THE CHROMOSOME BEHAVIOUR IN SPERMATOGENETIC MEIOSIS OF THE DRAGONFLY SYMPETRUM STRIOLATUM (CHARP.) (ODONATA: LIBELLULIDAE) FROM LUXEMBOURG

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Sympetrum striolatum striolatum (CHARPENTIER 1840) is a common and wide spread libellulid dragonfly of the palaearctic. It occurs nearly throughout the whole Europe and was recorded from Marocco, Algeria, Northern Persia and Turkestan as well. The species is represented in Central Asia, China and Japan by various infraspecific forms. It is new to the fauna of Luxembourg.

The large genus of more than fifty species, eleven of which are European, belongs predominantly to the North Temperate Zone, within which the Euro-Siberian, Sino-Japanese and American group could be destinguished. These are mostly pond insects that haunt the reedy shoals and forage ower wet meadows and other low vegetation. Their flight is halting and they rest frequently. On the other hand *S. striolatum* like some other species of the genus wanders often far from water and its long range migratory flights were frequently observed.

The cytology of *S. striolatum* has not yet been examined, however, SMITH (1916), OGUMA (1917, 1930), MAKALOWSKAJA (1940), KICHIJO (1942) and OKSALA (1945) reported briefly on the cytogenetical conditions and chromosome number in six American, Asiatic and European species of this genus.

Material and methods

The investigations were carried out on a single immature male, taken at the pond « Gypsweiher » near Bridel in the northern vicinity of the city of Luxembourg on August 6th, 1964.

The abdomen of the narcotised insect was opened dorsally while submerged in 0,67% NaCl solution. The testes were clipped out by means of lancet and scissors and small portions of the tissue transferred as quickly as possible to the fixing fluid. For fixing and staining the orcein squash method was used. The tissue was stained for three minutes in a 2% solution of orcein (GURR, MERCK) in lactic and acetic acids and squashed under a No. O siliconed coverslip. The slides were left to dry for several hours and than temporarily stored in a moist chamber. They were examined at this stage.

In order to make the slides permanent the preparations were frozen off on dry ice and the separated slides and coverslips transferred into 96% alcohol for about 30—60 seconds. They were mounted separately in Zeiss phase-contrast mounting medium L 25.

The photographs were taken from fresh preparations with a Zeiss photomicroscope, equipped with phase-contrast lenses, 100 X oil immersion objective (n. a. 1,25) and 8 X oculars, using green filter and Agepann FF panchromatic film. The positives were printed originally at a scale 2250 X. The figures in the present paper are reduced to a scale 1500 X.

The pinned insect and the slides are kept for future reference in the collection of the Institute of Genetics, University of Utrecht, The Netherlands.

Observations

The cysts containing different stadia of spermatogenesis are not localised and appear throughout the whole structure of the testis, therefore no essential difference could be seen in the frequency of cell division in various portions of the tissue. While no mitosis could be observed, each preparation contained practically all stages of both meiotic divisions.

I. Karyotype. The chromosome number was observed as n ♂ = 13 (12). Consequently it is expected to be 2 n ♂ = 25, 2 n ♀ = 26; n ♂ = 13 (12), n ♀ = 13.

At diakinesis are two bivalents considerably longer than the rest, the others being if decreasing magnitude. The m-chromosomes do not appear in this species.



Plate I. Meiotic stages in *Sympetrum striolatum* (CHARP.). (X 1500).

1, Leptotene. 2, Pachytene. 3, Diakinesis, early. 4, Diakinesis. 5, Metaphase I, polar view. 6, Metaphase I, ventral view.

