

FLORA AND FAUNA

Content

Wildlife in Svalbard.....	1
Mammals.....	3
Polar bear (<i>Ursus maritimus</i>)	3
Walrus (<i>Odobenus rosmarus</i>)	4
Ringed seal (<i>Phoca hispida</i>).....	4
White whale (Beluga, <i>Delphinapterus leucas</i>)	5
Svalbard reindeer (<i>Rangifer tarandus platyrhynchus</i>)	5
Arctic fox (<i>Vulpes lagopus</i>).....	5
Birds.....	6
Svalbard rock ptarmigan (<i>Lagopus muta hyperborea</i>).....	6
Common eider (<i>Somateria mollissima</i>).....	6
Snow bunting (<i>Plectrophenax nivalis</i>).....	7
Vegetation (plants in Svalbard)	7
The vegetation reflects past and present climate.....	8
Productivity, vegetation belts and diversity.....	8
Other important environmental factors and plant adaptations	9
Important landscape forms and vegetation units.....	10
Future scenarios and threats.....	10

Wildlife in Svalbard

<https://cruise-handbook.npolar.no/en/svalbard/wildlife.html>

By Øystein Overrein

Svalbard's wildlife is low in species diversity compared to temperate regions. However, those species that are present in Svalbard are often highly abundant, a pattern most pronounced for seabirds. Wildlife diversity peaks when migratory birds return to breed and there is intense bird activity at sea, in the bird cliffs and on the islands. This contrasts starkly with the wintertime, when only the sounds of the wind and the sea may be heard. Only the hardiest species like Svalbard reindeer, polar bears, Svalbard rock ptarmigan and Arctic foxes can be seen in winter.

Species living here have adapted to the extreme conditions in Svalbard. The greatest challenge is to get enough food for survival and reproduction. In winter, darkness prevails and the ground is covered in snow and ice. Herbivorous animals face their greatest challenges in winter. Very few land-living species are capable of surviving such harsh winters. The Svalbard reindeer, the Arctic fox and the Svalbard rock ptarmigan all have the capability to build energy reserves during summer and autumn,

building up a layer of body fat for survival through the winter when food supply is low. Utilization of this stored fat is crucial to maintain body functions until next summer.

Most birds that breed in Svalbard solve the winter problem by migrating south in late summer/autumn. They spend the winter in a more favourable climate in areas with greater food availability. The Svalbard rock ptarmigan is the only landbound bird species that overwinters in the archipelago. Among the seabirds it is normally only the common eider, the long-tailed duck and the black guillemot that overwinter in Svalbard, and only in small numbers along the coast. There are also northern fulmars and glaucous gulls at sea. The permafrost and sparse vegetation make life difficult for land mammals. For that reason, there are no mice, lemmings or other rodents this far north, with the exception of the sibling vole, an introduced species that now inhabits the lush, grassy slopes between Grumantbyen and Bjørndalen on the southern side of Isfjorden.

Terrestrial mammals and birds live a hectic life during the summer months of June, July and August. Lower coastal areas are usually snow-free, there is daylight around the clock, and temperatures are high enough to allow for young to be reared. For the seals, polar bears and seabirds, all feeding at sea, the sea ice and under-ice algal bloom at the ice edge are of utmost importance.

In Svalbard life in the sea and life on land are closely connected. During the breeding season seabirds transport large amounts of nutrients from the sea to the bird cliffs. A pair of little auks adds about 1 kg of faeces to the soil, which acts as fertilizer, in one season. No wonder the slopes beneath the bird cliffs are extremely green and lush. In this and other ways seabirds play an important ecological role – they enrich the ground and contribute to the lush vegetation that herbivores like reindeer, geese and ptarmigans live off. At the next trophic level in the food chain, the Arctic fox preys on these herbivores.

