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THE FLORA OF SOME UNINHABITED ŠIBENIK ARCHIPELAGO ISLANDS (DALMATIA, CROATIA)

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In 2001, floristic research into 10 uninhabited islands of the Šibenik archipelago was carried out. A total of 278 taxa was registered (242 species, 35 subspecies and 1 variety), belonging to 202 genera and 60 families. The richest with species are the families *Fabaceae* (35 species, 12.59%) and *Poaceae* (27 species, 9.71 %). Of the total number of taxa registered on the islands investigated, 168 taxa (60.43 %) belong to the Mediterranean floral element while in the life form spectrum therophytes are dominant with 113 taxa (40.65 %). Results of analysis show that the flora of all the islands investigated has the Mediterranean character.

Key words: flora, islands of the Šibenik archipelago, Croatia

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Tijekom 2001. godine obavljen je niz florističkih istraživanja na 10 nenaseljenih šibenskih otoka. Zabilježeno je ukupno 278 taksona (242 vrste, 35 podvrsta i 1 varijetet) u okviru 202 roda i 60 porodica. Vrstama su najbogatije porodice *Fabaceae* (35 vrsta, 12.59 %) i *Poaceae* (27 vrsta, 9.71 %). Od ukupnog broja taksona, 168 (60.43 %) pripada mediteranskom flornom elementu, dok su u spektru životnih oblika dominantni terofiti sa 113 svojti (40.65 %). Rezultati analize pokazuju mediteranski karakter flore svih istraživanih otoka.

Ključne riječi: flora, otoci šibenskog arhipelaga, Hrvatska

INTRODUCTION

In the relatively small area of the Šibenik archipelago lies the most indented and most numerous group of islands and islets in the Mediterranean region. The best known among them certainly are the Kornati islands, which, in 1980, were pro-

claimed a national park and which for about two hundred years have been the object of floristic investigation by many research workers. Thus, the first to investigate the Kornati islands was Host whose data were published by VISIANI (1826). Then followed BAUMGARTNER (1916), CUFODONTIS (1929), PEVALEK (1930), BEDALOV & GAŽI-BASKOVA (1969, 1981, 1987), GAŽI-BASKOVA (1975, 1978), GAŽI-BASKOVA & BEDALOV (1976, 1978, 1983), PANDŽA & STANČIĆ (1995), and TRINAJSTIĆ (1996). In addition to the Kornati islands, there is also a group of larger inhabited islands, which were researched systematically only in the last ten years. In the north-western part of the Šibenik county is the island of Murter (17.9 km^2), the largest inhabited island of the archipelago, which was investigated in the period of 1991–1995 (PANDŽA, 1998b). Together with this island, systematic research into the following inhabited islands has been undertaken – Kaprije (FRANJIĆ & PANDŽA, 1996), Zlarin (PANDŽA, 1998), Krapanj and Prvić (PANDŽA, 1998a). All these islands belong to the Mediterranean proper vegetation zone of the Mediterranean littoral belt. The base of their climazonal vegetation zone consists of the alliance *Quercion ilicis*, and in some of them the elements of the narrowly Mediterranean vegetation zone of the alliance *Oleo-Ceratonion* (as. *Oleo-Euphorbietum dendroidis* Trinajstić 1973 and *Pistacio lentisci-Juniperetum phoeniceae* Trinajstić 1987) are met, too, while the halophytic zone on the sloping rocks by the sea consists of the association *Plantagini-Limonietum cancellati* H-ć (1934) 1939.

INVESTIGATED AREA

The area investigated belongs to the uninhabited islands situated in the Šibenik archipelago (Fig. 1), and, in 2001, floristic research into 10 uninhabited islands was carried out. The islands of Kakan, Tijat, Zmajan and Logorun are farily large in area, while Sovljak, Prišnjak, Kamenica, Lukovnik, Mali and Veliki Borovnjak are much smaller. The islands of Sovljak, Prišnjak, Lukovnik, Logorun, Tijat and Kamenica are made of Senon rudist limestones, while in the geological structure of Kakan alternating limestones and dolomites predominate, with, in one part of the island, Alb-Cenoman dolomites (MAMUŽIĆ *et al.*, 1975). On Veliki and Mali Borovnjak limestones and dolomites alternate, and Zmajan is geologically an alternation of limestones and dolomites except the Oštrice cape which is built of Senon rudist limestones (MAMUŽIĆ *et al.*, 1975). The highest parts in the researched area are on the islands of Zmajan (the peak of Zmajan – 142 m) and Tijat (the peak of Vela glava – 118 m). According to the data from the weather reporting station in Šibenik, the climate on these islands is typically Mediterranean. The annual amount of precipitation in the 1981–1994 period was 690 mm, and the average annual temperature in the same period was 15.4 °C.

The favourable climatic conditions enable the development of evergreen vegetation and, therefore, on the islands of Kakan, Tijat, Logorun and Sovljak the holm-oak macchia of the alliance *Quercion ilicis* and ass. *Myrto-Quercetum ilicis* Trinajstić (1976) 1985 predominates. On Zmajan, sub-spontaneously spreading Aleppo pine forest has been planted, while the others are covered with grassland vegetation. Due to the vicinity of the land, Lukovnik is under a strong anthropogenic impact. On it,

