MICTIC AND AMICTIC MODES OF REPRODUCTION IN THE ROTIFER *BRACHIONUS PATULUS* MUELLER

T. RAMAKRISHNA RAO and S. S. S. SARMA
Department of Zoology, University of Delhi, Delhi 110007, India.

ABSTRACT

The mictic, amictic and resting eggs of the laboratory-cultured population of the rotifer *Brachionus patulus* could be distinguished from one another by the differences in size, shape and pigmentation. The rare male of the species, hatched from mictic eggs in the laboratory, differed from the amictic females in many respects including size, activity and longevity.

INTRODUCTION

THE diverse modes of reproduction in rotifers are generally believed to be related to the vicissitudes of their habitat[1]. In the Class Monogononta the female reproduces much of the time parthenogenetically, producing diploid (amictic) eggs which develop into females; periodically however, the females, apparently triggered by some changes in their environment, produce haploid (mictic) eggs, which if unfertilized, develop into males, and if fertilized, become dormant or resting eggs[1-3].

A perusal of literature indicates that for the majority of rotifers the males are yet to be described. One reason is that because of the marked sexual dimorphism[4], males in routine rotifer collections may be mistaken for a different species, or if identified as males, their taxonomic status could not be established definitively. Another reason is that in many species the specific factors triggering a switch in the mode of reproduction are poorly understood, making the appearance of males in a rotifer population unpredictable. It is only through maintenance of monocultures over a long period can one make a positive identification of the males when they appear in the cultures.

Brachionus patulus Mueller (Monogononta: Brachionidae) is a cosmopolitan rotifer species reported from many freshwater bodies in India[5]. We have successfully maintained *B. patulus* cultures for more than a year and were able to observe both the mictic and amictic modes of reproduction. We describe here the mictic, amictic and resting eggs as well as the male of this rotifer species.

