Report on project

"SECURING SUSTAINABLE FARMING TO ENSURE CONSERVATION OF GLOBALLY THREATED BIRD SPECIES IN AGRARIAN LANDSCAPE"

EVALUATION OF PROJECT REALIZATION SUCCESS (2011)

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2012

EVALUATION OF PROJECT REALIZATION SUCCESS IN 2011

Objective 1 – Ensuring favorable conservation status of the Aquatic warbler* by means of restoration of unfavorably managed or abandoned habitats in most important known sites in Lithuania and Latvia and forming favorable habitat conditions for species conservation

ACTION A.1: Ex-ante and Post-ante monitoring of Aquatic warbler in the project sites
Development and approval of methodic for counts and mapping of singing males and breeding females.
Methodic for counts and mapping of singing males development and approval. Methodic is developed considering the features of study areas, the necessary maps are prepared. Methodic envisages involvement of volunteers into counts.

Mapping of singing males two times during the breeding season on all project sites every year during project implementation (according to methods approved);
Absolute counts of singing males were carried out two times during the breeding season according to the methodic at all the project sites. Volunteers passed preliminary training were involved into counts. Position of each singing male was mapped. Thus, a quality results on number and location of all singing males at all the project territories were obtained in 2011. Counts of birds' number will be implemented early. Obtaining of knowledge on species number dynamics and changes in locations of singing males will be the main indicator of project implementation success.

Mapping of breeding females two times during the breeding season on all project sites.

Mapping of breeding females was carried out in 2011. As a result, the important data on timing of breeding and distribution of Aquatic Warbler breeding females were obtained. These data are used for planning of area management (timing of mowing, the area of plots that should not be mowed, etc.).

Development and approval of methodology for biotopes' mapping and description of vegetation structure.
During the developments of this methodology the experience of a number of other projects was used. As a result, methodology for biotopes' mapping and description of vegetation structure is developed and approved in practice. The main feature and merit of this methodology is usage of high-resolution satellite images and detailed description of vegetation at project territories. This methodic could be successfully used in similar projects aiming the habitats management.
The prolonged field works and processing of material with use of GIS technologies are necessary for implementation of this methodic. However, higher human and financial resources are needed mainly only for initial vegetation mapping. In subsequent years the considerably lesser efforts will be needed for evaluation of dynamics of vegetation associations under influence of management actions.

Implementation of mapping and description of vegetation structure before and after the implementation of the proposed management actions (according to methodology approved).
For the first time for the projects on conservation of Aquatic Warbler the comprehensive description and study of distribution of vegetation communities were done. As a result the detailed maps of vegetation with the description of each association are prepared.

Data on distribution of vegetation communities and recommendations made by botanists allow detailed planning of management activities at Aquatic Warbler habitats:
- to define the type of biotope of the project area – fen mire or floodplain meadow. This is very important for subsequent planning of different approaches to habitat management.
- to define plots to be mowed once or twice in the year;
-to define the timing of mowing on different plots to form optimal conditions for Aquatic Warbler;

Besides, mapping of vegetation is the very important instrument for evaluation of effectiveness of project activities. The area (sedge communities) suitable for Aquatic Warbler should enlarge considerably as a result of project activities on mowing and removal of vegetation, which, in turn, will lead to increasing of Aquatic Warbler numbers. Mapping of vegetation after implementation of planned actions should demonstrate changes of areas and structure of vegetation communities.

Recommendations:
- to conduct yearly research of changes of vegetation structure at territories with intensive management for studying dynamics of vegetation from reeds to sedge communities (projective coverage and other standard indicators). This will allow if necessary to recommend additional measures of habitat management. These works are especially important for project territory Tyrai.

LT1 TYRAI
(The area of habitat suitable for AW is 950 ha.
450 ha of Aquatic Warbler habitat restored/managed eliminating dense reed stands and scarce bushes).

Mowing for reed elimination on area of 450 ha two times per year (June and after breeding season in August) removing the mowed vegetation from the area;
Procurement of mowing machinery. It is recommended to use machinery with minimal pressure on the ground for mowing on fen mires with presence of peat layer. Crawler tractors (ratrak) with wide track and pressure on the ground about 0.07 kilos/sm2 are widely used for mowing of mires in Poland. However after long discussions with landusers it was decided to procure wheel tractor Valtra with pressure on the ground about 0.35 kilos/sm2. Usage of this tractor during season of 2012 has shown that pressure on the ground is higher than the Ratrack, however is acceptable, especially if double-wheels are attached to the machinery (reducing pressure to 0,175 kg/sm2). The tractor modification occurs to be suitable as it performs mowing more quickly and efficiently, petrol consumption is significantly lower.
Recommendations on exploitation of machinery:
- to set dual wheels on the tractor;
- to set additional wheels on press-pickup machine.

Mowing and removal of reeds on an area of 450 hectares
- works plans to be conducted in 2012, ant their evaluation will be made later.

Mowing of habitat favorable for AW (open fen mire plots) by stripes of 50-meters wide alternating with uncut stripes of 20 meters wide for increasing productivity of habitat;
It is recommended to test this methodic during the season of 2013.

Establishment of monitoring wells and water level control once per 2 weeks;

Three wells were established for water level monitoring. Results of measurements are on processing at present. After the processing is finished the water level dynamics will be analyzed and on the basis of these data the recommendations on the timing of mowing will be done.

LT02 TULKIARAGE

(The area of habitat suitable for AW is 400 ha.
400 ha of Aquatic Warbler habitat restored/managed eliminating dense reed stands and scarce bushes).

100 ha of the area are restored by cutting of bushes and trees once a year during two years;

- works were conducted in 2012, and will be evaluated later.

200 ha of the area are restored by removing of dense reed stands at least during two years repeating action twice a year;

Due to very high humidity level, it was not possible to take out biomass from the field. On the basis of discussions the decision was taken to use mulch machine and apply shredding where biomass take out is not possible due to high water table. For other areas where biomass can be removed – it shall be done so.
Restoration work has been performed according to the set plan, concluding positive results for 2011.

The whole area of 400 ha is managed by removing old vegetation.

To be evaluated later after second year restoration works.

Establishment of monitoring wells and water level control once per 2 weeks;

Two wells were established for water level monitoring. Results of measurements are on processing at present. After the processing is finished the water level dynamics will be analyzed and on the basis of these data the recommendations on the timing of mowing will be done.

Restoration of 2 water gates in the polder system and 200 meters of polder dyke.

The partner AB2 has fulfilled works on closing of water gates in a dam that barriers polder from the bay. The recommendations on usage of excavator and dam repair with the local ground were implemented during the constructions. Closing of washouts in dams will let regulations of water level in a whole polder.
Besides, the AB2 has established regulating gates, which prevent excessive water release from the polder.

Recommendations: The regulating gates in sluices should be installed at the level recommended by experts on the basis of water level measurements and soil surface level.

LT03 SYSA

The area of habitat suitable for AW – 300 ha.
The area suitable for AW, sustainably managed (late mowing, without nests disturbing) – 60 ha in 2014.

Water level in May-June is about the soil surface.

Development and implementation of agricultural and environment-friendly plan of use on the whole area: late mowing (from since 20th of July, the exact terms of mowing should be defined on the base of data on nesting phenology). It is possible as a compromise to start mowing from 1st of July, which allows AW to finish first clutches successfully.
Project territory Sysa is a high-productive floodplain meadow, which is owned by many landusers and is intensively used for hay making. Thus, it is extremely important to develop an agricultural and environment-friendly plan of use of this area for conservation of Aquatic Warbler. The project team has conducted a great job on development of such a plan: meetings and consultations with most of landusers are carried out; plan versions are discussed at AWCT workshops. At present it is agreed to use several kinds of landuse for areas occupied by Aquatic Warbler and where the species is absent at this year. These variants will be tested during subsequent years.

Regulation of water level by means of restored water gates so that the water level is maintained at soil surface from 1st of May till 15th of June.
Negotiations were conducted with management structures responsible for exploitation of sluice regulating water level at polder, but final agreement was not reached.

Recommendations: to develop and approve with local authorities the regulations of exploitation of polder system for maintenance of optimal water levels for conservation of Aquatic Warbler and ensuring stable hay making. Optimal water levels at polder could be reached by means of regulating of water release by pumping station and establishment of overflow optimal level on the sluice.

Establishment of monitoring wells and water level control once per 2 weeks;
Three wells were established for water level monitoring. Results of measurements are obtained and on processing at present. After the processing is finished the water level dynamics will be analyzed and on the basis of these data the recommendations on exploitation of water gates and pumping station will be done for maintenance of optimal water levels.

LT04 ZUVINTAS
(The area of suitable for AW habitat is 328 ha).

- Removal of reeds by means of controlled fire;
The activity was not conducted in 2011 due to necessity of changes in legislation in regard to controlled burning of vegetation. Activity is planned for 2012 during winter or early spring season.

Mowing of reeds in the late autumn/ winter time with the prototype tractor;
Process of procurement of tractor and mowers for hay making has been just started in 2011. However project administration has reached an agreement with local private company to borrow machinery for removal of shrubs and mowing the reeds in 2011. Thus, the considerable part of the project territory overgrown with close reed stands was cleared.
It is planned to finalize the procurement of necessary machinery in 2012 and start mowing in such a way that mowed biomass will be used for production of fuel pellets.

Removal of trees, bushes and cutting of the reed stands with the prototype tractor and manually, taking-away the biomass.

The local private company removed bushes by mulch machine in 2011, which is acceptable solution for the first year of vegetation management. In subsequent years the mowing at these areas shall be done by tractor procured by the project with obligatory removal of biomass from the place.

PAPE SITE, LAKE LIEPAJA

Removal of trees and bushes, cutting of reed stands with the prototype tractor and manually, taking-away the biomass
Removal of trees and bushes at Pape site was conducted according to all rules. Trees and bushes were cut and removed from the territory.

Recommendations:
In following years it is necessary to cut growing underbrush at places where bushes and trees were removed. This work could be done with use of mulch machine.

Cutting reeds in the late autumn/ winter time with the prototype tractor.
Habitat restoration has not been performed in 2011. Preparatory works has been conducted to find appropriate machinery for the restoration activities and reach agreement with land-owners to perform activities for the next season. Success will be evaluated after 2012 season.

Objective 2 – Establish and promote favorable and sustainable conditions for farmers/landowners to implement conservation measures by renewed agro-environmental schemes and supported by alternative economic solutions
ACTION A.4: Development of the recommendations on the solutions for landowners to manage properly Aquatic Warbler breeding habitats, ensuring sustainable economic benefit

Development of the recommendations on the solutions for landowners to manage properly Aquatic warbler breeding habitats, ensuring sustainable economic benefit;
At present the project team intensively collect and process the material for preparation of publication.

Holding of workshops for acquaintance with practical experience in alternative methods of usage.
The project team has done a great job with local landusers, explaining the importance of conservation of Aquatic Warbler habitats and sustainable landuse on rare bird species habitats. In particular, the owners of the most plots at project sites were revealed. Private meetings with farmers were conducted. Besides, the workshops were organized with presence of the most of farmers; after busy discussions the most of landuser agreed to implement proposed schemes of mowing. During this work the project employees have shown a high professionalism in organization and implementation of work with public and landusers.

ACTION C.6: **Demonstration of the innovative usage of late-cut biomass**
The briquetting facility is not setup. Associated beneficiary 4 is searching for available location where to place the facility. In parallel research work is ongoing on the type of the machinery to purchase. Market research indicates that pelleting instead of producing briquettes is preferred option. Progress of the action shall be evaluated in 2012.

Carrying of quality evaluation of fuel briquettes and its economic potential to sell it in the market (Analysis-study and market research of briquetting facility potential for Lithuanian conditions (results incorporated into publication made in action A4);
The draft publication is prepared by the project expert. At present the material is on editing.

Purchase of machinery and installed briquetting facility.
At present the process of procurement of machinery for briquetting facility is ongoing.

ACTION A.2: Development of specific regional agri-environmental measures for important Aquatic Warbler sites in the Nemunas delta

Development proposal for an agri-environmental scheme for the Nemunas delta region;

Development proposals for specific agri-environmental measures relevant for the region;

Economic analysis and calculation of reasonable agri-environmental payments for practicing these measures.

Agri-environmental scheme is developed considering all interested parties. At present the agreement of the Scheme with experts and Ministries is conducting. Approval of this Scheme is appropriate to conduct after its practical testing at project sites.

