Speciation or variation between moths from Malai peninsula and Indonesia (Borneo)?

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How much do moths vary? Or, in other words, how large may be infraspecific variation in measurements? In praxis, I have used ±5 % tolerance up to now, to decide that two specimens belong to the same species. It remains, however, to be cleared up, if that is correct.

Methods and material. Measurements (see Tab. 1) are taken with ocular micrometer on dry objects (palpus, legs) or from slides (legs of moths macerated and embedded in euparal with male genitalia). Taxa are identified according to Holloway (1996), Yazaki (1996), Holloway & Sommerer (1984) and Prout (1932).

It is well known that length of male and female palpi, as well as presence or absence of male hind tibial spurs, dilation, vestiture and the length of distal projection are diagnostic when present in various groups of Lepidoptera. So in emerald geometrids, genus *Agathia* Gn. as an example (Tab. 1).

During a routine taking measurements of study objects I have seen differences between Thailand and Borneo populations. Usually, when an object is smaller or larger than another, their measurements co-variate, i.e. change proportionally. In many of the presented cases they are not proportional. *Agathia quinaria* Moore, 1867, from Borneo has shorter

Tab. 1. Measurements of wingspan, 3rd segment of palpus, and hindlegs in some *Agathia* Gn. species from Thailand and Borneo (Sabah).

Species	locality T=Thailand B=Borneo	wingspan (mm)	slide no.	palpus 3 length X (mm)	tibia/tarsus length (mm)	tibial projection (mm)	tarsus 1 length (mm)	spur pair distance (mm)	palpus 3 length C (mm)
A. laeta	T	29	6764	0.13	5/2.5	0.5/0.7	1.25	1.45	
A. laeta	B	29-31		0.16	5/2.5	0.6/0.75	1.16	1.37	
A. quinaria	T	27	6768	0.25	**4.2/2.75**	**0.37**	**1.25**	1.25	0.9-1.0
A. quinaria	B	26.5		0.25	**4/3.25**	**0.5**	**1.0**	1.2	1.05
A. largita	T	31-32		0.2	4.2/3.25	0.3	1.5	1.1	
A. arcuata	T	25-28	6766	**0.25**	**4.2/2.75**	**0.4**	1.25	**1.12**	
A. arcuata?	T	25-28	6770	**0.3**	**4/3.25**	**0.25**	1.5	**1.25**	
A. arcuata	B	26		0.25	4.2/3.75	0.4-0.5	1.25	**1.25**	
A. deliciosa	B	27		0.27	–	–	–	–	
A. rubrilineata	T	30	6767	**0.3**	**4.75/3**	**0.5**	**1.6**	**1.37**	1.1
A. rubrilineata	B	34	6989	**0.5**	**5.3/3.3**	**0.3**	**1.75**	**1.62**	
A. diplochorda	B	29-29.5		0.4-0.5	4.25/3	0.4-0.5	1.5		
A. codina	B	44		0.4	7.2/4.5	0.9	2.5	2.25	
A. obsoleta	B	36-40	6733	0.27	7/3	1.4	1.4	2.0	
A. gigantea	B	37-40		0.25	4.25/3.7	0	2.0	1.0	
A. cristifera	T	24-25	6987	0.2	**3.5/2**	**0.45**	**1.75**	**1.0**	
A. cristifera	B	23-27	6988	0.23	**4.2/2.25**	**0.62**	**1.12**	**1.25**	
A. laqueifera	T	24	6990	0.2	–	–	–	–	0.35
A. laqueifera	B	23		0.14	3.5/2	0.45-0.6	1.0	0.87	
A. tetraplochorda	T	33		0.4	5.5/3	0.6	1.25	1.5	
A. angustilimes	T	32	6765	0.2	4.1/2.5	0.4	1.25	1.25	
A. diversiformis	T	30/39		0.16	6/2.5	0.87	0.87	2.5	1.25

tibia with longer distal projection, and longer tarsus with shorter basal segment when compared to material from Thailand. In the case of *A. arcuata* Moore, 1867, the two "variants" from Thailand and moths from Borneo differ in shape of costa, longer in "no. 6770" (*A. hemithearia* Guenée, 1858?), in presence of an additional flap-like projection medially in costa and in some other minor niceties that might fall within the limits of infraspecific variation, or characterise a vicarious species.

Taking measurements is a scrupulose and time-consuming activity. Why to do it?

It is easiest to identify butterflies and moths according to color pictures in atlases, in web, etc. It works when differences between taxa are clear-cut enough. It does not work when moths are similar one to another. And this case we must go in details. The emerald genus *Agathia* is used here as an example. Within this genus, there are groups of externally similar species, examples of clinal variation or vicarious taxa. Study of genitalia is essential for correct identification of most species. To save time, the material must be sorted somehow, in advance.

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New Geometridae from the Indopacific region

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Some species relationships in the genus *Metallolophia* Warren are discussed. Diagnostic characters between *Parasthena flexilinea* Warren and a potential new species from Seram and Papua New Guinea are presented.

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1. Heterospecifity of *Metallolophia ocellata* (Warren, 1897) and *M. devecisi* Herbulot, 1989.

M. devecisi is very similar to the Indian species *M. ocellata* and has been thought as conspecific. The differences of male antennae, wing markings and distribution range show that they are different species. The diagnostic characters were given to distinguish these two species: (1) The underside of these two species are similar to each other. But in *devecisi*, the postmedian fascia on forewing is rounded from costa to M_3, then continuous to Cu_2, and forms a distinct angle at its inner margin. Postmedian fascia on hindwing in *M. devecisi* is round, but that fascia on *M. ocellata* is angled. Yellow area in *devecisi* is fairly extended. (2) There are differences in genitalia. The apex of valva is slightly different. *M. ocellata* is narrower than that of *M. devecisi*. The basal lobe of *M. devecisi* is a little shorter.

2. The relationship between *Metallolophia variegata* Holloway, 1996 and *M. cineracea* Holloway, 1996.

After comparing the materials and original descriptions of both species it is concluded that these two species might be conspecific, the wing colour differences might represent different colour forms. Three main points support this result:

- Size, wing shape, wing markings of holotypes are almost the same except slight differences in colour.
- Male genitalia of both species are almost the same except for slight differences in the width of valva and saccular process, these differences are distinctly smaller than infraspecific variation in the genitalia of *M. arenaria* (Leech, 1889).
- The localities of holotypes, Sarawak: Gunung Mulu for *M. variegata* and Brunei, Telisai for *M. cineracea* are very close to each other, only 50-70 kilometers apart.