Abstract: The holm oak woodlands as ecotonic phytocoenoses occur under different ecological conditions, and frequently representing the climax of edaphoxerophilous series of crests and siliceous rocky areas. In this paper we study the floristic, ecological, and biogeographical differences of the edaphoxerophilous holm oak woodlands of the southwestern Iberian Peninsula, included in the Querco rotundifoliae-Olenion sylvestris suballiance. Our phytosociological (Braun–Blanquet methodology) and numerical analysis (hierarchical cluster analysis) of three formerly described association and our own samples lead us to propose a new association: Ulici argentei-Quercetum rotundifoliae, growing mostly on semihyperoceanic Monchique Sierran Biogeographic District, on rocky slopes and outcrops derived from schists and greywackes. Moreover, we present an overview of ecological features and the diversity of plant communities occurring in the serial dynamic of the thermophile holm oak woodlands of the southwest of the Iberian Peninsula.

Keywords: holm oak woodlands; Quercus rotundifolia; southwestern Iberian peninsula; numerical analysis; vegetation stages; landscape mosaic

1. Introduction

The vegetation geoseries or geosigmetum represents the basic unit of dynamic-catenal phytosociology. These correspond to a catena of edaphoxerophilous, climatophilous, climato-temporihygrophilous, and edaphohygrophilous vegetation series, which is found around a given bioclimatic belt and ascribed to an accurate biogeographical territory [1]. The corresponding topographic geosigmetum, which express the universal crest-slope-piedmont-valley model, comprise the vegetation series or sigmeta (sigmetum) zonation along specific ecological features, resulting from geomorphic systems that interact over time to shape the topography of the landscape unit.

According to Rivas-Martínez et al. [2] and Loidi [3], the climatophilous or zonal series occupy large areas of land (normally, are found in hillslopes) and are located on mature soils according to the mesoclimate, i.e., are conditioned by non-exceptional conditions; the temporihygrophilous series, included among the climatophilous, are those which have
additional water contribution due to slope runoff (piedmont), nevertheless during the summer or dry period the soil horizons are well-drained and aerated; the hygrophilous series grow on particularly wet soils and biotopes linked to river beds, marsh areas, salt flats, peat bogs, or any places which are wet due to the gravitational input of water. Finally, the xerophilous series can be found in the driest sites (crests, rocky slopes, lithosols, leptosols, and arenosols). In this context, the holm oak (*Quercus rotundifolia*) communities of the southwestern Iberian Peninsula are of particular interest. Frequently, they develop in edaphoxerophilous biotopes that appear as evidence of extreme xericity conditions, namely great edaphic draught as a result of the soils reduced capacity for water retention [4,5]. In these situations, which are often associated to crests and rocky areas, the edaphoxerophilous holm oak woodlands are characterized by xerophytic floristic patterns, in comparison with the encompassing potential natural vegetation.

The holm oak vegetation series dominate large areas of Iberian Peninsula, since *Quercus rotundifolia* plant communities are present in a wide range of bioclimatic stages (ranging from dry to humid ombroclimates in the thermomediterranean to supramediterranean belts) and pedological/lithological substrata (e.g., schist, greywacke, quartzite, limestone, calco-dolomitic), and tends to occupy environments with special characteristics, especially when compared with the other native forest species. Among the wide spectrum of sites and special environments, the widespread of *Quercus rotundifolia* has been also favoured by human activities, as a direct result of long-lasting impact of human agroforestry and grazing land-use practices.

The present paper aims to provide a new knowledge of the thermophilous holm oak communities of the southwestern Iberian Peninsula (Figure 1), included in the *Quercus rotundifoliae-Oleinion sylvestris* suballiance. The phytosociological and syntaxonomical vegetation analysis allow us to distinguish a new forest *Ulici argentei-Quercetum rotundifoliae*. In addition, we present an overview of ecologic factors and processes controlling the diversity of plant communities observed in their dynamic—as well as the characteristic vascular flora—which dominate large areas of holm oak forest landscape.

**Figure 1.** Biogeographic map of the southwest of the Iberian Peninsula at sector level, following [2] (1—Divisorio-Portuguese Sector; 2—Ribatejo and Sado Sector; 3—Algarve and Monchique Sector; 4—Cádiz and Littoral Huelva Sector; 5—Algeciras and Aljibe Sector; 6—Oretana Range and Tajo Sector; 7—Mariánica Range Sector; 8—Campiña of Guadalquivir Sector; 9—Ronda Sector; 10—Granada and Almijara Sector; 11—Subbética Sector). Numbers of dots correspond to those of Table A1 and Figure 2.
3.2. Description of Holm Oak Communities

From an ecological and edaphic point of view, the holm oak woodlands of the Southwestern Iberian Peninsula (in the geographic distributions (Appendix A, Table 2; Figure 2). These woodlands are exclusive to the southern territories of the Monchique Sierran District, particularly in the sub-coastal siliceous areas of the Caldeirão (1). They form edaphoxerophilous micro-forests on incipient lithosols, rocky substratum affinity information were taken from the literature: Rivas Goday et al. [23], Sequeira et al. [21] and Costa et al. [14]. For biogeographical and bioclimatological information we follow Rivas-Martínez et al. [1, 2, 22] and substrate affinity information were taken from the literature: Rivas Goday et al. [23], Rivas-Martínez et al. [12, 13], and Quinto-Canas [24], as evidence in Appendix A, Table A2. The phytosociological name of the new vegetation unit is given according to the International Code of Phytosociological Nomenclature [25].

Data analysis

The data matrix, consisted of 28 relevés and 212 taxa, was submitted to the Un-Weighted Pair-Group Method using Arithmetic Averages (UPGMA), with Bray-Curtis distance, to produce the dissimilarity measure, using the software Primer 6 [26, 27]. The Braun–Blanquet’s abundance-dominance indexes were transformed according to Van der Maarel [28]. This transformation is required, as a solution for converting the non-numerical values into numerical scale and in this form used as input data for numerical analysis. The relevés performed in data matrix include our field sampling (Appendix A, Table A3; Table A1, association 1; clusters 1–10) and relevés taken from the literature: Rivas Goday et al. [23] (Appendix A, Table A1, association 2; clusters 11–20), Rivas-Martínez et al. [12] (Appendix A, Table A1, association 3; cluster 21) and Rivas-Martínez et al. [13] (Appendix A, Table A1, association 4; clusters 22–28).

Figure 2. Classification analysis (UPGMA clustering dendrogram, with Bray-Curtis distance): Group A includes 1—Myrtille communis-Quercetum rotundifoliae (11–20); Group B includes 2—Ulici argentei-Quercetum rotundifoliae (B1; 1–10), 3—Rhamno oleoidis-Quercetum rotundifoliae (B21; 21) and 4—Rhamno laderoi-Quercetum rotundifoliae (B22; 22–28).

