

Seedbank, Seedrain and Seedling Recruitment along Climate Gradients in Southern Norway



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[**Front page:** Seed capsule *Veronica alpina*, Gudmesdalen, Aurland. Photo: Astrid Berge]

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Bergen, June 2010

A handwritten signature in black ink, appearing to read 'Astin Berge', with a stylized flourish at the end.

Abstract

Recruitment through seeds is a critical process in the life history of plants. Better knowledge about this process may be helpful in predicting species ranges and range shifts under climate change.

In western Norway, the climate is predicted to become warmer and wetter. In the Norwegian fjord landscape, precipitation increases from the continental fjords to the oceanic coast, and temperature increases from alpine to lowland. Recruitment was investigated in 12 sites which provide a “climate grid”, where effects of precipitation and temperature on recruitment can be explored independently.

Gap availability is the main requirement for maintaining diversity in plant communities. Generating gaps by inducing disturbance provides an opportunity for recruitment from seeds present in the seedbank, in the intact vegetation or by invasion through long-distance dispersal. Ninety-six gaps were created, and 5077 seedlings were recorded and id-tagged.

The number of seedlings emerging in the “climatic grid” was influenced by both precipitation and temperature, but also local factors including such as insulation and inclination were important. Seedlings responded to temperature at different levels depending on the precipitation regime. The effect of temperature on seedling emergence in closed vegetation shifted along the precipitation gradient. In wet areas the effect was negative, whereas in dry areas the effect was positive. In disturbed treatments the number of emerged seedlings increases with temperature along the entire temperature gradient, and do not show the same negative effect of precipitation as in the undisturbed treatments.

Findings from two comparable methods estimating dispersal sources imply that seedbank are the main source to seedling recruitment, and show a tendency towards a higher contribution in drier areas. Findings based on the recruit-tag approach estimate a seedbank contribution of 23% - 89%. The same approach was used to estimate the extent of long-distance dispersal across elevation categories. The vast majority of the seedlings were dispersed only short distances, however 2.8% of the total emerging seedlings are potentially long-distance dispersed.

Samandrag

Frørekruttering er ein kritisk prosess i plantar si livshistorie. Ei betre forståing av denne sårbare prosessen er viktig når ein freistar å predikere artsutbreiingsmønster, samt klima induserte endringar i utbreiingsmønster.

Klimaprediksjonar for vest Noreg viser at nedbør og tempertur vil auke i dei komande år. I det norske fjord landskapet aukar nedbøren frå kontinentale fjordområder til den oseaniske kysten, og temperaturen aukar frå fjell til lågland. Rekruttering har vorte studert i 12 lokalitetar, som til saman utgjer eit ”klima-rutenett”, der effektar av nedbør og temperatur på frørekruttering kan studerast både saman og kvar for seg.

Tilgjengelege vegetasjonsfrie områder er ein av dei viktigaste føresetnadane oppretthalding av artsmangfaldet i plantesamfunn. Forstyrning kan fremje rekruttering, anten ved å fremje spiring frå frøbanken i den intakte vegetasjonen eller frå langdistansespreidde frø. I dette studiet vart 96 slike vegetasjonsfrie område laga, og 5077 kimplantar vart registrert og id-merka.

Antal kimplantar som spirte i ”klimarutenettet” var påverka av både nedbør og temperatur, i tillegg var lokale faktorar som solinnstråling og helling viktig. Frøplantane sin respons til temperatur var avhengig av nedbørsregime i området. Effekten av temperatur i lukka vegetasjon endra seg langs nedbørsgradienten. I våte områder var det ein negativ effekt, mens i tørre områder var det ein positiv effekt. Mens i forstyrta behandlingar aukar antal spirer med temperatur langs heile temperaturgradienten, utan den negative effekten av nedbør som vart funnen i lukka vegetasjon.

Funn frå to alternative metodar nytta for å estimere spreingskjelder, viser at frøbank er hovudkjelda til frørekruttering, med ein tendens mot eit større bidrag i tørre klima. Same metode vart nytta til å estimere omfanget av langdistanse spreing. Majoriteten av frøplantane var spreidd frå kjelder i nærleiken, mens 2,8% av kimplantane var potensielt langdistanse spreidd.

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1. Introduction

Human-induced climate change is now regarded as an inevitable fact (Hughes, 2000, Walther et al., 2002, IPCC, 2007). The climate change is projected to affect life on earth at all levels of organization ranging from individuals to entire ecosystems (Walther, 2004, IPCC, 2007), generating severe long-term effects on the environment in the centuries to come (Opdam and Wascher, 2004). Climate constitutes the main factor determining the global pattern of vegetation structure and species composition (Woodward, 1987, McCarty, 2001). Hence, species distributions are often regulated by species-specific tolerance thresholds of temperature and precipitation (Walther et al., 2002). Scientists are already reporting effects of the ongoing climate change on vegetation (Bradley et al., 1999, Fitter and Fitter, 2002, Parmesan and Yohe, 2003). Alpine communities in particular are expected to be vulnerable to climate change effects (Grabherr et al., 1994, Fischlin et al., 2007).

Seedlings are frequently used to monitor the effects of climate change in plant communities (Lloret et al., 2004). The seedling stage is an especially vulnerable stage of the plant life-cycle (Harper, 1977, Kitajima and Fenner, 2000). Processes prior to seedling establishment, as well as seedling establishment itself, are highly controlled by temperature (Billings and Mooney, 1968, Covell et al., 1986, Smith, 1994). Seedlings are known to be more prone to changes in environmental conditions than adult stages (IPCC, 2002, Vandvik and Vange, 2003, Lloret et al., 2004). Seedlings are more sensitive to freezing and nutrient shortage, and their small size makes them more susceptible to predation than adult plants (Vandvik and Vange, 2003). It is therefore likely that the effects of climate change will be more pronounced at seed and seedling stages than adult stages. In general, an increase in temperature is expected to be favourable to plant recruitment, however conclusions are based on research predominantly carried out in the colder parts of the globe (Fenner and Thompson, 2005).

An increase in global mean surface temperature is predicted to generate changes in the precipitation pattern (IPCC, 2007), and precipitation is projected to increase in Western Norway in the years to come (Hanssen-Bauer et al., 2003). Plant recruitment is directly affected by precipitation (Germaine and McPherson, 1998, McCarty, 2001, Walther et al., 2002, Fay and Schultz, 2009). However, the implications of changes in precipitation on

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recruitment are hard to predict, mainly because the uncertainties in the precipitation projections, but also because the effects of precipitation on recruitment depends on the amount, the timing and the reliability of the rainfall (Fenner and Thompson, 2005). Nevertheless, findings imply that an increased precipitation level will increase the rate of primary production in dry to mesic regions (Sala et al., 1988, Austin, 2002), but decrease the rate of primary production in humid to wet regions (Austin, 2002). Other studies have found that seedling establishment might be negatively affected by high precipitation levels, at least under low temperatures, and this has been attributed to an increase in seed death caused by changes in the soil micro flora under high levels of soil moisture (Harper, 1977). Species responses to varying soil moisture regimes may influence their ability to establish under variable precipitation regimes. A greater understanding of how seeds and seedlings respond to varying soil moisture conditions is essential for revealing how soil moisture affects recruitment into plant communities (Fay and Schultz, 2009).

Even when a plant's requirements for environmental conditions are satisfied, successful germination depends on a suitable microhabitat. Only a minor fraction of the seeds present in the seed bank and seed rain result in established seedlings. The number of emerging seedlings can be thought of as a function of the abundance of "safe sites" present in the environment. A safe site should offer adequate amounts of water and oxygen as well as the absence of predators, competitors and soil borne pathogens. Plants have developed partially complex dispersal and germination regulating mechanisms, such as dormancy, environmental cueing, and dispersal mechanisms in order to increase the probability of seeds reaching and germinating in sites that are safe, both temporally and spatially (Fenner and Thompson, 2005).

The intact vegetation can be a serious obstacle to the seedling recruitment of many species, as seedlings are virtually incapable of obtaining enough resources in the face of competition from adult plants (Fenner, 1985, Chambers, 1995). Gaps, plant- and competitor-free space in the vegetation, are therefore important as "safe sites" for the recruitment of many species (Bullock, 2000). Gaps occur regularly in nature via landslides, floods or storms (Fenner, 1985), or smaller gaps created by animals or by external forces such as wind and frost damage (Kalamees and Zobel, 2002). Gaps provide higher light intensities compared to closed vegetation that may result in water shortage through decreased surface soil moisture, and seedlings emerging in gaps may also experience enhanced daily temperature amplitudes, with

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a higher daytime and lower night-time temperatures than seedlings undergo in closed vegetation (Bullock, 2000). Disturbance in the context of gap formation, has been shown to be essential for maintaining diversity in grassland (Bullock et al., 1995).

Dispersal is a crucial process for seedling recruitment (Fenner and Thompson, 2005). Myers and Harms (2009) emphasise the need for a greater understanding about how seed dispersal structures biodiversity. Dispersal through space is often referred to as seedrain, that is, the flow of seeds from reproductive plants (Nathan and Muller-Landau, 2000). The vast majority of seeds disperse short distances from their origin (Willson, 1993, Cain et al., 2000, Molau and Larsson, 2000). Accordingly, it is anticipated that the local seed rain plays an essential role in gap community regeneration (Peart, 1989). Despite the growing interest in the topic, little is known about the dynamics on seed dispersal (Myers and Harms, 2009), in particular the extent of long-distance dispersal, for reasons assigned to methodological limitations (Cain et al., 2000, Nathan and Muller-Landau, 2000). Although most seeds fall within the first metre from the dispersing unit, some seeds disperse into other vegetation belts (Molau and Larsson, 2000).

There has been an increasing effort in trying to estimate the extent of long-distance dispersal, based on the realisation that these rare events can regulate the rate of population spread (Clark et al., 2003), and the colonisation of empty habitats (Cain et al., 2000). An enhanced understanding of the extent of long-distance dispersal in alpine habitats is of paramount importance in the context of temperature induced changes of species ranges, and in the attempt to project the course of invasion by alien species (Cain et al., 2000). The frequency of long-distance dispersal events is assumed to be higher in the open alpine landscapes compared to lowland habitats associated with trees, variable topography and taller vegetation. Alpine habitats are often dominated by low productivity, low stature vegetation (Billings, 1973, Grime, 2001) and pioneer vegetation, and show a dominance of wind dispersed seeds (van der Pijl, 1982). Tackenberg and Stöcklin (2009) found that more than 50% of alpine species have good possibilities to be wind dispersed over long-distances, whereas only 25% of the species found in open lowland habitats had a chance to be dispersed the same distances. The role of wind dispersal is thought to be a result of weather conditions favouring long-distance dispersal in alpine habitats (Tackenberg and Stöcklin, 2009).

Seeds can also be dispersed through time via ungerminated seeds in the soil seedbank (Cain et al., 2000). Seedbanks consist of buried reserves of viable, ungerminated seeds in a habitat

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(Dutoit and Alard, 1995, Baskin and Baskin, 1998, Nathan and Muller-Landau, 2000), and are essential in the context of long-term survival of individual plant species and communities. A conspicuous feature of the seedbank is the discrepancy between species observed in the vegetation and species present in the seedbank. Some species do not arise from the seedbank and the seedbank can contain species lacking in the vegetation (Moore, 1980, Baskin and Baskin, 1998). Accordingly, it is anticipated that seedbanks act as a storage of species, which might be unable to germinate under current local environmental conditions, but have the potential to germinate if conditions change for example as a result of gap creation or environmental change.

Despite the seedbank's importance in regeneration and maintenance of species richness (Grubb, 1977), it is poorly understood how the edaphic and climatic conditions influence the development of seedbanks (Pakeman et al., 1999). Pakeman et al (1999) found some indications that climate change might have an indirect effect on seedbanks, suggesting a gradient in seedbank density of the study species. They found that drier, sunnier and warmer sites in the south and east had smaller seedbanks than the wetter, less sunny and colder sites in the north and west of Great Britain. Also, the relative contribution of seedbank and seedrain to seedling recruitment and the influence of climate are poorly known. Studies document an inconsistency in seedbank contribution to recruitment, Kalmaes and Zobel (2002) found a substantial amount of the emerging seedlings to originate from the soil seedbank, whereas Bullock et al. (1994) and Edwards and Crawley (1999) found that the seedbank had little impact on seedling recruitment.

Climate change research has mainly focused on the effects of temperature on established plants (e.g. Havstrom et al., 1993, Arft et al., 1999, Klanderud, 2008), and more recently, also on seedling recruitment (e.g. Gimenez-Benavides et al., 2007, Graae et al., 2009, Shevtsova et al., 2009). However, there are still a number of gaps in our knowledge, as little is known about how the seedling stage is influenced by the interactive effects of changes in temperature and precipitation levels, how climate change will affect the role of gaps as safe sites for germination, and how it will affect recruitment from different sources (seedbank versus seedrain). To fill these gaps in knowledge, I have used a space-for-time approach to investigate how the vulnerable recruitment stages respond to different temperature and precipitation regimes along climate gradients in Southern Norway. First I asked, (i) how does seedling establishment vary across the climatic gradients? Subsequently, open gaps were

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created to investigate the role of disturbance for seedling recruitment. Here I asked, (ii) does the relative significance of disturbance for seedling recruitment vary along the precipitation and temperature gradients? Seedrain shelter treatments and the recruit-tag approach (see Vandvik and Goldberg (2006)) were used to examine seedling origin, asking (iii) what is the relative contribution of seedrain and seedbank to seedling recruitment, and are there any systematic trends along the gradients? To investigate the pattern of dispersal distances, I ask; (iv) where in the vegetation do the seedlings originate from? And (v) is long-distance dispersal more common in alpine sites? Finally, I ask; (vi) what consequences will increased levels of precipitation and temperature have for seedling dispersal and emergence in the study system in the years to come?

2. Materials and Methods

2.1 Study Area and Environmental Data

The fjord landscapes of Western Norway provide a suitable area for evaluating impacts of climate change, as there are sharp gradients in the two major climatic gradients, precipitation and temperature, within a relatively small geographical area. The major precipitation gradient in the region decreases from the oceanic west to the continental inner fjords (Hanssen-Bauer et al., 2003), whereas temperature decreases from low to high altitudes with a regional lapse rate of ca. 0.5°C/100 meters above sea level (Tveito and Førland, 1999). The study is based on a space-for-time substitution approach, relying on the assumption that communities and ecosystems will respond to changes in the focal variables over time in the same way as they do in space (Fukami and Wardle, 2005).

The investigated sites were selected by the SeedClim project during summer 2008. The 12 sites are located along precipitation and temperature gradients, providing a “climatic grid” to study effects of mean annual precipitation and summer temperature (tetra term; mean temperature of four warmest months per year) separately and in synergy (Fig. 2.1). The precipitation gradient spans 4 levels of annual precipitation ranging from drier continental climate in the east to wet oceanic climate in the west, i.e. about 700 mm, 1100 mm, 2000 mm and 2700 mm (Table 2.1, Fig. 2.2). The temperature classes range from (I) north-boreal or “lowland” sites associated with ca. 10.5°C tetra term temperatures, (II) to subalpine or “intermediate” sites with ca. 9°C tetra term temperatures, and (III) low-alpine the “alpine” sites with ca. 6°C tetra term temperatures (Table 2.1, Fig. 2.2) (Moen, 1999).

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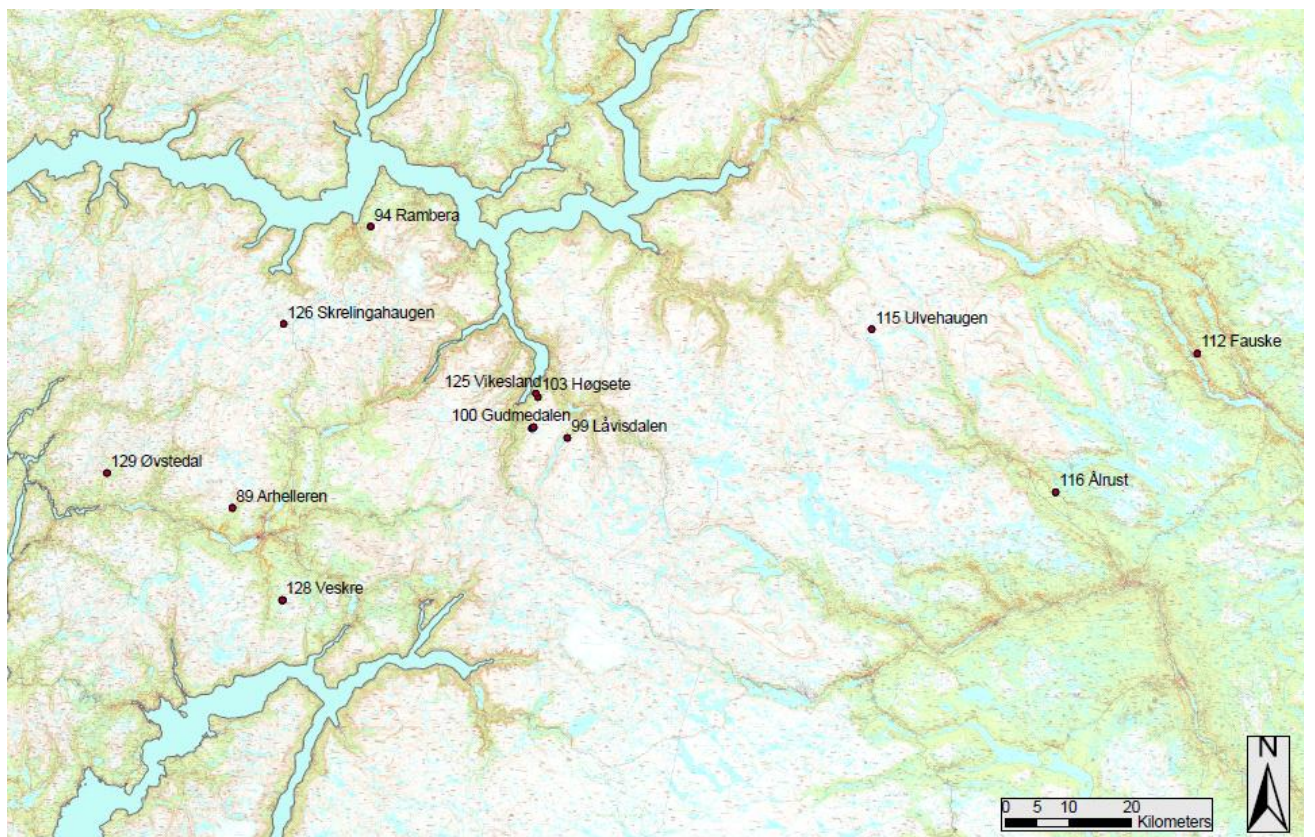
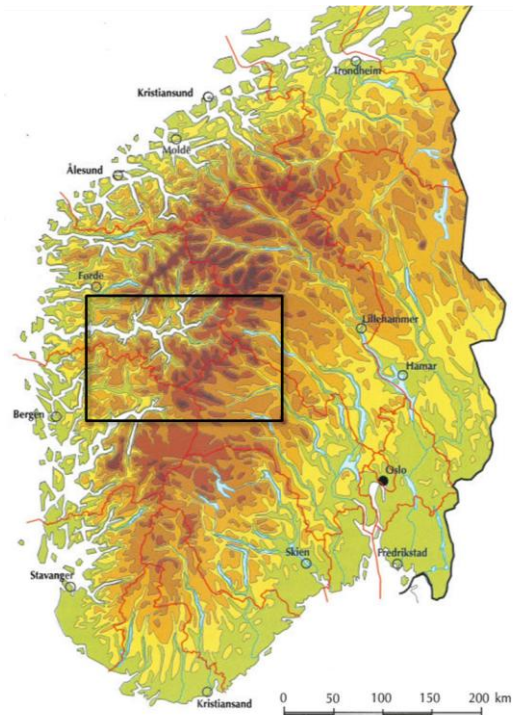


Fig. 2.1: The 12 study sites located in south western Norway. The map displaying southern Norway modified from Moen (1999), provided by the Norwegian Mapping Authorities. The number of the sites corresponds to the site numbers in Fig. 2.2.

