CYCLOMORPHOSIS IN ROTIFERS

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Abstract: The phenomenon of **Cyclomorphosis** has been noted in the dinoflagellates, rotifers, cladocerans and to a much striking degree in the copepods. Organisms those reproduce during most of the year by asexual especially by parthenogenesis process, exhibit this phenomenon more. Although the seasonal incidence of the change is clearly determined by environmental factors, there may also be inherited diversity in the capacities of different races of a species to react to these factors. The seasonal changes of form in certain Rotifers is so striking that the summer and winter forms of the same species would certainly be supposed to represent different species by an observer, unacquainted with the facts. Although there is no significant change in the physiological processes in these planktons but great change in the morphology as well as existence of polymorphism is observed. Rather it is a general belief that the cyclo-morphometric changes in these organisms do have some adaptive significance. It involves the alternation of different morphological units in a species in accordance to the climatic as well as environmental changes. Total body size may increase, decrease or remain the same throughout the cycle, depending on the species. The change in the shape of Lorica, size and number of outer ornamentation like spines and the shape of mastax in accordance to body shape is remarkable. The exhibition of polymorphic forms and the seasonal morphological changes in accordance to the environment in certain **Brachionusrotifers,** is investigated in the present work.

Key words: Zooplanktons, Rotifers, dinoflagellates, cladocerans, copepods, lorica, mastax, Morphometric changes, Outer spines, parthenogenesis,Physical factors.

Introduction: The Morphological change those occur in certain species of invertebrates in accordance to environmental conditions is called Cyclomorphosis. The term Cyclomorphosis was coined by Lauterborn (1904) but the actual concept came to lime light only after Coker (1939). The phenomenon has been noted in the dinoflagellates, cladocerans, and to a much striking degree in the copepods. Organisms that reproduce during most of the year by asexual or parthenogenesis methods appear to exhibit this phenomenon. The degree to which the Cyclomorphosis is developed within different populations of the same species is variable. Although the seasonal incidence of the change is clearly determined by environmental factors, there may also be inherited diversity in the capacities of different races of a species to react to these factors. The seasonal changes of form are so striking that the summer and winter forms of the same species would certainly be supposed to represent different species by an observer, unacquainted with the facts. It involves the alternation of different morphological units in a species in accordance to the climatic as well as environmental changes. Total body size may increase, decrease or remain the same throughout the cycle, depending on the species.

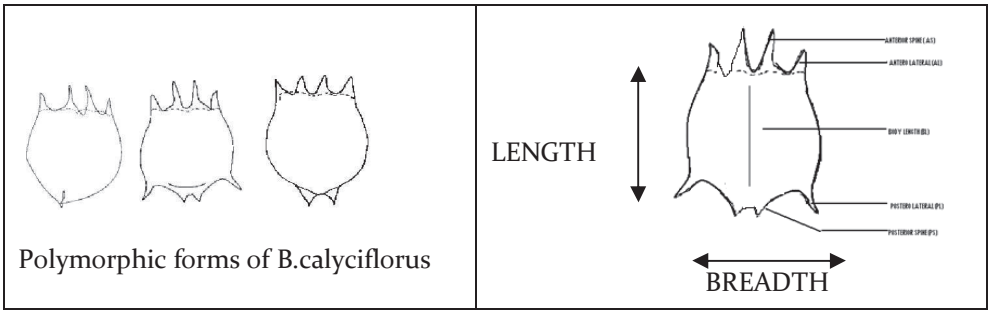
Rotifers are one such group of invertebrates found abundantly in any fresh water body throughout the globe. Popularly known as *"the wheel animalcules"*, these are although small in number but large populations are found in a particular environment. Among the Rotifers the monogonants especially that of order Ploima having the genus *Brachionus* are unique for their polymorphic forms and exhibition of Cyclomorphosis. Several investigation carried by earlier workers also reveal the same fact. Cyclomorphosis in rotifera was described first by Weisenberg-lund (1926) and later by several workers like Beauchamp (1952), Gallagher (1957), Hutchinson (1967), Gilbert (1973), Dodson (1974) also by Indian contributors like Arora (1965), Nayar (1968) and Dhanapathi (1980).

