

The grass genus *Aira* in Finland

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Three species of the genus *Aira*, viz. *A. praecox*, *A. caryophyllea* and *A. elegantissima*, have been found in Finland. The geographical range of each species is outlined. Whereas *A. praecox* has been known since 1912 in the Åland Islands, *A. caryophyllea* was found as a new species for Finland on the mainland of Kumlinge, Åland Islands, in 2008. *A. elegantissima* has been found as an introduced plant (weed or sown as an ornamental grass) in five localities in different parts of southern Finland between 1868 and 1985. All seven known localities with their separate stands of *A. praecox* were studied in detail in the Åland Islands in 2009. Of these localities, one was found in 2005 and two in 2009. The accompanying vascular plants were noted and their calcium dependence was assessed according to previous studies. The accompanying species comprised 113 field layer taxa, most of them common in the Åland Islands. The majority of the accompanying taxa belong to the calcium-neutral group. However, 27 calciphilic species were found, about 24 % of all the accompanying taxa. The amount of calciphilic species was compared to previous studies in Åland. Soil samples, chiefly fine sand, from all but one of the seven localities were analysed for pH, exchangeable Ca^{2+} , Mg^{2+} , K^{+} and PO_4^{-} . Further, NO_3^{-} and NH_4^{+} were determined and soluble nitrogen was calculated from values on NO_3^{-} and NH_4^{+} . The pH values of the soil samples were mostly rather low for the Åland Islands. The concentrations of exchangeable Ca^{2+} , K^{+} , Mg^{2+} , PO_4^{-} and soluble N were also mostly rather low. *A. praecox* often grows by bathing beaches, and thus a possible way of dispersal is by bathers and campers, e.g. with blankets. The locality in Kumlinge seems to be on ballast brought ashore from a sailing ship long ago. Although *A. praecox* has disappeared in some stands in localities 1 and 2 in Eckerö, much larger stands and three additional localities are known today. However, *A. caryophyllea* may be endangered, as it is hitherto known in one locality only and the number of specimens was about 50 in 2009.

Introduction

According to Tutin (1980) and Mabberley (1987), the grass genus *Aira* L. comprises nine annual species, of which eight are distributed in temperate areas of Europe and one is occurring in African mountains and Mauritius. Of these, three species have been found in Finland, viz. *A. praecox* L., *A. caryophyllea* L. and *A. elegantissima* Schur

(syn. *Aira elegans* Willd. & Gaud., *A. capillaris* Host). Whereas *A. praecox* has been known from a few localities in the Åland Islands since the early 20th century, *A. caryophyllea* was found as a new species for Finland in 2008. *A. elegantissima* has been found five times as a casual weed.

As a native plant, *Aira praecox* is restricted to western and central Europe (Hultén & Fries

1986). It has been found as an introduced species in Macaronesia, in Caucasus and western Asia, eastern and western North America, in Chile, Australia, New Zealand and in the Juan Fernandez Islands and the Falkland Islands (Hultén & Fries 1986, Clayton et al. 2010c). The distribution of *A. praecox* is south-western in the Nordic countries. It is quite common throughout Denmark, fairly common along the coasts of southern Sweden and southern and western Norway north to mid Uppland in Sweden and Møre og Romsdal in Norway (Hultén 1971, Pedersen 1974, Hansen 1981, Rydberg & Wanntorp 2001, Lid 2005, Schou et al. 2009, Jonsell 2010). *Aira praecox* has not been found in Estonia, but it occurs along the Baltic coasts from mid Latvia to Germany (Hultén 1971, Hultén & Fries 1986). In Finland, *Aira praecox* occurs only in the Åland Islands (Hultén 1971, Hægström 2008, 2010). It was protected and also declared as a species with strict protection according to the nature conservancy law of the Åland Islands in 1998 (ÅFS 113/98, Hægström & Koistinen 1999).

According to a short note by Luther (1951), *A. praecox* was found as an anthropochorous plant at N, Tvärminne, SW mainland of Finland. However, Luther's report was on the sedge *Carex praecox* Schreb., but for some reason the wrong genus was printed in the short note. The error was later corrected (Corrigenda 1953).

The distribution of *Aira caryophyllea* resembles that of *A. praecox*. However, it is distributed further south and southeast with its area covering most of Southern Europe and a part of north-western Africa (Hultén & Fries 1986, Frey 1997, Clayton et al. 2010a). In its northern and eastern distribution area the occurrences may be of a weedy character. It has been found throughout Denmark and is rather rare in southern Sweden north to Uppland (Hultén 1971, Pedersen 1974, Hansen 1981, Rydberg & Wanntorp 2001, Schou et al. 2009, Jonsell 2010). It has been found in a few localities in southern Norway, probably introduced with lawn seed (Lid 2005). *Aira caryophyllea* has not been found in Estonia, and in one place only in Latvia. It occurs in places along the Baltic coasts of Lithuania, the Kaliningrad area of Russia, Poland and Germany (Hultén 1971, Hultén & Fries 1986). *Aira caryophyllea* occurs further as an introduced plant in North Ameri-

ca, in Chile, South India, New Zealand, Australia and in some remote islands: Juan Fernandez, Falkland Islands and Tristan da Cunha (Hultén & Fries 1986). *Aira caryophyllea* is cultivated as an ornamental plant (e.g. Dave's Garden 2012, Gardening.eu 2012a).

