NATURESHIP

Marika Niemelä

ANIMALS TO THE SHORE – YES OR NO?

A Guide to Sustainable Grazing on Shore

NATURESHIP-PUBLICATIONS

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A Guide to Sustainable Grazing on Shore

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Contents

Preface

This publication is produced as part of the Natureship project (2009–2013) coordinated and partly financed by the Centre for Economic Development, Transport and the Environment (CEDTE) for Southwest Finland. Natureship is an international project including members from Estonia, Finland and Sweden. It is funded by Central Baltic Interreg IV A Programme together with national financiers. There are eleven project partners: CEDTE for Southwest Finland, University of Turku Department of Geography and Geology, Metsähallitus (Forest and Park Service), the cities of Hamina, Raisio and Salo, the municipality of Vihti, Norrtälje Nature Conservation Foundation, County Administrative Board of Gotland, Estonian Environmental Board, and University of Tartu Pärnu College.

The goal of the project is to increase cooperation in nature management and water protection in Finland, Sweden and Estonia. The project aims to carry out shore planning according to the principles of sustainable development, and by means of which, all partners in cooperation try to find the best cost-effective methods of promoting water protection and biodiversity. During the project Natureship partners test different planning methods in shore areas by combining geographic information data (GIS) with historical material, make innovative management experiments and recommendations, and study the indicator species of traditional biotopes. In addition, this project examines ecosystem services, i.e. all the material and immaterial benefits, which are supplied for people by natural ecosystems.

The main outcome of the project is a series of six nature management publications. All the publications can be downloaded from the Natureship web pages, *www.ymparisto.fi/natureship.*

Turku 25.5.2012

Mika Orjala and ***Annastina Sarlin***
Coordinators of the Natureship project

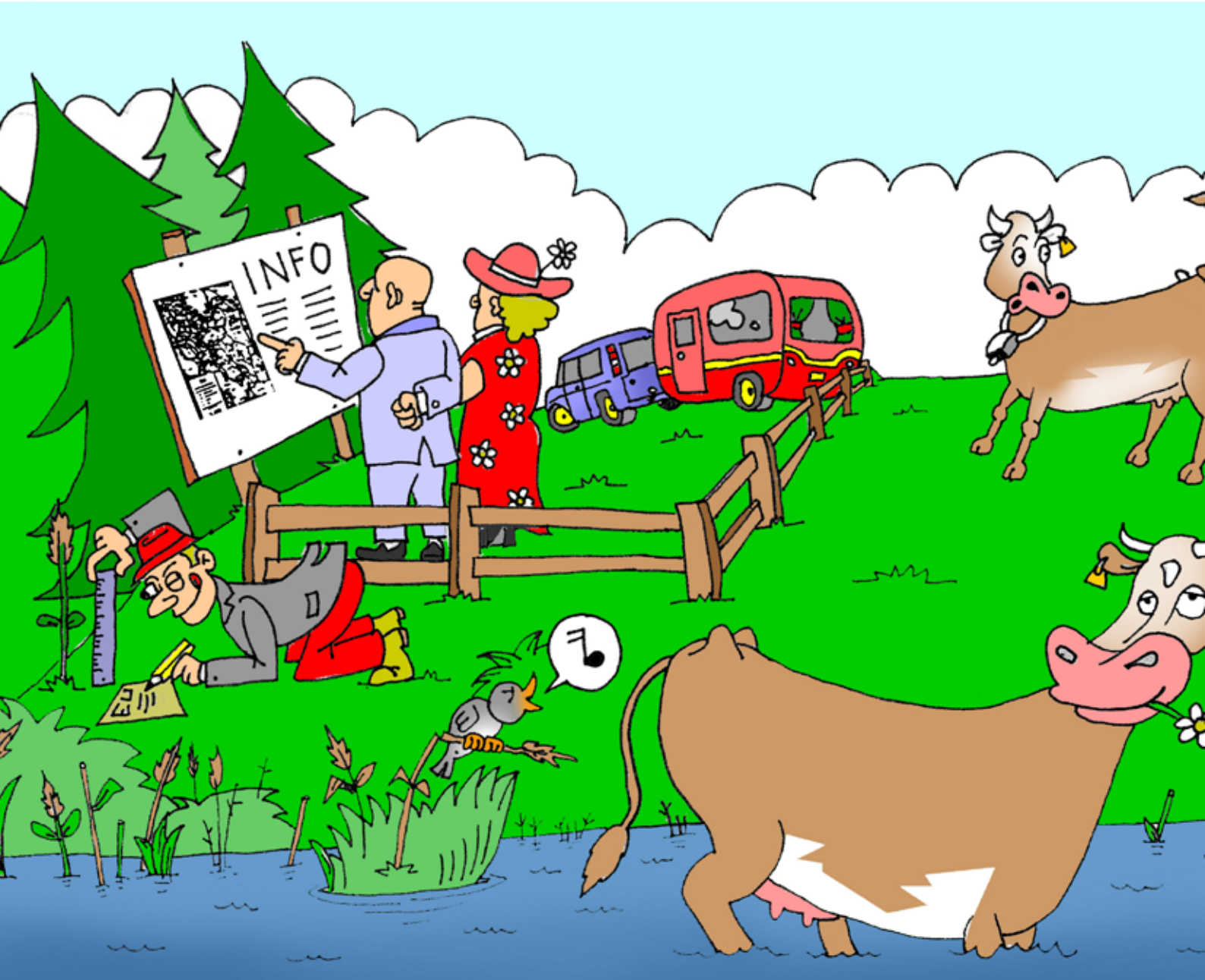
Photo: Pirjo Ferin, Image bank of the Environmental Administration

Joys and benefits of grazing on shore meadows

Grazing on shore areas causes both positive and negative associations. For many people who either live next to shore, have a shore cottage, or who use shore for recreational pursuits, the grazing livestock is a ”novel” phenomenon, which arouses questions and concerns for example over water quality and possibilities of accessing the shores. However, according to the results of an enquiry sent to the Finnish environmental authorities (CEDTEs) in the spring of 2011, the effects of animals grazing on shores are mainly positive. The practise promotes biodiversity and usually there has not been any problems in water quality.

Due to the intensification of agriculture, the use of semi-natural meadows and pastures decreased significantly by the 1950s[77]. Many meadows had already been taken into agricultural use at the time, and the remaining meadows have since widely overgrown. However, grazing on seashore meadows and on shore meadows by inland waters have gradually begun to revive after an overgrowing stage, which lasted for decades.

Nowadays, a central aim in managing shore meadows is to restore and to maintain traditional landscapes characterized by open meadows as well as the rich biota dependent on them.



It might be difficult to apprehend the scale of the nutrient load produced by the grazing on shore meadows. In Finland the major part of agricultural area is field (2.29 million hectares) while 40 000 hectares are traditional rural biotopes. More statistics and current topics of Finnish environment can be found from the web page, www.luonnontila.fi

Instead of open meadow sceneries, the shore landscapes are today in many places dominated by thick reed beds. For instance, it has been estimated that in the coastal area of southern Finland there are almost 29 000 hectares of reed beds[49]. In the region of Varsinais-Suomi (SW Finland), there are about 16 times more reed beds than shore meadows[20]. According to estimates there are only 4 200 hectares of seashore meadows in the whole Finnish coastal area, which is about 10 % of the amount in the 1950s[68]. As a consequence, seashore meadows are nowadays classified as an extremely endangered habitat type. The situation is similar also in Estonia and in Sweden. There are 5 100 hectares of valuable shore meadows in Estonia, and 8 000 hectares in Sweden[20]. The surface area of shore meadows by inland waters could not be estimated as reliably as the area of seashore meadows, but also meadows by riversides and by lakes are, for example in Finland, classified as endangered nature types[68].

An important area of the Finnish agri-environmental support system is to restore and to promote biodiversity. Many shore meadows have been managed since 1995 with the aid of special support program for the management of traditional rural biotopes, but it can last for years before the flora and other biota of a shore meadow revert to what they traditionally used to be like. However, positive results have already been achieved in many places[18].

In addition to managing the landscape and natural environment, grazing in shore meadows also brings income to many farmers while the vegetation of meadows can be used as human food via livestock production. When carried out correctly, grazing in semi-natural meadows also increases the well-being of the grazing animals.

Give a joyous greeting to the grazing animals when you see them next time on shore meadows!

What is sustainable grazing?

Common rules for grazing on shore meadow

After deciding to take animals to graze shore areas, there are several rules and regulations to take into account.

Shore pastures, buffer zones and wetlands managed as traditional rural biotopes should be grazed separately from fertilized lay pastures in order to prevent nutrition flow from the more nutrition-rich field to the meadow/shore zone and further into a water system. If the buffer zone is planned to be grazed together with the adjacent traditional rural biotope, it is recommended that it is grazed or mown separately in the first years to prevent nutrition flow from the buffer zone to the traditional rural biotope[71].

Securing welfare of the grazing animals is important from both economical and environmental aspects. **Animal density** and the number of grazing days must be adjusted to correspond to the productivity of the pasture. When the animal density is too low (under-grazing), the nutritional value of the vegetation weakens fast and the crop may remain unutilized to a large extent. In this case, the management is also not effective enough to maintain species, which require a low-growth environment. On the other hand, too high animal density may lead to depletion of forage and weakening of the condition score and growth of the animals. As a consequence, vegetation cover may erode exposing soil to the leaching of nutrients and suspended matter.

On occasions, it may be necessary to limit grazing in order to maintain the natural values of more sensitive habitat types within the traditional rural biotope, such as dry meadows, heaths and dunes. These dry, higher-located habitat types are often pleasant resting areas for grazing animals, and are thus exposed to erosion and eutrophication. Also, in areas with valuable **shore bird fauna** (such as the threatened Southern Dunlin), grazing must not begin until the brooding period is over[46]. One alternative is to graze the area in sections, in which case the grazing time can be limited in areas with sensitive habitat types or species. In this way, the yield of the meadow will also be more thoroughly utilized by cattle.

