

Rizína marsh – a brief profile of a unique subalpine wetland in NW Greece

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Abstract

Rizína (Rezina) marsh is a wetland of c. 3 ha, located in the subalpine belt of Tímfi, one of the highest mountains of the Pindos range in Ípiros (Epirus, NW Greece). In the 1990s the area became well known to paleoecologists as one of the possible glacial refugia for temperate tree species prior to their range expansions to central and northern Europe. The present paper summarizes all available information on the natural history, plant life and land use of the site, including original data from our excursion in August 2007. Rizína marsh is remarkable as a botanical site of several species of temperate and boreal distribution at or near the southern boundaries of their distribution areas. Full annotated inventories of the vascular plant taxa (35), moss species (2) and plant communities (10) are provided. The latter are assigned to habitat types of Annex I of the Habitats Directive. Although Rizína marsh is included in the Northern Pindos National Park as well as in the Natura 2000 network it remains vulnerable due to possible interference in the hydrological conditions of the site.

Keywords: aquatic vegetation; Balkan; Mediterranean wetland; Natura 2000; Pindos; Rezina; sedge reed bed

Kurzfassung: Das Rizína-Sumpfgebiet – ein einzigartiges subalpines Feuchtgebiet in Nordwest-Griechenland kurz porträtiert

Der Rizína-Sumpf ist ein Feuchtgebiet von etwas über 3 ha Größe in der subalpinen Stufe des Tímfi-Gebirges, einem der höchsten Gebirgsstöcke der Pindos-Kette in Epirus (Nordwest-Griechenland). Zu Beginn der 1990er Jahre wurde das Gebiet bekannt durch vegetationshistorische Befunde zu möglichen Refugialräumen temperat verbreiteter Baumarten vor ihrer postglazialen Ausbreitung. Der vorliegende Beitrag fasst alle verfügbaren natur-, vegetations- und landeskundlichen Informationen sowie eigene Erhebungen im August 2007 über dieses bemerkenswerte Gebiet zusammen. Trotz seiner relativen Artenarmut enthält es eine Reihe von in Griechenland seltenen, temperat-boreal verbreiteten Pflanzenarten und -gesellschaften, zum Teil an ihrem südlichen Arealrand. Vollständige kommentierte Listen der Pflanzenartenausstattung des Rizína-Sumpfgebiets (35 Gefäßpflanzen- und 2 Moosarten) und seiner 10 Pflanzengesellschaften werden vorgelegt. Letztere werden Lebensraumtypen des Anhangs I der FFH-Richtlinie zugeordnet. Obwohl der Schutzstatus des Gebietes (Nationalpark, Natura-2000-Gebiet) der höchstmögliche in Griechenland ist, können Gefährdungen durch Eingriffe in den Wasserhaushalt in der nahen Zukunft nicht ausgeschlossen werden.

Schlüsselwörter: Balkan; mediterranes Feuchtgebiet; Natura 2000; Pindos; Rezina; Seggenried; Wasservegetation

Nomenclature: vascular plants, if not otherwise stated: Greuter et al. (1984, 1986), Preston (1995), Strid & Tan (1991, 1997, 2002); bryophytes: Dierßen (2001)

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We dedicate this paper to Klaus Dierßen, committed conservtionist, brilliant bryologist, and ingenious phytosociologist and vegetation ecologist. We hope he might find interest in our contribution to the festschrift, and that we may contribute to the efforts to preserve and protect the Rizína marsh and the Ípiros region.

1 Introduction

Rizína marsh is a small basin at 1,750 m above sea level, in the Pindos Mountains of Ípiros (Epirus) in northwestern Greece. Due to climatic and geological reasons, wetlands that extend the size of springs are generally rare in the Pindos Mountains. The few permanent ponds, lakes and marshes that exist there are restricted to flysch and serpentine areas.

To a wider scientific community Rizína (or Rezina) marsh is better known for its vegetation history than for its present plant life and ecology. The 10,000 year pollen and macrofossil sequences extracted from this site provided the first evidence for the possible location of glacial refugia for temperate tree taxa in Greece and the southern Balkans (Willis 1992a, 1992b, 1994). Although the marsh has been known to botanical collectors at least since the second half of the 20th century (Quézel & Contandriopoulos 1965, Strid & Tan 1991, Authier 1995, Strid & Tan 2000), the first and only reasonably complete account of its present flora was provided by Sarika-Hatzinikolaou et al. (1997) who described plant records based on collections between 1989 and 1992. The same first author included the site in her paper on the macrophytic aquatic vegetation of Ípiros (Sarika-Hatzinikolaou et al. 2003), using field data collected in Rizína marsh from 1992 through 1995. However, despite the valuable insight provided by Sarika-Hatzinikolaou et al. (2003), wetland plant communities in northwest Greece are still insufficiently known, especially those of the montane and subalpine belts.

