

CoolBlue

Community Ocean Farms



Local Business Clusters

D3.2

Factsheets (M12) on candidate species for low-salinity cultivation in community ocean farms, targeting local authorities and community groups in the pilot regions, with a full report and protocol in M34



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About this deliverable

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Introduction

COOL BLUE is a Horizon Europe Coordination & Support Action under the EU Mission: Restore our oceans and waters by 2030. The overall objective of the project is to assess the feasibility of community-driven regenerative ocean farming (also known as restorative ocean farming or regenerative aquaculture) across social, ecological and economic indicators. To achieve this, the project partners will conduct market analyses, engage stakeholders, develop a manifesto, educational materials, conduct regulatory and socioeconomic assessments, identify regenerative species for cultivation or restoration, culminating in a strategic development plan for replication across Europe.

Background

Deliverable D3.2 – Factsheets (M12) on candidate species for low-salinity cultivation in community ocean farms, targeting local authorities and community groups in the pilot regions, with a full report and protocol in M34

Deliverable Number	D3.2	Lead Beneficiary	4. AÖ
Deliverable Name	Factsheets (M12) on candidate species for low-salinity cultivation in community ocean farms, targeting local authorities and community groups in the pilot regions, with a full report and protocol in M34		
Type	R — Document, report	Dissemination Level	PU - Public
Due Date (month)	18	Work Package No	WP3

Description
Factsheets (M18) on candidate species for low-salinity cultivation in community ocean farms, targeting local authorities and community groups in the pilot regions

Purpose of this document

The following deliverable provides a short introduction to the factsheets of identified low-salinity regenerative species. The factsheets themselves are a first iteration of a future list (full report) of regenerative species for cultivation. Since regenerative aquaculture is a relatively new concept, there is so far no defined list of regenerative species based on geographic distribution. Since the COOL BLUE partnership includes Finnish partners, where salinity is very low, a first step for the low salinity cultivation pilot was to establish suitable species with potential commercial or regenerative potential. The resulting factsheets are intended as a “catalogue” for newcomers to regenerative aquaculture, in order to help them develop business plans.



Methodology

Before this task began, the partners soon became aware that the species typically associated with regenerative ocean farming (seaweeds and bivalves) do not occur in the low salinity Eastern Baltic. The Finnish (AÖ) and Swedish (UGOT) partners therefore identified suitable local species via desk research. Their search criteria were for organisms that grow in coastal environments, with either commercial applications or regenerative applications for social health (e.g. in herbal medicine) or ecological health (e.g. known to provide ecological benefits such as habitat for other species, nutrient uptake or other remediation). The species selected for the factsheets display the greatest cultivation potential and business case according to their known applications. For example, cat tail is naturally found in freshwater or brackish wetland or coastal environments. It is commonly used in biological wastewater treatment at various scales. The rhizome can be eaten as food, and the cat tails themselves can be used for biomaterials such as textiles or insulation. Under the EU Nature Restoration Law, farmers are encouraged to restore part of their land to wetlands. Cat tail and similar species could therefore be used for regenerative purposes, both for wetland restoration and for commercial applications. Furthermore, plant species are commonly used in polyculture systems to counteract nutrient loading or sedimentation from co-cultivated species. Although the common perception regenerative ocean farming encompasses only macroalgae and bivalves, there is a much broader scope of species that could be classified as “regenerative”, especially in brackish or freshwater environments. This includes upstream, freshwater species which can also contribute to ocean regeneration through phytoremediation or by supporting biodiversity (e.g. migrating birds), especially in coastal environments. For this reason, coastal plants are included in the scope of COOL BLUE, since they are low-trophic and can be cultivated in subtidal (e.g. seagrasses), intertidal areas (e.g. marsh samphire) or wetland areas. In the outermost regions of the EU, mangroves are another example of regenerative plant species, since they provide support biodiversity (e.g. shelter for juvenile fish); stabilise and store carbon in sediments and act as a buffer against storm surges. There are a number of plant species in mainland Europe which perform similar functions and merit further investigation for regenerative aquaculture in coastal areas. While many plant species have novel food status, they have other potential commercial applications such as insulation material, textiles, feed, horticulture, ecosystem restoration services and so on.



