

## A glance at the Odonata of the Cambodian coastal mountainous regions: end of dry season in 2010.

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### **Abstract**

During a visit to the coastal regions of Cambodia within the Provinces of Koh Kong, Kampong Saom, Kampot and Kep within April 12-23, 2010, 59 species of Odonata were found. Of these, 51 were identified, 2 preliminarily identified (1 by exuviae, 1 to a known species with the valid name unresolved), 1 dubious (*Aciagrion* cf. *pallidum*), 3 not identified (just visual observations) and 2 seemingly undescribed, namely *Burmagomphus* sp. and *Microgomphus* sp. Fourteen species were recorded for the first time for this country, namely *Neurobasis chinensis*, *Dysphaea gloriosa*, *Euphaea masoni*, *Onychargia atrocyana*, *Copera marginipes*, *Copera vittata*, *Prodasineura autumnalis* *Prodasineura verticalis* sensu Asahina, 1983, *Lathrecista asiatica*, *Orthetrum chrysis*, *Rhyothemis obsolescens*, *Tramea transmarina euryale*, *Zygonyx iris malayana*, *Zyxomma petiolatum*; taking the current checklist for Cambodia up to 83 species. Some features of the collected specimens relevant to their taxonomy are discussed. Brief field notes are provided and Odonata records enumerated. The habitats and community of Odonata at the Cardamon Mts. foothills at the end of dry season are discussed.

### **Introduction**

Due to the very unfortunate history in quite recent past, Cambodia is the least studied of the Indochinese countries with respect to biodiversity. Until present, Cambodia misses a checklist of Odonata (Hämäläinen, 2004) and each short visit of anyone who knows these insects yields new country records. The first



ones for this country were made as early as by Martin (1904) in his paper devoted to Indochina in general. Distribution of some species were expressed as “Indo-Chine”, “Indo-Chine française”, or “commune en Indo-Chine” and it is not known if he had seen specimens from Cambodia or not. For some species he mentioned “Cambodge” and they may be considered as obviously recorded for the country. These 25 species are: *Archibasis oscillans* (Selys, 1877), *Coelellicia octogesima* (Selys, 1863) (as “*Trichocnemis octogesima* Selys”), *Orolestes octomaculatus* Martin, 1904 (described in the cited paper from Cambodia), *Aristocypha fulgipennis* (Guerin, 1871) (as “*Rhynocypha fulgipennis* Guer.”), *Heliocypha perforata* (Persheron, 1835) (as “*Rhynocypha perforata* Perch.”), *Euphaea guerini* Rambur, 1842, *Ictinogomphus decoratus melaenops* (Selys, 1858) (as “*Ictinus melanops* Selys”), *Anax guttatus* (Burmeister, 1839), *Gynacantha basiguttata* Selys, 1882, *Brachygonia oculata* (Brauer, 1878) (as “*Microdiplax delicatula* Selys.”), *Brachydiplax sobrina* (Rambur, 1842), *Camacinia gigantea* (Brauer, 1867), *Cratilla metallica* (Brauer, 1878) (as “*Protorthemis metallica* Brauer”), *Hydrobasileus croceus* (Brauer, 1867) (as “*Hydrobasileus extraneus* Kirb.”), *Lyriothemis cleis* Brauer, 1868 (as “*Calothemis priapea* Selys”), *Neurothemis intermedia atalanta* Ris, 1919 (as *N. intermedia*), *Neurothemis tullia* (Drury, 1773) (as “*Neurothemis equestris* Fabr.” and “*Neurothemis feralis* Burm.”), *Orthetrum pruinosum neglectum* (Rambur, 1842) (as “*Orthetrum neglectum* Ramb.”), *Rhodothemis rufa* (Rambur, 1842) (as “*Erythemis rufa* Ramb.” and “*Orthetrum oblitum* Ramb.”), *Rhyothemis phyllis* (Sulzer, 1776), *Rhyothemis variegata* (Linnaeus, 1763) (as “*Rhyothemis splendida* (Ramb.)”), *Trithemis pallidinervis* (Kirby, 1889) (as “*Diplax dryas* Selys”), *Urothemis signata* (Rambur, 1842) (as “*Urothemis sanguinea* Burm.”). Of this list, *C. octogesima* is as a Malaysian species rather improbable for Cambodia. “*Tamea chinensis* Degeer” was also reported, as “... qui habite à la fois les Indes orientales et la Chine. Semble commune au Tonkin, en Annam, au Cambodge”. The name is a synonym of *Tamea virginia* (Rambur, 1842) but this is an East Asiatic species which cannot be common in Indo-China. The record cannot be attributed to *Tamea basilaris burmeisteri* Kirby, 1889 (syn. *T. chinensis* Burmeister, 1839) either, for “*T. burmeisteri* Kirby” was mentioned separately. This record could be attributed to the indeed common *Tamea transmarina euryale* Selys, 1878 (confirmed for Cambodia herewith by my visual observation, see below). *Rhyothemis fuliginosa* Selys, 1883 is an East Asian species and is very improbable in Cambodia; nevertheless it was reported as “Trouvée en abondance au Cambodge, en Annam et au Tonkin”. This also was obviously a wrong identification, the closest candidate being *Rhyothemis plutonia* Selys, 1883, which goes next in the cited paper with the



following text: “Bengale, Tonkin. Peut être une petite race de la fuliginosa”. (Ridiculously, just as *Tramea transmarina euryale* I only observed, but not collected *R. plutonia*, although with less confidence). Of the species specified by Martin (1904) as “commune en Indo-Chine”, all but *Orthetrum glaucum* (Brauer, 1865) have been recorded for Cambodia later.

Only in 1964, Asahina recorded 22 more species for Cambodia (Asahina 1967a), namely: *Vestalis gracilis* (Rambur, 1842), *Libellago hyalina* (Selys, 1859) (as *Micromerus hyalina*), *Aciagrion occidentale* Laidlaw, 1919, *Aciagrion pallidum* Selys, 1891, *Agriocnemis pygmaea* (Rambur, 1842), *Ceriagrion cerinorubellum* (Brauer, 1865), *Ceriagrion olivaceum* Laidlaw, 1914, *Ischnura senegalensis* (Rambur, 1842), *Pseudagrion australasiae* Selys, 1876, *Pseudagrion williamsoni* Fraser, 1922, *Gynacantha subinterrupta* Rambur, 1842, *Brachydiplax c. chalybea* (Brauer, 1868), *Brachythemis contaminata* (Fabricius, 1793), *Crocothemis servilia* (Drury, 1770), *Diplacodes trivialis* (Rambur, 1842), *Diplacodes nebulosa* (Fabricius, 1793), *Neurothemis fluctuans* (Fabricius, 1793), *Neurothemis fulvia* (Drury, 1773), *Orthetrum sabina* (Drury, 1770), *Potamarcha congener* (Rambur, 1842) (as “*Potamarcha obscura* (Rambur)”), *Trithemis aurora* (Burmeister, 1839), *Zyxommoides breviventre* Martin, 1921. In that paper, only 3 species were in common with those recorded by Martin (1904), namely *B. oculata*, *N. intermedia* and *N. tullia* (as “*Neurothemis tullia feralis* (Burmeister)”).

In Asahina’s (1967a) paper, two species remained unidentified: *Prodasineura* sp. and *Coeliccia* sp. Later, in a paper on Thailand (Asahina, 1983), he considered the species of *Prodasineura*, with upright spines on prothorax, as *P. verticalis* Selys, 1860 but Hämäläinen & Pinratana (1999) claimed it is not conspecific to that Bornean species. *Coeliccia* sp. was later described by Asahina (1984) as *C. kazukoe* Asahina, 1984. Along with *N. i. atalanta*, Asahina (1967a) also reported “*Neurothemis intermedia degeneer* Selys(?)” based on a small specimen from Bokor with an extended wing amber. The occurrence of another subspecies within the range of *N. i. atalanta* but from a mountain seems improbable, hence this specimen should be considered as aberration. There is a problematic species reported by Asahina (1967a), *A. occidentale*, which is rare in Indochina, while the very similar *Aciagrion borneense* Ris, 1911 is common in dry season. In those early years, Asahina could still confuse them. Noteworthy that in his later paper (Asahina, 1982) devoted to Coenagrionidae of Thailand, most specimens of *A. borneense* were collected



from November to January, the scarce *A. occidentale* in July and August. The specimens reported in Asahina (1967a) were collected, at Phnom Penh and Bokor, on 15 XI and 2 XII, respectively. (Meanwhile, the conspecificity of Indo-chinese specimens referred to as *A. occidentale* and the true Indian *A. occidentale* was doubted by Hämäläinen, 2001.) Therefore, among the Cambodian Odonata we should list *A. occidentale* with caution.

The paper by Martin (1904) provided no Cambodian localities. Asahina's (1964) paper was based mostly on specimens collected by an expedition by Osaka University at Chêko on the western coast of the bay of Kampong Saom. (This locality is not found in general maps; in the internet I found different localities with this or similar names but one option, the village of 'Phnum Cheko' with coordinates of 103° 25' E, 10° 53' 0" N, points somewhere about the right place, close to a settlement named Thma Sa in Google Earth and Srae Trav on a map by Periplus Travel Maps (3<sup>rd</sup> edition). A forested mountain is seen in Google Earth somewhat NW of this place.) Some specimens from Phnom Penh, Angkor Wat, Bokor and Oudom were also included.

Furthermore, Cambodian specimens of *Ceriagrion malaisei* Schmidt, 1964 were mentioned in Asahina (1967b) from Kiri-Rom and the presence of "*Euphaea g. guerini*" in Cambodia noted in Asahina (1985b).

The above Cambodian records were seemingly summarised by S. Tsuda in his country lists (Tsuda, 1991; 2000), which are identical and include 36 species. For some reason he did not include 17 species reported by Martin (1904): *C. octogesima*, *R. fulgipennis*, *R. perforata*, *I. d. melaenops*, *A. guttatus*, *G. basiguttata*, *B. chalybea*, *B. sobrina*, *C. servilia*, *D. trivialis*, *H. croceus*, *L. cleis*, *N. tullia*, *O. p. neglectum*, *R. rufa*, *R. variegata* and *T. pallidinervis*. There could be doubts in Martin's identification of some species, such as *C. octogesima* or *A. fulgipennis*, but hardly for all of those missing from Tsuda's list. Those omissions resulted in erroneous claims of first Cambodian records for some of those species by Kosterin & Vihrev (2006) and Benstead (2006). Tsuda (1991; 2000) included also *Copera ciliata* (Selys, 1863), *Pantala flavescens* (Fabricius, 1798) and *Trithemis festiva* (Rambur, 1842) and I failed to trace the source of their inclusion.

There were four recent short reports concerning the results of tourist trips to Central Cambodian Plain, mostly to Angkor Wat and also to Lake Tonlesap and



Phnom Penh. Donnelly (2000) added *P. flavescens* and mentioned an observation of a dragonfly which reminded him *Rhyothemis regia* (Brauer, 1867), but he was far from being sure, so this cannot be regarded as a record of this species for the country. Kosterin & Vikhrev (2006) reported *Heliocypha biforata* (Selys, 1859) for the Ban Pakkard [Pailin] border cross (neither of these place names being mentioned in the publication) and *Lestes concinnus* Hagen in Selys, 1862, *Aciagrion borneense*, *Agriocnemis minima* Selys, 1877, *Agriocnemis nana* (Laidlaw, 1914), *Ceriagrion praetermissum* Lieftink, 1929 for the Siem Reap / Angkor Wat surroundings. They also reported *C. ciliata*. Simultaneously, in the same issue of 'Malangpo', Benstead (2006) reported *Paracercion calamorum dyeri* (Fraser, 1919), *Ceriagrion auranticum* Fraser, 1922, *Pseudagrion rubriceps* Selys, 1876, *Ictinogomphus rapax* (Rambur, 1842), *Acisoma panorpoides* Rambur, 1842, *Pseudothemis jorina* Förster, 1904, plus *A. minima* along with Kosterin & Vikhrev (2006), as a result of his visits to Angkor Wat / Siem Reap, Tonle Sap and Ang Trapeang Thmor. Finally, this year H.-J. Roland & U. Roland (2010), visited 13 localities in Central Cambodia in February and added records of *Aethriamanta aethra* Ris, 1912, *Aethriamanta brevipennis* (Rambur, 1842), *Aethriamanta gracilis* (Brauer, 1878) (a rather surprising Malaysian species identified by a photo), *Brachydiplax farinosa* Krueger, 1902 and *Rhyothemis triangularis* Kirby, 1889, and also mentioned a specimen suspicious to a very improbable *Neurothemis ramburii* (Brauer, 1866).

Hence, to April 2010, 69 species (excluding *T. virginia*, *R. fuliginosa*, *R. regia* and *N. ramburii*) were recorded in the Kingdom of Cambodia, of which presence of *A. occidentale*, *C. octogesima* and *A. gracilis* would better be confirmed. It is striking to what small extent the species lists in the above cited reports overlap, showing how far from saturation our knowledge still is.

Such a paucity of data of Odonata for such a potentially dragonfly-rich country calls for further research. In this situation it was tempting to make several trips to the most promising Cardamonian area in the southwest of the country. The first one has been undertaken in April 2010 and is reported in the following. Some of the sites visited were on protected territories, of regime and borders of which I was not fully informed. Therefore, collections in those areas were restricted to few voucher specimens inevitable for species identification, while specimens identifiable in the field were where possible registered through photographing. The photos are to be soon available at <http://asia-dragonfly>.



net and at my site at <http://pisum.bionet.nsc.ru/kosterin/odonata/odonata.htm>.

### **Area**

First I have to make a reservation on the toponymy. There are two systems of European spelling: that of a French origin with extensive use of diacritical marks and the other, using plain Latin letters (but the spelling is different) and accepted in English literature and road signs. In the latter system the important word denoting a mountain or hill is spelled in two alternative ways: 'phnom' or 'phnum'. Both systems are found in maps (e. g. in the article 'outline of Cambodia' in Wikipedia). Below I will use the latter system (and the version 'phnom'), sometimes referring to the synonyms in the former system.

The coastal regions of Cambodia mostly belong to the Cardamon (or Cardamom, or Kravanh, or Krâvanh) Mts., which stretches from north west to south east, along the coast and its spurs. This is a gentle range with the highest summit of Phnom Aural (1,813 m above sea level) situating quite far away from the sea. The coast along the western part of the main range belongs to Trat Province of Thailand, a situation that makes the western Cardamons within Cambodia scarcely accessible. The 500 m wide stripe of the Cambodian territory along the border was logged, burned out and mined in 1985-1989 according to the so-called 'K5 plan' against Khmer Rouge guerilla based in the Thai territory, that was a big impact upon nature. In Google Earth this stripe is still traced as mostly occupied by arable land. The south eastern offshot of the Cardamons is known as the Elephant Mts. or Dâmrei (Damrei) Mountains: this is quite a high ridge with rather a steep south slope facing the sea and the summit of Phnom Bokor (1,081 m a. s. l.). The Cardamons are mostly formed by sandstone, outcrops of which in the main river valleys form a series of rapids and low waterfalls and look like ladders of almost horizontal dark-grey plates, on the day surface speckled with curious round holes of different sizes formed as a result of erosion with participation of separate stones. In the Koh Por River valley, we noticed presence of some calcareous rocks in some bluffs. On Phnom Bokor, limestone is more extensively present as is well observable in places where road constructions are going on. We also visited the hill at Kep Town (Kep Province) at the very east of the Cambodian coast, which was formed by limestone but does not belong to the Cardamons.