Good light conditions and relatively high temperatures in the summer create the basis for plant production and a rich wildlife both on land and, especially, in the sea. Snow conditions on land and sea ice conditions are decisive factors. Bird cliffs and steep slopes are the first to become snow-free. Then follow islands and islets on the west coast, and lastly the flat tundra areas on the strandflats and further up the valleys. Migrating geese arriving in mid-May and onwards need snow-free areas for a successful breeding season. As soon as the conditions are right, they start breeding. In years with late snowmelt, certain species, like the Arctic tern and geese, may break off breeding to concentrate on surviving themselves.

The fjord ice (fast ice), which in some places lasts until late June and even into July, are important areas for ringed seals – firstly when they give birth in March/April and later during moulting in June. The ringed seals are the nutritional basis for polar bears and Arctic foxes. Common eiders and geese will not start breeding until the sea ice connecting the main islands to their breeding grounds on smaller islands and islets has melted away. Until then they cannot be safe from the greedy egg thief: the Arctic fox. However, the birds have no protection against polar bears, which easily swim out to the islets and “vacuum” up all the eggs in a colony, leaving the birds with an abortive breeding season.

The lack of trees and bushes in Svalbard means that the birds nesting here place their nests on the ground, on scree slopes or cliff ledges. Larger birds usually place their nests quite openly, while smaller birds, like the snow bunting, usually choose more protected sites in cracks, under rocks or on

scree slopes. Waders place their nests on mounds of vegetation or in beach vegetation just above the high tide mark.

Mammals

A total of 19 species of marine mammals are found in Svalbard waters. This includes polar bears, walruses, five species of seals and 12 species of whales. Of these, polar bears, walruses, narwhals, white and bowhead whales stay in the area year-round. The other species visit the area sporadically when food availability is favourable around Svalbard – in summer.

There are only three species of terrestrial mammals in Svalbard: Svalbard reindeer, Arctic fox and sibling vole. The vole was most probably introduced to Svalbard in animal fodder at the Russian mining settlement of Grumantbyen. Deliberate attempts to introduce other species – Arctic hare, hare and muskox – failed to establish populations capable of living there, and they have gone extinct. House mice in fluctuating numbers are seen irregularly in the settlements.

Below is a brief description of some of the species you may see along the coasts of Svalbard. (For more detailed descriptions, see the Norwegian Polar Institute's handbook "Birds and Mammals of Svalbard".)

Polar bear (*Ursus maritimus*)



To see the king of the Arctic probably tops the wish list for tourists visiting Svalbard. Once heavily hunted, the polar bear was protected by law in 1973. Through a joint Norwegian–Russian effort, the common population of Svalbard and Franz Josef Land – including the drift ice area – was estimated in 2004 to nearly 3000 animals. Polar bears may appear anywhere in Svalbard, but in summer they are most often seen in the north-western and northern parts of Spitsbergen, on the east coast and on Nordaustlandet and the surrounding islands. In summer, they can often be spotted in front of glaciers, where seals haul-out. The polar bears are strongly tied to the sea and sea ice, and they are proficient swimmers. In 2005, scientists documented (with the aid of a satellite transmitter) a swimming female bear crossing the fjord of Storfjorden in 24 hours. The distance is about 70 km.

Polar bears often follow the ice edge northwards in summer. Some individuals have a different strategy, staying on land and starving through summer, unless they go for birds' eggs and chicks or

are lucky to find a stranded whale carcass. Such incidents can bring together several polar bears. Do remember that it is prohibited to follow, seek out or lure polar bears. This great predator has little respect for humans and dangerous situations can easily arise if people get too close. Almost every year a polar bear is killed in Svalbard after confrontations with humans or because of safety perspective in the settlements. Observing polar bears safely from the deck of a large boat is highly recommended over a close meeting on land or in a small vessel. Females with first-year cubs are extra shy and vulnerable. Keep a distance, whether meetings occur on land or on ice.

