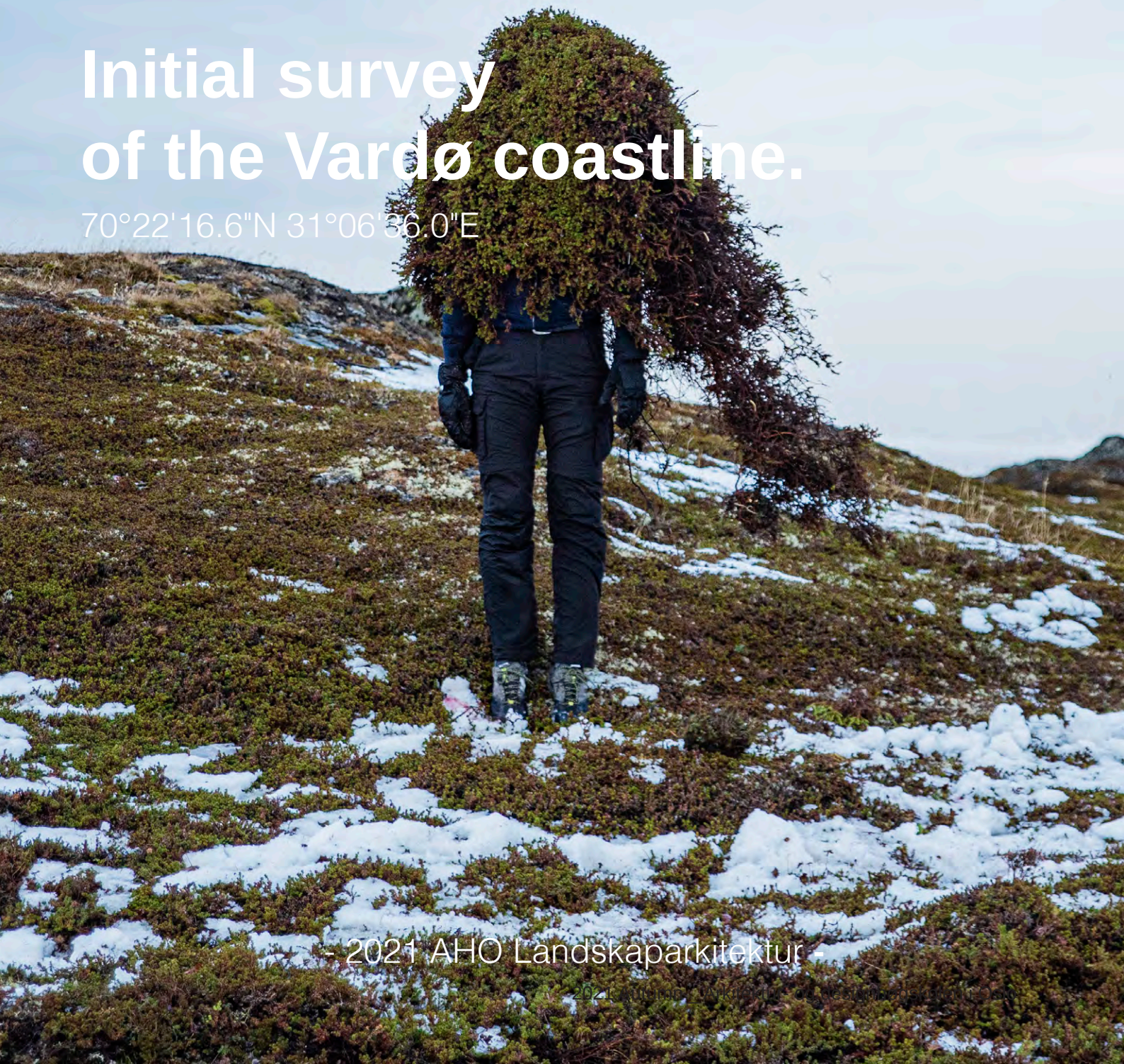
Resource Atlas for the Anthropocene

Initial survey of the Vardø coastline.

70°22'16.6"N 31°06'36.0"E



- 2021 AHO Landskaparkitektur -

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Vardø
70°22'15.7"N 31°06'32.9"E

Persfjorden
70°25'13.1"N 30°47'27.1"E

Sandfjord
70°30'22.4"N 30°32'49.1"E

Hamningberg
70°32'26.6"N 30°36'50.8"E

Teacher

Janike Kampevold Larsen
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External examiner

Brona Ann Keenan

Students

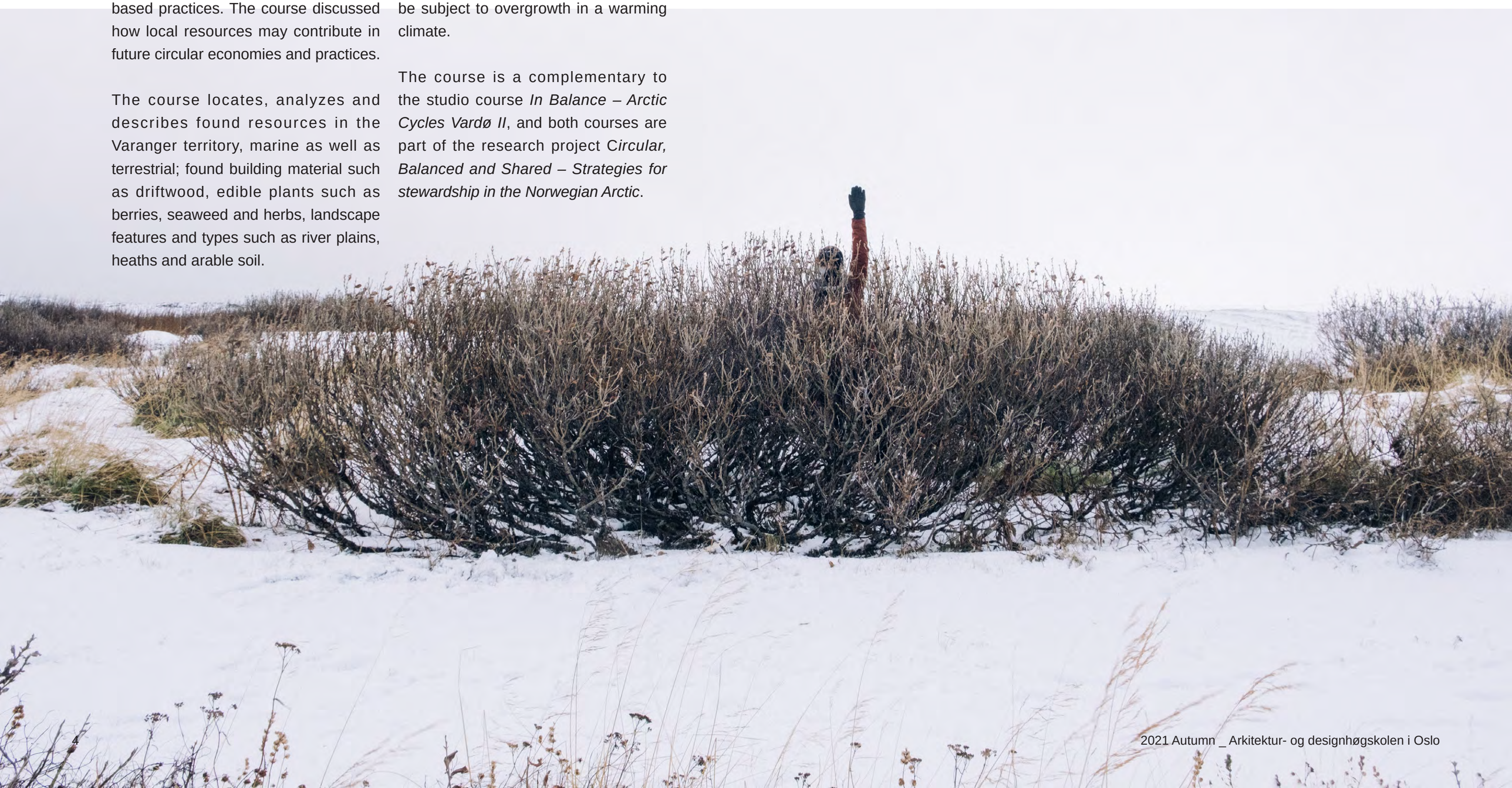
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The course Building a Circular Resource Archive is based in the conviction that circular resource networks will and must play a seminal role in future place-based practices. The course discussed how local resources may contribute in future circular economies and practices.

The course locates, analyzes and describes found resources in the Varanger territory, marine as well as terrestrial; found building material such as driftwood, edible plants such as berries, seaweed and herbs, landscape features and types such as river plains, heaths and arable soil.

The atlas forms a partial archive of local resources and suggests strategies for future management of depletable resources like soil meadows that may be subject to overgrowth in a warming climate.

The course is a complementary to the studio course *In Balance – Arctic Cycles Vardø II*, and both courses are part of the research project C*ircular, Balanced and Shared – Strategies for stewardship in the Norwegian Arctic*.



Intro

Climate change, policies and pandemics contribute to challenge the idea of the globally networked place, and to revive the idea of the local.

This course is founded in an idea of circular resource networks and their role in future place-based practices. It builds knowledge on both local and global cyclic systems - past, present and future.

Based in theories of innovative place development and transition design, the course discusses how local resources may contribute in future circular economies and practices.

Leaning on the cross-institute research project Circular, Balanced and Shared - Strategies for stewardship in the Norwegian Arctic, this course takes the Varanger peninsula as a case, and locates, analyzes and describes found resources in the Varanger territory, marine as well as terrestrial.

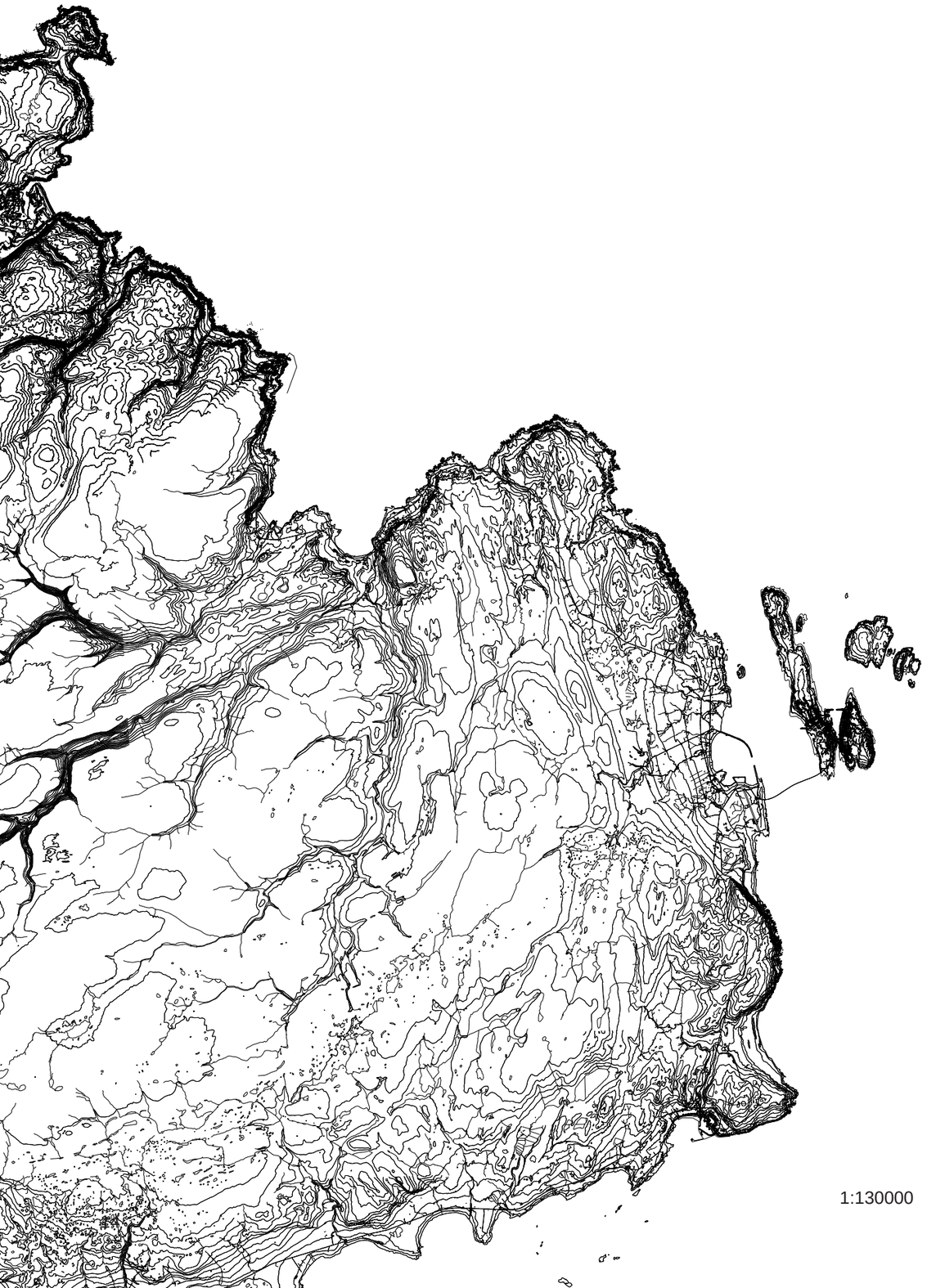
Aim is to make a comprehensive archive of local resources that can be of use for local entrepreneurs and the Vardø municipality for years to come. Resources in this context encompass found building material such as driftwood, local plants, seafood, reindeer, landscape features and landscape types such as national parkland, peatland and arable soil. All territorial resources will be considered objects to be catalogued.



Arctic Treeline







1:130000

Seaweed , plastic and drift wood

As a result from climate change and human footprint, every day we found more and more "garbage" on the beaches around the world. And also in northern Norway, and though there's some people in the main touristic points who have developed systems to clean them, fewer have thought about reusing it and making something out of it, keep the wheel turning, make a circular resource out of it. That's what our group is focusing on.

We drove alongside the coast of Varanger, stopping in almost every beach, and gathering information and pictures of what we found (mainly plastic, driftwood and seaweed, that it might not be "garbage" but it litters the beaches when it's driven out the water) to further analyse and propose possibilities of future use for the community. But our main investigation area is Hamningberg, mainly the western beach, where we found the highst amount of accumulation of our three main categories.

Photo: David Pedersen



Illustration: David Pedersen



Seaweed

There is a lot of natural resources hidden underneath the cold water of the Barents Sea. Our research aims to give inhabitants of the northern Varanger area knowledge of where they can find different kinds of seaweed species, how to identify them, and what they can be used for.

Seaweed, also called benthic marine algae, is a group of plants that can be found near the coastline, or further out on the ocean floor. We can classify seaweed intro three main groups, green (Chlorophyta), brown (Phaeophyta), and red (Rhodophyta).

Many species are known to grow really fast. During the summer time with a lot of sun hours they can grow up to 30cm each day! Especially where there are strong currents and the nutrient flow contribute to faster growth.

From what we have learned about the conditions in and around Hamningberg we established that there is larger accumulation of different species of seaweed on the western beach of Hamningberg (See page 26). Large amounts of driftwood collect in this bay as well due to the currents they drift on. That samen currents combined with strong winds and large waves gives perfect conditions for seaweed to grow in that specific area.

Seaweed is a resource that is not utilized well enough in our daily life. In this chapter, we will share some information that can help increase the competence related to the various algae that can be found along the coastline of Varanger. Our goal is to make it easier for people to include seaweed in their daily diet.

Seaweed species

An overview of the different seaweed species you can find along the Norwegian coastline. The description related to the pictures aims to inform about where the different species can be found in the sea, which parts of them are edible, and which parts should be left for further growth.

Illustrations: David Pedersen



WHAT IT IS: STORTARE (Laminaria Hyperborea)

WHERE TO FIND: The kelp plant thrives at a depth of 20m. Grows on rocky soils, and preferably in areas exposed to waves.

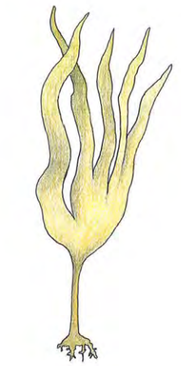
WHAT TO EAT: The stem and first part of the leaf are not used and should be left for further growth.



WHAT IT IS: GRISETANG (Ascophyllum Nodosum)
30cm - 2m

WHERE TO FIND: Grows at the top of the shore along the entire Norwegian coast.

WHAT TO EAT: This is seaweed and thus grows from the top. New shoots are being used in cooking.



WHAT IT IS: FINGERTARE (Laminaria Digitata)
Up to 2.5m

WHERE TO FIND: Located along the entire Norwegian coast in the border between the coastal zone and the sea zone. Grows from the bottom in transition stem to leaf.

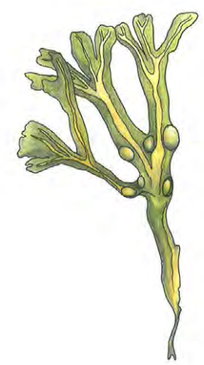
WHAT TO EAT: The stem and first part of the leaf are not used and should be left for further growth.



WHAT IT IS: SUKKERTARE (Saccharina Latissima)
Up to 3m and more.

WHERE TO FIND: Can be found along the entire Norwegian coast in sheltered waters. Grows from the bottom in transition stem to leaf.

WHAT TO EAT: Last year`s leaves in the tip are often frayed and worn with a lot of growths on and this part should be cut away.



