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# Habitat loss and deterioration explain the disappearance of populations of threatened vascular plants, bryophytes and lichens in a hemiboreal landscape

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ABSTRACT

Why populations of threatened species disappear is among the key questions in conservation biology. However, very few local and regional studies have attempted to quantify the importance of the various causes. In this investigation, the status of the populations of threatened vascular plants, bryophytes and lichens found between the years 1860–1979 in a national biodiversity hot spot in SW Finland was studied during the years 1990–2008. Of the populations, 82% had disappeared and 18% were re-discovered. The disappearance rate of populations differed between habitats: exceeding 80% in most habitat types whilst being lowest on rock outcrops (58%). Complete destruction of all locally suitable habitats was the main reason for the disappearance of the populations (73%) concerned. Habitat deterioration (including partial habitat loss) was identified as the reason for the disappearance for 22% of the populations. Only for 5% of the populations could it not be revealed whether habitat quality had changed or not, but deterioration of habitat quality or habitat loss is possible even in these cases. For none of the disappeared populations was no change in habitat quality verified. In most cases, habitat loss and deterioration were caused by agriculture or forestry. These results support the conclusion that vascular plant, bryophyte and lichen populations in the boreal landscape have disappeared directly because their habitats have disappeared, declined in size or deteriorated due to forestry, agriculture, construction, mining and pollution. More subtle changes in habitat quality, fragmentation, problems related to small population size per se and other reasons may have contributed to only a few disappearances of local populations. The disappearance rate was similar between the study groups, but the relative importance of reasons for disappearance was different. The results emphasize the importance of habitat protection for threatened vascular plants, bryophytes and lichens.


## 1. Introduction

Studies have shown rapid loss of global biodiversity over the past few centuries, indicating that a sixth mass extinction is under way and accelerating (Pimm et al. 1995, 2014, May, 2010; Ceballos et al., 2015). The process of identifying species at risk of extinction (species 'red-listing') is a crucial measure to determine the reasons behind mass extinction and to define species in need of special protection and management (Rodrigues et al., 2006; Zamin et al., 2010). It is well-established that

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threatened species disappear mainly because their habitats disappear totally (habitat loss) or habitat quality is negatively changed (habitat deterioration) (Wilcove et al., 1998; Pimm and Raven, 2000; Kerr and Deguise, 2004). In most cases, habitat loss and deterioration are caused by agriculture, forestry, urbanisation, and other building activities (Kerr and Cihlar, 2004; Goettsch et al., 2015; Rejmánek, 2018). Overexploitation by hunting, fishing and gathering plants also ranks among the main causes of threat (Goettsch et al., 2015; Maxwell et al., 2016). Chemical factors (particularly sulphur and nitrogen deposition) have also caused the decline of many species (Hallingbäck, 1992; Van Herk et al., 2003; Stevens et al., 2004). The importance of invasive non-native species (alien species) as an extinction factor is continuously increasing (Clavero and García-Berthou, 2005; Bellard et al., 2016). Human disturbance via recreation is also among the important threats to threatened plants (Burgman et al., 2007; McCune et al., 2013).

Nevertheless, there is high variation in the importance of various factors causing the disappearance of threatened species and their populations between geographical regions and taxonomic groups (Wilcove et al., 1998), as well as between habitat types (Juslén et al., 2016). In densely populated areas, agriculture and urbanisation have been the main causes of disappearance (Lavergne et al., 2005; Stehlik et al., 2007; Van Calster et al., 2008; Rejmánek, 2018). Northern Europe is sparsely populated in comparison to central and southern Europe. Thus, the area of arable land and disappearance of populations of threatened species due to conversion of habitats to arable land or eutrophication resulting from agriculture has not been so predominant in northern Europe. Forestry is generally considered to be a more important cause for threat status than agriculture (Thor, 1998; Rassi et al., 2010).

Numerous studies have also emphasised indirect causes of the disappearance of populations of threatened species: e.g. habitat fragmentation and isolation (Young et al., 1996; Lienert, 2004) and stochastic effects following it (Matthies et al. 2004), edge effects (Moen and Jonsson, 2003), and change in trophic interactions (Feeley and Terborgh, 2008). Habitat fragmentation may cause genetic erosion, inbreeding depression and Allee effects on reproductive success, and increase the susceptibility of populations to natural and human-made catastrophes as well as environmental stochasticity (Lande, 1993; Oostermeijer et al., 2003). Habitat fragmentation is considered to be detrimental to the maintenance of biodiversity (Krauss et al., 2010; Haddad et al., 2015; Hanski, 2015). The extinction risk of species is influenced by a myriad of factors (Ovaskainen and Meerson, 2010).

One of the key questions for conservation biology is what causes populations to disappear (Ceballos et al., 2018). Sessile organisms such as vascular plants and cryptogams (bryophytes and lichens) are particularly well suited to the study of this question because they tend to maintain continuous populations on the same local site for many years, as long as the habitat remains suitable.

However, local and regional studies of the matter using historical distribution data of plant or cryptogam species are uncommon. These studies are usually single-species studies or multi-species regional studies concerning plant species, not plant populations (e.g. Chocholoušková and Pyšek, 2003, Van der Veken et al., 2004; Walker and Preston, 2006, Stehlik et al., 2007, Van Calster et al., 2008). Surprisingly few studies have attempted to present empirical data on the relative importance of various factors causing the disappearance of populations of threatened plant or cryptogam species on local, regional or national scales (Bisang and Urmi, 1994; Hooftman et al., 2016). This is a major shortcoming. Comparisons of population disappearances between threatened vascular plants, bryophytes and lichens seem to be totally lacking.

In this respect, the persistence of the populations of threatened vascular plants, bryophytes and lichens found before 1980 (1860–1979) was studied in the municipality of Lohja which is among the biodiversity hot spots in Finland (Pykälä, 2007). Due to the relatively high number of historical records of threatened species, Lohja is a suitable study area for a case study in why populations of threatened species have disappeared. The main questions were: what are the disappearance rates of populations of threatened species? Do they differ between species groups? Do they differ between habitats? What are the reasons for disappearances of populations? Are disappearances mainly caused by habitat loss and deterioration, or by other reasons?

## 2. Material and methods

The study area, Lohja municipality is situated in inland SW Finland on the border of the hemiboreal and southern boreal vegetation zones. The land area is 278.5 $km^2$. Most of the land area is forest (61.5% of the total land area) and arable land (19%) (Tomppo et al., 1998). For a more detailed description of the study area, see Pykälä (2004). The number of old records of threatened vascular plants, bryophytes and lichens (Rassi et al., 2010) is among the highest in Finland in the study area, because Lohja has long been known for occurrences of many nationally rare species. This is particularly because of the occurrence of calcareous soils and the high topographic variability compared to most municipalities in southern Finland. Karjalohja, Nummi-Pusula and Sammatti municipalities, which were recently incorporated into Lohja, have been excluded from the study area.

The old records of threatened vascular plants, bryophytes and lichens were collected checking the major Finnish herbaria (H, TUR, OULU), literature and unpublished manuscripts, as well as from interviews of professional and amateur botanists, bryologists and lichenologists known to have visited the study area. Altogether 315 populations were found. When only the most accurate record type for a population is counted, 199 records are based on herbarium specimens, 42 on botanists' interviews, 7 on publications, 55 on unpublished field notes, and 12 on unpublished manuscripts (the latter two types are deposited in the Finnish Museum of Natural History). Altogether 68% of the vascular plant populations, 100% of the bryophyte populations and 93% of the lichen populations are backed up by herbarium specimens. If the old record was considered as

potentially unreliable (few records by amateurs), it was excluded from the analysis, but the populations were searched for (without success) in the field.

The old records were located using maps and ecological data on the herbarium labels or publications. Old herbarium records and other records vary in their spatial accuracy. They mostly included the name of the village or the nearest estate. The ecological data of old records usually included only the habitat type.

A total of 83 nationally threatened species (extinct, critically endangered, endangered and vulnerable) of vascular plants, bryophytes and lichens were found in the study area before 1980. *Galium verum* (VU) was excluded from the study, because it is rather common in the study area. *Jasione montana* (VU) was excluded because of difficulties in locating old finds, combined with a rather high number of existing populations (approx. 30) in the study area, i.e. causing severe uncertainty as to whether present and previous populations are the same or not. *Lecania koerberiana* (CR) and *Pleuridium subulatum* (VU) (one population each) were excluded, due to the inaccuracy of the old record combined with rather low detectability of the species.

All other populations (n = 315) of threatened vascular plants (n = 217), bryophytes (n = 55) and lichens (n = 43) found before 1980 (1860–1979) were included in the study. Records with only the name of the municipality were excluded (with one exception), because more exact data was available for all but one species, i.e. it was not possible to know whether such records were from the same or from a different locality than the more exact records.

Despite the inaccuracy of the old records, it was possible to pinpoint the original location of 48% of the records to within an area of <1 $km^2$ (n = 152), a further 49% to within an area of 1–3 $km^2$ (n = 154), and 3% to within an area of 3–10 $km^2$ (n = 8). One population (*Carex heleonastes*) could not be located geographically. The species grows on rich fens and it was carefully searched from all rich fens in the study area.

The habitat requirements of the studied species were compiled from the literature, after which all populations were intensively searched from these spatially identified areas. The habitats identified as non-suitable were also studied, but only once. The delimited areas were carefully studied by ground-based surveys covering the whole delimited areas. However, built areas were searched only if they were evaluated to have any potentially suitable habitat based on species ecology and maps. If a potentially suitable habitat was found or there was some uncertainty whether the entire habitat was completely destroyed, the search was performed three to five times per delimited potentially suitable area during various years. This repeated searching of potential remaining habitats reduced the probability of false absences that would lead to a conclusion of extinction when actually the populations still survived.

