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Plants used as fuel in the Arribes del Duero Natural Park (Salamanca-Zamora, Spain)

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Abstract: González, J. A.; García-Barriuso, M.; Ramírez-Rodríguez, R.; Bernardos, S. & Amich, F. 2013. Plants used as fuel in the Arribes del Duero Natural Park (Salamanca-Zamora, Spain). *Bot. Complut*. 37: 181-190.

In the present work we document and analyze traditional knowledge relating to the use of different plants as fuel and lighting, as wood burned for different purposes (hearths, ovens, etc) and for the elaboration of charcoal by the inhabitants of the Arribes del Duero area (Salamanca-Zamora, Spain). We interviewed 80 informants (44 men and 36 women, with a mean age range of 72 (from 45 to 98) who use or who have recently used 39 vascular plants (including 19 botanical families) as fuel. In all cases those plants were exploited in a sustainable way. We performed the calculations necessary to unveil the cultural importance (CI) of each species. The most important taxa were *Quercus ilex* L. subsp. *ballota* (Desf.) Samp. (CI = 0.90) and *Cytisus multiflorus* (L'Hér.) Sweet (CI = 0.84).

Key words: plant resources, fuel, traditional knowledge, Spain.

Resumen: González, J. A.; García-Barriuso, M.; Ramírez-Rodríguez, R.; Bernardos, S. & Amich, F. 2013. Plantas empleadas como combustible en el Espacio Natural de Arribes del Duero (Salamanca-Zamora, España). *Bot. Complut.* 37: 181-190.

En este trabajo se documenta y analiza el conocimiento tradicional relativo al uso de diferentes plantas como recurso para el encendido y la iluminación, como leña para diferentes fines (hogar, hornos, etc.) y para la elaboración de carbón vegetal por los habitantes de Arribes del Duero (Salamanca-Zamora, España). Se ha entrevistado a 80 personas (44 hombres y 36 mujeres; rango de edades, 45–98 años; media, 72), que usan, o usaron un pasado reciente, 39 plantas vasculares (incluidas en 19 familias botánicas) como combustible. En todos los casos dichas plantas fueron explotadas de manera sostenible. Se han realizado los cálculos necesarios para conocer la importancia cultural (*CI*) de cada especie. Los dos taxones más importantes son: *Quercus ilex* L. subsp. *ballota* (Desf.) Samp. (*CI* = 0,90) y *Cytisus multiflorus* (L'Hér.) Sweet (*CI* = 0,84).

Palabras clave: recursos vegetales, combustible, conocimiento tradicional, España.

INTRODUCTION

The most widespread use of wood is as fuel. The domination of fire has been the basis of technological advances from the appearance of metallurgy until the present; accordingly, plant fuels are an essential energy resource for human communities, in particular in rural settings (Blanco 2000).

In the past, these natural resources were crucial for heating homes, for cooking and baking bread in distant Iberian rural areas, such as the Arribes del Duero –henceforth the ARD– (provinces of Salamanca and Zamora in western Spain), where it is still possible to see people in the streets carrying a *mañuzo* (bundle/sheaf) of branches under their arms or putting *hornija* (wood or bundles of wood for heating ovens) in the woodshed.

Although the advent of butane gas and electricity has to a large extent replaced this traditional use of plants, there is a series of plant species whose use is essential (or has been in the recent past) for life in the ARD, since such plants serve to meet part of the basic needs of the inhabitants. As in neighbouring geographic areas (Blanco 1998, Blanco *et al*. 2000, Tapia Martín & Pierna Chamorro 2010), those most appreciated are chosen owing to a series of physical properties, in particular their calorific potential, and they have been exploited sustainably for centuries.

