Studies in Italian Cyperaceae 1. *Eleocharis pellucida*, new to Europe, naturalised in Piemonte (Italy)

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Ricerche sulle Cyperaceae Italiane. 1. Eleocharis pellucida, nuova per l'Europa, naturalizzata in Piemonte (Italia) - Si segnala per la prima volta il ritrovamento in Europa di Eleocharis pellucida J. Presl & C. Presl (Cyperaceae), una specie esotica originaria dell'Asia orientale e sudorientale, ben naturalizzata e localmente abbondante in diverse brughiere (baragge) delle province di Biella, Torino e Vercelli (Piemonte, Italia), probabilmente presente anche altrove ma sinora sfuggita all'osservazione. I caratteri diagnostici vengono illustrati e comparati con quelli delle specie simili, sia autoctone sia alloctone e viene elaborata una chiave aggiornata del genere Eleocharis in Piemonte. Infine si forniscono una fotografia e un disegno al tratto originale e si ipotizzano le modalità di introduzione.

Key words: Italy, Cyperaceae, Eleocharis pellucida, naturalisation, xenophyte.

Eleocharis R. Br. (Cyperaceae) is a nearly cosmopolitan genus of ca. 200 species (Mabberley, 2008). According to Conti et al. (2005) ten taxa are native in Italy: Eleocharis acicularis (L.) Roem. & Schult., E. carniolica W.D.J. Koch, E. mamillata (H. Lindb.) H. Lindb. subsp. austriaca (Hayek) Strandh. and subsp. mamillata, E. multicaulis (Sm.) Desv., E. ovata (Roth) Roem. & Schult., E. palustris (L.) Roem. & Schult., E. parvula (Roem. & Schult.) Palla, E. quinqueflora (Hartm.) O. Schwarz, and E. uniglumis Schult. Four additional species are locally naturalised (Conti et al., 2005; Celesti-Grapow et al., 2009): Eleocharis atropurpurea (Retz.) Kunth, E. flavescens (Poir.) Urb., E. geniculata (L.) Roem. & Schult.¹ and E. obtusa (Willd.) Schult., mostly as weeds of rice.

In the course of an excursion in a heath land (baraggia) near Benna (prov. Biella, Piemonte, Italy) in September 2008 I came across a tiny species of *Eleocharis* that did not match any of the species mentioned above. Diagnostic features proved to be its annual life form, acute spikelets, 3-fid styles and bluntly trigonous, yellowish-greenish achenes. The species obviously belonged to subgenus *Eleocharis* and more precisely to section *Eleocharis* and series *Multicaules* Svens. ex Kern (González-Elizondo & Peterson, 1997). It then easily keys out to *Eleocharis pellucida* J. Presl & C. Presl (Svenson, 1939), a species from eastern and south-eastern Asia, apparently never recorded before in Europe. Additional field work in September 2009 yielded supplementary records,

¹ Genuine *Eleocharis geniculata* probably has never been reliably recorded in Italy. The collections seen by Greuter & al. (2002) in fact belong to the related *Eleocharis caduca*.

again in Piemonte (provinces of Biella and Torino). Moreover, a herbarium specimen of *Eleocharis carniolica* from Villarboit (province of Vercelli), dating back to 1989, also turned out to be ascribable to *E. pellucida*.

So, this species is locally naturalised in abundance in several different heath lands and possibly overlooked elsewhere in north-western Italy. In the present paper *Eleocharis pellucida* is described and illustrated. Its diagnostic features are discussed and a key to the genus *Eleocharis* in Piemonte is presented. Finally, the species' potential introduction history in Piemonte is reconstructed.

Nomenclature

[Synonymy especially after Ohwi (1944), T. Koyama (1961), and partly after Govaerts & Simpson, (2007)].

Eleocharis pellucida J. Presl & C. Presl in C. Presl, Reliq. Haenk. 1: 196 (1828). Type: «Philippines, Luzon», *Haenke s.n.* (PR, holo).

Eleocharis sp.: Moritzi, Syst. Verz.: 97. 1845.

Eleocharis afflata Steud., Syn. Pl. Glumac. 2: 76 (1854).

Scirpus afflatus (Steud.) Benth., Fl. Hongkong.: 394 (1861); Kuntze, Rev. Gen. Pl. 2: 757 (1891), isonym. Type: «Java», Zollinger 405 (P, holo; L).

