

**Project “Stepping stones towards ensuring long-term favorable conservation status of
Aquatic Warbler in Lithuania” (LIFE MagniDucatusAcrola)**

Project No. LIFE15 NAT/LT/001024



**DETAILED MONITORING PROGRAM AND
METHODOLOGY**

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1. Background

The main goal of the project is contributing to the fragmentation reduction of Aquatic Warbler breeding habitats as a major precondition to achieve long-term favourable conservation status of one of the rarest passerine bird species. To tackle this issue, project will perform a restoration of the remaining degraded habitats in Lithuania as well as areas in Belarus, which are close to EU border and would serve as the best candidates to function as „stepping stone” habitats, connecting Aquatic Warbler population between Belarus and EU. In some project areas habitats are degraded, because of the overgrowth of bushes and reeds, while in some of them water level does not meet the conditions to be appropriate for the requirements of the species. These unfavourable conditions formed mainly because of the abandonment of land, regular traditional mowing and local economic changes. It is expected that degraded habitat restoration by clearance of bushes and regular mowing of redundant biomass and reeds as well as appropriate water level management would recreate and maintain habitats in a conditions that suits for establishing breeding populations of Aquatic Warbler.

Distribution of the project sites in Lithuania and Belarus are presented in Figure 1. The project “Stepping stones towards ensuring long-term favourable conservation status of Aquatic Warbler in Lithuania” (LIFE MagniDucatusAcrola) no. LIFE15 NAT/LT/001024 is financed by the EU LIFE Programme, Ministry of Environment of the Republic of Lithuania and project partners.



Fig. 1. General map of project sites

2. Components of the project monitoring program¹

To evaluate the effectiveness and impact of measures proposed in the project it is necessary to use monitoring. For this purpose, special monitoring system was introduced, which is described in detailed in this document. This document shall serve as methodological basis for implementation of the project monitoring program in all the project areas.

There are 3 project actions addressing all the monitoring activities:

- D.1 – Monitoring of the conservation actions impact:
 - Sub-action D.1.1. – Birds monitoring;
 - Sub-action D.1.2. – Vegetation monitoring;
 - Sub-action D.1.3. – Invertebrate monitoring;
 - Sub-action D.1.4. – Hydrological monitoring;
 - Sub-action D.1.5. – Areal mapping of project areas.
- D.2 - Assessment of socio-economic impact to local economy and social development:
 - Sub-action D.2.1. – Performing assessment on impact to provisional Ecosystem Services (further in the text referred as ES);
 - Sub-action D.2.2. – Assessment an impact to cultural ES.
- D.3 - Impact assessment to ecosystem functions.

Monitoring activities under the action D.1, are based on the collection of field data, which could be used to explain changes in Aquatic Warbler habitats and population dynamics, allows to fine-tune actions for maximum conservation benefit and provide solid background for gathered experiences. It will also help to evaluate conservation actions and to better plan further management activities for each site.

Impact of the project's conservation actions (Action D.1) shall be monitored by executing following thematic monitoring programs:

- **Birds monitoring** covers the inventory of singing males of Aquatic Warbler, as well as other rare bird species, which share habitat with the Aquatic Warbler in the project sites;
- **Vegetation monitoring** will be carried out in all project sites in order to identify peculiarities of plant communities in the Aquatic Warbler habitats, and areas where the conservation actions will be carried out. This sub-action also will include assessment of biomass accumulation rate, which allows the evaluation of site productivity and foresees frequency of future management activities;
- **Invertebrate monitoring** will focus on evaluation of species diversity and quantity of flying, hortobiontic and herpetobiontic insects and other invertebrates, which form food base for Aquatic Warbler;
- **Hydrological monitoring**, which includes remote automatic registration of water level fluctuations in all the project sites, will collect data on hydrologiel regime. It will also help to track the progress of the water level management in those project sites, where special water regulation measures will take place;
- **Aerial mapping** of the project sites will be implemented, to perform detailed vegetation mapping, and evaluate precise qualitative and quantitative changes in habitat structure. This sub-action will help to evaluate efficiency of implemented conservation measures as well.

Socio-economic impact of the project shall be monitored by action D2. The action is developed according to the LIFE+ 2015 guidelines and it is one of the obligatory actions of the project. It aims to deliver systematic impacts assessment on the local economy and society. The assessment will be implemented by two different methodologies:

- Assessment of the impact to provisional ES, wich have direct impact to socio-economic indicators. Provisional ES services and socio-economic indicators will be evaluated mostly by bio and geo reference and statistical data (some of the indicators listed in the project performance indicators in LIFE+ 2015 call);
- Evaluation of changes in social perception to cultural ES services using questionnaire and interviewing the representatives of the reference group.

D3 action is proposed to monitor an impact assessment to ecosystem functions. Though the project aims to have an impact on Aquatic Warbler habitats and species protection state, in a broader scope it also has an impact to ecosystem services. Within action D3 only regulatory ES will be assessed as these services are mostly related to ensure ecosystem functionality.

¹ For detailed description of the actions, please read the project application.

3. Introduction to Bird monitoring

Bird monitoring focuses on obtaining data on breeding populations of Aquatic Warbler and other rare birds, that are found breeding in the project sites, share the habitats with the Aquatic Warbler, and are expected to benefit from habitat management activities, that will be implemented during the project. Bird species, that are likely to be detected in the project sites are Spotted Crake, Corncrake, Great Snipe and others. The aim of the bird monitoring is to obtain reliable data on bird populations in the project areas, track how they change during the project time, and to assess the impact of project management activities. Full list of species, which will be addressed during the bird monitoring is given in Table 1.

Bird surveys will be held during the breeding season May-July. Depending on the breeding biology of the species, two or three rounds of bird counts will be held during each breeding season, to obtain reliable data on abundance of local population. During the 1st round of counts, which will be held in May, early breeding species, such as Citrine Wagtail (*Motacilla citreola*), Common Redshank (*Tringa totanus*), Black-tailed Godwit (*Limosa limosa*), Eurasian Curlew (*Numenius arquata*), Short-eared Owl (*Asio flammeus*), Montagu's Harrier (*Circus pygargus*), Great Snipe (*Galinago media*) and Spotted Crake (*Porzana porzana*) will be censused. During the 2nd round of bird counts, which will be held in June, the second census of early breeding species will be performed, as well as first census of singing males of Aquatic Warbler. First counts of Corncrake will be performed in June as well. During the 3rd round of counts, second census of singing males of Aquatic Warbler will be performed. At the same night calling males of Corncrake will be counted for the second time. Full time-frame of bird censusing activities at the individual project sites are given in the Table 2.

All the bird monitoring activities will be performed by experienced observers (ornithologists), who are involved in long-term monitoring programmes of the Aquatic Warbler at the national level, and are familiar with the biology and monitoring methodology of the other bird species, which populations will be monitored as well. National bird monitoring team leaders and persons responsible for data processing will be appointed by the project manager. Data on changes of habitats quality and distribution during the project time will be collected through implementation of vegetation monitoring.

Table 1. Species monitored according to project sites concerned

Species	Project sites						
	LT/01-Tyrai	LT/02-Apvardai	LT/03-Zuvintas	LT/04-Sysa/Sausgalviai	BY/05 – Dokudovskoe	BY/06-Servech	BY/07-Zvanets
Aquatic Warbler (<i>Acrocephalus paludicola</i>)	x	x	x	x	x*	x	x
Great Snipe (<i>Galinago media</i>)	x			x	x*	x	x
Citrine Wagtail (<i>Motacilla citreola</i>)	x	x	x	x	x	x	x
Common Redshank (<i>Tringa totanus</i>)	x	x	x	x	x	x	x
Eurasian Curlew (<i>Numenius arquata</i>)	x	x	x	x	x	x	x
Short-eared Owl (<i>Asio flammeus</i>)	x	x	x	x	x	x	x
Black-tailed Godwit (<i>Limosa limosa</i>)	x	x	x	x	x	x	x
Spotted Crake (<i>Porzana porzana</i>)	x	x	x	x	x	x	x
Montagu's Harrier (<i>Circus pygargus</i>)	x	x	x	x	x	x	x
Corncrake (<i>Crex crex</i>)			x	x		x	x
Migratory birds	x	x	x	x	x	x	x

* - activities will only take place after the implementation of action C2.

3.1. Detailed monitoring methodology for the Aquatic Warbler (*Acrocephalus paludicola*)

Populations of the Aquatic Warbler will be censused using adjusted mapping methodology. During the census observers will walk entire breeding area at the evening, recording locations of all calling males. Data on all observed birds are entered in a special field datasheet (Annex 1), while locations of all the individual males also are marked on the map. Two visits to each area during one breeding season will be used to map all the calling males of Aquatic warbler.

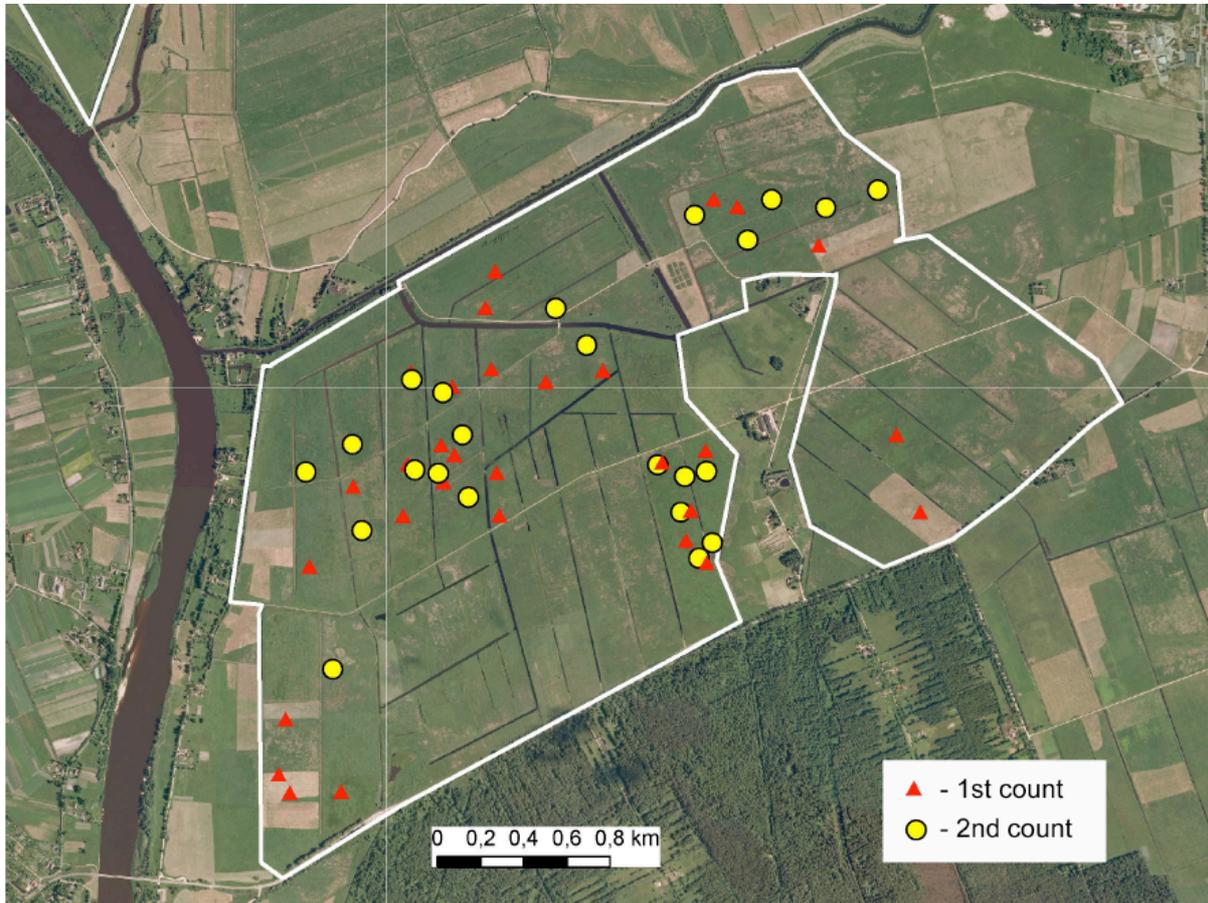


Fig. 2. Distribution of Aquatic Warbler singing males in LT/04-Sysa/Sausgalviai project site from previous Aquatic Warbler conservation project (LIFE09 NAT/LT/000233, 2010-2015)

Aquatic Warbler males will be censused in all project sites every year starting from 2017 and finishing in 2022, except in project site BY/05 - Dokudovskoe, because at the moment it is a bear peatland, and only after the C2 action will be implemented, bird monitoring activities in this project site will be applied. Bird census of entire study area (mapping of all singing males in the whole area of project site) will be applied in all project sites, except BY/07 - Zvanets, where due to big area of the project site, singing males will be counted in the two preselected 1,5-2 km long and 200 m wide transects. The results of these counts will be extrapolated into the whole area, taking into account quantity and distribution of suitable habitats.

In separate small areas (up to 30 ha), which are distributed among reedbeds and bushes or having clear boundaries in nature (ditches, roads), full mapping of singing Aquatic Warbler males can be carried out by one person. Suitable plots should be highlighted on the maps, and during the counts, locations of every singing Aquatic Warbler male are marked there.

