INVENTORY OF AQUATIC AND RIPARIAN FLORA OF ACHERON AND LOUROS RIVERS, AND ZIROU LAKE IN WESTERN GREECE

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ABSTRACT

Although rivers and riparian zone consists an important feature of the landscape, surveying aquatic and riparian flora has rarely been implemented in Greece. In this paper an updated inventory of aquatic and riparian species from the rivers Acheron and Louros and the adjacent Zirou Lake, located in Western Greece, is presented. The study area is partly included in the European network of protected areas 'Natura 2000' and is of great scientific interest due to its biodiversity. A total of 329 aquatic and riparian taxa were recorded, belonging to 85 families and 200 genera. Specifically in Acheron and Louros river 200 taxa and 220 taxa were recorded respectively and 21 taxa in Zirou lake. In the floristic inventory of the studied areas two taxa, *Batrachospermum* sp. and *Chara vulgaris* f. *longibracteata* are reported for the first time from Greece as well as three taxa *Chara gymnophylla, Plagiomnium cuspidatum*, and *Najas minor* are up today rare species for Greece. Furthermore, the bryophytes taxa *Cinclidotus aquaticus, Oxyrrhynchium speciosum, Eurhynchiastrum pulchellum* and *Plagiomnium cuspidatum* are reported for the first time from Western Greece. Several floristic parameters related to life forms and geographical distributions of plant species (chorology) were examined and the percentages of therophytes, widely distributed, ruderal, and invasive species were described.

KEYWORDS: aquatic macrophytes, bryophytes, riparian flora, Greece, Mediterranean

1. INTRODUCTION

Rivers and riparian zones are complex geomorphological systems that play a vital role in environmental function. Riparian corridors are one of the most diverse mosaics of landforms, communities, and environments within the landscape. The importance of riparian features is recognized by the European Water Framework Directive (2000/60/EC) since the assessment of a river's status is partly based on hydromorphological quality criteria that include the evaluation of the structure and condition of riparian zones [1]. Despite their important ecological role, the riparian ecosystems of Greece have not been studied sufficiently, and their flora and vegetation still remains much less explored than the flora of lakes and coastal wetlands.

The Greek vascular flora has attracted the interest of botanists for many decades [2, 3]. However, most of the botanical studies have been carried out in areas which are considered of high floristic interest, such as the high mountains and the Aegean islands [2-4]. On the other hand, although riparian zone is an important feature of the landscape that affects the quality of aquatic ecosystems, surveying aquatic and riparian flora has been rarely implemented in the Mediterranean countries [5]. In Greece, during the last decades, floristic and taxonomic research in aquatic environments has made considerable progress [6]. In particular, recent research on the plant flora of Greek rivers has been carried out in Macedonia for bryophytes [7], and in mainland Greece for riparian woodlands and habitat types [8, 9], but most of the published papers regard river deltas and estuaries [10-12].

The current study deals with the aquatic and riparian flora of two rivers, Acheron and Louros and the Zirou karstic lake, partly included in the Greek 'Natura 2000' Network sites named "GR 2140001-Ekvoles Acheronta and Stena Acheronta" and "GR 2110001-Amvrakikos Gulf, Louros and Arachthos Delta" [13]. The study area is located in the Region of Epirus, which is of the richest areas in water bodies in Greece, and thus of great scientific interest for the aquatic and riparian plants. However, little has been accomplished in regards to aquatic, and especially of riparian flora, in the study area. Additionally, human activities in river basins in recent years have changed the structure and composition of plant communities with the introduction of alien species or significant reduction of

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indigenous species. The aim of the present paper is to provide a full floristic inventory of the aquatic and riparian plants of the study area and present a species list along with the alien, nitrophilous, ruderal and weedy species, to serve as the basis for further monitoring projects and conservation plans.

2. MATERIALS AND METHODS

2.1. Study area

The present study was carried out in three important freshwater ecosystems of Western Greece (Figure 1a&b). The Epirus Water District is one of the fourteen national Water Districts that comprise the country's administrative units for water resources management. The Mediterranean climate in this region results in strong seasonal variations in the hydrological regime with a long dry period followed by a sudden episode of flooding usually during November and December. The average annual rainfalls in mountainous regions are 1073mm and mean annual air temperature reaches 14 °C. Along the coast the dry period begins in April and continues until October, while in mountainous areas the dry period begins in June and continues until September.

Acheron River is located in the southwest part of Epirus Region and its main springs are situated in Tomaros Mountain. The river discharges into the Ionian Sea, near Ammoudia Cove, its total length is approximately 50 km with mean annual discharge 23.5m^3s^{-1}. The catchment area is 763 km^2 and its delta belongs to lobate morphodynamic type. The delta area includes a complex wetland ecosystem that consists of Valanidorachi and Ammoudia marches. The most important tributaries of Acheron River are 'Cocytos' and 'Vouvo Rema' streams (Figure 1a). 'Cocytos' springs from the roots of Paramythia Mountains, its length is about 26 km, and it discharges into Acheron River, near Mesopotamos village. 'Vouvo Rema' stream is a small river which discharging into Acheron River near estuaries (Figure 1a).

Louros River, springs from Mount Tomaros, close to the Dodoni Oracle (Prefecture Ioannina). It flows southwards for about 73 Km, having a mean annual discharge of 19-28.6m^3s^{-1}, and finally discharges in the Salaora bay within the Amvrakikos Gulf (Figure 1b). The catchment area is 925 Km^2 and its delta belongs to lobate morphodynamic type.

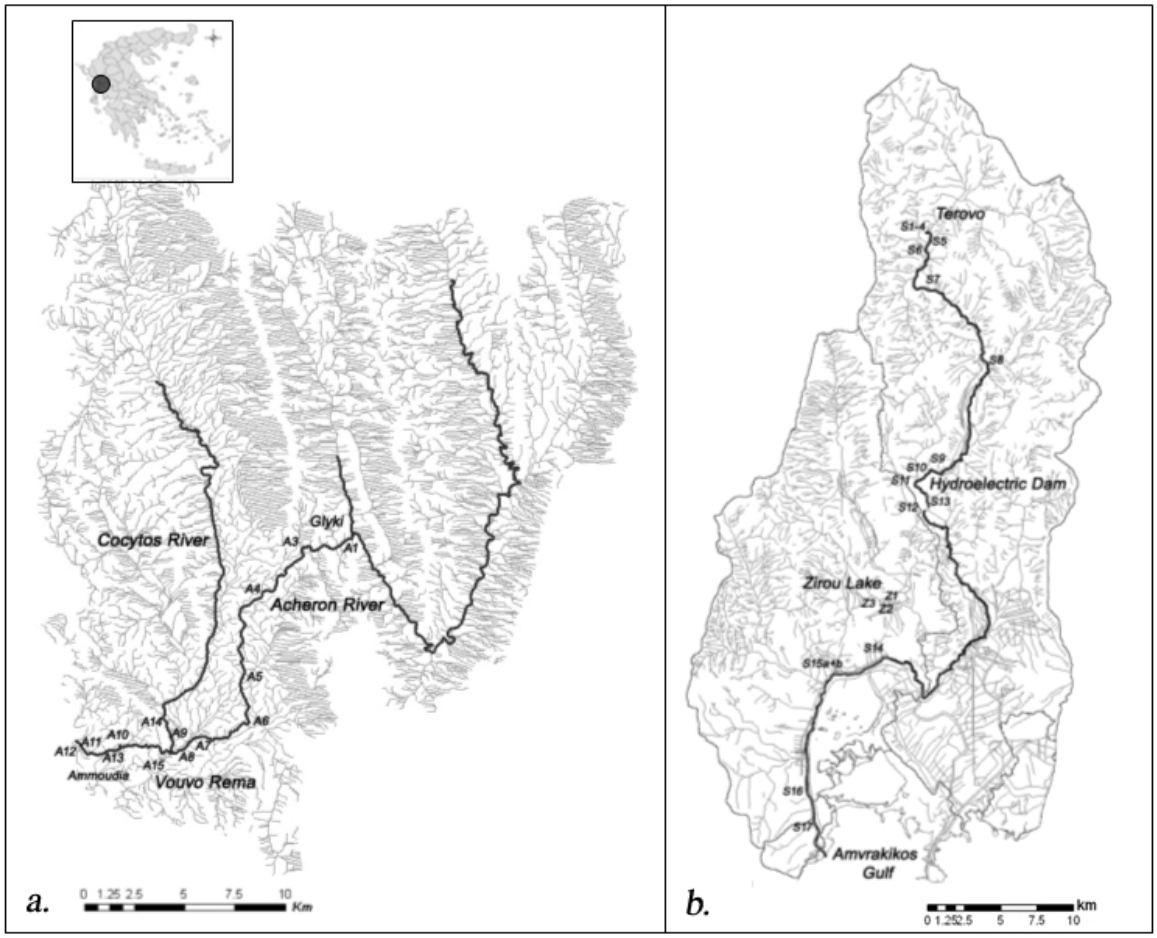

FIGURE 1 - Geographical position and maps of the study area a. Acheron river and tributaries (Vouvo Rema and Cocytos) and b. Louros river and Zirou lake.

Lake Zirou is a small karstic lake (40 m altitude), situated in the western part of Louros River catchment area (Figure 1b). Is a circular shaped lake, with diameter approximately 1000 m and total surface area 400 km^2. Depth varies from 9 m at the north part of the lake to very shallow at the southern part and has maximum depth 70 m.

2.2. Sampling Sites

This explorative survey is part of a holistic assessment approach of these riverine ecosystems in Western Greece (Manolaki, unpublished data). The surveys were conducted during the vegetation periods of the years 2005 to 2007. A total of 35 sites were selected along Acheron (A_{1-8} & $A_{11-A_{13}}$) and its tributaries (A_9, A_{10}, A_{14} and A_{15}), Louros ($S_{1-S_{17}}$), and Zirou lake (Z_1-Z_3) (Figure 1, Table 1). Representative river reaches were selected in order to conduct the plant surveys [14]. The assessment of both rivers started from springs (Terovo and Glyki respectively) and extended to the estuaries (Amvrakikos Gulf and the Ionian Sea respectively).

