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Review of the Nearctic species of *Bryotropha* Heinemann (Lepidoptera: Gelechiidae)

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Abstract

The Nearctic species of the genus *Bryotropha* Heinemann 1870 are reviewed. Seven species are recognized as valid, three of which are described as new: *B. gemella* **sp. n.**, *B. hodgesi* **sp. n.**, and *B. altitudophila* **sp. n.** Two other species, *B. plantariella* (Tengström, 1848) and *B. galbanella* (Zeller, 1939), are reported from the Nearctic for the first time. *B. pullifimbriella* (Clemens, 1863), *B. tahavusella* (Forbes, 1922) and *B. clandestina* (Meyrick, 1923) are synonymized with *B. similis*. A lectotype of *Gelechia branella* Busck, 1908 is designated. Adults and genitalia are illustrated, and keys to the species are provided.

Key words: *Bryotropha*, Gelechiidae, Nearctic, review

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Introduction

Bryotropha Heinemann is a medium-sized gelechiid genus with a Holarctic distribution. *Bryotropha* occupies a rather isolated position within Gelechiinae, with most affinities to the tribes Anomologini and Gelechiini. Many current checklists place *Bryotropha* as the last genus in the Anomologini. However, we do not know its closest relatives, and one could argue that it may represent a separate clade. Among Gelechiidae *Bryotropha* is one of the few groups that can be defined readily on external characters. Heinemann (1870: 233–234) referred to the trapezoidal shape of the hindwing and the distinctive labial palpus with a conspicuous furrowed brush underneath the second segment and third segment longer than the second as defining characters. The characteristic pecten scale at the base of the antenna (fig. 1), by which members of *Bryotropha* are most easily recognized, was first described by Forbes (1922: 104). *Bryotropha* is also one of few genera in Lepidoptera that feeds on mosses (Heckford & Sterling 2002, 2003), and in many regions of the Holarctic representatives of this genus are among the most common gelechiid moths. Nevertheless, this genus has never been popular with collectors because individual species are difficult to separate. Species of *Bryotropha* have neutral colors and lack striking markings, yet they often show considerable variation both geographical and ecological (Rutten & Karsholt 1998). It thus comes as no surprise that in the Nearctic *Bryotropha* has received little attention in the literature. Previously only four species have been recorded from this region (Hodges 1983). In contrast, more than 35 species are known from the western Palaearctic (Karsholt & Rutten, in press). Apart from the original descriptions, which were published between 1863 and 1922, Nearctic *Bryotropha* have been treated only once since (Busck 1939). To establish whether this low number might be the result of neglect, and because the information provided in the primary descriptions is insufficient for reliable determination, we here present a review of the Nearctic *Bryotropha*.

Our study has revealed seven species, three of which are new to science: *B. gemella* **sp. n.**, *B. hodgesi* **sp. n.**, and *B. altitudophila* **sp. n.** Moreover, *B. plantariella* and *B. galbanella* are reported from the Nearctic for the first time. Three of the original four Nearctic taxa, *B. pullifimbriella*, *B. tahavusella* and *B. clandestina*, were found to be junior synonyms of *B. similis*. Full descriptions are given for all the species treated. Adults as well as male and female genitalia are illustrated, and keys are provided.

Material and Methods

Material of *Bryotropha* was obtained from the following institutions and private collections:

ANSP Academy of Natural Sciences, Philadelphia, USA
BAL Personal Collection of G. Balogh, Portage, Michigan, USA

BLC	Personal Collection of B. Landry, Geneva, Switzerland
BMNH	The Natural History Museum (formerly British Museum of Natural History), London, UK
CUIC	Cornell University Insect Collection, Ithaca, New York, USA
EME	Essig Museum of Entomology, University of California, Berkeley CA, USA
CNC	Agriculture & Agri-Food Canada, Ottawa, Ontario, Canada
MOR	Personal Collection of J.K. Morton, Ontario, Canada
RMNH	National Museum of Natural History, Leiden, The Netherlands
USNM	US National Museum of Natural History, Washington, USA
ZMUC	Zoological Museum, University of Copenhagen, Denmark
ZMUH	Zoological Museum, University of Helsinki, Finland

We have examined more than 1200 specimens and about 250 genitalia preparations. A detailed material list is given for all species except *B. plantariella* and *B. similis*. A complete listing of all material including latitude/longitude coordinates is available as an Excel file upon request from the authors. Distribution maps were prepared with DMAP 7.0 (Morton 2000) using examined material only. When not given on the labels, longitude/latitude data were derived from major Internet gazetteers.

Preparation and illustrations

Genitalia preparations were made following the methods described by Landry & Wagner (1995). Male genitalia were either unrolled or laterally embedded. Measurements and terminology of the adult and genitalia are the same as in previous publications (Rutten 1999, 2002). Genitalia drawings were made after photographs taken with a Zeiss AxioCam digital camera attached to a Zeiss Axioscope. In a few cases damaged or misarticulated parts were rearranged to produce a complete picture.

Remarks on identification

Most species of the Nearctic *Bryotropha* lack distinct characters, although in a well-investigated area it is possible to tell the species apart on external features. Specimens should be examined under diffuse natural light. Older material whose colors are faded, and moths from areas where the fauna is poorly known, almost invariably have to be studied on the basis of genitalia.

A degree of variation occurs in the genitalia. In the males the valve and saccus can vary in length while the gnathos can vary somewhat in shape (figs. 51–74). Since the male genitalia are similar among species, variation can make a positive identification difficult but never impossible. The female genitalia show slight variation in the size of the signum, but otherwise are distinct and easily identified.

The synonymy of the species occurring in the Palaearctic region is discussed in detail by Karsholt & Rutten (in press) and is not repeated here.

Review of Nearctic *Bryotropha*

Bryotropha Heinemann, 1870

Bryotropha Heinemann, 1870, Die Schmetterlinge Deutschlands und der Schweitz. 2.2: 233. Type species: *Tinea terrella* ([Denis & Schiffermüller], 1775), by subsequent designation (Meyrick, 1925: 141) (see Sattler 1973: 177).

Mniophaga Pierce & Daltry, 1938: 226. Type species: *Gelechia similis* Stainton, 1854, by original designation.

Adelphotropha Gozmány, 1955: 310. Type species: *Gelechia senectella* Zeller, 1839, by original designation.

Diagnosis (based on Nearctic species). *Bryotropha* are small to medium-sized moths with a wingspan of 10–16 mm. The genus is characterized by the presence of a single strong pecten scale underneath the antennal scape (fig. 1); the pecten is very persistent, and even in worn specimens one or both pecten are still present. The labial palpus usually has a conspicuous furrowed brush on the underside of segment 2, while segment 3 is as long as or longer than segment 2. Exceptions are *B. galbanella* and *B. gemella* which have no furrowed brush beneath segment 2, and have segment 3 slightly shorter than segment 2. The forewing is lanceolate, with the ground color ochreous to dark grayish brown, occasionally grayish, usually with two plical and two discal stigmata sometimes followed by patches or streaks of light colored scales, costal and tornal patches often fused to form a fascia, the subapical area and termen often irrorate with blackish scales. The hindwing is as broad as the forewing, trapezoidal, with a pointed apex, pale grayish to pale fuscous, often distinctly darker toward the apex. Wing venation has 12 veins in the forewing and 8 veins in the hindwing (fig. 2).

Male genitalia. The uncus is subrectangular, and the socius has strong setae. The gnathos is slender and smooth, well developed, and hook shaped, with a sharp apex; the base is with or without microtrichia. The tegumen is broad, with the anterior emargination very deep; the part of the tegumen adjoining the gnathos ("thornshield") often is set with many small spikes. The valva is simple and straight, with a falcate sacculus at the base. The vinculum is with or without microtrichia. The saccus is rather narrow and long. The aedeagus is long and slender with a bulbous base, the tubular part curved, and the apex whip-like.

Female genitalia. The apophyses anteriores and posteriores are slender and moderately long. Segment VIII is well sclerotized with the sternum and tergum fused into a ring, distal margin dorsally straight to concave, sometimes with a median tongue, ventrally with a weak to strong excavation. The ventral groove is usually distinct, its distal end marked by a sclerotized extension. The ventral side of segment VIII bears the lamella postvaginalis and numerous microtrichia. The antrum is small; the ductus bursae long and slender, with

the ductus seminalis arising about halfway between the antrum and the bursa; the corpus bursa is oval to round, with the signum well developed and variable in form.

Checklist of Nearctic *Bryotropha*

Bryotropha Heinemann, 1870
Mniophaga Pierce & Daltry, 1938
Adelphotropha Gozmány, 1955

plantariella (Tengström, 1848)
cinerosella (Tengström, 1848)
serratulella (Tengström, 1848)
brevipalpella Rebel, 1893
galbanella (Zeller, 1839)
angustella (Heinemann, 1870)
ilmatariella (Hoffmann, 1893)
haareki Strand, 1920
fusconigratella Palm, 1947
gemella sp. n.
similis (Stainton, 1854)
thuleella (Zeller, 1857)
similiella (Doubleday, 1859)
pullifimbriella (Clemens, 1863) **syn. n.**
confines (Stainton, 1871)
obscurecinerea (Nolcken, 1871)
stolidella (Morris, 1872)
fuliginosella Snellen, 1882
tahavusella (Forbes, 1922) **syn. n**.
clandestina (Meyrick, 1923) **syn. n.**
hodgesi **sp. n.**
branella (Busck, 1908)
altitudophila **sp. n.**

Key to species based on external characters

1 Segment 2 of labial palpus without strong ventral brush, segment 3 slightly shorter than segment 2, large species (wingspan 13–16 mm)..... 2
- Segment 2 of labial palpus with strong ventral brush, segment 3 slightly longer than segment 2, small species (wingspan 11–13 mm)..... 3

2.(1) Ground color grayish ..... *B. galbanella*
- Ground color brownish ..... *B. gemella*
3.(1) Ground color blackish, frons and inside of labial palpus white, speckled fuscous..... ..... *B. similis*
- Ground color brownish, frons and labial palpus pale ochreous 4
4.(3) Forewing unicolorous ochreous gray to dark brown, stigmata distinct, second discal and first plical small and often elongate, second plical often distinctly larger and roundish; hindwing pale fuscous..... *B. plantariella*
- Forewing different, stigmata small and roundish, hindwing pale ochreous gray 5
5.(4) Small (10–11 mm) dark brownish species, forewing with small indistinct stigmata, occasionally having the subapical area darkened ..... *B. hodgesi*
- Larger (11–13 mm) ochreous brown species, forewing with small but rather distinct stigmata, termen lined with blackish scales..... *B. branella & B. altitudophila*

Key to species based on male genitalia

1 Base of gnathos covered with small hairs, thornshield without spikes (figs. 36–38) 2
- Base of gnathos without small hairs, thornshield set with small spikes (figs. 39–43). 4
2.(1) Gnathos with a large gradual bend, very slender without local thickening (figs. 51–54) ..... *B. plantariella*
- Gnathos with a sharp bend before halfway, clearly thickened at bend (figs. 55–56) 3
3.(2) Apex of aedeagus with long whip (fig. 25)..... *B. gemella*
- Apex of aedeagus with very short whip (fig. 23)..... *B. galbanella*
4.(1) Gnathos clearly thickened at or just after bend (figs. 57–60), vinculum with bend halfway (figs. 39, 40)..... *B. similis*
- Gnathos usually without distinct local thickening, vinculum always with bend at 1/3 or before (figs. 41–43) 5
5.(4) Gnathos with rather sharp bend at 1/3 (figs. 61–66), apex of aedeagus often broadened and with a distinct sharp bend (fig. 29); in unrolled preparations always recognized by the narrow uncus (not exceeding 130 µm in width) (fig. 41), in a lateral view by the height of the gnathos which never exceeds 250 µm..... *B. hodgesi*
- Gnathos with gradual bend at half length, apex of aedeagus not broadened and without a sharp bend"; uncus 160–190 µm in width, gnathos 300–350 µm in height 6
6.(5) All of basal half of gnathos evenly curved through at least 120º (figs. 71–74)..... ..... *B. altitudophila*
- Only part of the basal half of the gnathos curved to maximal 120º (figs. 67–70) .... *B. branella*

Key to species based on female genitalia*

***The features for *B. galbanella* are based on Palaearctic (European) material

1. Signum at least twice as long as wide, with two transverse folds, without strong spines (Figs. 45–46) 2
- Signum otherwise 3

2.(1) Ventral groove with undulating margins, lamella postvaginalis without medial extension (fig. 45) ..... *B. galbanella*
- Ventral groove without undulating margins, lamella postvaginalis with prominent medial extension (fig. 46) ..... *B. gemella*

3.(1) Distal end of ventral groove not marked by sclerotized extension; signum squarish with two transverse folds; distal and proximal sections, which are set with stout spikes, folded behind the smooth middle section (fig. 44) ..... *B. plantariella*
- Distal end of ventral groove clearly marked by sclerotized extension; signum different 4

4.(3) Ventral side of segment VIII invaginated to 1/3; dorsal side with median tongue (fig. 47) ..... *B. similis*
- Ventral side of segment VIII without a clear invagination; dorsal side without a median tongue 5

5.(4) Signum plate like, elongate trapezoidal, with strong spines on the corners (fig. 48) .. .. *B. hodgesi*
- Signum otherwise 6

6.(5) Signum with weakly sclerotized middle part flanked by heavily sclerotized lateral rims (fig. 49) ..... *B. branella*
- Weakly sclerotized middle part of signum completely surrounded by heavily sclerotized rim (fig. 50) ..... *B. altitudophila*

***Bryotropha plantariella* (Tengström, 1848)**
(figs. 3–5, 20, 22, 36, 44, 51–54, 75)

Gelechia plantariella Tengström, 1848: 128.
Gelechia cinerosella Tengström, 1848: 129.
Gelechia serratulella Tengström, 1848: 128.
Bryotropha brevipalpella Rebel, 1893: 47.

Diagnosis. Small, almost uniformly ochreous gray to brown species with ochreous labial palpus and (in the males) distinct stigmata.

Description. Adult (figs. 3–5). Sexual dimorphism moderately pronounced. Male:

Wingspan 11–13 mm. Labial palpus pale to bright ochreous on the inner side, weakly to heavily suffused brown on the outer side; segment 3 as long as segment 2. Antenna dark brown, indistinctly ringed with ochre. Head with frons ochreous, vertex somewhat darker. Thorax and tegula concolorous with forewing. Forewing dark ochreous gray to dark brown; plical and discal stigmata usually distinct, especially the second plical, which is often well developed; first discal beyond second plical; costal and tornal patches pale ochreous, fused to form a very faint, angulated fascia; termen indistinctly lined with blackish scales; cilia with one or more lines. Hindwing grayish brown; cilia concolorous with yellowish base.

Female. Slightly smaller and darker than the male, having both pairs of wings more slender and more pointed.

Variation. The subapical area on the forewing may be darkened due to suffusion with dark brown scales.

Similar species. Males can be separated from *B. similis* by the brownish color (blackish in *B. similis*) and the ochreous palpus (white, speckled fuscous in *B. similis*). In *B. hodgesi* the forewing are not as unicolorous as in *B. plantariella*, often with a distinct fascia and a darkened subapical area but with very indistinct roundish stigmata. In *B. plantariella* the stigmata are nearly always well developed, the second plical being particularly prominent. The dark, almost unicolorous females resemble B. *similis* but can be recognized by the much more pointed forewing and the ochreous colored labial palpus.

Male genitalia (figs. 20, 21, 36, 51–54). Uncus subrectangular. Socius with several setae. Gnathos slender and very long, with large gradual bend, base with microtrichia. Thornshield triangular, without spikes. Vinculum occasionally with small patch of microtrichia. The very long and slender gnathos with its base set with microtrichia, is characteristic.