Place of investigation: To understand the phenomenon of Cyclomorphosis in Rotifers in different seasons as well as in different ecological conditions, present work was carried out in two different perennial ponds in the city of Vizianagaram belonging to the state of Andhra Pradesh, India. Of these two ponds, one is highly polluted (Pond-1)and the other a bit clean and fresh water in nature (Pond-2) since no municipal or domestic wastages are allowed to pass in to this pond. Plankton samples were collected periodically (weekly once) from both pond-1 and pond-2. Species related to *Brachionus* are collected separately and measurements were being taken. Three species of Brachionus were only investigated, they are e.g., *Brachionuscalyciflorus, B.caudatus*and*Keratellacochlearis.*

Brachionuscalyciflorus Pallas:

Brachionuscalyciflorus is an extremely variable species, the variability is pronounced in the size, length of posterolateral spines as well as occipital spines. Examination of all the data from the localities surveyed, the data from Big Pond (Pond-I) was found continuous enough to explain the phenomenon of Cyclomorphosis, in B.calyciflorus. Although this

species was observed in the samples collected between April, 2009 and January, 2010, the continuous data could be obtained only from 7th October, 2009 to 9th January, 2010.On 23rdSeptember, 2009 when the surface temperature was 32.4°Cthere were few forms of this species in the samples. On 7th October the number of specimen appeared abit increased when the temperature was 28.5°C. The quantitative study of the rotifer revealed that there were two peak periods of abundance when the temperature was 21.0°C ON 26-11-09and the second peak when it was 20.0°C ON 02-01-10. The rotifer stated disappearing from the samples when the temperature rose to 23.0°C on 16th January, 2010 and found very few on 23rd January 2010.During the period of occurrence of these species, the hydrogen-ion concentration (pH) fluctuated between 8 and 9 and turbidity between 11 and 72 ppm.



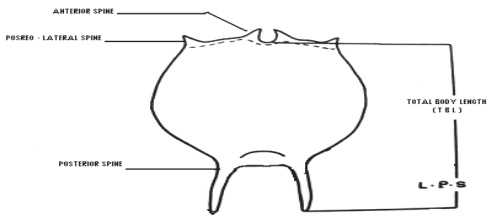
Polymorphic forms of B.calyciflorus

Morphological variations: Measurements were taken for thirty specimens from each sample collected once in a week. Length of lorica (TBL), Maximum breadth (B) of lorica and the length of Postero-lateral spines (PLS) were measured and their mean values were given in table. The respective points used in making the measurements were shown in Graphs.The lengths of the lorica ranged from 230 to 328 microns while the breadth from 200 to 228 microns. In case of Postero-lateral spines the length of the right posterolateral spine which was more variable was taken. Its length ranged from 21 to 53 microns while the length of left posterolateral spine ranged from 23 to 50 microns. Thus we can conclude that the right spine is elongated than the left one.

The specimens with and those without posterolateral spines were almost equal in the samples of 7th and 14th October. The specimens without posetrolateral spines gradually decreased and they disappeared completely in the samples collected from 4th November to 18th December. Again few specimens without posterolateral spines had re- appeared on 25th December and continued till 9thof January 2010.In the earlier collections the specimens without posterolateral spines (var. dorcas) are larger in size than those with posterolateral spines (var. dorcas f. spinosa). In the samples from 4th November till 18th December only var. dorcas forma spinosawas present. But the lateral Collections showed an assemblage of varied forms (var. dorcas, var. palaand var. dorcas f. spinosa). Some specimens without posterolateral spines were found smaller than those with posterolateral spines in the collection during 25th December, 2009 to 9th January, 2010.Increase in the length of the postero-lateral spine (right) with the decrease in the size of the lorica has been observed.

BrachionuscaudatusBarrios and Daday: Although this species occurred for most part of the year in both the ponds but for morphological variances, samples were collected from Pond – 1 were taken for present study. Only the measurements of the population collected from 05th March to 21st May 2009 were only analyzed for drawing the following conclusions.

Morphological Variation: This rotifer showed a variation in length of posterior spines, arising on either side of the foot. The measurements were taken for twenty specimens from each weekly sample. The length of lorica (TBL), maximum breadth of lorica (B) and the length of each posterior spine (PS) were measured and the mean values were presented in the Table. The respective points used in the making the measurements were shown. The lengths of Lorica ranged from 98 to 128 microns while the Breadth from 87 to 112microns. The Posterior spines are almost equal except in very few. As the right one showed much variation, measurements of this spine were taken for illustration. Its length varied from 12 to 63 microns. With the increase in the temperature the length of lorica increased and there was also a corresponding increase in the length of spines. But the rate of increase in the length of posterior spine is greater than the rate of increase in the length of lorica.