The welfare of grazing animals and the management output of the pasture may be essentially influenced also by the choice of the **type of livestock** (species, breed,

Traditional rural biotopes *term refers to semi-natural meadows and wooded biotopes (e.g. wooded pastures), which have been created by mowing and grazing practised in traditional livestock farming in the absence of cultivation and fertilization. As a result, the vegetation and other biota has developed more diverse.*

According to the Finnish agri-environmental support system a ***buffer zone*** *is a shore zone, which is established by a water system in a field, covered with perennial grass/meadow vegetation, left outside the actual field cultivation and is at least 15 meters wide. By* ***wetland*** *are meant built-up or natural small water systems with their flooded shore areas, which are managed for example by damming and removing nutrients from the shore zone by harvesting the vegetation. In both types of environments, especially in flood and erosion sensitive areas, the aim is to decrease the entering of nutrients drifted by runoff waters into water systems. Additional information in Finnish can be obtained from the following publications:*

Perinnebiotooppien hoitokorttisarja (ks. http://www.mavi.fi/fi/index/viljelijatuet/oppaatjaohjeet/ymparistotuenneuvonnallisetoppaat.html)
Monivaikutteisen kosteikon perustaminen ja hoito[52]
Monivaikutteisen kosteikon hoito[79]
Riistakosteikko-opas[1]
Suojavyöhykkeen perustaminen ja hoito[78]
Suojavyöhykkeiden hoitokortti [71]

and the stage of production). Cattle are the most suitable animals for shore meadows, because they are able to graze also on the waterfront, unlike sheep and horses, which prefer dryer areas[47,54]. Animals with relatively small production potential and whose energy requirements for maintenance are low, and therefore best adapted to the low yield of semi-natural pastures[38,23]. For example, the medium-sized beef cattle breeds Hereford and Aberdeen Angus as well as local cattle breeds are more suitable for semi-natural pastures than the big-sized breeds. Also, lighter animals cause less trampling damages to the wet soil of shore meadows. On shore pastures, where the water level may rise considerably during grazing season, there must be enough dry places above the flood-zone for the animals.

Generally, it is forbidden to bring additional forage to shore meadows. An exception to this are the **mineral supplements** in order to guarantee animal welfare. For instance it is possible to get a permission to give additional forage to beef calves in low-productive pastures with the reasoning that a multiple amount of phosphorus and nitrogen is removed from the meadow bound to the growth of calves, compared with the load coming from additional forage[80,42].

Furthermore, mineral supplements, additional forage for the calves, and the drinking point have to be located in a part of the pasture where the soil stands well the trampling of animals (fresh/dryish ground, generally as far from the waterfront as possible), and from which there is as little runoff to water systems as possible. The quality of the mineral supplements/additional forage and their delivery must be carried out in a way that the nutrient losses will be minimized[80,83]. The feeding place should be located in a place in which there are no valuable meadow species, which would suffer from erosion. It is recommendable to move the feeding place to another location if the vegetation on the ground does not stand prolonged trampling.

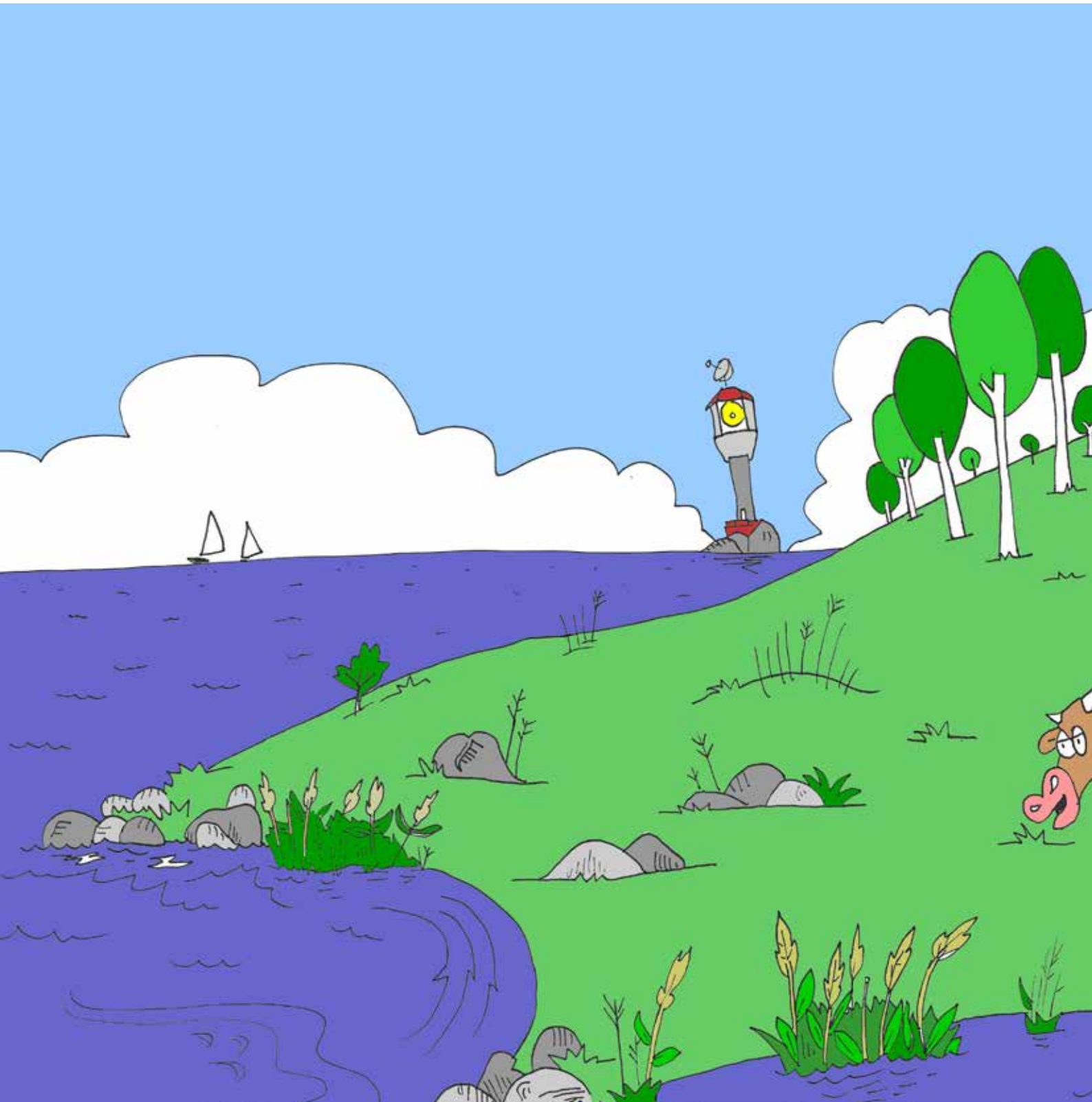
Another important point to note is that grazing on shore should not be allowed to cause any hygiene risks for beaches. If there is a beach near the pasture, the pasture should be fenced, if necessary, above the waterfront, and the supply of drinking water to the animals must be arranged elsewhere to prevent hygiene risks[83].

Photo: Kimmo Härjämäki

Seashores

The practice of grazing on hydrolittoral benefits many species which require open space. An important point to remember when establishing a pasture onto a seashore is that particularly on seashores with gently sloping shorelines, the sea water level may rise considerably high because of strong winds. Hence, it is especially important to include dryer upper parts into the pasture when grazing on seashores. At the same time living space for shore and other meadow vegetation is increased, and traditional rural biotypes above the shore will also be managed.

On seashores it is possible and recommendable to create large meadow unities. Geese, among others, graze preferably on open, low-growth shore meadows. Also, nest losses of many water birds and waders are decreased when the birds have an opportunity to nest on meadows above the flood-zone. The amount and variation of open habitats are further increased by buffer zones and wetlands, which are located between the shore area and the field above.

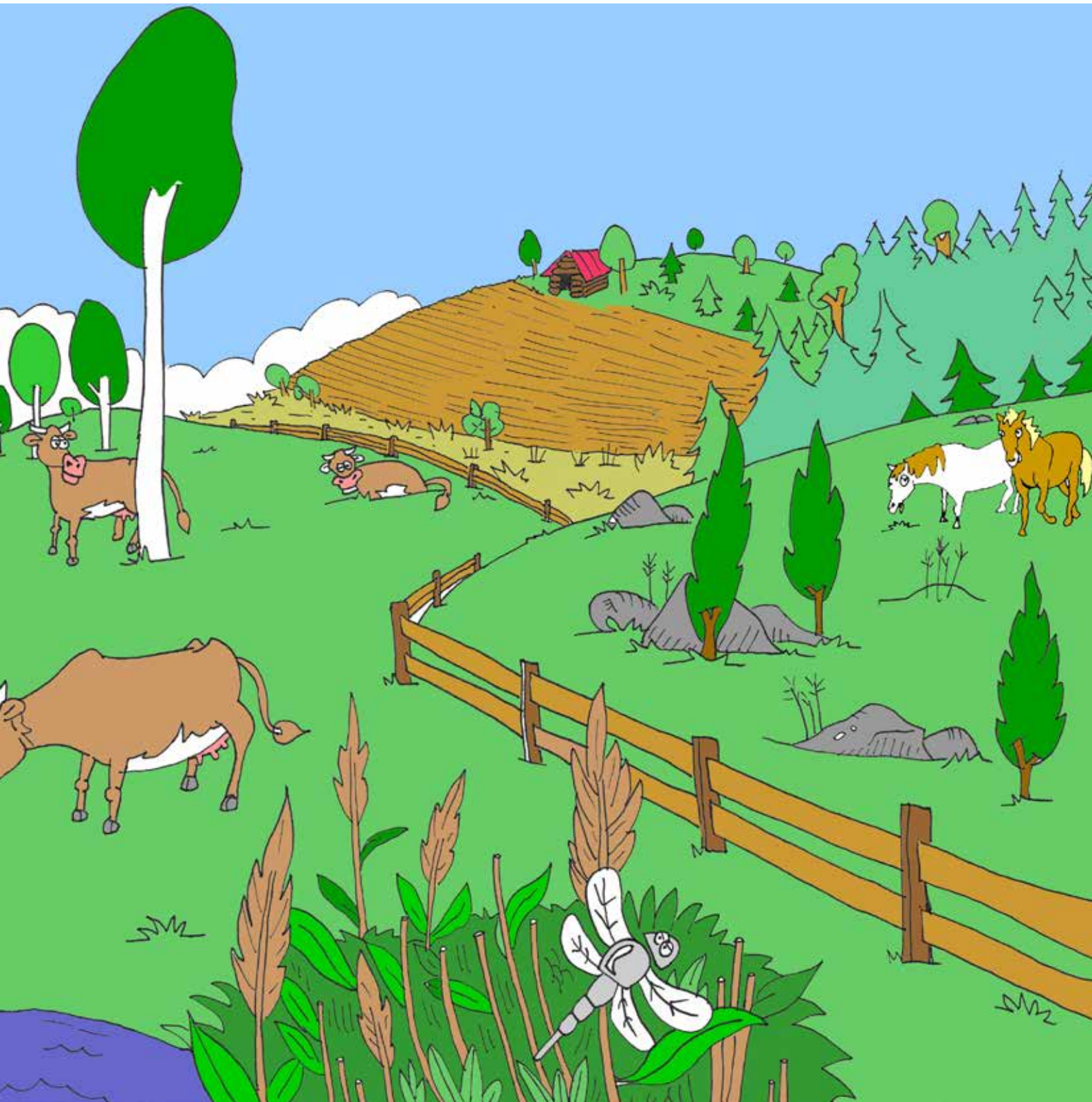


Shore pastures by inland waters

Shore pastures by inland waters are typically located in the immediate vicinity of cultivated fields and leys. Small inland waters are sensitive to eutrophication, which means that the grazing must be planned and carried out carefully in order to prevent damages to water systems.

