

Mantis Study Group Newsletter 23

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Editorial

Many thanks to Francesco and Philip for their contributions to this newsletter, and to Kieren Pitts for the abstracts. We now have what qualifies as a bumper issue, by recent standards.

Exhibitions

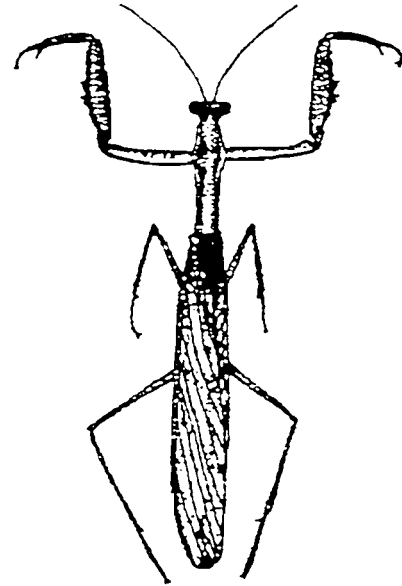
We hope to be exhibiting at the following events.

21st April 2002

Midlands Entomological Fair. At Kettering Leisure Village. Just off junction 8 of the A14.

5th October 2002 - (Provisional date).

AES exhibition at Kempton Park Racecourse.



Biology and captive breeding of the african dead leaf mantis *Phyllocrania paradoxa* — Francesco Tomasinelli, with drawings by Andrea Mangoni.

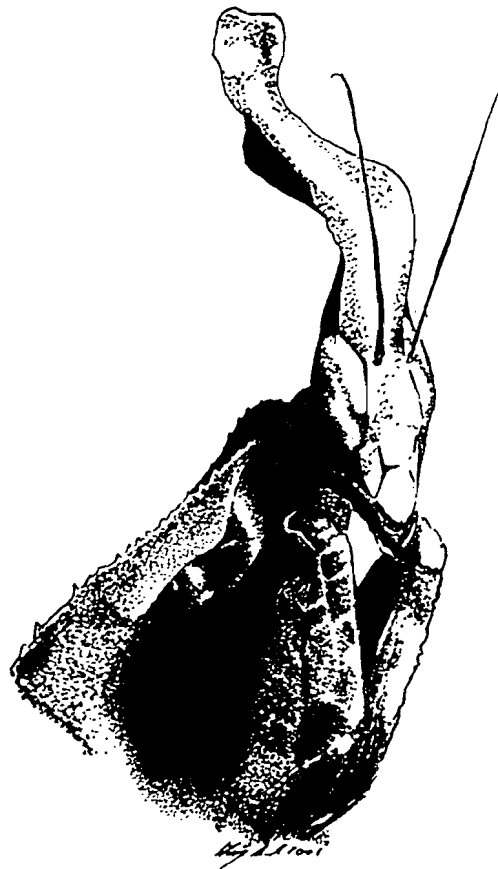
All animals employ some kind of defence to enhance their survival possibilities. Camouflage is certainly the most popular expedient, even among more evolved life forms. Some insect orders are especially famous for their cryptic colours and shapes and the better renowned are surely phasmids or walking sticks (Phasmida). Some praying mantids however have evolved a similar morphology to evade predators and sometimes seize prey. They present such camouflage skill that they compete with phasmids. Among them one of the most interesting genera is *Phyllocrania*, "a dead leaf mantis" of the family Hymenopodidae that includes most of the bizarre and weird-looking species. The range spans from Eastern to Western Africa, even in the south, Madagascar included. There are several species in the genus but the only available to hobbyist by now is *Phyllocrania paradoxa*.

They are not very big or conspicuous, but their unusual and extremely cryptic shape compensates for this drawback. Adult females reach 5-6cm in length and the same for the slightly slimmer male. This species is usually dark brown but various colour patterns occur. Sometimes is possible to obtain beige-greenish specimens, others may be almost black. They live in savannah bushes, rainforest limits, fields and gardens.

When hatched babies are already camouflaged and present all the survival adaptations of their parents. Besides these tricks they mimic ants. They are completely black and their size

matches that of various ants species. This kind of mimicry is quite common between insects and very common in mantids. Ants are unwelcome to many predators, including lots of spiders and insects, and are often rejected.

