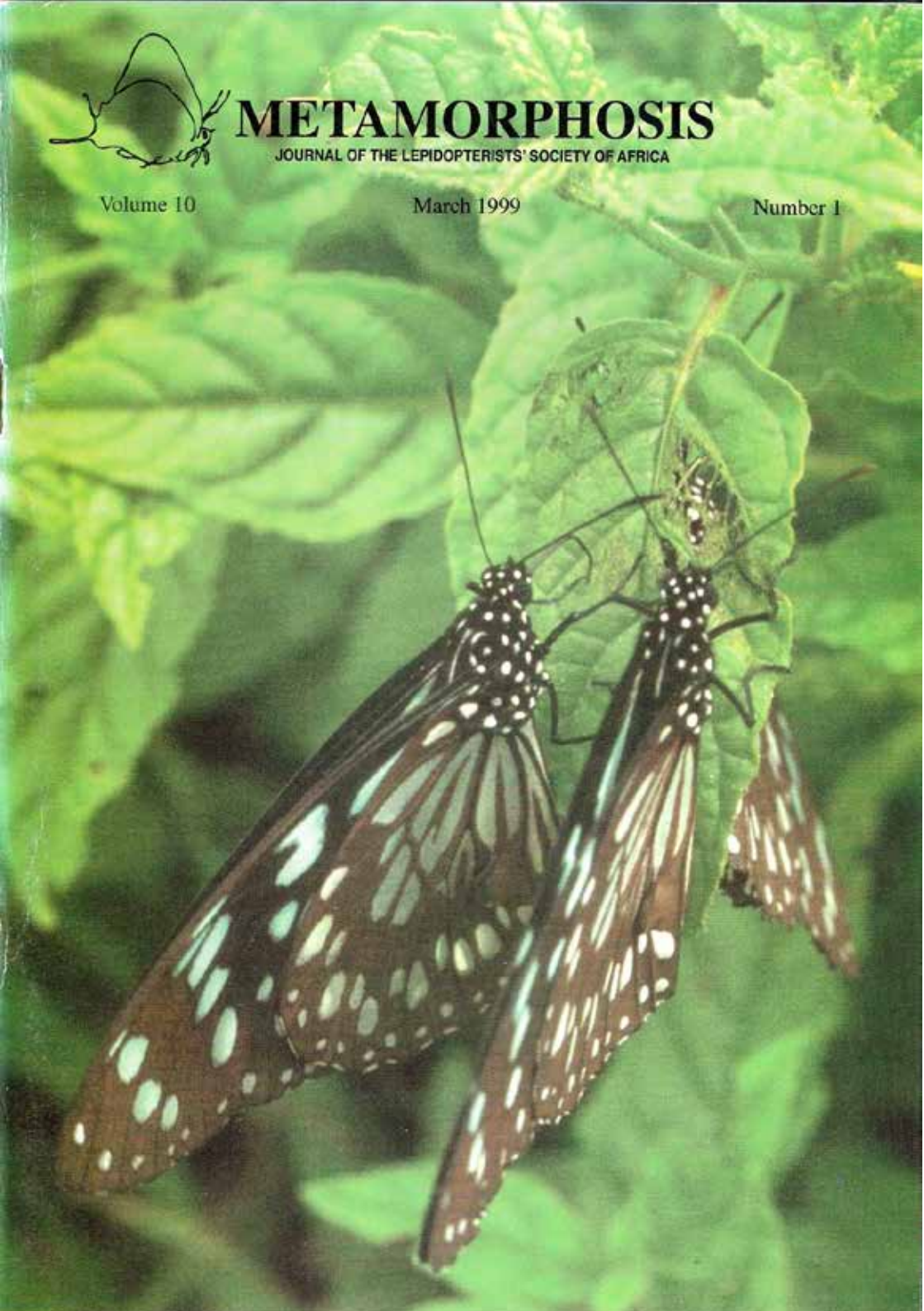

METAMORPHOSIS

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LEPIDOPTERISTS' SOCIETY OF AFRICA

EXECUTIVE COUNCIL

EDITORIAL

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The aims of The Lepidopterists' Society Of Africa are to promote the scientific study and the conservation of Lepidoptera in Africa, and to provide a communication forum for all people who are interested in African Lepidoptera.
Metamorphosis, which is the official journal of the Society, publishes original scientific papers as well as articles of a less technical nature.
Membership of the Society is open to all persons who are interested in the study of Lepidoptera. There is no geographical limit to membership.
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Covers: Front: Males of *Tirumala petiverana* (Danainae) gathering pyrrolizidine alkaloids from a leaf of a *Heliotropium* sp. after scratching at feeding holes of *Longitarsus* beetles to get access to the secondary chemicals. [Photo: M. Boppré]

Back: Males of *Tirumala petiverana* (top) and *Amauris niavius* (Danainae) extracting secondary chemicals (pyrrolizidine alkaloids) from dried fruit of *Heliotropium* sp. (cf. pp. 3-15) [Photo: M. Boppré]

Comments from the council

For many years a shortcoming existed in the operations of the council of the Lepidopterists' Society. This is to convey to the membership at large what is happening at council level. It was therefore decided to use this column as a vehicle to communicate with the members about various projects and other happenings the society is involved in.

The major event taking up effort is undoubtedly the International Conference on Lepidoptera hosted by ourselves and ABRI. It would be appropriate to highlight the enormous effort (and successful at that too) by Jenny and Alan Heath and the Western Cape branch. This conference promises to be outstanding with many excellent international and national speakers. We would really like to encourage our members to make a serious attempt to attend this worthwhile conference and I believe it will not be too late to present either papers or poster sessions at the conference.

Other events that took place included the Yebo Gogga week at the Johannesburg Zoo. This was again a great success with special thanks to Graham Henning and Peter Roos and family. It was a pity that so few members participated but we would like to thank those who did. Let's all pitch next year to ease the burden and make it an even greater success.

In the past years a number of changes happened within the society. Branches started up and we have in fact expanded to include the whole of Africa. For this reason it was felt that the current constitution of the society needs to be updated. The council has taken this task on as a project and we would like to encourage anyone with good ideas to submit them for consideration in a new constitution. The constitution is a very important document as it describes our reason for existence and regulates our conduct. A sound constitution which covers not only the administrative functions but also the ethics involved in collecting and studying our natural fauna and flora will go a long way in establishing our credibility in the scientific and conservation community.

Bennie Coetzer
(acting President)

'DRUG-ADDICTED' INSECTS IN AFRICA

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Abstract: Pharmacophagy and its diverse functional aspects is introduced using examples from studies on relationships between insects and pyrrolizidine alkaloids (PAs) in Africa. Remaining open questions are outlined, emphasizing the over-riding need for natural history information from the field on 'PA-insects' and 'PA-plants'.

Key words: Lepidoptera, Danainae, Arctiidae, Coleoptera, Alticinae, insect-plant relationships, pharmacophagy, pyrrolizidine alkaloids, chemical ecology, pheromone biology, chemical defences, mimicry, hostplants.

Introduction

> "Observe the butterflies, sombre black fellows ..., flying in a crowd round a shrub with thick silvery-looking leaves .... A branch is broken, and the leaves are hanging dry and wilted. The butterflies settle on the dead leaves in swarms, almost pushing and jostling one another to get a good place. Notice that it is the withered leaves and flowers that they prefer, and seem to become half stupid in their eagerness to extract the peculiar sweetness, or whatever it is, that the leaves contain." (Woodford 1890)

The 'peculiar sweetness' of a dried *Tournefortia* (Boraginaceae) branch, so attractive to *Euploea* (milkweed butterflies, Danainae) was subsequently found to be a toxin gathered to improve their fitness.

This paper provides_ a brief introduction to the general subject of such non-nutritional uses of plants by insects ("pharmacophagy") illustrated by the results of my personal field studies on relationships of insects to plants containing pyrrolizidine alkaloids (PAs) primarily conducted in Kenya during numerous visits between 1979 and 1990 but with some observations made in Benin, Togo and Uganda. In· combination with laboratory analyses such field observations have provided insights into various aspects of lepidopteran biology and chemical ecology. However, lack of knowledge on the natural history of PA-plants and PA-insects continues to curtail our understanding. This article, then, is a plea for information from readers with an interest in lepidopteran natural history, and an invitation for further collaboration in this area.

Non-nutritional insect-plant relationships

So-called secondary plant substances* extend the relationships between insects

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Chemicals that are not required for the general metabolism and do not occur in each cell of a plant; most serve defensive purposes, but there are many which mediate mutualistic relationships with animals (e.g., the scents of flowers). Caffeine, nicotine, herbal medicines as well as the smells and tastes of fruit are secondary plant metabolites, however, most are undetectable

and plants beyond nutrition: plants' secondary metabolites render them unacceptable for unadapted herbivores / phytophages and can also play a major role in mediating host localization and host recognition. Many insects sequester noxious plant chemicals for their own protection against predators and other antagonists. Such specialists are physiologically adapted to avoid noxious effects, but generally the utilized secondary chemicals are ingested incidentally in the course of feeding - often they are not perceived by the insects and even if they are, they alone do not modify insect behaviour, for instance, by eliciting feeding behaviour.

However, the special non-nutritional relationship between insects and plants called "pharmacophagy" (Boppré 1984) is exclusively mediated by and directed towards plant secondary compounds. This insect-plant interface is quite separate from the primary insect host-plant relationship.

The utilization of pyrrolizidine alkaloids (PAs) provides a widespread example. Numerous insects gather PAs as adults, usually from withered and dry plants of certain taxa which are unrelated to their larval hostplants. Generally, they store PAs (which are taste-deterrent for non-adapted phyto- as well as zoophages) for their defence, but among the Lepidoptera several taxa use PAs in addition as precursors for the biosynthesis of male courtship pheromones.
Details of insect-PA relationships are reviewed by Boppre (1986, 1990, 1994, 1997), Schneider (1987), Eisner & Meinwald (1995), Hartmann & Witte (1995).

Insects pharmacophagously associated with PA-plants in East Africa
The literature contains very few reports on adult Lepidoptera 'feeding' at dry PA-plants in Africa (Schneider *et al.* 1975; Smith 1975; Boppré 1981), and I myself have only rarely encountered such interaction during many months spent in the field. Spectacular congregations of insects gathering PAs only occur when PA-sources are very scant and PA-insects very abundant at the same time; usually, a single individual insect obtains PAs from a small wound or a small withered part of a PA-plant which escapes the eyes of an observer - or the observer does not recognize the interaction as anything 'special'. However, by using dry *Heliotropium indicum* or *H. pectinatum* (Boraginaceae) plants or PAs extracted and purified from *Crotalaria scassellatii* (Fabaceae) as baits (cf. Figs 1, 5), I have been able to lure insects of four orders (see Schneider *et al.* 1975; Boppré 1981; Boppré & Scherer 1982; Boppré *et al.* 1984; Boppré & Pitkin 1988; Fischer & Boppré 1997; Hauser & Boppré 1997; Scherer & Boppré 1997; M. Boppré unpubl.):
Lepidoptera. Nymphalidae: Danainae: All species known from Kenya *(Amauris albimaculata, A. echeria, A. ochlea* (Fig. 6), *A. niavius, Danaus chrysippus, Tirumala formosa , T. petiverana),* with the exception of *A. niavius* (and *A. tartarea?) ,* only males.
Arctiidae: Arctiinae: 10 species of *Amerila* (Figs 3, 11-14), 3 of which undescribed, no sex-bias.
Arctiidae: Nyctemerinae: *Nyctemera coleta* (Fig. 7) and 4 yet undetermined species (Fig. 5).
Arctiidae: Euchrominae: *Euchromia amoena* (Fig. 4), *E. jethe* (Fig. 8), *E. interrupta.*
Arctiidae: Hypsinae: *Digama* spp. (Fig. 9), *Aganais speciosa* (Figs 2, 10).

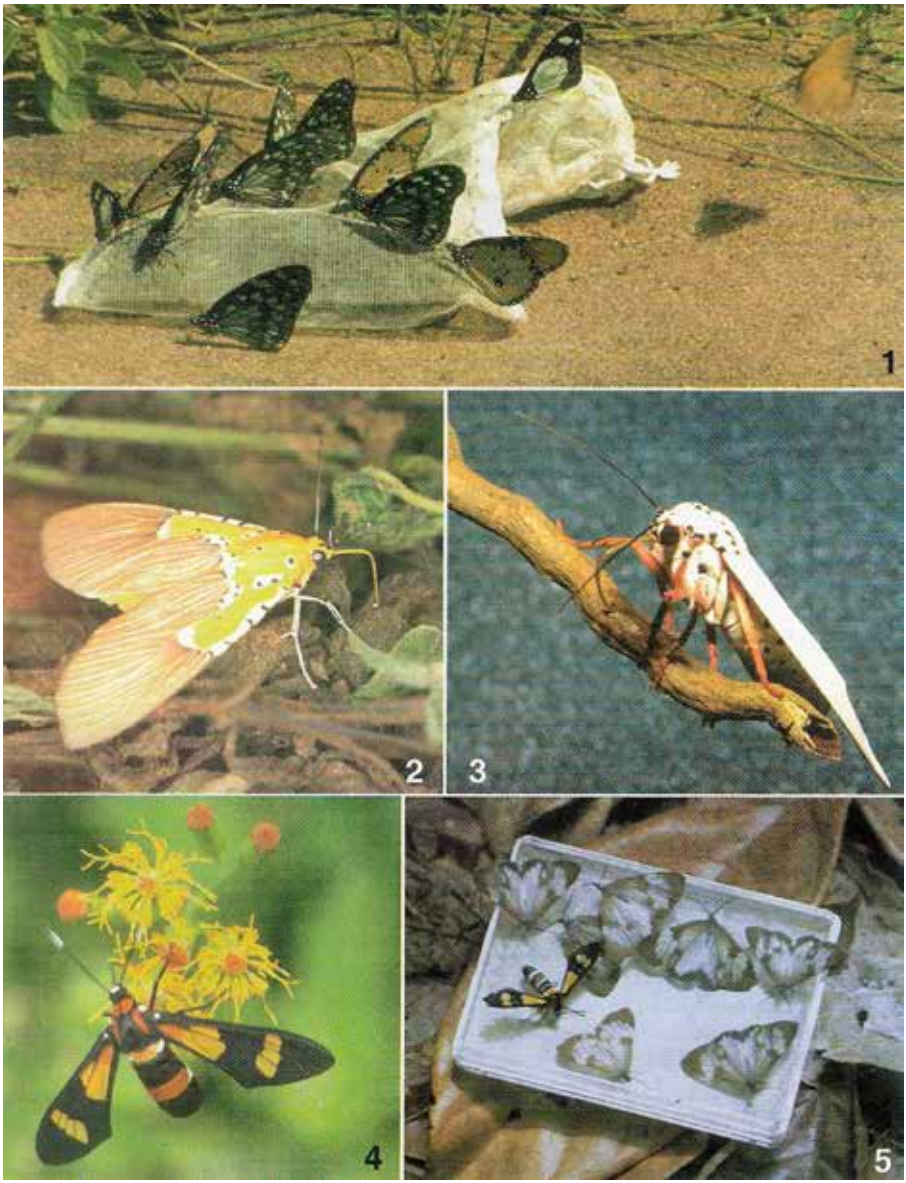


Plate 1. Lepidoptera gathering pyrrolizidine alkaloids: *Danaus chrysippus, Tirumala petiverana* and *Amauris ochlea* at a gauze-bag with withered material of *Heliotropium pectinatum* (1); *Aganais speciosa* at dry *Heliotropium* (2), *Amerila* sp. applying 'solvent' to a dry root of *Heliotropium* (3), *Euchromia amoena* at *Gynura scandens* (4), *Euchromia* and *Nyctemera* at a dish with pure PAs (5).