Female genitalia (fig. 44). Segment VIII with small triangular lamella postvaginalis and short, but stout, microtrichia. Ventral groove ends at about 3/5, and is followed by a narrow indentation. Distal margin of segment VIII dorsally weakly concave. Signum very characteristic; rectangular with two transverse folds; distal and proximal sections, which are set with stout spikes, folded behind the smooth middle section. Not to be confused with any other species.

The early stages are unknown. In Europe (Denmark) a few specimens were bred from *Sphagnum* sp. (Buhl *et al*. 1992). Adults were collected from early July to early August with a single specimen in late May, most likely in one generation.

Distribution (fig. 75).Widespread but local. In Canada *B. plantariella* occurs in lowland regions, in the USA it becomes restricted to higher altitudes of up to 2700 m. In the Palaearctic known from Scandinavia in the west to the far east of Russia (Omelko 1999: 170) in the east.

Material examined: 97 ♂, 9 ♀, including 32 male and 5 female genitalia preparations.

***Bryotropha galbanella* (Zeller, 1839)**
(figs. 7, 8, 22, 23, 37, 45, 55, 76)

Gelechia galbanella Zeller, 1839: 200.
Gelechia angustella Heinemann, 1870: 217.
Gelechia ilmatariella Hoffmann, 1893: 138.
Gelechia galbanella var. (et ab.) *griseella* Caradja, 1920: 99.
Gelechia galbanella var. *haareki* Strand, 1920: 64.
Gelechia fusconigratella Palm, 1947: 40.

Diagnosis. Large grayish species with a whitish fascia and distinct blackish stigmata.

Description. Adult (figs. 7, 8). Wingspan 15–16 mm (male). Labial palpus without a brush underneath segment 2 and with segment 3 slightly shorter than segment 2; white, speckled fuscous on the inner side, fuscous brown on the outer side. Antenna fuscous indistinctly ringed with ochreous. Head with frons creamy white, head thorax and tegula concolorous with forewing. Forewing dark brownish gray, suffused with creamy white; base darkened at costa; second plical and discal stigmata very distinct, first plical less clear; first discal beyond second plical; costal and tornal patches whitish, fused to form a distinct, angulated fascia; termen lined with patches of blackish scales; cilia dark gray with one or several ciliary lines. Hindwing uniformly fuscous gray; cilia concolorous.

Variation. The color of the forewing can vary from pale gray (strong suffusion with creamy white scales) to dark gray (weak suffusion with creamy white scales). In the latter forms the stigmata are rather indistinct. In the Palaearctic dark forms of *B. galbanella* only occur in the extreme north.

Similar species. The grayish tone, which is apparent even in very dark forms (fig. 8), separates *B. galbanella* from *B. gemella*, which always has a clear brownish tone.

Male genitalia (figs. 22, 23, 37, 55). Uncus broad, subrectangular. Socius with 5 or more setae. Gnathos slender, clearly thickened at bend, base with microtrichia. Thornshield triangular, without spikes. Vinculum covered with microtrichia. Apex of aedeagus with a very short (<100 µm) whip (arrowhead in fig. 23). The aedeagus with its short whip immediately separates *B. galbanella* from *B. gemella* whose aedeagus has a much longer whip (>200 µm) (arrowhead in fig. 25).

Female genitalia (fig. 45) (based on Palaearctic material). Segment VIII with small triangular lamella postvaginalis and many long needle-shaped microtrichia. Distal end of the ventral groove marked by a bulbous structure extending slightly beyond the distal rim of segment VIII. Ventral groove very distinct, with undulating margins. Dorsal side of segment VIII weakly concave. Signum large and clearly elongate, with two transverse folds, and densely covered with spikes. Similar to *B. gemella*, q.v.

Biology. Description according to Heckford & Sterling (2003). Larva with head and prothoracic plate black, body reddish brown, anal plate dark brown. In Europe the host plants include *Dicranum scoparium* (Hedw.) (Dicranaceae) and *Homalothecium lutescens* (Hedw.) H. Rob (Brachytheciaceae). The pupa is yellowish brown within a flimsy cocoon.

Adults are often disturbed during the day. In Europe (Denmark) they are most common in *Pinus* and *Larix* forests with the ground extensively covered with moss. Adults were collected from late June to early July indicating one generation only.

Distribution (fig. 76). Only known from a few localities in Alaska and extreme north-western Canada. Elsewhere this species is found from Europe to Japan.

Material examined. 5 ♂ — **CANADA, Yukon Territory:** 1 ♂: 31 km E Dawson City, marsh/Salix/Betula bush, 7.vii.1994, evening, L. Kaila leg. (ZMUH). — **USA, Alaska:** 2 ♂: 4 mi. N. Cantwell, 2000–2200 ft., 27.vi.1979, P. Opler & J. Powell, gen. slide AR 0721 (EME); 1 ♂: Steese Hwy, 63 mi. NE Fox, 2.vii.1979, P. Opler & J. Powell, gen. slide AR 0722 (EME); 1 ♂: 10 mi. SE Houston, 26.vi.1979, P. Opler & J. Powell (EME).

***Bryotropha gemella* sp. n.**
(figs. 6, 24, 25, 38, 46, 56, 76)

Type material. Holotype, 1 ♂: Ottawa, Can. 26.vi.1905, C.H. Young, gen. slide USNM 9885 (USNM). Paratypes, 26 ♂, 2 ♀. — **CANADA, New Brunswick:** 1 ♂: Chamcook, 15.vi.1938, T.N. Freeman, gen. slide AR 0546 (CNC). — **Nova Scotia:** 1 ♂: Baddeck, 2.vi.1936, J. McDunnough, gen. slide AR 0528 (CNC); 1 ♂: S. Milford, 21.VI.1934, J. McDunnough (CNC); 1 ♂: White Pt. Bch., Queens Co., 16.vii.1934, J. McDunnough, gen. slide AR 0723 (CNC). — **Ontario:** 1 ♂: Ottawa, 19.vii.1905, C.H. Young, gen. slide 4656 R.W. Hodges (CNC); 2 ♂: ibid., 16.vi.1906; 1 ♂: ibid., 21.vi.1906; 1 ♂: Bobcaygeon, 2.vi.1932, J. McDunnough, gen. slide AR 0649 (CNC); 2 ♂: ibid., 8.vi.1931[no abdomen]; 1 ♂: Minaki, 8.vii.1928, J. McDunnough (CNC); 1 ♂: Islington, 12.vii.1935, M.S. Parish (USNM); 1 ♀: Ottawa, 18.vii.1905, C.H. Young, gen. slide USNM 9872 (USNM); 1 ♂: Sparrow Lake, 9.vii.26, A.F. Braun (USNM); 1 ♂: ibid., 5.vii.1926. — **Québec:** 1 ♂: Bradore Bay, 19.vii.1929, W.J. Brown, gen. slide AR 0530 [CNC]; 1 ♂: Terrebonne, lac Brûlé, near Ste-Agathe, 6.vii.1994, J.-F. Landry, at MVL in mixed forest with birch, spruce, fir, maple (CNC); 1 ♂: ibid., 9.vii.1994, J.-F. Landry, daytime on fungus-covered logs (CNC); 1 ♂: ibid., 4.vii.1993, day, on moss growing on a boulder in mixed forest, genitalia slide m MIC 2644; 1 ♂: Masham, Lake Duncan, ad luc, 15.vi.1985, K. Mikkola leg. (ZMUH). — **USA, Michigan:** 1 ♂: Huron MTs, 26.vii.1943, A.F. Braun (USNM); 1 ♂: ibid., gen. slide USNM 9893 (USNM); 1 ♀: ibid., 24.vii.1943, gen. slide AR 0668 (USNM). — **New Hampshire:** 1 ♂: Bretton Woods White Mts. 1600 ft., 8.vii.1915, gen. slide USNM 13,527 (USNM); 1 ♂: ibid., 16.vii.1923, gen. slide USNM 13,528 (USNM); 1 ♂: 24.vii.1931, Mt. Washington 4000 ft. N.H., gen. slide USNM 13,526 (USNM). — **Virginia:** 1 ♂: Mountain Lake, 14–21.vi.1907, A. Braun (USNM).

Diagnosis. Large brownish species with distinct stigmata.

Description. Adult (fig. 6). Wingspan 15–16 mm (male), 13–14 mm (female). Labial palpus without a brush underneath segment 2 and with segment 3 shorter than segment 2; ochreous to pale ochreous on the inner side, slightly darker on the outer side. Antenna dark

brown very indistinctly ringed with ochreous. Head with frons pale ochreous to dark ochreous brown; vertex, thorax and tegula concolorous with forewing. Forewing dark ochreous brown, suffused with pale ochre; all stigmata very distinct, first plical obsolete; first discal beyond second plical; costal and tornal patches pale ochreous, fused to form a rather indistinct, angulated fascia; termen lined with distinct patches of blackish scales; cilia ochreous-brown with one or more ciliary lines and pale ochreous tips. Hindwing fuscous gray to fuscous brown all over; cilia concolorous, with one to several ciliary lines.

Variation. The material examined shows little variation. Individual specimens may be slightly darker or paler due to varying amounts of ochreous scales on the forewing.

Similar species. Very similar to *B. galbanella* q.v. The label data indicates that *B. galbanella* has an arctic range whereas *B. gemella* is found in more temperate regions, suggesting that these species are allopatric.

Male genitalia (figs. 24, 25, 38, 56). Uncus broad, subrectangular. Socius usually with 4 or 5 setae. Gnathos slender, clearly thickened at bend, base with microtrichia. Thornshield triangular, without spikes. Vinculum often covered with microtrichia but occasionally without. Apex of aedeagus with long (>200 µm) whip. Resembling *B. galbanella* q.v.

Female genitalia (fig. 46) Segment VIII with many microtrichia. Lamella postvaginalis small, with a narrow median extension reaching to the middle of segment VIII. The bulbous structure marking the distal end of the ventral groove not extending beyond the distal rim of segment VIII. Ventral groove very distinct, with curved margins. Dorsal side of segment VIII weakly concave. Signum large and clearly elongate, with two transverse folds; distal and proximal ends densely covered with small spikes, middle part with only few spikes. Separated from *B. galbanella* by the shape of the lamella postvaginalis.

Biology. Immature stages are unknown. Adults were collected from early June to late August, probably in one generation, at altitudes of up to 500 m. Several specimens were recorded during the day in forested areas, suggesting that the biology of this species may be similar to that of *B. galbanella*. Like *B. galbanella*, females of *B. gemella* are rarely collected: only two were present among the 29 specimens examined.

Distribution (fig. 76). Recorded from the northeast part of the USA and the adjoining southeast part of Canada.

Etymology. An adjective: *gemellus*: twin, referring to the similarity to *B. galbanella*; here in feminine in concordance with the female gender of *Bryotropha*.

***Bryotropha similis* (Stainton, 1854)**
(figs. 1, 2, 9, 10, 19, 26, 27, 39, 40, 47, 57–60, 77)

Gelechia similis Stainton, 1854: 115.
Gelechia thuleella Zeller (*in* Staudinger), 1857: 276.
Gelechia similiella Doubleday, 1859: 30.
Gelechia pullifimbriella Clemens, 1862: 120. Holotype ♂(?), “181” or “191” (on handwritten

label), USA, "type ANSP 7351" [ANSP]. **Syn. n.**

Gelechia confinis Stainton, 1871: 98.

Gelechia obscurecinerea Nolcken, 1871: 573.

Gelechia stolidella Morris, 1872: pl.108, fig. 1.

Bryotropha fuliginosella Snellen, 1882: 645.

Duvita (?) tahavusella Forbes, 1922: 103. Holotype ♂, USA: Uphill Brook, Mt. Marcy trail, N.Y., 10.VII.'18, Alt. 3200 ft, W.T.M. Forbes, Collector, CUIC, type No. 519 (examined). **Syn. n.**

Gelechia clandestina Meyrick, 1923: 19. Lectotype ♂ (published by Clarke, 1969: [381]): "Toronto, Canada, Parish, 6.12; Lectotype *Gelechia clandestina* Meyrick, J.F.G.C. 1947; *Gelechia clandestina* Meyr.; ♂ genitalia on slide 22.ix.1947, J.F.G.C. 5775" (BMNH) (examined). **Syn. n.**

Diagnosis. Small blackish species with indistinct wing markings and the inside of the labial palpus white, speckled fuscous.

Description. Adult (figs. 2, 9, 10, 19). Wingspan 10–12 mm. Labial palpus white, speckled fuscous on the inner side, heavily suffused with fuscous on the outer side, segment 3 darker than segment 2. Antenna fuscous indistinctly ringed with ochre. Head with frons white, speckled fuscous to fuscous; vertex, thorax and tegula concolorous with forewing. Forewing glossy blackish brown; plical and discal stigmata very indistinct, first discal beyond second plical; costal and tornal patches usually whitish and indistinct, often fused to form an irregular or outwardly fascia; subapical area with many blackish scales; cilia dark gray with one or two ciliary lines. Hindwing fuscous, darker toward apex; cilia concolorous.

Variation. The costal and tornal patches vary from rather prominent to absent; very occasionally they are yellowish instead of whitish. Some specimens are slightly lighter with more distinct stigmata while others are plain blackish without visible wing markings. Some specimens from Greenland have the forewing more or less suffused with white scales (fig. 19).

Similar species. *B. plantariella*, *B. hodgesi*, q.v.

Male genitalia (figs. 26, 27, 39, 40, 57–60). Uncus subrectangular. Socius with 3–4 setae. Gnathos relatively slender with a sharp 120 degree , distinctly thickened just after bend. Thornshield triangular with 50–80 spikes of different sizes. Margin of vinculum bent near halfway (figs. 39, 40).

The most important characters are the shape of the gnathos and that of the vinculum. The typical gnathos (fig. 57) is unmistakable, but it occasionally displays a much more gradual bend and may even lack a clear local thickening (fig. 60) thus resembling the gnathos of *B. hodgesi* and *B. branella*. The vinculum of *B. similis* is distinctly smaller than in *B. hodgesi*, *B. branella* and *B. altitudophila* and is bent slightly before halfway whereas in the other three species the vinculum is bent at one-third or even before (see arrowheads in figs. 39–43). A further subtle difference is observed in the aedeagus, which in *B. hodgesi*, *B. branella* and *B. altitudophila* has a stronger curve and is somewhat larger than in *B. similis*.

Female genitalia (fig. 47). Segment VIII ventrally with crescent-shaped lamella postvaginalis and microtrichia and a clearly marked semicircular invagination up to about 1/4. Distal end of the ventral groove marked by a heavily sclerotized extension. Dorsal side of segment VIII with a clear median tongue. Signum large, elongate rectangular to oval, with stout spikes on the corners. Not to be confused with any other North American species.

Biology. Larva with head and prothoracic plate dark brown, body brown (Meyrick, 1928: 623). In Europe (England) larvae have been collected from old walls covered with mosses (Stainton, 1871: 99). Adults fly from early June to late August, most likely in one generation. In the northern part of its range *similis* is widespread in lowland regions, toward the south this species becomes restricted to higher altitudes to 3100 m. This preference for temperate and Nordic climates is also observed in the Palaeractic (Karsholt & Rutten, in press).

Distribution (fig. 77). Widely distributed in Canada and the USA. One of the few gelechiid moths that also occurs in Greenland. Widely distributed and often very common throughout the Palaearctic.

Material examined: 484 ♂, 180 ♀, 4 ex, including 57 male and 30 female genitalia preparations.

Remarks. *Gelechia pullifimbriella* Clemens was described from an unstated number of specimens from an unstated locality. A syntype labeled “type ANSP 7351” is in the Academy of Natural Sciences, Philadelphia. It is badly damaged, missing the left pair of wings and the abdomen. Though we did not study the specimen itself, Mr. Jason Weintraub of the ANSP was so kind to provide us with a photograph of the type. This revealed a nearly unicolorous fuscous forewing and a dark hindwing. In the Nearctic this combination of features is only found in *B. similis*; dark forms of *B. hodgesi* have a much paler hindwing, and *B. plantariella* has a different wing shape and more distinct stigmata. The same conclusion had been reached by R. W. Hodges (in litt.) who studied the type of *B. pullifimbriella* in the past.