All potentially suitable habitats for the studied threatened species were checked within the identified areas during the years 1990–2008 during a floristic inventory of Lohja municipality. For vascular plants the search was usually done during the flowering season of the species (at least twice during the flowering season). For species visible when not flowering, an additional search may also have been done at another time in late spring, summer or early autumn. For bryophytes and lichens the search was done between March and October if the land was not covered by snow. Altogether 363 days of field work (8–10 h per day) were used for searching the populations.

Most of the study species are habitat specialists with strict habitat requirements. Potentially suitable habitats for such species are easily identified in the field and they are rare. Few species are more difficult in this respect, and in some cases most of the delimited area was evaluated as potentially suitable (although with suboptimal habitat quality) and was studied three to five times.

If no suitable habitat was found (i.e. no grassland for grassland species, no mire for mire species, no old forest for old forest species, etc.) within the delimited area, the habitat was considered totally destroyed. Grassland species were also searched from all edge habitats such as field margins and road verges within the delimited area. If data of the old record did not allow to determine in which particular habitat type the original record was located, the quality of all potential habitat types was evaluated within the search area.

Herbarium specimens of vascular plants were often collected although vascular plants were identified in the field. For bryophytes and lichens, specimens were almost always collected, and the identity of about half of the study species needed to be confirmed by microscopy. Specimens collected are deposited in H.

Here, habitat loss means the total destruction of a suitable habitat within the identified area. Habitat deterioration is used in two different meanings: (1) lowered habitat quality, (2) strongly reduced area of a potentially suitable habitat. This is because it was often not possible to separate these two factors or both occurred within the delimited area. In the first case only habitats with lowered quality (but perhaps not fully unsuitable for the species) were found. Typical examples are e.g. a drained mire with some potentially suitable mire vegetation as a habitat for mire plants, and forests with few old trees as habitats for epiphytes growing on old trees. In the second case more than 50% of the habitat (but less than 100%) in the delimited area was considered to have disappeared. If 0–50% of the area of the habitat was estimated as disappeared, change in habitat quality was considered as impossible to evaluate. Thus, habitat deterioration also includes many cases in which it is not possible to know whether the disappearance of a population was because of habitat loss or deterioration.

Usually only direct changes in habitat quality were herein considered to have caused habitat deterioration. However, air pollution was considered to have caused habitat deterioration for the pollution-sensitive lichens *Bryoria bicolor* (Thor, 1998, Jääskeläinen et al. 2010), *Lobarina scrobiculata* (Hallingbäck, 1989, Jääskeläinen et al. 2010) and *Usnea barbata* (Jääskeläinen et al. 2010).

Present arable land in Lohja was considered to be totally unsuitable for *Buglossoides arvensis*. Formerly, this species was common on arable land in southern Finland, but no recent records on arable fields occur in Finland. Thus, for *B. arvensis,* present arable land seems to be totally unsuitable.

If a species was found within the delimited area but from a different habitat type than previously recorded, the original population was, however, considered to have persisted. This is because (1) the original habitat description may have been obscure (e.g. fens may be in herbarium specimens sometimes labelled 'wet meadows'), (2) the original population may have occurred in more than one habitat type, but was reported only from one type, (3) the original population may have switched its habitat.

The probable reason for disappearance was evaluated for all populations that had disappeared (Appendix 1). In many cases, more than one reason within the delimited area of the old record occurred. Then a factor causing largest habitat loss within the delimited area (if possible to evaluate) was considered as a probable reason for disappearance.

The proportion of disappeared populations between the main habitat types (farmland, forests, mires, rock outcrops and shores), between the threat categories (regionally extinct − excluded due to the very low number of records) and between vascular plants, bryophytes and lichens were analysed with the chi-square test.

Species nomenclature follows Lampinen and Lahti (2018) for vascular plants, Hodgetts (2015) for bryophytes, and Stenroos et al. (2016) for lichens.

## 3. Results

From the total of 315 populations, 259 populations had disappeared (82%) and 56 were re-discovered (18%). All populations were discovered from habitats identified in the field as potentially suitable. Note that the actual disappearance rate may have been higher because it was frequently impossible to assess whether the population found was the same as the one observed previously or another adjacent population.

The proportion of disappeared populations significantly differed between the main habitat types (Table 1) ($p = <0.001$). From most habitat types, over 80% of the populations had disappeared. The lowest disappearance rate was on rock outcrops (58.3%).

The habitat was totally destroyed within the delimited area for 72.6% of the populations. Habitat deterioration (including partial habitat loss) was the second most important reason for disappearance: 22.4% of the populations. This includes twelve lichen populations, which were assessed to have disappeared due to air pollution. For 5.0% of the populations, it could not be reckoned with certainty whether habitat quality had changed or not. Most of these were populations of *Campanula cervicaria* and *Lythrum portula*.

The main reasons for population disappearance (Table 2, Appendix 1) were agriculture (45.6%) (particularly arable cultivation, eutrophication due to the use of fertilisers, and abandonment of grasslands) and forestry (17.4%) (particularly the felling of trees, drainage). It was frequently difficult to assess the probable reason for population disappearance because commonly more than one factor was identified within the delimited area to have caused habitat loss and deterioration. In those cases the factor which has probably caused highest habitat loss was defined as the probable reason for disappearance. However, in several cases it was not possible to evaluate whether the disappearance was caused by forestry or agriculture (7.7%). It was particularly difficult to evaluate whether semi-natural grasslands had disappeared due to agricultural changes or whether they had been actively afforested for forestry. Other important causes for population disappearance were construction (15.1%; the construction of houses, roads and waterways), limestone mining (5.0%), and air pollution (4.6%).

The proportion of agriculture as the reason for population disappearance was very high among vascular plants (60.3%), but rather low among bryophytes (16.3%) and lichens (8.1%). Bryophyte populations have mainly disappeared due to construction (30.2%) and forestry (25.6%). Lichen populations have mainly disappeared as a result of forestry (48.6%) and air pollution (32.4%).

The disappearance rate of populations did not differ between vascular plants, bryophytes and lichens (Fig. 1) ($p = 0.719$). The proportion of disappeared populations was higher among older than rather recent records (1960−1979), but the difference was smaller than expected (Fig. 2.). The first record group found between the years 1960−1979 also showed a high

**Table 1**
Disappearance rate (%) of populations of threatened vascular plants, bryophytes and lichens in various habitats.

| | % |
|---|---|
| Forests (n = 70) | 77.1 |
| - on the ground (n = 34) | 59.4 |
| - on standing old and dead trees (n = 26) | 88.5 |
| - on logs and stumps (n = 10) | 100 |
| Mires and springs (n = 38) | 78.9 |
| Rock outcrops (n = 48) | 58.3 |
| Shores and waters (n = 44) | 81.8 |
| Grasslands (n = 51) | 98.0 |
| Arable land (n = 22) | 95.5 |
| Other farmland habitats (n = 33) | 93.9 |
| Unknown habitat (n = 9) | 100 |

**Table 2**
The probable reasons for the disappearance of vascular plant, bryophyte and lichen populations. Number of disappeared populations given.

| | all | plants | bryophytes | lichens |
|---|---|---|---|---|
| Forestry | 45 | 16 | 11 | 18 |
| - felling of trees | 32 | 6 | 8 | 18 |
| - drainage for forestry | 3 | 0 | 3 | 0 |
| - afforestation | 10 | 10 | 0 | 0 |
| Agriculture/forestry | 20 | 18 | 2 | 0 |
| - disappearance of grasslands | 16 | 16 | 0 | 0 |
| - drainage | 4 | 2 | 2 | 0 |
| Agriculture | 118 | 108 | 7 | 3 |
| - converted to arable land | 20 | 17 | 3 | 0 |
| - disappearance of grasslands/ overgrowth after the end of grazing | 18 | 17 | 1 | 0 |
| - use of fertilisers or herbicides | 70 | 68 | 2 | 0 |
| - disappearance of wooden barns | 3 | 0 | 0 | 3 |
| - other reason/unknown | 5 | 5 | 0 | 0 |
| Limestone mining | 13 | 3 | 9 | 1 |
| Construction | 39 | 22 | 14 | 3 |
| Air pollution | 12 | 0 | 0 | 12 |
| Unknown cause | 12 | 12 | 0 | 0 |
| All | 259 | 179 | 43 | 37 |

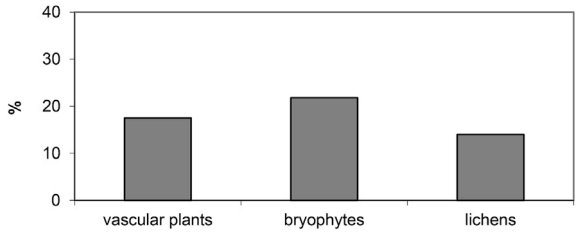


**Fig. 1.** The proportion (%) of the existing populations in different species groups.

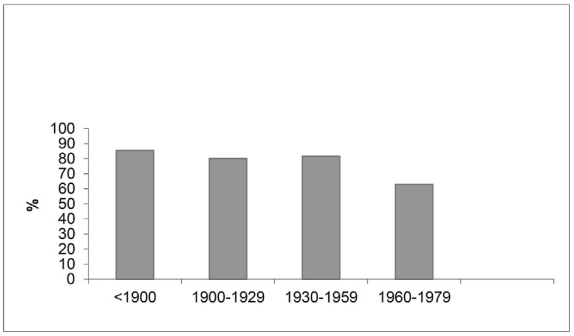


**Fig. 2.** The proportion of the populations that have disappeared on the basis of the earliest record of the population.

disappearance rate (62.9%). The proportion of populations that had disappeared differed among the three threat levels: it was highest among the vulnerable species and lowest among critically endangered species ($p = 0.001$) (Fig. 3.).

