

NEW CASES OF TERATOLOGY IN LUCANIDAE AND GEOTRUPIDAE (COLEOPTERA: SCARABAEOIDEA) FROM THE PALEARCTIC REGION

Igor V. Kizub* and Maksym V. Leshchenko**

* New York Medical College, 15 Dana Road, Valhalla, 10595, New York, USA. E-mails: igor.kizub@gmail.com; ikizub_p@nymc.edu; buzzmann@ukr.net

** Independent investigator, Kyiv, UKRAINE. E-mail: entomology@mail.ua

[Kizub, I. V. & Leshchenko, M. V. 2019. New cases of teratology in Lucanidae and Geotrupidae (Coleoptera: Scarabaeoidea) from the Palearctic Region. *Munis Entomology & Zoology*, 14 (1): 108-116]

ABSTRACT: New teratological cases in *Lucanus* (s. str.) *cervus cervus* (Linnaeus, 1758) and *Lethrus* (*Furcilethrus*) *banghaasi* Reitter, 1893 (Coleoptera, Scarabaeoidea) from the Palearctic Region are described and illustrated. Anomalies affect head structures: the right maxillary palpus (unilateral heterodynamic ternary schistomely) in *L. cervus* and the left ventral mandibular process (unilateral structural deformation) in *L. banghaasi*. Short review of some known teratological cases in families Lucanidae Latreille, 1804 and Geotrupidae Latreille, 1802 is provided.

KEY WORDS: Coleoptera, *Lethrus banghaasi*, *Lucanus cervus*, teratology, Scarabaeoidea, schistomely

Teratology is a structural malformations or abnormalities in leaving organisms. Morphological anomalies are common in insects, however its occurrence is sparse. Coleoptera is one of the groups of arthropods in which numerous teratological cases have been described (Asmuss, 1835; Antoine, 1912; Balazuc, 1948; Balazuc, 1952; Abdullah & Abdullah, 1969; Stachowiak, 1982; Prisiy, 1983; Chadwick & Brunet, 1985; Cmoluch, 1985; Read, 1994; Schneider & Thoma, 2004; Ćurčić et al., 2006; Nazarenko, 2006; Thouvenot, 2006; Degallier & Yves, 2007; Vitali, 2007; Kamal et al., 2008; Ferreira, 2008; Asiain & Márquez, 2009; Clark & Neto, 2010; Ferreira, 2011; Caruso & Savini, 2012; Nazarenko, 2014; Gasca-Álvarez et al., 2017; Yi et al., 2017). Teratology in the superfamily Scarabaeoidea Latreille, 1802 is comparatively rare. Within the superfamily, structural malformations are most abundant in subfamilies Cetoniinae Leach, 1815 (Benderitter, 1896; Antoine, 1912; Martín, 2001; Gasca-Álvarez et al., 2017), Dynastinae MacLeay, 1819 (Laboulbene, 1859; Heyden, 1881; Kraatz, 1881; Viturat, 1897; Antoine, 1912; Ferreira, 1966; Monty, 1974; Krell, 1992; Gasca-Álvarez et al., 2017), and Melolonthinae Samouelle, 1819 of the family Scarabaeidae Latreille, 1802 (Doumerc, 1834; Asmuss, 1835; Spinola, 1835; Perroud, 1855; Heyden, 1881; Kraatz, 1881; Bellevoyea, 1907; Antoine, 1912; Ortuño and Hernández, 1993; Ahrens, 2006; Vasko, 2008; Ferreira, 2011; Gasca-Álvarez et al., 2017). A few cases have been reported in the family Passalidae Leach, 1815 (Antoine, 1912). Relatively lot of teratological cases has been described in the family Lucanidae Latreille, 1804 (Asmuss, 1835; Mocquerys, 1880; Heyden, 1881; Kraatz, 1881; Planet, 1896; Balbi, 1897; Frivaldszky, 1889; Pic, 1898; Antoine, 1912; Gadeau de Kerville, 1930; Cockayne, 1937; Balazuc, 1948; Maes, 1981; Klausnitzer, 1982; Háva, 2006; Ferreira, 2014) and a few cases of structural malformations have been described within the family Geotrupidae Latreille, 1802 (Asmuss, 1835; Preudhomme de Borre, 1878; Mocquerys, 1880; Heyden, 1881; Kraatz, 1881; Frivaldszky, 1889; Bellevoyea, 1907; Antoine, 1912;

Clement, 1921; Royer, 1921; Gadeau de Kerville, 1923, 1930; Samko, 1928; Paulian, 1933; Balazuc, 1948; Bunalski & Lubecki, 1990).

