



Project „Securing sustainable farming to ensure conservation of globally threatened bird species in agrarian landscape“ **Projekto Nr. LIFE09 NAT/LT/000233** is co-financed by the EU LIFE+ Programme, Republic of Lithuania, Republic of Latvia and the project partners.

Project partners:



Ex-ante monitoring of Aquatic Warbler *Acrocephalus paludicola* in Lithuanian and Latvian project sites

Report for the 2011-2012

Monitoring carried out in the frame of the project „Securing Sustainable Farming to Ensure Conservation of Globally Threatened Bird Species in Agrarian Landscape“, financed by European Union LIFE+ programme, Lithuanian Ministry of Environment and project partners.

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INTRODUCTION

Aquatic Warbler *Acrocephalus paludicola* – the rarest and the only globally threatened passerine bird species of continental Europe. Species being protected not only by laws of European Union and Republic of Lithuania or Latvia, but by various international agreements as well. Aquatic Warbler included into EU Birds Directive (79/409/EEC) Annex I, Bern convention Annex II, Bonn convention Annex I, besides that included into Red data book of Lithuania category 2 (V). In 2003 was signed international Memorandum of Understanding for this species, where Lithuanian took part in signing as well.

Formerly common and widespread species in Europe, during last century disappeared from many countries. Nowadays global population is estimated to be only about 13 000 singing males (Aquatic warbler is a polygam, so breeding bird population size is estimating by number of singing males), which regularly being recorded in less that 40 sites. Few years ago Aquatic warbler regularly bred in 6 countries – Belarus, Germany, Poland, Ukraine, Hungary and Lithuania, irregularly in Russia and Latvia. However, in 2011 birds were not recorded breeding in Hungary and Germany. Nearest future will show whether species got extinct from these countries or it was temporal abandonment. But, anyway, it can be said that significance of Lithuanian population even more increasing, because Lithuania becomes one of very few countries, where Aquatic warbler still breeds regularly.

Aquatic warbler global population is strongly fragmented. Lithuanian birds are a part of Central European subpopulation, however, according to similarity of habitats, the closest is rapidly decreasing Western Pomeranian (Lower Odra river) subpopulation. Conserving and increasing Lithuanian population, it is logical to predict that might be restored Latvian local population in the future, where birds disappeared at least 5 years ago. Evaluating last years results we can conclude that Lithuanian Aquatic warbler local population is about 1,5 % of global population.

First birds from Africa to Lithuanian breeding grounds arrive at the beginning of May, leave – in second part of August.

The main previously known threats for the habitat in Lithuania are overgrowth of open sedge meadows by reeds (*Phragmites australis*), dead grass accumulation in meadows after their abandonment and intensive use of meadows expressed by early mowing.

The main aim of this study was to monitor breeding Aquatic warbler population and make detailed vegetation description of breeding or formerly breeding habitat in all project sites.

RESEARCH METHODOLOGY

Singing Aquatic warblers monitoring

Data on abundance and distribution of Aquatic warbler singing males before and after activities foreseen in the project is 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) were produced simple maps for all project sites.

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, main

method used for counting singing Aquatic warblers was full count method marking male dislocation points.

Method of the counts

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 were carried out by one person. In each of the distinguished plot, census taker on the map marked singing point of each Aquatic warbler male.

Counts on larger areas (over 100 ha) with even vegetation, suitable for Aquatic warbler, counts were performed by group of people. Participants standing in a row slowly were moving forward and counting singing males. Every participant was carrying area map with scale 1:10 000. All singing males as precise as possible were marked on the map.

Counts were carried out in the evenings without or with weak wind to ensure rather good audibility.

Time of the counts

Were performed 2 counts of Aquatic warbler singing males during the breeding season which are connected to 2 breeding cycles. First count was carried out between 25th of May to 10th of June, second – between 25th of June to 10th of July.

Counts of singing males were performed in the evening starting at around 1-2 hours before sunset and ending at around 1 hour after sunset.

Breeding success

The fieldwork was carried out in the breeding season of 2011 in Nemunas delta and in Tyrai mire. Nests were searched from approximately the 20th of May, when first Aquatic Warblers nests are about to be active until the 10th of August to assure that also late nests were found.

Search for Aquatic Warbler females

Aquatic Warbler nests are found via the detection of Aquatic Warbler females, which have to be constantly searched for from beginning of the breeding season onwards. Females were searched for in all sites where singing males were detected and in nearby sites with the attempt to cover as much area as possible. One or two persons were walking with constant speed systematically in loops across sites, trying to spot the females by observation or by hearing their alarming calls. Duration of search for one person alone was approximately one hour for the small sites and two or more hours for the larger sites. Studied sites retrieved equal search effort and were searched for in equal intervals across the whole breeding season.

Once a female was detected, the spot was marked in the field with a coloured ribbon and coordinates were saved using a GPS (Garmin etrex legend HCx).

Nest search

Females were constantly observed. At the spot where the female seemed to take off from or to arrive at the nest either for incubation or to feed her young, the vegetation was carefully searched for the nest. Thereby a distance that did not disturb the bird (20-60m) was kept, indicated by absence of warning calls. Caution was taken for producing as few tracks as possible in the nest-vicinity, in order to avoid leading predators to the nest.

Nests were marked clearly visible in the field by ribbons within a distance of a few meter from the nest. Another hidden ribbon was tightened to the vegetation near the nest indicating the exact location. Nest coordinates were recorded with a GPS (Garmin etrex legend HCx) and the nest content was recorded.

Nest controls

Nests were checked in intervals of three or four days in order to detect the exact hatching-date and/ or the fledging-date of nestlings. It was attempted to visit each nest when nestlings were assumed to be 14 days old, when they should be ready to fledge. The complete nest content was recorded on each nest visit. Since only few nests were found in the egg-stage, clutch size was calculated for all nests found, assuming that nest content was complete at that stage. A nest, that was found destroyed or empty long before the estimated fledging date, was considered as not being successful (3 days or more). A nest was considered as being successful when it was found empty on the day nestlings reached an age of 14 days or later.

Vegetation monitoring

Vegetation mapping using satellite images

Before vegetation description during fieldwork, mapping of the main vegetation types using of high definition satellite images was performed. Was conducted preliminary computer interpretation of different vegetation types: dense reeds and shrubs, open waterlogged meadows with dominating of sedges, mineral islands, forests, open water, water vegetation with depth more then 0.5 m.

There were outlined borders, numbered plots with different vegetation types and placed coordinates of the most typical points inside each defined contour. These coordinates later were used in field studies with GPS-navigator.

Detailed description of vegetation

A detailed description of vegetation was conducted for all territories in 2011. The work was carried out throughout whole vegetative period. A botanist visited the point guided by the GPS navigator. One sample plot 10 x 10 m was established on the plot of each association (minimum 2 plots of each association).

Methodology for selecting plots of similar vegetation type is a standard: the plot was selected inside representative vegetation community, including projective coverage of trees and scrubs.

The area of the plot was photographed. The perspective of the photography and the number of the sample plot were recorded in the form. After that, the other cells on the form were filled starting with the name of the mire.

The projective coverage of plant species was recorded using Braun-Blanquet scale. The height of herbs layer was measured as well. Plant species with their projective coverage were recorded in special columns. In case there were trees or shrubs on the plot, they were also recorded, and trees were measured (diameter and height of up to 5 trees/scrubs per plot). The moss species composition and its projective coverage were described. In case of difficulties with identification of species of mosses or plants the herbarium material was collected which was identified by specialists later.

RESULTS AND DISCUSSION

1. Aquatic warbler singing males monitoring

Bird counts were performed by Ž. Preikša, R. Jakaitis, V. Jusys, V. Knoefler, A. Kozulin, K. Mudinaitė, A. Pranaitis, J. Thielen, J. Zarankaitė, O. Keišs.

There were checked all suitable for Aquatic Warbler habitats within Lithuanian and Latvian project sites. Aquatic warbler counting results are presented in Table 1, Table 2 and Picture 1.

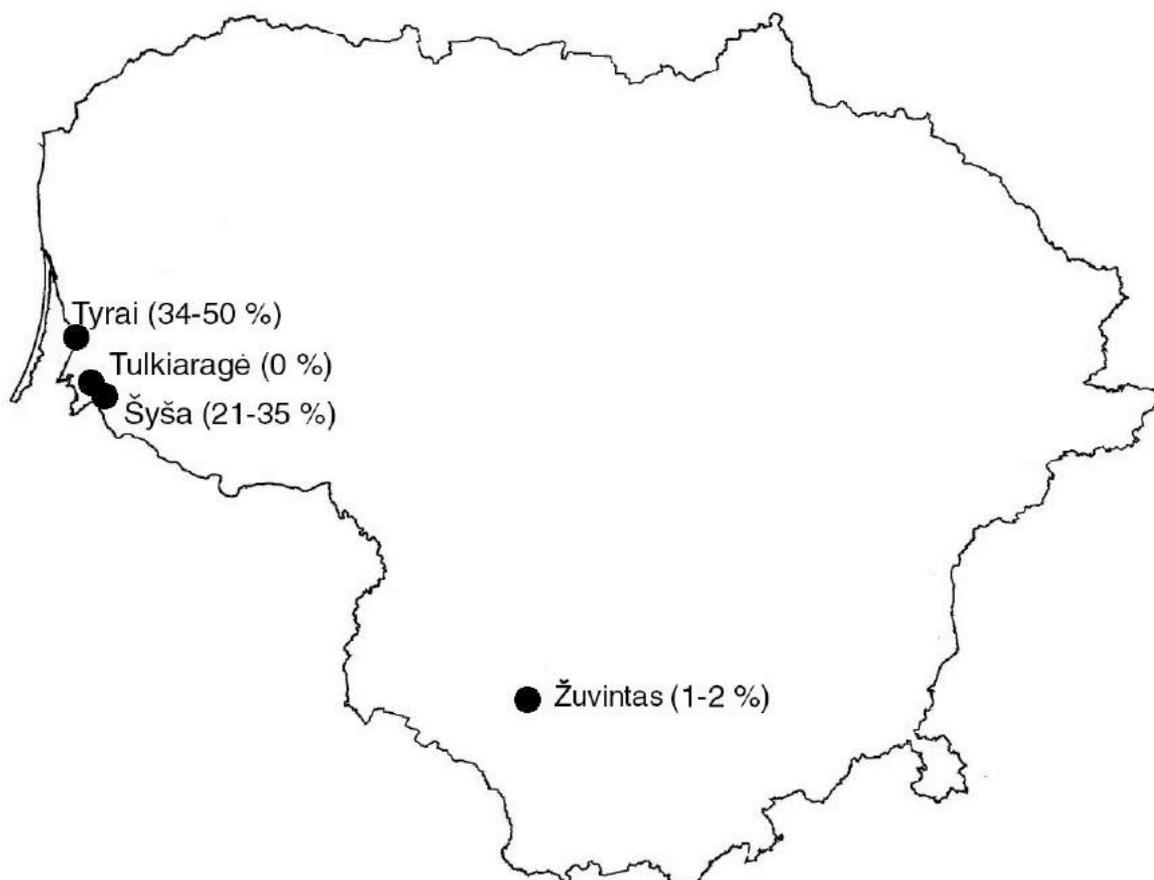
Unfortunately, there were no singing Aquatic Warblers found on Latvian sites both in 2011 and 2012.

Table 1. Distribution and abundance of Aquatic Warblers in Lithuanian project sites in 2011

Site	Municipality	Research area, ha	No of singing males		Size of local population, singing males	% of Lithuanian population	Density, males/100 ha
			1 st count	2 nd count			
Šyša	Šilutė	734	30	23	23-30	26-34	3-4
Tulkiaragė of Nemunas delta	Šilutė	455	0	0	0	0	0
Tyrai	Klaipėda	528	30	45	30-45	34-50	6-9
Žuvintas	Alytus	328	1	1	1	1	0.3
Totally:		2045	61	69	61-69	69-77	

Table 2. Distribution and abundance of Aquatic Warblers in Lithuanian project sites in 2012

Site	Municipality	Research area, ha	No of singing males		Size of local population, singing males	% of Lithuanian population	Density, males/100 ha
			1 st count	2 nd count			
Šyša	Šilutė	734	22	13	13-22	21-35	2-3
Tulkiaragė of Nemunas delta	Šilutė	455	0	0	0	0	0
Tyrai	Klaipėda	528	28	30	28-30	45-48	5-6
Žuvintas	Alytus	328	1	1	1	2	0.3
Totally:		2045	51	44	44-51	71-82	



Pic. 1. Lithuanian project sites and their importance for Aquatic Warbler in 2011-2012 (in brackets – part of total country's population)

Total size of researched area was 2295 ha (2045 ha in Lithuania and 250 ha in Latvia): in Nemunas delta – 1189 ha, on the coast of Curonian Lagoon – 528 ha, in Žuvintas – 328 ha, in Liepaja lake – 212 ha, in Pape – 38 ha. Singing males of Aquatic Warbler in 2011 and 2012 were discovered at 3 sites: Žuvintas lake environs, Šyša polder in Nemunas delta and Tyrai mire. Total Lithuanian population in 2011 was estimated to be about 90 singing males and in 2012 – 62. As we see, Aquatic warbler Lithuanian population decreased even by 31 % per year.

