

# Review of the northern Holarctic *Arctia caja* complex (Lepidoptera: Noctuidae: Arctiinae)

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**Abstract**—*Arctia olschwangi* Dubatolov, formerly known only from Arctic Siberia, Russia, is recorded from northern Alaska, United States of America. Distinguishing characters between northern populations of *Arctia brachyptera* Troubridge and Lafontaine, *Arctia caja* (Linnaeus), *A. olschwangi* Dubatolov, and *Arctia opulenta* (Edwards) are discussed. *Arctia brachyptera* Troubridge and Lafontaine is hypothesised to be a subspecies of *A. olschwangi* Dubatolov but more specimens need to be examined before this taxonomic change is made.

**Résumé**—*Arctia olschwangi* Dubatolov, auparavant connu seulement en Sibérie arctique, a été trouvé dans le nord de l'Alaska. Les caractères distinctifs des populations du nord de *A. brachyptera* Troubridge and Lafontaine, *A. caja* (Linnaeus), *A. olschwangi* Dubatolov et *A. opulenta* (Edwards) sont discutés. *Arctia brachyptera* Lafontaine & Troubridge pourrait être une sous-espèce de *A. olschwangi* Dubatolov, mais il nécessaire d'étudier plus de spécimens avant de changer ce statut taxonomique.

## Introduction

*Arctia olschwangi* Dubatolov was described from northwestern Asia, the Polar Ural Mountains, and the southern part of the Yamal Peninsula. Later, based on a single-damaged specimen, it was recorded from the Lena River delta (Dubatolov 1996, 2003, 2010); these localities were the only ones known until now.

In April 2004, K.W.P. sent to V.V.D. a set of tiger-moth photographs from the collection of the Alaska Lepidoptera Survey, and in 2007 the first author noticed that a set of specimens from the North Slope of Alaska, United States of America differed from *Arctia opulenta* (Edwards) specimens from the more southern parts of Alaska. Specimens of this series have more elongate forewings and a flatter position of the brown subbasal band on the forewings, characters of the sibling species from Arctic Siberia, Russia, *A. olschwangi*. The latter species was described as a sibling species to *Arctia caja* (Linnaeus), differing mainly by strongly reduced eyes (adaptation to

continuous daylight during the polar summer), absence of the blue tint in hindwing spots, and minute characters in male genitalia. Later comparisons of eye structure and male and female genitalia based on photographs kindly prepared by Clifford Ferris (University of Wyoming, United States of America) showed that there are no noticeable differences between the specimens from the Polar Urals and Yamal Peninsula, Russia and their relatives from Alaska. So, it should be stated that *A. olschwangi* is actually a Holarctic species; in North America it is known only from the northernmost part of Alaska (Dubatolov 2010; Lafontaine and Schmidt 2010). Nevertheless, there is one more very similar species in the North American fauna, *Arctia brachyptera* Troubridge and Lafontaine, which was described based on three females from St. Elias Range, southern Yukon Territory, Canada. This species is the most similar to *A. olschwangi*, based on very small eyes (smaller than in *A. opulenta* and much smaller than in *A. caja*). Unfortunately, it is difficult to say anything about elements of the forewing pattern,

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because it is greatly widened, and the position of the dark subbasal band on the forewings is not outlined. The female genitalia did have very small differences, which may be no more than subspecific differences.

A diagnosis for the northern Holarctic *A. caja* complex is given below; species are cited in a systematic order.

Specimens were examined from the following collections:

ALS – Alaska Lepidoptera Survey, Fairbanks, Alaska, United States of America

BPI – Institute of Biology and Soil Science, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia

ISEA – Institute of Systematics and Ecology of Animals, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia

YIB – Yakutsk Institute of Biology, Siberian Branch of the Russian Academy of Sciences, Yakutsk, Russia

ZIN – Zoological Institute, Russian Academy of Sciences, St.-Petersburg, Russia

ZMHU – Zoological Museum, Helsinki, Finland

### ***Arctia caja* (Linnaeus)**

(Figs. 1–2)

*Phalaena (Bombyx) caja* Linnaeus, 1758: 500–501. Type locality not stated, probably Europe (Watson *et al.* 1980).

