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# A mini review: biodiversity, life form and vegetation of flora in the Alpine zone

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**Abstract**

The Alpine and Arctic biomes cover 16% of the earth's surface area. Because of the importance of alpine flora, this review discuses on the results of different studies on the Biodiversity and phytogeography of the alpine flora. The Alpine Region has such a rich and diverse biodiversity. Alpine vegetation is defined zone of vegetation between the altitudinal limit for tree growth and the nival zone. Many different plant species live in the alpine environment. Terrestrial plants of arctic and alpine regions are mainly flowering plants (Angiosperms), bryophytes, and lichens; ferns are also represented but with fewer species. Almost all the Angiosperms are herbaceous perennials or very low shrubs; annuals are very rare. Alpine plants must adapt to the harsh conditions of the alpine environment, which include low temperatures, dryness, ultraviolet radiation, and a short growing season. Alpine plants face pollination problems caused by low temperatures which confine insect activities. The principal kinds of pollinating insects in alpine locations are short-tongued bees, bumblebees, flies, butterflies, and moths. Alpine plants use both sexual reproduction and asexual reproduction. The principal means of vegetative reproduction in both arctic and alpine plants is by rhizomes. During the past few decades, human activity has increased in alpine environments and our disturbance is probably the biggest threat to alpine plant. Climate change also poses a direct threat to alpine plants.

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**Introduction**

The Alpine biome is one of the coldest biomes in the world. It is so cold because of its high altitudes. Summer temperature range is between 2 - 10 °C. The average precipitation is 30 cm a year. It is very much like the Tundra biome. Both the alpine and tundra biomes are cold and dry throughout the year. The Alpine biome is also similar to the arctic biome. Alpine biomes are located all around the world in high altitudes. The Alpine and Arctic biomes cover 16% of the earth's surface area. Alpine biomes are located on mountains where trees can't grow. The growing season for plants is about 180 days. The night temperature is almost always below freezing. Unlike the arctic tundra, the alpine soil is well drained. The problem of light is quite different in alpine biomes than in other biomes. The little amount of atmosphere at high altitudes exposes the Alpine area to sunlight, especially UV, at a dangerous level (Bliss, 1960).The Alpine Region has such a rich and diverse biodiversity. Almost two-thirds of the plants on the European continent are present here. Several factors define the alpine zone, including elevation, aspect and high relief, but climate is probably the best determinant of where alpine zones begin (Price, 1981; Körner, 1999).

*Alpine climate*

Mountains are unique features of the Earth system in terms of their scenery, their climates, their ecosystems; they provide key resources for human activities well beyond their natural boundaries; and they harbor extremely diverse cultures in both the developing and the industrialized world (Beniston, 2000). Climate change presents another major threat. Because of the tight ecological and climatic bands in the mountains a small change could have devastating effects on their ability to absorb and retain water. Already there is evidence that the glaciers are shrinking, if they diminish further one can expect significantly more drought in the lowlands and marked changes in vegetation in the mountains, particularly at the higher elevations. Climate is the principal factor governing the natural environment of mountains on short time scales, and characterizes the location and intensity of biological, physical and chemical processes. Mountain climates are determined by four major factors, namely continentality, latitude, altitude, and features related to topography itself (Barry, 1994).

Latitude determines to a large extent the amplitude of the annual cycle of temperature and, to a lesser extent, the amount of precipitation that a region experiences. Mountains tend to amplify some of the characteristics of tropical, mid latitude and boreal climates for reasons related to topography. Altitude, however, is certainly the most distinguishing and fundamental characteristic of mountain climates. At high elevations, thermal conditions are often extreme; the only source of energy is the direct solar radiation that is absorbed by the surface (Klotzli, 1994; Ozenda, 1985; Quezel and Barbero, 1990; Rameau *et al*., 1993).

*Alpine vegetation*

Alpine vegetation is defined zone of vegetation between the altitudinal limit for tree growth and the nival zone. In areas where mountains can be considered typically alpine, the vegetation zones are often divided into distinct altitudinal bands. The alpine band usually consists of low growing herbaceous species given the cessation of most woody vegetation at the upper limit of the subalpine band. The upper limit of the alpine band often gives way to bare rock and permanent snow which continues on to the summit (Grime, 1979). The alpine zone is the area between the upper limit of trees (the treeline) and the lower limit of permanent snow. Alpine plants grow in the alpine climate, which occurs at high elevation and above tree line. The tree line is the edge of the habitat at which trees are capable of growing. Beyond the tree line, trees cannot tolerate the environmental conditions (usually cold temperatures or lack of moisture) (Korner,2003). Alpine regions are above timber-line which is dependent on the climate, slopes and human activities. For instance, In Iran timberline is around 3000 m above sea level (Noroozi *et al*., 2008; Rajaei *et al*., 2011) whereas in the Pyrenees

(Europe) it is well above 2,000 m, Hindu Kush 3,500 m (Breckle 1971), Pamir mountains 4,000 m (Breckle and Wucherer 2006). In New Zealand the treeline is around 1500 m above sea level.

