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Morphological Study of the *Sympetrum arenicolor* Jödicke, 1994 (Odonata: Libellulidae) Collected in Kurdistan R é gion-Iraq

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Abstract

This study includes a morphological study of the *Sympetrum arenicolor* Jödicke, 1994 (Odonata: Libellulidae). The specimens were collected in some localities of Kurdistan region-Iraq from the period of March until November 2014. The adults described in detail, important body parts such as antenna, rostrum, male and female genitalia were illustrated. Localities and date of collecting were mentioned.

Keywords: *Sympetrum arenicolor*; Kurdistan région–Iraq; Morphological study

Introduction

The predaceous order Odonata is a primitive group includes both the dragonflies and damselflies, separated into three suborders [1,2] namely Anisoptera (dragonfly with eight living families), Zygoptera (damselfly with 17 living families) and Anisozygoptera which is intermediated in its morphological characteristics between the two suborders and represented by two species, one in Himalaya Mountains and another species in Japan, although only one family is now living, fossil evidence of 10 extinct families indicates considerable early diversity within this suborder [3].More than 6000 species were recorded worldwide [4]. The Anisoptera is divided into three superfamilies: Libelluloidea, Aeshnoidea and Cordulegasteroidea [5]. Fraser [6] prepared a handbook for identification of British Odonata and mentioned the anatomy, bionomics, distribution, differentiation, economics, fossil history, classification, collection, preservation with key to families, genera and species, while Corbet [7,8] studied the biology particularly the physiology and behavior of dragonflies. Zedler [9] studied the Ecology of Southern California Vernal Pools and recorded the species Anax junius (Aeshnidae) and mentioned that dragonfly nymphs are among the largest insects to be found in vernal pools. Mature dragon flies are aerial predators feeding on flying insects, while the nymphal stages are aquatic and prey on aquatic insects, small crustaceans, and other small animals. Carl [10] studied some aquatic insects with discussing their distribution and habitats in Iraq and gave a general view on the distribution of those aquatic insects in the Near East with recorded of three species. Schaefer et al. [11] mentioned that the male of Epiaeschna hero Fab. is largest dragonfly in the northeastern US were caught unexpectedly in traps designed to catch Calosoma sycophanta which feeds on the larvae of the gypsy moth. Aguilar et al. [2] studied the Sperm competition in Odonata and the evolution of female sperm storage and described the four copulatory mechanisms used during sperm displacement. Bouchard [12] prepared a guide to aquatic macro-invertebrates of the Upper Midwest in the United States which included some insect orders especially the Odonata (Dragonflies and Damselflies) an illustrated keys to the larvae of the families are given and mentioned that they are most abundant and diverse in standing water and all the adults and larvae are predators. Hamalainen [13] studied the Caloptera damselflies from Fujian (China) with description of a new species based on literature records and the examination of an extensive Odonata collection made in Fujian in 1930-1940's, he recognized 21 spp. of Caloptera (Calopterygoidea) as occurring in Fujian province in eastern China. localities of north and east Syria and resulted that the specimens which collected are belong to eight species in five genera within four families. Carle et al. [15] studied the evolution and the phylogeny of 26 families of Odonata with special reference to Coenagrionoidea(Zygoptera) based on data from large and small subunit nuclear and mitochondrial ribosomal RNAs and part of the nuclear EF-1a, data were analyzed using bayesian methods and resulted that the extant Zygoptera and Anisoptera are monophyletic. Miroglu and Kartal [16] prepared an Additional Notes on 387 specimens of the Odonata Fauna which were collected and identified from the locality of streams and puddles of Kurupelit (Samsun, Turkey). Shiha et al. [17] studied 11 species six of them was new to Syria. Garstecki and Amr [18] studied the biodiversity and ecosystem management in the Iraqi marshlands and mentioned that the Dragonflies are an important component of fresh water ecosystems and excellent indicators of habitat changes. Other authors [19,20] pay attention to the Iraqi odonates fauna, and many odonates has been recorded by Iraqi entomologists [21-23], while Asahina [20] make a detailed description of the most body parts with focusing on male and female genitalia, also [24] studied the external morphology of the Diplacodes nebulosa (Fab.) (Libellulidae:Anisoptera:Odonata) and regard it as a new record for Iraq. The aim of this study was to make a detail description for the species Sympetrum arenicolor Jödicke, 1994, which is regarded as rare specimens for our region.

