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**THE RELATIONSHIP BETWEEN MALE WING
PIGMENTATION AND CONDITION IN
ERYTHRODIPLAX FUNEREA (HAGEN)
(ANISOPTERA: LIBELLULIDAE)**

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Theory predicts that sexual traits ought to be related to physiological indicators of condition. In Zygoptera, for example, wing pigmentation expression (i.e. a sexual trait) correlates positively with ♂ immune response, fat reserves and muscle mass. Here, it is for the first time investigated for anisopterans, whether such relationships hold in ♂ *E. funerea*. ♂♂ in territorial activity, were collected and challenged to induce a melanization-based immune response. ♂ wing pigmentation was then correlated with melanin, fat reserves and muscle mass. Unlike previous results in Zygoptera, pigmentation was negatively related with immune response but no significant relation was found with fat and muscle mass. Furthermore, immune response showed no relationship with fat content or muscle mass. Possibly, the extremely high levels of male aggression observed in this sp. may have caused ♂♂ to make an unusually high allocation of resources to wing pigmentation which may have impaired immune response.

INTRODUCTION

It has been suggested that secondary sexual characters reflect the physiological condition of their bearers (ADAMO & SPITERI, 2009). As parasites may play a key role in their host's survival and fitness, one measurement of a host's

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physiological condition could be parasite load and/or immune response expression (HAMILTON & ZUK, 1982). These ideas have been fitted into the immuno-handicap principle, which dictates that males with better immunity or greater pathogen resistance leave more offspring during reproductive competition (HAMILTON & ZUK, 1982).

One group in which the above ideas have been tested profusely is the Zygoptera (SUHONEN et al., 2008). In these animals, it has been suggested that the basis of the relationship between immune response and secondary sexual characters is melanin production, as this compound is the pigment underlying wing pigmentation (HOOPER et al., 1999), and it is used also for encapsulating relatively large pathogens during immune response (NAPPI & CHRISTENSEN, 2005). For example, melanin is related to pigmentation, the amino acids that form melanin (tyrosine and phenylalanine) being involved in male wing pigmentation in the calopterygid *Mnais costalis* (HOOPER et al., 1999). Furthermore, in studies on Zygoptera, two other components of male condition have been shown to be important which are fat reserves and muscle mass, two key traits during territorial defense (PLAISTOW & SIVA-JOTHY, 1996). For example, territorial males had more fat load and muscle content than non-territorial males (MARDEN & WAAGE, 1990; PLAISTOW & SIVA-JOTHY, 1996; KOSKIMÄKI et al., 2004; CONTRERAS-GARDUÑO et al., 2006) and old mature males had lower fat reserves and muscle mass levels than young mature males (possibly due to exhaustive reproductive activities of the former (CONTRERAS-GARDUÑO et al., 2008). However, the idea that wing pigmentation may indicate male condition (linked to immunity and flying ability) has not been explored in anisopterans. The closest study of this type is that of the libellulid *Erythemis vesiculosa* in which territorial males were found to have a higher melanization-based immune response than non-territorial males (CÓRDOBA-AGUILAR & MÉNDEZ, 2006). One excellent species on which to test these ideas is *Erythrodiplax funerea*, a territorial dragonfly whose males engage in highly aggressive fights for the possession of territories (BUSKIRK & SHERMAN, 1985). Males of this species bear wing pigmented patterns which may be interpreted as secondary sexual characters, such as occurs in Calopterygidae. In this paper, we explore the expression of wing pigmentation with the melanin-based immune response, fat reserves and muscle mass.

MATERIAL AND METHODS

We collected *Erythrodiplax funerea* in a pool in Tehuixtla, Morelos, Mexico (18°32'56" N, 99°16'23" W, August, 2006). Only mature males that engaged in fighting were collected. To recognize such "mature" males, we followed the age classification of PLAISTOW & SIVA-JOTHY (1996) and used sexually active animals with hard wings with some wear at their tip and signs of pruinescence. This control of age was used because fat reserves, muscle mass (PLAISTOW & SIVA-JOTHY, 1996) and immune response (KURTZ, 2007) change with age.

MELANIN IMMUNE RESPONSE — A previously disinfected nylon implant (1 mm length, 0.2

mm diameter) was inserted through the fourth abdominal pleura on the ventral mid-line using fine forceps. The implant becomes covered by melanin, which is the insect's immune response towards this kind of invasion (WIESNER & GOTZ, 1993). After implant insertion, animals were placed individually in plastic, transparent containers ($4.5 \times 1.4 \text{ cm}^2$) with a piece of wooden for perching and a piece of damp cottonwool to avoid dehydration. After 24 h, while the animal was still alive, the implant was retrieved by carefully cutting out the abdominal cuticle surrounding the implant under a dissecting microscope. The implant was preserved in 70% ethanol for 7 days and, prior to melanin measurement, rehydrated for 24 h. For melanin quantification, each implant was placed on a slide under a coverslip and placed under a stereoscopic microscope which was connected to a digital camera and a computer. Three photographs from each implant (each in a different, random position) were taken and a mean of the relative percentage of melanin cover was calculated. The relative percentage was measured using Image Tool for Windows® version 3.0.

FAT RESERVES AND MUSCLE MASS ESTIMATION – For fat measurements, the head of those males used for the immune response, was removed and the rest of the body was placed in a desiccator. We followed the protocol of PLAISTOW & SIVA-JOTHY (1996), which is based on fat extraction using chloroform immersion. During this, we recorded the weight (in g) of the animal before and after the extraction; this giving a measure of the fat reserves of the individual. Using these animals and knowing that chloroform does not have an effect on further measurements of muscle mass (e.g. CONTRERAS-GARDUÑO et al., 2008), this trait was then measured by immersing the thorax in potassium hydroxide (0.2 M) for 48 h (PLAISTOW & SIVA-JOTHY 1996). The weight of this body region was measured before and after treatment, the difference being interpreted as the thoracic muscle mass.

WING PIGMENTATION MEASUREMENT – We used the same set of males whose immune response, fat reserves and muscle mass were measured indicated above. Wing pigmentation was measured by cutting the hind- and forewings (at their point of insertion). A digital picture was taken of each wing and the relative percentage of the pigmented areas was measured using Image Tool for Windows® version 3.0. A mean was obtained from the four wings.

The observer was always “blind” in relation to all measurements (immune response, fat reserves, muscle mass and wing pigmentation).

RESULTS

We found a significant negative relationship between wing pigmentation and the area of melanin around the implant ($r_{\text{spearman}} = -0.75$, $P = 0.001$, $N = 14$) (Fig. 1).

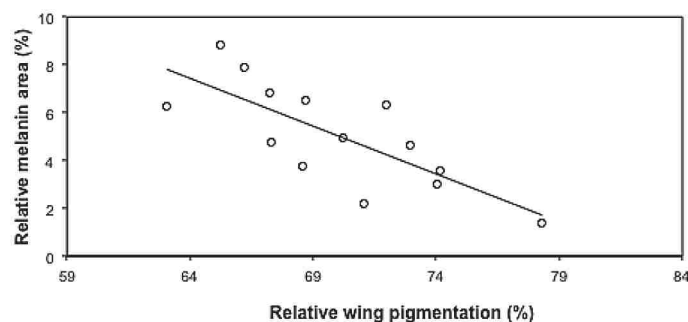


Fig. 1. The relationship between the amount of melanin around the implant and the degree of wing pigmentation.

However, neither fat reserves ($r_{\text{spearman}} = 0.22$, $P > 0.05$, $N = 14$) nor muscle mass ($r_{\text{spearman}} = -0.01$, $P > 0.05$, $N = 14$) were related to wing pigmentation. Neither was there any relationship between either fat reserves ($r_{\text{spearman}} = -0.48$, $P > 0.05$, $N = 14$) or muscle mass ($r_{\text{spearman}} = -0.07$, $P > 0.05$, $N = 14$) with melanin area around the implant.

DISCUSSION

Contrary to what has been found in damselflies, in *E. funerea* we found a negative relationship between the degree of wing pigmentation and melanin production in males; no relationship was found between degree of pigmentation with fat reserves or muscle mass. There are several explanations for these unusual findings. First, we suspect that sexual selection intensity is higher in this species than in zygopterans. This comes from the fact that during the collecting session, approximately 5 out of 41 males were observed to die during their territorial contests. While fighting, males made regular contact with each other, which even included bites. After such contacts, males ended up with broken wings and fell into the water (J. Contreras-Garduño, pers. obs.). One reason for this extreme level of aggression is that the pools that these animals use are ephemeral, unpredictable and short lasting (~30 days; J. Contreras-Garduño, unpublished data). Possibly, males invest unusually high levels of resources towards wing pigmentation and aggression, negatively affecting their immune response. A similar rationale has been put forward when male-male competition is very high (ZUK & STOEHR, 2002).

One other non-mutually exclusive explanation is related to juvenile hormone (JH) levels. The link between wing pigmentation expression and aggression level is well known in damselflies as more pigmented and aggressive males are more likely to become territory owners than less pigmented and less aggressive males (see for example, GRETHER, 1996). Furthermore, JH positively affects aggression: males with increased JH spent more time in fighting to defend a territory than control males (CONTRERAS-GARDUÑO et al., 2009). JH also affects phenoloxidase expression (CONTRERAS-GARDUÑO et al., 2009; RANTALA et al., 2003), which is involved in melanin formation during immune defense (CERENIUS & SÖDERHÄLL, 2004). If more aggressive and pigmented males show high JH levels, it is possible that a negative correlation will be found between both pigmentation and aggression with melanin production.

It has been suggested recently that fat content is not related to the flight or fight behavior but that its carrier apolipophorine III is (ADAMO et al., 2008). This protein is a sensor of the immune response and during energy-demanding behaviors, it combines with a high density lipophorine to form low density lipophorin. This last molecule can carry the lipids liberated from the fat body needed to fuel expensive behaviors such as the flight/fight behavior (revised in ADAMO et al.,

2008). During an immune challenge with crickets, the lipid content was not related to the immune response but the apolipophorin III levels were related, suggesting that this molecule rather than fat reserves is related to immune response (ADAMO et al., 2008). Whether this applies to *E. funerea* awaits further investigation.

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**NOVEL LIGATURE METHODS FOR STUDYING
SUBLETHAL EFFECTS OF SIT-AND-WAIT PREDATORS:
TEST USING *CORDULEGASTER BOLTONII*
(DONOVAN) LARVAE
(ANISOPTERA: CORDULEGASTRIDAE)**

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A novel method of labial palp ligature was tested as a substitute for palp ablation for studying sublethal effects of larvae of *C. boltonii* on prey populations and their consequences for ecosystem functioning. Two alternative types of ligature were designed to test for neutral or aggressive, but non-lethal, predator-prey interaction effects. Ligature efficiency in preventing prey capture was very high and the effects on larval survival and emergence success were negligible. Potential advantages and drawbacks, compared to other methods, are discussed. The results indicate that this fully reversible method should be applied whenever possible, especially for naturally rare or endangered odon. spp.

INTRODUCTION

Predators can have indirect consequences on prey communities that extend beyond direct predator-induced mortality, although very few studies have compared the relative importance of lethal and sublethal effects of predators (LIMA, 1998; PREISSER et al., 2005). Thus, investigation of the sublethal consequences of prey responses to predators is essential to fully understand predator impacts on prey populations and ecosystem functioning (PECKARSKY et al., 1993; ANHOLT & WERNER, 1998; LIMA, 1998). Until recently, very few studies have

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considered or focused on these “indirect” (i.e. sublethal) predator effects (PECKARSKY et al., 2008). For example, sublethal effects of odonate larvae on prey populations are often not measured (JOHNSON et al., 1987), or are assumed to be negligible compared with direct prey mortality through predation and consumption (WOODWARD & HILDREW, 2002a). However, predator avoidance can induce significant sublethal costs for aquatic invertebrates (PECKARSKY et al., 1993).

Studies considering sublethal effects of odonate larvae have often used caged animals that could not interact physically with their prey (TOUCHON & WARKENTIN, 2008; STAMPER et al., 2009). However, by segregating prey and predator, this method prevents physical encounter and accounts mostly for chemosensory interactions, excluding or interfering with other important cues (tactile or visual for example) through which prey can detect predators (BARBOSA & CASTELLANOS, 2005). Some experimental results have clearly highlighted the importance of investigating freely interacting predators and prey when studying potential effects of predator-prey physical interactions (HAMMOND et al., 2007).

Some studies have assessed the effects of sublethal interactions between larval odonates and their prey by removing the labial palps (VAN BURSKIRK, 1989; WISSINGER & McGRADY, 1993). These structures are at the distal end of the mentum, the extendable mouthpart used to capture prey. Individuals with the labial palps ablated are unable to capture large prey (VAN BURSKIRK, 1989; WISSINGER & McGRADY, 1993). Such larvae are thus assumed to interact physically with prey without causing fatality of the latter, thereby allowing sublethal effects to be tested.

However, there are several major issues to labial palp removal. It is ethically questionable and it increases larval mortality significantly (VAN BURSKIRK, 1989; WISSINGER & McGRADY, 1993). Also, it is irreversible and compromises larval growth (moulting) and emergence into the adult (WISSINGER & McGRADY, 1993). This clearly becomes problematic when considering rare or endangered species. Finally, this method is scientifically debatable as larvae with labial palps removed seem to adjust and switch to smaller prey that they are still able to capture, even without their mandibles (VAN BURSKIRK, 1989). This clearly induces a confounding factor when studying the predator’s sublethal effects.

Here we propose and describe an alternative method that allows predator-prey physical interactions without prey fatality and thus enables the study of the sublethal effects of odonate larvae on prey populations. This method uses a single ligature to prevent odonate larvae from capturing and killing prey. It is also adjustable to the type of predator-prey interaction under study, either antagonistic (predator aggression toward prey) or neutral (predator presence without aggression).

MATERIAL AND METHODS

STUDY SITE AND MODEL SPECIES – Animals were collected in the Montagne Noire, south-western France, a 1,450-km² highland region covered by a mixed broad leaf forest. It is drained by a high density of structurally similar first and second-order permanent streams (LECERF et al., 2005). Forestry management is the only major anthropogenic disturbance, without however any marked alterations of stream habitats (LAITUNG et al., 2002). These habitats are highly favourable to cordulegastrid dragonflies (ASKEW, 1988; FERRERAS-ROMERO & CORBET, 1999) and contain high densities of larvae of *Cordulegaster boltonii* (Donovan). Larvae used in our experiments were collected from a single 500 m reach in the Peyreblanque stream (43°25'N, 2°13'E; elevation, 750 m a.s.l.). Animals were captured using hand-nets (0.5 mm mesh size) and dredging the fine sediments of depositional zones where *C. boltonii* larvae burrow (FERRERAS-ROMERO & CORBET, 1999). Larvae were brought back to the laboratory and maintained at 14°C in 50 L coolers filled with aerated stream water until required. Two centimetres of sand (1 mm < Ø < 2 mm) were added to allow the larvae to burrow.

LIGATURES – Ligatures were done using a fine surgical needle and

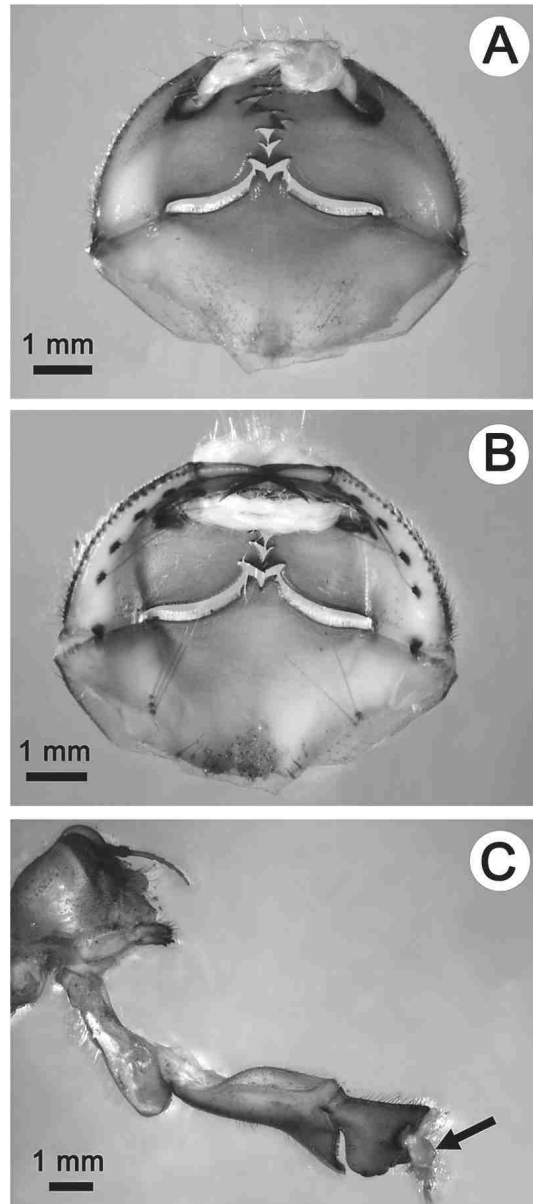


Fig. 1. Pictures of a type I ligature blocking the labial palps in the closed position but allowing full extension of the labium (prementum and submentum): – (A) ventral view of the ligature holding the labial palps closed; – (B) dorsal view of the same ligature; – (C) lateral view of the ligatured odonate larva's head with its labium fully extended and the labial palps maintained closed by the ligature (indicated by the black arrow). – [In the pictures, for visibility purposes, white cotton thread was used for the ligature instead of microbraided black nylon filament]

microbraided black nylon filament ($\varnothing = 0.1$ mm). Head-mounted magnifiers were used for precision. During ligation, the labium was gently extended to avoid wounding the larva's head with the needle; no chemical anaesthetic was needed during the operation. The filament was then passed through the first labial palp by piercing the cuticle with the surgical needle and back through the second palp to form a loop with the filament. The loop was loosely tightened to avoid injuries to the larva but still

prevent predation. Finally, ligatures were secured with a surgeon's knot. Two alternative ligation types were used. A first method (ligature type I) was designed to block the mandibles (i.e. labial palps) in the closed position (Fig. 1A and 1B) but allow normal extension of the labium (Fig. 1C). The second ligation method (type II) prevented both extension of the labium and opening of the mandibles; the filament going over the head-labium joint thus preventing prementum-submentum joint extension (Fig. 2A and 2B). When completed, both ligation types gave a superficially similar aspect to *C. boltonii* larvae (Fig. 2C).

SURVIVAL AND FEEDING TESTS — To test for ligation durability and efficiency in preventing

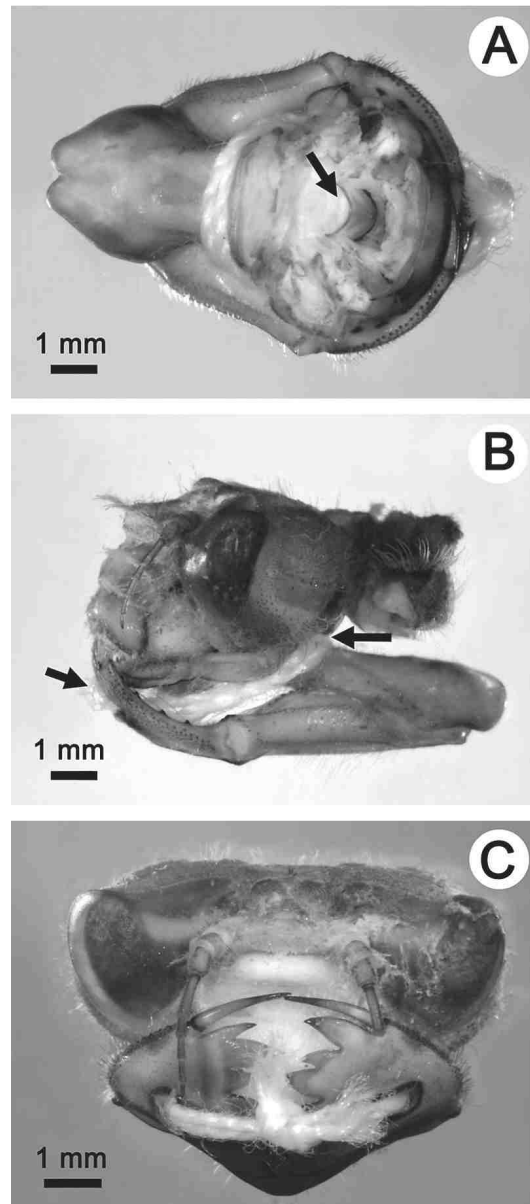


Fig. 2. Pictures of a type II ligation preventing both extension of the labium and opening of the labial palps: (A) dorsal view of the ligation going over the head-labium joint and preventing prementum-submentum joint extension (the black arrow indicates the position of the oesophagus); — (B) lateral view of the odonate larva's head with the labium maintained folded (resting position) and the mandibles closed by the ligation going through each labial palp and around the back of the head-labium joint (ligature indicated by black arrows); — (C) frontal view of the ligatured larva's head. — [Note that both ligation types appear superficially similar when completed. In the pictures, for visibility purposes, white cotton thread was used for the ligation instead of microbraided black nylon filament]

larvae from feeding, as well as possible ligature-induced mortality, control and ligatured *C. boltonii* larvae were kept in enclosures at the study site. For uniformity between treatments, only final instars of *C. boltonii* larvae with no external signs of metamorphosis were used in ligature tests (FERRE-RAS-ROMERO & CORBET, 1999). Thirty control (i.e. not ligatured) and 54 ligatured (27 with type I and 27 with type II ligatures) individuals were held individually in small 10 mm plastic mesh cages ($10 \times 10 \times 10$ cm). Cages were anchored to the stream substrate and contained 2 cm of sediment to allow burrowing. A third of the cages were retrieved after each of 7, 14 and 25 days to assess for temporal ligature effects on *C. boltonii* survival. Survival was compared in a pair-wise manner between treatments (control, type I and type II ligature) and treatment durations (7, 14 and 25 days) using Fisher's exact tests.

At the end of the survival test, *C. boltonii* larvae were returned to the laboratory and ligatures were removed using fine clippers. Larvae were kept individually in 400 mL containers filled with stream water. Animals were checked daily for a week or until faeces were released. Odonate larvae produce compact faeces enclosed in a strong peritrophic membrane, forming a faecal pellet allowing diet examination (LAWTON, 1970). These pellets were collected, fixed in 70% ethanol and examined under a compound microscope. Presence of sclerotized animal parts (mandibles or claws for example) in faecal contents indicated that larvae were able to kill and eat prey. Larvae were then offered four amphipods [*Gammarus fossarum* (Koch); Amphipoda: Gammaridae], which are large and fast moving prey, to test for post-ligature effects on *C. boltonii* predation abilities. Finally, larvae retrieved after 7 and 14 days were released at the study site. Individuals held in cages for 25 days were kept in the laboratory for emergence tests.

EMERGENCE TEST — Twenty-seven larvae held in cages at the study site for 25 days were kept in the laboratory to test for post-ligature effects on *C. boltonii* emergence success. Ten control and 17 previously ligatured (9 type I and 8 type II; one type II ligatured larva died before the cages were retrieved) individuals were kept in three separate 15 L aquaria (one per treatment group) filled with aerated stream water and 2 cm of sand. Emergence cages (5 mm diameter plastic mesh) were anchored to the substrate in the middle of the aquaria, allowing emergence (PURSE & THOMPSON, 2003). Larvae were fed *ad libitum* with live *G. fossarum*. Aquaria were checked daily for a month for newly emerged individuals (tenerals). Tenerals were retained until their body hardened, enabling flight. Emergence was considered successful for animals released alive and capable of flying. Deaths during emergence or deformities preventing flight were recorded. Furthermore, the labium of each newly emerged larva was checked for ligature-induced problems. Proportions of individuals that successfully emerged (i.e. emergence success rates) were compared in a pair-wise manner between treatments (control, type I or type II ligature) using Fisher's exact tests.

RESULTS

SURVIVAL AND FEEDING TESTS

Two individuals (one in type I and one in type II ligature treatments) lost their ligature during the experiment, but whether they actively removed it or it was not properly secured could not be determined.

Overall, mortality was very low and there was no significant ligature-induced mortality in caged animals; only one ligatured (type II ligature) larva died. Survival rates were not significantly different between treatments: control (100%), type I ligatures (100%) and type II ligatures (96.3%) ligatures (Fisher's exact tests in pair-wise comparisons; all $P > 0.05$). Similarly, mortality rates of ligatured individuals were not significantly different between treatment durations (Fisher's

exact tests; all $P > 0.05$). Contrary to labial palp ablation (WISSINGER & McGRADY, 1993), ligatures did not cause unsuccessful moulting or metamorphosis. Ligatures induced minimal damage and were effectively fully reversible. Indeed, after ligature removal, all animals resumed feeding and consumed the four *Gammarus fossarum* within 24 hours regardless of treatment origin (control, type I or type II ligatures).

All but one of the 30 larvae from the control treatment released faecal pellets and had thus been feeding hours before being brought back to the laboratory. Accordingly, all 29 pellets contained sclerotized parts of larval insects (Plecoptera, Ephemeroptera, Trichoptera and Coleoptera) or of the crustacean *G. fossarum*. In contrast, a third of ligatured larvae (8 type I and 9 type II ligatured individuals) did not release faecal pellets. Faecal pellets released by the other ligatured larvae did not contain animal remains but constituted an empty peritrophic membrane. Ligatured larvae were thus effectively unable to capture and eat their usual prey or even smaller ones. However, the two larvae that had lost their ligatures had indeed resumed feeding and released faecal pellets containing larval insect parts.

EMERGENCE TEST

After a month, two control, two type I and one type II individuals were still alive but yet to attempt emergence and were thus released at the study site. All remaining larvae (8 control and 7 of each ligature type) had made an attempt at emerging and were included in the analyses. Three individuals, one in each category, died during emergence. In all three cases, ecdysis was incomplete and tentacles were found dead, still partly embedded in the exuviae. Additionally, one individual from the control treatment was deformed, having crumpled wings and a bent abdomen; it was clearly not viable and was not considered as successfully emerged. In pair-wise comparisons, emergence success rates were not significantly different between control (75%), type I (87%) and type II (87%) ligatured *C. boltonii* larvae (Fisher's exact tests; all $P > 0.05$). Furthermore, the labium of newly emerged individuals did not bear any effects, such as scars, from the ligatures.

DISCUSSION

Prey often appear unable to locate odonate larvae and, following encounter, seem physically too slow to evade the typically rapid dragonfly larva attack (<20 ms; PRITCHARD, 1965). However, previous experiments showed that up to 40% of *C. boltonii* attacks were unsuccessful (WOODWARD & HILDREW, 2002b). Odonate larvae can thus interact with their prey without an obligatory fatal output but potentially have sublethal effects (stress or increased emigration rate, for example) on prey populations. Sublethal components of predator effects on prey

need to be decoupled from direct prey consumption to fully understand the top-down effects of these predators on aquatic ecosystems.

By permitting predator-prey physical interactions but preventing odonate larvae from actually capturing and eating their prey, ligatures allow testing for predator sublethal effects. This could be done through field and/or laboratory microcosm studies, combining type I (presence with aggression but without prey consumption) and type II (presence without aggression towards prey) ligatures as well as non-ligatured predators and a control treatment without the predator. This novel approach could substantially advance our understanding of the impacts of sit-and-wait invertebrate predators for which sublethal effects have been considered minor so far (WOODWARD & HILDREW, 2002a, 2002b), especially when compared to active predators (PECKARSKY et al., 1993; PECKARSKY & COWAN, 1995; SIH et al., 1998). Furthermore, odonate larvae are comparatively large-bodied invertebrates, potentially influencing smaller invertebrate species independently of predation, through competition for space and/or biotic disturbance, during burrowing phases for example. Overall, type I and type II ligatures should help shed light on the relative importance of predation, sublethal antagonistic interactions (type I ligature) and biotic disturbance (type II ligature) in determining prey distribution.

Compared to labial palp ablation, the method described herein is fully reversible and caused only minor lesions, i.e. a small puncture hole in each labial palp. As a result, ligatures were associated with extremely low mortality in *C. boltonii* larvae and had no effect on metamorphosis and emergence success. Furthermore, preliminary experiments in laboratory microcosms indicate that ligatured animals still behave as sit-and-wait predators, spending long periods of immobility in a buried position interrupted by short periods of active search for new hunting locations. This suggests that ligatures do not greatly affect animal behaviour, thus confirming the validity of our approach to address mechanistic issues in top-down effects of *C. boltonii* in stream food webs. We also believe that contrasting type I and type II ligatures will help shed light on the relative importance of sub-lethal predation due to aggressive behaviour (type I ligature) and biotic disturbance to the substrate (type II ligature) in determining prey distribution.

As animals used in ligature experiments can be released, this novel method is ethically less arguable than palp ablation and is absolutely necessary when using endangered or protected species. However, the method presents some shortcomings. Notably, it is not applicable to all odonate species; for example, larvae with hook-shaped labial palps, such as in the Aeshnidae, are unsuitable. Furthermore, there may be a size limitation in the application of our ligature methods, depending on odonate species and instar classes. Preliminary experiments on *C. boltonii* showed that larvae as small as F-2 instars could be ligatured (see FERRERAS-ROMERO & CORBET, 1999 for instar size classes). In our study, some *C. boltonii* larvae were also able to remove the ligature. This could probably be pre-

vented by using stronger ligatures. Despite these drawbacks, ligature methods should be considered whenever possible as the preferred alternative to labial palp ablation.

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ODONATA OF THE EASTERN BLACK SEA REGION OF TURKEY, WITH SOME TAXONOMIC NOTES

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The work is based on a collection of 2759 specimens, referable to 50 spp./sspp. brought together during 2005-2007 from 154 localities. *Sympecma fusca*, *Coenagrion ornatum*, *Erythromma viridulum orientale*, *Anax parthenope*, *Onychogomphus forcipatus albotibialis*, *O. lefebvrei*, *Sympetrum depressiusculum* and *S. meridionale* are new for the region. The *O. lefebvrei* record is the northernmost one within Turkey. Geographic distribution and taxonomic characters of *Calopteryx splendens amasina*, *C. s. waterstoni*, *C. virgo festiva*, *Ischnura elegans ebneri*, *I. e. pontica*, *Onychogomphus lefebvrei* and *Sympetrum haritonovi* are discussed.

INTRODUCTION

While many papers discuss the odonate fauna of Turkey (e.g. DUMONT, 1977; DEMİRİSOY, 1982; KALKMAN et al., 2003, 2004; VAN PELT, 2006a, 2006b), our knowledge of the Eastern Black Sea Region is mainly based on the studies by DEMİRİSOY (1982), KALKMAN et al. (2004) and VAN PELT (2004). DEMİRİSOY (1982) recorded 26 spp./sspp. from this region, whereas more recently KALKMAN et al. (2004) and VAN PELT (2004) listed 33 taxa. Most of the Demirsoy's records are from Erzincan-Kemaliye. The other region have not yet been studied in detail, therefore, the present paper focuses on the odonatologically relatively unexplored provinces of the Eastern Black Sea Region.

