Zootaxa 1032: 1–28 (2005)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

1032

The Plusiinae (Lepidoptera: Noctuidae) of Great Smoky Mountains National Park

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Abstract

Seventeen species of Plusiinae have been found in Great Smoky Mountains National Park, in Tennessee and North Carolina, USA. These species are documented with adult images, description, flight period, abundance, elevation range, Park and general distribution, and larval hosts from the literature. Maps illustrate the known distribution of each species within the Park. Sixteen of the 17 species occur above 4,000 feet in elevation. The most diverse locality in the Park has 14 species.

Key words: systematics, All Taxa Biodiversity Inventory, North Carolina, Tennessee, moths

Introduction

Great Smoky Mountains National Park (GSMNP) is one of the most biologically diverse areas in the temperate region. The Park straddles the Southern Appalachians in eastern Tennessee and western North Carolina and encompasses over 800 square miles (2,200 sq. km), ranging in elevation from 875 to 6,643 feet (266–2,025 m). Ascending in altitude is equivalent to moving northward in latitude, which results in many northern and boreal moth species reaching their southern distribution in GSMNP.

Global biodiversity is in crisis with the prediction of the fastest mass extinction in biological history currently in progress. A number of threats to the Park's ecological integrity include invasive species in both terrestrial and aquatic habitats, very high deposits of nitrogen and sulfur, high ozone levels, and fragmentation of surrounding natural areas as a result of increased human development. To monitor these effects an All Taxa Biodiversity Inventory (ATBI) is currently underway in GSMNP to document all species of life there. Discover Life in America (DLIA) (www.discoverlifeinamerica.org), a nonprofit organization, is involved in identifying and developing resources and

Accepted by J. Brown: 28 Jun. 2005; published: 8 Aug. 2005

partnerships to conduct this inventory and related educational activities. In order to protect global biodiversity there needs to be a basic knowledge of species occurrence, abundance, and distribution. This is what DLIA is trying to accomplish in GSMNP with the ATBI effort. GSMNP contains all of the major forest types in the eastern United States and has one of the highest diversity of plants with more than 130 species of trees and over 4,000 other plant species. These factors, along with it being the most visited National Park in the country, make it a prime candidate to host the first ATBI in the eastern United States.

Prior to the implementation of the ATBI, there were scattered collecting records housed in the GSMNP collection at the Sugarlands Visitor Center dating back to 1934. In the fall of 1987 a cooperative study between the National Park Service and the University of Tennessee was conducted at 10 sites in the Park. The results of this study, combined with the prior collections, yielded a total of 291 species of Noctuidae, of which 180 were new Park records (http://www.discoverlife.org/nh/cl/GSMNP/lepidoptera_GSMNP.html#NOCTUIDAE).

The first ATBI Lepidoptera surveys sponsored by DLIA were implemented in 1999 and have continued to the present. Season long (May-October) surveys have been conducted since 2000. The Park is currently known to have 490 species of Nocutidae. Using the Chao 1 species estimator (Coldwell and Coddington 1994), Chao 1 = $S_{obs} + a^2/2b$, where "S_{obs}" is the number of observed species (490), "a" is the number of species represented by one specimen (67), and "b" is the number of species represented by two specimens (46), 539 species of Noctuidae are predicted to be present. Hence approximately 91% of the total predicted Noctuidae fauna of GSMNP has been documented.

The Plusiinae are called Looper Moths because most larvae in the subfamily lack prolegs on abdominal segments 3 and 4 which results in a looping motion of their abdomen when crawling, similar to the inch worms. The Looper Moths are the first subfamily treated to document the Noctuidae fauna of GSMNP. They are relatively well known for North America with two recent revisions of the subfamily (Eichlin and Cunningham 1978, Lafontaine and Poole 1991). This treatment follows the nomenclature of Lafontaine and Poole (1991). The Plusiinae are characterized by large upturned labial palps that extend above the eye, large scale tufts on the thorax, dorsal scale tufts on 1 or more abdominal segments, and a quadrifid hindwing (vein Cu appears 4-branched). More than half of the species in the Park have a characteristic silver stigma spot in the middle of the forewing.

The plusiines are represented by approximately 400 species world wide, of which 76 species are found in North America. Seventeen species of Plusiinae are currently known from the Park. Species that are likely to occur in the Park have been added in an effort to more completely represent the predicted fauna. It is difficult to compare the species richness of the plusiines in GSMNP with other localities due to the lack of faunal studies. Several localities in Ohio have been sampled for Lepidoptera diversity, and the highest

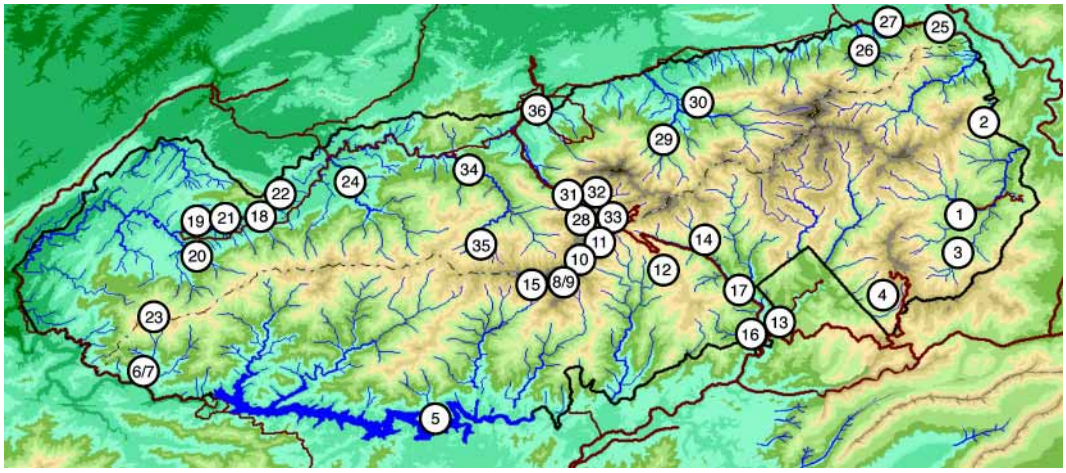
species richness of plusiines recovered from these sites is eight (Rings, et al. 1987, Rings and Metzler 1992). These localities lack many of the features that endow GSMNP with such a high diversity of life, so a comparison is not particularly meaningful.

Methods and Materials

Collections were made using a 15 w UV bulb attached to a box-type trap and various types of UV or mercury vapor light, either in bucket-type traps or against a white sheet. All specimens presently housed in the U. S. National Museum, Washington, DC collection have a unique number in the form of an attached barcode (USNM ENT 00000000). All specimens from the GSMNP ATBI project are databased. The Noctuidae database is in FileMaker7®; the author retains format and a copy. This database is also part of the ATBI database kept by DLIA.

Photographs of adult moths were taken with a Nikon D1X digital camera using a Microptics® ML-1000 Flash Fiber Optic Illumination System. In a few cases moths from outside the Park were photographed because of the poor condition of the Park specimens. Collection data is given for each illustrated specimen.

The Plusiinae have been collected in 35 localities within GSMNP (Map 1). Each locality in Map 1 is numbered and corresponds with the data provided in Table 1.



MAP 1. Collecting localities of Plusiinae. Numbers refer to localities in Table 1.

TABLE 1. Collecting localities of GSMNP Plusiinae.

Map no.	State	County	Locality
1	NC	Haywood	Cataloochee
2	NC	Haywood	Mt. Sterling Trail
3	NC	Haywood	Purchase Knob (includes multiple localities in the vicinity)
4	NC	Haywood	Flat Creek Trail on Balsam Mountain Road
5	NC	Swain	0.5 km from mouth of Chambers Creek
6	NC	Swain	0.1 mi NE of Twentymile Ranger Station
7	NC	Swain	0.2 mi NE of Twentymile Ranger Station
8	NC	Swain	1.2 mi NE of Clingman's Dome pkng. lot, Noland Divide Trail
9	NC	Swain	5.6 mi SW of Jct. 441 & Clingman's Dome Road, Noland Divide Trail
10	NC	Swain	3.3 mi NE of Clingman's Dome pkng. lot, Fork Ridge Trail
11	NC	Swain	5 mi N of Clingman's Dome
12	NC	Swain	Beetree Ridge
13	NC	Swain	Big Cove Road
14	NC	Swain	Kephart Prong Trail
15	NC	Swain	Mt. Buckley
16	NC	Swain	Oconaluftee Staff Housing
17	NC	Swain	Smokemont
18	TN	Blount	Cades Cove, house/Ranger Station
19	TN	Blount	Cades Cove, Hyatt Lane
20	TN	Blount	Cades Cove, Mill Creek
21	TN	Blount	Cades Cove, Primitive Baptist Church
22	TN	Blount	Campsite 6, Scott Mountain Trail
23	TN	Blount	Gregory Bald
24	TN	Blount	Tremont
25	TN	Cocke	5.1 mi E on Rt. 32 from Cosby
26	TN	Cocke	Cosby, house/campground
27	TN	Cocke	Foothills Parkway
28	TN	Sevier	1.3 mi W Jct. 441 & Clingman's Dome Rd. on Road Prong Trail
29	TN	Sevier	4 mi S. of Rt. 321 at end of Greenbrier Loop Road
30	TN	Sevier	Greenbrier area on Old Settlers Trail
31	TN	Sevier	5 mi S of Sugarlands Visitor Center, Chimney's Picnic Area
32	TN	Sevier	6 mi S of Sugarlands Visitor Center
33	TN	Sevier	7 mi S of Sugarlands Visitor Center
34	TN	Sevier	Elkmont
35	TN	Sevier	Jake's Creek Trail at campsite 27
36	TN	Sevier	Park Headquarters