After one or two moults *Phyllocrania* lose their resemblance to an ant since their size would render this trick useless. Their colour turns brown and the animals, according to some authors, present themselves as the most modified of all leaf mantids. The rest of their morphology already matches the adult form and is quite amazing. The pronotum (first segment of the thorax) has a lamellar enlargement and fringed, leaf-like expansion are visible on the legs and around the abdomen. If you look closely at the head you will see the eyes are concealed, have the same colour as the body and are surmounted by a big crest resembling extremity of a withered leaf. The forelegs are kept close beneath the head to further confuse the shape. The wings, present in the adult form of both sexes, have the same colour as the body and show thin veins all around that resemble those on a dead leaf. The male is less camouflaged, with narrower pronotum and partially transparent wings.



It is verifiable that these amazing adaptations are useful to escape vertebrates predators, mostly birds and small mammals. There is nothing in *Phyllocrania* to lure prey and they usually hide among dead foliage on bushes, small trees and are not used to eating very much. In a different way, floral simulators like the orchid mantis *Hymenopus coronatus* and *Pseudocrobotra* spp. actually lure insects with their shape or choose ambush positions in flowers, waiting for pollinating insects.

Phyllocrania is not an extremely voracious species and usually rest on dead leaves or branches upside down. They wait in this position for hours ready to seize unsuspecting insects. I have seen they prefer crawling prey and are not deadly against fast flying insects. They should not be fed with big prey, medium and small size crickets are ideal for adults. This species can rest in this position for hours, being almost indistinguishable from the background. If a sudden move grips its attention it turns the head immediately to observe, but the body is usually maintained in the same position. If forced to change position they move with small swinging movements rather like a leaf moved by a light breeze.

If threatened *Phyllocrania* adopt a particular defence mechanism called thanatosis: they play dead. At first, especially if already big, they ignore the torment or start swinging movements, but after a while drop on the ground holding the legs tightly to their body. Most predators - including mantids - are mostly interested in moving prey and often, if the potential prey remains motionless, it will be ignored. Such behaviour is really surprising to observe and the first time I thought I had accidentally killed the animal. They resume the normal posture after few minutes. I have never observed adult males performing thanatosis but I think is typical for adult females and big nymphs. Males usually prefer escape, running or

flying away. These different behaviours are probably related to the body sizes. Even if this species is not particularly dimorphic, the male is significantly slimmer and less cryptic and so favours other defence methods.

Phyllocrania are not difficult to keep. The temperature can be maintained at about 25°C, but a little higher or lower cannot harm the animal. Of course never expose them to direct sun in terrarium or temperatures above 30°C. Humidity is not very important. They can be sprayed two times a week and rarely die because of a bad moult. The enclosure can completely dry out without damaging the animals. Ventilation should be adequate, since high humidity levels are to be avoided.

Given this species is so impressive it could be interesting to build a special terrarium to observe the animal in their natural habitat. A 20cm x 20cm x 20cm glass cage is ideal for an adult female and good for mating also. You can add a bark background to one of the vertical sides of the cage and some dry soil to the bottom. In my opinion a mix of sand and soil is best and pleasant to observe in this cage. Remember to furnish the terrarium with lots of branches. It's advisable to select flexible and very branched pieces, better if with some dead leaves present. The sticks should be thin so they can be curved to fit in the cage. The thinner ends should go on the upper side so the mantis can suspend upside down from this natural roof and hide within leaves and wood of the same colour.

Of course nymphs and males can be reared in smaller containers but, as always with mantids, remember to place them in tall containers. The distance from the top to the floor must be at least three times the length of the insect. Otherwise your nymph could hit the ground with the neck while shedding the skin. Place fine netting on top of the cage of immature specimens; this way the mantis can obtain a firmer grip with legs while moulting. As mentioned before, if it loses its grip will fall on the ground and die. The nymphs do not grow too fast and take 4-5 months to reach adult age.

I found breeding this species is not difficult at all. The female is not aggressive so male can be introduced in her cage without too many worries. Probably the best approach is to put the adults together after 15 days, and after feeding both a lot. The male should be placed behind the female while she is engaged with food, just to be sure. The male should soon demonstrate his interest, following the female's moves. After some minute he will leap on her back to copulate. I have never observed aggressive reactions from the female, even if



the presence of the male is obviously recognized. They stay together for some hours, then the male disengages and goes away. After some weeks, 1-2 in my experience: this delay varies a lot depending on feeding conditions and temperature, the female produce a thin 3cm ootheca, fixed to a branch. It is not too conspicuous and usually contains 20-30 babies. Hatching time varies but on average about one month.

