



New Aquatic Macrophytes for the Flora of Albania from the Lake Shkodra, Drini and Buna Basins[#]

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Abstract: New records regarding the aquatic macrophytes of the lake Shkodra, Drini and Buna rivers basins based on last two years field trips are presented. Altogether 9 species of sedge family are reported and discussed, of which 2 species: *Carex elata* and *Carex melanostachya* are new for the flora of Albania, while 7 other species are less or not known. *Carex elata*, *Cyperus michelianus* and *Fimbristylis dichotoma* were found only on the shoreline of lake; *Carex cuprina* and *Isolepis setaceus* were found on the riversides, while *Carex vesicaria*, *Cyperus glaber*, *Eleocharis uniglumis* and *Carex melanostachya* on shoreline of lake, riversides and marshes were found. The variability of certain taxonomic characters, synonyms, life form, preferred habitat, distribution and actual knowledge for each species is presented.

Key words: Aquatic macrophytes, sedges, Lake Shkodra, Drini River, Buna River.

Introduction

The wetland ecosystem complex of the Lake Shkodra, Drini River and Buna River represent one of the most important hotspots for bird and nature conservation on the Adriatic coast. This comprises a small and recent river delta, several different lagoon complexes and freshwater lakes, as well as typical riverine and coastal landscapes favorable for the development of a high floristic diversity.

Family Cyperaceae (sedge family) is one of the ten biggest plant families in the world with 4550 species. In the Flora of Albania vol. 4 are included 10 genus with 62 species and 8 subspecies, of which 30 species belong to wetland plant species. The list includes 34 species and 6 subspecies to genus *Carex*, 10 species to *Cyperus*, 6 to *Scirpus*, 3 to *Eleocharis*, 3 to *Schoenus*, 2 to *Eriophorum*, and of one species to *Fimbristylis*, *Blysmus*, *Cladium* and *Kobresia*.

The field guide by Demiri (1983) lists 17 genus with 64 species, of which 35 species belong to genus *Carex*, 5 to *Pycnus*, 5 to *Schoenoplectus*, 3 to *Schoenus*, 2 to *Cyperus*, 2 to *Eleocharis*, 2 to *Eriophorum* and of one species to *Scirpus*, *Holoschoenus*, *Bulboschoenus*, *Dichostylis*, *Fimbristylis*, *Isolepis*, *Blysmus*, *Cladium*, *Galilea* and *Acorellus*. All the species presented in this paper belong to aquatic macrophytes group or wetland plants.

The different reports for flora of Albania during the last years: Barina & Pifko (2008); Desfayes (2004); Greuter & Raus (2000); Kashta & Rakaj (2001, 2003); Malo & Shuka (2008); Rakaj (2006, 2008); Rakaj & Kashta (2007); Rakaj & Rostanski (2008); Shuka (2008) *etc.*, showed that the flora of Albania in details is still insufficient known.

Material and Methods

Investigation area is Lake Shkodra, Kosan, Kamice, Jubice, Drini river, Vau i Dejes lake, Bahcallek, Beltoja, Buna river, Domen, Merxhani, delta of Buna, Rezervat of Velipoja. The result of the present contribution of sedges family is based mainly on personal observations in the field trip during 2007-2008 and partly on the material stored in herbarium of Faculty of Natural Science, University of Shkodra.

The collecting sites are arranged in the list and on the maps. A dot in the distribution map indicates that the species has been found in the certain square, however, it does not indicate the frequency of occurrences. The specimens are conserved in herbarium of Faculty of Natural Science, University of Shkodra.

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The plants were determined and described according to Albanian field guide (Demiri, 1983), Albanian Flora vol. 4 (Vangjeli *et al.* 2000), Flora of Shkodra (Ruci, 1986); European Flora vol. 5 (Defilips in Tutin *et al.*, 1980) as well as to specific literature of sedge family: Jermy and Tutin (1972); Simpson (2004).

A short description, synonyms, habitats, life form, distribution, collecting sites and actual knowledge of each species are provided on the base of published floras and electronic works: Tutin *et al.* (1980); Govaerts (2003); URL-1; URL-2, as well as on the base of our field trips.

