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# A taxonomic revision of the genus *Holoarctia* Ferguson, 1984 (Arctiidae)

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**Summary**

The genus *Holoarctia* Ferguson, 1984 is rearranged on the basis of formerly unrecognised characters of everted male vesica and female bursa. Three species are included : *H. cervini* (Fallou, 1864), *H. marinae* Dubatolov, 1985 and *H. puengeleri* (O. Bang-Haas, 1927). The taxa *fridolini* (Torstenius, 1971) and *perunovi* Dubatolov, 1990 are considered as subspecies of *H. puengeleri*. The status of *H. sordida* (McDunnough, 1921) is discussed. The adults and genitalia of *cervini*, *marinae* and *puengeleri* are illustrated and the distribution is presented for each species.

**Zusammenfassung**

Die Gattung *Holoarctia* Ferguson, 1984 wird aufgrund bisher unbekannter Merkmale der ausgestülpten männlichen Vesica und der weiblichen Bursa neu geordnet. Drei Arten werden in die Untersuchung einbezogen : *H. cervini* (Fallou, 1864), *H. marinae* Dubatolov, 1985 und *H. puengeleri* (O. Bang-Haas, 1927). Das Taxon *fridolini* (Torstenius, 1971) und *H. perunovi* Dubatolov, 1990 werden als Unterart von *H. puengeleri* aufgefasst. Der taxonomische Status von *H. sordida* (McDunnough, 1921) wird diskutiert. Die adulten Tiere und die Genitalien von *cervini*, *marinae* und *puengeleri* werden abgebildet und es wird die Verbreitung jeder Art behandelt.

**Résumé**

Les auteurs révisent le genre *Holoarctia* Ferguson, 1984 en se basant sur des caractères ignorés jusqu'à présent : vesica mâle evaginée, bursa de la femelle. Ce genre comprend trois espèces : *H. cervini* (Fallou, 1864), *H. marinae* Dubatolov, 1985 et *H. puengeleri* (O. Bang-Haas, 1927). Les taxons *fridolini* (Torstenius, 1971) et *perunovi* Dubatolov, 1990 sont considérés comme sous-espèces de *H. puengeleri*. Le status de *H. sordida* (McDunnough, 1921) est discuté. Illustration des imagos et des genitalia de *cervini*, *marinae* et *puengeleri* ; distribution géographique de chacune de ces espèces.

## Introduction

In 1864 Fallou described *Nemeophila cervini* from Zermatt in the Swiss Alps. Later its distribution, habitat and ecology have been studied thoroughly (for a review see Sotavalta *et al.*, 1984). Burmann (1952) gave a good description of internal variation of this taxon, and Burmann (1975) and Gerber (1979) discussed the interpopulation differences. They also mapped its distribution in the Alps. In 1927 O. Bang-Haas described a close relative of *N. cervini* from the Sayan Mountains he named "*Orodemnias püngeleri*". Specimens of related taxa have been found in new areas later on : the Kola Peninsula (Kol'skiy poluostrov) in northwestern Russia (Kusnezov, 1935 ; Torstenius, 1971 ; Sotavalta *et al.*, 1984) and northern Sweden. The latter population has been described by Torstenius (1971) as *Orodemnias cervini* ssp. *fridolini* ; this name was mentioned by Kusnezov (1935) as a nomen nudum. Specimens of the *Orodemnias cervini*-complex were also reported from Mongolia (Alberti, 1971) and Kamchatka (Sedykh, 1979). Later *Orodemnias* Wallengren, 1885 was synonymized with *Grammia* Rambur, 1866 and thus Leraut (1980) has placed *cervini* among species of that genus. However, Ferguson (1984) showed the taxa *cervini*, *puengeleri* and *fridolini* to differ in many characters from the type-species of *Grammia*, *Bombyx quenseli* Paykull, 1793 and established for them the genus *Holoarctia*.

There has been confusion about the connections between different taxa described and specimens of this group from different regions. Ferguson (1984, 1985) considered *Holoarctia cervini*, *H. puengeleri* and *H. fridolini* to be distinct species and reported *H. fridolini* for the first time for the Nearctic region from Alaska. He also transferred *Neoarctia sordida* McDunnough, 1921 to *Holoarctia* and treated it to be identical with *H. cervini* without examination of the genitalia. As a result he stated that both, *H. cervini* and *H. fridolini*, are holarctic species and that distribution of *H. puengeleri* is restricted to the Sayan Mountains. Sotavalta *et al.* (1984) described the early stages of *H. fridolini* from Scandinavia and presented photographs of everted male vesicas and female bursae. They considered *H. cervini* and *H. fridolini* to be conspecific, as they could not find any differences in the internal genitalia. They mentioned, however, that there were differences between the taxa in wing shape and colouration. They also studied one specimen of *H. puengeleri*, but did not illustrate its genitalia for comparison.

Dubatolov (1985a) described *Holoarctia marinae* from the Altai Mountains on the basis of external genitalia and wing characters. He


Figs. 1-6. *Holoarctia* spp. : 1 — *H. puengeleri fridolini* ♂, wingspan 38 mm, Chukchi Peninsula, 64°55′ N 172°36′ W, 45 km N. of Provideniya, Russia ; 2 — *H. puengeleri puengeleri*, lectotype ♀, wingspan 41 mm, Obo Sarym, Sayan Mts., Russia ; 3 — *H. puengeleri puengeleri* f. *bicolor*, type ♂, wingspan 38.5 mm, Chulugaischa, Mondy, Sayan Mts., Russia ; 4 — *H. puengeleri puengeleri* ♀, wingspan 43 mm, Malyi Okonon river, Stanovoi Mts., Russia ; 5 — *H. puengeleri puengeleri* f. *immaculata*, type ♂, wingspan 34 mm, Sayan Mts., Russia ; 6 — *H. marinae*, holotype ♂, wingspan 34 mm, Onguday, Altai Mts., Russia.

also considered all other taxa and specimens from Alaska, the former Soviet Union and Scandinavia to be conspecific and merged them (Dubatolov, 1985b) into one holarctic species, *H. puengeleri*. However, later on he reconsidered the status of *H. puengeleri* and *H. fridolini* and considered them to be conspecific with *H. cervini* and accepted them as subspecies (Dubatolov, 1990). He also doubted the specific status of *H. marinae*.

