NEW NEOPHYTES IN THE FLORA OF CROATIA

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The paper lists sixteen new neophytes for the flora in Croatia. The grass *Setaria parviflora* has been naturalized in the Šibenik area (Solaris, Zablać) for some time now but the grass *Bromus catharticus* has been found only recently, in Zadar (Voštarnica). Their seed was probably brought in as a seed admixture used to form lawns on public areas. The *Senecio angulata* species has been recently noticed as a decorative garden plant in the Zadar area and on the island of Rava, where it demonstrates the ability of subspontaneous spread. The remaining species were registered in the cargo port of Gaženica where they were probably brought in with raw materials shipments, especially of soy-beans and grains: *Amaranthus spinosus*, *Alternanthera caracasana*, *Commelina benghalensis*, *Ipomoea coccinea*, *I. hederacea*, *I. cordatotriloba*, *Eleusine coracana*, *Pennisetum glaucum*, *Physalis angulata*, *Senna obtusifolia*, *Sida rhombifolia*, *Solanum chenopodioides* and *Solanum sisymbriifolium*.

**Key words:** new neophytes, flora, Croatia

INTRODUCTION

The introduction of plants to areas where they are not native has been receiving increasing attention worldwide (Pyšek et al., 1995, 2006; Lonsdale, 1999; Hulme, 2003; Lambdon et al., 2008). In Croatia, the number of published papers which deal with alien plants has increased significantly over the last 40 or so years. Most of the au-

A proposal of the Croatian national standard and criteria for the treatment of alien flora in accordance with the latest suggestions of the world’s most eminent experts who research into alien flora (RICHARDSON et al., 2000; PYŠEK et al., 2004) was recently published (Mitić et al., 2006, 2007, 2008). A special module »allochthonous plants« was established in the Flora Croatica database (NIKOLIĆ, 2009; URL: http://hirc.botanic.hr/fcd/AlohtoneVrste).

A preliminary list of neophytes comprising 206 taxa, i.e. 3.7% of the total vascular flora in Croatia was recently published (DOBROVIĆ et al., 2005). This number is significantly smaller than the number of alien flora taxa of other European countries (LAMBDON et al., 2008). Very recently, a preliminary list of alien invasive flora containing 64 taxa was published (BORSIĆ et al. 2008). Croatian botanists have to produce a comprehensive catalogue of alien flora with the floristic status, degree of naturalization, date and mode of introduction as well as the chorological, biological and ecological data for each taxon as soon as possible.

During research into the vascular flora of the Zadar and Šibenik area, 16 neophyte species that had not been noted in the list of Croatian flora (NIKOLIĆ, 2009) were found. These findings are a significant contribution to the full inventory of the alien flora of Croatia.

METHODS

In this paper, all species that are not native to any area within the boundaries of the Republic of Croatia are considered to be alien. The definition of subsets within alien flora (neophytes, casual, naturalized and invasive) in this paper is used according to the suggestion of RICHARDSON et al. (2000), PYŠEK et al. (2004) and Mitić et al. (2008).


The neophyte species that are listed in this paper were not listed in the Flora Croatica database (NIKOLIĆ, 2009) and can therefore be considered to be new spe-
cies for the flora of Croatia. The nomenclature of the species and subspecies has been adjusted according to the GRIN Taxonomy for Plants, online Database (2009).

The paper lists the coordinates of all localities where the species were found according to the Gaus-Krüger coordinate system as well as the allocation of the localities to their corresponding MTB 1/64 quadrants.

The neophyte specimens that were collected are stored in the herbarium of the Botanical Institute of the University of Zagreb, Faculty of Science (Hb ZA). Photographs of the neophytes found, taken by the first author of the paper, are in the attachment.

RESULTS

During research into the flora of the Zadar and Šibenik area conducted over a period of several years, a total of 16 alien taxa, new for the flora of Croatia, was registered (Tab. 1). With the exception of *S. angulatus*, which was introduced in the culture as an ornamental plant on purpose, all of the remaining taxa were introduced by accident either during the import of merchandise via Gaženica port or were a part of the seed admixture used for lawns.

