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Archaic Food Uses of Large Graminoids in Agro Peligno Wetlands (Abruzzo, Central Italy) Compared With the European Ethnobotanical and Archaeological Literature

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Abstract

Large graminoid species, which often dominate wetland ecosystems with extensive and dense formations, are among the most indicative plants from the first human settlements, where they have been used (even transformed) for various functions ranging from food, cordage, weaving and other utilities. Wetland large graminoid foraging today represents one of the rarest and most archaic customs still in existence, as they have frequently disappeared following changes in society or the disappearance of marshes. These customs have (almost) disappeared in Europe, especially in Italy, following socio-economic changes and wetland reclamation; remaining uses can generally only be found in prehistoric traces. This research in Agro Peligno documents and describes for the first time the remains of these prehistoric uses, which are related to the ancient Peligni (or Paeligni) people. The data collected in the current field study were later compared with food uses of graminoids arising from a large spectrum of archaeological, ethnobotanical, and folkloric literature from other European areas, in a large sense. Problems and outlook regarding the loss of this traditional knowledge are also briefly discussed.

Keywords Agro Peligno · Archaic food · Ethnobotany · Global changes · Graminoids · Habitat conservation · Heritage · Peligni people · Prehistorical · Reedbed · Traditional knowledge · Wetlands

Riassunto

Le grandi specie di graminoidi che spesso dominano gli ecosistemi delle zone umide mediante formazioni che sovente risultano estese e dense, sono tra le piante più indicative nei primi insediamenti umani, dove queste specie sono state utilizzate (anche trasformate) per varie funzioni che vanno dall'alimentazione, all'intreccio, agli utensili ed altre utilità. L'uso nell'alimentazione umana delle grandi specie di graminoidi rappresenta oggi una traccia del retaggio più arcaico ancora

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esistente. Attualmente, questi usi alimentari sono (quasi) scomparsi in Europa, soprattutto in Italia, a seguito dei mutamenti socio-economici e delle bonifiche delle zone umide, pertanto tali usi restano generalmente relegati alle tracce preistoriche. Questa ricerca condotta nell'Agro Peligno, descrive per la prima volta i resti ancora attuali di questi usi arcaici in Italia, legati all'antico popolo dei Peligni (o Paeligni). I dati raccolti sul campo sono stati confrontati con gli usi alimentari registrati nella letteratura archeologica, etnobotanica e folcloristica di altre realtà di tipo europeo, in senso lato. Nello studio vengono brevemente discussi anche i problemi e le prospettive riguardanti la perdita di questa conoscenza tradizionale.

Introduction

Large graminoids issues

Wetlands are of considerable importance for their ecological services (e.g., Curtean-Bănăduc et al. 2007; Clarkson et al. 2013; Mitsch et al. 2015) and for human development (Verger 2005; Maltby and Acreman 2011; Bănăduc et al. 2020). Various studies have corroborated the idea that the earliest human food behaviour (prehistoric model of hunting and gathering) included plants in their diet before the advent of agriculture (i.e., Hardy et al. 2015, 2022; Marston et al. 2015). In this regard, the use of plants and the exploitation of wetlands may have played a fundamental role since these environments are species rich and productive in terms of biomass (Cherry 2011; Overbeek et al. 2020; Schlesinger and Bernhardt 2020; Cianfaglione 2021), being full of natural abiotic (e.g., water, stones, clay) and biotic (e.g., animals, plants, mushrooms) resources.

Wetlands are rich in reedbed species (large graminoid taxa), characterized by both high biomass productivity (Whigham et al. 1989; Durant et al. 2020; Engloner 2009) and a considerable edible mass (Harris 1995; Facciola 1998; Elias and Dykeman 2009), which have been used (raw and even transformed) by human communities in various ways since prehistoric times (e.g., Aranguren et al. 2008, 2011; Revedin et al. 2009, 2010, 2015; Longo et al. 2021a).

Large wetland graminoids, which are the object of our study, consist of different plant families (i.e., order Poales, APG 2016) that can form very extensive communities, to the point of creating large ecosystems, often dominated by "ligneous-like" species or by tall herbs. These species often characterize wetland ecosystems with widespread and dense formations (even in swamps), developing along the gradient between water and land (from helophytic to meso-xeric ecological conditions), belonging, for example, to the *Phragmito-Magno-Caricetea* Klika *in* Klika & Novák 1941, *Filipendulo ulmariae-Convolvuletea sepium* Géhu & Géhu-Franck 1987, and *Galio aparines-Urticetea dioicae* Passarge *ex* Kopecký 1969 phytosociological classes (i.e., Koch 1926; Oberdorfer 1949; Tüxen 1950; Pignatti 1953; Géhu 2006). These plant formations consist of different plant communities (with different assemblages) that are popularly known (depending on the local language) by a common folk cognitive label (e.g., reedbeds in English, *canneto* in Italian, *roselière* or *roselière haute* in French, *cañizar*, *cañaveral* and *juncal* in Spanish, *canyar*, *canyissar* and *jonquera* in Catalan, *röhricht* in German, *szuwary* in Polish, *vassbälte*, *vassrand*, *vassbräm*, *vasskant* or *vassgördel* in Swedish). In some southern areas of Russia (i.e., Caspian region and Cis-Caucasia) these communities are known as *plavni*. In the past, in some regions of Bulgaria, these plant formations were called *saz* (Ahtarov et al. 1939). Also in the past, these formations were known as rörmar in eastern Sweden, southern Finland and the Åland archipelago (Schagerström, 1949; Calissendorff 1981-82). These biotopes can be found at various latitudes, longitudes and altitudes (azonal vegetation), providing the same ecological services with the same dominant species (cosmopolitan or widely distributed taxa) or with very similar species considered as geographic vicariants. Therefore, in both cases, they represent a sort of common ecological standard base for human communities from the various biomes of the planet. The study of the archaic uses of wild large graminoids is important for understanding the human capacity to exploit a given environmental resource, the evolution of human society and its mechanisms of resilience, from the prehistoric age to today (Aranguren et al. 2011; Skakun et al. 2020; Longo et al. 2021a, b).

Models of prehistoric hunters-gatherers strongly support a carnivorous diet for hundreds of thousands of years (Sponheimer et al. 2013) before humans started to broaden their foraging spectrum. Despite progress in the methods for investigating the use of plants (Malamed et al. 2016; Revedin et al. 2017), the archaeological record is often fragmented and contested. Nevertheless, the profound change in food gathering and processing involved significant tempering events at both the biological and behavioural levels to gain nutritional benefits from eating starchy foods (Butterworth et al. 2011; Birarda et al. 2020). Knowledge regarding the gathering of starchy plants can be traced back to 177,000–60,000 years ago in South Africa, where evidence of charred geophytes (e.g., *Oxalis*, *Hypoxis*, *Typha*, and *Juncus* species) was found (Larbey et al. 2019; Wadley et al. 2020). This evidence supports the idea that the use of plants with starch-rich storage organs might have been an established dietary behaviour characterizing modern humans since their emergence in Africa (Longo 2016; Longo et al. 2021a). In Eurasia, research on pebble stones intentionally used to process plants has been carried out at several sites demonstrating that starch-rich "Under-surface Storage Organs" (USOs, like roots, tubers and rhizomes) from large graminoids have been processed since at least 38,000–36,000 years before present (Aranguren

et al. 2011; Revedin et al. 2010, 2015; Birarda et al. 2020; Longo et al. 2021a, b; Skakun et al. 2020).

Therefore, the evolutionary success of modern humans (*Homo Sapiens* Linnaeus) might have been rooted in efficient access to food resources, such as carbohydrates (starch compounds), from a wide variety of plants that did not include cereals until the Neolithic (Longo et al. 2021a, b). With crop domestication and cultivation, the biodiversity of food sources decreases. Today, carbohydrate-based staples represent 53% of the world's average daily calorie intake (FAO 2004), which mostly comes from a few cultivated species (Bélanger and Pilling 2019).

Large graminoids species greatly contributed to human development, possibly lasting until much later in our history (Liptay 1989; Köbbing et al. 2013). The use and trade of reedbed species by human civilizations is reported in numerous Greek and Roman texts, for example by Gaius Plinius Secundus (Pliny the Elder) in his *Naturalis Historia*. These traditional uses, although well maintained over time in various extra-European cultures (i.e.: Gott 1999; Zhang et al. 2020), have generally disappeared in Europe. In Italy, remains of food uses can only be found in the archaeological record (Revedin et al. 2009, 2015; Mariotti Lippi et al. 2015); but in Agro Peligno the remains of these prehistoric uses still exist, and they are described here for the first time.

Background

Studying wetland changes (in their characteristics and in people's perceptions of them) is not only an opportunity to retrace the adaptations of our ancestors, but also a way to improve strategies to better preserve and manage wetlands. This is especially necessary in the current context of global changes, transformations that the world's human populations had never witnessed before with such intensity and speed and on a global scale (see Davidson 2014). For these reasons, this study provides underrepresented insights into human society and the environment to better understand the long-lasting strategic role of wetlands (the wetland lesson). It also allows reflection on strategies for development that are more durable and as sustainable as possible in order to increase humanity's quality of life as outlined in the points of the Sustainable Development Goals (SDGs) defined in the 2030 Agenda for sustainable development (https://sdgs.un.org/goals).

Traditional literature holds that for millions of years plant food was included in the diet of hominids, who relied mainly on raw fruits and leaves (Sponheimer et al. 2013). Although the efficient digestion of dietary carbohydrates may have been a far more recent achievement (Perry et al. 2007, 2015; Frassetto et al. 2009; Hardy et al. 2015), it may have taken place while *Homo sapiens* were evolving in Africa, where plants rich in starch could have been readily available under favourable environmental conditions, like wetlands and their surroundings (Wadley et al. 2020; Larbey et al. 2019), Thus, modern human ancestors understood the importance of wetlands for their survival, clarifying the essential role played by wetlands in meeting energy demands by providing vital macronutrients (Nantel 1999; Mann et al. 2007; Speth 2012). High starch diets became prevalent much later, during the Neolithic, when cereals became major contributors to the diet (Zeder 2015).