Walrus (*Odobenus rosmarus*)



Svalbard and Franz Josef Land have a common walrus population. The walrus was protected in 1952, at a time when the Svalbard population was down to a few hundred animals. Estimates of the Svalbard population indicated in 2006 an approximate number of 2500 animals, in 2012 the population was estimated to be 3900. The population is predominantly males, but an increasing number of females with calves in the east. Walruses are social animals and are often seen in groups when searching for mussels on the sea floor and when resting on land or during moulting. They prefer lying on ice-floes or fast ice, if possible.

On land, walruses may seem undisturbed by the presence of people, and groups of males are more robust in this sense than females with calves. Anyway, one should never closely approach groups of walruses at their haul-out sites. Be aware that the walrus is a good swimmer and may attack zodiacs and kayaks at sea.

Ringed seal (*Phoca hispida*)

The ringed seal has a circumpolar distribution and is the most widespread and common seal at this latitude due to its unique ability to maintain breathing holes in the fast ice all year round. The Svalbard population is estimated to 100 000 individuals. The ringed seal is a small seal, with adult animals weighing 50–100 kg. A ringed pattern in its fur explains the common name. It is dependent on sea ice for birthing, moulting (May–July) and haul-out. During the moult, seals congregate in fjords with remaining fast ice, but disperse afterwards. Some seals move north to the ice edge, while others live in the open sea. Despite their small size they are capable of diving below 500 m. During the cruise season, ringed seals are most often observed swimming in open water. The ringed seal is vulnerable to changing climate.

White whale (Beluga, *Delphinapterus leucas*)



There are good chances of seeing white whales in Svalbard. This is a medium sized toothed whale, and males can reach lengths of 4.5 m and weigh 1500 kg. Females are somewhat smaller. At birth, the calves are light grey – the white colouration is not obtained until the age of seven for females and 12 for males. The number of white whales in Svalbard is not known. Being a social whale, it can often be spotted moving in groups near land. The groups are sexually segregated, with males forming separate groups from females and juveniles. In Svalbard white whales occur mostly in coastal areas, but also in areas of dense pack ice. In summer they often stay in front of glaciers where there is a good supply of food.

Svalbard reindeer (*Rangifer tarandus platyrhynchus*)

The Svalbard reindeer is so common that tourists are almost guaranteed to see one, even up close (at least in Longyearbyen). The Svalbard reindeer is a sub-species of reindeer that only lives in Svalbard. Its short legs, short neck, small and rounded head and thick coat make up its characteristic appearance. Males are larger than females. Svalbard reindeers are widely distributed in Svalbard in areas with sufficient vegetation. The total population is estimated at 10 000 animals, and the most dense populations are found at Nordenskiöld land, in the valley of Reindalen and on the islands of Edgeøya and Barentsøya. During winter, the reindeer concentrate on ridges and plateaus with little snow cover and sparse vegetation. Early in the summer they move to lower areas, to the standflats, lowland plains, bottom of the valleys and beneath the bird cliffs where they can feed on the lush, nutritious vegetation and accumulate fat. The reindeer gives birth in June and during this period the females are dispersed and are extremely sensitive to disturbances. To get close to adult reindeer, it is best to sit down and let them come to you. In some places the reindeers may seem curious and tame while they are extremely shy in other areas.

Arctic fox (*Vulpes lagopus*)

In mainland Norway, the Arctic fox is endangered, while in Svalbard there is a large, thriving population. There are great chances of seeing foxes along the coasts of Svalbard as they are widespread in almost all of the archipelago, even on the island of Bjørnøya, where the population has been re-established over the last years. The Arctic fox is short-legged and has a short snout, short and rounded ears and a small body covered by a thick, well-insulating coat. The bottoms of the paws are covered in fur. These are all adaptations to reduce heat loss in winter. The Arctic fox appears in two colour morphs – blue and white. The white morph is uniformly white in winter, and brown and yellowish in summer. The blue fox is dark brown/blue all year round.