Comparing data from first and second counts numbers in some areas differ significantly. In Šyša observed strong decrease of males later in the season and in Tyrai – increase. Such changes difficult to explain without more detailed research. Most likely, the biggest influence had changes in management regime of the meadows: after mowing in one site, birds moved to other more safe. Very high vegetation at the beginning of July in Šyša site (here predominate *Phalaridetum* plant associations) could be another reason.

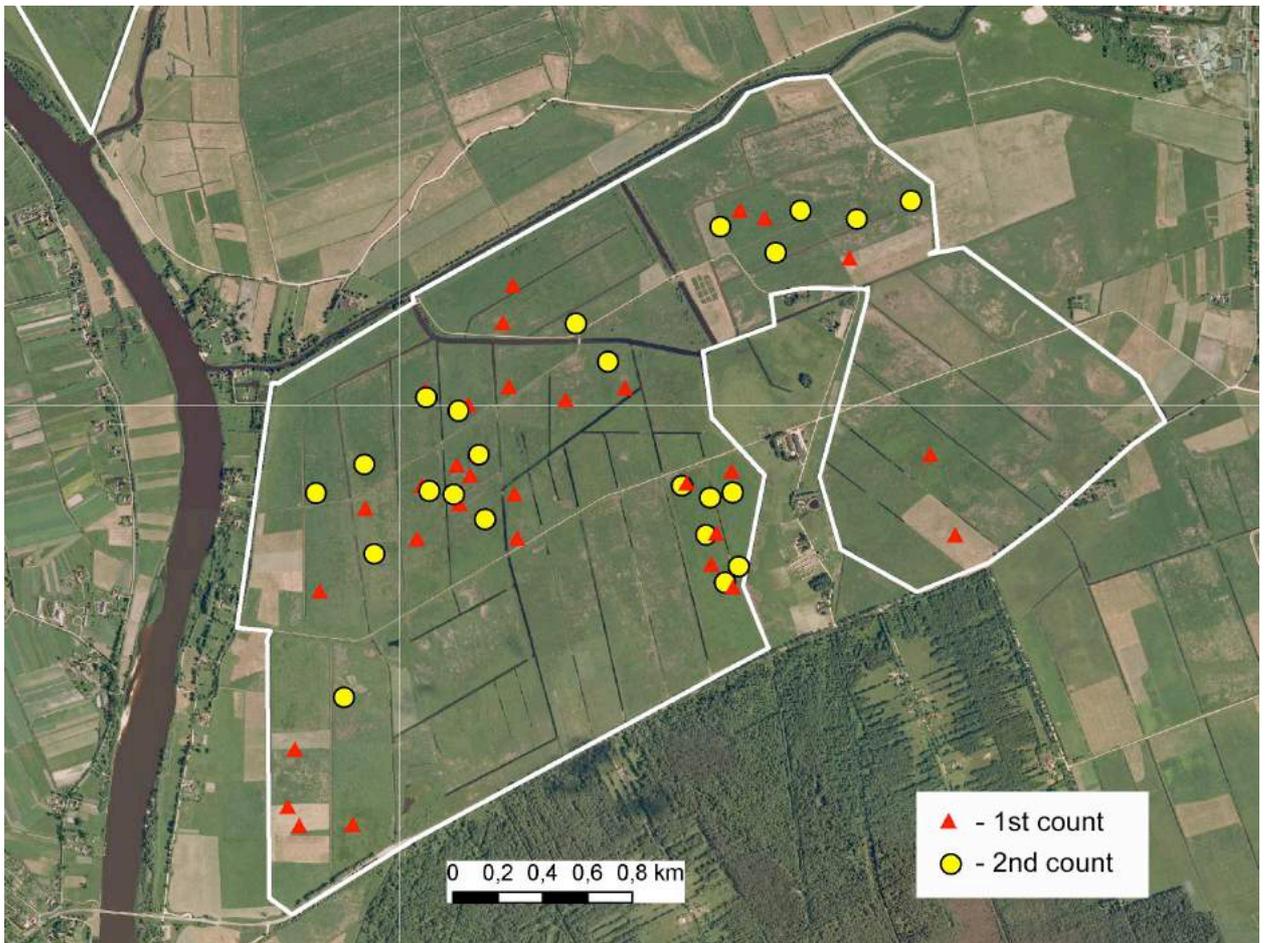
Further on presented data about distribution of singing males from each of the Lithuanian project sites.

ŠYŠA

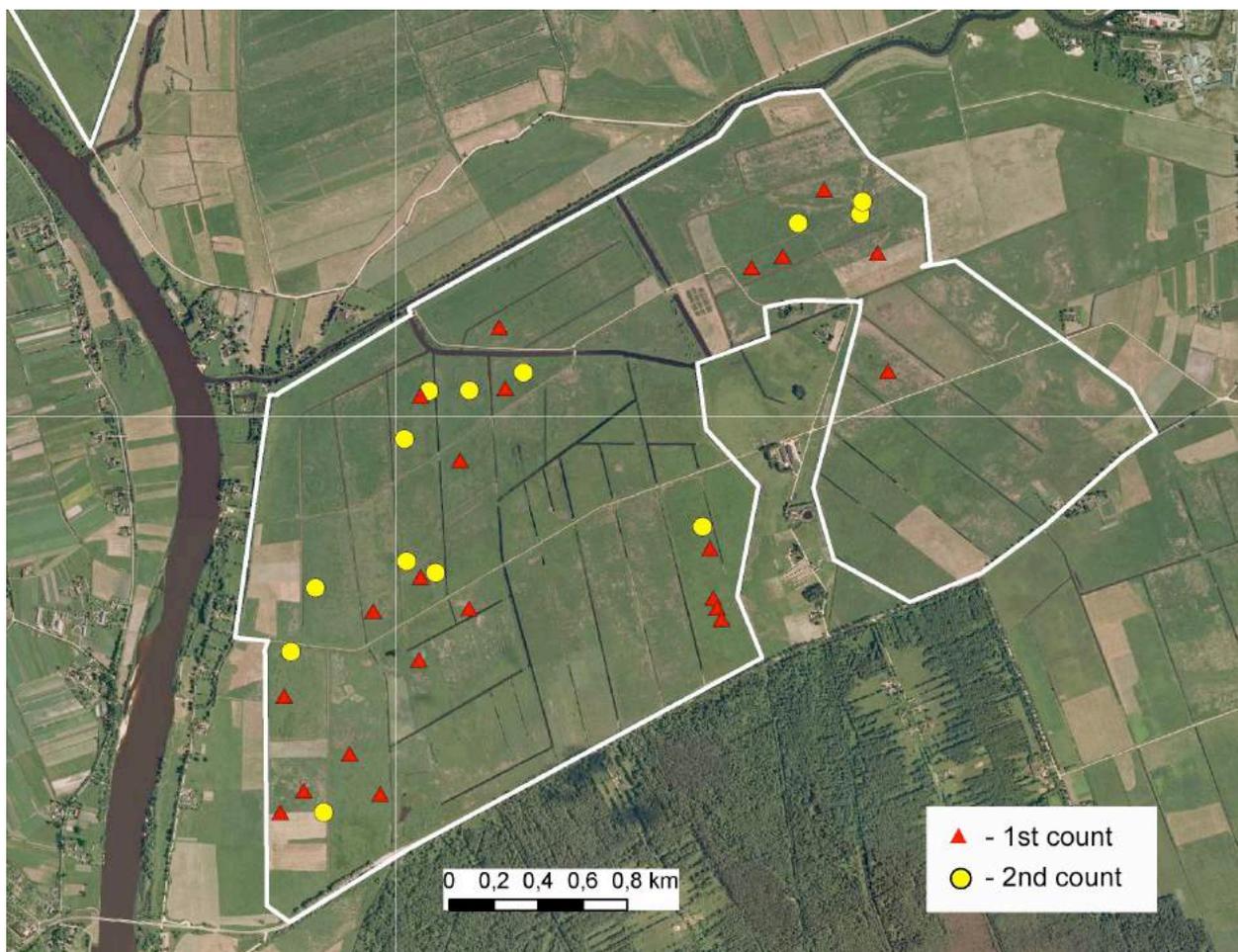
Site location. The area is located in Šilutė administrative district, 3 km southwest of Šilutė town, between Šilutė-Rusnė road and Šyša river.

Local population size. This is the second most important Aquatic warbler breeding site in Lithuania. Aquatic warblers were discovered here only in 2004. At that time was estimated to sing around 100 males. Later on number of males gradually decreased and in 2011 was estimated only 23-30 singing males, meanwhile in 2012 minimum number – only 13-22. Former densely occupied by Aquatic warblers meadow segments these days were empty due to essentially deteriorated habitat conditions. Aquatic warbler distribution in 2011 and 2012 years is shown in Pic. 2 and Pic. 3.

Other rare bird species, found breeding in the area: *Crex crex*, *Vanellus vanellus*, *Gallinago media*, *Limosa limosa*, *Tringa totanus* and *Philomachus pugnax* (possible breeding).



Pic 2. Aquatic warbler research area and distribution of singing males in Šyša site in 2011



Pic 3. Aquatic warbler research area and distribution of singing males in Šyša site in 2012

TULKIARAGÈ OF NEMUNAS DELTA

Site location. The area is located in Šilutė administrative district, 7 km west of Šilutė town (Pic. 4).

Local population size. During the last 10 years there were no Aquatic warbler records in the area, although there are some historical observations. Within the last 2 years of the project time, as usually, birds were not found due to very small and quite bad quality of suitable habitat. In order to attract Aquatic warblers, firstly need to restore site to favourable habitat conditions and in larger area.

Other rare bird species, found breeding in the area: *Botaurus stellaris*, *Haliaeetus albicilla*, *Crex crex*, *Circus aeruginosus*, *Panurus biarmicus*.



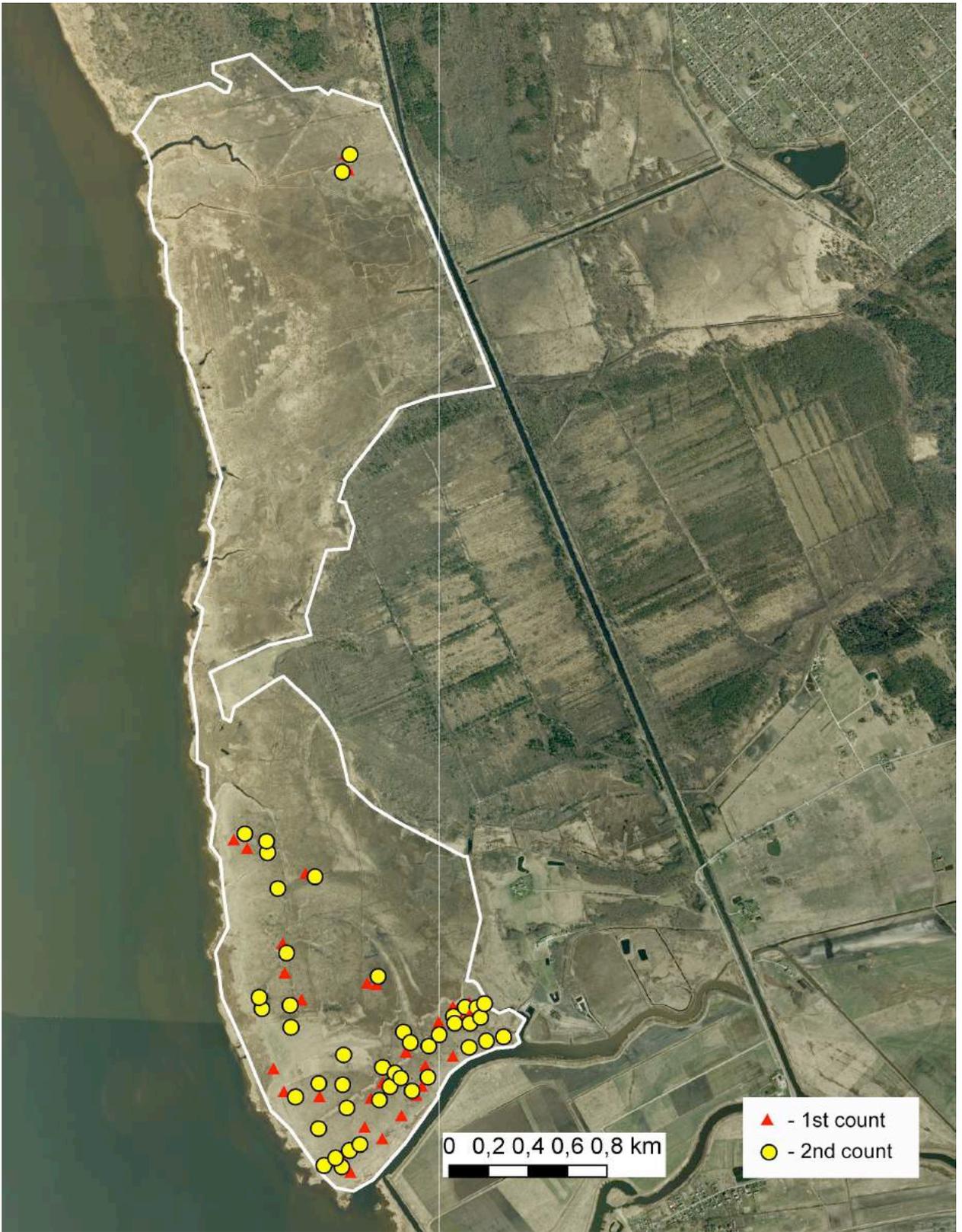
Pic 4. Aquatic warbler research area in Tulkiaragė of Nemunas delta site

TYRAI

Site location. The area is located in Klaipėda administrative district, 2 km northwest of Dreverna settlement.