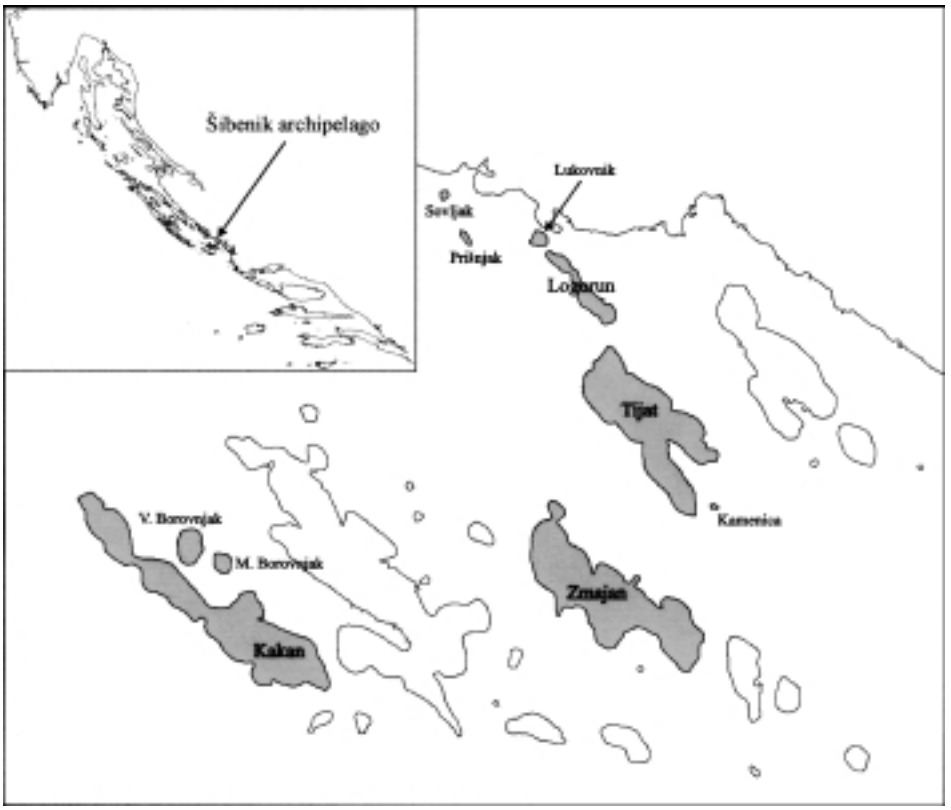

Fig. 1. The area investigated

the donkeys of the Tribunj Donkey Association lived for several years, but in 2001 they were moved to the neighbouring island of Logorun. On Kakan, there are some cultivated olive trees and one abandoned tourist facility. Being rather inaccessible (the shallow coastal sea), all these islands are visited rarely and, therefore, they have not previously been researched botanically.

MATERIAL AND METHODS

The nomenclature of the taxa has been confirmed according to NIKOLIĆ (1994, 1997, 2000) for all species indicated by him, and for the others, a dozen of them marked by an asterisk »*«, according to PIGNATTI (1982). Families are indicated in alphabetical order within superior taxa. Genera and species inside families are also given in alphabetical order. The life forms are indicated according to HORVAT (1949) and are given in the flora list before the species name using the following letters: Ch – chamaephyta, G – geophyta, H – hemicryptophyta, Hy – hydrophyta, Ph – phanerophyta, T – therophyta. The floral elements are indicated according to HOR-

VATIĆ (1963) and completed according to HORVATIĆ *et al*. (1967/68). The floral elements are given after the species name (marked using special letters). The endemic species analysis is shown according to TRINAJSTIĆ (1991, 1992). The localities of species on individual islands are marked with the abbreviations of island names and are given after the floral element (K – Kakan, MB – Mali Borovnjak, VB – Veliki Borovnjak, T – Tijat, Z – Zmajan, L – Logorun, KA – Kamenica, S – Sovljak, P – Prišnjak, LU – Lukovnik).

RESULTS OF THE INVESTIGATION

FLORISTIC LIST

PTERIDOPHYTA
FILICOPSIDA

ASPLENIACEAE

H *Asplenium ceterach* L. (= *Ceterach officinarum* DC.) – JEUM; K, T, Z, L
H *A. trichomanes* L. – ŠR; T, Z, L

SPERMATOPHYTA

GYMNOSPERMAE: CONIFEROPSIDA

CUPRESSACEAE

Ph *Cupressus sempervirens* L. – N; K, T, LU
Ph *Juniperus oxycedrus* L. subsp. *macrocarpa* (Sibth. et Sm.) Ball – CM; K, MB, T, L, Z, LU, P, S
Ph *J. oxycedrus* L. subsp. *oxycedrus* – CM; K, T, Z, L, LU
Ph *J. phoenicea* L. – CM; K, T, Z, L, LU, P, S

PINACEAE

Ph *Pinus halepensis* Mill. – CM; K, MB, VB, T, KA, Z, L, LU, P, S
Ph *P. pinea* L. – CM; T, L

GYMNOSPERMAE: GNETOPSIDA

EPHEDRACEAE

Ch *Ephedra fragilis* Desf. subsp. *campylopoda* (C. A. Meyer) Ascherson et Graebner (= *E. campylopoda* C. A. Meyer) – IM; Z, L, LU, S

ANGIOSPERMAE

DICOTYLEDONES

ANACARDIACEAE

Ph *Pistacia lentiscus* L. – CM; K, MB, VB, T, KA, Z, L, LU, P, S
Ph *P. terebinthus* L. – CM; K, VB, T, KA, L, Z, LU, P, S

APIACEAE

T *Bupleurum baldense* Turra subsp. *gussonei* (Arcang.) Tutin (= *B. veronense* Turra) – ILJEU; L, LU

Ch *Crithmum maritimum* L. – MA; K, MB, VB, T, KA, L, Z, LU, P, S

H *Daucus carota* L. subsp. *hispanicus* (Gouan) Thell. (= *D. gingidium* L.; *D. gummifer Lam.)* – MA; KA

H *D. carota* L. subsp. *major* (Vis.) Arcang. – JEUM; K, MB, L, LU

H *Eryngium amethystinum* L. – ILJEU; MB, VB

T *Scandix pecten-veneris* L. – ŠR; K

H *Seseli tomentosum* Vis. – ILJAE; K, VB, Z

H *Smyrnium olusatrum* L. – MA; P

T *Tordylium officinale* L. – IM; K, T, LU

T *Torilis nodosa* (L.) Gaertn. – MA; T

ASCLEPIADACEAE

G *Vincetoxicum hirundinaria* Medicus subsp. *adriaticum* (G. Beck) Markgraf (= *V. adriaticum* Beck) – ILJAE; K, MB, VB, Z, L, P

