Guidelines for Coastal Meadow Management

Guidance for Estonian Environmental Board land conservation specialists and land managers

Commissioned by Estonian Environmental Board in 2011
Translation into English by Estonian Fund for Nature in 2012

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The aim of the English translation is to give the opportunity to specialists around the Baltic Sea to be aware of Estonian guidelines for site managers. The guidelines in Estonian are more detailed and give lists of sites and species that are particularly important in Estonia. These lists are excluded from English version. The Estonian version of the guidelines is available on the website of Environmental Board: http://www.keskkonnaamet.ee/public/PLK/Lisa_1_Rannaniitude_hoolduskava_2011.pdf. The English vesion of guidelines is available on the website of Estonian Fund for Nature: www.elfond.ee.

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Saving the sea from Nutrient Overload by managing grasslands/Wetlands BALtically

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Introduction

These guidelines have been produced out of a need to describe to the relevant Estonian institutions and persons the types of coastal meadow habitats, provide an overview about the formation and persistence of coastal meadows, establish theoretical grounds for the creation of area based guidelines and provide general advice on optimal management. They are intended for use by Environmental Board's, conservation specialists, nature protection managers, land owners and any other institutions or persons involved in coastal meadow maintenance.

Included are the basics of coastal meadow habitat, their maintenance and a useful list of references and experts so that more detailed questions may be answered. The guidelines offer solutions to several problems that occur in practical management of coastal meadows (*e.g.* an inventory of the most valuable areas, requirements for maintaining and restoring coastal meadows, locality indicators to determine the 'health' of a particular coastal meadow, how to prioritise which areas to restore and other problems as indicated by the research of the Estonian Environmental Board).

Special thanks go to the coastal meadows working group of the LIFE-Nature project and other experts who were of great help in preparing these guidelines: Murel Merivee, Voldemar Rannap, Riinu Rannap, Elle Roosaluste, Hannes Pehlak, Heikki Luhamaa, Marek Sammul, Ilona Lepik, Veiko Maripuu, Annely Reinloo, Eike Lepmets, Georg Artma, Kaie Kattai, Ivar Ojaste, Marju Erit, Kaidi Jakobson, Mati Kose, Kadri Tali, Toomas Kukk, Jaak-Albert Metsoja, Meeli Mesipuu. Herdis Fridolon´s and Kaie Hlusova´s comments also helped to improve this text. The writer gives thanks to all.

The essence of coastal meadows

Coastal meadows form where the coast is flat and are subject to flooding. They consist of a low sward of herbaceous plants and require mowing or grazing to ensure their persistence. Coastal meadows are characterized by halophytes and a rich variety of wild birds.

Coastal meadows are semi-natural communities and their existence tightly connected to human activity. Estonian coastal meadows are primary habitats, forming on areas raised from the sea and preserved due to the actions of herbivores and flooding of the Baltic Sea. Coastal meadows considered in 'good' shape are usually open habitats. If however a particular meadow is small and generally unsuitable for grassland birds and therefore the value generally botanical, then patches of trees or bushes are acceptable.

Coastal meadows and pastures may be distinguished by management type, but in these guidelines are mostly used interchangeably (though they are considered separately in the chapter entitled "Management of coastal meadows").

References about coastal meadows (in Estonian):
Thematic articles in compendium "Pärandkooslused" Õpik-käsiraamat." T.
Kukk. Pärandkoosluste Kaitse Ühing 2004
A. Lotman "Rannaniidud." Keskkonnajuht, Eesti Roheline Liikumine 1996. In the internet:
http://www.roheline.ee/books/kkj296.html#RANNANIIDUD%20EESTIS
R. Rannap, L. Briggs, K. Lotman, I. Lepik, V. Rannap (editor) "Rannaniitude hooldus".
Keskkonnaministeerium 2005.
M. Pärtel jt „Bioloogiline mitmekesisus Eesti pooloduslikes ökosüsteemides" Tartu Ülikool 2003.
In the internet: http://www.botany.ut.ee/partel_helm_roosaluste_zobel_lk223-302.pdf

Habitats in coastal meadows

According to the European Union's Habitats Directive (92/43/EEC), Boreal Baltic coastal meadows in the middle and northern part of the Baltic Sea are designated with the code 1630*. These coastal meadows usually appear together with a small number of salines (Salicornia and other annuals colonizing mud and sand (1310). Other important habitats often found within the coastal meadow-saline complex include; sandbanks that are slightly covered by sea water all the time (1110); mudflats and sandflats not covered by seawater at low tide (1140); coastal lagoons (1150*); annual vegetation drift lines (1210); perennial vegetation of stony banks (1220); perennial vegetation of sandy banks (1640); Molinia meadows on calcareous, peat or clay-silt-laden soils (Eu-Molinion) (6410). Protection of coastal meadows is arranged to consider the whole complex of habitats. Some drier meadow communities may be semi-natural dry grasslands with scrubland facies on calcareous substrates (6210) or Nordic alvar on Precambrian calcareous flatrocks (6280). Boreal Baltic islets and small islands (1260) are also often managed as part of the habitat complex.

According to Estonian vegetation site classification coastal meadows belong to the geolittoral grassland (marsh) type (2.3.1.1) or epilittoral grassland site type (2.3.1.2).

The specific descriptions of Natura 2000 habitat types have been compared with the Estonian classification by J. Paal (2007) in "Loodusdirektiivi elupaigatüüpide käsiraamat", Keskkonnaministeerium, available online at: www.botany.ut.ee/jaanus.paal/n2000.pdf

Coastal meadows distribution and conditions

Estonian coastal meadows are mostly found on islands and the Western part of Estonian mainland, though they do occur on the limestone coast of northern Estonia. There are several tens of coastal meadows more than 10 ha in size and more than ten over 100 ha. The widest coastal meadow in Estonia is situated in Matsalu in the Hiiumaa Käina-Kassari district (see the chapter entitiled "The widest coastal meadows in Estonia").

Baltic coastal meadows are also found in Sweden, Denmark, Finland, Latvia and Lithuania. Estonia however is at forefront of the attention of the European Community and its member states because the coastal meadows in Estonia are the largest and most integrated in Europe. At the same time, the fact that the number of managed coastal meadows has decreased from 29 000 to 8 000 ha in the past 50 years shows they are in great danger. The gross area of coastal meadows is estimated to be 18,000 ha, but most of them have deteriorated from an overgrowth of reed.

Coastal meadows south of the Baltic Sea are marked in the Habitats Directive with code 1330 - Atlantic salt meadows. The coastal meadows of Baltic Sea differ from those of the Atlantic owing to the much lower salt content of Baltic waters.

Threats to coastal meadows

Only 10 % of Estonian historical coastal meadows have been preserved, therefore it is important to pay attention to each compromising factor in order to halt further impacts.

