Submitted Abstract

ID IMC22-FSAbstr- 541

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Country	Denmark
Region	Western Europe
Title	Camera Surveillance Uncovers Novel Plant-Pollinator Interactions In Montane Ecosystems.
Keywords	Pollinator, Moth, Camera, Swiss Alps, Bumblebee
Type	List Of Focus Session
Focus Session ID	53

Abstract

Recent decades have seen a surge in awareness about insect pollinator declines. While bees often enjoy the spotlight, most flower-visiting species – and around half of animal species – are non-bee insects. Despite this, non-bees are poorly represented in both science and media. Nocturnal flower visitors, e.g. moths, are especially difficult to observe and usually ignored. Within the few studies that do investigate nighttime pollinators, fair comparisons with daytime pollinators are almost never provided. Robust data are especially difficult to collect in montane areas, where access is difficult and terrain is hazardous.

Here we use remote time-lapse cameras for season-wide, day-and-night pollinator surveillance of an alpine grassland plant community. We reveal the first clear evidence that moths pollinate Trifolium pratense (L.; red clover), an important wildflower and forage crop species, contributing 34% of observed visits (bumblebees: 61%). This is a remarkable finding; moths have received no recognition throughout a century of T. pratense pollinator research in lowland agricultural systems. Our favored explanation for this is not that moth visits are negligible, but that nocturnal visitation has simply not been measured. Indeed, the most frequent nocturnal visitor to T. pratense was Noctua pronuba (L.; large yellow underwing/winter cutworm), a candidate for the most abundant macro-moth in Europe.

Crucially, we show how the relationship between visitation and seed set may only become clear after accounting for moth visits. It follows that trends in moths, as well as bees, could profoundly affect the reproduction of montane wildflowers. Above all, we show how camera surveillance permits data collection in montane ecosystems, while giving fair representation to non-bee pollinators. Furthermore, this approach builds a standardized image library - such libraries will be pivotal for automation of insect and flower identification in future.