



## Systematic ambiguity in the well-established model system insect *Scathophaga stercoraria* (Diptera: Scathophagidae): sister species *S. soror* revealed by molecular evidence

MARCO VALERIO BERNASCONI<sup>1</sup>\*, DAVID BERGER<sup>1</sup> & WOLF U. BLANCKENHORN<sup>1</sup>

<sup>1</sup>Zoological Museum, Institute of Evolutionary Biology and Environmental Studies, University of Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland

E-mails: marco.bernasconi@access.uzh.ch; david.berger@access.uzh.ch; wolf.blanckenhorn@ieu.uzh.ch

\*corresponding author

### Abstract

Even for well-established insect model systems, such as the yellow dung fly *Scathophaga stercoraria* (Linnaeus) (Diptera: Scathophagidae), there may be hidden systematic ambiguities that require clarification. Dung flies from the Afrotropical Region have been considered (i) as con-specific and not different from all the other Holarctic *Scathophaga stercoraria*; (ii) as a local and peculiar African subspecies of *S. stercoraria* (*Scathophaga stercoraria soror* Wiedemann), or (iii) as a separate valid species (*Scathophaga soror* Wiedemann). Our study represents an attempt, based on mitochondrial (COI, 12S, and 16S), nuclear (ITS2) as well as microsatellite markers, to clarify this problem. Results strongly suggest that *S. soror* is a separate taxon from *S. stercoraria*. Due to the importance of *S. stercoraria* as a model system for studies in ecology, behaviour and evolution, the systematic position of *S. soror* (relative to *S. stercoraria*) is not solely of interest for systematists, but for evolutionary ecologists as well.

**Key words:** Systematics, Phylogeny, Speciation, Cytochrome oxidase I, COI, 12S, 16S, ITS2, internal transcribed spacer 2, microsatellites

### Introduction

Scathophagid flies, with about 400 species described, are mainly confined to the Holarctic Region and are more northern in overall distribution than any other family of Diptera (e.g., Sack 1937; Vockeroth 1987; but see also Šifner 2003, 2008, 2009). Only a few species occur in South Africa and at high altitudes in East Africa, the Andes, and the Oriental Region (see references cited in Bernasconi *et al.* 2000a). Many adult scathophagids are predators (e.g., on Simuliidae; Werner *et al.* 2006), and several Arctic species are regularly observed on carrion and mammalian dung. Some species breed in rotting seaweed. The eggs are attached to the leaf surface or inserted into plant tissues, dung, or other substrates. Most of the larvae are phytophagous, while others are carnivorous in dung or coprophagous (Gorodkov 1986; Vockeroth 1987; Šifner 2008). Individuals of most species thus perform the ecologically important function of resource recycling.

Within this family, the species *Scathophaga stercoraria* (Linnaeus) has served since the early 1960s in numerous ecological, behavioural and evolutionary investigations, particularly as model system for studies of sperm competition, cryptic female choice, and life history evolution (summarised in Ward 2007). The species is included in the first tier of the Flytree (Assembling the Diptera Tree of Life) project for this reason (<http://www.inhs.illinois.edu/research/FLYTREE/>).

From a morphological point of view there is no unanimity within the entomological community about the taxonomic status of the South African dung flies. They have been considered (i) as con-specific and not different from all the other *S. stercoraria* worldwide (e.g., Šifner 2008), (ii) as a peculiar subspecies (*Scathophaga stercoraria soror* Wiedemann, e.g., Vockeroth 1958), or even (iii) as a separate species (*Scathophaga soror* Wiedemann, e.g., Werner *et al.* 2006).