WHAT IT IS: BLÆRETANG (Fucus Vesiculosus)

WHERE TO FIND: Grows at the top of the shore along the entire Norwegian coast. Has midrib, is olive green and has paired blisters, one on each side of the midrib, but may lack these.

WHAT TO EAT: The new shoots can be used for cooking.



WHAT IS IS: KRUSFLIK (Chondrus Crispus)
2 - 15cm

WHERE TO FIND: A red algae species found along the entire Norwegian coast. Often grows on rocky bottoms in shallow water.

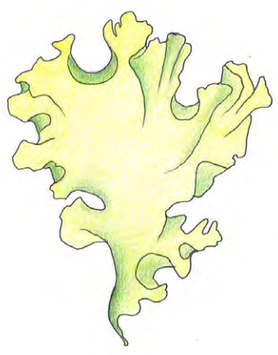
WHAT TO EAT: Grows from the top. Some of the algae should be left for further growth.



WHAT IS IS: SØL (Palmaria Palmata)
5 - 20cm

WHERE TO FIND: Found along the entire Norwegian coast in the spring zone, exposed waters. Often grows on the algae such as on the stalk of large kelp and mussels.

WHAT TO EAT: Grows from the base of the leaf and the whole algae can be used. Some of the algae should be left for further growth.



WHAT IS IS: HAVSALAT (Ulva Lactusa)
Up to 20cm

WHERE TO FIND: Can be found along the entire Norwegian coast.

WHAT TO EAT: Green algae is best used fresh. The whole leaf can be used for cooking.



WHAT IS IS: BUTARE (Alaria Esculenta)
20 - 30 cm wide and several meters long.

WHERE TO FIND: Grows most often a few meters down, but can be collected with rubber boots where shore is large.

WHAT TO EAT: It is the middle field that is used, the one that is outermost and worn is cut away. The bottom part should be left for regrowth.



WHAT IS IS: TARMGRØNSKE (Enteromorpha)
Varies from 10 - 40cm

WHERE TO FIND: Can be found along the entire Norwegian coast. Grows most often in puddles on boulders, but grows also directly on other species at the top of the shore.

WHAT TO EAT: Everything.

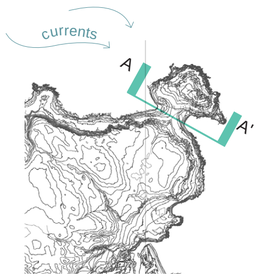


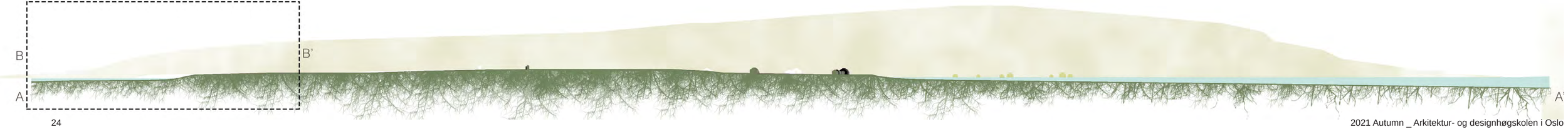
WHAT IS IS: SAGTANG (Fucus Serratus)

WHERE TO FIND: Grows at the top of the shore along the entire Norwegian coast.

WHAT TO EAT: These are the new shoots at the far end and approx. 3-5cm down on the blade that can be used in cooking.

Beach section, Hamningberg





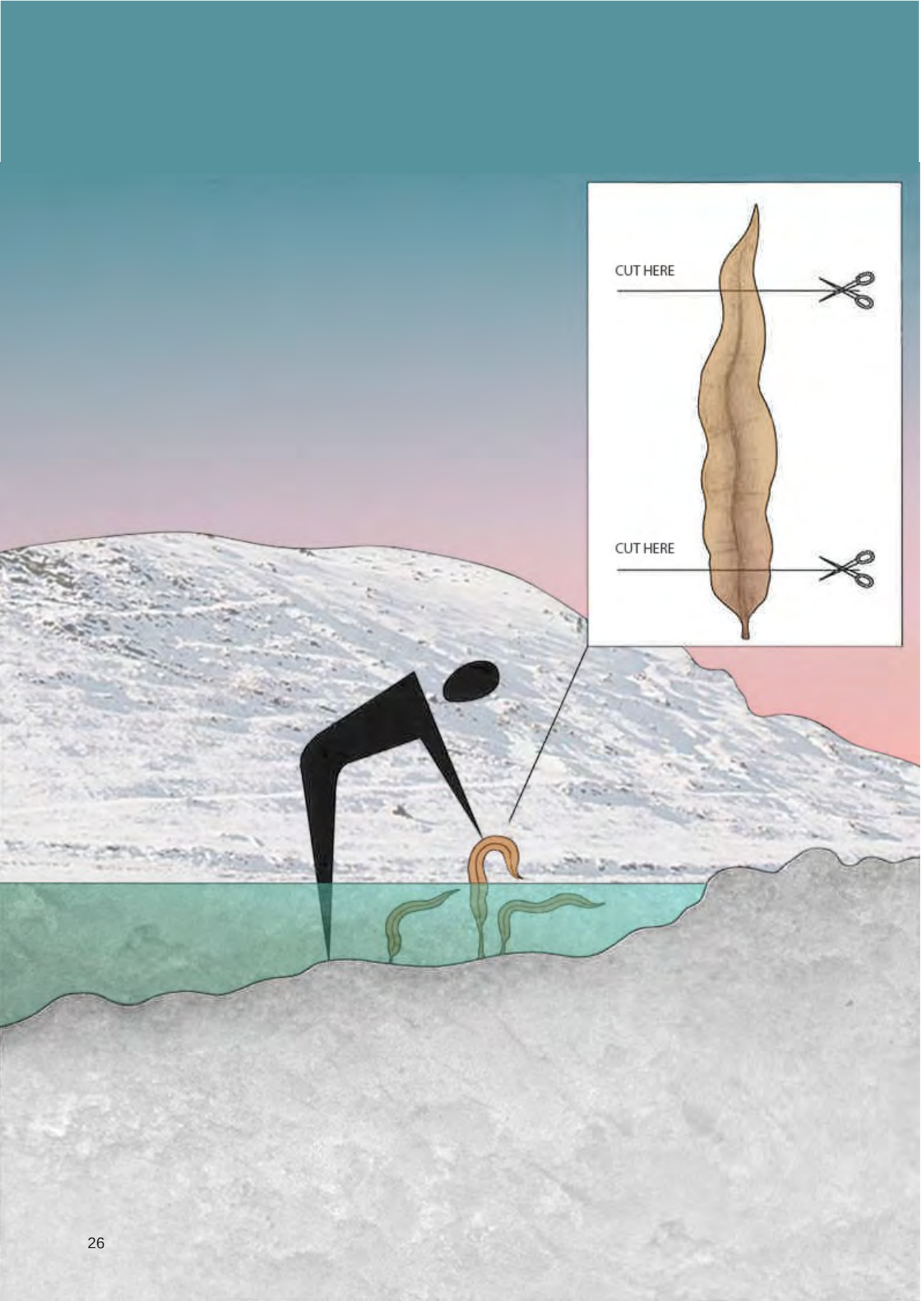

CUT HERE
CUT HERE

Photo: David Pedersen



Care for the p(l)ast(ic)

Our focal point has surrounded the edge of land and sea, mainly the coastal line. Specifically, we investigated parts of the drift material that our ocean washes back to us ashore. We received information that occurrences of driftwood were quite common on the beaches in our research area. As a circular resource, the potential of driftwood is easier to imagine. But our first investigations showed us that plastic is one of the main products arriving to the northern beaches, guided by the sea currents going north.

The research project Unruly Heritage: An Archaeology of the Anthropocene refers to the masses as the 'material legacies of the Anthropocene', pointing out the un-managed chaos that continues to strangle the lives of the ocean.[1] Through this project Þóra Pétursdóttir and Bjørnar Olsen criticises what we as a society perceive and cherish as cultural heritage and what we easily exclude despite UNESCO's inclusive definition of heritage: 'our legacy from the past, what we live with today, and what we pass on to future generations'. For a long time we, as a society, have dealt with unwanted byproducts with an attitude of 'out of sight, out of mind'. What we are witnessing today is our material past returning, haunting the landscape, harming nature and disrupting ecologies.[2] It would be ignorant to discard these man-made 'archipelagos of sea-borne debris', so strongly claiming presence, occupying physical space, demanding our attention, in fact are products of our culture, our modern society, indeed our 'legacy from the past'. And they are in need of care. Care is the keyword of how we deem what is valuable to pass on or to leave out - we need to care.

According to Pétursdóttir and Olsen, this implies a rethinking of care as a concept that exceeds humane acts and extends to a meaning of 'capacity' to be 'realized within actual material ecologies'.[3] Meaning to include how objects, environments, people and animals meet and co-inhabit a shared world. Heritage is commonly understood as a 'past cared for and consciously addressed'. Maybe lifting drift material and waste in the discussion of heritage could inspire an alternate, more careful approach.



[1] Pétursdóttir, Þ. & Olsen, B. (2016, November) Unruly Heritage: An Archaeology of the Anthropocene.

[2] Pétursdóttir, Þ. & Olsen, B. (2016, November) Unruly Heritage: An Archaeology of the Anthropocene, p 41

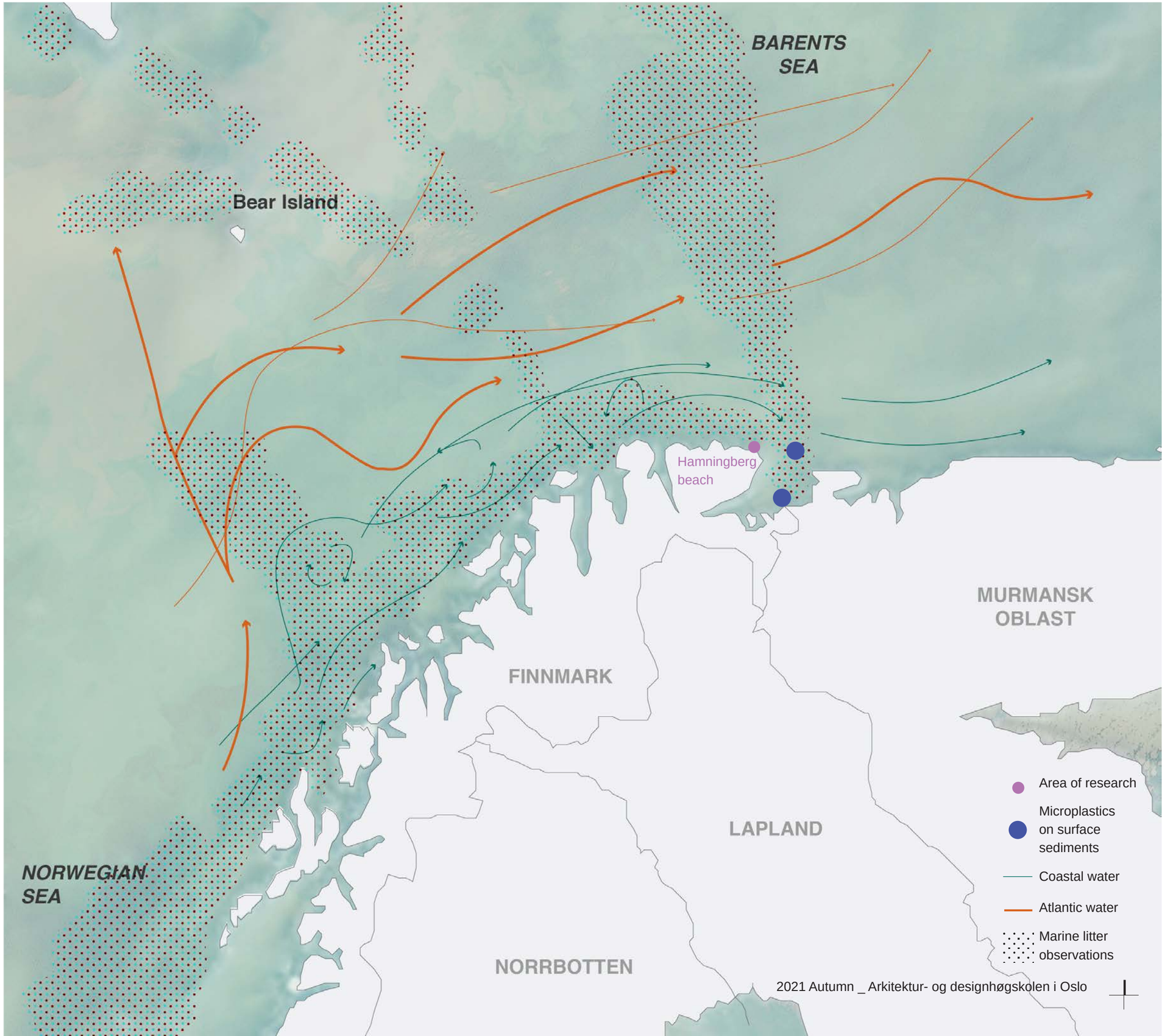
[3] Ibid.

Plastic pathways

To get a better understanding of how plastic gets transported, we looked at maps for ocean currents. We also wished to understand where the materials come from, where it accumulates and what types of plastic travels with the currents.

From the MAREANO database, an online map compiled by a research group from the Norwegian Institute of Marine Research, we gathered data of observed marine litter, mainly plastic.[1]

Two dots on the map signifies areas near our research site, where researchers have recently found the amount of microplastic to be 26-50 granulars/ particles per kilo of sediment dry weight.[2] Not surprisingly the ocean- and air currents carry microplastic to the arctic regions.



[1] http://mareano.no/kart/mareano.html#maps/6133 (10.11.21)
[2] https://mareano.no/nyheter/nyheter_2020/nye-kart-over-forurensing-og-mikroplast (10.11.21)

Areas of accumulation

1. Hamningberg
2. Sandfjordneset
3. Frøkenhollbukta & Persfjorden
4. Næringsbukta
5. Vesterbarbika
6. Sandvika, Vardøya
7. Laukvika
8. Skinnstakkvika
9. Molvika



Speaking to Frank Cato Lahti, a local plastic entrepeneur, and VarangerFjæras VenneForening, a non-profit organisation consisting of people growing up by the coast line, we gathered information on where the highest accumulation of marine litter, including plastic and driftwood, occurs.

There are organizations such as Rydd Norge and Nordic Ocean Watch that organize huge cleaning 'dugnad', that usually happens once or twice a year, often late spring and early autumn.[1] During which massive containers are temporarily placed on targeted places to gather all the trash collected. After a cleaning session, the container is driven to a recycling station. As we understood, everything is put into one big container.

According to a spokesperson of VFVF, much of the marine litter is in bad condition, if lucky it would be possible to find some reusable metal. We have found Sandfjordneset and Molvika to be two of the beaches where Rydd Norge organizes cleaning dugnad. Molvika is the beach where most of the usable driftwood was collected.

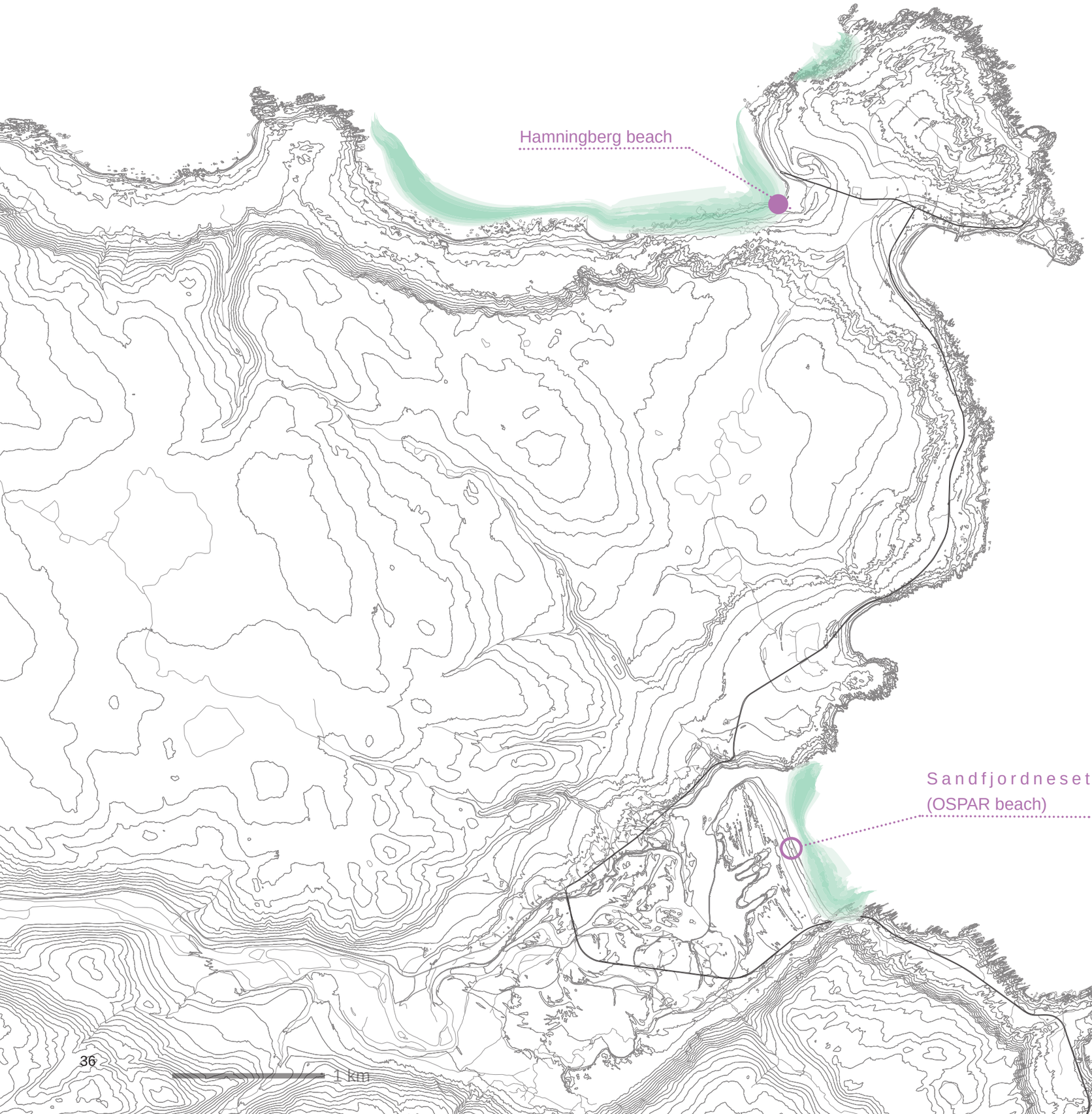
1. Persfjorden-Syltefjorden
2. Barvikmyran & Blodskytodden
3. Vardøya
4. Recycling station

Information gathered from Frank Cato Lahti and VarangerFjæras VenneForening

10 km

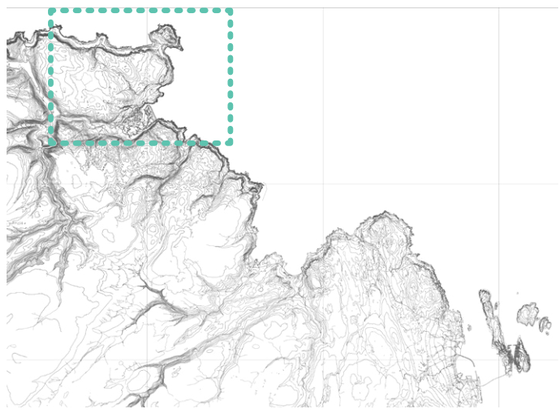
1:10000

[1] https://ryddenorge.no/aksjon/37322 (10.11.21)



Hamningberg is one of the beaches with high accumulation of litter. During our field trip to the beach, an open box was already placed for people to collect whatever marine litter they could find, even though the beaches most likely have already been cleaned, the box was overfilled.