Running along the mountains formed by soft sandstone, the very coast is



extremely flat and filled by alluvium. As a result, the major rivers (from West to East: Koh Por, Tatai, Areng, Preaek Piphat, Srae Ambel, Prek Thom), descending from the Cardamons through rocky valleys, form huge (long and wide) branchy estuaries as they enter the coastal plain, affected by tide and having partly a brackish water. Only at the Thai and Vietnamese borders, at Cham Yeam and Kep, respectively, sandy beaches are found; in the latter case this may be connected with the limestone nature of the coastal hills that form a steeper slope to the sea. All over the region, the ground is represented by red laterites (so that roads in the dry season look like brick graveled with claydite).

Most of the Cardamons are still covered by the primary dipterocarp tropical forest (there is information which I cannot check that this is its second largest primary forest massif in the Indo-Australian region). The higher elevations are occupied by the zone of low and thick mountain forest and even savannah-like open areas on the plateaux. There are forest swamps (most fruitful odonate habitats) and rivers with black water; but this time we did not penetrate so deep into the Cardamons to see these most interesting communities.

There is a great effort to protect these forest massifs which are now attributed to a series of protected areas of different status: Central Cardamonian Protected forest (mostly within Prusac Province), Southern Cardamonian Protected forest (Koh Kong Province), Phnom Samkos Wildlife Sanctuary (Prusac Province), Phnom Aural Wildlife Sanctuary (Kampong Speu Province) and Botum Sokor National Park (Koh Kong Province). With construction of the impressive 1.9 km long bridge (said to be funded mostly by casinos) through the wide estuary of Koh Por (Stung Koh Kong) in 2005, and opening in 2008 of the last bridge at the National Highway 48 (NH48), 'the Cardamonian Road' going through the Cardamons, the area becomes easily accessible and hence very vulnerable. The road surroundings were denoted as 'Koh Kong Conservation Corridor' as logging and other development is prohibited along it; this road serves as the border between Southern Cardamonian Protected forest and Botum Sokor National Park. The entire Elephant Mts. (within Kampong Speu Province) range belongs to Preah Monivong National Park (colloquially known as Bokor National Park). However, the conservation situation of these seemingly unspoilt mountains is alarming. Cambodia suffers from shortage of electric power, so there are plans for the construction of at least three hydropower stations on the Koh Por, Tatai and Srae Ambel rivers. Indeed, construction on the Koh Por has already started by a Chinese company



(blacklisted by conservation organisations), so the once crystal clear water of this river is now brownish.

The flat coast and the estuaries are covered with an enormous area of mangroves. Hence, Koh Kong Province is a unique place in the world where the full catena of biocenoses from hilltops to mangroves is still existing.

The Kampong Saom Peninsula (Kampong Saom or Sihanoukville Province) retains few habitats for wildlife, mostly within the peninsular Ream National Park. The peninsula is occupied by arable and waste lands, oil palm plantations and some eucalypt stands. (Noteworthy and fortunately, there are very few *Gewea* plantations in the entire area.).

The plateau at the top of Elephant Mts. (Kampot Province) is covered with coppice, if not to say elfin wood, of a mountain forest, with participation of small pines. It almost permanently enjoys cool weather and so is being immersed into mist. The top of Pnom Bokor is open with bushes alternating with rocks outcrops and grass/fern/club moss communities looking, especially in mist waves, quite like an alien planet.

Kep (Kep Province) is surrounded with rice fields but the very town is just several streets, hidden among vegetation, along the coast and around the hill, which retain primary forest within a small Kep National Park.

### ***Weather***

We (me and my companion Natalya Priydak) hoped to get to the area at the very beginning of the rainy season. The monthly precipitation for Phnom Penh, as seen in Wikipedia, forms rather a smooth histogram, with 74 mm in April (compare to 40 mm in March, 134 mm in May, 7 mm in January and 257 mm in October); the annual sum is 1,407 mm while the SW slope of the Cardamons gets up to 5,000 mm (the NE slope - just 1,000-1,500 mm). In the Atlas of the Dragonflies of Thailand (Hämäläinen & Pinratana, 1999), the flight period of most of the lotic species was said to start in April. In fact, our visit happened to take place at the very end of the dry season, the hottest period of the year. We had information on the temperature only for April 13 and 14 at Koh Kong, and it was 39 and 37°C, respectively. In fact, this dry season was not like that which can be observed in Central Thailand in midwinter: everything was green, including grass at roadsides and wasting lands; young leaves and sprouts were



seen everywhere on trees; and in almost half of the days (April 14-15 and 17-18) we had have at least some rains, accompanied with thunder, in the evening, while April 19 and 22 were mostly overcast and rainy. But these precipitations resulted just from local evaporation. The dry season was obvious as shown by the shortage of water in even the major rivers, while small rivers and all brooks were entirely dry even in the forest depth, so that some of the scarce demoiselles had to guard dry rocks. At the same time, the rather intense emergence of *Dysphaea gloriosa* Fraser, 1938, *Prodasineura autumnalis* (Fraser, 1922) and two gomphid species witnessed in Koh Kong Province suggests that at least some rheophilic species started getting on wing in advance of the monsoon rains.

Mr. Alan Andrews at Koh Kong informed us that the rain season in the area starts abruptly at any time within the two last weeks of April and first week of May and is manifested by torrential rains which may last for weeks and make forests full of water (so there was some probability for us to catch their onset). The end of the rain season was also told to be more or less abrupt and occurs somewhat around October. At the same time, Dr. Nikolay Doroshenko at Sihanoukville told us that the onset of rains is more or less gradual. The seeming controversy may be interpreted by that Mr. Andrews told us about the very summer monsoon while Mr. Doroshenko meant all precipitation including the local one. Then, it is not excluded that the amount of this local precipitation indeed increases along the coast from north-west (i. e. from Koh Kong) to south east: we saw the rice fields at Tatai village (not far from Koh Kong) to stay absolutely dry while at Kep some were already green and the peasants started to plough up others with buffalo pairs; and a tiny forest brook at the Kep hill had running water.

Anyway, the so contrasted seasons make it difficult to select the best time for an odonatological survey (needless to say it is necessary to make those in different seasons); perhaps this is November, just following the end of the rain season. My next trip is planned at this time. The period of this our visit appeared to be worst with respect of odonates; yet it was interesting to characterise their aspect in this period. Upon these circumstances, we found logical not to attempt long examination of any site but rather to overview in short many sites along the coast to learn what the area is and where it will be convenient to conduct thorough search in future.



**Field notes**

They are delivered below more or less in a geographical (from NW to SE) order, which coincides with the chronological one except for four inversions. Asterisks (\*) indicate species not hitherto recorded for Cambodia at their first record during the trip.

**April 12: Peam Krasaop National Park.**

A sunny and hot day.

In the middle of this sunny and very hot day we entered Cambodia through Cham Yem border pass and proceeded to the Peam Krasaop National Park at the village of Boyeng Kayak or Ang Kayak (pronounced rather as “Ban Kachan” by local people), south of Koh Kong. This national park embraces vast mangroves and has a system of elevated walkways going through (Fig. 1). Insects



**Figure 1. Mangroves as seen from elevated walkways at Peam Krasaop National Park.**

seemed to be very scarce there. There was a road going along an embankment that divides large mangrove trees growing from water and a marsh covered with bushes of another mangrove species; at the end of the road, next to



mangrove trees there was a small marketplace. Right in front of it, three individuals of *\*T. t. euryale* were found foraging until twilight at 17 hr. They were identified visually by the narrow triangular dark basal wing spot. Not a single dragonfly was observed elsewhere above the road. I passed along it towards the village. The marshy land was divided into squares by high roads accompanied with ditches, it looked once inhabited but abandoned. At ca 16:30 I reached an area covered with dense thickets of bushes and high halophytic *Acropteris* ferns and scarce tall 'normal' trees (Fig. 2) and found a



**Figure 2. Transition from halophytic shrubbery to forest at Boyen Kayak village, where first common dragonflies appeared.**

path through. Going for some distance, I saw a female *T. tillarga* (Fig. 3, right below) and a male *N. fluctuans* (Fig. 3, left and right above). At the very village I found a small pond with grassy banks looking good for *Agriocnemis*, but there



were only another male of *N. fluctuans*. All the area looked more or less saline; not a single odonate of quite a number of species adapted to such habitats was observed and the few ones encountered were most probably migrants from mainland.



Figure 3. Common dragonflies seen at transition from halophytic shrubbery to forest at Boyen Kayak village: left and right above, male *Neurothemis fulvia*; right below, female *Tholymis tillarga*).

#### April 14. Surroundings of Koh Kong.

A sunny and hot (+37°C) day, with some thunder and several raindrops in twilight.

This day surprisingly appeared to be the Khmer New Year. Children and foreigners painted faces with a white dye and children poured water over passers-by. We rented a motorbike and inspected the town of Koh Kong (Krong Koh Kong, or Koah Kong) and its surroundings. Above street No. 3 an individual of *R. phyllis* or *variegata* was fluttering. We visited one of the first outposts of saline marshes on the way to Peam Krasaop, near the Muslim cemetery, being a shallow, half-dried pool with some *Eleocharis*-like rush and



some Cyperaceae with partly sandy, partly muddy banks somewhere tinted white with salt, surrounding by shrubbery. No odonates were present. A roadside ditch with grassy banks at the southern margin of Koh Kong offered a common set of secondary habitat dragonfly species: *N. tullia* numerous, *N. fluctuans* second abundant (females were also seen), *C. servilia* and *B. chalybea* abundant, there was one individual of *R. phyllis* or *variegata*? and *A. panorpoides*; at the same time, of damselflies only a female *I. senegalensis* was collected.

There was a good series of different pools and shallow ponds aside the main road to Phnom Penh (NH48), left after ground excavation during the road construction, mostly with grassy banks or even emerging grass. The most abundant species at all of examined ponds were *N. tullia* and *C. cerinorubellum*. At seemingly the best habitat, a large grassy wetland with floating (quaking) bog that appeared to hide some large waders, these two species were the only odonates found. At other pools examined, *N. fluctuans* and *D. trivialis* were added. On a medium-sized pool with emergent grass, *D. nebulosa* were common and a male *T. pallidinervis* was perching on a stalk; there I also collected a female *T. tillarga*.

We proceeded to the bridge to a river arm, surrounded by tree mangroves, with participation of the *Nypa fruticans* palm, emerging from mud with some pools. At the edge of these mangroves we at last saw dragonflies: just several *D. trivialis*. They were also present at a nearby large, open almost dried marsh with sedge tussocks (Fig. 4), where I collected a mature (with blue ground colour) male of *A. borneense*, the only specimen of this common dry season species of our trip. Behind the bridge, the road started to ascend gently; it was surrounded by a grassy marsh (no odonates) and accompanied at its side by a tiny brook flowing among tall grass through a series of shallowest pools. There I found, at last, such usually common species as *I. senegalensis*, *A. pygmaea*, *O. sabina* (each represented by one male) and of course the actually common *C. cerinorubellum*, *N. tullia* and *N. fluctuans*.





**Figure 4.** A dried marsh at mangroves along a river arm 4 km SEE of Koh Kong, where *Aciagrion borneense* and *Diplacodes trivialis* occurred.

### **April 13. Koh Por Waterfalls.**

A sunny and extremely hot (+39°C) day.

This was our first trip into the vast primary forests on the Cardamon foothills. We hired a motor boat with a boatman and for an hour went upstream the huge estuary of Stung Koh Kong. Its flat banks were for long distance covered with mangroves, with very abundant *Nypa*, while the surrounding hills were covered with vibrant primary forests. Population was very scarce: few fishermen huts and one village. After quite a distance the estuary narrowed and the forest descended to the very banks where sandstone rocks appeared. We passed a pier from where a dreadful large red road started, recently made to the dam being constructed upstream, 6 km NNW. Then we passed the junction of two large rivers and entered the left one Koh Por (none of the maps we got provided names for rivers, even large ones). Soon, at ca 9:40, the



navigable part of the river ended: we arrived to our destination, giant sandstone plates upon which the river descended through rapids. The river had not so much water, which had a brownish colour due to the dam construction upstream. There were two series of low waterfalls (Fig. 5) in about



**Figure 5. The lower Koh Por Waterfall.**

1.5 km from each other. The rocky valley was very wide, the huge sandstone plates supported sparse bush vegetation, where *Melastoma* (which was intensively flowering), and some Myrtaceae (?*Acmena*, with white inflorescences somewhat resembling *Ledum*) and some others, being most conspicuous. Many bushes resembled willows to some extent, and from the first glance this large mountain river valley resembled one in high latitudes, but the jungle on the slopes left no doubts where we were.





Figure 6. *Orthetrum chrysis*, males, at the lower Koh Por Waterfall.

Within 9:40-16:00 we examined the valley between the lowermost rocks to the second waterfall step and the lowermost valley of the left tributary of the main river. There were few worn out butterflies. Noteworthy there were no mud-puddling butterfly males on the moist ground (bare one *Euploea* sp.) indicating the males did not need any more salt for the sperm formation, that is, their breeding season had been ceased. Odonates were not abundant either. Most common were libellulid males that were guarding sandstone plates with round holes filled with black water. Of those, most numerous were \**Orthetrum chrysis* (Selys, 1891), equally frequently perching on branches or stone surface (Fig. 6). Less abundant but common were *T. aurora*, followed by the very bright (that is fully mature) males of \**Lathrecista asiatica* (Fabricius, 1798), which perched only on dry branches (Fig. 7). *N. fluctuans* were quite





Figure 7. *Lathrecista asiatica*, a male, at the lower Koh Por Waterfall.



common everywhere and *N. fulvia* less frequent (Fig. 8); these two species did not seem to guard water holes or their vicinity. Twice on a dry rocky bed I noticed *O. sabina*; and saw, quite repeatedly for a long time, at least one individual of *P. flavescens* soaring over broad heated rocks.

Figure 8. *Neurothemis fulvia*, a male, at the lower Koh Por Waterfall.



Several times in the morning and a couple of times in the midday, from bushes growing on side rock plates of the valley we scared teneral medium-sized odonates which flew to higher tree branches and escaped from the net. Once I noticed what I thought to be a brown hawk fly having captured such a teneral dragonfly and sat on a bush branch, and spotted them. In fact it appeared to be a male *Dysphaea gloriosa* that had captured a very teneral, soft and not yet coloured, female of the same species. Hence these were *D. gloriosa* that emerged quite actively. Meanwhile mature males of this species appeared to perch on boulders or sticks (with about the same frequency) near or among the troubled river waters. They showed impressive saturated colours between deep amber and ebony, but not yet a full extension of the body pattern suggesting they were young. They were quite alert: attempts to photograph a male made him fly for several metres for another perch, until I found that I followed the male over and over along the same chain of perches. This was exactly the behaviour described for males of *Bayadera* and *Dysphaea* by Fraser (1934). Another species frequently seen near the river was *Prodasineura*, represented by very soft teneral individuals flying from water weakly but quite high in the air. I collected one female which was too teneral to identify by coloration and the shape of prothorax, which was rather deformed, but this must be *P. autumnalis* found later, also emerging, in other localities of Koh Kong Province.