ASTERACEAE

Ch *Artemisia caerulescens* L. – ILAP; L, Z

H *Bellis sylvestris* Cirillo – CM; K, T, Z, L, LU

T *Bombycilaena erecta* (L.) Smoljan. (= *Micropus erectus* L.) – JEUP; K, T, Z

H *Carduus micropterus* (Borbas) Teyber – ILJAE; LU

H *C. pycnocephalus* L. – CM; K, Z, LU

H *Carlina corymbosa* L. – CM; K, MB, VB, T, L, Z, LU

H *Dittrichia viscosa* (L.) Greuter (= *Inula viscosa* (L.) Aiton) – CM; K, MB, VB, T, L, Z, LU, P, S

T *Filago pyramidata* L. (= *F. spathulata* C. Presl) – JEUM; MB, T

Ch *Helichrysum italicum* (Roth) G. Don fil. – CM; K, MB, VB, T, KA, L, Z, LU, P, S

Ch *Inula crithmoides* L. – MA; K, MB, VB, T, L, Z, LU, P, S

H *I. spiraeifolia* L. (= *I. squarrosa* L.) – JEUM; MB

T *Pallenis spinosa* (L.) Cass. – CM; K

Ch *Senecio bicolor* (Willd.) Tod. subsp. *cineraria* (DC.) Chater (= *Cineraria maritima* L.) – ZM; MB, VB

T *S. vulgaris* L. – ŠR; K, LU

Ch *Tanacetum cinerariifolium* (Trevir.) Sch. Bip. (= *Pyrethrum cinerariifolium* Trevir.) – ILJAE; K, T, MB, Z, L, P, S

BORAGINACEAE

T *Echium plantagineum* L. – MA; Z, L, LU

BRASSICACEAE

Ch *Aethionema saxatile* (L.) R. Br. – JEUM; K, VB, T, KA, Z, LU, P, S

H *Arabis hirsuta* (L.) Scop. – ŠR; LU

Ch *Aurinia sinuata* (L.) Griseb. (= *Alyssanthus sinuatus* (L.) Trinajstić) – ILJAE; K, MB, VB, L, LU, P
T *Biscutella cichoriifolia* Loisel. – JEUM; KA
T *Cakile maritima* Scop. – ŠR; T, Z
T *Cardamine hirsuta* L. – ŠR; K
T *Clypeola jonthlaspi* L. – CM; Z
T *Erophilla verna* (L.) Cheval. subsp. *praecox* (Steven) Walters (= *Draba praecox Steven) – ŠR; T*

CACTACEAE

Ch *Opuntia vulgaris* Mill. – N; LU

CAMPANULACEAE

T *Campanula erinus* L. – CM; K, T, Z
H *C. pyramidalis* L. – ILJAE; K, T, Z, L, LU, P, S
H *C. rapunculus* L. – EAF; K, Z

CAPRIFOLIACEAE

Ph *Lonicera implexa* Aiton – CM; K, T, KA, L, Z, LU, P, S
T *Viburnum tinus* L. – CM; K, T, L, Z, S

CARYOPHYLLACEAE

T *Arenaria leptoclados* (Reichenb.) Guss. – EAF; K, T, Z
T *A. serpyllifolia* L. – ŠR; T, Z, L
H *Dianthus ciliatus* Guss. – ILJAE; KA
T *Herniaria glabra* L. – EAF; K, Z, P
H *Petrorhagia saxifraga* (Ser. ex DC.) Link (= *Tunica saxifraga* (L.) Scop.) – JEUM; K, T, Z, L, LU, S
T *Sagina maritima* G. Don – MA; K
H *Silene vulgaris* (Moench.) Garcke subsp. *angustifolia* Hayek – JEUM; K, MB, VB, T, KA, Z, L, LU, P, S
T *Spergularia salina* J. Presl et C. Presl (= *S. marina* (L.) Griseb.) – ŠR; K
T *Stellaria media* (L.) Vill. – ŠR; K
T *S. pallida* (Dumort) Pire' – ŠR; T

CHENOPODIACEAE

Ch *Arthrocnemum macrostachya* (Moric.) C. Koch (= *A. glaucum* (Delile) Ung.-Sternb.) – JEUM; K, MB, T, KA, L, Z, LU, P, S
T *Atriplex prostrata* Boucher ex DC. (= *A. hastata* L.) – ŠR; K, T, Z, L, LU, P
H *Beta vulgaris* L. subsp. *maritima* (L.) Arcangeli – MA; K, MB, T, Z
Ch *Halimione portulacoides* (L.) Aellen – ŠR; K, MB, L, Z

CICHORIACEAE

G *Aetheorhiza bulbosa* (L.) Cass. (= *Crepis bulbosa* L.) – CM; K, T, Z, L, P
H *Chondrilla juncea* L. – EAF; T
H *Cichorium intybus* L. – ŠR; K, MB, T, L

T *Crepis sancta* (L.) Babc. – IM; K
T *Hedypnois cretica* (L.) Dum. Cours. – CM; K
H *Hieracium heterogynum* (Froel.) Gutermann (= *H. stupposum* Rchb.) – IBE; K
H *H. praealtum* Will. ex Gochnat subsp. *bauhinii* (Besser) Petunn. – EAF; K, T
H *Lactuca serriola* L. – ŠR; LU
H *L. viminea* (L.) J. Presl et C. Presl – JEUP; K
H *Leontodon crispus* Vill. – JEUM; K, MB, Z
G *L. tuberosus* L. – CM; K, T, L, S
H *Picris hieracioides* L. – EAF; K
H *Reichardia picroides* (L.) Roth – CM; K, MB, VB, T, KA, L, Z, LU, P, S
T *Rhagadiolus stellatus* (L.) Gaertn. – CM; LU
H *Scorzonera villosa* Scop. – ILJEU; K, MB, VB, T, KA, Z, P
T *Sonchus asper* (L.) Hill. subsp. *glaucescens* (Jord.) Ball (= *S. glaucescens* Jord.) – CM; K, MB, T, Z, L, LU
T *S. oleraceus* L. – ŠR; K
H *Urospermum dalechampii* (L.) Scop. ex F. W. Schmidt – CM; K
T *U. picroides* (L.) Scop. ex F. W. Schmidt – CM; K, T, KA, Z