In August, 2007, we revisited the Rizína marsh, about 15 years after the work of Maria Sarika-Hatzinikolaou. We wished to complete a plant species inventory as well as exemplary relevés to document the current state of the plant communities. With the present contribution we attempt to summarize what is known to date on Rizína marsh, and to draw conclusions relevant to conservation. Issues of conservation have come to the fore in the implementation of the EU Habitats Directive and towards a management plan for the recently established Northern Pindos National Park.

2 Site description

Rizína marsh is located c. 2 km NNE of the Astráka summit (2,436 m) in the Tímfi range of the Pindos Mountains (39° 59' N 20° 46' E), at a height of c. 1,750 m a.s.l. The marsh is roughly triangular in shape. It consists of a shallow but permanent lake with grassland at its edges. The lake covers c. 3.1 ha with a maximum water depth of 1.5 m. It is largely vegetated by sedge reed beds partly forming floating mats (Plate 1). About 300 m SSW of the Rizína marsh, and immediately below the Astráka saddle where the lodge of the Hellenic Alpine Club is situated, lies a very shallow lake, seasonally filled with water and drying up by mid-July (Plate 2). It is named Xerólimni (or Xeroloútsa) by the locals and is included in the present study.

Rizína marsh and Xerólimni form part of a north-south-oriented basin of c. 1.8 km² called ‘*Oropédio limnón*’ (basin plain of the lakes). On official maps this basin is referred to as ‘*Láka Tsoumáni*’ (also by Sarika-Hatzinikolaou et al. 1997, 2003), named by land surveyors only half a century ago after a group of nomadic shepherd families by the name of Tsoumani who happened to have their summer camp in this place till the end of the 1980s. The local population never uses the name ‘*Láka Tsoumáni*’. The slopes and the marsh are summer pastures for sheep. The pastures form an integral part of the far distance pastoral system (‘*Fernweidewirtschaft*’) of the formerly nomadic Sarakatsan shepherds in the North Pindos (Beuermann 1967). The high mountains of Tímfi are still the domain of Sarakatsan shepherds as in former times. Rizína marsh and its surroundings are currently grazed by about 500 sheep from early June to mid-September. Horses which are used as pack animals by the shepherds roam the marsh in small groups of 2–8 and, during the hot hours of the summer days, they prefer standing in the water. Furthermore, cows, from a neighbouring pastureland, may visit the marsh especially in late September and October when the local shepherds remove their herds from the pasture. Sarakatsan summer camps consist of simple huts. In former times, but as recent as 1989, *rizína* (tall sedges) were used each summer as thatching for the huts, and are the namesake of the marsh.

Next to Smólikas (2,637 m) and Grámos (2,520 m), Tímfi (Tymphi, Gamíla, Zagória; with the highest summit, Gamíla, 2,497 m) is the third highest mountain of the Northern Pindos. The basin *Oropédio limnón* is surrounded by several summits of the Tímfi range, viz. Astráka (2,436 m), Plóskos (2,377 m), Koutsomítros (2,254 m) and Drakólimni (2,100 m). They form an impressive alpine panorama with steep slopes, deep ravines and magnificent cliffs. Recently the whole Tímfi range was merged with the Víkos-Aoós National Park to form the Northern Pindos National Park. These high mountain areas belong to the core zone (second highest of four levels of protection status) of this National Park. Following implementation of the EU Habitats Directive, both the Víkos-Aoós National Park (GR2130001) and the Tímfi Mountains (GR2130009) have been designated Natura 2000 sites (Dafis et al. 1996, Dimopoulos et al. 2005: 15).