**Material.** FINLAND: 2 ♀♀, Om, Haapavesi, A.G. Helenius leg. (ZMHU); 1 ♂, Ok, Kn, Puolanka, 15.vii.1956, O. Peltonen leg. (ZMHU); 1 ♀ Ok, Kuhmon, No. 616, K. Walle leg. (ZMHU); 1 ♂, Ob, Pello, No. 2273, Nordmann leg. (ZMHU). RUSSIA: Murmansk Province: 1 ♀, Munozero (ZIN); Sakha-Yakutia: 1 ♀, Janathal bei Sfici-bap, 6-7.vii.1901, O. Herz leg. (ZIN); 1 ♂, 1 ♀, in der tundra am Dogdo, 16.VI-18.vii.1901, O. Herz leg. (ZIN); 4 ♂, 1 ♀, Verkhoyansk, vii.1903, Rozhkovskii leg. (ZIN); 2 specimens, Verkhoyanskii Range, river Bytantai, left tributary of river Yana, village Kustur, 80 km NE from village Batagai-Alyta, vii.2002 (YIB); 1 ♂, Cherskogo Mts., Ulakhan-Chistai Range, river Ikar middle flow, right tributary of river Turakh, right tributary of river Dyapkachan, river Artyr basin, right tributary of river Nera, h = 1220 m,

bush tundra, 2.viii.2003 (Nogov, ISEA); Magadan Province: 2 ♂♂, 1 ♀, 1 specimen, river Kolyma upper flow, near Sibit-Tyellakh village, Aborigen Station, 17.vii.1983, vii.1986, 11-12.viii.1986, D. Berman, V. Dubatolov, V. Zintshenko leg. (ISEA, ZMHU); 1 ♂, Omsukchan, 16.vii.1990, V. Tuzov leg. (ISEA); 1 ♂, Magadan, 4.viii.1963 (BPI).

**Distribution.** The temperate belt of Eurasia, the mountains of Central Asia and Himalayas, the boreal belt of North America, and the cordilleras of western North America. The species is also known from the polar territories of Finland, the Murmansk Province of Russia, and the mountains of northeast Yakutia and the Magadan Province, Russia (Dubatolov 2010). In North America, its northernmost localities are Saskatchewan at 55°N and Quebec at 48°N (Handfield 2011), although it also occurs in temperate latitudes.

**Remarks.** All specimens from the northernmost *A. caja* populations are of smaller size, but have very large hemispheric eyes. The distance between the subbasal and antemedial brown bands is equal to the distance between the antemedial and postmedial bands. The subbasal brown band of the forewings is steep, and the dark spots of hindwings have a blue tint. The brown medial band on hindwings is wide and located between the discal vein and the wing base. In the male genitalia, there is a separate bulbous lobe on the vesica (Figs. 12–13). In the female genitalia, the sclerotised part of the ductus bursae is wide and long, the signae on bursae are large, the corpus bursae narrows towards the ductus bursae (Fig. 17).

### ***Arctia opulenta* (Edwards)**

(Fig. 3)

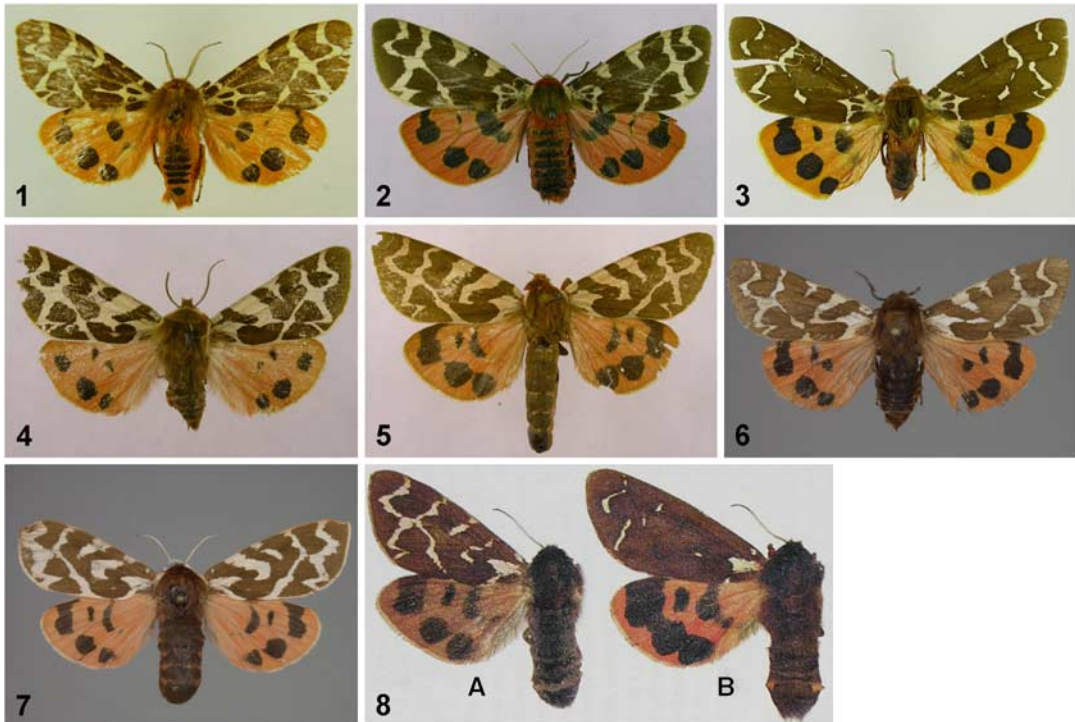
*Euprepia opulenta* Edwards, 1881: 38. Type locality: “Yukon River, Alaska, 700 miles from the mouth”.