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Table 2.1: The 12 study sites with their UTM coordinates, grouped into three elevation categories (lowland, intermediate and alpine) and the site-scale environmental variables. The mean annual precipitation and tetra term temperature (mean temperature for the four warmest months in one year)data are provided by the Norwegian Meteorological Institute (Norwegian Meteorological Institute, 2009)¹ and data on bedrock is provided by Norwegian Geological Surveys (NGU, 2009)².

Site	UTM zone 33 <i>Coordinate x</i>	UTM zone 33 <i>Coordinate y</i>	Altitude <i>m asl</i>	Precipitation ¹ <i>Mean Annual</i>	Temperature °C ¹ <i>Tetra Term</i>	Bedrock ²
<i>Alpine</i>						
Ulvehaugen	128833.00	6785010.00	1208	2923	6.17	Ryolite. Ryodacite. Dacite
Låvisdalen	80587.50	6767820.00	1097	1321	6.45	Phyllite. Mica schist
Gudmesdalen	75285.30	6769540.00	1213	1925	5.87	Phyllite. Mica schist
Skjellingahaugen	35627.60	6785870.00	1133	2725	6.58	Marble
<i>Intermediate</i>						
Ålrust	157951.00	6759200.00	815	789	9.14	(Meta)sandstone. Shale
Høgsete	75917.50	6774330.00	700	1356	9.17	Phyllite. Mica schist
Rambera	49407.80	6801320.00	779	1848	8.77	Phyllite. Mica schist
Veskre	35390.20	6742090.00	780	3029	8.67	(Meta)sandstone. Shale
<i>Lowland</i>						
Fauske	180405.00	6781200.00	589	600	10.3	Phyllite. Mica schist
Vikesland	75604.70	6774850.00	474	1161	10.55	Phyllite. Mica schist
Arhelleren	27494.10	6756720.00	439	2044	10.60	Phyllite. Mica schist
Øvstedal	7643.94	6762220.00	476	2923	10.78	Ryolite. Ryodacite. Dacite

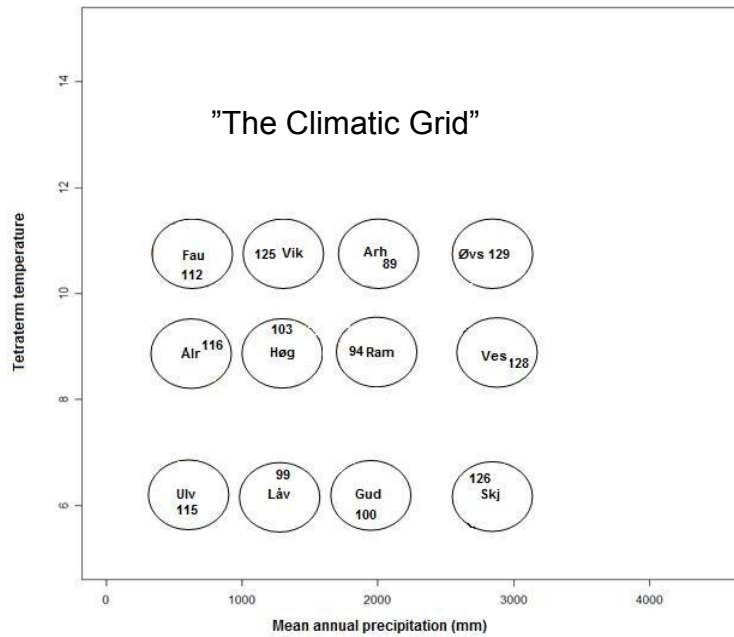


Fig. 2.2: The sites located in the climatic grid . Large circles reflect “target” climate, the site numbers reflect modelled climate of the selected sites (met.no). Abbreviations refer to the three first letters in the name of the study sites; Fau;Fauske, Vik;Vikesland, Arh;Arhelleren, Øvs;Øvstedal, Ålr;Ålrust, Høg;Høgsete, Ram;Rambara, Ves;Veksre, Ulv;Ulvehaugen, Låv;Låvisdalen, Gud;Gudmesdalen and Skj; Skjellingahaugen.

The climate data were obtained from the Norwegian Meteorological Institute (met.no). The climate variables were derived from temperature and precipitation monthly interpolated climate grids from 1961-1990. The data were interpolated with a 100 m resolution, interpolation methods with 1000 m resolution are described in (Tveito et al., 2000, 2001, 2005). The exception is the temperature data for Fauske, where data are not available. Here, temperature is calculated by a linear interpolation of temperature and precipitation measures at the nearby stations Vollen (UTM 32V GPS coordinates 61.0833: 8.983, 403 meters above sea level) and Beitostølen (UTM 32V GPS coordinates 61.2333: 8.933, 822 meters above sea level).

The sites were selected to be as similar as possible with respect to other abiotic and biotic factors to facilitate the comparisons between sites. The sites are all low productive grasslands with a high species diversity on a small scale, they are all associated with phyllite or other calcium rich bedrock, and all the sites are moderately grazed.

Inclination and soil moisture were recorded for every plot. The inclination was measured with a Silva Expedition 15 compass, and soil moisture was measured with a SM 200 Soil moisture sensor (Delta-T Devices Ltd, UK).

2.2 Training and Fieldwork Schedule

Training in species identification of seedlings was carried out by participating in recording seedling emergence in a seedbank study performed by the SeedClim project at the Arboretum at Milde in autumn and winter 2008 (see below for description of these data). Seeds were collected as a part of the SeedClim project in summer 2008 from the same sites as in this particular study.

The field work was conducted from 15th of June to 29th of September 2009. The experiments (see below) were set up between 15th of June and 26th of July. The first round of data recording started on the 27th July and lasted until the 26th August. The final recording was conducted from 8th September to 17th September. Due to differences in temperature between sites, and hence variations in growth rate, I always started the work in the lowland sites and finished in the alpine sites.

2.3 Experimental Design

The seedling recruitment experiment consist of three treatments: (I) Recruit-Tag Control (RTC), (II) Recruit-Tag Gap (RTG) and (III) Recruit-Tag Shelter (RTS). The RTC treatment, referred to as control hereafter, consists of a plot where the vegetation was intact and where regeneration under undisturbed conditions could be monitored. The RTG treatment, referred to as gap or open gap treatment hereafter, consists of a plot where all vegetation was removed. Comparing seedling emergence in open gaps and closed vegetation enables the exploration of the effects of disturbance on seedling recruitment. The RTS treatment, referred to as shelter treatment hereafter, consist of a gap covered with a fine meshed shelter to prevent seedrain from entering the gaps, such that only seedlings germinating from the seedbank should emerge. A comparison of gap and shelter treatments allowed assessment of the relative contribution of the seedrain and seedbank to seedling recruitment. To test whether the shelter provides unwanted side effects, a garden experiment was carried out by sowing a known amount of seeds in gaps with and without shelter (for details see Appendix I). All

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experimental plots were 25 x 25cm. One block contains a set of the three treatments, and four blocks were set up at each site.

The gaps were made by cutting the inner edges of a 25 x 25 cm square (Fig. 2.3b). The cut was made as clear as possible, although it was sometimes a challenge because of rocks and roots. The gaps were 5-10 cm deep, depending on the vegetation cover and soil depth. The above and below ground vegetation were removed from the resulting turfs by hand. Since most seeds are found in the upper 2 cm of the soil profile (Ooi et al., 2009), roots and above-ground vegetation were thoroughly separated from the soil trying to leave as much soil (and thereby seeds) as possible *in situ*. Making gaps under heavy rainfall is challenging. The high moisture content makes it difficult to remove the roots from the soil. Therefore, gap making was postponed on especially rainy days. A 4mm mesh sieve was used to separate soil and plant remains in some of the sites (alpine).

The shelters were made of two 80 cm long steel wires (3 mm in diameter), placed into metal pipes at the corners of the quadrats. The wires crossed at the centre, and were fastened with a backstay to the ground using cotton thread and two 95mm long sheathing nails as tent pegs (Fig. 2.3c). A 50 x 50 cm white meshed cloth was used as a tent canvas, with a mesh size of 0.8 x 1.0 mm. A node of cotton thread was made in every corner of the cloth, and a thread connected each node to a sheathing nail that was fastened in the ground. The same procedure was performed for every corner of the cloth. The cloth was fastened to the centre of the shelter at the crossed wires. This design allowed the easy removal of the cloth and sheathing nails when recording germination later in the summer. An opening (ca. 5 cm) was left between the cloth and the ground, to secure a draught and prevent a greenhouse effect inside the shelter.

The treatments were conducted in species rich herbaceous grasslands in every site. This particular experiment is one of four SeedClim experiments, all being assigned to a limited area within each block. In general the plots were placed systematically within the block, however there were exceptions to avoid areas containing rocks, especially steep hills and/or in other ways where the site exhibited non-representative properties. The gaps were created in level areas to avoid erosion, and hence seed loss from heavy rain. The gap and shelter plots were placed a sufficient distance from each other (typically 50 cm), to prevent the shelter from hindering seed dispersal into the gaps. The control treatment was conducted in areas with intact vegetation, at a distance ca. 50 cm from the other treatments. Once the plot sites

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for the different treatments had been allocated, four small pipes were fixed into the soil to mark the corners of a quadrat covering an area of 25x 25 cm. Making these plots permanent will enable the exact same quadrat to be re-sampled in the future.



Fig. 2.3: Illustration of the three treatments. **a)** Control treatment, with an id tagged seedling in closed vegetation. **b)** Gap treatment, 25 x25 cm square with vegetation removed, facilitating regeneration from both seedbank and seedrain. **c)** Shelter treatment, a fine meshed shelter covers the gap, allowing only seeds from the seedbank to germinate.

2.4 Potential Seed Sources - The Surrounding Vegetation and Seedbank

During the first period in field every site was surveyed for fertile plant species in concentric circles surrounding the plots. The presence/absence of fertile individuals was recorded at different distances i.e. within a 0.5 m radius, within a 1.0 m, within 5.0 m radius and within 10.0 m radius distance from the treatments (Fig. 2.4), with the first two being regarded as plot-level and the last two as site-level potential seed sources. However, in sites where the blocks were more spread out (diameter >5 m), I carried out two separated vegetation analyses with respect of 5 m and 10 m distances. Nomenclature follows Lid and Lid (2005).

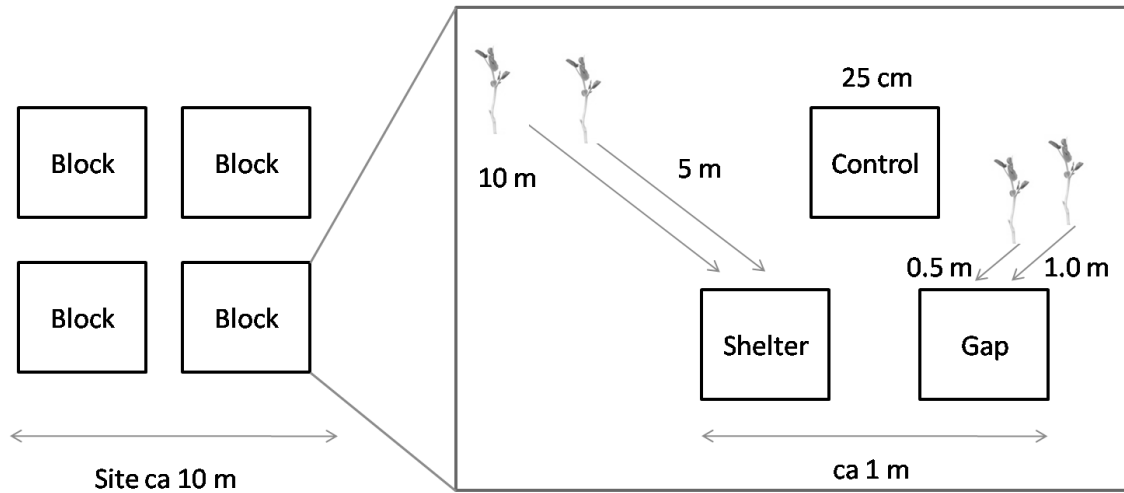


Fig. 2.4: Schematic outline of the recruit-tag approach. Each site has four blocks. Within each block, there are three treatments, control, shelter and gap. The presence of potential seeds sources (fertile individuals of forbs and grasses) were recorded in concentric circles with diameter 0.5 m, 1 m, 5 m, and 10 m surrounding each treatment plots. The approach enables a quantification of the contributors of dispersal across spatial scales.

The seedbank data were provided by the SeedClim project from a seedbank study carried out autumn and winter 2008. Soil samples were taken from the SeedClim study sites during summer 2008, seeds were extracted and sown in the greenhouse at the Arboretum at Milde during autumn 2009. One turf of 64 x 64 cm was sampled at every site. In total 4806 seedlings emerged, of which 3266 were accurately identified seedlings giving a total of 86 species.

2.5 Seedling Recording

Seedling emergence in the plots was recorded using a 25 x 25 cm vegetation analysis frame separated into 25 squares, each measuring 5 x 5 cm. Any seedlings that germinated in the treatments were id-tagged with a numbered plastic toothpick above and to the left of the seedling, and assigned a coordinate in the analysis frame. Every seedling was given its own unique id code and its frame coordinates, information about the site, block and treatment were all recorded. Seedlings were separated into two categories: forbs or graminoids. Seedlings that possessed enough characteristics were determined to species or genus level. Forb seedlings were only recorded when the two cotyledons were visible, and could easily be seen without a magnifying glass (ca. ≤ 2 mm cotyledon length). For identification, an Olotricon (23 mm - 10x) magnifying glass was used. Those that were difficult to identify, but exhibited some identification characteristics were coded, described and grouped in order to facilitate the

recording in the coming years of monitoring. None of the graminoids were identified to species level.

For individuals without cotyledons, those that were evidently bigger and more robust than the other seedlings were assumed to be vegetative. For doubtful species, I called for expertise and help and/or checked my assumptions and dug up the seedlings. For the control treatments in vegetation cover, moss cover and vegetation height were also recorded. In intact vegetation graminoids growing from seeds were hard to distinguish from ones arisen from vegetative shoots, so only forb species were recorded in the control treatment.

During the last period of field work 8th September to 17th September, seedlings identified in the second field season were verified, newly emerged seedlings were recorded, id tagged and identified. In addition, seedling mortality and grazing damage were recorded.

2.6 Statistical Analysis

2.6.1 Germination Data

To test the effect of the measured explanatory variables and treatment on seedling recruitment a manual model selection was carried out, using a linear mixed effect model (lmer) (Bolker, 2006). The number of emerging seedlings were the response variable. The following explanatory variables were tested in the model selection; treatment, temperature, precipitation and their interactions were included as fixed factors, soil moisture, solar radiation, aspect and inclination were incorporated as covariables. Additionally, block nested in site were implemented as random factors. The manual model selection found that treatment, temperature, precipitation and their interactions, in addition to solar radiation and inclination gave the best fit to the data and were included in the final model. The germination data consist of count data which are Poisson distributed. Overdispersion was corrected for by implementing a quasi Poisson distribution (Breslow and Clayton, 1993, Crawley, 2007).

Because of the lack of predict functions, adequate graphical tools and available p-values when incorporating quasi Poisson further analysis were carried out in a generalised linear mixed effect model (glmmPQL) (Bolker et al., 2009). Due to the presence of categorical explanatory variables a contrast analysis were carried out, that is, changing the control in the statistical analysis in order to obtain sufficient comparisons the explanatory variables. The

contrast analyses that reflect the different questions asked in the study are presented in the results all based on the same underlying model.

Based on the final model, a predict function was applied to estimate seedling emergence in the climatic grid in 2050, under warmer tetra term temperature and higher precipitation levels as predicted by the A1B scenario of the Intergovernmental Panel on Climate Change (IPCC, 2007). Predicted values on tetra temperature and mean annual precipitation under the A1B scenario are calculated by applying averaged values of 3 climate projection models, GFDL ECHAM and HADCM3 (see Geophysical Fluid Dynamics Laboratory, 2010, Max-Planck-institute, 2009, Met Office Hadley Centre, 2009 , respectively), provided by the Bjerknes Centre for Climate Research (Sorteberg and Skolem Andersen, 2008). According to this scenario, the mean tetra term temperature in the climatic grid is predicted to increase from 7.05°C to 9.01°C by 2050, whereas mean annual precipitation is expected to increase from 1722.5 mm precipitation to 1912.1 mm in 2050 (Norwegian Meteorological Institute, 2009).

For seedling emergence in intact vegetation, correlation tests were carried out to analyse the relationships between number of seedlings emerging and vegetation cover, moss cover and vegetation height. In addition, a test of the correlation between the degree of moss cover and the precipitation level was conducted.

A Shapiro Wilkison test was used to test for normality (p-value < 0.05). The precipitation data were log transformed. Solar radiation and aspect were obtained using the module “Area Solar Radiation” implemented in ArcGis 9.2 (ESRI, 2008). The calculation used a Digital Elevation model with a 100m resolution; latitude was set as the mean latitude of the climate grids (~ 61°N). Statistical tests were performed in the statistical programme R GUI version 2.10.1 (R Development Core Team, 2009).

2.6.2 Dispersal Distances and Seedling Origin

A subset from the germination data is used in these analyses, as only reliable species identifications recorded in the gap treatment are included. This subset of the germination data was used as a template when extracting data from the other datasets, i.e. seedbank data and distance data.

Materials and Methods

To investigate the relative contribution of seedbank and seedrain across the climatic gradients each seedling was assigned to one particular source (dispersal versus seedbank) and to a particular dispersal distance category as follows. The distance and seedbank data were arranged into identically arranged data sheets. For all species that were present in the vegetation, every seedling was assumed to originate from the nearest fertile congener. Some seedlings had congeners both in the nearby vegetation (within the 10 m radius circle) and in the seed bank. These seedlings were treated separately to allow quantification of the minimum and the potential maximum contribution of the seed bank and of dispersal from the different dispersal distances (see below) to recruitment in the gaps. Seedlings of species that were absent both from the seedbank and from the local vegetation, were assumed to have dispersed in form outside the 10m circle.

