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HELMET DEVELOPMENT IN *DAPHNIA CEPHALATA* KING UNDER LABORATORY CONDITIONS

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CYCLOMORPHOSIS is a seasonal change in the morphology of many planktonic crustaceans and has been described in several species of *Daphnia*[1-4]. It has been reported that the increase in helmet size in various species of zooplankton may be due to a rise in temperature[5-7] or turbulence[8-11] or a chemical released by a predator[12,13].

In Madurai (Lat: 9°53′ N; Long: 78°E), four species of helmeted *Daphnia* were recorded along with a non-helmeted species[14]. Among these four helmeted species, *Daphnia cephalata* King has a large cephalic expansion. It is abundant in nature and co-occurs with a round-headed *Daphnia similis* Claus. An invertebrate predator, *Anisops bouvieri* is also common in these ponds where the daphnids co-occur.

Grant and Bayley[12] and Kruger and Dodson[13] reported that a chemical substance released by the predator is responsible for helmet growth in daphnids. In the present study, to test the above hypothesis, we performed a few experiments. Gravid females of both *D. cephalata* and *D. similis* were cultured individually in a plastic container (50 ml) and the filtered pond water was used as the medium to study the life history following the method of Venkataraman[15]. About thirty *A. bouvieri* were taken and ground in 30 ml of distilled water centrifuged at 3000 rpm for 10 min. The supernatant was taken and 0.5 ml of this extract of *A. bouvieri* was added to one litre of the filtered pond water and used as medium for culturing the daphnids. This medium was changed daily. The body size, helmet size, width and the number of eggs were measured following the method of Hebert[7]. The results were analyzed statistically using ANOVA[16].

It was observed that the helmeted *D. cephalata* can produce only helmeted youngone and not the round-headed form and *vice versa*. An increase was noted in total length, head length and head width between the control and experimental forms; however, no significant change was noticed in H/C ratio (table 1).

In the present study the clutch size of *D. similis* is larger than that of *D. cephalata* (figure 1). One possible

