Contribution to the flora of the islets of the Medulin Archipelago (Istria)

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Abstract

The flora of six islets of the Medulin Archipelago (Bodulaš, Ceja, Fenera, Fenoliga, Šekovac, Trumbaja) in southern Istria was explored in 2014 and 2021. Altogether, 214 taxa belonging to 50 families were recorded. As expected, the families most represented were Poaceae and Fabaceae, the most common chorotypes were the Mediterranean floral element followed by widespread plants and the South European floral element, while the most represented life-forms were therophytes, hemicryptophytes and geophytes. Altogether 15 taxa within IUCN categories were recorded; however, the flora of the area is generally not threatened. The finding of *Anthemis tomentosa*, *Trifolium glomeratum*, *Coronopus didymus* and *Campanula rapunculus* f. *verruculosa* was particularly interesting.

Keywords: flora, plant diversity, Bodulaš, Ceja, Fenera, Fenoliga, Šekovac, Trumbaja

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Sažetak

Flora šest otočića Medulinskog arhipelaga (Bodulaš, Ceja, Fenera, Fenoliga, Šekovac, Trumbaja) u južnoj Istri istraživana je 2014. i 2021. godine. Zabilježeno je ukupno 214 svojti iz 50 biljnih porodica. Očekivano, najzastupljenije vrstama bile su porodice Poaceae i Fabaceae, najčešći horotipovi bili su mediteranski florni element, široko zastupljene vrste i južnoeuropski florni element, dok su najzastupljeniji životni oblici bili terofiti, hemikriptofiti i geofiti. Zabilježeno je ukupno 15 svojti sa IUCN kategorijama; međutim, flora istraživanog područja općenito nije ugrožena. Nalazi svojti *Anthemis tomentosa*, *Trifolium glomeratum*, *Coronopus didymus* i *Campanula rapunculus* f. *verruculosa* bili su posebno zanimljivi.

Ključne riječi: flora, biljna raznolikost, Bodulaš, Ceja, Fenera, Fenoliga, Šekovac, Trumbaja

Introduction

The Significant Landscape "Lower Kamenjak and the Medulin Archipelago" covers the southernmost tip of the Istrian peninsula together with islets scattered across the Medulin Archipelago (Fig. 1). This area is characterized by specific microclimatic conditions combined with rich and diverse flora and fauna and various landscapes, contributing to its exceptional natural value. For these reasons, the area has been legally protected since 1996. The history of land use includes centuries of traditional agriculture, during which the natural forest vegetation, *Fraxino orni-Quercetum ilicis* Horvatić (1956) 1958, gradually transitioned into a mosaic of semi-natural habitats. Long-term human activities related to agriculture transformed the native forest into maquis, garrigues and dry rocky grasslands; therefore, the current vegetation of the Significant Landscape is mostly a mixture of woody vegetation (littoral evergreen forests and maquis and anthropogenic forest stands), dry eu-Mediterranean grasslands (*Scorzoneretalia villosae* Kovačević 1959), agricultural land and ruderal vegetation (Ljubičić et al. 2020).

Although southern Istria has a very long history of botanical research (Tommasini 1873, Neugebauer 1875, Freyn 1877, 1881, 1900, Topić & Šegulja 2000, Vuković et al. 2011), researchers are always more focused on the mainland than on the islands. Additionally, many data from this area are very old and not available through the online Flora Croatica Database (Nikolić 2005-onwards), the area seeming at first glance to be unexplored. Still, floristic data on the islets of the Medulin Archipelago from the second half of the 19th century do exist in the literature (Tommasini 1873, Neugebauer 1875, Freyn 1877); they were gathered during detailed botanical surveys of southern Istria, which included the surrounding islands and islets. After these comprehensive historical surveys, the islets of the Medulin Archipelago were "forgotten" by botanists for almost a century. Some of them appear again in the literature in 1966, in the graduation thesis by Birač (1966) who studied the flora and vegetation of Bodulaš, Ceja, Fenera and Trumbaja and performed the most recent study of the islets to date, recording altogether 252 plant taxa. Our study focused on the six largest islets surrounding the peninsula of Premantura, five of them situated in Medulin Bay (Bodulaš, Ceja, Trumbaja, Šekovac and Fenera) and one situated westwards from Premantura (Fenoliga) (Fig. 1). Our field survey of Bodulaš, Ceja and Fenera was the first in approximately 50 years, while our survey of Fenoliga and Šekovac was the first in approximately 140 years.

The islets are very small; the area of the largest islet, Ceja, is less than 1 km^2. Birač (1966) grouped the vegetation of the islets into three groups: grasslands, halophytic vegetation and ruderal vegetation. Similarly, Ljubičić et al. (2020) report that the islets are mainly covered with Mediterranean grassland vegetation, accompanied by vegetation of coastal rocks on the margins. The islets are uninhabited and there is little human influence. Ceja is seasonally exploited for tourism, with a restaurant and a bar open during the summer months. Bodulaš is used for sheep and cow grazing, although only few animals were encountered at the time of our visit. The remaining islets are completely deserted, only sporadically visited by tourists or local inhabitants in small boats. Due to their isolated position, most of the islets are inhabited by nesting seagulls.

Material and methods

The islets were surveyed in two occasions within the scope of two different projects (Fig. 1). First visit was in June 2014 and second in May 2021. Islets Ceja, Fenera and Fenoliga were surveyed during both visits, while islets Bodulaš and Šekovac were surveyed during the second visit. Flora of the islets was mostly recorded in the field and some plant material was collected and transported to ZAGR and ZA collections (acronyms are according to Thiers 2023) for further analyses, where collected plant material is currently stored. All plant material from ZA herbarium is digitized. Finally, a complete list of vascular flora was compiled for each islet and total flora was analysed.