NEW NEOPHYTES FOUND IN THE PORT OF GAŽENICA (ZADAR)

From a total of 16 new species of neophytes, 13 were found in Zadar, in the port of Gaženica (Fig. 1), at the dock for reloading bulk cargo (mostly soy-bean and cereals) or in its vicinity (x=5521681, y=4882676; MTB: 1957–212). All plant species

Tab. 1. New neophytes for the flora of Croatia

<table>
<thead>
<tr>
<th>Species</th>
<th>Family</th>
<th>Geographic origin</th>
<th>Locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternathera caracasana Kunth</td>
<td>Amaranthaceae</td>
<td>tropical Asia &amp; America</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Amaranthus spinosus L.</td>
<td>Amaranthaceae</td>
<td>tropical America</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Bromus catharticus Vahl</td>
<td>Poaceae</td>
<td>South America</td>
<td>Voštarnica (Zadar)</td>
</tr>
<tr>
<td>Commelina benghalensis L.</td>
<td>Commelinaceae</td>
<td>palaeotropics</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Eleusine coracana (L.) Gaertn.</td>
<td>Poaceae</td>
<td>palaeotropics</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Ipomoea coccinea L.</td>
<td>Convolvulaceae</td>
<td>tropical America</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>I. hederacea Jacq.</td>
<td>Convolvulaceae</td>
<td>tropical America</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>I. cordatotriloba Dennst.</td>
<td>Convolvulaceae</td>
<td>trop. &amp; subtrop. America</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Pennisetum glaucum (L.) R. Br.</td>
<td>Poaceae</td>
<td>tropical Africa</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Physalis angulata L.</td>
<td>Solanaceae</td>
<td>tropical America</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Senecio angulatus L. f.</td>
<td>Asteraceae</td>
<td>South Africa</td>
<td>Arbanasi (Zadar), island of Rava</td>
</tr>
<tr>
<td>Senna obtusifolia (L.) H. S. Irwin &amp; Barneby</td>
<td>Caesalpinaceae</td>
<td>tropical America</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Setaria parviflora (Poir.) Kerguelen</td>
<td>Poaceae</td>
<td>tropical America</td>
<td>Solaris and Zablače (Šibenik)</td>
</tr>
<tr>
<td>Sida rhombifolia L.</td>
<td>Malvaceae</td>
<td>paleotropics</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>Solanum chenopodioides Lam.</td>
<td>Solanaceae</td>
<td>South America</td>
<td>Gaženica (Zadar)</td>
</tr>
<tr>
<td>S. sisymbriifolium Lam.</td>
<td>Solanaceae</td>
<td>South America</td>
<td>Gaženica (Zadar)</td>
</tr>
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</table>
found in the port of Gaženica grow on ruderal habitats enriched with soy-bean and cereal waste.

*Alternanthera caracasana* Kunth (Amaranthaceae)


This perennial plant (Fig. 2) originates from tropical areas of western Asia and tropical America (TUTIN & EDMONSON, 1993). In the Europe it was registered in Spain (SANZ ELORZA *et al.*, 2004) and in Great Britain (CLEMENT & FOSTER, 1994). It
is believed that it entered Great Britain with a wool cargo (CLEMENT & FOSTER, 1994). It differs from the similar species of *A. pungens*, which is recorded in Spain as a casual, by the shorter points of outer perianth segments, and by filaments about twice as long as the anthers.

*A. caracasana* was first observed in Gaženica in the autumn of 2005, and since then several specimens of this species have occurred in the same site but did not spread to the surrounding area.

**Amaranthus spinosus** L. (Amaranthaceae)

*A. spinosus* (Fig. 3) is an annual plant that probably originates from lowland tropical South and Central America and was introduced into other warmer parts of the world. Presently it occurs in all tropical and subtropical regions (JANSEN, 2004). *A. spinosus* is a very noxious weed in many parts of the world, especially in Africa – where it is found in maize, cassava, groundnut, cotton and in sugar cane (JANSEN, 2004). In TUTIN & EDMONDSON (1993) this species was not registered for the flora of Europe but it is reported to occur as a rare and casual newcomer in several countries: Italy (PIGNATTI, 1982), Great Britain (CLEMENT & FOSTER, 1994), Czech Republic (PYŠEK et al., 2002) as well as Denmark, the European part of Russia, Latvia and Sweden (NOBANIS, 2009). It can easily be distinguished from other species belonging to the genus *Amaranthus* by its leaf-axil spines (PIGNATTI, 1982).

