Life history and Morphometry of the Chinese Praying Mantis, Tenodera aridifolia sinensis (Blattopteroidea: Mantodea)

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Mantidae are generalist insect predators of considerable scientific interest, due to their excellent vision and neural coordination of movement patterns. However, data on the life history and morphometry are lacking for most species. This study contributes to fill this gap by collecting data on the life history and morphometry of the Chinese praying mantis, Tenodera aridifolia sinensis Saussure 1871, an east Asian species with a wide allochthonous distribution in E' North America. There are significant interspecific differences in morphometry and life-history, indicating that the sexes face different selective pressures. $\varphi$ $\sigma$ are larger, well adapted to catch large prey species, and tend to live longer than $\sigma\sigma$, $\varphi\varphi$, on the other hand, seem to allocate more resources to mobility and mate finding, and are probably restricted to smaller prey items. The sexual dimorphism in body measurements may also serve to reduce intraspecific competition and lead to resource partitioning among sexes.

Key words: Tenodera aridifolia sinensis Saussure 1871 – sexual dimorphism – intraspecific competition – resource partitioning


Gottesanbeterinnen sind räuberische Nahrungsm-Generallisten mit außergewöhnlichem Sehvermögen. Obwohl die neuronale Koordination ihrer Bewegungsabläufe starke wissenschaftliche Beachtung gefunden hat, fehlen für die meisten Arten grundlegende morphometrische Daten und Angaben zur Lebensweise. Die vorliegende Studie liefert entsprechende Daten für die in Ostasien und Nordamerika weit verbreitete Chinesische Gottesanbeterin, Tenodera aridifolia sinensis Saussure 1871. Die Geschlechter unterscheiden sich bei dieser Art sowohl hinsichtlich Lebensweise als auch in der Körpergröße, was auf unterschiedliche Selektionswirkungen hindeutet. $\varphi\varphi$ sind allgemein größer, angepaßt an das Fangen größerer Beute und leben länger als $\sigma\sigma$, $\varphi\varphi$ hingegen scheinen ihre Ressourcen vorwiegend in Mobilität und Partnerfindung zu investieren und sind wahrscheinlich auf kleinere Beuteobjekte beschränkt. Der Sexualdmsphorphismus bei $T\ aridifolia\ sinensis$ könnte zur Separation der ökologischen Nischen beider Geschlechter führen und damit der Reduzierung intraspezifischer Konkurrenz dienen.

Schlüsselbegriffe: Tenodera aridifolia sinensis Saussure 1871 – intraspezifische Konkurrenz – Separation ökologischer Nischen – Sexualdmsphorphismus

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1 Introduction

Although there is much literature on the biology and life history of mantids in the wild, comparatively little information is available for the species with which many researchers work in the lab [Prete 1999: review]. A notable exception is Spheleomantis lineolata Burchmeister 1838, a close relative of Tenodera aridifolia sinensis Saussure 1871, for which Prete 1999 collected an enormous amount of life history data on lab-reared individuals and found that developmental times and adult life spans are significantly higher in ♌ than in ♂♂. These results agree with those of Lawrence 1992, Hur et al 1994, and Maxwell 1998, who estimated higher survivorship and longer life spans for ♌ than for ♂♂ of Mantis religiosa Linnaeus 1758, Tenodera aridifolia sinensis Saussure 1871, and Iris oratoria Linnaeus 1758, respectively. Maxwell 1998 and Prete 1999 suggested four factors that could contribute to higher mortality rates in ♂♂, all of which have been supported by at least anecdotal evidence: (a) ♌ have shorter intrinsic life spans; (b) ♌ are smaller and less powerful than ♌, and thus possibly more vulnerable to predation; (c) in many species, only the ♌ appear to fly, so they might face a higher risk of being preyed upon than the ♌ that remain relatively stationary and cryptic; (d) ♌ probably experience more cannibalism in the adult stage than ♂♂, because they are smaller. Obviously, longer life spans and lower mortality rates of female mantids affect the sexual size ratio of a population during the season. In several species, the sex ratio was found to be close to equality or slightly male-biased when the mantids reached the adult stage, and it shifted more and more towards a female bias as the season progressed [Lawrence 1992, Hur et al 1994, Maxwell 1998].