2. Materials and Methods

Data Collection

Field sampling was carried out from March 2013 to April 2014, following the Zurich-Montpellier phytosociological method [6–9]. Here, we defined a new woodland association, based on the comparison of phytosociological relevés, performed in Table A1. According to Biondi [9], each relevé is a floristically and ecologically homogeneous plant community that represents the plant association on the ground. Within this definition, for each relevé, all plants that are found in an area whose floristic, structural, and ecological conditions are homogenous, were identified and assigned a quantitative value or index for their coverage, using the conventional abundance-dominance scale of Braun–Blanquet [10].

Nomenclatures used

Syntaxonomical typologies were checked according to Rivas-Martínez et al. [11–13] Costa et al. [14] and Mucina et al. [15] while for flora identification, the following works have been used: Coutinho [16], Franco [17], Franco and Rocha Afonso [18], Castroviejo [19], and Valdés et al. [20]. Botanic nomenclature were update using former Iberian lists elaborated by Rivas-Martínez et al. [12], Sequeira et al. [21] and Costa et al. [14]. For biogeographical and bioclimatological information we follow Rivas-Martínez et al. [1, 2, 22] and substrate affinity information were taken from the literature: Rivas Goday et al. [23], Rivas-Martínez et al. [12, 13], and Quinto-Canas [24], as evidence in Appendix A, Table A2. The phytosociological name of the new vegetation unit is given according to the International Code of Phytosociological Nomenclature [25].

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3. Results and Discussion

3.1. Classification of Southwestern Iberian Peninsula Holm Oak Communities

The dendogram and synoptic table reveal a clear separation between all phytosociological holm oak communities of the Southwestern Iberian Peninsula, included in the Querco rotundifoliae-Oleion sylvestris suballiance. Indeed, as showed in Figure 1, four different groups can be detected, based on floristic similarities (Appendix A, Table A1), responding to different ecological gradients (Appendix A, Table A2) and representing the following synonemonial units (associations): (A) Myrto communis-Quercetum rotundifoliae (clusters 11–20); (B1) Ulici argentei-Quercetum rotundifoliae (clusters 1–10); (B21) Rhamno oleoidis-Quercetum rotundifoliae (clusters 21); (B22) Rhamno laderoi-Quercetum rotundifoliae (cluster 22–28). Group A, encompasses samples contained the silicicolous association Myrto communis-Quercetum rotundifoliae, which mainly occurs in the dry to subhumid thermomediterranean bioclimatic areas of the Southern Iberian biogeographic territory. Group B comprises two subgroups. The first disjoin is subgroup B1, which encompasses the relevés contained in the association Ulici argentei-Quercetum rotundifoliae, which is proposed here as new association, largely confined to the siliceous mountains of southwest of Portugal (Monchique Sierran District). The subgroup B2, comprises two different basophilous associations: Rhamno laderoi-Quercetum rotundifoliae (B22) and Rhamno oleoidis-Quercetum rotundifoliae (B21). The first, which can be found on limestone, calco-dolomitic and ultramafic (serpentine) substrates of the Lusitania and Extremadura Subprovince, is highlighted by the presence of Rhamnus laderoi, whereas the latter occurs on limestone and calco-dolomitic substrates of the Bética Province, reaching the southernmost coastal or sub-coastal areas of Portugal (Algarve and Monchique Sector, Cádiz and Sado Subprovince).

The Table A1 (Appendix A) reveals the differences in floristic composition among these four groups defined in the dendrogram, based on the presence/absence of diagnostic species as a response to different bioclimatic stages, edaphic conditions, and biogeographic distributions (Appendix A, Table A2; Figure 2). The Quercus rotundifolia woodlands of the Southwestern Iberian Peninsula (in the Querco rotundifoliae-Oleion sylvestris suballiance) are briefly described below, from a floristic, ecological, and dynamic point of view.

3.2. Description of Holm Oak Communities

I-Ulici argentei-Quercetum rotundifoliae ass. nova hoc loco (Appendix A, Table A3; clusters 1–10)

The relevés of the new association Ulici argentei-Quercetum rotundifoliae (holotypus Appendix A, Table A3, relevé 7) have a high dissimilarity in relation to the other associations. These holm oak woodlands are exclusive to the southern territories of the Monchique Sierran District, particularly in the sub-coastal siliceous areas of the Caldeirão Mountains [24]. They form edaphoxerophilous micro-forests on incipient lithosols, rocky slopes and outcrops derived from schists and greywackes, and are found in the thermomediterranean sub-humid belt, where it appears to have its optimum.

Of particular interest is the frequent presence of Ulex argenteus, an acidic gorse, exclusively found in the oceanic biogeographic areas of the Algarve and Monchique Sector. Of the various species represented here, we also highlight the presence of other oceanic species, such as: Scilla monophyllos, Avenella stricta, Lavandula viridis, Osyris lanceolata, Cynara algarbiensis. As shown in Table A3 (Appendix A), the floristic composition of these woods also contains other characteristic species from the Quercetea ilicis species, like Erica arborea, Quercus coccifera, Pistacia lentiscus, Arbutus unedo, all occur frequently and Rhamnus alaternus, Phillyrea angustifolia, Olea europaea var. sylvestris, more occasionally. The canopy is further enriched by Smilax aspera var. alissima, Lonicera impexa, Rubia peregrina. Regarding the xerophilous position, the flora of the Ulici argentei-Quercetum rotundifoliae is characteristic with its much more obvious rupicolous elements: Umbilicus rupestris, Phagnalon saxatile, Rumex induratus, Saxifraga granulata, Chelidantes guanchica, Sanguisorba rugulosa, among others. The degradation of the Ulici argentei-Quercetum rotundifoliae woodland lead us to the formations dominated by Quercus coccifera, enriched by nanophanerophytes from Ericion
arbores (Rivas-Mart. ex Rivas-Mart. et al. 1986) Rivas-Mart. 1987 (Erica arborea and Arbutus unedo) and Calluno-Ulicetum Br.-Bl. Et Tx. Ex Klika et Hadac (Erica australis, Genista triacanthos, Calluna vulgaris). Nevertheless, cutting and burning have almost certainly reduced the extent of these communities, favoring the occurrence of the heathland characterized by Erica australis and Ulex argentaeus and the broomland dominated by Genista polyanthae (Genistetum triacanthi-polyanthi Vila-Vicosa, Mendes, Meireles, Quinto-Canas & Pinto-Gomes 2013). Elsewhere, though, all these communities persist as a fragment in their occurrence as landscape mosaic, now largely converted to gorse scrubland dominated by Cistus ladanifer and Ulex argentaeus (Cisto ladaniferi-Ulicetum argentei Br.-Bl., P. Silva & Rozeira 1964), whereas in its clearings occurs the pioneer communities dominated by the non-nitrophilous therophytes such as Plantago bellardii (Trifolio cherleri-Plantaginetum bellardii Rivas Goday 1958) and Brachypodium distachyon (Holco annui-Brachypodietum distachyi S. Ribeiro, Ladero & Espírito Santo 2012). Moreover, inhabiting narrow rocky fissures, we must highlight the presence of the chasmophytic community dominated by Chelanthus guanchica.

We place the Ulici argentei-Quercetum rotundifoliae ass. nova hoc loco, at the syntaxonomic level, in the Querco rotundifoliae-Oleion sylvestris suballiance (Oleo sylvestris-Quercion rotundifoliae, Quercetalia ilicis, Quercetaea ilicis).