Results and Discussions

Altogether 9 aquatic and wetlands plant species of family Cyperaceae are reported, of which 2 are new for flora of Albania: *Carex elata* and *Carex melanostachya*. Most of the species listed concerns with different treatment in Albanian flora and floristic contributions or with very rare taxa in Albania, the occurrence of which at Drini River, Buna River and Lake Shkodra is confirmed aiming clarify their taxonomy and distributions.

Family Cyperaceae

1. *Carex cuprina* (I.Sándor ex Heuff.) Nendtv. ex A.Kern., Verh. K. K. Zool.-Bot. Ges. Wien 13: 566 (1863).

Synonyms: *Carex otrubae* Podpera, *Carex vulpina* subsp. *cuprina* (I.Sándor ex Heuff.) O.Bolòs & Vigo, *Carex vulpina* subsp. *memorosa* (Lej. & Courtois) Schinz & R.Keller, *Carex memorosa* var. *cuprina* I.Sándor ex Heuff., *Vignea cuprina* (I.Sándor ex Heuff.) Soják.

Description: Rhizomes short; shoots stout, densely tufted; roots thick, grey-brown; scales brown, remaining as black fibers. Stems 30-100 cm, smooth below, rough above, trigonous, their faces \pm flat, hardly winged on angles. Leaves up to 60 cm x 3-8 mm, \pm erect, \pm auriculate, keeled, bright green, becoming grey-green; margins rough; sheaths white with green veins, becoming brown, apex straight; ligules 5-10 mm, \pm acute, tubular. Inflorescence an elongate panicle, becoming dense when in fruit; lower bracts setaceous, with leaf-like base, about as long as inflorescence, upper glumaceous. Spikes numerous, 8-14 mm, compound, upper σ , lower ρ . σ glumes 3.5-4 mm, oblanceolate-elliptic, pale orange-brown with green midrib; apex acute. ρ glumes 4-5 mm, ovate, pale red- or orange-brown, midrib green; apex acuminate. Utricles 5-6 mm, ovate, plano-convex, ribbed, green, dark brown at maturity; beak 1-1.5 mm, rough at apex, bifid, not split at back; stigmas 2; nut oblong-obovoid, biconvex. Fruiting June - September.

Hemicryptophytes or rhizome geophytes.

Habitat: *C. cuprina* is a species of heavy soils usually in damp situations, e.g. in roadside ditches or besides dykes; rarely if ever on peat and markedly absent from the uplands.

Distribution: Macaronesia, Europe, Mediterranean to Pakistan and NW. China

Localities: E Velipoja, in the marshes of Domen and Merxhani (Fig. 1, 2a).

Demiri (1983) mentioned the species. Later Desfayes (2004) reported the species from Devolli river.

2. *Carex elata* All., Fl. Pedem. 2: 272 (1785).

Synonym: *Carex caespitosa* var. *elata* (All.) Fiori

Description: Rhizomes very short, erect; shoots densely tufted, forming tussocks up to 40 cm high; roots up to 2 mm thick, purple-brown; scales light brown, shiny, persistent. Stems 25-100 cm, rough, sharply trigonous, solid. Leaves 40-100 cm x 3-6 mm, rough, thin, plicate, gradually tapering to a flat apex; sheaths becoming yellow-brown, persistent, inner face hyaline, fibrillose on splitting, apex concave; ligule 5-10 mm, acute, \pm tubular. Inflorescence c.1/7 length of stem; bracts leaf-like to setaceous, lowest not half length of infl. σ spikes 1-3, 15-50 mm, lower-most occasionally ρ at base; σ glumes c. 5 mm, oblanceolate, margin hyaline; apex obtuse. ρ spikes 2-3, usually contiguous, 15-40 mm, cylindric, erect, \pm sessile, often σ at top; ρ glumes 1-4 mm, ovate-elliptic, margins hyaline; apex obtuse or sub-acute. Utricles 3-4 mm, broadly ovoid-ellipsoid, ribbed, green; beak 0.2 mm, truncate; nut obovoid, biconvex, stalked. Fruiting May - June. Hemicryptophytes or rhizome geophytes. A very similar species, *C. caespitosa* L.

Habitat: It is a species of eutrophic fen where there is at least seasonal flooding and is therefore common by fen ditches, rivers and lakes.

Distribution: Europe to C. Asia (Iran).

Localities: E Lake Shkodra, in the marsh between Jubice and Kamice (Figures 1, 2b).
New for flora of Albania.