Coleoptera. Chrysomelidae: Alticinae: Males only of 18 spp. of *Gabonia* (Figs 16, 17), 13 of which undescribed, both sexes of a new species *(Nzerekorena filicomis,* Fig. 15), several species of other alticine genera.
Diptera. Chloropidae: Species of at least 2 subfamilies (Chloropinae, Oscinellinae) and 4 genera *(Melanochaeta, Chlorops, Eutropha, Oscinella),* no sex-bias. (These catches have not been fully evaluated.)
Orthoptera. Pyrgomorphidae: In South and West Africa, all stages and both sexes of *Zonocerus elegans* and *Z. variegatus* (Fig. 18).

This list is hardly comprehensive for insects gathering PAs from dry plant matter; it simply reflects my own experience in limited areas and limited time. In other habitats and/or at different times of the year, the composition of species is different as is the number of individuals at baits. Also, similar to the scarcity of encounters of congregations of insects at natural PA-sources (cf. above), visitation of baits depends on competition with natural sources of PAs, the abundance of respective insects in the area etc.; I have experienced attraction of 'any number' of insects, from none to many dozens.

PA-containing plants in East Africa
Because of the pharmaceutical importance of PAs, almost 400 species of plants have been analysed chemically for their presence; the 400 or so structures elucidated are found in some 90 genera of 11 families. However, only those PAs with the necine bases heliotridine or retronecine (Figs 19, 20) are known to be associated with insects, and these molecules occur in a smaller number of plant taxa - but those are the more abundant ones and include the following genera represented in Africa:
Asteraceae: *Ageratum, Emilia, Gynura,* some *Eupatorium;* Boraginaceae: *Heliotropium* (Fig. 23), *Toumefortia;* Fabaceae: *Crotalaria* (Fig. 24).

Adult insects obtain PAs usually from withering or even completely dry fruits, seeds, foliage or roots; which plant part is most attractive depends on the species and also on the stage of decomposition. With their proboscides butterflies and moths apply a fluid onto the dry plant matter and reimbibe it with dissolved PAs.

Over a distance, insects cannot detect and recognize PAs in living tissue where they are concealed in the cell vacuoles; in addition, it is not the intact PA molecules but a volatile breakdown product which mediates attraction. This 'volatile principle' (Boppré *et al.* in prep.) appears in tiny amounts after cells have been mechanically damaged by wounding or drying. (Because the occurrence of this scent requires hydrolysis, the attractiveness of dry PA-plants used as bait can be increased by moistening.) In many species PAs are synthesized in the roots which then contain highest concentrations and make particularly good baits although they are not accessible naturally to butterflies and moths.
Interestingly, *T. petiverana* have been observed gathering PAs from living tissue of *H. pectinatum:* they scratched green leaves with their tarsae to get access to the chemicals.· However, the leaves had been fed upon previously by leaf beetles *(Longitarsus* sp.), the dry edges of their feeding holes releasing the volatile principle (Boppré 1983).

There are, however, also plants which have PAs in their nectar. For example

flowers of *Gynura scandens* are exclusively visited by PA-gathering species and avoided by other nectar foragers, an observation that led to the discovery of new PAs in this species (Wiedenfeld 1982); puzzlingly, dry leaves and roots of *Gynura* are not attractive and fail as baits. Guided by insect behaviour, we have also demonstrated for the first time PAs in *Heliotropium pectinatum* (Schneider *et al.* 1975), *Crotalaria scassellatii* (Wiedenfeld *et al.* 1985) and others.

On the biology of PA-pharmacophagous species

Identifying certain insect taxa to be PA-pharmacophagous and certain plants to contain PAs, finding new PAs or describing new species provides the basis of our search for functional commonalities and differences, and of general conclusions regarding PA-pharmacophagous species.

A significant character of PA-pharmacophagy is that in many cases only males gather PAs, but there are others with no sex-bias or with female sex-bias. This already indicates basic differences in function.

So far, all species investigated chemically store unconverted plant PAs. Several research groups found that by storing PAs insects can gain protection from a large suite of vertebrate as well as invertebrate predators. Most such PA-insects exhibit aposematism in their appearance both morphologically (colour) and behaviourally (slow flight, day-active moths). Some species store part of the ingested plant metabolites in a slightly modified structure ("insect PAs", e.g. Hartmann *et al.* 1990).

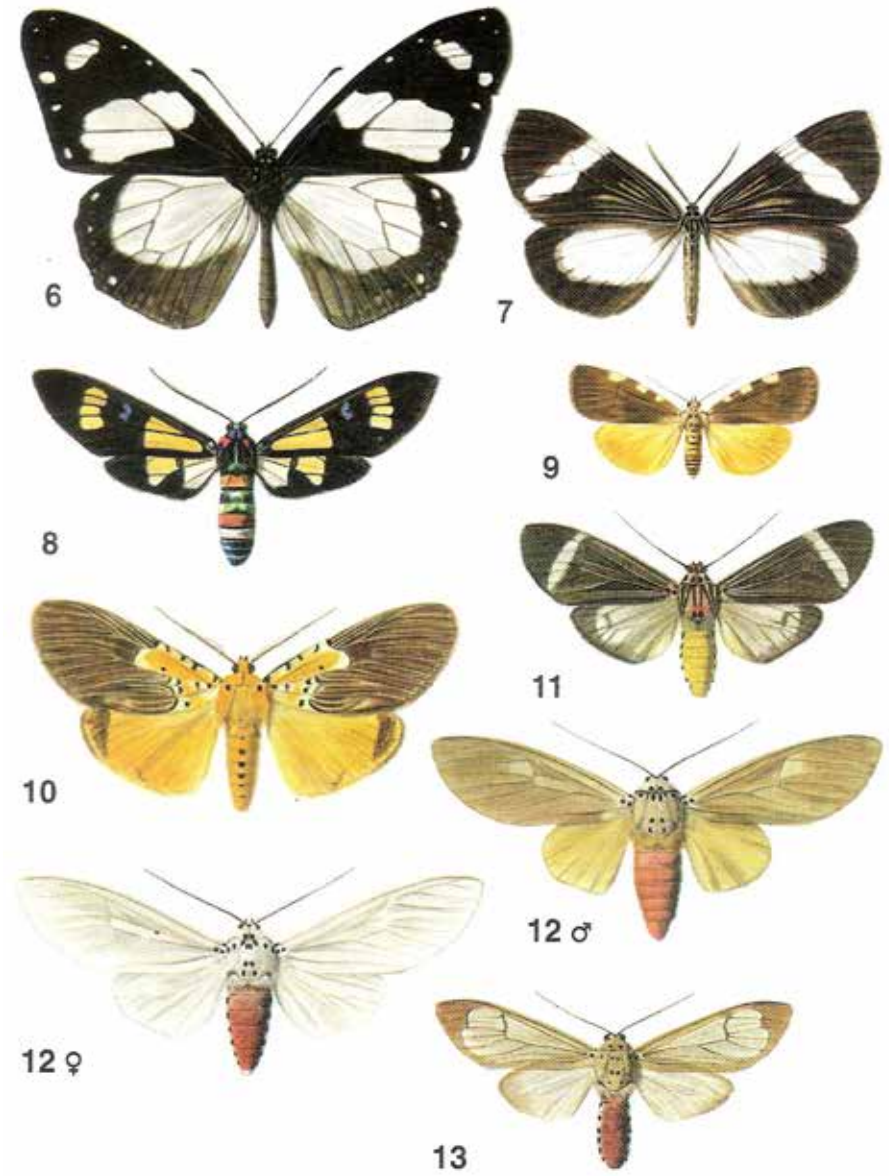
Males of many PA-utilizing Lepidoptera not only use PAs as defensive chemicals for themselves but also transfer large amounts to the females with their spermatophores; these, in turn, are incorporated into their eggs for protection (see Dussourd *et al.* 1989).

In addition, plant-derived PAs are used by males of many species to manufacture dihydropyrrolizine pheromone components (cf. Figs 21, 22)(Schneider *et al.* 1975; cf. Boppré 1990; Hartmann & Witte 1995), however, the use of PAs as precursors for pheromone biosynthesis is not a general feature of PA-insects. Not in all PA-insects do the males possess androconial organs, and even those which do need not necessarily produce PA-derived pheromones.

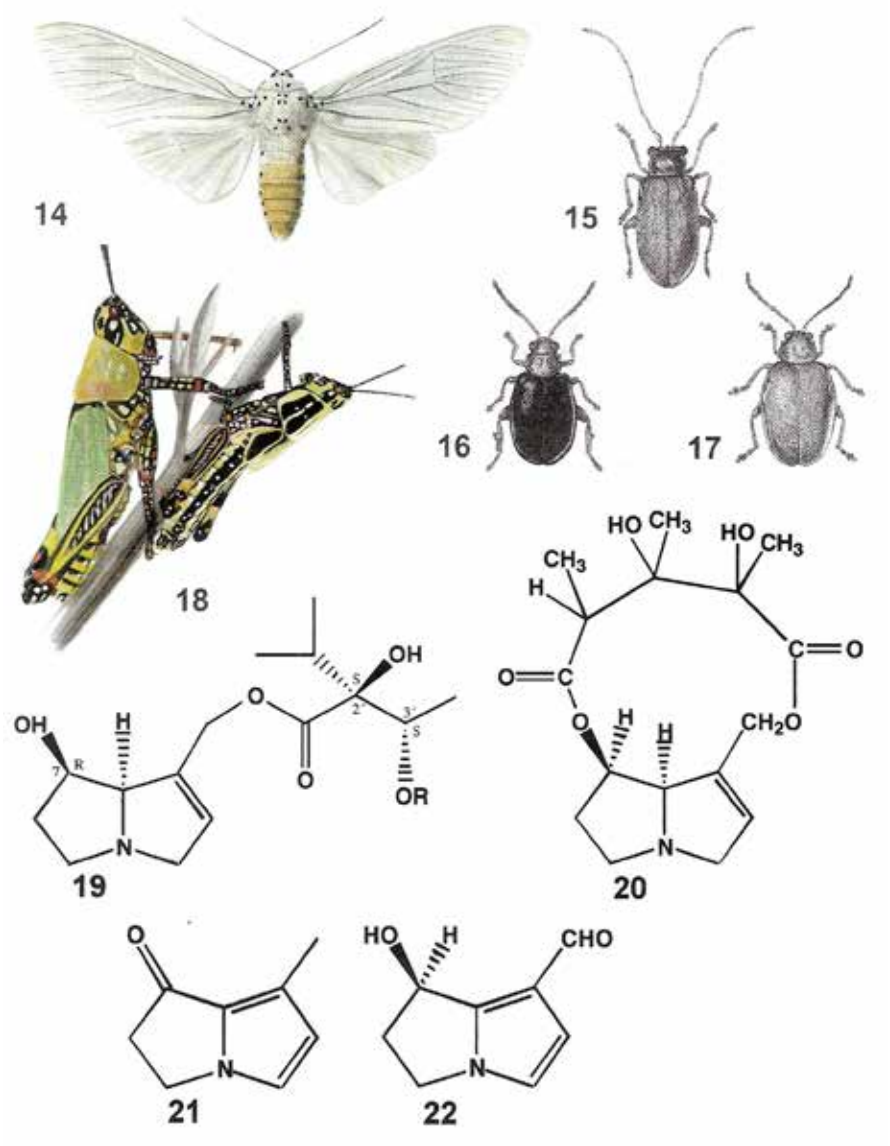
The extrudable abdominal hair pencils of male danaine butterflies (cf. Boppré & Vane-Wright 1989; Vane-Wright *et al.* 1992) emit species-specific bouquets of up to 80 volatiles, including components derived from PAs (e.g., danaidone, Fig. 21) (e.g. Schulz *et al.* 1993). The amount of these dihydropyrrolizines vary individually and seem to provide an indication to females of the amount of Pas that might be received through a spermatophore to protect the eggs (cf. Eisner & Meinwald 1995).

Within *Amerila,* androconial organs show great diversity; for example, expandable tubes at the claspers, hairbrushes at the abdomen, and glands on the wings (Fischer & Boppré unpubl.). They also emit bouquets of volatiles but – in contrast to danaines - only in some species are these PA-derived.

Our knowledge on the other PA-pharmacophagous Lepidoptera is very limited, but interesting data can be expected. For example, *Nyctemera* visit sources of PAs although the larval hostplants known for this are PA-plants. This is contrary to the expectation that they would have no need to undertake the costly search for and uptake of these chemicals as adults.



Plates 2 & 3. Examples of taxa attracted to dry PA-plants and pure pyrrolizidine alkaloids in East Africa: *Amauris ochlea* **(6) ,** *Nyctemera* sp. **(7) ,** *Euchromia lethe* **(8),** *Digama* sp. **(9),** *Aganais* sp. **(10)** *Amerila syntomina* **(11),** *A. phaedra* **(12,** ♂, ♀)



A. vitrea (**13**), *A. bubo* (**14**), *Nzerekorena filicornis* (**15**), *Gabonia bicolor* (**16**), G. *bicaveata* (**17**), *Zonocerus variegatus* (**18**). Examples of molecular structures of pyrrolizidine alkaloids [heliotrine (**19**), mono crotaline (**20**)] and of PA-derived male dihydropyrrolizine pheromones [danaidone (**21**), hydroxyd anaidal (**22**)].

The biology of *Gabonia* beetles is completely unknown; there are no records of primary hostplants, and for many species the females are quite unknown. Since the males of many species possess elaborate glandular structures on their antennae, elytra or legs (cf. Scherer & Boppré 1997), PA-visitation might relate to biosynthesis of pheromones as in many of the Lepidoptera.

General conclusions

Insect-plant relationships are generally highly specific, involving many adaptations, for instance, specialized receptors to detect appropriate plants for egg-laying. Pharmacophagous species exhibit 'double' insect-plant relationships, necessitating two sets of adaptations as the primary and secondary supplementary host plants are not taxonomically related.

The dual function of PAs as defensive chemicals and as precursors for pheromone synthesis intimately links chemical defence and sexual communication. Thus, finding individual variation and even temporal variation within an individual in pheromone content as well as in defensive outfit poses various new questions relevant to mate-choice and discussion of mimicry. The fact that pharmacophagous uptake of PAs is independent of uptake of nutrients and/or energy permits challenging experimental approaches on defence, mate-choice, mimicry, and the cost of sex.

It is interesting to note that the knowledge on lepidopteran associations with PAs led to the discovery of new techniques for management of *Zonocerus* grasshoppers, a pest in many countries of West Africa (Fischer & Boppré 1997).

Insects using PA-plants as primary hostplants

PA-plants are not only utilized pharmacophagously by certain adult insects but also used by many taxa as primary hostplants to obtain nutrients. Some species do not take advantage of PAs (rather they break-down and/or excrete these noxious compounds) while others take advantage of both the nutrients and the secondary metabolites of PA-plants. Again, storage for defence with associated aposematic characters is common as is the use of PAs to manufacture dihydropyrrolizine as male courtship pheromones. To date, only a few African arctiid species have been looked at (e.g., Rothschild *et al.* 1979), including *Amphicallia* (Fig. 27) (larvae on *Crotalaria), Utetheisa* (Fig. 28) (larvae on *Heliotropium, Crotalaria* and *Argina* (Fig. 29) (larvae on *Crotalaria)* and *Nyctemera* (Figs 7, 26) (larvae on *Senecio, Gynura*). *Utetheisa,* for instance, use dihydropyrrolizines in mate-choice as originally demonstrated with an American species by Thomas Eisner's group (see Eisner & Meinwald 1995).

Larvae using PA-plants are usually linked with certain taxa, that is they do not respond to a wide range of PAs as described above for adult PA-pharmacophagy. In fact, host choice appears not to be determined by the presence of PAs. However, larvae of the polyphagous Asian *Creatonotos* species (Arctiidae) are pharmacophagous: they consume even glass-fibre disks if they are impregnated with small amounts of pure PAs. *Creatonotos* not only utilize PAs for defence and male pheromone biosynthesis, PAs also act as morphogens regulating the size of the androconial organs quantitatively (e.g., Boppré & Schneider 1990). The African *C. leucanoides* (Fig. 30) shows the same features (Boppré *et al.* unpubl.).