Thus, the aims of the present work were as follows: (i) to document and analyze the traditional knowledge and

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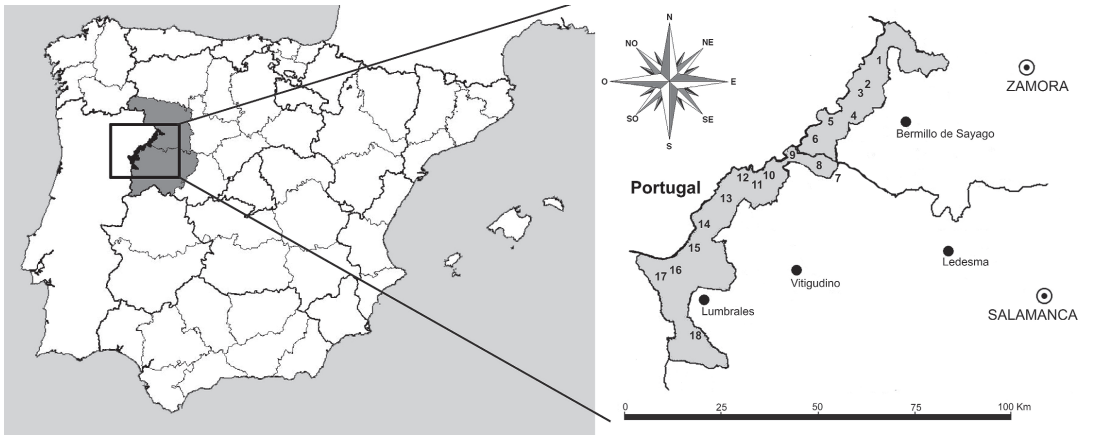

Fig. 1– Geographic location of the territory of the Arribes del Duero and the villages where interviews were held. Zamora province: **1:** Torregamones; **2:** Badilla; **3:** Fariza de Sayago; **4:** Formariz; **5:** Pinilla de Fermoselle; **6:** Fermoselle. Salamanca province: **7:** Almendra; **8:** Trabanca; **9:** Villarino de los Aires; **10:** Pereña de la Ribera; **11:** Masueco; **12:** Aldeadávila de la Ribera; **13:** Mieza; **14:** Vilvestre; **15:** Saucelle; **16:** Hinojosa de Duero; **17:** La Fregeneda; **18:** San Felices de los Gallegos. The edge of the Arribes del Duero Natural Park is shaded.

use of different plant species as a resource for setting home fires, for lighting, and as fuel for different purposes (hearths, ovens, forges, etc) and the elaboration of charcoal by people from the ARD; (ii) to contribute to the dissemination of the results within the scientific community in order to open a door to research in other disciplines; and (iii) to contribute to the knowledge and conservational possibilities of plant biodiversity, bearing in mind that biological diversity is also related to the use and applications of natural resources.

MATERIALS AND METHODS

Study area. Although the works cited above include a broad description of the study area (e.g. González *et al*. 2010, 2011), it is worth noting that the territory of the ARD forms the administrative border between Spain and Portugal along a stretch of some 120 km (40°50'-41°35' N, 6°00'-6°41' W; Fig. 1), and was declared a Natural Park in 2002 and is listed in the Sites of Community Importance proposed by Spain to become integrated in the European Natura 2000 network. It should also be noted that the peculiar climatology of the area makes it a singular space on the Iberian Peninsula, with a mild mean annual temperature (mean 11°C) and a relatively high precipitation (about 700 mm/year) (Calonge-Cano 1990). From the geomorphological point of view, the ARD is an extensive peneplain (plateau) featuring the deep valleys of the Duero river and its network of tributaries (call the "arribes"). The differences in altitude are seen in great plant diversity, characterized by the extensive abundance of typically Mediterranean plant species and crops that are not usually found at this latitude on the peneplain, such as olive groves, vineyards and almond trees (Amich *et al*. 2004, Santos *et al*. 2006, Amich & Bernardos 2008).

The economy is mainly based on the primary sector, livestock-raising being preponderant over crop-growing (Calabuig 2008), and the area is characterized by a strong demographic regression, which started half-way through the last century, with losses of almost 60% of the local population, a high ageing rate (almost 40% of people over 65) and a very low population density (8.6 inhabitants/km^2) (Morales & Caballero 2003). This rural community has undergone changes in recent decades, although they have been very slow to take effect. People have subsisted under survival conditions, and for generations have only seen a few, and then slow, alterations to their customary way of life. Thus, many villages have taken a long time to climb out of a subsistence routine, which formerly allowed the inhabitants to generate almost everything necessary for their survival.

