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Classification and characterization of anthropogenic plant communities at the ecoregion level

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Classification and characterization of anthropogenic plant communities at the ecoregion level

Abstract (300 words max.)

- *Questions* How can we classify the diversity of anthropogenic plant communities at the ecoregion level? How are these communities characterized by species origins (native plants, archaeophytes, and neophytes), species traits (lifeforms, plant height, and flowering phenology) and ecological preferences (temperature, moisture, light, nutrients, soil reaction, disturbance frequency, and disturbance severity)?
- *Location* Iberian Atlantic ecoregion (a.k.a. Cantabrian Mixed Forests); Portugal, Spain, and France; south-western Europe.
- *Methods* We compiled a vegetation database of 2,508 synanthropic plots and revised the regional checklist of anthropogenic vegetation alliances. We used modified TWINSPAN and semi-supervised classification to classify the plots into the revised alliances. We determined the proportion of natives, archaeophytes, and neophytes. We also described the alliances in terms of species traits and ecological requirements.
- *Results* We classified 2,081 vegetation plots into 28 anthropogenic alliances representing 9 vegetation classes (*Cymbalario-Parietarietea diffusae*, *Polygono-Poetea annuae*, *Papaveretea rhoeadis*, *Digitario sanguinalis-Eragrostietea minoris*, *Chenopodietea*, *Sisymbrietea*, *Bidentetea*, *Artemisietea vulgaris* and *Epilobietea*

angustifolii). The plots included 1,162 plant taxa: 78% natives, 15% archaeophytes, and 7% neophytes. Vegetation groups were organized along a principal axis of variation related to abiotic stress (dry-sunny to moist-shady habitats), and a second axis related to disturbance (low to high disturbance frequency and severity).

- *Conclusions* Ecoregion-level synthesis detected a discrepancy between the number of anthropogenic vegetation units described in the literature (38 alliances) and the number supported by numerical classification (28). The diversity of anthropogenic vegetation can be organized into three groups: trampled, weeds, and ruderals. In the Iberian Atlantic ecoregion, anthropogenic habitats host one third of the ecoregion plant species pool and one fifth of the Iberian flora. Mesic perennial ruderal vegetation is especially rich in native species and can be a biodiversity asset in urban ecosystems. Our ecoregion-level framework can improve the assessment and management of anthropogenic plant communities within biogeographically meaningful regions.

Keywords (10 max)

Synanthropic vegetation, manmade habitats, human-made habitats, urban biodiversity, neophytes, archaeophytes, alien plants, habitat classification, semi-supervised classification, Iberian Atlantic ecoregion

Introduction

Anthropogenic vegetation consists of plant communities assembled as a direct consequence of human activities. In general, this vegetation is composed of so-called weeds of arable fields and ruderal plants of human settlements and nearby habitats (Lososová & Simonova 2008). Anthropogenic communities make up an important part of the supply of biodiversity in urban and peri-urban areas (Kowarik 2018). In densely populated landscapes, the plant communities that colonize urban vacant lots (Johnson et al. 2017) are a useful natural resource with high ecological and societal potential (Anderson & Minor 2017). Anthropogenic vegetation can also mitigate regional-level extreme climatic events (Stefanon et al. 2014). Furthermore, many synanthropic plants can accumulate heavy metals in their biomass (Kostryukova et al. 2017), making them valuable candidates for nature-based solutions such as bioremediation and restoration of degraded post-industrial landscapes (Song et al. 2019).

In temperate Europe, anthropogenic vegetation is a melting pot of floras from different origins. Starting with a pool of native species favored by humans, and constantly enriched by human-assisted arrival of alien (i.e. non-native) species (Pokorná et al. 2018). The introduction of archaeophytes (i.e. alien species arriving before 1.500 CE) likely started in the early Neolithic and peaked in the Bronze Age, with successive waves during periods of accelerated human colonization such as the early Middle Ages (Pokorná et al. 2018). In Europe, synanthropic archaeophytes include many Mediterranean taxa originating from the segetal flora of the Near East (Zohary 1950). Some of these archaeophytes are 'obligate weeds' that do not occur in non-anthropogenic habitats and are assumed to have evolved together with human agriculture (Zohary 1950). Since many archaeophytes started their expansion into temperate areas during the Mid-Holocene warm period, it is difficult to disentangle to what extent this expansion was favored by human activities and/or ongoing climatic changes (Cayless & Tipping 2002; Cordova & Lehmann 2003). The synanthropic flora of Europe has been further enriched by neophytes, alien taxa that arrived after the expansion of intercontinental trade in the Modern Age (after 1.500 CE) (Brun 2009). Synanthropic neophytes therefore include many American, African, and Asian taxa that arrived in Europe because of the global trade networks established by western European colonialism (Lenzner et al. 2022). In the last century, the European anthropogenic vegetation has shown a decrease in species richness and diversity (Pyšek et al. 2004), as rare synanthropic species have become rarer, and neophytes have increased their abundance at the expense of natives and archaeophytes (Lososová & Simonova 2008).

Despite the potential of anthropogenic vegetation as a biodiversity asset in human-made landscapes, and its ecological interest as an assemblage of species pools from different biogeographical origins, human-made vegetation is largely absent from ecosystem management. A comprehensive management will require a solid definition, classification, and description of anthropogenic plant communities. However, the classification of anthropogenic vegetation is subject to particularities making it a special case compared to the classification of non-anthropogenic communities. In human-made habitats, the traditional understanding of community assembly based on sequential filtering (dispersal, abiotic, and biotic) must incorporate an additional filtering based on human preferences and actions (Swan et al. 2021). Human landscapes are a mosaic of land uses (Pauleit & Breuste 2011), having specific effects on plant community assembly, and driven by sociological rather than traditional ecological factors (Johnson et al. 2017). In addition to these potentially confounding factors, human-assisted dispersal means that anthropogenic floras are relatively homogeneous across large biogeographical scales. However, traditional phytosociology has tended to classify them with a level of detail similar to the one dedicated to non-anthropogenic vegetation, leading to an inflation of anthropogenic syntaxa (Loidi 2023). Another issue is defining anthropogenic vegetation, especially in a continent such as Europe where human impact on the landscape has been widespread since ancient times. The two major vegetation/habitat classifications coexisting in Europe today, phytosociological classification (Mucina et al. 2016) and the EUNIS habitat classification (Chytrý et al. 2020), have non-overlapping definitions of which plant communities fall within the 'anthropogenic' or 'manmade' categories. These issues are further muddled by the fact that most classification studies of anthropogenic vegetation have focused either on a restricted political unit (Nemec et al. 2011; Tabasevic, Jovanovic, et al. 2021) or in a subset of the vegetation, such as segetal (Zohary 1950), ruderal (Zaliberova 1995) or trampled (Golovanov et al. 2023) vegetation. There is a need for a numerical classification and synthesis of the full spectrum of anthropogenic vegetation, and an appropriate scale to conduct such study is the ecological region (ecoregion, hereafter), since these biogeographical units are assumed to encompass areas with a similar biogeographic history and recurrent local ecosystems (Bailey 2004).

The ~~Iberian Atlantic ecoregion~~ (a.k.a. Cantabrian Mixed Forests ecoregion; NW Iberian Peninsula) has a long history of human habitation dating back to the Cantabrian Upper Paleolithic (Straus 2005). This, together with its transitional position at the border between the temperate and Mediterranean climatic zones of Europe (Loidi 2017), suggests a long regional history for archaeophyte-rich anthropogenic plant communities, supporting the current diverse anthropogenic vegetation with both temperate and Mediterranean floristic elements (Díaz González 2020). Moreover, historical trade links with America and Asia, together with the warm and humid temperate climate, have made the region a hotspot for biological invasions (Fernández de Castro et al. 2018; Lázaro-Lobo et al. 2024). Recent post-industrial land-use changes have left large areas with abandoned industrial sites (i.e. brownfields) whose management and restoration requires an understanding of the anthropogenic communities able to colonize them (Gallego et al. 2016; Matanzas et al. 2021). Although there is a long tradition of studying weed and ruderal communities in the ecoregion (Aedo et al. 1988; Fernández González et al. 1988; Penas Merino, Díaz González, García González, et al. 1988; Penas Merino, Díaz González, Pérez Morales, et al. 1988) there is a current need for an ecoregion-level synthesis that revises and updates the classification in accord with recent developments in European vegetation science (Mucina et al. 2016) and habitat classification (Chytrý et al. 2020). In this article, we have performed such a synthesis with the following two objectives: (1) to provide an updated classification of anthropogenic plant communities in the Iberian Atlantic ecoregion; and (2) to characterize the diversity of anthropogenic vegetation in terms of species pools (natives, archaeophytes, neophytes); species traits (life form, plant height, flowering phenology); and ecological requirements (temperature, moisture, light, nutrients, soil reaction, disturbance frequency, and disturbance severity).

Methods

Data curation and taxonomic criteria

We performed all data management and analysis with R version 4.3.1 (R Core Team 2023), using the R package *tidyverse* (Wickham et al. 2019) for data processing and visualization. We homogenized all taxon names using Euro+Med (Euro+Med 2006) or Plants of the World Online (POWO 2023) for taxa not in Euro+Med. For the nomenclature of syntaxa, we followed Mucina *et al.* (2016) for alliances and higher ranks, and Rivas-Martínez *et al.* (2001) for associations. The original datasets, as well as R code for analysis and creation of the manuscript, are stored in a GitHub repository available at Zenodo (see 'Data availability statement').

Study ecoregion

We studied the anthropogenic plant communities of the Iberian Atlantic ecoregion (Fernández Prieto et al. 2020), i.e. the territories with a temperate climate in the north-western part of the Iberian Peninsula (NW Portugal, N Spain, SW France). Our study ecoregion broadly corresponds to the Cantabrian Mixed Forests ecoregion *sensu* Olson *et al.* (2001), to the Iberian part of the European Atlantic province *sensu* Rivas-Martínez *et al.* (2017) and to the Iberian section of the Atlantic biogeographical region of the European Environmental Agency (https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2).

Definition of anthropogenic vegetation

To circumscribe our study vegetation, we followed the definition of anthropogenic vegetation in the revised classification of the vegetation of Europe by Mucina *et al.* (2016). In our study area, this potentially includes the vegetation classes *Polygono-Poetea annuae*, *Papaveretea rhoeadis*, *Digitario sanguinalis-Eragrostietea minoris*, *Chenopodietea*, *Sisymbrietea*, *Bidentetea*, *Artemisietea vulgaris*, and *Epilobietea angustifolii*. For the sake of completeness, we also considered the class *Cymbalario-Parietarietea diffusae* included by Mucina *et al.* (2016) in the vegetation of rock crevices and screes, since this class encompasses the vegetation of human-made walls.

Checklist of anthropogenic syntaxa

To assist in our classification, we prepared a checklist of anthropogenic syntaxa that could be present in our study ecoregion (**Appendix S1**), based on regional syntaxonomical checklists (Izco et al. 2000; Díaz González 2020; Durán Gómez 2020) and recent revisions at the European level (Mucina et al. 2016; Preislerová et al. 2022). This syntaxonomical checklist included 38 anthropogenic vegetation alliances that could be present in the Iberian Atlantic ecoregion according to the literature.

Vegetation data selection

We retrieved Iberian Atlantic anthropogenic vegetation plots from the Iberian and Macaronesian Vegetation Information System (SIVIM) (Font et al. 2012). To identify plots as anthropogenic, we selected those plots that had been assigned by the original authors of the plot into any anthropogenic syntaxa in our syntaxonomical checklist. However, since not all plots in SIVIM have an assigned syntaxon, we also retrieved additional plots using the expert system created by Chytrý *et al.* (2020) to classify vegetation plots into EUNIS pan-European habitat types. We retrieved plots that had been assigned to any habitat related to the anthropogenic vegetation classes we had previously defined: all habitats in the level 1 code *V Vegetated man-made habitats*, plus level 3 codes *R55 Lowland moist or wet tall-herb and fern fringe* and *R57 Herbaceous forest clearing vegetation*. It must be noted that habitats *R55* and *R57* include communities that are classified as *R Grasslands and lands dominated by forbs, mosses or lichens* by EUNIS but as *Anthropogenic vegetation* by Mucina *et al.* (2016). The extraction of data from SIVIM produced an initial pool of 3,160 vegetation plots, to which we added 89 vegetation plots of urban or peri-urban plant communities sampled by us or extracted from local literature not included in SIVIM (Zabaleta Mendizábal 1990; Uría Arizaga 2020).

Vegetation data cleaning

We performed an exploratory data analysis of these 3,249 plots using modified Two-Way Indicator Species Analysis (TWINSPAN) (Roleček et al. 2009) with the R package *twinspanR* (Zelený 2021), 3 pseudospecies cut levels (0, 15, 25), a minimum group size of 10 plots, and Sørensen's average dissimilarity. During this analysis we identified 741 outlier plots which did not belong to either the target anthropogenic vegetation or to the geographical area of the ecoregion. The majority of these plots corresponded to coastal plant communities and had been misclassified by the expert system. We removed these plots, leaving a dataset of 2,508 vegetation plots for data analysis: 2,419 plots from SIVIM, originally recorded in 89 publications (**Appendix S2**); plus 89 plots added by us.

Training dataset for semi-supervised classification and validation of alliances

To create a training dataset for the semi-supervised classification (see below), we started by keeping only those plots (n = 2,201) that had been assigned by the original authors of the plot to any of the 38 anthropogenic alliances defined in our syntaxonomical checklist (i.e., we removed the plots without syntaxa, that had been retrieved solely by the expert system). We further cleaned this subset using a preliminary TWINSPAN classification, in which we attempted to match the plots into the 38 alliances. This step allowed us to identify those plots in which there was an agreement between (1) our TWINSPAN-based classification and (2) the classification based on the original author's syntaxon. These plots (n = 1,725) became our training dataset for semi-supervised classification. Furthermore, this step allowed us to validate which alliances from our syntaxonomical checklist were present in the study ecoregion (n = 28) and which were absent (n = 10).