OVERVIEW AND ANALYSIS OF SCIENTIFIC DATA OBTAINED DURING PROJECT IMPLEMENTATION, AIMING DEVELOPMENT OF MANAGEMENT STRATEGY FOR PROJECT AREAS

Relief

Nemunas Delta represents flat valley with gentle inclination to north-west. Absolute heights are up to 5-6 m. Some parts are situated lower than the sea level, and groundwater table is regulated here by dams and pump stations. The area of polder lands in the delta valley is considerable. (Galanin, 1991). Relief of all the littoral project sites located in Nemunas delta is leveled with scattered mineral islands elevated up to 40-80 cm over the surface of lowland meadows. The surface of flat meadows is only some tens centimeters higher than the sea level (Šyša – 0,2 m; Tyrai – 0,2 m) (Bitinas et.al,2002), resulting in flooding of meadows during sea level rising due to strong western wind.

Geology

Three of the project sites (Šyša, Tulkiaragė), which are situated in lowered parts of Nemunas Delta belong to the type of limnic flood-plains. From the historically-geological point of view they also could be considered as the natural sea coast meadows, formed by recession of the sea (Bitinas et.al, 2002).

The soil type according to the Latvian soil classification system (version of the year 2007) is Alluvial muck soil (ALi). The soil type according to the World Reference Base for Soil Resources 2006 (WRB) classification is Endogleyic Thaptohistic Limnic Fluvisol (Eutric, Endosiltic).

Fig. 1 – Part of Nemunas Delta in Šilute region. Photo by Marius Jovaiša (http://fotki.yandex.ru/users/tomcat11/).

Upper soil layer at the project sites (Šyša, Tulkiaragė) attributed to the Postlitorine marine sediments. Soil composition is a combination of silt with clay and inclusions of plant remains. These deposits contain silty material rich of organic substances. The last version of the soil map of Latvia, prepared by Oļģerts Nikodemus in 2003 improving the map of K. Brīvkalns, suggests that sod-gley soil and sod-podzolic gley soil on the sand bottom. Some areas here are recognized as hydro-morph peat soils and alluvial soils.

Some authors consider lowered parts of Nemunas floodplain adjacent to Curonian Lagoon as fen mires (Galanin, 1991). "There are considerable areas of fen mires with peat-gley humus (depth of peat layer less than 1 m) and peat-humus (depth of peat layer is several meters) soils in zone adjacent to the Lagoon. Plots of oligotrophic raised bogs could be found in central parts of fen mires". It could be proposed that lowered parts of Nemunas Delta previously represent waterlogged meadows and fen mires with minor peat layer. However since that the peat has been almost mineralized and mixed with alluvial deposits as a result of prolonged human activities (drainage, forming of hay meadows, cattle grazing, ploughing).

Absence of peat formation process at these areas during last centuries is explained also by specific water level dynamic. During spring floods and summer floods (when the sea level rises) the water level reaches more than 1 meter over the soil surface, but in summer mean the water descends for the long time up to 1 meter below the soil surface. Thus, above mentioned territories at present refer to waterlogged floodplain meadows as a process of peat formation is absent.

One of the project sites Tyrai is specific fen mire typical for sea coast. The upper soil surface on this territory is represented by sedge and reed peat with depth up to 40 cm (preliminary data of measuring in three points inside *Carex disticha* communities). Forming of fen mire with typical fen peat here could be possibly explained by relatively constant waterlogging of this area. It is situated far from Nemunas floodplain waters influence and do not subject to siltation by alluvial sediments. Besides, this area practically was not drained and was used only for hay mowing, which contributed to preservation of peat layer and peat formation process.

The last two project territories situated in Žuvintas Biosphere Reserve, are typical fen mires with presence of fen peat layer and typical fen mire vegetation.

Fig. 2 - Soil mine on meadows of Šyša site. Upper soil layer 30 cm deep consists of silt with clay, and is underlying by sand.

a –Tyrai

b – Tulkiaragė	c – Šyša

Fig. 3 (a,b,c) – Geological-geomorphological structure of the Nemunas delta. (m IV PL – marine sediment: Postlitorina Sea).

Water level dynamics

The water level dynamics during the year at the project site located in Nemunas river delta (Šyša, Tulkiaragė) are as following: in spring from March till mid May meadows are fully flooded, water level is 1 and more meters above soil surface. Then by the end of May the water drops till the soil surface and continue to decline reaching the level of 50–60 cm below the soil surface by summer mean (August-September). During several decades the water level in the meadows has been artificially lowered up to 0.3–1 m below the soil surface in the mid June by means of pumping by the pumping stations to allow mechanical mowing. However the situation can considerably vary year by year depending on flood intensity and financial opportunities. Particularly, some of the meadows are often flooded by wind floods as a result of sea level rise in coastal zone.

At Tyrai mire which practically was not dried and is not a polder, the water level has been regulated by natural processes. Water level dynamics at this mire entirely depends on water level dynamics at Kuršių Bay Curonian Lagoon. Due to elevation of the mire surface about 10-20 cm above the sea level (Bitinas et.al,2002), the water level here is maintained close to soil surface, and this perhaps stimulates formation of mire vegetation and deposit of fen peat.

Water level dynamics at fen mires in Žuvintas Biosphere Reserve is typical for natural fen mires judging by typical vegetation here: water level is higher than tussocks in spring, about the soil surface from May to July, and below the soil surface in August-September. There are practically no drainage channels here .

CHARACTERISTIC OF VEGETATION AT ŠYŠA POLDER

Plant communities at Šyša Polder

The communities of the *Phragmito-Magnocaricetea* class prevail in Šyša polder, which are distributed in the area of 581.82 ha. Among them, the *Magnocaricion* alliance communities encompass the largest area (557.08 ha) and dominant communities are distributed as follows: *Phalaridetum arundinaceae* (277.91 ha), *Caricetum gracilis* (211.88 ha) and *Caricetum distichae* (65.82 ha). These three communities occupy the area of 555.61 ha which amounts 77.47 % of all investigated area of Šyša polder. The most widespread communities of the *Phalaridetum arundinaceae* grassland are formed on slightly more elevated areas than *Caricetum gracilis* in Šyša polder. Very often these communities along with *Caricetum distichae* and *Caricetum gracilis* comprise a very complicated vegetation mosaic. The communities quickly react to intensive constant grazing and as a result, they give a way to *Rorripo-Agrostietum*, seldom – *Ranunculo-Alopecuretum geniculate* grassland. Under the influence of constant ecological conditions there is a trend of overgrowing the area with *Phalaroides arundinacea*. *Caricetum distichae* spread under the similar ecological conditions as well. The succession process is observed on areas with these plant communities. Due to cessation of mowing or waterlogging of habitats, formation of the *Lysimachio-Filipenduletum vulgaris*, rarely – *Thelypterido-Phragmitetum* starts, therefore transitional variants such as: *Caricetum distichae Filipendula vulgaris* facies (5.46 ha) and *Caricetum distichae Phragmites australis* facies (1.05 ha) are found there. The *Caricetum gracilis* grassland is distributed in the most waterlogged areas. It is the steadiest sedge phytocenosis in Šyša polder, therefore fluctuations are not so intense and frequent like with *Caricetum distichae*. The *Caricetum gracilis* phytocenosis, without having been mowed, remains stable for many years if it is not overgrown by reeds. The *Caricetum gracilis Phragmites australis* facies are distinguished in the area of only 1.05 ha. Other communities belonging to the alliance of *Magnocaricion* (*Galio palustris-Caricetum ripariae, Thelypteridi-Phragmitetum* and *Iridetum pseudacori*) are distributed sporadically and none of them occupy an area larger than 1 ha.

Table 1. The area covered by plant communities in Šyša polder

No.	Plant community	Area, ha
1	*Ranunculo-Alopecuretum geniculati*	0,32
2	*Salicetum pentandro-cinereae*	0,33
3	*Galio palustris-Caricetum ripariae*	0,60
4	*Thelypteridi-Phragmitetum*	0,65
5	*Iridetum pseudacori*	0,82
6	*Spiraea alba* community	1,32
7	*Convolvulo arvensis-Agropyretum repentis*	1,96
8	*Phragmitetum australis*	2,13
9	*Polygono-Bidentetum*	2,98
10	*Festucetum pratensis*	3,59
11	*Rumex confertus* community	4,11
12	*Poo palustris-Alopecuretum pratensis*	4,27
13	*Anthriscetum sylvestris*	4,29
14	*Anthoxantho-Agrosietum tenuis*	5,85

15	*Salicetum triandro-viminalis*	7,61
16	*Deschampsietum cespitosae*	12,53
17	*Glycerietum maximae*	13,01
18	*Urtico-Calystegietum sepium*	13,13
19	*Alopecuretum pratensis*	19,56
20	*Lysimachio vulgaris-Filipenduletum*	20,23
21	*Rorippo-Agrostietum*	33,32
22	*Caricetum distichae*	65,82
	Caricetum distichae Phragmites australis facies (1,05 ha)	
	Caricetum distichae Lysimachia vulgaris facies (5,46)	
23	*Caricetum gracilis*	211,88
	Caricetum gracilis Phragmites australis facies (2,49 ha)	
24	*Phalaridetum arundinaceae*	277,91
	In total:	717,21

Table 2. The coverage of plant communities belonging to different vegetation classes in Šyša polder

Vegetation class	Area, ha
Alnetea glutinosae	0,33
Artemisietea vulgaris	1,96
Bidentetea tripartite	2,98
Salicetea purpurea	7,61
Galio-Urticetea	22,85
Molinio-Arrhenatheretea	99,66
Phragmito-Magnocaricetea	581,82
In total:	717,21

Plant communities suitable for the Aquatic Warbler at Šyša polder

The Aquatic Warbler (*Acrocephalus paludicola*) singing males and breeding sites are concentrated in three sites: in southern, western and north-western and northern parts of the polder.

In southern part of the territory, Aquatic Warbler occurs only in the *Caricetum gracilis* communities (24.93 ha; 23, 38 contours on the map).

In western and north-western parts of the territory, Aquatic Warbler is found in the area of 109.68 ha. In this part of the territory it occurs where *Phalaridetum arundinaceae* communities dominate (92, 119 contours) or where these communities comprise a vegetation mosaic along with *Caricetum distichae* (115, 118 contours) or *Caricetum gracilis* and *Caricetum distichae* (121, 123 contours), or *Caricetum gracilis, Caricetum distichae* and *Glycerietum maximae* (94, 96 contours). The Aquatic Warbler also occurs in the *Caricetum gracilis* communities (116 contour) or in sites where small patches of the *Phalaridetum arundinaceae* community are interrupted among *Caricetum gracilis* (120 contour) or where *Phalaridetum arundianaceae, Caricetum distichae* and *Glycerietum maximae* are confined to the area (122 contour).

In northern part the Aquatic Warbler generally occurs in the community of *Phalaridetum arundinaceae* comprising a vegetation mosaic along with *Caricetum gracilis* (155 contour) or *Caricetum gracilis* with small patches of the *Caricetum*

distichae (146 contour). Birds also occur in the *Caricetum gracilis* communities with patches of *Phlaridetum arundinaceae* and *Caricetum distichae* (154 contour).

The results show that Aquatic Warbler confines to the areas where numerous plant communities of the *Phalaridetum arundinaceae* or *Caricetum gracilis* prevail in Šyša polder. In these areas, very often (but not necessary) interruptions of the *Caricetum distichae* community and rather rarely – community of *Glycerietum maximae* are observed.

