

# Diversity of Asteraceae family in the Black Sea coast floristic region of Bulgaria

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**Abstract:** In connection with the elaboration of Volume 12 of the Flora of the Republic of Bulgaria, the diversity of the Asteraceae family in the Black Sea coast floristic region was investigated. It was found that this floristic region is home to nearly half of the representatives of this family in Bulgaria – 242 species. Great is the number of the species of conservation value: 19 species are protected by the National Biodiversity Act and 15 are with limited distribution. About  $\frac{1}{4}$  of the representatives of the family in the studied territory are medicinal and aromatic plants, and 57 of them are enlisted in the National Act for the medicinal plants. This study shows that Black Sea floristic region has huge importance for the provision of appropriate conditions for the existence and preservation of the gene pool of Asteraceae in Bulgaria.

**Key words:** Plant diversity, floristic analysis, species of conservation value, medicinal and aromatic plants, invasive species

## Introduction

On the basis of the regularities in the distribution of plant species, Bulgaria is divided into 20 floristic areas. Among them the Black Sea coast is identified as a separate region, which is divided into two sub-regions: the North (NBSC) and South Black Sea coast (SBSC). In terms of the richness of plant species, this floristic region ranks fifth in the country with about 2000 species, representing around 50% of the Bulgarian flora. Asteraceae is the largest family of vascular plants in the Bulgarian flora with more than 480 species (ca. 12% of the total flora). The family includes annuals, biennials and herbaceous perennials, distributed across the whole country from the sea shore to the highest mountain peaks. This is also the richest family of species of conservation value in the Bulgarian flora, and a part of them are medicinal and aromatic plants. Meanwhile the family includes several invasive species with negative impact on the biological diversity and economy of Bulgaria. The flora of the Bulgarian Black Sea coast, incl. the diversity of the Asteraceae family, has not been a subject of a monographic study. The present

study is related to the development of the last, 12th volume, of the monographic series “Flora of the Republic of Bulgaria”.

## Material and methods

The area under investigation covers the Bulgarian part of the Black Sea coast, which covers a narrow strip of land (a few kilometers only) on the eastern state border of the country and extends to a length of 354 km between Cape Sivriburun at the northern state border with Romania and the mouth of the Rezovska River at the southern state border with the Republic of Turkey. Among all floristic regions in Bulgaria, the Black Sea coast is the most distinct and is characterized by the largest number of species, which occur only there. This is related to the presence of specific coastal habitats like the sand dunes, the coastal cliffs, the haline coastal lakes and the extensive coastal marble finds north from the town of Varna.

The object of the present study are the representatives of Asteraceae family. The data

**Table 1.** List of the representatives of Asteracea in the Black Sea coast floristic region in Bulgaria

**Legend:** N – Black Sea coast (North); S – Black Sea coast (South); Bal – Balkan Endemic; Bul – Bulgarian Endemic; M – Medicinal plant; BDA – Bulgarian Biodiversity Act; IUCN – International Union for Conservation of Nature.