*Arctia caja parva* Rothschild, 1910: 181. Type locality: “Labrador”.

*Arctia caja virginivir* Dyar, 1923: 12–13. Type locality: “Alaska ..., probably from one of the coastal islands”.

**Material.** 1 ♂, Canada, British Columbia, Pink Mountain, summit, emerged 5.VII.1990, Lynda Troubridge leg. (ISEA).

**Figs. 1–8.** Adults of: 1, *Arctia caja*, male, Russia, East Yakutia, “in der tundra am Dogdo”, 16.vi–18.vii.1901, Herz leg.; 2, *A. caja kamschadalis*, female, Russia, Kamchatka, Dal’nii, 18.vii.1967; 3, *Arctia opulenta*, male, Canada, British Columbia, Pink Mountain, summit, emerged 5.vii.1990, Lynda Troubridge leg.; 4, *Arctia olschwangi*, holotype, male, Russia, Yamal Peninsula, river Khadyta-Yakha, 5.viii.1985; 5, *A. olschwangi*, paratype, female, Russia, Polar Ural, Kharp, ex pupa, 30.vii.970, Olschwang leg.; 6, *A. olschwangi*, male, United States of America, Alaska, North Slope, Umiat, on bank of Colville River, 25.vii.1979, Springer leg.; 7, *A. olschwangi*, female, United States of America, Alaska, North Slope, VABM Aruk, larva 24.vii.1976, imago late viii.1976, Philip leg.; 8, *A. olschwangi brachyptera*, females, from the original description.



**Distribution.** North America: United States of America: Alaska, CANADA: east to Manitoba (arctic, alpine, and subarctic habitats) and across northern Québec to Labrador. There is a photograph of a female specimen from Kamchatka, Russia in a small book “Babochki Kamchatki” [Lepidoptera of Kamchatka] by Zykov and Lobkova (2004) that looks like a more-or-less melanistic specimen of *A. opulenta* or *A. olschwangi* with narrow forewings and without any blue tint on the dark hindwing spots, but it is impossible to say anything more without studying the specimen. In any case, all localities in Kamchatka are too southerly for *A. olschwangi*; it is better to consider that it might be a specimen of *A. opulenta*. It should be stated that *A. caja* is not a very rare species in Kamchatka, represented by a different subspecies,

*A. c. kamschadalis* Draudt, of which more than 10 specimens are known.

**Remarks.** This species is transitional between *A. caja* and *A. olschwangi*. It has noticeably reduced eyes (Fig. 9), but not so strongly as in the latter species; length to width ratio 1:1.2–1.3. The distance between the subbasal and antemedial brown bands is equal to the distance between the antemedial and postmedial bands; the subbasal brown band of forewings is steep, the dark spots of hindwings have a blue tint; these characters are common with *A. caja*. The brown medial band on hindwings, as in the previous species, is wide and located between the discal vein and the wing base. Taking into account the significant individual and geographic variability of genitalia structure, it should be noted we could not find

**Figs. 9–11.** Eyes of *Arctia* species: 9, *Arctia opulenta*, male, Canada, British Columbia, Pink Mountain, summit, emerged 5.vii.1990, Lynda Troubridge leg.; 10, *Arctia olschwangi*, paratype, male, Russia, Yamal Peninsula, river Khadyta-Yakha, 16.vii.1982, Olschwang leg.; 11, *A. olschwangi*, female, United States of America, Alaska, North Slope, VABM Aruk, larva 24.vii.1976, imago late viii.1976, Philip leg.



any noticeable specific character except for the structure of the vesica, which lacks a separate bulbous lobe (Fig. 14), but this character is shared with *A. olschwangi*. In the female genitalia, Lafontaine and Troubridge (1999) stated that “posterior corpus bursae of *A. opulenta* is swollen to about the same size as the anterior corpus bursae and separated from it by a slight constriction”.