Figure 9. Exuviae of *Zygonyx iris malayana* on the cellar of a niche behind the lower Koh Por Waterfall.



There were also remnants of unseen species. The lower waterfall fell from a very broad horizontal sandstone plate hanging over large niches. The river itself was not so broad this time but should be much wider in summer. On the horizontal ceiling of the largest niche, formed by the mentioned plate, there were attached about 10 exuviae of *Zygonyx*, which must be *\*Zygonyx iris malayana* Laidlaw, 1902 (Fig. 9). They were old and mostly broke when collected. They should have been preserved when the river was broader and the niche was behind the waterfall; most probably they retained while the dragonflies themselves ended their life. At the same time, on a horizontal slimy surface of a wet stone near the actual waterfall there was one exuvia of a small gomphid; it could not 'survive' higher water levels as situated in the close vicinity of the torrent and was obviously fresh.



**Figure 10. Habitat of *Coeliccia kazu-koae*: a shady rock sipping with water at Koh Por Waterfalls.**



The left valley board at the lowermost rapids had two high shady bluffs seeping with water. One was small, hidden in vegetation, formed by rocks and ground (Fig. 10). In its lower part I found two males of *C. kazukoae* (Fig. 11). As



**Figure 11.** *Coelliccia kazukoae*, a male, at a shady rock sipping with water (Fig. 10) at Koh Por Waterfalls.

typical for the genus, they perched on leaf tips close to the ground, made very short hunting flights and were not at all cautious. Nearby I collected a mature male of *\*Copera vittata* (Selys, 1863). The other bluff was large and rather open. Although looking very promising, it provided no odonates, perhaps due to being too open.



Just downstream the lower waterfall the Koh Por River accepted a smaller left tributary with crystal clear water flowing as rapids in a similar sandstone bed. We examined it for several hundred metres and observed several males of *D. gloriosa*.

#### **April 17. Tatai Waterfall.**

A hot overcast (*Stratus*) day, rain at sunset, lightings seen in the night sky.

In the morning we walked for 3 km along NH48 from Phnom Doung Bridge to the Tatai Waterfall on the Right Tatai River. Due to the New Year holidays, numerous cars went to the waterfall that consequently was rather crowded by local people and piled with rubbish. The waterfall appeared to be rather an impressive cascade over huge sandstone rocks (Fig. 12), below which the river



**Figure 12. Tatai Waterfall.**

soon becomes smooth and accessible by boat. The water in the river was very warm. So weird: in pools beneath the waterfall it became really hot at the bottom and in crevices between boulders, because the huge rock massive was heated by sun (hidden behind thin *Stratus* clouds!). This high temperature,



decreasing the amount of dissolved oxygen, should be undesirable for odonate larvae. We saw only the regular *D. gloriosa* males on boulders, *O. chrysis* males at pools on rocks, *N. fluctuans* of both sexes and one *N. fulvia* at the jungle margin at banks. Over wide rocks above the waterfall there were quite a few *P. flavescens* soaring, and one tandem oviposited into a pool.

The ground road leading from the main road to the waterfalls crossed valleys of two brooks, and the third brook was found somewhat behind the turn to the very waterfalls. These brooks appeared to be much more interesting than the waterfall itself. The first of them was 'alive' as having quite an amount of running water; upstream crossing the road through a concrete tube it formed a chain of muddy pools overshadowed by secondary forest and low *Pandanus*. There were a male *V. gracilis*, several *N. fluctuans*, a male *O. chrysis* and we saw a blue male *Pseudagrion* sp., which escaped, and collected a teneral female of *P. autumnalis* (this time allowing identification). On the tube a male



Figure 13. *Trithemis festiva*, a male, at the 'brook 1' at Tatai Waterfall.

of *T. festiva* perched (Fig. 13; the only individual seen during the trip). Downstream the road, the brook descended over an impressive sandstone bed



which formed several steps with small waterfalls, surrounded mostly with tall bamboo (Fig. 14). The only odonate found there was a male of *Euphaea masoni* Selys, 1859 perching on dead branches or thin lianas hanging from tree crowns (Fig. 15).



**Figure 14.** A shady valley of 'brook 1' 2 km SE of Tatai Waterfall.

The second brook had no running water. Its partly rocky, partly muddy, valley with some large pools lead into the depth of primary forest. In such a place I captured a couple of rival males of *C. vittata* and a female *V. gracilis*. The third brook also had no running water but its valley more resembled that of the first one – a shady part above the road and a rocky part beneath it (with a very large pool among the rocks). At the shady pool there was a male *V. gracilis*, perching on a stick.



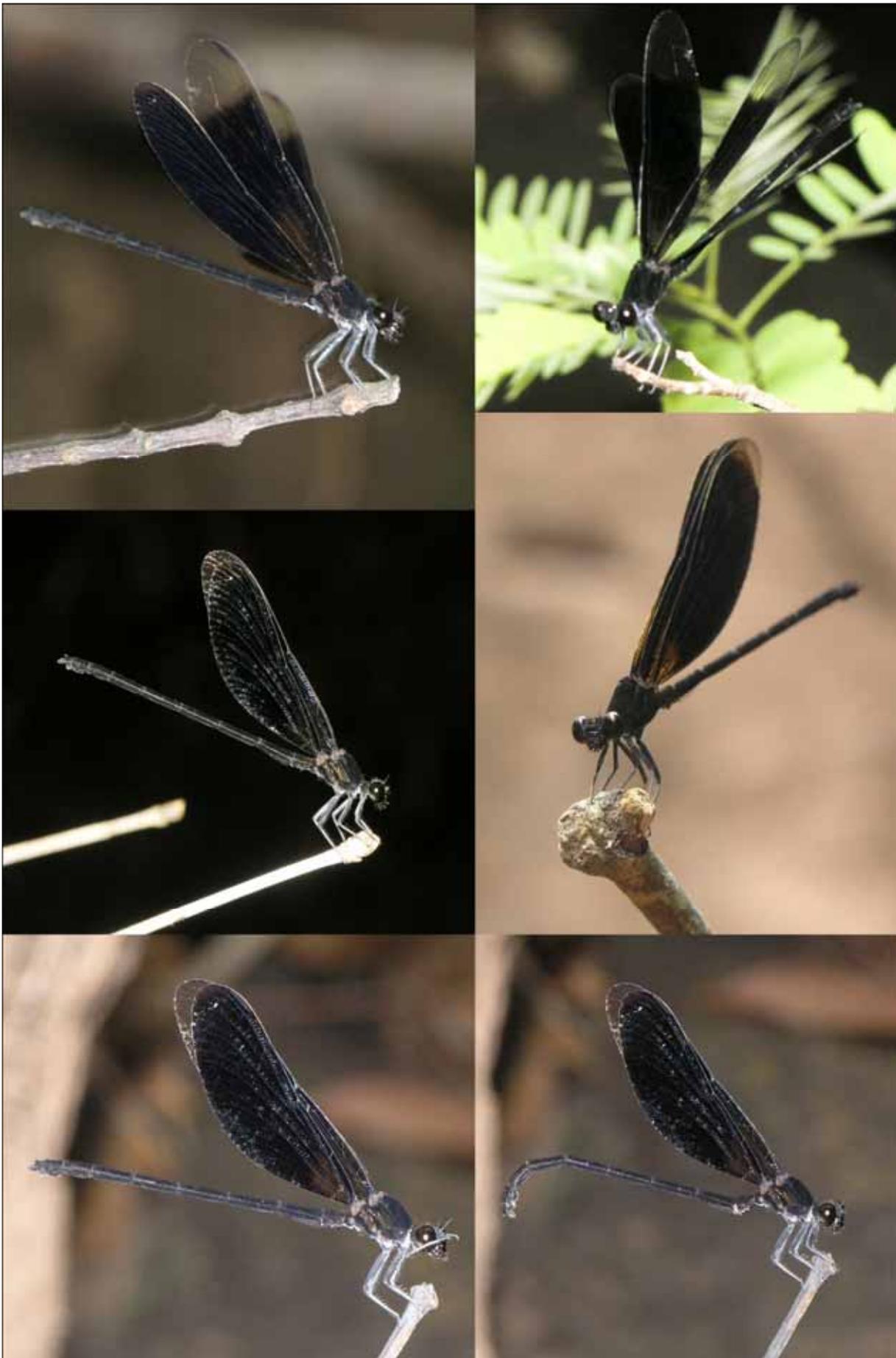


Figure 15. *Euphaea masoni*, a male, at 'brook 1' 2 km SE of Tatai Waterfall (Fig. 14).



At the open pool near the water there were a male *L. asiatica*, perching on a stick as obligatory for the species, and here and on the rocky part there were several males of *O. chrysis*. In all parts several *N. fluctuans* and one *N. fulvia* occurred.

#### **April 16. Left Tatai River.**

A sunny and hot day.

This day we moved to Tatai (Totay) village at Phnom Doung Bridge through Tatai River and were accommodated for three nights at Nature Waterways Resort held by Andy Schneidegger: a nice complex (to be expanded) of two bungaloes, bar, school class room, kitchen and garage under the same roof just aside of a hill slope covered with a primary forest and with a large-stone scree of a temporal waterfall bed (now without water). Just upstream the bridge two equally large Tatai Rivers join each other.

The second half of the day, ca 14:30-18:30 was devoted to an upstream excursion along the left bank of the Left Tatai River. The valley boards were, as everywhere in this area, covered with an intact dipterocarp forest. The rather narrow flat river terrace was explored by the village dwellers and occupied by rice fields, this time dry and empty, with small buffalo herds grazing on very scarce grass; and partly by thorny secondary vegetation. The land along the bank was shaded by coconut palms, bananas and other trees, among which a few houses were hidden. The very bank was formed with arboreal vegetation that looked quite natural (Fig. 16). There were no mangroves, but *Nypa* occurred frequently (Fig. 16, below). The water was very clear and fresh, not brackish and very warm, if not say hot - about body temperature, without a noticeable current. Not a single odonate was seen. Odonates started to occur only at beds of several temporary brooks situated among secondary vegetation at the end of the explored land. At that season, the brooks had muddy beds with separate shallow pools, shaded with bamboo and some *Pandanus*. We examined one of them thoroughly. In shade there were *V. gracilis*, at pools *O. chrysis* and *T. aurora*; at any place *N. fluctuans*, *D. trivialis* and less frequently *N. fulvia*. At a shaded place at one large pool I saw a blue *Pseudagrion* male but failed to catch it, at another I saw a large aeshnid, probably *A. guttatus*, which flew fast just above the surface and disappeared.

In twilight we went back along the road through the rice fields and a chain of small and very dirty cattle ponds. As it became darker, more and more indi-





Figure 16. The Rivers of Joint Tatai (above) and Left Tatai (below) at Phnom DOUNG Bridge.



viduals of *T. tillarga* of both sexes appeared to swiftly fly over the surface of these cattle ponds.

### **April 18. Valleys of two temporary rivulets downstream Phnom Doung bridge.**

A hot sunny day, rain with thunder at sunset, lightings seen in the night sky.

The terrace of our resort was situated at the edge of a steep scree of huge sandstone boulders, too steep and large to climb up, where a small waterfall appears in the rainy season. At these boulders several *N. fluctuans* of both sexes were repeatedly observed, and a male *N. fulvia*. They might have developed in a pond with grassy banks situated at the slope foot below the boulders. It looked quite suitable for various odonates but examination provided only several *D. trivialis* seen. Along the boulder scree, a path led up the steep forested slope and entered the rocky bed, which soon turned less steep and quite permeable. This provided us a good opportunity to penetrate into a primary forest on a mountain slope and to examine a valley of a temporary torrent. This excursion undertaken within ca 8:30-12:00, brought some rather unexpected species. In the morning we climbed up that path through the forest. First I scared from a bush a grey *Gynacantha*-looking aeshnid, which sat on another thin trunk nearby but appeared too alert to be captured. Natalya, who followed behind me, noticed and captured a very slender saturated blue coenagrionid sitting low on a bush branch in shade. It appeared to be a male *Aciagrion* cf. *pallidum* (see below). She proceeded following me and soon she noticed and captured another male of this species, which again I had failed to see. As we proceeded upwards, the boulder scree changed for a ladder of solid rock outcrops (Fig. 17). Here we found *V. gracilis*, as usually hiding in shade. At that place, rich in wet rocky bluffs but at a very small (several dozens of cm) ground bluff in deep shade, I managed to notice a male *C. kazukoae*. Then we entered a long section of an appearance common in this area, that the bed was formed by rather horizontal sandstone plates. There we found the only pool with dark water above the rock. On a thin liana hanging above it, a male *B. oculata* (Fig. 18) perched very steadily while two males of *O. chrysis*, a species invariably found in such habitats, ranged nearby. I collected *B. oculata* and soon the male *O. chrysis* occupied the vacant liana. Nearby I found a male *L. asiatica*. We proceeded further, the rocky bed branched into two narrower tributaries and one of them soon crossed a sunny clearing overgrown with bamboo. At the path going through it, I found three





**Figure 17. Dry valley of a temporary above Nature Waterways Resort at Phnom Doung Bridge.**





Figure 18. *Brachygonia oculata*, a male, at a dry valley of a temporary above Nature Waterways Resort at Phnom Doung Bridge (Fig. 17).



Figure 19. *Neurothemis intermedia atalanta*, a male left, a female right, at a sunny clearing in a forest above Nature Waterways Resort at Phnom Doung Bridge.



perching dragonflies: an androchromic female of *R. variegata* and a male (Fig. 19, left) and female (Fig. 19, right) of *N. i. atalanta*. It was curious that these male and female were found near each other and these were the only individuals of this common species observed during our entire trip.

In the afternoon (ca 14:00-17:00) we made an excursion downstream the joint Tatai on a Cambodian traditional long tented wooden boat with an oar-motor. First we had to wait for an hour until the water rose to a level allowing the boat to enter the river from its narrow 'avantport'; hence we learned that the river at our point was affected by tide and was in fact an estuary. We went downstream to a place where the estuary branched into two large arms embracing a large island, entered the left arm, went around the island and back along the right arm. All along our route there were few signs of human presence, like coconut palms and solitary huts here and there at the banks, while most of the banks were overgrown by natural vegetation, with quite abundant



**Figure 20. *Libellago hyalina*, a male, at a temporary brook valley downstream Phnom DOUNG Bridge (Fig. 21).**



*Nypa* and first sparse mangroves appearing. The low hills of a broad valley were entirely covered with primary forest. We stopped at one place, near some dwelling and observed numerous *N. fluctuans* of both sexes on branches hanging above the water, which was already salty by the way.



Figure 21. Dry valley of a temporary brook downstream of Phnom Doung Bridge; a habitat of *Libellago hyalina*, *Euphaea masoni*, *Vestalis gracilis*.



On the way back we stopped at another place on the right bank, already not far from the bridge. There was a broad brook valley came from the forest and opened to the estuary (where the water appeared salty as well, that lead us to a supposition that the river salinity is variable at our place due to tide), of a common appearance as its bed was formed by huge flat sandstone rocks but that time without any water (Fig. 21). This valley provided some surprise: not far from the estuary bank, there was a bamboo branch hanging over the rocky bank, on which a male *L. hyalina* perched (Fig. 20) at about 2 m above the ground. When it was captured, the branch was soon occupied by a female *E. masoni* (Fig. 22). A female *L. hyalina* was found nearby. At bushes at sides of the bed, a male and female of *V. gracilis* were observed. So, three demoiselle species, including a tiny *Libellago*, had to guard an absolutely dry brook bed awaiting the rainy season.