II-Myrto communis-Quercetum rotundifoliae Rivas Goday in Rivas Goday, Borja, Esteve, Galiano, Rigual & Rivas-Martínez 1959 (clusters 11–20, Figure 2)

This holm oak association occurs through the southern and southwestern part of the Iberian Peninsula, where represents the climax vegetation over siliceous substrates. Despite the wide distribution, it is in the thermomediterranean sites with dry ombrotype of the Mediterranean-Iberoatlantic biogeographic territories that this community constitutes the mature climatic stage, and therefore is not present in Monchique Sierran District, where it is substituted by the association Ulici argentei-Quercetum rotundifoliae. As evidenced by Rivas-Martínez et al. [13], the characteristic species of the Myrto communis-Quercetum rotundifoliae are Quercus rotundifolia, Myrtus communis, Chamaerops humilis and Lavandula sampaioana. According to the original description of Rivas Goday in [23], its floristic composition is very rich and characterized by an abundant presence of species of the order Pistacio lentiscis-Rhamnetalia alaterni Rivas-Mart. 1975: Pistacia lentiscus, Rhammus alaternus, Rhamnus oleoides, Osyris alba, Jasminum fruticans, Pistacia terebinthus, among others. On this basis, as first substitution stage, the silicicolous variant of the Asparago albi–Rhamnetum oleoidis Rivas Goday 1959 maquis emerges, where Pistacia lentiscus, Olea europaea var. sylvestris, Rhamnus oleoides, Asparagus albus, Osyris lanceolata dominate. Meanwhile, most of forest and pre-forest have been strongly influenced by human activity, which favoured the occurrence of seral scrub communities: Genisto hirsuta-Cistetum ladaniferi Rivas Goday 1955 and Genistetum triacanthi-polyanthi Rivas-Martinez & Belmonte ex Capelo, Louis & J.C. Costa 1996. The first, correspond to the association co-dominated by Cistus ladanifer, Lavandula luissieri and Genista hirsuta. The second association corresponds to the broomland almost constituted by Genista polyanthos. Additionally, typical in xerophilous positions, at lower level or open stands of the shrubs, are the Daucus criniti-Hyparrhenietum sinaicae Rivas-Martinez in Rivas-Martinez, Fernández-González & Sánchez-Mata 1986 corr. Diez Garretas & Asensi 1999 perennial grasslands, dominated by Hypharrenia sinaica accompanied by Daucus crinitus, Daucus setifolius, Dicpadi serotinum, Andryala integrifolia, among others.

Furthermore, at later stage in succession, zonation involves the annual grasslands of Trifolium cherleri-Plantaginetum bellardii, usually dominated by therophitic species, such as Plantago bellardii, Trifolium cherleri, Aira cupaniana, Tolpis barbata, Hymenocarpos lotoides, Leontodon taraxacoides subsp. longirostris, among others. In areas subject to moderate disturbance, often grazing-related, this community is replaced by the subnitrophilous grasslands, represented by the Trifolio cherleri-Taeniatheretum capitis-medusae Rivas-Martinez & Izco 1977 association, in which Taeniatherum caput-medusae, Trifolium cherleri, Stipa capensis, occurs. But the cumulative effect of trampling by regulated and persistent grazing, mainly sheep, promotes the occurrence of perennial grasslands included in the Trifolio subterranei-Poetum bulbosae Rivas-Martinez & Izco 1977 association (Poetum bulbosae Rivas Goday et
Rivas-Mart. in Rivas-Mart. 1978 vegetation class), dominated by the hemicryptophyte Poa bulbosa, usually accompanied by other characteristic species of the Poeta bulbosae class, such as Trifolium subterraneum, Trifolium bocconei, Trifolium gemellum, Trifolium glomeratum, Biscutella pelagonia, Bellis annua, Erodium bursa-pastoris, Erodium brachycarpum, Lupinus micranthus, among others [24]. This perennial grassland presents a high-value to livestock grazing and appears as part of managed, cultural silvopastoral or agro-silvopastoral systems known as montados in Portugal and dehesas in Spain. Furthermore, the intensive overgrazing increases in the abundance of nitrophilous species from Artemisia vulgaris Lohmeyer et al. in Tx. ex von Rochow 1951 vegetation class. According to Quinto-Canas et al. [29], on soils with poor drainage, with slight flooding length, occurs hygrophilous grasslands with a frequent presence of characteristic species from the Stipo giganteae-Agrostietea castellanae Rivas-Mart. et al. 1999 class (such as, Agrostis castellana, Gaudinia fragilis, Linum bienne, Rumex acetosella subsp. angiocarpos) or from the Isoeto-Nanojuncetea Br.-Bl. et Tx. in Br.-Bl. et al. 1952 class (Agrostis pourretri, Cicendia filiformis, Isoetes histrix).

When these holm oak woodlands cover edaphoxerophilous positions they typically form mosaics with other vegetation types, included in the class Asplenietea trichomanis (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977 and Phragmata saxatilis-Rumicetea indurati Rivas Godoy et Esteve 1972 Rivas-Mart. et al. 1973, which comprises plant communities characterized by rupicolous chasmophytic or chasmochromophytic species that grow on rocky crevices. Thus, in fissures of cliffs or rocky outcrops, occur the communities dominated by small ferns, such as Cosentinia vellea (Cheilantheno naderensis-Cosentinietum velleae Ladero ex F.J. Pérez, T.E. Díaz, P. Fernández & Salvo 1989) and Cheilanthes tinaei (Aspleniolum billoti-Cheilanthenetum tinaei Rivas-Martinez & Costa 1973 corr. Saénz & Rivas-Martinez 1979). In the group of the chasmochromophytic vegetation, we must highlight the presence of a community dominated by Dianthus caryophyllus, usually accompanied by Sanguisorba ripicola, which tend to colonize fissures with slight addition of soil.

**III-Rhamno oleoidis-Quercetum rotundifolii** Rivas-Martinez in Rivas-Martinez, Fernández-González, Loidi, Lousá & Penas 2002 (cluster 21, Figure 2)

The holm oak woodlands of the southwest of the Iberian Peninsula (Bética and Cádiz and Sado biogeographic territories) typically associated to limestone and calcio-dolomitic substrates corresponds to the Rhamno oleoidis-Quercetum rotundifolii. This woodland has its optimum development in the thermomediterranean, dry to subhumid, bioclimatic belt, and can be differentiated by the presence of typical basophilous species, such as Ulex baeticus subsp. scaber, Thymus capitatus, Cistus albidus, Pittosporum hispanicus. These Quercus rotundifolia woods can develop dense canopy, with a high presence of climbing species, such as Aristolochia baetica, Clematis flammula, Smilax aspera var. altissima, Rubia peregrina, Lonicera impexa. Other thermophile species, occurring throughout the community or more frequently in its preforest community (ascribed to the calcicoles variant of the association Asparago albi–Rhamnetum oleoidis), including Pistacia lentiscus, Phyllyrea latifolia, Olea europaea var. sylvestris, Rhamnus oleoides, Rhamnus alaternus, Chamaerops humilis, Phlomis purpurea, Ceratonia siliqua, Asparagus aphyllus, among others. In open areas of woodlands and their pre-forestry mantles, occur perennial xerophytic grasslands, dominated by Brachypodium phoenicoides, Brachypodium retusum, Stipa tenacissima, Hyparrhenia hirta and Hyparrhenia sinaica.