Local population size. This is the key Aquatic warbler breeding area in Lithuania. 15 years ago here were recorded up to 250 singing males, but later this number gradually decreased due to shrinking of suitable habitat. In 2012 during the first count were recorded 28 singing males, during the second count – 30 and this is the lowest ever known number for the area. Aquatic warbler distribution in 2011 and 2012 years is shown in Pic. 5 and Pic. 6.

Other rare bird species, found breeding in the area: *Circus aeruginosus*, *Circus pygargus*, *Vanellus vanellus*, *Motacilla citreola*.



Pic 5. Aquatic warbler research area and distribution of singing males in Tyrai site in 2011



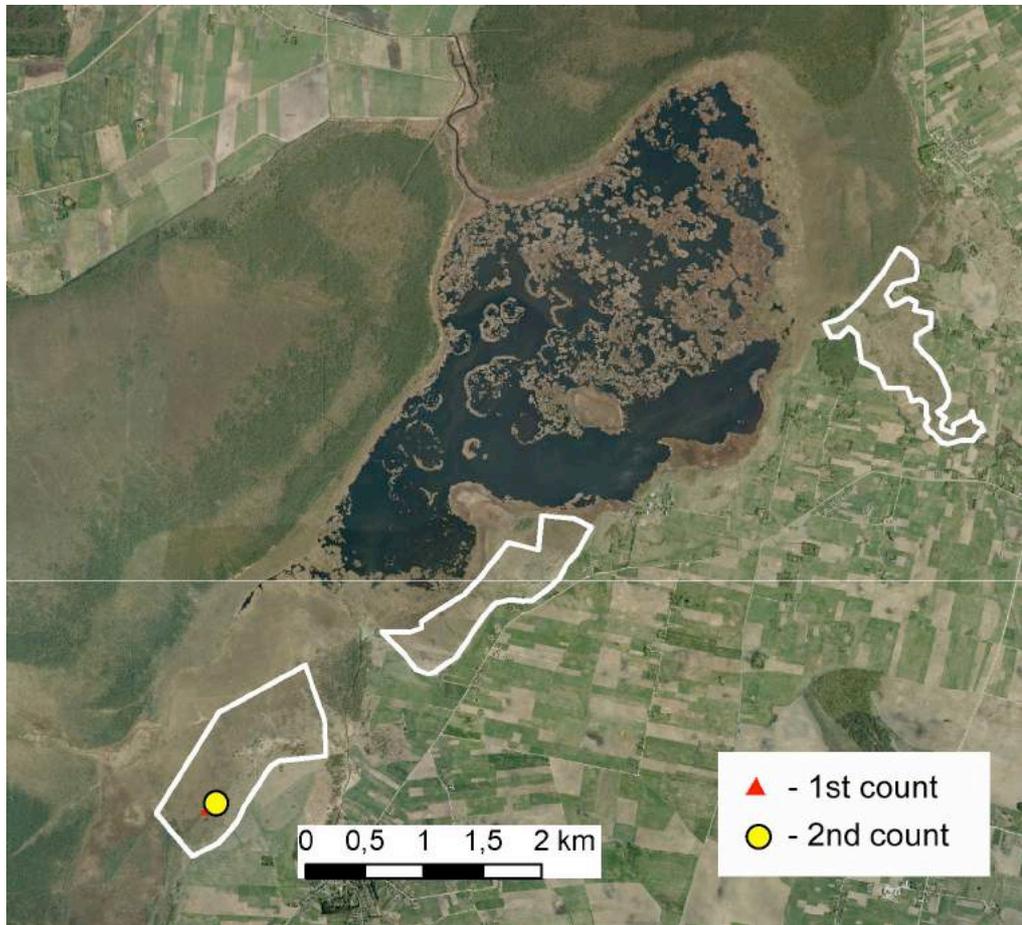
Pic 6. Aquatic warbler research area and distribution of singing males in Tyrai site in 2012

ŽUVINTAS

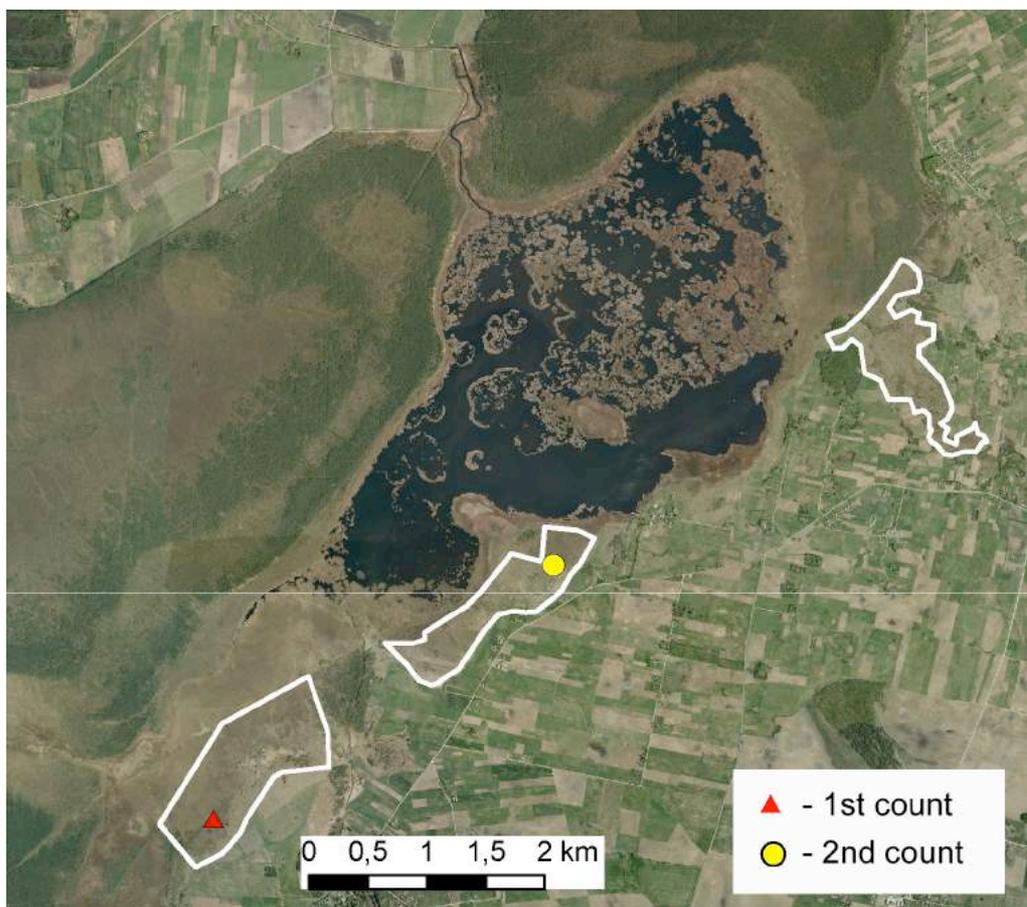
Site location. The area is located in Alytus administrative district, 7 km north of Simnas town.

Local population size. In 1986 in Žuvintas site the number of Aquatic warbler singing males was evaluated to be 20-25, but later population gradually decreased. In 2011 and 2012 was recorded only 1 singing male each year. Probably, Žuvintas local population is on the edge of extinction. Aquatic warbler distribution in 2011 and 2012 years is shown in Pic. 7 and Pic. 8.

Other rare bird species, found breeding in the area: *Crex crex*, *Vanellus vanellus*, *Limosa limosa*, *Tringa totanus*.



Pic 7. Aquatic warbler research area and distribution of singing males in Žuvintas site in 2011



Pic 8. Aquatic warbler research area and distribution of singing males in Žuvintas site in 2012

LIEPAJA LAKE

Site location. The area is located to the south from Liepāja City, on the southern coast of Liepāja Lake, to the north from Nīca village.

Local population size. The area is the last remnant of the Aquatic Warbler population in Latvia, where probable breeding of the species were observed in 2000 (3 males), 2001 (2 males), 2002 (1 male) and 2005 (1 male). Within the last 2 years of the project time, as usually, birds were not found due to very small and quite bad quality of suitable habitat. In order to attract Aquatic warblers, firstly need to restore site to favourable habitat conditions and in larger area.

PAPE

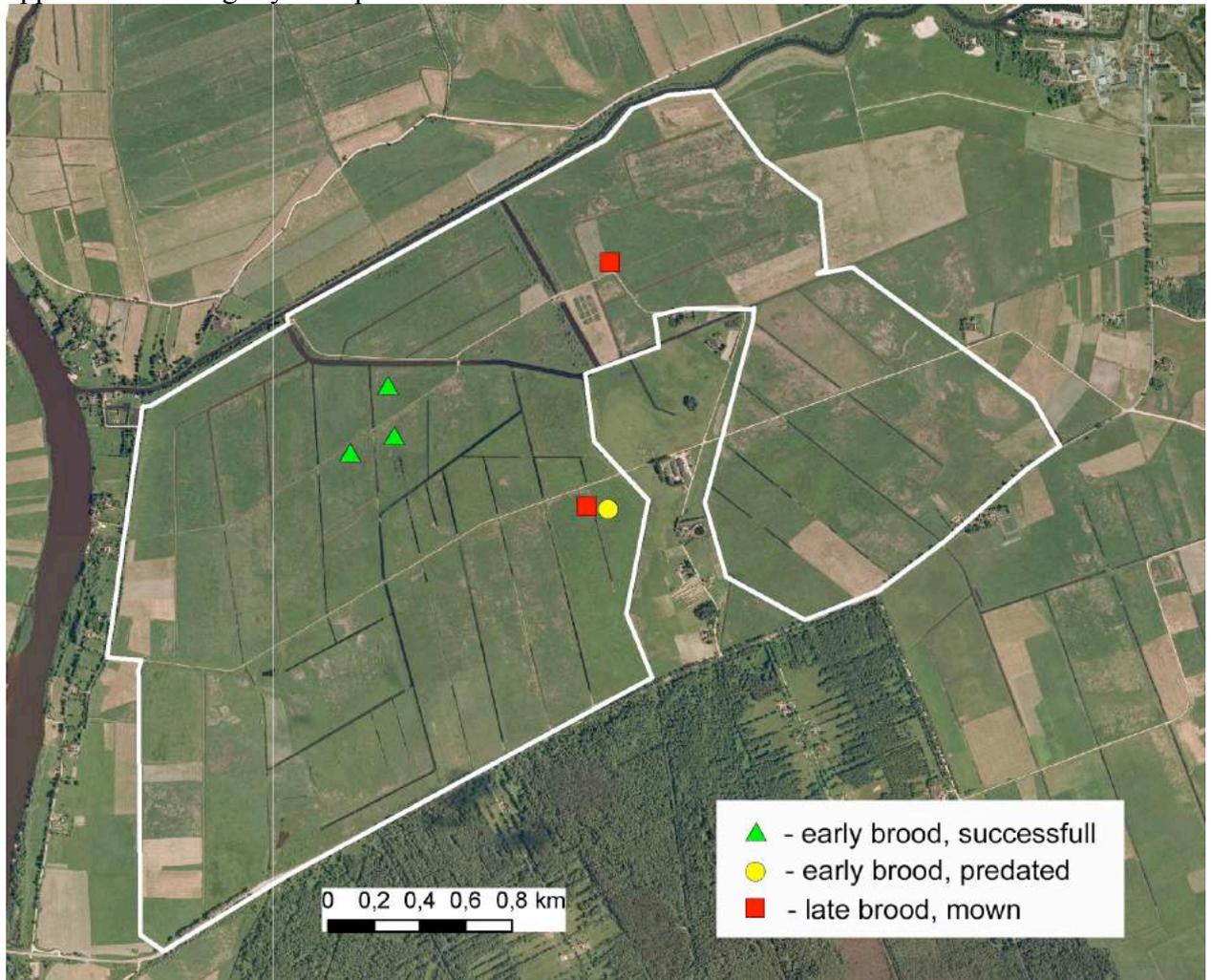
Site location. The area is located near Pape village, on the western coast of the Pape Lake, between the Baltic Sea and the Pape Lake in Latvia.

Local population size. During the last 10 years there were no Aquatic warbler breeding records in the area, but the area was the most important known migration stopover site in Latvia, where 30 birds were captured during EURING “*Acroproject*” bird capture activities at the site (last registered capture in May 12, 1990). Within the last 2 years of the project time, as usually, birds were not found due to very small and quite bad quality of suitable habitat. In order to attract Aquatic warblers, firstly need to restore site to favourable habitat conditions and in larger area.

2. Aquatic warbler nests monitoring and breeding success

Breeding success research was carried out in 2011 by V. Knoeffler and J. Thielen.

