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The Persistence of Flavor: Past and Present Use of Wild Food Plants in Sierra Norte de Madrid, Spain

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Despite the increasing scientific and public interest in wild food plants, their traditional knowledge is undergoing a deep cultural erosion process at a global scale. The paper assesses past and present use of wild food plants in Sierra Norte de Madrid (Spain) in order to understand which are the main drivers of its evolution. We interviewed 132 informants and analyzed the cultural importance and present use of the following: (1) the human food use-category compared with all the other use-subcategories, (2) the food plant species, and (3) the human food use-subcategories (e.g., vegetables, fruits, condiments, or beverages). The useful wild flora included 252 plant species, of which 74 were traditionally used as human food, which is the most culturally important use-category. The most important species were three vegetables consumed cooked (*Scolymus hispanicus*, *Bryonia dioica*, and *Silene vulgaris*), other two greens that were eaten raw (*Rumex papillaris* and *Montia fontana*), a condiment (*Thymus zygis*), and a fruit (*Rubus ulmifolius*). Among food use-categories, vegetables was the category with a higher cultural importance index, but beverages and condiments had the lowest cultural erosion rate. We found several drivers of change in the use of wild food plants, some enhancing the trend of abandonment that affects differently certain uses and species, and others encouraging their maintenance. Factors that may explain the general erosion trend are linked to the abandonment of traditional agricultural practices and shepherding: (1) the decrease in the abundance and quality of wild food plants; (2) wild food plants are no longer necessary for subsistence; (3) the reduction of time spent in the countryside; and (4) the negative connotations of some species that are considered famine food. On the other hand, there are several motivations for gathering and using wild food plants: (1) gathering is seen as a leisure and community building activity; (2) the intense flavor of wild plants, which cannot be substituted by cultivated or commercial ones; (3) positive values associated with some species consumed as everyday food that are now considered delicatessen; and (4) the medicinal role of food, mainly food uses closer to medicine such as beverages and condiments.

Keywords: wild edible plants merge, traditional ecological knowledge, ethnobotany, cultural erosion ratio, cultural importance, traditional gastronomy, trends in wild food consumption

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INTRODUCTION

Traditional knowledge about wild plants is still important for ensuring food and nutritional security to many people around the globe, especially for poor and marginalized communities (Kaoma and Shackleton, 2015; Ong and Kim, 2017; Ulian et al., 2020). It is mainly orally transmitted from generation to generation (Mesa, 1996). This body of knowledge is dynamic, since the relationship between human beings and plants is a coevolution process based on a continuous interaction leading to adaptive responses to the environment (Berkes et al., 2000). In traditional societies, this interaction is intimate, since the management of plants is the key for survival in every realm of life: nutrition, medicine, animal care, fuel, handcraft, symbolic uses, etc. But what happens when a society evolves to be less dependent upon the immediate environment? When need is not central in the equation, which traditional uses of plants remain, and which are left behind?

The globalization process is affecting rural societies all over the world, making them more dependent on external inputs and disconnecting them from their local resources, such as wild plants or landraces (Jackson et al., 2007). In many western rural societies, such as some Romanian, Italian, or Spanish territories, this change has happened several decades ago (Rey Benayas et al., 2007; Pascual and Herrero, 2017; Gras et al., 2020; Kalle et al., 2020; Mattalia et al., 2020a,b). In Spain, the crisis of traditional agrarian society started in 1960, associated with the industrialization of agriculture production based on fossil fuels, chemicals, and mechanization (Naredo, 2004). Since then, rural societies all over the country have lost, to a greater or smaller extent, their dependence on the surrounding environment.

The cultural erosion process affecting traditional knowledge on wild edible plants has been detected all around Europe (i.e., Pardo-de-Santayana et al., 2005; Tardío et al., 2006; Łuczaj, 2008; Sõukand and Kalle, 2011; Turner et al., 2011; Łuczaj et al., 2012; Łuczaj and Pieroni, 2016). Also at a global level, the Millennium Ecosystem Assessment found a general decline in the gathering and consumption of wild edibles (MEA, 2005). Some reasons underlying traditional knowledge erosion on wild foods in Europe are rural exodus, industrialization of agriculture, and changes in lifestyles and ecosystems (Kalle and Sõukand, 2013; Łuczaj et al., 2013b; Abbet et al., 2014; Reyes-García et al., 2015; Pieroni and Sõukand, 2017; Blanco-Salas et al., 2019; Acosta-Naranjo et al., 2020).

However, this process is not homogenous, since some traditional uses are completely lost, while others remain, and even new uses become popular due to the influence of mass and social media or the migrant's customs. For instance, in Europe, many children's snacks such as *Trapa natans* L. fruits have been abandoned, while today, Asian migrants look for *Pteridium aquilinum* (L.) Kuhn fiddleheads in European woods (Łuczaj and Pieroni, 2016).

While most European authors have presented qualitative analysis of the cultural erosion and current trends affecting wild food plants, only few have used quantitative methods (e.g., Polo et al., 2009; Reyes-García et al., 2015; Menendez-Baceta et al., 2017). In this paper, we give a wider insight into the cultural erosion process considering the whole ethnobotanical culture of the region and situating wild food plants within it, merging quantitative and qualitative data of their past and present use.

The main objective of the paper is to evaluate the trends in wild food plants traditionally used in Sierra Norte de Madrid exploring which traditional wild plant uses persist despite cultural erosion and why. We hypothesize that there is a negative correlation between the cultural importance index (CI) and the erosion rate (ER), both for use-categories and wild food plants; i.e., the more culturally important a species or use-category is, the less abandoned its use is.

MATERIALS AND METHODS

Study Area

The study area is a mountainous region located in Central Spain, in the north of the province of Madrid (**Figure 1**). Its population is 18,428 inhabitants, living in 41 villages (INE, 2020). The region, with a surface of 1,261 km^2, includes a granitic mountain range rising up to 2,428 m, and several sedimentary valleys, being the lowest point around 600 m high. Climate in the area is considered continental Mediterranean, with a strong temperature variation between summer (mean maximum temperature 25.8°C) and winter (mean minimum temperature −1°C) and annual rainfall ranging from 600 to 1,000 mm with a dry period in the summer. In the lowest areas, we found holm oak forests [*Quercus ilex* subsp. *ballota* (Desf.) Samp.] and aromatic Mediterranean shrub flora. In the mountainside until 1,600 m high, the forests are mainly composed of *Quercus pyrenaica* Willd., whereas in the meadows and wetlands grow several species used as fodder and as herbal teas.

Local population has maintained a subsistence economy until the mid-twentieth century based on livestock farming, forest resources, and agriculture (Barrios et al., 1992; Aceituno-Mata, 2010). Generally, each family took care of a flock of sheep or goats, herd mainly in the communal lands, one or two cows or oxen for plowing, a donkey for carrying and transport, and pigs and chickens for household consumption. Traditional agriculture made the most of the poor mountain soils of the region, combining irrigated crops in the fields close to rivers and villages, and cereal cultivation in further lands, using the mountainsides for growing rye. The decline of traditional agricultural society in 1960 led to a migration flow to urban areas (Naredo, 2004). Nowadays, the most important economic activities are the service and construction sector. The livestock farmers remaining in the region no longer have sheep or goats but mainly beef cattle. The population remaining in the area maintained part of their traditional practices, such as gathering wild plants, home gardening, or chicken care. However, these traditions are barely transmitted to the younger generations, and nowadays, most of the knowledge and use of wild plants is at risk of disappearing (Aceituno-Mata, 2010).

Field Study

In order to describe and analyze the traditional use of wild plants, we selected a sample of the population that has lived in the area before 1960. This population group have experienced the transformation of traditional agricultural society that occurred in

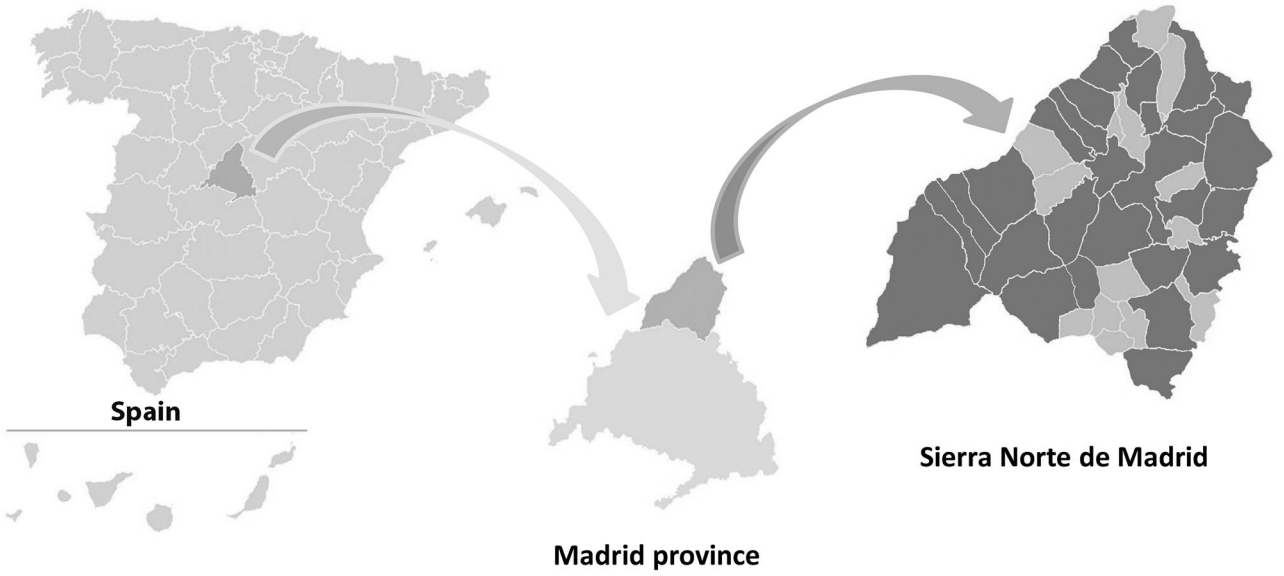

FIGURE 1 | Map of the study site showing the studied localities in dark gray (right map). Based on Aceituno-Mata et al. (2018).

this period, and hence, their testimony serves to track the changes in the use of wild food plants over the last century.