Modern classification of teratology in beetles has been developed by Balazuc (1948) and later modified by Prisniy (1983). However, it is not always possible to determine exact origin of malformations. Teratological changes in insects can be divided into two main groups: 1) abnormalities on genetic level such as mutations and phenocopies; 2) morphological changes on different developmental stages. Mechanical damages of imagines after the integument sclerotisation can also be taken into account. In turn, changes on different developmental stages may include i) deformations following affects of various external factors (including physical and chemical agents, viruses, and parasitism) on the pupa, or ii) physiological abnormalities elicited by changes in hormonal regulation of processes of molting, sclerotisation and melanisation. Malformations may occur in different parts of the beetle's body as aberrations in the appendages (mandibles, palpi, antennae, and legs), deformations of the head, wings, pronotum, and elytra, incomplete fusion of abdominal segments, and additional setae or perforations on the body covers.

The aim of this paper is to describe new cases of morphological malformations in imago of *Lucanus* (s. str.) *cervus cervus* (Linnaeus, 1758) (Lucanidae Latreille, 1804) and *Lethrus* (*Furcilethrus*) *banghaasi* Reitter, 1893 (Geotrupidae Latreille, 1802) from the Palearctic Region.

MATERIALS AND METHODS

The study material is deposited in the Kizub I.V. private collection (Kyiv, Ukraine). Photographs were taken by the Canon EOS 5D Mark III camera with the Canon Macro Lens EF 100 mm 1:2.8 L IS USM and the flash Nissin MF18 Macro.

RESULTS AND DISCUSSION

Lucanus (s. str.) *cervus cervus* (Linnaeus, 1758) (Fig. 1)

Material studied: 1 male: Ukraine, Kiev, Petrovskaya Alleya, 07.2001, Kizub I.V. leg. et det. **Additional material examined:** 11 normal male specimens from different regions of Ukraine.

Teratology description: The unilateral heterodynamic ternary schistomely in the right maxillary palpus (Fig. 1). Teratology affects the right maxillary palpus that presents three branches made up of smaller segments. The anomaly starts from the first palpomere which is swollen and curved inward in distal part where it gives a rise to three branches. The right outer branch consists of two palpomeri which is not differing from those of the normal left palpus. The left and inner branches share bifurcated palpomere in their basis. The terminal palpomere of the left outer branch of the palpus is similar to that of the normal left palpus, whereas the terminal palpomere of the inner branch is shortened and swollen in the basis.

Lethrus (*Furcilethrus*) *banghaasi* Reitter, 1893 (Fig. 2)

Material studied: 1 male: Tajikistan, Hazratishokh Ridge, Sarychor Pass, 15.05.1969, Mikhailov V. leg., Nikolaev G. V. det. (Figs. 2A-C). **Additional**

material examined: 1 male: Tajikistan, near Kulyab, Bodomtu vill., h = 1500 m., 22.04.2005, O. Pak leg., Vasko B. N. det. (Figs. 2D,E) plus 5 other normal male specimens from the Hazratishokh Ridge and the eastern part of the Vakh Ridge, Tajikistan.

Teratology description: The unilateral structural deformation of the left ventral mandibular process (Figs. 2B,C). The left ventral mandibular process in the middle strongly bent inward. In norm this process is directed forward and downward (Figs. 2D,E).