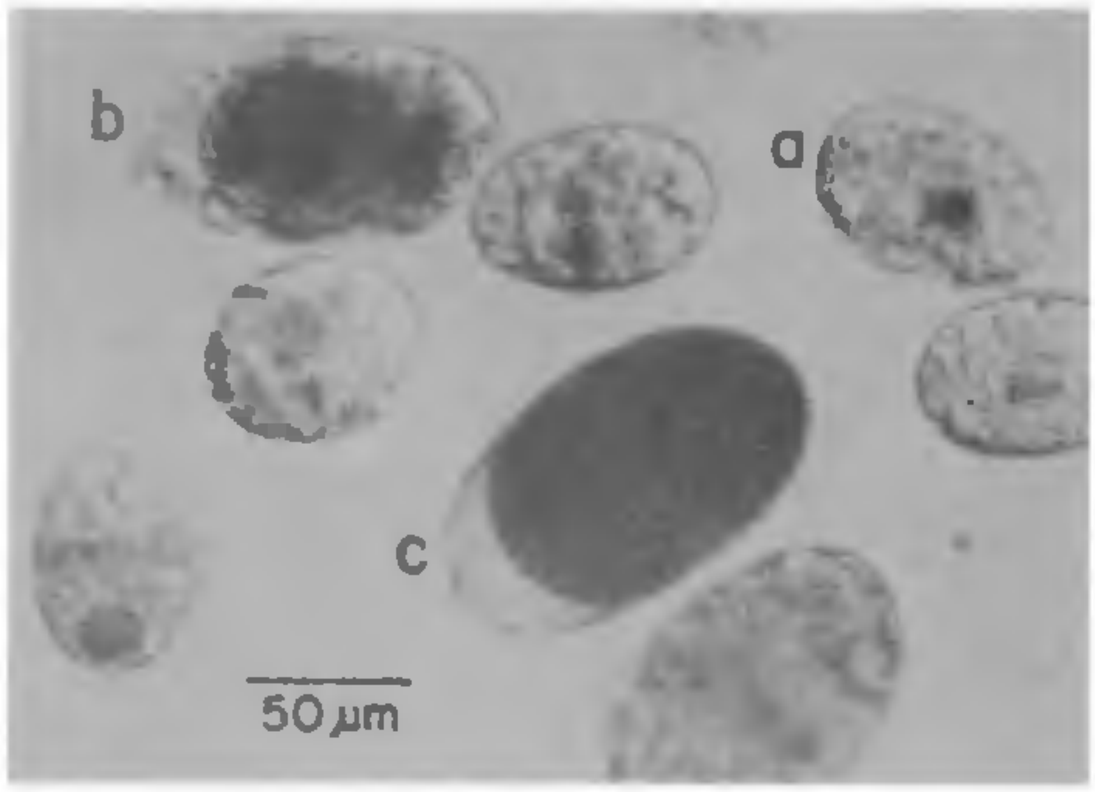
MATERIALS AND METHODS

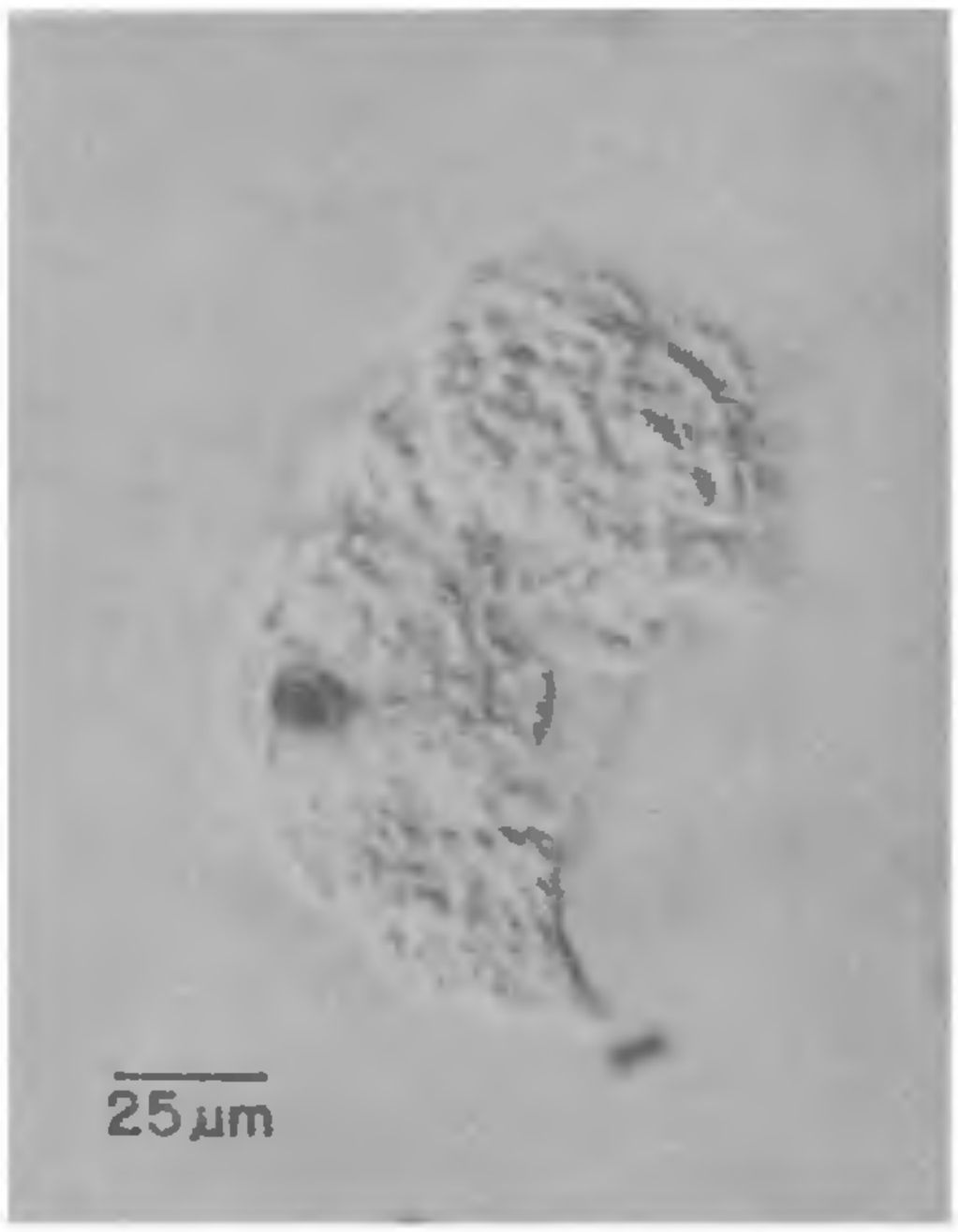
B. patulus, originally isolated from a sample of local pond plankton, was cultured in the laboratory using the unicellular alga *Chlorella* as the food. We found a temperature of 28–32°C, pH of 7–7.5, diffuse light, and food concentration of $2-4 \times 10^6$ cells/ml, optimal for their growth. Population densities reaching more than 100/ml were routinely obtained in culture containers ranging from 15 ml vials to 15 L aquaria. Daily observations on egg production in the cultures revealed from time to time the occurrence of females carrying three distinct types of eggs. These eggs, detached relatively easily from the female by gentle agitation, were collected in large quantities by filtering through Nytex cloth of appropriate mesh size and sorted out. The three types of eggs were incubated separately in glass cavity blocks kept in an incubator. The size of the eggs and newly hatched rotifers were measured using an ocular micrometer. Morphological and behavioural observations on the rotifers were made by slowing them down with MS222 (tricaine methane sulphonate) at a concentration of 25 ppm.