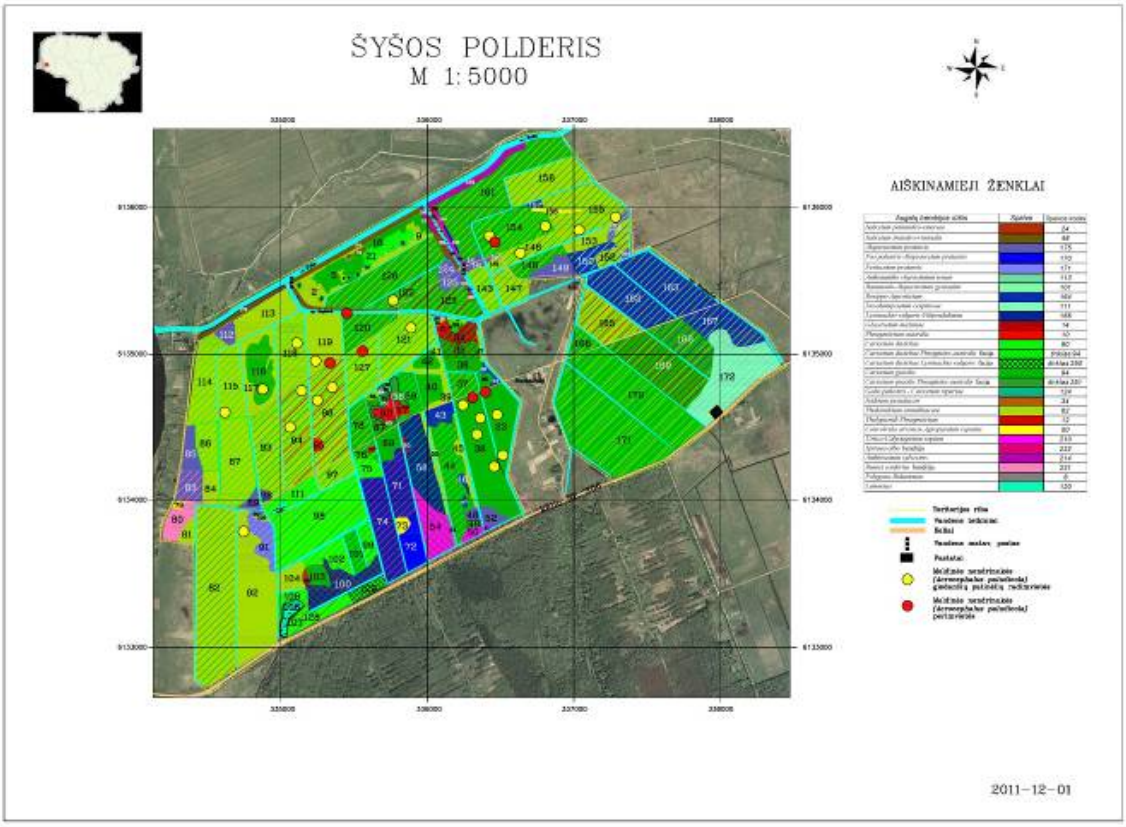

Fig. 4 – Vegetation of Šyša polder.

DIVERSITY, DISTRIBUTION OF VEGETATION IN TULKIARAGĖ POLDER

General characterisation of vegetation

Compendium of plant communities

The vegetation of Tulkiaragė polder belongs to 2 vegetation classes and consists of communities from 13 associations and 4 rankless units (table 3). The grassland vegetation predominates. Single trees and shrubs are observed in all territory except the eastern part where they grow more abundantly.

Table 3. Plant communities in Tulkiaragė polder.

Class/rankles unit	Association/rankles unit	Area, ha
Phragmito-Magnocaricetea Klika in Klika et Novák 1941	*Caricetum acutiformis* Sauer 1937	2.25
	Caricetum distichae (Steffen 1931) Jonas 1933	14.69
	Caricetum gracilis Graebner et Hueck 1931	127.43
	Galio palustris-Caricetum ripariae Balátová-Tuláčková et al. 1993	0.18
	Peucedano-Calamagrostietum canescentis Weber 1979	2.25
	Phalaridetum arundinaceae (W. Koch 1926) Libbert 1931	26.28
	Phragmitetum australis Schmale 1939	116.44
	Thelypteridi-Phragmitetum Kuiper 1957	23.32
Molinio-Arrhenatheretea elatioris R. Tx. 1937	*Alopecuretum pratensis* Kojić *et al*. 2003 *sensu lato*	0.38
	Caricetum cespitosae (Steffen 1931) Klika et Šmarda 1940	2.88
	Deschampsietum cespitosae Horvatić 1930	0.4
	Filipendulo-Geranietum W.Koch 1926	5.32
	Lysimachio-Filipenduletum ulmariae Hadač et al., 1997	50.92
Rankless vegetation units	Ecotonal plant communities with common plants from the *Filipendulion* alliance	0.48
	Overgrowths of *Salix* sp. and tree groups of *Alnus glutinosa*	2.10
	Cultivated meadow	12.59
	Overgrowths of ruderal plant species	9.76
	Total:	397.67

Grassland

In Tulkiaragė polder communities from the *Phragmito-Magnocaricetea* class comprised by tall forbs of halophytes attain dominance. These plant communities are distributed in the area of 313.95 ha and it makes up 78.88 % of all territory. Among of them, the largest plots are covered by the plant communities from the *Magnocaricion elatae* (174.19 ha or 43.77 % of territory total), whereas communities from the *Phragmition* alliance are distributed in the area of 139.76 ha and it makes up 35.12 %. In western and northern parts of

the territory tall sedge and reed communities are often observed in the largest areas of Tulkiaragė polder where groundwater level is the highest. In some parts of habitats of the *Phragmitetum australis, Thelypteridi-Phragmitetum* and *Caricetum gracilis* the water is stagnant there during mid-period of vegetation.

Fertile meadow (*Molinio-Arrhenatheretea*) class plant communities are distinguished in the dryer areas. These communities are distributed in the area of 57.82 ha and it makes up 14.53 %. In a lot of cases, due to high groundwater level cultivated meadows have been succeeded and fodder plants disappeared. In sites where groundwater level is favourable for mezophytes, overgrowths of cultivated plants are observed. 3.16 % of polder area is covered by this type of vegetation and mostly it is observed in eastern and some of it in southern marginal part of the polder. In some sites cultivated plants along with ruderal comprise vegetation mosaic. Ruderal plant overgrowths are distinguished in the area of 2.45 %.

Woody vegetation

In Tulkiaragė polder woody plants are not of prevailing component there and it makes just 0.53 % of all territory coverage. Just small clumps are formed by scrubs and trees which are singly distributed in all territory, and usually near canals. Groups of woody plants are distinguished in eastern part of the polder. There are numerous of *Salix aurita, S. cinerea* and *Salix fragilis.*

Coverage of plant communities

312 contours of vegetation have been distinguished and their size varied in extent – from 0.03 ha to 13.81 ha (fig. 5, 6). A large part (42.63 %) of contours are smaller than 0.5 ha and 33.65 % of contours are larger than 1 ha. Due to influence of antropogeniztion (polder vegetation is fragmented by canal system) there are a lot of contours of various size. Hidrological regime is conditioned by canals, which determined character of vegetation.

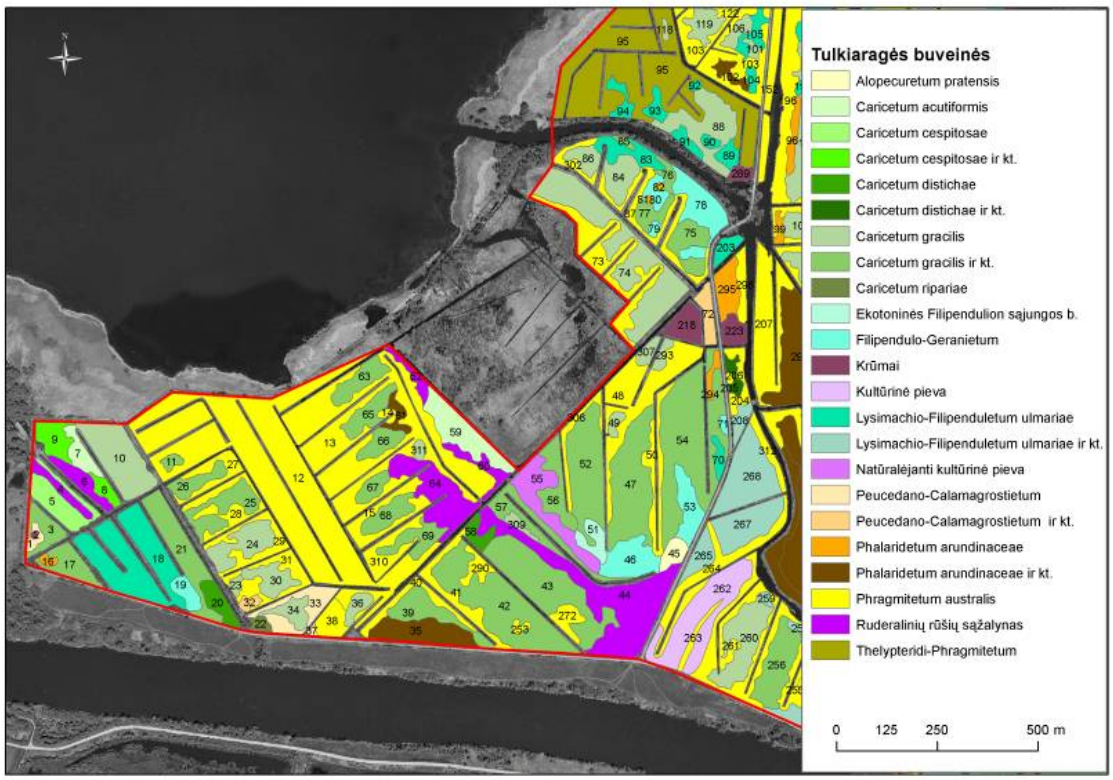

Fig. 5 – Vegetation of western part of Tulkiaragė polder

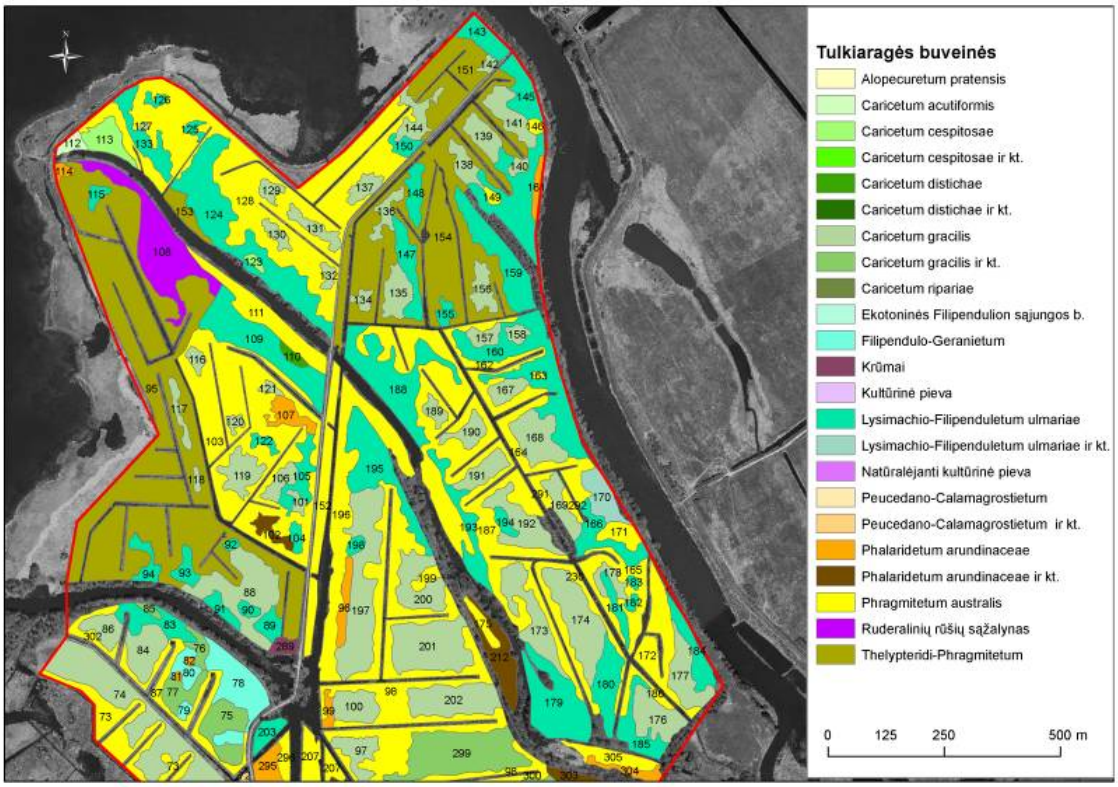

Fig. 6 – Vegetation of northern part of Tulkiaragė polder

Brief characterizations of main plant communities

Caricetum distichae

1. Physiognomy. Monodominant overgrowths of *Carex disticha.*
2. Coverage of shrubs. No scrubs.
3. Tussocks. No tussocks.
4. Stability. Under the influence of constant hydrological and farming conditions, communities are stable, however, due to cessation of mowing or waterlogging of habitats they are succeeded by the *Lysimachio-Filipenduletum vulgaris*, seldom – *Thelypterido-Phragmitetum.*
5. Variations of species composition. In unmowed plant communities *Lysimachia vulgaris* or *Phragmites australis* begins to dominate.
6. Successions, reasons and tendency. These communities are formed on slightly more elevated ground than *Caricetum gracilis.* Fluctuations steadily proceed under the influence of inconstant hydrological conditions i.e. *Caricetum gracilis* have formed under the influence of water balance after heavy inundation of water, but in drier seasons it withers and steps aside for the *Caricetum distichae.* Very often these two communities along with *Phalaroides arundinacea* comprise a very complicated vegetation mosaic. In the lower reaches of Nemunas these fluctuations previously were described in old literature. Succession proceeds differently due to cessation of mowing of plant communities or the waterlogging during abnormal long floods.
7. Farming and intensity. Some plots have been mowed.
8. The key factors in the development of community. The fluctuation of hydrological regime, mowing.