Carrying census on larger areas (over 100 ha) with even vegetation, suitable for Aquatic Warbler, censuses are performed by group of observers. Number of participants of the count should be calculated depending on the size of the area, assuming that distance between each person should be 50 meters. All the observers should form the row and move forward at the same speed, counting singing males from one side only, to prevent double-counting of the same birds. The length of transect covered in one evening, should be not longer than 1500 m. For

larger areas, covering few square kilometers, total area should be split into smaller ones, and natural boundaries, such as roads, ditches, dams, tree lines, etc. should be used if possible. The size of the smaller plots may vary, but should not exceed the area coverable by 5-7 people per one evening. If there are no clear natural boundaries, GPS receiver should be used to maintain bird counting in preselected area only. It is advisable during the census to use printed 1:10 000 scale maps, with all the important landmarks on it.

For each territory a field data sheet (Annex 1) should be filled. Locations of all the singing males should be marked on the map as precise as possible. In more complicated areas all measurements/evaluations of vegetation and water coverage should be made at daytime, in order to save time during the counts. In areas where detailed maps of vegetation have been already produced, it is advisable to use these maps during the counts.

Timing of the census. It is necessary to perform 2 census repeats during the breeding season, as those are associated to 2 breeding cycles of Aquatic Warbler. First count should be carried out between 20th of May to 10th of June, second – between 25th of June to 10th of July. Counts of singing males are being performed in the evening. It starts 2 hours before sunset and lasts no more than 3 hours. The counts must be finished in 1 hour after sunset. Counts could be carried out on the evenings without or with weak wind to ensure rather good audibility. Weak rain does not have bigger influence on singing males activity.

Initial data analysis. After finishing counts, all field datasheets and maps with locations of singing males, should be handled to responsible person (national coordinator). All data should be used to count number of calling males in each plot. Geographical coordinates of locations of all individual Aquatic warbler males could be obtained using GPS receivers during the count. However, in order to save time and avoid bird disturbance, coordinates could be obtained shortly after the counts, using GIS facilities (eg. GIS for desktop application or appropriate online GIS services). Maps, used by observers during the counts, should be used as a reference. After all counts are finished, Aquatic Warbler distribution maps in GIS format (one shape file for country) are being compiled and total number of singing males in the whole censused area being calculated. Each year, at the end of the census period, copies of filled field data sheets and ESRI shapefiles are forwarded to the coordinator of project monitoring activities. Deadline for the data submission is August 31st.

3.2. Monitoring methodology for Great Snipe (*Gallinago media*)

Populations of Great Snipe will be monitored in all project sites, where viable breeding populations has been observed before the start of the project – in sites BY/06-Servech, BY/07-Zvanets and LT/04 - Sysa/Sausgalviai. Meadows of Šyša and Sausgalviai are among a few known Great Snipe regular breeding sites in Lithuania, where the total number of individuals does not exceed 15 lekking males. Local population in BY/07-Zvanets is currently estimated at 20-30 lekking males. The aim of the monitoring is to evaluate exact number of lekking males in whole area of the project sites and to track annual changes.

Census of the Great Snipe is conducted at dusk, at males' displaying grounds (leks) within the period from the beginning of May to June, 10th. Two rounds of censuses should be conducted during the lekking period of Great Snipe: first – in the period from 1st to 20th of May and second – from 1st to 10th of July. Lekking sites are visited in the evening. Census should start one hour before the sunset, and could last till the sunrise, bearing in mind that activity of displaying males usually drops for one-two hours in the middle of the night. Males in the leks could be counted by their display voices, which could be heard from the distance of 30-40 m. Total number of completely finished songs per minute is calculated, which is divided by two (at later hours of the night - from 1,5), and thus the number of lekking males in the lek is obtained. Repeating this procedure for several times (usually 7 to 10 repeats are used), with a few minutes breaks, gives a fairly precise number of lekking males in particular lek.

If exact lekking places are not known, they could be located by visiting the site in advance, at the evening, preferably by 2 observers. The area should be walked all over from the perimeter to the center, trying to detect lekking males and places, which are suitable for lekking of the Great Snipe. Potential lekking grounds should be marked on maps and are visited later aiming to count all displaying birds. Every lek during the census should be observed from several points for the most accurate estimation of the number of displaying males.

When all the fieldwork is finished, data forms (Annex 2) and maps with marked locations of leks should be handled to responsible person. Finally, the total number of lekking males in the whole area being calculated and distribution maps in GIS format are compiled. Population unit for evaluation of population abundance is „calling male“.

Total number of lekking Great Snipes will be evaluated as a baseline in 2017. The censuses of Great Snipe will be carried every year from 2017 to 2022. Results of the counts will be presented in GIS format, where all the leks will be depicted as independent points, and number of lekking males for every lek of both – the 1st and the 2nd counts – will be shown in the separate fields of the attribute table in ESRI Shapefile format.

3.3. Monitoring methodology for Spotted Crake (*Porzana porzana*)

Populations of the Spotted Crake will be monitored in all the project sites with the aim to obtain exact numbers of calling males, and to monitor population changes in relation with the habitat management activities. Census of the Spotted Crake is conducted at night, during the first three hours after the sunset, and should be held within the period from the end of April to the end of May. During the period two or three census repeats should be performed by visiting all the project sites. If differences between the results of the first and second census are similar (the results differ by no more than 20%) the third census is optional. Size of the local population is determined according the census, during which the maximum number of calling males was obtained. However, account should also be taken of the fact that after the breeding pairs are formed, vocal activity of male Spotted Crake stops, hence the birds, which during subsequent surveys are being heard at the new locations, must be added to the birds of previous counts.

Depending on the distribution and size of the suitable habitats, census of Spotted Crake can be performed using different methods. In areas, where habitats are detected in isolated patches of different size, it is advisable to visit all the sites to determine the presence and abundance of Spotted Crake there. In sites where suitable habitats are found in large areas and are distributed evenly, counts of calling males could be performed using line transect or points transect methodology. An observer must take at least 5 minutes in one spot. If during this time the birds are not heard, it is necessary to broadcast recorded voice of male Spotted Crake for no more than 1 minute, and wait another 3 minutes. In this case, the total time of stay at one site or point is at least 8 minutes.

Ornitologists who carry out the counts of Spotted Crake, have to choose the most appropriate bird survey method, and decide on the best time for the counts, taking into account that the activity of Spotted Crake highly depends on wether conditions, as well as on hydrological regime in a particular spring.

The Spotted Crake counts will be performed every year from 2017 to 2022. Results of the counts should be sent to responsible person in the table, which is shown in Annex 2. The unit for evaluation of population abundance is „calling male“.

3.4. Monitoring methodology for Corncrake (*Crex crex*)

Populations of the Corncrake will be monitored in all the project sites, where the suitable habitats – natural and seminatural meadows – dominate in landscape. The aim of the monitoring is to assess exact numbers of calling males, and to monitor population changes in relation with the habitat management activities.

Counts of the Corncrake are conducted at night, during the first three hours after the sunset, and should be held within the period from the end of May to the end of July. During the period two count repeats should be performed by visiting all the project sites. First count should be carried out between 20th of May to 10th of June, second – between June 20th and 30th. Point counts or line transect metod should be used depending on the size of the area. If point counts are used, at least 5 minutes should be spent at one point. Size of the local population is determined according the census, during which the maximum number of calling males was obtained.

The Corncrake counts will be performed every year from 2017 to 2022. Results of the counts should be sent to responsible person in the table, which is shown in Annex 2. The unit for evaluation of population abundance is „calling male“.

3.5. Monitoring of Montagu's Harrier (*Circus pygargus*), Citrine Wagtail (*Motacilla citreola*), Common Redshank (*Tringa totanus*), Eurasian Curlew (*Numenius arquata*), Short-eared Owl (*Asio flammeus*) and Black-tailed Godwit (*Limosa limosa*)

As all these species prefer open habitats, are active during the day, are not very abundant and can be detected during the surveys of other birds, no special monitoring methodology is needed. Special attention should be paid to the search for these species only if during the breeding period (from the end of April to the end of June), researchers do not visit the project areas during the day. Then it is necessary to organise at least three visits per season during the daytime to all the project areas. Observations should be made early in the morning, starting one hour before sunrise and continuing for up to 3 hours after it. The recommended duration of one such survey at one area is at least 3-4 hours.

All observations of the species are recorded in observer's notes, aiming to be able to assess the abundance and breeding status of the birds in the project areas at the end of the breeding season. Therefore, all important details on birds' behaviour should be noticed during the observations. At the end of the season all data are summarized in the monitoring data table (Annex 2), which then are sent to the coordinator of the monitoring activities.

3.6. Monitoring of migratory birds

Since all areas of the project are dominated by open habitats, they are important not only as bird breeding sites, but also during the periods of bird migration attracts numbers of other migratory birds. For example, Lithuanian project areas LT/04-Šyša/Sausgalviai in the Nemunas River Delta, are designated as SPAs, aiming to ensure conservation of open flooded meadows which are important places for numbers of staging migratory geese, swans, various waders and other birds. Some habitat management activities, that will be implemented during the project, may also have an impact on habitat characteristics that are important for migratory birds, thus monitoring of migratory birds will be used for evaluation of such an impact. Additionally, numbers of staging migratory birds found in different project sites during the spring and autumn migration, will be used as an indicator in assessment of the project impact to ecosystem functions. Evaluation of function "Maintenance of life cycles of migratory birds" is foreseen to be used in project Action D.3 (Impact assessment to ecosystem functions) thus data on numbers of migratory birds should be collected in all the project sites.

The counts of migratory birds will be carried out twice during the project time: at the beginning of the project in years 2017-2018, and at the end of the project in year 2022. Maximum number of staging migratory birds during the spring and autumn migrations should be obtained in all the project sites.

In spring observers should organize three counts of migratory birds, focusing on three "peak" periods of the four species of most numerous staging geese: a) Greylag Goose (*Anser anser*) and Bean Goose (*Anser fabalis*), b) Greater White-fronted Goose (*Anser albifrons*) and c) Barnacle Goose (*Branta leucopsis*). The beginning of the first peak period (Greylag Goose and Bean Goose) may vary significantly in different years, and should be assessed by preliminary observations. In Nemunas River delta it usually starts in March. After obtaining the first peak and performing the counts in all the project sites, second count should be organized 1-2 weeks after the first count, and the third count – 1-2 weeks after the second. Thus counts of migratory birds in spring should take place in March-April. In autumn 5 counts should be organized during the period from September 10th to October 20th.

The aim of the counts is to obtain maximum numbers of most numerous migrants, that uses project areas as feeding or resting sites. Special focus during the counts should be taken to counting geese, swans and waders, in autumn significant numbers of staging Common Cranes (*Grus grus*) might be found. Observers should focus on obtaining bird numbers and exact identification of the species is not very important, because geese and waders usually form mixed flocks, and identification of the species during the counts would require disproportional amounts of time and efforts. It would be sufficient if only one or few most abundant species are identified, while other identified species could be indicated separately. It is desirable to evaluate total number of migratory species, either information on other rare species of migrating birds are welcome as well.

If monitored areas serve as a feeding grounds for migratory geese, counts are conducted during the daytime and could start 2 hours after the sunrise, and should be finished not later than 2 hours before the sunset. The counts should be finished as quick as possible, thus they could be performed by several (groups of) observers, who use the cars and counts the birds in preselected segments of counting areas using spotting scopes and binoculars. If the monitoring areas serve as a resting places for staging migratory birds, the counts should start early in the morning (1-0,5 hours before the sunrise), aiming to count all the birds, that spent the night there and are leaving the place for feeding. After the counts are finished, the data should be summarised by filling report table (Annex 3).

4. Vegetation monitoring

4.1. Overall goals and targets

Vegetation monitoring focuses on Aquatic Warbler breeding habitats and provides the information regarding distribution of plant communities, productivity of vegetation, including litter layer, vegetation coverage, vegetation structure changes during the lifetime of the project: removal of bushes, reeds and redundant biomass, regulation of water level in project areas. The purpose of the vegetation monitoring is to obtain and capture reliable data on the distribution of main vegetation types before and after the implementation of conservation actions. This

data would parallel with the results of Aquatic Warbler monitoring and other rare animal or plant species population dynamics, and will determine, how changes in plant communities affects these processes as well. It is also important to describe the main characteristics of vegetation types, which are typical habitats of Aquatic Warbler at present and to compare these optimal studied in other countries. This will allow estimating ecologically viable density of Aquatic Warbler in Lithuanian and Belarusian sites.

4.2. Methods

The method of work includes the solution of tasks by blocks:

- *Remote monitoring* – includes compilation of thematic maps of distribution of vegetation communities.
- *Ground monitoring* – includes gathering of complex ecological and phytocenotic parameters on permanent monitoring points.

In general, two visits during the June-August period are needed to be performed in each of the project sites. Monitoring will be carried out in all project sites, while in BY/05-Dokudovskoe vegetation monitoring will be performed every year from 2018, because extreme changes in the vegetation in BY/05-Dokudovskoe project site are foreseen, and therefore some uncertainties of how the vegetation succession will form is not clear: since there has not been any experiments for peatland rehabilitation by seedling sedges performed, the project will pay close attention to the succession of the vegetation in this project site.

Vegetation monitoring in different project sites will be organized by several project partners:

- BEF LT: LT/01- Tyrai, LT/02- Apvardai, LT/04- Sysa/Sausgalviai; LT/03- Zuvintas
- SPC - BY/05: Dokudovskoe, BY/06- Servech, BY/07- Zvanets

The final result of the vegetation monitoring is a GIS based layer of separate vegetation communities. Precise contours of plant communities will be depicted and labelled. Depiction of plant communities in Lithuanian sites will be performed by GIS expert in BEF, and depiction of plant communities in Belarusian sites will be performed by GIS expert of SPC. Example of preliminary result of vegetation monitoring is shown in the Figure 3.