In the absence of meteorological data from the high mountains of the Tímfi range, climatic data at about 2,000 m have been extrapolated by Sarika-Hatzinikolaou et al. (2003) to 11.5 °C mean annual temperature and c. 1,750 mm average annual precipitation. We regard a mean annual temperature of c. 7 °C at the height of Rizína marsh more realistic, using –0.6 °C/100 m as adiabatic lapse rate (instead of –0.2 °C/100 m in the calculation of Sarika-Hatzinikolaou et al. 2003). Due to the accumulation of cold air in the basin, colder and more frequent frost can be expected for Rizína marsh than for the surrounding slopes. The marsh is frozen and/or covered with snow from end of November to mid-April. Apart from snowmelt, the marsh is supplied with water through three permanent springs from April to November, and by a temporal streamlet from April to early June. Additional water may enter directly into the marsh from the water table. There is a natural drain northward along the basin and further into the Aoós gorge but there is no obvious outflow during August/September.

The formation of the Rizína marsh and the *Oropédio limnón* is uncertain. Most probably it constitutes a remnant glacial feature in an area pre-shaped by tectonic activity. There is a major fault near the southern end of the basin. In the Pindos Mountains, three glacial stages are evident from geomorphological records (Hughes et al. 2006). The slopes surrounding *Oropédio limnón* consist chiefly of flysch. Hard limestone occurs towards the north-northeast and south (Astráka) (IGME 1970). In the lower part the slopes are overlain by debris cones and angular limestone scree. The scree may be a relict feature of frost shattering that occurred

during the last glacial period (Willis 1992a), the so-called Tymphian stage equivalent to the Weichselian/Würmian stages of northern Europe and the Alps (Hughes et al. 2006). The bottom of the basin is formed of glacial deposits (IGME 1970).

Slopes surrounding Oropédio limnón and Rizína marsh are above the present anthropogenic tree line, although *Pinus heldreichii* occurs in the Tímfí range on rugged slopes and in ravines as high as 2,000 m. The vegetation surrounding the marsh consists of grasslands dominated chiefly by *Festuca koritnicensis* and *Festuca varia*, while *Drypis spinosa*, *Silene fabarioides* and *Nepeta spruneri* are common on limestone screes. A plant list of the spring flora of the area between the Astráka saddle (1,900 m) and the lake Drakólimni, with Rizína marsh in between, is provided by Strid & Tan (2000).

Palynological evidence suggests considerable reduction in all tree taxa from 4,250 BP. This is generally understood to be a result of the first significant anthropogenic effects on the vegetation (Willis 1992a, 1994). The slopes eroded and supported only herbaceous vegetation, as they do today. Diverse postglacial mixed forest dominated by *Abies* sp. and *Carpinus orientalis/Ostrya carpinifolia* had decreased already at 6,000–5,000 BP, and the grasses increased. With this onset of climatic/anthropogenic change the tree line was lowered and the depleted soils never allowed re-expansion of the rich woodlands in this area again. Pine forest colonised the slopes around Rizína marsh c. 1,990–1,170 BP, probably as a result of depopulation and abandonment of grazing (which roughly corresponds to the devastation of Ípiros by the Romans in 167 BC). After 1,170 BP *Pinus* pollen declined again. The last 1,000 years saw the present vegetation mosaic of herbs and grasses. *Cyperaceae* had almost totally colonised the lake, and as a result of this the organic content of the sediment rose to almost 80% (Willis 1992a).

According to measurements performed in July 1992 and early August 1995 the water temperature in summer ranges between 13 and 22 °C (Sarika-Hatzinikolaou et al. 1997, 2003). The conductivity is 98–176 µS/cm, but mostly 150–170 µS/cm. The water is neutral to slightly alkaline (pH 6.9–7.5; c. 100–200 HCO₃⁻ mg/l), and eutrophic with total inorganic nitrogen content between 0.7 and 3.6 mg/l.

3 Materials and methods

Plant community records were sampled on 20 August 2007, with full species lists (vascular plants and bryophytes), adopting the Braun-Blanquet approach. Species cover and abundance were estimated using the 9-point scale suggested by Barkman et al. (1964). Additionally, latitude-longitude coordinates, total cover and water level were measured. Plot size of mire and reed vegetation was 8–16 m², and 4–8 m² for annual and aquatic vegetation. The community records were edited and arranged in a species-by-stand table. For comparison, we added cumulative (constancy) values of the plant communities found by Sarika-Hatzinikolaou et al. (2003) at the same site. No attempt was made to entangle nomenclatural implications of syntaxa. Voucher specimens of most of the species present are deposited in the first author's herbarium.