According to Paiva-Ferreira and Pinto-Gomes [30] and Molero and Marfil [31], the vegetation occurring on more disturbed limestones soils include several gorses and thymes associations, which represent one of the richest complexes types that are found in the scheme of this holm oak woodland, where Ulex baeticus subsp. scaber, Thymus capitatus, Thymus baeticus, Cistus albidus, Genista retamoides, Genista equisetiformis, Genista hirsuta subsp. algarbiensis, Genista haenseleri, Retama sphaerocarpa, Ulex willkommii, Asparagus horridus, Fumana thymifolia, among others.

As evidence by Quinto-Canas et al. [32], the degradation of the shrubby communities by human activities (firewood, ploughing, deforestation) promotes the development of annual grasslands from the pioneer association Velezio rigidae-Asteriscetum aquaticae Rivas Goday 1964, dominated by non-nitrophilous therophytes, such as Asteriscus aquaticus, Cleo-
nia lusitanica, Velezia rigida, Campanula erinus, among others. In areas subjected to grazing, this pioneer community are replaced by Trifolium subterraneum-Plantagineta serrariae, dominated by graminoids and herbs (Poa bulbosa, Plantago serraria, Erhidium primulaceum, Trifolium tomentosum) and geophytes (Gynandris sisyrischinum, Scilla autumnalis) [26]. Moreover, on cliffs, rock outcrops or rocky soils, the Rhamno oleoidis-Quercetum rotundifolii woodlands behaves as more open formations and encompasses calcicolous chasmophytic communities, which inhabiting narrow fissures, such as those co-dominated by Narcissus calcicolae and Narcissus gaditanus (included in the association Narcissi calcicolae-gaditanae Pinto-Gome, E. Cano, J.A. Torres, Paiva-Ferreira & Rosa Pinto in Pinto-Gomes & Paiva-Ferreira 2005), mostly found in sub-coastal areas of southern part of Algarve (Algarve District).

IV-Rhamno laderoi-Quercetum rotundifolii Rivas-Martinez, M.T. Santos & Ladero 2011 (clusters 22–28, Figure 2)

For the Lusitania and Extremadura biogeographic territories, Rivas-Martínez et al. [13] published the holm oak forest Rhamno laderoi-Quercetum rotundifolii, well characterized by the presence of Rhamnus lycioides subsp. laderoi. This association occurs on calcareous, calcadolitic and ultramafic or serpentine substrates, within upper thermomediterranean or lower mesomediterranean, subhumid, bioclimatic belts. The floristic composition of these woodlands also contains other characteristic species from the Quercetea ilicis vegetation class, such as Olea europaea var. sylvestris, Quercus cocifera, Pistacia lentiscus, Pistacia terebinthus, Jasminum fruticans, Rhamnus oleoides, Teucrium fruticans, which reveals the catenal relationship with the first substitution stage, linked to the association Asparago albi-Rhamnetum oleoidis. As shown in Table A1 (Appendix A), the Quercus rotundifolia wood is also characterized by the presence of climbing shrubs (e.g., Rubia peregrina, Smlax aspera, Loniceræ impexa, Loniceræ etruscæ, Asparagus africanus, Asparagus albus), and nemoral herbs and geophytes in the understory, including Thapsia nitida, Elaeoselinum foetidum, Magydaris panacifolia, Paesia broteri, Ruscus aculeatus. The consistent presence of Cistus albidus in the companion group reveals the contact with the serial regressive community Lavandulo sampaiocae-Cistetum albidii M.T. Santos in Rivas-Martínez, Loussá, T.E. Díaz, Fernández-González & J.C. Costa 1990, favored by human-induced disturbance such as periodic soil mobilization. Finally, the land use and disturbance events promote the occurrence of the last subseral stage, linked to the annual grasslands from the Helianthenetum guttati Rivas Goday et Rivas-Mart. 1963 class, which colonize clearings of the scrublands and perennial grasslands.

3.3. Syntaxonomical Scheme

QUERCETAE ILICIS Br.-Bl. ex A. & O. Bolos 1950
QUERCETALIA ILICIS Br.-Bl. ex Moliner 1934
Oleó sylvestris-Quercion rotundifoliana Barbero, Quézel et Rivas-Mart. in Rivas-Mart. et al. 1986 Querco rotundifolii-Oleomion sylvestris J.C. Costa, C. Neto, C. Aguiar, J. Capelo, M.D. Espiríto Santo, J. Honrado, C. Pinto-Gomes, T. Monteiro-Henriques, M. Sequeira, M. Loussá 2012
Ulici argentei-Quercetum rotundifolii Quinto-Canas, Cano-Ortiz, Musarella, del Río, M. Raposo, Piñar Fuentes & Pinto-Gomes ass. nova
Myrtì communis-Quercetum rotundifolii Rivas Goday in Rivas Goday, Borja, Esteve, Galiano, Rigli & Rivas-Martinez 1959
Rhamno oleoidis-Quercetum rotundifolii Rivas-Martínez in Rivas-Martínez, Fernández-González, Loidí, Loussá & Penas 2002
Rhamno laderoi-Quercetum rotundifolii Rivas-Martínez, M.T. Santos & Ladero 2011

3.4. Considerations of the Typical Sequence of Vegetation Stages Occurring in the Holm Oak Vegetation Series

The Quercus rotundifolia woodlands constitute unique ecosystems that are recognized for their ecological value, linked to water retention, watershed protection, reducing fire risk and soil erosion, carbon sequestration and key-habitats for rare and endemic species [33]. However, as evidence by Quinto-Canas [24] and Quinto-Canas et al. [32] these oak forests have been transformed throughout history and well-preserved examples are rare, since their
extension have been considerably reduced in area due to the cumulative effect of various kind anthropic interference, namely cutting, inappropriate silvicultural management, mechanized shrub clearance, intensive grazing, agricultural intensification, and forest fires (Figure 3).

Figure 3. Diagram representing the typical sequence of vegetation stages occurring in the holm oak vegetation series from southwest of Iberian Peninsula.

These practices lead to the degradation of holm oak woodlands and consequently, current vegetation cover (in anthropic modified landscapes) are dominated by lower layers and stages of vegetal dynamics (such as, maquis scrubland, broomland, perennial grassland, gorse and cistaceous scrubland, and annual grasslands) or agricultural and silvopastoral systems.