As with most praying mantids, this species do not live too long, usually about one year for females, a little less for males.

Phyllocrania paradoxa are not very common among dealers but should not be rated as rare. Even if quite easy to keep and breed they do not reproduce in large numbers and usually command quite high prices.

I wish to thank Laura Marchese from Technotapes for her invaluable help with terrarium materials.

Article on the Praying Mantis species I found while on holiday in Tunisia

— by Philip Crisp (age 12).

In July 2001 I was on holiday with my family in the Skanes area of Tunisia in North Africa (fairly close to Monastir Airport). The plot of land next to our hotel had been partially developed, but with the skeleton of the new hotel built work seemed to have been stopped. This had allowed the grounds to become unused and overgrown. There were a number of different habitat areas ranging from the sandy sea front beach through bushy shrub to open grass areas. There were also a number of piles of rubbish and rubble scattered throughout.

I went on several 'insect spotting' expedition with my dad on this site finding a number of black beetles, a variety of fly species, some beautiful dragonflies which had a red thorax and a number of grasshoppers. It was while attempting to catch a grasshopper specimen to examine (it was very hot and the insects were very fast) I found our first mantis. It was an adult female but as it was well camouflaged it took a lot of time and energy trying to catch up with it and then persuade it into the narrow neck of a water bottle. We did not get much of a chance to study it as it was so hot and I was thirsty. Back in the cool of the hotel room I was able to take a closer look. This was not like the previous mantis species I had kept (*Creobroter* and *Sphodromantis*) as it was a small slender species with a plain light brown colouring. This find made me more determined in my "hunting" and during a few further visits I was able to find a number of specimens. I concentrated on a small dry grassy area (would have been a lawn once) where I found a number of small nymph hunting in the areas between the grasses. Once I had spotted one I found a few others and selected one female, one male and three nymphs to bring home for my collection.

Notes from my studies

I currently have little detailed information on this species as I have not been able to identify it. I have searched many internet sites, some books and I took my specimens to the AES Exhibition where despite asking several other mantis fans I have not yet identified the species. Phil Bragg was very helpful and having accepted some of the nymphs to take for his collection (the female had produced a number of oothecae which had hatched) he has volunteered to attempt to identify them from these specimens.

This is a fairly small, slender and delicate species which is extremely well camouflaged when seen on dried grasses (which is the type of habitat we found them living on). The

adults are approximately 35-40mm in length (top of head to end of cerci). This species has a distinctive head shape which is very angular and triangular in shape rather than the more usual heart shaped head. The cerci are also very distinctive due to their large size, both male and female have large cerci. The adult female has a generally fatter body shape than the male. She has little wing buds and cannot fly. The antennae are very fine and hair like.

The male looks smaller than the female due to the more slender body. Males have fully formed wings and can fly. The antennae of the male are much thicker and longer than those of the female.

As this is a slender and quite fragile mantis it seems to avoid any prey items that it thinks too large or likely to damage it. Adults of this species will happily eat the 'greenbottle' flies often found hanging out in the kitchen during the summer or maggots of these flies, however they appear to avoid the larger 'bluebottle' flies. They do seem to like as varied a diet as possible, spiders, moths, butterflies, ants (especially the large flying ones), mosquitoes etc will all be hunted and eaten. However I do not think it a good idea to feed them large spiders (which may turn the hunter into the hunted and eat the mantis) or wasps or bees etc which may kill or hurt the mantids.

On our return from holiday the insects were housed separately in cages with a sand substrate and dry grass stems on which to climb and hide. I chose this because it closely copies the environment in which I found them. The cages are kept on heat mats at about 25°C. I spray very lightly with water two or three times per week as their habitat is very hot and dry. I have noticed that they occasionally drink the water droplets but they do not seem to require frequent or heavy spraying. I believe this species requires males and females to mate to produce fertile eggs. I have observed mating on a few occasions usually late evening around bed time.

I think that the original adult female must have mated in the wild as within 2 weeks of our return she had laid some eggs. We had not introduced the male and female yet due to the risk of the male being eaten. The oothecae were in the form of a foam strip laid on the stem of the grass stalks. The stems were removed with the ootheca in place and kept in a separate container which was placed in the airing cupboard to ensure they were kept warm. Usually the ootheca are kept in a warm humid environment but as the humidity of the area in which they were found was very low we only lightly sprayed them two or three times per week. We noticed the young starting to hatch two weeks later.