Totally 13 Aquatic Warbler nests were found within project sites in 2011: 6 nests in Šyša (Pic. 9) and 7 in Tyrai (Pic. 10). Most of the nests found were in nestling stage. Nests in Šyša appeared to be slightly clumped.



Pic. 9. Distribution of Aquatic Warbler nests found in Šyša site in 2011



Pic. 10. Distribution of Aquatic Warbler nests found in Tyrai site in 2011

In Šyša investigated area covered about 260 ha. In Šyša nests were recorded with a density of 0.23 nest per 10 ha (0.023 nests/ ha). For Tyrai-mire nest density was not estimated, since clear boundaries of the study-area have not been established.

Based on the fact that Aquatic Warbler females certainly feeding young birds, that have already fledged, were observed in all studied areas, the numbers rather give an idea than indicating actual nest densities.

Out of 13 nests 4 suffered complete mortality (31 %). Three of the nest losses were located in Šyša, of which one nest was depredated at the beginning of the breeding season and two nests were mown late in the season (13.07.11 and 18.07.11) (Table 2). Another nest was depredated in Tyrai. Both depredated nests contained nestlings and predators could not be determined. None of the nests found were abandoned or flooded.

Thus 'traditional nest success' (n successful nests/ n total nests) would be 69 %.

Table 2. Data on nests found in project sites in 2011

Nest no.	Site	Date found	Content	Calculated lay date	Calculated hatching date	Calculated fledging date	No. of fledglings
1	Šyša	09.06.	5 eggs	01.06.11	14.06.11	depredated	0
2	Tyrai	10.06.	5 nestlings (5 days)	21.05.11	04.06.11	18.06.11	5
3	Tyrai	11.06.	6 nestlings (7 days)	21.05.11	04.06.11	18.06.11	6
4	Šyša	13.06.	6 nestlings (8 days)	23.05.11	06.06.11	18.06.11	4
5	Šyša	15.06.	4 nestlings (7 days)	25.05.11	08.06.11	21.06.11	4
6	Šyša	19.06.	5 nestlings (12 days)	25.05.11	08.06.11	21.06.11	5
7	Šyša	05.07.	5 eggs	28.06.11	12.07.11	mown	0
8	Šyša	13.07.	4 eggs	NA	mown	mown	0
9	Tyrai	19.07.	5 eggs	06.07.11	20.07.11	03.08.11	3
10	Tyrai	19.07.	2 nestlings, 2 eggs	29.06.11	13.07.11	27.07.11	2
11	Tyrai	25.07.	5 nestlings	03.07.11	17.07.11	depredated	0
12	Tyrai	26.07.	5 nestlings	30.06.11	14.07.11	28.07.11	5
13	Tyrai	28.07.	4 nestlings (7 days)	02.07.11	16.07.11	30.07.11	4

Out of 67 eggs laid 51 nestlings hatched (76.1 %), of which 38 nestlings successfully left the nest (74.5 % of hatched eggs). Thus 56.7 % of all eggs laid produced successful fledgelings. The average number of nestlings per successful nests (9 nests) was 4.2 nestlings. The averaged number of nestlings was 4.8 nestlings per successful early nest (5 nests) and 3.5 nestlings per successful late nest (4 nests).

3. Vegetation monitoring

Vegetation mapping was carried out in all Lithuanian project sites in 2011. Mapping was done by D. Matulevičiūtė, A. Balsevičius, S. Lisauskas, R. Narajauskas, E. Norkevičienė and A. Priede.

This is the first case when such detailed mapping was carried out in Lithuanian Aquatic warbler breeding sites. It is a starting point for further vegetation monitoring.

Further on are presented certain results from plant community inventory in each Lithuanian and Latvian project site.

ŠYŠA

The vegetation in Šyša polder is composed of 23 association communities and 2 undefined syntaxonomic range units – phytocenons belonging to 7 vegetation classes. Such high diversity is a consequence of many factors: well-expressed microrelief which creates different

hydrological conditions (from long-time inundated areas to dry hills), very different management regimes in a certain parts of the area (various intensity grazing and mowing, various duration of land abandonment). Distribution of plant communities is shown in Pic. 11.

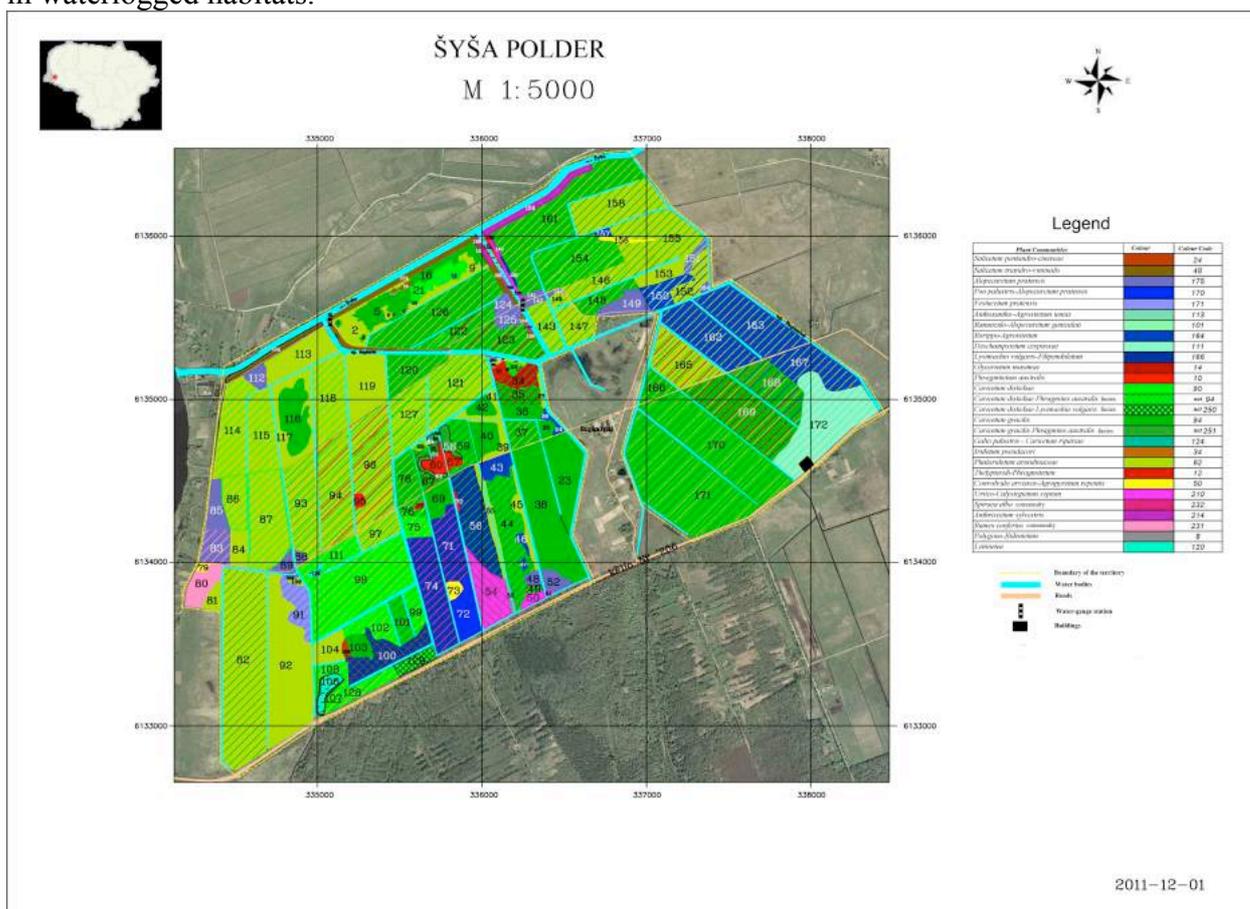
The communities of the *Phragmito-Magnocaricetea* class prevail in Šyša polder, which are distributed in the area of 581.82 ha. Among of them, the *Magnocaricion* alliance communities encompass the largest area (557.08 ha) and dominant communities are distributed as follows: *Phalaridetum arundinaceae* (277.91 ha), *Caricetum gracilis* (211.88 ha) and *Caricetum distichae* (65.82 ha). These three communities occupy the area even of 555.61 ha. It comprises 77.47 % of all investigated area of Šyša polder. The most widespread communities of the *Phalaridetum arundinaceae* grassland is formed on slightly more elevated areas than *Caicetum gracilis*. 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. *Caricetum distichae* comprises under the similar ecological conditions too. The succession process is observed in the occupied areas by 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 a larger area than 1 ha.

The communities of *Phragmition australis* encompass an area of 15.14 ha. These communities are formed in the wettest, and even in summer, inundated habitats by water. Amongst of them, *Glycerietum maximae* (13.01 ha) dominates and just a small plot is covered by *Phragmitetum australis* (2.13 ha).

The communities of the *Molinio-Arrhenatheretea* class cover the area of 99.66 ha. Among of them, *Rorippo-Agrostietum* grassland (33.32 ha) dominates and these communities are generally spread in north-eastern part of the territory. These communities have formed under the influence of assiduous grazing of the *Phalaridetum arundinaceae* grassland communities therefore these phytocenosis usually encompass a large area creating a mosaic with the *Phalaridetum arundinaceae*. The *Lysimachio vulgaris-Filipenduletum* grassland covers the area of 20.23 ha, which is concentrated in south part of the territory. It is possible, that origin of communities is different. In the drier and less flooded plain of polder, these plant communities are formed of the *Caricetum distichae*, under the influence of cessation of mowing, because of *Carex disticha*, for the present, is an abundant component in phytocenosis of species composition. Moreover, *Caricetum distichae* often tends to create a mosaic with the community of *Lysimachio vulgaris-Filipenduletum*. In damp habitats these plant communities have formed from *Caricetum gracilis* and *Phalaridetum arundinaceae*, which became extinct under the influence of longer period floods than regular. A fairly large area is occupied by *Alpoecuretum pratensis* grassland (19.56 ha). It is a mowing mesophylous grassland meadow, which due to excessive grazing, may give a way to *Deschampsietum cespitosae* grassland and in Šyša polder its occupied area is of 12.53 ha. Xeromesophylous grassland plant communities of the *Anthoxantho-Agrostietum* grassland (5.85 ha) are formed on the driest and highest level of non-flooded plains of polder but for the mesophylous grassland plant communities of the *Festucetum pratensis* (3.59 ha) suitable area is where water regime sometimes fluctuates.

Nitrophylous grassland plant communities of the *Galio-Urticetea* class cover the area of 22.85 ha. *Urtico-Calystegietum sepium* phytosenosis are concentrated in south part of the polder (13.13 ha). These plant communities have formed due to cessation of mowing of the *Lysimachio vulgaris-Filipenduletum* grassland or due to the overgrowing of *Polygono-Bidentetum* phytocenosis by perennial plants. In the drier habitats near canal embankments or on them *Anthriscetum sylvestris* phytocenosis is distinguished (4.29 ha).

The scrubs are distributed in the area of 7.94 ha and it comprises 1.11 % of all investigated area. The communities of *Salicetum triandro-viminalis* (7.61 ha) of the *Salicetea purpurea* class are generally distinguished near riverbanks. The communities belonging to the association of *Salicetum pentandro-cinereae* of the *Alnetea glutinosae* class were distinguished in waterlogged habitats.



Pic. 11. Distribution of plant communities in Šyša site in 2011

TULKIARAGĖ OF NEMUNAS DELTA

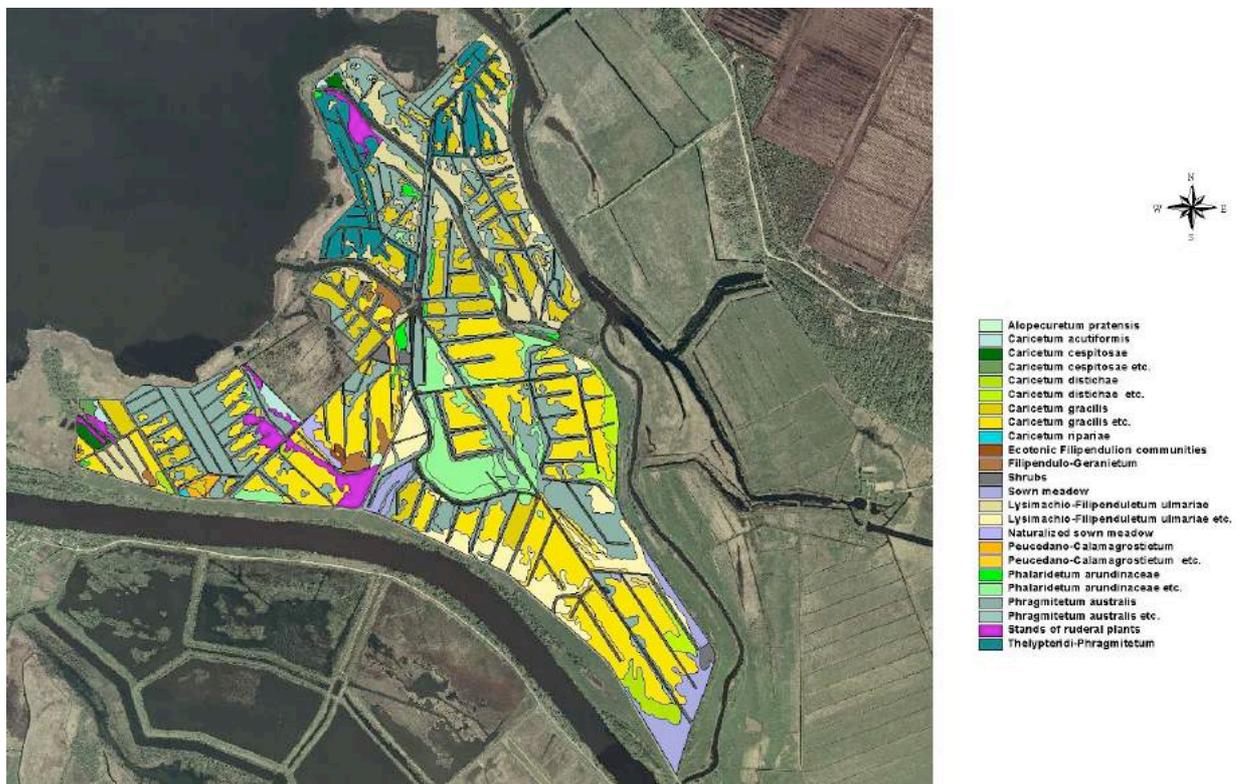
The vegetation of Tulkiaragė polder belongs to 2 vegetation classes and consists of communities from 13 associations and 4 rankless units. The grassland vegetation predominates. Single trees and shrubs are observed in all territory except the eastern part where they grow more abundantly. The key environmental factors which have fated the diversity and distribution of vegetation are hydrological and trophic conditions, as well as management (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. Distribution of plant communities is shown in Pic. 12.