The most significant threats to coastal meadows are:
- Infestation of reed and/or bushes as a direct result of abandonment of extensive agricultural management. These guidelines concentrate foremost on this factor, *i.e.* the maintenance and restoration of coastal meadows.
- Building boat landing places, summerhouses and other buildings on the waterfront, with pressure to construct wind farms a recent addition. Plans to build in Natura 2000 protected areas at the very least needs to be critically considered.
- Eutrophication of the Baltic Sea due to agricultural fertilisers, which has been a factor in the proliferation of reed and a higher level of nutrients in the coastal soil. Part of the protection of coastal meadows therefore also requires implementing water protection measures on agricultural producers both nearby and further afield.
- Drainage is an important reason why in some places coastal meadows have become unsuitable habitats for natterjack toad and some wading birds (*e.g.* ruff).
- The bird communities of coastal meadows suffer from nest predation due to the growing number of fox, raccoon dog and American mink.

See overview of problems in protection and dissemination of coastal meadows in:
R. Rannap, L. Briggs, K. Lotman, I. Lepik, V. Rannap (editor) “Rannaniitude hooldus”. Keskkonnaministeerium 2005.
A. Lotman “Rannaniidud.” Keskkonnajuht, Eesti Roheline Liikumine 1996. In the internet: http://www.roheline.ee/books/kkj296.html#RANNANIIDUD%20EESTIS

Defining coastal meadows

In the European Union Natura 2000 network areas are protected to ensure the endurance of valuable and threatened habitats. Every member state, including Estonia, must regularly report to the European Commission about the state of protected habitats. It is important therefore to define and map all habitats on a countrywide scale so it would be possible to give an overview of each, including coastal meadows. As coastal meadows are semi-natural communities requiring management, in order to promote works land managers need to receive different financial aid dependent on what is required. Subsidized maintenance also requires an overview of land ownership to coordinate the maintenance of large areas of the coast.

It is important to remember however that there are no clear and straight borders in nature. European Union laws on nature protection do not presume to maintain the static *status quo* of habitats and there is a need to consider natural dynamics.

In Estonia the inventory of Natura 2000 protected habitats is performed by experts, including defining borders of communities. *(The Estonian version of guidelines gives more detailed description of the habitat inventory for land managers in Estonia).*

The values of coastal meadow

This chapter focuses on the value of coastal meadows according to nature conservation. In addition coastal meadows have heritage and cultural value and although not included in these guidelines information can be found in the article “Poolloooduslike kooslustega seonduvast rahvapärimuses” by Mall Hiiemäe in “Pärandkooslused” (Pärandkoosluste kaitse ühing 2004) (In Estonian).

Specific communities

Both the plant and bird communities of coastal meadows need to be taken into account owing to their high value. Protecting whole communities is often beneficial to rarer species, such as when birds alert other to the presence of predators.

The sea affects the environmental conditions within coastal meadows leading to plant communities appearing in distinct zones based on salinity and hydrology. Seawater inundation creates areas of saline and suprasaline conditions. In the first one, the flooded zone, halophytes can be found, which can´t grow in other soil: glaux, sea arrowgrass, sea plantain, blackgrass, creeping spikerush, sea aster, also common glasswort, pedunculate sea-purslane, and herbaceous seepweed growing in salinas. The micro surface relief and grazing influence upon coastal meadows create a high variety of plant communities. According to Nordic vegetation cover classification there can be 8 different vegetation types on coastal meadows. In an article entitled "Rannaniidud" (in "Pärandkooslused") E. Roosaluste describes 15 different vegetation cover types on coastal meadows, whilst other authors have described up to 17 vegetation cover types. It needs to be emphasized that all of the vegetation cover types described on coastal meadows are considered to be vulnerable and threatened.

Vegetation

A total of 390 plants species have been found on coastal meadows, which is 26% of all Estonian species. More than 20 protected species grow on coastal meadows, including many orchids: *Dactylorhiza ruthei*, frog orchid, fen orchid, baltic orchid, blood-red dactylorhiza, early marsh-orchid, musk orchid, marsh helleborine, early-purple orchid, common spotted orchid, military orchid, fly orchid and fragrant orchid.
Other decorative species in coastal meadows are: *Gladiolus imbricatus*, *Armeria maritima*, *Tetragonolobus maritimus*, large pink *Dianthus superbus* and red kidney vetch. Species with high scientific value but modest looks include: hop trefoil, slender hare's-ear, sea pearlwort, sharpfruit knotweed, long-bracted sedge. Habitats Directive Annex II includes another species, marsh angelica. There is already an action plan for the protection of frog orchid (protected under category I in Estonia).

For more information about coastal meadows plant communities and species:
Article by E. Roosaluste “Rannaniidud” in “Pärandkooslused” Pärandkoosluste kaitse ühing 2004
K. Tali “Roheka õõskeele kaitse tegevuskava 2010-2014” Eesti maaülikool 2009

R. Rannap, L. Briggs, K. Lotman, I. Lepik, V. Rannap (editor) “Rannaniitude hooldus”. Keskkonnaministeerium 2005.

Invertebrates

Coastal meadows are valuable habitats for invertebrates. Seaweed mounds and salinas are home to an unconventional community of predatory beetles. One of the few endemic insects found in Estonia, *Aeschna osiliensis*, is specifically associated with coastal meadows and other coastal habitats. Shallow water bodies that appear in coastal meadows provide areas for the rare large white-faced darter *(Leucorrhinia pectoralis)*. In coastal meadows there are various dragonflies and species of homoptera, auchenorrhyncha and heteroptera. Coastal meadows with a long standing grazing tradition feature sods generated by species of *Lasius* and *Myrmica*. There are a lot of species of *Macrolepidoptera* in coastal meadows. As well as rarer and more local species, many other common insects occur.

The management of coastal meadows may have different impact on invertebrates. As many herbivorous insects eat only certain plant species, intensive grazing may reduce the number of insects by reducing their food source. Temporary grazing has a more positive impact on invertebrates, whilst no grazing alters the vegetation to such an extent as to make the habitat unsuitable for meadow insects. According to several sources, it is therefore recommended that the best management for invertebrates involves allowing plants in some parts of the coastal meadow to grow higher and bloom by stopping activities temporarily for one or two years.