Buffer zones in the fields that are especially sensitive to erosion and flooding should be managed primarily by mowing. Grazing on buffer zones should be avoided. However, if grazing is considerably easier to be carried out than mowing, and if it has considerable benefits for the biota of the area, the principles of water protection can be compromised over to some extent.

It is recommendable to graze buffer zones and wetlands together with other pasture areas, for example traditional rural biotopes, if there are such areas nearby. In this way it is possible to create diverse entities of open habitats.



Environmental benefits of sustainable grazing on shore

Significance for diversity

The traditional practise of grazing and mowing of shores increased significantly the area of open shore meadows. Many organisms have benefited from this. It has been found that as much as 75 % of plant species growing mainly on the shores of the Baltic Sea have benefited from cattle grazing[53,55]. Open, low-growth shore meadows are an important habitat also for many bird species[1,3] and insects[61]. Grazing on the hydrolittoral, too, has positive effects on many species. As the openness of water area increases, the living environment for low-growth plant species widens, and the amount of seed and insect forage for water and shore birds increases among other benefits[72,68]. Biological diversity guarantees central ecosystem services, such as plant production and nutrient cycling, especially in changing conditions[33].

After cessation of grazing and mowing, the area of open shore habitats has strongly decreased. In Finland, all types of shore meadows (both by inland waters and on seashores) are nowadays classified as endangered habitat types[68]. The decline of open shore meadows has also lead to decreased biodiversity and many species have become threatened. For example, one third (96 species) of the 290 threatened species primarily living on the shore habitats in Finland, occur on the meadow and swamp shores of the Baltic Sea and inland waters. The most significant reason for shore species becoming endangered is the overgrowth of open environments[58]. Although grazing on shores has increased in the past years, extending the shore meadow network further is still important in order to guarantee the maintenance of different species and nature habitats.

Significance for landscape

Traditional grazing and mowing practices created diverse, open meadow landscapes bordered by variable wooded semi-natural habitats. An open shore landscape with grazing animals is considered as a beautiful, uplifting sight. These landscapes can be enjoyed by both nearby inhabitants and tourists. An unmanaged alternative is often a reed bed, which blocks the view to the landscape and prevents people from passing through the shore. Well managed shore landscapes increase the attractiveness of the area, benefiting tourism. Landscapes formed by shore grazing are also an important part of our cultural history.

A shore pasture on Mietoistenlahti bay on the southwest coast of Finland (Mynämäki) in the 1930s. Photo: Risto Raimoranta

The changing usage of natural meadows

Traditionally natural meadows were an important source of subsistence, and they were utilized as thoroughly as possible in order to get forage for domestic livestock for the winter. Meadows flourished and landscapes were open. The fields were reserved for food production, especially for growing grain. Many shore meadows were productive hay lands, which were mown from July onwards, and the animals were not let to graze on them until the end of summer. The only source of nourishment for the grazing domestic livestock was the crop of the meadows. Livestock represented local breeds adjusted to scarce conditions. The most important task of cattle was to produce faeces as additional nutrient to the fields; the production of milk and meat was only secondary until the end of the 19th century[77]. The direction of nutrient flow was clearly from the meadows to the fields.

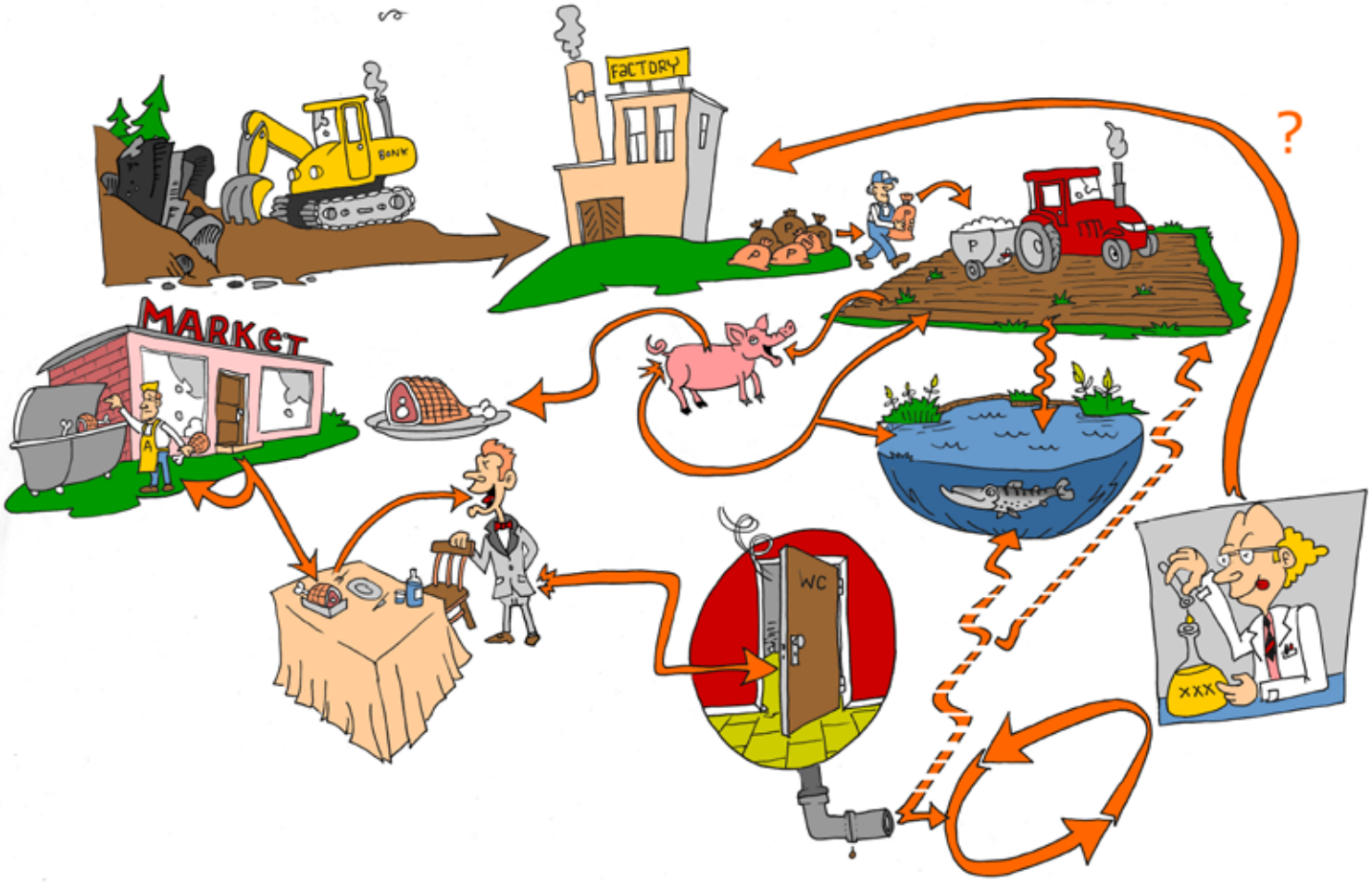
One of the most central objectives in the management of semi-natural meadows by grazing and mowing, is nowadays to maintain biodiversity while the winter forage for the animals is collected from artificially fertilized, cultivated fields. Although more and more shore meadows have begun to be managed again in the past few years, shore landscapes are still mostly unmanaged and overgrown. There is almost no mowing at all and most of the existing shore meadows are managed by grazing through the summer beginning typically in early June. Therefore, the management actions nowadays begin much earlier compared to traditionally mown meadows where hay-cutting was typically started at the beginning of July. In areas where there is a need to secure the nesting of shore birds, the beginning of the grazing season could be delayed until the end of June. The animals are taken away from the pasture usually in August-September.

Recreational use

Grazing creates openness to vegetation and, thus, variation to unmanaged shore landscapes, which increases possibilities of recreational use of the area. Variable landscape and its diverse species provide enjoyment for different user groups of the area, e.g. birdwatchers and hunters. Besides increasing general biodiversity, grazing also improves the living conditions of several game species. For example, increased openness of vegetation improves the nesting and foraging conditions for many water bird species[1]. Especially grazing by cattle decreases the amount of vegetation and increases the plant diversity of the hydrolittoral[54]. These changes in vegetation may on the one hand decrease the amount of cyprinids, and on the other hand improve the reproduction success for some fish species, such as perch[19].

Some recreational users think that grazing practises have a negative influence on shores by restricting access through fencing or by grazing animals. Grazing changes the character of the area. If the pasture is located near a popular beach, the entry of faecal bacteria (e.g. EHEC) to water may cause health risks. It is important to take into account the views of variable user groups and to prevent possible health risks when planning the location of the pasture.

Current landscape is much more closed up compared to the situation in the beginning of 20th century. Goats and eastern Finncattle in Halikonlahti. Photo: Eija Hagelberg



About 80 % of the mined phosphorus is lost in different stages of refining, production and delivery before the food reaches the consumer. A major part of the mined phosphorus ends up as a fertilizer in the fields, where, in addition to livestock farming, also the biggest losses of phosphorus occur, mainly as nutrient leaching to water systems. Decreasing the use of phosphorus as well as developing its recovery and recycling methods is necessary in order to secure the availability of limited phosphorus reserves for the growing needs of food production[8].