The IF function in Microsoft Office Excel[®] were used across identical arranged spreadsheets to estimate the minimal dispersal distance into the gaps and the relative impact of seedrain and the contribution of the seedbank to recruitment. Calculations were carried out both for “minimum” and “maximum” seedbank contribution and “minimum” and “maximum” seedrain contribution. The minimum seedbank contribution comprise seedlings of species that were present in the seedbank, and absent in the vegetation. The maximum seedbank contribution covers both the species only present in the seedbank, but also the species being present both in the vegetation and in the seedbank. The minimum seedrain contribution includes seedlings of all species only present in the vegetation, whereas the maximum seedrain includes the seedlings of all species only present in the vegetation but also those species being present both in the vegetation and in the seedbank. Both seedrain and shared seedbank – seed rain contributions were divided among the dispersal distances by assigning the seedlings to the nearest possible seed source (i.e. the first concentric circle in which it was encountered).

A forward manual model selection was carried out using a linear mixed effect model (lmer). The number of emerging seedlings m^{-2} as the response variable, and block nested in site as a random factor. The effects of the fixed factors temperature, precipitation, distance and altitude, and their interactions, on seedlings per m^2 were analysed in the forward selection. The manual model selection found that temperature, precipitation, distance and an interaction between precipitation and distance gave the best fit to the data. These were implemented into a glmmPQL model with a logarithmic function for further analysis, due to the constraints in

Materials and Methods

the lmer model mentioned above. The distance data were Poisson distributed. Overdispersion was corrected for by implementing quasi Poisson distribution. Only seedlings recorded in the gap treatment were analysed. Precipitation data were log transformed. A Shapiro Wilk test was used to test for normality ($p\text{-value} < 0.05$).

Minimum and maximum seedbank contributions to germination are calculated as a proportion of the number of germinated seedlings. The minimum contribution to recruitment includes species with no fertile congener in the vegetation and must therefore have originated from the seedbank, whereas the maximum contains seedlings having sources both in the vegetation and in the seedbank, and therefore include seedlings that cannot be unambiguously attributed to either source. Two separate analyses were carried out, with maximum and minimums seedbank estimate as response variables. The relationships of the response variables with the explanatory variables of temperature, precipitation and their interactions were analysed. Site was implemented as a random effect. Only data from the gap treatment are used, and alpine sites are omitted from the statistical analysis due to the limited number of recordings. The data are Poisson distributed, and overdispersion was corrected for by using quasi Poisson distribution. The data were found to be non normally distributed according to Shapiro-Wilk normality ($p\text{-value} < 0.05$). Microsoft Excel 2007[®] and R GUI version 2.10.1 were used for graphical illustrations. Statistical tests were performed in the statistical programme R GUI version 2.10.1 (R Development Core Team, 2009).

3. Results

In total, 5412 seedlings emerged in the 12 sites in the first year of colonisation, of which 325 died and 10 seedlings were trampled on by grazing animals. 5077 seedlings were alive at the end of the 2009 growth season, including 1167 graminoids and 3910 forbs. In the closed vegetation the number of emerging seedlings ranged from 0 to 28 per plot; in the gaps covered by a seed shelter the number of emerging seedlings ranged from 0 to 159; whereas in the open gaps the number of seedlings emerged varied from 0 to 211 seedlings.

The fixed effects treatment, temperature, precipitation and their interactions, and the covariable solar radiation were found significant after forward selection ($p < 0.05$, Table 3.1). These, in addition to the covariable inclination had the lowest AIC value after a forward selection and were included in the final model ($df = 17$, AIC 703.31). The results are presented in two contrast matrices used as a basis for question I –III.

3.1 Seedling Emergence along Climate Gradients (Question I)

In total 225 seedlings were recorded in intact vegetation across the gradients, 44% were recorded in the alpine, 22% were recorded in the intermediate and 34% were recorded in lowland sites (Table 3.2). Both precipitation ($df = 6$, $p = 0.0285$) and temperature ($df = 6$, $p = 0.0182$) had a significant impact on seedling emergence. The effect of these regional factors are the most important effects, however local factors such as insulation, inclination and soil moisture also play a considerable role (Table 3.1 Contrast analysis I).

The strong negative interaction between precipitation and temperature ($p = 0.0164$) alter the effect of the two interacting variables. Seedling emergence decreases in colder and drier areas, but increase in colder and wetter areas (Fig. 3.1a). Seedling emergence also have a negative response to an increasing temperature the three wetter regions, but increase in the driest region (Fig. 3.1a).

As a result of the interdependent variables, the highest seedling emergence is recorded in the warm lowland sites and the cold alpine sites (Fig. 3.1a). The maximum values of seedling emergence are comparable (ca. 20 seedlings plot⁻¹) in both dry lowland and wet alpine (Fig. 3.1a).

Results

Additionally, the number of seedlings decreased with increasing moss cover ($r = -0.54$, $df = 41$, $p < 0.001$), which again increased with increasing precipitation ($r = 0.41$, $df = 41$, $p < 0.01$). Seedling emergence in closed vegetation were not related to vegetation cover ($r = -0.22$, $df = 41$, $p > 0.05$) or vegetation height ($r = -0.09$, $df = 41$, $p > 0.05$).

Table 3.1: Summary from the glmmPQL model investigating the effect of temperature, precipitation, solar radiation and inclination on seedling emergence. In contrast analysis (I) treatment RTC is included as a control, whereas for contrast analysis (II) treatments RTG is included as a control. Parameter estimate values, standard errors, degrees of freedom, t-values and p-values are shown. Abbreviations: RTC (control), RTS (shelter) and RTG (gap). All effects with $p > 0.05$ are shown in italics.

	Value	Standard Error	df	t-value	p-value
Contrast Analysis (I)					
Intercept (RTC)	-36.28	14.74	76	-2.56	0.0161
Solar radiation kW	-2.64	0.92	6	-2.87	0.0284
Inclination	-0.01	0.01	76	0.73	0.4675
<i>Treatment RTG</i>	<i>29.56</i>	<i>15.14</i>	<i>76</i>	<i>1.95</i>	<i>0.0546</i>
Treatment RTS	41.89	14.77	76	2.84	0.0058
Temperature	5.73	1.78	6	3.22	0.0182
Precipitation	13.68	4.77	6	2.87	0.0285
TreatmentRTG:temperature	-4.14	1.79	76	-2.31	0.0237
TreatmentRTS:temperature	-5.35	1.77	76	-3.03	0.0033
TreatmentRTG:precipitation	-10.71	4.89	76	-2.19	0.0316
TreatmentRTS:precipitation	-14.23	4.79	76	-2.97	0.0040
Temperature:precipitation	-14.23	0.59	6	-3.30	0.0164
TreatmentRTG:temperature:precipitation	1.57	0.59	76	2.64	0.0101
TreatmentRTS:temperature:precipitation	1.91	0.59	76	3.25	0.0017
Contrast Analysis (II)					
<i>Intercept (RTG)</i>	<i>-6.72</i>	<i>7.93</i>	<i>76</i>	<i>-0.85</i>	<i>0.3995</i>
Solar radiation kW	-2.64	0.92	6	-2.87	0.0284
Inclination	-0.01	0.01	76	-0.73	0.4675
<i>Treatment RTS</i>	<i>-12.33</i>	<i>7.81</i>	<i>76</i>	<i>1.58</i>	<i>0.1188</i>
<i>Treatment RTC</i>	<i>-29.56</i>	<i>15.14</i>	<i>76</i>	<i>-1.95</i>	<i>0.0546</i>
Temperature	1.59	0.83	6	1.90	0.1056
Precipitation	2.96	2.47	6	1.20	0.2745
TreatmentRTS:temperature	-1.21	0.79	76	-1.54	0.1288
TreatmentRTC:temperature	4.14	1.79	76	2.19	0.0237
TreatmentRTS:precipitation	-3.52	2.46	76	1.43	0.1567
TreatmentRTC:precipitation	10.71	4.89	76	2.19	0.0316
Temperature:precipitation	-0.38	0.26	6	-1.45	0.1968
TreatmentRTS:temperature:precipitation	-1.57	0.60	76	1.36	0.0101

Results

Table 3.2: Mean seedling emergence \pm SD per plot and total number of seedlings per site and treatment. Treatments were; open gap (RTG); gap covered by shelter (RTS) and; intact vegetation (RTC). The data is separated into elevation categories with sites ordered according to increasing level of mean annual precipitation within elevation categories.

Site	Gap			Shelter			Control		
	Mean Seedlings plot ⁻¹	\pm SD	Σ seedlings site ⁻¹	Mean seedlings plot ⁻¹	\pm SD	Σ seedlings site ⁻¹	Mean seedlings plot ⁻¹	\pm SD	Σ seedlings site ⁻¹
<i>Alpine</i>									
Ulvehaugen	6.75	\pm 6.70	27	24.00	\pm 33.55	96	2.50	\pm 3.11	10
Låvisdalen	32.25	\pm 19.48	129	33.00	\pm 15.68	132	8.00	\pm 8.29	32
Gudmesdalen	8.75	\pm 6.60	35	8.50	\pm 9.68	34	9.50	\pm 5.92	38
Skjellingahaugen	20.50	\pm 9.47	82	23.75	\pm 12.87	95	4.50	\pm 4.20	18
<i>Intermediate</i>									
Ålrust	43.50	\pm 23.81	174	42.50	\pm 30.42	170	7.75	\pm 8.34	31
Høgsete	97.50	\pm 37.10	390	97.25	\pm 19.03	389	0.50	\pm 0.58	2
Ramberg	91.25	\pm 20.29	365	53.25	\pm 32.37	213	0.75	\pm 0.96	3
Veskre	20.00	\pm 18.42	80	14.75	\pm 11.64	59	3.50	\pm 3.42	14
<i>Lowland</i>									
Fauske	142.50	\pm 47.35	570	98.25	\pm 30.25	393	17.75	\pm 6.95	71
Vikesland	105.00	\pm 53.67	315	100.33	\pm 61.13	301	0.67	\pm 0.58	2
Arhelleren	63.50	\pm 37.08	254	46.50	\pm 27.18	186	1.00	\pm 1.41	4
Øvstedal	104.75	\pm 19.41	419	69.75	\pm 30.58	279	0.00	\pm 0.00	0
<i>Σ seedlings</i>			2840			2347			225
<i>Mean seedlings \pm SD</i>			60 \pm 50			50 \pm 40			5 \pm 7
<i>Total</i>									5412

Results

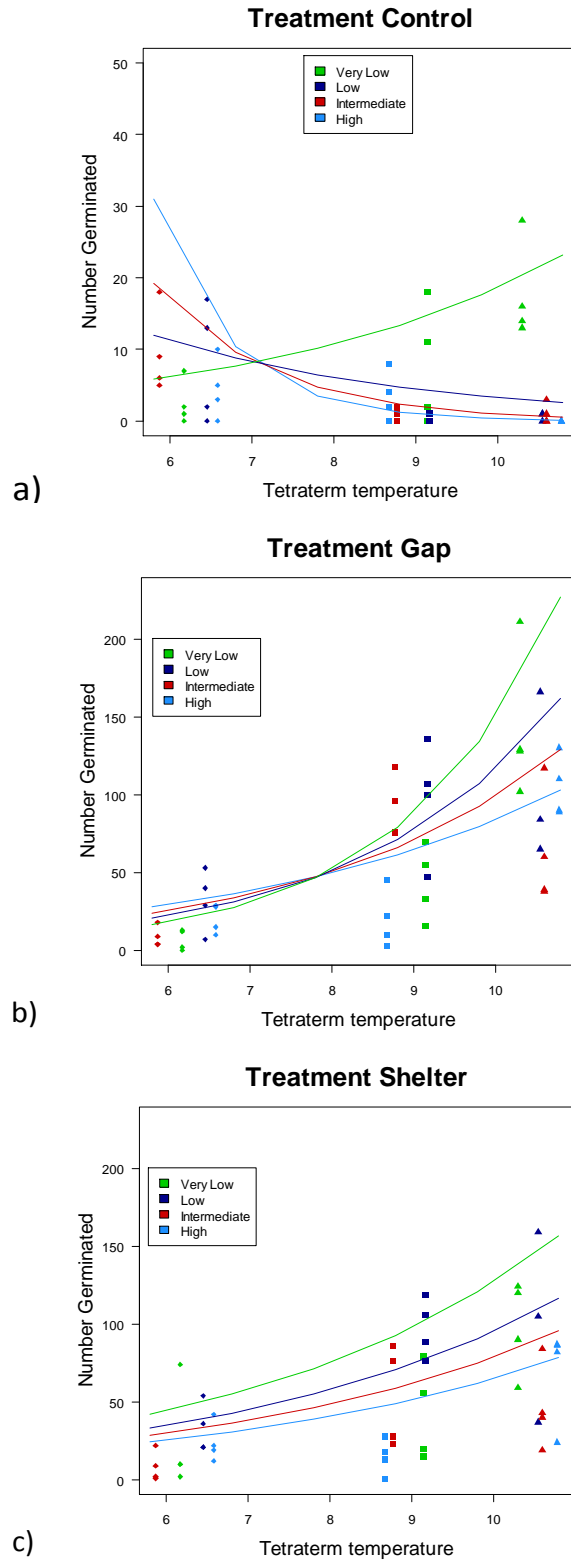


Fig. 3.1: Predicted seedling emergence across treatments based on the final model. Trend lines are predicted from averaged values from the four precipitation categories. The different symbols represent the elevation categories; \blacklozenge ; alpine, \blacksquare ; intermediate and \blacktriangle ; lowland sites. The different colours of the dots denote the precipitation level of the site, corresponding to the predicted line. **a)** Control treatment; closed vegetation. Note the different scale on the y-axis for the control plot. **b)** Gap treatment; open gap. **c)** Shelter treatment; gap covered with shelter.

3.2 Natural Regeneration Compared to Facilitated Regeneration (Question II)

A total of 2840 seedlings emerged in gaps, and across the climate gradient seedling emergence was higher in the open gap plots than in the intact vegetation (Table 3.1 Contrast analysis I). Overall, 53% of the total number of seedlings emerged in the open gap treatment, whereas only 4% emerged in the closed vegetation (Table 3.2).

A significant three way interaction was found between RTG, temperature and precipitation ($df = 46$, $p = 0.0101$) shows that the patterns in seedling emergence across different temperature and precipitation regimes in gaps differs from the patterns found in the intact vegetation (Table 3.1 Contrast analysis I, Fig. 3.1b).

Specifically, the number of seedlings emerging increases with temperature across the whole precipitation gradient in the open gap treatment (Fig. 3.1b), and the negative effect of increasing temperature found in closed vegetation three wettest regions is absent (Fig. 3.1a).

3.3 Seedrain versus Seedbank Contribution to Recruitment (Question III)

Overall the gaps with shelter have a lower number of emerging seedlings than the unsheltered gaps (Table 3.2), but they are not significantly different from each other ($df = 76$, $p = 0.0546$, Table 3.1 Contrast analysis II). A tree-way interaction term between shelter treatment, temperature and precipitation was found significant ($df = 76$, $p = 0.0101$, Table 3.2).

Consequently, relative contribution from seedrain and seedbank changes along the gradients. The model estimates show a gradual increase in seedbank contribution with increasing temperature especially in areas with low levels of precipitation (Fig. 3.1b,c, Table 3.3).

In the alpine sites the percentage contributions of seedbank show negative values for some of the sites (Fig. 3.1c, Table 3.3). The relatively high seedling emergence under the shelters, could possibly indicate a shelter effect, e.g. that the shelters have protected the gap against the low temperatures, or because they provide an increase in the total sum of temperature excreted on the seedlings, and thereby enhance the germination and growth rate.

Results

Table 3.3: Estimates on seedbank and seedrain contribution and mean seedrain and seedbank contribution \pm SD, based on predictions from the final model. Percentage seedrain contribution is calculated by subtracting shelter values (seedbank) from gap values (seedbank + seedrain). Estimates are based on mean values of precipitation and temperature.

Altitude	Temperature °C	Precipitation (mm)	Seedlings Shelter	Seedlings Gap	Seedrain Gap Percent	Seedbank Gap Percent
Lowland	10.5	2884	47	62	24%	76%
Lowland	10.5	1950	55	73	25%	75%
Lowland	10.5	1288	66	88	25%	75%
Lowland	10.5	661	87	118	26%	74%
Intermediate	9.0	2884	33	41	20%	80%
Intermediate	9.0	1950	38	44	14%	86%
Intermediate	9.0	1288	45	48	6%	94%
Intermediate	9.0	661	59	54	-9%	109%
Alpine	6.0	2884	16	18	11%	89%
Alpine	6.0	1950	18	16	-13%	113%
Alpine	6.0	1288	21	14	-50%	150%
Alpine	6.0	661	27	11	-145%	245%
Mean \pm SD					-5.5% \pm 47.1%	105.5% \pm 47.1%

3.4 Recruit-Tag Approach and the Impact of Seedrain and Seedbank (Question III)

A total of 716 seedlings emerging in the gap treatments possessed sufficient characteristics to be identified to species level. Two-thirds of the seedlings had congeners both in the seedbank and in the vegetation within a 10m radius, thus cannot be unequivocally be attributed to either source. 23.5% of the seedlings had no congener in the vegetation and consequently they are expected to have arisen from the seedbank. Based on a manual model selection, a model including as precipitation the as sole explanatory variable resulted in the lowest AIC value for both response variables (minimum seedbank contribution: $df = 4$, AIC 17.22, maximum seedbank contribution: $df = 4$, AIC 11.98). Temperature was not significant for either the response variables, nor was the interaction between the explanatory variables (Table 3.4).

Results

Table 3.4: Outputs from glmmPQL model, analysing the relationships between both maximum seedbank estimate and minimum seedbank estimate and the explanatory variable, precipitation, showing, values, standard error, degrees of freedom, t-value and p-values. Only recordings from the gap treatment are applied. Alpine sites are omitted due to insufficient observations.