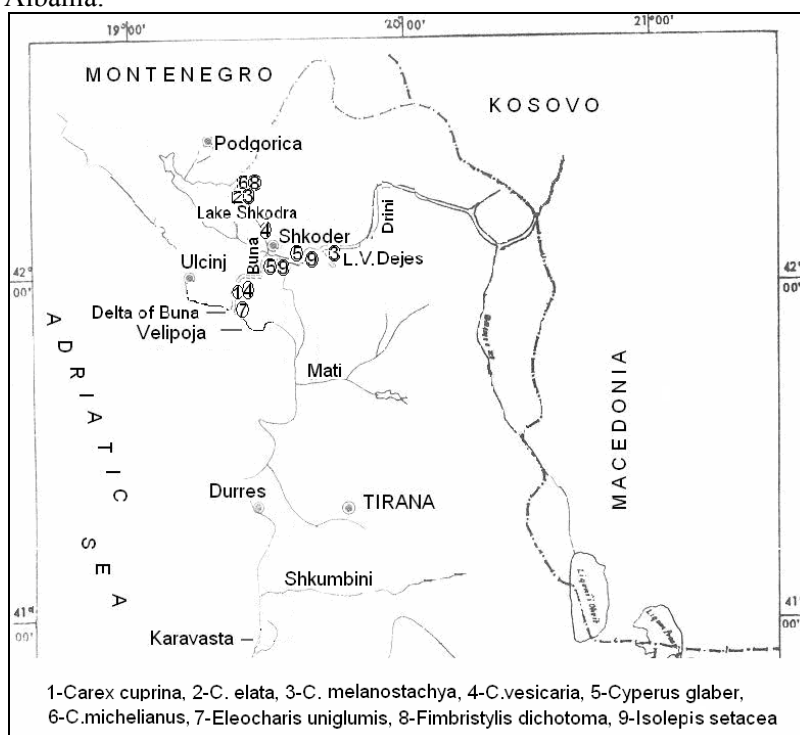


Figure 1. The sites of aquatic and wetland species listed in the present paper

3. *Carex melanostachya* M.Bieb. ex Willd., Sp. Pl. 4: 299 (1805).

Synonyms: *Carex nutans* Host, *Carex juncoides* J.Presl & C.Presl, *Carex sulcata* Schur, *Carex bornmulleri* Kük.

Description: Rhizomes often creeping; shoots; roots yellow, felted; scales purple, persistent. Stems 30-60 cm, shorter than leaves, rigid, trigonous, striate, and rare decumbent at base. Leaves narrow, 3 mm wide, \pm rough, thin, bright-purple; sheaths red-flushed, persistent, edges falsiforme; ligules 2 mm, obtuse. Inflorescences 1/4 length of stem; bracts leaf-like, lowest about as long as spike. σ spike 1, 10-25 mm; σ glumes 4-6 mm, narrowly rolling, purple-brown; apex \pm acute, apiculate. ρ spikes 1-3, till 3cm long, \pm oval; slender, smooth; ρ glumes 3-4 mm, obovate, purple-brown or red-purple with a green midrib; apex acute. Utricles 3-3.5 mm, obovoid to broadly ellipsoid, com-pressed, strongly ribbed, blue-green; stigmas 3; nut oviform, trigonous, bright-brown, 5mm long. Fruiting June - September. Hemicryptophytes or rhizome geophytes.

Habitat: It grows at edges of ditches, pools or in very wet meadows, marshes and shores.

Distribution: South Europe to NW. China; Balkan, Italy, France, Germany, Rusi etc.

Localities: In the edges of Vau i Dejes lake and the humid meadows or marshes of east of Lake Shkodra; Kosan (Fig. 1, 2c). New for flora of Albania.

4. *Carex vesicaria* L., Sp. Pl.: 979 (1753).

Synonyms: *Carex pendula* Moench., *Carex furcata* Lapeyr.