In comparison to teratological reports for some other Coleoptera groups, those for the Lucanidae and Geotrupidae are rather infrequent, however nonetheless numerous. Examples of such reports are presented in the Tables 1 and 2, respectively. Earlier, Bellevoyea (1907) has described unilateral heterodynamic binary schistomely in the maxillary palpus of *L. cervus*. Other described teratological cases which affect maxillary palpi in this species are referred to the atrophy of the palpi (Planet, 1896). Within other families of the Coleoptera, the schistomely in the maxillary palpi has been found in the family Carabidae, where it is quite abundant (Antoine, 1912; Ćurčić et al., 2006; Ferreira, 2011). The precise cause of this monstrosity is unknown. According to Balazuc (1948) schistomely in the maxillary palpus could result from an exterior action on the larva which caused a split in the palpal segment. In our opinion, a mere mechanical pressure would seem not to be a reasonable explanation, even if the pressure was in early stages. Such anomaly could be related to physiological or environmental influences during development, however the anomaly may also have a genetic basis or results from accidental failures in cells division. The genetic bases of the malformations are difficult to establish, mainly because most of them are characterized by diverse phenotypic expressions that may involve multiple genes and the interactions of those with the environment, or malformations can be produced by the effects of a single gene. Irrespective of the root cause, the type of palpal teratology observed in *L. cervus* is likely based on a failure in the palpomere multisegmentation during the metamorphosis.

We have not be able to find similar cases of teratology in the genus *Lethrus* Scopoli, 1777 in the literature, however, one case of malformation affected mandibles within the Geotrupidae has been described by Asmuss (1835) and a few other cases have been reported in families Lucanidae (Mocquerys, 1880; Heyden, 1881; Kraatz, 1881; Planet, 1896; Antoine, 1912; Gadeau de Kerville, 1930) and Carabidae Latreille, 1802 (Ćurčić et al., 2006). We believe that such pathology could arise as a consequence of physical impact on the ventral mandibular process at the stage of the formed pupa or at the stage of sclerotization of the integument of the imago.

Studying teratology in insects can increase our knowledge about the development processes. On the other hand, it is important because it could provide an alert for environmental pollution and harmful elements in the environment, and ecological alterations. When teratological rate in natural undisturbed populations is estimated, a higher rate can be used as a bioindicator of teratological agents in local environments.

LITERATURE CITED

- Abdullah, M. & Abdullah, A. 1969. Abnormal elytra, wings and other structures in a female *Trirhabda virgata* (Chrysomelidae) with a summary of similar teratological observations in the Coleoptera. Deutsche Entomologische Zeitschrift, 16: 405-409.

