

Species, characters and traits in the genus *Amerila* (Lep.: Arctiidae)

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<http://www.fzi.uni-freiburg.de> contains more information on *Amerila*, including keys for determination and downloadable PDF files of several publications.

Introduction

The paleotropical genus *Amerila* Walker 1855 (usually referred to previously as *Rhodogastrina*) comprises some sixty species of large, robust and aposematically coloured arctiine moths. The majority of species occurs in the Afrotropical region including Madagascar, but in the Indo-Australian region some 20 species are distributed from India to New Guinea, the Solomon Islands and NE Australia.



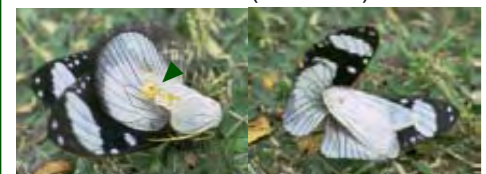
Drawing of an *Amerila* (18th century).

The genus has received quite little attention in science and the literature is almost entirely restricted to the pure description of species. Significant information on their biology is scant. Here, we want to demonstrate that *Amerila* moths deserve intense research because of their interesting combination of features. They exhibit a variety of traits which make them particularly interesting for chemoecological studies on chemical defenses, pheromone communication and evolutionary aspects of insect-plant relationships but they also bear a lot of systematic and biogeographic interest.

Our attention to *Amerila* was drawn by discovering their pharmacophagous relation to plants containing pyrrolizidine alkaloids (PAs) (see below), a syndrome *Amerila* share with several other insects, e.g., *Nyctemera*, *Digama*, Ctenuchinae, Danainae, Ithomiinae, *Zonocerus* grasshoppers, *Gabonia* leaf beetles, chloropid flies [cf. Boppré M (1999) 'Drug-addicted' insects in Africa. *Metamorphosis* 10: 3-15].

How intimate are relations of Rhopalocera and Heterocera?

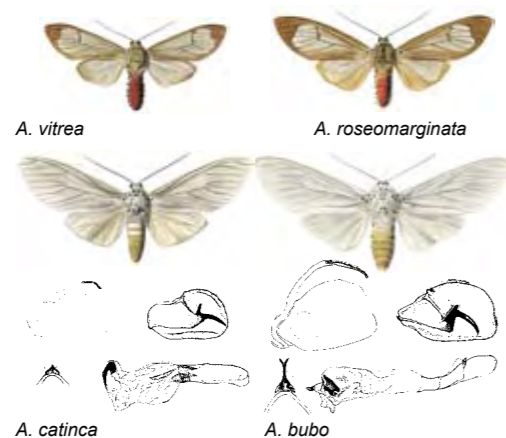
We know of two documented cases of courtship attempts of a male *Amerila bubo* with a male *Amauris niavius* (Danainae)



Note the display of expanded androconia by the *A. bubo* (arrow). Photos: courtesy of Paul Brakefield.

The diversity of species in Africa

Although *Amerila* moths can in general easily be recognized even in the field by a characteristic phenotypical appearance, most species are difficult to distinguish by external characters. Male genitalia and androconial organs, however, show remarkable differences.



The two colour patterns (white and brown) found do not reflect relatedness because striking sexual dimorphism in several species links both types of patterns.

Sexual Dimorphism

In a few species there is moderate sexual dimorphism, but usually the sexes show either no differences at all or they look completely different (males being brown, females white – the opposite situation does not occur). Then males and females, respectively, can hardly be distinguished from non-dimorphic species (cf. figures). Of several species only males are available, the females remain yet unknown.



Examples for strikingly sex-dimorphic species: males (left) and females (right) of *Amerila phaedra* (top) and *A. leucoptera*.

Mimicry?

Amerila syntomina was previously placed in the genus *Caryatis*. Indeed, the forewing pattern of *A. syntomina* is quite exceptional within *Amerila* and almost indiscriminable from *Caryatis*, particularly in resting position of the life moths. This also holds true for the (day-active) arctiids of the genus *Nyctemera*.