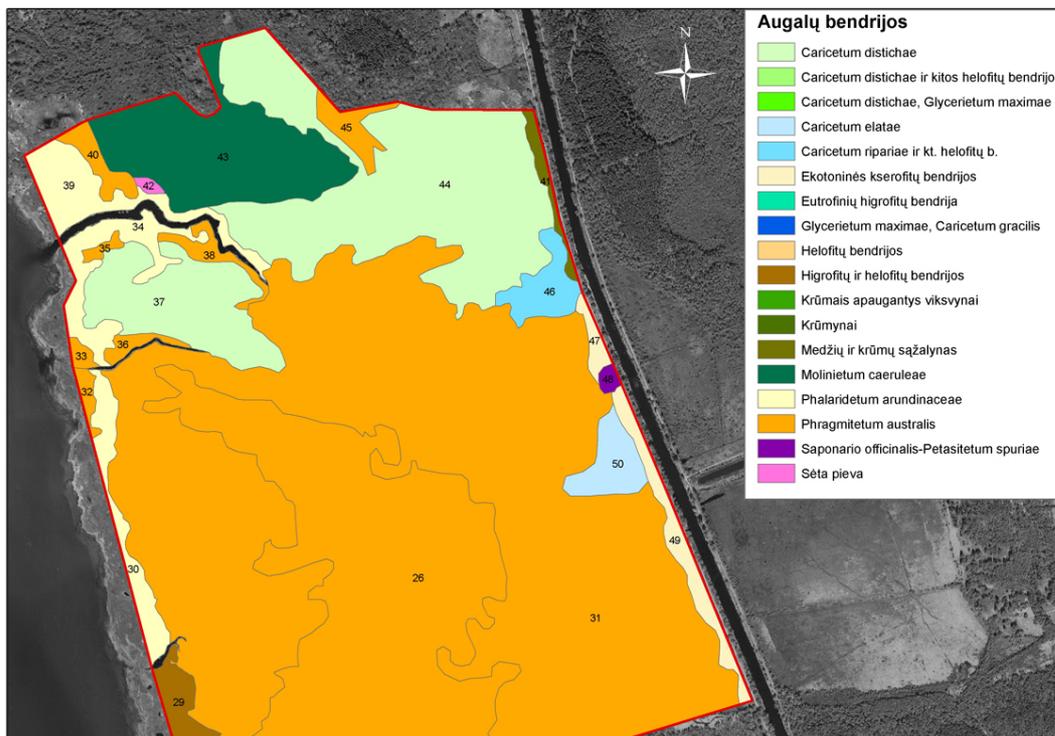


Fig. 3. Depiction of vegetation communities at the Tyrai bog made during previous Aquatic Warbler conservation project (LIFE09 NAT/LT/000233, 2010-2015).

Remote monitoring of vegetation communities

Work on compilation of geobotanical map includes the following stages:

- 1) *pre-field (cameral)* stage includes acquisition of fund data about the study area, selection of remote sensing imagery, primary processing of digital images and visualization of data, interpretation, automatic unsupervised classification, preparation of a preliminary map of vegetation communities;
- 2) *field investigation* stage envisages ground interpretation of distribution of vegetation communities based on materials of satellite remote sensing;
- 3) *post-field cameral stage* includes preparation of cartographic basis, systematization of field data, development of the final legend of the vegetation map, classification of reference patterns of images of vegetation communities for creation of cartographic models, conduction of supervised automatic classification, compilation of the map of vegetation.

Pre-field cameral stage

Selection of satellite remote sensing imagery. There are following requirements to the remote satellite imagery:

- multispectral sensing for synthesis of color images, using the near infra-red channel (NIR, length 0.7 - 1.3 mkm), which is the most informative for interpretation of vegetation cover;
- high resolution of sensing for reliable interpretation of objects with an area of up to 1.0 hectare;
- cloud-less (low-clouds, i.e. not higher than 10%) continuous sensing of the whole territory of the test site;
- affordable cost of space imagery data.

Given the existing financial capacities, remote sensing imagery from different satellite sensors (Landsat 8, RapidEye, Belarussian Spacecraft, Sentinel2) can be appropriate to use in the study areas (Figure 4). Besides the use of panchromatic and multispectral sensing, aerial photography data can be used. Images prepared on the basis of high-resolution and ultra-high-resolution photographs, available on geo services (Yandex Maps, Google Maps, Space Images, Bing), can also be used to validate the study results. The most precise data will be obtained surveying areas using drone.

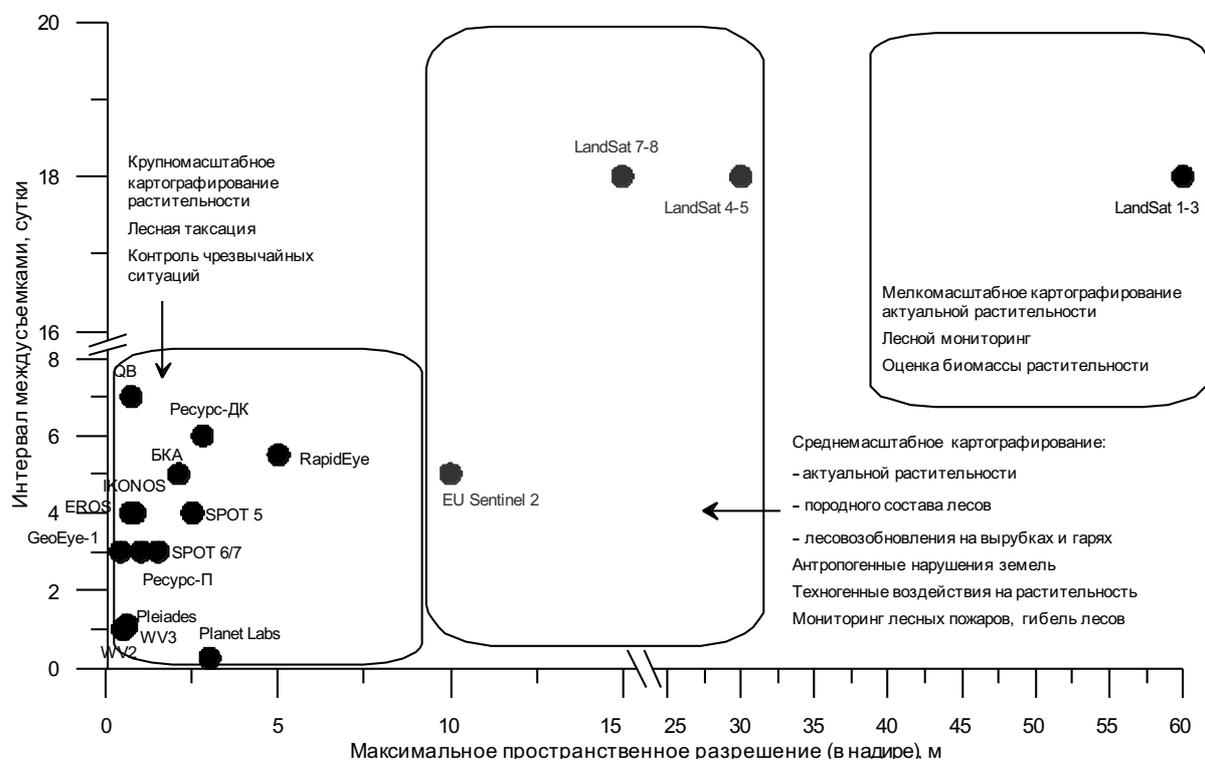


Fig. 4. Correlation between spatial and temporal resolution of images and tasks to be solved. Axis Y: Interval between surveys, days; Axis X: Maximal spatial resolution (in nadir), m. First chart dataset: Large-scale

cartography of vegetation (Forest Inventory; Disaster Control). Second chart dataset: Medium-scale cartography (Actual vegetation; Tree species composition of forests; Reforestation on felling and burned areas; Anthropogenic land disruptions; Anthropogenic impact on vegetation; Monitoring of forest fires, forest loss). Third chart dataset: Small-scale cartography of actual vegetation (Forest monitoring; Estimation of vegetation biomass).

Processing of remote sensing data is done using specialized software packages (ENVI, Erdas Imagine, ArcGIS), which allow the following actions: image input and formation; preliminary image processing (radiometric, geometric correction, noise reduction); creation of synthesized color images from a combination of spectral channels, etc.

Cameral pre-field interpretation (classification) of the territory. At the first sub-stage for easier interpretation the color composite images are compared with topographic map of the area, which allowed creating preliminary nature classification (typology) of the area. The most important parameters in interpreting are the pattern of the image, its morphological character, structural-textural and topological features. This work doesn't differ from commonly used approaches to preliminary expert interpretation of a territory. The preliminary legend is already a basis for the future final legend of the vegetation map.

At the stage of pre-field interpretation (classification) of the territory the *unsupervised automatic classification (isodata method)* is conducted in software package ENVI. Such processing gives the number of classes corresponding to the preliminary map legend, compiled during the study of the fund materials, literary sources, and visual interpreting of the territory. Automatic classification is carried out for the entire set of color composite images created on the basis of various syntheses of spectral channels.

Creation of the preliminary map (pre-map) is a closing stage of the preparation period. Composite color images are created (pre-map of types of interpretation units). Pre-map is the main material for planning the field study.

Field investigation stage:

The received information let us to target location of points for conducting geobotanical description to assess the accuracy of the distribution of vegetation communities received as a result of cameral interpretation. Number of description points should be increased for those vegetation classes, which distribution regularities are difficult to interpret uniquely.

During the field study data on the state of vegetation are gathered by means of classical geobotanical methods, but with use of GPS receiver to locate description points and route tracks.

When conducting the ground survey, the preliminary results of interpretation of space images are compared with ground data. Depending on the results obtained, previously allocated classes can be merged, or conversely, divided into several independent classes. The number of description points for each class can vary depending on homogeneity or heterogeneity of a pattern of vegetation cover image. The number of description points can be increased for all new or difficult for interpretation classes, so that it will be possible to gain a sufficient set of reference patterns during supervised automatic classification.

Additionally, there are special geobotanical description forms, which are filled in with information on vegetation state, succession processes, fires resistance, the main leading factors of natural and anthropogenic dynamics, presence of rare and protected plant species, etc.

Post-field cameral stage:

Cameral processing of the field data included several sub-stages.

Processing of geobotanical descriptions. Tables of descriptions of phytocenoses are made in the laboratory conditions. The database of geobotanical descriptions is created using a Microsoft Excel standard package, which enables the import (export) of data into other information analysis programs (JUICE, PC-ORD, ArcGIS and other). The geobotanical dataset is processed in a specialized program JUICE, and the algorithm includes the following sequential steps:

- sorting of geobotanical descriptions (manually and by TWINSpan method);
- analysis of the descriptions, revealing groups of diagnostic, constant and dominant species;
- compilation of the characterizing overview table of the mapped syntaxa.

Development of the final legend of the geobotanical map (of biotopes). Legend of the map can be constructed on the basis of ecological and floristic method (Braun-Blanquet method), or EUNIS biotope classification (not lower than 3-5 level of EUNIS classification).

Creation of the catalog of reference patterns of plant communities (biotopes). After developing the map legend, each geobotanical description is assigned a number of the map legend, and vector layer of field

reference patterns of vegetation classes is created. The quality of training samples is analyzed using instruments of training samples assessment in the Training Sample Manager. It was found that training samples are representative and statistically distinct.

Supervised automatic classification. Basing on the expert assessment, the final supervised automatic classification is conducted by means of Maximum Likelihood Estimation method, using the capabilities of software packages ArcGIS, ENVI.

Reliability of results is evaluated basing on calculation of percentage of correctly identified objects to the total number of classified objects. The reliability of the classification is first assessed visually, revealing the presence of blunders and inconsistencies.

Then the quantitative assessment is conducted, comparing the results of classification with reference plots. As reference plots we used the results of the ground observations, large-scale maps and images, fund materials. In case if the obtained results are found unsatisfied, then correction of the training sample is carried out (for example, by means of division of large classes to smaller ones) and the process should be repeated.

Generalization (process of generalization and geographic representation of the map content) is conducted at all stages of the map compilation, discovering new and general regularities at each level of the generalization. The geometrical and typological generalizations are carried out.

Geometrical generalization is aimed at merging of small types of vegetation communities with larger ones. In order to comply with the rules of geobotanical mapping (merging with the most ecologically and floristically close communities) contouring of polygons is performed manually. The filter is applied repeatedly; the result is controlled visually until an acceptable level of "smoothing".

Geographical generalization deals with a thematic selection of material, which is determined by the quality of the initial data, the purpose and scale of the map, the character of the territory and the complexity of the vegetation cover. Geographical generalization includes: selection of the main elements to be mapped, which matter for thematic content of the map; transition from lower classification units to higher levels of taxa, while removing transitional categories; selection of territorial structures of the vegetation cover using quantitative features of combinations of vegetation communities; merging of anthropogenic modifications of vegetation communities into the legend units; transition from series to generalized dynamic rows, reflecting spontaneous and anthropogenic dynamics of vegetation cover.

Analysis and design of the map is performed in ArcGIS program. Initially, the aggregation (merging) of spatial objects is conducted on the basis of the specified attributes (taxon code in the map legend). Areas of mapped units for compiled geobotanical map are calculated using the standard module built into the program platform ArcGIS.