When collecting data on the life history of mantids, it is important to consider that both developmental time and adult life span might depend on prey density, availability, and palatability. Pedrera & Stamp 1990 and 1993 demonstrated that episodes of unpalatable prey reduce food consumption and growth in juvenile Tenodera aridifolia sinensis Saussure 1871. Food availability for the nymphs also affects the adult size of adults which in turn determines potential weight gain during the adult phase of the life cycle [Eisenberg et al 1981]. Additionally, the number of eggs produced by female mantids increases with higher prey density during the adult stage, and the length of the preoviposition period decreases [Matuura & Morokava 1983]. Thus, it is difficult to compare life history data when rearing and feeding conditions differ among studies.

In many mantid species, there is a strong sexual dimorphism in body size, with ♌ being considerably smaller than ♂♂ e.g. Gensheimer et al 1994, Dettmers 1999, Prete et al 2002]. Sexual body size dimorphism is widespread in the animal kingdom [e.g. Lande 1980, Saltin 1984, Cockburn 1991], and it is generally accepted that both natural and sexual selection can shape the features of sexually dimorphic organisms [e.g. Darwin 1871, Lande 1980, Herrel et al 1999]. Sexual selection might act on overall body size or on specific body parts if these features are important in intrasexual competition or in intersexual interactions concerning courtship and mating [Herrel et al 1999]. Natural selection, on the other hand, can favor body size dimorphism in predators, because differences in body size may reduce competition by promoting differential resource use and niche partitioning [Saltin 1984, Mclean 1989, Herrel et al 1999].

The Chinese praying mantis, Tenodera aridifolia sinensis Saussure 1871, is a comparatively large species, with ♌ easily reaching body lengths of 85 mm and more [pers obs]. It has been introduced from Eastern Asia into North America around 1896, and it has since become native along the East coast where it is now widespread and common [Beier 1968, Swan & Pye 1972]. It inhabits open places with shrubs and bushes, like forest edges, old fields, and powerline cuts. In North Carolina, there is a distinct seasonality in the life cycle of Tenodera aridifolia sinensis due to the comparatively cold winters. Young mantids hatch from the egg-cases in early spring (March – May) [Hino 1988, Severson & Hino 1995], grow and molt all spring and during early summer until they reach the adult stage in the summer months. They mate, and the ♌ produce one or several egg-cases before the first frost kills them. The embryonic development is interrupted by a diapause during the cold months, so it can take up to six or seven months [Gensheimer et al 1994].

2 Material and methods

2.1 Collection and rearing conditions of mantids

Pregnant ♌ of the Chinese praying mantis, Tenodera aridifolia sinensis Saussure 1871, were collected at different sites in Duke Forest, Durham County, North Carolina, during the months of September and October 2001. All of the collected mantids laid egg-cases in October which were stored in the refrigerator at 4°C (46°F). Additional egg-cases were collected near Lake Jordan, Chatham County, North Carolina, on November 17th 2001.

When the egg-cases were taken out of the refrigerator and kept at 24–28°C, the young mantids hatched about four weeks later. They were reared in glass terrariums (51 cm x 25 cm x 29 cm, length x width x height) that were divided in half by a cardboard wall so that the offspring of two egg-cases could be kept in one terrarium without mixing the animals. Young mantids of each egg-case were reared collectively until they reached the 4th or 5th instar stage. Then they were separated and kept individually in glass jars of two different sizes: 14.5 cm high and 7 cm Ø, and 18 cm high and 8 cm Ø. For the last instar and the adult stage, they were moved back to glass terrariums that were divided into eight compartments by cardboard. The tops of the containers were tightly covered with cloth in which holes were cut to allow feeding. Pieces of foam were used to cover the holes. Juvenile mantids were fed fruit flies (Drosophila melanogaster Meigen 1830). After separating the mantids individually, they were fed on live house flies (Musca domestica Linnaeus 1758), grasshoppers (Chorthippus auratus Rehn & Hebard 1911), crickets (Acheta domestica Linnaeus 1758), and on dead mealworm larvae (Tenebrio molitor Linnaeus 1758).

The experiments were performed at Duke University in Durham, North Carolina, USA, between October 2001 and July 2002.

2.2 Life history

Dates of hatching were recorded for the egg-cases, and molting dates of the nymphs when recorded whenever possible. After separating the mantids individually, numbers were assigned to all animals, and molting dates, the day of death, and the cause of death were recorded for each individual. There were four possible causes of death: (a) some mantids fell down during molting or were unable to shed the old cuticle completely and thus were heavily irritated from molting; (b) a prey grasshopper or cricket sometimes gnawed upon a mantis during molting; (c) in some cases, a mantis escaped from its container into another one and was cannibalized; (d) most of the mantids died from unknown reasons that possibly include diseases, old age, and exhaustion.