The nymphs of this species start the hatching process by breaking through the protective ootheca case and emerge head first closely followed by the body and finally the legs. Having emerged they rest on the ootheca while their body hardens. Once they have hardened they are quite active and explore their environment. The tiny nymphs are so small they are difficult to see without a magnifying glass. Once they have hatched and hardened I remove them from the container and put them into a small pet pal type tank set up as for the adults. I keep several together and so far they do not seem to be too aggressive or to be eating each other (provided there is not too much of a size difference). I have been feeding these tiny nymphs on blackflies that I found on my sisters nasturtium plants and tiny flies that live in the compost heap. As they grow I feed them on fruit flies and when I can catch them other appropriate foods.

All of the original specimens captured in Tunisia died in October and November but their nymphs have grown on well. In early December the new adults have themselves produced oothecae and now, just prior to Christmas, the nymphs have started to emerge and a new generation is starting.

This species certainly seems to have a short life cycle. From the eggs being laid it seems

to only take two to three weeks for the young to hatch. From hatching to adult seems to take approximately three to four months with the adult stage appearing to last approximately two months.

I will provide an update when more information becomes available.

Mantis abstracts

The following are abstracts from papers published recently, or in some cases details of the paper but without an abstract. The papers are in English unless otherwise indicated. The editor would be grateful for copies of any recently published papers so that abstracts may be included in this section of the newsletters.

Andreotti, A. & Osella, G. (2001) Blattaria, Mantodea, Orthoptera, Phasmatodea, Dermaptera, dei Monti della Laga: Faunistica, ecologia e zoogeografia (Artropoda, Insecta). *Memorie del Museo Civico di Storia Naturale di Verona (2 Serie) Sezione Scienze della Vita*, (14): 3-93. [in Italian]

The results of our research on the Orthopteroidea Insects (Blattodea, Mantodea, Orthoptera, Dermaptera and Phasmida) of the Laga Mts., Mt. Prato and Montagna dei Fiori Massif (Central Apennines, Italy) are analyzed and discussed and include 67 taxa in total. This number was obtained from field research over a three year period (1996/1998) and the literature data. For each examined taxon the following notes are reported: literature data, list of the examined specimens (Laga Mts., Mt. Prato and Montagna dei Fiori Massif as well as the available unpublished data for the Central Apennines), the Italian and general chorology together with biological, chorological and zoogeographical notes. Sixty-two species were found in the Laga Mts., 30 in Mt. Prato and 29 in Montagna dei Fiori Massif. The most interesting analyzed species from both a faunistical and zoogeographical point of view are: *Barbitistes yersini* Brunner which has just been listed as part of the Apennine fauna therefore its Apennine distribution and ecology are explained; *Polysarcus denticauda* (Charpentier), up till now listed as a Central European taxon, in the Central Apennines it is known exclusively from the Reatini Mt. and the Gran Sasso massif, a small colony has also been found in the Laga Mts.; *Meconema meridionale* Costa, *M. thalassinum* (De Geer) and *Cyrtaspis scutata* (Charpentier), these rare (due to their ecology) mediterranean arboreal species have been found in several localities of the interior Central Apennines; *Eupholidoptera danconai* La Greca has been collected on the Montagna dei Fiori Massif and is the first finding in the Central Apennines of this very rare taxon envisaged as being endemic to the Southern Apennines; *Ephippiger melisi* Baccetti and *E. ruffoi* Galvagni, new findings of these uncommon Central Apennine endemic species are listed; *Podisma emiliae* Ramme, endemic to the Northern Apennines, new for the Central Apennines (Mt. Prato); *Podisma goidanichi* Baccetti, an endemic species to the Gran Sasso (Prati di Tivo and Mt. San Franco) is regarded for the first time as being common and widely distributed in all high pastures of the Laga Mts; *Euthystira brachyptera* (Ocskay), a new species for the Apennines, up till now listed in Italy only in the Alps and Calabria, two small colonies have been found in the Laga Mts. (Capricchia - Sacro Cuore and Monte Gorzano - Stazzo del Gorzano); *Glyptobothrus apricarius* (Herrich-Schaefer), the Laga Mts are the most southern occurrence of this

Eurosibirian species, the taxon is exceptionally rare in the Apennines. A comparative analysis of the most interesting ecological peculiarities of the orthopteran fauna of the Laga Mts. with other Central Apennine massifs is given together with a Canonical Variates Analysis and comments on living in pastures at high altitudes.

