

Sorbus aucuparia in Europe: distribution, habitat, usage and threats

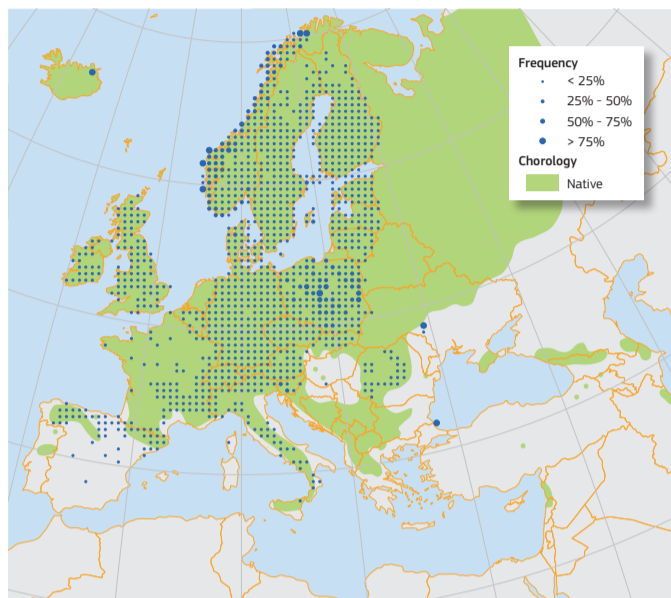
M. Rätty, G. Caudullo, D. de Rigo

The rowan or mountain ash (*Sorbus aucuparia* L.) is a widely spread deciduous tree species, which is only missing from the southernmost parts of Europe and large islands. It can survive in various growing conditions, but in poorer conditions it remains as a bush. A rowan can reach a height of 15-20 metres. It is known for its red fruit which is an important food source for birds particularly during the winter. Rowan and its varieties are popular planted trees in gardens and cities. A changing climate has already enhanced its spread to higher altitudes and further to the north, but in future it is expected to lose its presence in south, central and eastern Europe.

The rowan (*Sorbus aucuparia* L.) is a slender deciduous tree that can reach a height of 15-20 metres on good growing sites, but may remain a bush on poorer sites¹⁻³. The bark is greyish and the crown narrow. The roots are tough and fibrous¹ and form an anchoring root system, with a **morphogenesis** limited by groundwater table, prevailing direction of wind and slope⁴. The leaves are odd **pinnate**, 10-25 cm, consisting of 9-19 (usually 15) pairs of 2-6 cm leaflets, which are oblong, **sessile**, with acute apex, **serrate** margins, dark green in colour becoming orange in autumn^{5, 6}. This species is **monoecious** with numerous hermaphrodite white flowers arranged in dense and woolly **inflorescences**^{1, 2}, flowering from May to June³, or as late as July in northern Europe². It is insect pollinated³ and starts to produce seed at an age of 15 years¹. The fruits are scarlet round **pomes** of about 1 cm^{6, 7}, and its yield is usually good with alternating better and poorer years¹. The fruits stay attached to the tree during the winter and therefore offer food for birds⁷, which disperse the seeds^{1, 3}. The tree is usually not expected to reach an age of 100 years⁷.

Distribution

The genus *Sorbus* has a complex taxonomy, as their species can create not only hybrids, but also duplicate their genome resulting in different morpho-ecological characters that are classified as different species. The **diploid** form of *Sorbus aucuparia* belongs to subgenus *Sorbus*; furthermore **apomictic triploid** and **tetraploid** species, as a result of hybridisation with the members of subgenus *Aria*, are grouped in the subgenus *Soraria*⁸⁻¹⁰. This tree is widespread across Europe, from extreme northern regions (Iceland, Fennoscandia, Russia) to southern Europe (Spain, Italy, Balkans), where it is found only at higher elevations, and eastwards the species extends into Asia Minor (Caucasus) and Northern Asia (Siberia, North China). It can be found from sea-level in northern latitudes, up to 2400 m in



Map 1: Plot distribution and simplified chorology map for *Sorbus aucuparia*. Frequency of *Sorbus aucuparia* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *S. aucuparia* is derived after Meusel and Jäger¹¹.