About coastal meadows entomofauna, please read more (In Estonian, Finish and English):
Article by T. Talvi “Putukad pärandkooslustel” in “Pärandkooslused” Pärandkoosluste Kaitse Ühing 2004.
R. Pedmanson “Rannaniitude selgrootud” in “Eesti ranna- ja luhaniidud”. Commissioning editor: E. Leibak
Leibak, L. Lutsar, 1996
M. Meriste “Ämblikufauna Matsalu ranna- ja luhaniitudel, üleujutuste ja koosluste hooldamise mõju” Tallinna Tehnikaülikooli Tartu Kolledž (http://www.lote.ee/785174)
T. Rintala, P. Ahlroth “Matsalun merenrantaniityjen luteista ja muista hyönteisista” in “Ruovikot ja merenrantaniityt”, commissioning editor I. Ikonen, E. Hagelberg Suomen Ympäristokeskus 2007 (in Finnish)
A. Wanner „Management, biodiversity and restoration potential of salt grassland vegetation of the Baltic Sea: Analyses along the complex ecological gradient“. PhD theses defended in University of Hamburg

Vertebrate animals

Amphibians

The natterjack toad (*Bufo calamita*) was very common in Western Estonia and Pärnu county coastal areas in the first half on 20th century. In the last 50 years the number of natterjack toads has continuously decreased and today this species has disappeared from many parts of their former range. This tendency is not only relevant for Estonia, but occurs in almost every natterjack toad

distribution area. The main reason that natterjack toads have vanished is the disappearance of suitable habitats. Natterjack toads in Estonia mostly inhabit coastal meadows and dunes. If the decrease of this species continues, the natterjack toad will most likely disappear within the next 10-15 years. An action plan has already been produced to protect natterjack toads (under category I in Estonia).

For more about the protection of the natterjack toads:
R. Rannap, I. Lepik, P. Pappel "Tegevuskava kõre (*Bufo calamita*) kaitseks Eestis." Keskkonnaministeerium 2010
http://www.envir.ee/orb.aw/class=file/action=preview/id=1144763/KK_1512_tegevuskava.pdf
R. Rannap, I. Lepik, P. Pappel "Tegevuskava kõre (*Bufo calamita*) kaitseks Eestis." Keskkonnaministeerium 2004
Protection of toads on coastal meadows of Estonia. 2000
Keskkonnaministeerium
R. Rannap "Läänemere rannaniidud kõre elupaigana" in "Rannaniitude hooldus" Keskkonnaministeerium, 2005.
L. Briggs "Ohustatud kärnkonnaliikide kudemispaikade taastamine rannaniitudele" in "Rannaniitude hooldus" Environmental Ministry, 2005

Birds

The most valuable bird species of coastal meadows are the waders, ecpecially *Calidris alpina schinzii*, Eurasian avocet, black-tailed godwit, ruff, curlew, ringed plover, redshank, lapwing and oystercatcher. Among the species of perching birds, wagtails, skylark and meadow pipit use the treeless coastal meadows for nesting. In addition the coastal meadows are important resting and feeding places during migration for wildfowl: greylag goose, greater and lesser white-fronted goose and barnacle goose.

Calidris alpina schinzii is a subspecies of Dunlin, whose population is decreasing fast all around the Baltic Sea including Estonia. *Calidris alpina schinzii* is protected under category I due to the alarming population decrease both overall and locally (for example the breeding populations found in coastal areas of North Estonia). The main reason for this population decreasing is the neglecting of coastal meadow management. Inadequate maintenance impacts the population in several ways - the grass in the area is too high to feed in (especially for nestlings), there are insufficient muddy water bodies and aquifers. The population of other umbrella species has also decreased, partly as a consequence of an increased number of predators which inhabit the bushes and trees growing in the meadows. The decrease in bird populations due to the decline of habitats reduces genetic diversity and increases the risk of inbreeding. An action plan has been compiled to protect these species.

Ruffs are one of the largest wader species. The breeding population of ruff in the European temperate climate zone has disastrously decreased in past decades. Ruff is a protection category I species in Estonia with a remaining breeding population of only 10-30 nesting pairs. The main reason for this species decline is considered to be the disappearance of applicable managed coastal meadows, though the impact of several potentially important factors is unknown. The necessary actions to protect ruff are described in the corresponding action plan.

Lesser white-fronted geese are globally defined as a threatened species, in Europe as endangered

and under the Estonian Nature Protection Act (2004) as category I. Lesser white-fronted geese are also listed in the European Union Birds Directive as Annex I, Bonn Convention Annex I and Bern Convention Annex II. Lesser white-fronted geese do not nest in Estonia, but a large part of the European ecological population stops to feed in western Estonian coastal meadows during their spring migration. The protection of lesser white-fronted geese migration staging points is very important and requires continued maintenance of the large treeless coastal meadows where they rest, feed and roost. The actions to protect lesser white-fronted geese are described in the corresponding action plan.

Action plans for strictly protected species of coastal meadows (In Estonian):
M. Erit, A. Kuresoo, L. Luigujõe, H. Pehlak „Niidurüdi (*Calidris alpina schinzii*) kaitse tegevuskava 2008-2012" Keskkonnaministeerium 2010
E. Mägi, H. Pehlak „Tegevuskava tutka (*Philomachus pugnax*) kaitse korraldamiseks Eestis" Keskkonnaministeerium 2010
M. Toming, I. Ojaste "Tegevuskava väike-laukhane *(Anser erythropus)* kaitse korraldamiseks Eestis 2009 – 2013" Keskkonnaministeerum 2008
R. Rannap, L. Briggs, K. Lotman, I. Lepik, V. Rannap (editor) "Rannaniitude hooldus". Keskkonnaministeerium 2005.

Coastal meadows micro relief

The surface of coastal meadow is and should not be even. The diverse micro relief of coastal meadow needs to be considered as a separate value, since it is the base for the existence of the different plant communities and animals on coastal meadows. Micro relief is affected by water and ice, but also by coastal meadow management, especially grazing. It is important that there are shallow water bodies on coastal meadows. If these dry fast, then salines form. If pools persist, they become important foraging sites for waders and spawning grounds for amphibians. Wet areas on coastal meadows need special attention when mowed. Mowing with tractors may not be possible every year. It is essential to educate land managers that it is especially important to mow wet areas, despite the practical problems. In some cases wet areas could be mowed manually. In areas of difficult mowing aftermath grazing is helpful.

Scenery

From the human point of view, low grass coastal meadows have a traditional value of being beautifully scenic.

Ecosystem services

Coastal meadows are wetlands and function as a flood control, carbon store and also provide other ecosystem services.

Coastal meadow maintenance support schemes in Estonia

Based on data of the Estonian Agricultural Research Centre, financial aid to agriculture in 2008 formed 41% of the income of semi-natural community managers, but only 30-35% these units were economically sustainable. Financial aid based on agri-environmental schemes is therefore a necessary action.

The following support schemes can be used for the restoration and maintenance of coastal meadows:
- The Estonian Environmental Board supports the restoration of valuable semi-natural areas and the fencing needed to protect these areas through the Ministry of Environment regulation no 62 "The procedure for application for nature conservation subsidy, review of applications and payment of subsidy, the requirements for payment of subsidy, and the rates of subsidy", see https://www.riigiteataja.ee/akt/13299565
- In the framework of the Estonian Rural Development Plan, the Estonian Agricultural Registers and Information Board (PRIA) supports the maintenance of semi-natural communities according to the Ministry of Agriculture regulation no 19 "The specific requirements and procedure for applying and reviewing of applications for semi-natural community maintenance subsidy 2007-2012", https://www.riigiteataja.ee/akt/12911220.
In addition the EU Nature Directive (EC 2003) allows member states to apply for management aid of Natura 2000 special conservation areas. Program LIFE+ is administered by the European Commission for period 2007-2012. The main objective is to co-finance the creation, protection and management of the Natura 2000 network. In Estonia, the financial assistance of LIFE programs has been used successfully six times to restore coastal meadows in Natura 2000 areas. In addition it is possible to apply for financial aid for Natura 2000 areas through the European Rural Development Fund (ERDF). In Estonia the implementing agency is the Environmental Investment Center (KIK), where project proposals are submitted. There are 5 projects financed from this fund to protect coastal meadows, two of them specifically to protect coastal meadows and one so-called "conservation holiday" project that also includes the restoration of coastal meadow communities.