4 Annotated plant catalogue

Plant species are in alphabetical order. Records are by field observation (*obs.* = *observat*), or collection (indicated by collection number). Previous records in Rizína marsh are indicated by

the year of collection. They refer to Sarika-Hatzinikolaou et al. (1997, 2003), SH in the following list.

- Agrostis stolonifera* L. – B 07-436; Sarika-Hatzinikolaou et al. (2003) recorded *A. castellana* instead.
- Alopecurus aequalis* Sobol. – B 07-439, SH: 1989, 1990, 1992; infrequent in Greece and restricted to the north.
- Blysmus compressus* (L.) Link – B *obs.*, SH: 1990, 1992; scattered but locally abundant in the Greek mountains.
- Calliergonella cuspidata* (Hedw.) Loeske – B *s.n.*; according to our own observations and Düll (1995) this pleurocarpous moss is fairly common and widespread in wetlands in mainland Greece.
- Callitriche brutia* Petagna – SH: 1995 *obs.*; very scattered in Greece, mapped by Bazos & Yannitsaros (2004).
- Callitriche palustris* L. – SH: 1989, 1990; probably rare in Greece, no other recent records are known to us.
- Carex acuta* L. – B 07-434, SH: 1990, 1992, erroneously given as *C. acutiformis* in Willis (1992a); there are only few, mostly small populations in Greece but the distribution area extends as far south as Peloponnese (Bergmeier unpubl. data).
- Carex caryophyllea* Latourr. – SH: 1992.
- Carex echinata* Murray – SH: 1992; recorded from the Tímfi range (Hartvig 1991: 848) but its presence in Rizína marsh was not confirmed by us. It is doubtful for ecological reasons.
- Carex leporina* L. (*C. ovalis* Gooden., nomenclature follows Luceño (2007) – B *obs.*; scattered in the non-calcareous mountains of mainland Greece.
- Carex paniculata* L. – B 07-437; restricted to mountains of northern Greece and very variable in the Pindos; the Rizína population is in need of further study as it has the fruits of *C. paniculata* but the plants are smaller, with much narrower leaves and a laxly caespitose habit.
- Carex rostrata* Stokes – B 07-435, SH: 1990, 1992; rare in Greece and restricted to the northern mountains.
- Cerastium fontanum* subsp. *vulgare* (Hartman) Greuter & Burdet – B *obs.*, SH: 1992; uncommon in Greece and restricted to the mountains.
- Deschampsia cespitosa* (L.) P. Beauv. – B *obs.*, SH: 1992.
- Drepanocladus aduncus* (Hedw.) Warnst. – B *s.n.*; mentioned by Düll (1995) and probably widespread in suitable habitats in mainland Greece; the moss was previously recorded from the Pindos Mountains by Blockeel (1991).
- Elatine alsinastrum* L. – SH: 1995 *obs.*; very scattered in Greece; threatened.
- Eleocharis palustris* (L.) Roemer & Schultes – B *obs.*, SH: 1990; plants from Rizína marsh were referred to subsp. *palustris* by Sarika-Hatzinikolaou et al. (1997).
- Eleocharis quinqueflora* (F. X. Hartmann) O. Schwarz – B *obs.*; scattered but locally common in wet habitats in the flysch and serpentine mountains of northern Greece.
- Equisetum palustre* L. – B 07-432, SH: 1990, 1992.
- Festuca rubra* L. – B *obs.*
- Gnaphalium uliginosum* L. – B 07-442; rare in Greece, see distribution map in Schuler (2004: 35); in Ípiros otherwise known to us only on the shores of the Aoós reservoir (B 07-367, 12 August 2007).
- Hippuris vulgaris* L. – B 07-433, SH: 1989, 1990, 1992; no other population in Greece is known to us.
- Juncus articulatus* L. – B *obs.*, SH: 1990.
- Juncus compressus* Jacq. – SH: 1994 and 1995 *obs.*; the records are not substantiated by voucher material and require confirmation.
- Limosella aquatica* L. – SH: 1995 *obs.*, known from Tímfi (Lake Drakólimni) since Quézel & Contandriopoulos (1965: 73); very scattered in Greece and restricted to the mountains.
- Luzula sudetica* (Willd.) Schult. – SH: 1992; rare in Greece, present only in the northern mountains.
- Plantago lanceolata* L. – B *obs.*
- Poa compressa* L. – SH: 1992.
- Poa pratensis* L. – B *obs.*; the plants seen match subsp. *angustifolia* (L.) Lej.
- Polygonum arenastrum* Boreau – B 07-441, SH: 1989.
- Potamogeton trichoides* Chamisso & Schlechtendal – SH: 1989, 1990, 1992.
- Ranunculus trichophyllus* Chaix – B 07-440, SH: 1989, 1990, 1992.