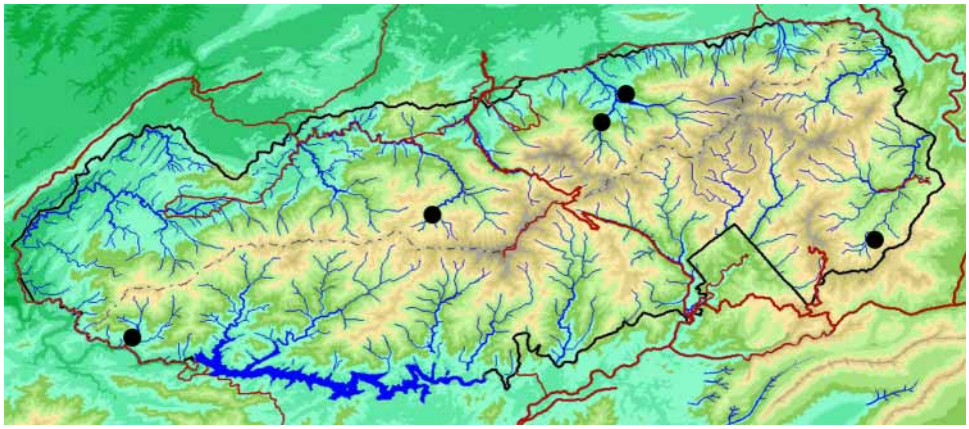
Tribe Abrostolini

1. *Abrostola ovalis* Guenée (Fig. 1, Map 2)

Identification: Forewing length 14.0–15.0 mm. *Abrostola ovalis* can be recognized by the pale ovate basal area of the forewing that is outlined with an inner brown line and an outer line of black scales. There are prominent scale tufts on the first three abdominal segments. Owing to the unique forewing pattern, this species cannot be confused with any other species known in the Park.

Flight period: 2 June to 1 August, with most records in June.

Collected localities: North Carolina: Haywood Co., Purchase Knob, N of house in forest; Swain Co., 0.2 mi NE of Twentymile Ranger Station. Tennessee: Sevier Co., Greenbrier area on Old Settlers Trail, end of Greenbrier Loop Rd., Jake's Creek trail. (7 specimens).



MAP 2. Collecting localities of *Abrostola ovalis.*

Elevation range: 1520–4998 ft. (463–1523 m)

General distribution: Northeastern North America from southern Quebec and Maine south to North Carolina and west to Wisconsin.

Larval hosts: Stinging nettles (*Urtica dioica* L., Urticaceae) and probably other native nettles (Lafontaine and Poole 1991).

2. *Abrostola urentis* Guenée (Fig. 2)

Identification: Forewing length 13.0–15.0 mm. The antemedial and postmedial lines, and the lines outlining a figure 8-shaped orbicular spot and a reniform spot consist of fine, erect, black scales. The pale ovate basal area is absent.

Flight period: May to July and August and September (Lafontaine and Poole 1991).

Collection localities: This species is likely to occur in the Park, but has not yet been recorded.

General distribution: This is a widespread northern species ranging from Nova Scotia across southern Canada to British Columbia and south to Washington and Oregon; in the remainder of the United States it is distributed from Maine south to western North Carolina, across the Great Plains to eastern Colorado; with an isolated population in southeastern Texas (Lafontaine and Poole 1991).

Larval hosts: Unknown.

Tribe Argyrogrammatini

3. *Enigmogramma basigera* (Walker) (Fig. 3)

Identification: Forewing length 13.0–16.0 mm. Forewing ground color is reddish-brown with a contrasting darker median area. The metallic spots are separate with the proximal spot looped and having a long tail. The antemedial line that borders the dark median area is silver. There are no other species in the park that have the combination of a distinct reddish-brown forewing color and separate metallic spots.

Flight period: Flies throughout most of the year with records from February to November.

Collection localities: This species has been recorded from western North Carolina and is likely to occur in the Park, but has not yet been recorded.

General distribution: This is an eastern species ranging southern Maine to Florida, along the gulf coast to southern Texas, west to central Texas, and sporadically north to Illinois, southern Michigan, and Ohio (Lafontaine and Poole 1991).

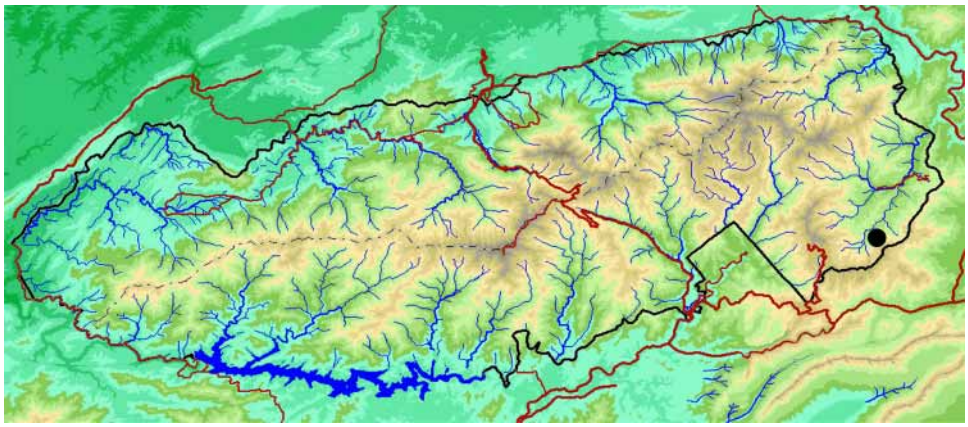
Larval hosts: Only two larvae are known, and these were reared on pennywort (*Hydrocotyle umbellata* L., Apiaceae) (Lafontaine and Poole 1991).

4. *Trichoplusia ni* (Hübner) Cabbage Looper (Fig. 4, Map 3)

Identification: Forewing length 15.0-18.0 mm. *Trichoplusia ni* has a silvery spot on the forewing that consists of a loop and a spot, which can either be separate or contiguous. The forewing is gray brown with a series of black streaks in the anterior half of the subterminal area. The hindwing is dark brown with a white fringe intersected with brown spots. Similar species that occur in the Park are *Autographa precationis* (Guenée) and *Pseudoplusia includens* (Walker). Both of the latter have a sheen to the forewing that is lacking in *T. ni*.

Flight period: Only three specimens are known, one collected on 9 June and the others taken from a malaise trap deployed 5-16 August 2002.

Collected localities: North Carolina: Haywood Co., Purchase Knob, N of house in forest. (3 specimens)



MAP 3. Collecting localities of *Trichoplusia ni.*

Elevation range: 4800–4924 ft. (1463–1501 m)

General distribution: This is the most widespread plusiine and occurs throughout the United States and southern Canada. It also occurs in the Antilles, Mexico, Central America, and in South America as far south as southern Brazil, Paraguay, and northern Argentina. In the Old World, *T. ni* occurs in most of Africa, the southern and central Palaearctic, and many areas in the Indo-Australian and Oriental regions (Lafontaine and Poole 1991).

Larval hosts: *Trichoplusia ni* is polyphagous on many herbaceous plants. It is a major economic pest and prefers hosts in the family Brassicaceae, especially the genus *Brassica*, thus its common name (Lafontaine and Poole 1991).

5. *Ctenoplusia oxygramma* (Geyer) (Fig. 5, Map 4)

Identification: Forewing length 15.0–18.0 mm. The silver spot in the forewing is elongate with either a round or pointed apex that is filled with slightly darker scales, which gives the spot its distinct thin silver margin. When the silver spot has a pointed apex, it resembles a pointed foot. The forewing is dark brown with a faint reniform spot that is outlined in black.

Flight period: June to mid October, with most specimens collected in early August.

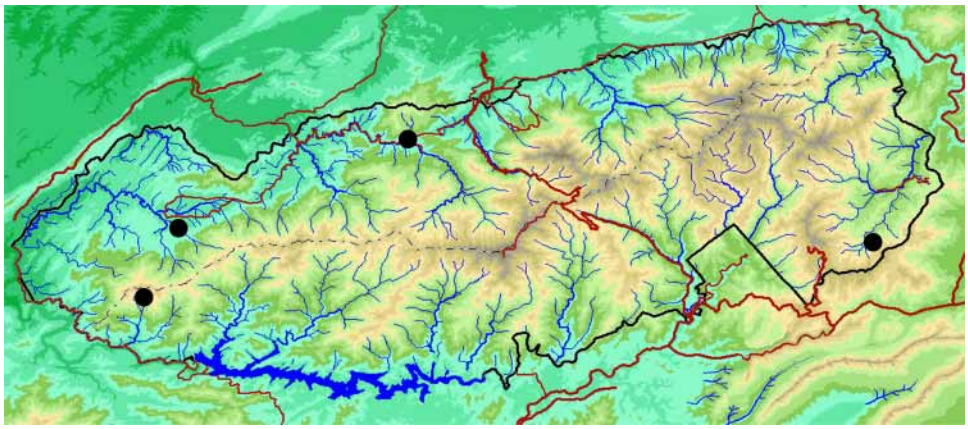
Collected localities: North Carolina: Haywood Co., Purchase Knob. Tennessee: Blount Co., Cades Cove, Gregory Bald; Sevier Co., Elkmont. (10 specimens)

Elevation range: 1800–4949 ft. (549–1508 m)

General distribution: Southern Ontario, Canada, throughout the eastern United States, with scattered records in Nebraska, Kansas, western Texas, and southeastern Arizona. In the Neotropics it occurs in Mexico, the Antilles, Central America, and South America to northern Argentina.