### ***Arctia olschwangi* Dubatolov**

(Figs. 4–7)

*Arctia olschwangi* Dubatolov, 1990: 89–93, figs. 1a, 2l. Type locality: “South Yamal, r.[iver] Khadyta”.

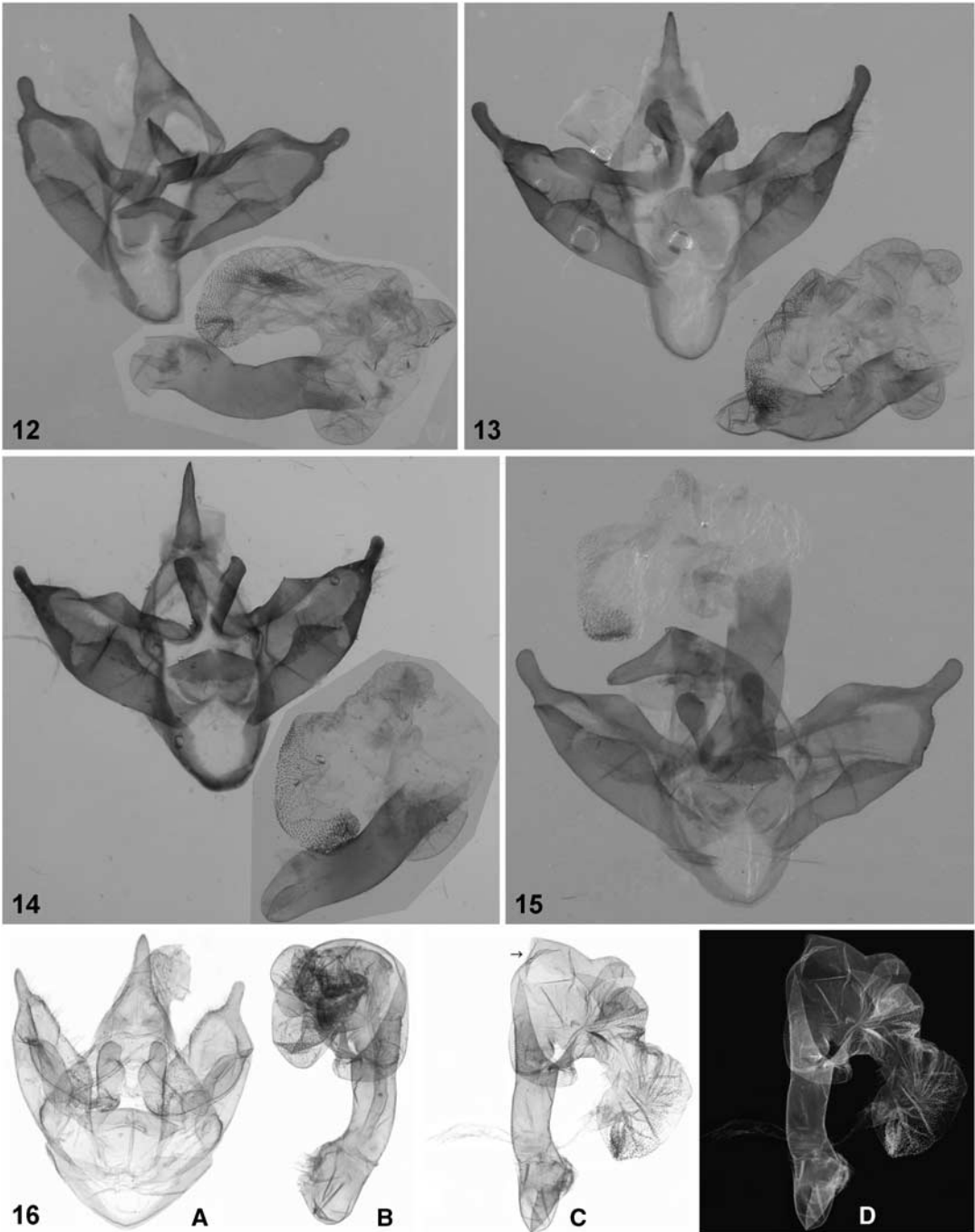
**Material.** RUSSIA: Yamal-Nenets Autonomous Region: 2 ♀♀ (paratypes), Polar Ural, Kharp Station, 30.vii.1970, V. Olschwang leg. (ISEA); 2 ♂♂ (holotype and paratype), 1 ♀, South Yamal, river Khadyta, 31.vii.1979, 16.vii.1982, 5.viii.1985, V. Olschwang leg. (ISEA); Sakha-Yakutia: 1 ♂ (without abdomen), Lena river delta, Ust'-Lenskii Nature Reserve, Is. Dunai, 27.vii.1988, D. Ivanova, (ZMMU). United States of America: Alaska: 1 ♂, North Slope, Umiat on bank of Colville River, 25.vii.1979, A.M. Springer leg. (ALS); 1 ♀ ex larva, North Slope, VABM Aruk, larva 24.vii.1976, imago late viii.1976, K. W. Philip leg.