The main financial aid scheme is under the framework of the Estonian Rural Development Plan 2007-2014; sub-measure 2.3.5 "Support for the maintenance of semi-natural habitats". This financial aid applies for semi-natural communities included in Natura 2000 special conservation areas and is available for farmers and other land managers. The rate of subsidy for coastal meadow maintenance according to Estonian Rural Development Plan is 185.98 Euros per hectare per year.

Requirements for support include: 1) semi-natural habitats must be mowed at least once before the 1st of October using the methods of from center-outwards or edge-to-edge, or if not mowed then grazed. Mowing is allowed from the 10th of July if not provided otherwise in protection rules, in the management plan, in the species action plan or in any other regulation. The earliest grazing date is also indicated in the protection rules, management plan or species action plan. Between the 1st of October and 1st of May the following year the mown grass must be removed; 2) the cutting of vegetation in the semi-natural habitat is allowed only with the permission of the Estonian Environmental Board; 3) Additional feeding of animals is forbidden in the semi-natural habitat; 4) the applicant may not damage or remove the valuable elements of landscape during the commitment period; 5) in order to receive support the applicant must participate in training on the maintenance

of semi-natural habitats. The State Nature Conservation Center issues the applicant detailed guidelines for the maintenance of semi-natural habitats, where in addition to the requirements arising from the legislation individual suggestions concerning the maintenance of specific area are also described (i.e. area-specific number of animals per hectare, mowing dates etc.). The support for the maintenance of semi-natural habitats cannot be applied for land which is already subject to the Single Area Payment Scheme (SAPS), Complementary National Direct Payment (CNDP) and other rural development support related to the CAP or nature protection support financed from the state budget. The object of the Estonian Rural Development Plan was to maintain 35,000 ha of semi-natural communities and by 2009 20,724 ha (59 %) was under the scheme. In 2009, 4000 ha of coastal meadow was maintained with the help of financial aid provided by the Estonian Agricultural Registers and Information Board, whilst a further 603.84 ha were restored with the help of state funds.

M.Kose's MA thesis gives a good overview about financial aid projects on coastal meadows (In Estonian):
"Rannikukoosluste taastamis- ja majandamisprojektide edukus ja jätkusuutlikkus Eestis"
http://www.botany.ut.ee/kaitsmised_2010/Marik_Kose_MSc.pdf

Coastal meadows eligible for financial aid

After defining an area scientifically, the problem arises as how to determine what financial aid an area requires for maintenance. The border of the sea may be based on both the Estonian base map and ortho-photos, but usually does not reflect the real area grazed or mowed. The border of the sea is mobile during the low tides of summer and during the flows in the autumn, therefore the size of area maintained may change significantly over the year. The area of interface between the sea and coastal meadow is very important and needs to be managed as shallow water site plant communities are often overgrown with reed making the coastal meadow much less suitable for waders. In the case of grazing of coastal meadows, the stock fence has to be built further into the sea so animals cannot escape during low tide. Sea action however often damages stock fencing, which is an additional cost to the land manager. Part of the land below the border of the sea needs therefore to be considered eligible in order to motivate land managers to maintain these areas. A simple rule is that the whole area where flora is growing should be eligible for financial aid and managed, including club rush and reed in the water. For mowed coastal meadows the area eligible for financial aid should include only the range in which the mower works. These facts need to be considered while assessing the maintenance plan. The area of maintained land can be measured only during the low tide.

The border of coastal meadow next to the shore is also hard to determine, because the community zones blend into each other. Between the coastal meadow and the land can be grassland on mineral soil, alvar or juniper thicket. As mentioned before, it is not so important whether only strictly coastal meadow is marked on the map, because all the others semi-natural communities around the coastal meadow need to be protected and managed as part of the whole complex. The whole mowed or grazed area needs therefore to be marked on the map.

‘Perfect’ coastal meadow

Here is provided a description of theoretically perfect coastal meadow to help understand the objectives of coastal meadow protection. It is based on the expert assessments written under the framework of the Life-nature project.

A perfect coastal meadow has low grass, but at the same time should not look homogeneous like golf course. It should be without of tall plants, reed, trees and bushes. The relief and plant life of the ideal coastal meadow are diverse.

Tussocks, sods, rills and drains are required to hide the nests and young of wadering birds. Waders also need need wet areas (rills, pools and drains etc.) to find food and shelter during the drier end of the breeding period. These have to be "open" and accessible by young birds and not filled with dense vegetation.

Ideally there are low sandbanks in the sea nearby covered in seaweed for adult birds to forage in. A seaweed mound provides invertebrates on which to feed, just as cow pats increase the number insects available to hungry wader nestlings.

Forage areas with low grass, water bodies for spawning, and places to hide and overwinter make coastal meadows suitable habitat for natterjack toads. Suitable water bodies for spawning natterjack toads are freshwater or brackish with some plant life. These water bodies have gentle shores and dry during summer. For overwintering the natterjack toad needs places outside off open water areas with a suitable surface within which to hide. These areas are usually far from coastal meadows and natterjack toads need to be able to access these without passing through forest or high grass.

Low or moderately grazed areas with blooming plants full of nectar are suitable for large numbers of insects and spiders. Ungrazed but not overgrown spots in coastal meadows should be in areas close to the shore, but the sea border itself should have low-mown plants.

Ideally horses, cattle and sheep are grazed in turn. Cattle are especially important, because they graze in water and therefore keep the sea and low water bodies open. In the perfect coastal meadow the herder is directing the animals to provides equal grazing intensity and frighten off foxes. A more practical option however is a system involving both moveable and permanent electric fencers.

Requirements on coastal meadows

This chapter focuses on indicators, which help to measure the coastal meadow and it´s quality of maintenance.

Indicator species

If there are weeds, such as thistles and nettles or warblers and other atypical birds on coastal meadows, it is a signal that the coastal meadow is not in good condition. Atypical species occurrence may have a lot of reasons: under-grazing, over-grazing, excessive nutrients etc.. Coastal meadow is not maintained well if reed and tall fescue are dominate and seeding. If there are a lot of typical coastal meadow plants, like sea milkwort, common arrowgrass, seaside plantain, blackgrass, creeping spikerush, sea aster, common glasswort, herbaceous seepweed, alkali grass and red fescue then the meadow is in good condition. Common coastal meadow bird species that indicate the meadow is in good condition are: northern lapwing, eurasian oystercatcher and common redshank. Rarer birds include: black-tailed godwit, ruff, pied avocet and *Calidris alpina schinzii*. That geese stop in coastal meadows during migration also indicates that coastal meadows are in relatively good condition.