Until this research, *A. spinosus* was not recorded for the Croatian flora (NIKOLIĆ, 2009). In the fall of 2005, several specimens of these taxa have been found in Gaženica port but they were not noticed thereafter.

**Commelina benghalensis** L. (Commelinaceae)

*C. communis* occurs both in crops and sub-spontaneously in most parts of Europe (WEBB, 1980) as well as in Croatia (NIKOLIĆ, 2009) whereas for the area of north
Italy *C. virginica* was registered as well (PIGNATTI, 1982; WEBB, 1980). *C. benghalensis* (Fig. 4) is originally an Old World species and was naturalized in the Americas and Hawaii (VAN DER BURG, 2004). It is a widely distributed weed that commonly invades agricultural sites and disturbed areas. Listed as an alien casual plant it was registered in Spain by SANZ ELORZA et al. (2004) but was not registered for other parts of Europe. TÄCKHOLM (1974) noted *C. benghalensis* for Egypt. It differs from the very similar species *C. virginica*, that was registered for Croatia previously, by ovate to lanceolate elliptic leaves, smaller siphates and by the sometimes present subterranean, cleistogamous flowers (EFLORAS, 2009).

In 2004, several specimens of *C. benghalensis* were found in the harbour of Gaženica (Zadar) at the dock for reloading bulk cargo, mostly soy-bean and cereals, and have, since then, persisted in the site where they were found, without spreading, however.

**Eleusine coracana** (L.) Gaertn. (Poaceae)

Syn.: *Eleusine indica* (L.) Gaertn. subsp. *coracana* (L.) Lye

The genus *Eleusine* comprises about 10 species, distributed in the tropical and subtropical parts of the world (DE WET, 2006). This genus is represented by two neophyte taxa – *E. indica* and *E. tristachya* in the European as well as in the Croatian flora (HANSEN, 1980, NIKOLIĆ, 2009) but not by *E. coracana*. *E. coracana* is an annual grass (Fig. 5) of East African origin but is widely cultivated as a cereal crop in the tropical and subtropical regions of Africa and southern Asia (HITCHCOCK, 1971; DE WET, 2006). In the Americas and Europe it is rare and occurs in culture and/or as a casual escape. It is very similar to *E. indica*, from which it differs by it more robust habit (up to 170 cm tall), stout and mostly incurved racemes and by spikelets not disarticulating at maturity (PIGNATTI, 1982; DE WET, 2006).

Several examples of this species were first found in Gaženica port in the autumn of 2005, but the plant was not found in the same locality thereafter.
Ipomoea sp. (Convolvulaceae)

The genus Ipomoea comprises 600–700 species that are widespread in tropical and subtropical areas worldwide. The majority of species occur in the Americas and Africa (AUSTIN, 1980; AUSTIN & HUÁMAN, 1996). In Europe, the genus Ipomoea is represented by only five species. I. stolonifera (Cyr.) J. F. Gmelin and I. sagittata Poiret, are usually considered to be native for the Mediterranean region but I. acuminata (Vahl) Roemer & Schultes, I. purpurea Roth and I. batatas (L.) occur in the culture and/or as an escape from culture (STACE, 1972).

The flora of Croatia referred I. batatas and I. purpurea (NIKOLIĆ, 2009), which comes in the culture and sometime escaping. In Zadar, in the port of Gaženica, a lot of examples of different plants from the genus Ipomoea have been found but were difficult to determine due to the lack of appropriate literature. Apart from I. purpurea, recorded previously, three other species, new for the flora of Croatia, were identified: I. coccinea (Fig. 6), I. hederacea (Fig. 7) and I. cordatotriloba (Fig. 8). A larger number of specimens of all three species have been growing in the Gaženica port during the whole period of the research (2005–2008).

Ipomoea coccinea L.

Syn.: Quamoclit coccinea (L.) Moench

The native range of I. coccinea (Fig. 6) consists of the tropical regions of America, but it is widely naturalized elsewhere (BRITTON & BROWN, 1913, as Quamoclit coccinea). In Europe it is very rare; it occurs as a casual plant in Lithuania (NOBANIS, 2009) and Great Britain, where it was introduced unintentionally as an oil-seed ad-
The red flowers and the entire or angulate-lobed leaves with points along the margins are two characteristics that help to distinguish *I. coccinea* from most of the other similar *Ipomoea* species (Knights, 1959).