The method used to select the sample was snowball sampling (Bernard, 1994), contacting in the first place with elderly groups (local associations, adult schools, etc.) and asking them for more references of people to be interviewed about wild plants. To cover all the regional differences of Sierra Norte, fieldwork was carried out in 28 of the 42 villages of the area. Interviews were conducted between 2003 and 2007. The first author has been living in the area since the beginning of the fieldwork.

Several methods were used for data collection: consented semi-structured in-depth interviews, field interviews for collection of plant samples, and participant observation. When starting each interview, the informant was asked for free informed consent, following the ethnobiological code of ethics (International Society of Ethnobiology, 2006). We conducted in-depth interviews about all the use-categories with 64 informants. Afterwards, we interviewed other 68 informants only about wild food plants. In total, 132 informants were interviewed in-depth, with an average age of 68, being 50% of them woman. Sample size was defined by the law of diminishing returns. As the number of interviewed informant increases, the amount of new information obtained per interview drops (Martin, 1995). We considered the research complete when the new data registered were scarce and when it was not necessary to confirm the available data with more informants.

The main method used for data collection was semi-structured interviews. We asked about all the uses of wild plants (e.g., food, medicine, and ornament). Regarding the food uses, we asked for all food categories (e.g., vegetables, fruits, and condiments), the part consumed, the mode of consumption (processing technique and consumption context), the collecting time, and habitat. We considered a use-report (UR) the citation of a plant species by an informant for a specific use-category. For each UR, we recorded if it was traditional or a new trend and whether the informant still practiced it or not. We asked them for the reasons for abandonment or maintenance of the use, in order to assess the drivers of change in wild food consumption. Interviews were recorded under informant consent, and notes were taken in a field notebook.

The informants were also asked to perform a field interview for collecting plant specimens and for checking the botanical identification of the plants mentioned, going for a walk in the surroundings of the village. A total of 3,500 photographs and 927 herbarium specimens were collected. Botanical plant names follow *Flora Iberica* (Castroviejo, 2019) and The Plant List (2013) for the not included taxa. Family names are those accepted in APG IV (Chase et al., 2016).

The dataset, the herbarium, and the media files (recordings and photographs) are kept in the archive of the Food and Medicine Ethnobotany Research Group (Universidad Autónoma de Madrid).

During all the fieldwork, the first author lived in the region, which allowed her to participate in day-to-day activities and understand local culture from inside. Participant observation was a way to look at plants and their uses from the local point of view. During participant observation, casual interviews were also carried out.

Data Analysis

In order to evaluate the trends in wild food plants traditionally used in the area, we analyzed quantitative and qualitative data. We focused on quantitative data for assessing the cultural importance and present use of: (1) the food use-category compared with all the other use-categories (medicine, technology and craft, veterinary, etc.), (2) the human food plants species,

(3) the food use-subcategories (vegetables, fruits, beverages, etc.), and (4) the relation between food and medicine. We focused on qualitative data for exploring the relevance of: (1) gathering and changes in ecosystem management, (2) the food perceptions and motivations for gathering and consumption, and (3) the context and function of food.

The data collected in the interviews were recorded in a MS Access database. The information unit was the UR, as previously defined. The main use-categories were medicine, veterinary, human food, animal food, symbolic uses, technology and craft, fuel and ornamental uses. The food use-subcategories were vegetables, fruits, condiments and preservatives, beverages, and sweets (Tardío et al., 2006). The category vegetables includes the leaves, stems, sprouts, and unripe fruits or seeds, consumed raw directly after gathering, prepared in salads, or cooked. Fruits include the ripe fruits or seeds consumed raw in the field or taken home to process and/or store them (dried, cooked, prepared in jams, etc.). Condiments and preservatives contain all the plant parts used in small amounts to give flavor to food and conserve it. The beverages category is composed of the liqueurs and infusions taken in a food context (social drinks, and digestive teas taken as part of the meal) and not with medicinal purpose, as stated by the informants. Sweets refer to flowers, sap or other plant secretions, bulbs, tubers, or rhizomes consumed as refreshments due to their high carbohydrate content and usually with sweet flavor. Generally, the use of a species for a certain category was only accepted when it was cited at least by two informants, with the exception of the information given by specialists or key informants, who were very reliable and had a comprehensive knowledge about plants (Alexiades, 1996; Scarpa, 2000). When the information could not be clearly associated with a botanical species, it was rejected.

Measuring Cultural Importance

The CI index, formulated by Tardío and Pardo-de-Santayana (2008), was initially used to assess the cultural importance of each species (CI_s) within the corpus of traditional knowledge registered for the study area. This index was defined as the mean number of all the URs mentioned by all the informants (N) for that species in all the use-categories considered (NC) and expressed by the following formula:

$$CI_s = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} UR_{ui} \diagup N$$

However, adaptations of this index have also been used to assess the cultural importance of the botanical family or of the use-categories (Pardo-de-Santayana et al., 2007; Tardío and Pardo-de-Santayana, 2008; Aceituno-Mata, 2010; Menendez-Baceta et al., 2014). In the case of use-categories, we fix the variable use-category (u) and sum all the URs of all the species mentioned by the informants for that use-category (UR_{is}), dividing by the number of informants (N). Therefore, the cultural importance of the use-category can be represented by the following formula:

$$CI_u = \sum_{i=i_1}^{i_N} \sum_{s=s_1}^{s_{Ns}} UR_{is}/N$$

It can be defined as the mean number of URs that the informants of an ethnobotanical survey mentioned for a certain use-category.

Measuring Present Use and Cultural Erosion

For studying whether a certain species or category is still used or not, we have separated the URs in present or abandoned. Each UR included the information about whether it was still practiced by the informant or not, which allows showing the proportions of present or abandoned component of the CI and to calculate the ER.

Firstly, as the present URs are a fraction of the total URs, the CI of the species (CI_{total}) can be expressed as the sum of the cultural importance of the abandoned uses (CI_{aband}) and the importance of the present uses (CI_{pres}). The following formula can be applied for both species or food use-subcategories.

$$CI_{total} = CI_{aband} + CI_{pres}$$

This way, a graphical representation of the CI with its two components will show the degree of cultural erosion in each species or use-category. For instance, *Scolymus hispanicus* L., an important species that is still used had a CI_s of 0.29, that is, the sum of CI_{pres} (0.23) and the CI_{aband} (0.06).

Secondly, to better express numerically this loss of traditional knowledge, we have calculated the ER, which is the complementary percentage of the prevalence ratio (PR) defined in our previous works (Aceituno-Mata, 2010; Menendez-Baceta et al., 2014). As the CI, it can be calculated for each species (ER_s) and use-category (ER_u). This index, expressed as a percentage, is the relation between abandoned URs (UR_{aband}) and the total number of URs (UR_{total}), i.e., the sum of the abandoned and present URs, expressed with the following equations:

$$ER_s\,(\%) = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} URaband_{ui} * \frac{100}{URtotal_{ui}} = CI_{aband_{ui}} * 100/CI_{total_{ui}}$$

$$ER_u\,(\%) = \sum_{s=s_1}^{s_{Ns}} \sum_{i=i_1}^{i_N} URaband_{si} * \frac{100}{URtotal_{si}} = CI_{aband_{si}} * 100/CII_{total_{si}}$$

We considered a UR of a species as present (UR_{pres}) when the informants affirmed that they were still using the species (s) for a certain use-category (u) in the date of the interview. In the case of a use-category (u), we consider the present URs of all the species mentioned for this use-category. Following the same formula as ER_u, the ER was also calculated for the mode of consumption and the food contexts. It should be noted that the present use refers to the period 2003–2007, when the interviews were carried out. This index assesses the trends of ethnobotanical knowledge, as it shows how different plants or use-categories are being or not abandoned. For instance, *S. hispanicus* has a ER_s is 18%, since 31 of the total 38 UR are being still practiced. The ER has to be understood in the context of the number of UR, since a species with few citations may have an ER of 0%, but its use is very rare.

Qualitative Analysis

In order to understand the complexity of the cultural erosion process in wild food plants use, we have analyzed the discourse

of the informants in relation with their explanations about the abandonment or maintenance of wild food plants use. We have grouped the results around two main topics: (1) changes in ecosystem management and patterns of gathering and (2) the context and function of food, from preparation to consumption.