Caricetum gracilis

1. Physiognomy. The overgrowth of *Carex acuta* monodominats.
2. Coverage of shrubs. No shrub layer.
3. Tussocks. No tussocks.
4. Stability. Like *Caricetum distichae*, under the influence of constant hydrological and farming conditions, communities are stable, but in plots which have been waterlogged for extensive periods of time, these communities are changed to the *Lysimachio-Filipenduletum vulgaris* and in plots, which have not been mowed for a long time – *Thelypterido-Phragmitetum*. However, these fluctuations are not frequent and intense like *Caricetum distichae* because of *Caricetum gracilis* is one of the most stable sedge communities in Tulkiaragė polder. This is determined by the competitive ability of *Carex acuta* and its ability to form dense overgrowth, where, under the influence of inconstant environmental conditions, plants of other separate species hardly penetrate through and grow singly. *Caricetum gracilis* phytocenosis, without having been mowed, remains stable for many years if it is not overgrown by reeds.
5. Variations of species composition. The facies of *Caricetum gracilis* and *Phragmites australis* are described.
6. Successions, reasons and tendency. The widespread communities are confined to lower and wetter areas than *Caricetum distichae* or *Phalaridetum arundinaceae* in Tulkiaragė polder.
7. Farming and intensity. Some plots have been mowed.
8. The key factors in the development of community. The fluctuation of hydrological regime and mowing.

Phragmitetum australis

1. Physiognomy. The overgrowth of *Pragmites australis* monodominats.
2. Coverage of shrubs. No shrub layer.
3. Tussocks. No tussocks.
4. Stability. Under the constant conditions communities are stable and expand in the area very quickly.
5. Variations of species composition. No variations.
6. Successions, reasons and tendency. In various areas communities are formed in the wettest and waterlogged habitats of polder and have come to replace sedges and Reed canary grasses communities (*Caricetum gracilis, Caricetum distichae, Phalaridetum arundinaceae*) because of absence of farming. A constant mowing would give an opportunity for communities of sedge or Reed canary grass to regenerate.
7. Farming and intensity. Absence of farming activities.
8. The key factors in the development of community. Cessation of mowing, partly – flooding of habitats.

Suitable plant communities for the Aquatic Warbler

In Tulkiaragė polder two Aquatic Warbler (*Acrocephalus paludicola*) singing males were observed in the *Caricetum distichae* community in contour 210. The *Caricetum distichae* communities were distinguished in 38 contours and they are distributed in the area of a small scale (14.69 ha – 3.69 % of total vegetation area). However, it is the most important that these communities were observed in small plots – 4 contours plots are larger than 1 ha and one of it is just of 3 ha (table 4).

Table 4. The distribution and coverage of the *Caricetum distichae* communities

Contour No.	Area, ha	Occupied part of the contour, %
1	2	3
210	3.44	100
220	1.30	70
43	1.21	40
235	1.17	40
242	0.92	15
232	0.72	50
225	0.57	15
20	0.52	100
280	0.41	10
57	0.41	40
229	0.35	25
303	0.34	30
58	0.34	100
288	0.32	15
241	0.27	10
249	0.27	10
212	0.24	30
301	0.23	30
239	0.23	30
234	0.21	40

219	0.16	20
206	0.15	60
110	0.14	100
278	0.13	10
244	0.12	10
248	0.12	10
283	0.08	10
228	0.08	25
246	0.07	20
231	0.06	30
56	0.04	4
1	2	3
8	0.03	1
256	0.01	1
46	0.01	1
32	0.01	5
258	0.01	5
259	0.01	5
257	0.01	5
Total	14,69	

Recommendations on management of the territory forming suitable plant communities for the Aquatic Warbler

The vegetation in Tulkiaragė polder has been formed under the influence of both environmental and anthropogenic factors.

The key environmental factors which have fated the distribution of vegetation are hydrological and trophic conditions. If we take into account that the term of spring tides partly depends on pumping station work intensiveness, then we can treat it that the flooding factor is partly of man-induced origin. Other important anthropogenic factors are: mowing and grazing. Mowing is a very important factor in the maintenance of plant communities, whereas grazing is important factor in changing of plant communities. Thus, in order to form suitable plant communities for the Aquatic Warbler in Tulkiaragė polder, attention must be paid to the intensity of grazing and mowing and favourable terms of flooding.

We recommend to start mowing of reedy vegetation of the *Caricetum distichae, Caricetum gracilis* and *Phalaridetum arundinaceae* communities as they are potencially suitable breeding ground for the Aquatic Warbler.

The assiduous mowing of vegetation (twice per year) is required in the areas where *Phragmitetum australis* and *Thelypterido-Phragmitetum* communities are distinguished and the trends of succession must be observed there too.

Hay must be taken away from the territory.

The extensive mowing or grazing can be applied in other areas occupied by plant communities from the *Molinio-Arrhenatheretea* class.

CHARACTERISTIC OF VEGETATION AT TYRAI MIRE

General characteristic of vegetation at Tyrai Mire

Grassland. The widespread grassland plant communities are distributed in 99.61 % of all studied territory. It has been influenced by the hydrological conditions – periodical flooding and long-lasting high water level during vegetation period. For these certain conditions communities composed by forbs of helophytes from the *Phragmito-Magnocaricetea* class attain dominance in Tyrai wetland. These plant communities are distributed in the area of 498.36 ha and it makes up 92.27 % of all territory. Among of them, the largest plots (337.49 ha or 62.50 % of territory total) are covered by the communities of the *Phragmition* alliance.

Tall sedge communities (All. *Magnocaricion elatae*) are distributed in the considerably smaller area – 160.87 ha or 29.79 % of all territory.

Fertile meadow plant communities (Cl. *Molinio-Arrhenatheretea*) are distinguished in the area of 21.84 ha (4.04 %). Phytocenosis from the *Artemisietea vulgaris* class encompass the smallest area of the territory (0.3 ha). Rankless plant communities have been observed in the area of 17.17 ha (3.18 %).

Among of all plant communities the *Phragmitetum australis* is of the most widespread occurrence in this territory and the area of 329.07 ha is occupied by it.

These plant communities have a tendency to expand in extent: reed beds (fig. 4, contour 10) expansion is observed in a south direction and sedge communities are replaced by them in some plots. Smaller areas (87.98 ha) are occupied by the *Caricetum distichae*. Also, *Caricetum distichae* communities are found with tangles of the communities comprised by forbs of helophytes in the territory (47.98 ha).

Woody Plants. Due to unfavourable hydrological conditions, large areas are not occupied by woody plants – it makes up just 2.12 ha (0.39 % of territory total). Generally, there are small patches of pussy-willow or tree groups (*Salix cinerea, C. aurita, S. pentandra, S. caprea, S. fragilis*) and seldom – inconsiderable clump of Black alder (*Alnus glutinosa*). Under the influence of unfavourable hydrological conditions, woody plants have found their niche where drainage is more intensive or in more elevated sites of this territory. Single scrubs are observed in northern part of the territory (contour 42 and eastern part of contours 43 and 44).

Coverage of plant communities at Tyrai Mire

The territory underwent a tenuous effect of anthropogenization, therefor plant communities are not fragmented and there are just 50 contours. The size of contours varies in extent (fig. 4–7) – from 0.20 ha to 110.98 ha. Prominently large plots of reed beds are distinguished in most part of the territory (contours 10, 26 and 31). Reed beds have a tendency to expand in extent. There are Two-ranked sedge (*Carex disticha*) plants observed in a marginal part of contour 10, therefor we can imply that previously there were communities of Two-ranked sedge and reed beds communities of high competitive ability have replaced them. These sedge communities were replaced by reed beds in contour 26 too.

Table 4. Coverage of Vegetation Contours.

Contour No.	Plant communities	Area, ha
1	2	3
1	*Glycerietum maximae* and *Caricetum gracilis* mosaic	2.06
2	*Phragmitetum australis*	3.02

3	*Glycerietum maximae* and *Caricetum gracilis* mosaic	2.81
4	*Caricetum distichae* and other halophyte communities	43.5
5	*Glycerietum maximae* and *Caricetum gracilis* mosaic	3.27
6	*Molinietum caeruleae*	8.81
7	Hygrophyte and halophyte communities	10.14
8	*Phragmitetum australis*	4.18
9	*Caricetum distichae*	39.55
10	*Phragmitetum australis* mosaic	110.98
11	Eutropic hygrophyte community	1.20
12	*Caricetum distichae* and *Glycerietum maximae* mosaic	4.48
13	Halophyte communities	0.28
14	Overgrown Tall sedge communities by scrubs	0.72
15	*Caricetum distichae*	5.53
16	Overgrown Tall sedge communities by scrubs	1.25
17	Scrubs	0.22
18	Hygrophyte and halophyte communities	3.20
19	Scrubs	0.21
20	Hygrophyte and halophyte communities	1.41
21	*Caricetum distichae*	3.13
22	*Phragmitetum australis*	19.85
23	*Caricetum distichae*	3.05
24	*Phragmitetum australis*	0.24
25	Hygrophyte and halophyte communities	1.35
26	Replaced Two-ranked sedge communities by *Phragmitetum australis*	80.80

Table 4 (continuous)

1	*2*	3
27	*Phragmitetum australis*	1.95
28	Scrubs	0.78
29	Hygrophyte and halophyte communities	4.06
30	*Phalaridetum arundinaceae*	2.88
31	*Phragmitetum australis*	102.47
32	*Phragmitetum australis*	0.51
33	*Phragmitetum australis*	0.36
34	*Phalaridetum arundinaceae*	3.54
35	*Phragmitetum australis*	0.31
36	*Phragmitetum australis*	0.61
37	*Caricetum distichae*	9.22
38	*Phragmitetum australis*	1.09
39	*Phalaridetum arundinaceae*	4.12
40	*Phragmitetum australis*	1.24
41	Overgrowth of trees and scrubs	0.91
42	Cultivated meadow	0.20
43	*Molinietum caeruleae*	13.03
44	*Caricetum distichae*	27.49
45	*Phragmitetum australis*	1.46
46	*Caricetum ripariae* and other halophyte communities	2.39
47	Ecotonal xerophyte communities	0.71
48	*Saponario officinalis-Petasitetum spuriae*	0.30

49	Ecotonal xerophyte communities	2.80
50	*Caricetum elatae*	2.43
	Total :	**540.1**

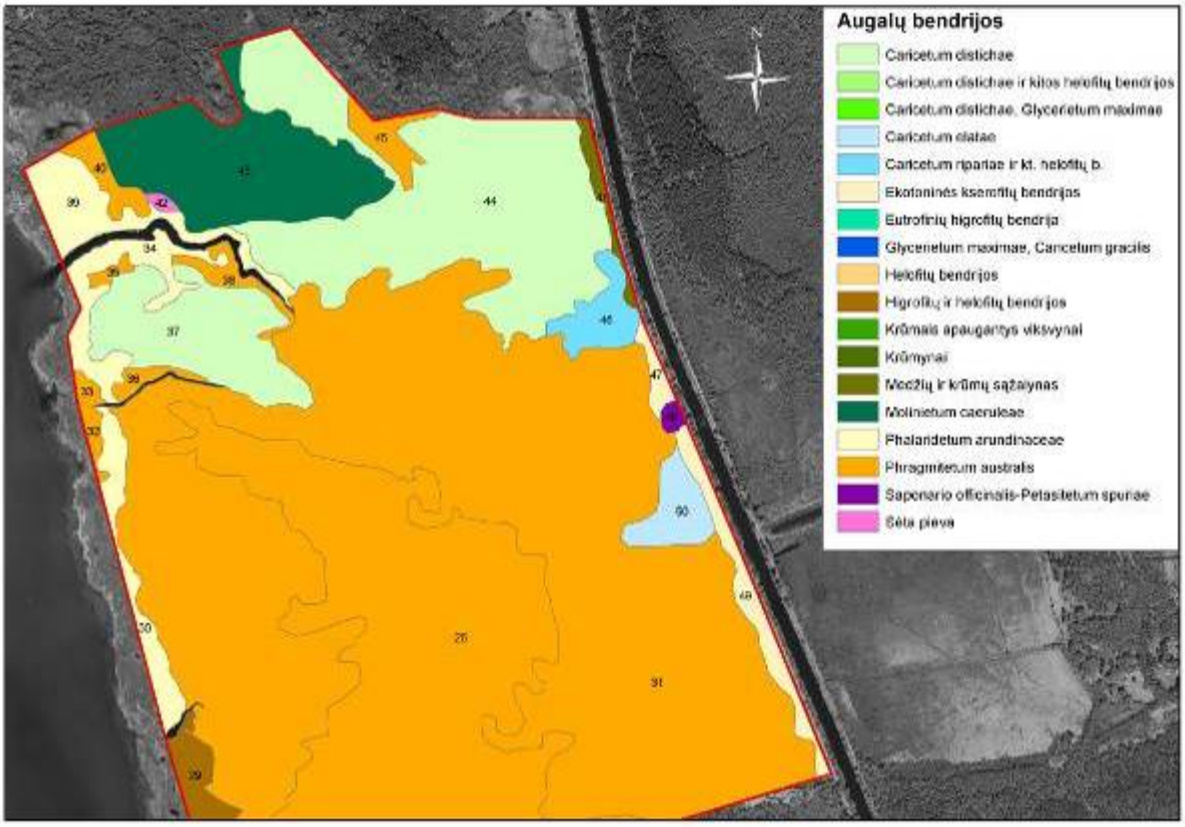

Fig. 7 (a) – Vegetation in northern part of Tyrai wetland.