- Ahrens, D.** 2006. The phylogeny of Sericini and their position within the Scarabaeidae based on morphological characters (Coleoptera: Scarabaeidae). *Systematic Entomology*, 31: 113-144.
- Antoine, M.** 1912. Notes entomologiques. 1. Coléoptères anormaux. *Bulletin de la Société Linnéenne du Nord de la France* 41, 21 (408): 175-183.
- Asiain, J. & Márquez, J.** 2009. New teratological examples in Neotropical Staphylinidae (Insecta: Coleoptera), with a compilation of previous teratological records. *Revista Mexicana de Biodiversidad*, 80: 129-139.
- Asmuss, H. M.** 1835. Monstrositates coleopterorum. *Commentatio Pathologico-entomologica*. E. Frantzen, Paris, 86 pp.
- Balazuc, J.** 1948. La tératologie des coléoptères et expériences de transplantation sur *Tenebrio molitor* L. *Mémoires du Muséum National d'Histoire Naturelle*, 25: 1-293.
- Balazuc, J.** 1952. Un *Ergates faber* L. gynandromorphe (Col. Cerambycidae). *Bulletin de la Société Entomologique de France*, 3: 34-38.
- Balbi, E.** 1897. Difformitates et monstrositates Coleopterorum in collectione Balbi. *Il Naturalista Siciliano*, 2: 150-156.
- Bea, A-M.** 2015. Rencontre avec un *Lucanus cervus* gynandromorphe. Les Coléoptères. Le Moulin De Prey. Available from: <https://www.le-moulin-de-prey.org/pages/le-monde-des-coleopteres/gynandromorphisme-chez-un-lucane.ht ml>. (Date of accessed 23.03.2018).
- Bellevoeye, A.** 1907. Documents pour l'étude de la tératologie des Coléoptères. *Compte Rendu de l'Association Française Pour L'avancement des Sciences*, 36 (2): 639-649.
- Benderitter, E.** 1896. Note sur une Cétoine anormale. *Bulletin de la Société Entomologique de France*, 2: 33.
- Bunalski, M. & Lubecki, K.** 1990. Interesting case of symmetric teratology in *Geotrypes (Trypocopris) vernalis* (L.) (Coleoptera, Scarabaeidae). *Bulletin Entomologique de Pologne*, 59: 821-825.
- Caruso, D. & Savini, V.** 2012. Tres casos teratológicos de *Gioia georgia* en Choróni, Venezuela. *Entomotropica*, 27 (2): 89-91.
- Chadwick, C. E. & Brunet, B. L.** 1985. Teratology in two species of beetles (Coleoptera). *Victorian Naturalist*, 103 (3): 106-108.
- Clark, S. M. & Neto, L. A. B.** 2010. A remarkable teratological specimen of *Pseudoluperus longulus* (Leconte) (Coleoptera: Chrysomelidae) from Utah, U.S.A. *The Coleopterists Bulletin*, 64 (4): 383-385.
- Clement, P.** 1921. Un cas tératologique chez *Geotrypes stercorosus* Scriba. *Bulletin de l'Association des Naturalistes de la Vallée de Loing*, 4: 73-74.
- Cmoluch, Z.** 1985. Weitere interessante teratologische Fälle bei *Sitona lineatus* (L.) und *Dorytomus tremulae* (Payk.) (Curculionidae, Coleoptera). *Polskie Pismo Entomologiczne*, 55 (4): 819-823.
- Cockayne, E. A.** 1937. Insect teratology: Reduplication of legs in Coleoptera, Diptera, and Hymenoptera. *Transactions of the Royal Entomological Society of London*, 86: 191-200.
- Ćurčić, S. B., Brajković, M. M., & Ćurčić, B. P. M.** 2006. On some malformations in the. Carabidae (Coleoptera, Insecta) of Serbia. *Periodicum Biologorum*, 108 (2): 203-211.
- Degallier, N. & Yves, G.** 2007. Malformations et cas tératologiques chez les Coléoptères Histeridae. *Le Coléoptériste*, 10 (1): 15-18.
- Doumerc, A.** 1834. Notice sur quelques monstruosités entomologiques. *Annales de la Société Entomologique de France*, 3: 171-177.