*I. hederacea* Jacq.

Syn.: *Pharbitis hederacea* (Jacq.) Choisy, *Ipomoea barbigera* Sweet

It is native in tropical America but it is cultivated worldwide as an ornamental plant and it seldom occurs naturalized or as a garden escapee. As a rare and casual weed it was registered in Denmark, Russia and Lithuania (Nobanis, 2009) and in
the Czech Republic (KUBAT et al., 2002). In Great Britain it was noted as an oil-seed and grain casual (CLEMENT & FOSTER, 1994). I. hederacea was included on the warning list of species that are weedy in America and are either invasive or naturalized or casual in Europe (FORMAN, 2003). It differs from I. purpurea by leaves cordate at base and deeply 3-lobed, by the light blue corolla and mostly by lanceolate sepals with long linear often recurved tips, much longer than the body of the sepals (KRINGS, 2002; STACE, 1997).

**I. cordatotriloba Dennst.**

Syn.: *Ipomoea trichocarpa* Elliott

This twining, herbaceous annual is native in tropical and subtropical regions of America where it grows along roadsides as well as on disturbed areas and fields. Leaves are heart-shaped, deeply 3- or 5-lobed, and corolla is 2.8–5 cm long, pink with a darker purple centre (BRITTON & BROWN, 1913, as *I. trichocarpa* Ell.; KRINGS, 2002). It differs from *I. purpurea* and *I. hederacea* by leaves that are glabrous above and below as well as by lanceolate sepals without tips but with ciliate margins (KRINGS, 2002).

*I. cordatotriloba* is closely related to the *I. batatas*, cultivated in tropical regions of the world for edible tuberous roots (»sweet potato«) and is registered in Europe and Croatia (NIKOLIĆ, 2009) in cultivation or more rarely as a vegetable escapee. In Europe, *I. cordatotriloba* is very rare and was registered by CLEMENT & FOSTER (1994, as *I. trichocarpa* Elliot) for Great Britain where it has grown from soy-bean waste.

**Pennisetum glaucum** (L.) R.Br. (Poaceae)


The genus *Pennisetum* comprises about 80 species and occurs throughout the tropics. In Europe, only two species of *Pennisetum* occur – *P. setaceum* (Forskal)
Chiov. and *P. villosum* R. Br. ex Frexen (CLAYTON, 1980). However, in Croatia only *P. villosum* has been recorded so far (NIKOLIĆ, 2009).

*P. glaucum* (Fig. 9) is an annual robust grass (up to 4 m tall) and it originates from tropical Africa (ANDREWS & KUMAR, 2006). It is commonly grown as a grain crop in the semi-arid regions of Africa and the Indian subcontinent as well as a fodder crop in the Americas, South Africa and Australia (ANDREWS & KUMAR, 2006). *P. glaucum* was recorded as a casual neophyte in the Great Britain where it occurs as a garden weed and in a mixture of maize and millet cultures (RYVES et al., 1996).

Just a few specimens of this species were found in Gaženica port in the autumn of 2005, and the plant was not observed on the same locality thereafter.

**Physalis angulata** L. (Solanaceae)

The genus *Physalis* comprises about 90 species native to tropical and temperate America with Mexico as a centre of diversity (MARTINEZ, 1998). The species are variable and taxonomically confusing and no comprehensive study of the genus exists (MAIRURA, 2008). Several species (*P. philadelphica* Lam., *P. peruviana* L.) have been under cultivation for their edible fruits in their native region as well as in India, Australia and Africa.

*P. angulata* (Fig. 10) is an annual herb, native in tropical America and now distributed pantropically as a weed (MAIRURA, 2008). It is very rare in Europe and is cultivated locally for its edible fruits and is found as an occasional casual (HAWKES, 1972). It was reported for Great Britain (CLEMENT & FOSTER, 1994), Czech Republic (PYŠEK et al., 2002), Denmark (NOBANIS, 2009) and Turkey (GÖNEN et al., 2000). In appearance *P. angulata* is most like *P. ixocarpa* Brot ex Hornem and *P. philadelphica*

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![Fig. 9. Pennisetum glaucum (L.) R. Br. (Poaceae)](image)
Lam., but it has longer flower pedicels, shorter anthers (1.5–2 mm), and smaller (10–12 mm), yellowish-green berries (HAWKES, 1972).