Early instars

Larval hostplants

The information in the literature on larval hostplants is very scant and dubious; in most cases it is unknown if the caterpillars had been found on the respective plants and normally utilize them or if they rather only had accepted this food in captivity. The information found in the literature on 9 species covers 15 plant families which is hard to believe. However, if it proves true, it is most interesting for phylogenetic considerations.

Agavaceae (*Dracaena*), Apocynaceae (*Beaumontia*), Asclepiadaceae (*Marsdenia*), Asteraceae (*Gynura*), Combretaceae (*Combretum*), Dioscoreaceae (*Dioscorea*), Ebenaceae (*Diospyros*), Euphorbiaceae (*Bridelia*), Moraceae (*Ficus*), Myrtaceae (*Eugenia*, *Syzygium*), Ochnaceae (*Ochna*), Papilionaceae (*Erythrina*), Periplocaceae (*Gymnanthera*), Rubiaceae (*Ixora*), Sapotaceae (*Mimusops*), Smilacaceae (*Smilax*), Solanaceae (*Solanum*), Steruliaceae (*Theobroma*).



5th-instar larva of *Amerila bubo* and caterpillars of *A. affinis* feeding on artificial diet.

Larval characters

Larvae have not yet been described, however, with the aid of an artificial diet we are able to rear many species (15 so far) and determine larval characters. In general, we recognize in several species considerable changes of characters between instars. A notable behaviour of the caterpillars is that they writhe around when disturbed.

Biology and ecology of Amerila

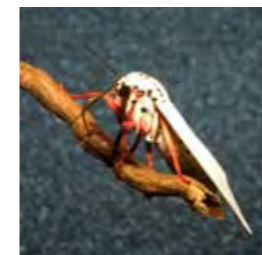
Apart from their pharmacophagous behaviour towards PAs, there are no field records of antagonists, courtship behaviour or any other biologically/ecologically relevant information in the literature but laboratory observations as well as morphological and chemical studies show that *Amerila* possess elaborate communication systems. Their defensive means constitute of hissing sounds, frothing and storage of deterrent-tasting PAs. Perhaps, ultrasonic signals are also

Relation of adults to plants containing pyrrolizidine alkaloids (PAs)

Adult *Amerila* are pharmacophagous with respect to pyrrolizidine alkaloids (PAs), i.e. independent of nutritional requirements, they are attracted to withered plants containing these secondary metabolites (as well as to dishes with pure chemicals) from which they take up these compounds and store them for defence. There seems to be no sex-bias in PA-related pharmacophagy.



Several species of *Amerila* attracted to dishes containing pure pyrrolizidine alkaloids.



Amerila can be baited with pure PAs as well as with natural sources of PAs, e.g., dry *Heliotropium* (Boraginaceae) or *Crotalaria* (Fabaceae). The moths gather the

PAs by applying a fluid *via* their proboscides onto the dry plant material or pure crystals, resp., and imbibe the dissolved PAs.

Acoustic communication

Tymbal and tympanic organs

When disturbed, adult *Amerila* produce hissing sounds which are in part detectable to human ears. For *Amerila phaedra* we have experimental evidence that these acoustic signals facilitate learning of repelling tasting moths in bats, i.e. there is some proof for the existence of acoustic aposematism.

Tymbal as well as tympanic organs are valuable taxonomic characters.

Defensive frothing

Jointly with hissing sounds, disturbance is responded with the release of large amounts of a repulsive-smelling froth from prothoracic glands. The froth is made up by haemolymph and, in case, contains PAs. Reimbibing froth after an attack likely is to avoid waste of valuable proteins and PAs.

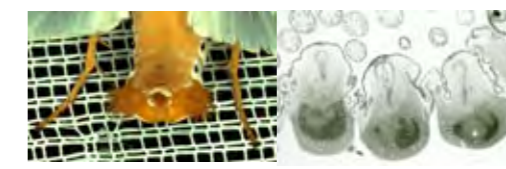


Frothing *A. bubo*.

