

Europe's ecological backbone: recognising the true value of our mountains

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Box 8.2 Alien plants in the Alps: status and future invasion risks

Alien (or non-native) species occur outside their native range only because of human-mediated dispersal. Among them, invasive alien species are those which spread rapidly in their new range and may have a negative impact on native biodiversity or lead to other economic costs. In the Alps, some 450 to 500 alien vascular plant species have been recorded (Aeschimann *et al.*, 2004): approximately 10 % of the total flora of the Alps (Aeschimann *et al.*, 2004) and 15 % to 20 % of all alien plant species recorded in Europe (Pysek *et al.*, 2008). However, the number of recorded alien plants is increasing rapidly in Europe (Pysek *et al.*, 2008) and probably also in the Alps. Most alien plant species in the Alps occur only at low elevations. A comprehensive survey along roadsides in the Swiss mountains showed that only about 90 out of 155 recorded alien plants were found above 1000 m, approximately 50 species above 1 500 m, and approximately 10 species above 2 000 m (see photo below); and that species that are more abundant and/or present for a longer time in lowlands tend to reach higher elevations (Becker *et al.*, 2005). Among the major invasive plant species of the European lowlands (Wittenberg, 2005), 23 occur in the montane zone, of which nine reach the subalpine zone (Table 8.7). At higher elevations, none of these species is known to have a strong negative impact on biodiversity or other human values.

The relative resistance of mountain ecosystems to plant invasions may be transient in the light of ongoing global change (Pauchard *et al.*, 2009). The paucity of alien species in mountains is partially related to the historic introduction process. Alien species were introduced to the lowlands and had to survive in lowland climates and habitats before they could spread to higher elevations. This low-altitude filter effect (Becker *et al.*, 2005) limited alien species found at higher elevations to climatically broadly adapted species that can occur across the complete altitudinal range (MIREN [Mountain Invasion Research Network], unpublished data). Increasingly, however, alien plants are directly introduced from one high elevation region to another, especially through the horticultural plant trade. These alien mountain specialists are pre-adapted to high-elevation climates and are expected to pose a greater invasion risk in mountains. The relative resistance of mountain ecosystems to plant invasions may also weaken in the future through other global change processes, in particular climate change and the expansion of anthropogenic disturbances. Invasive plants from lower elevations (Table 8.7) may move to higher elevations in a warming climate, and anthropogenic disturbances generally facilitate plant invasions.

Prevention is considered the most cost-efficient management strategy against the threats posed by invasive species. Globally, the Alps are one of few eco-regions not yet badly affected by plant invasions, but this may change. Now is thus the time to act to prevent future invasions: probable invasive species should be identified, and their transportation regulated. Species that have proven problematic in other mountain areas are particularly likely to become invasive, and MIREN (2010) has developed an online database of invasive plant species in mountains worldwide. However, most species currently listed in the database are native to Europe and thus, based on past invasions, only few potentially invasive alien species can be predicted for the Alps (Table 8.7). A threat may rather be expected from future introductions from novel source areas (for example, the very species-rich mountain region of Yunnan in China).

The establishment of ecological corridors will probably not increase the risk of the unassisted spread of most alien plants, because they mainly spread in anthropogenic habitats and through human movements. However, alien species can be transported accidentally between protected areas of an ecological network by tourists or natural area managers. Codes of conduct on the cleaning of clothes, tools and machines before entering natural areas may reduce the risk of spreading alien species. Networks of institutions and experts associated with ecological corridors represent an important institutional capacity for coordinating monitoring and control of these species.

Source: Christoph Kueffer (Institute of Integrative Biology, ETH Zurich, Switzerland) with contributions from Jake Alexander, Hansjörg Dietz, Keith McDougall, Andreas Gigon, Sylvia Haider and Tim Seipel (MIREN).



Photo: *Lupinus polyphyllus*, native to western North America, reaches the subalpine zone in the European Alps where it occasionally forms monospecific stands. The picture shows the species next to the Furka pass road in Switzerland at about 2 100 m above sea level.