The Arctic fox lives in two different types of areas – along the coast and inland. At the coast, the fox is closely associated with the bird cliffs, where food is plentiful in the form of eggs and chicks of

common eiders, geese and seabirds. During summer, the fox hoards food in anticipation of a long and severe winter. Inland, food is less plentiful and the most important food sources here are Svalbard rock ptarmigan, waders, Svalbard reindeer and geese. Mating takes place between February and April, and in May–June the cubs (normal litter size 5-6) are born in underground dens in sandy slopes or in dens under large boulders. Dens are often located in proximity to bird cliffs. At the age of 3-4 weeks, the cubs start to play outside the den. Do not disturb Arctic foxes at their den sites, and remember the hazard of rabies! The Arctic fox is also a host of the parasite *Echinococcus multilocularis* (also known as fox tape worm), which can be transmitted to humans through faeces, and may be fatal.

Birds

For cruise tourists, encounters with Svalbard's wildlife will perhaps be dominated by seabirds. A brief introduction to some of the most characteristic follows.

Svalbard rock ptarmigan (*Lagopus muta hyperborea*)



The Svalbard rock ptarmigan is the largest terrestrial bird overwintering in Svalbard and is widespread in most of the archipelago. Greatest densities are found in central areas of Spitsbergen where plant production is highest. The Svalbard rock ptarmigan is an endemic sub-species of rock ptarmigan. The male (cock) establishes a territory in March–April, which it protects through creating a diversion and making a burping sound. Males can often be spotted sitting on a rock or high ground guarding its territory. The female (hen) lays the 9-11 eggs within the territory. As soon as the chicks are hatched, they leave the nest and start wandering about. They are capable of flying after 10-12 days, but stay with the hen for another 10-12 weeks.

Common eider (*Somateria mollissima*)

The eggs and down of the common eider were heavily exploited in earlier times, resulting in reduction in the population and subsequent protection in 1963. In Svalbard today, the breeding population is estimated to be between 13 500 and 27 500 pairs. The common eider nests in dense colonies on islands and islets on the west coast, in the north of Svalbard and on Tusenøyane. They are also found breeding scattered across the whole archipelago. Just like the geese, common eiders are extremely vulnerable to disturbances during breeding and will easily be scared off the nest, leaving their eggs exposed to egg thieves like the Arctic fox, Arctic skua and glaucous gull. In certain areas, even the polar bear may interrupt the breeding season by plundering all the nests on an island. Many important common eider breeding areas were protected in 1973, and within the protection zone traffic is prohibited throughout the breeding season.

Snow bunting (*Plectrophenax nivalis*)



Visitors travelling inland will meet the snow bunting, the only songbird in Svalbard. When the snow bunting returns in April, its melodious lark-like song revives nature in Svalbard – in stark contrast to and in competition with noise from snowmobiles and other man-made sounds. The snow bunting is the most northerly passerine bird in the world. It nests in most areas of Svalbard, and occurs on the coast and inland, and also in the settlements, where it can find good nesting sites. Its main food is insects. In August–September it leaves Svalbard and migrates south to the Russian steppes north of the Caspian Sea and Kazakhstan for overwintering.

Vegetation (plants in Svalbard)

<https://cruise-handbook.npolar.no/en/svalbard/vegetation.html>

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At a distance, Svalbard appears to be dominated by bare rocks, glaciers, ice and snow. However, for those with an eye for plant life, the land up north gives another impression. As trees and shrubs are absent in Svalbard, the ground vegetation becomes more visible. In summertime, flowering plants, the dense moss tundra in the valleys, and the lush green vegetation under the bird cliffs are astonishing. Forming a transition between the mountains and the sea, the plateaus host important vegetation types. The plateau landscape varies from exposed ridges, plains and leeward sides with late snow melt (so-called snow beds).