Developmental time (until final molt), life span, and adult life span (from final molt until death) could easily be calculated from the data. For the analysis of the life span and the adult life span data, only animals from egg-cases # 3, 4, and 5 that reached the adult stage and died of unknown reasons were included.
2.3 Morphometry

Dead mantids were kept in the refrigerator for morphometric measurements. The sexes could easily be distinguished by the genitalia. The following measurements were performed with a caliper rule on the whole animal: body length with genitalia (BL), body length without genitalia (BL2), caput length (CL), caput width (CW), thorax length (TL), thorax width (TW), abdomen length with genitalia (AL), abdomen width (AW), front coxa length (FCL), front femur length (FFL), front tibia length (FTL), hind femur length (HFL), hind tibia length (HTL), and wing length (WL) (Fig 1 and 2). All these features were measured three times for 23 animals to calculate the standard error of the measurements. The other 52 animals were measured only once. Measurements were only taken from completely intact body parts, so some values are missing for individuals that got injured during moulting.

For the caput measurements, a dead mantid’s caput was fixed with insect pins on a piece of Styrofoam, and the following measurements were taken under a dissecting scope with ocular micrometer scale: caput length (CL, magnification 12x), caput width (CW, 12x), eye length (EL, 25x), eye width (EW, 25x), from width (FL, 25x), from width (FW, 25x), parietal suture distance (PSD, 12x for smaller animals, 25x for large individuals), dorsal ocellus distance (DOD, 50x), lateral ocellus distance (LOD, 50x), and antennal distance (AD, 50x) (Fig 2). To calculate the standard error of the measurements, 13 animals were measured three times, the other 52 animals were measured only once.

Sex differences in life history data, body and caput measurements were analyzed using two-sample t-tests or Wilcoxon rank sum tests in S-PLUS 2000. Linear regression lines were calculated in Ss 1.1.1a. Using this software, it was also possible to compare slope and intercept of the regression lines of $\bar{c} \bar{c}$ and $\bar{c} \bar{d}$ and to compute p-values for the differences.

3 Results

3.1 Life history

Egg-cases hatched 4–6 weeks after taking them out of the refrigerator. A cold period was not necessary to induce hatching, because some of the oothecae were not stored in the refrigerator, and these egg-cases also hatched after four to six weeks. Nymphs of the same egg-case went through the first molt almost synchronously (within one or two days) about 8–14 days after hatching. The following molts occurred in intervals of 8–20 days, with the differences in molting dates between siblings becoming larger as they grew older. The developmental rate of the nymphs seemed to depend on the food intake. The mantids molted 8–9 times before they reached the adult stage, in which the body length was about 8–12 times larger than during the first instar stage.

Female mantids lived on average 187 days, which was significantly longer than the $\bar{c} \bar{c}' \bar{c}$ average life span of 156 days (Tab 1). Both the developmental time and the adult life span were longer in $\bar{c} \bar{c}'$ than in $\bar{c} \bar{c}'$, although there was only borderline significance supporting these results (Tab 1). None of the life history variables was significantly correlated with body length for either sex (Tab 2).

Fig 1 (page 005): Morphological measurements on adult Tenodera aridifolia sinensis Saussure 1871 (Blattopteroidea: Mantodea). — A $\bar{c}'$, dorsal view; B $\bar{c}'$, ventral view; C $\bar{c}'$, p-w. Abbreviations: AL abdomen length, AW abdomen width, BL body length, FCL front coxa length, FFL front femur length, FTL front tibia length, HFL hind femur length, HTL hind tibia length, TL thorax length, TW thorax width, WL wing length.
Fig 2: Caput of an adult male of Tenodera aridifolia sinensis Saussure 1871 (Blattopteroidea: Mantodea). Caput measurements (CL, caput length; CW, caput width; EL, eye length; EW, eye width; FL, frons length; FW, frons width; PSD, parietal suture distance; DOD, dorsal ocellus diameter; LOD, lateral ocelli distance; AD, antennal distance).

