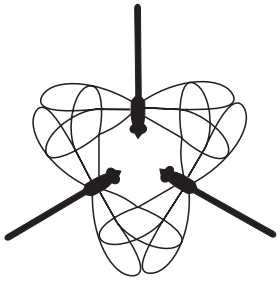

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OVERVIEW OF ODONATA KNOWN FROM MAURITANIA (WEST AFRICA)

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The current knowledge on the odon. fauna of Mauritania (20 spp.) is summarized based on literature and unpublished records. In all, 55 localities are listed along with their precise topographic positions. The fauna of Mauritania is poorly explored: 8 spp. are known from a single locality and *Trithemis annulata*, widespread in Africa, is brought here on record for the country for the first time.

INTRODUCTION

The Islamic Republic of Mauritania is situated at a "biogeographical crossroad", with northern and central regions occupied by the Sahara desert, southern regions covered by the Sahel, and the extreme southern areas formed by open savannahs (DEKEYSER & VILLIERS, 1956; BARRY et al., 1987). The presence of mountains in the northern and central regions alleviates partly the latitudinal gradient on temperature and water scarcity. These "mountain sky-islands" (sensu EZCURRA, 2006) increase the landscape complexity and create suitable habitats for the persistence of several water-dependent species. For these reasons, Mauritanian mountains present biodiversity hotspots, providing refuges for numerous organisms (DUMONT, 1982; QUÉZEL, 1978; TRAPE, 2009; BRITO et al., 2009, 2010, 2011; PADIAL et al., 2011), at least since the mid-Holocene, when the Saharan belt became definitely more arid (KRÖPELIN et al., 2008).

Mauritania is a good example of a region where biodiversity has been poorly investigated, due to its remoteness, harsh terrain and frequent civil unrest (TAJE,

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2010; WALTHER & RETAILLÉ, 2010). Most of the territory is a vast and arid plain, with approximately three quarters of it covered by desert or semi-desert. As the country has a large area where remoteness is a key word, field research suffered from severe logistic difficulties. Contrasting with the other Great Maghreb countries (Morocco, Algeria, Tunisia), the information on Mauritanian Odonata was almost inexistent before mid 20th century, when they were studied by FRASER (1952) and AGUESSE & PRUJA (1958). The only previous data published was a single record of *Palpopleura deceptor* by LACROIX (1924) from the Guidimaka province. A migrant *Anax ephippiger* was reported by MONOD (1958). The knowledge increased substantially with the works of DUMONT (1976, 1978a, 1978b, 1982), providing some data on distribution and biogeography. Currently, 19 species were known to occur in the country. Among these, eight species are known from a single record and only three are known from more than 10 records. Between 2008 and 2010, three overland expeditions were carried out in the course of herpetological surveys. Sampling was biased for the wetland habitats of the four main mountains of Mauritania: Adrar Atar, Tagant, Affolé and Assaba. These missions provided data on eight Odonata species.

In the present paper, all new and formerly published records are listed and, where appropriate, discussed.

MATERIAL AND METHODS

Data were collected during autumn 2008 and 2010 and in spring 2009 and are mainly photographically documented. Locality coordinates are georeferenced with a GPS. The previously published (AGUESSE & PRUJA 1958, DEKEYSER & VILLIERS 1956, DUMONT 1976, 1977, 1978a, 1978b, 1982, FRASER 1952, LACROIX 1924, MONOD 1958) and the reliable photographic records available through the internet (RENOULT 2006; ANDRE 2010) are also considered. Species distribution data from these two sources were georeferenced using rasterised topographic French maps 1/200.000 of Mauritania via the Fugawi software (Northport Inc. Ltd.). While some data were accurately ascribed to a precise locality and coordinates, others were only to a regional level and usually refer to larger regions.

LOCALITIES

Site No.	Province	Locality	Coordinates	Altitude (m)
S-1	Adrar	Atar	20°31.6'N, 13°03.5'W	225
S-2	Adrar	Ain el Berbera (=El Berbera)	19°59.3'N, 12°49.4'W	350
S-3	Adrar	E-n-Terguent	19°37.3'N, 12°58.5'W	110
S-4	Adrar	Guelta Aguenni	20°31.2'N, 13°08.0'W	270
S-5	Adrar	Guelta Foum N. Mouei	21°00.9'N, 11°43.1'W	510
S-6	Adrar	Guelta Oumm Lemhâr (=Molomhar)	20°35.1'N, 13°08.9'W	375
S-7	Adrar	Guelta Zli	19°31.5'N, 12°47.4'W	210
S-8	Adrar	Hamdoûn oasis; dayas	20°19.5'N, 13°08.5'W	180
S-9	Adrar	Oued Azougui	20°34.2'N, 13°06.0'W	245

S-10	Adrar	Terjît oasis	20°15.0'N, 13°05.2'W	360
S-11	Adrar	Tod oasis	20°43.5'N, 13°00.5'W	270
S-12	Adrar	Toumbahjît	20°14.2'N, 13°00.3'W	340
S-13	Adrar	Toûngâd guelta and oasis	20°03.7'N, 13°07.7'W	160
S-14	Assaba	Aouînet Nanâga	17°09.3'N, 12°11.9'W	100
S-15	Assaba	Boû Bleï'Îne (=Boubleïne)	17°08.4'N, 11°00.7'W	130
S-16	Assaba	Guelta El Ghâira	17°11.3'N, 12°14.9'W	100
S-17	Assaba	Hassei el Hellé	16°43.2'N, 12°11.1'W	60
S-18	Assaba	Le Bheyr (=El Beher); lake and guelta	16°34.3'N, 12°04.5'W	70
S-19	Assaba	Megta es Sfeira barrage	16°38.4'N, 11°03.4'W	110
S-20	Assaba	Oumm 'Aoueili	17°08.0'N, 12°30.3'W	60
S-21	Dakhlet Nouâdhibou	R'Gueiba	19°25.1'N, 16°28.0'W	0
S-22	Dakhlet Nouâdhibou	Road towards Nouakchott	21°03.2'N, 16°20.7'W	60
S-23	Gorgol	Mbout, 10km N of	16°05.1'N, 12°35.2'W	30
S-24	Gorgol	Mbout, 12km N of	16°06.2'N, 12°35.3'W	30
S-25	Guidimaka	Dafort, 2km NW of	15°41.0'N, 12°09.8'W	40
S-26	Guidimaka	Guidimaka area	14°45.3'N, 12°06.5'W	25
S-27	Guidimaka	Kalinioro, 5km N of	15°24.4'N, 11°45.0'W	60
S-28	Hodh Ech Chargui	El Mreyyé area	19°30.0'N, 07°00.0'W	340
S-29	Hodh Ech Chargui	Néma; dry oued	16°36.5'N, 07°13.9'W	290
S-30	Hodh El Gharbi	Tîntâne, 50 km W of	16°29.0'N, 10°33.7'W	250
S-31	Hodh El Gharbi	Ayoûn el Atroûs; pool	16°39.5'N, 09°37.3'W	230
S-32	Tagant	Amejjerji near Nbeika	17°59.5'N, 12°16.1'W	110
S-33	Tagant	Djouk; water pit SE of El Ghaira	17°10.2'N, 12°08.8'W	80
S-34	Tagant	El Housseînîya spring	17°44.3'N, 12°14.7'W	125
S-35	Tagant	Gueltas Gamra Ouarbî and Lemzailgé	17°39.1'N, 12°14.6'W	170
S-30	Tagant	Guelta Sellenbou near Moudjeria	17°49.0'N, 12°16.7'W	170
S-37	Tagant	Guelta El Gheddia (=El Khedia)	17°50.0'N, 11°33.4'W	425
S-38	Tagant	Guelta Laout, 1km S of	17°14.0'N, 12°06.0'W	250
S-39	Tagant	Marigot of El Mechra	17°52.4'N, 12°14.0'W	120
S-40	Tagant	Matmâta canyon; Guelta Tartêga	17°52.8'N, 12°05.6'W	100
S-41	Tagant	Moul Echnouk near Nbeika	18°00.3'N, 12°16.3'W	115
S-42	Tiris Zemmour	Bir Moghreïn (=Fort Trinquet)	25°13.6'N, 11°34.6'W	365
S-43	Trarza	Aftoût es Sâhel	17°11.9'N, 16°10.3'W	0
S-44	Trarza	Aftoût es Sâhel	17°01.9'N, 16°16.3'W	0
S-45	Trarza	Aftoût es Sâhel	16°55.4'N, 16°19.1'W	0
S-46	Trarza	Aftoût es Sâhel	16°50.9'N, 16°21.0'W	0
S-47	Trarza	Between Rosso and Nouakchott	17°30.1'N, 16°02.2'W	0
S-48	Trarza	Boubou Karli; creek	16°38.9'N, 14°21.0'W	10
S-49	Trarza	Chott Boul, 13km S of	16°29.4'N, 16°26.7'W	0
S-50	Trarza	Diaouling National Park	16°22.2'N, 16°25.5'W	0
S-51	Trarza	Ghani (=Gani); pond	16°36.2'N, 15°27.9'W	10
S-52	Trarza	Jreïda (=Coppolani)	18°18.8'N, 16°02.5'W	0
S-53	Trarza	Marigot de Bileyit	16°24.5'N, 16°26.7'W	10
S-54	Trarza	Rosso	16°30.4'N, 15°48.7'W	0
S-55	Trarza	Sedibé	16°35.9'N, 15°45.8'W	10

SPECIES RECORDED

The nomenclature follows BRIDGES (1994) and the subsequent systematic amendments, where appropriate (e.g. DIJKSTRA & MATUSHKINA, 2009).

Lestidae

Lestes pallidus Rambur, 1842
S-30: 22-II-1976 (DUMONT 1978).

Coenagrionidae

Agriocnemis zerafica LeRoi, 1915
S-34: 17-II-1976 (DUMONT 1978).

Ischnura saharensis Aguesse, 1958
S-6: 02-III-1951, as *I. senegalensis* (FRASER 1952); – S-6: 30/31-I-1976; – S-9: 31-I-1976 (DUMONT 1978).

S-5 (1♂ and 1♀ mating, 24-III-2009, photo).

NOTE: FRASER (1952) recorded an *I. senegalensis* in locality S-6, where Dumont collected some years later *I. saharensis*, not described at the time of Fraser's work. Considering the lack of evidence on sympatric occurrence of the two species, DUMONT (1978a, 1982) amended Fraser's *Ischnura* from this locality to *I. saharensis*.

Ischnura senegalensis (Rambur, 1842)
S-8: 21-II-1951 (FRASER, 1952); – S-2: 20-IV-1975, 26-IV-1975; – S-8: 23-V-1975; – S-10: 19-IV-1975; – S-13: 23-IV-1975; – S-16: 06-V-1975; – S-18: 07/08-V-1975; – S-32: 04-V-1975; – S-41: 04-V-1975; – S-51: 01-V-1975 (DUMONT, 1976); – S-31: 17-II-1976; – S-34: 17-II-1976; – S-35: 17-II-1976; – S-39: 16/17-II-1976; – S-40: 27-I-1976; – S-54: 21-II-1951 (DUMONT, 1978).

NEW RECORD: S-46 (1@, 28-X-2010, collected).

Pseudagrion hamoni Fraser, 1955
S-6: 02-III-1951; S-8: 21-II-1951, as *P. acaciae* Förster (FRASER 1952); – S-6: 19-IV-1975, 24-V-1975; – S-8: 20-IV-1975, 23-V-1975; – S-32: 04-V-1975, as *P. whellani* Pinhey, (DUMONT, 1976); – S-6: 30/31-I-1976; – S-34: 17-II-1976; – S-40: 16/17-II-1976, as *P. whellani* Pinhey (DUMONT, 1978); – S-6: 18-IX-2006 (RENOULT, 2006).

NOTE: *P. whellani* Pinhey, 1955 is considered a subjective synonym of *P. hamoni* (cf. BRIDGES, 1994, with references). FRASER's (1952) record of *P. acaciae* was suggested by DUMONT (1976) to be referable to *P. hamoni*.

Aeshnidae

Anax ephippiger (Burmeister, 1839)
S-1: 10-II-1951 (FRASER, 1952); – S-42: XI-1942; – S-52: 29-VII-1956 (AGUESSE & PRUJA, 1958); – S-28: 28-XII-1953 (MONOD, 1958); – S-2: 26-IV-1975; – S-3: 26-IV-1975 (DUMONT, 1976); – S-1: I/II-1976; – S-11: 01-II-1976; – S-47: 27-I-1976 (DUMONT, 1977); – S-6: 30/31-I-1976; – S-7: 08/09-II-1976; – S-8: 28-I-1976; S-9: 31-I-1976; – S-10: 28-I-1976; S-11: 01-II-1976;

– S-13: 07-II-1976; – S-29: ca 24-II-1976; – S-31: 23-II-1976; – S-35: 17-II-1976; – S-37: 17-II-1976; – S-39: 16-II-1976; – S-40: 16/17-II-1976; – S-54: 27-I-1976; – S-47: 27-I-1976 (DUMONT, 1978).
NEW RECORDS: S-45 (1♀, 28-X-2010, collected); – S-49 (1♀, 29-XI-2010, photo).

Anax imperator Leach, 1815
S-34: 17-II-1976 (DUMONT 1978).

Libellulidae

Acisoma panorpoides ascalaphoides Rambur, 1842
S-48: 02-V-1975 (DUMONT, 1976).

Brachythemis impartita (Karsch, 1890)
S-16: 06-V-1975; – S-18: 07/08-V-1975; – S-32: 04-V-1975; – S-41: 04-V-1975; S-48: 02-V-1975; – S-51: 01-V-1975 (DUMONT, 1976); – S-39: 16-II-1976 (DUMONT, 1978).
NEW RECORDS: S-15 (1@, 22-IV-2009, photo); – S-23 (1@ and 1♀, 04-XI-2010, collected); – S-27 (1♀, 07-XI-2010, collected); – S-25 (1@, 09-XI-2010, collected); – S-17 (1♀, 12-XI-2010, collected); – S-20 (1♀, 15-XI-2010, collected).
NOTE: DUMONT (1976, 1978) recorded the species as *B. leucosticta* (Burm.) According to the revision of DIJKSTRA & MATUSHKINA (2009) this species includes two morphotypes, which are presently considered distinct species, of which *B. impartita* is the species present in Mauritania.

Crocothemis erythraea (Brullé, 1832)
S-16: 06-V-1975; – S-48: 02-V-1975 (DUMONT, 1976); –S-6: 30/31-I-1976; – S-34: 17-II-1976; – S-39: 16-II-1976; – S-40: 16/17-II-1976 (DUMONT, 1978).
NEW RECORDS: S-19 (02-XI-2008, collected); – S-44 (1♀, 27-X-2010, photo).

Diplacodes lefebvrii (Rambur, 1842)
S-48: 02-V-1975 (DUMONT, 1976); – S-50: 03-I-2010 (ANDRÉ 2010).
NEW RECORDS: S-53 (2♀♀, 29-XI-2010, collected), S-55 (1@ and 1♀, 31-X-2010, collected).

Orthetrum chrysostigma (Burmeister, 1839)
S-16, 06-V-1975 (DUMONT, 1976); – S-40: 16/17-II-1976 (DUMONT, 1978).

Orthetrum trinacria (Selys, 1841)
Locality not stated (DUMONT, 1976).
NEW RECORDS: S-15 (1@, 22-IV-2009, photo).

Palpopleura deceptor (Calvert, 1899)
S-26: 1908 (LACROIX 1924).

Pantala flavescens (Fabricius, 1798)
S-48: 02-V-1975 (DUMONT, 1976); – S-22: 12-IX-2006 (RENOULT, 2006).
NEW RECORDS: S-12 (2♀, 05-X-2008, collected); – S-43 (1@, 27-X-2010, photo), S-55 (1♂, 31-x-2010, photo).

Sympetrum fonscolombii (Selys, 1840)
S-1: 28-II-1951 (FRASER, 1952).
NEW RECORD: S-21 (1@, 12-VII-2009, photo).

Tramea basilaris (Palisot de Beauvois, 1805)
S-33: 06-V-1975; – S-48: 02-V-1975 (DUMONT, 1976).

Trithemis annulata (Palisot de Beauvois, 1807)
NEW RECORDS: S-38 (1@, 14-IV-2009, photo); – S-55 (1@, 29-XI-2010, photo), S-24 (1@, 04-XI-2010, collected).

Trithemis arteriosa (Burmeister, 1839)

S-6: 02-III-1951; – S-8: 21-II-1951; – S-10: 25-II-1951 (FRASER, 1952); – S-2, 26-IV-1975, S-6: 19-IV-1975, 24-V-1975; – S-8: 20-IV-1975, 23-V-1975; – S-10: 19-IV-1975; – S-13: 23-IV-1975; – S-16: 06-V-1975; – S-18: 07/08-V-1975; – S-36: 04-V-1975; – S-41: 04-V-1975; – S-48: 02-V-1975 (DUMONT, 1976); – S-6: 30/31-I-1976; – S-8: 28-I-1976; – S-9: 31-I-1976; – S-10: 28-I-1976; – S-31: 23-II-1976; – S-34: 17-II-1976; – S-35: 17-II-1976; – S-39: 16-II-1976; – S-40: 16/17-II-1976 (DUMONT, 1978); – S-6: 18-IX-2006 (RENOULT, 2006).

NEW RECORDS: S-4 (1@, 26-IX-2008, photo); – S-14 (1@, 28-IV-2009, photo).

Urothemis edwardsii (Selys, 1849)

S-48: 02-V-1975 (DUMONT, 1976).

DISCUSSION

The present knowledge on Odonata from Mauritania is based on 127 records pertaining to 20 species, including *Trithemis annulata*, recorded here for the first time. The great majority (more than 100) of records are at least more than 30 years old or older and were collected between 1908 and the 1970's. This is a long period if we consider desert progression and the high human pressure in comparison with the low water availability. Photographic records, available on internet, report the occurrence of four species. In this way, the old record of *Pseudagrion hamoni* from Guelta Oum Lemhar is confirmed, showing the survival of this species as an Early Holocene relict in an isolated guelta. *Pantala flavescens*, first recorded by RENOULT (2006), is reported in this paper for the second time from Mauritania, and the first known locality of *Orthetrum trinacria* is presented. Lastly, *Azuragrion vansomereni* was recorded from Mauritania by WATERSTON (1984), based on SCHMIDT (1951). Nevertheless, Schmidt's locality (St. Louis) is currently within Senegal. The species may occur along the lower course of the Senegal river, which corresponds to the border between Mauritania and Senegal.

Although dragonfly larvae are dependent of water, the adults can fly over long distances or even migrate. These traits may partially explain the record of some species in very arid regions. *Pantala flavescens* is a good example. Also *Anax ephippiger*, native to Africa, Asia and parts of southern Europe, shows very strong migratory tendencies and is often found migrating in enormous numbers and over large distances (DUMONT, 1977). In contrast, some species are restricted their breeding site, e.g. *Pseudagrion hamoni*, which was shown by DUMONT (1976, 2007) to be confined to permanent mountain rock pools (locally known as *gueltas*) and should be regarded to a true relict of the Early Holocene Pluvial period.

The aridity and unstable climatic conditions of the Sahara pose evolutionary and conservation challenges to the Odonata. However, the lack of knowledge on their status and ecology in this geographical area hamper accurate analyses of their conservation status and vulnerability. In general, major threats to North African Odonata are habitat loss or degradation and water pollution (SAMRAOUI

et al., 2010). As occurs with some anuran populations in the Sahel, dragonflies might be suffering from the negative effects of intense wood harvesting and agro-pastoral use, as well as from the uncontrolled use of pesticides (PADIAL et al., 2011). Environmental factors related to a long standing desertification (HUBERT, 1920), further amplified by a rainfall decreased since the late 1950s and prolonged drought periods in the 1970's (AHMED et al., 2008), should be considered as potential threat to Mauritanian odonate populations, as recently demonstrated also in fishes and reptiles (TRAPE, 2009; BRITO et al., 2011). Additionally, water scarcity coupled with habitat fragmentation and drought episodes render Odonata populations particularly susceptible to local extinction.

While Saharan biodiversity is undoubtedly of special interest in several biological fields, the Sahara Desert is a remarkable example of historical logistic difficulties leading to low research activity and the disconnected information. Nevertheless, recent studies are filling this gap (BRITO et al., 2009, 2010, 2011; TRAPE, 2009; PADIAL et al., 2011). As exposed in the present work, the Mauritanian fauna still holds a good amount of potential surprises to stimulate the odonatologists. This future research is expected to provide crucial information for accurate analyses of Mauritanian Odonata diversity, threat risks and conservation status, besides contributing to the general understanding of North and West African biogeography and ecological dynamics. By providing an up-to-date, commented database of records, our aim is to support and stimulate the future biodiversity research in the country.

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SPATIAL MODELLING OF ODONATA HABITATS IN THE PACIFIC, 1: INTRODUCTION TO THE TECHNIQUES IN SPATIAL MODELLING

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The habitat modelling schemes are briefly reviewed with emphasis on their implication in various fields of science. The best practical solutions for habitat modelling encompassing large geographical units are sought. They are exploited and considered for a macro-scale project aiming in producing predictive habitat models for Odonata species inhabiting a vast territory of the Pacific. The present publication is the first part of a series of papers dealing with this mapping scheme. It represents the study area, explains some common terminology used in Geographical Information Systems (GIS)-based modelling and ecology, and introduces the methodology developed specifically for the purposes of the current investigation.

INTRODUCTION

The complexity and heterogeneity of natural systems pose significant challenges to those wishing to understand the environmental conditions which support a species' ecological niche at a particular location (GUISAN & ZIMMERMANN, 2000; SWENSON, 2006). Environmental conditions are influenced by a complicated network of spatially stochastic events that are difficult to follow and predict. Habitat selection by a species is a hierarchical process and absolute statements about preference or avoidance cannot be made (CIUCCI et al., 2003). In large areas where comprehensive, land-based surveys are unaffordable or impractical, spatial models can be used as indicators of potential species diversity (FOOK et al., 2009) or as predictors of species distribution based solely on habitat characteristics, which may also include measures of anthropogenic

disturbance and prey availability (ALEXANDER et al., 2006). Spatial models can focus on the fundamental species' ecological niche at a particular point location (SWENSON, 2006), population structures and metapopulation viability (SCHTICKZELLE et al., 2005), population connectivity in complex landscapes (EPPS et al., 2007), limiting factors in global species distribution (SÁNCHEZ-CORDERO et al., 2008), biodiversity forecasting (BROWN & BAKER, 2009), macroevolutionary processes and phylogenetic analyses (BLACKBURN et al., 2004). MARR et al. (1997) argue that modelling has two main functions: to simulate and predict based on observed processes, and second, to provide a detailed understanding of the inter-relationships among variables and processes described by the model. Generally speaking, modelling aims at converting the enormous and complicated natural structure of a particular region in question into manageable units. The models could emphasise priority species (LEHMAN, 2006; GAVASHELISHVILI & LUKAREVSKIY, 2008), their dependence on important environmental factors (BORGES et al., 2006; FLEISHMAN et al., 2001), topographic (landscape) and biotic (intra- and interspecies relations) features as well as historic factors (geographic barriers) that approach their requirements (COSTA et al., 2008). Having this information helps in highlighting the crucial conservation action needed to be taken for species preservation. To be successful a model must be able to integrate the various sources of knowledge available about the complexity and heterogeneity of a system (IRVINE et al., 2009). Once developed, models can be further enhanced by adding more parameters as input features and extracting the information that fits best the purpose of the investigation. However, due to intensive geomorphological development, climatic shift and human high input into these processes the prediction of the environmental models might be out of date prior to the practical conservation activities. Some nature elements could be lost well before establishing their existence in situ. Thus creating models is a proactive approach in describing and assessing nature environment as well as taking actions for its preservation.

Environmental models are different depending on a variety of considerations, such as the size of the investigation region, availability of input data and resources, support of input and validation data (MIEHLE et al., 2006). Usually a limited number of environmental characteristics is assigned to the models that investigate the dynamic in structural reorganisation within the ecological systems. These are determined upon the purpose of the research, the specificity of the topics in question, availability of resources, biological structure of the investigated group, or abiotic factors that are suitable for the monitoring. Reviewing the large set of predictive habitat distribution modelling techniques GUISAN & ZIMMERMANN (2000) conclude that the choice of an evaluation measure should be driven primarily by the goals of the study. When the priority is given to a specific species, the model focuses on its environment and tries to establish exactly where in the ecological systems the landscape topography and climatic

situation meet to create suitable conditions for its development. If, however, the entire system is investigated then the model could bring together the so called *leading species* that are representative for the system and describe it best in terms of their presence, abundance and dependence on the local environmental situation.

Choosing the proper nature object for a global assessment of the ecological systems could be a great challenge. It is highly debatable what should be the leading source of information in the choice – species' rarity in regional or global scale, efficiency and applicability of the study methodology developed for the target group or the degree of overall understanding upon it in terms of its biology, ecology, morphology, taxonomy, genealogy, etc. Personal bias could be highly restrictive, too because it influences the investigator's decision towards the favoured study group. Individual species models may play a very important role, however, their sole application in nature conservation is not desirable. Integration with other models must be sought in order to adequately capture the range of uncertainty associated with projecting species distributions into the future (BEAUMONT et al., 2007). This is to achieve a greater success in protection of the natural world.

The current investigation is meant to contribute to higher standard protection of natural habitats within the Pacific region. It seeks the best practical solutions for identification, localisation and prediction of the potential habitat distribution in order to apply them in entomological studies on Odonata. Here is presented the first part of the investigation – outlining the rationale of the study, defining the terminology and introducing the results of the research for the best spatial analysis tools in creating plausible habitat models. This is done in order to establish the position of the spatial analysis techniques used in the contemporary ecological investigations, to identify what percentage of them has been done on entomological investigations and to choose between the best applicable methods.

SCOPE OF THE RESEARCH

The Pacific Ocean is the largest geographical unit on earth. It stretches across the globe from North to South encompassing a territory of nearly 168,000,000 km^2 (McKNIGHT, 1995) reaching the shores of five continents. Only Africa and Europe do not have direct contact with it.

The Pacific Ocean is highly diverse in geographical, biological and cultural sense. Specialists are divided in opinions about its subdivision. This is due to geographical, historical, demographic, constitutional and political factors (CROCOMBE, 2001). The generalised scheme of dividing it on North and South Pacific is not always easily applicable. This is because for example the Northern Marianas extend far north from the equator while they are grouped within Micronesian islands often referred to as part of the South Pacific. Certainly any terms proposed for subdivision of this vast and assorted oceanic region are ambiguous (MAY &

NELSON, 1982) and must be clarified in terms of the purpose of the investigation carried out in it.

The current research is complementary to the global initiative for databasing and mapping world Odonata distribution. The region covered by it is selected to be outside of the scopes of other databases that have been already created or are building up at the moment. That is why it cannot be described with the existing classification scheme developed for the Pacific islands and needs to be outlined precisely. To the south its border encompasses New Zealand's main islands and the sub-Antarctic islands south of them (namely, Bounty, Antipodes, The Snares, Auckland, Campbell and Macquarie). It runs to north passing west of Norfolk Island, New Caledonia and Solomon Islands reaching the northern most point at the group of Northern Mariana Islands. From there the border continues SE passing east from the Marshall Islands, Kiribati, Easter Islands and joints New Zealand at Chatham Islands (Fig. 1).

RATIONALE OF THE RESEARCH

The Pacific Islands are characterised by great diversity in their origin and development. Many of them have never been part of larger continental land masses but have risen directly from the sea floor. They have developed in isolation with a low rate of immigrants from neighbouring islands and represent very important areas with unique biodiversity. Normally, high endemism is observed on geologically old islands among terrestrial species that cannot disperse over great ocean

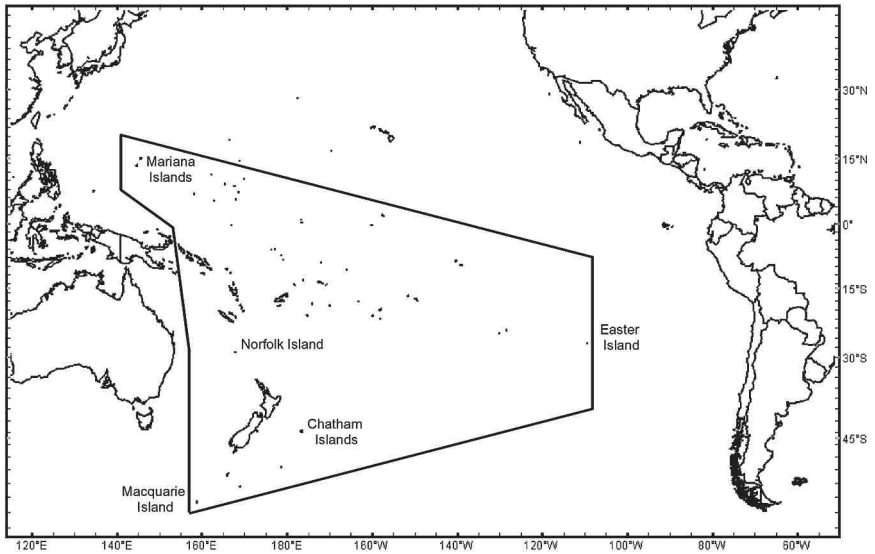

Fig. 1. Study area established for the Odonata modelling scheme.

areas. Those places are exposed to dynamic tectonic activity and their inhabitants are all potentially endangered as species could be lost if the island sunk below ocean level. In this case valuable information about evolution events that have taken place on the island would be lost. This ecological gap could be filled by the species with greater dispersal abilities. They could "transfer" their evolutionary experience to new territories and give a global picture of the paths and tendencies followed by different species lineages.

Insects offer enormous material for study in terms of species number, morphology, ecological plasticity, biological cycles and evolutionary trends. They are one of the best research subjects because they are considered as the group that dominates the Pacific Islands (GRESSITT, 1961). Insects also have a great potential for supplying investigators with information about environmental characteristics, their current and past development and predicting future conditions. They occupy a considerable part of natural world and play crucial role in maintaining the integrity of all its parts. Being included in various levels of the organisation of the ecological systems, these animals have imperative value in their overall functioning.

Unfortunately, these animals are often neglected or their position is overlooked. Commonly observed reasons are: (1) insects' huge species diversity which makes it very difficult to draw general conclusions over the entire animal class, (2) unresolved taxonomic problems that pose significant barriers in species utilisation for environmental research, and (3) high dispersal abilities and ecological plasticity of some species which create great obstacles in generating habitat models and predicting their future development. These constrains make it preferable to choose a model group that will help in understanding the above mentioned questions in the history of the natural world. Odonata were chosen as a model group for producing a habitat inventory scheme and to propose its integration within the nature conservation activities within the entire Pacific region.