The lake assessment included a lake shore survey. The shore surveys involved walking around the lake's littoral zone, between the upper limit of the inundation zone until the depth of approximately 1m and recording all existing aquatic plants [15].

The sampling biota material includes aquatic macrophytes and riparian plants of water courses, margins and inner bank. For the purposes of this study, a *Macrophyte* is defined as 'any plant observable with the naked eye, including larger algae, charophytes, bryophytes and vascular plants [14].

2.3. Species Identification

The floristic list is based on the first author's collections, which are deposited in the herbarium of the Botanical Institute of Patras University (UPA). In the list families, genera and species are arranged alphabetically within the six major groups of plants, viz. Phycophyta, Bryophyta, Pteridophyta, Spermatophyta (Gymnospermae, and Angiospermae: Dicotyledones and Monocotyledones). Taxa preceded by an asterisk (*) were previously reported from Acheron delta by Georgiadis et al. [11], by two asterisks (**) from Amvrakikos gulf by Sarika et al. [12] where the Louros river discharges, and finally by three asterisks (***) from both references [11, 12].

TABLE 1 - Location (latitudes and longitudes) and description (altitude, mean depth and land uses) of the sampling sites.

Site	Co-ordinates		Altitude (m)	Mean depth (m)	Land use
A_1	N39°19'38.8''	E020°37'30.4''	59	0.5	Broad leaved forest
A_3	N39°19'24.2''	E020°36'32.7''	37	1	Green urban areas
A_4	N39°18'54.4''	E020°35'59.2''	35	1	Fruit trees and berry plantations
A_5	N39°18'12.1''	E020°35'03.1''	32	0.8	Annual crops associated with permanent crops
A_6	N39°18'59.45''	E020°35'03.1''	34	1.5	Annual crops associated with permanent crops
A_7	N39°14'47.8''	E020°34'38.7''	3	2	Road and rail networks and associated land
A_8	N39°13'57.7''	E020°32'26.8''	4	1	Annual crops associated with permanent crops
A_9	N39°14'14.5''	E020°32'13.6''	7	1.5	Annual crops associated with permanent crops
A_{10}	N39°14'14.5''	E020°32'13.6''	3	2	Green urban areas
A_{11}	N39°14'10.4''	E020°28'46.4''	1	>3m	Sports and leisure facilities
A_{12}	N39°14'10.3''	E020°28'39.9''	0	4m	Sports and leisure facilities
A_{13}	N39°13'52.5''	E020°29'12.9''	1	>3m	Land principally occupied by agriculture, with significant areas of natural vegetation
A_{14}	N39°13'52.5''	E020°29'12.9''	7	1	Annual crops associated with permanent crops
A_{15}	N39°13'29.5''	E020°31'42.4''	10	0.7	Green urban areas
S_1	N39°25'54.5''	E020°50'17.1''	287	1.5	Natural wetland
S_2	N39°25'55.9''	E020°50'25.4''	287	1.5	Natural wetland
S_3	N39°25'58.0''	E020°50'26.5''	287	1.5	Natural wetland
S_4	N39°25'56.4''	E020°50'29.0''	287	1.5	Natural wetland
S_5	N39°26'01.5''	E020°50'26.5''	266	0.3	Agro-forestry area
S_6	N39°26'01.5''	E020°56'35.0''	262	1	Agro-forestry area
S_7	N39°23'52.8''	E020°50'24.9''	262	0.5	Broad leaved forest
S_8	N39°17'32.2''	E020°52'21.2''	116	0.5	Annual crop
S_9	N39°16'10.3''	E020°50'59.5''	67	0.3	Natural wetland
S_{10}	N39°16'15'.3''	E020°50'51.3''	127	1	Transitional woodland-shrubs
S_{11}	N39°15'52.1''	E020°51'03.2''	95	1.7	Natural wetland
S_{12}	N39°15'40.3''	E020°50'53.2''	83	1.5	Artificial area
S_{13}	N39°15'40.9''	E020°51'03.2''	88	3	Artificial area
S_{14}	N39°10'03.8''	E020°49'35.4''	0	4	Agriculture areas-Arable land
S_{15a}	N39°10'09.5''	E020°49'25.5''	1	1	Agriculture areas-Arable land
S_{15b}	N39°10'09.5''	E020°49'25.5''	1	0.4	Agriculture areas-Arable land
S_{16}	N39°03'44.5''	E020°46'19.4''	0	5	Annual crop
S_{17}	N39°02'56.4''	E020°46'38.6''	0	7	Natural wetland
Z_1	N39°14'20.8''	E020°51'06.1''	43	0.7	Natural wetland
Z_2	N39°14'12.1''	E020°50'58.4''	47	0.5	Natural wetland
Z_3	N39°14'07.0''	E020°50'44.6''	49	0.5	Natural wetland

Bryophyte samples were well air dried and kept in flat paper labeled packets [7]. For the bryophytes identification Smith [16, 17] were used. The nomenclature of mosses taxa follows Hill et al. [18] and Sabovljević et al. [19] and of liverworts follows Ros et al. [20].

Considering the identification of *Charophytes* important morphological characteristics such as stem and branchlets cortication, character of spine-cells, stipulodes, gametangia etc. have been examined. The identification was based mainly in Wood and Imahori [21] and Krause [22].

The determination of vascular plant specimens was made using mainly Tutin et al. [23, 24] and Fasset [25]. The nomenclature of vascular taxa follows Tutin et al. [23, 24], and Greuter et al. [26, 27].

For each taxon its life form and chorological type are reported in the plant list. Life forms and chorological types of bryophyte taxa are according to Düll [28, 29]. Life forms for aquatic macrophytes (hydrophytes and helophytes) were taken from Hutchinson [30] and for the other vascular taxa were taken from Raunkiaer [31]. Chorological types for the vascular taxa were taken from Pignatti [32] and for those taxa not included there, distribution data from other sources and floras were used and evaluated (Jalas and Suominen [33], Greuter et al. [26, 27]. For symbols and abbreviations of the floristic catalogue for Chorology see Table 3 and for Life forms see Table 4.

3. RESULTS AND DISCUSSION

3.1. Floristic catalogue

The annotated floristic catalogue for the study area is presented in Table 2. A total of 329 aquatic and riparian taxa are listed belonging to 85 families and 200 genera, while 94 taxa are common species of the two rivers Acheron and Louros.

TABLE 2 - Floristic catalogue of the studied area providing detailed composition information.

Family	Species	Life form	Chorology	Sampling sites
Chlorophytes				
Characeae	*Chara globularis* Thuill	Hyd/Charids	Cosmop	S_1, S_2, S_3, S_4, S_{15}
Characeae	*Chara gymnophylla* A. Braun	Hyd/Charids	S.Europ	S_1, S_2, S_9
Characeae	*Chara vulgaris* L. *f. longibracteata* Kutz	Hyd/Charids	NE. Europ	A_{15}
Characeae	*Chara vulgaris* L.	Hyd/Charids	N. Europ	A_{13}
Cladophoraceae	*Cladophora sp.* Kutz.	Hyd/Algae	Cosmop	A_{11}, A_{12}, A_{13}, A_{15}, S_{13}
Ulvaceae	*Ulva sp.* L.	Hyd/Algae	Cosmop	A_{11}, A_{12}, A_{13}, A_{15}, $S_{15\text{-}17}$
Ulvaceae	*Ulva linza* L.	Hyd/Algae	Cosmop	A_{11}, A_{12}
Ulvaceae	*Ulva prolifera* O. F Muller	Hyd/Algae	Cosmop	A_{11}, A_{12}, A_{13}, S_{15}, S_{17}
Ulvaceae	*Ulva rigida* C. Agardh	Hyd/Algae	Cosmop	S_{16}
Rhodophytes		**Life form**		
Batrachospermaceae	*Batrachospermum sp.* Roth	Hyd/Algae		S_4
Bryophytes				
Liverworts		**Life form**	**Chorology**	
Conocephalaceae	*Conocephalum conicum* (L.) Dumort.	Hemicryptophyte	holarc, subbor-mont	A_1, A_3
Pelliaceae	*Pellia endiviifolia* (Dicks.) Dumort.	Hemicryptophyte	holarc, s.temp	A_6
Ricciaceae	*Riccia fluitans* L.	Hemicryptophyte/ Hydrophyte	cosm., s.temp	A_{10}
Mosses				
Anomodontaceae	*Anomodon viticulosus* (Hedw.) Hook. & Taylor	Chamaephyte, Epiphyte	holarc, temp	S_4
Amblystegiaceae	*Cratoneuron filicinum* (Hedw.) Spruce	Chamaephyte	cosm, temp	S_1, S_2, S_4, S_9, S_{10}
Amblystegiaceae	*Leptodictyum riparium* (Hedw.) Warnst.	Chamaephyte, Hydrophyte	holarc(-bip), temp	A_{15}
Brachytheciaceae	*Brachythecium rivulare* Schimp.	Chamaephyte, Hydrophyte	holarc(-bip), subbor	A_3
Brachytheciaceae	*Brachythecium rutabulum* (Hedw.) Schimp.	Chamaephyte, (Epiphyte)	subcosm, temp	A_6, S_7
Brachytheciaceae	*Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen	Chamaephyte	holarc(-bip), subbor-mont	S_7
Brachytheciaceae	*Homalothecium lutescens* (Hedw.) H.Rob.	Chamaephyte, (Epiphyte)	eur-w.e.as-afr, temp	S_7
Brachytheciaceae	*Oxyrrhynchium speciosum* (Brid.) Warnst.	Chamaephyte	eur-w.e.as-afr-n.am, s.temp	A_1, S_4
Brachytheciaceae	*Platyhypnidium riparioides* (Hedw.) Dixon	Chamaephyte, Hydrophyte	holarc, temp	A_1, S_1, S_2, S_7
Fontinalaceae	*Fontinalis antipyretica* Hedw.	Chamaephyte, Hydrophyte	dj-holarc(-bip), subbor	A_5, A_7, A_9, S_1, S_7, S_{11}
Hypnaceae	*Calliergonella cuspidata* (Hedw.) Loeske	Chamaephyte	holarc(-bip), temp	A_3
Leucodontaceae	*Leucodon sciuroides* (Hedw.) Schwägr.	Chamaephyte, Epiphyte	euras-afr, s.temp	S_3
Plagiomniaceae	*Plagiomnium cuspidatum* (Hedw.) T.J.Kop.	Hemicryptophyte	holarc, subbor	S_7
Pottiaceae	*Cinclidotus aquaticus* (Hedw.) Bruch & Schimp.	Chamaephyte, Hydrophyte	eur-w.as-n.afr, submed-mont	S_7, S_{10}
Pteridophytes		**Life form**	**Chorology**	
Azollaceae	****Azolla filiculoides* Lam.**	Hyd/Lemn	American/Neotrop	A_{10}, A_{11}, S_{14}, S_{17}
Equisetaceae	*Equisetum arvence* L.	Grhiz	Circumbor	A_3
Equisetaceae	**Equisetum paluste* L.	Hel gramin/G rhiz	Eurasiat	S_5
Equisetaceae	*****Equisetum ramossissimum* Desf**	Hel gramin/G rhiz	Circumbor	A_5, S_6
Equisetaceae	**Equisetum telmateia* Ehrh	Hel gramin/G rhiz	Circumbor	A_1, A_5, A_8, A_{13}, S_8, S_{16}

