

NEW RECORDS AND DISTRIBUTION OF SPECIES FROM GENUS *ARCTOPHILA* SCHINER, 1860 (DIPTERA: SYRPHIDAE: ERISTALINAE) IN SERBIA

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ABSTRACT. The genus *Arctophila* comprises large, bumblebee-like species of hoverflies (Diptera: Syrphidae). In Europe occur three species from this genus: *A. bequaerti*, *A. bombiforme* and *A. superbiens* and all of them were recorded in Serbia. Species from this genus were registered only on few mountains in Serbia and are considered rare in the country. During a survey conducted in 2018 and 2019, all three species were registered at several localities. The new findings of these species, photographs, maps of distribution and flight period diagram are presented in this paper. The descriptions of localities and observations related to the ecology of the species are also presented.

Keywords: Hoverflies, *Arctophila bombiforme*, *A. bequaerti*, *A. superbiens*, fauna, Vlasina

INTRODUCTION

Hoverflies (Syrphidae) are one of the most species-rich families of Diptera, with over 6000 described species belonging to 188 genera (THOMPSON, 2013). In Europe occur about 870 species, while the hoverfly fauna list in Serbia contains 412 species (SPEIGHT, 2016; VUJIĆ *et al.*, 2018). This family is widespread in the world and is an ecologically important group of insects that perform ecosystem services, like plant pollination, predation of plant pests and nutrient recycling (ROTHERAY and GILBERT, 2011).

Genus *Arctophila* Schiner, 1860 contains large robust bumblebee-mimic flies with long hairs on thorax and abdomen. The wing contains characteristic wedge-shaped dark spot in the middle, arista is feathered with long hairs and face is extended downwards so it forms a conical snout. Species from this genus may be confused with other bumblebee-like syrphids like *Pocota* Le Peletier & Serville, 1828 and *Criorhina* Meigen, 1822 (though they have bare arista) or *Volucella* Geoffroy, 1762 (with closed R1 vein on the wing) (VAN VEEN, 2004). Some authors include this genus in genus *Sericomyia* Meigen, 1803, together with *Conosyrphus* Frey, 1915. In Europe 3 species from genus *Arctophila* can be found: *A. bequaerti* Hervé-Bazin, 1913, *A. bombiforme* (Fallén, 1810) and *A. superbiens* (Müller, 1776). *A. bequaerti* is so far in Europe known only from the southeast (Balkan Peninsula, Turkey and Caucasus) while in Serbia it has been discovered recently (SPEIGHT, 2015; VUJIĆ *et al.*, 2016). *A. bombiforme* and *A. superbiens*

are widespread species in Europe but their range is mostly restricted to mountainous areas (SPEIGHT, 2015).

MATERIAL AND METHODS

Field surveys were conducted during 2018 and 2019 at several localities in Serbia (Table 1.). Specimens were observed and caught by the entomological net and prepared by standard procedure. The identification of specimens was based on morphological characters and performed with the use of key SPEIGHT and SARTHOU (2017). The exact coordinates and altitudes were recorded on the spot using GPS devices, and all the data were systematized in our database Alciphron (<http://alciphron.habiprot.org.rs/>), after field surveys. The maps of distribution were made using QGIS 2.18 (www.qgis.org). The collected material is deposited in the private collection of the first author and at the Department of Biology and Ecology, University of Novi Sad (FSUNS).

Table 1. A list of studied localities.

Locality	Coordinates	Altitude (m)
Derekare, Bijela Voda	42.977566 20.10404	1546
Derekare, Stari Krst	42.985134 20.117226	1450
Jadovnik, Mali Jadovnik	43.306016 19.773967	1501
Jadovnik, Ogrljača 1	43.308792 19.765884	1480
Jadovnik, Ogrljača 2	43.314985 19.76571	1400
Vlasina, Cvejina dolina	42.739738 22.297523	1411
Vlasina, Dejanova reka	42.65465 22.381875	1242
Vlasina, Gadžini	42.748945 22.306708	1369
Vlasina, Jančin potok	42.72352 22.323433	1315
Vlasina, Jančini	42.722002 22.323132	1335
Vlasina, Mali Čemernik	42.747613 22.263256	1531
Vlasina, Plavilo 1	42.729608 22.28864	1494
Vlasina, Plavilo 2	42.732037 22.290498	1475
Vlasina Polom	42.760995 22.327713	1238
Vlasina, Srednja reka	42.750458 22.29165	1361
Vlasina, Taraija	42.74191 22.342627	1270
Vlasina, Teskovo	42.779191 22.312479	1227
Vlasina, Veliki Čemernik	42.728885 22.28165	1545
Vlasina, Vlasina Rid	42.725467 22.326393	1309