Methodology. The incidence and socio-economic context of the use of plants as fuel was studied as part of an ethnobotanical survey carried out in the ARD, conducted from 2005 to 2009. Key informants (80 people), with a sound traditional knowledge (TK) of useful plants, who were born in the region and long-time residents were interviewed. Ethnobotanical data were collected in 116 individual semi-structured interviews conducted with selected informants representing different social groups within the ARD rural community (44 men and 36 women; age range, 45-98 years; mean age, 72). They were from 18 localities shown in Fig. 1: 6 in the province of Zamora (localities 1-6) and 12 in the province of Salamanca (localities 7-18). Open questions were asked about the use of "fuel plants" to gain insight into past and present use.

In the analysis of the data we employed the index of cultural importance (*CI*) proposed by Tardío & Pardo-de-Santayana

(2008), which allows the relative value of each useful plant species to be calculated. First we summed the use-reports (*UR*) of species *s* within a certain use-category (u_i) for all the informants (from i_1 to i_N), and divided this by the total number of informants (*N*). We then summed the previously calculated quotients for each use-category, from u_1 to u_{NC}:

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

This varied between 0 and the total number of use-categories (*NC*), in this case 1.

To evaluate how informants' TK varied in relation to socio-demographic characteristics, we performed an Analysis of Covariance (ANCOVA), taking "UR" as the variable to model (number of use-reports provided by each informant) and using the XLSTAT 2009 program. Likewise, as explanatory variables we took the two items of personal data requested: "age" and "gender" (qualitative values of *m* = male or *f* = female).

Regarding plant taxonomy and nomenclature we followed Flora iberica (Castroviejo 1986-2012) for the families included therein and Flora Europaea (Tutin *et al*. 1964-1993) for the remaining ones, except for *Rhamnus lycioides* subsp. *laderoi* Rivas Mart. & J. M. Pizarro in Intern. J. Geobot. Res. 1: 58. 2011. Voucher specimens were deposited at SALA, the Herbarium of the Salamanca University, Spain. In the case of some species for which no voucher was available, a digital photography number (PHO) is included.

RESULTS AND DISCUSSION

The inhabitants of the ARD, use, or have used in the recent past, 39 vascular plants (included in 19 botanical families) as fuel. Table 1 lists the plant species cited by at least three informants and includes core ethnobotanical information about these useful plants. Most of the species cited are ligneous plants (34 species, 87% of the total). The taxa obtained were mainly wild (87%) and comprised approximately 3.5% of the ca. 1,100 species of vascular plants known in the territory of the ARD.

Among the botanical families best represented in the study are Fabaceae, with 7 species (18%), Cistaceae, with 5 species (13%), and Fagaceae, with 4 species (10%); representing a total of 41%. The two most important taxa within the TK of the ARD are *Quercus ilex* L. subsp. *ballota* (Desf.) Samp. (*CI* = 0.90) and *Cytisus multiflorus* (L'Hér.) Sweet (*CI* = 0.84). Another seven species also had a value equal to or higher than 0.50 for the *CI*: that is, they were mentioned by at least half of the informants (Fig. 2).

The informants interviewed provided a total of 945 UR (average 12 UR/informant; max. = 29). The results of the exploratory analysis conducted regarding the TK amassed by the different informants in terms of their characteristics show that 43% of the variability of the TK can be explained in terms of age and gender (R^2 adj. = 0.435). The remaining variability was due to certain effects (other explanatory variables) that were not or could not be measured during the study. Attending to the Analysis of Variance results, it may be concluded with a certain degree of confidence that the two explanatory variables do bring a significant amount of information to the model ($F_{2, 77} = 31.404$, $P < 0.0001$, confidence interval = 95%). Table 2 gives details of the model. Only the age parameter was found to have a significant effect. According to our data, women provided less information than men in this particular study. These data are consistent with those obtained in studies addressing the consumption of edible wild plants and the use of certain plants for industrial and artisanal purposes (González *et al*. 2011, González & Amich 2012). We believe that some socio-economic effects might be involved.