Floating gardens



Figure 1: The Finnish low-salinity cultivation pilot testing floating platforms

From the partner AÖ:

“The original list of species included plants that live in the water, various seagrasses, which we have excluded as we have not yet developed a system for cultivating them. We have focused on developing cultivation on floating platforms and seeing which plants could be grown on these and harvested primarily for food, but with additional benefits such as nutrient reduction and increased biodiversity both above and below the water surface. The first thing we started with was testing different constructions and materials for floating platforms. What material should they be made of and how do we achieve buoyancy? The material should meet the requirements of not releasing harmful substances into the environment and maintaining buoyancy throughout the summer. Plastics and imported materials were something we avoided, it was important to start with what is locally available and then see how they work for the plants. Regarding plants, it was not easy to obtain seeds and plants of the species we initially planned to test. Glasswort was ordered from Germany, while cattail rhizomes were collected and placed on the raft. This led us to also test other species to learn more about how cultivation in brackish water works.”

AÖ will continue to develop the optimal construction model for the floating gardens. To find sufficient buoyancy, they will search for even better constructions. They are also developing cooperation with gardeners that will produce the targeted plant species from seed.



Results

For the purpose of this report, around ten species were evaluated, as follows:

1. European crayfish (*Astacus astacus*)
2. Duck mussels (*Anodonta anatina*)
3. Marsh samphire (*Salicornia sp.*)
4. Broad leaf cat tail
5. Purple loosestrife
6. Sea Plantain
7. Clasping leaf pondweed
8. Valerian
9. Garden Angelica
10. Sweet Flag
11. Sea Sandwort
12. Bogbean
13. Flowering Rush
14. Sea Aster
15. Water mint

From this longlist, six species were shortlisted for factsheets in the first period of the project.

1. European crayfish (*Astacus astacus*)
2. Marsh samphire
3. Broad leaf cat tail
4. Purple loosestrife
5. Duck mussel (*Anodonta anatina*)
6. Sea arrowgrass

A full report and protocol for cultivation of regenerative species in low salinity environments will be developed in the second half of the project and made available online in M34.



Exploitation

Targeting locals and authorities with floating gardens and factsheets

In August, as the growing season was coming to an end and we could see what we had achieved with our tests at three different locations, AÖ invited the media to their test site. AÖ was featured on local radio as well as on national TV news. During the autumn, they also had Trädgårdsnytt - a Swedish-language gardening magazine - visit one of the test farms.

A local TV channel in Kristinesstad made a 30 minute film about the work with floating gardens. AÖ presented in Swedish and Finnish the work, the theory behind it and how we have tried to meet the challenges with growing in brackish water. Here you can see how we have chosen to build the floating islands, what kind of substrate for the species and which species to use.

Instructions for DIY construction of floating gardens

The partners have also developed instructions for the construction of floating gardens for local communities. Examples can be found in the annex.



Annex I: Factsheets



European crayfish

Other names: Noble crayfish (*Astacus astacus*)

Key Facts

- The European crayfish is the most common freshwater crustacean and a traditional food in Nordic and Eastern Baltic countries
- Crayfish are typically eaten during a late summer festival in Baltic countries called “Kräftskiva” in Swedish or “crayfish party”.
- The species is threatened by a disease spread by imported crayfish from North America, the signal crayfish
- European crayfish are omnivorous and require a varied diet of plants, other crustaceans insects, small fish or other organic matter. This means their feed can be produced from crustacean side streams and insect protein, without the need for unsustainable fish meal

Cultivation

- European crayfish are commonly cultivated in Nordic and Baltic countries.
- Crayfish can also be cultivated in integrated multi-trophic aquaculture systems (IMTA) such as aquaponics, a form of recirculating aquaculture systems (RAS).
- They are also cultivated in freshwater ponds or lakes
- Like lobster, they are prone to cannibalism so should be regularly sorted by size and kept well fed!
- They are a freshwater species, but can tolerate low salinity

Distribution and habitat

Crayfish are found Central Europe to the Balkans, as far as Scandinavia and Eastern Europe. They prefer streams, rivers and lakes with good water quality and a great deal of shelter. They are sensitive to pollution and physical damage to the environment.