Figure 22. *Euphaea masoni*, a female, at a temporary brook valley downstream Phnom DOUNG Bridge (Fig. 21).

#### April 15. Thma Bang.

A hot day, at about 16 hr clouds start gathering at NE, a weak rain with thunder at sunset.



Thanks to enthusiasm and hospitality of a great Nature lover, Mr. Alan Andrews and accompanied by his friend Mr. Alan Hanvey, we undertook a motor-bike trip to Thma Bang village. This was quite an immersion into the primary forests in the depth of the gentle Cardamon Mts. A road to Thma Bang branched north from NH48 soon after the Phnom Daung Bridge through the Tatai River, and everybody going along it have to be registered at the rangers' checkpoint there. The Thma Bang village was situated at rather an elevated place, surrounded by some plantations of banana, sugar cane etc. and embraced by jungles. The Thma Bang River valley is situated below: a human dwelling cannot be situated near a mountain river in that region.

First we examined a left tributary of the Thma Bang River (7 km SW of Thma Bang village centre), at two very close but quite different sections. One was rather a deep (1.5-2 m or more) and about 10-15 m wide reach situated just downstream of the bridge of the road to Thma Bang (Fig. 23, right); we were there at 12-13 hr. It was almost without current, of a comfortable (~25°C) temperature and with partly sandy, partly rocky ground with some logs. The banks were covered with primary forest, the trees hanging over the water; immediately near which some elephant-ear (*Alocasia* or *Colocasia*; in more open places) and *Pandanus* (in more shady places) being quite abundant. It was a rich place for odonates. The only shallow sandy bank at the bridge was patrolled by two males of *T. aurora* and two males of *D. gloriosa* (Fig. 24). Other males of *D. gloriosa* were found perching on branches on banks or of emerging inundated logs. On such emerging branches we found a male and then a female of *H. perforata*. On some hydrophyte plant floating among open water we witnessed emergence from larva of a male *D. gloriosa* (Fig. 25). There were quite a number of males of *P. willamsoni* and several *P. rubriceps*. As well abundant were \**P. autumnalis*, both teneral and matures. The latter used to hover over the water, as it is habitual for the genus, and used to land on a hand if stretched up from water. One bank patch near the water was overgrown with small-leafed Poaceae grass, and in this habitat usual for the species, a male *C. ciliata* was found out. Most interesting was a small teneral male of *Microgomphus* sp. scared from bank vegetation and spotted. It was still colourless but in captivity matured to normal coloration. The habitat fitted perfectly Fraser's statement concerning this genus: "The larvae breed in deep pools in submontane streams flowing through heavy primary jungle" (Fraser, 1936: 352). As elsewhere, several individuals of *N. fluctuans* were observed. Just upstream from the same bridge the river valley turned absolutely



different. Its bed was formed by huge and entire flat sandstone rock, over which the river either flowed as a very small brook in this season; the valley was mostly open and only partly shaded by solitary huge trees (Fig. 23, left). In



Figure 23. Valley of the Thma Bang River tributary 7 km SW of Thma Bang village centre; downstream (left) and upstream (right) of the bridge. Upstream: habitat of *Dysphaea gloriosa*, *Heliocypha perforata limbata*, *Prodasineura autumnalis*, *Microgomphus* sp., etc. Downstream: habitat of *Neurobasis chinensis*, *Vestalis gracilis*, *D. gloriosa*, *H. p. limbata*.



Figure 24. *Dysphaea gloriosa*, a male, at the Thma Bang River tributary 7 km SW of Thma Bang village centre; just upstream the bridge (Fig. 23, right).





a small area of several square metres under one of those, we found simultaneously a male and female of *\*Neurobasis chinensis* (Linnaeus, 1758), a male *H. perforata limbata* (Selys, 1879) and a male *\*E. masoni*. At another shady place there was a male *V. gracilis*. At the open sections, only a regular male of *D. gloriosa* was seen (Fig. 24, 25), and some unidentified large aeshnid flew by swiftly and low above the rock. In fact, the shade was not so important at the time of our observations there, ca 15:30-16:00, since the sun hid behind a thunderstorm cloud, but the shade-like demoiselles were still kept beneath trees.

**Figure 25. Emergency of a male *Dysphaea gloriosa* at the Thma Bang River tributary 7 km SW of Thma Bang village centre; upstream the bridge (Fig. 23, right).**



The Thma Bang River itself was examined upstream the waterfall (which we did not visit), 5 km SW of Thma Bang village centre. There, the river formed a kind of rather deep lake, without observable current, surrounded by large sandstone rocks and boulders, and then by forest (Fig. 26). We were there at ca 14:30-15:20, when the weather was already overcast. There were several *D. gloriosa* males on the boulders; several *N. fluctuans* and a male *N. fulvia* were found at bushes at the bank, and a male *V. gracilis* hid in shade behind the bushes. I went along the banks and chased 6 teneral *Burmagomphus* sp. from boulders and herbs (one with the pattern already formed but brown). To my surprise, all of them appeared to be females.



Figure 26. The Thma Bang River valley upstream the waterfall; habitat of *Burmagomphus* sp.

Noteworthy was absence of *O. chrysis* (as well as any other *Orthetrum*). Of all places visited by us in Cambodia, the Thma Bang River and its tributaries appeared most rich in demoiselles and provided the only gomphids. Generally, this trip was among the happiest days in my life.



### April 19. Kbal Chhay Cascades.

An overcast day, moderate temperature, a weak rain in the morning, a shower at midday at Sihanoukville, then the sky cleared.

In the morning we left Tatai village to Sihanoukville by bus which went along the excellent Cardamonian road allowing us to peer on primary forests on both sides of the road, continuing to smooth mountains on the horizon. In the afternoon we undertook a trip to Kbal Chhay cascades 12 km NE of Sihanoukville. The area in general was rather unpleasant: arable or waste lands, settlements. We turned northwards from the national road NH4 for a red unpaved road, rather slippery after the rain, which was surrounded mostly by alien eucalypt stands, to a large extent burnt out. Close to our destination we witnessed large areas of logged and burnt forest and dammed river, to form vast area of mud, obviously prepared for some construction. The cascades themselves were surprisingly impressive (Fig. 27) but overcrowded by local tourists



Figure 27. Kbal Chhay Cascades.

and spoilt by numerous resting platforms constructed for their convenience. Unfortunately, we arrived there too late in day (ca 16 hr) to see many dra-



gonflies. There were various sandstone rocks and bluffs seeping with water but no characteristic damselflies were found. The river was surrounded by secondary coppice with abundant bamboo and open areas with thick *Gleicheniaceae* ferns. Walking for some distance along a path through such coppice above the river left bank, we chased off a grey *Gynacantha*-looking aeshnid, as a day before. The main river accepted a smaller left tributary with crystal clear water. The last hundred of metres it flowed rather fast through an open area above the entirely sandstone bed. Here three dragonfly species were quite abundant: *T. aurora* (Fig. 28, right), *B. contaminata* (Fig. 28, left) and *D. trivialis*. *B. contaminata* was rather surprising, as I expected it in more muddy and



Figure 28. Common dragonfly species at Kbal Chhay Cascades: left, *Brachythemis contaminata*, a female; right, *Trithemis aurora*, a male.

lentic habitats. Further upstream the river became very slow and deep (1-1.2 m), shaded with stripes of rich vegetation of trees, bamboos and *Pandanus* (I saw a *Nepenthes* plant with some pitchers floating in river). The bed was partly rocky and partly sandy. This river appeared quite interesting as to odonates. Twice I saw an aeshnid fast passed by low above the water. Then I captured a female *Euphaea* sp. (see below), which perched on a bamboo branch hanging above the water at a steep bank. I descended to water, went for about 100 m along the river and collected above the water two males of *P. williamsoni* and observed several *V. gracilis* on the bank vegetation. We went back already in twilight (ca 17:50) and saw *T. tillarga* appearing flying fast above shallows of the main river above the rocky bed. This day we first encountered terrestrial



leeches, two having bitten my foot and one Natalya's; their occurrence was not surprising after the considerable rain. Although being a small refuge of natural habitats and too heavily used for recreation, the place deserved much more than two hours of superficial observations.

#### **April 20. Ream National Park.**

A sunny and very hot day, no precipitation.

In the morning we left for the Ream National Park about 15 km SE of Sihanoukville (twice as long along the road) and spent the daytime (ca 12:30-16:20) mostly at the recreation centre. The park occupies a hilly peninsula covered with a primary forest. Curiously, the Lonely Planet guide for Cambodia specially mentions: "All sorts of gleaming damselflies make their home in the park, too" (Ray & Robinson, 2008: 214). At the recreation centre there was a large artificial pond, this time with very small amount of water so that it did not cover about half of its surface opening a reddish muddy bottom. In spite of this unpleasant appearance, the pond appeared rich in dragonflies. Two males of *H. croceus* ranged above the water. On some of the rare sticks, there perched a male of *Ictinogomphus* sp. (*I. d. melaenops* being the most likely species) and 2 males of *T. pallidinervis*. On the muddy ground nearby, an individual of *O. sabina* was observed. Above the pond, there was a sandstone bed of a temporary forest brook, of a common type, but in its lowest part a tiny spring with reddish water appeared from the ground. Odonates found there were expectable as well: two males of *O. chrysis* at the sunny pools at a spring at least two *V. gracilis* in dry shady places. At a small shaded wet ground bluff near the spring there were 2 males of *C. kazukoae* and a male of *C. vittata*.

Parallel to this valley an asphalted road went. Above the road, a lonely *P. flavescens* ranged, with the abdomen slightly hanging down as it happens at too high aerial temperature. On a forest margin near the road, rather high in the coppice foliage, I collected a tandem of 'an arboreal' damselfly \**Onychargia atrocyana* (Selys, 1865). The male that was not fully mature as it still had its yellow thoracic pattern. Besides, there was a group of 3 individuals of small golden-black \**Rhyothemis obsolescens* Kirby, 1889. They mostly sat high in tree crowns but once two of them descended to lower bushes and I managed to photograph a female (Fig. 29). Unfortunately, I twice failed to capture a specimen since my reaction was slowed down by the hardly bearable heat. Two individuals of *R. obsolescens* were also observed at bushes of secondary



coppice between the pond and forest, along with a female of *R. rufa* and many *N. fluctuans* of both sexes.



Figure 29. *Rhyothemis obsolescens*, a female, at Ream National Park, Recreation Centre.

The road went by an impressive newly built wat (a Buddhist temple) to the National park headquarters, where, accompanied by a ranger, we visited the Andoung Tuek waterfalls (not to be confused with a village in Koh Kong Province with the same name). The path first went through a rich primary forest, but we saw no odonates but one *V. gracilis* in a small dry valley, overgrown with bamboo. Then we came to a plateau occupied by weirdly shaped



sandstone outcrops, with sparse stand of very low trees. There were no water in the waterfalls but in several holes; needless to say, there were three males of *O. chrysis* nearby (Fig. 30).



Figure 30. *Orthetrum chrysis*, a male, at Andoung Tuek Waterfall in Ream National Park.

### April 23. Phnom Bokor.

A hot and sunny day, but it was cool and misty atop, as it should be.

In Sihanoukville we failed to arrange an excursion to the Bokor Hill and on April 21 went directly to Kep. From there we could arrange a day-long tour on April 23, that implied only two hours spent atop. The tour was curiously arranged. A minibus picked up participants from all over the town of Kampot and then carried them to the foothill. There we moved to an open vehicle and a ranger, armed with Kalashnikov, joined us. The vehicle went for some distance along the road being reconstructed by the Soha company that is going to construct luxury hotels and golf fields on the hill. The new asphalt road was excellent and the reconstruction impressive: the scarped ground on slopes was recovered with lawn mats, which were watered from pipes by road workers, and adorned with flowering bushes. At some point the tourists were dis-



embarked and had to climb, using all the four limbs, up a pretty steep slope covered by luxuriant forest for 2.5 hours, by a prepared but still difficult path, of course accompanied with the armed ranger. This was a hard, funny and interesting journey but without odonates. The destination was the same road, still not reconstructed, where we were met by the same vehicle and continued our way to Bokor Hill Station aboard it. Our way back was arranged in the same way. We were said that the road section we skipped through the jungles was not too bad but presence of 'the westernise' is strictly forbidden there. We had only to guess what Soha could hide there.



**Figure 31. The surroundings of Bokor Hill Station.**

The natural conditions (Fig. 31) on the plateau differed drastically from the southern slope we climbed upon, which was like all other slopes we had experience before: tall diverse forest and hot air. The plateau was covered with low but very thick coppice made with thin and winding trees, which could be called an elfin wood. Among them, thin pines were seen here and there but we had no time to examine them closely. These thickets were immersed into clouds of fast going mist, and the air was fairly cool. Active road construction, rock crushing and digging was going on in many places along the road. I tried to trace water bodies but only short before the Bokor Hill Station we crossed



two small brooks. We were carried to the notorious 'Black Palace', ruins of a French casino, and for a period between 12:00-14:00 were left to wander freely, without any guide. This was what I needed, but the time span allowed was too short, and I had to act as a kind of a specialised odonate-searching robot.

'Bokor Hill Station' consists of a group of ruins of a French luxury town built in 20s of XX century (casino, church, hospital, villas etc.) and the recently built headquarters of the National Park. They reside on the Phnom Bokor top, being an open plateau with a forested sheer slope, good for gamblers committing suicide. The plateau is occupied by alternating flat rocks, shrubbery, patches grown up with ferns or club-mosses, and grassy boglet and seepages. They are immersed into wandering mists, with the sun appearing for several minutes, and inspire connotations about an alien planet. In spite of presence of small



Figure 32. Common Odonata species at Bokor Hill Station: top left, *Diplacodes nebulosa*, a female; bottom left, *Trithemis aurora*, a young male; top right, *Ceriagrion cerinorubellum*, a male; bottom right, *Neurothemis tullia*, a male.



grassy wetlands, the place seemed almost devoid of local odonates. Only at one tiny brook between two grassy boglets I found a male of *C. cerinorubellum* (Fig 32, top right). In the air, individuals of *P. flavescens* were seen repeatedly, while at the lee sides of each ruined building they formed huge swarms of many dozens of individuals. In such a swarm closest to the pond, I recognised a gynochromic female *R. variegata* participating. The mentioned pond was large, artificially encarved in limestone near the Park headquarters, with the banks formed by piled stones (Fig. 31, top left). There were quite a few of common odonate species, although their composition looked somewhat strange. The most abundant dragonfly was *T. aurora*. The males perched on stones and stalks, and in a nearby grass I found a fresh, still rust-coloured one (Fig. 32, bottom left). A cautious male *T. pallidinervis* perched on a stalk. The bank was patrolled by *A. guttatus*. Several tiny brooks entered the pond, forming small grassy boglets at the very bank. On such boglets, I recorded a male and female of *D. nebulosa* (Fig. 32, top left) and several individuals of *N. tullia* (Fig. 32, bottom right).