Table 2
ANCOVA results for the traditional ecological knowledge and model parameters

Parameter	Value	SD	Student's t	Pr > t
Intercept	–18.547	3.868	–4.795	<0.0001
Age	0.414	0.053	7.828	<0.0001
Gender – m	1.409	1.074	1.312	0.193
Gender – f	0.000	0.000	—	—

Setting fires (twigs and tinder). To set fires at home, as well as newspaper or cardboard the inhabitants hoard twigs or the branches of certain bushes able to catch fire easily. The species most appreciated are broom (*Cytisus* sp. pl.), and in all localities studied it is used to light fires, and gum rockrose (*Cistus ladanifer* L.), whose stems, branches and even the whole plant have been used to light hearth fires. To kindle fires, other species of importance such as the bushes known locally as *ardevieja* (*Halimium umbellatum* subsp. *viscosum* (Willk.) O. Bolòs & Vigo, and *Echinospartum ibericum* Rivas Mart., Sánchez Mata & Sancho). They would be gathered once dry; hence the term "*arde cuando está vieja*" (lit.: "she burns when she's old"). Tinder (*yesca*) refers to the flammable material that has traditionally been used to set hearth fires. It consists of a bundle of dry vegetable fibres that catch fire easily upon contact with sparks generated by hitting two stones together or striking flint against iron. In the ARD we

Table 1
Vascular plants reported as fuel in the rural community of the Arribes del Duero (W Spain).
[1] Status: **W:** wild (including naturalized); **C:** cultivated. **FC:** frequency of citation; **CI:** cultural importance index

Families and species (voucher or digital photograph number)	Status[1]	Local name	Part used	FC	CI
PTERIDOPSIDA (= FILICOPSIDA)					
Hypolepydaceae					
Pteridium aquilinum (L.) Kuhn in Kerst (SALA 15601)	W	Helecho, fenecho, jenecho	Frond	34	0.42
CONIFEROPSIDA					
Cupressaceae					
Juniperus oxycedrus L. (SALA 102358)	W	Enebro, nebro, jimbro, jimbrio, jimbre, jumbrio, joimbre, joimbrero, enjumbre, enjumbrio	Branch	5	0.06
Pinaceae					
Pinus sp. pl. (*P. halepensis* Mill., *P. pinaster* Aiton, *P. pinea* L.) (e.g., SALA 16167)	C	Pino, piñal	Wood, female inflorescence	10	0.12
MAGNOLIOPSIDA					
Anacardiaceae					
Pistacia terebinthus L. (SALA 17395)	W	Cornicabra, cuernicabra, cornipedrera, cornapedrera, cuernas, jediguera, jidiguera, fidiguera, geriguera, geregosera, fedegosa	Wood, branch	11	0.14
Apiaceae					
Ferula communis L. (SALA 41179)	W	Cañaleja, cañaheja, cañajeja, caña tufona, caña de burro	Stem (dried)	4	0.05
Asteraceae					
Chondrilla juncea L. (PHO 47)	W	Ajunjera, ajinjera, ajonjera, ajujera, jinjeriña, jinjerinas, gengerinas, baleo, balaguera, baleguera, baliadera, baleras	Aerial part	10	0.12
Helichrysum stoechas (L.) Moench (SALA 17069)	W	Manzanilla fina, manzanilla real, tomilleja, meaperros, siempreviva, flor de San Juan, perpetua	Branch	14	0.17
Phagnalon saxatile (L.) Cass (SALA 15200)	W	Yesca, hierba de la yesca, hierba de la mecha, diezca	Aerial part (dried)	33	0.41

