

## Effect of solar eclipse on the emergence of some freshwater cercariae

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**Abstract.** The effect of solar eclipse on the emergence of five species of freshwater cercariae from their snail hosts has been studied. Two cercariae showed visible changes from their normal emergence pattern from the snails during eclipse. It appears that changes in atmospheric light and temperature brought about by eclipse altered the behaviour of the snail and this has affected the emergence of cercariae.

**Keywords.** Cercariae; solar eclipse; *Cercariae indicae*; cercarial emergence.

### 1. Introduction

On 16 February 1980 (Saturday) total solar eclipse occurred for 2 to 5 minutes in a belt of 135 km from 14.17 hrs to 17.00 hr across peninsular India. Visakhapatnam, situated outside this belt, witnessed 95% eclipse for 2 minutes from 15.46 to 15.48 hr when the temperature dropped by 2°C. The eclipse commenced at 14.30 hr and terminated at 16.58 hr. Visible changes in light and temperature were observed between 15.30 hr and 16.30 hr.

Since cercarial emergence from snails is mainly controlled by light and temperature a simple experiment was designed to study if the climatic changes brought about by the solar eclipse alter the normal emergence pattern of cercariae. Five different cercariae showing different rhythms in their emergence from snails were selected for study. The hourly changes in the numbers of cercariae emerging from snails were followed for three consecutive days, the eclipse day and the pre- and post-eclipse days. The results for the three days are compared and the observed variations discussed in relation to changes in climatic factors brought about by the eclipse.

### 2. Materials and methods

Snails were obtained from two different sources: (i) 186 specimens of *Indoplanorbis exustus* collected from a lake at Kondakarla (ii) 45 individuals of *Thiara tuberculata* collected from a stream at Waltair. The infected snails were spotted out and the following 5 species of cercariae were selected for study.

#### 2.1 *Cercariae indicae* VIII Sewell, 1922

A pleurolophocercous cercaria belonging to Opisthorchioidea collected from *Thiara tuberculata*. The cercaria is fairly big in size, a swift swimmer and is uniformly distributed throughout the water column. It did not exhibit any photoperiodism

although equipped with eyespots.

### 2.2 *Cercariae indicae* XVII Sewell, 1922

A medium sized xiphidiocercaria of polyadenous group belonging to Plagiorchioidea emerging from the snail *Indoplanorbis exustus*. The cercaria swims close to the bottom of the dish and is thus positively geotropic.

### 2.3 *Cercariae indicae* V Sewell, 1922

A very small xiphidiocercaria from *T. tuberculata* identified as a plagiorchioid cercaria. The cercariae are negatively geotropic and they accumulate in large numbers close to the surface of water column forming a thick suspension of cercariae.

### 2.4 *Echinostome* cercaria

An unidentified 27 spined echinostome cercaria from the snail *I. exustus*. The cercaria is fairly big in size appearing as a white speck moving actively in the water. It did not exhibit phototropism or geotropism.

### 2.5 *Strigeid* cercaria

An unidentified strigeid cercaria with an inflated tail and two short furcae, emitted by *I. exustus*. The cercariae remain suspended in water at all levels.

The infected snails were placed individually in test tubes containing stored tap water and the test tubes were placed in an open space on the terrace of a two storied building where the temperature and light effects are easily felt. The numbers of cercariae that had emerged from the snail were counted at hourly intervals for three consecutive days, the eclipse day and pre- and post-eclipse days. The experiment began at 1000 hr on 15 February and ended on 18 February at 1000 hr. This covered the eclipse period which fell between 1530 and 1630 hr on Saturday, 16 February. When the cercariae were to be counted, the snails were removed to a new test tube and a small amount of 5% formaldehyde was added to the water in the used test tube in order to kill the cercariae. The cercariae that had settled down to the bottom of the test tube were counted. Snails were not fed during the experiment.

The significance of the differences in the numbers of cercariae that had emerged during eclipse time and during the same time on pre-eclipse and post-eclipse days were tested statistically by  $\chi^2$  test wherever possible.

