

M. Kropf, E. Sommerkamp & K.-G. Bernhardt

Population dynamics of *Barlia metlesicsiana* (Orchidaceae) endemic to Tenerife (Canary Islands)

Abstract

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The distribution of the orchid *Barlia metlesicsiana* is restricted to the Canary Island of Tenerife. We monitored *Barlia metlesicsiana* and its pollination success in four representative subpopulations on Tenerife during the years 2004 to 2010. Despite some yearly fluctuations (Bernhardt & al. 2009), the study years 2004, 2005, and 2007 indicated relatively constant population sizes (230 to 246 plants observed per year), and reproductive success was also relatively constant throughout the years 2004, 2005 and 2006 (yearly fruit set of 26.0% to 36.6%).

However, following a fire in July 2007 number of plants, proportion of flowering plants, and pollination success dropped down dramatically: in the first two years after the fire (i.e. 2008-2009) altogether only three plants managed to flower, and only one of those plant individuals obtained pollination. In 2010, subpopulations beginning recreation were still characterised by low absolute number of plants, but with the highest proportion of individuals flowering as observed throughout all seven study years (33.7%). However, pollination success (fruit set of 21.0%) was still at the lower end of the regular yearly fluctuations of this species. Therefore, our data show a strong influence of catastrophic events (i.e. fire) not only on the appearance and dormancy of terrestrial orchids in general, but also more specifically on the pollination success of the endangered orchid *Barlia metlesicsiana* on Tenerife.

Introduction

As the distribution of *Barlia metlesicsiana* W.Teschner, which recently has also been recognised as *Himantoglossum metlesicsianum* (W.Teschner) P.Delforge (Delforge 1999), is restricted to a small region on the Canary Island of Tenerife, this orchid species is considered as endangered in a world-wide perspective (IUCN 1998). Based on previous molecular analyses almost all individuals of this island endemic species nowadays distributed around the locations Santiago del Teide and Guia de Isora on Tenerife (Stierli-Schneider 2004; E. Sommerkamp, pers. obs.) seem to be thoroughly interconnected via gene flow (Kropf & al. 2005). Regardless, this world population is characterised by a patchy structure with several subpopulations and plant individuals growing isolated and/or solitary. Therefore, plants might be difficult to reach for pollinators, and pollination success should be strongly pollinator-limited due to low pollen

transfer rates and increased pollen loss. Moreover, occasional fires on Tenerife (see Arévalo & al. 2001) might influence the overall performance and the reproductive success negatively representing an important factor for the long-term survival of this endangered orchid. Therefore, our monitoring project should help to understand the population dynamics and their consequences for conservation action to preserve *Barlia metlesicsiana* in the long-term. We here present preliminary results based on the first seven years of monitoring.

Material and Methods

The Study Species. – Only 28 years ago, *Barlia metlesicsiana* has been described (Teschner 1982) as a species independent from the wide-spread Mediterranean *Barlia robertiana* (Loisel.) Greuter, which recently has also been recognised as *Himantoglossum robertianum* (Loisel.) P.Delforge (Delforge 1999). The description of *Barlia metlesicsiana* has become possible after the rediscovery of *Barlia* plants close to Santiago del Teide on Tenerife by H. Metlesics in the year 1979. During subsequent years a number of subpopulations around Santiago del Teide and Guía de Isora on Tenerife were reported (Teschner 1982; Rückbrodt & Rückbrodt 1988; León-Arencibia & al. 1992; Rysy 1992; Kretzschmar & al. 1993; Stierli-Schneider 2004; E. Sommerkamp, pers. obs.). However, the orchid is still regarded an endangered species (IUCN 1998; Stierli-Schneider 2004).

With respect to its pollination and mating system, the weeks from mid December to the beginning of February have been reported as typical flowering time (Teschner 1993; Stierli-Schneider 2004). During this time *Bombus canariensis* bumblebee queens act as effective pollinators (Teschner 1993; Stierli-Schneider 2004; E. Sommerkamp, pers. obs.). Moreover, *Apis mellifera* has been observed as an occasional visitor (Teschner 1993; Stierli-Schneider 2004) as well as *Anthophora alluaudi* (Teschner 1993). However, the pollinating bumblebee queens are likely not rewarded by *Barlia metlesicsiana*, as no nectar has been detected in the spurs of its flowers (Teschner 1993; M. Kropf, pers. obs.). Therefore, *Barlia metlesicsiana* seems to adopt the pollination syndrome of a rewardless, food-deceptive orchid, as its congener *Barlia robertiana* (see Vogel 1976; Smithson & Gigord 2001).

