

VEGETATION OF COASTAL AND INLAND MEADOW SALINE AREAS

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Abstract. The research was conducted in the coastal saline areas of Kępa Karsiborska and inland salt-marshes in Ciechocinek and Pyzdrowskie Łąki in vegetation seasons 2012–2015. Its aim was to compare a current state of halophile flora in coastal and inland areas and to identify threats to which their natural values may be exposed, in order to determine possibilities of their protection. Over 300 phytosociological relevés from inland areas and more than 60 ones from coastal areas underwent a complex floral and environmental analysis. The state of the preservation of natural values was assessed on the basis of: a total and an average number of the species in a phytosociological relevé, a phytosociological structure, a geographical and historical spectrum, the presence of protected species and a natural valorisation index. Environmental conditions, i.e. moisture, soil's reaction, the content of nitrogen and salination were assessed with a phytosociological method with the indicators of Ellenberg and Leuschener [2010]. The flora of research objects in Kępa Karsiborska, Łąki Pyzdrowskie and Ciechocinek is varied, mainly within the appearance of obligatory halophytes species which are an evidence for the state of their preservation and the scope of succession changes. The differentiation of environmental conditions, salination and moisture in particular, influenced the character of flora: on the most saline soils in Ciechocinek, salt-marsh communities were formed with large participation of obligatory halophytes, whereas the least saline and more moisturized soils of Kępa Karsiborska and Łąki Pyzdrowskie were the place where non-halophile communities mainly with facultative halophilous species developed. Their natural values are determined by the presence of halophile and protected species whose appearance is endangered due to changes in water management and abandonment of tillage, which protects specific and valuable flora and plants from extinction. All actions aimed at preservation of stability of moisturization conditions and salinization of soils, combined with systematic meadow-pasture exploitation, allow for the survival (Kępa Karsiborska, Łąki Pyzdrowskie) or maintenance (Ciechocinek) of salt-marsh communities in the researched objects.

Key words: meadow communities, halophytes, site conditions

INTRODUCTION

Polish halophile areas are priority environments in Natura 2000 program and, due to their unique character, are protected legally [Pieńkowski et al. 2008, Piernik et al. 2005]. What is often observed in these environments is the atrophy of halophile flora as a result of changes in environmental conditions which disenable its appearance. According to numerous authors, the reason for the atrophy of halophile flora is environmental changes, and particularly – decrease in soil salination [Alvarez et al. 2007, Szabolcs 1990]. What is more, like in other meadows ecosystems [Kryszak et al. 2009], anthropogenic actions lead to the dehydration of salt-marsh areas; lack of or rare harvesting and pasturage launch succession processes. They are often vis-

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ible in the expansion of some meadow species and common reed which results in photophilous halophile species (mainly obligatory) being overcome, and also in the appearance of few, and of small participation, halophilous halophile species within other non-halophile phytocenoses [Czyż et al. 2002, 2010, Esselink et al. 2002, Săgin 1999].

The aim of the research was to compare a current state of halophile flora in coastal and inland areas and to identify threats to which their natural values may be exposed, in order to determine possibilities of their protection.

MATERIAL AND METHODS

The research was conducted in the coastal saline areas of Karsiborska Kępa and in the area of inland salt-marshes in Ciechocinek and Łąki Pyzdrskie. Karsiborska Kępa, one of the islands located in the regressive delta of Świna River, is a vast alluvial area formed from materials carried by sea waters which regress in autumn and winter, and by river waters which flow from Zalew Szczeciński. The source of salination of Karsiborska Kępa is the waters of Stara Świna River, seasonally replenished with salt sea waters, which used to cover the whole island, yet have only filtered to ground waters since the reconstruction of the embankment. The current state of flora is a result of human's long-term activity, i.e. mainly extensive harvesting and pasturage exploitation and, what is more, control over water relations by constructing embankments and pumping the excess of water seasonally [Czyż et al. 2010].

Halophilous flora reserve in Ciechocinek of 1,88 ha is located nearby a graduation tower no. 3. Positions of halophytes, located low and seasonally waterlogged, form characteristic strip shapes in the meadows [Szafer and Zarzycki 1972, Wilkoń-Michalska 1963]. The state of flora from the halophytes' reserve is strongly influenced by a saline ditch which would be used for the disposal of brine from a swimming pool in the graduation tower.

Łąki Pyzdrskie complex is located within the impact area of Warta River, which influences the moisturization in this terrain. The wealth of habitats and plant communities, especially halophile ones, is conditioned by, among all, salt springs and the ascent of mineral waters, which are in contact with Zechstein salt structures, into ground waters [Samsonowicz 1928]. Moreover, the variability of flora in Łąki Pyzdrskie complex is also conditioned by meadow-pasturage managements which has been led extensively for 15 years.