Families and species (voucher or digital photograph number)	Status[1]	Local name	Part used	FC	CI
Cistaceae					
Cistus albidus L. (SALA 16886)	W	Jara blanca, ardivieja	Branch	10	0.12
Cistus ladanifer L. (SALA 18145)	W	Jara, jara pringosa, jara negra	Stem, branch	34	0.42
Cistus populifolius L. (SALA 16888)	W	Jara macho, jara cerval	Branch	5	0.06
Cistus salviifolius L. (SALA 16891)	W	Revieja, jarilla, jaguarzo morisco	Branch	43	0.54
Halimium umbellatum subsp. *viscosum* (Willk.) O. Bolòs & Vigo (SALA 18149)	W	Ardevieja, ardivieja, chaguarzo, chaguazo, chagarzo, jaguarzo, jaguarcio, faguarcio, jarilla	Branch	47	0.59
Ericaceae					
Arbutus unedo L. (SALA 16324)	W	Madroño, madroñera, madroñal	Wood	17	0.21
Fabaceae					
Adenocarpus complicatus (L.) J. Gay in Durieu (SALA 19094)	W	Codeso, escoba, escobajo	Branch	9	0.11
Cytisus multiflorus (L'Hér.) Sweet (SALA 19214)	W	Escoba blanca	Branch	67	0.84
Cytisus scoparius (L.) Link (SALA 19202)	W	Escoba negra, escoba verde, escoba rubia, escoba tamariz, escoba bermeja, retama negra	Branch	48	0.60
Cytisus striatus (Hill) Rothm. (SALA 16667)	W	Escoba amarilla, escobón, piorno	Branch	20	0.25
Echinospartum ibericum Rivas Mart., Sánchez Mata & Sancho (SALA 19135)	W	Ardevieja, ardivieja, cambrión, cambronera, escambrión, piorno, bolaga	Stem, branch	12	0.15
Genista hystrix Lange (SALA 19033)	W	Piorno, bolaga, aliaga, abrojo, escobajos	Branch	38	0.47
Retama sphaerocarpa (L.) Boiss. (SALA 16638)	W	Retama, piorno blanco, tamariz	Branch	10	0.12
Fagaceae					
Quercus faginea Lam. (SALA 16309)	W	Quejigo, cajigo, roble	Wood, branch, twig	26	0.32
Quercus ilex L. subsp. *ballota* (Desf.) Samp. (SALA 16331)	W	Encina, ancina, carrasco, carrasca	Wood, branch, twig	72	0.90
Quercus pyrenaica Willd. (PHO 4)	W	Roble, rebollo, melojo, roble marojo	Wood, branch, twig	51	0.64
Quercus suber L. (SALA 17519)	W	Alcornoque, corchero, sobrero, sobreiro, jebrero, jebrera, zofrero, zufreiro	Wood	22	0.27

Families and species (voucher or digital photograph number)	Status[1]	Local name	Part used	FC	CI
Oleaceae					
Fraxinus angustifolia Vahl (SALA 17874)	W	Fresno, freixo	Wood, twig, branch	3	0.04
Olea europaea L. (SALA 17872)	C (W)	Olivo, oliva, olivera	Branch, young shoot, fruits (waste)	31	0.39
Phillyrea angustifolia L. (SALA 17870)	W	Olivilla, labiérnago	Branch	21	0.26
Rhamnaceae					
Rhamnus lycioides subsp. *laderoi* Rivas Mart. & J. M. Pizarro (SALA 76319)	W	Espinero negro	Branch	3	0.04
Rosaceae					
Crataegus monogyna Jacq. (SALA 15394)	W	Espino, espinero, espinera, espino albar, majuelo, escambrión, galapero	Wood	6	0.07
Prunus dulcis (Mill.) D. A. Webb (SALA 15392)	C	Almendro, almendral, almendrera	Fruit (endocarp)	38	0. 47
Rubus ulmifolius Schott s. l. (SALA 17950)	W	Zarza, zarzal, zarcera, zarzamora	Branch	3	0.04
Salicaceae					
Populus nigra L. (PHO 211)	W	Chopo, chopa, chopo del país	Marrow	9	0.11
Santalaceae					
Osyris alba L. (SALA 15864)	W	Punteros, escoba barredera, escoba rubial pequeña, retama loca	Branch	8	0.10
Ulmaceae					
Celtis australis L. (SALA 134759)	W	Hojaranzo, ojaranzo, jaranzo, lodón, lodonero, dolonero, almez	Wood, branch	14	0.17
Ulmus minor Mill. (PHO 70)	W	Negrillo, olmo	Wood, branch	16	0.20
Vitaceae					
Vitis vinifera L. (PHO 13 / 15)	C	Vid, parra	Stem, branch	40	0.50
LILIOPSIDA					
Liliaceae					
Asphodelus albus Mill. (SALA 17696)	W	Gamón, gamona, gamonita, gamoneto	Stem	40	0.50
Poaceae					
Secale cereale L. (PHO 92)	C	Centeno	Stem (straw)	61	0.76