Semi-supervised classification

Next, we conducted a semi-supervised classification of the whole dataset (n = 2,508 plots) into the 28 validated anthropogenic alliances. Semi-supervised classification uses a training subset of *a priori* classified vegetation plots to classify a secondary subset of unclassified plots (De Cáceres et al. 2010). Since our goal was to refine the classification of the whole dataset, we allowed plots from the training subset to be re-assigned to other alliances during the classification. In addition, semi-supervised classification can create new groups to place data points that do not match the already existing *a priori* groups, but attempts to do so resulted in new groups with no ecological significance, and thus we kept the 28 alliances as final anthropogenic vegetation groups. Furthermore, we applied a noise clustering fuzzy algorithm, which allows plots to be classified either into the *a priori* alliances or into a *noise* group which includes outliers and transitional plots (Wiser & De Cáceres 2013). We set the fuzziness coefficient to a low value (m = 1) to accommodate a high number of transitional plots; and we set the distance to the noise class to d = 1. We performed this analysis with the R package *vegclust* (De Cáceres et al. 2010). The semi-supervised classification with noise clustering resulted in the final classification of 2,081 plots into 28 alliances and 427 plots left out in the noise group. We used pairwise PERMANOVA (with 100,000 iterations, Euclidean distances, and Holm's p-value correction) fitted with the R package *RVAideMemoire* (Herve 2023) to test the significance of the final vegetation alliances; along with Principal Component Analysis (PCA) as implemented in the R package *FactoMineR* (Lê et al. 2008) to visualize the relationships between the classes and alliances.

Characteristic species and EUNIS habitat correspondence

To facilitate the use of the classification by local managers and environmental consultants, we calculated sets of characteristic species (**Appendix S3**) (Chytrý et al. 2020) for each one of the final 28 vegetation alliances. We defined dominant species as species with more than 25% cover in at least 5% of the vegetation plots of the group; constant species as species with a frequency higher than 50% in the group; and diagnostic species as species whose *IndVal* had a p-value lower than 0.05, as calculated with the R package *labdsv* (Roberts 2016) using 1.000.000 iterations. Additionally, we assigned to each alliance its corresponding level-3 EUNIS habitat code or codes (https://eunis.eea.europa.eu/habitats-code-browser-revised.jsp).

Species origin as native, archaeophyte, or neophyte

We classified the species as native, archaeophytes, or neophytes in the Iberian Atlantic ecoregion using the information in *Flora iberica* (1987) and catalogues of archaeophytes for Britain (Preston et al. 2004) and the Czech Republic (Chytrý et al. 2021). We must stress that identifying archaeophytes in southern Europe is highly problematic (Celesti-Grapow et al. 2009) and our classification must be taken as an indication of putative archaeophyte character for the purposes of vegetation description and comparison with other European regions, rather than a definitive classification of the species; as stated by Preston *et al.* (Preston et al. 2004), the classification of a species as an archaeophyte should be interpreted as a hypothesis to be tested by further studies.

Species life form

Using *FloraVeg.EU* (2023) we extracted the species' life forms and kept *therophyte* and *geophyte* for further analysis since these two categories had the largest contribution to variance among alliances, as per an exploratory Principal Component Analysis (PCA) performed using the R package *FactoMineR* (Lê et al. 2008).

Species height and flowering phenology

From *Flora iberica* (1987) we extracted the maximum height, median month of flowering, and length of the flowering period of each species in the dataset. We used these variables to calculate plot-level community-weighted means (weighting by species cover) for each trait, to characterize the vegetation height and flowering phenology of the anthropogenic plant communities.

Species ecological indicator values

For each species in the dataset, we collected its ecological indicator values of temperature, moisture, light, nutrients, and soil reaction (Dengler et al. 2023); and its disturbance frequency and severity indicator values (Midolo et al. 2023). To those species lacking an indicator value in the accessed references, we assigned a value by reciprocal averaging, i.e. by (1) calculating weighted average values of the species with values for each plot (weighting by species cover), and (2) assigning to the missing species the weighted average values of the plots where they were present (weighting by species cover). Then, for each vegetation plot, we calculated the plot-level mean of each indicator value.

Results

Overview of the classification

The semi-supervised classification resulted in the classification of 2,081 vegetation plots into 28 anthropogenic alliances (**Fig. 1**, **Appendix S4**) representing 9 vegetation classes. Most of the alliances had a wide distribution in the ecoregion according to our dataset, but five of them (*Caucalidion lappulae*, *Linario polygalifoliae-Vulpion alopecuri*, *Convolvulo arvensis-Agropyrion repentis*, *Senecionion fluviatilis* and *Paspalo-Agrostion semiverticillati*) had isolated occurrences towards the southern limit of the Iberian Atlantic territories. The regional literature included in our dataset recognized 72 associations (**Appendix S5**) within these alliances, but exploratory analysis (not shown) indicated that the separation of these associations within the alliances had a generally weak support based on numerical classification methods.

The classified plots included 1,162 taxa or taxa aggregates. The 10 most frequent species were *Ochlopoa annua* (621 occurrences), *Urtica dioica* (592), *Sonchus oleraceus* (540), *Stellaria media* (516), *Capsella bursa-pastoris* (390), *Polygonum aviculare* (375), *Dactylis glomerata* (363), *Senecio vulgaris* (332), and *Anisantha sterilis* (301). Considering only those plots with the most frequent plot size range (10-30 m^2, n = 867 plots), the average species richness per plot was 16 (minimum = 3, maximum = 48). The class with the richest species pool was *Epilobietea angustifolii* (n = 615) and the poorest was *Cymbalario-Parietarietea diffusae* (n = 171).

PCA ordination of the floristic composition (**Fig. 2A**) clearly differentiated three vegetation groups: (1) trampled vegetation of class *Polygono-Poetea annuae*; (2) crop weeds of classes *Papaveretea rhoeadis* and *Digitario sanguinalis-Eragrostietea minoris*; and (3) perennial ruderal vegetation of classes *Artemisietea vulgaris* and *Epilobietea angustifolii*. The central position of the floristic space, between these three major groups, was occupied by the annual ruderal vegetation of classes *Chenopodietea*, *Sisymbrietea*, and *Bidentetea*; as well as by the wall vegetation of class *Cymbalario-Parietarietea diffusae*. Separate PCAs within the major vegetation groups indicated a coherent separation between most of the alliances, but with some cases of relatively high overlap: for example, between (i) *Galio valantiae-Parietarion judaicae* and *Cymbalario-Asplenion*; or (ii) *Geo urbani-Alliarion officinalis* and *Aegopodion podagrariae*.

Proportion of natives, archaeophytes and neophytes

The total synanthropic species pool (n = 1,162) was composed of 78% natives (n = 908), 15% putative archaeophytes (n = 178), and 7% neophytes (n = 76). The most frequent putative archaeophytes were *Capsella bursa-pastoris* (390 occurrences), *Senecio vulgaris* (332), *Anisantha sterilis* (301), *Anthemis arvensis* (280), *Hordeum murinum* (274), *Raphanus raphanistrum* (233), *Vicia sativa* (228), *Malva sylvestris* (197), *Sisymbrium officinale* (166), and *Echinochloa crus-galli* (165); while the most frequent neophytes were *Veronica persica* (212), *Erigeron canadensis* (138), *Amaranthus hybridus* (73), *Oxalis corniculata* (67), *Lepidium didymum* (57), *Oxalis latifolia* (51), *Paspalum distichum* (48), *Bidens frondosus* (35), *Cyperus eragrostis* (34), and *Symphyotrichum squamatum* (33).

By vegetation class, *Epilobietea angustifolii* had the highest proportion of natives in its species pool (82%); *Sisymbrietea* had the highest proportion of putative archaeophytes (31%); and *Bidentetea* had the highest proportion of neophytes (17%). The alliances with the highest proportions of archaeophytes in their species pools were *Caucalidion lappulae* (41%), *Chenopodion muralis* (35%%), and *Sisymbrion officinalis* (31%); while the alliances with the highest proportion of neophytes were *Bidention tripartitae* (19%), *Allion triquetri* (12%), and *Spergulo arvensis-Erodion cicutariae* (10%).

At the community level, focusing on plot average proportions (**Fig. 3**), the alliances with the most archaeophytes were *Caucalidion lappulae*, *Spergulo arvensis-Erodion cicutariae*, and *Sisymbrion officinalis*, in which only about half of the plot-level proportion was made up of native species. The alliances with the highest plot-level proportion of neophytes were *Bidention tripartitae*, *Paspalo-Agrostion semiverticillati*, and *Senecionion fluviatilis*. Some alliances had high proportions of native species, e.g. *Epilobion angustifolii*, *Convolvulo arvensis-Agropyrion repentis*, and *Linario polygalifoliae-Vulpion alopecuri*.

Community-level traits

The most frequent life form in the species pool (n = 1,162 species) were hemicryptophytes (44%), followed by therophytes (42%), geophytes (9%), chamaephytes (6%), phanerophytes (6%), bryophytes (1%), and hydrophytes (1%). The proportion of therophytes across classes and alliances (**Fig. 4**) agreed with the traditional description of the syntaxa: therophytes dominated the annual communities of trampled-soil vegetation (*Polygono-Poetea annuae*), crops weeds (*Papaveretea rhoeadis*, *Digitario sanguinalis-Eragrostietea minoris*), and annual ruderals (*Chenopodietea*, *Sisymbrietea*, *Bidentetea*); while perennial life forms (especially hemicryptophytes) dominated walls (*Cymbalario-Parietarietea diffusae*) and perennial ruderal vegetation (*Artemisietea vulgaris*, *Epilobietea angustifolii*). Geophytes represented a relatively high proportion of the vegetation in three alliances: *Allion triquetri*, *Convolvulo arvensis-Agropyrion repentis*, and *Senecionion fluviatilis*.

Community-weighted means for plant height (**Fig. 5A**) also agreed with the expected description of the syntaxa: the shortest communities were the dwarf-herb vegetation of trampled sites (*Polygono-Poetea annuae*, average height = 45.2 cm) and crop weeds (*Papaveretea rhoeadis*, 55.4 cm), while the tallest were the perennial ruderal vegetation of dry (*Artemisietea vulgaris*, 129 cm) and mesic (*Epilobietea angustifolii*, 136 cm) sites. The median month of flowering (**Fig. 5B**) corresponded to May (*Sisymbrietea*, *Chenopodietea*, *Papaveretea rhoeadis*), June (*Cymbalario-Parietarietea diffusae*, *Polygono-Poetea annuae*, *Epilobietea angustifolii*, *Artemisietea vulgaris*) or July (*Digitario sanguinalis-Eragrostietea minoris*, *Bidentetea*). The length of the flowering season (**Fig. 5C**) was generally high, from 5 months (*Artemisietea vulgaris*, *Epilobietea angustifolii*) to 6 (*Chenopodietea*, *Sisymbrietea*), 7 (*Bidentetea*, *Digitario sanguinalis-Eragrostietea minoris*, *Papaveretea rhoeadis*), 8 (*Polygono-Poetea annuae*), or 9 (*Cymbalario-Parietarietea diffusae*).

Community-level ecological preferences

To visualize the major patterns of variation in the ecological and disturbance preferences of the different anthropogenic communities (**Fig. 6**) we performed a PCA ordination of plot-level means (**Fig. 7**). The first two PCA axes explained 59% of the variability. The major contributors to axis 1 (36% variance explained) were light, nutrient, and moisture requirements; it separated communities of open, dry and comparatively nutrient-poorer sites (classes *Papaveretea rhoeadis*, *Polygono-Poetea annuae*, *Sisymbrietea*, *Artemisietea vulgaris*, *Chenopodietea*, and *Digitario sanguinalis-Eragrostietea minoris*) from communities of shady, moist and nutrient-richer sites (classes *Cymbalario-Parietarietea diffusae*, *Bidentetea*, and *Epilobietea angustifolii*). The major contributors to axis 2 (23% variance explained) were disturbance severity and frequency; this axis separated communities preferring less severe and less frequent disturbances (classes *Cymbalario-Parietarietea diffusae*, *Epilobietea angustifolii*, *Chenopodietea*, *Artemisietea vulgaris* and *Bidentetea*) from communities adapted to more severe and more frequent disturbances (classes *Papaveretea rhoeadis*, *Polygono-Poetea annuae*, *Sisymbrietea* and *Digitario sanguinalis-Eragrostietea minoris*).

Discussion

Our synthesis of the anthropogenic vegetation at the ecoregion level has detected a discrepancy between the number of vegetation units described in the literature (i.e. 38

alliances) and the number supported by numerical classification (28 alliances). Our classification supported that anthropogenic vegetation can be broadly divided into three groups belonging to trampled, weed, and ruderal communities. These groups are organized along a principal axis of variation related to abiotic stress, and a second axis related to disturbance. These two axes determine the characteristics of the communities in terms of species origins and species traits. This synthesis allows for a better understanding of anthropogenic vegetation, as a first step towards a better integration of this biodiversity asset into ecosystem management and nature-based solutions.

Vegetation and habitat classification of anthropogenic communities

Our analysis supports the existence of 28 anthropogenic alliances in the vegetation of the Iberian Atlantic ecoregion. While the core of this vegetation diversity is made up of temperate European alliances, these are enriched by the occurrence of eight Mediterranean alliances (*Galio valantiae-Parietarion judaicae*, *Polycarpion tetraphylli*, *Allion triquetri*, *Chenopodion muralis*, *Echio-Galactition tomentosae*, *Paspalo-Agrostion semiverticillati*, *Balloto-Conion maculati* and *Cynancho-Convolvulion sepium*); plus three alliances that are endemic of the Iberian coasts (*Linario polygalifoliae-Vulpion alopecuri*) and mountains (*Carduo carpetani-Cirsion odontolepidis*, *Cirsion richterano-chodati*) (Mucina et al. 2016). Seven of these alliances had been reported as absent or uncertain in the ecoregion (*Caucalidion lappulae*, *Chenopodion muralis*), or only present in the Portuguese sector of the ecoregion (*Spergulo arvensis-Erodion cicutariae*, *Allion triquetri*, *Echio-Galactition tomentosae*, *Carduo carpetani-Cirsion odontolepidis*, *Cynancho-Convolvulion sepium*) by the recently published distribution maps of vegetation alliances in Europe (Preislerová et al.