In some ways, ancient cultures contributed to the maintenance and conservation of wetland areas, albeit shaping them to better meet the needs of local communities. At the same time, the presence of wetlands has allowed the development and persistence of local civilizations. However, the deep connection between humans and wetlands has often been severed. In this respect, to understand the breakpoint events, we used large wetland graminoids as a model. We examined the folk use of these wetland plants in the human diet by using ethno-historical tools, the archaeological literature and an ad-hoc ethnographic field survey: (1) to assess the food uses of reedbed (large graminoid) species in the marshes of Agro Peligno (inland Abruzzo, Central Adriatic Italy), and (2) to compare the findings with those from the historical and ethnographic data from other European regions. The areas used in the comparison with the study area (Agro Peligno) were chosen on the basis of biological, geographical and anthropological similarities.

Methods

The study area and details of the local people

Valle Subequana and Valle Peligna (also known as Conca di Sulmona) are contiguous valleys along the Aterno-Pescara River Basin, in Central Adriatic Italy (Fig. 1). The first valley corresponds to the "Media Valle dell'Aterno" (middle Aterno River valley), while the second valley corresponds to the "Bassa Valle dell'Aterno" (lower Aterno River basin) and at the same time to the "Alta Val Pescara" (upper Pescara River valley). The "Gole di San Venanzio" Canyon separates these two valleys, both occurring in the same historical district, known as *Agro Peligno*. This historical district takes its name from the ancient pre-Roman population that lived there, namely the Peligni (or Pæligni), but the study area has been inhabited by man almost since the Palaeolithic era. The local population has subsequently seen an important Latin (Ancient Roman) influence and then a strong and very long Lombard presence (and to a lesser extent that of other Celtic peoples, like the Ostrogoths and the Gauls). Administratively, the study area mainly belongs to the province of L'Aquila and partially to the province of Pescara, in the Abruzzo region. Geographically, the study area is situated in central east

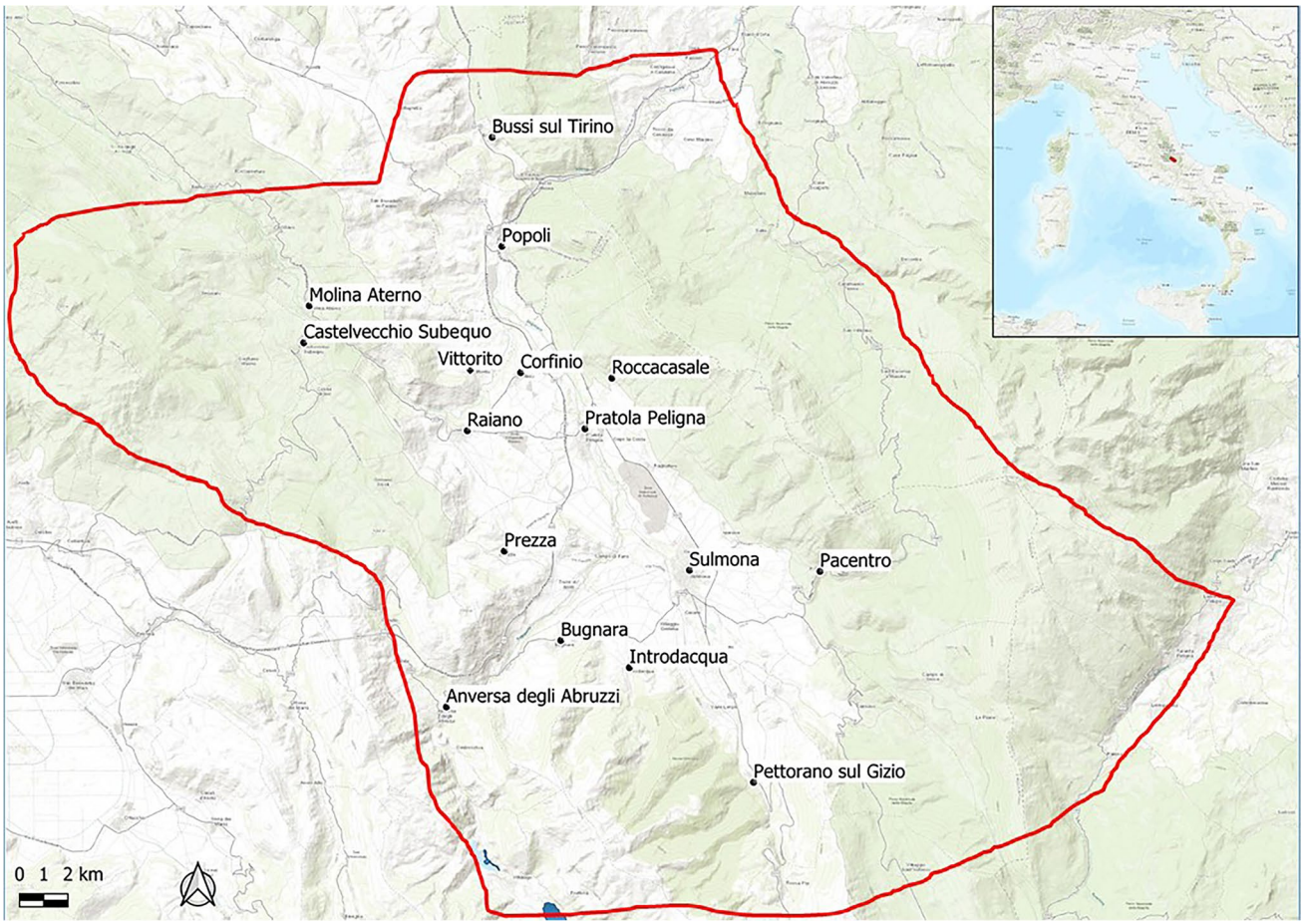

Fig. 1 Map of the study area within the Italian peninsula. In the foreground, names and locations of the municipalities where we recorded large graminoid food use reports. The red perimeter averagely corresponds to Agro Peligno area

Italy, adjoining the Adriatic Sea, and in the Central Apennine Mountain chain (home to the highest peaks of the Apennines).

Throughout the area of central Apennines, numerous depressions and basins with wetlands (reduced or eliminated after the Roman conquest until the modern age) exhibit remarkable traces attesting to the presence of protohistoric settlements and necropolises located on wetland borders or hilltops at the edge of bottom valleys, as is the case, for example, for Agro Peligno (Wonterghem 1981). Nowadays, bottom valleys are generally the more anthropized portions, but some extraordinary and large wetland biotopes remain, characterized by a mesic, aquatic, swampy and marshy environmental mosaic, i.e., reedbeds; fens; sedges; megaforbs; meadows; thickets; forests; oligotrophic, riverine, planitial, springs, vernal pools, and other lotic and lentic water bodies Ecotopes (viz. Buchwald 1994: Pirone and Frattaroli 1998; Cianfaglione and Di Felice, 2012; Cianfaglione 2009, 2011, 2019).

The Peligni population is considered to belong to the Sanniti (or Umbri) ethnic group family. More specifically, they developed locally with ethnic traits deriving from the fusion of several elements; however, the Umbrian/Osco-Umbrian contribution predominated in various ways (Devoto 1951). Following Strabo and Ovid, the Peligni people inhabited an area corresponding roughly to the land between the Aterno and Sangro Rivers (from the mountains), downhill to the Adriatic seacoast (to the east). The core area of this zone is identifiable among the "Valle Peligna" and "Valle Subequana" valleys and the immediately adjacent areas, where various toponyms still recall this past. In this area, some prehistoric human remains are present, together with land surfaces, including wetlands, that have remained rather wild (Cianfaglione 2009). In the study area, from the early Middle Ages to today, the surface relationship between wetlands and reclaimed areas has varied over the time as a result of changes in demographic trends and agricultural policies. The smallest relic marsh surface occurred between the eighteenth and twentieth centuries, but many wetlands were reconstituted at the end of the twentieth century as a consequence of cultivation abandonment (Ortolani 1964; Mattiocco and van Wonterghem 1995; Mattiocco 2000). In

the twenty-first century, due to mechanization and current policies, an inverse phenomenon has been occurring despite the decrease in demographic impact (Cianfaglione and Di Felice 2012; Cianfaglione 2014a; Bottacci 2018; Searchinger et al. 2018). Today, among the descendants of the Peligni people, there are still important residual traces of traditional ecological knowledge that can be traced back to the cultural and food heritage of prehistoric marshes, linked to the use of *Typha* species and other wild taxa widespread in marshes, such as *Phragmites australis* (Cav.) Trin. *ex* Steud. and *Arundo donax* L. In the study area, a large number of marsh plants are known and traditionally used as food, but we focused on reedbed species (large graminoids) because of their emblematic archaic (prehistoric archaeological) evidence, the originality of their food uses, the rarity of these uses nowadays (especially in Italy), and the peculiar local cultural and historical connection that links these uses with wetland heritage.

The local idioms belong to the Peligna area dialect group of western Abruzzo dialects (inland Abruzzo), included within the central and southern (Umbrian/Osco-Umbrian) dialect family, which encompasses most of the central and southern Italian dialects (Ascoli 1882-85; Bertoni 1916). The local dialect variations are mainly linked to villages, but sometimes they could even be related to settlement neighbourhoods. Local parlance is characterized by the frequent cutting of vowels in words. Some vowels are sometimes hinted at and consequently they are written with an umlaut (i.e., ë, ä, ï, etc.).

The field study and literature survey

The field study took place in the villages of Agro Peligno. We recorded the use of large graminoids in most of the villages where there are important wetland surfaces: Anversa degli Abruzzi, Bugnara, Bussi sul Tirino, Castelvecchio Subequo, Corfinio, Introdacqua, Molina Aterno, Pettorano sul Gizio, Popoli, Pratola Peligna, Prezza, Raiano, Roccacasale, Sulmona, and Vittorito municipalities (see Fig. 1). We did not separate the use reports by village, but rather we grouped them, for several reasons: 1) all the villages are close to each other and they have belonged to a geographically, environmentally, culturally and historically homogeneous community since ancient times; 2) people have often moved to other municipalities in the same area despite being native to another municipality in Agro Peligno; and 3) the reports are relatively few, due to the fact that the food use of large graminoids is now disappearing and the people who used them are often old or deceased.