From the pond I went back the road. There was a kind of a large wetland formed by wet ground, somewhere with current water, overgrown with sparse Juncaceae rush), over which workers carried out some construction. They obviously lived in a strange square 2-floored hostel near the road. Just behind the road from that building, there was very dense coppice, under which many small seepages joined to produce quite a brook. In the shade of the coppice, three *V. gracilis* individuals were found at the brook; and at their margin a male of the omnipresent *N. fluctuans*. The brook soon crossed the solid stripe of thickets and common sandstone plates appeared along its course (Fig. 31, bottom right). Naturally, a male *O. chrysis* was immediately met. So, only common odonates were seen, until an unidentified medium-sized gomphid was seen to sit on a rock just to disappear immediately. This should be some interesting species, as most of the gomphid are, and especially should be in such an unusual place. But it was right the time to depart...

Phnom Bokor must be examined much more thoroughly.

#### **April 21-22. Kep and surroundings.**

April 21: hot and sunny; April 22: mostly overcast, a weak rain at midday, then the sun appeared. We visited the most interesting habitats in Kep for both days spent there so it worth to report the results altogether.

On coastal lowland, just a couple of streets from the sea, there was a large



shallow pond with almost hot water, overgrown with richly flowering *Ludwigia adscendens*. It was visited on April 21 between ca. 12:30-13:00 at sunny weather and on April 22 at ca. 15:10-16:00 at overcast weather. There was a number of common lotic species: abundant *C. servilia*, quite common *B. chalybea* and *A. panorpoides*, rather scarce *B. contaminata* (1 male seen) *N. tullia* (2 males seen), *O. sabina* (2 seen), *R. phyllis* or *variegata*? (1 seen), *P. congener* (1 male seen, fig. 33); *A. guttatus* (at least 1 ranging male) and *I. senegalensis* (a male and female seen; the second and last sighting all over the trip), and one species that is not so common elsewhere but was already recorded for Cambodia: *Ceriagrion malaisei* Schmidt, 1964. Only males (Fig. 34), quite common, were seen above the emerging vegetation in the sun and in bushes at banks when overcast.



**Figure 33.** *Potamarcha congener*, a male, at a pond near the coast in Kep.

The hill was occupied with the preserved forest (appeared to be full of various birds), margined by rather a good but desolate ground road with nice benches in places with lovely view. Below the road there were guesthouses and resorts hidden in secondary and decorative vegetation, and some plantation. A very fruitful site was situated on the hill: it was a small valley of a brook descending





Figure 34. *Ceriagrion malaisei*, a male, at a pond near the coast in Kep.



from the primary forest preserved on the hill as Kep National Park. The brook ran among a very narrow stony (limestone) valley and should be small in any season. Surprisingly, it had running water. This suggests that in the Kep area, there is no such fluctuation in annual precipitation as in Koh Kong Province, where impressive broad rocky rivulet beds were perfectly dry. (Another sign of the area being relatively moist was a leech encountered active in the forest without any rain.) Just downstream that road, there was a deep, artificially excavated pond on the brook, with steep, slippery muddy banks and some logs, partly shaded by a huge tree. Upstream the road, there were some banana plantations embedded into a forested valley (which most probably was already within the national park), and we witnessed pasturing of several buffalos from the nearby village, but they seem to exert little disturbance to the ecosystem. The site was visited within ca 14:00-16:00 on April 21 and in the evening, within 16:30-18:15, on April 22.

The fauna found at the pond was rich and differed from the lowland pond, being rather fit to both primary and secondary habitats. At daytime there were 2-3 territorial bright red dragonflies which could be *C. servilia* or, most probably, *R. rufa*, two territorial males of *P. jorina*, a male of *R. phyllis* or *variegata*, a male of *N. fulvia*, a male of *Ictinogomphus* sp.; besides, several individuals of *Pseudagrion* were seen but I failed to collect them. In the evening these dragonflies were not seen but one male *P. jorina*, at the same time two individuals of another species appeared, which flew fast and erratically just above the water and hovered for a while and chased each other. They were medium-sized and in flight strongly resembled *Somatochlora* but were grey. I thoroughly prepared myself for a good strike in a convenient place on the bank and spotted one: it appeared to be a male of *\*Zyxomma petiolatum* Rambur, 1842. I also managed to collect a male of *P. australasiae* and a male of *\*Cooperia marginipes* (Rambur, 1842). The pond was closed by a narrow, about 2 m high, concrete dam. Behind it, in a deep tree shade, on Apr. 21 I collected a male of *V. gracilis*. To my surprise, on Apr. 22 there were already three of them. In twilight 22.04, at about 18 hr, above the road section near the pond, bordered by a small bluff and in shade of a large tree, a small aeshnid started to fly swiftly but sometimes sat on low branches. After a while, another one joined it. I managed to capture one, it was a fully coloured (with a greenish thorax and blue adornment of the two first abdominal segments) male *G. subinterrupta* (Fig. 35). No gynacanthas were seen along the rest of the road.





**Figure 35. *Gynacantha subinterrupta*, a male, captured above a road bordering Kep National Park at a pond.**

Just upstream the road, the brook formed a shallow pool about 10 m long, with some stones at banks. In the Apr. 21 daytime, 2 males *O. chrysis* perched on these stones (demonstrating its fidelity to rock with small pools), a male *B. chalybea* perched on grass, while a male of *P. australasiae* and a male of *P. williamsoni* flew above the water and perched on sparse emerging grass. A female of *T. aurora* was found nearby in the evening.

In the forest valley, the brook flew through a chain of small dark-brown pools partly hidden among herbs. At these pools, males of *\*Prodasineura verticalis* sensu Asahina, 1983 were found (Fig. 36). They were seen hovering almost immovable in the air above their water, as it is common for the genus. Two were collected at daytime on Apr. 21 and several observed in the evening on Apr. 22. Curiously, when we came back along the brook on Apr. 21, we observed 3 males of *C. vittata* on just the same 2 pools from where an hour before we removed 2 *Prodasineura*. Needless to say, in the valley we also saw a male of *V. gracilis*. On Apr. 21, in the more or less open place in the valley at the small banana plantation we observed an impressive foraging swarm of dragonflies from several species flying at a height of 3-7 m. There were at least 1 gynochromic female of *R. variegata*, 5 individuals of the '*R. phyllis* appearance'





Figure 36. *Prodasineura verticalis* sensu Asahina, 1983, a male, at a forest brook at Kep National Park.

(see below) and 3 smaller dragonflies with clear wings and bicoloured abdomen, which should be *P. jorina*. Some males of '*R. phyllis* appearance' and a gynochromic female of *R. variegata* were also observed sitting on vegetation. One moment another individual of *Rhyothemis* appeared for a while among



those flying but very soon disappeared among tree crowns. It has as large as *variegata* but has wings dark throughout but the transparent forewing tips. *R. plutonia* is the only suitable option but without a more clear sighting I abstain from claiming its record. In the evening next day, there were no *Rhyothemis* there but I collected a female *R. rufa* there (Fig. 37).



**Figure 37. *Rhodothemis rufa*, a female, at a forest brook at Kep National Park.**

There were some much smaller and temporary, presently without water, brooks descending towards the road circular road; their beds were totally hidden in the forest. In one of such valleys, there was a small reservoir with dark water at the road. Numerous individuals and one tandem of *C. vittata* (Fig. 38), as well as a male of each of such inevitable species as *O. chrysis* and *V. gracilis*, were found near it.

On April 22 we examined the Kep surroundings. In the morning, at a muddy cattle pool within the town we observed, quite expectably, a male *P. congener* and a male *O. sabina*. At quite a distance from the town north of it, near the





**Figure 38.** *Coper vittata*, a male, at a small reservoir at a road bordering Kep National Park.

notorious pepper plantation at a foot of a small hill, there was a pool surrounded by thorny vegetation. There were a male *C. servilia*, a female *P. congener*, an individual of *R. phyllis/variegata* and several *A. panorpoides*. We moved east of Kep along NH31 through arable lands and crossed two rivulets. Both formed some shallow and narrow ponds with sedge on their flat banks. At such a pond as the first one we at last found a male of *A. pygmaea*, a lot of *B. contaminata* of both sexes, and a male of *C. servilia*. At the pond of the next rivulet (full of tadpoles), *A. pygmaea* was quite common and a male of *C. malaisei* was unexpectedly met with, as well as several of *B. contaminata* and a male of a quite expectable *N. tullia*. This river made also a larger pond where a male of *C. servilia*, a male of *U. signata*, and a male of *Ictinogomphus* sp. perched on dry branches.

Noteworthy, not a single individual of the elsewhere omnipresent *N. fluctuans* was seen in Kep surroundings.



### **Locality-wise synopsis of Odonata records during the trip.**

The coordinates and elevations are retrieved from Google Earth.

#### **Koh Kong Province**

Peam Krasaop National Park, a small market (coordinates cannot be retrieved as Google Earth has a very old photo for this place), 12.04.2010.

Visual registrations: \**Tramea transmarina euryale* Selys, 1878 - 3 ind.

Transitory thickets at Boyen Kayak village, 12.04.2010.

Photos: *Tholymis tillarga* – 1 ♀; *Neurothemis fluctuans* (Fabricius, 1793) – 1 ♂. Visual registration: *N. fluctuans* – 1 more ♂.

A ditch at Koh Kong S suburb. 11°36'02" N, 102°58'42" E, 4 m, 14.04.2010.

Collections: *Ischnura senegalensis* (Rambur, 1842) – 1 ♀; *Brachydiplax c. chalybea* (Brauer, 1868) – 1 ♂; *Crocothemis servilia* (Drury, 1770) – 1 ♀; *Neurothemis fluctuans* – 1 ♀; *Neurothemis tullia* (Drury, 1773) – 2 ♀.

Visual registrations: *Acisoma panorpoides* Rambur, 1842 – 1 ind.; *B. c. chalybea* – several ♂; *C. servilia* – many of both sexes; *N. fluctuans* – many of both sexes; *N. tullia* – many of both sexes. Unidentified: *Rhyothemis phyllis* (Sulzer, 1776) or *R. variegata* (Linnaeus, 1763) – 1 ind.

Pools and wetlands in Koh Kong E suburbs along NH48. 11°36'22-57" N, 103°00'16'-01'15" E, 5-8 m, 14.04.2010.

Collections: *Ceriagrion cerinorubellum* (Brauer, 1865) – 2 ♂, 1 ♀; *Diplacodes nebulosa* (Fabricius, 1793) – 1 ♂, 1 ♀; *Neurothemis tullia* – 1 ♂; *Tholymis tillarga* – 1 ♀; *Trithemis pallidinervis* (Kirby, 1889) – 1 ♂.

Visual registration: *C. cerinorubellum* – many; *Diplacodes trivialis* (Rambur, 1842) – many; *N. tullia* – many.

At a bridge through a mangrove river arm 4 km SEE of Koh Kong. 11°36'23" N, 103°01'24" E, 8 m, 14.04.2010.

Collections: *Agriocnemis pygmaea* (Rambur, 1842) – 1 ♂; *Aciagrion borneense* Ris, 1911 – 1 ♂; *Ceriagrion cerinorubellum* – 1 ♂; *Ischnura senegalensis* – 1 ♂, 2 ♀.

Visual registration: *Orthetrum sabina* (Drury, 1770) – 1 ♂; *Diplacodes trivialis* – several; *Neurothemis tullia* – several; *Neurothemis fluctuans* – several.



Koh Por Waterfalls, 16-18 km NE of Koh Kong. 11°43'11"-44'58" N, 103°04'28"-05'09" E, 11-20 m, 14.04.2010.

Collections: \**Dysphaea gloriosa* Fraser, 1938 – 1 ♂, 1 teneral ♀; *Coeliccia kazukoae* Asahina, 1984 – 1 ♂; \**Copera vittata* (Selys, 1863) – 1 ♂; *Prodasineura* sp. – 1 teneral ♀, \**Lathrecista asiatica* (Fabricius, 1798) – 1 ♂; \**Orthetrum chrysis* (Selys, 1891)– 1 ♂; *Trithemis aurora* (Burmeister, 1839) – 1 ♂, \**Zygonyx iris malayana* Laidlaw, 1902 – 5 exuviae.

Photos: *D. gloriosa* – 1 ♂; *C. kazukoae* – 2 more ♂; *Prodasineura* sp. – 1 teneral ♂; *L. asiatica* – 1 ♂; *Neurothemis fulvia* (Drury, 1773) – 1 ♂; *O. chrysis* – 1 ♂; *Z. i. malayana* Laidlaw, 1902– about 5 more exuviae. Visual registrations: *D. gloriosa* – many ♂ and teneral ind., *Diplacodes trivialis* – many; *L. asiatica* – several ♂; *N. fluctuans* – many both sexes; *N. fulvia* – several ♂; *O. chrysis* – many ♂; *Orthetrum sabina* – 2 ind.; *Pantala flavescens* (Fabricius, 1798) – 1 ind.; *T. aurora* – many ♂. Unidentified: *Prodasineura* sp – several teneral ind., Gomphidae gen. sp. – 1 exuvium.

Brook 1, 2 km S of Tatai waterfalls. 11°34'39" N, 103°05'51" E, 68-70 m, 17.04.2010.

Collections: *Prodasineura autumnalis* (Fraser, 1922) – teneral ♀; *Trithemis festiva* (Rambur, 1842) - 1 ♂.

Photos: *Euphaea masoni* Selys, 1859 – 1 ♂; *T. festiva* – the same ♂. Visual registration: *Vestalis gracilis* (Rambur, 1842) – 1 ♂; *Neurothemis fluctuans* – several; *Orthetrum chrysis* – 1 ♂. Unidentified: *Pseudagrion* sp. – 1 ♂.

Brook 2, 0.8 km S of Tatai waterfalls. 11°34'52" N, 103°05'37" E, 80 m, 17.04.2010.

Collections: *Vestalis gracilis* – 1 ♀; *Copera vittata* – 1 ♂.

Visual registration: *C. vittata* – 1 more ♂.

Brook 3, 0.4 km WNW of Tatai waterfalls. 11°35'18" N, 103°05'36" E, 66-69 m, 17.04.2010.

Collections: *Vestalis gracilis* – 1 ♂; *Lathrecista asiatica* – 1 ♀.

Visual registrations. *Orthetrum chrysis* – several ♂; *Neurothemis fluctuans* – several; *Neurothemis fulvia* – 1 ♂.

Tatai Waterfall. 11°35'13" N, 103°05'45" E, 18-26 m, 17.04.2010.

Visual registrations: *Dysphaea gloriosa* – 3 ♂; *Orthetrum chrysis* –



several ♂; *Neurothemis fluctuans* – several of both sexes, *Pantala flavescens* – several of both sexes.

Left Tatai River left bank within 3 km upstream Phnom Daung Bridge. 11°33'54"-35'22" N, 103°07'42"-08'11" E, 13 m, 16.04.2010.

Collections: *Vestalis gracilis* – 2 ♂; *Orthetrum chrysis* – 1 ♂; *Tholymis tillagra* – 1 ♂, 1 ♀.

Visual registrations: *Diplacodes trivialis* – several; *Neurothemis fluctuans* – many of both sexes; *Neurothemis fulvia* – several ♂; *T. tillagra* – many. Unidentified: *Pseudagrion* sp. – 1 ♂, Aeshnidae Gen. sp. (? *Anax guttatus* (Burmeister, 1839)) – 1 ind.

A dry torrent at Tatai River right bank at Phnom Doung Bridge. 11°33'46-50" N, 103°07'23-30" E, 30-100 m, 18.04.2010.