Duvita tahavusella was described from five specimens from Adirondacks, New York; the holotype collected on 10 July 1918 in Uphill Brook, Mt. Marcy Trail 3200 ft, and 4 paratypes collected on 8 and 10 June 1916 in Peru (also Adirondacks). External features and genitalia do not differ from those of *B. similis*.

Gelechia clandestina was described from 14 specimens collected in June and July by Parish at Lake Muskoka, Parry Sound, Canada (Meyrick 1923: 19). The external features as well as the genitalia are characteristic of those of *B. similis*.

B. similis was first reported from the Nearctic region by Wolff (1964: 44), who recorded it from Greenland and Newfoundland.

***Bryotropha hodgesi* sp. n.**
(figs. 11–14, 28–31, 41, 48, 61–66, 78)

Type material. Holotype: 1♂: Canada: Québec, Gatineau, Aylmer, 18, rue Washington, MVL, 11.vii.1995, leg. B. Landry, gen. slide AR 0531 (CNC). Paratypes: 186 ♂, 86 ♀, including 52 male and 29 female genitalia preparations.

CANADA, Alberta: 1 ♀: Sandy Point cmpgr., 50º44' N, 110º03 W, 3.vii.1985, J.-F. Landry., at black light in short-grass prairie with grasswood, sage, prickly-pear and rabbit-brush, gen. slide AR 0534 (CNC). — **British Columbia:** 1 ♂: Sannichton, 8.viii.1922, J.G. Colville (USNM); 1 ♀: ibid., 10.vi.1922, "275"; 1 ♂: Victoria, 24.vi.1922, W. Downes, gen. slide AR 0540 (CNC). — **Newfoundland:** 1 ♂: Deer Lake, W Newfoundland, 12.vii.1949, H. Krogerus, "3169", gen. slide AR 0735 (ZMUC]. — **Nova Scotia:** 1 ♂: Parrsboro, 11.vii.1944, J. McDunnough, gen. slide AR 0625 (CNC); 1 ♂: ibid.. 19.vii.1944. — **Ontario:** 1 ♂: Manitoulin I., S end Pike L., 19.vii.1984, J.K. Morton, gen. slide AR 0582 (MOR); 1 ♂: ibid., Dominion Bay, 1.ix.1990, gen. slide AR 0567; 1 ♂: ibid., W end Greenbush rd. Howland Twpt, 16.vii.1994; 5 ♂: ibid., Track to Roberts Bay, M.I.I.R. 26, 6.viii.1990, gen. slides AR 0555, AR 0562, AR 0563; 1 ♂: ibid., Forest Alver, Misery Bay, 11.viii.1991, J.K. Morton, gen. slide AR 0560 (MOR); 1 ♂: ibid., S of Sucker Ck IR, 16.vii.1994; 1 ♂: ibid., Belenger Bay, 28.vii.1997, gen. slide AR 0556; 1 ♂: ibid., Burnt I. Hbr., 15.ix.1992, gen. slide AR 0559; 1 ♂: ibid., Mindemoya, S side of Mud L., 27.vii.1993; 1 ♂: ibid., Silver Water fire tower, 16.ix.1992; 1 ♂: ibid., Govt. Rd. B, N of Bidwell Rd, 31.vii.1991, gen. slide AR 0554; 1 ♂: ibid., Rd ENE of Mindemoya, 27.vii.1993; 5 ♂: ibid., Rockville jnct., Bog, Bidwell Rd., 29.vi.1991, gen. slide AR 0574; 6 ♂: ibid., Gt. Cloche I., 4.viii.1990, gen. slide AR 0566; 2 ♂: ibid., Rockville radio mast, Mindemoya, 4.viii.1990, gen. slides AR 0557, AR 0564; 1 ♂: ibid. Hwy 540 NE of Silver Lake, 16.ix.1992; 1 ♀: ibid., 21.vii.1993, gen. slide AR 0552; 2 ♂: Manitoulin. Is, Shegni-andeh I.R., NW of Turtle L., 31.vii.1997; 1 ♀: ibid., 9.viii.1991, gen. slide AR 0561; 1 ♂: Gt. Cloche I., Fisher Hbr. rd., 16.vii.1998, J.K. Morton (MOR); 3 ♂: Manitoulin Dis, Little LaCloche I., 16.vii.1998, J.K. Morton, gen. slide AR 0565 (MOR); 1 ♂: North Channel, Bears Back I., 10.vii.1981, J.K. Morton (MOR); 1 ♀: Ottawa, 7.vii.1932, C.H. Young, gen. slide AR 0648 (CNC); 1 ♂: Thunder Bay Area, Caught by U.V. Light, John P. Walas, 2.vii.1981, gen. slide AR 0725 (CNC); 2 ♂: 44º00'N 77º45'W, Presqui'le P.P., at light, 25.vii.1985, K. Mikkola Leg., gen. slides AR 0743, AR 0752 (ZMUH). — **Québec:** 1 ♂: , Rimourski-Neigette, Le Bic, baie des roses, 5.vii.1999, lvm, B. Landry, gen. slide AR 0647 (BLC); 1 ♂: ibid., 12.vii.1995, gen. slide AR 0630 (CNC); 1 ♀: ibid., 6.vii.1994, gen. slide AR 0629 (CNC); 1 ♀: ibid., 21—23.vii.1995, gen. slide AR 0532 (CNC). — **USA, Arizona:** 1 ♂: Rustler Park 8500 ft., Chiricahua Mtns., Ariz., 12.vii.1972, at light, J. Powell (EME). — **California:** 1 ♀: Loma Linda, 4.v.1912, G.R. Pilate (USNM); 1 ♂: ibid., 3.vi.1912; 2 ♀: ibid., 18.v.1912, gen. slides AR 0666, AR 0669; 1 ♂: Glen Ellen, Sonoma Co., 9.vii.1936, E.C.J., gen. slide AR 0700 (USNM); 1 ♂: Pinnacles, San Benito Co., 16.v.1939, E.C.Johnston, gen. slide AR 0688 (USNM); 1 ♂: ibid., gen. slide USNM 9881

(USNM); 4 ♂: S. Diego Co., Cardiff-by-Sea, 21–26.iv.1967, D. Davis, 50 ft., at light, gen. slide AR 0708 (USNM); 1 ♀: San Diego, viii.1920, Cal., Ricksecker, gen. slide AR 0709 (USNM); 1 ♀: ibid., iv, gen. slide AR 0654; 5 ♂, 4 ♀: Mendico Co., Mackerricher Bch., 5 mi N Ft. Bragg, on *Erysimum*, 1–2.v.1977, J. Powell, gen. slide ♀: AR 0719 (EME); 1 ♂, 2 ♀: Humboldt Co., 5 mi NW Briceland, at light, 2–3.ix.1973, J. Powell (EME); 1 ♂: Big Creek Reserve (UCNR), Monterey Co., So. Highlands pine-oak-manzanita 725 m, bl. light, 3–5.ix.1991, J.A. Powell (EME); 1 ♂: ibid., 675 m, bl. light, 3–5.ix.1991, gen. slide 6667; 1 ♂: ibid., vic French Camp pine oak woodland, 750–800 m, bl. light, 3–5.ix.1991; 7 ♂: ibid., Area 0–10 m coastal scrub blacklight, 3–4.x.1985 bl., J. Brown, J. Powell, HQ. gen. slide 6637, AR 0720 (EME); 2 ♂: ibid., SO Ridge Rd. red wood mixed hard woods 220 m, bl. trap, 5–8.vi.1989, Y-F. Hsu & J. Powell, gen. slide no. 2844 (EME); 1 ♂: ibid., Devil's Cr. Ranch, hardwood-riparian 125 m, blacklight, 7–8.vii.1986, Brown & Powell (EME); 1 ♂: ibid., Shakemakers Cr., Canogas Falls trail 670–730 m, 14–16.vi.1991, Y.F. Hsu & J.A. Powell (EME); 1 ♂: ibid., SO Ridge Rd. 230 m bl. trap, 5–6.vi.1990, Y.F. Hsu & J.A. Powell (EME); 1 ♀: ibid., So Highlands 650 m pine-oak-Ericacea, bl. light trap, 7–8.vi.1996, J.A. Powell (EME); 4 ♂, 3 ♀: ibid., 7–9.vi.1993, Y.F. Hsu & J. Powell (EME); 3 ♂, 2 ♀: L.A. Co., San Clemente I., 1 mi N Store Jct., Bl, 10–15.v.2002, 11.v.2002, Powell & Rubinoff, gen. slide ♂: JAP 8404 (EME); 3 ♂, 2 ♀: ibid., Store Cyn., V.10/15.2002, 11.v.2002; 3 ♂, 1 ♀: ibid., Ect Cove, Bl trap, V.10/15.2002, 12.v.2002; 2 ♂, 3 ♀: ibid., Thirst Cyn., V.10/15.2002, 11.v.2002; 4 ♂, 1 ♀: Santa Rosa Id, Santa Barbara Co., Lower Cherry Cyn. 75 m, blacklight trap, 30.iv.1995, J.A. Powell (EME); 1 ♂: ibid., Lower Cherry Cyn. 180 m, BL trap, 27.iv.1995; 2 ♂: ibid., 21.ix.2000, BL trap; 2 ♂: ibid., Cherry Canyon 60–80 m, collected at blacklight, 13.iii.1997, P. Jump & J. Powell, gen. slide JAP 7668 (EME); 2 ♂, 1 ♀: ibid., Canada Lobos, blacklight trap, 30.iv.1995, J.A. Powell (EME); 1 ♂: ibid., Lobos Cyn. 125 m, collected at blacklight, 28.iv.1995; 5 ♂, 4 ♀: ibid., 0.5 km W. Beechers Bay, 27.iv.1995, Bl, J.A. Powell, gen. slides ♂: JAP 7100, ♀: AR 0717 (EME); 4 ♂, 3 ♀: ibid., 1.v.1995, gen. slide ♀: AR 0718; 4 ♂, 1 ♀: ibid., IV.29.1995; 1 ♀: ibid., 13.iii.1997, P. Jump & J. Powell (EME); 4 ♂, 2 ♀: ibid., Torrey Pines area, collected at black light, 29.iv.1995, J.A. Powell & D. Kusher (EME); 2 ♂, 2 ♀: L.A. Co., Sta. Catalina I.- Middle Cyn. 500 ft., 1–2.v.1978, J. Powell, blacklight (EME); 1 ♂, 1 ♀: S. Benito Co., Hwy 101, 1 mi. E Mont. Co. line, 18.v.1977, J.Powell (EME); 1 ♂, 1 ♀: Mont. Co., Marina Dunes at Ft. Ord, 18.v.1977, J. Powell (EME); 1 ♂, 1 ♀: Yuba Co., Sierra Foothill Field Sta., 3 mi. N. Smartville at blacklight, 5–6.v.1980, J. Powell, J. DeBenedictis (EME); 1 ♂: ibid., 7.v.1980; 1 ♂: Yuba Co., Dry Creek, 4 mi. NW Smartville, blacklight trap 5–6.v.1980, J.A. Powell (EME); 1 ♀: Napa Co., 1 mi. W Angwin, at light, 5.vii.1979, Wagner and DeBenedictis (EME); 3 ♂: Marin County, Inverness Ridge, Upper Bay View Trail, 6–7.ix.2000 BL. trap, J. Powell, gen. slide JAP 8070 (EME); 1 ♂: Mt. Shasta City, Siskiyou Co., 5.viii.1958, at light, J. Powell, gen. slide 5878 (EME); 3 ♂, 1 ♀: Pt. Molate, Richmond, Contra Costa Co., Powell, 18–19.v.1988, blacklight (EME); 7 ♂, 2 ♀: ibid., 15–16.ix.1988; 2♂: S.L.O. Co., Alamo Cr., 16 air km E Nipomo 260 m, BL, 16.vii.1999, Powell (EME); 1 ♀: Antioch Natl. Wildlife Ref. (SP), Contra Costa Co., 20.ix.90, J. Pow-

ell, bl. light (EME); 1 ♀: Antioch Natl. Wildlife Ref. (LC), C. Costa Co., 11.vi.1991, Hsu & Powell, blacklight (EME); 1 ♂: Monterey Co., Hastings Reserve, Upper Carmel Vy, 28.vi.1998, Powell, S. Cho, Sperling, BL, gen. slide AR 0729 (EME). — **Illinois:** 1 ♂: Putnam Co., 5.vii.1968, M.O. Glenn, gen. slide USNM 13,458 (USNM); 1 ♀: ibid., 26.vi.1963; 1 ♀: ibid., 6.vii.1963, gen. slide AR 0689; 1 ♂: ibid., 8.vii.1963; 1 ♀: ibid., 18.vii.1963; 1 ♀: ibid., 22.vii.1971; 1 ♀: ibid., 3.vii.1964; 1 ♂: ibid., 18.vi.1944 / ♂ / genitalia in glass tube; 1 ♂: ibid., 20.vii.1965 / ♂ / genitalia in glass tube; 1 ♀: ibid., 14.vii.1969 / ♀ / genitalia in glass tube; 1 ♀: ibid., 30.vi.1963, gen. slide USNM 9863; 1 ♂: ibid., 28.vi.1962, gen. slide USNM 9878; 1♀: ibid., 21.vii.1953, gen. slide AR 0656. — **Michigan:** 1♀: Allegan Co, T2N R14W S6, oak savanna, 3.vii.1994, George J. Balogh, gen. slide AR 713 (BAL); 4 ♂, 1 ♀: Ocqueoc L., 25–26.vii.1970 at black light, RW & ER Hodges, gen. slides ♂: AR 0657, AR 0661, USNM 86799, ♀: AR 0658 (USNM); 7 ♂: Cheboygan Co., Ocqueoc Lake, 28.VII.1974, E. & R. Hodges, gen. slide AR0712 (USNM). — **Oregon:** 1 ♂: Ritter, Grant Co., 20.vii.1962 (USNM); 2 ♂: Baker, Spring Creek, 20.viii.1962, J.H. Baker, gen slide AR 0672 (USNM); 1 ♂: ibid., 5.vii.1963, gen slide AR 0701; 2 ♂: ibid., 20.vi.1970, gen slide AR 0674; 1 ♀: ibid., 3.vii.1970, gen slide AR 0697; 1 ♀: ibid., 21.vi.1970, gen slide AR 0652; 1 ♂: ibid., 16.viii.1970, gen slide AR 0707. — **Washington:** 8 ♂, 8 ♀: Yakima Co., 2.5 mi W Ft. Simcoe, 31.vii.1962, JFG Clarke, gen. slides ♂: AR 0659, AR 0660, AR 0676, ♀: AR 0675, USNM 9864 (USNM); 1 ♂, 2 ♀: Stevens Co., Kettle Falls, 21.vii.1962, JFG Clarke, gen. slide ♀: AR 0691 (USNM); 3 ♂, 3 ♀: Yakima Ind. Res. 10 mi SW White Swan. Mill Creek 2000 ft., 2.viii.62, JFG Clarke, gen. slides ♀: AR 0673, AR 0686 (USNM); 2 ♂, 6 ♀: Yakima Co., Ft. Simcoe, 1.viii.1962, JFG Clarke, gen. slides ♂: AR 0694, ♀: AR 0683, AR 0685, AR 0695 (USNM); 1 ♂: Klickitat Co., White Salmon, viii.1962, JFG Clarke, gen. slide AR 0705 (USNM). — **Wyoming:** 4 ♂, 1 ♀: Yellowstone N.P., O.F., 4.vii.1924, gen. slide ♀: AR 0681 (USNM).