4. Conclusions

As a result of this work we have been able to extend the forest communities dominated by Quercus rotundifolia in the south of Portugal. The new association Ullici argentei-Quercetum rotundifoliiæ, with an edaphoxerophilous character, has an original floristic patterns and specific ecological features that segregate biogeographically this association from the other holm oak woodlands of Querco rotundifoliiæ-Oelenion sylvestris suballiance in the southwestern Iberian Peninsula. In order to ensure its preservation, this community should be enacted through the Habitats Directive 92/43/EEC, under the Natura 2000 code: 9340 Quercus ilex and Quercus rotundifolia forests habitat, from the Annex I habitat types of the Council Directive 92/43/EEC of 21 May 1992.

Moreover, the Southwestern Iberian Peninsula holm oak woodlands occur in less accessible areas, mostly restricted to small patches and consequently, conservation measure required to achieve favorable conservation status of Quercus rotundifolia woodlands. Hence, strategic policies recommendations include: (i) Protect the holm oak woodlands through regulation, environmental planning instruments and assessment, in order to avoid its destruction driven by changes in land use (mainly, forestry planting, agricultural, grazing, soil mobilization); (ii) ensure that the protection of rare species is factored into management/monitoring objectives; (iii) increase efficiency of forest monitoring to ensure the long-term future of holm oak woodland habitat area; and (iv) apply environmental and ecological economics tools to the valuation of biodiversity conservation and ecosystem services of holm oak woodlands.

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A.C.-O., and C.M.M.; investigation: R.Q.C., A.C.-O., C.M.M., and J.C.P.F.; resources: R.Q.C., A.C.-O., C.M.M., and J.C.P.F.; data curation: R.Q.C., A.C.-O., C.M.M., and C.P.G.; writing—original draft preparation: R.Q.C.; writing—review and editing: C.P.G., A.C.-O., S.d.R., and C.M.M.; visualization: J.C.P.F.; supervision: C.P.G. and S.d.R. All authors have read and agreed to the published version of the manuscript.

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**Appendix A**

**Table A1.** Synoptic table of the holm oak woodlands linked to the *Querco rotundifoliae-Olenion sylvestris* suballiance in the southwest of the Iberian Peninsula.

| Association no. | 1 | 2 | 3 | 4 | P |
|-----------------|---|---|---|---|---|
| Characteristic  |   |   |   |   |   |
| *Ulex argenteus*| V | - | - | - | 10 |
| *Scilla monophyllos*| IV | - | - | - | 5 |
| *Hyacinthoides hispanica*| II | - | - | - | 3 |
| *Luzula forsteri subsp. baeticum*| II | - | - | - | 3 |
| *Avenella stricta*| II | - | - | - | 4 |
| *Carex hallarana*| I | - | - | - | 2 |
| *Senecio lopezii*| + | - | - | - | 1 |
| *Phillyrea media*| + | - | - | - | 1 |
| *Osyris lanceolata*| + | - | - | - | 2 |
| *Erica arborea*| V | - | - | - | 1 |
| *Quercus rotundifolia*| V | V | 4 | V | 28 |
| *Pistacia lentiscus*| V | V | 2 | V | 17 |
| *Rhamnus alaternus*| IV | II | 2 | II | 13 |
| *Rubia peregrina*| III | IV | 3 | IV | 13 |
| *Olea europaea var. sylvestris*| III | II | 2 | V | 17 |
| *Arbutus unedo*| V | IV | 2 | IV | 20 |
| *Quercus cocciifera*| V | II | - | V | 21 |
| *Smilax aspera var. altissima*| IV | III | 1 | - | 6 |
| *Phlomis purpurea*| IV | I | 1 | - | 14 |
| *Phillyrea angustifolia*| III | V | - | III | 10 |
| *Viburnum tinus*| II | + | - | III | 5 |
| *Daphne gnidium*| I | - | 1 | III | 17 |
| *Lonicera inglexa*| II | - | - | IV | 10 |
| *Ruscus aculeatus*| II | - | - | III | 8 |
| *Asplenium onopteris*| II | - | - | I | 3 |
| *Pyrus bourgaeana*| + | V | - | I | 12 |
| *Rhamnus olivoides*| + | - | 1 | III | 6 |
| *Myrtus communis*| I | V | - | - | 12 |
| *Arun italicum subsp. neglectum*| I | - | - | I | 2 |
| *Quercus suber*| + | III | - | - | 7 |
| *Phillyrea latifolia*| + | - | - | III | 3 |
| *Arizarum vulgare subsp. simorhinum*| + | - | - | II | 2 |
| *Elaeocarpus foetidum*| + | - | - | II | 2 |
| *Vincetoxicum mignanium*| + | + | - | - | 5 |
| *Moehringia pentandra*| + | + | - | - | 1 |
| *Asparagus acutifolius*| - | V | 1 | V | 16 |
| *Anemone palmata*| - | III | - | I | 6 |
| *Jasminum fruticans*| - | II | - | V | 10 |
| *Osyris alba*| - | II | - | III | 7 |
| *Chamaecyparis humifusa*| - | II | + | - | 4 |
| *Pistacia terebinthus*| - | I | - | V | 9 |
| *Aristolochia baetica*| - | - | 3 | - | 1 |
Table A1. Cont.

| Association no. | 1   | 2   | 3   | 4   | P   |
|-----------------|-----|-----|-----|-----|-----|
| *Ulex baeticus subsp. scaber* | -   | -   | 1   | -   | 1   |
| *Calicotome villosa* | -   | -   | 1   | -   | 1   |
| *Ceratonia siliqua* | -   | -   | 1   | -   | 1   |
| *Asparagus aphyllus* | -   | -   | 1   | -   | 1   |
| *Rosa sempervirens* | -   | -   | 1   | -   | 1   |
| *Clematis flammula* | -   | -   | 1   | -   | 1   |
| *Rhamnus laderoi* | -   | -   | V   | 7   |     |
| *Teucrium fruticans* | -   | -   | III | 4   | 10  |
| *Smilax aspera var. aspera* | -   | -   | III | 3   |     |
| *Thapsia nitida* | -   | -   | III | 3   |     |
| *Bupleurum fruticosum* | -   | -   | III | 3   |     |
| *Paonia broteroi* | -   | -   | I   | 2   | 2   |
| *Coronilla juncea* | -   | -   | II  | 2   |     |
| *Lonicer a etrusca* | -   | -   | II  | 2   |     |
| *Asparagus albus* | -   | -   | I   | 1   |     |
| *Coronilla glauca* | -   | -   | I   | 1   |     |
| *Juniperus oxycedrus subsp. lagunae* | -   | -   | -   | 1   | 1   |