The Monitoring Project. – We monitored *Barlia metlesicsiana* and its pollination success in four representative subpopulations/patches on Tenerife during the years 2004 to 2010. In early spring, individual plants within these four patches were categorised as (young) “vegetative” or (old) “flowering”, numbers of leaves were counted, plant height, maximum length and width of leaves were measured, and inflorescence length and flower number per inflorescence were reported. As an estimator of pollination success number of mature capsules was considered in relation to the total individual number of flowers; here, we will basically refer to this latter estimator relevant to reproduction and population performance of *Barlia metlesicsiana*.

Results & Discussion: Monitoring outcomes

Despite some yearly populational fluctuations (Bernhardt & al. 2009), well-known for different terrestrial orchid species (see Tamm 1948; Wells & Willems 1991; Vanhecke

1992; Kindlmann & al. 2002; Heinrich 2005), the study years 2004, 2005, and 2007 indicated relatively constant population sizes of *Barlia metlesicsiana* (230 to 246 plants observed per year; Fig.1). In addition, reproductive success was also relatively constant throughout the years 2004, 2005, and 2006 (yearly fruit set of 26.0% to 36.6%; Fig.2).

However, following a fire in July 2007 the total number of plants observed, the proportion of flowering plants, and the pollination success dropped down, dramatically: in the first two years after the fire (i.e. 2008-2009) only three plants managed to flower, and only one of those plant individuals obtained pollination and fruit set (60%; Fig.2). In 2010, subpopulations beginning recreation are still characterised by low absolute number of plants reappearing (Fig.1), but with the highest proportion of individuals flowering over all seven study years (33.7%; Fig.2), probably indicating the loss of young individuals not yet in the age of flowering and the partly successful regeneration of older flowering individuals (E. Sommerkamp, pers. obs.). However, pollination success (fruit set of 21.0%) is still at the lower end of the usual yearly fluctuations of this species (Fig. 2; Bernhardt & al. 2009). This might point at an increased pollinator limitation (see Tremblay & al. 2005) in the first years after the fire event which is likely due to the strong impact of such events also on

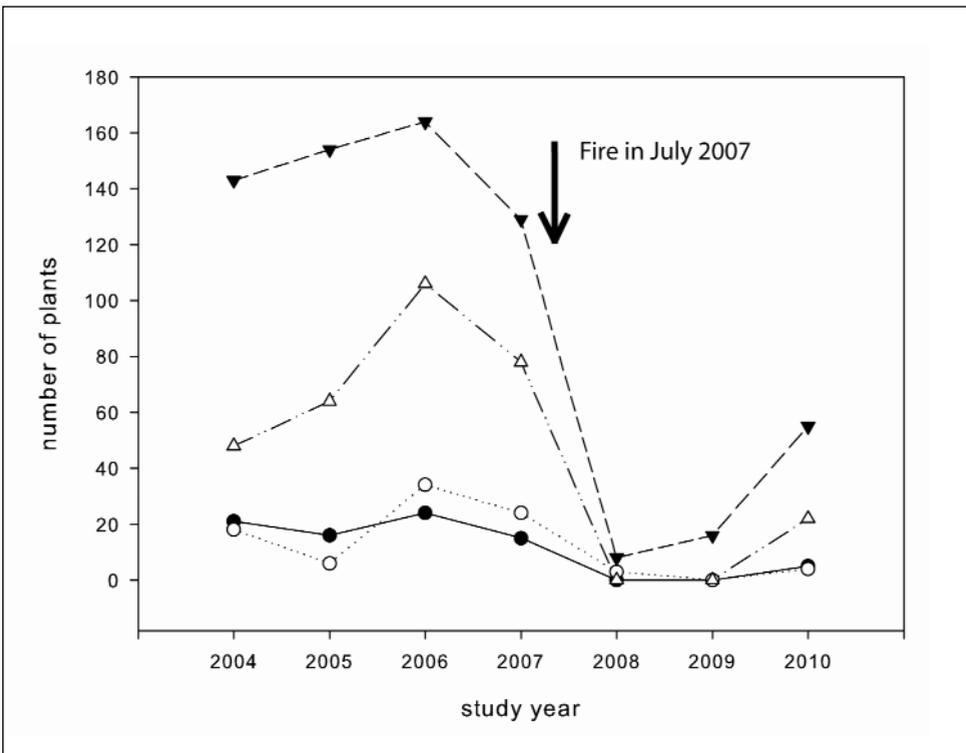


Fig.1. Population dynamics of *Barlia metlesicsiana* in four subpopulations on Tenerife. All four subpopulations marked by different symbols were studied from 2004 to 2010 and were simultaneously affected by a fire in July 2007.