Diagnosis. Small ochreous-brown to dark brown species with indistinct wing markings, often with a slightly darkened subapical area.

Description. Adult (figs. 11–14). Wingspan 10–12 mm. Labial palpus creamy ochreous to ochreous suffused brown on the outer side, segment 3 usually lighter than segment 2. Antenna fuscous ringed with ochre. Head with frons ochreous; vertex, thorax and tegula as forewing. Forewing ochreous brown; costa with a blackish spot near the base, otherwise not markedly darkened; plical and discal stigmata rather indistinct, first discal beyond second plical; costal and tornal patches ochreous and indistinct, fused to form an outwardly angulated fascia; subapical area heavily suffused with blackish scales; termen with an indistinct lining of blackish scales; cilia dark ochreous gray with indistinct ciliary lines and yellowish tips. Hindwing pale brownish, darker towards apex, cilia concolorous.

Variation. Specimens vary from dark ochreous brown with fairly distinct stigmata and a darkened subapical area, to uniformly dark brown without clear wing markings. Very occasionally the stigmata are followed by indistinct streaks of pale scales.

Similar species. Very dark forms resemble *B. similis*. In well-preserved material it will always be possible to distinguish the brownish ground color with ochreous markings of *B. hodgesi* from the blackish ground color with whitish markings that characterize *B. similis*.

Due to their variation, there are no absolute rules for distinguishing *B. hodgesi* from *B. branella* or *B. altitudophila*. On average *B. hodgesi* is slightly smaller and less vividly marked. In *B. branella* and *B. altitudophila* the costal edge of the forewing is often distinctly darkened, a rare feature in *B. hodgesi*. Specimens having the subapical area distinctly darkened are usually *B. hodgesi*. In a geographically restricted area it will be possible to distinguish *B. branella* from *B. hodgesi* without examination of the genitalia. In case of *B. hodgesi* and *B. altitudophila* the labels show that they never occur on the same location, suggesting different habitats.

Male genitalia (figs. 28–31, 41, 61–66). Uncus subrectangular, rather small. Socius with 3–4 setae. Gnathos slender and long with a 120 degree bend in the first third. Thornshield triangular with 50–80, usually small, spikes. Margin of vinculum bent at or before 1/3 (fig. 41).

The male genitalia show considerable variation. The gnathos can vary from very slender (fig. 63) to clearly thickened halfway (fig. 66), thus resembling *B. similis* (q.v.), while the bend may be more gradual and continue until half-way. In a lateral view the gnathos of *B. hodgesi* does not exceed 250 µm in height whereas the gnathos of *B. branella* and *B. altitudophila* measures 300–350 µm in height (figs. 66–69, 70–73). In northeastern USA and southeastern Canada, the aedeagus often displays a characteristic sharp bend underneath the apex, which is also remarkably broad (arrowhead in fig. 29). In other areas the aedeagus resembles that of *B. branella* and *B. altitudophila*.

Female genitalia (fig. 48). Segment VIII ventrally with crescent-shaped lamella postvaginalis, microtrichia and a shallow median invagination. Distal end of the ventral groove marked by a small sclerotized extension. Dorsal side of segment VIII without a median tongue. Signum large, about twice as long as wide, strongly tapering toward the distal end, with stout spikes on the corners and a clear pointed extension distal to the last spikes. Easily recognized by the shape of the signum in combination with the distal end of the ventral groove.

Biology. Early stages unknown. In the USA adults were found from mid-March to early October in California, whereas in Canada moths were collected from late June to mid-September. This indicates that in the southern part of its range there may be two generations, whereas in the northern part there probably is just one generation.

Distribution (fig. 78). *B. hodgesi* is common along the west coast of the USA. Elsewhere it is far more local, though when present it is often common. In Canada only recorded from the extreme south.

Etymology. A noun in genitive case. The species is dedicated to R.W. Hodges in honor of his many contributions to our knowledge of the Nearctic Lepidoptera fauna and his kind support of our work.

***Bryotropha branella* (Busck, 1908)**
(figs. 15, 16, 32, 33, 42, 49, 67–70, 79)

Gelechia branella Busck, 1908: 87. Lectotype ♂ (here published): Plummers, I Aug 1903 Md; Aug Busck Collector; Gelechia branella Busck, Cotype; USNM, ENT 00420345; Lectotype, Bryotropha branella (Busck 1908), A.L.M. Rutten design. 2004 (USNM).

Diagnosis. Small ochreous-brown species with small but rather distinct wing markings.

Description. Adult (figs. 16, 17). Wingspan 11–13 mm. Labial palpus creamy ochreous to ochreous suffused with fuscous on inner side, heavily suffused fuscous on the outer side, segment 3 darker than segment 2. Antenna fuscous ringed with ochre. Head with frons pale ochreous; vertex often darker. Thorax ochreous brown to dark brown, tegula lighter than thorax. Forewing ochreous to dark ochreous gray with costal edge fuscous and with distinct blackish basal spots at costa and tornus; plical and discal stigmata distinct, first discal beyond second plical; costal and tornal patches ochreous and indistinct, fused to form an outwardly curved fascia; subapical area slightly suffused with darker scales; termen with a distinct lining of blackish scales; cilia ochreous with one to several ciliary lines and yellowish tips. Hindwing pale ochreous gray, darker toward apex, cilia concolorous.

Variation. The stigmata can be followed by streaks of pale ochreous scales, producing very vividly marked specimens. The head may be ochreous all over.

Similar species. Specimens with an ochreous gray forewing superficially resemble *plantariella* but can be distinguished by the presence of three equally strong roundish stigmata; in *plantariella* the second discal is more prominent than the other stigmata, which are often absent or elongate in shape. *B. hodgesi* q.v., *B. altitudophila* q.v.

Male genitalia (figs. 32, 33, 42, 67–70). Uncus rather broad subrectangular. Socius with 3–4 setae. Gnathos slender and long with a rather gradual 120 degree bend about halfway. Thornshield triangular with up to 50, usually small, spikes. Margin of vinculum bent near 1/3 (fig. 42). Aedeagus long and slender. Variation is only slight.

The genitalia of *B. branella* are slightly more robust than those of the very similar *B. altitudophila*. In *B. branella* less then half the gnathos is involved in a gradual bend of approximately 120º; in *B. altitudophila* the larger part of the gnathos is involved in a gradual bend of at least 120º. In laterally mounted genitalia the shape of the gnathos easily separates *B. branella* (bend at half-way, height 300–350 µm) from *B. hodgesi* (bend in first third, height less than 250 µm). In unrolled genitalia this feature may be less clear due to distortions. Here the shape of the uncus is most useful. In *B. branella* and *B. altitudophila* the uncus is distinctly broader (160–190 µm) than in *B. hodgesi* (90–130 µm). As a consequence, in *B. branella* and *B. altitudophila* the width of the uncus is only marginally less then the distance socius to socius, whereas in *B. hodgesi* the width of the uncus is much less then the distance socius to socius (compare figs. 41, 42 and 43).

Female genitalia (fig. 49). Segment VIII with crescent-shaped lamella postvaginalis and microtrichia. Distal end of the ventral groove marked by a small sclerotized extension. Ventral side of segment VIII weakly invaginated, dorsal side without a median tongue. Signum complex, consisting of an elongate to oval weakly sclerotized middle part, set with microtrichia at proximal and distal ends. Laterally the middle part is flanked by a broad, heavily sclerotized and finely grooved, serrate rim. Two semicircular membranes, set with short blunt spikes, connect the signum to the corpus bursae. This last character of the signum is not as evident as in *B. altitudophila*. Separated from other species by the shape of the signum.

Biology. Early stages unknown. Adults were collected from late June to mid-August with a single specimen in mid-September, probably in one generation. All records are from lowland localities.

Distribution (fig. 79). Restricted to northeastern USA and adjoining southeastern Canada. Locally common.

Remarks. *B. branella* was described from an unstated number of specimens from Plummers Island, Maryland. We studied one of the syntypes kept in the USNM. In order to serve stability of nomenclature this specimen is here published as lectotype (see above).

Material examined: 34♂, 9♀. — **CANADA, Nova Scotia:** 1 ♂: Ottawa House, Parrsboro, 3.vii.1944, J. McDunnough, gen. slide AR 0650 (CNC); 1 ♀: Armdale, Halifax Co., 9.viii.1967, D.C. Ferguson, gen. slide AR 0651 (USNM). — **Ontario:** 1 ♀: Manitoulin I., Hwy 6, S of 542 jnct, 26.vii.1990, J.K. Morton, gen. slide AR0584 (MOR); 2 ♂: ibid., 4.viii.1990, Rockville radio mast, gen. slide AR0568; 2 ♂: ibid., Mud Creek, Lake Kagewong, 21.6.1991; 1 ♂: ibid., 3 mls due S of Billings, 24.vi.1991, gen. slide AR 0570; 1 ♂: ibid., 3 mls due S of Billings, 27.6.1991; 1 ♂: ibid., New England rd. N end, 14.viii.1992; 1 ♂: ibid., 2 mls inland Burnt I. Hbr, 15.ix.1992, gen. slide AR 0571; 3 ♂: ibid., S side of Mud L., Mindemoya, 27.vii.1993, gen. slide AR 0588, AR 0589; 1 ♂: ibid., Sheshegwaning rd at Silver Ck, 29.vii.1993; 1 ♀: ibid., track to NW side of Silver Lake, 29.vii.1993, gen. slide AR 0581; 3 ♂, 1 ♀: ibid., Silver Water Ranger Station, 29.vii.1993, gen. slides ♂: AR 0558, AR 0572, ♀: AR 0573; 3 ♂, 1 ♀: ibid., Hwy 540, NE of Silverlake, 29.vii.1993, gen. slides ♂: AR 0586, ♀: AR 0587; 3 ♀: ibid., Shesheg Waning Rd at Silver Lake, 29.vii.1993, gen. slide AR 0569; 1 ♂: ibid., W end Greenbush rd., Howland Twp., 16.vii.1994; 1 ♂: ibid., Escarpment S of 10 Mile Pt., 15.vii.1999, gen. slide AR 0549; 2 ♂: ibid., Beatty Bay, Clapperton I., 1.viii.1990, gen. slide AR 0583. — **Québec:** 1♂: Lac Mondor, Ste. Flore P.Q., 21.vii.1951, E.G. Munroe, gen. slide AR 0541 (CNC). — **USA, Maine:** 1 ♂: Lincoln, 10.vii, gen. slide AR 0682 (USNM). — **Michigan:** 1 ♂: Oceana Co, Little Point Sable, Lighthouse dunes, 26.vii.1997, George J. Balogh, gen. slide AR 0715 (BAL); 1 ♂: Oceana Co, T23N R19W S36, oak pine woods and wetlands, 26.vii.1997, George J. Balogh, gen. slide AR 0714 (BAL). — **New York:** 1 ♀: Six Mile Creek, Ithaca, 25.vii.1957, J.G. Franclemont, gen. slide AR 0655 (USNM); 1 ♂: Cornell Campus Ithaca, 27.vii.1959, D.R. Davis, gen. slide USNM 13,560 (USNM); 1 ♂: ibid., 22.vi.1959, gen.

slide AR 0706; 1 ♂: Ithaca, 9.vii, Cornell U., Exp. 1030, Traplight 1924 (CUIC); 1 ♂: ibid., 21.vii; 1 ♂: ibid., 30.vii, Gelechia branella, wing slide 20.ii.1925; 1 ♂: E. Aurora, 15.vii.1915, W. Wild (CUIC). — **Virginia:** 1 ♂: Mountain L., 17.vii.1938 GRENN, L.J. & M.J. Milne, gen. slide AR 0724 (CNC).

***Bryotropha. altitudophila* sp. n.**
(figs. 17, 18, 34, 35, 43, 50, 71–74, 79)

Type material. Holotype: ♂: West Fork 6500 ft., 16 mi SW Flagstaff, Coconino Co. Arizona, 15.vii.1961, Ronald W. Hodges, gen. slide USNM 9888 (USNM). Paratypes: 41 ♂, 14 ♀. — **CANADA, Saskatchewan:** 1 ♂: SW Sask., The Great Sand Hills, 60 km NE Tompkins, prairie, 28.vi.1994, ad luc, M. Ahola & L. Kaila leg., gen. slide AR 0741 (ZMUH); **USA, Arizona:** 1 ♂, 1 ♀: Apache Co., South Fork Cmpg., 12 km W Springerville, 20.vii.1989, MVL, B. & J.-F. Landry, gen. slide ♂: AR 0726, ♀: AR 0536 (CNC); 1 ♂, 1 ♀: Madera Canyon 4880 ft., Santa Rita Mnts., 9.vii.1959, R.W. Hodges, gen. slides ♂: USNM 13,310, ♀: USNM 9868 (USNM); 1 ♂: S.W.R.S. 5 mi W Portal, Cochise Co. 5500 ft., 1.vi.1965, V. Roth, gen. slide AR 0644 (USNM); 1 ♂: Fort Valley 7350 ft., 7-1/2 mi NW Flagstaff, Coconino Co., 28.vii.1961, Ronald W. Hodges, gen. slide USNM 9887 (USNM); 2 ♂: West Fork 6500 ft., 16 mi SW Flagstaff, Coconino Co., 4.vii.1961, Ronald W. Hodges, gen. slides USNM 9889, USNM 9890 (USNM); 1 ♂: ibid., 15.vii.1961; 1 ♀: ibid., 5.viii.1961, gen. slide USNM 9874. — **Colorado:** 1 ♂, 1 ♀: Chaffee Co., Poncha Ck., 3 km S Poncha Springs, at black light, pinyon-juniper-oak forest, 14.vii.1982, J.-F. Landry, gen. slides ♂: AR 0545, ♀: AR 0533 (CNC); 1 ♂: Alamosa Co., Sand Dunes Staff Quarters 8200 ft., 24.vi.1982, Ronald W. Hodges, gen. slide AR 0667 (USNM); 3 ♂: ibid., 27.vi.1982; 1 ♀: Alamosa Co., Great Sand Dunes, Mosca Creek 8200 ft., Ponderosa pine pinyon-juniper Douglas fir, 24.vi.1982, Ronald W. Hodges, gen. slide AR 0711 (USNM); 3 ♂, 1 ♀: Alamosa Co., Zapata Ranch 9500 ft., Ponderosa pine pinyon-juniper Douglas fir, 27.vi.1982, Ronald W. Hodges (USNM); 1 ♂: ibid., 8200 ft., 21.vi.1982; 2 ♂: 1 mi S Poncha Springs 7000 ft., Pinyon-juniper oak-cottonwood willow-Rhus, 13.vii.1982, Ronald W. Hodges, gen. slide AR 0665 (USNM); 1 ♂: ibid., 6.vii.1982. — **Nebraska:** 1 ♀: Cherry Co., Valentine NWR, Hackberry Lake, 24.vi.1983, Ronald W. Hodges (USNM); 1 ♀: ibid., 18.vi.1983; 1 ♀: ibid., 21.vi.1983, gen. slide AR 0639; 2 ♂: ibid., 22.vi.1983; 1 ♂: ibid., 29.vi.1983; 1 ♂: ibid., 1.vii.1983; 1 ♂, 1 ♀: ibid., 2.vii.1983, gen. slide ♀: AR 0642. — **New Mexico:** 1 ♀: Socorro Co., Gran Quivira Nat'l Mon. 6600 ft., 1–3.vii.1964, D.R. Davis (USNM). — **Texas:** 1 ♂: Brewster County, Chisos Mts., K-bar Ranch 3400 ft., 2.vi.1973, R.W. Hodges (USNM). — **Wyoming:** 3 ♂: 6 mi NW Newcastle, 25.vi.1965, R.W. Hodges (USNM); 1 ♀: ibid., 20.vii.1965; 1 ♂, 1 ♀: ibid., 10.vii.1965, gen. slides ♂: AR 0641, ♀: AR 0640; 1 ♂, 2 ♀: ibid., 13.vii.1965; 4 ♂, 1 ♀, ibid., 18.vii.1965, gen. slide USNM 9873; 1 ♂: ibid., 15.vii.1965, gen. slide USNM 9886; 3 ♂: ibid., 23.vi.1965, gen. slide AR 0662; 1 ♂: ibid., 28.vi.1965. — **MEXICO:** 1 ♂: Hgo Nr. Jacala, 2–3.vii.1965, Flint & Ortiz, gen. slide USNM 9848 (USNM).