This article presents a review of the genus *Holoarctia* based upon formerly unrecognized characters of the internal genitalia.

## Material and Methods

The examined specimens are listed under each taxon studied. Following abbreviations of institutions and museums are employed throughout the text :

BIN — Biological Institute, Novosibirsk, Russia ; ZMH — Finnish Museum of Natural History, Zoological Museum, Helsinki, Finland ; MNHB — Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany ; ZISP — Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia ; TLMF — Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria.

The genitalia were mounted by using the methods described by Lafontaine & Mikkola (1987). Both male vesicas and female corpus bursae were first everted with water and then fixed with absolute alcohol. Prepared genitalia were kept in alcohol until figured by using Leitz Wild M 10 stereomicroscope. The genitalia were not embedded into slide mounts before this, because three-dimensional structure of genitalia makes the interpretation of characters difficult. The length of forewing and the total wing span of all specimens studied was measured. The antennae, head, body and legs as well as wing pattern and colouration were studied as described in Sotavalta (1965) and Ferguson (1985). The terminology used follows them.

## *Holoarctia* Ferguson, 1984

*Proc. ent. Soc. Wash.* 86 : 452.
Type-species by original designation : *Nemeophila cervini* Fallou, 1864, *Ann. Soc. ent. Fr.* 4 (4) : 23, pl. 1.

External characters. Medium-sized tiger-moths, wingspan 28-39 mm in males and 31-43 mm in females. Forewing length 12-19 mm in males and 11-21 mm in females. Forewing pattern comprises five transverse pale bands present at costa. The transverse bands are fused

or broken so that only three of them meet the inner margin of the forewing. The primary longitudinal pattern at veins of the forewing may be present in some specimens and the secondary longitudinal pattern is weakly developed. The cubital and postcubital bands are always missing. The hindwing is usually pale yellow or white with a row of dark spots near the margin or may be suffused with dark. Eye elliptoid and bare, antenna bipectinate in male and serrate in female. Labial palpi long, with dark proximal and pale distal hairing. Head and thorax dark and hairy with pale stripes, abdomen dark with pale rings connecting segments. Legs pale with brown or black posterior shading on femur and tibia. In some specimens there are dark scales also on tarsomers.

Male genitalia. The shape of the external male genitalia varies widely so that the species usually cannot be identified by using these characters. Valva unilobed and simple. Juxta longer than wide, in all but one species with teeth at upper lateral margins. There is one distal spot of teeth on aedeagus. The everted vesica is at least half of the length of aedeagus. The form of the vesica is highly three-dimensional with four to five projecting diverticulae. The position of the opening of ductus ejaculatorius varies slightly between specimens.

Female genitalia. Ductus bursae strongly chitinized. Appendix bursae is expanded resembling a second corpus bursae in size. This character does not exist in any of the related genera. The opening of ductus seminalis is located at or laterally from the tip of appendix bursae.

For a detailed description see Ferguson (1984, 1985) and for a comparison of related genera see Ferguson (1985) and Dubatolov (1987, 1988).

***Holoarctia cervini* (Fallou, 1864)**
Figs. 9-12, 13, 18, 21.

*Nemeophila cervini* Fallou, 1864 : *Ann. Soc. ent. Fr.* 4 (4) : 23, pl. 1. Type-locality : Gornergrat near Zermatt, Walliser Alps, Switzerland.

*Arctia Cervini* var. *Hnateckii* Frey, 1872 : *Mitt. schweiz. ent. Ges.* 3 : 479. Type-locality : Wallis, Switzerland.

*Orodemnias cervini rougemonti* O. Bang-Haas, 1927 : In : Horae Macrolepidopterologicae Regionis Palaearcticae, p. 60, pl. 8. Type-locality : Augstbordpass, the Walliser Alps, Switzerland.

*Orodemnias cervini steitei* Röber, 1930 : *Ent. Z. Frankf. a. Main* 44 : 21. Type-locality : the Oetztaler Alps, 2900 m, Nordtirol, Austria.

*Orodemnias cervini scriniensis* Berthet, 1948 : *Rev. fr. Lép.* 11 : 369. Type-locality : "Glacier de l'Encoula", the Dauphiné Alps, France.

*Orodemnias cervini* f. *steitei* Burmann, 1952 : *Mitt. Münch. ent. Ges.* 42 : 179.
*Orodemnias cervini* f. *fumata* Burmann, 1952 : *Mitt. Münch. ent. Ges.* 42 : 182. Type-locality : "Oetztaleralpen", Austria.
*Orodemnias cervini* f. *fasciata* Burmann, 1952 : *Mitt. Münch. ent. Ges.* 42 : 182. Type-locality : "Oetztaleralpen", Austria.
*Orodemnias c. teriolensis* Burmann, 1975 : *Ber. nat.-med. Ver. Innsbruck* 62 : 124. Type-locality : "Terio. sept. Niedertal, Ötztaler-Alpen, 3000 m."
*Orodemnias c. splendida* Gerber, 1979 : *Mitt. ent. Ges. Basel* 29 : 36. Type-locality : the Oetztaler Alps, Austria, **syn. n.**
*Grammia cervini* Leraut, 1980 : Liste systématique et synonymique des Lépidoptères de France, Belgique et Corse. *Alexanor*, Suppl. : 155.
*Holoarctia cervini* Ferguson, 1984 : *Proc. ent. Soc. Wash.* 86 : 453, 454.