Odonates are selected as study object for two main reasons: (1) the group consists of species that exhibit great endemism and others with high dispersal abilities that in combination would give very valuable information about the evolution of the Pacific islands, and (2) Odonata fauna of the Pacific islands is poorly known. It is a generally observed trend that greater attention is paid to terrestrial insects than to freshwater. This is due to the fact that more scientists are involved in studies on species rich orders like Coleoptera and Lepidoptera as well as other groups that are dispersed over islands by humans. Those all are predominantly terrestrial inhabitants.

TERMINOLOGY

It is important for the purpose of this investigation that there be a clear understanding of the terminology used. Here is presented a short explanation on the

main GIS-related terms and notions that are used in ecology for describing species' requirements.

Geographic Information Systems (GIS) are a technology that was created to address the growing need for quickly accessing and spatially referencing the enormous array of geographical/ environmental data that had accumulated (AUDET & ABEGG, 1996). CONROY (2006) summarises the structure and organisation within a GIS environment as software to store, retrieve, map, and analyse geographic data. In GIS, all spatial data are geographically referenced to a map projection in an earth coordinate system. It also allows for integrating non-spatial data (spread-sheets, pictures, graphs, etc.) into the spatially referenced features. The latter works in two modes: vector and raster. Vector features assign geographic coordinates to three geometric forms that could be used to represent any geographic object. These are points (individual objects, like trees, peaks, etc.), polylines (streams, roads, contour lines, etc.), and polygons (symbolising surface areas, like lakes, forests, building footprints, etc.). The Raster mode operates as grid cells with consistent dimensions. These are interchangeable units that could be modified according to the purpose of the spatial analysis. Each cell bears a unique value representing concrete earth parameter (elevation, distance from main objects, structural changes in the environment, etc.). Values from different layers could be combined with simple mathematical calculations with preliminary numbers added/subtracted to concrete cell in terms of giving more effect on particular landscape features. These are important options in mapping species habitat distributions as they can be used to highlight the essential geographic elements that play vital role in choosing a particular habitat within a specific biotope.

Free treatment of terms like biotope and habitat has been observed on many occasions in the literature and has the potential to create confusion. There are, however, very precise definitions in the odonatological literature and agreement among the specialists upon this issue that must be taken into account in any research. P.S. Corbet (pers. comm.) defines: "... an ideal habitat ... that is the habitat where the production rate exceeds the death rate, could support numerous populations without immigrations, and provides for emigrants ready to colonise other habitats". When it comes to biotope one has to take into account the definite ecological system (forest, stream, or lake) and no attention should be paid to the specific habitats it contains (CORBET, 1999). Habitat, on the other hand, is the specific environment for each individual species and represents various levels of complexity and heterogeneity. Habitat structure is determined by the species composition and the degree of the individual species development. With respect to dragonflies, macrophytes, for example, are important visual stimuli during habitat selection. Egg-laying species are normally influenced by the general habitat appearance rather than the potentials for the larvae development it offers (WILDERMUTH, 1994). What some people understand under microhabitat at a certain stage in the ontogenesis overlaps with the notion of ecological niche. Its

description for every particular species depends upon the ability to be recorded through time and space in relation to food supply and presence of competitive species (CORBET, 1999). Two other terms, inhabiting area and locality, are also important in terms of the meaning giving them during this research. Inhabiting area overlaps with the notion of the habitat, however, its description requires individual approaches for every single wetland and species. Figure 2 represents what MARTENS (1996) considers as important characteristics for the habitat choice of *Platycnemis pennipes* (Pallas). Their availabilities vary in relation to the distance from the wetland where certain plant species develop. That is why the inhabiting areas of the populations of the same species may be different in an area even alongside a single stream. The inhabiting area is determined by the number of the localities within it. Those are the concrete spots where individuals from a particular species have been encountered. When specifying localities, it is also important to record the stage of maturity (teneral, immature, or mature) and the individual behaviour. This is crucial for establishing the species autochthony within a certain area. It depends upon the individual possibilities to complete the whole life-cycle within the same inhabiting area. A detailed description of the degree of reliability for species autochthony that is considered for the present research is given in the methodological part.

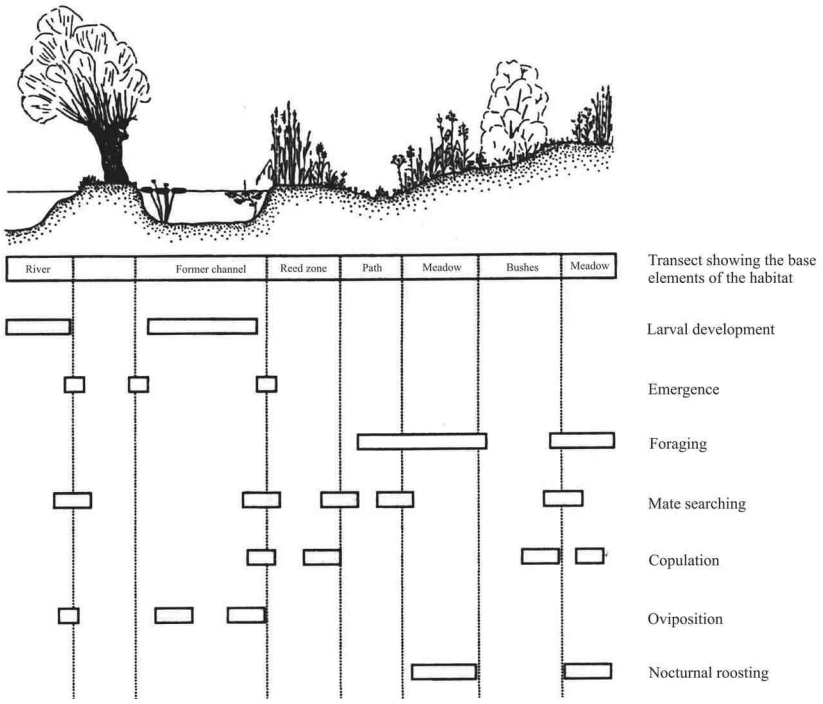

Fig. 2. Habitat structure required by *Platycnemis pennipes* (according to MARTENS, 1996).

MATERIAL AND METHODS

An extensive literature review was carried out to identify studies that had used GIS in habitat studies in the Life Sciences area. A total of 532 articles were downloaded prior to 01st September 2009 while browsing the Wiley InterScience internet site at: http://www3.interscience.wiley.com/cgi-bin/home. They were later analysed and sorted in six groups: (1) papers with general information on the importance and implications of GIS; (2) utilisation of GIS-based analyses in micro-scale habitat derivation exercises; (3) utilisation of GIS-based analyses in macro-scale habitat derivation exercises; (4) GIS-tools in other nature conservation actions including mapping distribution; (5) GIS in general environmental modelling schemes including mapping; and (6) GIS in entomological researches regardless of their purpose.

The division of the land surface on micro- and macro- units and distinguishing between them is highly biased and does not follow any particular methodology. TUSHABE & FJELDSÅ (2008) introduce coarse-scale maps (continent-wide) and more detailed maps (nation-wide), which were found to not be applicable for this study. Having the extremely large scope of the current project, however, it was fundamental for the current research to parameterise the land surfaces covered by previous studies. The macro-scale studies reviewed had been carried out over areas larger than 40,000 km^2, which is comparable with the size of a randomly selected administrative region of New Zealand (Canterbury). Use of the terms macro- and micro- has been selected instead of small-/large-scale which could lead to cartographic confusion: small-scale maps represent large areas while large-scale maps are developed for small areas.

A special scheme was used to classify the Odonata species according to their reproductive success. The scheme is based on the existing Representative Spectrum of Odonata species (RSO) (SCHMIDT, 1985) and Odonata Habitat Index (CHOVANEC & WARINGER, 2001) with some additional factors. Three groups were defined:

AUTOCHTHONOUS SPECIES (AUS)

(1) Presence of ultimate exuviae (larval skin) with/without newly emerged adult.
(2) Newly emerged (teneral) individuals. Several occasions can be pointed out:
    Newly emerged individual caught in a spider web or killed by ants.
    Newly emerged individual found in the middle of the territory.
    Newly emerged individual found at the borderline of the territory.
    Newly emerged individuals (assemblages).
(3) Pre-emerging larvae or larvae prior to emergence.
(4) Submerged pre-ultimate larval exuviae.

POSSIBLY AUTHOCHTHONOUS SPECIES (PAS)

(5) Egg-laying females.
(6) Pre- or postcopulatory tandems; copulating wheels.
(7) Males defending territories.
(8) Dead individuals on the road.
(9) Concentration of mature individuals.
ACCIDENTAL SPECIES (ACS)
(10) Hunting individuals.
(11) Passing/single individuals.

SPATIAL MODELLING IN ENVIRONMENTAL SCIENCES AND PARTICULARLY IN ENTOMOLOGY

GIS-based spatial analyses have revolutionised many branches of the science as CONROY (2006) argues that application in the contemporary studies ranges greatly from in business and industry, archeology and ecology to dental genetics and morphology. However, the most frequent utilisation is in conservation species-environment relationship modelling (ALEXANDER et al., 2006). The current investigation revealed a large number of studies where GIS-based analyses have been used for modelling or mapping natural environment. Figure 3 gives the relative performance of each group according to the classification scheme accepted in the methodology part. It also shows what percentage is for GIS-related studies in entomology.

Three main conclusions could be drawn from this analysis: (1) increased utility of environmental modelling, (2) habitat model building on micro-scale is preferred over macro-scale projects, and (3) GIS in entomology is in its infantile stage.

It is apparent that modern environmental science relies much upon GIS spatial analyses. Summed up the percentages gained for micro-, macro- and general environmental modelling surpass the simple GIS mapping schemes that are popular in nature conservation and environmental studies. The mutual support that mathematical modelling and GIS could have in predicting species distribution based on constructing habitat utilisation schemes, is prerequisite for the increased studies in this field. Most mathematical models could be visualised or directly realised in a GIS environment as the GIS packages are designed to perform some methodological steps in model building process. There are, however, some disadvantages that are commented upon in GUISAN & ZIMMERMANN (2000). These are related to calibration of the models outside of the GIS. This is not so easy because most of the statistical packages cannot read GIS-maps directly and the interchange files are generally huge in size.

Habitat model building over smaller regions (nature parks and reserves, patches of forests and wetlands, administrative regions, etc.) is preferred before spatial analyses over large areas (e.g. whole state, continent, vast biomes, etc.). That is usually because the presence/absence data needed for model building are more

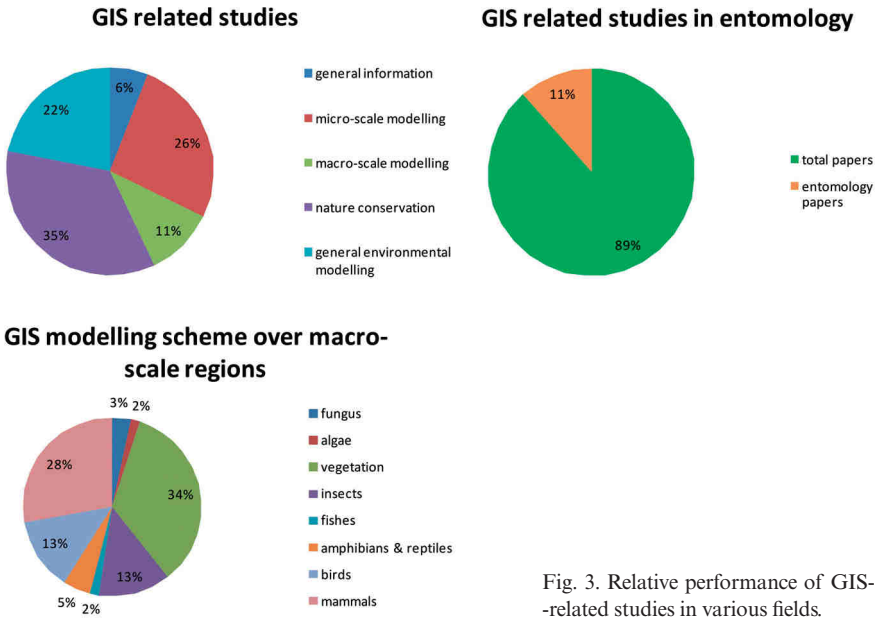

Fig. 3. Relative performance of GIS--related studies in various fields.

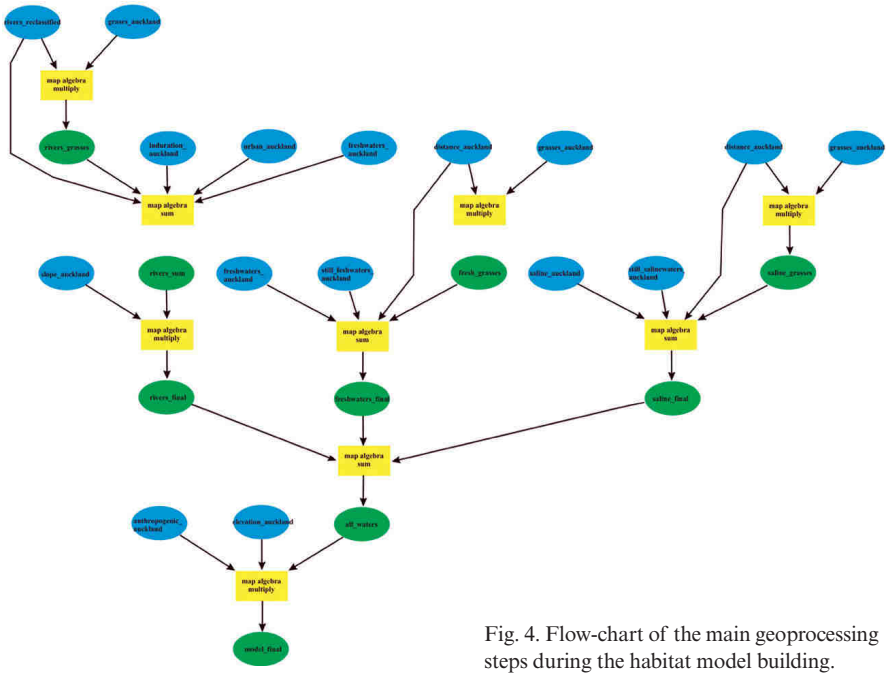

Fig. 4. Flow-chart of the main geoprocessing steps during the habitat model building.

easily obtained and more accurate for smaller geographical units. Also a limited number of environmental variables over large areas is preferred as the calculations are much more difficult to handle in GIS software. Area partitions could be a solution, however a very precise input data and calculations must be employed in order to achieve consistent results over all parts of the investigated region.

Naturally GIS-based macro-scaled projects on vegetation structure predominate followed by studies on mammals and birds. These groups do not suffer so greatly from the limitations mentioned above. Remote sensing (RS) technology is a useful tool for extrapolating information from ground-based ecological studies to larger unsampled areas (CAYUELA et al., 2006). It is commonly used in combination with the Normalized Difference Vegetation Index (NDVI) for estimating net primary productivity (NPP) (a key component of energy and matter transformation in the terrestrial ecosystem) (PENG et al., 2008), measuring phenological variability in plant communities (HOARE & FROST, 2004; REED et al., 1994), or identifying tree diversity (CAYUELA et al., 2006). RS is easily applicable in studies about large animals, like stocks of wild mammals (MUSIEGA & KAZADI, 2004) and birds (commented in OSBORNE et al., 2001). It could be used for studies on invertebrates where predictions on the suitable habitats are based upon remote sensing data on vegetation important for habitat selection. BOND et al. (2006) apply RS for trapdoor spider of genus *Apomastus* and LUOTO et al. (2002) use it for studies of clouded apollo (*Parnassius mnemosyne* L.).

It may look like entomological and ornithological studies are compatible, however, the equal percentage gained is due to the dominant role of pest control management investigations over purely scientific research. The relatively low number of spatial analyses dealing with insects (11%; Fig. 3) reflects the situation established via search within studies from a broad range of scientific fields. It is indicative of these important animals being neglected from the GIS-analyses. In fact many entomological research employed GIS for mapping study localities because they offer a simple way for precise identification of the sampling area. The constraints in using GIS-spatial analyses are perhaps in some peculiars of the group outlined in the Rationale of research part. The identification of an insect species' habitat borders is not always a simple task. It requires tremendous autecological investigations, details on population dynamics, understanding of ecological requirements, etc. Those are very time consuming tasks and not always economically viable. However, the great natural role that these animals have in life of the earth, their economic importance and high social impact over entire planet oblige us to intensify the GIS-spatial analyses and bring the entomological studies to a higher level. Below the approach selected for analysing dragonfly habitats within the study area in the Pacific as outlined above is described.

METHODOLOGY FOR GIS-SPATIAL ANALYSIS OF ODONATA HABITATS WITHIN THE PACIFIC REGION

In the present study a special note is made regarding what should be considered as Odonata habitat. This is necessary because the generally accepted opinion that a water body itself forms the main part of the living environment for odonates must be thoroughly revised. CORBET (1999) deals specifically with this topic and the number of studies emphasising the importance of the surrounding wetland, grass, shrub and forest vegetation is continuously growing. Recent introduction of the telemetric technique in studying dragonfly diurnal behaviour supported the view that a *habitat* in the Odonata sense is much broader than would normally accept. Water constitutes the most important environment for the larvae, however airborne adults spend great part of their life away from it returning to the wetland's edge mainly for reproducing. HARDERSEN (2007) established that adult *Libellula fulva* Müller, 1764 spend at least 92.5% of their life high among the trees and out of reach of the human's sight.

An Odonata habitat may occupy areas of two bordering biotopes. As stated above it is the surface that plays important role in an individual's life and support it during maturation period, feeding, roosting, migrating and reproducing behaviour. All landscape features combined with climatic variables that an individual requires for its survival contribute to the viability of the whole population which sustains the species' survival. Those requirements are met at various distances from the water's edge which depend upon the vegetation cover, local topography and climatic situation. That is why working with a single unit (wetland and its surroundings) would establish various sizes and surface inhabiting areas compare to other areas that appear similar in general appearance. Those inhabiting areas are identified by the number of localities for a particular species established during the field studies. They must be precisely measured and mapped which is now well facilitated with the modern technologies of Global Positioning Systems (GPS). Details on species' distribution must be linked to the estimations of population size and the local climatic situation.

In the lack of population investigation over the selected study region within the Pacific, limited data on the precise species localities, non-uniformity in the GIS and climatic data, a new approach is necessary in order to build predictive habitat models for odonates. MIEHLE et al. (2006) specifically point out that when working with limited support from the input and validation data the prediction accuracy of the model may be overestimated. Moreover any range map reflects the extent of occurrence of species and not necessarily the area of occupancy (HABIB et al., 2003). These maps could be confounded by the lack of distribution data because potential habitable areas simply may not have been sufficiently studied yet (ANDERSON, 2003).

GUISAN & ZIMMERMANN's (2000) suggestion for constructing models

directly into a GIS environment seems most applicable for the present study. It is designed to work with the scarce data on individual species biology and ecology (ISBE) in order to establish the landscape features important in habitat choice for dragonflies. The study method is also limited by the large size of the area. Species with low ecological plasticity that occupy vast regions must be included in this general scheme with caution. Constructing statistical models for a whole region is not recommended as often models are not transferable between areas because they tend to reflect dominant landscape feature with local importance only (BAMFORD et al., 2009). When applied to the same species in other areas, different features might be highlighted as having greater significance. However, model building for smaller easily manageable units is another great constrain because this makes research financially very difficult.

For this project, the model building will be performed in the raster mode. It will employ land cover spatial data and assign different values to the various raster cells depending on the established significance of ground features (e.g. water bodies, vegetation types, elevation, etc.) and their distance from a local primary wetland. The values will be derived based on the ISBE. Some explanations of the land cover data sets that are considered crucial for the spatial analysis are provided below.

- SURFACE WATERS. – Dragonfly species have an aquatic stage in their life-cycle and that is why the information on the surface waters and their limnology is a priority in this scheme.
- AQUATIC AND TERRESTRIAL VEGETATION. – Both types are considered of very high importance as elements of the Odonata habitats. Even if the larvae are not so dependent on the fresh/saline macrophytes, the imago almost certainly would need vegetation at definite distance around the wetlands. Multiple conversions and reclassifications must be made on the land-cover shape-files in order to incorporate the different vegetation types into the spatial analysis. Plants will be classified in the following way: freshwater, saline, grasses, bushes and forests.
- LAND USE. – Farms will be excluded from the analysis although some species have been reported from water bodies within the arable land (CUMBER, 1962; CUMBER & EYLES, 1961). The reason for this is that the status of every land use unit must be checked out individually in order to obtain a reliable picture. Farmers differ in their preferences towards their land and attitude to the wetlands. Intensive land utilisation is not favourable for the species and in spite of the occasionally observed insects, those territories are abandoned in terms of aquatic life forms. Moreover the ownership might be shifted in the near future and the model will then be wrong for those particular places.
- URBAN AREAS. – The urban environment is not fully supportive for Odonata habitat development. However, the amenity value of the green territories within a city's borders is highly appreciated by the inhabitants and some species might

accomplish their life-cycles in the wetlands available. FERGUSON (1982) reports on larvae of *Xanthocnemis zealandica* (McLachlan) and *Austrolestes colensonis* (White) during a limnological study at Hagley Park, Christchurch, New Zealand. For this reason rivers and stagnant waters that intersect with urban areas will deliberately be reclassified and included in the analysis.

– SLOPE. – This is an important characteristic of the landscape. Dragonfly larvae cannot withstand the fast water current of the rivers running down highly elevated slopes. The Digital Elevation Model (DEM) (where available for the countries) will be reclassified in order to exclude parts of the terrain with higher than 20 degree inclination. Five classes will be justified according to the scheme in Table I.

Table I
Five slope classes established for the habitat modelling scheme

Slope class	Value	Description
1	0	slope > 20 degrees
2	1	20 degrees > slope > 15 degrees
3	2	15 degrees > slope > 10 degrees
4	3	10 degrees > slope > 5 degrees
5	4	5 degrees > slope > 0 degrees

– ALTITUDE. – Species differ in their adaptation to certain elevations. Dragonflies are known as being warm-adapted, however some species have developed high preferences towards harsh conditions of high altitudes. Considering the limits of individual species distribution in the vertical direction is compulsory for every study of a similar character. At this stage, having in mind the insufficient information on the vertical distribution, the species classification must be done based on the data on the species' localities. Some presumptions must be made for each species individually and only records on surely/possibly breeding species incorporated. For this purpose the autochthony classification scheme (described above) will be followed.

– INDURATION. – This is another important characteristic of the terrain dealing with how "hard" or compact the soil is due to its physical properties. Soils with high induration levels are more likely to support open water bodies and not permit the water to be drained out. Five induration classes will be established (where GIS data available) according to Table II.

Table II
Five induration classes established for the habitat modelling scheme

Induration class	Value	Description
1	0	non-indurated
2	1	very weakly indurated
3	2	weakly indurated
4	3	strongly indurated
5	4	very strongly indurated

– SPECIES BIOLOGY. – Individual Species Biology and Ecology (ISBE) will be assessed upon the information given in the literature sources. According to this information the zones around the wetlands will be classified into three classes: highest importance for breeding (value of 3), moderate importance (value of

2) and low importance (value of 1). Those values correspond with the three classes of autochthony identified in the methodology above. More weight on some specific land features important as habitat clues for species will be put where necessary.

Habitat models have already been built and tested for the New Zealand situation (results will be published separately). They followed the generalized scheme displayed on Figure 4 which will be applied with slight modification for the entire study region within the Pacific. It shows the final processes in the spatial analysis for an imaginary species that develops mainly in freshwaters (rivers and saline waters are of secondary importance), needs aquatic vegetation, and during its maturation, mate search, or foraging uses grasses situated at certain distance from the wetlands. Final habitat models will represent the territories of the Pacific countries with four classes of importance (marked with different colours):

- ✓ no importance – areas that do not contain any land features of interest for the species and which odonates are unlikely to choose for any type of activity;
- ✓ low importance – areas distant from the main water source, but falling within the buffer zone considered as important for the species during its maturation period or migration;
- ✓ moderate importance – areas closer to wetlands which are usually used by species on a more regular basis during their daily activities such as foraging, mate searching, hiding in bad weather, maturation, or nocturnal roosting; and
- ✓ high importance – areas that are of particular importance for larvae development, ovipositing, mating, or territory defense.

These models are believed to reveal the areas from the local landscape where the species ecological requirements are met/approached and highlight them as potential important habitat. There are, however, some drawbacks of this approach. Indirect parameters (such as slope and elevation) could only be applied with certainty within a limited geographical extent because predictive variables vary along topographical gradients (GUISAN & ZIMMERMANN, 2000). The model predictions will not be linked to the climatic situation. This is deliberately avoided due to the lack of precise data on species distribution. Any modelling based on the scarce information is deemed to be impractical for future management. The proposed modelling scheme is for rapid ecological assessment over the entire region. It will screen the investigated area and is believed to highlight the regions for future investigations. Intensified observations could then be related to local environmental variables and incorporated in static environmental modelling that will give a better understanding of the habitat distribution within the research areas. Such an approach has been suggested by CARRIERE et al. (2006) because local models cannot fit within the global scale picture and results based on this research lead to imprecise predictions.

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J.W. GOETHES *WASSERPAPILLON*: GESCHICHTE EINES LIBELLENGEDICHTES

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J.W. GOETHE'S *WASSERPAPILLON*: THE HISTORY OF A DRAGONFLY POEM – In 1770 the young Johann Wolfgang (von) Goethe (1749-1832), the German poet, universally acknowledged to be one of the giants of world literature, published his earliest poems, among which '*Die Freuden*' refers to Odonata. As a metaphor, Goethe's poem depicts the irritating flight pattern as well as the changing reflections of body and wing colour of *Calopteryx* damselflies. The text of this poem is near to plagiarism, for it is but an abridged translation of the French poem '*Le plaisir et le papillon*' by A.M.H. Blin de Sainmore, published in 1764. Goethe substitutes a damselfly, a "Wasserpapillon", for the butterfly of the French poem. Some linguistic aspects of the term "Wasserpapillon" are discussed.

EINLEITUNG

Es gibt nicht viele Schriftsteller, denen Insekten so viel bedeuten, dass sie in ihren poetischen Werken über bloße Erwähnung hinaus auftauchen oder gar ihre Sammelobjekte sind. Hermann Hesse sammelte leidenschaftlich Schmetterlinge. Er reiste unter anderem wegen der Schmetterlinge nach Asien und schrieb zusammen mit dem bedeutenden schweizerischen Biologen Adolf Portmann ein Buch über die Schönheit der Schmetterlinge (PORTMANN & HESSE, 1935). Auch Vladimir Nabokov war eminenter Schmetterlingskenner, Spezialist für die Familie der Lycaeniden (ZIMMER, 1996; BOYD & PYLE, 1999). Ernst Jünger ist als Spezialist für Käfer, insbesondere die Cicindeliden, weltbekannt und ließ seine Leidenschaft für Entomologie in ‚*Subtile Jagden*' einfließen (JÜNGER, 1980). Nach meiner Kenntnis hat sich kein einziger Poet so intensiv den Libellen gewidmet, aber immerhin erschienen im Lauf der letzten 250 Jahre mehrere Gedichte, in denen Libellen erwähnt werden, darunter auch eines von Goethe (RUDOLPH, 1992). Im Oktober 1979 fand im Landesmuseum für Naturkunde

in Münster die erste Zusammenkunft westdeutscher Libellenkundler statt, deren Teilnehmer beschlossen, es solle eine Zeitschrift mit dem Namen *Libellula* herausgegeben werden. Als ich damals das erste Heft der *Libellula* herstellte, erinnerte ich mich, Jahre zuvor das Libellengedicht ‚*Die Freuden*' von Goethe gelesen zu haben – ein Zitat aus diesem Gedicht wollte ich als Motto auf dem ersten Heft der *Libellula* abdrucken. Einer der Großen, Goethe, teilte offenbar unsere Libellenleidenschaft! Damals bemerkte ich bei der Suche nach dem Text dieses Gedichtes mit dem Titel ‚*Die Freuden*', dass mehrere Varianten existieren.

DIE ERSTE GEDICHTFASSUNG UND IHR ANLASS

‚*Die Freuden*' ist eines der frühesten Gedichte Goethes, geschrieben während seines Aufenthaltes in Leipzig zum Jurastudium, das er im Alter von 16 Jahren im Oktober 1765 begann und an seinem 19. Geburtstag im August 1768 abbrach. Das genaue Entstehungsdatum des Gedichtes ist allerdings nicht bekannt, kann aber nur im Zeitraum kurz nach seinem 17. bis kurz nach seinem 18. Geburtstag liegen. Noch heute ist in der Universitätsbibliothek Leipzig das handgeschriebene Exemplar des Libellengedichtes vorhanden, welches der 18jährige Goethe Anfang August 1768 zusammen mit einigen anderen Frühgedichten unter dem Sammeltitel ‚*Lieder mit Melodien Mademoiselle Friederiken Oeser gewidmet von Goethen*' seiner Freundin Friederike Oeser überreichte. Goethes Freund Bernhard Theodor Breitkopf hatte diese Gedichte vertont, von daher ist der Titel ‚*Lieder mit Melodien*' verständlich. Friederike Oeser war die Tochter von Goethes Zeichenlehrer in Leipzig, Kurfürstlicher Hofmaler und Professor Adam Oeser. Die Gedichtsammlung mit dem Libellengedicht war ein Abschiedsgeschenk für Friederike Oeser, denn am 28. August 1768, seinem 19. Geburtstag, reiste Goethe wegen Krankheit und ohne Juraexamen aus Leipzig ab und kehrte nach Frankfurt/Main in sein Elternhaus zurück. Details dazu, auch dass von den Gedichten ‚ein Theil das Unglück gehabt hat' (Goethe), der Mademoiselle zu missfallen, wissen wir aus der umfassend archivierten Korrespondenz (JAHN, 1849; RICHTER & KURSCHEIDT, 2008) des jungen Dichters mit Friederike Oeser, Bernhard Theodor Breitkopf und etlichen anderen Leipziger Personen.