Diagnosis. Small ochreous-brown to dark brown species with indistinct wing markings.

Description. Adult (figs. 17, 18). Wingspan 11–13 mm. Labial palpus creamy ochreous to ochreous suffused with fuscous on the inner side, heavily suffused fuscous on the outer side, segment 3 darker than segment 2. Antenna fuscous ringed with ochre. Head with frons ochreous to brown; vertex darker. Thorax as forewing, tegula lighter than thorax. Forewing ochreous gray to brown with costal edge fuscous and with distinct blackish basal spots at costa and tornus; plical and discal stigmata moderately distinct, first discal beyond second plical; costal and tornal patches ochreous and indistinct, fused to form an outwardly angulated fascia; subapical area heavily suffused with darker scales; termen with an indistinct lining of blackish scales; cilia ochreous with one to several lines and yellowish tips. Hindwing pale ochreous gray, darker toward apex; cilia concolorous, with one or more faint lines.

Variation. The ground color may vary from dark ochreous to dark brown. In light colored specimens the subapical area with its many dark scales can stand out. The stigmata may be followed by streaks of pale ochreous scales, and the head may be ochreous all over.

Similar species. Similar to *B. branella*, which generally has a more ochreous gray tinge as compared with a more brownish tinge in the allopatric *B. altitudophila*. *B. hodgesi* q.v.

Male genitalia (figs. 34, 35, 43, 71–74). Uncus rather broad subrectangular. Socius with 3–4 setae. Gnathos slender and long, the first half gradually curved at 150º or more. Thornshield triangular with up to 50, usually small, spikes. Vinculum curved at 1/3. Aedeagus remarkably slender. Variation is only slight. Similar species *B. branella* q.v.

Female genitalia (fig. 50). Segment VIII with crescent-shaped lamella postvaginalis and microtrichia. Distal end of the ventral groove marked by a small sclerotized extension. Ventral side of segment VIII weakly invaginated, dorsal side without a median tongue. Signum complex, consisting of an elongate to oval weakly sclerotized middle part, surrounded by a broad, heavily sclerotized and finely grooved, rim. Two semi-circular membranes, set with short sharp spikes, connect the signum to the corpus bursae. Separated from other species by the shape of the signum.

Biology. Early stages unknown. Adults were collected from early June to early August between 900 and 2200 m, probably in one generation.

Distribution (fig. 79). Locally common in the central part of the Nearctic from Saskatchewan, Canada in the north to Mexico in the south.

Etymology. Noun in apposition, referring to the higher altitudes which this species prefers (altitudo [Lat.] = altitude; philo [Gr.] = friend of).

Conclusions

The genus *Bryotropha* is poorly represented in the Nearctic as compared to the western Palaearctic (Karsholt & Rutten, in press). Three of the species, *B. similis*, *B. plantariella*, and *B. galbanella*, not only have a Holarctic distribution, but also have a clear preference for Nordic climates. Two of these, *B. plantariella* and *B. galbanella*, are reported from the Nearctic for the first time.

According to their distribution, the four taxa that are restricted to the Nearctic region prefer warmer climates. One of these, *B. gemella*, is closely related to *B. galbanella*; the external features and genitalia of the other three resemble to a certain degree Palaearctic species from the Mediterranean region, such as *B. gallurella* Amsel. However, the signum of *B. branella* and *B. altitudophila* has a very peculiar shape, which is not found in the Palaearctic species.

It has long been recognized that *Bryotropha* is far from homogeneous. Previous groupings as proposed by Pierce & Metcalfe (1935) or Gozmány (1955) proved untenable though (see Busck 1939, Sattler 1971). However, the mistakes were mainly due to the paucity of material on which these divisions were postulated. Recent studies involving all Palaearctic taxa (Karsholt & Rutten, in press) revealed three distinct species-groups: 1) the *similis*- group, involving species in which the males have a slender and smooth gnathos while the female genitalia have a lamella postvaginalis and microtrichia on the ventral side of segment VIII; 2) the *terrella*-group, characterized by males having a large and complex gnathos and females lacking a lamella postvaginalis and microtrichia on segment VIII; 3) the *domestica*-group, consisting of only two species with aberrant genitalia, characterized by an aedeagus with an acute apex.

It is interesting that all Nearctic taxa belong to the *similis*-group, and it is not clear how to interpret the absence of the *terrella*- and *domestica*-groups from the Nearctic. Nevertheless, we still have very little knowledge of the *Bryotropha* fauna of Asia. New data from there would serve to fill in the gaps in known distributions and would make a phylogenetic analysis more reliable.

Pending such an analysis we tentatively suggest that the Nearctic *Bryotropha* fauna originates from at least two colonization events from the Palaearctic. The first involved the ancestors of *B. gemella, B. hodgesi, B. branella* and *B. altitudophila*. They may have originated from the western Palaearctic, entering the Nearctic by a southern route (see e.g. Nuss et al. 1997). A second, more recent addition to the Nearctic fauna took place with the arrival of *B. plantariella, B. galbanella* and *B. similis*. The distribution patterns of these three species in the Palaearctic make a crossing of the Beringian Strait the most likely route.

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Zeller, P.C. (1857) See Staudinger, O. (1857).

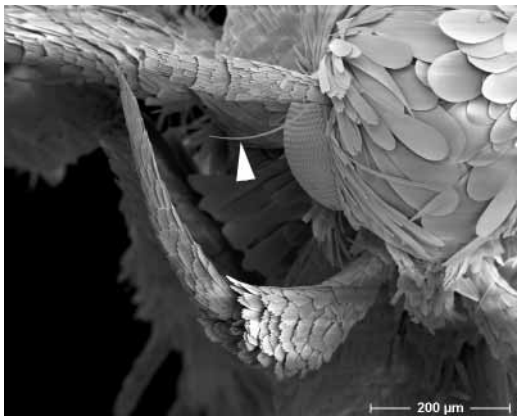


FIGURE 1. Head of *Bryotropha similis* in detail showing the characteristic pecten scale underneath the antennal scape.

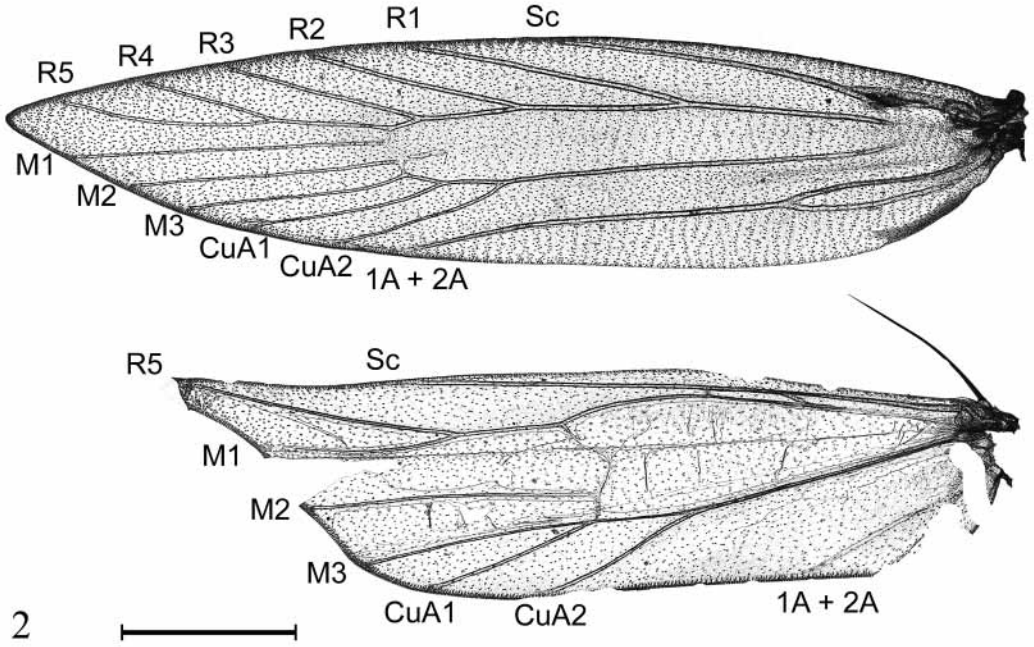
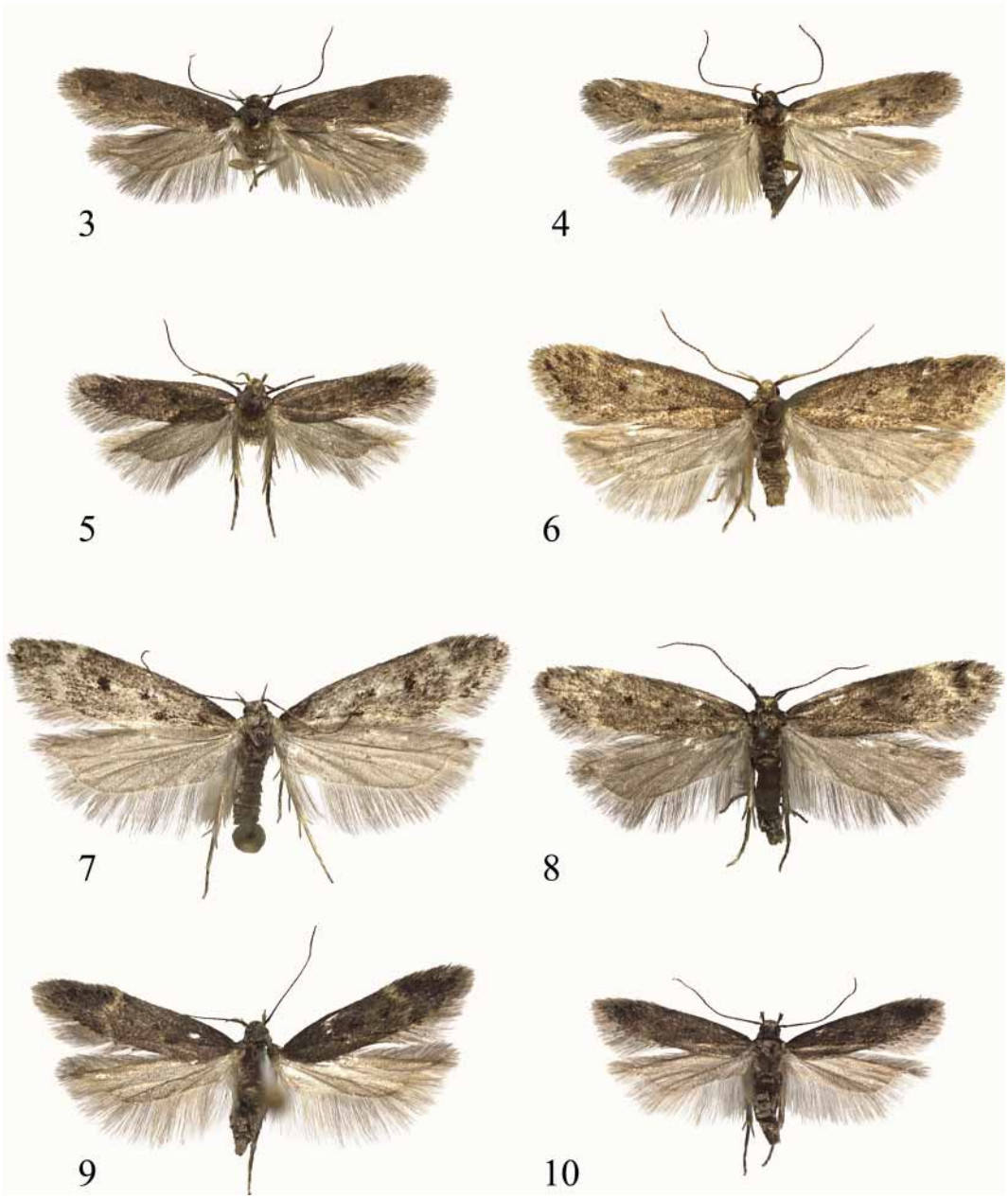
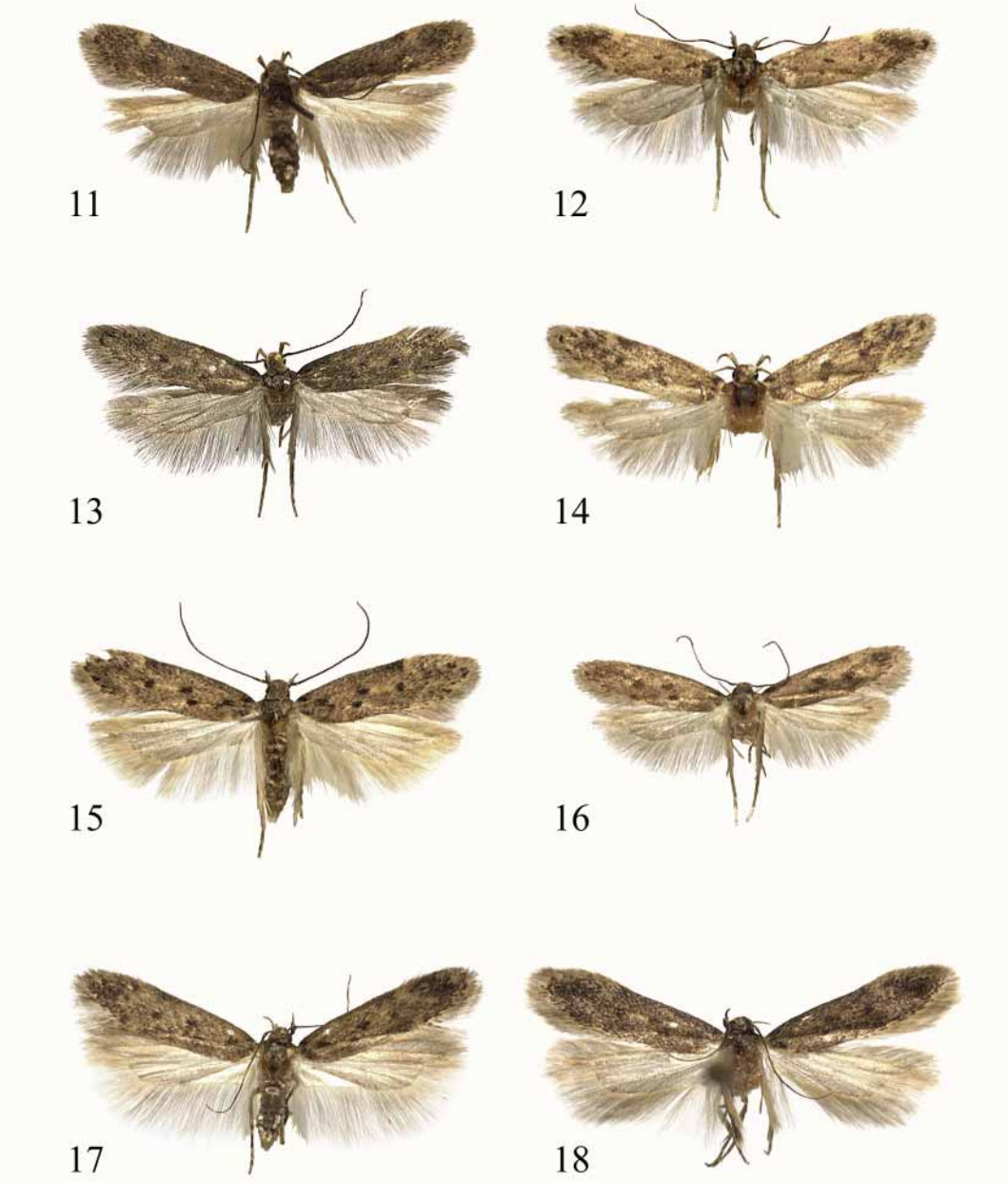


FIGURE 2. Wing venation of *B. similis*, prep. JFL512 (CNC). Bar = 200µm.