Significance for water and air protection

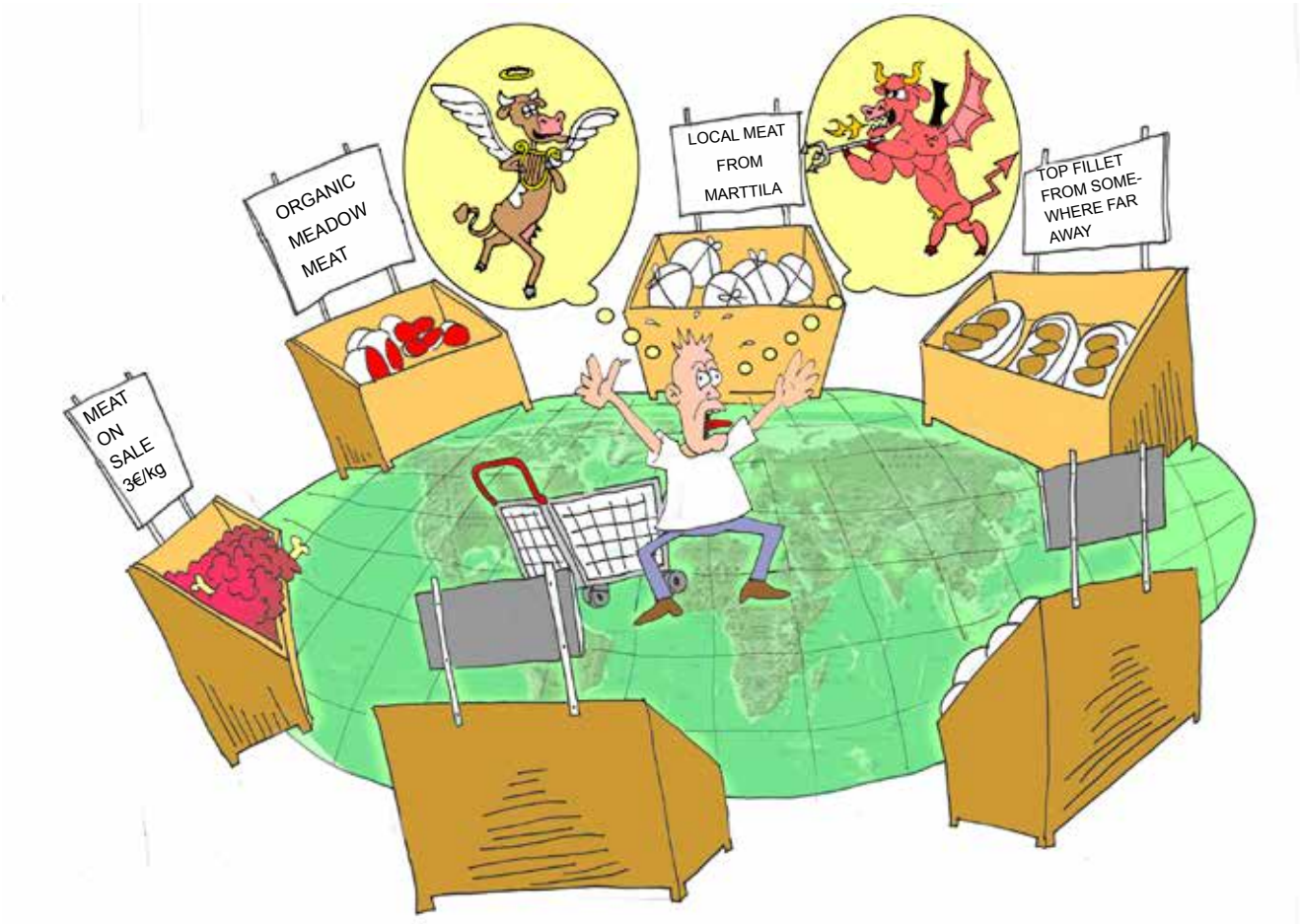
When carried out correctly grazing removes nutrients from the shore which increases the species diversity of the shore meadow and improves the quality of adjacent water system. However, when carried out improperly the impacts of grazing can be quite the opposite, weakening the condition of the environment.

The significance of grazing from the point of view of air protection is a complex subject, which is closely linked to the nutrient economy of the shore ecosystem. The decline of common reed and other helophytes as a result of grazing may decrease the accumulation and release of methane from the underlying sediment substrate, and thus decrease the greenhouse gas emissions of the shore area. On the other hand, it has been found out that grazing increases the methane emissions of the meadow. This may be the result of the disturbed methane oxidation of micro-organisms as a response to trampling[43]. Methane is also produced in the rumens of ruminants by microbes. However, cattle produces methane emissions anyway, whether it grazes on a ley pasture or on a shore meadow. Regarding nitrous oxide, which is also an important greenhouse gas, grazing was not found to have a significant effect on the emission levels[43].

Ecological food and well-being

Food produced by grazing animals on shore pastures and other traditional rural biotopes is more environmentally friendly than food produced by animals raised in conventional, intensive, animal husbandry. In comparison of material input of different foodstuffs, the meat of dairy breed cattle raised in conventional animal husbandry proved to be the most environment-consuming food. For example, the production of pork and broiler meat consumes 2–4 times less natural resources, despite the fact that a considerable amount of forage used in their production consists of soya produced abroad[27]. These calculations did not, however, take into account all environmental effects of the end products[27]. For example, the destruction of original natural environment in South America is caused by the soya farming[62]. In this sense the production of cattle or lamb meat based on almost 100 % domestic forages[60] is more environmentally friendly alternative.

In field production phosphorus, among others, is needed as a fertilizer. The non-renewable phosphorus reserves in bed-rock will exhaust globally in 50–100 years, unless its use is limited and its recycling is considerably improved. Nowadays a high amount of phosphorus is lost in different stages of production, so that of the phosphorus



A consumer is surrounded by challenging choices.

that is mined for fertilizing purposes, only about 20 % ends up on a dinner plate[8].

The environmental-friendly qualities of foodstuffs can be increased by grazing on shore meadows and other traditional rural biotopes. The forage of animals grazing on semi-natural pastures consists of natural vegetation for which no fertilizers of other natural resources have been wasted. However, the forage yield of semi-natural pastures is lower than in cultivated lay pastures[42]. Therefore, it is important to take into account the sufficient nutrient supply of the livestock when planning the length of grazing season, animal density, and deciding the type of grazing animals.

In spite of the scarce crop, the vegetation of shore pastures provides benefits from the point of view of livestock's welfare and production. Grazing animals are healthier than animals raised indoors, and are able to engage in their natural grazing behavior[6,44]. Furthermore, beef cows, which are much used in the management of traditional rural biotopes, have a chance to species-specific behavior via the maintenance of cow-calf relationship. Meat and milk of animals grown in semi-natural pastures has been found to be healthier in quality, containing, for example, more vitamin E and polyunsaturated fatty acids like omega-3 than that of animals, which have been grazing on ley pastures or fed indoors[7,81]. Beneficial properties related to production methods, environmental effects and the quality of products give additional value to the products. This can be utilized, for example, in marketing the meat of animals under the name "meat from meadows"[12].

Eutrophication – nutrients from the earth, sea and air

Good nutrient, bad nutrient

Increased volumes of residential settlement, industry as well as agriculture and forestry have caused that a multiple amount of nutrients is released to the air and water systems than a century ago. The eutrophication of water systems has also been accelerated by the cleanings of small water systems and wetlands, and by the drainage of fields, forests and fens resulting in intensified flows of nutrients entering the lakes and the sea. Especially the main plant nutrients, phosphorus (P) and nitrogen (N) are problematic for water systems causing for example growth of algae to a harmful level. In fresh waters (inland waters, river deltas on the coast, the Bay of Bothnia) algal growth is usually limited by phosphorus and in seawater by nitrogen[29].

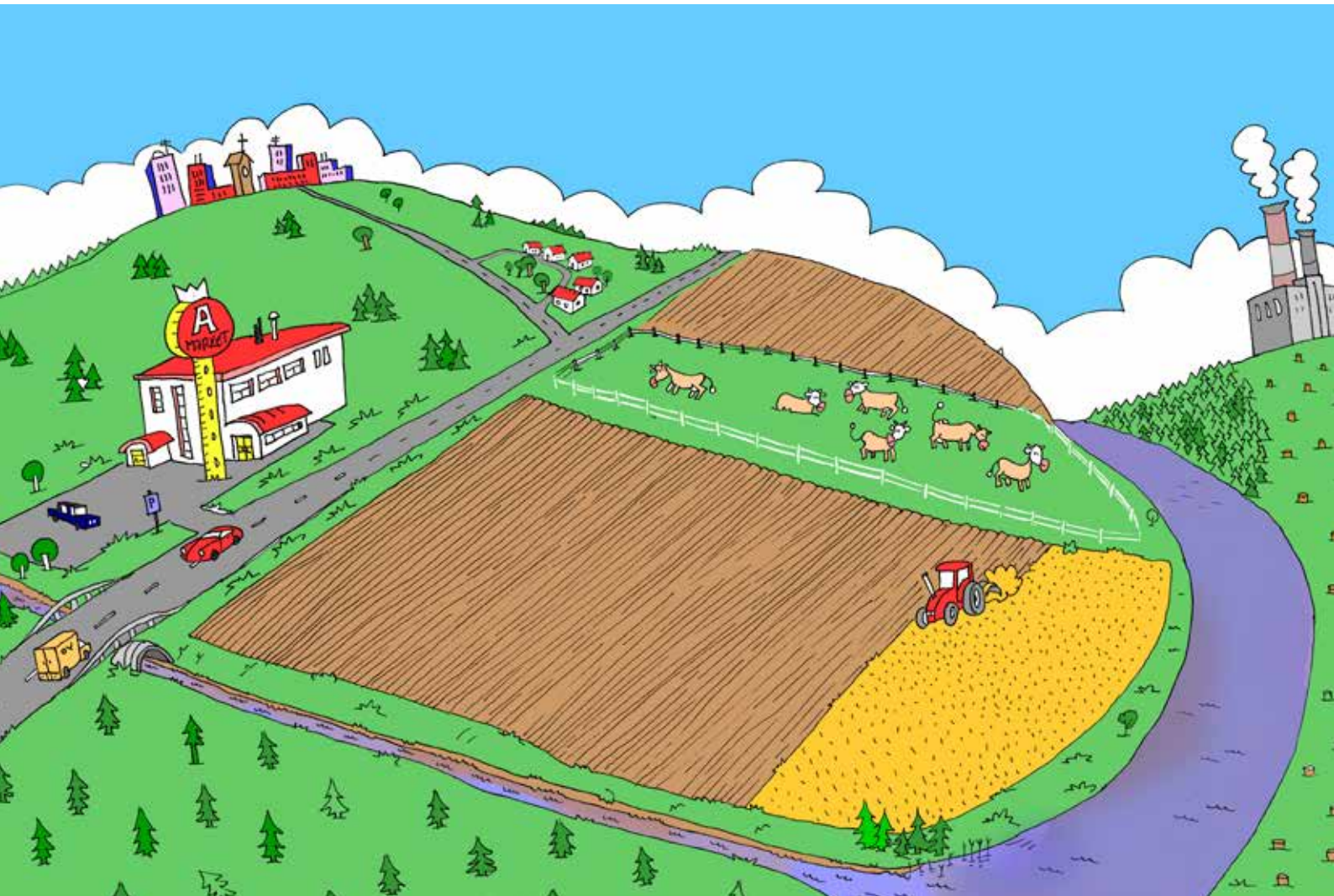
The excessive accumulation of nutrients causes many changes in water systems. When the production of algae and water plants increases, water systems begin to overgrow, harmful algal blooms get common, and the water becomes cloudy. The accumulation of biomass increases decomposition which causes oxygen depletion in profundals. As a result of eutrophication there will also be changes in flora and fauna: for example cyprinids get common while fish species requiring clean, oxygen-rich water decrease.[25]

It has been estimated that as a result of human activities the nutrient load of the Baltic Sea has increased eightfold in phosphorus and fourfold in nitrogen compared

Landscape of a countryside about a century ago (picture on left) and at present time (picture on right). In the course of time, cultivated fields have replaced semi-natural meadows, the amount of settlements, industry and fellings have increased and small water systems with their wetlands have been cleared. All these changes have increased the nutrient load of water systems.

with pre-industrial time[28]. Set against other studied sea areas, the eutrophication of the Baltic Sea is on an average level[17]. However, due to its brackish-water nature, the Baltic Sea can poorly resist eutrophication, because the low-salt, more oxygen-rich surface water and the salty bottom water do not mix properly with each other, which accelerates the development of oxygen depletion in water layers near the bottom[49].