Bland, R.G. (2001) Additions to the Orthoptera (sens. lat.) of the Canary Islands. *Journal of Orthoptera Research*, 10(1): 113-119.

A new subspecies of Pamphagidae (*Purpuraria erna lanzarotensis*) is provided, and additional distributions, and nomenclature changes of Orthoptera (sens. lat. to include Blattaria, Mantodea and Phasmida) of the Canary Islands. A significant inter-island difference in body size of the acridid *Calliptamus plebeius* is discussed.

Boyd, R.S. & Wall, M.A. (2001) Responses of generalist predators fed high-Ni *Melanotrichus boydi* (Heteroptera: Miridae): Elemental defense against the third trophic level. *American Midland Naturalist*, 146(1): 186-198.

The recent discovery of herbivores that feed on Ni-hyperaccumulating plants and contain elevated Ni concentrations in their bodies suggests that Ni may be transferred to their predators. We tested this hypothesis using the high-Ni herbivore *Melanotrichus boydi* and four predator species: the spiders *Pholcus phalangioides* and *Misumena vatia*, the mantis *Stagmomantis californica* and the lacewing *Chrysoperla carnea*. Survival of each predator species was compared when individuals were fed either *M. boydi* or low-Ni prey. No significant survival difference between diets was observed for *P. phalangioides* or *S. californica*, although individuals fed *M. boydi* contained significantly elevated Ni concentrations ($470\mu\text{g Ni g}^{-1}$ for *P. phalangioides* and $460\mu\text{g Ni g}^{-1}$ for *S. californica*). No significant difference in survival to adulthood was observed for *C. carnea*: adult production was 45% for high-Ni and 55% for low-Ni diets. In contrast, survival of *M. vatia* was significantly decreased when fed high-Ni prey: only 32% of those fed *M. boydi* survived after 20 d, in contrast to 89% of those fed low-Ni prey. *Misumena vatia* collected from Ni-hyperaccumulating *Streptanthus polygaloides* plants in the wild contained some Ni (a maximum of $110\mu\text{g Ni g}^{-1}$), but significantly less than the $420\mu\text{g Ni g}^{-1}$ measured in those fed *M. boydi*. This indicated that *M. vatia*, which is native to *S. polygaloides* sites, consumes some *M. boydi* under natural conditions. We concluded that: (1) Ni can be transferred from a high-Ni herbivore to its predators; (2) predators varied in their sensitivity to the Ni contained in *M. boydi*, and; (3) Ni can poison predators which specialize upon high-Ni herbivores and thus may act as an elemental herbivore defense.

Bruce, M.J., Herberstein, M.E. & Elgar, M.A. (2001) Signalling conflict between prey and predator attraction. *Journal of Evolutionary Biology*, 14(5): 786-794.

Predators may utilize signals to exploit the sensory biases of their prey or their predators. The inclusion of conspicuous silk structures called decorations or stabilimenta in the webs of some orb-web spiders (Araneae: Araneidae, Tetragnathidae, Uloboridae) appears to be an example of a sensory exploitation system. The function of these structures is controversial but they may signal to attract prey and/or deter predators. Here, we test these predictions, using a combination of field manipulations and laboratory experiments. In the field, decorations influenced the foraging success of adult female St. Andrew's Cross spiders, *Argiope keyserlingi*: inclusion of decorations increased prey capture rates as the available prey also increased. In contrast, when decorations were removed, prey capture rates were low and

unrelated to the amount of available prey. Laboratory choice experiments showed that significantly more flies (*Chrysomya varipes*; Diptera: Calliphoridae) were attracted to decorated webs. However, decorations also attracted predators (adult and juvenile praying mantids, *Archimantis latistylus*; Mantodea: Mantidae) to the web. St. Andrew's Cross spiders apparently resolve the conflicting nature of a prey- and predator-attracting signal by varying their decorating behaviour according to the risk of predation: spiders spun fewer decorations if their webs were located in dense vegetation where predators had greater access, than if the webs were located in sparse vegetation.