Floral research has been conducted in vegetation seasons of 2012–2015. Around 280 phytosociological relevés were made in representative areas of up to 25 m² in inland terrains with the Braun-Blanquet's method [1964]. 62 relevés were made in coastal areas and stored in Turboveg program's database [Hennekens and Schaminee 2001].

A detailed analyses was conducted on the relevés of communities which dominated in the research objects, whereas, the preliminary classification and analysis of the relevés was conducted with the Twinspan program [Hill 1979]. The state of natural values preservation was assessed on the basis of: total and average numbers of species in the phytosociological releve, phytosociological structure, geographical and historical spectrum, the appearance of protected species and with the natural valorisation index (L_{wal}), which was calculated with the authorship-modified Oswit's method [2000]. Modification was implemented to the species of hydrogenic habitats which are often halophile and protected, and which were not taken into consideration in Oswit's elaboration. The value of an indice attributed to them was between 4 and 8 (Table 1).

Protected species were determined on the basis of a current Environment Ministry Regulation on protected species [2014]. Ecological and habitat conditions i.e. light conditions (L), moisture (F), reaction (R), the content of nitrogen (N) and salination (S) were assessed with

Table 1. The value of natural valorisation index of some species were not taken into Oświt method

Natural valorisation Index (L_{wal})	Species
4	<i>Gratiola officinalis</i> , <i>Juncus bufonius</i> , <i>J. bulbosus</i> , <i>Limosella aquatica</i> , <i>Lotus tenuis</i> , <i>Schoenoplectus tabernaemontani</i> , <i>Sphagnum sp.</i>
6	<i>Carex dystans</i> , <i>Glaux maritima</i> , <i>Plantago coronopus</i> , <i>P. maritima</i> , <i>Salicornia europaea</i> , <i>Samolus valerandi</i> , <i>Spergularia salina</i> , <i>Tetragonolobus maritimus</i>

a phytoindication methods with Ellenberg's and Leuschner's indices [2010]. The calculation of F, R, N, S and H' indice was conducted with Juice 7.0 program [Tichy et al. 2011]. Nomenclature of syntaxons was based on Matuszkiewicz [2001].

RESULTS AND DISSCUSION

The analysed halophile areas show floral differentiation which is visible in the communities' structure i.e. the number and frequency of appearance of the featured syntaxons (Table 2). What is characteristic for the vegetation of Karsiborska Kępa, as well as the flora in the area of Pyzdry, is its larger variation than in Ciechocinek object. A particularly high variation is visible

Table 2. The structure of the analysed halophile areas

Plant community	Number of releves	%
Karsiborska Kępa		
Class: <i>Phragmitetea</i>	15	28.3
Class: <i>Molinio-Arrhenatheretea</i>	34	64.2
Class: <i>Asteretea tripolium</i>	4	7.5
Total	53	100
Pyzdry		
Class: <i>Phragmitetea</i>	57	27.9
Class: <i>Molinio-Arrhenatheretea</i>	108	53.0
Class: <i>Scheuchzerio-Caricetea nigrae</i>	28	13.7
Class: <i>Asteretea tripolium</i>	11	5.4
Total	204	100
Ciechocinek		
Class: <i>Molinio-Arrhenatheretea</i>	16	28.1
Class: <i>Asteretea tripolium</i>	37	64.9
Class: <i>Agropyretea intermedio-repentis</i>	4	7.0
Total	57	100

in the area of Łąki Pyzdrskie, where communities were distinguished from the following classes: *Phragmitetea*, *Molinio-Arrhenatheretea*, *Scheuchzerio-Caricetea nigrae*, *Asteretea tripolium*, and even ones referring to *Nardo-Callunetea*. At the same time, typically halophile phytocenoses were found in the research object of Ciechocinek. Among the phytosociological relevés taken here, floral composition of almost 65% of them allowed for their classification to the class *Asteretea tripolium*. In other areas their participation was not more than 5,5%. Apart from habitat conditions, such significant differentiation between the flora of the objects was caused by agricultural exploitation. The terrains of both Karsiborska Kępa and Łąki Pyzdrskie, which are covered in about 64% and 46%, respectively, with phytocenoses from *Molinio-Arrhenatheretea* class, are exploited as harvesting or pasturage areas, whereas the terrains in Ciechocinek which are nearby a saline ditch with flora of halophile syntaxons, are not exploited at all.