Der Urtext von ‚*Die Freuden*' in dem Manuskript für Friederike Oeser sei hier als Kuriosum in der originalen Schreibweise wiedergegeben:

DIE FREUDEN

Da flattert um die Quelle
die wechßelnde Libelle,
der Waßer Papillon,
bald dunckel und bald helle,
wie ein Camäleon.
Bald roth und blau, bald blau und grün,
O daß ich in der Nähe
doch seine Farben sähe!
Da fliegt der Kleine vor mir hin,
und sezt sich auf die stillen Weiden.
Da hab ich ihn! da hab ich ihn!
Und nun betracht ich ihn genau,
und seh ein traurig dunckles blau.
So geht es dir Zergliedrer deiner Freuden.

Als der 18jährige Goethe im August 1768 die Gedichtsammlung an Friederike Oeser gab, hatte er sich drei Monate vorher von seiner ersten Freundin getrennt, die er als 16jähriger kennengelernt hatte, nämlich Anna Katharina („Kätchen") Schönkopf aus Leipzig (FISCHER-LAMBERG & GRUMACH, 1999). Ihr hatte er ebenfalls eine handschriftliche Sammlung anderer Gedichte verehrt, heute als ‚*Buch Annette*' bekannt, aber anders als die ‚*Neuen Lieder ...*' nicht eigenständig gedruckt. Diese aus der Sicht des alten Dichters problematische Trennung (GOETHE, 1814a) schlägt sich nach Meinung der Kommentatoren in einigen Leipziger Frühgedichten erkennbar nieder. Auch in der zweiten Hälfte des Libellengedichtes könnte man, so meine ich, mit etwas Zynismus eine Begründung für die Trennung des jungen Goethe von Kätchen Schönkopf orten, sei sie erst geplant oder schon vollzogen (wir kennen ja nicht das genaue Entstehungsdatum des Libellengedichtes). Für den jugendlichen Dichter ist die Libelle, der Wasserpapillon, in ihrer Färbung mehr Schein als Sein – vielleicht erlebte er Kätchen Schönkopf in derselben Weise. Trifft mein Gefühl zu, dann passen in jene Situation maßgeschneidert diese Zeilen aus seinem Gedicht ‚*Unbeständigkeit*', das der 17jährige in derselben Zeit schrieb und zusammen mit dem Libellengedicht in ‚*Neue Lieder ...*' (BREITKOPF, 1770) publizierte: ‚*Es küßt sich so süße der Busen der zweiten, als kaum sich der Busen der ersten geküßt*'. Dieses Gedicht hat er übrigens – ebenso wie sein Libellengedicht – im späten Alter für seine Werkeausgabe letzter Hand (GOETHE, 1827) verändert: diese beiden zitierten Zeilen textlich entschärft und das Gedicht in ‚*Wechsel*' umbenannt. Es sei einmal die Formulierung erlaubt, dass Goethe über sein langes Leben hin ja ausgesprochen „polygam" war.

ERSTE VERÖFFENTLICHUNGEN

Bernhard Theodor Breitkopf, Sohn des schon damals auf Musikalien spezialisierten Verlagshauses Breitkopf in Leipzig (später: Breitkopf & Härtel), ließ ‚*Die Freuden*' auch an das Licht der Öffentlichkeit gelangen. Er produzierte im elterlichen Verlag einen Band mit dem Titel ‚*Neue Lieder in Melodien gesetzt von Bernhard Theodor Breitkopf*' mit der an Friederike Oeser überreichten Gedichtsammlung und einigen weiteren Frühgedichten, aber ohne Nennung von Goethes Autorschaft (BREITKOPF, 1770). Das Impressum dieses Bandes gibt zwar als Erscheinungsjahr 1770 an, Briefe Goethes und andere Quellen belegen aber das Vorhandensein des Buches ‚*Neue Lieder. ...*' schon im Oktober 1769. So kommt es zu unterschiedlichen Angaben zum Erstveröffentlichungsdatum des Libellengedichtes. Diese Veröffentlichung war zwischen Goethe und Breitkopf abgesprochen, es ist allerdings nicht feststellbar, ob die Gedichte mit Goethes Wissen ohne seine Namensnennung gedruckt werden sollten, was übrigens damals nicht ungewöhnlich war. Gewiss war der junge Goethe von seiner ersten Publikation geschmeichelt, wenngleich sie ohne seinen Namen erschien. Zeitgenössische Kommentare und ein vermutlicher Raubdruck mit Nennung von Goethes Namen (siehe unten) zeigen, dass in Leipzig bald jeder von der Autorschaft Goethes wusste. In seiner Korrespondenz kündigte er das Buch jedenfalls im Voraus an und beklagte sich über die Verzögerung des Erscheinens (JAHN, 1849; RICHTER & KURSCHEIDT, 2008). Bis heute ist diese erste publizierte Gedichtsammlung Goethes mit dem Libellengedicht, in der Sekundärliteratur oft ‚*Leipziger Liederbuch*' genannt, von mehreren Verlagen als Faksimile reproduziert worden (Insel Verlag 1906; Xenien Verlag 1913; Breitkopf und Härtel Verlag 1932).

Gegenüber der handschriftlichen Urfassung des Libellengedichtes von 1768 enthält der Erstdruck von 1770 nur eine auffallende Änderung: das im Manuskript so emphatische doppelte „Da hab ich ihn! Da hab ich ihn!" ist nur einmal gedruckt, baut also weniger Erwartungsspannung auf. Ob diese Änderung von Goethe oder Breitkopf stammt, ist nicht feststellbar. Diese erste Druckfassung des Libellengedichtes erschien sechs Jahre später ein zweites Mal, diesmal mit Goethes Namen, nämlich in dem von Christian Heinrich Schmid herausgegebenen ‚*Almanach der deutschen Musen auf das Jahr 1776*' (SCHMID, 1776, S. 110). Vermutlich ist dies ein Raubdruck, jedenfalls war der Almanach damals als Raubdruckmagazin bekannt, und aus Goethes Korrespondenz lässt sich seine Veranlassung dieses Druckes nicht nachweisen. Ein drittes Mal erschien diese frühe Form des Libellengedichtes weitere 11 Jahre später von Goethe selbst publiziert in seinen ‚*Schriften*' (GOETHE, 1787).

DIE LETZTE GEDICHTFASSUNG

Von allen weiteren Veröffentlichungen ist für uns nur noch die Fassung unter dem jetzt singularischen Titel ‚*Die Freude*' im letzten von Goethe selbst besorgten Druck von 1827 bedeutsam, also in seiner Werkeausgabe letzter Hand (GOETHE, 1827, S.62), denn sie zeigt im Text plötzlich eine erhebliche Evolutionsklimax. Sie sei deshalb als auffallender Kontrast zur frühen Fassung zitiert, wiederum in der Schreibweise und Formatierung des alten Druckes:

DIE FREUDE

Es flattert um die Quelle
die wechselnde Libelle,
mich freut sie lange schon;
bald dunkel und bald helle,
wie der Chamäleon,
bald roth, bald blau,
bald blau, bald grün;
O daß ich in der Nähe
doch ihre Farben sähe!

Sie schwirrt und schwebet, rastet nie!
Doch still, sie setzt sich an die Weiden.
Da hab' ich sie! Da hab' ich sie!
Und nun betracht' ich sie genau,
und seh' ein traurig dunkles Blau -

So geht es dir, Zergliedrer deiner Freuden!

Als Motto für den Einband von *Libellula* 1(1) wählte ich damals die ersten drei Zeilen dieser letzten autorisierten Fassung von 1827, weil mir ihr emotionales „mich freut sie lange schon" passender als das neutrale „der Wasserpapillon" aus der Urfassung erschien. In dieser letzten Fassung gibt es neben mehreren geringfügigen Wortänderungen („Es" statt „Da", „an" statt „auf", „sie" statt „ihn" usw.) aber auch einige bedeutende Textänderungen. Der „Wasserpapillon" wird durch „mich freut sie lange schon" ersetzt, wodurch es klarer wird, worin ‚Die Freude' des Titels konkret besteht: es sind unsere Libellen! Daneben finden wir in dem „Da hab' ich sie! Da hab' ich sie!" die erwartungsvoll-emphatische, ja triumphierende Verdoppelung wiederhergestellt. Die Verdoppelung lässt die folgende Enttäuschung um so dramatischer erscheinen, die in der mahnenden letzten Zeile gipfelt, welche vom übrigen Textkörper abgesetzt wird und durch dieses formale Stilmittel ebenfalls mehr Gewicht erhält. Ganz neu ist die Zeile „Sie schwirrt und schwebet, rastet nie", die zweifellos mehr über das Libellenverhalten aussagt und als subtile Umschreibung des schwierigen Fanges viel mehr Spannung aufbaut

als das simple „Da fliegt der Kleine vor mir hin“ in der frühen Fassung. Man erkennt: Goethe hat sich im Laufe von rund 60 Jahren eingehend mit seinem Libellengedicht beschäftigt. In modernen Goethe-Ausgaben, in Sekundärliteratur und populärer Literatur findet man vorwiegend diese letzte Fassung, außerdem nicht von Goethe stammende Gemische aus beiden Versionen, Verstümmelungen (siehe folgenden Abschnitt), ja sogar eine Zuschreibung dieses Gedichtes an Heinrich Heine.

‚*DIE FREUDEN*‘ – FAST EIN PLAGIAT

Ausgerechnet das Libellengedicht unter den Frühgedichten muss besonders häufig zu philosophierenden Auslegungen in der Sekundärliteratur herhalten. Den Gipfel stellt ein Buch von MACKENTHUN (2000) dar, in dem „Goethe als Psychologe“ (Zitat) analysiert und in abstrusem Maß hochstilisiert wird – und das auf der Basis dieses Libellengedichtes, mit dem ein 18jähriger Student seine Angebetete beeindrucken wollte, der das Gedicht noch nicht einmal gefiel. Bei MACKENTHUN (2000) ist übrigens das Libellengedicht erheblich verfälscht wiedergegeben und Goethes Alter bei Abfassung des Gedichtes unrichtig angegeben. Die extrem gewichtige Auslegung des Libellengedichtes durch Mackenthun wertet man sofort gebührend ab, sobald man die folgenden Aspekte kennt, zu denen mich der „*Papillon*“ in der ersten Gedichtversion führte. Im Goethe-Jahrbuch 1894 (GEIGER & GOETHE-GESELLSCHAFT WEIMAR, 1894, S. 342) fand ich einen kurzen Hinweis auf einen Aufsatz von STRACK (1893), worin „zwei französische Vorbilder“ für Goethes Leipziger Liederbuch erwähnt seien. Details bei STRACK (1893) führten mich weiter zu ‚*L'Élite de poésies fugitives*‘ (BLIN DE SAINMORE, 1764), eine zunächst dreibändige Anthologie von Gedichten damals populärer Schriftsteller. Dieses Werk nahm ich mir vor, stieß im zweiten Band auf das Gedicht ‚*Le plaisir et le papillon*‘ von Blin de Sainmore und kann nach dessen Lektüre konstatieren: Die Freuden des Studenten Goethe sind in Wirklichkeit alles andere als eigene Emotion, sondern nur eine freie und stark verkürzte Übersetzung des langen französischen Vorbildgedichtes ‚*Le plaisir et le papillon*‘. Goethe sprach und korrespondierte ja schon als Jugendlicher französisch. Diese Anthologie ‚*L'Élite de poésies fugitives*‘ war damals sehr populär. Sie erschien im seinerzeit erfolgreichsten französischen Verlag des Charles Joseph Panckoucke, erlebte mehrere, später um einige Bände erweiterte Auflagen und wurde sofort nach Erscheinen in zwei deutschen Zeitschriften lobend rezensiert, nämlich in ‚*Neue Bibliothek der schönen Wissenschaften und freyen Künste*‘ 1, 1765, S. 183, und in ‚*Göttingische Anzeigen von gelehrten Sachen*‘ 1765, 18. Stück, S. 137. Diese Rezensionen fand ich durch Zufall in einem vollkommen anderen Zusammenhang, als ich nämlich in diesen und ähnlichen alten deutschen „Intelligenzblättern“ nach möglichen Ankündigungen des Libellenbilder enthaltenden Buches ‚*An exposition of British insects*‘ von Moses Harris suchte (in den *Göt-*

tingischen Anzeigen übrigens erfolgreich). Die erste dieser beiden Rezensionen beantwortete auch gleichzeitig die Frage, wie der sehr junge Jurastudent Goethe vom Vorbildgedicht ‚*Le plaisir et le papillon*' überhaupt Kenntnis erhalten konnte. Die Antwort ergab sich nämlich mit meiner Feststellung, dass die ‚*Neue Bibliothek der schönen Wissenschaften und freyen Künste*' in Goethes Wohnort Leipzig erschien und wer der Herausgeber war, nämlich der Leipziger Literat und „Hofrath" Christian Felix Weisse, der vermutlich persönlich die anonym gedruckte Rezension von ‚*L'Élite ...*' in seiner Zeitschrift geschrieben hat (ANONYM, 1765). In dessen Kreis verkehrte bekanntlich der Student Goethe, der – obgleich Zugereister und schriftstellerisch noch völlig unbekannt – als von seinem sehr wohlhabenden Vater her finanziell exzellent ausgestatteter junger Mann und versehen mit Empfehlungsschreiben von Honoratioren seiner Heimatstadt Frankfurt doch sofort in die Leipziger high society aus herzoglichen „Hofräthen", „wirklichen Geheimen Räthen", Kammerherren und Professoren gelangte. Es lässt sich sogar zeigen, dass der Student Goethe von diesem Christian Felix Weisse geschriebene Gedichte ebenfalls als Vorbilder für seine eigenen Frühdichtungen nahm, um nicht zu sagen: sie imitierte (JAHN, 1849; BIEDERMANN, 1865). Das enge Verhältnis von Goethe zu Weisse war offenbar auffallend, und JAHN (1849, S. 14) charakterisiert es sogar als „dauernde Anhänglichkeit". Man darf also annehmen, dass Weisse mit seinem Goethe einschließenden Kreis über die Gedichte in ‚*L'Élite ...*' diskutiert hat und dass sowohl das Leipziger Rezensionsorgan ‚*Neue Bibliothek der schönen Wissenschaften ...*' als auch die Anthologie mit ‚*Le plaisir et le papillon*' selber dem Jungdichter in der Bibliothek seines Vorbildes und Mentors Weisse zur Verfügung gestanden haben. Da war der Student Goethe 17 Jahre alt.

Die vielen Anleihen des Dichterfürsten bei fremden Dichtungen, bis hin zu ungenierten Plagiaten, sind oft kommentiert worden. In unserem Zusammenhang sei nur kurz ein Kommentar (DAINAT, 2004) zu einem bestimmten Plagiat erwähnt, weil Goethe es als Naturphilosoph beging, nämlich das ‚*Fragment über die Natur*', sowie auf den eklatanten, seit etwa 1860 bekannten Fall im ‚*West-oestlichen Divan*', worin der inzwischen geadelte Goethe einige von seiner Freundin Marianne von Willemer geschriebene Gedichte als eigene ausgab (UNSELD, 1998). Der alte Goethe, der übrigens immer entschieden „den Unfug der Pressefreiheit" (Goethe) bekämpft hatte, verurteilte einerseits das damals übliche und ihn finanziell schädigende Raubdruckwesen (GOETHE, 1814b), verteidigte andererseits aber nachdrücklich seine zeitlebens verfolgte eigene Maxime „Nur durch Aneignung fremder Schätze entsteht ein Großes" (Goethe); fremde Dichtung sei Allgemeingut, über das ein Goethe beliebig verfügen könne (GRUMACH, 1959; BURKHARDT, 1870) – und an diese Maxime hielt sich, wie wir sehen, konsequent schon der junge Goethe mit seinem Libellengedicht ‚*Die Freuden*'. Als Akzent auf allem darf keineswegs unerwähnt bleiben, dass Goethe unmittelbar nach Erscheinen des Libellengedichtes in ‚*Neue Lieder ...*' (BREITKOPF, 1770)

in einem Brief an seinen Leipziger Freund Ernst Theodor Langer (RICHTER & KURSCHEIDT, 2008) ausdrücklich versicherte, diese Gedichte seien „nicht ein Strich Nachahmung“ (Goethe). Das Gegenteil trifft zu, und man dürfte also die keineswegs genuin Goetheschen Libellenfreuden eigentlich nicht derart gewichtig als überragendes Psychologentum eines 17 oder 18 Jahre jungen Studenten interpretieren, wie es bei MACKENTHUN (2000) geschieht.

VERSUCH EINER ARTBESTIMMUNG

Man neigt dazu, die „wechßelnde Libelle“, den „Waßer Papillon“, als eine unserer Prachtlibellenarten, also *Calopteryx*, anzusehen. Deren Flug mutet ja oft schmetterlingshaft an. Dafür sprechen „Papillon“, „dunckles blau“, das sich auf Flügel- und Körperfarbe der Männchen beziehen mag, und „grün“. Dagegen spricht das „roth“. Immerhin kann das Grün alter Prachtlibellenweibchen bronzerötlich überhaucht sein. Jedenfalls hat der spätere Verfasser einer Farbenlehre das Changieren der Prachtlibellenfärbung sehr genau bemerkt. Einen Hinweis darauf, ob Goethe bei der letzten Überarbeitung seines Gedichtes 1827 den von LEACH (1815) geprägten wissenschaftlichen Namen *Calopteryx* für die Prachtlibellen kannte, habe ich nicht gefunden. Natürlich wäre ihm, der selbstverständlich Latein, Griechisch und Hebräisch gelernt hatte, die Bedeutung *Calopteryx* = Schönflügel bewusst gewesen, doch das hätte ihn Wortlaut und Moral des Gedichtes wohl nicht weiter verändern lassen. Schon die Urfassung drückt ja aus, in der Ferne erscheine der Wasserpapillon als Schönflügel; erst nah in der Hand des Fängers werde die Farbe „traurig“. Goethe wird spezielle libellenkundliche Literatur, etwa den nomenklatorischen Aufsatz von LEACH (1815), nicht gekannt haben, denn er war vor allem Botaniker, weniger Zoologe und, abgesehen von seinem kurzzeitigen Interesse an der Metamorphose der Schmetterlinge, Insektenkundler überhaupt nicht. Publiziert hat er bekanntlich nichts Entomologisches. Sein Aufsatz ‚*Blumenmalerei*‘ (GOETHE, 1818) zeigt, dass er zwar die Bücher der Maria Sibylla Merian sehr schätzte und, ausgehend von seinem Metamorphoseinteresse, intensiv studiert hatte, allerdings ihre botanischen Aspekte viel höher wertete als die entomologischen. Sein geringes entomologisches Interesse dokumentiert sich auch darin, dass er – ansonsten ein geradezu exzessiver Sammler! – zwar eine aus seiner Jugend stammende Insektensammlung besaß (damals normales Bildungsgut), die aber nur 235 Exemplare umfasste, darunter keine Libellen (MAUL, 1999; LEVINSON & LEVINSON, 2001), wovon ein Rest noch heute in Weimar aufbewahrt wird.

Den französischen „papillon“ metamorphosierte Goethe einfach zu „Waßer Papillon“, vielleicht damit sein Rückgriff auf ‚*Le plaisir et le papillon*‘ nicht zu offensichtlich sei. Im französischen Vorbildgedicht ist von einem wirklichen Schmetterling die Rede, der durch Anfassen seine Flügelfärbung verliert und dann traurig unscheinbar aussieht. Der uns Heutigen nicht geläufige Begriff „Wasserpapillon“

für Libelle, den er aus der späten Gedichtfassung wieder herausnahm, könnte auf den ersten Blick eine Neuschöpfung Goethes sein, ist es aber wahrscheinlich nicht. Mir gelang ein Nachweis dieses Wortes außerhalb der Frühfassung des Goethe-Gedichtes nicht früher als in dem 26 Jahre später erschienenen ‚*Grammatisch-kritischen Wörterbuch ...*' von ADELUNG (1796), und hier geringfügig zu „Wasserpapilion" verändert. In diesem Wörterbuch von ADELUNG (1796, Band 2, S. 331) ist das Schlagwort „Frühlingsfliege" erläutert durch die Begriffe „Wasserpapilion" und „Afterschmetterling", wobei letzteres den Wasserpapilion seinerseits klar als Köcherfliege identifiziert, was der Zusatz „Engl. Cadew" noch unterstreicht (cadew = altes Englisch für Köcherfliege). Das damals gängige Präfix „After..." (im alten Deutsch oft mit Doppel-f geschrieben) bedeutete früher wie heute ja „falsch" oder „unecht" (siehe dazu: FRISCH, 1741). Hier sei an den altertümlichen Begriff „Afterjungfer" für die mit echten Jungfern, also Libellen, zu verwechselnde Imago des Ameisenlöwen erinnert. Der bei ADELUNG (1796) unter „Frühlingsfliege" hinzugefügte Verweis auf das Schlagwort „Wassermotte", in dessen Erläuterung noch einmal „Wasserpapilion" und sogar der rund 40 Jahre früher von Linné geprägte wissenschaftliche Name *Phryganea* erscheinen, bestätigt noch einmal die Identität von Wasserpapillon/Wasserpapilion mit Köcherfliege. Jedenfalls lässt mich diese konkrete lexikalische Erläuterung Wasserpapilion = Afterschmetterling = Köcherfliege nicht an eine Erfindung des Wortes Wasserpapillon durch Goethe glauben. Geübte Philologen dürften den Wasserpapillon/Wasserpapilion also schon vor Goethe nachweisen können. Der auch naturwissenschaftlich hervorragend gebildete junge Goethe hat die Bedeutung von Wasserpapillon = Köcherfliege unzweifelhaft gekannt, sie aber in dichterischer Freiheit und, wie Christian Morgenstern es einmal ausgedrückt hat, sozusagen „um des Reimes willen" auf Libelle ausgeweitet. Ob er Jahrzehnte später den Begriff Wasserpapillon aus dem Gedichttext entfernte, weil er ja gerade nicht eine farbenfrohe Libelle, sondern eine bescheiden bräunliche Köcherfliege bedeutet? Übrigens gibt es weder „Wasserpapillon" noch „Wasserpapilion" als Schlagworte im ‚*Deutschen Wörterbuch*' von GRIMM & GRIMM (1854). Darin finden sich nur unter dem Schlagwort „Libelle" die drei Anfangszeilen von Goethes Gedicht in seiner ersten Version mit „Wasserpapillon" kommentarlos zitiert.

EINE SCHLUSSFOLGERUNG

Goethes ‚*Die Freuden*' ist zwar das erste deutsche Gedicht, in dem nicht einfach nur das Wort Libelle, Wasserjungfer oder ein ähnlicher Begriff vorkommt, sondern das etwas mehr Bezug zu dem Insekt hat, aber die gelegentlich so hoch gewertete moralisierende Aussage des Gedichtes ist keineswegs Goethes eigenes Werk. Vermutlich hätte die Gesellschaft deutschsprachiger Odonatologen den Naturwissenschaftler Goethe nicht als Mitglied gewinnen können, denn für Entomologie oder gar Libellen im Besonderen zeigte er kein tieferes Interesse. Li-

bellen waren nur einmaliger Inhalt eines nach einem französischen Vorbild mehr übersetzten als selbst verfassten Gedichtes des sehr jungen Goethe, das genau betrachtet auch nicht einmal ein Gedicht über eine Libelle ist. Die Prachtlibelle ist ja nicht Topos dieses Gedichtes, sondern nur eine Metapher, und zwar im ursprünglichen, buchstäblich klassischen Sinn des Erfinders dieses Begriffes (und Tierkundlers) Aristoteles, also mit Täuschung, Überraschung und Abweichung von einer Erwartung.

DANKSAGUNG

Seit etwa fünfunddreißig Jahren führte ich mit BASTIAAN KIAUTA und MARIANNE KIAUTA viele lange Gespräche über Libellen auch außerhalb der Biologie. An diese immer fruchtbaren Unterhaltungen erinnere ich mich mit hoher Wertschätzung.

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THE NUMBER OF EGGS DEVELOPED IN THE OVARIES OF THE DRAGONFLY *SYMPETRUM INFUSCATUM* (SELYS) IN RELATION TO DAILY FOOD INTAKE IN FOREST GAPS (ANISOPTERA: LIBELLULIDAE)

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Daily food intake of *S. infuscatum* was estimated using the quantity of faeces produced. Dry weight of faeces excreted during 24 h after capture was measured for each sex of both sexually immature and mature stages. The grain-like faeces (faecal pellets) contained many fragments of cuticle of prey insects. In the laboratory, there was a relationship between the amount of daily faeces excreted and the quantity of daily food intake. Although both sexes excreted a similar amount of faeces in the immature stages, mature ♀♀ had greater faecal weight than ♂♂, suggesting that ♀♀ fed on more prey than ♂♂. The estimated daily dry weight of prey insects was about 17.7 mg in ♀♀. The relationship between the number of mature eggs in the ovaries and the quantity of food intake indicated that about 8 days were needed to accumulate enough mature eggs in the ovaries to lay in rice paddy fields. The duration of the mature stage in ♀♀ was one and a half months, hence the number of visits to rice paddy fields must be 6, confirming the importance of food intake during visits to the forest gaps between bouts of oviposition.

INTRODUCTION

The energy budget of dragonfly females is important in order to develop eggs in their ovaries (CORBET, 1999). However, the quantity of food intake in wild adults has been difficult to estimate because of their powerful flying behaviour (WATANABE et al., 2005) and the small size of prey insects (WATANABE et al., 1998). The onset of feeding behaviour in most dragonfly species is a specific

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take-off flight or an attack on the wing (WORTHINGTON et al., 2005). Once in flight, dragonflies swoop upwards from underneath their flying prey, grabbing the prey with their outstretched legs. Feeding habits of dragonflies has been studied in many species in relation to temperature (MAY, 1976) and sex (HIGASHI, 1978). High feeding success rate has been reported for *Pachydiplax longipennis* (BAIRD & MAY, 1997) and low for *Sympetrum infuscatum* (IWASAKI et al., 2009). The weight of gut contents has been used to estimate the food intake of adults (MAY & BAIRD, 2002; HIGASHI, 1973).

S. infuscatum adults mainly inhabit forest gaps, with intermittent visits to rice paddy fields for oviposition. Natural perches in forest gaps were located some distance away from reproductive rendezvous sites (WATANABE et al., 2005). The majority of foraging occurs in forest gaps. WATANABE et al. (2004) reported that adults in the forest gap show so-called percher behaviour and that they used sit-and-wait tactics to feed.

The effect of food intake during sexually immature stages has been reported for *Erythemis simplicicollis* (McVEY, 1985). However, sexually mature individuals have to use intake energy not only for somatic maintenance but also for the development of reproductive organs (CORBET, 1999). BAIRD & MAY (1997) pointed out that most of the energy gained by foraging was invested in reproductive activity, such as producing gametes, mate-finding and mating behaviour, oviposition behaviour and so on, and also suggested a sexual difference in energetic investment. There have been few reports on sexual difference in food intake of adult odonates, though the comparison in gut content mass between sexes has been clarified (e.g. MAYHEW, 1994). ANHOLT (1992) showed that, in *Enallagma boreale*, the quantity of energy gained by males is lower than that of females. However, an equal energy gain might be observed between sexes because of the territorial behaviour of males, which requires high energy expenditure (FRIED & MAY, 1997).

CORBET (1999) stated that dragonfly females lay almost all their eggs in a single oviposition episode and that they return to the feeding sites to forage in order to develop a number of mature eggs again. For *S. infuscatum*, SUSA & WATANABE (2007) estimated that a female laid more than 500 eggs in a single visit to rice paddy fields and that only a few eggs remained in the ovaries after oviposition. Therefore, females develop their eggs while foraging in the forest gaps.

In the present study, we investigated daily faeces excreted in the field by sexually immature and mature adults of *S. infuscatum* to estimate the amount of daily food intake. The number of mature eggs developed in the ovaries was examined in relation to the quantity of daily food intake. Lifetime reproduction is discussed in terms of the oviposition interval between females visiting the rice paddy fields.

STUDY AREAS AND METHODS

Faeces sampling of wild adults of *S. infuscatum* was carried out in the Kamishiro region in Shirouma, Nagano prefecture, a cool temperature zone of Japan. A detailed description of the study area has been reported by WATANABE et al. (2004). A total of 72 sexually immature and 44 sexually mature adults were captured in the forest gaps during sunny and windless days in late July and late August of 2006, 2007, 2008 and 2009 (total 110 days). Perching adults were captured from 0600 to 0800, during which period every adult rested and had not started daily foraging behaviour due to low air temperature (WATANABE et al., 2005).

Immediately after capture, the lengths of the hind wing and the abdomen of each adult were measured. Adults were reared individually in a plastic cup (φ11 cm and 4.5 cm in height), adding adequate moisture using wet tissue papers, for 5 days, feeding on a single drop of water artificially administered in the morning and again in the afternoon. An important assumption in the interpretation of the results was that the quantity of faeces represented the feeding activity of the previous day.

The faeces were derived from undigested foods fed on the day before they were captured and the dry weight was measured to estimate the quantity of food intake. Because the faeces consist of a grain-shaped solid pellet which is not very wet, the faecal pellets were easily collected in a cup every 24 h. They were dried in an oven at 80°C for 8 h and weighed using an electronic balance (accuracy, 0.01 mg).

We controlled each adult's food intake by hand feeding. Diets for the adults in the laboratory consisted of the sheep blowfly, *Phaenicia cuprina*. For sexually immature adults, the dry weight of flies was 5.9 ± 0.28 mg (SE, n = 15) and 4.4 ± 0.14 mg (SE, n = 15) for females and males, respectively. For sexually mature adults, the dry weight of both sexes of the flies averaged 6.2 ± 0.21 mg (SE, n = 20). When a fly was pressed against the dragonfly mouth, most dragonflies started to chew and completely ate the whole body within 5 minutes. Adult dragonflies used for the experiment were captured in the early morning, and they were not allowed to feed for 24 h after capture in the laboratory. They were then fed on 0, 1, 2, 3, and 4 sheep blowflies.

Lone females found in the rice paddy fields were captured to understand the relationship between food intake and the number of mature eggs developed. Immediately after capture, the tip of the abdomen of each female was repeatedly dipped vertically in water in vials at a rate of once per second until they stopped releasing eggs, therefore allowing the females to release all of her mature eggs. Then, 21 females were supplied with only water and dissected at 0, 3 and 8 days after capturing, as a control.

Seventeen females were fed on three sheep blowflies every day, and dissected at 1, 2, 4 and 6 days after capture in order to count the number of mature eggs in their ovaries. The criteria for classifying the degree of egg maturation in *S. infuscatum* have been reported by SUSA & WATANABE (2007).