2022). Our dataset supports that six of these alliances are relatively well distributed in the ecoregion, while *Caucalidion lappulae* only has isolated occurrences. On the other hand, our dataset does not support the occurrence in the ecoregion of nine Mediterranean alliances (*Roemerion hybridae*, *Diplotaxion erucoidis*, *Euphorbion prostratae*, *Alysso granatensis-Brassicion barrelieri*, *Hordeion murini*, *Taeniathero-Aegilopion geniculatae*, *Parietarion lusitanico-mauritanicae*, *Onopordion castellani*, *Silybo mariani-Urticion piluliferae*) and one temperate alliance (*Fragarion vescae*) that had been cited as potentially occurring here (Izco et al. 2000; Mucina et al. 2016; Díaz González 2020; Durán Gómez 2020; Preislerová et al. 2022). For habitat classification purposes, we propose that this vegetation diversity can be summarized into 15 EUNIS habitat types: one constructed habitat (*J2.5*), ten vegetated human-made habitats (*V11*, *V12*, *V13*, *V15*, *V32*, *V35*, *V34*, *V37*, *V38*, *V39*), three habitats of woodland fringes and clearings and tall forb stands (*R54*, *R55*, *R57*) and one habitat of periodically-exposed shores (*Q61*). In general, we have followed the correspondence between alliances and EUNIS habitats proposed by the EUNIS expert system (Chytrý et al. 2020), except for *Echio-Galactition tomentosae* which, in the context of the ecoregion, seems to be more adequately placed in the habitat *V37 Annual anthropogenic herbaceous vegetation* rather than in the habitat *V33 Dry Mediterranean land with unpalatable non-vernal herbaceous vegetation*.

Since our goal was to match the classification of the ecoregion classification to the EuroVegChecklist (Mucina et al. 2016), we refrained from merging recognized alliances or changing their assignation to superior syntaxa. However, there are some cases that could deserve further scrutiny. For example, the two wall alliances (*Galio valantiae-Parietarion* *judaicae* and *Cymbalario-Asplenion*) had a large overlap in their geographic distribution, their floristic composition, their proportion of alien species, their community traits, and their ecological preferences. These two alliances are well recognized in the European literature, and they are generally interpreted as representing the Mediterranean (*Galio valantiae-Parietarion judaicae*) and temperate (*Cymbalario-Asplenion*) versions of wall vegetation (Brullo & Guarino 1998; Jasprica et al. 2021). It is therefore not surprising that in biogeographic transitional regions - such as the Iberian Atlantic territories - these two alliances coexist and show a high overlap. Also, there was overlap between the alliances *Geo urbani-Alliarion officinalis* and *Aegopodion podagrariae*, two alliances that can occupy ruderal to semi-natural nitrophilous fringes, and which are mostly differentiated by dominant vegetation height, as was supported by our dataset.

Characterization of anthropogenic communities

We found 22% non-native species (including neophytes and archaeophytes) in the anthropogenic vegetation of the Iberian Atlantic ecoregion. This percentage is intermediate between that found in urban areas of temperate Europe and North America (30-50%) (Pyšek 1998; Clemants & Moore 2003; La Sorte et al. 2007; Lososová et al. 2012) and Italy (12-26%) (Celesti-Grapow & Blasi 1998). A survey of anthropogenic vegetation in the north-west Balkans found 13% non-native plants, with more neophytes than archaeophytes (Silc et al. 2012). A similar study in the Czech Republic found 32% archaeophytes and 7% neophytes (Simonova & Lososová 2008). Taken together, these results suggest that the Iberian Atlantic anthropogenic vegetation shows an incidence of non-native species that is intermediate between southern and central-northern Europe, which is in agreement with the biogeographical position of our ecoregion. Previous studies also suggested that the non-natives were more frequent in early successional anthropogenic communities (Pyšek et al. 2004), and our results confirmed this as the proportion of native species tended to be higher in the perennial ruderal classes *Artemisietea vulgaris* and *Epilobietea angustifolii*. The classes with more non-native species also tended to be those adapted to more frequent and more severe disturbances (*Papaveretea rhoeadis*, *Digitario sanguinalis-Eragrostietea minoris*, *Sisymbrietea*), also in agreement with previous research (Simonova & Lososová 2008). Archaeophytes had a higher proportion in the vegetation associated to arable habitats (*Papaveretea rhoeadis*, *Digitario sanguinalis-Eragrostietea minoris*, *Sisymbrietea*), in agreement with the ancient origin of archaeophytes during the development of agriculture (Zohary 1950; Preston et al. 2004). On the other hand, neophytes tended to be in higher proportions in vegetation types associated to wet conditions (*Bidentetea*), as has been found in other European regions (Chytrý et al. 2008).

The traits of the Iberian Atlantic anthropogenic communities agreed with those found in other European regions (Lososová et al. 2006; Silc 2010), with more annual species in habitats associated to arable land and more perennials in ruderal habitats, and a general dominance of therophytes and hemicryptophytes in the species pool (Tabasevic, Lakusic, et al. 2021). We found that the main drivers of variation in anthropogenic community composition was a gradient from open-dry to shady-wet sites, supporting the importance of the moisture gradient in shaping anthropogenic vegetation (Golovanov et al. 2023). Mesic and moist human-made habitats of the Iberian Atlantic territories harbor perennial communities, some of which are especially rich in native species and have semi-natural characters. At the same time, the wetter habitats have some of the higher prevalences of non-native species.

Conclusions

Ecoregion-level synthesis detected a discrepancy between the number of anthropogenic vegetation units described in the literature and the number supported by numerical classification. The diversity of anthropogenic vegetation can be organized into trampled, weed and ruderal communities varying primarily along an axis of abiotic stress. Importantly, the anthropogenic vegetation of the Iberian Atlantic ecoregion is home to 1,162 plant taxa. This is approximately one third of the whole ecoregion species pool represented in the SIVIM database (Font et al. 2012), and one fifth of the Iberian flora (Ramos-Gutiérrez et al. 2021). More than half of this synanthropic diversity (615 taxa) occurs in mesic to wet perennial ruderal vegetation, highlighting the potential of some anthropogenic habitats as a source of biodiversity in human-dominated landscapes (Anderson & Minor 2017; Kowarik 2018). These results suggest three main objectives for the sustainable management of human-made habitats: (1) focusing efforts on alien plant management in anthropogenic plant communities of wet habitats; (2) conserving examples of archaeophyte-rich annual weed communities, especially those linked to traditional agricultural practices (Meyer et al. 2013); and (3) conserving and promoting mesic ruderal and fringe vegetation as a biodiversity refuge in urban and peri-urban areas.

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Supplementary Information

Appendix S1 Checklist of anthropogenic syntaxa that could be present in the Iberian Atlantic ecoregion according to the literature. Syntaxa names are provided as recorded by the original authors of the vegetation plot. The file indicates if the presence of the syntaxon in the Iberian Atlantic ecoregion was validated or not by our analysis.

Appendix S2 Original publications providing the vegetation plots stored in SIVIM and used in our analysis.

Appendix S3 Characteristic species combinations of the anthropogenic vegetation alliances in spreadsheet format, divided into diagnostic, constant, and dominant species.

Appendix S4 Synthetic description of the 28 alliances present in the Iberian Atlantic anthropogenic vegetation.

Appendix S5 Revised checklist of vegetation associations described in the regional literature and belonging to the 28 alliances present in the Iberian Atlantic anthropogenic vegetation.

Figures

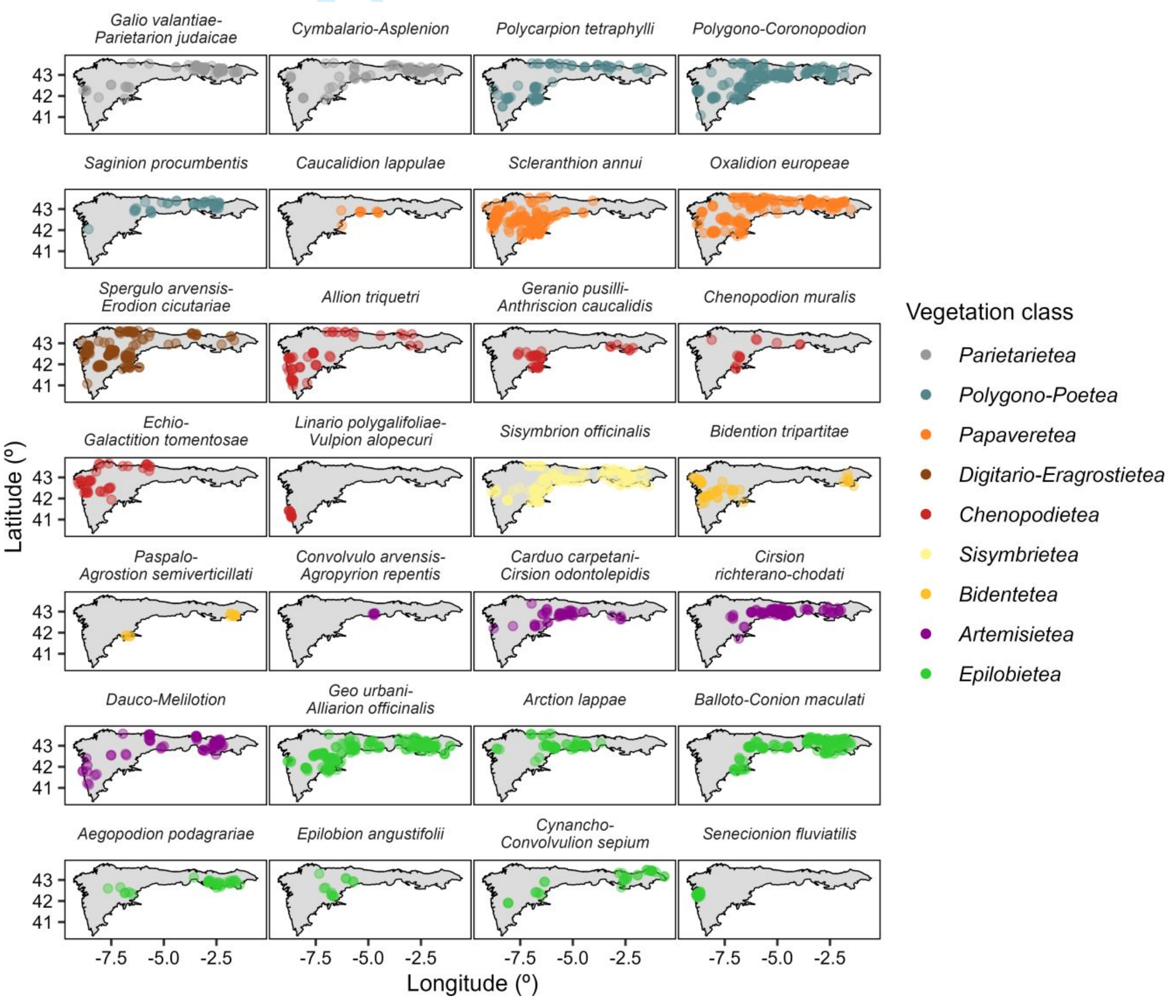

Figure 1: Anthropogenic vegetation alliances of the Iberian Atlantic ecoregion. Each dot is a vegetation plot. Dot colors indicate the vegetation class.

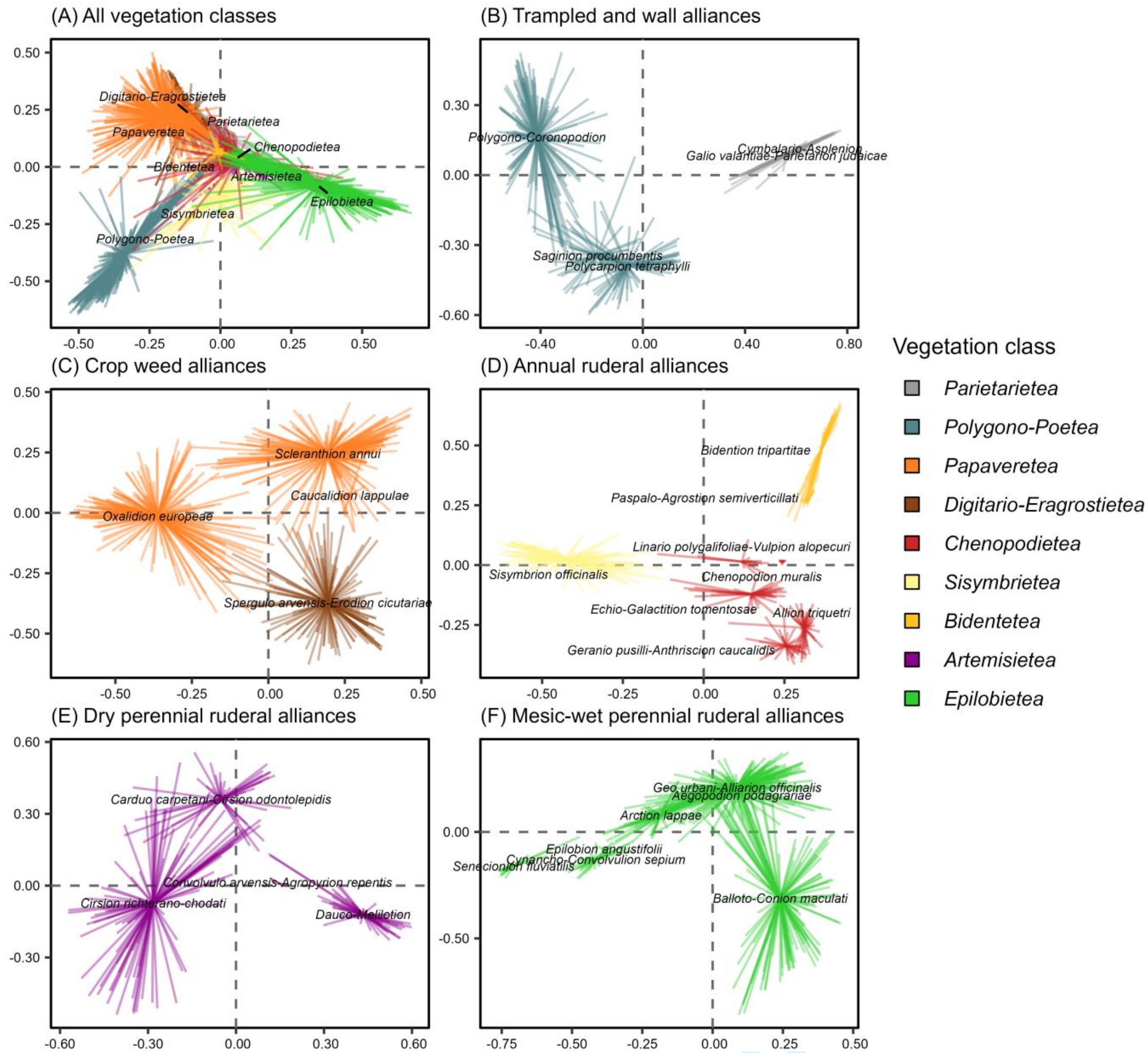

Figure 2: Floristic diversity of the anthropogenic plant communities of the Iberian Atlantic ecoregion. Biplots produced by Principal Component Analysis (PCA) with Hellinger transformation. PCAs were conducted for the whole vegetation (A) and for specific subsets (B-F). Colors indicate the vegetation class.