(ALS); 1 ♀, North Slope, Itkillik River, 21 mi. E Outpost Mtn., 69°10'N, 150°24'W, 8.vii.1971, J.L. Harry leg. (ALS); 1 ♀, North Slope, Itkillik River camp, 46 mi. ESE Umiat, 22 mi. E Outpost Mtn., 17.vii.1971, J.L. Harry leg. (ALS).

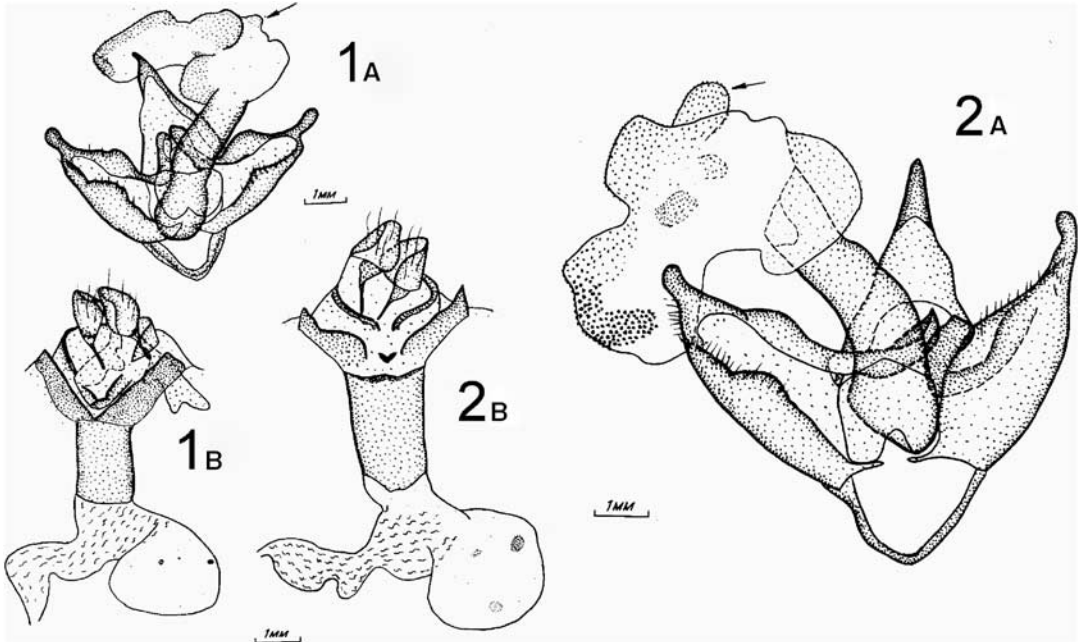
**Distribution.** Russia: the Polar Ural Mountains, west Siberia: the plains of south part of the Yamal Peninsula; east Siberia: the Lena river delta in Yakutia; United States of America: north Alaska.

**Remarks.** The species is distinctly separated from *A. caja* by very small reduced eyes (Figs. 10, 11), length to width ratio 1:1.5–1.6 (an adaptation for constant sunshine during the polar summer), small size (forewing length 20 mm in males and 22 mm in females), absence of a blue tint in hindwing spots, and the position of the subbasal brown band on the forewing upperside. This band is narrow and noticeably more oblique than in *A. caja* and *A. opulenta*. Moreover, the distance between the subbasal and antemedial brown bands is noticeably wider than that between antemedial and postmedial bands. In addition, rudiments of a narrow brown medial band on the hindwings are located close to the discal vein. In the male genitalia, a separate bulbous lobe on the vesica is reduced to a small inflation (Figs. 15–17). In the female genitalia, the sclerotised part of the ductus bursae is wide but short, the signae on the bursae are small like dots, the corpus bursae does not noticeably narrow towards the ductus bursae.