Soils salination enabled the appearance of halophile species in all the researched objects, including other non-halophile communities, yet often with their low participation. Despite from a frequent low participation of halophile syntaxons in the occupied area in the research object, 102 plant species were found in Kępa Karsiborska, including 9 obligatory halophile species and 47 – facultative ones. Whereas in phytocenoses formed in inland areas, the presence of almost 220 taxons was observed, including 75 facultative ones and 6 obligatory ones.

The structure of species in a sociological perspective in saline areas shows great differentiation between the investigated objects (Table 3).

Table 3. Phytosociological structure of the plant communities in classes (%)

Plant community with class	<i>Scheuchzerio-Caricetea nigrae</i>	<i>Phragmitetea</i>	<i>Molinio-Arrhenatheretea</i>	<i>Asteretea</i>	<i>Thero-Salicornietea</i>	Other species	Total
Karsiborska Kępa							
Class: <i>Phragmitetea</i>	0.3	52.7	33.6	0.5	0.0	12.9	100
Class: <i>Molinio-Arrhenatheretea</i>	18.6	3.1	67.0	2.2	0.0	9.1	100
Class: <i>Asteretea tripolium</i>	0.0	5.6	24.1	28.4	0.0	41.9	100
Pyzdry							
Class: <i>Phragmitetea</i>	2.7	73.6	20.2	1.1	0.0	2.4	100
Class: <i>Molinio-Arrhenatheretea</i>	1.8	5.1	72.1	1.3	0.0	19.7	100
Class: <i>Scheuchzerio-Caricetea nigrae</i>	1.6	25.1	27.2	43.9	0.0	2.2	100
Class: <i>Asteretea tripolium</i>	53.8	6.0	32.4	1.3	0.0	6.6	100
Ciechocinek							
Class: <i>Molinio-Arrhenatheretea</i>	0.0	0.0	73.7	11.2	0.0	15.1	100
Class: <i>Asteretea tripolium</i>	0.0	0.1	19.2	42.3	20.8	17.6	100
Class: <i>Agropyreteae intermedio-repentis</i>	0.0	11.6	1.8	58.3	11.4	16.9	100

Sociological structure of the flora of Kępa Karsiborska and Łąki Pyzdrskie meadow communities show large similarities. Phytocenoses were dominated by species from *Molinio-Arrhenatheretea* class (67–72%), moreover, with large participation of *Phragmitetea* class (3–5%) and small – of *Asteretea tripolium* (ca. 1–2%). The presence of halophilic species, frequently of *Puccinellia distans*, *Festuca arundinacea*, *Trifolium fragiferum*, within the scope of non-halophile communities, is the best example for a special character of the flora of both objects. Whereas in meadow communities formed in Ciechocinek, no species from *Phragmitetea* class were found, yet there was far more participation, when compared to other objects, of *Asteretea tripolium* class (over 19%). Their appearance may be a prove for high soil salination – according to Jacksona EC more than 20 mS·cm⁻¹ [Piernik 2003].

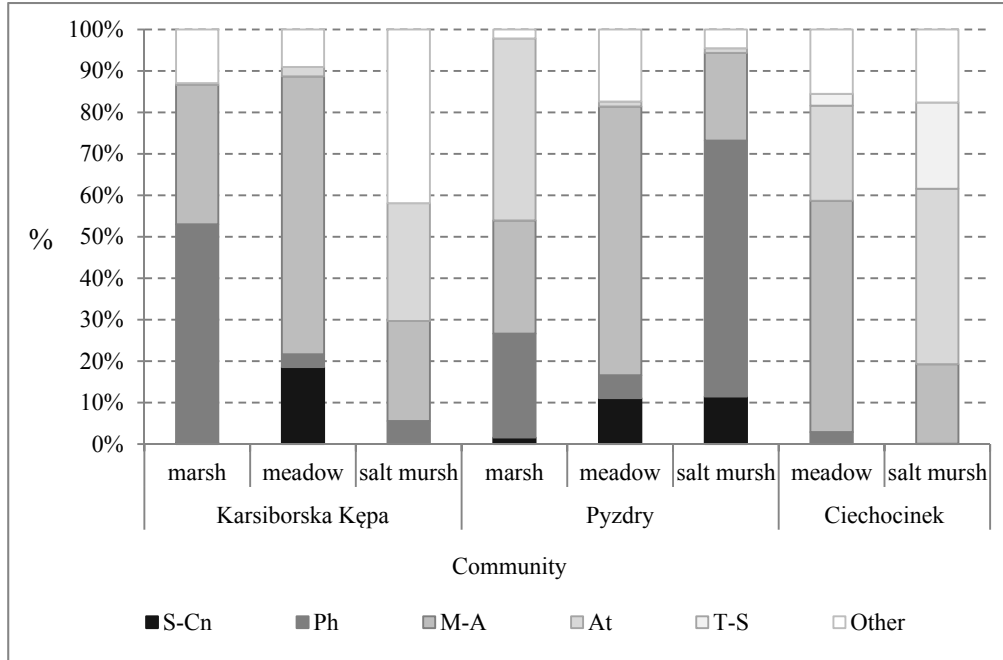
Reed phytocenoses found in Kępa Karsiborska and Łąki Pyzdrskie show much differentiation in the participation of species from *Phragmitetea* class. Their larger participation (ca. 73,5%) was observed in their phytocenoses in Pyzdry. Similarly to meadow communities, little percentage of species characteristic to saline syntaxons were found in their floral composition (0,5–1%) with a simultaneous participation of *Potentilla anserine* and *Juncus compressus*. Such sociological structure of phytocenoses as given by Piernik and Hulicz [2011] is more often observed in anthropogenic saline areas.

