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A new record of gynandromorphism in *Trichopria nigra* (Nees, 1834)

(Hymenoptera, Diapriidae, Diapriinae)

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Gynandromorphism is a rare condition known to occur in various taxa, such as arthropods. It exists in different forms and describes the occurrence of male and female sex-specific characteristics on one single individual. In this study, we investigate a hymenopteran specimen of *Trichopria nigra* (Nees, 1834) with lateral gynandromorphism. Like many species within the Diapriidae family, *Trichopria* shows sexual dimorphism. Due to extreme levels of that dimorphism and due to uneven sexes distribution in the populations, the association of males and females is often hard. The condition of lateral gynandromorphism presents therefore an unexpected but highly useful opportunity to align both sexes reliably.

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Introduction

Gynandromorphism describes the occurrence of male and female sexspecific characteristics that are found on one single individual (Seifer 2008, Baranov & Perkovsky 2014, Comério et al. 2015). It is a well-known phenomenon among arthropods (Szabad & Nöthiger 1992, Blair 2003), with cases having already been documented as early as in the early 19th century (Dalla Torre 1898).

Gynandromorphism can be expressed in different forms, namely (1) along the lateral axis, (2) along the anterior-posterior axis, and (3) as a mosaic throughout the entire body. For (1), individuals display morphological characters of one gender on the right side of the body, and those of the other gender on the left. For (2), traits of one gender appear on the anterior side of the individual's body while the traits of the other gender appear on its posterior side. For (3), characters of both genders appear all over the individual's body in a puzzle-like structure (Martin 1995, Baranov & Perkovsky 2014).

There are several reasons for the occurrence of gynandromorphism. On one hand, innate genetic modifications, such as the elimination of sex chromosomes (Laidlaw & Tucker 1964, Mori & Perondini 1980) or partial fertilization of haplodiploid animals (Tulgetske 2010) can be responsible. On the other hand, gynandromorphism can be triggered artificially by bacterial (e. g., *Wolbachia pipientis* Hertig, 1936) or nematode parasites (e. g., Mermithidae) (Rempel 1940, Martin 1995, Negri et al. 2009). Moreover, environmental changes such as increasing temperatures or centrifugation (Kawamura 1979) can induce the appearance of gynandromorphic phenotypes.

Hymenopterans (bees, ants, and wasps) show sexual dimorphism commonly and are prone to gynandromorphism. That might be the reason why this rare condition is documented on a regular basis (Wilson 1962, Caltagirone 1970, Pereira et al. 2003, Wcislo et al. 2004, Turrisi et al. 2022). Various cases are also already known within the highly sexually dimorphic family Diapriidae (Sveum 1980, Comério et al. 2015). Some of those cases were documented for

Fig. 1. A. Gynandromorphic *Trichopria nigra* specimen, total, lateral view; **B.** difference in male and female antenna (schematic).

the genus *Trichopria* (Bin 1976, Rajmohana & Narendran 1999). In the framework of the German Barcode of Life (GBOL III: Dark Taxa) project, a specimen of *Trichopria nigra* was found, the first individual of that species to exhibit that rare condition.

Methods

The specimen of interest (accession number: ZSM-HYM-33107-B10) was collected in July 2020 in a private garden in Malsch, Baden-Württemberg, Germany (15 km south of Karlsruhe) using a Malaise trap. Insect bulk samples were stored in 80 % EtOH denaturant.

The specimen was identified by its morphology as *Trichopria nigra* (Nees von Esenbeck, 1834) by Ingmar Wall using the Nixon (1980) key. DNA barcoding was conducted in Guelph, Canada at the Centre for Biodiversity Genomics. The obtained genetic barcode ADU7317 confirmed the morphologically determined identification. The specimen was dry mounted and is now stored at the Bavarian State Collection of Zoology in Munich (ZSM). Photographs were taken with an Olympus camera E-M10 and a Novoflex Mitutoyo Plan Apo 5x microscope lens. The manufactures' software, OM Capture (version 3.0), was used to take deep-focused images by stacking 70–130 individual images. The images were subsequently stacked using the program Helicon Focus (version 8). References were added using Photoshop CS2 freeware.

Results

The specimen displays both male- and female-specific morphological characters. The right half is male, the left one female (all figures). The right antenna displays 14 antennomeres with a sexual modification on A4 that is male-specific (Figs 1A,B and 2). The left antenna counts 12 antennomeres, with segments A9 to A12 forming a club that is characteristic for female representatives (Fig. 1B).

Another feature displaying sex-specific variations is the wing length, which also shows a variation between the left and right body half. The left wing is 7 % shorter and 10 % more slender than the right one (Fig. 2). Wing length per se is not a character to determine the sex of a *Trichopria nigra* specimen, but a difference is clearly visible. Further indication of the division of the body is displayed in the eyes: the left eye is smaller and contains less ommatidia than the right one. In frontal view a clear asymmetry can be seen (Fig. 3A,B). The upper and lower edge of the eyes are not on the same level, a fact that has also been observed in the past (Bin 1976).

Discussion

As demonstrated, lateral gynandromorphy is a relatively easily recognizable form of teratology, unlike e. g., mosaic forms. While some insect speci-

Fig. 2. Dorsal view. Arrow: male sexual modification in A4.

mens from different families are known to differ only in the reproductive features, the investigated animal shows (as most species within the family of Diapriidae) characters all over the body, especially in the antennae. For taxa with high sexual dimorphism and partly abnormally high ratios between the sexes, both genders are often difficult to align to the species that they are. Gynandromorphic specimens present a rare chance to have a clear, side-by-side comparison. One subject of interest, the internal body parts, in particular the genitalia, were not studied. Although dried material is less suitable for scanning bioimaging approaches such as a synchrotron scan, a 3-D reconstruction could provide more insight but has not been performed yet. Such methodology, however, should be kept in mind as a method of choice when handling dry mounted gynandromorphic specimens in the future, since genitalia play an important role to identify diapriids (mainly members of the subfamily Belytinae (Nixon 1957)). Therefore, many in ethanol preserved specimens in collections around the world wait to be detected and properly examined for the first image reconstruction of a gynandromorphic genitalia apparatus.