## 4. Discussion

In revisitation studies of plants, only repeated revisits allow the separation of population extinctions from simple non-detection (Kéry et al., 2006). To avoid pseudoextinctions, the populations of threatened species were searched 3–5 times during various years if it was not certain after one visit that no suitable habitat exists anymore. Nevertheless, some vascular plants have very long persistent seedbanks or may hide a long time in adult dormancy. One cannot be certain whether the species has permanently disappeared or will reappear in the future after a long absence. Such species are at least *Campanula*

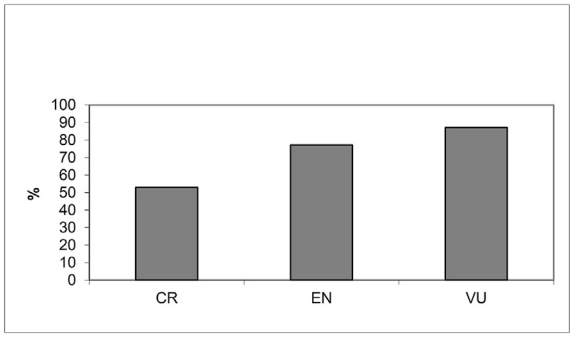


**Fig. 3.** The proportion of the populations that have disappeared assigned to the IUCN red list categories. CR = critically endangered, EN = endangered, VU = vulnerable.

*cervicaria* and *Lythrum portula* (long-term persistent seed bank) and *Cephalanthera rubra* (adult dormancy), which are also the most problematic study species for evaluating whether any potentially suitable habitat exists anymore.

Because there is often substantial uncertainty regarding the spatial location of old records, it is difficult to evaluate why the populations have disappeared (Stehlik et al. 2007). Nevertheless, the change in the study landscape during the past century has been so drastic that in most cases no suitable habitat for threatened species occurred anymore within the delimited area of 1–3 square kilometres or even more (3–10 square kilometres).

If more than half (but not all) of potentially suitable area for a species has been lost within the delimited area, the disappeared population was judged to have disappeared as a result of habitat deterioration. In these cases, no high quality habitats occurred, but habitat patches may have been potentially suitable. Even for these populations, habitat loss is a more probable reason for disappearance, since most of the habitat was probably lost. Due to the inaccuracy of old records, this cannot be proven.

It remained unclear for 13 disappeared populations whether habitat quality had changed or not. Even in these cases, habitat loss or some deterioration of habitat quality is possible or even probable. Most of these were populations of *Campanula cervicaria* and *Lythrum portula* records lacking habitat information. *C. cervicaria* grows mainly on edge habitats, mainly road banks and field margins. In edge habitats, *C. cervicaria* has declined in Finland, due to overgrowth, nutrient enrichment and the use of herbicides (Ryttäri et al., 2012). *L. portula* is an ephemeral annual species of open wet habitats somewhat infrequently present in its habitats.

Alternatively, most of these 13 population disappearances may be pseudoextinctions. *Campanula cervicaria* and *Lythrum portula* have a long-persistent seed bank and *Cephalanthera rubra* may hide decades in adult dormancy. Thus, one cannot be certain whether the populations have permanently disappeared or have the potential to reappear from dormancy.

The presented results suggest that vascular plant, bryophyte and lichen populations have disappeared almost exclusively because their habitats have totally disappeared, reduced in size or reduced in quality due to forestry, agriculture, construction, mining and pollution. In the Finnish red list (Rassi et al., 2010), these are the most important factors for the decline of threatened plants, bryophytes and lichens. More subtle changes in habitat quality, fragmentation, problems related to small population size per se and other reasons may have contributed to only a few disappearances of local populations of threatened species.

It is well-known that habitat destruction and deterioration are the main reasons for the disappearance of populations of threatened species (Pimm and Raven, 2000; Maxwell et al., 2016). However, numerous studies have also emphasised other reasons, such as fragmentation (Matthies et al. 1994). Despite the importance of the issue, there are only a few local and regional studies that have tried to quantitatively evaluate the causes of disappearance of populations of all threatened species among at least one species group of plants or cryptogams. Hooftman et al. (2016) studied the population extinctions of declining vascular plants in the UK, and concluded that half of the extinctions were caused by habitat loss and half by gradual processes causing delayed extinctions. In this case, a clearly larger proportion of populations disappeared due to habitat loss and deterioration. This may reflect the longer time period of the study.

The results of subtle or no importance of habitat fragmentation and small population size per se are against the major paradigm in ecology emphasising the importance of fragmentation (Haddad et al., 2015). Nevertheless, results similar to those presented here have been reported in some single species studies (Lindborg and Ehrlén, 2002; Jacquemyn et al., 2003; Adriaens et al., 2009). In a study of populations of threatened plant *Primula farinosa,* Lindborg and Ehrlén (2002) found out that no population has disappeared when habitat quality has remained the same, but in cases of lowered habitat quality most populations have disappeared.

The present results do not necessarily mean that subtle changes in habitat quality, fragmentation, etc., have no importance for the decline of threatened species in the study area. In this connection, the effects of habitat loss and deterioration were so overwhelming that the importance of other factors could not be verified. The present results suggest that, in a real world,

human-made habitat destruction and deterioration have been so severe that other theoretically important factors causing the disappearance of populations of threatened species seem somewhat negligible.

The result of the present study may be related to the long temporal scale of the study. Within the time scale of 30–130 years, most of the habitats of threatened species have been destroyed. On shorter temporal scales, the importance of other factors besides habitat quality may be seen (Fischer and Stöcklin, 1997; Paltto et al., 2006; Hooftman et al., 2016). However, as old detailed habitat information on habitat quality is generally missing, it may be very difficult to notice changes in habitat quality potentially important for threatened species (Mortelliti et al., 2010). Thus, changes in habitat quality are easily downgraded or neglected as a cause of population disappearances (Mortelliti et al., 2012; Heinrichs et al., 2016).

There is a clear correlation between the number of threatened species and human population density (Thompson and Jones, 1999; McKee et al., 2003). Human population density in Lohja is 131 people/km$^2$. Considered in a European context, this is a rather low density. In more densely populated areas, effects of habitat destruction and deterioration on threatened species have probably been even more pronounced than in the present study area.

The proportion of populations that have disappeared was opposite to the threat status, as it was highest among vulnerable species and lowest among critically endangered species. This may be because species having highest threat status are originally very rare habitat specialists for the most part, and several species in the lower threat status have originally been rather common, but strongly reduced. The results also suggest that the threat status of some species assigned as vulnerable may be underestimated.

The disappearance rates between different habitats in the present study show similarities to other European studies (Lampolahti and Syrjänen, 1992; Stehlik et al., 2007). The area of semi-natural grasslands, mires (particularly rich fens) and springs has much decreased in northern Europe, particularly in its southern part. In forests, high disappearance rates of populations of threatened species are particularly caused by the decline of old-growth forests (Hanski and Hammond, 1995; Esseen et al., 1997). Many arable weeds have strongly declined in Europe, mainly due to the use of fertilisers, pesticides and improved crop seed cleaning (Storkey et al., 2011). The high disappearance rate on arable land was mostly caused by one species (*Buglossoides arvensis*) and it is related to habitat change due to fertilisation and use of herbicides (Svensson and Wigren, 1986).

Population persistence was highest on rock outcrops. This is in accordance with the fact that the negative influence of human activities on biodiversity has commonly been less severe on rock outcrops than elsewhere in the landscape (Pykälä, 2004; Fitzsimons and Michael, 2017). However, the disappearance rate of 55% on rock outcrops is high if compared with known habitat changes on rock outcrops. More than 90% of the original area of rock outcrops has remained in the study area. However, negative human impacts have been more severe on those rock outcrops, mainly due to limestone mining and construction that have harboured threatened species, i.e. calcareous rocks and rocks by the lakeshores. Furthermore, air pollution has been an important factor with regard to population disappearances of threatened lichens on rocks.

No previous local or regional study comparing the disappearance rates of populations of threatened vascular plants, bryophytes and lichens seems to be available. In the present study, the rates were similar, suggesting that during the national red-listing of these three groups, criteria have been used similarly. Interestingly, the importance of different reasons for the disappearance of populations highly differs between the species groups studied. Agriculture was the main reason for disappearance of vascular plant populations, forestry for lichen populations, and construction and forestry for bryophyte populations. This difference can largely be explained by the absence of obligatory epiphytic and epixylic vascular plants in northern Europe, whereas 30% of threatened bryophytes and 61% of threatened lichens in the study area are such.

Threatened vascular plants mainly grow in sites where the growth of trees is suppressed by natural (e.g. drought, flooding) or human-made factors. Many such species benefitted from traditional animal husbandry, i.e. livestock grazing and mowing of the landscape, which largely compensated suppression of natural disturbances (by fires, flooding, gap dynamics and large herbivores) made by humans (Pykälä, 2000). Drastic change in agriculture during the past 100–150 years has resulted in their existence being threatened by agriculture.