Collections: *Vestalis gracilis* – 1 ♂; *Aciagrion* cf. *pallidum* Selys, 1891 – 2 ♂; *Coeliccia kazukoae* – 1 ♂; *Brachygonia oculata* (Brauer, 1878) – 1 ♂; *Rhyothemis variegata* – 1 androchromic f. Photos: *V. gracilis* – 1 ♂; *C. kazukoae* – the same ♂; *B. oculata* – the same ♂; *Neurothemis intermedia atalanta* Ris, 1919 – 1 ♂, 1 ♀.

Visual registrations: *Lathrecista asiatica* – 1 ♂; *Neurothemis fluctuans* – several of both sexes; *Neurothemis fulvia* – 1 ♂. Unidentified: Aeshnidae gen. (*Gynacantha* ?) sp.

A dry rivulet ~ 1 km SEE of Phnom Doung Bridge. ? 11°33'33" N, 103°08'03" E, 11 m, 18.04.2010.

Collections: *Vestalis gracilis* – 1 ♀; *Euphaea masoni* – 1 ♀; *Libellago hyalina* (Selys, 1859) – 1 ♂, 1 ♀.

Photos: *E. masoni* – the same f; *L. hyalina* – the same ♂.

Visual registration: *V. gracilis* – 1 ♂, 1 ♀.

The Thma Bang River left tributary, a deep reach upstream bridge, 7 km SW Thma Bang village. 11°38'49" N, 103°23'47" E, 339 m, 15.04.2010.

Collections: *Dysphaea gloriosa* – 2 ♂, 1 ♀ (+ its exuvium); *Heliocypha perforata limbata* (Selys, 1879) – 1 ♂, 1 ♀; *Pseudagrion rubriceps* Selys, 1876 – 1 ♂; *Pseudagrion williamsoni* Fraser, 1922 – 3 ♂; *Copera ciliata* (Selys, 1863) – 1 ♀; \**Prodasineura autumnalis* – 4 ♂ (1 teneral), 1 ♀; \**Microgomphus* sp. – 1 ♂. Photos: *D. gloriosa* – 1 ♂, the mentioned f with exuvium.

Visual registrations: *D. gloriosa* – several more ♂; *P. williamsoni* – many ♂; *P. autumnalis* – several more ind.; *Neurothemis fluctuans* – several;



*Trithemis aurora* – 2 ♂.

The Thma Bang River left tributary, a shallow reach downstream bridge, 15.04.2010.

Collections: *Vestalis gracilis* – 1 ♂; \**Neurobasis chinensis* (Linnaeus, 1758) – 1 ♂; \**Euphaea masoni* – 1 ♂.

Photos: Visual registrations: *Dysphaea gloriosa* – 1 ♂; *Heliocypha perforata limbata* – 1 ♂; *N. chinensis* – 1 ♀. Unidentified: Aeshnidae gen. sp.

Thma Bang River upstream waterfall, 5 km SW Thma Bang village. 11°39'31" N, 103°24'14" E, 366 m, 15.04.2010.

Collections: *Vestalis gracilis* – 1 ♂; *Burmagomphus* sp. – 4 ♀ (3 in alcohol). Photos: *V. gracilis* – the same ♂; *Burmagomphus* sp. – 2 more ♀.

Visual registrations: *D. gloriosa* – several ♂; *Neurothemis fluctuans* – several; *Neurothemis fulvia* – 1 ♂.

## Kampong Saom Province

Kbal Chhay Cascades, 12 km NE of Sihanoukville. 10°40'29-36" N, 103°36'30-32" E, 47-50 m, 19.04.2010.

Collections: *Vestalis gracilis* – 1 ♂; 1 ♀; *Euphaea* sp. – 1 ♀, *Pseudagrion williamsoni* – 2 ♂; *Brachythemis contaminata* (Fabricius, 1793) – 2 ♀; *Lathrecista asiatica* – 1 ♂; *Trithemis aurora* – 1 ♀. Photos: *B. contaminata* – 1 ♀; *T. aurora* – 1 ♂.

Visual registrations: *V. gracilis* – several; *Tholymis tillarga* - several. Unidentified: Aeshnidae Gen1. (*Gynacantha* ?) sp. – 1 ind., Gen2. sp. – 1 ind.

Ream National Park Recreation centre 15 km SE Sihanoukville. 10°30'57" N, 103°37'02" E, 34-44 m, 20.04.2010.

Collections: *Vestalis gracilis* – 1 ♂; \**Onychargia atrocyana* (Selys, 1865) – 1 ♂, 1 ♀; *Copera vittata* – 1 ♂; *Coeliccia kazukoae* – 1 ♂; *Neurothemis fluctuans* – 1 ♀.

Photos: *C. kazukoae* – another ♂; *Orthetrum chrysis* – 1 ♂; \**Rhyothemis obsolescens* Kirby, 1889 – 1 ♀.

Visual registrations: *V. gracilis* – 2 more ind.; *Hydrobasileus croceus* (Brauer, 1867) – 2 ♂; *Neurothemis fluctuans* – several of both sexes; *O.*



*chrysis* – 2 ♂; *Orthetrum sabina* – 1 ind.; *R. obcolescens* – 4 more ind; *Trithemis pallidinervis* – 2 ♂; *Pantala flavescens* – 1 ind.; *Rhodothemis rufa* (Rambur, 1842) – 1 ♀. Unidentified: *Ictinogomphus* sp. (? *decoratus melaenops* (Selys, 1858)).

Andoung Tuek Waterfalls and a nearby forest in Ream National Park. Ca 10°31'17" N, 103°37" E, 125 m, 20.04.2010.

Photos: *Orthetrum chrysis* – 1 ♂.

Visual registration: *Vestalis gracilis* – 1 ind.; *O. chrysis* – 2 more ♂.

## Kampot Province

Bokor Hill Station. 10°37'19-55" N, 104°01'18-38" E, 1030-1037 m, 23.04.2010.

Photos: *Ceriagrion cerinorubellum* – 1 ♂; *Diplacodes nebulosa* – 1 f; *Neurothemis tullia* – 1 ♂; *Trithemis aurora* – 1 teneral ♂.

Visual registrations: *Vestalis gracilis* – 3 ind.; *Anax guttatus* – at least 1 ♂, *Crocothemis servilia* – 1 ♂; *D. nebulosa* – 1 ♂; *Neurothemis fluctuans* – 1 ♂; *T. aurora* – many ♂; *Trithemis pallidinervis* – 1 ♂, *Pantala flavescens* – immense, *Rhyothemis variegata* – 1 gynochromic ♀, *Orthetrum chrysis* – 1 ♂, Not identified: Gomphidae Gen. sp. – 1 ind.

## Kep Province

A *Ludwigia* pond at the coast within Kep. 10°29'10" N, 104°17'36" E, 27 m.

Collections: *Ceriagrion malaisei* Schmidt, 1964 – 3 ♂; *Ischnura senegalensis* – 1 f; *Crocothemis servilia* – 2 ♂, 1 ♀ (21.04); *Acisoma panorpoides* – 1 f; *Orthetrum sabina* – 1 ♂ (21.04).

Photos: *C. malaisei* – 1 ♂ (21.04), 1 ♂ (22.04); *Potamarcha congener* (Rambur, 1842) – 1 ♂ (22.04).

Visual registrations: *C. malaisei* – several ♂ (21.04), 3 ♂ 1 ♀ (22.04); *Ischnura senegalensis* – 1 ♂ 1 ♀ (21.04); *Anax guttatus* – at least 1 ♂ (21.04); *C. servilia* – many (21.04), several (22.04); *Brachythemis contaminata* – 1 ♂ (22.04); *Neurothemis tullia* – 2 ♂ (21.04), 1 ♂ (22.04).

Unidentified: *Rhyothemis phyllis* or *R. variegata* – 1 ind.

A forest edge pond at E hill slope, Kep National Park, 1.5 km N of Kep centre. 10°29'25" N, 104°18'13" E, 91 m.

Collections: *Vestalis gracilis* – 1 ♂; *Pseudagrion australasiae* Selys, 1876 – 1 ♂ (22.04); \**Copera marginipes* (Rambur, 1842) – 1 ♂ (22.04);



*Gynacantha subinterrupta* Rambur, 1842 – 1 ♂ (22.04); \**Zyxomma petiolatum* Rambur, 1842– 1 ♂ (22.04); Visual registrations. *V. gracilis* – 3 ♂; *P. australasiae* – 1 ♂, 1 ♀ (22.04); *G. subinterrupta* – a more ♂ (22.04); *Neurothemis fulvia* – 1 ♂ (21.04); *Pseudothemis jorina* Förster, 1904 – 2 ♂ (21.04), 1 ♂ (22.04); *Z. petiolatum* – another ♂ (22.04).

A nearby shallow pool.

Collections: *Pseudagrion australasiae* – 1 ♂ (21.04); *Pseudagrion williamsoni* – 1 ♂ (21.04); *Brachydiplax c. chalybea* – 1 ♂ (21.04); *Tri-themis aurora* – 1 ♀ (22.04).

Visual registration: *Orthetrum chrysis* – 2 ♂ (22.04).

A forest brook and its valley. 10°29'25" N, 104°18'09-13" E, 90-110 m.

Collections: \**Prodasineura nec verticalis* sensu Asahina, 1983 nec Selys, 1860 – 2 ♂ (21.04); *Copera vittata* – 2 ♂ (21.04); *Rhyothemis pyllis* – 1 ♂; *Rhyothemis variegata* – 2 ♀ (one androchromic) (21.04); *Rhodothemis rufa* – 1 ♀ (22.04). Photos: *Vestalis gracilis* – 1 ♀; *P. nec verticalis* – 1 ♂ (22.04). Visual registrations: *V. gracilis* – several ind. (21.04); *C. vittata* – 3 ♂ (21.04); *P. nec verticalis* – several ♂ (22.04); *R. variegata* – another gynochromic ♀ (21.04); *Pseudothemis jorina* – 3 ♂ (21.04). Unidentified: *Ictinogomphus* sp. (? *I. decoratus melaenops*); *Rhyothemis pyllis* or *variegata* (with a restricted pattern) – several; *Rhyothemis* sp. (? *plutonia* Selys, 1883) – 1 ind. (21.04).

A smaller brook with a reservoir at Kep National Park margin, ca 2.5 km N of Kep centre (21.04).

Photos: *Copera vittata* – 1 ♂.

Visual registration: *Vestalis gracilis* – 1 ♂; *C. vittata* – many; *Orthetrum chrysis* – 1 ♂.

A cattle pool in Kep (22.04).

Visual registrations: *Orthetrum sabina* – 1 ♂, *Potamarcha congener* – 1 ♂.

A pond at pepper plantation, 11 km NE of Kep (22.04). 10°33'36" N, 104°21'16" E, 62 m.

Collections: *Acisoma panorpoides* – 1 ♀; *Potamarcha congener* – 1 ♀. Visual registrations: *Crocothemis servilia* – 1 ♂; *Acisoma panorpoides* – several. Unidentified: *Rhyothemis pyllis* or *variegata* – 1 ind.

A rivulet, 10 km NNE of Kep (22.04). 10°31'51" N, 104°22'24" E, 11 m.

Collections: *Agriocmenis pygmaea* (Rambur, 1842) – 1 ♂; *Brachythemis contaminata* – 1 ♂.



Visual registrations: *B. contaminata* – many, both sexes.

A rivulet, 12 km NNE of Kep (22.04). 10°32'12" N, 104°23'37" E, 11 m.

Collections: *Agriocmenis pygmaea* – 2 ♂, 2 ♀ (1 teneral); *Ceriagrion malaisei* – 1 ♂; *Crocothemis servilia* – 1 ♂; *Urothemis s. signata* (Rambur, 1842) – 1 ♂.

Visual registration: *C. servilia* – 1 ♀; *Brachythemis contaminata* – several; *Neurothemis tullia* – 1 ♂. Unidentified: *Ictinogomphus* sp. (? *I. decoratus melaenops*).

Any specimens are available for investigation upon request, but take into account great difficulties with sending specimens abroad from Russia.

### Notes on specimens and their taxonomy

1. I collected 9 males and 3 females and observed about 20 more individuals of *Vestalis gracilis* in all visited provinces, and all they had the wingtips smoky-brown (Fig. 39), as it is the case in most specimens in Vietnam and some regions of eastern Thailand (pers. comm. by Matti Hämäläinen).



Figure 39. *Vestalis gracilis*: left – male (a dry temporary torrent valley at Phnom Doung Bridge, 18.04); right – female (Kep National Park, 22.04).

2. Males of *Dysphaea gloriosa* correspond to the characters given by Asahina (1985b) but with a more extended orange-brown pattern over the black background because they were collected young (Fig. 24): head with a brownish labrum, genae and frons (Asahina erroneously mentioned postclypeus but depicted the head correctly); prothorax with a pair of large spots at the lateral swellings of the median lobe but also with light spots at the leg bases and hind angles; the



pterothorax with a full set of regular lighter stripes (2 forming an oval on mesepisternum, 2 on the mesepimeron, 1 on metepisternum and 2 on metepimeron), but not so wide as in female and fading on the mesepisternum; there are elements of two (the lower along the tergite margins) lateral stripes on either side of abdominal segments 1-8; in 2 males there were also a pair of spots aside the ocelli and traces of reddish on all the femora. The female coloration is as shown in Asahina (1985b).

3. Asahina (1977) described *Euphaea guerini inouei* Asahina, 1977 from S Thailand and S Vietnam, which Hämäläinen & Pinratana (1999) attributed to the species *E. masoni* and doubted its validity as a subspecies. Our male specimen of *E. masoni* is in line with this doubt as demonstrating a mixture of characters of *masoni* s. str. sensu Asahina and ssp. *inouei*: hind wing 27 mm as in *inouei* (29 mm in *masoni* s. str. sensu Asahina), its apex hyaline for about 1.5 mm that corresponds to *masoni* s. str. sensu Asahina ( $\leq 1/15$  of the wing length, while  $1/8$  in *inouei*); fore wing hyaline basally for 11 mm that is 0.38 of its length (even more than  $1/3$  is stated for *inouei*;  $1/4$  stated for in *masoni* s. str.); tergite 8 with a hairy ridge as in *masoni* s. str. The photographed male (Fig. 15, upper row) has the identical proportions of the wing hyaline portions. The female of *E. masoni* from the Tatai environs shows all the characters of this taxon as described and depicted by Asahina (1977), with the following slight differences: the fore margin of the black coloration on the frons is somewhat dentate as having 7 blunt projections; there is a black spot at  $1/3$  of the mandible base proximal margin; the genae darkened (Fig. 40, top left). The female was collected in 5.5 km from a site where a male was registered and in analogous conditions (but the brook lacked any water). The female of *Euphaea* from Kbal Chhay has a dark face coloration that is found e. g. in females of *E. guerini*, but females of these species should differ also in the shape of prothorax (pers. comm. by Matti Hämäläinen) while our two specimens do not differ substantially in this respect (Fig. 40, centre and right). Hence it would better left the Kbal Chhay female unidentified as *Euphaea* sp. In this Kbal Chhay female, the clypeus and frons is entirely black, the light colour on the cheeks extends to the antenna level but has straight margins and the paired spots aside the ocelli are very small (Fig. 40, bottom left). The Kbal Chhay female is curious in having the discoidal vein crossed only on the right hind wing and entire on the other wings. Some other its characters are as follows: abdomen 30 mm (29 mm in the Tatai female); fore wing 29x6 mm (30x7 mm in the Tatai female); hind wing 27x6 mm (28x7.5 mm in the Tatai female); fore



wing pterostigma 2.5 mm, covers  $1/2+6+1/2$  cells (3.5 mm covering 8 cells in the Tatai); hind wing pterostigma 3 mm, covering  $6+1/2$  cells (3.5 mm, covering  $1/1+7$  cells in the Tatai female); fore wing Anq 23 and 25 (20 and 23 in the Tatai female); hind wing Anq 19 and 20 (19 and 19 in the Tatai female); veins in basal cell on fore wing 2 and 2 (2 and 3 in the Tatai female).