Material examined. ♂, "Zermatt, e. o. Huttwll, 17.4.63, M. Rüttimann" (ZMH) ; ♂, "Helvetia", Coll. Duske. (ZMH, genitalia studied) ; ♀, "Helvetia", coll. Duske. (ZMH, genitalia studied) ; ♂, "Helv., Gorner Grat, 3000 m e. l." (Coll. E. Suomalainen, genitalia studied) ; ♂, "Gornergrat, Zcht. i Huttwil, 15.9.52, Rüttimann leg." (Coll. E. Suomalainen) ; ♂, "Monte Rosa" (ZISP, genitalia studied) ; ♀, "2, Hel, Nf / Kol. Vel. Kn. Nikolaja Mikhailovitsha" (text in Cyrillics) (ZISP, genitalia studied) ; ♂, "Tirol, Samoar, Hütte e.l., 3000 m, 8.8.1948 / Koppeller, Innsbruck" (TLMF) ; ♂, "Tirol, Ötztal, Sammoar, Hütte 3000 m, 6.8.1948 / Koppeller, Innsbruck" (TLMF, genitalia studied) ; ♀, "e. o. 12.1.78, Eigel 5.8.76, Kreüzep. 3000 m, Ötzt. Alpen / P. Münck" (TLMF) ; ♀, "e. o. 22.1.77, Eigel. 5.8.76, Kreüzsp. 3000 m, Ötztal. Alpen / P. Münck" (TLMF, genitalia studied) ; ♂, "ex ovo BERN, ♂ Augstbord × ♀ Gornergrat, 20.4.1973, Rene DUSS" (coll. R. Johansson).

External characters (Figs. 9-12). The smallest species of the genus. Ground-colour of the forewing greyish brown with sharp yellow transverse and longitudinal bands forming a reticulation. The width of yellow reticulation on forewing varies considerably between specimens and several forms or varieties have been described on this basis. These are reviewed by Burmann (1952, 1975). The extent of grey shading on forewing varies from darkly suffused to almost missing, and the colouration of hindwing varies from almost grey to bright yellow with only a row of dark spots near the margin. These differences have been used to distinguish between populations (Gerber, 1979). The colouration of head, thorax and abdomen are as that of forewing. Antenna is bipectinate in males and serrate in females.

The adult size is largest in the Oetztaler Alps population and smallest in the type locality. In our material from the type locality the length of forewing is 13.5-15.0 mm in males (n = 5) and 15.5-16.0 mm in females (n = 2). The wingspan 28.5-33.0 mm in males (n = 5) and 32.5 mm in females (n = 2). In the Oetztaler population the length of forewing is 15.0-15.5 mm in males (n = 2) and 15.5-17.0 mm in


Figs. 7-12. *Holoarctia* spp. : 7 — *H. puengeleri fridolini* ♂, wingspan 34 mm, Nissuntjårro, Torne Lappmark, Sweden ; 8 — *H. puengeleri fridolini* ♀, wingspan 37 mm, Nissuntjårro, Torne Lappmark, Sweden ; 9 — *H. cervini* ♂, wingspan 28.5 mm, Zermatt, Wallis, Switzerland ; 10 — *H. cervini* ♀, wingspan 32.5 mm, Zermatt, Wallis, Switzerland ; 11 — *H. cervini* ♂, wingspan 32.5 mm, Oetztaler Alps, Austria ; 12 — *H. cervini* ♀, wingspan 32.5 mm, Oetztaler Alps, Austria.

females (n = 2). The wingspan 32.5-33.5 mm in males (n = 2) and 32.5-36.0 mm in females (n = 2). In a male from a crossing between Augstbord and Gornergrat populations the wingspan is 28.0 mm and the forewing length is 13.5 mm.

Male genitalia (Fig. 13). Valva simple, tapering towards apex. The width of valva is variable, on the average broader than in *H. puengeleri.* Juxta bears teeth on the lateral margins, aedeagus with a group of spines at distal end, near the opening of vesica. Vesica is more than half of the length of aedeagus. The opening point of ductus ejaculatorius (arrow) is located at the middle of the distal third of the vesica diverticle.

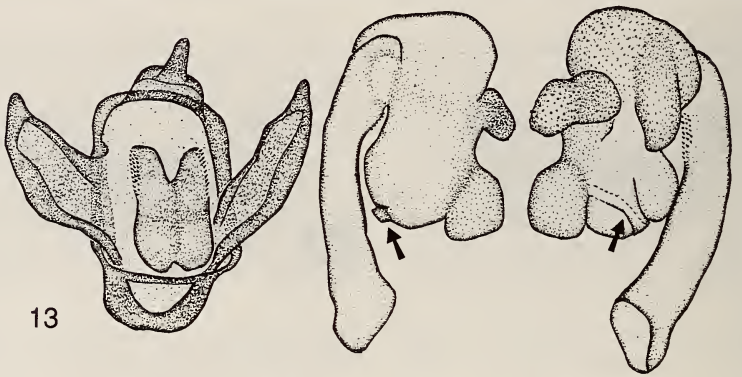



Fig. 13. Male genitalia of *Holoarctia cervini*, Zermatt, Wallis, Switzerland. Aedeagus with everted vesica shown from opposite directions (arrow indicates the opening point of ductus ejaculatorius).

Female genitalia (Fig. 18). Ductus bursae strongly chitinized, appendix bursae unusually broadened, resembling an additional corpus bursae. The opening of ductus seminalis (arrow) is located at the distal tip of appendix bursae. This is the strongest character to distinguish *H. cervini* from *H. puengeleri.*

We did not find any differences in genitalia between specimens from the type locality and the Oetztaler Alps.