In the period from 2010 to 2016 the Norwegian-Russian ecosystem surveys (a collaboration project between the Norwegian Institute of Marine Research and the Knipovich Polar Research Institute of Marine Fisheries and Oceanography), have been monitoring marine litter in the Barents Sea showing a dominance of plastic waste.[1] The Oslo/Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) recorded that nearly 90% of the litter on the beaches are plastic. Accordingly most of the plastic originates from the fishing industry.[2]

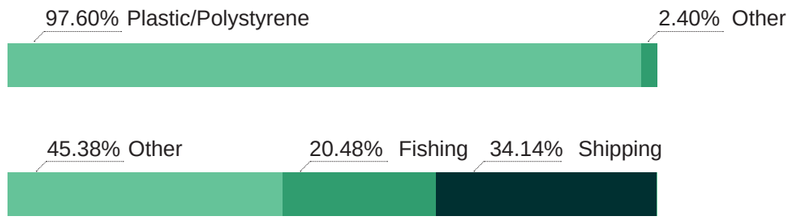


1 Strand et al. ,“Potential sources of marine plastic from survey beaches in the Arctic and Northeast Atlantic”, p. 2
2 Ibid.

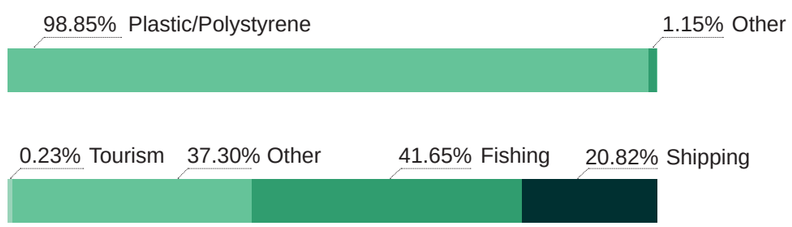
OSPAR registers the marine litter using different categories, including sub-categories: Plastic & polystyrene, metal, wood (machined), rubber and cloth. Only from 2012 to 2014 the number of items have nearly doubled:

We understand from these charts (2012 and 2014) that the amount of plastic deriving from fishing has more than doubled.[12] Tourism also entered the statistics.

Sandfjordneset 1 km, 2012
No. of items: 249



Sandfjordneset 1 km, 2014
No. of items: 437



Information gathered from OSPAR

Photo: Tu-Uyen Phan-Nguyen



1 https://beachlitter.ospar.org/beach/sandfjordneset/survey/1km/2012-10-02/summary (11.11.21)
2 https://beachlitter.ospar.org/beach/sandfjordneset/survey/1km/2014-10-02/summary (11.11.21)

Photo: Tu-Uyen Phan-Nguyen



Suggestions for future scenarios

As a result of our investigations, we came up with suggestions of what to do with the resources found on the northern coastline and beaches, one for driftwood (that InBalance Studio from AHO developed in Vardø), one for plastic and one for seaweed.

Driftwood on the beach. Photo: Tine Hegli



Seaweed - Kitchen

Seaweed is a natural and forgotten vegetable that is not often used for cooking, but which is suitable for it. You can find it along the entire Norwegian coastline and harvest it by yourself!

Seaweed can be prepared and used in many different ways. As a spice, salat or simply a decoration on your dish. You can even find a spiecies that taste like truffle. That's why there is a lot of potential in that amazing resource that is not yet seen that often in a typical house. It could be a good contributor to include more nutrients in our diet. There is a few companies like Lofoten Seaweed that promotes it and sell different kinds of products made out of seaweed. As well as u could get more information about what you could make out of it. Pasta Carbonara with truffle seaweed or perhaps a vegan burger?[1]

[1] https://lofotenseaweed.no/no/
Illustration: David Pedersen

SIMPLY SEAWEED RISBURGER

Ingredients:

4 tablespoons Simply Seaweed +
8 tablespoons water
2 tablespoons ground flaxseed +
6 tablespoons water
2 dl boiled rice
1 onion
3 garlic cloves
1 carrot
0.5 dl oatmeal / ground oats
2 tbsp soy sauce
1 tbsp lemon juice
1 dl sunflower seeds
olive oil
a pinch of smoked paprika spice
salt and pepper



TRØFFELTANG - CARBONARA

Ingredients:

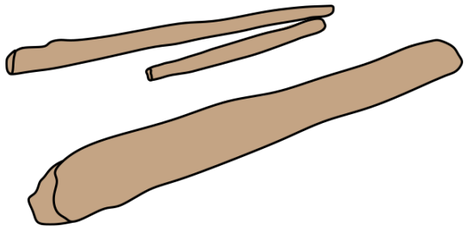
500 g Tagliatelle with seaweed
2 tbsp oil
2 eggs and 2 egg yolks
50 g grated parmesan
1 tablespoon truffle seaweed salt
1 teaspoon pepper



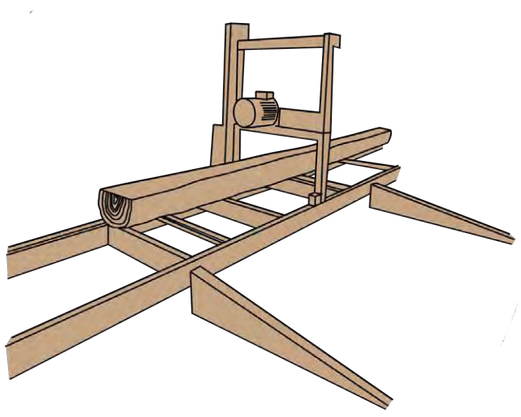
Driftwood process

A possible driftwood future use could be Hjellen, a shelter designed by a group of AHO architecture students for Vardo, from the source to the final product.

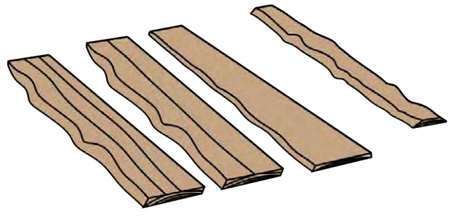
Credit: In Balance studio autumn 2021



1. Impregnated driftwood collected from the beach. Can be used both as construction and cladding material.



2. Material production on the sawmill.

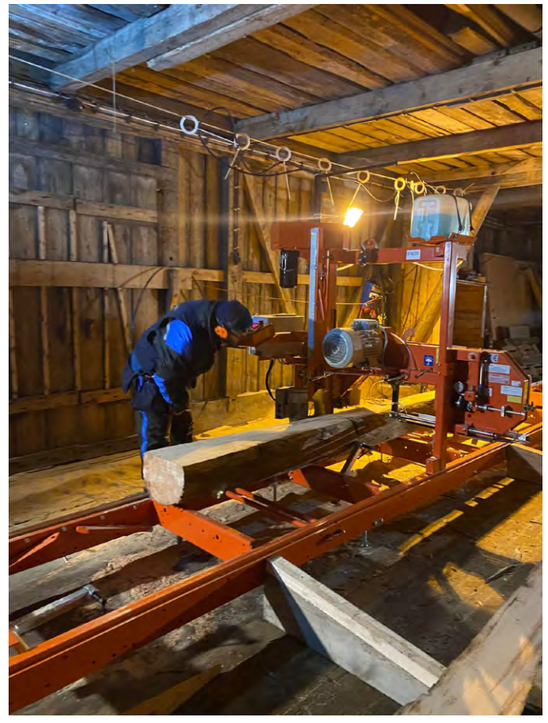


3. Cladding made of 'leftovers' from the sawing process of construction parts.

a.

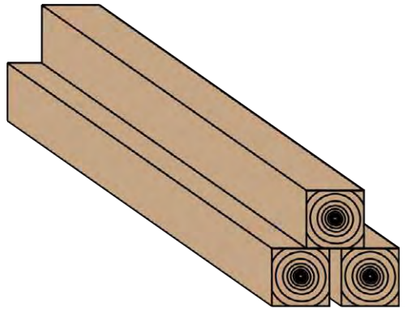


b.

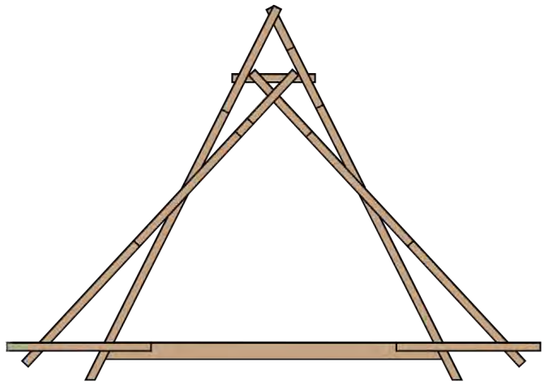


c.

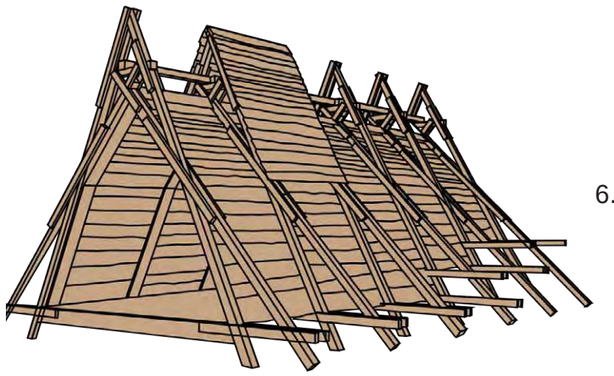




4. The core of the timber which is the strongest part of it can be used for construction.

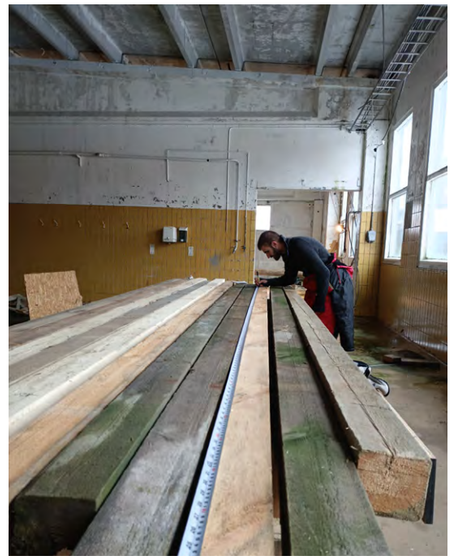


5. Example of a frame built of driftwood.



6. The end result. The project aims to show how to utilize local resources. In this case driftwood that ends up along the beaches along the Norwegian coast.

d.



e.



f.

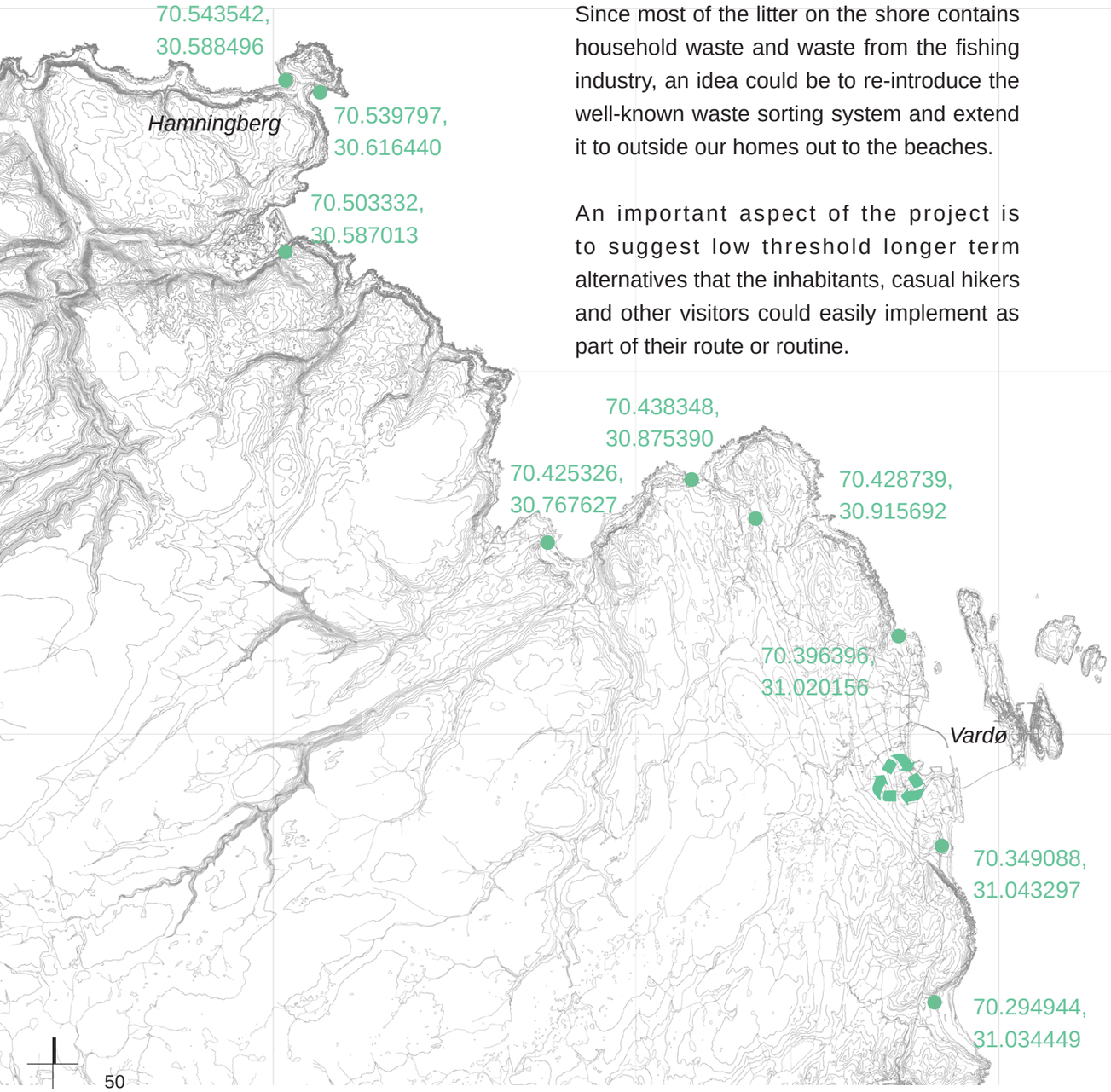


Photos:
a. Hanna Lie Bakken
b. David Pedersen
c. David Pedersen
d. Paula Costa Sot
e. Paula Costa Sot
f. David Pedersen

Plastic collection system

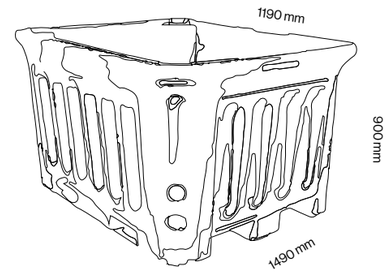
With an ambition to highlight the circular potential in plastic waste, we want to stress the importance of sorting the waste collected from the beaches as much as possible. Since most of the litter on the shore contains household waste and waste from the fishing industry, an idea could be to re-introduce the well-known waste sorting system and extend it to outside our homes out to the beaches.