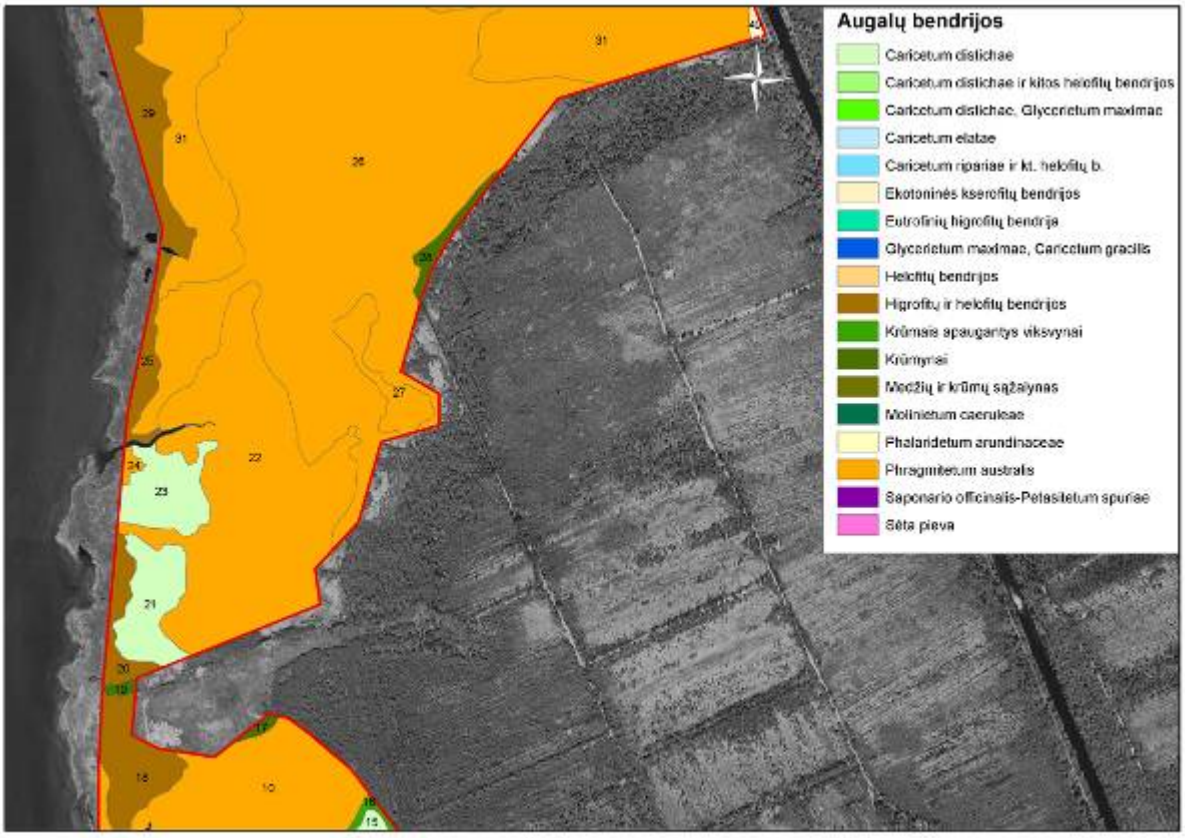

Fig. 7 (b) – Vegetation in central part of Tyrai wetland (to north forest side)

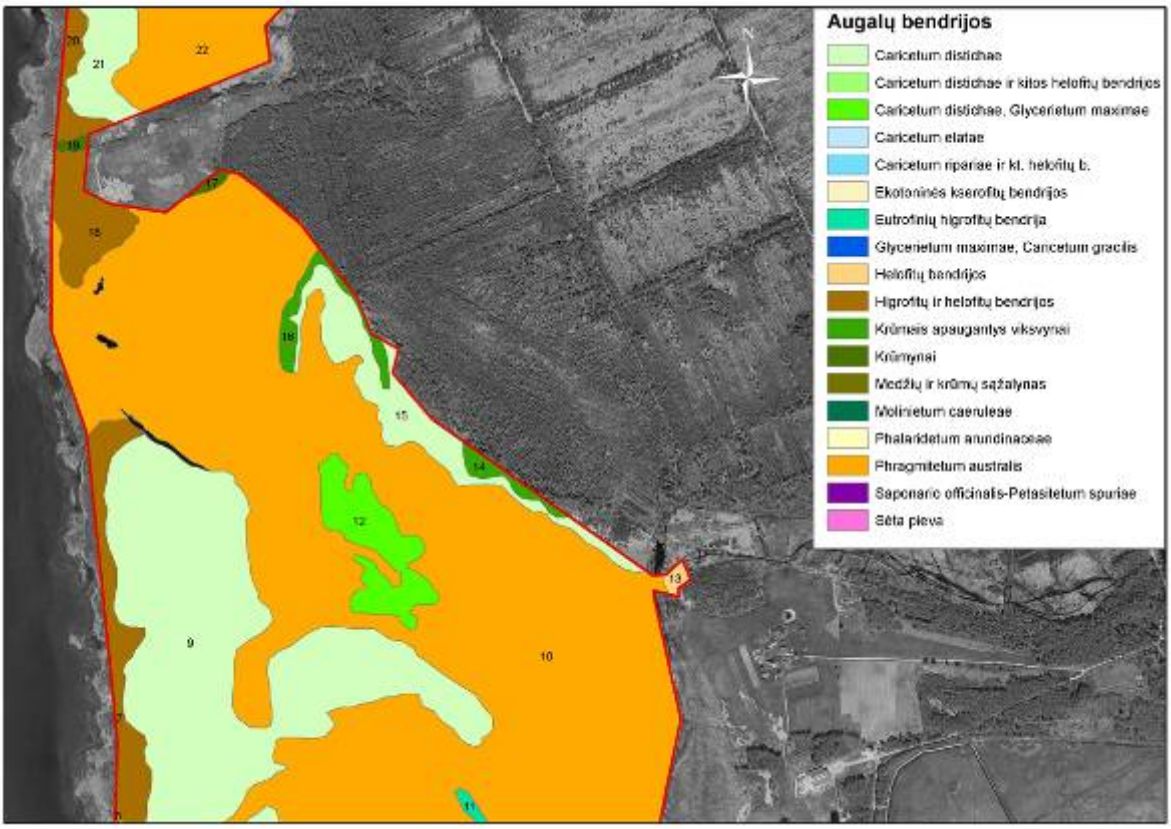

Fig. 7 (c) – Vegetation in central part of Tyrai wetland (to south forest side)

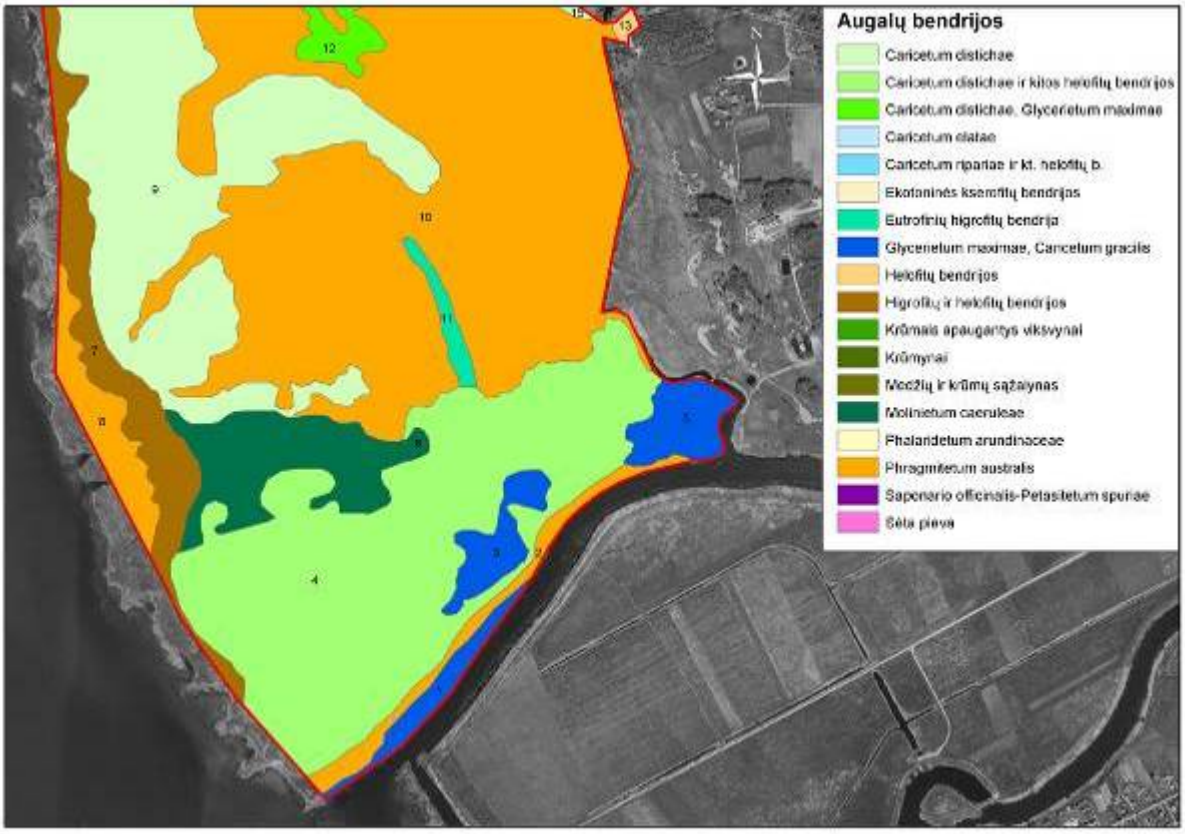

Fig. 7 (d) – Vegetation in northern part of Tyrai wetland.

Brief characteristic of plant communities of Tyrai Mire

Caricetum distichae

1. *Physiognomy*. Monodominant overgrowths of *Carex disticha*.
2. *Coverage of shrubs*. No scrubs.
3. *Tussocks*. Tussocks are observed just in northern part of the territory (northern part of contour 44)
4. *Stability*. Under the influence of constant hydrological and farming conditions, communities are stable, however, due to absence of mowing, the stands of the community are invaded by reeds.
5. *Variations of species composition*. Common reed (*Phragmites australis*) domination starts in unmown communities.
6. *Successions, reasons and tendency*. These communities vegetation without being mown have a tendency to be overgrown by reeds, under the influence of biomass accumulation, which increases habitat's trophicity.
7. *Farming and intensity*. Absence of mowing.
8. *The key factors in the development of community*. Fluctuations of hydrological regime and application of mowing treatment.

Phragmitetum australis

1. *Physiognomy*. The overgrowth of monodominat *Pragmites australis*.
2. *Coverage of shrubs*. No shrub layer.
3. *Tussocks*. Tussocks are absent usually. They occur just in areas, which are in contiguous with contour 50.
4. *Stability*. Under the constant conditions communities are stable and expand in area very quickly.
5. *Variations of species composition*. No variations.
6. *Successions, reasons and tendency*. In various areas communities are confined to the wettest and waterlogged habitats and have come to replace sedge and Reed canary grass communities (*Caricetum elatae, Caricetum distichae, Phalaridetum arundinaceae*) due to absence of farming. A constant mowing would give an opportunity for communities of sedge or Reed canary grass to regenerate.
7. *Farming and intensity*. No farming activities.
8. *The key factors in the development of community*. Cessation of mowing and partly – flooding of habitats.

