

CHROMOSOMAL ABERRATIONS FOUND IN *PARACALANUS ACULEATUS*
(GIESBRECHT) AT THE TIME OF SOLAR ECLIPSE

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ABSTRACT

Chromosomal aberrations in the form of an unequal heteromorphic homologous pair and a supernumerary chromosome were observed in the gonad of a copepod—*Paracalanus aculeatus* after being exposed to the total solar eclipse of Feb. 16, 1980. The behaviour of these chromosomes during the course of mitosis and meiosis are presented here.

Key words: Chromosomal aberration, solar eclipse, copepod, *Paracalanus*.

Karyotype is generally recognised as a constant species character. Sometimes, however, departures from the main pattern may take place due to some abnormal environmental conditions (Swanson, 1965). These morphological and numerical changes are called in a broad sense chromosomal aberrations (Rieger, Michaelis and Green, 1968).

On 16th February, 1980, in Goa, the total solar eclipse started at 1417 hrs. IST, reached its peak at 1540 hrs and ended at 1652 hrs. On such an occasion when the natural environmental conditions were known to undergo a change, it was planned to conduct field experiments to observe the chromosomal changes in wild populations of some predominant species of estuarine copepods. Amongst the five species studied only *Paracalanus aculeatus* showed chromosomal aberrations which are reported here.

Specimens of *Paracalanus aculeatus* Giesbrecht were sorted out from zooplankton collections from the mouth of the Zuari estuary, Goa, made on 15th, 16th and 17th February 1980 so as to cover the periods both before and after the total solar eclipse. The details of methodology and analysis are same as described elsewhere (Goswami and Goswami, 1973, 1974 and 1979).

Twentyfive percent of the specimens studied on 16th and 17th February, showed chromosomal mosaicism and possessed cells with the normal and abnormal karyotypes in the same gonad. Whereas the cells of specimens collected on 15th February showed the normal karyotype.

The normal karyotype of both the exposed and the unexposed animals showed a diploid number of 12 and haploid number of 6 chromosomes during the gonial and meiotic metaphases (Figs. 1-5). The karyotype formula was $6M+4SM+2A$ in the chromosomes of the size range of $0.6\mu-3.0\mu$ (Table 1).

In the abnormal karyotype, the largest homologous pair had changed into an unequal pair with chromosomes of 2.5μ and 5.5μ in size. The smaller homologue was metacentric and the larger one submetacentric in nature.

In addition to this a heterochromatic supernumerary chromosome of 0.6 μ size was noticed. The percentage of cells at mitosis and meiosis on different dates, showing the presence of heteromorphic pair and the supernumerary chromosome is given in Table II.

The general course of mitosis and meiosis in the chromosomes of both normal and abnormal karyotypes of the exposed and unexposed animals was found to be regular. However, in the former case, general effects of exposure to radiations on stickiness of chromosomes and anaphase-telophase bridges were seen (Figs. 7-9, 11 and 12).

Spontaneous chromosomal aberrations originate from some sort of chromosomal rearrangements induced by the naturally occurring radiations (Swanson, 1965). Herskowitz (1965) described that the rate of occurrence of induced chromosomal changes is rather high in case of exposure to ultraviolet and other electromagnetic rays of higher energy. These high energy rays are prominently present during the total solar eclipse.

In the present study, the chromosomal aberrations suggest that *P. aculeatus* has been affected. It is difficult to ascribe the possible pathway of chromosomal changes, but, the total absence of aberrant cells in the unexposed animals collected a day and a year earlier, and presence of mosaicism in the exposed animals suggest that the changes might have occurred during the present total solar eclipse. The possible target seems to be some gonial cells.

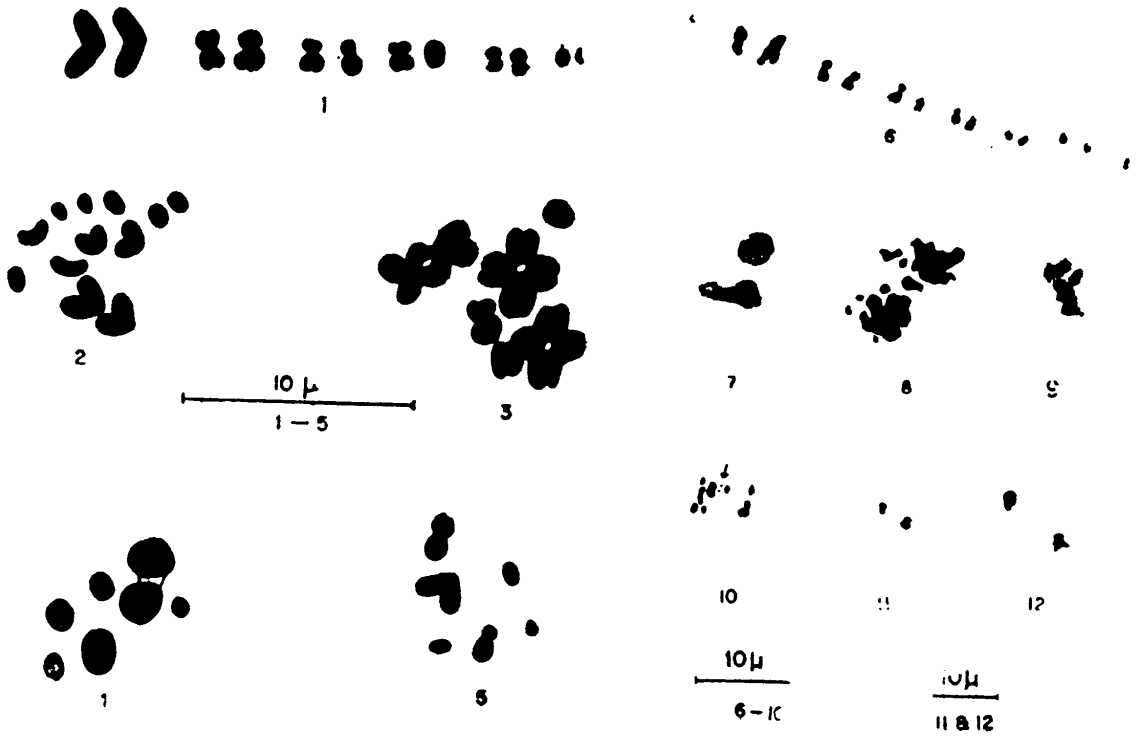
Table I. Karyotype formula and size of the chromosomes (in microns) in normal and abnormal karyotypes of *Paracalanus aculeatus*.