Tab 1: Summary statistics and results of two-sample tests for sex differences for the 12 body measurements in Tenodera aridifolia sinensis Saussure 1871 (Blattopteroidea: Mantodea): 12 caput measurements, and the three life history variables. All values in mm. Body measurements: BL, body length; BL2, body length without genitalia; TL, thorax length; TW, thorax width; AL, abdomen length; AW, abdomen width; FCL, front coxa length; FFL, front femur length; FTI, front tibia length; HFL, hind femur length; HTL, hind tibia length; WL, wing length. Caput measurements: CL, caput length; CL2, caput length measured under a dissecting scope; CW, caput width; CW2, caput width measured under a dissecting scope; EL, eye length; EW, eye width; FL, frons length; FW, frons width; PSD, parietal suture distance; DOD, dorsal ocellus diameter; LOD, lateral ocelli distance; AD, antennal distance. Life history variables: develop, developmental time from hatching until final molt; life span, hatching until death; adult life span, final molt until death. Significance of the p-values: * p<0.05, ** p<0.01, *** p<0.001, n.s. not significant, bs. borderline significance.
When the date of the final molt was normalized for the animals of egg-cases # 3, 4, and 5, the adult sex ratio was almost even in the beginning (Fig 3). It shifted more and more towards a female bias as the mantids became older, because the adult life span of the ♂♀ was — on average — longer than that of the ♀♂ (Tab 1) (Fig 3). However, since the sample size was relatively small, inferences drawn from the analysis of the life history data have to be considered with caution.

Fig 3: Adult life spans of male and female individuals in Tenodera aridifolia sinensis Saussure 1871 (Blattopteroidea: Mantodea) and change in sex ratio over the adult life span. The day of the final molt is set as day 1 of the adult stage for all individuals.

3.2 Morphometry

Tenodera aridifolia sinensis Saussure 1871 is a moderately sexually dimorphic species. ♂♀ were significantly larger (mean body length 76.7 mm in ♀♂, 73.4 mm in ♀♂), with significantly larger capitis, thoraces, pedes-1 and -II, and broader abdomen (Tab 1). Surprisingly, abdomen length did not differ between the sexes, and neither did wing length (Tab 1). All caput measurements were significantly larger for the ♂♀ than for the ♀♂, with the exception of the dorsal ocellus diameter that was larger in ♀♂, and the distance of the lateral ocelli that did not differ between the sexes (Tab 1).

Tab 2 (page 009): Results of linear regressions between selected body measurements, caput measurements, and life history variables in Tenodera aridifolia sinensis Saussure 1871 (Blattopteroidea: Mantodea). For each regression, degrees of freedom, r²-value, and p-value are given for both sexes, respectively. To evaluate sex effects, slope and intercept of the regression lines for ♂♀ and ♀♂ were compared. Significant sex effects are flagged with stars: *p<0.05, **p<0.01, ***p<0.001. For the abbreviations of the body and caput measurements and the life history variables see Tab 1.
Regression analyses on log-log-scale were conducted to investigate whether the transformations reduce departures from normality or homoscedacity or improve correlation coefficients. However, as for many other intraspecific morphometric analyses [Smith 1980], the effects of the transformations were negligible, so the untransformed data were used in the analysis.

All body measurements were significantly correlated with body length for both sexes. Comparisons of the regression lines of $\sigma$ $\mathcal{O}$ and $\varphi$ $\mathcal{Q}$ with statistical and graphical methods revealed significant sex effects in most cases (Tab 2): caput width (CL), caput length (CL), thorax length (Fig 5: TL), thorax width (TW), abdomen width (AW), front coxa length (Fig 6: FCL), front femur length (FFL), and front tibia length (FTL) were disproportionately larger in $\varphi$ $\mathcal{Q}$, but $\sigma$ $\mathcal{O}$ had relatively longer abdomina. The regression lines for the hind tibia lengths did not differ. For wing length and hind femur length, the slopes of the lines differed between sexes; scatter plots show that $\sigma$ $\mathcal{O}$ tend to have larger wings than $\varphi$ $\mathcal{Q}$ (Fig 7), but there seems to be no apparent difference in hind femur lengths (Fig 8).

All caput measurements except the dorsal ocellus $\Theta$ were positively correlated with caput width for both sexes (Tab 2). Surprisingly, the sexes differed in most of the caput proportions when compared to the caput width. Frons length and width, parietal suture distance, and antennal distance were disproportionately larger in $\varphi$ $\mathcal{Q}$, but $\sigma$ $\mathcal{O}$ had longer eyes and the distance between the lateral ocelli was greater (Tab 2). The regression lines for eye width versus caput width did not differ between the sexes (Tab 2).

