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ASPECTS OF INVASIVE PLANTS DOMINATED HABITATS USE BY MARSH WARBLER (*ACROCEPHALUS PALUSTRIS*) IN SOMEȘ RIVER FLOODPLAIN

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Abstract: Exotic, invasive plants are a constant presence in most European river landscapes. In Someș River floodplain, invasive plant associations have replaced most of the native ones. Birds use invasive plants as living habitats for nesting and often prefer them to the native habitats. In 2014 – 2016 period, we assessed the marsh warbler (*Acrocephalus palustris*) habitat selection preferences in Someș river meadow (North-Western Romania). The marsh warbler is the most abundant species in all investigated habitats. As a whole, the singing male density values are close for native and invasive habitats. At the scale of the habitat categories, the highest recorded densities were found in *Helianthus tuberosus* L. dominated associations and the lowest in *Fallopia japonica* (Houtt.) Ronse Decr. homogenous monodominant stands. For all habitat types densities calculated are higher for small areas than for the largest. Marsh warbler is one of the few bird species that exploit these invasive, anthropogenetic habitats, largely available in the Someș river agricultural landscape.

Keywords: Marsh warbler, *Acrocephalus palustris*, density, invasive habitats, preference

1. INTRODUCTION

Wetlands are strongly disturbed by human activities and biological invasions: wetlands host ones of the most invasive plant species on the planet (Zedler & Kercher, 2004; Gagnon Lupien et al., 2014). Introduced, non-native vegetation usually replaces native plants, alters the native habitats, modifies the species community composition. This has a direct influence on natural habitats modification, degradation, fragmentation and loss of the most valuable habitats for birds, affecting their distribution and nesting success (Wilson & Belcher, 1989; Schmidt & Whelan, 1999; Remes, 2003).

Natural habitats (with natural features) occupy small areas in the Someș river meadow. They consist of riverside coppice, the most valuable habitat in the area, reduced to narrow strips along the riverbanks and some small swamp patches that were not used for agricultural purpose.

Due to intense human activities, Someș river valley landscape is largely dominated by agricultural and built-up areas with small patches of natural or semi-natural habitats. The river floodplain meadow is covered mostly by an anthropogenic habitats mosaic composed of small crops, alternating with small uncultivated areas of wild vegetation, developed among cultivated parcels, on abandoned lands, bordering roads, infield irrigation ditches etc.

A large number of adventive species invaded the Someș river valley. Most of them displaced the natural vegetation and formed monodominant, or very low biodiversity plant associations (Drăgulescu & Macalik, 1999). Among these species, *Amorpha fruticosa* L., *Fallopia japonica* (Houtt) Ronse Decr., and *Helianthus tuberosus* L., definitely dominate the landscape, covering large areas of the meadow and riverbanks. These invasive plants associations occupy almost every uncultivated area and spaces between crops.

The most important feature of these habitats is the vegetation structure, composed mostly of invasive plants, which develop first on these areas. Another defining feature is their great mobility, they appear, disappear, and change rapidly. Uncultivated land is covered by wild vegetation, becoming unrecognizable in 2 – 3 years, but can always be

introduced into farming, leading to loss of these ”new” habitats.

These poor quality habitats created through human intervention meet the requirement of marsh warbler (Snow et al., 1998). The marsh warbler is the only riparian passerine, present in great numbers, occupying virtually every suitable habitat in the river floodplain.

Marsh warbler (*Acrocephalus palustris*) is found in marsh, river and lake ecosystems. The specific habitats consist ofrank, tufty and fairly tall herbage, especially nettles (*Urtica dioica* L.), one of the most important nesting plants of the marsh warbler (Dowsett-Lemaire, 1981), meadowsweet (*Filipendula ulmaria* (L.) Maxim.), brambles (*Rubus fruticosus* agg.) and many others, often in the vicinity of taller bushes or trees. It also occurs in cultivated land with low bushes or hedgerows, as well as in wasteland with tall grass, herbs and small bushes, in tall herbaceous vegetation along ditches, in marsh vegetation, in reeds, and even in gardens (BirdLife International, 2016). Such vegetation is characteristic of moist or seasonally flooded soils and of neglected edges or depressions (Snow et al., 1998). All territories fit into a pattern containing a layer of dense herbaceous low vegetation with vertical vegetation elements – bushes, small trees, or tall dry stems (Dowsett-Lemaire, 1981).