<i>Achillea clypeolata</i> Sm. (N, S, Bal, M)	<i>C. alba</i> L. (N, S)
<i>A. coarctata</i> Poir. (N, S)	<i>C. apiculata</i> Ledeb. (N, S)
<i>A. collina</i> J. Backer & Reichb. (N, S)	<i>C. arenaria</i> M. Bieb. (N, S, BDA)
<i>A. crithmifolia</i> Waldst. & Kit. (N, S)	<i>C. biebersteinii</i> DC. (N, S)
<i>A. millefolium</i> L. (N, S, M)	<i>C. bovina</i> Velen. (S, Bal, BDA)
<i>A. nobilis</i> L. (N, S, M)	<i>C. calcitrapa</i> L. (N, S, M)
<i>A. pannonica</i> Scheele (N, S)	<i>C. caliacrae</i> Prodan (N, Bal)
<i>A. pseudopectinata</i> Janka (S, Bal)	<i>C. cuneifolia</i> Sm. (N, S)
<i>A. setacea</i> Waldst. & Kit. (N, S)	<i>C. cyanus</i> L. (N, S, M)
<i>Anthemis arvensis</i> L. (N, S)	<i>C. diffusa</i> Lam. (N, S)
<i>A. cotula</i> L. (N, S, M)	<i>C. euxina</i> Velen. (N, S, Bul)
<i>A. regis-borisii</i> Stoj. & Acht. (N, Bul, BDA)	<i>C. gracilenta</i> Velen. (N, S, BDA)
<i>A. rumelica</i> (Vel.) Stoj. & Acht. (S, IUCN, Bul, BDA)	<i>C. indurata</i> Janka (N, S)
<i>A. ruthenica</i> M. Bieb. (N, S)	<i>C. jacea</i> L. (N, S)
<i>A. virescens</i> Velen. (S, IUCN, Bul, BDA)	<i>C. marshaliana</i> Spreng. (N, BDA)
<i>Arctium lappa</i> L. (N, S, M)	<i>C. orientalis</i> L. (N, S)
<i>A. minus</i> (Hill.) Bernh. (N, S, M)	<i>C. pannonica</i> (Heuff.) Dost. (N, S, M)
<i>A. tomentosum</i> Mill. (N, S, M)	<i>C. pichleri</i> Sm. (S, BDA)
<i>Artemisia absinthium</i> Turra (N, S, M)	<i>C. rocheliana</i> (Heuff.) Dost. (N, S, M)
<i>A. alba</i> L. (N, M)	<i>C. rutifolia</i> Sm. (N, S, Bal)
<i>A. annua</i> L. (N, S, M)	<i>C. salonitana</i> Vis. (N, S)
<i>A. austriaca</i> Jacq. (N)	<i>C. scabiosa</i> L. (N, S)
<i>A. campestris</i> L. (N, S, M)	<i>C. solstitialis</i> L. (N, S, M)
<i>A. lerchiana</i> Stechm. (N, S, BDA, M)	<i>C. stenolepis</i> A. Kern. (N, S)
<i>A. pedemontana</i> Balb. (N, BDA)	<i>C. stereophylla</i> Besser (N, S)
<i>A. pontica</i> L. (N, S, M)	<i>C. sterilis</i> Stev. (N, S)
<i>A. santonicum</i> L. (N, S, M)	<i>C. stoebe</i> L. (N, S)
<i>A. scoparia</i> Waldst. & Kit. (N, S)	<i>C. thirkei</i> Sch. Bip. (N, S)
<i>A. vulgaris</i> L. (N, S, M)	<i>C. thracica</i> (Janka) Hayek (N, S)
<i>Aster amellus</i> L. (N, S)	<i>C. tymphaea</i> Hausskn. (N, Bal)
<i>A. oleifolius</i> (Lam.) Wagenitz (N)	<i>C. varnensis</i> Velen. (N, S, Bal)
<i>Bellis perennis</i> L. (N, S, M)	<i>C. wagenitziana</i> Bancheva & Kit Tan (S, Bal, BDA)
<i>B. sylvestris</i> Cyrillo (S)	<i>Chondrilla juncea</i> L. (N, S)
<i>Bidens bipinnatus</i> L. (N, I)	<i>Cichorium endivia</i> L. (S)
<i>B. cernuus</i> L. (N, S)	<i>C. inthybus</i> L. (N, S, M)
<i>B. frondosus</i> L. (N, I)	<i>Cirsium alatum</i> (S.G.Gmel.) Bobr. (N, S)
<i>B. tripartita</i> L. (N, S, M)	<i>C. arvense</i> (L.) Scop. (N, S)
<i>Bombycilaena erecta</i> (L.) Smoljan. (N, S)	<i>C. bulgaricum</i> DC. (S, BDA)
<i>Carduus acanthoides</i> L. (N, S, M)	<i>C. canum</i> (L.) All. (N, S)
<i>C. acicularis</i> Bertol. (N, S)	<i>C. creticum</i> (Lam.) D'Urv. (N, S)
<i>C. candicans</i> Waldst. & Kit. (N, S)	<i>C. italicum</i> (Savi) DC. (S)
<i>C. nutans</i> L. (N, S)	<i>C. ligulare</i> Boiss. (N, S)
<i>C. pycnocephalus</i> L. (N, S)	<i>C. pannonicum</i> (L. f) Link (S)
<i>C. thoermeri</i> Weinm. (N, S)	<i>C. stojanovii</i> Kuzmanov (S, Bul, BDA)
<i>Carlina acanthifolia</i> All. (N, S, M)	<i>C. vulgare</i> (Savi) Ten. (N, S)
<i>C. corymbosa</i> L. (N, S)	<i>Cnicus benedictus</i> L. (S, M)
<i>C. lanata</i> L. (N, S)	<i>Conyza bonnariensis</i> (L.) Cronq. (N, S)
<i>C. vulgaris</i> L. (N, S, M)	<i>C. canadensis</i> (L.) Cronq. (N, S)
<i>Carthamus dentatus</i> (Forssk.) Vahl. (N, S)	<i>Cota altissima</i> (L.) J. Gay (S)
<i>C. lanatus</i> L. (N, S, M)	<i>C. austriaca</i> (Jacq.) Sch. Bip. (N, S)
<i>Centaurea affinis</i> Friv. (N, S)	<i>C. tinctoria</i> (L.) J. Gay (N, S, M)

