5. Juxta triangular, with long dorsal process.
6. Coremata with two lobes.





Coremata with two lobes (6)

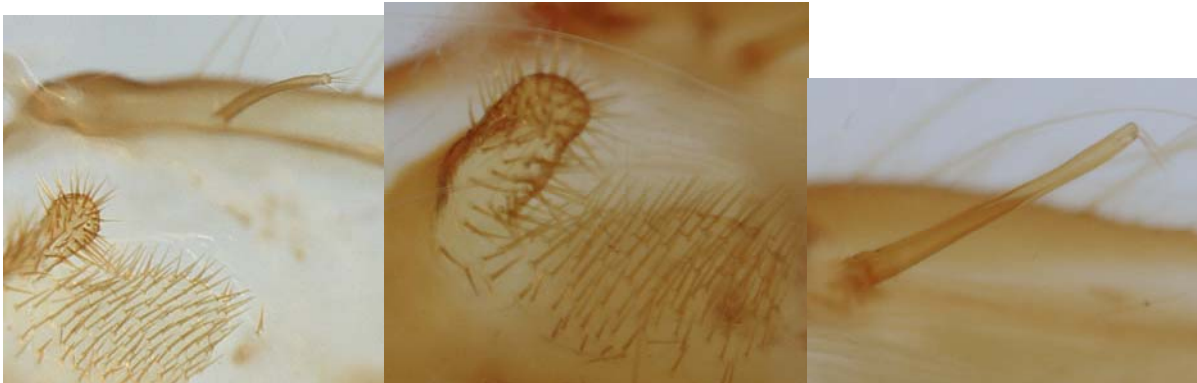
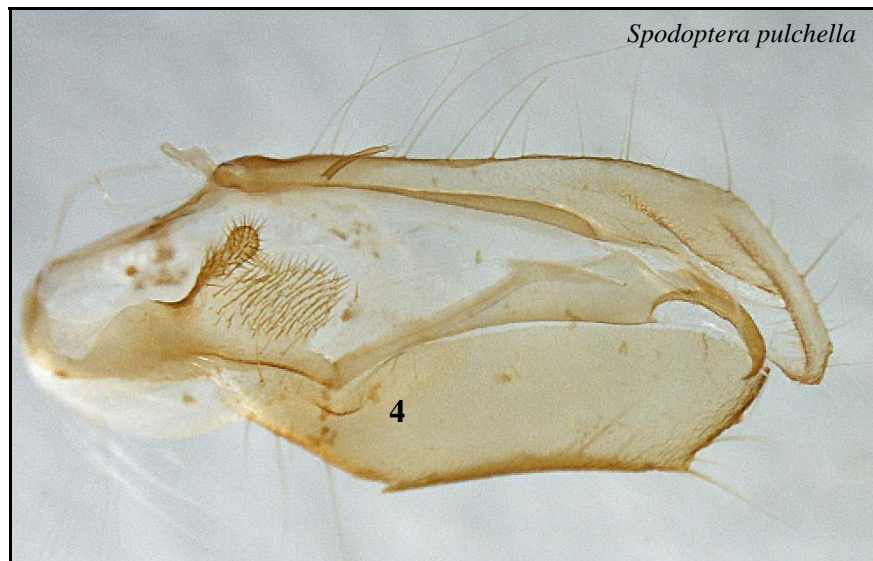


Aedeagus

Spodoptera pulchella

The genitalia of *Spodoptera pulchella* are nearly identical to the genitalia of *S. ornithogalli*. A small spine in the vesica of the aedeagus is the distinguishing characteristic, but is difficult to find. Also, the coremata lobes are of nearly equal size. Fortunately, the wings are distinctive, plus, apparently, this species is found only in southern Florida (and the West Indies).

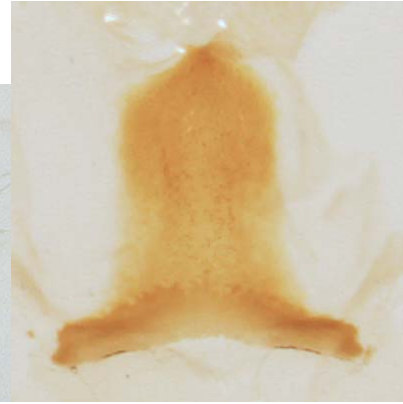
1. Clavus shaped as a hairy toe.
2. Costal process small, elongate, narrow, and either straight or slightly curved.
3. Ampulla elongate and curved.
4. Basal sclerite rounded.
5. Juxta narrow at base (concave) with broad process.
6. Coremata with two lobes.
7. Spine on vesica.