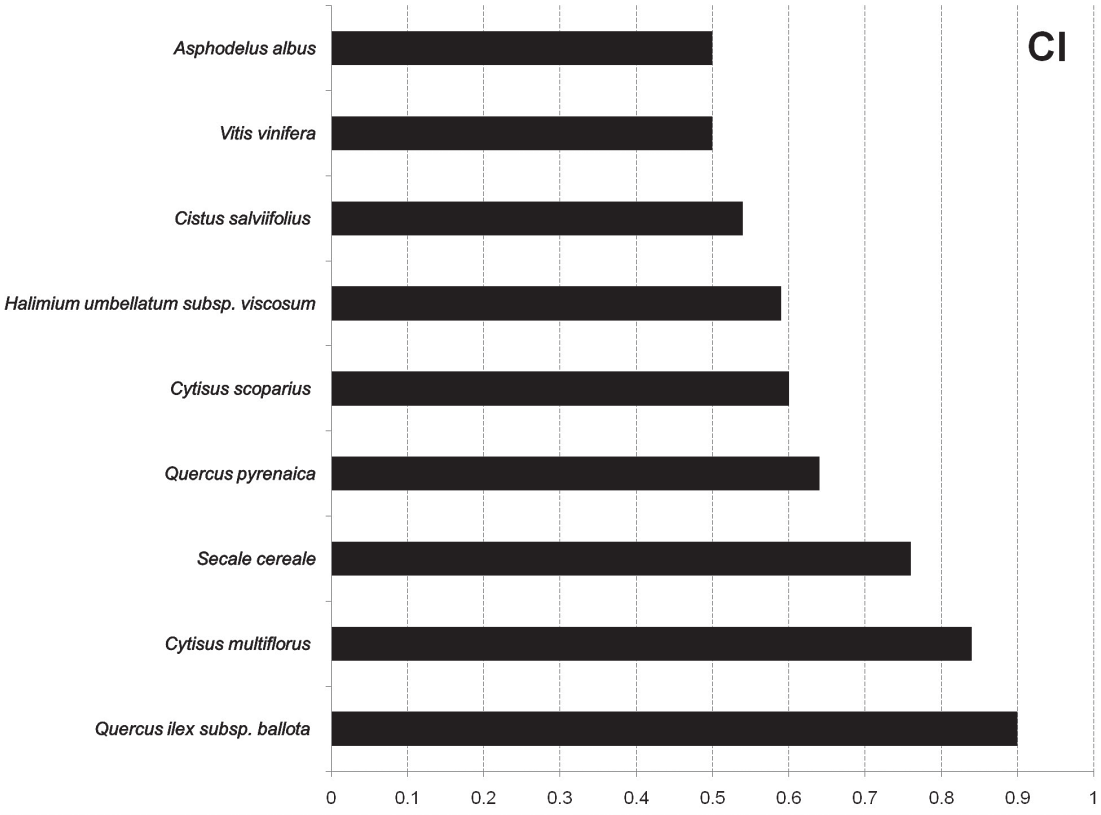

Fig. 2– Cultural importance value (*CI*) of the nine most relevant species in the study.

documented the use of the small bush *Phagnalon saxatile* (L.) Cass, which is abundant on sunny walls and rocky places; this was dried and beaten flat; of *Helichrysum stoechas* (L.) Moench and poplar marrow (*Populus nigra* L.). Informants who had been shepherds (now retired) used to use the dry stems of *Ferula communis* L. to light fires outdoors when there was a lot of wind and keep them burning when it was raining.