Grass height in coastal meadow

The amount of low grass is often used on quality assessments of coastal meadow maintenance (grazing). Low grass is considered to 3-5 cm high. It is important that the coastal meadow waterfront area is low grass, because this wetter part of the meadow is important for feeding waders (especially *Calidris alpina schinzii*). It is hard to say what is the correct proportion of low grass area on coastal meadows, as some wading birds also require tussocky areas with higher vegetation in which to nest. Still, it can be determined based on particular areas, e.g. in the guidelines for coastal meadow management in Manija Island 75 % of total area was determined should be low grass. Nevertheless, it is not normally meaningful to demand the proportion of low grass be more than 30 %. Basically it depends on the marked borders of the maintained area.

On well maintained coastal meadows the grass patches with different height (10-12 cm) are formed between the low grass areas, which are good for birds. The rest of the grass on coastal meadow should not be higher than 50-57 cm (except single reed tussocs). It is also important that the low grassed part in coastal meadow remains so into October, as otherwise aftermath may grow may be so high as to make spring grass height unsuitable for foraging breeding birds. The maintenance of coastal meadow is not effective if there is sparse or dense reed in the whole or seaward area. When tackling reed growth, it is important to know on which parts of coastal meadows removal is most important for waders. Keeping the waterfront free of reed is imperative, but in other areas sparse reed is not such huge problem and is actually beneficial for ducks. Whether there should be reed-bed in the sea depends on the local conservation objectives.

With or without trees and bushes?

For wader species nesting in the coastal meadow, it is important they be without trees or bushes. If a coastal meadow is of particular importance for breeding wader, then this is a prime aim of maintenance. Waders do not nest near trees and bushes as they contain predators, but they also avoid stock fences and therefore there is need to be careful when considering building different structures (including observation towers) on such coastal meadows. If the aim of the coastal meadow protection is foremost botanical, then single junipers or other trees and bushes rather illustrates the scenery. On coastal meadow where trees and bushes are allowed, they should be restricted to small patches spaced sparsely and in a random formation.

Absence of plant litter

The coastal meadow is in good condition, if there is no plant litter and it´s not possible to identify the remains of grass chopping.

Ditches, low water bodies and hydrology of coastal meadow

A ditch on a coastal meadow does not necessarily mean that it is not in a favorable condition. Still, the ditches influence the natural hydrology of coastal meadows and it is mandatory to follow the rules not to build new ditches or dredge the existing ones.

The relief of coastal meadows allows formation of many shallow small water bodies, which are good for spawning natterjack toads and foraging waders. Grazing and manual mowing keeps such water bodies open and free of tall grass. Small water bodies that are not flooded by sea waters are very important for natterjack toads and ruff. Small fish (mostly sticklebacks) do not invade these fresh water bodies during sea floods, so natterjack spawn and tadpoles are less predated upon. In addition water bodies with low salinity are suitable foraging sites for ruff. If the grazing intensity is low, then sedges grow in wetter areas and as plants die-back over the years these water bodies clog up and eventually dry out. It is therefore important that if grazing does not help to keep these water bodies open, then they should be mown and the cut vegetation removed.

How to measure the priority of coastal meadow for restoration?

Restoration of coastal meadows overgrown with reed or trees is expensive and the decision to restore should be considered and justified by taking into account both the scientific and social aspects. This chapter focuses on possible criteria to help choose which coastal meadows should be restored first. The listing includes the oral assessments of coastal meadow experts and from examples that can be found in the reference list. Answers to socio-economic or pragmatic issues should be found before restoration. Aspects showing the biological value of the area are indicated separately. The clearer the aims of restoration are to all parties involved (land owner, land manager, national officials and the public), the more successful the restoration will be.

Scientific criteria:

– Size: as coastal meadow size is important for species such as wading birds, then priority should be given to the restoration of larger areas or expanding existing meadows.
– Coherence: if the coastal meadow forms a complex with other coastal meadows or it is located between several coastal meadows in good condition, then its value as habitat is larger than isolated coastal meadows. Closeness to other meadows makes it possible for species to return to restored meadows (for example seeds or insects travelling very far are unlikely).
– Situation: the more typical meadow species that remain in degraded areas, the more important it is to restore the meadow. Usually the situation of the meadow is better if the area has only been abandoned for a short time. The longer a meadow goes unmanaged the more coastal meadow species disappear.
– Potential as gathering and feeding areas for migratory birds: coastal meadows on the migratory route should be considered more important, because these meadows are a significant part of migratory birds life circles. Restored coastal meadows in suitable areas for migratory birds also helps prevent the birds gathering in nearby fields and contributing to the loss of crops. The larger the meadow massif, the more suitable they are for migratory birds. Also the shape and position of the coastal meadow may influence the birds that stop there during migration.
– Past value: previous data about threatened species inhabiting the meadow (e.g. natterjack toad population or rare plant species), show that the area has high potential for restoration is it has not been permanently altered by the construction of ditches or buildings.
– Islands and islets: it is important to restore coastal meadows situated in separate areas from the mainland, because here the impact of predators (foxes, raccoons) upon nesting birds is lower. It is easier to maintain those island coastal meadows that are closer to the mainland.

Socio-economic aspects:

– Sustainability of maintenance: is there a land manager who is interested in carrying on the maintenance in long term? Information about previous grazing and location of historical paddocks compared to coastal meadows or other opened habitats maintained today may be for great help.
– Restorability: is it possible to mow or graze on the whole area up to the waterfront; how dense is the brushwood? Is the area devastated with drainage?
– Economic motives: restoring coastal meadows can benefit local inhabitants and land managers through diversification and rural development, e.g. tourism – the view of the sea and the grazing

animals are attractive to tourists. Also coastal meadows are suitable for raising beef cattle, which brings money into the local community raising the value of restoration for society.
– Local awareness: it is important that all the values of restoring coastal meadows are clearly explained to the local community, because habitat restoration is expensive and usually financed with the help from the public sector. The better the aims of restoration activities are presented to the local community, visitors and decision-makers, the more likely project aims are accomplished.

Considerations of restoring coastal meadow are thoroughly analyzed in A. Wanner's doctoral thesis "Management, biodiversity and restoration potential of salt grassland vegetation of the Baltic Sea: Analyses along the complex ecological gradient" Hamburg 2009 (http://ediss.sub.uni-hamburg.de/volltexte/2010/4596/pdf/Antonia_Wanner_dissertation_salt_grasslands.pdf)

Restoring of coastal meadows

Maintenance of coastal meadows means that of the whole habitat complex and thus the different needs of various species taken into account. First we focus on ways of restoring coastal meadows and in following chapter describe their annual maintenance. Basically there is a need for two things to restore coastal meadow: clear the area of reed and brushwood and then commence annual grazing or mowing. Before starting restoration, in the interest of the safety of animals and the protection of equipment and operators, it is advisable that any old barbwire fencing, bottles or other dangerous objects are removed.