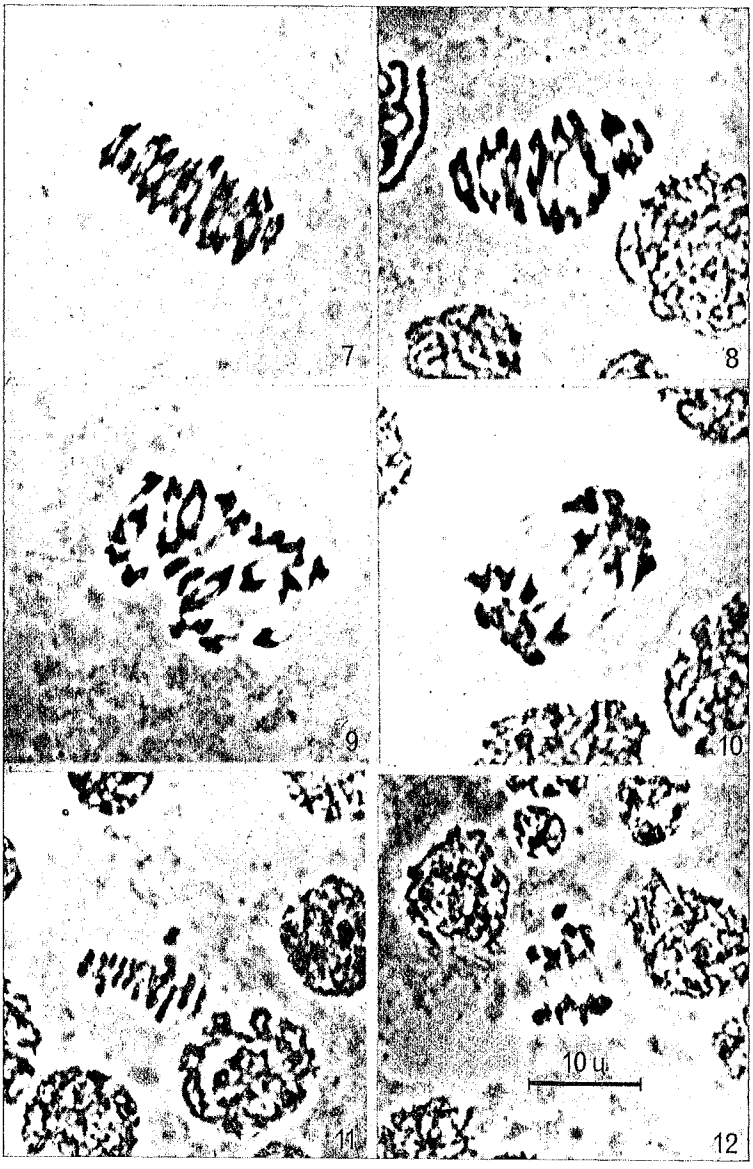


Plate II. Meiotic stages in *Sympetrum srtiolatum* (CHARP.). (X 1500).

7—9, Anaphase I, ventral views. 10, Telophase I. 11, Anaphase II, ventral view. 12, Telophase II.

During both spermatocyte divisions is the unpaired X-element somewhat 1,5 μ long. In nearly hundred photographs the longitude practically does not vary, however, it has been measured in one figure at the bouquet stage and in one of the early diakinesis as 1,9 μ long body. During the second meiotic division is the volume of the X-element approximately half smaller than it is at the first spermatocyte division. This observation agrees with the reduced size of the cells in the second maturation division.

II. Behaviour of the meiotic chromosomes. We were able to follow spermatogonial meiosis in this species from leptotene to telophase II almost completely.

At leptotene there does not exist individuality of any chromosome (Pl. I, Fig. 1).

At zygotene and pachytene the X-chromosome appears as clearly heteropicnotic body. At the latter stage are the chromosomes organised in a typical bouquet orientation (Pl. I, Fig. 2).

By diakinesis the bivalents have contracted considerably and the unpaired X-element could be clearly distinguished from the autosomal bivalents. In all available figures it lies always at the perifery of the plate (Pl. I, Fig. 4).

The X-element appears as the smallest body also in the figures of the ventral view of the metaphase I (Pl. I, Fig. 5). In lateral views of this stage 13 chromosomes could be counted and the X-element can be often clearly distinguished from the bivalents by its inferior size (Pl. I, Fig. 6). According to our evidence, the sex element lies also at this stage always at the perifery of the plate (Pl. I, Fig. 5).

At anaphase I the X-chromosome devides equationally and simultaneously with the autosomes. According to the figures of the lateral views of this stage, separating of the chromosomes begins simultaneously along the whole equatorial line (Pl. II, Fig. 7).

At the early anaphase II the X-element segregates from the equatorial line considerably earlier than the other chromosomes and proceeds undivided to one pole or the other (Pl. II, Fig. 11). This behaviour could be followed up to the

early telophase II (Pl. II, Fig. 12). Such an evidence indicates clearly the post-reductional mode of meiosis in this species.

The biger size of the lateral views of metaphase I, anaphase I and telophase I (Pl. I, Fig. 6; Pl. II, Figs. 7—10) is caracteristical for the first maturation division. The cell diameters are at those stages approximately once biger than the ones of the adequate stages in the second spermatocyte division (Pl. II, Figs. 11—12). The lack of the intercinetic growth period is evident.

Discussion

Since the sex determining mechanism in *Odonata* is XX - XO with the male being the heterogametic sex, it is possible to calculate on the base of the published data the karyotype of all hitherto examined species of the genus *Sympetrum*. The calculation based upon papers of SMITH (1916), OGUMA (1917, 1930), MAKALOWSKAJA (1940), KICHIJO (1942) and OKSALA (1945) shows that *S. danae* (SULZ.), *S. flaveolum* (L.), *S. pedemontanum* (ALLIONI) and *S. semicinctum* (SAY) have like *S. striolatum* (CHARP.) a karyotype 25 ♂, 26 ♀; 13 (12) ♂, 13 ♀ and *S. frequense* (SELYS) 23 ♂, 24 ♀; 12 (11) ♂, 12 ♀. The karyotype of *S. eroticum* (SELYS) is not clear. According to KICHIJO (1942) it is either like in *S. frequense* (SELYS) or it is 21 ♂, 22 ♀; 11 (10) ♂, 11 ♀. The occurrence of such a variety in karyotype within a single genus is rather surprising. Among 36 cytologically examined species of the family *Libellulidae,* belonging to 15 genera, all but five have the karyotype 25 ♂, 26 ♀; 13 (12) ♂, 13 ♀.

The m-bivalent has been reported with certainty for *S. pedemontanum* (ALLIONI) and *S. semicinctum* (SAY). It does not occur in *S. frequense* (SELYS) and in *S. striolatum* (CHARP.). Its existence in *S. eroticum* (SELYS) and in *S. flaveolum* (L.) is not clear while for *S. danae* (SULZ.) the evidence is lacking.

All so far examined *Odonata* have post-reductional meiosis, but one exeption to post-reduction has been reported for *Libellula lectuosa* BURM. (syn. *L. basalis* SAY) (SMITH 1916). Although the exception could be possible, it has to be considered most critically until the species will be reexamined.

Until more species will be examined cytologically and until more evidence of anatomy, ecology and behaviour will become known, any attempt to interpret the phylogenetical relationships within the genus *Sympetrum* is bound to remain a mere speculation.

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