Larval hosts: Probably feeds on a wide variety of herbaceous plants (Lafontaine and Poole 1991). Crumb (1956) lists Canadian horseweed (*Conyza canadensis* (L.) Cronq.,

Asteraceae), goldenrod (*Solidago* sp., Asteraceae), and cultivated tobacco (*Nicotiana tabacum* L., Solanaceae).



MAP 4. Collecting localities of *Ctenoplusia oxygramma*.

6. *Pseudoplusia includens* (Walker) Soybean Looper (Fig. 6, Map 5)

Identification: Forewing length 13.0–18.0 mm. *Pseudoplusia includens* has two silvery spots on the forewing that consist of a larger loop and a smaller circular spot, which are always separate. The forewing is gray brown with shiny, brassy-brown patches surrounding the silvery spots. These brassy-brown patches are best observed with a microscope. At the base of the forewing is a small dark patch that is faintly surrounded by thin white lines. The hindwing is dark brown with a white fringe intersected with brown spots. *Pseudoplusia includens* may be confused with *A. precationis*, but it can be separated by the presence of a dark spot in the marginal fringe of the forewing that is lacking in *A. precationis.*

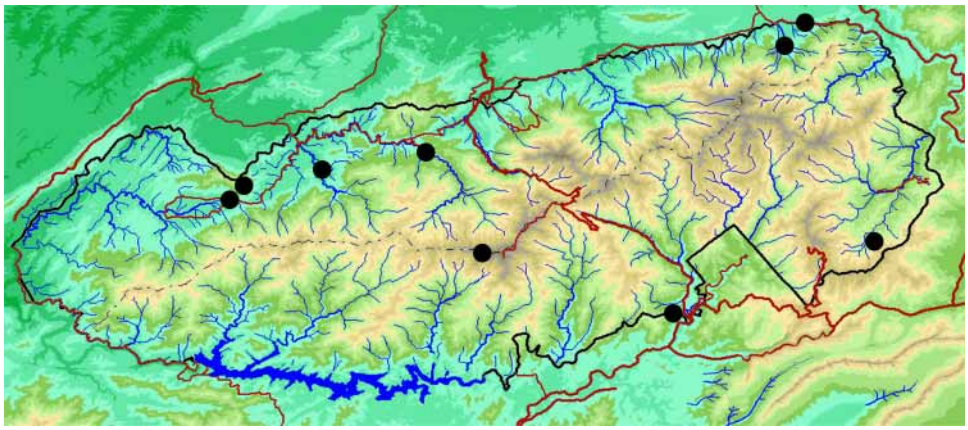
Flight period: June to mid October, with the majority of specimens collected in September.

Collected localities: North Carolina: Haywood Co., Purchase Knob; Swain Co., Mt. Buckley; Oconaluftee staff housing. Tennessee: Blount Co., Cades Cove near Ranger Station; Campsite 6, along Scott Mountain Trail; Tremont; Foothills Parkway, 2.1 mi W Hwy. 321; Cocke Co., Cosby house and campground; Sevier Co., Elkmont. (19 specimens)

Elevation range: 1360–6540 ft. (415–1993 m)

General distribution: This is the most common species of plusiine in the southeastern and south central United States. In the East it occurs as far north as Nova Scotia, southern Quebec, and southern Ontario; in the Midwest, it ranges as far north as South Dakota and Wisconsin; and in the West it has been collected in southern California, Arizona, New Mexico, and southern Colorado. In the Neotropics it ranges from Mexico,

the Antilles, to South America, except southern most Argentina and Chile (Lafontaine and Poole 1991).



MAP 5. Collecting localities of *Pseudoplusia includens.*

Larval hosts: *Pseudoplusia includens* is a major agricultural pest and is considered polyphagous on many herbaceous plants. Agricultural hosts include alfalfa, kidney bean, soybean, cotton, tobacco, tomato, mustard, and lettuce. It is the most serious pest of soybean, hence its common name (Lafontaine and Poole 1991).

Tribe Plusiini

7. *Rachiplusia ou* (Guenée) Gray Looper Moth (Fig. 7)

Identification: Forewing length 13.0–20.0 mm. *Rachiplusia ou* has a gray forewing with a pale oblique subterminal band that extends from the costa to the posterior margin. There is a small dark zigzag mark below the apex in the terminal portion of the forewing. The metallic silver spot consists of a loop with a small dot at its apex; the dot may or may not be separate from the loop. This species could be confused with *T. ni*, but all of the tibiae in *R. ou* are spined, especially the hind tibia; in contrast, there are no tibial spines in *T. ni*.

Flight period: Can be found in all months of the year in the southern part of its range (Lafontaine and Poole 1991).

Collection localities: This species is likely to occur in the Park, but has not yet been recorded.

General distribution: This is a widespread species in North America. In Canada it ranges from Nova Scotia to Manitoba; in the United States from New York to Florida, across Texas and the Great Plains to Montana, Colorado, New Mexico, Arizona, and California; and *R. ou* is also found in Bermuda and the Dominican Republic; and Mexico south through Central America, Venezuela, and the Andes to Ecuador (Lafontaine and Poole 1991).

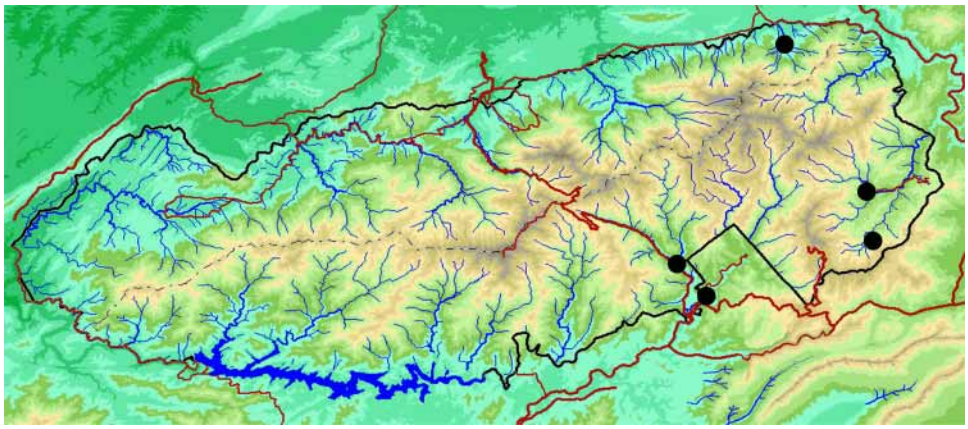
Larval hosts: Probably a general feeder on herbaceous plants. Hosts include Mexican tea (*Chenopodium ambrosioides* L., Chenopodiaceae), cultivated tobacco (*Nicotiana tabacum* L., Solanaceae), clover (*Trifolium* sp., Fabaceae), mint (*Mentha* sp., Lamiaceae), common wheat (*Triticum aestivum* L., Poaceae), and nasturtium (*Tropaeolum* sp., Tropaeolaceae) (Eichlin and Cunningham 1978).

8. *Allagrapha aerea* (Hübner) Unspotted Looper Moth (Fig. 8, Map 6)

Identification: Forewing length 15.0–19.0 mm. *Allagrapha aerea* lacks a silvery spot in the forewing. The forewing ground color is dark rufous brown, a subterminal band of dark brown runs diagonally from the apex to the posterior margin. This species can be confused with *Diachrysia aereoides* (Grote), but can be separated by several differences. In *A. aerea* the forewing pattern is not well defined, whereas in *D. aereoides* the forewing pattern consists of distinct lines, a spot with its apex attached to vein M in the middle of the discal cell, and a reniform spot, both outlined in black. The underside of the thorax is pale yellow to cream in *A. aerea* and pale orange in *D. aereoides*. The foretibia is gray to grayish brown; quite distinct from the thorax color in *A. aerea*, in *D. aereoides* the foretibia and thorax are concolorous.

Flight period: End of May to early June and end of July to mid October, two broods seem to be evident in GSMNP, with the first brood occurring from the end of May to mid June and a second from the end of July through mid October.

Collected localities: North Carolina: Haywood Co., Cataloochee, Purchase Knob; Swain Co., Big Cove Road, Smokemont Forney Creek. Tennessee: Cocke Co., Cosby house. (13 specimens)



MAP 6. Collecting localities of *Allagrapha aerea*.

Elevation range: 2040–4934 ft. (622–1504 m)

General distribution: Widely distributed in eastern North America from southern Ontario to the panhandle of Florida and west to western Nebraska.