The study intensity prior to 1980 was much higher among plants than bryophytes or lichens. If the sampling intensity had been the same among the three groups, forestry may have been a more important reason for total population disappearance than agriculture. The high disappearance rate of bryophytes due to construction may be an artefact. Bryologist S. O. Lindberg mainly collected bryophytes during the late 1800s from the present centre of the City of Lohja, i.e. from the area most heavily influenced by the construction of houses.

The results suggest an increasing rate of disappearance of populations of threatened species during the latter part of the study period. Walker and Preston (2006) also reported an increase in the vascular plant species-related disappearance rate after 1950 as compared to the previous century. In accordance with these results, Pykälä (2004) showed high recent disappearance rates of threatened and rare epiphytic lichen populations growing on old trees in the study area during the 1990s.

## 5. Conclusion

The final message of the present study is unambiguous. Habitat loss and deterioration have caused almost all disappearances of populations of threatened vascular plants, bryophytes and lichens. Disappearance rates differ from one habitat to another, but no habitat type occurs with low disappearance rates. The loss of populations of threatened species has

increased after 1950. Efficient conservation measures are needed for the habitats of threatened species. Biodiversity loss cannot be stopped without increasing habitat conservation. Species cannot survive without suitable habitats.

## Declarations of interest

None.

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**Appendix. The disappeared populations and the reasons for disappearance. S = species group: B = bryophyte, L = lichen, V = vascular plant, T = threat class: RE = regionally extinct, CR = critically endangered, EN = endangered, VU = vulnerable, Exact = delimited area of the population (km2), F = first positive record, L = last positive record, Rea1 = reason for disappearance: 1 = habitat loss, 2 = habitat deterioration, 3 = unknown. Rea2 (reason for disappearance): A = agriculture, C = construction, F = forestry, M = limestone mining, P = air pollution, W = water construction, ? = unknown**

| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| B | Acaulon muticum | RE | Kiviniemi | 1 | 1883 | 1889 | 1 | Arable field | A | No arable fields in the area. Disappeared from Finland due to intensification in arable use (fertilisation and/or use of herbicides) |
| B | Amblyodon dealbatus | VU | Panimo | 0.5 | 1900 | 1900 | 1 | Rich fen | C | No rich fens in the area, whole area built up (with houses and industry) |
| V | Androsace septentrionalis | EN | Kirkniemi | 0.5 | 1933 | 1935 | 2 | Road verge | C | Decreased habitat quality (or habitat loss) due to 1. construction of houses, 2. abandonment (end of grazing and mowing), 3. nutrient enrichment due to fertilizers |
| B | Aneura mirabilis | EN | Immula | 0.1 | 1974 | 1974 | 1 | Spruce mire | F | Habitat destroyed due to forestry (drainage and clear felling) |
| L | Blastenia ferruginea | VU | Tamsaari | 1 | 1968 | 1968 | 1 | Forest | F | Habitat destroyed due to felling of trees for forestry |
| V | Botrychium matricariifolium | EN | Vaanila | 0.1 | 1960 | 1960 | 1 | Semi-natural grassland | A | Overgrowth after the end of grazing, no grasslands in the area |
| B | Brachythecium tommasinii | EN | Pitkäniemi | 0.5 | 1903 | 1903 | 2 | Calcareous rock | M | Most of the calcareous rocks in the area destroyed due to mining, but one potentially suitable site existing |
| L | Bryoria bicolor | EN | Mustasaari | 0.2 | 1937 | 1937 | 2 | Siliceous rock | P | Lowered habitat quality due to air pollution |
| V | Buglossoides arvensis | EN | Kiviniemi | 0.5 | 1881 | 1881 | 1 | Arable field | A | No arable field in the area. Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of grain seeds) |
| V | Buglossoides arvensis | EN | Hermala | 0.5 | 1890 | 1890 | 1 | Calcareous rock | A | Habitat destroyed due to change in agriculture (overgrowth after the end of grazing, pesticides, fertilisation) |
| V | Buglossoides arvensis | EN | Kirkonkylä | 1 | 1892 | 1892 | 1 | ? | A | No suitable habitat. Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of grain seeds) or due to building of houses. |
| V | Buglossoides arvensis | EN | Outamo | 2 | 1892 | 1892 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of grain seeds) |
| V | Buglossoides arvensis | EN | Sandbacka | 1 | 1892 | 1892 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Paloniemi | 5 | 1892 | 1892 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Seppälä | 1.5 | 1892 | 1892 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of grain seeds) |
| V | Buglossoides arvensis | EN | Vappula | 3 | 1892 | 1892 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Humppila | 1 | 1884 | 1893 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of grain seeds) |
| V | Buglossoides arvensis | EN | Iivars | 0.5 | 1886 | 1893 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of grain seeds) |

(*continued*)

| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| V | Buglossoides arvensis | EN | Koivula | 1 | 1893 | 1893 | 1 | Probably arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Lojoby | 2 | 1893 | 1893 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Seppä | 1 | 1892 | 1893 | | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Suoniitty | 2 | 1893 | 1893 | 1 | By house | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Niitunpaita | 1 | 1893 | 1893 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Osuniemi | 3 | 1900 | 1900 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of grain seeds) |
| V | Buglossoides arvensis | EN | Ojamo | 2 | 1902 | 1902 | 1 | Semi-natural grassland | A | No grasslands in the area, probably overgrown after abandonment |
| V | Buglossoides arvensis | EN | Hiittinen | 3 | 1907 | 1907 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of grain seeds) |
| V | Buglossoides arvensis | EN | Kirkniemi | 4 | 1907 | 1907 | 1 | Semi-natural grassland | A | No grasslands in the area. Habitat destroyed by overgrowth after the end of grazing and/or change in agriculture (pesticides, fertilisation) |
| V | Buglossoides arvensis | EN | Sedola | 1 | 1892 | 1910 | 1 | Probably arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Askola | 2 | 1892 | 1916 | 1 | Arable field | A | Habitat destroyed due to change in agriculture (pesticides, fertilisation and efficient cleaning of seeds) |
| V | Buglossoides arvensis | EN | Varola | 2 | 1956 | 1956 | 1 | Rock on field margin | A | Overgrowth after the end of grazing and eutrophication due to fertilisers |
| V | Buglossoides arvensis | EN | Kouvola | 0.3 | 1960 | 1960 | 2 | Small rock by the house | A | Habitat deterioration or loss due to overgrowth (abandonment of grazing) |
| V | Buglossoides arvensis | EN | Maksjoki | 0.2 | 1964 | 1985 | 1 | Railway verge | C | Habitat destroyed due to macadamisation of the railway verge |
| B | Buxbaumia viridis | CR | Jalassaari | 0.1 | 1963 | 1963 | 2 | Forest | C | Lowered habitat quality due to the construction of summer cottages and forest management |
| L | Calicium abietinum | EN | Humppila | 1 | 1891 | 1891 | 1 | Wooden barn | A | Habitat destroyed due to removal of barns |
| L | Calicium quercinum | CR | Torhola | 0.1 | 1938 | 1938 | 1 | Garden | C | Felling of trees, no suitable looking trees |
| V | Campanula cervicaria | VU | Prestgården | 0.5 | 1868 | 1868 | 2 | Garden | C | Lowered habitat quality or loss due to the construction of houses, nutrient enrichment and ornamental plants |
| V | Campanula cervicaria | VU | Hermala | 3 | 1879 | 1879 | 2 | ? | A | Lowered quality of edge habitats due to fertilisation, use of herbicides and overgrowth |
| V | Campanula cervicaria | VU | Routio N | 2 | 1887 | 1887 | 1 | Semi-natural grassland | A/F | No grasslands in the delimited area, overgrown after abandonment or afforested |
| V | Campanula cervicaria | VU | Sedola | 2 | 1887 | 1887 | 1 | Semi-natural grassland | A/F | No grasslands in the delimited area, overgrown after abandonment or afforested |
| V | Campanula cervicaria | VU | Paavola | 0.5 | 1890 | 1890 | 2 | ? (Edge habitat?) | A | Lowered quality of edge habitats due to fertilisation, use of herbicides and overgrowth |
| V | Campanula cervicaria | VU | Hakala | 1 | 1892 | 1892 | 3 | ? | ? | Not known (lowered quality?) |
| V | Campanula cervicaria | VU | Kirkonkylä | 2 | 1893 | 1893 | 2 | ? | A | No grasslands in the area, most of the previously potentially suitable habitat turned to arable land, afforestated or built up for houses |
| V | Campanula cervicaria | VU | Rajaportti | 1 | 1893 | 1893 | 2 | ? | A | No grasslands in the area, lowered quality of edge habitats due to fertilisation |
| V | Campanula cervicaria | VU | Lylyinen | 3 | 1894 | 1900 | 1 | Semi-natural grassland | A/F | No grasslands in the delimited area, disappeared due to agriculture or forestry |
| V | Campanula cervicaria | VU | Kouvola | 2 | 1910 | 1910 | 3 | Ditch | ? | Not known (possibly subsurface drainage, overgrowth or nutrient enrichment) |
| V | Campanula cervicaria | VU | Askola | 2 | 1913 | 1913 | 2 | ? | A | No grasslands on the area, lowered quality of edge habitats due to fertilisation |
| V | Campanula cervicaria | VU | Jalassaari | 2 | 1913 | 1913 | 1 | Semi-natural grassland | A | No grasslands in the delimited area, abandoned or converted to arable land |
| V | Campanula cervicaria | VU | Piispala | 3 | 1900 | 1913 | 3 | ? | ? | Not known |
| V | Campanula cervicaria | VU | Tamminiemi | 1 | 1874 | 1916 | 1 | Semi-natural grassland | A | No grasslands in the delimited area, probably converted to arable land |