The reports from our study area and the comparison with other similar European regions were structured as a classical logical analysis (see Cucinotta and Pieroni 2018; Prakofjewa et al. 2020; Cianfaglione et al. 2022), that is, in an anecdotal and narrative way as the literature data are qualitative and not quantitative.

We recruited study participants among elderly community members, who have worked or are still working in strong connection to the natural environment and attached to traditional activities. Fifty-four people, aged 60 to 98 years, were interviewed. During the interviews, we focused on past and present local food uses of marsh graminoids growing in the area. We focused, in particular, on the reedbed (large graminoid) species of wetlands because these plants are the most productive in terms of biomass, they are the most common species in wetlands and their food uses are more peculiar and rarer compared to other graminoid taxa. Consequently, we excluded smaller graminoid species (i.e., *Avena*, *Arrhenatherum*, *Carex*, *Cyperus*, *Eleocharis*, *Juncus, Scirpus* species, etc.) that are often used as snacks, which also occurs in the study area. Interviews were conducted in Italian and local dialects. All the respondents were questioned during oral interviews about reedbed (large graminoid) presence, perceptions and traditional knowledge. The objectives of the research were to address the following questions:

- Which reedbed species are included in local traditional knowledge?
- What is the traditional local knowledge regarding these species?
- Which plants were used in the past and which ones are still used today?
- How are they used for food purposes?
- How and when they are harvested?

The main questions posed to the informants included:

- What reed plants are used as food?
- Which species are preferred to be eaten and why?
- How and when are these species harvested?
- Where do you prefer to harvest these species? Why?
- How are they cooked and prepared?

In addition, we collected anecdotes and stories freely shared by the interviewees. We also conducted identification sessions to ascertain which taxa were used by local inhabitants. This session consisted of both *in-situ* and *ex-situ* experiences, with the former comprising two trials:

Firstly, walking in search of the used species mentioned by the interviewees. The interviewees conducted us to the places where they generally used to harvest them.
Secondly, we proceeded by accompanying the interviewees to the nearest wetlands to check whether they recognized a species and if they had any knowledge about the uses of this species.

In the case of the unavailability of interviewees to travel to gathering locations, or when they could not move around easily, it was decided to show samples of the various local large graminoid taxa to the informants (*ex-situ* experience).

To analyse food use trends, we asked respondents to tell us when they perceived the use of the studied species from before World War II up to the present day, based on their direct experience and that handed down by their ancestors. We divided recent history into periods that are recognizable by Italians because of socio-cultural and environmental vicissitudes, and therefore easily datable.

Prior informed consent was always verbally obtained before conducting the interviews and the research adhered to the ethical guidelines of the International Society of Ethnobiology (ISE 2008) and the American Anthropological Association (AAA 2012), guaranteeing anonymity in the collected data. The local name(s) of each quoted taxa were specifically recorded in order to preserve these data, to make them known to the scientific community, to make them available for future investigations in other disciplines, and to have an interdisciplinary reference that can be used as an interface with local traditional knowledge. The plants were identified following Tutin (1964-1993), Zangheri (1976), Pignatti (1982), and Baroni (2001). Taxonomic identification was conducted by the authors, and herbarium samples were stored in the Phytochemistry and Ethnoecology Section of the Herbarium of the University of Western Brittany (BRE), Brest, Brittany, France. Specimens were stored under the following codes: *Phragmites australis* (Cav.) Trin. *ex* Steud. (Code: kcsu1), *Arundo donax* L. (Code: kcsu2), *Typha latifolia* L. (Code: kcsu3), *Typha angustifolia* L. (Code: kcsu4), *Schoenoplectus lacustris* (L.) Palla (Code: kcsu6). Plant nomenclature followed the data and information available through "Plants of the World Online" (http://powo.science.kew.org) and syntaxonomic nomenclature follows the EVA—European Vegetation Archive (http://euroveg.org/eva-database).

A field qualitative sensorial analysis was carried out (raw and cooked material) to interpret the perceptions of the informants, directly considering texture and taste, with the aim of typifying the perceived characteristics of the studied plants.

The analysed literature consisted of papers and books, in English and local languages, from the 18th to twenty-first centuries. We searched for literature available on the Internet, in the "*Archivio tradizioni subequane*" archive (Castelvecchio Subequo AQ, Italy), the "*Biblioteca comunale Publio Ovidio Nasone*" library of Sulmona, the "*Biblioteca del Centro servizi culturali*" (Sulmona, AQ, Italy), and the Italian National Library "*Biblioteca Nazionale Centrale*" of Rome and Florence. Subsequently, we went back to publications that were cited in the papers we had reviewed which could be of interest for our study. Finally, the co-authors examined the literature from other European areas, published in their national languages during the past century. Literature analysis was conducted considering all the available ethnobotanical, historical, folkloric and archaeological sources reporting local and past food plant uses in Europe. The comparison with the literature also included, however, some data coming from nearby extra-European regions (Northern Africa, Near East, and central Asia). In the results, we grouped the comparative data arising from the literature based on bio-geographical and cultural affinities.

Results

Large graminoids in Agro Peligno

Used species

The most common graminoid taxa identified in our study included *Phragmites australis*, *Typha latifolia*, *Arundo donax* and *Schoenoplectus lacustris* (Table 1).

All these plants generally had multiple and multipurpose uses in the study area. The leaves were used to make strings, litter for livestock, and a fodder mixture locally called "strame" [later, in addition to or instead of these leaves, simple straw (from cultivated cereals) or maize (*Zea mays* L.) plant portions were added]. The stems were used as wood substitutes to make poles, tools, and other objects. These plants were also used as fuel, and in particular for cooking. Subsequently, this function expanded to include the stems of *Sorghum* species and maize (*Zea mays* L.) sticks and corncobs (Cianfaglione 2014b).

At the global level, the study species have a very large distribution area, and as they are all native to the Mediterranean Basin, they are harvested in nature in our study area. More in detail, *Phragmites australis* is a (sub)cosmopolitan species, whose native range extends from temperate and subtropical areas to tropical mountains. In our study area, this species is locally called "cannizzëlë", "cannizzele", "cannuccia", "cannuccië", or "canne piccole" (all meaning small cane), and it is harvested in early spring (Fig. 2). The young shoots (no more than 50 cm long) are harvested and then cleaned for eating. To collect the sprouts, it is necessary to pull the upper stem internodes, detaching the apical portion. Then they need to be cleaned by removing the outer leaf layers until the whitish, softer inner portion (the core) is reached. Cores can be eaten raw, but they are preferably boiled. Raw cores have a similar flavour to that of *Typha* species, but with more marked tones of cucumber and grass. Rarely, they may have a slightly bitter taste. The mature stems of *Phragmites australis* were largely used to make fences and musical instruments (e.g., Zampogna/Cornamusa, Piffero, Oboe/Ciaramella), or in masonry, along with

Table 1 Recorded food uses of large graminoids in the study area and related features reported

Species	Family	Used parts	Harvesting time	Morphological aspect	Food utilization	Taste description
Typha latifolia L. and similar species	*Typhaceae* Juss., 1788	Basal core of young stems and sprouts	Spring, generally before flowering; or even later for non-flowering stems, before the end of the vegetative season	Similar to heart of palm	Raw or cooked	Raw: like grass, corn, and cucumbers; Cooked: like heart of palm
Arundo donax L	*Poaceae* [R.Br.] Barnhart, 1895	Apical buds of rhizome	Generally during dormancy, between winter and spring, before the vegetative season	Similar to an onion	Cooked	Very bitter, reminiscent of artichoke
Phragmites australis (Cav.) Trin. *ex* Steud	*Poaceae* [R.Br.] Barnhart, 1895	Apical core of stem	In the early vegetative season, before the stem reaches 1 m long	Similar to green asparagus	Generally cooked, more rarely raw	Raw: like grass and cucumbers; Cooked: more neutral
Schoenoplectus lacustris (L.) Palla 1888 and similar species	*Cyperaceae* Juss., 1789	Young sprouts	In the early vegetative season, before the stem reaches a few cm long	Similar to green asparagus	Cooked, boiled	Like a neutral green vegetable; a bit fibrous

lime, to create light partition walls and false ceilings. *Phragmites australis* formations (especially the marshiest ones to be cultivated) were also commonly used as pastures. With the loss of the local traditional culture, the status of *Phragmites austalis* is fading, becoming considered an obstacle to modern agricultural practices and increasingly considered as weeds. After all, the new agricultural practices that have replaced the traditional ones are not only erasing the typical human elements of the landscape (in actively used soil parcels) and the fossil landscape (sensu Gorfer 1982) in parcels transformed into forests or left in secondary succession, but also allowing land grabbing, eliminating the traditional environmental mosaic, eradicating field trees, shrub edges, and ancient fruit varieties, as well as denuding and simplifying the landscape with extensive monocultures. The same phenomenon happens with forests, where more extensive and intensive logging increasingly takes the place of selective cutting (single-tree selection), branch removal, the coppicing of field boundary hedges, and other ancient interventions that cause less impact on trees or on the forest structure.

Typha species includes several taxa that have strong morphological similarity and similar food characteristics and that are therefore equally usable, for which reasons no clear distinction among them is made by the local people. *Typha* species are locally called "mazzanguro" (singular) or with the plural "mazzangurë" (meaning bat/club); "mazzafrusta" (meaning bat/club whip); "mazzajatta" (cat bat/club); "mazzatatona" or "mazza dëi nonni" (grandfathers bat/club); and "iscië", "lisca" or "liscie" (meaning a bundle of rushes, sedges, etc.). In the study area, we also identified the presence of similar species like *T. latifolia*, *T. angustifolia* and *T. domingensis* (Fig. 3). The presence of other usable large *Typha* taxa cannot be excluded. In Agro Peligno, there is no real folk differentiation between these similar species (thus in this work they are referred to collectively as the *Typha latifolia* group). We used *T. latifolia* as the flag species for this group, even if *T. angustifolia* is equally widespread in the study area, because this species is the most preferred to be harvested in the study area.