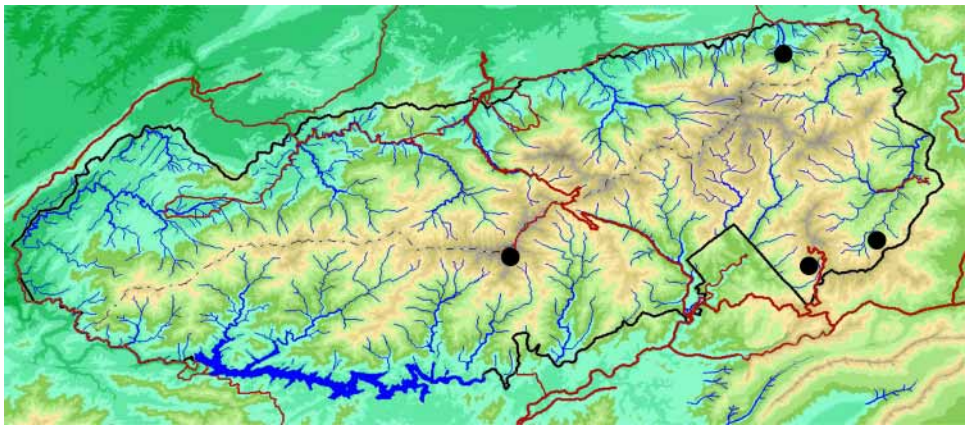
Larval hosts: This species is probably a general feeder on herbaceous plants with larvae recorded from nettle (*Urtica* sp., Urticaceae), aster (*Aster umbellatus* Mill., Asteraceae), and soybeans (Lafontaine and Poole 1991).

9. *Diachrysia aereoides* (Grote) Dark-spotted Looper Moth (Fig. 9, Map 7)

Identification: Forewing length 17.0–18.0 mm. *Diachrysia aereoides* lacks a silvery spot on the forewing. The forewing ground color is rufous with a distinct pattern of lines and spots. The hindwing is gray with a tan fringe. This species may be confused with *A. aerea*; the differences between the two are described above.

Flight period: Early June to end of July.

Collected localities: North Carolina: Haywood Co., Flat Creek Trail on Balsam Mountain Road, Purchase Knob; Swain Co., 5.6 mi SW of Jct. 441 and Clingman's Dome Road, Noland Divide Trail. Tennessee: Cocke Co., 5.1 mi E on Rt. 32 from Cosby. (4 specimens)



MAP 7. Collecting localities of *Diachrysia aereoides.*

Elevation range: 2200–5950 ft. (671–1814 m)

General distribution: This species has a more northern, transcontinental, distribution from Newfoundland west to northern California. It reaches its southern most distribution in Great Smoky Mountains National Park.

Larval hosts: Most host records are herbaceous plants in Asteraceae, Lamiaceae, and Rosaceae, but some woody plants also are recorded; it is probably a general feeder (Lafontaine and Poole 1991).

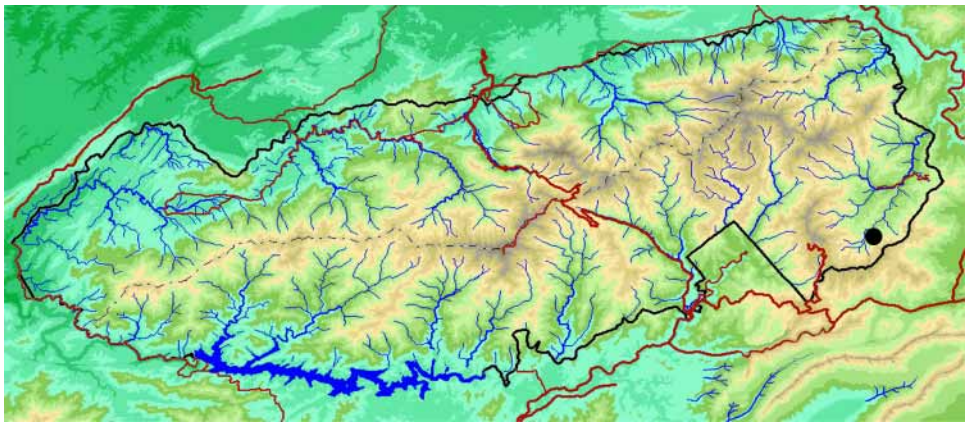
10. *Diachrysia balluca* Geyer (Fig. 10, Map 8)

Identification: Forewing length 20.0–25.0 mm. *Diachrysia balluca* is distinct with a pale gray forewing ground color with large patches of metallic green from below the discal cell to beyond the postmedial line and from the reniform spot to the outer margin. The

hindwing is gray. The underside of the thorax is white with a brownish-yellow and brown prothorax. This species cannot be confused with any other in the Park. It is the largest plusiine in North America.

Flight period: End of July.

Collected localities: North Carolina: Haywood Co., Purchase Knob. (3 specimens)



MAP 8. Collecting localities of *Diachrysia balluca*.

Elevation range: 4838–4925 ft. (1475–1501)

General distribution: This species occurs in northeastern North America from Nova Scotia west to Manitoba and south to western North Carolina. Great Smoky Mountains National Park is the southern limits of this species. The only other records in the South are from the type locality of Georgia (described in 1832) and Kimble's (1965) record from Liberty County in northwestern Florida, possibly representing strays.

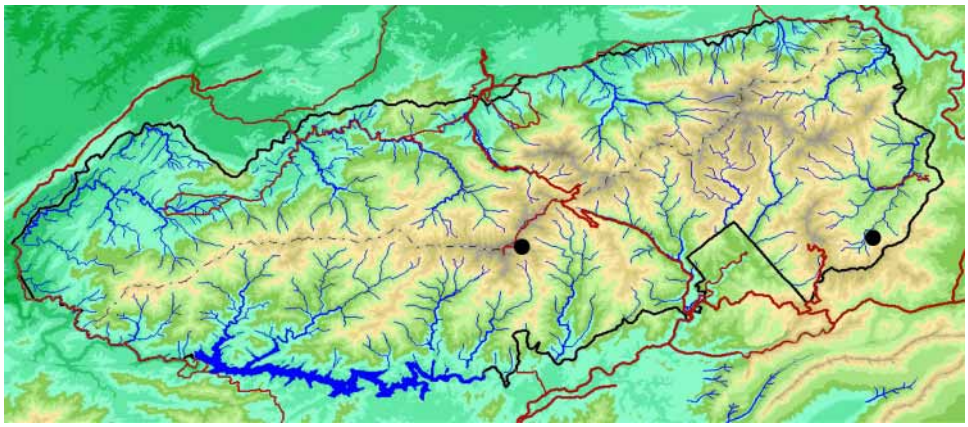
Larval hosts: *Diachrysia balluca* feeds on mostly woody plants and including common hop (*Humulus lupulus* L., Cannabaceae), quaking aspen (*Populus tremuloides* Michx., Salicaceae), Canadian woodnettle (*Laportea canadensis* (L.) Wedd., Urticaceae), and raspberry (*Rubus* spp., Rosaceae).

11. *Polychrysia morigera* (Hy. Edwards) (Fig. 11, Map 9)

Identification: Forewing length 15.0–16.0 mm. The foot-shaped silvery spot in the forewing consists of a thin white line that extends to the postmedial line. The labial palpus is large and sickle-shaped, extending well above the head. These two characters separate *Polychrysia morigera* from all other plusiines in the Park. Forewing ground color is dark brown with an irregularly shaped black spot in the subterminal area just below the apex. Hindwing is gray to dark gray with a white fringe that is gray basally.

Flight period: Early June (1 specimen) and the end of July (3 specimens).

Collected localities: North Carolina: Haywood Co., Purchase Knob at lower creek; Swain Co., 1.2 mi NE of Clingman's Dome parking lot, Noland Divide Trail; 5.6 mi SW of Jct. 441 and Clingman's Dome Road, Noland Divide Trail. (4 specimens)



MAP 9. Collecting localities of *Polychrysia morigera.*

Elevation range: 4000–6000 ft. (1219–1829 m)

General distribution: This species is the rarest of the North American plusiines (Lafontaine and Poole 1991). It has a clumped distribution. In the East, it is found in the Mississippi, Missouri, and Ohio River Valleys from Pennsylvania to Tennessee; in the Rocky Mountains it is found from Montana to Colorado; and on the West Coast it occurs from Oregon to northern California.

Larval hosts: The only reported host is Columbian larkspur (*Delphinium trolliifolium* Gray, Ranunculaceae) (Lafontaine and Poole 1991). Covell and Medley (1986) reported adults trapped in the labellum of Kentucky lady's slippers (*Cypripedium kentuckiense* Reed, Orchidaceae) in Tennessee.

12. *Pseudeva purpurigera* (Walker) Straight-lined Looper Moth (Fig. 12, Map 10)

Identification: Forewing length 14.0–16.0 mm. *Pseudeva purpurigera* lacks a silvery spot on the forewing. Forewing ground color is pale rufous with metallic yellow patches below discal cell and proximal to the postmedial line and in the subterminal area. A pair of parallel postmedial lines with brown proximally and white distally are distinct and angulate from the apex to the posterior margin. There is a small black dot adjacent to the postmedial line at 3/4 length from costa on well-marked specimens. These characters distinguish *P. purpurigera* from other plusiine species in the Park. Hindwing is pale with a thin median line and darker marginal band.

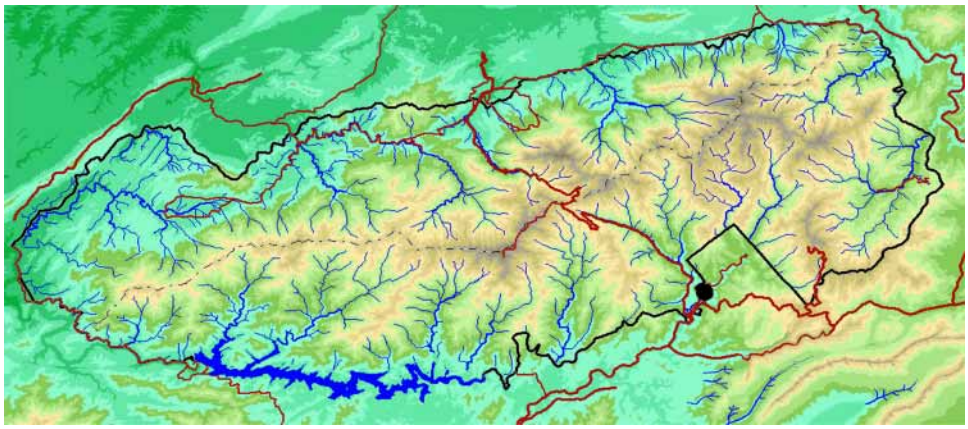
Flight period: Early July.