	Value	Standard Error	df	t-value	p-value
<i>Seedbank maximum</i>					
(Intercept)	1.53	1.06	22	1.44	0.16
Precipitation	-0.55	0.33	6	-1.64	0.15
<i>Seedbank minimum</i>					
(Intercept)	5.70	2.75	22	2.07	0.05
Precipitation	-2.29	0.90	6	-2.54	0.04

Results

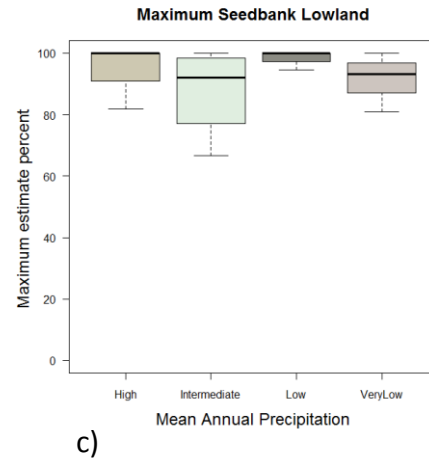
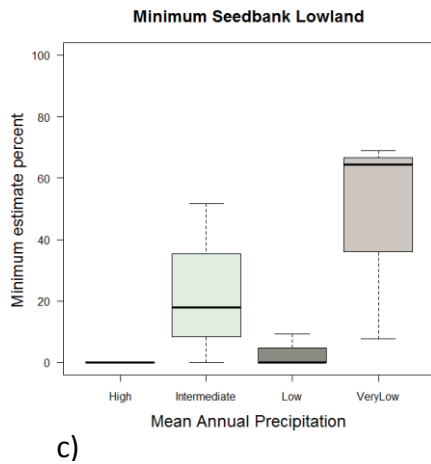
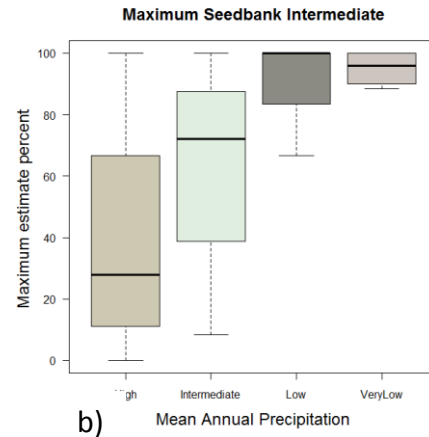
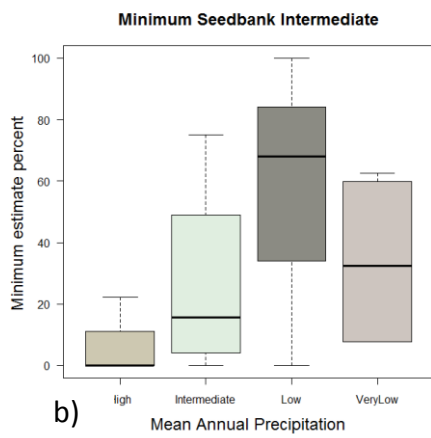
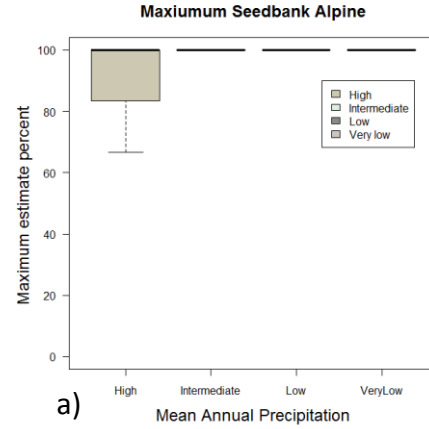
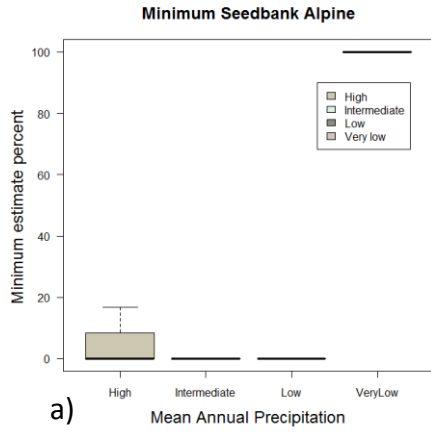


Fig. 3.2: Boxplots showing minimum estimates for seedbank contribution to recruitment in gaps across precipitation regimes at different elevations. Mean annual precipitation: high ca. 2700 mm, intermediate ca. 2000 mm, low ca. 1100 mm, very low ca. 700 mm. Proportion data based on germination recorded from the gap treatment allowing both seedrain and seedbank contributions to recruitment at the plot level. Only seedlings that could unequivocally be attributed to the seedbank (i.e. lacking local dispersal sources in the vegetation) are included. **a)** Alpine sites **b)** intermediate sites **c)** lowland sites.

Fig. 3.3: Boxplots showing maximum estimates for seedbank contribution to recruitment in gaps across precipitation regimes at different elevations. Mean annual precipitation: high ca. 2700 mm, intermediate ca. 2000 mm, low ca. 1100 mm, very low ca. 700 mm. Proportion data based on germination recorded from the gap treatment allowing both seedrain and seedbank contributions to recruitment at the plot level, proportion minimal seedbank contribution of total germinated. All seedlings that could potentially have originated from the seedbank (i.e. species present in the local seed bank) are included. **a)** Alpine sites **b)** intermediate sites **c)** lowland sites.

Results

The total seedbank contribution to seedling recruitment ranged from 23% to 89% across all sites. This contribution varies along the precipitation gradients, with a trend towards a higher seedbank contribution to recruitment in drier areas. In the alpine, the contribution of the seedbank is difficult to estimate due to the low number of emerging seedlings and a high fraction of small seedlings without identifiable characteristics. Accordingly, data from alpine sites were excluded from the statistical analyses.

3.5 Dispersal Distances and the Recruit-Tag Approach (Question IV-V)

Two-thirds of the seedlings had congeners both in the vegetation and in the seedbank within the 10m radius, and therefore could not unequivocally be assigned to either source. 7.1% of the seedlings had no congener in the seedbank and were therefore assigned to the seedrain, whereas 23.5 of the seedlings had no congener in the vegetation and were therefore assigned to the seedbank.

The vast majority of the seedlings are dispersed in short distances. 48% of the total number of seedlings that potentially could have arrived from the seedrain had their closest dispersing unit within a 0.5 m radius (distance 1), of which ca. 93% could potentially have emerged from the seedbank. Whereas 7% of the seedlings were not present in the seedbank and therefore must have originated from the seedrain. 18% of had a dispersing unit present within the range a of 0.5 m -1.0 m (distance 2), of which 98% could have originated either from the seedbank or the seedrain, and 2% from fertile individuals. 31% of seedlings with a congener in the vegetation are estimated to be dispersed from the 1-5 m interval (distance 3). Here, 81% are dispersed either through seedrain or seedbank, and 18% have most likely arrived from seedrain. Only about 2.7% seedlings were recorded with their closest fertile individual within the 5-10 m radius (distance 4), but none of the seedlings could be separated as unambiguously originating from the seedrain and accordingly 100% are classified as originating from either the seedbank or seedrain. Across both distance categories and elevation categories the impact of seedrain to recruitment is low (Fig. 3.4), however the intermediate sites, seedrain potentially play a greater role to recruitment (Fig. 3.4b). 2.8% of the total number of seedlings emerging in the gap treatment had no fertile congener either in the vegetation or in the seedbank, within the 10m radius from the treatments. Accordingly, these individuals must have arrived via seedrain from distances further away, and could potentially have arrived through events of long-distance dispersal.

Results

In the data analysis the fixed effects of distance, precipitation and their interactions as well as temperature are significant ($p < 0.05$) and are included in the final glmmPQL model (df = 8, AIC 3917, Table 3.5). Accordingly, the number of seedlings per square meter within each distance varies with precipitation level and the temperature.

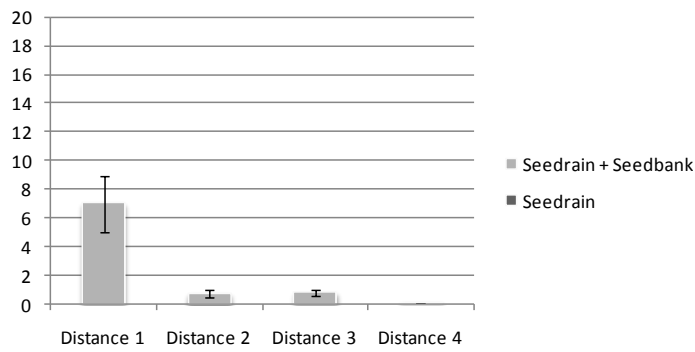
Table 3.5: Results from the glmmPQL model analyzing number of seedlings per m^2 as a function of dispersal source, environmental factors and their interactions, providing parameter estimates values, their standard errors , degrees of freedom, t-value and p-value.

	Value	Standard Error	df	t-value	p-value
(Intercept)	7.64	2.62	186	2.92	0.0039
Distance	-3.76	1.29	186	-2.92	0.0039
Precipitation	-3.13	0.79	9	-4.01	0.0031
Temperature	0.63	0.13	9	5.03	0.0007
Distance:precipitation	0.83	0.42	186	1.98	0.0496

Results

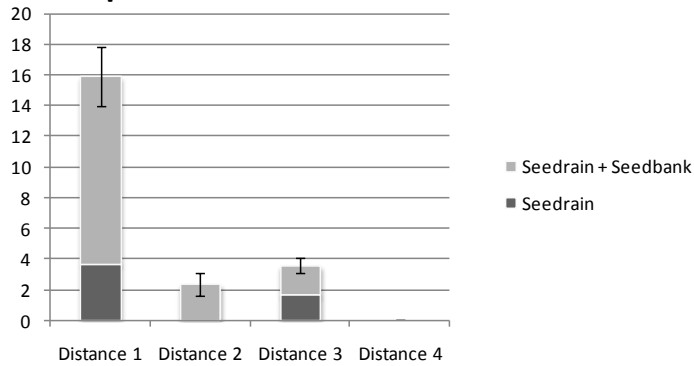
a)

Dispersal Distances Alpine



b)

Dispersal Distances Intermediate



c)

Dispersal Distances Lowland

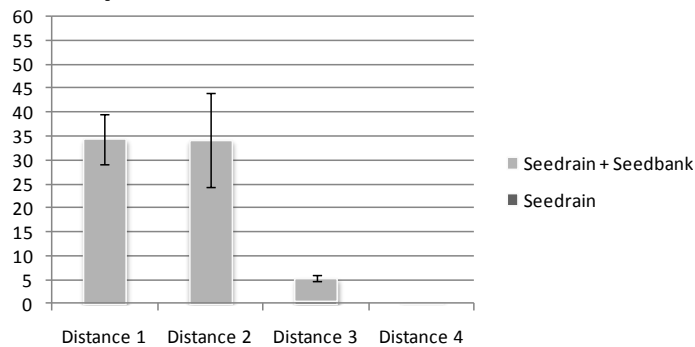


Fig. 3.4: Mean number of seedlings originating from the consecutive distance (1-4) categories. 95% confidence interval are indicated. The distance categories are separated into seedrain only (dark grey) and seedrain plus seedbank (light grey). **a)** Alpine sites, **b)** intermediate sites, **c)** lowland sites. Note the different y-axis for the lowland sites.

3.6 Predicted Recruitment under a Warmer and Wetter Climate (Question VI)

Predictions based on mean current precipitation and temperature levels and projected increased levels for 2050, suggest that seedling emergence in gaps will increase under a warmer wetter climate, but not in intact vegetation. In open gaps the mean number of emerging seedlings is predicted to increase by ca. 51%, from 23.4 to 45.7, and under the shelter treatment it is expected to increase by ca. 63%, from 25.0 to 39.5. In closed vegetation, in contrast, mean seedling emergence is projected to decrease from 4.9 to 1.3 seedlings, a decrease of ca. 27%.

4. Discussion

4.1 Frequency of Seedling Recruitment

Overall, a substantial number of seedlings germinated in the study sites. In the intact vegetation controls, there is a mean seedling density of 77 seedlings m^{-2} , for open gap treatment the mean density is 967 seedlings m^{-2} and in the gap covered by a shelter the mean density is 799 seedlings m^{-2} . During the first year of colonisation the total seedling mortality was 6%, with minor differences between altitudes.

Billings and Mooney (1968) argued that the degree of seedling emergence in alpine habitats are low due to the harshness of the environment. Consequently, many of the alpine species have adapted to such environments by not relying on annual seedling establishment (Billings and Mooney, 1968, Körner, 2003). However, this study show a relatively high seedling emergence in undisturbed patches in alpine compared to lowland and intermediate sites.

Findings imply that seedling emergence in intact vegetation is not controlled by temperature *per se*, but rather the degree of competition from the surrounding vegetation. Seedling emergence in intact vegetation are highest in warm and dry habitats, and lowest in the warm and wet lowland. A plausible explanation for the trend is a high degree of competition at low elevations. Seedlings are thought to be vulnerable to competition with their limited root system and small leaf size. These are likely to fall short in the competition for light, water and nutrient availability with established higher plants and bryophytes (Fenner and Thompson, 2005).

The interdependency of the focal variables, temperature and precipitation, show a non-consistent pattern in seedling emergence across elevation categories. Contrary to lowland and intermediate sites, the highest seedling emergence in the alpine in undisturbed patches is found in the wettest sites, and the lowest seedling emergence in the driest sites. A similar result was found by Forbis (2003) studying seedling emergence in undisturbed plots in the alpine tundra, but contrary to Billings and Mooney (1968) who found the highest seedling emergence in the driest alpine areas. An important point in this context is the negative correlation between moss cover and seedling emergence, along with the positive correlation between moss cover and the level of precipitation. Implying that the moss cover play a less role in regulating seedling emergence in the alpine sites.

4.2 Recruitment in Open Gap Compared to Intact Vegetation

Seedling emergence in intact vegetation is very low to absent in all sites, reflecting the findings in range of other studies (e.g. Fenner, 1978, Vandvik and Goldberg, 2006). Despite their disadvantages some seedlings do succeed and establish in the intact vegetation. Some argue that these colonizers possess special adaptations to competition, such as food reserves in their seeds, ability to respond with morphological responses to shade and physiological tolerances to shade (Fenner, 1978).

Without exceptions more seedlings emerged in the disturbed compared to undisturbed plots across the elevation categories. Across all the sites the 7% of the seedlings emerged in undisturbed plots whereas the remaining 93% emerged in disturbed plots. Evidently, gaps provide favorable environments for successful fulfillment of the recruitment niche requirements enabling less competitive individuals to establish and coexist. Gaps also provide higher light intensities and an enhanced daily temperature amplitude compared to closed vegetation (Bullock, 2000), which are expected to promote seed germination and seedling establishment in open gaps (Chambers, 1995). Acknowledging that seeds contain a limited internal reserve of nutrients (Fenner and Thompson, 2005), an increased nutrient content in the soil after disturbance (Canham and Marks, 1986), may also enhance seedling establishment in disturbed vegetation (Fenner and Thompson, 2005).

In accordance with other studies (see Körner, 2003), the seedling emergence in closed vegetation relative to open gaps was much higher in the alpine sites, compared to the intermediate and lowland sites; 3.5% of the total number of seedlings recorded in the alpine sites were recorded in closed vegetation, compared to a substantially lower percentage in intermediate (2.8%) and lowland sites (2.6%). These findings imply that the balance between facilitation and negative interactions such as competition shifted along the temperature gradient. In lowland and intermediate sites associated with more benign environmental conditions, negative interactions such as competition was dominating, whereas positive interactions might be prevailing ones in the alpine sites associated with severe environmental conditions (Brooker and Callaghan, 1998, Tielborger and Kadmon, 2000). Presence of facilitation in areas with harsh growth conditions such as alpine habitats, is expected to be a result of the benefits provided by established plants in their surroundings. Seedling establishment under closed canopies take advantage of so called “nurse plants” in the

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proximity, by reducing their water stress as a result of shading from the establish vegetation, less heat stress and shield from herbivory (Grime, 2001).

Soil moisture may also regulate seedling establishment in disturbed plots in warmer areas. Model estimates show a 47% higher seedling emergence in the driest lowland site compared to the wettest (Table 3.3). Plausible explanations for this trend might be that seedlings in the wettest sites experience a higher abundance of herbivores, e.g. slugs, associated by moist environments (Wareborn, 1969). Or it might be the result of a higher influence of soil fungi and microorganisms potentially pathogenic to seeds (Fenner and Thompson, 2005). These are often associated with areas of high levels of precipitation and increased soil moisture (Burdon, 1987), attacking critical life stages such as the germination and seedling growth, either by killing the plant or substantially reducing its competitive ability (Harper, 1977). Kirkpatrick and Bazzaz (1979) tested the impact of fungal isolates on four colonising annuals, and their findings imply that seed germination and seedling development are affected by fungal pathogens.

When comparing seedling emergence across the climatic gradients other factors than the measured explanatory variables may have affected the seedling emergence. Although an attempt to minimise the variation in land use among sites was made, and fences were erected to exclude domestic grazers from the plots, no accurate data on the influence of grazing are available. Pre-dispersal predation could potentially have affected the level of emergence and the degree of grazing by generalist herbivores prior to the experiment setup may have affected the number of seeds deposited in the seedbank. Consequently, the frequency of seedling emergence might be limited by other factors affecting seed availability in addition to temperature and precipitation.

The observed pattern in seedling emergence may in addition to being regulated by precipitation and temperature, also be influenced by the seeds available in the particular habitat. For example moss cover prior to the experimental setup may also have influenced the result, that potentially could cause “source limited“ habitats influencing the degree of seedling emergence, seed limitations are documented in several studies (e.g. Eriksson and Ehrlén, 1992, Turnbull et al., 2000). Reasons might also be that the degree of heavy cloud bursts, and thus soil erosion and seedling burial are higher at the wettest end of the precipitation gradient than in the driest, as was probably the case for two plots in one of the alpine sites.

When removing the above-and-below-ground vegetation and leaving behind the seeds in the uppermost layer of the soil the seeds became accessible to seed predators, such as granivorous mammals, birds, insects and slugs (Fenner and Thompson, 2005). Post dispersal predation should not be ignored either. Nevertheless, experiments show that post-dispersal predation is likely to play a minor role in regulating seedling emergence (Peart, 1989). Only 22 seedlings were observed with invertebrate grazing damage, recorded in lowland and intermediate sites. Myrmecochory, that is, seed dispersal by ants, was observed in one of the sites, affecting at least to a certain extent the number of seeds in the gap, and providing a potential error in the comparative approach. In intact vegetation however, seed predation is not expected to limit recruitment, unless if regeneration is limited by seed availability (Fenner and Thompson, 2005).

4.3 Relative Contribution of Seedrain versus Seedbank

The contribution of seedrain and seedbank to seedling recruitment was tested using two different methods. In the recruit-tag approach species were used as dispersal “tags” to disentangle the number of seedlings originating from the seedrain opposed to those originating from the seedbank (Vandvik and Goldberg, 2006), whereas in the factorial treatments gaps with and without seedrain shelters were constructed to seek for differences in seedling emergence from the seedbank and the seedbank and seedrain combined. By using these two methods to estimate the contribution of the seedbank to recruitment, model testing was thus possible. Although the numbers between the two methods vary, there are no indications of contradictory results; both are estimating a dominance of seedbank compared to seedrain.