To analyze the changes in the ecosystem management, the habitats of the wild flora in Sierra Norte de Madrid were classified in eight groups: edges (path sides, stone walls, house surroundings, and plot boundaries), rainfed lands (formerly cultivated with dry-land crops and now neglected land), forests, meadows (meadows and pasture lands), home gardens (irrigated crops, maintained at present), wetlands (water spring, stream, and riverbank), shrublands (poor sandy land with shrub formations), and rock outcroppings (rock fissures or rock sides). In the analysis of the context and function of food, the past and present relevance of each food use in the diet was analyzed by following the food groups proposed by Turner and Davis (1993): (1) everyday food, (2) famine food, and (3) snack food.

In the vegetables, the context of consumption and the processing methods are analyzed by means of a Venn diagram, following Tardío (2010), establishing three main groups: (1) consumption raw in the countryside without preparation; (2) consumption raw in salads, so the plants are brought home to be prepared and dressed; and (3) consumption after being cooked.

Caveats

There are three main caveats that should be considered. Firstly, the sample excludes purposefully younger generations, and thus there is a potential bias of underestimation in the cultural erosion ratio. Secondly, the results cannot be generalized to the whole population of the region, since the sample was not randomly selected. As the sample includes the age range that has experienced traditional uses in the past, the cultural erosion is expected to be higher in younger generations. Thirdly, the field study was carried out between 2003 and 2007, and therefore, the erosion ratio is referred to that period, and following the trend, it has probably increased in the last years. Finally, the CI is a proxy for cultural importance; it mainly measures the commonness of use, which is related to cultural reasons but also has relation to multiple other reasons that may influence the use. In this study, we use the index to perform a quantitative analysis, but only the qualitative data capture the complexity of the cultural roles of food plants.

RESULTS

The Cultural Importance Index and Erosion Rate of Human Food Uses Compared With Other Use-Categories

The useful wild flora found in Sierra Norte included 252 species, 74 of which were traditionally used as edible. The wild food plants belong to 58 genera and 25 botanical families. The summarized data about all the use-categories are presented in **Table 1** ($N = 64$) and those about the human food use-subcategories in **Table 2** ($N = 132$). The complete ethnobotanical wild flora catalog is compiled in Aceituno-Mata (2010). All the food species and the description of their food uses (use-subcategory, part used, mode of consumption, and collection period) are presented as **Supplementary Material**. This table includes also the quantitative data (number of URs, CI, and erosion ratio of each species). **Figure 2** shows the CI of each use-category (CI_u) with its components of present (CI_{pres}) and abandoned (CI_{aband}) URs, also indicating their ER (ER_u).

According to the CI_u (**Figure 2**, **Table 1**), the most important use-category of wild plants was human food ($CI_u = 6.03$), followed by animal food (3.64), technology and craft (3.39), and medicine (3.31). However, according to the CI_{pres}, human food ($CI_{pres} = 3.53$) and medicine (1.74) are currently clearly the most important categories, followed by technology and craft (1.08), ornamental (0.53), and fuel (0.52), with animal food (0.21), toxic (0.06), and veterinary (0.03) being nearly residual categories.

Regarding cultural erosion, the overall ER (ER_s) for all the useful species is 62% considering all the use-categories (**Table 1**). However, in the human food category, the ER (ER_u) decreases to 41% ($N = 64$, **Table 1**), a rate that remains similar in the enlarged sample ($N = 132$) of interviews in relation with human food ($ER_u = 44\%$, **Table 2**). **Figure 2** shows that the cultural erosion process has affected differently each use-category: some traditional uses remain partially alive, whereas others are almost extinct. The highest ERs were found in veterinary ($ER_u = 98\%$) and animal food (94%), whereas the lowest were found in ornamental (33%), human food (41%), and medicine (47%). **Figure 2** also shows that the trends in the ER of the use-categories are not in line with the variation in the CI. For instance, the less abandoned category is ornamental use, one of the use-categories of wild plants with the lowest CI. The correlation between the two variables was calculated to test the initial hypothesis (negative correlation between CI and ER). We found a negative correlation between CI_u and ER_u, although very weak ($r = -0.29$) and not significant ($p = 0.445$). Therefore, the null hypothesis is accepted: the CI of a use-category is not related with which uses prevail and which are abandoned.

Cultural Importance Index and Erosion Rate of Wild Food Species

Figure 3 shows the 25 wild food species with the highest CI_s and the proportion of present and abandoned URs for each species. The most important species ($CI_s \geq 0.2$) were two vegetables consumed cooked (*Scolymus hispanicus*, $CI_s = 0.29$; *Bryonia dioica* Jacq., 0.29; and *Tamus communis* L., 0.20), other two greens that were eaten raw (*Rumex papillaris* Boiss. & Reut., 0.28; and *Montia fontana* L., 0.24), a fruit (*Rubus ulmifolius* Schott, 0.22), and a condiment (*Thymus zygis* L., 0.22).

The use of wild food plants is in force in more than half of the URs, since the total ER of this category (ER_u) is 44% (**Table 2**). However, this ratio varies greatly among the species, which is related to specific characteristics, such as the main food use-category of the plant, the way of processing, and the context of consumption of each species.

The species with the lowest ER are those consumed as beverages and condiments, i.e., *T. zygis* (ER_s 14%) or *Mentha pulegium* (16%). They are followed by vegetables consumed after

TABLE 1 | Summary of the results of the interviews ($N = 64$) about all the use-categories: number of use-reports, number of species, total and present cultural importance index, and erosion rate.

Use-categories	UR	N. species	CI_u	$CIpres_u$	ER_u
Human food	386	74	6.03	3.53	41%
Animal food	233	92	3.64	0.21	94%
Technology and craft	217	55	3.39	1.08	68%
Medicine	212	55	3.31	1.74	47%
Veterinary	84	34	1.31	0.03	98%
Symbolic	84	45	1.31	0.34	74%
Fuel	82	27	1.28	0.52	59%
Ornamental	51	31	0.80	0.53	33%
Toxic	26	12	0.41	0.06	85%
Overall results for all the useful species	1,375	252	21.48	8.04	62%

TABLE 2 | Summary of the results of the interviews ($N = 132$) about all the food use subcategories: number of use-reports, number of species, total and present cultural importance index, and erosion rate.

Food use subcategories	UR	N. species	CI_u	$CIpres_i$	ER_u
Vegetables	338	34	2.56	1.35	47%
Fruits	104	18	0.79	0.36	54%
Beverages	77	17	0.58	0.46	21%
Condiments	75	12	0.57	0.42	25%
Sweets	17	8	0.13	0.01	88%
Overall results for all the wild food plants	611	74	4.61	2.60	44%

being cooked, such as the asparagus of *Asparagus acutifolius* L. (ER_s 0%), the midribs of *S. hispanicus* (18%), or the young shoots of *B. dioica* (24%) and *T. communis* (26%). Other vegetables prepared in salads are still consumed as well, but less frequently, such as *M. fontana* (ER_s 34%) and *Rorippa nasturtium-aquaticum* (L.) Hayek (42%). On the contrary, among wild vegetables, the most abandoned are those that were consumed raw as a snack, directly in the field [*Armeria arenaria* (Pers.) Schult., 75%; *Malva sylvestris* L., 88%; or *Vicia lutea* L., 67%].

Figure 4 shows the wild vegetable species grouped according to their mode of processing and consumption and the ER of each group. There is a great variability in the ER among these groups: cooked vegetables have been abandoned only in 20% of the UR ($RU_{total} = 135$), while the consumption raw in salads was abandoned in 58% of the cases ($RU_{total} = 89$), and the vegetables eaten raw as a snack were no longer consumed in 70% of the URs ($RU_{total} = 99$). In Sierra Norte, the species used cooked are not the same as the ones consumed raw, with the exception of *Taraxacum* gr. *officinale*, which is consumed in the three modes considered.

The importance of preparation is not so clear among fruits, since there are opposite present trends among culturally relevant wild fruits, as can be seen in **Figure 3**. For instance, we find the neglected consumption of acorns (*Quercus ilex* subsp. *ballota*), which were consumed both cooked and raw. There are also scarcely used species such as *Crataegus monogyna* Jacq. and *Rosa* sp. pl., in which fruits were eaten raw in the countryside. Finally, there are species in which fruits are still frequently gathered and consumed, such as *R. ulmifolius*, *Rubus caesius* L., and *Prunus spinosa*, formerly eaten raw and now generally consumed after preparation.

We also found two new practices related with the preparation of fruits, which were incorporated after the 1970s and became very popular. Firstly, although it was common to eat the fruits of *P. spinosa* raw after the first frosts, to macerate them in alcohol as a liqueur was very rare, and only one informant mentioned to have prepared it in the past. However, in the 1980s, the sloe liqueur called *pacharán* became widespread in restaurants and cafes all around Spain. Thus, the local population of Sierra Norte, who already knew the fruit, started to make it more frequently. At present, in Sierra Norte, the use of raw sloes is extinct, but the gathering to make *pacharán* is very popular, both in middle-age people and in older generations.

The fruits of *Rubus* sp. pl. were also gathered as snacks, and they still are. Nevertheless, their use has become more intense due to the new tradition of elaborating jams, after sugar became cheaper in the 1960s and rural populations could afford to buy it in larger amounts. At present, it is common to find families gathering big amounts of blackberries to bring them home and make jam for all year round.