Having compared sociological structures of the research objects, the largest participation of species characteristic to *Asteretea tripolium* and *Thero-Salicornietea* classes (over 63%), with a simultaneous small percentage of species from *Phragmitetea* class (less than 1%) and *Molinio-Arrhenatheretea* class (ca. 19%), was observed in the salt-marsh communities in Ciechocinek. The participation of species characteristic to saline syntaxes was similar in two other objects and oscillated around 45%. What is striking at this point is that salt-marsh communities formed in Pyzdry had significant participation (ca. 25%) of species characteristic to *Phragmitetea* class whereas in Kępa Karsiborska – of *Molinio-Arrhenatheretea* class (almost 48%) (Fig. 1).

When comparing species composition of *Phragmitetea* class communities, which were found only in Łąki Pyzdrskie and Kępa Karsiborska, what draws attention is larger species wealth of those observed in inland halophile areas. It is visible in a higher average number of plant species in a phytosociological releve which oscillates between 10,0 and 13,6, and 7,0 and 12,5, respectively.

Communities which represent *Molinio-Arrhenatheretea* class were found in all three research objects. Similarly to the phytocenoses of *Phragmitetea* class, the highest average number of species in a phytosociological releve was found in the ones formed in Łąki Pyzdrskie: the number was 16,46 (from 10 to 19,5), whereas the lowest number of taxons in a phytosociological releve, i.e. 11,28 (from 9,25 to 12,3) was found in the phytocenoses of this class in halophile areas of Ciechocinek.

However, natural values of these objects are mostly conditioned by the presence of saline phytocenoses and the appearance of halophile and protected species. In the objects of Kępa Kariborska and Łąki Pyzdrskie almost twice as many halophile species were found in communities, including saline ones, as in the discussed ones in Ciechocinek. Nevertheless, what is worth paying attention to is the differences in the structures of halophile species from salt-marsh communities which represent *Asteretea tripolium* and *Thero-Salicornietea* classes between the researched objects. Salt-marsh communities of Kępa Karsiborska and Łąki Pyzdrskie are much more dominated by facultative halophytes, especially *Puccinellia distans*, whereas Ciechocinek – by obligatory halophytes. Despite a smaller number of these species in a phytosociological releve, their participation in the structure of halophile species is about 61,5%. Whereas, in salt-marsh communities in Kępa Karsiborska and Pyzdry, obligatory halophytes sum up only to ca. 38 and 14,5%, respectively (Fig. 2).



S-Cn – *Scheuchzerio-Caricetea nigrae*; Ph – *Phragmitetea*; M-A – *Molinio-Arrhenatheretea*; At – *Asteretea tripolium*; T-S – *Thero-Salicornietea*

Fig. 1. The comparison of a social structures of flora in reed, meadow and salt-marsh communities observed in the research areas

