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Sexual differences in relative length of forewing in Hemerobiidae (Neuroptera)

With 3 figures and 1 tables

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Abstract

The differences in relative length of forewing in females and males of twenty Palaearctic species of Hemerobiidae are provided. In ten species the forewing of females is significantly narrower than that of males.

Zusammenfassung

Es werden die Größenunterschiede der Vorderflügel der Geschlechter von 20 paläarktischen Arten der Hemerobiidae bestimmt. Bei zehn Arten sind die Vorderflügel der weiblichen Flügel bedeutend schmaler als die der männlichen.

Introduction

Secondary sexual structural characters occur very rarely in the order Neuroptera. They have been recorded only in a few taxa. The fore coxa of females in most species of Osmylinae is armed with a quite long projection (KILLINGTON 1936; MAKARKIN 1985). In males of Dilaridae most flagellar segments of the antennae have elongate lateral processes which are absent in the females. A similar process is developed in the antennal scape of males of *Zachobiella pallida* BANKS (Hemerobiidae) (NEW 1988). Antennae of males in *Wesmaelius asiaticus* YANG (Hemerobiidae) differ from those of females in shape and in size of basal segments and bristles (MAKARKIN 1990).

Besides such dimorphic sexual characters there are the differences between sexes in relative size of particular organs. Sexual differences in wing shape are well known in the family Dilaridae where females have more elongate forewings (ADAMS 1970; MONSERRAT 1988). Similar differences in relative length of wings in Hemerobiidae have never been recorded in the literature.

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Material and methods

Twenty species and subspecies of five Palaearctic genera of Hemerobiidae were examined. The material was collected in the Far East of Russia except for three Central Asian species of the genus *Wesmaelius*. As far as it was possible, up to 25 individuals of each sex were investigated. One of the forewings was detached, mounted on a slide, and measured under the binocular microscope with scales of 0.05 mm or 0.1 mm (depending on size of the specimen). Wing length was measured along an axis from the wing base to its apex, and the width as the maximum distance between the anterior and hind margins of the wing perpendicular to the length axis. Wing index was calculated as a relation of length of the wing to its width.

Results

Wing indices of all the species examined are quite similar and ranged from 2.16 to 2.81 in males, and from 2.21 to 2.84 in females. The wing index of females has higher value than that of males in most of the species (14 of 20 species). Of these, in ten species these differences are statistically significant ($p < 0.05$) (Table 1). To understand this we examined a number of relationships.

Table 1. Mean forewing length (L), wing index (Ind), coefficient of variation (CV), and the intersexual difference in wing indices for males and females of twenty species of Palaearctic Hemerobiidae. The significant differences are marked with an asterisk.

Species	Males				Females				
	L±S.e	Ind_m±S.e.	CV	N	L±S.e.	Ind_f±S.e.	CV	N	Ind_m-Ind_f
Drepanepteryx									
D. phalaenoides L.	12.89±0.24	2.28±0.01	1.91	15	13.74±0.24	2.25±0.01	1.88	15	0.03 *
Neuronema									
N. laminata TJEDER	11.89±0.15	2.17±0.02	2.33	10	11.59±0.21	2.21±0.02	2.49	10	-0.04
Wesmaelius									
W. quadrifasciatus REUT.	8.64±0.20	2.30±0.02	3.89	15	9.26±0.26	2.34±0.02	2.98	15	-0.04
W. asiaticus YANG	9.46±0.19	2.16±0.01	2.27	15	10.17±0.13	2.24±0.01	2.45	15	-0.08 *
W. nervosus F.	8.67±0.11	2.44±0.02	2.64	15	9.07±0.15	2.56±0.03	4.92	15	-0.12 *
W. sinicus TJEDER	8.02±0.11	2.37±0.02	2.30	12	8.52±0.14	2.38±0.02	2.62	12	-0.01
W. amseli Asp. et Asp.	7.15±0.09	2.57±0.02	2.54	15	7.35±0.17	2.63±0.02	2.16	15	-0.06 *
W. mongolicus STEINM.	7.32±0.04	2.67±0.03	2.31	4	6.58±0.13	2.84±0.03	2.51	5	-0.17 *
Hemerobius									
H. tristriatus KUW.	6.92±0.11	2.38±0.01	2.54	20	7.58±0.07	2.51±0.02	2.81	20	-0.13 *
H. marginatus STEPH.	8.29±0.07	2.29±0.01	1.89	25	9.07±0.14	2.40±0.01	2.18	25	-0.11 *
H. m. lapponicus MEIN.	6.12±0.12	2.44±0.05	4.43	5	7.10±0.17	2.44±0.01	0.92	5	-0.00
H. subfalcatus NAKAH.	8.58±0.10	2.31±0.03	3.08	6	8.50±0	2.46±0.02	1.45	2	-0.15 *
H. fenestratus TJEDER	7.55±0.14	2.42±0.02	3.40	15	8.05±0.12	2.44±0.02	2.47	15	-0.02
H. atrifrons MCLACH.	6.91±0.13	2.50±0.02	2.81	15	7.01±0.13	2.49±0.02	3.15	15	0.01
H. humulinus L.	6.89±0.10	2.40±0.01	2.38	25	7.57±0.13	2.48±0.02	2.97	25	-0.08 *
H. simulans WALKER	8.63±0.09	2.72±0.01	2.22	25	8.91±0.09	2.70±0.01	2.13	25	0.02
H. stigma STEPH.	7.26±0.10	2.48±0.01	2.54	20	7.64±0.07	2.59±0.02	2.84	20	-0.11 *
Micromus									
M. pagamus L.	9.90±0.13	2.55±0.01	2.35	20	11.04±0.19	2.62±0.02	2.77	20	-0.07 *
M. angulatus STEPH.	6.28±0.08	2.54±0.02	2.94	25	6.52±0.07	2.52±0.01	2.37	25	0.02
M. dissimilis NAKAH.	8.81±0.20	2.81±0.04	4.29	12	9.34±0.37	2.81±0.03	2.66	5	0.00