Tyrol^{1, 11, 12}. It has also been introduced in the United States and Canada as an ornamental tree and has become naturalised in some northern regions¹³.

Habitat and Ecology

Rowan is a tree species adapted for a short growing season and it can tolerate high summer temperatures, if the temperature is not accompanied by high water stress. In other words, its spread is limited rather by a combination of poor drought tolerance, adaption to a short growing season and a cold requirement for bud burst than by high temperature¹. It is a stress-tolerant competitor¹⁴, cold

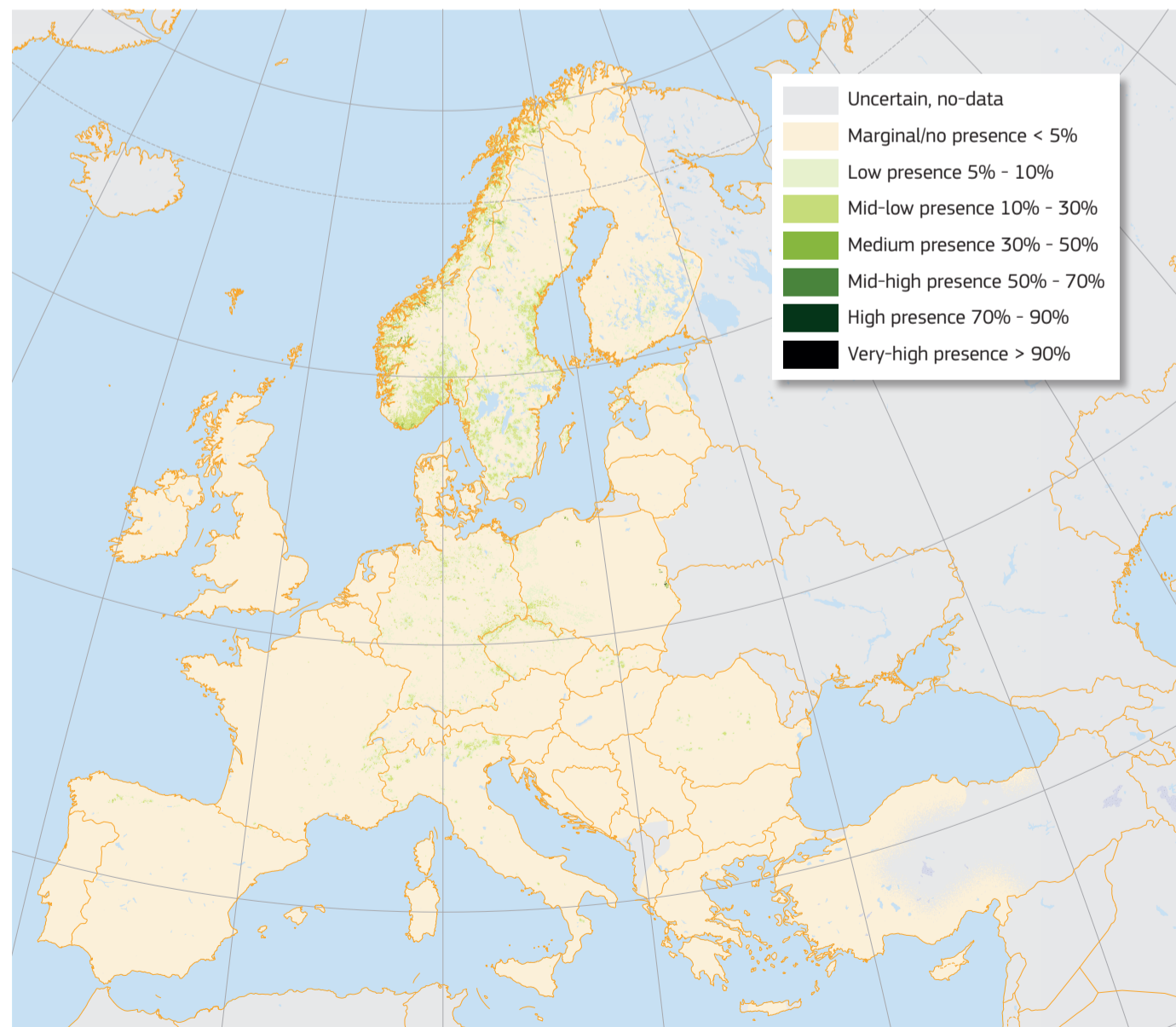


Scarlet fruits of 1 cm in diameter; these pomes stay attached to the tree during the winter. (Copyright Aldo De Bastiani, www.actaplantarum.org; AP)