Data were analyzed using SPSS ver. 12.0 (SPSS Inc., 1989 - 2003). Differences were considered significant at 0.05 using two-tailed tests. Mann-Whitney U tests were performed to examine the differences between males and females in the hind wing and abdomen lengths, dry body weight and the dry weight of faeces. Changes in the quantity of faeces excreted by each sex captured in the morning and reared without feeding were analyzed using the Dunnet-T3 test. The relationship between the number of sheep blowflies fed and the dry weight of faeces excreted the following day were tested with a t-test.

RESULTS

In late July, both sexually immature females and males were found in the early morning, still perching in the tips of branches or on top of grass blades in understories in the forest gaps. Due to low air temperature, no interactions among these adults were found. In late August, both sexually mature females and males

Table I
Body size in *S. infuscutam* for sexually immature and mature stages (±SE)

Size / Mass	Female		Male	
	Immature	Mature	Immature	Mature
Abdomen length (mm)	29.6±0.3 (14)	30.2±0.4 (11)	29.4±0.4 (11)	28.4±0.5 (12)
Hind wing length (mm)	34.5±0.3 (14)	34.9±0.4 (11)	33.6±0.3 (11)	32.9±0.6 (12)
Body mass (dry weight, mg)	73.1±12.4[a] (4)	123.4±7.8[a] (11)	52.9±5.6[b] (4)	82.3±3.6[b] (12)

( ): Number of individuals measured; − a: Significant difference at $P < 0.01$ (Mann-Whitney U-test, $U = 0$); − b: Significant difference at $P < 0.01$ (Mann-Whitney U-test, $U = 1$).

were also found perching there, though the air temperature was somewhat higher than that in late July. Again there were no interactions between them.

There was no significant difference in either the length of the abdomen or the hind wing in either sex when comparing sexually immature and sexually mature stages (females: Mann-Whitney U-test, $U = 61$, $P > 0.05$, $U = 63.5$, $P > 0.05$, males: Mann-Whitney U-test, $U = 39$, $P > 0.05$, $U = 48$, $P > 0.05$) (Tab. I). However, body mass was significantly different between sexually immature and mature stages both for females (Mann-Whitney U-test, $U = 0$, $P < 0.001$), and for males (Mann-Whitney U-test, $U = 1$, $P < 0.01$) (Tab. I). Although no significant difference between sexes was observed in the immature stages (Mann-Whitney U-test,

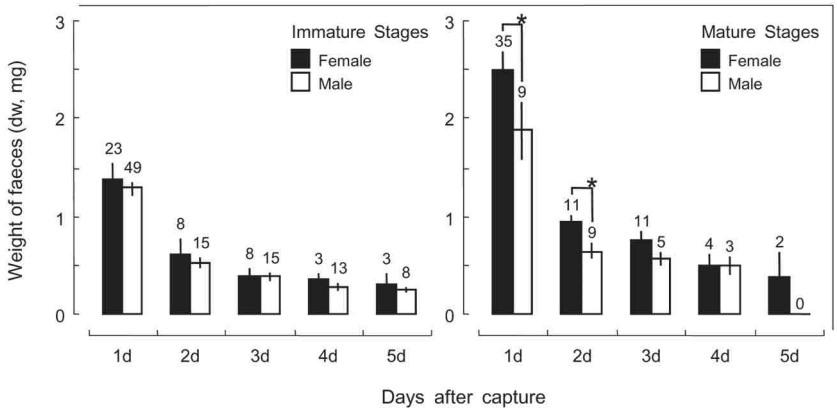

Fig. 1. Changes in the weight of faeces excreted during each day after capture (±SE). The numerals indicate the number of individuals examined. − represents a significant difference between sexes at a probability of less than 0.05 for 1 day ($U = 87.5$), and 2 days ($U = 19.5$), using the Mann-Whitney U-test.

$U = 4$, $P > 0.05$), the body mass of females was significantly heavier than that of males in the sexually mature stages (Mann-Whitney U-test, $U = 0$, $P < 0.001$).

The grain-like faecal pellets included a lot of cuticle fragments, which seemed to be derived from the small insects fed on during the previous day. Each faecal pellet had a similar size (ca. 2 mm × 1 mm) and the colour was dark brown. During the second day after capture, the faecal pellet size decreased,the colour changed to red and there were no fragments of cuticle, indicating that, although small portions of the prey insects remained in the gut for two days, most of them must be digested by the gut within one day after feeding; this applied to both sexes. Thereafter, a few small faecal pellets were excreted, with the colour remaining red, suggesting that the guts were largely emptied after 1 day.

For both sexes in the immature stage, each adult excreted 5 to 6 grain-like faecal pellets during the first day after capture, weighing 1.4±0.17 mg (SE) for females and 1.3±0.07 mg (SE) for males (Fig. 1). During the next day, the number of faecal pellets excreted decreased, and the total dry weight was around 0.5 mg. On this and subsequent days there were no significant differences between sexes for daily faecal pellets excreted, suggesting that both sexes in the field fed on a similar quantity of prey daily.

During day one after capturing mature stages, females excreted 12 to 13 and males 9 to 10 faecal pellets. Consequently, the total dry weight of faeces for females was 2.5±0.18 mg and for males, 1.9±0.30 mg (Fig. 1). Thus presumably sexually matured females fed on more prey daily than did males. The daily weight of the faeces decreased to less than 1 mg the next day, in which the weight of the faeces in females was still significantly heavier than that of males.

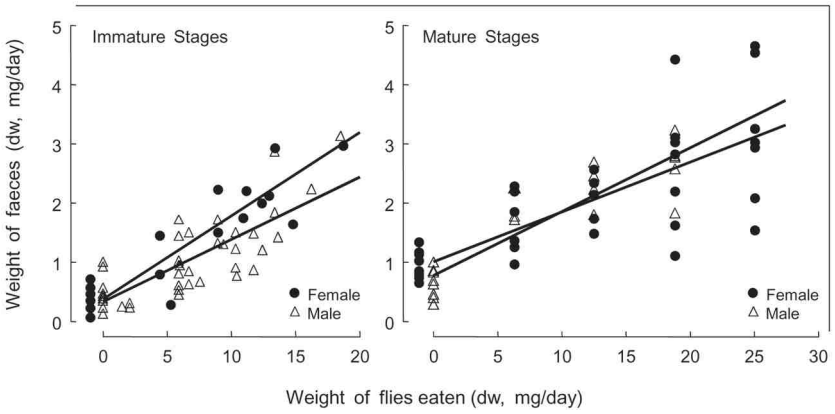

Fig. 2. Relationships between the weight of faeces excreted and the weight of sheep blowflies eaten in sexually immature and mature stages. In the immature stages, the regression line was $Y = 0.45 + 0.13X$ ($r^2 = 0.81$, $P < 0.01$) for females, and $Y = 0.42 + 0.10X$ ($r^2 = 0.65$, $P < 0.01$) for males. In the sexually mature stages, the regressionline was $Y = 0.97 + 0.09X$ ($r^2 = 0.57$, $P < 0.01$) for females, and $Y = 0.76 + 0.11X$ ($r^2 = 0.82$, $P < 0.01$) for males.

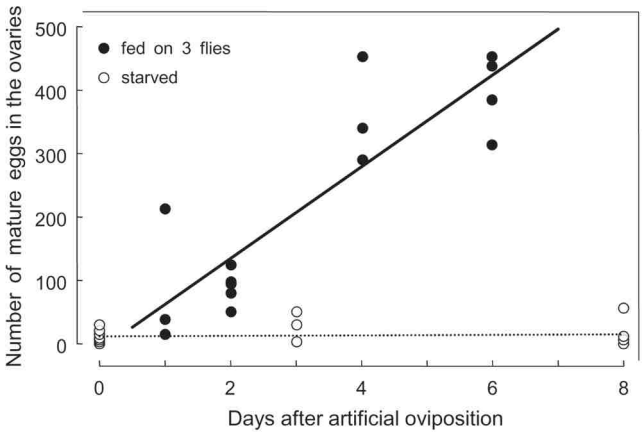

Fig. 3. Relationships between the number of mature eggs in the ovaries and the number of days after artificial oviposition . The solid line shows the regression line for females fed on three sheep blowflies each day ($Y = -9.7 + 72.3X$, $r^2 = 0.77$, $P < 0.001$). The broken line shows the regression line for starved females ($Y = 10.4 + 0.59X$, $r^2 = 0.02$, $P = 0.58$).

Although most individuals that did not feed on sheep blowflies excreted less than 1 mg of faeces the second day after capture, individuals fed on sheep blowflies excreted a considerable amount of faeces, which were dark brown. All faeces excreted after feeding contained a lot of cuticle fragments, which came from the sheep blowflies. There was a significant relationships for dry weight between faeces excreted and dry weight of sheep blowflies consumed (Fig. 2). There were no significant differences in the relationship between sexes for either the immature stages (ANCOVA, $F = 3.49$, $P = 0.06$) or the mature stages (ANCOVA, $F = 1.17$, $P = 0.28$). Each regression line was also similar among sexes and stages, suggesting no changes in digestion process in the gut between sexes and ages (ANCOVA, females, $F = 2.74$, $P = 0.10$; males, $F = 0.64$, $P = 0.43$).

To estimate the amount of food intake in the wild, the quantity of faeces excreted during 24 h after the capture in the field (cf. Fig. 1) was applied to the regression lines. For immature females, the excretion of 1.4 mg of faeces corresponded to 7.2 mg of the sheep blowflies consumed, and for males 1.3 mg of faeces corresponded to 9.1 mg of the flies. For mature stages, 2.5 mg and 1.9 mg of faeces corresponded to 17.7 mg and 10.1 mg of flies, for females and males, respectively. This indicated that a mature female fed on the equivalent of three sheep blowflies.

A few mature eggs were found in the ovaries of females at day zero after capture (Fig. 3). Females that were supplied with only water developed few mature eggs throughout the experiment. They could fly only weakly 8 days after capture. On the other hand, females reared with 3 sheep blow flies every day developed eggs. The number of mature eggs increased significantly with time. The regression indicated that the daily number of mature eggs developed was about 72, and that it might take 7-8 days for a female to accumulate 500 mature eggs in her ovaries.

DISCUSSION

Gut contents of dragonfly adults have been examined for estimating the quality and the quantity of food intake, and the gut of a starved adult for one day was usually empty in *S. danae* (SUKHACHEVA, 1996) and *S. frequens* (HIGASHI, 1978). In the present study, the faeces excreted by *S. infuscatum* during the first 24 h after capturing in the field were derived from prey insects consumed during the previous day. Red faeces without cuticle fragments might not be from the prey insects but from the wastes of metabolism. Faeces excretion stopped 24 h after feeding in *Pachydiplax longipennis* (FRIED & MAY, 1983). Guts of *Calopteryx splendens* and *Erythromma najas* were largely emptied after only a few hours (MAYHEW, 1994). Therefore, the quantity of food intake affects the quantity of faeces excreted the following day.

Although sexually mature adults were heavier than immature ones for both sexes, the relationship between the quantity of food intake and the faeces excreted for sexually mature adults was not different from that for immature ones and also was not different between sexes. Assuming that prey insects provide similar nutrients to adult dragonflies, little change in the assimilating process occured with age. Therefore, the quantity of faeces excreted during 24 hrs should be an indicator of the quantity of food intake of the previous day.

Although MAYHEW (1994) suggested females in general feed more than males, in the present study no significant difference of daily food intake between sexes in immature stages of *S. infuscatum* was found. However, in the mature stages, the daily food intake of females (17.7 mg) was greater than that of males (10.1 mg), suggesting that females require more nutrients than males, probably for egg development. IWASAKI et al. (2009) calculated that 18.4 mg for females and 15.2 mg for males in sexually mature *S. infuscatum* were the daily amount of prey insects eaten, based on observed daily foraging frequencies in forest gaps. Females can produce additional eggs with additional resources.

RICHARDS & WINDSOR (2007) reported that forest gaps have high plant densities and many young leaves contributing to higher availability of food resources for insect herbivores, suggesting that the forest gaps provide high food resources for insect predators such as Odonata. Both sexes of *S. infuscatum* fly directly toward the point of prey interception by steering to minimize the movement, as do *E. simplicicollis* and *Leucorrhinia intacta* (OLBERG et al., 2000). In the present study, the estimates of daily food intake suggested that foraging activity increased in mature females more than in males. No sexual differences in prey capture rate, nor any tendency to take different sizes of prey insects were found in forest gaps (IWASAKI et al., 2009). Although there have been several reports that mature males feed very little during their territorial activities (FRIED & MAY, 1983; MACKINNON & MAY, 1994), ANHOLT (1992) pointed out that feeding effort was similar between sexes in territorial species with relative costs and

benefits, rather than non-territorial species. In *S. infuscatum*, however, males do not exhibit territoriality, and foraging in forest gaps was located some distance away from reproductive rendezvous sites, in which copulations occurred, such as the border of forests near rice paddy fields (WATANABE et al., 2004). The large quantity of food intake in females rather than males might be due to the requirements of egg production.

In *S. infuscatum*, the male remains in tandem with the female during oviposition on the wing above the rice paddy fields. Because the females return to forest gaps immediately after pair separation, the duration of visits to the rice paddy fields was short (WATANABE et al., 2004). Short visits to oviposition sites were also reported in *S. vicinum* (McMILLAN, 1996) and *S. danae* (MICHIELS & DHONDT, 1989). Foraging behaviour in *E. boreale* was observed on the hillside away from the pond after reproduction took place (ANHOLT, 1992). SUSA & WATANABE (2007) noted that females of *S. infuscatum* had few mature eggs left immediately after ovipositing during a short visits to the rice paddy fields and estimated that about 500 eggs were released in a single visit. This suggests that foraging in forest gaps during inter-clutch intervals will lead to higher lifetime egg production.

In order to visit the rice paddy fields to lay 500 eggs (SUSA & WATANABE, 2007), a female has to develop eggs in her ovaries throughout her duration in the forest gaps. Since the daily number of mature eggs developed was 72 in the present study, about 8 days of exclusive feeding were needed to accumulate sufficient eggs. Most females are apt to stay in forest gaps even when it is time for the oviposition period in rice paddy fields. Because the duration of mature stages in females was one-and-a-half months, the number of visits to rice paddy fields must be six, apparently confirming the importance of food intake in the forest gaps.

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SHORT COMMUNICATIONS

REDISCOVERY OF *TELEBASIS ERYTHRINA* (SELYS, 1876), WITH NOTES ON HABITAT AND CONSERVATION (ZYGOPTERA: COENAGRIONIDAE)

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T. erythrina was previously known from 5 ♂, all collected in Minas Gerais (Brazil). 4 ♂ of the type series are deposited in IRSN and the fifth specimen, collected in Santa Barbara, MG, Private Reserve Peti, 18-X-1980, is deposited in ABMM collection (now UFMG). Recently the sp. has been rediscovered in São Paulo state, and data on habitat and conservation are presented here for the first time.

INTRODUCTION

Telebasis erythrina was described by SELYS (1876) from four males (three incomplete) and one female, the female was reported as being the female of *T. corallina* (Selys, 1876) by von ELLENRIEDER & GARRISON (2007); all specimens are deposited in the Institut Royal des Sciences Naturelles, Brussels, Belgium (IRSN). The fifth known specimen is a single male specimen collected in Santa Barbara (MG), Private Reserve Peti, 18-X-1980, deposited in the Angelo B.M. Machado private collection (ABMM), now Universidade Federal de Minas Gerais collection (UFMG). It was first figured by LENCIONI (2006), and GARRISON (2009) revised the genus, provided additional illustrations and designated a lectotype.

Almost nothing is known so far on the preferred habitat of this species. The type locality, indicated simply as "Minas Gerais", is an extremely broad area of 586.528,30 km² and has a mosaic of environments that, according to a 2005 survey (SCOLFORO & CARVALHO, 2006), cover almost 34% of its area; of this total 31% is represented by Atlantic Forest (mountain shrubs and lowland forests),

59% by the Cerrado Savannas (open grassland, grassland with scattered trees and forest patches, cerrado s. stricto [open, scrubby woodland], savanna and flooded savanna) and 10% by the Caatinga (xerophytic and deciduous vegetation).

The most recently reported specimen was collected from the Private Reserve Peti, which is situated in a transition area between Cerrado and Atlantic Forest. Much of the reserve is covered by secondary vegetation, predominantly mesophytic and gallery forests, but including patches of cerrado vegetation and mountain shrubs (BERTOLUCI et al., 2009).

On a recent trip to the city of Salesópolis (São Paulo state), with the objective of photographing specimens of *Cyanallagma angelae* Lencioni, for the second edition of my book, *Damselflies of Brazil*, I found a colony of the very rare and poorly known *Telebasis erythrina*, a species not seen for 30 years.

HABITAT AND ASSOCIATED SPECIES

The lake where *T. erythrina* was now found is located in Salesópolis (23º35'51"S & 45º43'41"W, elevation 1074 m), which is a small town located in the seaward slope of the Serra do Mar (Atlantic Rainforest), with an average elevation of 850 m, extending over an area of 426 km^2. The environs of the city have been systematically degraded, and now one third of the area is occupied by eucalyptus plantations to supply the growing paper production industry in Brazil. The climate is subtropical with an average temperature of 19º C, and annual rainfall is 1300 mm.

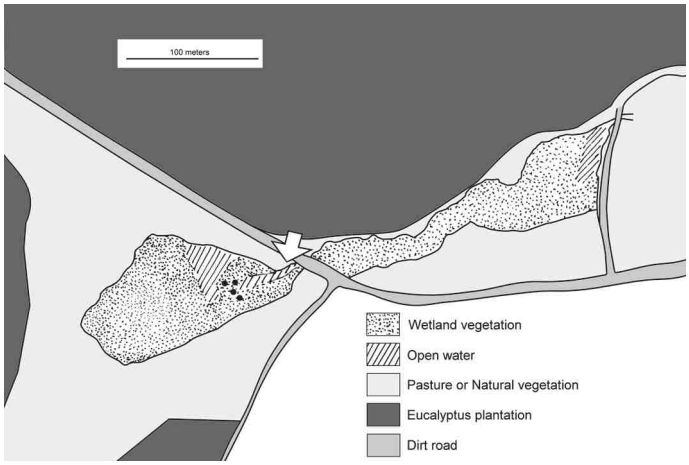

Fig. 1. Map of the lake area, arrow indicates the location of Fig. 2. – [Solid black circles represent the sites where the *T. erythrina* specimens were collected]

The lake seems to have been formed more than 30 years ago by damming a stream during the construction of the road, and it still flows, feeding a large lake across the road (Fig. 1). The vegetation (Fig. 2) in and surrounding the lake is mainly (A) *Typha domingensis* Pers., (B) *Echinodorus grandiflorus* (Cham. & Schltdl.), (C) *Eleocharis* sp., and (D) *Nymphaea caerulea* Savigny, and to a lesser extent, *Baccharis usteri* Heering, *Tibouchina semidecandra* Cogn., *Syngonanthus* sp., and *Sinningia* sp.

I have been studying the odonatological fauna of this particular site for the past 11 years and have visited it nine times, with samples in seven different months (14-III-1999, 03-IV-1999, 07-XI-1999, 03-XI-2000, 02-IX-2001, 04-X-2003, 22-I-2011, 29-I-2011 and 19-II-2011). Throughout these visits, I collected 162 specimens of 17 species, which comprised: 3 ♂ *Heteragrion aurantiacum* Selys, 1 ♂ and 1 ♀ *Hetaerina hebe* Selys, 5 ♂ *Peristicta aeneoviridis* Calvert, 1 ♂ *Acanthagrion gracile* (Rambur), 3 ♂ *A. lancea* Selys, 1 ♂ *A. truncatum* Selys, 6 ♂ and 2 ♀ *Homeoura chelifera* (Selys), 9 ♂ and 10 ♀ *Ischnura capreolus* (Hagen), 1 ♀ *I. fluviatilis* Selys, 2 ♂ and 2 ♀ *Minagrion mecistogastrum* (Selys), 4 ♂ *Oxyagrion microstigma* Selys, 11 ♂ *O. simile* Costa, 14 ♂ and 1 ♀ *O. terminale* Selys, 1 ♂ and 1 ♀ *O. pavidum* Hagen *in* Selys, 1 ♂ *Telebasis carmesina* Calvert, 1 ♂ and 1 ♀ *Telebasis corallina* (Selys), and 54 ♂ and 26 ♀ *Cyanallagma angelae* Lencioni (the large number of specimens in the latter is because the lake is its type locality).

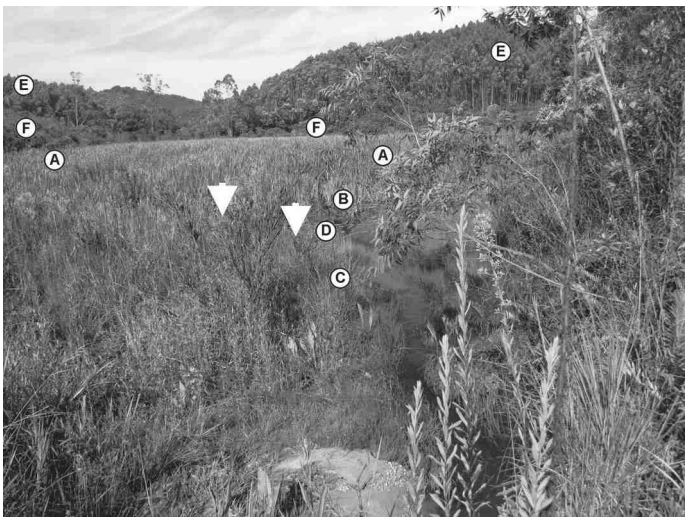

Fig. 2. Habitat of *Telebasis erythrina*: (A) *Typha domingensis*; – (B) *Echinodorus grandiflorus*; – (C) *Eleocharis* sp.; – (D) *Nymphaea caerulea*; – (E) eucalyptus plantation; – (F) natural vegetation. – [White arrow indicates the sites where the *T. erythrina* specimens were collected]

DISCUSSION

During the last three visits to the lake (22-I-2011, 29-I-2011 and 19-II-2011), a few individuals of *Telebasis erythrina* were observed (a few voucher specimens are collected), only between 11:00 AM and 1:00 PM. Almost all specimens were observed perching on *Eleocharis* sp. (30-40 cm above ground), over the wetland adjacent to the lake and never over the water.

T. erythrina does not appear to startle easily and allows the observer to approach with relative ease (more than in *T. corallina*). Out of the short time interval in which the specimens were observed they simply disappear and, as the area around the lake is currently covered by eucalyptus plantations, the only plausible possibility I see for this disappearance is that they have a behavior similar to that I observed in Bolivia in 2003 for *T. bickorum* Daigle. The latter (which is relatively similar to *T. erythrina*) was observed perched on tips of tree leaves, about 3 meters high, in a forest, however in the case of *T. erythrina,* perhaps they use taller trees. No copula or tandem formation was observed during the three days of observation.

Fig. 3. *Telebasis erythrina* male perched on *Eleocharis* sp.

The population of this rare and poorly known species is apparently very small, probably much smaller than the population of some species which, in developed countries, will gain the attention of government and non-governmental organizations to promote efforts for its preservation. Unfortunately, this does not occur in Brazil, and with the ongoing devastation created by the unbridled greed of human beings, in a short time we will no longer have the opportunity to observe this beautiful species.

ACKNOWLEDGEMENTS

To FREDERICO LENCIONI NETO, my father, who helped me with the field work and took the habitat pictures. To DENNIS PAULSON, JOHN C. ABBOTT and MIKE MAY for critically reading the manuscript.

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DREPANOSTICTA HAMALAINENI SPEC. NOV. AND *SULCOSTICTA SIERRAMADRENSIS* SPEC. NOV. FROM THE NORTHERN SIERRA MADRE NATURAL PARK, LUZON, THE PHILIPPINES (ZYGOPTERA: PLATYSTICTIDAE)

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D. hamalaineni sp. n. (holotype ♂: Dipinantahikan area, Dipagsangan, Palanan, Isabela, Luzon Island, the Philippines, 12/20-IX-2008, to be deposited in RMNH, Leiden) and *S. sierramadrensis* sp. n. (holotype ♂, same locality, date and deposition) are diagnosed, described and illustrated.

INTRODUCTION

HÄMÄLÄINEN & MÜLLER (1997) presented a synopsis of what is known about the Odonata in the Philippines and listed 224 named taxa. Since then several papers have been published, increasing the recorded taxa in the country up to 270 species. (GAPUD, 2006; GAPUD & RECUENCO-ADORADA, 2001; GASSMANN & HÄMÄLÄINEN, 2002; HÄMÄLÄINEN, 2000; RAMOS & GAPUD, 2006; VAN TOL, 2005; VILLANUEVA, 2005a, 2005b, 2009a, 2009b, 2009c, 2010a, 2010b, 2010c; VILLANUEVA et al., 2009).

The Northern Sierra Madre Natural Park (NSMNP) situated in north-eastern Luzon is the largest protected region of the Philippines, with an area of 359,486 ha (DENR, 2001). The park represents the majority of habitats and species found on Luzon Island (VAN WEERD & UDO DE HAES, 2010). Agricultural encroachment, logging and the use of destructive hunting and fishing methods

form severe threats to the biodiversity of the Park.

From 12 to 24 September 2008, we conducted a biodiversity survey in *sitio* Dipagsangan, *barangay* Didian in the municipality of Palanan. We recorded 35 species, all except one endemic to the Philippines (VILLANUEVA et al., 2009). The present paper describes two new species found during the survey.

ILLUSTRATIONS AND DEPOSITION OF MATERIAL

Drawings were made with the aid of a stereomicroscope equipped with micro ocular camera. Acronyms for collections are as follows:

- RJTV: Reagan Joseph T. Villanueva
- RMNH: Nationaal Natuurhistorisch Museum Naturalis, Leiden, the Netherlands

DREPANOSTICTA HAMALAINENI SP. NOV.

Figures 1-4

Drepanosticta sp. n. (VILLANUEVA et al., 2009)

M a t e r i a l. – **Holotype** ♂: Dipinantahikan area, Dipagsangan, Palanan, Isabela, Luzon Island, Philippines, 12/20-IX-2008, R.J.T. Villanueva leg. (to be deposited in RMNH); – **paratypes**: – 6♂, 2♀, same data (in RJTV); – **Other material**: – 11♂, same data (in RJTV).

E t y m o l o g y. – Dedicated to Dr Matti H ä m ä l ä i n e n, for his constant support to the first author's odonatological study.

DIAGNOSIS. – This is the largest species in the *Drepanosticta halterata*-group and lacks the basal abdominal white ring/spot at least in segments 3-7. It differs from *D. halterata* by the presence of pale spot on the sides of the synthorax, and a shorter posterior lobe. It is distinct from *D. philippa* and *D. trimaculata* since both species have elongate posterior lobe.

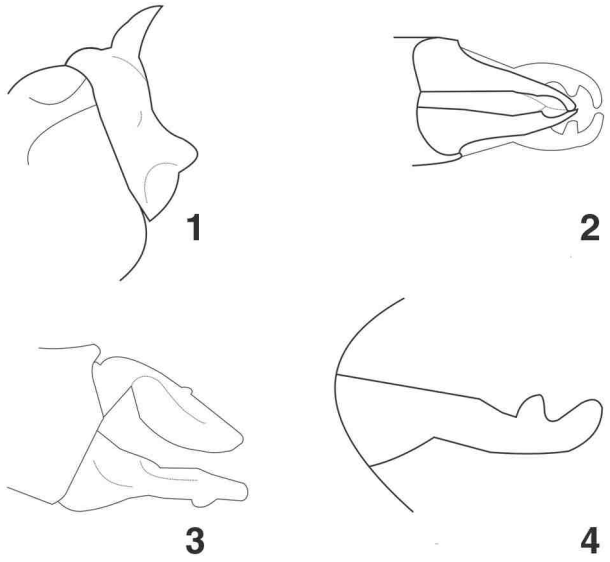
MALE. – H e a d. – Labium and mandible are brownish except for the blackish apices. Labrum, genae and anteclypeus are bluish white except for the black outer margin of labrum. The rest of the head is matt black. Transverse occipital carina is well developed but without distinct lateral extremities.

T h o r a x. – Prothorax black with streaks of dark brown except for a large white ovoid spot on each medial lobe. Anterior lobe short; its lateral portion broadly fan-shaped and erect. Posterior lobe collar-like with lateral portion broadly triangular, its tip shortly elongate directed caudo-laterad (Fig. 1). Synthorax matt black except for a small ovoid white spot at the distal portion of metepisternum and pale distal third of metepimeron. Legs generally brownish except for the blackish streaks at the lateral portion of coxae, knees and proximo-basal section of tibiae.

Wings hyaline with brown venation. Ac and Ab forming Y-shape. Arc is beyond Ax2; Pnx 20/18 in forewing and hindwing respectively; R4+5 at subnodus, while IR3 is a little distal to it. Pterostigma blackish, rhomboidal with costal and basal

corners shorter than the opposite sides.

A b d o m e n. – S1 light brown, S2 brown, a little darker on apical and basal portion, S3-S7 black, laterally blackish brown, S8-S10 black. Cerci (Figs 2-3) black, brownish medial aspect, thrice longer than S10, the basal 1/5th directed acute dorsad viewed laterally, the distal portion is wedge-shaped with a blunt tooth along the dorsal half, and slightly concave on its medial surface. Paraproct kinked at the middle with the distal portion directed outward, brown basal half and blackish distal portion, surpassing the tip of the cerci. The paraproct (Fig. 4) clasper-like, its tip rounded and equipped with a large medio-subterminal tubercle.



Figs 1-4. *Drepanosticta hamalaineni* sp. n.: (1) posterior lobe of prothorax, oblique lateral view; – (2) cerci, dorsal view; – (3) cerci, lateral view; – (4) paraproct, left ventral view.

M e a s u r e m e n t s (in mm). – Abdomen + cerci: 50; hindwing: 32.

FEMALE (taken in copula with the holotype). – Similar to male except the lateral portion of posterior lobe is more elongated. Abdominal segments are relatively paler, and S9 is mainly pale/white. Ovipositor surpassing the cerci. Cerci simple, brown with similar length as S10.

M e a s u r e m e n t s (in mm). – Abdomen: 44; hindwing: 29.

VARIATIONS. – S9 has a large blue patch occupying most of the segment. In some wings the pterostigma is five-sided.