Legal status

Crayfish has been a traditional food for at least 500 years and therefore can be commercially cultivated and sold for food or other uses.



Uses and benefits

- **Food:** Crayfish
- **Restocking:** Since crayfish are threatened by invasive species, there is commercial value in cultivation for restocking purposes, especially where native populations have been depleted.
- **Ecosystem benefits:** Crayfish predate on insects, other crustaceans, small fish and plant matter
- **Pets:** Crayfish are also commonly sold as aquarium pets
- **Chitin and chitosan:** Crustacean shells are a good source of chitin, a biopolymer with multiple uses from bioplastics to coagulants
- **Ecological benefits:** *A. astacus* is regarded as a keystone species and an important part of the freshwater food web as they provide a source of food to many other species and boost primary productivity by foraging on freshwater plants. The loss of crayfish can cause plant overgrowth, leading to eutrophication and an overall degradation in water quality.



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Duck mussel

Other names: Freshwater mussel (*Anodonta anatina*)

Key Facts

- The duckmussel and swan mussel are species of freshmussel, aquatic bivalve mollusc in the family *Unionidae*
- Like marine bivalves, they are filter feeders and obtain their food from the water column



Cultivation

- A method for cultivating freshwater mussels from the juvenile stage is being developed at the University of Jyväskylä. These can then be placed in the chosen cultivation environment for 2-3 years before being transferred to mussel cages in clean, low-salinity seawater for purification from contaminants. After 1-3 months of depuration, they can be consumed as food.
- They can be co-cultivated in combination with other species in integrated multi-trophic aquaculture systems (IMTA) such as trout farms. The first pilot cultivation trials in an offshore site are ongoing as part of the COOL BLUE project

Distribution and habitat

The duck mussel is a Palearctic species found in northern and central Europe as well as in Siberia, extending to the Pacific coast. In Finland, it occurs throughout the country, almost up to the northernmost Lapland. They generally dwell in muddy substrates in lakes or ponds, buried in the mud to protect themselves from predation.

Uses and benefits

- **Food:** Duck mussels are not traditionally eaten as a food, but are edible for humans, representing a good source of protein.
- **Feed:** Duck mussels can also be consumed by animals such as freshwater fish or other livestock, which can replace the use of unsustainable fish meal in aquaculture feeds.
- **Ecological benefits:** As filter feeders, mussels reduce eutrophication and improve water quality, reducing the risk of harmful algae blooms. The material that the mussel cannot use for its growth is secreted to sediments where it is a food source for smaller organisms. Through filtration, the water becomes clearer with increased light penetration (visibility) and less turbidity (cloudiness), leading to increased photosynthesis, which in turn supports benthic fauna and overall species richness.

Legal status

Duck- and swan mussels have no legal status as a food, so cannot be sold commercially as food in the EU unless evidence of use can be found in the EU before May 15, 1997



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Broadleaf cattail

Other names: Cattail, bulrush (*Typha latifolia*)



Key Facts

- Perennial aquatic and shoreline plant.
- Height ranges between 1-2 meters.
- The inflorescence is dense, cylindrical, and bipartite at the top of the stem. The flowering period is in July-August. The female flower is usually 8-20 cm long and 1.3-2.5 cm wide. The male flowers are located at the top of the inflorescence.
- Leaves are light bluish-green, long, stiff, and narrow. They are arranged alternately in two rows, mainly at the base of the stem. Sheaths are 20 cm long. Leaf blades are 40-160 cm long and 10-20 mm wide.
- The stem is upright, unbranched, and smooth, with a horizontal and creeping rhizome.
- The fruit is a nutlet, and in late autumn or winter, seeds with tufts of hair are released from the inflorescence.