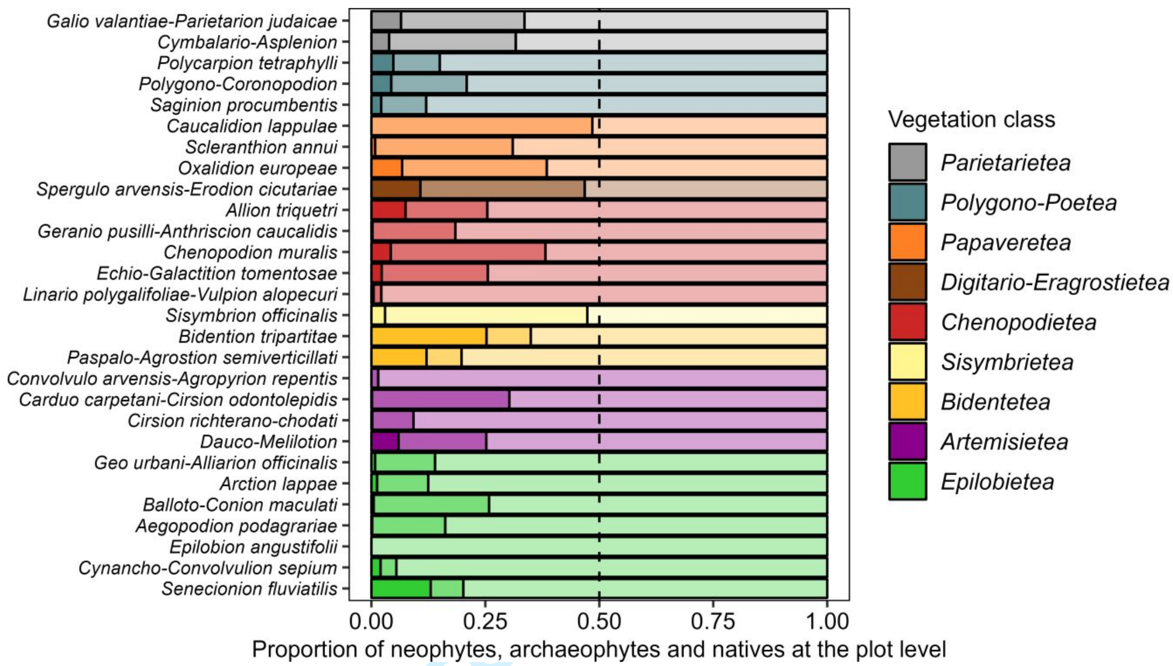

Figure 3: Proportion of neophytes, archaeophytes, and native species in the anthropogenic plant communities of the Iberian Atlantic ecoregion. Each bar represents the plot-level average proportion of neophytes (dark shade), archaeophytes (medium shade), and natives (light shade) in each vegetation alliance. Colors indicate the vegetation class.

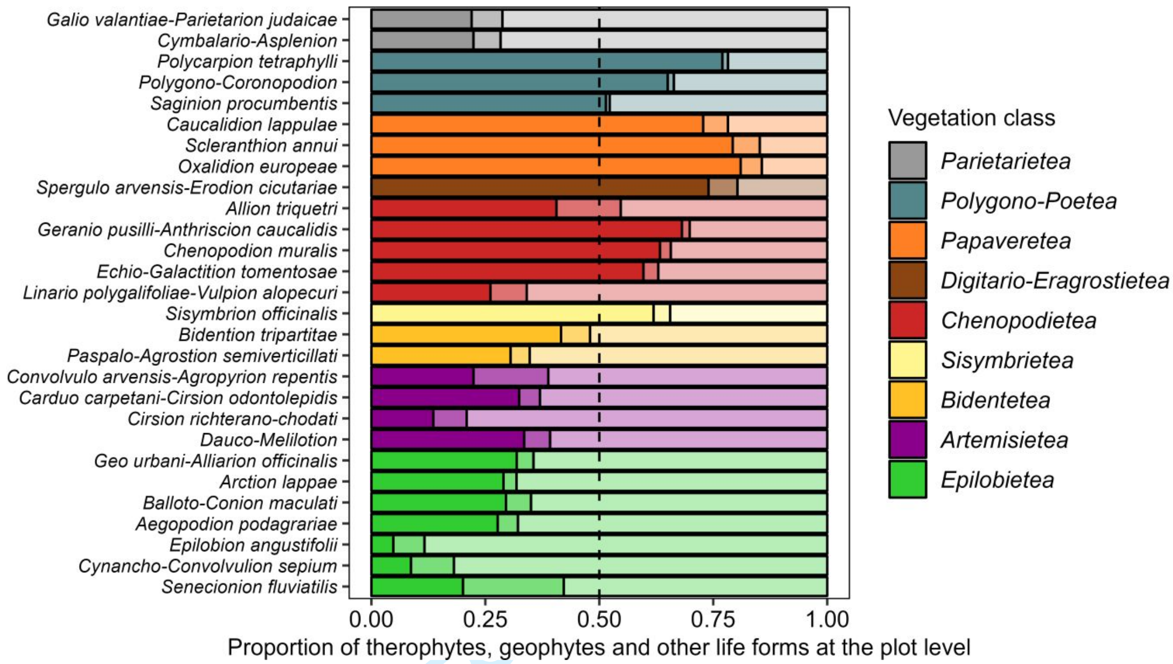

Figure 4: Proportion of therophytes, geophytes, and other life forms (hemicryptophytes, chamaephytes, phanerophytes, bryophytes, hydrophytes) in the anthropogenic plant communities of the Iberian Atlantic ecoregion. Each bar represents the plot-level average proportion of therophytes (dark shade), geophytes (medium shade), and other life forms (light shade) in each vegetation alliance. Colors indicate the vegetation class.

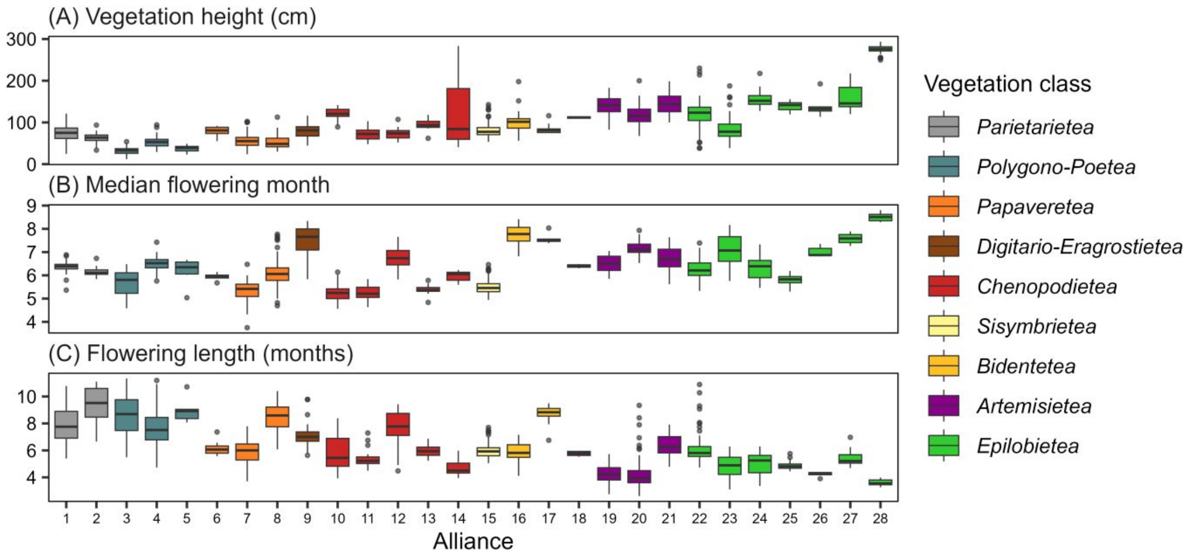

Figure 5: Vegetation height and flowering phenology of the anthropogenic plant communities of the Iberian Atlantic ecoregion. Boxplots show the community-weighted mean for plant height, median month of flowering, and length of the flowering season for each vegetation alliance. Colors indicate the vegetation class. Alliances as ordered as in Figures 1 and 3-4, and alliance numbers are the same as listed in Appendix S4.

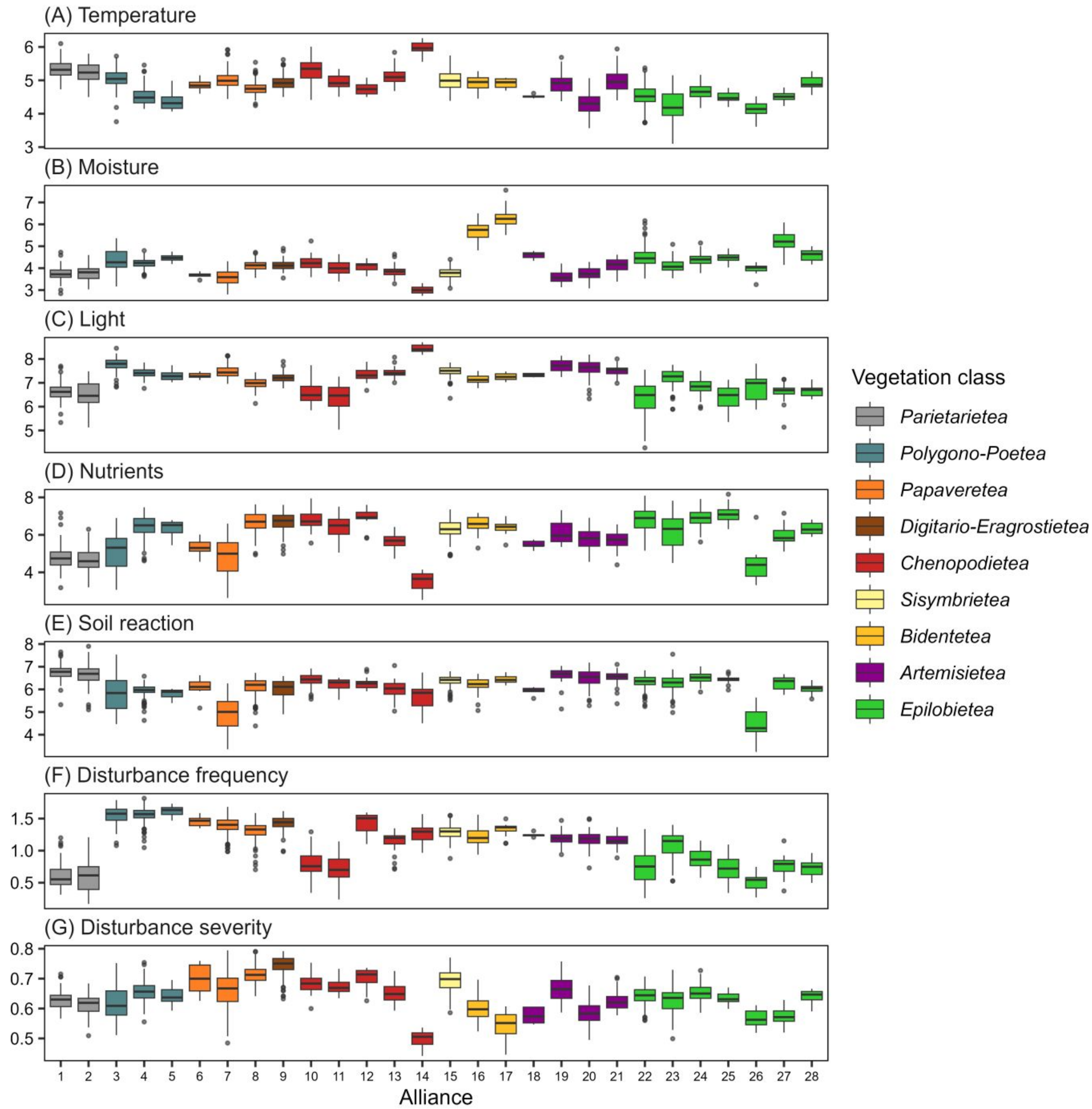

Figure 6: Ecological requirements of the anthropogenic plant communities of the Iberian Atlantic ecoregion. Boxplots show the plot-level means for the ecological indicator values of temperature, moisture, light, nutrients, soil reaction, disturbance frequency, and disturbance severity, calculated for each vegetation alliance. Colors indicate the vegetation class.

Alliances as ordered as in Figures 1 and 3-4, and alliance numbers are the same as listed in Appendix S4.