Plant communities suitable for the Aquatic Warbler at Tyrai

The Aquatic Warbler singing males are observed in the *Caricetum distichae* communities: contour 4 – 1 male, contour 44 – 4 males.

In Tyrai wetland the *Caricetum distichae* communities are distinguished in 8 contours, which make up 25.17 % of the territory total. In two contours (4 and 12) there are small tangles of plant community composed by Tall sedge as well as community comprised by Reed canary grass.

Table 5. The distribution and coverage of the *Caricetum distichae* in Tyrai wetland.

No. on map	Habitat	Area, ha
9	*Caricetum distichae*	39.55
15	*Caricetum distichae*	5.53

21	*Caricetum distichae*	3.13
23	*Caricetum distichae*	3.05
37	*Caricetum distichae*	9.22
44	*Caricetum distichae*	27.49
4	*Caricetum distichae* and other communities comprised by halophytes	43.5
12	*Caricetum distichae* with tangles of the *Glycerietum maximae*	4.48
	Total:	135.95

DAMBAVARAGIS MEADOWS AND KIAULYČIA SWAMP (ŽUVINTAS)

The general overview of vegetation characteristic at Dambavaragis meadows and Kiaulyčia fen mire

The vegetation of Dambavaragis meadows and Kiaulyčia fen mire consists of communities from 19 associations and 2 rankless units – phytocenosis from 6 vegetation classes. Also, another alliance have been characterised – *Caricion lasiocarpae*, which syntaxonomical composition is not detailed.

The grassland (fen mire). In Dambavaragis meadows and Kiaulyčia swamp plant communities belonging to the *Phragmito-Magnocaricetea* class prevail and are distributed in the area of 184.52 ha. The largest plots among them are covered by the communities of the *Magnocaricion* alliance (183.30 ha) and according to attained dominancy these communities are distributed as follows: *Thelypteridi-Phragmitetum* (155.89 ha), *Caricetum distichae* (14.75 ha), *Caricetum appropinquatae* (6.72 ha) and *Caricetum elatae* (4.57 ha).

Preponderant *Thelypteridi-Phragmitetum* phytocenosis (155.89 ha) from the *Magnocaricion* alliance are distributed alongside the Žuvintas Lake.

The *Caricetum distichae* communities (14.75 ha) unlike other phytocenosis of the *Magnocaricion* alliance are formed on slightly elevated areas. These communities along with *Caricetum appropinquatae* and *Carex lasiocarpa* communities (*Magnocaricion*) often comprise a complicated vegetation mosaic.

The *Caricetum appropinquatae* associations (6.72 ha) and *Carex lasiocarpa* communities (6.72 ha) have formed in alike *Caricetum distichae* habitats.

The *Caricetum elatae* (4.57 ha) as well as the *Thelypteridi-Phragmitetum* is confined to the wettest habitats compared with other communities from the *Magnocaricion* alliance.

During the last 15 years, declining in distribution of these communities is observed and due to intrusion of reeds, they are replaced by the *Thelypterido-Phragmitetum*. In 1996, the communities of the *Caricetum elatae* formed a straight belt alongside the Žuvintas Lake in Dambavaragis meadows (BALSEVIČIUS, 1996).

Other plant communities belonging to the *Magnocaricion* alliance are distinguished in the smaller areas and do not attain a significant meaning in the field layer of the studied territory.

A small area is occupied by phytocenosis from the *Phragmition* alliance (1.22 ha). A single *Glycerietum maximae* community has been described. These communities have formed alongside the Bambena River in flooded habitats.

The *Scheuchzerio-Caricetea fuscae* class communities have been distinguished in the area of 20.15 ha. The *Caricion lasiocarpae* alliance phytocenosis is distributed in the area of 18.23 ha in the transitional swamp part, whereas the *Caricion davallianae* alliance – 1.92 ha in the peripheral swamp part.

The *Molinio-Arrhenatheretea* class communities are distributed in the area of 14.90 ha. Large areas are occupied by the *Carex disticha (Calthion*) phytocenosis (5.45 ha).

The central elevated conformation parts of the swamp are covered by the *Molinietum caeruleae* (4.83 ha). The *Deschampsietum cespitosae* (2.06 ha) is distributed in the fringe of the swamp and contiguous with the tall slender communities from the swamp side as well as with cultivated fields and meadows on the pothole slope of the swamp. In alike habitats the *Lysimachio vulgaris-Filipenduletum* (0.77 ha) has been distinguished. Other communities from the *Molinio-Arrhenathereta* are distributed patchily.

The shrubs. The Alnetea glutinosae class is represented by the association of *Salicetum pentandro-cinereae* in Dambavaragis meadows. The willow shrub communities are distributed in the area of 14.33 ha and it makes up 6.13 % of the total studied area of the territory.

The communities from the *Salicetum pentandro-cinereae* association have formed due to encroachment of shrubs in the swamp communities which belong to the *Magnocaricion* association.

The coverage of plant communities at Dambavaragis meadows and Kiaulyčia fen mire

Table 6. The covered areas by plant communities in Dambavaragis meadows and Kiaulyčia swamp.

Plant community	Area, ha
Caricetum gracilis	0.09
Galio palustris-Caricetum ripariae	0.09
Poo palustris-Alopecuretum pratensis	0.20
Alopecuretum pratensis	0.23
Calamagrostietum strictae	0.28
Filipendulo-Geranietum	0.32
Carex lasiocarpa community (*Magnocaricion*)	0.39
Cirsietum rivularis	0.52
Lolio-Cynosuretum	0.52
Phalaridetum arundinaceae	0.52
Lysimachio vulgaris-Filipenduletum	0.77
Glycerietum maxime	1.22
Campylio stellati-Caricetum paniceae	1.92
Deschampsietum cespitosae	2.06
Caricetum elatae	4.57
Molinietum caeruleae	4.83
Carex disticha community (*Calthion*)	5.45
Caricetum appropinquatae	6.72
Salicetum pentandro-cinereae	14.33
Caricetum distichae	14.75
Caricion lasiocarpae	18.23
Thelypteridi-Phragmitetum	155.89
In total:	233.90

The coverage of vegetation classes at Dambavaragis meadows and Kiaulyčia fen mire

Table 7. The coverage of plant communities belonging to the different vegetation classes in Dambavaragis meadows and Kiaulyčia swamp.

Vegetation class	Area, ha
Alnetea glutinosae	14.33
Molinio-arrhenatheretea elatioris	14.90
Scheuchzerio-caricetea nigrae	20.15

Phragmito-magnocaricetea	184.52
In total:	233.90

Plant communities suitable for the Aquatic Warbler at Dambavaragis meadows and Kiaulyčia fen mire

The Aquautic Warbler has been located in the *Caricetum elatae* community (4.57 ha – contour 25) in Dambavaragis meadows.

In Šyša polder, the Aquautic Warbler has been observed in plant communities of the *Caricetum gracilis, Caricetum distichae* and *Phalaridetum arundinaceae*. However, areas covered by *Caricetum gracilis* and *Phalaridetum arundinaceae* are very patchy and furthermore, these areas are flooded permanently in Dambavaragis meadows. In Kiaulyčia swamp these communities are not distinguished at all.

The *Caricetum distichae* is distributed in fairly large and uniform plots in Dambavaragis meadows (contour 10 – 7.01 ha; contour 19 – 6.57 ha). Theoretically, these communities might be suitable for the Aquatic Warbler to breed too. In Belarus, the Aquatic Warbler is found in the *Caricetum appropinquatae* as well as in the communities formed by *Carex lasiocarpa* (KOZULIN, FLADE, 1999), however, areas covered by these communities are very patchy and small in Dambavaragis meadows.

ISLAND ON ŽUVINTAS

The general overview of vegetation characteristic on Žuvintas Island

The vegetation of island consists of communities from 2 associations. The vegetation of island belongs to the *Magnocaricion* alliance of the *Phragmito-Magnocaricetea* class. Prevailing *Thelypteridi-Phragmitetum* community (9.64 ha) is distributed in the peripheral island parts. The *Caricetum elatae* communities (0.85 ha) have formed in slightly elevated areas in the central part of the island.

The coverage of plant communities on Žuvintas Island

Table 8. The covered areas by plant communities in the island.

Plant community	Area, ha
Caricetum elatae	0.85
Thelypteridi-Phragmitetum	9.64
In total:	10.48

The coverage of vegetation classes on Žuvintas Island

Table 9. The coverage of plant communities belonging to the different vegetation classes in the island.

Vegetation class	Area, ha
PHRAGMITO-MAGNOCARICETEA	10.48

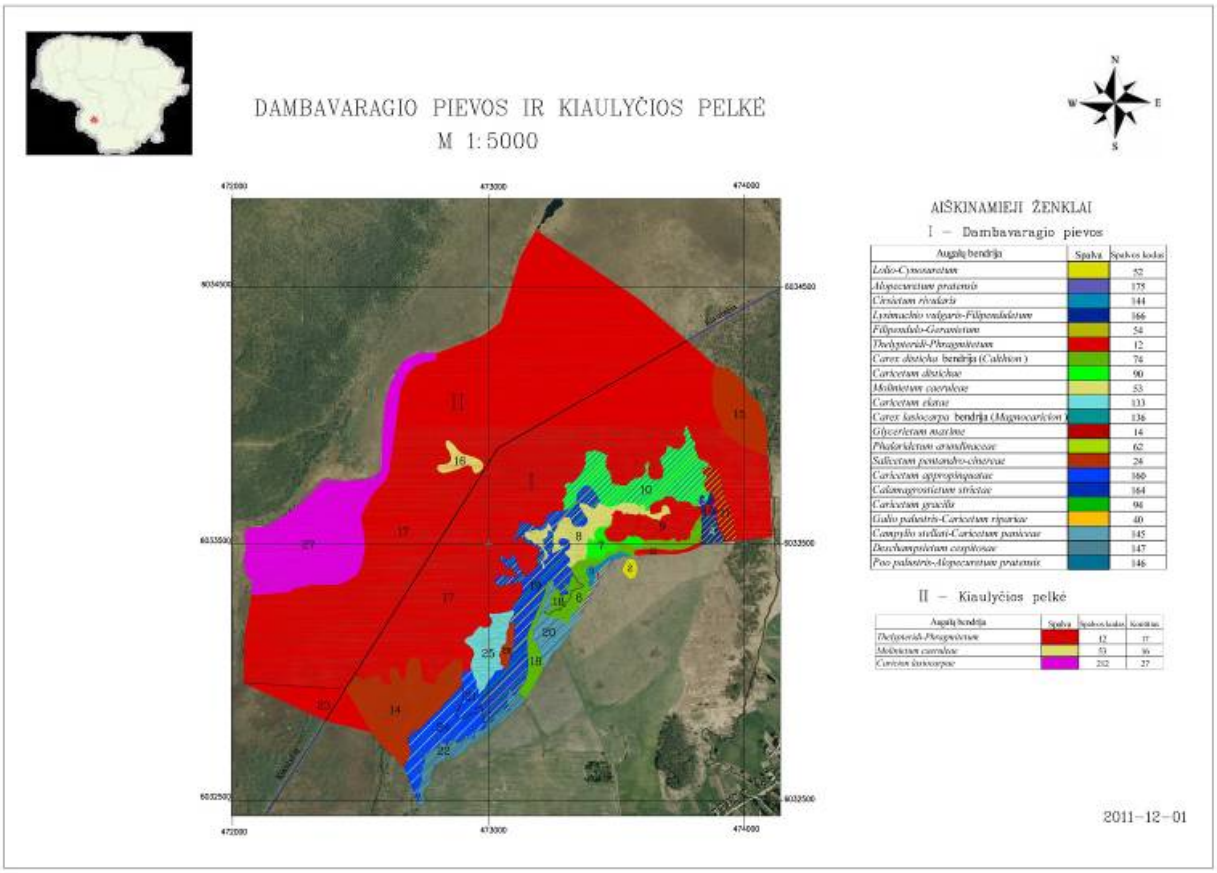

Fig. 8 – Vegetation of Dambavaragis meadows and Kiaulyčia fen mire

Brief characteristic of plant communities

Caricetum elatae

1. *Physiognomy*. Phytocenosis are formed by monodominant tussocks *Carex elata* in the mid part of the island.
2. *Coverage of shrubs*. Community is not covered by shrubs because of the water level is too high.
3. *Tussocks*. Tussocks are formed by *Carex elata*.
4. *Stability*. Under the constant hydrological conditions, communities are quite stable.
5. *Variations of species composition*. Variations are not established.
6. *Successions, reasons and tendency*. Encroachment of reeds.
7. *Farming and intensity*. Absence of farming activities.
8. *The key factors in the development of community*. Permanent flooding and mowing of the habitats.

