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Article

The karyotype of *Artona (Fuscartona) martini* Efetov, 1997 (Lepidoptera: Zygaenidae, Procridinae, Artonini)

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Abstract

After the last revision of Procridinae (Efetov & Tarmann 2024b) this subfamily consists of five tribes: Thyraasiini, Pollanisini, Artonini, Cleleini, and Procridini. Hitherto, the karyotypes were known only for Pollanisini and Procridini. This paper presents information about the haploid chromosome number ($n = 31$) that is determined for the first time for a representative of the tribe Artonini, viz. *Artona martini* Efetov, 1997. The previous information on 'Artonini' (Efetov *et al.* 2015) refers to *Pollanisus commoni* Tarmann, 2004, which is now a species of the tribe Pollanisini.

Key words haploid chromosome number; Zygaenidae, Procridinae; Artonini; *Artona martini*.

Introduction

There are some groups in Lepidoptera with extremely variable chromosome numbers even in closely related species. In butterflies we know this is the case for such groups as the genera *Agrodiaetus* Hübner, 1822 (Lycaenidae) and *Erebia* Dalman, 1816 (Nymphalidae). Previously, we have discovered that an extreme high variability of chromosome numbers is also present in the family Zygaenidae and especially in the subfamily Procridinae (Efetov 1998b, 2001b, c, 2004; Efetov & Tarmann 1999a; Efetov *et al.* 2003, 2004, 2015, 2025; Efetov & Parshkova 2003, 2004, 2005). After the last revision of Procridinae (Efetov & Tarmann 2024b) this subfamily consists of five tribes: Thyraasiini Efetov & Tarmann, 2024; Pollanisini Efetov & Tarmann, 2024; Artonini Tarmann, 1994; Cleleini Efetov & Tarmann, 2024; and Procridini Boisduval, 1828. The further investigation of the karyotypes as well as genetics, morphology and biology of the Zygaenidae could be very important for understanding evolutionary relationships and the systematic position of species in this family (Can *et al.* 2019; Efetov 1996a, b, 1997a, b, 1998a, 1999, 2001a, b, 2006, 2010; Efetov *et al.* 2006, 2011, 2014, 2018, 2019a–c, 2022, 2023, 2024a, b; Efetov

& Gorbunov 2024; Efetov & Hayashi 2008; Efetov & Knyazev 2014; Efetov & Savchuk 2009; Efetov & Tarmann 1999b, 2013a, b, 2014, 2016a, b, 2017a, b, 2024a; Knyazev *et al.* 2015; Mirić *et al.* 2024; Vrenozi *et al.* 2019; Yardim *et al.* 2024).

Hitherto, in the subfamily Procridinae the karyotypes were known only for Pollanisini and Procridini. This paper for the first time presents information about the karyotype for a representative of the tribe Artonini. The previous information on ‘Artonini’ (Efetov *et al.* 2015) in fact belongs to *Pollanisus commoni* Tarmann, 2004, which is now a species of the tribe Pollanisini.

In the subfamily Zygaeninae the haploid chromosome number in the majority of previously studied species is 30 (Lukhtanov & Kuznetsova 1988; Tremewan 2002, 2006; Efetov & Parshkova 2003) whereas the Procridinae species (tribe Procridini) show a large variability of the karyotypes (haploid chromosome numbers from 12 to 47) (Efetov 2001a, b; Efetov & Parshkova 2005).

Materials and methods

As an object for investigation, we chose the East Asian species *Artona (Fuscartona) martini* Efetov, 1997, that was recently introduced to Europe (northern Italy) (Marianelli *et al.* 2020). In 2020 we asked our Italian colleagues Dr Leonardo Marianelli and Dr Immacolata Iovinella to send us adult larvae of *A. martini* from the vicinity of Genova (Liguria). Our friends kindly sent us 20 larvae fixed in a mixture of ethanol / glacial acetic acid in the volume ratio 3:1. Unfortunately, the larvae were fixed too late in the season and most of them turned out after dissection to be females. However, for our karyological investigations male testes are necessary. We found only one male among these 20 specimens, but it did not give a result. Therefore, we (Efetov and Tarmann) decided to visit the locality ourselves and collect as many larvae of this pest-species as possible. On 18 September 2022 we visited the locality Scaruglia, river Lavagna (province of Genova, Liguria) and collected larvae of *A. martini* (Figure 1).



Figure 1. Adult larva of *Artona (Fuscartona) martini* Efetov, 1997. Italy, Liguria, vic. Genova, 2022. Photo: K.A. Efetov.