Distribution (Fig. 21). The area of Zermatt in Wallis, Switzerland (nominotypical form) ; mountains between Turtmanntal and Mattertal in Wallis, Switzerland (*H. cervini hnateckii* — Gerber, 1979) ; Dauphiné Alps in France ; Oetztaler Alps in Austria (*H. cervini steitei*) and Italy ; Graubünden Alps in Switzerland.

REMARKS. Burmann (1975) placed the populations of *Holoarctia cervini* into two subspecies : *H. c. cervini* from the area of Wallis in Switzerland and described *H. c. teriolensis* from the Oetztaler Alps. Gerber (1979) described *H. c. splendida* also from the Oetztaler Alps. However, as noted by Ferguson (1985) *H. cervini steitei* (Röber, 1930) was described from the same locality and this is the oldest available name. The names *H. c. teriolensis* and *H. c. splendida* must therefore be treated as a junior subjective synonyms of *H. c. steitei.* Burmann based the distinction of the Oetztaler population on bigger size and more rounded forewing. The type series of *teriolensis* as well as the material from the Walliser Alps used by Burmann (1975) for comparison were reared from eggs and larvae, and the conditions under which they were reared could have caused these differences. However, Gerber (1979) used specimens collected in the wild and found the same differences between specimens from the type locality and these of the Oetztaler population. He also found the specimens from the area of Augstbordpass in Wallis to differ from the nominotypical form. These specimens are larger in size and paler in colouration, with more restricted dark shading on forewing. The hindwing is more extensively yellow with only a dark spots series near the margin. Gerber considered *H. cervini hnateckii* (Frey, 1872) to be described from this area by comparing the original description and his material, and stated the name to be valid for this population. The differences between populations are reviewed in more detail by Gerber (1979).

It seems obvious that there are constant, genetically fixed differences in wing colouration and size between the populations of *H. cervini* in the Alps. Our material does not allow a comprehensive study on this issue, but we question whether it is reasonable to consider these taxa as subspecies inside such a restricted geographical area, or just local forms, which bear the same biological information.

***Holoarctia marinae* Dubatolov, 1985**
Figs. 6, 14, 21.

*Ann. ent. Fenn.* 51 : 57. Type-locality : Onguday, Altai Mountains, Russia.

MATERIAL EXAMINED. Holotype ♂, 2.7.1908, Onguday, A. Jakobson leg. (ZISP, genitalia studied).

EXTERNAL CHARACTERS (Fig. 6). Resembles *H. cervini* in external appearance. Ground colour of forewing brown as in *H. cervini*, but the brown-yellow reticulation is more suffused and the hindwing is more intensely yellow. Head, thorax and abdomen have the same

colouration of brown and yellow stripes. Male antenna is shortly bipectinate. Wingspan 34.0 mm, forewing length 16.0 mm in the holotype ; according to Dubatolov (1985a) it is 14 mm in the male paratype.

Male genitalia (Fig. 14). The external genitalia like those in *H. cervini*, but the marginal teeth of juxta are missing. Vesica is shorter than in *H. cervini*, about half of the length of aedeagus. On the distal part of vesica there are two large diverticulae, instead of three, and the opening point of ductus ejaculatorius (arrow) is located on the diverticulum proximal to aedeagus. Because of differences in the length and structure of the vesica we consider *H. marinae* to be a separate species.

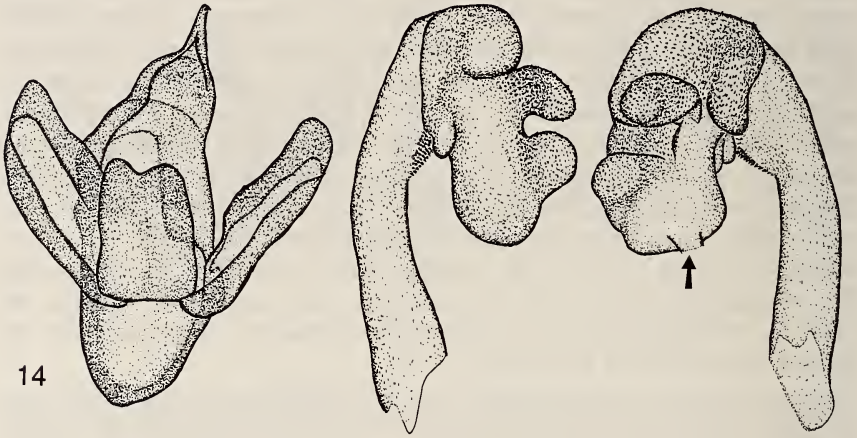



Fig. 14. Male genitalia of *Holoarctia marinae* holotype. Aedeagus with everted vesica shown from opposite directions (arrow indicates the opening point of ductus ejaculatorius).

Female genitalia. Not studied.

Distribution (Fig. 21). Known only after four specimens from the Altai Mountains in southern Siberia (Dubatolov, 1985a, 1985b, 1990).

Note 1. When examining the holotype we have pointed out that in the original description (Dubatolov, 1985a) the photographs of the holotype and the paratype have accidentally changed places. This does not effect changes in the validity of types because their label information is explained in the text, and the holotype is demonstrably designated with a red label on pin.

Note 2. Draudt (1931) described a yellow form of *H. puengeleri* as f. *flava*, probably from the Sayan Mountains. The description is

short but the type specimen shown on the colour plate very much resembles *H. marinae*. Unfortunately, we were not able to locate this specimen. If it is found in the future, it should be checked whether it is conspecific with *H. marinae*. In that case the name *H. marinae* would become a junior subjective synonym of *H. flava*.

***Holoarctia sordida* (McDunnough, 1921)**
Fig. 21.

*Neoarctia sordida* McDunnough, 1921 : *Can. Ent.* 53 : 167. Type-locality : Banff, Alberta, Canada.
*Holoarctia cervini* Ferguson, 1984 : *Proc. ent. Soc. Wash.* 86 : 453, 454.

