NOBANIS –Invasive Alien Species Fact Sheet

Anthriscus sylvestris

Author of this fact sheet: Sigurður H. Magnússon, Icelandic Institute of Natural History, Post Box 125, 212 Garðabær, Iceland; Tel.: +354 590 0500, E-mail: sigurdur@ni.is

Bibliographical reference – how to cite this fact sheet:
Magnússon, S.H. (2011): NOBANIS – Invasive Alien Species Fact Sheet – ***Anthriscus sylvestris***. – From: Online Database of the European Network on Invasive Alien Species – NOBANIS www.nobanis.org, Date of access x/x/200x.

Species description

Scientific names: *Anthriscus sylvestris* (L.) Hoffm., Apiaceae

Synonyms: *Chaerefolium silvestre* (L.) Sch. et Thell., *Chaerophyllum sylvestre* L., *C. nemorosum Bieb.*, *Chaerefolium sylvestre* (L.) Thell., *Cerefolium sylvestre* Besser., *Anthriscus nemorosa (Bieb.) Spreng.*
The species can be subdivided into three subspecies: 1) *Anthriscus sylvestris* subsp. *sylvestris*; 2) *Anthriscus sylvestris* subsp. *alpina* (Vill.) Gremli (= *Chaerophyllum alpinum* Vill. = *Chaerefolium sylvestre* var. *alpinum* (Vill.) Thell. = *Anthriscus sylvestris* var. *tenuifolia* DC. = *Anthriscus sylvestris* var. *torquata* W. D. J. Koch p.p.); 3) *Anthriscus sylvestris* subsp. *stenophylla* (Rouy & Camus) Briq. (= *Anthriscus stenophylla* Rouy & Camus = *Chaerefolium sylvestre* var. *stenophyllum* (Rouy & Camus) Thell. = *Anthriscus sylvestris* var. *torquata* W. D. J. Koch p.p. = *Anthriscus torquata* Thomas)
Very similar, closely related and sometimes regarded as a subspecies is *Anthriscus nitida* (Wahlenb.) Hazsl. (= *Chaerophyllum nitidum* Wahlenb. = *Anthriscus sylvestris* subsp. *nitida* (Wahlenb.) Briq. = *Anthriscus alpestris* Wimm. & Grab. = *Anthriscus sylvestris* subsp. *alpestris* (Wimm. & Graeb.) Gremli = *Chaerefolium sylvestre* subsp. *alpestris* (Wimm. & Grab.) Thell. = *Anthriscus torquata* DC. = *Anthriscus alpestris* subsp. *torquata* (DC.) Nyman).

Common names: Cow parsley (GB), Wiesen-Kerbel, Wilder Kerbel (DE), vild kørvel (DK), Metsharakputk (EE), Koiranputki (FI), Skógarkerfill (IS), Krūminis builis (LT), Meza sunburkškis (LV), Fluitenkruid (NL), Hundekjeks (NO), Trybula lesna (PL), купырь лесной (RU), Hundkex (SE), kerblík lesní (CZ).

Fig. 1. *Anthriscus sylvestris* in its native range in Germany, photo by T. Muer.

Fig. 2. *Anthriscus sylvestris* invading Nootka lupin (*Lupinus nootkatensis*) areas in Southwestern Iceland, photo by S.H. Magnússon, June 2003.

Fig. 3. *Anthriscus sylvestris* invading abandoned grass fields in Southwestern Iceland, photo by S.H. Magnússon, June 2003.

Species identification
A. sylvestris is a perennial 0.3–1.5 m tall rosette plant with a thick tap root up to 2 m long (Grime *et al.* 1988, Spalik and Woodell 1994, Darbyshire *et al.* 1999). The species has alternately arranged, fern-like leaves, and each segment of the leaf is 1.5-5 cm in length. The inflorescence is a compound umbel 20–60 cm in diameter and the flowers are white, 3–6 mm in diameter. The fruits are smooth, lanceolate in shape and around 6 mm long. The fruits are green at the beginning but turn brown when they ripen (Darbyshire *et al.* 1999).

Native range
A. sylvestris is native to Europe and temperate Asia. In Europe it is common in most countries, but rare in the Mediterranean region. It is, however, not native to Iceland, the Faroe Islands nor Greenland (Tutin *et al.* 1968, Hultén and Fries 1986, Clapman *et al.* 1987, Baskin *et al.* 2000, Rutkowski 2004, Latvian database on plants – *Anthriscus sylvestris*, Флора Восточной Европы 2004).