Polypodiaceae	*Andiantum capillus-veneris* L.	Grhiz	Pantrop	A_1
Polypodiaceae	**Asplenium ceterach* L.	Hros	Sub-Atlantic-Sub Medit	A_1, S_{11}
Polypodiaceae	**Asplenium trichomanes* L.	Hros	Cosmop	A_1
Polypodiaceae	*Polypodium vulgare* L.	Hros	Circumbor	S_{11}
Polypodiaceae	**Pteridium aquilinum* (L.) Kuhn	Grhiz	Cosmop	A_1,A_6, S_5, S_6, S_{10}
Selaginellaceae	*Selaginella denticulata* (L.)Spring	Chrept	Medit	A_1
Spermatophytes				
Gymnospermae		**Life form**	**Chorology**	
Cupressaceae	*Cupressus sempervirens* L.	Phscap	E. Medit	S_{17}
Angiospermae				
Dicotyledones		**Life form**	**Chorology**	
Aceraceae	*Acer campestre* L.	Phscap	Medit–Europ	S_6
Apocynaceae	**Nerium oleander* L.	Phcaesp	S.Medit	S_{14}
Araliaceae	**Hedera helix* L.	Nphlian	Medit-Atl.	A_1, A_3, A_6, A_9, S_3, S_4, S_6, S_7, S_{11}
Betulaceae	**Alnus glutinosa* (L.) Gaerthner	Phscap	Paleotemp	A_1, A_3, A_{5-9}, A_{13}
Betulaceae	**Carpinus orientalis* Miller	Phcaesp (Phscap)	Medit-Pont	S_6
Boraginaceae	*Anchusa arvensis* (L.) MB.	Thscap	Eurasiat	S_1
Boraginaceae	*Anchusa cf. italica* Retz.	Hscap	Euri-Medit	S_7
Boraginaceae	*Cerinthe minor* L.	Hbienne/(Tscap)	SE-Europ-Pontica	S_{10}
Boraginaceae	*Myosotis sylvatica* Hoffm.	Hscap (Hbienne)	Paleotemp	A_4
Boraginaceae	*Symphytum bulbosum* C. Schimper.	Grhiz	SE. Europ	S_7
Celastraceae	*Euonymus europaeus* L.	Phcaesp (Phscap)	Eurasiat	S_6
Callitrichaceae	***Callitriche stagnalis* Scop	Hyd parvopot	Eurasiat-Suborean	S_{15}
Campanulaceae	**Campanula patula* L.	Hbienne	Eurasiat	A_1, S_7
Caprifoliaceae	*Sambucus nigra* L.	Hscap (Grhiz)	Euri-Medit	A_{12}, S_5
Caryophyllaceae	*Stellaria media* (L.) Vill	Thrept	Cosmop	A_5, S_8
Ceratophyllaceae	****Ceratophyllum demersum* L.	Hyd cerat	Subcosmop	$A_{9\text{-}14}$, $S_{12\text{-}17}$
Chenopodiaceae	***Chenopodium ambrosioides* L.	Thscap (Hscap)	Tropical-America-Alien	A_{13}
Chenopodiaceae	*Chenopodium botrys* L.	Thscap	Eurasiat/Subcosmop	A_5
Compositae	*Anthemis maritima* L.	Hscap	W.Medit	S_{14}
Compositae	*Aster linosyris* (L.) Berth.	Hscap	Euri-Medit -S Siber	S_8
Compositae	****Aster tripolium* L.	Hbienne	Eurasiat	A_4, A_8, A_{11}, A_{12}, S_{16}
Compositae	****Bellis annua* L.	Thscap	St.Medit-Macarones	S_3
Compositae	*Bellis perennis* L.	Hros	Circumbor	S_7
Compositae	*Bidens frondosa* L.	Thscap	Naturalized (American)	S_{10}
Compositae	*Bidens tripartita* L.	Thscap	Eurasiat	S_8
Compositae	*Chamaemelum nobile* (L.) All	Hscap	W.Europ	A_3, A_4
Compositae	*Chrysanthemum coronarium* L.	Thscap	St.Medit	S_1
Compositae	**Conyza canadensis* (L.) Cronq	Thscap	Naturilized (American)	A_4, A_5, A_7, A_{12}, A_{13}
Compositae	**Crepis fraassi* Sch. Bip.	Hscap	St.Medit-Oriental	A_1
Compositae	****Dittrichia viscosa* (L) Greuter	Hscap	Euri-Medit	$A_{3\text{-}5}$, $A_{7\text{-}8}$, $A_{10\text{-}13}$, S_{14}, S_{16}
Compositae	**Inula crithmoides* L.	Chsuffr	Europ	A_{12}
Compositae	**Lactuca serriola* L.	Hbienne	Eurosiber	A_8
Compositae	*Lactuca virosa* L.	Thscap/Hbienne	Medit.-Atl	S_4
Compositae	*Lapsana communis* L.	Thscap	Paleotemp.	S_8
Compositae	**Leontodon crispus* Vill.	Hros	SE.Europ-Caucas	A_4
Compositae	*Leontodon tuberosus* L.	Hros	St.Medit	S_3
Compositae	*Matricaria recutita* L.	Thscap	Subcosmop	A_{13}
Compositae	*Picris hieracioides* L.	Hscap/Hbienne	Eurosiber	A_8
Compositae	**Pulicaria dysenterica* (L.) Bernh	Hscap	Euri-Medit	S_4, S_5, S_8
Compositae	**Pulicaria odora* (L.) Rchb.	Hscap	Ciscum-Medit	A_9, A_{14}
Compositae	*Pulicaria vulgaris* Gaerther	Thscap	Paleotemp	A_7, S_{14}
Compositae	**Sonchus asper* (L.) Vill	Thscap/Hbienne	Subcosmop	A_7, A_{11}, S_4, S_6, S_8, S_{11}
Compositae	*Sonchus palustris* L.	Hscap	Europeo-Caucas	A_5, A_{14}
Compositae	*Taraxacum officinale* F.H. Wigg.	Hros	Circumbor	A_5
Compositae	**Tussilago farfara* L.	Grhiz	Paleotemp	A_5, A_7
Compositae	****Xanthium strumarium* L.	Thscap	Amer-Cosmop	A_8, A_{13}, S_{14}, S_{16}
Convolvulaceae	**Convolvulus althaeoides* L.	Hscand	Circum-Medit	S_1, S_2
Convolvulaceae	****Calystegia sepium* (L.) R. Br	Hscand	Paleotemp	A_7, $A_{10\text{-}13}$,$S_{5\text{-}6}$, S_8, $S_{10\text{-}12}$, S_{14}, S_{16}
Cornaceae	**Cornus sanguinea* L.	Phcaesp	Eurasiat	A_6, A_8, S_5, S_7
Cruciferae	*Alliaria petiolata* (M.B.) Cavara at Grande	H bienn	Paleotemp	S_7
Cruciferae	**Brassica tournefortii* Gouan	Thscap	Euri-Medit	S_8, S_{14}
Cruciferae	**Capsella bursa-pastoris* (L.) Medicus	Hbienne	Cosmop.	A_8, A_{13}, A_{14}, S_7
Cruciferae	*Hirschfeldia incana* (L.) Lagrze-Fossat.	Hscap (Tscap)	Medit-Macarones	S_{17}
Cruciferae	*Lunaria annua* L.	Hscap	SE.Europ	S_7
Cruciferae	****Nasturtium officinale* R. Br	Hel herb/Hscap	Cosmop	$A_{9\text{-}10}$, $A_{13\text{-}15}$, S_6, S_8, S_{11}, $S_{13\text{-}16}$