The Black Sea Region, from the eastern edge of Sakarya plain in the West, to Georgia in the East, is divided into three subregions: the West, Centre and East. The Eastern Region extends from East of Melet Stream to the border of Geor-

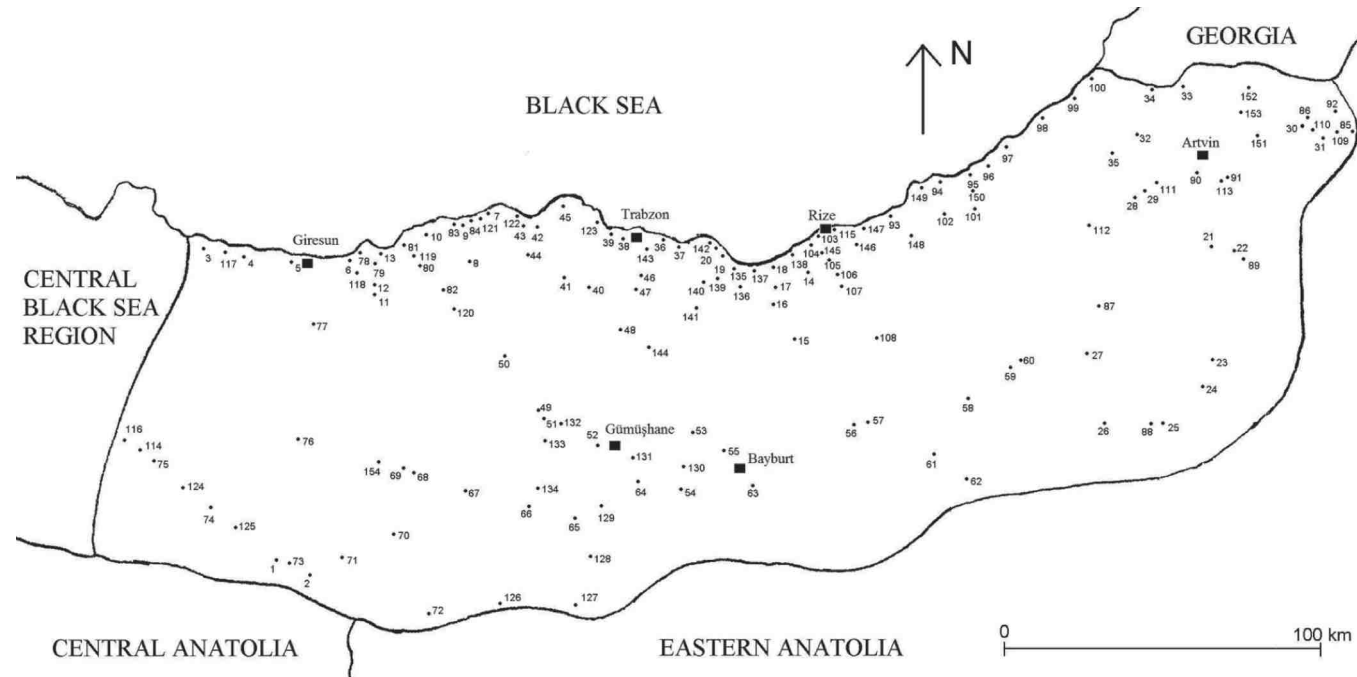


Fig. 1. Topographic position of the Odonata collection localities in the Eastern Black Sea region (Turkey).

LIST OF LOCALITIES, WITH LOCALITY NUMBERS, COORDINATES, ALTITUDE AND COLLECTION DATES

Locality No.	Province	Locality	Coordinates	Altitude (m)	Date	Locality No.	Province	Locality	Coordinates	Altitude (m)	Date
1	Sivas	Akıncılar-Yağlıca	40°06'N 38°17'E	859	17-V-2006 01-V-2006 21-VI-2007 21-IX-2007	13	Giresun	Espiye	40°56'N 38°41'E	sea level	08-VI-2006 17-VIII-2007
2	Sivas	Gölova-Boğazköy	40°05'N 38°31'E	1160	17-V-2006 21-VI-2007 21-IX-2007	14	Trabzon	Hayrat-Şişli	40°55'N 40°20'E	82	17-VII-2006 26-VI-2007 26-VII-2007
3	Giresun	Piraziz	40°57'N 38°06'E	sea level	05-VI-2006 13-VI-2007 25-VII-2007	15	Trabzon	Çaykara-Uzungöl	40°37'N 40°18'E	1109	17-VII-2006 26-VI-2007
4	Giresun	Bulancağ-Küçükklü	40°56'N 38°17'E	sea level	05-VI-2006 25-VII-2007	16	Trabzon	Çaykara-Koldere	40°42'N 40°14'E	448	17-VII-2006 26-VI-2007
5	Giresun	Batlama	40°54'N 38°21'E	sea level	05-VI-2006 13-VI-2007 25-VII-2007	17	Trabzon	Dernekpazarı-Akköse	40°47'N 40°14'E	251	17-VII-2006 26-VI-2007
6	Giresun	Keşap-Altınpınar	40°54'N 38°30'E	sea level	05-VI-2006 13-VI-2007 17-VIII-2007	18	Trabzon	Of-Balıca	40°53'N 40°16'E	48	17-VII-2006 26-VI-2007 26-VII-2007
7	Giresun	Eynesil	41°03'N 39°08'E	sea level	06-VI-2006 02-VIII-2006 14-VI-2007 25-VII-2007	19	Trabzon	Sürmene-Aşağıçavuşlu	40°55'N 40°04'E	sea level	17-VII-2006 26-VI-2007 26-VII-2007 08-VIII-2007
8	Giresun	Çanakçı-Kaledibi	40°56'N 39°00'E	89	06-VI-2006 02-VIII-2006 14-VI-2007	20	Trabzon	Araklı	40°56'N 40°03'E	sea level	17-VII-2006 26-VI-2007 26-VII-2007 08-VIII-2007
9	Giresun	Görece	41°01'N 38°59'E	sea level	06-VI-2006 14-VI-2007 25-VII-2007	21	Erzurum	Olur-Taşlıköy	40°45'N 41°55'E	830	21-VII-2006 04-VII-2007 07-VIII-2007
10	Giresun	Tirebolu-Akıncılar	41°00'N 38°51'E	18	06-VI-2006 13-VI-2007 25-VII-2007	22	Erzurum	Olur-Yeşilbağlar	40°46'N 42°06'E	947	21-VII-2006 08-VIII-2006 04-VII-2007 07-VIII-2007
11	Giresun	Yağlıdere-Kızılelma	40°51'N 38°37'E	89	08-VI-2006 14-VI-2007	23	Erzurum	Oltu	40°32'N 41°59'E	1277	21-VII-2006 04-VII-2007 07-VIII-2007
12	Giresun	Yağlıdere	40°52'N 38°37'E	77	08-VI-2006 02-VIII-2006 13-VI-2007	24	Erzurum	Oltu-Toprakale	40°27'N 41°59'E	1409	21-VII-2006 08-VIII-2006 04-VII-2007 07-VIII-2007

Locality No.	Province	Locality	Coordinates	Altitude (m)	Date	Locality No.	Province	Locality	Coordinates	Altitude (m)	Date
25	Erzurum	Narman-Karadağ	40°20'N 41°48'E	1798	21-VII-2006 08-VIII-2006 07-VIII-2007	36	Trabzon	Yomra	40°57'N 39°52'E	sea level	28-VII-2006 27-VI-2007 26-VII-2007
26	Erzurum	Tortum-Yukarısivri	40°20'N 41°37'E	1851	21-VII-2006 08-VIII-2006 04-VII-2007	37	Trabzon	Arsin	40°57'N 39°56'E	18	28-VII-2006 27-VI-2007 09-VIII-2007
27	Erzurum	Uzundere-Altınçanak	40°34'N 41°36'E	1025	07-VIII-2007 21-VII-2006 08-VIII-2006	38	Trabzon	Akyazı-Derecik	40°59'N 39°36'E	20	29-VII-2006
28	Artvin	Yusufeli-İnanlı	40°52'N 41°42'E	446	04-VII-2007 07-VIII-2007 21-VII-2006	39	Trabzon	Akçaabat-Söğütlü	41°00'N 39°34'E	25	29-VII-2006 14-VI-2007 10-VIII-2007
29	Artvin	Yusufeli-Demirkent	40°54'N 41°44'E	448	04-VII-2007 07-VIII-2007 26-VII-2005	40	Trabzon	Düzköy-Çalköy	40°52'N 39°24'E	656	29-VII-2006 10-VIII-2007
30	Artvin	Şavşat-Saylıca	41°20'N 42°20'E	1703	21-VII-2006 04-VII-2007 07-VIII-2007	41	Trabzon	Tonya-Çamlı	40°54'N 39°17'E	873	29-VII-2006 10-VIII-2007
31	Artvin	Şavşat-Elmalı	41°15'N 42°20'E	902	21-VII-2006 08-VIII-2006 04-VII-2007	42	Trabzon	Vakfikebir-Güneyköy	41°00'N 39°17'E	41	29-VII-2006 14-VI-2007 10-VIII-2007
32	Artvin	Borçka	41°22'N 41°41'E	107	07-VIII-2007 17-VII-2005 22-VII-2006	43	Trabzon	Beşikdüzü-Akkese	41°02'N 39°12'E	18	29-VII-2006 14-VI-2007 10-VIII-2007
33	Artvin	Borçka-Karagöl	41°23'N 41°51'E	1477	03-VII-2007 12-VIII-2007 22-VII-2006	44	Trabzon	Şalpazarı-Üzümlü	40°58'N 39°11'E	207	29-VII-2006 14-VI-2007 10-VIII-2007
34	Artvin	Borçka-Muratlı	41°27'N 41°43'E	98	29-VI-2007 08-VIII-2007 13-VIII-2006	45	Trabzon	Çarşıbaşı	41°05'N 39°22'E	sea level	29-VII-2006 14-VI-2007 26-VII-2007
35	Artvin	Murgul-Akantaş	40°18'N 41°36'E	234	23-VII-2006 13-VIII-2006 29-VI-2007	46	Trabzon	Maçka-Esiroğlu	40°52'N 39°42'E	127	30-VII-2006 27-VI-2007 09-VIII-2007
					08-VIII-2007	47	Trabzon	Maçka	41°49'N 39°37'E	306	30-VII-2006 27-VI-2007
						48	Trabzon	Maçka-Yazlıtaş	40°44'N 39°33'E	639	30-VII-2006 27-VI-2007
						49	Gümüşhane	Torul-Budak	40°36'N 39°19'E	1004	30-VII-2006 23-VI-2007
						50	Gümüşhane	Kürtün-Özkürtün	40°40'N 39°08'E	656	30-VII-2006
						51	Gümüşhane	Torul	40°33'N 39°18'E	952	30-VII-2006 23-VI-2007

Locality No.	Province	Locality	Coordinates	Altitude (m)	Date	Locality No.	Province	Locality	Coordinates	Altitude (m)	Date
52	Gümüşhane	Tekkeköy	40°24'N 39°33'E	1219	30-VII-2006 23-VI-2007	72	Erzincan	Refahiye-Çavuşköy	39°58'N 38°40'E	1571	01-VIII-2006 21-IX-2007
53	Bayburt	Aydıntepe-Çig' demtepe	40°19'N 40°07'E	1575	30-VII-2006 22-VI-2007	73	Sivas	Akıncılar-Sevindik	40°05'N 38°26'E	1000	01-VIII-2006 21-VI-2007 22-IX-2007
54	Bayburt	Demirözü-Güneşli	40°11'N 39°55'E	1669	30-VII-2006 22-VI-2007 21-IX-2007	74	Sivas	Suşehri-Akçaağıl	40°12'N 38°04'E	812	01-VIII-2006 20-IX-2007
55	Bayburt	Danışment	40°14'N 40°09'E	1642	30-VII-2006 22-VI-2007	75	Sivas	Koyulhisar-Gölcük	40°15'N 37°54'E	673	01-VIII-2006 20-V-2007 24-IX-2007
56	Erzurum	Pazaryolu-Laleli	40°24'N 40°37'E	1358	31-VII-2006	76	Giresun	Şebinkarahisar-Saplıca	40°20'N 38°26'E	1272	01-VIII-2006 23-VI-2007 22-IX-2007
57	Erzurum	Pazaryolu	40°26'N 40°46'E	1277	31-VII-2006	77	Giresun	Derele-Heydere	40°42'N 38°27'E	358	01-VIII-2006 25-VII-2007
58	Erzurum	İspir	40°27'N 40°58'E	1207	31-VII-2006	78	Giresun	Keşap-Yolağzı	40°56'N 38°34'E	19	02-VIII-2006
59	Erzurum	İspir-Numanpaşa	40°33'N 41°04'E	1047	31-VII-2006	79	Giresun	Espiye-Demircili	40°54'N 38°39'E	39	02-VIII-2006 13-VI-2007 14-VI-2007 25-VII-2007 17-VIII-2007
60	Erzurum	İspir-Çamlıkaya	40°34'N 41°07'E	973	31-VII-2006	80	Giresun	Güce	40°54'N 38°48'E	347	02-VIII-2006 13-VI-2007 25-VII-2007
61	Erzurum	İspir-Mülköy	40°20'N 40°55'E	2010	31-VII-2006	81	Giresun	Tirebolu-Doğancı	40°58'N 38°45'E	sea level	02-VIII-2006 13-VI-2007 25-VII-2007
62	Erzurum	İspir-Karakale	40°12'N 40°58'E	2137	31-VII-2006	82	Giresun	Tirebolu-Eymür	40°51'N 38°51'E	90	02-VIII-2006 17-VIII-2007
63	Bayburt	Maden	40°09'N 40°24'E	1675	31-VII-2006 22-VI-2007	83	Giresun	Görele-Kuşçulu	41°02'N 38°58'E	18	02-VIII-2006 13-VI-2007
64	Gümüşhane	Köse-Şalyazı	40°14'N 39°48'E	1678	31-VII-2006 22-VI-2007 21-IX-2007	84	Giresun	Görele-Aralıköz	41°02'N 39°01'E	sea level	02-VIII-2006 25-VII-2007
65	Gümüşhane	Kelkit-Karaçayır	40°08'N 39°28'E	1421	31-VII-2006 22-VI-2007	85	Artvin	Şavşat-Kocabey	41°14'N 42°27'E	1917	27-VII-2005 05-VIII-2006
66	Gümüşhane	Şiran-Çilhoroz Gateway	40°10'N 39°16'E	1587	31-VII-2006 23-VI-2007 22-IX-2007	86	Artvin	Şavşat-Şalcı	41°20'N 42°19'E	1785	18-VII-2005 06-VIII-2006 02-VII-2007
67	Gümüşhane	Şiran-Belen	40°09'N 39°00'E	1289	01-VIII-2006 23-VI-2007 22-IX-2007						
68	Giresun	Alucra-Gürbulak	40°16'N 38°53'E	1627	01-VIII-2006 23-VI-2007 22-IX-2007						
69	Giresun	Alucra-Kamışlı	40°16'N 38°49'E	1564	01-VIII-2006 23-VI-2007 22-IX-2007						
70	Giresun	Çamoluk-Kaledere	40°08'N 38°48'E	1069	01-VIII-2006 21-IX-2007						
71	Sivas	Gölova	40°02'N 38°37'E	1301	01-VIII-2006 21-IX-2007						

Locality No.	Province	Locality	Coordinates	Altitude (m)	Date	Locality No.	Province	Locality	Coordinates	Altitude (m)	Date
87	Erzurum	Uzundere-Tortum Waterfall	40°39'N 41°40'E	1009	03-VIII-2007 06-VIII-2007 16-VIII-2007	99	Artvin	Hopa-Sugören	41°23'N 41°26'E	21	14-VIII-2006 29-VI-2007 27-VII-2007
88	Erzurum	Narman-Demirdağ	40°19'N 41°43'E	2005	08-VIII-2006 04-VII-2007 07-VIII-2007	100	Artvin	Hopa-Kemalpaşa	41°29'N 41°31'E	sea level	14-VIII-2006 29-VI-2007 27-VII-2007
89	Erzurum	Olur-Coşkunlar	40°45'N 42°11'E	1026	08-VIII-2006 04-VII-2007 07-VIII-2007	101	Rize	Çamlıhemşin-Dikkaya	41°05'N 41°02'E	18	14-VIII-2006 29-VI-2007
90	Artvin	Ardanuç-Ferhatlı	41°08'N 42°01'E	306	08-VIII-2006 04-VII-2007 07-VIII-2007	102	Rize	Hemşin-Yaltkaya	41°05'N 40°53'E	141	14-VIII-2006 28-VI-2007 27-VII-2007
91	Artvin	Ardanuç-Harmanlı	41°06'N 42°05'E	610	26-VII-2005 08-VIII-2006 04-VII-2007	103	Rize	Derepazarı-Bürtücek	41°01'N 40°25'E	sea level	15-VIII-2006 28-VI-2007 09-VIII-2007
92	Artvin	Şavşat-Karagöl	41°18'N 42°28'E	1616	20-VII-2005 10-VIII-2006 13-VIII-2007	104	Rize	İyidere	41°00'N 40°20'E	sea level	15-VIII-2006 28-VI-2007 27-VII-2007
93	Rize	Çayeli	41°05'N 40°42'E	sea level	14-VIII-2006 28-VI-2007 27-VII-2007	105	Rize	Kalkandere	40°55'N 40°25'E	63	15-VIII-2006 28-VI-2007
94	Rize	Pazar-Ocak	41°10'N 40°55'E	sea level	14-VIII-2006 28-VI-2007	106	Rize	İkizdere-Güneyce	40°49'N 40°28'E	253	15-VIII-2006 28-VI-2007
95	Rize	Ardeşen	41°11'N 40°58'E	sea level	14-VIII-2006 29-VI-2007 27-VII-2007	107	Rize	İkizdere	40°47'N 40°33'E	503	15-VIII-2006 28-VI-2007
96	Rize	Ardeşen-Işıklı	41°12'N 41°03'E	sea level	14-VIII-2006 29-VI-2007	108	Rize	İkizdere-Ovit Mountain Gateway	40°37'N 40°46'E	2731	15-VIII-2006
97	Rize	Fındıklı	41°16'N 41°09'E	sea level	14-VIII-2006 29-VI-2007	109	Artvin	Şavşat	41°14'N 42°22'E	1252	19-VII-2005
98	Artvin	Arhavi	41°21'N 41°17'E	sea level	27-VII-2007 14-VIII-2006 29-VI-2007 27-VII-2007	110	Artvin	Şavşat-Kayadibi	41°18'N 42°21'E	1488	24-VII-2005 27-VII-2005 03-VII-2007 12-VIII-2007
						111	Artvin	Yusufeli-Yarbaşı	40°58'N 41°45'E	445	26-VII-2005
						112	Artvin	Yusufeli-Nato Stream	40°48'N 41°32'E	634	26-VII-2005 04-VII-2007
						113	Artvin	Ardanuç-Ekşinar	41°06'N 42°03'E	515	26-VII-2005 07-VIII-2007
						114	Sivas	Koyulhisar-Çaylı	40°17'N 37°44'E	655	30-VI-2005 20-IX-2007

Locality No.	Province	Locality	Coordinates	Altitude (m)	Date	Locality No.	Province	Locality	Coordinates	Altitude (m)	Date
115	Rize	Centre	41°01'N 40°31'E	sea level	17-X-2006 28-VI-2007 27-VII-2007	136	Trabzon	Köprübaşı-Yağmurlu	40°50'N 40°06'E	179	26-VI-2007 26-VII-2007
116	Sivas	Koyulhisar-Sugözü	40°18'N 37°39'E	576	24-V-2007 20-IX-2007	137	Trabzon	Sürmene-Yeniay	40°54'N 40°10'E	sea level	26-VI-2007 09-VIII-2007
117	Giresun	Bulancak-Pazarsuyu	40°55'N 38°10'E	sea level	13-VI-2007 17-VIII-2007	138	Trabzon	Of-Doğançay	41°58'N 40°18'E	sea level	26-VI-2007 26-VII-2007
118	Giresun	Keşap-Dokuztepe	40°53'N 38°32'E	44	13-VI-2007 17-VIII-2007	139	Trabzon	Araklı-Bereketli	40°51'N 40°03'E	155	26-VI-2007 26-VII-2007
119	Giresun	Tirebolu-Şirinköy	40°55'N 38°47'E	277	13-VI-2007 25-VII-2007	140	Trabzon	Araklı-Değirmencik	40°51'N 40°00'E	75	26-VI-2007 08-VIII-2007
120	Giresun	Dog̃ ankent-Kozköy	40°50'N 38°54'E	145	13-VI-2007 25-VII-2007	141	Trabzon	Araklı-Taştepe	40°47'N 39°59'E	192	26-VI-2007 08-VIII-2007
121	Giresun	Görele-Çavuşlu	41°02'N 39°03'E	sea level	14-VI-2007 17-VIII-2007	142	Trabzon	Araklı-Yalıboyu	40°57'N 39°59'E	sea level	27-VI-2007 26-VII-2007 08-VIII-2007
122	Trabzon	Beşikdüzü	41°03'N 39°14'E	sea level	14-VI-2007 10-VIII-2007	143	Trabzon	İncesu	40°56'N 39°44'E	63	27-VI-2007 09-VIII-2007
123	Trabzon	Akçaabat-Darca	41°02'N 39°32'E	sea level	14-VI-2007 26-VII-2007 10-VIII-2007	144	Trabzon	Maçka-Sumela Monastery	40°41'N 39°39'E	1119	27-VI-2007
124	Sivas	Koyulhisar-Dilekli	40°14'N 37°57'E	707	21-VI-2007 20-IX-2007	145	Rize	İyidere-Denizgören	40°58'N 40°21'E	24	28-VI-2007 27-VII-2007
125	Sivas	Suşehri-Solak	40°10'N 38°07'E	911	21-VI-2007 20-IX-2007	146	Rize	Güneysu-Adacami	41°00'N 40°38'E	119	28-VI-2007 09-VIII-2007
126	Erzincan	Refahiye-Olgunlar	39°54'N 38°48'E	1603	21-VI-2007	147	Rize	Balıkçılar	41°03'N 40°38'E	sea level	28-VI-2007 09-VIII-2007
127	Erzincan	Ahmetli	39°51'N 39°21'E	1849	21-VI-2007	148	Rize	Çayeli-Buzlupınar	41°00'N 40°47'E	254	28-VI-2007 27-VII-2007
128	Gümüşhane	Kelkit-Yukarı Özlüce	39°58'N 39°31'E	1609	21-VI-2007	149	Rize	Pazar	41°10'N 40°52'E	13	28-VI-2007 27-VII-2007
129	Gümüşhane	Kelkit-Öbektaş	40°09'N 39°35'E	1482	22-VI-2007 21-IX-2007	150	Rize	Ardeşen-Akkaya	41°08'N 41°00'E	72	29-VI-2007 27-VII-2007
130	Bayburt	Söğütlü	40°13'N 40°03'E	1671	22-VI-2007 21-IX-2007	151	Artvin	Şavşat-Dereiçi	41°19'N 42°14'E	749	05-VII-2007 05-VIII-2007
131	Gümüşhane	Akçahisar	40°22'N 39°47'E	1636	23-VI-2007	152	Artvin	Şavşat-Meydancık	41°25'N 42°15'E	1170	05-VII-2007 05-VIII-2007
132	Gümüşhane	Mescitli	40°29'N 39°27'E	1059	21-VI-2007	153	Artvin	Şavşat-Dutlu	41°23'N 42°15'E	1783	05-VIII-2007
133	Gümüşhane	Hasköy	40°26'N 39°20'E	1176	21-VI-2007	154	Giresun	Alucra-Aktepe	40°20'N 38°43'E	1592	22-IX-2007
134	Gümüşhane	Şiran-Dilekyolu	40°14'N 39°17'E	1652	23-VI-2007 22-IX-2007						
135	Trabzon	Sürmene-Dirlik	40°52'N 40°06'E	44	26-VI-2007 26-VII-2007						

gia and includes Giresun, Gümüşhane, Bayburt, Trabzon, Rize and Artvin provinces and Akıncılar, Gölova, Koyulhisar, Suşehri (Sivas province), Refahiye (Erzincan province), Narman, Oltu, Olur, Pazaryolu, Tortum and Uzundere (Erzurum province) towns. There are two mountain chains (Coastal Mountains and Interior Mountains), separated from each other by the Çoruh and Kelkit Valley, parallel to the shore.

In this study, 50 spp./sspp. from 154 localities were recorded during 2005-2007. The localities and collection dates are given below. Their topographic position is shown in Figure 1.

RECORDS

Calopterygidae

Calopteryx splendens amasina (Bartenev, 1911)

(2): (21-VI-2007), 1 ♂; - (3): (05-VI-2006), 1 ♂, (13-VI-2007), 2 ♂; - (5): (13-VI-2007), 2 ♀; - (6): (05-VI-2006), 1 ♀, 1 ♂, (13-VI-2007), 1 ♂, (17-VIII-2007), 2 ♀, 1 ♂; - (9): (06-VI-2006), 1 ♀; - (11): (14-VI-2007), 1 ♂; - (12): (08-VI-2006), 6 ♀, 2 ♂, (13-VI-2007), 1 ♀, 1 ♂; - (13): (08-VI-2006), 1 ♀, (17-VIII-2007), 1 ♀; - (21): (21-VII-2006), 3 ♀, 3 ♂, (04-VII-2007), 2 ♀, (07-VIII-2007), 3 ♀; - (23): (04-VII-2007), 1 ♀, (07-VIII-2007), 1 ♀; - (24): (21-VII-2006), 1 ♀; - (27): (08-VIII-2006), 6 ♀, 3 ♂, (04-VII-2007), 2 ♀, 7 ♂, (07-VIII-2007), 2 ♀, 4 ♂; - (51): (30-VII-2006), 2 ♀, 1 ♂, (23-VI-2007), 2 ♀; - (57): 3 ♀, 2 ♂; - (67): (01-VIII-2006), 1 ♂; - (68): (01-VIII-2006), 1 ♀, 1 ♂; - (78): 2 ♀, 1 ♂; - (79): (02-VIII-2006), 3 ♀, 2 ♂, (13-VI-2007), 1 ♀, 1 ♂, (25-VII-2007), 3 ♀; - (81): (13-VI-2007), 1 ♀; - (82): (02-VIII-2006), 1 ♀; - (84): (02-VIII-2006), 3 ♀; - (87): (04-VII-2007), 4 ♀, 1 ♂, (07-VIII-2007), 3 ♂; - (89): (04-VII-2007), 2 ♀, 1 ♂, (07-VIII-2007), 1 ♀; - (117): (13-VI-2007), 1 ♀; - (118): (13-VI-2007), 1 ♀, 1 ♂, (17-VIII-2007), 1 ♀, 1 ♂; - (132): 1 ♀.

Calopteryx splendens waterstoni (Schneider, 1984)

(7): (06-VI-2006), 1 ♀, (02-VIII-2006), 2 ♀, (14-VI-2007), 4 ♀, 1 ♂, (25-VII-2007), 1 ♀; - (18): (17-VII-2006), 1 ♀; - (19): (26-VI-2007), 4 ♀, (26-VII-2007), 2 ♀, (08-VIII-2007), 2 ♀, 1 ♂; - (20): (17-VII-2006), 2 ♀, (26-VI-2007), 4 ♀, 2 ♂, (26-VII-2007), 1 ♀, 1 ♂; - (37): (28-VII-2006), 1 ♀, (27-VI-2007), 1 ♂, (09-VIII-2007), 1 ♂; - (38): 2 ♀; - (41): (29-VII-2006), 2 ♀, 1 ♂, (10-VIII-2007), 3 ♀, 1 ♂; - (42): (29-VII-2006), 2 ♀, 3 ♂, (14-VI-2007), 2 ♂; - (43): (14-VI-2007), 1 ♂; - (45): (29-VII-2006), 1 ♂, (14-VI-2007), 4 ♀, 4 ♂; - (46): (30-VII-2006), 1 ♀; - (47): (30-VII-2006), 1 ♀; - (84): (25-VII-2007), 1 ♀; - (123): (14-VI-2007), 1 ♀, 1 ♂; - (135): (26-VI-2007), 1 ♂; - (136): (26-VI-2007), 1 ♀; - (137): (09-VIII-2007), 1 ♂; - (138): (26-VI-2007), 1 ♀, 1 ♂; - (139): (26-VI-2007), 1 ♀, 1 ♂, (26-VII-2007), 1 ♀; - (143): (27-VI-2007), 1 ♀; - (145): (28-VI-2007), 6 ♀, (27-VII-2007), 1 ♀, 1 ♂; - (146): (28-VI-2007), 2 ♀, 1 ♂, (09-VIII-2007), 1 ♀; - (147): (28-VI-2007), 1 ♀.

Calopteryx virgo festiva (Brullé, 1832)

(4): (05-VI-2006), 1 ♀, 1 ♂; - (11): (14-VI-2007), 1 ♀; - (12): (08-VI-2006), 1 ♀; - (17): (17-VII-2006), 2 ♀, 1 ♂; - (18): (17-VII-2006), 2 ♀, (26-VI-2007), 1 ♀, (26-VII-2007), 2 ♀; - (37): (28-VII-2006), 1 ♀, 1 ♂, (27-VII-2007), 1 ♂; - (40): (29-VII-2006), 1 ♀; - (44): (29-VII-2006), 2 ♀, 2 ♂; - (79): (13-VI-2007), 1 ♀; - (80): (02-VIII-2006), 2 ♀, 1 ♂, (13-VI-2007), 1 ♀; - (84): (02-VIII-2006), 1 ♂; - (93): (27-VII-2007), 2 ♀; - (94): (28-VI-2007), 1 ♀; - (97): (14-VIII-2006), 1 ♀; - (98): (29-VI-2007), 1 ♀, (27-VII-2007), 1 ♀, 1 ♂; - (103): (15-VIII-2006), 1 ♀, (28-VI-2007), 1 ♀; - (112): (26-VII-2005), 1 ♀; - (119): (25-VII-2007), 1 ♀, 1 ♂; - (121): (14-VI-2007), 1 ♀; - (137): (26-VI-2007), 1 ♀; - (144): 1 ♀; - (145): (28-VI-2007), 1 ♀, 1 ♂, (27-VII-2007), 3 ♀, 1 ♂; - (148): (27-VII-2007), 1 ♀; - (149): (28-VI-2007), 1 ♀, (27-VII-2007), 1 ♀.

