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**Heteroploidy and diploidy in bisexual *Artemia* living  
in the salterns of S. Antioco and Carloforte  
(Sardinia)**

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**Genetica.** — *Heteroploidy and diploidy in bisexual Artemia living in the salterns of S. Antioco and Carloforte (Sardinia)*<sup>(\*)</sup>. Nota di LAURA BARATELLI, GIANFRANCO BADARACCO, VITTORIO VAROTTO, GRAZIELLA MURA, CLAUDIO BARIGOZZI e BRUNO BATTAGLIA, presentata<sup>(\*\*)</sup> dal Socio C. BARIGOZZI.

ABSTRACT. — The chromosome numbers of the bisexual *Artemia* from the salterns of Carloforte and S. Antioco (Sardinia) are reported: the population of Carloforte is predominantly diploid (42 chromosomes), while that of S. Antioco is predominantly heteroploid (44 chromosomes). The two populations are interfertile, and also fertile with the diploid population of Cagliari.

KEY WORDS: *Artemia*; Heteroploidy; Reproductive Barrier.

RIASSUNTO. — *Eteroploidia e diploidia nelle Artemie bisessuate delle saline di S. Antioco e Carloforte (Sardegna)*. In questa nota vengono riferite le osservazioni sul numero cromosomico delle *Artemie* di S. Antioco e di Carloforte (Sardegna meridionale, provincia di Cagliari) che vengono studiate per la prima volta. La disparità del numero (42 cromosomi a Carloforte e 44 a S. Antioco) ha richiesto il controllo della fecondità degli incroci fra le due popolazioni, che è stata dimostrata.

L'eteroploidia delle *Artemie* di S. Antioco non è dunque un fattore di differenziazione a livello di specie.

#### INTRODUCTION

The variants of the chromosome number in the Genus *Artemia* exhibit three aspects:

1) Polyploidy (the best known and the most common one) now comprising diploidy (42 chromosomes), triploidy (63 chromosomes), tetraploidy (84 chromosomes) and pentaploidy (105 chromosomes); 2) heteroploidy known so far mainly in the salterns of the Iberian Peninsula, generally present in the parthenogenetical *Artemia* (Barigozzi and Baratelli Zambruni 1982); 3) heteroploidy in the sibling species *A. persimilis* (Piccinelli and Prosdocimi, 1968) where the chromosomes are smaller than in the other species of the Genus and is genetically isolated from *A. franciscana* and *A. salina* (Barigozzi, 1974).

Heteroploidy (44 chromosomes instead of 42) in the bisexual *Artemia*, as it is

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found in the Sardinian saltern of S. Antioco without any reproductive barrier with the diploid population of Carloforte, is a phenomenon analyzed now for the first time.

#### MATERIAL AND METHODS

The shrimps, used as Nauplii for the chromosome investigation and as adults for the crosses, were obtained from cysts collected in both salterns (S. Antioco, province of Cagliari, 1462 hectares and Carloforte, in the same province, 79 hectares).

The chromosomes were studied on micrographs of the mitoses of the Nauplius, after staining with acetic orcein (Barigozzi *et al.*, 1984), in the Department of Genetics and Biology of the Microorganisms of the University of Milan. The crosses between single individuals of the populations of S. Antioco, Carloforte, Cagliari and *A. persimilis* were performed in sea water at room temperature in the Department of Animal Biology of the University of Padua. As food unicellular algae were used. The generation time was, on the average, about one month.

#### RESULTS

##### A) The chromosome set.

1) S. Antioco. Out of a total of 28 mitoses found in 28 Nauplii, 23 exhibited 44 chromosomes and five 42. The great majority is thus heteroploid. No particular characters were found to differ the 22<sup>nd</sup> chromosome pair from the others.

2) Carloforte. Out of 50 mitoses found in 17 Nauplii, 45 exhibited 42 chromosomes and five 44 chromosomes. The Carloforte population, therefore, is predominantly diploid.

In both populations the resting nuclei exhibit only 1-2 chromocentres. In the Sant Antioco's shrimps some additional small masses of chromatin are visible but no repetitive DNA of the Alu I family was found. The presence of 44 chromosomes recalls the occurrence of the same number in *A. persimilis*, but in this species all chromosomes are smaller than in the other species. A size difference was not observed in the 44 chromosomes of S. Antioco which do not differ from those of Carloforte and of other bisexual populations. In absence of a karyogramme of the Genus, there is no possibility to determine which chromosome is duplicated in S. Antioco's set.

##### B) The morphological characters of the adult.

Three morphological characters were examined for the species determination (Barigozzi, 1974): shape of the furca in both sexes, shape of the ovisac in the female and shape and size of the knob on the second antenna of the male.

All correspond, without any noticeable difference, to the typical morphology of *A. salina*, as the mediterranean species was called (Barigozzi, 1974).

C) The fertility of the crosses involving S. Antioco and Carloforte for determining the existence of a reproductive barrier.

The reciprocal crosses proving the existence of a reproductive barrier are the infertile ones, while the others (fertile ones) demonstrate its absence. In parenthesis the number of crosses is indicated:

|            |   |                           |         |
|------------|---|---------------------------|---------|
| Carloforte | × | S. Antioco (8)            | fertile |
| Carloforte | × | Cagliari (9)              | fertile |
| S. Antioco | × | Cagliari (25)             | fertile |
| S. Antioco | × | <i>A. persimilis</i> (38) | sterile |

In all cases the reciprocal crosses failed to show any difference. The crosses show therefore that the chromosome number difference (44 and 42) in the *Artemia* of Carloforte, S. Antioco and Cagliari do not indicate any specific barrier.

#### DISCUSSION

The results demonstrate, on one hand, that the chromosome number difference between the Carloforte and the S. Antioco populations does not involve any speciation process expressed as reproductive barrier. On the other hand, the same chromosome number (44) in *A. persimilis* and in the *Artemia* from S. Antioco does not indicate any genetical identity, since *A. persimilis* and S. Antioco's shrimps when crossed fail to produce offspring. In both cases the sex-chromosomes seem not to be involved.

To which species of the Genus *Artemia* should the populations of S. Antioco, Carloforte and Cagliari be ascribed is a problem which requires the comparison between a larger list of populations. This will be discussed elsewhere.

#### LITERATURE

- BARIGOZZI C. (1974) *Artemia: A Survey of its Significance in Genetic Problems*. «Evolutionary Biology», 7, 221-252.
- BARIGOZZI C. (1980) *Genus Artemia*: in «The Brine Shrimp *Artemia*». Universa Press, Wetteren, Belgium, *Problems of Systematics* 1, 147-153.
- BARIGOZZI C. and BARATELLI ZAMBRUNI L. (1982) *New data on the chromosome number of the genus Artemia* «Rend. Acc. Naz. Lincei» 73, 139-143.
- BARIGOZZI C., BADARACCO G., PLEVANI P., BARATELLI L., GINELLI E. and MENEVERI R. (1984) *Heterochromatin in the Genus Artemia*. «Chromosoma Berl.» 90, 332-337.