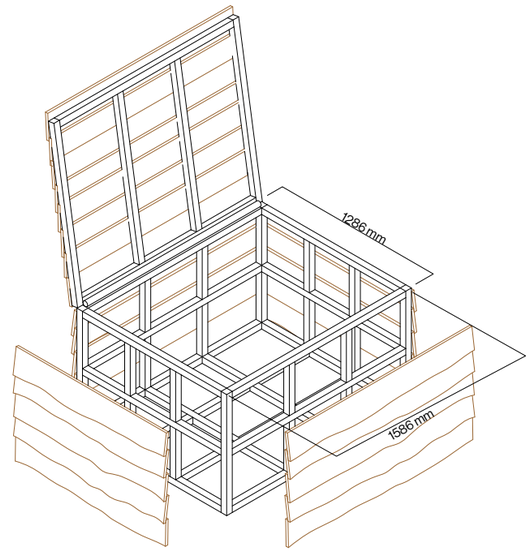
An important aspect of the project is to suggest low threshold longer term alternatives that the inhabitants, casual hikers and other visitors could easily implement as part of their route or routine.



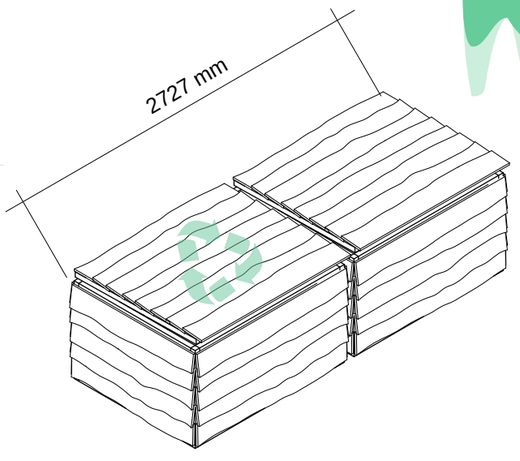
A suggestion is to strategically place out 1m^3 boxes with a simple sorting system: household waste and waste from the fishing industry. The modularity of the design allows for multiple boxes if needed. The dimensions of the boxes is determined by the common fishing box of 1m^3. The boxes are then protected with a structure made from driftwood. When emptying the internal container can be lifted from its shell, and be replaced or put back when emptied.

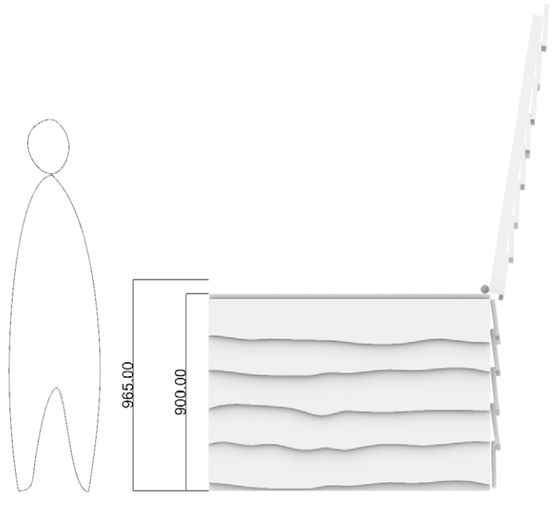
The strategy implies using the existing roads as the main access route to the boxes. Most of the placements are near a main road for easy access. Suggested placements are indicated by the green dots and fixed with coordinates.











Photos: David Pedersen







1:30000

Soil

Soil is a living organism. It is said that it takes 1000 years to make 1 cm of soil. Therefore soil is not a renewable source and has to be maintained. Creating a circular system in a rough landscape like Vardø comes with a great challenge. Our main focus has been the research on existing soil conditions and the increase of soil by analyzing the useful waste and natural resources that already exist the island of Vardø. Looking into the present industries and resources on the island, to find a way to live in symbioses rather than just taking from the existing.

The increase of temperatures in the future in places like Vardø will make it possible to get bigger crops from growing their own foods and vegetables in the future. The climate change will bring challenges and opportunities. In order to be prepared to work with these challenges and turn them into benefits some ground work has to be done.

In northern islands like Vardø, that are based on a massiv rock layer, there might be a possible in lack of soil. In order to understand the existing soil it has been important to look into the historical past of vardo. For decades fishing and the usage of the ocean have been the great resource for the island. This is still visible in the cultural face of vardo and is still present today. Our first focus was to analyze the impacts of fish and the nutritions. Making assumptions about the soil conditions under the fishing racks regarding our knowledge from earlier research projects, which show that the soil here might contain valuable nutritions.

According to our assumption there should be a lot of good soil under the fish racks, as a lot of fish waste should have turned into nutritions and soil over the years. Our field investigations showed that the earth layer is not necissarily thick under the fish wrack, and that rock appears directly after a mossy view of the earth. But also shows that some plant species live and florish even here. Research projects show that the growth power of plants in the arctic are almost the same as in the rainforest. The growth season is short so the soil could provide a lot of nutritions for the short growing season and build up new nutritions over the winter season. However, there are also places on the island that have built up a more massive layer of soil over decades, through processes such as the nesting of birds, the sprouting and dying of plants, the tide and nutrients of the surrounding sea and erosion of rocks. In these areas we found an organically living earth layer approx. 15 cm thick. The greenhouse also has a valuable existing layer of soil that could provide a basis for planting, possibly from earlier inhabitants using their plot for growing. This knowledge is valuable for the further process of further earth reclamation.

An existing source of earth is crucial for the processes. Compost methods, the already used method of seaweed and sand, ensuring horses as a natural fertilizer on the island may play an important role for the future. For this process we analyzed compost methods from areas with a similar climate. "Hugelkultur" could in the future become one of those methods. This method could be used with the resources available on the island. By digging a hole, filling it with nutrients and covering it with soil, over winter this pile will be fed with nutrients from within, and gives valuable soil for years coming. Driftwood could be brought in for the base of the "hugel". The existing soil and a mixture of sand and seaweed could form the second layer of the hill. This structure could firstly try being built by the greenhouse, and potentially expand if sucsessful. There it could also function as a wind barrier for the ground plants.

After talking to some actors in the city that are catalysators of the greenhouse project, we learnt about what is possible to plant in the future and what the community thinks is relevant to grow. Next to southern plants like basil or comparable herbs we also suggest to work with historical valuable plants like rhubarb, cabbage, potatoes. The demand of plants that are harder to get in the north is large, since they have to be shipped from the south and only arrives at some times.

Soil is a living complex, even tough you don’t see the life going on in this complex good healthy soil has millions of small organisms living inside it.



1



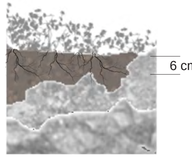
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3

Soil condition

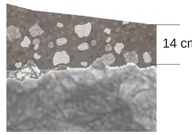




1

Thin and rocky soil layer under the fish racks

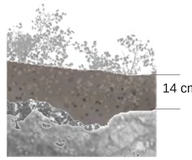




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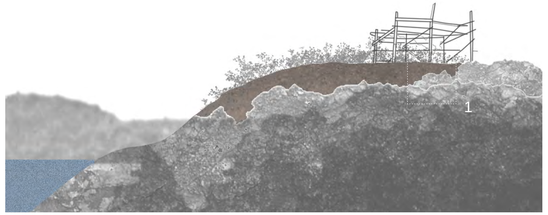
Rocks eroded over winter and enters the thick and dense soil layer





3

Thick and dense soil layer near the ocean. Grass and herbs grow here, and earthworms are found







- Agricultural land
- Meadows
- Thin soil
- Landfill
- Area reserved for leisure buildings
- Fish racks



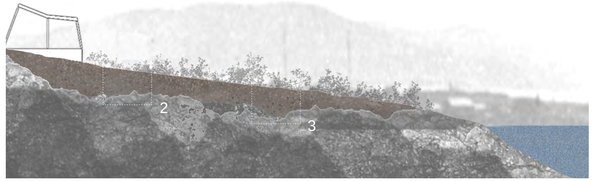
Weeds and grass prove that there are nutriets in the soil



Here "krekling" grows on rocky terrain with a thin soil layer. They could effect the quality of the soil in the area.



Some species can grow fairly large from nutriets found in a thin layer of soil. This soil can be very nutritious.



2021 Autumn _ Arkitektur- og designhøgskolen i Oslo

Waste for soil making

There are horses living on the island today. These already produce a valuable potential source for soil creation and fertilizer. Most of the feces found is already dried, therefore can be used as found.

Horse feces



The food waste we create everyday contains valuable bacterias for soil creation. Today compost goes to Tana and further on to Båtsfjord, which is a long travel for a valuable resource for Vardø.

Compost



The sea weed is led inland with the tide, and is left laying on the shore many places around Vardø. Many of these are already dry or the salt is washed out, and can be picked and mixed with soil or used as fertalizer straight away.

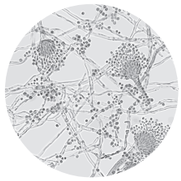
Seaweed



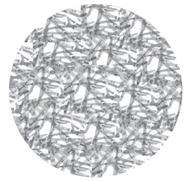


Recipe

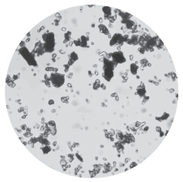
Preparing of soil is the starting point for a florishing garden. In order to have the nutritios booster and food for the SOIL BIOTA living in between its important to add the right amount of spices. The right mixture is key in preparing a good tasting soil.



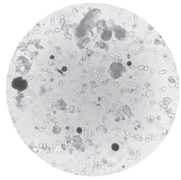
Fungi



Algae



Bacteria



Bacteria

35 %

existing soil (preferably from Vardo)

25 %

dry horse poop/seaweed (optional)

25 %

fine sand and bigger rocks

15 %

water

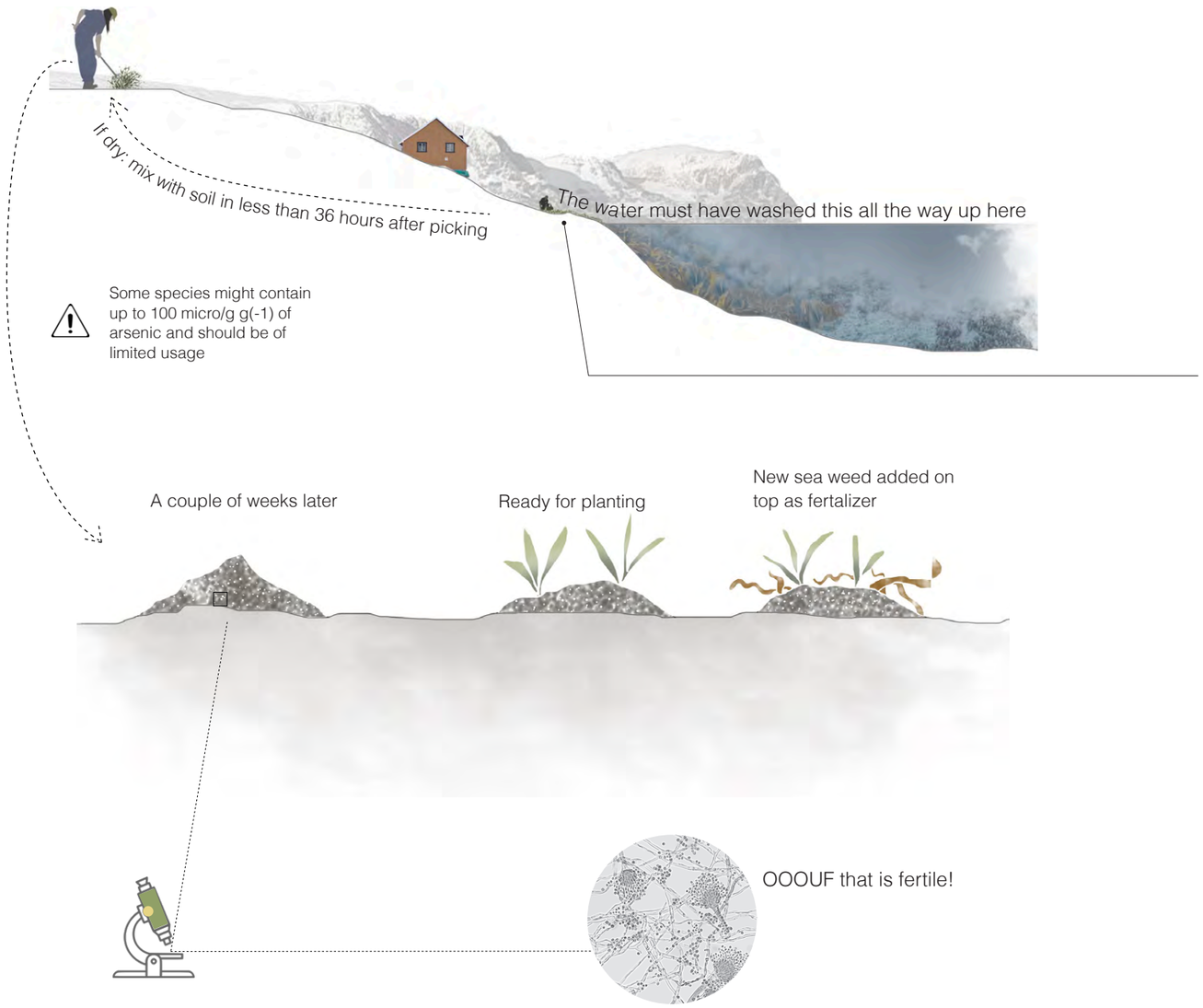
Preparation for growing season for one medium sized planting box

1. Dry horse feces over the winter season (Fresh horse poop could burn seedlings)
2. Apply feces to the existing soil in the spring. Don‘t dig it to deep so the air can help activate it
3. Wait for a few rainless days to apply the fertilizer on slack soil
4. Add fine sand to the mixture to improve the airyness of the existing soil (beneficial for plants like potatoes, raddish..)
5. Add water and mix up everything
6. Let it work for a few days
7. Plant seedlings



Mixing seaweed with soil

In southern parts of Norway seaweed has traditionally been used in agriculture for soil making and fertilizing. With the arctic areas getting warmer in the future, the southern techniques can be useful and applied in the arctic.





Horse feces



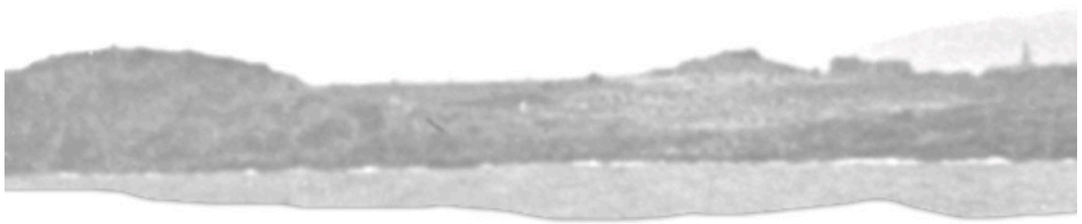
12

Looking into natural resources for soil making, we learnt that farmers in Kiberg might have dried sheep feces stored. With horses already living on the island there is a valuable resource for this already excisting on the island. Seaweed could also be introduced into this process. In some areas of the world seaweed is used as beding in stalls. The seaweed acts desinfecting for the horse feet and imidiatley mix with the horce feces to create a fertilizer booster for the Soil.









Hugelkulture with compost



"[Soil is] kind of like thinking about a brick house, you can't build a house out of sand and straw. You've got to glue them together somehow. You have to bring them together into the smallest building block for brick house, which of course is a brick. So that smallest unit of structure in a brick house, that's what a micro aggregate is.

So it's the bacteria that provide the glue to hold that brick together. Well, you're not making a brick house with bricks alone. You've got to have something to glue those bricks together and start building the walls. You have to leave holes for the windows, for the doors. You got to put a ceiling, you got to put a roof on that house.

You got out floors. Who is it that's going to build those structures for you in the brick house structure and your soil. Those are going to be the fungi. The fungi build our strands, our filaments, and they're going to take those micro aggregates and pull together a whole bunch of those. So we're starting to build the walls.

We're building the doors, the ceilings, the floors of the structure in our soil. And as we start to build these structures, you can see where we're pulling things together. And now we have space for oxygen and water, and a roof."