Eleocharis japonica Miq., Ann. Mus. Lugd.-Bat. 2: 142. (1866, "1865").

Scirpus japonicus (Miq.) Franch. & Sav., Enum. Pl. Japon. 2: 109. (1879).

Eleocharis afflata var. *japonica* (Miq.) C.B. Clarke ex Lév., Bull. Acad. Intern. Géogr. Bot. 14: 203. (1904).

Eleocharis pellucida forma japonica (Miq.) Ohwi, (Cyper. Japon. 2) Mem. Coll. Sci. Kyoto Univ. B, 18: 40. (1944).

E. congesta D. Don var. japonica (Miq.) Koyama, J. Fac. Sci. Univ. Tokyo, Sect. 3, 8: 89. (1961).

Eleocharis pellucida var. japonica (Miq.) Tang & F.T. Wang, Fl. Reipubl. Popul. Sin. 11: 58. (1961).

E. congesta D. Don subsp. japonica (Miq.) Koyama, Fl. Taiwan 5: 220, t. 1324. (1978). – Type: Buerger s.n. (L, holo, sh, no. 902.76-87), Japan.

Heleocharis japonica Boeckeler, Linnaea 36: 422. (1876), non *Eleocharis japonica* Miq. (1866; orth. var.). – Syntypes: *Oldham, Schottmüller, Wichura* (B, extant?), Japan.

Eleocharis thomsonii Boeckeler, Linnaea 36: 451. (1876; "thomsoni").

Scirpus thomsonii (Boeckeler) Kuntze, Rev. Gen. Pl. 2: 758. (1891). Type: Hooker f. & T. Thomson E. gracilis

p.p. «India, Khasia», (B, holo, extant?; K).

Eleocharis chlorocarpa Boeckeler, Flora 61: 34. (1878). – Type: *Hooker f. & T. Thomson E. gracilis p.p.* (B, holo, extant?; K, L), India, Khasia.

Eleocharis kuntzei Boeckeler, Beitr. Cyp. 1: 14. (1888). – Type: n.v. (B, extant?) Reference in Govaerts & Simpson (2007) is erroneous, apparently copied from IPNI.

Eleocharis gambleana Boeckeler, Allg. Bot. Zeitschr. 1896: 54. (1896; "gableana"). – Type: Gamble s.n. (B, holo, extant? K), India, Tamil Nadu, Nilgiris.

Scirpus attenuatus Franch. & Sav., Enum. Pl. Japon 2: 543. (1879).

Eleocharis attenuata (Franch. & Sav.) Palla, Mond. Pl.: 40. (1910).

Eleocharis pellucida forma japonica (Miq.) Ohwi, (Cyper. Japon. 2) Mem. Coll. Sci. Kyoto Univ. B, 18: 40. (1944). Type: not indicated (material in P). Japan.

Eleocharis shimadae Hayata, Icon. Pl. Form. 6: 107, t. 24. (1916; "shimadai"). – Type: «Taiwan, Hokutu» Shimada 14 (TI, holo).

Taxonomy

Densely caespitose annual with filiform to capillary culms up to 20 (-40) cm long and 0.3-0.5 mm wide, striate to slightly sulcate. Uppermost leaf sheath oblique at apex, tight and firm (not translucent). Spikelets ovoid to ovoid-cylindrical, acute at apex, many-flowered, 5-7 mm long. Glumes ovateoblong, obtuse to subacute at apex, the upper reddish-brown with green midrib and membranous margins, the lowest larger and often paler (entirely green or suffused with reddish-brown), ca. 1-1.4 mm long. Stamens 2(-3), anthers ca. 0.5 mm long, style 3-fid. Perianth bristles usually 6, as long as or slightly longer than achene. Achenes ca. 1 mm long, bluntly trigonous, narrowly obovate, olive to yellowishgreen, tubercle (stylopodium) darker, narrowly triangular, acuminate at apex, much narrower than the achene and clearly constricted at base (Figs. 1, 2).