The marsh warbler has a very brief breeding season and high local densities (Dowsett-Lemaire, 1981). The frenetic and noisy behavior of males make them easy to detect, identify and count.

The aim of this study was to investigate the preferences for habitats made up of invasive vegetation invasive vegetation habitats of the Marsh warbler in Someș river floodplain.

2. MATERIAL AND METHODS

2.1. Study area

The study area was located in the Someș river floodplain (North-Western Romania). The investigated plots were selected from 7 locations along the Someș river valley: Vadu (Cluj county), (7 plots); Benesat (Sălaj county), (11 plots); Mireșu Mare (10 plots), Ardusat (13 plots), (Maramureș county); Pomi (11 plots), Roșiori (10 plots), Cărășeu (8 plots), (Satu Mare county); (Fig. 1.) The monitoring plots were selected according to the study objectives: to have small surfaces, well defined from surrounding habitats, and if possibly isolated from similar habitats.

The study was carried out between 2014 and 2016, with a preparatory period (2014 – 2015), during which were investigated the spread of the species along the river, and the habitats used for breeding; year 2016 was dedicated for the actual count of all territorial males in the previously selected study plots.

The number and specific location of observation points have been established to ensure full visual and aural coverage of the monitored plot. The monitoring time has been set to 15 minutes at each point: 5 minutes to accommodate and 10 minutes for counting, only on good weather and before 10 a.m.

Taking into account the characteristics of the studied area, the optimum monitoring period was between May 10 – June 15, with 2 counts at an interval of at least one week.

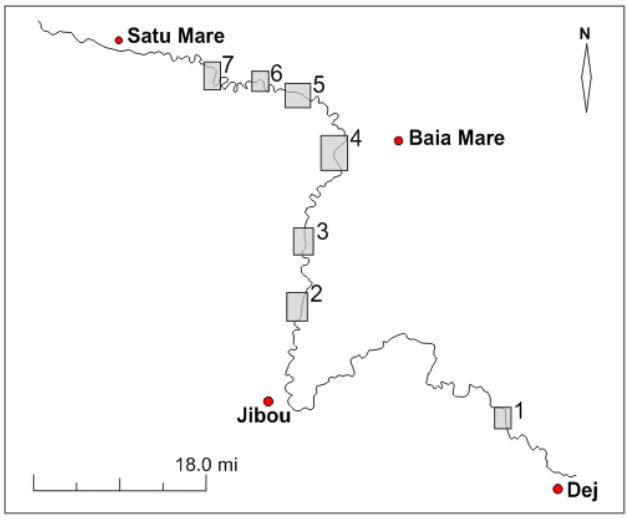

Figure 1. Location of the monitored areas along the Someș river: 1- Vadu, 2- Benesat, 3- Mireșu Mare, 4- Ardusat, 5- Pomi, 6- Roșiori, 7- Cărășeu.

During the study Nikon Monarch 10 x 42 binoculars, Garmin Etrex Legend GPS, and photo cameras were used. Identification of the species was made both visual and aural.

The singing males as recording units is commonly used in bird studies (Emlen, 1971; 1977; Bibby et al., 1998; Lukač & Vujčič-Karlo, 2000; Gregory et al., 2004). Even if the method does not provide absolute data for the nesting populations size (Davis, 1965; Vickery et al., 1992a; 1992b; 1992a), it may be used for comparing species preference for available habitats during the nesting period.

Areas with native vegetation, natural marshes, reed beds are present only sporadically in the study area. Nettle *(Urtica dioica* L.*)*, is present only in very small quantities, usually in mixed vegetal association.

Almost all available habitats of marsh warblers in the studied area are dominated by invasive plants. The monitored plots can be classified into the following habitat categories according to the most numerous (predominant) plant species within the

plant community.

- Habitats dominated by common reed (*Phragmites australis* (Cav.) Steud.) (S)

S1 - Reed beds - compact, homogeneous and monospecific stands of the common reed, developed on natural wetlands or remnants of original marshland habitats within large agricultural or other anthropogenic areas of Someș meadow. They consist almost exclusively of *Pharagmites australis* (Cav.) Trin. ex Steud., other plant species having a negligible contribution. Rare trees or bushes may occur (*Amorpha fruticosa* L., *Salix* spp., *Sambucus nigra* L., *Populus* spp).