Alien distribution

History of introduction and geographical spread
A. sylvestris has been introduced to several parts of the world. In North America the species is now widely distributed. It is found in eastern and western Canada, in the north-eastern, mid-Atlantic and mid-western USA, in the state of Washington (Darbyshire *et al.* 1999) and in Alaska (Carlson and Shephard 2007). The species is also found in several countries in the southern hemisphere. e.g. in South Georgia, New Zeeland and central and southern Africa (Webb *et al.* 1989, Hultén and Fries 1986). In Europe *A. sylvestris* has also been introduced to the west of its native range. In Iceland the first record is from Akureyri 1927 (Óskarsson 1932).

Pathways of introduction
A. sylvestris may have been spread from its native range with wildflower mixtures or for ornamental purposes.

Alien status in region
During the last decades, *A. sylvestris* has increased in abundance in many biotopes within its native range in Europe such as hay meadows, roadside verges and on abandoned habitats formerly used for hay production (van Mierlo and van Groenendael 1991, Hansson 1994, Hansson and Persson 1994, Oberdorfer 2001, Zarzycki *et al.* 2002, Rutkowski 2004). In Britain the species has e.g. increased at several sites in semi-natural habitats during the last decades (Smart *et al.* 2005, Walker *et al.* 2009). The species is widely distributed in Scandinavia, especially in the southern part (Hultén 1971). In Sweden, it appears to be increasing in species rich nature reserves (Hansson and Persson 1994). In Norway the species has become a problem in agriculture, horticulture and for conservation of cultural landscape (Rosef and Bele 2007, Bele and Nilsen 2009). In Poland the species has increased its number of stands on the country scale in the last decades and also expanded into new habitats (Zarzycki *et al.* 2002).

Following its introduction, the species has also increased considerably outside its native range (table 1). In Iceland, the species became widely established during World War II especially around army camps and gardens in Reykjavík south west Iceland. Between 1940 and 1965 it spread very rapidly, reached most parts of the country and became naturalised at several sites (Davidsson 1967). However, it did not become invasive until quite recently (Fig. 1 and 2).

In the Faroe Islands *A. sylvestris* is found in gardens in Thorshavn (Jóhansen 2000) and has naturalised at several sites on the islands (Anna Maria Fosaa, pers. comm.). The species is found with scattered distribution in SW Greenland (Kenneth Høegh, pers. comm.) but it is not found in Svalbard (Cecilie von Quillfeldt, pers. comm).

Country	Not found	Not established	Rare	Local	Common	Very common	Not known
Austria						Native	
Belgium						Native	
Czech republic					Native		
Denmark					Native		
Estonia					Native		
European part of Russia						Native	
Finland					Native		
Faroe Islands				X			
Germany						Native	
Greenland			X				
Iceland					X		
Ireland						Native	
Latvia					Native		
Lithuania					Native		
Netherlands						Native	
Norway						Native	
Poland					Native		
Sweden					Native		

Table 1. The frequency and establishment of *Anthriscus sylvestris*, please refer also to the information provided for this species at www.nobanis.org/search.asp. Legend for this table: **Not found** –The species is not found in the country; **Not established** - The species has not formed self-reproducing populations (but is found as a casual or incidental species); **Rare** - Few sites where it is found in the country; **Local** - Locally abundant, many individuals in some areas of the country; **Common** - Many sites in the country; **Very common** - Many sites and many individuals; **Not known** – No information was available; **Native** – when a species is native in a country this is indicated in the table under the relevant frequency category.

Ecology

Habitat description

In its native range, *A. sylvestris* is found in nutrient rich (Ellenberg value 8) moderately disturbed grassland habitats, such as hay meadows, roadside verges and abandoned hayfields (Grime *et al.* 1988, Parr and Way 1988, Silvertown and Tremlett 1989, van Mierlo and van Groenendael 1991, Hansson and Göransson 1993, Hansson and Persson 1994, Austrheim 2002, Rutkowski 2004, Jensen 2004). The species grows along hedgerows, woodland- and forest edges and in waste places (Clapman *et al.* 1987) and is commonly recorded in field margins (Marshall 1989).