Collected localities: North Carolina: Swain Co., Big Cove Road. (1 specimen)

Elevation range: 2120 ft. (646 m)

General distribution: This species has a wide distribution and is most common in southern Canada and the northeastern U.S. It ranges from Newfoundland south to western North Carolina, west to Alberta, south to Colorado, New Mexico, and east-central Arizona. It is absent from the Great Plains states west of Illinois.

Larval hosts: Early and tall meadow rue (*Thalictrum dioicum* L. and *T. polygamum* Muhl. Ranunculaceae) (Lafontaine and Poole 1991).



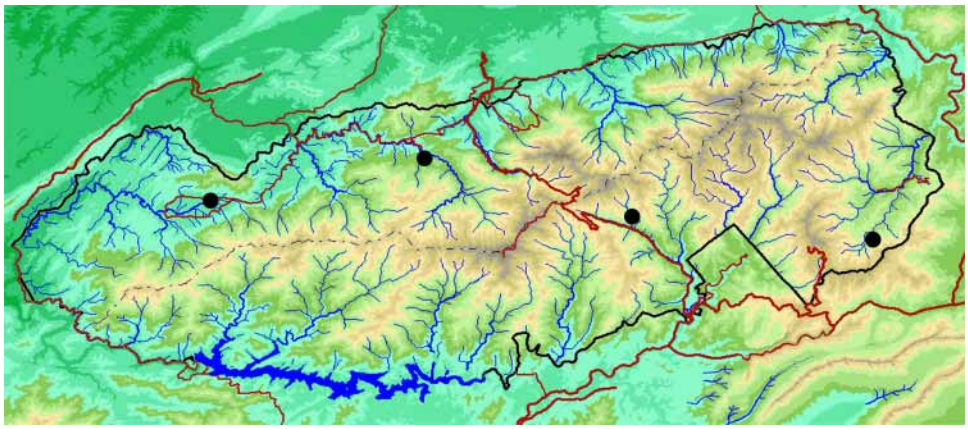
MAP 10. Collecting localities of *Pseudeva purpurigera.*

13. *Chrysanympha formosa* (Grote) Formosa Looper Moth (Fig. 13, Map 11)

Identification: Forewing length 15.0–17.0 mm. *Chrysanympha formosa* cannot be confused with any other plusiine in the Park. The basal area adjacent to the posterior margin is gray and dorsal to this is a large arching white patch streaked with gray. The subterminal area consists of a proximal white band, gray band, and black line. Hindwing is gray with a white fringe spotted with gray. The outer margin of the forewing, from apex to tornus, is more rounded than for other plusiine species.

Flight period: Early June to mid August.

Collected localities: North Carolina: Haywood Co., Purchase Knob; Swain Co., Kephart Prong trail. Tennessee: Blount Co., Cades Cove, Primitive Baptist Church; Sevier Co., Elkmont. (6 specimens)



MAP 11. Collecting localities of *Chrysanympha formosa.*

Elevation range: 1800–4924 ft. (549–1501 m)

General distribution: This species occurs from Newfoundland west to Manitoba and south to the mountains of North Carolina and Tennessee.

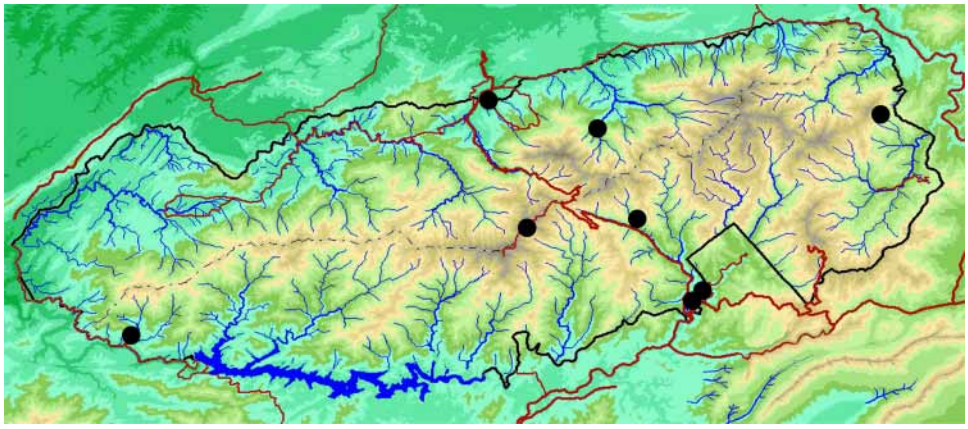
Larval hosts: Kearfott (1904) lists dwarf huckleberry (*Gaylussacia dumosa* (Andr.) T. & G.) and blueberry (*Vaccinium* sp.), both in the Ericaceae, as larval hosts.

14. *Eosphoropteryx thyatyroides* (Guenée) Pink-patched Looper Moth (Fig. 14, Map 12)

Identification: Forewing length 16.0-18.0 mm. *Eosphoropteryx thyatyroides* has two silvery spots that consist of a small V-shaped loop and a separate oval spot. Forewing ground color is gray with a pink basal patch and dark brown streak extending from postmedial line to just below apex. This is a distinct species that cannot be confused with any other plusiine in the Park. Hindwing is gray with a white fringe and small gray dots basally.

Flight period: June to early August and mid October.

Collected localities: North Carolina: Haywood Co., Mt. Sterling Trail; Swain Co., Big Cove Road, 3.3 mi NE of Clingman's Dome parking lot on Forked Ridge Trail, Kephart Prong Trail, Oconaluftee staff housing, 0.1 mi NE Twentymile Ranger Station. Tennessee: Sevier Co., 4 mi S of Rt. 321 end of Greenbrier Loop Road, 6 mi S of Sugarlands Visitor Center on Hwy. 441. (9 specimens)



MAP 12. Collecting localities of *Eosphoropteryx thyatyroides.*

Elevation range: 1508–5780 ft. (460–1762 m)

General distribution: In the northeast, this species occurs from Nova Scotia and northern Ontario south to Minnesota, Michigan, Ohio, and along the Appalachians from Maine to eastern Tennessee and western North Carolina. In the northwest, it occurs from central Alberta and southern British Columbia, south in the Cascades to southern Oregon, and in the Rockies to northern Idaho (Lafontaine and Poole 1991).

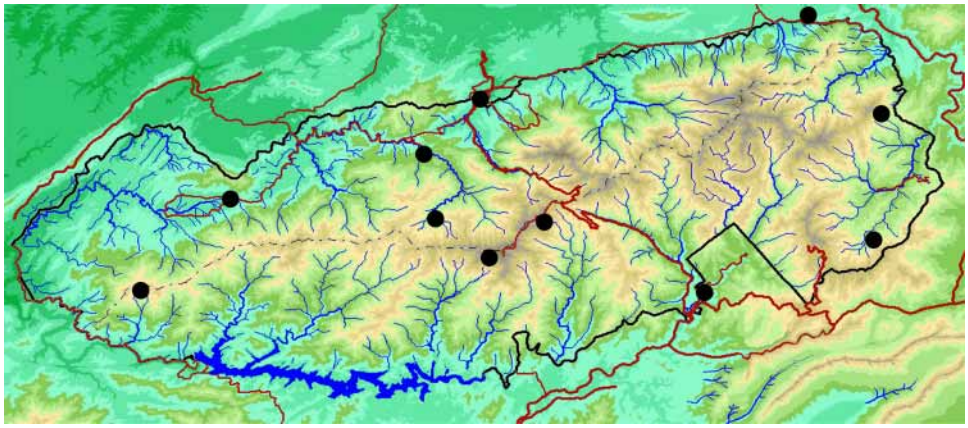
Larval hosts: This species feeds on early and tall meadow rue (*Thalictrum dioicum* L. and *T. polygamum* Muhl., Ranunculaceae), the same hosts as *P. purpurigera* (Lafontaine and Poole 1991).

15. *Autographa precationis* (Guenée) Common Looper Moth (Fig. 15, Map 13)

Identification: Forewing length 14.0–18.0 mm. *Autographa precationis* usually has two silvery spots on the forewing that consist of a loop and a spot, which can be either contiguous or separate. Forewing ground color is brown, with a shiny brassy area that surrounds the silvery spots and extends to the tornal area, and a large dark triangular patch in the terminal area from the apex to middle of outer margin. *Autographa precationis* may be confused with *P. includens*, but the shiny brassy brown areas are more extensive in *P. includens*, the silvery spots are separate, and there is a small dark spot on the fringe in the middle of the outer margin. *Autographa precationis* has a less extensive and not as shiny brassy brown area, the silvery spots are usually contiguous, but in some specimens they are separate, and there is no dark spot on the fringe in the forewing.

Flight period: June to October.

