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THE ROLE OF THE MORPHOLOGICAL FEATURES OF PLANTS IN THE LOCATION OF THE MARSH WARBLER'S NEST (*Acrocephalus palustris*)

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Lukač, G., Vujčić-Karlo, S. & Maguire, I.: The role of the morphological features of plants in the location of the Marsh Warbler's nest (*Acrocephalus palustris*). Nat. Croat., Vol. 8, No. 4., 421–430, 1999, Zagreb.

The Marsh Warbler (*Acrocephalus palustris*) nests in the plant communities of indigenous European species such as: *Urtica dioica*, *Filipendula ulmaria*, *F. vulgaris* and *Phragmites communis*. The biotopes that are colonized in Central Europe by the nettle (*Urtica dioica*) are covered with neophytes in Croatia (*Solidago gigantea*, *S. canadensis*, *Helianthus tuberosus*, *Artemisia verlotiorum*, etc.). The aim of this study was to establish to what extent these new plant species are appropriate for the settlement of the *Acrocephalus palustris*. The importance and role of plant species and the way the Marsh Warbler constructs its nest in vegetation structures with different shares of neophyta were studied. In the laboratory, the morphological features of plants relevant to nest building were measured.

Key words: Marsh Warbler, nest building, plant morphology, neophytes, morphology-vegetational complex

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Trstenjak mlakar (*Acrocephalus palustris*) je u Europi tipična gnjezdarica autohtonih biljnih sastojina koju čine vrste *Urtica dioica*, *Filipendula ulmaria*, *F. vulgaris*, *Phragmites communis* i dr. U vegetaciji europskih riječnih obalnih staništa dominira kopriva, *Urtica dioica*, dok u Hrvatskoj iste tipove staništa nastanjuju uglavnom neofiti *Solidago gigantea*, *S. canadensis*, *Helianthus tuberosus*, *Artemisia verlotiorum* i dr. Cilj ovog priloga je prikazati kako neofitske sastojine i odabrana morfološka obilježja pojedinih biljnih vrsta utječu na odabir gnijezdilišta i postavljanje gnijezda trstenjaka mlakara u četiri kontinentalna područja Hrvatske.

Ključne riječi: trstenjak mlakar, gradnja gnijezda, morfološke osobitosti biljaka, neofiti, morfološko-vegetacijski kompleks

INTRODUCTION

The Marsh Warbler (*Acrocephalus palustris*) nests in river bank vegetation and at the fringes of forests (regularly flooded), throughout Europe. As a migratory bird it arrives from its wintering grounds in Africa in the first or second week in May and leaves the nesting site in September (DOWSETT – LEMAIRE & DOWSETT, 1987). In Africa it appears in a similar type of vegetation (BÖCKER & LÜTGENS, 1976), especially grasslands, although these are much less suitable. The majority of bird species choose a specific type of vegetation for nesting (CYR & OELKE, 1976; CYR, 1977; LEISLER, 1977, 1981; CYR & CYR, 1979; CODY, 1985; DORSCH & DORSCH, 1985; REDDIG, 1986; LEY, 1988; TUOMENPURO, 1989). The Marsh Warbler nests in plant communities with predominantly vertical vegetation elements (LEISLER, 1977, 1981; REDDIG, 1986). Some species of European bank vegetation, in which we can find the Marsh Warbler, are: *Urtica dioica, Tanacetum vulgare, Rubus idaeus, R. fruticosa, Epilobium palustre* (SCHULZE-HAGEN, 1983, 1984a; FRANZ, 1981; PETRIK, 1983), *Filipendula ulmaria* (SCHÜCKING, 1965), *F. vulgaris* (BEZZEL, 1982), *Helianthus tuberosus* (SCHULZE-HAGEN, 1984a; LUKAČ, 1988), *Solidago gigantea* (LUKAČ, 1988), *Ribes nigrum, Rumex aquaticus, Symphoricarpus albus* (SCHÜCKING, 1965), *Eupatorium cannabinum, Phragmites australis* (ERLINGER, 1987), *Salix alba, Rosa canina, Peucedanum palustre* (FRANZ, 1981), *Secale cereale* (SPRINGER, 1960), *Salix triandra, S. viminalis, Lysimachia* sp., *Epilobium* sp., *Rosa* sp., *Prunus padus, Alnus* sp. (CRAMP, 1992), *Sorbus aucuparia, Angelica archangelica, Chaerophyllum temulum, Galium aparine, Glyceria maxima, Sparganium erectum,* and *Phalaris arundinacea* (STELTE & SOSSINKA, 1996).