Distribution and Habitat

Cattails grow in all climate zones. In Europe, they are found as far north as the Gulf of Bothnia and Southern Lapland. Cattails are particularly common in wet and marshy areas, such as the shores of lakes, ponds, and rivers, as well as in ditches and wetlands.

Legal status

Cattails have no legal status as a food, so cannot be sold commercially as food in the EU unless evidence of use can be found in the EU before May 15, 1997. However, it can be used as part of a multi-trophic aquaculture cultivation system (e.g. aquaponics, wetland restoration), and the biomass can be used for sustainable bio-based materials listed above.

Uses and benefits

- **Food**
- Building Material (e.g. insulation)
- Polyester replacement in textiles
- Feed
- Wastewater treatment
- Wetland restoration
- Herbal medicine(antiseptic)
- Compostable tableware
- Supports biodiversity by providing habitat for nesting birds, fish, and aquatic organisms.
- Prevents soil erosion caused by waves and currents and helps stabilise sediments.
- Removes nutrients such as phosphorus, nitrogen, environmental toxins, and heavy metals from water bodies, helping to prevent the formation of blue-green algae.
- Can be cultivated by farmers for wetland restoration



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Purple loosestrife

Other names: Purple loosestrife (*Lythrum salicaria*)

Key Facts

Purple loosestrife is a perennial plant that grows in wetlands, such as by lakes, rivers, and seas. It blooms in July-August and can reach a height of 40-120 cm. The plant is common in Finland and other European coasts, but in North America, it is considered an invasive species. Historically, purple loosestrife was used for medicinal purposes.

Cultivation

Purple loosestrife can be grown from both seeds and plants. It thrives best in moist and nutrient-rich soil with a neutral or slightly acidic pH. The seeds are sown either directly in the soil in autumn or indoors in spring, after which the plants are moved outside. The plant requires little maintenance, but it is good to monitor its spread.

The cultivation of purple loosestrife can be expanded, for example, as part of wetland farming or for wastewater purification systems.

The plant attracts pollinators and thus contributes to the ecosystem's diversity. There are also possibilities for medicinal use, as its antibacterial properties have been studied.

Legal status

Purple loosestrife has no legal status as a food, so cannot be sold commercially as food in the EU unless evidence of use can be found in the EU before May 15, 1997. However, it can be used in polyculturesystems such as IMTA for phytoremediation, as well as non-food applications



Uses and benefits

- **Food:** Leaves, shoots, and roots can be used in salads and other dishes.
- **Herbal medicine:** Used to treat diarrhea, inflammation, and wounds.
- **Wastewater purification:** Reduces the amount of nitrogen and phosphorus.
- **Pollinator attraction:** Supports the reproduction of pollinators and the ecosystem's biodiversity.
- **Cosmetics and supplements:** Used in skincare products and for digestive issues in animals.

Distribution and habitat

Lythrum salicaria is native to Europe, temperate Asia and northwest Africa. It is also naturalized in many temperate parts of the world, including parts of southern Africa, North America, and South America.



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Marsh samphire

Other names: Samphire, glasswort (*Salicornia europaea*)

Key Facts

Glasswort is an annual plant that grows in salty areas such as coasts and wetlands. It belongs to halophytes, which are plants that tolerate high salt concentrations. In Finland, it is rare and endangered. The plant is about 15 cm long, and its stem is juicy and salty. Historically, it has been used to make salt.



Cultivation

- Cultivation of glasswort is possible in salty areas that are not suitable for conventional agricultural crops.
- The species tolerates high salt levels and grows in saltwater but cannot survive in freshwater.
- Cultivation can be scaled up to large areas, as the plant requires few resources in terms of freshwater and fertilizers.
- Additionally, cultivating glasswort can help sequester carbon and reduce soil erosion.
- Plants can also be grown in water (hydroponically). This allows it to be grown in brackish water or other non-traditional growing environments. Additionally, cultivating glasswort can help sequester carbon and reduce soil erosion.