Rorippa sylvestris (L.) Besser – B 07-438; represented by very slender, short-lived plants with rather ellipsoid fruits, but distinct by petal length, non-auriculate petioles and tuberculate seeds from *R. pyrenaica* and *R. islandica*, which have also been recorded in the Tímfi range (Jonsell 2002).

Sparganium angustifolium Michaux – SH: 1992, 1995 *obs.*; known in Greece only from the mountains of Smólikas (Hartvig 1978) and Tímfi (Sarika-Hatzinikolaou et al. 1997, 2003). The latter authors do not cite voucher material from Rizína marsh and the species could not be confirmed by us.

Taraxacum cf. sect. *Palustria* – B *obs.*, species not identifiable in the absence of fruiting and flowering plants.

Trifolium repens L. – B *obs.*

Veronica beccabunga L. – B *obs.*, SH: 1989, 1990.

5 Plant communities and their conservation relevance

5.1 *Gnaphalium uliginosum*-*Polygonum arenastrum* community (Table 1, column 1) – *Heleocharito acicularis*-*Limoselletum aquaticae* Wendelberger-Zelinka 1952 (Table 1, column 2)

We rank both plant communities under the class *Isoeto-Nano-Juncetea*. The former consists of only two annual species of which *Gnaphalium uliginosum* is in Greek mountains ecologically representative of ephemeral vegetation of semi-wet habitats. Once the seasonal lake Xerólimni dries up in June/July, hundreds of thousands of tiny plants of *Polygonum arenastrum* and *Gnaphalium uliginosum* emerge on the non-organic silty sediments, covering an area of a few thousand square metres (Plates 2 and 3). Phytosociological records with *Gnaphalium uliginosum* from Greece are scarce (Bergmeier & Raus 1999, Schuler 2004). Although *G. uliginosum* is mentioned in the Interpretation Manual of European Union Habitats (European Commission, DG Environment 2007) as a characteristic plant species for the habitat type ‘Mediterranean temporary ponds’ (coded as 3170), it seems more reasonable to assign the Xerólimni ecosystem to the habitat type ‘Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletalia uniflorae* and/or *Isoeto-Nanojuncetea*’ (3130). The latter habitat type has not been documented in Greece so far, although its presence on the banks of the nearby lakes called Drakólimni and Louítsa Rompozí with *Limosella aquatica* and *Elatine alsinastrum* as characteristic plants is indisputable. The latter two species were also found in Rizína marsh by Sarika-Hatzinikolaou et al. (2003), and the plant community recorded under the name *Heleocharito acicularis*-*Limoselletum aquaticae*.

5.2 *Eleocharitetum palustris* Ubrizsy 1948 (Table 1, column 3) – *Eleocharito palustris*-*Hippuridetum vulgaris* Passarge 1955 (Table 1, columns 9–11)

The *Eleocharito palustris*-*Hippuridetum vulgaris* was found by Sarika-Hatzinikolaou et al. (2003) in Rizína marsh for the first time in Greece. Still no other sites in the country are known to us. *Hippuris vulgaris* grows in shallow, open eutrophic waters, often associated with *Equisetum palustre*, on the edges of the marsh (Plate 4). Horse trampling keeps the water open, thus controlling expansion of the competitive tall sedges.

Reed beds dominated by *Eleocharis palustris* are widespread in Greece and fairly common from sea level to the mountains. The *Eleocharitetum palustris* was recorded by Sarika-Hatzinikolaou et al. (2003) from Lake Pamvótis near Ioánnina. It is otherwise little known in the region and the whole country. Although the small reed beds with *Hippuris vulgaris* and

Eleocharis palustris do not match any Annex I habitat type of the Habitats Directive, they form part of the marsh ecosystem which, *in toto*, may be identified as a complex habitat of ‘Alkaline fens’ (7230) and ‘Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* vegetation’ (3150).