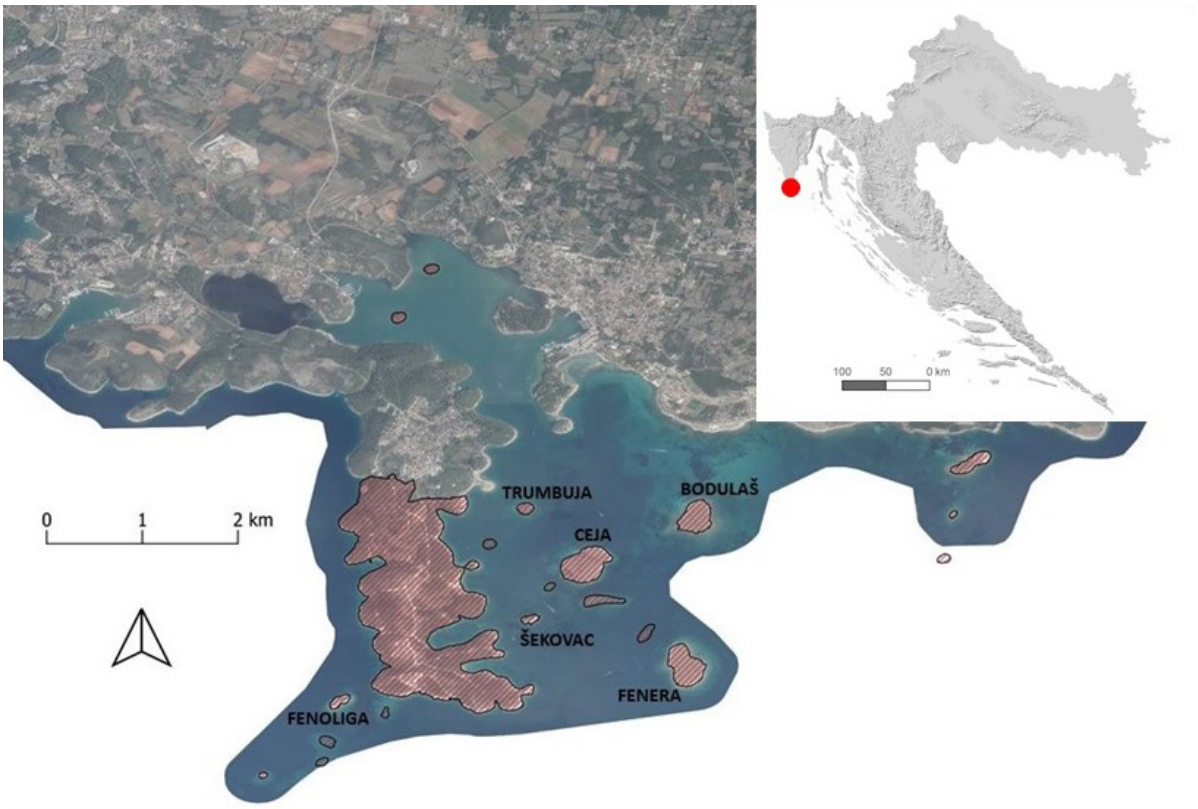

Figure 1. The studied area. Dashed – Significant Landscape "Lower Kamenjak and the Medulin Archipelago". Red dot – location of the study area within Croatia.
Slika 1. Istraživano područje. Iscrtano – Značajni krajobraz "Donji Kamenjak i Medulinski arhipelag". Crvena točka – smještaj istraživanog područja unutar Hrvatske.

Chorotypes were assigned ccording to Horvatić (1963) and Horvatić et al. (1967/1968), using abbreviations as follows:

1. Circum-Holarctic plants (CHSP)
2. Cultivated and adventive plants (CUAD)
3. Eurasian floral element (EUAS)
4. European floral element (EU)
5. Mediterranean floral element
    a. Circum-Mediterranean plants (CME)
    b. East Mediterranean plants (EME)
    c. European Mediterranean plants (EUME)
    d. Illyrian Mediterranean plants
        i. Illyrian-Adriatic plants
            1. Illyrian-Adriatic endemic plants (IADE)
            2. Kvarnerian-Liburnian endemic plants (KLE)
            3. Illyrian-Apennine plants (IAP)
        ii. Illyrian-South European plants (ISEU)

e. Mediterranean-Atlantic plants (MEAT)
f. Mediterranean-Pontic plants (MEPO)
g. West Mediterranean plants (WME)

6. South European floral element
   a. South European-Atlantic plants (SEUAT)
   b. South European-Mediterranean plants (SEUME)
   c. South European-Pontic plants (SEUPO)
7. Widespread plants (WSP)

The life-form spectrum was prepared according to Raunkiaer (1934). Life-forms were given according to Pignatti (1982), abbreviated as follows: Ch – chamaephytes, G – geophytes, H – hemicryptophytes, P – phanerophytes and T – therophytes.

Nomenclature of taxa, as well as IUCN categories and invasive status were assigned ccording to Flora Croatica Database (Nikolić 2005-onwards).

Results and discussion

We have recorded altogether 214 plant taxa from 50 plant families in the studied area (Appendix 1). Most families are represented with fewer than 10 taxa; only the families Poaceae, Fabaceae, Asteraceae and Caryophyllaceae are represented with more (31, 28, 13 and 11 taxa, respectively) (Fig. 2). The greatest number of taxa was recorded on Ceja (151 taxa) (Fig. 3), visited twice during our study. Its floristic richness is a consequence of both size and ruderal influence; Ceja is the largest of all the islets investigated and comparatively more anthropogenized.

