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Fluctuating asymmetry and mating success in males of *Libellula fulva* Müller, 1764

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"Fluctuating asymmetry" und Paarungserfolg bei Männchen von *Libellula fulva* Müller, 1764. – Veränderliche Bilateralsymmetrie kann als Maßstab für die "Stärke" eines Individuums gelten und ist häufig mit Paarungserfolg korreliert. Die sich oft widersprechenden Ergebnisse diesbezüglicher Studien erlauben jedoch nicht, die Rolle veränderlicher Bilateralsymmetrie oder deren Auswirkungen zu klären. In der vorliegenden Untersuchung wurden individuell markierte *Libellula fulva*-Männchen herangezogen, um Kurzzeit- und Langzeitmethoden, basierend auf der Korrelation zwischen Flügelasymmetrie und Paarungserfolg, zu vergleichen.

Fluctuating asymmetry (the absence of bilateral symmetry) can be a measure of the potential fitness of an individual (Leung & Forbes 1997) and is often related to reproductive success. Short-term studies by Córdoba-Aguilar (1995) as well as Carchini et al. (2000) were based on collecting paired and unpaired individuals at the peak time of their reproductive activity and measuring their bilateral traits (legs, wings etc.). Long-term studies (Cordero et al. 1997, Harvey & Walsh 1993) covered the whole reproductive period of a population, worked with individually marked specimens and related symmetry to the frequency of copulations. The often contradictory results deriving from different methods do not, however, allow us to clear the role of fluctuating asymmetry and its implications. In this study, individually marked *Libellula fulva* males were used to compare short-term and medium-term methods on the basis of correlating wing asymmetry with mating success.

Direct observations on 106 individually marked *Libellula fulva* males were made at the Kutas-canal, Ártánd, E-Hungary. The distance between arculus and proximal corner of the pterostigma were measured to the nearest 0.1 mm at the time of marking. During a ten-day period (6 - 15 June, 2000, hereafter referred to as medium-term study) marked males were observed daily along a 600 m stretch of the stream, and their reproductive state (paired or unpaired) was noted. Furthermore, 13 paired and 29 unpaired males were captured and measured between 16 and 18 May 2000 and these data were later analysed as a short-term study. The rate of fluctuating asymmetry (FA) was expressed as the absolute difference between right and left. The Kolmogorov-Smirnov test was applied to verify the normality of the distribution of differences, and paired t-test and Mann-Whitney U test were used to analyse variables with normal and non-normal distribution, respectively.

Of 106 marked individuals 35 (33 %) were never seen again, and were therefore excluded from the statistical analysis. Males never involved in pairing (52 individuals, 49 %) and males observed at least once in a wheel position (19 individuals, 18 %) were separated into

two groups (unpaired and paired). Individuals were never seen mating more than twice. The right and left hind wings exhibited stronger asymmetry than the forewings (paired t-test for unpaired males: t=3.43, df=51, p=0.01; for paired males: t=2.01, df=18, p=0.05). The $FA_{forewings}$ of paired males was significantly smaller than that of unpaired ones (Mann-Whitney U test: Z=-1.93, p=0.05). The $FA_{hind\ wings}$ showed no differences between the two groups (Mann-Whitney U test: Z=-1.48, p=0.62). No differences in FA were revealed in haphazardly captured and measured paired and unpaired individuals (one-sampled t-test for forewings: t=-0.13, df=40, p=0.89; Mann-Whitney U test for hind wings: Z=-1.29, p=0.19), although they had more symmetrical wing pairs than marked ones.

The fact that no similar habitat for dragonflies was available within easy reach made the study area ideal for frequent encounters with marked individuals and ensured a rather high resighting rate (67 % of marked males were seen at least twice). Only the forewings were significantly more symmetric in the marked, paired males than the unpaired ones, and no such relationship was found in the case of the hind wings, which may correlate with the different role of the two wing pairs. Since forewings are the 'steering-wheels' of dragonflies and have the main function of holding and changing direction in flight, while hind wings take part chiefly in acceleration, we can assume that symmetry of the wings may influence the manoeuvring ability. Males more efficient at manoeuvring are more successful in expelling rivals and obtaining mates (Convey 1989). Short-term study revealed no correlation between wing FA and mating success, which may be due to the limited number of specimens. Thus, we cannot conclude that observations on a longer run are superior to short-time methods, although they seem much more reliable and provide more additional information on the behaviour of a population.

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