Specimina visa

ITALY: Piemonte - Prov. Biella, Benna (SE-Biella), baraggia, heath land (in shallow water), locally abundant, along with *E. obtusa*, 15.09.2008, *F. Verloove* 7426 (priv. herb. author, dupl. priv. herb. E.J. Clement, BR, K, LG, MBK, TO); Benna, baraggia, heath land (military training area), 08.09.2009, *F. Verloove* 7842 (priv. herb. author); Candello, baraggia, heath land (military training area), locally abundant, along with *E. obtusa* and *E. flavescens*,

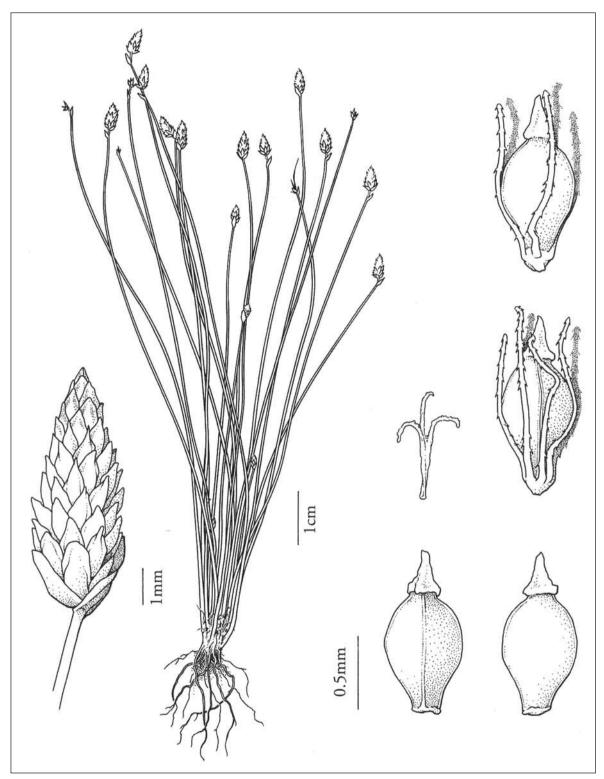


Fig. 1 - Eleocharis pellucida: general habit and floral details (original drawing Sven Bellanger).

11.09.2009, *F. Verloove* 7852 (TO) - Prov. Torino, Lombardore, Riserva Naturale Orientata della Vauda, heath land, former military base, 07.09.2009, *F. Verloove* 7851

(priv. herb. author, dupl. BR, TO) - Prov. Vercelli, Villarboit, baraggione presso lo stagno, 03.09.1989, *A. Soldano* 6836 (priv. herb. A. Soldano, sub *E. carniolica*).



Fig. 2 - *Eleocharis pellucida* in a shallow, temporarily wet track in the baraggia in Benna (12.09.2009; photo Daniela Bouvin).

Soldano & Sella (2000) cite five species of *Eleocharis* from the province of Biella: *Eleocharis acicularis, E. carniolica, E. multicaulis, E. obtusa* and *E. palustris. Eleocharis pellucida* obviously is most closely similar to the perennial *E. carniolica* and *E. multicaulis.* All belong to series *Multicaules*², are densely caespitose (tufted) and also share similar ecological preferences. The unique combination of 3-fid styles and bluntly trigonous achenes (best seen when immature) by far provides the best distinguishing feature of *Eleocharis pellucida*. Life form is often indicative but surely not decisive: *Eleocharis pellucida* usu-

ally is an annual but coarser, perennial forms do exist (these are mostly considered to be a distinct species, *E. congesta* – see below). On the other hand, *Eleocharis carniolica* is said to be perennial but often flowers in the first year and slender forms are much reminiscent of *E. pellucida*. In addition to the characters mentioned above and in the key below both are also readily distinguished by the colour of their spikelets: these are distinctly tinged with red in *Eleocharis pellucida* (giving it a typical wine-coloured appearance; see Fig. 2) and merely greenish in *E. carniolica*. Confusion with *Eleocharis multicaulis* is

² The taxonomic position of *Eleocharis carniolica* is somewhat critical. Species of series *Multicaules* are usually told to have trigonous achenes (Kern, 1974; González-Elizondo & Peterson, 1997) but those of *E. carniolica* are definitely biconvex.