![Graph](image1.png)

**Fig 4:** Caput width versus body length in *Tenodera aridifolia sinensis* Saussure 1871 (Blattopteroidea; Mantodea): squares represent $\sigma$ $\mathcal{O}$, circles are $\varphi$ $\mathcal{Q}$. Regression lines indicate significant correlations (sample sizes: $\sigma$ $\mathcal{O}$: n=35, $\varphi$ $\mathcal{Q}$: n=36).

![Graph](image2.png)

**Fig 5:** Thorax length versus body length in *Tenodera aridifolia sinensis* Saussure 1871 (Blattopteroidea; Mantodea): squares represent $\sigma$ $\mathcal{O}$, circles are $\varphi$ $\mathcal{Q}$. Regression lines indicate significant correlations (sample sizes: $\sigma$ $\mathcal{O}$: n=35, $\varphi$ $\mathcal{Q}$: n=36).

![Graph](image3.png)

**Fig 6:** Front coxa length versus body length in *Tenodera aridifolia sinensis* Saussure 1871 (Blattopteroidea; Mantodea): squares represent $\sigma$ $\mathcal{O}$, circles are $\varphi$ $\mathcal{Q}$. Regression lines indicate significant correlations (sample sizes: $\sigma$ $\mathcal{O}$: n=35, $\varphi$ $\mathcal{Q}$: n=35).
To sum up the results, female mantids were larger than the ♂♂ in overall body size and most body measurements, with even disproportionately larger capites, thoraces, and pedes-I, and broader abdomina. However, abdomen length and wing length were relative to body length – greater in ♂♂. Most caput dimensions are larger in ♀♀ than in ♂♂ (Fig 9A), although ♂♂ have relatively slightly longer eyes (when compared to caput width) and their ocelli are more prominent (Fig 9B and 9C).

4 Discussion

The finding that the average life span of ♀♀ is longer than that of ♂♂ in *Tenodera aridifolia sinensis* Saussure 1871 agrees with the results of studies on other species of the subfamily Mantinae [Lawrence 1992, Hurd et al 1994, Maxwell 1998, Prete 1999]. Additionally, Prete [1999] found the developmental time from hatching to final ecdysis to be significantly longer in ♀♀ than in ♂♂ of *Sphodromantis lineola* Burmeister 1838, which seems to be true also for *Tenodera aridifolia sinensis*.

In this study, the difference in intrinsic life spans alone is sufficient to cause a shift in the adult sex ratio towards a female bias over the season. In the field, however, it is likely that an increased risk of predation and cannibalism for ♂♂ due to their smaller size also contributes to this effect [Lawrence 1992, Hurd et al 1994, Maxwell 1998].

It makes sense, evolutionarily speaking, that male mantids reach adulthood sooner and have shorter adult life spans than ♀♀ given the facts that high mortality rates due to predation and cannibalism create selective pressure for both early maturity and increased reproductive effort early in life and that these two characteristics are correlated with decreased performance later on in life and/or a shorter life span [e.g. Reznick & Endler 1982, Cockburn 1991, Prete 1999].
Additionally, early maturation in female pools is favored by natural selection because the probability that a female has already mated increases as the season progresses, and, since mated females are supposedly less attractive to potential mates [Maxwell, 1999], the chances of finding a mate decrease for the female as time goes by [Prete, 1999]. On the other hand, female q adults show different selective pressures. They can produce several oothecae over the course of a season, so a long life span is advantageous because the probability that a female will lay additional oothecae increases the longer she can stay alive [Matsura & Morooka, 1983, Prete, 1999].

The results of this study indicate that there is a male sexual dimorphism in body size of Tenodera aridifolia sinensis, with the mean values for each body and caput measurement being significantly smaller for female than for male, except for abdomen length, wing length, ocellus diameters, and ocelli distance. Sexual size dimorphism is a common phenomenon among mantids, with the female being larger than the male, e.g., [Grother, 1994, Prete et al, 2002]. Interestingly, caput, thorax, and pedes-I of female Chinese praying mantids were even larger than expected when sexual size differences were accounted for. Similarly, Prete et al. [2002] found disproportionately larger thoracies and pedes-I in female pools of Sphodromantis lineola, but caput size was independent of body length for either sex. Mantids with larger pedes-I will have a longer reach within a larger three-dimensional strike zone and will be able to catch larger prey items than will smaller individuals [Prete & Hamilton, 1999, Prete et al, 2002]. But, the smaller overall body size and the disproportionately smaller pedes-I in male Chinese praying mantids suggest that they are restricted to smaller prey than are females [Prete et al, 2002]. The females' greater caput width will allow them to catch the prey. Prete et al. [2002] provide further evidence that this is related to depth perception [Prete et al, 2002].