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 Tulkiaragè 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 plants 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*.



Pic. 12. Distribution of plant communities in Tulkiaragè of Nemunas delta site in 2011

TYRAI

The vegetation of Tyrai Wetland belongs to 4 vegetation classes and consists of communities from 10 associations and 4 rankless units. The grassland vegetation predominates. Single trees and shrubs are observed in all territory except the northern part where they grow more abundantly. The vegetation in Tyrai wetland has 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. Relief in the area is poorly expressed and hydrological conditions almost equal to entire area. Management of the area

(mowing, grazing) ceased around 20 years ago. Thus, all the area is under the same development conditions, diminishing diversity of plant communities and area mosaic. Distribution of plant communities is shown in Pic. 13.

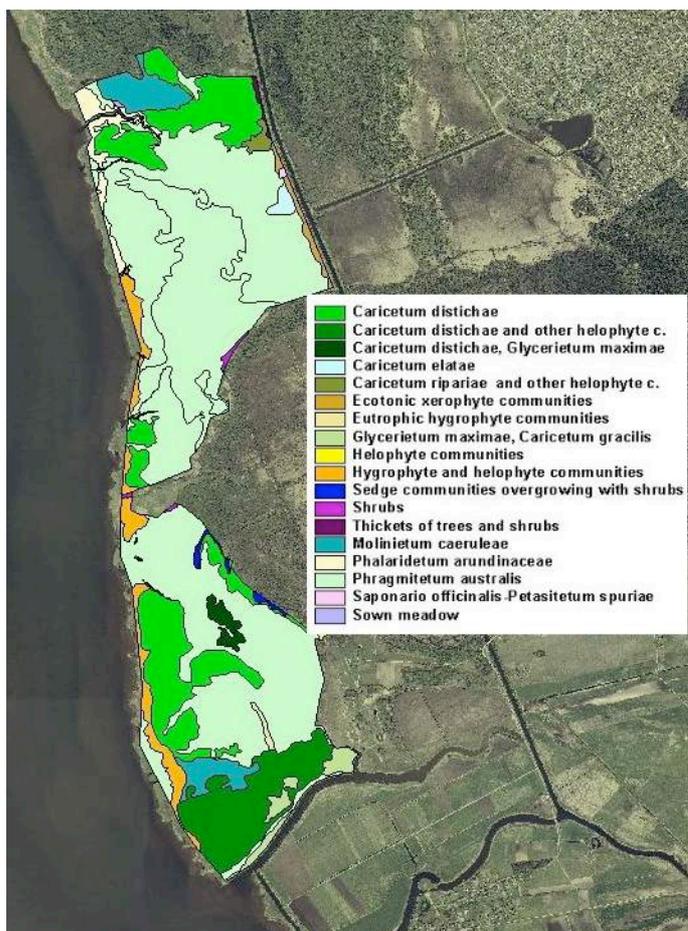
The widespread grassland plant communities are distributed in 99.61 % of all studied territory. It has been influenced by the hydrological conditions – periodical flooding and long-lasting high water level during vegetation period. For these certain conditions communities composed by forbs of helophytes 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 %).

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: reedbeds 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).

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.



Pic. 13. Distribution of plant communities in Tyrai site in 2011

ŽUVINTAS

Žuvintas site is fragmented and total area comprised of 3 separate plots.

The vegetation of Dambavaragis meadows and Kiaulyčia swamp consists of communities from 19 associations and 2 rankless units – phytocenons from 6 vegetation classes. Also, another alliance have been characterised – *Caricion lasiocarpae*, which syntaxonomical composition is not detailed. Most of the area is not mosaic due to long abandonment, except of small part closer to fields. Distribution of plant communities is shown in Pic. 14.

In Dambavaragis meadows and Kiaulyčia swamp plant communities belonging to the *Phragmito-Magnocaricetea* class prevail and are distributed in area of 184.52 ha. Among of them, the largest plots 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).

The *Caricetum distichae* communities (14.75 ha) which, unlike other phytocenosis of the *Magnocaricion* alliance are formed on slightly elevated areas. Often these communities along with *Caricetum appropinquatae* and *Carex lasiocarpa* community (*Magnocaricion*) 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.

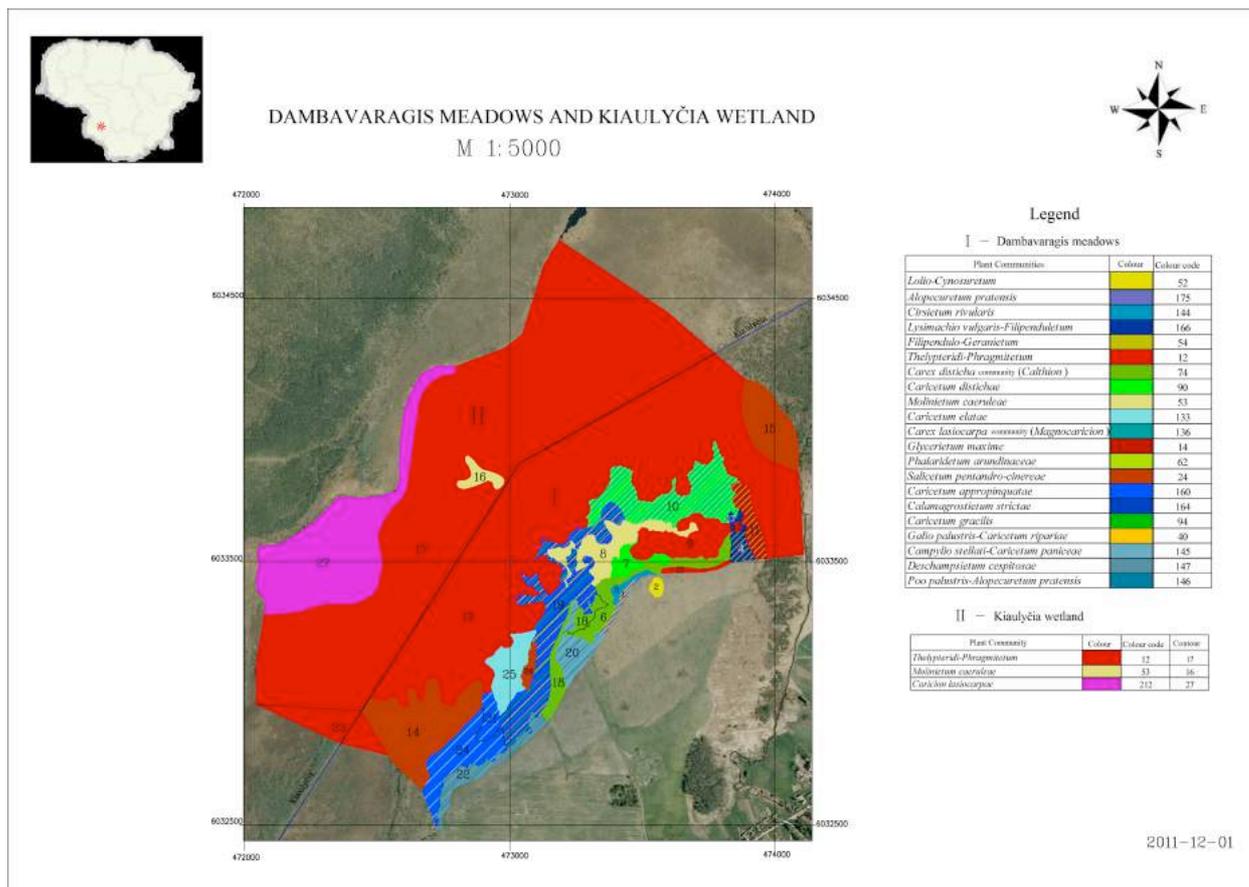
The *Caricetum elatae* (4.57 ha) as well as the *Thelypteridi-Phragmitetum* is confined to the wettest habitats compared with other communities from the *Magnocaricion* alliance. During the last 15 years, declining in extent of these communities is observed and due to intrusion of

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.

The *Scheuchzerio-Caricetea fuscae* class communities have been distinguished in the area of 20.15 ha. The *Caricion lasiocarpae* alliance phytocenosis are 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 *Alnetea glutinosae* class is represented by the association of *Salicetum pentandrocinereae* in Dambavaragis meadows. There willow scrub communities are distributed in the area even of 14.33 ha and it makes up 6.13 % of all studied area of the territory.



Pic. 14. Distribution of plant communities in Žuvintas site “Dambavaragis meadows and Kiaulyčia swamp” in 2011

The meadow grassland communities of the peninsula of Epušė and Grebelė belong to 16 associations and 2 rankless units – phytocenons, which are from 4 vegetation classes. Distribution of plant communities is shown in Pic. 15.

In the peninsula of Epušė meadow and Grebelė meadows communities belonging to the *Phragmito-Magnocaricetea* class dominate, which are distributed in the area of 87.15 ha. Among this group, the largest plots are covered by communities of the *Magnocaricion* alliance (79.07 ha). Among of them dominants are as follows: *Caricetum distichae* (30.38 ha), *Thelypterido-Phragmitetum* (22.89 ha), *Caricetum appropinquatae* (9.03 ha) and *Carex lasiocarpa* plant community (9.03 ha). These communities are distinguished in the area even of 71.33 ha. It totals up to 69.66 % of all investigated area of the meadows of the peninsula of Epušė and Grebelė.

The most widely spread communities of the *Caricetum distichae* are formed on slightly elevated areas than other phytocenosis from the *Magnocaricion* alliance in the meadows of both locations. In the south part of the territory these plant communities encompass a large area of

