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Occurrence of the invasive Japanese rose (*Rosa rugosa*) in the Åland Islands

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The Japanese rose (*Rosa rugosa* Thunb.) is an invasive alien species in Europe that exerts adverse ecological effects on biodiversity. In Finland, it occurs mainly along the coastline and in the archipelagos of the Baltic Sea, where it replaces native plant species and threatens rare and red-listed habitats, like sand beaches and coastal meadows. This study sums for the first time occurrences of Japanese rose stands on the seashores of the Åland Islands in SW Finland. Altogether, 57 stands of Japanese rose were found, mainly from inventories made by the authors in 2014–2020. The median size of the stands was 7 m^2. Although the most common habitat was stone shores, coastal meadows were also typical. The largest stand, measuring 238 m^2, was found on a sand beach. Knowledge of the distribution, stand sizes, and habitat types of the naturalized Japanese rose is essential for planning, eradication, and control measures. Since large areas of the archipelago are still without occurrence data, further inventories should be conducted to understand better the occurrence of the Japanese rose in the Åland Islands.

Introduction

The Japanese rose (*Rosa rugosa* Thunb.) is a native shrub species in East Asia, where it occurs on the coasts of the Pacific Ocean. The species was transported to Europe as an ornamental plant, and its use became common by the 1870s (Bruun 2005) when it also started to naturalize. The first naturalized Japanese rose in the Nordic Countries was found in Denmark in 1875 (Svart & Lyck 1991), and in Finland, the first record in nature was made in 1919 in Helsinki (Erkamo 1949). The first Swedish record near the coast was observed in Stockholm in 1927 (Naturvårdsverket 2024).

Nowadays, the species' naturalized distribution covers the entire Baltic Sea region, the North Sea, and the British Isles (Bruun 2005, Weidema 2009, GBIF 2024). The Japanese rose has spread throughout the Finnish coast and archipelagos. It is most common on the southern coast, in the archipelago of the Gulf of Finland, and in the Archipelago Sea (Kunttu et al. 2016, Ryttäri & Kunttu 2022).

The Japanese rose is one of Europe's most harmful invasive species (Nentwig et al. 2018). It threatens coastal ecosystems because it replaces native plant species, changes the composition of habitat types, and suppresses natural vegetation of high biological diversity (Kollmann et al. 2009, Thiele et al. 2010, 2011).

In Finland, its negative ecological effects on native species and natural habitat types are exceptionally high on the coast and in the archipelagos, where it is the most harmful alien plant species (Niemivuo-Lahti 2012, Kunttu et al. 2016). It has invaded, for example, habitats like sand beaches, dunes, stone and shingle shores, and coast-

al meadows (Kunttu et al. 2016). Many of these habitat types are red-listed (Kontula & Raunio 2018). Consequently, the overgrowth of the Japanese rose leads to the reduced diversity of native species, while seashores supporting specialized biodiversity and several red-listed species are also adversely affected (e.g., Aspelund & Ryttäri 2010, Reinikainen et al. 2018, Hyvärinen et al. 2019).

Thus, the Japanese rose is on the Finnish list of Government Decree on Invasive Alien Species of National Concern (Finlex 2023), which means that according to Act on Managing the Risks Caused by Alien Species, it is forbidden to sell, keep, grow, or import it in Finland. In addition, this species must be removed from plantings, and naturalized shrubs must be eradicated if they can cause severe harm to biodiversity (Finlex 2021).

The flora of the Åland Islands has long been a subject for interest, and extensive field studies spanning over a century have been performed there (e.g., Bergroth 1894, Eklund 1958, Palmgren 1961, Hæggström & Hæggström 2010). Nevertheless, no earlier records of naturalized Japanese rose plants were made before 1952, when one stand was observed on a rocky skerry in Hammarland, with three further records in the 1960s (FinBIF 2024). Thus far, only Hæggström and Hæggström (2010) and Kunttu et al. (2016) commented on the occurrence of Japanese rose in the Åland Islands at a general level. A common understanding has been that the Japanese rose occurs scarcely throughout the Åland Islands on sand beaches, shingle and stone shores, and road verges.