Alpine Grasslands and Shrublands include all vegetated areas above the upper treeline in the highest mountains, as well as significant expanses of grassland just below the upper treeline within the sub-alpine zone. Upper treeline is defined as the elevation above which trees are unable to grow in an upright form**.**

There is a striking reduction in number of species with increasing latitude that results from an increasing severity of the environment and a reduction of land area and available soil (Porsild, 1951).

Alpine plants grow together as a plant community (Austrheim, 2005). Alpine plants are not a single taxon. Rather, many different plant species live in the alpine environment. Terrestrial plants of arctic and alpine regions are mainly flowering plants (Angiosperms), bryophytes, and lichens; ferns are also represented but with fewer species. Almost all the Angiosperms are herbaceous perennials or very low shrubs; annuals are very rare. The perennial herbs are of four principal life-forms: cushion or pollster plants, rosette plants, leafy-stemmed plants, and grass-form plants (Bliss, 1960). Some representative images of vegetation types have been shown in fig.1.

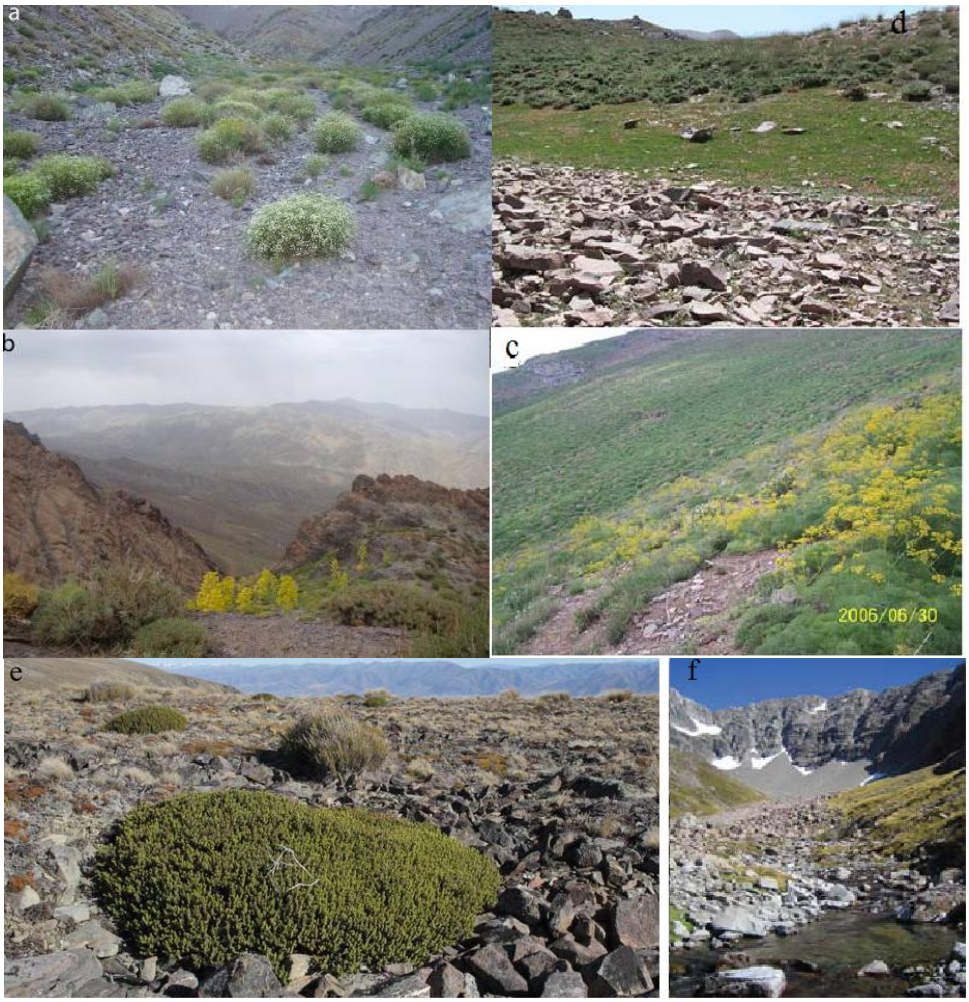


**Fig. 1.** A, b: Representative images of vegetation types in Hezar Mt 3800 m (Iran) (Rajaei *et al.*, 2011); c, d: Representative images of vegetation types in Alborz, 2300m (Iran) (Noroozi *et al.*, 2008); e, f: Representative images of vegetation types in New Zealand (A.F. Mark and Nancy M.Adams)