Description: Rhizomes shortly creeping; shoots slender, markedly trigonous, 2-3 in each tuft; roots thick, pale yellow-brown; scales brown or purple-red, usually persistent. Stems 30-120 cm, trigonous, rough on the angles above, smooth below. Leaves up to 150 cm x 4-8 mm, serrulate for entire length, thin, rigid, plicate, gradually tapered to a fine point, mid or yellow-green; sheaths becoming purple-red, persistent, inner face hyaline, fibrillose on splitting, apex straight or concave; ligule 5-8 mm, acute. Inflorescence 1/4 length of stem; bracts leaf-like, lower exceeding inflorescence. σ spikes 2-4, 10-40 mm, the lower often with setaceous bracts; σ glumes 4-6 mm, elliptic or oblanceolate, purplish-brown with green or paler midrib and hyaline margins; apex \pm acute. ρ spikes 2-3, \pm contiguous but distant from the σ spikes, 2-4 cm, oblong-cylindric, erect, subsessile or lowest with peduncle as long as spike; ρ glumes 4-6 mm, narrowly lanceolate, purplish-brown with paler or green midrib; apex

acute or acuminate, hyaline. Utricles 6-8 mm, ovoid-ellipsoid, inflated, ribbed, \pm shiny, olive green; beak c. 2 mm, smooth, bifid; stigmas 3; nut obovoid, trigonous. Fruiting July - August. Variable in size of utricle and glume and in leaf structure. Hemicyptophytes or rhizome geophytes.

Habitat: A plant of wet peat-lands forming a characteristic community around lake. In more open situations and on inorganic soils, at edges of streams, dykes and canals.

Distribution: Europe to Japan, NW. Africa, Canada to W. USA.

Localities: On the shoreline of Lake Shkodra and in the marshes of Domen and Merxhan (Fig. 1, 2d). The only report for this species from Albania is by Demiri (1983) without any exact location.

5. *Cyperus glaber* L., Mant. Pl. 2: 179 (1771).

Boiss., Fl. Or. 5: 371. 1882; C. B. Clarke, l.c. 606; R. R. Stewart, l.c. 89; Kukkonen, in Rech.f., l.c. 110; Nyárády, in Fl. Rep. Soc. România 11: pl. 119. 3. 1966;

Synonyms: *Chlorocyperus glaber* (L.) Palla, *Cyperus banaticus* Kit. ex Nyman, *Cyperus patulus* Kit. ex Host, *Pycneus glaber* (L.) Hayek, *Dichostylis glabra* (Palla) Palla, *Cyperus viridis* Sieber ex C.Presl.

Description: Annual, 25-50 cm, forms small tufts. Stem 1.5-2 mm diameter, trigonous, smooth. Leaves basal or subbasal, equalling or longer than stem; sheaths up to 10 cm, lowermost blade-less, yellow-brown, often reddish, upper grey-yellow, mouth margin straight; blades up to 45 cm, 3-6 mm wide, flexuous, flat, yellowish green, margins scabrous towards apex, which long, acute, scabrous. Inflorescence an irregular, primary branches up to 30 mm; lowest 3-5 bracts foliose, up to 30 cm; branches ending with tight cluster of spikes of c. 50 spreading spikes. Spikes 7-9 x 2.5-3 mm, compressed, with 8-14 flowers; rachis laterally compressed, 4-angled, internode c. 1.3 mm, winged; glumes 2-2.5 mm, cymbiform, mid-nerve area green, scabrous mucronate, sides with 2-3 conspicuous, yellow nerves, more or less reddish brown, margins scarious. Nut c. 1.3 mm, obovoid, triangular, apiculate, with a short stipe, minutely papillose, black-brown or grayish black. Thermophytes.

Habitat: Riverbeds, moist fields.

Distribution: C and SE Europe east to Tajikistan, and from Turkey and Israel to Pakistan.

Localities: In Beltoje and Bahçallek, on the riverbeds of Drini and Buna (Fig. 1, 2e).

The only report for this species from Albania is by Demiri (1983) as *Pycneus glaber* L.) Palla.

6. *Cyperus michelianus* (L.) Delile, Descr. Egypte, Hist. Nat. 3: 50. 1813;

Synonyms: *Scirpus michelianus* L., *Dichostylis micheliana* (L.) Nees.

Description: Tufted annual, 3-10 cm. Roots fibrous. Stem trigonous, grooved, smooth. Leaves basal or subbasal, as long as the stem; sheaths to 25 mm, soft, grey or brownish grey, mouth margin slightly concave; blades 1-1.5 mm wide, keeled, folded, smooth, grey green, apex slightly scabrous. Inflorescence a globosely head, 7-12 mm diameter, lower part with several short branches, upper part unbranched, spikes on rachis and branches numerous, compactly spirally arranged; bracts 5-6, up to 70 mm, spreading; spike 1.5-2.5 x 0.8-1.5 mm, with 20-30 3-ranked, spirally arranged glumes; glumes 2-2.5 mm, lowest sterile, up to 2.8 mm, narrowly cymbiform, grayish brown, keeled, apiculate, apex slightly recurved. Stamens 1-2, stigmas 2. Nut c. 0.8 x c. 0.3 mm, bi-convex or plano-convex, ellipsoid or parallel-sided, finely reticulate. Flower: September - October. Thermophytes.