This article is the first review of the occurrence of naturalized Japanese rose on the seashores of the Åland Islands. This study aims to improve the understanding of Japanese rose distribution, habitats, and stand sizes in the Åland Islands for the effective preservation of native flora and also to facilitate the control of this invasive alien species.

Study area

The Åland Islands are located between Finland and Sweden in the middle of the Baltic Sea. The Åland archipelago is a biogeographic province called Alandia, located in the hemiboreal zone. Its land area is 1 554 km^2, comprising 6 757 islands of at least 0.25 hectares and approximately 20,000 smaller islets and skerries (Lindqvist 2023).

The mean annual temperature is +6.3°C, and the annual precipitation is 628 mm. According to Jomala weather station, the predominant wind direction is from the south (20 %) and southwest (16 %) (Jokinen et al. 2021). The growing season is, on average, 200 days, and the temperature sum is 1 400–1 500 (Finnish Meteorological Institute 2022). The islands consist mainly of rapakivi granite bedrock with soil layers of glacial till, sand, or gravel deposits (Hæggström & Hæggström 2010). Also, there are also Ordovician limestones. After the last glacial period, the land uplift is still ongoing, with changes of up to 5 mm per year (Poutanen 2024).

Both the flora and nature habitat types include several rarities in Finland, which occur only in the Åland Islands or are common only there (Hæggström & Hæggström 2010, Kontula & Raunio 2018). Therefore, the protection of native species and habitats is essential to the conservation of Finnish biodiversity.

Material and methods

Although records were gathered from several sources, the core of this study included several seashore inventories, which authors PK and SMK carried out throughout the archipelagos of the Åland Islands in 2014–2020. Four areas were surveyed by systematic inventories of each island and skerry with perennial vegetation. The entire shorelines of all islands and skerries were investigated in these areas. Further, if the inner parts of the islands appeared to be a potential habitat for the Japanese rose, they were checked also. These systematically inventoried areas included: ca. 184 islets in the Delet archipelago in 2015, ca. 55 islets in the eastern parts of Kökar and Sottunga in 2016, ca. 195 islets in Kökar in 2018, and ca. 90 islets in Kumlinge in 2019 (Fig. 1). Furthermore, the authors also made several field surveys in Föglö, Saltvik, and Eckerö.

In addition, von Numers (2011) inventoried ca. 120 islets in the eastern archipelago of the