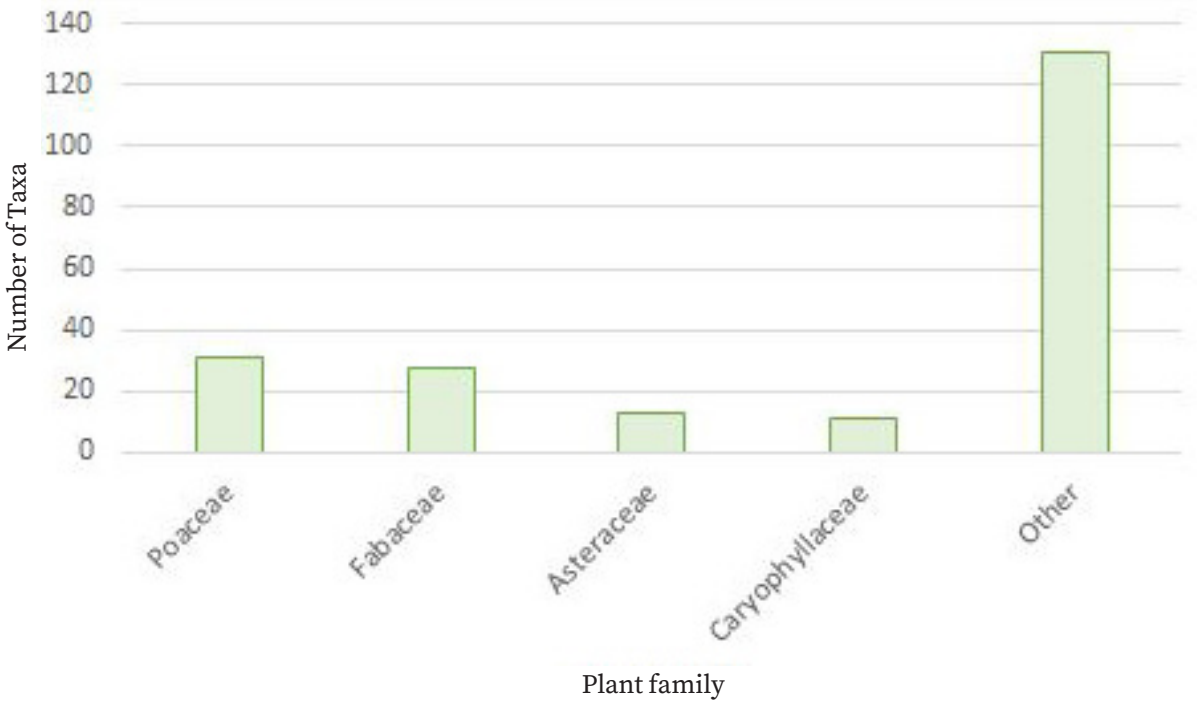

Figure 2. The number of taxa belonging to different plant families in the studied area.
Slika 2. Broj svojti po porodicama u istraživanom području.

Figure 3. The number of taxa recorded on each islet in the studied area.
Slika 3. Broj svojti zabilježenih na svakom otočiću u istraživanom području.

The majority of plant taxa from the islets are typically Mediterranean, i.e. commonly occurring in the eu-Mediterranean belt of Croatia. The occurrence of these taxa on islands is therefore usual and is to be expected in the whole of the studied area. Interestingly, the pattern observed in the field was that, although the flora consists of typical taxa, the islets are obviously dissimilar in species composition and many taxa are confined to a single islet. The analysis has shown that as many as 82 taxa were found on a single islet, while as few as 15 taxa were common to all these islets (Fig. 4). This pattern is a consequence of geographical isolation combined by poor connection by means of transport, which reduces the opportunity for biological exchange.

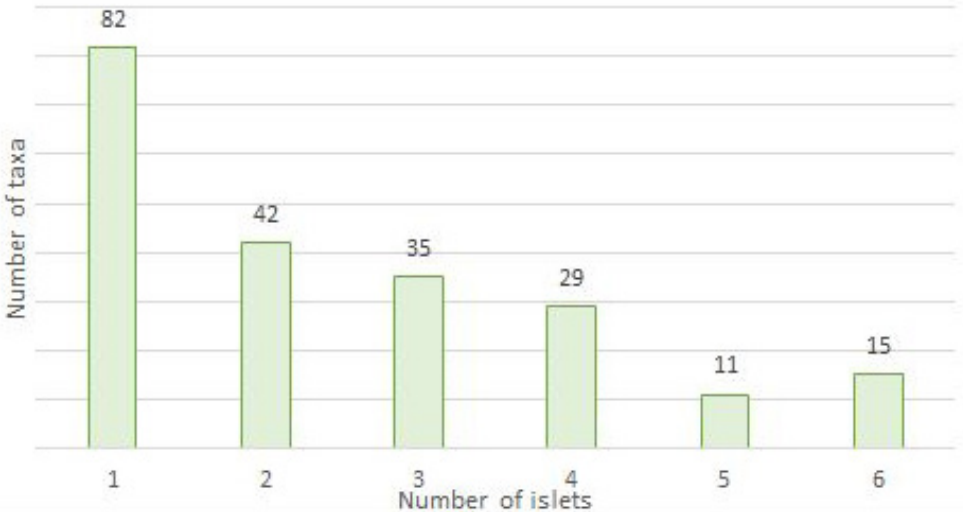

Figure 4. The number of taxa found only on a certain number of studied islets (1-6 – number of islets).
Slika 4. Broj svojti zabilježenih samo na određenom broju istraživanih otočića (1-6 – broj otočića).

The chorological spectrum shows the dominance of Mediterranean plants and clearly reflects the phytogeographical position of the investigated area, which is in line with floristic studies of similar areas (Pandža 2003, Pandža & Milović 2015, Milović et al. 2016, Limić et al. 2018, Justić et al. 2021). Plants from the Mediterranean floral element clearly dominate and constitute 43.46% of the total flora (93 taxa) (Fig. 5). They are followed by widespread plants (53 taxa, 24.77%) and South European plants (39 taxa, 18.22%). Such a composition of the flora with large shares of Mediterranean and South European elements is typical for areas with a Mediterranean climate, characterized by hot, dry summers and mild winters. Altogether five taxa are considered endemic, with limited Illyrian-Adriatic distribution. The stenoendemic *Serapias istriaca* was described from southern Istria (Perko 1998), and is so far known only in this area. We recorded this taxon on Šekovac islet.