CISTACEAE
Ph *Cistus incanus* L. subsp. *creticus* (L.) Heywood – IM; T, Z, S
Ph *C. incanus* L. subsp. *incanus* – CM; T
Ph *C. salviifolius* L. – CM; K, T, Z
Ch *Fumana ericoides* (Cav.) Gand. – CM; K, T, Z, S

CLUSIACEAE (*HYPERICACEAE*)
H *Hypericum perforatum* L. (incl. *H. veronense* Schrank) – JEUM; K, MB, T, L, Z, LU, P, S

CONVOLVULACEAE
H *Convolvulus althaeoides* L. subsp. *tenuissimus* (Sibth. et Sm.) Stace – IM; K, MB, VB, T, KA, L, Z, LU, S
H *C. cantabrica* L. – JEUM; K, T
Ch *C. cneorum* L. – ILAP; KA

CRASSULACEAE
Ch *Sedum acre* L. – EAF; Z, LU
Ch *S. ochroleucum* Chaix – JEUM; Z
T *S. rubens* L. – JEUM; K

DIPSACACEAE
H *Cephalaria leucantha* (L.) Roem. et Schult. – CM; VB, KA, Z, L, LU

ERICACEAE
Ph *Arbutus unedo* L. – CM; K, T

EUPHORBIACEAE
Ch *Euphorbia characias* L. subsp. *wulfenii* (Hoppe ex Koch) A. R. Sm. – ILJAE; K

T *E. exigua* L. – JEUM; K, T, L, Z
Ch *E. fragifera* Jan. – ILJAE; K, MB, VB, T, KA, L, Z, P
T *E. helioscopia* L. – ŠR; K, Z
Ch *E. paralias* L. – MA; L, Z
T *E. peplus* L. – ŠR; Z
Ch *E. pinea* L. – CM; K, VB, T, KA, Z, L, LU, P, S
T *E. segetalis* L. – CM; LU
Ch *E. spinosa* L. – CM; S
T *Mercurialis annua* L. – ŠR; K, T, Z, L, LU, P, S

FABACEAE

H **Anthyllis vulneraria* L. subsp. *praepropera* (A. Kerner) Bornm. – EUM; K, MB, VB, KA, Z, P
Ch *Argyrolobium zanonii* (Turra) P. W. Ball – ZM; K, Z
Ph *Ceratonia siliqua* L. – N; K
Ch *Chamaecytisus spinescens* (C. Presl) Rothm. (= *Cytisus spinescens* Presl) – ILJEU; P
Ph *Colutea arborescens* L. – CM; VB, Z
Ph *Coronilla emerus* L. subsp. *emeroides* Boiss. et Spruner – IM; K, MB, VB, T, KA, L, Z, LU, P, S
T *C. scorpioides* (L.) Koch – CM; K, MB, L, Z
Ch *Dorycnium hirsutum* (L.) Ser. – CM; K, MB, VB, T, KA, L, Z, P, S
Ch *Genista sylvestris* Scop. subsp. *dalmatica* (Bartl.) H. Lindb. – ILJAE; K, VB
T *Hippocrepis ciliata* Willd. – CM; K, MB
T *Lathyrus aphaca* L. – JEUM; K, T, Z, LU
T *L. cicera* L. – CM; K, T, Z
T *L. sphaericus* Retz. – JEUM; Z
Ch *Lotus cytisoides* L. – CM; K, MB, T, KA, Z, L, LU, P, S
T *L. edulis* L. – CM; K, KA, Z
T *L. ornithopodioides* L. – CM; K, T, Z
T *Medicago litoralis* Loisel. – CM; K, T, Z, P, S
T *M. minima* (L.) Bartal. – ŠR; K, T, KA, Z, L
T *Ononis reclinata* L. – JEUM; K, MB, T, Z
T *Pisum sativum* L. subsp. *elatius* (M. Bieb.) Asch. et P. Graebn. – JEUM; Z
Ph *Robinia pseudoacacia* L. – N; K, KA
T *Scorpiurus muricatus* L. – CM; K, MB, T, Z
T *Securigera cretica* (L.) Lassen (= *Coronilla cretica* L.) – IM; Z
Ph *Spartium junceum* L. – CM; K, MB, VB, L, Z, P, S
T *Trifolium angustifolium* L. – CM; K
T *T. arvense* L. – EAF; T, Z
T *T. campestre* Schreber – ŠR; K, T, Z, L, LU, P, S
T *T. lappaceum* L. – CM; K, T, Z, L
T *T. scabrum* L. – CM; K, MB, T, KA, Z, L, LU, P, S
T *T. stellatum* L. – CM; K

T *T. suffocatum* L. – CM; T
T **Trigonella corniculata* (L.) L. – EUM; T, LU
T **T. monspeliaca* L. – MP; T
T *Vicia hirsuta* (L.) Gray – ŠR; K
T *V. angustifolia* L. subsp. *angustifolia* (= *V. sativa* L. subsp. *nigra* (L.) Ehrh.) – EF; K, T, L, LU

FAGACEAE

Ph *Quercus ilex* L. – CM; K, VB, T, KA, L, Z, P, S

FUMARIACEAE

T *Fumaria flabellata* Gaspar. – CM; K, L, LU
T *F. parviflora* Lam. – ŠR; Z

GENTIANACEAE

T *Blackstonia perfoliata* (L.) Huds. – MA; K, T, L, Z
T *Centaurium erythraea* Rafn – ŠR; K, MB, T, L, Z
T *C. spicatum* (L.) Fritsch – CM; K, T, Z