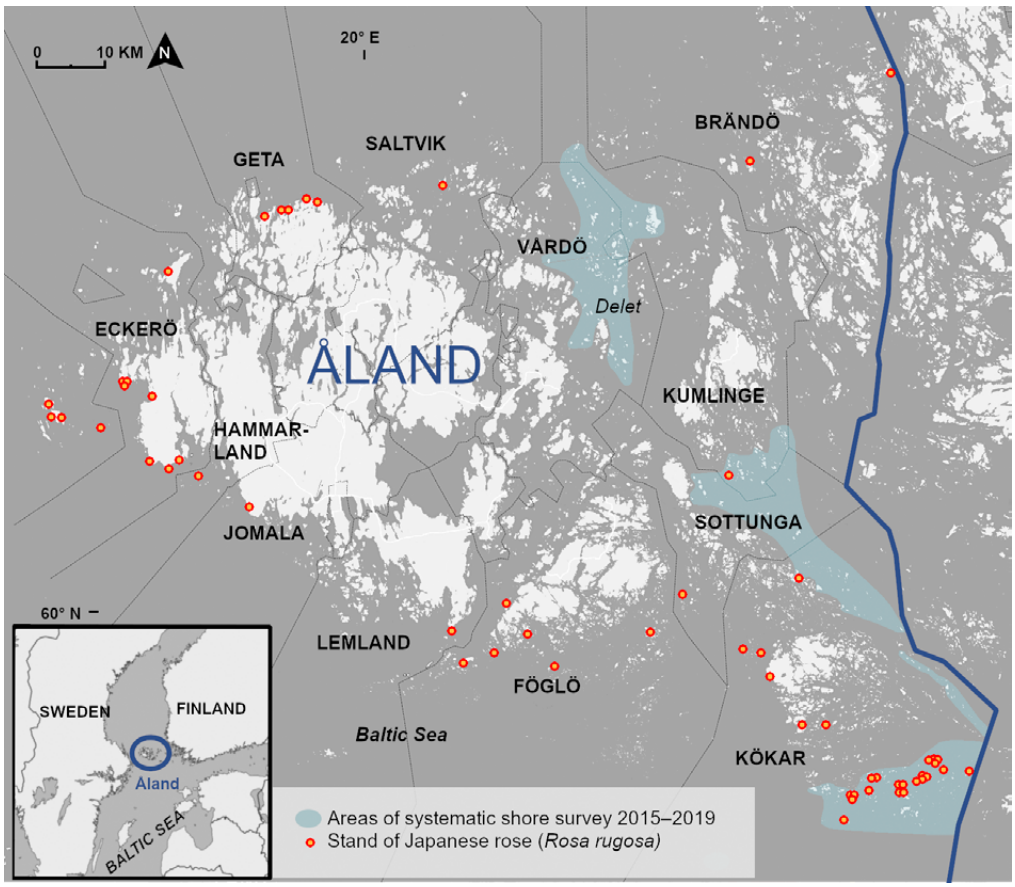


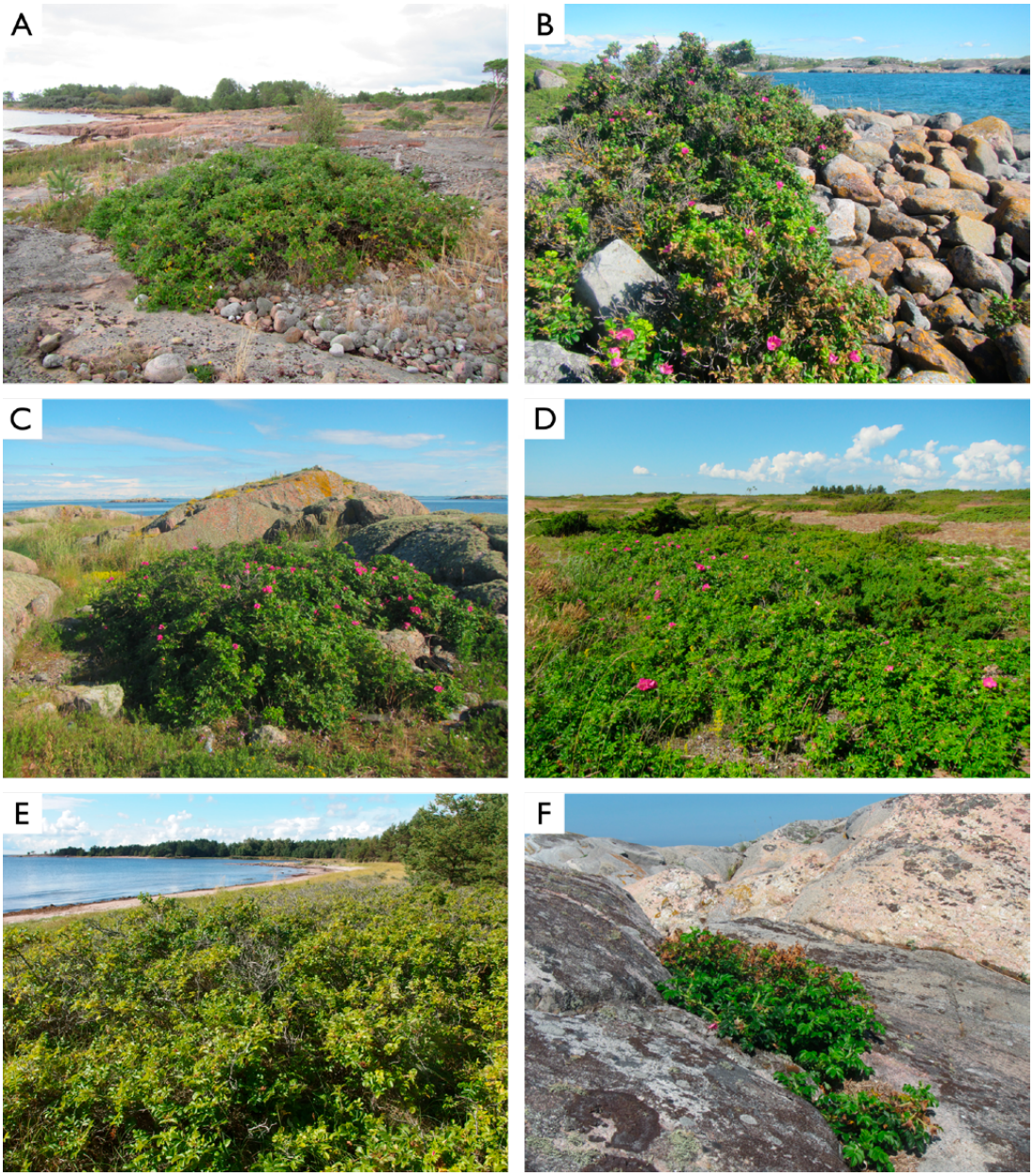
Fig. 1. Study area in the Åland Islands: areas of systematic shore survey and the distribution of Japanese rose stands.