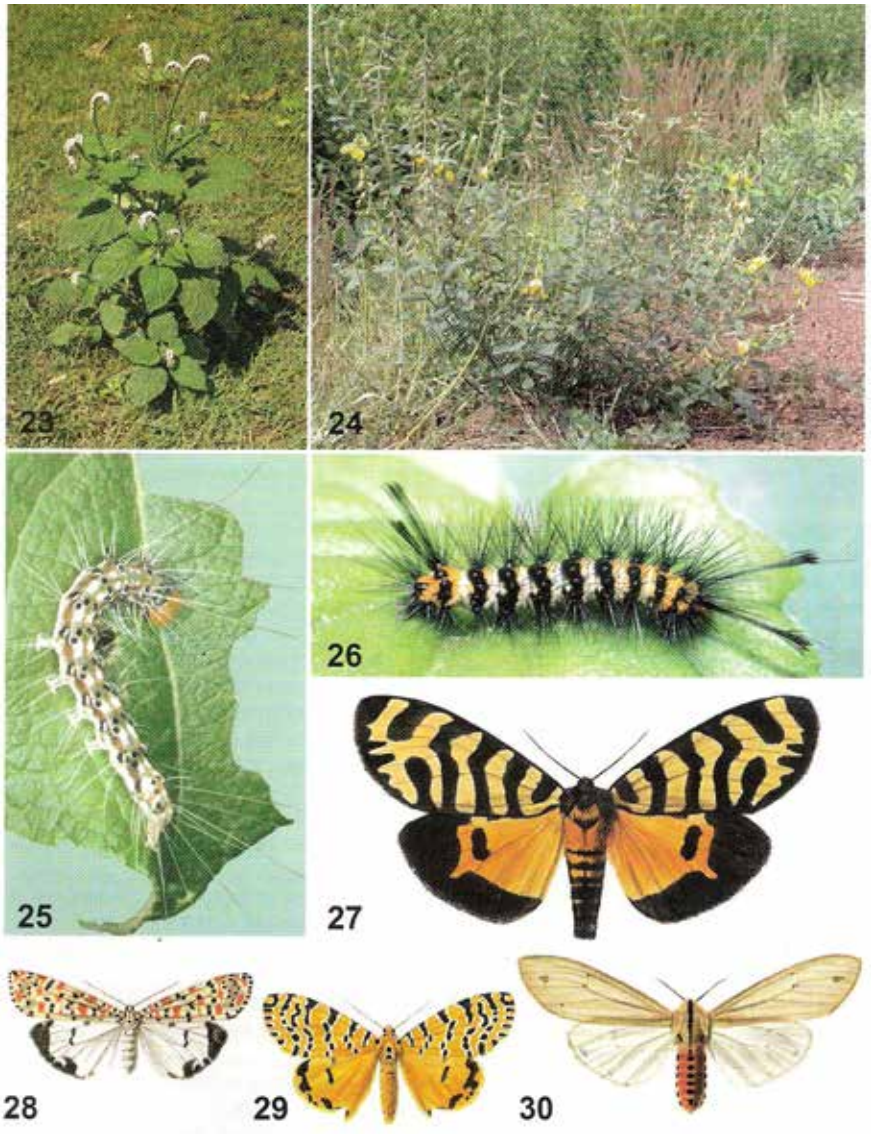


Plate 4. Examples of plants providing pyrrolizidine alkaloids for insects [*Heliotropium indicum* (**23**); *Crotalaria* sp. (**24**)] larvae of PA-pharmacophagous species [*Amerila bubo* (**25**), *Nyctemera* sp. (**26**)], and examples· of arctiids using PA-plants as larval hosts [*Amphicalfia bellatrix* (**27**), *Utetheisa* sp. (**28**), *Argina* sp. (**29**), *Creatonotos leucanoides* (30)].

Open questions / Call for cooperation

Looking at insect-plant(-predator) relationships not from a (plant or insect) taxonomic point of view but focussing on a group of plant chemicals and studying the diverse taxa of plants and insects linked with it appears as a rewarding approach. Done in a multidisciplinary way, news is gathered on many - at first sight seemingly unrelated - aspects. However, this point of view also reveals non-predictability: if we find an insect at a PA-plant we cannot predict if and, in case, how it utilizes the PAs. Even with more knowledge this situation will remain - but this does not make further studies less interesting or less relevant.

Despite significant findings, we are only at the beginning of understanding PA-pharmacophagy. For example, further laboratory analyses on selectivity, specificity and variation of storage of PAs and, in case, pheromone production will provide further insight into the chemical ecology of insects. Also, experimental field-studies on, e.g., mimicry and mate-choice, are made possible by the fact that secondary chemicals (and in consequence pheromones, too) can be modified qualitatively and quantitatively without artificial manipulations.

Yet, there are basic gaps in our knowledge of the natural history of PA-associated species, gaps that could be filled by basic observations and simple tests in the field (cf. Appendix). For example:

• There are surely many more plants which provide insects with PAs than the ones named above. These are, by the way, all ruderal plants; so, what are the PA-sources of species living in forests? (In a Kenyan forest, we have accidentally found a rhizome without overground parts which is very attractive to PA-insects. Chemical analyses have revealed several PAs - but we can't even have a good guess as to which plant species the rhizome belongs....) Knowing further PA-sources would, for example, permit general chemotaxonomic conclusions and a better understanding of the specificity of insect-PA associations. Finding 'new' PA-plants is a matter of chance but awareness of pharmacophagy provides an insight into the possibilities inherent in noticing an insect at a dead plant part. Simple tests can make the discovery of a 'new' PA-source very likely.

• Certainly, there must be many more species of insects that gather PAs pharmacophagously. These can be collected by baiting in as many habitats as possible and in as many seasons as possible.

• For many PA-insects their larval hostplants and their general natural history is - if at all - poorly known. Knowledge on their primary hostplants and their behaviour provides important pieces for the general "puzzle" and is likely to reveal interesting evolutionary interpretations.

• Several *Amerila* are sex-dimorphic (Fig. 12) while for some species only one sex is known. Of most *Amerila* not only larval hostplants but even larval characters (cf. Fig. 25) are unknown.

• Feeding guilds at PA-plants have not been investigated in the tropics at all but an inventory of insect species associated with PA-plants is most relevant to understand if PAs are peculiar secondary plant metabolites and to find further uses of PAs, in case.

Pharmacophagy, of course, is not a uniquely African syndrome. PA-plants as well as PA-insects known from other continents belong to the same families; in South America Ithomiinae utilize PAs for defence and for male pheromones (e.g. Brown

1984), also very many species of the Ctenuchinae are involved in PA associations. As in Africa, in South America and in Asia *I* Australia there is great demand for natural history information on PA-pharmacophagy.

Also, pharmacophagy is not restricted to pyrrolizidine alkaloids and there are non-nutritional relationships of insects with other natural products - but they are not the subject of this paper.

References

Bergomaz, R. & M. Boppré (1986). A simple instant diet for rearing Arctiidae and other moths. *Journal of the Lepidopterists' Society* **40**: 131-137.

Boppré, M. (1981). Adult Lepidoptera 'feeding' at withered *Heliotropium* plants (Boraginaceae) in East Africa. *Ecological Entomology* **6**: 449-452.

Boppré, M. (1983). Leaf-scratching - a specialized behaviour of danaine butterflies for gathering secondary plant substances. *Oecologia* (Berl) **59**: 414-416.

Boppré, M. (1984). Redefining "pharmacophagy". *Journal of Chemical Ecology* **10**: 1151 -1 154.

Boppré, M. (1986). Insects pharmacophagously utilizing defensive plant chemicals (pyrrolizidine alkaloids). *Naturvvissenschaften* **73**: 17-26.

Boppré, M. (1990). Lepidoptera and pyrrolizidine alkaloids: exemplification of complexity in chemical ecology. *Journal of Chemical Ecology* **16**: 165-185.

Boppré, M. (1994). Sex, drugs, and butterflies. *Natural History* **113**: 26-33.

Boppré, M. (1997). Pharmacophagy in adult Lepidoptera: the diversity of a syndrome. pp 285-289 *in* H. Ulrich (ed.) *Tropical Biodiversity and Systematics.* Proc Intern Symp Biodiversity and Systematics in Tropical Ecosystems. D-Bonn: ZFMK.

Boppré, M. & B.P. Pitkin (1988). Attraction of chloropid flies to pyrrolizidine alkaloids (Diptera: Chloropidae). *Entomologia Generalis* **13**: 81-85.

Boppré, M. & G. Scherer (1982). A new species of flea beetle (Alticinae) showing male-biased feeding at withered *Heliotropium* plants. *Systematic Entomology* **6**: 347-354.

Boppré, M. & D. Schneider (1990). The biology of *Creatonotos* (Lepidoptera: Arctiidae) with special reference to the androconial system. *Zoological Journal of the Linnean Society* **96**: 339-356.

Boppré, M. & R.I. Vane-Wright (1989). Androconial system in Danainae (Lepidoptera): functional morphology of *Amauris, Danaus, Tirumala* and *Euploea. Zoological Journal of the Linnean Society* **97**: 101-133.

Boppre, M., W. Wickler & U. Seibt (1984). Pharmacophagy in grasshoppers? *Zonocerus* being attracted to and ingesting pure pyrrolizidine alkaloids. *Entomologia experimentalis et applicata* **35**: 115-117.

Brown, K.S. jr. (1984). Adult-obtained pyrrolizidine alkaloids defend ithomiine butterflies against spider predator. *Nature* **309**: 707-709.

Dussourd, D.E., Harvis, C.A., Meinwald, J. & T. Eisner (1989). Paternal allocation of sequestered plant pyrrolizidine alkaloid to eggs in the danaine butterfly, *Danaus gilippus. Experientia* **45**: 896-898.

Eisner, T. & J. Meinwald (1995). The chemistry of sexual selection. *Proc Natl Acad Sci USA* **92**: 50-55.

Fischer, O.W. & M. Boppré (1997). Chemoecological studies reveal causes for increased population densities of *Zonocerus* (Orth.: Pyrgomorphidae) and offer new means for management. Pp 265-279 *in* Krall, S., Peveling, R. & D. Ba Diallo (eds) *New Strategies in Locust Control.* CH-Basel: Birkhauser Verlag.
Häuser, C.L. & M. *Boppre* (1997). A revision of the Afrotropical taxa of the genus *Amerila* Walker (Lepidoptera: Arctiidae). *Systematic Entomology* **22**: 1-44.
Hartmann, T. & L. Witte (1995). Chemistry, biology and chemoecology of the pyrrolizidine alkaloids. Pp 155-233 *in* Pelletier, S.W. (ed.) *Alkaloids: Chemical and Biological Perspectives.* Vol 9. GB-Oxford: Pergamon Press.
Hartmann, T., Biller, A., Witte, L., Ernst, L. and M. Boppré (1990). Transformation of plant pyrrolizidine alkaloids into novel insect alkaloids by arctiid moths (Lepidoptera). *Biochemical Systematics and Ecology* 18: 549-554.
Rothschild, M., Aplin, R.T., Cockrum, P.A., Edgar, J.A., Fairweather, P. & R. Lees (1979). Pyrrolizidine alkaloids in arctiid moths (Lep.) with a discussion on host plant relationships and the role of these secondary plant substances in the Arctiidae. *Biological Journal of the Linnean Society* **12**: 305-326.
Scherer G. & M. Boppré (1997). Attraction of *Gabonia* and *Nzerekorena* to pyrrolizidine alkaloids - with descriptions of 13 new species and notes on male structural peculiarities (Insecta, Coleoptera, Chrysomelidae, Alticinae). *Spixiana* **20**: 7-38.
Schneider, D. (1987). The strange fate of pyrrolizidine alkaloids. Pp 123-142 *in* Chapman, R.F., Bernays, E.A., & J.G. Stoffolano (eds) *Perspectives in Chemoreception and Behavior.* D-Berlin: Springer Verlag.
Schneider, D., Boppre, M., Schneider, H., Thompson, W.R., Boriack, C.J., Petty, R.L. & J. Meinwald (1975). A pheromone precursor and its uptake in male *Danaus* butterflies. *Journal of Comparative Physiology* **97**: 245-256.
Schulz, S., Boppré, M. & R. I. Vane-Wright (1993). Specific mixtures of secretions from male scent organs of African milkweed butterflies (Danainae). *Philosophical Transactions of the Royal Society of London* B **342**: 161-181.
Smith, D.A.S. (1975). The significance of aggregations in danaid butterflies. *Bulletin of the East African Natural History Society* (Nairobi) **1975**: 72-73.
Vane-Wright, R.I., Schulz, S. & M. Boppre (1992). The cladistics of *Amauris* butterflies: congruence, consensus and total evidence. *Cladistics* **8**: 125-138.
Wiedenfeld, H. (1982). Two pyrrolizidine alkaloids from *Gynura scandens. Phytochemistry* **21**: 2767-2768.
Wiedenfeld, H., Roder, E. & E. Anders (1985). Pyrrolizidine alkaloids from seeds of *Crotalaria scassellatii. Phytochemistry* **24**: 376-378.
Woodford, C.M. (1890). *A Naturalist Among Head Hunters.* London: Philip & Son.

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Appendix

Specific tasks on the natural history of PA-plants and PA-insects

Baiting tests with PAs
In order to improve our knowledge on which adult insects (species, sex) are attracted to sources of PAs, baiting tests are required in as many habitats at as many times of the year and at all times of a day.

Since adults searching for PAs seem not to be hooked on a given PA-containing plant species, putting out dried plants (including roots) of *Heliotropium* sp. (Figs 1, 23) is the most simple technique, and a very efficient one as well. A dried plant remains attractive at least for a week or so, and its attractiveness can be reinforced by moistening it (after drying).

Alternatively – or in addition – pure PAs, extracted from *Heliotropium, Crotalaria* or other PA-plants, can be used. Such bait dishes (Fig. 5) last for many months (unless spoiled by rain or 'eaten up' by insects). They should be exposed where there is some wind to carry the 'PA-odour' (e.g. hung up).

Reference specimens should be collected for proper determination. Since species of *Amerila* and *Gabonia* resemble each other greatly and cannot be separated easily, a good number of reference specimens should be taken in case a sample comprises several species.

Searching for natural sources of pyrrolizidine alkaloids
Finding individual Lepidoptera or small groups of butterflies or moths at a dry or wounded part of a plant is suggestive for PA-pharmacophagy. To test it, fresh parts (including roots) can be dried artificially and offered in a different area and or at a different time to see if more specimens*/* other species are attracted.

Biology of insects visiting PA-sources as adults
Plants providing adult insects with PAs are quite different from their primary hostplants. For *Amerila* and *Gabonia* there is hardly any host-plant record. Of most *Gabonia* the females are unknown, it is also an open question if the plants providing *Gabonia* adults with nutrients are the same as those on which the larvae develop.

Guilds of insects using PA-plants as primary hosts
Of no tropical plant containing PAs the feeding guild is known because research so far concentrated on some conspicuous species. Which taxa (Lepidoptera, Coleoptera, Orthoptera, others; leaf-feeders, stem and root borers, pollinators) utilize PA-plants as primary larval */* adult hosts?

Readers in Africa or elsewhere who are interested in the subject and in collaboration are most welcome to contact us (boppre@uni-freiburg.de). We can provide PA-baits for screening tests, an artificial diet for rearing many species of moths (Bergomaz & Boppré 1986), pictures of larvae to help searching for natural hostplants, etc. Also, our website (http://www.forstzoo.uni-freiburg.de) provides additional information (e.g., information on artificial diet, keys to *Amerila* and *Gabonia*).

