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A NOTE ON THE KARYOTYPES OF *BURMAGOMPHUS PYRAMIDALIS* LAIDLAW AND *ONYCHOGOMPHUS SAUNDERSI DUARICUS* FRASER (ANISOPTERA: *GOMPHIDAE*)

B.K. TYAGI

Department of Zoology, D.A.V. College,
Dehra Dun – 248001, Uttar Pradesh, India

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Male gonial chromosome complements of *B. pyramidalis* (n=12, *m*, XO) and *O. s. duaricus* (2n=22, n=12, 13, *m*, neo-XY), are briefly described on the basis of material from Dehra Dun Valley, U.P., India. Some speculations on the possible origin of the reduced chromosome number and on the neo-XY mode of sex determination in the latter species are offered. The two species have not been previously examined cytologically and are new records for the fauna of the Dehra Dun Valley.

INTRODUCTION

The gomphide chromosome cytology has been receiving considerable attention recently, and the karyotypes of 48 species, pertaining to 20 genera of all five subfamilies have been so far placed on record. (For a review and bibliography cf. KIAUTA, 1972; additional taxa in KIAUTA, 1973, 1975). The cytogenetics of the family is also fairly well known (KIAUTA, 1969), and it became clear that the gomphids are in more than one feature deviating from what is considered the usual pattern of the dragonfly karyotype. In spite of the clear-cut type number (12), unique in the Anisoptera, and several other karyomorphological and cytogenetical features, peculiar to the family, the variation between various lower taxa in a number of cytotaxonomic details is unusually broad. This circumstance renders the gomphids one of the few dragonfly families in which unexpected new discoveries may turn up with every new species studied. It seems tempting to expect that the cytotaxonomic aspect may become of value for our understanding of the classification of and the relationships within the group.

For this reason it seems useful to give here a brief description of the karyotypic conditions encountered in two Indian species that have not been previously studied cytologically, the more so since also the genus *Burmagomphus* Williamson is new to cytology.

MATERIAL AND METHODS

Seven mature males of *Burmagomphus pyramidalis* Laidlaw, and ten of *Onychogomphus saundersi duaricus* Fraser were collected on the Song River, near the Satyanarain Temple, 40 km S of Dehra Dun, Uttar Pradesh, India, on September 28, 1975. Both species are recorded here for the first time from the Dehra Dun Valley.

The testes were removed in 0.75% saline, pretreated in a 1% hypotonic solution of sodium citrate and fixed in 1:3 acetic alcohol (Carnoy). After air drying, the tissue was stained in carbol fuchsin, and the slides mounted in Euparal mounting medium. They are kept, along with the specimens, in the author's collection.

OBSERVATIONS AND DISCUSSION

BURMAGOMPHUS PYRAMIDALIS LAIDLAW
Figures 1-4

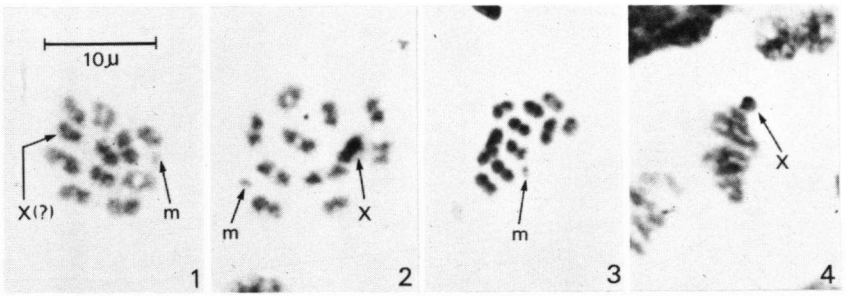
During the primary and secondary spermatocyte stages there are 12 elements and sex determination is of the usual XO mode. Spermatogonial metaphases are not represented in our material.

Save for a minute *m*-bivalent, the spermatocyte I metaphase bivalents vary little in size and shape. Nevertheless, 4 larger, 4 medium-sized and 2 smaller elements can be discerned. The sex chromosome is about the size of the smaller bivalents, though it cannot be clearly distinguished in our metaphase I (Figs. 1-2) and metaphase II (Fig. 3) figures. It is recognizable, however, in lateral views of metaphase/anaphase II (Fig. 4).