For karyological analysis only males were used. When the larvae began to spin cocoons on 28 September 2022 the testes were removed from the dissected abdomens and then were immediately fixed in a solution of 3 parts ethanol to 1 part of glacial acetic acid. On 17 March 2023, the gonads were stained in 2 % lacto-acetic orcein. On 2 June 2023 temporary slides were prepared in a drop of 40 % lactic acid by using the squash method. Investigation of the karyotype and calculation of the number of chromosomes was carried out in the metaphase stage with the help of light microscopy using a LOMO MICMED-6 (Russia), x 100 oil immersion objective. The images were obtained by a digital camera SONY NEX-6 (Japan).

Results and discussion

The colour of the testes of *Artona martini* is pink.

During the experiments we obtained several metaphase plates of good quality with a haploid chromosome number: $n = 31$ (Figure 2).

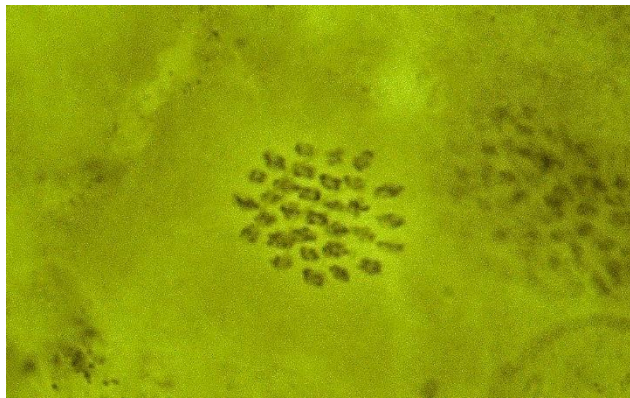


Figure 2. *Artona (Fuscartona) martini* Efetov, 1997. Meiotic metaphase of spermatogenesis. Haploid chromosome number: $n = 31$. Male specimen No. 5, preparation 531.5b. Photo: K.A. Efetov.

30–31 is the modal haploid chromosome number for Lepidoptera generally (Robinson, 1971; 1990; Lukhtanov & Kuznetsova, 1988).

30 is also characteristic for the subfamily Zygaeninae (Zygaenidae) (Lukhtanov & Kuznetsova 1988; Tremewan 2002, 2006; Efetov & Parshkova 2003) and 31 for the subfamily Chalcosiinae (Efetov *et al.* 2003).

In some species of the tribe Procradini of the subfamily Procridinae 31 is also a common number (Efetov, 2004). However, in many species of this subfamily the haploid chromosome numbers differ from the modal. In species of the subgenera *Roccia* Alberti, 1954, *Tremewania* Efetov & Tarmann, 1999, and *Jordanita* Verity, 1946, of the genus *Jordanita* Verity, 1946, the haploid chromosome number is 31, while in *Jordanita (Solaniterna) subsolana* (Staudinger, 1862) it is 27. The same situation is found in the genus *Adscita* Retzius, 1783. While the majority of species of the subgenera *Adscita* Retzius, 1783, and *Tarmannita* Efetov, 2000, have the haploid chromosome number 31, in *Adscita (Adscita) jordani* (Naufock, 1921) it is 30, in *Adscita (Eurasiterna) geryon* (Hübner, 1813) it is 32 and in *Adscita (Procriterna) subtristis* (Staudinger, 1887) it is 17. The reduced number of chromosomes (compared with the modal) is also seen in *Illiberis (Primilliberis) rotundata* Jordan, 1907 ($n = 25$) and *Theresimima ampellophaga* (Bayle-Barelle, 1809) ($n = 28$). The most dramatic differences in chromosome numbers were found in the genus *Rhagades* Wallengren, 1863, where the haploid chromosome numbers in different species can vary from 12 to 47.

Earlier we determined the haploid chromosome number for *Pollanisus commoni* (Procridinae, Pollanisini). It was 31 (Efetov *et al.* 2015). According to morphology Pollanisini and Artonini represent ancient groups of Procridinae. As we have now determined the haploid chromosome number for Artonini ($n = 31$), which is also modal, we can conclude that the variability in chromosome numbers in Procradini could possibly be an evolutionary young (apomorphic) character.

Conclusion

For the first time the haploid chromosome number ($n = 31$) was determined for a representative of the tribe Artonini, viz. *Artona martini* Efetov, 1997 (Zygaenidae, Procridinae).

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