Euphaeidae

Epallage fatime (Charpentier, 1840)

(4): (05-VI-2006), 1 ♂; – (18): (26-VI-2007), 1 ♀; – (56): 3 ♀; – (57): 1 ♀; – (58): 3 ♀; – (60): 2 ♀;
– (112): (26-VII-2005), 1 ♀; – (119): (13-VI-2007), 1 ♂.

Lestidae

Lestes barbarus (Fabricius, 1798)

(30): (17-VII-2005), 2 ♀, 1 ♂, (22-VII-2006), 1 ♀, 1 ♂, (12-VIII-2007), 19 ♀, 4 ♂; – (53): (30-VII-2006), 1 ♀; – (66): (31-VII-2006), 1 ♀; – (81): (02-VIII-2006), 1 ♀; – (110): (24-VII-2005), 4 ♀, 2 ♂, (27-VII-2005), 1 ♀, 1 ♂, (12-VIII-2007), 2 ♀, 2 ♂.

Lestes dryas Kirby, 1890

(55): (30-VII-2006), 1 ♀, 1 ♂, (22-VI-2007), 1 ♀, 1 ♂; – (57): 1 ♂; – (64): (22-VI-2007), 1 ♂; – (65): (31-VII-2006), 1 ♀; – (86): (02-VII-2007), 10 ♀, 6 ♂.

Lestes sponsa (Hansemann, 1823)

(30): (17-VII-2005), 5 ♂, (12-VIII-2007), 6 ♀, 5 ♂; – (53): (30-VII-2006), 6 ♀, 3 ♂; – (54): (30-VII-2006), 1 ♂; – (55): (30-VII-2006), 11 ♀, 1 ♂; – (110): (24-VII-2005), 1 ♀, (12-VIII-2007), 1 ♀, 1 ♂.

Lestes virens (Charpentier, 1825)

(30): (12-VIII-2007), 13 ♀, 9 ♂; – (25): (21-VII-2006), 1 ♀; – (55): (30-VII-2006), 2 ♂; – (110): (24-VII-2005), 3 ♀, 1 ♂, (27-VII-2005), 4 ♀, (12-VIII-2007), 2 ♀.

Sympecma fusca (Vander Linden, 1820)

(1): (17-V-2006), 2 ♀; – (112): (04-VII-2007), 3 ♀, 3 ♂; – (116): (24-V-2007), 1 ♀, 2 ♂.

Platycnemididae

Platycnemis pennipes (Pallas, 1771)

(3): (05-VI-2006), 4 ♀, 2 ♂, (13-VI-2007), 3 ♀, 3 ♂, (25-VII-2007), 4 ♀, 1 ♂; – (4): (05-VI-2006), 3 ♀, 2 ♂, (25-VII-2007), 3 ♀; – (5): (05-VI-2006), 3 ♀, (13-VI-2007), 1 ♂, (25-VII-2007), 1 ♀, 1 ♂; – (6): (13-VI-2007), 1 ♀, 1 ♂, (17-VIII-2007), 2 ♀; – (7): (02-VIII-2006), 2 ♀, 1 ♂, (14-VI-2007), 3 ♀, 1 ♂, (25-VII-2007), 2 ♀; – (8): (06-VI-2006), 2 ♀, (02-VIII-2006), 2 ♀, 1 ♂, (14-VI-2007), 2 ♀, 2 ♂; – (9): (14-VI-2007), 1 ♀; – (10): (25-VII-2007), 2 ♀; – (12): (08-VI-2006), 2 ♀, (02-VIII-2006), 5 ♀; – (13): (08-VI-2006), 3 ♂, (17-VIII-2007), 2 ♀, 2 ♂; – (15): (26-VI-2007), 1 ♀, 1 ♂; – (18): (26-VII-2007), 3 ♀, 1 ♂; – (19): (17-VII-2006), 1 ♀, 1 ♂; – (20): (17-VII-2006), 2 ♀, 1 ♂, (26-VI-2007), 2 ♀, 2 ♂, (26-VII-2007), 6 ♀, 2 ♂, (08-VIII-2007), 7 ♀, 3 ♂; – (37): (09-VIII-2007), 2 ♀; – (38): 2 ♀; – (39): (29-VII-2006), 3 ♀, 1 ♂, (10-VIII-2007), 1 ♀, 1 ♂; – (42): (14-VI-2007), 1 ♀; – (43): (29-VII-2006), 2 ♀, 1 ♂, (14-VI-2007), 2 ♀; – (44): (14-VI-2007), 2 ♀, 1 ♂; – (45): (26-VII-2007), 3 ♀; – (57): 5 ♀, 6 ♂; – (61): 1 ♀, 1 ♂; – (68): (01-VIII-2006), 1 ♀; – (70): (01-VIII-2006), 1 ♀; – (73): (01-VIII-2006), 3 ♀, 2 ♂; – (74): (01-VIII-2006), 2 ♀; – (75): (01-VIII-2006), 1 ♂; – (76): (01-VIII-2006), 2 ♀, 1 ♂; – (78): 2 ♀; – (79): (02-VIII-2006), 1 ♀, 1 ♂, (13-VI-2007), 1 ♀, (25-VII-2007), 1 ♀, 1 ♂, (17-VIII-2007), 1 ♀; – (80): (25-VII-2007), 4 ♀, 1 ♂; – (81): (02-VIII-2006), 6 ♀, 3 ♂, (13-VI-2007), 2 ♀, (25-VII-2007), 2 ♀; – (82): (17-VIII-2007), 3 ♀; – (83): (02-VIII-2006), 1 ♀; – (84): (02-VIII-2006), 5 ♀, (25-VII-2007), 1 ♀; – (93): (27-VII-2007), 2 ♀, 1 ♂; – (98): (29-VI-2007), 2 ♀, 1 ♂; – (99): (29-VI-2007), 2 ♀; – (105): (28-VI-2007), 2 ♀; – (117): (17-VIII-2007), 4 ♀; – (118): (17-VIII-2007), 3 ♀; – (121): (14-VI-2007), 4 ♀, 1 ♂, (17-VIII-2007), 3 ♀; – (122): (14-VI-2007), 2 ♀, 1 ♂, (10-VIII-2007), 2 ♀, 2 ♂; – (136): (26-VII-2007), 1 ♀, 1 ♂; – (137): (09-VIII-2007), 1 ♀; – (141): (26-VI-2007), 2 ♂, (08-VIII-2007), 1 ♀, 1 ♂; – (142): (27-VI-2007), 1 ♂; – (146): (09-VIII-2007), 1 ♀; – (147): (09-VIII-2007), 2 ♀.

Coenagrionidae

Coenagrion ornatum (Selys, 1850)

(54): (30-VII-2006), 3 ♀, (22-VI-2007), 1 ♀; – (72): (01-VIII-2006), 1 ♀.

Coenagrion ponticum (Bartenev, 1929)

(11): (08-VI-2006), 1 ♀; – (12): (08-VI-2006), 4 ♀, 1 ♂, (02-VIII-2006), 7 ♀, 1 ♂, (13-VI-2007), 1 ♀; – (13): (17-VIII-2007), 1 ♀; – (14): (17-VII-2006), 2 ♀, (26-VI-2007), 2 ♀; – (18): (26-VII-2007), 5 ♀, 1 ♂; – (20): (17-VII-2006), 1 ♀, 1 ♂; – (30): (22-VII-2006), 3 ♀, (12-VIII-2007), 2 ♀; – (33): (23-VII-2006), 7 ♀, 3 ♂, (13-VIII-2006), 5 ♀, (08-VIII-2007), 10 ♀, 4 ♂; – (34): (08-VIII-2007), 3 ♀; – (38): 2 ♀; – (39): (29-VII-2006), 1 ♂; – (47): (27-VI-2007), 3 ♀; – (48): (27-VI-2007), 2 ♀; – (79): (02-VIII-2006), 2 ♀, (13-VI-2007), 5 ♀, 2 ♂, (25-VII-2007), 5 ♀, 3 ♂; – (80): (02-VIII-2006), 4 ♀, 1 ♂, (13-VI-2007), 3 ♀; – (84): (02-VIII-2006), 2 ♀; – (92): (20-VII-2005), 4 ♀, (10-VIII-2006), 8 ♀, 1 ♂, (13-VIII-2007), 8 ♀, 2 ♂; – (93): (28-VI-2007), 2 ♀; – (95): (14-VIII-2006), 2 ♀, (29-VI-2007), 3 ♀, (27-VII-2007), 4 ♀; – (96): (29-VI-2007), 1 ♀; – (97): (29-VI-2007), 8 ♀, 6 ♂, (27-VII-2007), 8 ♀, 2 ♂; – (99): (27-VII-2007), 3 ♀; – (100): (29-VI-2007), 3 ♀; – (101): (14-VIII-2006), 2 ♀, 1 ♂, (29-VI-2007), 4 ♀; – (102): (14-VIII-2006), 1 ♀, (27-VII-2007), 3 ♀; – (105): (28-VI-2007), 3 ♀, 1 ♂; – (110): (12-VIII-2007), 1 ♀; – (119): (25-VII-2007), 2 ♀; – (123): (14-VI-2007), 1 ♀; – (143): (27-VI-2007), 8 ♀, 3 ♂; – (145): (28-VI-2007), 2 ♀; – (148): (27-VII-2007), 2 ♀; – (150): (29-VI-2007), 2 ♀, (27-VII-2007), 3 ♀.

Coenagrion puella (Linnaeus, 1758)

(2): (21-VI-2007), 1 ♂; – (12): (08-VI-2006), 3 ♀, 1 ♂; – (15): (17-VII-2006), 1 ♀; – (27): (04-VII-2007), 1 ♀; – (29): (04-VII-2007), 1 ♀; – (30): (17-VII-2005), 7 ♀, 2 ♂, (03-VII-2007), 7 ♀, (12-VIII-2007), 2 ♀; – (58): 3 ♀; – (66): (31-VII-2006), 2 ♀, 1 ♂, (23-VI-2007), 5 ♀; – (67): (23-VI-2007), 2 ♀; – (69): (01-VIII-2006), 7 ♀, (23-VI-2007), 1 ♀; – (76): (23-VI-2007), 2 ♀; – (86): (02-VII-2007), 6 ♀, 1 ♂; – (87): (08-VIII-2006), 1 ♀, (04-VII-2007), 3 ♀; – (88): (04-VII-2007), 2 ♀; – (92): (20-VII-2005), 8 ♀, 3 ♂; – (109): 1 ♀; – (110): (24-VII-2005), 25 ♀, 3 ♂, (27-VII-2005), 1 ♀, 1 ♂, (03-VII-2007), 31 ♀, (12-VIII-2007), 2 ♀; – (125): 21-VI-2007, 2 ♀; – (129): (22-VI-2007), 13 ♀, 3 ♂; – (134): (23-VI-2007), 1 ♀; – (151): (05-VII-2007), 3 ♀, 1 ♂; – (152): (05-VII-2007), 7 ♀, 1 ♂, (05-VIII-2007), 1 ♀, 1 ♂.

Coenagrion pulchellum (Vander Linden, 1825)

(110): (24-VII-2005), 1 ♂; – (112): (04-VII-2007), 1 ♂; – (129): (22-VI-2007), 1 ♂.

Erythromma viridulum orientale Schmidt, 1960

(38): 2 ♀; – (32): (08-VIII-2007), 2 ♀; – (79): (13-VI-2007), 2 ♀; – (92): (10-VIII-2006), 6 ♀, 1 ♂, (13-VIII-2007), 14 ♀, 3 ♂.

Enallagma cyathigerum (Charpentier, 1840)

(20): (08-VIII-2007), 1 ♀; – (22): (21-VII-2006), 4 ♀; – (23): (21-VII-2006), 1 ♀; – (26): (21-VII-2006), 4 ♀, 2 ♂, (08-VIII-2006), 3 ♀, 1 ♂, (04-VII-2007), 6 ♀, 3 ♂, (07-VIII-2007), 1 ♀, 1 ♂; – (30): (12-VIII-2007), 2 ♀; – (33): (23-VII-2006), 4 ♀, (13-VIII-2006), 2 ♀; – (53): (30-VII-2006), 2 ♀, (22-VI-2007), 2 ♀; – (54): (30-VII-2006), 3 ♀, 3 ♂, (21-IX-2007), 2 ♀; – (55): (30-VII-2006), 7 ♀; – (63): (22-VI-2007), 1 ♀; – (64): (31-VII-2006), 4 ♀, 1 ♂, (22-VI-2007), 2 ♂, (21-IX-2007), 1 ♀; – (67): (22-IX-2007), 2 ♀; – (71): (01-VIII-2006), 2 ♀; – (75): (24-V-2007), 1 ♀; – (87): (08-VIII-2006), 5 ♀; – (92): (20-VII-2005), 5 ♀, 2 ♂, (10-VIII-2006), 8 ♀, (13-VIII-2007), 9 ♀; – (110): (24-VII-2005), 4 ♀, (03-VII-2007), 3 ♀, (12-VIII-2007), 3 ♀; – (125): (20-IX-2007), 1 ♀; – (127): 1 ♀; – (128): 2 ♀; – (129): (21-IX-2007), 2 ♀; – (130): (23-VI-2007), 2 ♀, (21-IX-2007), 3 ♀; – (134): (22-IX-2007), 2 ♀.

Ischnura elegans ebneri Schmidt, 1938

(1): (01-VIII-2006), 1 ♂; – (3): 05-VI-2006, 1 ♀; – (5): 05-VI-2006, 2 ♀; – (6): 05-VI-2006, 1 ♀; – (10): (06-VI-2006), 1 ♀; – (11): (08-VI-2006), 1 ♂; – (14): (26-VII-2007), 2 ♀, 1 ♂; – (20): (08-VIII-2007), 5 ♀, 1 ♂; – (36): (28-VII-2006), 5 ♀, 1 ♂, (27-VI-2007), 4 ♀, 2 ♂; – (37): (09-VIII-2007), 1 ♀.

1 ♂; - (38): 4 ♀, 1 ♂; - (39): (14-VI-2007), 1 ♀; - (40): (10-VIII-2007), 4 ♀, 3 ♂; - (41): (10-VIII-2007), 9 ♀, 3 ♂; - (42): (10-VIII-2007), 6 ♀, 6 ♂; - (44): (10-VIII-2007), 6 ♀, 4 ♂; - (46): 6 ♀, 1 ♂; - (48): (27-VI-2007), 1 ♀, 1 ♂; - (51): (30-VII-2006), 1 ♂; - (53): (30-VII-2006), 10 ♀, 4 ♂; - (55): (30-VII-2006), 2 ♀, 1 ♂; - (64): (31-VII-2006), 7 ♀, 3 ♂, (22-VI-2007), 1 ♀; - (65): (22-VI-2007), 1 ♀; - (69): (01-VIII-2006), 1 ♀; - (70): (01-VIII-2006), 1 ♀, 1 ♂; - (71): (01-VIII-2006), 1 ♀; - (75): (01-VIII-2006), 2 ♂, (20-IX-2007), 1 ♀; - (77): (01-VIII-2006), 2 ♂; - (79): (25-VII-2007), 1 ♀, (17-VIII-2007), 1 ♀; - (81): (02-VIII-2006), 1 ♀; - (93): (28-VI-2007), 1 ♀; - (95): (14-VIII-2006), 1 ♀; - (96): (14-VIII-2006), 1 ♂; - (99): (14-VIII-2006), 2 ♀; - (100): (14-VIII-2006), 1 ♂, (27-VII-2007), 4 ♀, 2 ♂; - (102): (14-VIII-2006), 1 ♀; - (103): (09-VIII-2007), 2 ♀, 5 ♂; - (104): (15-VIII-2006), 4 ♀, 5 ♂, (28-VI-2007), 3 ♀, 1 ♂, (27-VII-2007), 5 ♀, 3 ♂; - (105): (28-VI-2007), 1 ♀; - (106): (15-VIII-2006), 2 ♀, 1 ♂; - (114): (20-IX-2007), 1 ♀, 1 ♂; - (115): (27-VII-2007), 1 ♀, 3 ♂; - (116): (24-V-2007), 1 ♀; - (117): (13-VI-2007), 4 ♀, 1 ♂, (17-VIII-2007), 2 ♀, 1 ♂; - (122): (10-VIII-2007), 4 ♀, 3 ♂, (13-VIII-2006), 1 ♀; - (123): (10-VIII-2007), 5 ♀, 3 ♂; - (133): 1 ♀; - (135): (26-VII-2007), 2 ♀; - (140): (08-VIII-2007), 1 ♀, 1 ♂; - (142): (26-VII-2007), 1 ♀, 1 ♂; - (143): (27-VI-2007), 2 ♀, 2 ♂, (09-VIII-2007), 5 ♀, 3 ♂; - (146): (09-VIII-2007), 1 ♀, 1 ♂; - (147): (09-VIII-2007), 1 ♂.

Ischnura elegans pontica Schmidt, 1938

(22): (08-VIII-2006), 2 ♀; - (26): (21-VII-2006), 1 ♀; - (27): (08-VIII-2006), 4 ♀, 4 ♂, (04-VII-2007), 8 ♀, (07-VIII-2007), 2 ♀, 3 ♂; - (29): (21-VII-2006), 3 ♂, (08-VIII-2006), 5 ♀, 2 ♂, (07-VIII-2007), 2 ♀, 1 ♂; - (32): (23-VII-2006), 3 ♀, 7 ♂, (13-VIII-2006), 1 ♀, (08-VIII-2007), 2 ♀, 1 ♂; - (34): (23-VII-2006), 1 ♀; - (24): (21-VII-2006), 3 ♀, 1 ♂, (08-VIII-2006), 1 ♀, (04-VII-2007), 1 ♀, 1 ♂, (07-VIII-2007), 4 ♀, 1 ♂; - (27): (07-VIII-2007), 1 ♂; - (32): (23-VII-2006), 1 ♂, (29-VI-2007), 4 ♀, 3 ♂; - (34): (29-VI-2007), 2 ♀, 3 ♂; - (35): (23-VII-2006), 13 ♀, 10 ♂, (13-VIII-2006), 4 ♀, 1 ♂, (29-VI-2007), 5 ♀, 3 ♂, (08-VIII-2007), 1 ♀, 1 ♂; - (36): (28-VII-2006), 2 ♀, 1 ♂, (26-VII-2007), 2 ♀, 1 ♂; - (43): (10-VIII-2007), 1 ♀; - (45): (29-VII-2006), 1 ♀, 2 ♂; - (53): (22-VI-2007), 1 ♀; - (54): (30-VII-2006), 3 ♀; - (55): (30-VII-2006), 2 ♀, 1 ♂; - (58): 1 ♀; - (63): (22-VI-2007), 1 ♀; - (130): (21-IX-2007), 2 ♀; - (64): (31-VII-2006), 1 ♀, 1 ♂, (22-VI-2007), 2 ♀, 1 ♂, (21-IX-2007), 3 ♀, 2 ♂; - (65): (31-VII-2006), 3 ♀, 1 ♂; - (66): (31-VII-2006), 1 ♀, (23-VI-2007), 1 ♀, (22-IX-2007), 5 ♀, 2 ♂; - (68): (23-VI-2007), 1 ♀; - (69): (01-VIII-2006), 1 ♀, (23-VI-2007), 2 ♀; - (71): (01-VIII-2006), 1 ♀; - (72): (01-VIII-2006), 1 ♀, (21-VI-2007), 1 ♀; - (73): (01-VIII-2006), 1 ♀, (21-IX-2007), 1 ♀; - (74): (01-VIII-2006), 1 ♀, (20-IX-2007), 2 ♀; - (75): (20-IX-2007), 1 ♀; - (76): (22-IX-2007), 1 ♀, 2 ♂; - (77): (01-VIII-2006), 1 ♀; - (78): 1 ♀; - (79): (02-VIII-2006), 1 ♀, (13-VI-2007), 1 ♀, 1 ♂, (27-VII-2007), 1 ♀, (17-VIII-2007), 1 ♀; - (90): (08-VIII-2006), 2 ♀, 3 ♂; - (91): (08-VIII-2006), 9 ♀, 3 ♂, (04-VII-2007), 1 ♀; - (93): (14-VIII-2006), 2 ♂; - (94): (14-VIII-2006), 1 ♀, 1 ♂; - (95): (27-VII-2007), 3 ♀, 2 ♂; - (98): (14-VIII-2006), 1 ♀; - (103): (14-VIII-2006), 1 ♀; - (104): (28-VI-2007), 1 ♀, (27-VII-2007), 1 ♀, 1 ♂; - (105): (14-VIII-2006), 1 ♂; - (109): 1 ♀, 1 ♂; - (114): (30-VI-2005), 2 ♀; - (116): (24-V-2007), 2 ♂; - (120): (13-VI-2007), 2 ♀; - (124): (21-VI-2007), 1 ♂; - (125): (20-IX-2007), 2 ♀; - (126): 2 ♀; - (128): 2 ♀; - (133): 1 ♀; - (134): (23-VI-2007), 1 ♀, (22-IX-2007), 1 ♀; - (143): (09-VIII-2007), 1 ♀, 3 ♂; - (148): (27-VII-2007), 3 ♀; - (149): (27-VII-2007), 2 ♀; - (150): (27-VII-2007), 4 ♀, 1 ♂.

Ischnura pumilio (Charpentier, 1825)

(1): (17-V-2006), 2 ♀, (01-VIII-2006), 3 ♀, 1 ♂, (21-IX-2007), 1 ♂; - (2): (17-V-2006), 1 ♀, (21-VI-2007), 1 ♀; - (6): (05-VI-2006), 1 ♀; - (10): (13-VI-2007), 1 ♀; - (13): (17-VIII-2007), 1 ♀, 1 ♂; - (15): (17-VII-2006), 1 ♀, 1 ♂; - (22): (08-VIII-2006), 5 ♀, (07-VIII-2007), 1 ♀; - (23): (07-VIII-2007), 1 ♀; - (24): (21-VII-2006), 3 ♀, 1 ♂, (08-VIII-2006), 1 ♀, (04-VII-2007), 1 ♀, 1 ♂, (07-VIII-2007), 4 ♀, 1 ♂; - (27): (07-VIII-2007), 1 ♂; - (32): (23-VII-2006), 1 ♂, (29-VI-2007), 4 ♀, 3 ♂; - (34): (29-VI-2007), 2 ♀, 3 ♂; - (35): (23-VII-2006), 13 ♀, 10 ♂, (13-VIII-2006), 4 ♀, 1 ♂, (29-VI-2007), 5 ♀, 3 ♂, (08-VIII-2007), 1 ♀, 1 ♂; - (36): (28-VII-2006), 2 ♀, 1 ♂, (26-VII-2007), 2 ♀, 1 ♂; - (43): (10-VIII-2007), 1 ♀; - (45): (29-VII-2006), 1 ♀, 2 ♂; - (53): (22-VI-2007), 1 ♀; - (54): (30-VII-2006), 3 ♀; - (55): (30-VII-2006), 2 ♀, 1 ♂; - (58): 1 ♀; - (63): (22-VI-2007), 1 ♀; - (130): (21-IX-2007), 2 ♀; - (64): (31-VII-2006), 1 ♀, 1 ♂, (22-VI-2007), 2 ♀, 1 ♂, (21-IX-2007), 3 ♀, 2 ♂; - (65): (31-VII-2006), 3 ♀, 1 ♂; - (66): (31-VII-2006), 1 ♀, (23-VI-2007), 1 ♀, (22-IX-2007), 5 ♀, 2 ♂; - (68): (23-VI-2007), 1 ♀; - (69): (01-VIII-2006), 1 ♀, (23-VI-2007), 2 ♀; - (71): (01-VIII-2006), 1 ♀; - (72): (01-VIII-2006), 1 ♀, (21-VI-2007), 1 ♀; - (73): (01-VIII-2006), 1 ♀, (21-IX-2007), 1 ♀; - (74): (01-VIII-2006), 1 ♀, (20-IX-2007), 2 ♀; - (75): (20-IX-2007), 1 ♀; - (76): (22-IX-2007), 1 ♀, 2 ♂; - (77): (01-VIII-2006), 1 ♀; - (78): 1 ♀; - (79): (02-VIII-2006), 1 ♀, (13-VI-2007), 1 ♀, 1 ♂, (27-VII-2007), 1 ♀, (17-VIII-2007), 1 ♀; - (90): (08-VIII-2006), 2 ♀, 3 ♂; - (91): (08-VIII-2006), 9 ♀, 3 ♂, (04-VII-2007), 1 ♀; - (93): (14-VIII-2006), 2 ♂; - (94): (14-VIII-2006), 1 ♀, 1 ♂; - (95): (27-VII-2007), 3 ♀, 2 ♂; - (98): (14-VIII-2006), 1 ♀; - (103): (14-VIII-2006), 1 ♀; - (104): (28-VI-2007), 1 ♀, (27-VII-2007), 1 ♀, 1 ♂; - (105): (14-VIII-2006), 1 ♂; - (109): 1 ♀, 1 ♂; - (114): (30-VI-2005), 2 ♀; - (116): (24-V-2007), 2 ♂; - (120): (13-VI-2007), 2 ♀; - (124): (21-VI-2007), 1 ♂; - (125): (20-IX-2007), 2 ♀; - (126): 2 ♀; - (128): 2 ♀; - (133): 1 ♀; - (134): (23-VI-2007), 1 ♀, (22-IX-2007), 1 ♀; - (143): (09-VIII-2007), 1 ♀, 3 ♂; - (148): (27-VII-2007), 3 ♀; - (149): (27-VII-2007), 2 ♀; - (150): (27-VII-2007), 4 ♀, 1 ♂.

Aeshnidae

Aeshna affinis Vander Linden, 1823

- (30): (12-VIII-2007), 4 ♀; – (58): 2 ♀; – (110): (03-VII-2007), 1 ♀, (12-VIII-2007), 1 ♀, 1 ♂.
- Aeshna cyanea* (Müller, 1764)
(33): (13-VIII-2006), 2 ♀, (08-VIII-2007), 1 ♀; – (85): (27-VII-2005), 1 ♀; – (92): (20-VII-2005), 1 ♀, (10-VIII-2006), 1 ♀.
- Aeshna juncea* (Linnaeus, 1758)
(85): (27-VII-2005), 2 ♀, 4 ♂, (05-VIII-2006), 1 ♂; – (108): 5 ♀, 1 ♂.
- Aeshna mixta* Latreille, 1805
(92): (20-VII-2005), 1 ♂.
- Anaciaeschna isosceles antehumeralis* Schmidt, 1950
(79): (13-VI-2007), 1 ♀; – (105): (15-VIII-2006), 1 ♀; – (110): (27-VII-2005), 1 ♀; – (143): (27-VI-2007), 5 ♀.
- Anax imperator* Leach, 1815
(27): (04-VII-2007), 1 ♀; – (92): (20-VII-2005), 2 ♀, (10-VIII-2006), 2 ♀, (13-VIII-2007), 3 ♀, 2 ♂; – (97): (29-VI-2007), 1 ♀; – (110): (03-VII-2007), 1 ♀, (12-VIII-2007), 1 ♀; – (143): (27-VI-2007), 1 ♀.
- Anax parthenope* (Selys, 1839)
(16): (17-VII-2006), 1 ♀; – (38): 1 ♀.
- Hemianax ephippiger* (Burmeister, 1839)
(107): (15-VIII-2006), 1 ♀.
- Caliaeschna microstigma* (Schneider, 1845)
(18): (26-VI-2007), 2 ♀; – (28): (04-VII-2007), 1 ♀; – (29): (21-VII-2006), 1 ♀, (04-VII-2007), 1 ♀, (07-VIII-2007), 1 ♀; – (52): (23-VI-2007), 1 ♀; – (114): (30-VI-2005), 2 ♀; – (131): 1 ♀; – (136): (26-VI-2007), 1 ♀; – (149): (28-VI-2007), 1 ♀; – (151): (05-VIII-2007), 1 ♀; – (152): (05-VII-2007), 2 ♀, (05-VIII-2007), 1 ♀.

G o m p h i d a e

- Onychogomphus assimilis* (Schneider, 1845)
(111): 1 ♀.
- Onychogomphus forcipatus albotibialis* Schmidt, 1954
(5): (05-VI-2006), 1 ♂, (13-VI-2007), 1 ♂; – (9): (06-VI-2006), 1 ♀, (14-VI-2007), 3 ♀, 2 ♂, (25-VII-2007), 1 ♂; – (43): (29-VII-2006), 1 ♀, (14-VI-2007), 1 ♀; – (79): (17-VIII-2007), 1 ♀; – (81): (02-VIII-2006), 2 ♀, (13-VI-2007), 3 ♀; – (83): (13-VI-2007), 1 ♂; – (84): (02-VIII-2006), 1 ♀; – (113): (26-VII-2005), 1 ♀; – (133): 1 ♀.
- Onychogomphus lefebvrei* (Rambur, 1842)
(67): (01-VIII-2006), 1 ♂.

C o r d u l e g a s t r i d a e

- Cordulegaster insignis mzymtae* Bartenev, 1929
(153): 2 ♀.
- Cordulegaster picta* Selys, 1854
(86): (06-VIII-2007), 1 ♀, (16-VIII-2007), 1 ♀.

C o r d u l i i d a e

- Cordulia aenea* (Linnaeus, 1758)
(92): (20-VII-2005), 2 ♀.

Libellulidae

Crocothemis erythraea (Brullé, 1832)

(10): (13-VI-2007), 1 ♂; – (29): (04-VII-2007), 1 ♀; – (32): (13-VIII-2006), 1 ♀; – (75): (01-VIII-2006), 2 ♀, (20-IX-2007), 1 ♀, 1 ♂; – (79): (02-VIII-2006), 1 ♂, (13-VI-2007), 1 ♂, (25-VII-2007), 1 ♀, (17-VIII-2007), 1 ♀; – (97): (29-VI-2007), 1 ♀; – (105): (28-VI-2007), 1 ♀; – (117): (13-VI-2007), 1 ♂; – (124): (20-IX-2007), 1 ♂; – (135): (26-VI-2007), 1 ♀; – (138): (26-VI-2007), 1 ♀, (26-VII-2007), 1 ♀; – (143): (27-VI-2007), 2 ♀, 2 ♂

Libellula depressa Linnaeus, 1758

(1): (21-VI-2007), 1 ♂; – (2): (21-VI-2007), 1 ♀; – (15): (17-VII-2006), 2 ♀; – (22): (04-VII-2007), 2 ♀, (07-VIII-2007), 1 ♀; – (27): (04-VII-2007), 1 ♀; – (30): (17-VII-2005), 2 ♀; – (32): (08-VIII-2007), 1 ♀; – (49): (30-VIII-2006), 2 ♀, (23-VI-2007), 1 ♀; – (52): (30-VII-2006), 1 ♂; – (79): (02-VIII-2006), 1 ♀; – (86): (18-VII-2005), 4 ♀; – (02-VII-2007), ♀; – (125): (21-VI-2007), 1 ♀; – (129): (22-VI-2007), 2 ♀, 1 ♂; – (133): 2 ♀, 2 ♂; – (151): (05-VII-2007), 1 ♀; – (152): (05-VII-2007), 1 ♀, (05-VIII-2007), 1 ♂.