Most of the nutrient load caused by human activities comes from settlements (phosphorus) and agriculture (nitrogen) ending up through water systems to the Baltic Sea and its catchment area[15]. However, the significance of different emission sources differs from country to country. In Finland, for example, the share of agriculture in the phosphorus load ending up to the Baltic Sea as a result of human activities is 60 %, and in the case of nitrogen load 52 %[76]. In Estonia, on the other hand, the proportion of agriculture in the phosphorus load (inland waters) was estimated to be significantly lower, 33 %, and in the case of nitrogen load somewhat higher, 60 %[31]. At least one fourth of the whole nitrogen load of the Baltic Sea comes through air as fallout; the most important source is boat traffic but also other traffic, agriculture and industry are significant sources of nitrogen in the atmosphere[15].



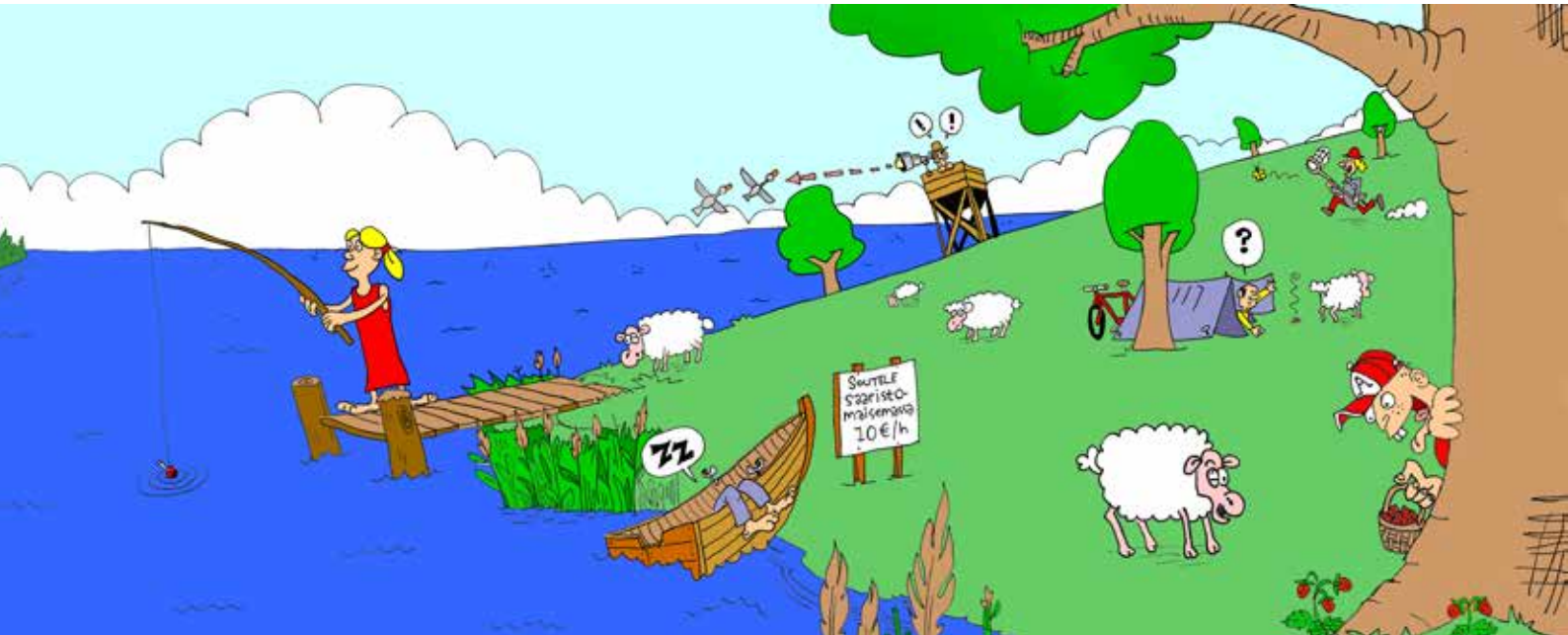
The impacts of eutrophication to the vegetation of the coastal meadows

The excessive accumulation of nutrients is harmful also for meadow vegetation, which is usually most diverse in relatively nutrient-poor conditions[9]. In eutrophic conditions many tall-growth species increase and low-growth species, which are weaker in competition, decrease. This will reduce plant species richness. Especially the accumulation of nitrogen and phosphorus has been found to lower the species richness of meadow vegetation[10,70]. The nutrient load in shore meadows has been increased by the growing amount of nutrients coming from the air and water as well as through the eutrophicative grazing practices.

Due to increased nutrient load traditional rural biotopes are more susceptible to eutrophication and overgrowth than previously. Natural disturbance (variations in water level, ice scouring), which have kept shore meadows open, are not enough anymore to maintain the species typical of low-growth meadows. In eutrophicated conditions, the role of management is increasingly important, and more efficient management practices are needed in order to keep meadows open[53].

Intensification of management is needed in shore meadows in the future also in order to diminish the negative effects of climate change. The rise of sea level is predicted to counteract the effect of land uplift. As a result, emergence of virgin soil above the waterline will be reduced. Thus, less competition-free space will be available for low-growth plant species between the waterline and taller vegetation upper in the shore. Consequently, efficient management also in the upper parts of the shore is increasingly important in order to maintain open meadow area.[59]

A well managed, species-rich shore meadow provides many kinds of recreational possibilities.