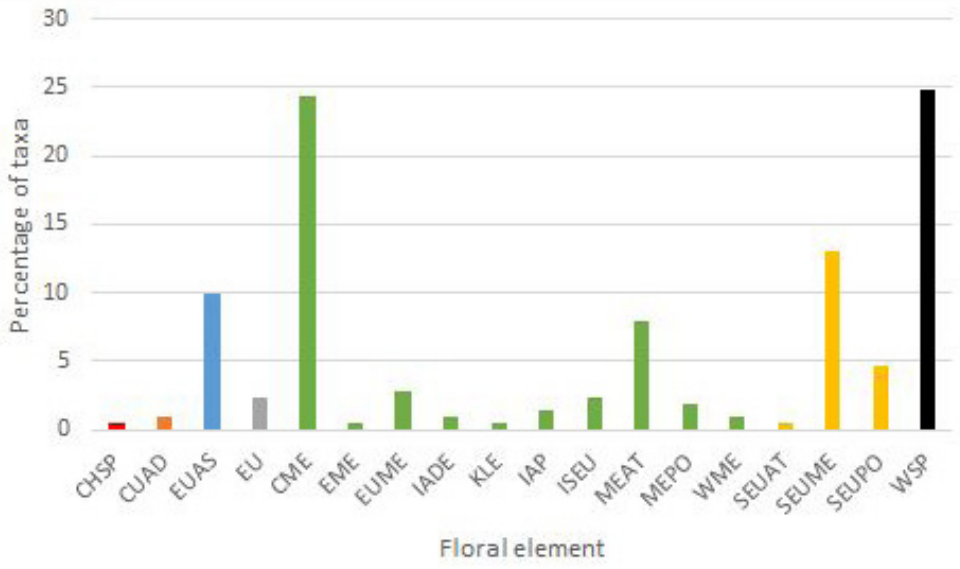

Figure 5. Chorological spectrum of the flora of the studied area. Different colours indicate different floral elements. CHSP – Circum-Holarctic plants, CUAD – Cultural and adventitious plants, EUAS – Eurasian floral element, EU – European floral element, CME – Circum-Mediterranean plants, EME – East Mediterranean plants, EUME – European Mediterranean plants, IADE – Illyrian-Adriatic endemic plants, KLE – Kvarnerian-Liburnian endemic plants, IAP – Illyrian-Apennine plants, ISEU – Illyrian-South European plants, MEAT – Mediterranean-Atlantic plants, MEPO – Mediterranean-Pontic plants, WME – West Mediterranean plants, SEUAT – South European-Atlantic plants, SEUME – South European-Mediterranean plants, SEUPO – South European-Pontic plants, WSP – Widespread plants.

Slika 5. Horološki spektar flore istraživanog područja. Različite boje označavaju različite florne elemente. CHSP – Cirkumholarktičke biljke, CUAD – kultivirane i adventivne biljke, EUAS – Euroazijski florni element, EU – Europski florni element, CME – Cirkummediteranske biljke, EME – Istočno-mediteranske biljke, EUME – Europsko-mediteranske biljke, IADE – Ilirsko-jadranske endemične biljke, KLE – Kvarnersko-liburnijske endemične biljke, IAP – Ilirsko-apeninske biljke, ISEU – Ilirsko-južnoeuropske biljke, MEAT – Mediteransko-atlanske biljke, MEPO – Mediteransko-pontske biljke, WME – Zapadno-mediteranske biljke, SEUAT – Južnoeuropsko-atlantske biljke, SEUME – Južnoeuropsko-mediteranske biljke, SEUPO – Južnoeuropsko-pontske biljke, WSP – široko rasprostranjene biljke.

Euphorbia adriatica, recently separated from *E. nicaeensis* according to molecular and morphological analyses, is distributed in the northern and central Apennine Peninsula and the northern Balkan Peninsula (Stojilković et al. 2022). In our study, it was recorded in grassland vegetation on the islet of Trumbaja. *Stachys subcrenata* displays a similar range, mainly distributed around the eastern Adriatic coast and the Balkan Peninsula (Chrtek 1992). We found this taxon only on Fenoliga. *Vincetoxicum hirundinaria* ssp. *adriaticum* is distributed more narrowly and occurs along the Adriatic coast, with records mainly in the eastern part of the Adriatic but also in the west. It is common in the studied area, recorded on Trumbaja, Fenoliga and Šekovac. Although *Limonium cancellatum* was frequently recorded in the past and is apparently widely distributed along the eastern Adriatic coast (Nikolić 2005-onwards), more recent taxonomic revision of the group shows that *L. cancellatum* is restricted to the Northern Adriatic where it is common, and is replaced with various other *Limonium* taxa towards the south (Bogdanović & Brullo 2015). This taxon was recorded in the vegetation of calcareous rocks on all the islets.

The life-form spectrum (Fig. 6) is also typical for the studied area. The clear domination of therophytes (94 taxa, 43.93 %) indicates the Mediterranean character of the area, where many plants finish their life cycle every year, thus avoiding the summer months, when the conditions are unfavourable (dry period with high temperatures and insolation). The overall dominance of therophytes, hemicryptophytes and geophytes clearly reflects the prevalence of grassland vegetation, which is the main vegetation cover in the study area.