M e a s u r e m e n t s (in mm). – Abdomen + cerci: 43-50; hindwing: 29-32

SULCOSTICTA SIERRAMADRENSIS SP. NOV.

Figures 5-8

Drepanosticta sp. ?n. (VILLANUEVA et al., 2009)

M a t e r i a l. – **Holotype** ♂: Dipinantahikan area, Dipagsangan, Palanan, Isabela, Luzon Island, Philippines, 12/20-IX-2008, R.J.T. Villanueva leg. (to be deposited in RMNH); – p**aratypes**: – 3♂, 1♀, same data.

E t y m o l o g y. – – Refers to Sierra Madre, the largest remaining forest in the archipelago.

DIAGNOSIS. – The characteristic Y vein of *Drepanosticta* is present. It is similar to *S. pallida* van Tol, whose Y vein is not close at base, but rather widely separate. The new species differs from the former in the shape of prothorax, cerci and paraproct.

MALE (**Holotype**). – H e a d. – Labium and mandible are pale brown with a little darkening on the apices. Labrum, genae and anteclypeus are pale blue except for the brownish distal half of the labrum. The rest of the head is black except for the yellowish antennae. Transverse occipital carina well developed but its lateral extremities not pronounced.

T h o r a x. – Prothorax pale yellow except for the brownish lateral lobes, brownish patch on the center of median lobes, and a pair of large ovoid greenish patches on the middle portion of posterior lobe. Anterior lobe short, erect and its lateral portion rounded but not elongated. Posterior lobe collar-like, its lateral portion angulated and just surpassing the median line (Fig. 5). Synthorax generally pale grey except for the large greenish patch on the dorsum, occupying the medial half of mesepisternum, black streak on both anterior and posterior sides of the spiracle, thin black line along the second suture, and blackish streak at the posterior corner of metepimeron. Poststernum black except for the pale streak at both sides on the bulging portion.

Legs yellowish except for the brownish tinge on the bases of coxae, blackish tinge on the knees and insertion of the brown spines, and light brown broad band just distal to the middle of the femora. Tarsi brownish.

Wings hyaline with brown veins. 1 pcv situated between the wing base and Ax1. Arc off Ax2. Ac and Ab veins present, but widely separate. Postnodals 13/13 in forewing and hindwing, R4+5 starts just off subnodus; IR3 a little further distal to it. Pterostigma brown, rectangular.

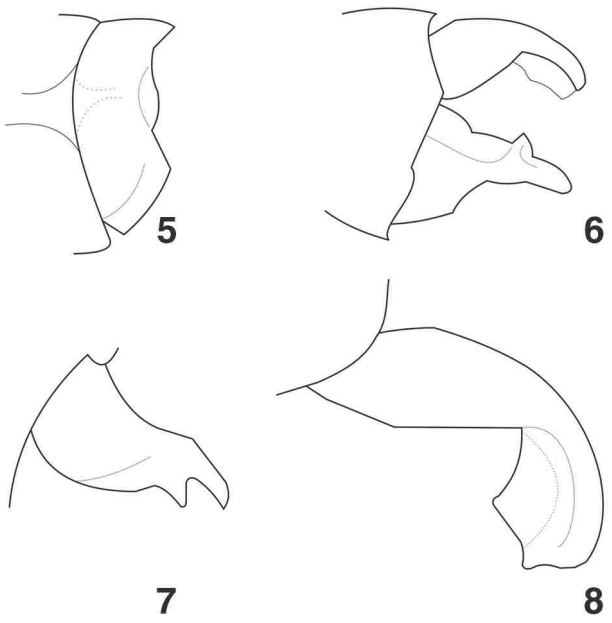
A b d o m e n . – Generally pale yellow-brown except: for the brownish basal and ventro lateral portion of S1, S2 narrow brown basal ring, faint brown dorso-medial spot, and broad dark brown apical ring, S3-S6 thin brown basal ring that is broader dorsally, whitish tinge beside it along the lateral portion, and dark brown apical ring that is broader dorsally, S7 whitish basal half, and black apical portion, S8-S10 entirely black. S7 gradually inflate at the basal 1/5th achieving the maximum size at the middle of S8, about 4.5 times that is S3-S6; S10 nearly 3 times that of S3-S6. Cerci brown (Figs 6, 8), viewed laterally gently curved, a broad basal half, and a sub-cylindrical distal portion with a thin plate-like projection medially. Paraproct brownish and a little darker sub-terminally (Fig. 7), when viewed laterally a little surpassing the cerci, broad base and a pointed sub-terminal tubercle directed dorsad, viewed ventrally the tip is bifid, the inner branch rounded and covered with fine pale hairs, the outer branch is larger and triangular, when viewed internally a sub-terminal short tubercle forming a ridge obliquely across over the bifurcation.

Measurement (inmm). – Holotype: abdomen + cerci: 29; hindwing: 19.

VARIATION. – No variation is noted on the two mature paratype males. The teneral male paratype is relatively paler in coloration, perhaps due to age.

Measurement (in mm). – Abdomen + cerci: 28-31; hindwing: 19-20.

FEMALE. – Similar to male except for black band on the labrum between the brown distal portion and blue basal portion, blackish streak at both sides of the center on the anteclypeus. S6 generally pale except for the black apical 1/5th. S8 has the whitish streak restricted on the basal 1/4th. S10 brownish. S6 gradually inflate starting on the basal 1/5th with the maximum size on the middle of S7, about 3 times the size of S3-S5. Narrow constriction is noted on the basal portion of S8, about 2.5 times the size of S3-S5. Cerci simple and a little longer than S10. Ovipositor not reaching the tip of cerci.



Figs 5-8. *Sulcostica sierramadrensis* sp. n.: (5) posterior lobe of prothorax, lateral slightly oblique; – (6) cerci, lateral view; – (7) paraproct, right ventral view; – (8) cerci, left infero-ventral view.

Measurement (in mm). – Abdomen: 30; hindwing: 21.

DISCUSSION

Platystictidae is one of the most speciose families in the archipelago, and at least one species is encountered in any running water habitat. Presently, the country has 30 species in three genera of which *Drepanosticta* constitutes the largest group (VAN TOL, 2005).

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Odonatologica 40(4): 339-345 *December 1, 2011*

DESCRIPTIONS OF *ANAX IMMACULIFRONS* RAMBUR AND *TETRACANTHAGYNA WATERHOUSEI* McLACHLAN EXUVIAE FROM CHINA (ANISOPTERA: AESHNIDAE)

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The ♂ and ♀ exuviae of the 2 spp. are described and illustrated from Zhuhai (Guangdong) and some notes on larval ecology and behaviour are provided. Larval morphology of the Guangdong *A. immaculifrons* is compared to that of the larvae from the westernmost known population of this sp., i.e. from the island of Karpathos, Greece.

INTRODUCTION

The larva of *Anax immaculifrons* was earlier described and illustrated by LIEFTINCK (1940; Sri Lanka), FRASER (1943; India [?]), SANGAL & KUMAR (1972; India), KUMAR (1984; India) and BATTIN (1990; Greece). Some descriptive notes were provided by ST. QUENTIN (1973; Sri Lanka). It was keyed by KUMAR (1973). Most of these authors and WILSON (1995) presented also some information on its habitats.

The larva of *Tetracanthagyna waterhousei* was originally described and illustrated by MATSUKI (1988; Hong Kong, Thailand) and its morphological features were compared by ORR et al. (2010) to those of *T. degorsi* and *T. plagiata*. DUDGEON's (1999) figures of larval morphology of this species (?) are not particularly useful for identification purposes. WILSON (1995) photographically documented its peculiar fish-feeding behaviour, supplied some information on its Hong Kong habitats and stated that "larvae grow at an incredibly rapid rate,

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given ample feed, and are capable of achieving the mature larval stage within a few months of hatching".

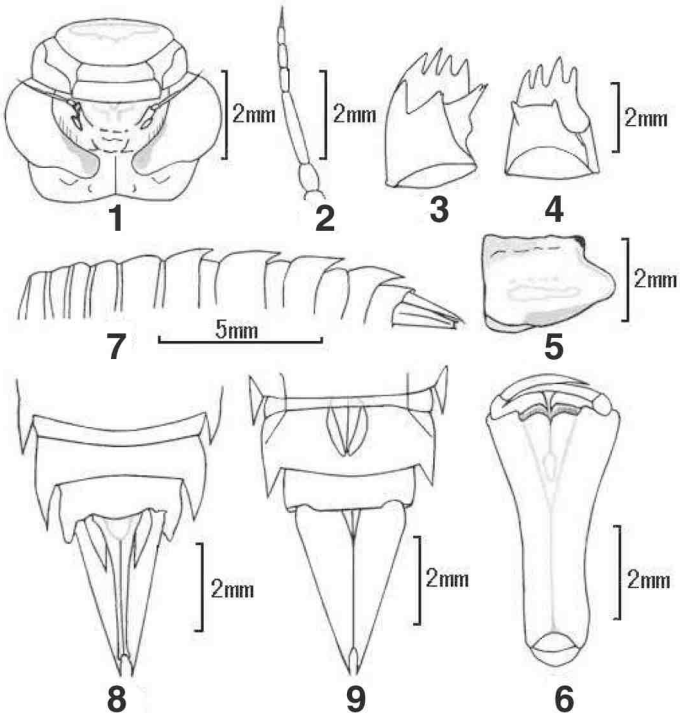
Here, the exuviae of the two species are described from Zhuhai, Guangdong (China) and some bionomic notes are appended. Larval morphology of the Guangdong *A. immaculifrons* specimens is compared to that of the final instar larvae from the westernmost known population of this species, occurring in the island of Karpathos, Greece.

ANAX IMMACULIFRONS RAMBUR, 1842

Figures 1-9

M a t e r i a l. – 1♂ and 1♀ exuviae, Zhuhai city, Guangdong, China, 10-VII-2006, Mo Shan--Lian leg.. The adult emerged on 20-X-2006.

Body length 56.0 mm, ground colour yellow, length of abdomen (including appendages) 35.0 mm, maximum head width 10.5 mm, length of hind femur 10.1



Figs 1-9. *Anax immaculifrons*, female exuviae: (1) head, dorsal view; – (2) right antenna; – (3) left mandibula, ventral view; – (4) right mandibula, inner view; – (5) right side of prothorax, dorsal view; – (6) labium, ventral view; – (7) right side lateral spines on abdomen, dorsal view; – (8) tip of abdomen, dorsal view; – (9) same, ventral view.

mm. Dorsal hooks absent, lateral spines on abdominal segments 6-9 present (Fig. 7).

H e a d. – Labium yellow, prementum narrow and elongate (Fig. 6). Labrum of usual shape with a narrow black marking, inner margin of interanal lobe with a row of blunt teeth; anteclypeus brown, with a longitudinal ditch on the middle, ground rough; postclypeus smoother than anteclypeus, but a black spot on the middle anterior margin, the spot occupies 1/2 the width of postclypeus, ocellar triangle smooth and brown with pale yellow spots, occipital lobe rounded at both sides. Antennae filiform, 7-segmented (Fig. 2). Length ratios of segments as follows: 0.4: 0.5: 1.35: 0.5: 0.5: 0.5: 0.45. Basal pedicel and scapus of antenna expanded and brown, basal flagellum segment 1 with brown marking, others yellow no hair on surface. Mandibular formula (sensu WATSON, 1956): L1234yaa'bb'/R1234a(m^0) bd (Figs 3-4).

T h o r a x. – Prothorax yellow, lateral margin obviously outward prominent, mesothorax and metathorax yellow, smooth and no hair, with black marking on entire dorsum. Legs brown, with black markings on the margin of middle and terminal tibia. Wing cases not parallel, forewing cases reach to the middle of abdominal segment 4; hindwing cases reach to hind border of abdominal segment 4.

A b d o m e n. – Spindle-shaped and yellow, with short brown hairs on the surface. Abdominal segment 1 without markings, abdominal segments 2-8 with black markings, entire dorsum and sides with two little black, almost round-shaped spots, abdominal segment 9 without markings, abdominal segment 10 with small round spots on sides of entire dorsum, pleura with irregular black markings and with a small black spot on dorsum, a round spot on sides; abdominal segments 8-9 with few yellow hairs. Dorsal hooks absent, lateral spines on segments 6-9 present. Basal epiproct with two small black spots, other black-brown. Paraproct longer than epiproct, distal margin black, but outer margin of paraproct and epiproct smooth and no hair on surface (Figs 8-9), cercus longer than abdomen segment 10.

Table I

Comparison of *Anax immaculifrons* larval morphology from China and from its westernmost population in Greece (BATTIN, 1990)

Characters	China	Greece
Body length	56.0 mm	30.1 mm
Hindwing cases	reach to hind margin of abdominal segment 4	reach to anterior third of abdominal segment 1
Outer margin of paraproct and epiproct	smooth and no hair	with hair
Cercus	longer than abdominal segment 10	as long as abdominal segment 10

BIOMETRIC RATIOS (n = 2). – Head/prothorax: 2.10-2.20; – prementum L/W+: 1.70-1.71; – prementum W+/W-: 2.00-2.10; – anal pyramid L/W: 1.74-1.75; – antennal annulus 1 > antennal annuli 4+5.

REMARK. – *A. immaculifrons* is widespread from China across southern Asia, reaching its westernmost limit in Cyprus, on the Aegean coast of southern Turkey and in some of the Greek islands, including the island of Karpathos (DIJKSTRA, 2006). From the latter locality, the female ultimate instar larva was described and illustrated by BATTIN (1990), who stated that its morphology is almost identic to that described from India by KUMAR (1984). However, there are some minor structural differences between our (almost easternmost) and Battin's westernmost specimens. These are listed in Table I.

TETRACANTHAGYNA WATERHOUSEI McLACHLAN, 1896

Figures 10-19

M a t e r i a l. – 2 ♂ and 1 ♀ exuviae, 10-VI-2006, Zhuhai city, Guangdong, China, Mo Shan-Lian leg.. The adult emerged on 16-III-2007.

Body length 50.7 mm, length of abdomen (including caudal appendages) 35.0 mm, maximum head width 9.1 mm. Ground colour pale black in male and red brown in female, length of hind femur 9.0 mm, abdomen with pale yellow triangle marking. Both sexes with lateral spines on abdominal segments 5-9, and dorsal hooks on abdominal segments 8-9.

H e a d. – Labium black-brown in male (Fig. 10) and brown in female. Fore border of the labrum level with yellow long hairs, circle on both sides, a large black marking and pale yellow spot on the markings; anteclypeus trapezoid, with black marking, surface smooth, postclypeus with a ridge on anterior margin, occipital lobe convex at sides (Fig. 15). Antennae filiform (Fig. 13), 7-segments, length ratios of segments as follows: 0.3: 0.4: 0.6: 0.4: 0.5: 0.5: 0.5, pedicel yellow and with black marking terminally, flagella 3 and 4 black in base and terminal, lateral ocellus black. Mandibular formula (sensu WATSON, 1956): L12340ab/R1234abd (Figs 16-17).

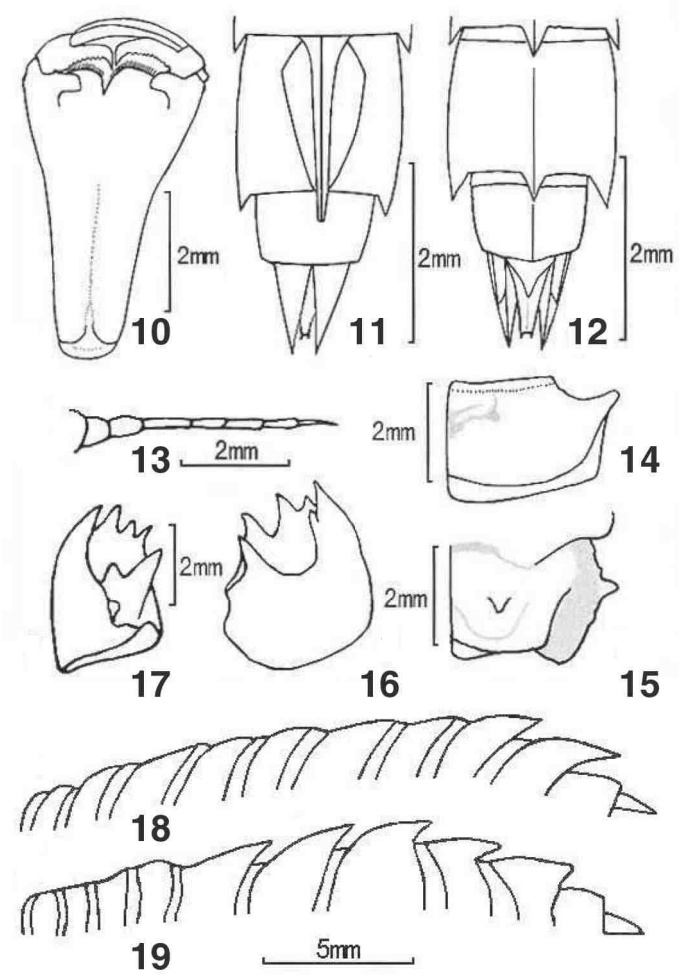
T h o r a x. – Prothorax brown, anterior margin deep-brown, sides of prothorax prominent outward (Fig. 14), mesepisternum with a black marking on the entire dorsum. Wing cases deep-brown and parallel, forewing cases reach to fore border of abdominal segment 3, wing cases with pale yellow spot on middle anterior margin. Legs brown, femora and tibia with black markings.

A b d o m e n. – Brown with pale yellow spots, entire dorsum of abdominal segments 1-8 with triangular spots. Dorsal hooks on abdominal segments 8-9 (Fig. 18), lateral spines present on segments 5-9 (Fig. 19); dorsal hooks pale dark, dorsal abdomen fringed with yellow short hairs. Anal pyramid black (Figs 11-12).

BIOMETRIC RATIOS (n = 3). – Head/prothorax: 1.00-1.10; – prementum

L/W+: 1.60-1.61; – prementum W+/W-:1.86-1.87; – anal pyramid L/W: 1.24-1.25; – antennal annulus 1 < antennal annuli 4+5.

REMARK. – Structural features of the Guangdong specimens are completely in agreement with the descriptions and illustrations of material from Hong Kong and Thailand, described and illustrated by MATSUKI (1988) and ORR et al. (2010).



Figs 10-19. *Tetracanthagyna waterhousei*, female exuviae: (10) labium, ventral view; – (11) tip of abdomen, ventral view; – (12) same, dorsal view; – (13) right antenna; – (14) right side of prothorax, dorsal view; – (15) right occipital lobe, dorsal view; – (16) left mandibula, ventral view; – (17) right mandibula, ventral view; – (18) dorsal hooks, lateral view; – (19) right side lateral spines on abdomen, dorsal view.

NOTES ON ECOLOGY AND BEHAVIOUR

Basically, *Anax immaculifrons* is a rheophilous species, although LIEFTINCK (1940) and FRASER (1943) reported it from sluggish channels, ponds and even tanks. It breeds in montane streams in Hong Kong's ria habitat (sea level), in rocky pools of hill streams with steep gradient (alt. ca 430-2150 m) in India (KUMAR & PRASAD, 1981; SANGAL & KUMAR, 1981), and in rocky pools in lower reaches of small permanent streams (alt. ca 300 m) on the island of Karpathos, Greece (BATTIN, 1990).

KUMAR (1984) reared it from the egg, reported 13 larval instars, and in the laboratory the larval cycle was completed within 132 days).

Larvae from Guangdong and from Liaoming, situated some 2000 km further North, emerged in a greenhouse. Prior to emergence, they stop feeding, headstand for ca 8-9 days, the edge of the prementum becomes transparent, and the larva raises its head above the water surface.

Tetracanthagyna waterhousei is a common and widespread dragonfly in southern and southwestern Asia. In China, it has been reported from Hong Kong (WILSON, 1995, 1997), Hainan (WILSON & REELS, 2001), Guangxi (WILSON, 2005) and Guangdong (WILSON & XU, 2008).

Prior to emergence, the larva stops eating and protrudes from the water's surface. From the beginning of emergence to the point where the abdomen is fully extended takes about 3 hours. The wings require 1-2 hours to stretch completely.

During the rearing, we have noticed a rather peculiar predatory behaviour. When a larva preyed on a small fish, it would raise the prey from the water immediately after capture, in order to prevent its escape. It ingests the fish after crawling onto the surface of a stone or on a small branch. In nature, this behaviour was photographically documented by WILSON (1995).

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ST. QUENTIN, D., 1973. Results of the Austrian Ceylonese hydrobiological mission 1970, pt 12: Contributions to the ecology of the larvae of some Odonata from Ceylon. *Bull. Fish. Res. Stn Sri Lanka (Ceylon)* 24(1/2): 113-124.

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ODONATOLOGICAL ABSTRACTS

2000

(18568) NAGANO, M., H. OOKI, Y. MIZUTANI, S. SHIMANO & J. AOKI, 2000. List of insects collected in the Campus of Yokohama National University, 1. *Bull. Inst. envir. Sci. Technol. Yokohama natn. Univ.* 26(1): 123-134. (Jap., with Engl. title & taxon. nomencl.). – (First Author: Dept Soil Zool., Inst. Envir. Sci. & Technol., Yokohama Natn. Univ., Yokohama, 240-8501, JA).
Lists 6 odon. spp. (Aug.-Oct. 1999); – Japan.

(18569) PETRULEVIČIUS, J.F. & R.G. MARTINS-NETO, 2000. Checklist of South American Cenozoic insects. *Acta geol. hispan.* 35(1/2): 135-147. (With Span. s.). – (First Author: Depto Paleozool. Invert., Paso del Bosque s/n, AR-1900 La Plata).
The checklist is a compilation from literature. Palaeomacromia multicellulata is the only odon. sp. listed. For its description, see *OA* 14937.

2002

(18570) GARCIA-AVILÉS, J., 2002. *Biodiversidad de los humedales del Parque Regional del Sureste, 2: Libélulas*. Cent. Invest. ambient. Comunidad Madrid, (*Documentos* No. 36): 62 pp. ISBN 84-89198-46-2. – (Publishers: San Sebastián 71, ES-28791 Soto del Real, Madrid).
A checklist of the Odon. of Madrid (Spain) is presented (53 spp.), and the fauna (17 spp.) of the Sureste Regional Park is dealt with in some detail.

(18571) HUGUET, A., A. NEL, X. MARTINEZ-DELCLOS, G. BECHLY & R. MARTINS-NETO, 2002. Preliminary phylogenetic analysis of the Protanisoptera (Insecta: Odonatoptera). *Geobios* 35: 537-560. (With Fr. s.). – (Second Author: Entomologie, Mus. Natn. Hist. Nat., 45 rue Buffon, F-75005 Paris).
This Permian suborder is revised and a new phylogenetic hypothesis is proposed. The fam. Camptotaxineuridae and Kaltanoneuridae are excluded from the Protanisoptera. Proditaxineura gen. n. is described in Ditaxineuridae (type sp.: P. pritykinae Novokshonov).

(18572) STEWART, T.W., T.L. SHUMAKER & T.A. RADZIO, 2002. Linear and nonlinear effects of habitat structure and composition and abundance of the macroinvertebrate community of a large river. *Am. Midl. Nat.* 149: 293-305. – (First Author: Dept Nat. Resour. Ecol & Mngmt, Iowa St. Univ., Ames, IA 50011, USA).
An experiment and regression analyses were used to quantify effects of spatial variation in habitat structure abundance on a riverine macroinvertebrate community of the upper James river (Nelson co., Virginia, USA). Nonlinear relationships occurred between stone abundance and abundance of Erpetogomphus sp.

2003

(18573) STATON, S.K., A. DEXTRASE, J.L. METCALFE-SMITH, J. DI MAIO, M. NELSON, J. PARISH, B. KILGOUR & E. HOLM, 2003. Status and trends of Ontario Sydenham river ecosystem in relation to aquatic species at risk. *Envir. Monit. Assmnt* 88: 283-310. – (First Author: Great Lakes Lab. Fish. & Aquat. Sci., Dept Fisheries & Oceans, 867 Lakeshore Rd, Burlington, ON, CA).
Deals with freshwater mussels, fishes and a turtle, and lists also 8 provincially rare odon. spp. that

have been found in the Sydenham river, SW Ontario (Canada).

2004

(18574) HUANG, K.-Y., Y.-S. LIN & L. LIU SEVERINGHAUS, 2004. The diet of Besra sparrowhawk (Accipiter virgatus) in Yangmingshan area, northern Taiwan. *Taiwania* 49(3): 149-158. (With Chin. s.). – (Third Author: Res. Cent. Biodiv., Acad. Sinica, Taipei, Taiwan).
Anotogaster sieboldii is reported in the diet of the bird, occurring in the frequency of 0.7% and representing 0.1% of the consumed biomass.

(18575) KVAČEK, Z., M. BÖHME, Z. DVOŘÁK, M. KONZALOVÁ, K. MACH, J. PROKOP & M. RAJCHL, 2004. Early Miocene freshwater and swamp ecosystems of the Most Basin (northern Bohemia) with particular reference to the Biline Mine section. *J. Czech geol. Soc.* 49(1/2): 1-40. (With Czech s.). – (First Author: Inst. Geol. & Palaeontol., Fac. Sci., Charles Univ., Albertov 6, CZ-12843 Praha-2).
Various stages of ecosystem development within the Early Miocene Most Formation, the coal-bearing fill of the Most Basin in N. Bohemia (Czech Republic) are reviewed on the basis of recent sedimentological and palaeontological studies. Gomphidae gen. & sp. indet. larvae are described and reference is made (phot. incl.) to odon. taxa described by J. Prokop & A. Nel (*Eur. J. Ent.* 97[2000]: 427-431; *Acta Soc. zool. bohem.* 66[2002]: 141-150).

(18576) PAGEL, M., 2004. *Massnahmenkonzept zur Optimierung der Lebensräume von Amphibien und Libellen im Zollhausried bei Blumberg*. Diplomarbeit Fachbereich Landschaftsarchitektur, Umwelt- und Stadtplanung, Hochsch. Nürtingen. 127 pp. – (Author's current address unknown).
The current odon. fauna (19 spp.) of the Zollhausried nr Blumberg (Baden-Württemberg, Germany) is presented and compared to its previously recorded composition (31 spp.). A draft of the measures required to maximally increase the functionality of the breeding habitats is worked out in great detail.

(18577) UPM, [Publrs], 2004. *Suomen sudenkorennot*. UPM, Helsinki. 23 pp. ISBN none. (Finn.).
Portraits and brief presentation of 53 Finnish odon. spp.

2005

(18578) [BALINSKY, B.I.] HANRAHAN, S.A., 2005. Boris Ivan Balinsky (10 September 1905 – 1 September 1997). *Afr. Ent.* 13(2): 390-392. – (Anim., Plant & Envir. Sci., Univ. Witwatersrand, Johannesburg, SA).
A biography, appreciation of his work and his complete bibliography (1925-1987).

(18579) BRUNKEN, G., 2005. Zur Odonatenfauna eines Tongrubengewässers bei Zwinge (Eichsfeldkreis). *Naturk. Ber. Fauna Flora Süd-Niedersachs.* 10: 113-121. – (Kalklage 1, D-37077 Göttingen).
A commented list of 26 spp. recorded from a clay pit nr Zwinge, Eichsfeld distr., Lower Saxony (Germany).

(18580) JOSEPH, C.A. & M. BALAKRISHNAN, 2005. Abundance and richness of insects in Kazhakuttom Grama panchayat in Kerala. *Bull. natn. Inst. Ecol.* 16: 19-27. – (Dept Zool., Univ. Kerala, Kariavattom-695581, Kerala, India).
A list of 5 odon. fam.; no spp. identified; – India.

(18581) NIECHOJ, S., 2005. *Die Libellenfauna des Naturschutzgebietes Krickenbecker Seen*. Diplomarbeit Univ. Münster, Münster. iii+70 pp. – (c/o Inst. Landschaftsökol., Univ. Münster, Robert-Koch-Str. 26, Münster, Germany).
The Krickenbecker lakes are situated in the Naturpark Schwalm-Nette (districts of Viersen and Kleve), close to the Dutch border nr Venlo (Northrhine-Westphalia, Germany). Since the early 20th cent., 46 odon. spp. were recorded there, of these 33 spp. in 2004. The ecology and composition of the fauna are analysed. The recent increase of temperature is apparent from the (adult) phenology graphs and from the recent appearance of Crocothemis erythraea. Various protective measures are suggested.

2006

(18582) COUCEIRO, S.R.M., N. HAMADA, S.L.B. LUZ, B.R. FORSBERG & T.P. PIMENTEL, 2006. Deforestation and sewage effects on aquatic macroinvertebrates in urban streams in Manaus, Amazonas, Brazil. *Hydrobiologia* 2006: 14 pp.; – DOI: 10.1007/s10750-006-0373-z – (First Author, last known address: Inst. Nac. Pasquisas Amazônia, Av. André Araújo 2936, CP 478, BR-69060-001

Manaus, Amazonas).
In all, 65 streams were sampled in Oct.-Nov. 2003. Total nitrogen, total phosphorus, depth, width, electrical conductivity, temperature and dissolved oxygen were measured, and over 150.000 specimens, referable to 152 taxa were collected. Higher deforestation, nitrogen and phosphorus were correlated with lower oxygen, greater conductivity, pH and water temperature. Deforestation, nitrogen and phosphorus were not associated with water velocity and stream width. Depth was the only variable, correlated (negatively) with deforestation, but not with phosphorus and nitrogen. Greater deforestation, nitrogen and phosphorus were correlated with lower richness of taxa. Canonical Correspondence Analysis ordinated the streams into 2 groups, viz.: (1) that with high levels of deforestation and high phosphorus, nitrogen, pH, conductivity and temperature values, and (2) well-oxygenated and deep streams. 14 odon. gen. and (on fam. level) 4 fam. were considered. The correlation between taxa and first Axis of the Canonical Correspondence Analysis shows positive values related to well-oxygenated streams with greater depth and water velocity (Aeschnosoma, Epigomphus, Erythrodiplax, Gynothemis, Hetaerina, Macrothemis, Micrathyria, Orthemis, Perithemis, Phyllocycla, Progomphus, Zenythoptera, "Coenagrionidae", "Megapodagrionidae" and "Libellulidae"), while negative values are correlated with higher deforestation rates, pH and conductivity (Erythemis, Pantala, "Aeshnidae"). Progomphus is suggested as environmental indicator for nonimpacted streams and Gynothemis for those impacted by deforestation.

