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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
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 Palearctic (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:

<table>
<thead>
<tr>
<th>Institution</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSP</td>
<td>Academy of Natural Sciences, Philadelphia, USA</td>
</tr>
<tr>
<td>BAL</td>
<td>Personal Collection of G. Balogh, Portage, Michigan, USA</td>
</tr>
</tbody>
</table>
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 Schweiz. 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.


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, 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)  
*pullifimbiella* (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......
- 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,
ocken 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)
- 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 broad-
ened and with a distinct sharp bend (fig. 29); in unrolled preparations always recog-
nized 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 with-
out 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 120° (figs. 71–74)........
- Only part of the basal half of the gnathos curved to maximal 120° (figs. 67–70) ....
- B. branella
Key to species based on female genitalia*

*The features for B. galbanella are based on Palaeartic (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 ................................................................................................. B. plantariella

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 sclero-
     tized rim (fig. 50) .................................................................................................. B. altitudophila

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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. plantaeriella* 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 angustella Heinemann, 1870: 217.
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. Thorn-shield 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.


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


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.


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 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.**


**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.


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 Palaearctic (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)


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NEARCTIC BRYOTROPHA

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.


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)


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 120°; in *B. altitudophila* the larger part of the gnathos is involved in a gradual bend of at least 120°. 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).

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

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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References


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 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, ♀; 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 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 = 200 μm
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 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*.