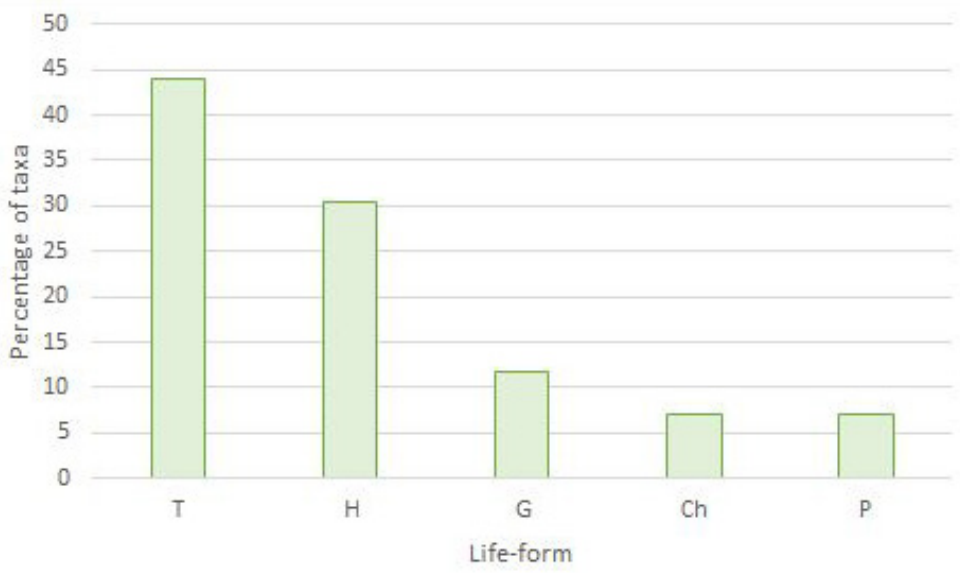

Figure 6. Life-form spectrum (Ch – chamaephytes, G – geophytes, H – hemicryptophytes, P – phanerophytes and T – therophytes) of the flora of the studied area.
Slika 6. Spektar flornih oblika (Ch – hamefiti, G – geofiti, H – hemikriptofiti, P – fanerofiti i T – terofiti) istraživanog područja.

Although 15 taxa belong to some IUCN category (Appendix 1), the flora of the islets is generally not threatened. The number of taxa designated as endangered (CR, EN or VU) is low (seven taxa, 3.27 %). Additionally, the area is almost fully free of negative impacts, due to its isolation. The impact of tourism is negligible, and the influence of secondary succession is not significant. The islets are almost completely covered with grasslands, with a small number of woody taxa scattered around with no significant coverage. The influence of invasive species is also negligible as the only two taxa listed as invasive were *Amaranthus deflexus* and *Opuntia ficus-indica*, both recorded on a single islet (Fenera and Ceja, respectively) with very low abundance.

Records of *Anthemis tomentosa*, *Trifolium glomeratum*, *Coronopus didymus* and *Campanula rapunculus* f. *verruculosa* were intriguing and the collected material is listed in Tab. 1.

In Croatia, *Anthemis tomentosa* is so far known only from southern Istria, with published findings by Topić et al. (1997) and Vuković et al. (2022), as well as a personal communication by Rottensteiner who found several plants on the islet of Fenoliga. The species is accordingly designated as critically endangered (CR); however, the discovery of a large, vigorous population on Šekovac during this study was in line with our previous observations that the Croatian population of *A. tomentosa* is spreading, rather than declining (Vuković et al. 2022). We may conclude that, although *A. tomentosa* is rare in Croatia and restricted to southern Istria, its population is so far stable and even appears to be enlarging; therefore, the threat level is not as severe as previously thought.

In Croatia, *Trifolium glomeratum* is designated as data deficient (DD) and the number of findings is relatively low. Its Croatian distribution is mainly Mediterranean (Nikolić 2005-onwards), with few literature records in southern Istria to date (Freyn 1877, Topić and Šegulja 2000, Brana 2007, Rottensteiner 2014) and herbarium records from Bogdanović and Ljubičić (ZAGR 37801-37802). We found a small population among grassland vegetation on Bodulaš.

Coronopus didymus is another interesting plant, relatively rarely recorded in Croatia with records in the Mediterranean part of the country. Most previous occurrences are in the northern Adriatic, in Istria and Kvarner Bay (Nikolić 2005-onwards). During our study this small decumbent ruderal plant was found only on Fenera, on bare ground between grassland and calcareous rocks.

Specimens of *Campanula rapunculus* were identified as *C. rapunculus* f. *verruculosa*, a form with glandular calyx already noted by Freyn (1877) and Topić & Šegulja (2000) for southern Istria. Although *C. rapunculus* is widely distributed throughout the Croatian coast, the glandular form is typically found only in northern parts. In this study it was recorded in grasslands of Bodulaš, Ceja and Trumbaja.

During our study it came to our attention that the historical findings of *Lotus parviflorus* Desf. in the area were very interesting. This species is very similar to (and easily mistaken for) *L. angustissimus*, with which it shares habitats. During fieldwork we collected several plants belonging to this group (from Bodulaš, Ceja and Rt Kamenjak; ZA76271, ZA76272, ZAGR77211), which were studied in detail and after careful consideration finally identified as *L. angustissimus*. In Croatia, *L. parviflorus* was only recorded historically and has never since been confirmed in the field since, although historical findings were cited later several times. Historical records refer to Bodulaš islet (= S. Marina, Tommasinii 1873) and Lošinj and Unije (Tommasinii 1895, Haračić 1905). All these papers mention both *L. parviflorus* and *L. angustissimus* occurring in the same localities. Freyn (1877) however does not confirm the findings from Bodulaš (1873), but interestingly includes Tommasinii's findings under *L. angustissimus*. Recent taxonomic study of this group (Kramina 2006) locates *L. parviflorus* in former Yugoslavia countries; however, the study does not cite any herbarium material from this

area. Moreover, the collections ZA, ZAHO, ZAGR and CNHM have no specimens of *L. parviflorus*. In conclusion, *L. parviflorus* is a quite mysterious plant recorded in the studied area in bygone times but not confirmed in the field for the last 118 years. The occurrence of this species in Croatia should be checked in the field.

Table 1. A list of herbarium sheets of interesting taxa collected during our study.
Tablica 1. Popis herbarijskih listova zanimljivih svojti skupljenih tijekom ovog istraživanja.

Taxa	Locality	Collection	ID
Anthemis tomentosa L.	Šekovac	ZA	75344-75348
Trifolium glomeratum L.	Bodulaš	ZA	76484-76486
Coronopus didymus (L.) Sm.	Fenera	ZA	75357-75358
	Fenera	ZAGR	37873
Campanula rapunculus L. f. *verruculosa* Freyn	Bodulaš	ZA	76488
	Trumbaja	ZA	76557

In conclusion, the vascular flora of the studied area is mainly composed of typical representatives, commonly found in the Mediterranean zone of Croatia, with most taxa, as a result of geographical isolation, inhabiting only a small number of islets. Although some rare and endangered taxa were recorded, their populations are so far not threatened in any way. Our results represent a valuable contribution to the knowledge on the studied area, considering the age of previous floristic data.