Collected localities: North Carolina: Haywood Co., Mt. Sterling Trail; Purchase Knob (forest and field); Swain Co., Big Cove Road; 5 mi N of Clingman's Dome; Mt. Buckley. Tennessee: Blount Co., Cades Cove house; Gregory Bald; Cocke Co., Foothills Parkway; Sevier Co., Campsite #27 on Jakes Creek Trail, Elkmont; Park Headquarters. (29 specimens).



MAP 13. Collecting localities of *Autographa precationis.*

Elevation range: 1300–6560 ft. (396–2000 m)

General distribution: This is a common species occurring throughout eastern North America as far north as central Quebec and Nova Scotia, south to northern Mississippi and northern Georgia. Westward it occurs in the plains from southern Manitoba to Kansas, with specimens known from western Kansas and central Wyoming.

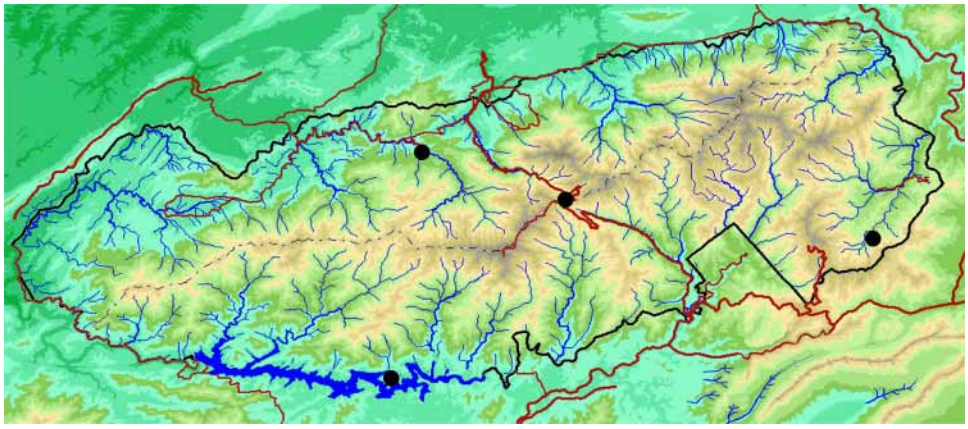
Larval hosts: This is a polyphagous species that feeds on a wide variety of herbaceous plants in the following families: Apiaceae, Asteraceae, Brassicaceae, Chenopodiaceae, Convolvulaceae, Fabaceae, Malvaceae, Plantaginaceae, and Verbenaceae. Occasionally it is a pest of garden plants (Lafontaine and Poole 1991).

16. *Autographa ampla* (Walker) Large Looper Moth (Fig. 16, Map 14)

Identification: Forewing length 18.0–21.0 mm. *Autographa ampla* is a distinct species that has a small, narrow, loop-shaped silvery spot. Forewing ground color is brown with a large dark brown contrasting patch below the silvery spot along the posterior margin and a black outline of scales forming the reniform spot.

Flight period: June to mid July.

Collected localities: North Carolina: Haywood Co., Purchase Knob; Swain Co., 0.5 km from mouth of Chambers Creek. Tennessee: Sevier Co., Elkmont, 7 mi S of Sugarlands Visitor Center. (5 specimens)



MAP 14. Collecting localities of *Autographa ampla.*

Elevation range: 1990–4800 ft. (607–1463 m)

General distribution: This is a boreal species that ranges from Newfoundland across Canada to British Columbia and southeastern Alaska. In the eastern United States, it occurs from Maine to eastern Tennessee and western North Carolina; and in the west, it occurs in the Rockies from Idaho, Montana, and Wyoming to Arizona, and along the west coast from Washington to northern California.

Larval hosts: Larvae feed on a wide variety of deciduous shrubs and small trees including alder (*Alnus* sp., Betulaceae) and Birch (*Betula* sp., Betulaceae), willow (*Salix* sp., Salicaceae), balsam poplar (*Populus balsamifera* L., Salicaceae), quaking aspen (*P. tremuloides* Michx., Salicaceae), cherry (*Prunus* sp., Rosaceae), serviceberry (*Amelanchier alinifolia* (Nutt.) Nutt. Ex M. Roemer, Rosaceae), and with-rod (*Viburnum*

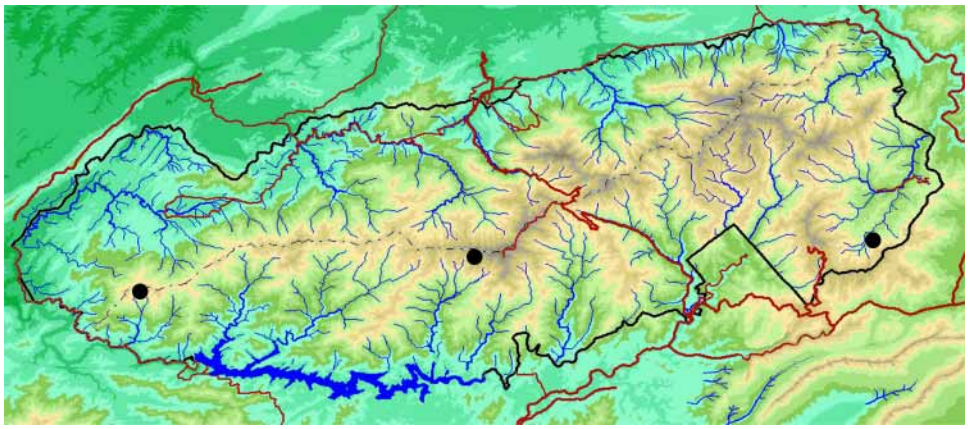
nudum L. var. *cassinoides* (L.) Torr. & Gray, Caprifoliaceae) (Eichlin and Cunningham 1978).

17. *Megalographa biloba* (Stephens) Bilobed Looper Moth (Fig. 17, Map 15)

Identification: Forewing length 14.0–19.0 mm. *Megalographa biloba* is a distinct species with a large bilobed silver spot surrounded by a patch of brassy brown. Forewing is brown, with a silvery, comma-shaped reniform spot, a small black dot dorsal to it, and a narrow terminal line along outer margin with a narrow brown patch at middle. Hindwing is gray to brown with a slightly darker marginal band.

Flight period: Late May to July.

Collected localities: North Carolina: Haywood Co., Purchase Knob; Swain Co., Mt. Buckley. Tennessee: Blount Co., Gregory Bald trail N of campsite #13. (4 specimens)



MAP 15. Collecting localities of *Megalographa biloba.*

Elevation range: 4690–6540 ft. (1512–1993 m)

General distribution: This is a widespread, highly migratory species that occurs throughout southern Canada, except western Canada, and throughout most of the U.S. It occurs throughout the rest of the New World except extreme southern South America. It has been collected in Hawaii and has migrated to Great Britain (Lafontaine and Poole 1991).

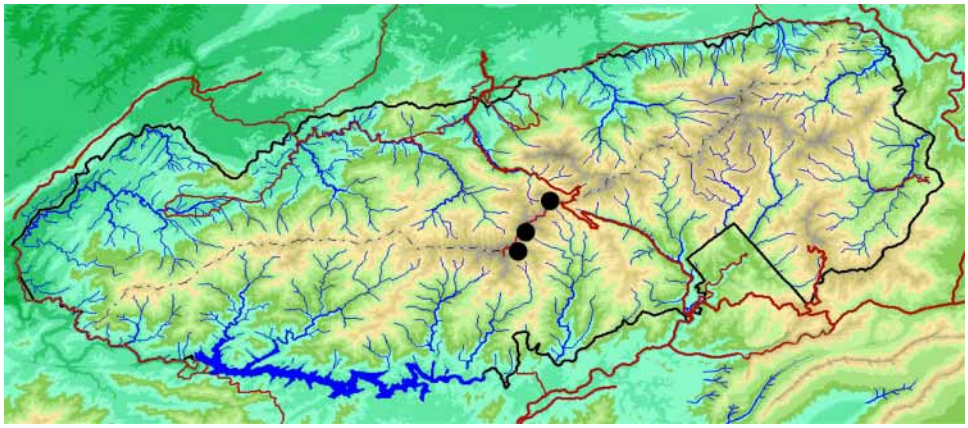
Larval hosts: This is a polyphagous species that feeds on a wide variety of herbaceous plants. Hosts include alfalfa, banana, barley, beans, cabbage, clover, delphinium, *Ephedra* sp. (Ephedraceae), geranium, gladiolas, lettuce, *Mimulus cardinalis* Dougl. ex Benth. (Scrophulariaceae), *Phacelia* sp. (Hydrophyllaceae), *Salvia leucophylla* Greene, *Soleirolia soleirolii* (Req.) Dandy (Urticaceae), *Stachys ajugoides* Benth. (Lamiaceae), and tobacco.

18. *Syngrapha alias* (Ottolengui) (Fig. 18, Map 16)

Identification: Forewing length 14.0–16.0 mm. *Syngrapha alias* has a silvery spot with two lobes that project toward the posterior margin. Forewing ground color is dark gray with a black area immediately surrounding the silvery spot, and fringe is white with black spots at end of wing veins giving a checked appearance. Hindwing is dark brown with a darker marginal band and white fringe with dark spots.

Flight period: Late July.

Collected localities: North Carolina: Swain Co., 1.2 mi NE Clingman's Dome parking lot on Noland Divide Trail, 3.3 mi NE Clingman's Dome parking lot on Fork Ridge Trail, 5.6 mi SW of Jct. 441 & Clingman's Dome Road. Tennessee: Sevier Co., 1.3 mi W of Jct. 441 & Clingman's Dome Road on Road Prong Trail. (8 specimens).