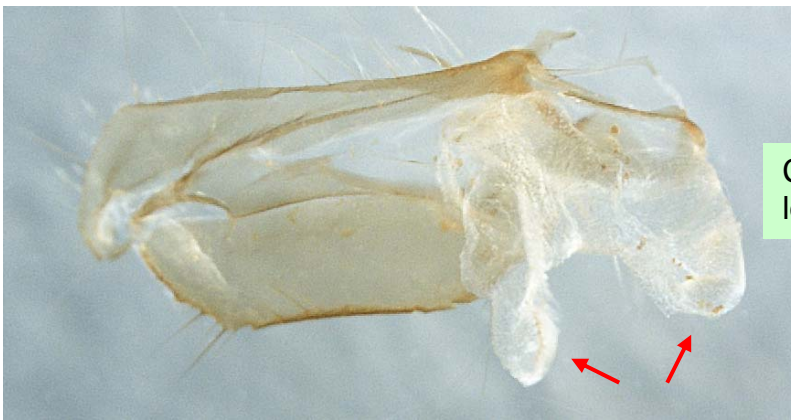
Clavus (1) and costal process (2)



Ampulla (3)



Juxta (5)



Coremata with two long lobes (6)



Aedeagus



Spine on vesica present in *S. pulchella* and not in *S. ornithogalli* (7).



Cornutal patch on vesica.

Spodoptera latifascia

Spodoptera latifascia is easily distinguished by the large clavus, costal process and ampulla.

1. Clavus club shaped.
2. Costal process large.
3. Ampulla elongate, broad, and curved.
4. Juxta deeply concave at base and with a dorsal process.
5. Coremata composed of two lobes.



Clavus (1)

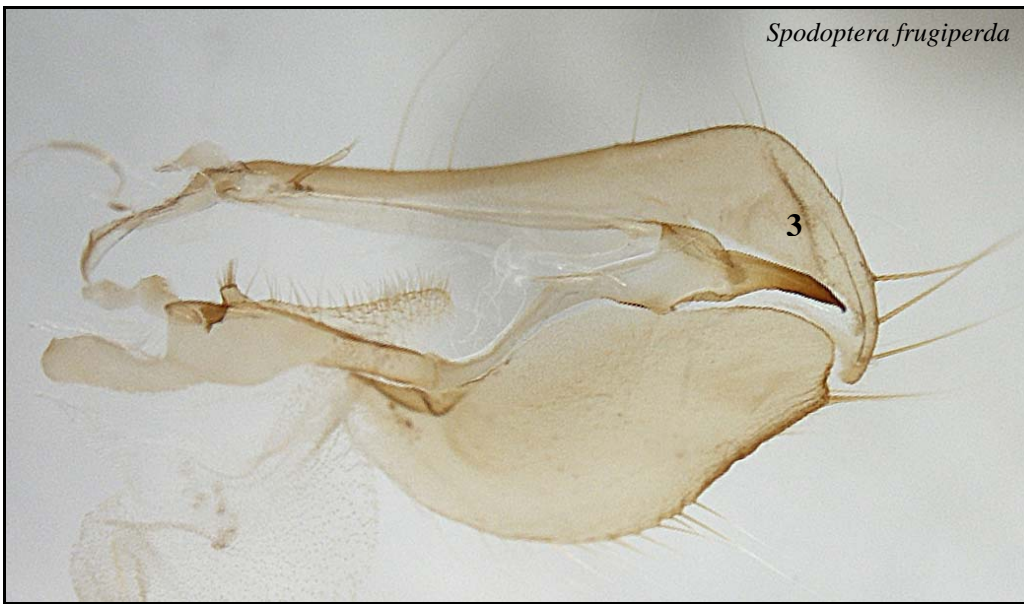


Juxta (4)

Spodoptera frugiperda

The coremata of *Spodoptera frugiperda* are characterized by having a single lobe. The base of the valve resembles that of *S. littoralis*.

1. Clavus short.
2. Costal process small, narrow, elongate, straight, inclined.
3. Ampulla slightly curved.
4. Juxta concave at base and with a dorsal process.
5. Coremata composed of a single lobe.



Costal process (2)



Clavus (1)