Esteves, L. & Mendes, L.F. (1999) Mantodea of the Zoological Center (Lisbon, Portugal) I. - Amorphoscelidae. Mantodea do Centro de Zoologia I. - Amorphoscelidae. *Garcia De Orta Serie de Zoologia*, 23(1): 93-97.

One male of *Amorphoscelis tuberculata* Roy deposited in the Centro de Zoologia entomological collection is studied. The examined specimen is the only one observed after the species description and *Amorphoscelis tuberculata* Roy is reported for the first time to Mozambique. Some notes are presented on the male genitalia of further Afrotropical *Amorphoscelis*.

Fagan, W.F. & Folarin, A. (2001) Contrasting scales of oviposition and parasitism in praying mantids. *Population Ecology*, 43(1): 87-96.

We report on spatial patterns of parasitism of oothecae (egg cases) of praying mantids (*Stagmomantis limbata*) by Torymid wasps, *Podagrion* spp. Using collections of mapped mantis oothecae from riparian sites in the Sonoran desert and grassland sites in the Chiricahua Mountains (both in Arizona, USA), we characterized the spatial distributions of oothecae and parasitism. The likelihood of an egg case suffering some parasitism was higher at grassland sites, which had high oothecal densities, than at low-density riparian sites. However, experimental isolation of grassland oothecae to densities comparable to riparian sites reduced parasitism rates. At riparian sites, parasitized oothecae exhibited on average the same extent of parasitism as parasitized oothecae at high densities but with much greater variation. Indeed, large fractions of riparian oothecae suffered both severe (>50%) and light (<20%) parasitism, whereas most parasitized grassland oothecae suffered intermediate levels of parasitism. Analysis of first nearest neighbour distances indicated that the parasite load of an ootheca did not depend on its immediate isolation. However, extending the analysis to include subsequent nearest neighbours (using a technique from spatial statistics called the R(K) function), we found that even though oothecae of *S. limbata* were spatially clustered, some oothecae in a (statistically defined) cluster escaped parasitism when overall oothecal densities were low. This pattern suggests that when oothecae are sparsely distributed, *Podagrion* wasps exploit only a fraction of the oothecae available locally, even though the oothecae are strongly aggregated relative to their overall density. We suggest this lack of congruency in the scales of oothecal deposition and parasitism at low densities (which is absent when oothecae are at high densities) may be explained in part by behavioral aspects of the parasite's reproduction, including increased host fidelity by relatively sedentary female parasites.

Hahn, B.-S., Cho, S.Y., Ahn, M.Y. & Kim, Y.S. (2001) Purification and characterization of a plasmin-like protease from *Tenodera sinensis* (Chinese mantis). *Insect Biochemistry and Molecular Biology*, 31(6-7): 573-581.

A novel type of protease (mantis egg fibrinolytic enzyme, MEF-2) was isolated from the egg cases of *Tenodera sinensis*. The protease was homogeneous by SDS-PAGE and its apparent molecular mass was 32,900 Da. The amino acids in the N-terminal region were Ile-Val-Gly-Gly-Glu-Glu-Ala-Val-Ala-Gly-Asp-Phe-Pro-Ile-Val-Ser-Leu-Gln-Glu. The enzyme was inhibited by PMSF, TLCK, aprotinin, benzamidine, soybean trypsin inhibitor and also slightly by elastatinal, EDTA, EGTA, cysteine and beta-mercaptoethanol, but TPCK, iodoacetate and E-64 did not affect the activity. MEF-2 was not sensitive to alpha1-antitrypsin but antithrombin III and alpha2-antiplasmin inhibited the enzyme. MEF-2 preferentially cleaved the oxidized B-chain of insulin between Arg22 and Gly23. Among chromogenic protease substrates, the most susceptible to MEF-2 hydrolysis was benzoyl-Phe-Val-Arg-p-nitroanilide with maximal activity at 30°C and pH 5.0. These results indicate that MEF-2 belongs to the trypsin family. Upon incubation of crosslinked fibrin with MEF-2, a steady increase of D-dimer suggests that the enzyme has a strong fibrinolytic activity. In conclusion, MEF-2 is a new type of proteolytic enzyme and has some potential for practical application in fibrinolysis.

Hatle, J.D. & Salazar, B.A. (2001) Aposematic coloration of gregarious insects can delay predation by an ambush predator. *Environmental Entomology*, 30(1): 51-54.