Habitat: In alluvial river shores on clay and sand;

Distribution: Old World: From Algeria, C and S Europe to S Vietnam,

Localities: NE Lake Shkodra around Syri i Zi and Syri i Kripes (Fig. 1, 2g).

The only report for this species from Albania is by Demiri (1983) as *Dichostylis micheliana* (L.) Nees without any exact location. Pulevic (2005) reported it also as *Dichostylis micheliana* from Montenegrin part of Lake Shkodra.

7. *Eleocharis uniglumis* (Link) Schult. in J.J.Roemer & J.A.Schultes, Mant. 2: 88. 1824.

Synonyms: *Scirpus uniglumis* Link, Jahrb. Gewächsk. 1(3): 77. 1820; *Eleocharis halophila* (Fernald & Brackett) Fernald; *Eleocharis affinis* C.A.Mey. ex Claus, *Eleocharis carinata* Sakalo, *Eleocharis conica* J.Presl & C.Presl.

Description: Plants perennial, mat-forming; rhizomes evident, long, 0.3-1 mm thick, soft to firm, cortex often fugacious, longer internodes 10-25 mm, scales fugacious, 5-6 mm, membranous, not fibrous. Culms terete, often with some blunt ridges when dry, (5-)10-60 cm x 0.2-1.5 mm, firm,

internally spongy. Leaves: distal leaf sheaths persistent, not splitting, proximally red, distally stramineous to green, often callused, thinly papery to thickly membranous, apex often dark red-brown, obtuse to subacute, tooth absent. Spikes with 10-30 flowers; spikelets ovoid to lanceoloid, $5-10 \times 2-3(-4)$ mm, apex acute; proximal scale amplexicaulous, entire; subproximal scale with flower; floral scales often spreading in fruit, 10-20, 3-4 per mm of rachilla, brown to often red-brown, midrib regions mostly stramineous to green, broadly ovate, $3-4 \times 1.8-2.5$ mm, entire, apex acute to obtuse, often some carinate in distal part of spikelet. Flowers: perianth bristles 0-4(-5), light brown to stramineous, stout, usually unequal, rudimentary to equaling achene; stamens 3; anthers dark yellow to stramineous, 1.2-2 mm; styles 2-fid. Achenes not persistent, dark yellow or medium or dark brown, ellipsoid, obovoid, or obpyriform, biconvex, angles obscure, $1.3-1.8 \times 1-1.4$ mm, apex rounded, neck absent or short, smooth at 30X, or sometimes finely rugulose at 10-20X with 20 or more horizontal ridges in vertical series. Tubercles brown to whitish, pyramidal, much higher than wide to slightly depressed, sometimes spongy and with vertical rows of depressions, $0.4-0.8 \times 0.3-0.8$ mm. Fruiting summer. Hemicytrophites.

Habitat: Mostly coastal, brackish to fresh shores and marshes;

Distribution: Europe to Russian and Pakistan, Subarctic America to N. U.S.A.

Localities: In Preserve of Velipoja and in Delta of Buna (Fig. 1, 2f).

Desfaeys (2004) reported this species from the east of Bulqize and Lake Ohrid.

8. *Fimbristylis dichotoma* (L.) Vahl, Enum. Pl. 2: 287. 1805.

Synonyms: *Scirpus dichotomus* Linnaeus, Sp. Pl. 1: 50. 1753; *Scirpus annuus* Allioni, *Fimbristylis annua* (Allioni) Roemer & Schultes; *F. brizoides* Nees & Meyen; *F. diphylla* (Retzius) Vahl subsp. *diffusa* D. B. Ward; *F. glauca* Vahl; *F. polymorpha* Boeckeler; *Isolepis dichotoma* (L.) Kunth; *Eleocharis dichotoma* (L.) H.Karst.