Typha latifolia L. is a cosmopolitan species, whose native range extends from the temperate Northern Hemisphere to South America and central Africa. *Typha angustifolia* L. is a semi-cosmopolitan species, whose native range is the temperate Northern Hemisphere. *Typha domingensis* Pers. is also a semi-cosmopolitan species, whose native range includes tropical and subtropical belts, encompassing the Mediterranean Basin and with propagation along the Atlantic coasts (Cianfaglione 2018). It is an underestimated plant that sometimes is excessively considered as an alien species, or it is confused with *T. angustifolia*. Other very similar species complete the global distribution of this natural worldwide food resource. At the local level, the preferred species in the study area is the largest one

Fig. 2 *Phragmites australis* gathering in the study area: **A**. harvesting young sprouts; **B**. excision of the apical stem by pulling with the hand to detach the apex from the node; **C**. edible parts assembled in a bunch

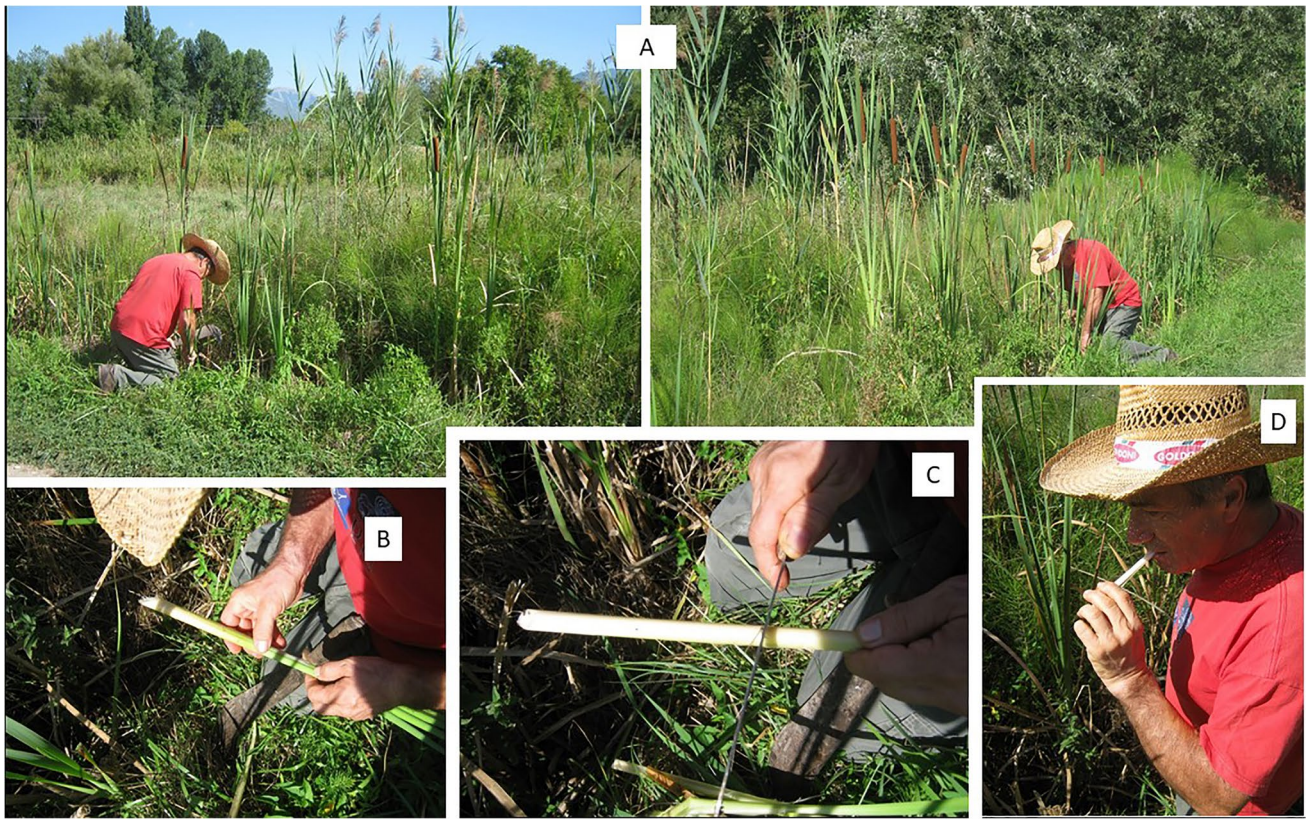

Fig. 3 *Typha* species harvesting in the study area: **A**. approaching *Typha*; **B**. excision of the stem from the rhizome with a billhook; C. selection of the edible part with a knife; **D**. eating the basal stem

(*T. latifolia*). Once a suitable group of these species has been identified for harvest, it is necessary to follow the stem of the plant using the hands, in an attempt to reach the hard rhizome in the mud. Then, it is possible to harvest the stem sprouts by pulling them. If it is difficult to reach, it is possible to push and pull in any direction or even cut it (generally with a knife or billhook, locally called "ronca" or "ronga") as low to the ground as possible. The

latter case is the most undesirable, because when the stem is generally cut (severed), there is a higher risk of losing the best (basal) part to be consumed. Once harvested, the stem is cleaned by removing the outer leaves. On the core (at the level considered edible), the leaves are not yet well formed, and the texture is softer, fleshier, and less fibrous, taking on a white, yellowish, or clear green colour, according to the degree of development. The basal stem portion is identifiable by a transparent jelly substance, which can generally be found among the leaves (foliar sheaths) and around the stem growing in the mud. Young shoots and the base of a mature stem (especially non-flowering ones) are the most suitable for harvesting the best cores. Cores can be eaten raw or cooked (boiled or made into soups). The core appears very similar to "palm cores" and they can be prepared the same way. Cores that are whiter, thicker, softer, and sweeter are considered the best (as they have a more neutral or maize-like flavour). Higher up, the core becomes thinner and increasingly greenish, with a less palatable texture and flavour. Young shoots are harvested in spring, and they can be collected until they are half a meter long. When raw, the taste of the core resembles unripe corn, grass, or cucumber; when boiled the taste is more neutral.

Arundo donax is a sub-cosmopolitan species. This taxon has become naturalized (Neophyte) and consequently considered as invasive in some regions, as it is in southern Africa, continental America, the Caribbean and Pacific islands (Hafliger and Scholz, 1981). *A. donax* is classically considered as a native species in the Mediterranean Basin (Hickman 1993) or, more generally, the warmer regions of the Old World (Munz 1959). Its chorology remains uncertain as other authors consider this plant as an ancient introduced species (Archaeophyte) in the Mediterranean region (Hardion et al. 2014; Jiménez-Ruiz et al. 2021), sometimes regarding it as an invasive alien. In any case, in a more thoughtful way, thinking about the heritage and historical characteristics of its presence, this taxon needs to be considered as a typical species for the Mediterranean landscape and as a significant plant for Mediterranean culture. *Arundo donax*, which is locally called "canna" (meaning cane) or "canna grossa" (meaning big cane), is harvested between winter and late spring. The youngest shoots (from buds in the rhizome stage, up to a few centimetres in length) are harvested and then cleaned for eating (Fig. 4). The harvesting procedure consists of identifying the vegetative buds of the rhizome, which are onion-shaped and can emerge from the soil line. The buds are locally called "cane onion" (cipolle delle canne or cipollë dë lë cannë), "canneroli" or "cannëroli". As the season progresses, these shoots tend to lengthen, developing a stem. They need to be removed, with a strong knife or billhook, from the rhizome as soon

Fig. 4 *Arundo donax* harvesting in the study area: **A**. approaching bud (cane onions); **B**. excision of the buds from the rhizome with a billhook; **C**. selection of the edible part with a knife; **D**. and **E**. preparing the bud for cooking them

as possible, before it develops. To be prepared for use, the rhizome portion must be removed because it is quite hard and excessively fibrous; and it is also necessary to remove the outer scale layers. They are very bitter and thus can be eaten only after they are boiled. The boiling process makes them softer and more pleasant in flavour (less bitter and more reminiscent of artichoke). The mature stems of *Arundo donax* were the most preferred substitute for wood (lumber and firewood). They were used to make garden poles, fences, grids, agriculture tools, and other various woody objects. *Phragmites australis* and *A. donax* were also used to make buoyancy, fishing, masonry and hunting devices.

Arundo donax represents a particularly emblematic plant for the local culture of the study area and its related traditional knowledge. *Arundo donax* was the most valued species among the studied large graminoids. It was often planted (facilitated in its diffusion) at the edges of gardens, ditches, channels, and roads (in planitial, mesic slope and riverine environments) to reinforce embankments and for its numerous important multipurpose uses. In the study area, it is possible to find, albeit rarely, a variegated form of this species. In the past, this form was less popular because it was considered to be of lower quality (less woody and thinner), but now it is increasingly appreciated as a garden decoration. We also noted a variety known in the past, with reddish-yellowish leaves, for which no trace of its current existence has been found. With the loss of traditional culture and related ecological knowledge, even the favoured status of *Arundo donax* is fading, becoming considered an obstacle to intensive, extensive, and mechanized agricultural practices. Consequently, in many cases, this plant is disappearing from the agriculture landscape, uprooted from places where it was common and welcomed. In this way, the fading and increasingly negative perception of this plant is similar to other large graminoids and even other wild marsh plants that are increasingly considered as weeds.