GERANIACEAE

T *Erodium ciconium* (L.) L. 'Her. – MP; T
T *E. malacoides* (L.) L. 'Her. – CM; K, LU
T *Geranium purpureum* Vill. – JEUM; K, MB, VB, T, L, Z, LU, P, S
T *G. rotundifolium* L. – EAF; K, T, L, Z, LU, P, S

LAMIACEAE

T *Acinos arvensis* (Lam.) Dandy – EF; Z
T *Ajuga chamaepytis* (L.) Schreb. – CM; K, T, KA, Z, L, LU
H *Calamintha nepetoides* Jord. – JEUP; K
T *Lamium amplexicaule* L. – EAF; Z
Ch *Micromeria juliana* (L.) Rchb – CM; K, MB, T, KA, Z, L
Ch *Prasium majus* L. – CM; K, MB, VB, T, KA, Z, L, LU, P, S
Ch *Salvia officinalis* L. – ILJAE; T, Z
Ch *Satureja montana* L. subsp. *variegata* (Host) P. W. Ball – ILJAE; K, MB, Z, L, LU
T *Sideritis romana* L. – CM; K, T, KA, Z, L, LU, P
H *Stachys cretica* L. subsp. *salviifolia* (Ten.) Rech. fil. – ILAP; LU
H *S. subcrenata* (Vis.) Briq. – JEUP; P
Ch *Teucrium chamaedrys* L. – JEUP; K, MB, VB, T, L, Z, LU, P, S
Ch *T. flavum* L. – CM; K, T, Z, P, S
Ch *T. montanum* L. – JEUM; K, MB, VB, T, L, Z
Ch *T. polium* L. – MP; K, MB, VB, T, KA, Z, L, LU, P, S

LINACEAE

T *Linum strictum* L. subsp. *strictum* – CM; K, T, KA, Z, LU, P
T *L. strictum* L. subsp. *corymbulosum* (Rchb.) Riony (= *L. liburnicum* Scop.; *L. corymbulosum* Rchb.) – MP; K, VB, T, KA, Z, L, LU, P, S

MALVACEAE
T *Althaea hirsuta* L. – JEUM; T, L
Ph *Lavatera arborea* L. – EUM; K, P

MORACEAE
Ph *Ficus carica* L. – CM; K, VB, T, KA, L, Z, LU, P

MYRTACEAE
Ph *Myrtus communis* L. – CM; K, MB, VB, T, Z, L, S

OLEACEAE
Ph *Fraxinus ornus* L. – JEUM; K, T, Z, L, P
Ph *Olea europaea* L. (incl. var. *sylvestris* Brot.) – CM; K, MB, VB, T, KA, Z, LU, P
Ph *Phillyrea latifolia* L. (incl. *Ph. media* L.) – CM; K, VB, T, KA, L, Z, S

OROBANCHACEAE
T *Orobanche minor* Sm. – JEUM; K, MB, T, KA, L, LU, Z

PAPAVERACEAE
H *Glaucium flavum* Crantz – MA; T

PLANTAGINACEAE
H *Plantago altissima* L. – JEUM; K
T **P. coronopus* L. subsp. *commutata* (Guss.) Pilger – MP; K
H **P. holosteum* Scop. var. *scopulorum* (Degen) Pilger – ILJAE; KA
H *P. lanceolata* L. – ŠR; K, LU

PLUMBAGINACEAE
H *Limonium cancellatum* (Bernh. ex Bertol.) O. Kuntze – ILJAE; K, MB, VB, T, KA, L, Z, LU, P, S
H *L. serotinum* (Reichenb.) Pignatti – CM; K, MB, VB, T, L, Z

PRIMULACEAE
T *Anagallis arvensis* L. – ŠR; K, T, L, Z, LU, P, S
T *A. coerulea* Schreb. (= *A. foemina* Mill.) – ŠR; K, MB, VB, T, L, Z, P, S
T *Asterolinum linum-stelattum* (L.) Duby – CM; K
G *Cyclamen repandum* Sibth. et Sm. – EUM; K

RANUNCULACEAE
G *Anemone hortensis* L. – CM; K, T, Z, LU, P
Ph *Clematis flammula* L. – CM; K, MB, VB, T, KA, L, LU, Z, P, S

RESEDACEAE
T *Reseda phyteuma* L. – JEUM; K, MB, VB, L

RHAMNACEAE
Ph *Frangula rupestris* (Scop.) Schur. – ILJAE; K, Z, L
Ph *Paliurus spina-christi* Mill. – ILJEU; L, LU
Ph *Rhamnus alaternus* L. – CM; K, MB, VB, L, Z, LU, P, S
Ph *R. intermedius* Steudel. et Hochst. – ILJAE; VB, L, LU

ROSACEAE

T *Aphanes arvensis* L. – ŠR; T
Ph *Crataegus monogyna* Jacq. – EAF; L, LU
H *Potentilla recta* L. – EAF; K, L, LU
Ph *Prunus mahaleb* L. – JEUP; K, VB, T, Z, L, LU
Ph *Rubus ulmifolius* Schott – MA; K, MB, VB, T, L, Z, LU
H *Sanguisorba minor* Scop. subsp. *muricata* Briq. (= *S. muricata* (Spach) Gremli) – JEUM; K, T, Z, L, LU
Ph *Sorbus domestica* L. – CM; K, Z, LU

RUBIACEAE

H *Asperula aristata* L. subsp. *scabra* (J. Presl. et C. Presl) Nyman (= *A. longiflora* Wadst. et Kit) – JEUM; K, MB, VB
T *Crucianella latifolia* L. – CM; K
T *Galium aparine* L. – ŠR; K, L, LU
H *G. corrudifolium* Vill. – JEUM; K, MB, VB, T, KA, L, Z, P, S
T *G. murale* (L.) All. – CM; K, T
Ph *Rubia peregrina* L. – CM; K, T, L, Z
T *Sherardia arvensis* L. – ŠR; K, T, LU
T *Valantia muralis* L. – CM; K, MB, VB, T, KA, L, Z, LU, P, S