Description: Plants perennial, cespitose, (10-) 20-80 cm, base thickened, not bulbous; rhizomes absent. Leaves nearly distichously, spreading to ascending, 1/2 length of culms; sheaths distally ciliate, backs mostly glabrous; ligules line of short hairs; blades narrowly linear, 2-3 mm wide, flat to broadly involutes, scabrid ciliate. Inflorescences: anthelia compound, dense or open, ascending-branched, longer than broad; scales slender, 1 mm wide, slightly compressed distally; proximal most involucre bract exceeding anthelia. Spikelets pale drab brown to chestnut brown, ovoid-lanceolate, 4-8 mm; fertile scales broadly oblong or ovate, 2 mm, acute to obtuse angled, glabrous, midrib reaching scale tip or excurrent, finely mucronate. Flowers: stamens 1-2; styles 2-fid, flat, fimbriate. Achenes white to brownish, lenticular, obovoid, 1-1.2 mm, cancellate, each face longitudinally with (5-)10-12 ribs, connected by vertical rows of horizontally rectangular pits. $2n = 20, 30$. Fruiting summer- late fall. Thermophytes or hemicytrophites.

Habitat: Moist, usually sandy waste areas, roadsides, low fields; 0-200m.

It is one of the most widespread and weedy species of *Fimbristylis*, unquestionably with many races and forms.

Distribution: Trop. & Subtrop. Old world to NW Pacific.

Localities: NE Lake Shkodra around Syri i Zi and Syri i Kripes (Figure 1, 2h).

Demiri (1983) mentioned this species from Albania. Pulevic (2005) reported it as *Fimbristylis annua* (Allioni) Roemer & Schultes from Montenegrin part of Lake Shkodra.

9. *Isolepis setaceus* (L.) R. Br., Prodr.: 222. 1810.

Synonym: *Scirpus setaceus* Linnaeus, Sp. Pl. 1: 49. 1753, *Schoenoplectus setaceus* (L.) Palla, *Isolepis pleurocarpa* Hochst. ex Boiss. *Cyperus setaceus* (L.) Missbach & E.H.L.Krause.

Description: Plants perennial, forming dense mats; rhizomes creeping; culms, leaves, and bracts orange-punctate at 10-15x. Culms $3-25 \text{ cm} \times 0.2-0.3$ mm. Leaves: sheaths usually reddish proximally; distal blade rudimentary to $6 \text{ cm} \times 0.2-0.5$ mm. Inflorescences: involucre bracts 1 or 2; proximal bract erect to spreading, 3-10(-20) mm; distal bract reflexed, to 5 mm. Spikelets $3-6 \times 2$ mm; scales partly orange- to red- or blackish brown, midrib greenish to stramineous, not gibbous, prominently ribbed near midrib, often with 1+ pale veins on dark sides, $1.2-1.6 \times 0.6-1$ mm, membranous, hyaline, apex rounded to obtuse; proximal scale like others. Flowers: anthers 0.3-0.5 mm; styles 3-fid or 3-fid and 2-fid. Achenes falling separately from floral scales, orange-brown, each face prominently longitudinally 5-8-ribbed, many fine transverse ridges evident at 20-30X, broadly obovoid to oblong, thickly

biconvex to compressed-trigonus, biaxial angle obscure, lateral angles prominent, faces convex, 0.8-1 × 0.5 mm. 2n = 28. Fruiting late spring-fall. Thermophytes or hemicryptophytes.

Habitat: Stream banks, pond margins, ditches, coastal, rarely inland; 0–1500 m; It is cultivated as an ornamental.

Distribution: Temp. & Subtrop. Eurasia, Africa.

Localities: On the riverside of Drini and Lake of Vau i Dejes, Beltoja (Figure 1, 2i).

Demiri (1983) mentioned this species from Albania. Pulevic (2005) reported it from Montenegrin part of Lake Shkodra. Later Barina & Pifko (2008) reported it as *Scirpus setaceus* L. from north of Peshkopi.

Conclusions

1. Altogether 9 aquatic macrophytes and wetland species of sedges family are found in Lake Shkodra, Drini river and Buna river basins.
2. Two species are new for flora of Albania: *Carex elata* and *Carex melanostachya*, while 7 other species were less or not known in that area: *Carex cuprina*, *Cyperus glaber*, *Carex vesicaria*, *Cyperus michelianus*, *Eleocharis uniglumis*, *Fimbristylis dichotoma* and *Isolepis setaceus*.
3. Most of the species are widely distributed in Europe, Asia and N America, but rarely in the Balkan Peninsula.