hardy and frost tolerant^{1, 3}. It is absent from wetlands, bare soil sites, clays and soft limestones^{1, 3}. Otherwise, it is one of the least site-demanding trees³. Rowan and birch (*Betula* spp.) have quite similar site requirements for growth with respect to acidity (up to pH 7.0) and non-waterlogged conditions, but rowan is more shade tolerant and can persist at higher elevations^{14, 15}. It is widespread as a minor component of several vegetation communities, occurring from the lowlands to rocky mountain slopes and cliffs. Typical sites for rowan are forest edges, glades, rocky and stony sites, riverbank bluffs and undergrowth with several forest types and tree species^{1, 2}. Often it occurs as a pioneer tree in open habitats and also in forests, as it is able to geminate and establish successfully on thick layers of raw humus in dense forest stands of spruce (*Picea abies*) particularly, and tolerates competition from herbs¹⁶. Dominant well developed trees regenerate principally by seeds, while pioneer trees spread laterally, developing clones by roots^{1, 14-16}. It has been shown that the genetic variation has remained relatively high even in quite fragmented populations, and there are no clear indications of inbreeding, which is a good sign for forest restoration¹⁷.



Hermaphrodite white flowers arranged in corymbs formed of numerous individuals. (Forestry Commission, www.forestry.gov.uk; © Crown Copyright)



Map 2: High resolution distribution map estimating the relative probability of presence.

Importance and Usage

Rowan is among the most widely distributed species in Europe, including several areas with high erosion rates such as the European mountain systems¹⁸. Its adventitious roots are very suitable to be exploited for soil bioengineering to increase the stability of slopes and mitigate erosion¹⁹. It is also useful for deep reinforcement and soil strength enhancement²⁰.