- Elaine Ingham (speech)


13


14


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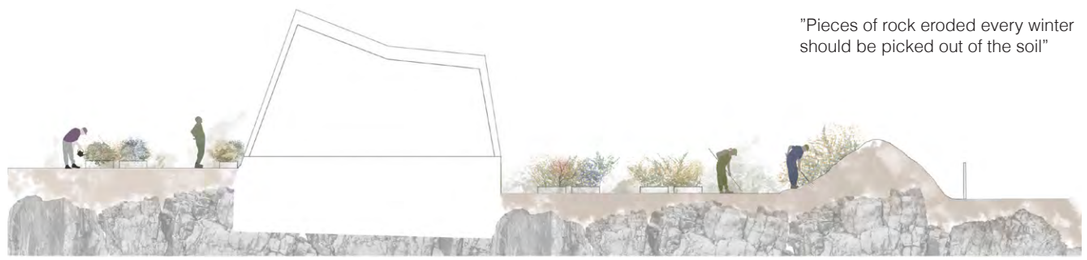

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Section A-A

Grow in the greenhouse

INSIDE

Basil travels ca 10 000 km to get to vardø, and is only avai-lable once a week

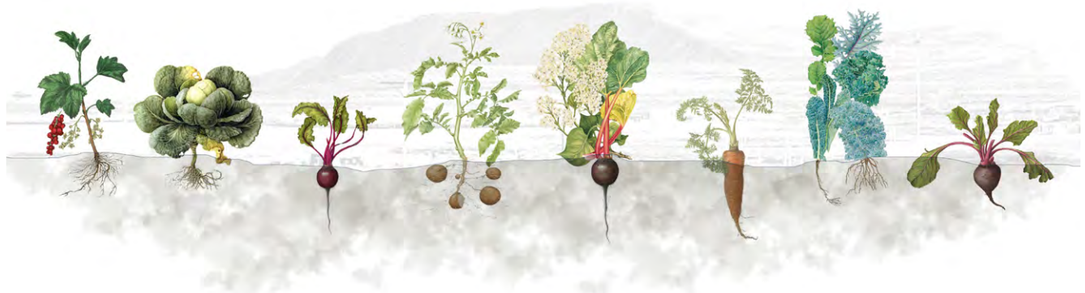
Because of the long sun hours, strawberries and tomatoes become more tasteful in the north



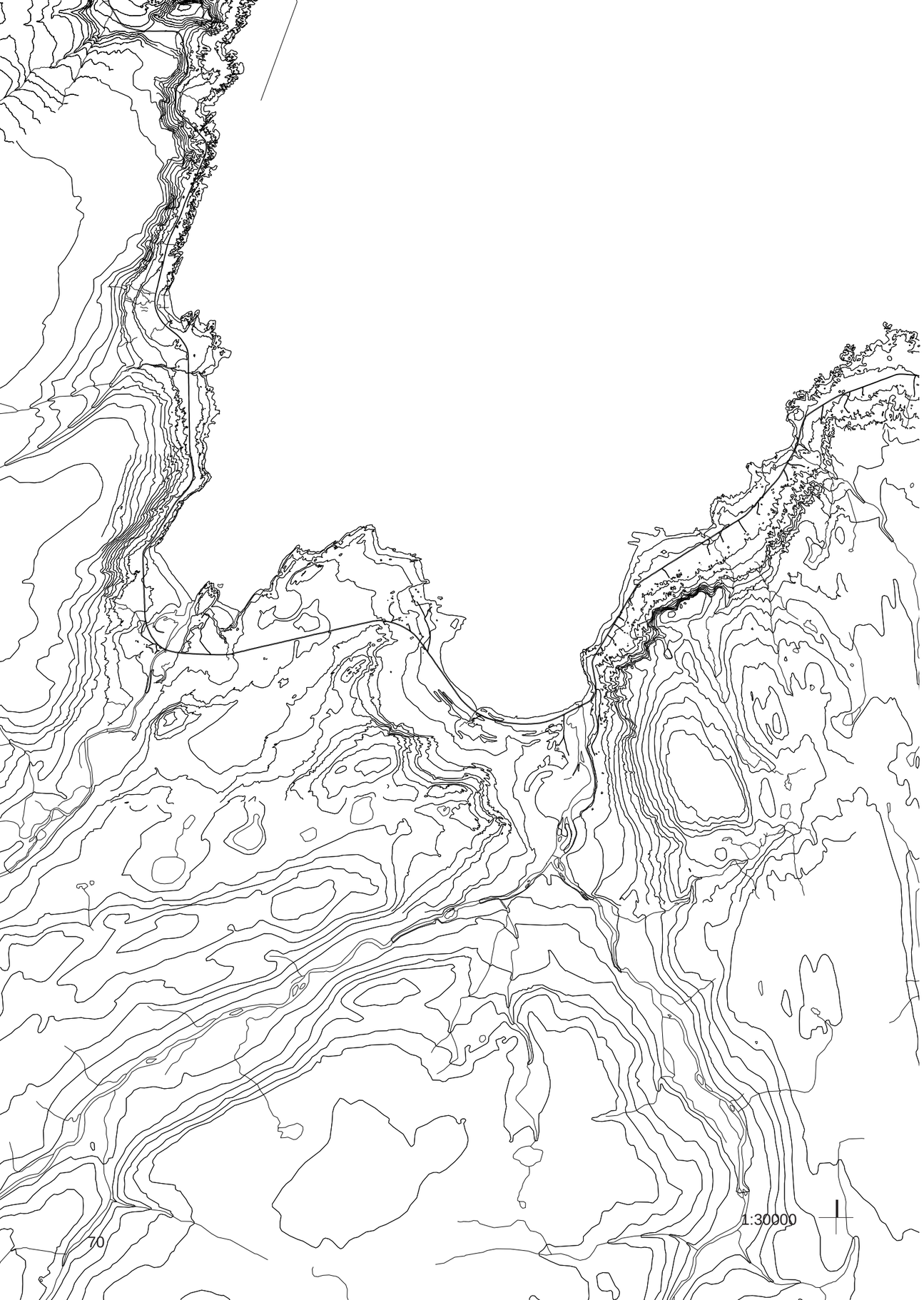
Cucumber Tomato Basil Strawberries Grass onion Salad Green peas Parsley

Black cabbage.....

OUTSIDE



Red currant Cale Bete Potato Raddish Carrot Spinage Mangold

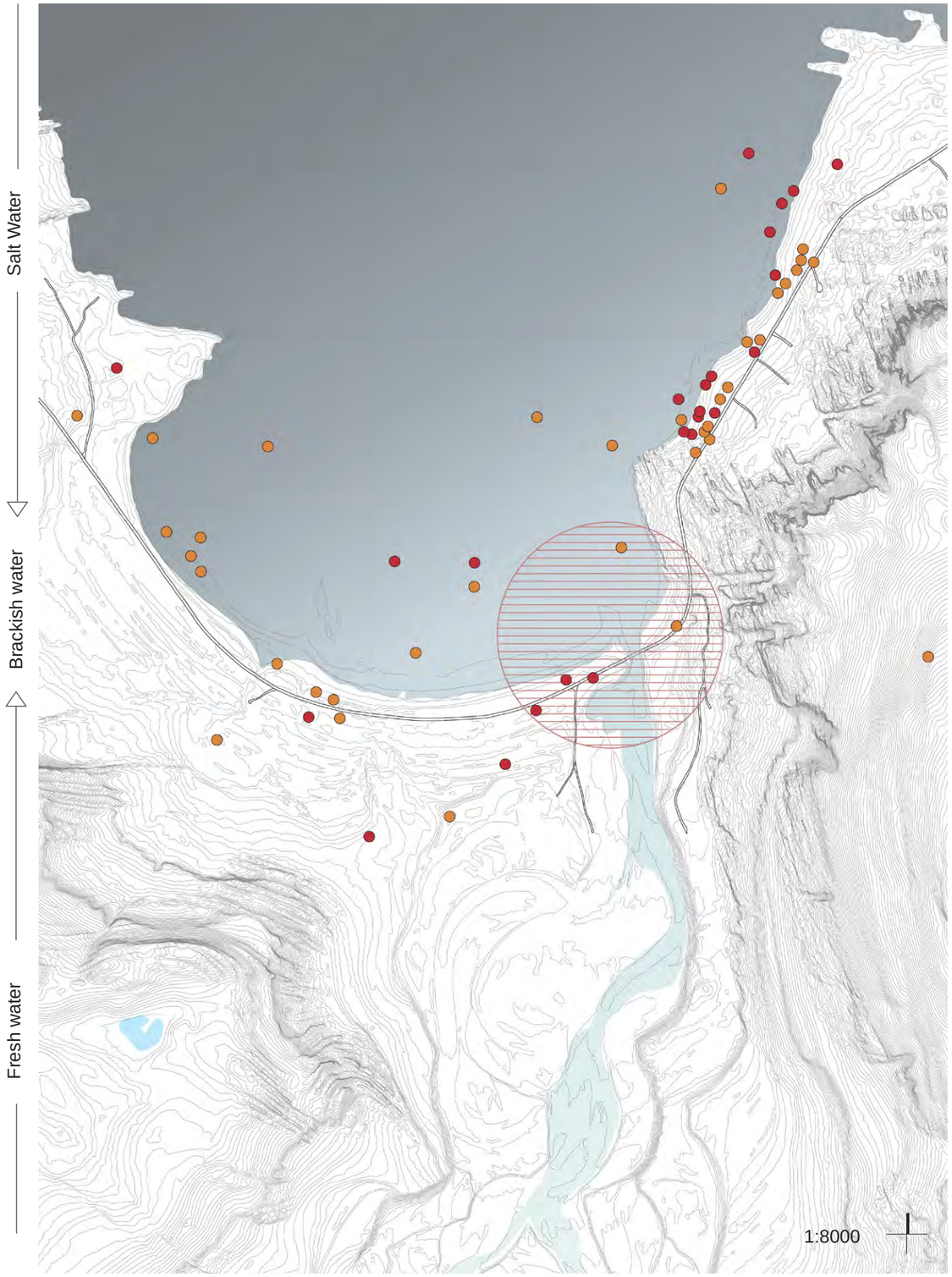


Persfjord

Most of Persfjord is a landscape conservation area (landskapsvernområde) established in 2006 in order to protect a unique and arctic natural and cultural landscape together with the landscape's biological diversity. The settled parts of the area have not been included in the conservation area.

Persfjord is a lush valley surrounded by hills. The river Austadelva flows through the valley and ends up in Persfjorden. This creates a brackish water delta which is rich in biodiversity and important for several species in the area. The movement of the river has over the years created a meandering pattern of older river courses throughout the valley and also a coherent layer of soil (river and creek deposits) that can be up to 10 meters thick. A long beach runs along the alluvial plain, and the remainder of the coastline here has the characteristic vertical rugged rocks of the area and a long sandy beach.
There have been settlements in Persfjord since ------, and some of the soil surrounding the existing cabins and houses has been cultivated to make grass/animal feed since then and until the mid 1980's. Our research of Persfjord has revealed that the brackish water delta, although omitted from the conservation area, is an important nature type to take care of.

We will make some suggestions for how to deal with the previously cultivated areas whilst considering future scenarios like sea level rise and higher temperatures. Based on a mapping of the different soil types in Persfjord we will make suggestions for cultivation and what to grow in the future.



Endangered species Brackish water

Delta

On the eastern side of Persfjord, Austadelva runs into the fjord and the ocean. Fresh water meets salt water and a brackish delta is formed. Deltas are typically threatened by development as these areas also attract humans. Because of this the Brackish water delta as a type, depending on the level of interventions already done, is protected.

“Brackish water deltas are often "high productive" wetfields/floodfields and therefore of great importance for birds, especially when they are migrating. Rare types of nature and species (birds and plants) often thrive here.”

From the maps of Artsdatabanken and a registration sheet from Bioforsk about the birds of Persfjord we know that quite a few rare and endangered species of both plants and birds gather here. (Sjøorre, Gulnebblom, Havelle, Kalkarve, Finnmarkssvineblom) The river outlets are specifically pointed out as spots to look for birds. So even though the delta is not a part of the landscape conservation area we consider it an important area to protect and maintain. Shrubs are a specific threat for the delta as they thrive close to water and in areas protected from wind. The landscape conservation area in Persfjord is important to protect. Our mapping suggests however, that if in a future scenario one is in dire need of more arable land it is worth considering repealing the zone in some places. For this scenario, we studied the zones outside the conservation area.



David Pedersen

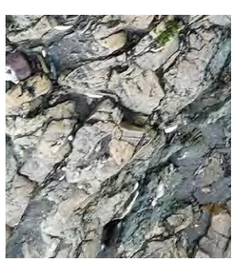
Soil

There are four soil types present in Persfjord, bare rock, marine beach deposits, creek deposits and wind deposits. It is the creek deposit soil that is best suited for creating more arable land. This soil has more humus than the other types which have more sand and stone. Humus is a decomposed organic matter that improves the soil's pH stability and improves the condition of the soil. The river also brings minerals, further enriching the nutritious soil in the delta area.

Miljødirektoratet's maps tell us that the already developed and cultivated areas in Persfjord have been omitted from the protected landscape conservation area. This means that the existing arable areas, former outfields around houses, also lie outside the protected area. We propose to keep and maintain the existing arable areas. If they are not maintained we fear they might be overtaken by shrubs or crowberries.

Bare rock





Marine beach deposits





River and creek deposits

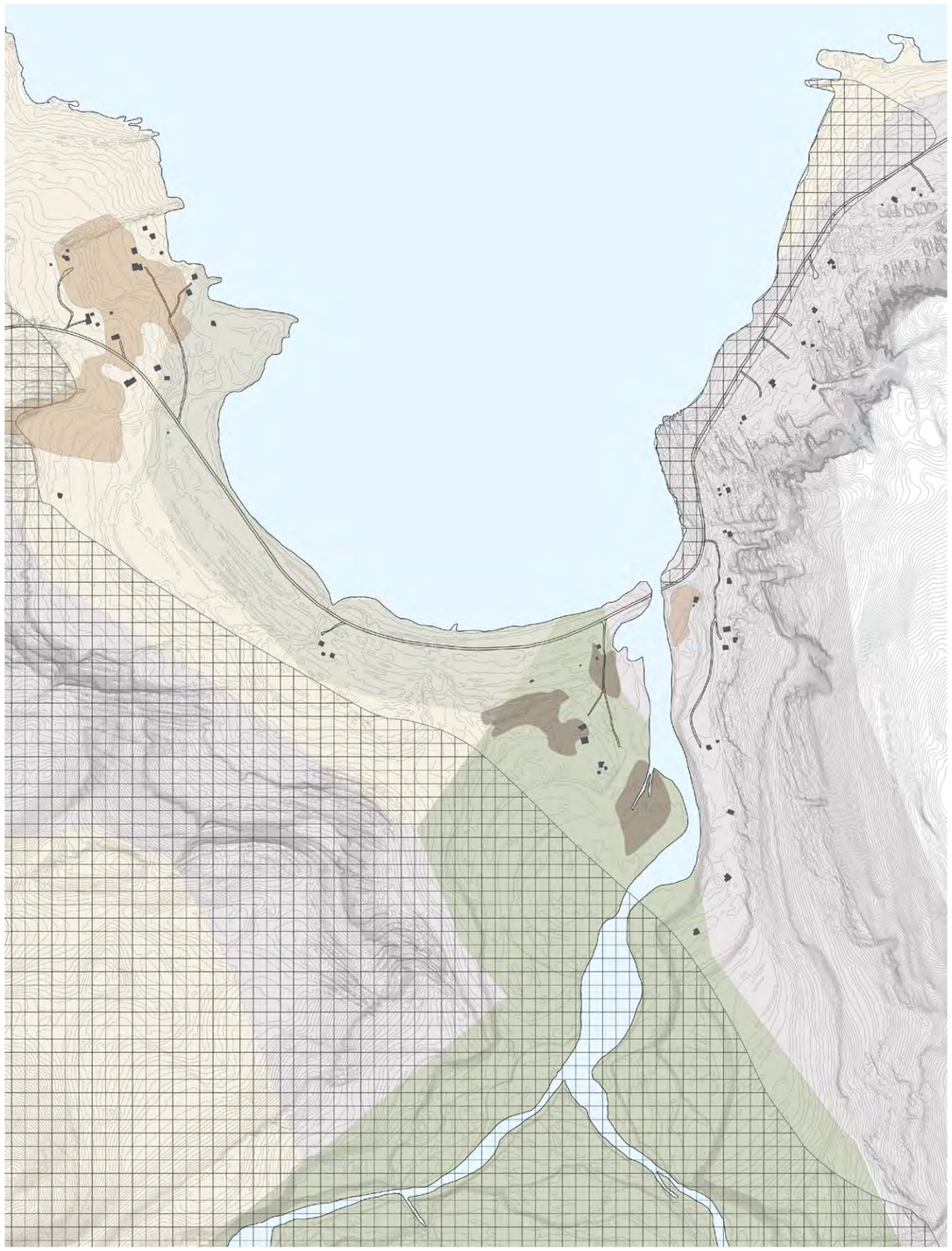




Wind deposits



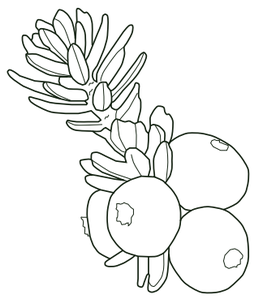




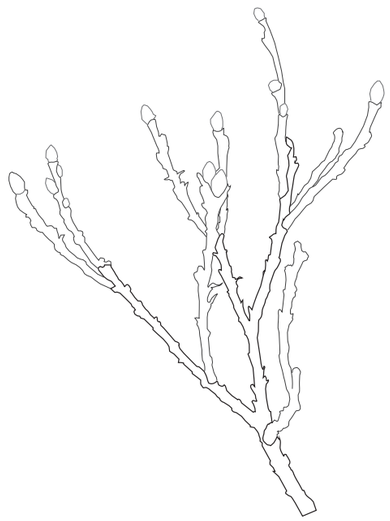
Arctic climate zone?

The coastline between Vardø and Hamningberg has been lying within the Arctic climate zone until very recently. Arable soil is scarce in the Arctic, and it takes a long time to build. If one wants to have the opportunity to grow in this area in the warming future, we may have to take some measures today. We have observed a rich carpet of Empetrum (krøkebærlyng) at the outskirts of the grasslands. Crowberry and shrubs are a threat for Persfjord's biodiversity if they are allowed to grow undisturbed.

Shrubs thrive in wet areas and can overtake large areas of land. Shrubs are already spreading on the east side of the river and if we look to Sandfjord and Sandfjordelva we can make assumptions that the shrubs will start spreading along Austerelva in Persfjord as well. Another threat for Persfjord's biodiversity is crowberries. Crowberries are a threat to the biodiversity of the tundra because of their high adaptability and the unfertile soil they leave behind when removed. It is important to find a way to prevent the spreading of these species in order to preserve the arable land, grazing areas, existing landscape and biodiversity.