Table 1. Continued

<i>Crepis biennis</i> L. (N, S)	<i>I. spiraeifolia</i> L. (N, BDA)
<i>Crepis foetida</i> L. (N, S)	<i>Jacobaea aquatica</i> (Hill.) Gaertn. (S)
<i>C. pulchra</i> L. (N, S)	<i>J. erucifolia</i> (L.) Gaertn (N, S)
<i>C. sancta</i> (L.) Babc. (N, S)	<i>J. maritima</i> (L.) Pelser & Meijden (S)
<i>C. setosa</i> Hall. (N, S)	<i>J. vulgaris</i> Gaertn. (N, S, M)
<i>C. tectorum</i> L. (N, S)	<i>Jurinea albicaulis</i> Bunge (S)
<i>C. zacintha</i> (L.) Babc. (S)	<i>J. consanguinea</i> DC (N, S)
<i>Crupina vulgaris</i> Cass. (N, S)	<i>J. stoechadifolia</i> (M. Bieb.) DC. (N)
<i>Doronicum hungaricum</i> Rchb. f. (N, S)	<i>J. tzar-ferdinandii</i> Dav. (N, Bal, BDA)
<i>D. orientale</i> Hoffm. (N, S)	<i>Lactuca quercina</i> L. (N, S)
<i>Echinops banaticus</i> Rochel & Schrad. (N, S)	<i>L. saligna</i> L. (N, S)
<i>E. microcephalus</i> Sm. (N, S)	<i>L. serriola</i> L. (N, S, M)
<i>E. ritro</i> L. (N, S)	<i>L. tatarica</i> (L.) C. A. Mey. (N, S)
<i>E. sphaerocephalus</i> L. (N, S, M)	<i>L. viminea</i> (L.) J. & Presl. (N, S)
<i>Erigeron acer</i> L. (N, S)	<i>Laphangium luteoalbum</i> (L.) Tzvelev (N, S)
<i>E. annuus</i> (L.) Desf. (N, I)	<i>Lapsana communis</i> L. (N, S)
<i>E. sumatrensis</i> Retz. (N, S, I)	<i>Leontodon autumnalis</i> L. (N, S)
<i>Eupatorium cannabinum</i> L. (N, S)	<i>L. cichoraceus</i> (Ten.) Sanguin. (N, S)
<i>Filago arvensis</i> L. (N, S)	<i>L. crispus</i> Vill. (N, S)
<i>F. gallica</i> L. (S)	<i>L. hispidus</i> L. (N, S)
<i>F. germanica</i> (L.) Huds. (N, S)	<i>L. tuberosus</i> L. (S)
<i>F. lutescens</i> Jord. (N, S, M)	<i>Leucanthemum vulgare</i> Lam. (N, S, M)
<i>F. minima</i> (Sm.) Pers. (N, S)	<i>Matricaria chamomilla</i> L. (N, S, M)
<i>Galatella linosyris</i> (L.) Rchb. (N, S)	<i>M. discoidea</i> DC. (S, M, I)
<i>G. villosa</i> (L.) Rchb. (N)	<i>Mycelis muralis</i> (L.) Dum. (N, S)
<i>Galinsoga parviflora</i> Cav. (N, S, M, I)	<i>Onopordum acanthium</i> L. (N, S, M)