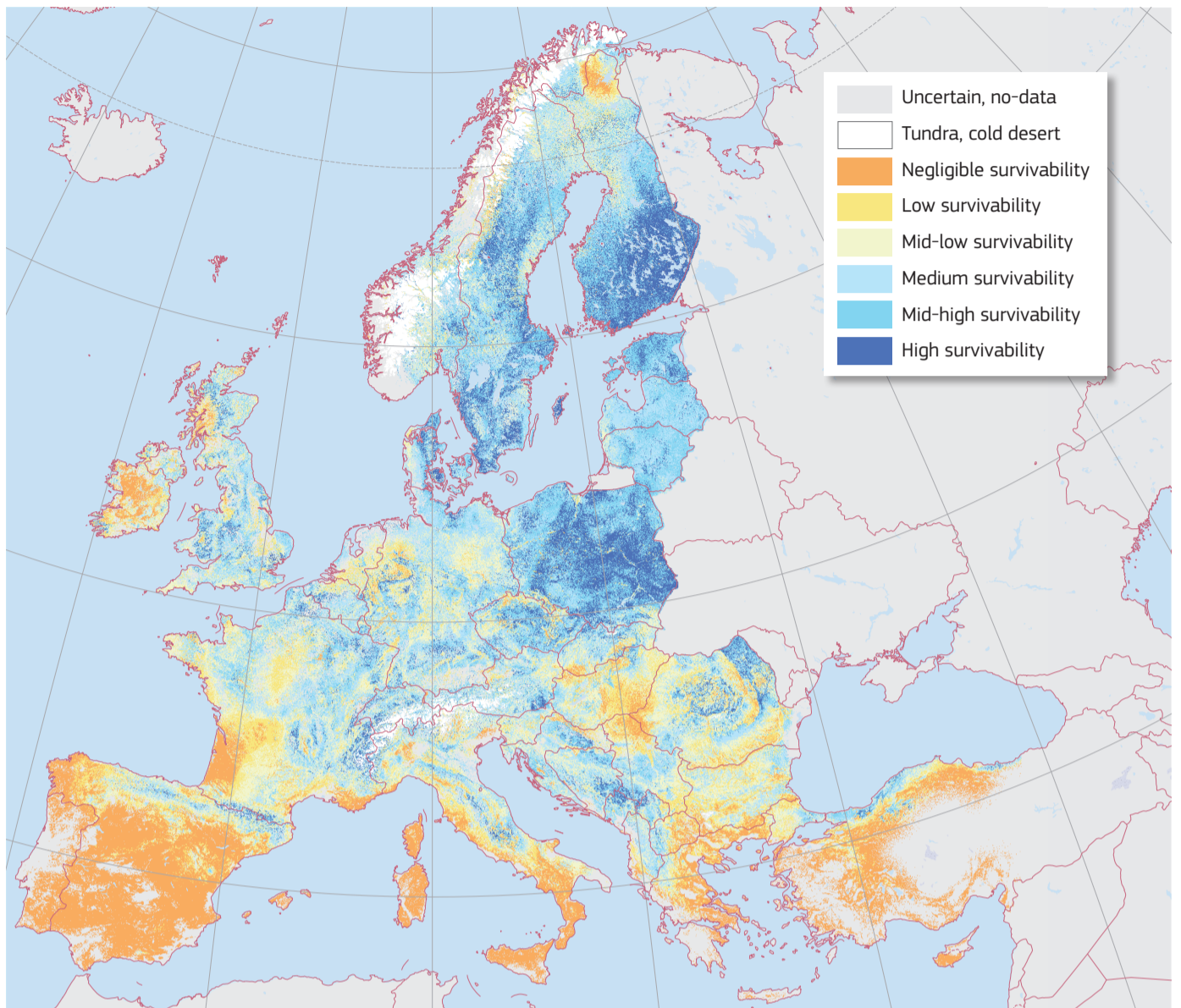
The wood is strong, hard and tough, but not durable outdoors³. It has been used for tool handles, turnery, furniture and craftwork¹⁻³. The fruits are rich in vitamins (especially vitamin C) and antioxidants^{21, 22} and have been used as a medicine, for example for scurvy and kidney stones⁷. Fruits have been also used to flavour vodka and to make juice and jams^{1, 7}. Rowan is known for its ornamental value and therefore it is cultivated in gardens and cities^{2, 3, 7}. It was believed to have magical powers like mistletoe, and a branch could be used as a divining rod to find treasures⁷. The Celts called it 'wizard's tree' and in Ireland it plays an important role in popular magic; e.g. protection against the spirits, especially the dead²³. Fruits are particularly important for bird nutrition, especially in northern Europe where the size of rowan crop can affect the overwintering survival or the amount of migrating population¹.

Threats and Diseases

The rowan supports a relatively species-poor insect fauna²⁴. The apple fruit miner *Argyresthia conjugella* uses the rowan as a host and its caterpillars eat the fruit²⁵. The periodic masting of rowan could be a defence to reduce the numbers of this insect^{25, 26}. Ringspots and variegation are very common on the leaves^{27, 28}. Deer and moose are reported to browse the seedlings intensively, causing in some cases multi-stemmed trees or the complete absence of rowan from the tree layer^{1, 3}. Ever since the 1950s rowan has advanced in the Swedish Scandes, due to a warming climate²⁹. On the other hand, for the same reasons, rowan distribution has been estimated to lose its presence first in southern Europe and later in central and Eastern Europe³⁰. As several woody plants, the rowan is susceptible to be attacked by the gypsy moth (*Lymantria dispar*) and by the nun moth (*Lymantria monacha*)³¹⁻³³. Both moths have the potential to expand their virulence, due to climate change, in the European boreal and temperate oceanic ecological zones³¹. *Heterobasidion annosum* is also able to affect the rowan along with a variety of woody plants, and this pest is potentially subject to expansion in the European boreal and temperate continental ecological zones^{1, 31, 34}.