The species prefers a moist or mesic soil; according to the Ellenberg scale the moisture value is 5, indicating fresh soils of average dampness (Ellenberg 1979). The species is rather shade tolerant and grows under light conditions from semi-shade to fully open sites (Ellenberg values 5–7). These

ecological requirements are confirmed by 5-degree Zarzycki's scale used in Poland (Zarzycki *et al.* 2002).

Outside its native range, the species also grows under a range of conditions but thrives best in wet to moist disturbed sites, especially where soils are rich (Darbyshire *et al.* 1999). In Iceland it also invades old patches of *Lupinus nootkatensis* on eroded gravel soils where the lupin has increased the nitrogen status of the soil (Magnússon *et al.* 2004).

Reproduction and life cycle

A. sylvestris reproduces both from seeds and from root buds at the top of the root. The species produces large numbers of small white flowers. Flowering is size dependent and usually takes place in the plant's third or fourth year (Hansson and Persson 1994). The species is andromonoecious, the male and hermaphrodite flowers are on the same plant. The species attracts a wide range of unspecialized insect pollinators (Darbyshire *et al.* 1999). The flower development is centripetal with the outer flowers in the umbellula developing first. The seeds ripen in late June through July and in Iceland even later (Ásrún Elmarsdóttir, pers. comm.) and disperse slowly. Seed production of single plants is in the range of 800 – 10,000 (Keller *et al.* 1934 cited in Darbyshire *et al.* 1999, Forurnier 1947 cited in Darbyshire *et al.* 1999). Seeds have no apparent dispersal mechanisms, most of them fall close to the parent plant (Rew *et al.* 1996).

The seeds of *A. sylvestris* are generally short lived. They need a chilling period to germinate (Baskin *et al.* 2000) and most of them survive only for one winter (Grime *et al.* 1988, Thompson *et al.* 1997, Berge and Hestmark 1997). The seeds germinate in early spring (Roberts 1979) and a rosette plant is formed. The seeds are relatively lagre (2.8 mg) (Eriksson and Eriksson 1997) and have the ability to germinate under low light conditions beneath a dense canopy or litter layer (Roberts 1979, Hovstad and Ohlson 2009). The seedlings also have the capability to penetrate rapidly through and establish leaves above the litter layer (Hovstad and Ohlson 2009) and have high recruitment success in grassland compared to other grassland species of similar seed size (Jakobsson and Eriksson 2000).

According to van Mierlo and van Groenendael (1991) the life cycle is as follows: During the first season the rosettes remain in the vegetative phase and form a basal rosette with a taproot. When these rosettes reach a certain minimum size, vernalisation can lead to flowering during the next growing season. After pollination, seeds are produced and the life cycle is completed. After flowering and death of the parent rosette the side rosettes become independent. Sexual and asexual reproduction may thus occur simultaneously.

Dispersal and spread

Once *A. sylvestris* is established in a new area, dispersal can take place by several means. The seeds have no obvious dispersal mechanisms, and although they may be spread by birds and other animals like sheep and cattle (Fischer *et al*. 1996, Kiviniemi and Telenius 1998, Mouissie *et al*. 2005) or with wind and water, dispersal is primarily mediated by human activities (Darbyshire *et al.* 1999).

The spreading along roads, fence-lines and pastures seems to be very effective (Evans *et al.* 2003), but secondary dispersal mediated by agricultural practices, traffic and transport is today probably the most common method (Grime *et al.* 1988, Rew *et al.* 1996, Darbyshire *et al.* 1999). For the city of Prague, Kopecký (1984, cited in Wittig 2004) described how *A. sylvestris* may have spread from natural habitats (riparian margins, forests, forests edges) along rivers and streets which act as a corridor for population expansion into the nitrogen rich habitats of settlements.

Impact

Affected habitats and indigenous organisms
The increase in abundance of *A. sylvestris* within its native range in Europe during the last decades is commonly considered to be related to an increase in nitrogen compounds in the soil (Hansson and Persson 1994, Zigmantas Gudzinskas, pers. comm., Frank Klingenstein, pers. comm., see also Smart *et al*. 2005). The effects on diversity seem to vary considerably. In Germany *A. sylvestris* only increases in intensively managed and fertilised meadows due to changes in land use practises. These habitats are already species poor and diversity is therefore little affected (Klingenstein, F. pers. comm.). For some regions it is, however, reported that the species may threaten the local flora worth preserving (Hansson and Persson 1994). The species competes with other plants for light, water, space, and nutrients and the rapid growth of the broad leaves in spring forms a canopy which shades and out-competes lower growing species sometimes resulting in an open sward. Therefore, spread of *A. sylvestris* can increase susceptibility of soils to erosion on sloping ground (van Mierlo and van Groenendael 1991).

