

## ORIGINAL PAPER

# How Far do Ciliate Flagships Sail? A Proposed Gondwanaland Endemic Species at Anchor in Idaho Soils



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In terms of protist biogeography, “flagship species” (Foissner 2005) have been defined as those so remarkable or “showy” that they are unlikely to be overlooked when present in a given habitat. On this basis, flagship species have been suggested as an ideal or ultimate test for the existence of protist endemism. One example of a flagship ciliate is the terrestrial lepidosome-bearing trachelophyllid, *Luporinophrys micelae*, previously thought to be a Gondwanan endemic. This report comprises a morphologic description of two populations of *L. micelae* from Laurentian soils (Idaho, Northwest USA). The flagship concept is briefly reviewed and ciliate biogeography is discussed in light of these findings. © 2017 Elsevier GmbH. All rights reserved.

**Key words:** Biogeography; endemism; lepidosome; scanning electron microscopy; *Luporinophrys micelae*; Trachelophyllidae.

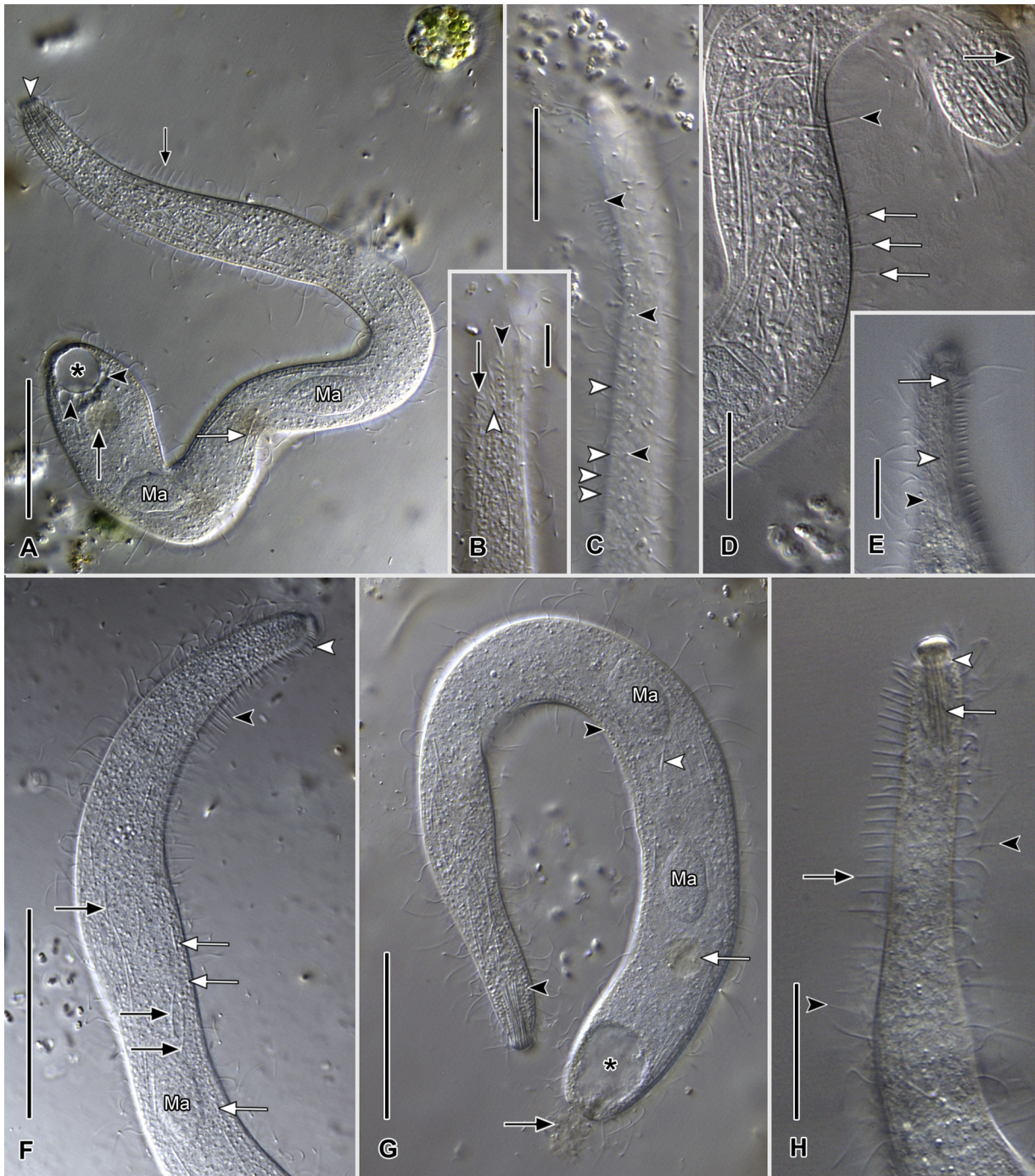
## Introduction

The long-running controversy regarding the ubiquity versus non-random dispersal of microbial eukaryotes continues unabated (Bass and Boenigk 2011; Grossmann et al. 2016; Nicholls 2015). Endemism occurs on a continuum of scale, from local endemism (e.g. a single lake) to, in the opinion of some, global or “holoendemism” (Myers and De Grave 2000; Williams 2011). In the context of this report, the scale of endemism is continental, the divide between the ancient supercontinents Laurasia and Gondwana (McLoughlin 2001).

The concept of “flagship taxa” (i.e. species that are sufficiently distinctive in size, form or other features that they are unlikely to be overlooked when