Despite the general erosion trend, during the economic crisis of 2008, we observed an increase in the cultivation of home gardens and the collection of wild edibles. The construction sector collapsed, and the unemployed population, mainly men, returned to their original subsistence economy, cultivating vegetables in the bare family lands and gathering wild food plants in their spare time to be able to continue providing food for the household. Twelve years later, the mobility restrictions

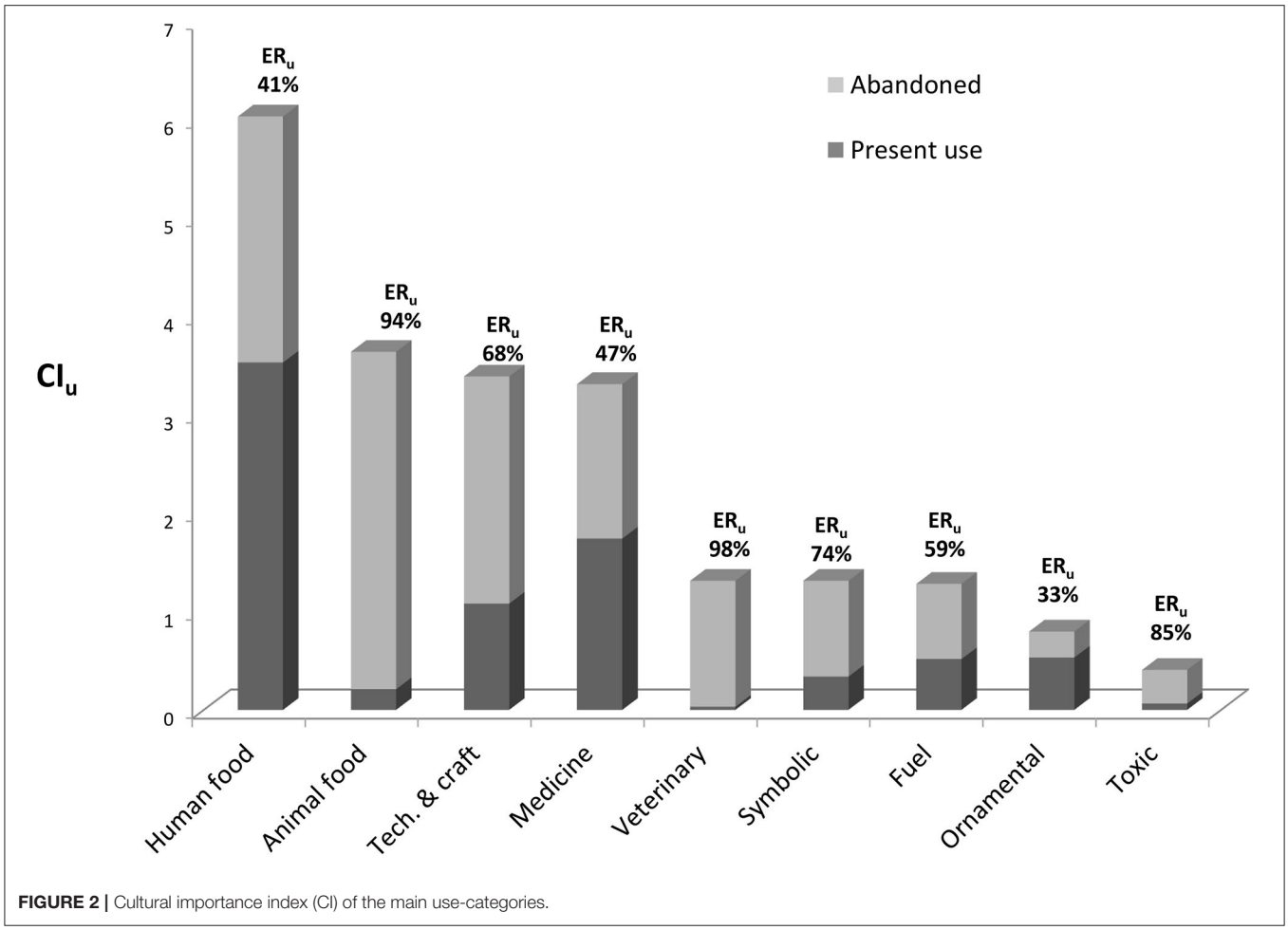

FIGURE 2 | Cultural importance index (CI) of the main use-categories.

established due to the coronavirus disease 2019 (COVID-19) have also stimulated the recovery of traditional activities such as gathering of plants and mushrooms in leisure walks, home gardening, or husbandry.

Trends in Wild Food Use-Subcategories

Results show that there are significant differences in the CI_u of the food use-categories (see **Figure 5** and **Table 2**). The most important food use-subcategory is vegetables ($CI_u = 2.56$), followed by fruits (0.79), beverages (0.58), condiments (0.57), and sweets (0.13). However, the ER_u does not follow this gradient: the subcategories with a lesser erosion are beverages (21%) and condiments (ER = 25%), followed by vegetables (47%) and fruits (54%), while the use of sweets is nearly abandoned (88%).

We tested the hypothesis of a negative correlation between CI_u and ER_u of the food use-categories and found out that the correlation was negative but very low (−0.22) and not significant ($p = 0.716$).

Relation Between Food and Medicine

In order to understand the differential erosion process among use-categories, we explored the relation between human food and medicine. As shown in **Table 3**, in Sierra Norte de Madrid, there is a high coincidence of wild species used both in human food and medicine. There are 21 species used both as food and as medicine, representing 40% of the medicinal plants and 28% of the food plants. Among these shared species, 15 are used in remedies administered orally, so the active compounds are supplied in the same way as in the food context. The plant part used is the same in 11 species, in all the cases the inflorescences. Comparing the ER_s of the species in **Table 3**, the plants in which inflorescences are administered orally in medicine and are also consumed as condiments or to make beverages have a mean ER_s of 25%, while the other species have a mean ER of 48%.

Changes in Ecosystem Management and Patterns of Gathering

Wild food plants were traditionally gathered in certain habitats more than others. **Figure 6** shows the percentage of UR associated with each habitat, and the **Supplementary Material** describes the habitat where each species is gathered. Edges (34%), forests (19%), and rainfed lands (14%) were the habitats that included most UR.

However, as ecosystem management has changed drastically in the past 60 years, the landscape and its habitats have been

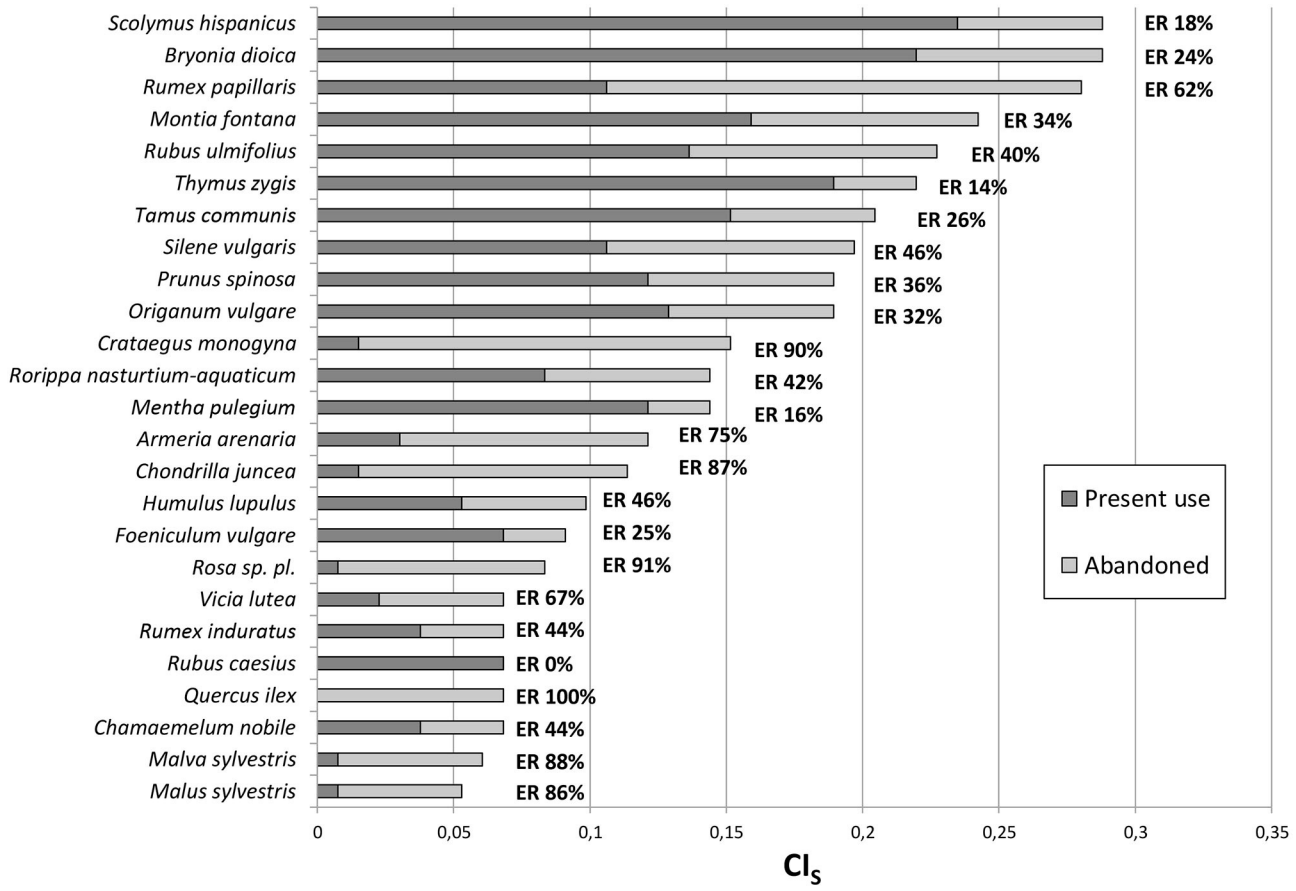

FIGURE 3 | Cultural importance index (CI) and erosion rate (ER) of the 25 wild food species with the highest CI in Sierra Norte de Madrid.