RESULTS AND DISCUSSION

The amictic, mictic and resting eggs differ from one another in size, shape and intensity of pigmentation (figure 1). The resting eggs were the largest (large diameter: $122.8 \pm 2.9\ \mu m$, small diameter: $73.8 \pm 2.6\ \mu m$), followed by the amictic eggs (large diameter: $105.5 \pm 3.9\ \mu m$, small diameter: $69.4 \pm 5.7\ \mu m$) and mictic eggs (large diameter: $65.6 \pm 6.4\ \mu m$, small diameter: $51.8 \pm 3.6\ \mu m$). The size differences among the three types of eggs were statistically significant ($P < 0.01$, t-test).

In our cultures, amictic reproduction was the predominant mode involving the production of diploid eggs by the female. The amictic eggs, of which 1–3 were carried simultaneously by the female, were ellipsoid and thin-shelled, whereas the fertilized resting eggs were thick-shelled and diagnostically dark-





Figures 1, 2. 1. The mictic (a), amictic (b), and resting eggs (c) of *B. patulus*. **2.** the male of *B. patulus*.

coloured. At normal, light microscope magnifications, the surface structure of the resting egg did not reveal any sculpture pattern which in some rotifer species appears to be species-specific[2]. We never encountered a female carrying more than one resting egg at a time. The mictic, haploid eggs, of which four were usually carried at a time by the mictic female, were less ellipsoidal and lighter in pigmentation than the other two types. These eggs differed from the others also in their site of attachment on the female—while the amictic and resting eggs were always attached near the base of the foot, the mictic eggs were attached, two on each side, to the posterolateral spines of the lorica.

The adult females carrying the mictic and amictic eggs showed no readily recognizable differences except in the pattern of their locomotion which probably was related to the number and site of attachment of eggs on them. Although significant size differences between mictic and amictic females have been reported for some cultured rotifer species[3], the size differences were not significant in *B. patulus*. Isolated individuals of mictic females were regularly observed over their entire lifespan but they never produced amictic eggs, indicating that amphoteric females are absent in this brachionid species.

Under the laboratory conditions of incubation, the amictic eggs hatched most readily and with maximum hatching success (> 90%), while mictic eggs showed poor hatching success (< 60%). We incubated the resting eggs for a week but none hatched. Various environmental factors that stimulate development and hatching in rotifer resting eggs were discussed by Blanchot and Pourriot[6].

As in many rotifer species for which males have been described[1,4,7], the male of *B. patulus* bore no resemblance to the female (figure 2) and differed from it in many parameters (table 1). In the male the most prominent organ was the testis, visible as the dark spot which could be clearly recognized even in the developing mictic eggs (figure 1).