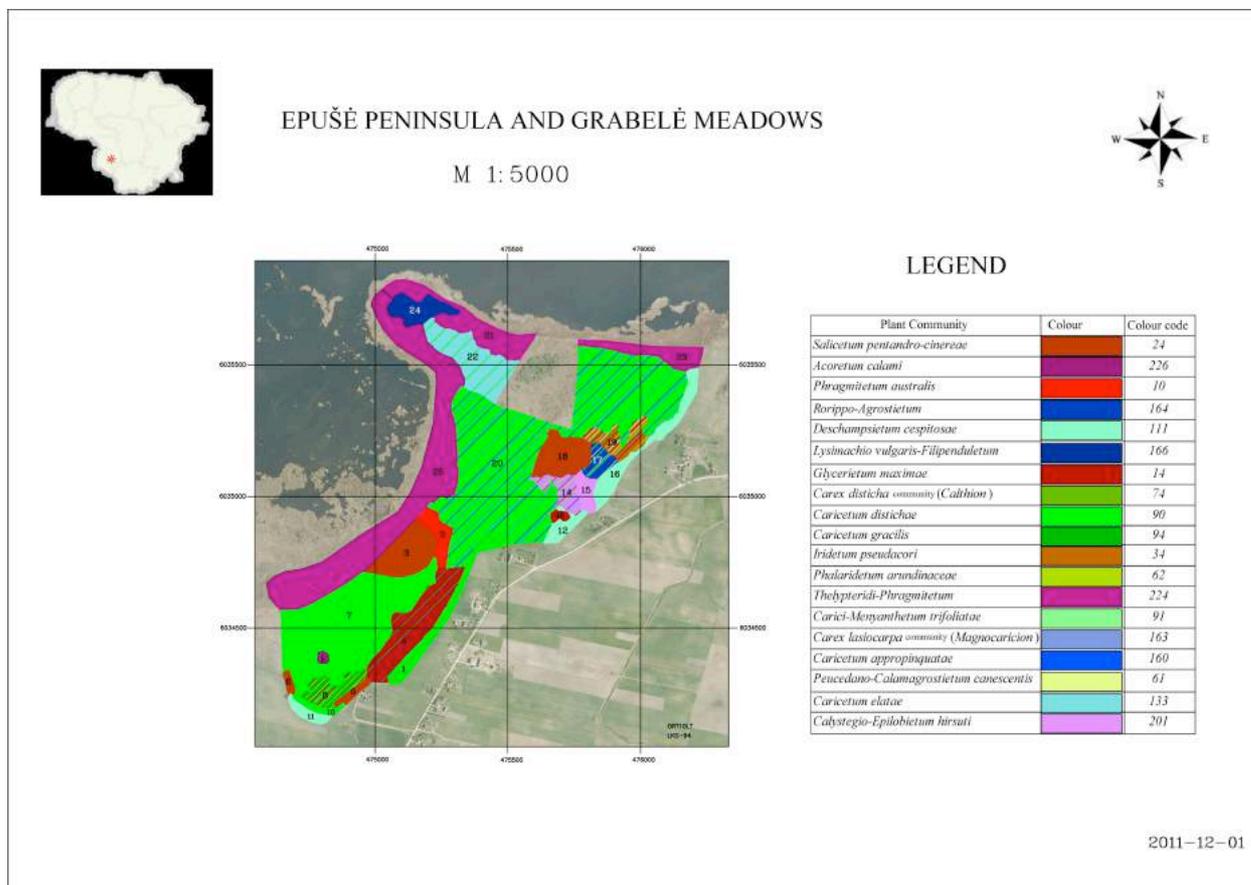
14.68 ha. In other large areas, these communities along with communities of the *Caricetum appropinquatae*, *Caricetum elatae* and *Carex lasiocarpa* (*Magnocaricion*) comprise a complicated vegetation mosaic. In a marginal part of the swamp, where habitats are wetter and surface-water occurs above the soil table, these communities occur intermixed with the *Caricetum gracilis*, *Phalaridetum arundinaceae* and *Glycerietum maximae* communities. The plant communities of the *Caricetum distichae* with tangles of *Rorippo-Agrostietum* and *Carici-Menyanthetum trifoliatae* are distributed in flooded marginal swamp areas. A tendency of declining in areas of the *Caricetum distichae* plant community is observed in south and north parts of the investigated territory. These communities step aside for phytocenosis of the *Caricetum gracilis*, *Phalaridetum arundinaceae*, *Glycerietum maximae*, *Rorippo-Agrostietum* and *Carici-Menyanthetum trifoliatae*.

The phytocenosis of *Thelypteridi-Phragmitetum* belonging to the alliance of *Magnocaricion* have been distinguished in the large areas of the territory (22.89 ha), which are distributed on the banks of Žuvintas lake. In similar habitats like *Caricetum distichae*, association of the *Caricetum appropinquatae* and communities of the *Carex lasiocarpa* are formed too.

Remarkably smaller area (8.08 ha) is occupied by phytocenosis of the *Phragmition* alliance. Among of them, prevalence of *Acoretum calami* (3.67 ha) and *Glycerietum maximae* (3.07 ha) is observed there.

The communities of the *Molinio-Arrhenatheretea* class are distributed on the area of 7.15 ha. All associations, except *Rorippo-Agrostietum*, belong to the *Calthion* alliance.

The *Alnetea glutinosae* class is represented by the association of *Salicetum pentandro-cinereae* in Grabelė meadows. The Willow scrub community is distributed in the area of 7.14 ha. Some overgrowths of scrub have been cut off in last years but regeneration successfully took its previous position back. In Grabelė meadows, scrubs are distributed in the area of 7.14 ha and it totals up 6.97 % of investigated territory.



Pic. 15. Distribution of plant communities in Žuvintas site „Epušė peninsula and Grebelė meadows“ in 2011

The vegetation in Liepakojai swamp consists of communities from 15 associations and 3 rankless units – phytocenons from 6 vegetation classes (Pic. 16).

In Liepakojai swamp plant communities belonging to the *Phragmito-Magnocaricetea* class prevail and are distributed in area of 68.20 ha. Among of them, the largest plots are covered by the communities of the *Magnocaricion* alliance (66.90 ha) and according to attained dominancy these communities are distributed as follows: *Caricetum distichae* (28.88 ha), *Caricetum appropinquatae* (13.24 ha) and *Caricetum elatae* (11.72 ha).

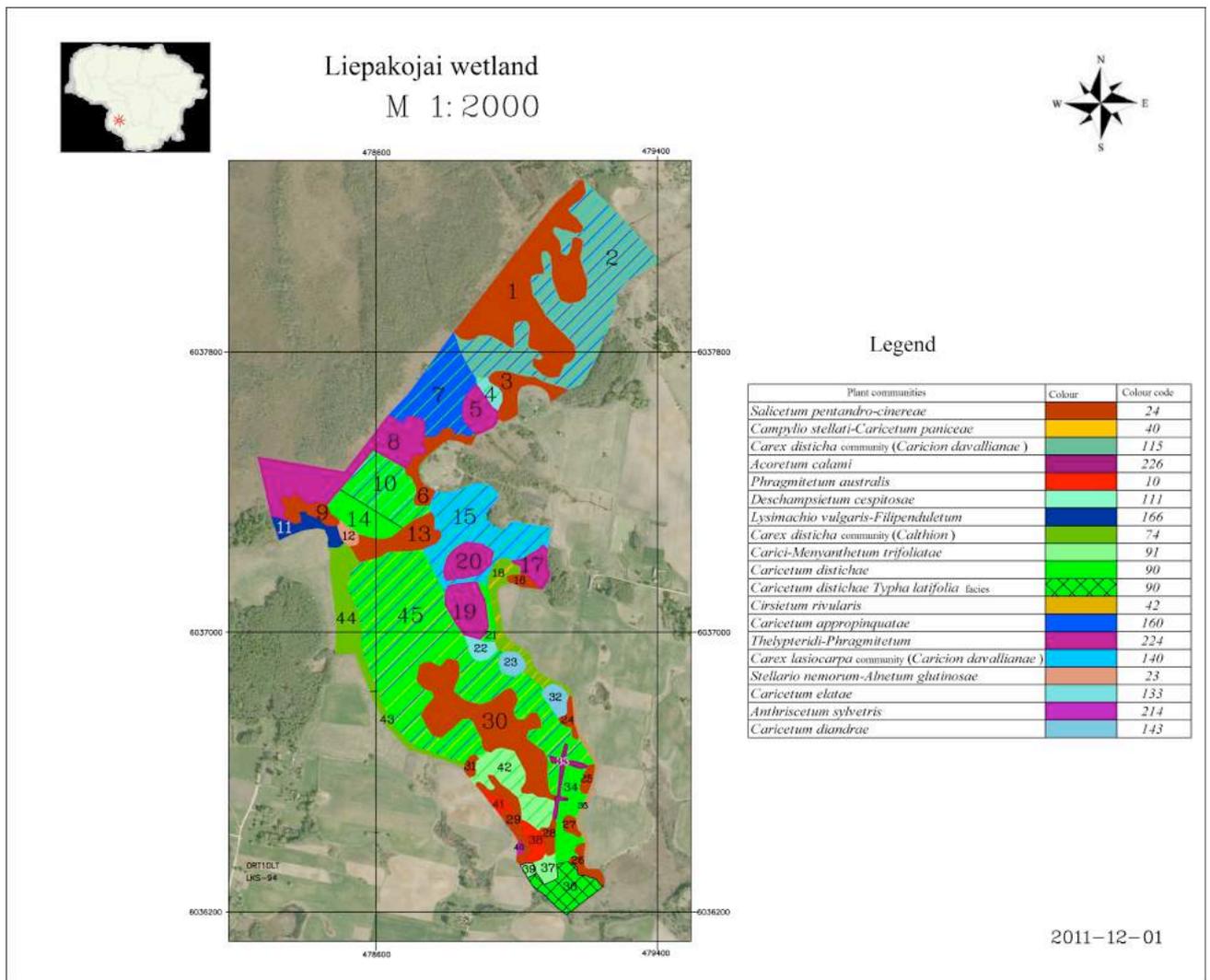
These 3 prevailing plant communities encompass the area of 53.84 ha. It makes up 49.72 % of all studied area in Liepakojai swamp.

In Liepakojai swamp the *Caricetum distichae* community is of widespread occurrence, which, unlike other phytocenosis of the *Magnocaricion* alliance, is formed on slightly elevated areas. In central part of the territory these communities are distinguished in the large areas (in contour 10 – 13.84 ha, contour 45 – 7.96 ha). These communities along with the *Caricetum appropinquatae*, *Caricetum elatae* and *Carex lasiocarpa* community (*Caricion davallianae*) comprise a complicated vegetation mosaic. The *Caricetum distichae* with tangles of the *Carici-Menyanthetum trifoliatae* is distributed on a flooded area in the southern part of the swamp. The declining tendency in extent of the *Caricetum distichae* communities is observed in the southern part of the studied territory. Here these communities are on the successional way to the phytocenosis of the *Carici-Menyanthetum trifoliatae*, furthermore, invasion of *Typha latifolia* is observed there too (*Caricetum distichae Typha latifolia* facies is distinguished).

Associations of the *Caricetum appropinquatae* (21.33 ha) occur with tangles of the *Carex lasiocarpa* (*Caricion davallianae*) and *Carex disticha* (*Caricion davallianae*) and *Caricetum distichae*, which are distributed in the habitats of the similar moistness.

The *Caricetum elatae* (11.72 ha) is confined to the wettest habitats compared with other communities from the *Magnocaricion* alliance and comprises vegetation mosaics with the *Caricetum distichae* and *Caricetum appropinquatae*. The largest plots occupied by these plant communities are in the central part of the swamp – contour 10 (11.07 ha).

The *Alnetea glutinosae* class is represented by the association of *Salicetum pentandro-cinereae* in Liepakojai swamp. There Willow scrub community is distributed in the area even of 21.33 ha and it makes up 19.70 % of all studied area of the territory. The communities from the *Salicetum pentandro-cinereae* association have formed due to encroachment of scrubs in the swamp communities which belong to the *Magnocaricion* association.

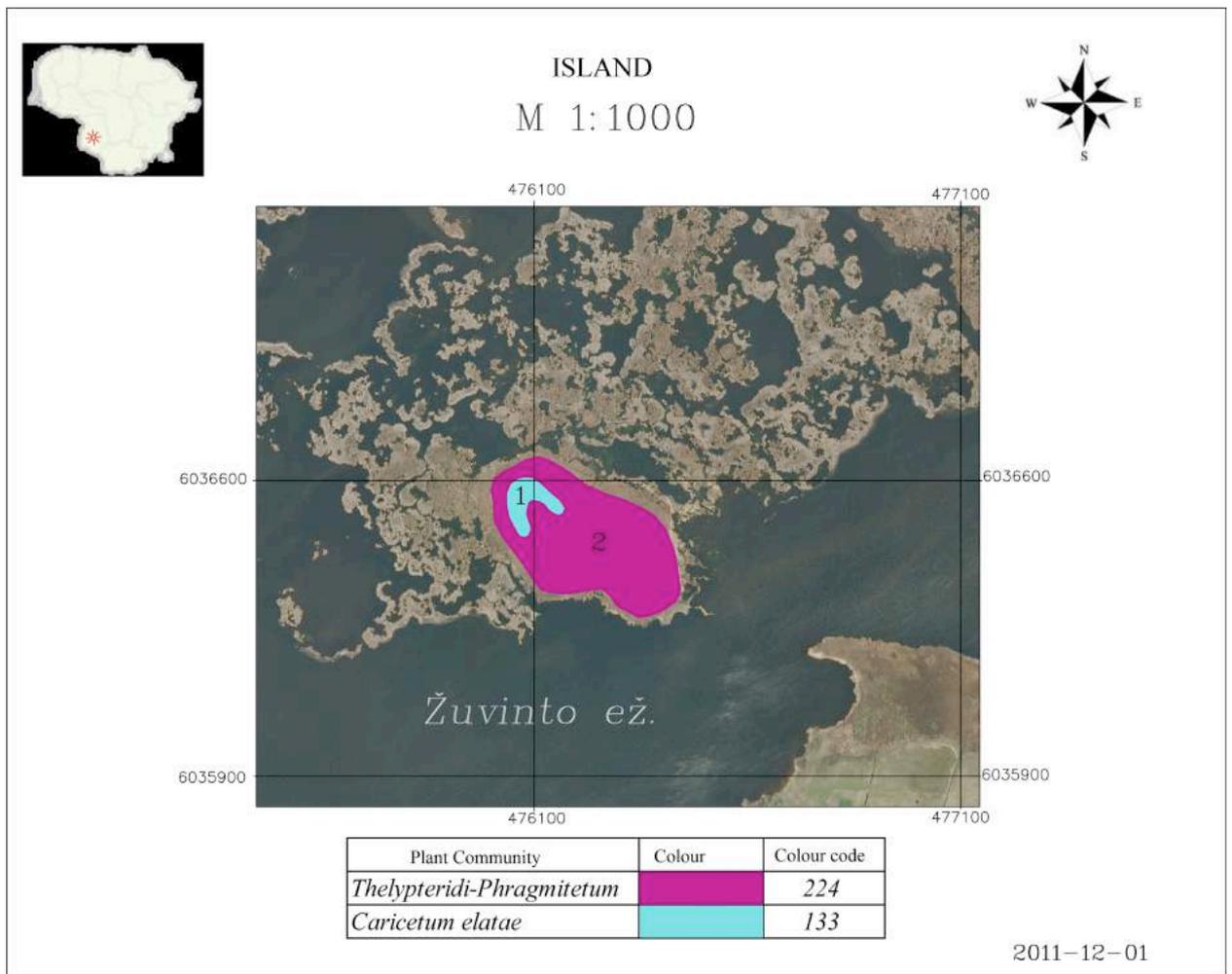


Pic. 16. Distribution of plant communities in Žuvintas site “Liepakojai swamp” in 2011

The vegetation of island consists of communities from 2 associations (Pic. 17).

