A remarkable teratological case for *Eucymatodera parva* Schenkling, 1908 (Cleridae: Tillinae) from Namibia

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Teratology can be defined as the study of the causes producing abnormalities, malformations or defects of the physical development (Ujházy *et al*. 2012). Teratological examples have been described in almost all animal groups, including insects (Ferrer *et al*. 2014). The importance of reporting teratological events in insects has been discussed by Glasgow (1925), Cockayne (1937) and Savini & Furth (2004). Glasgow (1925) stated that insect malformations should be documented to make these cases available to investigators who may have a special interest in such events. Cockayne (1937) mentioned that, even if the observed teratologies do not represent something novel, it seems desirable to publish these descriptions accompanied by plates illustrating the nature of the abnormality. Savini & Furth (2004) in their discussion of malformations in Coleoptera, stressed the importance of recording insect abnormalities, indicating that, in some cases, these abnormalities offer valuable information about the influence of environmental conditions during insect development.

Balazuc (1948) was the first to describe and classify various teratological cases within Coleoptera and provided a standard nomenclature for these abnormalities. Since the publication of his teratological glossary, numerous forms of teratomorphs in beetles (Carabidae, Cerambycidae, Chrysomelidae, Meloidae, Staphylinidae, Scarabaeidae and Tenebrionidae) have been reported and discussed by various authors, including Balazuc (1948, 1968), Haget (1949), Green (1952), Winkler (1958), Strand (1959), Delkeskamp (1969), Frank (1981), Gamarra & Outerelo (1986), Osuna (1992), Ortuño & Hernández (1993), Navarrete-Heredia *et al*. (2002), Lays (2003), Savini & Furth (2004), Asiain & Marquez (2009), Clark & Belo Nieto (2010), and Ferrer *et al*. (2014).

Here, we report a remarkable teratological case in a clerid male of the species *Eucymatodera parva* Schenkling, 1908 with an anomaly in the right antenna (Figs 1A–B). The specimen was captured in the Sossusvlei Dune area, south of Sesriem, Namibia, and is deposited in the insect collection of the Ditsong National Museum of Natural History, Pretoria, South Africa (TMSA). The specimen label has the following information:

MATERIAL EXAMINED. South West Africa, Namib Sossus vlei, 24.40S 15.24E, 15-1-1975, E-Y: 546 at light, Endrödy-Younga col.

Eucymatodera Schenkling is a clerid genus in the subfamily Tillinae which is currently composed of eight species (Corporaal 1950). The group is relatively common in sub-Saharan Africa, and it predominantly inhabits thorny forests, savannas and scrublands. The affected specimen displays a polymely (presence of supernumerary appendages) with a trifurcate right antenna emerging from a single scape (Fig. 1A–B). It appears that the right scape in this specimen is, in reality, three scapes fused together. Each antenna emerging from the fused scape is composed of 10 antennomeres and has the proportional size and shape of a normal antenna (Fig. 1B). The teratomorphic and left antennae are normally situated, just below the antennal emargination (Fig. 1B–C). The left antenna appears to be normal (Fig. 1C). The head, including mouthparts, and the thorax, abdomen, and legs also appear normal.

The existence of teratomorphic specimens in various groups of insects is probably caused by changes in embryonic or postembryonic development (Balazuc 1948). On the other hand, certain malformations have no genetic background, but are triggered by chemical elements (Walton 1989; Martinez & van Emden 2001; Harrison *et al*. 2012), parasites (Marcangeli *et al*. 1992; Csosz 2012) or environmental factors (Clark & Belo Neto 2010). Irrespective of the cause, teratomorphs are scientifically important as they can provide insightful information about certain traits that, through

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Fig. 1. **A**, Habitus of affected specimen of *Cymatodera parva*; **B**, Close-up of right antenna showing trifurcate appendage emerging from fused scape; **C**. Close-up of normal left antenna.

time, can become fixed in the population. Teratological malformations can also function as bioindicators of certain pollutants present in the environment (Vermeulen 1995; Schulz & Martins-Junior 2001; Dziengo-Czaja *et al*. 2008).

Asiain & Márquez (2009) indicated that teratomorphs affecting elytra and legs are among the most common malformations reported in Coleoptera, followed by antennal abnormalities. Antennal defects have been regularly recorded for the order Coleoptera, especially in the families Cerambycidae, Carabidae and Staphylinidae (Balazuc 1948; Osuna 1992; Ortuño & Hernández 1993; Asiain & Márquez 2009). According to Ferrer *et al*. (2014), teratomorphs are more frequent in Carabidae, Cerambycidae and Staphylinidae; however, the authors argue that these groups are among the most studied families of Coleoptera, and this bias in reports may be affecting the ratio of published terotological cases.