Karyotype formula	Chromosomes												
	1	2	3	4	5	6	7	8	9	10	11	12	13 (S)
Normal													
6M+4SM+2A	3.0 M	3.0 M	1.6 M	1.6 M	1.6 SM	1.6 SM	1.2 SM	1.2 SM	0.8 M	0.8 M	0.6 A	0.6 A	—
Abnormal													
6M+5SM+2A	2.5 M	5.5 S	1.6 M	1.6 M	1.6 SM	1.6 SM	1.2 SM	1.2 SM	0.8 M	0.8 M	0.6 A	0.6 A	0.6 M

M=metacentric SM=submetacentric A=acrocentric S=supernumerary.

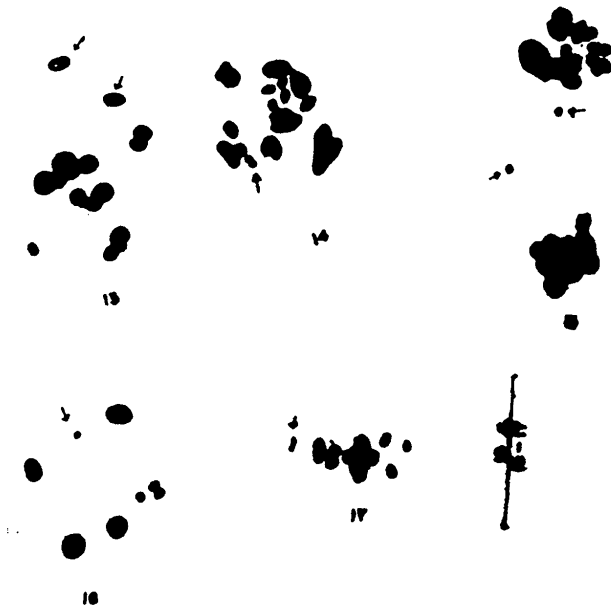
Table II. Percentage of cells at mitosis and meiosis on different dates showing the presence of heteromorphic pair and supernumerary chromosome in *Paracalanus aculeatus*.

Date	Mitosis	Meiosis I	Meiosis II
27-2-1979 & 15-2-80	absent	absent	absent
16-2-1980	10%	absent	absent
17-2-1980	3%	10%	50%



Species: *Paracalanus aculeatus* Giesbrecht
(Figs. 1-17)

1. Normal karyotype (male)
2. Oogonial metaphase
3. Diakinesis (male)
4. Metaphase I (male)
5. Metaphase II (male)
6. Abnormal karyotype
- 7-9. Chromatic masses at spermatogonial metaphase, anaphase and metaphase I
10. Metaphase II showing a supernumerary (arrow) and precariously separated chromosomes
11. Anaphase I bridge (complete)
12. Anaphase I bridge (broken)
13. Metaphase I with two univalents (arrows)
14. Spermatogonial metaphase with one supernumerary
15. Spermatogonial anaphase, supernumerary chromosomes lagging behind
16. Metaphase I with one supernumerary
17. Metaphase II with one supernumerary



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REFERENCES

- Goswami, Usha and S. C. Goswami, 1973. Karyological studies in the genus *Acartia* (Copepoda). *Current Science*, **42**: 242-243.
- Goswami, Usha and S. C. Goswami, 1974. Cytotaxonomical studies on some calanoid copepods. *Nucleus*, **17**: 109-113.
- Goswami, Usha and S. C. Goswami, 1979. Karyology of the genus *Labidocera* Lubbock from the Laccadive Sea (Lakshadweep). *Indian Journal of Marine Sciences*, **8**: 259-261.
- Herskowitz, T. H., 1965. *Genetics*. 2nd ed., Little Brown and Company, Boston and Toronto, 554 pp.
- Reiger, R., A. Michaelis and M. M. Green, 1968. *A Glossary of Genetics and Cytogenetics, Classical and Molecular*. Springer-Verlag, Berlin, Heidelberg, New York, 506 pp.
- Swanson, C. P., 1965. *Cytology and Cytogenetics*. Macmillan & Co. Ltd., London, 596 pp.