MATERIAL. No material available.

This taxon was diagnosed by Ferguson (1984, 1985) and according to him it resembles very much *H. cervini* in the exterior appearance (Ferguson, 1985 : figs 23, 24). He identified *H. sordida* as *H. cervini* without examination of the genitalia. By 1985, *H. sordida* was known only after two females from the Rocky Mountains in Alberta and British Columbia, Canada. Unfortunately, the type specimen has lost its abdomen and Ferguson did not dissect the other known specimen. *H. sordida* may be a distinct species or a subspecies of *H. puengeleri*, but the connection to *H. cervini* seems improbable because of the large distributional gap between the Alps and Rocky Mountains.

***Holoarctia puengeleri* (O. Bang-Haas, 1927), stat. rev.**
Figs. 1-5, 7-8, 15-17, 19-21.

EXTERNAL CHARACTERS (Figs. 1-5, 7-8). The most variable species in the genus *Holoarctia*. Forewing ground colour black with white reticulation. The width of the white reticulation varies in specimens from different regions and is widest in the surroundings of Lake Baikal and on both sides of the Bering Strait. In northern Fennoscandia and in the Altai Mountains this reticulation is narrow. The hindwing is suffused almost whole or completely black in Fennoscandia and in the Altai Mountains, but almost white with a series of black spots near the margin in the Baikal region and in Beringia. The size of moths is largest in the mountains of southern Siberia and decreases northwards. Also the forewing is widest in the south and gets narrower towards the north. Male antenna bipectinate, female antenna serrate. Colouration of head, thorax and abdomen is as that of forewing, with black and white hairing. Antennae and legs whitish with a varying number of black scales.

Male genitalia (Figs. 15-17). Valva simple, narrower than in *H. cervini*. Juxta bears teeth at lateral margins. Vesica compact with a few projecting diverticulae resembling that of *H. cervini*, but on the distal part of vesica there are two projecting diverticulae instead of three. The opening of ductus ejaculatorius (arrow) is located on the diverticulum proximal to aedeagus.

Female genitalia (Figs. 19-20). Appendix bursae dilated like if it is another corpus bursae. The opening of ductus seminalis (arrow) is located laterally from the tip of appendix bursae unlike *H. cervini*. This is the most confident character to distinguish *H. puengeleri*.

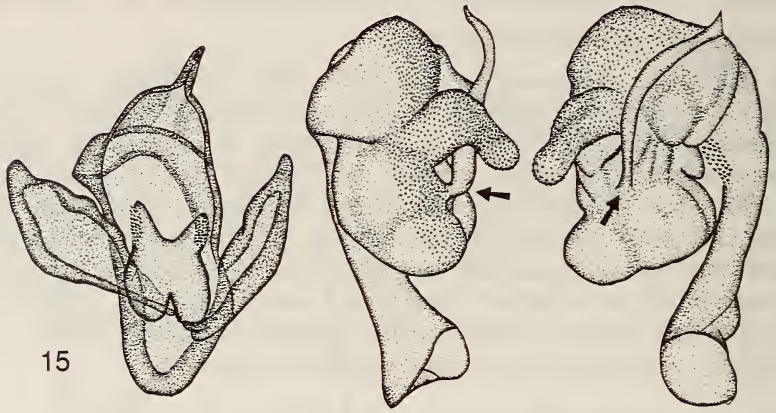



Fig. 15. Male genitalia of *Holoarctia puengeleri puengeleri*, type of f. *immaculata*. Aedeagus with everted vesica shown from opposite directions (arrow indicates the opening point of ductus ejaculatorius).

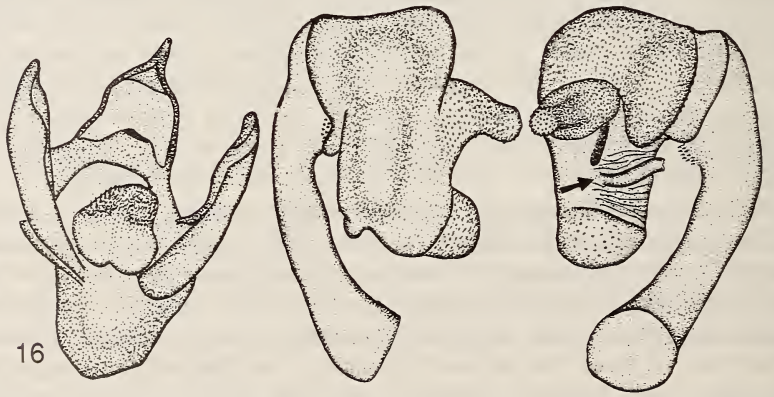



Fig. 16. Male genitalia of *Holoarctia puengeleri fridolini*, Chukchi Peninsula, Russia. Vesica poorly inflated (arrow indicates the opening point of ductus ejaculatorius).