For the area of Croatia, along with the native Ph. alkekengi, three more adventive species – P. heterophylla Nees, P. peruviana L. and P. pubescens L., have been recorded but not P. angulata (NIKOLIĆ, 2009). Several specimens of P. angulata were found in Gaženica port in May 2005. Since then, it has been growing in the port of Gaženica and was noticed during the entire period of the research (2004–2008).

Senna obtusifolia (L.) H.S. Irvin & Barneby (Caesalpinaceae)

Syn.: Cassia obtusifolia L.

S. obtusifolia is an annual or short-lived perennial herb or shrub up to 2 (~2,5) m tall (Fig. 11), a native of tropical America but widely cultivated for medicinal uses and naturalized. It is found along rivers and on lake shores, as well as on cultivated land (BOSCH, 2004). It is considered a serious invader of crops and pasture land in the wet tropics of Americas, Australia, Africa and Asia (MACKEY et al., 1997).

In the most recent time, several species of Senna have been reported as rare casuals from a few European countries – Spain (SANZ ELORZA et al., 2004, as Cassia sp.), Great Britain (CLEMENT & FOSTER, 1994) and Denmark (NOBANIS, 2009, as Cassia sp.).

S. obtusifolia has been reported only from Great Britain (CLEMENT & FOSTER, 1994) where it is considered as a casual from soy-bean waste that rarely reaches flowering (STACE, 1997) and from Spain (SANZ ÉLORZA et al., 2004). It is distinguished from the similar Senna species by leaves with 3 pairs of obovate leaflets and by glands (petiolar nectaries) between the lower and occasionally the second pair of leaflets (WAGNER et al., 1999).

Several specimens of Senna obtusifolia were found growing in the port of during the entire period of the research (2004–2008).
**Sida rhombifolia** L. (Malvaceae)

*S. rhombifolia* (Fig. 12) is a short-lived perennial sub-shrub (woody stem and herbaceous branches) commonly growing up to 60 cm, but sometimes reaching 1.5 m in height. Today, it grows in over 70 countries throughout the tropical, subtropical and warm temperate regions (HOLM *et al.*, 1997). Its native range is unknown, but the presence of multiple subspecies and varieties seems to indicate that it originates from the palaeotropics. It is a common weed in pastures and cultivated fields as well as along roadsides and in ruderal sites in urban areas. S.
plants have been used for medicinal purposes and the stems for fibre (Holm et al., 1997).

In Europe this plant is very rare; it was registered in Great Britain (Stace, 1997), Czech Republic (Pysek et al., 2002), Spain (Sanz Elorza et al., 2004), Denmark, Sweden and Lithuania (Nobanis, 2009). In Great Britain it has been growing as a wool and oil-seed casual (Clement & Foster, 1994).

In the summer of 2005, several specimens of *Sida rhombifolia* were found in Gaženica port (Zadar). Since then, the plant has been growing in the same place throughout the duration of this research, but it did not spread to the surrounding area.

*Solanum* sp. (Solanaceae)

During this research several newcomers from the genus of *Solanum* L. were found in the port of Gaženica. *S. eleagnifolium* Cav., *S. rostratum* Dunal and *S. carolinense* L. have been previously recorded but findings of *S. chenopodioides* and *S. sisymbriifolium* were new for the flora of Croatia (Nikolić, 2009). In the period observed (2004–2008), both species have been growing with a larger number of specimens in ruderal habitats in Gaženica.

*Solanum chenopodioides* Lam.

Syn.: S. gracile Dunal, S. gracilius Herter, S. sublobatum Willd. ex Roem. & Schult.

*S. chenopodioides* is an erect perennial herb (Fig. 13) native to eastern parts of South America whence it has been introduced to other regions of the world. It belongs to *Solanum nigrum* L. group of closely related species (Edmonds & Chiewya, 1997) from which it is distinguished by umbellate cymes, strongly deflexed fruiting pendules and by ovoid, dull purple berries (Hawkes & Edmonds, 1972: 197, as *S. sublobatum*).