In Svalbard, plant growth and distribution are limited by large temperature fluctuations, a short growth season, nutrient deficiency, wind exposure and soil movement caused by freeze–thaw cycles. The most important factors determining plant distribution are temperature, bedrock type, soil texture and topography. The permafrost thaws 30-150 cm every summer. This makes it possible for plants to grow in the shallow frost-free layer of the soil. This active layer also permits drainage of precipitation and meltwater. Variations in the terrain, drainage, and snow cover thickness and duration contribute to the variation in habitats and vegetation types.

The vegetation reflects past and present climate

As early as 10 000-11 000 years BC there was some ice-free areas with scattered vegetation in coastal parts of Svalbard. Between 9000 and 2000 years BC there was a warmer epoch, and denser and more abundant vegetation was established. Thick peat deposits found in Rosenbergdalen on the island of Edgeøya are dated to this epoch. As most of the archipelago was ice-covered during the last ice age it is plausible that most plant species immigrated during the Holocene (i.e. the last 10 000 years).

The Svalbard climate differs from other Arctic areas at the same latitude – elsewhere in the circumpolar region plant life this far north is very scarce – but the West Spitsbergen Current brings warm Atlantic water northwards along the west coast of Svalbard and contributes to a warmer climate. Warm air currents from the south and west also bring some heat. At the east coast, cold ocean currents transport cold water from the Arctic Ocean southwards, and this part of Svalbard hosts more typical high-Arctic vegetation.

Productivity, vegetation belts and diversity

In Svalbard, the land area with productive vegetation is small. Less than 10 % of the total land area has biological productivity of any importance, and the productivity is often restricted to small areas. A continuous vegetation cover is mainly found in the lowlands near the coast and in the large, ice-free valleys. During the last 120 years the vegetation has been mapped, described and categorized in different ways. According to the bio-climatic criteria currently used to classify regions of the Arctic, Svalbard is divided into the mid-Arctic tundra zone, the northern Arctic tundra zone and the Arctic polar desert. This division into zones reflects the mean temperature for the warmest month: 5-7 °C for the mid-Arctic tundra zone; 3-5 °C for the northern Arctic tundra zone and less than 3 °C for the Arctic polar desert. The zones are recognized by their different plant communities, known as zonal vegetation types, defined by various plant and moss species. The zonal vegetation types for the mid-Arctic, the northern Arctic and the polar desert tundra zones are white Arctic bell-heather communities, Arctic wood-rush communities and Svalbard poppy communities, respectively.

As of 2015, about 178 vascular plants, 380-390 moss species, 708 lichen species and >750 species of fungi have been documented in Svalbard. Seven species of vascular plants have been introduced by people. Their establishment appears to be permanent, but these introduced species are confined to

areas with human settlements. Examples of these are tufted hair-grass (*Deschampsia cespitosa*), northern meadow-grass (*Poa pratensis* ssp. *alpigena*) and red fescue (*Festuca rubra*). In addition, 9 introduced species with scarce distribution are known, for example, knotgrass (*Polygonum aviculare*), sheep's sorrel (*Rumex acetosella*) and sea mayweed (*Tripleurospermum maritimum*). In total, 68 Svalbard species do not grow on the Norwegian mainland, but floristically link Svalbard to the Russian and Greenland Arctic. Three species are endemic to Svalbard – i.e., they grow only in Svalbard. These are Svalbard cinquefoil (*Potentilla × insularis*), Svalbard saxifrage (*Saxifraga svalbardensis*) and Svalbard saltmarsh grass (*Puccinellia svalbardensis*). Biological diversity in Svalbard is low compared to the mainland, consistent with the general rule of thumb that biological diversity decreases with increasing latitude, that is, with greater distance from the equator.