- Fairmaire, L.** 1856. Coleoptera maroccana. *Revue et Magasin de Zoologie Pure et Appliquée*, (2) 8: 530-531.
- Ferreira, R. N.** 1966. Casos teratológicos - atrofia do tarso posterior de um *Oryctes nasicornis* L. (Col). Graellsia. *Revista de Entomologos Ibéricos*, 22: 25-27.
- Ferreira, R. N.** 2008. A teratological specimen of *Calosoma sycophanta* (L.), (Coleoptera; Carabidae) from Connecticut, USA. *Entomological News*, 119 (3): 307-309.
- Ferreira, R. N.** 2011. Three anomalies of Coleoptera (Carabidae, Staphylinidae, and Scarabaeidae) from Connecticut. *Insecta Mundi*, 0169: 1-3.
- Ferreira, R. N.** 2014. Two physical abnormalities in Coleoptera (Cerambycidae, Lucanidae) from Rhode Island, U.S.A. *Arquivos Entomoloxicos*, 10: 173-174.
- Frivaldszky, J.** 1889. Difformitates et monstrositates Coleopterorum Muszei nationalis Hungarici. *Természetrázi Füzetek*, 12 (2/3): 72-79.
- Gadeau de Kerville, H.** 1886. Séance du 24 novembre. *Annales de la Société Entomologique de France*, 6: CLXXIX-CLXXX.
- Gadeau de Kerville, H.** 1923. Description et figuration d'anomalies coléoptérologiques. *Bulletin de la Société Entomologique de France*, 18: 229-233.
- Gadeau de Kerville, H.** 1930. Description et figuration de deux Lucanidés anormaux. *Bulletin de la Société Entomologique de France*, 4: 63-64.
- Gasca-Álvarez, H. J., Deloya, C. & Reyes-Castillo, P.** 2017. Teratological cases in five species of *Cotinis* Burmeister (Coleoptera: Scarabaeidae: Cetoniinae: Gymnetini), with a compilation of teratologies in Scarabaeoidea. *The Coleopterists Bulletin*, 71 (2): 329-338.
- Háva, J.** 2006. Tři teratologičtí brouci z čeledi Silphidae, Lucanidae a Chrysomelidae (Coleoptera). *Acta Musealia*, 1-2: 22-23.
- Heyden, L.** 1881. Monströse Käfer aus meiner und der Sammlung des Herrn Prof. Doebner in Aschaffenburg. *Deutsche Entomologische Zeitschrift*, 25 (1): 105-110.
- Kamal, J., Gandi, K. & Hermes, D. H.** 2008. Report on the largest occurrence of morphological anomalies in ground beetles (Coleoptera, Carabidae). *The Coleopterists Bulletin*, 62 (1): 104-113.
- Klausnitzer, B.** 1982. Hirschkafer oder Schroter (Lucanidae). A. Ziemsen Verlag, Wittenberg Lutherstadt, Leipzig, 22 pp.
- Kraatz, G.** 1881. Monströse Käfer. *Deutsche Entomologische Zeitschrift*, 25 (1): 110-112.
- Krell, F.-T.** 1992. Verschmelzung von Antennenomeren (Symphysocerie) als Regenfall bei *Temnorhynchus repandus* Burmeister, 1847, sowie phylogenetische, taxonomische, faunistische und nomenklaturische Anmerkungen zu diversen Taxa dieser Gattung. *Deutsche Entomologische Zeitschrift*, 39: 295-367.
- Laboulbene, A.** 1859. Note sur une monstruosité de l'*Oryctes silenus*. *Annales de la Société Entomologique de France*, 30 série 7: 645-646.
- Linnaeus, C.** 1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Tomus I. Editio decima, reformata. Holmiae: Impensis Direct. Laurentii Salvii, iv + 824 pp.
- Linnaeus, C.** 1763. *Centuria insectorum quam praeside D. D. Car. von Linné proposuit Boas Johansson, Calmariensis*. In: *Amoenitates academicae; seu dissertationes variae physicae, medicae, botanicae, antehac seorsim editae, nunc collectae et auctae cum tabulis aeneis*. Tomus 6. G. Kiesewetter, Holmiae [= Stockholm]: 384-415.