Cruciferae	*Raphanus sativus* L.	Thscap/Hscap	Euri-Medit	A_{14}
Cruciferae	*Rorripa amphibia* (L.) Besser	Hel herb/Hscap	Eurosiber	Z_2
Cruciferae	**Rorripa sylvestris* (L.) Besser	Hscap	Eurasiat	S_7
Dioscoreaceae	**Tamus communis* L.	Grad	St. Medit	A_1
Dipsacaceae	**Knautia integrifolia* (L.) Bertol.	Thscap	Euri-Medit	S_2
Dipsacaceae	*Knautia mollis* Jordan	Hscap	St.Medit	S_3
				A_1, A_5, A_7, A_8, A_{10}, S_8,
Euphorbiaceae	**Euphorbia helioscopia* L.	Thscap	Cosmop	S_{14}
Euphorbiaceae	*Euphorbia nicaeensis* All.	Grhiz/Chsuffr	W.C. Medit	A_{13}
Euphorbiaceae	**Euphorbia terracina* L.	Thscap/ Hscap	St.Medit	A_6, A_{14}
Euphorbiaceae	*Mercurialis annua* L.	Thscap	Paleotemp	S_1, S_8, S_{17}
Fagaceae	**Quercus coccifera* L.	Phcaesp	Medit-Occid	S_7, S_{11}, S_{12}
Fagaceae	*Quercus pubescens* Wild.	Phcaesp/Phscap	SE. Europ	Z_1
Geraniaceae	**Geranium columbinum* L.	Thscap	Eurosiber	A_4, A_5, A_{14}
Geraniaceae	*Geranium lucidum* L.	Thscap	Paleotemp	S_7
Geraniaceae	*Geranium pusillum* Burm. fil.	Thscap	Europ-W.Asia	A_{10}, A_{13}, S_{14}
Geraniaceae	*Geranium robertianum spp. purpureum* (Vill.) Nyman	Thscap	Paleotemp	$S_{1\text{-}4}$, S_{14}
				A_9, A_{13}, S_2,
Geraniaceae	*Geranium rotundifolium* L	Thscap	Euri-Medit	S_{10}, S_{11}, S_{15}
				$A_{9\text{-}14}$, $S_{11\text{-}13}$,
Haloragaceae	***Myriophyllum spicatum* L.	Hyd myriophyllids	Subcosmop-Temp	S_{15}, S_{17}
Haloragaceae	*Myriophyllum verticillatum* L.	Hyd myriophyllids	Circumbor	Z_1, Z_2, Z_3, A_{15}
Juglandaceae	*Juglans regia* L.	Phscap	SW. Asiat	S_5
Labiatae	*Ajuga reptans* L.	Chrept	Europ-Caucas	S_5, S_7, S_9
Labiatae	*Galeopsis segatum* Necker.	Thscap	Subatlant	S_7
				$A_{9\text{-}12}$, A_{14}, S_5,
Labiatae	**Lycopus europaeus* L.	Hel herb/H scap	Circumbor	$S_{7\text{-}11}$, S_{14}
Labiatae	*Melissa officinalis* L.	Hscap	Euri-Medit	S_3, S_5, S_7
				Z_3, A_3,A_5,A_7, A_9,$A_{12\text{-}14}$,$S_{1\text{-}2}$,
Labiatae	**Mentha aquatica* L.	Hel herb/H scap	Subcosmop	$S_{5\text{-}11}$,$S_{15\text{-}16}$
				A_4, A_9, A_{14},
Labiatae	***Mentha longifolia* (L.) Hudson	Hel herb/ Hscap	Paleotemp	S_1, S_5, S_8, S_9, S_{10}
Labiatae	***Mentha pulegium* L.	H scap	Euri-Medit /Subcosmop	A_3, $A_{5\text{-}8}$, S_5
Labiatae	*Mentha spicata* L.	Hscap	Euri-Medit	S_6, S_7, S_9, S_{14}
Labiatae	*Origanum vulgare* L.	Hscap	E.Medit	A_4
Labiatae	**Phlomis fruticosa* L.	Nph	E.Medit	A_4, S_3, S_{11}, S_{14}
				A_4, A_5, A_9, S_5,
Labiatae	**Prunella vulgaris* L.	Hscap	Circumbor	S_7
Labiatae	*Satureja grandiflora* (L.) Scheele	Hscap	Orofo.Medit.-E.S.Medit	S_1
Labiatae	**Satureja nepeta* (L.) Scheele	Hscap	Euri-Medit	A_4, S_1, S_2, S_5
Labiatae	**Stachys palustris* L.	Hel herb/Grhiz	Circumbor	A_{12}, S_5
Leguminosae	*Astragalus scorpioides* Willd.	Thscap	SW.Medit	S_{14}
Leguminosae	**Cercis siliquastrum* L.	Phscap	S-Europ.-W-Asiat	S_7
Leguminosae	*Colutea arborescens* L.	Phcaesp	Euri-Medit	A_3
Leguminosae	*Coronilla valentina* L.	Nph	SW.Medit	A_5
Leguminosae	**Dorycnium rectum* (L.) Ser	Hscap/Chsuffr	St.Medit	A_5
				A_9, A_{13}, A_{14},
Leguminosae	**Galega officilalis* L.	Hscap	Euri-Medit	S_9
Leguminosae	**Lathyrus aphaca* L.	Thscap	Euri-Medit	A_{13}
Leguminosae	*Medicago arabica* (L.) Hudson	Thscap	Euri-Medit	A_{13}, S_3
Leguminosae	**Medicago orbicularis* (L.) Bartal.	Thscap	Medit-Irano-Turan	S_1
Leguminosae	*Medicago sativa* L.	Hscap	Subcosmop	A_3, A_5
Leguminosae	*Melilotus officinale* (L.) Lam	Hbienne	Subcosmop	A_3
Leguminosae	**Trifolium aureum* Pollich	Thscap	Europ	Z_1,Z_2
Leguminosae	***Trifolium campestre* Schreber	Thscap	Paleotemp	A_8
Leguminosae	*Trifolium hybridum* L.	Hcaesp	Medit-Atl	A_5, S_1, S_2
Leguminosae	*Trifolium hybridum L. spp. elegans* Savi	Hcaesp	S.Europ	S_7
Leguminosae	*Trifolium pratense* L.	Hscap	Subcosmop	A_{13}
				Z_1, Z_2, A_3, A_4,
Leguminosae	**Trifolium repens* L.	Hrept	Subcosmop	A_9, A_{14}
Leguminosae	***Trifolium resupinatum* L.	Thrept/Hrept	Paleotemp	A_7
Leguminosae	*Vicia hirsuta* (L.) Gray	Thscap	Paleotemp/Subcosmop	Z_3
Leguminosae	*Vicia lutea* L.	Thscap	Euri-Medit	S_{16}
Leguminosae	**Vicia parviflora* Cav.	Thscap	Euri-Medit	A_4
				A_3, A_5, A_7,
Leguminosae	**Vicia sativa* L.	Thscap	St.Medit	A_{10}, A_{13}, S_{13}
Leguminosae	*Vicia villosa* Roth	Thscap (Hscap)	S.Medit	Z_3, A_{14}
Linaceae	**Linum strictum* L.	Thscap	Medit-Irano-Turan	A_3
				A_9, A_{10}, A_{12},
Lythraceae	**Lythrum junceum* Banks & Solander.	Hel herb /Hscap	St. Medit	A_{13}
				$Z_{1\text{-}2}$, A_3, $A_{8\text{-}10}$, A_{15}, S_4, S_8,
Lythraceae	***Lythrum salicaria* L.	Hel herb/Hscap	Subcosmop	S_{12}, S_{14}, S_{16}
Moraceae	**Ficus carica* L.	Phscap	Medit-Turan	A_9, S_4,S_3, S_{10}
				A_9, S_5, S_6, S_8,
Moraceae	***Humulus lupulus* L.	Phlian	Europ-Caucas	S_{11}
Myrtaceae	*Eucalyptus camaldulensis* Dehn.	Phscap	Australia-Alien	A_{10}