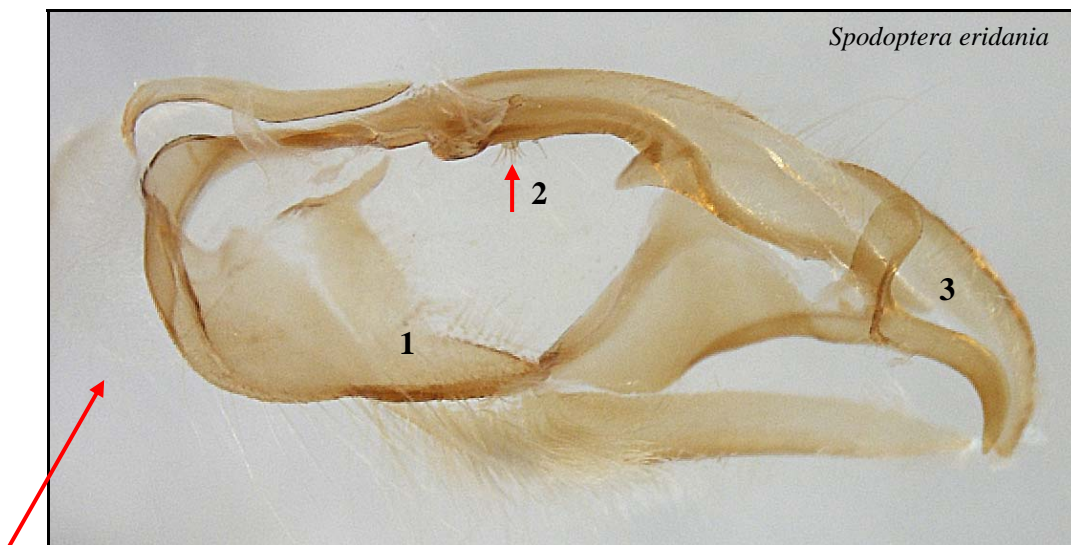


Coremata with one lobe (5)

Spodoptera eridania

The coremata of *Spodoptera eridania* are characterized having a single lobe. The valve lacks a clavus.

1. Clavus absent.
2. Costal process short.
3. Ampulla short, curved, and with a thumb-shaped process.
4. Juxta angular at base with a dorsal process broad at base.
5. Coremata composed of a single lobe.



Coremata with one lobe (5)



Costal process (2)

Spodoptera albula

Spodoptera albula is distinguished by a short, twisted ampulla with a thumb-like process on its side.

1. Clavus absent.
2. Costal process narrow and elongate.
3. Ampulla short and curved, with a thumb-shaped process.
4. Juxta angular at base and with a dorsal process.
5. Coremata composed of a single lobe.

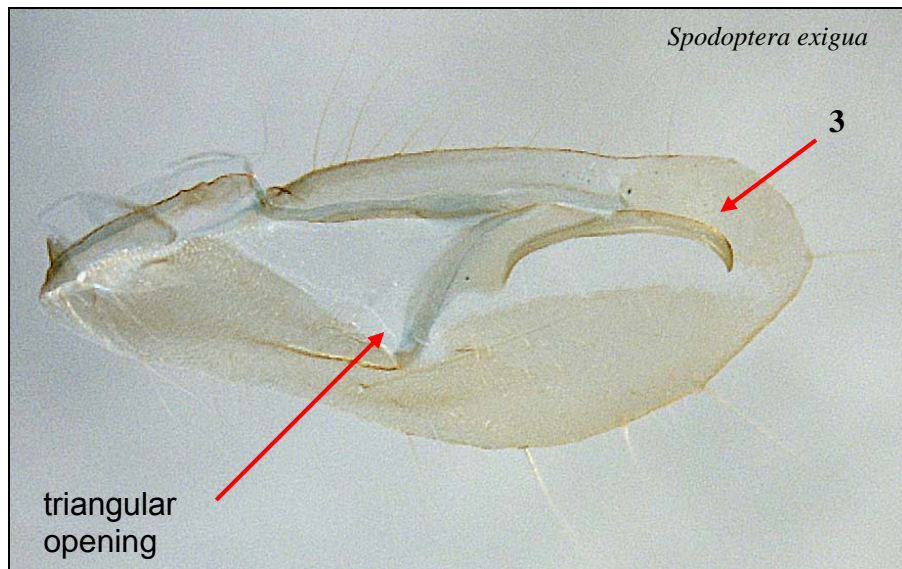


Ampulla curved (3)

Spodoptera exigua

Spodoptera exigua is distinguished by a long, thin, curved ampulla, and a rectangular opening at the base of the valve.

1. Clavus absent.
2. Costal process absent.
3. Ampulla elongate, thin, curved.
4. Juxta with base narrow, ventral margin convex and dorsal process narrow.
5. Coremata composed of a single lobe.
6. Large spine on vesica (“distal cornutus”).



aedeagus
with a prominent
spine in the vesica

Acknowledgements: I thank Dr. Robert Meagher (USDA-ARS) for providing specimens. Terminology, morphological details, and some photos were taken from Dr. Michael Pogue's (USDA-ARS-SEL) 2002 monograph titled "A World revision of the genus *Spodoptera* Guenée (Lepidoptera: Noctuidae)", *Memoirs of the American Entomological Society*, Number 43, 202 p.

Photos taken by J.Brambila (USDA-APHIS-PPQ) unless otherwise indicated.