Thelypteridi-Phragmitetum

1. *Physiognomy*. A wide vegetation belt is formed by monodominant overgrowths of *Pragmites australis* with a quite abundance or abundance intermixes of *Thelypteris palustris* or sedge in the peripheral island parts.
2. *Coverage of shrubs*. The communities are not covered by shrubs.
3. *Tussocks*. Absence of tussocks.
4. *Stability*. Under constant conditions, these communities are stable and expand in the area.
5. *Variations of species composition*. Variations are not established.
6. *Successions, reasons and tendency*. The communities have formed under the influence of absence of farming activities. An invasion of the community to the areas covered by sedges is observed. Due to regular mowing of vegetation, sedges regeneration may be expected.
7. *Farming and intensity*. Absence of farming activities.
8. *The key factors in the development of community*. Cessation of mowing.

Suitable plant communities for the Aquatic Warbler on Žuvintas Island

The Aquatic Warbler has not been located in the island. Favourable *Caricetum elatae* community plot is too small (0.85 ha) for the Aquatic Warbler to breed.

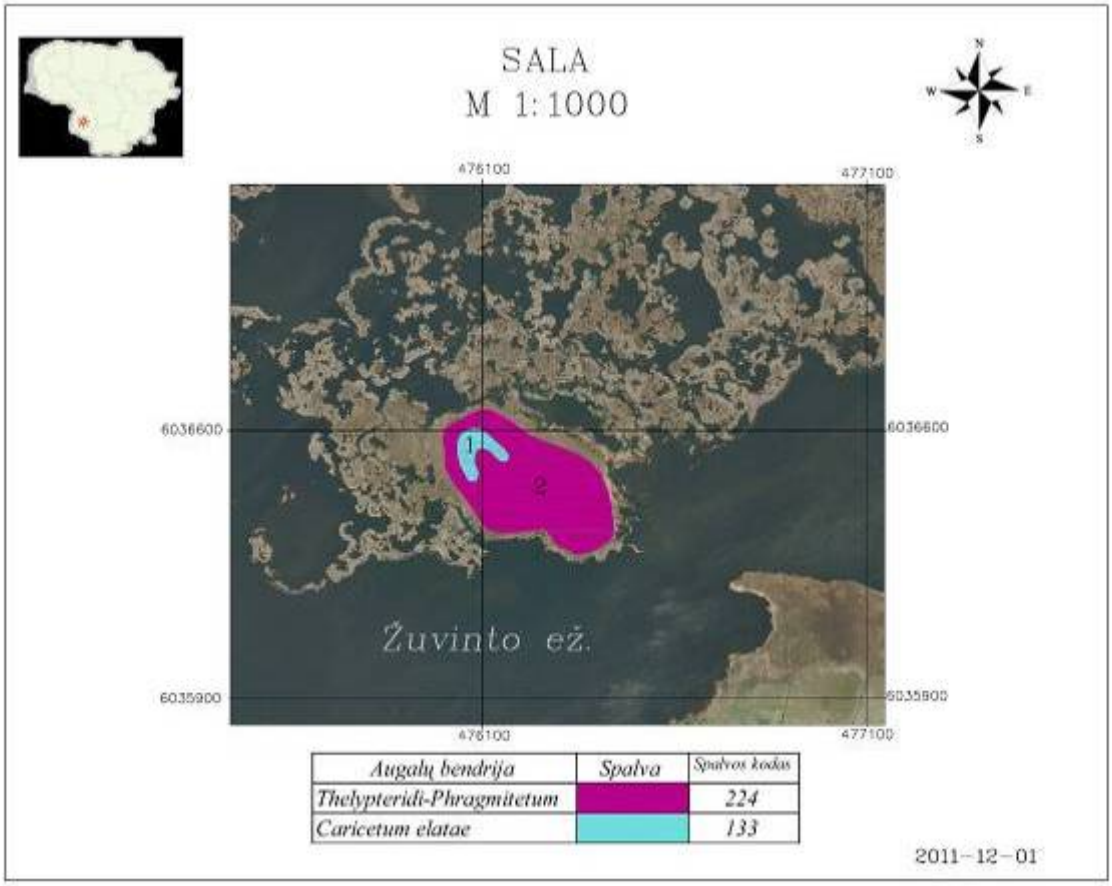

Fig. 9 – Vegetation of Žuvintas Island

DYNAMICS OF THE AQUATIC WARBLER NUMBER ON THE PROJECT SITES

Research methodology

Data on abundance and distribution of Aquatic Warbler singing males before and after activities foreseen in the project will be the main indicator of effectiveness of activities improving habitat quality for this globally threatened species and for other many rare and protected species living in the open sedge meadows.

Planning the fieldwork to evaluate Aquatic Warbler abundance and distribution or planning management activities (mowing, bush removal) it is necessary to produce simple maps for all project sites in GIS format in which will be marked plant associations. In these simple maps using satellite image analysis should be marked at least following plant association parameters: open sedge meadows (marshy meadows), meadow (mire) places fully overgrown by bushes, places covered with reeds, open water areas, tree patches and finally roads, ditches, dams, mineral islands.

Obtained data about open mires and wet meadows distribution allow properly to plan Aquatic Warbler counts. In Lithuania Aquatic Warbler occupied territories usually cover 30-100 ha area. In most cases areas are fragmented by reeds and bushes. Besides that, most of the areas have old drainage systems, where ditches divide area into smaller segments. Corresponding to that, could be made a decision, that main method for counting singing Aquatic warblers will be full count method marking male dislocation point.

Preparatory work

According to vegetation map preparing potential habitat which needed to be explored, scheme and calculating number of persons necessary to carry out counts. Bird counts in dense reedbed or bushland need to be done in case when in the area planned to do management activities. After that, have to be prepared enlarged area scheme by scale 1:10 000 and distributed to each participant. For the counts each participant must have following equipment: scheme of the count area, GPS receiver, binocular, pen, flashlight.

Count methods

In separate small areas (up to 30 ha) suitable for breeding, distributed among reedbeds and bushes or having clear boundaries in nature (ditches, roads), full counts can be carried out by one person. Suitable plots distinguished on the maps. In each of the distinguished plot, census taker on the map marks singing point of each Aquatic Warbler male. At the same time should be taken co-ordinates of each point using GPS device.

Carrying counts on larger areas (over 100 ha) with even vegetation, suitable for Aquatic Warbler, counts are performed by group of people. Number of participants calculating depending on area size and that distance between each person should be 50 m. Participants standing in a row slowly moving forward and counting singing males. By practical reasons most of the census takers counting males only from one side. It should be ensured, that whole group will move forward with the same speed al together. During the evening the length of one segment should not be longer than 1500 m. For larger areas, covering few square kilometers, total area should be split into smaller ones. In the ideal case should be used natural boundaries, such as roads, ditches, dams, tree lines, etc. 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 not clear natural boundaries, then with GPS receiver needs to mark co-ordinates of every angle of each plot. Every participant should carry area map with scale 1:10 000. For each territory should be filled in observation card

(Annex 1) where are noted all measurements including number of singing males. All singing males as precise as possible should be marked on the map.

In more complicated areas all measurements should be made at daytime in order to save time during sunset counts. In areas where vegetation monitoring has been already done, very useful to use these data during bird counts.

During the counts of Aquatic Warbler at the same time on the map should be marked all other rare bird species, for instance Corncrake (*Crex crex*), Great Snipe (*Gallinago media*), Montague's Harrier (*Circus* pygargu)s.

Counts could be carried out on the evenings without or with weak wind to ensure rather good audibility. Weak rain bigger influence on singing males activity does not have.

Time of the counts

It is necessary to perform 2 counts of Aquatic warbler singing males during the breeding season which are connected to 2 breeding cycles. First count should be carried out between 20th of May to 10th of June, second – between 25th of June to 10th of July. It is necessary to do because in May and June hydrological situation can be very different and number of singing males can be influenced a lot.

Counts of singing males are being performed in the evening. It starts at around 1-2 hours before sunset and ends at around 1 hour after sunset.

Results

All breeding sites of Aquatic Warbler in Lithuania discovered during last decade were checked. Results are presented in Table 10 and Pictures 8 and 9.

Table 10. Distribution and abundance of Aquatic Warblers in Lithuania in 2011.

Site	Municipality	Research area, ha	No of singing males		Size of local population, singing males	No of singing males in 1990
			1st count	2nd count		
Alka polder	Šilutė	498	1	0	0-1	
Kniaupas bay environs	Šilutė	202	2	1	1-2	
Krokų Lanka environs	Šilutė	273	1	1	1	
Minija ox-bow	Šilutė	69	1	3	1-3	
Sausgalviai polder	Šilutė	255	16	9	9-16	
Šyša polder	Šilutė	753	30	23	23-30	100-110
Uostadvaris polder	Šilutė	350	7	7	7	
Tulkiaragė polder	Šilutė	466	0	0	0	10-20
Vorusnė polder	Šilutė	157	0	0	0	
Svencelė	Klaipėda	38	0	0	0	
Tyrai	Klaipėda	726	30	45	30-45	250-300
Pušnis	Ignalina	52	0	0	0	
Svyla river valley	Ignalina	45	0	0	0	
Žuvintas	Alytus	240	1	1	1	10
	Totally:	4124	88	90	73-106	

Fig. 10 – Aquatic Warbler distribution in Lithuania in 2011.

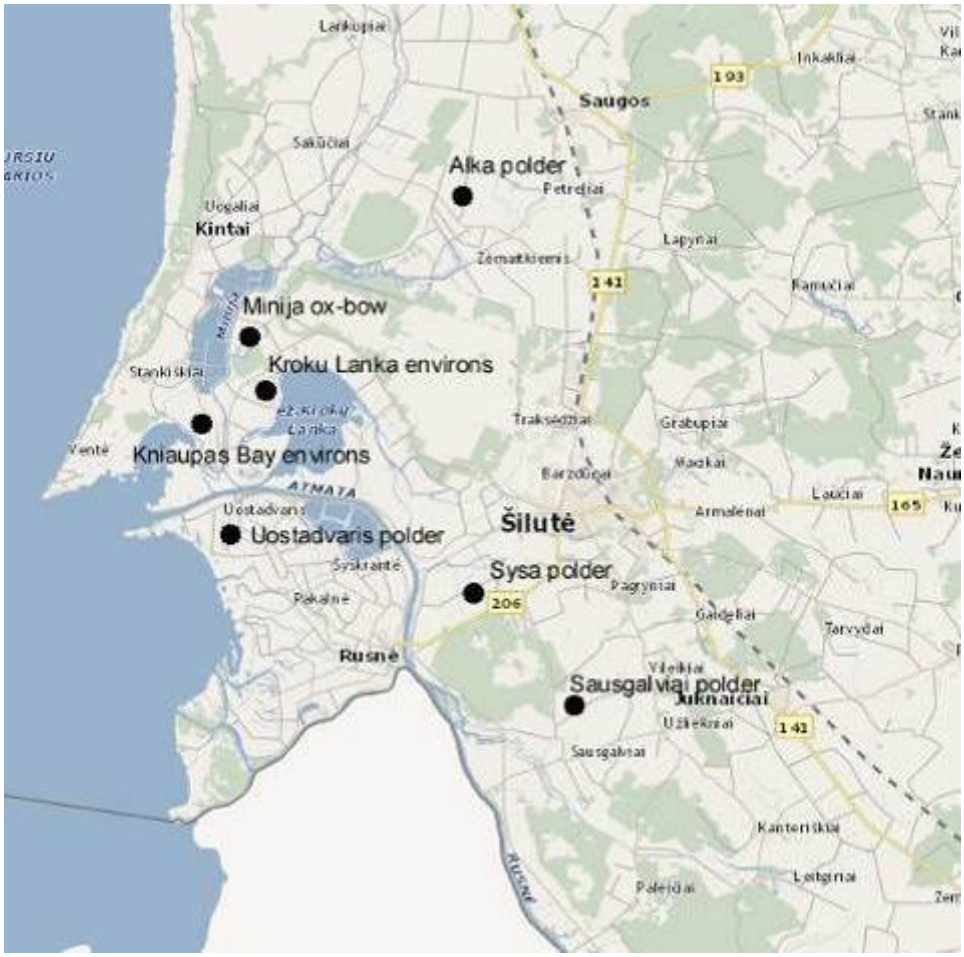

Fig. 11 – Aquatic Warbler distribution in Nemunas delta in 2011.