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| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| V | Campanula cervicaria | VU | Lillojamo | 1 | 1913 | 1919 | 1 | Semi-natural grassland | A/F | No grasslands in the delimited area, disappeared due to agriculture or forestry |
| V | Campanula cervicaria | VU | Vohloinen | 2.5 | 1932 | 1932 | 2 | Ditch bank | A | Lowered quality of edge habitats due to fertilisation, use of herbicides and overgrowth or habitat destruction due to subsurface drainage |
| V | Campanula cervicaria | VU | Virkkala | 3 | 1934 | 1934 | 1 | Semi-natural grassland | A | No grasslands in the delimited area, disappeared due to abandonment (?) |
| V | Campanula cervicaria | VU | Linnaniemi | 0.5 | 1934 | 1936 | 2 | Road bank & field margin | A | Lowered habitat quality due to fertilisation |
| V | Campanula cervicaria | VU | Skraatila | 3 | 1964 | 1964 | ? | | ? | Not known |
| V | Campanula cervicaria | VU | Hormavik | 0.1 | 1973 | 1973 | 2 | Road verge | A | Lowered habitat quality due to fertilisation and overgrowth |
| V | Campanula cervicaria | VU | Talpelanlahti | 0.1 | 1978 | 1978 | 1 | Clear cut forest | F | Disappeared due to planting of trees for forestry |
| V | Carex hartmanii | EN | Pitkäniemi | 1 | 1893 | 1893 | 1 | Semi-natural grassland | C | Habitat destroyed due to the building of factories |
| V | Carex heleonastes | VU | ? | 250 | 1893 | 1893 | 1 | Rich fen | A/F | No undrained rich fens in the study area, drained for forestry or converted to arable land |
| V | Carex remota | EN | Porla | 0.1 | 1965 | 1988 | 1 | Springy forest | W | Habitat destroyed due to water construction (pumping of water) (Pykälä 1993) |
| V | Carex viridula var. bergrothii | VU | Lehmijärvi | 3 | 1934 | 1934 | 2 | Lakeshore | A | Lowered habitat quality because of overgrowth of shores due to nutrient enrichment, construction of summer cottages, and drainage |
| V | Cephalanthera rubra | CR | Karhuniemi | 0.2 | 1890 | 1898 | 2 | Forest | C | Summer cottages built on the site, small patches of potential habitat still existing |
| V | Cephalanthera rubra | CR | Pitkäperä | 0.1 | 1945 | 1945 | 1 | Forest | F | Clear felling of the growing site c. 1980 (Pykälä 1992) |
| V | Cephalanthera rubra | CR | Harvakkala | 1.5 | 1958 | 1958 | 2 | Forest | F | Most of the delimited area clear cut, small patches of potential habitat may be left |
| V | Cephalanthera rubra | CR | Maksjoki | 2 | 1959 | 1959 | 2 | Forest | F | Clear felling of more than half of the delimited area |
| V | Cephalanthera rubra | CR | Palanutkallio | 2 | 1962 | 1962 | 3 | Forest | ? | Not known (summer cottages possibly built on the site, possibly collecting) |
| V | Cephalanthera rubra | CR | Pietilä | 0.1 | 1968 | 1975 | 3 | Forest | ? | Unknown, possibly hiding in adult dormancy |
| V | Cephalanthera rubra | CR | Koikkala | 0.1 | 1972 | 1983 | 2 | Forest | F | Lowered habitat quality due to increase of spruce in the growing site (too shady for the species), possibly illegal collecting |
| B | Cephalozia lacinulata | RE | Tytyri | 1 | 1885 | 1885 | 1 | Forest | M | Habitat loss, habitat mainly destroyed due to mining, and partly due to felling of trees |
| B | Cephalozia macounii | EN | Lill-Ojamo | 1 | 1877 | 1877 | 1 | Forest | F | Habitat destroyed due to felling of trees or possibly construction of houses |
| L | Cetrelia olivetorum | EN | Ivars | 0.2 | 1917 | 1917 | 2 | Siliceous rock | F | Habitat deterioration due to clear felling for forestry |
| L | Cetrelia olivetorum | EN | Kaijola | 3 | 1945 | 1945 | 3 | Siliceous rock | F | Habitat deterioration due to clear felling for forestry and air pollution |
| L | Chaenotheca phaeocephala | VU | Humppila | 1 | 1892 | 1892 | 1 | Wooden barn | A | Habitat destroyed due to removal of barns |
| L | Cliostomum corrugatum | EN | Humppila | 1 | 1892 | 1892 | 1 | Wooden barn | A | Habitat destroyed due to removal of barns |
| L | Cliostomum griffithii | VU | Tamsaari | 1 | 1892 | 1892 | 1 | Forest | F | No suitable habitat in the delimited area. Reason for disappearance: felling of trees for forestry |
| L | Collema subnigrescens | VU | Tamminiemi | 0.5 | 1892 | 1917 | 2 | Forest | F | Habitat deterioration (or total loss) due to felling of aspens |
| L | Collema subnigrescens | VU | Virkkala | 2 | 1929 | 1929 | 1 | Forest | F | No suitable habitat in the delimited area. Probable reason for disappearance felling of trees for forestry |
| B | Conocephalum salebrosum | VU | Ojamo | 0.5 | 1891 | 1900 | 1 | Spring | C | Habitat destroyed due to construction of houses or fish farm |
| V | Crassula aquatica | VU | Jalassaari | 3 | 1874 | 1874 | 1 | ? (probably lakeshore) | A | Habitat destroyed due to water eutrophication (due to agriculture and industry) and water level regulation |
| V | Crassula aquatica | VU | Pulli | 3 | 1874 | 1874 | 1 | ? (probably lakeshore) | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Crassula aquatic | VU | Ojamo | 1 | 1877 | 1877 | 1 | Spring | C | Habitat destroyed due to construction of houses or fish farm |
| V | Crassula aquatica | VU | Hevonsaari | 0.5 | 1882 | 1882 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Crassula aquatica | VU | Bredvik | 1 | 1886 | 1886 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |

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| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| V | Crassula aquatica | VU | Kirkniemi | 3 | 1886 | 1886 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Crassula aquatica | VU | Kyrkön | 0.5 | 1886 | 1886 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Crassula aquatica | VU | Pitkäniemi | 0.5 | 1888 | 1888 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation or the building of factories |
| V | Crassula aquatica | VU | Tytyri | 1 | 1886 | 1888 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Crassula aquatica | VU | Kyrkstad | 2 | 1891 | 1891 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Crassula aquatica | VU | Lylyinen | 3 | 1893 | 1893 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Crassula aquatica | VU | Karhuniemi | 1 | 1903 | 1903 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Dactylorhiza incarnata ssp. cruenta | VU | Anttila | 0.5 | 1884 | 1888 | 1 | Wet meadow (prob. rich fen) | A | No rich fens or meadows, probably converted to arable land |
| V | Dianthus arenarius | EN | Lohjan as. | 2 | 1874 | 1884 | 2 | Esker forest | F | Lowered habitat quality: 1. total prevention of forest fires causing increase of trees, 2. the building up of many previously potentially suitable habitats |
| V | Diphasiastrum tristachyum | EN | Lohja-Ojamo | 2 | 1892 | 1894 | 1 | Esker forest | F | No suitable habitat due to fire suppression and increase of tree density due to silvicultural measures (planting of trees) |
| B | Drepanocladus lycopodioides | VU | Seppälä | 1 | 1874 | 1874 | 1 | Fen meadow | A | Turned to arable land |
| B | Drepanocladus lycopodioides | VU | Pietilä | 2 | 1879 | 1879 | 1 | Fen | A | Turned to arable land or drained for agriculture |
| B | Drepanocladus sendtneri | EN | Karhuniemi | 0.3 | 1946 | 1946 | 1 | Rock | C | Probably disappeared due to the construction of summer houses |
| V | Drosera intermedia | VU | Vohloinen | 1 | 1877 | 1877 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Drosera intermedia | VU | Haikari | 0.5 | 1883 | 1883 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Drosera intermedia | VU | Niemis | 1 | 1883 | 1883 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Drosera intermedia | VU | Kirkniemi | 3 | 1886 | 1886 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Drosera intermedia | VU | Pitkäniemi | 0.5 | 1888 | 1888 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication, water level regulation and building of factories |
| V | Drosera intermedia | VU | Hiittinen | 0.1 | 1889 | 1889 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Drosera intermedia | VU | Lill-Ojamo | 1 | 1894 | 1894 | 1 | Fen | C | Habitat destroyed due to the construction of houses |
| V | Drosera intermedia | VU | Ojamo | 1 | 1898 | 1898 | 1 | Fen | C | Habitat destroyed due to the construction of houses |
| V | Drosera intermedia | VU | Kirkonkylä | 2 | 1906 | 1906 | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Drosera intermedia | VU | Bredvik | 1 | 18.. | 18.. | 1 | Lakeshore | A | Habitat destroyed due to water eutrophication and water level regulation |
| V | Elatine alsinastrum | EN | Paksalo | 4 | 1909 | 1909 | 1 | Pond | A | No ponds in the area, filled probably due to change in agricultural use |
| V | Elatine alsinastrum | EN | Karnainen | 0.5 | 1898 | 1927 | 1 | Pond | A | No ponds in the area, filled probably due to change in agricultural use |
| L | Enchylium bachmanianum | EN | Hermala | 3 | 1890 | 1890 | 2 | Lime quarry | M | Overgrowth or lime mining, lime quarries in the area too overgrowth, close to lime quarries very small patches of potentially suitable habitat |
| V | Epilobium lamyi | EN | Hermala | 0.5 | 1916 | 1916 | 1 | Lakeshore | A | Habitat destruction due to overgrowth of shores, caused by eutrophication mainly caused by the use of fertilisers in agriculture |
| V | Epilobium lamyi | EN | Paavola | 0.5 | 1922 | 1922 | 2 | Ditch on arable field | A | Lowered habitat quality due to 1. decrease of ditches (subsurface drainage), 2. afforestation of approx. half of the potential area, 3. competition with invasive alien species (Epilobium adenocaulon) |
| V | Epilobium lamyi | EN | Jalassaari | 0.1 | 1979 | 1979 | 2 | Herb-rich forest (gap) | C | Lowered habitat quality due to 1. the construction of summer cottages, 2. competition with invasive alien species (Epilobium adenocaulon) |
| V | Epilobium obscurum | EN | Lohja II | 1 | 1906 | 1906 | 1 | Lakeshore | C | Habitat destroyed due to the construction of houses (Murto & Pykälä 1988) |
| V | Epilobium obscurum | EN | Lohja I | 1 | 1889 | 1958 | 1 | Spring and ditch | C | Habitat destroyed due to the construction of houses (Murto & Pykälä 1988) |
| V | | EN | Laakspohja | 0.5 | 1903 | 1962 | 1 | Spring | A | |