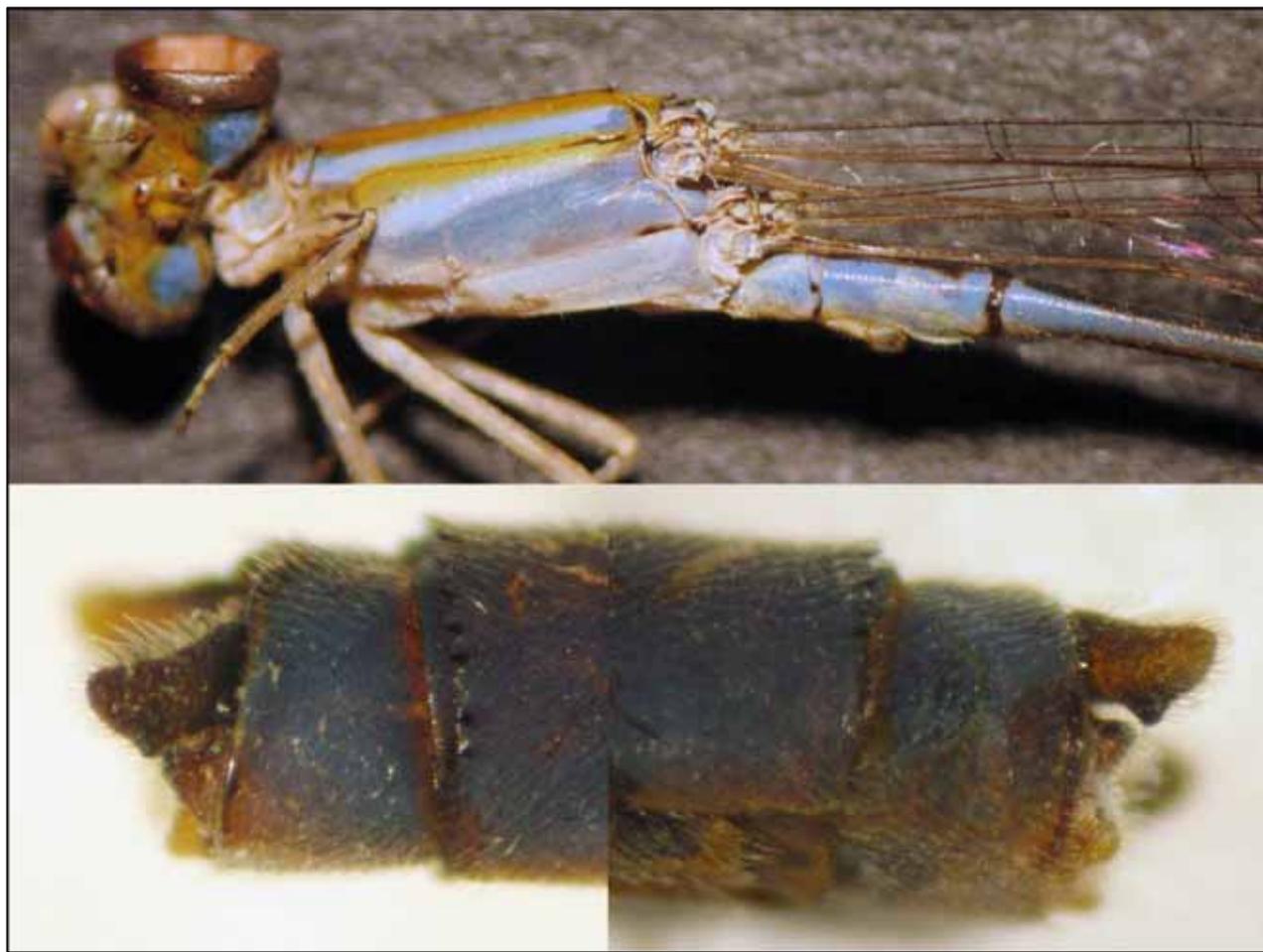


Figure 40. Females of *Euphaea masoni* (a temporary river valley downstream of Phnom Doung Bridge, 18.04), above, and *Euphaea* sp. (Kbal Chhay Cascades, 19.04), below; left – head, centre and right – prothoraces.

4. Specimens of *Libellago hyalina* show characters identical to those depicted by Asahina (1985a) but hardly noticeable differences in the details of the pattern of male abdomen, which is identical to the described in general, with dorsal sides of tergites 3 to 7 dark crimson red with black at their hind margin (Fig. 21). But the pattern of the female metepisternum on Fig. 3 in (Asahina, 1985a) seems to be shown negatively (with the black and light areas confused with each other while their border is shown correctly); besides, our specimens have 7 antenodals while Asahina's text says 'less than seven'.

5. Two males of *Aciagrion* sp. collected in a dry steep rocky valley of a temporal torrent are closest to *Aciagrion pallidum* Selys, 1891 as having the identical vague bronze pattern on head and thorax and the dark pattern on the abdomen, and also being of the same size. But they are by no means pale. Their ground





**Figure 41. *Aciagrion* sp. cf. *pallidum* , a male (a dry temporary torrent valley at Phnom DOUNG Bridge, 18.04); above - the fore body part, beneath – anal appendages.**

colour is saturated blue, either when alive or dried (Fig. 41, top). Moreover, their upper appendages are substantially longer and more processed caudally (Fig. 41, bottom) than the straight-sided in the profile view upper appendages in available to me males of *pallidum* from Chanthaburi Province of Thailand, corresponding to the schematic drawings in Fraser (1933), Laidlaw (1924) and Asahina (1990) (which in fact insubstantially differ from each other with respect to the lower appendage shape). Besides, the upper margin of tergite 10 is in our specimens not so much raised as in *A. pallidum*. Laidlaw (1924), who investigated numerous specimens from Lower Burma and some from Assam and Peninsular India, characterised *pallidum* as “without any blue colouring on abdomen”, while Fraser (1933), also having most specimens from dry areas of Decan, Assam and Burma, characterised it as “palest azure blue” (as it can also be seen e. g. on photos from Chiang Mai, North Thailand by Faz at [www.asia-dragonfly.net](http://www.asia-dragonfly.net)). Yet, our specimens have a saturated blue abdomen. Rory Dow (pers. comm.) kindly informed me that he seems to have an impression that in the west (India, Burma) most specimens are tan-coloured, in the east (Indo-



china) they are mostly or all blue. Specimens from Thailand seem to be intermediate and in some populations the males turn blue upon maturity while in other populations they stay tan. As far as I could infer, no Asian species without black pattern on head and abdomen except for *A. pallidum* have been described. Taking into account the processed upper appendages in our specimens, they might be suspected to represent a still undescribed 'blue *pallidum*' species. Noteworthy in this respect is that Hämäläinen (2001: 170) pointed out: "Also under *A. pallidum* have been lumped two distinct species; the real *pallidum* and another, as yet undescribed species". However, Rory Dow (pers. comm.) found the full spectrum of variation in the appendages in both blue and tan specimens. Thus, what has been being hitherto considering as *A. pallidum* deserves a thorough investigation involving many specimens from its entire range.

6. *Coelliccia kazukoa* specimens are unmistakable, especially for the shape of the anal appendages. I have noted that in all 4 specimens available to me (3 above mentioned from Cambodia and 1 from Khao Khitchakut National Park, Chanthaburi Province, Thailand) there is almost no incision between the terminus and ventral projection of the male upper appendage that is shown in Asahina (1984): the slanting lower hind margin of the cercus is almost straight or very slightly convex. Besides, the Asahina's holotype seems to be not fully coloured: in all my specimens the hind dark stripe of the postfrons, pale in Asahina's specimens, is equally dark and contacting to the fore black pattern of the postfrons (Fig. 42, right). In all Cambodian specimens the ground colour of the eyes, thorax and the fore part of abdomen is light blue (Fig. 42, left) rather than whitish, as in the holotype and my Thai male (for that specimen see the cover photo in Malangpo 22). In the most mature male from Koh Por, the mentioned hind stripe of the postfrons is black and totally fused with the fore black pattern leaving just a brownish lightening between them (Fig. 41, top right), that makes the hind part of vertex looking rather as in *Coelliccia megumii* Asahina, 1984. Besides, in this specimen the pterothorax pattern is dark brownish (although still diffuse) obscuring the darker striae (Fig. 42, top). The specimens are given to Rory Dow who is preparing a revision of *Coelliccia*.





Figure 42. Males of *Coeliccia kazukoae* in nature (left) and collection (heads; right). Top - Koh Por Waterfalls, 13.04; middle - a dry temporary torrent valley at Phnom DOUNG Bridge, 18.04; bottom - Ream National Park, Recreation Centre, 20.04 (middle line: the same specimen in nature and collection, others not).



7. *Prodasineura* from Kep is exactly the species also present in E Thailand which Asahina (1983) considered to be *P. verticalis* but Hämäläinen & Pinratana (1999) claimed it is not conspecific to that Bornean species. We did not find females of this species, which should bear a pair of upstanding slender spines (Asahina, 1983): a character depicted by Asahina (1967a) for a female from Chêko left unidentified in the latter cited paper.



Figure 43. Males of *Burmagomphus* sp. (above), the Thma Bang River 4 km SW of Thma Bang village, 15.04 - and *Microgomphus* sp. (below) – the Thma Bang River left tributary, 7 km SW of Thma Bang village, 15.04.

8. A teneral *Microgomphus* specimen was collected. It had no coloration when captured during its maiden flight but acquired it in one day of captivity. Be-



cause of its unique combination of characters (Fig. 43, bottom) it must be a new species. It has plain black stripes along the borders mesepimeron / metepisternum and metepisternum/metepimeron, that among so far described Asian species is found in *M. thainaldicus* Asahina, 1981 (Continental Thailand) and *M. jurzitzi* Karube, 2000 (South Vietnam), from which our male differs by the absence of an antehumeral spot under the antelar sinus and a much smaller size, as having the hind wing 20.5 mm long (26.1 mm in *jurzitzi*, 28-29 mm in *thainaldicus*) and the abdomen+appendages 22 mm long (33 mm in *thainaldicus*) (Asahina, 1981, 1986; Karube, 2000). The dorsal yellow spots at the mesepisternum join the stripes of the anterior collar near its middle, as in *M. liliputians* Fraser, 1925 (Lower Burma) (Fraser, 1936), but otherwise the pattern is different and venation is not so reduced. As different from *M. jurzitzi*, our specimen has no lateral yellow spots on the antefrons but has such on the postclypeus, and the suture between the antefrons and postfrons is marked with a yellow streak, as in many other species. The upper appendage has the branch sprouting about its middle and extending further the tip of the appendage corpus and has no additional denticles and knobs, as in *M. loogali* Fraser, 1923 (Upper Burma) (Fraser, 1936) and *M. jurzitzi*. However, due to the teneral condition when captured, the appendages are folded and twisted so that their shape and position is unclear and the new species cannot be described presently based solely on this single specimen.

9. All 6 teneral individuals of *Burmagomphus* sp. found at the Thma Bang River appeared to be females, 4 of them collected. One was not so teneral and acquired the brownish pattern, another one was left to harden in captivity. They showed the head and thoracic pattern (Fig. 43, top) identical to the damaged male (also collected teneral) from Chieng Dao, N. Thailand, described and depicted but left unnamed by Asahina (1986: 32-33, fig. 12), with the only difference of the broad yellow band across the frons being completely interrupted at middle. At the same time, the occiput sculpture and coloration in our females appeared strikingly identical with those of *B. williamsoni* Förster, 1914 as described and depicted by Lieftinck (1964): there is a large triangular yellow prominence in the centre of occiput and black transversally flattened tridental spikes at the sides of the occipital plate. At the same time, there is a strong horn-like straight spine behind each lateral ocellus, missing in females of *B. williamsoni* while those of *B. divaricatus* Lieftinck, 1964 has at this point a pair of downcurved spines (Lieftinck, 1964). The head pattern is identical to *B. williamsoni*. The thoracic pattern differs strongly from that of *B. williamsoni* or any other up to date described *Burmagomphus*: the antehumeral yellow stri-



pes broad but short, going down to the middle coxae but far from reaching the narrow dorsal stripes. The size is slightly larger than *B. williamsoni*: hind wing 25-26 mm, abdomen 30 mm. A male from Thma Bang is missing to describe this species, for its conspecificity to the Chiang Dao specimen is to prove, and the hamuli are unknown.

10. Males of *Neurothemis tullia* had milky stripes on their wings (apt to seasonal variation).

11. The photo of female *Rhyothemis obsolescens* Kirby, 1889 (Fig. 29) shows a triangular lighter spots at the nodus, two lengthwise lighter stripes at the hind wing bases, and a series of pyriform darker spots at antenodals, that allowed to reliably identify the species. Various photos and drawings of the species show the presence and extent of the clear wing tips to be variable. The photographed female had the fore wing tips clear from the middle of pterostigma and the hind wing clear from its distal end. Another observed individual had at least the fore wing tips clear.

12. *Rhyothemis phyllis* and *R. variegata* were not easy to distinguish in the field because of a close similarity of males of both species and the occurrence of androchromic females of *R. variegata*. But in fact, they are hard to distinguish in collection as well. So far nobody seems to point at any structural differences between these two species, their distinction is based solely on the wing pattern, which is very variable in both so that numerous subspecies are described. The diagnostic characters between them found in Vol. III 'Fauna of British India' by Fraser (1936) are as follows.