Fig. 3. **A.** Frontal view; **B.** frontal view of the head (schematic), eye size highlighted.

References

Baranov, V. & Perkovsky, E. 2014. First record of gynandromorphy in fossil Chironomidae (Diptera) from Late Eocene Rovno amber. Chironomus, Newsletter on Chironomidae Research 27: 55–57. https://doi.org/10.5324/cjcr.v0i27.1701

Bin, F. 1976. Record of a teratological *Trichopria* Ashm. (Hymenoptera, Diapriidae). Entomologica 12: 67–70.

Blair, S. S. 2003. Genetic mosaic techniques for studying *Drosophila* development. Development 130 (21): 5065–5072.

Caltagirone, L. 1970. Gynandromorphism in the polyembryonic encyrtid *Pentalitomastix plethoricus* Cali. (Hymenoptera, Encyrtidae). Bollettino del Laboratorio di Entomologia Agraria Filippo Silvestri 28: 98–112.

Comério, E. F., Perioto, N. W. & Lara, R. I. R. 2015. A gynandromorph and teratological case in *Spilomicrus* sp. (Hymenoptera, Diaprioidea, Diapriidae). EntomoBrasilis 8 (3): 249–252. https://doi.org/10.12741/ebrasilis.v8i3.540

Dalla Torre, K. W. & Friese, H. 1898. Die hermaphroditen und gynandromorphen Hymenopteren. Berichte des Naturwissenschaftlich-medizinischen Vereins in Innsbruck 24: 1–96.

Kawamura, N. 1979. Cytological studies on the mosaic silkworms induced by low temperature treatment. Chromosoma 74 (2): 179–188.

Laidlaw, H. H. & Tucker, K. W. 1964. Diploid tissue derived from accessory sperm in the honey bee. Genetics 50 (6): 1439–1442.

Martin, J. 1995. A mutation in *Chironomus tentans* Fab. that leads to gynandromorph and mosaic formation. Pp. 55–60 in: Cranston, P. S. (ed.). Chironomids: from genes to ecosystems. Proceedings of the 12th International Symposium on Chironomidae, January 23–26, 1994. East Melbourne, Australia (CSIRO).

Mori, L. & Perondini, A. L. P. 1980. Errors in the elimination of X chromosomes in *Sciara ocellaris*. Genetics 94 (3): 663–673.

Negri, I., Franchini, A., Gonella, E., Daffonchio, D., Mazzoglio, P. J., Mandrioli, M. & Alma, A. 2009. Unravelling the *Wolbachia* evolutionary role: the reprogramming of the host genomic imprinting. Proceedings of the Royal Society B, Biological Sciences 276 (1666): 2485–2491.

Nixon, G. E. J. 1957. Hymenoptera: Proctotrupoidea, Diapriidae subfamily Belytinae. 107 pp. in: Handbooks for the identification of British insects, Vol. 8, Part 3(dii): Royal Entomological Society of London. https://doi.org/10.5281/zenodo.23920

– – 1980. Diapriidae (Diapriinae): Hymenoptera, Proctotrupoidea. 55 pp. in: Fitton, G. (ed.). Handbooks for the identification of British insects, Vol. 8, Part 3(di). Royal Entomological Society of London.

Pereira, R. A. S., Prado, A. & Kjellberg, F. 2003. Gynandromorphism in pollinating fig wasps (Hymenoptera: Agaonidae). Entomological News 114 (3): 152–155.

Rajmohana, K. & Narendran, T. 1999. An interesting teratological *Trichopria* Ashmead (Diapriidae: Proctotrupoidea) from India. Zoo's Print Journal 14 (8): 94–96.

Rempel, J. G. 1940. Intersexuality in Chironomidae induced by nematode parasitism. Journal of Experimental Zoology 84 (2): 261–289.

Seifer, R. 2008. Teratology. Pp. 333–343 in: Haith, M. M. & Benson, J. B. (eds). Encyclopedia of infant and early childhood development. Elsevier.

Sveum, P. 1980. A record of gynandromorphism in *Basalys* Westwood (Hymenoptera, Diapriidae) from Norway. Fauna Norvegica B 27: 77.

Szabad, J. & Nöthiger, R. 1992. Gynandromorphs of *Drosophila* suggest one common primordium for the somatic cells of the female and male gonads in the region of abdominal segments 4 and 5. Development 115 (2): 527–533.

Tulgetske, G. M. 2010. Investigations into the mechanisms of *Wolbachia* induced parthenogenesis and sex determination in the parasitoid wasp, *Trichogramma*. PhD thesis, University of California, Riverside.

Turrisi, G. F., Palmerini, M., Demetriou, J., Palmerini, M. & Forbicioni, L. 2022. Description of the new teratological cases including chromatic aberrations in Mutillidae (Hymenoptera, Vespoidea). Redia: Giornale di Zoologia 105: 145–162.

Wcislo, W. T., Gonzalez, V. H. & Arneson, L. 2004. A review of deviant phenotypes in bees in relation to brood parasitism, and a gynandromorph of *Megalopta genalis* (Hymenoptera: Halictidae). Journal of Natural History 38 (11): 1443–1457.