*Alpine plant characteristic*

Alpine plants must adapt to the harsh conditions of the alpine environment, which include low temperatures, dryness, ultraviolet radiation, and a short growing season (Bliss, 1960). The most obvious adaptations to severe tundra or alpine environments are reduction in plant height and a tendency toward an herbaceous habit. Many alpine plants have wiry, tough branches with densely packed leaves at the tips to reduce wind battering. Their leaves are also generally small and tough, which makes them less easily frozen or dried out and less likely to be damaged by wind, hail and snow. Hairs on the leaves prevent air movement over the leaf surface and thereby protect the leaves from the cold (Went, 1964).Another feature of many alpine plants is a deep root system that provides strong anchorage. Cushion plants such as vegetable sheep are actually a collection of thousands of tiny individual plants. Individual alpine plants would not survive on their own but by growing in closely packed clusters; they trap warm air and moisture and protect themselves from wind and movements of snow down a slope (Tranquilwli, 1963).

*Pollination*

Alpine plants face pollination problems caused by low temperatures which confine insect activities to a few weeks, and even then mainly to the sunny daylight hours (Mani, 1962). The principal agents, of course, are insects, birds, and wind. Flora of the Caucasus which shows that 89% of the species are insect-pollinated and 11 % are wind-pollinated. The principal kinds of pollinating insects in alpine locations are short-tongued bees, bumblebees, flies, butterflies, and moths. Bumblebees are more common above timberline in the Northern Hemisphere Mountains than any other kinds of bees (Mani, 1962).

*Reproduction*

Alpine plants use both sexual reproduction and asexual reproduction. Sexual reproduction has limits in high alpine areas, especially in areas with a short growing season in alpine zones at high latitudes. In tropical alpine zones with a year round growing season, such as the northern Andes, plants can flower year round. Regardless of when alpine plants flower, pollinators are often scarce. The activity of pollinators decreases with increasing altitude (Tsukaya, 2001). As sexual seed production decreases and becomes unreliable in the most severe environments, vegetative reproduction seems to increase. The principal means of vegetative reproduction in both arctic and alpine plants is by rhizomes. Layering is also important in some species, particularly in cushion plants and prostrate shrubs. Alpine populations from both America and Europe, however, did not form perennating buds until the photoperiod was down to 12 hr., at which day length the bud was formed rather quickly. (went, 1953). Some plants flower immediately after snow melt or soil thawing. These early flowering plants always form their flowers in the previous season, called preformation. Consequently, they risk frost damage to the preformed inflorescence (Bliss, 1971). In order to minimize frost damage, preformed flowers are often surrounded by tightly packed bracts that are densely covered in trichomes (Bliss, 1971). This helps to keep the interior of a flower bud warm (Hacker *et al.*, 2008). Because of early season pollinator limitation, plants that bloom early generally have a low rate of reproductive success One advantage of flowering early is that seeds that are produced have a greater chance of developing to maturity before the next freeze. They also have a high outcrossing rate, which helps to increase genetic diversity (Bliss, 1971).

*Alpine Threat*

During the past few decades, human activity has increased in alpine environments and our disturbance is probably the biggest threat to alpine plants (Guisan *et al.*, 1995, Beniston *et al.*, 1996, Kienast *et al.*, 1998).

Climate change also poses a direct threat to alpine Plants. There are three basic ways in which mountain plants may respond to climatic change (i) persistence

in the modified climate, (ii) migration to more suitable climates or (iii) extinction. Three types of persistence are possible: gradual genetic adaptation of populations, phenotypic plasticity or ecological buffering (Huntley, 1991). Climate change posses a direct threat to alpine plants. After the Polar Regions, alpine environments are amongst those most affected by global climate change (Kullman 2004). Cold-adapted alpine species are stressed by climate warming, and more importantly, must compete with species from lower elevations extending their ranges upward (Theurillat & Guisan, 2001).

In addition, in recent years strong grazing impact is increasingly threatening the fragile subalpine and alpine ecosystems. Over-exploitation of medicinal plants by herbalists, local people and traders, threatens rare alpine species. Because alpine plants grow very slowly, they cannot quickly re-grow the lost leaves or flowers. Ultimately, alpine environments need strong management to survive (Rajaei *et al*., 2011).

**References**

**Austrheim G, Kristian H, Atle M.** 2005. The role of life history traits for bryophyte community patterns in two contrasting alpine regions. The Bryologist **108** (**2**), 259–271. http://dx.doi.org/ doi:10.1639/0007-2745 (2005) 108[0259:TROLHT]2.0.CO;2

**Barry R.G.** 1994. Past and potential future changes in mountain environments; A review. In (Beniston, M., ed. Routledge Publishing Company, London and New York, Mountain Environments in Changing Climates pp. 3–33.