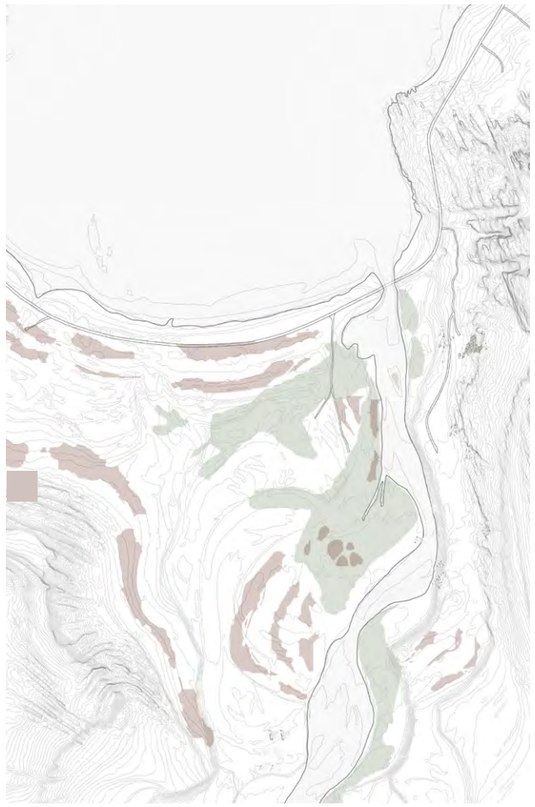


Crowberries

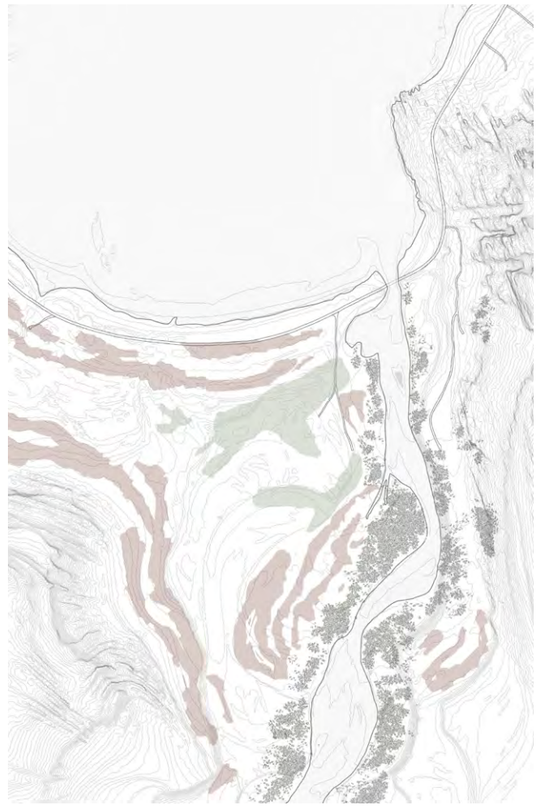


Shrubs

Present situation



Future scenario (2070)



Crowberry Grass Shrubs

Cultivate the delta

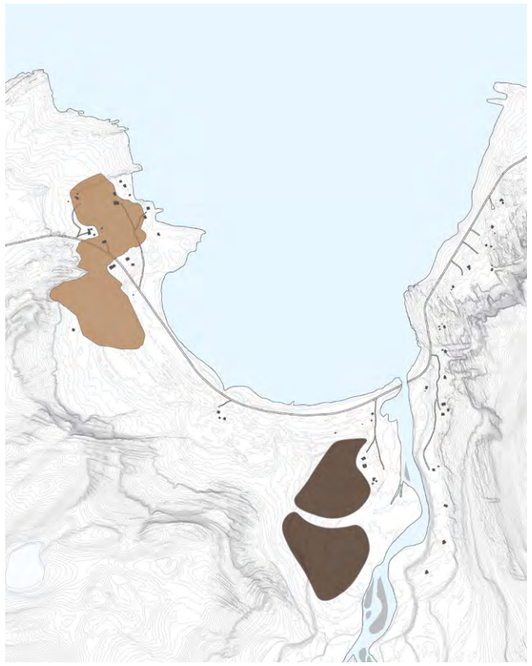
A way to prevent the unwanted species from spreading is to cultivate soil and control the growth. Persfjord has a history of growing and harvesting grass. The grass was used to feed animals (we know Persfjord has had sheep, cows, pigs, horses and chickens) and the surplus was sold to farmers in Kiberg and Kramvik. The last grass was harvested in 1985, and many of the farmers moved to Vadsø. Since then, the farms have been used as cabins and Persfjord is now a place for recreation where birdwatching and hiking are the main activities. If property owners were to start cultivating grass and soil again and expand the current registered arable land, this could provide great benefits for the Persfjord's biodiversity. This would keep the unwanted species away while also utilizing the fertile soil.

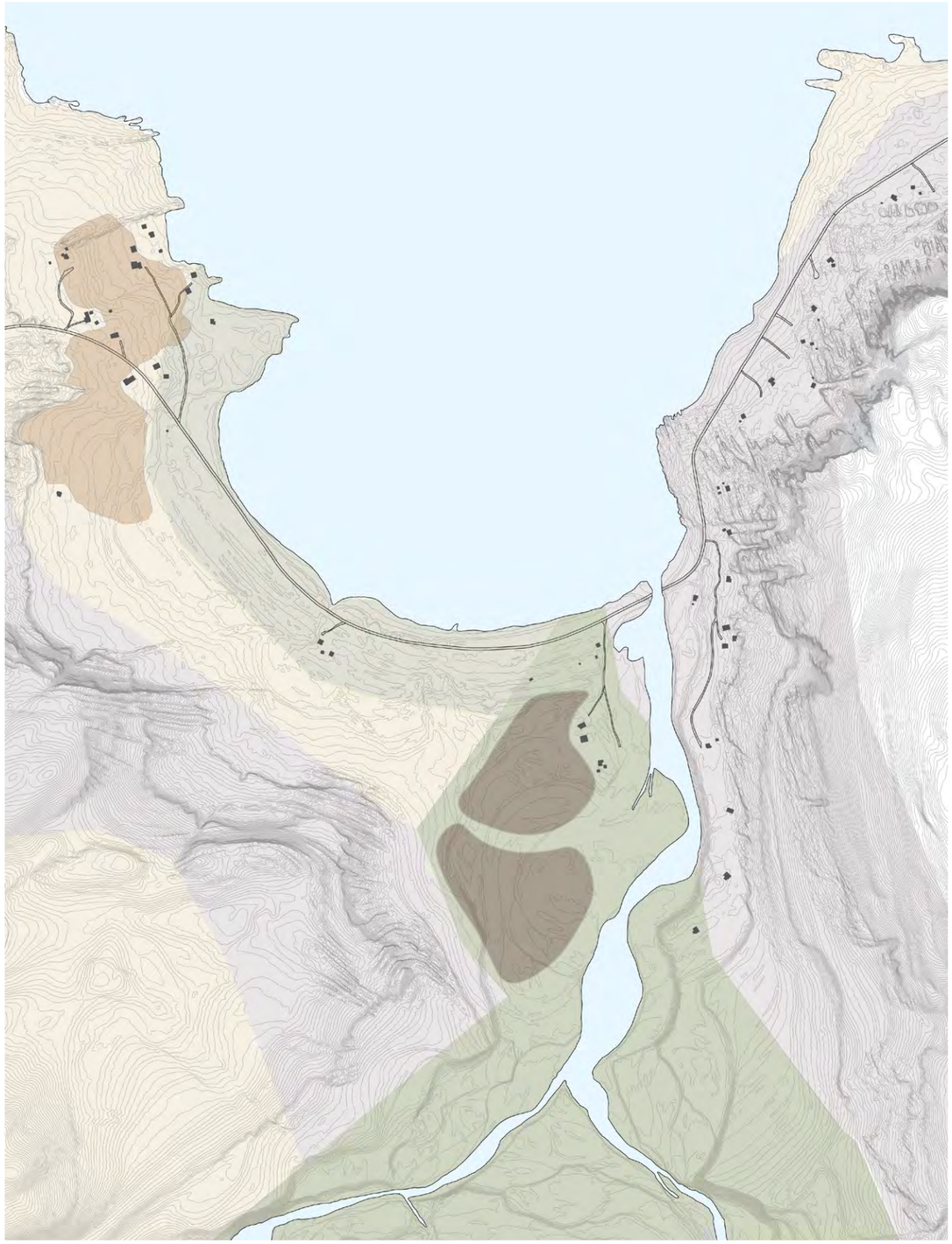
During the past years we have heard more stories of reindeer starving to death, and one of the main reasons for this is the warmer and more unstable winter climate. When snow melts and then freezes, ice is formed on the ground and then the reindeer can't get to their food. Because of this we also consider the possible growing of grass in Persfjord as an emergency supply for starving reindeer.

Cultivated soil today



Cultivated soil future





Marine beach deposits
River and creek deposits
Wind deposits
Bare rock
Fully cultivated soil
Surface cultivated soil
1:9000

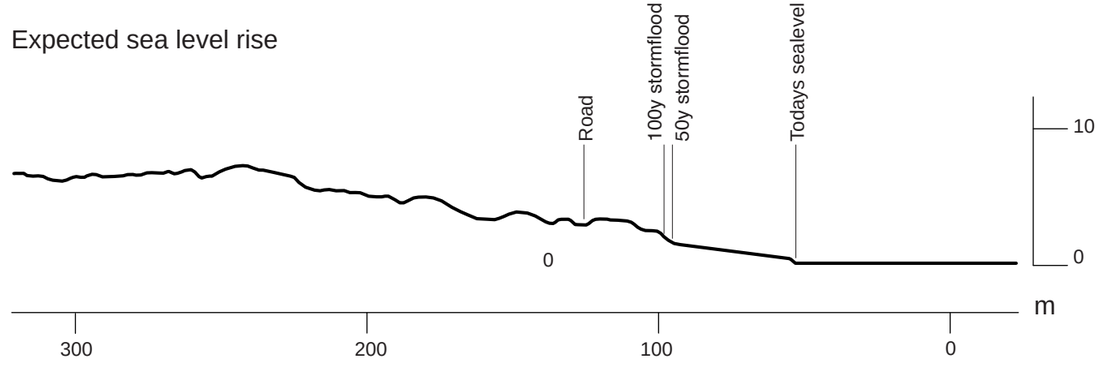
Flooding



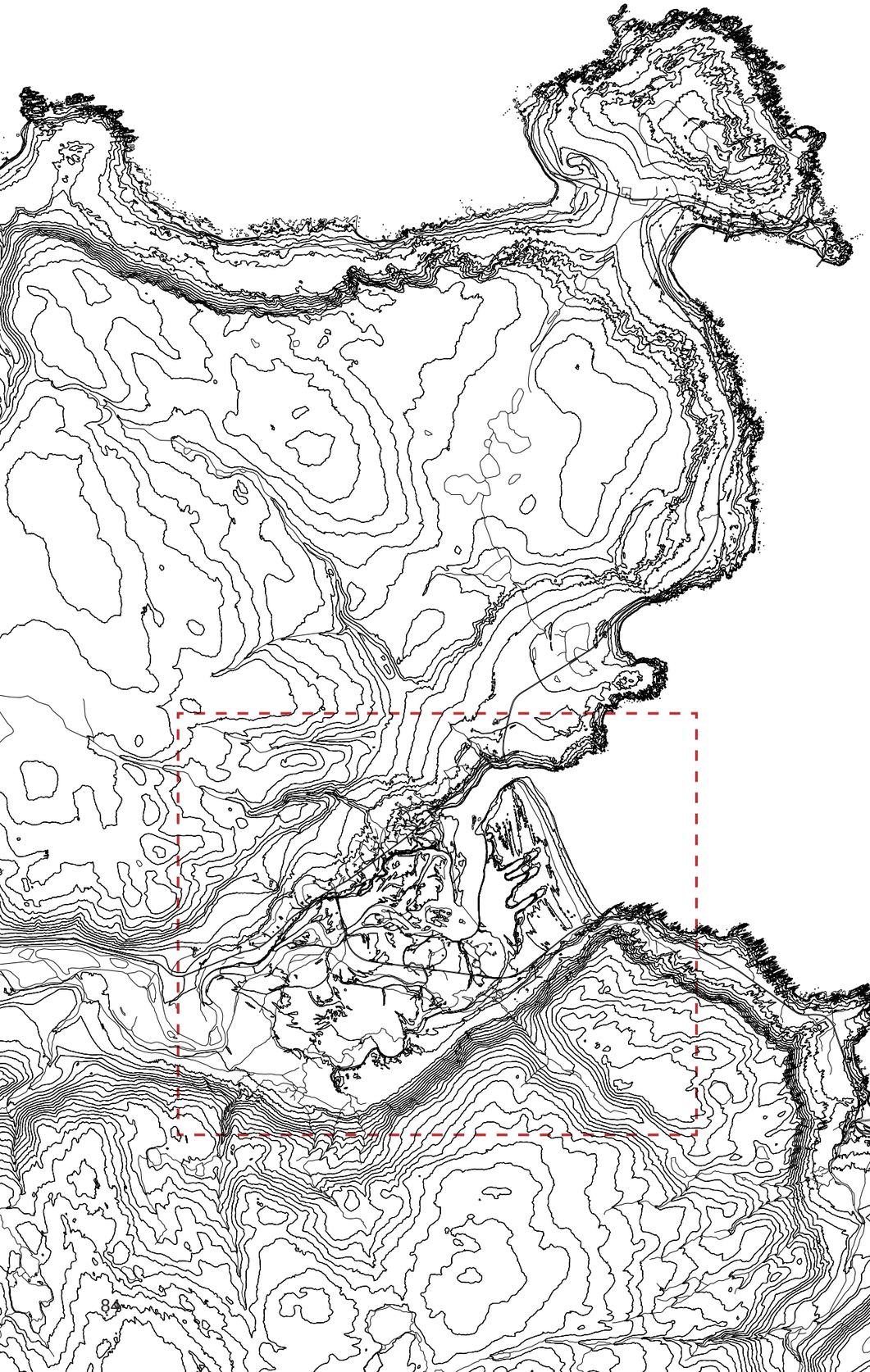
Janike Kampevold Larsen

A prerequisite for having areas with arable soil in the future is that the area lies higher than the predicted height for sea level rise. The road running along the Persfjord beach varies in MASL (MOH in Norwegian) from approximately 4 to 6 MASL, but as we can see from the picture (above) water has already made patterns in the sand quite close to the road. The expected sea level rise with a storm flood in a hundred years is 3 meters, but we can expect the waves to be higher and wash over the road.

Hence, cultivated soil needs to be above the road and towards the south, slightly up the valley (see section) the valley. Flooding from the river is also a challenge when cultivating in the delta. It may be important not to plow the soil in order to make sure that the soil has roots that hold it in case of flooding.







Climate impact on ecosystems

The following booklet consists of a compilation of diagrams, cartographic maps, and analytic sections that study vegetation resources, ecosystem evolution, and the interaction between the different species that co-exist in the Varanger Peninsula. This work aims to provide a comprehensive archive of local resources that can be used by local entrepreneurs and the Vardø municipality for years to come. Having access to this type of resources and databases has been proved to be especially important for communities that have been left outside of the globalized network.

Throughout the different pages concepts as evergreening, greening and circular practices will be tackled to localize, analyze and describe found resources on the coast of northern Norway.

The ecosystem along Varanger's northern coastline consists of rich flora and fauna, not only inland but also its shores. The onshore part of the peninsula is largely characterized by Arctic rock desert, but river deltas contain nutrient-rich soil that attracts the widest variety of species. Meadow, grass vegetation, heath (Crowberry and dry heather), mountain birch forest, and willow thicket are representative of the area. The fauna is characterized by a rich birdlife with nesting space along the coast, grazing reindeer that are drawn to rich valley sides and bays, which also represent a core area for mountain foxes.