Acknowledgements

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Appendix 1. List of all taxa recorded in the studied area arranged by alphabetical order of plant families. IUCN – IUCN status, Inv – invasive plant, End – endemic plant, Chor – chorotype, LF – life-form, Isl – number of islets where the taxa was recorded. For abbreviations of chorology and life-forms see Material and methods.

Prilog 1. Popis svih svojti zabilježenih u istraživanom području, organiziran abecedno po porodicama. IUCN – IUCN status, Inv – invazivna biljka, End – endemična biljka, Chor – horotip, LF – životni oblik, Isl – broj otočića na kojima je vrsta zabilježena. Za skraćenice horoloških tipova i životnih oblika pogledati poglavlje Materijali i metode.

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
Amaranthaceae	*Amaranthus deflexus* L.					+			INV		CUAD	T	1
Amaryllidaceae	*Allium ampeloprasum* L.	+			+	+					CME	G	3
	Allium commutatum Guss.				+						CME	G	1
	Allium sphaerocephalon L.		+		+						SEUME	G	2
	Narcissus tazetta L.		+	+		+		NT			CME	G	3
Anacardiaceae	*Pistacia terebinthus* L.		+								CME	P	1
Apiaceae	*Bupleurum veronense* Turra		+	+							ISEU	T	2
	Crithmum maritimum L.	+	+	+	+	+	+				MEAT	CH	6
	Daucus carota L.			+			+				EUAS	H	2
	Eryngium amethystinum L.		+	+							ISEU	H	2
	Eryngium campestre L.		+								SEUME	H	1

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Oenanthe silaifolia M. Bieb.	+	+								SEUPO	H	2
	Tordylium apulum L.		+								CME	T	1
	Torilis nodosa (L.) Gaertn.	+	+			+					MEAT	T	3
Aristolochiaceae	*Aristolochia rotunda* L.	+									CME	G	1
Asclepiadaceae	*Vincetoxicum hirundinaria* Medik. ssp. *adriaticum* (Beck) Markgr.			+	+		+	LC		END	IADE	G	3
Asparagaceae	*Asparagus acutifolius* L.	+	+	+	+	+	+				CME	G	6
	Muscari comosum (L.) Mill.	+	+		+	+					SEUME	G	4
	Ornithogalum kochii Parl.						+	LC			WME	G	1
	Ornithogalum sphaerocarpum A. Kern.	+	+	+	+	+					EUME	G	5
	Ruscus aculeatus L.		+	+	+			LC			MEPO	G	3
Asteraceae	*Achillea millefolium* L.	+									WSP	H	1
	Anthemis tomentosa L.						+	CR			SEUME	T	1
	Bombycilaena erecta (L.) Smoljan.		+								SEUPO	T	1
	Carduus micropterus (Borbás) Teyber	+	+	+	+	+	+				IADE	H	6

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Carduus pycnocephalus L.		+								CME	H	1
	Carlina corymbosa L.		+	+							CME	H	2
	Carthamus lanatus L.	+	+			+					CME	T	3
	Dittrichia viscosa (L.) Greuter	+	+		+		+				CME	H	4
	Filago pyramidata L.		+								SEUME	T	1
	Helichrysum italicum (Roth) G. Don		+	+			+				CME	CH	3
	Inula crithmoides L.	+			+						MEAT	CH	2
Boraginaceae	*Echium vulgare* L.		+								EU	H	1
	Myosotis ramosissima Rochel	+									EUAS	T	1
Brassicaceae	*Cakile maritima* Scop.	+	+	+		+					WSP	T	4
	Capsella rubella Reut.		+								CME	T	1
	Cardaria draba (L). Desv.	+	+			+					WSP	H	3
	Coronopus didymus (L.) Sm.					+					WSP	T	1
	Diplotaxis erucoides (L.) DC.				+						WME	T	1
	Diplotaxis tenuifolia (L.) DC.	+		+							WSP	H	2

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Erophila verna (L.) Chevall.				+						WSP	T	1
	Hornungia petraea (L.) Rchb.				+	+	+				WSP	T	3
	Sisymbrium officinale (L.) Scop.	+	+			+					WSP	T	3
Cactaceae	*Opuntia ficus-indica* (L.) Mill.		+						INV		CUAD	P	1
Campanulaceae	*Campanula rapunculus* L. f. *verruculosa* Freyn	+	+	+							EUAS	H	3
Caprifoliaceae	*Lonicera etrusca* Santi		+								CME	P	1
Caryophyllaceae	*Arenaria leptoclados* (Rchb.) Guss.	+	+	+		+					EUAS	T	4
	Cerastium brachypetalum Pers.	+	+	+	+						SEUAT	T	4
	Herniaria glabra L.			+							EUAS	T	1
	Polycarpon tetraphyllum (L.) L.		+								SEUME	T	1
	Sagina maritima Don		+		+	+	+				MEAT	T	4
	Silene gallica L.	+	+			+	+				WSP	T	4
	Silene latifolia Poir. ssp. *alba* (Mill.) Greuter et Bourdet	+	+			+					EUAS	H	3

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Silene vulgaris (Moench) Garcke ssp. *vulgaris*	+	+			+	+				EUAS	H	4
	Silene vulgaris (Moench) Garcke ssp. *angustifolia* Hayek	+		+		+					SEUME	H	3
	Spergularia salina J. Presl et C. Presl	+	+		+	+					WSP	T	4
	Stellaria media (L.) Vill.		+								WSP	T	1
Chenopodiaceae	*Arthrocnemum macrostachyum* (Moric.) K. Koch	+	+	+	+	+	+				SEUME	CH	6
	Atriplex prostrata DC.	+	+	+	+	+	+				WSP	T	6
	Beta vulgaris L. ssp. *maritima* (L.) Arcang.	+	+	+		+					MEAT	H	4
	Chenopodium album L.		+	+	+	+					WSP	T	4
	Halimione portulacoides (L.) Aellen	+									WSP	CH	1
	Salsola kali L.		+					VU			WSP	T	1
	Salsola soda L.	+	+	+		+		VU			SEUPO	T	4
Cichoriaceae	*Aetheorhiza bulbosa* (L.) Cass.		+		+		+				CME	G	3
	Hedypnois cretica (L.) Dum. Cours.		+	+							CME	T	2