Smooth grey-brown bark in a young tree. (Copyright Aldo De Bastiani, www.actaplantarum.org; AP)



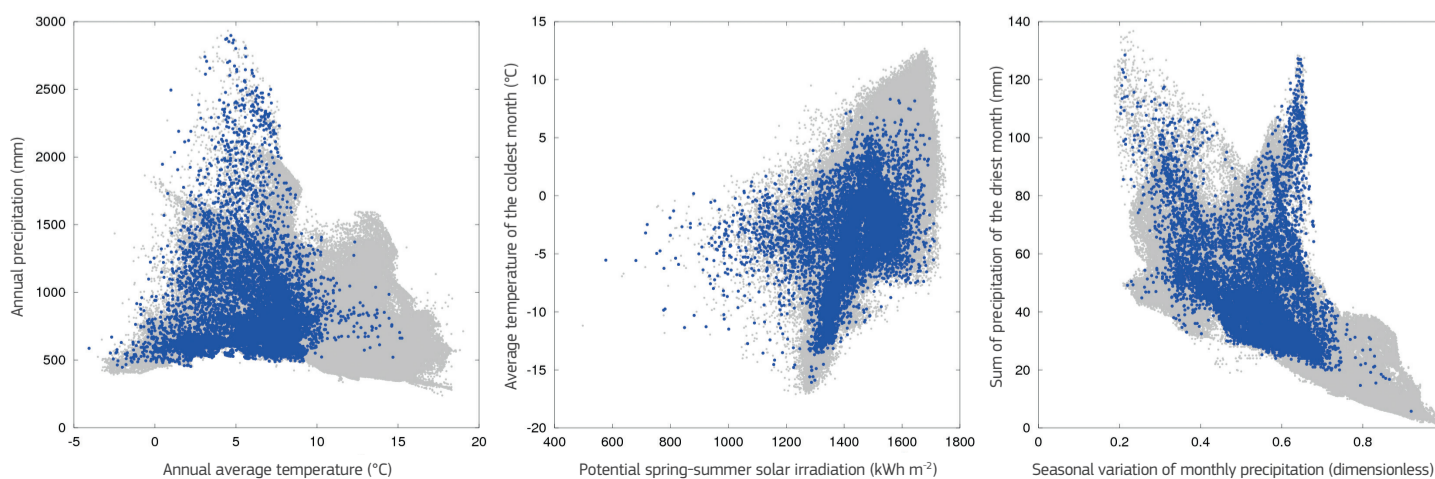
Map 3: High resolution map estimating the maximum habitat suitability.



Rowan tree grown in a dwarf mountain pine thicket (*Pinus mugo*) in the Adamello-Brenta Natural Park (Trentino-Alto-Adige, North Italy). (Copyright Giallopolenta, commons.wikimedia.org; PD)

Field data in Europe (including absences) ● Observed presences in Europe ●

Autoecology diagrams based on harmonised field observations from forest plots.