Aira elegantissima is native of Central and Southern Europe, Crimea in Ukraine, and North Africa. It occurs worldwide as an introduced weed, e.g. in Macaronesia, mid Asia of Russia, Caucasus, western Asia, Australia, New Zealand, USA, Brazil and southern South America (Tutin 1980, Clayton et al. 2010b). It has been found as an occasional weed in Denmark and Sweden (Gwannon 2012).

Aira elegantissima is cultivated as an ornamental grass and seeds are sold by gardening firms (e.g. Chiltern seeds 2012, Gardening.eu 2012b)).

Aira praecox in the Ålands Islands

Aira praecox was first collected on a rock outcrop at Käringsund in the village of Storby, municipality of Eckerö, westernmost Åland Islands, by Väinö Heikinheimo in 1912 [(H; for herbarium acronyms, see Index Herbariorum (2011).)]. Thereafter, it was collected frequently in several places in Storby between 1919 and 2010. Another locality was discovered at the sandy beach of the former seaside resort of Möckelö, municipality of Jomala, in 1949 by Maida and Alvar Palmgren (H; Palmgren 1951). *A. praecox* was also found in the sandy area of Degersand in the village of Torp, south-western Eckerö by the author CAH in 1983 (H).

One voucher specimen labelled Åland Islands, Brändö, stony seashore, 5 July, 1932, K. Saastamoinen, is preserved in H. Dr. Gunnar Marklund, curator of the vascular plant collections of the Museum, doubted the origin of this voucher in 1954. The habitat is not typical of the species.

Aira praecox in Åland today

During investigations of the vascular plants for the flora of the Åland Islands (Hægström & Hægström 2008, 2010), the authors CAH and



Fig. 1. Locality 1, stand 1a. A small stand of *Aira praecox* grew on the open, trampled, stony rock meadow in the foreground. Åland Islands, Eckerö, Storby, Käringsund. Photo: C.-A. Hæggström, June 18, 2009.

EH found *Aira praecox* in three hitherto unknown localities, namely in Kumlinge in 2005, and in Sund and Vårdö in 2009. Further, we visited Möckelö in July 2008 where *A. praecox* grew abundantly at the sandy beach.

To investigate the actual status of *A. praecox* in the Ålands Islands, we visited all known localities in 2009. The spring and early summer of 2009 were quite favourable for *A. praecox* as the spring was wet. Thus the specimens were often 15 cm tall or more. The accompanying vascular plants in each locality and their separate stands were noted [(Table 1; the nomenclature of the vascular plants is according to Hämet-Ahti et al. (1998).)] *Aira praecox* was found in seven localities, of which some comprised a few separate stands.

Locality 1. Eckerö, Storby, Käringsund

Aira praecox was known to grow in several separate stands in the Käringsund area. Three small stands were found on June 18, 2009.

Stand 1a) Käringsund, on an open, trampled, stony rock meadow about 200 m SW of the Museum for Hunting and Fishing with the open sea about 100 m to the west (Fig. 1; Uniform Coordinate System (UCS): Grid 27 °E 670338:308724).

The vegetation was low and lax. Approximately 200 specimens of *Aira praecox* grew on a triangular area of about 3 m × 6 m. A few specimens grew a few metres towards the NE. The accompanying field layer flora included 10 taxa, among them *Calluna vulgaris*, *Festuca ovina*, *Galium verum*, *Pilosella officinarum* coll. and *Rumex acetosella* subsp. *acetosella*.

Another small stand of *Aira praecox* growing on a footpath near the above mentioned stands was discovered on June 13, 2002 (Carl-Adam Hæggström 8566 & Eeva Hæggström, H). This stand was, however, destroyed two years later as soil was dumped on it.

Stand 1b) Käringsund, in a lax tree stand next to a pine and a juniper about 5 m W of the road and 60 m SSE of the restaurant of the Käringsund tourist village (UCS: 670405:308758). The seashore is about 40 m to the west. A dense stand of *Aira praecox* was more or less covering a sandy spot of 2.5 m × 0.6–0.7 m. The accompanying field layer flora included 8 taxa, among them *Arabidopsis thaliana*, *Festuca ovina* and *Galium verum*. A dense stand of *Epilobium angustifolium* surrounded the sandy spot with *Aira*.

Stand 1c) Käringsund, an open, dry, sandy meadow between small rock outcrops a few metres from the seashore about 270 m S of the res-

restaurant of the Käringsund tourist village (UCS: 670383:308762). This stand of *Aira praecox* has diminished considerably since the 1960s. The main part of the stand has disappeared as it became overgrown by young pines. In 2009, some tens of small *Aira* tufts grew on about 1 m². The accompanying field layer flora included 12 taxa, among them *Cerastium semidecandrum*, *Festuca ovina*, *F. rubra*, *Honckenya peploides*, *Myosotis stricta* (fairly abundant), *Poa annua* (very abundant), *Potentilla argentea*, *Rumex acetosella* subsp. *acetosella* and *Scleranthus annuus* subsp. *polycarpus*.

Ranta (1989) investigated a stand of *Aira praecox* about 50 m S of our stand 1c. This area is now overgrown with tall vegetation.