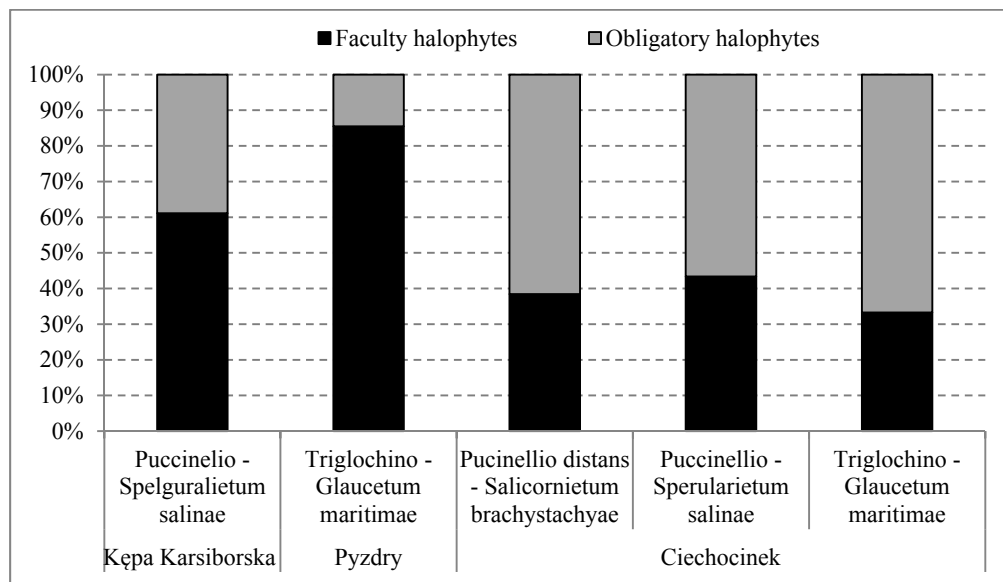


Fig. 2. Differences in the structure of halophile species of saline phytocenoses in the research objects

Table 4. Natural valorisation of the selected communities in the research objects

Phytosociological unit	Number of species		Number of halophytes in releve		Number of protected species in releve	Geographical-historical spectrum of flora (number of species)			Index of natural valorisation	
	all	in releve from – to	obligatory			spontaneo-phytes	apophytes	archo-phytes		other
			facultative from – to	from – to	from – to					
Kępa Karsiborska										
Class: <i>Phragmitetea</i>	29.3	3-22	2-15	0-3	0-2	9.3	19.7	0.0	0.3	3.6
Class: <i>Molinio-Arrhenatheretea</i>	51.7	3-29	3-19	0-3	0-3	17.0	34.7	0.0	0.0	2.9
Class: <i>Asteretea tripolium</i>	17.5	7-14	1-9	1-4	0-2	5.5	10.5	1.0	0.5	2.9
Pyzdry										
Class: <i>Phragmitetea</i>	54.4	5-22	2-14	0-2	0-4	22.6	31.2	0.6	0.0	3.6
Class: <i>Molinio-Arrhenatheretea</i>	74.3	7-32	4-18	0-2	0-4	23.0	49.9	0.7	0.7	2.5
Class: <i>Scheuchzerio-Caricetea nigrae</i>	49.0	6-19	3-14	0-3	1-5	20.0	28.0	1.0	0.0	4.0
Class: <i>Asteretea tripolium</i>	58.3	6-26	6-18	0-1	0-3	25.3	23.3	9.3	0.3	3.4
Ciechocinek										
Class: <i>Molinio-Arrhenatheretea</i>	30.0	7-15	3-9	0-3	0-1	3.3	22.0	3.3	1.3	2.1
Class: <i>Asteretea tripolium</i>	18.7	3-14	0-6	1-4	0-2	4.7	12.0	1.7	0.3	2.7
Class: <i>Agropyretea intermedio-repentis</i>	23.0	5-17	2-8	1-3	0-1	3.0	16.0	4.0	0.0	2.0

At the same time, communities in these areas were characterized by a larger number of protected species and it is them, among all, that influence the natural valorisation index significantly. Its calculated value of L_{wal} 2,80–3,88 for the communities in Kępa Karsiborska, where the following protected and endangered species were found: *Juncus gerardi*, *Spergularia salina*, *Plantago coronopus*, *Glaux maritima*, *Plantago maritima*, *Lotus tenuis*, is an evidence for their average and significant natural values. However, according to Pernik and Hulisz [2011], these species are more often observed in naturally – rather than anthropogenically saline areas. Therefore, despite low values of L_{wal} indice, their appearance is an evidence for the uniqueness of this object. Natural values of the presented communities of Łąki Pyzdrskie were assessed from very low to very high (L_{wal} 1,98–4,02). The appearance of only vernacular species was observed there, including the endangered ones: *Parnassia palustris*, *Polygala amarella*, *Glaux maritima*, *Pedicularis palustris* and rare ones: *Carex disticha* and *Triglochin maritima*. Low figures of the indice (L_{wal} 1,84–2,95) are visible and are an evidence for little and medium natural values of the communities nearby Ciechocinek, despite the observed curios – obligatory halophytes: *Salicornia europaeae*, *Spergularia salina*, *Glaux maritima*.