In the center of each vegetation allotment, a number index is placed, corresponding to its content according to the working legend of the map, and the color of the allotment corresponds to the accepted color of the scale range. In the system of color-dashed notation, the color scale accepted in the domestic cartography was used.

As an example, we give a vegetation map and a map of biotopes of the project area "Servech (as of 2016) (Figures 6, 7).

If possible additional map of ecologically dangerous (conflict) situations of anthropogenic and natural origin, threatening the functioning of natural ecosystems, should be created (Picture 4). Essential in assessing the state of vegetation is the duration of exposure to a particular factor. Some of them have occurred quite recently, others influence for a long time and up to the present. Impact of some of factors has stopped in the last decade or earlier. This let to plan correctly actions for sustainable use of the biological diversity of the project areas.

Method of ground monitoring²

At the second stage of the study the part of the project area is selected for implementation of measures for management of fen mires. This plot can be selected by the expert way (on the basis of proportion of the main vegetation types) (Figure 5), or based on the distribution of indicator animal and plant species (Picture No. 6). If the geobotanical map (or map of distribution of indicator species) is compiled correctly, locations of these plots will coincide.

² The methodological approach is described based on example of one specific project area (BY/06-Servech), but should be applicable for all project sites.

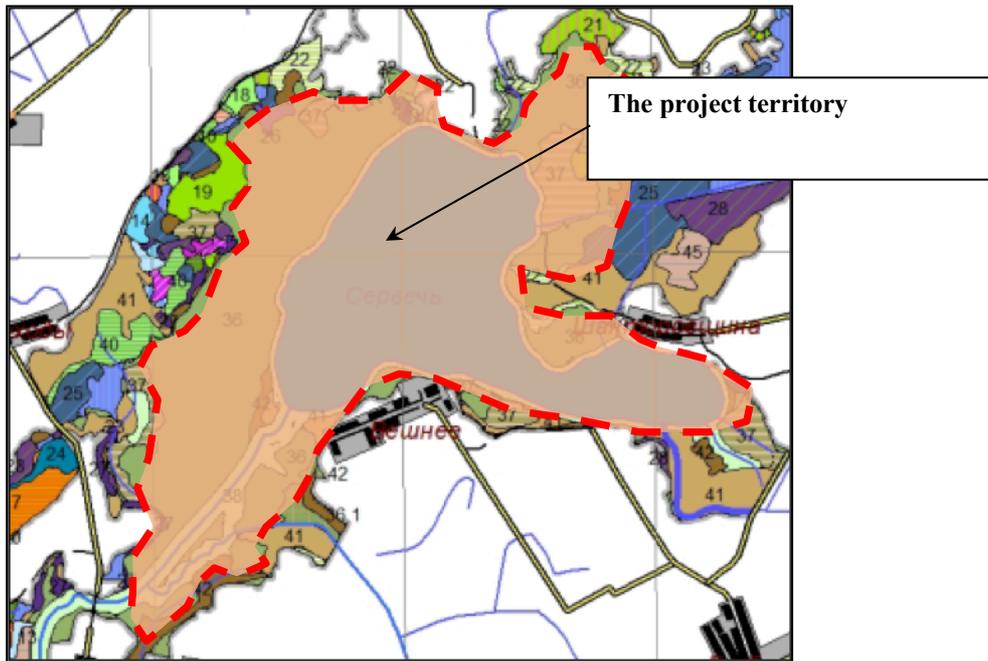


Fig. 5. Borders of the territory “Servech”, which is selected for implementation of measures for sustainable management of fen mires (compiled on the basis of proportion of the main vegetation types)

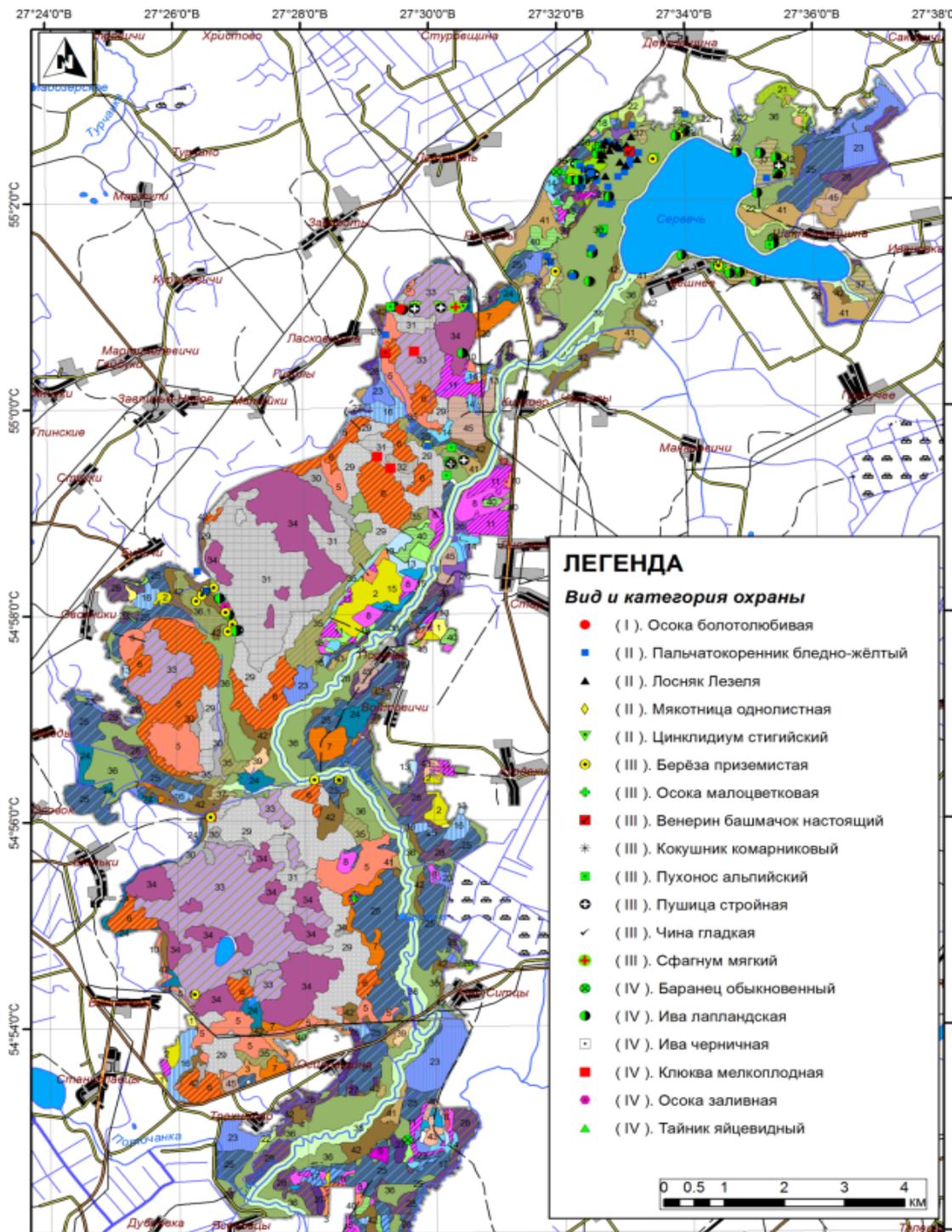


Fig. 6. Vegetation map of the project area “Servech” (2016). Legend – Species and category of its protection (in brackets): *Carex helionastes*; *Dactylorhiza ochroleuka*; *Liparis loeselii*; *Malaxis monophyllos*; *Cinclidium stygium*; *Betula humilis*; *Carex pauciflora*; *Cypripedium calceolus*; *Gymnadenia conopsea*; *Trichophorum alpinum*; *Eriophorum gracile*; *Lathyrus laevigatus*; *Sphagnum nitidum*; *Huperzia selago*; *Salix lapponum*; *Salix myrtilloides*; *Oxycoccus microcarpus*; *Carex magellanica*; *Listera ovata*

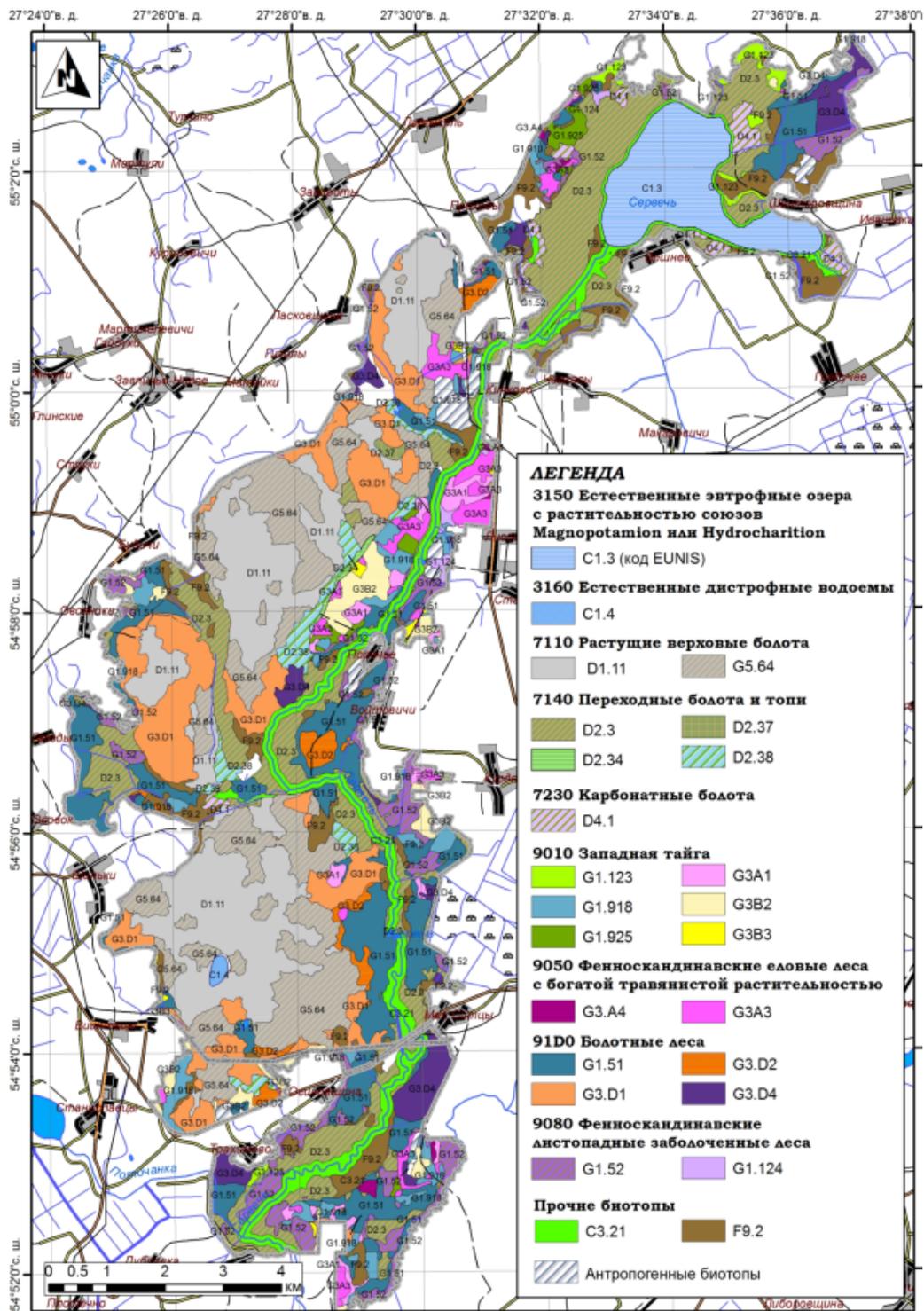


Fig. 7. Map of habitats of the project area “Servech” (EUNIS classification, divided by groups according “NATURA 2000” classification). Legend: 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*; 3160 Natural dystrophic lakes and ponds; 7110 Active raised bogs; 7140 Transition mires and quaking bogs; 7230 Alkaline fens; 9010 Western Taiga; 9050 Fennoscandian herb-rich forests with *Picea abies*; 91D0 Bog woodland; 9080 Fennoscandian deciduous swamp woods; Other biotopes (C3.21; F9.2); Anthropogenic biotopes.

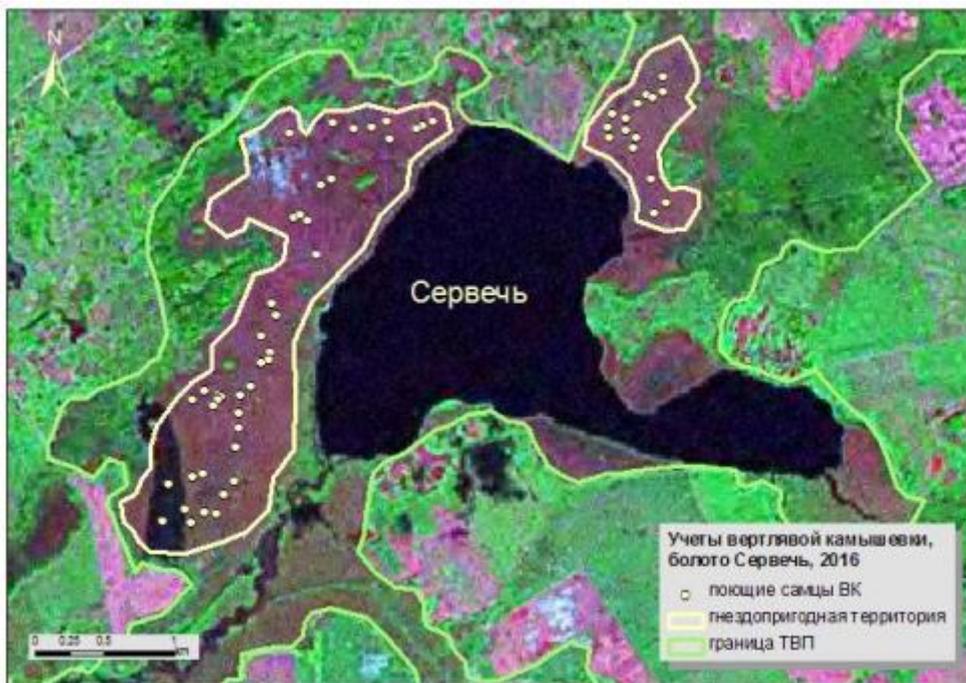


Fig. 8. Borders of the territory “Servech”, which is selected for implementation of measures for sustainable management of fen mires (compiled on the basis of Aquatic Warbler counts).