Karoom et al. [14] studied primarily the suborder Zygoptera in nine

Materials and Methods

The study depended on 30 specimens of adult stage which were collected from different localities in Erbil, Sulaymaniyah and Duhok governorates of Kurdistan region/Iraq, from the period March until November 2014 by air nets. The specimens were killed by freezing for 48 hrs. The morphology of the adults were studied by using dissecting microscope, while the minute parts were studied by preparation of microscope slides, the adults dissected by using two fine pins, then

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the required parts (the head and the abdomen) put in a beaker 100 ml contains 50 ml water with KOH 10% and placed on fire with shaking for about 10 minutes for dissolving of lipid maters of the body and destroying the muscles. After that it was placed in distilled water for 5 minutes in order to reduce the effect of the alkali. Mouthparts and abdomen are placed in ethyl alcohol 25% and dissected under microscope to obtain the different parts, then transferred to ethyl alcohol 50%, 75% and 100% respectively for two minutes of each concentrations to dehydration of water, then placed in Xylol for two minutes, for translucency then placed in Canada balsam to prepare slides for examination under microscope, so the slides were examined by using dissecting binocular microscope, compound microscope and digital computerized microscope for the minute parts of the body, after that these parts and the whole body been pictured by using Celestrone hand held Digital Microscope (5 MP), and the lengths of the parts were measured by using a linear micrometer with a stage-micrometer. Insect samples been diagnosed depending on [25] with taxonomic keys found in reliable internet websites, also specimens have been sent to Mr. Rafal Bernard (rbernard@amu.edu.pl) from Poland republic for confirmation the identification.

Results and Discussion

Morphological study of Sympetrum arenicolor Jödicke, 1994

Syn: Sympetrum deserti Jödicke, 1994

BODY (Figure: 1a, 1b): Body large, cylindrical, elongated, nearly spindle-like, brown colored and non-metallic, 39.9-40.1 mm long and 4.7-5.1 mm wide in the male and 40.1-40.4 mm long and 4.9-5.5 mm wide in the female, thoracic segments compressed laterally, strongly carinated along the longitudinal midline of abdominal segments' tergites, fore-wing 29.9-31.2 mm long and 6.9-7.2 mm wide. Fraser [6] studied the general features of the body of some species belong to this family.

Head (Figure: 2a,2b): Head large, spherical and robust, vertex semi-triangular, with rounded apex from the face, concaved dorsally, covered with fine yellow hairs, brown colored. The head 3.5-3.7 mm long and 4.1-4.3 mm wide, occiput small acute short based triangular brown colored piece, covered with long hairs, compound eyes large, hemispherical, well developed with alight bluish underside, the compound eye composed of 10000-28000 ommatidia in adult [26] projected, extensively fused along the head dorsal mid-line 3.8-4.1 mm long, 1.9-2.1 mm wide, two small brown lateral clearly projected circular visible ocelli, each located between the vertex and a compound eye, in addition to third brown median bigger ocellus located between the vertex and the frons. Frons semi-triangular, with median groove divided it to two equal lobes, yellow colored, covered with black hairs, clypeus, triangular transversally, brown colored, divided by a groove to a small anteclypeus and a big postclypeus which rounded the anteclypeus from the sides by its rounded lateral edges which covered by little long black hairs. Corbet [7] and Carle [15] studied some characteristics of the head from some species belong to this family.

Antennae (Figure: 2c): Antennae very short, bristle-like, brown colored, carried on the antifer which arises from the antennal socket on the lower surface of the head immediately attaching to the compound eyes and the median occelli. Antennae consists of five thin segments, first segment, the scape is the shortest, square shaped with rounded angles, stouter than the remaining segments. Second segment, the pedicel, elongated rectangle. The third, fourth, fifth and the sixth

gradually and finally ended with the sixth spine-like segment. Fraser [6] and Hamalainen [13] studied the antennae of some species belong to this family.

segments collectively are composing the flagellum which narrowed

Page 2 of 6







Mouthparts (Figures: 3a-3f): Mouthparts are modified for biting, directed foreword (Prognathous) and consists of the following parts:

Labrum (Figure: 3a): Labrum cup-like structure, consists of one piece, semi-circular, pale brown colored, covered with fine pale brown hairs, its posterior margin which attached the anteclypeus widely with two median long dark brown processs and two rounded angles, median inner surface punctuated.