An important hypothesis concerning the role of aggregation in the antipredator defense of aposematic insects is that a group projects a larger aposematic signal to a predator. The nearly exclusive use of birds as model predators may be leading us to over-emphasize the importance of signal amplification as an explanation for the gregarious behaviour of aposematic insects. Ambush (sit-and-wait) predators such as amphibians and praying mantids make predatory decisions relying primarily on prey movement, and secondarily on prey size, with prey colour being less important. Therefore, we tested the interaction of aposematic coloration and gregarious behaviour in insect defense from frogs. We offered frogs four types of mealworm prey: (1) cryptic and solitary, (2) cryptic and gregarious, (3) aposematic and solitary, and (4) aposematic and gregarious. The frogs ate aposematic and gregarious prey significantly later than they ate cryptic and gregarious prey and cryptic and solitary prey. Our results support the hypothesis that aposematic coloration in gregarious prey, but not in solitary prey, can function to produce a sufficient aposematic signal to delay attack by an ambush predator. This result was not due to predator learning. Hence, the antipredator benefits of aposematic coloration in aggregated prey may function in encounters with a wide range of predators, including frogs.

James, D.G. & Vogele, B. (2001) The effect of imidacloprid on survival of some beneficial arthropods. *Plant Protection Quarterly*, 16(2): 58-62.

In laboratory bioassays, the field rate of imidacloprid registered for control of aphids in stone fruit (0.0053% a.i.), was highly toxic to *Oechalia schellebergii* (Guerin-Meneville) (Hemiptera: Pentatomidae) and *Archimantis* sp. (Mantodea: Mantidae), partially toxic to *Coccinella transversalis* (F.) (Coleoptera: Coccinellidae) and non-toxic to *Pristhesancus plagipennis* Walker (Hemiptera: Reduviidae) and *Dicranolaius bellulus* (Guerin-Meneville) (Coleoptera: Melyridae). This rate was also harmless to the predatory mites, *Typhlodromus dossei* Schicha and *T. doreenae* Schicha (Acari: Phytoseiidae), although a ten-fold increase

in rate caused 19% mortality in *T. doreenae*. Populations of *Stethorus vagans* (Blackburn), *Rhyzobius lophanthae* (Blaisdell) (Coleoptera: Coccinellidae), coccinellid and neuropteran larvae, were significantly reduced for 4-9 weeks by a single application of imidacloprid (0.0053% a.i.) to an apricot orchard. Populations of *D. bellulus*, spiders and parasitic Hymenoptera were not reduced by imidacloprid. The variability of imidacloprid in its impact on different species of beneficial arthropods is discussed with reference to its use in integrated pest management programs.

Lombardo, F. & Agabiti, B. (2001) The mantids from Ecuador, with some biogeographic considerations. *Journal of Orthoptera Research*, 10(1): 89-104.

The authors studied a rich collection of mantids from Ecuador, belonging to the Pontificia Universidad of Quito. Forty species were identified, among them 18 are new for the Ecuadorian fauna and *Chopardiella poulaini* is new to science.

Schmidt-Rhaesa, A. & Ehrmann, R. (2001) Horsehair worms (Nematomorpha) as parasites of praying mantids with a discussion of their life cycle. *Zoologischer Anzeiger*, 240(2): 167-179.

Praying mantids (Mantoptera) are the most important hosts of horsehair worms (Nematomorpha) in tropical and subtropical regions worldwide. 82 reports of nematomorph-mantis relationships are reported, 11 of which are new to science. The majority of nematomorph species parasitizing mantids belong to the genus *Chordodes*. The life cycle consists of a free-living stage in which copulation and early embryological and larval development take place and parasitic phases in an intermediate and a final host. The intermediate hosts, which are insects with aquatic larvae, serve as vectors between the aquatic and the terrestrial environment. Development can only be completed if the intermediate host is captured and eaten by the final host, praying mantids. Inside the host, the main development of the worms takes place, with a size increase from about 100 μ m up to several centimetres. The factors influencing emergence from the hosts, which must be established close to water, remain not well understood.

Tribblehorn, J.D. & Yager, D.D. (2001) Broad versus narrow auditory tuning and corresponding bat-evasive flight behaviour in praying mantids. *Journal of Zoology*, 254(1): 27-40.