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Hieracium piloselloides Vill.			+							ISEU	H	1
	Reichardia picroides (L.) Roth		+	+	+		+				CME	H	4
	Scolymus hispanicus L.		+			+					CME	H	2
	Scorzonera villosa Scop.		+	+							ISEU	H	2
	Sonchus asper (L.) Hill	+	+	+	+	+	+				CME	T	6
	Sonchus oleraceus L.				+						WSP	T	1
	Urospermum dalechampii (L.) F. W. Schmidt	+	+	+			+				CME	H	4
Clusiaceae	*Hypericum perforatum* L. ssp. *veronense* (Schrank) H. Lindb.		+	+			+				SEUME	H	3
Convolvulaceae	*Convolvulus arvensis* L.	+			+	+					WSP	G	3
	Convolvulus cantabrica L.	+	+	+		+	+				SEUME	H	5
Crassulaceae	*Sedum acre* L.		+	+	+	+	+				EUAS	CH	5
	Sedum rubens L.		+								SEUME	T	1
Cyperaceae	*Carex divisa* Huds.	+	+			+		EN			MEAT	G	3
	Carex divulsa Stokes	+	+								WSP	H	2
	Carex flacca Schreb.	+	+	+	+	+	+				WSP	G	6

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Schoenus nigricans L.		+								WSP	H	1
Ericaceae	*Erica arborea* L.		+	+							CME	P	2
Euphorbiaceae	*Euphorbia adriatica* Stojilkovič, Záveská et Frajman			+						END	IAP	G	1
	Euphorbia helioscopia L.	+	+			+	+				WSP	T	4
	Euphorbia paralias L.		+				+				MEAT	CH	2
	Euphorbia peplus L.		+								WSP	T	1
Fabaceae	*Anthyllis vulneraria* L. ssp. *praepropera* (A. Kern.) Bornm.			+			+				EUME	H	2
	Dorycnium hirsutum (L.) Ser.	+	+	+	+		+				CME	CH	5
	Genista tinctoria L.	+				+					WSP	CH	2
	Lathyrus aphaca L.		+								SEUME	T	1
	Lathyrus latifolius L.	+				+					SEUME	H	2
	Lotus angustissimus L.	+	+								EUME	T	2
	Lotus corniculatus L. ssp. *corniculatus*		+								WSP	H	1
	Lotus corniculatus L. ssp. *hirsutus* Rothm.		+	+			+				SEUME	H	3

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Lotus cytisoides L.		+	+	+		+				CME	CH	4
	Lupinus micranthus Guss.						+				EME	T	1
	Medicago arabica (L.) Huds.		+								WSP	T	1
	Medicago orbicularis (L.) Bartal.		+								CME	T	1
	Melilotus indicus (L.) All.	+			+						CME	T	2
	Melilotus officinalis (L.) Lam				+						EUAS	H	1
	Scorpiurus muricatus L.		+	+							CME	T	2
	Spartium junceum L.	+	+								CME	P	2
	Trifolium angustifolium L.	+	+								CME	T	2
	Trifolium arvense L.	+	+								EUAS	T	2
	Trifolium campestre Schreb.	+	+	+	+		+				WSP	T	5
	Trifolium glomeratum L.	+						DD			SEUME	T	1
	Trifolium lappaceum L.		+								CME	T	1
	Trifolium pratense L.	+									EUAS	H	1

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Trifolium repens L.		+								WSP	H	1
	Trifolium scabrum L.		+	+	+		+				CME	T	4
	Trifolium stellatum L.		+	+							CME	T	2
	Trifolium subterraneum L.		+								MEAT	T	1
	Vicia cracca L.					+					CHSP	H	1
	Vicia sativa L.	+			+	+	+				WSP	T	4
Fumariaceae	*Fumaria officinalis* L. ssp. *wirtgenii* (W. D. J. Koch) Arcang.			+							EUME	T	1
Gentianaceae	*Blackstonia perfoliata* (L.) Huds.		+	+			+				MEAT	T	3
	Centaurium maritimum (L.) R. M. Fritsch		+				+				CME	T	2
	Centaurium erythraea Rafn				+						WSP	T	1
	Centaurium pulchellum (Sw.) Druce		+	+	+		+				EUAS	T	4
Geraniaceae	*Erodium cicutarium* (L.) L'Hér.	+									WSP	T	1
	Geranium columbinum L.		+	+		+	+				EUAS	T	4
	Geranium molle L.						+				WSP	T	1
	Geranium pusillum Burm. f.		+								EU	T	1

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
Juncaceae	*Juncus acutus* L.	+									MEAT	H	1
	Juncus bufonius L.	+									WSP	T	1
Lamiaceae	*Calamintha nepetoides* Jord.		+								SEUPO	H	1
	Salvia bertolonii Vis.	+		+			+				EU	H	3
	Satureja montana L.			+							SEUME	CH	1
	Stachys recta L.	+	+	+	+	+	+				SEUPO	H	6
	Stachys subcrenata Vis.				+					END	IAP	H	1
	Teucrium chamaedrys L.	+	+	+							SEUPO	CH	3
	Teucrium polium L. ssp. *capitatum* (L.) Arcang.		+	+			+				MEPO	CH	3
	Thymus serpyllum L.		+								EUAS	CH	1
Linaceae	*Linum strictum* L. ssp. *corymbulosum* (Rchb.) Riony		+	+							MEPO	T	2
	Linum trigynum L.			+			+				CME	T	2
	Linum usitatissimum L.	+	+	+							WSP	T	3
Malvaceae	*Althaea cannabina* L.	+				+					SEUPO	H	2
	Malva sylvestris L.	+	+		+	+	+				WSP	H	5
Moraceae	*Ficus carica* L.		+	+		+	+				CME	P	4