Åland Islands in 2001–2003, and Sundström and Sjöblom (2016) made a plant species inventory of 21 sand islets in the eastern part of Åland in 2016. The Finnish Biodiversity Information Facility (FinBIF) was an important record source. The FinBIF is an open-access data repository used by many research institutes and biologists (FinBIF 2024). Also the collections of Helsinki (H) and Turku (TUR) herbaria, as well as a Finnish floristic database Kastikka were went through. Although the official database of alien species in the Åland Islands was checked, there were only duplicates of records that this paper's authors reported (Ålands Landskapsregering 2024). Moreover, records were gathered from other literature, such as books, articles, and reports.

The records made by the authors contain the stand area, habitat type, and growing site location, including their ETRS-TM35FIN coordinates (European Terrestrial Reference System). The classification of habitat types is according to Kontula and Raunio (2018), and the following types used in this study include: sand beach, stone shore (also including gravel, shingle, and boulder shores), coastal meadows, rock outcrops, and dwarf shrub heaths. It should be noted that villages, yards, gardens, and verges were excluded from this study.

Results

There were 57 reliable records of naturalized Japanese rose on the shores of the Åland Islands (Fig 1, Appendix). The inventories made by the authors produced 38 stands; ten were found from the database of the Finnish Biodiversity Information Facility (FinBIF 2024), while some records were gathered from various publications (Kulves 2004, Clayhills & Clayhills 2010, Sundström &



Figs. 2A–F. Typical habitats of the Japanese rose in the Åland Islands. A. Stone shore (middle-size stones). B. Stone shore (boulders). C. Stony meadow. D. Epilittoral meadow next to heath. E. Sand beach. F. Rock outcrop on the seashore. Photos: Panu Kunttu.

Sjöblom 2016). The distribution was concentrated in the southern areas of the Åland Islands, especially in the municipality of Kökar, where 26 stands were found (Fig 1, Appendix).

The authors documented the exact location, stand area, habitat type, distance to the mean water line, and a compass bearing from the shore from 38 stands (Table 1). According to the data, the median stand area was 7 m^2. The largest area measured 238 m^2. Although the most common habitat was stone shore, coastal meadows were also typical. We present the different habitat types in Figs 2A–F. The most extensive stands occurred on sand beaches. We observed one Japanese rose

Table 1. Stands of the Japanese rose (*Rosa rugosa*) with information on their area and distance to the mean water line according to habitat type. The data is based on field studies carried out by the authors in 2014–2020.