MAP 16. Collecting localities of *Syngrapha alias.*

Elevation range: 5260–6000 ft. (1603–1829 m)

General distribution: This species is fairly widespread across North America from Newfoundland and northern Quebec to Alaska; in the east, from Maine to New Jersey; in the Appalachians, from eastern Tennessee and western North Carolina; in the Mid-West, from Michigan and Minnesota; in the west from Montana, Wyoming, Idaho, Colorado, New Mexico; and on the West Coast, from Washington to northern California.

Larval hosts: This is a Pinaceae feeder that seems to prefer white spruce (*Picea glauca* (Moench) Voss.) and balsam fir (*Abies balsamea* (L.) Mill.); other hosts include black spruce (*Picea mariana* (Mill.) B. S. P.), western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), Engelman spruce (*Picea englemannii* Parry.), Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco), and red spruce (*Picea rubens* Sarg.). Other minor hosts include Pacific silver fir (*A. amabilis* (Dougl. ex Loud) Dougl. ex Forbes), jack pine (*Pinus banksiana* Lamb.), grand fir (*A. grandis* (Dougl. ex D. Don) Lindl.), tamarack (*Larix laricina* (Du Roi) K. Koch), western white spruce (*Picea glauca* (Moench) Voss), subalpine fir (*A.*

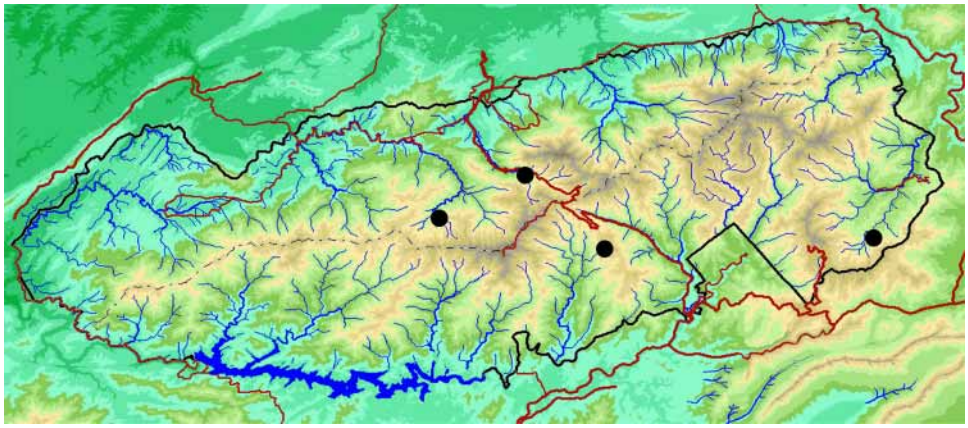
lasiocarpa (Hook.) Nutt.), western white pine (*Pinus monticola* Dougl. ex D. Don), and western red cedar (*Thuja plicata* Donn ex D. Don, Cupressaceae). These hosts are arranged by number of larvae collected on each (Prentice 1962).

19. *Syngrapha rectangula* (Kirby) Salt-and-pepper Looper Moth (Fig. 19, Map 17)

Identification: Forewing length 14.0–17.0 mm. *Syngrapha rectangula* has a similar shaped silvery spot to *S. alias*, but the spot is usually more robust and somewhat variable in shape and is contiguous with the large silvery basal area of the forewing. The middle of the forewing is black and the terminal third is banded white and gray with a black zig-zag line from apex to about 1/3 wing width. The fringe is white with black spots at ends of the wing veins as in *S. alias*. Hindwing is gray with a dark marginal band and fringe white with gray dots.

Flight period: End of June to August.

Collected localities: North Carolina: Haywood Co, Purchase Knob; Swain Co., Beetree Ridge. Tennessee: Sevier Co., Jake's Creek Trail nr. Campsite #27; 5 mi S of Sugarlands Visitor Center at Chimney's Picnic Area. (5 specimens)



MAP 17. Collecting localities of *Syngrapha rectangula.*

Elevation range: 2720–4934 ft. (829–1504 m)

General distribution: This species has a disjunct distribution in North America. In the north it ranges from Newfoundland, central Quebec, and northern Ontario to Manitoba, and south to northern Pennsylvania, southern Michigan, and northern Wisconsin. It is found in the Appalachians from southwestern Virginia, eastern Tennessee, and western North Carolina. In the West, it ranges from northern British Columbia, northern Idaho, western Montana, and south to southern Oregon.

Larval hosts: This is another Pinaceae feeder, but prefers balsam fir (*Abies balsamea* (L.) P. Mill) and western hemlock (*Tsuga heterophylla* (Raf.) Sarg.); other hosts include

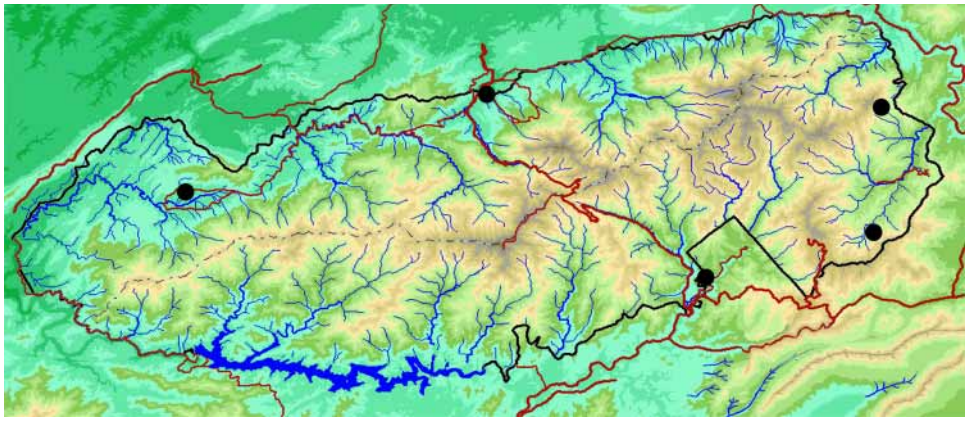
white spruce (*Picea glauca* (Moench) Voss), Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco), Pacific Silver fir (*A. amabilis* (Dougl. ex Loud) Dougl. ex Forbes), grand fir (*A. grandis* (Dougl. ex D. Don) Lindl.), sitka spruce (*Picea sitchensis* (Bong.) Carr.), red spruce (*Picea rubens* Sarg.), black spruce (*Picea mariana* (Mill.) B. S. P.), mountain hemlock (*Tsuga mertensiana* (Bong.) Carr.), tamarack (*Larix laricina* (Du Roi) K. Koch), and subalpine fir (*A. lasiocarpa* (Hook.) Nutt.). These hosts are arranged by number of larvae collected on each host (Prentice 1962).

20. *Anagrapha falcifera* (Kirby) Celery Looper (Fig. 20, Map 18)

Identification: Forewing length 14.0–18.0 mm. *Anagrapha falcifera* is a distinct species with a single silvery spot that forms a solid loop. Forewing ground color is gray with a large patch of brown below silvery spot. Hindwing is gray with darker marginal band.

Flight period: End of April; early June; end of July to early August; and end of September. There are three broods in the south (Lafontaine and Poole 1991) and this appears so in GSMNP, with a spring, summer, and early fall brood.

Collected localities: North Carolina: Haywood Co., Mt. Sterling Trail, Purchase Knob; Swain Co., Big Cove Road. Tennessee: Blount Co., Hyatt Lane; Sevier Co., Park Headquarters. (12 specimens)



MAP 18. Collecting localities of *Anagrapha falcifera.*

Elevation range: 1480–4925 ft. (451–1501 m)

General distribution: This is one of the most common and widespread plusiines. It occurs across Canada from Newfoundland and northern Quebec to British Columbia, and in the U.S. from Maine to northern California and south to Texas and Arizona (Lafontaine and Poole 1991).

Larval hosts: This species is found on a wide variety of herbaceous plants and very rarely on shrubs. Some of the more important hosts include beet, celery, lettuce, cabbage, corn, carrot, and blueberry (Eichlin and Cunningham 1978).

Discussion

The Plusiinae in Great Smoky Mountains National Park are predominately a high altitude group, with all species occurring above 4,000 ft. except for *P. purpurigera*, which is known from only a single specimen. Additional collecting may find *P. purpurigera* at higher altitudes because it has a boreal distribution like many other species of plusiines and reaches its southern most distribution in GSMNP. Two species, *E. thyatyroides* and *P. includens*, have the greatest altitudinal range within the park from below 2,000 ft. to above 5,000 ft. Only *P. morigera* is restricted to elevations above 5,000 ft.

The most species-rich locality within GSMNP is in the vicinity of Purchase Knob in Haywood Co., North Carolina with 14 species. Eleven separate geo-referenced localities represent the collections at Purchase Knob from 4,000 to 4,998 ft. in elevation. Several habitats occur here ranging from forests to open fields with grasses and wildflowers. This diversity in habitat, as well as being the most intensively collected of any of the sites results in the high species richness. The second most diverse localities each have five species: Elkmont (Sevier Co., TN) and three localities along Big Cove Rd. (Swain Co., NC), with an altitudinal range between 2,040 and 2,200 ft. Again, both of these localities have had more intensive collecting than others in this study.