Myrtaceae	**Myrtus communis* L.	Phcaesp	St.Medit	A_1
Oleaceae	*Fraxinus angustifolia* Vahl.	Nphscap	SE.Europ	Z_2, S_{16}
Oleaceae	***Fraxinus angustifolia spp. oxycarpa* (Willd.) Franco & Rocha Afonso	Nphscap	SE.Europ	S_{16}
Oleaceae	*Fraxinus ornus* L.	Phscap	Euri-Medit-Pontico	Z_2
Oleaceae	**Olea europaea* L.	Pcaesp/Pscap	St.Medit	S_{14}
Oleaceae	*Phillyrea media* L	Phcaesp (Phscap)	St.Medit	S_7, S_{12}
Onagraceae	**Epilobium angustifolium* L.	Hscap/Hel herb	Paleotemp	A_{10}, S_6, S_8 A_{12}, A_{15}, S_2,
Onagraceae	**Epilobium hirsutum* L.	Hscap/Hel herb	Paleotemp (Subcosmop)	S_5, $S_{9\text{-}12}$
Onagraceae	*Ludwigia palustris* (L.) Elliott	Hel decod/Thrept(Hcaesp)	Subatl-Medit	S_5
Orobanchaceae	*Orobanche minor* Sm.	Thpar	Subcosmop	A_1
Oxalidaceae	*Oxalis corniculata* L.	Hrept	Cosmop	S_4
Papaveraceae	*Papaver rhoeas* L.	Th scap	E. Medit	S_8
Plantaginaceae	**Plantago lanceolata* L.	Hros	Eurasiat (Cosmop.)	A_3, A_5, A_7, $A_{13\text{-}14}$, S_1, S_2, $S_{5\text{-}8}$
Plantaginaceae	**Plantago major* L.	Hel herb/ Hros	Eurasiat (Subcosmo.)	$A_{3\text{-}5}$, $A_{7\text{-}14}$, S_5, S_6, S_8, S_{11}, S_{16}
Platanaceae	****Platanus orientalis* L.	Phscap	Euri-Medit	$A_{1\text{-}10}$, A_{15}, $S_{3\text{-}11}$
Polygonaceae	***Polygonum hydropiper* L.	Hel herb /Thscap	Circumbor	A_5, A_{13}, A_{14}
Polygonaceae	*Polygonum hydropiperoides* Michx.	Hel herb /G rhiz	Naturilized (American)	S_7
Polygonaceae	*Polygonum mite* Schrank	Hel herb/ Thscap	Europ-Caucas	A_{14}
Polygonaceae	***Polygonum persicaria* (L.) Gray	Hel herb /G rhiz	Subcosmop	A_7, A_{12}, A_{15}, S_5
Polygonaceae	****Polygonum salicifolium* Brouss	Hscap	Subcosmop	A_4, A_9, A_{15}
Polygonaceae	****Rumex conglomeratus* Murray	Hscap	Medit.Atl.	Z_1, A_4, A_8, $A_{13\text{-}14}$, $S_{1\text{-}12}$, S_{14}, $S_{16\text{-}17}$
Polygonaceae	*Rumex obtusifolius* L.	Hscap	Subcosmop	A_7, S_{15}
Polygonaceae	****Rumex pulcher* L.	Hscap	Euri-Medit	A_9, $A_{14\text{-}15}$, S_1, S_2, S_7, S_{11}, S_{13}, S_{17}
Primulaceae	****Anagallis arvensis* L.	Thrept	Boreo-Trop	A_8, A_{13}
Primulaceae	*Cyclamen graecum* Link.	Gbulb	E Medit	S_{11}
Primulaceae	*Lysimachia nummularia* L.	Hel herb /Hscap	Europ-Caucas	A_9
Primulaceae	****Samolus valerandi* L.	Hel herb/ Hscap	Subcosmop	A_{10}, S_8
Ranunculaceae	**Clematis flammula* L.	Nphlian	Eu.Medit	A_5
Ranunculaceae	**Clematis vitalba* L.	Phscand	Europ-Caucas	A_8, A_{14}, S_1, $S_{4\text{-}6}$
Ranunculaceae	*Nigella damascena* L.	Thscap	Euri-Medit	S_{12}
Ranunculaceae	*Ranunculus aquatilis* L.	Hyd batrachids	Subcosmop.	A_{13}
Ranunculaceae	*Ranunculus cornutus* DC	Thscap	Euri-Medit	A_9, A_{13}
Ranunculaceae	*Ranunculus flammula* L.	Hel heb / Hscap	Eurasiat	S_{15}
Ranunculaceae	***Ranunculus marginatus* Dum.-Urville	Hscap	St.Medit	A_{14}
Ranunculaceae	**Ranunculus muricatus* L.	Thscap	Euri-Medit	S_7, S_{15}, S_3
Ranunculaceae	***Ranunculus peltatus* Schrank	Hyd batrachids	Medit-atl	S_{16}
Ranunculaceae	*Ranunculus penicillatus* (Dumort) Bab.	Hyd myriophyllids	Subatl	S_8, S_9, S_{10}, S_{11}, S_{13}
Ranunculaceae	**Ranunculus trichophyllus* Chaix	Hyd myriophyllids	Europ	S_1, S_2, S_3, S_{15}
Rosaceae	*Amygdalus webbii* (Spach) Vierh	Phcaesp	E.Medit	S_{14}
Rosaceae	**Crataegus monogyna* Jacq.	Phcaesp (Phscap)	Paleotemp.	S_5, S_7, S_{10}
Rosaceae	*Prunus cocomilia* Ten	Phscap/Phcaesp	NE-Medit-Mont	S_6, S_7
Rosaceae	****Potentilla reptans* L.	Hros	Paleotemp (Subcosmop.)	A_{10}
Rosaceae	**Pyrus amygdaliformis* Vill	Phcaesp (Phscap)	St.Medit	S_7, S_{11}
Rosaceae	**Rosa sempervirens* L.	Nph	St.Medit	A_6, S_4, S_6, S_{10}
Rosaceae	*Rubus fruticosus* L.	Nhp	Europ	A_1, A_3, S_4, S_5, S_6, S_7, S_9, S_{10}, S_{11}
Rosaceae	*Rubus hirtus* Waldst. & Kit.	Nhp	Eurasiat	A_6
Rosaceae	**Rubus ulmifolius* Schott	Nphscand	Euri-Medit	Z_2, A_4, A_6, $A_{8\text{-}15}$, S_8, S_{16}
Rosaceae	**Sanguisorba minor Scop*.	Hscap	Paleotemp-Subcosmop	A_3
Rubiaceae	*Asperula aristata* L.	Hscap/Chsuffr	Medit-Mont	A_8, S_{11}
Rubiaceae	*Asperula laevigata* L.	Hscap	W.E.C Medit	S_{11}
Rubiaceae	*Cruciata laevipes* Opiz	Hscap	Eurasiat	A_{14}, S_7
Rubiaceae	**Galium aparine* L.	Thscap	Eurasiat	A_{10}, A_{14}, $S_{1\text{-}5}$, S_7, S_9, $S_{13\text{-}14}$, $S_{16\text{-}17}$
Rubiaceae	**Galium palustre* L.	Hscap	Europ-W.Asia	S_{11}
Rubiaceae	*Galium setaceum* Lam.	Thscap	Medit-Turan	S_3, S_8
Rubiaceae	**Sherardia arvensis* L.	Hscap	Euri-Medit (Subcosmop.)	A_4
Salicaceae	****Populus alba* L.	Mpscap	Paleotemp	A_7
Salicaceae	*Populus deltoides* W. Bartram ex Marshall	Phscap	Naturalized	A_7
Salicaceae	****Populus nigra* L.	Phscap	Paleotemp	A_8
Salicaceae	****Salix alba* L.	Phscap	Paleotemp	A_1, A_4, A_5, $A_{7\text{-}9}$, A_{13}, A_{15}, $S_{5\text{-}6}$, S_8, S_{10}
Salicaceae	**Salix amplexicaulis* Bory & Chaub	Nph	NE-Medit	A_5, A_8