Legal status

Salicornia is recognised as a food in the EU and can therefore be cultivated and sold commercially.

Uses and benefits

- **Cooking:** Used in salads, as a steamed side dish, and as a salt substitute.
- **Health benefits:** Rich in minerals and vitamins, a good source of magnesium.
- **Environment:** Helps reduce soil erosion and sequester carbon.
- **Bioenergy:** Biofuels, such as biodiesel and bioethanol, can be produced from glasswort.
- **Glass & soap:** The ashes of glasswort and saltwort plants (barilla) and of kelp were long used as a source of soda ash (mainly sodium carbonate) for glassmaking and soapmaking.

Distribution and habitat

The species of *Salicornia* are widely distributed over the Northern Hemisphere and in southern Africa, ranging from the subtropics to subarctic regions. They grow in coastal salt marshes and in inland salty habitats like shores of salt lakes. *Salicornia* species are halophytes and can generally tolerate immersion in salt water (hygrohalophytes).



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Sea arrowgrass

Other names: saltmarsh arrowgrass (*Triglochin maritima*)

Key Facts

- Sea arrowgrass occurs both as an annual and perennial plant
- It has cylindrical, spiked shoots and conical seed heads
- It is a member of the grass family

Cultivation

- Sea arrowgrass can be cultivated from seed, with both plants and seeds available from horticultural suppliers.
- It has been demonstrated to grow well in hydroponic environments such as floating wetlands, platforms or gardens.
- It can tolerate high salinity environments such as salt marshes
- It could also be co-cultivated in polyculture systems for water filtration and oxygenation (phytoremediation)

Distribution and habitat

It can be found throughout Northern Europe in brackish marshes, freshwater marshes, wet sandy beaches, fens, damp grassland and bogs. It generally occurs near to the coast and not inland.

Legal status

According to the information available to the competent authorities of the Member States, this product was not consumed to a significant degree as a food in the EU before May 15, 1997. Therefore, prior authorization for placing it on the market as a food is required under Regulation (EU) 2015/2283. Without authorization, sea arrowgrass cannot yet be used commercially to produce food products or dietary supplements for commercial markets.



Uses and benefits

- **Cooking:** The white base of the leaves can be used in salads, as a steamed side dish, and as a salt substitute, with a coriander aroma and taste. IMPORTANT: the green upper leaves can contain cyanide, so should not be consumed (only the lowest, paler colour 1cm is safe to eat, and always in small doses)
- **Ecological benefits:** It is found to promote other plant growth and is a food source for several herbivores such as rabbits and deer. The seed heads are also a source of food for birds.