Wood (hearths, ovens, etc). Traditionally, the main combustible element has been wood, which is abundant in the ARD, where the inhabitants have used both the sub-products of forest clearing and the wood from trees used specifically for such purposes. To heat bread ovens, both in baker's shops and in homes in which there was a family oven, bushy species with good combustion properties were used; that is the different species of Cistaceae and Fabaceae documented and *Osyris alba* L. All these plants were collected daily. Once the oven had acquired the right temperature the ash was swept out and the dough was placed in the oven. Sometimes, the small branches of certain arboreal species were used for such purposes; for example, twigs from *Quercus faginea* Lam. or *Fraxinus angustifolia* Vahl. Also of cultural importance in the ARD community is the use of broom and *piorno* (*Genista hystrix* Lange) as fuel for heating the winepress and for heating stills, a popular way used to obtain home-made *aguardiente* (similar to Italian grappa). To combat the rigours of winter it used to be essential to have wood for home heating. Some types of wood have considerable calorific potential (oak, holm-oak, etc) and are hence those most appreciated. Holm-oak wood (*Q. ilex* subsp. *ballota*) is very much appreciated and considered to be the best. Other tree species that provide "good quality wood" are: *Quercus suber* L., *Celtis australis* L., *Ulmus minor* Mill., *Pistacia terebinthus* L. and *Arbutus unedo* L. Sometimes the inhabitants of the ARD used the wood of *Rhamnus lycioides* subsp. *laderoi* and *Phillyrea angustifolia* L.

Land use is distributed in concentric bands around the various localities. The closest to these are vegetable-growing plots and *cortinas* (enclosed areas devoted to the cultivation of forage plants), which form a mosaic of

privately owned plots. The second band comprises the *tierras*, or open communal fields or meadows for public use, whose right to exploitation is decided on by drawing lots. Finally there is the *monte*, for use by all of the inhabitants, and, on flatter lands there are the *dehesas*, which are private properties located at the limits of the municipal territory where free-range livestock-raising is the norm (Prada Llorente 2005, García Feced *et al*. 2007). The *monte* (~woodland) is used in common by the inhabitants. Its legal status is defined as "a public utility possession" and has been used by the community since time immemorial. The wood of different species is distributed among inhabitants based on different lots. Cutting firewood, once sorted into equally among all residents of the settlement or houses, is the responsibility of each resident (Prada Llorente 2005).

Pine wood was and still is used in the ARD for almost everything. However it does not have such an important use as in other parts of central-western Spain (see Blanco 1998, Blanco *et al*. 2007). As fuel, the wood from *Pinus halepensis* Mill. and *P. pinaster* Aiton has been used, but only locally. A group of bushes such as *Cytisus multiflorus*, *C. scoparius* (L.) Link, *Cistus ladanifer*, *Genista hystrix* or *Echinospartum ibericum* used to be employed as the major source of heating when better quality wood was scarce. Some species such as Spanish white broom (*C. multiflorus*), which is very abundant thanks to territorial management, used to be very scarce. A few years ago it was extremely difficult to find patches of broom and when they were present they were protected as a valuable piece of property and as an important resource for many different purposes. This led to swapping in some villages where these bushes were gathered to exchange them, for example at the baker's. However, they also involved disputes and even theft.

As a fuel for heaters, what is known as *brujo* is used. *Brujo* refers to the residues of olives after pressing them for oil (this source is available in large amounts). Also used are pinecones from *Pinus pinea* L. and the woody parts (endocarp) of almonds. It is worth noting, from the social point of view, the extended use of certain plant elements to obtain embers with which to roast meat: in particular a favourite element is the wood obtained from pruning olive trees (*Olea europaea* L.) and cutting back old vines and their shoots (*Vitis vinifera* L.).