The results from the two methods give comparable estimations, and imply that the vast majority of seedlings can be addressed to the seedbank, but that seedrain also plays an role. However, the recruit-tag approach might underestimate the impact of seedrain to seedling recruitment. The final model estimates a mean seedbank contribution of $82.2\% \pm 9.9\%$ whereas the contribute seedrain on average $17.5\% \pm 9.9\%$ (alpine sites excluded). In comparison the estimates gained using the recruit-tag approach 23% - 90% for seedbank and 7% - 74% for seedrain (overlap between the sources 67%). The findings to Vandvik and Goldberg (2006) support the expectations regarding a underestimated seedrain contribution using the recruit-tag approach. They found the seedrain to contribute to recruitment with 20%- 45% using the same approach as for this study, investigating sources of dispersal in a

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grassland in eastern Norway. Similar results regarding seedbank contribution was found by Kalmaes and Zobel (2002) studying the role of the seedbank in gap regeneration using gap and seedrain shelter treatments. They found that during the first year after disturbance as 44% of the seedlings arose from the seedbank, suggesting that the seedbank plays a crucial role in recruitment in grassland community. Studies done by Pakeman et. al (1998) and Pakeman and Small (2005) found similar contribution of seedbank to recruitment, i.e. 45% and 43%, respectively.

When comparing the gap treatment with the shelter treatment one could, at least in theory, disentangle the impact of seedrain and seedbank. For lowland and intermediate sites the contribution of seedrain falls within a range of - 9% to 26%, whereas the contribution of the seedbank is estimated to be within 74% to 109% (Table 3.3). This implies a dominance of the seedbank in the gap treatments, although the contribution varies with precipitation levels.

Some shortcomings are inevitable in such an experimental design. A potential side effect of the shelter was considered prior to the study, and an experiment was carried out to test the impact of the shelter (Appendix I). The experiment found no significant difference between shelter and open gap, implying that the shelter did not provide environments favourable for regeneration with respect to wind exposure, different light conditions, water availability or temperature levels. However, the method was tested in a grassland located at 185 m asl, and given that the recruitment stages are affected by temperature (Smith, 1994), it is assumed that the shelter might have improved conditions for seedling emergence at higher elevations. Model based predictions in support this assumption by showing a negative percentage contribution of seedrain to recruitment in the alpine sites (Table 3.3). For future research, data loggers measuring temperature and light intensity in gaps with and without shelter would provide useful information to evaluate the applicability of this method.

Other plausible explanations of the high seedling emergence under shelter may be that some very small seeds have entered the gaps through the fine-meshed canvas. When choosing mesh size, it clearly governs a tradeoff between hindering the impact of seedrain, and reducing the availability of precipitation, light and nutrients. Additionally, to reduce the potential greenhouse effect of the tent, an opening between the ground and shelter was made, which could have provided an entrance for seeds from the seedrain.

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Since the shelter was constructed to hinder the impact of seedrain, all seedlings germinating in the gaps should, in theory, arise only from the seedbank. However, the results from the recruit-tag approach, indicate that 10% of the seedlings germinated under the shelter probably originated from the seedrain, because they are absent from the seedbank but do have seed sources in the vegetation surrounding the plots. These comprise 61 seedlings, of which 27 *Ranunculus acris*, 13 *Prunella vulgaris*, 13 *Knautia arvensis*, 5 *Galium uliginosum*, 2 *Sibbaldia procumbens* and 1 *Potentilla erecta*. The impact of errors in single plots can have a great influence on the total numbers, for example, 26 of the *Ranunculus acris* seedlings are recorded from one plot, and could in have arisen from one single flower head rolling into the plot.

Some species could also have been dispersed into the shelter treatments despite the shelters, for example, *Knautia arvensis* possess an oil containing fleshy appendage (elaiosome) on their seeds promoting dispersal by ants (Pemberton and Irving, 1990). Seeds may also have arrived through the openings between the mesh and the ground, or through the fine meshed tent canvas. It is further likely that some of the 13 *Prunella vulgaris* seedlings can be of vegetative origin, but have been recorded as a seedling originating from seed due to the resemblance between young vegetative shoots and newly emerged seedlings of this particular species. On the other hand, there can be misidentified seedlings in the gaps and/or overlooked species in the seedbank, and unequivocal conclusions about the 61 “misclassified” species impossible. Still, this does not change the main conclusion, which is that the overwhelming majority of seedlings originated from the seedbank, not the current year’s seed rain.

4.4 Dispersal Distances and Seedling Origin

As shown in a number of other attempts to estimate dispersal distances (Harper, 1977, Howe and Smallwood, 1982, Eriksen et al., 1993, Molau and Larsson, 2000), the vast majority of seedlings germinating in the treatments are found to have been dispersed only short distances. In this study seed dispersal is highly local, 49% are dispersed from the > 0.5 m distance from the gaps, and 66% are dispersed from distances less than 1m from the open gap treatment. Contrarily, Kalmaes and Zobel (2002) found that seeds originating from a distance of less than 0.5 m accounted for only ca. 12%, of seedlings in their study, which they attributed to a seed limitation caused by the patchiness of the vegetation.

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The extent of dispersal from beyond 10 m in this study is minor, with only 2.8% of the seedlings estimated to have dispersed from distances exceeding 10m. Species that are found to be potentially long-distance dispersed include *Cardamine* sp., *Hieracium pilosella*, *Prunella vulgaris*, *Rumex acetosa* and *Viscaria vulgaris*. The lacking knowledge regarding long-distance dispersal is mainly due to methodological challenges, as is also the case in this study. Long-distance dispersal is sometimes defined as seeds dispersing to distances exceeding 100 m from the source (Cain et al., 2000). However, in this particular study the longest distance of concern is more than >10 m from the treatments. Consequently, any conclusions concerning whether some seeds are dispersed through long-distance dispersal is a matter of discussion. More accurate estimates of long-distance dispersal could have been obtained by surveying the vegetation at a distance of 100 m radius from the treatments. Limited growth season, time constraints and multiple sites made this infeasible.

Whether or not long-distance dispersal is more frequent in the alpine sites is still under debate. The slow growth rate of alpine seedlings (Billings and Mooney, 1968) must be seen as an inevitable shortcoming of the first-year data, and resulted in a disproportionally low number of identified seedlings in the alpine areas, a common issue when monitoring seedlings in the first year of colonisation (Forbis, 2003). The subset of species used here shows a predominance of lowland and intermediate species, because of the low number of identified alpine species. This implies that trends in dispersal patterns might be missed, such as the preponderance of long-distance dispersed species in the alpine compared to lower elevations, or the presence of invasive lowland species emerging in the gaps. A further fieldwork season would greatly enhance the applicability of the method, as by this time seedlings will have grown and show enough characteristics to enable accurate species identifications. However, despite the low degree of species determinations, the method is clearly applicable and the trends in dispersal patterns are evident.

4.5 Seedling Recruitment in a Changing Climate

The predictive modeling of seedlings response to climate change estimated a 51% increase in seedling emergence in open gaps, and an increase of 63% under shelter under warmer and wetter conditions by 2050. Predictions imply that the projected increase in mean surface temperature and increased level of annual precipitation will enhance successful seedling establishment in these so called safe sites. However the vast majority of seeds fail to reach such safe sites. According to the model predictions seedling emergence is predicted to decrease by 27% under warmer and wetter conditions. In this particular study germination increased towards drier regions, comparable results was found by Sternberg et al. (1999) investigated the effect of climate change on seedling emergence in intact vegetation, in areas with a mean annual precipitation of ca. 700 mm and summer temperatures 11.2°C - 22.8°C, and found the plant cover to significantly increase when supplied with additional water. Additionally, Ibanez et al. (2008) also found a positive correlation between water availability and seedling performance studying tree seedling recruitment.

Predicting seedling emergence is ambitious, since the consequences of climate change to plant regeneration are likely to be intricate and comprehensive (Fenner and Thompson, 2005). Therefore, in an analysis of this type, predictions must be interpreted with some caution. It should also be mentioned that the projections are based on averaged values of the explanatory variables included in the final model, and whether or not these are the most appropriate values to form the basis of the predictions is a matter of discussion. The discrepancy in seedling emergence between disturbed and undisturbed treatments, suggest that seedlings response to climate change will be influenced by the disturbance regime the seedlings are subjected to.

4.6 Concluding Remarks

Based on the findings of this study, I conclude that seedling emergence in the study system are highly influenced by both temperature and precipitation, but those local variables such as insulation and inclination additionally plays a considerable role. The interdependency between temperature and precipitation result in different effects of temperature on seedling emergence depends on the precipitation regime. In undisturbed areas the highest seedling emergence in undisturbed patches were recorded in the wet and cold regions and the dry and warmer regions. However, findings of this study imply that competition regulate seedling recruitment in closed vegetation in low elevations. The response in seedling emergence to

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different temperature and precipitation regimes was found to be significantly different in open gap treatment and intact vegetation, implying a switch from negative interactions in warm areas and a positive interactions in temperature limited areas.

In the estimation of the relative contribution of seedbank and seedrain to seedling recruitment, the two methods provide comparable results, implying that the vast majority of seedlings can be attributed to the seedbank, but that seedrain also plays a noteworthy role. Comparing the validity of the two methods, gaps with and without shelter may produce somewhat biased results in temperature limited areas, but most likely applicable in warmer areas. The recruit-tag approach demands detailed information about species present in the seedbank and is consequently more time demanding. Additionally, two growth seasons are desirable to obtain complete species data for the emerging seedlings. Overlooking the potential side-effects of the shelters, the shelter/gap method may provide more accurate estimates of the relative contribution to recruitment, especially in systems with large and species-rich seedbanks, since the recruit-tag approach only provides ranges of minimum and maximum estimates and their overlap.

In concordance with other studies the vast majority of seedlings germinating in the treatments are found to have dispersed only short distances, although a few seedlings might be the result of long-distance dispersal. Whether or not the frequency of long-distance dispersal is greater in alpine sites is still in question. There is no unequivocal evidence in the data for such a trend, as the data have a disproportionally low degree of alpine species due to the limited number of identified species. Here, as well as for the other treatments, accurate species identifications will increase the power of the conclusions. Therefore, a second year of monitoring is highly recommended, and would provide a good basis for future work aiming to obtain greater knowledge about the dynamics of seedling recruitment and their response to climate change.

In an attempt to predict implications of a changed climate on seedling recruitment, model-based predictions estimate an inconsistent response to an increased level of precipitation and temperature depending the degree of disturbance. In undisturbed areas, seedling emergence will suffer from climate change, with an estimated decrease of approximately 30% by 2050 relative to ambient levels of seedling emergence. The main reasons for this trend are the negative response to increased precipitation levels in undisturbed areas, the possibly higher

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degree of pathogens, and the negative correlation with moss cover. In disturbed areas, seedling emergence is predicted to benefit from climate change, with an increase in seedling emergence of approximately 50% relative to ambient seedling emergence. Here, the effect of increased temperature on seedling emergence is thought to overrule the negative effect of precipitation.

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6. Appendices

Appendix I: Garden Experiment

Introduction

To test whether the shelter had unwanted side effects, I collected and sowed equal amounts of seeds in gaps with and without shelter, and recorded the differences in germination between the treatments. Here, I was not interested in the properties of the seed bank itself, but to find out whether the shelter provided favourable environments for germination compared to the open gap. Consequently, the intact vegetation and the upper soil layer were removed including most of the seedbank, aiming to promote as little as possible of the naturally occurring seed bank to germinate.

Materials and Methods

The experiment was performed in Voss (32V 0361209 - UTM 6727841), situated 185 meters above sea level on a South West facing low-productive grassland, similar to those conditions found in the lowland study sites. The elevation co-ordinates and aspect was measured with Garmin Oregon 300 handheld GPS. To ensure comparative abilities of the field experiment, the collected seeds were from the same species as recorded in the study sites.

At seed maturity seeds were collected from randomly chosen individuals from 6 different species. The seeds were considered as mature when seeds fell easily from the plant and the natural dispersal commences (Baskin and Baskin, 1998). The seeds were collected, air dried and counted and due to time constraints sown the same summer as they matured, and therefore the seeds had not been stratified. However, according to Jakobsen et al. (2006), many seeds germinate directly and thus do not need cold stratification.

The following seed mix ($n = 275$) was sown in equal amounts in two treatments: 26th of July - 50x *Viola riviniana*, 50x *Ranunculus acris*, 50x *Bistorta vivipara* and 25x *Geranium sylvaticum*: 16th of August - 50x *Hypericum maculatum* and 50x *Veronica officinalis*. These latter two species were sown later since they matured as seeds later in the summer. The seeds were sown in equal amounts in 3 gaps covered by a shelter and 3 gaps lacking a seed shelter. Germination was recorded on the 29th of September 2009 ensuring maximum germination percentage in advance of the frost. The vast majority of the seedlings were too small to identify to species level, and consequently they were grouped into categories of forbs and

Appendices

graminoids. As only forb species were sown, the graminoids emerging must have come from the seedbank, but the difference in graminoid emergence between the treatments is still of interest with respect to testing the method.

Statistical Analysis

Three separate analyses were carried out. The number of germinated seedlings was the response variable, divided into forbs, graminoids, and total number of seedlings emerging, and the treatment was the explanatory variable. The data were analysed using a Generalised Linear Model. The data were Poisson distributed. Overdispersion was corrected for by using a quasi-Poisson distribution. Since the seedlings were too small to identify to species level, the number of emerging seedlings were separated into three analyses in order to separate the seeds germinated from the seedbank and the seeds germinating from the sowing experiment.

Results

Of the 1050 seeds sown in the experiment 296 seedlings were recorded at the end of the growing season (Table 6.1). In the open gap, the number of seedlings emerging ranged from 13 to 49 and the in sheltered gap the number of seedlings emerging ranged from 11 to 39. When analysing only the number of emerged forbs the analysis showed no significant difference between shelter and gap treatment ($p = 0.27208$, $df = 4$, Fig. 6.1b). Neither was there any significant difference in the number of graminoids germinating from the two treatments ($p = 0.9547$, $df = 4$, Fig. 6.1c), nor when the graminoids and the forbs were combined ($p = 0.419$, $df = 10$, Fig. 6.1a).

Table 6.1: Total number recorded seedlings, percent of total recorded seedling emergence, number of Forbs recorded separated among the two treatments. In addition, the last columns shows mean number of forb seedlings \pm SD and mean forb germination percentage per treatment.

Treatment	Σ total seedlings	% germinated of total	Σ total forbs plot ⁻¹	Mean total forbs plot ⁻¹ \pm SD	Mean % forb germination
<i>RTG</i>	169	57%	76	25.33 \pm 20.50	9.21%
<i>RTS</i>	127	43%	36	12.00 \pm 1.73	4.36%
Σ total	296	100%			

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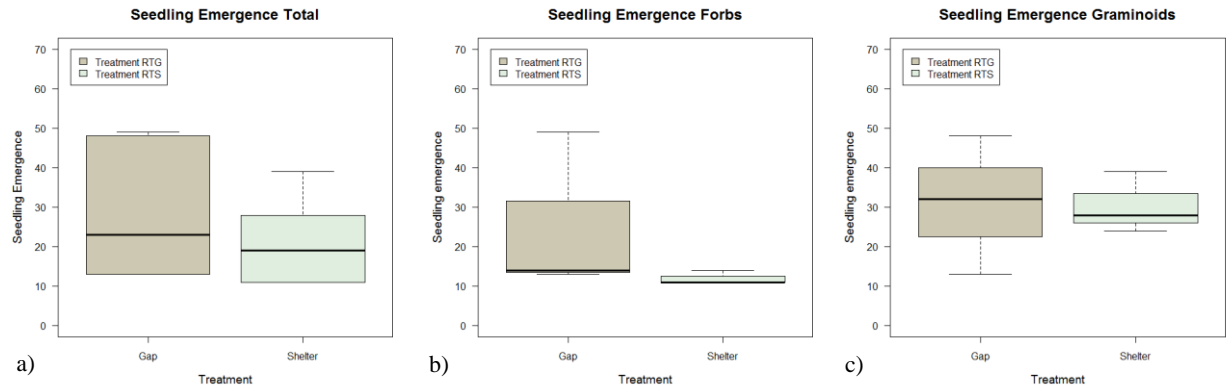


Fig. 6.1. a) The total number of emerged seedlings divided among the two treatments. b) Number of emerging forbs divided among the two treatments c) Number of emerging graminoids separated between the treatments.

Discussion and Conclusion

The non significant germination differences between the two treatments indicate that seed shelters do not produce a significant greenhouse effect. However, it is important to emphasise that the experiment was carried out in the lowland, and the effect of the shelter might be more pronounced in temperature-limited areas. The relatively small sample size and quality of the data must also be taken into account. Due to time constraints, seeds were collected and sown during the same growth season, and consequently some might have been sown too late in the growth season to successfully establish.