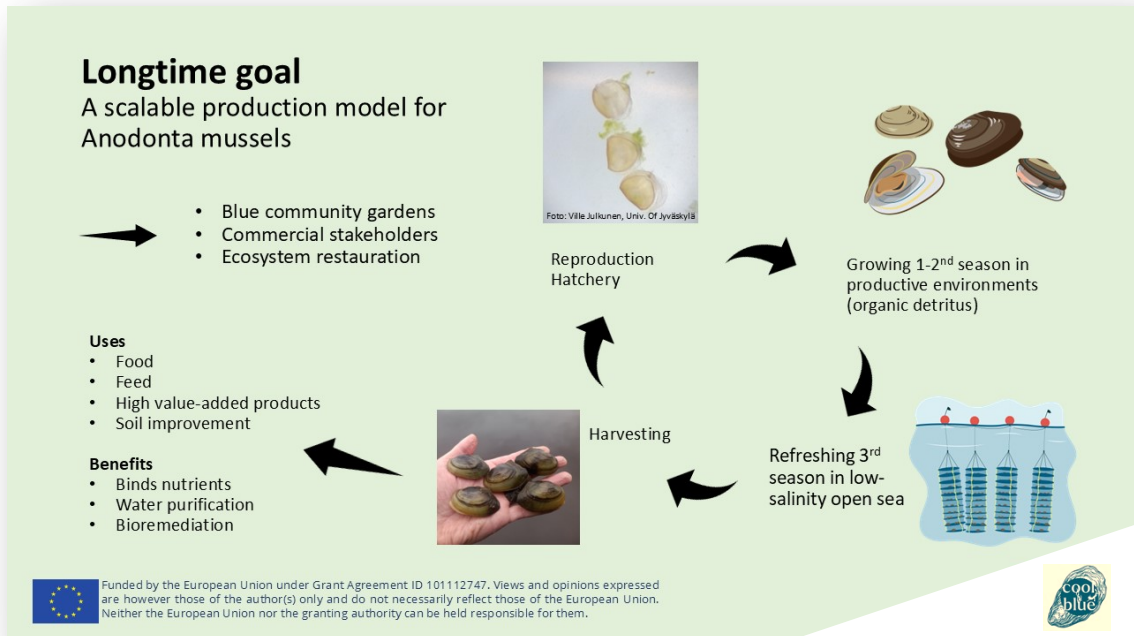


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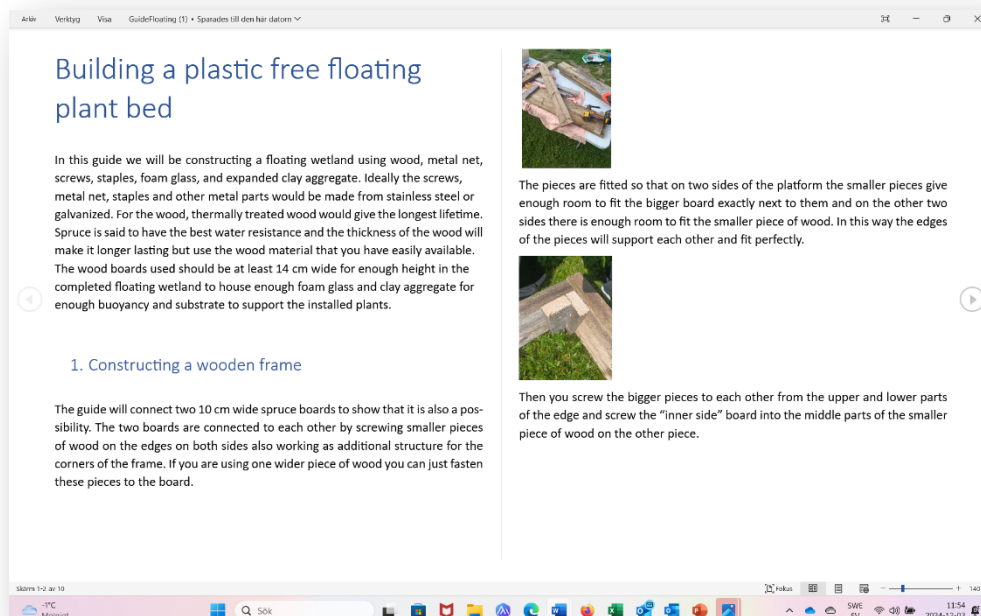


Annex II: The development of a business case for freshwater mussel farming



Annex III: Communication and Dissemination of this deliverable

Instructions for floating garden construction, the first one is made for Kindergarten children up to 9th grade, the second one is for communities interested in building a floating garden themselves:



First DIY instruction for locals how to build floating platforms for growing food



Collaboration with konstfack Stockholm: a scenario for floating gardens in bigger scale

Flytande odlingstappa ger ätbart och gör havet friskare

Går det att odla i brackvatten? Bland annat detta undersöker man som bäst i det tvärläns projektet Cool Blue Nordic. Anita Storm arbetar med projektet i Åkion Österbotten. Vid hennes villa i Malax skärgård har under sommaren funnits flera flytande odlingsplattformar vid stranden. Liknande testplattformar har även funnits i Jakobsbad och Kristinestad.

