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SCIENTIFIC NOTE

Flower-visiting insects observed on the critically endangered alpine plant species *Callianthemum kernerianum* Freyn ex A. Kerner (Ranunculaceae)

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Abstract: In the present paper we provide the first contribution to the knowledge of the flower-visiting insect assemblages of the alpine plant species *Callianthemum kernerianum* Freyn ex A. Kerner (Ranunculaceae). This focal plant species was selected since it is a steno-endemic and critically endangered species belonging to the IUCN red-list. Fifteen taxa were recorded, among which very few are true pollinators, whereas all the others can be considered only indirect pollinators. The peculiar phenology of the plant and the harsh habitat conditions in which it grows probably affect the richness and abundance of flower-visiting insects as well as of true pollinators. This could be the reason for this plant to be a self-compatible species.

Key words: Endemism, IUCN red-list, plant-insect interactions, pollinators, Alps.

Data Text

Callianthemum kernerianum Freyn ex A. Kerner is a steno-endemic Alpine plant belonging to the family Ranunculaceae. It occurs only at Mt. Baldo (Central-Eastern Italian Alps, Province of Trento and Verona). The extent of occurrence and the area of occupancy are 20 km² as the species grows along a narrow and windy mountain ridge on limestone in subalpine pastures between 1,500 and 2,100 m asl. Only 17 subpopulations are currently

known (Prosser 2000). The flowering season is limited to four weeks, after the snow melt (generally in May). It is a self-compatible species with an average of 50% of autogamous reproduction and 50% of cross-reproduction (Bonomi *et al.* 2010). The pollen viability is probably very reduced and the seed production is also low. It suffers from competition with other herbs (Bonomi et al. 2010). The main threat is the decrease in habitat quality due to two main factors that affect some subpopulations: firstly, the human disturbance due to tourist trampling as some populations are crossed by paths with high tourist frequentation during the summer months; secondly, vegetation and soil removal for winter skiing activities (Bonomi *et al.* 2010). As a consequence of these threats, it is listed as Critically Endangered (CR) in the IUCN Red List of Threatened Species (Bonomi *et al.* 2013). Due to the distinctive phenology (early and very short flowering season), the habitat requirement (narrow mountain ridge), and the extinction risk of *C. kernerianum*, we aimed to investigate the presence of flower-visiting insects on its flowers in order to evaluate the presence of pollinators. Since pollination influence plant fitness, specifically in harsh habitats like those located at high elevations (Ai *et al.* 2013; Losapio *et al.* 2016) and mountain ridge, the knowledge of the pollinator presence and per-visit effectiveness is an important point useful to understand the extinction risk of threatened entomophilous plant species. In addition, the insect assemblages visiting high altitude alpine plants are poorly known.

Two populations of *C. kernerianum* were selected in the Mt. Baldo area (45°43'N; 10°50'E; Fig. 1). The former is located on Monte Altissimo (2030 m asl) while the second one on Bocca di Tratto Spino (1830 m asl).

Within each population we selected three subpopulations far from each other about twenty meters. For each subpopulation, flower-visiting insects were collected, by one of the authors (MG), during one sampling session (Monte Altissimo: 20.V.2009 and Bocca di Tratto Spino: 27.V.2009). It was not possible to perform more surveys due to the very short flowering season and the bad weather (rain or permanent strong wind) conditions, before and after the chosen sampling date, that were able to affect insects occurrence. The insects were collected with an entomological aspirator and net (Gobbi & Latella 2011) from 10 am to 5 pm. The insects were observed/sampled in each subpopulation every 80 minutes (thus surveys of 40 minutes for each subpopulation). Not to undermine insect activity the flower-visiting insects were sampled from a distance of 1 m away from plants and wearing dull clothes. Any insect seen on the flowers that could make contact with the anthers and/or stigma has been collected or identified directly on the field. The collected insects were preserved in ethanol 70% and then identified in lab. Flower-visiting insects were identified to species level, when possible, otherwise to genus or family level.

Even if *Callianthemum kernerianum* is a plant with a life cycle apparently not dependent to insects for pollination (it is self-compatible), and not attractive for flower visiting insects (reduced pollen availability), fifteen insect taxa were observed on it. Notwithstanding the sampling method did not permit to obtain quantitative data on insects abundance, the most frequent flower visitors (at least one individuals on each flower during the sampling time) were flies (Diptera, eight families) followed by ants (Hymenoptera: Formicidae, two species) and other taxa: bees and bumblebees (Hymenoptera Apoidea), rove beetles (Coleoptera: Staphylinidae) and bagworms (Lepidoptera: Psychidae) (Table 1). In particular, each flower was regularly visited by one ant species (*Formica lemani*; Fig. 1) feeding on nectar positioned at the base of the petals. Each insect observed on the flowers touched with the thorax, legs and abdomen the anthers and stigma of the flowers and thus could be considered as potential pollinators. On the other hand very few species showed structures adapted to transport pollen (e.g. body-hairs). Specifically, the only true pollinators found were syrphid flies (*Scaeva* sp.), bees and bumblebees (*Apis mellifera* and *Bombus* sp.)

Figure 1. Location of the study area (black star) and the ant *Formica lemani* feeding nectar on *Callianthemum kernerianum*.

Table 1. List of the flower-visiting taxa observed in each of the two sampling stations. The observations made in each subpopulation were merged in order to present a presence/absence table. The abundance of each taxa is not reported due to the qualitative sampling methods used.

Order	Family	Species	Monte Altissimo	Bocca di Tratto Spino
Diptera	Anthomyiidae	*Pegoplata* sp.		*
	Calliphoridae	*Bellardia* sp.		*
	Chloropidae		*	*
	Conopidae	*Myopa* sp.		*
	Empididae		*	
	Scatophagidae	*Scatophaga* sp.	*	
	Sciaridae			*
	Syrphidae	*Scaeva* sp.		*
Hymenoptera	Formicidae	*Formica lemani* Bondroit, 1917	*	*
		Formica rufibarbis Fabricius, 1793	*	
	Apidae	*Apis mellifera* Linnaeus, 1758	*	*
		Bombus sp.	*	*
Lepidoptera	Psychidae		*	
Coleoptera	Staphylinidae	*Eusphalerum limbatum diolii* Zanetti, 1982		*
		Amphichroum canaliculatum (Erichson, 1840)		*

while the other families were on the flowers as predators (e.g. Scatophagidae) or to eat floral parts or pollen/nectars (e.g. Diptera: Conopidae, Lepidoptera: Psychidae, Coleoptera: Staphylinidae, Hymenoptera: Formicidae) (Losapio *et al.* 2016, Gobbi & Latella 2011), thus they can be considered only indirect pollinators. The environmental conditions during flowering showed three factors limiting the presence of rich, abundant and trophically differentiated insect assemblages: early and short flowering season, low temperatures during the flowering season (average temperature recorded on May 2010-2011 = 9,2°C), permanent strong wind, few flowered species able to attract a more heterogeneous flower-visiting insect assemblages, grazed pastures. Probably, the observed taxa have not a significant effect on the pollination effectiveness; it could be a possible explanation about the self-compatibility of the plant in order to survive in a so harsh and competitive environment.

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