<i>G. quadriradiata</i> Ruiz & Pav. (N, I)	<i>O. tauricum</i> Willd. (N, S, M)
<i>Gnaphalium uliginosum</i> L. (N, S, M)	<i>Otanthus maritimus</i> (L.) Hoffm. & Link (N, S, BDA)
<i>Grindelia squarrosa</i> (Pursh) Dunal (N, I)	<i>Petasites hybridus</i> (L.) Gaertn., B. Mey. & Schreb. (N, S, M)
<i>Hedypnois cretica</i> (L.) Dum. Cours. (S)	<i>Picnomon acarna</i> (L.) Cass. (N, S)
<i>Helichrysum arenarium</i> (L.) Moench (N, S, M)	<i>Picris altissima</i> Delile (S)
<i>Hieracium cymosum</i> L. (N, S)	<i>P. echioides</i> L. (N, S)
<i>H. echioides</i> Lumn. (N, S)	<i>P. hieracioides</i> L. (N, S)
<i>H. halimifolium</i> Froel. & Fr. (N, S)	<i>P. pauciflora</i> Willd. (N, S)
<i>H. hoppeanum</i> Schult. (N, S)	<i>P. sprengerana</i> (L.) Poir. (N, S)
<i>H. latifolium</i> Froel. & Link. (N, S)	<i>Ptilostemon afer</i> (Jacq.) Greuter (N, S)
<i>H. pilosella</i> L. (N, S, M)	<i>Pulicaria dysenterica</i> (L.) Bernh. (N, S, M)
<i>H. praealtum</i> Vill. & Goch. (N, S)	<i>P. vulgaris</i> Gaertn. (N, S, M)
<i>H. umbellatum</i> L. (N)	<i>Reichardia picroides</i> (L.) Roth (S, BDA)
<i>H. virosus</i> Pall. (N)	<i>Rhagadiolus stellatus</i> (L.) Gaertn. (N, S)
<i>Hypochaeris glabra</i> L. (N)	<i>Scolymus hispanicus</i> L. (N, S, M)
<i>Inula aschersoniana</i> Janka (N, S, M)	<i>S. maculatus</i> L. (S)
<i>I. bifrons</i> L. (N, S)	<i>Scorzonera austriaca</i> Willd. (N)
<i>I. britanica</i> L. (N, S)	<i>S. cana</i> (C. A. Mey.) Hoffm. (N, S)
<i>I. conyza</i> DC. (N, S)	<i>S. hispanica</i> L. (N, S, M)
<i>I. ensifolia</i> L. (N, S, M)	<i>S. laciniata</i> L. (N, S)
<i>I. germanica</i> L. (N, S, M)	<i>S. mollis</i> M. Bieb. (N, S)
<i>I. helenium</i> L. (N, S, M)	<i>S. parviflora</i> Jacq. (S, BDA)
<i>I. hirta</i> L. (N, S)	<i>Senecio macrophyllus</i> M. Bieb (S)
<i>I. oculus-christi</i> L. (N, S)	<i>S. sylvaticus</i> L. (N, S)
<i>I. salicina</i> L. (N, S)	<i>S. vernalis</i> Waldst. & Kit. (N, S)