(18583) HONCŮ, M., 2006. Dragonflies (Odonata) of Kokorinsko Protected Landscape Area. *Bohemia centralis* 27: 231-239. (Czech, with Engl. s.). – (Vlastivědné Muzeum & Galerie, Nám. Osvobozeni 297, CZ-470-01 Česká Lipa).
Records of 33 spp., with comments. Noteworthy is the occurrence of Lestes dryas, Aeshna isosceles, Ophiogomphus cecilia, Crocothemis erythraea and Leucorrhinia pectoralis.

(18584) MATTEI, D., S. CATAUDELLA, L. MANCINI, L. TANCIONI & L. MIGLIORE, 2006. Tiber river quality in the stretch of a sewage treatment plant: effects of river water or desinfectants to Daphnia and structure of benthic macroinvertebrates community. *Water Air Soil Pollution* 177: 441-455. – (Last Author: Dipto Biol., Univ. Roma "Tor Vergata", Via della Ricerca Scientifica, I-00133 Roma).
The Tiber (Italy) was sampled in March, July, Oct. and Dec. at 3 sites: 600 m upstream the Roma Sud sewage treatment plant, at the outflow of the plant, and 200 m downstream. Platycnemis, Ischnura and Pyrrhosoma occurred in the upstream samples, and Ischnura and Orthetrum in those taken from the downstream station.

(18585) McMURRAY, P.D., Jr & S.A. NEWHOUSE, 2006. An annotated list of the aquatic insects collected in 2004 in the Wabash river watershed, Indiana. *Proc. Indiana Acad. Sci.* 115(2): 110-120. – (Biol. Stud. Sect., Indiana Dept Envir. Mngmt, 100 North Senate Ave, Indianopolis, IN 46204, USA).
47 streams and rivers were sampled; 25 identified odon. spp. are listed.

(18586) TENNESSEN, K.J., 2006. Description of the larva of Gomphus sandrius Tennessen (Odonata: Gomphidae). *Proc. ent. Soc. Wash.* 108(2): 381-388. – (125 N. Oxford St., Wautoma, WI 54982, USA).
The final instar larva from Tennessee (USA) is described, illustrated, and the feature distinguishing it from the sympatric G. exilis and G. lividus are pointed out.

2007

(18587) BRACCIA, A., J.R. VOSHELL, Jr & V.D. CHRISTMAN, 2007. The Odonata of newly constructed ponds, with life history and production of dominant species. *Aquat. Insects* 29(2): 115-130. – (First Author: Dept Ent., Virginia Tech, Blacksburg, VA 24061-0319, USA).
The species composition of an odon. assemblage from 6 new ponds in Virginia, USA, was documented, and life histories and production of 3 dominant spp. (Anax junius, Gomphus exilis, Enallagma civile) were determined. The assemblage consisted of 19 spp. and was numerically dominated by A. junius, G. exilis, E. civile, and libellulids. Production of A. junius, G. exilis, and E. civile was 795 mg DW m^{-2} yr^{-1}, 27 mg DW m^{-2} yr^{-1}, and 236 mg DW m^{-2} yr^{-1}, respectively. Coefficients of variation for production of each sp. were 50-77%, which suggest that variance should be considered in production estimates, especially if results are to be compared

across studies or habitats. Low density and production of the dominant spp. in this study may be a result of inadequate densities of food items and limited availability of preferred habitat in the newly created ponds.

(18588) C[ORDERO] RIVERA, A. & R.A. SÁNCHEZ-GUILLÉN, 2007. Male-like females of a damselfly are not preferred by males even if they are the majority morph. *Anim. Behav.* 74: 247-252. – (Gr. Ecol. Evol. & Conserv., Depto Ecol. & Biol. Anim., Univ. de Vigo, EUET Forestal, Campus Universitario, ES-36005 Pontevedra).
Animals searching for prey and ♂♂ searching for mates share similar problems of detection if their targets are diverse in colour or physical appearance. There is good evidence for predators switching their preferences for prey in a frequency-dependent way; predators focus on the most common form, and the decreased predation on rarer forms allows multiple forms to survive. Frequency-dependent mate selection has also been proposed to explain the maintenance of several ♀ colour morphs in Zygoptera. However, the fact that one of the ♀ morphs is coloured like a ♂ (androchrome) and behaves similarly to ♂♂ suggests the phenomenon of ♂ mimicry in this system as an alternative explanation for the polymorphism. Androchrome frequencies in populations and mating pairs were compared in Ischnura elegans, over a range of androchrome frequencies (8-90%). In 22 of 23 samples androchromes mated less often than expected (significantly in 13 samples). No evidence was found for ♂♂ switching their preferences in a frequency-dependent way. A test of ♂ preference for ♀ morphs in a population with 85% androchromes indicated that ♂♂ behaved indiscriminately and did not prefer the commonest (♂-like) morph. The results support androchrome ♂ mimicry rather than learned mate recognition by ♂♂ (a purely frequency-dependent model) as the main mechanism behind the maintenance of this sex-limited colour polymorphism.

(18589) HUANG, D.-Y. & A. NEL, 2007. Oldest "libelluloid" dragonfly from the Middle Jurassic of China (Odonata: Anisoptera: Cavilabiata). *N. Jb. Geol. Paläont. Abh.* 246(1): 63-68. – (First Author: Nanjing Inst. Geol. & Paleont., Chin. Acad. Sci., Nanjing-210008, China).
Juralibellula ningchengensis gen. n., sp. n. is described and illustrated from Jiulongshan Formation of Ningcheng co., Inner Mongolia. Juralibellulidae fam. n. is defined.

(18590) MARTILL, D.M., G. BECHLY & S.W. HEADS, 2007. Species list for the Crato Formation. *In*: D.M. Martill, G. Bechly & R.F. Loveridge, [Eds], *The Crato fossil beds of Brazil: window into an ancient world*, pp. 482-607, Cambridge Univ. Press, Cambridge. – (Second Author: Staat. Mus. Naturk. Stuttgart, Rosenstein 1, D-70191 Stuttgart). Odon. list on pp. 585-587.

(18591) MATTHEWS, J.H., S. BOLES, C. PARMESAN & T. JUENGER, 2007. Isolation and characterization of nuclear microsatellite loci for the common green darner dragonfly Anax junius (Odonata: Aeshnidae) to constrain patterns of phenotypic and spatial diversity. *Mol. Ecol. Notes* 2007: 3 pp.; – DOI: 10.1111/j.1471-8256.2007.01724.x. – (First Author: Sect. Integrative Biol., Univ. Texas, Austin, TX 78712, USA).
14 polymorphic microsatellite loci were developed from an enriched genomic library of A. junius. For a group of 22 larvae, these loci averaged 16 alleles, with individual loci ranging from 9 to 29 alleles. Observed heterozygosity averaged 0.784 per locus.

(18592) MULLEN, S.P. & J.A. ANDRES, 2007. *Rapid evolution of sexual signals in sympatric Calopteryx damselflies: reinforcement or 'noisy-neighbour' ecological character displacement?* 12 pp. – DOI: 10.1111/j.1420-9101.2007.01297.x. – (First Author: Dept Biol., 4211 Biol./Psychol. Bldg, Univ. Maryland, College Park, MD 20742, USA).
Enhanced prezygotic isolation in sympatry is one of the most intriguing patterns in evolutionary biology and has frequently been interpreted as evidence for reinforcement. However, the frequency with which reinforcement actually completes speciation remains unclear. C. aequabilis and C. maculata have served as one of the few classic examples of speciation via reinforcement outside of Drosophila. Although evidence for wing pattern displacement and increased mate discrimination in this system have been demonstrated, the degree of hybridization and gene flow in nature are unknown. Here it is shown that sympatric populations of these 2 spp. are the result of recent secondary contact, as predicted under a model of speciation via reinforcement. However, no phenotypic evidence of hybridization in natural populations was found and a complete

association between species-specific haplotypes at 2 different loci (mitochondrial CO I and nuclear EFI-α), suggesting little or no contemporary gene flow. Moreover, genealogical and coalescent-based estimates of divergence times and migration rates indicate that speciation occurred in the distant past. The rapid evolution of wing colour in sympatry is recent, therefore, relative to speciation and seems to be better explained by selection against wasting mating effort and/or interspecific aggression resulting from a 'noisy neighbour' signalling environment.

(18593) ROBIN, J., S. ALBINET & M. FUSARI, 2007. Atlas préliminaire des odonates de Tarn-et-Garonne. *Bull. Soc. Sci. nat. Tarn-et-Garonne* 31: 1-21. − (First Author: 6 rue de Stade, F-82370 Corbarieu).
Commented distribution maps of 48 spp; − dept Tarn-et-Garonne, France. − For an addition, see *OA* 18621.

(18594) SHARMA, G. & P.C. JOSHI, 2007. Diversity of Odonata (Insecta) from Dholbaha dam (distr. Hoshiarpur) in Punjab Shivalik, India. *J. Asia-Pacif. Ent.* 10(2): 177-180. − (First Author: Div. Ent., Indian Agric. Res. Inst., Pusa campus, New Delhi-110012, India).
A commented list of 30 spp., of which 5 spp. are recorded for the first time from the region.

2008

(18595) ANIKIN, V.V. & E.W. SEMENUSHKINA, 2008. Odonata checklist from Saratov province in Museum of Zoology of the Saratov State University. *In*: V.V. Anikin & N.V. Popov, [Eds], *Entomological and parasitological investigations in Volga region*, No. 7, pp. 59-62, Saratov Univ. Press. (Russ., with Engl. s.). − (Authors' addresses not provided.
An annotated list of 49 spp.

(18596) DE ALMEIDA ANDRADE, H.T., A.S. SANTIAGO & J.F. MEDEIROS, 2008. Structure of benthic invertebrate community with focus on the aquatic insects of the Piranhas-Assu river, state of Rio Grande do Norte, Northeast Brazil. *Entomo-Brasilis* 1(3): 51-56. (Port., with Engl. s.). − (First Author: Depto Microbiol. & Parasitol., Cent Biosciẽncias, Univ. Fed. Rio Grande do Norte, Brazil).
Includes a familywise review of the abundance of 8 odon. fam.

(18597) GIESEN, T., P. VERBEEK & P. KREKELS, 2008. *De libellen, sprinkhanen en krekels van [Dragonflies, grasshoppers and crickets of] Beekvliet, Heidenhoekse Vloed en Grote Beek*. Giesen & Geurts, Ulft. 38 pp. (Dutch). − ('tGoor, N-7071 PC Ulft).
35 odon. spp. are recorded from the 3 localities, Achterhoek, the Netherlands.

(18598) KAWNSAR-UL, Y., A.K. PANDIT & A.W. SHAHID, 2008. Some aspects of habitat ecology of aquatic entomofauna in two freshwater lakes of Kashmir Himalaya. *Proc. 12th World Lake Conf.*, pp. 1916-1921. − (Aquat. Ecol. Lab., P.G. Dept Envir. Sci., Univ. Kashmir, Srinagar-190006, J&K, India).
Deals with the fauna of the Dal and Nilnag lakes in the Srinagar area (alt. 1586 and 2180 m a.s.l., respectively), India. 5 odon. genera are listed. Aside of some misspellings ("Helecordulia" = Hemicordulia?) and errors in fam. affiliations, the identifications are in need of confirmation.

(18599) McNULTY, S., 2008. Rare dragonfly found on H[untington] W[ildlife] F[orest[. *Spruce Moose* 2008 (Fall): 10. − (Adirondack Ecol. Cent., 6312 State Rte 28N, Newcomb, NY 12852, USA).
1 ♂, Gomphus quadricolor, early June 2006 (New York, USA).

(18600) MEDINA, F.M., M. LÓPEZ-DARIAS, M. NOGALES & R. GARCIA, 2008. Food habits of feral cats (Felis silvestris catus L.) in insular semiarid environments (Fuerteventura, Canary Islands). *Wildl. Res.* 35: 162-169). − (First Author: Unidad de Medio Ambiente, Cabildo Insular de la Palma, Avda Los Indianos 20, 2º, ES-38700 Santa Cruz de la Palma, Canary Islands).
Anax imperator and indet. Odon. were identified in the cats diet.

(18601) MOLINERI, C., 2008. Impact of rainbow trout on aquatic invertebrate communities in subtropical mountain streams of northwest Argentina. *Ecol. austral.* 18: 101-117. (With Span. s.). − (ISSUE-CONICET, Fac. Cien. Nat., Lillo 205, AR-4000 San Miguel de Tucumán, Tucumán).
In the 3 water courses studied, the density of aeshnid larvae amounted to 0-4 ind/m^2. Their relative abundance in rainbow trout (Oncorhynchus mykiss) stomachs (n = 26) was 0.02% and their relative frequency there was 3.9%.

(18602) OERTLI, B., N. INDERMUEHLE, S. ANGÉLIBERT, H. HINDEN & A. STOLL, 2008. Macroinvertebrate assemblages in 25 high alpine ponds of the Swiss National Park (cirque of Macun) and relation to environment variables. *Hydrobiologia* 597: 29-41. – (First Author: École d'Ingénieurs, Univ. Appl. Sci. Western Switzerland, 150 rte Presinge, CH-1254 Jussy, Geneva).
During the sampling conducted between 2002 and 2004, no odon. were encountered in any of the Macun ponds, alt. 2480-2714 m a.s.l.), Engadine, Switzerland.

(18603) PEROVA, S.N., 2008. The taxonomic composition of macrozoobenthos in central Russian small karst lakes. *Inland Water Biol.* 1(4): 371-379. – (Papanin Inst. Biol. Inland Waters, Russ. Acad. Sci., RU-1527427 Borok, Yaroslavl oblast).
6 odon. spp. are reported from 4 lakes in Vladimir oblast.

(18604) RICCARDI, C., 2008. Libellule e dragonfly-watching nel Parco Adda Sud. *In*: R. Groppali, G. d'Amico & C. Riccardi, *Osservare gli insetti: farfalle e libellule del Parco Adda Sud. Atlante-guida per la fruizione della fauna minora nell'area protteta*, pp. 121-204, Parco Adda Sud [ISBN none]. *Conoscere il Parco*, No. 6. – (Adresses of Authors and Publishers not provided).
A detailed treatment of the 33 spp. so far recorded from the Park (Pianura Padana, Italy). The main objective of this work was to provide an account of the topics (and their respective methodology) in which the non-professional odonatologists could significantly contribute to the knowledge of local odon. biology.

(18605) STEINMANN, P., 2008. *Makrozoobenthos und aquatische Neozoen im Greifensee und Pfäffikersee, 2008*. Untersuchung im Auftrag der Baudirektion des Kantons Zürich (AWEL). Stein am See. 28 pp.
In samples from Greifensee, Platycnemis pennipes, Erythromma najas, Gomphus pulchellus and Onychogomphus uncatus, and in those from Pfäffikersee P. pennipes, E. najas, G. pulchellus, Libellula quadrimaculata and Orthetrum cancellatum larvae were identified. The differences in the inventories of the summer (July) and winter (Nov.) samples are specified. Canton Zürich, Switzerland.

(18606) WEI, L., N. HAN, L. ZHANG, K.M. HELGEN, S. PARSONS, S. ZHOU & S. ZHANG, 2008. Wing morphology, echolocation calls, diet and emergence time of black-bearded tomb bats (Taphozous melanopogon, Emballonuridae) from southwest China. *Acta chiropterol.* 10(1): 51-59. – (Last Author: Sch. Life Sci., East China Normal Univ., 3663 Zhongshan Beilu, Putuo, Shanghai-2000062, China).
The monthly (June-Oct.) abundance of odon. and their representation in diet of the bats are presented.

2009

(18607) BROCKHAUS, T. & A. RYCHŁA, 2009. Vorläufige kommentierte Checkliste der Libellen des Muskauer Faltenbogens (Insecta: Odonata). *Ber. naturf. Ges. Oberlausitz* 17: 77-82. (With Engl. s.). – (First Author: An der Morgensonne 5, D-09387 Jahnsdorf/Erzgebirge).
A commented list of 49 spp.; – Muskauer Faltenbogen (NE Saxony, Germany/SW Lubuskie, Poland).

(18608) BROYER, J., L. CURTET, J. BOUNIOL & J. VIEILLE, 2009. L'habitat de Leucorrhinia pectoralis Charpentier, 1825 (Odonata, Libellulidae) dans les étangs piscicoles de la Dombes (Ain). *Bull. mens. Soc. linn. Lyon* 78(3/4): 77-84. (With Engl. s.). – (Office Natn. Chasse & Faune Sauvage, Montfort, F-01330 Birieux).
A detailed description of the L. pectoralis habitats in the fishponds of Dombes (Ain, France).

(18609) CHEN, X., Y. FENG & Z. CHEN, 2009. Common edible insects and their utilization in China. *Ent. Res.* 39: 299-303. – (Res. Inst. Resource Insects, Chin. Acad. Forestry, Kunming-650224, China).
At present, 178 edible common insect spp. from 11 orders have been identified in China. Among these, there are odon. larvae of 6 or 7 spp., e.g. Lestes praemorsa, Gomphus cuneatus and Crocothemis servilia. The raw protein content of an odon. larva amounts to 40-65%. The nutritive elements of 3 odon. spp. have been analysed by Y. Feng et al. (2001, *Forest Res.* 14/4: 421-424).

(18610) FRAKER, M.E., F. HU, V. CUDDAPAH, S.A. McCOLLUM, R.A. RELYEA, J. HEMPEL & R.J. DENVER, 2009. Characterization of an

alarm pheromone secreted by amphibian tadpoles that induces behavioural inhibition and suppression of the neuroendocrine stress axis. *Hormones Behav.* 55: 520-529. – (Last Author: 3065/C Kraus Bldg, 830 North University Ave, Univ. Michigan, Ann Arbor, MI 48109-1048, USA).
It is shown that an alarm pheromone is produced by Rana sylvatica tadpole skin cells, is released into the medium via an active secretory process upon Anax junius larva attack and signals predator presence to conspecifics. The composition of the pheromone is described.

(18611) GROPPALI, R., 2009. Odonati europei e riscaldimento globale. *Studi trent. Sci. nat.* 86: 115-118. (With Engl. s.). – (Dipto Ecol. Territorio, Univ. Pavia, Via s. Epifanio 14, I-27100 Pavia).
The different effects of global warming on different European odon. spp. are concisely outlined.

(18612) HUMALA, A.E. & A.V. POLEVOY, 2009. On the insect fauna of South-East Karelia. *Trudy karel. nauch. Cent. russk. Akad. Nauk* 2009(4): 53-75. (With Engl. s.). – (First Author: Forest Res. Inst., Karelian Res. Cent., Russ. Acad. Sci, Pushkinskaya 11, RUS-185910 Petrozavodsk, Karelia).
Includes a checklist (with localities) of the 30 odon. spp. hitherto recorded from SE Karelia, Russia.

(18613) KARUBE, H., 2009. Present status of Odonata species in the Ogasawara islands and conservation effort to preserve endangered endemic species. *Jap. J. Limnol.* 70: 239-245. (Jap., with Engl. s.). – (Kanagawa Prefectural Mus. Nat. Hist., 499 Iryuda, Odawara, 250-0031, JA).
Since mid of the 1980s the status of the 5 endemic spp. of the oceanic islands of Ogasawara (Japan), viz. Boninagrion ezoin, Indolestes boninensis, Rhinocypha ogasawarensis, Hemicordulia ogasawarensis and Boninthemis insularis, is rapidly declining. This is probably due to the predation by an invasive alien sp. ("green anoles"), the taxonomic name of which is not stated. Currently, almost all the endemic odon. have gone extinct from the main islands of Chichi-jima and Haha-jima, but they are still surviving on a few satellite islands, where the construction of artificial ponds appears effective in their conservation.

(18614) LUTTBEG, B., J.I. HAMMOND & A. SIH, 2009. Dragonfly larvae and tadpole frog space use games in varied light conditions. *Behav. Ecol.* 20: 13-21 – (Dept Zool., Oklahoma St. Univ., 430 Life Sciences West, Stillwater, OK 74078, USA).
Predators and prey often engage in a game where predators attempt to be in areas with higher prey densities and prey attempt to be in areas with lower predator densities. A few models have predicted the resulting distributions of predators and prey, but little empirical data exist to test these predictions and to examine how abiotic and biotic factors shape the distributions. Thus, it was observed how Anax larvae and Pacific tree frog tadpoles (Pseudacris regilla) either together or separately distributed themselves in an arena with a high- and a low-prey resource patch. Trials were conducted in high- and low-light conditions to manipulate predation risk and to view the effects of this abiotic factor. Counter to the model predictions, predators were not more abundant in high-resource (HR) patches, and they thus did not force prey toward being uniformly distributed. Using a model selection approach to assess what factors affected predator and prey patch-switching movement, here it was found that prey more often left patches that had more predators present, but predators surprisingly more often left patches with more prey present. Light levels did not affect predation risk; however, in the dark with the associated reduction in visual information predators preferred HR patches. This caused a lower coincidence of prey and predators in patches. Predators also switched patches less often when they occupied the same patch as the other predator. This suggests that predator distributions, and indirectly prey distributions, are affected by the risk of intraguild predation.

(18615) MENKE, N. & M. OLTHOFF, 2009. Individuenreiche Vorkommen der Grossen Moosjungfer (Leucorrhinia pectoralis) in Westfalen im Jahr 2008: Massenflug oder übersehene Vorkommen? *Natur Heimat*, Münster 69(3): 69-72, Cover phot. excl. – (First Author: Stephanweg 15, D-48653 Münster).
Per locality/date, in Northrhine-Westphalia (Germany) only single or few L. pectoralis individuals were always observed. Here, a massive occurrence of this sp. in nature reserves of "Heiliges Meer" and "Gagelbruch Borkenberge" is brought on record (June, 2008).

(18616) MESSLINGER, U., 2009. Mond-Azurjungfer Coenagrion lunulatum (Charpentier, 1840).

MerkBl. Artenschutz bayer. Landesamt Naturschutz 28: 1-4. – (Am Weiherholz 43, D-91604 Flachslanden).
The ecological requirements of C. lunulatum are outlined and the measures for its protection in Bavaria (Germany) are suggested.

(18617) MESSLINGER, U., 2009. Vogel-Azurjungfer Coenagrion ornatum (Selys, 1850). *MarkBl. Artenschutz bayer. Landesamt Naturschutz* 27: 1-4. – (Am Weiherholz 43, D-91604 Flachslanden).
The ecological requirements of C. ornatum are outlined and the measures for its protection in Bavaria (Germany) are suggested.

(18618) NEL, A. & G. BECHLY, 2009. The third petalurid dragonfly from the Lower Cretaceous of Brazil (Odonata: Cretapetaluridae). *Annls zool.*, Warszawa 59(3): 281-285. – (First Author: Entomologie, Mus. Natn Hist. Nat., 45 rue Buffon, F-75005 Paris).
Cratopetalura petruleviciusi gen. n., sp. n. is described and illustrated from the Upper Aptian of Chapada do Araripe, NE Brazil.

(18619) PRYKE, J.S. & M.J. SAMWAYS, 2009. Conservation of the insect assemblages of the Cape Peninsula biodiversity hotspot. *J. Insect Conserv.* 13: 627-641. – (Dept Conserv. Ecol. & Ent., Cent. Agric. Biodiv., Fac. AgriSci., Univ. Stellenbosch, P.B. XI, Matieland-7602, SA).
Based on the PhD diss. as described in *OA* 17882, and including the reference to Azuragrion nigridorsum and Trithemis dorsalis that are new for the Cape Peninsula (S Africa).

(18620) RADWELL, A.J. & N.B. CAMP, 2009. Comparing chemiluminescent and LED light for trapping water mites and aquatic insects. *SEast. Nat.* 8(4): 733-738. – (First Author: Dept Biol. Sci., Univ. Arkansas, Fayetteville, AR 72701, USA).
The research compared the effectiveness of red, yellow, green and blue chemiluminescent candles and white light from a light emitting diode (LED) source in capturing water mites and insects in a macrophyte bed of a small reservoir in Arkansas, USA. Coenagrionidae, Lestidae, Gomphidae and Libellulidae were attracted by all light colours (save for Lestidae that did not turn up at blue). The traps were placed on the bottom of the lake and operated during 9 consecutive days throughout the night. The numbers of individuals captured per colour are stated.

(18621) ROBIN, J. & M. FUSARI, 2009. Deux nouvelles espèces pour l'atlas préliminaire des odonates de Tarn-et-Garonne. *Bull. Soc. Sci. nat. Tarn-et-Garonne* 33: 23-26. – (First Author: 6 rue de Stade, F-82370 Corbarieu).
Somatochlora m. metallica and Macromia splendens are added to the Tarn-et-Garonne inventory as presented in *OA* 18593 (France).

(18622) STEINER, U.K. & J. VAN BUSKIRK, 2009. Predation-induced changes in metabolism cannot explain the growth/predation risk tradeoff. *PLoNS ONE* 4(7): e6160, pp. 1-4. – (Inst. Zool., Univ. Zürich, Winterthurer Str. 190, CH-8057 Zürich).
Defence against predators is usually accompanied by declining rates of growth or development. The classical growth/predation risk tradeoff assumes reduced activity as the cause of these declines. However, in many cases these costs cannot be explained by reduced foraging effort or enhanced allocation to defensive structures under predation risk. Here, it was tested for a physiological origin of defence costs by measuring oxygen consumption in Rana temporaria tadpoles exposed to Aeshna cyanea predation risk over short and long periods of time. The short term reaction was an increase in oxygen consumption, consistent with the "fight-or-flight" response observed in many organisms. The long term reaction showed the opposite pattern: tadpoles reduced oxygen consumption after three weeks exposure to predators, which would act to reduce the growth cost of predator defence. The results point to an instantaneous and reversible stress response to predation risk. This suggests that the tradeoff between avoiding predators and growing rapidly is not caused by changes in metabolic rate, and must be sought in other behavioural or physiological processes.

(18623) SVENSSON, E.J., J.K. ABBOTT, T.P. GOSDEN & A. COREAU, 2009. Female polymorphism, sexual conflict and limits to speciation processes in animals. *Evol. Ecol.* 23: 93-108. – (First Author: Sect. Anim. Ecol., Lund Univ., Ecology Bldg, S-223-62 Lund).
Deals largely with Ischnura elegans.

(18624) THEISCHINGER G., 2009. *Identification*

guide to the Australian Odonata. Dept Envir., Climate Change & Water NSW, Sydney. iv + 283 pp. Softcover (21.0 × 29.5 cm). ISBN 978-74232-475--3. Publishers: 59-61 Goulbura St., P.O. Box A290, Sydney South-1232, AU).
The book covers 325 described spp. in 110 recognised gen., and provides keys to the identification of the adults and to the larvae as far as known and diagnosable. In order to facilitate identification and to increase confidence, particularly in the identification of some larvae, detailed distribution maps of all spp. are included. In addition, profiles are given for spp. of serious conservation concern. The keys are constructed with much skill and they are easy to use. The accompanying illustrations of structural features greatly facilitate the identification. In all, this is an excellent, most useful and very much needed work.

(18625) *TOMBO. ACTA ODONATOLOGICA JAPONICA* (ISSN 0495-8314), Vol. 52 (30 Dec. 2009). (Engl. & Jap., mostly with Engl. s's). − (c/o S. Wada, 3-8-18, Nishikida, Fukui-shi, Fukui, 918-8004, JA).
Tanaka, H.: A heterospecific copulation between the male of Sympetrum e. eroticum (Selys, 1883) and the female of S. baccha matutinum Ris, 1911 (col. cover phot.); − *Sasamoto, A.*: A new record of the rare libellulid Celebophlebia dactylogastra Lieftinck, 1936 (Anisoptera, Libellulidae, Tetrathemistinae) from Sulawesi island, Indonesia (pp. 1-5); − *Sasamoto, A. & I. Kayashima*: Description of the last instar larva of Nepogomphus walli (Fraser, 1924) (Anisoptera, Gomphidae, Onychogomphinae (pp. 7-12); − *Kamada, T. & N. Kawase*: An autumn emergence record of Gomphus postocularis Selys (p. 13); − *Futahashi, R. & H. Futahashi*: The first record of Sinogomphus flavolimbatus (Matsumura in Oguma, 1926) from Toyama prefecture, Honshu, Japan (p. 14); − *Yakita, R.*: Rediscovery of Stylogomphus shirozui watanabei Asahina from Ishigaki-jima island, Yaeyama isls, Japan (pp. 15-16); − *Kawashima, I.*: Oviposition by a female Onychogomphus viridicostus (Oguma) with deformed abdomen (p. 17); − *Eda, S.*: An unusual oviposition of Aeshna j. juncea (Linnaeus) (p. 18); − *Kita, H.*: A female Anaciaeschna martini (Selys, 1897) laid eggs into a decayed wood (pp. 19-20); − *Tsuchiya, F. & S. Eda*: A mature female of Polycanthagyna melanictera (Selys) with blue eyes (p. 20); − *Kita, H.*: A heterospecific copulation between the male of Sympetrum risi yoshiko Asahina, 1961 and the female of S. danae (Sulzer, 1776) (pp. 21-22); − *Kawashima, I.*: Male Sympetrum infuscatum (Selys) in tandem with only head and prothorax of female showed oviposition motion (pp. 23-24); − *Kita, H.*: Contact flying oviposition of Sympetrum frequens (Selys) onto grass (pp. 25-27); − *Itoh, S. & A. Sugimoto*: New records of Sympetrum fonscolombei (Selys) from Miyagi prefecture, northeastern Honshu (p. 28).

(18626) TORRALBA-BURRIAL, A. & F.J. OCHARAN, 2009 Two gynandromorphs of Sympetrum striolatum (Charpentier, 1840) (Odonata: Libellulidae). *Ent. Sci.* 12: 182-187. − (Dept Biol., Univ. Oviedo, ES-33071 Oviedo).
The 2 specimens (Huesca prov., Spain) are described and illustrated. One of these is a bilateral gynandromorph, the other has a ♀ gonopore but resembles a ♂ in general appearance.

(18627) VAUPOTIČ, M. & M. GOVEDIČ, 2009. Distribution of the thick shelled river mussel (Unio crassus Philippson, 1788) in the Goričko region (NE Slovenia). *Natura Sloveniae* 11(2): 27-38. (Slovene, with Engl. s.). − (First Author: ul. Generala Meistra 5, SI-9000 Murska Sobota).
During a Cordulegaster heros survey in Goričko, in numerous samples U. crassus was also represented; cf. *OA* 16577.