At diakinesis there is a single chiasma per bivalent.

ONYCHOGOMPHUS SAUNDERSI DUARICUS FRASER
Figures 5-14

Of the two, this is by far the most interesting species. There are probably 23 elements at spermatogonial metaphase, though one of these seems more or less clearly attached to the giant sex element, causing thus a neo-X/neo-Y sex determination in this species. From the photographic evidence it seems that 22 free elements occur in mitosis (cf. Figs. 6-7). If the secondary fusion and attachment



Figs. 1-4. Spermatocyte stages of *Burmagomphus pyramidalis* Laidlaw (Dehra Dun Valley, India; carbol fuchsin squash; 1500 X): (1-2) Primary spermatocyte metaphase, polar view; – (3) Secondary spermatocyte metaphase, polar view; – (4) Secondary spermatocyte metaphase/anaphase, lateral view.

were permanent, this would yield 11 elements (10 a + neo-X, 10 a + neo-Y) at metaphase I. This, however, is not the case.

At primary spermatocyte metaphase there are 12 elements (10 a + neo-Y + neo-X) in most figures (Figs. 9-10), while in one micrograph 13 elements (probably 12 a + X) could be counted (Fig. 11).

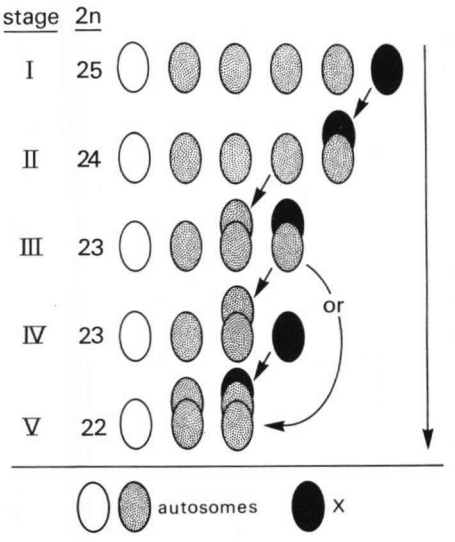
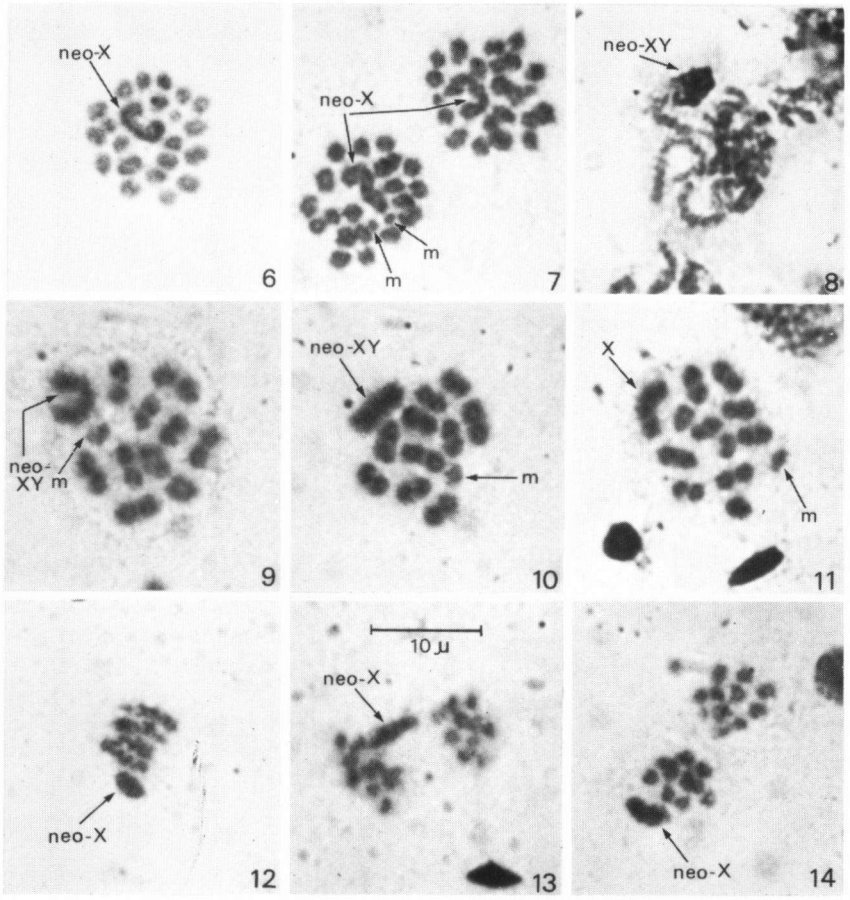