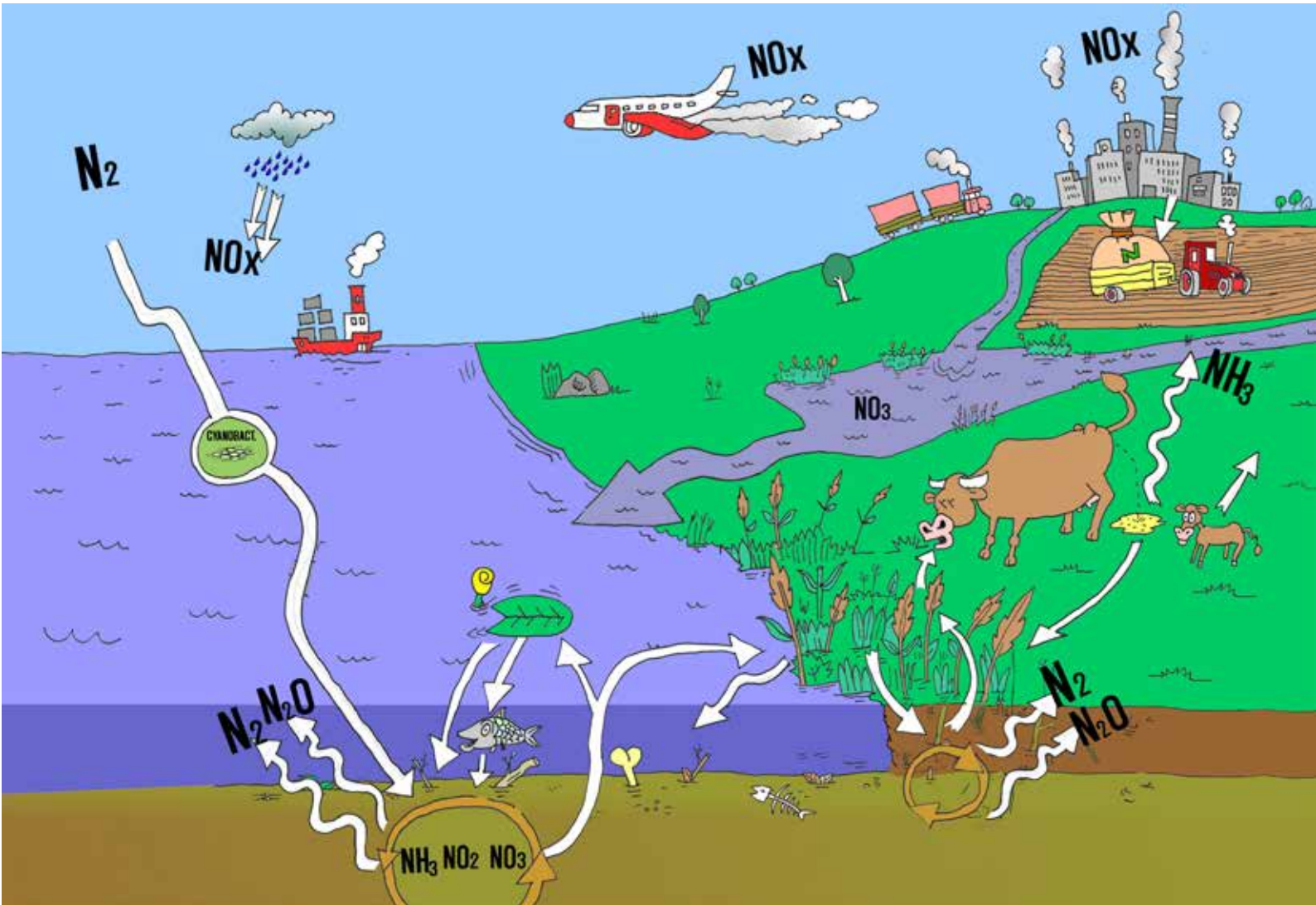
Nutrient flows in shore meadows

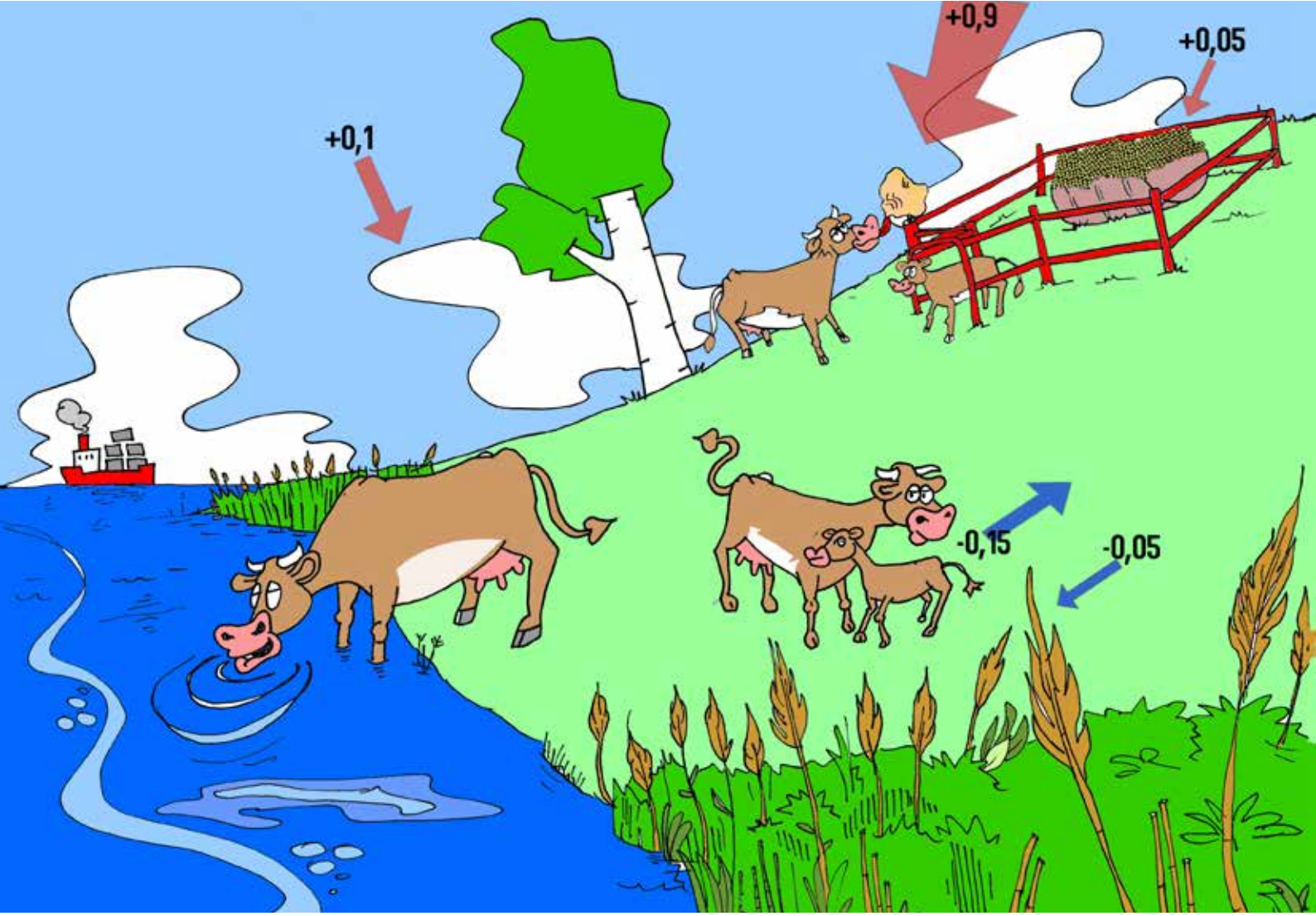
The cycle of nutrients

The biogeochemical cycles of phosphorus and nitrogen in the ecosystem differ considerably from each other. Most of the phosphorus in the soil is bound to solid particles. Phosphorus cycles mainly through water bound to organic matter (for example particles of dead plants) and inorganic soil particles[2]. In the runoff waters of grass fields a considerable amount of phosphorus can also be in soluble form[73,74]. Compared to phosphorus, nitrogen is a more movable nutrient and is present in the environment also in soluble and gaseous form. Different microorganisms have an important role in transforming nitrogen from one form to another.

Grazing has various effects on the nutrient cycle in a meadow. A majority of nitrogen and phosphorus foraged by the livestock is released back to the meadow as urine and faeces, the rest is bound to the growth of the grazing animals[4,24,65]. In excreta nutrients have degraded into a more usable form and are thus more quickly recyclable for the use of plants. Under grazing, continuously regrowing vegetation can efficiently bind nutrients running off from fields above. For example, the contents of nitrate (NO_3) have been found to be lower in the runoff waters of grazed than of ungrazed meadows[22]. Part of nitrogen in urine and faeces exits the nutrient cycle of the meadow by leaching or evaporating[4,65].

Nitrogen cycle is affected by several factors. In water systems blue-green algae fix nitrogen from the atmosphere, in the soil nitrogen fixation is performed by nitrogen-fixing bacteria e.g. in the root nodules of legumes (not shown in the picture). In the soil nitrogen accumulated to organic matter is decomposed by microorganisms into a form usable for plants, first into ammonia (NH_3) and further by oxygenating it into nitrites (NO_2) and nitrates (NO_3; nitrification). Part of microorganisms remove nitrogen accumulated in water systems and soil back into atmosphere in the denitrification process as nitrogen gas (N_2) and as nitrous oxide (N_2O). Nitrogen exits pasture also as bound to the growth of grazing animals and via leaching and evaporation from excreta (NH_3). The biggest nitrogen load to the Baltic Sea and its catchment area comes from agriculture (e.g. NO_3), settlements and traffic (e.g. nitrogen oxides, NOx). [74,69,65,15,30,48]





A simplified model of the nutrient flows of phosphorus (P) (kg/ha/year) in a seashore meadow, which is grazed by beef cattle. In the Gulf of Bothnia the phosphorus was estimated to enter the meadow as atmospheric fallout and possibly through mineral supplements and additional feeding of calves (red arrows); in practice, minerals are rarely given to animals in seashore pastures. Phosphorus was estimated to exit the meadow bound to the growth of calves and by leaching (blue arrows).[42]

As a result of trampling by grazing animals the soil becomes more compact, its water permeability is reduced and its oxygen content decreases, i.e. the conditions become unfavourable for some decomposers[57,56,45]. If conditions that slow down the nutrient cycle prevail, nitrogen-containing organic matter and nitrogen compounds can accumulate in the soil to such an extent, that the ability of the coastal zone to act as a buffer against the nutrient load from the upper land may weaken[45]. Erosion of vegetation and soil as a result of high grazing pressure may lead to leaching of nutrients and soil particles to water systems. The moister the soil is and the less protective vegetation it has, the more easily trampling damages will occur. This is why for example a buffer zone with a newly established grass cover is not very suitable for grazing; when the buffer zone gets older it will be more resistant to grazing, because in the course of time a layer of organic matter is formed on the ground protecting the soil from trampling damages[63].

Through grazed vegetation, nutrients are bound to the growth of animals and thus exit the meadow. For example, in a study carried out in Switzerland, a cow-calf pair of Highland cattle (beef cattle breed) was found to remove in average 26.2 g phosphorus daily via forage from a mountain meadow and to return in average 22.3 g phosphorus back to the meadow via manure; the rest was mainly bound to the growth of calves[24]. Picture above shows the average nutrient flows of phosphorus in the Gulf of Bothnia seashore meadow grazed by beef cattle. The proportion of the possible additional feeding of calves was taken into account in the calculations of phosphorus budget. Additional feeding may be necessary at the end of grazing season in order to secure the welfare and growth of the calves. It does not cause a significant nutrient load, because a three-fold amount of phosphorus and nitrogen is removed from the meadow bound to the growth of calves, compared with the load coming from additional forage[40,42,80].

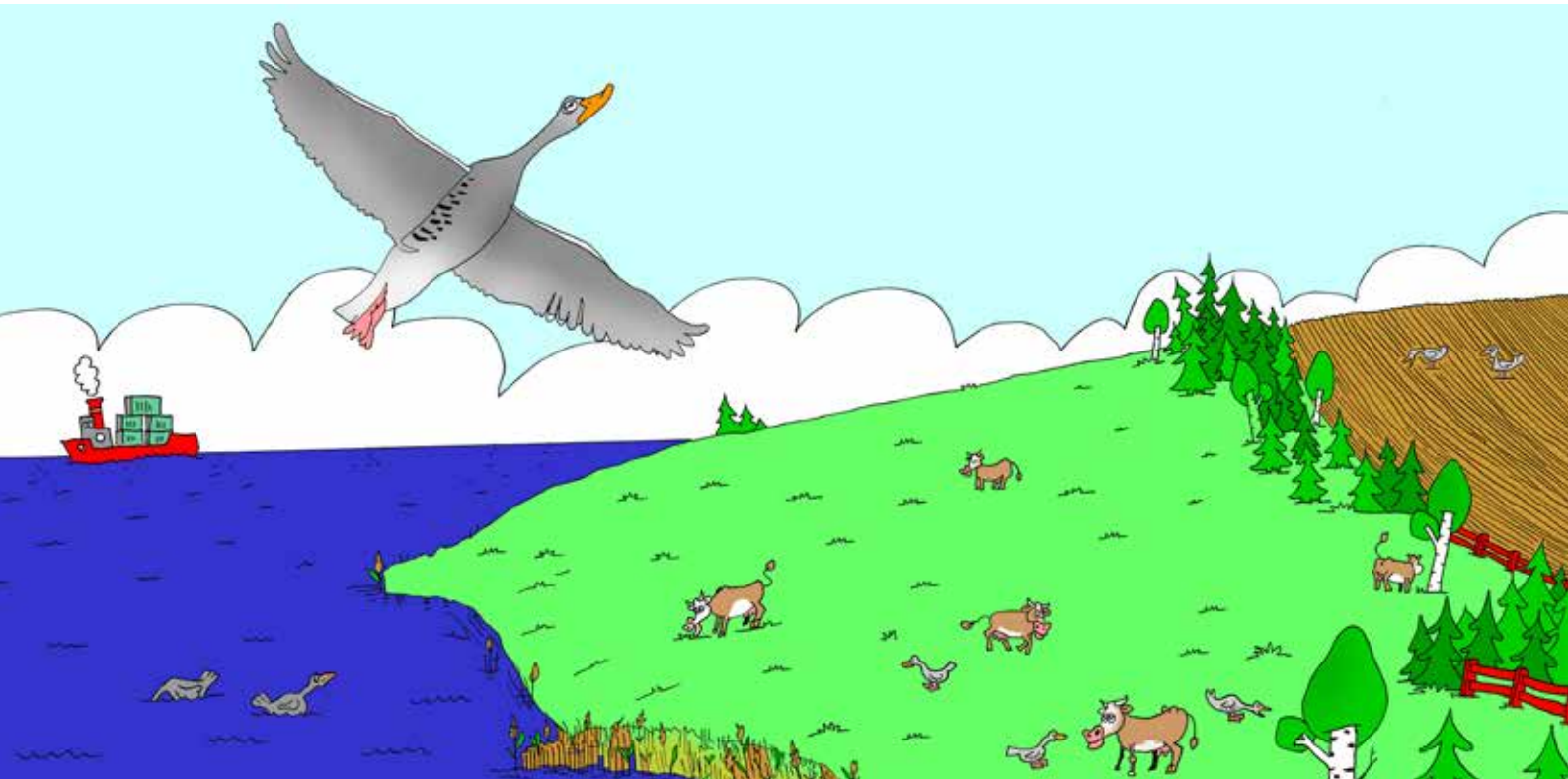
The biggest potential source of phosphorus load in traditional rural biotopes is the feeding of animals with mineral supplements[80,42]. However, in practice minerals are not given to animals in seashore pastures, because the cattle receive salts naturally from vegetation and sea water. Instead, in the shores of inland waters mineral supplement is often necessary; in this case the supplements have to be served far enough from the water line in order to minimize nutrient losses to the soil. When carried out corretly grazing does not cause nutrients enrichment, which would eutrophicate the meadow or adjacent water systems.