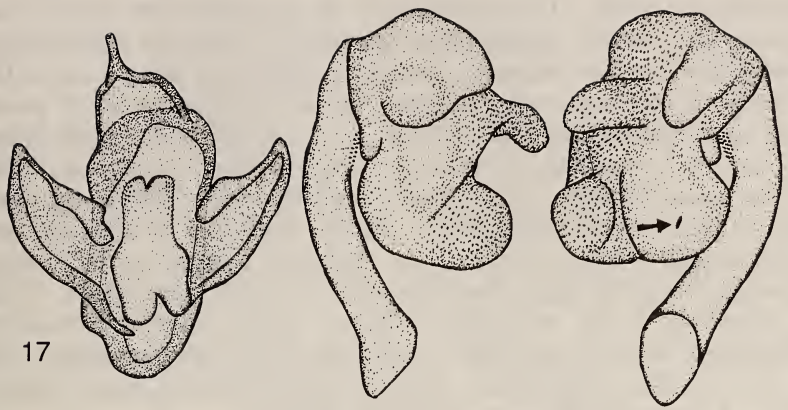
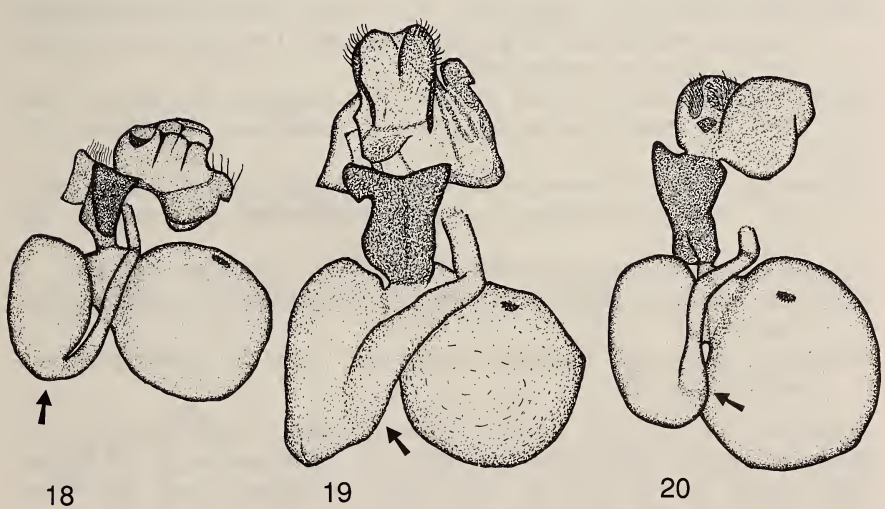



Fig. 17. Male genitalia of *Holoarctia puengeleri fridolini*, Nissuntjårro, N. Sweden. Aedeagus with everted vesica shown from opposite directions (arrow indicates the opening point of ductus ejaculatorius).




Figs. 18-20. Female genitalia of *Holoarctia* spp. with bursa everted : 18 — *H. cervini*, Zermatt, Wallis, Switzerland ; 19 — *H. puengeleri puengeleri*, Stanovoi Mts., Russia ; 20 — *H. puengeleri fridolini*, Nissuntjårro, N. Sweden (arrow indicates the opening point of ductus seminalis).

Distribution (Fig. 21). Specimens of *H. puengeleri* are rare in collections, and samples which would completely show the variation between populations in exterior characters apparently do not exist. On the basis of specimens we examined, known populations of *H. puengeleri* may represent three subspecies : *H. p. puengeleri* (O. Bang-Haas, 1927) in the Sayan Mts., the Khamar-Dhaban Mts. (Dubatolov, 1990) and the Stanovoi Mts. ; *H. p. perunovi* (Dubatolov, 1990) in the Altai Mts. on both Russian (Dubatolov, 1985b, 1990) and Mongolian sides of the border (Alberti, 1971) ; *H. p. fridolini* (Torstenius, 1971) from N. Sweden and the Kola Peninsula over N. Siberia to Alaska. Thus, *H. puengeleri* is an arcto-alpine species having a typical holarctic distribution. We were not able to study the few known specimens from the S. Ural Mts. (Dubatolov, 1985b ; V. N. Olshvang, pers. comm.) and the Kamchatka Peninsula (Sedykh, 1979).

Remarks. We could not find any constant differences in the internal genitalia between moths from different areas and mountain ranges. However, the size of genitalia is allometrically dependent on the body size of a moth.

***Holoarctia puengeleri puengeleri* (O. Bang-Haas, 1927)**
Figs. 2-5, 15-16, 19.

*Orodemnias püngeleri* O. Bang-Haas, 1927 : Horae Macrolepidopterologicae Regionis Palearcticae : 60, pl. 8. Type-locality : Obo Sarym and Mondy Sardyk, Sayan Mountains, Russia.

*Orodemnias püngeleri* f. *bicolor* Draudt, 1931. *In* : Seitz, A. (Hrsg.), 1930-1934, Die Palaearktischen Spinner und Schwärmer, Supplement : 77, pl. 6.

*Orodemnias püngeleri* f. *immaculata* Draudt, 1931. *In* : Seitz, A. (Hrsg.), 1930-1934, Die Palaearktischen Spinner und Schwärmer, Supplement : 66, pl. 6.

*Holoarctia pungeleri* Ferguson, 1984 : *Proc. ent. Soc. Wash.* 86 : 453, 454.

*Holoarctia puengeleri* Dubatolov, 1985b. *In* : Arthropods of Siberia and Far East, p. 150.

*Holoarctia cervini* ssp. *puengeleri* Dubatolov, 1990. *In* : Arthropods and helminths, p. 152.

Material examined. ♀, 8.7.1914, Stanovoi Mts., Malyi Okonon river, Dorogostaiskij leg. (ZISP, genitalia studied) ; ♀, "Chulugaischa, Mondy, Sajan Gbg., Burgät. Republ., 3100 m Juli" (ZMH) ; lectotype ♀, "gef. Juli 16.ten, Obo Sarym." (designated by Ferguson (1985) ; a specimen figured by O. Bang-Haas (1927 : pl. 8, fig.14) and Draudt (1931-32 : pl. 6), MNHB) ; ♂, "e.l. 12.9.1929" (type of f. *immaculata*, MNHB, genitalia studied) ; ♂, "Chulugaischa, Mondy, Sajan Gbg., Burgät.[!] Republ., 3100 m Juli" (type of f. *bicolor*, MNHB, genitalia studied).