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 area for Aquatic warbler is not suitable at the moment.



Pic. 17. Distribution of plant communities in Žuvintas site “Island” in 2011

LIEPAJA LAKE

All the area is located within the floodplain of the Liepāja Lake and borders with the straightened River Bārta. The territory occurs in low depression with high ground water table and influenced by frequent water table fluctuations in Liepāja Lake and adjoining canals. All the area is encircled by large open polder canals.

The vegetation is dominated by tall sedge and herb communities (*Caricetum acutae* and *Caricetum distichae*) (Pic. 18). *Caricetum acutae* covers the largest areas, the variations in the community depends on the degree of overgrowing caused by abandonment and moisture conditions. The soils under the community is slightly wet, the wet hollows in the vicinity of the canals and the former stretches of small streams is overgrown with *Phragmites australis*, overwhelming *Carex acuta*. In small wet hollows the tall sedge community is dominated by *Acorus calamus* mixed with *Carex acuta*.

Slightly drier patches are dominated by *Carex disticha*, accompanied by *Menyanthes trifoliata*, *Comarum palustre* and other hygrophytic plant species.

Drier elevations are dominated by *Filipendula ulmaria* and/or *Phalaris arundinacea* forming almost monodominant stands or sometimes being mixed (both species with very small proportion of other accompanying species).

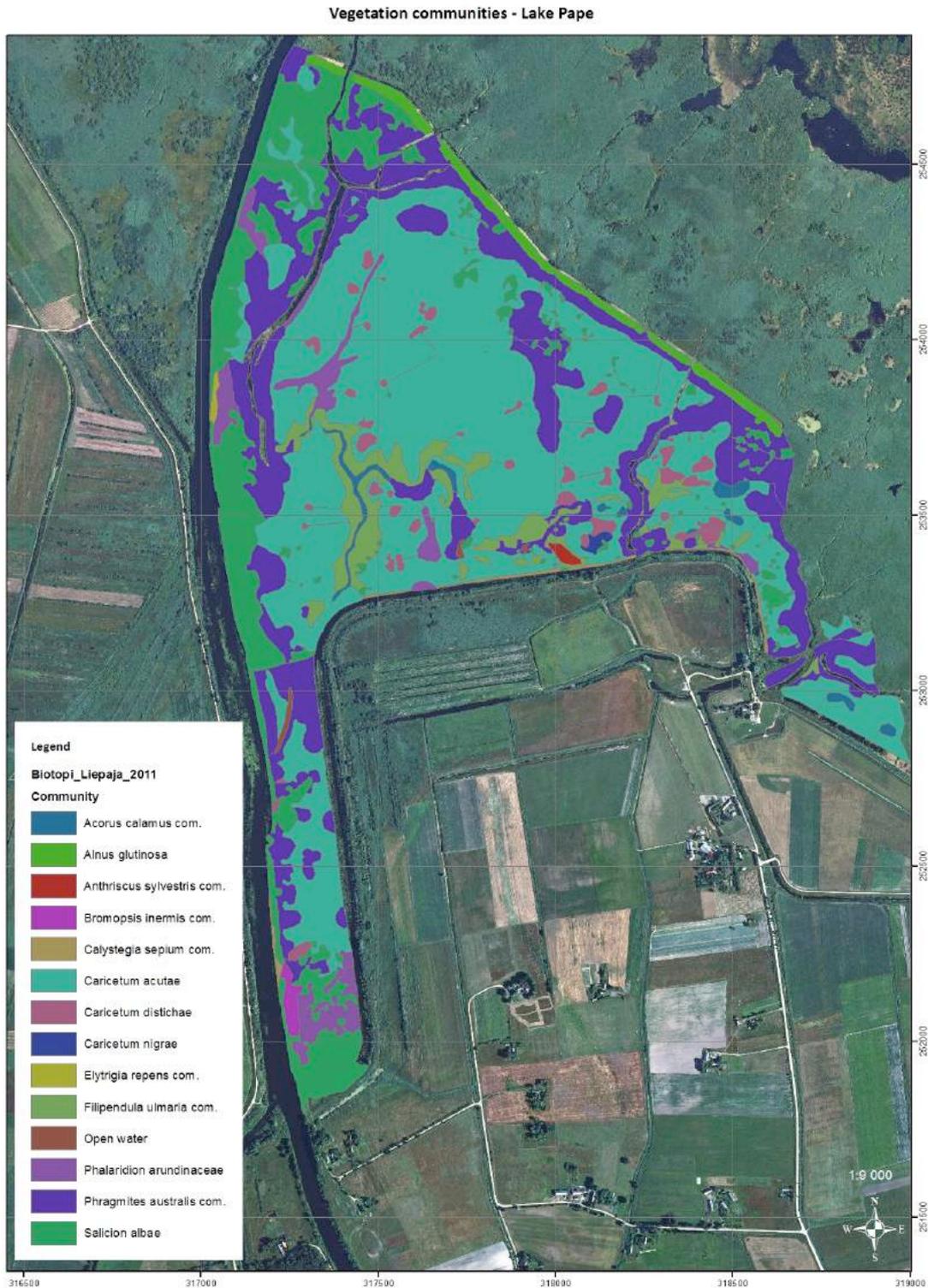
Dense or sparse stands of *Phragmites australis* is present in wet depressions, the former tall sedge communities overgrown due to lack of management (or being too wet for management) and on the margins of canals and non-functioning branches of the river.

Moss cover is almost absent in all plant communities, except little coverage of *Calliergon spp.* in wet tall sedge communities.

Vegetation structure:

Tussocks formed by tall sedges (*Carex acuta*) are found in some parts of the area, mostly in the wet depressions, which are likely to be abandoned earlier than the dried parts of the area. *Caricetum distichae* community occurs on even surfaces and do not form tussocks.

Regular grassland management (hay making and grazing) was ceased in the 1990's. Due to abandonment, some parts of the floodplain grassland are overgrown with willow shrubs (both patches of shrubs and single shrubs).



Pic. 18. Distribution of plant communities in Liepaja lake site in 2011

PAPE

The area is covered with mosaic of several grassland types, the spatial pattern is defined by levels of water table and soil properties (Pic. 19). All grassland types occur on dry to moderately moist poor sandy or poor wet peat soils (shallow peat on sandy ground). All the area is being abandoned since the 1980ies or the beginning of the 1990s, and is largely overgrown with shrubs (mostly *Salix spp.* and *Betula pendula*). Some parts of the area are used for storing and processing the reed sheafs cut in the Pape Lake.

Festuco-Plantagini grassland occurs on the driest part of the area along the road. This is dry semi-natural grassland, formed on the former fallow, on dry sandy acidic soils. Most of the grassland is open, without shrubs, with some young pines; however, the territory is gradually overgrowing with pines, birches and willows. The grassland community is polydominant and patchy, largely dominated by grasses such as *Poa angustifolia*, *Festuca rubra*, *Helictotrichon pubescens* and sedge *Carex arenaria* etc. Vegetation cover is sparse, sward is short; open patches with mosses (e.g. *Polytrichum juniperinum*, *Pleurozium schreberi*, *Tortula ruralis*, *Brachytecium albicans*, *Rhytidiadelphus squarrosus*) and lichens (*Peltigere sp.*) are present.

Numerous plant species typical form semi-natural grasslands area present, including the indicators of so called biologically valuable grasslands, e.g. *Dianthus deltoides*, *Sedum acre*, *Sieglingia decumbens*, *Saxifraga granulata*, *Viola rupestris*. Most of the plants are typical fro dry to moderately moist grasslands: e.g. *Trifolium arvense*, *Agrostis tenuis*, *Festuca pratensis*, *Holcus lanatus*, *Rumex acetosa*, *Anthoxanthusm odoratum*, *Ranunculus acris*, *Plantago lanceolata*, *Dactylis glomerata*, *Leucanthemum vulgare*, *Achillea millefolium*, *Daucus carota*, *Pilosella officinarum*, *Hieracium umbelatum*, *Linaria vulgaris*.

Deschampsion cespitosae grassland is moderately moist grassland, formed on the former fallow, perhaps used as pasture at the end of the 20th century. The plan community occurs on sandy, moderately wet sandy soils. Currently there is no management and the grassland is gradually overgrowing with shrubs. The grassland habitat covers the transitional area between the lakeside and the dry elevation covered by *Festuco-Plantagini* community. The dominating grass *Deschampsia cespitosa* forms small tussocks, which is a result of abandonment. There is a well pronounced domination of *D. cespitosa*, resulting from abandonment. The plant diversity is not large. Besides the dominant *D. cespitosa* *Rumex acetosa*, *Ranunculus acris*, *Ranunculus repens*, *Potentilla reptans*, *Potentilla anserina*, *Vicia cracca*, *Galium album*, *Galium uliginosum*, *Lychnis flos-cuculi*, *Geum rivale*, *Peucedanum palustre*, *Iris pseudacorus*, *Juncus conglomeratus*, *J. effusus* and *Elytrigia repens* are present.

Caricetum nigrae grassland. As a result of abandonment and natural succession most of the former grassland has transformed into a transitional community of grassland-fen (open patches) or dense *Salix* shrubland. Most probably in the past the wet grassland was used as pasture, but currently it is abandoned at least 20 years, therefore heavily overgrown. The plant community is formed on shallow acidic slightly wet peat soils and is seasonally flooded. The structure of vegetation is characteristic with small tuccocks of *Carex nigra*. The grassland is polydominant, dominated by sedge *Carex nigra* or co-dominated by *Carex nigra* and *Deschampsia cespitosa*. Constant accompanying plant species are *Juncus conglomeratus*, *J. effusus*, *J. filiformis*, *Lysimachia vulgaris*, *Iris pseudacorus*, *Galium uliginosum*, *Potentilla anserina*, *Carex vesicaria*, *Peucedanum palustre*, *Eriophorum polystachion*, *Carex leporina*, *Cardamine pratensis*, *Comarum palustre*, *Scutellaria galericulata* etc. On wet depressions *Iris pseudacorus* predominates. Due to abandonment some patches are overgrown with *Phragmites australis*, in some patches *Phragmites australis* co-dominates with *Urtica dioica*, while the species typical for *Caricetum nigrae* are nearly absent.

Drainage in this area is of minor importance. Ditches occur only in the marginal area (northern part) in the vicinity of road and do not significantly affect the habitat.

Carici-Menyanthetum fen covers the depression between the lakeside reed beds and drier elevations. The plant community occurs on wet peat soil, being seasonally flooded. There is a well pronounced dominance of *Equisetum fluviatile* and *Menyanthes trifoliata*. Frequent accompanying species are *Iris pseudacorus*, *Rumex aquatica*, *Solanum dulcamara*, *Comarum palustre*, *Lysimachia vulgaris*, *Galium uliginosum*, *Typha latifolia*, *Lythrum salicaria*, *Carex diandra* – species typical for nutrient-poor fens, shallow standing or slow flowing waters and floodplain grasslands.