5.3 *Ranunculetum aquatilis* Géhu 1961 (Table 1, columns 4–8) – *Potamogetonetum trichoidis* Tx. 1974

Ranunculus trichophyllus is the most common species of the subgenus *Batrachium* in Greece. Both associations occur chiefly at low altitudes but have been recorded for Rizína marsh by Sarika-Hatzinikolaou et al. (2003). We found the first association in fairly deep clear waters such as in a well slightly away from the lake but also on wet mud at ground water level.

The *Potamogetonetum trichoidis* was not sampled by Sarika-Hatzinikolaou et al. (2003) and could not be confirmed by us. Both associations occur as part of the Annex I habitat type ‘Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* vegetation’ (3150).

5.4 *Carex rostrata*-[*Magno-Caricion elatae*] community (Table 1, columns 12–15) – *Caricetum gracilis* Almquist 1929 (Table 1, column 16)

The major part of Rizína marsh is covered by reed beds of *Carex acuta* (*C. gracilis*) and *C. rostrata*. The Rizína tall sedge reed beds are among the most extensive in the country. The *Caricetum gracilis* has not been previously recorded from Greece. *Carex acuta* has been interpreted by the team responsible for the implementation of the Habitats Directive in Greece as an Annex II plant species (Dafis et al. 1996, Dimopoulos et al. 2005), as most taxonomists treat *Carex panormitana*, listed in Annex II, as a synonym of *C. acuta*.

The *Carex rostrata* community occurs in similar situations but generally in shallower waters. It was recorded by Sarika-Hatzinikolaou et al. (2003) from Rizína marsh and for the first time in Greece. The authors measured eutrophic site conditions, slightly alkaline and relatively nutrient-rich, more so for nitrogen than for phosphorus. The plant community is otherwise rare in Greece and restricted to the northern mountains (Bergmeier, unpubl. data). In contrast to its occurrences in acidophytic habitats in central and northern Europe, the ecology and ecosystem context of the *Carex rostrata* reed beds suggests its relation to the Annex I habitat type ‘Alkaline fens’ (7230). It seems reasonable to treat the whole complex of tall sedge reed beds of Rizína marsh under ‘Alkaline fens’ (7230). More typical stands of this habitat type have otherwise been recorded for just a few Natura 2000 sites in northern Greece.

5.5 *Junco compressi-Trifolietum repentis* Egger 1933 (Table 1, columns 17–19) – *Eleocharitetum quinqueflorae* Lüdi 1921 (*‘Eleocharitetum pauciflorae’*) (Table 1, column 20)

The *Junco compressi-Trifolietum repentis* was recorded by Sarika-Hatzinikolaou et al. (2003) from Rizína marsh “in the transitional zone between land and water”. The *Eleocharitetum quinqueflorae* forms small patches at similar sites but with trickling water. Both plant communities consist of small rhizomatous and caespitose perennials, especially *Cyperaceae* such as *Blysmus compressus*, *Eleocharis quinqueflora* and *Carex leporina*, as well as rushes (*Junco articulatus*) and grasses (*Agrostis stolonifera*, *Deschampsia cespitosa*, *Festuca rubra*).

Table 1: Plant communities of Rizina marsh. Cg, *Caricetum gracilis*; Cr, *Carex rostrata*-[*Magno-Caricion elatae*] community; Ep, *Eleocharitetum palustris*; Eq, *Eleocharitetum quinqueflorae*; EH, *Eleocharito palustris-Hippuridetum vulgaris*; GP, *Gnaphalium uliginosum-Polygonum arenastrum* community; HL, *Heleocharito acicularis-Limoselletum aquaticae*; JT, *Junco compressi-Trifolietum repentis*; Ra, *Ranunculetum aquatilis*. Columns 1, 3–7, 9–10, 12–14, 16, 18–20 represent original relevés with species abundance values from August 2007, while columns 2, 8, 11, 15, 17 are from Sarika-Hatzinikolaou et al. (2003). Where available (11, 15, 17), relevés from the same community were merged in one column. Percentage constancy values are in italics, and abundance values in superscript. Doubts remain as to M. Sarika's identification of *Carex echinata* and *Agrostis castellana* (see also plant catalogue).