In Iceland *A. sylvestris* has invaded several nutrient rich habitats including abandoned hay fields, river banks and Nootka lupin patches (Figs.1 and 2). With the present climatic conditions and reduced livestock grazing intensity in Iceland, the spread and abundance of this plant is likely to increase considerably during the next decades, especially in areas where the Nootka lupin has increased soil fertility. *A. sylvestris* communities in Iceland are so recent that their succession is not known. However, experience from Central Europe shows that vegetation types containing the species are susceptible to invasion of alien species (Pysek and Pysek 1995, Godefroid and Koedam 2003). Therefore, sites grown with *A. sylvestris* can be future spots for invasion of non-native species, especially those with high demand for nutrient rich soils.

Genetic effects
No genetic effects have been reported.

Human health effects
The species has been reported to have been used in several ways as a medicine (see Darbyshire *et al*. 1999). As an example, *A. sylvestris* has been used for the prevention and treatment of various diseases, including bronchitis, and as an analgesic (Jeong *et al*. 2007, Yong *et al*. 2009). The plant contains chemical compounds which have been reported to have anti-proliferative (Ikeda *et al*. 1998), anti-tumor, and anti- viral activities against human cancer cells (Suh *et al.* 2009). Therefore, the number of studies on the therapeutic effects of the species have increased considerably in recent years.

Economic and societal effects (positive/negative)
Positive effects of *A. sylvestris* are reported both within and outside its native range. In Europe, Asian countries, including Korea and Japan, it has been used for medical purposes (see above). In America, the Faroe Islands, Greenland and Iceland, the species has been cultivated in gardens (Darbyshire *et al.* 1999, Jóhansen 2000, Kenneth Høegh, pers. comm., Eyþór Einarsson, pers. comm.). The plant is palatable to livestock, especially the young foliage (Hansson and Persson 1994, Darbyshire *et al.* 1999). The beneficial effects of the species for grazing or for fodder production are, however, limited and may even be negative as the species may reduce other more valuable species (Darbyshire *et al.* 1999, Weed alert, Nova Scotia Noxious Weeds). Stems of *A. sylvestris* have also been reported to dry slowly, which interrupts hay making
Other negative economic and societal effects of *A. sylvestris* are related to its competitive ability in meadows and pastures where it increases at the expense of other species. This has been reported

both within (Hansson and Persson 1994, see also Parr and Way 1988) and outside its native range (Darbyshire *et al.* 1999, Guide to weeds in British Columbia).

The species is susceptible to several viruses and can act as a host for viral diseases that infect other plants in the same family; including carrots, parsnips, and celery (see Plant viruses online, VIDE database).

Management approaches

Prevention methods
Within its native range in Europe, no prevention methods have been described for the species. In general, care should be taken in disposal of garden waste infested with *A. sylvestris*, as this may fascilitate spreading of the species into new areas. Care should also be taken with regards to all transport of soil and plant material from sites with *A. sylvestris* to uncolonized areas. As a prevention measure for the spread of the disease sheep scrapie in Iceland, all transport of hay, manure and soil is prohibited between farms in infested versus healthy areas (see Icelandic Ministry of Agriculture on sheep scrapie (in Icelandic)). This may delay the spread of *A. sylvestris* within the country.

In Iceland national strategy for invasive alien species is in progress, based on the Guiding Principles of the Convention on Biological Diversity. In several US states and in Canada, *A. sylvestris* is regarded as a weed (Darbyshire *et al.* 1999). Therefore, general information of the species together with description of prevention methods has been published on the Internet (see links below).

Eradication, control and monitoring efforts
Mechanical control of the species is possible but it is very labour and cost-intensive. Newly infested sites can be controlled by pulling out small plants or by cutting the plants before they set seeds. If seeds are developed, it is effective to burn the growing area or kill seeds and plants in other ways.