The choice of plants for the Marsh Warbler's nesting sites has already been described (LEISLER, 1977; 1980; 1981; FRANZ, 1981; PETRIK, 1983). The size of the nesting and wintering territories (KELSEY, 1989) and the choice of plants for singing on (MAYR, 1984) are already well known. Scientific investigations have focused on the correlation between bird morphology and the way it builds its nests (LEISLER, 1975) and the structure of vegetation (WINKLER & LEISLER, 1985) as well as on the implications of nesting on the reproductive strategy of birds. This study investigates the connection between plant morphology and its influence on nest building habits.

MATERIALS AND METHODS

In Croatia, field research was done between 1981–1995 at four locations: Varaždin, Osijek, Zagreb and Lonjsko polje (Fig. 1). The birds were observed in the field with the help of binoculars and telescope (magnifying 8x30, 20x50). Thirty six nests were spotted in the bank vegetation. During the Marsh Warbler's nesting period, 8 plant species were collected: *Urtica dioica, Solidago gigantea, S. canadensis, Filipendula ulmaria, F. vulgaris, Helianthus tuberosus, Artemisia vulgaris* and *A. verlotiorum*. These plants were dried and measured for the following morphological characteristics (Tab. 1): 1. height; 2. diameter (at 20 cm and at 70 cm from ground level); 3. the number of leaves; 4. distance between the leaf and the node (at 20 cm and 70 cm from the ground). The sizes of leafstalks were also established (stalkless leaf, short

leafstalk or long leafstalk, Tab. 2). Altogether 75 plant specimens were analyzed. Statistical parameters (median, standard deviation, minimum, maximum and variance) were calculated after SOKAL & ROHLF (1973, 1981), BEN – HORI & LEVY (1984). Plant taxa names were used according to Flora Europea (TUTIN *et al.*, 1965–1980).

In addition the plant communities as a whole were measured for the following characteristics (Tab. 3): 1. height of community; 2. height till the lower edge of nest; 3. number of plants used for nest construction; 4. number of leaves; 5. number of plants within the area of $1m^2$; 6. distance between the nest and the edge of the plant community.

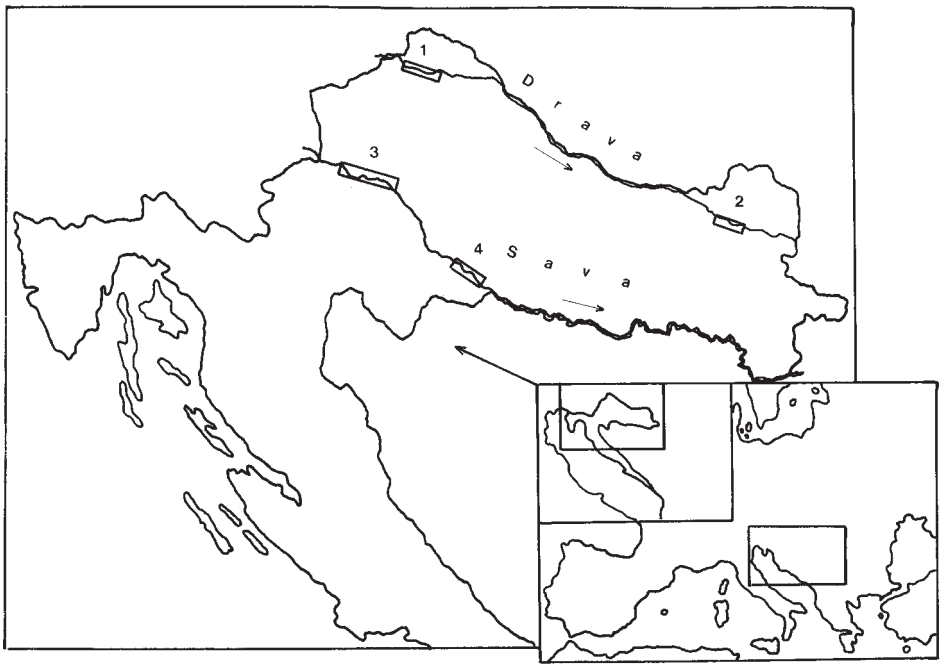

Fig. 1. The area investigated in Croatia. 1., 2. The Drava River; 3., 4. The Sava River.