## 3. Observations

### 3.1 *Cercariae indicae* VIII

The periodicity in the emergence of the cercaria from the snail for the 3 days is shown in figure 1. Cercariae emerged from the snail throughout the day but the peak emergence occurred between 1600 and 1800 hr. The cercarial emergence on the eclipse day followed the same periodicity as on the other two days but a notable feature is that prior to the commencement of eclipse *i.e.* during the period between 1400 and 1500 hr on 16 February, because of intense heat the snail became inactive and as a result no cercariae were shed during this period. After the commencement of eclipse and associated sudden drop in temperature and light intensity, the snail regained activity and significantly more cercariae were shed during the eclipse

(between 1600 and 1700 hr than during the same period on the other days ( $p < 0.05$ ). Thus there seems to be some enhancement in the shedding of cercariae from the snail during the eclipse period. On the third day of the experiment there is some depletion in the numbers of cercariae emerging from the snail.

### 3.2 *Cercariae indicae XVII*

This cercaria emerged predominantly during darkness between 1900 and 0800 hr the peak being at 2400 hr. No cercariae emerged during day time between 0900 and 1800 hr (figure 2). During eclipse, however, some cercariae emerged between 1600 and 1800 hr.

### 3.3 *Cercariae indicae V*

This cercaria emerged in large numbers from 1600 hr to 0400 hr the peak emergence being between 0500 and 1500 hr. Similar rhythm was observed on all the three days but on the first day of the experiment, cercariae showed two peaks in their emergence from the snail, one at 2000 hr and another at 2400 hr. There was considerable depletion in the numbers of cercariae that had emerged from the snail on the third day of the experiment (figure 3).

### 3.4 *Strigeid cercaria*

The emergence of this cercaria appears to be stimulated by light as it emerged between 1000 hr and 2000 hr when high light intensity conditions prevailed (figure 4). Shedding was most intense during bright daylight. Some difference was observed