Grazing geese

Of the natural grazers of the Baltic Sea shore meadows geese can move in the flocks of hundreds, even thousands of individuals when gathering to moulting areas. Like grazing domestic livestock, also geese can accelerate the nutrition cycling in a meadow. After moulting period at the end of July greylag geese may graze in big flocks in the arable fields and thereafter rest on the adjacent shore. This can cause significant crop losses for farmers and considerable amounts of nutrients can be transferred to shore areas. However, negative effects of geese occur only on a very small scale and the grazing by geese has also many positive effects on the nature of shores.[11,51,36,41]

Geese prefer to forage in shore meadows grazed by cattle. An open shore meadow is a safe foraging place for geese. In addition, low-growth vegetation developed as a result of cattle grazing provides high-quality forage for geese[11,32]. If there is enough suitable shore meadows available for geese the utilization of arable fields, and thus also crop losses, remain smaller. It is possible in Finland to apply for compensation through Centres for Economic Development, Transport and the Environment for crop damages caused by some protected goose breeds, but greylag goose is not one of them. Therefore, it is recommended to prevent damages in important gathering areas of geese, for example, by the management of shore meadows or by establishing game fields to fields near the shore[36]. It is possible to apply for agri-environmental support for these activities.

Geese prefer to forage in shore meadows grazed by cattle. If suitable shore meadows are not available, geese may cause significant crop losses by grazing in fields near the shore.



Nutrients on an unmanaged shore

Plenty of nutrients are bound to shore vegetation with the amount of nutrients depending on the biomass and quality of the vegetation (Table). Common reed, for instance, can produce a dry matter crop of 10 000 kg in nutrient-rich shore areas[14]. When vegetation dies and is decomposed, part of the nutrients are released and exposed to leaching. Due to alteration of frost and melt periods a considerable amount of nutrients are dissolved from the decomposing vegetation to surface runoff water, for example soluble phosphorus[74,75]. Significant losses of phosphorus and nitrogen have been discovered after the first frosts in the vegetation of buffer zones managed in different ways[64]. It is obligatory to remove plant biomass either by mowing or grazing from buffer zones, which are maintained as agricultural water protection measures; one aim of the regular removal of vegetation is to decrease nutrients from the shore area.

From the point of view of water protection grazing is less suitable for the management of buffer zones than mowing, because the possible weakening of soil structure caused by trampling may increase the risk of surface runoff and erosion. However, a grazed buffer zone is a better alternative than no buffer zone at all, if mowing as management is difficult to be carried out[57].

More information on the significance and the use of reed beds can be found from the following web pages:

www.ruoko.fi
ruoko1.vuodatus.net
www.pilliroog.ee

*Common reed (*Phragmites australis*). Photo: Terhi Ajosenpää*

The amount of dry matter and nutrients in different types of shore vegetation.*)

Vegetation type	biomass kg / ha	nitrogen kg / ha	phosphorus kg / ha
reed bed vegetation, summer[14]	10 000	90	9,0
seashore meadow, grazed, end of June[41]	1 700	32	4,1
seashore meadow, grazed, end of July[41]	2 590	37	3,9
buffer zone, unmanaged (14 years), August[63+]	6 000	65	8,7
buffer zone, grazed (14 years), August[63++]	2 130	28	3,1
grass, 1. yield, end of June[39+++]	5 400	130	18

*) The numbers in the table are partly approximate, because part of the variables has been estimated on the basis of diagrams in the source articles.
Wild grasses (slimstem reedgrass, common reed, creeping bentgrass) and sedges as dominant species, vegetation of the sample quadrats has been ungrazed until the collection of the samples in a study year[41];
Wild grasses (e.g. colonial bent grass) and herbaceous plants (e.g. meadow pea, common dandelion) as well as sparsely low-growing bushes and trees (e.g. alpine currant, European cranberry bush, rowan, birch) as dominant species in the unmanaged buffer zone[62+].
Cultivated grasses (timothy, meadow fescue) in the grazed buffer zone, vegetation of the sample quadrats of the grazed buffer zone has been grazed through the summer.[63++]
Grass biomass according to Valio Oy´s harvest time statistics during 2003–2005 in Finland (Lapland not included), the amounts of nitrogen and phosphorus have been calculated according to the reference[+++].

The ambiguous common reed

Common reed, which builds up wide, tall-growth stands, is in many ways a significant plant for shore nature. Common reed colonizes easily unmanaged, nutrient-rich shores and thus replaces most meadow species. In this sense common reed is a species indicating harmful environmental changes. One central aim in the restoration of meadows is to decrease the amount of common reed. On the other hand, reed beds with their characteristic biota are a natural part of wetland nature. In the planning the management of coastal nature it is necessary to take into account that enough reed beds will be preserved.[21]

Common reed binds nutrients efficiently and removes pollutants in stream and river deltas. The removal of nutrients requires, however, removing the reed vegetation by mowing or grazing. Otherwise nutrients are released back to the water system when the vegetation decomposes. Especially young common reed is rich in nutrients and the grazers eat it willingly. The harvested vegetation can be used as a raw material for bioenergy, building material and fertilizer in fields.[37,14,13,34]

Reed beds can cause considerable methane emissions, because the shoots pump efficiently methane from soil to atmosphere. Methane (CH_4) is one of the important greenhouse gases that contribute to global warming. It is generated by microbes in anaerobic conditions, for example, in nutrition-rich wetlands where abundant vegetation provides plenty of decomposable material for the soil microbial community. In a long term (>60 years), reed beds can function as a net sink of greenhouse gases, because common reed produces plenty of biomass and thus binds a lot of carbon dioxide (CO_2), which is also a significant greenhouse gas. However, there are still relatively scarcely studies on greenhouse gas emissions of wetlands situated along water systems.[5,26,30,66]

Reed bed provides shelter, nesting places and nourishment for many species.

The planning of grazing in shore areas

A careful planning of shore grazing helps to achieve a sustainable management result and to obtain possible support payments to carry it out. Depending on the type of the shore area, a special agri-environmental support for the management of either traditional rural biotopes, wetlands, buffer zones or landscape diversity can be applied for the establishment and management of a pasture. Support for non-productive investment can be applied for the establishment costs (traditional rural biotopes, wetlands) (see more information on *www.mavi.fi*). Usually the applicant is the owner of the grazing animals, who has to be committed to the conditions of the agri-environmental support system in order to obtain support. Nowadays also registered associations can apply for support (excluding the management of buffer zones).

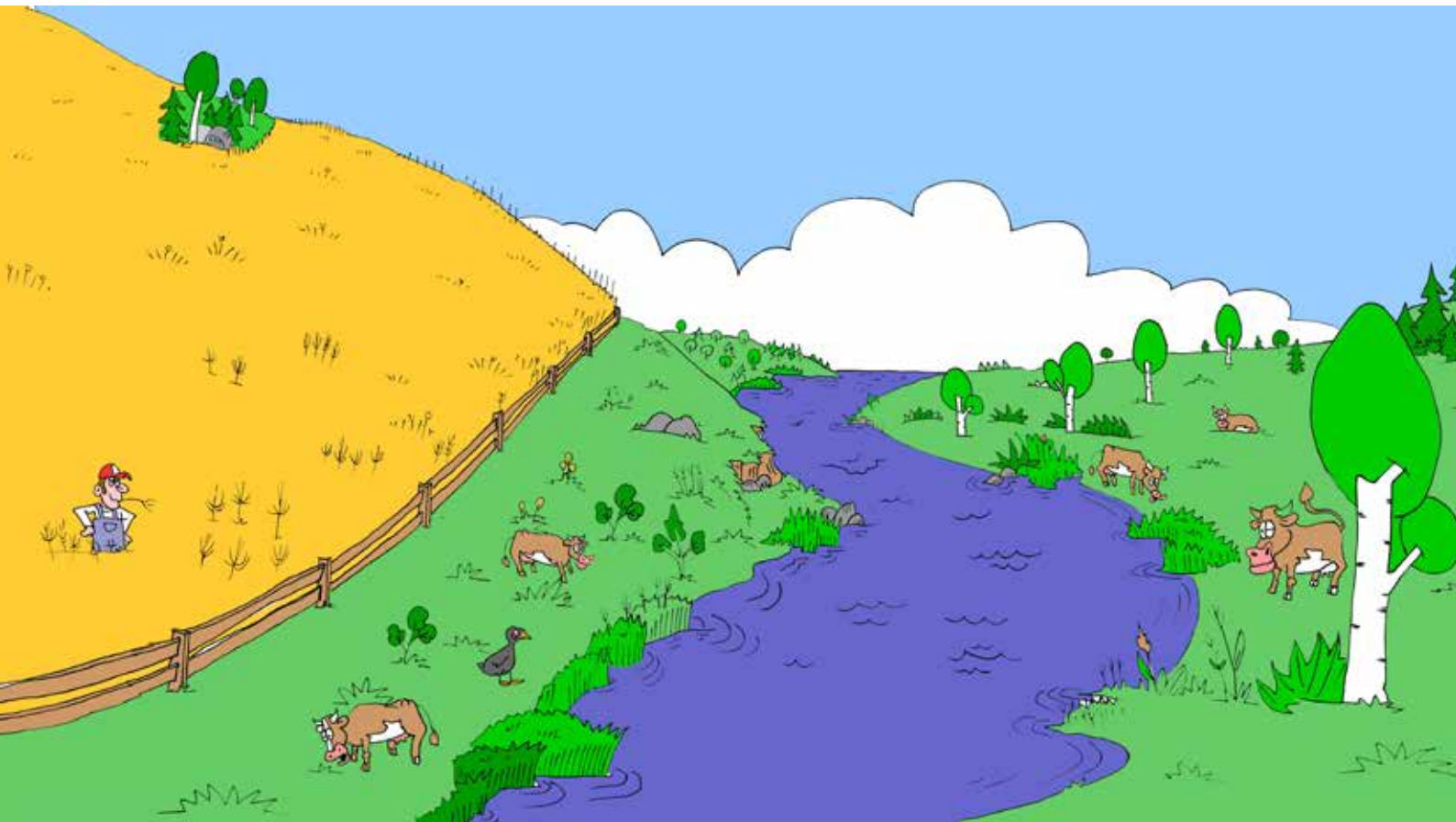
It is possible to obtain general information on making the application and the management plan from the authorities of CEDTEs and municipal agriculture offices. Advice on making the actual plan is given by municipal support advisers. If the area, which is planned to be grazed, is not owned by the applicant of the support, its use and renting possibilities must be clarified from the landowner before the application is left.