Table 1. Continued

<i>S. viscosus</i> L. (N, S, M)
<i>S. vulgaris</i> L. (N, S, M)
<i>Serratula radiata</i> (Waldst. & Kit.) M. Bieb. (N)
<i>Silybum marianum</i> (L.) Gaertn. (N, S)
<i>Solidago virgaurea</i> L. (N, S, M)
<i>Sonchus arvensis</i> L. (N, S)
<i>S. asper</i> (L.) Hill. ssp. <i>asper</i> (N, S)
<i>S. oleraceus</i> L. (N, S)
<i>S. palustris</i> L. (N, S, BDA)
<i>Steptorhamphus tuberosus</i> (Jacq.) Grossh. (N)
<i>Symphyotrichum squamatum</i> (Spreng.) G. L. Nesom (N)
<i>Tanacetum achilleifolium</i> (M. Bieb.) Sch. Bip. (N)
<i>T. corymbosum</i> (L.) Sch. Bip. (N, S)
<i>T. macrophyllum</i> (Waldst. & Kit.) Sch. Bip. (N, S)
<i>T. millefolium</i> (L.) Tzvelev (N, S)
<i>T. parthenium</i> (L.) Sch. Bip. (N, S)
<i>T. vulgare</i> L. (N, S, M)
<i>Taraxacum bessarabicum</i> (Hornem.) Hand.-Mazz. (N)
<i>T. erythrospermum</i> Andr. & Besser (N, S)

<i>T. hybernum</i> Steven (S)
<i>T. officinale</i> L. (N, S, M)
<i>T. palustre</i> (Lyons) Symons (N, S)
<i>T. serotinum</i> (Waldst. & Kit.) Fisch. (N, S)
<i>Tragopogon dubius</i> Scop. (N, S)
<i>T. orientalis</i> L. (N, S)
<i>T. pratensis</i> L. (N, S, M)
<i>T. stribrnyi</i> Hayek (S, Bul, BDA)
<i>Tripleurospermum inodorum</i> (L.) Sch. Bip. (N, S)
<i>T. tenuifolium</i> (Kit.) Freyn (N, S)
<i>Tripolium pannonicum</i> (Jacq.) Dobrocz. (N, S)
<i>Tussilago farfara</i> L. (N, S, M)
<i>Tyrimnus leucographus</i> (L.) Cass. (S)
<i>Xanthium italicum</i> Moretti (N, S, I)
<i>X. spinosum</i> L. (N, S, M, I)
<i>X. strumarium</i> L. (N, S, M)
<i>Xeranthemum annuum</i> L. (N, S, M)
<i>X. cylindraceum</i> Sm. (N, S)
<i>X. inapertum</i> (L.) Mill. (N)

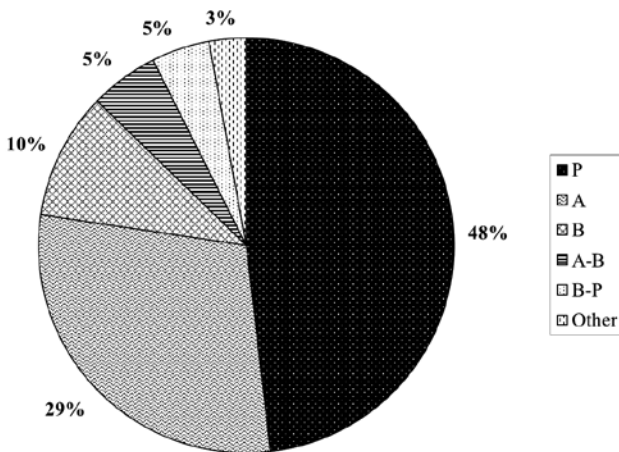


Fig. 1. Percentage participation of the representatives of Asteraceae by biological type.