Box 8.2 Alien plants in the Alps: status and future invasion risks (cont.)**Table 8.7 Potentially invasive plants of higher elevations in the European Alps**

Genus	Species	Family	Elevation
<i>Acacia</i>	<i>dealbata</i> ⁽¹⁾	Fabaceae	colline ⁽¹²⁾
<i>Ambrosia</i>	<i>artemisiifolia</i> (*)	Asteraceae	colline ⁽¹²⁾
<i>Artemisia</i>	<i>verlotiorum</i> (*)	Asteraceae	montane
<i>Buddleja</i>	<i>davidii</i> (*)	Buddlejaceae	montane
<i>Bunias</i>	<i>orientalis</i> (*)	Brassicaceae	montane
<i>Caragana</i>	<i>arborescens</i>	Fabaceae	no data
<i>Conyza</i>	<i>canadensis</i> (*)	Asteraceae	subalpine
<i>Elodea</i>	<i>canadensis</i> ^{(2),*}	Hydrocharitaceae	subalpine
<i>Epilobium</i>	<i>ciliatum</i> (*)	Onagraceae	montane
<i>Erigeron</i>	<i>annuus</i> (*)	Asteraceae	montane
<i>Fagopyrum</i>	<i>esculentum</i>	Polygonaceae	montane
<i>Fagopyrum</i>	<i>tataricum</i> ⁽³⁾	Polygonaceae	subalpine
<i>Heracleum</i>	<i>mantegazzianum</i> ^{(4),*}	Apiaceae	subalpine
<i>Hordeum</i>	<i>jubatum</i>	Poaceae	montane
<i>Impatiens</i>	<i>glandulifera</i> ^{(5),*}	Balsaminaceae	montane
<i>Impatiens</i>	<i>parviflora</i> (*)	Balsaminaceae	subalpine
<i>Juncus</i>	<i>tenuis</i> (*)	Juncaceae	subalpine
<i>Lupinus</i>	<i>polyphyllus</i> (*)	Fabaceae	subalpine
<i>Matricaria</i>	<i>discoidea</i> (*)	Asteraceae	subalpine
<i>Mimulus</i>	<i>guttatus</i> (*)	Scrophulariaceae	montane
<i>Papaver</i>	<i>croceum</i> ⁽⁶⁾	Papaveraceae	alpine
<i>Pinus</i>	<i>strobus</i> ⁽⁷⁾	Pinaceae	montane
<i>Polygonum</i>	<i>nepalense</i> ⁽⁸⁾	Polygonaceae	montane
<i>Polygonum</i>	<i>polystachyum</i> (*)	Polygonaceae	colline ⁽¹²⁾
<i>Prunus</i>	<i>laurocerasus</i> (*)	Rosaceae	montane
<i>Reynoutria</i> ⁽⁹⁾	<i>japonica</i> (*)	Polygonaceae	montane
<i>Reynoutria</i> ⁽⁹⁾	<i>sachalinensis</i> (*)	Polygonaceae	subalpine
<i>Robinia</i>	<i>pseudoacacia</i> (*)	Fabaceae	montane
<i>Sedum</i>	<i>spurium</i> ^{(10),*}	Crassulaceae	montane
<i>Senecio</i>	<i>inaequidens</i> (*)	Asteraceae	montane
<i>Senecio</i>	<i>rupestris</i> (*)	Asteraceae	alpine
<i>Solidago</i>	<i>canadensis</i> ^{(11),*}	Asteraceae	montane
<i>Solidago</i>	<i>gigantea</i> ^{(12),*}	Asteraceae	montane

Note: The table includes species that are recognised invaders in a European country (Wittenberg, 2005; DAISIE, 2010) and occur in the montane zone or higher in the European Alps (Aeschmann *et al.*, 2004); and species that are, on a species or genus level, invasive in mountains outside of Europe (MIREN, 2010). Priority invasive species in Europe are indicated in bold.

(*) Listed as an invasive species for lowland areas in Europe (Wittenberg, 2005); ⁽¹⁾ a subspecies *subalpina* has been described in Australia; ⁽²⁾ aquatic plant; ⁽³⁾ synonym: *Polygonum tataricum*, ⁽⁴⁾ and other alien *Heracleum* species; ⁽⁵⁾ syn: *Impatiens taprobanica*; ⁽⁶⁾ syn: *Papaver nudicaule*; ⁽⁷⁾ and other alien *Pinus* species; ⁽⁸⁾ syn: *Persicaria nepalensis*; ⁽⁹⁾ syn: *Fallopia*; ⁽¹⁰⁾ syn: *Phedimus spurium*; ⁽¹¹⁾ syn: *Solidago altissima*; ⁽¹¹⁾ syn: *Solidago serotina*; ⁽¹²⁾ experts believe the species has the potential to reach higher elevations.