Conclusion: The proximal causes including Cyclomorphosis can be mooted with the environmental conditions those change within no time along with the climate. A relatively warm or warming temperature, turbulence presence of light, female principle and predation are some of the prime reasons. Exuberant forms of rotifers have been correlatedwith starvation for *Branchious* or with dense food or cold water. Gilbert had the opinion that incase of *Branchiou s*the abundance of *Asplanchana*(a predator)in the same locality also influence Cyclomorphosis. Turbidity appears to be also an important factor influencing the reproduction and abundance of both the species. *B.calyciflorus*was observed in abundance when the turbidity was low. Another important factor which was observed in the present observation was dissolved oxygen. With the increase in the dissolved oxygen content there was a corresponding increase in the abundance of both the species. Nayar (1956) was of the opinion that these physico-chemical factors may not have direct influence on the rotifer *B.calyciflorus*. This may be true to certain extent but in the present investigation it is clear that the occurrence of Cyclomorphosis is basically due to the physico-chemical changes inthe environment.

In both these ponds the maximum size of the lorica was observed for all the species during the period of high temperature. In *B.calyciflorus* with the decrease in the temperature, there was a corresponding decrease in the length of the loricaand increase in the length of postero-lateralspine. But in *B.caudatus* with the increase in temperature, there was a corresponding increase in the length of loricaand length of posterior spines. Itmay be concluded that no single factor can account for this seasonal polymorphism but a combination of many factors like temperature, turbidity and hydrogen-ion (pH) Concentration, dissolved oxygen and feeding behavior, etc. are all responsible for these variations which might act in a cumulative manner.

Brachionus is typical for its polymorphic forms and specialized spiny outgrowths. It was also noticed that the species of Brachious examined from pond-I are much enlarged, healthy in look and much spinous comparatively to the samples brought and examined from pond-II. One of the biggest reasons for such variance may be attributed in the form of domestic sewage pollution which is opened into the pond-I in large accounts.

After a fresh spell of monsoon, the distribution of phytoplankton is plenty. The malleate or malleo-ramatemastex of herbivorous rotifers such as *Brachionus a*nd *Keratella* is specialized to capture such nanno planktons, while the incudatetrophy of *Asplancha* are specialized for capturing small rotifers.This suggests that prey of the right size but wrong shape is never accepted in predation, hence many be rejected after being caught. For example, the presence of long spines on *B.calyciflorus* does not affect the rate of collision with *Asplancha* but decreases the probability of being eaten once caught. Hence, a spine or any such thing at the right place at right time makes the prey unsuitable for predation. In the present investigation, a correlation between the distribution and species composition is also observed during the period of elongation of outer ornamentation. More the spine elongations less was the species composition.It can be finally be said that the morphological structures, the lorica , abundance as well as the size and population of one species is inter related to the other especially to that of predator.

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BODY DIMENSIONS OF *B.calyciflorus*(08-10-09 TO 21-01-10)				
DATE	MEAN LENGTH OF LORICA	MEAN BREADTH OF LORICA	MEAN LENGTH OF POSTERIO LATERAL SPINES	
			RIGHT	LEFT
08-10-09	328	227	21	23
15-10-09	327	228	23	23
22-10-09	302	221	25	26
29-10-09	266	212	30	28
05-11-09	301	220	31	30
12-11-09	302	224	35	34
19-11-09	293	218	52	49
26-11-09	256	202	53	50
03-12-09	277	212	51	49
10-12-09	235	204	43	46
17-12-09	242	208	51	48
24-12-09	236	208	40	40
31-12-09	230	200	40	38
07-01-10	250	210	37	37
21-01-10	246	204	35	36

BODY DIMENSION OF *B. caudatus* (05-03-09 TO 21-05-09)				
DATE	MEAN LENGTH OF LORICA	MEAN BREADTH OF LORICA	MEAN LENGTH OF POSTERIOR SPINES	
			RIGHT	LEFT
05-03-09	98	87	12	11
12-03-09	102	96	13	13
19-03-09	105	100	17	16
26-03-09	106	102	19	19
02-04-09	107	102	23	23
09-04-09	109	101	31	30
16-04-09	114	104	41	41
23-04-09	117	106	48	48
30-04-09	118	108	48	48
07-05-09	120	110	56	52
14-05-09	124	116	59	56
21-05-09	128	122	63	60

VARIATION OF SPINE LENGTH IN K. cochlearis			
DATE	NO.OF SPECIES	WATER TEMP.	SPINE LENGTH
08-10-09	35	30.0	54
15-10-09	36	28.5	57
22-10-09	32	28.5	64
29-10-09	35	27.5	71
05-11-09	07	25.5	74
12-11-09	21	27.5	87
19-11-09	21	25.0	89
26-11-09	04	24.5	85
03-12-09	36	23.4	93
10-12-09	36	22.5	94
17-12-09	33	21.2	96
24-12-09	30	22.0	91
31-12-09	26	22.0	90
07-01-10	36	20.6	96
21-01-10	36	21.8	94
28-01-10	36	23.0	88
04-02-10	22	25.7	65

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