Totally 14 potential breeding sites of Aquatic Warbler were checked. Total size of researched area was 4124 ha: in Nemunas Delta – 3023 ha, on the coast of Curonian Lagoon – 764 ha, in Žuvintas – 240 ha, in Eastern Lithuania – 97 ha. Singing males of Aquatic Warbler in 2011 were discovered at 9 sites in 3 regions: Žuvintas lake environs, Nemunas Delta and Tyrai mire (Pic 8). In Nemunas Delta region aquatic warblers were detected in 7 areas (Fig. 11).

During the first and second counts nearly the same numbers of singing males in total were estimated, 88 and 90 respectively, but bird numbers in various areas (Šyša polder, Sausgalviai polder, Tyrai) differ significantly. Such changes are difficult to explain without more detailed research. Most likely, the management regime on the meadows has influenced the distribution of birds' numbers: after one site has been mowed, birds moved to another. Total number of local population is between 73 and 106 singing males. Evaluating results of the counts, we can conclude, that Aquatic Warbler population in Lithuania in 2011 was about 90 singing males.

Tyrai. In 1994 the number of breeding Aquatic Warblers in Tyrai mire (Fig.12) was estimated to be 250-300 singing males. Since then, a gradual decrease has been observed with 190-210 singing males in 2000, 110-130 in 2004, 56-70 in 2008, and only 30-45 in 2011.

Tulkiaragė polder. There were no special surveys of the species in previous ten years. However, there are data on the rather numerous population of the Aquatic warbler in 1990s there (for example, 10-20 singing males in 1995). Lately, the first singing males were "re-discovered" in 2007 and 2008. However, no detailed counts were made and the total number of Aquatic warblers is not known precisely.

Šyša polder. Aquatic Warbler was discovered in Šyša polder in 2004 when the total number of singing males was about 100-110 individuals. Recently the numbers declined to 45-55 and 35-45 males in 2006 and 2008, respectively and to 23-30 in 2011.

Žuvintas Biosphere Reserve (Fig. 13) up to 10 pairs of the Aquatic Warbler were recorded in 1990s, but in 2011 – only 1 bird.

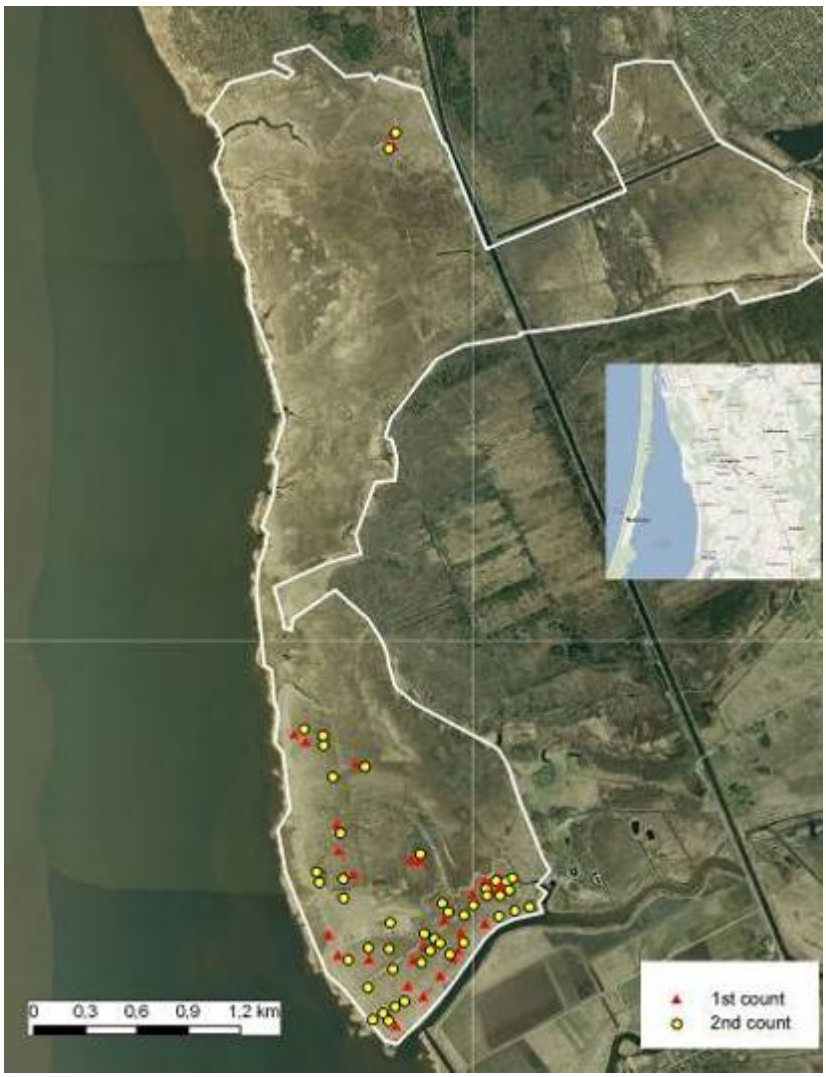

Fig. 12 – Aquatic warbler investigation area and distribution of birds in Tyrai mire, in **2011**

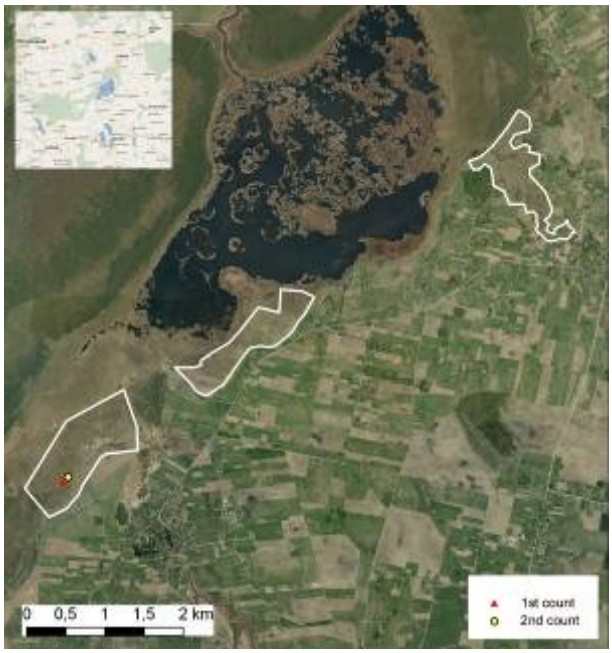

Fig. 13 – Aquatic warbler investigation area and distribution of birds in Žuvintas lake environs, in **2011**

ANALYSIS AND DISCUSSION

ŠYŠA POLDER

Lithuanian sites **Šyša,** Tulkiaragė and others situated in Nemunas River Floodplain are referred to floodplain meadows. Floodplain waterlogged meadows is characterized by increased productivity and trophic status due to yearly income of mineral material with flood waters. Water level dynamics has wide amplitude (more than 1 m) of level fluctuations and during vegetation period the water level falls below the soil surface. Such conditions explain the absence of peat formation on floodplain meadows. Aquatic Warbler occurrence on floodplain meadows is critically dependent on annual management.

At Šyša floodplain meadows typical mostly sedge communities are preserved due to regular mowing and grazing. This has ensured conservation of Aquatic Warbler population.

Recommendations on habitats management at Šyša

1. To change timing of mowing of meadows to ensure breeding success of Aquatic Warbler. Meadows should be mowed after 15 July especially if the site could not be mowed in the preceding year. Within at least 100 m of AW males, meadows must not be mowed before 1 August. The AES prescriptions and rules for AES payments will have to take this into account.
2. In order to guide mowing, regular mapping of AW must be done at least twice before onset of mowing under favorable conditions. Also, occurrence of other threatened species (e.g. Great Snipe, Godwit, Corncrake) must be taken into account. The compliance of farmers with AES prescriptions must be monitored.
3. Water levels should be kept not lower than 10-30 cm and not higher than 10 cm according to soil surface in May-June. Before the onset of mowing, water tables can be lowered to 30-40 cm below surface (July-August). This will ensure the conservation of present distribution of vegetation communities and even contribute to increase of area of Carex disticha communities.
4. Annual mowing before 15.7. is required in areas covered by *Phragmitetum australis* and *Thelypterido-Phragmitetum* communities.
5. All the cut vegetation should be removed from the territory of the meadows until March.

TULKIARAGĖ

Waterlogged meadows of Tulkiaragė are completely overgrown with reeds and shrubs today as a result of termination of farming activities here for more than 15 years. This made meadows completely unsuitable for the Aquatic Warbler and other globally threatened bird species, typical for open floodplain meadows (Great Snipe, Godwit). Management aimed at restoring these meadows will create habitats favourable for the Aquatic Warbler and other rare bird species.

Recommendations on habitat management at Tulkiaragė.

1. To organize mowing on the most part of the meadows' area twice during the vegetation period (Mid July and beginning-mid September). This will ensure gradual decrease of projective coverage of reeds and increase distribution of sedge associations.
2. After successful restoration, management should follow the recommendations for Šyša.

TYRAI

Tyrai is the main Aquatic Warbler habitat in the Baltics. Water supply of this mire is provided by waters of Curonian Lagoon which is characterized by lower water mineralization in comparison with Nemunas River. Perhaps, water level during the vegetation period is maintained at soil surface and thus peat formation is ongoing. Tyrai is the only site with peat layer of about 40 cm among all the Lithuanian sites in the Nemunas floodplain. Thus, Tyrai could be classified as mesotrophic mire – typical Aquatic Warbler habitat. The ecologically maximal species density could be reached at such mires and stable existence of the population is possible. Under the combination of favourable conditions (maintenance of the open structure of sedge associations) the maximal number of the species could be reached here followed by further distribution of the species to other habitats (Šyša, Tulkiaragė and others).

Recommendations on habitat management at Tyrai

To organize yearly mowing of mire parts where reeds prevailing, until reeds' projective coverage decreases to minimal values and the process of sedge communities recovery starts in place of reed stands.

1. Mowing of reeds should take place in the second part of July (on the territory where the AW do not nesting) and if necessary at the end of September (if reeds grow up after first mowing more then 50 cm).
2. Areas dominated by sedges and where males of Aquatic Warbler have been observed should not be mowed in 2012.
3. All the cut vegetation should be removed from the territory of the fen mire until March.

The final decision on timing and frequency of reeds mowing should be taken in 2013 after study of the reed growth rate. In case if reeds grow slowly and reach its' full size by July, one mowing per year will be enough and should be conducted at the end of August–November. In case of such slow reeds' growth and its' yearly mowing the recovery of sedge communities and Aquatic Warbler breeding will become possible. Late mowing will let yearly using of maximal vegetation biomass and ensure restoration of Aquatic Warbler habitats. Besides, yearly removal of vegetation biomass will help to decrease vegetation productivity and thus slow down reeds' growth.

ŽUVINTAS BIOSPHERE RESERVE

Project sites in Žuvintas Biosphere Reserve are presented by typical fen mires with distinctive water dynamics: small fluctuations during the year. Peat layer is 30-50 cm deep. Perhaps, sedge communities (*C.lasiocarpa, C.disticha*) were originally prevailing at these mires. Afterwards these communities were completely overgrown by shrubs in places withdrawn from mowing or by reeds. At present open sedge mires are preserved as small patches up to 20 ha. Overgrowing of open sedge mires with shrubs and reeds is the main reason of practically total disappearance of Aquatic Warbler from here.

Recommendations on habitat management in Žuvintas.

In order to form plant communities suitable for the Aquatic Warbler breeding, the attention should be paid to the intensity of mowing as well as to the favourable duration and intensity of floods.

The shrub communities must be removed from the territory and according to the growth rate, the young sprouts must be eliminated each year for at least 3–5 years, otherwise shrubs will regenerate during two years and form a dense canopy. The area cleaned from shrubs must be mown each year and hay must be taken away from the territory.

Immediate mowing of the *Thelypterido-Phragmitetum* community vegetation is required in order to regenerate vegetation of the *Caricetum elatae* communities, which are suitable for the Aquatic Warbler to breed. In order to achieve an efficient result, the mowing must be applied not less than 2 years whilst coenopopulation of the *Phragmites australis* will be withered.

Žuvintas mires are situated beyond the main Aquatic Warbler migration routes and even if the open structure of the mires will be maintained the appearance and increase of birds number will be gradual.

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