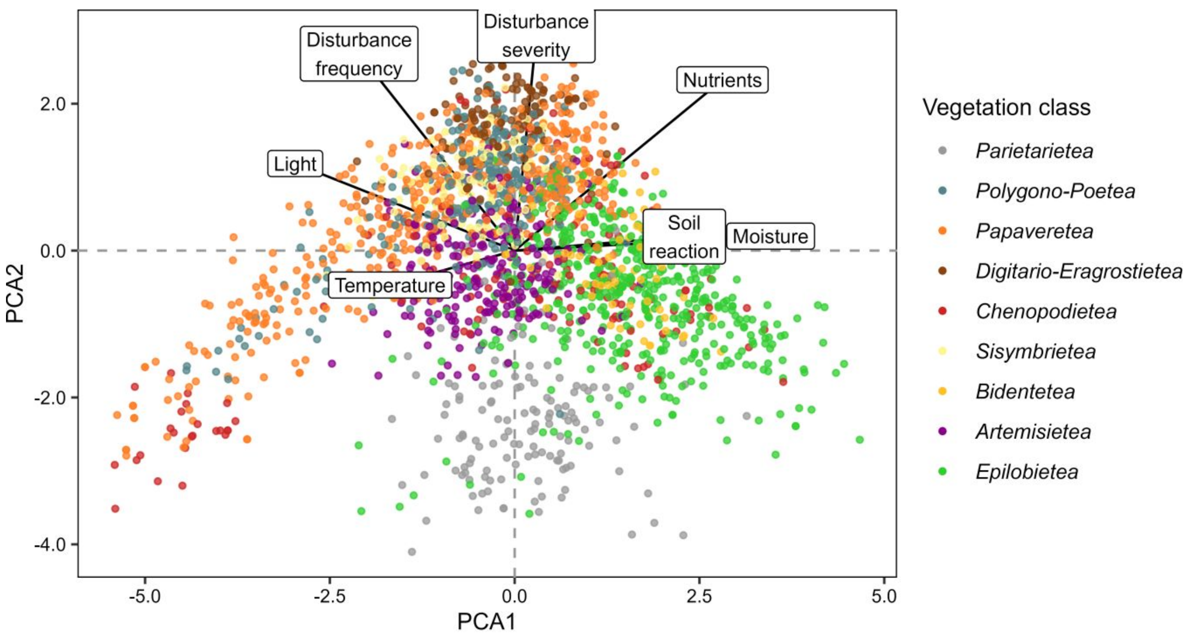

Figure 7: Ecological requirements of the anthropogenic plant communities of the Iberian Atlantic ecoregion. Biplot produced by Principal Component Analysis (PCA) of the plot-level means for the ecological indicator values of temperature, moisture, light, nutrients, soil reaction, disturbance frequency, and disturbance severity. Labels and arrows indicate the contribution of each indicator to the first and second principal components. Colors indicate the vegetation class.

SIVIM_sint	Alliance	Order	Class	Vegetation	Iberian_Atlantic
Comunidad	Convolvulo	Agropyreta	Artemisiete	ANTHROP	Yes
Carduo car	Carduo car	Carthameta	Artemisiete	ANTHROP	Yes
Comunidad	Carduo car	Carthameta	Artemisiete	ANTHROP	Yes
Carlino cor	Onopordion	Carthameta	Artemisiete	ANTHROP	No
Onopordet	Onopordion	Carthameta	Artemisiete	ANTHROP	No
Onopordion	Onopordion	Carthameta	Artemisiete	ANTHROP	No
Carduo bou	Silybo mari	Carthameta	Artemisiete	ANTHROP	No
Carduo bou	Silybo mari	Carthameta	Artemisiete	ANTHROP	No
Comunidad	Silybo mari	Carthameta	Artemisiete	ANTHROP	No
Echio rosul	Silybo mari	Carthameta	Artemisiete	ANTHROP	No
Carduo nut	Cirsion rich	Onopordeta	Artemisiete	ANTHROP	Yes
Carduo nut	Cirsion rich	Onopordeta	Artemisiete	ANTHROP	Yes
Cirsio chod	Cirsion rich	Onopordeta	Artemisiete	ANTHROP	Yes
Cirsio chod	Cirsion rich	Onopordeta	Artemisiete	ANTHROP	Yes
Comunidad	Cirsion rich	Onopordeta	Artemisiete	ANTHROP	Yes
Comunidad	Cirsion rich	Onopordeta	Artemisiete	ANTHROP	Yes
Comunidad	Dauco-Meli	Onopordeta	Artemisiete	ANTHROP	Yes
Comunidad	Dauco-Meli	Onopordeta	Artemisiete	ANTHROP	Yes
Echio rosul	Dauco-Meli	Onopordeta	Artemisiete	ANTHROP	Yes
Helmintio e	Dauco-Meli	Onopordeta	Artemisiete	ANTHROP	Yes
Picridi echi	Dauco-Meli	Onopordeta	Artemisiete	ANTHROP	Yes
Bidentetea	Bidention tr	Bidentetalia	Bidentetea	ANTHROP	Yes
Bidenti tripa	Bidention tr	Bidentetalia	Bidentetea	ANTHROP	Yes
Cypero era	Bidention tr	Bidentetalia	Bidentetea	ANTHROP	Yes
Filaginello	Bidention tr	Bidentetalia	Bidentetea	ANTHROP	Yes
Polygono h	Bidention tr	Bidentetalia	Bidentetea	ANTHROP	Yes
Xanthio ital	Bidention tr	Bidentetalia	Bidentetea	ANTHROP	Yes
Xanthio-Po	Bidention tr	Bidentetalia	Bidentetea	ANTHROP	Yes
Comunidad	Paspalo-Ag	Paspalo-He	Bidentetea	ANTHROP	Yes
Paspalo-Ag	Paspalo-Ag	Paspalo-He	Bidentetea	ANTHROP	Yes
Coincyo se	Alysso gran	Brometalia	Chenopodi	ANTHROP	No
Coleosteph	Echio-Gala	Brometalia	Chenopodi	ANTHROP	Yes
Asociaci�r	Hordeion m	Brometalia	Chenopodi	ANTHROP	No
Bromo scop	Hordeion m	Brometalia	Chenopodi	ANTHROP	No
Carduo ten	Hordeion m	Brometalia	Chenopodi	ANTHROP	No
Comunidad	Hordeion m	Brometalia	Chenopodi	ANTHROP	No
Scrophulari	Linario poly	Brometalia	Chenopodi	ANTHROP	Yes
Medicagini	Taeniather	Brometalia	Chenopodi	ANTHROP	No
Trifolio che	Taeniather	Brometalia	Chenopodi	ANTHROP	No
Chenopodi	Chenopodi	Chenopodi	Chenopodi	ANTHROP	Yes
Chenopodi	Chenopodi	Chenopodi	Chenopodi	ANTHROP	Yes
Chenopodi	Chenopodi	Chenopodi	Chenopodi	ANTHROP	Yes
Sisymbrio i	Chenopodi	Chenopodi	Chenopodi	ANTHROP	Yes
Urtico uren	Chenopodi	Chenopodi	Chenopodi	ANTHROP	Yes
Allio triquet	Allion trique	Geranio pu	Chenopodi	ANTHROP	Yes
Chelidonio	Allion trique	Geranio pu	Chenopodi	ANTHROP	Yes
Comunidad	Allion trique	Geranio pu	Chenopodi	ANTHROP	Yes
Urtico-Smy	Allion trique	Geranio pu	Chenopodi	ANTHROP	Yes
Anthrisco c	Geranio pu	Geranio pu	Chenopodi	ANTHROP	Yes
Anthrisco-G	Geranio pu	Geranio pu	Chenopodi	ANTHROP	Yes
Comunidad	Geranio pu	Geranio pu	Chenopodi	ANTHROP	Yes
Galio apari	Geranio pu	Geranio pu	Chenopodi	ANTHROP	Yes
Anogramm	Parietarion	Geranio pu	Chenopodi	ANTHROP	No
Comunidad	Cymbalario	Tortulo-Cyr	Cymbalario	VEGETATI	Yes
Cymbalarie	Cymbalario	Tortulo-Cyr	Cymbalario	VEGETATI	Yes

Cymbalario	Cymbalario	Tortulo-Cyr	Cymbalario	VEGETATI	Yes
Centrantho	Galio valan	Tortulo-Cyr	Cymbalario	VEGETATI	Yes
Hedero-Pol	Galio valan	Tortulo-Cyr	Cymbalario	VEGETATI	Yes
Oxalido-Pa	Galio valan	Tortulo-Cyr	Cymbalario	VEGETATI	Yes
Oxali-Parie	Galio valan	Tortulo-Cyr	Cymbalario	VEGETATI	Yes
Parietarietu	Galio valan	Tortulo-Cyr	Cymbalario	VEGETATI	Yes
Polypodion	Galio valan	Tortulo-Cyr	Cymbalario	VEGETATI	Yes
Heliotropio-	Diplotaxion	Eragrostieta	Digitario sa	ANTHROP	No
Amarantho	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Asociaci�r	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Asociaci�r	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Comunidac	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Lamio (hyb	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Lamio diss	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Lamio hybr	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Panico-Set	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Panicum cr	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Panicum sa	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Setario ver	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Setario-Ech	Spergulo a	Eragrostieta	Digitario sa	ANTHROP	Yes
Euphorbiet	Euphorbior	Euphorbieta	Digitario sa	ANTHROP	No
Gnaphaliio	Euphorbior	Euphorbieta	Digitario sa	ANTHROP	No
Arction	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Asociaci�r	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Chenopodi	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Chenopodi	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Chenopodi	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Comunidac	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Comunidac	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Comunidac	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Galactito to	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Geranio lus	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Malvo mau	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Senecioni c	Arction lapp	Arctio lappa	Epilobietea	ANTHROP	Yes
Balloto foet	Balloto-Cor	Arctio lappa	Epilobietea	ANTHROP	Yes
Balloto-Cor	Balloto-Cor	Arctio lappa	Epilobietea	ANTHROP	Yes
Comunidac	Balloto-Cor	Arctio lappa	Epilobietea	ANTHROP	Yes
Galio apari	Balloto-Cor	Arctio lappa	Epilobietea	ANTHROP	Yes
Urtico dioic	Balloto-Cor	Arctio lappa	Epilobietea	ANTHROP	Yes
Chaerophy	Aegopodio	Circaeo lut	Epilobietea	ANTHROP	Yes
Galio apari	Aegopodio	Circaeo lut	Epilobietea	ANTHROP	Yes
Atropetum	Fragarion v	Circaeo lut	Epilobietea	ANTHROP	No
Comunidac	Cynancho-	Convolvule	Epilobietea	ANTHROP	Yes
Convolvulo	Cynancho-	Convolvule	Epilobietea	ANTHROP	Yes
Picridio hie	Cynancho-	Convolvule	Epilobietea	ANTHROP	Yes
Picrido hier	Cynancho-	Convolvule	Epilobietea	ANTHROP	Yes
Arundini-Co	Senecionio	Convolvule	Epilobietea	ANTHROP	Yes
Comunidac	Senecionio	Convolvule	Epilobietea	ANTHROP	Yes
Asphodelo	Epilobion a	Galeopsio-	Epilobietea	ANTHROP	Yes
Asphodelo	Epilobion a	Galeopsio-	Epilobietea	ANTHROP	Yes
Comunidac	Epilobion a	Galeopsio-	Epilobietea	ANTHROP	Yes
Alliarion pe	Geo urbani	Galio-Alliar	Epilobietea	ANTHROP	Yes
Geranietum	Geo urbani	Galio-Alliar	Epilobietea	ANTHROP	Yes
Geranio rot	Geo urbani	Galio-Alliar	Epilobietea	ANTHROP	Yes
Geranio rot	Geo urbani	Galio-Alliar	Epilobietea	ANTHROP	Yes
Oxalido ace	Geo urbani	Galio-Alliar	Epilobietea	ANTHROP	Yes

Chrysanthe	Oxalidion e	Aperetalia s	Papaveretea	ANTHROP	Yes
Comunidad	Oxalidion e	Aperetalia s	Papaveretea	ANTHROP	Yes
Fumario ca	Oxalidion e	Aperetalia s	Papaveretea	ANTHROP	Yes
Holosteo u	Oxalidion e	Aperetalia s	Papaveretea	ANTHROP	Yes
Lamio amp	Oxalidion e	Aperetalia s	Papaveretea	ANTHROP	Yes
Oxalidi latif	Oxalidion e	Aperetalia s	Papaveretea	ANTHROP	Yes
Polygono-C	Oxalidion e	Aperetalia s	Papaveretea	ANTHROP	Yes
Polygonum	Oxalidion e	Aperetalia s	Papaveretea	ANTHROP	Yes
Aperetalia s	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Aphanion a	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Asociaci�r	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Asociaci�r	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Asociaci�r	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Bunio-Vicie	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Catapodiet	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Centaureo	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Chenopodi	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Chrysanten	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Chrysanthe	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Cnico bene	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Comunidad	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Comunidad	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Comunidad	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Comunidad	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Comunidad	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Linaria delp	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Linario ame	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Linario eleg	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Linario eleg	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Miboro min	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Secalietalia	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Spergularic	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Tolpidi bart	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Triseto ova	Scleranthio	Aperetalia s	Papaveretea	ANTHROP	Yes
Veronico tri	Roemerion	Gladiolo ita	Papaveretea	ANTHROP	No
Centaureet	Caucalidion	Papavereta	Papaveretea	ANTHROP	Yes
Cerutoceph	Caucalidion	Papavereta	Papaveretea	ANTHROP	Yes
Crassulo til	Polycarpion	Polygono a	Polygono-F	ANTHROP	Yes
Polycarpion	Polycarpion	Polygono a	Polygono-F	ANTHROP	Yes
Polycarpo t	Polycarpion	Polygono a	Polygono-F	ANTHROP	Yes
Poo annua	Polycarpion	Polygono a	Polygono-F	ANTHROP	Yes
Comunidad	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Coronopod	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Matricario-I	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Matricario-I	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Polycarpo t	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Polygono a	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Polygono a	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Polygono-C	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Polygono-N	Polygono-C	Polygono a	Polygono-F	ANTHROP	Yes
Bryo argen	Saginion pr	Polygono a	Polygono-F	ANTHROP	Yes
Bryo argen	Saginion pr	Polygono a	Polygono-F	ANTHROP	Yes
Sagino pro	Saginion pr	Polygono a	Polygono-F	ANTHROP	Yes
Sagino-Bry	Saginion pr	Polygono a	Polygono-F	ANTHROP	Yes
Bromo diar	Sisymbrion	Sisymbrieta	Sisymbriete	ANTHROP	Yes
Bromo-Hor	Sisymbrion	Sisymbrieta	Sisymbriete	ANTHROP	Yes