reshaped. The abandonment of most of the agrarian activities and the exodus to the cities have left neglected rainfed land and edges unattended. Home gardens were maintained by the families who stayed in the area, but the plots of the settlers who moved to the cities were abandoned or reduced, because they were left as a leisure weekend activity. Moreover, wet habitats are less abundant and are lost among the thicket, since there are less flocks grazing around and thinning out the shrubs. Besides, the herding activities are less intense, which included cleaning the water springs, fountains, and water basins. On the contrary, shrublands are more abundant, since they have occupied part of the neglected pasturelands and formerly cultivated rainfed land. Furthermore, the forests have increased their area, due to the reduction of cattle grazing but also because pine plantations were carried out in the 1970s to reduce erosion in slopes, thus avoiding the silting of the reservoirs constructed in that period.

Based on the informants' perception, this transformation process has affected the abundance and quality of food plants in each habitat, being rainfed lands the most affected habitat, since cereal cultivation has completely disappeared. All the wild food species that appeared as weeds in the cereal plots, such as *Chondrilla juncea* L., *Cichorium intybus*, *R. papillaris*, *S. hispanicus*, *Silene vulgaris*, or *V. lutea*, have suffered a similar trend. Since cereals are no longer cultivated in the region, these species are less prevalent, both in the fields and in the dishes. Informants stated that not only the abundance but also the quality of the food plants has been affected by the changes in ecosystem management, leading to a drastic reduction of the use. This trend seems to have affected more acutely some species. For instance, *sonjera* (*C. juncea*), eaten raw in salads, was a very popular wild vegetable in the past and has a very low present use. The informants connected the sharp decrease in the use of the plant with the abandonment of traditional plowing, which led to the disappearance of the habitat and the worsening of its taste and texture. As an elder woman stated: "Now it does not grow so often because the land is not plowed anymore, and when it grows it is not so tender." The traditional plowing created a perfect habitat for the plant and buried the sprouts, which contributed to the whitening of the stems and first leaves and made them more tender and less bitter. Another example is *acedera* (*R. papillaris*), which used to appear as a weed in the wheat crops, and "when it grew in the wheat it was less acid than the ones growing in the meadows now" (67-year-old woman).

Other cultivated areas have also suffered deep changes. Home gardens' total surface has been reduced, and the food plants weeded are mainly left for chickens (e.g., *C. intybus*, *T. officinale*,

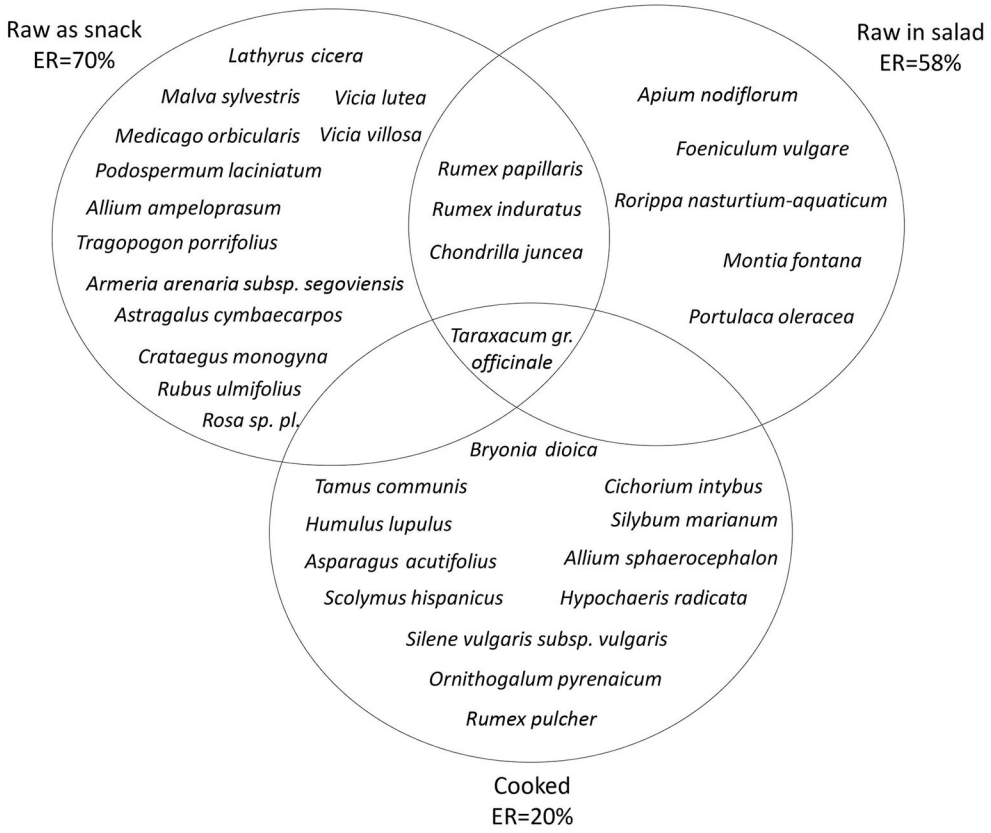

FIGURE 4 | Wild vegetable species consumed in each mode of consumption and their overlaps. The erosion rate (ER) of each group is presented next to the name.

and *R. papillaris*). Edges have also suffered from the dominance of shrubs and the reduction of herbaceous plants presence due to management lessening in path sides, plot boundaries, and stone walls. On the contrary, plants gathered in shrublands or rock outcroppings have not suffered deep changes, since the plants growing in these habitats do not undergo grazing and thus are more abundant.

Apart from the landscape changes, the gathering patterns have changed as well due to the socioeconomic transformation. As mentioned above, until the 1970s, many plants were gathered while weeding, but also when going to the fountain for water [*Apium nodiflorum* (L.) Lag., *M. fontana*, and *R. nasturtium-aquaticum*] or collected as refreshments while herding the cattle (*Echium vulgare* L., *Rubus* sp. pl., *Rumex induratus* Boiss. & Reut., and *Vicia* sp. pl.). However, since the abandonment of the agrarian traditional economy in the 1970s, the frequency and patterns of gathering have changed. Nowadays, the agrarian tasks of most people are reduced to taking care of home gardens and chickens, which are considered as a hobby, since most local people do not depend on them for their subsistence.

Context and Function of Food: From Preparation to Consumption

Besides analyzing plants by the type of food they represent (vegetables, fruit, etc.), we considered it necessary to understand their context and function. Therefore, each plant use has been assigned to three food contexts following Turner and Davis (1993): everyday food, famine food, and snack food (see **Supplementary Material**). Calculating the mean ER of each food context, we found that everyday food has an ER of 28%, while snack food rises up to 65% and famine food to 89%. In this section, we present some examples of each food context and function.

Everyday Food

Forty species were used as staple food, including the wild food plants with the highest CI values. They were culturally important in the past and consumed frequently in the periods when they were available. At present, they are still consumed, but only occasionally. Some examples are *S. hispanicus*, *S. vulgaris*, *B. dioica*, *T. communis*, *M. fontana*, or *R. nasturtium-aquaticum*. Wild vegetables included in this group are species with some kind of preparation, being cooked or prepared in salads. As what happens in other Spanish regions, bitter herbs, like *T. communis* or *A. acutifolius*, are generally cooked to improve their taste and texture. However, other species are consumed raw (e.g., *M. fontana* and *R. nasturtium-aquaticum*), because they are so tender and low in fiber that they fall apart if cooked. Condiments and beverages with strong flavors such as *T. zygis* or *Chamaemelum nobile* are also included in this group.