Description of localities

Derekare is a place in the western part of Serbia, between Pešter plateau and the border with Montenegro. Dominant forests are of beech (*Fagus* sp.), spruce (*Picea abies* (L.) H.Karst.), silver fir (*Abies alba* Mill.) with some mountainous grasslands. Quite a lot of cattle can be found in the area, especially cows.

Locality Bijela Voda is montane grassland, close to a beech-evergreen forest and with abundant livestock. The most numerous plants are Poaceae, *Veratrum* sp., *Gentiana lutea* L. and *Parnassia palustris* L.

Locality Stari Krst is situated next to the road, in the spruce-silver fir forest. A stream is flowing nearby, and dominant plants are *Vaccinium myrtillus* L., *Rubus idaeus* L., *Sambucus racemosa* L. and *Cirsium* sp.

Jadovnik is a mountain in the southwestern part of Serbia, on the western edge of Pešter plateau, close to the town of Prijepolje. On mountain slopes dominant are forests of beech, spruce and fir, while higher parts are covered with meadows and pastures with shrubs of *Juniperus communis* L., *Rubus idaeus* L., *Ribes* sp. and *Chamaecytisus* sp. (MARKOVIĆ, 1990). In many places was evident intensive logging that can destroy pristine habitats and endanger the survival of lignicolous organisms.

Locality Mali Jadovnik is subalpine grassland surrounded by evergreen forests with dominant plants of the Asteraceae family (*Cirsium* sp., *Centaurea* sp., *Carduus* sp) and shrubs of *Juniperus communis* L. and *Rubus idaeus* L.

Localities Ogrljača 1 (Fig 1. D) and **Ogrljača 2** (Fig 1. E) are localities in the beech-evergreen forest where dominant plants next to the road were *Mentha* sp., *Centaurea* sp., *Cirsium* sp., *Veratrum nigrum* L. and Poaceae.

The plateau of **Vlasina** is in the southeastern Serbia, close to the border of Bulgaria. The lowest altitude at Vlasina is around 1200m a.s.l., making this area one of the widest and highest plateaus in the country. The area is surrounded by mountains that belong to the Rhodope Massif: Vardenik, Čemernik, Gramada (Plana) and Bukova Glava (STANKOVIĆ and LAUŠEVIĆ, 1997; RANĐELOVIĆ and ZLATKOVIĆ, 2010). Vlasina is a water-rich area with many small springs, streams and rivers. Extensive hydro technical interventions caused the formation of Vlasina Lake (BELIJ *et al.*, 2014), located in the center of the area. Geology and water caused the forming of acid soils. This is a zone of dystric brown forest soil, which develops in mountainous regions within a beech forest zone but is nowadays mostly eroded and covered by grassy vegetation. Inside of this zone, eugley and dystric cambisol (swamp) soil types are also present (RANĐELOVIĆ and ZLATKOVIĆ, 2010). Zonal beech forests are very fragmented nowadays and have been replaced by dry grassland vegetation due to strong anthropogenic pressure in the past. Other major vegetation types include silver birch (*Betula pendula* Roth) forests, developing as a succession stage and hygrophilous vegetation communities along streams and the lake itself (RANĐELOVIĆ and ZLATKOVIĆ, 2010).

Localities Cvejina Dolina and **Srednja Reka** are situated in a valley between beech forests, near to the confluence of Plavilo river into Cvejina Reka river and along the course of the Srednja Reka river. In vicinity, dominant are beech forests, shrubs such as *Rubus idaeus* and *Vaccinium myrtillus* L., umbellifers, composites and *Filipendula* sp.