Comunidad	Sisymbrion	Sisymbrieta	Sisymbriete	ANTHROP	Yes
Sisymbrio c	Sisymbrion	Sisymbrieta	Sisymbriete	ANTHROP	Yes

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Penas Meri	1988	Datos sobr	Lazaroa, 10: 65-79.
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Alliance	Species	Type	Value
Aegopodio	Urtica dioic	Constant	100
Aegopodio	Anthriscus	Constant	100
Aegopodio	Galium apa	Constant	97.05882
Aegopodio	Heracleum	Constant	79.41176
Aegopodio	Anisantha s	Constant	67.64706
Aegopodio	Geranium p	Constant	58.82353
Aegopodio	Lamium ma	Constant	50
Aegopodio	Rumex obt	Constant	50
Aegopodio	Anthriscus	Diagnostic	97.58415
Aegopodio	Heracleum	Diagnostic	58.05971
Aegopodio	Galium apa	Diagnostic	34.1514
Aegopodio	Anthriscus	Dominant	97.05882
Aegopodio	Urtica dioic	Dominant	38.23529
Aegopodio	Galium apa	Dominant	26.47059
Allion trique	Urtica mem	Constant	67.85714
Allion trique	Sonchus ol	Constant	58.92857
Allion trique	Urtica mem	Diagnostic	64.40183
Allion trique	Smyrnium (	Diagnostic	45.56765
Allion trique	Tradescant	Diagnostic	34.79457
Allion trique	Smyrnium (	Dominant	46.42857
Allion trique	Urtica mem	Dominant	44.64286
Allion trique	Tradescant	Dominant	14.28571
Allion trique	Urtica dioic	Dominant	10.71429
Allion trique	Allium triqu	Dominant	7.142857
Arction lap	Urtica dioic	Constant	89.28571
Arction lap	Oxybasis ru	Constant	64.28571
Arction lap	Senecio du	Constant	57.14286
Arction lap	Oxybasis ru	Diagnostic	63.40707
Arction lap	Senecio du	Diagnostic	53.84273
Arction lap	Oxybasis ru	Dominant	33.92857
Arction lap	Senecio du	Dominant	14.28571
Arction lap	Urtica dioic	Dominant	10.71429
Arction lap	Blitum bonu	Dominant	7.142857
Balloto-Cor	Urtica dioic	Constant	96.06299
Balloto-Cor	Sambucus	Constant	81.88976
Balloto-Cor	Galium apa	Constant	74.80315
Balloto-Cor	Sambucus	Diagnostic	74.4542
Balloto-Cor	Sambucus	Dominant	59.05512
Balloto-Cor	Urtica dioic	Dominant	27.55906
Balloto-Cor	Conium ma	Dominant	22.04724
Balloto-Cor	Galium apa	Dominant	10.23622
Bidention tr	Lythrum sa	Constant	87.23404
Bidention tr	Persicaria h	Constant	80.85106
Bidention tr	Bidens fron	Constant	70.21277
Bidention tr	Helosciadiu	Constant	59.57447
Bidention tr	Lycopus eu	Constant	57.44681
Bidention tr	Phalaroides	Constant	55.31915
Bidention tr	Cyperus er	Constant	53.19149
Bidention tr	Echinochlo	Constant	53.19149
Bidention tr	Persicaria l	Constant	51.06383
Bidention tr	Persicaria h	Diagnostic	80.12695
Bidention tr	Bidens fron	Diagnostic	70.16011
Bidention tr	Lythrum sa	Diagnostic	59.32772
Bidention tr	Helosciadiu	Diagnostic	55.99265
Bidention tr	Phalaroides	Diagnostic	53.24776

Bidention tr	Cyperus er	Diagnostic	50.0326
Bidention tr	Dysphania	Diagnostic	38.0004
Bidention tr	Bidens fron	Dominant	59.57447
Bidention tr	Persicaria I	Dominant	53.19149
Bidention tr	Persicaria I	Dominant	27.65957
Bidention tr	Xanthium o	Dominant	19.14894
Bidention tr	Lythrum sa	Dominant	8.510638
Bidention tr	Artemisia v	Dominant	8.510638
Carduo car	Onopordun	Constant	88.37209
Carduo car	Echium vul	Constant	67.44186
Carduo car	Carduus ca	Constant	60.46512
Carduo car	Dipsacus fu	Constant	55.81395
Carduo car	Lactuca vir	Constant	51.16279
Carduo car	Rumex cris	Constant	51.16279
Carduo car	Onopordun	Diagnostic	86.21676
Carduo car	Onopordun	Dominant	48.83721
Carduo car	Echium vul	Dominant	11.62791
Carduo car	Carduus ca	Dominant	6.976744
Caucalidior	Cyanus seg	Constant	100
Caucalidior	Papaver rh	Constant	90
Caucalidior	Anthemis a	Constant	80
Caucalidior	Convolvulu	Constant	60
Caucalidior	Vicia sativa	Constant	60
Caucalidior	Trifolium ar	Constant	50
Caucalidior	Anacyclus	Constant	50
Caucalidior	Bromus ho	Constant	50
Caucalidior	Chenopodi	Constant	50
Caucalidior	Trifolium ca	Constant	50
Caucalidior	Cyanus seg	Diagnostic	96.69095
Caucalidior	Papaver rh	Diagnostic	70.22851
Caucalidior	Trifolium ar	Diagnostic	38.74341
Caucalidior	Anacyclus	Diagnostic	37.17855
Caucalidior	Valerianella	Diagnostic	20
Caucalidior	Cyanus seg	Dominant	30
Caucalidior	Anthoxanth	Dominant	10
Caucalidior	Anacyclus	Dominant	10
Caucalidior	Papaver rh	Dominant	10
Chenopodi	Malva negl	Constant	85.71429
Chenopodi	Polygonum	Constant	64.28571
Chenopodi	Urtica uren	Constant	64.28571
Chenopodi	Plantago la	Constant	57.14286
Chenopodi	Ochlopoa a	Constant	50
Chenopodi	Malva negl	Diagnostic	74.80469
Chenopodi	Urtica uren	Diagnostic	62.6446
Chenopodi	Urtica uren	Dominant	28.57143
Chenopodi	Amaranthu	Dominant	14.28571
Chenopodi	Atriplex ros	Dominant	14.28571
Chenopodi	Artemisia a	Dominant	7.142857
Chenopodi	Polygonum	Dominant	7.142857
Chenopodi	Malva negl	Dominant	7.142857
Cirsion rich	Carduus ca	Constant	64
Cirsion rich	Cirsium eri	Constant	63
Cirsion rich	Jacobaea v	Constant	56
Cirsion rich	Cirsium vul	Constant	55
Cirsion rich	Cirsium arv	Constant	52
Cirsion rich	Cirsium eri	Diagnostic	59.98642

Cirsion rich	Carduus ca	Diagnostic	40.5036
Cirsion rich	Carduus nu	Diagnostic	35.80729
Cirsion rich	Cirsium eri	Dominant	22
Cirsion rich	Cirsium rich	Dominant	19
Cirsion rich	Carduus ca	Dominant	15
Cirsion rich	Carduus nu	Dominant	9
Cirsion rich	Cirsium arv	Dominant	9
Cirsion rich	Jacobaea v	Dominant	5
Convolvulo	Avenella fle	Constant	100
Convolvulo	Poa compr	Constant	100
Convolvulo	Potentilla re	Constant	100
Convolvulo	Rumex cris	Constant	100
Convolvulo	Elytrigia rep	Constant	100
Convolvulo	Valerianella	Constant	80
Convolvulo	Cirsium arv	Constant	60
Convolvulo	Rumex con	Constant	60
Convolvulo	Sisymbrella	Constant	60
Convolvulo	Herniaria g	Constant	60
Convolvulo	Carex hirta	Constant	60
Convolvulo	Chamaeme	Constant	60
Convolvulo	Convolvulu	Constant	60
Convolvulo	Poa compr	Diagnostic	99.85401
Convolvulo	Elytrigia rep	Diagnostic	98.09415
Convolvulo	Potentilla re	Diagnostic	88.36032
Convolvulo	Valerianella	Diagnostic	64.68805
Convolvulo	Sisymbrella	Diagnostic	59.85528
Convolvulo	Avenella fle	Diagnostic	55.82589
Convolvulo	Herniaria g	Diagnostic	51.77459
Convolvulo	Carex hirta	Diagnostic	46.47453
Convolvulo	Rumex cris	Diagnostic	42.5174
Convolvulo	Carum vert	Diagnostic	39.95322
Convolvulo	Sanguisorb	Diagnostic	39.31741
Convolvulo	Elytrigia rep	Dominant	100
Convolvulo	Potentilla re	Dominant	40
Cymbalario	Cymbalaria	Constant	100
Cymbalario	Asplenium	Constant	67.79661
Cymbalario	Parietaria ju	Constant	52.54237
Cymbalario	Cymbalaria	Diagnostic	79.10389
Cymbalario	Cymbalaria	Dominant	57.62712
Cynancho-(	Eupatorium	Constant	100
Cynancho-(	Picris hiera	Constant	73.52941
Cynancho-(	Angelica sy	Constant	67.64706
Cynancho-(	Mentha sua	Constant	58.82353
Cynancho-(	Rubus ulmi	Constant	50
Cynancho-(	Eupatorium	Diagnostic	96.31208
Cynancho-(	Angelica sy	Diagnostic	64.24655
Cynancho-(	Picris hiera	Diagnostic	44.4771
Cynancho-(	Eupatorium	Dominant	61.76471
Cynancho-(	Mentha sua	Dominant	17.64706
Cynancho-(	Angelica sy	Dominant	14.70588
Cynancho-(	Mentha lon	Dominant	5.882353
Cynancho-(	Ranunculus	Dominant	5.882353
Dauco-Meli	Daucus car	Constant	89.85507
Dauco-Meli	Helminthotl	Constant	65.21739
Dauco-Meli	Plantago la	Constant	55.07246
Dauco-Meli	Foeniculum	Constant	53.62319

Dauco-Meli	Holcus lana	Constant	52.17391
Dauco-Meli	Dactylis glo	Constant	50.72464
Dauco-Meli	Helminthotl	Diagnostic	55.37944
Dauco-Meli	Daucus car	Diagnostic	50.5155
Dauco-Meli	Melilotus al	Diagnostic	44.07194
Dauco-Meli	Foeniculum	Diagnostic	40.92062
Dauco-Meli	Foeniculum	Dominant	24.63768
Dauco-Meli	Melilotus al	Dominant	20.28986
Dauco-Meli	Helminthotl	Dominant	15.94203
Dauco-Meli	Dipsacus fu	Dominant	10.14493
Dauco-Meli	Erigeron ca	Dominant	5.797101
Dauco-Meli	Daucus car	Dominant	5.797101
Echio-Gala	Galactites t	Constant	100
Echio-Gala	Dactylis glo	Constant	65.85366
Echio-Gala	Sonchus ol	Constant	65.85366
Echio-Gala	Daucus car	Constant	65.85366
Echio-Gala	Vicia sativa	Constant	63.41463
Echio-Gala	Plantago la	Constant	63.41463
Echio-Gala	Coleosteph	Constant	58.53659
Echio-Gala	Holcus lana	Constant	51.21951
Echio-Gala	Lolium mult	Constant	51.21951
Echio-Gala	Galactites t	Diagnostic	96.22819
Echio-Gala	Coleosteph	Diagnostic	42.53218
Echio-Gala	Anisantha r	Diagnostic	37.76593
Echio-Gala	Galactites t	Dominant	68.29268
Echio-Gala	Anisantha r	Dominant	21.95122
Echio-Gala	Coleosteph	Dominant	12.19512
Echio-Gala	Echium vul	Dominant	9.756098
Epilobion a	Epilobium a	Constant	100
Epilobion a	Digitalis pu	Constant	83.33333
Epilobion a	Avenella fle	Constant	50
Epilobion a	Epilobium a	Diagnostic	99.71709
Epilobion a	Digitalis pu	Diagnostic	68.54322
Epilobion a	Luzula lacte	Diagnostic	39.93985
Epilobion a	Helictochlo	Diagnostic	25
Epilobion a	Vaccinium	Diagnostic	25
Epilobion a	Peucedanu	Diagnostic	25
Epilobion a	Eryngium d	Diagnostic	24.80086
Epilobion a	Epilobium a	Dominant	66.66667
Epilobion a	Avenella fle	Dominant	8.333333
Galio valan	Parietaria ju	Constant	95
Galio valan	Cymbalaria	Constant	80
Galio valan	Asplenium	Constant	60
Galio valan	Centranthu	Constant	51.25
Galio valan	Asplenium	Constant	51.25
Galio valan	Parietaria ju	Diagnostic	72.22401
Galio valan	Centranthu	Diagnostic	44.80099
Galio valan	Asplenium	Diagnostic	38.89201
Galio valan	Parietaria ju	Dominant	37.5
Galio valan	Centranthu	Dominant	12.5
Galio valan	Asplenium	Dominant	8.75
Galio valan	Hypericum	Dominant	6.25
Galio valan	Erigeron ka	Dominant	5
Galio valan	Cymbalaria	Dominant	5
Geo urbani	Urtica dioic	Constant	94.68085
Geo urbani	Galium apa	Constant	66.48936