Habitat type	Number of stands	Median size (m^2)	Range (m^2)	Distance to mean water line (m)
Sand beaches	2	137	35–238	10
Stone shores	17	6	1–31	8
Coastal meadows	13	14	0,5–80	11
Rock outcrops	6	5	1–8	10
All stands	38	7	0,5–238	10

Fig. 3. Japanese rose bushes growing in the middle of a dense stand of sea buckthorn (*Hippophaë rhamnoides*). Photo: Panu Kunttu

bush growing in the middle of a very dense stand of sea buckthorn (*Hippophaë rhamnoides*) (Fig. 3). This phenomenon has also been recorded in the Kvarken Archipelago in the Gulf of Bothnia (Forststyrelsen 2020).

The distance between the stand and the mean water line according to habitat type is shown in Table 1. The distances in all habitat types ranged from 2 to 40 metres. 76 % of the Japanese rose stands were found between the compass bearings facing southeast, south, and southwest, respectively, with 85 % of the total stand area occurring in this sector (Table 2). Four stands out of 38 were white-flowered forms.

Discussion

Since there is a lack of systematic inventory data in several areas of the Åland Islands, it is not easy to make definite conclusions about the actual current occurrence of the Japanese rose there. Moreover, although some archipelago areas have been systematically inventoried, their results differ.

Table 2. Compass bearings on shorelines where stands of Japanese rose were observed (n=38).

Compass bearing	Number of stands	Total stand area (m^2)
North	5 %	4 %
East	5 %	1 %
Southeast	21 %	8 %
South	42 %	64 %
Southwest	13 %	13 %
West	11 %	9 %
Northwest	3 %	1 %

This invasive species is common in the southern Kökar area but is non-existent in the Delet archipelago. The absence of the Japanese rose on sand islands in the eastern Kökar and Sottunga areas is particularly gratifying since these islands still maintain a rich native flora (von Numers 2011, Sundström & Sjöblom 2016).

However, there are at least sporadic records of the Japanese rose all over the province. Therefore, the potential for further spread is notable. More data should be collected, and new areas should be systematically inventoried to confirm the current situation.

Although there is no monitoring data on the occurrence of Japanese rose, at least some large stands have grown relatively recently. For example, one of the largest stands on Stora Sandören is relatively new since it was absent from an earlier plant inventory in 2006 but observed there in 2016 (Sundström & Sjöblom 2016, von Numers 2011). Further, Sundström and Sjöblom (2016) opined that the stand was relatively new since it was not dense and well established.

Most stands were relatively small and were only slightly larger than in the Archipelago Sea National Park and its surroundings, where the median size was 5 m^2 (Kunttu & Kunttu 2021). Stone shores were the most common habitat in both areas, while the largest stands grew on sand beaches. Although the study material from the Åland Islands is not extensive, it seems that the proportion (10,5 % vs. 3 %, respectively) of the white-flowered form of Japanese rose may be higher in the Åland Islands than in the Archipelago Sea National Park and its surrounding (Kunttu & Kunttu 2021).

Since the Japanese rose is both abundant and widespread in the neighbouring areas of Åland, i.e., in the Finnish province of Varsinais-Suomi and on the Swedish east coast (Kunttu & Kunttu 2021, SLU 2024), the risk of further spread remains high. This species' ability for long-distance dispersion is well-known: the hips of the Japanese rose can float up to 40 weeks in seawater (Jessen 1958), and birds can spread its seeds also (Snow & Snow 1988, Bruun 2005). After a stand becomes established, vigorous rhizomes also produce root sprouts for vegetal dispersion.

An interesting observation was that the stands were mainly found on the southern shores of the islands, and the prevailing winds in the Åland Islands are south and southwest. Is there a connection between these two factors?

The Japanese rose continues to be grown as an ornamental plant in the Åland Islands. Unlike mainland Finland, no local legislation restricts it (Finlex 2021). Nevertheless, the Government of Åland (Ålands Landskapsregering) has started eradicating Japanese rose stands. It is imperative to continue this control work in the future to safeguard the biological diversity of shore habitats. There are several methods to eradicate the Japanese rose, and applicable means should be chosen according to the stand size, geographical location, and growing site (Backlund et al. 2022, Forststyrelsen 2022).