**Companions**

| Sedum forsterianum | V   | -   | -   | -   | 9   |
| Lavandula viridis  | V   | -   | -   | -   | 8   |
| Dactylis hispanica subsp. lusitanica | V   | -   | -   | -   | 9   |
| *Pieris spinifera* | IV  | -   | -   | -   | 7   |
| *Thapsia villosa*  | IV  | -   | -   | -   | 7   |
| *Rumex induratus*  | IV  | -   | -   | -   | 6   |
| *Tamus communis*   | IV  | -   | -   | -   | 5   |
| *Umbilicus rapestris* | III | -   | -   | -   | 6   |
| *Arrhenatherum album var. erianthum* | III | -   | -   | -   | 4   |
| *Lithodora lusitanica* | III | -   | -   | -   | 5   |
| *Phagnalon saxatile* | III | -   | -   | -   | 5   |
| *Cynara algarbiensis* | II  | -   | -   | -   | 4   |
| *Asphodelus aestivus* | II  | -   | -   | -   | 6   |
| *Genista triacanthos* | II  | -   | -   | -   | 4   |
| *Erophaca baetica*  | II  | -   | -   | -   | 3   |
| *Lavandula luisieri* | II  | -   | -   | -   | 3   |
| *Digitalis purpurea* | II  | -   | -   | -   | 3   |
| *Cistus populifolius* | II  | -   | -   | -   | 2   |
| *Lavandula x alportelensis* | II  | -   | -   | -   | 2   |
| *Cistus x hybridus* | II  | -   | -   | -   | 2   |
| *Anthyllis vulneraria subsp. maura* | II  | -   | -   | -   | 3   |
| *Sanguisorba rupicola* | II  | -   | -   | -   | 4   |
| *Magydaris panacifolia* | II  | -   | -   | -   | 3   |
| *Celtica gigantea* | II  | -   | -   | -   | 2   |
| *Helichrysum stoechas* | II  | -   | -   | -   | 2   |
| *Erica australis* | II  | -   | -   | -   | 3   |
| *Geranium purpureum* | II  | II  | 1   | -   | 8   |
| *Saxifraga granulata* | II  | I   | -   | -   | 6   |
| *Brachypodium phoenicoides* | II  | I   | -   | -   | 4   |
| *Cistus salvifolius* | III  | V  | -   | -   | 16  |
| *Cistus ladanifer* | III  | III | -   | -   | 11  |
| *Pulicaria odora* | I   | III | -   | -   | 7   |
| *Aristolochia paucinervis* | I   | II  | -   | -   | 3   |
| *Hymenocarpus lotoides* | I   | II  | -   | -   | 3   |
| *Campanula rapunculus* | +   | II  | -   | -   | 4   |
| *Cistus monspeliensis* | -   | V   | -   | -   | 9   |
| Association no.                      | 1 | 2 | 3 | 4 | P |
|-------------------------------------|---|---|---|---|---|
| Briza maxima                        | V |   | V |   | 9 |
| Agrostis castellana                 | V |   | V |   | 9 |
| Tuberaria guttata                   | V |   | V |   | 9 |
| Cistus crispus                      | V |   | V |   | 9 |
| Vulpia bromoides                    | V |   | V |   | 9 |
| Trifolium angustifolium             | IV|   | IV|   | 7 |
| Eryngium tenue                      | IV|   | IV|   | 8 |
| Castridiun ventricosum              | IV|   | IV|   | 7 |
| Tolpis barbata                      | IV|   | IV|   | 7 |
| Trifolium scabrum                   | IV|   | IV|   | 7 |
| Cynosurus echinatus                 | IV|   | IV|   | 7 |
| Brachypodium distachyon             | IV|   | IV|   | 7 |
| Rumex acetosella                    | IV|   | IV|   | 7 |
| Trifolium glomeratum                | IV|   | IV|   | 7 |
| Bellis annua                        | IV|   | IV|   | 7 |
| Lavandula stoechas                  | III|  | III|  | 6 |
| Agrostis pourretii                  | III|  | III|  | 6 |
| Calamintha nepeta                   | III|  | III|  | 4 |
| Cynara humilis                      | III|  | III|  | 6 |
| Parentucellia viscosa               | III|  | III|  | 5 |
| Taniatherum caput-medusae           | III|  | III|  | 6 |
| Scilla autumnalis                   | III|  | III|  | 6 |
| Leucojum autumnale                  | III|  | III|  | 5 |
| Aria cupaniana                      | III|  | III|  | 5 |
| Aria caryophyllea                   | III|  | III|  | 5 |
| Molineriella minuta                 | III|  | III|  | 6 |
| Dactylis glomerata                  | III|  | III|  | 6 |
| Teucrium haenseleri                 | II |   | II |   | 4 |
| Cerastium brachypetalum             | II |   | II |   | 4 |
| Silene rubella subsp. segetalis     | II |   | II |   | 3 |
| Briza minor                         | II |   | II |   | 2 |
| Ditrichia viscosa                   | II |   | II |   | 3 |
| Erica scoparia                      | II |   | II |   | 3 |
| Thymus mastichina                   | II |   | II |   | 3 |
| Ulex australis subsp. australis     | II |   | II |   | 4 |
| Cytisus scoparius subsp. scoparius  | II |   | II |   | 4 |
| Margotia gummifera                  | II |   | II |   | 3 |
| Lathyrus latifolius                 | II |   | II |   | 3 |
| Coronilla dura                      | II |   | II |   | 4 |
| Carlina racemosa                    | II |   | II |   | 4 |
| Pulicaria paludosa                  | II |   | II |   | 4 |
| Gaudinia fragilis                   | II |   | II |   | 3 |
| Gladiolus reuteri                   | II |   | II |   | 4 |
| Crataegus monogyna                  | III|   | III|   | 7 |
| Retama sphaerocarpa                 | III|   | III|   | 10|
| Cephalantera longifolia             | II |   | II |   | 6 |
| Melica ciliata subsp. magnolii      | II |   | II |   | 5 |
| Piptatherum miliacum                | II |   | II |   | 1 |
| Cistus albidus                      | II |   | II |   | 1 |
| Thymbra capitata                    | II |   | II |   | 1 |
| Rubus ulmifolius                    | II |   | II |   | 1 |
| Vinca difformis                     | II |   | II |   | 1 |
| Ptilostemon hispanicus              | II |   | II |   | 1 |
| Urginea maritima                    | II |   | II |   | 1 |
| Cytisus striatus subsp. eriocarpus   | II |   | II |   | 1 |
| Cytisus scoparius subsp. bourgaei    | II |   | II |   | 1 |
Table A1. Cont.

| Association no. | 1   | 2   | 3   | 4   | P |
|-----------------|-----|-----|-----|-----|---|
| Ballota hirsuta  | -   | -   | -   | -   | 1 |
| Rosa pouziniti   | -   | -   | -   | -   | 1 |
| Rosa canina      | -   | -   | -   | -   | 1 |
| Nepeta tuberosa  | -   | -   | -   | -   | 1 |

Other taxa—Companions: Selaginella denticulata (P-2), Genista hirsuta (P-1), Clinopodium arundanum (P-1), Lonicer a periclymenum subsp. hispanica (P-1), Carilina corymbosa (P-1), Hypparrhenia sinaica (P-2) I in I, Arenaria montana (P-1), Senecio sylvaticus (P-1), Lupinus micranthus (P-1), Ranunculus paludosus (P-1), Allium massaeysyl (P-1), Bellis sylvetris (P-1), Asplenium billotia (P-1), Allium roseum (P-1), Silene latifolia (P-1), Dianthus lusitanus (P-2), Ranunculus gramineus (P-2), Thymelaea villosa (P-2), Allium pallens (P-1), Campanula lusitanica (P-1), Anogramma leptophylla (P-1), Orchis morio (P-1) in I; Origanum virens (P-4), Flueggea tinctoria (P-2), Scirpus spicatus (P-2), Mentha spicata (P-2), Mentha pulegium (P-2), Halimum halimifolium (P-2), Calepina irregulares (P-2), Thapsia transtagana (P-2), Aristolochia baetica (P-2), Narcissus serotinus (P-2), Paronychia cymosa (P-2), Hymenocarpos cornicinata (P-2), Salix atrocinerea (P-1), Nerium oleander (P-1), Juncus inflexus (P-1), Linum tenue (P-1) + in II.