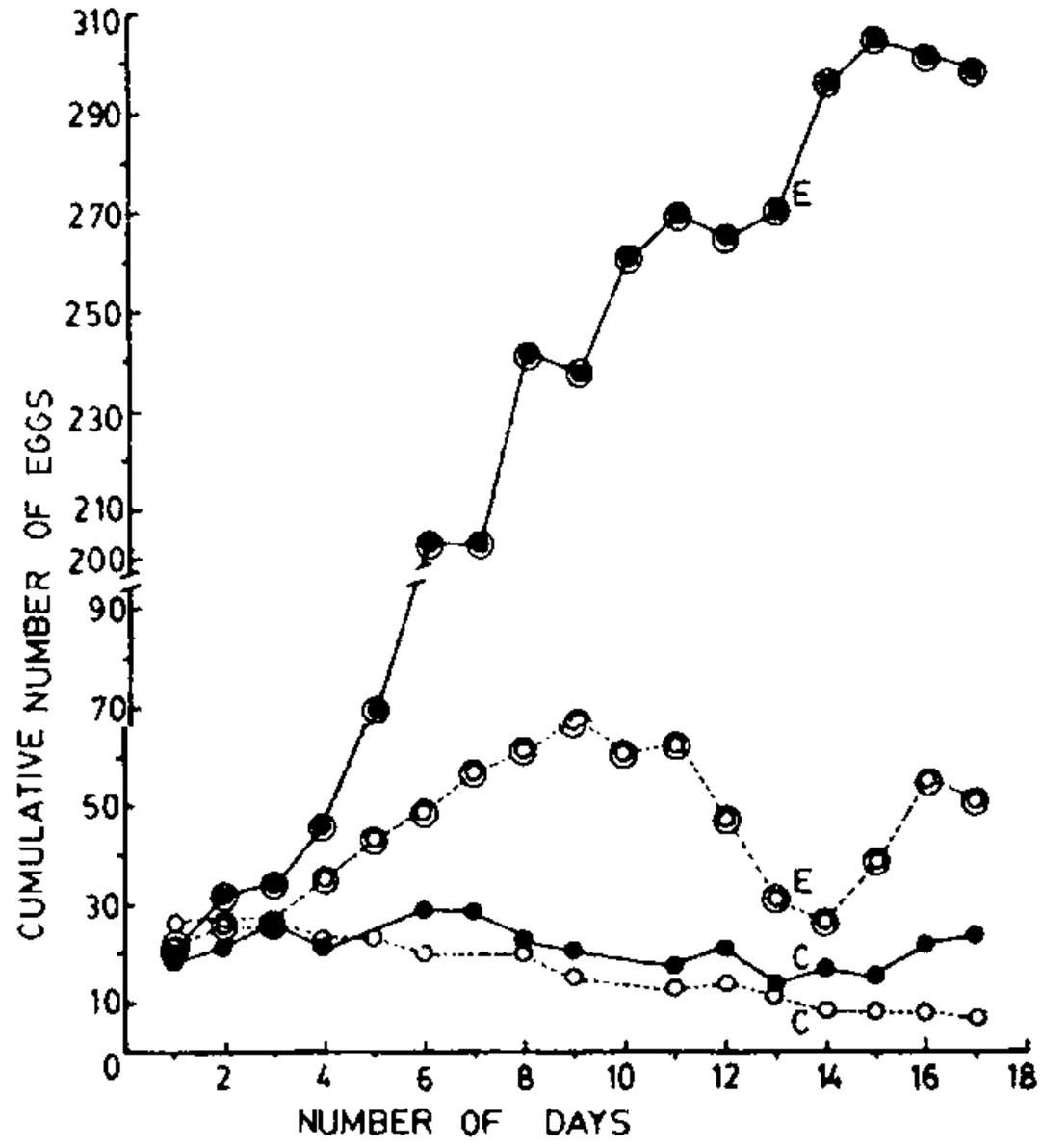

Figure 1. Fecundity of *D. similis* and *D. cephalata* in relation to number of days. (E—experimental; C—control; solid line—*D. similis*; dotted line—*D. cephalata*).

Table 1 *Statistical analysis of D. similis and D. cephalata under experimental conditions*

Name of species	Head length	Head width	Total length	Head per carapace ratio
D. similis	$P < 0.01$*	$P < 0.01$*	$P < 0.005$**	$P > 0.5$***
D. cephalata	$P < 0.0025$**	$P < 0.05$*	$P < 0.01$*	$P > 0.05$*

*Significant; **Highly significant; ***Not significant.

explanation for the larger clutch size in *D. similis* may be the allocation of more energy towards reproduction whereas, in helmeted *D. cephalata* part of the absorbed energy is used mainly for producing a larger helmet. This larger helmeted forms can easily evade predation by *A. bouvieri*[17]. The same type of energy allocation as found in the present study is also observed in helmeted and non-helmeted *D. galeata*[18] and in *D. retricurva*[19].

In the present study, temperature, food and other physico-chemical parameters were kept constant and the only variable was the extract of the predator. The extract-induced head length and head width are greater in *D. cephalata* than in *D. similis*. From the results it appears that the extract of *A. bouvieri* has an effect on *D. cephalata* in producing a helmet when compared to *D. similis* under laboratory conditions. The helmet of *D. cephalata* and other helmeted forms of *Daphnia* acts as an antipredator device[17, 20–22] by which the helmeted forms can easily escape from the invertebrate predators. The round-headed forms are more susceptible to *A. bouvieri* predation[16, 23]. Because of predation pressure these round-headed forms tend to increase their population by producing more eggs (figure 1), as found in the present study. Similar increase has been reported earlier in *D. retrocurva*[17].

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EFFECT OF pH ON HORMOGONE FORMATION

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HORMOGONES are small pieces of trichome with one or more uniform cells, and are usually enclosed by a