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| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Epilobium obscurum | | | | | | | | | Habitat destroyed due to the building of an artificial pond (Murto & Pykälä 1988) |
| V | Epipactis palustris | EN | Virkkala | 0.1 | 1954 | 1975 | 1 | Rich fen | C | Habitat destroyed due to drainage (probably for the construction of houses or less likely for forestry) |
| V | Epipogium aphyllum | VU | Hällberg | 0.3 | 1902 | 1902 | 1 | Lakeshore forest | C | Habitat destroyed due to the construction of summer cottages |
| V | Epipogium aphyllum | VU | Jalassaari | 3 | 1918 | 1918 | 2 | Forest | F | Habitat deterioration or loss due to felling of trees and part of the delimited area converted to arable land |
| V | Euphrasia officinalis | EN | Hermala | 0.5 | 1923 | 1923 | 1 | Semi-natural grassland | A | No grasslands in the area, overgrowth due to end of grazing or nutrient-enrichment due to use of fertilizers |
| L | Evernia divaricata | VU | Nälkömoss | 1 | 1886 | 1886 | 1 | Forest | F | Habitat destruction due to felling of trees |
| L | Evernia divaricata | VU | Krunninmäki | 0,3 | 1891 | 1891 | 2 | Forest on rock | F | Habitat deterioration due to felling of trees and air pollution, few mature pines left in the locality |
| V | Gentianella amarella | EN | Hermala | 0.4 | 1860 | 1860 | 2 | Calcareous rock | A | Habitat deterioration or loss due to overgrowth after the end of grazing, fertilisation and the construction of houses |
| V | Gentianella amarella | EN | Prestgården | 1 | 1868 | 1868 | 1 | Arable field or grassland | A | Habitat destroyed due to change in agricultural use (fertilisation and use of herbicides) |
| V | Gentianella amarella | EN | Kiviniemi | 0.5 | 1886 | 1886 | 1 | Semi-natural grassland | A | Habitat destroyed due to 1. conversion to arable land or 2. abandonment (end of grazing and mowing) |
| V | Gentianella amarella | EN | Hiidensaari | 0.5 | 1887 | 1887 | 1 | Semi-natural grassland | F | No grasslands in the area, probably afforestation |
| V | Gentianella amarella | EN | Jalassaari | 1 | 1890 | 1890 | 1 | Semi-natural grassland | A | No grasslands in the delimited area, probably converted to arable land |
| V | Gentianella amarella | EN | Kylmälahti | 0.5 | 1890 | 1890 | 1 | Semi-natural grassland | A | No grasslands in the delimited area, probably converted to arable land |
| V | Gentianella amarella | EN | Mongola | 0.5 | 1883 | 1893 | 1 | Semi-natural grassland | A | Habitat destroyed due to abandonment or conversion to arable land |
| V | Gentianella amarella | EN | Tytyri | 0.5 | 1881 | 1893 | 2 | Calcareous rock | M | Habitat deterioration or loss due to 1. mining and 2. overgrowth |
| V | Gentianella amarella | EN | Vappula | 2 | 1893 | 1893 | 1 | Semi-natural grassland | A | No grasslands in the area, converted to arable land or afforestated |
| V | Gentianella amarella | EN | Paavola | 0.5 | 1898 | 1898 | 1 | Semi-natural grassland | A/F | No grasslands in the area, converted to arable land or afforestated |
| V | Gentianella amarella | EN | Pietilä | 2 | 1898 | 1898 | 1 | ? (probably grassland) | A | No grasslands in the delimited area, probably converted to arable land |
| V | Gentianella amarella | EN | Piispala | 0.5 | 1913 | 1913 | 1 | Lakeshore grassland | A/F | No grasslands in the area, converted to arable land or afforestated |
| V | Gentianella amarella | EN | Askola I | 1 | 1913 | 1932 | 1 | Semi-natural grassland | A | No grasslands in the area, probably converted to arable land |
| V | Gentianella amarella | EN | Askola II | 2 | 1916 | 1943 | 1 | Semi-natural grassland | A | No grasslands in the area, probably converted to arable land |
| V | Gentianella amarella | EN | Svinängen | 0.5 | 1900 | 1900 | 1 | Semi-natural grassland | A | Disappeared because habitat converted to arable land (Hällström 1903) |
| V | Gentianella amarella | EN | Seppä | 0.5 | 1900 | 1900 | 1 | Semi-natural grassland | A | Disappeared because habitat converted to arable land (Hällström 1903) |
| V | Gymnadenia conopsea var. conopsea | VU | Pensaari | 1 | 1855 | 1855 | 1 | ? (probably grassland) | A/F | No grasslands in the area, abandoned or afforestated |
| V | Gymnadenia conopsea var. conopsea | VU | Tytyri | 0.5 | 1880 | 1880 | 1 | Semi-natural grassland | M | No grasslands in the area, habitat destroyed due to mining |
| V | Gymnadenia conopsea var. conopsea | VU | Heimo | 0.5 | 1886 | 1886 | 1 | ? (probably grassland) | A/F | No grasslands in the area, abandoned or afforestated |
| V | | VU | Puusilta | 0.5 | 1887 | 1887 | 1 | Field margin | A | No grasslands in the area, field margins eutrophicated due to use of fertilisers |

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| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gymnadenia conopsea var. conopsea | | | | | | | | | |
| V | Gymnadenia conopsea var. conopsea | VU | Jantoniemi | 1 | 1887 | 1887 | 1 | Semi-natural grassland | A/F | No grasslands in the area, abandoned or afforestated |
| V | Gymnadenia conopsea var. conopsea | V | Santalahti | 1 | 1887 | 1887 | 1 | ? (probably grassland) | C | No grasslands in the area, built up for summer cottages |
| V | Gymnadenia conopsea var. conopsea | VU | Sarvi | 0.5 | 1887 | 1887 | 1 | Semi-natural grassland | C | No grasslands in the area, built up for summer cottages or converted to arable land |
| V | Gymnadenia conopsea var. conopsea | VU | Paloniemi | 2 | 1887 | 1887 | 1 | Field margin | A | No grasslands in the area, converted to arable land or afforestated, field margins eutrophicated due to use of fertilisers |
| V | Gymnadenia conopsea var. conopsea | VU | Palomäki | 1 | 1887 | 1887 | 1 | ? (probably grassland) | A/F | No grasslands in the area, converted to arable land or afforestated |
| V | Gymnadenia conopsea var. conopsea | VU | Kullaksäng | 0.5 | 1891 | 1891 | 1 | Fen meadow | A | No grasslands or fens in the area, probably drained for arable cultivation |
| V | Gymnadenia conopsea var. conopsea | VU | Hakala | 1 | 1891 | 1891 | 1 | Semi-natural grassland | A/F | No grasslands in the area, abandoned or afforestated |
| V | Gymnadenia conopsea var. conopsea | VU | Kyrkstad | 0.5 | 1892 | 1892 | 1 | Semi-natural grassland | C | No grasslands in the area, build for houses or afforestated |
| V | Gymnadenia conopsea var. conopsea | VU | Jönsböle | 3 | 1892 | 1892 | 1 | Semi-natural grassland | A | No grasslands in the area, probably converted to arable land |
| V | Gymnadenia conopsea var. conopsea | VU | Rajaportti | 0.5 | 1893 | 1893 | 1 | ? (prob. semi-n. grassland) | A/F | No grasslands in the area, abandoned or afforestated |
| V | Gymnadenia conopsea var. conopsea | VU | Routio | 3 | 1893 | 1893 | 1 | Semi-natural grassland | A | No grasslands in the area, abandoned? |
| V | Gymnadenia conopsea var. conopsea | VU | Hiittinen | 1 | 1893 | 1907 | 1 | Semi-natural grassland | A | No grasslands in the area, converted to arable land? |
| V | Gymnadenia conopsea var. conopsea | VU | Tamminiemi | 1 | 1892 | 1907 | 1 | Herb-rich forest | A/F | No suitable habitat (grassland patches within a forest), disappeared due to fertilisation or overgrowth after the end of grazing |
| V | Gymnadenia conopsea var. conopsea | VU | Virkkala | 3 | 1911 | 1911 | 1 | Fen meadow | A/F | No suitable habitat, drained for agriculture or forestry |
| V | Gymnadenia conopsea var. conopsea | VU | Piispala | 0.5 | 1900 | 1913 | 1 | Semi-natural grassland | A/F | No grasslands in the area |
| V | Gymnadenia conopsea var. conopsea | VU | Paavola | 0.2 | 1916 | 1916 | 1 | Oak forest | A | Overgrown after abandonment (the end of grazing) |
| V | Gymnadenia conopsea var. conopsea | VU | Suvantola | 1 | 1929 | 1929 | 1 | Semi-natural grassland | A | No grasslands in the area, overgrown after abandonment? |
| V | Gymnadenia conopsea var. conopsea | VU | Torhola | 3 | 1932 | 1932 | 1 | Semi-natural grassland | F | No grasslands in the area, probably afforested |
| V | Gymnadenia conopsea var. conopsea | VU | Huhtasaari | 0.1 | 1956 | 1956 | 1 | Herb-rich forest | F | Too shady, increase in the density of trees |
| V | Gymnadenia conopsea var. conopsea | VU | Talpela | 0.1 | 1979 | 1982 | 1 | Clear cut forest | F | Afforestation of the habitat |
| V | Gymnadenia conopsea var. conopsea | VU | Ivars | 1.5 | 1890 | 1890 | 1 | Semi-natural grassland | A | No grasslands in the area, fields margin eutrophicated due to use of fertilisers |
| V | Gymnadenia conopsea var. conopsea | VU | Jantoniemi | 1 | 1890 | 1890 | 1 | Semi-natural grassland | A/F | No grasslands in the area, abandoned or afforestated |