- Maes, J. M.** 1981. Contribution à l'étude des Coléoptères Lucanidae Odontolabinae. Bulletin de la Institut Royal des Sciences Naturelles de Belgique, 53: 1-7.
- Martín, F. H.** 2001. Descripción de cinco casos teratológicos en Coleóptera Scarabaeoidea. Boletín de la Asociación española de Entomología, 25 (1-2): 97-102.
- Mocquerys, S.** 1880 Recueil de Coléoptères anormaux par feu M. S. Mocquerys avec introduction par M. J. Bourgeois. L. Deshayes, Rouen, 142 pp.
- Monty, J.** 1974. Teratological effects of the virus *Rhabdionvirus oryctes* on *Oryctes rhinoceros* (L.) (Coleoptera, Dynastidae). Bulletin of Entomological Research, 64: 633-636.
- Nazarenko, V. Y.** 2006; A case of teratology in weevil *Hypera transsylvanica* (Coleoptera, Curculionidae). Vestnik Zoologii, 40 (2): 181-183.
- Nazarenko, V. Y.** 2014. Morphological anomalies in Molytinae weevils (Coleoptera, Curculionidae). Ukrainian Entomological Journal, 1 (8): 69-72.
- Ortuño, V. M. & Hernández, J. M.** 1993. Several teratological cases in Coleoptera. Boletín de la Real Sociedad Española de Historia Natural (Sección Biológica), 89 (1-4): 163-179.
- Paulian, R.** 1933. Un *Geotrupes niger* Marsh. anomal. Miscellanea Entomologica, 41, 35 (2): 13-14.
- Perroud, B. P.** 1855. Description d'une monstruosité existant dans un *Rhisotrogus aestivus*. Annales de la Société Linnéenne de Lyon, 2: 325-326.
- Pic, M.** 1898. Sur quelques Coléoptères anormaux. Bulletin de la Société Entomologique de France, 4: 113-114.
- Planet, L. M.** 1896. Note sur deux Lucanus cervus anormaux. Bulletin de la Société Entomologique de France, 6: 168-169.
- Preudhomme de Borre.** 1878. Note sur des difformités observées chez l'*Abax ovalis* et le *Geotrupes sylvaticus*. Annales de la Société Entomologique de Belgique, 21: 249-251.
- Prisniy, A. B.** 1983. Morphological abnormalities Colorado potato beetle *Leptinotarsa decemlineata* Say (Coleoptera, Chrysomelidae). Entomological Review, 52 (4): 690-701.
- Read, R. W. J.** 1994. An unusual specimen of *Sciaphilus asperatus* (Bonsdorff) (Curculionidae). The Coleopterist, 3 (1): 23-24.
- Reitter, E.** 1893. Neunter Beitrag zur Coleopteren-Fauna des russischen Reiches. Wiener Entomologische Zeitung 12: 219-224.
- Royer, M.** 1921. Note sur un cas tératologique observé chez *Geotrupes stercorosus* Scriba. Bulletin de l'Association des Naturalistes de la Vallée de Loing, 4: 74-75.
- Samko, K. P.** 1928. Anomalnyi ekzemplar *Geotrupes stercorarius* Linne. (Ooleoptera, Scarabaeidae). Biuletén Obshestva Izucheniya Kraya Pri Muzee Tobolskogo Severa, 4 (5): 4.
- Schneider, N. & Thoma, J.** 2004. Malformation antennaire observée chez *Callichroma velutinum* (Fabricius, 1775) (Coleoptera, Cerambycidae). Bulletin de la Société des Naturalistes Luxembourgeois, 105: 105-108.
- Scriba, L. G.** 1791. Entomologische Bemerkungen und Erfahrungen. Journal für die Liebhaber der Entomologie, 3: 244-255.
- Spinola, M.** 1835. Notice sur un Coléoptère monstrueux. Annales de la Société Entomologique de France, 4: 587-595.
- Stachowiak, P.** 1982. An interesting case of teratology in *Otiorhynchus rotundatus* Sieb. (Coleoptera, Curculionidae). Przegląd Zoologiczny, 26 (1): 115-117.
- Stephens, J. F.** 1831. Description of *Chiasognathus grantii*, a new lucanideous insect forming the type of an undescribed genus, together with some brief remarks upon its structure and affinities. Transactions of the Cambridge Philosophical Society, 4: 209-217.
- Thouvenot, M.** 2006. Note sur trois anomalies antennaires chez des Prioninae Callipogonini de Guyane française (Coleoptera Cerambycidae). L'Entomologiste, 62 (1-2): 45-46.
- Vasko, B. N.** 2008. Occurrences of teratosis and gynandromorphism among some species of beetles of the genus *Polyphylla* (Coleoptera, Melolonthidae). Vestnik zoologii, 42 (3): 221-227.
- Vitali, F.** 2007. Anomalies multiples chez un exemplaire tératologique d' *Acanthinodera cumingii* (Hope, 1833) (Coleoptera Cerambycidae). L'Entomologiste, 63 (2): 87-88.
- Viturat.** 1897. Un *Pentodon* monstrueux. Miscellanea Entomologica, 5 (8): 98.