Locality Dejanova Reka is situated next to the road where beech forests and fragmented mires are present. Dominant are plants that prefer mires and wetlands: *Succisa pratensis* Moench, *Epipactis palustris* (L.) Crantz, *Equisetum* sp. and *Salix* sp.

Locality Gadžini is situated next to the road in the beech-birch forest. Present are numerous shrubs of *Vaccinium myrtillus* L.

Locality Jančin Potok is located next to the road, on the beech forest edge and dominant plants are *Epilobium angustifolium* L. and *Rubus idaeus* L.

Locality Jančini is situated next to the road, between *Pinus sylvestris* L. forest and beech-birch forest.

Locality Mali Čemernik is situated in the beech forest on Čemernik mountain. Present are little puddles and numerous rotten beech trunks.

Localities Plavilo 1 and **Plavilo 2** are situated next to the Plavilo river on the Čemernik mountain. The river is surrounded by flooded meadows overgrown with *Polygonum bistorta* L., *Filipendula* sp., *Potentilla* sp., *Valeriana officinalis* L. and spruce forest. In the forest present are springs, puddles and semi-liquid mud that may be a habitat for larval development.

Locality Polom is a place in the beech-birch forest where concrete pipes were laid for transferring water from Polomska Reka river to Vlasina Lake accumulation. In this site a very pronounced anthropogenic influence is evident.

Locality Taraija is the edge of willow forest with a spring. In the surrounding area also present are forests of pine, spruce and birch.

Locality Teskovo is situated near Vlasina River, on the edge of a willow forest. The most numerous plants by the river are *Mentha* sp. and *Scabiosa* sp.

Locality Veliki Čemernik is situated on Čemernik mountain, along the course of a stream winding through coniferous forest. Quite a lot of cattle use it for pasture and water in stream is contaminated with cow feces. Stream shores are overgrown with *Vaccinium myrtillus* L., *Chamaecytisus* sp. and *Polygonum bistorta* L.

Locality Vlasina Rid is a settlement above Vlasina Lake. There are many private houses, few streams and beech-birch forests.

The entomofauna of Vlasina has been actively researched for the past few years (Lepidoptera, Odonata, Orthoptera, Hemiptera, Diptera: Syrphidae). Results indicate there are many rare, endangered, endemic and relict species in the region (PAVIĆEVIĆ *et al.*, 2014; SKEJO and IVKOVIĆ, 2015; TOT *et al.*, 2015; VUJIĆ *et al.*, 2016; ŠEAT, 2017; TOT *et al.*, 2017; TOT *et al.*, 2018; ĐUKIĆ *et al.*, 2019; PROTIĆ and NADAŽDIN, 2019).



Figure 1. Localities where *Arctophila* species have been observed and collected; A) Vlasina, Plavilo 1; B) Vlasina, Veliki Čemernik; C) Vlasina, Dejanova reka; D) Jadovnik, Ogrljača 1; E) Jadovnik, Ogrljača 2; F) Karamanica, locality bumblebee-like syrphid resembling *Arctophila bombiforme* was observed (photos by M. Vujić, 2018-2019).

RESULTS AND DISCUSSION

Altogether 41 specimens of all three *Arctophila* species occurring in Serbia and Europe were collected – *A. bequaerti*, *A. bombiforme* and *A. superbiens*.

Arctophila bequaerti Hervé-Bazin, 1913 (Figs. 2A, 3A)

Published records: VUJIĆ *et al.* (2016).

New records: Vlasina: Dejanova reka, 16.8.2019., 1♂, leg. M. Vujić; 2.9.2019., 1♀, leg. M. Vujić; Plavilo 1, 3.9.2019., 1♂, leg. M. Vujić, I. Tot; Plavilo 2, 3.9.2019., 5♂, leg. M. Vujić; Jančin potok, 5.9.2019., 1♂, leg. M. Vujić

Notes: *A. bequaerti* is a recently discovered species in Serbia and its ecology is not well known (VUJIĆ *et al.* 2016). This species is present in Turkey, southern Russia, Ukraine, Armenia and in the Balkan Peninsula (Albania, Greece, Bulgaria and certain parts of former Yugoslavia) (SPEIGHT, 2015). In Serbia *A. bequaerti* was registered only at Vlasina plateau, where it inhabits wetlands and marshes by the roads or forest edges and can be found together with *A. bombiforme* on localities Dejanova reka, Jančin potok, Plavilo 1, Plavilo 2 and Vlasina Rid. Specimens of both species were most numerous at localities Plavilo 1 and Plavilo 2. Adults were observed feeding on flowers of *Succisa pratensis* Moench, *Scabiosa* sp. and *Gentiana asclepiadea* L.