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| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| B | Hamatocaulis vernicosus | VU | Lohjanselkä | 4 | 1884 | 1884 | 1 | Fen | C | No rich fens, built up for houses |
| B | Hamatocaulis vernicosus | VU | Paavola-Pieti | 2 | 1890 | 1890 | 1 | Fen meadow | A | No rich fens, turned to arable land |
| B | Hamatocaulis vernicosus | VU | Kyrkstad | 3.5 | 1891 | 1891 | 1 | ? (probably fen) | A/F | No rich fens in the delimited area, 1. drained for forestry or 2. converted to arable land |
| B | Hamatocaulis vernicosus | VU | Pietilä-Askola | 2 | 1892 | 1892 | 1 | Fen meadow | A | No rich fens, turned to arable land |
| B | Hamatocaulis vernicosus | VU | Ojamo | 0.5 | 1877 | 1900 | 1 | Lakeshore (fen) | C | No rich fens in the delimited area, build for houses |
| B | Hamatocaulis vernicosus | VU | Panimo | 0.5 | 1900 | 1900 | 1 | Fen? meadow | C | No rich fens, destroyed due to the construction of houses |
| B | Herzogiella turfacea | VU | Torhola | 3 | 1878 | 1878 | 1 | Fen | F | Habitat destoyed due to forestry |
| B | Herzogiella turfacea | VU | Lillojamo | 1 | 1885 | 1885 | 1 | ? | C | Habitat destroyed due to the construction of houses or forestry |
| B | Herzogiella turfacea | VU | Paloniemi | 5 | 1889 | 1889 | 2 | ? | F | Habitat deterioration or loss due to cutting of forests and drainage, small patches of potentially suitable habitat in the delimited area |
| B | Herzogiella turfacea | VU | Osuniemi | 3 | 1891 | 1891 | 2 | ? | F | Habitat deterioration or loss due to cutting of forests and drainage, small patches of potentially suitable habitat in the delimited area |
| V | Lathraea squamaria | VU | Isoteutari | 3 | 1902 | 1902 | 2 | Forest | F | Habitat deterioration or loss, most of the area clear cut or turned into arable land |
| V | Lathraea squamaria | VU | Kirkniemi | 0.5 | 1930 | 1930 | 1 | Forest | F | Growing site clear cut |
| L | Lobarina scrobiculata | VU | Lojobacke | 0.1 | 1886 | 1886 | 1 | Siliceous rock | C | Habitat destroyed due to the construction of houses |
| L | Lobarina scrobiculata | VU | Lahdennummi | 1 | 1887 | 1887 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution |
| L | Lobarina scrobiculata | VU | Niitunpaita | 1 | 1887 | 1887 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution and forestry practices |
| L | Lobarina scrobiculata | VU | Ulvalansaari | 1 | 1887 | 1887 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution or the construction of summer cottages |
| L | Lobarina scrobiculata | VU | Varola | 3 | 1890 | 1890 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution |
| L | Lobarina scrobiculata | VU | Saukolahti | 0.1 | 1917 | 1917 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution and forestry practices |
| L | Lobarina scrobiculata | VU | Kivikumpu | 0.1 | 1959 | 1959 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution and forestry practices |
| L | Lobarina scrobiculata | VU | Lehtikallio | 0.3 | 1959 | 1959 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution |
| L | Lobarina scrobiculata | VU | Laukkamäki | 0.1 | 1960 | 1960 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution and later by forestry practices |
| L | Lobarina scrobiculata | VU | Myllylampi | 0.3 | 1937 | 1960 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution and forestry practices |
| L | Lobarina scrobiculata | VU | Skraatila | 2 | 1892 | 1964 | 2 | Siliceous rock | P | Habitat deterioration due to air pollution |
| V | Lythrum portula | VU | Tytyri | 1 | 1887 | 1887 | 2 | Road | M | Reduction in the area of potentially suitable habitat due to lime mining |
| V | Lythrum portula | VU | Routio | 3 | 1888 | 1888 | 3 | ? | ? | Unknown |
| V | Lythrum portula | VU | Solhem | 0.5 | 1889 | 1889 | 1 | ? | A | Habitat destroyed due to arable cultivation or construction |
| V | Lythrum portula | VU | Niitunpaita | 0.5 | 1892 | 1892 | 3 | Road | ? | Unknown |
| V | Lythrum portula | VU | Vappula | 2 | 1892 | 1892 | 3 | Forest road | ? | Unknown |
| V | Lythrum portula | VU | Askola | 3 | 1893 | 1893 | 3 | ? | ? | Unknown |
| V | Lythrum portula | VU | Jönsböle | 2 | 1894 | 1894 | 1 | Lakeshore | A | Habitat destroyed due to eutrophication and water level regulation |
| V | Lythrum portula | VU | Outamo | 3 | 1898 | 1898 | 1 | Lakeshore | A | Habitat destroyed due to eutrophication and water level regulation |
| V | Lythrum portula | VU | Lylyinen | 3 | 18.. | 1903 | 1 | Lakeshore | A | Habitat destroyed due to eutrophication and water level regulation |
| V | Lythrum portula | VU | Gustafsberg | 4 | 1913 | 1913 | 1 | Lakeshore | A | Habitat destroyed due to eutrophication and water level regulation |
| | Lythrum portula | VU | Söderkulla | 1 | 1913 | 1913 | 3 | Road | ? | Unknown |
| V | | VU | Vaanila | 2 | 1919 | 1919 | 1 | Lakeshore | A | Habitat destroyed due to eutrophication and water level regulation |

(*continued*)

| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lythrum portula | | | | | | | | | |
| V | Lythrum portula | VU | Isoteutari | 3 | 1957 | 1957 | 3 | Clay road | ? | Unknown |
| V | Lythrum portula | VU | Jalaskylä | 1 | 1959 | 1959 | 1 | Pond | A | No such habitat in the area, probably disappeared due to agricultural changes |
| V | Malaxis monophyllos | EN | Panimo | 0.5 | 1884 | 1884 | 1 | Wet meadow (rich fen) | C | No rich fens or meadows in the delimited area, destroyed due to the construction of houses |
| V | Malaxis monophyllos | EN | Anttila | 0.5 | 1887 | 1887 | 1 | Wet meadow (rich fen) | A | No rich fens or meadows, probably converted to arable land |
| V | Malaxis monophyllos | EN | Ojamo | 0.5 | 1886 | 1888 | 1 | Fen | W | No rich fens, destroyed due to the construction of fish farm or houses |
| V | Malaxis monophyllos | EN | Laakspohja | 2 | 1889 | 1889 | 1 | Fen | A | No rich fens, probably converted to arable land |
| V | Malaxis monophyllos | EN | Hermala | 1 | 1893 | 1894 | 2 | Fen | A | Habitat deterioration or loss due to drainage of rich fens (one drained fen with some potentially suitable habitat), most rich fen area probably converted to arable land |
| V | Malaxis monophyllos | EN | Pensaari | 0.1 | 1975 | 1975 | 1 | Forest | C | Habitat destroyed due to the construction of summer cottages |
| B | Meesia longiseta | EN | Ojamo | 0.5 | 1886 | 1886 | 1 | Rich fen/ spring | C | No rich fens, destroyed due to the construction of houses |
| B | Meesia longiseta | EN | Muijala | 2 | 1960 | 1960 | 1 | Rich fen | F | No rich fens, drained for forestry |
| B | Moerckia hibernica | VU | Ojamo I | 0.5 | 1877 | 1877 | 1 | Lakeshore | C | Habitat destroyed due to the construction of houses or regulation of water level of the lake |
| B | Moerckia hibernica | VU | Ojamo II | 0.5 | 1878 | 1890 | 1 | Rich fen/ spring | C | Habitat destroyed due to building houses or fish farm |
| B | Neckera pennata | VU | Ojamo | 1 | 1886 | 1886 | 1 | Forest | F | Habitat destroyed due to felling of trees (or the construction of houses) |
| B | Neckera pennata | VU | Tamminiemi | 0.8 | 1917 | 1917 | 2 | Forest | F | Habitat deterioration due to felling of trees |
| B | Neckera pennata | VU | Aiskuunpuro | 0.2 | 1969 | 1969 | 1 | Forest | F | Habitat destroyed due to cutting of trees for forestry |
| B | Orthotrichum cupulatum | VU | Kiviniemi | 0.2 | 1900 | 1900 | 1 | Calcareous rock | M | Habitat destroyed due to limestone mining |
| B | Orthotrichum cupulatum | VU | Lindkulla | 0.5 | 1900 | 1900 | 1 | Calcareous rock | M | Habitat destroyed due to limestone mining |
| B | Orthotrichum cupulatum | VU | Mongola | 0.5 | 1900 | 1900 | 1 | Calcareous rock | M | Habitat destroyed due to limestone mining |
| L | Pertusaria pertusa | VU | Kuoppanokka | 0.1 | 1891 | 1891 | 2 | Siliceous rock | W | Habitat deterioration due to increase of trees (because of lowering of water table of the lake) causing too much shade to the rock outcrop, and possibly also air pollution |
| V | Polygala amarella | VU | Jantoniemi | 0.8 | 1933 | 1933 | 1 | Grassland (?) | A/F | No grasslands in the area, converted to arable land, afforestated or less likely construction for summer cottages |
| V | Polygala vulgaris | VU | Virkkala | 3 | 1938 | 1938 | 1 | Semi-natural grassland | A | Grasslands in the delimited area disappeared after the end of grazing or actively afforestated and later most of the area built up for houses |
| V | Psammophila muralis | VU | Kihilä | 0.5 | 1874 | 1874 | 1 | Semi-natural grassland ? | A | Habitat destruction due to fertilisation, use of pesticides and overgrowth |
| V | Psammophila muralis | VU | Kiviniemi | 0.5 | 1881 | 1884 | 1 | Arable field | A | No arable fields in the area, habitat destroyed due to change in agricultural use |
| V | Psammophila muralis | VU | Karnainen | 2 | 1890 | 1890 | 2 | ? | A | Habitat deterioration or loss due to fertilisation, use of pesticides and overgrowth |
| V | Psammophila muralis | VU | Ollila | 1 | 1890 | 1890 | 2 | Path | A | Habitat deterioration or loss due to fertilisation, use of pesticides and overgrowth |
| V | Psammophila muralis | VU | Ruolahti | 1 | 1890 | 1890 | 2 | Arable field margin | A | Habitat deterioration or loss due to fertilisation, use of pesticides and overgrowth |
| V | Psammophila muralis | VU | Niitunpaita | 0.5 | 1892 | 1892 | 2 | Road ditch | A | Habitat deterioration or loss due to fertilisation, use of pesticides and overgrowth |
| V | Psammophila muralis | VU | Hiittinen | 0.5 | 1887 | 1893 | 2 | Road bank | A | Habitat deterioration or loss due to fertilisation, use of pesticides and overgrowth |
| V | Psammophila muralis | VU | Lylyinen | 3 | 1892 | 1894 | 2 | Grassland and arable field | A | Habitat deterioration or loss due to fertilisation, use of pesticides and overgrowth |
| V | Psammophila muralis | VU | Jantoniemi | 3 | 1913 | 1913 | 2 | ? | A | Habitat deterioration or loss due to fertilisation, use of pesticides and overgrowth |

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| S | Species | T | Locality | Exact | F | L | Rea1 | Habitat | Rea2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| V | Psammophila muralis | VU | Lohjan asema | 3 | 1936 | 1936 | 2 | Arable field | A | Habitat deterioration or loss due to fertilisation, use of pesticides and overgrowth |
| V | Psammophila muralis | VU | Torhola | 0.1 | 1900 | 1945 | 1 | Small road | F | Habitat destroyed due to overgrowth (open path turned to forest path) |
| V | Psammophila muralis | VU | Vaanila | 0.1 | 1961 | 1961 | 1 | Open forest path | F | Habitat destroyed due to overgrowth (too shady due to increase of trees) |
| B | Pyramidula tetragona | RE | Solhem | 0.2 | 1883 | 1891 | 2 | ? | A | Habitat deterioration or loss due to abandonment and fertilisation |
| L | Ramalina thrausta | VU | Gustafsberg | 1 | 1886 | 1886 | 1 | Forest | F | No suitable habitat, habitat destroyed due to felling of trees by forestry |
| L | Ramalina thrausta | VU | Sandbacka | 1 | 1892 | 1892 | 1 | Forest | F | No suitable habitat, habitat destroyed due to felling of trees by forestry |
| L | Ramalina thrausta | VU | Joenpelto | 1 | 1892 | 1892 | 1 | Forest | F | No suitable habitat, habitat destroyed due to felling of trees by forestry |
| L | Ramalina thrausta | VU | Outamolahti | 2 | 1892 | 1892 | 1 | Forest | F | No suitable habitat, habitat destroyed due to felling of trees by forestry |
| L | Ramalina thrausta | VU | Vaanila | 3 | 1934 | 1934 | 1 | Forest | F | No suitable habitat, habitat destroyed due to felling of trees by forestry |
| L | Ramalina thrausta | VU | Lylyinen | 3 | 1946 | 1946 | 1 | Forest | F | No suitable habitat, habitat destroyed due to felling of trees by forestry |
| L | Ramalina thrausta | VU | Maksjoki | 0.2 | 1965 | 1965 | 1 | Forest | F | No suitable habitat, habitat destroyed due to felling of trees by forestry |
| B | Rhodobryum ontariense | EN | Solhem | 0.2 | 1889 | 1889 | 1 | Calcareous rock | M | Habitat destroyed due to limestone mining |
| B | Rhodobryum ontariense | EN | Kiviniemi | 0.5 | 1891 | 1891 | 1 | Calcareous rock | M | Habitat destroyed due to limestone mining |
| B | Rhodobryum ontariense | EN | Lindkulla | 1 | 1900 | 1900 | 1 | Calcareous rock | M | Habitat destroyed due to limestone mining |
| B | Riccia beyrichiana | EN | Kiviniemi | 0.5 | 1877 | 1877 | 1 | ? (prob. calcareous rock) | M | Habitat destroyed due to limestone mining |
| B | Riccia huebeneriana | EN | Ivars | 1 | 1891 | 1891 | 1 | ? | A | No suitable habitat in the area, habitat loss due to overgrowth because of the end of grazing or arable cultivation |
| B | Riccia huebeneriana | EN | Lylyinen | 3 | 1907 | 1907 | 1 | Pond | A/F | Drainage for forestry or agriculture |
| V | Saxifraga adscendens | EN | Painiemi | 0.2 | 1913 | 1913 | 2 | Calcareous rock | A | Habitat deterioration due to overgrowth (increase of trees) after the end of grazing |
| B | Syzygiella autumnalis | VU | Ojamo | 1 | 1877 | 1877 | 1 | Forest | W | Habitat destroyed due to the construction of fish farm or houses |
| B | Syzygiella autumnalis | VU | Liessaari | 2 | 1878 | 1878 | 1 | Forest | F | No mature logs in the area, habitat destroyed due to felling of trees |
| B | Syzygiella autumnalis | VU | Ojamo | 0.5 | 1890 | 1903 | 1 | Springy forest | C | Habitat destroyed due to the construction of houses or a fish farm |
| B | Trichocolea tomentella | VU | Ojamo | 0.5 | 1875 | 1913 | 1 | Spring | C | Habitat destroyed due to the construction of houses or a fish farm |
| B | Trichocolea tomentella | VU | Vaanila | 0.5 | 1961 | 1961 | 1 | Spring | F | Habitat destroyed due to drainage for forestry purposes |
| V | Ulmus glabra | VU | Pitkäniemi | 0.5 | 1887 | 1893 | 1 | Forest on lakeshore | C | Habitat destroyed due to construction of factories |
| V | Ulmus laevis | VU | Skraatila | 1 | 1886 | 1886 | 2 | Lakeshore | C | Habitat deterioration or loss, most of the potentially suitable habitats build for summer cottages |
| L | Usnea barbata | VU | Lohjanharju | 5 | 1890 | 1890 | 1 | Forest | F | Habitat destroyed due to felling of trees by forestry |
| L | Usnea barbata | VU | Tamminiemi | 0.5 | 1917 | 1917 | 2 | Forest | P | Habitat deterioration due to air pollution and possibly felling of trees |
| L | Usnea barbata | VU | Vaanila | 3 | 1934 | 1934 | 1 | Forest | F | Habitat destroyed due to felling of trees by forestry |
| L | Usnea barbata | VU | Lylyinen | 3 | 1947 | 1947 | 1 | Forest | F | Habitat destroyed due to felling of trees by forestry |
| V | Viola stagnina | EN | Askola | 1 | 1894 | 1894 | 1 | Lakeshore | A | Overgrowth due to eutrophication, drainage and/or regulation of the water table |
| V | Viola stagnina | EN | Kirkniemi | 3 | 1936 | 1936 | 1 | Lakeshore | A | Overgrowth due to eutrophication, regulation of the water table and drainage |
| V | Viola stagnina | EN | Tamsaari | 0.2 | 1936 | 1948 | 1 | Lakeshore grassland | A | No grasslands in the area, overgrowth due to eutrophication and/or regulation of the water table |

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