Cool Blue Nordic projektet målning är ta reda på hur man genom regneratvirk hushållning kan få fram resurser för livsmedel och biogasproduktion. Åkion Österbotten deltar i projektet tillsammans med yrkeshögskolorna Novia och VAMK. I samma projekt undersöks även användningen av dammskor som vattenrensare och filter. Den delen av projektet sköts av Yrkeshögskolan Novia.

I mitten av september var det dags att ta upp odlingsplattformarna ur vattnet, ta vattensprover och utvärdera hur växterna hade klarat sig i det salta vattnet. På plats vid villan i Malax fanns även studerande från VAMK och deras lärare i Irma Hyyri, läkare i miljöteknik.

Men mätte näringsämnen i vattnet och tog prov på de odlade växterna. – För att få reda på hur mycket växterna rensat vatten börde mätningarna göras var je månad, men eftersom vi fick tillgång till testapparaturen först i september hinner vi inte mätta.



Glädde som vuxit på en odlingsplattform.

endast vi få mätresultat från hösten detta år, berättar Johannes Nieman som studerar miljöteknik vid VAMK. Projektet har även testat olika typer av odlingsplattformar. Plattformar med vass, reed och hampsträsk har använts under sommaren.

– De håller en såsag. Vårt mål är att ta fram plattformar som kan användas under flera säsonger säger Johannes Nieman, som gör sitt examensarbete inom projektet.

De flesta testar de nu en plattform som är tillverkad av värmehandlat trä. Här högt den flyter kan justeras med hjälp av tyngder. Plattformerna ram är tillverkad av värmehandlat trä, det fjärdaste elementet består av dammskor. Som odlingsplattform används lecagras. Skumglas tillverkas av återvunnen glas och används i hushåll som fyllnads- och isoleringsmaterial, inom infrastruktur och husbyggnad.

– I början då växterna rotar sig bör de vara i kontakt med vattnet. Senare då de växer upp är det till fördel för växternas utveckling om det finns en luftspalt mellan växten och vattenytan berättar Johannes Nieman.

Anita Kekomäki som undervisar i energiteknik vid VAMK har i sitt examensarbete fokuserat på växternas användningsområden och biogaspotential. Hon berättar att kornet är en mångsidig växt. Den kan användas som mat, i frägnadskärl, som fyllning i kläder och som filter. Som mat används den på liknande sätt som sparris. Man kan skära från den lösa delen av växten, steka eller koka den i saltet vatten. Bladen kan användas som tillbehör i sallader.

Även kornet kan ha sin nytta som gräs, på vägen innan den blommar. Den kan stekas eller grillas. Smaken påminner mycket om mandel säger Anita Kekomäki.



Studeranderna Johannes Nieman och Anita Kekomäki tar loss växterna från odlingsplattformen för att sedan



samt deras lärare Irma Hyyri (i mitten) jobbar med att väga biomassan.



Här testas en ny plattform som är tillverkad av värmehandlat trä. Här högt den flyter kan justeras med hjälp av tyngder.



Det mesta sker under ytan. Det fanns rikligt med långa rötter under plattformarna. För att få bort näringen ur vattnet är det viktigt att plattformarna tas upp på hösten.

Flera orsaker att ha en flytande odling

Mat
Om du vill testa detta för att odla mat, kan du till exempel plantera en odlingsplattform full med grönska och få en väldigt special grönska till hösten.

Blomsterträd
Plantera strandveronica och tack-

elblomster i en odlingsplattform så får du en vacker blomsterträd, och bidrar samtidigt till biodiversiteten.

Rena havet
Om du önskar ta bort näringsämnen vid din strand är kornet, starr och missne bra växter att plantera på odlingsplattformen.

A Swedish gardening magazine made an article about the work that has been done during the summer. Text of materials, substrate and species.