Libellula quadrimaculata Linnaeus, 1758

(30): (17-VII-2005), 1 ♂; – (92): (20-VII-2005), 4 ♀, (10-VIII-2006), 4 ♀, (13-VIII-2007), 3 ♀.

Orthetrum albistylum (Selys, 1848)

(20): (08-VIII-2007), 1 ♂; – (32): (13-VIII-2006), 1 ♀, (29-VI-2007), 1 ♀, (08-VIII-2007), 1 ♂; – (36): (27-VI-2007), 1 ♀; – (26-VII-2007), 1 ♀; – (38): 2 ♀; – (79): (13-VI-2007), 1 ♀, 1 ♂; – (93): (14-VIII-2006), 1 ♀, (28-VI-2007), 1 ♀; – (94): (14-VIII-2006), 3 ♀; – (103): (15-VIII-2006), 1 ♀, 1 ♂, (28-VI-2007), 3 ♀, 2 ♂; – (104): (28-VI-2007), 1 ♀, 1 ♂; – (105): (15-VIII-2006), 1 ♀, (28-VI-2007), 1 ♀, 2 ♂; – (138): (26-VI-2007), 3 ♀, 1 ♂, (26-VII-2007), 1 ♀; – (143): (27-VI-2007), 2 ♀, (09-VIII-2007), 1 ♀.

Orthetrum coerulescens anceps (Schneider, 1845)

(1): (01-VIII-2006), 3 ♀; – (3): (25-VII-2007), 1 ♀; – (5): (25-VII-2007), 1 ♀; – (11): (14-VI-2007), 1 ♀; – (14): (17-VII-2006), 3 ♀, (26-VI-2007), 1 ♀, (26-VII-2007), 1 ♀; – (16): (26-VI-2007), 1 ♀; – (17): (26-VI-2007), 1 ♀; – (18): (28-VI-2007), 2 ♀; – (19): (08-VIII-2007), 1 ♀, 1 ♂; – (24): (04-VII-2007), 1 ♀, 2 ♂; – (27): (21-VII-2006), 2 ♀, (04-VII-2007), 1 ♀; – (28): (21-VII-2006), 1 ♂, (04-VII-2007), 1 ♀, (07-VIII-2007), 3 ♀; – (29): (26-VII-2005), 4 ♀, (21-VII-2006), 1 ♀, (08-VIII-2006), 7 ♀, (04-VII-2007), 1 ♀, (07-VIII-2007), 5 ♀, 2 ♂; – (32): (13-VIII-2006), 1 ♀, (29-VI-2007), 3 ♀; – (34): (08-VIII-2007), 2 ♀; – (35): (29-VI-2007), 4 ♀, (08-VIII-2007), 4 ♀; – (39): (29-VII-2006), 2 ♀; – (43): (10-VIII-2007), 1 ♀; – (45): (26-VII-2007), 2 ♀; – (46): (27-VI-2007), 1 ♀; – (57): 1 ♂; – (59): 1 ♂; – (73): (01-VIII-2006), 3 ♀, (21-IX-2007), 1 ♀; – (77): (25-VII-2007), 2 ♀; – (79): (02-VIII-2006), 7 ♀, (13-VI-2007), 3 ♀, 1 ♂, (14-VI-2007), 2 ♀, (25-VII-2007), 2 ♀; – (80): (13-VI-2007), 1 ♀, (25-VII-2007), 1 ♀; – (81): (02-VIII-2006), 1 ♀, 1 ♂, (13-VI-2007), 1 ♀, 1 ♂; – (82): (17-VIII-2007), 1 ♀; – (91): (26-VII-2005), 1 ♀; – (94): (28-VI-2007), 2 ♀; – (95): (14-VIII-2006), 1 ♀, (27-VII-2007), 3 ♀; – (96): (14-VIII-2006), 1 ♀, (29-VI-2007), 3 ♀, ♂; – (97): (27-VII-2007), 1 ♀; – (99): (14-VIII-2006), 1 ♀, (29-VI-2007), 1 ♀, (27-VII-2007), 1 ♀; – (100): (14-VIII-2006), 1 ♀, (29-VI-2007), 1 ♀, (27-VII-2007), 2 ♀; – (101): (29-VI-2007), 2 ♀, 1 ♂; – (102): (28-VI-2007), 2 ♀, (27-VII-2007), 2 ♀; – (103): (28-VI-2007), 4 ♀; – (104): (15-VIII-2006), 2 ♂, (28-VI-2007), 8 ♀, 1 ♂, (27-VII-2007), 2 ♀, (15-VIII-2006), 10 ♀; – (105): (28-VI-2007), 1 ♀; – (106): (28-VI-2007), 2 ♀; – (107): (28-VI-2007), 3 ♀, 2 ♂; – (110): (03-VII-2007), 1 ♀, (12-VIII-2007), 6 ♀, 1 ♂; – (113): (26-VII-2005), 1 ♀, (07-VIII-2007), 1 ♀; – (114): (30-VI-2005), 5 ♀, 1 ♂; – (115): (28-VI-2007), 1 ♀, (27-VII-2007), 1 ♀; – (117): (17-VIII-2007), 1 ♀; – (120): (25-VII-2007), 1 ♀; – (121): (17-VIII-2007), 1 ♀; – (123): (14-VI-2007), 1 ♀, (26-VII-2007), 4 ♀, (10-VIII-2007), 1 ♀, 1 ♂; – (135): (26-VII-2007), 1 ♀, 1 ♂; – (136): (26-VII-2007), 1 ♂; – (137): (26-VI-2007), 4 ♀; – (138): (26-VI-2007), 3 ♀, (26-VII-2007), 3 ♀; – (140): (26-VI-2007), 1 ♀; – (141): (08-VIII-2007), 1 ♀; – (142): (27-VI-2007), 3 ♀, 2 ♂, (26-VII-2007), 1 ♀, (08-VIII-2007), 2 ♀; – (143): (27-VI-2007),

4 ♀; – (147): (28-VI-2007), 3 ♀, 1 ♂, (09-VIII-2007), 2 ♀, 1 ♂; – (150): (29-VI-2007), 3 ♀, 1 ♂, (27-VII-2007), 2 ♀; – (151): (05-VII-2007), 10 ♀, 3 ♂, (05-VIII-2007), 6 ♀, 1 ♂.

Orthetrum brunneum (Fonscolombe, 1837)

(1): (01-VIII-2006), 2 ♂, (01-VIII-2006), 1 ♀, (21-VI-2007), 3 ♀, 7 ♂; – (14): (17-VII-2006), 1 ♀; – (15): (17-VII-2006), 1 ♀; – (20): (17-VII-2006), 1 ♂; – (22): (21-VII-2006), 3 ♀, (08-VIII-2006), 2 ♀, (04-VII-2007), 1 ♀; – (24): (08-VIII-2006), 3 ♀, 1 ♂, (08-VIII-2006), 2 ♀, (07-VIII-2007), 2 ♀; – (27): (04-VII-2007), 1 ♀; – (29): (26-VII-2005), 2 ♀, (07-VIII-2007), 1 ♀, 1 ♂; – (30): (17-VII-2005), 2 ♀; – (48): (30-VII-2006), 1 ♀, 1 ♂; – (50): 1 ♀; – (58): 1 ♀; – (69): (01-VIII-2006), 1 ♀; – (71): (01-VIII-2006), 1 ♀; – (72): (01-VIII-2006), 1 ♀; – (73): (01-VIII-2006), 1 ♀, (21-VI-2007), 1 ♀, 1 ♂; – (74): (01-VIII-2006), 1 ♀; – (79): (13-VI-2007), 1 ♀; – (84): (25-VII-2007), 1 ♀; – (87): (08-VIII-2006), 2 ♀; – (89): (08-VIII-2006), 2 ♀, (07-VIII-2007), 1 ♂; – (91): (26-VII-2005), 4 ♀, (08-VIII-2006), 1 ♀, (04-VII-2007), 1 ♀; – (104): (28-VI-2007), 1 ♀; – (107): (15-VIII-2006), 1 ♂, (28-VI-2007), 1 ♀; – (109): 1 ♀; – (110): (24-VII-2005), 4 ♀, (27-VII-2005), 3 ♀, 1 ♂; – (113): (26-VII-2005), 2 ♀, (07-VIII-2007), 1 ♀; – (114): (30-VI-2005), 2 ♀; – (125): (21-VI-2007), 1 ♀; – (133): 3 ♀; – (143): (27-VI-2007), 1 ♀, 1 ♂; – (144): 1 ♀; – (151): (05-VII-2007), 1 ♀, (05-VIII-2007), 2 ♂; – (152): (05-VII-2007), 5 ♀, 1 ♂.

Orthetrum cancellatum (Linnaeus, 1758)

(32): (08-VIII-2007), 1 ♀; – (92): (20-VII-2005), 4 ♀, 1 ♂, (10-VIII-2006), 1 ♀, (13-VIII-2007), 2 ♀; – (110): (24-VII-2005), 1 ♀.

Sympetrum depressiusculum (Selys, 1841)

(2): (21-IX-2007), 4 ♀, 1 ♂; – (112): (26-VII-2005), 14 ♀, 1 ♂, (04-VII-2007), 12 ♀, 8 ♂.

Sympetrum flaveolum (Linnaeus, 1758)

(25): (21-VII-2006), 1 ♂, (08-VIII-2006), 6 ♂, (07-VIII-2007), 1 ♂; – (30): (17-VII-2005), 2 ♀, 2 ♂; – (46): (30-VII-2006), 1 ♀; – (53): (30-VII-2006), 1 ♂; – (54): (30-VII-2006), 1 ♀, 2 ♂; – (55): (30-VII-2006), 1 ♀; – (61): 1 ♀, 2 ♂; – (62): 3 ♀; – (67): (22-IX-2007), 2 ♀, 1 ♂; – (69): (22-IX-2007), 3 ♀, 2 ♂; – (72): (01-VIII-2006), 1 ♂; – (75): (01-VIII-2006), 1 ♂; – (85): (05-VIII-2006), 1 ♀, 1 ♂; – (88): (08-VIII-2006), 1 ♂; – (92): (20-VII-2005), 1 ♂; – (110): (24-VII-2005), 2 ♀, 1 ♂.

Sympetrum fonscolombii (Selys, 1840)

(9): (06-VI-2006), 1 ♀; – (10): (13-VI-2007), 1 ♀, 1 ♂; – (15): (17-VII-2006), 2 ♀, 1 ♂; – (19): (17-VII-2006), 1 ♂, (08-VIII-2007), 1 ♀; – (20): (17-VII-2006), 1 ♂, (08-VIII-2007), 2 ♀, 3 ♂; – (26): (21-VII-2006), 2 ♀, (08-VIII-2006), 1 ♀; – (31): 1 ♀; – (35): (23-VII-2006), 2 ♀; – (36): (28-VII-2006), 1 ♀; – (38): 6 ♀, 3 ♂; – (39): (10-VIII-2007), 1 ♀, 1 ♂; – (40): (10-VIII-2007), 2 ♀; – (43): (10-VIII-2007), 1 ♂; – (46): (09-VIII-2007), 3 ♀; – (54): (21-IX-2007), 2 ♀; – (59): 2 ♂; – (64): (31-VII-2006), 1 ♀, 1 ♂, (22-VI-2007), 1 ♀; – (71): (01-VIII-2006), 2 ♀, 2 ♂, (21-IX-2007), 1 ♂; – (75): (01-VIII-2006), 1 ♂; – (79): (14-VI-2007), 1 ♀; – (83): (02-VIII-2006), 1 ♀; – (95): (14-VIII-2006), 2 ♀, 3 ♂; – (96): (14-VIII-2006), 1 ♂; – (112): (26-VII-2005), 1 ♂; – (114): (20-IX-2007), 2 ♀, 1 ♂; – (115): (17-X-2006), 1 ♂; – (116): (20-IX-2007), 2 ♀, 1 ♂; – (124): (20-IX-2007), 2 ♀; – (129): (21-IX-2007), 2 ♂; – (138): (26-VI-2007), 2 ♀; – (140): (08-VIII-2007), 2 ♀; – (142): (08-VIII-2007), 1 ♀, 1 ♂; – (143): (09-VIII-2007), 2 ♂; – (154): (22-IX-2007), 1 ♀.

Sympetrum haritonovi Borisov, 1983

(24): (08-VIII-2006), 2 ♀.

Sympetrum meridionale (Selys, 1841)

(25): (21-VII-2006), 2 ♀, 1 ♂, (07-VIII-2007), 1 ♂; – (27): (21-VII-2006), 1 ♂; – (154): 1 ♂.

Sympetrum pedemontanum (Müller, 1766)

(2): (21-IX-2007), 8 ♀, 4 ♂.

Sympetrum sanguineum (Müller, 1764)

(5): (05-VI-2006), 1 ♂; – (25): (21-VII-2006), 5 ♂, (08-VIII-2006), 5 ♂, (07-VIII-2007), 3 ♂; – (27): (21-VII-2006), 4 ♀, 1 ♂, (08-VIII-2006), 4 ♀, (07-VIII-2007), 1 ♀; – (30): (17-VII-2005), 7 ♀, 3 ♂, (22-VII-2006), 1 ♀, 1 ♂, (12-VIII-2007), 14 ♀, 12 ♂; – (31): 1 ♀; – (34): (29-VI-2007), 1 ♀, 2 ♂; –

(53): (30-VII-2006), 3♂; – (54): (30-VII-2006), 1♀; – (55): (30-VII-2006), 1♀; – (58): 1♀, 2♂; – (59): 1♂; – (63): (31-VII-2006), 2♂; – (72): (01-VIII-2006), 3♂; – (75): (01-VIII-2006), 1♂; – (86): (06-VIII-2006), 1♂, (03-VIII-2007), 1♀, (06-VIII-2007), 1♀, 1♂; – (87): (08-VIII-2006), 1♀, 1♂; – (88): (08-VIII-2006), 1♂; – (92): (20-VII-2005), 1♀, 1♂, (10-VIII-2006), 2♀, 10♂, (13-VIII-2007), 1♀, 14♂; – (100): (27-VII-2007), 1♀, 2♂; – (110): (24-VII-2005), 2♀, 3♂, (27-VII-2005) 2♀, (12-VIII-2007), 2♀, 1♂; – (113): (26-VII-2005), 1♂, (07-VIII-2007), 1♀, 2♂; – (151): (05-VIII-2007), 1♂.

Sympetrum striolatum (Charpentier, 1840)

(1): (21-IX-2007), 1♂; – (2): (21-IX-2007), 2♀, 1♂; – (24): (21-VII-2006), 1♀; – (25): (08-VIII-2006), 1♀; – (26): (08-VIII-2006), 1♂; – (27): (07-VIII-2007), 2♀, 6♂; – (29): (21-VII-2006), 1♂, (08-VIII-2006), 4♀, 9♂, (07-VIII-2007), 1♂; – (32): (23-VII-2006), 2♀; – (46): (27-VI-2007), 1♀, 1♂; – (55): (30-VII-2006), 1♀, 1♂; – (68): (22-IX-2007), 1♀, 1♂; – (77): (25-VII-2007), 1♂; – (79): (02-VIII-2006), 2♀, (13-VI-2007), 2♂, (14-VI-2007), 1♀, (25-VII-2007), 3♂; – (82): (02-VIII-2006), 3♂, (17-VIII-2007), 2♂; – (88): (07-VIII-2007), 2♀; – (105): (15-VIII-2006), 1♂, (28-VI-2007), 1♀, 1♂; – (110): (24-VII-2005), 1♂; – (115): (28-VI-2007), 2♀; – (120): (25-VII-2007), 1♂; – (137): (09-VIII-2007), 2♀; – (138): (26-VII-2007), 3♀; – (143): (27-VI-2007), 5♀, 3♂; – (152): (05-VIII-2007), 1♀.

Sympetrum vulgatum decoloratum (Selys, 1884)

(1): (21-IX-2007), 1♀; – (2): (21-IX-2007), 7♀; – (25): (08-VIII-2006), 2♀, 1♂; – (30): (12-VIII-2007), 2♀; – (71): (21-IX-2007), 2♀; – (110): (27-VII-2005), 1♀, (12-VIII-2007), 1♀.

DISCUSSION

The taxonomy of *Calopteryx splendens* is not clear. *C. s. amasina*, *C. s. intermedia*, *C. s. waterstoni* and *C. s. tschaldirica* are the subspecies in Turkey (KALKMAN, 2006). *C. s. waterstoni* occurs along the Black Sea coast, between Giresun-Görele in the West and Artvin-Kemalpaşa near Georgia in the East. The range of *amasina* extends up to the western boundary of *waterstoni* (DUMONT et al., 1987).

Calopteryx virgo is represented in Turkey by two subspecies (*festiva* and *feminalis*) (KALKMAN, 2006). While *C. v. feminalis* is found along the eastern part of the Turkish Black Sea coast, *C. v. festiva* occurs in western and southern Turkey. KALKMAN (2006) has pointed out that *feminalis* has the underside of S9 black and S10 and underside of inferior appendages whitish (Fig. 2a), while *festiva* has ventral side of S9, S10 and of inferior appendages red (Fig. 2b). These characters coexist in specimens collected from coastal parts of the eastern Black Sea and from anywhere else within the study area. Because of the impossibility of co-occurrence of two subspecies in the same locality, we consider the colour differences in S9, S10 and inferior appendages as an individual variation of *festiva*.

Ischnura elegans ebneri and *I. e. pontica* are the infraspecific taxa known from Turkey (DUMONT, 1977; KALKMAN et al., 2003). While in *I. e. ebneri* the inner branches of the male superior appendages are crossed, these lie parallel to each other in *I. e. pontica* (SCHMIDT, 1967; DUMONT, 1991). *I. e. pontica* has been recorded from Turkish Thrace and *I. e. ebneri* from Anatolia (HACET &

AKTAÇ, 2004; SALUR & ÖZSARAÇ, 2004; SALUR & KIYAK, 2006, 2007b; MİROĞLU & KARTAL, 2008). DUMONT (1977) has reported the *I. e. pontica* occurrence along the Black Sea coast. However, MİROĞLU & KARTAL (2008) stated that Black Sea coast (Samsun province) specimens are referable to *I. e. ebneri*. According to KALKMAN (2006), the intraspecific identity of *I. elegans* is not clear. HACET (2009) considered that the identification of the subspecies is controversial and treated *I. elegans* specimens from the Western Black Sea region at species level only. Taking into account the structural peculiarities in male superior appendages, *Ischnura elegans ebneri* occurs along the coastal parts [Giresun, Trabzon, Rize and Artvin (Hopa town) provinces] while *I. e. pontica* in the inner parts [Artvin (Borçka, Murgul, Şavşat and Yusufeli towns) and Erzurum provinces] of the study area, which is in disagreement with the records of DUMONT (1977).

Onychogomphus lefebvrei, is a new record for the study area, documented by a single female and based on the descriptions provided by DUMONT (1991), KALK-

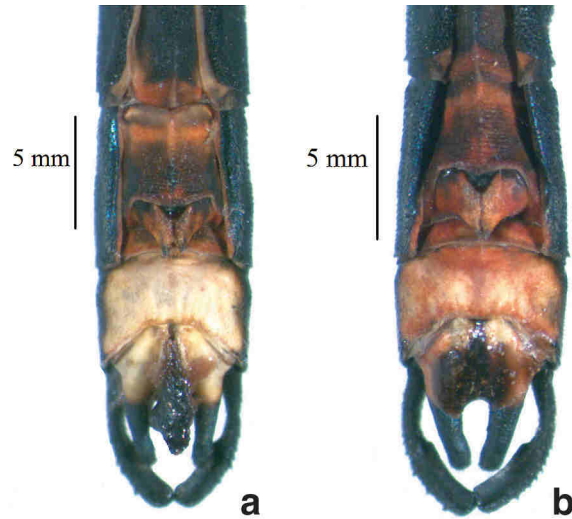


Fig. 2. *Calopteryx virgo festiva*, males from Rize-İyidere (Turkey): colour variation on ventral side of S9, S10 and inferior appendages.

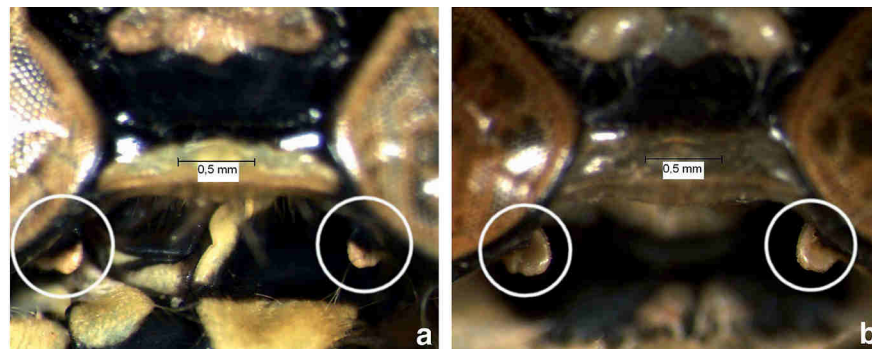


Fig. 3. Female occipital tubercles: (a) *Onychogomphus forcipatus albotibialis*; — (b) *O. lefebvrei*.

MAN (2006) and DIJKSTRA & LEWINGTON (2006). According to KALKMAN (2006) and DIJKSTRA & LEWINGTON (2006), the most important distinctive feature between *O. forcipatus albotibialis* and *O. lefebvrei* females is the size of the occipital tubercles. In *O. lefebvrei*, tubercles on hind rim of occiput are small and only faintly visible while in *O. forcipatus albotibialis*, these are large and clearly visible. However, in our *O. lefebvrei* female (Fig. 3b), the tubercles on hind rim of occiput are large and clearly visible like in *O. f. albotibialis* (Fig. 3a). Although, *O. lefebvrei* has a wide distribution in the Mediterranean basin and in southeastern Turkey (ASAHINA, 1974; DUMONT, 1977; KALKMAN et. al., 2004; KALKMAN, 2006; KALKMAN & VAN PELT, 2006b), there were no previous records from the Black Sea region.

To date, *Sympetrum haritonovi* has been only recorded in Turkey from Erzurum and Antalya provinces (DUMONT et al., 1995; VAN PELT, 2004; SALUR & KIYAK, 2007a). Here, it is recorded from a single locality (Erzurum-Oltu); it was not found in other parts of the study area. According to all records, in Turkey, the species occurs in two areas, which are geographically different from each other. These two populations could not be compared in taxonomic sense. New records from the intervenient areas (Antalya and Erzurum provinces) are expected.

In the study area, there are no boundaries between *Coenagrion ponticum* and *C. puella*, and there are no intermediate specimens. They co-occur in the same localities (Giresun, Trabzon and Artvin provinces).

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SHORT COMMUNICATIONS

**DESCRIPTION OF THE LAST INSTAR LARVA OF
ICTINOGOMPHUS ACUTUS (LAIDLAW) FROM SARAWAK,
WITH A KEY TO THE LARVAE
OF THE CONGENERIC SPECIES
(ANISOPTERA: GOMPHIDAE)**

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A ♂ final instar larva is described, illustrated and compared with the exuviae of congeneric spp. The exuviae of *I. decoratus melaenops* (Sel.), which also occurs in Sarawak (Malaysia), differ from *I. acutus* by having apical margin of labium convex to straight, without strong marginal teeth; no processes between eye and antennae; lateral ventral head processes are not visible dorsally; dorsal spines are highly arched; and anal appendages extend beyond spines on segment 9.

INTRODUCTION

Ictinogomphus acutus is a large-sized, rather uncommon gomphid, restricted to Peninsular Malaysia and Borneo, often found in blackwater drains on the edge of swamp forest, or the marshy margins of mangrove (ORR, 2005).

Here, its larva is described and illustrated for the first time.

***ICTINOGOMPHUS ACUTUS* (LAIDLAW, 1914)**

Figures 1-5

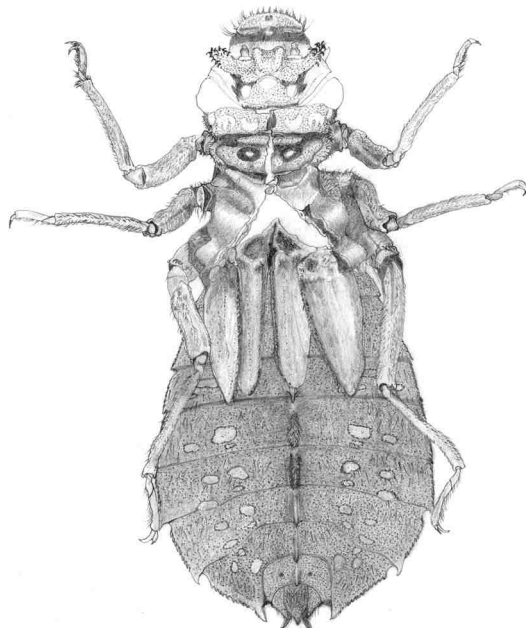
M a t e r i a l: — 4 ♂ and 4 ♀ final exuviae, Sungai Penyilam, Binyo, Sarawak, Malaysia. [The exuviae were cleaned and laid out, but not flattened and each labium was extended in situ for dorsal viewing. Some antennae were detached during preparation, but could be used for measurement purposes, the described specimen was illustrated using a flatbed scanner, stereo microscope and metric eye piece.]

Other material (all final instar exuviae):

- *I. acutus*: 3 ♂ and 4 ♀, same site as above, 2008, R. Dow leg.;
- *I. decoratus melaenops* (Sel.): Chanburi, Thailand, 24-V-1984, M. Hämäläinen leg.; – Langkawi, Malaysia, 1-III-2008, S. Butler leg.
- *I. dobsoni* (Watson): Murchison river, W. Australia, 29-XII-2002, D.G. Pryce leg.
- *I. fraseri* (Kimmins): Kotto, W. Cameroon, 9-IV-1970, S. Corbet leg.
- *I. rapax* (Rambur): Bang Phra, Thailand, 25-V-1984, M. Hämäläinen leg.; – Pokhara, Nepal, 26-V-2000, S. Butler leg.
- *Gomphidictinus perakensis* (Laidlaw): Ulu Langat, Malaysia, 17-I-2003, 29-III-2006, S. Butler leg.
- *Sinictinogomphus clavatus* (Fabr.): Tsushima, Ehime pref., Japan, 1-VIII-1986, M. Sugimura leg.

H a b i t u s (Fig. 1). – Total length 20,5 mm. In common with many members of the Lendeniinae, it is a typical limpet-shaped larva. Overall grey-brown in coloration.

H e a d. – sub-pentagonal, with a projecting frons having a frontal fringe of long hairs and a surface covered with short fine setae, overall colour mid-brown with a dark sinuous pattern near the pale basal margin and a dark central spot near the frontal margin. The anteclypeus is similarly dark and shelves smoothly onto the frons where a tiny tubercle marks the central border. Postclypeus appears paler and is horizontally aligned, with a slightly granular surface, its frontal border armed with small setae.



The concave edge of the frontal shelf is raised and projects forward from between the antennal bases. The whole of the vertex is covered with small tubercles, apart from the pale smooth ocelli. The anterior-lateral corner of the vertex is developed on the outside of the antennal base into a remarkable tubercle (Figs 1, 2) which is armed with 10 sharp and recurved spines, some bearing fine setae on their tip. Below these can be seen a sharp horn projecting from underneath the head.

Antennae (flagella detached but measurable), are set level with the vertex, scape is mid-

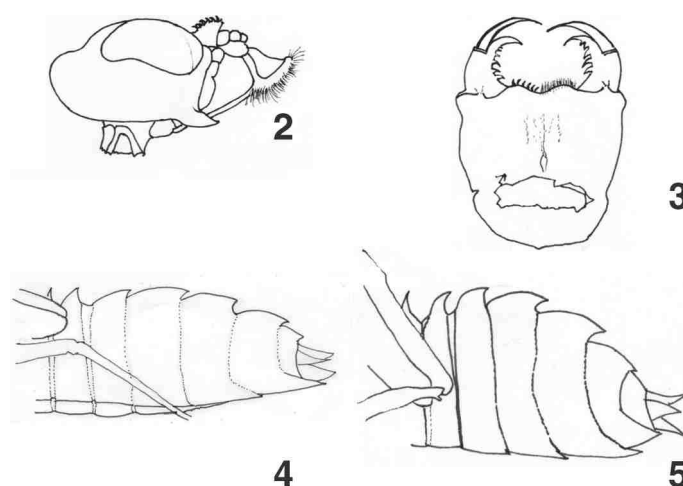
Fig. 1. *Ictinogomphus acutus*, habitus of final instar larva.

brown and smooth with a few small setae, the longer outer margin producing an inward curvature of the succeeding segments. The pedicel is smaller and paler, segment 3 is long and slender, extending over the frons and is slightly incurved. Segment 4 is tiny, pale and nipple-shaped. Ratios segments 1-4 = 1 : 0,53 : 4,93 : 0,06). All segments have a scattering of small setae.

Eyes are quadrant-shaped and bulge slightly at their posterior-lateral corners, producing the widest part of the head. The baso-lateral margin of the occiput, which has a moderate tubercle at its lateral angle, projects slightly rearwards. Inwardly the rear margin curves forwards to produce a concave effect and its borders decline quite steeply. The surface is granular apart from the usual muscle scars and a scarcely perceptible hump is present on the occiput basal to the lateral ocellus.

In lateral view (Fig. 2) the sharp horn, referred to above, can be seen as the extension of a marked ridge running the length of the midpoint of the eye and may have a function in either restricting the maxillae or locating the labium at rest.

Labium (Fig. 3) with a ratio l : b of 1 : 1,07 is widest at its fronto-lateral corners, where the basal hinge processes project laterally. The frontal margin is noticeably concave, its side lobes each having six stout and recurved teeth which are masked dorsally by a row of overlying bristles. Basal to the scooped margin is a sub-rectangular area outlined by a two parallel rows of fine setae and filled with a scattering of tiny fine setae which attract particles of dirt. The lateral margins



Figs 2-5. Structural features of *Ictinogomphus acutus* larva: (2) head, right lateral view, showing tubercle above and processes underneath; — (3) labium, dorsal view, showing left side distal margin with setae removed to show teeth; — (4) dorsal spines, lateral view; — (5) *I. decoratus melaenops* larva, dorsal spines, lateral view.

of the prementum are sub-parallel and armed with a row of 12+ spiny setae. The palps are robust and strongly recurved at the tips, the inner margin bearing 6 recurved stout teeth. The movable hook is both long and curved.