S2 - rare reed stands, usually developed between cultivated plots or uncultivated land, along canals or ditches, and in the wetter years even in crops. Reed may occur simultaneously with other herbaceous plants, rare bushes or trees.

- Thickets - dense stands of native trees or shrubs (T)

T1 - typical compact shrubs. Consists mainly of native species (*Salix* spp., *Sambucus* spp., *Populus* spp., *Rosa canina* L., *Prunus spinosa* L.,) with a rich herbaceous layer. They are present as narrow strips along the river bank, alongside valleys, or as "islands" between crops.

- Habitats dominated by *Helianthus tuberosus* L.(H)

H1 - compact homogenous and monospecific stands of *Helianthus tuberosus* L., composed almost exclusively of this species, possibly with some rare bushes or trees (*Amorpha fruticosa* L., *Salix* spp., *Sambucus* spp.).

H2 - stands dominated by less compact *Helianthus tuberosus* L., allowing the development of grasslands, possibly with some rare bushes or trees (*Amorpha fruticosa* L., *Salix* spp, *Sambucus* spp., *Robinia pseudacacia* L.).

- Habitats dominated by *Amorpha fruticosa* L. (A)

A1 - compact, homogenous and monospecific thickets of *Amorpha fruticosa*.

A2 - thickets dominated by less compact *Amorpha fruticosa,* allowing the development of grassland, possibly with some rare bushes or trees (*Amorpha fruticosa* L., *Salix* spp., *Sambucus* spp., *Robinia pseudacacia* L.*)*.

- Habitats dominated by *Fallopia japonica* (Houtt) Ronse Decr.(F)

F1 - compact, homogenous and monospecific stands of *Fallopia japonica* (Houtt) Ronse Decr.

F2 - stands dominated by less compact *Fallopia japonica* (Houtt) Ronse Decr. mixed with other plant species (*Phragmites australis* (Cav.) Trin. ex Steud, *Helianthus tuberosus* L., *Amorpha fruticosa* L. etc.).

Within these categories, reedbeds and shrubs (S1, S2, T1) can be considered as reference natural habitats for marsh warbler, all others being formed or dominated by invasive plants, recently introduced in Someș river ecosystem.

During the study, 70 plots with a total area of 5.03 ha were monitored. Their size was between 0.0045 ha (45 m^2), and 0.32 ha (3200 m^2), with an average of 0.0718 ha (718 m^2).

2.2. Statistical analysis

Data were analysed using Past Paleontological Statistics Version 1.99. Surface samples studied in the field have been hierarchized by cluster analysis to capture the distance between them, and their grouping according to similarity. Also, data on the density of individuals in the various sample areas were tested by Anova one way, to capture any significant differences between samples.

3. RESULTS

In the investigated plots were spotted 503 territorial individuals of 19 species: *Acrocephalus palustris, Acrocephalus arundinaceus, Sylvia atricapilla, Sylvia communis, Sylvia curruca, Phylloscopus collybita, Parus major, Pica pica, Oriolus oriolus, Lanius colurio, Luscinia megarhynchos, Erithacus rubecula, Saxicola torquatus, Saxicola rubetra, Turdus merula, Passer montanus, Carduelis carduelis, Carduelis chloris, Emberiza calandra.* 360 of these individuals were marsh warblers. The marsh warbler was the dominant species for all habitat categories investigated, surpassing in abundance all other species (Table 1).

Marsh warbler was spotted in all suitable habitats in the studied area. On the two counts, a total of 360 marsh warbler singing males were spotted. Their average density for all the monitored plots was 64.02 singing males/ha.

Average densities determined for the two main types of habitats were 65.62 singing males/ha for natural habitats and 63.24 singing males/ha for those dominated by invasive plants. There were big differences between categories of component habitats, as evidenced by the data in Table 1, and illustrated in figure 2.

Analysis of correlation between the size of the stand and singing males density revealed a negative association between these elements. For all habitat types, densities calculated were higher for small areas than for the largest (Fig. 3).

