

**CILIATE PRESENCE AND THE INCIDENCE OF
CASTRATION IN THE OBLIGATELY
PARTHENOGENETIC MAYFLY, *CENTROPTILUM
TRIANGULIFER* (EPHEMEROPTERA: BAETIDAE)**

SHELLEY L. BALL^{1,2,*} AND SCOTT A. TURNER¹

ABSTRACT - We measured infection rates of a putative parasitic castrating ciliate, in a population of the obligately parthenogenetic mayfly, *Centroptilum triangulifer*. Eleven percent of females sampled contained ciliates. All infected females oviposited ciliates when their abdomen contacted the water surface during oviposition trials. Furthermore, none of these females possessed eggs, yet all females contained gonadal tissue remnants within their abdomens, suggesting that ciliates were directly consuming gonadal tissue.

INTRODUCTION

The role of parasites in aquatic communities has been largely overlooked, despite their importance for the host's fitness. Studies have shown that the presence of endoparasites (Vance and Peckarsky 1997) and ectoparasites (Leonard et al. 1999) can influence behaviour, leaving prey more vulnerable to predation. Furthermore, parasites such as the parasitic trematodes found in some freshwater snail species, can have significant effects on reproductive mode and capacity (Lively 1987).

In mayflies, the presence of parasites has been documented in several species (Arvy and Peters 1973, Codreanu and Codreanu-Balcescu 1979, Gaino and Rebora 1998, Gonser and Spies 1997, Hominick and Welch 1980, Tokeshi 1988, Vance and Peckarsky 1997,). Specifically, the presence of ciliate parasites in mayflies was first documented in a *Baetis* sp. in 1921, by Lichtenstein and has subsequently been recorded in other mayfly species (Arvy and Peters 1973, Codreanu 1930, Codreanu 1934, Codreanu 1972, Gaino and Rebora 2000). Although their roles as parasitic castrators has been documented, relatively little is known about the biology of ciliate parasites in mayflies. Mayfly ciliate parasites have been shown to be both haematophagous and histophagous, feeding on haemolymph as well as gonadal and muscle tissue and fat bodies (Arvy and Peters 1973, Gaino and Rebora 2000). Clearly the destruction of gonadal tissue can have significant fitness implications. Thus, knowledge of the extent of parasitic castration by

¹Department of Biology, Bates College, Lewiston, ME, 04240. ²Current address - Molecular Diagnostics Laboratory, National Centre for Advanced Bio-protection Technologies, Box 84, Lincoln University, Canterbury, New Zealand *Corresponding author - ball@lincoln.ac.nz.

ciliates, in mayfly species, will contribute to our understanding of the influence of parasites on aquatic insect communities.

Here, we document the first case of a presumed parasitic castrating ciliate in an obligately parthenogenetic mayfly. We report the incidence of ciliates in adult females of the baetid mayfly, *Centroptilum triangulifer*.

MATERIAL AND METHODS

Final instar *C. triangulifer* nymphs were collected from a small tributary of the North Branch of the Dead River (45°13' N, 70°29' W), approximately 2 km north of Eustis, Franklin County, Maine. This is a second order, depositional stream with dense aquatic vegetation along the banks. Nymphs were collected between 16 and 23 July, 2001, by gently sweeping a benthic D-ring net (500 micron mesh size) through vegetation along the stream bank. Nymphs were placed in 2 l plastic containers with stream water and were transported to the laboratory where they were identified to species. We transferred nymphs to glass aquaria containing stream water, for rearing. Only female nymphs were present in this population. Mesh screens were placed over aquaria to collect emerging subadults (subimagos), which emerged 1–4 days later. Upon emerging, subimagos were transferred to individual plastic vials with mesh lids until they molted into mature adults (imagos). This typically occurred 12–24 hours after emergence of subimagos.

The presence of ciliates was discovered during oviposition trials where females were allowed to oviposit into small petri dishes containing filtered tap water. This was done as part of a larger study examining the percent hatching of unfertilized eggs. Females were held gently by the wings and their abdomens touched to the water surface to stimulate egg laying. If females did not oviposit within 5 minutes, their eggs were dissected from the abdomen. Once eggs were laid, females were inspected under a dissecting microscope to ensure that they had laid all of their eggs.

RESULTS AND DISCUSSION

Instead of laying eggs, infected females 'oviposited' ciliates. Examination of wet mount preparations, using a compound microscope, confirmed that these females oviposited ciliates. However, species identification could not be determined at that time. We are currently using morphology and molecular identification tools (DNA "bar coding") to ascertain species identification.

We found that 11 % (5/45) of females in our sample were infected with ciliates. This incidence of infection is consistent with that of Gaino and Rebora (2000), who found that 5% of *Caenis luctuosa* individuals sampled were infected with the parasitic castrating ciliate, *Ophryoglena* sp. This is also consistent with observations by Codreanu (1934) who

found *Ophryoglena* sp. infection rates of 8%, in the mayfly, *Oligoneuriella rhenana*. Whether the ciliates we observed are truly parasitic, directly consuming gonads, muscle tissue, fat bodies or haemolymph, is unknown. Further studies are needed to directly illustrate the role of these ciliates as parasites and to determine the specific types of tissues they may consume. Post oviposition dissection of the female's abdomens showed that all infected individuals did not contain any eggs. The presence of ovarian tissue remnants in the abdominal cavity suggests that gonadal tissue was directly consumed by the ciliates. In contrast to Lichtenstein (1921) and Gaino and Reborá (2000), we did not observe ciliates within the haemocoel. Arvy and Peters (1973) reported that *Ophryoglena* sp., parasites of *Rhithrogena* sp. and *Baetis* sp., were both haematophagous and histophagous. Gaino and Reborá (2000) suggested that, *Ophryoglena* acts as a histophagous parasite by blocking the development of ovarioles rather than feeding on them directly. However, the presence of tissue remnants in the *C. triangulifer* females we observed suggests that ciliates likely consumed gonadal tissue.

This study provides the first observation of probable parasitic castration by ciliates in an obligately parthenogenetic mayfly. The occurrence of such putative castrating parasites in obligate parthenogens can have important implications for the fitness of populations as well as for the evolution and maintenance of sexual reproduction in these mayflies. Further studies are needed to show the direct role of these ciliates as parasitic castrators.

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