Within its native range in Europe, cutting has been an important control practice for *A. sylvestris* (see Darbyshire *et al.*). However, studies show that the effects of cutting are variable and can range from causing an increase in the population (Hansson 1994), having little significant effect (Hansson 1994, Hansson and Persson 1994) to causing a decrease in the population (Grime *et al.* 1988, Parr and Way 1988, van Mierlo and van Groenendael 1991). The frequency and timing of cutting seem to be very important for the results (Hansson 1994, Darbyshire *et al.* 1999). Cutting early in the season, particularly on nutrient rich and disturbed soils, may increase the population through inducing side rosette development and enhanced survival of seedlings (Hansson 1994). In contrast, repeated cutting (three or more times per year) will reduce the abundance of *A. sylvestris*, at least in the short term (Parr and Way 1988, Hansson and Persson 1994, Darbyshire *et al.* 1999). The competitiveness of the species increases with nutrient status of the soil. Therefore, application of artificial fertilizers or other nutrient inputs should be avoided.

A. sylvestris is palatable, especially in the rosette stage (Wagner 1967 cited in Hansson and Persson 1994), and is eaten by cattle and rabbits. It has been reported to be intolerant to heavy trampling (Grime *et al.* 1988), and cattle's grazing has been found to suppress it (Hansson 1994, Darbyshire *et al.* 1999). The effects of sheep grazing, as a means of control, are unclear. In a study in northern Finland, sheep grazing in semi-natural meadows did not have significant effect on the abundance of the species (Hellström *et al.* 2003). In Iceland the species does generally not colonize sheep grazing

areas but has on the other hand been actively spreading into areas where sheep and other livestock grazing is no longer practised.

In Europe and in North America experiments have been carried out to control *A. sylvestris* with herbicide application. Although the results vary, the species seems to be resistant to many types of herbicides (Darbyshire *et al.* 1999). However, good results have been obtained with *dichloroprop*, applied during early flowering, or *chlorfurecol-methyl* together with *maelic hydrazide*, applied in the spring (Williams 1984 cited in Darbyshire *et al.* 1999). Also *picloram* and *2,4-DP* have been found effective (see Darbyshire *et al.* 1999). In addition, effective control has been reported by applying *dicamba* (3,6-dichloro-2-methoxybenzoic acid) when plants are in the vegetative stage (see: Crofts and Jefferson 1999, see also Article on wild Chervil – prepared by Sid Bosworth, University of Vermont.

In Iceland attempts are being made to control the spread and growth of *A. sylvestris* by cutting, herbicide application (glyphosate, dichloroprop + 2,4-D, amidosulfuron)(Magnússon *et al.* 2006), uprooting by hand and by preventing seed setting (Bergþóra Kristjánsdóttir, pers comm). Of the herbicides the application of glyphosate was found to be most effective (Magnússon *et al.* 2006).

Information and awareness
In Iceland the general public has been informed and warned about the species in published papers (Einarsson 1997, Kristinsson 1997, Magnússon *et al.* 2006) see also Icelandic Institute of Natural History, homepage on *A. sylvestris*.

Knowledge and research
None reported.

Recommendations or comments from experts and local communities
None reported.

References and other resources

Contact persons
Frank Klingenstein (DE) Federal Agency for Nature Conservation, Konstantinstr. 110, DE-53179 Bonn, Germany; Tel.: +49 228 8491 264, E-mail: frank.klingenstein@bfn.de

Merike Linnamägi (EE), Estonian Ministry of Environment, Nature Conservation Department, Narva mnt 7a, 15172 Tallinn, Estonia. E-mail: merike.linnamagi@envir.ee

Anna Maria Fosaa (FO) Føroya Náttúrugripasavn, V. U. Hammershaimbsgøta 13, FO-100 Tórshavn, Faroe Islands, Tel.: +298 35 23 00, E-mail: E-mail: anmarfos@ngs.fo

Kenneth Høegh (GL) Nunalerinermut Siunnersorteqarfik/Konsulenttjenesten for Landbrug, Kirkegaardsvej B5, Box 153, GL-3920 Qaqortoq, Greenland, Tel.: +299 642306, E-mail: savacon@greennet.gl

Sigurður H. Magnússon (IS) Icelandic Institute of Natural History, P.O.Box 5320, IS-125 Reykjavik, Iceland, Tel.: +354 5 900 500, E-mail: sigurdur@ni.is