Table 1. Comparative analysis of marsh warbler density and abundance in the studied habitats

Habitat		S1	S2	T1	H1	H2	A1	A2	F1	F2
Nr. plots		8	8	7	8	8	8	8	7	8
ACR PAL	mean density	**65.94**	**87.65**	**40.08**	**116.04**	**109.03**	**31.20**	**76.94**	**9.74**	**29.82**
	min	24.61	28.00	11.11	15.62	13.33	12.50	18.00	0.00	6.66
	max	90.90	250.00	85.71	333.33	250.00	75.00	188.67	25.00	60.00
	median	71.36	50.00	33.33	98.64	99.29	25.83	71.21	5.00	25.26
	st dev	22.49	75.16	24.10	94.68	82.26.	19.46	52.89	10.12	19.26
	conf. 95%	15.58	52.08	17.85	65.61	57.00	13.48	36.65	7.50	13.35
Total abundance		72	60	54	52	66	53	71	13	62
ACRPAL abund.		60	48	25	41	53	37	53	7	36
Dominance $_{ACRPAL}$(%)		**83**	**80**	**46**	**78**	**80**	**69**	**74**	**53**	**58**

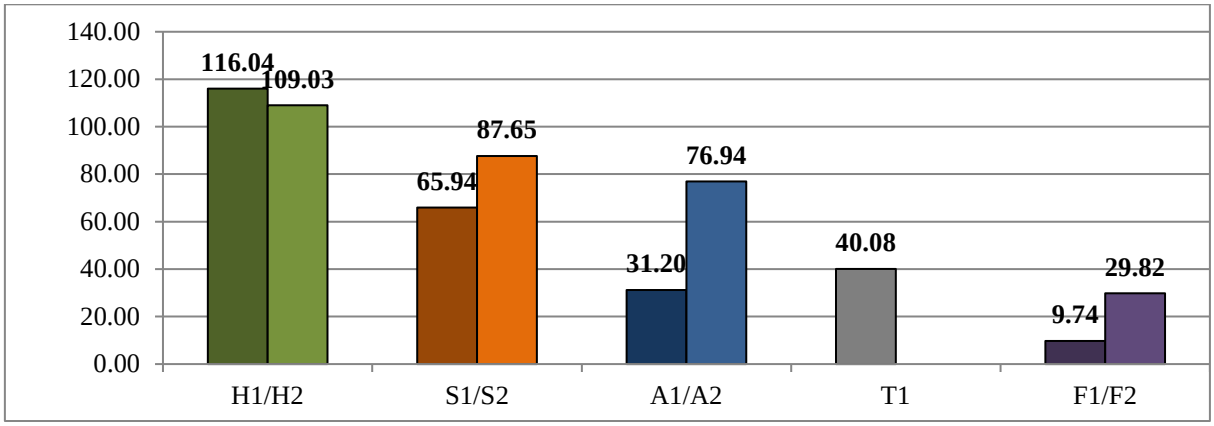

Figure 2. Comparative densities (singing males/ha) of marsh warbler in investigated habitats.

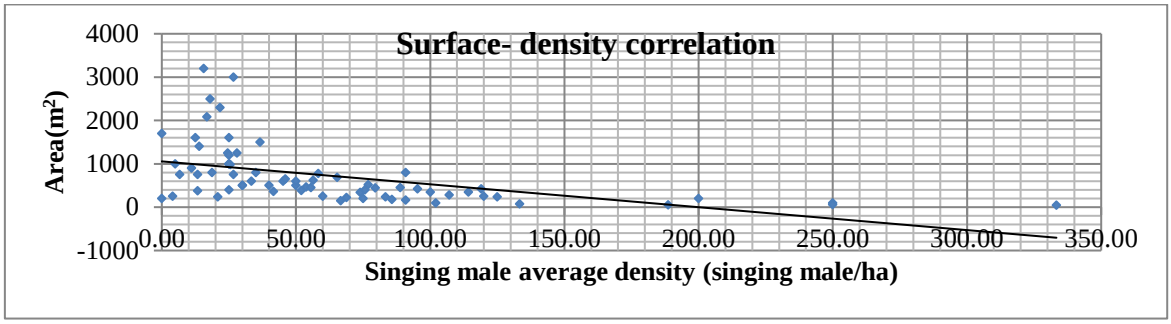

Figure 3. The negative correlation between stand size and singing marsh warblers density.