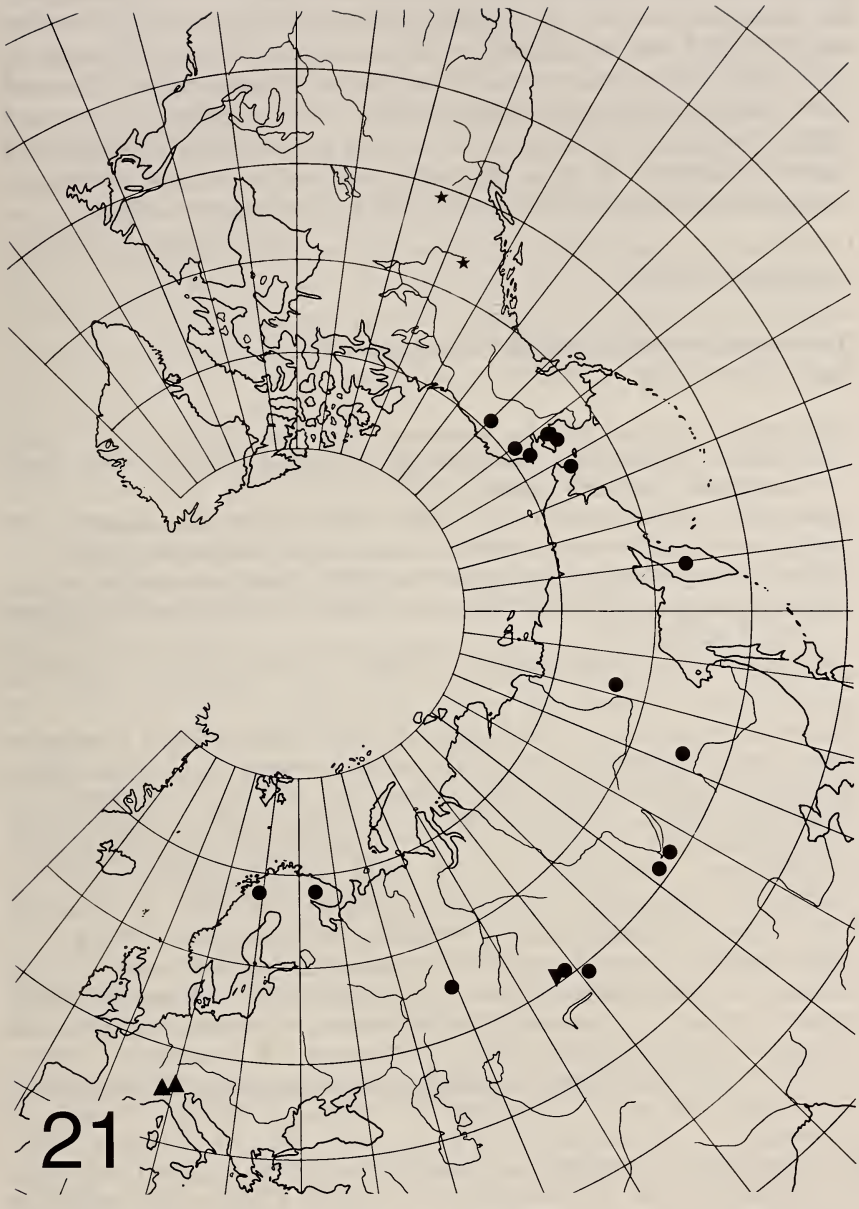



Fig. 21. Distribution of *Holoarctia* spp. : ▲ — *H. cervini*, ▼ — *H. marinae*, ● — *H. puengeleri*, ★ — *H. sordida*.

Diagnosis. The largest of three subspecies (Figs. 2-5). Wingspan 34.0-38.5 mm in males (n = 2), 39.0-43.0 mm in females (n = 3). Forewing length 12-18,5 mm in males (n = 2) and 19.0-21.0 mm in females (n = 3). The smaller male studied (the type of f. *immaculata*) is reared from a larva, which may explain its small size. According to Ferguson (1985) the length of forewing of a male in the British Museum of Natural History is 20 mm. The white reticulation on the forewing is wide and the hindwing is white with black spots near the margin.

Distribution. Sayan Mts., Khamar-Dhaban Mts. and Stanovoi Mts. in southern Siberia.

***Holoarctia puengeleri fridolini* (Torstenius, 1971)**
Figs. 1, 7-8, 17, 20.

*Orodemnias cervini* ssp. *fridolini* Torstenius, 1971 : *Ent. Tidskr.* 92 : 173. Type-locality : Nissuntjårro Mountain, E. of Abisko National Park, Torne Lappmark, northern Sweden.
*Orodemnias fridolini* Burmann, 1975 : *Ber. nat.-med. Ver. Innsbruck* 62 : 121.
*Holoarctia fridolini* Ferguson, 1984 : *Proc. ent. Soc. Wash.* 86 : 453, 454.
*Holoarctia cervini fridolini* Sotavalta *et al.*, 1984 : *Notul. entomol.* 64 : 161.
*Holoarctia puengeleri fridolini* Dubatolov, 1985b. *In* : Arthropods of Siberia and Far East : 150.
*Holoarctia cervini fridolini* Dubatolov, 1990. *In* : Arthropods and helminths : 152.