Tackling the reed

This chapter focuses on those coastal meadow covered with reed from the seaward side. Removal requires additional attention. When removing large areas of reed there is a need to consider the impact on water self-purification. Additionally is a need to consider whether reed should remain between fields and wetlands or in the sides of ditches and in river estuaries. If the ditches or rivers pass through the meadow dividing it, then reed should be removed so not to provide shelter for predators. If the ditch passes between landward fields and the meadow, then reed can be allowed to grow on the side of the ditch next to the field. Clearing these habitats of reed may have a negative impact on the aquatic ecosystem, because it may increase the nutrition flow resulting in eutrophication. There is a need to remember that the aim is not to destroy the reed habitat, but to restore the coastal meadow habitat. The value of reed is highest in areas where the reed is permanently in at least 5 cm in the water. Reed growing on drier land does not have any special value.

Tackling the read by grazing

Since animals are not keen to invade large reed massifs, it is useful to cut the reed first. The best time to cut reed is in the second half of summer or in winter from the frozen surface. It is important to remove the read after cutting or burn it on site. Dense reed swards prevent light reaching the soil surface and the development of herbaceous plants. The negative aspect of cutting reed is that their stubs remain, which may injure the legs of animals in summer. This problem is resolved if reed is chopped in late summer or autumn with an appropriate machine which cuts close to the ground and in a way that makes stubs less dangerous. The negative side is that the chopped reed litter remains on the coastal meadow, eases the marshing and prevents the development of herbaceous plants. Therefore it is useful to chop the stubs in previously mowed areas only.

If reed beds are very large or difficult, the alternative is to cut suitable transit routes for animals through the reed. The width of the transit routes should be at least 2 meters and optimally 4. The distance between the transit routes must be less than 10 meters and at least every 20 meters there should be connecting paths. This kind of network provides for the free movement of animals and also movement of air. Air will not move in too narrow transit routes and the animals go unwillingly

into these overheated areas. Tackling new reed growth in the next season must be provided by sufficient grazing intensity. Mowing of reed is meaningful only if grazing is planned for the next season.

Grazing should be started before reeds open their leaves and turn green. Reed leaves appear only when the plant is 30-40 cm high, therefore in pasture areas overgrown with reed it is not allowed to assess the quality of feedstuff for animals according to reed colour (that means in principle "if it´s not green, then there is nothing to eat") but by examining the reed height locally and starting grazing before reed height is no more than 15 cm. Commencing grazing in this way increases the fending off of reed greatly. Green reed in the spring provides valuable nutrition for livestock. Both cattle and horses eat young reed shoots gladly. Reed grows very fast in the first part of the summer, but by midsummer the stalks lignifying and are then not of interest to animals.

During the restoration of coastal meadows, grazing intensity has to be greater than during regular maintenance because the plants growth more quickly owing to the greater nutrient content of the soil compared to meadows grazed for a long time. Different paddocks can be constructed during the restoration of coastal meadow to increase the grazing intensity on certain areas, such as by using moveable electric fencing.

Mowing the reed in the summer

In the areas where it is important to tackle the reed but grazing is not viable, the reed can be fended off by mowing it repeatedly during the summer. For this the reed has to be mowed and removed at least three times during the summer starting from the middle of June. The stems should be mown below the water surface if possible. Mowing decreases the strength of reed, so within 3-4 years it is possible to reduce it significantly. The result of mowing the reed plants is they become slender and grow less tall and dense. After several consecutive years of mowing gaps start to form among the reed stands. After 5-10 years of mowing reed should disappear altogether. This method is far more time-consuming and ecologically less effective, therefore it is only worth using in special cases.

If grazing intensity is low, it is recommended to combine it with mowing. Mowing reed in the summer (between mid-June and the middle of July) provides new grow of nutritional value for livestock rearing. If by the end of the summer some reed plants have grown tall, it is necessary to mow them and repeat the cycle. By combining systematic mowing and grazing it is possible to deplete the underground rhizomes of reed faster and make the reed retreat. Studies prove that rhizomes of reed may even store nutrients for up to 7 years and therefore it is hard to tackle the reed only by mowing or grazing.

Mowed reed should be gathered together and removed from the coastal meadow or burnt. If it is not possible because of the wet surface or storms, mowing is still more useful than not. When water is high, it takes the mowed reed into the higher areas of the coastal meadow. It can then be gathered and burned. If the coastal meadow is large enough and drifted reed piles are far enough from the seafront, there is a hope that livestock will trample and eat the fresh plants growing on piles and thus help in the extermination process. In low water and rocky areas grass has to be mowed manually using a strimming machine.

Burning the reed

Burning the reed helps dispose of large amounts of dry biomass, removing litter from the coastal meadow and allowing herbaceous plants to grow. It also does not produce dangerous methane emissions, which form when biomass decomposes in conditions lacking oxygen. Burning must however be followed by high intensity grazing or regular mowing. Burning reed in spring makes the coastal meadows suitable for livestock in early summer.

The reed should be burned when the surface is still frozen - biomass is driest at the end of winter or early spring. Burning the reed in late summer is not recommended, because the water content of reed is high and invertebrates more plentiful. Burning the reed in winter or early spring usually does not damage the reed shoots. Fire impacts reed growth during the next season only if it affects the soil sub-surface or if it is followed by flooding, which weakens the reed's ability to transport oxygen.

In the case of burning it is important to co-ordinate with rescue services and thoroughly plan all the work. Burning needs the presence of a lot of people to keep the fire under control and be prepared for emergency situations. Nesting birds also need to be considered, if nesting has begun then it is forbidden to burn the reed.

Smashing the reed

This reed smashing guidance is based on I. Huolman´s article, describing Finaland´s experience: "Back to the Meadow – restoration of coastal meadows that have been overtaken by reed beds in the Lintulahdet LIFE project" in "Reed up on Reed" Vammalan Kirjapaino Oy, by I. Ikonen and E. Hagelberg. (download in English from http://www.ymparisto.fi/download.asp?contentid=73503&lan=fi).

Removing brushwood

Coastal meadows overgrown with brushwood are cleared either manually or with the help of machinery. Cutting smaller single bushes with a brush hook is not a complicated job, but usually overgrown areas are large and in this case the help of chainsaws, brush cutters or mulchers is required. It is important to remember that the result of removing all brushwood is to create an area possible to graze or mow.