Zigmantas Gudžinskas (LT) Institute of Botany, Žaliųjų Ežerų Str. 49, LT-08406 Vilnius, Lithuania, E-mail zigmantas.g@botanika.lt

Damian Chmura (PL) Institute of Nature Conservation, Polish Academy of Sciences, Mickiewicza 33, PL-31-120 Kraków, Poland, E-mail: chmura@iop.krakow.pl

Margareta Hansson (SE) Swedish University of Agricultural Sciences, Department of Ecology and Crop Production Science, P.O. Box 7070, SE-750 07 Uppsala, Sweden, E-mail: Margareta.Hansson@evp.slu.se

Links

Latvian database on plants – *Antriscus sylvestris*
Guide to Weeds in British Columbia
Nova Scotia Noxious Weeds - Wild Chervil *Anthriscus sylvestris* (L.) hoffm.
Article on wild Chervil – prepared by Sid Bosworth, University of Vermont
Icelandic Institute of Natural History, homepage on *A. sylvestris* (in Icelandic)
Weed alert from the government of British Columbia on *A. sylvestris*

References

Austrheim, G. (2002). Plant diversity patterns in semi-natural grasslands along an elevational gradient in southern Norway. Plant Ecology 161: 193–205.

Baskin, C.C., Milberg, P., Anderson, L. and Baskin, J.M. (2000). Deep complex morphophysiological dormancy in seeds of *Anthriscus sylvestris* (Apiaceae). Flora 195: 245–251.

Bele, B. and Nilsen, S. (2009). Slått av næringsrik veikant - effekter av ulike skjøtselstiltak på Fosen, Sør-Trøndelag. Sluttrapport. Bioforsk Rapport 4 (171), 36 pp.

Berge, G. and Hestmark, G. (1997). Composition of seed banks of roadsides, stream verges and agricultural fields in southern Norway. Annales Botanici Fennici 34: 77–90.

Clapman, A.R., Tutin, T.G. and Moore, D.M. (1987). Flora of the British Isles. Cambridge University Press. 3rd ed. 688 pp.

Carlson, M. L. and Shephard, M. (2007). Is the spread of non-native plants in Alaska accelerating? In: Meeting the challenge: invasive plants in Pacific Northwest ecosystems, Portland, OR (Harrington, T. B., and S. H. Reichard, tech. eds.). U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, En. Tech. Rep. PNW-GTR-694.: 111-127.

Crofts, A. and Jefferson, R.G. (eds) (1999). The Lowland grassland management handbook 2nd ed. Chapter 7, English Nature, Peterborough.

Darbyshire, S.J., Hoeg, R. and Haverkort J. (1999). The biology of Canadian weeds. 111. *Anthriscus sylvestris* (L.) Hoffm. Can. J. Plant Sci. 79: 671–682.

Davidsson, I. (1967). The immigration and naturalization of flowering plants in Iceland since 1900. In: Greinar IV.3. Vísindafélag Íslendinga (Societas Scientiarum Islandica). Leiftur, Reykjavík, pp 1–37.

Einarsson, E. (1997). Aðfluttar plöntutegundir á Íslandi. In: Nýgræðingar í flórunni. Ráðstefna Félags garðyrkjumanna 21. og 22. febrúar 1997. Reykjavik, pp 11–15 (In Icelandic).

Ellenberg, H.E. (1979). Zeigerwerte der Gefässpflanze Mitteleuropas. Scripta Geobotanica. 9. 97 pp.

Eriksson, A. and Eriksson, O. (1997). Seedling recruitment in semi-natural pastures: the effects of disturbance, seed size, phenology and seed bank. Nordic Journal of Botany 17: 469–482.

Evans, J.R., Nugent, J.J. and Meisel, J.K. (2003). Invasive plant species, inventory and management. Plan for the Hanford Reach National Monument. The Nature Conservancy, Washington Field Office. 198 pp.

Fischer, S.F., Poschlod, P., Beinlich, B. (1996). Experimental studies on the dispersal of plants and animals on sheep in calcareous grasslands. Journal of Applied Ecology 33: 1206–1222.

Godefroid, S. and Koedam, N. (2003). Identifying indicator plant species of habitat quality and invasibility as a guide for peri-urban forest management. Biodiversity and Conservation 12: 1699–1713.

Grime, J.P., Hodgson, J.G. and Hunt, R. (1988). Comparative plant ecology: a functional approach to common British species. London: Unwin Hyman. 742 pp.