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Appendix II: Seedling Recording

Fauske													
Block	I	I	I	II	II	II	III	III	III	IV	IV	IV	
Treat	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Campanula rotundifolia</i>	0	2	0	0	0	0	0	0	0	0	0	0	2
<i>Cardamine sp</i>	0	11	12	0	1	0	0	0	0	0	0	2	26
<i>Cerastium fontanum</i>	0	0	1	0	0	0	0	16	1	0	2	2	22
<i>Dhianthus deltoides</i>	0	4	4	0	1	3	0	7	2	0	0	2	23
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	2	0	0	0	2
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	0	0	0	0	4	0	0	0	0	72	6	82
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	3	0	0	0	0	6	3	12
<i>Leucanthemum vulgare</i>	0	0	0	0	0	14	0	3	9	1	0	0	27
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	4	0	0	0	4
<i>Potentilla erecta</i>	0	11	22	0	0	0	0	0	0	0	2	0	35
<i>Prunella vulgaris</i>	0	0	4	0	0	0	0	0	0	0	0	0	4
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	1	0	2	0	0	0	1	1	2	0	7
<i>Rumex acetosella</i>	0	0	0	0	0	0	0	0	1	0	3	0	4
<i>Sibbaldia procumbens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>Stellaria graminea</i>	0	0	0	0	0	35	0	0	1	0	0	0	36
<i>Stellaria media</i>	0	2	0	0	1	0	0	13	4	0	1	0	21
<i>Taraxacum vulgaris</i>	0	2	2	0	1	2	0	5	2	0	1	1	16
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	1	0	0	0	0	0	1	0	0	0	0	2
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	1	22	24	0	6	4	0	0	1	0	2	0	60
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	1	3	3	0	2	0	0	0	2	0	0	0	11
<i>Viscaria vulgaris</i>	0	0	0	0	0	1	0	0	0	0	0	0	1
Unidentified	26	68	17	13	85	49	14	83	94	14	116	41	620
Forb unidentified	26	66	17	13	85	41	14	83	94	14	116	41	610
Gram unidentified	0	2	0	0	0	8	0	0	0	0	0	0	10
Mortality	0	3	0	0	3	5	0	0	0	0	3	2	16
Total germinated	28	129	90	13	102	120	14	128	124	16	211	59	1034

Appendices

Appendix II: Seedling Recording Continued

Arhelleren													
Block	I	I	I	II	II	II	III	III	III	IV	IV	IV	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Campanula rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dhianthus deltoides</i>	0	0	1	0	0	0	0	0	0	0	0	0	1
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>Hieracium pilosella</i>	0	0	0	0	1	0	0	0	0	0	0	0	1
<i>Hypericum maculatum</i>	0	2	13	0	1	3	0	28	0	0	12	17	76
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	5	0	0	1	0	0	0	0	6
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	1	0	0	0	0	0	0	0	0	0	0	1
<i>Prunella vulgaris</i>	0	2	3	0	1	1	0	0	0	0	0	0	7
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	2	2
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosella</i>	0	1	0	0	0	0	0	0	0	0	0	0	1
<i>Sibbaldia procumbens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	7	0	0	8	5	20
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	1	0	0	2	0	3
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	0	0	0	0	0	0	0	0	0	8	0	8
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	3	32	17	0	29	14	1	21	40	0	81	55	293
Forbs unidentified	3	24	12	0	10	6	1	7	27	0	21	19	130
Graminoids unidentified	0	8	5	0	19	8	0	14	13	0	60	36	163
Mortality	0	1	6	0	1	1	0	2	3	0	5	5	24
Total germinated	3	39	40	0	38	19	1	60	43	0	117	84	444

Appendices

Appendix II: Seedling Recording Continued

Lävisdalen													
Block	I	I	I	III	III	III	IV	IV	IV	V	V	V	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Campanula rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Prunella vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sibbaldia procumbens</i>	0	0	1	2	1	4	0	26	25	0	0	0	59
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola biflora</i>	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	16	21	18	7	43	28	1	11	26	0	6	21	198
Forbs unidentified	16	15	15	7	25	25	1	10	26	0	1	11	152
Graminoids unidentified	0	6	3	0	18	3	0	1	0	0	5	10	46
Mortality	1	8	2	2	9	4	1	3	3	0	1	0	34
Total germinated	17	29	21	13	53	36	2	40	54	0	7	21	293

Appendices

Appendix II: Seedling Recording Continued

Skjellingahaugen													
Block	I	I	I	II	II	II	III	III	III	IV	IV	IV	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Campanula rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	5	0	1	0	0	0	0	0	0	0	6
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Prunella vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sibbaldia procumbens</i>	0	4	1	0	3	2	0	0	4	0	16	1	31
<i>Silene acaulis</i>	0	0	0	0	2	0	0	0	0	0	0	0	2
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	0	11	37	0	21	9	2	10	16	3	11	18	138
Forbs unidentified	0	10	32	0	21	9	2	9	16	3	11	17	130
Graminoids unidentified	0	1	5	0	0	0	0	1	0	0	0	1	8
Mortality	0	0	0	0	1	1	1	0	2	2	2	0	9
Total germinated	0	15	43	0	28	12	3	10	22	5	29	19	186

Appendices

Appendix II: Seedling Recording Continued

Ulvehaugen													
Block	I	I	I	II	II	II	III	III	III	IV	IV	IV	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Campanula rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Prunella vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Rumex acetosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sibbaldia procumbens</i>	0	1	0	1	0	2	0	0	0	0	0	0	4
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	1	11	73	4	12	8	2	2	10	0	0	2	125
Forbs unidentified	1	4	65	4	8	5	2	1	6	0	0	0	96
Graminoids unidentified	0	7	8	0	4	3	0	1	4	0	0	2	29
Mortality	226	0	0	1	1	1	0	0	0	0	0	0	229
Total germinated	1	12	74	7	13	10	2	2	10	0	0	2	133

Appendices

Appendix II: Seedling Recording Continued

Veskre													
Block	II	II	II	III	III	III	IV	IV	IV	V	V	V	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	3	0	0	0	0	0	0	0	0	0	0	3
<i>Campanula rotundifolia</i>	0	0	0	0	0	0	0	0	0	2	0	0	2
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	0	0	0	0	0	0	0	1	0	0	0	1
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	2	0	0	2	1	2	0	0	0	1	0	8
<i>Prunella vulgaris</i>	7	8	2	0	7	3	0	1	2	2	0	0	32
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Rumex acetosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sibbaldia procumbens</i>	0	4	2	0	0	0	0	0	0	0	0	0	6
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	1	0	0	0	0	0	0	0	0	0	0	1
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	1	26	14	0	12	23	0	8	8	0	2	1	95
Forbs unidentified	1	24	12	0	9	7	0	8	8	0	2	1	72
Graminoids unidentified	0	2	2	0	3	16	0	0	0	0	0	0	23
Mortality	0	0	1	0	0	1	1	0	0	2	0	0	5
Total germinated	8	45	18	0	22	28	2	10	13	4	3	1	154

Appendices

Appendix II: Seedling recording continued

Vikesland										
Block	II	II	II	IV	IV	IV	V	V	V	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	0	0	0
<i>Campanula rotundifolia</i>	0	3	1	0	5	3	0	31	20	63
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	0	0
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	0	0	0	0	0	0	0	0	0
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	0	0	0	0	5	0	0	0	5
<i>Prunella vulgaris</i>	0	0	0	0	0	0	0	4	2	6
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	1	1
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosella</i>	0	18	6	0	20	6	0	17	1	68
<i>Sibbaldia procumbens</i>	0	0	0	0	0	0	0	0	0	0
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	2	0	0	0	0	2
<i>Stellaria media</i>	0	0	0	0	0	0	0	2	4	6
<i>Taraxacum vulgaris</i>	0	0	1	0	0	0	0	0	1	2
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	1	2	0	3	0	0	1	0	7
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	2	0	0	0	4	6
<i>Viola tricolor</i>	0	8	7	0	4	6	0	9	8	42
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0
Total unidentified	1	30	16	1	48	85	0	93	94	368
Forbs unidentified	1	26	16	1	30	75	0	36	52	237
Graminoids unidentified	0	4	0	0	18	10	0	57	42	131
Mortality	0	0	5	4	0	0	0	0	9	18
Total germinated	1	65	37	1	84	105	0	166	159	618

Appendices

Appendix II: Seedling Recording Continued

Øvstedal													
Block	I	I	I	II	II	II	III	III	III	IV	IV	IV	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Campanula rotundifolia</i>	0	0	0	0	0	0	0	2	0	0	3	3	8
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	1	0	0	0	0	0	0	0	0	5	0	6
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	1	0	0	12	8	21
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Prunella vulgaris</i>	0	2	2	0	0	0	0	0	0	0	0	0	4
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosella</i>	0	7	2	0	7	18	0	32	15	0	1	1	83
<i>Sibbaldia procumbens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	1	0	0	0	0	0	0	0	0	2	0	3
<i>Veronica serpyllifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	0	92	17	0	72	64	0	83	63	0	56	70	517
Forbs unidentified	0	18	12	0	6	6	0	7	5	0	31	27	112
Graminoids unidentified	0	74	5	0	66	58	0	76	58	0	25	43	405
Mortality	24	0	7	3	0	11	5	0	12	4	0	10	76
Total germinated	0	110	24	0	90	87	0	130	82	0	89	86	698

Appendices

Appendix II: Seedling Recording Continued

Ålrust													
Block	I	I	I	II	II	II	III	III	III	V	V	V	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	1	3	0	0	0	0	0	0	0	0	0	0	4
<i>Campanula rotundifolia</i>	1	11	1	0	0	0	0	0	0	0	0	0	13
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	1	0	0	0	0	0	1	0	2
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	5	0	0	0	1	6
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	1	1	0	0	0	0	0	0	0	0	0	0	2
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	2	0	0	0	1	0	0	0	0	0	3	6
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	2	0	0	0	0	0	3	1	0	0	1	7
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Prunella vulgaris</i>	7	1	2	1	1	1	0	2	1	9	0	2	27
<i>Ranunculus acris</i>	0	0	1	1	0	0	0	0	0	0	0	2	4
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Rumex acetosella</i>	0	0	0	0	0	3	0	9	1	0	9	2	24
<i>Sibbaldia procumbens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	1	0	0	0	0	0	4	0	0	0	5
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum vulgaris</i>	0	0	1	0	0	0	0	0	0	0	0	0	1
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	0	2	2	4	0	0	0	15	0	0	0	23
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	4	7	0	0	0	0	2	0	0	0	4	17
<i>Viola tricolor</i>	0	0	0	0	1	0	0	2	1	0	3	1	8
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	3	0	0	0	0	3
Total unidentified	1	9	4	2	9	10	2	44	33	8	42	61	225
Forbs unidentified	1	5	4	2	9	10	2	33	29	8	39	58	200
Graminoids unidentified	0	4	0	0	0	0	0	11	4	0	3	3	25
Mortality	3	0	0	1	2	0	0	0	0	0	1	0	7
Total germinated	11	33	20	8	16	15	2	70	56	18	55	79	383

Appendices

Appendix II: Seedling Recording Continued

Gudmesdalen													
Block	I	I	I	II	II	II	IV	IV	IV	V	V	V	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	2	0	0	0	0	2
<i>Campanula rotundifolia</i>	0	0	0	0	0	0	1	0	0	0	0	0	1
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Prunella vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sibbaldia procumbens</i>	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	0	0	0	0	0	0	0	1	0	0	0	1
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	18	4	2	5	9	9	4	2	0	8	12	19	92
Forbs unidentified	18	4	1	5	7	9	4	1	0	8	4	14	75
Graminoids unidentified	0	0	1	0	2	0	0	1	0	0	8	5	17
Mortality	0	0	0	0	0	0	1	0	0	1	6	2	10
Total germinated	18	4	2	5	9	9	6	4	1	9	18	22	107

Appendices

Appendix II: Seedling Recording Continued

Høgsete													
Block	I	I	I	III	III	III	IV	IV	IV	V	V	V	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Campanula rotundifolia</i>	0	3	0	0	0	1	0	0	0	0	0	3	7
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	1	5	0	0	0	6
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	1	1	0	0	0	0	0	0	0	0	0	2
<i>Prunella vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ranunculus acris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex acetosa</i>	0	0	0	0	0	1	0	0	0	0	0	0	1
<i>Rumex acetosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sibbaldia procumbens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	10	0	1	1	12
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Trifolium repens</i>	0	1	2	0	0	0	0	0	2	0	0	0	5
<i>Veronica chamaedrys</i>	0	2	0	0	0	3	0	0	0	0	0	1	6
<i>Veronica officinalis</i>	0	0	23	0	0	17	0	1	4	0	0	2	47
<i>Veronica serpyllifolia</i>	0	0	0	0	0	0	0	0	1	0	0	0	1
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	1	0	0	0	0	0	0	2	0	0	1	4
<i>Viola tricolor</i>	0	17	6	0	0	9	0	0	2	0	0	2	36
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	0	86	74	0	107	71	1	42	58	1	89	64	593
Forbs unidentified	0	58	23	0	61	53	1	34	53	1	75	53	412
Graminoids unidentified	0	28	51	0	46	18	0	8	5	0	14	11	181
Mortality	0	25	13	0	0	4	0	2	4	0	10	2	60
Total germinated	0	136	119	0	107	106	1	47	88	1	100	76	781

Appendices

Appendix II: Seedling Recording Continued

Ramberg													
Block	II	II	II	III	III	III	IV	IV	IV	V	V	V	
Treatment	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	RTC	RTG	RTS	Sum
<i>Alchemilla alpina</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Bistorta vivipara</i>	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Campanula rotundifolia</i>	0	0	0	0	0	0	0	0	0	0	3	0	3
<i>Cardamine sp</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cerastium fontanum</i>	0	0	0	0	0	0	0	0	2	0	0	1	3
<i>Dhianthus deltoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Galium uliginosum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Geranium sylvaticum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hieracium pilosella</i>	0	2	0	0	0	0	0	0	0	0	0	0	2
<i>Hypericum maculatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Knautia arvensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leucanthemum vulgare</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lotus corniculatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago lanceolata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Plantago media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Potentilla erecta</i>	0	0	0	0	1	0	0	0	1	0	1	0	3
<i>Prunella vulgaris</i>	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>Ranunculus acris</i>	0	9	26	0	0	0	0	1	0	0	3	0	39
<i>Rumex acetosa</i>	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Rumex acetosella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sibbaldia procumbens</i>	0	1	0	0	0	0	0	2	0	0	0	0	3
<i>Silene acaulis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Silene vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria graminea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stellaria media</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Taraxacum vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica chamaedrys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica officinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Veronica serpyllifolia</i>	0	0	0	0	4	6	0	0	1	0	5	3	19
<i>Viola biflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola riviniana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viola tricolor</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Viscaria vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Total unidentified	1	84	46	2	62	63	0	64	17	0	74	20	433
Forbs unidentified	1	65	33	1	48	52	0	47	13	0	31	13	304
Graminoids unidentified	0	19	13	1	14	11	0	17	4	0	43	7	129
Mortality	0	22	4	0	8	17	0	8	2	0	9	3	73
Total germinated	1	118	76	2	75	86	0	76	23	0	96	28	581

Appendices

Appendix III: Distance Categories

Site	Block	Treatment	<i>Alc alp</i>	<i>Bis viv</i>	<i>Cam rot</i>	<i>Car sp</i>	<i>Cer fon</i>	<i>Dhi del</i>	<i>Gal uli</i>	<i>Ger syl</i>	<i>Hie pil</i>	<i>Hyp mac</i>	<i>Kna arv</i>	<i>Leu vul</i>	<i>Lot cor</i>	<i>Pla lan</i>	<i>Pla med</i>	<i>Pot ere</i>	<i>Pru vul</i>	<i>Ran acr</i>	<i>Rum ace</i>	<i>Rum ad</i>	<i>Sib pro</i>	<i>Sil aca</i>	<i>Sil vul</i>	<i>Ste gra</i>	<i>Ste med</i>	<i>Tar vul</i>	<i>Tri pra</i>	<i>Tri rep</i>	<i>Ver cha</i>	<i>Ver off</i>	<i>Ver ser</i>	<i>Vio bif</i>	<i>Vio riv</i>	<i>Vio tric</i>	<i>Vis vulg</i>
Arhelleren	I	RTC	0	1	2	0	0	0	0	3	2	3	0	0	0	2	0	1	3	3	3	0	0	0	0	2	0	0	1	1	3	0	0	0	0	0	0
Arhelleren	I	RTG	0	1	1	0	0	0	0	3	3	3	0	0	0	1	0	1	3	3	3	0	0	0	0	2	0	0	1	2	3	0	0	0	0	0	0
Arhelleren	I	RTS	0	1	1	0	0	0	0	3	2	3	0	0	0	1	0	1	3	3	3	0	0	0	0	3	0	0	1	1	3	0	0	0	0	0	0
Arhelleren	II	RTC	0	2	2	0	0	0	0	2	2	2	0	0	0	2	0	2	3	3	3	0	0	0	0	3	0	0	3	2	3	0	0	0	0	0	0
Arhelleren	II	RTG	0	1	1	0	0	0	0	3	1	1	0	0	0	1	0	1	3	3	3	0	0	0	0	3	0	0	3	1	3	0	0	0	0	0	0
Arhelleren	II	RTS	0	2	2	0	0	0	0	2	2	3	0	0	0	1	0	1	3	3	3	0	0	0	0	3	0	0	3	1	3	0	0	0	0	0	0
Arhelleren	III	RTC	0	1	1	0	0	0	0	3	3	3	0	0	0	1	0	1	3	3	3	0	0	0	0	3	0	0	3	1	3	0	0	0	0	0	0
Arhelleren	III	RTG	0	1	1	0	0	0	0	3	3	2	0	0	0	1	0	1	3	3	3	0	0	0	0	3	0	0	3	1	3	0	0	0	0	0	0
Arhelleren	III	RTS	0	1	2	0	0	0	0	3	3	3	0	0	0	1	0	1	3	3	3	0	0	0	0	3	0	0	3	1	3	0	0	0	0	0	0
Arhelleren	IV	RTC	0	3	3	0	0	0	0	3	3	3	0	0	0	2	0	1	3	3	3	0	0	0	0	3	0	0	3	3	3	0	0	0	0	0	0
Arhelleren	IV	RTG	0	2	3	0	0	0	0	3	3	1	0	0	0	1	0	1	3	3	3	0	0	0	0	3	0	0	3	3	1	0	0	0	0	0	0
Arhelleren	IV	RTS	0	3	3	0	0	0	0	3	3	1	0	0	0	2	0	1	3	3	3	0	0	0	0	3	0	0	3	1	3	0	0	0	0	0	
Fauske	I	RTC	0	3	0	0	0	1	0	4	3	0	3	3	3	0	0	0	0	3	3	3	0	0	3	0	0	3	1	2	3	1	0	0	0	0	0
Fauske	I	RTG	0	3	0	0	0	1	0	4	3	0	2	3	3	0	0	0	0	3	3	3	0	0	3	0	0	3	1	3	3	2	0	0	0	0	0
Fauske	I	RTS	0	3	0	0	0	2	0	4	3	0	3	3	3	0	0	0	0	3	3	3	0	0	3	0	0	3	2	3	3	2	0	0	0	0	0
Fauske	II	RTC	0	3	0	0	0	1	0	4	3	0	3	1	3	0	0	0	0	3	3	3	0	0	3	0	0	3	1	3	2	1	0	0	0	0	0
Fauske	II	RTG	0	3	0	0	0	1	0	4	3	0	3	1	3	0	0	0	0	3	3	3	0	0	3	0	0	3	1	3	2	1	0	0	0	0	0
Fauske	II	RTS	0	3	0	0	0	1	0	4	3	0	3	1	3	0	0	0	0	3	2	3	0	0	3	0	0	3	1	2	1	2	0	0	0	0	0
Fauske	III	RTC	0	3	0	0	0	1	0	4	3	0	3	1	3	0	0	0	0	3	2	3	0	0	3	0	0	3	1	3	3	2	0	0	0	0	0
Fauske	III	RTG	0	3	0	0	0	1	0	4	3	0	3	1	3	0	0	0	0	3	3	3	0	0	3	0	0	3	1	3	3	2	0	0	0	0	0
Fauske	III	RTS	0	3	0	0	0	1	0	4	3	0	3	1	3	0	0	0	0	3	3	3	0	0	3	0	0	3	1	3	3	1	0	0	0	0	0
Fauske	IV	RTC	0	1	0	0	0	1	0	4	1	0	3	1	1	0	0	0	0	3	3	3	0	0	3	0	0	3	1	3	3	3	0	0	0	0	0
Fauske	IV	RTG	0	1	0	0	0	1	0	4	1	0	3	1	1	0	0	0	0	3	3	1	0	0	3	0	0	3	1	3	3	3	0	0	0	0	0
Fauske	IV	RTS	0	1	0	0	0	1	0	4	1	0	3	1	3	0	0	0	0	3	3	2	0	0	3	0	0	3	1	3	3	3	0	0	0	0	0