The *Schoenoplectus lacustris* group is considered in our manuscript as an aggregate, which includes several taxa that have strong morphological similarity and similar food characteristics and that are therefore equally usable, for which reasons no distinction among them is made by the local people. Often, these taxa are debated, their taxonomic ranks reconsidered, and their names changed by the scientific community (see Fay et al. 2003). In the study area, we identified the presence of similar species, like *Schoenoplectus tabernaemontani* (C.C.Gmel.) Palla, and some intermediate forms, sometimes referred to as hybrids [e.g., *Schoenoplectus*×*carinatus* (Sm.) Palla or *S.*×*kuekenthalianus* (Junge) Palla], whose classification are very difficult and controversial (see Fay et al. 2003; Lansdown and Rumsey 2020). The presence of other usable and similar taxa cannot be excluded. In the study area, there is no real folk differentiation between these similar taxa (therefore here they are referred to collectively as the *Schoenoplectus lacustris* group). We used *S. lacustris* as the flag species for this group because this species is largely the most common in the study area. The plants in this group were used in the past as asparagus-like vegetables, locally called "spargenë dë lë padure", "spargënë de lë paurë", "spergënë du padulë", and "spergënë d'aquë", meaning marsh or water asparagus. The young sprouts were harvested by hand or with a knife when tender, in the early vegetative season. The whitish basal stem portion was preferred, being cut into pieces and boiled. The tenderest sprouts could be cooked completely. The largest sprouts are locally preferred, in that *S. tabernaemontani* seems to be the most appreciated taxon to be harvested, but *S. lacustris* appears to currently represent the most widespread taxon in the study area. *Schoenoplectus lacustris* is a sub-cosmopolitan species, whose native range encompasses parts of Afroeurasia (Old world), especially the Northern Hemisphere (from Europe to Mongolia, India, and the Red Sea), but also southern Africa. The native distribution range of *Schoenoplectus tabernaemontani* is cosmopolitan.

Use trends and more details

To analyse the trends of large graminoid food uses, we asked respondents to tell us how much they used the studied species up to the present day, based on their direct experience and on what was handed down by their ancestors. We divided recent history into periods that are recognizable by local people because of socio-cultural and environmental vicissitudes and therefore easily datable: (0) before World War II (before 1940); (1) during WWII and the immediate post-war period (1940 to 1950); (2) before 1970 (1951 to 1969); (3) before 2000 (1970 to 2000); and (4) today (2001 to 2022) (Table 2).

The period before World War II was considered as period (0) of our study, since the findings mostly derive from information handed down from previous generations, sometimes accompanied by childhood memories. Period (1) was characterised by increasing hardship and difficulties linked to war, the autocratic regime, Nazi occupation and finally the consequences of war and state reconstruction. Period (2) represented a time of great socio-economic changes. For example, the Kingdom of Italy was transformed into a republic. This period also involved constant economic growth for Italy, the so-called "boom economico", with a strong push towards globalization and the consequent new "modernization", in a consumerist way (Cederna 1980; Gabrielli 2011). Previously, modernization was viewed as imperialistic and futuristic. During this time, the loss of traditional lifeways including uses, knowledge and traditions intensely began. Also during this period, there was a definitive emancipation of the countryside and internal areas from a land system based on the medieval feudal structure and

Table 2 Large graminoid use trends by species, using the local cognitive label, and period. Report % are based on the total number of respondents (54)

	Typha latifolia L. and similar species	*Phragmites australis* (Cav.) Trin. *ex* Steud	*Arundo donax* L	*Schoenoplectus lacustris* (L.) Palla 1888 and similar species
Percentage of respondents that noticed edible uses	100	57.41	46.30	7.41
(0)—Reports before WWII (%)	100	50.00	18.52	7.41
(1)—Reports during WWII and the immediate post-war period (%)	100	57.41	46.3	7.41
(2)—Reports before 1970 (%)	100	18.52	33.33	7.41
(3)—Reports before 2000 (%)	64.81	9.26	3.70	0
(4)—Reports today (%)	14.81	5.56	3.70	0

from sharecropping with landowners (e.g., rich lords, the nobility, the Catholic Church). Some inland areas remained "unmodernised" and were increasingly considered marginal or disadvantaged. During period (3) the "modernization" great changes reached the countryside, as in the case of our study area. In the first half of this period (1970–1990), the economic growth linked to globalization and consumerism reached even the smallest villages of the innermost areas. The displacement of people to cities and the reduction in the human birth rate led to a continuous demographic reduction, which together with the creation of industries and employment in the third sector even in the innermost areas led to strong abandonment of both traditional uses and land uses, especially in the second half of this period (1990–2000). On the one hand, this meant the loss of traditions, established uses and ancient knowledge. Urbanization (concreting over land) became widespread, eliminating the most profitably cultivable land. The inaccessible or less productive soils were left abandoned, consequently rewilding themselves through secondary succession dynamics. This happened in many areas of the Agro Peligno wetlands, which have seen a notable return of natural vegetation (including forests and marshes) across large areas up to the present day. Between the 1950s and 1990s, there was a proliferation of new roads, often asphalted, redundant and unnecessary, among the bottom valleys and in the mountains of Agro Peligno. Many of these roads were closed or covered by vegetation in alternating phases in the following decades. During the 1970s and 1980s, the last major reclamation and hydraulic works in the Agro Peligno wetlands took place (e.g., canalization, reclamation, creation of new roads, concreting waterbody banks/shorelines), first under the authority of the State and then the regional administration. The reclaimed surfaces and reclamation work reached its highest historical peak in our study area. In recent years (particularly starting from 2000), thanks to soil use abandonment, the condition of the marshes has improved. The abandonment of wetland surfaces occurred nearly 30 years later than those located up in the mountains. Period (3) is also the time when there was a historical peak of water pollution caused by, above all, sewage discharge (of urban, industrial and livestock origin) and also by the intensification/industrialization of agricultural practices in a large sense (including livestock). During this period river crayfish [i.e.: *Austropotamobius pallipes* (Lereboullet, 1858)] and freshwater crabs [i.e.: *Potamon fluviatile* (Herbst, 1785)] disappeared almost everywhere; once exceptionally common and distributed, the individuals now remaining are very rare, localized and strongly threatened. All these phenomena have left their mark on the local collective memory to the point of being considered as real space–time landmarks.

From 1970 to 1974, the intensive and extensive spreading of insecticides in urban and suburban areas, crops and marshes reached its historical peak, protracted in large part by municipalities and to a lesser extent by private organisations. Between 1990 and 2000, more attention to the environment and better management of sewage discharge began, especially following the advent of the European Community regulations and directives. The result was higher water quality and a very strong reduction in ordinary pollution; however, occasional and accidental pollution events remained worrying. Period (4) represents the current period, and despite being marked by continuous demographic decline and the re-naturalization of large, abandoned areas, it has seen an incremental and increasingly strong return of land uses, even in previous abandoned areas (with modern and intensive uses rather than traditional ones). This is linked not only to current socio-economic conditions, but also to incentives and policies for development, agriculture, energy production and forest harvesting. In this current period, although population density has continued to decrease, human activity and the resulting impact on the territory has begun to increase and spread once again. Urbanization (with major and minor moments) has never stopped expanding.

After the Second World War, vegetation cover reached its minimum historical level in the study area (see Cianfaglione et al. 2022). In relation to the environmental and biodiversity impact, some species became greatly reduced or locally

extinct after WWII, but some strong changes also occurred in more ancient times (see Cianfaglione et al. 2014). It should be noted that some of these species were threatened or locally extinct in even earlier times, demonstrating how the impact of humans on the Agro Peligno wetlands has been increasing for centuries, from the first medieval reclamations to today, with some variation over time and space (i.e., not uniform across the surface). The heterogeneity of human pressure in space and time has allowed some species to perpetuate themselves, even if they become rare and endangered. Most species are now reappearing or re-expanding, albeit with many difficulties, thanks to "nature's comeback", and large graminoids are now spreading a lot, re-covering large surfaces, even in swampy conditions.

Consequently, we have tried to define trends of recordable uses, as represented by the following graph (Fig. 5).

Arundo donax is the species for which food uses increased the most during the war period, followed by *Phragmites australis*. This can be explained by its use as a famine food: a reserve food to be used in extreme circumstances. Although less palatable than other species, it was the less exploited as food purposes (ratio of vegetation surface / surface used for food purpose), and due to the scarcity of food resources it became a useful locally available resource to be used, which was therefore exploited more. Despite being more palatable than *Arundo donax* (which is bitter and difficult to collect), the limited use of *Schoenoplecuts lacustris* group species over time may be the result of their lower availability in the territory, even today. Being largely the most popular, the use of *Thypa* species could not increase, likely because they were already exploited to the maximum extent possible.

Discrepancies concerning the increase in use of less palatable species during WWII can only be explained by the exploitation of more palatable species to their natural limit and consequently to the greater exploitation of those species that were less appreciated, as a famine reserve food. In the Agro Peligno, the development of both herbaceous and woody vegetation was reduced to a minimum during that period, and until the 1970s, as everything was overexploited (Cianfaglione et al. 2022).

As can be seen in the graph, the most used plants are species of large cattails (*Thypha latifolia* group), while the least used are species of large sedges (*Schoenoplectus lacustris* group). The general food use trend of the studied species can be explained as follows: from period (0) to (1), food uses remained fairly constant. They increased during the worst period of famine and hardship, that is, during the Nazi occupation of Italy, because in addition to the difficulties of the war, resources and workforce were subject to requisition by the occupying forces and this required local people to provide more for their own needs, amplifying the use of wild natural resources. After this period, the trend in the use of the studied plants was one of constant decline, following the pressures of "modernity", which is reflected in the ever-greater detachment of the local population from their own wetlands and related traditional/natural resources.