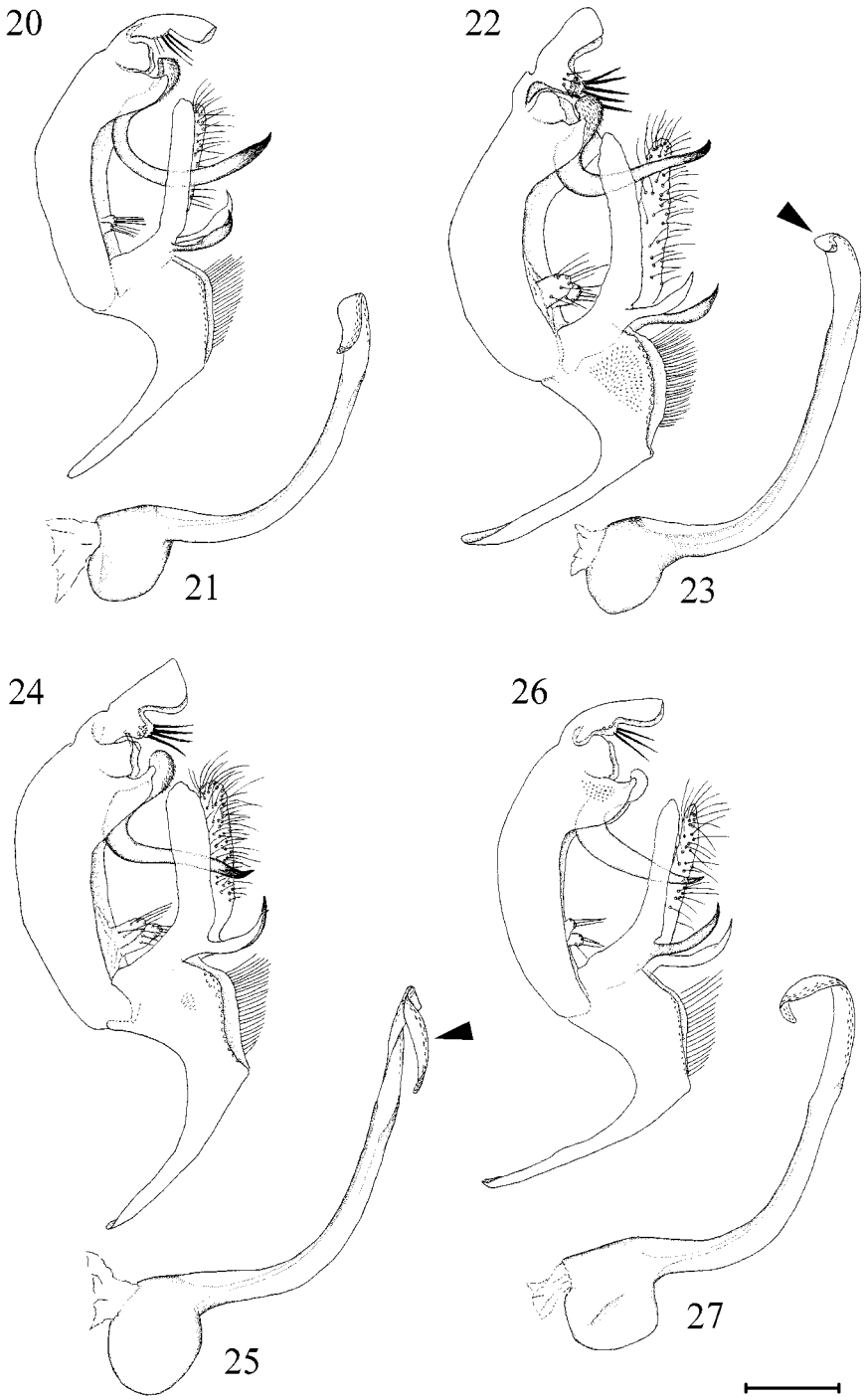


FIGURES 3–10. *Bryotropha* spp., adults. 3, *B. plantariella*, ♂, Canada, Ontario; 4, *B. plantariella*, ♂, Canada, Ontario; 5, *B. plantariella*, f, Canada, Ontario; 6, *B. gemella*, ♂, holotype, Canada, Ottawa; 7, *B. galbanella*, ♂, USA, Alaska; 8, *B. galbanella*, ♂, Canada, Yukon Territory; 9, *B. similis*, ♂, USA, Colorado; 10, *B. similis*, ♂, Canada, Québec. All on same scale, ca. 4x.

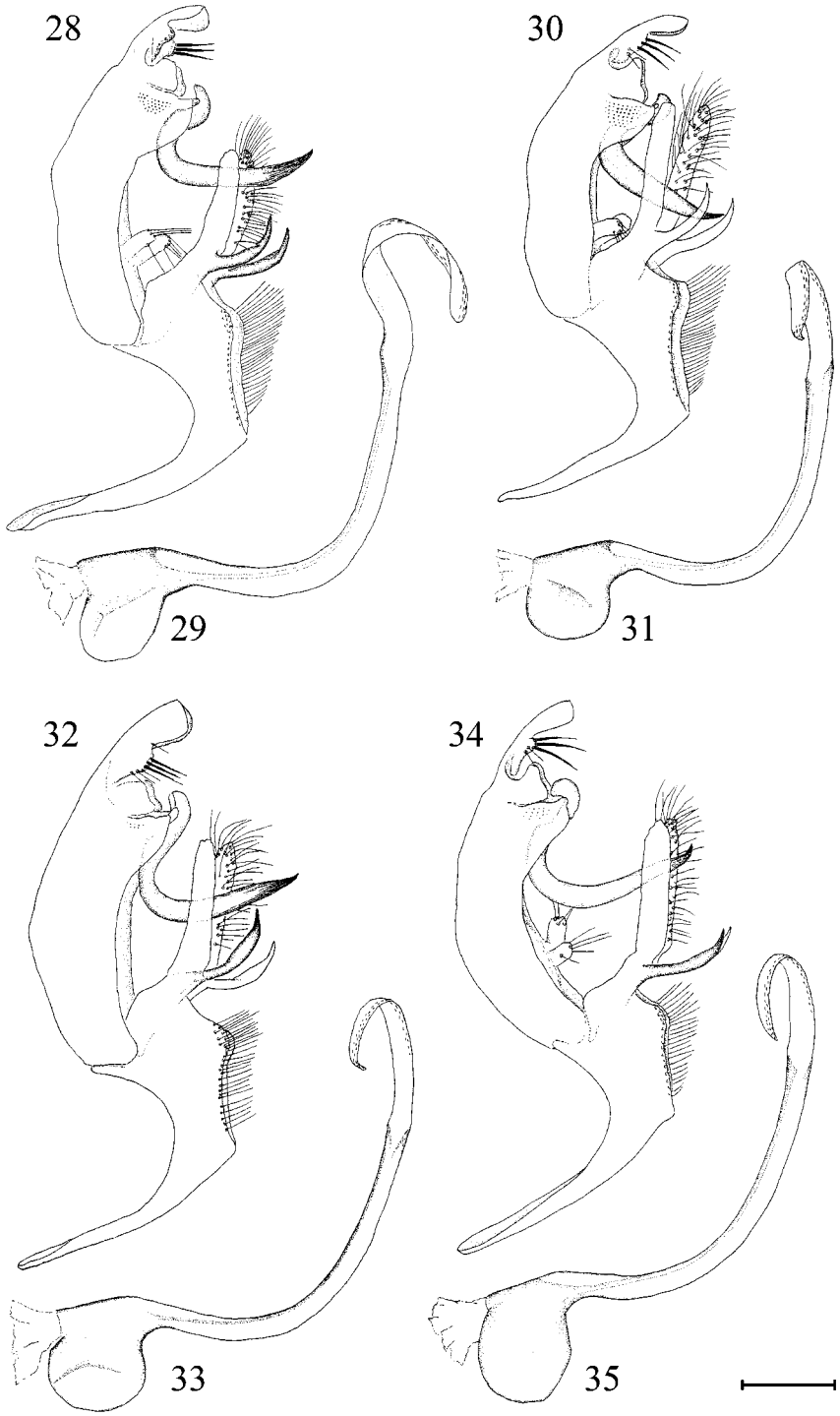


FIGURES 11–18. *Bryotropha* spp., adults. 11, *B. hodgesi* ♂, paratype, USA, California; 12, *B. hodgesi*, ♂, paratype, Canada, Québec; 13, *B. hodgesi*, ♂, holotype, Canada, Québec; 14, *B. hodgesi*, f; paratype, USA, Illinois; 15, B. branella, ♂, Canada, Ontario; 16, *B. branella*, ♂, Canada, Ontario; 17, *B. altitudophila*, ♂, paratype, USA, Colorado; 18, *B. altitudophila*, ♂, paratype, USA, Colorado. All on same scale, ca. 4x.

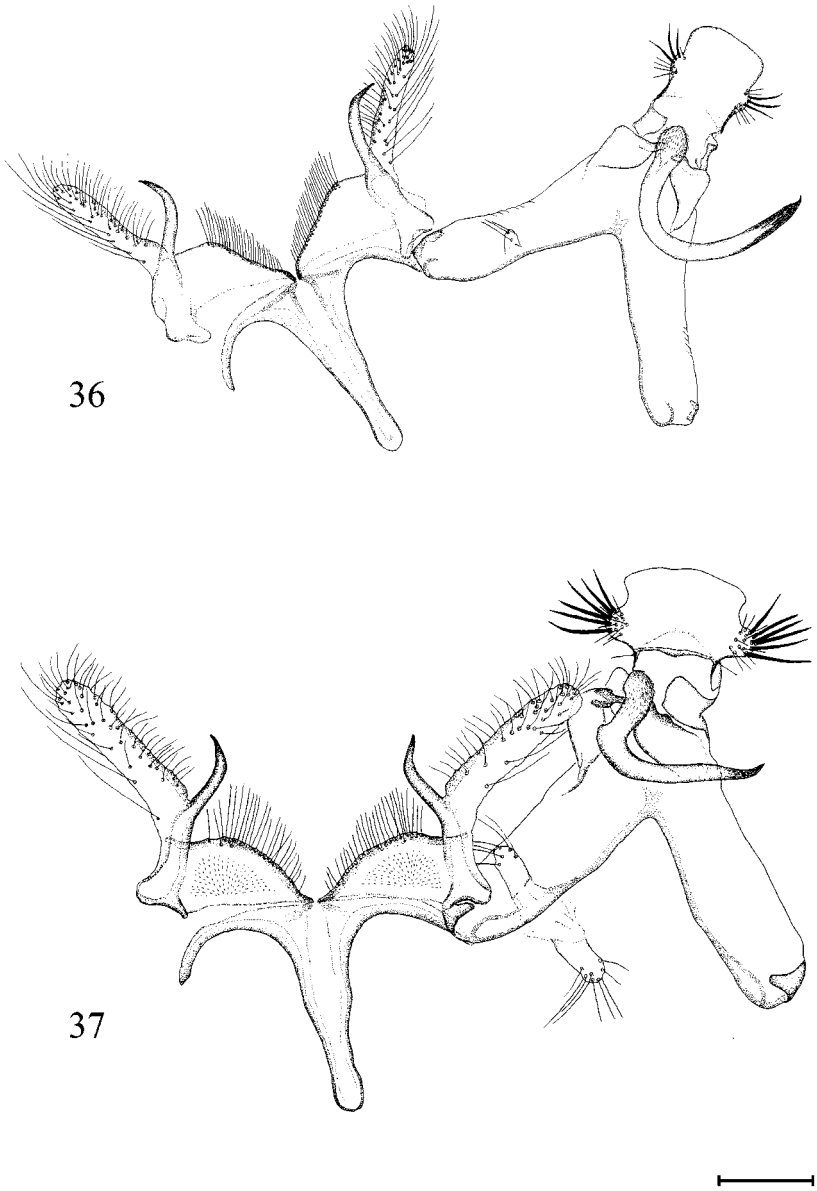
FIGURE 19. Habitus of *B. similis* on Greenland, note the heavy irroration with white scales.



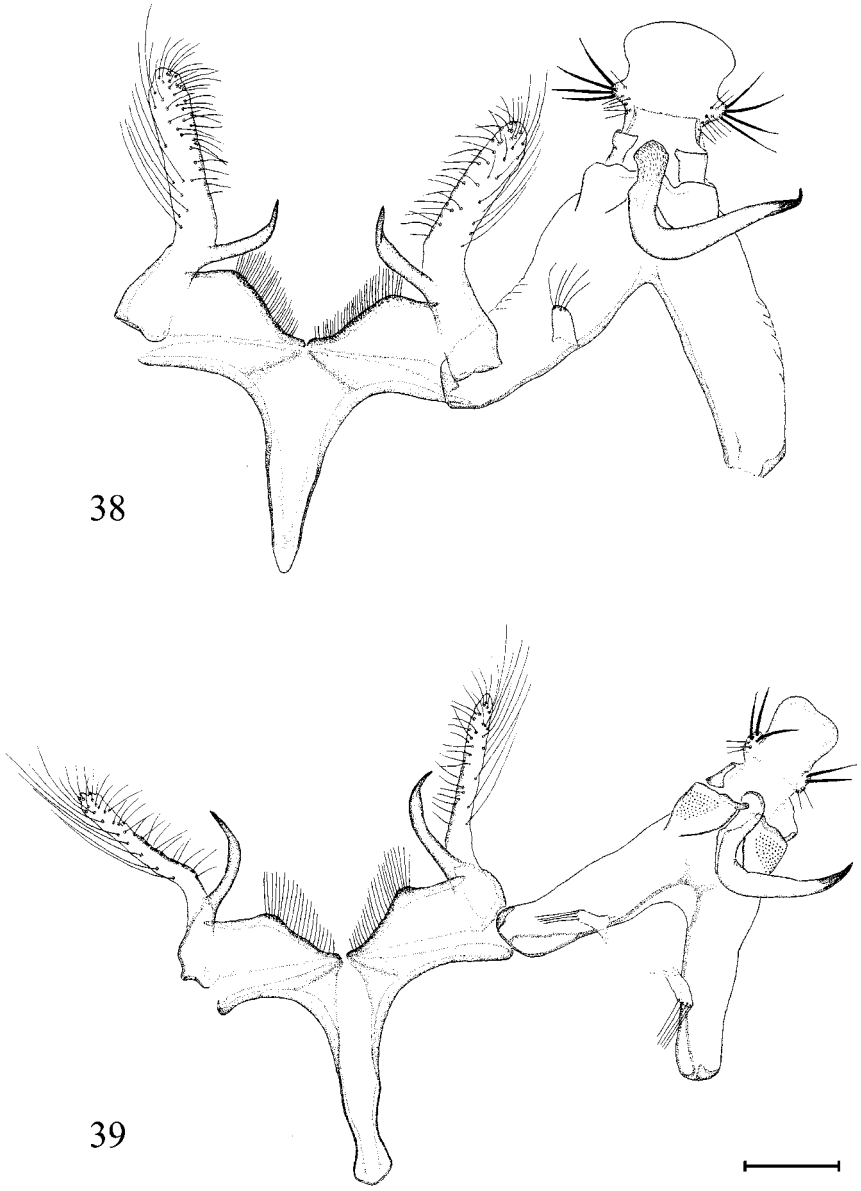
FIGURES 20–27. *Bryotropha* spp., male genitalia in lateral view, capsules (20, 22, 24, 26) and aedeagus (21, 23, 25, 27). 20, 21, *B. plantariella*, Canada, Alberta, slides AR0535 and AR537 (21) (CNC); 22, 23, *B. galbanella*, USA, Alaska, slide AR0722 (EME); 24, 25, *B. gemella*, Canada, New Brunswick, slide AR0546 (CNC); 26, 27, *B. similis*, USA, Colorado, slide AR0538, Canada, Ontario, slide AR0514 (26) (CNC). Bar = 200µm