**Legend:** *Perennial* (149 species); *Annuals* (77 sp.); *Biennial* (24 sp.); *Annuals – Biennial* (13 sp.); *Biennial – Perennial* (11 sp.); *Other* [*Annuals – Perennial* (2 sp.), *Half-shrub* (2 sp.), *A-B* (P) (1 sp.), *Bush – P* (1 sp.), *Bush* (1 sp.)].

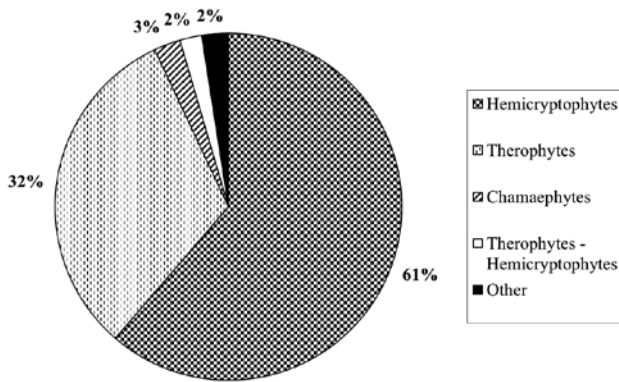
presented in this paper are results of the author’s research on the surveyed territory, as well as of the aggregated literature data. The field observations were carried out during years 2016 and 2017. Route and semi-stationary methods were used. Literary sources containing information on flora and vegetation in the studied area have been analyzed. They include mainly studies on psammophytic and halophytic vegetation (DAVIDOV 1905, 1912, GANCHEV et al. 1971, BONDEV & VELCHEV 1982), on protected areas (MESHINEV et

al. 1982, PETROVA 1997), on dune and steppe vegetation (VELCHEV 2002, TZONEV et al. 2005, 2006), etc. Partial information on the diversity of Asteraceae is available in ANCHEV (2012) and data on their threatened species are included in the Bulgarian Red Data Book (PEEV 2015). The determination of the geoelements follows DIMOPOULOS et al. (2013).

## Results

As a result of this study we found that Black Sea floristic region is home to nearly half of the representatives of the family Asteraceae in Bulgaria – 242 species (Table 1). Along the northern coastline, 213 species have been identified, while on the southern Black Sea coast there were two more species. The richest in species is the genus *Centaurea* L. (33), followed by *Artemisia* L. (11), *Inula* L. (11), *Cirsium* Mill. (10), *Achillea* L. (9), *Hieracium* L. (9), etc.

In terms of the biological type, the perennial plants dominated (48%), followed by annuals (29%), biennials, annual-biennials (10%), etc. (Fig. 1). We found only two semi-shrubs and one shrub of the Asteraceae family. In the studied area there were representatives of all the life forms typical of the Asteraceae in Bulgaria. The most numerous were the Hemicryptophytes (69%) and Therophytes (32%), while the other life forms were poorly represented: Chamaephytes (3%), Therophytes-hemicryptophytes (2%), Geophytes (1%), etc. (Fig.



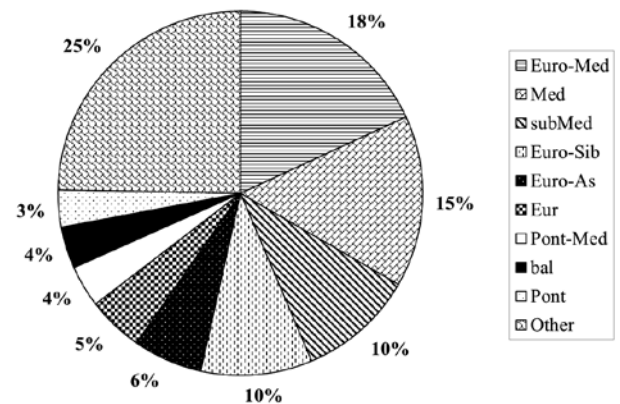
**Fig. 2.** Percentage participation of the representatives of Asteraceae by life form.