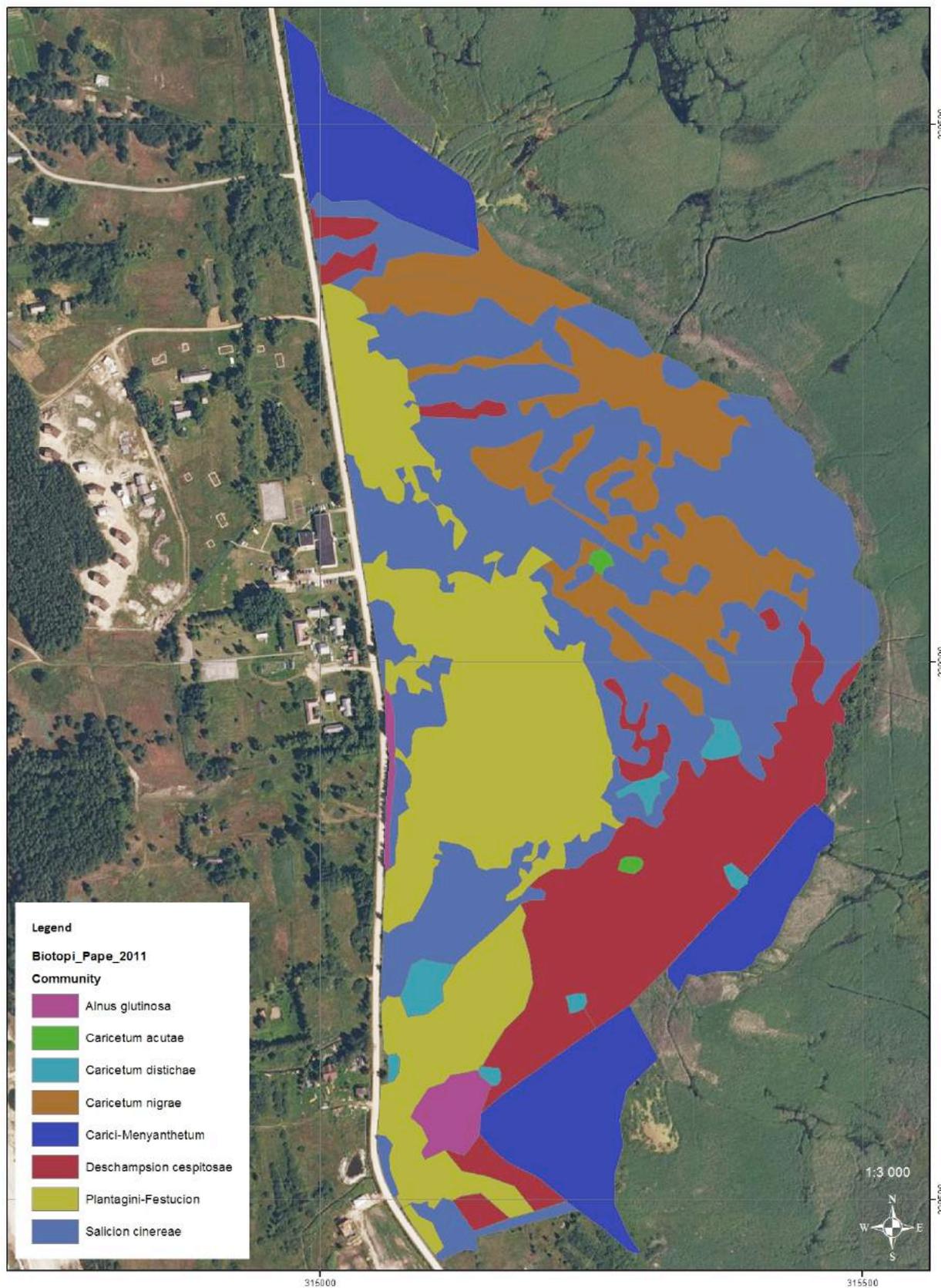
Caricetum distichae covers few patches covering less than 1 ha. The plant community occurs on sandy, moderately moist soils. Typically the community is nearly monospecific, while in this case it is accompanied by mesophytic plant species from the neighbouring communities, the same as in the neighbouring *Deschampsion cespitosae* community.

Caricetum acutae. Overall, the community is not characteristic for the Project area and occurs fragmentary. The soils are too dry for the typical *Caricetum acutae* community. Only two patches of about 100-300 m² were found, enclosed by shrubs, partly overgrown with reeds. In the community, *Carex acuta* dominated accompanied by few accompanying species, e.g. *Lysimachia vulgaris*, *Solanum dulcamara*, *Lathyrus palustris*, *Lychnis flos-cuculi*.

Willow and birch shrublands. Formed as a result of secondary succession replacing the former open grasslands.

Black alder *Alnus glutinosa* stand. Covers a relatively small patch (less than 0.5 ha) on the southern part of the Project area. The tree layer is formed by *Alnus glutinosa*, the ground layer does not have the structures typical for black alder swamps, the herbaceous layer is ruderalized (*Urtica dioica*, *Anthriscus sylvestris*, *Epilobium hirsutum*), numerous grassland species from the adjacent vegetation are present, e.g. *Caltha palustris*, *Iris pseudacorus*, *Lysimachia vulgaris*, *Deschampsia cespitosa*, *Juncus conglomeratus*.

Vegetation communities - Lake Pape



Pic. 19. Distribution of plant communities in Pape site in 2011

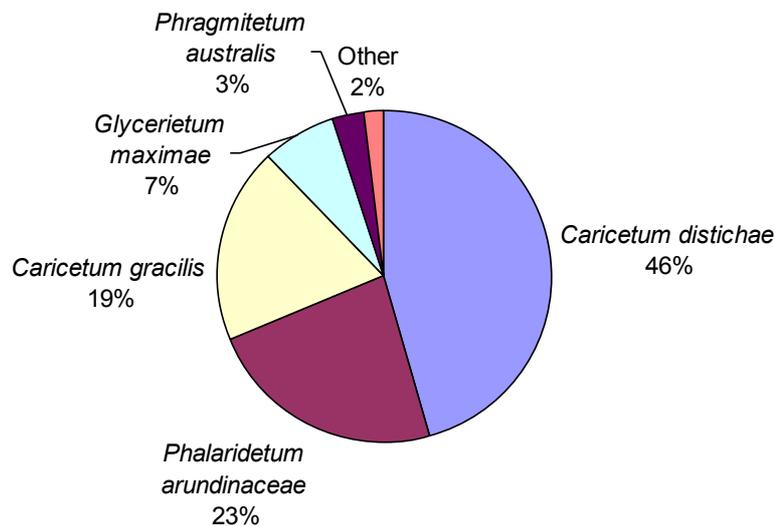
4. Aquatic warbler relations to vegetation type

Widely accepted that Aquatic warbler is a habitat specialist. In Lithuania it occupies wet seasonally flooded meadows or fen mires. Going to plant community level, we can see that many types of communities can be used (Table 3). Totally was discovered, that Aquatic warbler males sing in 11 different plant communities of *Phragmito-Magnocaricetea* and *Molinio-Arrhenatheretea elatioris* classes. Plant communities among sites differ a lot. The biggest diversity found in Šyša site and the smallest one in Tyrai. In Šyša site predominate *Phalaridetum arundinaceae* and *Caricetum gracilis* communities, meanwhile in Tyrai - *Caricetum distichae*. General plant community proportions in all project sites are shown in Pic. 20. From the picture we can see that *Caricetum distichae* and following *Phalaridetum arundinaceae* and *Caricetum gracilis* are the most important plant communities for Aquatic warbler in Lithuania, comprising 88 % of all communities. Others cover only 12 % of the singing males area.

Table 3. Aquatic warbler singing male distribution according to plant communities in 2011 and 2012

Site	Year	Repeat	No of singing males	Plant community
Šyša	2011	1	11	<i>Phalaridetum arundinaceae</i> mosaic
			6	<i>Caricetum gracilis</i>
			4	<i>Caricetum gracilis</i> , <i>Phalaridetum arundinaceae</i>
			2	<i>Phalaridetum arundinaceae</i>
			2	<i>Caricetum gracilis</i> mosaic
			2	<i>Caricetum gracile</i> , <i>Caricetum distichae</i> , <i>Phalaridetum arundinaceae</i>
			2	<i>Phalaridetum arundinaceae</i> , <i>Caricetum gracilis</i> , <i>Caricetum distichae</i> , <i>Glycerietum maximae</i>
		1	<i>Rorippo-Agrostietum</i> mosaic	
		2	8	<i>Phalaridetum arundinaceae</i> mosaic
			7	<i>Caricetum gracilis</i>
			3	<i>Caricetum gracili</i> , <i>Phalaridetum arundinaceae</i> +
			2	<i>Phalaridetum arundinaceae</i>
			2	<i>Caricetum gracilis</i> mosaic
		2012	1	10
	4			<i>Caricetum gracilis</i>
	3			<i>Phalaridetum arundinaceae</i>
	2			<i>Caricetum distichae</i> , <i>Phalaridetum arundinaceae</i> ,
	1			<i>Caricetum gracilis</i> mosaic
	1			<i>Phalaridetum arundinaceae</i> , <i>Caricetum gracilis</i> , <i>Caricetum distichae</i> , <i>Glycerietum maximae</i>
	1	<i>Phalaridetum arundinaceae</i> , <i>Caricetum gracilis</i> , <i>Glycerietum maximae</i>		
2	7	<i>Phalaridetum arundinaceae</i> mosaic		
	2	<i>Phalaridetum arundinaceae</i> , <i>Caricetum gracilis</i> , <i>Caricetum distichae</i> , <i>Glycerietum maximae</i>		
	1	<i>Phalaridetum arundinaceae</i>		

			1	<i>Caricetum gracilis</i>	
			1	<i>Caricetum gracilis, Phalaridetum arundinaceae</i>	
			1	<i>Caricetum gracilis</i> mosaic	
Tyrai	2011	1	16	<i>Caricetum distichae</i> and other halophyte communities	
			7	<i>Caricetum distichae</i>	
			3	<i>Glycerietum maximae</i> and <i>Caricetum gracilis</i> mosaic	
			3	<i>Phragmitetum australis</i> mosaic	
			1	Hygrophyte and halophyte communities	
		2	2	28	<i>Caricetum distichae</i> and other halophyte communities
	11	<i>Caricetum distichae</i>			
	4	<i>Glycerietum maximae</i> and <i>Caricetum gracilis</i> mosaic			
	2	<i>Phragmitetum australis</i> mosaic			
	2012	1	1	18	<i>Caricetum distichae</i> and other halophyte communities
				6	<i>Caricetum distichae</i>
				3	<i>Glycerietum maximae</i> and <i>Caricetum gracilis</i> mosaic
1				<i>Phragmitetum australis</i> mosaic	
2		2	17	<i>Caricetum distichae</i> and other halophyte communities	
			10	<i>Caricetum distichae</i>	
			2	<i>Glycerietum maximae</i> and <i>Caricetum gracilis</i> mosaic	
			1	<i>Phragmitetum australis</i> mosaic	
Žuvintas	2011	1	1	<i>Caricetum elatae</i>	
		2	1	<i>Caricetum elatae</i>	
	2012	1	1	<i>Caricetum elatae</i>	
		2	1	<i>Caricetum distichae, Caricetum appropinquatae, Carex lasiocarpa</i> bendrija (<i>Magnocaricion</i>)	



Pic. 20. Plant community proportion in all Aquatic warbler Lithuanian project sites

Analyzing Aquatic warbler singing male distribution in plant communities during the whole breeding season, there were not determined any more important proportional changes. That means, if the birds disappear or leave the area, decrease visible in all plant communities.

Totally were found 13 nests of Aquatic warbler in project sites in 2011. It is too small number to draw very reliable conclusions, but tendencies are visible.

Aquatic Warbler nests in the Nemunas delta were located on patches where *Carex gracilis* or *Phalaris arundinacea* were the dominant plant species. In Tyrai mire, where open areas dominated by *Carex disticha* alternate with reed-belts of *Phragmites australis*, nests were only found in open areas. Only one nest in Tyrai was found in vegetation dominated by *Phalaris arundinacea* and *Cirsium arvense*. Other plant species relatively frequently found at nest sites were *Glyceria maxima* and *Potentilla palustre* (the latter one only in Tyrai mire). Nest sites did not differ visually from the surrounding area. Nest distribution according to plant communities shown in Table 4.

Table 4. Aquatic warbler nest distribution according to plant communities in 2011

Site	Brood time*	No of nests	Plant community
Šyša	1	1	<i>Caricetum gracilis</i>
		1	<i>Caricetum gracilis</i> , <i>Phalaridetum arundinaceae</i>
		1	<i>Phalaridetum arundinaceae</i> , <i>Caricetum distichae</i> , <i>Caricetum gracilis</i>
		1	<i>Phalaridetum arundinaceae</i> mosaic
	2	1	<i>Caricetum gracilis</i>
		1	<i>Caricetum gracilis</i> mosaic
Tyrai	1	2	<i>Caricetum distichae</i> and other helophyte communities
	2	4	<i>Caricetum distichae</i> and other helophyte communities
		1	<i>Glycerietum maximae</i> , <i>Caricetum gracilis</i>

* 1 – early brood, 2 – late brood

By far, not entire project area is suitable for Aquatic warbler. According to vegetation mapping in 2011, only 20.5 % of total project area was estimated to be moreless suitable (Table 5). The largest suitable areas determined in Tyrai and Šyša sites, smallest – in Tulkiaragė.

Table 5. Suitable for Aquatic warbler area within project sites in 2011

Site	Total area	Suitable area	% of total area
Šyša	734	163.37	22.3
Tulkiaragė of Nemunas delta	455	14.69	3.2
Tyrai	528	135.95	25.7
Žuvintas	328	105.22	32.1
Totally:	2045	419.23	20.5

Conclusions

1. Aquatic Warbler Lithuanian population continuous to decline. Population within project sites decreased by 26 % per year down to 51 singing male in 2012. In Latvian sites, as was during the last 5 years, no singing Aquatic Warblers were recorded.

2. Project sites hold 82 % of Aquatic Warbler Lithuanian population. Tyrai mire remains the most important breeding site, followed by Šyša polder.

3. Totally were found 13 Aquatic Warbler nests. Breeding success estimated to be 69 % with 2 nests depredated and 2 mown.

4. Totally was discovered, that Aquatic Warbler males sing in 11 different plant communities of *Phragmito-Magnocaricetea* and *Molinio-Arrhenatheretea elatioris* classes.

Caricetum distichae followed by *Phalaridetum arundinaceae* and *Caricetum gracilis* are the most important plant communities for Aquatic Warbler in Lithuania, comprising 88 % of all communities.

5. Only 20.5 % of total project area in Lithuania was estimated to be moreless suitable for Aquatic Warblers in 2011. The rest area is either overgrown with reeds or bushes, or accumulated thick litter layer deteriorates habitat structure and quality.