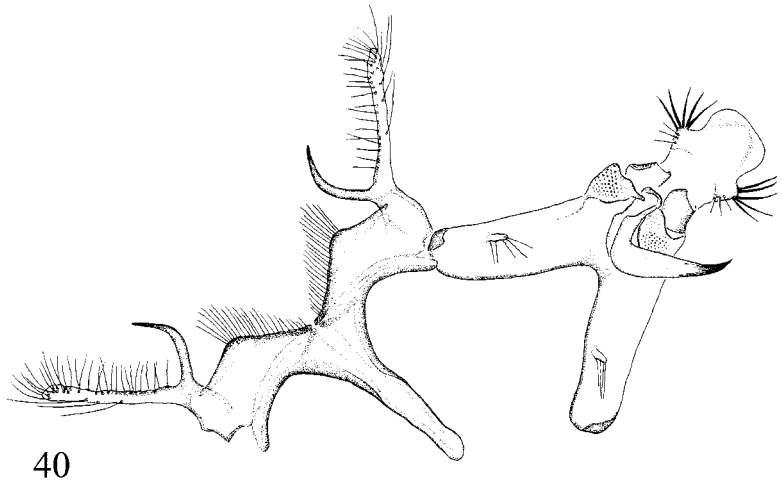
FIGURES 28–35. *Bryotropha* spp., male genitalia in lateral view, capsules (28, 30, 32, 34) and aedeagus (29, 31, 33, 35). 28, 29. *B. hodgesi*, Canada, Québec, slide AR0531 (CNC); 30, 31, *B. hodgesi*, Canada, British Columbia, slide AR0540 (CNC); 32, 33, *B. branella*, USA, Virginia, slide AR0724 (CNC); 34, 35, *B. altitudophila*, USA, Wyoming, slide MSNM9886 [NHNM]. Bar = 200µm



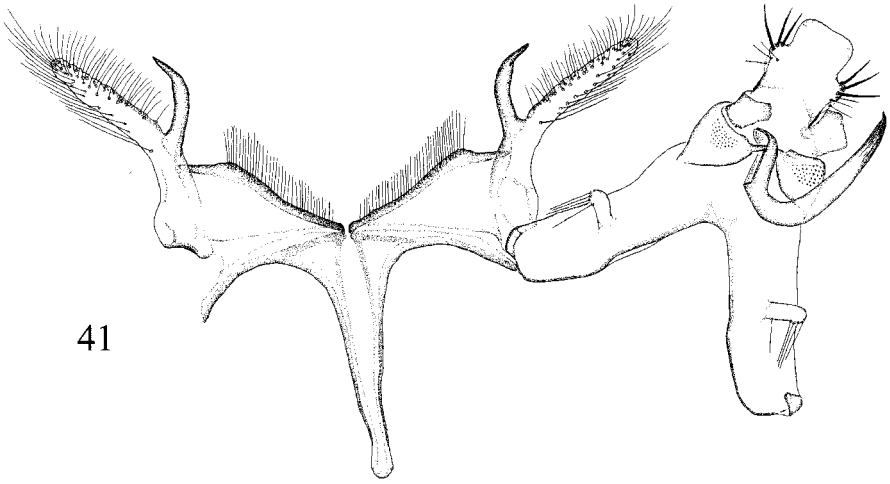
FIGURES 36–37. *Bryotropha* spp., male genitalia unrolled. 36, *B. plantariella*, USA, New Mexico, slide AR0646 (CNC); 37, *B. galbanella*, USA, Alaska, slide AR0721 (EME). Bar = 200µm



FIGURES 38–39. *Bryotropha* spp., male genitalia unrolled. 38, *B. gemella*, Canada, Québec, slide AR0530 (CNC); 39, *B. similis*, Canada, Québec, slide AR0510 (CNC). Bar = 200µm

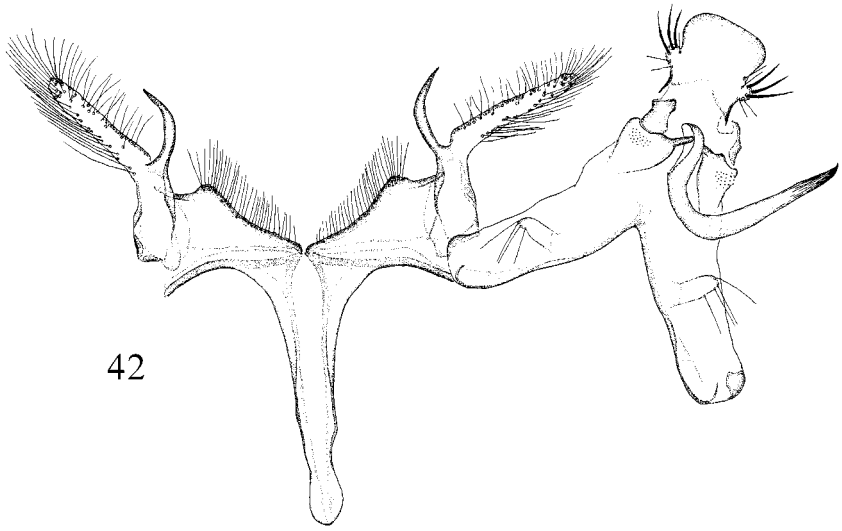


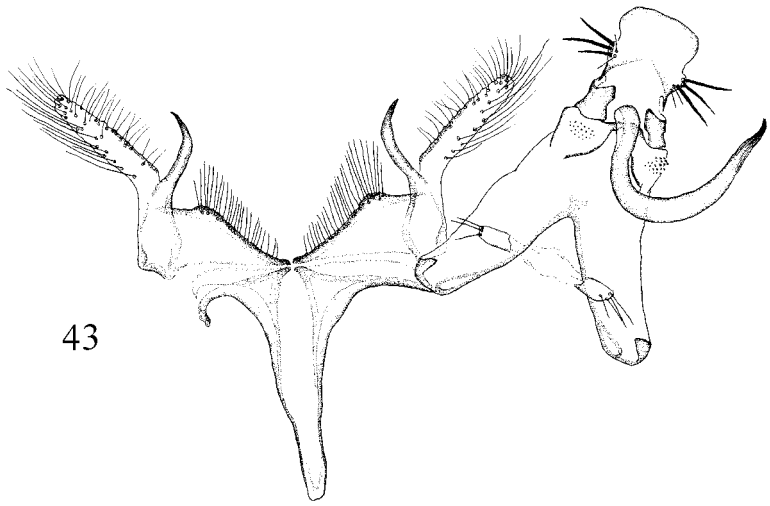
40



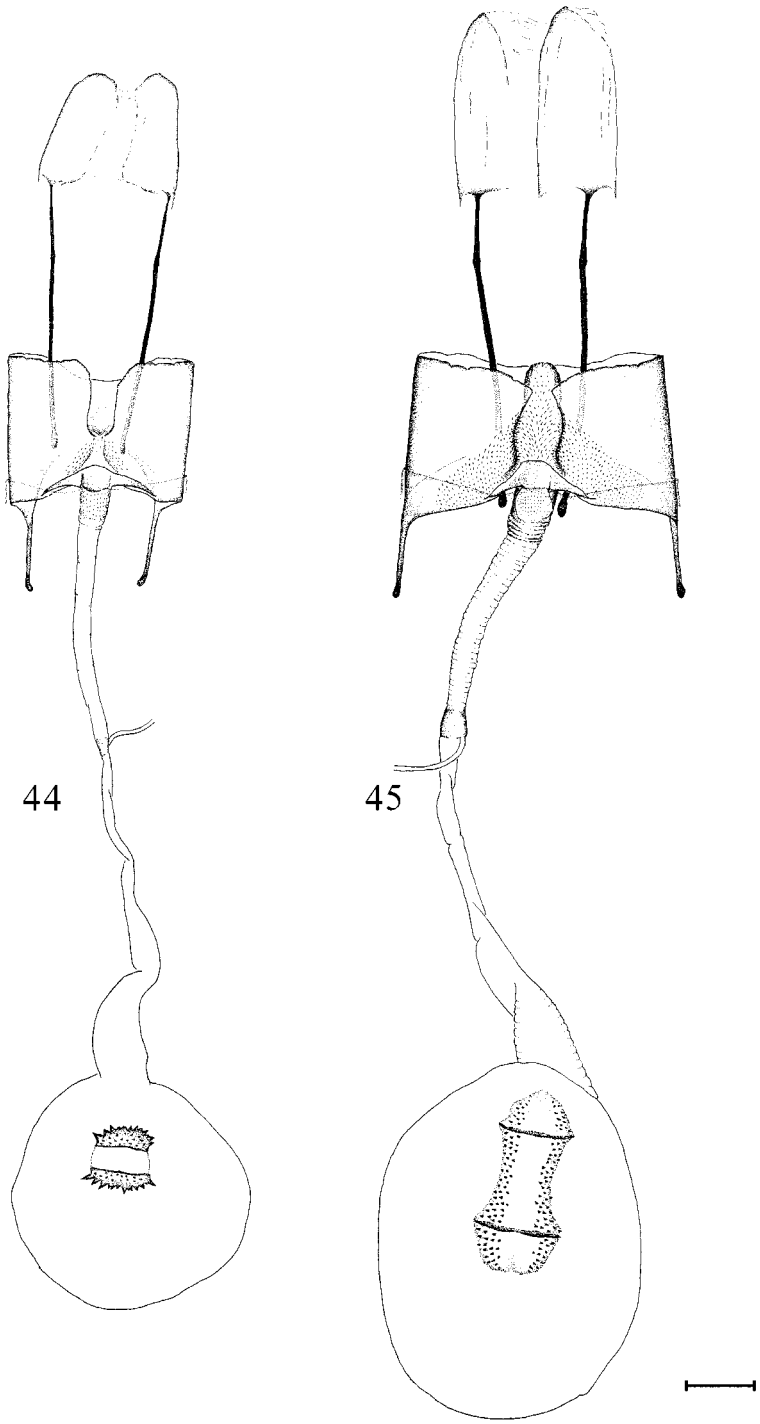
41

FIGURES 40–41. *Bryotropha* spp., male genitalia unrolled. 40, *B. similis*, Canada, Saskatchewan, slide AR0513 (CNC); 41, *B. hodgesi*, Canada, Québec, slide AR0647 (CNC). Bar = 200µm