SANTALACEAE

Ph *Osyris alba* L. – CM; T, Z, L
H *Thesium divaricatum* Jan ex Mert. et Koch – CM; K, VB, T, KA

SAXIFRAGACEAE

T *Saxifraga tridactylites* L. – ŠR; K, T, Z

SCROPHULARIACEAE

T *Chaenorhinum minus* (L.) Lange subsp. *litorale* (Bernh. ex Willd.) Rouy – ILAP; K, T, Z
T *Kickxia commutata* (Bernh. ex Rchb.) Fritsch – EUM; K, T
T *Linaria simplex* (Willd.) DC. – CM; K, T
T *Misopates orontium* (L.) Raf. – EAF; K
H *Scrophularia canina* L. – JEUM; Z
T *Veronica arvensis* L. – EAF; K, T
T *V. cymbalaria* Bodard – JEUM; K, T
T *V. hederifolia* L. – EAF; K, Z

TAMARICACEAE

Ph *Tamarix dalmatica* Baum – ZM; L

ULMACEAE

Ph *Celtis australis* L. – JEUM; K

URTICACEAE

H *Parietaria judaica* L. – JEUM; K, T, Z, L,

VERBENACEAE
Ph *Vitex agnus-castus* L. – CM; K, MB, T, L

VIOLACEAE
T *Viola arvensis* Murray – ŠR; K, T

VITACEAE
Ph *Vitis vinifera* L. – ŠR; K, Z

MONOCOTYLEDONES

CYMODOCEACEAE
Hy *Cymodocea nodosa* (Ucria) Asch. – MA; in the sea by islands

CYPERACEAE
H *Carex divisa* Huds. – MA; K, L, Z
H *C. extensa* Gooden. – MA; K, T, Z, L
G *C. flacca* Schreb. – ŠR; K, MB, T, Z, KA, L

IRIDACEAE
G *Crocus thomasii* Ten. – ILAP; LU
G *Iris illyrica* Tomm. – ILJAE; K, T, KA, L, Z, P, S
G *Romulea bulbocodium* (L.) Sebast. et Mauri – CM; K

LILIACEAE
G *Allium commutatum* Guss. – CM; K, MB, VB, T, KA, L, Z, LU, P, S
G *A. flavum* L. – CM; MB, L
G *A. guttatum* Steven subsp. *dalmaticum* (A. Kerner ex Janch.) Stearn – IBE; MB
G *A. sphaerocephalon* L. – JEUM; K, VB, KA, Z, L, P, S
G *A. subhirsutum* L. – CM; K, MB, VB, T, Z, L, LU, P, S
G *Asparagus acutifolius* L. – CM; K, MB, VB, T, KA, Z, L, LU, P, S
G *Asphodeline liburnica* (Scop.) Rchb. – ILJAE; L, Z, S
G *Asphodelus aestivus* Brot. (= *A. microcarpus* Viv.) – CM; K, MB, VB, Z, L, LU, P, S
G *Muscari comosum* (L.) Mill. – JEUM; K, T, KA, Z, LU, P
G *M. neglectum* Guss. ex Ten. (= *M. racemosum* (L.) Lam. et DC.) – CM; K, VB, KA
G *Ruscus aculeatus* L. – MP; S
Ph *Smilax aspera* L. – CM; K, MB, VB, T, KA, L, Z, LU, P, S

ORCHIDACEAE
G *Ophrys sphecodes* Mill. subsp. *atrata* (Lindl.) E. Mayer – EUM; K
G *Orchis quadripunctata* Cirillo ex Ten. – IM; K
G *Serapias parviflora* Parl. – CM; K

POACEAE
T *Aegilops geniculata* Roth – CM; K
T *Avena barbata* Pott ex Link – ŠR; K, Z, L, LU
T A. *sterilis* L. – JEUP; KA

T *Brachypodium distachyon* (L.) Beauv. – CM; K, T

H *B. retusum* (Pers.) Beauv. – CM; K, MB, VB, T, KA, L, Z, LU, P, S

T *Briza maxima* L. – CM; K, LU

H *Bromus erectus* Huds. subsp. *condensatus* (Hack.) Asch. et Graebn. (= *B. condensatus* Hackel) – JEUM; K, MB, VB, KA, Z

T *B. madritensis* L. – MA; K

T *B. sterilis* L. – ŠR; K, LU

T *Catapodium marinum* (L.) Hubbard – MA; K, T, KA, L, Z, P

H *Chrysopogon gryllus* (L.) Trin. – MP; K, VB, Z

H *Cynodon dactylon* (L.) Pers. – ŠR; K, MB, VB, T, KA, L, Z

T *Cynosurus echinatus* L. – JEUM; LU

H *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman – CM; K, T, KA, L, Z, LU, P, S

T *Desmazeria rigida* (L.) Tutin (= *Scleropoa rigidum* (L.) Griseb.) – MA; K, MB, VB, T, L, Z, LU, S

H *Dichanthium ischaemum* (L.) Roberty (= *Bothriochloa ischaemon* (L.) Keng) – JEUM; LU

G *Elymus pycnanthus* (Godr.) Melderis – CM; K, MB, VB, T, KA, L, Z, LU, P, S

T *Gastridium ventricosum* (Gouan) Schinz et Thell. – MA; MB, T, L

T *Hordeum murinum* L. subsp. *leporinum* (Link) Arcang. – CM; K, T, L, LU

T *Lagurus ovatus* L. – CM; K, LU

H *Lolium perenne* L. – EF; K, T, LU

T *Lophochloa cristata* (L.) Hyl. (= *Koeleria phleoides* (Vill.) Pers.) – ŠR; K, T