**Fig. 13. Solanum chenopodioides** Lam. (Solanaceae)
S. chenopodioides is locally naturalized in South-West Europe (Hawkes & Edmonds, 1972) but it occurs as a casual plant in other parts of Europe as well: Italy (Banfi, 1987), Great Britain (Clement & Foster, 1997) and Denmark (Nobanis, 2009). Its occurrence around railway stations and cuttings, docksides and mills, especially in Europe, is undoubtedly associated with the importation of wool as well as the importation of grain and oil seeds from South America, especially from Argentina (Edmonds & Chweya, 1997; Clement & Foster, 1994).

S. sisymbriifolium Lam. (Fig. 14) is an erect annual or short-lived perennial herb up to 1.5 m high, with a number of spines on the stalk, leaves and calyx (Stace, 1997). S. sisymbriifolium is most similar in appearance to S. sodomaeum L. but is distinguished from it by its larger corolla (30–35 mm in diameter) and red berry partly enclosed by the accrescent calyx (Hawkes & Edmonds, 1972). It originates from South America but has been introduced into warm and temperate regions worldwide. It occurs in waste places and in cultivated ground both in its native as well as most of its non-native range (Bean, 2006). Recently, it is best known for its use as a trap crop for potato cyst nematodes (PCN) (Timmermans et al., 2006). In Great Britain it is occasionally found as a wool, oil-seed, bird-seed and agricultural seed casual (Clement & Foster, 1997). As a casual plant it is referred to also for Italy (Pignatti, 1982), Czech Republic (Pyšek et al., 2002), Spain (Sanz Elorza et al., 2004), Turkey (Karaer & Kutbay, 2007), Estonia and Germany (Nobanis, 2009).

In 2004, for the first time, a population of about ten individuals of Solanum sisymbriifolium was found in Gaženica port near dock nr. 3, for reloading bulk cargo (soy-bean and cereals). Since then this species has been well established in three populations, each a bit more remote from the other, but the species did not expand past those sites. Each of these populations consists of 10 to 20 well developed and fertile individuals.
NEW NEOPHYES FOUND IN OTHER PARTS
OF THE ZADAR AND ŠIBENIK AREA

**Bromus catharticus** Vahl (Poaceae)

Syn.: *B. wildenowii* Kunth, *B. unioloides* Kunth

According to SMITH (1980), two species from the *Bromus* sect. *Ceratochloa*, occur in Europe – *B. carinatus* Hook & Arn and *B. catharticus* (SMITH, 1980). Neither species mentioned has been recorded in Croatia so far (NIKOLIĆ, 2008).

*B. catharticus* is a South American short-lived perennial grass (Fig. 15), widely introduced as a winter forage and is found as an escapee in most temperate regions. Commercial pasture varieties of this grass are available and are suited to the tablelands (CLAYTON et al., 2009). In South Europe, *B. catharticus*, occasionally cultivated for fodder, is locally naturalized and occurs as a casual elsewhere (SMITH, 1980). It was recorded for the flora of Italy (PIGNATTI, 1982), Czech Republic (PYŠEK et al., 2002), Great Britain (RYVES et al., 1996), Spain (SANZ ELORZA et al., 2004) as well as in Denmark, Germany, the European part of Russia and Lithuania (NOBANIS, 2009).

In May 2006, *B. catharticus* was found in Zadar (Voćarnica district) in the city park of »Vrulja« (x=5518924, y=4886332; MTB:1857–342) where it has been growing on green-lawn. It can be assumed that it was introduced as part of seed admixture to the green-lawn establishment.

**Senecio angulatus** L. f. (Asteraceae)

*S. angulatus* (Fig. 16) is a scrambling, glabrous perennial up to two metres tall and native to South Africa. It has thick, fleshy, coarsely toothed leaves, with one to three
teeth on each side and produces yellow daisy-like flowers in compound corymbs or panicles. It is cultivated for ornamental purposes and sometimes occurs as a garden escapee in North Italy (Liguria) and South Spain (Pignatti, 1982; Chatter & Walters, 1976). resembles Delairea odorata Lem. (=Senecio micranoides) most in its being a scrambling fleshy-leaved plant with a more or less woody stem, but it is distinguished from it by the absence of auricles at petiole bases, the more fleshy leaf lamina, the outwardly curved leaf teeth and by yellow ligules present in the flower capitula.

Among alien species from the genus Senecio, S. micranoides Otto ex Walp. and S. inaequidens DC. have been noted for the flora of Croatia so far but not S. angulatus (Nikolić, 2009).