Salicaceae	**Salix elaeagnos* Scop.	Nphcaesp	S.Europ	A_5, S_5, S_6
Salicaceae	****Salix fragilis* L.	Nphcaesp (Pscap)	Eurosiber	A_3, S_5, S_{10}, S_{11}
Salicaceae	*Salix rubens* Schrank	Phscap	Paleotemp	A_3, S_8
Salicaceae	*Salix triandra* L	Phscap	Eurosiber	A_5, S_8
Scrophulariaceae	**Verbascum sinuatum* L.	Hbienn	Euri-Medit	A_1, A_5, S_1, S_3
Scrophulariaceae	*Veronica acinifolia* L.	Hel herb/ Thscap	Centro SE-Europ	A_4
Scrophulariaceae	**Veronica anagalis aquatica* L.	Hel herb/Hscap	Cosmop	A_4, A_{8-9}, A_{14-15}, S_{1-3}, S_{5-6}, S_{8-10}, S_{15}
Scrophulariaceae	**Veronica arvensis* L.	Thscap	Subcosmop	S_7
Scrophulariaceae	**Veronica beccabunga* L.	Hel herb/ Hrept	Eurasiat	A_4
Solanaceae	**Solanum dulcamara* L.	Hscand	Paleotemp	S_5
Solanaceae	**Solanum nigrum* L.	Thscap	Paleotemp	A_5, A_{12}, S_5, S_{16}
Tamarixaceae	**Tamarix parviflora* DC	Nphcaesp	E.Medit	A_4, A_5
Tamarixaceae	*Tamarix tetragyna* Ehrenb.	Nphcaesp	Euri-Medit -Turan	S_{17}
Theligonaceae	*Theligonum cynocrambe* L.	Thscap	Circum-Medit	A_4
Ulmaceae	****Ulmus minor* Mill.	Nphcaesp/Nphscap	Europ-Caucas	A_{15}, S_6, S_{11}
Umbelliferae	*Ammoides pucilla* (Brot.) Breistr	Thscap	Circum-Medit	A_{11}
Umbelliferae	*Angelica sylvestris* L.	Hscap	Eurosiber	S_{12}
Umbelliferae	*Anthriscus cerefolium (*L) Hoffm.	Thscap	W. Asian	S_6, S_7
Umbelliferae	*Anthriscus silvestris* (L) Hoffm	Hscap	Paleotemp	S_5
Umbelliferae	****Apium nodiflorum* (L.) Lag.	Hel herb/Hrept	Euri-Medit	A_4, A_{9-11},A_{14-15}, S_5, S_{8-11}, S_{14-15}
Umbelliferae	*Apium repens* Lag.	Hel herb/ Hscap	Europ	A_{15}
Umbelliferae	***Berula erecta (*Hudson*)* Coville	Hel herb	Circumbor	A_{11},A_{15}, S_9, S_{14}, S_{15}
Umbelliferae	*Bunium pachypodum* P.W. Ball	G bulb	S. W. Medit	A_{12}
Umbelliferae	**Daucus carota* L.	Hbienne/Thscap	Paleotemp (Subcosmop)	A_4, A_5, A_7, A_8, A_{11}, A_{13}
Umbelliferae	*Daucus muricatus* L.	Thscap	W-Medit	S_{16}
Umbelliferae	*Oenanthe crocata* L.	Hel herb /Hscap	Subatl.	A_3, S_{15}, S_{16}
Umbelliferae	*Peucedanum officinale* L.	Hscap	Eurosiber	S_{10}
Umbelliferae	*Ptychotis saxifraga* (L.) Loret et. Barrandon	H bienn	SW.Europ	A_1
Umbelliferae	**Scaligeria napiformis* Grande	Hscap	Euri-Medit	A_{14}
Umbelliferae	***Tordylium officinale* L.	Thscap	NE-Medit	S_2, S_{14}
Umbelliferae	**Torilis arvensis* (Huds.) Link	Thscap	Subcosmop	A_4, S_1, S_7, S_8, S_{17}
Umbelliferae	****Torilis nodosa* (L.) Gaertner	Thscap	Euri Medit -Turan	A_4, S_{17}
Urticaceae	**Parietaria judaica* L.	Hscap	Euri-Medit	A_3, S_4, S_6, S_7, S_{9-11}
Urticaceae	**Urtica dioica* L.	Hscap	Subcosmop.	S_1, S_4, S_{5-7}, S_{10-11}, S_{14}
Verbenaceae	****Verbena officinalis* L.	Hscap/Thcap	Paleotemp. (Cosmop.)	S_1, S_3
Verbenaceae	**Vitex agnus-castus* L.	Nphcaesp	St.Medit-Turan	Z_{1-2}, A_{3-4}, A_9, A_{14}, S_{10}, S_{11-14}
Violaceae	*Viola riviniana* Rchb.	Hscap	Europ	A_1
Monocotyledones				
Alismataceae	***Alisma lanceolatum* With	Hel sagitt/Hscap	Subcosmop	A_{14}, S_{15}
Alismataceae	****Alisma plantago aquatica* L.	Hel sagitt/Hscap	Subcosmop	S_{10}, S_{14}
Araceae	**Arum italicum* Miller	Grhiz	St. Medit	A_1, A_{3-4}, A_7, A_9, A_{13-15}, S_{3-5}, S_7, S_{10}, S_{17}
Araceae	**Arum maculatum* L.	Grhiz	Europ	A_{10}, S_9, S_{17}
Cyperaceae	*Carex acuta* All	Hel gramin/Grhiz/He	Eurasiat	A_1, A_3
Cyperaceae	*Carex cuprina* Th. Nendtv. ex A. Kerner	Hel gramin /Hcaesp.	Euri-Medit -Atl.	S_9
Cyperaceae	*Carex distans* L.	Hel gramin /Hcaep	Euri-Medit	Z_1, Z_2, S_9
Cyperaceae	*Carex extensa* Gooden	Hel gramin / Hcaesp.	Medit-Atlant.	S_5
Cyperaceae	**Carex flacca* Schreber	Grhiz	Europ	A_3, A_{15}
Cyperaceae	*Carex melanostachya* M. Bieb. ex Willd.	Hel gramin /He/Grhiz	Eurasiat-Temp	A_{13}
Cyperaceae	*Carex muricata* L	Hcaesp	Eurasiat	S_{12}
Cyperaceae	*Carex pendula* Huds	Hel gramin /Hcaesp	Eurasiat	S_5, S_6
Cyperaceae	*Carex rupestris* All.	Hcaesp	Circum-Artico-Alp	A_9
Cyperaceae	***Cyperus fuscus* L.	Hel gramin/Thcaesp	Paleotemp	Z_1, Z_2, A_9, A_{13} Z_3, S_9, S_{10}, S_{11}, S_{12}, S_{15}, S_{16}
Cyperaceae	****Cyperus longus* L.	Hel gramin/Grhiz	Paleotemp	S_{15}
Cyperaceae	****Eleocharis palustris* (L.) Roem.&Schult.	Hel gramin/Grhiz	Subcosmop	A_4, A_5, A_{13}, S_1, S_4, S_8, S_9, S_{16}, S_{17}
Cyperaceae	**Scirpus holoschoenus* L.	Hel gramin/Grhiz	Euri-Medit	S_{16}, S_{17}
Cyperaceae	****Scirpus lacustris* L.	Hel gramin/Grhiz	Subcosmop	A_{15}
Cyperaceae	*Scirpus lacustris spp.lacustris* L.	Hel gramin	Euri-Medit	S_{17}
Cyperaceae	****Scirpus maritimus* L.	Hel gramin	Cosmop	A_4, A_5, A_{11}, A_{14}
Graminae	**Aira elegantissima* Schur	Thscap	Euri-Medit	A_8, A_{15}, S_8, S_{16}
Graminae	***Arundo donax* L.	Grhiz	Subcosmop-Alien	A_{13}
Graminae	*Avena barbata* Pott ex Link	Thscap	Euri-Medit-Turan	

Graminae	**Briza maxima* L.	Thscap	Paleo-sub-tropic	S_{12}, S_{14}
Graminae	*Bromus arvensis* L.	Thscap	Eurosiber	S_1
Graminae	*Bromus diandrus* Roth	Thscap	Euri-Medit	S_1, S_2, S_{15}
Graminae	**Bromus hordaceaceus* L.	Thscap	Subcosmop.	A_4
Graminae	**Bromus madritensis* L.	Thscap	Euri-Medit	A_4
Graminae	**Bromus rigidus* Roth	Thscap	Paleosubtrop.	A_{14}
Graminae	*Cynosurus cristatus* L.	Thscap	Europ-Caucas	S_2
Graminae	***Digitaria sanguinalis* (L.) Scop	Thscap	Cosmop	A_5, S_4
Graminae	*Hordeum leporinum* Link.	Thscap	Euri-Medit	S_2
Graminae	****Hordeum marinum* Huds.	Thscap	Circumbor	A_{14}, S_{17}
Graminae	**Hordeum murinum* L.	Thscap	Circumbor	A_3, A_{13}, A_{15}, S_7
Graminae	*Hordeum vulgare* L.	Thscap	Africa-Orient	S_2
Graminae	***Lolium multiflorum* Lam	Thscap/Hscap	Euri-Medit	S_7, S_8
Graminae	****Lolium rigidum* Gaudin	Thscap	Paleotemp	A_4, A_5, A_{10-11}, A_{13-15}
Graminae	*Paspalum paspalodes* (Michx.) Scribn.	Hel gramin/ Grhiz	Neotropic	Z_{1-3}, A_5, A_8, A_9, S_2, S_{14-17}
Graminae	*Paspalum vaginatum* Sw.	Grhiz.	Cosmop	A_{13}, A_{14}
Graminae	****Phragmites australis* (Gav.) Trin ex Steudel	Hel gramin/Grhiz	Cosmop	A_3, A_{10-14}, S_1, S_2, S_8, S_{12}, S_{14}, S_{16-17}
Graminae	**Piptatherum miliaceum* (L.) Coss.	Hcaesp	St.Medit	A_4, S_{12}
Graminae	*Poa angustifolia* L	Hcaesp	Circumbor	S_2
Graminae	*Poa annua* L.	Thcaesp.	Cosmop	S_3, S_7
Graminae	*Poa palustris* L.	Hcaesp	Circumbor	S_2
Graminae	****Poa trivialis* L.	Hcaesp	Eurasiat	A_{14}
Graminae	*Setaria verticillata* (L.) P. Beauv	Thscap	Cosmop	A_8
Graminae	*Vulpia myuros* (L.) C.C. Gmelin	Thcaesp	Subcosmop	A_6
Hydrocharitaceae	****Hydrocharis morsus -ranae* L.	Hyd hydroch	Eurasiat-temp	S_{15}, S_{16}
Iridaceae	***Iris pseudacorus* L.	Hel gramin/Grhiz	Eurasiat-Medit	S_{10}, S_{16}, S_{17}
Juncaceae	****Juncus acutus* L.	Hel gramin/Hcaesp.	Euri-Medit	A_{12}
Juncaceae	*Juncus bulbosus* L.	Hyd isoetids	Europ	A_8
Juncaceae	***Juncus fontanesii* J. Gay ex Laharpe	Hel gramin /Grhiz	St-Medit	S_9
Juncaceae	*Juncus heldreichianus* Marsson ex Parl	Hel gramin /Hscap	E. Medit	S_5
Juncaceae	***Juncus inflexus* L.	Hel gramin /Hcaesp	Paleotemp	S_8, S_{10}
Juncaceae	****Juncus maritimus* Lam.	Hel gramin/Grhiz	Subcosmop	S_{17}
Lemnaceae	***Lemna gibba* L.	Hyd lemn	Subcosmop	A_{11}, A_{13}, A_{15}, S_4, S_{9-10}, S_{14-15}, S_{17}
Lemnaceae	***Lemna minor* L.	Hyd lemn	Subcosmop	A_{10}, S_{12}, S_{13}, S_{17}
Lemnaceae	***Lemna trisulca* L.	Hyd wolf	Subcosmop	S_9, S_{13}
Liliaceae	*Allium roseum* L.	Gbulb	Circum-Medit	A_4
Liliaceae	*Ornithogalum umbellatum* L.	Gbulb	Euri-Medit	S_7
Najadaceae	*Najas marina* L.	Hyd parvopot	Cosmop	Z_1, Z_2, Z_3
Najadaceae	*Najas minor* All.	Hyd parvopot	Paleotemp/Subtrop	Z_3
Potamogetonaceae	****Potamogeton crispus* L.	Hyd magnopot	Subcosmop	A_{10}, A_{14}, S_{1-3}, S_{8-11}, S_{13}, S_{17}
Potamogetonaceae	*Potamogeton lucens* L.	Hyd magnopot	Circumbor	S_1, S_{15}
Potamogetonaceae	**Potamogeton natans* L.	Hyd natopot	Subcosmop	A_9
Potamogetonaceae	***Potamogeton nodosus* Poiret	Hyd natopot	Subatl/Submedit	Z_{1-3}, A_{10-15}, S_{14-16}
Potamogetonaceae	*Potamogeton obtusifolius* Mert. & W.D.J. Koch	Hyd parvopot	Cosmop	S_9, S_{10}
Potamogetonaceae	****Potamogeton pectinatus* L.	Hyd parvopot	Subcosmop	A_{10}, A_{11}, A_{13}, A_{15}, S_{15-17}
Potamogetonaceae	*Potamogeton perfoliatus* L.	Hyd magnopot	Subcosmop	S_{12}, S_{13}
Potamogetonaceae	***Potamogeton pusillus* L.	Hyd parvopot	Subcosmop	A_{14}, S_8, S_9, S_{14}
Potamogetonaceae	*Potamogeton trichoides* Cham & Schlecht.	Hyd parvopot	Subatl- SubMedit	S_{15}, S_{16}, S_{17}
Potamogetonaceae	****Zannichellia palustris* L.	Hyd parvopot.	Cosmop	A_{13}
Ruscaceae	**Ruscus aculeatus* L.	Chfrut	Circum-Medit	A_1, A_{13}, S_6
Sparganiaceae	****Sparganium erectum* L.	Hel gramin/Grhiz	Eurasiat	S_8, S_{10-14}
Typhaceae	****Typha angustifolia* L.	Hel gramin/Grhiz	Circumbor	S_{11}, S_{12}, S_{13}

Taxa recorded by: Georgiadis et al. (1997) *
Sarika-Hatzinikolaou et al. (2005) **
Georgiadis et al. (1997) and Sarika-Hatzinikolaou et al. (2005) ***

3.2. Richness of taxa

Aquatic and riparian ecosystems are considered to be among the most productive and biologically diverse habitats. In the current survey in Acheron river 200 taxa were recorded of 135 genera and 63 families, in Louros river 220 taxa were identified of 149 genera and 72 families and finally in Zirou lake 21 taxa were recorded of 16 genera and 14 families.