Then the plot of size 100×100 m is marked out, where the influence of the measures for the sustainable management of fen mires will be studied (for example, mowing, fire management, water level regulation) (Figure 9).

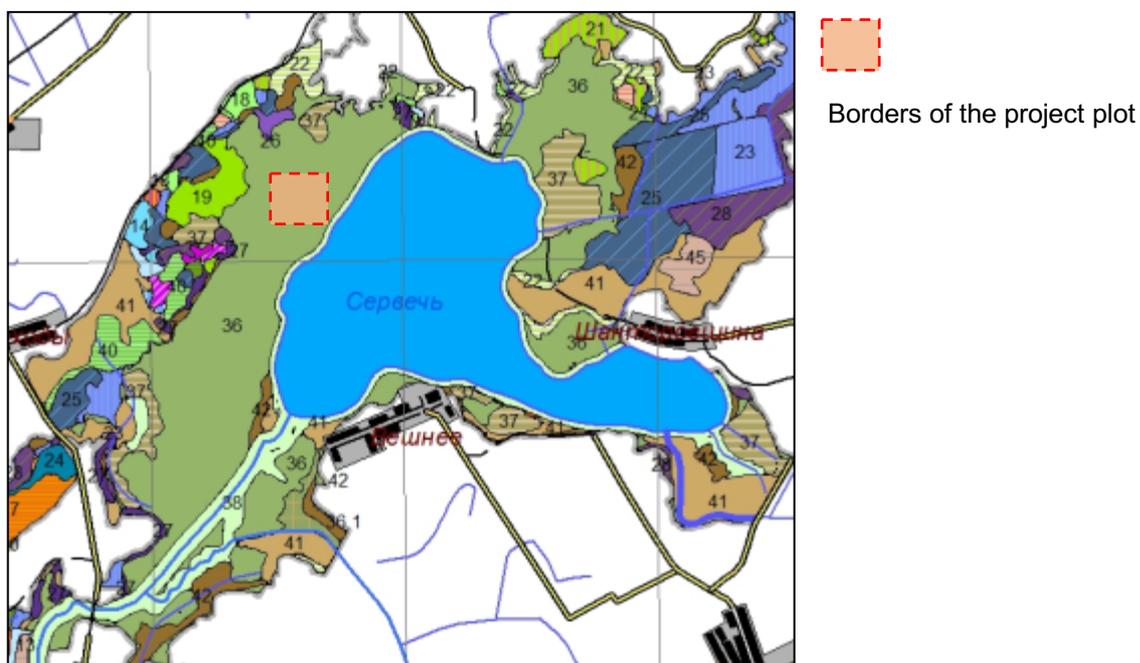


Fig. 9. Location of the plot, where the influence of the measures for the sustainable management of fen mires will be studied.

Actions to be implemented within the plot:

1. Detailed large-scaled maps are compiled (1:500 – 1:10 000), which traditionally used for assessment of territories, subject to any action.

2. For stationary studies that include an instrumental survey of a complex of ecological and phytocenotic parameters, it is necessary to establish several permanent trial plots. Trial plots (size of 10×10 m) are instrumentally bounded by sight lines 0.5 – 1.0 meters wide, their corners are marked with poles. Location of the permanent trial plots is registered in the field by GPS. Trial plots should be placed along the line (ecological profile) (Figure 10).



Fig. 10. Recommended scheme for location of the permanent trial plots.

Together with the system of the monitoring points, where the project actions will be implemented (mowing, fire management, etc.) the system of **control samples** is established, where conservation actions will not be conducted.

To study the influence of **mowing** the following control options are established:

- Control permanent trial plot (system of trial plots) without impact of management actions
- Twice repeated mowing (the end of June, the beginning of August)
- Mowing once at the beginning of August.

To study the influence of **the fire management** the following control options are established:

- Control permanent trial plot (system of trial plots) without impact of management actions
- Trial plot with fire management (100×50 m)
- With uncontrolled burning (if it happens).

To study the influence of **chemical methods** of reed elimination (if not prohibited by law):

- Control permanent trial plot without impact of management actions
- Use of chemicals at the beginning of August.

Detailed description of vegetation monitoring

Vegetation monitoring is conducted in order to detect changes in vegetation over the period of project in selected sites. The main aim is to determine vegetation composition, structure and condition and if it changes in response to management activities, then how.

Monitoring program main applications are:

- Study of distribution of associations in the vegetation cover of the trial plot (large-scale mapping of the 100×100 plot);
- Study of features of the tree layer (if present);

- Assessment of the state of undergrowth of the main forest-forming tree and shrub species (number, height, age, living condition);
- Study of features of grass-dwarf shrub and moss storeys (species composition, projective coverage, phytomass, development of indicator species);
- Study of 10x10 fields' vegetation (species composition, projective coverage, phytomass, development of indicator species).

Study of distribution of associations in the vegetation cover of the trial plot (large-scale mapping of the 100x100 plot)

Selection of 100x100 m plots is described previously. This application is done in order to determine the homogeneity of vegetation associations distinguished by remote monitoring. Coordinates of these plots are registered in the center of each plot. A relevé of representative 1m² plot is made in order to ascertain more accurate habitat with it's dominant plant species. If vegetation is more heterogeneous then few more relevés can be done.

Study of features of the tree layer (if present)

Forestry-taxation characteristic of tree stands (in case of forested mire) on the trial plot is described using the instrumental taxation. Processing of the forestry taxation materials is done by the standard methods (Zacharov, 1967; Anuchin, 1982). In a case of tree presence, random 5 trees are selected. Their height is measured using altimeter and at the height of 1,3m the diameter is determined with caliper.

Assessment of the state of undergrowth of the main forest-forming tree and shrub species (number, height, age, living condition)

Undergrowth of forest-forming tree species, understory, depending on their density, are studied by the total count, or by count on 5 count plots size of 2x2 m, situated on the permanent trial plots as an envelope (in the corners and in the middle). The following parameters are recorded on the permanent trial plot:

- Shrub cover of the area;
- Height of the shrubs generally and on the example of one bush;
- Thickness of stalks generally and on the example of one bush ;
- Number of stalks (on the example of one bush to estimate renewal after the impact);
- Biomass per hectare;
- Terms of maturation and dispersion of seeds.

Study of 10x10 fields' vegetation (species composition, projective coverage, phytomass, development of indicator species)

10x10m plot's traits are evaluated. First of all GPS-coordinates are registered. Then the structure parameters (forested, shrubby, even surface, etc.) are determined. If there is any open water then abiotic parameters (conductivity, pH level) and height above the soil surface are measured. When the plot contains trees then they are measured as already mentioned earlier. Common information (like cover open peat, open water, brown moss, shrub, etc.) is evaluated by using Braun-Blanquet scale. The same scale is used define the coverage of each herbaceous species. The survey of 10x10m plots is given in annex 7a.

Furthermore, in 10x10 m fields 25 random 1m² sized fields are chosen. Then they are thoroughly evaluated. This evaluation includes:

- Coverage (%) of the layers (divided in to shrub, herb, bryophyte, open ground and dead phytomass layers);
- Coverage (%) of the plant groups (*Phragmites*, *Carex sp.*, other herbs, braun mosses, *Sphagnum spp.*);
- *Phragmites* individuals are evaluated separately (height and diameter of 5 random stems, number of alive and dead stems);
- Vertical structure is divided in to four layers and then the coverage (%) and height (cm) of each layer is evaluated;

- Then same parameters (coverage and height in four levels) evaluation for each herbaceous species is conducted;
- Bryophytes, shrub and tree species are evaluated separately. Bryophytes need to be identified and the percent of coverage is estimated. Shrub and tree species evaluation besides coverage requires maximum and minimum heights of individuals falling into 1m² fields, also the number of individuals and their condition is added.

After these steps are done then survey of the above-ground phytomass of the lower vegetation storeys is conducted on count plots size of 1×1 m or 50×50 cm depending on the grass density. The above - ground parts of vegetation are cut at the soil level fivefold. Count plots are situated on the permanent trial plots as an envelope (in the corners and in the middle). All species in the mowed vegetation mass should be defined. Different groups of plants (shrubs and dwarf shrubs, *Carex spp.*, other edicator, *Equisetum spp.*, *Poaceae*, *Phragmites australis*, other herbaceous species) need to be weighted separately. Samples of the above-ground parts are selected for subsequent laboratory analysis (calculation of air-dry and absolute dry weight, chemical composition).

Separately the biomass of the litter is weighed to estimate its influence on the productivity.

The survey of these 1m² plots is given in annex 4b.

The main results of the **monitoring study for the whole object** are:

- vegetation map;
- areas of the main vegetation communities before and after the project;
- general characteristic of the main vegetation communities.

Vegetation monitoring to assess the management efficiency on the plots where habitat management activities are carried out

1. Assessment of the ratio of vegetation communities on the plot 100×100 m, on the basis of the detailed large-scale mapping of vegetation
2. Vegetation description of the monitoring plots
 - Characteristic of the tree layer (if present);
 - Assessment of the state of undergrowth of the main forest-forming tree and shrub species (number, height, age, living condition);
 - Characteristic of grass-dwarf shrub and moss storeys (species composition, projective coverage, phytomass, development of indicator species).
 - Mire water: the depth of occurrence, pH, electrical conduction (May-September). During the fieldwork assessment of physical and chemical parameters of unfiltered mire water (pH, electrical conductivity) is carried out using the portative pH-meter with built thermosensor and conductivity measuring instrument.
 - Chemical composition of the water (May, August). The general mineralization of mire water is measured twice a year: in May and August. The detailed analysis of the water quality is conducted once – in May (see Annex 4 for details on chemical composition investigated).
 - Chemical composition of the peat (August, on plots, where the fire management is planned).

Monitoring of habitats and species protected under the EU Habitats directive 92/43/EEC

Since there are habitats and species that are under protection of the EU Habitats directive 92/43/EEC (further in text “habitats/species of EU importance”) and other rare plant species found in the project sites, all data on their distribution, status, quantity and trends will be collected during implementation of vegetation monitoring activities in all project sites. Mapping and monitoring of habitats of EU importance will be a derived result from the vegetation monitoring and multispectral aerial photos, which will be taken using drone and analysed in accordance with the procedure described in chapter 4.2.1. Baseline data will be presented in a monitoring report after the action will be implemented in 2018. Assessment of state of natural habitats and rare plant species will be applied twice: as a baseline in 2017 (rare species) and 2018 (natural habitats) and at the end of the project – in 2022.

5. Invertebrate monitoring

5.1. Overall goal and targets

Main insect species diversity and quantity indicates the food availability for the Aquatic Warbler. This monitoring will be performed in the project sites, where water level management and prescribed burning actions will be performed. As invertebrates are the main food source of Aquatic Warbler, such monitoring is very important to establish the most effective management scheme for large areas.

Invertebrate monitoring is composed of 3 stages:

- Monitoring of the hortobiontic (living in grass layer) insects. For this type of monitoring insects inhabiting the grass layer will be monitored using sweep netting to catch insects. Samples are collected in series of 50 sweeps. Since there are to be 100 sweeps on every transect, it should be performed this procedure twice.
- Monitoring of flying insects. For this type of monitoring Malaise traps will be used to catch insects. They are particularly suitable for catching flying beetles and flies. Standard full-sized Malaise traps (2 m long by 1.2 m high, 1 m wide) will be used. A reasonably flat area of around 2 m² in the center of monitoring plot is chosen for each monitoring plot.
- Monitoring of the herpetobiontic (ground beetles) invertebrates. For this purpose, plastic cups with an opening diameter of 72 mm and a volume of 250 ml are used as pitfall traps. At each site, 15 cups are arranged along the random rectilinear transect 5 m apart. One transect is used on every monitoring plot. (See detailed monitoring description in Annex 8).

As evaluation of number and abundance of pollinating insect species is foreseen as an indicator for assessment of ecosystem services (Table 7), data on pollinating insects should be reported for all the project sites. As there is no universal way to evaluate the pollination service, number of identified taxa and number of specimens of non-parasitic *Hymenoptera*, *Lepidoptera* and *Diptera* should be presented.

Monitoring of invertebrates will be performed according to the BACI scheme (Before - After - Control – Impact) – on specific monitoring transects (Fig. 11.), i.e. on transects, where Aquatic Warbler's habitats (also the potential ones) shall be modified, and on control transects (where no modifications will take place). Monitoring will be performed in the same sample areas, where vegetation monitoring will take place.