Lighting. Fire, as well as being a source of heat, also provides light and, although a long time ago, it was a basic means to gain access to light at night-time. Some plants served to provide lighting and as a source of fire for setting other objects alight. Thus, the dry stems of *Asphodelus albus* Mill. were used to light candles or as torches to transport fire, since they burn easily and are consumed very slowly. In the kitchens of some localities the inhabitants of the ARD used to use branches of *Juniperus oxyedrus* L.

Charcoal. Until a few years ago, the elaboration of charcoal from wood was a generalized practice throughout the ARD territory. As in other rural zones of Spain (see Marcos Martín 1989), the process essentially consists of an incomplete combustion of wood, which turns into a much lighter combustible material with very high calorific potential. The types of wood valued for making charcoal vary, but basically holm-oak and oak *Quercus pyrenaica* are used, which on the peneplain are often found forming dehesas –savannah-like grasslands with occasional stands of trees– (Santos *et al*. 2006, García Feced *et al*. 2007, Calabuig 2008). In these cases, their cover has a rounded crown, not very tall, shaped through human intervention, which involves the pruning of large branches every 10 or 12 years. These are used to make the charcoal, leaving a few main branches on the trees, which every 3 or 4 years are pruned and the *chupones* (shoots from the roots) are removed, together with the thinner branches (Tapia Martín & Pierna Chamorro 2010). To a lesser extent, wood from *Q. faginea* has been used, and in the villages where *Celtis australis* was abundant in the past the inhabitants used to make an excellent charcoal out of this species. Strawberry tree wood was used to obtain a highly calorific charcoal for use in forges. The thinner twigs and branches are used to make *cisco*, a fine charcoal mainly used in *braseros* (flat braziers fitted under the skirts of a (generally) round table). The plant most valued for this is *Cistus ladanifer*, whose charcoal reaches very high temperatures and a better yield is obtained with this species than with others using the same amount of source wood (Gallego & Gallego 2008). In the past, *cisco* was also made from other species of rockrose, in particular *Cistus albidus* L., *C. populifolius* L. and *C. salviifolius* L., and by burning thin branches of holm-oak and oaks, branches of *Crataegus monogyna* Jacq., of *espino negro* (*Rhamnus lycioides* subsp. *laderoi*), of *Pistacia terebinthus*; and even the thicker branches of bramble (*Rubus ulmifolius* Schott s.l.).

Other uses. Regarding the plant-derived fuels used in the ARD, here we wish to mention the use of different species to singe the bristles of pigs during the traditional *matanza* (home slaughter), although this is becoming increasing less frequent owing to the widespread use of butane torches and also the gradual abandonment of the laborious process slaughtering pigs at home. Rye straw

(*Secale cereale* L.), the dry fronds of *Pteridium aquilinum* (L.) Kuhn and, to a lesser extent, the dry aerial parts of *Chondrilla juncea* L. are strewn in bundles over the carcass and set alight, thus singeing away the bristles. Another method used is to cover the carcass with broom branches or *piornos* and then set them alight. Finally, *Helichrysum stoechas* is still used by some beekeepers in the ARD to obtain smoke to make bees drowsy when their hives are being attended to.

CONCLUSIONS

Wood is one of the best fuels; it is the most natural one and has traditionally been used by humans. In recent years, it has been replaced by fossil fuels (heating oil, natural gas, butane, etc). However, we must be aware that these are non-renewable resources, such that sooner or later (depending on the different studies) they will run out. By contrast, wood, and plant resources in general, only require years to be renewed. Taking as a model the TK of the inhabitants of the ARD, a good idea would be the return to the use and exploitation of wood as a natural resource, for example as fuel for heating. In all cases (studied here), the land was exploited sustainably owing to the need the preserve it usefulness in the medium- and long-term.

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