Tab. 1: Pflanzengesellschaften des Rizina-Sumpfgebietes. Cg, *Caricetum gracilis*; Cr, *Carex rostrata*-[*Magno-Caricion elatae*]-*Gesellschaft*; Ep, *Eleocharitetum palustris*; Eq, *Eleocharitetum quinqueflorae*; EH, *Eleocharito palustris-Hippuridetum vulgaris*; GP, *Gnaphalium uliginosum-Polygonum arenastrum*-*Gesellschaft*; HL, *Heleocharito acicularis-Limoselletum aquaticae*; JT, *Junco compressi-Trifolietum repentis*; Ra, *Ranunculetum aquatilis*. Spalten 1, 3–7, 9–10, 12–14, 16, 18–20 stellen Originalaufnahmen dar mit Deckungswerten; Spalten 2, 8, 11, 15 und 17 sind Sarika-Hatzinikolaou et al. (2003) entnommen. Bei 11, 15 und 17 liegen in der Quelle mehrere Aufnahmen aus dem Gebiet vor und die Stetigkeitswerte sind hier kursiv in Prozent angegeben, die Abundanzspanne hochgestellt. Die von M. Sarika vorgenommene Identifizierung von *Carex echinata* und *Agrostis castellana* ist nicht zweifelsfrei (siehe auch Artenliste im Text).

Column number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Plant community	GP	HL	Ep	Ra	Ra	Ra	Ra	Ra	EH	EH	EH	Cr	Cr	Cr	Cr	Cg	JT	JT	JT	Eq
Number of relevés (if not 1)									14						10		5			
Cover total (%)	75	80	95	35	65	100	80	70	45	80	70-100	100	100	90	100	100	100	95	98	100
Mean water level (cm; + above, - below surface)	dry	+1	+3	+6	+1	0	+1	+2	+3	+2	+15/+70	+1	+5	+1	+20/+70	+1	0/+20	-3	-15	-20
(Mean) plot size (m²)	2	20	12	4	8	4	8	30	16	12	29	16	12	12	30	12	28	8	16	8
(Mean) species richness	2	4	2	1	4	5	3	5	1	2	5.6	2	6	1	4.4	1	4.6	9	7	11
<i>Polygonum arenastrum</i>	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Gnaphalium uliginosum</i>	2a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Callitriche brutia</i>	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Limosella aquatica</i>	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Elatine alsinastrum</i>	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Eleocharis palustris</i> subsp. <i>palustris</i>	.	3	5	.	1	1	1	1	.	.	86 ¹⁻⁴	.	.	.	50 ¹⁻³	.	60 ^{r-1}	1	.	.
<i>Ranunculus trichophyllus</i>	.	.	.	3	4	3	4	4	.	.	21 ¹⁻²	.	.	.	.	.	.	.	.	.
<i>Alopecurus aequalis</i>	.	.	.	.	+	2b	.	.	.	.	64 ¹⁻⁴	.	+	.	10 ²	.	.	.	.	.

Two pleurocarpous mosses were found: *Calliergonella cuspidata* and *Drepanocladus aduncus*; more thorough research might reveal more bryophyte species. The plant communities are somewhat intermediate between flood meadows (to which the *Junco compressi-Trifolietum repentis* belongs) and *Caricetalia davallianae* mires (to which the *Eleocharitetum quinqueflorae* belongs). The latter is named here tentatively, referring to a widespread association in boreal and temperate Europe. It is recorded here for the first time for Greece but is fairly widespread in the base-rich non-calcareous northern mountains. In Rizína marsh, both communities form part of the habitat complex ‘Alkaline fens’ (7230) of the Habitats Directive.

6 Concluding remarks

Rizína marsh is one of the very few sizable subalpine marshes of the Pindos and northern Greece. It is a significant habitat for several wetland plants widely distributed in temperate and boreal Europe but rare in the Mediterranean biogeographic region. Some species of Rizína marsh reach their southern boundaries of distribution in the mountains of northern Greece. While the total number of plant species is small, our findings confirm the presence of several plant communities otherwise rare in Greece. The plant communities are remarkable in that species indicating anthropogenic disturbance are largely missing, hence reflecting a balanced ecological situation between ecosystem and land use, viz. grazing.