**Legend:** *Hemicryptophytes* (149 species); *Therophytes* (77 sp.); *Chamaephytes* (6 sp.); *Therophytes – Hemicryptophytes* (5 sp.); *Other* [Geophytes (3 sp.), *Chamaephytes – Hemicryptophytes* (2 sp.), *Geophytes – Hemicryptophytes* (1 sp.)].

2). The prevailing types of geoelements (67%) were the Mediterranean (29% Euro-Mediterranean, 18% Mediterranean, 16% Sub-Mediterranean and 4% Ponto-Mediterranean), followed by Euro-Siberian (10), Euro-Asian (10), European (5), Pontic (4%), etc. (Fig. 3).

The species of conservation significance are a special focus in the study of each flora. Our investigation showed that the number of the species with conservation value, belonging to Asteraceae, was remarkable: 19 species were protected by the National Biodiversity Act and 15 were with limited distribution, six of them were Bulgarian endemics, and nine were Balkan endemics. Some species were found only on the Black Sea coast floristic region: *Artemisia pedemontana* (NBSC), *Centaurea caliacrae* (NBSC), *Otanthus maritimus* (SBSC), *Reichardia picroides* (SBSC), *Scorzonera parviflora* (SBSC). Other species, apart from this floristic area, were found in one more floristic region: *Anthemis regis-borisii*, *Centaurea euxina* and *Lactuca tatarica* in Black Sea Coast and Northeastern Bulgaria; *C. tymphaea* in Black Sea Coast and Tundzha hilly country; *C. varnensis* in Black Sea Coast and Thracian plain; *Cirsium bulgaricum* in Black Sea Coast and Strandzha; *C. stoyanovii* in Black Sea Coast and East Rhodope.

About ¼ of representatives of the family in the studied area were medicinal and aromatic plants. Amongst them 57 were from the National Act for the medicinal plants, and six species were under special regime of use (two with a quota and four prohibited



**Fig. 3.** Percentage participation of the geoelements of Asteraceae.

**Legend:** *Euro-Med* (44 species); *Med* (37 sp.); *subMed* (25 sp.); *Euro-Sib* (24 sp.); *Euro-As* (15 sp.); *Eur* (12 sp.); *Pont-Med* (9 sp.); *Bal* (9 sp.); *Pont* (8 sp.); *Other* [Boreal (7 sp.), *Pont-Sib* (6 sp.), *Bul* (6 sp.), *Bal-Anat* (5 sp.), *Bal-Dac* (3 sp.), *Kos* (3 sp.), *Pann-Bal* (3 sp.), *SAM(Adv)* (3 sp.), *Adv* (2 sp.), *Adv (NAm)* (2 sp.), *Adv (SAM)* (2 sp.), *NAm (Adv)* (2 sp.), *Pont-Bal* (2 sp.), *Carp-Bal* (1 sp.), *Euro-As and Nam* (1 sp.), *Euro-OT* (1 sp.), *Euro-subMed* (1 sp.), *Euro-WAs* (1 sp.), *Eux-Pont* (1 sp.), *Pont-OT* (1 sp.), *Pont-As* (1 sp.), *Pont-CAs* (1 sp.), *Pont-Pann-Bal* (1 sp.), *subBal* (1 sp.), *SPont* (1 sp.), *subBoreal* (1 sp.), *subMed-Sib* (1 sp.)].

for collection: *Arctium lappa* L. and *Artemisia pontica* L.). Ten foreign species of invasive nature were found on the territory of the Black Sea floristic region.

## Discussion

This study shows that Black Sea floristic region is significant for the provision of appropriate conditions for the existence and preservation of the gene pool of Asteraceae in Bulgaria. The large number of representatives of the genus *Centaurea* is one more proof that the Balkan Peninsula, and in particular the study area, belongs to the center of speciation of this genus. Meanwhile there were registered important corridors for the entrance of foreign plant species, some of which were with invasive properties. All this requires conducting of annual monitoring of the populations of rare plant species and annual surveys on invasive species for taking appropriate measures for the overall protection of the biodiversity in these areas.

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