A plethora of studies have documented the structural malformations in *Drosophila* caused by mutations in the homeotic gene *Antennapedia* (*e.g*. Struhl 1981; Carroll *et al*. 1986; Kaufman *et al*. 1990; Hooper *et al*. 1992; Yao *et al*. 1999). These mutations may lead to striking homeotic transformations of the *Drosophila* head structure called atavistic malformations, which means the return of a specialised segment into a more primitive condition (Stuhl 1981). Shockley & Ulyshen (2009) have mentioned that reduplicated legs are the result of genetic mutation(s) of one or more genes involved in ventral appendage formation and elongation during normal development. Shockley & Ulyshen (2009) further indicate that mutant expression of these genes sometimes produces malformations on non-locomotory appendages, such as antennae. We argue that, in a number of instances, antennal malformations are caused by mutations of the gene *Antennapedia*, a HOM-C gene highly

conserved among various groups of arthropods (Gauchat *et al*. 2000), and suspect that the triplication of the right antenna reported herein has very likely been triggered by such mutation(s).

Previous teratologies in the beetle family Cleridae have been documented (*e.g*. Winkler 1958; Verdugo & Coello 2012; Castro-Tovar *et al*. 2014); however, we were unable to verify cases of antennal bifurcation in other clerid beetles. Undoubtedly, there must be various clerid teratomorphs among entomological collections, but perhaps there is little interest on reporting them. On the other hand, these abnormalities may be so mild that entomologists believe there is no necessity to make these cases publicly available. We believe that teratomorphs should receive more attention among taxonomists and non-taxonomists alike since, on many occasions, antennal malformations, such as the existence of extra or fused antennomeres, may lead to the misidentification of entomological material at various taxonomic levels.

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REFERENCES

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.

BALAZUC, J. 1948. La tératologie des Coléoptères et expériences de transplantation chez *Tenebrio molitor* L. *Mémoires du Muséum National d'Histoire Naturelle* n.s. **25**: 1–293.

BALAZUC, J. 1968. Supplément a la tératologie des coléoptères. *Redia* **51**: 39–111.

CASTRO-TOVAR, A., BAENA, M. & LÓPEZ VERGARA, M.A. 2014. New teratological records in Coleoptera (Insecta). *Zoologica Baetica* **25**: 3–12,

CLARK, S.M. & BELO NETO, L.A. 2010. A remarkable teratological specimen of *Pseudoluperus longulus* (Le Conte) (Coleoptera: Chrysomelidae) from Utah, U.S.A. *The Coleopterists Bulletin* **64**(4): 383–385.

COCKAYNE, E.A. 1937. Insect teratology. Reduplication of legs in Coleoptera, Diptera, and Hymenoptera. *Transactions of the Royal Entomological Society of London* **86**(11): 191–200.

CSOSZ, S. 2012. Nematode infection as significant source of unjustified taxonomic descriptions in ants (Hymenoptera: Formicidae). *Myrmecological News* **17**: 27–31.

DELKESKAMP, K. 1969. Abnormale Verkurzung des rechten Vorderbeines bei einem S von *Timarcha tenebricosa* F. (Col. Chrysom.). *Deutsche Entomologische Gesellschaft* **28**: 39–40.

DZIENGO-CZAJA, M., KOSS, J. & MATUSZAK, A. 2008. Teratological forms of diatoms (Bacillariophyceae) as indicators of water pollution in the western part of Puck Bay (southern Baltic Sea). *Oceanological and Hydrobiological Studies* **37**: 119–132.

FERRER, J., FERNÁNDEZ-LÓPEZ, J., FERNÁNDEZ-GONZÁLEZ, A. & FERNÁNDEZ-MENÉNDEZ, D. 2014. Unusual teratology for a tenebrionid: antennal schistomelia in *Probaticus granulatus* (Allard, 1876) (Coleoptera: Tenebrionidae). *The Coleopterists Bulletin* **68**(1): 139–142.

FRANK, J.H. 1981. A review of teratology in Staphylinidae, with description of a teratological specimen of *Tachinus axillaris* Erichson (Coleoptera, Staphylinidae, Tachyporinae) from Florida. *Florida Entomologist* **64**: 337–340.

GAMARRA, P. & OUTERELO, R. 1986. Diversos casos teratológicos en *Estafilinoideos* (Coleoptera, Staphylinoidea). *Actas de las VII Jornadas de la Asociación Española de Entomología*, Seville, Octubre 1–3: 539–547.

GLASGOW, R.D. 1925. A specimen of *Melanoplus diffentialis* Thomas with four ocelli. *Psyche* **32**: 285–290.

GREEN, J. 1952. Three cases of abnormal nervous systems in Coleoptera. *Entomologist's Monthly Magazine* **88**: 154–155.

HAGET, A. 1949. Quelques remarques au sujet de larves symeles obtenues par section transversal du germe de *Leptinotarsa*. *Comptes Rendus des Seances de la Societe de Biologie et des ses Filiales* **144**: 413–414.

HARRISON, J.F., WOODS, H.A. & ROBERTS, S.P. 2012. *Ecological and Environmental Physiology of Insects.* Oxford University Press, Oxford, U.K.