The marsh hosts also a significant colony of Greek Alpine newts (*Triturus alpestris* subsp. *veluchiensis*, Bergmolch), a colony of Yellow-bellied toads (*Bombina variegata*, Gelbbauchunke) and several Green toads (*Bufo viridis*, Wechselkröte). Dice snake (*Natrix tessellata*, Würfelnatter) has also been recorded. The marsh is a key habitat for a colony of House martins (*Delichon urbica*, Mehlschwalbe), which, quite unusual and in contrast to what the English common and the scientific names suggest, nest in a non-synanthropic habitat at the cliffs beneath the Plóskos summit, at 2,200 m, which is the highest nest site ever recorded in Greece. They frequent Rizína marsh to collect nesting materials and to feed on the insects supported by the wetland. At evening hours they are substituted by bats. Rizína marsh is also a stepping-stone for birds during the autumn migration.

Obviously land use, including ‘traditional’ use, is dynamic and has always been. We do not know the characteristics of vegetation at the marsh during historic periods of heavier grazing or more intensive gathering of *rizína* thatch. However, impacts from these land uses must have been moderate compared to contemporary uses that interfere with the hydrology of the site. Water is pumped from one of the three springs that flow into the marsh and piped up to the lodge. Recently, the lodge has become a veritable mountain resort, accommodating about 50 people. The increase in tourism in the neighbouring villages of Zagóri at the foot of the Tímfí mountains, mainly Pápingo, causes water shortage. The problem increases year by year, and it is not mere guesswork that local water resources such as that of Rizína marsh will come into focus and might be exploited in ways unseen hitherto. Awareness has to be raised that hydrological misuse of any kind will set this unique ecosystem at risk.

The Northern Pindos National Park includes (partly or entirely) nine Natura 2000 sites. For all sites collectively, and the National Park on the whole, a management body has been established (Bergmeier et al. 2006). Such management institutions are authorized, among other responsibilities, to control human impacts, to develop management plans and regulations, and to increase public awareness (Dimopoulos et al. 2006). However, many of the decentralized management institutions do not have the personnel support and financial means to fulfil their responsibilities. To date, there is no detailed management plan for the Northern Pindos Na-

tional Park and its Natura 2000 sites. Additionally, the responsible institution, although established, is not provided with sufficient staff or materials to devise a management plan or to control human impacts in Rizína marsh effectively and routinely.

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Plate 1: Rizína marsh from east. Angular shaped patterns in the reed beds indicate former cutting. The left gap in the reed beds is where H. P. in 1988 saw the shepherd Alekos Tsoumanis cutting the sedges for the last time. From then on sheet-metal roofing came into general use. Photo: H. Papaioannou, July 2004.

Tafel 1: Das Rizína-Sumpfgebiet aus östlicher Richtung. Eckige Muster im Seggenried deuten auf frühere Mahd. Dort, wo sich das linke „Loch“ im Ried befindet, sah H. P. 1988, wie der Schäfer Alekos Tsoumanis die Seggen zum letzten Mal schnitt. Seither kam Zinkblech für die Hüttendächer in Gebrauch. Foto: H. Papaioannou, Juli 2004.



Plate 2: The seasonal lake Xerólimni, with the summit of Astráka in the Tímfi range. The dried sediments are greening and reddening from annual vegetation germinating on the lake floor. Photo: H. Papaioannou, July 2004.

Tafel 2: Der See Xerólimni mit dem Astráka, einem der höchsten Gipfel des Tímfi-Massivs. Der Flachsee trocknet im Frühsommer aus und Vegetation aus kurzlebigen Arten erscheint. Der rötliche Ton stammt von *Polygonum arenastrum*. Foto: H. Papaioannou, Juli 2004.



Plate 3: The vegetation on dried-up soil on the lake floor of Xerólimni consists of tiny short-lived plants of *Gnaphalium uliginosum* and *Polygonum arenastrum*. Photo: E. Bergmeier, August 2007.

Tafel 3: Trockenrisse durchziehen den ausgetrockneten Seeboden von Xerólimni. Die Vegetation besteht aus Hunderttausenden winziger Pflanzen von *Gnaphalium uliginosum* und *Polygonum arenastrum*. Foto: E. Bergmeier, August 2007.



Plate 4: In shallow waters at the edge of Rizína marsh grows *Hippuris vulgaris* (foreground) and *Carex acuta* reed beds (background). Photo: E. Bergmeier, August 2007.

Tafel 4: Im flachen Wasser am Rande des Rizína-Sumpfes wachsen Tannenwedel (*Hippuris vulgaris*) und dahinter Schlankseggen-Riede (*Carex acuta*). Foto: E. Bergmeier, August 2007.