RESULTS

Marsh Warbler nesting sites have also been found in a mixed plant community of *Amorpha fruticosa* and *Solidago gigantea*, and in the community of *Vicia cracca*, *Centaurea jacea*, *Solidago canadensis*, *Tanacetum vulgare*, *Artemisia vulgaris*, *A. verlotiorum* and *Saponaria officinalis*. During the study, the Marsh Warbler was spotted within 8 different biotopes. The biotope type is determined according to the most

Tab. 1. Statistical values of morphological characteristics of the species *Urtica dioica*, *Solidago gigantea*, *S. canadensis*, *Filipendula ulmaria*, *F. vulgaris*, *Helianthus tuberosus*, *Artemisia vulgaris* and *Artemisia verlotiorum*.

Plant species	Feature	Statistical data					
	Plant height (cm)	X	V	SD	Med.	Min.	Max.
U. dioica		89,3	55,2	7,4	87,5	79	100
F. ulmaria		78,9	15,3	3,9	78,5	72	85
F. vulgaris		75	8,2	3	74	71	80
S. gigantea		97,1	83,5	9,1	96	85	110
S. canadensis		76,3	40	6,3	76	68	90
A. vulgaris		94,9	1238,6	35,2	83	79	200
A. verlotiorum		86,3	49,2	7	83,5	80	98
H. tuberosus		116,3	648,2	25,5	111	80	158
	Plant thickness at 20 cm altitude						
U. dioica		3,6	1	1	3,6	2	5,9
F. ulmaria		4,2	1,1	1,1	3,7	3,1	6,3
F. vulgaris		2,8	0,5	0,7	2,7	1,6	3,7
S. gigantea		4,4	0,5	0,7	4,3	3,4	5,6
S. canadensis		3,5	0,2	0,5	3,3	3	4,2
A. vulgaris		4,1	2,2	1,5	3,6	2	7,8
A. verlotiorum		3,7	0,2	0,4	3,9	3	4,1
H. tuberosus		5,7	2,8	1,7	5,3	3,4	9
	Plant thickness at 70 cm altitude						
U. dioica		1,6	0,3	0,5	1,5	1	2,8
F. ulmaria		1,9	0,1	0,3	1,9	1,3	2,4
F. vulgaris		1,2	0,1	0,2	1,2	1	1,7
S. gigantea		2,8	0,2	0,5	2,9	2	3,4
S. canadensis		2,5	0,2	0,5	2,5	2	3,3
A. vulgaris		2,3	0,3	0,6	2,4	1	3,3
A. verlotiorum		1,9	0,04	0,2	2	1,6	2,1
H. tuberosus		2,7	0,2	0,5	2,7	2	3,5
	Number of leaves						
U. dioica		21,6	4,6	2,2	22	18	26
F. ulmaria		6,4	1,6	1,3	6,5	5	8
F. vulgaris		5,6	1,1	1,1	6	4	7
S. gigantea		31,6	17,2	4,2	30	27	40
S. canadensis		34,7	11,2	3,3	35	29	40
A. vulgaris		24,7	8	2,8	24,5	20	30
A. verlotiorum		44,5	108,8	10,4	47	28	56
H. tuberosus		18,7	2,4	1,6	18	16	22
	Distance between leaves and nodes (cm)						
U. dioica		4,4	22,5	1,5	4,2	0,9	9,2
F. ulmaria		8,4	145,9	3,8	8	1,8	17,1
F. vulgaris		10,5	92,9	3,1	10,6	2,8	16,3
S. gigantea		1,6	1,9	0,4	1,6	0,5	2,8
S. canadensis		1,2	0,8	0,3	1,1	0,5	2,2
A. vulgaris		2,4	5,3	0,7	2,4	0,9	4,1
A. verlotiorum		1,3	5,6	0,8	1	0,6	3,2
H. tuberosus		4,2	73,3	2,7	3	1,1	11,8

numerous (predominant) plant species within the plant community. The morphological characteristics of these 8 plant species are given in Tab. 1. On average, the highest plant was *Helianthus tuberosus*. Variance values were highest for *Artemisia vulgaris* and *Helianthus tuberosus*. The smallest height was recorded for *Solidago canadensis*. The comparison of heights yielded maximum values for *Artemisia vulgaris* (200 cm), followed by *Helianthus tuberosus*, *Solidago gigantea*, *Artemisia vulgaris* etc. On average, the largest width, at 20 cm from ground level, was found in *H. tuberosus*, and *S. gigantea*, *F. ulmaria*, *A. vulgaris*, *A. verlotiorum*, *U. dioica* etc. The smallest