A serious question is how to get rid of the stumps that can damage animal legs after cleaning an area overgrown by junipers or other brushwood. It does not matter how carefully the work is done, both mulchers and brush cutters leave stumps and even if cut at the surface, soil erosion in following years can expose them. Although very time-consuming, it is possible to use a brush cutter to cut the stubs once a year. It is reasonable to use this type of method when more people are available, such as volunteers on conservation holidays. Other possible solutions include up-rooting junipers in spring when the soil surface if soft or burning the stubs, but at the moment there have been no trials to determine the best methods.

Alder bushes need cutting every year, because new shoots begin to grow from the stumps. Cattle do not eat the alder shoots, therefore mowing during summer for at least the next three years is required to eradicate them. Further brushwood tackling should be repeated according to need.

Restoring hydrology

A lot of Estonian coastal meadows have been historically wetter than today. Soil moisture is an important factor for lots of species existing in coastal meadows. Old ditches on coastal meadows which are no longer part of draining system should be closed off. If there are large important ditches on coastal meadows, their sides should be made to slope more gently, thus providing access for cattle which will help to keep them clear of tall vegetation. If there are ditches on coastal meadow, filling the ditches or reconstructing the entrances of the ditches to multi legged or shallow water body could be considered. Before starting any works, there is a need to for an expert assessment of the hydrology of each coastal meadow that provides a list of the individual actions needed. The aim would be to make sure that whilst the biota of coastal meadow is promoted, the surrounding land (e.g. arable fields) is not made too wet. It is possible to use different methods of closing down ditches and each can raise the water content of coastal meadow soils. If the catchment areas' drainage and ditch flow rates are low, it is possible to fill a section of ditch within 10 m range with a substance of low hydraulic conductivity (e.g. clayey moraine or loam). This method however is in danger of being undone owing to erosion and water breakthrough. It is also possible to dike the ditches, using wood or another material.

Wooden dikes

One of the simplest ways to damn ditches is to create wooden dikes. To construct the dike, it is necessary to dig a channel approximately 3 meters long and 0.5-0.7 m deep across the ditch, construct the dike with floorboards (boards with pegs and threads) and the infill with soil around the dike edges to prevent leakage and erosion. The dikes should not rise above the soil surface. With this kind of dike, it is possible to incorporate adjustable sills to change the level of barrage. Measuring height differences should take place before either closing or dredging ditches. This allows the planner to find optimal places and heights for new dikes. Wooden dikes may not fit with the coastal meadow scenery and only last a few decades, but this is advantageous in that ditches may have closed over anyway by the end of the working span of the dike. Building wooden dikes is a good decision when it is anticipated that ditches may grow over in time, but the manager wants to fasten the process. Constructing wooden dikes may be comparatively expensive however and only land managers with the necessary material for a small expenditure may choose this option.

Dikes made of clay filling

It is possible to close the ditches with a filling, if the catchment area is small and drainage of ditches not high. Gravel and sand are too porous are not suitable fillings. More feasible would be clayey or loam moraine soils. Loams and sandy loams may be suitable, but risk of erosion is higher. To block a ditch, it is necessary to fill a 5-10 m section tightly with filling so forms a gentle pile over the sides of the ditch. The pile should cover approximately 5m either side of the ditch. The "pile" is

important, because until plants bind the surface it is easily erodible, but when the soil is dispersedly over the surface of the meadow it is not so sensitive to erosion. Over a couple of years the piles will blend into the coastal meadow scenery. Using piles depends on the width of the ditch and the micro relief of the surrounding area. A fast flow converging into the edge of the pile should be avoided, because in this situation the water starts to erode the filling.

A good example of an expert assessment on restoring coastal meadow hydrological systems is (in Estonian): R. Pajula „Eksperthinnang: Tahu niidurüdi pesitsusalal paiknevate kraavide mõju ning sulgemisvõimaluste kohta“ Eesti Märgalade Ühing 2008

Maintenance of coastal meadow

General requirements

Fertilizing, sowing, draining, additional feeding of cattle and curing with antibiotics are forbidden on coastal meadows. If cattle fall ill, they need to be removed from the coastal meadow while being treated. In addition to the agricultural factors, the following aspects should be remembered: construction activities should be prohibited and the number of visiting tourists limited during the nesting time of birds on coastal meadows. Coastal meadows should be grazed more intensively on the waterfront and it is also important to grazing ditch edges so they will not overgrow with reed.

Stock yards and gates

Though the position of shepherd should be promoted, in Estonia the construction of stock yards and fenced pastures is rather entrenched. Yards are mostly made from ferro-concrete or impregnated wood. Pole fences are also common and making them from local material is always welcome. Barbered wire is also used in some places, but today they have mostly been replaced by electric fences. For permanent fences that surround the whole paddock it is more effective to buy thick electric wire that will last for years. For movable fences it is also possible to use cheaper and finer electric fence wire or rope or band. Today there are also electric fencers with solar cells which are advantageous for isolated grazing areas. On coastal meadows, protecting nesting birds with fox proof fences should also be considered. These fences are made from several electric fences combined or electric netting. To maintain the fence, the grass should be trimmed regularly so it does not 'short' the fence and make it ineffective.

It is important to choose paddocks of appropriate size and layout for cattle to successfully maintenance the coastal meadow. Cattle tend to move around in large areas and forage in favorite zones. In this case it is hard to achieve the result of equably low grass everywhere. The coastal meadows should be fenced so cattle can eat the grass growing on the waterfront or in low water. The fence therefore needs to extend into the water during periods of low water. It is a complicated, time-consuming and ongoing task to construct water fences to keep cattle inside because water level fluctuations. Such fences should be removed every autumn or the sea and ice will break it up during winter.

The best solution for access to paddocks is to use gates that animals cannot pass, but allows human or machine access without moving the gate. One excellent solution is the cattle grid, which consists of a 1 m deep trench covered over by pipes or narrow logs with a gap of 5-8 cm between them. Animals will not cross this obstacle, but it is easily passable with vehicles and on foot. This kind of gate may trap small animals, which fall into the trench and cannot get out. This problem can be solved by constructing narrow stairs or ramps at the edges of the trench for small animals to climb out.

The waterside manager should pay intention to the fact that according to law, fences should not

entirely obstruct access to foot traffic.

Grazing intensity and period

The grazing intensity foreseen in Estonia is 0.4-1.3 LSU/ha (1 livestock unit (LSU) = 1 adult bovine animal or horse, 2 heifers or foals, 3 calves or colts, 5 sheep or goat), with more specific recommendations dependent on each particular coastal meadow. Higher grazing intensity is suitable for areas with high productivity, especially on coastal meadows in the restoring phase. High grazing intensity supports the growth of salines and other characteristic flora of coastal meadows. Skipping grazing in some years may be recommended in areas with less productivity. This supports the distribution of invertebrates and better fruit-ripening of flowering plants. In the current situation under the requirements of the financial aid for semi-natural community maintenance, it is more advantageous to take more land under maintenance and graze with minimum intensity. The Estonian Environmental Board has the right and obligation to assign the specific requirements for grazing, therefore during the applications phase attention should be paid to whether the land manager has enough animals to meet the target. In case of obvious under-grazing the area should also be mown in autumn and more intensive grazing targeted to key-elements (waterfront, shallow water bodies, ditch sides). A proportional cattle grazing is not recommended if the whole area is not grazed with equal intensity due to this. If one important area is targeted but another unmaintained, then the number of animals is not enough to meet the maintenance requirements.

