

DNA Barcodes of Moths (Lepidoptera) from Lake Turkana, Kenya

Author(s): Scott E. Miller , Dino J. Martins , Margaret Rosati and Paul D.N. Hebert

Source: Proceedings of the Entomological Society of Washington, 116(1):133-136. 2014.

Published By: Entomological Society of Washington

DOI: <http://dx.doi.org/10.4289/0013-8797.116.1.133>

URL: <http://www.bioone.org/doi/full/10.4289/0013-8797.116.1.133>

BioOne (www.bioone.org) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/page/terms_of_use.

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

NOTE

DNA barcodes of moths (Lepidoptera) from Lake Turkana, Kenya

DOI: 10.4289/0013-8797.116.1.133

This paper provides metadata for DNA barcode (COI) data in GenBank for a collection of moths (Lepidoptera) made at South Turkwel near Lake Turkana, Kenya. This paper aims to make DNA barcode data available to document ongoing research, to contribute to the International Barcode of Life (iBOL; www.ibol.org) and Kenya Barcode of Life projects, and to encourage enhancement in identifications, in line with the concept of DNA barcode data release papers and the Fort Lauderdale principles for genetic data (Schindel et al. 2011). Data for 89 sequences representing 35 barcode clusters (putative species) have been released on GenBank (accession numbers KF147250-KF147332, KF603887) including the required fields for the BARCODE data standard (Benson et al. 2012) and more data, including images, are available on BOLD (www.boldsystems.org; Ratnasingham and Hebert 2007), accessible from the project TBILE using a DOI (dx.doi.org/10.5883/DS-TBILE).

There is very little literature on the moths of the Turkana Basin. Probably the best known collection was made by the 1934 Lake Rudolf Rift Valley Expedition, but the results were never published, although we have seen specimens in Natural History Museum, London (BMNH) (Buxton 1936, Vári 1964). We have also seen Turkana moth specimens in the National Museums of Kenya (NMK), but there is no comprehensive published documentation. We have been able to identify some of the moths by comparison to collections at the Smithsonian National Museum of Natural History (USNM),

BMNH, and NMK, the literature, or matching DNA sequences in BOLD. However, because of the poor state of knowledge of African Lepidoptera (e.g., Mey 2011), further refinement will take considerable time. Thus, we are making these data available now, while we continue the process of identifications. Where taxonomic names are not readily available from existing literature, the DNA cluster-based morphospecies can be used as species hypotheses that can be confirmed by future taxonomic studies in broader context of the African fauna (Schindel and Miller 2010, Ratnasingham and Hebert 2013).

MATERIALS AND METHODS

Sixty-six of the specimens were collected at the Turkana Basin Initiative (TBI) station at West Turkana, 465 m, on the Turkwel River, 29 km east of Lodwar, near Lake Turkana, 3.144° N, 35.863° E, 14–18 August 2011. Most specimens were collected at lights, and all were killed by freezing and dried as pinned voucher specimens. Four specimens of *Eoophyla excentrica* Mey & Speidel (Crambidae: Acentropinae) were collected offshore Central Island, Lake Turkana, 360 m, 3.507° N, 36.033° E, 16 August 2011. Comparative specimens are included from Kenya (6), Nigeria (10), Papua New Guinea (2), and the United States (1).

Genital dissections follow Robinson (1976). Morphological comparisons were made to both the literature and to collections of USNM, BMNH, and NMK. Additional context was provided by intensive sampling of moths from light at Mpala Research Centre in central Kenya,

from 1998 to 2011 by Scott Miller and Tina Kuklenski (Adamski et al. 2010). Vouchers are retained by USNM and NMK. DNA sequencing (COI barcode) followed standard methods at the Biodiversity Institute of Ontario, University of Guelph, between 2008 and 2012 (Craft et al. 2010, Hrcek et al. 2011, Wilson 2012), using legs from pinned moths. Up to five specimens per morphospecies were sampled (9 in one case because of marked variation in wing pattern). All of the Turkana vouchers sampled for DNA yielded successful sequences, all but one of which yielded a full length barcode meeting the BARCODE keyword standard in GenBank (Benson et al. 2012). Full details on the sequences are provided in BOLD (Ratnasingham and Hebert 2013) through DOI ([dx.doi.org/10.5883/DS-TBILE](https://doi.org/10.5883/DS-TBILE)). Barcode clusters are based on the RESL algorithm as implemented in BOLD as described by Ratnasingham and Hebert (2013).

The climate of this region is arid and considered semi-desert with > 250 mm of rain falling annually. Temperatures are high and maximum daily highs typically exceed 40 °C and occasionally 50 °C. The vegetation at the collection sites is dominated by the trees *Acacia tortilis* and *Acacia reficiens*, shrubs *Salvadora persica* and *Cadaba rotundifolia*, and perennial herbaceous *Indigofera spinosa*, with annual *Aristida* spp. grasses occurring seasonally after rains.