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Appendix. Stands of naturalized Japanese rose on the seashores of the Åland Islands.

Municipality	Site	ETRS-TM35FIN	Size (m^2)	Main habitat type	Distance to mean water line (m)	Compass bearing of shore	First observation year	Note	Source and observer(s)
Brändö	Österkobben	6719655, 160541	14	Meadow	7	N	2020		Field record by Kunttu & Kunttu
Brändö	Hamnskärs kobben						?		von Numers pers. comm. 2024
Eckerö	Finbo	6713591, 91071	30	Stone shore	12	W	2014	White-flowered form	Field record by Kunttu & Kunttu
Eckerö	Västerön, Röd-klobbsanden	6701800, 84308	238	Sand beach	10	S	2006		FinBIF 2024 (Hæggström & Hæggström), field record by Kunttu & Kunttu
Eckerö	Västerön, Lurarskatan						1986	In year 1986 a stand was 5–6 meter long	FinBIF 2024 (Hæggström)
Eckerö	Västerön, Lurarskatan E	6701711, 84756	35	Sand beach	9	S	2020	In the middle of *Hippophaë rhamnoides* stand	Field record by Kunttu & Kunttu
Eckerö	Storby, Krogarviken	6699338, 87439	22	Meadow	11	W	2006		FinBIF 2024 (Hæggström et al.)
Eckerö	Långnabban	6690715, 88006					2019		FinBIF 2024 (Koivula)
Eckerö	Vätingen						2006		FinBIF 2024 (Hæggström & Carlsson)
Eckerö	Torp, SW-cape						1962	0,5 km N of SW-cape	FinBIF 2024 (Suominen)
Eckerö	Degersand						2009		Clayhills & Clayhills 2010
Föglö	Stora Sandören	6665278, 143120	80	Meadow	7	SW	2016	On dry meadow, near shrub heath.	Sundström & Sjöblom 2016
Föglö	Sältingskär	6664608, 124340	6	Stone shore	2	S	2017		Field record by Kunttu & Kunttu
Föglö	Yttre Ängholm	6666488, 128571	6	Stone shore	2	SW	2020		Field record by Kunttu & Kunttu
Föglö	Björkör, Stengrundet						1974		FinBIF 2024 (Hæggström & Skytén)
Föglö	Bråttö, Rödskär						2006		FinBIF 2024 (Hæggström & Hæggström)
Geta	Rävsund						2006		FinBIF 2024 (Hæggström)
Geta	Själviken						1970s		Field record by Carlsson
Geta	Dånö						1962		Kastikka-database (Törnroth)
Geta	Fågelberget, Korsbergs-klobben						2024		Field record by Carlsson
Geta	Havsöra, Öraudden						2024		Field record by Carlsson
Hammar-land	Signilskär	6698008, 76186	6	Stone shore	6	E	2020		Field record by Kunttu & Kunttu

Appendix cont.