H *Melica ciliata* L. – EAF; T, K, Z, L, LU

T *Parapholis incurva* (L.) C. E. Hubb. – MA; K, T, L, Z, P

H *Poa bulbosa* L. – EAF; K, T, Z

H *Stipa bromoides* (L.) Doerfl. – CM; K, T, Z, L, LU, P, S

T *Vulpia ciliata* Dumort. – JEUM; K, T, LU

POSIDONIACEAE

Hy *Posidonia oceanica* (L.) Delile – CM; K, T, KA, L, Z

ANALYSIS OF THE FLORA

TAXONOMIC ANALYSIS

Tab. 1. Analysis of quantity of taxonomic ranks

Taxa	Family	Genus	Species	Subspecies	Variety
Pteridophyta	1	1	2	–	–
Gymnospermae	3	4	4	3	–
Angiospermae					
Dicotyledones	49	158	191	27	1
Monocotyledones	7	39	45	5	–
Σ	**60**	**202**	**242**	**35**	**1**

Tab. 2. Analysis of quantity of species by the islands and the MTB and UTM coordinates

Islands with their MTB and UTM coordinates	Number of species per island	Islands with their MTB and UTM coordinates	Number of species per island
Kakan – 2360/1; WJ44, WJ53	206	Mali Borovnjak – 2360/1	74
Zmajan – 2360/2; WJ63	158	Prišnjak – 2260/1; WJ64	73
Tijat – 2260/4; WJ63, WJ64	152	Sovljak – 2260/1; WJ64	65
Logorun – 2260/4; WJ64	124	Veliki Borovnjak – 2260/3; WJ44, WJ53	64
Lukovnik – 2260/1; WJ64	104	Kamenica – 2260/4; WJ63, WJ64	62

ANALYSIS OF LIFE FORMS

Tab. 3. Life form structure of the flora of the area investigated

Life forms	Number of taxa	%
Therophyta (T)	113	40.65
Hemicryptophyta (H)	64	23.02
Phanerophyta (Ph)	41	14.75
Chamaephyta (Ch)	34	12.23
Geophyta (G)	24	8.63
Hydrophyta (Hy)	2	0.72
Total	**278**	**100.00**

PHYTOGEOGRAPHICAL ANALYSIS

An analysis of the floral elements is shown in the figure (Fig. 2.).

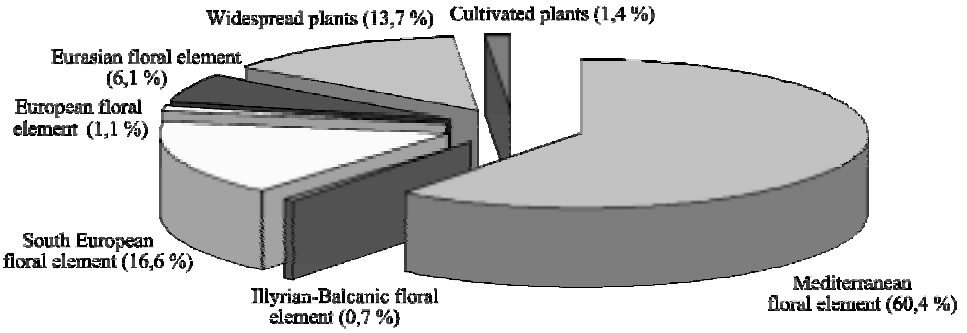

Fig. 2. Analysis of the floral elements

1. MEDITERRANEAN FLORAL ELEMENT (168 species – 60.43 %)
   - A. Circum-Mediterranean plants – (96 species) – CM
   - B. West Mediterranean plants – (3 species) – ZM
   - C. East Mediterranean plants – (8 species) – IM
   - D. Illyrian – Mediterranean plants
     - a) Illyrian South European plants – (5 species) – ILJEU
     - b) Illyrian Adriatic plants:
       1. Illyrian Adriatic endemic plants – (18 species) – ILJAE
       2. Illyrian Apennine plants – (5 species) – ILAP
   - E. Mediterranean Atlantic plants – (20 species) – MA
   - F. European Mediterranean plants – (6 species) – EUM
   - G. Mediterranean Pontic plants – (7 species) – MP
2. ILLYRIAN-BALCANIC FLORAL ELEMENT (2 species – 0.72 %)
   - A. Illyrian-Balcanic endemic plants – (2 species) – IBE
3. SOUTH EUROPEAN FLORAL ELEMENT (46 species – 16.55 %)
   - A. South European Mediterranean plants – (39 species) – JEUM
   - B. South European Pontic plants – (7 species) – JEUP
4. EUROPEAN FLORAL ELEMENT – (3 species – 1.08 %) – EF
5. EURASIAN FLORAL ELEMENT – (17 species – 6.11 %) – EAF
6. WIDESPREAD PLANTS – (38 species – 13.67 %) – ŠR
7. CULTIVATE PLANTS (4 species – 1.44 %) – N

DISCUSSION AND CONCLUSION

The flora of the Šibenik archipelago islands, except that of the Kornati islands, was previously completely unresearched. In only the last ten years has there been systematic flora research into the islands of Murter, Kaprije, Zlarin, Krapanj and Prvić. In 2001, the floristic investigation of the uninhabited islands of Kakan, Tijat, Zmajan, Logorun, Lukovnik, Sovljak, Prišnjak, Kamenica, Mali and Veliki Borovnjak was carried out. In the flora of the researched islands, a total of 278 taxa was registered. The richest with taxa is Kakan (206), then come Zmajan (158), Tijat (152), Logorun (124) and Lukovnik (104) (Tab. 2). An exception is, for instance, Lukovnik island which although small, due to the vicinity of the land (Tribunj) and a strong anthropogenic impact, has the largest number of species as compared to surface area.