What is interesting, is the differences between the objects in terms of the values of natural valorisation indexes according to Oświat of the same syntaxons. The examples are: *Puccinellio-Spergularietum salinae* – for the one formed in Kępa Karsiborska $L_{\text{wal}}=3,07$, whereas for the one from Ciechocinek – $L_{\text{wal}}=2,51$, and *Triglochino-Glaucetum maritimae* – for the ones in Łąki Pyzdrskie $L_{\text{wal}}=4,02$, whereas in Ciechocinek – $L_{\text{wal}}=2,68$.

Natural values of the communities in the research objects, including halophile communities, are also influenced by the appearance of synantropic species (Table 4).

Their largest participation in species composition of about 85% was observed in the communities from Ciechocinek, which may, among all, be the reason for their lower natural values when compared to the other objects, in spite of the presence of numerous percentage of halophile species.

Selected communities in the research objects were formed in highly differentiated habitats, especially in terms of salination and moisture. The smallest differentiation was observed in light condition indices in phytocenoses.

What draws attention when comparing the research objects in terms of average values of the calculated indices, is that the largest figures (apart from moisture) are observed in Ciechocinek. At the same time, habitats in this area have the lowest moisture (the average value of the indice for the whole object is $F=6,01$).

Significantly lower salination, only a little lower reaction and lower content of nitrogen, simultaneously at higher moisture, were observed in soils in the objects in Kępa Karsiborska and, especially, in Łąki Pyzdrskie (Fig. 3).

It was not only between habitat conditions between the research objects that was found, but also between the selected communities of the following habitat types: reed, meadow and salt-marshes. This relation is especially visible in soils' salination, which was mentioned by Wilkoń-Michalska [1963], Piernik et al. [1996], Westhus et al. [1997], among all, who claim that such a state contributes to the formation of flora areas towards its gradients. This relation explains the appearance of *Puccinellio distans-Salicornietum brachystachyae*, *Puccinellio-Spergularietum salinae* and *Triglochino-Glaucetum maritimae* communities on most saline soils among the research objects i.e. in Ciechocinek. The values of S indice here oscillate between 6,88 and 8,97 which is an evidence for ca. 2,3% Cl content. What is significant, is that meadow communities selected from this community were also formed on soils which were more saline when compared to the other ones. Whereas when compared to other research objects, communities of the same habitat types, i.e. meadow and salt-marsh ones, in Kępa Karsiborska were formed in the