Fig. 5. Schematic interpretation of the evolution of sex determination and reduction of chromosome number in the Gomphidae, based on KIAUTA (1969). In the case of *Onychogomphus saundersi duaricus* Fraser the stages (I) through (III) and (V) are applicable and cytologically demonstrable.

A tentative explanation of this situation requires the assumption that in the construction of the giant sex element instead of one, two autosomes are involved, while the neo-Y is likewise composed of two original autosomes instead of one.

The primary chromosome number of *O. saundersi duaricus* seems to have been 25. The reduction to a 23 complement, involving two autosomes, and one autosome and the primary X, and resulting in a neo-X/neo-neo-Y sex determination seems to have been rather well stabilized, hence in most spermatocyte I figures 12 elements occur. In spermatogonial complements, however, a further stage has been achieved by subsequent fusion of the neo-X with an autosome, giving



Figs. 6-14. Male germ cell chromosomes of *Onychogomphus saundersi duaricus* Fraser (Dehra Dun Valley, India; carbol fuchsin squash; 1500 X): (6-7) Spermatogonial metaphase, polar view; – (8) Pachytene, – (9-10) Polar view of metaphase I, n=12 complement; – (11) Ditto, n=13 complement; – (12) Metaphase/anaphase II, lateral view (note the large neo-sex element); – (13) Late anaphase II (note the delayed kinesis of the neo-sex element); – (14) Telophase II, one daughter cell with, and the other without the neo-X.

a neo-neo-X/neo-neo-Y sex determination, and reducing the chromosome number to 22. This fusion is not stable, and in the reductional cycle the original, n=23, stage is restored, yielding 12 elements, at metaphase I all with a bivalent structure.

The single primary spermatocyte figure with 13 elements shows that even the stabilization at 23 is not absolutely obligatory. Similar isolated cases are

known in other odonate families as well (e.g. in the *Aeshnidae*; cf. KIAUTA, 1971, with references).

In Figure 5 we present a schematic interpretation of the evolution of sex determining mechanisms and reduction of the chromosome number in the *Gomphidae*, based on figure 4 of KIAUTA (1969). In the case of *O. saundersi duaricus* the stages (I) through (III) and (V) are applicable and cytologically demonstrable. For further details reference is made to KIAUTA (1969, pp. 135-145).

Aside from the large neo-sex element, the spermatogonial metaphase chromosomes are of gradually decreasing magnitude, including a rather large *m*-pair which, however, is not always clearly visible (cf. Figs. 6-7).

During spermatocyte prophase the huge sex element is visible from the zygotene onwards. At diakinesis a single chiasma occurs per bivalent. The original X chromosome must have been extremely large, since such is the size of the positively heteropycnotic body at pachytene (Fig. 8), and of the sex element in n=13 metaphase I figures (Fig. 11) and at anaphase II (Fig. 12) and telophase II (Figs. 13-14).

So far only two other *Onychogomphus* species have become known cytologically, viz. *O. bistrigatus* (Hagen) from Nepal (KIAUTA, 1975) and *O. forcipatus* (L.) from Austria (KIAUTA, 1969). It is interesting that the latter is the only gomphid species in which next to the n=12 complements also the n=13 sets occur in primary spermatocytes. It seems that, as far as the *Gomphidae* are concerned. this phenomenon is peculiar to the genus *Onychogomphus*, though in *O. bistrigatus* it is not found.

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