less likely although both share a 3-fid style and trigonous achenes. However, the latter is a much coarser plant with a lignescent rootstock and is much larger in all its floral parts (spikelets, glumes, achenes). Finally, *Eleocharis pellucida* could be mistaken for *E.* flavescens [especially var. olivacea (Torr.) Gleason; syn.: E. olivacea Torr.], a native of the south-eastern United States but locally naturalised in northern Italy (in Lombardia and Piemonte, according to Conti et al., 2005). The latter two belong to section *Eleogenus* (Nees) Benth. & Hook. f. series *Maculosae* Svenson subseries Ocreatae (C.B. Clarke) Svenson (González-Elizondo & Peterson, 1997) and shares the small olive-green achenes with a highly constricted tubercle and acute spikelets with *Eleocharis pellucida*. However, Eleocharis flavescens has membranous upper leaf sheaths, biconvex achenes and 2-fid styles. Moreover, it is a rhizomatous perennial but rhizomes

are often short and the plant may appear more or less tufted. The main diacritic features for the separation of *Eleocharis carniolica*, *E. flavescens* and *E. pellucida* are summarised in **table 1**.

The circumscription of *Eleocharis pellucida* is rather controversial. It is here accepted as a species of its own following Govaerts & Simpson (2007) and Svenson (1939). Other authors tend to simply include it in a broadly circumscribed *Eleocharis congesta* (Kern, 1974; González-Elizondo & Peterson, 1997) or subsume it under the latter at varietal or subspecific rank (Simpson & Koyama, 1998). *Eleocharis congesta* is a taller, perennial plant with thicker culms and larger spikelets and glumes. According to Kern l.c. there is no obvious dividing line between both species. However, the plants thus far seen in Piemonte are delicate annuals with filiform stems and perfectly agree with *Eleocharis pellucida*.

Key to the species of Eleocharis in Piemonte

1	at base and thus not clearly demarcated from achene	Eleocharis quinqueflora (native)
	Spikelets with (much) more than 7 flowers. Tubercle clearly demarcated from achene, usually	
	swollen and constricted at base	2
2	Achenes terete, distinctly cross-ribbed (trabeculate)	
	Achene triquetrous or trigonous, smooth or finely punctate, never cross-ribbed	
3	Achene triquetrous or trigonous (sometimes bluntly so), not biconvex. Style branches usually 3	
	(rarely 2)	4
	Achenes compressed, biconvex. Style branches usually 2 (rarely 3)	5
4	Coarse, caespitose perennial, culm 1-1.5 mm across. Achene 1.5-2 mm	<i>E. multicaulis</i> (native)
	Slender, caespitose annual, culm 0.3-0.5 mm across. Achene ca. 1 mm	<i>E. pellucida</i> (introduced)
5	Long-rhizomatous perennial, ultimately mat-forming. Culm up to 100 cm tall	6
	Caespitose annual or perennial, more rarely shortly-rhizomatous perennial (never mat-forming).	
	Culm rarely exceeding 40 cm	
6	Tubercle at least twice as long as wide. Perianth bristles usually 5 (sometimes 4 or 6) E. ma	<i>amillata</i> subsp. <i>austriaca</i> (native)
	Tubercle less than twice as long as wide. Perianth bristles usually 4 (rarely 0)	
7	Upper leaf sheath membranous, hyaline, often wrinkled and inflated at the apex. Shortly-rhi-	1
	zomatous perennial	<i>E. flavescens</i> (introduced)
	Upper leaf sheath firm at the apex. Annual or caespitose perennial	
8	Caespitose perennial. Lowest glume of spikelet empty, encircling base of spikelet	
	Annual. Two lowest glumes of spikelet empty, subequal and half encircling base of spikelet	
9	Achene shiny, black, very small (0.3-0.5 mm long). Tubercle minute	
	Achene dull, brownish or greenish, 0.75-1.3 mm long. Tubercle at least half as wide as the ach-	Tarana (
	ene, compressed and lamelliform	10
10	Tubercle 0.5-0.8 mm wide, nearly as wide as achene. Style branches usually 3. Culm up to 1.5	
		<i>E. obtusa</i> (introduced)
	Tubercle 0.3-0.5 mm wide, ca. 2/3 as wide as achene. Style branches usually 2. Culm ca. 1 mm	(======================================
	across	<i>E. ovata</i> (native)

Table 1 – Comparison of main distinguishing	features of <i>Eleocharis pellucida</i> ,	E. carniolica, and E. flavescens in Piemon-
te (Italy).		