Learning about butterflies in the land of Disney - Butterfly World goes West

By Esther van der Westhuizen
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One late afternoon in October 1998, my father and I boarded a jumbo to Miami, Florida. This was not to be a trip to see where the Miami Vice guys hang out, but to go to a butterfly conference. My father, Gottfried Pretorius, is a businessman, and does not know a lot about butterflies. Actually he knows very little. So why would I tow him all the way over the Atlantic to a butterfly do?

The reason was to attend the Second International Conference for Butterfly Breeders and Exhibitors (SICBES) in Winter Haven, Florida, USA. I went to learn more about keeping butterflies in captivity, and to find out why so many of my caterpillars die when I am looking after them better than my own baby. My dad went to learn about the business side of butterfly parks.

Like the First ICBES in 1997 in Costa Rica, this was a great opportunity for 75 delegates from 20 countries to get together and discuss a rapidly growing industry. Attendance was limited to established commercial butterfly breeders and suppliers that sell butterflies for public exhibition, and to representatives of established public exhibits. The reason is that all of these people put in a lot of money and effort to establish their businesses and they are here to share problems and solutions. They are not going to give away this information to newcomers who do not really know what the industry entails. Butterfly World Cape certainly had its fair share of a steep learning curve and can only now appreciate such a get together with fellow exhibitors.

Prof.Thomas C. Emmel, Director of the Division of Lepidoptera Research at the University of Florida, delivered the keynote address. He is the author of more than 25 books on nature subjects and more than 300 scientific papers on butterflies. To say his speech was fascinating, encouraging and educational, is an understatement. He gave an interesting account on the problems involving Lepidoptera conservation around the world, especially in tropical countries. He mentioned that many life histories of butterflies are actually worked out by butterfly breeders, and as one of their successes counted the extensive breeding of birdwing species, taking 6 out of 7 species off the endangered list.

Our first visit to an exhibit was the Wings of Wonder display in Cypress Gardens, a nature theme park where world famous skiing displays are held. Richard Hesterberg, the Director, welcomed us proudly in this Victorian-styled glass house display. To enter the theme park, you have to fork out $32 (+- R192), then you can visit all the attractions such as the butterfly display, etc. There were many butterflies in this 300 m2 exhibit - plenty of species, but 2 or 3 individuals of each only.

As part of the conference we had group discussion sessions, of which one was about diseases and parasitism. One of the interesting points that came up was that it seems that the problem of inbreeding is not a genetic one, but rather a gradual build-up of pathogens. There are two types of breeders: those who keep everything sterilised and use antibiotics, etc., and those who keep

things natural. The results of these two groups do not seem to be significantly different. Discussions of disease and parasitism will be ongoing during future ICBES's, and breeders will report back on any findings. There is very little data available on this subject, and getting together at an ICBES to discuss diseases will be a starting point in getting valuable information together.

We were treated one evening to a 'cook out' at Butterfly Dan's (Dan Dunwoody, butterfly breeder). Dan's regular job is at Disney World as a chef, and the meal he prepared was excellent. During the course of the evening, and preferably after a couple of beers, we were challenged to hit a sign with a *Morpho* painted on it, with a golf ball, by using one of a professional looking selection of golf clubs. Naturally I had to try. My dad gave me a quick hint: "Hold your hands lower on the grip!", but I missed the first ball completely, then gave it a soft nudge towards the sign. For the next ball (you get three tries), I was determined at least to hit the damn ball with the first swing, which I did, and the resounding gong told me that I HIT THE MORPHO! I was astonished, to put it mildly, but the nicest surprise of all was that I won a ticket to Disneyland with this momentous hit!

The next day was spent discussing the dreaded, but necessary, import control regulations. Canada has an approved list of Lepidoptera species that any butterfly park may import, provided their facilities are approved for keeping butterflies in captivity. The USA works on the same principle: approve the facility first, then allow certain species to be imported.

There were a lot of local (USA) breeders who breed butterflies for releasing at weddings, birthdays, funerals, etc. It is a contentious issue, and the "releasers" as they are called, were sometimes asked touchy questions on the ethics of the practice. They did, however, contribute valuable information towards discussions on breeding, as their livelihood also depends on rearing healthy adults. They defend their trade by saying things like monarch larvae feed on a USDA declared noxious weed, the genes of the gene pool "get together" yearly at the over wintering spot, monarchs may not be transported across the Rockies (apparently the West coast monarchs overwinter at a different locality than those east of the Rockies) etc. But personally, while I am also in the business of using butterflies commercially, the way these butterflies are transported in envelopes, get into the hands of inexperienced people, shaken out at any place, flying (or not) in a disoriented state, is not my idea of showing the public the wonderful life and beauty of a butterfly. This is a money spinning part of butterfly exploitation. One pamphlet advertised 12 live monarchs for $110!

Incidentally, Butterfly World (us in the Cape), receives more and more requests to provide butterflies for weddings. In short, we don't do it. It takes a lot of my time diplomatically to explain to a would-be bride that her idea of a cloud of butterflies should be replaced by a cloud of biodegradable confetti, and believe me, would-be brides, when they get their head set on something, can be very difficult (I was one too!). So please, please, please LepSoc members, DO NOT refer such requests to us!

Another useful discussion was about problems facing exhibitors in their display houses. Everything from light requirements, heat solutions, control of aphids, rats and naughty children was discussed. Some exhibitors had wonderfully innovative ideas and very useful tips on approaching various issues.

I finally had my trip to Disney's Animal Kingdom. To walk in this tropical make believe Africa with fellow exhibitors and breeders is an education in its own. Food plants are pointed out, butterflies flying freely around you are identified, and then there's fun too! I was very impressed with the Animal Kingdom, being from Africa and prepared to find fault with anything phoney! But it is an amazing place and well worth a day or two's visit.

During the last weekend we had a field trip to meet more butterfly breeders and see a couple more exhibits. Butterfly World in Coconut Creek near Miami, was an experience in its own. The exhibit consists of three flight areas, and the overall impression is one of extreme neatness. Not a leaf out of its place. They had a well-stocked gift shop, and the biggest regret was that I did not have enough time and dollars to spend there!

All in all, the conference was a remarkable experience to meet people and see places you have only read about. I came away enlightened and excited about our business, and am glad to be part of a group of people who are eager to regulate themselves in a new and growing industry.

THE THIRD INTERNATIONAL CONFERENCE FOR BUTTERFLY EXHIBITORS AND SUPPLIERS

The Third International Conference for Butterfly Exhibitors and Suppliers will take place from 11 - 14 November 1999, in Cape Town, South Africa.

For more information, contact:

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ON THE DISTRIBUTION OF *NAMANGANA THYATIRODES* HAMPSON IN SOUTH AFRICA (LEPIDOPTERA, NOCTUIDAE)

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Abstract: The distribution of the noctuid *Namangana thyatirodes* Hampson in South Africa is detailed, and comments are made on the taxonomic position of the species.

Introduction

The amphipyrine noctuid *Namangana thyatirodes* was described by Hampson (1918), based on a single female from Lourenço Marques, Portuguese East Africa (now Maputo, Mozambique). The moths, which are beautifully marked with green, especially when fresh, have a characteristic wing pattern (Figs 1, 2). After its description, the rare species remained elusive, and both Gaede (1935) and Janse (1938) were unable to list any further records.

More recently, *N. thyatirodes* appears either to have extended its range southwards, or to have become more numerous, as the species is now known from a range of localites in Zululand, the northern part of KwaZulu-Natal province, South Africa (Fig. 3). The purpose of this note is to draw attention to the existence of this interesting species in South Africa, and to invite further observations.

Material examined.

32 and 3, in the collection of the Transvaal Museum, Pretoria, South Africa. South Africa, KwaZulu-Natal: 9, 1, Nyalazi River, III. 1968, III. 1982; 7,Nyalazi Forest, III, 1968; 2 St Lucia, II. 1984; 1, St. Lucia Estuary, III. 1974; 1, St Lucia Lake, X. 1927; 2, Dukuduku [Forest], III. 1968, II. 1980; 1, Gollel, N. Zululand, XI,XII. 1945;1, Zululand, no further data, I. 1948; 3, Sordwana Bay, XI. 1992; 6, 1, Charter's Creek, X. 1997.

Biology.

The life history remains unknown. The South African records are from two subtropical savanna types as defined in Low & Rebelo (1998), types 23 (Coastal Bushveld/Grassland) and 26 (Natal Lowveld Bushveld). Adults have been collected from October to March.

Taxonomic position.

The type species of the genus *Namangana* Staudinger, 1888, *cretacea* Staudinger, 1888, was described from Namangan in Uzbekistan (Nye, 1975). Currently, the genus comprises 12 species, three each from Asia, India, the Neotropical (Mexico, Argentina) and the Afrotropical regions (Poole, 1989).

The three Afrotropical species, all of which are confined to southern Africa, differ markedly in adult habitus and structure of the female genitalia, leading to doubts about the monophyly of *Namangana* (Janse, 1938). Until recently, two of the three

Afrotropical species (*N. atripars* Hampson and *N. thyatirodes*) were known from females only. As males of the latter species have now come to hand, comparison of the male genitalia with those of *N. cretacea* should enable a decision as to whether our species are correctly placed. Until then, their position must be considered doubtful.

Fig. 1. *Namangana thyatirodes*, male
South Africa, KwaZulu-Natal: Nyalazi River. Scale bar in mm.

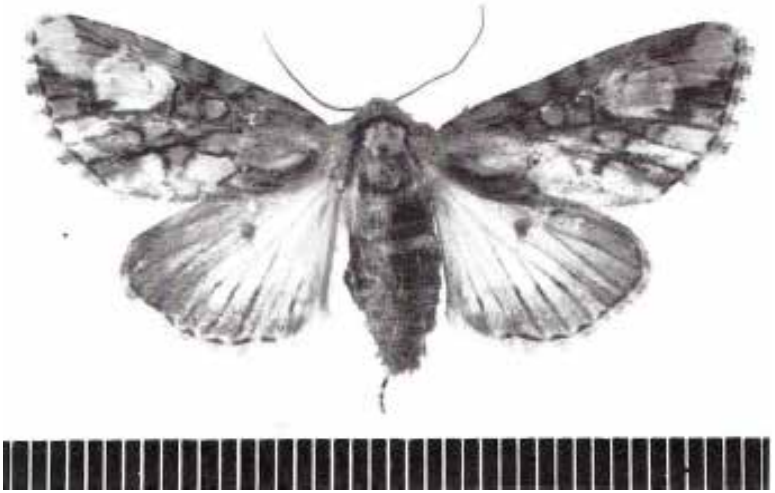

Fig. 2. *Namangana thyatirodes*, female . South Africa, KwaZulu-Natal: St. Lucia Estuary. Scale bar in mm.

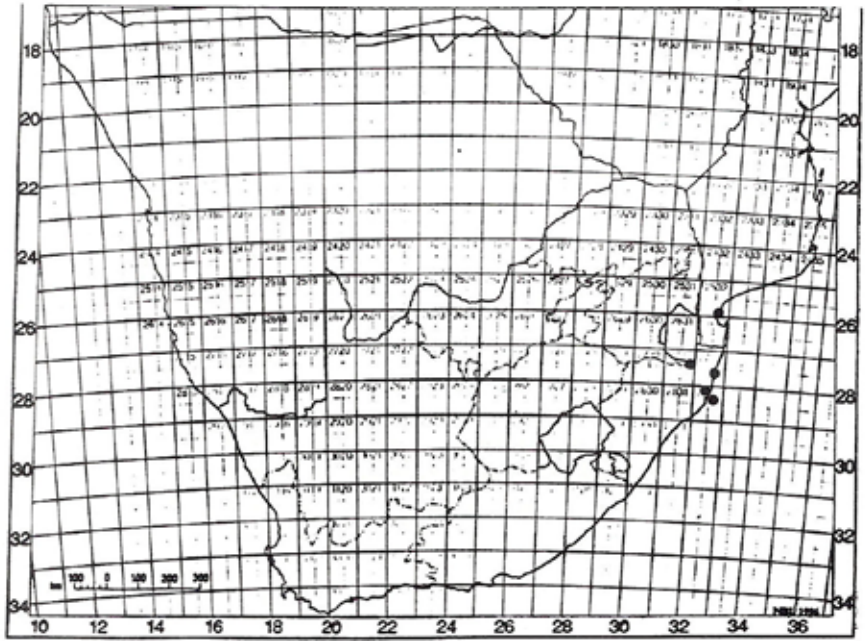

Fig. 3. Distribution of *N. thyatirodes*.

References

GAEDE, M. 1935. Noctuid Heterocera. In: SEITZ, A. (ed.), The Macro-Lepidoptera of the World,Volume 15. Alfred Kernen Verlag,Stuttgart.

HAMPSON, G.F. 1918. Descriptions of new genera and species of Amatidae, Lithosidae, and Noctuidae. Novitates Zoologicae **25**: 93-217.

JANSE, A.J.T. 1937-39. The Moths of South Africa, vol. 3. Cymatophoridae, Callidulidae and Noctuidae (partim). 435 pp. E.P. & Commercial Printing Co., Durban.

LOW, A.B. & REBELO, A. 1998. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria. 85 pp and map.

NYE, I.W.B. 1975. The Generic Names of Moths of the World. Vol. 1, Noctuoidea (Part):Noctuidae, Agaristidae, and Nolidae. 568 pp. British Museum (Natural History), London.

POOLE, R.W. 1989. Lepidopterorum Catalogus (New Series). Fascicle 118, Noctuidae, Part 2. 1013 pp. E.J. Brill/Flora & Fauna Publications, Leiden.

HAZARDS OF BUTTERFLY COLLECTING - Fax for you, Sir - Korup, Cameroun, February 1997

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We were camping at a small research station in Korup National Park in Cameroun, some twenty kilometres from the park entry. Today we had trekked an extra ten kilometres to Rengo Rock, a big round rocky outcrop that suddenly juts out of the rainforest. I had real hopes of good hilltopping here, but the descriptions had been better that reality. The tops of some surrounding trees were taller than the summit, so no hilltopping on the - otherwise wonderful - rock. Triste - but not a major issue; butterflies were everywhere. As indeed they should be, for Korup National Park (and the contiguous Oban Hills in Nigeria) has about 1,100 species of butterflies - about a third of all species in continental Africa. This really is biodiversity writ large. A good day in Korup may well yield about 170 species of butterflies, including firm sight records. That is pretty good, though my personal record in a 24 hour period was actually 225 species in the Gambari Forest near Ibadan in Nigeria on a day where everything was perfect (August 1969) - weather wonderful, traps pulling in almost anything trappable, a fantastic grid of paths, plenty of the Crematogaster ants on which the Lipteninae depend, and a finely honed and toned collector.

Just after noon at Rengo Rock a profusely perspiring ranger exited from the forest and ran up to me, saluting extravagantly: Fax for you, Sir! - and a fax was duly produced. It came out of a uniform pocket - it ought to have come from a cleft stick. In Evelyn Waughs novel, Scoop, the hero (or anti-hero if you prefer) asked his tropical outfitters for some cleft sticks: I am sorry, Sir, said the shop assistant brightly, we don't have them in stock. But we can send some sticks down to our cleaver to have them cloven.

The fax was from the World Bank's Washington Headquarters. I had planned to participate on behalf of the European Commission in the World Bank-led Donor Consortium for health and population - a small matter of about a billion dollars over five years, of which it was hoped the Commission would cough up some 100 million. The fax informed me the meeting was going to start a week earlier than planned. I started counting backwards .... I had to get a Bangladesh visa in London, so I would need to leave Douala four days from now. I had to send the poor ranger back immediately to Headquarters to ensure that we could have porters the next morning to carry out our gear. Poor chap - more than sixty kilometres that day, without the benefit of World Bank remuneration (I still wonder what the World Bank compensation for 60 km of rough walking might be, but I never found a Bank staffer who could even begin to visualize it!).

