Title: Symbiont Replacement Between Bacteria of Different Classes Reveals Additional Layers of Complexity in the Evolution of Symbiosis in the Ciliate *Euplotes*

Authors: Vittorio Boscaro, Sergei I. Fokin, Giulio Petroni, Franco Verni, Patrick J. Keeling, Claudia Vannini

PII: S1434-4610(17)30108-6
DOI: https://doi.org/10.1016/j.protis.2017.12.003
Reference: PROTIS 25603

To appear in:

Received date: 5-7-2017
Accepted date: 12-12-2017

Please cite this article as: Boscaro, Vittorio, Fokin, Sergei I., Petroni, Giulio, Verni, Franco, Keeling, Patrick J., Vannini, Claudia, Symbiont Replacement Between Bacteria of Different Classes Reveals Additional Layers of Complexity in the Evolution of Symbiosis in the Ciliate Euplotes.Protist https://doi.org/10.1016/j.protis.2017.12.003

ORIGINAL PAPER

Symbiont Replacement Between Bacteria of Different Classes Reveals Additional Layers of Complexity in the Evolution of Symbiosis in the Ciliate *Euplotes*

Running title: New Symbiotic *Devosia* in *Euplotes*

Vittorio Boscaro[a,b], Sergei I. Fokin[a,c], Giulio Petroni[a], Franco Verni[a], Patrick J. Keeling[b], and Claudia Vannini[a,1]

[a]University of Pisa, Department of Biology, Italy
[b]University of British Columbia, Department of Botany, Canada
[c]St.-Petersburg State University, Department of Invertebrate Zoology, Russia

Submitted July 5, 2017; Accepted December 12, 2017
Monitoring Editor: Genoveva F. Esteban

[1]Corresponding author; fax +39 0502211393
e-mail claudia.vannini@unipi.it (C. Vannini).

Symbiosis is a diverse and complex phenomenon requiring diverse model systems. The obligate relationship between a monophyletic group of *Euplotes* species ("clade B") and the betaproteobacteria *Polynucleobacter* and "*Candidatus* Protistobacter" is among the best-studied in ciliates, and provides a framework to investigate symbiont replacements. Several other *Euplotes*-bacteria relationships exist but are less understood, such as the co-dependent symbiosis between *Euplotes magnicirratus* (which belongs to "clade A") and the alphaproteobacterium "*Candidatus* Devosia euplotis". Here we describe a new *Devosia* inhabiting the cytoplasm of a strain of *Euplotes harpa*, a clade B species that usually depends on *Polynucleobacter* for survival. The novel bacterial species, "*Candidatus* Devosia symbiotica", is closely related to the symbiont of *E. magnicirratus*, casting a different light on the history of bacteria colonizing ciliates of this genus. The two *Devosia* species may have become symbionts independently or as the result of a symbiont exchange between hosts, in either case replacing a previous essential bacterium in *E. harpa*. Alternatively, both may be remnants of an ancient symbiotic relationship between *Euplotes* and *Devosia*, in which case