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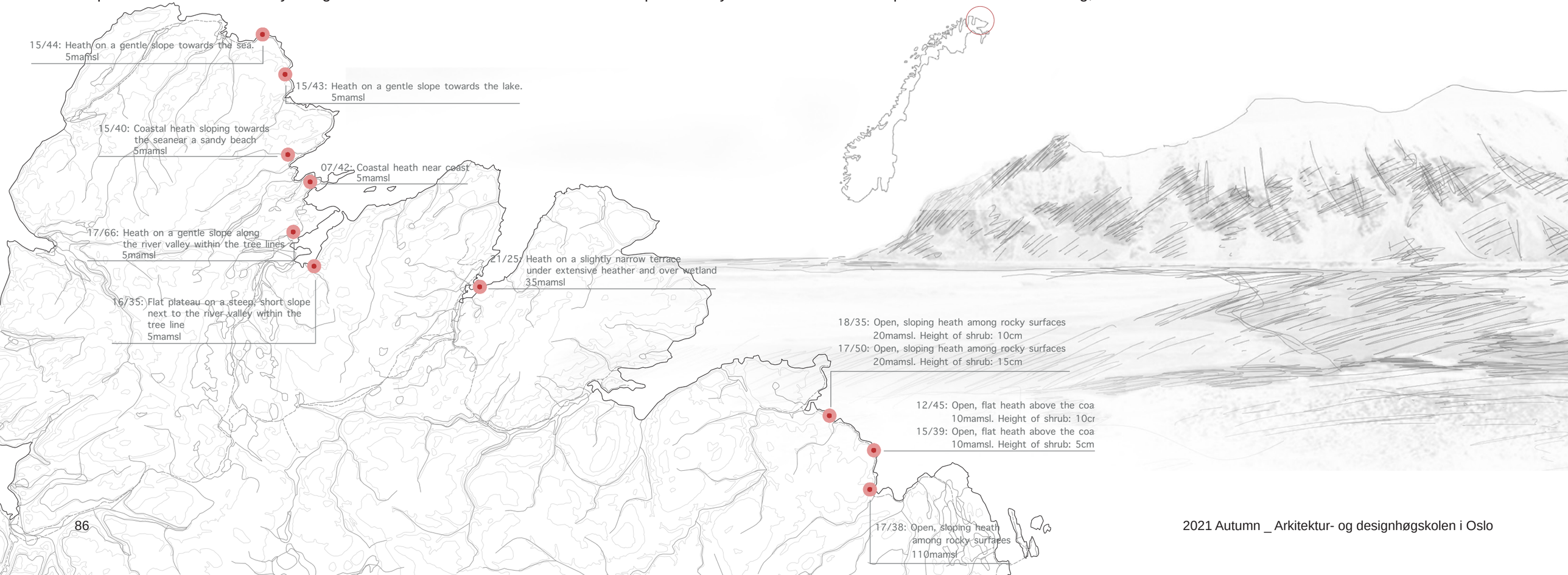
Previous research

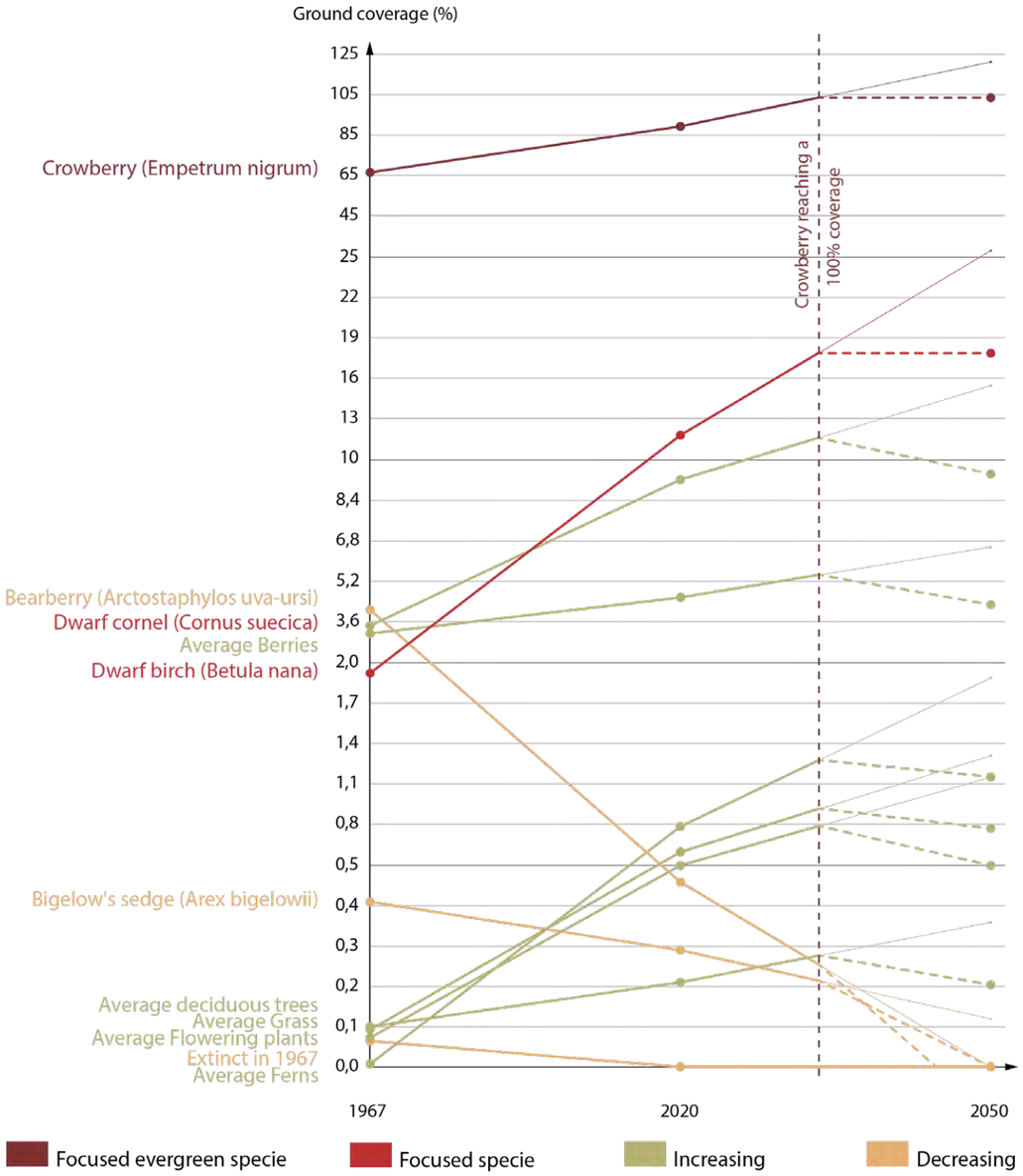
It may be possible that a multiplicity of interacting factors, more or less regulated by a law, operate in concert to form a unit, a system. The organisms, the ways of life and the interactions that take place in the biosphere in general, exhibit an extraordinarily high level of complexity. Such a complexity is difficult to imagine other than in vast systems, which explains and makes it possible to clearly take the measure of the deep human ignorance relative to the relations established within the biosphere, and consequently relative to the effects of the disturbances which the human activities can introduce into it.
The topic of our role within the ecosystem requires before than anything else a reflection on how we understand ourselves as a specie. Due to our capacity for critical thinking, human beings tend to see themselves as superior to the rest of the biosphere. It is therefore necessary that first of all, we abandon the anthropocentric vision of the world around us in order to continue with the discussion. Undestanding ourselfes as part of the ecosystem will make us aware that taking care of it is selfcare.

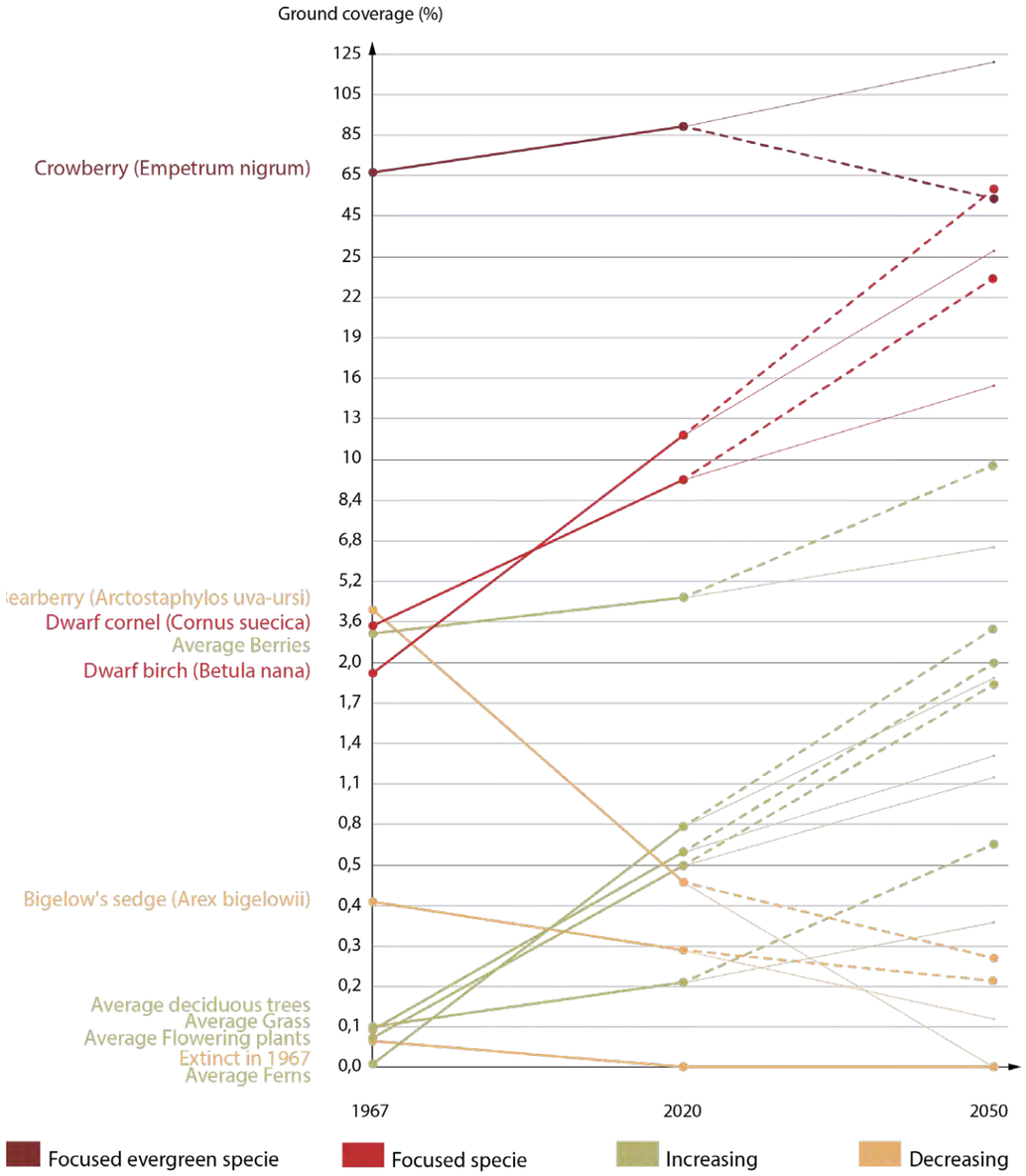
Based on the data provided by Brona Ann Keenan, which compares the evolution of different vegetal species between 1967 and 2020 in 10 different spots across the northern coast of the Varanger Peninsula, we project the future evolution that these species may experience in a context of climatic change and rising temperatures. By analyzing the average growth/decrease of the main plants present in the landscape, we can provide a database to compare with our specific point of study - Sandfjord.

This study will also put on the table interesting questions about our right as one more species inside an already tottering ecosystem to alter it. We have to be conscient about our role as one more needle inside the chain. We sometimes forget that we are part of it, and that we need to see ourself again as part of the ecosystem.
Rethink our relationship with nature and the central position we assume having, over the other species, might bring us to consider us again as being part of the ecosystem. Could we then consider interacting with the different species without having a superior position. As the previous civilisation took care of the land burning the invasive plants, we might have a role in taking care of the ecosystem.

Burning is the fastest and easiest solution, but is it the best one? The entire biodiversity of the burned area will therefore be destroyed and the stored CO2 in plants will be released in the atmosphere. The carbon footprint of such an action would be dramatic.







Future scenario 1

Comparing the data of 1960 and 2020 with the global warming situation, we projected two different scenarios for the evolution of the different species. The first scenario illustrate the evolution of the latter without any human intervention on crowberry overgrowth. We assumed that, when the crowberry will reach 100% ground coverage, it will therefore continue its expension by slowly overtake the other different species, altering the entire eco-system.

Future scenario 2

We consquently assumed that the crowberry represent a threat, as the human lifestyle, on the biodiversity.
The second scenario consider a human interaction on crowberry, to limit its expension, and reduce its ground coverage. The ground will therefore allows more space for the other species, and due to climate change, their expension will get even more important, favorising diversity of species in the eco-system.



Sanfjord river delta

Sandfjord is a river base area formed by maritime sediments that, like other similar areas in the northern territories, is experiencing dramatic changes in the ecosystem. Fuelled by climatic change, disturbances in the distribution of certain species have accelerated. This is leading to imbalances in the vegetation composition, with retroactive effects on the whole system.

Between these imbalances we can highlight the crowberry resistance which squeezes out other species through toxins, resulting in a large number of plants experiencing a drastic decline (meadow plants, herbs, heather, between others). The other main process that will be deepened is the densification and overgrowth of (bush areas) that is also drastically transforming artic fluvial valleys.

Greening and evergreening

However, all this ecosystem is undergoing two big transformations driven by milder temperatures: greening and evergreening. Greening is the process where bushes, grasses, and sedges are growing more abundant during warmer, and now more lasting, seasons encroaching land that was before more desertic. It is mainly characterized by fast-growing and short-life species, which generally die in colder seasons and become fertilizer for the new generation next spring.On the other hand evergreening is led by species that remain green and functional through more than one growing season. These are low nutrients species, which makes them less attractive for animals grazing. The main two species that fall into this category in our area of study are crowberry and lingonberry. Within these two plants, crowberry is the one threatening the ecosystem the most. The process represents a high menace for meadow areas, considered to be the most dynamic, fertile, and biodiverse ecosystem in the area. This dynamism makes them good indicators of arable land presence and is the main source of graze for reindeer and sheep.

The ecological consequences of evergreen-plants expansion, however, are markedly different from the effects of taller, deciduous species. Here, we argue that predictions of how shrub expansion will affect tundra ecosystems based on characteristics only applicable to deciduous shrubs hampers our understanding of the complex ecosystem feedbacks related to arctic vegetation shifts. We are aware of several ecological differences between deciduous and evergreen shrubs and how they may affect ecosystem processes in opposing ways, and highlight the key mediating role played by herbivores and if humans could also interfere in this mediation.



Crowberry
Evergreening



Gray willow
Greening





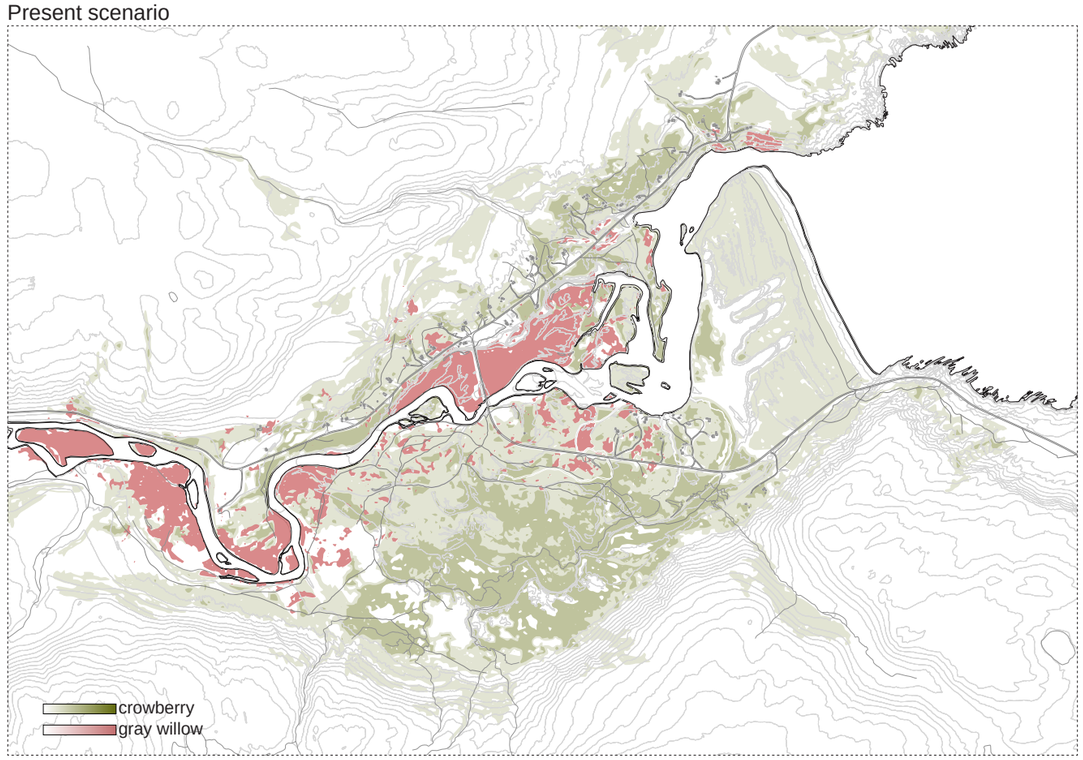
Overgrowth present and future scenario

The maps shows the density and expantion of crowberry (Empetrum nigrum) and gray willow (Salix Glauca) in the Sanfjord river delta, both in present time and in the future scenario. The time reflects their expected growing dominance in the ecosystem. It is impossible to predict the future conditions, but it is important to take in consideration that it is likely to happen. Their apparance will show as both spreading out, spreading higher up in the terrain due to temperature rise and by getting more dense in already established areas.