Early next morning we raced back to Park Headquarters, with the porters following. An interim report was written. A quick debriefing was held. Transport to Douala was arranged. A very hasty good-bye party wished me the best of luck - direct trips from Korup to Dhaka are rare events indeed. Wednesday evening a booking on Air France was made in Douala for that

same night, Thursday morning on the way home from Heathrow the visa application was dropped off at the Bangladesh High Commission, Friday afternoon the passport was retrieved on the way back to Heathrow, and Saturday I was in Dhaka.

Oh good, you're here, said the World Bank Resident Representative the next morning, I hope the change in schedule was not too disruptive. I would save my comments on that one for later. I did lose six days in the field, and what a shame that was. But I did also collect about 500 species of butterflies. There has been some previous work in Korup, and lots of work in the Oban Hills. About 950 species have been recorded in all; another 200 have been found in close proximity in both Nigeria and Cameroun. The estimate of 1,100 species is both a safe and conservative one. This means more species in Korup/Oban Hills than in all of the Malay Peninsula (just over 1,000 species) or in the Philippine Archipelago (900 species), where I currently live.

Korup and the Oban Hills are among the most important conservation areas in Africa, indeed in the world. They are truly exceptional, wondrous places - conserving also the gorilla, the chimpanzee, and the drill. So let us make this Hazard interactive. Do write a letter extolling the virtues of these two contiguous parks to the respective High Commmissioners:

His Excellency,The High Commissioner of Cameroun,84 Holland Park, London W 11.

His Excellency,The High Commissioner of Nigeria,9 Northumberland Av., London WC 2.

Key words:

* You are the custodians of Africa's most outstanding biodiversity, which is the heritage not just of Africa, but of the entire world.
* Please convey our best wishes to your conservation authorities for what they have achieved.
* Africa often gets a bad press; the conservation of Korup and the Oban Hills will lead to a good press.
* Future generations will be proud of the efforts being made today to conserve Korup and the Oban Hills.
* Let us go into the new millenium with the hope that the National Parks of Korup and the Oban Hills will foil the predictions that extinction of organisms is going to be rampant.

Written in Nairobi, ii.1999

BUTTERFLY PREDATION BY ROBBER FLIES (DIPTERA: ASILIDAE)

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Abstract: Predation of Lepidoptera, and in particular butterflies, is reported on after the analysis of database records held at the Natal Museum. Of 138 lepidopteran records 81 relate to butterflies. A complete list of butterfly species known to have been attacked and fed upon by robber flies is provided. The range and size of butterflies involved suggests that robber flies are probably capable of catching virtually any butterfly. Attention is drawn to the need to study all aspects of butterfly ecology in the interests of establishing truly effective conservation programmes.

Keywords: Afrotropical; database; Asilidae; robber flies; predation; butterflies; conservation.

Introduction

The Lepidoptera, and in particular butterflies, are among the best studied insect groups. While a great deal is known about butterflies in general, very little research emphasis has been placed on such matters as their predation by other animals (New, 1993). A thorough understanding of butterfly biology is necessary before effective programmes can be designed for their conservation. Although it is well-known that birds, small mammals, toads and lizards will feed on adult lepidopterans, there is also likely to be significant predation by a variety of invertebrate animals. While well-known predators such as praying mantids, dragonflies and assassin bugs probably account for a proportion of this predation, the sheer magnitude of robber fly diversity (105 genera and 1114 species listed in the Afrotropical catalogue – Oldroyd, 1980) and their abundance in almost every terrestrial ecosystem suggests that they may well constitute the largest and most important group of butterfly predators.

The Natal Museum has developed and, for a number of years, maintained a database of Afrotropical robber fly prey records. Interrogations of these data have led to the publication of two papers on the feeding habits of these predatory flies. The first dealt with predation of honey bees (Londt, 1993) while the second examined the predation of robber flies by other robber flies (Londt, 1995). This article has been written in order to report on the limited information available on lepidopteran predation by robber flies and to sensitise lepidopterists to the role they can play in the collection of more data.

Materials and methods

Natal Museum entomologists and their close colleagues have been assembling a collection of robber flies and their prey items for many years. Prey items are pinned together with the fly predators involved (Fig. 1). The museum's

prey database presently contains 1645 records. The computer programme in current use is Microsoft Access. While the database records are mainly based on specimens in the museum's collection, the excellent data published by Hobby (1935) have also been captured. This study is based solely on these sources of information. While other prey records exist, the fact that the material is not readily accessible for the verification of identifications led to the decision to exclude such data from the database.

Identifications of the robber flies has been done by a variety of specialists. The Natal Museum flies have been identified primarily by myself, although there are specimens identified by people such as Harold Oldroyd who produced an excellent guide to the southern African species (Oldroyd, 1974). Identifications of the Lepidoptera prey items have also been made by a variety of people. As accurate identifications have not yet been made of the moths (even to family level is many cases) this paper concentrates on the butterflies. Butterfly identifications have been undertaken by such people as Clive Quickelberge, Louis Schoeman and myself. All have been checked using Pringle *et al.* (1994). Specific identifications of the few non southern African butterflies have not been undertaken as yet. Unfortunately, some prey items are too poorly preserved to allow specific identification to be made with any degree of confidence. Only names believed to be reliable are supplied. While the information published by Hobby (1935) has not been checked for accuracy, the names used by him have been modified in accordance with the taxonomic changes that have taken place. Butterfly names uniformly follow the terminology employed by Pringle *et al*. (1994).

Results and discussion

The database contains 138 Lepidoptera prey records of which 81 (59%) relate to adult butterflies. In general, robber flies are diurnal predators that locate prey by sight. This means that the moth records probably relate to diurnal or crepuscular species captured early in the morning or late in the afternoon when light levels allowed interaction with robber flies. Two of the non-butterfly records are caterpillars (probably moths). This is interesting as asilids usually capture flying prey items. Caterpillars may, however, sometimes suspend themselves from silken threads and so it is assumed that the two caterpillars in the sample were encountered under such circumstances.

Table 1. The butterfly prey of Afrotropical robber flies. (? indicates that the sex of the specimen cannot be established).

Butterfly Prey	**Robber Fly Predator**
Hesperiidae	
Ampittia capenas capenas (Hewitson, 1867-8) _	*Alcimus* sp. _
Durbaniopsis saga (Trimen, 1883) _	*Neolophonotus abuntius* (Walker, 1849) _
Kedestes macomo (Trimen, 1862)	*Alcimus* sp. _
Kedestes macomo (Trimen, 1862)	*Alcimus* sp. _
Netrobalane canopus (Trimen, 1864) _	*Alcimus* sp. _
Lycaenidae	
Undetermined Kenyan sp.	*Alcimus* sp. _
Undetermined Kenyan sp.	*Alcimus* sp. _
Undetermined Kenyan sp.	*Alcimus* sp. _
Undetermined Kenyan sp.	*Alcimus* sp. _
Undetermined Kenyan sp.	*Alcimus* sp. _
Cacyreus lingeus (Stoll, 1782) _	*Alcimus* sp. _
Chrysoritis chrysantas (Trimen, 1868)	*Neolophonotus albofasciatus* (Ricardo, 1900) _
Euchrysops malathana (Boisduval, 1833) _	*Alcimus* sp. _
Euchrysops malathana (Boisduval, 1833) _	*Alcimus* sp. _
Euchrysops malathana (Boisduval, 1833) _	*Alcimus* sp. _
Euchrysops malathana (Boisduval, 1833) _	*Alcimus* sp. _
Hypolycaena sp.	*Alcimus* sp. _
Lampides boeticus (Linnaeus, 1767)	*Alcimus* sp. _
Lampides boeticus (Linnaeus, 1767) _	*Alcimus* sp. _
Leptotes pirithous (Linnaeus, 1767) _	*Alcimus* sp. _
Leptotes pirithous (Linnaeus, 1767) _	*Alcimus* sp. _
Leptotes pirithous (Linnaeus, 1767) _	*Alcimus* sp. _
Leptotes pirithous (Linnaeus, 1767) _	*Alcimus* sp. _
Leptotes pirithous (Linnaeus, 1767) _	*Alcimus* sp. _
Leptotes pirithous (Linnaeus, 1767) _	*Alcimus* sp. _
Chrysoritis aureus (van Son, 1966)	*Promachus* sp. _
Spindasis ella (Hewitson, 1865) _	*Neolophonotus schoemani* Londt, 1985 _
Thestor sp.	*Alcimus* sp. ?
Nymphalidae	
Undetermined sp. (Satyrinae)	*Alcimus sp.* _
Acraea caldarena caldarena Hewitson, 1877 _	*Alcimus* sp. _
Acraea caldarena caldarena Hewitson, 1877 _	*Alcimus* sp. _

Acraea caldarena caldarena Hewitson, 1877 _	*Alcimus* sp. _
Acraea caldarena caldarena Hewitson, 1877 _	*Alcimus* sp. _
Acraea neobule neobule Doubleday, 1848 _	*Alcimus* sp. _
Acraea neobule neobule Doubleday, 1848 _	*Alcimus* sp. _
Acraea neobule neobule Doubleday, 1848 _	*Alcimus* sp. _
Bicyclus campinus campinus (Aurivillius, 1901) _	*Alcimus* sp. _
Bicyclus campinus campinus (Aurivillius, 1901) _	*Alcimus* sp. _
Bicyclus campinus campinus (Aurivillius, 1901) _	*Alcimus* sp. _
Bicyclus campinus campinus (Aurivillius, 1901) _	*Alcimus* sp. _
Bicyclus safitza safitza (Hewitson, 1851)	*Alcimus* sp. _
Bicyclus safitza safitza (Hewitson, 1851) _	*Alcimus* sp. _
Byblia anvatara acheloia (Wallengren, 1857)	*Alcimus* sp. _
Charaxes jasius saturnus (Butler, 1865) _	*Alcimus* sp. _
Charaxes zoolina zoolina (Westwood, 1850) _	*Alcimus* sp. _
Danaus chrysippus aegyptius (Schreber, 1759)	*Neolophonotus schoemani* Londt, 1985 _
Hyalites igola (Trimen & Bowker, 1889) _	*Alcimus* sp. _
Lachnoptera ayresi Trimen, 1879 _	*Alcimus* sp. _
Neptis nr. *goochii* Trimen, 1879	*Alcimus* sp. _
Neptis swynnertoni Trimen, 1912 _	*Alcimus* sp. _
Precis hierta cebrene (Trimen, 1870)	*Alcimus* sp. _
Sallya boisduvali boisduvali (Wallengren, 1857) _	*Alcimus* sp. _
Sallya boisduvali boisduvali (Wallengren, 1857) _	*Alcimus* sp. _
Sallya boisduvali boisduvali (Wallengren, 1857) _	*Alcimus* sp. _
Papilionidae	
Graphium policenes laurentia (le Cerf, 1924) _	*Alcimus* sp.?
Graphium angolanus angolanus (Goeze 1779) _	*Alcimus* sp. _
Papilio demodocus demodocus Esper, 1798	*Alcimus* sp. _
Papilio echerioides chirindanus van Son, 1956 _	*Alcimus* sp. ?
Papilio nireus lyaeus Doubleday, 1845 _	*Alcimus* sp. ?
Pieridae	
Belenois aurota (Fabricius, 1793)	*Alcimus* sp._
Belenois aurota (Fabricius, 1793)	*Alcimus* sp._
Belenois aurota (Fabricius, 1793)	*Alcimus* sp._
Belenois aurota (Fabricius, 1793)	*Alcimus* sp._
Belenois aurota (Fabricius, 1793)	*Alcimus* sp._
Belenois aurota (Fabricius, 1793)	*Neolophonotus torridus* Londt, 1985 _

Belenois aurota (Fabricius, 1793)	*Alcimus* sp._
Catopsilia florella (Fabricius, 1775) _	*Alcimus* sp. _
Colotis sp.	*Promachus* sp. _
Colotis sp.	*Alcimus* sp. _
Colotis agoye bowkeri (Trimen, 1883) _	*Daspletis hirtus* Ricardo, 1925 _
Colotis antevippe gavisa (Wallengren, 1857) _	*Neolophonotus torridus* Londt, 1985 _
Colotis danae annae (Wallengren, 1857)	*Alcimus* sp. _
Colotis pallene (Hopffer, 1855)	*Alcimus* sp. _
Eronia cleodora cleodora Hübner, 1823 _	*Alcimus* sp. _
Eurema sp.	*Alcimus* sp. _
Eurema brigitta brigitta (Stoll, 1780)	*Neolophonotus schoemani* Londt, 1985 _
Eurema brigitta brigitta (Stoll, 1780)	*Alcimus* sp. _
Eurema hecabe solifera (Butler, 1875) _	*Alcimus* sp. ?
Eurema hecabe solifera (Butler, 1875) _	*Alcimus* sp. _
Eurema hecabe solifera (Butler, 1875) _	*Alcimus* sp. _
Leptosia alcesta inalcesta Bernardi, 1959 _	*Alcimus* sp. _

Geographical distribution of records

Lepidoptera prey items are available from five Afrotropical countries – South Africa (69 records – i.e. 50% of records), Zimbabwe (56 – 41%), Kenya (7 - 5%), Namibia (5 – 4%), Ivory Coast (1 – 1%). This obvious bias is as a result of biased collecting. All the Zimbabwean records are those of Hobby (1935) while all the South African records were assembled by Natal Museum research staff (chiefly me) and their associates. With 94% of the records being southern African the findings reported in this paper have greatest relevance to this subregion.

Lepidoptera as prey of robber flies

An analysis of all 138 Lepidoptera records reveals that 13 genera of Asilidae are represented – arranged alphabetically, with the number of records indicated in brackets, these are: *Alcimus* (93), *Daspletis* (4), *Euscelidia* (1), *Gonioscelis* (1), *Heligmonevra* (1), *Neolophonotus* (22), *Neomochtherus* (2), *Nusa* (2), *Oratostylum* (1), *Pegesimallus* (3), *Philodicus* (2), *Proagonistes* (1), and *Promachus* (5). The genera *Alcimus* and *Neolophonotus* account for 67% and 16% of these records respectively.

Looking at the sexual breakdown of robber flies feeding on Lepidoptera reveals that 71 (54%) were females and 61 (46%) males (the sexes of the remaining 6 records could not be ascertained). Previously published work shows the same kind of relationship (Londt 1990). However, what is of particular interest is that of the 87 records involving *Alcimus* - 50 (57%) are males and only 37 (43%) females. The significance of this apparent reversal of the usual trend is not known.

Butterflies as prey of robber flies

A complete list of the butterfly species taken as prey by robber flies is presented in Table 1. Of the 81 listed records there are 5 (6%) Hesperiidae, 23

(28%) Lycaenidae, 26 (32%) Nymphalidae, 5 (6%) Papilionidae, and 22 (27%) Pieridae. The wide variety of species, representing all butterfly families, suggests that robber flies are capable of catching virtually any butterfly. Similarly the great size range represented in the sample (from small lycaenids to large papilionids) suggests that there are few butterfly species which are not vulnerable to predation by asilids. The fact that there are examples of at least a few species usually considered to be 'distasteful' (e.g. *Danaus chrysippus* and the *Acraea* species) may signify that robber flies are not affected by the defences developed by butterflies against other predators.

Of particular significance is the large number of records (71 or 88% of the total number) involving predators of the easily recognised robber fly genus *Alcimus*. Although the database contains many specific identifications, mainly *A. setifemoratus* Hobby, 1934 and *A. mimus* (Wiedemann, 1828), species of *Alcimus* are difficult to identify and the genus is in need of revision. For the purposes of this report, specific names are not provided as many of these would probably be incorrect. Species of *Alcimus* are generally large, being approximately 30 – 50 mm in length, and having a wing span of between 50 – 70 mm. *A. setifemoratus* is usually found resting on the ground and, judging from all prey records available for it, feeds mainly on grasshoppers. *A. mimus* on the other hand is normally found perched on low shrubs and appears to favour Lepidoptera.