**Beniston M, Fox DG, Adhikary S, Andresson R, Guisan A, Holten JI, Ines J, Maitima B, Bliss LC.** 1960. Adaptations of arctic and alpine plants to environmental conditions. Symposium Life under Extreme Conditions.

**Bliss LC.** 1971. Arctic and Alpine Plant life Cycles. Annual Review of Ecology and Systematics **2**.

**Breckle SW.** 1971. Vegetation in alpine regions of Afghanistan. In: Davis PH *et al* (eds) Plant life of South- West Asia. Proceedings of the symposium Edinburgh, 107–116.

**Breckle SW, Wucherer W**. 2006. Vegetation of the Pamir (Tajikistan): land use and desertification problems. In: Spehn E, Ko¨rner C, Liberman M (eds) Land use change and mountain biodiversity. CRC Taylor & Francis, Boca Raton, pp 225–237

**Grime JP.** 1979. Plant stratergies and vegetation processes. (John Wiley: Chichester.)

**Guisan A, Holten JI, Spichiger R, and Tessier L (eds.).** 1995. Potential Ecological Impacts of Climate Change in the Alps and Fennoscandian Mountains, Conservatoire et Jardin botaniques,Genève, p. 194.

**Hacker J, Gilbert N.** 2008. Ice Propagation in Dehardened Alpine Plant Species Studied by Infrared Differential Thermal Analysis (IDTA). Arctic, Antarctic, and Alpine Research **40** (4), 660–670. http://dx.doi.org/10.1657/1523-0430(07-077) [HACKER] 2.0.CO;2.

**Huntley B.** 1991. How Plants Respond to Climate Change: Migration Rates, Individualism and the Consequences for Plant Communities. Ann. Botany 67 (Suppl. 1), 15–22.

**Kienast F, Wildi O, Brzeziecki B, Zimmermann N, Lemm R.** 1998. Klimaänderung und mögliche langfristige Auswirkungen auf die Vegetation der Schweiz, Schlussbericht NFP31, VDG Hochschulverlag, Zürich, p. 71

**Klotzli F.** 1994. Vegetation als Spielball naturgegebener Bauherren, Phytocoenologia **24**, 667–675.

**Körner C.** 2003. Alpine plant life: functional plant ecology of high mountain ecosystems. Springer.

**Kullman L.** 2004. The changing face of the alpine world. IGBP, Global Change Newsletter **57**, 12–14.

**Mani MS.** 1962. Introduction to high altitude entomology. Insect life above the timber-line in the north-west Himalaya**.** London. **302** pp.

**Noroozi J, Akhani H, Breckle S.** 2008. Biodiversity and phytogeography of the alpine flora of Iran. Biodiversity and Conservation **17**, 493–521.

**Ozenda P.** 1985. La ve´ge´tation de la chaıˆne alpine dans l'espace montagnard europe´en,Masson, Paris, 344 pp.

**Porsild AE.** 1951. Plant life in the Arctic. Canadian Geographical Journal **42**,120-45

**Quezel P. and Barbero M.** 1990. Les foreˆts me´diterrane´ennes: proble`mes pose´s par leur signification historique, e´cologique et leur conservation, Acta Botanica Malacitana **15**, 145–178.

**Rajaei P, Maassoumi AA, Mozaffarian V, Nejad Sattari T, Pourmirzaei A.** 2011**.** Alpine flora of Hezar mountain (SE Iran). Rostaniha **12(2)**, 111-127.

**Ramau JC, Mansion D, Dume G, Lecointe A, Timbal J, Dupont P, Keller R.** 1993. Flore Forestie`re Franc¸aise, Guide Ecologique Illustre´. Lavoisier TEC and DOC Diffusion, Paris, 2419.

**Theurillat JP & Guisan A**. 2001. Potential impacts of climate change on vegetation in the European Alps: a review. Climatic Change **50**, 77–109.

**Tranquilwli N.** 1963. Climate and water relations of plants in the sub-alpine region. In The Water Relutions of Plants**,** pp. 153-67**.** Ed. **A. J.** Rutter. Dorking, England.

**Tsukaya H, Tsuge T.** 2001. Morphological Adaptation of Inflorescences in Plants that Develop at Low Temperatures in Early Spring: The Convergent Evolution of "Downy Plant. Plant Biology **3 (5),** 536–543.
http://dx.doi.org/ doi:10.1055/s-2001-17727

**Went FW.** 1964**.** Growing conditions of alpine plants. Israel Journal of Bot. 13, 82-92.

**Went FW.** 1953**.** Annual plants at high altitudes in the Sierra Nevada, California. Mudrono **12**, 109-114.

**Price LW. 1981.** Mountains and man: a study of process and environment. University of California, Berkeley, USA.