Appendices

Appendix III: Distance Categories Continued

Site	Block	Treatment	<i>Alc alp</i>	<i>Bis viv</i>	<i>Cam rot</i>	<i>Car sp</i>	<i>Cer fon</i>	<i>Dhi del</i>	<i>Gal uli</i>	<i>Ger syl</i>	<i>Hle pil</i>	<i>Hyp mac</i>	<i>Kna arv</i>	<i>Leu vul</i>	<i>Lot cor</i>	<i>Pla lan</i>	<i>Pla med</i>	<i>Pot ere</i>	<i>Pru vul</i>	<i>Ran acr</i>	<i>Rum ace</i>	<i>Rum acl</i>	<i>Sib pro</i>	<i>Sil aca</i>	<i>Sil vul</i>	<i>Ste gra</i>	<i>Ste med</i>	<i>Tar vul</i>	<i>Tri pra</i>	<i>Tri rep</i>	<i>Ver cha</i>	<i>Ver off</i>	<i>Ver ser</i>	<i>Vio bif</i>	<i>Vio riv</i>	<i>Vio tric</i>	<i>Vis vulg</i>		
Gudmesdalen	I	RTC	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	3	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gudmesdalen	I	RTG	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gudmesdalen	I	RTS	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gudmesdalen	II	RTC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gudmesdalen	II	RTG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gudmesdalen	II	RTS	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gudmesdalen	IV	RTC	1	4	0	0	0	0	0	3	4	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gudmesdalen	IV	RTG	3	4	0	0	0	0	0	3	4	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gudmesdalen	IV	RTS	3	4	0	0	0	0	0	3	4	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gudmesdalen	V	RTC	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Gudmesdalen	V	RTG	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Gudmesdalen	V	RTS	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Høgsete	I	RTC	1	0	1	0	0	0	3	0	0	1	3	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	3	3	3	3	0	0	3	0	0	0
Høgsete	I	RTG	1	0	1	0	0	0	2	0	0	1	1	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	3	1	3	3	0	0	3	0	0	0
Høgsete	I	RTS	1	0	1	0	0	0	3	0	0	1	3	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	3	3	3	3	1	0	0	3	0	0	0
Høgsete	III	RTC	-	0	0	0	0	0	1	0	0	3	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	3	3	3	3	0	0	3	0	0	0	
Høgsete	III	RTG	1	0	0	0	0	0	2	0	0	3	3	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	1	3	1	1	0	0	1	0	0	0	
Høgsete	III	RTS	3	0	0	0	0	0	3	0	0	3	3	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	1	3	3	3	0	0	3	0	0	0	
Høgsete	IV	RTC	1	0	3	0	0	0	3	0	0	3	3	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	3	1	1	0	0	3	0	0	0	
Høgsete	IV	RTG	1	0	3	0	0	0	3	0	0	3	3	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	1	3	3	1	0	0	1	0	0	0	
Høgsete	IV	RTS	1	0	2	0	0	0	3	0	0	2	3	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	3	1	1	3	0	0	1	0	0	0	
Høgsete	V	RTC	1	0	1	0	0	0	3	0	0	3	3	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	3	1	1	3	0	0	3	0	0	0	
Høgsete	V	RTG	1	0	1	0	0	0	3	0	0	3	3	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	3	1	1	1	0	0	3	0	0	0	
Høgsete	V	RTS	1	0	1	0	0	0	3	0	0	3	3	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	3	1	1	1	0	0	3	0	0	0	

Appendices

Appendix III: Distance Categories Continued

Site	Block	Treatment	<i>Alc alp</i>	<i>Bis viv</i>	<i>Cam rot</i>	<i>Car sp</i>	<i>Cer fon</i>	<i>Dhi del</i>	<i>Gal uli</i>	<i>Ger syl</i>	<i>Hie pil</i>	<i>Hyp mac</i>	<i>Kna arv</i>	<i>Leu vul</i>	<i>Lot cor</i>	<i>Pla lan</i>	<i>Pla med</i>	<i>Pot ere</i>	<i>Pru vul</i>	<i>Ran acr</i>	<i>Rum ace</i>	<i>Rum acl</i>	<i>Sib pro</i>	<i>Sil oca</i>	<i>Sil vul</i>	<i>Ste gra</i>	<i>Ste med</i>	<i>Tar vul</i>	<i>Tri pra</i>	<i>Tri rep</i>	<i>Ver cha</i>	<i>Ver off</i>	<i>Ver ser</i>	<i>Vio bif</i>	<i>Vio riv</i>	<i>Vio tric</i>	<i>Vis vulg</i>	
Låvisdalen	I	RTC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	3	0	0	0	0	2	0	0	0	0	0	3	0	0	0	
Låvisdalen	I	RTG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	2	0	0	0	0	0	3	0	0	0	
Låvisdalen	I	RTS	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	1	0	0	0	0	3	0	0	0	0	0	3	0	0	0	
Låvisdalen	III	RTC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	1	0	0	0	0	1	0	0	0	0	0	2	0	0	0	
Låvisdalen	III	RTG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	2	0	0	0	0	1	0	0	0	0	0	3	0	0	0	
Låvisdalen	III	RTS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	
Låvisdalen	IV	RTC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	
Låvisdalen	IV	RTG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	1	0	0	0	0	2	0	0	0	0	0	1	0	0	0	
Låvisdalen	IV	RTS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	
Låvisdalen	V	RTC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	3	0	0	0	0	3	0	0	0	0	0	3	0	0	0	
Låvisdalen	V	RTG	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	3	0	0	0	0	1	0	0	0	0	0	3	0	0	0	
Låvisdalen	V	RTS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	3	0	0	0	0	3	0	0	0	0	0	3	0	0	0	
Rambera	II	RTC	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	3	3	3	0	0	0
Rambera	II	RTG	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	2	3	3	0	0	0
Rambera	II	RTS	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	3	3	3	0	0	0
Rambera	III	RTC	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	1	3	3	0	0	0
Rambera	III	RTG	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	1	3	3	0	0	0
Rambera	III	RTS	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	1	3	3	0	0	0
Rambera	IV	RTC	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	3	3	3	0	0	0
Rambera	IV	RTG	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	3	3	3	0	0	0
Rambera	IV	RTS	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	3	3	3	0	0	0
Rambera	V	RTC	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	1	3	3	0	0	0
Rambera	V	RTG	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	1	3	3	0	0	0
Rambera	V	RTS	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	3	0	1	3	3	0	0	0

Appendices

Appendix III: Distance Categories Continued

Site	Block	Treatment	<i>Alc alp</i>	<i>Bis viv</i>	<i>Cam rot</i>	<i>Car sp</i>	<i>Cer fan</i>	<i>Dhi del</i>	<i>Gal uli</i>	<i>Ger syl</i>	<i>Hie pil</i>	<i>Hyp mac</i>	<i>Kna arv</i>	<i>Leu vul</i>	<i>Lot cor</i>	<i>Pla lan</i>	<i>Pla med</i>	<i>Pot ere</i>	<i>Pru vul</i>	<i>Ran acr</i>	<i>Rum ace</i>	<i>Rum acl</i>	<i>Sib pro</i>	<i>Sil oca</i>	<i>Sil vul</i>	<i>Ste gra</i>	<i>Ste med</i>	<i>Tar vul</i>	<i>Tri pra</i>	<i>Tri rep</i>	<i>Ver cha</i>	<i>Ver off</i>	<i>Ver ser</i>	<i>Vio bif</i>	<i>Vio riv</i>	<i>Vio tric</i>	<i>Vis vulg</i>	
Veskre	II	RTC	3	0	3	0	4	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	II	RTG	3	0	3	0	4	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	II	RTS	3	0	3	0	4	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	III	RTC	3	0	3	0	4	0	0	0	0	3	0	0	0	0	0	2	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	III	RTG	2	0	3	0	4	0	0	0	0	3	0	0	0	0	0	3	1	0	0	0	3	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
Veskre	III	RTS	3	0	3	0	4	0	0	0	0	3	0	0	0	0	0	2	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	IV	RTC	3	0	3	0	4	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0
Veskre	IV	RTG	3	0	3	0	4	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	IV	RTS	3	0	3	0	4	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	V	RTC	2	0	3	0	4	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	V	RTG	2	0	3	0	4	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0
Veskre	V	RTS	1	0	3	0	4	0	0	0	0	3	0	0	0	0	0	3	1	0	0	0	3	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0
Vikesland	II	RTC	4	0	3	0	0	0	0	0	0	3	3	0	0	0	0	3	0	3	3	3	0	0	3	3	0	0	3	3	0	3	0	0	3	3	0	0
Vikesland	II	RTG	4	0	3	0	0	0	0	0	0	3	3	0	0	0	0	3	0	2	2	3	0	0	3	1	0	0	1	1	0	3	0	0	3	2	0	0
Vikesland	II	RTS	4	0	3	0	0	0	0	0	0	3	2	0	0	0	0	3	0	3	3	3	0	0	3	2	0	0	1	3	0	3	0	0	3	3	0	0
Vikesland	IV	RTC	4	0	3	0	0	0	0	0	0	3	1	0	0	0	0	1	0	3	1	2	0	0	3	1	0	0	3	3	0	3	0	0	3	1	0	0
Vikesland	IV	RTG	4	0	3	0	0	0	0	0	0	3	2	0	0	0	0	1	0	3	1	1	0	0	3	1	0	0	3	3	0	3	0	0	3	1	0	0
Vikesland	IV	RTS	4	0	3	0	0	0	0	0	0	3	1	0	0	0	0	1	0	3	3	1	0	0	3	1	0	0	3	3	0	3	0	0	3	1	0	0
Vikesland	V	RTC	4	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	3	1	1	0	0	3	1	0	0	2	1	0	1	0	0	1	1	0	0
Vikesland	V	RTG	4	0	2	0	0	0	0	0	0	2	1	0	0	0	0	1	0	3	1	2	0	0	3	1	0	0	2	1	0	1	0	0	2	1	0	0
Vikesland	V	RTS	4	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	3	1	1	0	0	3	1	0	0	1	2	0	1	0	0	1	1	0	0

Appendices

Appendix III : Distance Categories Continued

Site	Block	Treatment	<i>Alc alp</i>	<i>Bis viv</i>	<i>Cam rot</i>	<i>Car sp</i>	<i>Cer fon</i>	<i>Dhi del</i>	<i>Gal uli</i>	<i>Ger syl</i>	<i>Hie pil</i>	<i>Hyp mac</i>	<i>Kna arv</i>	<i>Leu vul</i>	<i>Lot cor</i>	<i>Pla lan</i>	<i>Pla med</i>	<i>Pot ere</i>	<i>Pru vul</i>	<i>Ran acr</i>	<i>Rum ace</i>	<i>Rum acl</i>	<i>Sib pro</i>	<i>Sil oca</i>	<i>Sil vul</i>	<i>Ste gra</i>	<i>Ste med</i>	<i>Tar vul</i>	<i>Tri pra</i>	<i>Tri rea</i>	<i>Ver cha</i>	<i>Ver aff</i>	<i>Ver ser</i>	<i>Via bif</i>	<i>Via riv</i>	<i>Via tric</i>	<i>Vis vula</i>
Øvstedal	I	RTC	0	3	3	0	0	0	0	0	3	4	0	0	0	0	0	1	0	0	3	2	0	0	0	0	0	0	0	0	0	1	0	0	4	0	0
Øvstedal	I	RTG	0	1	3	0	0	0	0	0	1	4	0	0	0	0	0	1	0	0	3	2	0	0	0	0	0	0	0	0	0	2	0	0	4	0	0
Øvstedal	I	RTS	0	1	3	0	0	0	0	0	1	4	0	0	0	0	0	1	0	0	3	1	0	0	0	0	0	0	0	0	0	1	0	0	4	0	0
Øvstedal	II	RTC	0	1	3	0	0	0	0	0	1	4	0	0	0	0	0	3	0	0	3	1	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0
Øvstedal	II	RTG	0	1	3	0	0	0	0	0	1	4	0	0	0	0	0	3	0	0	3	1	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0
Øvstedal	II	RTS	0	3	3	0	0	0	0	0	3	4	0	0	0	0	0	3	0	0	3	1	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0
Øvstedal	III	RTC	0	3	3	0	0	0	0	0	3	3	0	0	0	0	0	3	0	0	1	3	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0
Øvstedal	III	RTG	0	3	1	0	0	0	0	0	3	1	0	0	0	0	0	3	0	0	1	3	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0
Øvstedal	III	RTS	0	3	1	0	0	0	0	0	3	1	0	0	0	0	0	3	0	0	1	3	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0
Øvstedal	IV	RTC	0	3	3	0	0	0	0	0	3	4	0	0	0	0	0	1	0	0	3	3	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0
Øvstedal	IV	RTG	0	1	3	0	0	0	0	0	1	4	0	0	0	0	0	1	0	0	3	3	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0
Øvstedal	IV	RTS	0	1	3	0	0	0	0	0	1	4	0	0	0	0	0	1	0	0	3	3	0	0	0	0	0	0	0	0	0	1	0	0	4	0	0
Ålrust	I	RTC	4	3	0	0	3	0	0	0	3	0	3	3	1	1	0	4	1	3	3	0	0	0	0	0	3	0	2	1	3	3	0	0	0	3	0
Ålrust	I	RTG	4	3	0	0	3	0	0	0	3	0	3	3	1	1	0	4	1	3	3	0	0	0	0	0	3	0	2	2	3	3	0	0	0	3	0
Ålrust	I	RTS	4	3	0	0	3	0	0	0	3	0	3	3	1	1	0	4	1	3	3	0	0	0	0	0	3	0	2	1	3	3	0	0	0	3	0
Ålrust	II	RTC	3	3	0	0	3	0	0	0	3	0	3	1	3	3	0	4	1	1	3	0	0	0	0	0	3	0	3	1	3	3	0	0	0	3	0
Ålrust	II	RTG	3	3	0	0	1	0	0	0	3	0	3	1	3	3	0	4	1	3	3	0	0	0	0	0	3	0	3	1	3	3	0	0	0	3	0
Ålrust	II	RTS	3	3	0	0	3	0	0	0	3	0	2	1	1	1	0	4	1	3	3	0	0	0	0	0	3	0	1	1	3	3	0	0	0	3	0
Ålrust	III	RTC	0	1	0	0	0	2	0	0	1	0	3	3	1	2	0	0	1	0	0	1	0	0	2	0	0	0	1	1	0	0	0	0	0	1	0
Ålrust	III	RTG	0	1	0	0	0	1	0	0	1	0	1	3	1	3	0	0	1	0	0	1	0	0	2	0	0	0	1	1	0	0	0	0	0	2	0
Ålrust	III	RTS	0	3	0	0	0	2	0	0	3	0	1	3	1	2	0	0	1	0	0	1	0	0	2	0	0	0	1	1	0	0	0	0	0	1	0
Ålrust	V	RTC	0	1	0	0	0	3	0	0	3	0	3	3	1	1	0	0	1	3	1	3	0	0	3	0	0	0	1	1	0	0	0	0	0	3	0
Ålrust	V	RTG	0	1	0	0	0	3	0	0	3	0	3	3	1	1	0	0	1	2	3	1	0	0	3	0	0	0	2	1	0	0	0	0	0	3	0
Ålrust	V	RTS	0	1	0	0	0	3	0	0	3	0	3	3	1	1	0	0	1	3	1	3	0	0	3	0	0	0	1	1	0	0	0	0	0	3	0

Appendices

Appendix III: List of Abbreviations

Abbreviation	Latin	Abbreviation	Latin	Abbreviation	Latin
<i>Alc alp</i>	<i>Alchemilla alpina</i>	<i>Lot cor</i>	<i>Lotus corniculatus</i>	<i>Ste med</i>	<i>Stellaria media</i>
<i>Bis viv</i>	<i>Bistorta vivipara</i>	<i>Pla lan</i>	<i>Plantago lanceolata</i>	<i>Tar vul</i>	<i>Taraxacum vulgaris</i>
<i>Cam rot</i>	<i>Campanula rotundifolia</i>	<i>Pla med</i>	<i>Plantago media</i>	<i>Tri pra</i>	<i>Trifolium pratense</i>
<i>Car sp</i>	<i>Cardamine sp</i>	<i>Pot ere</i>	<i>Potentilla erecta</i>	<i>Tri rep</i>	<i>Trifolium repens</i>
<i>Cer fon</i>	<i>Cerastium fontanum</i>	<i>Pru vul</i>	<i>Prunella vulgaris</i>	<i>Ver cha</i>	<i>Veronica chamaedrys</i>
<i>Dhi del</i>	<i>Dhianthus deltoides</i>	<i>Ran acr</i>	<i>Ranunculus acris</i>	<i>Ver off</i>	<i>Veronica officinalis</i>
<i>Gal uli</i>	<i>Galium uligonosum</i>	<i>Rum ace</i>	<i>Rumex acetosa</i>	<i>Ver ser</i>	<i>Veronica serpyllifolia</i>
<i>Ger syl</i>	<i>Geranium sylvaticum</i>	<i>Rum acl</i>	<i>Rumex acetosella</i>	<i>Vio bif</i>	<i>Viola biflora</i>
<i>Hie pil</i>	<i>Hieracium pilosella</i>	<i>Sib pro</i>	<i>Sibbaldia procumbens</i>	<i>Vio riv</i>	<i>Viola riviniana</i>
<i>Hyp mac</i>	<i>Hypericum maculatum</i>	<i>Sil aca</i>	<i>Silene acaulis</i>	<i>Vio tric</i>	<i>Viola tricolor</i>
<i>Kna arv</i>	<i>Knautia arvensis</i>	<i>Sil vul</i>	<i>Silene vulgaris</i>	<i>Vis vulg</i>	<i>Viscaria vulgaris</i>
<i>Leu vul</i>	<i>Leucanthemum vulgare</i>	<i>Ste gra</i>	<i>Stellaria graminea</i>		