Most praying mantids possess a single tympanal ear located in the ventral midline between the metathoracic legs. The auditory system is generally most sensitive to ultrasound in the 25-50kHz range. Flying males exhibit a short-latency, stereotyped, multi-component response to ultrasound that allows them to escape from attacking bats. This study describes a small subset of species that differs in three major respects from the majority of mantis species: (1) their auditory tuning is 1.5-2 times broader; (2) they are sensitive to frequencies above 60kHz (up to 130kHz in some species) with thresholds as low or lower than at 25-50kHz; (3) the behavioural response of the broadly tuned (BT) species includes 10-50 times more flight cessations and can be far less stereotyped, i.e. more 'evitable', than that of narrowly tuned (NT) species. However, BT species do not differ from NT species in overall sensitivity. Two species from one subfamily, the Amelinae (family Mantidae), stand out because they are among the least sensitive of any hearing mantids so far tested. Although the two amelines differ from one another in tuning curve shape, they are both more broadly tuned than most mantids. The occurrence of BT species does not follow any obvious phylogenetic pattern;

they are patchily distributed among the mantis families, and both BT and NT species can be found in the same subfamily or tribe. We suggest that BT species are responding to a shared ecological pressure. Based on their tuning, the nature of their behavioural response, and their geographic distribution, we hypothesize that high duty cycle (HDC) bats (Rhinolophidae and Hipposideridae) pose a special danger to BT mantids in addition to the threat that all flying mantids face from the more common and widely distributed low duty cycle (LDC) bats.

Wheeler, W.C., Whiting, M., Wheeler, Q.D. & Carpenter, J.M. (2001) The phylogeny of the extant hexapod orders. *Cladistics*, 17(2): 113-169.

Morphological and molecular data are marshalled to address the question of hexapod ordinal relationships. The combination of 275 morphological variables, 1000 bases of the small subunit nuclear rDNA (18S), and 350 bases of the large subunit nuclear rDNA (28S) are subjected to a variety of analysis parameters (indel and transversion costs). Representatives of each hexapod order are included with most orders represented multiply. Those parameters that minimize character incongruence (ILD of Mickevich and Farris, 1981, *Syst. Zool.*, 30: 351-370), among the morphological and molecular data sets are chosen to generate the best supported cladogram. A well-resolved and robust cladogram of ordinal relationships is produced with the topology (Crustacea ((Chilopoda Diplopoda) ((Collembola Protura) ((Japygina Campodeina) (Archaeognatha (Zygentoma (Ephemerida (Odonata (((Mantodea Blattaria) Isoptera) Zoraptera) ((Plecoptera Embiidina) (((Orthoptera Phasmida) (Grylloblattaria Dermaptera)) (((Psocoptera Phthiraptera) Thysanoptera) Hemiptera) ((Neuropteroidea Coleoptera) (((((Strepsiptera Diptera) Mecoptera) Siphonaptera) (Trichoptera Lepidoptera) Hymenoptera))))))))))))))))).

Wyniger, D. & Muhlethaler, R. (2000) *Mantis religiosa* Linnaeus (Gottesanheterin) Nachweise vom DB-Areal und den Spittelnmatten (Lange Erlen). *Mitteilungen der Entomologischen Gesellschaft Basel*, 50(4): 147-148. [in German]

Mantis religiosa Linnaeus (praying mantis): Information from the German Railway area and the Spittelnmatten (Lange Erlen). No abstract available.

To all new members welcome to the Mantis Study Group, and to existing members, thank you for your subscriptions. Members wishing to contact the Membership Secretary should note this new E-mail address:
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and mobile no: 07811 423198.

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☎ 01494 446130.
E-mail: graham.smith19@virgin.net

Graham will always welcome any contact from members but please be patient when contacting him. If you phone and do not get an answer, please leave your details on the answering machine including your MSG number, and Graham will make contact at the earliest opportunity.

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Web Site

Members who have tried to access the Mantis Study web site, will know that it no longer exists. Unfortunately we were not notified that it was closing as a third party was running and administering the site. We will be getting a new site up and running in the very near future (in fact it may be partly on line by the time you receive this newsletter). The site will be run and administered by Robbie Whytock and Graham Smith and will have forums and information for both members and other visitors to the site. We will also be setting up a special members section, which will require a password, and you will be notified about this in due course. The web site is www.praying-mantis.co.uk.