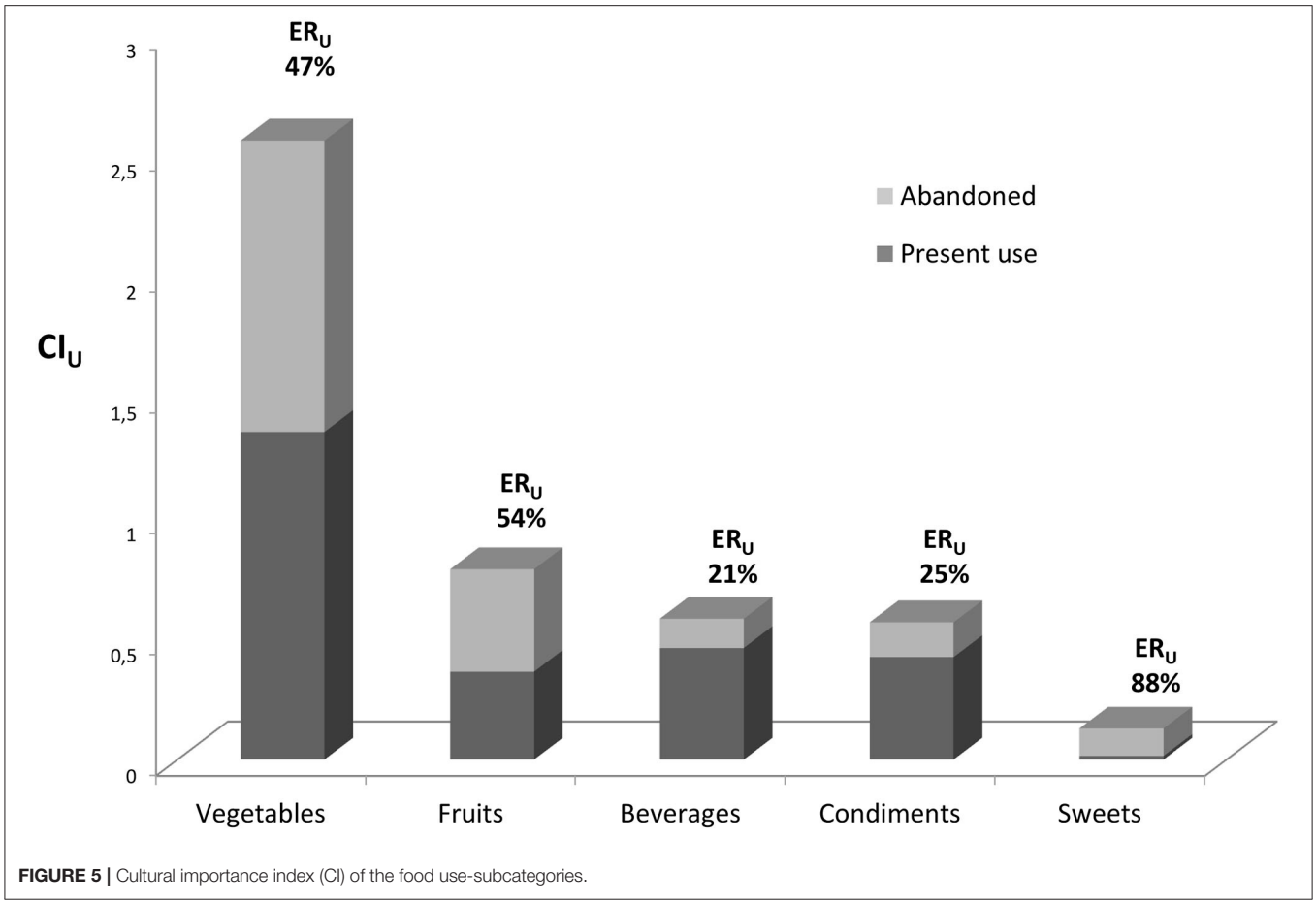

FIGURE 5 | Cultural importance index (CI) of the food use-subcategories.

The consumption of the wild vegetables in this group was associated in the past to a seasonal period of scarcity in spring, which was not a famine period but a predictable food shortage because it repeated every year. In Sierra Norte de Madrid, a mountainous region with a marked continental climate, from March to June, the cultivated vegetables were in short supply. In this period, the reserves of stored food were dwindled by the winter. However, from middle of March until the end of May, wild vegetables were abundant, and thus people gathered them to complete the diet.

Famine Food

This group includes 13 species that were commonly used in the past, but their use has been completely abandoned nowadays. They include *Q. ilex* subsp. *ballota* acorns, *Malus sylvestris* (L.) Mill. fruits (wild apples), and some wild vegetables consumed mostly raw (*Portulaca oleracea*, *T.* gr. *officinale*) or cooked (*Hypochaeris radicata*, *C. intybus*, or *Silybum marianum*). Acorns were widely considered a famine food by informants. In the post-war period (1940s), holm oak trees producing sweet acorns were selectively harvested for human consumption, while the bitter ones were left for pigs. They were consumed raw (after drying or smashing them), boiled, or roasted. There were also some plants used just in occasional circumstances of scarcity, such as the condiments used by the shepherds when they stay in the mountain with their flock, like *Lavandula pedunculata*, *Allium ampeloprasum*, or *Allium sphaerocephalon*.

Snack Food

Wild snacks include the use of 37 species of vegetables, fruits, and sweets consumed raw just after being collected and between main meals. People used to eat them when they were found in their way, especially in spring, as the immature seeds of some species of the legume family (*Vicia lutea* L., *Vicia villosa* Roth, *Astragalus cymbaecarpos* Brot., and *Lathyrus cicera* L.) or the immature fruits of *M. sylvestris*. Some stems were eaten as a snack, selecting the more tender part in the case of *Podospermum laciniatum* (L.) DC or *Tragopogon porrifolius* L. or after being peeled in the case of the sprouts of thorny plants (*Rubus* sp. pl., *Rosa* sp. pl. and *C. monogyna*). Other tender stems were just chewed, such as *A. arenaria* and *Stipa gigantea* Link, extracting the sugars and water present in the stem and not swallowing the indigestible fibers. Moreover, the flowers of certain species were collected and their nectar is sucked, picking them one by one without damaging the plant, such as *Trifolium pratense* L., *Viola odorata* L., *Pedicularis schizocalyx* (Lange) Steininger, or *E. vulgare*. These plant parts that were chewed or sucked usually were left in the lips or mouth for a long time, "in order to have something in the mouth." In autumn, the mature fruits of *C. monogyna*, *Sorbus torminalis* (L.) Crantz, and *Sorbus aria* (L.) Crantz were consumed as a snack but

TABLE 3 | Species used both in the categories of medicine and human food in Sierra Norte de Madrid.

Scientific name	ER_S (%)	Medicinal internal use (oral administration)	Plant part used in medicine	Plant part used as food and use-category[†]
Bryonia dioica	10		Fruits	Tender shoots (VEG)
*Chamaemelum nobile**	44	•	Inflorescences	Inflorescences (BEV)
*Chiliadenus glutinosus**	20	•	Inflorescences	Inflorescences (BEV)
Cistus ladanifer	50		Leaves	Seeds (FRU)
Foeniculum vulgare	25	•	Seeds	Tender stems and leaves (SEA,VEG), seeds (BEV)
*Inula salicina**	100	•	Inflorescences	Inflorescences (BEV)
*Jasonia tuberosa**	0	•	Inflorescences	Inflorescences (BEV)
Malva sylvestris	87	•	Flowers and leaves	Unripe fruits (VEG)
*Mentha arvensis**	0	•	Inflorescences	Inflorescences (BEV)
*Mentha pulegium**	16	•	Inflorescences	Inflorescences (BEV)
*Origanum vulgare**	32	•	Inflorescences	Inflorescences (SEA, BEV)
*Rosmarinus officinalis**	0	•	Inflorescences	Inflorescences (SEA)
Rubus ulmifolius	40		Leaves	Fruits (FRU) and tender stems (VEG)
Scolymus hispanicus	18	•	Inflorescences	Leaf stalk and midrib (VEG)
Silybum marianum	0	•	Inflorescences	Leaf stalk and midrib (VEG)
Tamus communis	26		Fruits	Young shoots (VEG)
*Thymus mastichina**	50	•	Inflorescences	Inflorescences (SEA)
*Thymus vulgaris**	0	•	Inflorescences	Inflorescences (SEA, BEV)
*Thymus zygis**	14	•	Inflorescences	Inflorescences (SEA, BEV)
Tragopogon porrifolius	100		Latex	Tender inflorescence stem (VEG)
Trifolium pratense	100		Leaves	Flowers (SWE)

In the species marked with an, the same plant part is used as medicine and food.*
[†] *Human food use-categories: vegetables (VEG), fruits (FRU), seasonings (SEA), beverages (BEV), and sweets (SWE).*

were not gathered in great amounts or not even carried home to store, since *C. monogyna* fruits were not highly valued and *Sorbus* are rare in the region. Another plant parts were also consumed as snack in autumn and winter, such as the "bulbs" (corms) of *Crocus carpetanus* Boiss. & Reut. and *Crocus serotinus* Salisb., or the gum of *Erica arborea* L.

However, there are some vegetables eaten as snacks, which were also consumed at home after elaboration, like the leaves of *R. papillaris* and *Rumex acetosa* L., and thus its use is not completely abandoned. Moreover, some fruits, namely, *Rubus* sp. pl. blackberries and *P. spinosa*, were formerly eaten only as snacks and at present have become very popular due to new trends in food elaboration and consumption.