Figure 2. The habitus of species from genus *Arctophila*; A) *A. bequaerti*; B) *A. bombiforme*; C) *A. superbiens* (photos by T. Tot, 2019)

Arctophila bombiforme (Fallén, 1810) (Figs. 2B, 3B)

Published records: GLUMAC (1955); RADENKOVIĆ (2008); RADENKOVIĆ *et al.* (2013); MILIČIĆ *et al.* (2018).

New records: Đerekare: Bijela Voda, 31.7.2019., 1♂, leg. M. Vujić; Stari Krst, 31.7.2019., 1♂1♀ leg. M. Vujić; Jadovnik: Mali Jadovnik, 17.8.2019., 1♂, leg. M. Vujić; Vlasina: Vlasina Rid, 24.9.2018., 1♀, leg. T. Tot; Veliki Čemernik, 20.7.2019., 2♂1♀, leg. M. Vujić, T. Tot; Mali Čemernik, 20.7.2019., 1♂, leg. M. Vujić, T. Tot; Cvejina dolina, 25.7.2019., 3♂, leg. T. Tot; Srednja reka, 25.7.2019., 3♂, leg. T. Tot; Taraija, 25.7.2019., 1♂1♀, leg. M. Vujić; Teskovo, 13.8.2019. leg., 1♀, M. Vujić; Dejanova reka, 16.8.2019. leg., 1♂, M. Vujić; Plavilo 1, 3.9.2019. leg., 1♂, leg. I. Tot; Plavilo 2, 3.9.2019., 6♂, leg. M. Vujić; Jančin potok, 5.9.2019., 1♂, leg. M. Vujić; Jančini, 5.9.2019., 2♂ (just observed), leg. M. Vujić; Polom, 6.9.2019., 1♂, leg. I. Tot; Gadžini, 26.10.2019., 1♀, leg. I. Tot.

Notes: *A. bombiforme* is a species whose presence has long been known in Serbia (GLUMAC, 1955) and is widespread in Europe. The species is present in Scandinavia, mountainous parts of much of Europe, including Pyrenees, Apennines, the Alps, Balkan, mountain ranges in Spain, Crete and Turkey (SPEIGHT, 2015). In Serbia *A. bombiforme* was recorded on mountains Kopaonik, Šar planina, Zlatar and Jadovnik (RADENKOVIĆ, 2008; MILIČIĆ *et al.* 2018). At localities Jadovnik, Mali Jadovnik, Đerekare and Bijela Voda specimens were collected while feeding on *Scabiosa* sp. flowers in subalpine grasslands. On

locality Derekare, Stari Krst adults were observed in copulation which lasted a few seconds during the flight, some two meters above the ground. At the same spot noted were specimens frequently fling around *Vaccinium myrtillus* L. shrubs next to the stream contaminated with cow feces. At localities on Vlasina plateau specimens were mostly spotted in wetlands, marshes, at forest edges and near streams and springs. The exception is Polom, where one specimen was collected while resting on the concrete pipe transferring water from Polomska Reka river to the Vlasina Lake accumulation. *A. bombiforme* was recorded together with *A. bequaerti* at localities Jančin potok, Plavilo 1, Plavilo 2 and Vlasina Rid. This species may be also present on Karamanica Mt. (42.353432 22.337244) (Fig. 1F) and Sopotnica (43.289428 19.744572) where bumblebee-like hoverflies were also observed at beech forest edges but were not caught. Adults were observed feeding on flowers: *Succisa pratensis* Moench (Fig. 2D), *Scabiosa* sp. (Fig. 2E), *Gentiana asclepiadea* L. and *Cirsium* sp.