During a botanical excursion in June 1969, Holger Törnroth, who had a very good knowledge of the vascular plant flora of Eckerö (cf. Hægström 2009), showed us two stands of *Aira praecox* in the Käringsund area. One of them was a sandy spot by the small sauna just west of the restaurant (UCS: 670409:308747), the other one a sandy roadside north of the restaurant building (UCS: 670439:308750). *Aira* still grew in these two places on June 17, 1986, and in 1989–1990 (Ranta 1989, 1991), but we were not able to find *Aira* there in 2009. No *Aira praecox* was seen on the sandy ground around the sauna, probably because there was a new, much bigger sauna building just on the *Aira* spot. The roadside was overgrown with forest mosses.

Locality 2. Eckerö, Storby, the vicinity of the 19th century Custom's building

Aira praecox has been collected numerous times in the area next to the 19th century Custom's building. No observations have been made on the W shore of Krogarviken bay since the 1950s. Ranta (1995) investigated an area about 150 m SSE of the Custom's building. Several small stands grew here in a lax pine wood (UCS: 67019:30875). The wood has grown taller and denser since. We did not observe *Aira* there in 2009.

Stand 2a) A few dozen specimens of *Aira* were found growing in the sand and gravel together with *Herniaria glabra* on the cobbled yard of the Custom's building (UCS: 670207:308747)

on July 31, 2010 (Carl-Adam Hægström 9817 & Eeva Hægström, H).

Several separate stands of *Aira praecox* occurred between the Custom's building, the sandy beach of Sandviken and the boat houses at Svartflytta on June 15, 2009 (stands 2b–2f).

Stand 2b) On the sandy road side between Sandviken's music pavilion and the hotel (UCS: 670192:308753). A few tufts of *Aira praecox* grew approximately in the same spot where it was found already on June 15, 1969 (Carl-Adam Hægström s.n. (H)).

Stand 2c) On the sandy beach of Sandviken, above the harrowed area of the beach (UCS: 670188–670191:308747–308753). Three separate stands of *Aira praecox* grew here. The easternmost was a fairly dense stand on an area of approx. 15 m², the mid stand covered an area of 10 × 10 m and the westernmost stand covered about 10 m². Wilted *Aira* from the previous year was seen in this area on May 15, 2006 (Carl-Adam Hægström 9055 & Eeva Hægström, H). Due to drought, no fresh plants were seen then. The accompanying field layer flora included 27 taxa, among them *Achillea millefolium*, *Arabidopsis thaliana*, *Avenula pratensis*, *Calamagrostis epigejos* (fairly abundant), *Cerastium semidecandrum*, *Erophila verna*, *Galium verum*, *Phragmites australis* (abundant), *Saxifraga granulata* and *Veronica arvensis*. A few small pines grew on the uppermost part of the beach.

Stand 2d) At the path from the beach to the music pavilion area and next to a hut above the beach (UCS: 670190:308740). *Aira praecox* grew here on hundreds of square metres forming several separate stands of various sizes. The accompanying field layer flora included 14 taxa, among them *Bromus hordeaceus*, *Festuca arundinacea*, *F. ovina*, *F. rubra*, *Myosotis ramosissima*, *Plantago lanceolata*, *Poa annua*, *P. pratensis*, *Trifolium dubium* and *Veronica spicata*.

Stand 2e) Under the pines about 20–30 m NW of the music pavilion (UCS: 670194:308742). *Aira praecox* grew, partly in very dense stands, on an area of approx. 100 m². The accompanying field layer flora included 17 taxa, among them *Allium oleraceum*, *Arabidopsis thaliana*, *Bromus hordeaceus*, *Cerastium semidecandrum*, *Festuca ovina*, *F. rubra*, *Galium verum*, *Myosotis ramosissima*, *M. stricta*, *Plantago lanceolata*, *Poten-*



Fig. 2. *Aira praecox* grows on sandy meadows between flat rock outcrops at the eastern border of the locality 3, stand 3 a. Åland Islands, Eckerö, Torp, Degersand. Photo E. Hægström, June 15, 2009.

tilla argentea, *Saxifraga granulata*, *Scleranthus annuus* subsp. *polycarpus* and *Spergula morisonii*. Ranta (1989) investigated the same area.

Stand 2f) Svartflytta, on the gravel road area at the boat houses and on sandy rock meadows in an triangular area (UCS: NW corner – 670191:308721; S corner – 670184:308720; E corner – 670191:308732). About ten separate stands of *Aira praecox* grew on at least 150–200 m². The accompanying field layer flora included 36 taxa, among them *Achillea millefolium*, *Allium schoenoprasum*, *Anthoxanthum odoratum*, *Bromus hordeaceus*, *Cerastium semidecandrum*, *Festuca ovina* (abundant), *F. rubra*, *Filago arvensis*, *Galium verum*, *Herniaria glabra*, *Lychnis viscaria*, *Myosotis stricta*, *Pilosella officinarum* coll., *Plantago lanceolata*, *Poa annua*, *Potentilla argentea*, *Rumex acetosella* subsp. *acetosella*, *Saxifraga granulata*, *S. tridactylites*, *Scleranthus annuus* subsp. *polycarpus*, *Sedum acre*, *S. album*, *Veronica spicata* and *V. verna*. Scattered small pines grew among the rocky areas.