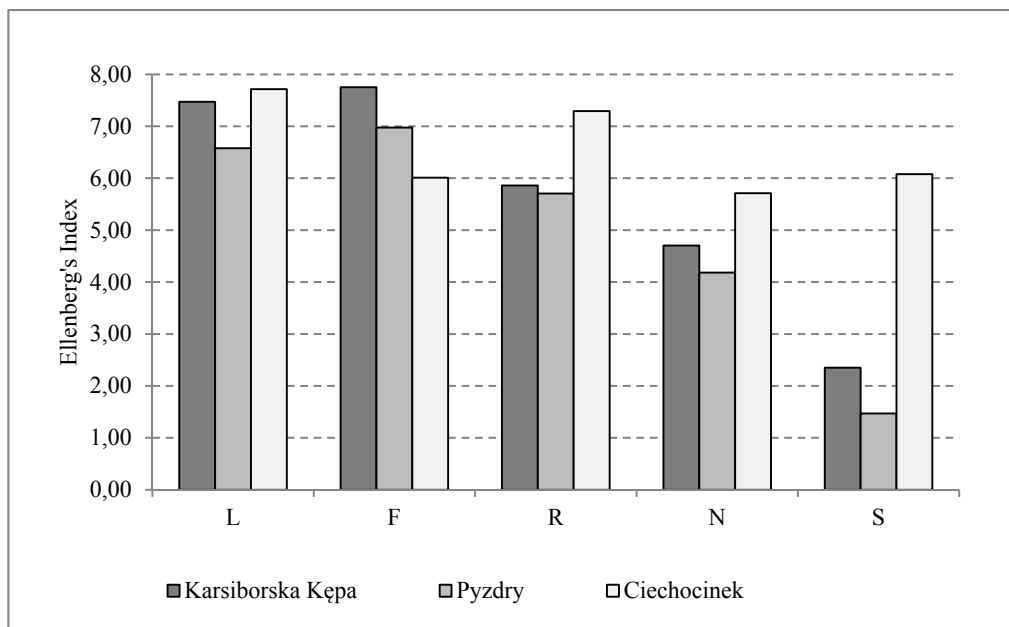


Fig. 3. Differences in habitat conditions of the research objects

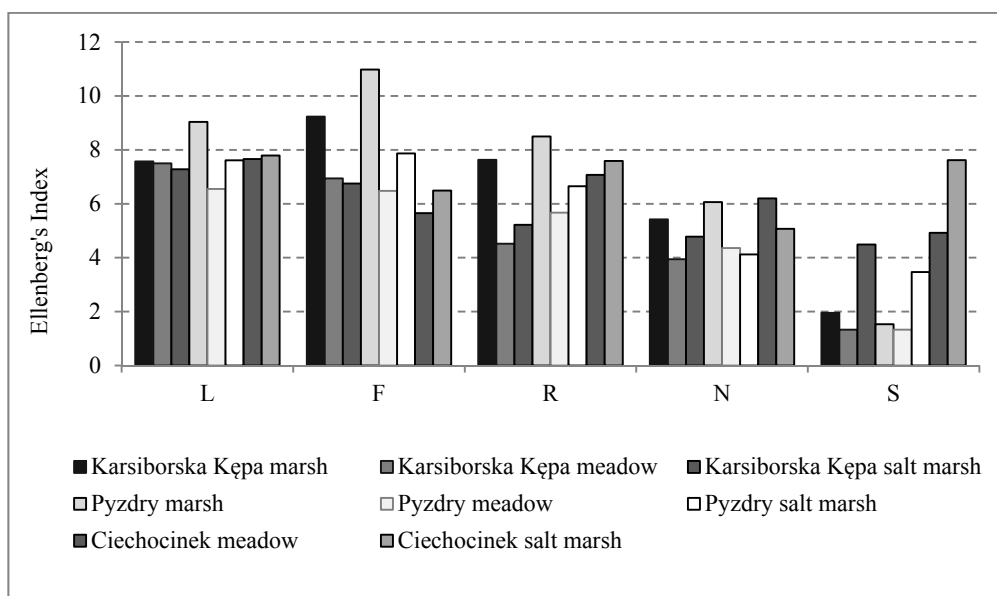


Fig. 4. Comparison of habitat conditions of reed, meadow and salt-marsh communities in the research objects measured with Ellenberg's indices

least saline soils (S indice from 0,84 to 4,27). When compared to other objects, reed, meadow and salt-marsh communities in Kępa Karsiborska formed in the most moisturized habitats (Fig. 4). It is also significant that in salt-marsh phytocenoses, especially in Pyzdry and Ciechocinek, far more species were observed along with the increase in light interception of green growth measured with the L indice, i.e. requiring up to 30% of day light (L indice from 6,67 to 8,79).

High dependence of floral composition on habitat conditions was scientifically proved by numerous authors [Bockholt et al. 2002, Saġin 1999, Trzaskoś et al. 1999, Zander 2002]. Similar relations were found in the research objects. Differentiated habitat conditions had significant effect on the character of flora, which is visible in the sociological structure of the selected communities. In halophile phytocenoses which developed on the most saline and the least moisturized soils in Ciechocinek, the largest number of species from *Asteretea tripolium* and *Thero-Salicornietea* classes were found, whereas the fewest ones – from *Phragmitetea* class. At the same time, in more moisturized habitats of Kępa Karsiborska and especially – of Łąki Pyzdrskie, the presence of species characteristic to *Phragmitetea* class was observed in meadow and salt-marsh communities. High participation of obligatory halophytes in the selected phytocenoses in Ciechocinek is also enabled by their physiognomy, the domination of low species and little compactness contributes to light interception by plants. Moreover, what is clearly visible, is the tendency to the decrease in the average number of species, including facultative halophytes in phytosociological releves in meadow communities along with the increasing salination of soils, which can be particularly well observed in Ciechocinek. This relation was also confirmed by Piernik and Hulisz [2011] – according to the results of their research, high salination limits the number of species.

According to Czyż et al. [2002], the distribution of communities in Kępa Karsiborska is determined by soil and water conditions. At the same time, the appearance of *Phragmites australis* – especially in flooded areas, and of meadow species such as *Agrostis stolonifera*, *Elymus repens* in moist habitats as a result of harvesting and pasturage being abandoned and water management control, which ensured the flow of salt waters to canals, being limited, is a threat to the natural values of halophile phytocenoses in Kępa Karsiborska [Czyż et al. 2010]. In order to mitigate an unfavourable tendency in a species composition of phytocenoses, Saġin [1999] points out the necessity to harvest *Phragmites australis* and thus limit its secondary expansion. The author claims that the fluctuations in the intensity of exploitation of meadow areas in post-war times resulted in the transformation of Kępa Karsiborska's flora, which subsequently led to the decline in specific and valuable elements of flora and plant. What is more, Czyż et al. [2010] emphasizes the need to improve the functioning of ameliorative infrastructure with the possibility to control and regulate ground water level in order to maintain natural values of this area.