In September 2005, S. angulatus was found in Zadar, in the city region of Arbanasi (x=5520181, y=4884515; MTB:1857–433), where several specimens have been growing in the courtyard of a house that has been abandoned for some time now. This plant was originally introduced into cultivation as an ornamental but in the meantime it managed not only to maintain itself but also to spread by runners all over the yard of the abandoned house. Most recently, this plant is observed growing as an ornamental plant in gardens as well as a garden escapee in the settlement of Vela Rava (x=5505167, y=4875267; MTB: 1956–341) on the island of Rava (Zadar archipelago).

*Setaria parviflora* (Poir.) Kerguélen (Poaceae)

Syn.: *Setaria geniculata* (Lam.) Beauv

This grass (Fig. 17 and 18) is native to tropical America (Hitchcock, 1971). In parts of South-West Europe it is more or less naturalized on cultivated ground or waste places (Clayton, 1980). As a rare casual it is registered in Italy (Pignatti, 1982), Denmark (Nobanis, 2009) and in Great Britain where it was introduced by
wool or bird-seed (Ryves et al., 1996). *S. parviflora* mostly resembles *Setaria pumila* (Poir.) Roem. & Schult., but it is a perennial, with short creeping rhizomes, more slender panicles and smaller spikelets (Hubbard, 1984).

In 1997, *S. parviflora* was observed for the first time by the first author in the Šibenik area – in the Solaris hotel resort and in the settlement of Zablaće. In Solaris, it has been growing on lawns situated around hotel Niko and along nearby paths
In the centre of the settlement of Zablaće it was found on a lawn in a house yard. Since 1997, the plant has managed to survive in the habitats where it was originally observed and has spread along nearby roads and footways, at both localities where it was first found. Therefore, according to the definition of Richardson et al. (2000), this alien grass can be considered as a naturalised species in the area of Šibenik.

**DISCUSSION AND CONCLUSION**

Out of 16 species of neophytes that are listed in the paper, 13 were registered in the area of Gaženica cargo port (Tab. 1). Most of the neophytes registered originate from the tropical and subtropical areas of the Americas.

Only three species (*Amaranthus spinosus*, *Eleusine coracana* and *Pennisetum glaucum*) were observed only once in the Gaženica port, whereas nine species (*Alternanthera caracasana*, *Commelina benghalensis*, *Ipomoea coccinea*, *I. hederacea*, *I. cordatotriloba*, *Physalis angulata*, *Senna obtusifolia*, *Sida rhombifolia*, *Solanum chenopodioides*) were found during the entire period in which the research was conducted (2004–2008). Given the fact that neither of the above mentioned species has emerged on localities outside of the original point of entry (Gaženica port, dock nr. 3), all of them can be considered to be casuals, whose occurrence depends on the repeated import of seeds during the transport of raw materials, especially soy-bean and cereals.

During the research (2004–2008), only *Solanum sisymbriifolium* managed to produce three self-reproducing populations, approximately a hundred meters from the original point of entry. Due to this fact, this species can, according to the definition of Richardson et al. (2000), be considered a naturalized one. In the future, we should monitor the behaviour of this species due to the peril of its invasive expansion outside of the Gaženica port into the surrounding areas.

The *Senecio angulatus* is a South African species that was brought into the Zadar area and the Island of Rava very recently and occurs as an escapee from the culture very rarely. We should investigate whether this species is present in other parts of Dalmatia, and monitor its possible spread outside the culture in the future, because in certain parts of the world it is registered as a dangerous weed (Richardson et al., 2006).