The extrinsic and intrinsic factors triggering a switch from an amictic to mictic mode of reproduction and the production of resting eggs in rotifers are not thoroughly understood[2]. This is particularly so in the case of laboratory-cultured populations where males and resting eggs appear periodically inspite of the prolonged constancy of ambient conditions. The

Table 1 *Differences between the male & amictic female of B. patulus.*

Parameter	Female	Male
	(Lorica only)	
Body size (µm) Length	195.8 ± 8.4	91.2 ± 5.9
Width	145.1 ± 9.8	52.2 ± 5.3
Lorica	Present	Absent
Foot	3-segmented	Reduced
Mastax	Present	Absent
Feeding activity	Present	Absent
Post-hatching growth	Present	Absent
Locomotion	Slow, tumbling or revolving	Fast and saltatorial
Longevity (days)	10–12	0.8

biotic and abiotic factors that cause a switch in the mode of reproduction in *B. patulus* are currently under investigation.

ACKNOWLEDGEMENTS

The financial support provided by the Department of Environment, Government of India, is gratefully acknowledged.

12 December 1984

1. Hyman, L. H., *The invertebrates*, Vol. III. *Acanthocephala, Aschelmenthes and Entoprocta.* McGraw-Hill, New York, 1951, p. 572.
2. Pourriot, R. and Snell, T. W., *Hydrobiologia*, 1983, **104**, 213.
3. Gilbert, J. J., Rotifera, In: *Reproductive biology of invertebrates*, Vol. I. *Oogenesis, Oviposition, and Oosorption*. (eds) K. G. Adiyodi and R. G. Adiyodi, John Wiley & Sons, New York, 1983, p. 770.
4. Gilbert, J. J. and Williamson, C. E., *Ann. Rev. Ecol. Syst.*, 1983, **14**, 1.
5. Sharma, B. K., *Hydrobiologia*, 1983, **104**, 31.
6. Blanchot, J. and Pourriot, R., *C. R. Acad. Sci.*, Ser. III, 1982, **295**, 243.
7. Pourriot, R., *Bull. Soc. Zool. Fr.*, 1967, **92**, 185.

ANNOUNCEMENT

AWARDS UNDER ISCA YOUNG SCIENTISTS PROGRAMME

Indian Science Congress Association introduced the programme for the benefit of young scientists from the 68th Session of the Science Congress in January, 1981. The programme enables young scientists to present their proposed research work with opportunities to exchange ideas in the relevant scientific problems with their counterparts and specialists. The details of the programme are given below:

(i) Only members of the Association are eligible for consideration for the Award;
(ii) The upper age limit for the Award is 30 years as on January 1 of the session;
(iii) The papers to be presented for consideration shall have to be:

(a) under single authorship, (b) preference will be given for independent work preferably at the post-doctoral level, and (c) the work must have been carried out in India, (d) stress will be on both quality of research and performance.

One copy of the full paper alongwith three copies of its abstract 100 words (to be clearly indicated on the top of the first page of the full paper and on the top of all the three copies of the abstracts the section where it is desired to be presented) shall have to reach the office of the General Secretary (Headquarters) not later than August 16 preceding the Session. Biodata, including full name and address alongwith the date of birth (duly supported by attested copy of the certificate), research experience, list of publications should be given in the top sheet of the complete paper.

(iv) The papers/abstracts will be scrutinised and the scientists will be required to present their papers in respective sections, if invited by the Sectional Presidents concerned.
(v) The names of awardees will be announced by the General President at the meeting of the General Body of Members. The Certificate of Merit and the Cash Award of Rs. 500/- will be handed over to the recipient with the citation. A further amount of Rs. 2,500/- towards incidentals, etc. will be sent to the awardees later from the headquarters of the Association. The total number of Awards are twenty; and
(vi) The young scientists as recommended by the concerned sections will be provided with the admissible travelling and daily allowances by Indian Science Congress Association.

For further details, please contact Asst. Executive Secretary, Indian Science Congress Association, 14, Dr. Biresh Guha Street, Calcutta 700017.