T h o r a x (Fig. 1). — The pronotum of the prothorax, has a frontal ridge separated from the succeeding saddle-shaped lobe by a pair of reniform smooth depressions each marked with a dark spot surrounded by a pale circle producing the impression of an eye. Raised areas are setosed, especially on their lateral margins. Wing cases are slightly parted (see discussion), the hind cases reaching the base of segment 5.

Legs show two tarsal segments, all legs bearing a covering of variable short setae, longest on the dorsal surfaces, these fields separated by longitudinally aligned smooth muscle scars. No burrowing hooks are present, though the distal portions of the tibiae are slightly swollen.

A b d o m e n (Fig. 1). — Grey-brown, darkening towards the apex and is sub-oval in shape. The maximum width appears to be at segments 6 and 7. The surface is generally granulate with a scattering of long fine setae. The lateral margins of segments 2-9 are endowed with several rows of stout setae which are developed into a single row of strong curved serrations- most pronounced on segments 7-9. Small disc-shaped muscle scars are visible approximately half-way between centre of the dorsum and lateral margin, a smaller scar is present outside this – on segments 7 and 8 it is placed on the distal margin and emphasised by a depression. These markings are somewhat obscured on segment 9. Segment 10 is fully enclosed by segment 9 the inner margins of which run almost longitudinally. Distal margins of each segment are spinous, but as the margins of 7-10 become more sinuous, the central portions of the margin are almost obscured (Fig. 1).

In cross-section the abdomen is triangular, the highest arch being on segment 6. Dorsal spines (Fig. 4) are present on segments 2-10, those on 2-5 being short, erect and slightly recurved, those on 6-10 becoming gradually thicker and forming horizontal ridges ending in spiny distal tips. Each spine although overlapping the base of the next segment remains separate from its successor and does not interlock as in some species of *Gomphidia* (BUTLER, 2007).

Ventrally the surface is evenly covered with small tubercles, the lateral portions of sternites 2-7 bearing a pronounced lobe, darker in appearance and smoother, the last condition presumably caused by friction in the larval environment. Genital markings are clearly present on segments 2, 3 and 9. The distal margins of segments are not markedly spinous- the intersegmental margin between 8 and 9 being almost vestigial.

Anal appendages are short, only the paraprocts- which curve outwards at their tips- project beyond the spines of segment 9, thus producing a rather truncated appearance. All appendages are covered with short warty setae and also sparse fine hairs. Ratio of cerci : paraprocts 4 : 7, ratio epiproct : paraprocts 5 : 7.

DISCUSSION

The remaining seven exuviae collected from the same site are identical, apart from their colouration, which varies from pale brown to blackish, and their wing cases, which vary from widely separated to almost touching.

Although no adults associated with the exuviae were taken, the species had been observed commonly in the vicinity (R. Dow, pers. comm.) and the exuviae is markedly different from *Ictinogomphus decoratus melaenops* specimens from my collection, this being the only other species of the genus recorded from Sarawak (ORR, 2005). The two exuviae of the latter species (from Thailand and Langkawi and both appearing identical), differ from *I. acutus* as follows: Apical margin of labium convex to straight, without strong marginal teeth. No processes between eye and antennae. Lateral ventral head processes not visible dorsally. Dorsal spines highly arched (Fig. 5). Anal appendages extend beyond spines on segment 9, producing tapering effect to distal segments of abdomen.

The nearest lindenids to have the same head processes inside the eye as *I. acutus*, are *I. fraseri* (where tubercles are developed frontally and horizontally, rather than vertically and do not bear sharp spines) and *I. ferox* (SUHLING et. al., 2003). *Gomphidictinus* (*Gomphidia*) *perakensis* has similar processes, which are spinous, but not so vertically developed, whilst other Asian *Gomphidia* species have similar, but much smaller processes (BUTLER, 2007).

PROVISIONAL KEY TO THE LARVAE OF SELECTED ICTINO GOMPHUS
AND GOMPHIDICTINUS SPECIES

- 1 Abdomen extended, tapering dorsal spines on segments 7-9, not ridged *I. clavatus*
- Abdomen truncated appearing disc-shaped in dorsal view with segments ridged 2
- 2 Some marginal spines laterally developed 3
- Marginal spines not as above 4
- 3 Lateral spines on segments 3-7 markedly laterally developed *G. perakensis*
- Lateral spine on segment 7 stout and somewhat developed laterally *I. fraseri*
- 4 Head with prominent spinous process between antenna and eye *I. acutus*
- Head without such prominent spinous process 5
- 5 Lateral spine segment 9 reaching tips of cerci 6
- Anal appendages projecting well beyond spines on segment 9 *I. dobsoni*
- 6 Palpal hook well developed beyond last tooth inner margin *I. rapax*
- Above hook recurved and not much extended beyond final tooth *I. d. melaenops*

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**COMPARATIVE MOLECULAR GENETICS
OF *NEHALENNIA SPECIOSA* (CHARPENTIER)
FROM GEOGRAPHICALLY DISTANT POPULATIONS
(ZYGOPTERA: COENAGRIONIDAE)**

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The populations from western Russia, the Russian Far East and Japan are compared using *Cytochrome Oxidase I (COI)* gene and Internal Transcribed Spacer 1 (ITS1) region of rDNA sequences. The exceptionally low variation is discussed.

INTRODUCTION

Nehalennia speciosa (Charp.) is a stenotopic species found only in sphagnum bogs. It has a wide but discontinuous range covering all of the Palearctic (BERNARD & WILDERMUTH, 2005). In western Russia, *N. speciosa* has hitherto been known only from single individuals (KOLESSOV, 1930) but, in July 2005, a population located in the Moscow region was discovered (SUVOROV, 2006).

According to hypotheses of speciation, geographic isolation is still considered to be one of the main drivers of population differentiation. This raises the question whether there are genetic differences in such isolated populations as those of *N. speciosa*, which live separated by long distances. It would also be interesting to know more about possible sibling species and gene flow (migration) in this species.

Polymorphisms in mtDNA make it possible to evaluate the rate of phylogenetic similarity or difference between individuals, populations or species (MITROFANOV et al., 2002). In recent years, DNA barcoding has been developed to study sequences of the *Cytochrome Oxidase I COI* gene, which exists in all eukaryotic mitochondrial genomes (HEBERT et al., 2003a, 2003b). Several insect taxa have been studied to determine the level of genetic differentiation based on

Table I
Mean and standard deviation of the percentage sequence divergences at *COI* [*n* indicates the number of congeneric pairs examined in each group] (HEBERT et al., 2003b)

Order	<i>n</i>	Mean	s. d.
Coleoptera	891	11.2	3.8
Diptera	1429	9.3	3.5
Hymenoptera	2993	11.5	3.8
Lepidoptera	882	6.6	2.2

sequence data of the *COI* gene and species within one genus exhibit genetic variation of about 10 % (Tab. I).

The Internal Transcribed Spacer 1 ITS1 is a highly variable region of nuclear rDNA due to insertions, deletions and point mutations, so it could be potentially useful for evolutionary studies (SUMIDA et al., 2004). Together with ITS2, ITS1 is used in molecular work as species-level divergence is common within these regions of rDNA (KUPERUS & CHAPCO, 1994; SILVA et al., 1999; PILGRIM et al., 2002). Successful use of the *COI* gene and the ITS1 region as molecular markers for studying the molecular phylogeny of the Odonata was shown by ARTISS et al. (1999; only *COI*), PILGRIM et al. (2002; only ITS1), WEEKERS & DUMONT (2004; rDNA including ITS1), DUMONT et al. (2005; rDNA including ITS1), TAKUJA & TEIJI (2006) and DUMONT et al. (2010; rDNA including ITS1).

The purpose of this study was to look at genetic differentiation among populations of *N. speciosa* using the *COI* gene and ITS1 region.

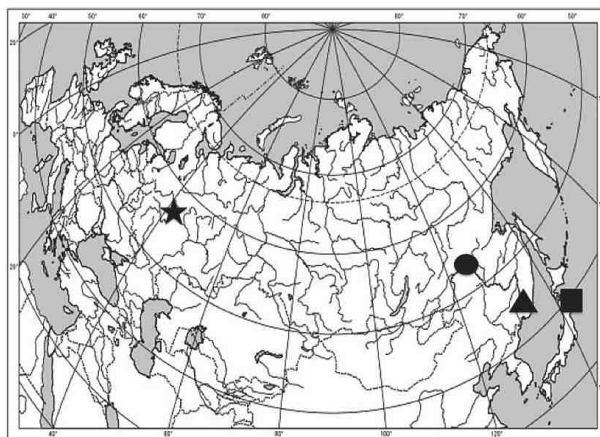


Fig. 1. Collection sites of *N. speciosa* from western Russia (star), eastern Russia (circle, triangle) and Japan (square).

MATERIAL AND METHODS

Nehalennia speciosa individuals were collected from one population in Western Russia (Moscow), two in Eastern Russia (Blagoveshchensk and Primorye) and one in Japan (Aomori) (Fig. 1). Five specimens from western Russia, four from eastern Russia (two from each site) and one from Japan were used.

DNA EXTRACTION – DNA was extracted from either the abdomen or from the whole specimen. Individuals which had been obtained from eastern Russian and Japanese populations were stored in separate 1.5 ml Eppendorf microcentrifuge tubes containing approximately 1 ml of 98% ethanol. The manufacturer's protocol of the DIAatom™ DNA Prep 100 kit (Isogene, Russia) was followed.

A 710 b.p. region of the mitochondrial genome, which is a part of the *COI* gene, was sequenced. PCR amplification was performed using LCO1490 (Forward, 5'-GGTCAACAAATCATAAAGA-TATTGG-3') and HCO2198 (Reverse, 5'-TAAACTTCAGGGTGACCAAAAAATCA-3') primers (FOLMER et al., 1994). PCR conditions: hot start 94°C for 5 min; pre-PCR 5 cycles: denaturation at 94°C for 1 min, annealing at 45°C for 1 min 30s, elongation at 72°C for 1 min 30s; 35 cycles: denaturation at 94°C for 1 min, annealing at 50°C for 1 min 30s, elongation at 72°C for 1 min.

In order to amplify the entire ITS1 region (165 b.p.) of rDNA including small partial 18S and 5.8S sequences (245 b.p. with ITS1), forward (N18SF, 5'-CCGTAGGTGAACCTGCAGAA-3') and reverse (N5.8R, 5'-CGAGTGATCCACCGTTTAGG-3') primers were designed with the program Primer3 (ROZEN & SKALETSKY, 2000) using a partial sequence of *N. speciosa* rDNA from GenBank (accession no. FN356135). The reaction program was 1 cycle at 95°C for 3 min, 56°C for 20 sec, and 72°C for 35 sec followed by 34 cycles at 95°C for 30 sec, 56°C for 20 sec, and 72°C for 35 sec and a final extension of 72°C for 10 min (PILGRIM et al., 2002). Amplification products were run on 1% TBE agarose gel (Sigma, USA).

GEL EXTRACTION – PCR products of 710 b.p. (*COI*) and 245 b.p. (ITS1) were extracted from an agarose gel via the manufacturer's protocol of the JETQUICK Gel Extraction Spin Kit 250 (GENOMED, GmbH).

SEQUENCING – The *COI* gene and the ITS1 region were sequenced from ten individuals of *N. speciosa*. Sequencing was performed using a sequenator ABI PRISM 310 with reagents from an Applera kit (USA).

Table II
GenBank accession numbers of *COI* gene partial sequences and ITS1 sequences

Individual	Sex	Location	COI GenBank accession number	ITS1 GenBank accession number
M6P	♂	E Russia	AM696290	HM598667
F4P	♀	E Russia	FN252231	HM598671
MB	♂	E Russia	FN252224	HM598669
FB	♀	E Russia	FN252223	HM598668
F2Mo	♀	W Russia	FN252227	HM598673
M2Mo	♂	W Russia	AM696290	HM598672
F6Mo	♀	W Russia	FN252228	HM598674
F7Mo	♀	W Russia	FN252229	HM598676
M8Mo	♂	W Russia	FN252230	HM598675
F2J	♀	Japan	FN252226	HM598670

DATA AND ALIGNMENT – All *COI* and ITS1 sequences were analyzed and assembled with ChromasPro 13.3, aligned using Clustal W (THOMSON et al. 1994) and implemented in MEGA4 software (TAMURA et al., 2007). GenBank Accession numbers are presented in Table II.

RESULTS

Among the *COI* sequences, two variable sites have been found (Tab. III), but no variation has been found in the ITS1 region.

DISCUSSION

An almost complete similarity of nucleotide sequences of the *COI* gene and full identity of ITS1 sequences in *Nehalennia speciosa* individuals from all studied habitats were found. Such a reduced genetic variation was also present in *N. speciosa* populations from Poland, using allozyme loci data (BERNARD & SCHMITT, 2009). Nevertheless, a higher genetic differentiation would be thought to occur between populations, separated by great distances and with a discontinuous range because geographical isolation and, probably, habitat fragmentation are the primary factors affecting genetic structure (RUIZ et al., 2009). A correlation between geographical distribution and genetic differentiation has been discovered in the majority of animals examined so far (AVISE et al., 1987).

Our individuals from the East were similar to the ones from western Russia. This supports the hypothesis that populations of the species inhabit a continuous range. But according to many researchers *N. speciosa* populations are isolated from each other (BERNARD & WILDERMUTH, 2005). There is, therefore, an apparent contradiction between data on nucleotide sequence similarities and data on geographic disconnection of populations. Perhaps the chosen molecular genetic markers may not reflect the rate of genetic differentiation between *N. speciosa* populations. This could be the case if it could be shown that there is an especially high level of conservation of the *COI* gene sequence and the ITS1 sequence in this species. One way to investigate this would be to use other molecular nuclear or mitochondrial markers. An AFLP analysis, using a large number of anonymous loci, is an obvious possibility. In the *Calopteryx splendens* group, where ITS provided no or minimal resolution within the subspecies (WEEKERS et al., 2001); AFLP revealed plenty of hidden variation (SADEGHI et al., 2010).

Alternatively, the disjunction between the populations may be of recent date, say, of the order of centuries or a couple of millennia at most.

Table III

Polymorphic sites (positions 339 and 489) of 10 *COI* gene sequences (556 b.p in length). – M: male, – F: female, – Mo: western Russia, – B, P: eastern Russia, – J: Japan. – M6P represents a consensus sequence. Full stops indicate identical nucleotides

Individual	339	489
M6P	G	T
F2J	C	.
F2Mo	.	C
F6Mo	.	C
F7Mo	.	C
M8Mo	.	.
M2Mo	.	.
F4P	.	.
MB	.	.
FB	.	.

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***NANNOPHLEBIA KALKMANI* SPEC. NOV.,
A REMARKABLE NEW SPECIES FROM PAPUA NEW GUINEA
(ANISOPTERA: LIBELLULIDAE)**

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The new species is described from the foothills of the Muller Range, Western Province, Papua New Guinea. Holotype ♂: Gugusu, alt. 515 m a.s.l., 4-IX-2009; deposited at RMNH, Leiden. Diagnostic characters of the adult ♂ are illustrated and the affinities of the sp. are discussed.

INTRODUCTION

The Muller Range is a large, semi-isolated mountain block that straddles Western and Southern Highlands Provinces in central-western Papua New Guinea. The range is included on the World Heritage Tentative List on the basis of its spectacular karst environments but has been poorly explored biologically, and in 2008 it was identified as a priority target for biodiversity documentation by Conservation International's RAP biodiversity survey program. In September 2009, a RAP survey team spent one month in the Muller Range, documenting the flora and fauna at elevations ranging from 500-2,900 m a.s.l. Among the species recorded were several new species of odonates, one of which has subsequently been described (ORR & KALKMAN, 2010).

Here we describe a second new odonate species that was discovered during the Muller Range expedition; a distinctive new species of the libellulid genus *Nannophlebia*.

MATERIAL AND METHODS

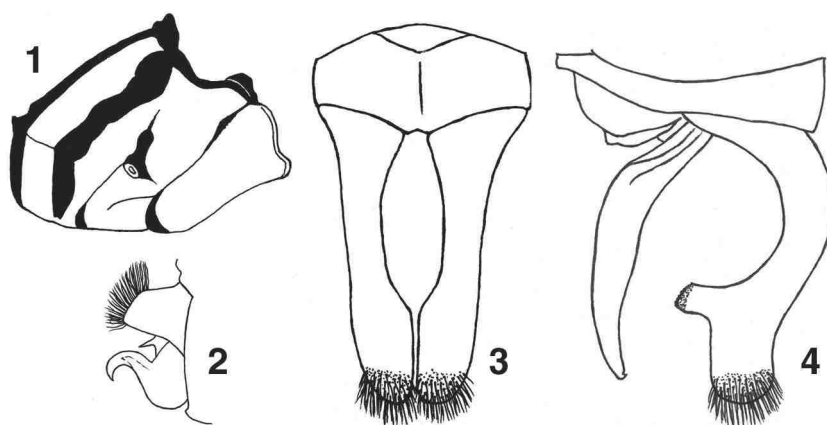
Descriptive terminology largely follows CHAO (1953) and WATSON & O'FARRELL (1991). Coloration is given as detectable from the preserved material and measurements are given in millimetres (mm). All illustrations were done with the aid of a camera lucida and are not to scale.

RMNH stands for National Museum of Natural History Naturalis (Leiden).

NANNOPHLEBIA KALKMANI SP. NOV.

Figures 1-6

Material. — **Holotype** ♂: Papua New Guinea, Western Province, Muller Range, Conservation



Figs 1-4. *Nannophlebia kalkmani* sp. n., male: (1) synthorax, lateral view; — (2) secondary genitalia, lateral view; — (3-4) anal appendages, dorsal and lateral views.



Fig. 5. *Nannophlebia kalkmani* sp. n.: holotype male.

International Muller Range expedition, Camp 1 (Gugusu), 5°43.751'S/142°15.797'E, 515 m a.s.l., 4-IX-2009, V.J. Kalkman leg. (RMNH); – **Paratype** ♂: same data and depository as holotype.

E t y m o l o g y. – The species is dedicated to its collector, the eminent and dynamic odonatologist Vincent J. K a l k m a n.

MALE. – **Head.** – Labium yellow; mandible bases yellowish green, apices black and brown; labrum largely black, narrowly yellowish green along much of base; clypeus yellowish green; frons yellowish green with wide median black patch adjacent to the black vertex and narrowly black along part of eye-margin; antennae black; eyes pale yellow (but almost certainly vividly green in life); occiput black on top, yellow at the back; postgenae black.

T h o r a x. – **Prothorax:** Pronotum with anterior lobe largely yellow, median lobe largely reddish brown with bright yellow patch each side along mid-line and yellow along lateral edges, and posterior lobe reddish- to greyish brown, posteriorly somewhat paler than anteriorly; episternum and epimeron yellowish green with rather indistinct grey patches; coxa yellowish green, trochanter yellowish green with greyish black patch adjacent to the femur which is largely black with a greyish yellow patch for basal 2/3 of inner face; tibia largely black, rather narrowly greyish yellow for much of outer face; spines of femur and tibia black; tarsus black; claws blackish brown. **Synthorax:** Spiracular dorsum largely brown, yellow only between the spiracles; adjacent collar and dorsal carina yellow; slightly less than anterior half of mesepisternum, including antealar ridge and sinus, black, posterior half bright yellowish green; a black stripe covering approximately anterior half of mesepimeron transgressing mesopleural suture only marginally in dorsal 1/5; remainder of synthorax largely bright yellowish

green with black subalar ridge and with black patch each, dorsal to metastigma, along dorsal half of metapleural suture and at the basis of metepisternum and metepimeron. Coxae yellowish green; trochanters yellowish green with black patch adjacent to the femora which are largely black with greyish yellow patch across basal 2/3 of inner face; inner face and apex of tibiae black, remainder of outer face yellow; spines of femora and tibiae black; tarsi black, claws reddish to blackish brown; postcoxae and poststernum pale yellowish green; tergal area black with mesoscutum, mesopostnotum and metascutum largely bright greenish yellow.

Wings. — Membrane hyaline, tinted brownish yellow at base to level of discoidal cell in forewing, to 1 cell beyond level of discoidal cell in hindwing; venation black; axillary sclerites bright yellow; pterostigma black, slightly shorter in forewing than in hindwing; Ax 6, 7/5; Px 5/5, 6.

A b d o m e n. — Tergum 1 yellowish green with blackish brown patch, wider basally and apically; tergum 2 yellowish green with black hour-glass-shaped mid-dorsal mark; tergum 3 basally and apically black, yellowish green in between; terga 4-6 black, each with sub-trapezoid yellow patch each side (medially narrowly separated) in posterior half; terga 7-9 almost completely black; segment 10 dorsally and laterally black, ventrally somewhat paler; sternum 1 yellowish; secondary genitalia from yellow to dark brown; sternum 3 pale yellow; sternum 4-6 very dark basally and apically, pale in between; sternum 7-9 black. Genital hamule hooked, large, strongly curved; genital lobe narrowly subtriangular. Superior anal appendages pale yellowish green with proximal portion almost semicircularly down-curved, subapical projection strongly developed and bearing small black warts along its margin, and apex evenly rounded in all directions, the resulting hemisphere densely set with black spine-like setae; inferior appendage pale yellow.

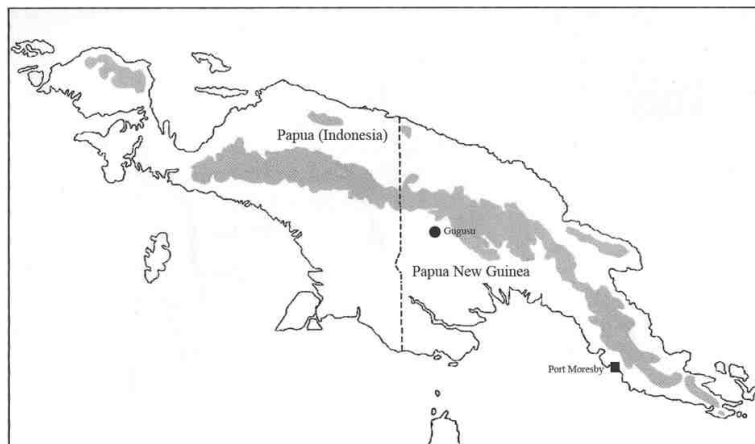


Fig. 6. *Nannophlebia kalkmani* sp. n.: topographic position of type locality.

lowish green, almost as long as superiors and with apex curved and hooked.

V a r i a b i l i t y. – The male paratype is a subadult specimen and as such accordingly distinctly paler than the holotype which is definitely an adult specimen. The main difference is an additional, not sharply defined, pale ring on tergum 7. Ax 6/5; Px 5/5.

M e a s u r e m e n t s (in mm). – Hindwing 19.6-19.9, abdomen (including appendages) 19.0-19.4.

FEMALE unknown.

HABITAT. – The type locality (Gugusu) is at an altitude of 515 m on a low ridge at the base of the Muller Range. Gugusu Camp was in medium-crowned upland (hill) forest containing some elements more typical of montane vegetation. The forest was extremely wet and a number of small streams drained the ridge near camp. The two available males were collected at small, shallow and steep streams, 1 to 2 m wide, in undisturbed rainforest.

DISCUSSION. – *N. kalkmani* sp. n. shows close affinities with some congeners from Papua New Guinea and does not appear closely related to any species outside of New Guinea. The total number of *Nannophlebia* species hitherto known from Papua New Guinea is 13. Of these, three species [*N. amphicyllis* Lieftinck, *N. braueri* (Förster) and *N. i. infans* Lieftinck], have 7 or more antenodal crossveins in the forewing (LIEFTINCK, 1933, 1963). *N. adonia*, *agalma*, *alexia*, *amaryllis*, *amnesia*, *amphycteria*, *anatya*, *antiacantha* and *axiogasta*, all described by Lieftinck and *N. biroi* (Förster) have only 6 antenodals in the forewing, and the superior appendages of their males are apically pointed (LIEFTINCK, 1933, 1938, 1942, 1955, 1963). *N. kalkmani* has 6 antenodals in the forewing (and an extra 7th in one forewing of the holotype), but is clearly distinguished from all of these by having the apex of the superior anal appendages hemispherically rounded and strongly setose. In their overall shape the male anal appendages of *N. kalkmani* come closest to those of *N. amphicyllis*, and the colour pattern is rather similar in these two species. Both species coexist at the type locality. Even though the overall shape of the male anal appendages of *N. kalkmani* and *N. amphicyllis* is similar, the hemispherically rounded and strongly setose apex of the superiors also clearly distinguishes *N. kalkmani* from *N. amphicyllis* that has the apex of the superiors pointed and not particularly hairy or setose.

MATERIAL OF OTHER NANNOPHLEBIA SPECIES STUDIED: *N. amphicyllis*: 1 subadult male, Papua New Guinea, Southern Highland Province, Muller Range, CI Muller Range expedition, Camp 1 (Gugusu), 5°43.751'S / 142°15.797'E, 515 m a.s.l., 4-IX-2009, V.J. Kalkman leg. (RMNH).

ACKNOWLEDGEMENTS

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we are very grateful to VINCENT KALKMAN for making available this undescribed species (plus photo) for this publication, for information on its habitat and for help with material for comparison. We are also extremely grateful to the PNG Department of Environment and Conservation, the National Research Institute, and provincial authorities for relevant approvals and export permits.

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**DESCRIPTIONS OF *BAYADERA BIDENTATA* NEEDHAM AND
ASIAGOMPHUS CUNEATUS (NEEDHAM) LARVAE FROM
HUANGSHAN MOUNTAIN, CHINA
(ZYGOPTERA: EUPHAEIDAE; ANISOPTERA: GOMPHIDAE)**

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The morphology of the last instar larvae is described and illustrated for the first time, based on specimens from Anhui. Notes on their ecology and habitat are provided.

INTRODUCTION

The adults of *Bayadera bidentata* and *Asiagomphus cuneatus* were described by NEEDHAM (1930). The latter species is known also from the studies by SCHMIDT (1931), NEEDHAM (1941, 1944) and CHAO (1953, 1990) and ASAHINA (1961, 1985). *Bayadera bidentata* was described by NEEDHAM (1930). Here, we describe and illustrate their hitherto unknown larvae and exuviae, collected from Huangshan Mountain, Anhui, China.

***BAYADERA BIDENTATA* NEEDHAM**

Figures 1-10

Material. — 5 ♂, 6 ♀, exuviae, 23-V-2010, Wuxi village, Huangshan mountain, Anhui, China. Jiang Yao-Hua leg. Larvae were found along rocky sections of rivers and streams, under stones.

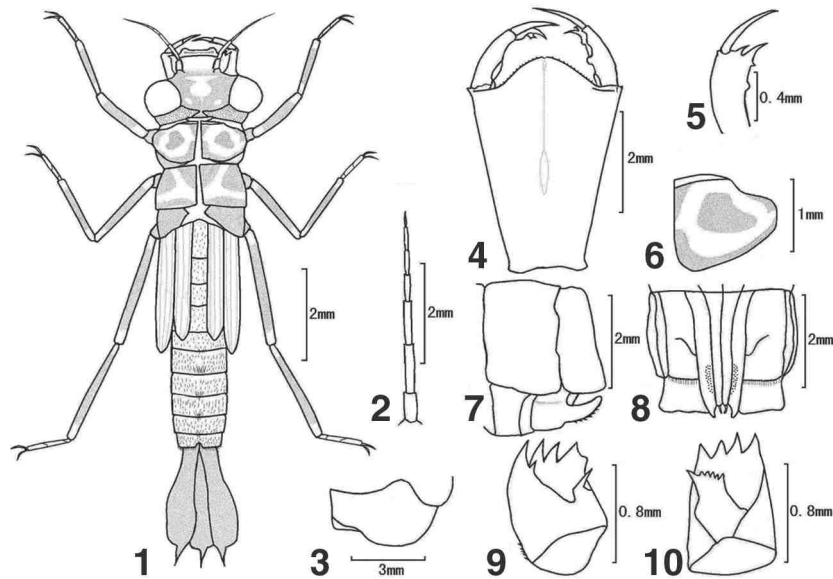
Body length 25 mm, length of abdomen (including caudal appendages) 22 mm, maximum head width 5 mm (Fig. 1). Ground colour light yellow. Length of hind

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femur 6 mm. Abdomen segments 8-10 black. Body surface with yellow-brown hairs with thick hair on the dorsum of abdominal segments 5-9.

H e a d. — 1.5 times as long as wide, occiput concave, labium yellow, surface smooth, with yellow fine hair on the distal third 1/3 to the apex of the mentum. Ratio of length to width of prementum 4.5 : 3.0 (Figs 4-5), and labial palp with two teeth of which the inner tooth is longer than outer tooth. Labrum brown; anteclypeus deep brown, with yellow marking; postclypeus brown. Antenna filiform in shape, 7-segmented (Fig. 2). Length ratios of antennal segments 1-7 as follows: 0.5 : 0.9 : 1.1 : 0.8 : 0.5 : 0.4 : 0.3. Scapus and pedicellus of antenna black, with rough surface; flagellum light yellow; ocellar triangle with light marking, surface smooth and no hair; compound eye yellow. Occipital lobe rounded at sides, with black, short spine and brown lamellar setae (Fig. 3). Molar of mandible pink in colour (Figs 9-10). Mandibular formula (sensu WATSON, 1956) L 1234 0 a(m¹²³⁴) b/ R 1234 y d.

T h o r a x. — Prothorax brown (Fig. 6), with brown short hair and lamellar setae. Legs brown with sparse short hair; hair of tibia thicker than femur; tarsus no hair visible in dorsal view, but black brown hair present in ventral view. Wing cases parallel. Forewing cases reaching to hind border of fifth abdominal segment. Hindwing cases reaching to fore border of sixth abdominal segment, fore and hindwing cases with yellow hair in longitudinal rows.



Figs 1-10 *Bagaderella bidentata* Needham: (1) male exuviae; — (2) left antenna; — (3) right occipital lobe in dorsal view; — (4) labium in ventral view; — (5) left labial palp, dorsolateral view; — (6) right prothorax in dorsal view; — (7) caudal abdomen segments in lateral view; — (8) female primary genitalia in ventral view; — (9) right mandible, inner view; — (10) left mandible, inner view.

A b d o m e n. — Yellow, with yellow brown hair which is obvious on the dorsal abdominal segments 5-9 (Fig. 1). Abdominal segments 8-10 deep-brown coloured; other segments yellow. Primary lateral valvula of female longer than primary inner valvula; primary lateral valvula with spine at ventral tip; female primary genitalia reaching to hind border of abdominal segment 10 or beyond (Figs 7-8). Caudal gills black and narrowly protruded at apex.

B i o m e t r i c r a t i o s. — Head / prothorax: 1.04-1.06 (\bar{x} = 1.05; n = 6), prementum L / W+ : 1.50-1.54 (\bar{x} = 1.52; n = 6), prementum W+ / W : 2.50-2.52 (\bar{x} = 2.51; n = 6), antennal annulus 1 > antennal annuli 4 + 5).