5.2. Detailed description of invertebrate monitoring

Monitoring of the hortobiontic insects

Sweep netting method is the most universal, simple and informative to collect insects inhabiting the grass layer. The sweep netting method is considered the most feasible method for real-time sampling of a large number of sites and has been widely used in dietary studies of grassland birds (Robel et al. 1995).

Dimensions of the sweeping net: 35 cm diameter, with a cloth bag of 70 cm length, 80 cm handle.

Sweeping is carried out between 10 am and 5 pm, we propose the time between 10 and 12 a.m.

Weather conditions: Performed on sunny and windless days, not or partly clouded, no or little wind, dry vegetation. The sweep net must not get wet since then it becomes useless. If it is cloudy and wet, invertebrates hide among the plants and it is difficult to catch them. The sweep net should be held as low as possible, without hitting the ground.

Samples are collected in series of 50 sweeps. Since there are to be 100 sweeps on every transect, you should perform this procedure twice. While sweep netting, you should not stop or look inside the net, since the invertebrates may escape.

The monitoring plot for study is a square with every side 100 meters long. Four series of sweeps will be done from the center to every corner of the plot (Figure 11).

After 50 sweeps, carefully place the net in a plastic bag with ethyl acetate (put a soaked swab into the bag), close the bag for 10 min, subsequently pour (by turning it inside-out) the dead invertebrates from the net into the bag, put a label inside (use a pencil!) and tie it up. There must be air in the bag, because if you try to "squeeze it out", the sides of the bag shall stick together and the insects, especially the smaller ones, may be crushed. After fieldwork, the bags should be stored in a refrigerator. In the laboratory, place the collected material using tweezers in a test-tube (carrying necessarily a label) or a small container filled with 70 percent alcohol. Do not cram the insects, because they become crushed and it is difficult to identify them. The containers ought to be dense, so that the alcohol does not evaporate.

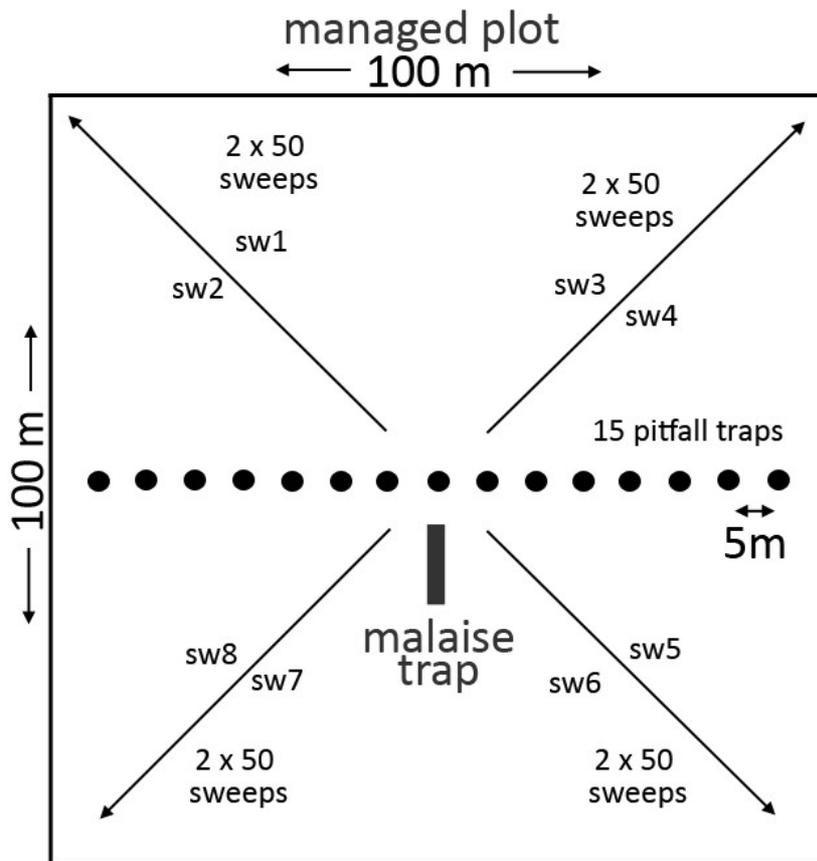


Figure 11. Outline of the monitoring plot with indication of the methods of invertebrate monitoring (designed for 8 series of 50 sweeps).

Sweeping samples will be collected at the time of early (from the 1st to 20th June) and late (from the 1st to 20th July) broods. The collected invertebrates will be identified to the so-called practical taxonomical level (usually order) to adult or larva, and after measuring assigned to size classes. Weight was calculated using reference curves (Tanneberger et al. 2013) derived from dry weight determination of reference samples for large taxonomic groups. Weight data were combined to weight classes (1–5 mg, 6–10 mg, 11–20 mg, > 20 mg). Reference curves for length–weight transformation and the studied length spectrum they are valid for (in brackets). x = length (mm), y = weight (mg):

- Arachnida: $y = 0.447e^{0.3389x}$ (2–12 mm)
- Mollusca: $y = 0.6383e^{0.2894x}$ (1–15 mm)
- Coleoptera: $y = 0.0533x^{2.3191}$ (2–12 mm)
- Diptera: $y = 0.3313x$ (2–17 mm)
- Heteroptera: $y = 0.332e^{0.2573x}$ (2–10 mm)
- Homoptera: $y = 0.5373e^{0.2239x}$ (2–9 mm)
- Hymenoptera: $y = 0.0779x^{1.8611}$ (2–31 mm)
- Lepidoptera larvae: $y = 0.0162x^{2.3209}$ (9–42 mm)
- Lepidoptera adults: $y = 0.4223e^{0.254x}$ (6–21 mm)
- Odonata: mean Zygoptera weight 11 mg; mean Anisoptera weight 56 mg
- Orthoptera: $y = 0.4477e^{0.25x}$ (2–14 mm)
- Trichoptera: $y = 0.0885x^{1.8926}$ (3–13 mm)

Tanneberger F., Bellebaum J., Helmecke A., Minets M. 2013. Nesting and foraging characteristics of Aquatic Warblers *Acrocephalus paludicola* in the fast declining Pomeranian population (NE Germany/NW Poland)(Acta Ornithol. 48: 109–118. DOI 10.3161/000164513X670061). Robel R. J., Press B. M., Henning B. L., Johnson K. W., Blocker H. D., Kemp K. E. 1995. Nutrient and energetic characteristics of sweep-collected invertebrates. J. Field Ornithol. 66: 44–53.

Monitoring of flying insects

Malaise traps are ‘tent-like’ passive intercept traps that primarily catch flying insects. Malaise traps are particularly well suited for inventory because they catch a wide variety of flying insects and some ground active insects that climb. They are particularly suitable for flying beetles and flies. Malaise traps are simple, easily transported, erected and serviced. They will work continuously once set. Malaise traps are useful for monitoring whether a species is present or absent, and its relative abundance. This is because they are simple, work passively, and are easily operated.

Standard full-sized Malaise traps (2 m long by 1.2 m high, 1 m wide) will be used. A reasonably flat area of around 2 m² in the center of monitoring plot is chosen for each monitoring plot. Trap corners are tied out so the structure is erected like a tent. The collection jar is located at a high point at one end of the trap and the collection jar filled with 70% propylene glycol. The traps are tied to existing vegetation in order to minimize trap-site disturbance. Malaise traps should be set up so the highest point faces north, the brightest direction.

The traps will be inspected every 10-14 days, twice in June and in July.

Monitoring of the herpetobiontic invertebrates (to assess the effects of natural and man-made disturbances)

Herpetobiontic insects, especially ground beetles (*Carabidae*), living on the soil surface are the most appropriate object for ecological monitoring due to their sensitivity to the different disturbances. Plastic cups with an opening diameter of 72 mm and a volume of 250 ml are used as pitfall traps. A formalin mixture (4 %) or propylene glycol is used as a fixing agent. The cups are filled by fixing liquid up to 1/3. At each site, 15 cups are arranged along the random rectilinear transect 5 m apart. One transect is used on every monitoring plot.

The traps will be inspected every 10 days from the 1st June to 20th July.

The following classes of beetle abundance are determined to estimate the association dominance structure: dominants – species with abundance more than 5%; subdominants – abundance from 2 to 5%; recedents – abundance from 1 to 2%; subrecedents – abundance less than 1%.

5.3. Timing of invertebrate monitoring

Approximate timetable for monitoring is presented below:

- June 3-5 sweep+malaise+pitfall setup
- June 14-15 pitfall, malaise change
- June 25-26 pitfall, malaise change
- July 3-4 pitfall, malaise change
- July 13-14 sweep, pitfall, malaise change
- July 22-23 pitfall, Malaise collect

Baseline of the data will be set in June-July, 2017 in all project sites in Lithuania: LT/01-Tyrai, LT/02-Apvardai, LT/03 - Zuvintas, LT/04 - Sysa/Sausgalviai. In Belarussian sites - BY/05-Dokudovskoe, BY/06-Servech and BY/07-Zvanets invertebrate monitoring activities will start in 2018. Invertebrate monitoring will be performed annually. The schedule of monitoring for every type of invertebrate groups is provided in Table 2.

Table 2. Detailed schedule of invertebrate monitoring

June			July		
3-5	14-15	25-26	3-4	13-14	22-23
<ul style="list-style-type: none"> • 1st sweep netting • Malaise traps setup • Pitfall traps setup 	<ul style="list-style-type: none"> • 1st Malaise traps change • 1st Pitfall traps change 	<ul style="list-style-type: none"> • 2nd Malaise traps change • 2nd Pitfall traps change 	<ul style="list-style-type: none"> • 3rd Malaise traps change • 3rd Pitfall traps change 	<ul style="list-style-type: none"> • 2nd sweep netting • Malaise traps change • Pitfall traps change 	<ul style="list-style-type: none"> • Malaise traps collection • Pitfall traps collection

6. Hydrological monitoring

Water level dynamics during the vegetation period are measured to assess the amplitude of natural water level dynamic, and to estimate changes in those areas where water level regulation measures are going to be implemented. Special remote automatic water level gauges should be set up in each project area, in accordance with the manufacturer's instructions. Data from the gauges (water level monitoring devices) should be constantly downloaded and integrated into general monitoring database.

The water level data must be recorded twice a day during the entire vegetation period. The results of the dynamics in the water level of each individual project site at separate season should be presented graphically. The data must be processed according to the manufacturer's instructions, compensating the influence of the ambient air pressure to the initial data of measuring devices. Final results should be presented graphically, depicting fluctuations in water level in relation to the soil surface.

7. Areal mapping of project sites

Areal mapping of the project sites (Sub-action D1.5) is foreseen for 3 different purposes:

- Producing of high resolution digital maps from RGB and Multi-Spectral areal images for identification and monitoring of natural habitats in project sites (Action D.1);
- Producing of high resolution vegetation maps for exploration of selected potential “stepping stone” areas (Action A.3);
- Recording habitat restoration and other management activities performed in the project areas (Action C.1; C.4).

Areal images and digital maps for detailed mapping of vegetation will be produced 2 times: Ex-ante (2018) and Ex-post (2022) in all project sites, which in total cover 20 509 ha. Examination of preselected stepping-stone habitats for Aquatic Warbler will be done in 2018, during the vegetation period visiting the main sites and performing areal mapping for further analysis. Areal pictures in the sites, where concrete conservation actions take place, will precisely record results of habitat restoration, as well as will help track changes in hydrological conditions of the area. Gathered images will be used as a basis for all monitoring activities within actions D.1 and D.3, and will help to perform precise modelling of project impact to the target ecosystems.

8. Impact assessment of socio-economic impact to local economy, social development and ecosystem functions

8.1. Overall goal and targets

Assessment of socio-economic impact of the project actions on the local economy and population, and assessment the project's impact on the ecosystem functions are the obligatory actions according the guidelines of LIFE+2015 programme. The action will be implemented through the assessment of some socio-economic parameters and evaluation of Ecosystem services (ES), which could be assessed and measured during implementation of other project monitoring activities. To perform a baseline assessment, the profile of each project area will be developed at the beginning of the project (2017). Final (second) evaluation, consolidating data and results over the project lifetime, will be developed at the end of the project (2022).

Since the project foresees to evaluate project impact on socio-economic conditions and affected ecosystem functions, some of the bio and geo reference data gathered during the vegetation/invertebrates/hydrology monitoring and some extra data collected together with the general data will be directly used for the impact of socio-economic and ecosystem functions.

Action D3 aims to deliver impact assessment to be able to measure the project impact to ES. Though the direct contribution of the project is to restore Aquatic Warbler habitats, in the broader scope it has also an impact to ecosystem functions, which is defined as the capacity or potential to deliver ecosystem services. The goal of the action is to develop a report, which will compile results from all the monitoring actions and link these results to ES. The report will include a description of ES, which were impacted by activities of the project, linkage of ecosystem functions to socio-economic indicators, and results from stakeholder perception to concrete conservation actions.

8.2. Methods employed

The action D2 will be implemented using two different methodologies:

1. Evaluation the impact of project activities to relevant **provisional** ES and to socio-economic indicators;
2. Assessment of change in social perception to **cultural** ES and importance of nature conservation actions.

The value of provisional ES will be identified based on monitoring data and analysis of some external data sets. An assessment of the socio-economic impact of the project actions on the local economy and population will be determined using the following indicators: implication of NGO, employment, economic growth, payback time, continuation/replication/transfer/scope and costs. Change in social perception to cultural ES will be assessed during social survey of the preselected group of project stakeholders (reference group).