The 17 species of Plusiinae present in GSMNP is significant when related to the fauna of the eastern and southeastern U.S. The most species-rich states in the east are Maine (31 species), New York (30), New Hampshire (26), Ohio (24) (Rings, et al. 1992), Kentucky (21) (Covell 1999), Pennsylvania (18), Maryland and Florida (Kimball 1965) (14), Virginia and Georgia (12), New Jersey (11), South Carolina (10), and Mississippi (9). There are 15 species reported from Tennessee and 13 of these occur in the Park. Of these 15 species, seven were new state records that were collected in the Park. North Carolina has been collected more extensively than Tennessee, and there are 20 species recorded for the state including 2 new state records from the Park. Sixteen of the 17 species in the Park are found on the North Carolina side.

Acknowledgments

Discover Life in America (DLIA) provided partial funding for this project in 2003 and 2004. I thank Jeanie Hilten of DLIA for providing logistic support during my stays in GSMNP and Keith Langdon of the National Park Service for providing collecting permits. Thanks are extended to David L. Wagner, University of Connecticut, Storrs, CT and Brian Scholtens, College of Charleston, Charleston, SC for organizing and inviting me to participate in the Lepidoptera BioBlitzes held during 2000, 2002, and 2004. Many thanks to Brian Scholtens for also providing me with a database of specimens housed in the GSMNP collection and from other collectors associated with the BioBlitzes. I thank David Adamski, Systematic Entomology Laboratory, U.S.D.A., Washington, DC for preparing

the maps and figures. For critically reviewing a draft of this paper, I thank Marc E. Epstein, California Department of Food and Agriculture, Sacramento, CA; and Thomas J. Henry of the Systematic Entomology Laboratory, U.S.D.A., Washington, DC.

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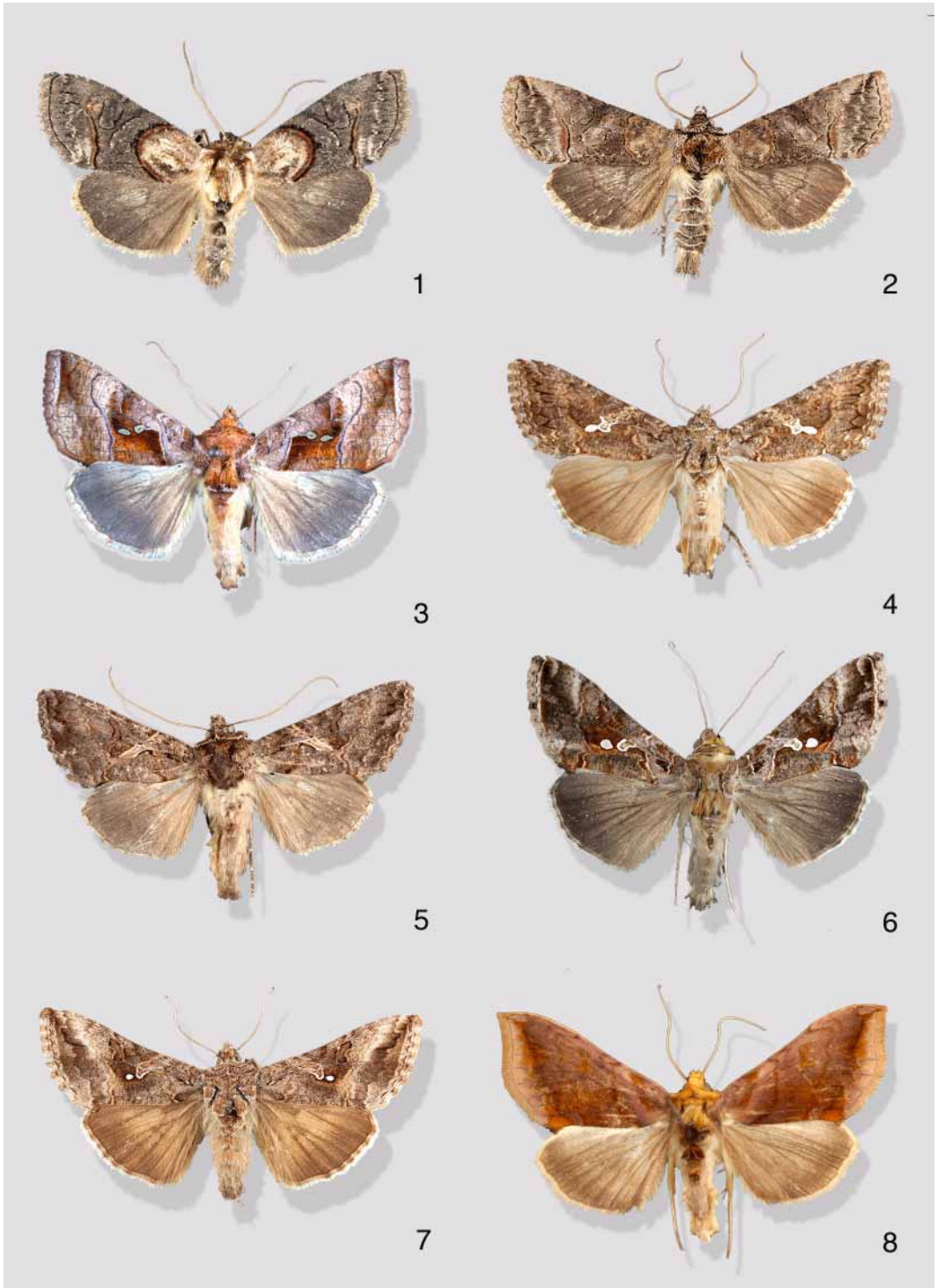
FIGURES 1–8. Adults. 1, *Abrostola ovalis*, ♂, Tennessee, Sevier Co., Greenbrier area, Old Settlers Trail, off Ramsey Cascade Rd., GSMNP, 1675 ft., 26 June 2004, M.G. Pogue, USNMENT 00221372; 2, *Abrostola urentis*, ♂, Nebraska, Cherry Co., Hackberry Lake, Valentine N.W.R., 24 June 1983, D.C. Ferguson; 3, *Enigmogramma basigera*, ♂, South Carolina, Charleston Co., McClellanville, Wedge Plantation, 28 Nov. 1970, D.C. Ferguson; 4, *Trichoplusia ni*, ♂, Illinois, La Salle Co., La Salle, 31 August 1966, D.C. Ferguson; 5, *Ctenoplusia oxygramma*, ♂, Maryland, Anne Arundel Co., Southaven, 11 August 1991, H.G. Stevenson; 6, *Pseudoplusia includens*, ♂, Tennessee, Blount Co., Campsite 6, along Scott Mtn. Trail, GSMNP, 3324 ft., 5 August 2003, M.G. Pogue, USNMENT 00219092; 7, *Rachiplusia ou*, ♀, Texas, Uvalde Co., Utopia, 12 October 1967, A. & M.E. Blanchard; 8, *Allagrapha aerea*, ♂, New York, Chemung Co., Horseheads, 13 June 1949, L.R. Rupert.



FIGURES 9–16. Adults. 9, *Diachrysia aereoides*, ♂, Tennessee, Cocke Co., Cosby, 5.1 rd mi E on Rt. 32, GSMNP, 2200 ft., 9 June 2002, Powell & Rubinoff, USNM 00154033; 10, *Diachrysia balluca*, ♂, North Carolina, Haywood Co., Purchase Knob, E of house, forest, GSMNP, 4838 ft., 31 July 2003, M.G. Pogue, USNMENT 00156731; 11, *Polychrysia morigera*, ♂, North Carolina, Swain Co., 1.2 mi NE Clingman's Dome prk. lot, Noland Divide Trail, GSMNP, 6000 ft., 30 July 2003, M.G. Pogue, USNMENT 00156672; 12, *Pseudeva purpurigera*, ♂, Canada, Nova Scotia, Lequille, 31 July 1946, D.C. Ferguson; 13, *Chrysanympha formosa*, ♂, North Carolina, Swain Co., 8.3 mi NW GSMNP entrance on 441, Kephart Prong Trail, GSMNP, 2825 ft., 10 June 2003, M.G. Pogue, USNMENT 00155818; 14, *Eosphoropteryx thyatyroides*, ♀, North Carolina, Swain Co., 0.1 mi NE Twentymile Ranger Station, GSMNP, 1508 ft., 2 June 2003, M.G. Pogue, USNMENT 00155317; 15, *Autographa precationis*, ♀, North Carolina, Haywood Co., Purchase Knob, N of house, forest, GSMNP, 4950 ft., 11 October 2003, M.G. Pogue, USNMENT 00219695; 16, *Autographa ampla*, ♀, Canada, Nova Scotia, Halifax Co., Arndale, 2 July 1960, D.C. Ferguson.

FIGURES 17–20. Adults. 17, *Megalographa biloba*, ♀, Colorado, Denver Co., Denver, 8-15 September, Barnes Collection; 18, *Syngrapha alias*, ♂, North Carolina, Swain Co., 5.6 mi SW of Jct. 441 & Clingman's Dome Rd., GSMNP, 5950 ft., 28 July 2003, M.G. Pogue, USNMENT 00156481; 19, *Syngrapha rectangula*, ♀, Tennessee, Sevier Co., Jake's Creek Trail, nr. Campsite #27, GSMNP, 3590 ft., 22 July 2004, M.G. Pogue, USNMENT 00221791; 20, *Anagrapha falcifera*, ♂, North Carolina, Haywood Co., Purchase Knob, NE of house, field, GSMNP, 4925 ft., 31 July 2003, M.G. Pogue, USNMENT 00156840.