Tab. 2. The leafstalk length, number of dry and fallen leaves on the sheath between 20–70 cm.

Plant species	Petiole length	Number of	
		dry leaves	fallen leaves
Urtica dioica	long	0	2
Filipendula ulmaria	"	0	0
F. vulgaris	"	0	0
Solidago gigantea	short	1/3	8
S. canadensis	"	1/3	8
Artemisia vulgaris	long	0	5
A. verlotiorum	"	0	4
Helianthus tuberosus	"	2	1

width was recorded in *F. vulgaris* at 70 cm from ground level (1–3,5 mm). The number of leaves varied considerably. On average, the smallest numbers were recorded in *F. vulgaris* and *F. ulmaria* whereas *A. verlotiorum*, *S. gigantea* and *S. canadensis* had the largest numbers of leaves. *U. dioica* and *H. tuberosus* showed similar numbers of leaves. Mean distances between leaves and nodes were smallest in *S. canadensis* and *A. verlotiorum*, and largest in *F. vulgaris* and *F. ulmaria* which showed a high variability. The longest leafstalk was recorded in *U. dioica*, followed by *F. ulmaria* and *F. vulgaris*, with a well-developed sheath. *A. vulgaris*, *A. verlotiorum* and *H. tuberosus* also have long leafstalks. Short leafstalks appear to be characteristic only in *S. gigantea* and *S. canadensis* (Tab. 2). The nest height in plant communities was variable (27–88 cm, Fig. 2). Mean height of the nests varied around 52 cm. The number of leaves woven into the nest varied from 1–12, (mean: 4,6 leaves, Tab. 3). The number of stems on which the nest was hanging was from 3–7, (mean: 4.8). The height of plant communities, in which the birds nests were found, varied from 73–350 cm (mean: 134.9 cm). The number of plants per square metre was variable, from 78–269 cm (mean: 163.8). The distance between the nests and the edge of the plant communities was from 35–700 cm (mean: 178.2 cm). Thirty six nests were found, of which 25 were in *H. tuberosus*, 4 in *S. gigantea*, 2 in *A. vulgaris* community, 1 in a mixed community of *R. caesius* and *C. jacea* and 1 in a mixed community of *T. vulgare*, *V. cracca*, *A. fruticosa*, *S. officinalis* and *S. canadensis*.

Tab. 3. Marsh Warbler *(Acrocephalus palustris)* nest characteristics and stand composition

Stand	Height of plants (cm)	Plant species	Height of nest (cm)	Number of stems used in the nest	Number of leaves	Number of plants ($1m^2$)	The distance of the nest from the edge (cm)
1.	75	*S. gigantea*	40	6	7	/	/
2.	100	*T. vulgare*	40	4	8	/	/
3.	100	*A. vulgaris*	49	5	12	100	/
4.	110	*H. tuberosus*	45	/	/	203	60
5.	110	″	45	8	6	/	110
6.	110	″	30	11	0*	/	42
7.	112	″	41	3	8	108	700
8.	120	″	38	3	3	172	180
9.	120	″	45	6	1	/	60
10.	120	*A. vulgaris*	27	4	6	126	500
11.	120	*H. tuberosus*	70	7	6	/	220
12.	120	″	50	3	6	78	35
13.	120	*S. officinalis*	64	2	6	150	240
14.	125	*H. tuberosus*	55	/	/	/	100
15.	130	″	37	/	/	/	60
16.	130	″	49	5	2	/	125
17.	130	″	40	10	1	/	100
18.	140	″	60	4	4	170	150
19.	140	″	69	4	6	/	50
20.	140	*S. gigantea*	64	5	7	123	68
21.	145	*H. tuberosus*	60	6	1	/	180
22.	145	″	44	6	0	/	80
23.	150	″	45	5	4	199	120
24.	150	″	78	2	4	127	150
25.	150	″	88	6	6	241	490
26.	150	*S. canadensis*	46	3	8	98	150
27.	150	*S. gigantea*	61	3	5	230	310
28.	150	″	47	3	5	296	100
29.	350	*A. fruticosa*	75	4	0	/	250
30.	/	*H. tuberosus*	/	5	/	200	/
31.	/	″	/	3	4	/	/
32.	/	″	/	3	6	/	/
33.	/	″	/	/	0	/	/
34.	/	″	/	/	3	/	160
35.	/	″	"	6	3	/	200
36.	/	*R. caesius*	/				
		C. jacea	/	/	8	/	/
n=	29	36	29	30	32	16	28
X=	134,9		51,8	4,8	4,6	163,8	178,2