Mandibles (Figure: 3b): Mandibles large, robust, dark brown colored, with solid incisor region, molar medium sized, its outer surface covered with long hairs.

Maxillae (Figure: 3c): Maxillae smaller than the mandibles, brown colored, consist of the: median fused lobed galea and lacinia which their inner edges with long pale brow out-directed long hairs, upper toothed dark brown molar, black long sickle-like maxillary palp which covered with long pale brown hairs, elongated pale brown colored stipe which covered with scattered fine yellow colored and which fused with a short pale brown base (cardo).

Labium (Figures: 3d): Labium large piece, symmetrical rectangular, with rounded margins, pale brown colored, consists of: heart-like median lobe, two separated squarely lateral lobes which with round angles, their inner lower angles ornamented by two black opposite spines and each separated by a groove from their small triangular structure upper parts which with an acute inner dark brown angle near the median lobe and two outer rounded angles, the inner and outer surfaces covered with long brown setae.

Hypopharynx (Figures: 3e): Jug-like structure, punctuated, pale brown colored, covered with long hairs, outer angles rounded, lateral





margins brown colored, concaved but distance margin brown colored, convex.

Thorax (Figures: 4a, 4b): prothorax small part, pronotum saddlelike, with median narrowing divided it into anterior and posterior parts which separated by an projected transverse edge, the posterior part of the pronotum districted by the posterior lobe which with lower concave margin and long yellow hairs, pronotum brown colored, attached by membrane to a large strong ptero- or synthorax which composed by closely fused mesothorax and metathorax, a pseudo- or false dorsum formed by the anterior median wide pleurites which expanded forwards and upwards to meet in the keel-like or a mid-dorsal suture or carina-like middle line while the true dorsum or upper surface looking backwards rather than upwards, the tergites and sternites are narrow, the sternits, the humeral suture in the region of the shoulder, and two lateral sutures, the first more or less obsolete and obvious only in its lower third, at the lower end of the metepisternal space is situated the opening of the thoracic spiracle. Fraser [6] studied the thorax of some species belong to this family.

Legs (Figure: 5a-5c): The legs suited to perching and to holding prey, not to walking.

Fore-legs: Fore-legs tubular, pale brown colored, pilose, consists of; Coxa: Conic lobed shaped, pale brown colored covered by tall hairs; Trochanter: small short nearly triangular shaped, convex in outer surface with a few numbers of short hairs; Femur, semi-cylindrical shaped, inner surface with a row of tall yellow spines and a row of seven short black robust thick spines and ended with a long black spine and which opposite with of those on the tibia; Tibia: elongated, tubular

Page 3 of 6

Page 4 of 6



shaped, as long as the femora but narrower, inner surface with 13 long black spines and nine shorter brown spines, and the outer surface with a row of very short spines, tarsus tubular, curved, consists of three segments which graduated in length and with short black spines and ended by a two long double-headed claws.

Mid-legs: Mid-legs resembling fore-legs except for coxae are smaller relatively and femur and tibia tallé and the inner surface of the tibia with two rows each with 13 long black spines.

Hind-legs: Hind-legs resembling fore and mid-legs except the coxae are smaller relatively and femur and tibia taller and the inner surface of the tibia with two rows each with 15 long black spines.

Wings (Figure 6a, 6b): Wings long, narrow, translucent, membranous, anal triangle of the hind wing elongated, one celled, pale brown colored, membranule of the hind wing absent, each wing with long, narrow rectangular, brown, pterostigma, its anterior and posterior margins thickened but its short sides are thin, occupied one cell, arculus fused in the beginning as one vein in both wings, costal vein pale brown, with two edges, ornamented by a row of very short brown spines, nodus brown colored, nearly located at the midway between the base and the outer angle of the wings, with Hierarchical composite structures, Fauziyah et al. [27] indicate that there was variation of the node between species ,this variability is related to the size of the dragonfly and its wing. We can note that the area fractions and perimetral values of resilin (for individual dragonflies) are always higher on the ventral face of the nodus than on the dorsal face, regardless of species. Most of the longitudinal and cross veins ornamented with very short brown spines, the number of the cross veins between the costal and the subcostal veins and before the nodus is seven but the last (the distal) one which called incomplete distal antenodal nervure is incomplete in the fore-wing and five in the hind-wing, held horizontally outward when at rest and net-veined, the discoidal cell of the fore-wing consists of one oblique and one triangular cell, directed downward (transversally) but the discoidal cell of the hind-wing consists of one triangular cell, directed (outward) longitudinally and hind wings' base rounded in both sexes, one cubital cross vein (nervure) (Cun) occur in each wing, cubitus of the hind wing separated from the posterior angle of the triangular cell, cubital nervure pale brown colored, one in each wing, anal loop wide, consists of two rows of cells separated by the cross vein mid-rib, discoidal field in the fore-wing with three rows of cells but ended in four rows before the wing margin . Many researchers [6,15,28,29] depended on the wings veins and the nodus to identify some genera and species of this family.