Locality 3. Eckerö: Torp, Degersand

The Degersand area comprises an approx. 300 m long sandy area exposed to the south between rock outcrops. A sand beach with a low primary dune ridge runs along the sea shore. The areas nearer the shore are flat, partly covered with pines and other trees and partly overgrown with a dense *Carex arenaria* meadow. A restaurant, a caravan camping area, gravel roads and a small parking place cover a considerable part of Degersand. There is a quite high, partly white dune area about 200–250 m from the sea shore.

Aira praecox grew almost in the whole lower area of Degersand above the primary dune on June 15, 2009.

Stand 3a) Sandy meadows between flat rock outcrops at the eastern border (UCS: 669448:308972). *Aira praecox* was first found here on June 4, 1983 (Carl-Adam Hægström 4013 (H)). Several small stands of *Aira praecox* grew on approx. 8–10 m² (Fig. 2). The accompanying field

Fig. 3. Dense reddish brown and green carpets of *Aira praecox* in locality 3, stand 3e. Åland Islands, Eck-erö, Torp, Degersand. Photo: E. Hægström, June 15, 2009.



layer flora included 29 taxa, among them *Allium schoenoprasum*, *Arabidopsis thaliana*, *Bromus hordeaceus*, *Calluna vulgaris*, *Erophila verna*, *Festuca ovina*, *F. rubra*, *Galium verum*, *Myosotis ramosissima*, *M. stricta*, *Pilosella officinarum* coll., *Plantago lanceolata*, *Poa annua*, *Potentilla argentea*, *Sagina nodosa*, *Scleranthus annuus* subsp. *polycarpus*, *Sedum acre*, *S. album* and *Veronica arvensis*. The tiny pteridophyte *Botrychium simplex*, which was found here in 1989, was not seen. Ranta (1989) investigated this area.

Stand 3b) Eastern part of Degersand, on a foot path and in car tracks near the hut, at the edge of a *Carex arenaria* meadow about 50 m from the beach (UCS: 669451:308968). *Aira praecox* grew here in two small stands, one with some tens of tufts on an area of 1 m × 2 m; the other only a few tufts on an area of 1 m × 1 m. The accompanying field layer flora included 12 taxa, among them *Carex arenaria* (abundant), *Cerastium semidecandrum*, *Erophila verna*, *Festuca ovina*, *Myosotis ramosissima*, *Rumex acetosella* subsp. *acetosella* and *Tanacetum vulgare*.

Stand 3c) Two small stands of *Aira praecox* with a few hundred tufts each grew on 2–3 m × 8 m large sandy areas with sparse vegeta-

tion in the mid part of the plain shore meadow between pines, about ca 120 m SSE of the restaurant (UCS: 669453:308956). The accompanying field layer flora included 13 taxa, among them *Carex arenaria*, *Cerastium glutinosum*, *C. semidecandrum*, *Erophila verna*, *Festuca ovina*, *Galium verum*, *Leymus arenarius* (a few weak shoots), *Potentilla argentea* and *Veronica verna*.

Stand 3d) *Aira praecox* grew on the rapakivi macadam of the caravan park on more than 10 m² (UCS: 669453:308954). Only four other field layer species were seen here, namely *Carex arenaria*, *Cerastium semidecandrum* (fairly abundant), *Festuca ovina* and *Senecio sylvaticus*.

Stand 3e) *Aira praecox* grew on an area of perhaps half a hectare in the westernmost part of the sandy beach area towards the rocks in W (UCS: 66945:30895–66944:30894). Dense, pure stands grew especially between pines and spruces at the western border (Fig. 3). The accompanying field layer flora included 6 taxa, among them *Festuca rubra*, *Filago arvensis* and *Spergula morisonii*.

Stand 3f) At the W edge of the eastern car park (UCS: 669459:308964). A small stand of *Aira praecox* grew in the sand and gravel.



Fig. 4. *Aira praecox* covers the northern edge of the sand beach at locality 4, stand 4 a. Åland Islands, Jomala, Möckelö. Photo: E. Hæggström, June 13, 2009.

Locality 4. Jomala, at the sand beach of the former seaside resort of Möckelö

Aira praecox was found about 100 m NW of the sand beach in 1949 by Maida and Alvar Palmgren (Palmgren 1951). A small stand grew on dry gravelly soil in a pine stand near the seashore. Ranta (1991) investigated this area in 1990 and found *Aira praecox* on the same place (UCS: 668544:310615). When we investigated Möckelö on July 16, 2008, we found a large stand at the northern edge of the sand beach exposed to the west. However, when investigating the area where Palmgren and Ranta saw the species, we did not observe it.

On July 1, 2012, we visited the area again. The spot where Palmgren and Ranta had seen the species was quite overgrown and the soil was covered with a thick layer of pine needle litter. No *Aira* could be found. However, we found a small stand of *Aira* about 50 metres to the NE (stand 4 d).

The sand beach area was investigated more thoroughly on June 2 and 13, 2009.

Stand 4a) *Aira praecox* occurred on an area of at least 400 m² below spruces, pines and birches (*Picea abies*, *Pinus sylvestris*, *Betula pubescens*)

at the northern edge of the sand beach (Fig. 4) and northwards to the road track north of a small building leading towards the west (UCS: 668541–668547:310628–310633). Fairly dense stands grew on the rapakivi granite macadam of the road and some plants grew along the low concrete wall on the sea shore side about 30–40 m south of the building. The beach is overgrown with a dense reed bed (*Phragmites australis*) below the main stand of *Aira*. The orchid *Dactylorhiza incarnata* subsp. *incarnata* grew on the landward edge of the reed bed. The accompanying field layer flora included 20 taxa, among them *Achillea millefolium*, *Bromus hordeaceus* (abundant in some spots), *Carex hirta*, *Cerastium semidecandrum*, *Erophila verna*, *Festuca ovina* (abundant in some spots), *F. rubra*, *Myosotis stricta*, *Poa annua*, *Potentilla argentea*, *Rumex acetosella* subsp. *acetosella*, *Scleranthus annuus* subsp. *polycarpus* and *Veronica officinalis*.