Table 1. Some reported cases of teratology in the family Lucanidae Latreille, 1804.

Species	Affected parts of the body	Teratology	References
<i>Sinodendron cylindricum</i> (Linnaeus, 1758)	Legs	Male. Unilateral heterodynamic ternary schistomely in the right metathoracic leg	Háva, 2006
<i>Chiasognathus grantii</i> Stephens, 1831	Mandibles	Male. Bilateral mandibular deformation	Gadeau de Kerville, 1930
<i>Odontolabis bellicosa</i> (Castelnau, 1840)	Mandibles	Male and female. Right and left side unilateral gynandromorphy in the mandibles	Maes, 1981

<i>Dorcus parallepipedus</i> (Linnaeus, 1758)	Legs	Male. Hemiatrophy in the left prothoracic leg	Pic, 1898
		Male. Hemiatrophy in the left metathoracic leg	Pic, 1898
	Elytra	Male. Elytra deformation	Pic, 1898
<i>Lucanus (Pseudolucanus) capreolus</i> (Linnaeus, 1763)	Legs	Male. Unilateral meiomely in the left metathoracic leg	Ferreira, 2014
	Antennae	Male. Hemiatrophy in the right antenna	Balazuc, 1948
Male. Bilateral antennae atrophy		Planet, 1896; Gadeau de Kerville, 1930	
Male. Unilateral heterodynamic binary schistomely in the right antenna		Gadeau de Kerville, 1886	
Male. Deformation of the left antenna		Balbi, 1897	
<i>Lucanus</i> (s. str.) <i>cervus</i> (Linnaeus, 1758)	Palpi	Male. Hemiatrophy in the right maxillary palpus	Planet, 1896
		Male. Bilateral atrophy in the maxillary palpi	Planet, 1896
		Male. Unilateral heterodynamic binary schistomely in the maxillary palpus	Bellevoeyea, 1907
Mandibles	Male. Binary schistomely and dystrophy in the left mandible	Mocquerys, 1880	
	Male. Binary schistomely in the left mandible	Kraatz, 1881	
	Male. Bilateral atrophy in the mandibles	Heyden, 1881; Planet, 1896; Gadeau de Kerville, 1930	

	Male. Bilateral deformation in the mandibles	Frivaldszky, 1889; Antoine, 1912
	Male. Unilateral deformation and hypertrophy of the left mandible	Planet, 1896; Antoine, 1912
	Male. Unilateral deformation of the left mandible	Balbi, 1897
Clypeus	Male. Unilateral deformation of the clypeus	Frivaldszky, 1889
Head	Male. Pedunculate and irregular tumor on the head.	Kraatz, 1881
	Male. Head deformation and asymmetry	Planet, 1896
Elytra	Male. Tubercles on the elytral posterior surface	Antoine, 1912; Balazuc, 1948
	Male. The elytral sculpture deformation	Planet, 1896; Balbi, 1897
Legs	Male. Unilateral heterodynamic ternary schistomely in the left mesothoracic leg	Cockayne, 1937
	Male. Hemiatrophy in the right prothoracic leg	Planet, 1896
Whole body	Gynandromorphy	Asmuss, 1835; Heyden, 1881; Balazuc, 1948; Klausnitzer, 1982; Bea, 2015

Table 2. Some reported cases of teratology in the family Geotrupidae Latreille, 1802.

Species	Affected part of the body	Teratology	References
<i>Trypocopris vernalis</i> (Linnaeus, 1758)	Legs	Ternary schistomely and deformation of the metatarsus	Mocquerys, 1880; Antoine, 1912
	Pronotum	Symmetric deformation of the pronotum	Bunalski & Lubecki, 1990
<i>Geotrupes stercorarius</i> (Linnaeus, 1758)	Pronotum	Hemispheric tumors on the pronotal surface	Gadeau de Kerville, 1923
	Elytra	Bilateral deformation of elytral surface as a hemispheric protuberance	Bellevoeyea, 1907
		The elytral sculpture and coloration deformation	Samko, 1928
<i>Anoplotrupes stercorosus</i> (Scriba, 1791)	Pronotum	Pronotoschisis and absence of the scutellum	Balazuc, 1948
		Symmetric deformation of the pronotum	Heyden, 1881
		Unilateral deformation of the pronotum and absence of the scutellum	Heyden, 1881
	Elytra	Bilateral deformation of the elytral surface as a hemispheric protuberance	Preudhomme de Borre, 1878; Mocquerys, 1880; Bellevoeyea, 1907; Antoine, 1912
		Deformation of the elytral surface	Heyden, 1881
<i>Ceratophyus hoffmannseggii</i> (Fairmaire, 1856)	Antennae	Male. Hemiatrophy in the left antenna	Asmuss, 1835
	Mandibles	Male. Hemiatrophy in the left mandible	Asmuss, 1835