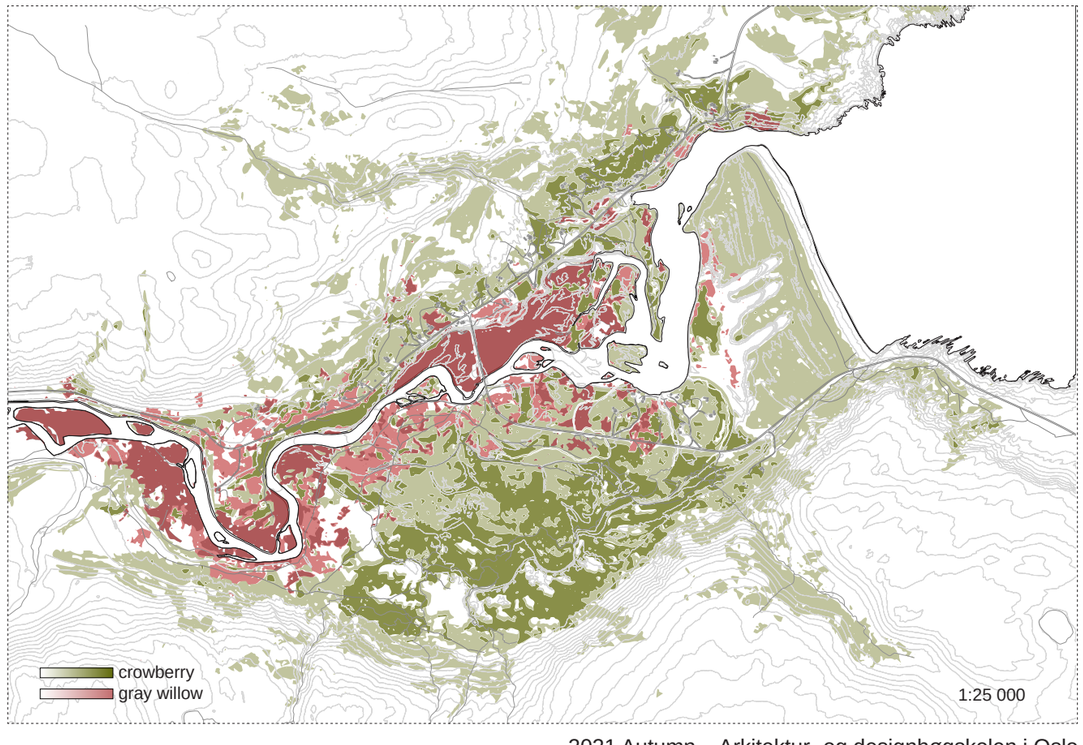
Through field observations, we found that the crackling thrives in everything from crate soil higher up in the terrain, to sedimentary substrates near rivers and coasts. We observed that the crater, in other words, is not only higher up but also completely down to has managed to establish itself from higher terrain with box soil and all the way down to moist maritime sediments.

Expantion and density of gray willow and crowberry

Present scenario



Future scenario



Crowberry

Crowberry (Empetrum nigrum) is an evergreen creeping dwarf shrub naturally present in tundra ecosystems and various climates, from humid coastal climates to high mountains and dry inland. The plant grows very slowly and thrives in nutrient-poor areas where it can live almost on bare stones and windswept areas. All it requires is enough sun. The berries from the crowberry are nutritious and tasty for grazing animals and birds, but there are few of them compared to the number of leaves. The leaves are only edible when very young, and therefor have a low grazing value.

Crowberry has, in recent years, been spreading through the north and now poses a threat to the tundra up-to-now balanced structure with its strong and often long-lasting influence on many of the ecosystem processes (directly to other vegetable species and undirectly to grazing animals). In short, the crowberry has no competitors. Its leaves contain small glands with toxins that come into contact with soil organisms and other plant roots as they fall to the ground at two to four years old. The poison accumulates in the soil changes the soil and creates inhospitable conditions for other plants. In the worst case, the poison can damage and cause restrictions or death in other species. Furthermore Melting snow helps to spread the poison further and into rivers. The leaves also break down so slowly that long after their death they continue to spread their venom to their surroundings. Wind and birds also help to spread the plant over larger areas and the plants are pollinated by the wind.



Crowberry is therefore responsible for reducing diversity and further ecological imbalance where it thrives. According to the doctoral thesis from Kari Anne Bråthen professor at UIT - Norway's Arctic University - the presence of crowberry leads to long-term changes in the soil environment, which in turn harms the occurrence and distribution of other plants species, especially grazing plants such as herbs and grasses. The thesis also points to crowberry as a bad grazing plant. Lastly, it shows that warmer climates can be a driving force for the crowberry's advance in the Arctic.

Gray Willow

Gray willow (Salix glauca) is widespread throughout Finnmark, along the entire coastline of the Barents Sea, and is an important part of ecosystems along water and watercourses.
The plant is highly profitable for insects and birds, and with a height up to two meters, it is not only an important food source but also a hiding place and nesting place for lots of fauna. Species such as domestic reindeer, elk, lynx, and rich species of sparrows thrive here, in addition to blue-throated divers and hawks.
In the lower layer of the vegetation in the willow shrub, grass species grow and is almost an oasis for many organisms. However, willow shrubs represent a danger for the ecosystem as it will experience a gradual “overgrowth”, resulting in a decline of other species. In the spring and summer, the river delta in Sanfjord is part of the reindeer herd area, as it's an area with easy access to nutritious food. Reindeers eating gray willow can help keep the growth of willow shrubs down. However, the extent to which reindeer and other grazing animals manage to keep the number of shrubs down remains unclear but, as it looks today, grazing animals are not enough to hold back the overgrowth.



Sandfjord



B

A

Field work

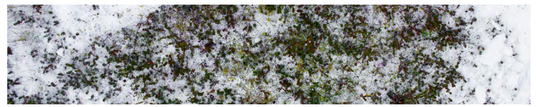
During the last week of October 2021 we traveled to the work area in order check if all the approaches, reflections and material that we had collected in the classroom are transferred to the reality of the place. Visiting the site allowed us to walk a transect through the river valley, taking samples and photographs of the terrain every few meters. Thanks to this fieldwork we were able to conclude that the evergreening process is much more present and developed in the Sandfjord area than we had previously thought. The empetrum not only extends to the areas farthest from the river but also reaches the very banks. The only terrain we found in which this species was not present is the islands of sedimentary origin created by the river itself.

Transect
of the Sanfjord riverdelta in october


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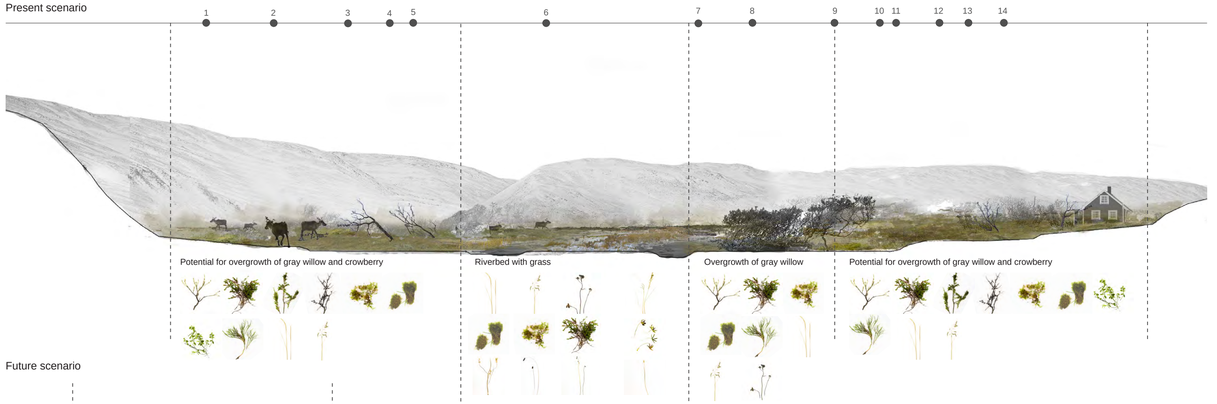

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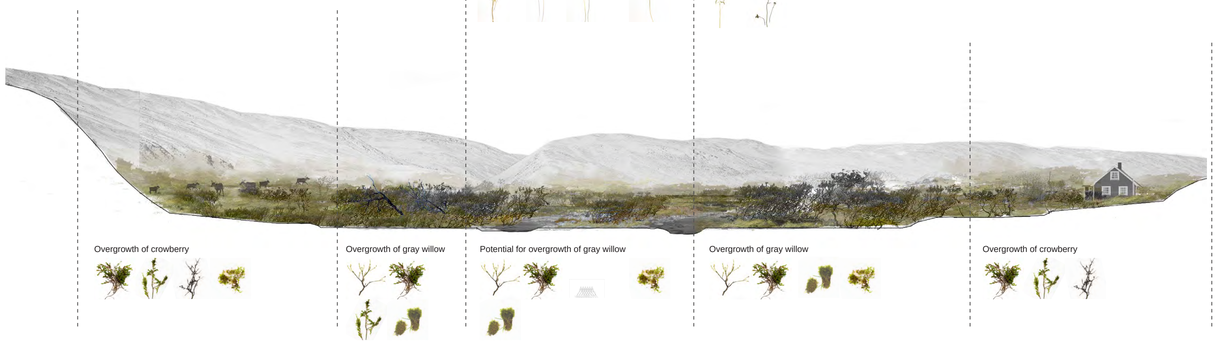

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Present scenario



Future scenario




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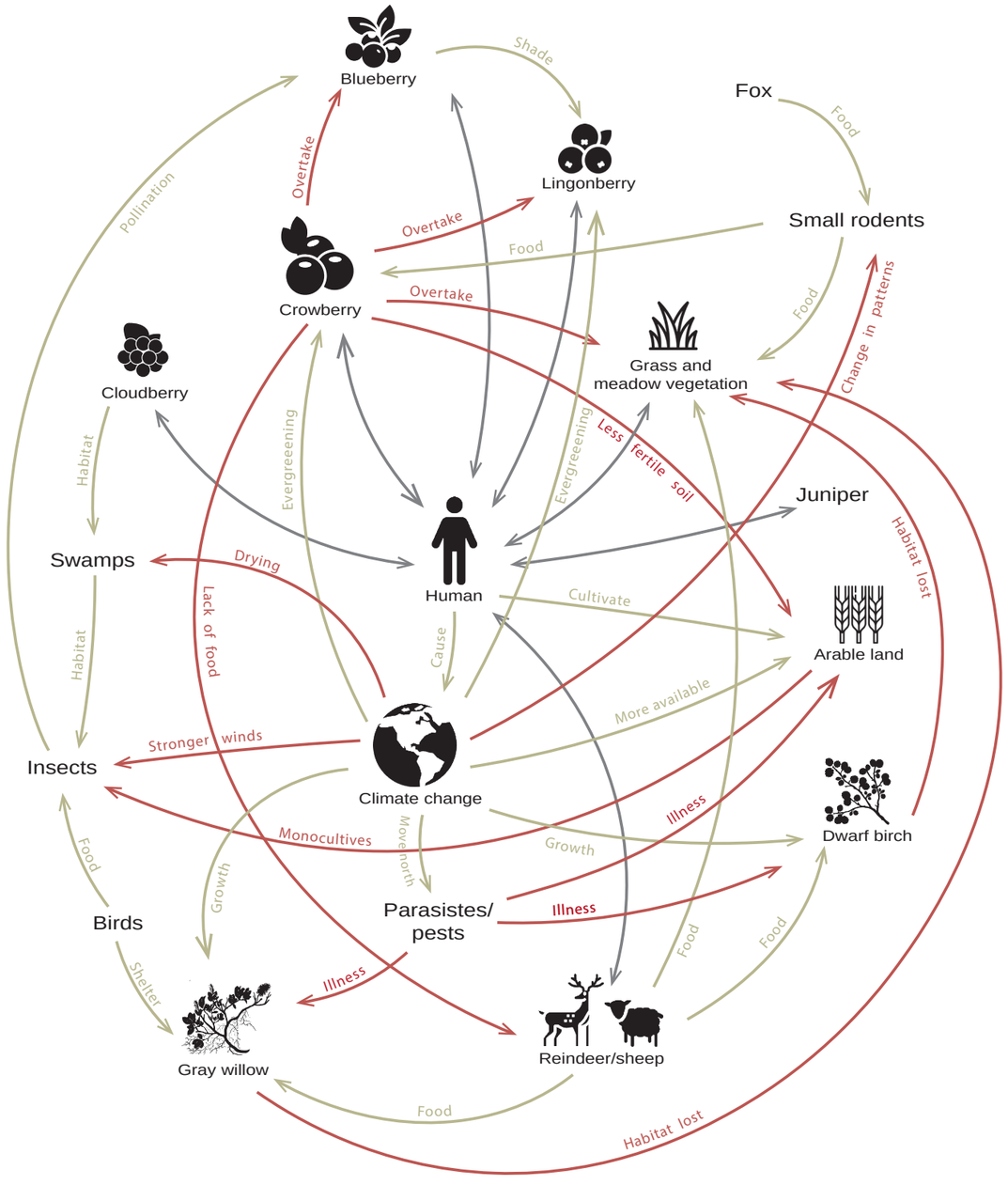

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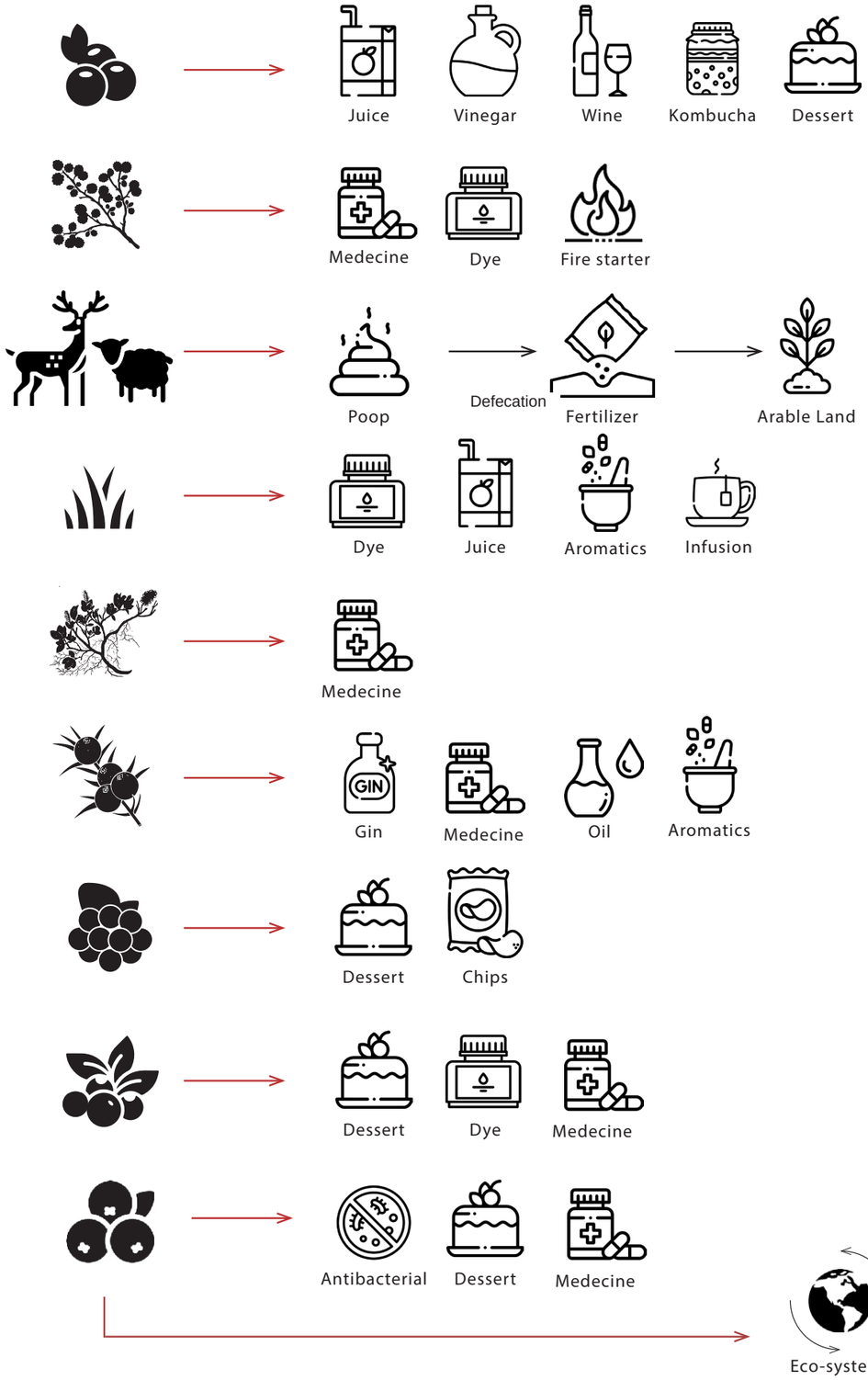


The ecosystem along the northern coast of Varanger

Together with climate change, the loss of species and habitats is considered one of today's biggest environmental challenges. Ecological balance is about how species affect each other and how our footprints and usage of resources have ripple effects down the chain. Today, the Varanger Peninsula experiences dramatic effects on the ecosystem related to climate change, especially in the distribution of certain species and imbalances in the vegetation composition, with retroactive effects on the climate system. The attached diagram shows the interrelationships inside the Sandfjord ecosystem we have become aware of. It materializes how every link in the chain not only has a direct impact on its close fellows but also can trigger uncontrolled effects on other species that seemed independent. The study of climate change in northern and arctic areas represents an important field of research because they are experiencing a faster rise in temperature and thus faster change than elsewhere on the globe. If we aim to continue to utilize natural resources, we are dependent on understanding inter-relations between non-human species, essential to the ecosystem's stability.

We have identified two different types of connection inside the network, impact, and threats (red arrows), and beneficial relationships (green arrows).

Although all relationships are considered to be in the same level of importance human resources (grey arrows) have been highlighted as an important outcome for the local community and have been further developed in the second diagram. Altough all relationships are considered to be in the same level of importance, human ressources have been highlighted as an important outcome for the local community and have been further developed in the attached diagram.


Juice
Vinegar
Wine
Kombucha
Dessert
Medecine
Dye
Fire starter
Poop
Defecation
Fertilizer
Arable Land
Dye
Juice
Aromatics
Infusion
Medecine
Gin
Medecine
Oil
Aromatics
Dessert
Chips
Dessert
Dye
Medecine
Antibacterial
Dessert
Medecine
Eco-systems