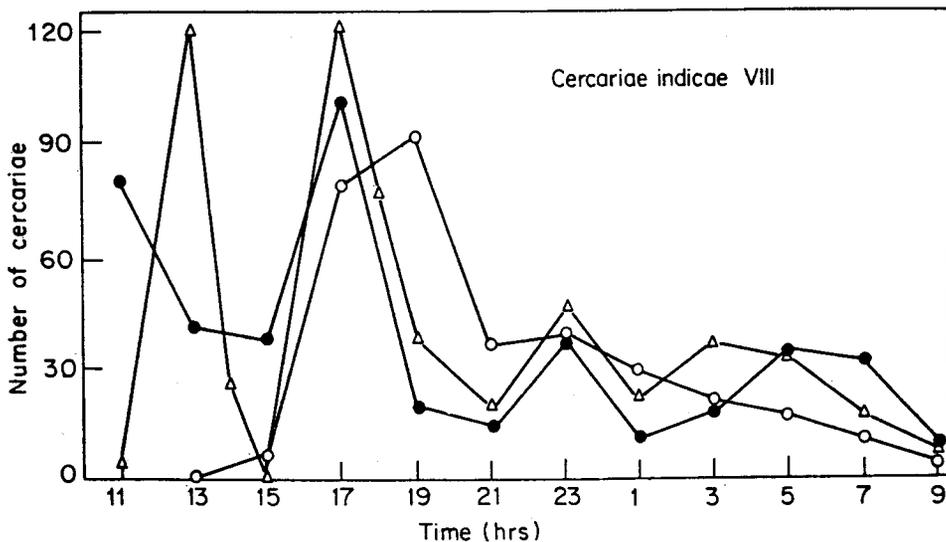
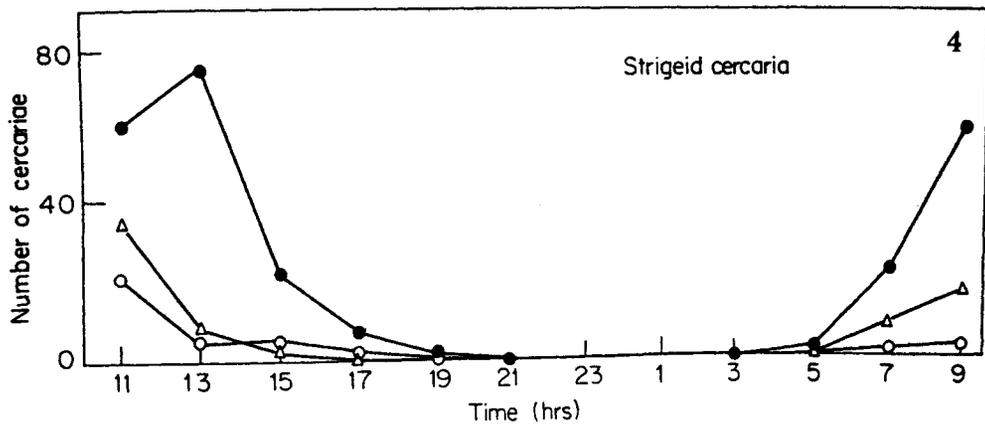
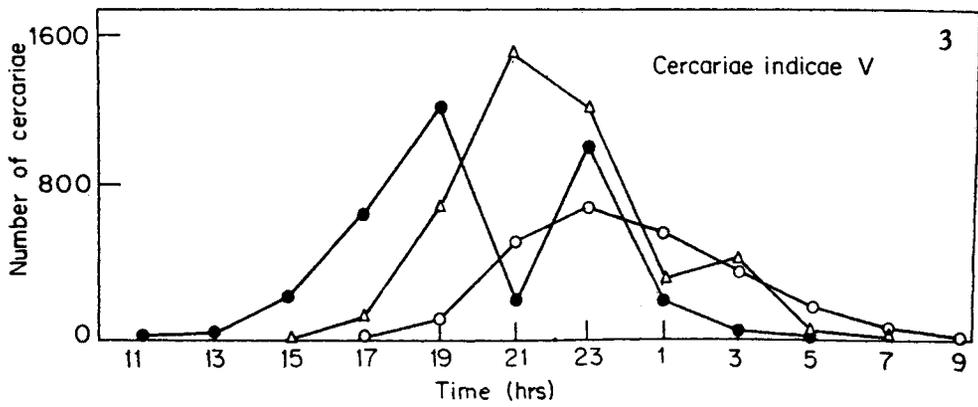
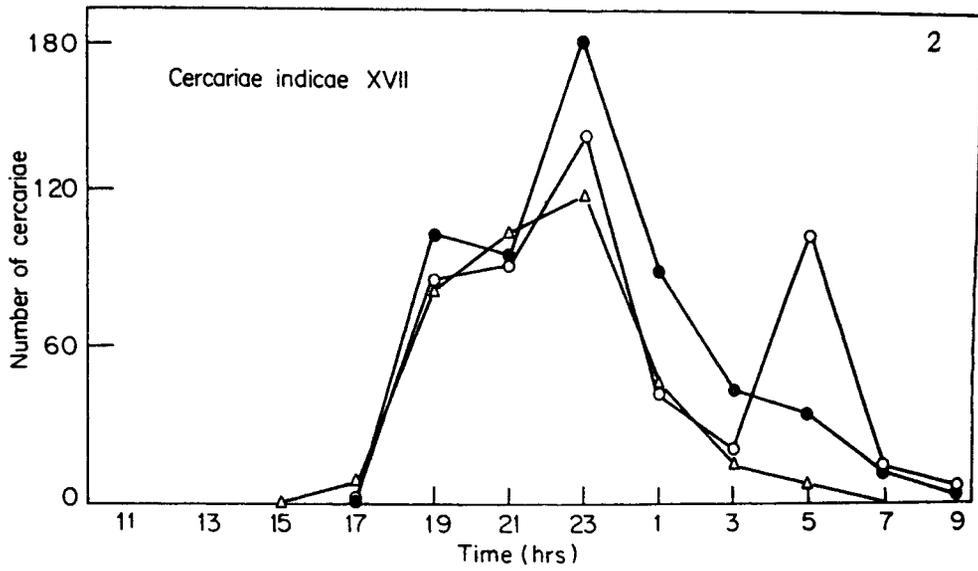
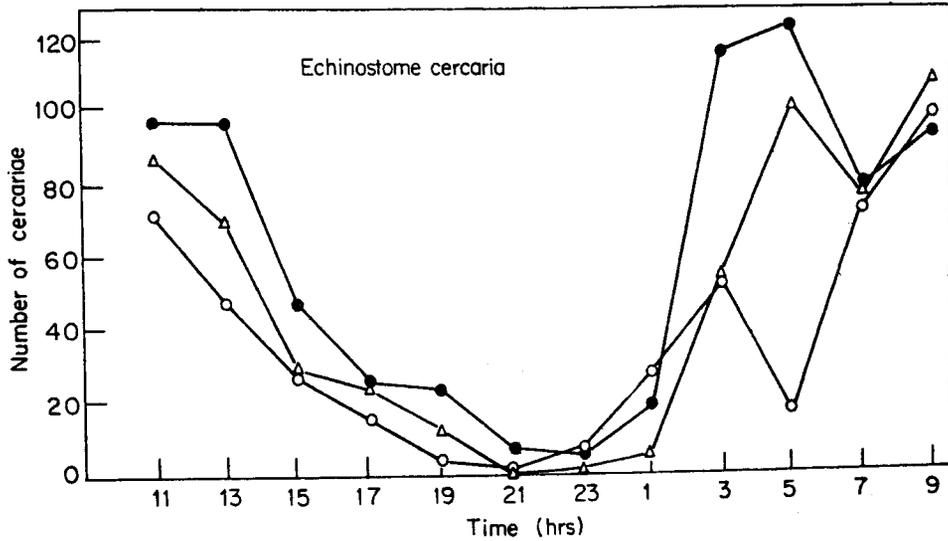