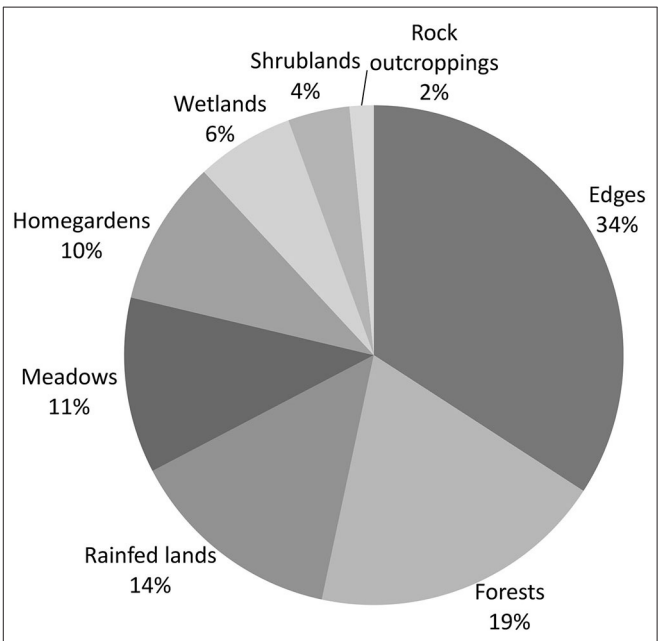

FIGURE 6 | Percentage of use-reports related to the habitat where wild food species grow in Sierra Norte de Madrid.

DISCUSSION

The high ER of plant uses evidences that in the study region there is a clear cultural erosion process. However, this process does not affect evenly all the use-categories and species. Wild plants still have a role in human food, medicine, and ornamental uses, while in other use-categories, they have been substituted at a greater extent by modern commodities.

As shown in *The Cultural Importance Index and Erosion Rate of Human Food Uses Compared With Other Use-Categories*, food plants are the core of the wild vegetal culture of the region, since they were the most important use-category in traditional society, and their use has remained despite the deep socioeconomic changes that occurred. As observed by other authors, the knowledge about wild edible plants is more likely to be maintained under cultural change than other use-categories, since it is intermingled with the local cuisine, traditional flavors,

and social events (Pieroni et al., 2002b; Ertug, 2003; Nebel et al., 2006).

The study also indicates that the maintenance of certain uses at present is not correlated with the CI, which measures their use in the past. Then, what factors can explain the differences in the cultural erosion process among use-categories and plant species? The culture has changed, and new needs and values drive the collection and use of wild plants. Moreover, the landscape has been reshaped by the socioeconomic changes that occurred in the last decades. The reasons underlying the diet changes are complex, including cumulative effects of cultural, socioeconomic, and environmental factors (Turner and Turner, 2008). Following previous research (Kalle and Sõukand, 2013; Łuczaj et al., 2013b; Reyes-García et al., 2015; Pieroni and Sõukand, 2017), the informant's perceptions, and our own interpretations, we proposed several drivers of change in the use of wild food plants with opposite effects: some enhance the trend of abandonment in certain uses and species, while others encourage their maintenance.

Decrease in Abundance and Perceived Quality of Wild Food Plants Due to Changes in Ecosystem Management

The abandonment of traditional agrarian practices has affected the abundance and quality of the wild food plants in Sierra Norte de Madrid, as evidenced by the informants' quotations presented in the section Results. The decrease in the abundance of edible weeds due to changes in agriculture and gardening practices has also been documented in other regions of Spain and Europe (Polo et al., 2009; Łuczaj et al., 2012). An example in the study region is *acedera* (*Rumex papillaris*), a species that has shown important changes in its productivity, as an informant stated: "the *acederas* were larger when we grew them in the wheat crops, with a lot of good soil" (69-year-old woman). The expression "we grew" used for a wild plant that appeared spontaneously is noteworthy, reflecting the local view of edible weeds as semi-domesticated plants. As has been argued by many authors, wild food plants may have several stages of domestication along a continuum ranging from entirely wild to semi-domesticated (Harris, 1989; Bye, 1993; Heywood, 1999; Bharucha and Pretty, 2010). Wild food plants in traditional agrarian societies were favored by human activities, since the cultivation created disturbed habitats ideal for their growth, increasing their productivity and improving their quality for human consumption. In traditional agriculture, weeds were not just undesirable invaders but also resources used as food, fodder, or fiber (Turner et al., 2011).

As shown in the case of *sonjera* (*Chondrilla juncea*), several informants expressed their preference for wild food plants gathered in habitats disturbed by human activities, as plowed or fallow lands, because they were more palatable. Nowadays, the semi-domestication process is reversed, and thus, the plants have returned to their sharp flavors and textures. On the contrary, human palates are more domesticated, getting less used to wild flavors. Nowadays, human beings are coevolving less intensively with plants, and therefore, the intermediate positions of semi-domesticated plants and semi-wild palates are moving away.

At present, the quality and availability of wild edibles depend on the encouragement of the synergy between farming and wild biodiversity (Pretty, 2007), i.e., through organic farming practices that tend to increase the biodiversity of weeds (Turner et al., 2011) or the organic cultivation of highly valued wild food species (Molina et al., 2014).

Changes in the Motivations for Gathering and Consumption

In the study region, before 1970 wild food plants were collected as a subsistence activity, since food plants complemented the familiar economy based mainly on local resources. At present, informants told us that they spend less time out in the country than in former times, and wild food plants are collected in leisure walks. This trend was also documented in other regions of Spain (Tardío et al., 2006) and Europe (Łuczaj and Pieroni, 2016), affecting all generations but especially children, who used to help herding, an activity associated with the acquisition and maintenance of traditional ecological knowledge. Regarding motivations, many informants stated that the gathering and consumption of wild food plants was a way of recalling the ancient flavors and maintaining the traditions that bring together the families and the community. Nowadays, the gathering of wild plants is no longer motivated by necessity but by pleasure and identity.

The use of wild plants binds together the community in several ways. In many cases, the collection is a social activity, carried out during the evening walks, when the female relatives or neighbors meet to go across the surroundings of the villages. In other cases, especially when men are the collectors, the gathering is performed alone, but the harvest is usually shared with relatives or friends as part of the gift economy that still rules in rural societies (Acosta-Naranjo et al., 2020). As an informant in his 50's explained: "I like going to collect wild asparagus, even if i do not find any. When I find some, I bring them to my mother, and she prepares them with lard and scrambled eggs, as when I was a kid." Eating wild food plants is closely related with memories, values, and perceptions, as we will discuss in the next section.

The Values and Perceptions of Wild Food Plants

The perceptions of wild food plants are important to determine the maintenance of the use or its abandonment. In this section, we discuss how the appreciation of certain flavors and the values associated with each food context influence the degree of cultural erosion of plant uses, and ultimately contribute to the creation of cultural identity.

The Persistence of Flavor

The unique taste of wild food plants is a key factor for the maintenance of the use, as stated by our informants and pointed by several authors (Pieroni et al., 2002b; Serrasolses et al., 2016). However, the acceptance and appreciation of the flavor of wild plants need a previous education of the palate. Bitterness, a taste very frequent in wild vegetables, is the gustatory response that is first rejected (Harborne, 1993), since this flavor is related with the presence of toxic compounds. However, one can get used to

deriving pleasure for bitter food, especially in early childhood. As stated by Johns (1996), in the weaning process, human beings lose the neophobia characteristic of our eating habits, and for a short period, we are open to all the new flavors offered to us. If in this period children learn to appreciate bitter taste, this gustatory experience is fixed lifelong. The gustatory memory of people that have eaten wild food plants in their childhood made them recall these strong flavors and motivate them to keep them in their diet, even if only present occasionally and in small amounts. Moreover, other authors have argued that the exploratory nature of children may have been a source of introduction of new plants in the diet (Łuczaj and Kujawska, 2012; Łuczaj and Pieroni, 2016). However, some elder informants stated that their grandchildren rejected wild flavors because they had been pampered by being offered only sweets and pasta. When children stop eating wild plants, not only traditional knowledge is lost but also the gustatory memory maintained through generations is impoverished.

Finally, wild plants are part of traditional recipes that, once in the mouth, restore the memory of a completely lost world, such as the Proust madeleine. In the interviews, it was frequent that the informants expressed a longing for the flavors of their childhood. Even if the taste of wild plants is stronger and sometimes bitter than cultivated vegetables, it is preferred and highly valued. A retired shepherd said: "some weeds, their flavor … you do not know why, but are pleasing to the palate." A home gardener in his 60's affirmed that for him the *Asparagus acutifolius* omelet is tastier than that made with cultivated *Asparagus* ones. This preference for wild flavors is marked in the case of plants used as condiments and beverages, such as *Thymys zygis* or *Chamaemelum nobile*, still gathered and consumed at present due to their intense flavor, which cannot be easily substituted by cultivated or commercial plants.

Values Associated With the Food Context

Results show that degree of cultural erosion is very different depending on whether a wild food plant has been consumed as everyday food, as a snack, or as famine food.

Everyday foods include the most valued wild food plants, appreciated for their flavor, texture, and nutritional quality. The species in this group have been part of the diet both in times of scarcity and in abundance periods. They include vegetables such as *A. acutifolius* L., *Scolymus hispanicus*, *Montia fontana*, or *Rorippa nasturtium-aquaticum*, nowadays, considered as delicatessen (Reyes-García et al., 2015). Their consumption requires some types of preparation and are cooked in stews, soups, omelets, grilled, or dressed in salads. Most species in this group are still gathered at present, not as everyday food but as an occasional meal, prepared following the traditional recipes.