Introduced plant taxa once cultivated as ornamentals that escaped from cultivation make a significant share of the total number of taxa in alien floras of the European countries (Pyšek et al., 2002; Kowarik, 2003). In the area of Croatia the research and recording of cultivated alien plants that possess a smaller or a larger ability to survive outside of cultivation has been unjustly neglected. Croatian authors have, mostly, included only the taxa that have naturalized outside of cultivation and those taxa that possess the ability of invasive expansion to the surrounding areas into the lists of flora. The cultivated species with a limited ability of sub-spontaneous expansion (casuals) are usually left out of the lists. This is the one of the main reasons why alien flora of Croatia (Dobrović et al., 2005) contains a significantly smaller number of taxa than the lists of alien flora of other European countries (Lambdon et al., 2008).
In the upcoming period, special attention should be given to alien grass, *Bromus catharticus* and *Setaria parviflora*, probably imported as a seed admixture for lawn establishment. The *B. catharticus* species was, until now, found only in the Zadar area and, for the time being, can be considered an impermanent species that however possesses a potential to become naturalized. Since 1997, *S. parviflora* has been present in the Šibenik area (Solaris, Zablače), where it has, in the meantime, become naturalized on lawns and alongside paths. For the time being it does not show the ability of invasive expansion, but this possibility cannot be excluded. One can assume that both these grass species are present on suitable habitats, as well as other parts of Dalmatia. This assumption should be investigated into more detail.

The considerable amount of newly found neophytes in Gaženica port confirms the assumption that ports (sea, river, air) are in fact the key locations through which alien species from remote geographic areas come into local areas and local floras (MACK, 2003; JEHLIK, 1998). For instance, the largest amount of impermanent alien species in the total flora of the United Kingdom was brought in by accident during the transporation of wool, cereals or soy-beans (CLEMENTS & FOSTER, 1994; RYVES *et al.*, 1996).

Thus it is of the utmost importance to conduct detailed research into the flora in the areas of larger ports along Croatian littoral (Ploče, Rijeka, Split, Šibenik), with a special emphasis on the recording of alien species that come to Croatia via cargo transport. This will enable us to take the necessary steps to efficiently suppress potentially invasive alien species in the early stages of their arrival.

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S AŽETAK

Novi neofiti u flori Hrvatske

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Tijekom višegodišnjeg istraživanja flore zadarskog i šibenskog područja pronađeno je 16 vrsta neofita koji su novi za floru Hrvatske. Među njima, 13 je zabilježeno na području teretne luke Gaženica, dok su tri vrste pronađene u drugim dijelovima Zadra i na širem području Šibenika.

Tri su vrste (Amaranthus spinosus, Eleusine coracana i Pennisetum glaucum) zapožene samo u jednom navratu, a devet je vrsta (Alternanthera caracasana, Commelina


Vrsta Senecio angulatus je južnoafrička vrsta koja je na područje Zadra unešena u hortikulturu u najnovije vrijeme i za sada rijetko dolazi kao prebijeg iz kulture. Treba obratiti pažnju da li je ova vrsta prisutna u drugim dijelovima Dalmacije, te pratiti njeno moguće širenje u budućnosti, jer je u nekim područjima svijeta zabilježena kao opasan korov.

Proučavanje i evidentiranje hortikulturnih biljaka koje imaju manju ili veću sposobnost održavanja izvan uzgoja u Hrvatskoj je do sada bilo neopravdano zanemarenio. Domaći autori, od stranih kultiviranih vrsta, u popise flore uglavnom uključuju samo one svoje koje su se udomačile («naturalized») izvan uzgoja i imaju sposobnost invazivnog širenja («invasive») na okolna staništa. Kultivirane vrste s manjom sposobnošću subspontanog širenja («casual») uglavnom su zanemarene. To je jedan od razloga zašto je strana flora Hrvatske znatno siromašnija vrstama od stranih flora drugih europskih država.

Posebnu pažnju treba posvetiti stranim travama, Bromus catharticus i Setaria parviflora, koje su vjerojatno unešene kao primjesa u sjemenju uvezenom za ozelenjavanje tratina (travnjaka). Vrsta B. catharticus je do sada pronađena samo u Zadru i za sada se može smatrati nestalnom vrstom, ali s potencijalom da se udomači. S. parviflora je već duge vrijeme prisutna u okolici Šibenika (Solaris, Zablaće) gdje se udomačila na travnjacima te uz rubove pješačkih staza. Za sada ne pokazuje sposobnost invazivnog širenja što se u budućnosti ne može isključiti. Za pretpostaviti je da su obje ove vrste trava prisutne, na odgovarajućim staništima, i u drugim dijelovima Dalmacije, što bi trebalo detaljnije istražiti.

Veliki broj novozabilježenih neofita na području Gaženice potvrđuje zaključke da su upravo luke (morske, riječne, zračne) ključna mjesta preko kojih strane vrste iz udaljenih geografskih područja dospijevaju u lokalna područja i lokalne flore.