Geo urbani	Urtica dioic	Diagnostic	31.86205
Geo urbani	Urtica dioic	Dominant	62.23404
Geo urbani	Galium apa	Dominant	15.42553
Geo urbani	Geranium r	Dominant	7.446809
Geo urbani	Pentaglottis	Dominant	7.446809
Geranio pu	Geranium l	Constant	100
Geranio pu	Galium apa	Constant	82.35294
Geranio pu	Anthriscus	Constant	58.82353
Geranio pu	Anisantha s	Constant	55.88235
Geranio pu	Geranium l	Diagnostic	87.9836
Geranio pu	Anthriscus	Diagnostic	52.50239
Geranio pu	Geranium l	Dominant	70.58824
Geranio pu	Anthriscus	Dominant	23.52941
Linario poly	Vulpia alop	Constant	70.83333
Linario poly	Artemisia c	Constant	62.5
Linario poly	Crucianella	Constant	62.5
Linario poly	Jasione mc	Constant	62.5
Linario poly	Malcolmia l	Constant	62.5
Linario poly	Ammophila	Constant	58.33333
Linario poly	Helichrysur	Constant	58.33333
Linario poly	Leontodon	Constant	54.16667
Linario poly	Vulpia alop	Diagnostic	70.83333
Linario poly	Malcolmia l	Diagnostic	62.5
Linario poly	Crucianella	Diagnostic	62.5
Linario poly	Artemisia c	Diagnostic	62.37784
Linario poly	Ammophila	Diagnostic	58.33333
Linario poly	Helichrysur	Diagnostic	58.33333
Linario poly	Leontodon	Diagnostic	54.16667
Linario poly	Jasione mc	Diagnostic	52.52241
Linario poly	Linaria poly	Diagnostic	41.66667
Linario poly	Corynepho	Diagnostic	41.66667
Linario poly	Scrophulari	Diagnostic	39.67002
Linario poly	Seseli tortu	Diagnostic	37.5
Linario poly	Cistus salvi	Diagnostic	33.33333
Linario poly	Achillea ma	Diagnostic	20.83333
Linario poly	Daphne gn	Diagnostic	20.83333
Linario poly	Pancratium	Diagnostic	20.83333
Linario poly	Silene port	Diagnostic	20.83333
Linario poly	Vulpia alop	Dominant	20.83333
Linario poly	Artemisia c	Dominant	16.66667
Linario poly	Carex aren	Dominant	8.333333
Linario poly	Cistus salvi	Dominant	8.333333
Linario poly	Corema alb	Dominant	8.333333
Linario poly	Crucianella	Dominant	8.333333
Oxalidion e	Stellaria me	Constant	96.60194
Oxalidion e	Senecio vu	Constant	72.3301
Oxalidion e	Veronica pe	Constant	69.90291
Oxalidion e	Ochlopoa a	Constant	62.62136
Oxalidion e	Sonchus ol	Constant	62.13592
Oxalidion e	Stellaria me	Diagnostic	62.79958
Oxalidion e	Veronica pe	Diagnostic	58.57388
Oxalidion e	Stellaria me	Dominant	54.85437
Oxalidion e	Ochlopoa a	Dominant	11.65049
Oxalidion e	Veronica pe	Dominant	9.223301
Paspalo-Ag	Paspalum c	Constant	100
Paspalo-Ag	Persicaria l	Constant	75

Paspalo-Ag	Cyperus lo	Constant	68.75
Paspalo-Ag	Lythrum sa	Constant	62.5
Paspalo-Ag	Schoenople	Constant	50
Paspalo-Ag	Lycopus eu	Constant	50
Paspalo-Ag	Paspalum (	Diagnostic	96.52209
Paspalo-Ag	Cyperus lo	Diagnostic	58.05595
Paspalo-Ag	Schoenople	Diagnostic	49.95321
Paspalo-Ag	Eleocharis	Diagnostic	31.07222
Paspalo-Ag	Juncus arti	Diagnostic	24.76798
Paspalo-Ag	Paspalum (	Dominant	100
Paspalo-Ag	Eleocharis	Dominant	6.25
Paspalo-Ag	Xanthium s	Dominant	6.25
Polycarpior	Ochlopoa a	Constant	70.42254
Polycarpior	Plantago co	Constant	56.33803
Polycarpior	Sagina ape	Constant	54.92958
Polycarpior	Sagina ape	Diagnostic	47.24556
Polycarpior	Plantago co	Diagnostic	35.47583
Polycarpior	Crassula til	Diagnostic	33.72656
Polycarpior	Spergularia	Diagnostic	32.39437
Polycarpior	Spergularia	Dominant	21.12676
Polycarpior	Ochlopoa a	Dominant	14.08451
Polycarpior	Crassula til	Dominant	5.633803
Polycarpior	Plantago co	Dominant	5.633803
Polygono-C	Ochlopoa a	Constant	97.04142
Polygono-C	Polygonum	Constant	94.67456
Polygono-C	Matricaria s	Constant	59.76331
Polygono-C	Plantago m	Constant	54.43787
Polygono-C	Matricaria s	Diagnostic	55.161
Polygono-C	Polygonum	Diagnostic	53.54944
Polygono-C	Polygonum	Dominant	27.21893
Polygono-C	Ochlopoa a	Dominant	18.3432
Polygono-C	Matricaria s	Dominant	10.65089
Saginion pr	Ochlopoa a	Constant	94.87179
Saginion pr	Sagina pro	Constant	82.05128
Saginion pr	Bryum arge	Constant	76.92308
Saginion pr	Polygonum	Constant	58.97436
Saginion pr	Sagina pro	Diagnostic	79.90261
Saginion pr	Bryum arge	Diagnostic	76.52238
Saginion pr	Ochlopoa a	Dominant	23.07692
Saginion pr	Bryum arge	Dominant	17.94872
Saginion pr	Sagina pro	Dominant	17.94872
Scleranthio	Anthemis a	Constant	68.85965
Scleranthio	Raphanus	Constant	57.01754
Scleranthio	Spergula a	Constant	52.19298
Scleranthio	Rumex ace	Constant	51.75439
Scleranthio	Mibora min	Diagnostic	40.29409
Scleranthio	Rumex ace	Diagnostic	32.80294
Scleranthio	Mibora min	Dominant	9.210526
Scleranthio	Anthemis a	Dominant	7.894737
Scleranthio	Anthoxanth	Dominant	5.701754
Scleranthio	Spergula a	Dominant	5.701754
Senecionio	Arundo dor	Constant	100
Senecionio	Silene latifo	Constant	96.66667
Senecionio	Pteridium a	Constant	80
Senecionio	Calystegia	Constant	73.33333
Senecionio	Mentha sua	Constant	60

Senecionio	Pentaglottis	Constant	53.33333
Senecionio	Arundo dor	Diagnostic	99.99684
Senecionio	Silene latifo	Diagnostic	51.34474
Senecionio	Arundo dor	Dominant	100
Sisymbrion	Hordeum m	Constant	100
Sisymbrion	Sisymbrium	Constant	72.41379
Sisymbrion	Lolium pere	Constant	54.48276
Sisymbrion	Anisantha s	Constant	53.7931
Sisymbrion	Hordeum m	Diagnostic	82.13867
Sisymbrion	Sisymbrium	Diagnostic	50.90752
Sisymbrion	Hordeum m	Dominant	64.13793
Sisymbrion	Sisymbrium	Dominant	13.7931
Spergulo ai	Chenopodiu	Constant	81.94444
Spergulo ai	Echinochloa	Constant	70.13889
Spergulo ai	Persicaria r	Constant	70.13889
Spergulo ai	Digitaria sa	Constant	63.19444
Spergulo ai	Stellaria me	Constant	56.25
Spergulo ai	Digitaria sa	Diagnostic	51.41471
Spergulo ai	Echinochloa	Diagnostic	50.3007
Spergulo ai	Chenopodiu	Diagnostic	45.52249
Spergulo ai	Amaranthu	Diagnostic	40.22668
Spergulo ai	Amaranthu	Dominant	13.88889
Spergulo ai	Echinochloa	Dominant	12.5
Spergulo ai	Chenopodiu	Dominant	12.5
Spergulo ai	Digitaria sa	Dominant	10.41667

Appendix S4 Synthetic description of the 28 alliances present in the Iberian Atlantic anthropogenic vegetation.

Cymbalario-Parietarietea diffusae Vegetation of human-made walls.

1. *Galio valantiae-Parietarion judaicae* Hemicryptophyte-rich vegetation of walls. Occupies slightly warmer and sunnier situations than the other alliance in the class and has a shorter flowering season. Wide distribution in the ecoregion. Diagnostic species in the ecoregion: *Parietaria judaica*, *Centranthus ruber*, *Asplenium trichomanes*. Correspondence with EUNIS (2012) habitat *J2.5 - Constructed boundaries*.

2. *Cymbalario-Asplenion* Fern-rich vegetation of walls. Occupies slightly colder and shadier walls than the other alliance in the class and has a longer flowering season. Wide distribution in the ecoregion. Diagnostic species in the ecoregion: *Cymbalaria muralis*. Correspondence with EUNIS (2012) habitat *J2.5 - Constructed boundaries*.

Polygono-Poetea annuae Dwarf-herb vegetation of heavily-trampled sites.

3. *Polycarpion tetraphylli* Dwarf-annual trampled vegetation of warm and sunny sites. Occupies warmer, sunnier and nutrient-poorer situations than the other alliances in the class and has an earlier flowering season. Wide distribution in the ecoregion, specially along the coast and in submediterranean valleys of the interior. Diagnostic species in the ecoregion: *Sagina apetala*, *Plantago coronopus*, *Crassula tillaea*, *Spergularia marina*. Correspondence with EUNIS habitat *V34 Trampled xeric grassland with annuals*.

4. *Polygono-Coronopodion* Annual trampled vegetation of dry sites. Occupies sites that are colder than those preferred by *Polycarpion tetraphylli*, but drier than those of *Saginion procumbentis*. Has a specially high proportion of neophytes. Wide distribution in the ecoregion. Diagnostic species in the ecoregion: *Matricaria suaveolens*, *Polygonum aviculare*. Correspondence with EUNIS habitat *V34 Trampled xeric grassland with annuals*.

5. *Saginion procumbentis* Bryophyte-rich trampled vegetation of mesic sites. Occupies colder and wetter situations than the other alliances in the class, is less dominated by therophytes and has a relatively high proportion of bryophytes. Distribution concentrated in the central part of the ecoregion. Diagnostic species in the ecoregion: *Sagina procumbens*, *Bryum argenteum*. Correspondence with EUNIS habitat *V35 Trampled mesophilous grassland with annuals*.

Papaveretea rhoeadis Annual weed vegetation of crops and gardens.

6. *Caucalidion lappulae* Annual weed vegetation of cereal crops on base-rich soils. Very high proportion of putative archaeophytes. Distribution mostly limited to the more submediterranean valleys south of the Cantabrian Mountains. Diagnostic species in the ecoregion: *Cyanus segetum*, *Papaver rhoeas*, *Trifolium arvense*, *Anacyclus clavatus*, *Valerianella eriocarpa*. Correspondence with EUNIS habitats *V11 Intensive unmixed crops* and *V13 Arable land with unmixed crops grown by low-intensity agricultural methods*.

7. *Scleranthion annui* Annual weed vegetation of cereal crops on base-poor soils. Occupies more acidic soils than the other alliances in the class, and flowers earlier. High proportion of putative archaeophytes. Wide distribution in the ecoregion, but especially in the west, where acidic bedrocks dominate. Diagnostic species in the ecoregion: *Mibora minima*, *Rumex acetosella*. Correspondence with EUNIS habitats *V11 Intensive unmixed crops*, *V12 Mixed crops of market gardens and horticulture*, *V13 Arable land with unmixed crops grown by low-intensity agricultural methods* and *V15 Bare tilled, fallow or recently abandoned arable land*.

8. *Oxalidion europeae* Annual weed vegetation of gardens and root crops. Occupies wetter, shadier and nutrient-richer situations, and has a longer flowering season, than the other alliances in the class. High proportion of putative archaeophytes, and more neophytes than the other alliances in the class. Wide distribution in the ecoregion. Diagnostic species in the ecoregion: *Stellaria media*, *Veronica persica*. Correspondence with EUNIS habitats *V11 Intensive unmixed crops*, *V12 Mixed crops of market gardens and horticulture*, *V13 Arable land with unmixed crops grown by low-intensity agricultural methods* and *V15 Bare tilled, fallow or recently abandoned arable land*.

Digitario sanguinalis-Eragrostietea minoris Summer-annual C4 weed vegetation.

9. *Spergulo arvensis-Erodion cicutariae* Summer-annual C4 weed vegetation. Late-flowering alliance rich in neophytes and grasses, occurring in highly-disturbed and nutrient-rich sites. Wide distribution in the ecoregion. Diagnostic species in the ecoregion: *Digitaria sanguinalis*, *Echinochloa crus-galli*, *Chenopodium album*, *Amaranthus hybridus*. Correspondence with EUNIS habitats *V11 Intensive unmixed crops*, *V12 Mixed crops of market gardens and horticulture* and *V13 Arable land with unmixed crops grown by low-intensity agricultural methods*.

Chenopodietea Winter-annual fringe and ruderal vegetation.

10. *Allion triquetri* Geophyte-rich fringe vegetation. This vegetation occupies warmer, shadier and less frequently disturbed situations than other alliances in the class, and is comparatively taller and earlier-flowering. Has a higher proportion of geophytes and a lower proportion of therophytes. The proportion of neophytes is the highest in the class. Wide distribution in the ecoregion. Diagnostic species in the ecoregion: *Urtica membranacea*, *Smyrnium olusatrum*, *Tradescantia fluminensis*. Correspondence with EUNIS habitat *V37 Annual anthropogenic herbaceous vegetation*.

11. *Geranio pusilli-Anthriscion caucalidis* Winter-annual fringe vegetation. Occupies situations similar to the previous alliance, but in colder sites, and is a shorter vegetation dominated by therophytes instead of geophytes. Mostly distributed in the submediterranean valleys south of the Cantabrian Mountains. Diagnostic species in the ecoregion: *Geranium lucidum*, *Anthriscus caucalis*. Correspondence with EUNIS habitat *V37 Annual anthropogenic herbaceous vegetation*.

12. *Chenopodion muralis* Low-growth winter-annual ruderal vegetation. Short vegetation occupying colder situations than the other alliances in the class and more disturbed sites. Flowering season longer and later. Has a high proportion of archaeophytes. Sparse occurrence throughout the ecoregion. Diagnostic species in the ecoregion: *Malva neglecta*, *Urtica urens*. Correspondence with EUNIS habitat *V37 Annual anthropogenic herbaceous vegetation*.

13. *Echio-Galactition tomentosae* Tall-herb winter-annual ruderal vegetation. Occupies drier, sunnier and less nutrient-rich situations than other alliances in the class. Mostly distributed in the west of the ecoregion. Diagnostic species in the ecoregion: *Galactites tomentosus*, *Coleostephus myconis*, *Anisantha rigida*. Correspondence with EUNIS habitat *V37 Annual anthropogenic herbaceous vegetation*.