Famine wild food plants are the less valued, only consumed when there is a necessity, in famine periods due to wars or bad harvests; and their use is mainly abandoned. As in other regions of Spain (Tardío et al., 2006; Menendez-Baceta et al., 2012), acorns are the most emblematic example of this category. They were highly important in the past but are now completely abandoned. In Sierra Norte, in the post-war period, holm oak trees producing sweet acorns were selectively harvested for human consumption, while the bitter ones were left for pigs. Acorns were the only wild food gathered for trade between villages: the mountain dwellers exchanged sweet acorns for chickpeas with the villages of the plain (one cup of chickpeas for two cups of acorns). They were so valuable in those periods that the villages with more abundance of sweet acorns suffered the visit of neighboring villagers who steal them at night. Famine foods include bitter, rough-texture herbs like *Hypochaeris radicata* L. or *Cichorium intybus* L. that need repeated boiling and eliminating the cooking water to improve their taste or texture to make them palatable (Tardío, 2010).

The use of these plants is associated with poverty, and therefore, there is a negative cultural connotation linked to its food use (Aceituno-Mata, 2010; Łuczaj, 2010; Menendez-Baceta et al., 2012). For some informants, it was a taboo to recognize that they have consumed these wild foods in the past, while others associated them with fodder rather than human food, saying, "this is pig food." However, these wild foods have been of crucial importance for survival in critical periods (Łuczaj and Pieroni, 2016). According to Johns (1994), the maintenance of the occasional use of famine plants, despite that they are not preferred, allows to preserve a knowledge that could be necessary in times of scarcity. Nowadays, the use of these species is completely abandoned, and the memory of their use is only kept by the older generations.

Finally, snack foods provide small amounts of nutrients, mainly sugar and vitamins, but have had a relevant role as thirst quenchers and refreshments for shepherds and children while herding the sheep's and goats' flocks or looking after the pigs, as also have been documented in other Mediterranean regions (Łuczaj et al., 2013a; Mattalia et al., 2020b). The use of these species is associated with an extinct way of life, when shepherds and children spent long periods of time out in the countryside and ate wild plants to stave off the hunger or just to entertain themselves. As several authors have argued, children (Łuczaj and Kujawska, 2012; Kalle and Sõukand, 2013) and shepherds (Mattalia et al., 2020b) have a wild food flora of their own, since the way they interact with nature shares some aspects with the hunter-gatherers, who wander around looking for something to eat for hours. As a female informant in her 70's told us: "when we were children we were always out in the country, with the cows, the sheep, the pigs. The day was too long, and we spent time looking for what we could find around." At present, these wild snacks are mostly abandoned or only occasionally consumed "to recall former times."

Ultimately, the maintenance or abandonment of plant uses is related with the construction of cultural identity. Some plant uses are rejected because they are a reminder of the harder experiences associated with the peasant life, such as famine, child labor, or harsh life conditions. On the contrary, other uses are associated with the remembrance of "real" meals, community life, and close contact with nature, and thus, their persistence binds the present society with the positive aspects of its origins.

Medicinal Role of Wild Foods

From the perspective of ecological chemistry, there is a gradient in the way the toxic secondary compounds of plants are managed, from poisons to food (Johns, 1996). Considering this continuum from medicine to food, on the one hand, there are plants administered with therapeutic aims occasionally and in small doses and, on the other hand, plants consumed in great amounts and frequently in a food context. In the middle of the medicine–food continuum, we find condiments and beverages (Johns, 1996), with condiments being closer to medicine since their dosage is low.

In Sierra Norte, the less abandoned food subcategories are beverages and condiments. Therefore, we argue that the intermediate role that these two categories have in the medicine–food continuum has favored the maintenance of their use. The marked cultural appreciation for the intense flavor of the plants used as condiments or beverages, like species belonging to the Lamiaceae and Asteraceae families, may be based on the importance that these plants have for health and nutrition. These flavors were repeatedly associated by informants with "good," "body cleansing," or "healthful" properties. Moreover, several testimonies stated that the intensity of flavor (i.e., secondary compounds) in wild food plants cannot be easily substituted by cultivated or commercial plants, which has motivated the maintenance of the gathering and use of wild species. On the other hand, it is easy to supply a household with wild plants for condiments and beverages, since the amount required yearlong is small. However, eating wild vegetables or fruits at a regular basis requires a higher effort in collection and processing.

The food subcategory that follows condiments and beverages with a lower ER is vegetables, which is the most culturally important. The prominence of vegetables among wild food plants agrees with the findings of an ethnobotanical review of traditional wild food plants in Spain (Tardío et al., 2006), where vegetables were the subcategory with the highest number of species and UR. The people of the study region can be considered to have a "herbophilic" culture (Łuczaj, 2008, 2010; Aceituno-Mata, 2010), who highly appreciate wild vegetables and continue consuming them even when there is no shortage of cultivated food. The appreciation for wild greens has also health connotations, since their bitter taste is associated with plants that stimulate appetite, "depurate blood," or act as liver and stomach tonic, as has been documented in other Mediterranean regions (Ertug, 1998; Pieroni et al., 2002b; Vallès et al., 2017).

The traditional culture in Sierra Norte de Madrid was centered in stockbreeding and subsistence agriculture. As in many other traditional agrarian cultures, there is a long history of consuming wild foods, including game and wild edible plants. As some authors have argued, the maintenance of small doses of wilderness in the agrarian cultures' diet has had a therapeutic effect, since the content of secondary compounds is higher in wild plants (Etkin, 1996), and they have a prophylactic effect (Johns, 1996), especially necessary in diets based on carbohydrates, meat, and cultivated vegetables. In the Mediterranean area, studies on the nutritional value of wild vegetables found out that these species could contribute significantly with interesting micronutrients (i.e., minerals, vitamins E and C, carotenoids, and α-linolenic acid) that could improve health. The antioxidant effects of some of these substances could act as preventives of coronary illnesses, hypertension, cancer, and immune system deficiencies (Guil et al., 1997; Bianco et al., 1998; Pieroni et al., 2002a; Zeghichi et al., 2003; Schaffer et al., 2005a,b; Alarcón et al., 2006; Sánchez-Mata et al., 2012; Romojaro et al., 2013; Barros et al., 2016; Sánchez-Mata and Tardío, 2016).

Therefore, the high coincidence of medicinal and human food species and their intermediate role between food and medicine seem to explain that they are maintained to a greater extent.

CONCLUSIONS

In Sierra Norte de Madrid, a general trend of cultural erosion in the use of wild plants has been detected. However, food plants are still valued and consumed among the studied population. Some use-categories are still in force, such as beverages, condiments, and vegetables, while others have almost completely disappeared, such as wild snacks or the use of acorns.

The decline of the traditional agrarian society starting in the 1960s has led to the progressive abandonment of several activities, including the gathering and consumption of wild plants. Linked to this process, we detected several factors influencing the disuse of wild food plants. Firstly, a prominent factor is the reduction of abundance and quality of wild vegetables associated with the abandonment of agrarian tasks. This study shows that, following informant perceptions, there is a marked impact of cultivation practices on the taste and texture of wild vegetables. Such evidence points out the semi-domesticated status of wild food plants growing as weeds, which become less palatable and productive when the agrarian management disappears. Secondly, another factor affecting the loss of cultural significance of wild food plants is the disappearance of the subsistence economy, where wild plants were an important resource to complete the diet in periods of seasonal scarcity. Thirdly, the reduction of the time spent in the countryside because there are less tasks to carry out, had led to a diminution of the chances for gathering. Finally, the negative connotation linked to famine plants has influenced the disappearance of the use of certain species, mainly holm oak acorns.

On the other hand, there are several drivers of the maintenance in the use counteracting the general erosion trend. In the first place, there are still motivations for gathering, despite the socioeconomic changes occurred. Firstly, gathering wild plants is no longer collected as a subsistence activity but rather as a leisure activity that strengthens the bonds with the territory, neighbors, and relatives through the gift economy, which still present in rural societies. Secondly, the intense flavor of wild plants, particularly aromatic plants and bitter wild vegetables, is a strong driver for the maintenance of the use, since cultivated or commercial plants cannot substitute wild flavors. Thirdly, the values associated with the food context are positive in the case of plants used traditionally as everyday meals, which are still consumed occasionally and considered

delicatessen (Reyes-García et al., 2015). Finally, another factor that may explain the maintenance of the use of wild plants is their intermediate role between food and medicine. Specifically, the categories beverages or condiments, situated in the middle of the medicine–food continuum, are the most prevalent at present. The maintenance of the use of wild plants as condiments, beverages, and vegetables represents the nexus between medicine and food, and a living memory of our foraging past.

The maintenance of the use despite the deep socioeconomic changes occurred shows the resilience of this body of knowledge. As long as the knowledge still exists and the plant is available, there is a chance to reverse the cultural erosion trends. This eco-cultural restoration is currently driven by the need of recovering food sovereignty and the desire for healthy and culturally significant foods (Turner and Turner, 2008). In this regard, the persistence of wild flavors in the gustatory memory of the community, including the younger generations, allows wild plants to be reintroduced as everyday food in case of need or interest.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Materials**. Further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

The fieldwork was designed by the three authors but was conducted by LA-M, supervised by JT and MP-S. LA-M also analyzed the data and wrote the paper with the help and input of all the authors. All authors read and accepted the final version of the paper.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2020.610238/full#supplementary-material

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