HOOPER, J.E., PIREZ-ALONSO, M., BERMINGHAM, J.R., BRYAN, M.P., ROCKLEIN, A., WAGENBACH, M., EDSTROM, J.E., FRUTOST, R. & SCOTT, M.P. 1992. Comparative studies of drosophila *Antennapedia* genes. *Genetics* **132**: 453–469.

JORGENSEN, E.M. & GARBER, R.L. 1987. Function and misfunction of the two promoters of the *Drosophila antennapedia* gene. *Genes and Development* **1**: 544–555.

KAUFMAN, T.C., SEEGER, M.A. & OLSEN, G.J. 1990. Molecular and genetic organization of the antennapedia gene complex of *Drosophila melanogaster*. *Advances in Genetics* **27**(C): 309–362.

LAYS, P. 2003. Observations de formations teratologiques parmi des donacies (Coleoptera Chryso-

melidae: Donaciinae). *Bulletin de la Société Royale Belge d'Entomologie* **139**: 180–183.

MARCANGELI, J., MONETTI, L. & FERNANDEZ, N. 1992. Malformations produced by *Varroa jacobsoni* on *Apis mellifera* in the province of Buenos Aires, Argentina. *Apidologie* **23**: 399–402.

MARTINEZ, S.S. & VAN EMDEN, H.F. 2001. Growth disruption, abnormalities and mortality of *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) caused by azadirachtin. *Neotropical Entomology* **30**(1): 113–125.

NAVARRETE-HEREDIA, J.L., NEWTON, A.F., THAYER, M., ASHE, J. & CHANDLER, D. 2002. *Illustrated Guide to the Genera of Staphylinidae (Coleoptera) of Mexico.* Universidad de Guadalajara y Conabio, México, D.F.

ORTUÑO, V.M. & HERNÁNDEZ, J.M. 1993. Diversos casos teratológicos en Coleoptera. *Boletín de la Real Sociedad Española de Historia Natural* (*Sección Biología*) **89**:163–179.

ORTUÑO, V.M. & RAMOS-ABUÍN, J.A. 2008. Reflexiones sobre la teratología y descripción de cuatro teratosis apendiculares en Coleoptera. *Boletín de la Sociedad Entomológica Aragonesa* **43**: 435–439.

OSUNA, E. 1992. Fenómeno teratológico en *Psalidognathus* sp. (Coleoptera: Cerambycidae). *Boletín Entomológico Venezolano*, N. S. **7**:145–156.

SAVINI, V. & FURTH, D. 2004. Teratologia en Coleoptera: un caso en *Gioia bicolor* (Blake 1969) (Chrysomelidae, Alticinae) de Jamaica. *Entomotropica* **19**: 165–167.

SCHULZ, U.H. & MARTINS-JUNIOR, H. 2001. *Astyanax fasciatus* as bioindicator of water pollution of Rio dos Sinos, RS, Brazil. *Brazilian Journal of Biology* **61**(4): 615–622.

SHOCKLY, F.W. & ULYSHEN, M.D. 2009. An interesting deformity in *Alobates pennsylvanica* (De Geer, 1775) (Coleoptera: Tenebrionidae). *Journal of Entomological Sciences* **44**(3): 284–286.

STRAND, A. 1959. Misdannelser av brystkjoldet hos Atheta divisa Mark. (Col., Staph.). *Norsk Entomologisk Tidsskrif* **11**: 43–45.

STRUHL, G. 1981. A homoeotic mutation transforming leg to antenna in *Drosophila. Nature* **292**: 635–638.

UJHÁZY, E., MACH, M., NAVAROVA, J., BRUCKNEROVA, I. & DUBOVICKY, M. 2012. Teratology – past, present and future. *Interdisciplinary Toxicology* **5**: 163–168.

VERDUGO, A. & COELLO, P. 2012. A proposito de un caso de esquistomelia binaria heterodinamica de propata izquierda en *Enoclerus sphegeus* (Fabricius, 1787) (Coleoptera: Cleridae). *Revista Gaditana de Entomologia* **3**(1–2): 57–60.

VERMEULEN, A.C. 1995. Elaborating chironomid deformities as bioindicators of toxic sediment stress: the potential application of mixture toxicity concepts. *Annales Zoologici Fennici* **32**(3): 265–285.

WALTON, T. 1989. Insects as indicators of toxicity, bioaccumulation and bioavailability of environmental contaminants. *Environmental Toxicology and Chemistry* **8**: 649–658.

WINKLER, J.R. 1958. Une importante nouvelle aberration de l'espèce *Trichodes reichei* (Coleoptera: Cleridae). *Bulletin de la Société Entomologique de Mulhouse* Mai–Juin: 2 pp.

YAO, L.C., LIAW, G.J., PAI, C.Y. & SUN, L.H. 1999. A common mechanism for antenna-to-leg transformation in *Drosophila*: suppression of homothorax transcription by four HOM-C genes. *Developmental Biology* **211**: 268–276.