The analysis of clusters (Fig.4.) shows that among the ecological factors that have been analyzed, the type of native / allogeneic vegetation, the grassy / woody consistency, the density of the vegetal carpet, and the dominant species, the greatest significance seems to have the last two listed. *Helianthus tuberosus*, infiltrated into the original habitats of native trees / shrubs, builds a preferred habitat of the reference species. By introducing the numerical data into the Euclidean equation and calculating the dendrogram of the analyzed sample surfaces, there is a reduced similarity between the analyzed samples. of habitats, as also noticed in other studies in Central Europe.

On the one hand, the habitats considered to be most favorable differ from the rare vegetation, both the native *Phragmites sp.* and the allogeneic *Amorpha sp.*, the distance being over 60%. On the other hand, the least favorable habitats are grouped in particular on the basis of the degree of cohesion of the vegetal carpet. Dense habitats, such as those built by *Fallopia sp.*, *Amorpha sp.*, are approaching significantly the built trees and shrubs, which can be colonized by the reference species, due to their compact structure. From an ecological point of view, the initial premise was the preference of the species for the original habitats, made up of native species. Both field studies and the one-off statistical analysis of the habitats

surveyed (Anova one way) highlight the absence of significant differences between habitats in terms of their colonization by the species *Acrocephalus palustris* (F=1,126; df=27,05; p=0,3764). Thus, with regard to the distribution of ornithofauna, the species of invasive alien plants, can constitute propitious support habitats.

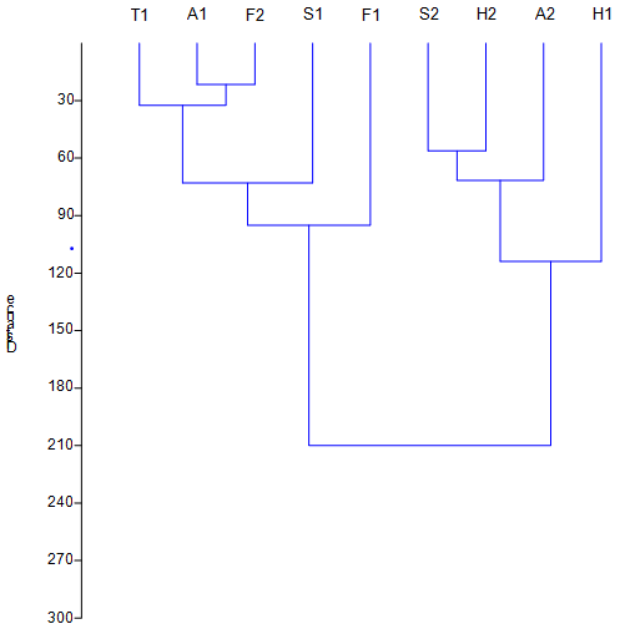

Figure 4. Analysis of clusters based on the Euclidean equation of studied samples.

S1 - reed beds, S2 - rare reed stands, T1 - compact shrubs, H1 - compact stands of *Helianthus tuberosus* L., H2 - stands dominated by less compact *Helianthus tuberosus* L., A1 – compact thickets of *Amorpha fruticosa* L., A2 - thickets dominated by less compact *Amorpha fruticosa* L., F1 - compact, homogenous and monospecific stands of *Fallopia japonica* (Houtt) Ronse Decr., F2 - stands dominated by less compact *Fallopia japonica* (Houtt) Ronse Decr.

4. DISCUSSIONS

The densities calculated for habitats dominated by invasive plant species showed a clear preference of marsh warbler for *Helianthus tuberosus* L., with the highest values recorded (116.04 singing males/ha), surpassing all other categories of habitats, including the natural ones. The preference of marsh warbler for *Helianthus tuberosus* L. was noticed in all kinds of habitats where this plant prevails, with higher values in compact monospecific stands (H1).

Compact thickets of young plants, combined with higher dry stems of previous year, almost perfectly fit the pattern preferred by marsh warbler. The preference of marsh warbler for *Helianthus tuberosus* L., as nesting habitat was also found in Croatia (Lukač et al., 1999; Lukač & Vujčič-Karlo, 2000).

Of invasive plants, *Fallopia japonica* (Houtt) Ronse Decr. is obviously avoided by the marsh warbler, with the lowest density values recorded in the studied area (9.74 singing males/ha). In the absence of prefered habitats, *Fallopia japonica* L. stands may provide replacement nesting sites, but are neglected when other, more suitable habitats are available (Dowsett-Lemaire, 1981).