ASIAGOMPHUS CUNEATUS (NEEDHAM)

Figures 11-20

M a t e r i a l. — 5 ♂, 4 ♀, exuviae 21-V-2010, Wuxi Village, Huangshan mountain, Anhui, China. Jiang, Yao-Hua leg.

Body length 34 mm, length of abdomen (including caudal appendages) 25 mm (Fig. 11), maximum head width 7.5 mm, ground colour deep yellow-brown, length of hind femur 8 mm; abdomen with black spots and black markings on the dorsum. Body surface with yellow-brown, fine hair. Both sexes with lateral spines on abdominal segments 7-9.

H e a d. — Labium brown; labrum of usual shape, light brown, with narrow black stripe at anterior margin. Labial palp brown with granulated surface at base and inner margin with small teeth; distal margin of mentum beset with a tidy row of short hairs separated in the middle by a short gap. Movable hook deep brown, surface with luster and sharply-pointed apex. Ratio of length to width of prementum 5 : 4.5 (Fig. 12); labrum, antefrons and postfrons yellow brown, ocellar triangle light brown, with black markings at sides of the lateral ocelli, antenna eggplant-shape and yellow, with fine yellow hairs. Antennae 4-segment ratio 1-4 is 1.0 : 0.5 : 3.6 : 0.2 (Fig. 20). Compound eye yellow, occipital lobe rounded. Mandibular formula (sensu WATSON, 1956) L 1234 0 a (m¹²³⁴⁵⁶) b / R 1234 y a (m¹²³⁴) (Figs 13-14).

T h o r a x. — Sides of pronotum rounded in shape, deep brown, with two large, dark blackish-brown, rounded tubercles on posterior margin (see Fig. 15). Mesothorax blackish-brown, with yellow-brown hairs at sides. Legs stout; fore leg no burrowing spine, tarsus with yellow hairs, length hind femur 8 mm. Wing cases parallel. Forewing cases reaching to posterior margin of third abdominal segment. Hindwing cases reaching to anterior margin of fourth abdominal segment, fore and hindwing cases yellow.

A b d o m e n. — Yellow brown, lateral spine present on abdominal segments 7-9 (Fig. 19), no dorsal spines except barely visible trace at middle of third abdominal segment (see Fig. 18); dark black spots and markings on abdominal seg-

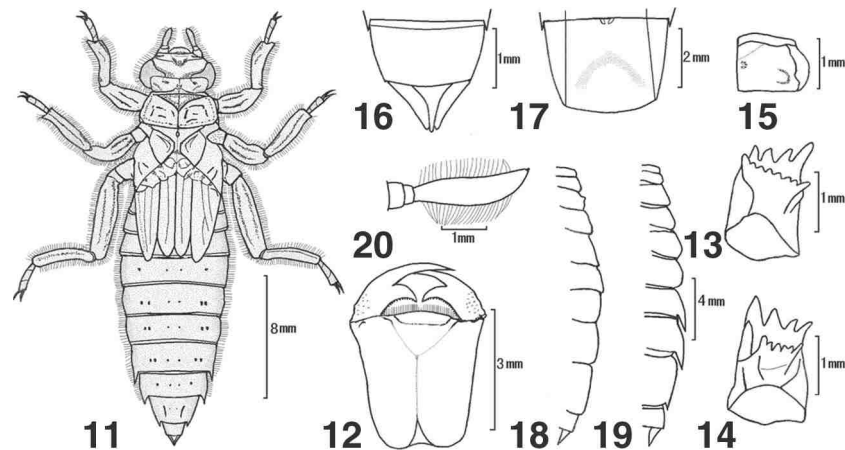
ments 4-9; abdomen covered with sparse yellow brown hairs. Epiproct with blunt and deep brown apex and length longer than paraproct (Fig. 16).

Biometric ratios. — Head / prothorax: 1.5-1.54 (\bar{x} = 1.52; n = 5), prementum L / W⁺: 1.58-1.60 (\bar{x} = 1.59; n = 5), prementum W⁺ / W⁻: 2.10-2.15 (\bar{x} = 2.12; n = 5), anal pyramid L / W: 1.22-1.24 (\bar{x} = 1.23; n = 5).

DISCUSSION

The genus *Asiagomphus* was erected by ASAHINA (1985). To date, it includes 26 species and subspecies which are distributed all over Asia. The larvae have been described for about seven species in China and Japan. *A. cuneatus* is distributed mainly in central and eastern China including Zhejiang, Jiangxi, Fujian and Anhui. The larvae dwell in coarse sand in fast flowing streams. The adults begin emerging in May and exuviae can be found on rocks, damp soil and thick growth of grass, often up to 3-4 m away from water. The emergence peak is in the second decade of May. Emergence time is from 8:00 to 16:00 h. It can also emerge in cloudy conditions. Larvae of *A. hainanensis* (Chao), *A. perleatus* (Chao) and *A. pryori* (Selys) share common features such as lateral spines on abdominal segments 7-9, but the trace of a dorsal spine on the dorsum of abdominal segment 3, can serve in differentiation of *A. cuneatus*.

Bayadera bidentata is distributed mainly in Zhejiang, Fujian, Guangxi and Anhui, China. Its habitats are similar to those of *A. cuneatus* and *Heliogomphus retroflexus*. Usually the habitat elevations are between 400-500 m, but if this altitude



Figs 11-20. *Asiagomphus cuneatus* (Needham), female exuviae: (11) general aspect, dorsal view; — (12) labium, ventral view; — (13) left mandible, inner view; — (14); right mandible, inner view; — (15) prothorax, right side, dorsal view; — (16) caudal abdominal segments, dorsal view; — (17) same, ventral view; — (18) dorsum of abdomen, lateral view; — (19) lateral spines of abdomen; — (20) right antenna.

is exceeded, population densities are lower. Adults emerge in May and June; the emergence time is 7:00-10:00 h. Their exuviae can be found on rocks, 3-5 m away from water.

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ODONATOLOGICAL ABSTRACTS

2006

- (18303) BORISOV, S.N., 2006. Distribution and ecology of *Sympetrum arenicolor* Jödicke, 1994 (Odonata, Libellulidae) in Middle Asia. *Euroasian ent. J.* 5(4): 278-284 (Russ., with Engl. s.). — (Inst. Anim. Syst. & Ecol., Russ. Acad. Sci., Frunse 11, RUS-630091 Novosibirsk).
The distribution data are presented and it is shown the sp. mainly inhabits the artificial lowland ponds. It is univoltine. Seasonal migrations to mountains and back to the lowlands are characteristic during the pre-reproductive period. This is the most krenophilous odon. sp. in the Middle Asian desert zone. Its reproductive period during the autumn and early winter is described.
- (18304) BRACCIA, A. & J.R. VOSHELL, 2006. Benthic macroinvertebrate fauna in small streams used by cattle in the Blue Ridge Mountains, Virginia. *NEast. Nat.* 13(2): 269-286. — (Dept Ent., Virginia Tech., 300A Price Hall, Blacksburg, VA 24061, USA).
The adverse effects of cattle grazing on stream habitats and macroinvertebrates have been well documented. The purpose of this study was to provide a list of taxa that can be expected to occur in small streams impacted by cattle in the southern Blue Ridge Mts. *Gomphus*, *Lanthus*, *Stylogomphus albistylus* and *Cordulegaster* are listed and their pollution tolerance values are stated.
- (18305) FERREIRA, S. & J.M. GROSSO-SILVA, 2006. On the dragonflies of Portugal: study of a collection from the 1980s (Insecta, Odonata). *Boln Asoc. esp. Ent.* 30(3/4): 11-23. (With Span. s.). — (CIBIO, Univ. Porto, Campus Agrário de Vairão, PT-4485-661 Vairão).
The records are presented for 42 spp., collected from various regions of Portugal.
- (18306) GERARD, C., 2006. *The Great Fen. Artists for nature in England*. Langford Press, Peterborough. 167 pp., hardcover, flappers 27.5 × 31.0 cm. ISBN 1-904078-13-3. Price: € 55.-- net. — (Publishers: 10 New Rd, Langtoft, Peterborough, PE6 9LE, UK).
On the long-term development project of linking the extremely valuable Woodwalton Fen and the Holme Fen National Nature Reserves, S of Peterborough (UK), with water colour paintings of dragonflies (on 25 pp.) by some of the 28 artists from various countries (incl. Russia and the USA) that have visited the area in 2004 and 2005.
- (18307) KIM, S.-T., M.-P. JUNG, H.-S. KIM, J.-H. SHIN, J.-H. LIM, T.-W. KIM & J.-H. LEE, 2006. Insect fauna of adjacent areas of DMZ in Korea. *J. Ecol. Fld Biol.* 29(2): 125-141. — (Last Author: Entomology Program, Sch. Agric. & Biotechnol., Seoul Natn. Univ., Seoul 151-921, Korea).
Lists 10 odon. spp. from the Eastern mountain and Middle inland regions, adjacent to the Demilitarized Zone (DMZ).
- (18308) NOVELO-GUTIÉRREZ, R. & J.A. GÓMEZ-ANAYA, 2006. A description of the larva of *Argia funcki* (Selys, 1854) (Odonata: Zygoptera: Coenagrionidae). *Proc. ent. Soc. Wash.* 108(2): 261-266. (With Span. s.). — (Depto Ent., Inst. Ecol., A.C., Apdo Postal 63, MX-91070 Xalapa, Veracruz).
The last instar larva is described and illustrated. A comparison to its closest relative, *Argia lugens*

(Hag.), is provided. The scale-like setae on sternite 8 and gonapophyses, and the bluntly-tipped gonapophyses easily separate the 2 spp. *A. funciki* larva belongs to the group of spp. with ligula very prominent and one palpal seta. It is the largest of all known larvae of the genus.

- (18309) ROWE, R.J., 2006. Patterns and processes in freshwater systems: the social dimension. *N. Z. natural Sci.* 31: 59-70. – (Sch. Marine & Trop. Biol., James Cook Univ., Townsville-4811, AU). Social interactions within species present an under-appreciated complicating factor in freshwater ecology. Such processes can markedly alter distribution patterns. Odon. are an important group of animals in freshwater systems and have the capacity, under some circumstances, to exclude other organisms (invertebrate and vertebrate) from otherwise suitable habitats. Within the Odon. stylised agonistic behaviours are widespread in larvae of Zygoptera and have important consequences for both the ecology of the spp. concerned and for the impact of zygopteran larvae within the ecosystems. In this paper the diversity of agonistic displays within the Zygoptera is reviewed. On phylogenetic grounds, supported by fossil dates, zygopteran display systems are very ancient (~150-200 My). Given the obvious costs in energy, increased exposure to predators, and the real risk of damage during interactions, agonistic behaviours must have considerable adaptive significance. Investigations of the processes involved in social interactions, and how they generate the patterns that are more generally recorded, will probably require a return to large aquarium studies, or to in situ examination of microhabitats using underwater observatories.

2007

- (18310) BORISOV, S.N. & A.Yu. HARITONOV, 2007, 2008. The dragonflies (Odonata) of Middle Asia, 1: Caloptera, Zygoptera; – 2: Anisoptera. *Euroasian ent. J.* 6(4): 343-360, 7(2): 97-123. (Russ., with Engl. s.). – (Inst. Anim. Syst. & Ecol., Russ. Acad. Sci., Frunse 11, RUS-630091 Novosibirsk). A review is presented of the 85 spp. hitherto reported from central Asia, incl. 51 spp. from Turkmenistan, 56 Uzbekistan, 56 Tajikistan, 58 Kyrgyzstan, and 66 spp. from the southern Kazakhstan. Taxonomic aspects, distribution characteristics and ecology are outlined and distribution maps are provided.
- (18311) CANO-VILLEGAS, F.J., 2007. Odonatos del río Borosa (Jaén, sur de España) (Odonata). *Boln Soc. ent. aragon.* 41: 468-470. (With Engl. s.). – (Area Zool., Depto Sistemas Físicos Químicos Naturales, Univ. P. de Olavide, ES-41013 Sevilla). A commented list of 13 spp. from the Sierra de Cazorla Natural Park, Spain.
- (18312) HOLUŠA, O. & P. MÜCKSTEIN, 2007. *Dragonflies (Odonata) of the Žďárské vrchy Mts. Faunistic-ecological study.* Parnassia 2, 77 pp. ISBN 978-80-254-1228-2. (Czech, with Engl. s.). – (First Author: Bruzovská 420, CZ-738-01 Frýdek-Místek). 42 spp. are reported from 59 localities in this Protected Landscape Area (Czech Republic), and the fauna is discussed in much detail.
- (18313) KRATZER, E.E. & D.P. BATZER, 2007. Spatial and temporal variation in aquatic macroinvertebrates in the Okefenokee Swamp, Georgia, USA. *Wetlands* 27(1): 127-140. – (First Author: Dept Biol. Sci., Virginia Polytechnic Inst. & St. Univ., Blacksburg, VA 24061, USA). The temporal variation among seasons and spatial variation among 5 plant community habitats are assessed across 6 areas of the Swamp. Odon. were represented by 14 gen. of 5 fam., the libellulids (8 gen.) were among the taxa with the greatest generic richness. *Lestes* and *Epithea* were among the taxa with significant abundance variation among sample months. *Lestes* were most abundant in Dec. and *Epithea* in Aug.
- (18314) NOVELO-GUTIÉRREZ, R., 2007. *Progomphus lambertoi* (Odonata: Anisoptera: Gomphidae), a new species from Mexico. *Proc. ent. Soc. Wash.* 109(4): 791-797. (With Span. s.). – (Depto Ent., Inst. Ecol., A.C., Apdo Postal 63, MX-91070 Xalapa, Veracruz). The new sp. is described and illustrated. Holotype ♂: La Chichihua, Michoacán, Mexico, alt. 1127 m, 21-IV-2006; deposited in IEXA, Xalapa. It appears closely related to *Progomphus borealis* McLachlan, from which it can be distinguished by its smaller stature, paler colouration, enlarged and carinated hook of hamule, and by not basoventrally carinated ♂ cerci.
- (18315) RODRIGUEZ-BARRIOS, J., R. OSPINA-TORRES, J.D. GUTIÉRREZ & H. OVALLE,

2007. Density and biomass of drifting aquatic macroinvertebrates in a tropical mountain creek at Bogotá, Colombia. *Caldasia* 29(2): 397-412. (Span., with Engl. s.). (Second Author: Lab. Invert. Acuáticos, Univ. Nac. Colombia, Bogotá, D.C., Colombia).
- The density and biomass of odon. in a stream in the Eastern Hills of Bogotá were very small; names of spp. are not stated.
- (18316) SHOSTELL, J.M. & B.S. WILLIAMS, 2007. Habitat complexity as a determinante of benthic macroinvertebrate community structure in cypress tree reservoirs. *Hydrobiologia* 575: 389-399. — (First Author: Dept Biol., Penn. St. Univ., Rte 119N, Uniontown, PA 15401, USA).
- Benthic samples (n = 128) collected from 4 cypress-tree population areas within a large, shallow, eutrophic Arkansas reservoir (Lake Conway) are analyzed. The odon. were represented by a small number of *Gynacantha* sp. individuals.
- (18317) TUPINAMBÁS, T.H., M. CALLISTO & G.B. SANTOS, 2007. Benthic macroinvertebrate assemblages structure in two headwater streams, southeastern Brazil. *Revta bras. Zool.* 24(4): 887-897. (With Port. s.). — (First Author: Lab. Ecol. Benthos, Depto Biol. Geral, Inst. Ciênc. Univ. Fed. Minas Gerais, C.P. 486, BR-30161-970 Belo Horizonte, MG).
- Coenagrionidae, Gomphidae and Libellulidae were recorded from 2 streams of the upper São Francisco river basin, but a list of spp. is not provided.
- (18318) ZHANG, W., 2007. Computer inference of network of ecological interactions from sampling data. *Envir. Monit. Assmt* 124: 253-261. — (Res. Inst. Ent., Sch. Life Sci., Zhongshan Univ., Guangzhou-510275, China).
- An algorithm and software are developed to infer the network of direct or indirect ecological interactions in ecosystem. The rice-field Odon. are among the material used.
- 2008**
- (18319) ADEBOTE, D.A., S.J. ONIYE & Y.A. MUHAMMED, 2008. Studies on mosquitoes breeding in rock pools on inselbergs around Zaria, northern Nigeria. *J. vector borne Dis.* 45: 21-28. — (Dept Biol. Sci., Ahmadu Bello Univ., Zaria, Nigeria).
- The rainwater in the depressions of rocks in the Nigerian northern Guinea savanna represents the exclusive breeding habitat of *Aedes vittatus*, *Anopheles ardensis*, *A. distinctus*, *A. wilsoni* and *Culex ingrami*. Interestingly, most of the pools devoid of mosquito larvae are populated by (unidentified) odon. larvae and tadpoles.
- (18320) BEZMATERNYKH, D.M., 2008. *Zoobentos ravnimyh pritokov Verhney Obi.* — [*Zoobenthos of the lowland tributaries of the Upper Ob river*]. Altay. Gos. Univ., Barnaul. 186 pp. ISBN 978-5-7904-0809-0. (Russ.). — (Author: Inst. Water & Envir. Problems, Siber. Sect. Russ. Acad. Sci., Molodezhnaya 1, RUS-656032 Barnaul).
- 16 odon. spp. are listed from 3 river systems; — Siberia, Russia.
- (18321) BORISOV, S.N., 2008. The larva of *Anormogomphus kiritchenkoi* Bartenev, 1913 (Odonata, Gomphidae). *Euroasian ent. J.* 7(4): 307-310. (Russ., with Engl. s.). — (Inst. Anim. Syst. & Ecol., Russ. Acad. Sci., Frunze 11, RUS-630091 Novosibirsk).
- The ultimate instar is described and illustrated, and some notes on bionomy are provided. The life cycle probably lasts 4 yr.
- (18322) CANO-VILLEGAS, F.J., 2008. Interesantes observaciones de artrópodos en Sierra Nevada (Granada, Andalucía). *Boln SAE* 15: 99-102. — (Area Zool., Depto Sistemas Físicos Químicos Naturales, Univ. P. de Olavide, ES-41013 Sevilla).
- The records are listed of *Ischnura graellsii* and *Pyrphosoma nymphula*; — Andalusia, Spain.
- (18323) HARABIŠ, F. & A. DOLNÝ, 2008. Red list of dragonflies (Odonata) of the Czech part of Silesia (2008). *Čas. slez. Muz. Opava (A)* 57: 31-36. (With Czech s.). — (First Author: Dept Ecol. & Envir., Fac. Envir. Sci., Czech Univ. Life Sci., Kmýčská 129, CZ-16521 Prague-6).
- The Red List is compiled in accordance with the IUCN criteria. 65 spp. are known in the region.
- (18324) HARDERSEN, S., 2008. Dragonfly (Odonata) communities at three lotic sites with different hydrological characteristics. *It. J. Zool.* 75(3): 271-283. — (Cent. Naz. Studio & Conservaz. Biodiv. Forestale, Bosco della Fontana, Strada Mantova 29, I-46045 Marmirolo, MN).
- In nature reserve "Bosco della Fontana" (Lom-

bardy, Italy), the communities of larval and adult odon. were studied at 3 sites in small streams. It is concluded that streams with a highly modified hydrology may represent "ecological traps" for specialized spp. and that odon. surveys based solely on the observation of adults can be misleading.

- (18325) KOŠČO, J., P. MANKO, D. MIKLISOVÁ & L. KOŠUTHOVÁ, 2008. Feeding ecology of invasive *Percottus glrnii* (Perciformes, Odontobutidae) in Slovakia. *Czech J. Anim. Sci.* 53(11): 479-486. — (First Author: Fac. Human & Nat. Sci., Univ. Presov, 17-Novembra 1, SK-08116 Prešov). Stomach contents of 331 fish specimens were examined. In May and August, odon. larvae were found among the diet items.
- (18326) KRACH, J.E., 2008. Libellenvorkommen im Landkreis Eichstätt. *Facetta* (Suppl.) 3: 1-338 pp. — (Oberstimmerstr. 62, D-85051 Zuchering). A very detailed treatment of the 52 spp. known to occur in Eichstätt distr., Bavaria (Germany), based on 15 yr of systematic field work.
- (18327) REMSBURG, A.J., A.C. OLSON & M.J. SAMWAYS, 2008. Shade alone reduces adult dragonfly (Odonata: Libellulidae) abundance. *J. Insect. Behav.* 21: 460-468. — (First Author: Unity Coll., Unity, ME 04988, USA). It is demonstrated that physical habitat conditions influence adult Anisoptera riparian site selection. In naturally treeless riparian areas of South Africa, invasive trees create shade and reduce native vegetation. It was hypothesized that most breeding odon. select riparian areas (1) without shade, and (2) with high density and variety of understory perch structures. In 2 experiments at reservoir shorelines, shade and perch structures were varied. Dragonfly abundances (predominantly *Trithemis arteriosa* and *T. dorsalis*) were lower at sites with high (75%) or moderate (55%) shade cover than at sites with no shade, and lower at bare sand sites than sites containing stick perches. Perch density and variety (variety of heights and diameters) did not affect dragonfly abundance. These results indicate that shade alone directly reduces dragonfly habitat selection, isolating an aspect of habitat change that can alter insect behaviours.
- (18328) SENTHILKUMAR, N., N.D. BARTHANKUR & M.I. RAO, 2008. Bioprospecting with reference to medicinal insects and tribes in India: an overview. *Indian Forester* 2008 (Dec.): 1575-1591. — (First Author: Forest Res. Cent., Hyderabad, Andhra Pradesh, India). The tonic prepared from larval *Acisoma panorpoides* and *Aeshna petalura* is used by Ao-Nagas as blood purifier and against anaemia, respectively. The original information on this was published (1997) by V.B. Meyer-Rechow & S. Changkija, *Ecol. Food Nutr.* 36: 159-185.
- (18329) ZHANG, J., C. ZHOU, Y. GAI, D. SONG & K. ZHOU, 2008. The complete mitochondrial genome of *Parafronurus youi* (Insecta: Ephemeroptera) and phylogenetic position of the Ephemeroptera. *Gene* 424: 18-24. — (First Author: Jiangsu Key Lab. Biodiv. & Biotechnol., Coll. Life Sci., Nanjing Normal Univ., Nanjing-210046, China). Based on the nucleotide dataset and the corresponding amino acid dataset of 12 protein-coding genes, Bayesian inference and maximum likelihood, analyses yielded stable support for the relationship of the 3 basal clades of wing insects as Ephemeroptera + (Odonata + Neoptera).

2009

- (18330) ALIEV, S.I. & A.R. ALIEV, 2009. Zoogeograficheskiy analiz gidrofauny rr. Kury i Araks. — [Biogeographical analysis of aquatic fauna of the rivers Kura and Araks]. *Ekologiya, evolyuciya i sistematika zhivotnykh* [ISBN 978-5-98436-015-9], pp. 31-32, Golos Gubernii, Ryazan'. (Russ.). In the rivers Kura and Araks (Azerbaijan), the odon. are represented by 28 and 21 spp. respectively; a checklist is not provided. Instead, various spp. are listed within different biogeographic groups, such as the Mediterranean, Central Asian, Tropical, etc.
- (18331) ALLEN, K., 2009. *The ecology and conservation of threatened damselflies*. Environment Agency, Bristol. vi + 142 pp. ISBN 978-1-84911-093-8. — (Publishers: Rio House, Waterside Dr., Aztec West, Almondsbury, Bristol, BS32 4UD, UK; — Author: c/o D.J. Thompson, Sch. Biol. Sci., Biosci. Bldg, Crown St., Univ. Liverpool, Liverpool, L69 7ZB, UK). The results are presented of an autecological study of *Ischnura pumilio* in SW England, and those of survival analyses and population size estimates for *Coenagrion mercuriale*.

- (18332) BABU, R. & H.S. MEHTA, 2009. [Faunal diversity of Simbalbara Wildlife Sanctuary]: Insecta: Odonata. *Zool. Surv. India Conserv. Area Ser.* 41: 21-28. — (Second Author: High Altitude Regn. Cent., Zool. Surv. India, Solan-173 211, India). The records are presented of 18 spp. from the Sanctuary, Shiwalik Hills, Himachal Pradesh (India).
- (18333) BABU, R., H.S. MEHTA & S. KAMAL, 2009. [Faunal diversity of Pong Dam]: Insecta: Odonata. *Zool. Surv. India Wetland Ecosyst. Ser.* 12: 13-19. — (First Author: Zool. Surv. India, M-Block, New Alipore, Kolkata-700 053, India). Records of 15 spp.; — Kangra distr., Himachal Pradesh, India.
- (18334) BABU, R., C. SINHA & M. PRASAD, 2009. New records of Odonata (Anisoptera) from Maharashtra. *Rec. zool. Surv. India* 108(4): 113-117. — (Zool. Surv. India, M-Block, New Alipore, Kolkata-700 053, India). *Anormogomphus heteropterus*, *Onychogomphus grammicus*, *Indothemis l. limbata*, *Orthetrum japonicum internum* and *O. t. testaceum* are listed for the state (India).
- (18335) BORISOV, S.N., 2009. Study on dragonfly (Odonata) migrations in the western Tien Shan mountains using ornithological traps. *Ent. Rev.* 89(9): 1025-1029. Original Russian text published in *Zool. Zh.* 88(10): 1184-1188. — (Inst. Anim. Syst. & Ecol., Russ. Acad. Sci., Frunse 11, RUS-630091 Novosibirsk). Migrations were studied in Chokpak Pass using large ornithological traps of the Rybachy type. The obligatory autumnal southward migrations were proved for *Anax parthenope* and *Sympetrum fonscolombii*, and supposed for *Hemianax ephippiger*, which is a rare sp. in this region. The autumnal movement from the mountains to the plains was recorded in *Aeshna mixta*, *Sympetrum arenicolor* and *S. striolatum pallidum*. The cold air fronts increase the intensity of flights.
- (18336) BURK, G., J. OTT & K. SCHRÖDER, 2009. *Entwicklung der Libellen im Eglinger Filz, 2004-2008*. Landesbund für Vogelschutz, Kreisgruppe Bad Tölz-Wolfratshausen, Wolfratshausen. 79 pp. — (Authors' addresses not stated). The data on the annual abundance of the observed individuals of 48 spp. are presented and briefly annotated for the 5 yr of research; — Bavaria (Germany).
- (18337) BYLAK, A., K. KUKULA & E. KUKULA, 2009. Influence of regulation on ichthyofauna and benthos of the Różanka stream. *Ecohydrol. Hydrobiol.* 9(2/4): 211-223. — (Dept Envir. Biol., Univ. Rzeszów, Pigoń 6, PO-35-310 Rzeszów). The stream is located in the Strzyżów Foothills, SE Poland. The information is presented on odon. density (indiv./m²) and biomass (mg/m²) at 5 sampling stations. *Calopteryx virgo* is the only sp. mentioned.
- (18338) CARRICO, C., T.C. SANTOS, J.M. COSTA & A.D. TRAPERO QUINTA, 2009. Occurrence of *Neoneura maria* (Scudder, 1866) (Odonata: Protoneuridae) in the province of Santiago de Cuba. *Biota neotrop.* 9(4): 261-263. (Port., with Engl. s.). — (Third Author: Depto Ent., Mus. Nac., UFRJ, Quinta da Boa Vista, São Cristóvão, BR-20940-040 Rio de Janeiro, RJ). During a survey of macroinvertebrates associated with the root system of *Eichhornia crassipes*, a larva of the endemic *N. maria* was for the first time recorded from the prov. of Santiago de Cuba, Cuba.
- (18339) FLENNER, I., K. OLNE, F. SUHLING & G. SAHLEN, 2009. Predator-induced spine length and exocuticle thickness in *Leucorrhinia dubia* (Insecta: Odonata): a simple physiological trade-off? *Ecol. Ent.* 34: 735-740. — (Last Author: Ecol. & Envir. Sci., Halmstad Univ., P.O. Box 823, SE-30118 Halmstad). Morphological defence structures evolve against predators but are costly to the individual, and are induced only when required. A well-studied example is the development of longer abdominal spines in dragonfly larvae in the presence of fish. Numerous attempts to discover trade-offs between spine size and behaviour, development time or body size have, however, produced little evidence. A physiological trade-off is considered. Spines consist of cuticle and using material to build longer structures may result in less material remaining elsewhere. Therefore exocuticle thickness at nine locations on *L. dubia* larvae from habitats with and without fish were measured. The results show a significant effect of the interaction between fish presence and spine length on head and fore leg exocuticle thickness. Relative thickness

increased with relative length of lateral spine 9 in the absence of fish, whereas no such relationship existed with fish. Hence, synthesis and secretion of cuticle material occur as a trade-off when larvae react to fish presence. It is assumed the mechanism to be a selective synthesis of material with different responses in different parts of the larval body. These findings offer a new angle to the fish/spine trade-off debate.