Both sexes of *phyllis* are identical and have the following wing markings (Fig 44a):

- basal coloured area on the hind wing not extending beyond the anal loop, with two black bands, of which the hind is not notched,
- small nodal dark spots, often absent on the hind wing
- darkened wing apices

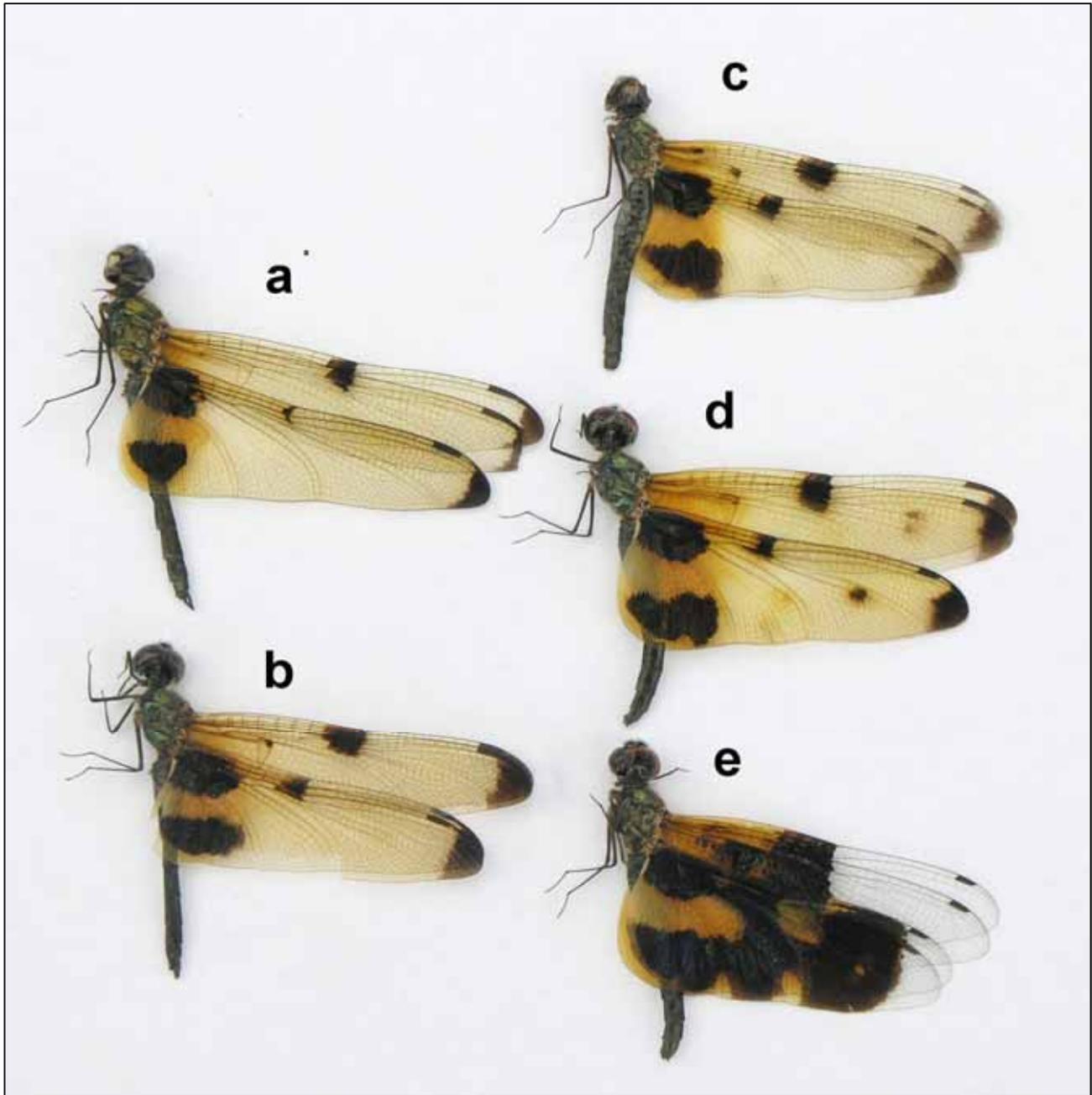
Males (Fig. 44b) and androchromic females (Fig. 44c) of *R. variegata* are claimed to be rather similar to *phyllis* (and very variable) but differ in:

- the basal area extending quite beyond the anal loop and with the lower black band notched,
- nodal dark spots being large on both wings
- appearance of additional very small dark spots appear at discoidal cell



base on fore wing

- sometimes additional spots appear at middle of vein  $R_3$  (Fig. 44d).



**Figure 44. Wing pattern in two species of *Rhyothemis*:**

*R. phyllis*: a, a male, Cambodia, Kep Province, a brook in Kep National park, 21.04.2010, Kosterin leg.

*R. variegata*: b, a male, Thailand, Nakhon Ratchasima Province, Non Bun Nak village, 13-14.05.2010, Zinchenko leg.; c, an androchromic female without spots at  $R_3$ , a Cambodia, Koh Kong Province, a hill at Phnom Doung Bridge, 18.04.2010, Kosterin leg.; d, an androchromic female with spots at  $R_3$ , Cambodia, Kep Province, a brook in Kep National park, 21.04.2010, Kosterin leg.; e, a gynochromic female, the same label as previous.



From the specimens available it appears that the differences in extension of the basal coloured area and presence of the notch of the lower black band seem to be too variable to consider them diagnostic characters.

The 'regular' females of *R. variegata* (let us call them further 'gynochromic') (Fig. 44e), with the majority of wing surface coloured but the fore wing tups clear, are well known and hardly variable.

According to these guidelines, I collected 1 male of *phyllis* (Fig. 44a, note its slightly longer wings), 1 gynochromic (Fig. 44e) and 1 androchromic female (with spots at R<sub>3</sub>) (Fig. 44d) of *variegata* at the Kep forest brook and 1 androchromic female of *variegata* without spots at R<sub>3</sub> (Fig. 44c) on a hill at Phnom Doung Bridge. I should have collected much more specimens to clarify the situation but this might not be easy due to a seeming rarity of *Rhyothemis* males in nature, in particular *R. variegata*. Females of *R. variegata* are very commonly seen in continental Thailand, at the same time Matti Hämäläinen kindly informed me that he has never seen a male from Thailand. In two summarising papers Asahina (1981; 1989) reported 9 females and 1 male with an unusually extended dark pattern (see Fig. 95 in Asahina 1989). According to Fraser's characters, Fig. 98 in the cited paper shows not *R. phyllis* but an androchromic female of *R. variegata* with spots at vein R<sub>3</sub>. Dr. V. Zinchenko passed me his small collection made this summer in Nakhon Ratchasima Province of Thailand, which included 3 males (Fig. 44b) and 2 gynochromic females of *R. variegata*. Hence, males from Thailand are now available for comparison.

All this tempts me to suspect that *R. phyllis* and *R. variegata* could in fact be the same species. Female-limited polymorphism is common in Odonata (and in butterflies as well). It means that in males the manifestation of the 'gynochromic' allele is suppressed. If we assume that in *Rhyothemis* the gynochromic allele is not completely suppressed, we get a situation when the same genotypes differ drastically in females and only slightly in males. In our hypothetical united species, which would bear the older name *Rhyothemis variegata* (Linnaeus, 1764), there could be no 'gynochromic' allele in the south and hence both sexes look like '*phyllis*' there without exception. In population of the continental Asia, i.e. in the range of the presumed *R. variegata*, this allele appears and produces the phenotypes of 'gynochromic female *variegata*' and 'male *variegata*'. The 'androchromic *variegata*' females may be hetero-



zygotes; if we suppose that male heterozygotes are indistinguishable from 'phyllis' then we would explain the deficit of 'variegata males'.

## **Discussion**

During a 12-day trip to the coastal regions of Cambodia we found 51 identified species plus 2 preliminarily identified species (*Prodasineura verticalis* sensu Asahina, 1983 with the valid name unresolved, and *Zygonyx iris malayanus* identified by exuviae). Fourteen species are recorded for the first time for this country, namely *Neurobasis chinensis*, *Dysphaea gloriosa*, *Euphaea masoni*, *Onychargia atrocyana*, *Copera marginipes*, *Copera vittata*, *Prodasineura autumnalis* *Prodasineura verticalis* sensu Asahina, 1983, *Lathrecista asiatica*, *Orthetrum chrysis*, *Rhyothemis obsolescens*, *Tramea transmarina euryale*, *Zygonyx iris malayana*, *Zyxomma petiolatum*. Besides, *Aciagrion* cf. *pallidum* is a dubious case, and *Burmagomphus* sp. and *Microgomphus* sp. apparently are undescribed species. Summing up four unidentified species: *Ictinogomphus* sp., Gomphidae gen. sp. on Bokor and *Rhyothemis* sp. at Kep. but excluding *Euphaea* sp. from Kbal Chhay, which might be *E. masoni*, we found 58 species in total. Hence, the list of species identified for Cambodia now includes 84 items.

The end of the dry season is perhaps the worst time for Odonata: in those species which pass this season as imagines only the last survivors seems to remain. Others, such as some lotic species, that spend the season as larvae, only started to emerge. Some peculiarities of this time of the year can be however noticed.

In the Oriental region, the complex of common species of secondary lentic habitats such as ditches and ponds scarcely depends on time of the year. We observed it in the westernmost and easternmost points of our trip, in the surroundings of Koh Kong and Kep and found even this complex impoverished. A considerable shortage of coenagrionids was noticeable, including the rarity of the commonest *I. senegalensis* and *Agriocnemis* spp. Of the latter, only *A. pygmaea* has been recorded. *A. femina* (Brauer, 1868) which is the commonest elsewhere, is still not recorded for Cambodia. Rather surprising was scarcity of usually omnipresent *P. flavescens* (except at Phnom Bokor where it was present in immense), *O. sabina* and *B. contaminata* (the latter appeared



to be common in secondary habitats in Kep Province and was also found in an almost primary habitat at a river at Kbal Chhay). Most probably, these omnipresent species are also apt to some seasonality and were depleted in that hottest time of the year. The most abundant species everywhere of this complex appeared to be *N. tullia*; quite common were *D. trivialis*, *C. servilia*, *B. chalybea* and *A. panorpoides*. Much less expected was the abundance of *C. cerinorubellum* that was found at almost any pool at Koh Kong.

A species abundant in all examined sites (but the Kep environs) and in both primary and secondary habitats was *N. fluctuans*, less abundant but omnipresent were *N. fulvia* and *T. aurora*.

Primary habitats were more interesting but at this season rather poor in odonates. Mangroves seemed devoid of them in this season, only few individuals of the most common species *N. tullia*, *N. fluctuans*, *D. trivialis*, *T. tillarga* were found in the vicinity of mangroves. The salinity of water should be at maximum at this time but it is not clear at what stage and where the mangrove-dwelling odonate species survive the dry season. Perhaps in the surrounding forested hills, where we met a male of one of those, *B. oculata*. Almost no odonates were observed at the remarkable large and long lower reaches of major rivers. The lowland section of the Tatai River looked like a wide river with arboreal vegetation (not mangroves) at banks and to our northern view superficially appeared perfect for dragonflies but none were seen. In fact, the amount of freshwater brought by the actual rivers in this season was insufficient to fill such wide and deep lowland sections, which hence were rather estuaries than rivers. Their level reflected tide, the current seemed to change its direction accordingly, and salinity was probably unstable. We happened to taste water twice in the afternoon: in the left Tatai somewhat upstream the bridge', and it was fresh, and somewhat downstream the bridge', and it appeared salty. Anyway, in both cases the water was too warm (about body temperature) and should contain a very small amount of oxygen that, along with an unstable salinity, makes it hostile for Odonata larvae.

Of rather fruitful habitats, we examined the valleys of several major rivers and their rapids and a number of existing and dried brooks. All of them except for a brook in the Kep hill had round holes, often filled with black water, on large sandstone plates and were mostly exposed to sun. Every time we encountered such a habitat (except the Thma Bang area) it was guarded by males of *O.*



*chrysis*, and in many cases *L. asiatica* (not a single female of either species was noticed). These dragonflies were not observed in other habitats. As a rule, *T. aurora*, *N. fluctuans*, *N. fulvia* and *D. trivialis* were also present but they are generalists. Another odonate commonly found, although not so readily noticeable, in such habitats was *C. vittata*, known to prefer such small water holes if shady. All these species but *L. asiatica* were observed also at the Kep hill, near pools of forest brooks with some lime stones (*O. chrysis* was scarce there while *C. vittata* was very abundant in one place).

But it is the lotic species that are of most interest in tropics. Of those, two were seen almost invariably, one under the sun, the other in deep shade. At all rivers with sandstone beds and boulders, often with waterfalls, in Koh Kong Province, namely Koh Por, Tatai and Thma Bang, there were males of *D. gloriosa* guarding sunny boulders near the troubled water. Another species invariably seen in the shade at any river (for some reason except for Koh Por) or brook valley (including brooks that were absolutely dry at this time) was *V. gracilis*. The meetings of *E. masoni* suggests that this species prefers minor rivulets and brooks with stony beds (a Thma Bang left tributary, a Right Tatai right tributary and a joint Tatai right tributary, the latter without water) and keeps to vegetation (especially hanging bamboos). *P. autumnalis*, a species preferring slow current water, was abundant at the Koh Por River, Thma Bang River tributary and recorded at brooks at Tatai Waterfall. All other lotic species were encountered once or twice. The Thma Bang River and its tributary were most fruitful, providing, in addition to the three mentioned above, also *N. chinensis*, *H. perforata*, *Microgomphus* sp. and *Burmagomphus* sp. and two rather common species of *Pseudagrion*: *P. rubriceps* and *P. willamsoni*. The richness of these middle reaches of medium-sized rivers quite deep in the Cardamons was not surprising. River headwaters would seem more promising, but at this season they most probably are chains of stagnant pools: although the visited middle reaches of the Thma Bang River and its tributary were wide and deep, the actual amount of flowing water was very small. It was also noteworthy that *D. gloriosa* and *P. autumnalis* at Koh Por and the same two species and *Microgomphus* sp. and *Burmagomphus* sp. at Thma Bang were actively emerging, most probably in advance of the rainy season not to be washed as larvae by high water.

In three quite distant sites: the Koh Por Waterfalls, a stony bed of a temporary brook at Phnom Daung Bridge across the Tatai River (Koh Kong Province), and



in the lowest reaches of a brook at the recreation centre of Ream National Park (Kampong Saom Province) we found males of *C. kazukoae*. Each time the habitats were identical: shaded ground bluffs in sandstone valleys: in the first case the bluff was large, situated aside a major river valley, and had water seepages; in the second time it was small and the brook valley was dry; in the third case the bluff was also small but the brook had very small amount of red water. Hence, this species described from the Cambodian coast is indeed at home there. Unfortunately, no other *Coeliccia*, or any Platystictidae or Megapodagrionidae preferring similar habitats, were recorded.

Records of other interesting species were singular and show no regularity. Noteworthy is presence of different species of *Prodasineura* in Koh Kong Province (*P. autumnalis*) and at Kep (*P. cf. verticalis*), and that in some genera with a number of possible options we found just species already recorded for Cambodia, such as *Libellago hyalina*, *Heliocypha perforata*, *Agriocnemis pygmaea*, *Ceriagrion malaisei*, that is a sign of some reproducibility of faunistic data.

The challenging (if not crazy) supposition of conspecificity of the well-known and widely accepted *R. phyllis* and *R. variegata* demands a thorough check. I am sceptical as to the ability of molecular phylogenetic methods to resolve biological species from conspecific entities in all cases, but in sympatry a strict correlation of some molecular character with functionally unrelated external characters claimed to be diagnostic would indicate different species (correlation by descend). By contrast, independent segregation for molecular and external diagnostic characters would stand for the same species. I plan to collect DNA material of those *Rhyothemis* from some localities in Cambodia for analysing some variable mitochondrial DNA sequences.

On this trip we explored just the Cardamon foothills, with just two escapades into the mountains: to Thma Bang area (ca 350 m above sea level) and Bokor Hill Station (ca 1000 m). Hopefully, I shall manage to explore the mountainous interior of Koh Kong Province in a next planned trip in autumn.

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**Figure 45. From left to right: Natalya Priydak, Alan Hanvey, Alan Andrews and a local gentleman on the road to Thma Bang village, 15.04.2010.**

accommodation at Nature Waterways Resort the next day after our acquaintance and for other valuable help, to Alan Hanvey (Fig. 45, second left) for help in that Thma Bang voyage and to my companion Natalya Priydak (Fig, 45, left) for permanent help in the field. I thank Alexey Yakovlev for identifying some plants and Sergey Kopyl for help in specimen photography. Klaus Reinhardt is specially acknowledged for kindly editing the content and language of the manuscript.

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