Pheromonal communication

Female pheromone glands

Strikingly, so far, no pheromone glands have been found in females of *Amerila* – but there is no indication that mate-locating is not mediated by female sex pheromones in this genus. However, the females of *A. bubo* possess elaborate hair brushes laterally to the abdominal tip which are almost indiscriminable to the male scent organs of this species. We have observed that they are displayed at night.



Female *A. bubo* displaying abdominal hairbrushes (left) which contain large glandular cells (right).

Androconial organs

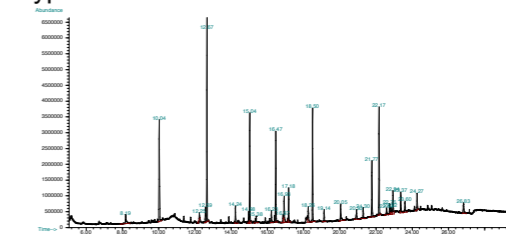
Scent organs in male *Amerila* are more diverse than in any other genus of moths. Most peculiar are pneumatically expandable coremata originating from the valves, but brushes at certain sternites or the abdominal tip, tergal scale bands, forewing glands and felted patches on hindwings also occur. Some species lack such organs entirely.



Artificially protruded androconial organs of *Amerila catinca*, *A. luteibarba*, *A. roseomarginata* and *A. vitrea*.

Chemistry of androconial secretions

The diverse morphology is reflected in their chemistry. For the human nose only some species emit an odour which can be pleasant or repulsive. Chemically, we always find a complex bouquet composed of different types of molecules.



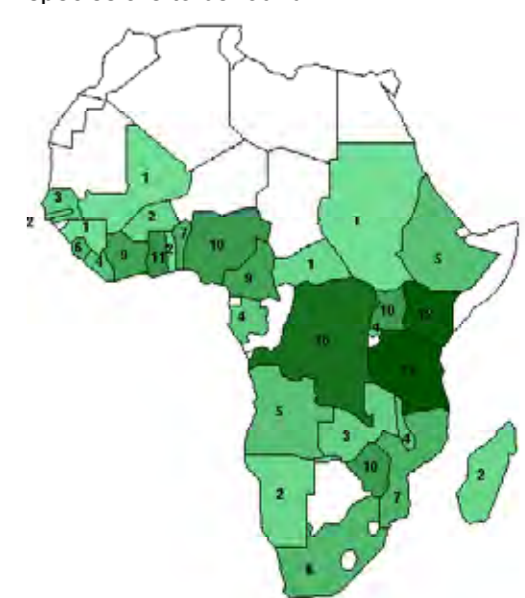
Gas chromatogram of an extract of scent organs of *A. vitrea*.

Gaps in knowledge and prospects

The diversity of characters and traits found in the genus *Amerila* makes this taxon most suitable for morphological, physiological, chemical, behavioural, ecological, genetical, evolutionary and taxonomic studies. We aim to continue to investigate this genus thoroughly to eventually come up with cladistic analyses considering all kinds of characters.

However, there are still huge and quite general gaps in knowledge; in particular data from the field are missing. Data on larval host plants, adult sources of PAs, information on habitat requirements, seasonality, parasitoids, etc., are urgently needed.

Apparently, we do not yet have a complete overview on the African species. In our recent revision [Häuser & Boppré (1997) *A revision of the Afrotropical taxa of the genus Amerila* Walker (Lepidoptera: Arctiidae). *System Entomol* 22: 1-44] we have recognized 35 species (of several males only) – in the meantime from several collectors/museums we have received material containing undescribed species. A look at a distribution map also suggests that further species are to be found.



Call for help and cooperation

Lepidopterists interested in this genus are cordially invited to cooperate with us. With the knowledge on attraction of both sexes of *Amerila* to baits containing PAs, simple means to collect specimens in the field exist. Also, rearing on artificial diet is no problem. We can assist you by providing PA-baits, artificial diet, etc.

PLEASE, CONTACT US!