- (18340) FRAKER, M.E., 2009. Predation risk assessment by green frog (*Rana clamitans*) tadpoles through chemical cues produced by multiple prey. *Behav. Ecol. Sociobiol.* 63: 1397-1402. — (Dept Ecol. & Evol. Biol., Univ. Michigan, 830 North University, Ann Arbor, MI 48109-1048, USA).
In the predation trials, *Anax junius* larvae consumed significantly more *Hyla versicolor* than *R. clamitans* tadpoles. *R. clamitans* tadpoles assess risk from the chemical cue produced by *H. versicolor* during predation.
- (18341) FRAKER, M.E., 2009. The dynamics of predation risk assessment: responses of anuran larvae to chemical cues of predators. *J. Anim. Ecol.* 77: 638-645. — (Dept Ecol. & Evol. Biol., Univ. Michigan, Ann Arbor, MI 48109-1048, USA).
The results of experimental work suggest that the perceived risk of *Rana clamitans* tadpoles varies over time and does not correspond directly to their behavioural response (i.e. activity level). However, their perceived risk does appear to vary in accordance with the predation risk associated with *Anax junius* and *A. longipes* chemical cue and the reliability of the information from the cue.
- (18342) HANNELLY, E.C., 2009. *The effects of introduced trout on native macroinvertebrates from lakes in the Trinity Alps Wilderness in northern California*. MA thesis, Humboldt St. Univ. ix + 61 pp. — (Author's address not stated).
The differences in macroinvertebrate assemblages were examined among 4 lake management categories (fish stocked, temporary stocking suspension, fish removal lakes, and historically fishless lakes) in NE California, USA. The taxa are listed on genus level. *Libellula* was most common in fish stocked lakes. Its life history and morphology seem to give it an advantage over other invertebrate predators in fish lakes, apparently regulating other insect abundances.
- (18343) HASSALL, C., D.J. THOMPSON & I.F. HARVEY, 2009. Variation in morphology between core and marginal populations of three British damselflies. *Aquat. Insects* 31(3): 187-197. — (First Author; Sch. Biol. Sci., Univ. Liverpool, Biosci. Bldg, Crown St., Liverpool, L69 7ZB, UK).
As selective pressures are altered by the changing climate, species have been shown to shift their distributions. Here, morphological variation in dispersal-related traits between core and marginal populations is investigated in 3 spp. of Odon., a taxon that is known to be expanding polewards. Individuals were sampled of (i) *Calopteryx splendens*, a sp. with a rapidly expanding range, (ii) *Erythromma najas*, a sp. with a slowly expanding range, and (iii) *Pyrhosphoma nymphula*, a sp. that does not exhibit a range margin in the UK (as a control). Only *C. splendens* exhibited consistent trends within 2 dispersal-related traits (wing : abdomen length ratio and aspect ratio). This result suggests that proximity to range margin alone does not account for variations in Zygoptera morphology, but that the rate of range expansion may also be important in determining variation.
- (18344) ICHINOSE, T., J. ISHII & T. MORITA, 2009. Relationships between distribution of Odonata species and environmental factors on the irrigation ponds in Awaji Island, central Japan, analyzing spatial autocorrelation. *J. rural Plann. Ass.* 27 (Special Issue): 191-196. (Jap., with Engl. s.). — (First Author, incomplete address: Fac. Envir. & Information Stud., Keio Univ. JA).
The odon. fauna was surveyed (May-Oct. 2002) on 38 small irrigation ponds; 1568 individuals of 28 spp. were recorded. Out of these, 9 spp. with more than 40 recorded individuals were selected, and their relationships with the environmental factors were analyzed. These included conductivity, NO_2^- , NO_3^- , NH_4^+ , PO_4^{3-} , COD, the surrounding land use within 50 m from the edge of the pond, the number of aquatic plant spp., and autocovariants explaining spatial autocorrelation, using General Linear Models (GLM). The results showed that NO_3^- , COD, the surrounding grassland, woodland and the number of aquatic plant spp. were critical factors in the distribution of some odon. spp.
- (18345) LEHMANN, F.-O., 2009. Wing-wake interaction reduces power consumption in insect tandem wings. *Exp. Fluids* 46: 765-775. — (BioFuture Res.

Gr., Univ. Ulm, Albert-Einstein-Allee 11, D-89081 Ulm).

Insects are capable of a remarkable diversity of flight techniques. Dragonflies, in particular, are notable for their powerful aerial manoeuvres and endurance during prey catching or territory flights. While most insects such as flies, bees and wasps either reduced their hindwings or mechanically coupled fore- and hindwings, dragonflies have maintained two independent-controlled pairs of wings throughout their evolution. An extraordinary feature of dragonfly wing kinematics is wing phasing, the shift in flapping phase between the fore- and hindwing periods. Wing phasing has previously been associated with an increase in thrust production, readiness for manoeuvrability and hunting performance. Recent studies have shown that wing phasing in tandem wings produces a twofold modulation in hindwing lift, but slightly reduces the maximum combined lift of fore- and hindwings, compared to two wings flapping in isolation. Despite this disadvantage, however, wing phasing is effective in improving aerodynamic efficiency during flight by the removal of kinetic energy from the wake. Computational analyses demonstrate that this increase in flight efficiency may save up to 22% aerodynamic power expenditure compared to insects flapping only two wings. In terms of engineering, energetic benefits in four-wing flapping are of substantial interest in the field of biomimetic aircraft design, because the performance of man-made air vehicles is often limited by high-power expenditure rather than by lift production. This paper provides a summary on power expenditures and aerodynamic efficiency in flapping tandem wings by investigating wing phasing in a dynamically scaled robotic model of a hovering dragonfly.

- (18346) MILESI, S.V., C. BIASI, R.M. RESTELLO & L.U. HEPP, 2009. Distribution of benthic macroinvertebrates in subtropical streams (Rio Grande do Sul, Brazil). *Acta limnol. bras.* 21(4): 419-429. (With Port. s.). — (First Author: Lab. Biomonitoramento, Depto Ciênc. Biol., Univ. Alto Uruguai & Missões, Campus Erechim, Av. Sete de Setembro 1621, BR-99700-000 Erechim, RS). The density of 6 odon. taxa in the Erechim streams is family-wise considered.

- (18347) OBOŁOWSKI, K. & A. STRZELCZAK, 2009. Epiphytic fauna inhabiting Stratiotes aloides

in a new lake of the Słowiński National Park (Smoldzińskie lake, Poland). *Ecohydrol. Hydrobiol.* 9(2/4): 257-267. — (First Author: Dept Water Ecol., Pomeranian Univ., Arciszewskiego 22/b, PO-76-200 Słupak).

In the epiphytic fauna, the odon. are said to have been represented by Calopteryx sp. and Aeshna grandis larvae. The taxonomic identification of these spp. seem rather questionable.

- (18348) REECE, B.A., 2009. Diversity, distribution, and development of the Odonata of the Southern High Plains of Texas. PhD thesis, Texas Tech. Univ., Lubbock. ix + 118 pp. — (Dept Biol. Sci., Texas Tech. Univ., Lubbock, TX 79409-3131, USA).

The odon. diversity, distribution and development patterns were examined in the playa system of the Southern High Plains of Texas (USA) during 2003-2008. Comparisons were made in these factors between playas surrounded by the 2 dominant forms of land use (cropland, grassland). Controlled field and laboratory experiments were performed to examine the causal relationship between environmental variables and growth development and larvae survival of the focal sp., Enallagma civile. Land-use type did not have an influence on certain variables, but not consistently or on all variables. Over 100 new county records were discovered, indicating how little is known about this system. In addition, the Anisoptera holdings at the Museum of Texas Tech Univ. were sorted, identified and completed, revealing numerous other new county records.

- (18349) ROSA, B.F.J.V., R.T. MARTINS, V.C. DE OLIVEIRA & R. DA G. ALVES, 2009. Phoretic association between larvae of Rheotanytarsus (Diptera: Chironomidae) and genera of Odonata in a first-order stream in an area of Atlantic Forest in southeastern Brazil. *Zoologia* 26(4): 787-791. — (Lab. Invertebrados Bentônicos, Depto Zool., Inst. Ciênc. Biol., Univ. Fed. Juiz de Fora, BR-36036-330 Juiz de Fora, MG).

The phoretic association is reported in which Heteragrion sp. larvae and those of an unknown calopterygid gen. are involved.

- (18350) SARZETTI, L.C., C.C. LABANDEIRA, J. MUZÓN, P. WILF, N.R. CÚNEO, K.R. JOHNSON & J.F. GENISE, 2009. Odonata endophytic oviposition from the Eocene of Patagonia: the ichnogenus Paleoovoidus and implications for behav-

journal stasis. *J. Paleontol.* 83(3): 431-447. — (Third Author: Inst. Limnol. “Dr R.A. Ringuelet”, Av. Calchaqui 712, Florencio Varela, AR-1888 Buenos Aires).

The evidence is documented of endophytic oviposition on fossil compression/impression leaves from the early Eocene Laguna del Hunco and middle Eocene Río Pichileufú floras of Patagonia, Argentina. Based on distinctive morphologies and damage patterns of elongate, ovoid, lens- or teardrop-shaped scars in the leaves, the authors assign this insect damage to the ichnogenus *Paleoovoidus*, consisting of an existing ichnospecies, *P. rectus*, and two new ichnospecies, *P. arcuatum* and *P. bifurcatus*. In *P. rectus*, the scars are characteristically arranged in linear rows along the midvein; in *P. bifurcatus*, scars are distributed in double rows along the midvein and parallel to secondary veins; and in *P. arcuatum*, scars are deployed in rectilinear and arcuate rows. In some cases, the narrow, angulate end of individual scars bear a darkened region encompassing a circular hole or similar feature indicating ovipositor tissue penetration. A comparison to the structure and surface pattern of modern ovipositional damage on dicotyledonous leaves suggests considerable similarity to certain zygoterans. Specifically members of the Lestidae probably produced *P. rectus* and *P. bifurcatus*, whereas spp. of Coenagrionidae were responsible for *P. arcuatum*. Both Patagonian localities represent an elevated diversity of potential fern, gymnosperm, and especially angiosperm hosts, the targets of all observed ovipositions. However, the targeting of particular plant families was not detected. The results indicate behavioural stasis for the 3 ovipositional patterns for at least 50 million yr. Nevertheless, synonymy of these oviposition patterns with mid-Mesozoic ichnospecies indicates older origins for these distinctive modes of oviposition.

- (18351) TÓTH, S., 2009. Dragonfly fauna (Odonata) based on the Biodiversity Days at Gyűrűfű. *Natura samogiyensis* 13: 77-80. (Hung., with Engl. s.). — (Széchenyi u. 2, HU-8420 Zirc).
24 spp. recorded from the surroundings of Gyűrűfű (Hungary) are discussed. The most important of these is *Cordulegaster heros*.

- (18352) VIEIRA, C., 2009. *Avaliação da ordem Odonata na ribeira do Vascão para estatuto Ramsar*. Inst. Politécnico de Beja, Escola Superior Agrária, Beja.

vi + 38 pp. — (Author's address not stated).

The odon. fauna of the Vascão rivulet (a tributary of the Guadiana, Portugal) is assessed. 12 spp. (adults and/or larvae) are recorded, of which 4 spp. are new to the region. During the survey (Feb.-June 2009), *Coenagrion mercuriale* and *Oxygastra curtisii* were not encountered.

- (18353) ZHERIKHIN, V.V., I.D. SUKACHEVA & A.P. RASNITSYN, 2009. Arthropods in contemporary and some fossil resins. *Paleont. J.* 43(9): 987-1005. — (First Author deceased; the others: Borissiak Paleont. Inst., Russ. Acad. Sci., Profsoyuznaya 123, RUS-117997 Moscow).

In a tab., showing the composition of arthropod inclusions in some fossil resins, the odon. are mentioned from Baltic, Bitterfeld and Dominican Ambers.

- (18354) ZIMMERMANN, W. & C. ARENHÖVEL, 2009. Die Südliche Heidelibelle, *Sympetrum meridionale* (Selys, 1841) aktuell neu in Thüringen. *Landschaftspflege Naturschutz Thüringen* 46(1): 42-45. — (First Author: Thomas-Müntzer-Str. 5, D-99423 Weimar).

The odon. fauna of the “Legfelder Seeteich” near Weimar (Germany) was surveyed in 2008. 21 spp. are listed, including *S. meridionale*, which represents the 64th sp. known to occur in Thuringia. The habitat is described and the fauna is briefly discussed.

2010

- (18355) ALLEN, K.A. & D.J. THOMPSON, 2010. Movement characteristics of the Scarce blue-tailed damselfly, *Ischnura pumilio*. *Insect Conserv. Diver.* 3: 5-14. — (Sch. Biol. Sci., Univ. Liverpool, Liverpool, L69 7ZB, UK).

I. pumilio is threatened in the UK and exists in small, transient colonies. Consequently, little is known about its dispersal characteristics. This study investigates movement in two contrasting habitats with the aim of informing conservation management on a landscape scale. Mark-release-recapture studies were performed at an established colony in the New Forest and a smaller population in the Red River valley in southern England. A total of 2304 individuals was marked. *I. pumilio* was found to be exceptionally sedentary. Mean gross lifetime movement was 56 m and 43% of individuals moved <50 m in their lifetime. Movements over 150 m were

very rare. Maximum lifetime movement was 1165 m. As such, the sp. is the most sedentary odon. studied in the UK to date. Movement was inversely density dependent, which has important conservation implications if individuals attempt to emigrate from small populations because of low density. The presence of parasitic mites (*Hydryphantes* sp.) significantly increased movement distance. *I. pumilio* had a low dispersal probability compared to other damselflies. As the smallest British odonate, this is in keeping with the relationship between size and dispersal found across taxa. It has been regarded as a 'wandering opportunist' due to its tendency to appear in locations far from known sites. However, this study suggests that long range movement rarely occurs from prime habitat that is maintained in an early successional stage. This has implications for the conservation of the species in the UK.

- (18356) ALY, M.Z.Y., K.S.M. OSMAN, E.E. IBRAHEEM & A.M. NOUR, 2010. Diversity of some aquatic and aerial odonate dwellers of the river Nile in Upper Egypt. *Egypt. Acad. J. biol. Sci.* 3(2): 83-93. (with Arabic s.). — (Address incomplete: Dept Zool., Fac. Sci., South Valley Univ., Egypt). The aim of the paper was to present the regional diversity of adult and larval odon. There is a list of 8 spp. from Luxor, but a complete regional list of spp. is not provided. All those mentioned in the text have a wide distribution in Europe, no reference is made to a typically African taxon. Generally, the accuracy of identification is dubious.
- (18357) ARULPRAKASH, R. & K. GUNATHILAGARAJ, 2010. Abundance and diversity of Odonata in temporary water bodies of Coimbatore and Salem districts in Tamil Nadu. *J. threatened Taxa* 2(8): 1099-1102. — (Dept Agric. Ent., Tamil Nadu Agric. Univ., Coimbatore, Tamil Nadu-641003, India). The odon. occurrence (21 spp.) in 13 water bodies that contain water only during the rainy season (Dec.-Apr.) is described and analysed, based on sampling the adults.
- (18358) BABU, R. & S. NANDY, 2010. Recorded diversity of odonates from Maharashtra, India. *J. exp. Zool. India* 13(1): 63-74. — (Zool. Surv. India, M-Block, New Alipore, Kolkata-700 053, India). An updated list of the 97 spp. recorded from Maharashtra (India) is provided along with information on their distribution within the state.
- (18359) [BELYSHEV, B.F.] GORIZONTOVA, L. Yu., 2010. 13 Dekabrya 1910: 100 let so dnya rozhdeniya odonatologa, doktora biologicheskikh nauk B.F. Belysheva (1910-1993). *Altayskiy Kray* 2010: 117-120. (Russ.). — (Author's address not stated). In the BFB's biography presented here, various details are provided that were never published in western periodicals. Among other aspects, the Author dwells on BFB's (aristocratic) parentage and genealogy and on his persecution by the Soviet authorities. After the conclusion of his work at Tomsk Univ. (1930), he attempted to continue the studies at the Univ. of Leningrad. Due to a conflict with the Komsomol (communist youth organisation), he was expelled from the Univ. in 1932 and he moved to Siberia, where he did much field research as a scientific collaborator of the Novosibirsk Museum. In 1935, he was denounced walking in the field dressed up in the style of a "British colonial", accused of being a "kontrik" (i.e., a "contra-revolutionist"), and was sentenced to 10 years, which he served in various forced-labour camps. [In his correspondence with foreign odonatologists, he referred to this period as a "diapause", a term that could not be understood by the police, who were strictly checking all his letters]. — The 3 photographs appearing in this paper also enhance its value.
- (18360) BLAKELY, T.J., J.S. HARDING, E. CLEWS & M.J. WINTERBOURN, 2010. *An illustrated guide to the freshwater macroinvertebrates of Singapore*. Sch. Biol. Sci., Univ. Canterbury, Christchurch. iv + 74 pp. (Spring binding, 17.0 × 25.0 cm). ISBN 978-0-473-16730-1. — (Publishers: Sch. Biol. Sci., Univ. Canterbury, P. Bag 4800, Christchurch-8140, NZ). A useful guide, including an account of freshwater habitats in Singapore, detailed description of field sampling and laboratory methods, and a pictorial key to the higher taxa (Odon. larvae pp. 46-50).
- (18361) BOLEK, M.G., H.R. TRACY & J. JANOVY, 2010. The role of damselflies (Odonata: Zygoptera) as paratenic hosts in the transmission of *Halipegus eccentricus* (Digenea: Hemiuridae) to anurans. *J. Parasitol.* 96(4): 724-735. — (Dept Zool., Oklahoma St. Univ., Stillwater, OK 74078, USA). *H. eccentricus* is a common hemiurid trematode in the Eustachian tubes of N America frogs. However, its life cycle has never been completely elucidated. Studies on *H. eccentricus* suggest that it has

a 3-host life cycle. Here it is shown through field-work and host specificity experimental infections that the life cycle utilizes 4 hosts. Metamorphosed anurans become infected with *H. eccentricus* by feeding on infected zygopterans; worms reside in the stomach of anurans, migrate to the Eustachian tubes within 32-39 days post-exposure (DPE), and release eggs 50-60 DPE. Cystophorous cercariae develop in *Physa gyrina* snails within 32-35 DPE, infect ostracod (*Cypridopsis* sp.) second intermediate hosts, and develop to metacercariae. Fifteen- to 19-day-old metacercariae from ostracods are infective to both Zygoptera larvae and metamorphosed anurans. Field surveys of Zygoptera and tadpoles, along with laboratory exposure of Zygoptera larvae, metamorphosed anurans, and tadpoles with infected ostracods indicated that only metamorphosed anurans and zygopterans become infected with *H. eccentricus*, whereas field-collected tadpoles and laboratory-exposed tadpoles were never infected with *H. eccentricus*. Because little morphological change occurred in the metacercaria stage of *H. eccentricus* between the ostracod second intermediate host and Zygoptera host, and metamorphosed anurans became infected with *H. eccentricus* metacercariae recovered from both host groups, we suggest that odon. serve as paratenic hosts in this life cycle. Additionally, our field work and experimental infections provide data on the use of odon. as the route of infection by another North American *Haliplus* sp. that matures in the stomach of frogs. Our data indicate that when the life cycles are known, the use of odonates as the route of infection to anurans is common in the life cycles of *Haliplus* spp., and all species exhibit remarkable infection site fidelity in their amphibian hosts.

- (18362) BOTS, J., S. VAN DONGEN, L. DE BRUYN, N. VAN HOUTTE & H. VAN GOSSUM, 2010. Clutch size and reproductive success in a female polymorphic insect. *Evol. Ecol.* 2010: 15 pp.; — DOI: 10.1007/s10682-010-9362-9. — (First Author: *Evol. Ecol. Gr.*, Univ. Antwerp, Groenenborgerlaan 171, B-2020 Antwerpen) In *Enallagma cyathigerum*, under 2 laboratory food treatments, clutch size correlated with offspring number early in larval life, but this relation was reduced by variation in survival in later developmental stages. Clutch size was moderately correlated with the number of offspring that successfully metamorphosed to adults. Patterns did not differ between ♀ morphs and the nature of the correlation could not be explained from offspring quantity-quality trade-offs.
- (18363) BRAUNE, E., A. MARTENS, O. RICHTER, D. SÖNDGERATH & F. SUHLING, 2010. A spatially explicit model for interacting populations of dragonflies in arid Namibia. In: U. Schmiedel & N. Jürgens, [Eds], *Biodiversity in southern Africa, 2: Patterns and processes at regional scale*, pp. 289-294, Klaus Hess, Göttingen-Windhoek. ISBN 978-3-933117-46-5. — (Second Author: Univ. Educ. Karlsruhe, Bismarckstr. 10, D-76133 Karlsruhe). In order to understand the spatial and seasonal odon. distribution in W Namibia, a model framework was developed based on habitat suitability models, a local population dynamic model of interacting spp. and a dynamic landscape model combined with a spatially explicit model. Local population dynamics as well as the spatial patterns of the aggregated model showed good accordance with field data. Therefore, the model approach may be useful for the identification and understanding of odon. spatial patterns as well as for predicting future spatial patterns, which are influenced by changes in the water balance due to climate change.
- (18364) CERCION (ISSN 1771-5288), No. 5/6 (June 2010).
[Selected articles:] Simon, A., A. Cabaret & X. Houard: Espèces nouvelles et premières mentions (p. 2); — Anonymous: Bilan cartographique (pp. 3-10); — Lorthiois, M.: Premiers indices d'autochtonie d'*Anax parthenope* en Normandie (p. 14); — Houard, X., L. Robert & A. Simon: Le plan national d'action en faveur des odonates: déclinaisons régionales en Haute et Basse-Normandie (pp. 12-13); — Robert, L.: Démarche d'élaboration d'une Liste rouge régionale (pp. 14-15); — Ameline, M., X. Houard, C. Mouquet & L. Robert: Liste rouge provisoire des odonates de Basse-Normandie selon les critères de l'UICN et proposition de nouvelles listes de status de rareté et d'espèces déterminantes de ZNIEFF (pp. 16-17); — Dodelin, C., X. Houard, M. Lorthiois & A. Simon: Liste rouge provisoire des odonates de Haute-Normandie ... (pp. 18-19); — Dardillac, A. & A. Simon: Le Cercion en week-end dans le Perche (pp. 20-21; records); — Houard, K.: Étude génétique sur *Coenagrion mercuriale* (p. 22).
- (18365) CHOVANEC, A., M. SCHINDLER, K. PALL & K. HOSTETTLER, 2010. *Bewertung des*

österreichischen Bodenseeufer auf der Grundlage libellenkundlicher Untersuchungen. SchrReihe Lebensraum Vorarlberg 59. Vorarlberger Landesregierung, Bregenz. iv + 43 pp. ISBN 978-3-902290-90-0. (With Engl. s.). — (Publishers: Römerstr. 4, A-6900 Bregenz; — First Author: Krottenbachgasse 68, A-2345 Brunn am Gebirge).

The ecological status of the littoral areas of Lake Constance (Bodensee) in Austria is assessed by an odon. survey. The key element of the approach, which is oriented towards the Water Framework Directive (WFD), is the Odonata Habitat Index. The assessment is based on the comparison between the status quo and a reference condition derived from current and historical data on odon. and macrophytes. 28 spp. were recorded from 15 investigation sites, among these 25 spp. are classified as autochthonous. The ecological status of the lake shore section is ranked as class II ("good ecological status") in the WFD classification scheme.

- (18366) COOPER, I.A., 2010. Ecology of sexual dimorphism and clinal variation of coloration in a damselfly. *Am. Nat.* 176(5): 566-572. — (Dept Zool., Michigan St. Univ., Kellogg Biol. Stn, Hickory Corners, MI 49060, USA).

Sexual selection, more so than natural selection, is posited as the major cause of sex differences. Here are shown ecological correlations between solar radiation levels and sexual dimorphism in body colour of the Hawaiian Megalagrion calliphya. It exhibits sexual monomorphism at high elevations, where both sexes are red in colour; sexual dimorphism at low elevations, where ♀♀ are green; and ♀-limited dimorphism at midelevations, where both red and green ♀♀ exist. Within a midelevation population, red ♀♀ are also more prevalent during high daily levels of solar radiation. It was found that red pigmentation is correlated with superior antioxidant ability that may protect from UV damage and confer a benefit to insects in exposed habitats, including ♂♂, which defend exposed mating habitats at all elevations, and ♀♀, which are in shaded habitats except at high elevation. This study characterizes the ecology of sexual dimorphism and provides a new, ecological hypothesis for the evolution of ♀-limited dimorphism.

- (18367) CORSER, J.D., 2010. Status and ecology of a rare gomphid dragonfly at the northern extent of its range. *NEast. Nat. Notes* 17(2): 341-345. — (New

York Natural Heritage Program, 625 Broadway, 5th Floor, Albany, NY 12233, USA).

New records of *Stylurus plagiatus* are described from the Hudson river estuary, eastern NY, USA. Breeding occurred primarily in tidal mudflats. At its northern range margin, *S. plagiatus* populations in eastern NY are likely to be temperature-limited.

- (18368) DOW, R.A., 2010. Revision of the genus *Coeliccia* (Zygoptera: Platynemididae) in Borneo, 1: the borneensis-group of species. *Zool. Med. Leiden* 84(7): 117-157. — (Naturalis, P.O. Box 9517, NL-2300 RA Leiden).

The group is characterised based on the form of the penis, the form of the posterior lobe in ♀ pronotum and the mesostigmal plates in ♀. 6 spp. are recognised as occurring in Borneo, incl. *C. kenyah* sp. n. (holotype ♂: Sarawak, foot of Mt Dulit, 31-III-2006). *C. campioni* is shown to be a valid sp. Keys to both sexes and illustrations of important characters of all spp. are provided.

- (18369) DOW, R.A. & J. UNGGANG, 2010. The Odonata of Binyo Penyilam, a unique tropical wetland area in Bintulu Division, Sarawak, Malaysia. *J. threatened Taxa* 2(13): 1349-1358, phot. of *Brachygonia puella* on journal cover excl. (With Bahasa Malaysian s.). — (First Author: Naturalis, P.O. Box 9517, NL-2300 RA Leiden).

An annotated list is presented of 61 spp., incl. an undescribed *Mortonagrion* sp. *Pseudagrion coomansi*, *Merogomphus femoralis*, *Brachygonia puella* and *Chalybeothemis fluviatilis* have still not been found elsewhere in the state and no other location is known for the genus *Merogomphus* in Borneo.

- (18370) ENDERSBY, I.D., 2010. A revised, annotated checklist of Victorian dragonflies (Insecta, Odonata). *Proc. R. Soc. Vict.* 122(1): 9-27. — (56 Looker Rd, Montmorency, Vict.-3094, AU).

A revised, updated and annotated list of 76 spp. is presented. Generic names of *Aeshna* and *Trapezostigma* are changed, and some changes in higher level names and relationships, based on recent phylogenetic analyses, are incorporated. Distribution maps for all spp., based on museum collections, are provided in alphabetic sequence of the genera concerned.

- (18371) ENDERSBY, I., 2010. *Caliagrion billinghursti* (Martin) (Odonata): now a listed species in

- Victoria. *Victorian Entmologist* 40(6): 137-139. — (56 Looker Rd, Montmorency, Vict.-3094, AU).
On 19-X-2910, *C. billinghursti* was listed as a threatened sp. under the Fauna and Flora Guarantee Act 1988 (*Victorian Govt Gaz.* G42: 2571). Here, a commented list is presented of its data from the collections of all museums in Australia which have their collections electronically registered. A map of its known distribution (SE Australia) is also provided.
- (18372) EREMINA, E.E., 2010. New records of dragonfly species (Insecta, Odonata) from southern Urals. *Euroasian ent. J.* 9(1): 19-21. (Russ., with Engl. s.). — (P.O.B. 2775, RUS-454014 Chelyabinsk).
Among the 48 spp. collected in 2009 in the southern Ural and the Trans-Ural regions (Bashkortostan, the provinces of Chelyabinskaya, Kurganskaya and Orenburgskaya; — Russia), *Coenagrion glaciale* (hitherto considered endemic to E. Siberia), *Aeshna caerulea*, *A. subarctica* and *Somatochlora arctica* are for the first time recorded from the region
- (18373) FERREIRA, R.G.N., 2010. *Seleção sexual e sua relação com o dimorfismo sexual em três espécies de Zygoptera (Odonata) no sudeste do Brasil*. Diss. Mestre em Ciências, Fac. Filosofia, Univ. São Paulo, Ribeirão Preto. viii + 60 pp. (Port., with Engl. s.). — (Author's address not stated).
In some spp., sexual size dimorphism (SSD) may result from the selection acting through different mating tactics. Here, the behaviour is described of *Acanthagrion truncatum*, *Argia reclusa* (Coenagrionidae) and *Hetaerina rosea* (Calopterygidae), and it is shown how the SSD develops in spp. with different mating tactics. In territorial spp. the ♂♂ are larger than ♀♀, while in non-territorial spp. the ♀♀ are larger than the ♂♂. It is suggested that in Zygoptera the mating system adopted by ♂♂ may determine the SSD of a sp.
- (18374) FORTIN, B.L., 2010. *Selenium dynamics in Canadian Rocky Mountain lakes*. M.Sc. thesis (Ecol.), Univ Alberta, Edmonton. x + 130 pp. — (Author's current address unknown).
Water, invertebrates and fishes from lakes in Banff National Park and Kananaskis co. were investigated for Se, an element known to be toxic to vertebrates. At some depths, Se concentrations in sediment exceeded recognized threshold for bird and fish reproductive impairment. Se concentrations in water were over USEPA guidelines after spring melt runoff. In aquatic invertebrates, Se concentrations exceeded values known to cause reproductive impairment in fish and bird predators. Coenagrionidae, Aeshnidae and Libellulidae were among the taxa studied.
- (18375) GASHTAROV, V. & S. BESHKOV, 2010. *Lindenia tetrphylla* (Vander Linden, 1825) (Odonata: Gomphidae) a new genus and species for the Bulgarian fauna. *Ent. Rec. J. Var.* 122: 272-274. (First Author: P.O. Box 1733, BG-1000 Sofia).
On 16-VI-2009, a ♀ was collected (Novo Konopladi, Petrich distr., SW Bulgaria), and several individuals were sighted at the same locality on 17 and 20-VI-2009. This is the 67th odon. sp. known to occur in Bulgaria.
- (18376) GIANNATOS, G., A. KARYPIDOU, A. LEGAKIS & R. POLYMENI, 2010. Golden jackal (*Canis aureus* L.) diet in southern Greece. *Mammal. Biol.* 75: 227-232. — (First Author: Sect. Zool.-Marine Biol., Dept Biol., Univ. Athens, Panepistimiopolis, GR-15784 Athens).
The diet of jackals was studied in the Mediterranean lowlands of Fokida and Samos island, by analyzing 127 scats collected between Jan. 2002 and May 2003. Among 45 insect items, 3 odon. were found.
- (18377) HARABIŠ, F. & A. DOLNÝ, 2010. Ecological factors determining the density-distribution of central European dragonflies (Odonata). *Europ. J. Ent.* 107: 571-577. — (First Author: Dept Ecol., Czech Univ. Life Sci., Kamýcká 129, CZ-165-21 Praha-6).
Habitat specificity is the most important factor affecting the odon. regional distribution. Nevertheless, spp. with the highest specificity are not always the scarcest. Several important determinants of odon. density-distribution relationships were identified. Altitude preference and altitude range are significantly associated with odon. distribution. Some of the spp. that are habitat specialists but occur over a wide range of altitudes should be classified as rare but not endangered. This very simple principle is based on the assumption that habitat specialists have a very limited number of suitable biotopes. Obviously, spp. with a marginal distribution prefer a narrow range of altitudes (especially in terms of temperature limitation) and biotopes (effect of biogeography, marginality). Surprisingly, there is

no "critical" life stage that is significantly associated with the regional distribution, although most spp. spend most time in the larval stage. Knowledge of the dispersal ability of particular spp. is limited, although it could significantly affect species survival and distribution.

- (18378) GLIGOROVIĆ, B., V. PEŠIĆ & A. GLIGOROVIĆ, 2010. A contribution to the knowledge of the dragonflies (Odonata) from the river Morača (Montenegro). *Acta ent. serb.* 15(2): 149-159. (With Serb. s.). — (Dept Biol., Fac. Sci., Univ. Montenegro, Cetinjski put b.b., ME-81000 Podgorica).

The records of 35 spp. are presented. *Trithemis anulata* is for the first time recorded from Montenegro. *Calopteryx s. splendens* occurs in the upper and middle and *C. s. balcanica* in the lower course of the river. *O. c. coerulescens* is recorded from Lukovci and Manastirski Lug, *C. c. anceps* from Podgorica.

