GONGED (Geometridae of New Guinea Electronic Database): a progress report on development of an online facility of images

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Holloway, J. D., Miller, S. E., Pollock, D. M., Helgen, L. & Darrow, K. (2009): GONGED (Geometridae of New Guinea Electronic Database): a progress report on development of an online facility of images. Pp. 122-123 in: Hausmann, A. (ed.): Proceedings of the fifth Forum Herbulot 2008. Global strategies for plotting geometrid biodiversity in web-based databases (Munich, ZSM, 24-28 June 2008). – Spixiana **32/1**: 122-123

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This project is the information repatriation portion of a larger programme of research on environmental health in Papua New Guinea coordinated by the University of Utah and University of Papua New Guinea and funded by the United States National Institute of Health. Geometridae are proving to be a particularly useful group for biodiversity studies and as environmental indicators, and there are many studies in the Indo-Australian area and, increasingly, South America and Africa that demonstrate this. Images of the moths and the genitalia of both sexes are being prepared, using type material wherever possible, to facilitate identification of Geometridae in sampling, rearing and barcoding programmes within New Guinea and neighbouring areas. The product is expected to be an illustrated atlas of some 1500 species that will in turn be linked to similar efforts on Geometridae elsewhere, as well as to the Biodiversity Heritage Library (www.biodiversitylibrary.org) and Encyclopedia of Life (www.eol.org).

The images for each species (including some undescribed but clearly distinct taxa) will include external characters of both sexes and characters of genital and abdominal morphology from slide-mounted preparations. The latter require an extensive programme of dissection. For this, enzymatic maceration of abdomens will enable extracts of DNA to be preserved and used initially in pilot studies for the barcoding of old specimens. Labels and metadata will also be recorded. These data, when available, will enable species concepts to be modified where necessary (synonymy, matching sexes etc.), and new species will be described where appropriate. The species will also be placed within modern generic concepts, perhaps requiring some revisional work, e.g. on the many New Guinea species of Geometrinae currently assigned to the inappropriate African genus *Prasinocyma*. Genera will also be placed within tribal concepts that have been developed and discussed over the past few decades, e.g. in 'The Moths of Borneo' series.

The island of New Guinea is critical area for our understanding of the development of biodiversity, as it is a geologically young but complex landmass that has only very recently attained both its large overall area and its extensive high mountain ranges. Its geometrid species richness is approaching that of Borneo, and its generic diversity, currently estimated at 242, is only slightly less than that for Borneo (265). The total for Australia (334) is inflated by unique components such as the Ennominae tribe Nacophorini (60) and the principal radiation of the Oenochrominae in both the strict sense (stout species) and the broader one (genera such as *Dichromodes*), leading to about 30 additional genera. In contrast, New Guinea, with 67 genera, has significantly more Larentiinae than Borneo (56) and Australia (45), though the last total is likely to be expanded by revision. Most of these larentiines are found at higher altitudes and are indicative of the dynamism of evolution of biodiversity in New Guinea, given the geological youth of its mountain chains.

Currently, 50 of the 242 genera are unplaced to tribe. 20 are in the Larentiinae, where the tribal classification outside the Eupitheciini and Trichopterigini is unsatisfactory. The rest are in the Geometrinae and Ennominae, but it is likely that many of the former will prove to be Hemitheini, and many of the latter will be Boarmiini.

At the time of Forum Herbulot 2008, virtually all the Oenochrominae, Desmobathrinae and Geometrinae had been processed and imaged – only a quarter of the generic total, but, with species-rich genera such as *Eucyclodes* (52 species) and *"Prasinocyma"* (68 species) included, perhaps a third of the species total.

A major focus on Australasian Lepidoptera from the barcoding initiative has resulted so far in a considerable number of sequences for Geometridae, including for 163 species of Geometrinae from Australia and New Guinea. A phenetic tree kindly provided for these Geometrinae from the Barcode of Life Data System (BOLD) by Paul Hebert's group at

the Canadian Centre has given a flavour of the sort of interaction that may develop between the barcoding initiative and the more morphological approach represented by the imaging project. Major clusters recognised in the tree support tribal groupings such as the Nemoriini and Comibaenini, and also generic groupings such as the synonymy recently published in the Pseudoterpnini of *Rhuma*, *Oxyphanes* and *Sterictopsis*, and the grouping of genera round *Hemithea* such as *Cosmogonia*, *Idiochlora*, *Metallochlora* and *Urolitha*. On the other hand, the two species currently in *Agathiopsis*, *maculata* and *basipuncta*, are widely separated in the tree, and therefore their congeneric status may need fresh scrutiny.

The images will be placed online using the software framework provided by the Atrium® system developed by plant systematists at the Botanical Research Institute of Texas who also have a strong focus on New Guinea plant diversity. The system has tools for handling large numbers of images and enabling sequences of annotations by specialists to be incorporated. We intend to link original descriptions through the Biodiversity Heritage Library. Atrium also has links to the Global Biodiversity Information Facility (GBIF). It is intended to get a New Guinea geometrid pilot demonstration site online shortly for comment, and this will be announced through Forum Herbulot in due course.

Distributing Lepidops© – A test case for sharing virtual museums and other data

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Staude, H. S. (2009): Distributing Lepidops© – A test case for sharing virtual museums and other data. Pp. 123 in: Hausmann, A. (ed.): Proceedings of the fifth Forum Herbulot 2008. Global strategies for plotting geometrid biodiversity in web-based databases (Munich, ZSM, 24-28 June 2008). – Spixiana **32/1**: 123

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Most private and institutionalised museums have unpublished information, data and unworked specimens in their possession. Traditionally access to the above was restricted to persons who visited the museum and therefore a form of control was in hand to minimise plagiarism, unauthorised use of data and to ensure that proper acknowledgement was given to the originators of the information, data and specimens. The formal publication of information and data is the traditional method used to regulate the above issues. The problem with the above system was that information and many data were very much difficult to extract resulting in costly travelling for anyone wanting to gather basic information and data on a particular group of organisms he or she may be working on. This resulted in the slow progress of value-added science based on these data, information and specimens.

In today's computer age the boundaries of the above mechanisms are being challenged all the time through the ease of information, data and virtual specimen storage and exchange. It is now quite possible to have a virtual copy of the holdings of all the major museums on a single PC. Many museums are data-basing and digitising their collections and associated bits of information. This will, if made widely available, greatly speed up the pace of all types of research into our biodiversity in many fields.

Our knowledge of geometrid fauna worldwide is far from satisfactory, especially in third world countries where even the basic species taxonomy is inadequate. The necessity of a rapid increase in basic taxonomic research is emphasized as we are losing our biodiversity at a rapid pace and a stable taxonomy for the Geometridae will be of great assistance in our plight to save our geometrid biodiversity. Many new capital developments that may threaten geometrids require environmental impact studies prior to development in more and more countries. These are of no use however if we are not aware of threatened habitat or taxa in that particular area.

It is therefore imperative that we urgently promote the free flow of museum data, information and specimens amongst geometridologists in order to speed up basic research into them. The database Lepidops©, contains an updated catalogue, over 8000 images, including many undescribed taxa and types, and more than 16000 records of Afrotropical Geometridae. As an experiment, to test the possible growth of research into African Geometridae, Lepidops is conditionally offered at only the cost of software and hardware to Forum Herbulot members. This is done in spite of the obvious risks involved. It is proposed that a protocol for data sharing be established by the forum in order to facilitate more frequent data sharing and minimise the possibility of plagiarism in all its forms.