The taxa in the floristic catalogue of Acheron river (200 in total) are new records except 68 previously reported from the area of Acheron delta by Georgiadis et al. [11]. The taxa in the floristic catalogue of Louros river (220 in total) are new records except 74 previously reported from Amvrakikos gulf by Sarika et al. [12] where the Louros river discharges. Furthermore 10 taxa belonging to Phycophyta (Chlorophytes, Rhodophytes) and 17 Bryophytes are reported for the first time from the studied areas.

In Acheron river the 67.16% of the recorded flora belonged to Dicotyledones, 19.60% to Monocotyledones, 5.88% to Bryophytes, 4.46% to Pteridophytes, and 2.9% to Chlorophytes. In Louros river, the 63.11% of the recorded flora belonged to Dicotyledones, 24.44% to Monocotyledones, 5.33% to Bryophytes, 3.11% to Chlorophytes and 2.67% to Pteridophytes.

In Zirou lake only 21 species were recorded in the littoral zone of the lake for the first time. Species pooorness is a common feature of aquatic macrophytic vegetation [15]. The submerged macrophytes *Najas marina, Myriophyllum verticillatum* and *Najas minor* and the helophytes *Rorripa amphibia, Cyperus fuscus* and *Carex distans* dominated the littoral zone of the lake. *Najas minor* is a rare species known only from a few lakes of northern Greece [34]. *Myriophyllum verticillatum* is also a relatively rare species known only from lake Prespa and Mitrikou in north Greece [34], Lysimachia in Aitoloakarnania and Toumpa in Epirus [35].

From Phycophyta, only one species *Batrachospermum* sp. (Rhodophytes) was recorded in Louros river. Red algae have a complex, long life cycle and therefore they need a hydrological stable environment. More specifically, they are weak competitors for space, so in our study we found this species isolated from other plants (especially mosses) only in the Terovo springs. Nine species of Chlorophytes were recorded belonging to 3 families (Characeae, Cladophoraceae, and Ulvaceae). Due to their ecological requirements, charophytes is an extremely endangered algal group, given that their habitats are fragmented or even destroyed, to a greater or lesser extent, by draining or by eutrophication. Despite that some species of the genus *Chara* are widely distributed, the species *Chara vulgaris* was found only on Acheron river (A_{13}) near the Ammoudia bay, while *Ch. globularis* and *Ch. gymnophylla* were found only on Louros river sites ($S_{1\text{-}4}$ & S_9). All *Chara* species are listed as LR (lower risk) in the SE Europe according to IUCN threat categories and criteria [36]. In Greece the species *Chara vulgaris* and *Ch. globularis* was reported from previous studies in Strofylia marshes [37], Argolis area [38] and in Cyclades Islands [39]. *Chara gymnophylla* is also reported from Argolis area [38], while *Chara vulgaris* f. *longibracteata* is a new record for the Acheron river.

A total of 17 Bryophyte taxa were reported (3 hepatics and 14 mosses) that belong to 11 families; bryophytes represent 5.2% of the total plant number in the floristic list. Among them three taxa are first time reported from the Pindos floristical region of Greece. These are: *Cinclidotus aquaticus*, *Oxyrrhynchium speciosum* and *Plagiomnium cuspidatum* with the last one being reported so far only from the North East floristical region (the limit of Pindos floristical region (PI) for bryophytes is as accepted in Düll [29]). Also *Eurhynchiastrum pulchellum* was recollected from Pindos area; the species was only known from Pindos, North Central and North East floristical regions of Greece.

From Pteridophyta 11 species were recorded, belonging to 4 families. One of them *Azolla filiculoides* is an invasive alien freshwater pteridophyte which is reproduced rapidly and colonizes large areas in many inland wetlands of Greece [34].

From Spermatophyta only one species of the Gymnospermae was found (*Cupressus sempervirens* L.) in Louros river. From Angiospermae (Monocotyledones and Dicotyledones) 290 species were recorded. Monocotyledones plants were represented by 75 species (23.33%) belonging to 14 families and Dicotyledones plants included 215 species from 51 families. Compositae, Leguminosae and Graminae were the richest families and account for almost one fifth of the reported flora.

The most prevalent trees of the riparian zone were: *Platanus orientalis, Salix alba, Populus alba, Alnus glutinosa*, *Populus nigra, Salix fragilis,* and *Salix triandra* which is also refered as the most dominant species in the riparian woodlands of the Mediterranean and included in the protected habitat types as characteristic species [5, 8, 9, 13]. From an ecological point of view the most important species of the aquatic flora of both rivers includes all submerged and free floating macrophytes in the main water courses (Table 3) as well as the species, *Apium nodiflorum, Berula erecta, Lycopus europaeus, Nasturtium officinale, Oenanthe aquatica, Rorripa amphibian, Alisma plantago-aquatica, A. lanceolatum, Sparganium erectum, Veronica beccangunga* (Table 3) which already listed in European indices for assessing water trophy and organic pollution [1, 14, 15].

Non-native species such as *Paspalum paspalodes* L, *Chenopodium ambrosiodes* L, *Conyza canadensis* (L) Cronq, *Eucalyptus camaldulensis* Dehn, *Medicago arabica* (L) Hudson, *Rumex obtusifolius* L, *Salix rubens* Schrank, *Xanthium strumarium* L, were also recorded in the study area and had a rather patchy distribution or marginal presence. Some of these invasive alien species expands very quickly and eventually compete with indigenous species for resources [40]. It is important to be pointed out that many taxa recorded in the study area, are considered as nitrophilous (67), ruderal (49) and weedy species (50). The strong moisture gradient and the flood disturbance existing in Mediterranean rivers constrains the river corridor [41, 42] and reduces the wetted area occupied by aquatic and amphibious plants, thereby facilitating the river's bed colonization by annual species of terrestrial origin. Also the disturbance of the river channel and use of the river valley for agriculture are relevant to the increase in richness of terrestrial, ruderal and invasive species [41]. The high number of the above taxa indicates the existence of colonization and the disturbance of the riparian zone.

3.3. Chorological spectrum

In the chorological spectrum, 25 different types were distinguished, 3 types for Bryophytes and 22 types for Phycophytes, Pteridophytes and Spermatophytes (Table 3).

TABLE 3 - Chorological spectrum of the study area flora along with the number of taxa and the proportion of each chorological group.

Chorological group	Acheron n° (%)	Louros n° (%)	Zirou n° (%)
Bryophytes	**10 (5)**	**10 (4.6)**	-
Holarctic	7 (3.5)	5 (2.3)	-
Sub/cosmop.	2 (1)	1 (0.5)	-
Euras	1 (0.5)	4(1.8)	-
Phycophytes-Pteridophythes-Spermatophytes	**192 (95)**	**210 (95.4)**	**20**
Mediterranean	46 (22.8)	54 (24.6)	3 (15)
Cosmop/Subcosmop	42 (20.8)	40 (18.2)	3 (15)
Paleotemp	21 (10.4)	19 (8.6)	4 (20)
Eurasiat	14 (6.9)	19 (8.6)	-
European	13 (6.4)	10 (4.6)	3 (15)
Circumbor	12 (5.9)	14 (6.4)	1 (5)
Eurasiber	5 (2.5)	5 (2.3)	1 (5)
S-E.Europeo-Caucas	7 (3.5)	5 (2.3)	-
Alien/Naturalized/American/Africa/WS Asiat	7 (3.5)	5 (2.3)	-
Pan/Paleo/Sub/Boreo/Tropic	4 (2)	3 (1.4)	1 (5)
Circum-Med	5 (2.5)	2 (0.9)	-
Med-Atl./ Eu.Med-Atl	3 (1.5)	7 (3.2)	1 (5)
Eu/St.Med-Turan	4 (2)	5 (2.3)	2 (10)
Subatl/Subatl-Med	3 (1.5)	7 (3.2)	1 (5)
Med.-Irano-Turan	1 (0.5)	1 (0.5)	-
St. Med-Macarones	-	2 (0.9)	-
SE. Europe-Pontica	-	1 (0.5)	1 (5)
S. Europe-W. Asia	1 (0.5)	5 (2.3)	-
Eu.Med-Pontico	1 (0.5)	1(0.5)	-
Circumbor-Artico-Alp.	1 (0.5)	-	-
St. Med-Oriental	1 (0.5)	-	-
Med.-Pont/ Med.-Occid/ Med.-Mont/Orof-Medit	1 (0.5)	5 (2.3)	-

The chorological spectrum of Acheron river reveals clearly the dominance of Mediterranean species, which comprise 46 taxa (22.8% of the total plant number). There was a sig-nificant presence of Cosmopolitan species (42 species, 20.8%). Paleotemperate species present the next highest percentage (21 taxa, 10.4%), while the proportion of Eurasiatic species is also remarkably high (14 taxa, 6.9%). European (6.4%) and Circumboreal (5.9 %) chorological types occur with smaller percentages and Eurasiber species comprise a minor component of the spectrum (less than 3 %). As for Bryophytes, 7 species were Holarctic (3.5% of the total flora), 2 species were cosmopolitan/ subcosmopolitan (1%) and the proportion of European/ Eurasian species was 0.5 % of the total flora (Table 3).