2010

(18628) ANDERSON, C.N. & G.F. GRETHER, 2010. Character displacement in the fighting colours of Hetaerina damselflies. *Proc. R. Soc.* (B) 2010: 7 pp.; DOI: 10.1098/rspb.2010.0935. − (Dept Ecol & Evol. Biol., Univ California, 621 Charles E. Young Dr. South, Los Angeles, CA 90095-1606, USA).
Aggression between spp. is a seldom-considered but potentially widespread mechanism of character displacement in secondary sexual characters. Based on previous research showing that similarity in wing coloration directly influences interspecific territorial aggression in Hetaerina, the authors predicted that wing coloration would show a pattern of character displacement (divergence in sympatry). A geographical survey of 4 Hetaerina spp. in Mexico and Texas showed evidence for character displacement in both species pairs that regularly occur sympatrically. H. titia that typically has large

black wing spots and small red wing spots, shifted to having even larger black spots and smaller red wing spots at sites where a congener with large red wing spots is numerically dominant (H. americana or H. occisa). H. americana showed the reverse pattern, shifting towards larger red wing spots where H. titia is numerically dominant. This pattern is consistent with the process of agonistic character displacement, but the ontogenetic basis of the shift remains to be demonstrated.

(18629) BECHLY, G., 2010. Additions to the fossil dragonfly fauna from the Lower Cretaceous Crato Formation of Brazil (Insecta: Odonata). *Palaeodiversity* 3 (Suppl.): 11-77. (With Germ. s.). – (Staat. Mus. Naturk. Stuttgart, Rosenstein 1, D-70191 Stuttgart).
Several interesting new discoveries of fossil odon. from the Lower Cretaceous Crato Formation of NE Brazil are presented. 2 new Zygoptera taxa (Euarchistigma peterknobli sp. n., and Santanagrion longipes sp. n.) are described, and a new specimen of Euarchistigma marialuiseae with preserved colour pattern, distinct from the type sp., is featured. Among the Anisoptera, 3 new fam. (Megaphlebiidae fam. n., Cratogomphus erraticus gen. n., sp. n., Cratohagenius erichweberi gen. n., sp. n., Megaphlebia rayandressi gen. n., sp. n., Magnathemis marcusthorhalli gen. n., sp. n. and Cratopetalia whiteheadi gen. n., sp. n.) are described. A further putative new anisopt. gen. and sp. is discussed and featured, but not formally described because of the poor preservation of the single available specimen. The original descriptions of Euarchistigma marialuiseae, Cratostenophlebia schwickerti, Eotanypteryx paradoxa, Paramesuropetala gigantea, Cordulagomphus hanneloreae and Cordulagomphus winkelhoferi are emended with new data and supplemented with drawings and photos. The newly discovered counter plate of the holotype of Cratopetalura petruleviciusi is featured. Some errors concerning collection numbers and depositions of fossil odon. are corrected and new collection numbers are updated for the Senckenberg museum collection.

(18630) BERNARD, R. & T. SCHMITT, 2010. Genetic poverty of an extremely specialized wetland species, Nehalennia speciosa: implications for conservation (Odonata: Coenagrionidae). *Bull. ent. Res.* 100(4): 405-413. – (First Author: Dept Gen. Zool., Mickiewicz Univ., Umultowska 89, PO-61-614 Poznan).
Oligo- and mesotrophic wetlands such as bogs, fens and swamps, have become more and more restricted in Europe, and wetland spp. related to them are increasingly threatened. Due to increasing habitat fragmentation, the exchange of individuals of these spp. among sites and, as a consequence, gene flow has been reduced or even eliminated. Here, the genetic structure of 11 populations of the stenotopic N. speciosa in Poland and Lithuania are analysed by means of allozyme electrophoresis of 14 gene loci. The overall genetic diversity of all populations was low (A: 1.32; H: 2.6%; P_{tot}: 29.2%), and no significant differences were observed among the different groupings of populations (degree of fragmentation, habitat type and size, population size). The genetic differentiation among populations was also low (F_{ST}: 2.0%) and no regional groups were detected. A low degree of isolation by distance was observed for genetic distances. Taking into account these results, the conservation effort for this sp. should be focused on large local populations and not necessarily on metapopulation structures. Furthermore, N. speciosa could be (re-)introduced in extinct patches and seemingly suitable localities. Genetically, such relocations should be feasible due to the generally high genetic homogeneity of populations.

(18631) BÖNSEL, A., 2010. Zum Vorkommen der Libellenarten aus der FFH-Richtlinie in Mecklenburg-Vorpommern (Odonata). *NaturschutzArb. Mecklenburg-Vorpommern* 53(1/2): 24-33. – (Krähenberger Holz 8, D-18337 Marlow).
Comments on the occurrence of Sympecma paedisca, Aeshna viridis, Gomphus flavipes, Leucorrhinia caudalis and L. pectoralis in Mecklenburg-Vorpommern (Germany).

(18632) DAS, S., S. ROY & A. MUKHOPADHYAY, 2010. Diversity of arthropod natural enemies in the tea plantations of North Bengal with emphasis on their association with tea pests. *Current Sci.* 99(10): 1457-1463. – (Ent. Res. Unit, Dept Zool., Univ. North Bengal, Darjeeling-734013, India).
In 5 tea estates in the Darjeeling hill slope, Dooars and Terai Region (NE India), Ceriagrion sp., Pseudagrion sp., Anax sp. and Ictinogomphus sp. constitute 4% of the predator fauna.

(18633) DOLNÝ, A. & H. MIŽIČOVÁ, 2010. Habitat requirements and significance of artificial habi-

tats of critically endangered dragonfly Sympetrum depressiusculum. *Čas slez. Muz. Opava* (A) 59: 113-119. (With Czech s.). – (Dept Biol. & Ecol., Fac. Sci., Univ. Ostrava, Chittussiho 10, CZ-710-00 Ostrava).
As a result of anthropogenic changes of aquatic habitats, the sp. abandons quickly and irreversibly its natural habitats. Recently it appeared in artificial habitats where, in suitable conditions, large populations may occur. One of the most suitable habitats are fishponds. This paper is primarily focused on S. depressiusculum occurrence in fish breeding ponds in N Moravia (Czech Republic). Habitat conditions prevailing in these and required for breeding of this sp. are analysed.

(18634) DUDAREV, A.N., 2010. Strekozy (Insecta, Odonata) verhovogo bolota "El'nya". – [Dragonflies (Insecta, Odonata) of the "Yelnya" raised bog]. *Vesn. Vitebsk. derzh. Univ.* 2010(2): 80-84. (Russ., with Engl. s.). – (Author's address not stated).
Yelnya (Belarus) is one of the largest European raised bogs. A commented overview is presented of the 20 spp. recorded there during 2007-2009.

(18635) EDIA, E.O., M. GEVREY, A. OUATTARA, S. BROSSE, G. GOURENE & S. LEK, 2010. Patterning and predicting aquatic insect richness in four West-African coastal rivers using artificial neural networks. *Knowledge & Mngmt aquatic Syst.* 2010, 398.06: 15 pp.; – DOI: 10.1051/kmae/2010029. (With Fr. s.). – (First Author: Lab. Envir. & Biol. Aquat., U.F.R.-S.G.E., Univ. Abobo-Adjamé, 02 BP 801, Abidjan-02, Ivory Coast).
Lists 15 odon. taxa (on sp. or gen. level), recorded from 8 sampling stations on the rivers of Soumié, Eholié, Ehania and Noé (Ivory Coast). Some identifications need confirmation.

(18636) FULAN, J.A., R. RAIMUNDO, D. FIGUEIREDO & M. CORREIA, 2010. Abundance and diversity of dragonflies four years after the construction of a reservoir. *Limnetica* 29(2): 279-286. (With Span. s.). – (First Author: Inst. Educ., Agric. & Ambiente, Univ. Fed. Amazonas, Rua 29 de Agosto 786, BR-69800-000 Humaitá, Amazonas).
Immediately prior to and 4 yr after the construction of the Alqueva dam on the Guadiana river (S Portugal), 17 spp. were recorded from 21 sites. The impoundment did not change species richness, but did modify the composition of the odon. community.

(18637) GIRGIN, S., N. KAZANCI & M. DÜGEL, 2010. Relationship between aquatic insects and heavy metals in an urban stream using multivariate techniques. *Int. J. envir. Sci. Technol.* 7(4): 653-664. – (First Author: Biol. Dept, Gazi Educ. Fac., Gazi Univ., Teknikokullar, Ankara, Turkey).
The relationship between some aquatic insects (incl. larvae of 14 odon. spp.) and some heavy metals (cadmium, lead, copper, zinc nickel, iron, manganese) and boron was assessed using data obtained from the Ankara stream (Ankara, Anatolia, Turkey). Environmental data were used to explain biological variation using multiple techniques provided by canonical correspondence analysis ordination. Data sets were classified by two way indicator species analysis. Platycnemis pennipes was placed close to the arrows representing cadmium, boron, iron and total hardness; Aeshna juncea was placed close to the arrows representing manganese, lead and nickel.

(18638) GRUNWELL, M.J., 2010. Dragonflies and damselflies in the state of Quatar. *Newsl. Qatar nat. Hist. Gr.* 2009/2010(3): 2-13. – (Author's address not stated).
A review of the 11 hitherto recorded spp. from Qatar, with an illustrated guide to the spp. documented or potentially occurring in Qatar, UAE.

(18639) HASSALL, C. & D.J. THOMPSON, 2010. Accounting for recorder effort in the detection of range shifts from historical data. *Methods Ecol. Evol.* 1: 343-350. – (Sch. Biol. Sci., Univ. Liverpool, Liverpool, L69 7ZB, UK).
Climate-induced range shifts have been detected in a large number of plant and animal taxa and a significant portion of these shifts have been found using records collected over a long period of time. However, the absence of standardized collecting procedures in some historical data sets introduces bias and skew into the data which can result in misleading conclusions. A range of different methods has been employed to account for this heterogeneity, but these methods have yet to be compared using a single data set. Here, the accuracy of published methods for accounting for this heterogeneity was tested. An extensive heterogeneous data base of sightings of Odon. from the United Kingdom was analysed using 4 published methods to control for uneven recorder effort. For each method, 5 different range statistics were calculated. The results were

compared and tested against changes in temperature over time to select the most accurate method. Significant variation existed between results derived using different methods to account for uneven recorder effort. Range statistics were also shown to exhibit different biases to varying recorder effort, particularly those most commonly used in published studies. A combination of existing methods is recommended to control for temporal variation in recorder effort. This focuses on random resampling of the more heavily recorded time period. A novel range statistic based on a gamma frequency distribution, which avoids the inherent bias of existing statistics, is suggested as a descriptor for range margins. – When the most robust methods to control for uneven recorder effort were combined with the most robust range statistics describing the range shift, British Odon. as a group were shown to be tracking isotherms between 1960 and 2005. Accurate description of past range shifts is essential for correct predictions of future trends and for making decisions concerning conservation priorities. The use of the best performing methods outlined here is strongly recommended to ensure consistency and accuracy in future studies.

(18640) HUDSON, J., 2010. Ocellated emerald dragonfly (Somatochlora minor) new to Alaska. *Newsl. Alaska ent. Soc.* 3(1): 1. – (Author's address not stated).
1 ♀, Kanuti National Wildlife Refuge, date not stated. A month later, a population was discovered at Juneau's Auke Lake; a photograph is provided.

(18641) *IDF-REPORT*. Newsletter of the International Dragonfly Fund (ISSN 1435-3393), Vols 28 (2010), 29 (2010). – (c/o M. Schorr, Schulstr. 7/B, D-54314 Zerf).
[Vol. 28]: *Schröter, A.*: The Odonata of Kyrgyzstan, 1: critical national checklist, annotated list of records and collected data of the summer half years 2008 and 2009 (pp. 1-72); – [Vol. 29]: *Kosterin, O.E.*: A glance at the Odonata of the Cambodian coastal mountainous regions: end of dry season in 2010 (pp. 1-75).

(18642) *INTERNATIONAL JOURNAL OF ODONATOLOGY* (ISSN 1388-7890), Vol. 13, No. 2 (1 Oct. 2010).
Orr, A.G., R.W.J. Ngiam & T.M. Leong: The larva of Tetracanthagyna plagiata, with notes on its biology and comparisons with congeneric species (Odonata: Aeshnidae) (pp. 153-166, pl. 1a excl.); – *Sarfaty, A. & S. Pruett-Jones*: Coloration indicates body size in Calopteryx maculata (Odonata: Calopterygidae) (pp. 167-180); – *Rüppell, G. & D. Hilfert-Rüppell*: Kinematic analysis of maiden flight of Odonata (pp. 181-192); – *Mauersberger, R.*: Leucorrhinia pectoralis can coexist with fish (Odonata: Libellulidae) (pp. 193-204); – *Dow, R.A.*: A review of the Teinobasis of Sundaland, with the description of Teinobasis cryptica sp. nov. from Malaysia (Odonata: Coenagrionidae) (pp. 205-230, pl. 2 excl.); – *Zhang, H., M. Hämäläinen & X. Tong*: Indiocypha catopta sp. nov. from Guizhou, China (Odonata: Chlorocyphidae) (pp. 231-240, pl. 3 excl.); – *Martens, A.*: Ecology of the dragonflies at the westernmost spot of Africa, the island of Santa Antão, Cape Verde (Odonata) (pp. 241-254, pl. 4a excl.); – *Kipping, J.*: Lestinogomphus silkeae sp. nov. from the Okawango and Zambezi rivers (Odonata: Gomphidae) (pp. 255-265); – *Suhling, F. & E. Marais*: Crenigomphus kavangoensis sp. nov. from the Okavango river, Namibia (Odonata: Gomphidae) (pp. 267-276, pl. 1b, c excl.); – *Kosterin, O.E. & V.V. Zaika*: Odonata of Tuva, Russia (pp. 277-328, pl. 4b excl.).

(18643) KAWASHIMA, I. & I. TSUJI, 2010. Records of Aeschnophlebia anisoptera Selys and Gynacantha japonica Bartenef (Odonata: Anisoptera: Aeshnidae) from the southern part of the Miura peninsula, Kanagawa prefecture. *Nat. Hist. Rep. Kanagawa* 31: 37-40. (Jap., with Engl. title). – (Author's addresses not provided).
[Abstract not provided].

(18644) KMOKSY, [Publrs], 2010. *Slovence böcek adlari / Slovenian insect names*. Keçiören, Ankara. 13 pp.
Lists some Slovenian appellations for various odon. spp.

(18645) KMOKSY, [Publrs], 2010. *Tatarca böcek adleri / Tartar insect names*. Keçiören, Ankara. 5 pp.
Lists Tartar appellations for "Odonata" and Aeshna grandis, the former with literal translation of the meaning, in Russian.

(18646) LE GALL, P., J.-F. SILVAIN, A. NEL & D. LACHAISE, 2010. Les insects actuels témoins des passés de l'Afrique: essai sur l'origine et la singu-

larité de l'entomofaune de la region afrotropicale. *Annls Soc. ent. Fr.* (N.S.) 46(3/4): 297-343. (With extensive Engl. s.). – (First Author: Lab. Evolution, Génomes, Spéciation, Av. de la Terrasse Bât. 13BPI, F-91198 Gif-sur-Yvette Cedex).
Only a few odon. fossils are hitherto known from Africa, therefore hardly any references are made here to the order. The publications concerned are listed in the appended and very comprehensive bibliography.

(18647) *LIBELLULA*. Zeitschrift der Gesellschaft deutschsprachiger Odonatologen, GdO (ISSN 0723-6514), Vol. 29 (3/4) (20 Dec. 2010). (Mostly Germ., with Engl. s's). – (c/o T. Fliedner, Louis-Seegelken-Str. 106, D-28717 Bremen).
Roland, H.-J.: Schlupfphänologie von Anax imperator und A. parthenope an einem Braunkohlerestloch in der Wetterau (Odonata: Aeshnidae) (pp. 143-154); – *Clausnitzer, H.-J., R. Hengst, C. Krieger & A. Thomes*: Boyeria irene in Niedersachsen (Odonata: Aeshnidae) (pp. 155-168); – *Hertzog, M.*: Beobachtung eines frisch geschlüpften Weibchens von Boyeria irene am Seerhein (Odonata: Aeshnidae) (pp. 169-174); – *Schweighofer, W., T. Hochebner & G. Rotheneder*: Lestes macrostigma im westlichen Niederösterreich (Odonata: Lestidae) (pp. 175-182); – *Staufer, M.*: Beobachtungen zur Mortalität wandernder Sympetrum striolatum und S. vulgatum an einem Autobahnzubringer im Nordburgenland (Odonata: Libellulidae) (pp. 183-196); – *Staufer, M. & O. Holuša*: First record of Cordulegaster heros in the Czech Republic, with notes on Cordulegaster spp. in southern Moravia (Odonata: Cordulegastridae) (pp. 197-204); – *Finkenzeller, M.*: First record of Pantala flavescens in Croatia (Odonata: Libellulidae) (pp. 205-208); – *Schröter, A.*: On a collection of dragonflies from eastern Georgia, with the first record of Sympetrum arenicolor (Odonata: Libellulidae) (pp. 209-222); – *Kunz, B.*: Heterospecific copulation with subsequent oviposition in Libellulidae (Odonata) (pp. 223-230); – *Roland, H.-J.*: Haltbarkeit von Anax-Exuvien am Ort der Emergenz (Odonata: Aeshnidae) (pp. 231-240); – *Tamm, J.*: Keineswegs nur braun: vom blauen Fleck an der Flügelbasis von Sympecma fusca (Odonata: Lestidae) (pp. 241-246).

(18648) LIN, C.-P., M.-Y. CHEN & J.-P. HUANG, 2010. The complete mitochondrial genome and phylogenetics of a damselfly, Euphaea formosa, support a basal Odonata within the Pterygota. *Gene* 468: 20-29. – (First Author: Dept Life Sci., Tunghai Univ., Taichung, Taiwan).
The first complete mitochondrial genome of E. formosa is determined, and a phylogeny is reconstructed, based on 13 protein-coding genes of mitochondrial genomes in 25 representative hexapods to examine the relationships among the basal Pterygota. The E. formosa mitochondrial genome is a circular molecule of 15,700 bp long, and contains the entire set of 37 genes typically found in insects. The gene arrangement, nucleotide composition, and codon usage pattern of the mitochondrial genome are similar across the three odonate species, suggesting a conserved genome evolution within the Odon. The presence of the intergenic spacer S5 likely represents a synapomorphy for the Anisoptera. Maximum parsimony, maximum likelihood, and Bayesian analyses of both mucleotide and amino acid sequences cannot support the three existing phylogenetic hypotheses of the basal Pterygota (Palaeoptera, Metapterygota, and Chiastomyaria). In contrast, the phylogenetic results indicate an alternative hypothesis of a strongly supported basal Odon. and a sister relationship of the Ephemeroptera and Plecoptera. The unexpected sister Ephemeroptera + Plecoptera clade, which contradicts with the widely accepted hypothesis of a monophyletic Neoptera, requires further analyses with additional mitochondrial genome sampling at the base of the Neoptera.

(18649) LOHR, M., 2010. *Libellen zweier europäischer Flusslandschaften*. Wolf & Kreuels, Bösensell. [Arb. Inst. Landschaftsökol. Univ. Münster 17]. vi + 183 pp. (With Fr. & Engl. s's). ISBN 978-3-937455-14-3. – Price: euro 25.- net. – (Author: Rottmündetal 48, D-37691 Boffzen; – Publishers: c/o NLU-Projektgesellschaft, Kley 22/A, D-48308 Bösensell).
The odon. colonisation in the alluvial floodplains of the semi-natural and regulated lower course of the Allier (France) and of the upper course of the Weser (Germany) is described. The spatio-temporal dynamics of the odon. communities is outlined. Based on the results of this study, the recommendations for the regeneration of the 2 floodplains are derived.

(18650) MAES, D., N. TITEUX, J. HORTAL, A. ANSELIN, K. DECLEER, G. DE KNIJF, V. FI-

CHEFET & M. LUOTO, 2010. Predicted insect diversity declines under climate change in an already impoverished region. *J. Insect Conserv.* 14: 485-498. − (First Author: Res. Inst. Nature & Forest, INBO, Kliniekstraat 25, B-1070 Brussels).

The possible changes in diversity and composition of (among others) Odon. in Belgium under increasingly severe climate change scenarios in the yr 2100 are forecast, using 2 species modelling techniques. Odon. diversity is predicted to decrease significantly in all scenarios, but odon.-rich locations are predicted to move upwards only in the less severe scenarios.

(18651) MALTCHIK, L., C. STENERT, C. BENDER KOTZIAN & M. MARQUES PIRES, 2010. Responses of Odonata communities to environmental factors in southern Brazil wetlands. *J. Kans. ent. Soc.* 83(3): 208-220. − (First Author: Lab. Ecol. & Conserv. Ecosist. Aquát., Univ. Vale do Rio dos Sinos, Av. Unisinos 950, BR-93022-000 São Leopoldo, Rio Grande do Sul).

The objectives of this study were to conduct a survey of the diversity of odon. larvae in southern Brazil wetlands, and to determine how much variation in odon. richness, abundance and composition is explained by wetland area, altitude, water conductivity and nitrate, hydroperiod, and dominant aquatic vegetation in 140 wetlands in an extensive area of the Neotropical region (±280,000 km^2, S Brazil). A total of 4,039 individuals distributed among 4 fam. and 28 gen. were collected. Libellulidae, Coenagrionidae and Aeshnidae showed the greatest richness. Erythrodiplax was observed in more than 70% of the sampled wetlands, and comprised 61% of individuals collected. Richness was negatively associated with water conductivity and nitrate, and it was higher in aquatic beds than in emergent wetlands. Richness and abundance were higher in permanent than in intermittent wetlands. Variation in odon. composition was correlated with wetland altitude, area and water conductivity. Hydroperiod and dominant aquatic vegetation also influenced composition. The results show that southern Brazil wetlands are important habitats for 28 odon. gen., and that richness, abundance and composition are influenced mainly by hydroperiod, nitrate, and aquatic vegetation type. They should be seen as important to determine the environmental factors that shape and maintain odon. diversity in southern Brazil wetlands.

(18652) NAGEL, L., T. ROBB & M.R. FORBES, 2010. Inter-annual variation in prevalence and intensity of mite parasitism relates to appearance and expression of damselfly resistance. *BioMed Central Ecology* 2010, 10: 5, 9 pp.; − http//www.biomedcentral.com/1472-6785/10/5 − (Dept Biol., Charleton Univ., 1125 Colonel By Dr., Ottawa, ON, K1S 5B6, CA).

Insects can resist parasites using the costly process of melanotic encapsulation. This form of physiological resistance has been studied under laboratory conditions, but the abiotic and biotic factors affecting resistance in natural insect populations are not well understood. Mite parasitism was studied in a temperate Lestes disjunctus population over 7 seasons to determine if melanotic encapsulation of mite feeding tubes was related to degree of parasitism, host sex, host size, emergence timing, duration of the emergence period, and average daily air temperature. Although parasite prevalence in newly emerged Lestes was > 77% each yr, hosts did not resist mites in the early years of study. Resistance began the yr that there was a dramatic increase in the number of mites on newly emerged insects. Resistance continued to be correlated with mite prevalence and intensity throughout the study. However, the percentage of hosts resisting only ranged from 0-13% among years and resistance was not sex-biased and was not correlated with host size. Resistance also was not correlated with air temperature or with timing or duration of Lestes emergence. Resistance in host damselflies was weakly and variably expressed over the study period. Factors such as temperature, which have been identified in laboratory studies as contributing to resistance by similar hosts, can be irrelevant in natural populations. This lack of temperature effect may be due to the narrow range in temperatures observed at host emergence among years. Degree of mite parasitism predicted both the appearance and continued expression of resistance among parasitized zygopterans.

(18653) NGIAM, R.W.J., 2010. Heliogomphus cf. retroflexus Ris, 1912 (Odonata: Anisoptera: Gomphidae), a possible new record for Singapore. *Nature Singapore* 3: 221-325. − (National Biodiv. Cent., National Parks Bd, 1Cluny Rd, Singapore-259569).

Based on 2 (not bred) larvae, H. cf. retroflexus was provisionally identified, though the known range of this sp. is well outside Singapore. − For the correction, see *OA* 18687.

(18654) OERTLI, B., 2010. The local species richness of dragonflies in mountain waterbodies: an indicator of climate warming? *BioRisk* 5: 243-251. − (Ecole d'Ingénieurs, 150 rte Presinge, CH-1254 Jussy, Geneva).

With climate warming, many odon. spp. are extending their geographical area. In Switzerland, as in many parts of the world, this phenomenon may lead to a regional increase in species richness. The local richness (i.e. the richness of individual waterbodies) is also expected to increase, particularly in the alpine and subalpine areas, where the waterbodies are particularly species-poor. Based on the species richness recorded in 109 waterbodies scattered all across Switzerland, a model is presented here relating the local species richness of adult odon. to environmental variables, including the mean annual air temperatures. The model predicts a sharp increase of species richness for alpine and subalpine waterbodies, which is expected to double or even treble before the end of the 21st century. This increase would be mainly the consequence of the immigration of eurythermal spp. extending their geographical range, together with potential local extinctions of the cold stenothermal spp. The altitudinal distributions in Switzerland of the 7 cold stenothermal spp. expected to exhibit a decrease of their geographical area, at the risk of extinction on the long range (Coenagrion hastulatum, Aeshna caerulea, A. juncea, A. subarctica, Somatochlora alpestris, S. arctica, Leucorrhinia dubia) and of the 9 eurythermal spp. that are likely to become more frequent at higher altitudes (Enallagma cyathigerum, Lestes sponsa, Aeshna cyanea, A. grandis, Cordulegaster bidentata, Cordulia aenea, Somatochlora metallica, Libellula quadrimaculata, Sympetrum danae) are shown in a graph.

(18655) OUTOMURO, D., A. TORRALBA-BURRIAL & F.J. OCHARAN, 2010. Distribution of the Iberian Calopteryx damselflies and its relation with bioclimatic belts: evolutionary and biogeographic implications. *J. Insect Sci.* 10, art. 61, 16 pp.; available online: insectscience.org/10.61 − (Depto Biol. Organismos & Sistemas, Univ. Oviedo, ES-33071 Oviedo).

Using bioclimatic belts as habitat and distribution predictors, the present study examines the implications of the potential distributions of the 3 Iberian Calopteryx spp. with the aim of investigating the possible consequences in specific interactions among the spp. from a sexual selection perspective and of discussing biogeographical patterns. To obtain the known distributions, the literature on this genus was reviewed, relating the resulting distributions to bioclimatic belts. Specific patterns related to bioclimatic belts were clearly observed in the Mediterranean region. The potential distribution maps and relative frequencies might involve latitudinal differences in relative abundances, C. virgo meridionalis, being the most abundant sp. in the Eurosiberian region, C. xanthostoma in the northern half of the Mediterranean region and C. haemorrhoidalis in the rest of this region. These differences might explain some previously described latitudinal differences in secondary sexual traits in the 3 spp. Changes in relative abundances may modulate interactions among these spp. in terms of sexual selection and may produce sexual character displacement in this genus. C. virgo meridionalis distribution and ecological requirements explain its paleobiogeography as a sp. which took refuge in Iberia during the Würm glaciation. Finally, possible consequences in species distributions and interactions are discussed within a global climate change context.

(18656) PAILLAT, R., 2010. Les libellules (Odonata) de l'étang de la Benette, à Senonches. *Gazette Eure-et-Loir Nature* 2010: 9-12. − (Author's postal address not stated).

21 spp. were recorded from the Benette marsh at Senonches (Eure-et-Loir, France). The occurrence of Aeshna grandis, Boyeria Irene and Cordulegaster boltonii is emphasized.

(18657) PINTO, A.P. & C.J.E. LAMAS, 2010. Navicordulia aemulatrix sp. nov. (Odonata, Corduliidae) from northeastern Santa Catarina state, Brazil. *Revta brasil. Ent.* 54(4): 608-617. (With Port. s.). − (Mus. Zool., Univ. São Paulo, Av. Nazaré 481, Ipiranga, BR-04263-000 São Paulo, SP).

The new sp. is described and illustrated from 3 ♂. Holotype ♂ Brazil, Santa Catarina state, São Bento do Sul, Rio Vermelho, II-1952; deposited in MNRJ. The long cercus places it in the longistyla-group, along with N. kiautai, N. longistyla and N. nitens. An unusual process on tergal portion of prothorax is reported in Navicordulia for the first time. A map of Navicordulia records in Atlantic Forest and a list of the Brazilian corduliids by state are included.

(18658) POINAR, G., Jr, 2010 Palaeoecological perspectives in Dominican amber. *Annls Soc. ent. Fr.* (N.S.) 40(1/2): 23-52. (With Fr. s.). – (Dept Zool., Oregon St. Univ., Corvallis, OR 97331, USA).
Palaeoecological and palaeobiogeographical aspects of Domiican amber are discussed based on the known insect fauna. A reference is made (along with a phot.) to Diceratobasis worki, whose present day relatives deposit eggs in tank bromeliads (cf. *Odonatologica* 25: 381-385; 1996).

(18659) PROKOP, J., A. NEL & A. TENNY, 2010. On the phylogenetic position of the palaeopteran Syntonopteroidea (Insecta: Ephemeroptera), with a new species from the Upper Carboniferous of England. *Organisms Divers. Evol.* 10: 331-340. – (First Author: Dept Zool., Fac. Sci., Charles Univ., Vinična 7, CZ-128-44 Praha-2).
Wing venation synapomorphies are proposed for the Syntonopteroidea (sensu novo) and for a potential clade, (Ephemeroptera + Syntonopteroidea) + Odonatoptera, separated from the Palaeodyctiopterida.

(18660) RANTALA, M.J., J. HONKAVAARA, D.W. DUNN & J. SUHONEN, 2010. Predation selects for increased immune function in male damselflies Calopteryx splendens. *Proc. R. Soc.* (B) 2010: 8 pp.; – DOI: 10.1098/rspb.2010.1680. – (First Author: Sect. Ecol., Dept Biol., Univ. Turku, FI-20014 Turku).
Predation selects for numerous traits in many animal species, with sick or parasitized prey often being at high risk. When challenged by parasites and pathogens, prey with poor immune functions are likely to be at a selective disadvantage. Here, the hypothesis that predation by birds selects for increased immune function was tested in a wild population of ♂ C. splendens, while controlling for a trait known to be under selection by bird predation, dark wing-spots. It was found that selection on both immune function and wing-spot size was significantly positive, and that selection on either trait was independent of selection on the other. There was no evidence of nonlinear quadratic or correlational selection. In contrast to previous studies, no phenotypic correlation was found between immune function and wing-spot size. There was also no difference in immune response between territorial and non-territorial ♂♂. This study suggests that predation may be an important agent of selection on the immune systems of prey, and because the detected selection was directional, it has the potential to cause phenotypic change in populations.