- (18379) HOLLY, M., 2010. Ważki w Bieszczadach. — [Dragonflies in Bieszczady mountains]. *Bieszczady* 2010(10): 19-21. (Pol.). — (Bieszczady Natn. Park, Belska 7, PO-38-700 Ustrzyki-Dolne).
A brief outline of odon. fauna of the region, with annotations on some faunistically interesting spp. (See also OA 17552).

- (18380) HONKANEN, M., A.-M. SORJANEN & M. MÖNKÖNEN, 2010. Reconstructing responses of dragonfly species richness to area, nutrients, water plant diversity and forestry. *Oecologia* 2010: 11 pp. — DOI 10.1007/s100442-010-1846-3. — (Dept Biol. & Envir. Sci., Univ. Jyväskylä, P.O. Box 35, FIN-40014 Jyväskylä).

Understanding large-scale variation in species richness in relation to area, energy, habitat heterogeneity and anthropogenic disturbance has been a major task in ecology. Ultimately, variation in species richness results from variation in individual spp. occupancies. Here it was studied whether the individual spp. occupancy patterns are determined by the same candidate factors as total species richness. 26 boreal forest ponds were sampled for odon. and the effects of shoreline length, water vascular plant species density (WVPSD), availability of nutrients, intensity of forestry, amount of Sphagnum peat cover and pH on dragonfly species richness and individual spp. were studied. Removal of 6 odon.

spp., experiencing strongest responses to WVPSD, cancelled the relationship between species richness and WVPSD. By contrast, removal of 9 least observed spp. did not affect the relationship between WVPSD and species richness. Thus, the results showed that relatively common spp., responding strongly to WVPSD, shaped the observed species richness pattern whereas the effect of least observed, often rare spp. was negligible. Also, the results support the view that, despite of the great impact of energy on species richness at large spatial scales, habitat heterogeneity can still have an effect on species richness in smaller scales, even overriding the effects of area.

- (18381) HOPPENBROUWERS, P., 2010. *Jaaroverzicht libellen Gelderse Poort 2010*. Circulated by the Author. 6 pp. (Dutch). — (c/o De Vlinderstichting, P.O. Box 506, NL-6700 AM Wageningen).

Documented is the occurrence of *Erythromma lindenii*, *Ceragrion tenellum*, *Platynemis pennipes*, *Aeshna affinis*, *Anax parthenope*, *Gomphus pulchellus*, *G. flavipes*, *Sympetrum meridionale* and *S. pedemontanum*; — the Netherlands.

- (18382) JOVIĆ, M., M. STANKOVIĆ & L. ANĐUS, 2010. *Aeshna grandis* (Linnaeus, 1758), a new species in Serbian fauna (Odonata: Aeshnidae). *Bull. nat. Hist. Mus.*, Belgrade 3: 137-140. (With Serb. s.). — (First Author: Nat. Hist. Mus., Njegoševa 51, RS-10000 Belgrade).

The sp. is recorded from the Drina river in the vicinity of Badovinci, NW Serbia and its occurrence in Slovenia, Croatia, Bosnia-Herzegovina and Montenegro is reviewed and mapped.

- (18383) KULIJER, D. & M. MARINOV, 2010. Odonata from Bulgaria in the collection of National Museum of Bosnia and Herzegovina. *Acta ent. serb.* 15(2): 161-169. (With Serb. s.). — (First Author: Natn. Mus. Bosnia-Herzegovina, Zmaja od Bosne 3, BA-71000 Sarajevo).

19 spp. are brought on record and new distribution data of several of these are discussed.

- (18384) LANGHEINRICH, U., F. BRAUMANN & V. LÜDERITZ, 2010. Niedermoor- und Gewässerrenaturierung im Naturpark Drömling (Sachsen-Anhalt). *Waldökol. Landschaftsfor. Naturschutz* 10: 23-29. (With Engl. s.). — (Second Author: Naturparkverwaltung Drömling, Bahnhofstr. 32, D-39646

Oebisfelde).

Includes a list of 14 red-listed odon. spp. occurring in various water bodies in the Park (Saxony-Anhalt, Germany).

- (18385) *LIBELLENNACHRICHTEN*. Mitteilungsblatt der Gesellschaft deutschsprachiger Odonatologen (GdO) (ISSN 1437-5621), No. 24 (30 Sept. 2010). — (c/o W. Piper, Kollenhof 31, D-22527 Hamburg).
20 pp.; mostly notes and reports on the GdO society life. Drs G. Peters and H. Wildermuth were awarded the Membership of Honour, their portraits and short biographies are provided. Of general interest are short articles, all by *M. Schorr*, on dragonfly depictions on coins, in Art Nouveau, and in municipality blazons.
- (18386) MARINOV, M., 2010. Further knowledge of the colonisation of the South Island, New Zealand by *Hemicordulia australiae* (Odonata: Corduliidae). *Weta* 39: 17-28. — (7/160 Rossall St., Merivale, Christchurch-8014, NZ).
Information on *H. australiae* from New Zealand is summarised with emphasis on its colonisation over South Island. The first records of possibly breeding individuals from Canterbury plains are also presented.
- (18387) MARTENS, A., O. RICHTER & F. SUHLING, 2010. The relevance of perennial springs for regional biodiversity and conservation. In: U. Schmiedel & N. Jürgens, [Eds], *Biodiversity in southern Africa, 2: patterns and processes at regional scale*, pp. 70-74, Klaus Hess, Göttingen-Windhoek. ISBN 978-3-933117-46-5. — (First Author: Univ. Educ. Karlsruhe, Bismarckstr. 10, D-76133 Karlsruhe).
Natural perennial surface water in the interior parts of Namibia only occurs at widely separated springs around mountains. These waters host a very diverse and unique Odon. assemblage, which is threatened due to the habitat restriction of several spp., as well as by recent habitat loss and degradation. Spp. occurring permanently at these waters, including *Crocothemis sanguinolenta*, *Orthetrum julia* and *Trithemis stictica*, differ significantly in seasonality, dispersal and life cycle characteristics from spp. colonising temporary waters. Their larvae grow slowly and they are present in these habitats as larvae throughout the year. This presence is the key factor why invaders with rapid development, which are dominant elsewhere, do not outcompete these spp. in these unique habitats. There is significant potential for stream odon. spp. to act as indicators for threatened freshwater wetlands in arid Namibia and they may also serve as an indication of the sustainable use of water resources, including the evaluation of measures to rehabilitate environments.
- (18388) MARTYNOV, A.V. & V.V. MARTYNOV, 2010. Dragonflies (Insecta, Odonata) of National Natural Park "Guculshina". *Prirodnichiy Al'manah* 2010: 100-106. (Russ., with Engl. s.). — (Dept Zool., Fac. Biol., Donetsk Natn. Univ., Shchorsa 46, UKR-83050 Donetsk).
The Park is situated in the Pokutsko-Bukovinski Carpathians (the Ukraine). A commented list of 33 spp. is presented.
- (18389) McCAULEY, S.J., T. BRODIN & J. HAMMOND, 2010. Foraging rates of larval dragonfly colonists are positively related to habitat isolation: results from a landscape-level experiment. *Am. Nat.* 175(3): E66-E73. — (Cent. Pop. Biol., Dept Ent., Univ. California, Davis, CA 95616, USA).
There is increasing evidence of intraspecific variation in dispersal behaviour. Individual differences in dispersal behaviour may be correlated with other traits that determine the impact individuals have on patches they colonize. The present authors established habitat patches (artificial pools) across a landscape, and these pools were naturally colonized by *Libellula* (mostly *L. saturata*) larvae. Larvae were collected from pools at different levels of isolation and held under common lab conditions for 5 months. Then larval foraging rates were compared. Foraging rate was positively related to habitat isolation, and colonists from the most isolated artificial pools had significantly higher foraging rates than individuals from the least isolated pools. The results indicate that spatial patterns in colonist behaviour can develop across a landscape independent of species-level dispersal limitation. This finding suggests that studies of community structure across space should include an assessment of the distribution of phenotypes as well as species-level dispersal limitation patterns.
- (18390) MITRA, T.R. & R. BABU, 2010. Revision of Indian species of the families Platynemididae and Coenagrionidae (Insecta: Odonata: Zygoptera): taxonomy and zoogeography. *Rec. zool. Surv. India*

- (Occ. Pap.) 315: 1-103. ISBN 978-81-8171-258-5. Price: US \$ 25.-- net. — (Zool. Surv. India, M-Block, New Alipore, Kolkata-700 053, India; — First Author, current address: 208/K/8, Raja Ram Mohan Roy Rd, Netaji Sarak, Kolkata-700 008, India).
87 spp. are considered and keyed; no new spp. are described.
- (18391) MUZÓN, J., G.R. SPINELLI, G.C. ROSSI, P.I. MARINO, F. DIAZ & M.C. MELO, 2010. Nuevas citas de insectos acuáticos para la Meseta de Somuncurá, Patagonia, Argentina. *Revta Soc. ent. argent.* 69(1/2): 111-116. (With Engl. s.). — (First Author: Inst. Limnol. "R.A. Ringuelet", CC 712, AR-1900 La Plata).
New localities are listed for 6 spp. of Coenagrionidae, Aeshnidae, Gomphidae and Libellulidae.
- (18392) NAGY, H.B., 2010. *Population dynamics of Libellula fulva Müller, 1764 in the lowland creeks of landscape Bihari-sik*. PhD thesis, Univ. Debrecen. x + 113 pp. (Hung., with Engl. s.; title not translated). — (Dept Hydrobiol., Univ. Debrecen, Egyetem tér j, HU-4032 Debrecen).
The effects of population density, weather conditions and body size on ♂ behaviour are described.
- (18393) NARITA, S., R.A.S. PEREIRA, F. KJELLBERG & D. KAGEYAMA, 2010. Gynandromorphs and intersexes: potential to understand the mechanism of sex determination in arthropods. *Terrest. Arthropod Rev.* 3: 63-96. — (First Author: Natn. Inst. Agrobiol. Sci., Owashi 1-2, Tsukuba, Ibaraki, 305-8634, JA).
The specimens of 1 calopterygid and 5 libellulid spp. having ♂ and ♀ morphologies are listed.
- (18394) NEISS, U.G. & N. HAMADA, 2010. The larva of *Perilestes attenuatus* Selys, 1886 (Odonata: Perilestidae) from Amazonas, Brazil. *Zootaxa* 2614: 53-58. (With Port. s.). — (Inst. Nac. Pesquisas Amazônia, Caixa Postal 478, BR-69011-970 Manaus, AM).
The larva is described and illustrated based on exuviae of reared larvae and last instar collected in Manaus. It can be distinguished from that of *P. fragilis* by the presence of a pair of tubercles on the ligula and the arrangement of the spines and hooks on the abdominal segments.
- (18395) NEL, A., P. NEL, J.F. PETRULEVIČIUS, V. PERRICHOT, J. PROKOP & D. AZAR, 1010. The Wagner parsimony using morphological characters: a new method for palaeosynecological studies. *Annls Soc. ent. Fr.* (N.S.) 46(1/2): 276-292. (With Fr. s.). — (First Author: Entomologie, Mus. Natn. Hist. Nat., 45 rue de Buffon, F-75005 Paris).
The limits and difficulties related to the tools currently in use for palaeosynecological comparisons of faunas or floras of different geological periods are discussed. The new method of the Wagner parsimony Applied to Palaeosynecology Using Morphology (WAPUM method), is defined and tested on morphological characters gathered from two insect groups Odonatoptera and Thripida. The difficulties related to the monophyly of the taxonomic groups used in the more traditional approaches are no longer a problem when using the WAPUM method. In the WAPUM a character is 'presence versus absence of species bearing a morphological structure'. The results obtained from use of the WAPUM minimize the number of changes among character states. Application of the WAPUM could reveal signals to confirm or object the currently available scenarios for the global changes in the evolution of past diversity and disparity of organisms (major changes or global crises of diversity).
- (18396) NEL, A. & J.F. PETRULEVIČIUS, 2010. Afrotropical and nearctic genera of Odonata in the French Oligocene: biogeographic and paleoclimatic implications (Insecta: Calopterygidae, Aeshnidae). *Annls Soc. ent. Fr.* (N.S.) 46(1/2): 228-236. (With Fr. s.). — (Entomologie, Mus. Nac. Hist. Nat., 45 rue Buffon, F-75005 Paris).
Includes the descriptions of *Sapho legrandi* sp. n. (holotype MNHN-LP-R 63847) and *Epiaeschna pseudoheros* sp. n. (holotype MNHN-LP-R 63848) from Late Oligocene insect deposits of Les Figons, Aix-en-Provence, France.
- (18397) NEWSLETTER SUSSEX GROUP BRITISH DRAGONFLY SOCIETY (ISSN none), Nos 23 (Autumn 2009), 24 (Spring 2010), 25 (Autumn 2010). — (c/o P. Green, Sussex Dragonfly Soc., Sussex Wildlife Trust, Woods Mill, Henfield, BN5 9SD, UK).
See OA 17776.
- (18398) NOVELO-GUTIÉRREZ, R. & K.J. TENNESSEN, 2010. Description of the larva

- of *Aeshna persephone* Donnelly, 1961 (Odonata: Aeshnidae). *Zootaxa* 2484: 61-67. — (Second Author: P.O. Box 585, Wautoma, WI 54982, USA). The last instar larva is described, illustrated and compared to the congeners inhabiting Mexico and the SW USA. A key is provided to separate it from the 6 other sympatric *Aeshna* spp. *A. persephone* larvae inhabit roots of riparian herbaceous vegetation in open streams with boulders.
- (18399) OBOLEWSKI, K., W. GOTKIEWICZ, A. STRZELCZAK, Z. OSADOWSKI & A.M. AS-TEL, 2010. Influence of anthropogenic transformations of river bed on plant and macrozoobenthos communities. *Envir. Monit. Assmt* 2010: 17 pp.; — DOI: 10.1007/s10661-010-1420-9. — (First Author: Int. Biol. & Envir. Prot., Pomeranian Acad., Arciszewskiego 22/b, PO-76-200 Słupsk). The study was conducted on the Słupia river, N Poland. *Lestes viridis* and the Aeshnidae are briefly considered.
- (18400) ODONATOLOGICAL ABSTRACT SERVICE (ISSN 1438-0269), Nos 27 (July 2010), 52 p. & 28 (Aug. 2010), 52 pp. — (Distributor: M. Schorr, Schulstr. 7/B, D-54314 Zerf). Abstract Nos 8530-8887 and 8888-9236, respectively.
- (18401) PRASAD, M. & S.B. MONDAL, 2010. [Fauna of Uttarakhand]: Odonata: Zygoptera. *Zool. Surv. India St. Fauna Ser.* 18(2): 17-28. — (Zool. Surv. India, M-Block, New Alipore, Kolkata-700 053, India). The 47 spp. known to occur in Uttarakhand are keyed and the records are presented. *Lestes umbrinus* is new to the fauna of the state (India).
- (18402) PRASAD, M. & C. SINHA, 2010. [Fauna of Uttarakhand]: Odonata: Anisoptera. *Zool. Surv. India St. Fauna Ser.* 18(2): 29-52. — (Zool. Surv. India, M-Block, New Alipore, Kolkata-700 053, India). The 75 spp. known to occur in Uttarakhand are keyed and the records are presented. *Anotogaster nipalensis*, *Cordulegaster parvistigma*, *Hemicordulia asiatica* and *Sympetrum fonscolombii* are new to the fauna of the state (India).
- (18403) ROWE, R., 2010. The Dragonflies project (<http://medusa.jeu.edu.au/Dragonflies>). *Weta* 39: 44-48. — (Sch. Marine & Trop. Biol., James Cook Univ., Townsville 4811, AU). A detailed description of the information presented at the website.
- (18404) ŠÁCHA, D., 2010. Dragonflies (Odonata) observed during monitoring of species of the European importance in southern Slovakia. *Folia faun. slovacae* 15(6): 43-46. (Slovak, with Engl. s.). — (Podtatranského 31, SK-03101 Liptovský Miluláš). 16 spp. are recorded from 6 sites. Of particular interest are *Gomphus flavipes*, *Ophiogomphus cecilia* and *Cordulegaster heros*.
- (18405) ŠALAMUN, A., M. PODGORELEC & M. KOTARAC, 2010. *Dopolnitev predloga območij za vključitev v omrežje Natura 2000: kačji pastirji (Odonata): koščični škratec (Coenagrion ornatum). Končno poročilo.* — [Supplement to the proposal of regions to be included in the Natura 2000 network; dragonflies (Odonata): *Coenagrion ornatum*. Final report]. Center za kartografijo favne in flore, Miklavž-na-Dravskem-polju. 34 pp. (Slovene). — (CKFF, Klunova 3, SI-1000 Ljubljana). An overview of *C. ornatum* records in Slovenia is presented, the results of the current field work are analysed and 3 additional regions are proposed for inclusion in the Natura 2000 network.
- (18406) SAMRAOUI, B., J.P. BOUDOT, S. FERREIRA, E. RISERVATO, M. JOVIĆ, V.J. KALKMAN & W. SCHNEIDER, 2010. The status and distribution of dragonflies. In: N. García et al., [Eds], *The status and distribution of freshwater biodiversity in northern Africa*, pp. 51-70, IUCN, Gland-Cambridge-Málaga. ISBN 978-2-8317-1271-0. (First Author: Lab. Rech. & Conserv. Zones Humides, Univ. Guelma, BP 401, Guelma, Algeria; — Book available from: IUCN Cent. for Mediterr. Cooperation, C/Marie Curie 22, ES-29590 Campanillas, Málaga). Includes an overview of the regional fauna, presents the description of the patterns of species richness, and an account of major threats to Odon., and provides conservation recommendations.
- (18407) SERMEÑO CHICAS, J.M., D. PÉREZ & P.E. GUTIÉRREZ-FONSECA, 2010. *Guía ilustrada para el estudio ecológico y taxonómico de los insectos acuáticos del orden Odonata en El Salvador.* Univ. El Salvador, San Salvador, Salvador. v + 30 pp.

ISBN 978-99923-27-49-4. — (First Author: Depto Prot. Vegetal, Fac. Cien. Agron., Univ. El Salvador, San Salvador, Salvador).

The ecology of odon. fam. is described and their abundance and distribution in Salvador is mapped. A family key to the larvae is provided.

- (18408) SIMAIKA, J.P. & M.J. SAMWAYS, 2010. Large-scale estimators of threatened freshwater catchment species relative to practical conservation management. *Biol. Conserv.* 143: 311-320. — (Dept Conserv. Ecol. & Ent., Stellenbosch Univ., P. Bag XI, Matieland-7602, SA).

Freshwater ecosystems are among the most threatened in the world. In light of the threats to freshwater biodiversity, it is essential to map the distribution and status of species to ascertain their threat status for prioritizing conservation action. However, while there is agreement that the conservation of freshwater ecosystems depends on whole-catchment management, there are still a wide variety of large-scale mapping methods in use, the advantages and disadvantages of which have not been fully explored. Based on Odon., this study shows that area estimation based on minimum convex polygons should not be encouraged for aquatic spp. The IUCN definition of area of occupancy (AOO) is a useful term, albeit highly scale-dependent, for assessment of the total approximate area over which a sp. occurs. However, for aquatic fauna, and perhaps many other organisms, assessment of occurrence should be based on the more accurate point-locality presences only. The IUCN extent of occurrence (EOO), for freshwater catchment spp., should be redefined as “the sum of the smallest hydrological units identified, of presently known, inferred or projected occurrences of a taxon, excluding cases of vagrancy, that are used to estimate the threat to a taxon”. A single hydrological unit is also the conservation or management unit. Here it is suggested that this unit is the quaternary catchment. This new mapping approach is more appropriate and practical for use in both management planning and conservation action. It is also advocated that conservation managers and decision makers facilitate co-operation in freshwater mapping efforts by working at the same spatial scale, i.e. the same hydrological unit.

- (18409) SIRAJ, S., A.R. YOUSUF, F.A. BHAT & M. PARVEEN, 2010. The ecology of macrozoobenthos in Shallabugh wetland of Kashmir Himalaya. *J.*

Ecol. nat. Envir. 2(5): 84-91. — (First Author: Cent. Res. for Develop., Univ. Kashmir, Srinagar, J. & K.-190006, India).

Includes a reference to a *Lestes* sp., documented in the assemblage during the study period (Dec. 2004–Nov. 2005).

- (18410) SKVORTSOV, V.E., 2010. *The dragonflies of eastern Europe and Caucasus: an illustrated guide*. KMK Scient. Press, Moscow. 623 pp. Hardcover (20.0 × 14.5 cm), ISBN 978-5-87317-657-1. (Bilingual: Russ./Engl.).

The well-organised and richly illustrated work covers approximately the fauna of the territory of the former European USSR, excluding the Baltic states, but reaching up to the Transural. The adults and larvae are described, illustrated and keyed, distribution maps and the list of localities for all spp. are provided, and an exhaustive regional bibliography is appended.

- (18411) SODHI, N.S., D.S. WILCOVE, R. SUBARAJ, D.L. YONG, T.M. LEE, H. BERNARD & S.L.H. LIM, 2010. Insect extinctions on a small denuded Bornean island. *Biodiv. Conserv.* 19: 485-490. — (First Author: Dept Organismic & Evol. Biol., Harvard Univ., Cambridge, MA 02138, USA).

Since 1928 and due to deforestation *Archibasis melanocyana*, *Camacinia gigantea*, *Gynacantha dohrni*, *Lestes praemorsa* and *Raphismia bispina* are likely to have been extirpated on Pulau Mengalum. In 2007, however, 14 odon. spp. were added to the island list, which stands now at 18 spp. Mengalum is a small sandy island (surface ca 4.2 km²) and lies offshore 56 km NW of Kota Kinabalu, Sabah (Malaysian Borneo).

- (18412) SUHLING, F., M.J. SAMWAYS, J.P. SIMAIKA, O. RICHTER, E. MARAIS, A. MARTENS & J. KIPPING, 2010. Dragonfly diversity from the Cape to the Kavango. In: U. Schmidel & N. Jürgens, [Eds], *Biodiversity of southern Africa, 2: patterns and processes at regional scale*, pp. 64-69, Klaus Hess, Göttingen-Midhoek. ISBN 978-3-933117-46-5. — (First Author: Inst. Geoökol., Tech. Univ. Braunschweig, Langer Kamp 19c, D-38106 Braunschweig).

Odon. are among the most well-studied insects and there is an ongoing worldwide initiative in which the diversity and conservation status of all spp. are being assessed. In Africa, where about 900 spp. oc-

cur, the southern part of the continent is currently the best surveyed. Here are analysed and depicted biodiversity distribution patterns in the BIOTA transect area, from the Cape in the S, to the Okavango river in the N, using Odon. databases for Botswana, Namibia and South Africa. Species numbers were counted in each WWF Terrestrial Ecoregion and freshwater basin. They were highest in the Zambezian ecoregion followed by the Cape ecoregions, whereas the drier ecoregions had fewer spp., except for a few outstanding localities. The proportions of range-restricted spp. were highest in the Cape and Zambezian ecoregions accounting for at least one third of the spp., whereas all other ecoregions were almost exclusively populated by widespread spp.

- (18413) SUMINA, M., 2010. Odlok o grbu, zastavi, žigih in občinskem prazniku občine Log-Dragomer. — [Act on blazon, flag, stamps and the municipal red-letter day of the Log-Dragomer municipality]. *Uradni List Republike Slovenije* 20(24): 3285-3288. (Slovene).
A dragonfly appears in the coat-of-arms, flag and in all the stamps of the municipality; the drawings with the indication of colours are provided. — Slovenia.

2011

- (18414) BOLLIGER, J., D. KELLER & R. HOLDEREGGER, 2011. When the landscape variables do not explain migration rates: an example from an endangered dragonfly, *Leucorrhinia caudalis* (Odonata: Libellulidae). *Eur. J. Ent.* 108: 327-330. — (Swiss Fed Res. Inst., WSL, Zürcherstr. 111, CH-8903 Birmensdorf).
Despite evidence on the recent extension of *L. caudalis* distribution range, it is unknown whether the sp. regularly or hardly ever migrates among ponds. Its contemporary migration patterns were investigated using Bayesian assignment tests and the migration rates related to landscape structural and thematic variables (distance between ponds, forest area, area of water body, area of hedgerow). Migration rates are independent of any landscape element. Thus, the landscape structure is not a barrier or corridor for migration in this sp. The study was conducted in canton Aargau, Switzerland.
- (18415) GIUGLIANO, L. & F. TERZANI, 2011. Gli odonati delle aree umide retrodunali nel Parco Regionale di Migliarino, San Rossore, Massaciuccoli (Toscana settentrionale). *Boll. Soc. ent. ital.* 143(1): 3-13. (With Eng. s.). — (First Author: Dipto Biol. Evoluz., Univ. Firenze, via Romana 17, I-50125 Firenze).
A commented list of 29 spp.; — southern Tuscany, Italy.
- (18416) GUILLERMO-FERREIRA, R. & K. DEL-CLARO, 2011. Resource defence polygyny by *Hetaerina rosea* Selys (Odonata: Calopterygidae): influence of age and wing pigmentation. *Neotrop. Ent.* 40(1): 78-84. — (Second Author: Inst. Biol., LECI, Univ. Fed. Uberlândia, C.P. 593, BR-38400-902 Uberlândia, MG).
As revealed by the studies at the Laureano stream, Ribeiro Preto co. (S Brazil), ♂♂ with larger pigmented areas won more contests, independently from body size. Old ♂♂ changed from territoriality to sneaking strategy. contrary to other *Hetaerina* spp., *H. rosea* ♂♂ do not display lek behaviour but defend resources according to polygyny strategy.
- (18417) KLOSKOWSKI, J., 2011. Impact of common carp *Cyprinus carpio* on aquatic communities: direct trophic effects versus habitat deterioration. *Fundam. Appl. Limnol.* 178(3): 245-255. — (Dept Nat. Conserv., Inst. Biol., MCSU, Akademicka 19, PO-20-033 Lublin).
In enclosure/exclosure experiments, the presence of a 1-yr old carp resulted in the complete absence of odon.
- (18418) NIEKISCH, M. & B. STREIT, [Eds], 2011. *Status and future of tropical biodiversity*. Soc. Trop. Ecol., Frankfurt a. M. 261 pp. ISBN 978-3-89973-000-5. — (First Ed.: Frankfurt Zoo, Bernhard-Grzimek-Allee 1, D-60316 Frankfurt a. M.).
Abstracts of papers presented at the Conference titled as above; odonatol. titles: *Ojha, N., V. Clausnitzer, F. Suhling & G. Schaab*: Adding a distribution modelling tool for conservationists to the African Odonata database (p. 163); — *Feindt, W., S. Damm & H. Hadrys*: Speciation in the neotropical giant damselfly *Megaloprepus caerulatus* reflects forest fragmentation (Pseudostigmatidae: Odonata) (p. 190).
- (18419) OLTHOFF, M. & D. IKEMEYER, 2011. Erstnachweis von Hochmoor-Mosaikjungfer (*Aeshna subarctica*) und Arktischer-Smaragdlibelle

- (*Somatochlora arctica*) im Amtsvenn-Hündfelder Moor (Kreis Borken) (Anisoptera: Aeshnidae, Corduliidae). *Natur Heimat*, Münster 71(1): 1-8. (With Engl. s.). — (c/o Bio. Stn Zwillbrock, Zwillbrock 10, D-48691 Vreden).
- A. subarctica* and *S. arctica* are for the first time recorded from the Amtsvenn-Hündfelder Moor Nature Reserve (distr. Borken, Westphalia, Germany). It is assumed that the observed *A. subarctica* individuals represent part of a metapopulation, comprising other peat bogs in the district, the adjacent Netherlands and Lower Saxony.
- (18420) POPA, M.E. & A. ZAHARIA, 2011. Early Jurassic ovipositories on bennettitalean leaves from Romania. *Acta palaeontol. Romaniae* 7: 285-290. — (Lab. Palaeontol., Fac. Geol. & Geophysics, Univ. Bucharest, Balceascu Ave 1, RO-010041 Bucharest).
- Early Jurassic (Hettangian-Sinemurian) insect ovipositories on *Pterophyllum* sp. from Pregheda are described, illustrated and assigned to Odon.
- (18421) SCHREUDER, A., 2011. De laatste vlucht van sierlijke witsnuitlibel. — [The last flight of *Leucorrhinia caudalis*]. *NRC Handelsblad* 41(170): 14-15; issue of 19 April. (Dutch).
- An article in a Netherlands national daily. Due to the Government's drastic reduction of nature conservancy and management budget, hardly any funds are available for the required management of reserves and other nature areas in the Netherlands, in consequence of which some odon. spp. are likely to become nationally extinct. Among these, *Sympecma paedisca*, *Coenagrion armatum* and *Leucorrhinia caudalis* are mentioned.
- (18422) SIVAPERUMAN, C., S. KUMAR SHAH, C. RAGHUNATHAN & [-] RAMAKRISHNA, 2011. Diversity and distribution of odonates in Great Nikobar Biosphere Reserve (GNBR), Andaman and Nikobar islands. In: B.K. Tyagi & V. Veer, [Eds], *Entomology: ecology and biodiversity*, pp. 119-127, Scient. Publishers (India), Jodhpur, ISBN 978-81-7233-727-8. — (First Author: Zool. Surv. India, Andaman & Nikobar Isls Centre, Port Blair-744 102, Andaman & Nikobar Isls, India).
- The study was conducted during 2008-2010. The odon. diversity and distribution were assessed at 11 localities in the Reserve. The 20 encountered spp. are listed.
- (18423) TERZANI, F., F. CIANFERONI, L. GIUGLIANO, G. MAZZA, S. ROCCHI & F. ZINETTI, 2011. Segnalazioni faunistiche italiane, 503: *Lestes virens virens* (Charpentier, 1825) (Odonata: Lestidae). *Boll. Soc. ent. ital.* 143(1): 40. — (Sec. Zool. "La Specola", Mus. Stor. Nat., Univ. Firenze, via Romana 17, I-50125 Firenze).
- The first *L. v. virens* record for Tuscany (Italy): Arcipelago Toscano, Isola di Capraia, Stagnone (alt. 320 m), 14-IX-2007.

NOTICE TO AUTHORS

The journal is covered by *Current Contents*, *Science Citation Index* etc., and by most of the major abstracting services.

In addition to the usual *Research Papers*, three types of papers are published: (1) *Review Articles* (original and critical accounts of theoretically important, rounded-off topics, pointing out lacunae in our knowledge on the subject and making suggestions for future research), (2) *Short Communications* (concise but complete accounts of small rounded-off topics, which will not be included in a later paper) and, (3) *Preliminary Research Notes* (brief reports of work that has progressed to the stage where research would be advanced if the results were made available to other workers in the same field).

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