Figure 3. Habitus of *Arctophila* species and plants that they visit; A) *Arctophila bequaerti*, habitus of the male (photo by S. Ivković, 2019); B) *A. bombiforme*, the habitus of the male (photo by I. Tot, 2019); C) *A. superbiens*, habitus of the male (photo: I. Tot, 2019); D) *Succisa pratensis* Moench (Caprifoliaceae) (photo by M. Vujić, 2019); E) *Scabiosa* sp. (Caprifoliaceae) (photo by M. Vujić, 2019).

***Arctophila superbiens* (Müller, 1776)** (Figs. 2C, 3C)
syn. *A. mussitans* (Fabricius, 1776)

Published records: RADENKOVIĆ (2008); RADENKOVIĆ *et al.* (2013); MILIČIĆ *et al.* (2018).

New records: Jadovnik: Ogrljača 1, 17.8.2019., 1♂, leg. M. Vujić; Ogrljača 2, 17.8.2019., 2♂, leg. M. Vujić

Notes: *A. superbiens* is widespread species in Europe and its range includes Scandinavia, southward to the Pyrenees, Ireland, eastward through central and south Europe, European parts of Russia, southward from northern France. Since 1950, in Belgium and Denmark was noted a rapid decline of this species (SPEIGHT, 2015). In Serbia *A. superbiens* was registered only on two mountains, Kopaonik and Zlatar (RADENKOVIĆ, 2008; MILIČIĆ *et al.* 2018). During this survey, *A. superbiens* has been registered at two localities on mountain Jadovnik (Ogrljača 1 and Ogrljača 2). Both localities are in the beech-coniferous forest, next to the road and specimens were observed resting on leaves and flying round *Rubus idaeus* shrubs. SPEIGHT (2015) registered that *A. superbiens* shows preference for pink-colored flowers, such as *Succisa pratensis* Moench, *Scabiosa* sp., *Centaurea* sp., *Cirsium vulgare* (Savi) Ten., but also feeds on white umbellifers and yellow composites, *Ranunculus* sp., *Sonchus* sp. and *Rubus* sp. During this fieldwork, we did not observe feeding on flowers.

Specimens were collected and observed in the second half of the year. Although SPEIGHT (2015) states that *A. bombiforme* and *A. bequaerti* occur in May and June, during fieldwork we did not record species of this genus earlier than the second half of July. The latest record in a year is that of *A. bombiforme*, registered at the end of October at locality Gadžini on Vlasina plateau. An altitude and date dependency diagram is shown in Figure 4.