The social survey will be based on face-to-face interviews with selected stakeholders and experts from following sectors: ornithology (professional ornithologists, bird photographers, professional birdwatching guides and birdwachers), botany (scientists), land management (specialists at local municipalities), agriculture (farmers; specialists at local municipalities) and landscape (scientists; specialists of protected areas). An additional group of interviewed persons will consist of visitors from the project area (local or foreign tourists, birdwachers, fishermen and other visitors of the site).

Before the first survey, a target group of 30-40 people must be formed, covering individuals from all of the above-mentioned social sectors. Since the survey will have to be repeated at the end of the project (after 5 years) it is likely that the same people will not be interviewed. Therefore, during the second survey, the same number of respondents in each social sector should be interviewed and the aim should be to match the number of respondents interviewed during the first survey with the duties or professional qualifications in the first interview. The number of visitors of the surveyed areas should remain the same as in the first survey. It is desirable for at least 10 people (visitors of the area) to be interviewed in each project site.

Within D2 action impact to provisioning ES will be assessed mainly by monitoring data, geo reference data, statistical data collected from available data sets at the central statistical bureau, subordinated institutions of the Ministry of Environment and Ministry of Agriculture, as well as from local authorities. Some provisional ES will be assessed by interviews with land-owners (eg. evaluation of produced animal/plant biomass), while impact to cultural ES will be mainly assessed by face-to-face interviews with site visitors and experts from the different professional sectors.

Within action D3 regulatory ES will be assessed, because ES are mostly related to ensure ecosystem functionality. The relevant ES categories will be selected according to the Common International Classification of Ecosystem Services (CICES), while specific indicators and assessment methodology were selected following recommendations of working group of Mapping and Assessment of Ecosystems and their Services (MAES).

8.3. Time frame for the assessment

Baseline for the assessment will be set in 2017. A second assessment will be performed at the end of the project (in 2022) by applying the same methodology. As a result, baseline assessment report and Ex post assessment report will be compiled.

8.4. Classification of Ecosystem services, indicators and their assessment

Definitions of selected ES, methodological aspects of their evaluation are presented below, and are based on the Common International Classification of Ecosystem Services (CICES Version 5.1³) developed from the work on environmental accounting undertaken by the European Environment Agency (EEA). CICES is built on the principle that a classification of services needs to describe the contribution that ecosystems make to human well-being, defined in terms of “what ecosystems do”. Thus, in the classification the definition of a service highlights the ecological outcomes that particular ecosystem characteristics or processes generate, that can ultimately benefit people. The aim has therefore been to build a classification that identifies the purposes or uses that people have for the different kinds of ecosystem service and associate them with the particular ecosystem attributes or behaviours that support them. To emphasise the ‘purposeful’ nature of CICES, the definition of each service is

³ See: <https://cices.eu/resources/> for more details on ES classification and technical guidance.

made up of two parts, namely a clause describing the biophysical output (i.e. the ‘ecological clause’ noting what the ecosystem does) and a clause describing the contribution it makes to an eventual use or benefit (“use clause”).

At the most general level of the hierarchical structure of CICES there are three categories (sections) of ES identified: “provisioning”, “regulation and maintenance”, and “cultural”. Below these sections are a series of “Divisions”, “Groups” and “Classes”. “Provisioning” services cover all nutritional, non-nutritional material and energetic outputs from living systems as well as abiotic outputs (eg. water). Section “Regulation and maintenance” includes all the ways in which living organisms can mediate or moderate the ambient environment that affects human health, safety or comfort, together with abiotic equivalents. The Division level therefore covers the “transformation of biochemical or physical inputs to ecosystems” in the form of wastes, toxic substances and other nuisances, and the “regulation of physical, chemical, biological conditions”, which categorizes the various ways in which living systems can mediate the physico-chemical and biological environment of people in a beneficial way. ES of “Cultural” section of CICES includes all the non-material, and normally non-rival and non-consumptive, outputs of ecosystems (biotic and abiotic) that affect physical and mental states of people. Cultural services are primarily regarded as the environmental settings, locations or situations that give rise to changes in the physical or mental states of people, where the character of those settings is fundamentally dependent on living processes. They can involve individual species, habitats and whole ecosystems.

Hierarchical classification of ecosystem services, indicators and data sources to be used in the assessment of ecosystem services, as well as project sites, where particular indicators will be evaluated, are presented in the Table 7. The selected indicators were chosen by common agreement of project partners, in order to evaluate all the most important ecosystem services and functions, using data from project monitoring activities and publically available data.

Under the section of **provisional** services there are seven indicators selected under the classes of “Animals reared for nutritional purposes”, “Wild animals (terrestrial and aquatic) used for nutritional purposes” and “Cultivated terrestrial plants for nutrition, materials or energy” (see Table 7 for details):

- Data on **Production from livestock** are relevant only on those project sites, where farming activities are implemented by land users. In Lithuania only sites LT/03-Zuvintas and LT/04-Sysa/Sausgalviai are considered for evaluation of production from Livestock evaluation, because in the other sites no agricultural activities are implemented at the moment, and no changes in land-use is foreseen in the future (during the project time). Details on data structure for “Production from livestock” evaluation presented in questionnaire (Annex 6), which will be used to interview land users and landowners, whose land plots fall into the project areas. At least 15 land owners and contracted land-users will be interviewed to obtain data on production gained from livestock in all the target project sites. In the territories LT/04-Sysa/Sausgalviai representative sample of randomly selected land-owners will be interviewed, because total number of land-owners in the site is 88.
- **Production of honey** will be evaluated in the project area BY/07-Zvanets, because the site is well known in Belarussia and abroad for it’s high-quality natural honey, that is produced from the flowers of Zvanets mire. All the beekeepers in the vicinity of the project site are known, thus direct interview with them will be used to obtain information on amount of honey produced.
- **Wild game bag** data should be obtained from the data bases, reports or other sources produced by local offices of hunter organizations, or interviews with hunters that manage data on hunting bags in particular project sites. Data on exact numbers of different species of hunted ungulates should be given for each project site.
- Evaluation of **Fish production** is relevant in Lithuanian sites LT/04-Sysa/Sausgalviai only, because the territories are regularly flooded in spring, and are serving as a feeding and spawning places for some fish from Curonian Lagoon and Nemunas river. In late spring, when the water goes off from the polders, the fish that remains in the channels, are cached by authorized fishermen and supplied to the market. Data on annual catches are stored at the regional office of the Environmental Protection Agency.
- Amount of **Grassland area** will be evaluated in all the project sites, using areal mapping and GIS facilities. Total area covered by grass will be measured once per vegetation period, in late summer, to evaluate total area of not abandoned grassland.
- **Yealds of dry phytomass** will be evaluated according data gained during implementation of vegetation monitoring. Samples of above-ground vegetation will be collected in selected 1x1 m plots, dried and weighted. This monitoring procedure will be applied in all the project sites, and in all permanent 100x100 m vegetation monitoring plots. The phytomass of dry above-ground vegetation will be measured in all different types of vegetation associations, that will be found in 100x100 m plots, thus number of samples collected will depend on heterogeneity of the vegetation. Yealds of the phytomass for the project sites will be evaluated using detailed vegetation maps. Phytomass data from different associations will be related to the area covered by similar associations in the whole territory, and total productivity will be calculated. Tons of dry phytomas per hectare (t/ha) will be used as an evaluation unit for the indicator.

- After the biomass processing facility will be established (Action C5) amount of **Produced pellets** will be used as an indicator for evaluation of biomass, that will be produced from late-cut grass, that are left in the breeding grounds of Aquatic Warbler. Only production from project sites LT/01-Tyrai and LT/04-Sysa/Sausgalviai will be measured, as biomass processing facility is situated in Nemunas river delta and transportation of materials from other project sites is not appropriate.
- In some breeding areas of Aquatic Warbler farmers voluntarily do not mow till the end of the breeding season, and are obliged to mow all the biomass starting from August 15th. **Late-cut biomass** is not suitable for feeding of cattle or other livestock, thus usually biomass in the fields are put into “old hay rolls”, and according the regulations of Agri-environmental schemes, should be removed from the fields till October 30th, or exceptionally, till 1st of March in the next year. The utilization of old hay is still problematic and depends on farmer’s efforts to supply them for a few cattle farms to be used as a litter. Small amount (several tons) of late-cut biomass are used as a fuel in few local heating plants. Most of the late-cut biomass at the moment are not used for any purpose, and are considered as not usefull biomass waste. Thus tracking of amount of not used biomass will serve as an indicator for measuring potential of phytomass production. Evaluation of the amount of late-cut biomass produced in the project territories in Lithuania should be performed by counting “Old hay rolls”, that are produced in meadows in the period from August 15th to October 30th. According the average mass of one roll (one roll of dry hay weights 300 kg) all the production should be converted to tons. Responsible person should visit the site at least twice a week, starting from the period from August 15th to September 1st, and counts all the produced hay rolls in separate mowed areas. Data on amount of late-cut biomass production should be checked during the interviews with land users.

In the section of **Regulation and Maintenance** services there are eight indicators selected under the classes of “Hydrological cycle and water flow regulation”, “Flood protection”, “Pollination and seed dispersal”, “Maintaining nursery populations and habitats”, “Regulation of the chemical condition of freshwaters by living processes” and “Regulation of chemical composition of atmosphere and oceans” (see Table 7 for details):

- **Amount of water in peat layer** will be evaluated in all the project sites, using data obtained during the implementation of Hydrological monitoring. Water holding capacities of the project sites will be evaluated bearing into account that storage of water in peat is related to the physical properties of peat (degree of decomposition and soil compression), thus special coefficients will be used in calculations of the volume of water stored in peat layer. Data on average peat level in the site and average water level during the vegetation period (from May to August) should be used as well.
- Flood protection services can only be assessed in the field in sites, that have inflows and outflows or obvious flood periods. Thus **Amount of water during flood period** will be measured in the polders of Nemunas delta (LT/04-Sysa/Sausgalviai) which are affected by regular floods, and BY/07-Zvanets, where as a result of water flow management activities water inflow and outflow properties will be controlled. Size of the flooded area can be obtained using "Sentinel-2" images, in which colour band combinations are suitable for segregation of flooded areas from other kinds of landscapes. Amount of water during flood period (flood storage capacity of a wetland) can be obtained calculating the difference between the potential maximum volume of water stored (maximum of the water level during the flood) in the wetland and the average water level during the vegetation period.
- As there is no universal way to evaluate the pollination service, we chose to compare the combined **Number of the taxa** identified and **number of specimens** collected by net sampling and Malaise traps in each project site during the implementation of invertebrate monitoring. Only the numbers of following main pollinator groups of flying insects will be counted: *Hymenoptera* (all non-parasitic hymenopterans), *Lepidoptera* and *Diptera* (all families). Common indices used for standardised evaluation of species richness (Shannon H'), diversity (Simpson 1-D) and equality of taxa abundance (Pielou E) should be calculated and used for comparison of pollinator diversity among the project sites. Separate chapter to invertebrate monitoring report should be added and the data from different project sites of the country compared.
- **Amount of natural habitats** should be measured in all the project sites using Natura 2000 habitat classification (see chapter 4.2.4 for details).
- **Total number of breeding bird species** should be evaluated in all the project sites, building and updating the lists of all the birds observed in the project sites by the ornithologists, who perform the bird monitoring activities. The bird lists are reviewed and updated annually.
- **Total number of migratory birds** are evaluated for project sites LT/01-Tyrai, LT/03-Zuvintas and LT/04-Sysa/Sausgalviai in accordance with the methods described in chapter 3.6.
- **Nutrient retention**, as an ability of wetland to improve water quality, will be directly measured in project site BY/07-Zvanets, where the water quality of the inflows and outflows could be measured and compared based on water chemical composition data. Nutrient retention in the other project sites will be

evaluated indirectly, combining data on total phytomass produced during the vegetation period (vegetation monitoring) and amount of Nitrogen (N) and Phosphorus (P) in it.

- **Carbon sequestration in vegetation and soils** should be measured for all the project sites, using instructions provided in TESSA toolkit⁴. Methods “Climate M3” and “Climate M5” should be used for direct measurement of above-ground live carbon stock and below-ground carbon stock estimation for grass-dominated areas. Method “Climate M13” should be used for estimation of carbon sequestration for *Sphagnum* spp. dominated wetland areas.