RESULTS

Identifications for all specimens are provided on BOLD ([dx.doi.org/10.5883/DS-TBILE](https://doi.org/10.5883/DS-TBILE)) and GenBank. While many specimens remain unidentified, some identifications are worth comment here:

Cosmopterigidae: Chrysopeleiinae

Bifascioides leucomelanella (Rebel)
(male genitalia slide USNM 125903);

previously recorded from Kenya based only on a specimen collected in 1935 inside an Imperial Airways airplane at Kisumu (Kasy 1968: 513).

Crambidae: Spilomelinae

Marasmia trapezalis Guenée; DNA barcode results confirm its status as a cosmopolitan species (Clarke 1971) as specimens from Nigeria (GenBank KF147300, 147304-147312), Papua New Guinea (GenBank KF147302-KF147303) and Florida (GenBank KF603887) possess almost identical DNA sequences. Barcode cluster AAC0297 in BOLD also includes specimens from Mexico, Australia, Sierra Leone, South Africa (BOLD, unpublished data), and Palau (GenBank JX017849, Haines and Rubinoff 2012). This species is the major rice leaf folder in West Africa (Heinrichs and Barrion 2004: 63), and is a pest of various graminaceous crops in Asia (Mathew and Menon 1986, Khan et al. 1988). This species is often placed in the genus *Cnaphalocrocis*, but we follow Munroe (1991) in placing it in *Marasmia*. Buettiker and Gallagher (1980) comment on the biology of the species in Oman.

Erebidae: Erebininae

Gnamptonyx innexa (Walker); widespread from North Africa to India, but not previously recorded from Kenya (Hacker et al. 2010: 22).

While the sample size is too small for serious biogeographic analysis, some interesting trends are evident from comparison to other barcode clusters in BOLD, including an extensive sampling of about 2000 moths from Mpala, Kenya, representing over 700 barcode clusters. Of the 34 species from the TBI station near Lodwar, none are represented in BOLD from Mpala, or from Serengeti, Tanzania (Hebert, unpublished data in BOLD). However, two of the species recorded at

TBI are also known from Nguruman in southern Kenya (1.848° S, 36.1° E, 660 m), including *Dysodia lutescens* Whalley 1968 (Thyrididae), and an unidentified Phycitinae. Interestingly, five also occur in the United Arab Emirates (E. van Nieukerken, unpublished data in BOLD) and three others occur in Yemen (A. Hausmann, unpublished data in BOLD). Thus, the fauna at Turkana has a distinctly North African relationship.

ACKNOWLEDGMENTS

Miller's work is a collaboration between the International Centre of Insect Physiology and Ecology (ICIPE), the Smithsonian Institution, and the National Museums of Kenya. DNA sequencing was supported by the Smithsonian Institution and by a grant from the Government of Canada through Genome Canada and the Ontario Genomics Institute in support of the iBOL project. David Adamski, David Agassiz, John Brown, Karolyn Darrow, Don Davis, Axel Hausmann, Lauren Helgen, Koen Maes, Megan Milton, Erik van Nieukerken, and many staff at the Biodiversity Institute of Ontario, provided technical assistance and identifications. The National Museums of Kenya and The Natural History Museum, London, provided vital access to collection for the identifications.