Hansson, M.L. (1994). Response of *Anthriscus sylvestris* (L) Hoffm. to defoliation and different nitrogen supply levels. Swedish Journal of Agricultural Research 24: 21–29.

Hansson, M.L. and Göransson, A. (1993). Growth and biomass partitioning of *Anthriscus sylvestris* (L) Hoffm. and *Festuca ovina* (L) at different relative addition rates of nitrogen. Plant and Soil 156: 187–190.
Hansson, M.L. and Persson, T.S. 1994. *Anthriscus sylvestris* - a growing conservation problem. Annales Botanici Fennici 31: 205–213.
Hellström, K., Huhta, A., Rautio, P., Tuomi, J., Oksanen, J. and Laine, K. (2003). Use of sheep grazing in the restoration of semi-natural meadows in northern Finland. Applied Vegetation Science 6: 45–52.
Hovstad, K.A. and Ohlson, M. (2009). Conspecific versus heterospecific litter effects on seedling establishment. Plant Ecology 204: 33–42.
Hultén, E. (1971). Atlas of the distribution of vascular plants in North West Europe. 2nd ed. Generalstabens litografiska anstalts förlag, Stockholm (in Swedish with English summary).
Hultén, E. and Fries, M. (1986). Atlas of north European vascular plants north of the tropic of cancer. Vol. 2: map 1388, Koeltz Scientific Books, Königstein. p. 694.
Ikeda, R., Nagao, T., Okabe, H., Nakano, Y., Matsunaga, H., Katano, M. and Mori, M. (1998). Antiproliferative constituents in umbelliferae plants. III. Constituents in the root and the ground part of *Anthriscus sylvestris* Hoffm. Chemical & pharmaceutical bulletin 46: 871–874.
Jakobsson, A. and Eriksson, O. (2000). A comparative study of seed number, seed size, seedling size and recruitment in grassland plants. Oikos 88: 494–502.
Jensen, C. (2004). The vegetation history of a coastal stone-age and iron-age settlement at 70° N, Norway. Vegetation History and Archaeobotany 13: 269–284.
Jeong, G.S., Kwon, O.K., Park, B.Y., Oh, S.R., Ahn, K.S., Chang, M.J., Oh, W.K., Kim, J.C., Min, B.S., Kim, Y.C., Lee, H.K. (2007). Lignans and Coumarins from the Roots of *Anthriscus sylvestris* and Their Increase of Caspase-3 Activity in HL-60 Cells Biological & Pharmaceutical Bulletin 30: 1340–1343.
Jóhansen, J. (2000). Føroysk flora. Føroya Skúlabókagrunnur, Tórshavn. 484 pp.
Kiviniemi, K. and Telenius, A. (1998). Experiments on adhesive dispersal by wood mouse: seed shadows and dispersal distances of 13 plant species from cultivated areas in southern Sweden. Ecography 21: 108–116.
Kristinsson, H. (1997). Uppruni og framvinda íslenzku flórunnar. In: Nýgræðingar í flórunni. Ráðstefna Félags garðyrkjumanna 21. og 22. febrúar 1997. Reykjavik. pp 6–9 (In Icelandic).
Magnússon, B., Magnússon, S.H. and Sigurðsson B.D. (2004). Plant succession in areas colonized by the introduced Nootka lupin in Iceland. In: van Santen, E. and Hill, G.D. (eds). Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand. pp 170–177.
Magnússon, S.H., Björnsson, I. and Guðleifsson, B.E. (2006). Skógarkerfill – ágeng jurtategund í íslenskri náttúru. Fræðaþing landbúnaðarins 2006: 410–415 (In Icelandic).
Marshall, E.J.P. (1989). Distribution patterns of plants associated with arable field edges. Journal of Applied Ecology 26: 247–257.
Meijden, van der R.. 2006. Heukels' Flora van Nederland, ed. 23. Groningen.
Mouissie, A.M., Lengkeek, W., and van Diggelen, R. (2005). Estimating adhesive seed-dispersal distances: field experiments and correlated random walks. Functional Ecology 19: 478-486.
Oberdorfer, E. (2001): Pflanzensoziologische Exkursionsflora. 8. Aufl. - Stuttgart (Ulmer).
Óskarsson, I. (1932). Some observations of the vegetation of Eyjafjörður and Akureyri. Vísindafélag Íslendinga. Rit 13: 1–47.
Parr, T.W. and Way, J.M. (1988). Management of roadside vegetation: the long-term effects of cutting. Journal of Applied Ecology 25: 1073–1087.
Pysek, P. and Pysek, A. (1995). Invasion by *Heracleum mantegazzianum* in different habitats in the Czech Republic. Journal of Vegetation Science 6: 711–718.
Rosef, L. and Bele, B. (2007). Hundekjeks - en problemart i kulturlandskapet. Naturen 2: 69–75.
Rew, L.J., Froud-Williams, R.J. and Boatman, N.D. (1996). Dispersal of *Bromus sterilis* and Anthriscus sylvestris seed within arable field margins. Agriculture, Ecosystems and Environment 58: 107–114.
Roberts, H.A. (1979). Periodicity of seedling emergence and seed survival in some umbelliferae. Journal of Applied Ecology 16: 195–201.
Rutkowski, L. 2004. Klucz do oznaczania roslin naczyniowych Polski nizowej. PWN, Warszawa. 816 pp.
Silvertown, J. and Tremlett, M. (1989). Interactive effects of disturbance and shade upon colonization of grassland: an experiment with *Anthriscus sylvestris, Conium maculatum , Daucus carota* and *Heracleum sphodylium*. Functional Ecology 3: 229–235.
Smart, S.M., Bunce, R.G.H., Marrs, R., Le Duc, M., Firbank, L.G., Maskell, L.C., Scott, W.A., Thompson, K., Walker, K.J. (2005). Large-scale changes in the abundance of common higher plant species across Britain between 1978, 1990 and 1998 as a consequence of human activity: tests of hypothesised trait representation. Biological Conservation 124: 355–371.