Municipality	Site	ETRS-TM35FIN	Size (m^2)	Main habitat type	Distance to mean water line (m)	Compass bearing of shore	First observation year	Note	Source and observer(s)
Hammarland	Enskär	6699986, 74894	1	Stone shore	20	S	2020		Field record by Kunttu & Kunttu
Hammarland	Kappelkobben	6698230, 75311	6	Stone shore	8	SE	2021		Field record by Kunttu
Hammarland	Tödding						1952		FinBIF 2024 (Törnroth et al.)
Jomala	Hammarudda, N-part of Nabbviken						1997		FinBIF 2024 (Sandelin)
Kumlinge	Stegelören	6682938, 154399	7	Meadow	11	S	2019	White-flowered form	Field record by Kunttu & Kunttu
Kökar	Klovaskär	6644727, 173616	7	Meadow	16	W	2018		Field record by Kunttu & Kunttu
Kökar	Luckuskär	6644922, 174278	2	Stone shore	5	SW	2018		Field record by Kunttu & Kunttu
Kökar	Luckuskär	6645039, 174140	5	Stone shore	9	SW	2018		Field record by Kunttu & Kunttu
Kökar	Luckuskär	6644977, 174590	4	Rock outcrop	8	E	2018	White-flowered form	Field record by Kunttu & Kunttu
Kökar	Mannskär, S-skerry	6645539, 168096	5	Stone shore	13	S	2018		Field record by Kunttu & Kunttu
Kökar	Nabban, Grönvik	6658925, 157041	6	Rock outcrop	16	W	2015		Field record by Kunttu & Kunttu
Kökar	Norra Finnhäran	6643673, 165174	1	Rock outcrop	13	SE	2018		Field record by Kunttu & Kunttu
Kökar	Norra Finnhäran	6643670, 165174	7	Stone shore	11	SE	2018		Field record by Kunttu & Kunttu
Kökar	Norra Finnhäran	6643670, 165170	2	Stone shore	8	SE	2018		Field record by Kunttu & Kunttu
Kökar	Norra Skarsudd	6644146, 171508	9	Stone shore	8	SE	2018		Field record by Kunttu & Kunttu
Kökar	Norra Skarsudd	6644328, 171631	10	Meadow	12	NW	2018		Field record by Kunttu & Kunttu
Kökar	Skarvkloster	6645252, 179876	5	Rock outcrop	11	SW	2018		Field record by Kunttu & Kunttu
Kökar	Skepparkläpparna, northernmost skerry	6643959, 167652	8	Rock outcrop	9	SE	2018		Field record by Kunttu & Kunttu
Kökar	Stora Flyskär	6645775, 168550	13	Meadow	6	N	2018		Field record by Kunttu & Kunttu
Kökar	Storgadden	6645710, 176880	3	Stone shore	10	S	2018		Field record by Kunttu & Kunttu
Kökar	Södersta Gadden (Västra Gadden)	6646758, 175508	7	Meadow	18	SE	2018		Field record by Kunttu & Kunttu

Appendix cont.

Municipality	Site	ETRS-TM35FIN	Size (m²)	Main habitat type	Distance to mean water line (m)	Compass bearing of shore	First observation year	Note	Source and observer(s)
Kökar	Södra Skarsudd	6643564, 171247	56	Meadow	11	S	2018		Field record by Kunttu & Kunttu
Kökar	Södra Skarsudd	6643566, 171224	7	Stone shore	12	S	2018		Field record by Kunttu & Kunttu
Kökar	Tordmulkobben	6646660, 175821	13	Stone shore	10	S	2018		Field record by Kunttu & Kunttu
Kökar	Tordmulkobben	6646665, 175809	2	Rock out-crop	9	S	2018		Field record by Kunttu & Kunttu
Kökar	Tordmulkobben	6646708, 175872	19	Meadow	6	SE	2018		Field record by Kunttu & Kunttu
Kökar	Vidskär, NE-luoto	6652248, 163427	30	Meadow	7	S	2015	White-flowered form	Field record by Kunttu & Kunttu
Kökar	Östra Långskär, Gråskär	6670064, 161712	5	Stone shore	2	S	2018		Field record by Kunttu & Kunttu
Kökar	Segels-kobbarna	6662047, 154314	32	Meadow	24	S	2020		Field record by Kunttu & Kunttu
Kökar	Kökarsören	6640658, 164334	0,5	Meadow	40	S	2020	In the highest point of the skerry	Field record by Kunttu & Kunttu
Kökar	Brunnskär, northern shore						2007		FinBIF 2024 (Hæggström & Hæggström)
Kökar	Stenskär						ca. 2001–2003		von Numers 2011
Lemland	Herrö						1964		FinBIF 2024 (Nurmi)
Saltvik	Länsmans-grunden						1980		Kulves 2004, J. Eriksson pers. comm 2014
Sottunga	Lilla Labbskär	6669164, 147742	31	Stone shore	2	S	2020		Field record by Kunttu & Kunttu