A similar chorological spectrum was resulted for Louros river. In a total of 220 taxa the 54 (24.6%) were Mediterranean species. There was a significant presence of Cosmopolitan species 40 (18.2%). Paleotemperate and Eurasiatic species occur with the same percentages 19 species (8.6%) while Circumboreal (6.4%) and European (4.6%) chorological types occer with smaller percentages. As for Bryophytes, 5 species were Holarctic (2.5 % of the total flora), 4 species were European /Eurasian (1.8%) and the proportion of cosmopolitan/subcosmopolitan species was 0.5% of the total flora (Table 3).

The chorological spectrum of Zirou lake follows the typical spectrum of small lakes and ponds in Greece [34] with low number of species most of them are paleotemperate species followed by the cosmopolitan/ subcosmopolitan (15%), Mediterranean (15%) and European species (15%).

The analysis of the phytogeographical spectrum highlighted the increase of the widespread species especially cosmopolitan/subcosmopolitan species (57 taxa). However the presence of the Mediterenean species was also high (79 taxa), leading to the conclusion that the advensive, alien and widly distributed species have not expanded to the whole riparian area.

3.4. Life form spectrum

The life form spectrum of the three different ecosystems (Acheron river, Louros river and Zirou lake) is presented in Table 4. In both river ecosystems Hemicryptophytes is the most numerous group (50 species in Acheron river and 53 species in Louros river) followed by Therophytes (42 species in Acheron river and 49 species in Louros river), Phanerophytes (32 species in Acheron river and 34 species in Louros river), Geophytes (14 species in Acheron river and 7 species in Louros river) and Chamaephytes (3 species in Acheron river and 2 species in Louros river).

In the life forms of bryophytes, in both rivers (Acheron and Louros respectively) three life form types occurred. Chamaephytes-Hydrophytes were the most abunbant group (2% and 1.4%) of the total taxa, Chamaephytes was represented by 1% and 1.4%, Chamaephytes-Epiphytes by 0.5% and 1.4% and only 0.5% in Acheron river were Hemicryptophytes-Hydrophytes (Table 4).

Life form spectrum of Zirou lake consists of Helophytes (30%), followed by Phanerophytes (25%), Hydro- phytes (20%), Therophytes (15%) and only 2% of the species are Hemicryptophytes (Table 3).

According to the life form spectum the helophytes were more abundant than hydrophytes (Table 4). The proportions of the individual life forms of Hydrophytes (*lemn*, *myriophyllids*, *napot*, *parvopot*, *charids*, *algae*, *batrach*, *cerat*, *hydroch*, *wolf*, *isoetid* and *magopot*) and Helophytes (*sagitt*, *herb* and *gramin*) are also shown in Table 3. The most abundant growth form of helophytes was *gramin* represented by 26 species and for hydrophytes is *parvopotamits* (8 species).

Concerning the life form spectrum, results seem to reflect the bioclimate as well as the physical geomorphology of the rivers in the study area. In response to prevailing abiotic gradients, river plants display a wide range of growth forms, from totally submerged (e.g. *Ranunculus triphophyllus, Potamogeton perfoliatus*) or floating (e.g. *Azolla filiculoides, Lemna minor*), to riparian woody perennials occupying full bank limits.

TABLE 4 - Life form spectrum (absolute numbers and percentages) of the flora of Acheron and Louros rivers and Zirou lake.

Life forms		Acheron n° (%)	Louros n° (%)	Zirou n° (%)
Bryophytes		**10 (4.95)**	**10 (4.6)**	**-**
	Chamaephyte	2 (1)	3 (1.4)	-
	Chamaephyte-Hydrophytes	4 (2)	3 (1.4)	-
	Chamaephyte-Epiphyte	1 (0.5)	3 (1.4)	-
	Hemicryptophyte	2 (1)	1 (0.5)	-
	Hemicryptophyte- Hydrophyte	1 (0.5)	-	-
Therophytes	**Th**	**42 (20.8)**	**49 (22.3)**	**3 (15)**
Th. caespitose	Thscaesp	1	1 (0.5)	-
Th. scapose	Thscap	37	47 (21.4)	3 (15)
Th. parasite	Thpar	1	-	-
Th. reptant	Thrept	3	1 (0.5)	-
Geophytes	**G**	**14 (6.9)**	**7 (3.2)**	**-**
G. bulbous	Gbulb	3	2 (0.9)	-
G. rhizomatosus	Grhiz	10	5 (2.3)	-
G. radicose	Grad	1		-
Hemicryptophytes	**H**	**50 (24.8)**	**53 (24.1)**	**2 (10)**
H. biennial	Hbienn	8	6 (2.7)	-
H. caespitose	Hcaesp	4	6 (2.7)	-
H. scapose	Hscap	30	32 (14.5)	1 (5)
H. rosulate	Hros	6	5 (2.3)	-
H. reptant	Hrept	1	1 (0.5)	1 (5)
H. scandent	Hscand	1	3 (1.4)	-
Chamephytes	**Ch**	**3 (0.2)**	**2 (0.9)**	**-**
Ch. fruticose	Chfrut	1	1 (0.5)	-
Ch. reptant	Chrept	1	1 (0.5)	-
Ch. suffroticose	Chsuffr	1	-	-
Phanerophytes	**Ph**	**30 (14.9)**	**34 (15.5)**	**5 (25)**
Ph. scapose	Phscap	11	10 (4.6)	1 (5)
Ph. caespitose	Phcaesp	3	10 (4.6)	1 (5)
Ph. lianas	Phlian	1	1 (0.5)	-
Ph. scandent	Phscand	1	1 (0.5)	-
Nano-phanerophytes	Np	14	12 (5.5)	3 (15)
Hydrophytes	**Hyd**	**21 (10.4)**	**26 (11.8)**	**4 (20)**
	lemn	3	3 (1.4)	-
	myriophyllids	2	3 (1.4)	1 (5)
	natopot	2	1 (0.5)	1 (5)
	parvopot	3	5 (2.3)	2 (10)
	charids	2	2 (0.9)	-
	algae	4	5 (2.3)	-
	batrachids	1	1 (0.5)	-
	cerat	1	1 (0.5)	-
	hydroch	1	1 (0.5)	-
	wolf	-	1 (0.5)	-
	magnopot	1	3 (1.4)	-
	isoetids		-	-
Helophytes	**Hel**	**32 (15.8)**	**39 (17.7)**	**6 (30)**
	gramin	11	21 (9.5)	4 (20)
	herb	20	15 (6.8)	2 (10)
	decod	-	1 (0.5)	-
	sagitt	1	2 (0.9)	-

The proportion of these different growth forms presents a tremendous natural variation across broad spatial scales and very different flow regimes and river habitats. The lower percentage of truly aquatic plants might be the result of the physical character of Mediterranean rivers, which are characterized by rough channel material, steep slopes, especially on the upper reaches [41]. Also, in the lower parts of the rivers, high water depth and low water transparency lead to the reduction of truly aquatic species (hydrophytes). Apart from the physical character of the riparian area, human settlements and agriculture have played for centuries an important role in moulding the landscape into a mosaic of agricultural fields; consequences of those disturbances (e.g. agriculture, over-grazing) are also evident in the life form spectrum of the flora.

The dominance of Hemicryptophytes which are perennial plants with storage organs and different strategies of resourse allocation could be attributted to the survival strategies of these plants under extreme desert conditions [41, 43]. They have the advantage to store resourses during a "good" year, a feature that enables them to survive in the unstable Mediterranean environment with long dry summer or even a whole dry year. The relatively high percentage of therophytes might be a result of the intense anthropogenic influence to the area. Therophyte life form includes plant species which complete their biological cycle in a period less than one year. It is prevalent in arid and hot areas and represents the basic life form of subtropical vegetation zone. This life form includes usually the categories of nitrophilous plants, weeds and ruderal plants because of anthropogenic dispersal and has been proposed in literature as a measure of the degree of the human disturbance. The invasion of therophytes throughout the Mediterranean ecosystems [44] (regardless of the altitude or ecosystem type) has been considered as an indication of degradation caused mainly by overgrazing and other human activities.

4. CONCLUSION

The current research added almost 166 unpublished records in the flora of the two rivers Acheron and Louros, and Zirou lake in Western Greece and also confirmed the species identified in previous studies in the broader area. In the present floristic inventory two taxa, namely *Batrachospermum* sp. and *Chara vulgaris f. longibracteata* are reported for the first time for Greece, as well as, *Chara gymnophylla, Plagiomnium cuspidatum,* and *Najas minor* are up today rare species in Greece. Furthermore, the following bryophytes taxa are reported for the first time for Western Greece: *Cinclidotus aquaticus*, *Eurhynchiastrum pulchellum Oxyrrhynchium speciosum,* and *Plagiomnium cuspidatum.*

The results of this research contribute with important information on the flora of the partly protected Natura 2000 areas and are essential for a reliable documentation of their biodiversity. However, the changes that have been taken place in the recent years, such as extensive agricultural cultivations and constructions in the main river courses, threaten the floristic diversity. The floristic composition highlights the effect of human interventions and disturbance occurred locally over the last decades in the catchment areas. Furthermore, the current research can provide useful information for further monitoring projects and conservation measures of the freshwater environment.

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