P – frequency of total occurrence of the species in the dataset.

Association: No. 1 *Ulici argentei-Quercetum rotundifoliae* (synthetic table from Appendix A, Table A3 of this paper, 10 relevés; clusters 1-10); No. 2 *Myrto communis-Quercetum rotundifoliae* Rivas Goday et al. 1959 ([23]: Tab. 11, 10 relevés; clusters 11–20); No. 3 *Rhamnio oleoidis-Quercetum rotundifoliae* Rivas-Martínez in Rivas-Martínez, Fernández-González, Loddé, Lousé & Penas 2002 ([12]: 1 relevé; cluster 21); No. 4 *Rhamno laderoi-Quercetum rotundifoliae* Rivas-Martínez, M.T. Santos & Ladero 2011 ([13]: 463, 7 relevés; clusters 22–28).

Table A2. Biogeographic, bioclimatic, substratum and floristic comparison between holm oak communities of the Southwestern Iberian Peninsula, included in the *Querco rotundifoliae-Olenion sylvestris* suballiance.

| Holm Oak Association | Biogeographic Units or Territories | Bioclimatic Units (Thermotypes and Ombrotypes) | Substratum Affinity | Characteristics and Main Differentials |
|----------------------|-----------------------------------|-----------------------------------------------|---------------------|--------------------------------------|
| *Ulici argentei-Quercetum rotundifoliae* | Monchique Sierran District | Thermomediterranean sub-humid | Silicicolous (schists and greywackes substrates) | Ulex argenteus, Scilla monophyllos, Avenella stricta, Lavandula viridis, Cynara algarbiensis. |
| *Myrto communis-Quercetum rotundifoliae* | Mediterranean-Beroatlanitic | thermomediterranean dry | Silicicolous (schists and greywackes substrates) | Myrtus communis, Chamaerops humilis, Lavandula sampaioana. |
| *Rhamnio oleoidis-Quercetum rotundifoliae* | Bética Province, reaching the Algarve and Monchique Sector, Cádiz and Sado Subprovince | thermomediterranean, dry to subhumid | Calcicolous (limestone and calcio-dolomitic substrates) | Ulex baeoticus subsp. scaber, Thymus capitata, Aristolochia baetica, Phlomis sardou. |
| *Rhamno laderoi-Quercetum rotundifoliae* | Lusitania and Extremadura Subprovince | upper thermomediterranean or lower mesomediterranean, subhumid | Calcicolous (calcareae, calcio-dolomitic and ultramafic or serpentine substrates) | Rhamnus lycioides subsp. laderoi, Teucrium fruticans. |

Table A3. *Ulici argentei-Quercetum rotundifoliae* ass. nova hoc loco (Querco rotundifoliae-Olenion sylvestris, Oleo sylvestris-Quercion rotundifoliae, Quercetea ilicis, Quercetalia ilicis).

| Relevé no. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------|---|---|---|---|---|---|---|---|---|----|
| Surface (m²) | 200 | 250 | 150 | 400 | 300 | 200 | 300 | 150 | 150 | 150 |
| Altitude (m) | 170 | 135 | 155 | 165 | 260 | 165 | 160 | 390 | 375 | 385 |
| Cover rate (%) | 90 | 80 | 70 | 85 | 95 | 80 | 100 | 90 | 95 | 70 |
| Orientation | O | SE | SE | O | NE | NE | O | SE | NE | SE |
| Slope (%) | 35 | 20 | 25 | 25 | 30 | 20 | 30 | 10 | 30 | 5 |
| Altura media (m) | 6 | 6 | 5 | 5 | 8 | 6 | 8 | 4 | 7 | 3 |
| No. of species | 30 | 27 | 32 | 39 | 19 | 38 | 35 | 35 | 24 | 15 |

**PRESENCES**

| Characteristic of association and higher units | Quercus rotundifolia | Erica arborea |
|-----------------------------------------------|---------------------|-------------|
| 1 | 2 | 3 | 4 | 5 | 4 | 4 | 3 | 3 | V |
| 1 | 2 | 1 | + | + | 1 | + | 2 | + | V |
Table A3. Cont.

| Relevé no. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------|---|---|---|---|---|---|---|---|---|----|
| Surface (m²) | 200 | 250 | 150 | 400 | 300 | 200 | 300 | 150 | 150 | 150 |
| Altitude (m) | 170 | 135 | 155 | 165 | 260 | 165 | 160 | 390 | 375 | 385 |
| Cover rate (%) | 90 | 80 | 70 | 85 | 95 | 80 | 100 | 90 | 95 | 70 |
| Orientation | O | SE | SE | O | NE | NE | O | SE | NE | SE |
| Slope (%) | 35 | 20 | 25 | 25 | 30 | 20 | 30 | 10 | 30 | 5 |
| Altura média (m) | 6 | 6 | 5 | 5 | 8 | 6 | 8 | 4 | 7 | 3 |
| No. of species | 30 | 27 | 32 | 39 | 19 | 38 | 35 | 35 | 24 | 15 |

**Companions**

| Dactylis hispanica | + | + | + | 1 | - | 1 | + | + | + | + | V |
| Sedum forsterianum | + | 1 | 1 | 1 | - | 1 | + | + | - | - | IV |
| Lavandula viridis | 1 | 1 | - | - | + | 1 | + | 2 | - | - | IV |
| Picris spinifera | - | 1 | 1 | 1 | 1 | + | + | - | - | - | IV |
| Cistus salvifolius | + | + | + | - | + | - | + | + | - | - | IV |
| Thapsia villosa | + | + | + | 1 | 1 | + | - | 2 | - | - | IV |
| Umbilicus rupestris | - | - | - | - | - | - | - | + | - | - | II |
| Phagnalon saxatile | + | + | + | + | - | - | - | + | - | - | III |
| Rumex induratus | + | + | + | + | + | - | - | + | - | - | III |
| Tamus communis | 1 | + | - | - | 2 | 2 | 2 | - | 1 | - | III |
| Lithodora lusitanica | - | + | + | + | - | - | + | + | - | - | III |
| Cistus ladanifer | - | - | + | + | - | - | - | + | - | - | III |
| Arrenatherum album var. erianthum | - | - | + | + | - | - | + | - | - | - | II |
| Cynara algarbiensis | + | - | 1 | - | - | + | + | - | - | - | II |
| Saxifraga granulata | - | - | - | + | 1 | + | - | + | - | - | II |
| Genista tripolitica | - | - | - | - | - | 1 | - | + | - | - | II |
| Sanguisorba rupicola | + | + | - | + | - | - | + | - | - | - | II |
| Erica australis | + | + | - | 1 | - | - | + | - | - | - | II |
| Geranium purpureum | + | + | + | - | - | + | - | + | - | - | II |
| Brachypodium phoeniceus | + | + | + | - | - | + | - | - | - | - | II |
| Eruphaca barica | + | - | - | - | - | - | + | - | - | - | II |
| Lavandula lasiurus | - | - | 1 | - | - | - | + | 1 | + | - | II |
| Digitalis purpurea | + | - | - | - | - | - | + | - | - | - | II |
| Alyssum vulgare | - | - | + | + | - | - | - | - | - | - | II |