The optimal grazing period on coastal meadows in Estonia is 130-140 days per year. To maximize the efficiency of nature protection, it is important to prolong the grazing in to the autumn as long as possible. This is the best method to achieve low grass on coastal meadows in spring. It also postpones the start of grazing in spring, which reduces the danger of nest trampling by livestock. In regular years, grazing should last until consistent frosts or until there is not enough nourishment for livestock. Optimally in the end of the grazing period, the nourishment for one year is also depleted. This provides good nesting opportunities to the lapwings and *Calidris alpina schinzii*. Grazing should start two weeks after turfs greening on coastal meadows in good conditions. Maintaining the coastal meadow and protecting nesting birds creates a contradiction: to protect nests and young birds it is recommended to start grazing late, but in the best interest of maintaining the habitat it is better to start earlier. 50% grazing intensity is enough in the spring on areas properly grazed in previous years.

Selection of grazing animals

Considering the required results, it is important to select the right kind of animals to maintain the coastal meadow. Grazing different domestic animals together or periodically provides the best result, because different species prefer different plants and therefore have different impacts upon vegetation communities. Grazing different species in the same area also helps to reduce the impact of parasites on cattle. Parasites swallowed with grass usually only infect its own host species and die if they end up in a different organism. The preferences of animals should be also taken account. Higher and drier areas are suitable for maintenance with sheep, but wet and low areas need cattle or horses to tackle the reed. Cattle can also move around in areas with a soft surface, such as muddy bays where horses will not go. Goats and sheep should be grazed less on areas with rare flora, because their way of foraging is more selective and therefore grazing pressure is higher on favorite

plants. Cattle or horses should be preferred in areas like this, especially in the first half of the summer before the fruit-ripening of plants.

Highland cattle, Hereford cattle and the Estonian horse are the preferred breeds, because they have proven their endurance and compatibility to the natural conditions of Estonian coastal meadows. Estonian indigenous breeds are best adapted to local circumstances. Beef cattle is preferred compared to dairy cattle, because unlike dairy cattle they do not have to be moved often for milking, plus milk production is more dependent on the quality of the forage and dairy cattle often have weaker health than beef. Heifers from the dairy cattle are suitable for coastal meadows, but constant monitoring is very important in their case because they are far more mobile and less easy to control. Beef animals, especially suckling-cows with calves, tend to stay steady in pasture land; they are calm, unpretentious about the quality of forage and overall more durable. They can be kept in the pasture until late fall, when they will eat with pleasure the bushes and other plants they usually will not eat during the summer.

Mowing the coastal meadow

Mowing usually provides a higher variety of meadow plants on a smaller scale. Mowing is better for several plants, such as marsh angelica. A little taller grass during nesting is good for ruffs, which prefer mown meadows for nestling. Therefore mowing as coastal meadow managing method is highly recommended. The rocks and complicated landscape of coastal meadows often makes mowing difficult. In the case of mowing it is important the waterfront is also maintained. If it is not accessible due to rocks, this area should be trimmed. If the meadows are wet, the purchased machinery should be as light as possible, so it would not leave marks on the surface. Mowing with a tractor in the wet and muddy areas is fairly complicated and not possible in every year. Mowing as a constant management measure is good for areas with valuable plant life or with low fresh water bodies suitable for ruff.

Purple moor grass communities can also appear on coastal meadows. These communities may form plant litter which cattle tend to avoid. Considering the historical management methods of coastal meadows, it is recommended to combine grazing and mowing so the waterfront is grazed and drier inland areas mown. After mowing aftermath cattle grazing is beneficial. The golden rule of bird-friendly mowing is to mow either from the middle out or edge to edge, as in this way birds and animals hiding in the grass can get around the mower. If it is not possible to mow bird-friendly because of the mower, a little area with higher grass should be left in the middle for nestlings to hide in. In areas with high wader populations a later mowing, starting 1st of July is recommended reduce losses. It is also important to notice that it is important to remove the hay. Chopping as a means of every year maintenance method is therefore not possible.

Additional activities

There may be also other necessary activities on coastal meadows besides grazing and mowing; e.g. on some coastal meadow the higher waves regularly bring seaweed and other wracks on shore, that form high piles and promotes the thriving of nitrophilous plants. In this case it is recommended to clean the wrecks and remove them from the coast. Traditionally this substance is used for fertilizing. Nitrophilous plants on waste grounds may be mowed, but additional action may be

necessary if they are dominating large areas. Usually cattle eat most of the nitrophilous plants with pleasure. Appearance of thistles and nettles may be a sign of coastal meadow being over-grazed.

Redundant plant litter may form on well maintained coastal meadows, but this can be reduced by winter burning. There is no need to do it more often than once or twice during a decade. In several places, aftermath grazing has been a traditional method of managing coastal meadows. After mowing the permitted grazing intensity is 0.5 LU/ha. Grazing of mowing aftermath has a very important advantage; otherwise plant litter establishes next spring which waders will not tolerate in their nesting areas. Also plants can seed faster if the cattle have tramped on the surface and created small areas of open soil. Grazing of aftermath is highly recommended from both a bird and plant conservation point of view. Besides the aftermath is also a valuable feedstuff for cattle.

Animal re-wilding projects

Both in Eastern and Western Europe projects have been developed to restore and manage semi-natural communities with re-wilded (left to their own devices) horses, cattle, sheep and bison. Those closest to Estonia are in Latvia around lakes Pape and Engure. The Oostvaardersplassen protected area in Holland is one of the best known areas. In Estonian only partly re-wilded sheep have been let off to nature on unsettled small islets. Although these are interesting projects, there is little need in Estonia at present for this kind of management, except on some small islets.

Awareness of land managers

Nature conservation, especially protection of semi-natural communities can be successful if land owners, locals, farmers and the general public are aware of the value of nature and the aims of protection. Paradoxically, global environmental issues are better known than local problems. Usually, the topic of historical usage of land and introduction of protected species gives a better understanding of semi-natural community issues. Local education centers and people working in environmental institutions play a key role on educating the public. It is essential to point out for land managers how important their role in nature protection is and connect the activities today to the heritage of earlier generations. It is important to talk a lot to land managers and organize training days and field trips for them. It should be considered to train special agricultural advisers for land managers. Ideally, land managers should be aware of the value of nature and encouraged to become involvement in monitoring and possible future agricultural measures that require deeper knowledge. It is recommended to compile information on typical species of coastal meadows for land managers and owners. The officers of the Estonian Environmental Board could have informative materials in different modules, so a dossier with specific information about the species and needs of every land manager's particular coastal meadow could be easily produced.

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