	Eleocharis pellucida	E. carniolica	E. flavescens
Number of style branches	3	2	2
Form of achene	Bluntly trigonous	Biconvex	Biconvex
Length of achene	< 1 mm	Ca. 1.5 mm	0.6-1.8 mm
(incl. stylopodium)			
Life form	Usually tufted annual	Usually tufted perennial	Usually rhizomatous perennial
Upper leaf sheath apex	Firm and tight, not at all	Firm and tight, not at all	Slightly inflated and wrinkled,
	translucent (herbaceous)	translucent (herbaceous)	translucent (membranous)

Ecological and historical notes

So far, *Eleocharis pellucida* has been found in several different heath lands (baraggias), most often in protected areas (Parco Baragge, Riserva Naturale). The species is always confined to temporarily wet habitats, mostly tracks or other shallow depressions (often bomb craters) and usually occurs in abundance. There further is a remarkable overall resemblance between all locations where Eleocharis pellucida has been discovered so far: all have numerous exceptional non-native species in common. Apart from Eleocharis pellucida, they further share (among others) Digitaria violascens Link, Eleocharis flavescens, E. obtusa, Hypericum mutilum L., Sporobolus vaginiflorus Vasey, ... Moreover, the locations in Benna, Candello and Lombardore all harbour Aristida longespica Poir. (syn.: A. gracilis Elliott) and Dichanthelium acuminatum (Sw.) Gould & C.A. Clark (syn.: Panicum acuminatum Sw.). At least the latter two are doubtlessly associated with the military activities that are still ongoing in these areas (compare with Borghesio, 2004; Lonati & Lonati, 2007). The unintentional introduction in Europe of North American plants in military training areas surely is an important but insufficiently known vector of introduction (many military bases are not or hardly accessible).

However, the introduction of *Eleocharis pellucida* in Piemonte can hardly be explained by these military activities since it is not known from North America (Smith et al., 2002). It is a common weed in Japan and Taiwan (Holm et al., 1979). According to Reed (1977) and Häfliger (1982) it is furthermore present as a weed of wet places in the Indian subcontinent, south-eastern Asia, China, Korea, Philip-

pines, and Indonesia. It is also native in the Russian Far East (Govaerts & Simpson, 2007). In large parts of its native distribution range it is a common weed of rice fields.

To our current knowledge *Eleocharis pellucida* was first recorded in Piemonte in Villarboit in 1989 (see above). This area is very famous for its exotic rice field flora (see for instance Koch, 1952; Becherer, 1969; Cook, 1973; Raynal, 1979; Desfayes, 2005; ...). A majority of this weed flora evidently originates in Asia. An initial introduction of *Eleocharis pellucida* as a rice field weed in the Vercelli area therefore seems most likely. Most of the former obligate weeds of rice of the genus *Eleocharis* (E. flavescens, E. obtusa and apparently also *E. pellucida*) in north-western Italy have spread to other suitable habitats (mainly heaths and river banks) and only sporadically (if at all) occur in rice fields nowadays (see also Verloove, in prep.). Finally, it apparently managed to spread with military vehicles from heath lands in the rice-growing areas in Benna and Vercelli to the Vauda nature reserve in Lombardore.

Eleocharis pellucida is a rather inconspicuous species and, at a glance, closely resembles native *E. carniolica* (and to some extent *E. multicaulis*). All also seem to have similar ecological preferences and share the same habitats. Therefore, it is not unlikely that *Eleocharis pellucida* has been overlooked so far in north-western Italy (or elsewhere). Further fieldwork will probably yield additional records. It should be looked for in heaths in the rice growing areas and perhaps even more in military training areas where exchanges took place with vehicles that were used before in Benna, Candello and/or Lombardore.

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vin (Torino) provided a photograph (Fig. 2). Gabriele Galasso (Milano) is acknowledged for preparing the Italian summary and Adriano Soldano (Vercelli) and Alberto Selvaggi (Torino) for providing general information about the genus *Eleocharis* in Piemonte.

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Summary: *Eleocharis pellucida* J. Presl & C. Presl (Cyperaceae), native in south-eastern and eastern Asia, is reported for the first time as a xenophyte in Europe. It is locally abundant and well-naturalised in several heaths (baraggias) in the provinces of Biella, Torino and Vercelli (Piemonte, Italy) and possibly overlooked elsewhere. Diagnostic features are discussed and compared with those of related native and non-native species. An updated identification key for the genus *Eleocharis* in Piemonte as well as a photograph and an original line drawing are presented. Finally, the species' potential introduction history in Piemonte is discussed.