(18661) RESENDE, D.C., 2010. Residence advantage in heterospecific territorial disputes of Erythrodiplax Brauer species (Odonata, Libellulidae). *Revta bras. Ent.* 54(1): 110-114. (With Port. s.). – (Lab. Bioinform. & Evol., Depto Biol. Geral, Univ. Fed. Viçosa, BR-36570-000 Viçosa, MG).
The aggressiveness during territorial disputes was studied (São José, MS, Brazil) in E. famula, E. fusca, E. latimaculata, E. media and E. pallida. It was examined whether larger spp. are more aggressive than the smaller ones, and whether the residence advantage prevails in heterospecific disputes. Large spp. were not more aggressive than the smaller ones and winners of intra- and interspecific territorial disputes were defined mainy by the residence. The advantage of residence appears to prevail over any other asymmetry among these spp. This pattern may be due to the circumstance that despite the ♂ territorial behaviour, heterospecific disputes may not increment ♂ reproductive success, because they may not increase their access to ♀♀.

(18662) ROLAND, H.-J., U. ROLAND & E. POLLARD, 2010. Incidental records of dragonflies and damselflies (order Odonata) in Cambodia. *Cambodian J. nat. Hist.* 2010(2): 97-102. – (First Author: Im Mühlahl 35, D-61203 Reichelsheim).
Records of 33 spp., from 13 localities. Aethriamanya aethra, A. brevipennis. A. gracilis, Brachydiplax farinose and Rhyothemis triangularis are for the first time reported from Cambodia.

(18663) SAMEJIMA, Y. & Y. TSUBAKI, 2010. Body temperature and body size affect flight performance in a damselfly. *Behav. Ecol. Sociobiol.* 64: 685-692. – (Cent. Ecol. Res., Kyoto Univ., 2-509-3 Hirano, Otsu, Shiga, 520-2113, JA).
Though it is well-known that the flight performance is influenced by body temperature and body size, the relative importance of these factors is not well-understood. Laboratory experiments were performed using the ♂-polymorphic Mnais costalis with larger territorial ♂♂ and smaller non-territorial ♂♂ in a population. The effects were analysed of body temperature and body size, measured as the thoracic temperature and left hindwing length, respectively, on indices of flight performance: maximum lifting

force and size-corrected lifting force. The latter is an index of acceleration that is related to aerial agility. The results showed that higher body temperature produced both larger maximum lifting force and larger size-corrected lifting force. In contrast, while larger size produced a larger maximum lifting force, it produced a lower size-corrected lifting force. The results of field measurements showed that territorial males had variable thoracic temperatures depending on the insolation in their territories. In contrast, non-territorial ♂♂ had less variable and generally higher thoracic temperatures than territorial ♂♂ as they are mostly found in sunny spots. Until now, the influence of body temperature on behavioural performance has remained unclear although considerable studies have suggested such influence. The combined effects of body size and body temperature on flight performance are shown here for the first time. It is also shown that body temperature was influenced by the mating strategies of a damselfly. These findings provide new insights into the cost and benefits of territorial behaviour in ectothermic animals.

(18664) SÁNCHEZ, M., E. REALPE & C. SALAZAR, 2010. A neotropical polymorphic damselfly shows poor congruence between genetic and traditional morphological characters in Odonata. *Mol. Phylogen. Evol.* 2010: 6 pp.; – DOI: 10.1016/j.ympev. 2010.08.016. – (First Author: Lab. Zool. & Ecol. Acuática, Univ. Andes, Cr. 1, No. 18A, CO-10-J307 Bogotá).
The genus Polythore consists of 19 described morphospecies. The COI barcode locus (799 b), ♂ genitalia, wing venation and geometrical pattern variation are used to clarify specific status in 4 Polythore procera populations in the Andean foothills of Colombia. Morphological data corroborates that all populations are P. procera, but molecular data suggests 2 well-supported reciprocal monophyletic clades. A high genetic divergence (~3%) was observed between them, and different degrees of gene flow were estimated by MDIV among populations. The results support a recent (1.4 mya) possible speciation with morphological stasis where unknown reproductive mechanisms may be involved.

(18665) SANTOS, T.C., J.M. COSTA & C. CARRICO, 2010. A new species of Neocordulia Selys, 1882 (Odonata: Corduliidae) from Minas Gerais state, Brazil. *Biota neotrop.* 10(2): 89-91. (With Port. s.). – (Depto Ent., Mus. Nac., UFRJ, Quinta da Boa Vista, São Cristóvão, BR-20940-040 Rio de Janeiro, RJ).
N. machadoi sp. n. is described and illustrated. Holotype ♂; Brazil, Minas Gerais, Cachoeira da Eubiose stream, São Tomé das Letras, 15-X-2009; deposited in MNUFRJ, Rio de Janeiro.

(18666) SCHIEL, F.-J & N. HUNGER, 2010. *Libellenerfassung und Effizienzkontrollen von wasserbaulichen Massnahmen im Life-Natur-Projekt „Lebendige Rheinauen bei Karlsruhe“*. INULA, Sasbach. 92 pp. – (Inst. Naturschutz u. Landschaftsanalyse, Turenneweg 9, D-77880 Sasbach).
During 2005-2009, the odon. communities of 25 water bodies, situated within the project area nr Karlsruhe (Germany), were systematically studied and analysed; 45 spp. were recorded.

(18667) SHARMA, C. & D.S. SAINI, 2010. Studies on the zygopterous dragonfly larval forms from Rewa. *Int. J. Pharmacy Life Sci.* 1(6): 350-356. – (Zool. Lab., Janata P.G. Coll., Rewa, M.P., India).
The structural features of instars 2-14 in Pseudagrion decorum, Ischnura delicata and I. senegalensis are described. Figs are not provided.

(18668) SHERRATT, T.N., R.A. LAIRD, C. HASSALL, C.D. LOWE, I.F. HARVEY, P.C. WATTS, A. CORDERO-RIVERA & D.J. THOMPSON, 2010. Empirical evidence of senescence in adult damselflies (Odonata: Zygoptera). *J. Anim. Ecol.* 79: 1034-1044. – (First Author: Dept Biol., Charleton Univ., 1125 Colonel By Dr., Ottawa, ON, K1S 5B6, CA).
Odon. provide excellent candidate spp. for evaluating demographic senescence as they are large enough to be marked individually and they are easily re-sighted without recapture. The prevailing opinion, based entirely on qualitative examination of the declines in log numbers alive with time since marking, is that odon. exhibit age-dependent daily survivorship. Here are examined mark-recapture data on Coenagrion puella over 2 consecutive seasons. For the first time evaluated and compared the fit of quantitative models that not only account for weather-dependent daily variation in daily re-sighting rates, but also age-dependent variation in daily survivorship. Models with age-dependent declines in daily survivorship provide a more parsimonious explanation for the data than similar models with-

out these age-dependent effects. In general, models in which mortality increases in an exponential (Gompertz) fashion explain the mark-recapture sequences more efficiently than a range of alternative models, including those in which mortality increases as a power function (Weibull) or reaches a plateau (logistic). These results are indicative of a general senescent decline in physiological functioning, which is particularly marked after 15 days as a mature adult. Weather (temperature, sun and precipitation) and initial mite load influenced the probability of daily re-sighting. Weather and mite load also influenced daily survivorship, but their effects differed between seasons. Overall, fitting models with age as an explicit covariate demonstrates that odon. do indeed senesce. This contradicts previously held assumptions that Odon. do not exhibit age-dependent survivorship in the wild.

(18669) SITES, R.W. & A. VITHEEPRADIT, 2010. Recovery of the freshwater lentic insect fauna in Thailand following the tsunami of 2004. *Raffles Bull. Zool.* 58(2): 329-348. – (Enns Ent. Mus., Div. Plant Sci., Univ. Missouri, Columbia, MO 65211, USA).
Along the Andaman Sea coast, the adults of 23 odon. spp. were recorded from the perimeter of tsunami-inundated and nearly unaffected ponds, but the larvae could be identified at fam. level only. The inundated ponds were re-colonized quickly by taxa with high salt tolerance (incl. some libellulids). Other groups arrived later during freshwater recharge. 5 months after the tsunami, odon. taxonomic diversity was similar between the inundated and unaffected ponds.

(18670) STARZOMSKI, B.M., D. SUEN & D.S. SRIVASTAVA, 2010. Predation and facilitation determine chironomid emergence in a bromeliad-insect food web. *Ecol. Ent.* 35: 53-61. – (Biodiv. Res. Cent. & Dept Zool., Univ. Brit. Columbia, Vancouver, BC, V6T 1Z4, CA).
Ecological theory has focused on negative interactions, such as competition and predation, to explain species' effects on one another. This study demonstrates the importance of considering both positive and negative interactions in explaining how species influence abundances at the local scale. 2 experiments were conducted using the aquatic insect food web in Costa Rican bromeliad phytotelmata. Manipulations contrasted the strength of predation between trophic levels versus facilitation within a trophic level on the emergence of detritivore chironomids. Predation had a strong negative effect on chironomids, reducing emergences by 81% overall. Most predation was as a result of the top predator, the odon. Mecistogaster modesta; the intermediate predator, a tanypodine chironomid, had little effect. In the absence of predators, shredder and scraper detritivores (tipulid and scirtid larvae) increased the emergence rate of chironomid larvae by 86%. The mechanism of facilitation was likely the processing, by tipulids and scirtids, of intact detritus into fine particles that the detritivore chironomids consume or use to build protective cases. This study is among the first demonstrations of a processing chain in a multi-species context, and in bromeliad-insect food webs. The finding that top-down effects are of similar magnitude to facilitative effects suggests that the relative importance of processing chains in nature will depend on food web context.

(18671) SUHONEN, J., M. HILLI-LUKKARINEN, E. KORKEAMÄKI, M. KUTTUNEN, J. KULLAS, J. PENTTINEN & J. SALMELA, 2010. Local extinction of dragonfly and damselfly populations in low- and high-quality habitat patches. *Conserv. Biol.* 24(4): 1148-1153. (With Span. s.). – (Dept Biol. & Envir. Sci., Univ. Jyväskylä, P.O. Box 35, FI-40014 Univ. Jyväskylä).
Understanding the risk of extinction of a single population is an important problem in both theoretical and applied ecology. Local extinction risk depends on several factors, including population size, demographic or environmental stochasticity, natural catastrophe, or the loss of genetic diversity. The probability of local extinction may also be higher in low-quality sink habitats than in high-quality source habitats. This hypothesis was tested by comparing local extinction rates of 15 odon. spp. between 1930-1975 and 1995-2003 in central Finland. Local extinction rates were higher in low-quality than in high-quality habitats. Nevertheless, for the 3 most common spp. there were no differences in extinction rates between low- and high-quality habitats. These results suggest that a good understanding of habitat quality is crucial for the conservation of spp. in heterogeneous landscapes.

(18672) TARUNKUMAR SINGH, O., J. CHAKRAVORTY & R. VARATHARAJAN, 2010. Entomofauna of Kane Wildlife Sanctuary, Arunachal

Pradesh, northeastern India. *J. threatened Taxa* 12(13): 1392-1400. – (First Author: Cent. Biodiv., Dept Zool., Rajiv Gandhi Univ., Itanagar, Arunachal Pradesh-791112, India).
Lists 23 odon. spp.

(18673) TAYLOR, A.N., 2010. Impacts of cadmium contamination and fish presence on wetland invertebrate communities: an application of population measures and multi-metric tests. *Ecol. Indicators* 10: 1206-1212. – (Dept Natur. Resour., Cornell Univ., Ithaca, NY 14853, USA).
Invertebrate communities (incl. 6 odon. gen.) were examined in 6 experimental wetland ponds in the Cornell Experimental Pond System (Ithaca, NY, USA) to assess the effects of residual cadmium. They were constructed in 1965 and have sustained themselves long enough to be considered natural wetland ecosystems. They were structurally identical, littoral vegetation occurring along the periphery of each pond. 3 of the ponds received cadmium impact in 1983: the cadmium ($CdCl^2$) levels were 2.9, 3.5 and 4.4 mg/kg, respectively. No cadmium was detectable in the other 3 ponds. 3 ponds had fish and 3 were fishless. The abundance of odon. larvae was the highest in fishless, cadmium free ponds, but the odon. taxon diversity was the highest in a cadmium treated fishless pond; Tetragoneuria occurred only in cadmium treated fish- and fishless ponds (8 ind/m^2 and 25 ind/m^2, respectively), and Lestes (1 ind/m^2) only in a cadmium treated fishpond. The study suggests that trophic interaction between fish and odon. should be considered in wetland index development and implementation.

(18674) TOŃCZYK, G. & M. STANKIEWICZ, 2010. Wazki (Odonata). *In*: R. Jakuła & G. Tończyk, [Eds], *Owady (Insecta) Parku Krajobrazowego Wzniesień Łódzkich*, pp. 17-26, Dyrekcja PKWL, Łódz. ISBN 978-83-915293-7-9. (Pol.). – (First Author: Dept Invert. Zool. & Hydrobiol., Univ. Łodz, Banacha 12/16, PO-90-237 Lodz).
Records of 41 spp.; – Landscape Park "Wzniesień Łódzkich", Poland.

(18675) TORRALBA BURRIAL, A. & M. ALONSO NAVEIRO, 2010. Biodiversidad de odonatos de la sierra de Fonfria y Cuenca del Jiloca (Teruel): faunistica. *Xiloca* 38: 111-147. (With Engl. s.). – (First Author: Depto Biol. Organismos & Sistemas, Univ. Oviedo, ES-33071 Oviedo).
A survey is presented of the odon. fauna (35 spp.) of Fonfria Mts and the Jiloca river basin (Teruel prov., NE Spain). Of particular interest are populations of the threatened Coenagrion caerulescens, C. mercuriale, C. scitulum, Onychogomphus uncatus and Sympetrum flaveolum.

(18676) TSUBAKI, Y., Y. SAMEJIMA & M.T. SIVA-JOTHY, 2010. Damselfly females prefer hot males: higher courtship success in males in sunspots. *Behav. Ecol. Sociobiol.* 2010: 8 pp; – DOI: 10.1007/s00265-010-0968-2. – (First Author: Cent. Ecol. Res., Kyoto Univ., Hirano 2-509-3, Otsu, Shiga 520-2113, JA).
♂♂ of some territorial calopterygids show an elaborate courtship display that involves high-frequency wing-beats directed toward an incoming ♀. Although it has been suggested that ♀ mate preference is based on some characteristics of ♂'s courtship display, it is unclear whether the courtship display varies between ♂♂ or is influenced by environmental conditions. 2 recent technologies, thermographic imaging and high-speed digital videography, were here combined, to show that the wing-beat frequency during courtship (i.e., courtship intensity) in Mnais costalis is correlated with thorax temperature. The data indicated that (1) ♂ thorax temperature was associated with solar exposure in his territory, (2) environmentally derived thermal gain enhanced courtship intensity, (3) hotter ♂♂ were more likely to copulate than others, and (4) ♀ thorax temperature during oviposition within a territory was associated with solar exposure. ♂♂ with territories that have longer exposure to sun spots are expected to attain higher thorax temperatures for longer and so are able to successfully court more ♀♀. It is suggested that ♀♀ benefit from mating with hot ♂♂ because they will be on a warmer territory while ovipositing. Hot ♂♂ might also have greater mate guarding ability, and/or eggs may develop faster in warmer territories.

(18677) TSUCHIYA, K. & F. HAYASHI, 2010. Factors affecting sperm quality before and after mating of calopterygid damselflies. *PLoS ONE* 5(3): e9904, 7 pp.; – DOI: 10.1371/journal. pone.0009904. – (Dept Biol., Tokyo Metropol. Univ., Minamiosawa 1-1, Hachioji, Tokyo, 192-0397, JA).
Zygoptera have a more complex sperm transfer system than other internally ejaculating insects. ♂♂ translocate sperm from the internal reproductive

organs to the specific sperm vesicles, a small cavity on the body surface, and then transfer them into the ♀. To examine how the additional steps of sperm transfer contribute to decreases in sperm quality, sperm viability (the proportion of live sperm) was assessed at each stage of mating and after different storage times in ♂ and ♂ reproductive organs in Mnais pruinosa and Calopteryx cornelia. Viability of stored sperm in ♀♀ was lower than that of ♂ stores even just after copulation. ♂ sperm vesicles were not equipped to maintain sperm quality for longer periods than the internal reproductive organs. However, the sperm vesicles were only used for short-term storage; therefore, this process appeared unlikely to reduce sperm viability when transferred to the ♀. ♂♂ remove rival sperm prior to transfer of their own ejaculate using a peculiar-shaped aedeagus, but sperm removal by ♂♂ is not always complete. Thus, dilution occurs between newly received sperm and aged sperm already stored in the ♀, causing lower viability of sperm inside the ♀ than that of sperm transferred by ♂♂. If ♀♀ do not remate, sperm viability gradually decreases with the duration of storage. Frequent mating of ♀♀ may, therefore, contribute to the maintenance of high sperm quality.

(18678) WATTS, P.C., S. KENT & D.J. THOMPSON, 2010. Patterns of spatial genetic structure and diversity at the onset of a rapid range expansion: colonisation of the UK by the small red-eyed damselfly Erythromma viridulum. *Biol. Invasions* 12: 3887-3903. – (Sch. Biol. Sci., Univ. Liverpool, Biosci. Bldg, Crown St., Liverpool, L69 7ZB, UK).
Species' geographic ranges may vary in size in response to a change in environmental conditions. The specific genetic consequences of range expansions are context dependent, largely depending upon the rate of colonisation as well as the origins and numbers of founders, and the time since colonisation. Like other "charismatic" taxa, such as birds and lepidopterans, the distributions of odon. are well-known through substantial monitoring programmes co-ordinated by various societies. E. viridulum has undergone a substantial, northward range expansion in Europe in the last 30 yr and has recently-colonised 2 distinct areas in the UK. Here, the immediate genetic consequences of this rapid colonisation are quantified by genotyping more than 1,400 E. viridulum from 39 sites across the NW margin of its geographic range. Levels of genetic diversity and spatial structure are impacted by the recent range expansion and non-equilibrium conditions that drive weak genetic divergence, even at regional spatial scales. E. viridulum populations become less diverse towards the edge of its distribution, presumably as a consequence of colonisation through a series of founder events. Specifically, there is a significant reduction in genetic diversity in the smallest, most recent focus of colonisation in the UK; however, there are generally low levels of genetic diversity across this northern range margin. While most populations are generally poorly differentiated, E. viridulum nonetheless consists of 2 distinct lineages that broadly differentiate between eastern and western Europe. Genetic divergence between the 2 UK colonisation foci are indicative of distinct immigration events from separate sources; however a general lack of spatial structure prevents pinpointing the specific origins of these migrant zygopterans.

(18679) WILLIGALLA, C. & T. FARTMANN, 2010. Libellen-Diversität und -Zönosen in mitteleuropäischen Städten. *Naturschutz Landschaftsplan.* 42(11): 341-350. (With Engl. s.). – (First Author: Am Grossen Sand 22, D-55124 Mainz).
Since 1986, almost 30 odon. surveys are available for the cities in central Europe. 77% (62 spp.) of the total Odon. fauna of Germany have been found in cities. This high species richness can be explained by the structural richness due to the high natural diversity of habitats within the biogeographical regions of the cities. However, increased urbanization leads to homogenization of the fauna. The odon. assemblages of the cities are more similar than those of not built-up areas, which was indicated by a significantly higher Sörensen coefficient. Within the city borders an urban gradient can be observed. To the city centre the total number of spp. and the proportion of specialists markedly decrease. In the cities' centres the odon. communities only occur rudimentarily, and not even the 21 most frequent spp. have been found in all cities. The highest species diversity in cities was reported before 1975 with a decreasing trend thereafter. Since the 1990ies the number of spp. recorded in cities has increased again, probably because of the improvement of the total quality of lotic waters. Approximately 37% of the total Odon. fauna of Germany can be classified as "urbano-neutral" to moderately "urbano-philous". Correspondingly, 63% of all spp. are re-

stricted to non-sealed areas and can be classified as (moderately) urbanophobe. – The comprehensive bibliography that goes with this paper is available on Internet only.

(18680) YOON, J., J.M. NAM, H. KIM, Y.J. BAE & J.G. KIM, 2010. Nannophya pygmaea (Odonata: Libellulidae), an endangered dragonfly in Korea, prefers abandoned paddy fields in the early seral stage. *Envir. Ent.* 39(2): 278-285. – (Last Author: Dept Biol. Educ., Second Natn. Univ., Seoul, 151-748, Korea).
22 larval habitats in 8 areas of Korea were analysed. N. pygmaea prefers habitats displaying the characteristics that are typical of the early stages of succession in abandoned paddy fields. It is suggested that its primary habitats in Korea are recently abandoned paddy fields in an oligotrophic state. As the succession proceeds, N. pygmaea disappears, therefore a habitat management program should be launched to conserve the habitats and their populations of the sp.

(18681) ZAWAL, A., S. STOJANOVSKI & S. SMILJKOV, 2010. Preliminary investigations on Odonata from the Lake Ohrid (Macedonia). *Proc. 2nd Balkan Conf. Biol.*, Plovdiv, pp. 636-638. – (First Author: Dept Invert. Zool. & Limnol., Univ. Szczecin, Waska 13, PO-71-415 Szczecin).
Records of 17 spp., from 21 localities (June, 2009).

(18682) ZHANG, H.-M., W.-C. YEH & X.-L. TONG, 2010. Descriptions of two new species of the genus Planaeschna from China (Odonata: Anisoptera: Aeshnidae). *Zootaxa* 2674: 51-60. – (First Author: Dept Ent., Coll. Nat. Resour. & Envir., Sth China Agric. Univ., Guangzhou-510642, China).
P. laoshanensis sp. n. and P. nankunshanensis sp n. are described and illustrated from Shandong and Guangdong, respectively. They are diagnosed from their congeners, and the description of P. nankunshanensis ultimate instar larva is provided.

(18683) ZODER, S., 2010. Libellula fulva Müller, 1764 (Spitzenfleck) am Unteren Inn (Odonata, Anisoptera, Libellulidae). *Mitt. zool. Ges. Braunau* 10(1): 91-94. – (Am Ziegelstadelberg 17, D-94094 Rotthalmünster).
The occurrence of L. fulva in the area of the Lower Inn river (Austria, Germany) is outlined, discussed and new records are presented.

2011

(18684) BORISOV, S.N., 2011. Migrant dragonflies in Middle Asia, 1. Anax ephippiger (Burmeister, 1839) (Odonata, Aeshnidae). *Euroasian ent. J.* 10(2): 125-130. (Russ., with Engl. s.). – (Siber. Zool. Mus., Inst. Anim. Syst. & Ecol., Russ. Acad. Sci, Frunze 11, RUS-630091 Novosibirsk).
Data on its distribution, phenology and autumnal migrations in Middle Asia, Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan and Tadjikistan are presented. The period of spring arrivals lasts from Apr. to mid June, and the hatching period lasts from late May to Sept. Annual (2008-2010) autumnal migrations in southern direction were established in Chok-Pak mountain range using ornithological traps from 28 Aug. to 13 Oct. A fast univoltine life-cycle and prolonged pre-reproductive period, including wintering migrations, are probably characteristic for A. ephippiger in Middle Asia.

(18685) *IDF-REPORT*. Newsletter of the International Dragonfly Fund (ISSN 1435-3393), Vols 32-39 (2011). – (c/o M. Schorr, Schulstr. 7/B, D-54314 Zerf).
[Vol. 32]: *Toan, P.Q., D.M. Cuong & M. Hämäläinen*: Xuan Son National Park, a paradise for Caloptera damselflies in northern Vietnam (pp. 1-34); – [Vol. 33]: *Cuong, D.M., B.M. Hong, N.T. Hoai & P.Q. Toan*: Anisoptera of Cuc Phong National Park, North Vietnam (pp. 1-18); – [Vol. 34]: *Villanueva, R.J.T.*: Odonata of Siargao and Bucas Grande islands, the Philippines (pp. 1-25); – [Vol. 35]: *Roland, H.-J., T. Sacher & N. Roland*: New records of Odonata for Cambodia: results from a trip through various places of the country, November 14th – December 1st, 2010 (pp. 1-22); – [Vol. 36]: *Cuong, D.M.*: Notes on three species of gomphid dragonflies from Vietnam (Odonata: Gomphidae) (pp. 1-9); – [Vol. 37]: *Zhang, H.*: Karst forest Odonata from southern Guizhou, China (pp. 1-35); – [Vol. 38]: *Villanueva, R.J.T.*: Odonata fauna of Diamabok Lake and its surroundings, Davao Oriental, Mindanao island, Philippines (pp. 1-29); – [Vol. 39]: *Villanueva, R.J.T. & J.R.S. Gil*: Odonata fauna of Catanduanes island, Philippines (pp. 1-38).

(18686) JUNG, K.-S., 2011. *Odonata larvae of Korea*. Nature & Ecology Academic Series, Vol. 3, Seoul. 400 pp. Hardcover with flappers (19.5 × 26.5 cm). ISBN 978-89-962995-6-1. (Korean, with

Engl. title & taxonomic nomenclature). – Price: ca US$ 100.—net. – (Author: 6F, IBS Bldg, 1572-18 Seocho-Dong, Seocho-ku, Seoul, 137-070 Korea).
A splendid book on the odon. larvae (110 spp.) of Korea, with detailed descriptions, a portrait drawing and col. photographs of almost all spp. and of structural peculiarities important for identification. Due to the exceptionally good illustrations, the book can be used to much advantage also by the reader not familiar with the Korean language. – The Author is President of the Odonatological Research Society of Korea, Chief of the Institute of Korean Odonata, and has published earlier (2007) also the book "*Odonata of Korea*", Ilgongyuksa, Seoul, 512 pp.

(18687) NGIAM, R.W.J., S.W. SUN & J.Y. SEK, 2011. An update on Heliogomphus cf. retroflexus Ris, 1912, with notes on Microgomphus chelifer Selys, 1858 in Singapore (Odonata: Anisoptera: Gomphidae). *Nature Singapore* 4: 95-99. – (First Author: National biodiv. Cent., National Parks Bd, 1 Cluny Rd, Singapore-259569).
With reference to the paper listed in *OA* 18653, 2 additionally collected larvae (♂, ♀) were bred, and they appear to be referable to Microgomphus chelifer rather than to H. retroflexus. The latter sp. has never been found in Singapore.

(18688) *NYHETSBLAD FÖR PROJEKTET TROLLSLÄNDOR I SKÅNE 2009-2014*. – [*NEWSLETTER OF THE PROJECT DRAGONFLIES IN SKÅNE 2009-2014*], 2011 (June): 4 pp. (Swed.). – (Naturskyddsföreningen i Skåne, Box 1013, S-221-04 Lund).
Gives the 2011 records (up to 12 June) of 8 spp. (vernacular names only), and a list of the first dates of the local appearance of adults of 18 spp. (24 Apr.-8 June 2011). Depending on sp., these are 1-20 days earlier than previously on record.

(18689) *ODONATOLOGICAL ABSTRACT SERVICE* (ISSN 1438-0269), No. 30 (Feb. 2011), 68 pp. – (Distributor: M. Schorr, Schulstr. 7/B, D-54314 Zerf).
Abstract Nos 9593-9967.

(18690) PAN, B.-Z., H.-J. WANG, X.-M. LIANG & H.-Z. WANG, 2011. Macrozoobenthos in Yangtze floodplain lakes: patterns of density, biomass, and production in relation to river connectivity. *Jl N. Am. benthol. Soc.* 30(2): 589-602. – (St. Key Lab. Freshw. Ecol. & Biotechnol., Inst. Hydrobiol., Chin. Acad. Sci., Wuhan, Hubei-430072, China).
Dromogomphus sp. and "Gomphidae" are reported from Dongting Lake (China).

(18691) PAULSON, D.R. & S.W. DUNKLE, 2011. *A checklist of North American Odonata, including English names, etymology, type locality and distribution*. iv + 86 pp. – http://odonatacentral.org/docs/NA_Odonata_Checklist_2011.pdf – (First Author: 1724 NE 98th St., Seattle, WA 98115, USA; – Second Author: 8030 Lakeside Parkway, Apt 8208, Tucson, AZ 85730, USA).
A completely revised and updated edn of the work published originally as *Occ. Pap. Slater Mus. nat. Hist.* 56; 1999. It includes all 461 spp. of N America considered valid at this time. For each sp. the original citation, type locality, etymology of both taxonomic and Engl. names, and approximate distribution are given. Literature citations for original descriptions of all spp. are provided in the appended list of references.

(18692) SCHLETTERER, M., M. SCHÖNHUBER & L. FÜREDER, 2011. Biodiversity of diatoms and macroinvertebrates in an east European lowland river, the Tudovka river (Tver region, Russia). *Boreal Envir. Res.* 16: 12 pp. [preprint]. – (First Author: Dept River Ecol. & Invert. Biol., Inst. Ecol., Univ. Innsbruck, Technikerstr. 25, A-6020 Innsbruck).
The Tudovka river is a right tributary of the Volga. Calopteryx virgo is reported from Redkino.

(18693) SCHMIDT DALZOCHIO, M., J.M. COSTA & M.A. UCHÔA, 2011. Diversity of Odonata (Insecta) in lotic systems from Serra da Bodoquena, Mato Grosso do Sul state, Brazil. *Revta brasil. Ent.* 55(1): 88-94. (With Port. s.). – (Second Author: Depto Ent., Mus. Nacional, UFRJ, Quinta da Boa Vista, São Cristovão, BR-20940-040 Rio de Janeiro, RJ).
33 spp. are listed from 4 localities.

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ASANA, J.J. & S. MAKINO, 1935. A comparative study of the chromosomes in the Indian dragonflies. *J. Fac. Sci. Hokkaido Univ*. (VI) 4: 67-86.

COWLEY, J., 1935. Remarks on the names of some odonates. *Entomologist* 26: 154-156.

FRASER, F.C., 1957. *A reclassification of the Odonata*. R. zool. Soc. N.S.W., Sydney.

The abbreviations of the titles of journals should be strictly in accordance with the World List of Scientific Periodicals.

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