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To Whom It May Concern

This is to certify that Dr. Utpal Singha Roy, Assistant Professor of Zoology, P. R. Thakur Government College, Thakurnagar is my research collaborator. We have been working together on various projects since 2011 and the collaboration is continuing till date. Recently, we are working on Biodiversity conservation and ecotoxicology. Some of the research outputs are available at this links (<https://doi.org/10.1007/s10201-018-0540-8>).

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Effect of a total solar eclipse on the surface crowding of zooplankton in a freshwater lake ecosystem

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Abstract

Zooplankton surface crowding in a freshwater lake ecosystem during a total solar eclipse (maximum eclipse at 06:28:43 Indian Standard Time, 22 July 2009) was studied in relation to ambient physicochemical conditions and compared with the crowding that occurred during pre- and post-eclipse days. Rapid light attenuation on the eclipse day led to changes in zooplankton surface crowding, which manifested as alterations to community structure and statistical parameters. Zooplankton diversity and density varied depending on the day (either the pre-eclipse day, the eclipse day, or the post-eclipse day) and the sampling time considered. A total of 20 zooplankton species were recorded during the study. On the day of the eclipse, the highest zooplankton density in the surface water was recorded just after the end of totality at 06:30 IST. The populations of two adult cladoceran species (*Alona rectangula rectangula* and *Chydorus sphaericus*) were particularly prominent in the zooplankton, whereas rotifers were almost absent from the surface water during the eclipse. Rather than decreasing, the primary production of the phytoplankton increased on the day of the TSE compared to that seen on the control days. Comparatively high Lindeman's efficiency values were observed during the eclipse, indicating particularly efficient utilization of photons in photosynthesis.

Keywords Diel migration · Primary productivity · Solar irradiance · Total solar eclipse (TSE) · Zooplankton surface crowding

Introduction

The longest total solar eclipse (TSE) of the twenty-first century occurred in East and South Asia on 22 July 2009. The path of the lunar umbral shadow commenced in India, before crossing Nepal, Bangladesh, Bhutan, Myanmar, and finally reaching China (Chen et al. 2010). Sudden, rapid, and significant changes in light attenuation during the TSE provided a unique opportunity to study the photobehavior of zooplankton in natural systems (Ringelberg 2010). The study reported in the present paper was carried out to investigate

the impact of the sudden, brief light depletion caused by the solar eclipse in the early morning on zooplankton in a freshwater lentic ecosystem. The heliozooplankton surface crowding and primary productivity on pre-eclipse, eclipse, and post-eclipse days were studied and compared, and the results were also contrasted with the surface crowding and primary productivity that occurred during other total solar eclipses. This allowed us to check for and analyze temporal variations in the TSE-mediated surface crowding response of zooplankton. Plankton biologists have long studied the effects of solar eclipses on the migratory behavior of marine zooplankton (Backus et al. 1965; Skud 1967; Sherman and Honey 1970; Bright et al. 1972; Economou et al. 2008; Pratiwi et al. 2017). However, the effects of TSEs on freshwater biota and ecosystems have only rarely been explored (Jana and De 1981; Babu 1983; Mukhopadhyay et al. 1997; Jana and Chakrabarti 1999; Ramkumar and Chandran 2011). Solar irradiance is a key influence on various physicochemical variables (Kumar and Rengaiyan 2011) and on the photosynthesis and primary productivity (Economou et al. 2008)

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