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Reproductive phenology and seed development of *Gentianella caucasea* in different habitats in the Central Caucasus

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Abstract

Flowering phenology, seed development and reproductive characteristics influencing seed set were investigated in four populations of *Gentianella caucasea*, a therophyte growing in different habitats (subalpine meadows, pastures and alpine grassland) along an altitudinal gradient between 1900 and 2700 m a.s.l. in the Central Caucasus. During the growing season phenological stages were recorded and samples were collected at short intervals. The embryological stages and the time course of seed formation were determined microscopically using the interference contrast technique.

Considerable differences in phenological dates, seed development and seed set were observed between the population growing in the alpine grassland, the population in a hay meadow which is regularly mown during the first decade of August, and the population on an intensively grazed sheep pasture. The extremely low seed set connected with a high percentage of anomalous and abortive ovules as observed in the latter population can be regarded as a criterion for severe stress due to habitat disturbance. Very little variation in reproductive characteristics was found among the population growing in a short-grass vegetation extending from 2200 to 2750 m a.s.l. Along such an altitudinal transect the developmental processes would be expected to be retarded in view of the decrease in temperature with increasing altitude. However it appears that, for herbaceous plants, it is not the adiabatic lapse rate which is important, but the specific microclimatic conditions, which on southward slopes are more favourable even at higher altitudes.

Key words: *Gentianella caucasea*, phenology, embryology, seed development, mountain plants, grassland management

1. Introduction

Therophytes are uncommon life forms in alpine and arctic areas (only less than 15% of most floras above tree line: RAUNKIAER 1934; JACKSON & BLISS 1982). In regions with a cold climate and short growing seasons ephemeral plants must be able to complete their life cycle within a few weeks. Particularly in late flowering plants such as certain species of *Gentianella*, the interval between onset of flowering in late summer and the occurrence of first autumn frosts is short. According to ZUEV (1992), the wide distribution of ephemeral Gentianaceae in mountain areas may have been promoted by preacclimation during continental alterations in the Paleogene and Neogene. During this period the evolution of the Gentianaceae in northern Eurasia proceeded towards adaptation to arid and cold regions. The genus *Gentianella* is still an actively evolving and therefore a very adaptable taxon, growing in widely differing habitats from the colline to the subnival zone of mountain regions. Manifold ecotypes with different morphological characteristics and flowering times from summer to late autumn have developed (WETTSTEIN 1895, ZOPFI 1991).

Gentianella caucasea is a polymorphic annual species in the Caucasus, growing in subalpine hay meadows, in intensively grazed sheep pastures and in graminoid vegetation up to the subnival zone. In such a wide diversity of habitats the species has segregated into populations with peculiar morphology and phenological patterns.

The objective of the present study was to investigate phenology, seed development and seed set of four different populations of *Gentianella caucasea* growing in different plant communities along an altitudinal gradient. The reproductive behaviour is discussed with regard to the environmental conditions of the habitats.