Spalik, K. and Woodell, S.R.J. (1994). Regulation of pollen production in *Anthriscus sylvestris*, an andromonoecious species. International Journal of Plant Sciences 155: 750-754.
Suh SJ, Kim JR, Jin UH, Choi HS, Chang YC, Lee YC, Kim SH, Lee IS, Moon TC, Chang HW, Kim CH (2009). Deoxypodophyllotoxin, flavolignan, from *Anthriscus sylvestris* Hoffm. inhibits migration and MMP-9 via MAPK pathways in TNF-alpha-induced HASMC. Vascular pharmacology 51: 13-20.
Thompson, K. J., Bakker J.P. and Bekker, R.M. (1997). The soil seed bank of northwest Europe: methodology, density and longevity. Cambridge University Press, Cambridge. 276 pp.
Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.A., Walters, S.M. and Webb, D.A. (1968). Flora Europea, Cambridge University Press. 455 pp., with additional maps.
Walker, K.J., Preston, C.D. and Boon, R. (2009). Fifty years of change in an area of intensive agriculture: plant trait responses to habitat modification and conservation, Bedfordshire, England. Biodiversity and Conservation 18: 3597-3613.
van Mierlo, A. and van Groenendael, J. (1991). A population dynamic approach to the control of *Anthriscus sylvestris* (L.) Hoffm. Journal of Applied Ecology 28: 128–139.
Webb, C.J., Sykes, W.R., Garnock-Jones, P.J., Given, D.R. and Brownsey, P. (1989). Checklist of dicotyledons, gymnosperms, and pteridophytes naturalised in New Zealand: additional records and corrections. New Zealand Journal of Botany 27: 139–162.
Wittig, R. (2004). The origin and development of the urban flora of Central Europe. Urban Ecosystems 7: 323-329.
Yong, Y., Shin, S.Y., Lee, Y.H. and Lim, Y. (2009). Antitumor activity of deoxypodophyllotoxin isolated from *Anthriscus sylvestris*: Induction of G2/M cell cycle arrest and caspase-dependent apoptosis. Bioorganic & medicinal chemistry letters 19: 4367-71.
Zarzycki, K., Trzcinska-Tacik, H., Rózanski, W., Szelag, Z., Wolek, J. and Korzeniak, U. (2002). Ecological indicator values of vascular plant of Poland. W. Szafer Institute of Botany, PAN, Kraków. pp 183.
Флора Восточной Европы, том XI (2004). Товарищество научн. изданий КМК, М.-СПб. 536 pp.

Date of creation/modification of this species fact sheet: 22-08-2007 / 27-01-2011.