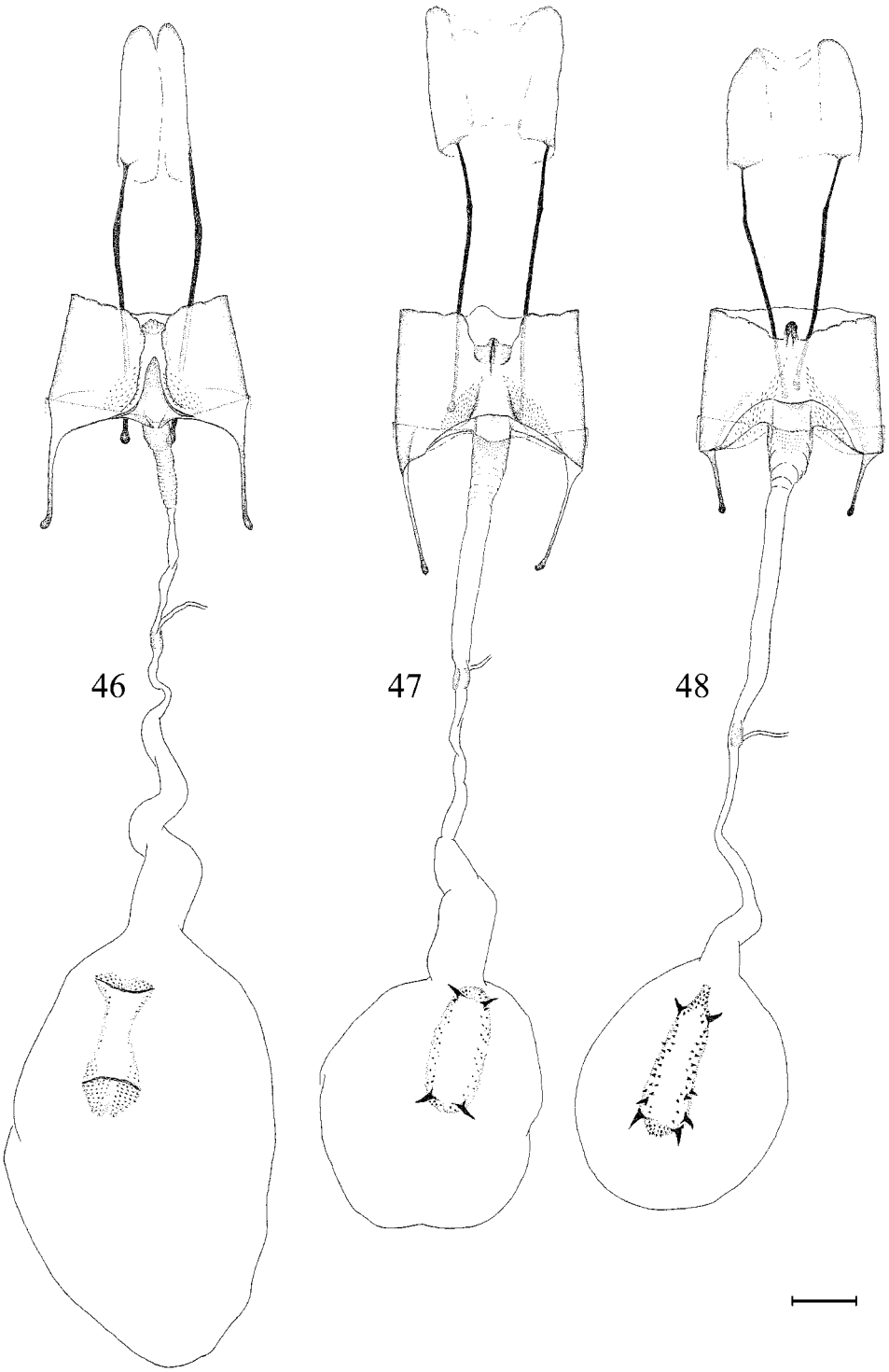




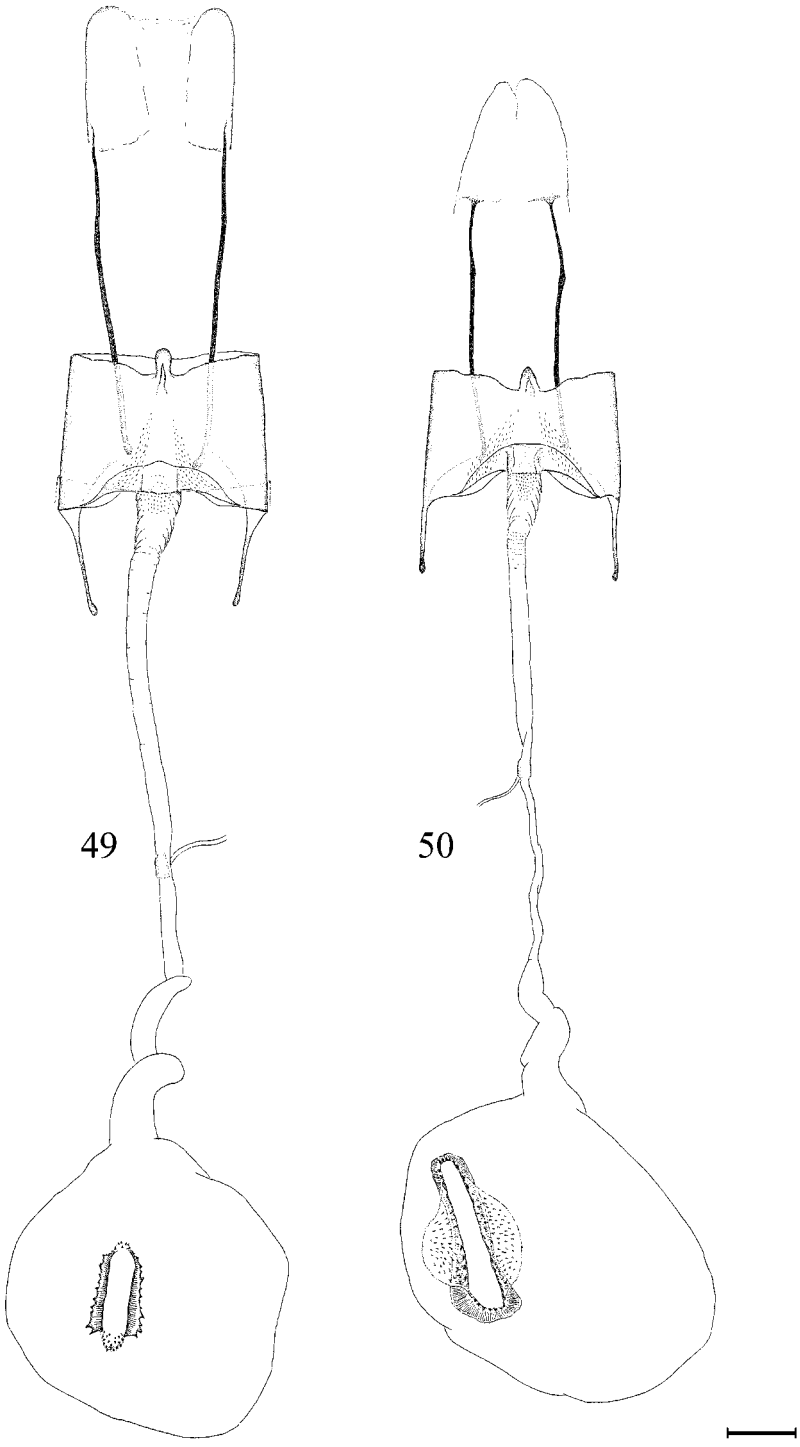
FIGURES 42–43. *Bryotropha* spp., male genitalia unrolled. 42, *B. branella*, Canada, Nova Scotia, slide AR0650 (CNC); 43, *B. altitudophila*, USA, Colorado, slide AR0545 (CNC). Bar = 200µm



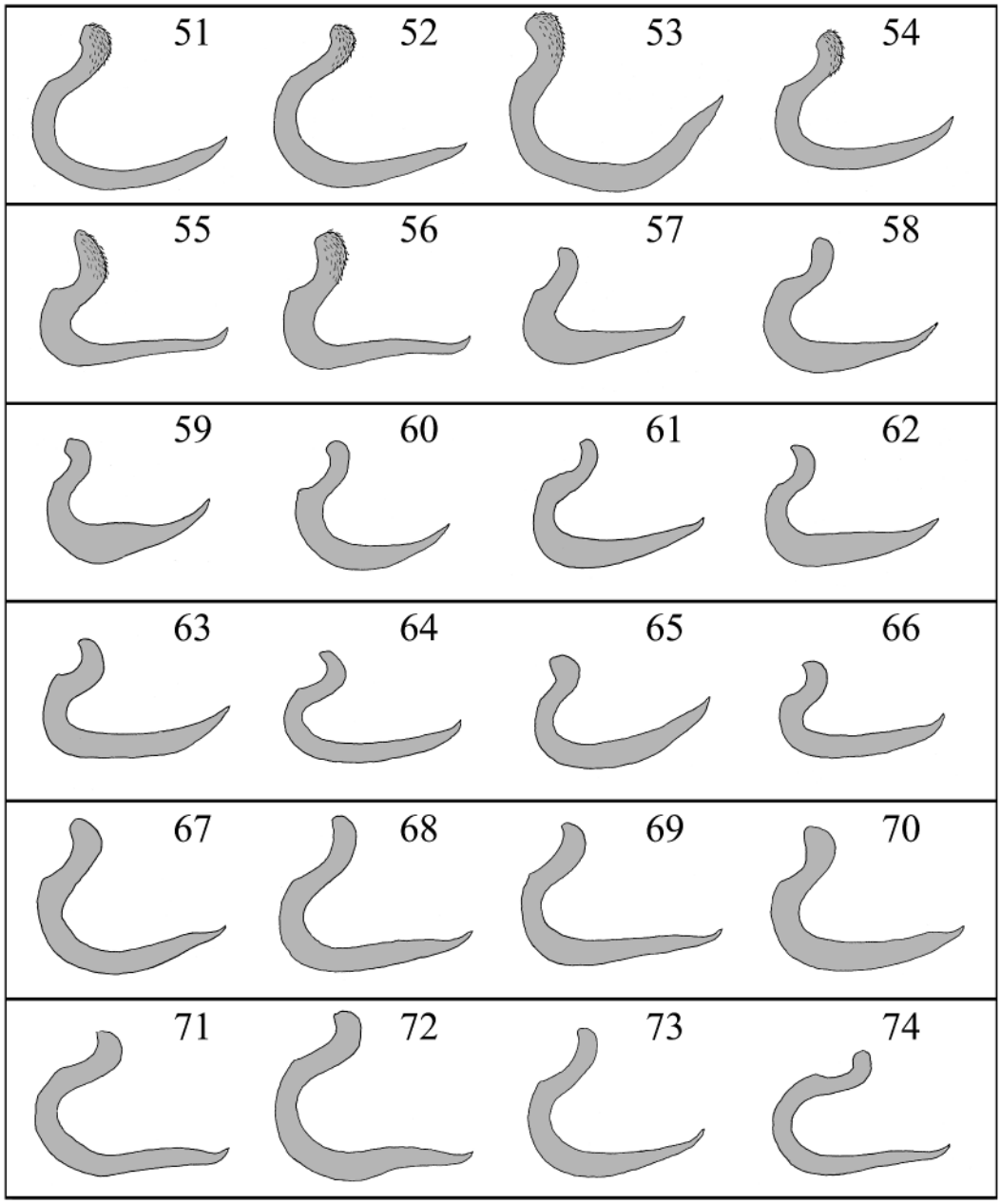
FIGURES 44–45. *Bryotropha* spp., female genitalia. 44, *B. plantariella*, Canada, Ontario, slide AR0577 (MOR); 45, *B. galbanella*, Sweden, slide AR0529 (CNC). Bar = 200µm



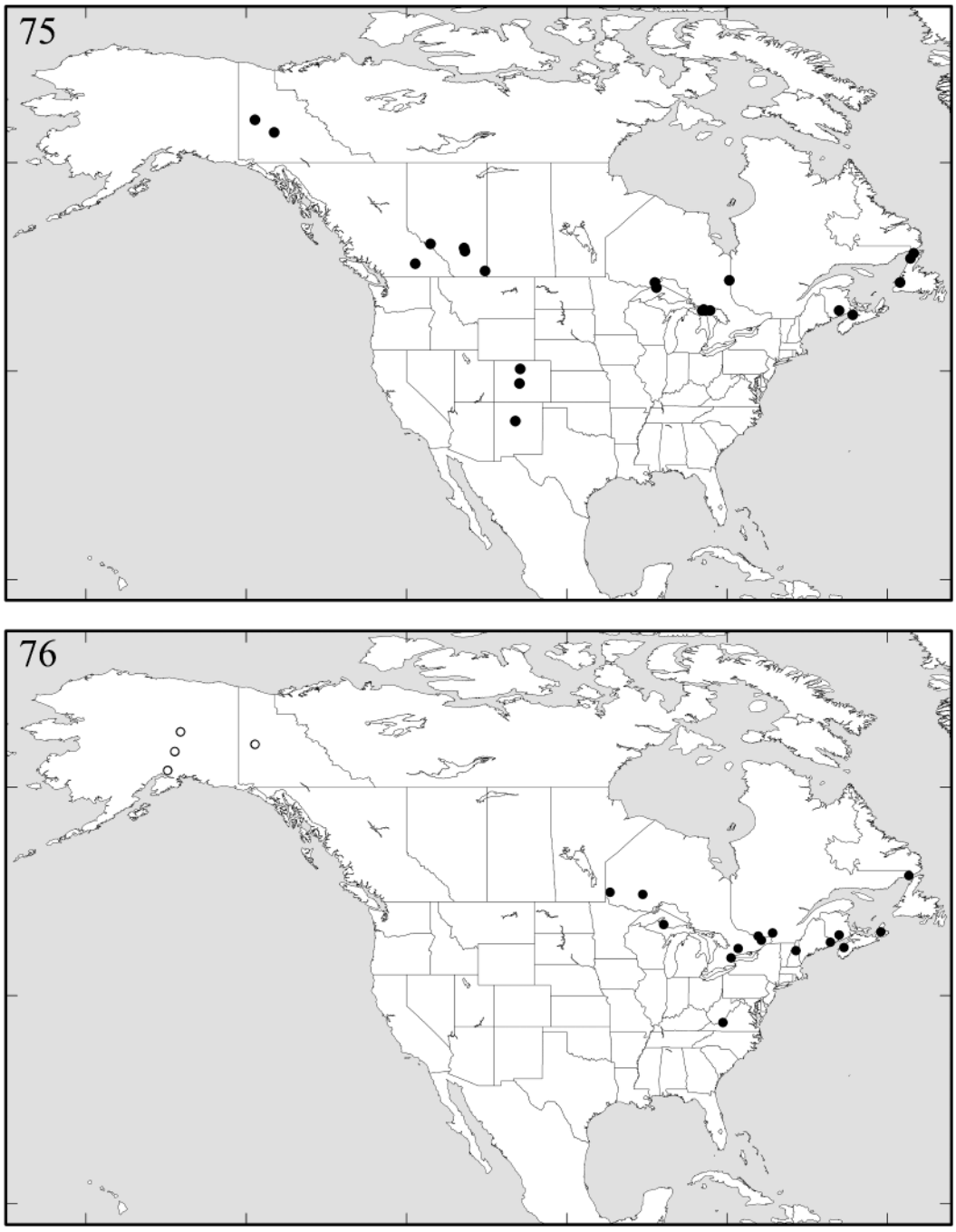
FIGURES 46–48. *Bryotropha* spp., female genitalia. 46, *B. gemella*, USA, Michigan, slide AR0668 [NHNM]; 47, *B. similis*, Canada, Québec, slide AR0511 (CNC); 48, *B. hodgesi*, Canada, Ontario, slide AR0648 (CNC). Bar = 200µm



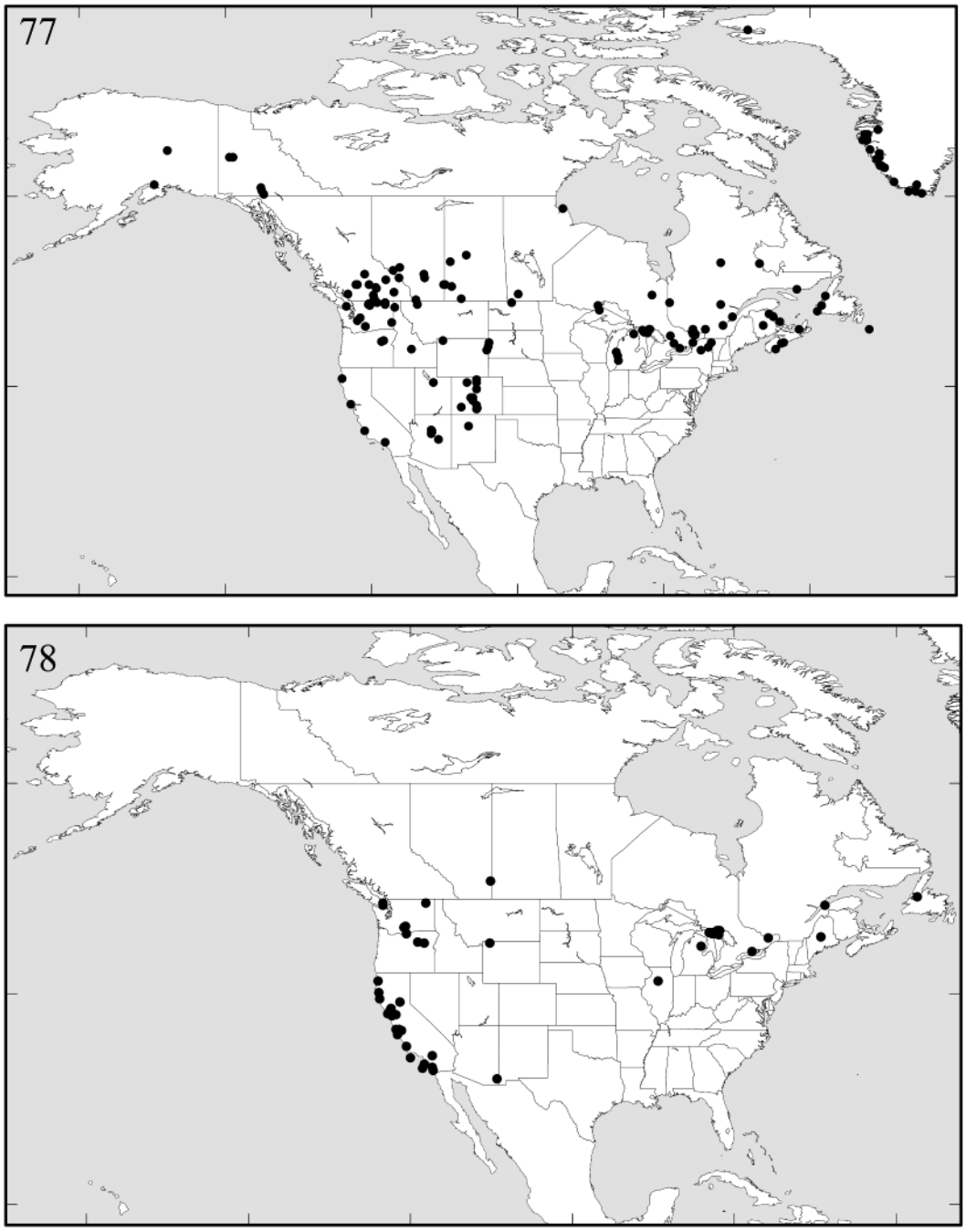
FIGURES 49–50. *Bryotropha* spp., female genitalia. 49, *B. branella*, Canada, Ontario, slide AR0571 (MOR); 50, *B. altitudophila*, USA, Arizona, slide AR0536 (CNC). Bar = 200µm



FIGURES 51–74. Variation in the gnathos of *Bryotropha* spp. 51–54, *B. plantariella*, slides AR0522, MSNM10.056, MSNM12.011, AR0576; 55, *B. galbanella*, slide AR0722; 56, *B. gemella*, slide AR0546; 57–60, *B. similis*, slides AR0512, AR0702, AR0526, AR0527; 61–66, *B. hodgesi*, slides AR531, AR0661, AR0660, AR0720, AR0657, AR0540; 67–70, *B. branella*, slides AR0583, AR0682, AR0714, AR0706; 71–74, *B. altitudophila*, slides AR0644, MSNM9889, MSNM9890, AR0665.



FIGURES 75–76. Distribution maps of *Bryotropha* species. 75, *B. plantariella*; 76, *B. galbanella* (open dots) and *B. gemella* (black dots).



FIGURES 77–78. Distribution maps of *Bryotropha* species. 77, *B. similis*; 78, *B. hodgesi*.

FIGURE 79. Distribution map of *Bryotropha altitudophila* (open dots) and *B. branella*.