Figure 1. See caption in p. 69.



Figures 2-4. See captions in p. 69



**Figures 1 to 5.** Periodicity in the emergence of cercariae for 3 days. Each point on the graph indicates the numbers of cercariae that had emerged during the 1 hr period prior to the time indicated in the abscissa. ● Emergence from 1000 hr on 15 February to 0900 hr on 16 February; ▲ from 1000 hr on 16 February to 0900 hr on 17 February; ○, from 1000 hr on 17 February to 0900 hr on 18 February.

in the cercarial emergence on the eclipse day. In the normal days cercariae continued to emerge till 2000 hr but on the eclipse day the emergence of cercariae ceased right from 1600 hr and this may be a reflection of the drop in the light intensity during eclipse time. On the third day of the experiment the snail host became inactive, hence only a few cercariae were shed.

### 3.5 *Echinostome cercaria*

This cercaria emerged throughout the day but only in small numbers between 2000 hr and 0200 hr, the peak emergence being between 0400 and 600 hr (figure 5). No changes were observed in the emergence pattern of the cercaria during eclipse time. The slight variations noted were not statistically significant.

## 4. Discussion

Among the free swimming larval stages of helminths, cercariae are known to exhibit rhythms in their emergence from the molluscan hosts. Some cercariae emerge maximally during day-time, others at night and there are some which do not show any periodicity in their emergence pattern. Previous studies on the emergence of cercariae from snails and the influence of various environmental factors on the cercarial emergence suggested photoperiod and thermoperiod as the major synchronising factors controlling the process (Rees 1931; Kuntz 1947; Olivier 1951; Asch 1972; Wagenbach and Alldredge 1974; Combes and Theron 1977). Other factors such as pH and oxygen content of the medium, nutritional condition and physiological state of the host also exert their influence either individually or in

combination with others (Mohandas 1974). The peak period of emergence of cercariae from the snail is also correlated to the period of peak occurrence of hosts which the cercariae attack (Yamaguti 1970)

Of the five cercariae subjected to experimental work in the present study, the strigeid cercaria emerged only during day-time and in large numbers under bright light, thus the emergence of this cercaria seems to be elicited by light. Among others, *Cercariae Indicae* V and XVII emerged only during periods of darkness in the absence of light. Thus they reacted negatively to light. *C. Indicae* VIII and the echinostome cercaria emerged regularly at all hours of the day and night although more were shed in daylight than in diffuse light, or at night. Light does not seem to be the causative factor for the emergence of these cercariae.

Only two cercariae responded to climatic changes brought about by eclipse and showed some deviations from their normal pattern of emergence. The strigeid cercaria, the emergence of which is triggered by light, stopped emerging during eclipse time and this appears to be directly related to the disturbance in light intensity caused by solar eclipse. Similarly *C. Indicae* XVII which emerges only during dusk and night and not during daytime, emerged though in small numbers during eclipse as a result of fall in temperature and light. Among others, *C. Indicae* VIII showed some variation from the normal periodicity in that it emerged in significantly greater numbers during eclipse period than during the same period on the other days. This enhancement in the numbers of cercariae that had emerged appears to be a result of the change in the behaviour of snail which became active following the fall in temperature and light during eclipse time.

In three of the five cercariae studied, there is some decline in the numbers of cercariae released on the third day of the experiment. Since the snails were not fed during the experimental period, the decline may have been due to nutritional factors.

It is evident that eclipse did influence the periodicity of some cercariae. However, this influence appears to be only of an indirect nature. The change in atmospheric light and temperature during eclipse period altered the behaviour of the snail which resulted in changing the cercarial emergence pattern. As stated by Erasmus (1972) the presence of larval trematodes in a mollusc represents a particularly close host-parasite relationship with variations in the physiology of the one having profound effects on the other.

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