Conclusions

Although the Natal Museum database contains only 138 records of robber flies preying on Lepidoptera, there is no doubt that these predatory flies will readily attack and feed upon a wide variety of butterflies and moths. The range of butterflies represented in the available sample suggest that robber flies have a catholic taste and are not influenced by any chemical defence mechanisms which may have been developed against predation by other animals. Although work on certain Neuroptera suggests that these insects may have developed mechanisms to counter attacks by robber flies (Picker *et al*. 1991, 1992) it remains to be shown that butterflies have evolved any specific defence mechanisms in response to predation by these flies.

Although we can be proud of the considerable knowledge which has been accumulated on African Lepidoptera, far more ecological information is required before a really good understanding of how butterflies live can be achieved. An appreciation of the effects of predation by robber flies, and indeed of all the other animals that feed on butterflies, may be crucial to the development of conservation strategies aimed at rare and endangered species. Researchers and students interested in Lepidoptera are encouraged to assist in the work of gathering data on robber fly predation by providing the Natal Museum with any preserved material they may be in a position to acquire.

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References

HOBBY, B. M. 1935. Rhodesian Asilidae (Diptera) and their prey collected by Mr C. F. M. Swynnerton. *Journal of Animal Ecology* **4**: 90-112.

LONDT, J. G. H. 1990. Afrotropical Asilidae: Prey survey of adult flies. *Abstract 2nd International Congress of Dipterology, Bratislava, Aug. 27-Sep. 1, 1990*. p. 134.

LONDT, J. G. H. 1993. Afrotropical robber fly (Diptera: Asilidae) predation of honey bees, *Apis mellifera* Linnaeus (Hymenoptera: Apidae). *African Entomology* **1** (2): 167-173.

LONDT, J. G. H. 1995. Afrotropical Asilidae (Diptera) 27: Predation of Asilidae by Asilidae. *Annals of the Natal Museum* **36**:161-167.

NEW, T. R. 1993. Introduction to the biology and conservation of the Lycaenidae. *In*. Conservation Biology of Lycaenidae (Butterflies), New, T. R. (Ed.) *Occasional Paper of the IUCN Species Survival Commission* No. **8**: 1-21.

OLDROYD, H. 1974. An introduction to the Robber Flies (Diptera: Asilidae) of Southern Africa. *Annals of the Natal Museum* **22**(1): 1-171.

PICKER, M. D., LEON, B. & LONDT, J. G. H. 1991. The hypertrophied hindwings of *Palmipenna aeoleoptera* Picker, 1987 (Neuroptera: Nemopteridae) reduce attack by robber flies by increasing apparent body size. *Animal Behaviour* **42**: 821-825.

PICKER, M. D., LEON, B. & LONDT, J. G. H. 1992. Influence of hindwing size in nemopterids (Insecta: Neuroptera: Nemopteridae) on predation by robber flies (Diptera: Asilidae). *Current Research in Neuropterology. Proceedings of the 4th international symposium on Neuropterology. Bagnères-de-Luchon, France. 1991* pp 313-318.

PRINGLE, E.L.L., HENNING, G.A. & BALL, J.B. (Eds) 1994. *Pennington's Butterflies of southern Africa*. Second Edition. Struik Winchester, Cape Town. Pp. 800.

BITS AND PIECES OF COLLECTING

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The longer I live in Southern Africa, the more I suffer from the law of diminishing returns. A few years ago I wanted to get everything in one year – then I realized it is best to "spin it out" as we used to say in the north of England. I have been lucky enough to be blessed with a job that allows me to organize my presence in an area where and when one of the gaps in the collection happens to be flying. I don't even have to worry about sniping from co-workers – our MD always finds it necessary to be in the UK *exactly* when there is a Springbok test… so arranging to be in Cape Town in November is a tiny sin never noticed. The result is that the collecting progresses in "bits and pieces". Funnily enough, adopting this approach nets more and better butterflies than trying to do it all at once – a case of the rifle shot being better than the shotgun, I suppose!

Last December, we were faced with the situation many ex-British living in Africa experience – relatives coming out from the UK. It's always a blast to hit new ones with Africa in all her glory. Most of this lot had never been outside Europe before, so we arranged a visit to Lapalala first. And Lapalala put on her best for us. Clive Walker's people organised Lepotedi, which has to be the best camp in the reserve. We all get spoilt, on collecting trips. Sunrises with meat on the braai, the first beer of the day in hand, miles and miles of bloody Africa in the distance… tame black rhinos… the effect on raw pale white Englishmen is awesome to behold!

One of the best things about Lepotedi is the little river that flows below the camp. You can sit there and watch all sorts of things playing about. We saw lots of *Graphium antheus* sitting on the mud. As well as these, there were plenty of whites about, and skippers, etc, etc. All the usual Lapalala stuff. We can get a little blasé about these things, but to see them through the eyes of people new to Africa (and these were non-Lepidopterists) makes it all fresh and beautiful all over again. So much so that one of them kept pinching my net and attempting the difficult trick of netting these things.

The *Ozoroa* trees were in full flower on this trip, and the foamy white blossom was attracting all sorts of delectable beasties. As well as the aforementioned swordtails, there were some glorious zygaenid moths, which were out in numbers. These await the attentions of the moth men – in all their petrol blue, red and yellow glory.

It was in the middle of all this interesting stuff, that wasn't really adding to the SEW Collection, that I espied one of my bits and pieces. A wonderful Day-Glo red thing floated gently over the trees – *Acraea barberae*, forsooth! I can never resist these. The trouble is, they can resist me all too easily. My relatives were treated to the unedifying sight of Woodhall cow-shots all over the veld. I did get a few males, but then the females turned up. These insects

should be investigated by scientists because they *can* levitate. No visible wing movement on a still windless day – and yet they can simply waft away into the empyrean with the humble collector as much use as a Windies tail-ender facing Allan Donald. To hoots of pommy laughter.

We had persuaded these relatives that Knysna was a good place to visit – and as one of them *had* been here before but had never been to Knysna, this wasn't too difficult to sell. The fact that numerous holes in the SEWC fly in the vicinity had absolutely nothing to do with this. On the way down, I even held myself in check when driving past Lootsberg Pass, home of all sorts of interesting things. We went to Nieu Bethesda and the Owl House, which is really worth a visit. Who should we bump into here but Renier and Juanita Terblanche? We promised to get in touch later in the trip but we never made it. The Compassberg beckoned on the way to Nieu Bethesda, like a huge fang pointing at the sky. I'll have to reduce the beer boep somewhat before attempting *that* one.

Another place we saw was the Valley of Desolation near Graaff-Reinet. I'm sure we've all seen those marvelous pictures of finger-shaped rocks against a background of the dusty plains of Camdeboo. And I'm sure we've all shuddered at the thought of the hot and long walk needed to get there. Well… you can drive there! On the way up we found some interesting *Aloeides* feeding on *Carissa* (Num-Num) in a kloof next to the road. This is a *forest* plant, for heck's sake. Talk about micro-habitats! Graham Henning informs me that they are *depicta.* Every time I find a funny *Aloeides* in an unusual place, he tells me it is *depicta.* I'm beginning to suspect this is his garbage species.

Eventually we got to Knysna via Uniondale and Avontuur. The Kammanassie was in glorious unattainable sunshine, but I thought, later… The hillside at Avontuur that used to be so good has been ploughed up or covered in pines. Spitskop produced nothing, so I started resigning myself to seven days of the inside of pubs. We got to our accommodation, not in Knysna itself but in a private forest reserve called Narina on the Karatara road.

Well we did warn the visitors about "rustic" bush accommodation, but even I had to admit that I have stayed in more salubrious bush bothies. No electricity, pump your own water from rain tanks, at a price the same as a central Knysna B+B, but 30 minutes from Knysna… and it was raining… the poms lasted one night before they decided to retreat to a somewhat posher pozzie in Knysna itself. Jayne, myself and my mother, who is made of sterner stuff than most of her countrymen (it's all in the genes), remained behind to savour the delights of being right in the middle of Knysna forest.

Strangely enough, traps failed to produce more than the ubiquitous *Charaxes varanes varanes*. These were smaller and darker with less pearly white than the ones we had been trapping at Lapalala a week earlier. The forest was showing signs of stress as everything was seriously dry, which might explain the lack of butterflies.

On the first sunny day, I was able to persuade wife and mother that they would enjoy looking around George whilst I explored the delights of the Outeniquas. I had my mind on my old adversary, *Pseudonympha hippia.* I was in possession of a hot tip that it was known to inhabit the peaks of these hills.

Up the old Montagu Pass we went in the RAV4, finding it a breeze – the road is in good condition. At the summit off I went, finding that a year of gym has helped my hill-climbing ability. There is an inverse correlation between waistline centimeters and speed up hills. Woodhall's fourth law, I think. The sun was hot, no clouds and no cold wind. Bliss!

There were precious few beasties around for the first half of the climb and I was starting to get anxious when up popped a bright orange thing in front of me. It was the first of several *Aloeides quickelbergei,* which proceeded to get commoner as I ascended the steep slopes. They are delightful little insects, the males flashing in the sun as they imitate miniature jet fighters. Netting them is like all *Aloeides* – the good old "tap-and-swipe"! Following them in this rocky wilderness wasn't very easy and since Alan Heath's whoopsie on the Kammanassie I have tended to lurk and wait rather than chase. But… it's no good doing that with the butterfly I had come here to catch.

As I clambered up some huge rock slabs below the summit of the spur I was on, I espied a flickering silver UFO coming at me at a rate of knots. It saw me, and immediately ducked off into a deep gully choked with big restios. Then another one came past. This time I was off down into the greenery and got in position – net fully extended and hunkered down in the herbs. Thus concealed I was able to get off a good pull shot and I had him – after ten years of trying, *Pseudonympha hippia* at last!

This was not a common insect. Eventually I got to the top of the spur and found blue *Lepidochrysops*, probably *outeniqua* but requiring confirmation. The browns were feeding on flowers on a steep fynbossy slope above a cliff that I would not survive a tumble off! Every now and then one would patrol over the summit and 30% of the time I would get him. I say him, because despite a hair-raising, bossie-clutching, knee-trembling sortie down to the clifftop not a female did I see.

I had promised to be back at the road by 1400hrs, so I left the summit at about 1300hrs. This shows extreme dedication as things were still buzzing. Even so, on the way down the occasional *hippia* would cause excitement.

I had run out of water on the way down so the cold beer Jayne had brought me was somewhat welcome. Pork pies, sandwiches, etc… wives are *such* civilized people to have on collecting trips. As it was the beer was a mistake because when I got back to camp I found I had left my best net at the picnic site… and when I went back to look for it, it had gone. Luckily I had a spare, but it only had a 1m handle – no more long pull shots for me!

Another bright sunny day followed so I borrowed the RAV off Jayne and set off Kammanassie-wards with warnings of dire consequences of any harm coming to her baby. As I got to the CNC office and picked up the keys, the weather was cloudless – as I got to the base of the massif a little cloud had appeared on the summit – and an hour later as I got to the plateau below the peaks, only this was clear, the peaks being totally socked in. Kammanassie, you did it again!

Even so, there were some extremely desirable little magaftas about. The small peaks on the edge of the plateau were attracting blue

Lepidochrysops… and boy were they hard to get with a 1m net handle. Eventually I found some below a peak near the *Orachrysops brinkmani* spot (none of those, alas) feeding on *Selago* flowers, a female included (yippee) but looking more like *L. outeniqua* or *L. swartbergensis* than the paler *L. balli* that were on the peaks. There were some bigger, silvery blue ones as well that could be *L. braueri* – I'll just have to get an expert to sort them out for me.

The RAV4 is the vehicle for this mountain – no more scrabbling up the tracks in road cars. I got a lot further than I had dared before – all the way to the base of the peak that has the radio mast on top. There was one bit that needed diff lock, but all else was plain sailing. On the way, colonies of big black *Serradinga kammanassiensis* kept on distracting me. You only find these in patches of *Merxmuellera* grass among the fynbos – a perfect example of niche speciation. And on one bit of road an *Aloeides pallida jonathani* popped up right in front of me and nearly made me incur Jayne's wrath. They were frequenting a small ridge running along the road and were quite rare – and the butterfly I got last time I was here and thought was this one, was obviously just a very big female *A. juana.* Next to this ridge I caught – at last! an undoubted, perfect female *Lepidochrysops balli*.

By this time it was starting to spot with rain so I shoved off, and by the time I got to the bottom I was fording rushing rivers up to RAV's doors in a downpour. What a place!

The next day saw more rain and grey clouds, so we hied ourselves to the winelands for a day. Robertson is further from Sedgefield than we thought but we got some good wine. The weather cleared up en route and the hills were in sunshine. Boesmanskloof beckoned but I was forcefully reminded that there are other things to do on holiday than catch butterflies. Is there?

After another day of clouds, another bright sunny day! After some fast talking I had RAV for the day – and I went off to Uniondale again. Believe it or not, Kammanassie did its same trick once more! Yet again I didn't get to the peaks, so things like *Chrysoritis daphne* and *balli* will just have to wait until next time I get there with a 4x4. At least I got a *Pseudonympha detecta* this time as well.

The next day was time to buzz off, so we packed and I went to pick up the traps. In one, to my joy I found a male *Charaxes xiphares xiphares.* It had got into the trap whilst I was battling with the weather the day before and I had not even noticed it.

During this trip we kept in touch with two other teams of lepidopterists, the aforementioned Terblanches and Benny and André Coetzer, who were on the *adonis* trail. Benny had set off back before us and popped into Springfontein on the way. They found *Stygionympha robertsoni* at the koppie by the graveyard. We stopped off there the day after and found them too – which pleased me as I had only got one before.

After the excesses of Christmas, Bill Steele and I went off to the Great Saltpan to see if we could catch his flying Dutchman, the *Orachrysops* he once found there. We went on the day before Old Year's Eve, and found everything to be green and verdant. Pierids were abundant but not as numerous as they can be in May. Not a single plant of *Ocimum canum* did we see, or a single

specimen of *Lepidochrysops vansoni.* There was plenty of *Indigofera* of more than one species, so we started to get excited. But despite hours of wandering over the veld, not a sausage, much less an *Orachrysops,* did we see. There was lots of other boring stuff around – things like *Acraea stenobea* and *Colotis ione.* One weird thing we did see were Sphingids – *Hippotion celerio* – feeding off foxglove flowers in the full sun of noon. We took a couple for Alf Curle's diurnal moth collection!

That was it for a while. I got sent to the UK for a week's business in January, was forced by flight availability to spend two weekends over there, and froze half to death. All Brits living in Africa should be forced occasionally to go back to the Septic Isle for a week in winter to make them appreciate their new home. And I missed two weekends of prime collecting time.

This job is not that bad, though, because I had to go to PE on the last weekend of January. What else could I do but have another crack at the Van Stadens Berg? I contacted Paul Liversidge who was in the throes of business and couldn't make it, but he did talk me up to the right spots by cellphone. Business being business, our branch manager had arranged for some customers and I to watch South Africa give the Windies a cricket lesson at St Georges Park, (oh hardship) so Saturday was out. But who should I bump into but that man again, Ernest Pringle, sitting only a row or two away? This was a long hot beery day, and Ernest has more stamina than I do because the last I saw of him was in the pub. If our branch manager hadn't been under wife pressure to spend the evening sedately, I would have stayed there and I suspect I would not have been in a fit state to venture out on the morrow.

As it was I had a mild case of cocktail flu and when I woke to clouds on Sunday I wasn't terribly dismayed. But by 10.00 I had recovered and set off towards Humansdorp. First I stopped at Van Stadens Pass to hang traps, then I headed for Van Stadens Berg. Here I must thank Paul because I had to phone for help, this being a big place. I have been up it before looking for *Chrysoritis pyroeis hersaleki*, and failed. This time I had a cellphone and a remote guide!