Of the total number of taxa registered on the islands investigated, 168 taxa (60.43 %) belong to the Mediterranean floral element and among them the most numerous are circum-Mediterranean plants (96 taxa, 34.5 %). This is the largest percentage of the Mediterranean floral element in relation to the neighboring islands. Thus, for instance, Kaprije has 146 taxa as that are circum-Mediterranean plants (52.5 %; FRANJIĆ & PANDŽA, 1996), Zlarin 155 taxa (45.2 %; PANDŽA, 1998), Krapanj and Prvić have 181 taxa (50.0 %; PANDŽA, 1998a). Inside the Mediterranean floral element, special attention from the plant-geographical point of view is deserved by the Illyrian-Adriatic endemic plants with 18 species (6.47 %) and the Illyrian-Apennine plants (5 species, 1.8%). Of endemic plants, it should be noted the Illyrian-Adriatic species *Iris illyrica* is registered for the islands of Kakan, Tijat, Kamenica, Logorun, Zmajan, Sovljak and Prišnjak, and the Illyrian-Apennine species *Convolvus cneorum* has been recorded for the small island of Kamenica near Tijat. According to their distribution, the Mediterranean floral element plants are followed by South European floral element plants (46 taxa, 16.55%) and widespread plants (38 taxa, 13.67%) on the small islands researched, while there are 65 taxa (23.4 %) on Kaprije (FRANJIĆ & PANDŽA, 1996), 69 taxa (20.1 %) on Zlarin (PANDŽA, 1998), and 73 taxa (20.2 %) on Krapanj and Prvić (PANDŽA, 1998a). The much smaller number of widespread plants on the islands investigated suggests a less strong anthropogenic impact there. Although uninhabited, these islands have four naturalized species, *Opuntia vulgaris* on Lukovnik, *Cupressus sempervirens* on Kakan, Tijat, Lukovnik and *Robinia pseudoacacia* on Kakan and Kamenica. *Ceratonia siliqua* is known in the Šibenik archipelago from the island of Murter only (PANDŽA, 1998b), but during the latest researches it has been registered on the islands of Kornati (Ropotnica) and Kakan, too, which present new localities of this species, although it is deemed to have been imported there.

The families richest with species are *Fabaceae* (35 species, 12.59%) and *Poaceae* (27 species, 9.71 %), then come *Cichoriaceae* (19 species, 6.8 %), *Asteraceae* (15 species, 5.4 %) and *Lamiaceae* (15 species, 5.4 %). In the life form spectrum, therophytes are dominant with 113 taxa (40.65 %), hemicryptophytes (64 taxa, 23.02 %) and phanerophytes (41 taxa, 14.75 %). The neighbouring islands have a higher share of therophytes – Kaprije 132 taxa (47.5 %), Zlarin 160 taxa (46.7 %), Krapanj and Prvić 175 taxa (48.3 %). Generally, it can be concluded that the flora of all the islands investigated has a Mediterranean character.

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S A Ž E T A K

Flora nekih nenaseljenih šibenskih otoka (Dalmacija, Hrvatska)

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Tijekom 2001. godine obavljena su floristička istraživanja nenastanjenih otoka Kakna, Tijata, Zmajana, Logoruna, Lukovnika, Sovljaka, Prišnjaka, Kamenice, Malog i Velikog Borovnjaka (sl. 1). U flori istraživanih otoka zabilježeno je ukupno 278 taksona. Najviše taksona ima Kakan (206), a zatim slijede Zmajan (158), Tijat (152), Logorun (124) i Lukovnik (104) (tab. 2). Jasno je vidljivo da broj vrsta opada s površinom otoka (usp. sl. 1 i tab. 2). Iznimku, npr., predstavlja Lukovnik koji je s obzirom na površinu malen, ali je na njemu, zbog blizine kopna (Tribunj) i zbog jakog antropogenoga utjecaja, broj vrsta velik u odnosu na površinu. Od ukupnoga broja taksona zabilježenih na istraživanim otocima, mediteranskom flornom elementu pripada 168 (60.43 %), među kojima su najbrojnije cirkummediteranske biljke (96 taksona, 34.5 %). To je najveći postotak mediteranskoga flornog elementa u usporedbi sa susjednim otocima. Unutar mediteranskoga flornog elementa, s biljnogeografskoga gledišta, posebnu pozornost zaslužuju ilirsko-jadranske endemične biljke kojih ima 18 vrsta (6.47 %) i ilirsko-apeninske biljke (5 vrsta, 1.8 %). Od endema ističemo ilirsko-jadransku vrstu *Iris illyrica* koja je zabilježena za otoke Kakan, Tijat, Kamenicu, Logorun, Zmajan, Sovljak i Prišnjak, te ilirsko-apeninsku vrstu *Convolvulus cneorum* s otočića Kamenice. Po rasprostranjenosti iza biljaka mediteranskoga flornog elementa slijede biljke južnoeuropskoga flornog elementa (46 taksona, 16.55 %) i biljke široke rasprostranjenosti (38 taksona, 13.67 %). Znatno manji broj biljaka

široke rasprostranjenosti na istraživanim otocima ukazuje na njihov manji antropogeni utjecaj. Iako su otoci nenastanjeni, na njima su nazočne i četiri naturalizirane vrste *Opuntia vulgaris* na Lukovniku, *Cupressus sempervirens* na Kaknu, Tijatu i Lukovniku, *Robinia pseudoacacia* na Kaknu i Kamenici te *Ceratonia siliqua*. Vrsta *Ceratonia siliqua* poznata je u Šibenskom arhipelagu samo s otoka Murtera (PANDŽA, 1998b). Najnovijim istraživanjima zabilježena je na otoku Kornatu (Ropotnica) i na Kaknu što predstavlja nove nalaze te vrste, iako se smatra da je ona tamo unijeta.

Vrstama su najbogatije porodice *Fabaceae* (35 vrste, 12.59 %) i *Poaceae* (27 vrsta, 9.71 %), a zatim slijede *Cichoriaceae* (19 vrsta, 6.8 %), *Asteraceae* (15 vrsta, 5.4 %) i *Lamiaceae* (15 vrsta, 5.4 %). U spektru životnih oblika dominiraju terofiti sa 113 taksona (40.65 %), a zatim slijede hemikriptofiti (64 taksona, 23.02 %) i fanerofiti (41 takson, 14.75 %). Susjedni otoci imaju veće učešće terofita – Kaprije 132 taksona (47.5 %), Zlarin 160 taksona (46.7 %), Krapanj i Prvić 175 taksona (48.3 %). Općenito se može zaključiti da flora svih istraživanih otoka ima mediteranski karakter.