**Preseances**

| Quercus coccifera | + | + | 1 | 1 | 2 | 1 | + | + | 1 | V |
| Ulex argenteus | 1 | + | 2 | 2 | - | 1 | + | 1 | + | 2 | V |
| Pistacia lentiscus | + | 1 | 2 | + | - | 1 | + | + | 1 | + | V |
| Arbutus unedo | 1 | + | 1 | 1 | 1 | - | 1 | + | - | 1 | IV |
| Phlomis purpurea | - | 1 | 1 | 1 | - | + | + | 1 | - | - | IV |
| Rhamnus alaternus | + | 1 | - | - | 1 | + | - | + | - | - | III |
| Smilax aspera var. altissima | 1 | 1 | 1 | - | 1 | + | + | - | - | - | III |
| Phillyrea angustifolia | 1 | - | - | - | + | - | 1 | - | 2 | - | III |
| Olea europaea var. sylvestris | - | + | + | - | + | + | - | + | - | - | III |
| Scilla monophyllos | 1 | 1 | + | - | 2 | - | - | 2 | - | - | III |
| Rubia peregrina | - | - | + | - | - | 1 | - | 2 | - | - | III |
| Lonicera implexa | - | - | - | + | - | - | 2 | - | - | - | III |
| Acrobata stricta | - | - | - | + | - | - | + | - | - | - | III |
| Ruscus aculeatus | - | - | - | + | - | 1 | + | - | - | - | III |
| Hyacinthoides nonscripta | - | - | - | - | 1 | + | - | - | - | - | III |
| Luzula forsteri | - | - | - | - | - | + | + | - | - | - | II |
| subsp. baeticum | - | - | - | - | - | + | - | - | - | - | II |
| Asplenium onopteris | - | - | - | - | - | - | + | 2 | - | - | III |
| Daphne nudiflora | - | - | - | - | - | - | + | - | - | - | III |
| Ogris lanceolata | - | - | - | - | - | - | - | - | + | - | I |
| Myrtus communis | - | - | - | - | - | - | - | - | - | + | I |
| Carex hallerana | - | - | - | - | - | - | - | - | - | - | I |
| Rubia peregrina | + | + | + | + | + | - | - | - | - | - | II |
| Digitalis purpurea | + | + | + | + | + | - | - | - | - | - | II |
| Anthyllis vulneraria subsp. maura | + | + | + | + | + | - | - | - | - | - | II |
| Dactylis hispanica | + | + | + | 1 | - | 1 | + | + | + | + | V |
| subsp. lusitanica | + | 1 | 1 | 1 | 1 | + | - | + | + | + | V |
| Sedum forsterianum | + | 1 | 1 | 1 | 1 | + | 1 | - | - | - | IV |
| Lavandula viridis | 1 | 1 | - | - | + | 1 | + | 2 | - | - | IV |
| Picris spinifera | - | 1 | 1 | 1 | 1 | + | + | - | - | - | IV |
| Cistus salvifolius | + | + | + | + | - | - | - | + | + | + | IV |
| Thapsia villosa | + | + | + | 1 | 1 | + | - | 2 | - | - | IV |
| Umbilicus rupestris | - | - | - | + | + | - | + | + | - | - | III |
| Phagnalon saxatile | + | + | + | + | + | - | - | + | - | - | III |
| Runex induratus | + | + | + | + | + | - | - | + | - | - | III |
| Tamus communis | 1 | + | - | 2 | 2 | - | - | 1 | - | - | III |
| Lithodora lusitanica | - | + | + | + | - | - | + | + | - | - | III |
| Cistus ladanifer | - | - | + | - | - | + | - | + | + | - | III |
| Arrhenatherum album var. erianthum | - | - | + | + | - | - | + | - | - | - | II |
| Cynara algarbiensis | + | - | 1 | - | - | + | + | - | - | - | II |
| Saxifraga granulata | - | - | - | + | 1 | + | - | - | - | - | II |
| Genista tripolitica | - | - | - | - | - | 1 | - | + | - | - | II |
| Sanguisorba rupicola | + | + | - | + | - | - | + | - | - | - | II |
| Erica australis | + | - | - | 1 | - | - | + | - | - | - | II |
| Geranium purpureum | + | - | - | - | - | 1 | + | - | - | - | II |
| Brachypodium phoeniceus | + | - | - | + | - | - | - | - | - | - | II |
| Erophaca baetica | + | + | - | - | - | + | - | - | - | - | II |
| Lavandula lasiurus | - | - | 1 | - | - | - | + | 1 | + | - | II |
| Digitalis purpurea | + | - | - | - | - | - | + | - | - | - | II |
| Anthyllis vulneraria subsp. maura | - | - | + | + | - | - | - | - | - | - | II |
### Table A3. Cont.

| Relevé no. | Surface (m²) | Altitude (m) | Cover rate (%) | Orientation | Slope (%) | Altura média (m) | No. of species |
|-----------|--------------|--------------|----------------|-------------|-----------|-----------------|---------------|
|           |              |              |                | O SE SE O NE NE O SE NE SE | 35 20 25 25 30 20 30 10 30 5 | 6 6 5 5 8 6 8 4 7 3 |

| PreseNCes |
|-----------|
|            | 30 27 32 39 19 35 35 24 15 |

**Other taxa**—Characteristics: + Senecio lopezii in 3; + Pyrus bourgaeana in 6; 2 Arum italicum subsp. neglectum in 7; + Quercus suber, + Rhamnus oleoides in 8; Campanions; + Senecio sylvaticus in 1; + Urginea maritima, + Lupinus micranthus, + Ranunculus paludosus in 3; + Campanula rapunculus, + Arenaria montana in 4; + Asplenium billitii in 5; + Allium roseum, 1 Silene latifolia, r Dianthus lusitanus; r Ranunculus grammieus in 6; + Allium massaesylum, + Bellis sylvestris in 7; + Cheilanthes guanchica, + Allium pallens, + Campanula lusitana in 8; + Anogramma leptophylla, + Orchis morio in 9.

**Location of the relevés**: 1–Monte Novo da Eirinha (near Azilheira); 2–Cerro da Fonte (near S. Marcos da Serra); 3–Corte Peral; 4–Carrapareira; 5–Casinha; 6–Aziheira; 7 (* holotypus)–Boi (near Rib.ª de Odelouca); 8–Negro; 9–Barranco da Muda (near Cova da Muda); 10–Negro.

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