Abdomen (Figures 7a, 7b and 8a-8c): The abdomen long and narrow consists of ten flexible visible segments. The males with a pair of upper superior anal cornicle-like appendages as clasping organs and a single lower inferior anal appendage, the latter located above the anus. The 1st, 2nd and the 1st half of the 3rd segments are swollen but the 2nd half is narrowed then swollen again in the remain segments, each segment formed by a dorsal convex tergite which covers the whole of the dorsum, sides and adjacent part of the ventral surface, and a ventral sternite united at each side to the tergite by a membranous pleurite which allows of free respiratory movements of the abdomen, from 1st-8th segments each bear a pair of spiracles which are situated on the pleural membrane, 2nd segment bears on each side an ear-shaped process (auricle or oreillet), its function to direct the female during the act of copulation, enabling her to find the situation of the male



vein A1: 1st Anal nurvulus Idta: Last discontinued transverse arculus Riii: 3rd Radius vein Riv: 4th Radius AL: Anal loop MA: Median Arculus vein ANC: Transverse antenodal nurvulus Mspl: Nervulus between Cu & MAIA Rs: Radius vein Arc: Arculus Nod: Nodus Rspl: Nervulus between IRiii & RivST C Costal vein PNC: Transverse post nodal nurvulus Sc: Subcosta vein Cn: Transverse Cubital nurvulus Pt: Pterostigma Sn: Subnodus Cu: Cubital vein Ri: 1st Radius vein T: Triangular cell

DF: Discal field

Page 5 of 6



Figure 7: Abdomen of Sympetrum arenicolor Jödicke. a) (Dorsal view); b) (Ventral view)



genitalia, the abdomen 2.2-2.5 cm long in male, 2.4-26 cm in female, the male abdomen is less wide than the female abdomen, the ring between each two abdominal segments ornamented with brown thorn-like processes. Carle [29] studied some of the abdominal parts of some species belong to this family.

Male genitalia (Figure: 9a, 9b): Male genitalia are the most

important diagnostic characteristics used to distinguish between the different species. Many researchers [2,6,7] studied the male genitalia of species belong to this family. The male genitalia (or secondary intromittent sexual apparatus) are situated on the ventral surface of the 2nd and 3rd abdominal segments and consist of a deep channel or pit (the fossa) in which lie a 4-segmented tubular penis. The 1st distal segment is conic shaped, the 2nd segment is small and with longitudinal median cleavage, the 3rd is rectangular shaped, the 4th segment, the penis vesicle which is a big irregular shaped segment. The penis protected by a kidney-like sheath and two pairs of hooks (hamules) which bended down and backwards and by which the female genitalia link firmly with those of the male, the posterior pair of hamules are usually furnished with an outer and inner lobe or hood. The second and third abdominal arched haired sternite (anterior lamina) and elongated haired tergite (genital lobes) correspondingly, are extended to cover the penis whilst the genital pore, the primary genitalia (where sperm are produced) located on the ventral surface of ninth abdominal segment.

Female genitalia (Figure: 10a, 10b): Many researchers [2,6,7,29] studied the female genitalia of this family. Female genitalia consists of lamellate type ovipositor, the inner parts composed of valvulae and membranous branches. The female genitalia arise as appendages of the eighth and ninth abdominal segments, where the abdominal tergites of these segments are folded inward at each side to form the paratergites of corresponding segments. Eighth and ninth abdominal sternites are membranous, covered by the seventh abdominal sternum. In the female, the abdomen is generally somewhat shorter and stouter than in the male and is more or less cylindrical throughout. Superior





Page 6 of 6

anal appendages yellow and shorter than those of the male. Eighth abdominal sternite wide apically narrowed basically where arises the valvar scale which has a brown concave apex which narrowed gradually toward the base which is dale brown. Ninth abdominal sternites' base wider than its apex. The vestigial style which is small structure round shaped, brown colored.

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