This is also confirmed by the change in frequency of use of these species, as the war period and the immediate post-war period (between 1940 and 1950) saw an increase in frequency due to the scarcity of economic resources and famine foods. During this period, large graminoids were also consumed once a day or more, based on availability and family circumstances. During subsequent periods, the use frequency of these species has progressively decreased up to the present. Gradually, large graminoid species were less and less used. Today, even species often used in the past are rarely used. In fact, large graminoid food use (harvesting, cooking and consumption) is more linked to taste in the past, a way to remain tied to traditions, rather than to a food need. It is also something that is done once, or only a few

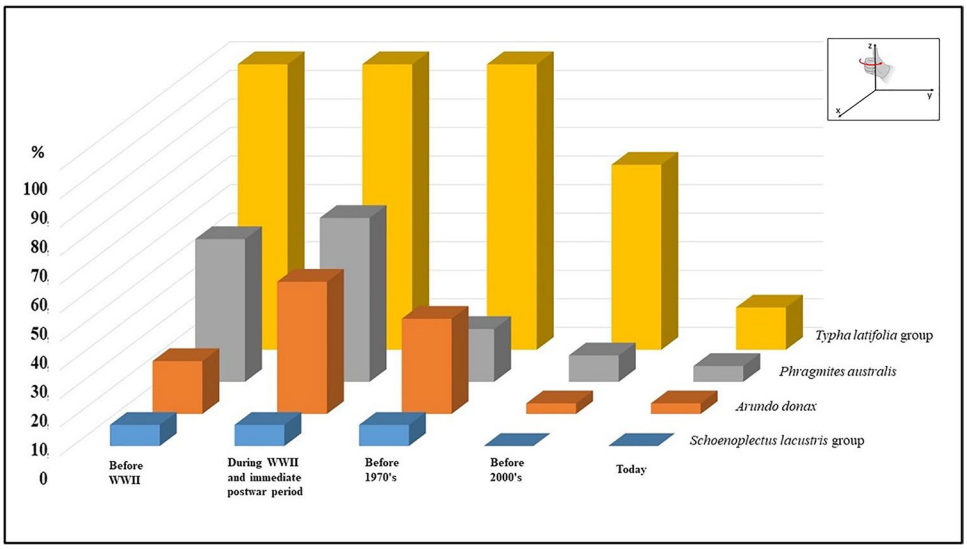

Fig. 5 Large graminoid use trends by species (X), using the local cognitive label, and time (Y). Report % (Z) are based on the total number of respondents (54)

times a year, to justify the presence of these people in the wetlands (often this was referred to by respondents as "an excuse to take a walk" or "an excuse to keep coming to see these places"). Only those individuals who ate these species in the past are among those who continue to do it today. The specific trend regarding the *Typha latifolia* (and similar species) group decreased less rapidly because it was more appreciated in terms of taste (as stated by the interviewees). Ease of harvesting did not have a significant impact on this. In fact, *Phragmites australis* and the *Schoenoplectus lacustris* (and similar species) group appear to be the most easily harvestable plants, followed by *Typha* species and finally by *Arundo donax*, which is the least easy to harvest.

More specifically, the interviews revealed that currently the most used species in the study area, and the most appreciated for their palatability, are the large *Typha* species (*T. latifolia*, *T. angustifolia* and *T. domingensis*). The first species was the most preferred as it has the largest stems, followed by *T. angustifolia* and then *T. domingensis*. *Phragmites australis* and *Arundo donax* followed in order of preference. There are also remnant traces of the use of the *Schoenoplectus lacustris* and similar species group, but this group represents the least used plants. Concerning uses and harvesting details, it is possible to highlight that the sprouts of *Typha* species and *P. australis* "are preferably harvested during the crescent moon period, while *A. donax* buds during the waning moon period" (man, 78 years old). This can perhaps be explained in the former as a way to increase lymph content and therefore sweetness, while in the latter to decrease lymph content and therefore bitterness. "To reduce the bitterness of *A. donax*, it is favourable to pre-boil the buds and then immediately remove them from the cooking water, after which they are washed" (woman, 82 years old). "The young non-flowering stems of *Typha* species are most suitable for eating, producing the best quality cores" (man, 67 years old). "Vinegar of red wine and olive oil are useful to reduce the bitterness in cooked *A. donax* buds" (man, 94 years old). To reduce the problems related to the most fibrous basal portion of "cane onions" buds, they can be reduced into thin slices to be cooked or grated and then cooked (women, 85, 87, 92, 95 years old). "The bitterness of *A. donax* cooked buds is mitigated and the flavour is enhanced by using olive oil and garlic during the cooking process and using red chili pepper as a condiment (fresh or dried)" (man, 76 years old). "Cooked apples, kaki, quinces or pears (especially the bitter and astringent types—wild or cultivated) can be mixed with boiled *A. donax* buds to mask their bitterness" (woman, 89 years old). "The cooked buds of *Phragmites australis* can be used as a substitute for asparagus and vegetables" (man, 87 years old). Four respondents (man, 80, and women, 85, 88, and 91 years old, respectively) mentioned that *Schoenoplectus lacustris s.l.* was used in the past, until about 40 or 50 years ago. Regarding our study on large graminoids, the respondents all agreed that the uses of these species were intensified during Nazi occupation during the Second World War, representing an emergency food. In Molina Aterno and Popoli, these plants were traditionally used in various combinations, accompanying frog meat (and even that of toads, during WWII; unlike frogs, the use of toads was often hidden and considered an embarrassment) (men, 86, 87, 95, and 88, women, 90 and 95 years old, respectively). In the past (average time from 1800 to the1950s), these species were widely considered as fodder because of the scarcity of grass and herbs (because pastures and meadows were overexploited or cultivated), and as fuel because of the acute scarcity of firewood in the study area because of deforestation or wood overexploitation (all participants).

The comparison with the Italian ethnobotanical databases showed that the food use of these plants is still unknown in Italy (Guarrera 2006; Atzei 2018), but it has been recorded at prehistoric archaeological sites in central and southern parts of the country (Aranguren et al. 2007, 2008, 2011; Revedin et al. 2009, 2010, 2015). The uses we recorded are of particular interest because they are still present in the study area, albeit now rare and disappearing. The fieldwork data and literature analysis support the fact that graminoids were very important foraging species in Italy in the past.

Among the interviewed people, all the informants mentioned *Thypa* species, as 42 people spoke about *P. australis*, 20 participants mentioned *A. donax* and only four participants mentioned *Schoenoplectus* species. The study species were cited evenly among the municipalities of the Agro Peligno wetlands, whereas *A. donax* was mentioned only in Valle Peligna. This can be explained by the fact that this species is widespread in this valley, but it is rare in the adjacent Valle Subequana. The results of our field study highlighted a trend in which males are largely dedicated to harvesting (70% males and 30% females) while women are mostly involved in preparation and cooking (15% males and 85% females).

In Agro Peligno, the multiple and multipurpose uses of large graminoids were intensified during "dearth" periods (i.e., Nazi occupation during the Second World War, when troops requisitioned most of the food, animals and male labour force). The formations created by these plants were also managed as pastures. For this purpose, these formations were generally burned from late autumn to early spring to eliminate the dry woody debris, in order to facilitate movement and the grazing of livestock and to increase the palatability (green/dry biomass ratio) of these pastures. This slash-and-burn practice was called "addebbiatura" ("a addebbià" in local dialect), "bruciatura" ("a abbruscià" in local dialect, meaning burning), or "pulizia" ("a rëpulì" in local dialect, meaning cleaning). This practice was used to manage all marsh graminoid formations (i.e., reedbeds, sedges, rushes,

grasslands, meadows, etc.) to obtain pastures or cultivated fields. For the former, this was done to reduce the necromass and the woody/fibrous mass in favour of green and more tender biomass for grazing. For the latter, it was done to remove the vegetation to facilitate the practices of cultivation preparation. In the past, this vegetation management practice was widely used, but it is rarely utilised today (often forbidden or discouraged) due to the negative effects it can have. Local study participants widely foraged the aforementioned large graminoids in these types of pastures, as well as in fallow fields, cultivated fields, damp edges, and in more natural marshy habitats and swamps. The fuel purpose is also very important with respect to the food issue, as fuel was mostly used for cooking all year round and not just for heating during the cold season. The smoke deriving from the combustion of large graminoids was accepted as that of Garriga plants (it was considered sweet) and therefore acceptable with respect to the flavour that it would leave on both simple and smoked foods. The wetland large graminoid formations were used as an important fuel source from around the 1930s to 1950s. At that time, there was a severe scarcity of combustible woody biomass, and the soil and vegetation had become widely overexploited, to the point that even suffruticose (Garriga) plants and herbs/grass had become difficult to find because they were also used as fuel (see also Cianfaglione 2014b, 2022). At that time, large graminoids played an important role as a great reserve of woody multipurpose biomass. Lastly, the baskets and other objects obtained from large graminoids were valued for handling food, as they were considered neutral or likely not to negatively affect the taste or preservation of food.

Food utilizations of large graminoids in other Euroasian areas

Mediterranean and Near East

The use and trade of reeds by human civilizations since the Neolithic has been documented across scholarly fields in Egypt and Mesopotamia (Postgate 1980; Zohary et al. 2013). For example, several Sumerian tablets, dating to 2500 BC, mentioned thousands of bundles of reed culms being imported across Mesopotamia (Joannès et al. 2001). Le Floch (1983) completed an overview of local general uses of *Thypa* species: the base of the stem is eaten raw; male and female flowers are eaten before they bloom; leaves, basal, and subterranean parts are also harvested; old roots are crushed, peeled, and stripped of excessively hard fibres, then they are dried and subsequently reduced to obtain a flour, which is eaten after having been moistened or is prepared in porridge or pancakes. The food use of *Arundo donax* has also been documented in Iberian cultures. In Catalan-speaking territories (see Gras et al. 2021) their use as fodder (for cows, donkeys, goats, hens, mules) has been reported for several localities, including the Balearic Islands, namely Formentera (Mayans 2013) and Ibiza/Eivissa (González in progress), Catalonia (Aiguaviva and Bescanó) (Serrasolses 2014), and some central Valencian districts (Valencian Community) (Pellicer 2005). *A. donax* leaves are used as an ingredient (condiment or other food additive) in the preparation of food and drinks. More specifically, in the Valencian community, *A. donax* leaves are used in the preparation of domestic olive (*Olea europaea* L. var. *europaea*) preserves to prevent them from turning yellow and becoming soft (Ferrando 2012). The leaves are also employed in preparing pepper (*Capsicum annuum* L.) preserves to prevent the peppers from becoming soft (Ferrando 2012) or turning whitish (Mulet 1990). Young *Arundo donax* shoots are also used in the preparation of olive brine preserves in Santa Coloma de Farners (Catalonia) to make the olives turn yellow (Selga 1998). The leaves are used in Argençola (Catalonia) as an ingredient of ratafia, a liquor prepared by macerating several plants in alcohol for 40 days (Talavera 2018). *Phragmites australis* (Catalan names: canyís, sistra) has been reported as fodder (cows and probably other livestock) in Piles and Tavernes de la Valldigna (Valencian Community) (Pellicer 2005). *Typha angustifolia* is also used as fodder for cows, donkeys, horses, and mules in Ibiza/Eivissa (Balearic Islands) (González in progress) and in Miramar and Grau de Gandia (Valencian Community) (Pellicer 2005). The subterranean parts of *T. angustifolia* and *T. latifolia* are eaten in the central Valencian Community (Pellicer 2005).