**Figs. 12–16.** Male genitalia of: 12, *Arctia caja kamtschadalis*, Russia, Kamchatka, Ust'-Kamchatskii District, collective farm Maiskii, 25.vii.1971, Kostina leg.; 13, *A. caja utahensis*, United States of America, Colorado, Grand County, Radium, 2.viii.1986, Bowman leg.; 14, *Arctia opulenta*, Canada, British Columbia, Pink Mountain, summit, emerged 5.vii.1990, Lynda Troubridge leg.; 15, *Arctia olschwangi*, paratype, Russia, Yamal Peninsula, river Khadyta-Yakha, 16.vii.1982, Olschwang leg.; 16, (A–D) *A. olschwangi*, United States of America, Alaska, North Slope, Umiat, on bank of Colville River, 25.vii.1979, Springer leg.; (B–D) aedeagus.



**Fig. 17.** Male (A) and female (B) genitalia of *Arctia olschwangi* (1) and *Arctia caja* (2), from: Dubatolov (1990). Arrows show differences in vesica structure.



### ***Arctia brachyptera* Troubridge and Lafontaine**

(Fig. 8)

*Arctia brachyptera* Troubridge and Lafontaine in Lafontaine and Troubridge 1999: 90–92, figs. 1a, 1b, 2b. Type locality: “Canada, Yukon, Nickel Creek, 4500’, St. Elias Range”.

**Distribution.** CANADA: southern Yukon Territory and Mackenzie Mountains, Northwest Territories.

**Remarks.** We suspect that *A. brachyptera* is a subspecies of *A. olschwangi* that penetrated into the subarctic mountains of North America. Both species have similarly reduced eyes. There is the single noticeable character in wing pattern: all the white bands of the forewings are very narrow in *A. brachyptera*, or wholly disappear. In all *A. olschwangi* specimens both from Siberia and north Alaska, the white antemedial band *sensu* Ferguson (1985) between the brown subbasal and antemedial bands is not narrow, being wider than or equal to the medial white band *sensu*

Ferguson between the brown antemedial and post-medial bands. However, the female forewings are not brachypterous as might be assumed from the specific name *A. brachyptera*. In all northern populations of *A. brachyptera*, *A. caja*, *A. olschwangi*, and *A. opulenta*, the ratio of thorax width to forewing length is about 1:3.5–4.0. Nevertheless, all characters cited in the original description for *A. brachyptera* (entirely brown abdomen, small size of bursa) are found in *A. olschwangi*. But the unclear shape of the appendix bursae in *A. brachyptera* might be caused by its position in the genitalia slide. The more sinuous postmedian forewing band of *A. brachyptera* is poorly visible and might indicate no more than a subspecific difference. Unfortunately, the authors of *A. brachyptera* did not compare their species from Yukon with its relative from Polar Siberia, and did not discuss their affinities and similarities. So, the most noticeable differences between these two taxa are seen in the forewing pattern, and appear to be no more than subspecific. For a conclusive decision on the taxonomic status of *A. brachyptera*,

### Key to northern Holarctic species in the *Arctia caja* complex

- 1 Eyes large, hemispheric . . . . . *A. caja* (Linnaeus)  
 — Eyes small, ellipsoidal . . . . . 2  
 2 Eyes slightly ellipsoidal, length to width ratio 1:1.2–1.3. Dark spots on hindwings with blue tint . . . . . *A. opulenta* (Edwards)  
 — Eyes strongly ellipsoidal, length to width ratio 1:1.5–1.6. . . . . Dark spots on hindwings without blue tint . . . . . 3  
 3 Dark bands on forewings not wide, white pattern not reduced. Distance between subbasal and antemedial brown bands along forewing costa is noticeably wider than that between antemedial and postmedial bands . . . . . *A. olschwangi* Dubatolov  
 — Dark bands on forewings wide, white pattern strongly reduced. Distance between subbasal and antemedial brown bands along forewing costa is equal to the distance between antemedial and postmedial bands . . . . . *A. brachyptera* Troubridge and Lafontaine

a serious comparison of individual variation in Siberian and North American populations of *A. olschwangi* and *A. brachyptera* is necessary; the material we examined is not enough for such a determination.

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