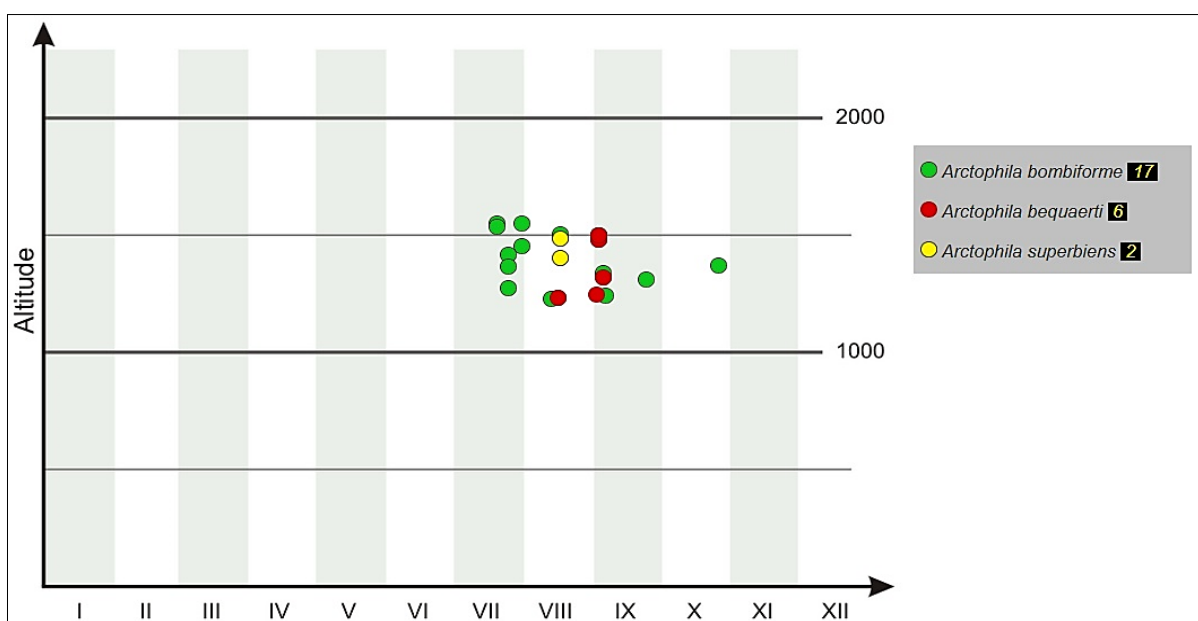


Figure 4. An altitude and date dependency diagram from the Alciphron database.

Species from genus *Arctophila* are considered rare in Serbia and previously were registered only on few mountains (Kopaonik, Jadovnik, Zlatar, Šar-planina) and on Vlasina plateau (GLUMAC, 1955; RADENKOVIĆ, 2008; RADENKOVIĆ *et al.*, 2013; VUJIĆ *et al.*, 2016; MILIČIĆ *et al.*, 2018). *A. bombiforme* was the most common at studied sites. Previously conducted studies indicate the presence of this species on three mountains in Serbia: Kopaonik, Šar-planina and Jadovnik (GLUMAC, 1955; RADENKOVIĆ, 2008; RADENKOVIĆ *et al.* 2013; MILIČIĆ *et al.* 2018). *A. bombiforme* was registered on the Vlasina plateau and in Đerekare for the first time. *A. bequaerti* was previously registered only at one locality on Vlasina plateau (Vlasina Rid) (VUJIĆ *et al.* 2016). During this survey, we registered this species on four localities on Vlasina plateau (Dejanova Reka, Plavilo 1, Plavilo 2, Jančin Potok), and many specimens, especially at localities Plavilo 1 and Plavilo 2, so that indicates the population on Vlasina plateau is large and stable. The data confirming the presence of *A. superbiens* in Serbia

was published by RADENKOVIĆ (2008), RADENKOVIĆ *et al.* (2013) and MILIČIĆ *et al.* (2018). This species was registered on mountains Kopaonik and Zlatar. *A. superbiens* was recorded for the first time on mountain Jadovnik. The distribution of species of genus *Arctophila* in Serbia and on Vlasina plateau is presented in Figures 5 and 6.