Material examined. ♂, 22.7.1926, ♂, 23.7.1926, Chibiny Mountains, tundra-zone, Tschetverikov leg. (ZISP, genitalia studied) ; ♀, 8.1931, Chibiny Mountains, Tshaska-Gadar Chain, Fridolin leg. (ZISP) ; ♂, "Sweden, To., Nissuntjårro, 700 m e.p., 12.VII.1990, R. Johansson" (coll. E. Suomalainen, genitalia studied) ; ♀, "Suecia To. ovo, 11.7.1980, Nissuntjårro, ca. 1050 möh., RN 1626/7579, G. Palmqvist" (coll. E. Suomalainen, genitalia studied) ; ♂, "SVERIGE / Nissuntjårro, To. lpm. Ova-80, e.p. 19.2.1981, G. Palmqvist & O.S." (coll. E. Suomalainen) ; ♀, "Sweden, To., Nissuntjårro, 1300 m e.p., 16.VII.1990, R. Johansson" (coll. E. Suomalainen, genitalia studied) ; 2 ♂, "Sweden, To., Nissuntjårro, 670 m e. p., 8-15.VII.1982, R. Johansson" (ZMH, genitalia studied) ; ♀, "Sweden, To., Nissuntjårro, 670 m e.p., 8.VII.1984, R. Johansson" (ZMH, genitalia studied) ; ♀, "Sweden, To., Nissuntjårro, 1200 m e.p., 10.VII.1989, R. Johansson" (ZMH, genitalia studied) ; ♂, "Sweden, To., Nissuntjårro, 1300 m e.p., 11.VII.1988, R. Johansson" (coll. R. Johansson) ; ♂, "Sweden, To., Nissuntjårro, 670 m e.o., emg. 1983, R. Johansson" (coll. R. Johansson) ; ♀, "Sweden, To., Nissuntjårro, 1250 m e.p., 10-15.VII.1982, R. Johansson" (Coll. R. Johansson) ; ♂, "USSR, Chukchi Pns., 64°55′ N 172°36′ W, 45 km N. Providenya, Per. Medved. gravel 300 m, 9.7.1991, K. Mikkola leg." (ZMH, genitalia studied).

Diagnosis. In Fennoscandia moths of this subspecies are smaller than of the nominotypical subspecies (Figs. 7-8). In our material the wingspan 31.0-34.5 mm in males (n = 8) and 33.5-37.0 mm in females (n = 4). Forewing length 15.0-16.0 mm in males (n = 8) and 15.5-17.5 mm in females (n = 4). In the type specimens of Torstenius (1971) the wingspan was 35 mm (1 ♂) and 35.5 mm (1 ♀). The width of white reticulation varies but is narrower than in *H. p. puengeleri.* Hindwing is suffused with black with a whitish stripe near the margin, or completely blackish grey.

Distribution. From northern Sweden and the Kola Peninsula (Kol'skiy poluostrov) in northwestern Russia eastwards to Yakutia, the Chukchi Peninsula (Chukotskiy poluostrov) and Alaska. The two known specimens from the S. Ural Mountains (V. N. Olshvang, pers. comm.) may also belong to this subspecies.

Remarks. According to a specimen studied by us (Fig. 1) and specimens from both sides of the Bering Strait of which we have seen photographs (Ferguson, 1984, 1985 ; Dubatolov, 1985b ; Johansson, *in litt.*), the Beringian populations may represent a distinct subspecies. The wingspan of these specimens (altogether four from the Chukchi Peninsula and eight from Alaska) is 32.0-38.0 mm in males and 36.0-39.0 mm in females. Forewing length 15.0-17.5 mm in males and 17.0-18-0 mm in females. Thus, these specimens are slightly larger than *H. p. fridolini* from Fennoscandia, but smaller than the nominotypical subspecies from southern Siberia. Their colouration is similar to the nominotypic with wide white reticulation on forewing and a white hindwing with black spots near the margin. However, these specimens have a narrower forewing, as in *H. p. fridolini.* A single male from Yakutia is similar in wing shape and size (38.0 mm — Johansson, *in litt.*) to the Beringian specimens, but it has a wing colouration typical of Fennoscandian specimens. Because more material is needed for a study of this problem, we found it better to follow Ferguson (1984, 1985) and present these specimens under *fridolini.* The status of the Kamchatka population is to be clarified later on.

***Holoarctia puengeleri perunovi* Dubatolov, 1990 comb. n.**
Fig. 22.

*Holoarctia cervini* ssp. *perunovi* Dubatolov, 1990. *In* : Arthropods and Helminths : 152.

Material examined. ♂, holotype, 16.7.1982, Kurai Chain, Taboshak, Perunov leg. (BIN, genitalia studied).

Fig. 22. *Holoarctia puengeleri perunovi*, holotype ♂, wingspan 36.5 mm, Taboshak, Altai Mts., Russia.

Diagnosis. Dubatolov (1990) described this subspecies on the basis of a specimen collected from the Russian Altai Mountains. The specimen resembles *H. p. fridolini* having narrow pale transverse bands with black forewing ground-colour and completely darkened hindwing (Fig. 22). The forewing is more rounded than in *fridolini*. Wingspan of the holotype 36.5 mm, forewing length 17.0 mm.

The specimen from Mongolia figured by Alberti (1971) is worn but its wing pattern is typical for *H. p. perunovi*, not for *H. cervini* as stated by Ferguson (1984, 1985).

## Discussion

Following the reasons expressed by Lafontaine & Mikkola (1987) and Mikkola (1992) and using so far unrecognized diagnostic characters of the internal genitalia, we suggest *Holoarctia cervini*, *H. marinae* and *H. puengeleri* to be separate species. The status of *H. sordida* demands further studies. *H. cervini* and *H. marinae* are restricted to the Alps and Altai Mountains, respectively. *H. puengeleri* is a true holarctic species with three subspecies included at present. The relationships between described subspecies and many poorly studied populations of *H. puengeleri* can be solved only on the basis of new material from numerous mountain ranges of Siberia. Especially interesting in this respect are the Ural Mountains, the Verkhoyansk Mountains in

Yakutia, the whole arctic coast of Siberia and the Dzhugdzhur Mountains connecting southern Siberia to the Beringian region.

We are aware that the number of specimens examined during this study is limited and we apparently have not seen the whole variation range in the internal genitalia. This is especially the case with *H. marinae* known to us only after the holotype. However, differences between *H. cervini* and *H. puengeleri* seem to be fairly constant.

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