Similarly, in Ciechocinek, installing drainage and enabling meadows to be flooded with salt water, caused the desiccation of habitats and, according to Piotrowska [1957] and Saġin [1999], the character of halophytes is unstable at low moisturization. Also Pieńkowski et al. [2008] points out to the dehydration of terrains as one of the reasons for the degradation of halophile ecosystems.

Halophile phytocenoses in Łąki Pyzdrskie are mostly endangered by exploitation which leads to the expansion of *Phragmites australis*, and subsequently – to the atrophy of halophile species.

CONCLUSIONS

1. The flora of research objects in Kępa Karsiborska, Łąki Pyzdrskie and Ciechocinek is varied, mostly in terms of the appearance of obligatory halophytes' species, which is an evidence for the state of their preservation and the ongoing succession changes.
2. The differentiation of habitat conditions, especially salination and moisturization, had impact on the character of flora; the most saline soils in Ciechocinek were a place where salt-marsh communities with large participation of obligatory halophytes were formed, whereas less saline yet strongly moisturized soils of Kępa Karsiborska and Łąki Pyzdrskie – where non-halophile communities mainly with facultative halophilic species developed.
3. Natural values of the investigated areas are determined by the presence of halophile and protected species whose appearance is endangered as a result of changes in water management and the abandonment of tillage which protects specific and valuable flora from decline.
4. All the actions aimed at the maintenance of moisture conditions and salination of soils, combined with systematic meadow-pasture exploitation ensure the survival (Kępa Karsiborska, Łąki Pyzdrskie) and preservation (Ciechocinek) of salt-marsh communities in the research objects.

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ROŚLINNOŚCI NADMORSKICH I ŚRÓDLĄDOWYCH ŁĄK TERENÓW HALOFILNYCH

Synopsis. Obszary halofilne Polski należą do siedlisk priorytetowych – chronionych w ramach sieci Natura 2000. W siedliskach tych często obserwuje się zanikanie roślinności halofilnej na skutek zmian w warunkach siedliskowych uniemożliwiających jej występowanie. Badania prowadzono na terenie słonaw nadmorskich Karsiborskiej Kępy oraz solnisk śródlądowych w Ciechocinku oraz w kompleksie Łąk Pyzderskich, w sezonach wegetacyjnych 2012-2015. Ich celem było porównanie roślinności halofilnej łąk terenów nadmorskich i śródlądowych oraz określenie zagrożeń, na jakie narażone są ich walory przyrodnicze by wskazać możliwości ich zachowania. W analizie wykorzystano ponad 360 zdjęć fitosocjologicznych wykonanych metodą Braun –Blanqueta. Stan zachowania walorów przyrodniczych oceniono na podstawie: ogólnej i średniej liczby gatunków w zdjęciu fitosocjologicznym, struktury fitosocjologicznej, spektrum geograficzno-historycznego, obecności gatunków chronionych oraz wskaźnika waloryzacji przyrodniczej. Warunki siedliskowe, tj. uwilgotnienie, odczyn gleb, zawartość w niej azotu oraz zasolenie oceniono metodą fitoindykacyjną z zastosowaniem wskaźników Ellenberga i Leuschnera. Roślinność obiektów badawczych Karsiborskiej Kępy, Łąk Pyzderskich jak i Ciechocinka wykazuje zróżnicowanie, głównie w występowaniu gatunków halofitów obligatoryjnych świadczących o stanie ich zachowania. Zróżnicowanie warunków siedliskowych, szczególnie zasolenie oraz uwilgotnienie miały wpływ na charakter szaty roślinnej, a mianowicie – na najsilniej zasolonych glebach w Ciechocinku ukształtowały się zbiorowiska solniskowe z dużym udziałem halofitów obligatoryjnych, natomiast na mniej zasolonych i silniej uwilgotnionych glebach Karsiborskiej Kępy i Łąk Pyzderskich – zbiorowiska niehalofilne z obecnością przede wszystkim fakultatywnych gatunków słonolubnych. O ich walorach przyrodniczych decyduje przede wszystkim obecność gatunków halofilnych oraz chronionych. Wszelkie działania zachowujące stabilność warunków wilgotnościowych oraz salinizację gleb połączone z systematycznym użytkowaniem łąkowo-pastwiskowym zapewnią przetrwanie (Karsiborska Kępa, Łąki Pyzderskie) lub utrzymanie (Ciechocinek) zbiorowiskom solniskowym na badanych obiektach.

Słowa kluczowe: zbiorowiska łąkowe, gatunków halofilne, warunki siedliskowe

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