present in a habitat) led Foissner (2005) to suggest that the lepidosome-bearing ciliates of family Trachelophyllidae Kent, 1881 could be “ideal models” for the study of ciliate endemism (Bass and Boenigk 2011; Foissner et al. 2002; Foissner 2005; Foissner et al. 2008). There are currently at least 19 described species comprising ten genera in the family Trachelophyllidae Kent, 1881. The beautiful, genus-specific lepidosomes are intricate, ornate organic structures assembled in the cytoplasm and exported onto the cell surface to which they adhere by means of a mucus layer (Foissner 2005, 2016; Foissner et al. 2002; Nicholls and Lynn 1984). To date, twelve morphologic types of lepidosomes have been described (Nicholls and Lynn 1984; Foissner 2016). Their function remains obscure. Foissner (2005) described two “flagship” trachelophyllids, *Sleighophrys pustulata* and *Luporinophrys micelae*, from Venezuelan soil samples. Both gen-

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**Figure 1. (A–H)** *Luporinophrys micelae* (IDT population) in life, differential interference contrast. **(A)** View of uncontracted specimen showing oral bulge (white arrowhead), food vacuole (black arrow), cilia of dorsal brush row 3 (small black arrow), and contractile vacuole (asterisk) with collecting vesicles (black arrowheads). **(B)** Dorsal view showing dorsal brush rows 1 (black arrow), 2 (white arrowhead), and 3 (black arrowhead). **(C)** Dorsal view showing cilia of brush row 2 dikinetids (white arrowheads) and cilia of brush row 3 monokinetids (black arrowheads). **(D)** Lateral view showing dorsal brush rows 1 (black arrow), 2 (white arrows) and 3 (black arrowhead). Note the the longer posterior cilium of brush row 2 dikinetids. Brush row 1 dikinetids have cilia of equal length. **(E)** Dorsal view showing dorsal brush row 1 (black arrowhead), row 2 (white arrowhead) and the condensed rightward-curving anterior part of brush row 1 (white arrow). **(F)** Lateral view showing contractile vacuole (asterisk) and collecting vesicles (black arrowheads). **(G)** Lateral view showing contractile vacuole (asterisk) and collecting vesicles (black arrowheads). **(H)** Lateral view showing contractile vacuole (asterisk) and collecting vesicles (black arrowheads).

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