Appendices

Appendix IV: Species Recording

Species list Ålrust GPS position (157951,00 - 6759200,00)*		Species list Høgsete GPS position (75917,5 - 6774330,00)*	
<i>Achillea millefolium</i>	<i>Plantago lanceolata</i>	<i>Achillea millefolium</i>	<i>Veronica officinalis</i>
<i>Aconitum lycoctonum</i>	<i>Poa pratensis</i>	<i>Agrostis capillaris</i>	<i>Viola palustris</i>
<i>Agrostis capillaris</i>	<i>Potentilla erecta</i>	<i>Alchemilla alpina</i>	<i>Viola riviniana</i>
<i>Alchemilla alpina</i>	<i>Prunella vulgaris</i>	<i>Anthoxanthum odoratum</i>	<i>Viola tricolor</i>
<i>Anthoxanthum odoratum</i>	<i>Ranunculus acris</i>	<i>Avenella flexuosa</i>	
<i>Atocion rupestris</i>	<i>Rhianthus minor</i>	<i>Campanula rotundifolia</i>	
<i>Bistorta vivipara</i>	<i>Rumex acetosa</i>	<i>Carex leporina</i>	
<i>Campanula rotundifolia</i>	<i>Rumex acetosella</i>	<i>Carex pallescens</i>	
<i>Catha palustris</i>	<i>Rumex longifolius</i>	<i>Carex vaginata</i>	
<i>Cerastium fontanum</i>	<i>Schedonorus pratensis</i>	<i>Dechampsia cespitosa</i>	
<i>Dechampsia cespitosa</i>	<i>Sedum annuum</i>	<i>Euphrasia stricta</i>	
<i>Dhianthus deltoides</i>	<i>Silene pratense</i>	<i>Festuca ovina</i>	
<i>Erigeron acer</i>	<i>Solidago virgaurea</i>	<i>Festuca rubra</i>	
<i>Euphrasia wettsteinii</i>	<i>Stellaria media</i>	<i>Galium saxatile</i>	
<i>Festuca rubra</i>	<i>Trifolium pratense</i>	<i>Galium uliginosum</i>	
<i>Galeopsis bifida</i>	<i>Trifolium repens</i>	<i>Galium verum</i>	
<i>Galium boreale</i>	<i>Veronia chamaedrys</i>	<i>Hypericum maculatum</i>	
<i>Galium uliginosum</i>	<i>Veronica officinalis</i>	<i>Juniperus communis</i>	
<i>Gentianella amarella</i>	<i>Viccia cracca</i>	<i>Knautia arvensis</i>	
<i>Hieracium pilosella</i>	<i>Viola tricolor</i>	<i>Leontodon autumnalis</i>	
<i>Knautia arvensis</i>	<i>Viscaria vulgaris</i>	<i>Luzula multiflora</i>	
<i>Leontodon autumnalis</i>		<i>Phleum alpinum</i>	
<i>Leucanthemum vulgare</i>		<i>Phleum pratense</i>	
<i>Lotus corniculatus</i>		<i>Poa pratensis</i>	
<i>Luzula multiflora</i>		<i>Potentilla erecta</i>	
<i>Melampyrum sylvaticum</i>		<i>Ranunculus acris</i>	
<i>Myositis sp</i>		<i>Trifolium pratense</i>	
<i>Plantago media</i>		<i>Trifolium repens</i>	
<i>Phleum alpinum</i>		<i>Vaccinium myrtillus</i>	
<i>Pimpinella saxifraga</i>	* Only fertile individuals recorded (10m radius)	<i>Veronia chamaedrys</i>	* Only fertile individuals recorded (10m radius)

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Appendix IV: Species Recording Continued

Species list Rambera GPS position (49407,80 - 6801320,00)*		Species list Veskre GPS position (35390,20 - 6742090,00)*	
<i>Achillea millefolium</i>	<i>Rumex acetosa</i>	<i>Alchemilla alpina</i>	<i>Omalotheca sylvatica</i>
<i>Agrostis capillaris</i>	<i>Saxifraga oppositifolia</i>	<i>Alchemilla sp</i>	<i>Parnassia palustris</i>
<i>Alchemilla alpina</i>	<i>Sorbus aucuparia</i>	<i>Anemone nemorosa</i>	<i>Potentilla erecta</i>
<i>Anthoxanthum odoratum</i>	<i>Trifolium repens</i>	<i>Antennaria dioica</i>	<i>Prunella vulgaris</i>
<i>Avenella flexuosa</i>	<i>Urtica dioica</i>	<i>Anthoxanthum odoratum</i>	<i>Rhianthus minor</i>
<i>Betula pubescens</i>	<i>Vaccinium myrtillus</i>	<i>Bistorta vivipara</i>	<i>Salix glauca</i>
<i>Bistorta vivipara</i>	<i>Vaccinium uliginosum</i>	<i>Calluna vulgaris</i>	<i>Salix myrsinites</i>
<i>Calluna vulgaris</i>	<i>Vaccinium vitis-idaea</i>	<i>Campanula rotundifolia</i>	<i>Saxifraga aizoides</i>
<i>Campanula rotundifolia</i>	<i>Veronica alpina</i>	<i>Carex capillaris</i>	<i>Sibbaldia procumbens</i>
<i>Carex echinata</i>	<i>Veronica officinalis</i>	<i>Carex echinata</i>	<i>Solidago virgaurea</i>
<i>Carex leporina</i>	<i>Veronica serpyllifolia</i>	<i>Carex flava</i>	<i>Taraxacum vulgare</i>
<i>Carex pallescens</i>	<i>Viola biflora</i>	<i>Carex nigra</i>	<i>Thalictrum alpinum</i>
<i>Carex panicea</i>	<i>Viola palustris</i>	<i>Carex pallescens</i>	<i>Tofieldia pusilla</i>
<i>Chamerion angustifolium</i>		<i>Carex panicea</i>	<i>Trichophorum cespitosum</i>
<i>Cirsium palustre</i>		<i>Carex pulicaris</i>	<i>Trifolium repens</i>
<i>Cornus suecica</i>		<i>Cerastium fontanum</i>	<i>Vaccinium myrtillus</i>
<i>Dechampsia cespitosa</i>		<i>Cirsium vulgare</i>	<i>Vaccinium uliginosum</i>
<i>Euphrasia stricta</i>		<i>Dechampsia cespitosa</i>	
<i>Festuca vivipara</i>		<i>Euphrasia stricta</i>	
<i>Galium uliginosum</i>		<i>Festuca vivipara</i>	
<i>Galium verum</i>		<i>Fragaria vesca</i>	
<i>Hieracium vulgata</i>		<i>Gentiana nivalis</i>	
<i>Juniperus communis</i>		<i>Hieracium vulgata</i>	
<i>Leontodon autumnalis</i>		<i>Hypericum maculatum</i>	
<i>Luzula multiflora</i>		<i>Juncus articulatus</i>	
<i>Nardus stricta</i>		<i>Juniperus communis</i>	
<i>Omalotheca supina</i>		<i>Leontodon autumnalis</i>	
<i>Potentilla erecta</i>		<i>Luzula multiflora</i>	
<i>Prunella vulgaris</i>		<i>Nardus stricta</i>	
<i>Ranunculus acris</i>	* Only fertile individuals recorded (10m radius)	<i>Oxalis acetosella</i>	* Only fertile individuals recorded (10m radius)

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Appendix IV: Species Recording Continued

Species list Ulvehaugen GPS position (128833,00 - 6785010,00)*		Species list Låvisdalen GPS position (80587,50 - 6767820,00)*	
<i>Aconitum lycoctonum</i>	<i>Silene pratense</i>	<i>Alchemilla alpina</i>	<i>Phyllodoce caerulea</i>
<i>Agrostis capillaris</i>	<i>Taraxacum vulgare</i>	<i>Antennaria alpina</i>	<i>Pyrola minor</i>
<i>Alchemilla alpina</i>	<i>Thalictrum alpinum</i>	<i>Antennaria dioica</i>	<i>Ranunculus acris</i>
<i>Antennaria dioica</i>	<i>Vaccinium uliginosum</i>	<i>Anthoxanthum odoratum</i>	<i>Rhodiola rosea</i>
<i>Anthoxanthum odoratum</i>	<i>Vaccinium vitis-idaea</i>	<i>Arabis alpina</i>	<i>Rumex acetosa</i>
<i>Astragalus alpinus</i>	<i>Veronica alpina</i>	<i>Betula pubescens</i>	<i>Sagina saginoides</i>
<i>Avenella flexuosa</i>	<i>Veronica serpyllifolia</i>	<i>Bistorta vivipara</i>	<i>Salix Forbaceae</i>
<i>Bistorta vivipara</i>		<i>Cardamine pratensis</i>	<i>Salix lanata</i>
<i>Campanula rotundifolia</i>		<i>Carex atrofusca</i>	<i>Salix reticulata</i>
<i>Carex atrofusca</i>		<i>Carex bigelowii</i>	<i>Saxifraga aizoides</i>
<i>Carex bigelowii</i>		<i>Carex capillaris</i>	<i>Saxifraga stellaris</i>
<i>Carex vaginata</i>		<i>Carex nigra</i>	<i>Sibbaldia procumbens</i>
<i>Dechampsia cespitosa</i>		<i>Carex norvegica</i>	<i>Silene acaulis</i>
<i>Epilobium hornemannii</i>		<i>Cerastium cerastoides</i>	<i>Solidago virgaurea</i>
<i>Euphrasia wettsteinii</i>		<i>Coeloglossum viride</i>	<i>Taraxacum vulgare</i>
<i>Gentiana nivalis</i>		<i>Dechampsia cespitosa</i>	<i>Thalictrum alpinum</i>
<i>Gentianella amarella</i>		<i>Dryas octopetala</i>	<i>Tofieldia pusilla</i>
<i>Juncus trifidus</i>		<i>Epilobium lactifolium</i>	<i>Vaccinium myrtillus</i>
<i>Juniperus communis</i>		<i>Euphrasia wettsteinii</i>	<i>Vaccinium uliginosum</i>
<i>Luzula multiflora</i>		<i>Hieracium alpinum</i>	<i>Veronica alpina</i>
<i>Luzula spicata</i>		<i>Juncus trifidus</i>	<i>Viola biflora</i>
<i>Phleum alpinum</i>		<i>Luzula multiflora</i>	
<i>Poa alpina</i>		<i>Luzula spicata</i>	
<i>Potentilla crantzii</i>		<i>Nardus stricta</i>	
<i>Phyllodoce caerulea</i>		<i>Omalotheca supina</i>	
<i>Rhodiola rosea</i>		<i>Parnassia palustris</i>	
<i>Rumex acetosa</i>		<i>Phleum alpinum</i>	
<i>Rumex acetosella</i>		<i>Pinguicula vulgaris</i>	
<i>Sedum acre</i>		<i>Poa alpina</i>	
<i>Silene acaulis</i>	* Only fertile individuals recorded (10m radius)	<i>Potentilla crantzii</i>	* Only fertile individuals recorded (10m radius)

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Appendix IV: Species Recording Continued

Species list Gudmesdalen GPS position (75285,30- 6769540,00)*		Species list Skjellingahaugen GPS position (35627,60 - 6785870,00)*	
<i>Achillea millefolium</i>	<i>Leontodon autumnalis</i>	<i>Agrostis capillaris</i>	<i>Omalotheca supina</i>
<i>Aconitum lycoctonum</i>	<i>Leucanthemum vulgare</i>	<i>Alchemilla alpina</i>	<i>Parnassia palustris</i>
<i>Alchemilla alpina</i>	<i>Lotus corniculatus</i>	<i>Alchemilla sp</i>	<i>Poa alpina</i>
<i>Alchemilla sp</i>	<i>Luzula multiflora</i>	<i>Antennaria dioica</i>	<i>Potentilla crantzii</i>
<i>Antennaria dioica</i>	<i>Nardus stricta</i>	<i>Anthoxanthum odoratum</i>	<i>Pyrola media</i>
<i>Anthoxanthum odoratum</i>	<i>Omalotheca norvegica</i>	<i>Bistorta vivipara</i>	<i>Rhianthus minor</i>
<i>Astragalus alpinus</i>	<i>Parnassia palustris</i>	<i>Botrychium lunaria</i>	<i>Saxifraga aizoides</i>
<i>Avenella flexuosa</i>	<i>Phleum alpinum</i>	<i>Campanula rotundifolia</i>	<i>Sibbaldia procumbens</i>
<i>Bartsia alpina</i>	<i>Pinguicula vulgaris</i>	<i>Carex atrofusca</i>	<i>Silene acaulis</i>
<i>Betula nana</i>	<i>Poa alpina</i>	<i>Carex bigelowii</i>	<i>Thalitrictrum alpinum</i>
<i>Bistorta vivipara</i>	<i>Potentilla crantzii</i>	<i>Carex capillaris</i>	<i>Tofieldia pusilla</i>
<i>Botrychium lunaria</i>	<i>Potentilla erecta</i>	<i>Carex flava</i>	<i>Vaccinium uliginosum</i>
<i>Calluna vulgaris</i>	<i>Prunella vulgaris</i>	<i>Carex nigra</i>	<i>Veronica alpina</i>
<i>Campanula rotundifolia</i>	<i>Phyllodoce caerulea</i>	<i>Carex norvegica</i>	<i>Veronica fruticans</i>
<i>Carex atrofusca</i>	<i>Pyrola minor</i>	<i>Carex vaginata</i>	<i>Viola palustris</i>
<i>Carex bigelowii</i>	<i>Pyrola norvegica</i>	<i>Cerastium alpinum</i>	
<i>Carex capillaris</i>	<i>Ranunculus acris</i>	<i>Cerastium fontanum</i>	
<i>Carex flava</i>	<i>Rhianthus minor</i>	<i>Coeloglossum viride</i>	
<i>Carex norvegica</i>	<i>Saxifraga aizoides</i>	<i>Dechampsia cespitosa</i>	
<i>Carex vaginata</i>	<i>Silene acaulis</i>	<i>Empetrum nigrum</i>	
<i>Cerastium cerastoides</i>	<i>Solidago virgaurea</i>	<i>Epilobium anagallidifolium</i>	
<i>Coeloglossum viride</i>	<i>Thalitrictrum alpinum</i>	<i>Euphrasia wettsteinii</i>	
<i>Dechampsia cespitosa</i>	<i>Tofieldia pusilla</i>	<i>Festuca vivipara</i>	
<i>Euphrasia wettsteinii</i>	<i>Trichophorum cespitosum</i>	<i>Galium verum</i>	
<i>Festuca rubra</i>	<i>Vaccinium myrtillus</i>	<i>Gentiana nivalis</i>	
<i>Galium boreale</i>	<i>Vaccinium uliginosum</i>	<i>Juncus trifidus</i>	
<i>Geranium sylvaticum</i>	<i>Veronica alpina</i>	<i>Juncus castaneus</i>	
<i>Geum rivale</i>	<i>Veronica officinalis</i>	<i>Leontodon autumnalis</i>	
<i>Hieracium pilosella</i>		<i>Luzula multiflora</i>	
<i>Juncus trifidus</i>	* Only fertile individuals recorded (10m radius)	<i>Nardus stricta</i>	* Only fertile individuals recorded (10m radius)

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Appendix IV: Species Recording Continued

Species list Fauske GPS position (180405,00 - 6781200,00)*		Species list Vikesland GPS position (75604,70 - 6774850,00)*	
<i>Achillea millefolium</i>	<i>Trifolium pratense</i>	<i>Achillea millefolium</i>	<i>Valeriana sambucifolia</i>
<i>Agrostis capillaris</i>	<i>Trifolium repens</i>	<i>Agrostis capillaris</i>	<i>Veronica officinalis</i>
<i>Alchemilla sp</i>	<i>Veronia chamaedrys</i>	<i>Alchemilla alpina</i>	<i>Viola riviniana</i>
<i>Anthriscus sylvestris</i>	<i>Veronica officinalis</i>	<i>Anthoxanthum odoratum</i>	<i>Viola tricolor</i>
<i>Arrhenatherum elatius</i>	<i>Viccia cracca</i>	<i>Campanula rotundifolia</i>	
<i>Campanula rotundifolia</i>		<i>Carex leporina</i>	
<i>Capsella bursa-pastoris</i>		<i>Carum carvi</i>	
<i>Carum carvi</i>		<i>Euphrasium wettsteinii</i>	
<i>Dhianthus deltoides</i>		<i>Festuca ovina</i>	
<i>Galium verum</i>		<i>Festuca rubra</i>	
<i>Geranium sylvaticum</i>		<i>Galium verum</i>	
<i>Hieracium hieracioides</i>		<i>Hieracium vulgata</i>	
<i>Hieracium pilosella</i>		<i>Hypericum maculatum</i>	
<i>Hypochaeris maculata</i>		<i>Knautia arvensis</i>	
<i>Juniperus communis</i>		<i>Leontodon autumnalis</i>	
<i>Knautia arvensis</i>		<i>Luzula multiflora</i>	
<i>Leontodon autumnalis</i>		<i>Luzula pilosa</i>	
<i>Leucanthemum vulgare</i>		<i>Pimpinella saxifraga</i>	
<i>Lotus corniculatus</i>		<i>Pleum pratense</i>	
<i>Oxalis acetocella</i>		<i>Poa pratensis</i>	
<i>Plantago media</i>		<i>Potentilla erecta</i>	
<i>Pimpinella saxifraga</i>		<i>Ranunculus acris</i>	
<i>Potentilla argentea</i>		<i>Rubus idaeus</i>	
<i>Potentilla crantziii</i>		<i>Rumex acetosa</i>	
<i>Ranunculus acris</i>		<i>Rumex acetosella</i>	
<i>Rumex acetosa</i>		<i>Silene pratense</i>	
<i>Rumex acetosella</i>		<i>Stellaria graminea</i>	
<i>Sedum acre</i>		<i>Trifolium pratense</i>	
<i>Silene pratense</i>		<i>Trifolium repens</i>	
<i>Taraxacum vulgare</i>	* Only fertile individuals recorded (10m radius)	<i>Urtica dioica</i>	* Only fertile individuals recorded (10m radius)

Appendices

Appendix IV: Species Recording Continued

Species list Arhellern GPS position (27494,10 - 6756720,00)*		Species list Øvstedal GPS position (7643,94 - 6762220,00)*	
<i>Agrostis capillaris</i>	<i>Veronia chamaedrys</i>	<i>Achillea millefolium</i>	
<i>Anthoxanthum odoratum</i>	<i>Viccia cracca</i>	<i>Agrostis capillaris</i>	
<i>Avenella flexuosa</i>	<i>Viola palustris</i>	<i>Anthoxanthum odoratum</i>	
<i>Bistorta vivipara</i>		<i>Arrhenatherum elatius</i>	
<i>Campanula rotundifolia</i>		<i>Avenella flexuosa</i>	
<i>Carex leporina</i>		<i>Betula pubescens</i>	
<i>Carex pallescens</i>		<i>Campanula rotundifolia</i>	
<i>Carex panicea</i>		<i>Carex leporina</i>	
<i>Dechampsia cespitosa</i>		<i>Dantoria decumbens</i>	
<i>Euhprasia stricta</i>		<i>Dechampsia cespitosa</i>	
<i>Geranium sylvaticum</i>		<i>Hieracium pilosella</i>	
<i>Hieracium pilosella</i>		<i>Hieracium vulgata</i>	
<i>Hypericum maculatum</i>		<i>Hypericum maculatum</i>	
<i>Leontodon autumnalis</i>		<i>Juniperus communis</i>	
<i>Luzula multiflora</i>		<i>Luzula multiflora</i>	
<i>Melampyrum pratense</i>		<i>Moloina caerulea</i>	
<i>Melampyrum sylvaticum</i>		<i>Nardus stricta</i>	
<i>Nardus stricta</i>		<i>Omalotheca sylvatica</i>	
<i>Plantago lanceolata</i>		<i>Potentilla erecta</i>	
<i>Potentilla erecta</i>		<i>Prunus padus</i>	
<i>Prunella vulgaris</i>		<i>Rumex acetosa</i>	
<i>Ranunculus acris</i>		<i>Rumex acetosella</i>	
<i>Ranunculus repens</i>		<i>Solidago virgaurea</i>	
<i>Rhianthus minor</i>		<i>Veronica officinalis</i>	
<i>Rumex acetosa</i>		<i>Viola riviniana</i>	
<i>Rumex acetosella</i>			
<i>Solidago virgaurea</i>			
<i>Stellaria graminea</i>			
<i>Trifolium pratense</i>			
<i>Trifolium repens</i>	* Only fertile individuals recorded (10m radius)		* Only fertile individuals recorded (10m radius)