Stand 4b) A small stand of *Aira praecox* grew together with *Veronica arvensis* on a few square metres by the northern pavilion building (UCS: 668549:310628).

Stand 4 c) On the E side of the main road, S of the fence, about 60–70 m SE of the entrance be-

tween the two buildings (UCS: 668542:310635). A few small tufts of *Aira praecox* grew at the road verge and dense stands on a sandy soil area of about 4 m² located S of a tall pine. The accompanying field layer flora included 13 taxa, among them *Achillea millefolium*, *Arabidopsis thaliana* (fairly abundant), *Calamagrostis epigejos* (fairly abundant), *Cerastium semidecandrum* (fairly abundant), *Erophila verna*, *Festuca ovina*, *Pilosella officinarum* coll., *Plantago lanceolata* and *Rumex acetosella* subsp. *acetosella*.

Stand 4 d) Between the house and the western sea shore about 140 m W of the road (UCS: 668548:310617). Some ten tufts of *Aira praecox* grew on a 1 m² large spot where the soil was worn with sandy patches on July 1, 2012. The surrounding is covered by a pine wood with abundant *Deschampsia flexuosa* and *Vaccinium myrtillus*. The accompanying field layer flora was poor in species and it included 6 taxa, among them *Anthoxanthum odoratum*, *Cerastium semidecandrum*, *Deschampsia flexuosa*, *Festuca ovina* and *Poa annua*.

Locality 5. Sund, Prästö, SW sea shore (UCS: 66965:31262)

Aira praecox was found above the approx. 80 m long sand beach towards the south next to the main road from Bomarsund to Prästö ferry har-

bour on June 2, 2009. Several small stands of *Aira* grew on sandy soil among scattered pines and a black alder (*Alnus glutinosa*) on an area of approx. 15 m × 50 m; it occurred very abundantly in one spot of more than 100 m². The accompanying field layer flora included 13 taxa, among them *Achillea millefolium*, *Carex hirta*, *Cerastium semidecandrum*, *Erophila verna*, *Festuca ovina* (abundant), *F. rubra*, *Pilosella officinarum* coll., *Plantago lanceolata*, *Poa annua*, *P. pratensis*, *Rumex acetosella* subsp. *acetosella*, *Saxifraga granulata* and *Tanacetum vulgare*.

Locality 6. Vårdö, Mickelsö, Horsholm, Sandviken (UCS: 669501–669505:312756)

Aira praecox was found on the about 100 m long sand beach of the Sandviken bay on September 20, 2009. The bay is exposed towards the W. It is located about 2 km SE of the Prästö beach. A dry pine heath forest grows on the inland side. Some dozens of tufts of *Aira* grew in the northern and mid parts of the beach and most of the tufts were found at the forest edge with a few specimens in the upper part of the open sand beach. Besides pines, a few spruces and birches (*Betula pendula*) grew at the forest edge. The accompanying field layer flora included 9 taxa, among them *Arabidopsis thaliana*, *Atriplex prostrata*, *Festuca arundinacea*, *Festuca ovina* and *Galeopsis bifida*.



Fig. 5. Kumlinge. *Aira praecox* on sandy meadows in locality 7. Åland Islands, Kumlinge, Prestgården, Kastören, Remmarina. Photo: R. Carlsson, June 11, 2009.

Locality 7. Kumlinge, Prestgården, Kastören, Remmarina, UCS: 669935:315386

Aira praecox was found in this place on May 27, 2005. It grew on the southern slope between the café and the boat houses of Remmarina (Remmarhamn). The place was visited again on July 29, 2008 and June 11, 2009. A dense stand of *Aira praecox* grew on an area of approx. 80 m² in a 12 m × 12 m large area between the rock outcrops (Fig. 5). The sandy soil is perhaps ballast soil transported to this place by sailing ships long ago. The accompanying vascular plant flora included 44 taxa, among them *Aira caryophyllea* (see below), *Achillea millefolium*, *Arabidopsis thaliana*, *Cerastium semidecandrum*, *Erophila verna*, *Festuca ovina* (fairly abundant), *F. rubra* (fairly abundant), *Galium verum*, *Geranium sanguineum*, *Hypochoeris radicata* (2 specimens), *Myosotis ramosissima*, *M. stricta* (abundant), *Phragmites australis* (some weak shoots), *Pilosella officinarum* coll., *Plantago lanceolata*, *Potentilla argentea*, *Rumex acetosella* subsp. *acetosella* vel subsp. *tenuifolius* (fairly abundant), *Tanacetum vulgare*, *Trifolium arvense* and *Veronica verna*.

Aira caryophyllea in Åland

When visiting the locality for *Aira praecox* in Kumlinge on July 29, 2008, we found a few specimens of *A. caryophyllea* growing in the dense *A. praecox* stand. The locality was visited again on June 11, 2009. About 50 specimens of *A. caryophyllea* were then seen (Fig. 6). No prior report of this species have been made from Finland.