Information (in Finnish) for associations on the planning and carrying out the management of traditional rural biotopes as well as on the applying for support is found for example on page *www.kotiniitty.net* maintained by Association for Traditional Rural Landscape in the Southwest Finland. Important matters to be clarified are for example rental agreements of the area, persons in charge, insurances of volunteers, and how grazing will be organized.

During the application and processing stage of the support procedure neither the applicant nor the authorities are obliged to hear the inhabitants of the area nor ask for statements from associations. However, if needed CEDTE officials will ask expert statements about the applications in order to better take into account the nature or water protection. Authorities have thus the possibility to influence the grazing plans mainly in the stage when support is applied for the management of the area. If the grazing of the shore area causes or is suspected to cause any harm later, it is recommended to contact the party carrying out the management and/or the local CEDTE.

It is recommendable to inform of the grazing plans and to hear the inhabitants of the area already in the planning stage. In this way management by grazing can be carried out in a good spirit taking into account the views of different user groups as far as possible.

Shore pastures by a river. On the steep shore on the left there is a buffer zone below the field and a zone of natural vegetation along the river, which are managed by grazing. On the right-hand shore there is a semi-natural pasture, which is managed as a traditional rural biotope.



When the idea of shore grazing and applying for support has arisen, the application process often proceeds as follows:

1) Finding out the landowner and renting possibilities (if the area is not owned by the applicant).

2) Contacting Centre for Economic Development, Transport and the Environment (CEDTE), municipal agriculture office or support advisers in order to get additional information.

3) Leaving the support application together with a management plan and a budget at CEDTE.

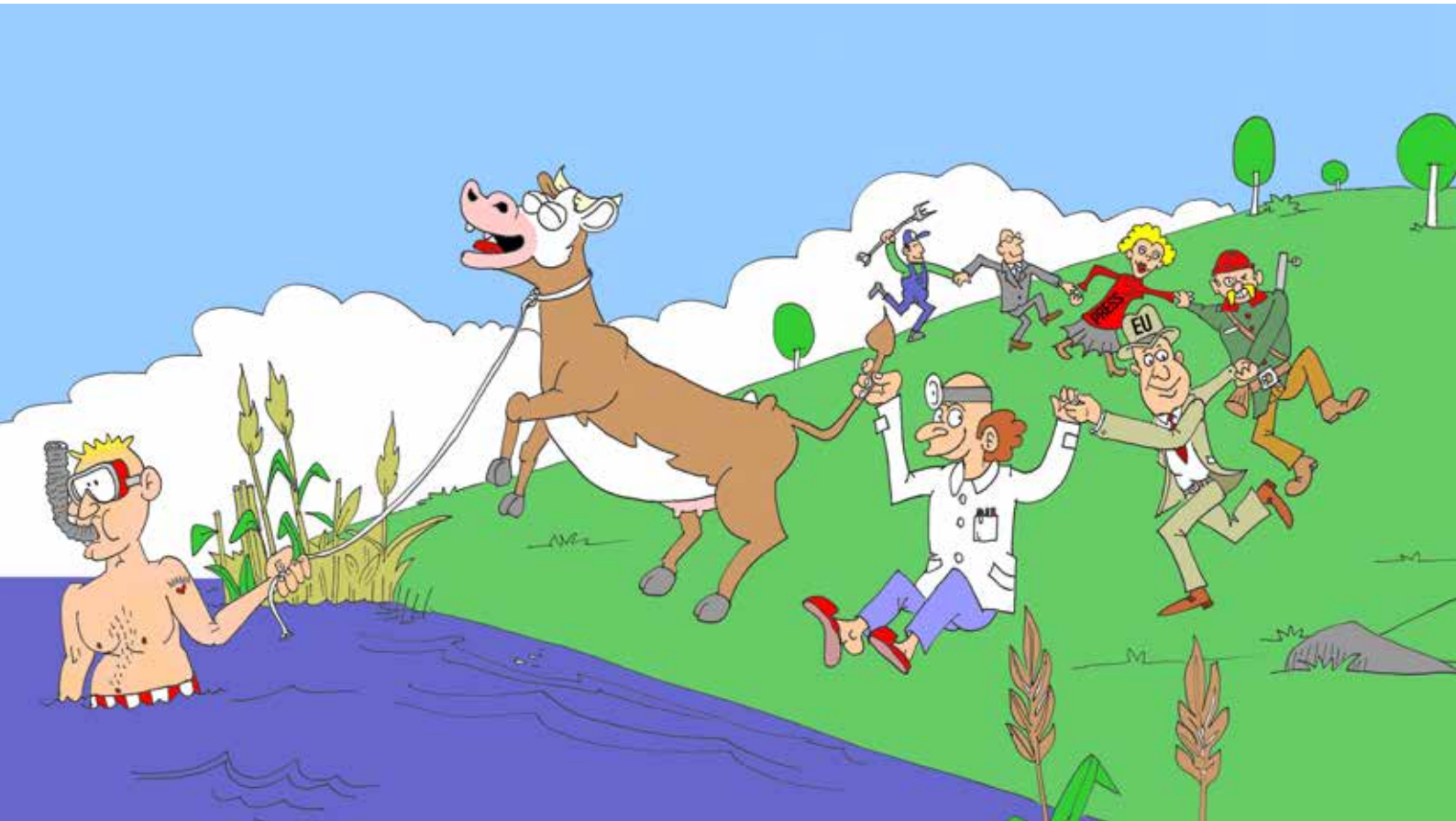
4) CEDTE processes the application and asks, if necessary, an expert of nature or water protection for a statement on whether the grazing plan is appropriate from the point of view of environment protection.

5) CEDTE makes a decision on granting the support and sends a copy of the positive decision to a municipal agriculture office, to an authority responsible for rural economic development.

6) The fences will be built and the grazing can be started.

Photo: Kimmo Härjämäki

In the planning stage of shore grazing it is worthwhile to cooperate and consider the views of different parties; this leads to an end result, which pleases as many parties as possible



Case study: Grazing in Raisionlahti

Raisionlahti bay, located near the city of Raisio, is a part of a national program for the conservation of bird waters. Raisionlahti bay is a significant resting place for migratory birds and a bird nesting area. In the inventory of valuable traditional rural landscapes in the region of Varsinais-Suomi the shore meadows in the west and east shores of Raisionlahti bay were classified as locally valuable because of their vegetation. The city of Raisio owns the area and applied for protection for the area under the Nature Conservation Act. By the decision of provincial government an area of ca. 28 hectares was protected in 1984.

The seashore meadows of Raisionlahti bay have been grazed continuously since 1994, first by cattle and later by sheep. Before this, there was a break of about thirty years in grazing. Reasons for the change from cattle to sheep grazing and the preceding long break in the management were changes in the farmer generations and lack of willing entrepreneurs. Nowadays, the size of the grazed area is 27.8 hectares, and a sheep farm SikkaTalu in Rymättylä acts as a contractor. The sheep farmer Katja Sikka watches over the sheep in cooperation with the local inhabitants and summer shepherds. People training herding dogs act as summer shepherds and visit the area with their dogs about four times a week to prevent vandalism. In addition, the inhabitants of the neighbourhood monitor regularly the welfare of the animals.

The openness and zonation of vegetation in Raisionlahti bay have been tried to restore by sheep grazing. As a result of grazing the vegetation of dry meadows has been able to maintain low-growth and fewer nutrients end up to the shore zone. In the wet shore areas, however, additional mowing and crushing of reed beds are needed, because sheep do not like to graze on the soft sediments of wetlands. After the reeds beds are mown, the cut material is collected and removed to prevent the decomposing reed litter from causing nutrient releases to the eutrophic, shallow and muddy-bottomed Raisionlahti bay. The crushing and harrowing of reed beds commissioned by the city of Raisio aim at intensifying the effect of grazing and reduce the growth of reed bed when needed. In some shore areas of Raisionlahti bay reed beds will, however, be saved; in this way a balance is kept between reed bed birds and bird species living in open meadow areas.

The recreational value of the area is significant for the local inhabitants, because there is a route for light traffic beside the area; in the middle of the meadow, there is a bird-watching tower. The bottom of Raisionlahti bay is circled by a path called Uikkupolku (“grebe path”), and in the so-called Kukonpää area there is a path called Timalipolku (“babbler path”), which has got its name from the bearded reedling, a rare bird species occurring in the area. A large and open pasture entity increases the diversity of both landscape and biota as well as slows down the overgrowth of the bay.

Bordercollies Roti and Taku sheparding sheeps. Photo: Amy Fowler

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ANIMALS TO THE SHORE – YES OR NO?
A Guide to Sustainable Grazing on Shore

For decades the inland and seashore meadows have been overgrown with vegetation due to lack of management. Now, however, management by grazing has gradually begun to revive. Nowadays a central aim of management in the shore meadows is to restore and to maintain traditional landscapes characterized by open meadows as well as biota dependent on them. However, the situation is still challenging. Instead of open meadows, shore landscapes are in many places today dominated by thick reed beds.

It has been estimated that there are only 4 200 hectares of seashore meadows in the whole Finnish coastal area, which is about 10 % of the amount in the 1950s. The situation is similar in Estonia and in Sweden. There are 5 100 hectares of valuable shore meadows in Estonia and 8 000 hectares in Sweden. Many of the shore meadows have been managed with the aid of special support for management of traditional biotopes since 1995. When carried out in the right way, grazing in semi-natural meadows also increases the well-being of the grazing animals.

Elinkeino-, liikenne- ja ympäristökeskus

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