Many common Scandinavian alpine plants occur in Svalbard, in addition to species that are rare or absent on the mainland. Examples of the latter are spiked snow-grass (*Phippsia algida*), Svalbard poppy (*Papaver dahlianum*), tundra chickweed (*Stellaria longipes*) and sulphur-coloured buttercup (*Ranunculus sulphureus*). They are all rare in Scandinavia, but common in Svalbard. For other species the reverse is true: they are rare in Svalbard but common on the mainland. For example, alpine rock-cress (*Arabis alpina*), polar bilberry (*Vaccinium uliginosum*), cloudberry (*Rubus chamaemorus*), mountain crowberry (*Empetrum nigrum* ssp. *hermaphroditum*) and dwarf birch (*Betula nana*) are rare in Svalbard.

In Svalbard, the equivalent to the mainland shrub vegetation consisting of birch and willow is low-growing vegetation reaching a maximum height of 25 - 30 cm in favourable places. The only Svalbard shrub reaching a considerable height is dwarf birch. It is confined to a few sheltered localities in the Isfjorden area. The two small shrub species, polar willow (*Salix polaris*) and net-leaved willow (*Salix reticulata*), are common, but only reach a height of 2-5 cm.

Other important environmental factors and plant adaptations

There are two main groups of bedrock in the Svalbard archipelago. One is of granitic origin (eruptive and metamorphic) with minerals containing much silica. Granitic bedrocks give an acidic (low pH) soil type. The other bedrock type is of sedimentary origin, and often contains calcium, which supports nutrient-rich soil types with a higher pH. The species composition and proportion of vegetation cover are influenced by the pH in the soil, and some species prefer alkaline (high pH) soil types, for instance, mountain avens (white dryad, *Dryas octopetala*), alpine meadow-grass (*Poa alpina*) and yellow mountain saxifrage (*Saxifraga aizoides*). Other species are most common in areas with acidic soil, such as white Arctic bell-heather (*Cassiope tetragona*), polar fir clubmoss (*Huperzia arctica*), northern wood-rush (*Luzula confusa*) and tundra chickweed.

Many species of Svalbard plants feature ecological and/or physiological adaptations that enable them to survive and reproduce in harsh and changing conditions. Tussocks and mat-forming growth forms, hairs, umbrella-shaped flowers, elastic roots, clonal dispersal (by which the plant produces stolons or rhizomes from which genetically identical new plants develop) and nodes are commonly observed and are adaptations to an Arctic life. Most species are also perennial. This is because Arctic plants grow very slowly, and one season is often not sufficient to accumulate resources for flowering and seed production. The few annual species in Svalbard are very small, for instance, Iceland purslane (*Koenigia islandica*), mountain eyebright (*Euphrasia wettsteinii*) and diminutive gentian (*Comastoma tenellum*).

Important landscape forms and vegetation units

Ridges with a thin snow cover become free of snow early in spring, exposing plants to severe stress due to temperature fluctuations, strong light, wind exposure and dry weather. However, the advantage is a relatively long growing season. The ridges host one of the most beautiful and interesting plant associations in Svalbard – the mountain avens heaths. In early June, species like mountain avens, purple saxifrage (*Saxifraga oppositifolia*) and various species of whitlow-grass (*Draba* spp.) can initiate growth. Habitats with a thicker snow cover (snow beds), become snow-free much later and therefore have a shorter growth season. In places where the snow cover persists longest, the vegetation does not become snow-free until mid-July, and the plants only have a few weeks to grow, flower and produce seeds. This is the habitat for minute species such as polar willow, alpine bistort (*Bistorta vivipara*), pygmy buttercup (*Ranunculus pygmaeus*) and outspread snow-grass (*Phippsia concinna*). The short growth season leads to a high rate of inbreeding, self-fertilization and clonality.

The plant associations of the large valleys in central parts of Spitsbergen, which have a relatively long growth season, are dominated by bryophytes (mosses and liverworts). Plant associations here are characterized by a moisture gradient ranging from relatively dry moss tundra to moist mires and wet marshes. Vascular plants common to these areas are polar foxtail (*Alopecurus magellanicus*), polar cress (cuckooflower, *Cardamine pratensis* ssp. *angustifolia*), Arctic cottongrass (*Eriophorum scheuchzeri* ssp. *arcticum*), black cottongrass (*E. angustifolium* ssp. *triste*), alpine hair-grass (*Deschampsia alpina*), tundra grass (*Dupontia fisheri*), Arctic wood-rush (*Luzula nivalis*), polar horsetail (field horsetail, *Equisetum arvense* ssp. *alpestre*), two-flowered rush (*Juncus biglumis*) and various sedges. Along with the bird cliff vegetation, these habitats are the most important grazing areas for reindeer and geese in Svalbard.