Aira elegantissima in Finland

Aira elegantissima has been found five times in Finland. The first collection was made by J. P. Norrlin in a garden in Ta, Hollola, Hälvälä (UCS: 6765:3416) in August 1868 (H). — The plant was determined as *Aira elegans* Willd. & Gaud. by B. Federley in 1973.

The second collection was made in Ab, Åbo / Turku by N. Aschan where it grew on a street ... (the rest of the description of the locality on the label is unreadable) (UCS: 6713:3240) in August

1893 (H). — The plant was determined as *Agrostis pulchella* by the collector and to *Aira capillaris* var. *ambigua* by Harald Lindberg in 1910.

Next collection was made in Tb, Rautalampi by J. Hämäläinen in a dry meadow (UCS: 695:349) on July 14, 1895, (JYV). — The plant was collected as *Agrostis tenuis* and determined as cf. *Aira caryophyllea* by L. Hämet-Ahti in 1980. It was determined as *A. elegantissima* by the author CAH in 2010.

The fourth collection was made in N, Helsingfors / Helsinki (UCS: 6672–3:3382) by Bror Pettersson (H). He investigated a factory yard with a storage space for cork bark imported from Morocco on August 5, 1940 (Pettersson 1940, 1952). — The plant was determined as *Agrostis capillaris* by the collector and as *Aira elegantissima* Schur by Arto Kurtto in 1993.

The fifth and latest collection was collected by T. Lahtonen in a field in Ta, Tampere, Vehmainen (UCS: 68221:33361) on 23 September, 1985 (H). *A. elegantissima* was sown in the field together with other ornamental grass seeds (seed mixture no. 6640/Hortus) on 31 May, 1985.



Fig. 6. *Aira caryophyllea* on sandy meadows in locality 7. Åland Islands, Kumlinge, Prestgården, Kastören, Remmarina. Photo: R. Carlsson, June 11, 2009.

Accompanying species of *Aira praecox*

The Åland Islands are renowned for their rich vascular plant flora with many calciphilic species (e.g. Palmgren 1915; Eklund 1946, Hæggström 1983, Carlsson et al. 2008, Hæggström & Hæggström 2008, 2010). Eklund (1946) classified the vascular plants of the south-western archipelagos of Finland according to their calcium dependence. He used the following categories: strictly limestone-dependent (*kalkstet*), strongly calciphilic (*stark kalkhold*), moderately calciphilic (*kalkbegünstigt*), calcium-neutral (*kalkindifferent*), calcium avoiding (*kalkscheu*) and strongly acidophilic (*azidophil*). We used the same categories in this study (cf. also Carlsson et al. 2008).

As *Aira praecox* is typical of dry, sandy, acid and nutrient poor habitats, the majority of the accompanying 113 field layer plant taxa (Table 1) are common in the Åland Islands (Hæggström & Hæggström 2008, 2010). Only a few rare species were found, e.g. *Honckenya peploides* in stand 1c, *Herniaria glabra* and *Trifolium dubium* in stand 2d, *Carex arenaria* in stand 3b–d, and *Aira caryophyllea* and *Hypochoeris radicata* in locality 7.

The majority of the accompanying taxa belong to the calcium-neutral group. However, 27 calciphilic species were found. This amounts to 23.9 % of all the accompanying taxa. It is somewhat lower than the 28.5 % of calciphilic species found in shell gravel pits in Åland (Carlsson et al. 2008). The number of calciphilic species per locality or stand varied between 0 and 14 and the percentage of calciphiles of all taxa per locality or stand thus varied between 0 and 36.8. Of the different categories of calcium dependence, the strictly limestone-dependent species were only three, two lignoses (*Fraxinus excelsior*, *Hippophaë rhamnoides*) and one herb (*Saxifraga tri-dactylites*). The strongly calciphilic species were 13 and the moderately calciphilic species 11.

Most of the calciphilic species occurred in one or few localities only. Two species, *Cerasium semidecandrum* and *Erophila verna*, were fairly common.

The number of acidophilic taxa was low: only five calcium avoiding (including *Aira caryophyllea*) and four strongly acidophilic taxa were noted. Of them, only *Rumex acetosella* subsp. *acetosella* was common.

The psammophytes were few. Besides the both *Aira* species, only *Carex arenaria*, *Honckenya peploides* and *Leymus arenarius* belong to the more or less typical psammophytes in Åland.

The soil of the localities with *Aira praecox*

As *Aira praecox* is considered to be an oligotrophic and xerophilic species growing on infertile soil (e.g. Pedersen 1974, Ellenberg et al. 1992), we took 3–5 soil samples (approx. 0.5 l) from all the localities, but no. 6 (Vårdö, Mickelsö, Horsholm, Sandviken). The samples were taken from the uppermost part of the soil to a depth of 4–6 cm.

The analyses were performed at the laboratory of the Environmental and Health Protection Agency of the Åland Islands. From each sample a subsample of 25 ml of dried and ground soil was mixed with 62.5 ml of ion-exchanged water and pH was measured after 17 hours. Further, subsamples of 15 ml dried and ground soil were extracted for one hour in a solution of ammonium acetate (pH 4.65) and analysed for exchangeable Ca^{++} , Mg^{++} , K^{+} and PO_4^{-} . NO_3^{-} was determined on moist soil potentiometrically, and NH_4^{+} was determined with atomic absorption spectrometry. Soluble nitrogen was calculated from values on NO_3^{-} and NH_4^{+} .

