The Reindeer Oestrids *Hypoderma tarandi* and *Cephenemyia trompe* (Diptera: Oestridae): Batesian Mimics of Bumblebees (Hymenoptera: Apidae: *Bombus* spp.)?

Arne C. Nilssen,1,4 John R. Anderson,2,3 and Robert Bergersen1

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INTRODUCTION

Mimicry exists when two or more species, which may not be closely related, come to resemble each other in some respects and at least one species

1Zoology Department, Tromsø Museum, University of Tromsø, N-9037 Tromsø, Norway.
2Division of Insect Biology, University of California, Berkeley, California 94720.
3Present address: 1283 NW Trenton, Bend, Oregon 97701.
4To whom correspondence should be addressed at Zoology Department, Tromsø Museum, University of Tromsø, N-9037 Tromsø, Norway; e-mail: arnec@imv.uit.no.
benefits from the resemblance (Friedlander, 1976). In Batesian mimicry, the benefited species is palatable and harmless, but is protected from predators by virtue of its similarity to a distasteful or harmful species. The protected species is known as a mimic, and the one that it imitates is called the model (Rettenmeyer, 1970). In Müllerian mimicry, two or more distasteful/harmful species resemble one another; the benefits work through enhanced predator learning when the proportion of distasteful species increases (e.g., Rettenmeyer, 1970).

Many harmful, distasteful, or poisonous insects advertise their unpalatability by having a conspicuous pattern of coloration. Such species are referred to as being aposematic, and this phenomenon is considered to be a warning signal that can be learned by predators (Waldbauer, 1988). In Batesian mimicry, mimics have evolved external features (sometimes also behavioral elements) that resemble aposematic characters. Potential predators are unable to detect the difference, and the mimic is protected (even if perfectly suitable as food). Protection associated with mimicry is based on the fact that predators can learn to avoid the colors of the distasteful/dangerous prey, even if unlearned responses are also possible (Waldbauer, 1988; Guilford, 1990; Alatalo and Mappes, 1996).

In Batesian mimicry, a model can tolerate only a certain proportion of mimics. If there are too many mimics, they will be taken by predators that forget to associate inedibility or harmfulness with the aposematic pattern and subsequently also destroy some individuals of the model species. Brower (1960) found, however, that if as few as 30% of the prey were models, a significant amount of protection from predation would occur (see also Nonacs, 1985).

Since the first description of mimicry (Bates, 1862), many mimicry complexes have been recognized (e.g., Owen, 1980; Brower, 1988). Among the many examples, bumblebees are obvious models since their venomous stings give them considerable protection (Friedlander, 1976; Patent, 1978; Owen, 1980; Plowright and Owen, 1980). Among others, the following Diptera have been reported as mimics of various bumblebees: *Bombylius major* (Bombyliidae), *Mallophora bomboides* (Asilidae), *Mesembrina* spp. (Muscidae), and *Merodon equestris, Mallota bautias*, and *Volucella bombylans* (Syrphidae) (Owen, 1980; Evans and Waldbauer, 1982; Thorp et al., 1983). In these examples of Batesian mimicry, the dense pile over the entire body of the mimic is colored to resemble a certain species of bumblebee, especially the details of pile coloration (Plowright and Owen, 1980, and references therein). Brower et al. (1960) and Evans and Waldbauer (1982) showed through various experiments that these resemblances are selectively advantageous and that such flies are indeed Batesian mimics of bumblebees. Bumblebees are even Batesian models for beetles (Thorp et al., 1983; Fisher and Tuckerman,