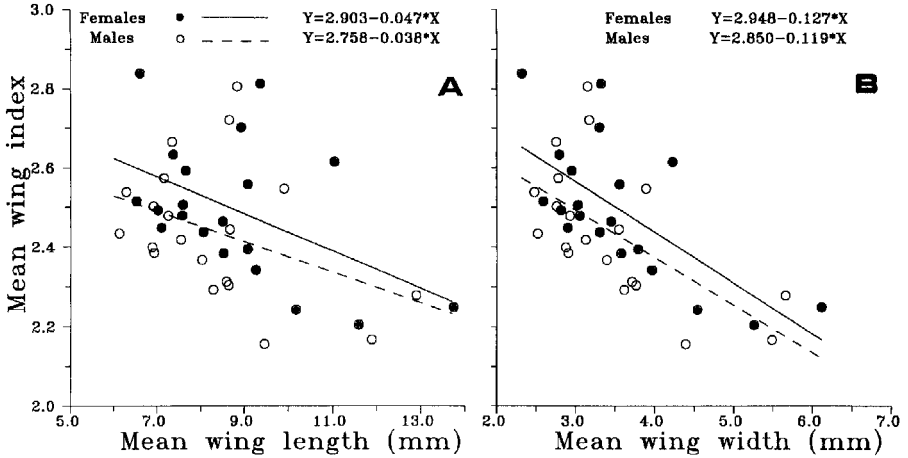

Fig. 1. The relationships between mean wing index and mean wing length (a) and width (b) for males and females of twenty Palaearctic species of Hemerobiidae.

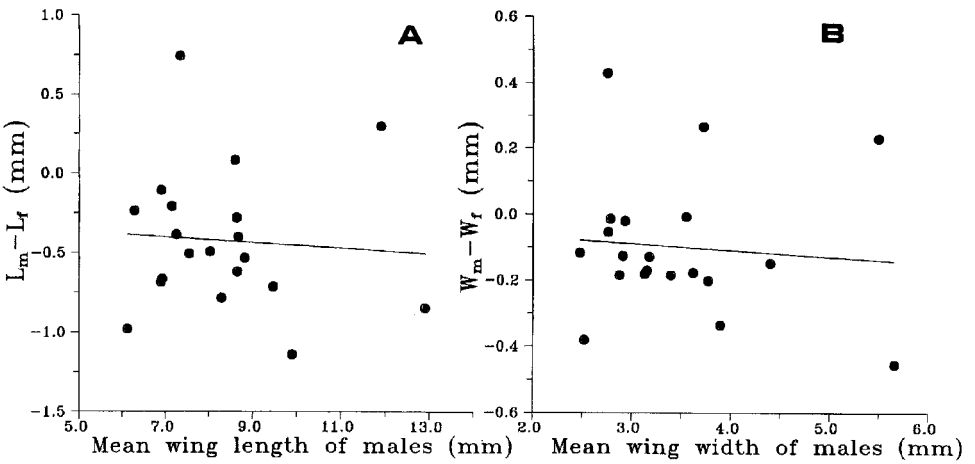

Fig. 2. The relationships between mean wing length of males and intersexual differences in wing length (L_m-L_f) (a) and in wing width (W_m-W_f) (b) for twenty species of Palaearctic Hemerobiidae.