The soil was chiefly fine sand (Table 2). At Käringsund (stand 1a), *A. praecox* grew on a dry rock meadow. The humus content mixed with the sand was higher in the localities and stands with trees. At Storby Svartflytta (stand 2f), the soil was partly road gravel. At Degersand, stand 3f grew on rapakivi granite gravel and sand in a car park. Two stands (Degersand 3c, part of Möckelö 4a) grew on rapakivi granite macadam.

The pH values of the soil samples were mostly rather low for the Åland Islands (Table 2). The concentrations of exchangeable Ca^{2+} , K^{+} , Mg^{2+} , PO_4^{-} and soluble N were also mostly rather low (Table 2).

Discussion

According to the Central European vegetation classification (Ellenberg 1988, Conert 2000), *Aira*

Table 1 continued

<i>Tripleurospermum maritimum</i>																			+	1
<i>Vaccinium myrtillus</i>	Ca ⁻	+																		1
<i>Veronica arvensis</i>				+	+	+														3
<i>Veronica chamaedrys</i>							+													1
<i>Veronica officinalis</i>	Ca ⁻												+							1
<i>Veronica spicata</i>	Ca ²⁺						+	+												2
<i>Veronica verna</i>	Ca ⁺						+			+										3
<i>Vicia cracca</i>								+												1
<i>Vicia hirsuta</i>	Ca ²⁺						+						+							3
<i>Vicia tetrasperma</i>																				1
<i>Viola arvensis</i>																				1
<i>Viola tricolor</i>								+												1
Trees																				
<i>Alnus glutinosa</i>																			+	1
<i>Betula pubescens</i>														+					+	2
<i>Picea abies</i>														+					+	2
<i>Pinus sylvestris</i>				+	+	+						+	+	+	+	+	+	+	+	9
Total number of taxa: 117	11	9	13	29	15	19	38	30	13	14	5	7	23	15	8	24	12	45		
Number of calciphilic taxa	0	0	4	6	3	6	14	8	3	5	1	1	6	3	1	7	0	10		
Number of acidophilic taxa	4	2	1	0	0	1	0	0	1	0	0	0	2	0	0	1	0	3		
Percentage of calciphilic taxa	0	0	30.8	20.7	20.0	31.5	36.8	26.7	23.1	35.7	20.0	14.3	26.1	20.0	12.5	29.2	0	22.2		

praecox and *A. caryophyllea* are character species of the order *Thero-Airetalia*, alliance *Thero-Airion* (short-lived Hairgrass communities). Only two of the accompanying species on Åland, namely *Filago arvensis* and *Scleranthus annuus* subsp. *polycarpus*, belong to the character species of this alliance. *Aira praecox* is a character species of the association *Carici arenariae-Airetum praecocis* in Öland (Löbel & Dengler 2008) or *Airetum praecocis* in Central Europe (Conert 2000, Černý *et al.* 2007), *A. caryophyllea* is a character species of the association *Airo caryophylleae-Festucetum ovinae* (Conert 2000). According to Černý *et al.* (2007), *Airetum praecocis* is poor in psammophytes, but it shares common meadow species. This is the situation in Åland, too.

The majority of the localities of *Aira praecox* in the Åland Islands are located at or near sand beaches with an exposition towards the south, southwest and west. All the beaches are used by tourists for sunbathing and swimming in the sea. Several of the localities and their separate stands are on open ground, but some stands grew in lax copses of pine, spruce and black alder. A few stands are on ruderal soil, e.g. the cobbled yard of the Custom's building (Storby, stand 2a) and the caravan park and car park of Degersand (stands

3d, 3f). It was also found on foot paths and road sides, e.g. in Käringsund and Storby. It seems that *A. praecox* thrives, besides in sand beach areas, on trampled and heavily disturbed ground.

Both *Aira praecox*, and particularly *A. caryophyllea* are weak competitors (Georgson *et al.* 1997, Bertilsson, A. *et al.* 2002). As such, both often occur on different ruderal sites in Sweden, e.g. on road sides, railway embankments and in gravel pits, and *A. caryophyllea* further in dry abandoned fields (Weimarck & Weimarck 1985, Georgson *et al.* 1997, Bertilsson, A. *et al.* 2002, Edqvist & Karlsson 2007). Abundant stands of *A. praecox* and scattered tufts of *A. caryophyllea* were observed by the authors CAH and EH on the railway yard of Frederikshavn, northeastern Jutland, Denmark, on 7 July, 2012.

The pH values of the soil samples were mostly rather low for the Åland Islands compared to values found previously, e.g. in the soil of old fields on the mainland and the island of Nåtö, municipality of Lemland (Silfverberg 1980), in the wooded meadows, former wooded meadows and hazel copses of Nåtö (Hæggström 1983), and in shell gravel pits in the Åland Islands (Carlsson *et al.* 2008).

Table 2. Chemical properties of the 22 soil samples in the localities 1-5 and 7 with *Aira praecox*. The range of pH and the concentrations of exchangeable Ca²⁺, K⁺, Mg²⁺, PO₄⁻, soluble N, NO₃⁻-N and NH₄⁺-N are given as mg l⁻¹ dry soil.