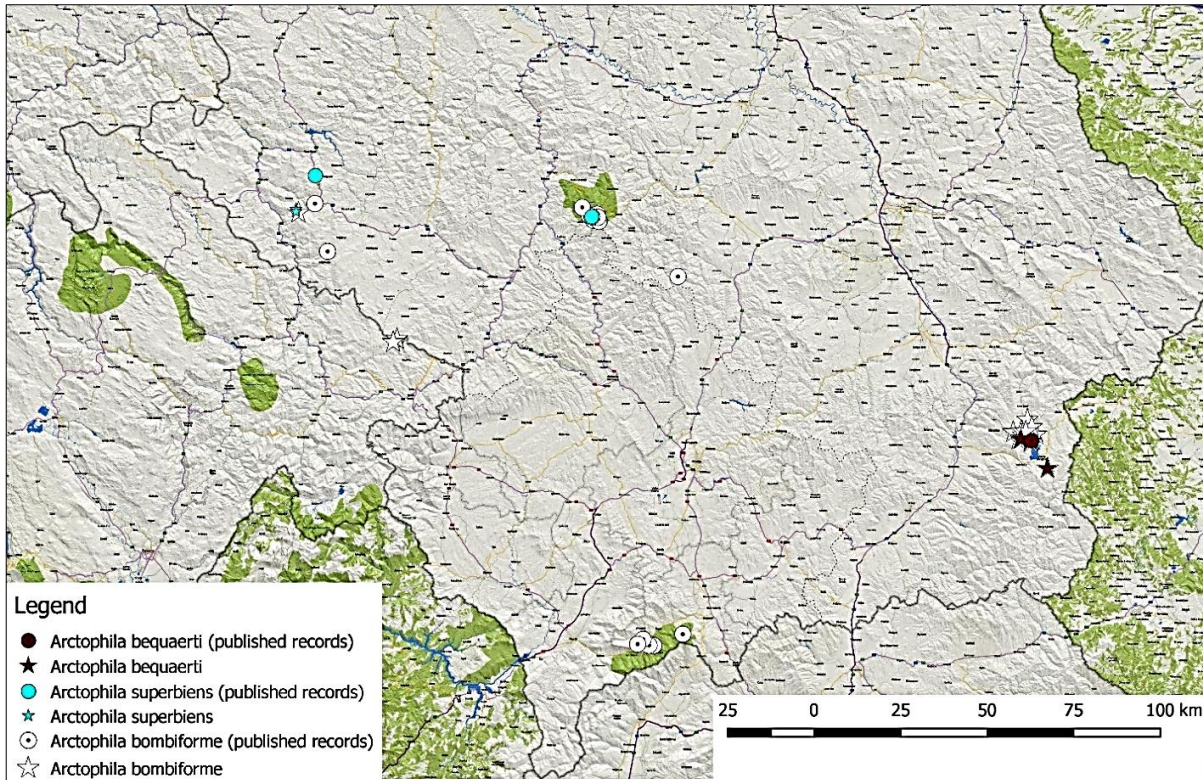


Figure 5. The distribution of species of genus *Arctophila* in Serbia.

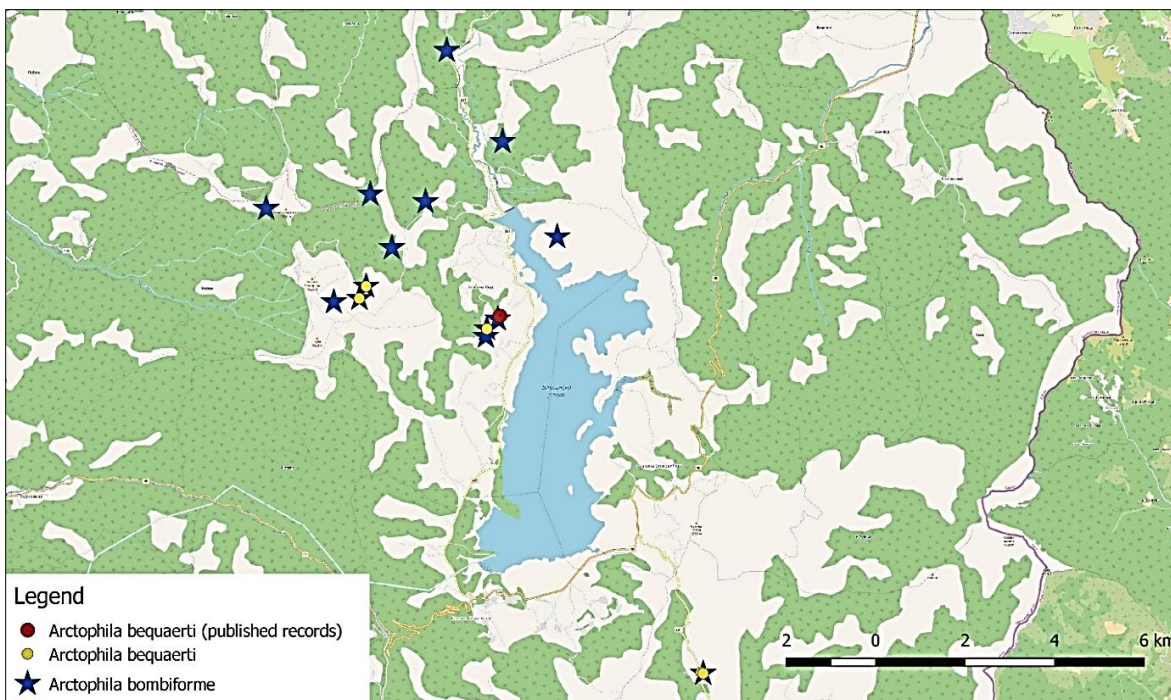


Figure 6. The distribution of species of genus *Arctophila* on Vlasina plateau.

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