Under the section of **cultural** services there are four indicators selected under the classes of “Experiential use of plants, animals and landscapes in different environmental settings”, “Physical use of land in different environmental settings” and “Educational” (see Table 7 for details):

- **Numbers of visitors in project areas** will be monitored using two different methodological approaches.
 - Direct monitoring of visitors of the project sites will be performed by the project staff during the most attractive periods for nature tourists to visit the sites. As project sites are best known as special protected areas for breeding and migratory birds, the most appropriate periods for monitoring number of site visitors would be periods of spring and autumn migration of birds, as well as some periods during the summer. The person devoted to counting of visitors to the project area thus should spend in total 24 hours at the particular site during the bird migration and breeding period in spring, 24 hours during selected periods in summer, and 24 hours during the period of autumn migration of birds. The exact dates and time of the day for counting of the site visitors vary in different territories, thus they should be selected individually. For the project sites, where the site visitors can be counted by permanent staff members at the information/visitors centres of the protected areas (e.g. project sites LT/03-Zuvintas and BY/07-Zvanets), average number of visitors in 3 day-period should be calculated for the following three periods: April 25th – May 30th, June 10th – July 20th and September 1st – October 20th.
 - Indirect monitoring of the project site visitors will be performed using Google URL Shortener service, which could be obtained by all Google account users at <https://goo.gl/>. Generated QR codes with the link to song of male Aquatic Warbler could be an attractive feature for some project site visitors when it's used with the information on ecology of the species, which is presented on information stands. Statistics of every scan of QR code, with the unique shortened URL placed on different information stands, can be tracked at the Google URL Shortener's page, thus number of visitors, who scanned the code, could be obtained for every individual project territory, individual stand, and desirable period of time. Number of all QR code “clicks” for every project site should be monitored yearly.
- Changing trend of **Proportion of “nature” tourists in local enterprises** offering tourism related accommodation services could be used for evaluation of the change in tourist's interests for the period of the project. Proportion of “nature” tourists among the other interest groups will be evaluated during the interviews with the representatives of the enterprises, who can provide statistical information on interests of persons, who used an accommodation services. All enterprises providing accommodation services in the vicinity of the project sites will be interviewed within the radius of 5 km from the project sites LT/04-Sysa/Sausgalviai and LT/01-Tyrai, and 10 km radius will be used for all other project sites.
- **Number of leisure fishing (angling) individuals** in the project sites will be counted at the same time as the counting of visitors of the project areas will be performed. Average number of angling individuals for 24 hours period should be presented for project sites LT/04-Sysa/Sausgalviai and all the project sites in Belarusia.
- **Number of web-site visitors** of the project web-site, along with the other web-site using statistics, will be obtained from appropriate internet services, will be analysed, and used for evaluation of use of project information for educational purposes.

⁴ Peh, K. S.-H., Balmford, A. P., Bradbury, R. B., Brown, C., Butchart, S. H. M., Hughes, F. M. R., MacDonald, M. A., Stattersfield, A. J., Thomas, D. H. L., Trevelyan, R. J., Walpole, M., & Merriman, J. C. (2017) Toolkit for Ecosystem Service Site-based Assessment (TESSA). Version 2.0 Cambridge, UK Available at: <http://tessa.tools>

Table 7. Classification of ecosystem services, indicators and data sources to be used in their assessment (ES Classes presented according CICES V5.1)

Section	Division	Group	Class	Indicator	Data source or evaluation method	Project sites, where ES evaluation will take place
Provisioning	Nutrition	Biomass	Animals reared for nutritional purposes	Food production from livestock	Interview with farmers/land owners	LT/03-Zuvintas; LT/04-Sysa/Sausgalviai
				Production of honey (kg/year)	Interview with beekeepers	BY/07-Zvanets
			Wild animals (terrestrial and aquatic) used for nutritional purposes	Wild game bag data	Official statistics of hunted animals/Interview with hunters	All project sites
				Fish production (catch in tonnes by commercial fisheries)	Official statistics	LT/04-Sysa/Sausgalviai
			Cultivated terrestrial plants for nutrition, materials or energy	Grassland area, ha	Areal mapping/GIS	All project sites
	Yealds of dry phytomass (ton (dry matter)/ha)	Botanical monitoring/GIS		All project sites		
	Materials	Biomass	Fibres and other materials from cultivated plants,<...> for direct use or processing (excluding genetic materials)	Produced pellets (ton)	Data from producer	LT/01-Tyrai; LT/04-Sysa/Sausgalviai
				Late-cut biomass (“Old hay”) produced at the end of vegetation period (t)	Interview with farmers/Areal photos	LT/03-Zuvintas; LT/04-Sysa/Sausgalviai BY/07-Zvanets
Regulation and Maintenance	Regulation of physical, chemical, biological conditions	Regulation of baseline flows and extreme events	Hydrological cycle and water flow regulation (Including flood control, and coastal protection)	Amount of water in peat layer (m ³ /ha)	Hydrological monitoring, GIS	All project sites
			Flood protection	Amount of water during flood period (m ³)	Hydrological monitoring, Remote imagery, GIS	LT/04-Sysa/Sausgalviai BY/07-Zvanets
		Lifecycle maintenance, habitat and gene pool protection	Pollination and seed dispersal	Number of taxa and number of specimens of pollinating insect taxa	Insect monitoring	All project sites
			Maintaining nursery populations and habitats	Amount of natural habitats (ha)	Botanical monitoring, GIS	All project sites

				Total number of breeding bird species	Ornithological monitoring	All project sites
				Total number of migratory birds	Ornithological monitoring	LT/01-Tyrai; LT/03-Zuvintas; LT/04-Sysa/Sausgalviai
				Nutrient retention (kg/ha/year)	Water quality monitoring, Vegetation monitoring, GIS	All project sites
				Carbon sequestration in vegetation and soils (t C/ha/year)	TESSA tool	All project sites
Cultural	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment	Experiential use of plants, animals and landscapes in different environmental settings	Numbers of visitors in project areas	1. Direct monitoring 2. Tracking QR codes on information stands	All project sites
			Physical use of land in different environmental settings	Proportion of “nature” tourists in local enterprises offering tourism related services	Monitoring	All project sites
		Intellectual and representative interactions with natural environment	Educational	Number of leisure fishing (angling) individuals	Monitoring	All project sites
				Number of web-site visitors	Monitoring	All project sites

9. Annexes

Annex 1. Field data sheet of Aquatic Warbler monitoring

Annex 2. Data form for reporting monitoring results of Citrine Wagtail (*Motacilla citreola*), Spotted Crake (*Porzana porzana*), Corncrake (*Crex crex*), Montagu's Harrier (*Circus pygargus*), Common Redshank (*Tringa totanus*), Black-tailed Godwit (*Limosa limosa*), Eurasian Curlew (*Numenius arquata*), Short-eared Owl (*Asio flammeus*) and Great Snipe (*Galinago media*)

Annex 3. Data form for reporting monitoring results of migratory birds

Annex 4a. Field datasheet for vegetation monitoring

Annex 4b. Survey form of the vegetation in 1 m² plot

Annex 4c. Field data sheet for phytomass sample analysis

Annex 5. Table for collecting data on chemical composition of surface mire water

Annex 6. Questionnaire for interview with farmers/land-owners for evaluation of Provisional Ecosystem services in project sites, where ecosystems are used for agriculture

Annex 4a. Field data sheet for general vegetation description

Name of the monitoring site	Name of botanist	Date														
GPS device:	Waypoint Nrs.:															
GPS-coordinates (WGS 84)																
N:	E:															
Picture numbers:																
<u>Structure parameter:</u> <ul style="list-style-type: none"> • Mosaic natural hummocks & hollows (hh), • even surface (e), • uneven surface caused by dredgers (ue), • densely forested (df), • forested (f), • slightly covered by trees (sf), • tussocks from sedges (t), • dense reed (dr), • reed with normal density (nr), • loose reed (lr), • shrubby (sh), • densely covered with shrubs (dsh), • open peat (op) • tussocks Eriophorum (te) 	Cover scale: Braun-Blanquet scale <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>index</th> <th>cover [%]</th> </tr> </thead> <tbody> <tr> <td>+</td> <td>Few individuals, covering < 1%</td> </tr> <tr> <td>1</td> <td>1–5%</td> </tr> <tr> <td>2</td> <td>5–25%</td> </tr> <tr> <td>3</td> <td>25–50%</td> </tr> <tr> <td>4</td> <td>50–75%</td> </tr> <tr> <td>5</td> <td>75–100%</td> </tr> </tbody> </table> <p>Remark: tree species always divide into: herb layer (0-40cm), shrub layer (40-200cm), tree layer (>200cm)</p>		index	cover [%]	+	Few individuals, covering < 1%	1	1–5%	2	5–25%	3	25–50%	4	50–75%	5	75–100%
index	cover [%]															
+	Few individuals, covering < 1%															
1	1–5%															
2	5–25%															
3	25–50%															
4	50–75%															
5	75–100%															
Abiotic parameters		Productivity of vegetation														
Conductivity 1		Weight of green grass in 1 m ² , g														
Conductivity 2		Weight of dry grass in 1 m ² , g														
Conductivity 3		Height of grass layer														
pH 1 (surface peat)		Height of 1 grass layer, cm														
pH 2 (surface peat)		Height of 2 grass layer, cm														
pH 3 (surface peat)		Height of 3 grass layer, cm														
Common information		Water level														
cover open peat		Height above the soil surface, cm														
cover brown moss		Minimum level, cm														
cover sphagnum		Maximum level, cm														
cover open water																
Coverage of the tree layer																
cover shrub																
cover herbs																
cover sedges																
cover other grasses																
height hummocks																
cover hummocks																
Additional data on tree layer:		Additional data on <i>Phragmites</i>														
number of trees		Number of stems per 1m ²														
diameter of tree 1																
diameter of tree 2																
diameter of tree 3																
diameter of tree 4																
diameter of tree 5																
tree height no 1																
tree height no 2																
tree height no 3																
tree height no 4																
tree height no 5																
Peat thickness																

Annex 4c. Field data sheet for phytomass sample analysis

Territory and number of the plot _____

Sample 1

Plant group	Fresh weight (g) 1/0,25 m ²	Dry weight (g)
Shrubs and dwarf shrubs		
Ferns		
<i>Carex</i> spp.		
Other edificator		
<i>Equisetum</i> spp.		
<i>Poaceae</i>		
<i>Phragmites australis</i>		
Other herbaceous plants		
Dead plant remnants		

Sample 2

Plant group	Fresh weight (g) 1/0,25 m ²	Dry weight (g)
Shrubs and dwarf shrubs		
<i>Carex</i> spp.		
Other edificator		
<i>Equisetum</i> spp.		
<i>Poaceae</i>		
<i>Phragmites australis</i>		
Other herbaceous plants		
Dead plant remnants		

Sample 3

Plant group	Fresh weight (g) 1/0,25 m ²	Dry weight (g)
Shrubs and dwarf shrubs		
Ferns		
<i>Carex</i> spp.		
Other edificator		
<i>Equisetum</i> spp.		
<i>Poaceae</i>		
<i>Phragmites australis</i>		
Other herbaceous plants		
Dead plant remnants		

Sample 4

Plant group	Fresh weight (g) 1/0,25 m ²	Dry weight (g)
Shrubs and dwarf shrubs		
Ferns		
<i>Carex</i> spp.		
Other edificator		
<i>Equisetum</i> spp.		
<i>Poaceae</i>		
<i>Phragmites australis</i>		
Other herbaceous plants		
Dead plant remnants		

Sample 5

Plant group	Fresh weight (g) 1/0,25 m ²	Dry weight (g)
Shrubs and dwarf shrubs		
Ferns		
<i>Carex</i> spp.		
<i>Equisetum</i> spp.		
<i>Poaceae</i>		

Other edificator		
<i>Phragmites australis</i>		
Other herbaceous plants		
Dead plant remnants		

Annex 5. Table for collecting data on chemical composition of surface mire water

Name of the specimen and geographical coordinates	Indicators													
	Date taken	Total nitrogen, mg(NH ₄ ⁺)/l	Nitrite, mg(NO ₂ ⁻)/l	Nitrate, mg(NO ₃ ⁻)/l	Chlorides, mg(Cl ⁻)/l	Sulphate, m(SO ₄ ²⁻)/l	Hydrocarbons, m(HCO ₃ ⁻)/l	Magnesium, m(Mg ²⁺)/l	Calcium, mg(Ca ²⁺)/l	Hardnes, mg/l	pH	Phosphorus, mg(P)/l	Silicon, mg(SiO ₂)/l	Total mineralization, mg/l

Annex 6. Questionnaire for interview with farmers/land-owners for evaluation of Provisional Ecosystem services in project sites, where ecosystems are used for agriculture (relevant for project sites LT/04-Sysa/Sausgalviai only)

Name and code of the project site:

Name of the respondent: Savininkui priklausančių žemės sklypų skaičius ir bendras plotas ha
 Iš jų dirbama savarankiškai: ha
 Nuomojama: ha
 Išnuomota: ha

Žemėnaudos tipai: Pievos ha Iš jų natūralios: ha; pusiau natūralios: ha; kultūrinės: ha
 Ariama žemė: ... ha; Apleista, nenaudojama: Ha

Plotuose ganomų gyvulių skaičius ir bendras ganyklų plotas

Per metus iš projekto teritorijos plotuose esančių žemės sklypų gaunamos ŽŪ produkcijos kiekis per metus:

Iš augalų gaunama produkcija		Gyvulininkystės produkcija (vertinamas tik projekto teritorijoje pagaminta produkcija)	
Pavadinimas	Kiekis, t	Pavadinimas	Kiekis, t
Žolė (žalia masė gyvulių pašarams)		Mėsiniai galvijai (užauginta, gyvo svorio)	
Šienainis		Pienas	
Šienas		Sviestas	
Pašarams netinkama žolės biomasė, panaudota kompostavimui ar pakratams*		Varškės produktai	
Pašarams netinkama žolės biomasė, panaudota (parduota) perdirbimui*		Ūkyje laikomų gyvulių skaičius	
		Išlaikoma maitinant projekto teritorijoje užaugintais pašarais	Išlaikoma maitinant ne projekto teritorijoje užaugintais pašarais
Kita (įrašyti):		Mėsiniai galvijai	Mėsiniai galvijai
		Pieniniai galvijai	Pieniniai galvijai
		Avys	Avys
		Ožkos	Ožkos
		Arkliai	Arkliai

* - kai šienaujama po liepos/rugpjūčio 15 d. MN agroaplinkosauginei priemonei deklaruotuose plotuose.

Anketos užpildymo data: Duomenis surinko