Locality	1. Käringsund	2. Storby	3. Degersand	4. Möckelö	5. Prästö	7. Kumlinge	Range of all samples
Number of soil samples per locality	3	5	4	3	3	3	
Soil properties	humus on bed rock, humus-rich fine and coarse sand	fine sand, humus-rich fine sand, gravel and sand	fine sand	fine sand, humus-rich fine sand, rapakivi granite macadam	humus-rich coarse sand with a few gravel grains	fine sand	
pH	4.8 – 6.6	5.2 – 6.5	5.1 – 5.8	5.3 – 6.2	5.4 – 6.1	6.0 – 6.2	4.8 – 6.6
Ca ²⁺	498 – 1067	64 – 528	97 – 709	212 – 979	231 – 691	216 – 675	64 – 1067
K ⁺	41 – 123	19 – 54	17 – 71	23 – 50	24 – 37	46 – 75	17 – 123
Mg ²⁺	44 – 148	21 – 59	19 – 101	9 – 159	28 – 41	33 – 131	9 – 159
PO ₄ ⁻	5.2 – 6.8	2.0 – 4.2	1.6 – 3.7	0.8 – 4.5	1.4 – 2.5	1.0 – 1.4	0.8 – 6.8
Soluble N	7.0 – 10.3	4.5 – 7.3	4.4 – 7.4	5.5 – 12.4	4.7 – 6.1	6.8 – 7.8	4.4 – 10.3
NO ₃ ⁻ -N	0.4 – 0.8	0.3 – 0.6	0.3 – 0.6	0.4 – 0.6	0.5 – 0.6	0.8 – 1.0	0.3 – 1.0
NH ₄ ⁺ -N	6.2 – 9.6	4.0 – 6.9	3.9 – 7.1	5.1 – 11.8	4.2 – 5.5	5.8 – 7.0	3.9 – 11.8

According to Ellenberg et al. (1992), the reaction indicator values for *Aira praecox* and *A. caryophyllea* are 2, which mean that they are indicators of sites between extreme acidity, never found on weakly acid or basic soils and acidity indicators occurring mainly on acid soils, but exceptionally also on nearly neutral ones. However, a higher reaction indicator value was recommended for *A. praecox* in Britain (Ecofact 1999): it should have the value 4, i.e. between an acidity indicator occurring mainly on acid soils, but exceptionally also on nearly neutral ones and an indicator of moderately acid soils, only occasionally found on very acid or on neutral to basic soils. The same conclusion was drawn by Schafers & Sýkora (2000) in The Netherlands. Ecofact (1999) recommended a reaction indicator value of 5 for *A. caryophyllea*, namely an indicator of moderately acid soils, only occasionally found on very acid or on neutral to basic soils. These higher reaction values are in good accordance with the situation in Åland where fairly numerous calciphilic but only a few calcium avoiding species grew together with the *Aira* species.

The concentrations of exchangeable Ca²⁺, K⁺, Mg²⁺, PO₄⁻ and soluble N were also mostly lower than the corresponding values measured in the soil of old fields, wooded meadows, former

wooded meadows, hazel copses and shell gravel pits (Hægström 1983, Silfverberg 1980, Carlsson et al. 2008).

According to Ellenberg et al. (1992), the nitrogen indicator values for both *Aira* species are 1, i.e. they are indicators of extremely infertile sites. However, in Britain the indicator value has been raised to 2, which means that they are indicators of extremely infertile sites to more or less infertile sites (Ecofact 1999). The nitrogen values of the *Aira* localities on Åland correspond well with the British indicator values.

Aira praecox can be dispersed in mud adhering to footwear (Clifford 1956), but this way of dispersal can possibly be only over short distances in the case of Åland Islands. However, as *A. praecox* often grows at bathing beaches, Rydberg & Wanntorp (2001) and Jonsell (2010) suggest that a possible way of dispersal is by bathers and campers, e.g. with blankets. The locality in Kumlinge seems to be on ballast brought ashore from a sailing ship long ago; sailing ships were moored wintertime in a sea bay quite near this place. The accompanying species *Hypochoeris radicata* was previously found on ship ballast at Marsund in the municipality of Hammarland in 1897 (H) and on ruderal soil in the town of Mariehamn 1988 (Grönholm 1991).

The number of localities of *Aira praecox* has diminished by 46–60 % and of *A. caryophyllea* by approx. 90 % in Scania, southernmost Sweden (Tyler & Olsson 1997). In other areas of southern Sweden, *A. caryophyllea* has also become rarer. In the Åland Islands, the situation for *A. praecox* is more complex. Several stands have disappeared in locality 1 (Eckerö, Käringsund), but, as far as we know, localities 2 (Eckerö Storby), 3 (Eckerö, Degersand) and 4 (Jomala, Möckelö) harboured much larger stands in 2009 than known before. Further, localities 5 (Sund, Prästö), 6 (Vårdö, Horsholm) and 7 (Kumlinge, Kastören) were unknown before 2005. In the 2010 Red List of Finnish Species (Kalliovirta et al. 2010), *A. praecox* was assessed as near threatened (NT), whereas *A. caryophyllea* was not assessed at all. However, *A. caryophyllea* may be endangered, as it is hitherto known in one locality only and the number of specimens was about 50 in 2009.

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