References

- [1] O. Raspé, C. Findlay, A.-L. Jacquemart, *Journal of Ecology* **88**, 910 (2000).
- [2] V. L. Komarov, et al., Flora of the USSR - Volume IX: Rosales and Sarraceniales, vol. 9 of Flora of the USSR (Keter Press, Jerusalem, 1970).
- [3] P. S. Savill, *The silviculture of trees used in British forestry* (CABI, 2013).
- [4] O. Maurer, E. Palátová, *Journal of Forest Science* **48**, 342 (2002).
- [5] A. F. Mitchell, P. Dahlstrom, E. Sunesen, C. Darter, *A field guide to the trees of Britain and northern Europe* (Collins, 1974).
- [6] O. Johnson, D. More, *Collins tree guide* (Collins, 2006).
- [7] A. Anderberg, A. L. Anderberg, *Den virtuella floran* (Elektronisk publikation, Naturhistoriska riksmuseet, Stockholm, 1996). <http://linnaeus.nrm.se/flora>.
- [8] E. Nelson-Jones, D. Briggs, A. Smith, *Theoretical and Applied Genetics* **105**, 953 (2002).
- [9] A. Robertson, et al., *Molecular Ecology* **19**, 1675 (2010).
- [10] J. J. Aldasoro, C. Aedo, C. Navarro, F. M. Garmendia, *Systematic Botany* **23**, 189 (1998).
- [11] H. Meusel, E. Jäger, S. Rauschert, E. Weinert, *Vergleichende Chorologie der Zentraleuropäischen Flora* (Gustav Fischer Verlag Jena, 1978).
- [12] E. Hultén, M. Fries, *Atlas of North European vascular plants (North of the Tropic of Cancer)*, Vols. I-III. (Koeltz scientific books, 1986).
- [13] C. S. Sargent, *Manual of the Trees of North America (exclusive of Mexico)*, vol. 2 (Dover Publications, New York, 1961), second edn.
- [14] J. P. Grime, J. G. Hodgson, R. Hunt, *Comparative Plant Ecology: A Functional Approach to common British Species* (Castlepoint Press, 2007).
- [15] D. N. MacVean, D. A. Ratcliffe, *Plant communities of the Scottish Highlands. A study of Scottish mountain, moorland and forest vegetation* (Her Majesty's Stationery Office, London, 1962).
- [16] S. Zebre, *Polish botanical journal* **46**, 229 (2001).
- [17] C. F. E. Bacles, A. J. Lowe, R. A. Ennos, *Molecular Ecology* **13**, 573 (2004).
- [18] C. Bosco, D. de Rigo, O. Dewitte, J. Poesen, P. Panagos, *Natural Hazards and Earth System Science* **15**, 225 (2015).
- [19] F. Florineth, H. P. Rauch, H. Staffler, *Proceedings of the International Congress INTERPRAEVENT 2002 in the Pacific Rim* (2002), vol. 2, pp. 827-837.
- [20] J. E. Norris, A. Di Iorio, A. Stokes, B. C. Nicoll, A. Achim, *Slope Stability and Erosion Control: Ecotechnological Solutions*, J. E. Norris, et al., eds. (Springer Netherlands, 2008), pp. 167-210.
- [21] A. Gil-Izquierdo, A. Mellenthin, *European Food Research and Technology* **213**, 12 (2001).
- [22] K. Haffner, S. F. Remberg, *Chronica Horticulturae* **46**, 19 (2006).
- [23] J. E. Milner, *The tree book: the indispensable guide to tree facts, crafts and lore* (Collins & Brown, 1992).
- [24] S. D. Wratten, P. Goddard, P. J. Edwards, *The American Naturalist* **118**, 916 (1981).
- [25] G. Jaastad, et al., *Agricultural and Forest Entomology* **4**, 233 (2002).
- [26] S. Kobra, et al., *Population Ecology* **45**, 25 (2003).
- [27] Z. Polak, J. Zieglerova, *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz* **103**, 432 (1996).
- [28] N. Mielke, H.-P. Muehlbach, *Journal of General Virology* **88**, 1337 (2007).
- [29] J. Grace, F. Berninger, L. Nagy, *Annals of Botany* **90**, 537 (2002).
- [30] P. A. Harrison, P. M. Berry, N. Butt, M. New, *Environmental Science & Policy* **9**, 116 (2006).
- [31] D. de Rigo, et al., *Scientific Topics Focus 2*, mri10a15+ (2016).
- [32] CABI, *Lymantria dispar* (gypsy moth) (2015). Invasive Species Compendium. <http://www.cabi.org>
- [33] CABI, *Lymantria monacha* (nun moth) (2015). Invasive Species Compendium. <http://www.cabi.org>
- [34] CABI, *Heterobasidion annosum* (2015). Invasive Species Compendium. <http://www.cabi.org>

This is an extended summary of the chapter. The full version of this chapter (revised and peer-reviewed) will be published online at <https://w3id.org/mtv/FISE-Comm/v01/e0179de>. The purpose of this summary is to provide an accessible dissemination of the related main topics.

This QR code points to the full online version, where the most updated content may be freely accessed.
Please, cite as:
Ráty, M., Caudullo, G., de Rigo, D., 2016. *Sorbus aucuparia* in Europe: distribution, habitat, usage and threats. In: San-Miguel-Ayanz, J., de Rigo, D., Caudullo, G., Houston Durrant, T., Mauri, A. (Eds.), *European Atlas of Forest Tree Species*. Publ. Off. EU, Luxembourg, pp. e0179de+