Of the natural habitats, the singing male density values in reedbed stands were greater (87.65 singing males/ha) than those recorded in thickets (40.08 singing males/ha). As expected, reedbeds are considered among the habitats preferred by marsh warbler (Snow et al., 1998), while the hedges correspond less to species habitat pattern.

The singing male density values in homogenous monospecific habitats (S1, A1, F1) were smaller than those recorded in rare, mixed habitats (S2, A2, F2), except the *Helianthus tuberosus* L. stands (Fig. 2).

Most of marsh warblers prefer smaller stands, breed more frequently in ditches and small marshes (Surmacki, 2005). A negative association between stand size and breeding density was also found in other *Acrocephalus* species (Orlowski & Gorka, 2013).

The preference of marsh warbler for small habitats can be explained by the edge effect (Baldi, 2006) manifested more clearly in the case of smaller stands. These small stands with good development of herbaceous vegetation fit the nesting requirements of marsh warbler. The defended breeding territory, with suitable nest sites, is often smaller than the foraging territory. Food can be searched for largely outside the nesting territory (Dowsett-Lemaire, 1981; Surmacki, 2005; Orlowski & Gorka, 2013). In the absence of natural habitats, the marsh warbler is the main species which exploit this type of invasive habitats, not only as nest-sites but also for food (Dowsett- Lemaire, 1981).

The results of this study provide useful information regarding the marsh warbler preference for the available habitats of Someș Valley. However, census result by count of singing birds show equivocal results for breeding population size evaluation or reproductive success. Quantifying the presence or abundance of adult birds does not indicate the quality of a territory as breeding habitat (Van Horne, 1983; Vickery et al., 1992b; Rivers et al., 2003; Bock & Jones, 2004; Morgan, 2007; Morgan et al., 2010; Schlossberg & King, 2010). The breeding population of marsh warbler assessed by the standard methods of bird censusing was underestimated, due to arrivals over a long period and the rapidity with which males got paired and therefore became silent

(Dowsett-Lemaire, 1981).

Another noteworthy aspect of birds nesting in invasive vegetation habitats is linked to the ecological traps. It is possible that a particularly attractive habitat is not selected as nesting place or does not really provide adequate resources for reproductive success (Weidinger, 2000; Kokko & Sutherland, 2001; Schlaepfer et al., 2002; Remes, 2003, Battin, 2004; Shochat et al., 2005). To clarify all these issues further studies are needed.

In Someș meadow landscape, where natural habitats have been replaced by anthropogenic ones, dominated by invasive vegetation, marsh warbler proved to be one of the few species that exploit them, and seems to thrive on these types

In Croatia, during nesting, the marsh warbler seems to prefer using *Helianthus tuberosus* L. and *Solidago gigantea* Ait., rather than the *Urtica dioica* L. (Lukač et al., 1999). In Poland, a positive effect of the invasive vegetation was found for only three species: whinchat (*Saxicola rubetra*), marsh warbler (*Acrocephalus palustris*), and pheasant (*Phasianus colchicus*) (Skórka et al., 2010).

5. CONCLUSIONS

The problem of biodiversity in built habitats of allogeneic vegetal species versus original habitats is a challenge to contemporary ecology.

The reference species was tested as a key species that could help decipher the mechanisms of adaptation of fauna to new habitat conditions generated by the replacement of the dominant species in the habitat.

From the perspective of the avifauna species characteristic of the habitats of beaches and banks covered with vegetation, *Helianthus tuberosus* L., offers nesting and feeding conditions, similar to the best original habitats.

Fallopia japonica (Houtt) Ronse Decr. is one of the most damaging invasive species in terms of biodiversity. Besides the already known effects of drastic elimination of native plant species, the study of avifauna shows that the species does not provide favorable conditions for bird species that natively colonized these lands.

The alien plant species, even if they completely change the appearance of the habitats, do not generate the same answers from the fauna attached to the original habitats. Even though flora species are similarly eliminated by competing alogenes, some faunal species can adapt differently to new biotope conditions. The deciphering of all the responses, triggered by the new built habitats of alien species, aim at complex analyzes of biodiversity.

For avifauna species that do not depend on the habitat by feeding mode, preservation of the spatial - structural characteristics of phytocoenosis is the essential condition for using the habitat as a nesting site. For the avifauna, the species of the habitat is of secondary importance, while for native plant species, interactions with non-native plants can lead to poor floristic composition.

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