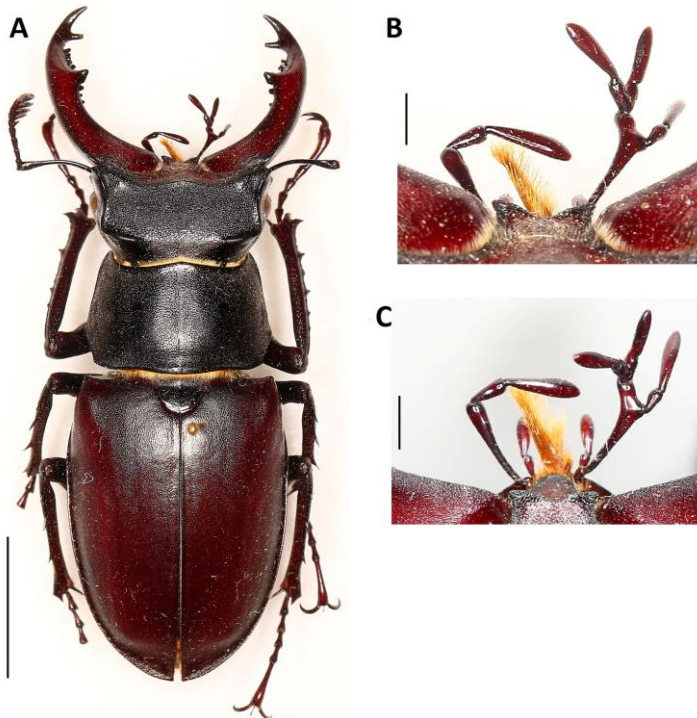


Figure 1. Teratologic male specimen of *Lucanus* (s. str.) *cervus cervus* (Linnaeus, 1758). A) Dorsal view of the habitus; B) and C) the unilateral heterodynamic ternary schistomely in the right maxillary palpus (dorsal view under different angles). Scale bar in A: 1 cm; scale bar in B and C: 1 mm.

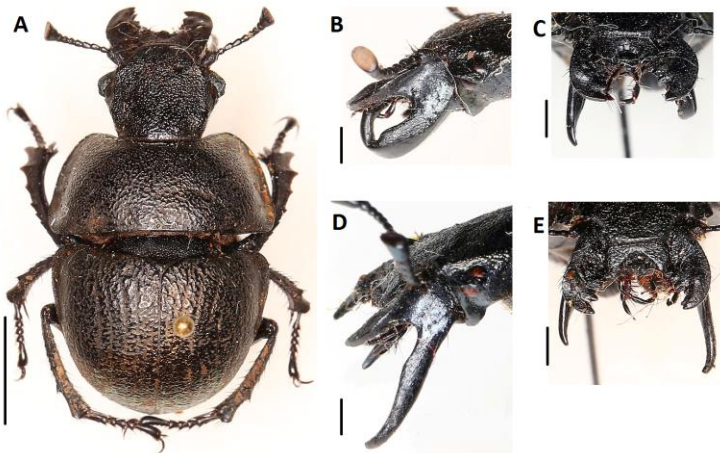


Figure 2. Teratology in the male of *Lethrus* (*Furcilethrus*) *banghaasi* Reitter, 1893. A) The habitus of the teratologic specimen, dorsal view; B) the unilateral structural deformation of the left ventral mandibular process, lateral view; C) the unilateral structural deformation of the left ventral mandibular process, frontal view; D) the left ventral mandibular process in normal male specimen, lateral view; E) the left ventral mandibular process in normal male specimen, frontal view. Scale bar in A: 0.5 cm; scale bars in B-E: 1 mm.