In Figs 1a-b mean wing index is plotted against the mean wing length (Fig. 1a) or the mean wing width (Fig. 1b), separately each for males and females. For both males and females the value of the wing index decreases with increasing length and width. In respect to width the correlation is higher ($r = -0.61$, $p < 0.005$ for males, $r = -0.68$, $p = 0.0001$ for females) than in respect to length ($r = -0.40$, $p < 0.1$ for males, $r = -0.49$, $p < 0.03$ for females). It means that species with larger wings have relatively wider forewings in both sexes.In Figs 2a-b the

male mean wing length and width are plotted against the intersexual differences in the mean wing length and width respectively. It is found that these variables are not correlated ($r = -0.07$, $p > 0.5$ for the length, $r = -0.08$, $p > 0.5$ for the width). It means that the differences between sexes in the mean length and width of forewing are not related to the wing size.

In Figs 3a-b are shown the relationships between the intersexual differences in wing index and such differences in mean wing sizes. There is a tendence for the intersexual differences in wing index to increase with decreasing the mean sizes of wings of females in relation to those of males. In respect to width this regression is significant ($r = -0.60$, $p < 0.01$) while for the length it is not ($r = -0.23$, $p < 0.5$). The differences between the wing indices are absent or minimal in species whose females have larger forewing size than males. On the contrary, these differences are maximal in species with larger males than females.

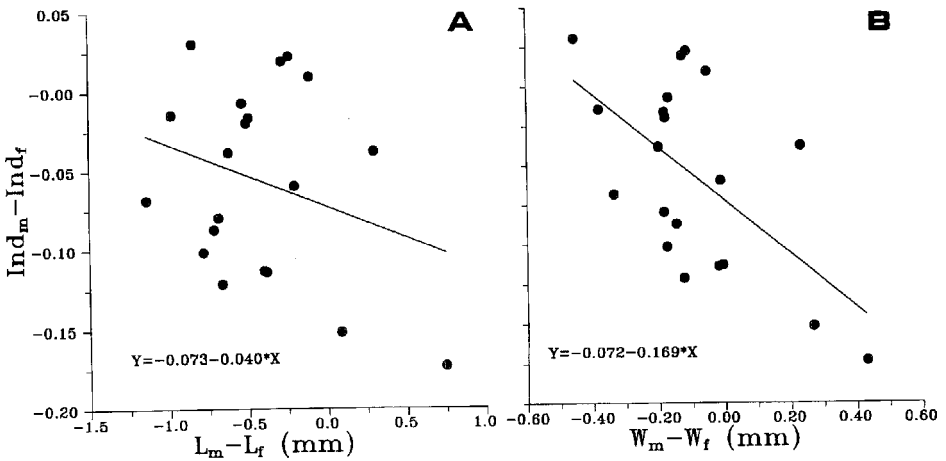

Fig. 3. The relationships between the differences in mean wing index of males and females an the respective differences in mean wing length (L_m-L_f) (a) and in mean wing width (W_m-W_f) (b) for twenty species of Palaearctic Hemerobiidae.

Discussion

The differences between male and female hemerobiids in relative length of forewing agree with such relationships between sexes in Dialaridae: females in both families have relatively narrower forewings than males. In the family Dilaridae these differences are more distinct than in hemerobiids.

As is mentioned above, mean values of wing indices increase with increasing the wing sizes in both males and females. The forewings in the more long-winged species are relatively wider than in the short-winged species. Thus, the differences between males and females in wing index do not relate to the absolute wing size. Nor are the differences between sexes in mean wing size related to the absolute wing size.

Females in the most of hemerobiid species are larger than males. In these species the intersexual differences in relative length of forewings are minimal and often not significant. It was found

that if males are larger than females these differences become maximal and females are the more narrow-winged. However, it should noted that this tendency is supported by statistically significant regression only in respect to the forewing width.
Thus, we found that the range of intersexual differences in relative length of forewing in the hemerobiid species is only related to the relative sizes of males and females of these species. Unfortunately, we can not propose any resonable explanations for these differences.

Acknowledgements

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