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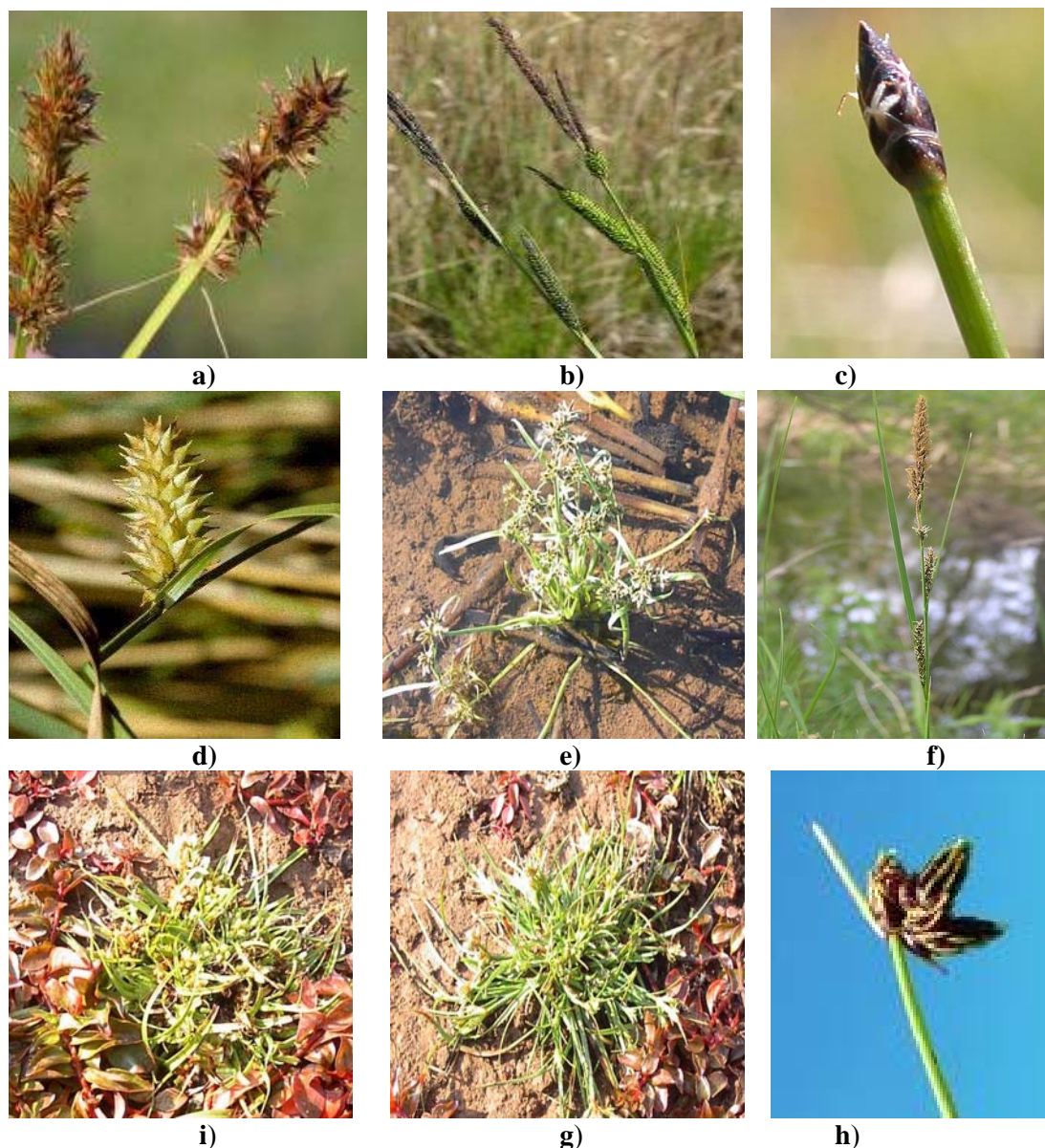


Figure 2. a) *Carex cuprina* , b) *C. elata*, c) *Eleocharis uniglumis* d) *C. vesicaria*, e) *Cyperus glaber*, f) *Carex melanostachya*, g) *Cyperus michelianus*, h) *Fimbristylis dichotoma*, I) *Isolepis setacea*.