* the nodes of grass

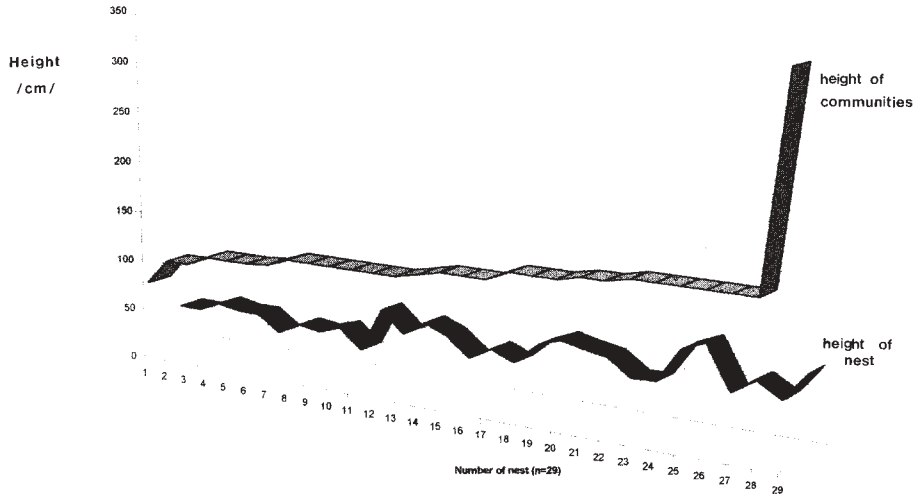

Fig. 2. Height of communities and height till lower edge of nest.

DISCUSSION

The Marsh Warbler *(Acrocephalus palustris)* is a breeding bird typical of biotopes with dense vegetation and well developed vertical elements (LEISLER, 1977; SCHULZE-HAGEN, 1983; 1984a; 1984b; 1991). It is an established fact that, in Central Europe, it nests on many plant species (SCHÜCKING, 1962; FRANZ, 1981; BEZZEL, 1982; PETRIK, 1983; SCHULZE-HAGEN, 1983; 1984a; ERLINGER, 1987; SCHULZE-HAGEN, 1991; CRAMP, 1992; STELTE & SOSSINKA, 1996). Too dense a plant structure makes nest construction more difficult (SCHULZE-HAGEN, 1984a; 1984b), but in some cases a positive correlation was found between successful nesting and the density of vertical structures of vegetation (WRAY & WHITMORE, 1979). Until recently, Warblers have been observed in cornfields for two reasons: a) when searching for food (MAYR, 1984) b) when singing males have occupied new types of biotopes. The genus *Artemisia, Solidago* has the largest number of leaves per stem, followed by the genus *Helianthus, Urtica* and by the genus *Filipendula* (Tab. 1). Thus, this information can be used as a useful tool for the analysis of the morphological characteristics of these plants. Leaf shape and size are not analyzed in detail in this study, although this information is important (in particular the leaves of *U. dioica* and *Helianthus tuberosus*) as a key factor for the protection of nest and eggs against the elements (SCHULZE-HAGEN, 1984b). The reproduction success in *Solidago* and *Artemisia* vegetation remains to be investigated under the assumption that smallest leaf sizes are less appropriate for nest protection. One important morphological characteristic to be taken into account is the number of leaves per stem at nest level. There is a strong variation in morphological characteristics, as well as in the distance between nodes, in all the plants that we studied (Tab. 1, 2). We also studied