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
Oleaceae	*Olea europaea* L. var. *sylvestris* Brot.			+							CME	P	1
Orchidaceae	*Ophrys bombyliflora* Link			+				VU			CME	G	1
	Serapias istriaca Perko						+			END	KLE	G	1
	Serapias lingua L.			+							CME	G	1
Papaveraceae	*Glaucium flavum* Crantz	+	+					EN			MEAT	H	2
Pinaceae	*Pinus halepensis* Mill.			+							CME	P	1
Plantaginaceae	*Plantago coronopus* L.	+	+		+	+					EUAS	T	4
	Plantago holosteum Scop.			+			+				SEUME	T	2
	Plantago lanceolata L.	+	+	+	+	+					WSP	H	5
Plumbaginaceae	*Limonium cancellatum* (Bernh. ex Bertol.) Kuntze	+	+	+	+	+	+			END	IAP	H	6
	Limonium narbonense Mill.					+					CME	H	1
	Plumbago europaea L.		+								CME	CH	1
Poaceae	*Aegilops uniaristata* Vis.		+					NT			CME	T	1
	Aira elegantissima Schur		+								SEUME	T	1

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Anthoxanthum odoratum L.	+	+	+		+					EUAS	H	4
	Avena barbata Link	+	+		+	+	+				WSP	T	5
	Brachypodium pinnatum (L.) P. Beauv.		+								WSP	H	1
	Briza maxima L.	+	+	+			+				CME	T	4
	Bromus erectus Huds.	+	+	+	+		+				SEUME	H	5
	Bromus hordeaceus L.		+		+	+	+				SEUME	T	4
	Bromus madritensis L.		+	+							MEAT	T	2
	Bromus sterilis L.				+						WSP	T	1
	Chrysopogon gryllus (L.) Trin.		+	+			+				MEPO	H	3
	Cynodon dactylon (L.) Pers.		+		+	+					WSP	G	3
	Dactylis glomerata L. s.l.	+	+	+	+	+	+				EUAS	H	6
	Dasypyrum villosum (L.) P. Candargy		+			+					SEUME	T	2
	Desmazeria marina (L.) Druce				+	+	+	VU			MEAT	T	3
	Desmazeria pauciflora Merino		+	+			+				CME	T	3
	Desmazeria rigida (L.) Tutin		+								MEAT	T	1

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Elymus pycnanthus (Godr.) Melderis	+	+	+	+	+	+	NT			CME	G	6
	Elymus repens (L.) Gould				+						WSP	G	1
	Gastridium ventricosum (Gouan) Schinz et Thell.		+								MEAT	T	1
	Holcus lanatus L.		+		+	+					EUAS	H	3
	Hordeum bulbosum L.	+	+	+		+					SEUME	H	4
	Hordeum murinum L. ssp. *leporinum* (Link) Arcang.	+	+			+					CME	T	3
	Lagurus ovatus L.		+	+		+	+				CME	T	4
	Lolium perenne L.	+	+			+					EU	H	3
	Lophochloa cristata (L.) Hyl.		+		+						WSP	T	2
	Melica ciliata L.		+								EUAS	H	1
	Parapholis incurva (L.) C. E. Hubb.	+	+	+	+	+	+				WSP	T	6
	Phragmites australis (Cav.) Steud.	+	+								WSP	G	2
	Poa trivialis L. ssp. *sylvicola* (Guss.) H. Lindb.	+				+		LC			EUME	H	2
	Vulpia ciliata Dumort.		+								SEUME	T	1

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
Polygonaceae	*Polygonum avivulare* L.				+						WSP	T	1
	Rumex crispus L.	+			+	+					WSP	H	3
	Rumex pulcher L.	+	+			+					SEUPO	H	3
Primulaceae	*Anagallis arvensis* L.	+	+	+	+	+	+				WSP	T	6
Ranunculaceae	*Ranunculus ficaria* L.		+								EU	G	1
	Ranunculus sardous Crantz	+	+								WSP	T	2
	Thalictrum minus L.					+					WSP	H	1
Rhamnaceae	*Paliurus spina-christi* Mill.	+									ISEU	P	1
Rosaceae	*Crataegus monogyna* Jacq.		+								EUAS	P	1
	Filipendula vulgaris Moench		+								EUAS	H	1
	Potentilla hirta L.	+	+	+							SEUME	H	3
	Prunus mahaleb L.		+								SEUPO	P	1
	Rosa canina L.		+			+					WSP	P	2
	Rubus ulmifolius Schott	+	+	+	+	+	+				MEAT	P	6
	Sanguisorba minor Scop. ssp. *muricata* Briq.	+	+	+		+	+				SEUME	H	5
Rubiaceae	*Galium aparine* L.	+	+	+	+	+	+				WSP	T	6
	Galium lucidum All.		+	+	+						SEUME	H	3

Family	Taxa	BODULAŠ	CEJA	TRUMBAJA	FENOLIGA	FENERA	ŠEKOVAC	IUCN	INV	END	CHOR	LF	ISL
	Galium murale (L.) All.		+								CME	T	1
	Galium verum L.	+				+					WSP	H	2
	Sherardia arvensis L.	+	+								WSP	T	2
	Valantia muralis L.		+	+	+		+				CME	T	4
Santalaceae	*Osyris alba* L.		+	+							CME	P	2
Saxifragaceae	*Saxifraga tridactylites* L.			+							WSP	T	1
Scrophulariaceae	*Bellardia trixago* (L.) All.						+				CME	T	1
	Kickxia commutata (Rchb.) R. M. Fritsch				+						EUME	H	1
	Linaria pelisseriana (L.) Mill.	+	+								MEAT	T	2
	Verbascum phoeniceum L.	+	+			+					SEUPO	T	3
Smilacaceae	*Smilax aspera* L.		+	+	+		+				CME	P	4
Urticaceae	*Parietaria judaica* L.	+	+		+	+	+				SEUME	H	5
Valerianaceae	*Valerianella dentata* (L.) Pollich		+								SEUME	T	1
Xanthorrhoeaceae	*Asphodelus aestivus* Brot.		+	+							CME	G	2
	Total number of taxa	90	151	86	65	74	66	15	2	5	214	214	214