Eastern Europe and central Asia

Marsh-rich Eastern Europe has surprisingly few records of wetland graminoid plants being used as food. This may be related to the fact that arable weeds are used as emergency food. This is true even in wetland areas in the Podlasie and Polesie (Polesia) regions on the border of Belarus, Ukraine, and Poland – one of the largest marsh complexes in Europe (Łuczaj 2008, Łuczaj et al. 2013). In Poland, the most widely used wetland food plant was sweet manna grass, *Glyceria fluitans* (L.) R.Br. and related species (e.g., *Glyceria notata* Chevall.). Their grains were harvested in early summer and constituted an item of commerce. They were also paid as tribute by peasants to local landowners (Łuczaj et al. 2012). The use of manna grass gradually ceased due to the draining of marshy meadows as well as the disappearance of tributes which may have fuelled the use of this expensive cereal. The inner parts of young shoots of *Schoenoplectus lacustris* were eaten in north-eastern Poland in the nineteenth century. They are still eaten in the Polesia region in northern Ukraine and made into a salad with cream, and it is probably this species that is listed as *Scirpus* spp. by Pieroni and Soukand (2018) (Łuczaj personal observation, unpubl. data). Throughout

the Polish Carpathians, the inner parts of young shoots of *Scirpus sylvaticus* L. are a well-known children's snack even today (Łuczaj 2004, 2008). *Typha* species are very common in Eastern Europe (Łuczaj and Köhler 2011), but the shoots and rhizomes were only occasionally used as famine food in north-eastern Poland (Pirożnikow 2010). *Typha* species stalks were, however, locally used for basket making, mainly in the Lublin area (e.g., near Opole Lubelskie), where a thriving community of *Typha* basket makers, who even provided exports to western European shops, existed until 1970. Now only a few people in the region know this skill, which has recently been revived by the Serfenta society (Łuczaj 2018).

In the nineteenth century, however, *Typha* species shoots were commonly eaten and appreciated on a large scale by Cossacks at the mouth of the Don River near the Azov Sea (Clarke 1817, 1848). The Loptuq (Loplik) people, a Turkic Mongol group living as fisher-foragers in the East Turkestan area (Hällzon et al. 2019), from the Lower Tarim River area (Xinjiang, China), consumed both *Phragmites* and *Typha* species. Reeds (*Phragmites australis*) provide construction material and fuel for the Loptuq, while its fresh shoots are eaten, and sugars extracted from the rhizomes. Southern cattail (*Thypha domingensis*) is also used in soups (stalks and spouts) by the Loptuq people.

The Yakuts (Sakha) people gathered the roots and rhizomes of some species (including *T. latifolia*) (Sieroszewski 1900) and after being dried and grilled (roasted in the fire) they were used to obtain flour for preparing food (Maurizio 1927). Similarly, Mongols collected the seeds of *Psammochloa villosa* (Trin.) Bor (syn.: *Arundo villosa* Trin.) and *Leymus racemosus* (Lam.) Tzvelev (syn.: *Elymus giganteus* Vahl) in large quantities for culinary purposes (Rockhill 1891). The gathering and consumption of the fruits and rhizomes of *Phragmites communis* (syn. *P. australis*), *Typha latifolia*, and other aquatic species were highly important to Romanian fishermen living in the Danube Delta (Antipa 1916) and the Hungarian Pákász people of the Great Hungarian Plain. The young shoots of *Typha* species and *P. australis* used to be consumed as a salad in the Sárköz region of Hungary, a tradition abandoned a long time ago (Dénes et al. 2012). The starchy (flour-containing) rhizomes were also used raw, boiled, and roasted (Gunda 1949). According to ethnographic data, Bulgarians do not positively view every type of soil (substrate). Some of them are perceived as "unclean" and people do not consume plants or fruits that grow in such places (i.e., graves, dumps, and places that are believed to be inhabited by strange mythical creatures). These mythical characters are associated with taboo foods for humans. Bulgarians allow these taboo foods to become part of their table only in exceptional situations, such as a great famine, devastating war, terrible epidemic, etc. (Marinov 2003; Markova 2011). Swamps and marshes are among the typical habitats of mythical creatures (Marinov 2003; Georgiev 2013), which is probably the reason why plants (and also animals) from such places have not been widely used for food in the past. This, then, explains the very scarce ethnographic data. The rhizomes of *Typha* species were used to make bread mixed with rye and wheat flour. The bread is dark in colour, sweet, and pleasant in taste. Other doughy meals made with milk were also prepared (Stojanov and Kitanov 1960). During times of famine, flour is made from the stems, in which the middle part of the stem is separated and dried, and then made into loaves (Popova 2017). The rhizomes are given to pigs for food instead of potatoes (Stojanov and Kitanov 1960). In the Caucasus, the rhizomes are eaten roasted, while the young stems are marinated and eaten as vegetables (Stojanov and Kitanov 1960). *Typha* species, however, appear in books (manuals) and on websites advocating the use of wild edible plants for survival during extreme conditions or as new edible plants for vegetarians and vegans, as well as in cookbooks that promote the use of wild plants for food (Dalev 2016).

Northern Europe

In Sweden, *P. australis* has seen wide use, especially to cover roofs, but also for making various tools, rugs, and music pipes, as well as to produce a dye. There is no ethnographic data on its use as human food (Svanberg 2011). However, modern foragers, scouts, and Swedish soldiers trained for survival situations use boiled rhizomes and rhizome shoots as food and drink the leftover water as it is sweet (Källman 1991, 1992). Rhizomes were also suggested as human food in handbooks published around World War II (Holmboe 1942). In Sweden, *T. angustifolia* and *T. latifolia* have both been used for various handicraft purposes (e.g., braided rugs, which are still popular for ornamental purposes) (Svanberg 2011). There are some early data that the starch-rich rhizomes of *T. angustifolia* could be dried and mixed with flour as emergency food. It was also used as fodder for cattle. Modern foragers, scouts, and Swedish soldiers trained for survival situations take out the white marrow in the lower part of the *Typha* species stalk and eat it raw or cooked (Källman 1991, 1992). Reedbed species used in Finland are similar to those in Sweden, most importantly as winter animal fodder, but also for various kinds of handicrafts, including simple musical instruments (Ikonen and Hagelberg, 2007). On the basis of ethnographic sources from the twentieth century and modern fieldwork data, children all over Estonia (especially in eastern and south-eastern regions) have snacked on the lower white part, and less often the rhizome at the end, of the stem of *S. lacustris*, as well as different rhizomes that are uprooted by storms on the shores of lakes or seas (presumably *P. australis*) (Sõukand and Kalle 2016; Kalle and Sõukand 2012, 2013a, b). In the

Baltic German literature of the nineteenth century, it was written that the rhizomes/shoots of *Typha* species could be used for salads or stews; and by the end of the twentieth century, making *Typha* species rhizome stew was also taught in books written in Estonian and promoted through various survival courses (including in the military). For the latter, some have started experimenting with making different foods, but no historical ethnographic evidence of the eating of rhizomes in dishes (or bread) has been found in Estonia (Kalle and Sõukand 2012, 2013a; Sõukand and Kalle 2016).

Discussion

There are common, worldwide recurrent uses of the studied graminoid plants, which historically bind human communities from Palaeolithic times to the present day. This involves the extensive multipurpose exploitation of large wetland graminoids (e.g., Appelt 1941; Kiviat and Hamilton 2001; Arenas and Scarpa 2003; Lim 2016; Lidström and Svanberg 2019), which incorporates a peculiar alimentary use (Svanberg and Ståhlberg 2020).

Today, we can observe modern uses that are not directly linked to uses of the past, but rather are related to new trends [i.e., military sector, survival skills enthusiasts, vegetarians/vegans, rural life enthusiasts, past tradition revivals, or wild plant/foraging lovers (Dalev 2016)]. In Poland, traditional knowledge and know-how regarding the use of *Typha* species has been declining since the 1970s due to socio-economic changes, and now only a few local communities in the region maintain this skill, which recently has been revived by the Serfenta society (Łuczaj 2018). In Italy (Villanova di Bagnacavallo), for example, a museum was created (*Ecomuseo Palustris*) to exhibit plants, tools and other cultural material related to marsh culture and to the marshy graminoid manufacturers that were active until the last century (https://ecomuseoerbepalustri.it/).

This allows us to better understand how the residual patches of traditional culture heritage and its legacies must be described and preserved, even with an applied view to increase human health and well-being, together with the biodiversity, resistance, resilience, and sustainability strategies for human society in a global change scenario. The problems that link the loss of biodiversity (environmental changes) and the loss of cultural diversity to environment quality degradation have not always been systematically investigated (especially among Western countries), even though this issue is increasingly considered of interest because of the multiple repercussions it has on quality of life and on bio–cultural heritage preservation (i.e., Cámara-Leret and Bascompte 2021).

In this study, a classic Hamletic doubt emerges as to whether local communities have maintained biodiversity by choice (necessity), or biodiversity has been maintained more unwittingly, because human pressure was not sufficient to transform everything. These hypotheses are not mutually exclusive, and therefore, if the human impact is not very strong and thus people and culture are in harmony, wetlands will be preserved until environmental conditions change or something changes in the local society to the point that people prefer to sacrifice the wetlands to obtain something else more coveted (local people *vs*. traditional culture). On the basis of our results, we can affirm that large wetland graminoid uses endure as long as the wetlands and the traditional societies that inhabit them continue to survive global changes (in particular, the reclamation of wetlands and socio-economic changes).