The starting point was an NG Kerk graveyard (why do so many butterflies fly near graveyards?) on the road to Uitenhage. The first part of the climb was through a Mato Grosso of Port Jackson willow, pines and dead Proteas, in intermittent cloud. Paul said I must persevere, the clouds would clear. They did, and I got out of the bad stuff and started following a line of gum trees leading to a ridge, which led to the top. Paul said this was a 30 minute climb. At the end of the trees, a blue flash shot past me, and another, and another. A wild hook had one in the net, and to my joy I had a fresh male *Lepidochrysops asteris.* These were patrolling the edge of the gum plantation exactly as *L.rossouwi* does at Stoffberg. Soon I had a dozen in the bag and was back on my path to the summit. But, I kept being interrupted by these mint female *asteris* that kept popping up and insisting I catch them. Then the phone went and it was Paul. Was I at the summit yet? No chance, you didn't tell me about all these ruddy *asteris*!

Eventually I got to the top, a harder climb than I had planned for through being thoroughly knackered from chasing blues. I found the rocky slopes on the southern side of the hill, and noticed how similar this all was to

the *nigricans* spot at Boesmanskloof. Sure enough, I found the first male *C. pyroeis hersaleki* flitting around a small flat bare territory between the rocks and the fynbos. What a treat! This is one of the most wonderful lycaenids to see on the wing, because the flame-like blue over copper is easily seen as it flies. For my money it is right up there with *C.adonis* and *C.nigricans.* I was a bit early

in the season so all I got were six males, and no females despite extensive searching of the rocks. Ah well… I'll just have to go back…

The traps produced no *Charaxes…* you can't win them all.

The way things worked out, I had to be in Durban the next week so I arranged to stay with Kevin Cockburn at Greytown and as he was tied up on the Saturday, have another go at *Dira oxylus* at Kokstad.

After a week of hard work with the Durbs weather doing its worst (one night there was a downpour that washed roads away all over town), it was good to wake on the Saturday morning (February 6) to bright sun. I was staying in Hillcrest, and as I drove over Key Ridge on the way to the Richmond road, clouds appeared. Oh blast I thought, but I've nothing else to do so I might as well go on… it got cloudier and wetter all the way through Richmond, Ixopo, Umzimkulu… but all the time brighter weather could be seen to the north. Perhaps the hills would be clear? As I drove over the ridge of berg foothills that separates Kokstad from the Natal Midlands, the blue sky appeared as if by magic. But where were the butterflies? All around I could see big green peaks and I had heard that *oxylus* was like *clytus*… everywhere. But it wasn't. I grabbed the trusty cellphone and cudgelled my brain for names of those who have caught it. Eventually I lit on good old Nolan who told me I'd gone past the spot, but not to worry, I was there at the right time and if I drive along the Matatiele road they would turn up. As he said this, just after I had passed the new C-Max prison they are building, this huge satyrid floated over the road like a galleon in full sail. I screeched to a halt, said a quick cheerio and thanks to Nolan, and was after it. I found a field with clumps of big rocks with trees growing on them. Every so often one of these big fellas would bounce out of the trees and sail over the grass to the next clump of rocks. Chasing these was highly hazardous, as I found out later.

Flying with them was another hole in the SEWC, a primary experience I have waited for too long… *Aloeides penningtoni.* This is a lovely copper, but also difficult to net.

After a while I decided to inspect the other spot Nolan had mentioned, a small koppie on the right of the Umzimkulu road out of Kokstad. Here there were *L.asteris, Chrysoritis chrysaor* that look just like *natalensis*, but none of the *lyncurium* – like ones that have been caught here. There were several *oxylus* including females, but this was an even more dodgy locality than the last one. Eventually I came short. The browns were flying over a fairly steep slope littered with boulders and dotted with bushes and trees, all of which were surrounded by big rocks. Obviously I was a week too early as females were scarce and everything was fresh, and the numbers did not come near the description in Pennington. I would walk up to a bush and an *oxylus* would sail out of it and head for the next tree 20m away. They fly deceptively fast, and one has to hop from rock to rock to follow them. Then I hopped once too often and set left foot

on a sofa-sized boulder that moved downwards under my weight. I tried to use my momentum to reach the next rock, but then the rock pivoted right over suddenly and banged my shin hard before trapping my foot. I was able to fling myself backwards and this got me out of trouble, but not before I felt my shin bend and threaten to say "howzit?"

The pain was incredible and at first I thought I had broken something, but after a lot of rubbing and sotto voce swearing I was mobile again… just. I was about 200m from the car and had my cellphone, but I'm glad I didn't have to test my ability to crawl that distance.

This put an end to the safari, and I drove to Greytown through gathering rain and mist. Eventually I got to Kevin and a few cold frosties made my leg hurt less, but as I write this two weeks later it is still very swollen and sore.

I was glad the next day to do something non-strenuous. I had hopes of *Papilio euphranor* in the forests but it was raining. Can't have it all. We watched some cricket then sauntered off in Kevin's Hilux (a kindred spirit of Hermann's Sani – this vehicle does not worry about little things like there not being a road up that slope), Kevin was duly initiated into the gentle art of piggling for *Iolaus* larvae in gentle rain on the abundant *Loranthus* in the dry bush on the Muden side of the hills. There were plenty of *Iolaus silarus* larvae on the hairy *Loranthus* it uses everywhere. There was another *Loranthus* with thin yellow and red flowers and smooth leaves, which had lots of *Iolaus* eggs and eating damage but not a larva did we find. Eventually we found two different types of eggs, white ones and yellow ones. As I write these have hatched, so we wait with bated breath to see what Kevin gets out of them.

Then I was lucky enough to arrange a few days in Cape Town to do a bit of business, then (ahem) go off in search of the elusive malagridas. I arrived in the middle of a heatwave and thought, wow, hope this lasts! Friday was dull and it rained… typical. But Saturday the 27th February dawned hot and sunny, and I hied myself to the Paardeberg.

The road up the mountain was long and bumpy, but when I got to the top it was… glorious. *Charaxes pelias* males battled for territorial advantage over the Proteas and on the mountainside, *Trimenia malagrida paarlensis* swarmed – at least the males did. Every little gully had seven or eight of them, all daisy-chaining one another over the rocks. There must have been several hundred flying. Females were found skulking about in thicker vegetation and once flushed, refused to perform as they should. I watched one for half an hour and she kept sniffing at grass stems and bossies, but not an egg did she part with.

With this success under my belt I decided to give Lions Head another bash on the morrow. I have looked for nominate *malagrida* for years and saw one two years ago, which I failed to net. But the infamous Cape weather was to win again… as I climbed the fire road, lacy clouds started to obscure the sun. But it was patchy, so I persevered. As I left the path and started down the steep scree towards the spot, I noted how dry and dusty everything was. I searched for an hour or two with long waits for cloud to clear… and then something dark orange flitted up in front of me. My net crashed down and there she was – a perfect female. Into a film can she went, to await photography. I expected to find more, but despite another hour's search… nothing.

SAA's ridiculous hand baggage rules had meant a decision on camera (fun) or laptop (work), and this being a work trip the laptop had won. So I could not get a picture in the wild. I also could not justify taking away what could easily be the only female to fly this year… so I released her, none the worse for a couple of hours in the darkness, where I found her. At least we know *malagrida* still flies on Lions Head, but for how long? The vegetation looks similar to the *paarlensis* spot, but it is both overgrown (these butterflies like bare rocks) and seriously drought-afflicted. Some management will get rid of the overgrowth, but the rain is in the lap of the Gods.

That evening, I stayed with Esther and Eugene van der Westhuizen. Esther had arranged a jazz piano recital in the butterfly house and I was able to attend. This was held in the twilight and we all got a wondrous treat. *Caligo* (Owl) butterflies are crepuscular, and in the dusk these massive bat-like lepidopterans daisy-chained one another just like those *malagridas* had on Paardeberg. As Esther did her MC's duties, six of them started dancing around her head… a magical sight.

My thanks to Nolan Owen-Johnston, Tony Brinkman, Harald Selb and Ernest Pringle for help with localities, and Kevin Cockburn and Esther and Eugene van der Westhuizen for their company and hospitality. Also I wish to thank Western Cape Nature Conservation for issuing permit no. 262/98 and Eastern Cape Nature Conservation for issuing permit no. 56/98EC. A full list of species seen is available and will be sent to the issuing authorities. All specimens caught are in the S E Woodhall Collection. A full list of species recorded is available from the author.

OBSERVATIONS ON THE RETICULATE MOTH *ANAPHE RETICULATA* WALKER, 1855 AND THE BANDED MOTH *ANAPHE PANDA* (BOISDUVAL, 1847) (LEPIDOPTERA THAUMETOPOEIDAE:) IN ESHOWE, KWAZULU-NATAL.

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Abstract: The bagnesting behaviour of the processionary moths *Anaphe reticulata* Walker, 1855 and A*naphe panda* (Boisduval,1847) and the differences between them are described. Incidents of feeding damage in and around Eshowe and the longer term effect are reported. The food-plants utilized by the larvae of these moths in the area are reported on.

Key words: Lepidoptera, moths, Thaumetopoeidae, *Anaphe* , bagnest, defoliation processionary.

INTRODUCTION

During April 1997 bunches of hairy, rather dark-coloured caterpillars were found hanging from leaves on the trees in the Dlinza Forest Nature reserve (D.F.N.R.). When these caterpillars were found walking on branches and on the ground in long lines nose to tail, it was established that we were probably dealing with processionary caterpillars whose adults were known as bagnest moths. The investigations into their breeding strategy and species was resumed and completed during 1998 & 1999.

Similar larvae were observed during March 1998 in the gardens of two households in Eshowe. The larvae however, as there were morphological differences, were of a different species from the one in the D.F.N.R. and a different food-plant was involved. Similar investigations were completed in 1999.

MATERIALS & METHODS

Rearing boxes were used to supplement field observations. Short lengths of a tree branch or plank were placed in each box in order to simulate natural conditions. Larvae were fed leaves of their respective food plants. Emergence of adults were recorded from early Dec. '98 to mid Jan. '99.

RESULTS

Anaphe reticulata

Caterpillars from the D.F.N.R. were seen in the picnic site area and compound clearing, feeding on Cross-berry *Grewia orientalis*, Forest White Pear *Dombeya tiliacea* and Red Currant *Rhus chirindensis*.

Evidence of pupation seen in the field was a small cocoon on the ground involving a few larvae and two small groups on a toilet wall in the picnic site involving some more. On a nearby storeroom wall in the compound site, 6

small cocoons with a typical light-brown colour were found but all larvae inside were dead. The live cocoon together with the 2 groups of larvae were moved and placed in a rearing box in the laboratoty. Nests were spun and emergence during Dec.'98 & Jan.'99 proved that the moths were *Anaphe reticulata* Walker (fig.2) - 26 in all.

Some of the same type of larvae from the picnic site and compound were placed in 2 other breeding boxes and 2 separate nests were spun. These nests were made of white silk. Their shapes varied viz. triangular, elliptical and rectangular and all were flattish. Larvae went into diapause, spun silk around them & remained in this state until pupation. Nest building took place in the breeding boxes during April and June '98 & emergence during Dec.'98 & Jan.'99 proved that the species was also *Anaphe reticulata* - 16 in all.

Anaphe panda

Bagnests made by larvae feeding on the leaves of *Bridelia* sp. were found to be plentiful in Eshowe town. Bagnests of processionary moths were described by Pinhey, 1975 as being "various shapes, sometimes resembling a purse and at other times more extended and amorphous''. I found them in various shapes and sizes, often ball shaped on trees at times and at other times more extensive and amorphous. These nests were brown when seen outdoors but white in breeding boxes. One nest measuring 60 cm x 100 cm , possibly 15 cm thick, wrapped around the base of the trunk of a *Bridelia* was found in a garden in Eshowe.

A round bag of *Anaphe panda* larvae approximately 10 cm in diametre when opened on 21.11.98 was found to contain 220 larvae. Imagine the number of larvae there must have been in the bag next door measuring 60 cm x 100 cm at the foot of the *Bridelia* tree!

The tree, like all the others, recovered, but the owner did not want worms in his garden again so he had the tree chopped down.

Four breeding boxes with larvae from 3 different premises, spun silk nests around themselves and eventually 17 adult moths emerged as well as one from a small cocoon taken from the church curtain. All 18 were *Anaphe panda* (Boisduval) (fig.1.),emergence in Dec. '98 & Jan '99.

DISCUSSION

Scoble, 1995 states ''....the larvae of the family Thaumetopoeidae are processionary, colonial and live in silken nests, at night they move in to feed.'' This study however showed that silken nests were spun by both species of larvae only after they reached their last instars, the larvae did not actually leave these nests to feed and subsequently pupated.

Processionary activity to feed was only observed during the daytime. Pinhey 1975 refers to the larva of *A. panda* as ''dingy white hairy''. Eshowe larvae were infact, olive green in colour.

Extensive defoliation took place in all cases of the approximately 8 *Brindelia* trees seen, sometimes with only small patches of leaves left. Wild adult *A. reticulata* & *A. panda* were seen during Jan. '99.

Much variation of shapes and sizes of bagnests (in *Bridelia* often ball shaped) was noted, but *A. reticulata* was inclined to make much smaller nests and away from its host tree.

Interspecific variation (fig. 1&2)

The hind-wing of *A. panda* is light yellow and the forewing is a lighter yellow than *A. reticulata. S. reticulata* mostly has one more forewing closed cell than *A.panda*, usually 8, sometimes 7. *A. panda* usually has 7, sometimes 5 or 6. The lower parralel band in the forewing always goes through from the base to the lower outer corner in *A. reticulata*, never in *A. panda*. The brown bands in both species are dark or light brown.

CONCLUSIONS

It would appear that the food-plants of the early stages of *A. reticulata* are Cross-Berry *Grewia orientalis*, Forest White Pear *Dombeya tiliacea* and Red Currant *Rhus Chirindensis* and that of *Anaphe panda* is Coastal Goldenleaf *Bridelia micrantha*, in Eshowe. Pinhey, 1975 mentions the host-plant of *A. reticulata* as *Diplorrhynchus* and *Dombeya* ; of *A. panda* as *Diplorrhynchus* and *Bridelia*.

Wildlife managers and gardeners are advised not to be concerned about the defoliation phenomenon as no permanent damage to any of these trees was observed.

REFERENCES

SCOBLE, M.J., 1995, *The Lepidoptera, form function and diversity*. Oxford University Press.

PINHEY, E.C.G., 1975 , *Moths of Southern Africa*, Tafelberg, Cape Town.

fig.1 *Anaphe panda*

fig.2 *Anaphe reticulata*

NEW HOST-PLANT RECORDS OF LOOPERS (LEPIDOPTERA: GEOMETRIDAE) FROM SOUTH AFRICA

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Abstract: 25 new host-plant records for South African Geometridae, obtained from larvae found feeding on them in the field and reared to adults in the laboratory are presented.
Key words: Lepidoptera, Geometridae, host-plant [foodplant], South Africa.

INTRODUCTION

New South African geometrid host-plant records have appeared in a number of important publications: Platt, 1921; Taylor 1946, 1949, 1951, 1953, 1965; Duke & Duke, 1998.

The purpose of this short article is to make available those host-plant records in possession of the author that do not appear in the above publications, but exclude those contained in pending publications by the author. The motivation for publishing these records now is to make them available for possible inclusion in the upcoming major work on the known host-plants for all southern African Lepidoptera, currently being prepared by D. M. Kroon.

MATERIALS AND METHODS

With the exception of *Pitthea neavei,* larvae feeding on the respective host-plants in the field were collected and brought into the laboratory, by the author, where they were reared to pupation on the plants they were found on. For rearing methods see Woodhall, 1992. In the case of *Pitthea neavei* a larva was found by A. Mayer on the host-plant but had subsequently pupated by the time it reached the author. Emerged adults were pinned, labelled and identified by comparing with previously identified material in the Staude collection, Magaliesburg. Voucher specimens are housed in the above collection.