14. *Linario polygalifoliae-Vulpion alopecuri* Ephemeral annual vegetation of disturbed coastal dunes. Occupies warm, dry and sunny coastal sites, and has a high number of coastal dune species. Isolated occurrence in the southern coast of the ecoregion. Diagnostic species in the ecoregion: *Vulpia alopecuros*, *Malcolmia littorea*, *Crucianella maritima*, *Artemisia campestris*. Correspondence with EUNIS habitat *V32 Mediterranean subnitrophilous annual grassland*.

Sisymbrietea Summer-annual ruderal vegetation.

15. *Sisymbrion officinalis* Summer-annual ruderal vegetation. Rich in therophytes and archaeophytes and adapted to severe disturbances. Wide distribution in the ecoregion. Diagnostic species in the ecoregion: *Hordeum murinum*, *Sisymbrium officinale*. Correspondence with EUNIS habitats *V15 Bare tilled, fallow or recently abandoned arable land* and *V37 Annual anthropogenic herbaceous vegetation*.

Bidentetea Summer-annual pioneer vegetation of temporarily flooded sites.

16. *Bidention tripartitae* Summer-annual pioneer vegetation of temporarily flooded sites. Occupies nutrient-richer sites than the other alliance in the class and has a higher proportion of therophytes and neophytes.

Dispersed throughout the ecoregion. Diagnostic species in the ecoregion: *Persicaria hydropiper*, *Bidens frondosus*, *Lythrum salicaria*. Correspondence with EUNIS habitat *Q61 Periodically exposed shore with stable, eutrophic sediments with pioneer or ephemeral vegetation.*

17. *Paspalo-Agrostion semiverticillati* Summer-annual pioneer vegetation of temporarily flooded and warm sites. Occupies wetter and more frequently disturbed sites than the other alliance in the class and has a longer flowering season. Isolated occurrences in the south of the ecoregion. Diagnostic species in the ecoregion: *Paspalum distichum*, *Cyperus longus*, *Schoenoplectus lacustris*. Correspondence with EUNIS habitat *R55 Lowland moist or wet tall-herb and fern fringe.*

Artemisietea vulgaris Perennial ruderal vegetation of dry sites.

18. *Convolvulo arvensis-Agropyrion repentis* Semiruderal grasslands. Occupies wetter, shadier and nutrient-poorer situations than the other alliances in the class, and has a higher proportion of geophytes, grasses and native species. Isolated occurrence in the south of the ecoregion. Diagnostic species in the ecoregion: *Poa compressa*, *Elytrigia repens*, *Potentilla reptans*, *Valerianella locusta*. Correspondence with EUNIS habitat *V38 Dry perennial anthropogenic herbaceous vegetation.*

19. *Carduo carpetani-Cirsion odontolepidis* Thistle ruderal vegetation of warm sites. Occupies warmer situations than the other thistle alliance in the class and has a high proportion of archaeophytes. Mostly distributed in the Cantabrian Mountains. Diagnostic species in the ecoregion: *Onopordum acanthium*. Correspondence with EUNIS habitat *V38 Dry perennial anthropogenic herbaceous vegetation.*

20. *Cirsion richterano-chodati* Thistle ruderal vegetation of cold sites. Occupies colder situations than the other thistle alliance in the class. Mostly distributed in the Cantabrian Mountains. Diagnostic species in the ecoregion: *Cirsium eriophorum*, *Carduus carpetanus*, *Carduus nutans*. Correspondence with EUNIS habitat *V38 Dry perennial anthropogenic herbaceous vegetation.*

21. *Dauco-Melilotion* Biennial ruderal vegetation. Occupies wetter situations than the two thistle alliances in the class and has a higher proportion of neophytes. Occurrence throughout the ecoregion. Diagnostic species in the ecoregion: *Helminthotheca echioides*, *Daucus carota*, *Melilotus albus*, *Foeniculum vulgare*. Correspondence with EUNIS habitat *V38 Dry perennial anthropogenic herbaceous vegetation.*

Epilobietea angustifolii Perennial fringe and ruderal vegetation of mesic to wet sites.

22. *Geo urbani-Alliarion officinalis* Low-herb short-lived semiruderal and fringe vegetation. Occupies shadier and less frequently disturbed situations than the other alliances in the class and has a higher proportion of therophytes and shorter plants. Wide distribution in the ecoregion. Diagnostic species in the ecoregion: *Urtica dioica*. Correspondence with EUNIS habitat *V39 Mesic perennial anthropogenic herbaceous vegetation.*

23. *Arction lappae* Low-herb short-lived ruderal vegetation. Occupies sunnier and more frequently disturbed situations than the other alliances in the class, and has a higher proportion of therophytes and shorter plants. Distribution concentrated in the Cantabrian Mountains. Diagnostic species in the ecoregion: *Oxybasis rubra*, *Senecio duriaei*. Correspondence with EUNIS habitat *V39 Mesic perennial anthropogenic herbaceous vegetation.*

24. *Balloto-Conion maculati* Tall-herb perennial ruderal vegetation. Occupies warmer situations than the other alliances in the class. Has a high proportion of archaeophytes. Distribution concentrated in the Cantabrian Mountains and the east of the ecoregion. Diagnostic species in the ecoregion: *Sambucus ebulus*. Correspondence with EUNIS habitat *V39 Mesic perennial anthropogenic herbaceous vegetation.*

25. *Aegopodion podagrariae* Tall-herb perennial vegetation of forest margins and clearings. Occupies shadier and less disturbed situations than the other alliances in the class. Sparse occurrence throughout the ecoregion. Diagnostic species in the ecoregion: *Anthriscus sylvestris*, *Heracleum sphondylium*, *Galium aparine*. Correspondence with EUNIS habitats *R55 Lowland moist or wet tall-herb and fern fringe* and *V39 Mesic perennial anthropogenic herbaceous vegetation.*

26. *Epilobion angustifolii* Tall-herb perennial vegetation of forest margins and clearings in acidic soils. Occupies colder, nutrient-poorer, more acidic and less disturbed situations than the other alliances in

the class. Distributed towards the west of the ecoregion. Diagnostic species in the ecoregion: *Epilobium angustifolium*, *Digitalis purpurea*, *Luzula lactea*. Correspondence with EUNIS habitats *R54 Pteridium aquilinum vegetation* and *R57 Herbaceous forest clearing vegetation*.

27. *Cynancho-Convolvulion sepium* Tall-herb fringe vegetation of nutrient-rich riparian habitats. Occupies wetter and less disturbed situations than the other alliances in the class and has a later flowering season. Dispersed throughout the ecoregion. Diagnostic species in the ecoregion: *Eupatorium cannabinum*, *Angelica sylvestris*, *Picris hieracioides*. Correspondence with EUNIS habitat *R55 Lowland moist or wet tall-herb and fern fringe*.

28. *Senecionion fluviatilis* Tall-herb vegetation of nutrient-rich riverbanks and ditches. Occupies warmer and wetter situations than the other alliances in the class, flowers later, has taller plants and has a high proportion of neophytes and geophytes. Isolated occurrence in the western coast of the ecoregion. Diagnostic species in the ecoregion: *Arundo donax*, *Silene latifolia*. Correspondence with EUNIS habitat *R55 Lowland moist or wet tall-herb and fern fringe*.

Alliance	Associatior	Autores
Aegopodio	Chaerophy	Rivas-Mart�nez & Costa 1997
Aegopodio	Galio apari	Loidi, Berastegi, Biurrun, Garc�a-Mijangos & Herrera 1995
Allion trique	Allio triquet	Alves, Honrado & Barreto de Oliveira 2003
Allion trique	Chelidonio	Amigo & Romero 1997
Allion trique	Urtico mem	A. & O. Bol�s in O. Bol�s & Molinier 1958
Arction lap	Chenopodi	Rivas-Mart�nez 1964
Arction lap	Galactito to	Bellot & Casaseca in Casaseca 1959
Arction lap	Geranio lus	Honrado, Alves, Lomba, Rocha, Torres, Ortiz & Barreto Caldas 2004
Arction lap	Malvo mau	Oberdorfer & T�xen in T�xen & Oberdorfer 1958
Balloto-Cor	Galio apari	Rivas-Mart�nez ex G. L�pez 1978
Balloto-Cor	Urtico dioic	(Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936) Br.-Bl. in Br.-Bl., Roussine &
Bidention tr	Bidenti tripa	Rivas-Mart�nez, Belmonte, Fern�ndez-Gonz�lez & S�nchez-Mata in S�ncl
Bidention tr	Cypero era	Amigo 2006
Bidention tr	Filaginello	Amigo 2006
Bidention tr	Polygono h	Lohmeyer ex Passarge 1955
Bidention tr	Xanthio ital	O. Bol�s 1957
Carduo car	Carduo car	Rivas-Mart�nez, Penas & T.E. D�az 1986
Caucalidior	Biforo radia	Vigo, Carreras, Carrillo & I. Soriano in Carreras, Carrillo, X. Font, Masalles, Ninc
Caucalidior	Caucalido l	T�xen & Oberdorfer 1958
Chenopodi	Chenopodi	Carretero 1994
Chenopodi	Chenopodi	Lohmeyer & Trautmann 1970
Chenopodi	Sisymbriet	(Ladero, Socorro, Molero, M.L�pez, Zafra, Mar�n, Hurtado & P�rez-Raya 198
Chenopodi	Urtico uren	(Knapp 1945) Lohmeyer in T�xen 1950
Cirsion rich	Carduo nut	Rivas-Mart�nez & F. Prieto in Penas, T.E. D�az, M.E. Garc�a, L�pez Pache
Cirsion rich	Carduo nut	Loidi 1983
Cirsion rich	Cirsio chod	Rivas-Mart�nez, T.E. D�az, F. Prieto, Loidi & Penas 1984
Cirsion rich	Cirsio chod	Rivas-Mart�nez, T.E. D�az, F. Prieto, Loidi & Penas 1984
Convolvulo	Cardario dr	M�ller & G�rs 1969
Cymbalario	Cymbalarie	G�rs 1966
Cymbalario	Cymbalario	Rivas-Mart�nez 1969
Cynancho-	Picrido hier	Loidi & C. Navarro 1988
Dauco-Meli	Echio rosul	P. Alves & J. Honrado
Dauco-Meli	Helminthio	Loidi & C. Navarro 1988
Echio-Gala	Coleosteph	Izco & Collado 1985
Epilobion a	Asphodelo	Izco, J. Guiti�n & Amigo 1986 corr. Izco & Amigo 2001
Galio valan	Centrantho	Rivas-Mart�nez 1969
Galio valan	Hedero-Pol	Loriente Escallada 1985
Galio valan	Parietariet	K. Buchwald 1952
Geo urbani	Geranietum	Loidi, Berastegi, Biurrun, Garc�a-Mijangos & Herrera 1995
Geo urbani	Geranio rol	Izco, J. Guiti�n & Amigo 1986
Geo urbani	Oxalido ace	Loidi, Berastegi, Biurrun, Garc�a Mijangos & Herrera 1996
Geranio pu	Anthrisco c	O. Bol�s & Vigo in O. Bol�s 1967
Geranio pu	Galio apari	Rivas-Mart�nez 1978
Linario poly	Scrophulari	Br.-Bl., Rozeira & P. Silva in Br.-Bl., G. Br.-Bl., Rozeira & P. Silva 1972
Oxalidion e	Fumario ca	Aedo, Herrera, F. Prieto & T.E. D�az 1988
Oxalidion e	Holosteo u	Penas, T.E. D�az, C. P�rez, Puente, M.E. Garc�a & Terr�n 1988
Oxalidion e	Lamio amp	Aedo, Herrera, F. Prieto & T.E. D�az 1988
Paspalo-Ag	Paspalo dis	Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936
Polycarpior	Crassulo til	Rivas-Mart�nez 1975
Polycarpior	Polycarpo t	Wildpret, P�rez de Paz, Del Arco & Garc�a Gallo 1988
Polycarpior	Poo annua	Herrera, Aedo, T.E.D�az & F. Prieto 1988
Polygono-C	Coronopod	Br.-Bl. in Br.-Bl., Gajewski, Wraber & Walas 1936
Polygono-C	Matricario-I	M�ller ex Oberdorfer 1971 corr. Passarge 1996
Polygono-C	Polycarpo t	Rivas-Mart�nez, Wildpret, Del Arco, O. Rodr�guez, P�rez de Paz, Garc�a G
Saginion pr	Sagino-Bry	Diemont, Sissingh & Westhoff 1940

Scleranthio	Bunio eruca	Rivas-Mart�nez, Izco & Costa 1971
Scleranthio	Catapodieti	Br.-Bl., P. Silva, Rozeira & Fontes 1952
Scleranthio	Centaureo	Penas, T.E. D�az, P. Morales, Puente, M.E. Garc�a & Terr�n 1988
Scleranthio	Chrysanthe	Bellot 1951
Scleranthio	Linario ame	Izco 1982
Scleranthio	Linario delp	Bellot & Casaseca in Casaseca 1959
Scleranthio	Linario eleg	T�xen & Oberdorfer 1958
Scleranthio	Miboro min	Rivas-Mart�nez & C. Rivas-Mart�nez 1970
Scleranthio	Spergularia	Rivas-Mart�nez & C. Rivas-Mart�nez 1970
Senecionio	Arundini do	T�xen & Oberdorfer ex O. Bol�s 1962
Senecionio	Solano dulc	Biurrun, Garc�a-Mijangos, Benito Crespo & Fern�ndez-Gonz�lez 2008
Sisymbrion	Bromo diar	Ortiz in�d.
Sisymbrion	Hordeetum	Libbert 1933
Sisymbrion	Sisymbrio c	Br.-Bl. 1967
Spergulo ar	Amarantho	T�xen & Oberdofer 1958
Spergulo ar	Lamio disse	T�xen & Oberdorfer 1958
Spergulo ar	Setario veri	Bartolom� & Mart�nez-Parras 1985

: N�gre 1952
hez-Mata 1989

ɔt, I. Soriano & Vigo 1998

81) Rivas-Mart�nez & Ladero ass. nova (addenda)

ɛco, Puente & L. Herrero 1988

Gallo, Acebes, T.E. D�az & Fern�ndez-Gonz�lez 1993