Intersexual size dimorphism may be adaptive in preventing competition between the sexes, because it can lead to resource partitioning when prey are scarce [Prete et al, 1999], which is likely to be the case for mantids in the field [Hurd, 1999]. Male and female mantids appear to face different selective pressures on body measurements. Female pools are highly adapted to effectively detect and capture prey by their larger thoraxes, pedes-I and caput, whereas male pools have longer abdomens and wings than female pools and thus seem to focus their investments on reproduction and mobility. These hypotheses agree with observations on behavior and ecology of the Chinese mantis female pools need to catch more prey to be able to allocate resources to the production of egg case [Matsura & Morooka, 1983], they remain more or less stationary [Eisenberg et al, 1981] and presumably attract female pools via pheromones [Less & Davis, 1987], whereas male pools do not gain weight at all as adults [Eisenberg et al, 1981], because they only need to catch prey for their own survival, but they have to invest in flight in order to find mates. The allostatic data for the caput measurements indicate that the caput proportions differ between sexes, which may also be connected with adaptations concerning prey detection via perception and processing of visual information, assuming that the external differences correlate with a dimorphism in internal features. The interspecies difference in ocelli diameter is difficult to explain, because the function of the ocelli is still poorly understood. However, they have been suggested to play a role for stability and orientation during flight [Berg, 1968, Evans, 1984], which would provide an explanation why they should be more prominent in the mobile female pools than in the more stationary male pools.

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The productive and self-assured (see pages 323–325) author presents a voluminous revision of the stick insects of the suborder Arocatae using cladistic analyses. Generally, the volume is well-constructed. It begins with a short introduction touching on phasmid taxonomy, previously discussed sister-group relationships, characters and evolutionary trends, nomenclature especially considered in the analyses, and biogeography. Details of the biology including further information on the egg capsule composition (e.g. amino acids, minerals; that the egg capsule sclerotizes (p. 24) is a premature generalisation) are inevitably lacking or superficial. The descriptive diagnoses are relatively detailed. Regarding Phasmatodea the book contains very valuable keys to families, eggs (with detailed drawings of the eggs of the investigated species), subfamilies, tribes and genera. The different taxa including fossil forms are characterized by their (autapomorphies), so far possible. Genera and species are largely described in a standardized pattern: synonyms, distribution, diagnosis, description, type species, name, material examined, species included and comments. Descriptions are illustrated by photos of preserved specimens, not in all cases of satisfactory quality, and drawings. The SEM-photos and the macro-photos are less convincing. The list of references is extensive containing substantial articles, but also many less important (casual observations). It is followed by a useful checklist of the genera of Phasmatodea, critical comments on some recent publications and a short index. Here is not the space to list all the changes regarding the transfer of genera to different or even new families or the description of new species etc. I think the most important results may be summarized as follows: The author suggests 1) a sister-group relationship of Phasmatodea to (Plecoptera + (Tinematodea + Embioptera)) that all are united in the Phasmomorph n. tax. 2) he stresses again and demonstrates the importance of the egg structure for taxonomic and systematic purposes, which has been proved also by previous authors) to be relatively constant within families and their subordinate taxa. 3) he postulates that Anacolatae are polyphyletic, that they may be derived Arocatae, and that their subfamilies may be attributed to families within the Verophasmatodea n. subord. (see the summarizing discussion). The author may well be right establishing all the (autapomorphies), but in most cases I largely miss exact grounds why this and that structure is an (autapomorphy) that means that a clear argumentation is lacking or does not become directly comprehensible in the text. The inexperienced reader is merely confronted with “facts” that he may believe or not. Interestingly, the reasons why the author accepted monophyly of some taxa (suggested by previous authors) were “the lack of real arguments to doubt monophyly and an intuitional feeling, based on 25 years of experience with Phasmatodea” (page 21). Nevertheless, this revision is a useful piece of work that everybody interested in the taxonomy and systematics of Phasmatodea must take into consideration.