LITERATURE CITED

- Adamski, D., R. S. Copeland, S. E. Miller, P. D. N. Hebert, K. Darrow, and Q. Luke. 2010. A review of African Blastobasinae (Lepidoptera: Gelechioidea: Coleophoridae), with new taxa reared from native fruits in Kenya. *Smithsonian Contributions to Zoology* 630: vi + 68 pp.
- Benson, D. A., I. Karsch-Mizrachi, K. Clark, D. J. Lipman, J. Ostell, and E. W. Sayers. 2012. GenBank. *Nucleic Acids Research* 40(D1): D48–D53. doi:10.1093/nar/gkr1202
- Buettiker, W. and M. D. Gallagher. 1980. First records of ophthalmotropic behaviour of Lepidoptera in Oman. *Journal of Oman Studies Special Report* 2: 217–221.
- Buxton, D. R. 1936. Insects of the Lake Rudolf Rift Valley Expedition, 1934.—1. Orders other than Coleoptera. *Annals and Magazine of Natural History* (series 10) 17: 579–588. doi:10.1080/00222933608655099
- Clarke, J. F. G. 1971. The Lepidoptera of Rapa Island. *Smithsonian Contributions to Zoology* 56: i-iv + 1-282.
- Craft, K. J., S. U. Pauls, K. Darrow, S. E. Miller, P. D. N. Hebert, L. E. Helgen, V. Novotny, and G. D. Weiblen. 2010. Population genetics of ecological communities with DNA barcodes: An example from New Guinea Lepidoptera. *Proceedings of the National Academy of Sciences of the United States of America* 107: 5041–5046. doi:10.1073/pnas.0913084107
- Hacker, H. H., H.-P. Schreier, and E. Aistleitner. 2010. Noctuidae of Cape Verde Islands (Lepidoptera, Noctuoidea). *Esperiana Memoir* 5: 7–95.
- Haines, W. P. and D. Rubinoff. 2012. Molecular phylogenetics of the moth genus *Omiodes* Guenée (Crambidae: Spilomelinae), and the origins of the Hawaiian lineage. *Molecular Phylogenetics and Evolution* 65: 305–316. doi:10.1016/j.ympev.2012.06.021
- Heinrichs, E. A. and A. T. Barrion. 2004. Rice-feeding insects and selected natural enemies in West Africa: Biology, ecology, identification. IRRI and WARDA, Los Banos and Abidjan. vi + 242 pp.
- Hrcek, J., S. E. Miller, D. L. J. Quicke, and M. A. Smith. 2011. Molecular detection of trophic links in a complex insect host-parasitoid food web. *Molecular Ecology Resources* 11: 786–794. doi:10.1111/j.1755-0998.2011.03016.x
- Kasy, F. 1968. Ergebnisse der Zoologischen Nubien-Expedition 1962. Teil XXXV. Lepidoptera: Walshidae. *Annalen des Naturhistorischen Museums in Wien* 72: 497–525.
- Khan, Z. R., A. T. Barrion, J. A. Litsinger, N. P. Castilla, and R. C. Joshi. 1988. A bibliography of rice leafrollers (Lepidoptera: Pyralidae). *Insect Science and Its Application* 9: 129–174. doi:10.1017/S1742758400005919
- Mathew, G. and M. G. R. Menon. 1986. Identification of some leaf rollers belonging to the genera *Bradina*, *Marasmia* and *Cnaphalocrocis* (Lepidoptera, Pyraustidae). *Entomon* 11: 311–317.
- Mey, W. 2011. Basic pattern of Lepidoptera diversity in southwestern Africa. *Esperiana Memoir* 6: 1–316.

- Munroe, E. G. 1991. Transfer of *Aulacodes eupselias* Meyrick to Pyraustinae, with notes on the genus *Marasmia* Lederer and on cataclystiform wing patterns in the family Crambidae (Lepidoptera: Pyraloidea). Bishop Museum Occasional Papers 31: 122–130.
- Ratnasingham, S. and P. D. N. Hebert. 2007. The Barcode of Life Data System (www.barcodinglife.org). Molecular Ecology Notes 7: 355–364. doi:10.1111/j.1471-8286.2007.01678.x
- Ratnasingham, S. and P. D. N. Hebert. 2013. A DNA-Based Registry for All Animal Species: The Barcode Index Number (BIN) System. PLoS ONE 8(7): e66213. doi:10.1371/journal.pone.0066213
- Robinson, G. S. 1976. The preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. Entomologist's Gazette 27: 127–132.
- Schindel, D. E. and S. E. Miller. 2010. Provisional Nomenclature: The On-Ramp to Taxonomic Names, pp. 109–115. In A. Polaszek, ed. Systema Naturae 250: The Linnaean Ark. CRC Press, Boca Raton, Florida.
- Schindel, D. E., M. Stoeckle, C. Milensky, M. Trizna, B. Schmidt, C. Gebhard, and G. Graves. 2011. Project Description: DNA barcodes of bird species in the National Museum of Natural History, Smithsonian Institution, USA. ZooKeys 152: 87–91. doi:10.3897/zookeys.152.2473
- Vári, L. 1964. South African Lepidoptera, 4. Three new Heterocera from the Kruger National Park. Koedoe 7: 43–51. doi:10.4102/koedoe.v7i1.799
- Whalley, P. E. S. 1968. A revision of the African species of the genus *Dysodia* Clemens, 1860 (Lepidoptera: Thyrididae, Pachythyrinae). Annals of the Transvaal Museum 26: 1–29, plates 1–4.
- Wilson, J. J. 2012. DNA barcodes for insects, pp. 17–46. In W. J. Kress and D. L. Erickson, eds. DNA Barcodes: Methods and Protocols. Springer, New York.
- Scott E. Miller, Dino J. Martins, Margaret Rosati and Paul D.N. Hebert, *National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, MRC 105, Washington, D.C. 20013-7012, U.S.A. (e-mail: millers@si.edu); Turkana Basin Institute – Stony Brook University, Stony Brook, New York 11794 U.S.A., and Insect Committee of Nature Kenya, P O Box 44486 GPO 00100 Nairobi, Kenya; National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, MRC 105, Washington, D.C. 20013-7012, U.S.A.; Department of Integrative Biology and the Biodiversity Institute of Ontario, University of Guelph, Guelph, Ontario N1G 2W1, Canada*