After the comparison with other areas in the literature, we can say, with a broader view, that apart from the transformations imposed by wars (foreign domination), we cannot exclude the fact that with the arrival of new graminoids and other more convenient (more nutritious, more palatable, more productive) food plants the appreciation for wetlands has faded over time and therefore local people have preferred to transform wetlands into arable land (after the Agriculture Revolution). Subsequently, the same land was then allocated for other increasingly economically convenient activities according to the period, until it became urbanized land for cities or industrial areas (after the Industrial Revolution). The sudden or gradual decrease in large graminoid uses is coincident in time with the loss of local names. This occurs even if plant formations increased in surface as confirmed by the literature analysis, even looking to the trends of reed bed formations names listed in Sect. 1.1. All this can only reflect a diminishing importance of wetlands, which now deserve thorough and comprehensive conservation policies to balance the problem of their management (new and traditional uses, heritage and human impact, conservation, restoration, rewilding, etc.), especially in territories strongly influenced by nature and centuries of human presence, as is Agro Peligno.

Food and eating habits are complex phenomena rooted in both biological and social responses that cannot be simply reduced to numbers or economic rewarding. Ethnographic research can be a valuable tool to provide ecological, conservation, public health and nutrition research with metadata, aiming to adapt interventions to fit diversified human environmental contexts. It may be the case that today large graminoids represent complementary feeding practices, but history tells us more about the intense use of different parts of these plants (storage organs like roots and tubers) later transformed into staple foods. The biological perspective behind the nutritional content of large graminoids is reflected in ethnographic uses and could provide insights into the policy sphere regarding vitamin and other macronutrient recommendations (e.g., vitamins A and C or minerals like calcium, magnesium, etc.).

The loss of food uses of the target wetland species has contributed to the problem raised by the FAO regarding the impoverishment of food biodiversity, and today only a few cultivated species represent the main source of nutrition globally, through a limited variability of compounds and products, which also reflects a food quality issue. The domestication and intensification of other graminoids, like cereals, with a much higher yield have reduced access to the broad range of plants needed for a healthy diet, based on local and sustainable sourcing. Corn is an interesting example because, unlike other neophytes or archaeophytes, it may have taken the past nutritional role of large wild graminoids, and it may even have taken their symbolic role as corn is also a large graminoid, like reeds. Corn crops are in some way the "new" reedbeds. Corn was introduced into Europe after the discovery of the Americas (1492) and as early as 1517 was painted in frescoes near Rome. Therefore, it has been known in central Italy since the Renaissance, although it might have only played a role in embellishing gardens with extravagant species; however, it is safe to say that it became popular in Europe after the seventeenth century (Tenaillon and Charcosset 2011).

The connection of the historical cultural heritage of reedbed food uses with the popular theory regarding the origin of the ancient pre-Roman population name of Pæligni, from *Pædilimnus* (at the foot/edge of a waterbody, i.e., lakes, marshes, swamps) and the words *Peline/Pelagos/Pelagus* (muddy), identifiable as meaning "the people who live at the edge/around/surrounded by wetlands", is very fascinating as there are numerous traditional cultural affinities linking these people to the perception, management and use of natural resources from wetlands and of waterbodies, from prehistory up to the modern age. Traces of the strong historical (cultural and spiritual) relationship with water in the Agro Peligno area are also confirmed by the widespread cult of Hercules and subsequently that of Saint Michael the Archangel (San Michele Arcangelo), who are typically related to water and wetlands, and the fact that the name Sulmona has been associated with water (Krahe 1949-1950; van Wonterghem 1984; Tuteri 1992). In the study area, many terms, phytonyms and toponyms related to water and wetlands (even when they have been reclaimed) are still widespread and commonly used.

In the Agro Peligno study area, the large number of local toponyms and phytonyms recalling wetland and its plants yields important information about human perceptions of their surroundings and their relationship with the environment, which can be seen as a historical path and a mental (cognitive) map of the history of the Peligni people. This corroborates the hypothesis that the ancient Peligni were the "people of wetlands". In the study area, changes in the perception of the study species are linked to environment and knowledge loss (global changes). The disappearance of ancient/traditional cultural heritage is reducing awareness (considered unimportant/negligible) of wetland graminoids, generating a negative perception of these species (namely weeds or rubbish), and consequently their coenoses becoming considered/perceived negatively (useless or as sign of feral vegetation and abandoned places that need to be tilled or cleaned up by this vegetation). In the remaining old tradition of Agro Peligno, graminoids are used directly as food (raw or cooked), but not processed for the extraction of starches or other food products. Processed product uses may have disappeared over time, following the arrival of more exploitable plants for carbohydrate content [e.g., wheat (*Triticum* species), barley (*Hordeum vulgare* L.), potato (*Solanum tuberosum* L. sl.), mais (*Zea mays* L.), sunroot (*Helianthus tuberosus* L.), etc.] that are typically cultivated in the study area. In this regard, until the 1950s, the sweet or leached semi-sweet acorns of various oak species were also used in the study area. Another remarkable difference is the lack of data on the use of *Glyceria* species, most likely due to the drastic decline of these species as a result of reclamation and land use effects (Conti 1998; Cianfaglione and Di Felice 2012; Cianfaglione 2014a). With the loss of this traditional culture and the related ecological knowledge, perceptions of these large graminoids and wetland habitats are changing, to the point of being considered useless or worse (i.e., as a weed). Similarly, the traditional culture of the Pákász people, which was linked to marshes and wetlands, declined in the nineteenth century when the wetlands of the Great Hungarian Plain were drained (Gunda 1949).

We are witnessing the final moments of the ancient Peligni culture, and the local traditional knowledge linked to these wetlands. Both the perceptions of wetlands and cognitive changes with respect to large graminoids correspond to the alienation of local people from their past as well as with their surrounding environment, chasing modernity (local people *vs.* their traditional culture). Modernity in the past was agriculture and pastoralism, but today it translates into an urban global society (even in mountain and countryside villages) that is increasingly disconnected from nature. This also applies to people who still are engaged in agricultural, forestry, pastoral, and environmentalist activities today. A cognitive distortion that in the last few years has also been driven, on the one hand, by a desire for unscrupulous economic growth and, on the other hand, by a misunderstood environmentalist sense or mistaken bucolic (rural and forestry) ideas that are often unrealistic, based on partial truths or false myths of the past.

We observe a paradoxical "modernization" process, which increases the quality of life on one hand, but which severs cultural roots on the other hand, causing the loss of knowledge and survival strategies, then the human resistance, sustainability, and resilience. This phenomenon has accelerated during the last 50 years and has become

far-reaching, taking place throughout Italy, from the post-war period to the present, which has been notoriously denounced by known humanists such as Alberto Moravia (*paradossi della borghesia*) and Pier Paolo Pasolini (*un'Italia ormai tutta imborghesita*) (see Inzerillo 2020). This dynamic is particularly advanced in "Western" countries, and it is expanding with greater or lesser intensity in various parts of the world as a manifestation of the changes due to globalization, economic-based growth, and the current consumerist development model.

The archaic residual food uses of large graminoids by the Peligni people seem limited when compared to the other examples from the literature, especially since the Peligni currently use fewer starchy plant portions (viz. stems, not rhizomes), except for those of *A. donax* (viz. the rhizomes buds). Given our knowledge from other contexts, this difference may indicate that in ancient times, these plants played a more important role, but they became secondary after the arrival of new food (exotic cultivated) plants which were preferred to wetland graminoids. Large graminoids have consequently become more and more accessory foraging plants, as supplementary or occasional food (snacks). However, young stems or sprouts are relatively easily digestible, and they can make an important dietary contribution not only in terms of carbohydrates, but also soluble fibres, mineral salts, proteins, other macronutrients, vitamins, and nutraceuticals, representing a good supplementary food source, in normal times or in the case of food shortages. The few local people who still harvest these large graminoids claim that their consumption is good for health, according to the traditional knowledge handed down from previous generations. This is one of the factors that drives them to still use this resource; other motivations are linked to the preservation of traditions and to personal eating habits.

Conclusion

Large graminoid uses endure as long as the wetlands and the traditional societies that inhabit them continue to survive global changes (in particular, the reclamation of wetlands and socio-economic changes). In this regard, Agro Peligno is an important site for Italy and on a larger scale for all of Europe as it represents a last relic of past great wetland complexes that is still linked with an important and long-standing human heritage. Here we can still find archaic food uses of wetlands species, although these uses are residual, this ancestral culture is in continual decline and the human impact on wetlands is constantly increasing (albeit with periodic high and low peaks). The decline of these archaic uses and ancient knowledge is attributable to the disappearance of wild wetlands (modification or reclamation) and to socio-economic changes, as confirmed by the various cases analysed from the literature. Our evidence for the long-lasting interrelatedness of the environment, human diet and human heritage provides a relevant perspective for future nutritional strategies, and for the improvement of wetland biodiversity and habitat conservation measures. It suggests that informed policies on environmental issues, nutrition and food security are linked aspects, and they are necessary for future food trajectories supported by biodiversity preservation, in accordance with the FAO (Biodiversity for Food and Agriculture issues), EU development and environment strategies (i.e., Birds, Habitats, Water, and Renewable Energy Directives; Natura 2000 network; etc.), Ramsar Convention, and ONU Agenda 2030. Long-acquired knowledge of vegetable resource exploitation might provide insights into the complexity of dietary practices. Interdisciplinary studies, such as this one, can help raise awareness about the connectedness of diversified research questions. This type of study could be useful for promoting thoughtful choices made by stakeholders and policymakers to make increasingly sustainable decisions for wellbeing and socio-economic development, as well as for cultural heritage, biodiversity and habitat conservation. A conscious and ethical rediscovery of ancient food knowledge, practices and perceptions within modern and innovative frameworks could represent a useful tool to study the phenomenon of rewilding, to the ecosystems restoration issues, to manage human impact: for safeguarding the environment, wetland bio-cultural diversity, and consequently improving the quality of life.

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Declarations

Conflicts of Interest/Competing Interests Authors declare any conflict of interests.

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