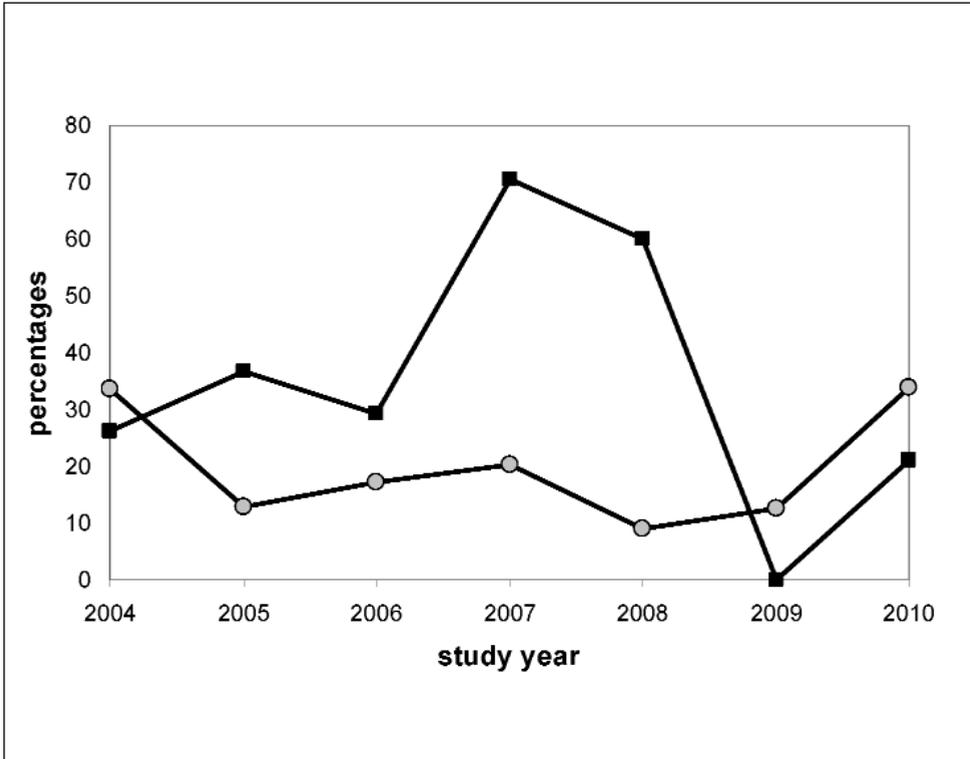


Fig. 2. Proportions of flowering *Barlia metlesicsiana* plants (grey circles) and of their reproductive success (i.e. fruit set; black squares) over the seven study years. Note that in 2008 a single flowering plant obtained 60% fruit set.

pollinator communities (e.g. Potts & al. 2003). Given the limited number of co-flowering plants during the early flowering time of *Barlia metlesicsiana* (Teschner 1993; Stierli-Schneider 2004), this obviously increased pollinator limitation might be indicative of a higher attractiveness of patches with more *Barlia metlesicsiana* individuals flowering in parallel. Such a visual attractiveness of conspicuous patches of rewardless plants has also been found in experiments as well as in other orchid species in the wild (e.g., Keasar 2000; Kropf & Renner 2008). Furthermore, the high single plant attractiveness (i.e. large floral display in terms of plant/inflorescence height and flower number; see Tremblay & al. 2005) might represent a general feature of *Barlia metlesicsiana* to cope with respective challenging conditions.

In summary, our data showed a generally strong influence of catastrophic events (i.e. fire) not only on the appearance and dormancy (see Tamm 1948) of terrestrial orchids, but also specifically on the pollination success of the endangered orchid *Barlia metlesicsiana* on Tenerife. Ongoing monitoring of the four subpopulations will indicate if and when these *Barlia metlesicsiana* subpopulations can reach their original population size and performance.

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Addresses of the authors:

Matthias Kropf,

University of Natural Resources and Life Sciences (BOKU), Institute of Integrative Nature Conservation Research, Vienna, Austria. E-mail: matthias.kropf@boku.ac.at
Elisabeth Sommerkamp,

Grupo Orquideófilo Canarias, Apartado 453, Puerto de la Cruz, Tenerife, 38400 Spain.

Karl-Georg Bernhardt*,

BOKU, Institute of Botany, Vienna, Austria. E-mail: karl-georg.bernhardt@boku.ac.at

* Corresponding author