the differences in the way that the leaves are attached to the stem. The only species with stalkless leaves that during nesting get dry and fall off during nesting are *S. gigantea* and *S. canadensis*. The other species have leaves on long petioles, and these leaves, even when dry, stay attached to the stem during the nesting period. This is especially important when birds attach their nests to the stem. The number of leaves woven into the nest is between 1–12 (mean: 4,6 leaves). In four cases, the nests were not built close to the leaves. Another important factor in setting up the nests may be the different types of hairs on stems and leaves (hairs around nodes, on the base of leaf petioles, e.g. in *U. dioica*, *H. tuberosus*, *S. canadensis).* Long thin hairs or sting hairs may defer potential predators, even those who rarely enter into this kind of plant community. The Central European Marsh Warbler in nettle communities seems to a have the highest number of fledglings i.e. as many as 77.1% (SCHULZE-HAGEN, 1984b). This is even higher than records for Warbler species breeding in reeds, such as *Acrocephalus scirpaceus* and *A. arundinaceus* (CATCHPOLE, 1974). It is probable that nettles, because of their morphological characteristics and sting hairs, are not suitable biotopes for many predators that could potentially endanger the Marsh Warbler's nests. The distance between leaf scars is, on average, the smallest in the *Artemisia* and *Solidago* species and it becomes even larger within the genera *Helianthus*, *Urtica* and *Filipendula*. If grass stems are woven into the nest, then the nest will be attached to the node or to more stems, but this is not always the case. Taking into account the height of the plant community ranging between 75 and 350 cm it appears that the height of the nest site mean vary from 22–88 cm. By measuring different diameter of plant stems, we discovered that the width is smaller than the Central European average (4–7 mm) (SCHULZE-HAGEN, 1984a; 1984b). These thinner plants seem to bend more easily so that the birds use more stems (2–7) at a time during nesting. The biotopes in north-west Croatia that were once covered by nettle are now dominated by neophyte vegetation species such as *H. tuberosus* and *S. gigantea*. During nesting in Croatia, the Marsh Warbler seems to prefer using *H. tuberosus* and *S. gigantea*, rather than the nettle (PETRIK, 1983; SCHULZE-HAGEN, 1984a; 1984b). The analysis of all the above mentioned characteristics, reveals that a specific **morphology-vegetation complex** plays an important role in the nest building of the Marsh Warbler. Within the **morphology-vegetation complex**, it is possible to describe all morphological characteristics of plants, ecological characteristics of communities and their role in the nesting of this species. Beyond this, these plant communities are also home to a wide variety of different insect species (for example *Diptera – Culicidae, Anophelidae* etc.) thus providing the Warbler with a rich food supply, which is of high importance (within the biotope) for the Warbler when choosing its nesting site.

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SAŽETAK

Značajke morfoloških obilježja biljaka i njihova uloga u postavljanju gnijezda trstenjaka mlakara (*Acrocephalus palustris*)

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Trstenjak mlakar (*Acrocephalus palustris)* je gnjezdarica različitih tipova biljnih sastojina u kojima prevladavaju vertikalne strukture vegetacije i to u staništima riječnih obala srednje Europe. Ovdje ova vrsta nastanjuje uglavnom sastojine s dominantnim autohtonim biljnim vrstama kao npr. *Urtica dioica*, *Filipendula ulmaria*, *F. vulgaris*, *Phragmites communis*, i dr.

Uz riječne obale Hrvatske, trstenjak mlakar je zabilježen u osam (8) tipova sastojina s pretežno dominantnim neofitskim vrstama *Solidago gigantea*, *S. canadensis*, *Helianthus tuberosus*, *Artemisia verlotiorum*, *Amorpha fruticosa* i dr. Naša istraživanja su pokazala kako morfološka obilježja biljaka (njihova visina, dlakavost stabljike, broj listova i udaljenost između lisnih ožiljaka – nodija), utječu na odabir gnijezdilišnih sastojina nakon povratka iz afričkih zimovališta i na način postavljanja gnijezda. Prilikom gradnje gnijezda posebnu ulogu imaju morfološke karakteristike stabljike, pa smo uveli pojam **morfološko-vegetacijskog kompleksa**, kao važnog čimbenika u načinu postavljanja gnijezda na stabljikama neofitskih biljaka.