Plants were identified mainly by comparing collected material with illustrations in van Wyk & Malan 1988, Pooley 1993, Fabian & Germishuizen 1997 and van Wyk & van Wyk 1997. No voucher plant specimens were preserved.

The information in the results section was extracted from the label data on the voucher specimens mentioned above. Dates on the labels reflect the date that the larvae were collected in the field and not the date of emergence of the adult in the laboratory, unless otherwise stated.

RESULTS

Ennominae

Plateoplia acrobelia (Wallengren, 1875). *ab larva* collected on *Ximenia americana* Olacaceae.

South Africa, Tvl, Melkrivier, Lapalala Sanctuary, 1100m, 23°44ˡS.28°20ˡE, mixed savanna, 19-02-1994, H. S. Staude.

Sicyodes cambogiaria [Guenée, 1858]. *ab larva* collected on *Maytenus heterophylla* group of sp. probably *Gymnosporia buxifolia* Celastraceae.
South Africa, PWV, Hekpoort, Gloster game farm, 1400-1674m, 25°56'S. 27°38'E, Wooded kloof, 13-02-1996, H. S. Staude.

Omizodes complanata Prout, L.B.,1922. *ab larva* collected on *Rothmannia capensis* Rubiaceae.
South Africa, Magaliesburg, Seekoeihoek, 1500m, 25°58'S.27°30'E, *Burkea/ Ochna* vegetation, 11-11-1995, H. S. Staude.

*Acanthovalva inconspicuaria** (Hübner,1796). *ab larva* collected on *Acacia nilotica* Mimosaceae.
South Africa, Natal, Mkuze, Chaos, 220m, 27°40' S. 32° 00'E, dry mixed savannah, 26-12-1996, H. S. Staude.

Isturgia catalaunaria (Guenée, 1857). *ab larva* collected on *Indigofera daleoides* Fabaceae.
South Africa, Northwest Province, Koster Dam, 1250m, 25°42'S. 26°54'E, mixed bushveld, 29-03-1998, H. S. Staude.

Isturgia deerraria (Walker, 1861). *ab larva* collected on *Acacia karroo* Mimosaceae.
South Africa, PWV, Magaliesburg, Golden valley, 1550m, 26°02' S. 27°33' E, grassland/protea, 04-02-1995, H. S. Staude.

Coenina poecilaria (Herrich Schäffer,1854). *ab larva* collected on *Sphenostylis angustifolia* Fabaceae.
South Africa, Gauteng, Magaliesburg, Golden valley, 1550m, 26°02' S. 27°33' E, grassland/protea, 13-03-1998, H. S. Staude.

Omphalucha maturnaria (Möschler,1883). *ab larva* collected on *Rhus gueinzii* Anacardiaceae.
South Africa, Natal, Mkuze, Chaos, 220m, 27°40' S. 32°00' E, dry mixed savannah, 26-12-1996, H. S. Staude.

Omphalucha albosignata Janse,1932. *ab larva* collected on *Rhus leptodictya* Anacardiaceae.
South Africa, PWV, Hekpoort, Gloster game farm, 1400-1674m, 25°56'S. 27°38'E, Wooded kloof, 11-11-1993, H. S. Staude.

Mauna homales (Prout,L. B.,1922). *ab larva* collected on *Proteae caffra* Proteaceae.
South Africa, Gauteng, Magaliesburg, Golden valley, 1550m, 26°02' S. 27°33' E, grassland/protea, 15 -10-1998, H. S. Staude.

Pitthea neavei Prout, L.B.,1915. *ab larva* collected by A. Mayer on *Clausena anisata* Rutaceae.
South Africa, Transvaal, Woodbush, Magoebaskloof, montane forest, 23°52' S. 29°59'E, 1500m, 15-07-1994 emerged.

Erastria biskraria (Oberthür,1884). *ab larva* collected on *Ziziphus mucronata* Rhamnaceae.
South Africa, Brits, Silkaatsnek , 1200m, 25°41'S.27°53'E, sand-bushveld, 12-09-1995 , H. S. Staude.

*new combination, Krüger (submitted)

Durbana setinata (Felder & Rogenhofer, 1875). *ab larva* collected on *Stangeria eriopus* Stangeriaceae.

South Africa, Kwazulu-Natal, Pinetown, Krantzkloof Nature Reserve, 200m, 29° 46' S. 30° 50'E, grassland, 25-04-1998, H. S. Staude.

Sterrhinae

Scopula cf. S. nigrinotata. ab larva collected on *Litanthus pusillus* Liliaceae.

South Africa, Gauteng, Hekpoort, Gloster game farm, 1400-1674m 25°56'S. 27°38'E, Wooded kloof, 16-02-1996 emerged, H. S. Staude.

Epicosymbia perstrigulata (Prout, L. B., 1913). *ab larva* collected on *Pygmaeothamnus zeyheri* Rubiaceae.

South Africa, Gauteng, Magaliesburg, Golden valley, 1550m, 26°02'S. 27°33' E, grassland/protea, 09 -10-1997, H. S. Staude.

Geometrinae

Centrochria deprensa (Prout, L.B., 1913). *ab larva* collected on *Rhus leptodictya* Anacardiaceae.

South Africa, Bophuthatswana, Pilanesberg National Park, 1200m, 25°11'S. 27°08'E, sour bushveld, 17-09-1993, H. S. Staude.

Syndromodes cellulata Warren,1898. *ab larva* collected on *Acacia karroo* Mimosaceae.

South Africa, Gauteng, Magaliesburg, Golden valley, 1550m, 26°02' S. 27°33'E, grassland/protea, 10 -10-1991, H. S. Staude.

Microloxia ruficornis Warren, 1897. *ab larva* collected on flowers of *Helichrysum acutatum* Asteraceae.

South Africa, Gauteng, Magaliesburg, Golden valley, 1550m, 26°02'S. 27°33' E, grassland/protea, 25-05-1990, H. S. Staude.

Heterorachis perviridis (Prout, L.B., 1912). *ab larva* collected on *Cathium mundianum* Rubiaceae.

South Africa, PWV, Hekpoort, Gloster game farm, 1400-1674m, .25°56'S. 27°38'E, Wooded kloof, 20-10-1993, H. S. Staude.

Heterorachis despoliata Prout, L.B., 1915. *ab larva* collected on *Cathium mundianum* Rubiaceae.

South Africa, PWV, Hekpoort, Gloster game farm, 1400-1674m, .25°56'S. 27°38'E, Wooded kloof, 20-10-1993, H. S. Staude.

Heterorachis roseifimbria Prout, L.B., 1930. *ab larva* collected on *Pygmaeothamnus zeyheri* Rubiaceae.

South Africa, Gauteng, Magaliesburg, Golden valley, 1550m, 26°02'S. 27°33' E, grassland/protea, 19-01-1994, H. S. Staude.

Victoria fuscithorax Warren,1905. *ab larva* collected on *Agelanthus natalitius* Loranthaceae.

South Africa, PWV, Hekpoort, Gloster game farm, 1400-1674m, .25°56'S. 27°38'E, Wooded kloof, 16-01-1996, H. S. Staude.

Omphax idonea Prout, L.B., 1916. *ab larva* collected on *Vangueria infausta* Rubiaceae.

South Africa, Gauteng, Magaliesburg, Golden valley, 1550m, 26°02'S. 27°33' E, grassland/protea,10-11-1992, H. S. Staude.

Prasinocyma immaculata (Thunberg,1784). *ab larva* collected on *Rhus dentata* Anacardiaceae.

South Africa, Gauteng, Magaliesburg, Golden valley, 1550m, 26°02'S. 27°33' E, grassland/protea, 06-02-1990, H. S. Staude.

Prasinocyma germinaria (Guenée,1857). *ab larva* collected on *Rhus pyroides* Anacardiaceae.

South Africa, Tvl, Melkrivier, Lapalala Sanctuary, 1100m, 23°44'S. 28°20'E, mixed savanna, 19-02-1994, H. S. Staude.

ACKNOWLEDGEMENTS

I would like to thank Willem Prinsloo, Gloster game farm, for taking me to the cliff where *Litanthus pusillus* grows, for identifying the plant , for pointing out the larvae feeding on this tiny plant and for permission to work on the farm; Andy Mayer, Johannesburg, for finding and donating the specimen of *Pitthea neavei*; Doug Kroon, Sasolburg, for checking and correcting the manuscript; and Axel Hausmann, Zoologische Staatssammlung, München, for identification of the *Scopula*.

REFERENCES

DUKE, N.J., & DUKE, A.J., 1998. An annotated list of larval Host-plants utilized by southern African Geometridae (Lepidoptera), *Metamorphosis* Vol.**9** No.1: 5-22.

FABIAN, A., & GERMISHUIZEN, G., 1997. *Wild Flowers of Northern South Africa*. Fernwood Press, Vlaeberg.

PLATT, E.E.,1921, List of foodplants of some South African Lepidopterous larvae. *South African Journal of Natural History,* **3**(1): 65-138.

POOLEY, E., 1993. *The Complete Field Guide to Trees of Natal Zululand & Transkei.* Natal Flora Publications Trust, Durban.

TAYLOR, J. S., 1946. Foodplants of some South African Lepidoptera. *Journal of the Entomological Society of southern Africa* **9**: 45-48.

TAYLOR, J. S., 1949. Notes on the Lepidoptera in the Eastern Cape Province (1). *Journal of the Entomological Society of southern Africa* **, 12**:78-95.

TAYLOR, J. S., 1951. Notes on the Lepidoptera in the Eastern Cape Province (2). *Journal of the Entomological Society of southern Africa* **, 14**:94-126.

TAYLOR, J. S., 1953. Notes on the Lepidoptera in the Eastern Cape Province (3). *Journal of the Entomological Society of southern Africa* **, 16**:143-167.

TAYLOR, J. S., 1965. Notes on the Lepidoptera in the Eastern Cape Province (5). *Journal of the Entomological Society of southern Africa* **, 28**:137-154.

VAN WYK, B., & MALAN, S., 1988. *Field Guide to the Wild Flowers of the Witwatersrand & Pretoria Region including the Magaliesberg & Suikerbosrand*. Struik publishers, Cape Town.

VAN WYK, B., & VAN WYK, P., 1997. *Field Guide to Trees of Southern Africa*. Struik publishers, Cape Town.

WOODHALL,S.E., (Ed.), 1992, *A Practical guide to Butterflies and Moths in Southern Africa,* The Lepidopterists' Society of Southern Africa, Florida Hills.

Book review

DANNER, F., EITSCHBERGER, U. & SURHOLT, B., 1998, Die Schwärmer der westlichen Palaearktis, in two volumes: Volume 1, 368 pp. 1 colour plate, 1 b/w plate and 84 distribution maps. Volume 2, 772 pp. with 122 colour plates containing adults as well as all pre-imaginal stages, 293 plates with genitalia photographs and 156 plates containing 1248 Raster electron microscope images of eggs, larvae and pupae. Format DIN A4, stitch bound in hard cover. Both volumes DM 620,--, available from Dr. Ulf Eitschberger, Humboldtstrasse 13, D-95168, Marktleuthen, Germany. Tel. 09285 480, Fax 09285 8238, e-mail ulfei@metronet.de.

It is said that 'a picture is worth a thousand words'..... If this saying is true then these volumes would be worth in excess of 1 612 000 words to you, even if you don't understand a word of German.

These volumes deal with the hawk moths of the western Palearctic region and, for some genera, the whole of the Palearctic region. Each taxon is redescribed and a facsimile of the original description for each species is included. Seven new species and two new subspecies are described. All the adults and all the stages in the life history of the vast majority of species are illustrated in full colour. Point distribution maps are included for each taxon, but only as regards their distribution in the western Palearctic region.

What does a publication dealing with hawk moths of another faunistic region got to do with Africa?

First, because hawk moths are such prolific wanderers, many of the taxa also occur in the Afrotropical region and the information is therefore relevant in the Afrotropical context.

Second, the hundreds of photographs of the early stages and of live adults make this book something special. Anyone who has an interest in Lepidoptera, even if not specifically in these lovely streamlined moths, will be enthralled by the beauty of the subjects photographed so professionally.

Third, the 293 plates full of genitalia illustrations, photographed in their natural state (not flattened) and from different angles in some instances, provide you with an opportunity to easily study the variation in these structures as it occurs across the taxa.

Fourth, the 1248 electron micrograph images of assorted structures, are on a scale which offers you the opportunity to have a proper look into a world beyond our normal senses. I will never seize to be amazed by the detail of structures even at such magnifications.

650 DM may seem to be a lot of money, but once you have had these volumes in hand and experienced the thousands of top quality images, you will realize that it is worth every penny. The authors must be congratulated on a magnificent work.

Hermann Staude.

Letters to the Editor

Cyrestis camillus conserved

In Metamorphosis **7**:43 (1996) I informed readers that I had applied to the International Commission on Zoological Nomenclature (ICZN) for the conservation of the name *Papilio camillus* for continued use in the well-known combination *Cyrestis camillus* Fabricius 1781. The name is a junior synonym of *Papilio camillus* Stoll 1780, which is itself a junior synonym of what is now known as *Azanus isis* Drury, 1773, and which has never been used. The next name for the Fabricius species is *Papilio pantheus* Drury, 1782, which has recently been used in South African literature.

I am happy to say that in OPINION 1917 the ICZN has unanimously conserved the name *Papilio camillus* Fabricius, 1781 and suppressed the name *P. camillus* Stoll, 1780. This makes *P. pantheus* Stoll, 1782 a junior synonym of *P. camillus* Fabricius, 1781.

So *CYRESTIS CAMILLUS* it is indeed. Let us rejoice in the fact that the arcane processes of the ICZN has led to such an eminently sensible conclusion! I am particularly pleased since *Cyrestis camillus* has graced my notepaper for the West Africa Butterfly Project for the past five years!

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LEPIDOPTERA: Larval host-plant Records

An appeal is hereby made to members of the Lepidopterists' Society of Africa, professional entomologists and botanists, who may have, and be willing to, provide valid lepidopterous larval host-plant associations, for inclusion in a my collated list of such records, and planned for publication.

Full acknowledgement will be given of the source of the information. It would be preferable if material, and identifications of plants have been validated [source identifications viz. ***Determinavit***]. Voucher specimens, if these exist, provide valuable additional information, and the repository of such material serves as an important research resource. Personal records based on bred material are particularly important especially if these have not been previously published. In every case a reference should be provided if they have previously been published.

Authentic records based on personally bred material, especially moths, and those of Zimbabwe, Namibia or Botswana will be particularly important.

Several individuals have acquired a wealth of information by breeding insects, but these records are often not published. This is an opportunity for them to be included in my broadly based database. They will importantly contribute to the general information acquired by members of the Society, so often just shelved, but which should be shared with others before disappearing in the mists of oblivion. Even single records may be sufficiently interesting or unique providing new insights of the range of host-plant utilization within a single species, group, or a particular family. Exotic plants, if properly identified, also qualify for inclusion.

If you do have such records with baseline information, and would be willing to share the information, please contact me directly for further details.

Thank you

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The Society gratefully acknowledges the following members who have answered the call for sponsor membership:

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A hard copy of the manuscript, and the originals of illustrations, and the computer diskette must be submitted to the editor. The text should be printed on A4 paper, with double line spacing, and a margin of at least 2cm on each side. The pages should be numbered consecutively, beginning with the title page, and including those carrying references, tables and legends to figures. All figures and tables must be referred to in the text. If a computer diskette is not available, then tables are to be typed on A5 paper, exactly as found in the printed journal.

Figures must be boldly drawn in black waterproof ink, and arranged in clear and logical plates on stiff, white, preferably A4-sized board. All figures must be numbered in a common sequence in Arabic numerals, irrespective of whether they are line drawings, photographs, diagrams, graphs or maps. Magnifications should be indicated by scale bars on the figures.

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