The vegetation is lush by the foot of bird cliffs and other breeding places for birds. The moss, grass, and herb vegetation is one of Svalbard's most diverse and species-rich habitats. The soil richly fertilized by bird droppings, bird cliff plants can become quite tall. Common species are hawkweed-leaved saxifrage (*Saxifraga hieracifolia*), tufted saxifrage (*S. cespitosa*), drooping saxifrage (*S. cernua*), polar scurvygrass (*Cochlearia groenlandica*), mountain sorrel (*Oxyria digyna*) and boreal Jacob's ladder (*Polemonium boreale*).

At the coast, by the lagoons and by the river deltas, a special vegetation type occurs – the salt marsh. The salt marshes vary in species composition along a gradient of increasing sea salt influence. Typical species are Arctic saltmarsh sedge (*Carex subspathacea*), polar bear sedge (*C. ursina*), creeping saltmarsh grass (*Puccinellia phryganodes* ssp. *vilfoidea*) and snow pearlwort (*Sagina nivalis*). The species composition gives the area a characteristic red to red-brown colour. At or near beach ridges, the beautiful oysterplant (*Mertensia maritima* ssp. *tenella*) grows in association with dense mats of sea sandwort (*Honkenya peploides* ssp. *diffusa*).

Future scenarios and threats

The official Norwegian Red List of threatened species lists 50 species occurring in Svalbard, of which five species are found near the hot springs in Bockfjorden in the Nordvest-Spitsbergen National Park. The inner fjord areas of Spitsbergen, especially the inner parts of Kongsfjorden, Isfjorden and Van Mijenfjorden, have a particularly rich flora. More than 75 % of all plant species in Svalbard grow here.

Species diversity is closely related to the climate, and when climatic conditions change, plant life is affected. In the Arctic, even small changes in environmental conditions can have large impacts on the vegetation – and consequently on the fauna. Climate models predict a warmer and wetter climate in Svalbard as a consequence of increasing concentration of greenhouse gases in the atmosphere.

Currently observed climate change in Svalbard is expected to cause changes in vegetation cover and species composition due to increased establishment of non-native species and altered competition between species. The plausible scenario for the near future is that thermophilous (warm-loving) species, like dwarf birch, Arctic holy grass (*Hierochloa alpina* ssp. *alpina*), crowberry and polar bilberry, will expand in distribution.

Grazing and trampling are two important ecological factors in reindeer grazing areas. Trampling from both humans and reindeer is detrimental to the vegetation cover partly due to increased erosion. Grazing geese has the same impact on the vegetation. Where some damage is caused in the vegetation cover, wind can increase erosion in dry areas, and in wet areas, a similar type of erosion is caused by the repetitive forces of freezing and thawing of water. Some vegetation types are more vulnerable to human impact than others. Low plant productivity leads to very slow re-growth following damage. Because of the permafrost, areas with continuous vegetation cover are especially vulnerable to damage. Once damaged, the insulating effect of the vegetation cover is reduced and leads to increased summer ground thaw and increased erosion.

Vegetation-rich areas such as the moss tundra, mires and marshes are especially vulnerable to disturbance. The same applies to the steep hills below the bird cliffs. This is why tourist groups should always be directed around such areas, to avoid causing damage to the vegetation. Our recommendation is that groups of tourists should walk on the dry and least vegetated areas where possible. If you follow these recommendations, the walk may seem tortuous and winding, but will be environmentally friendly.