Niche complementarity between pollinators increases community-level plant reproductive success

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Short running title: Network structure effects on ecosystem functioning

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**Abstract**

Declines in pollinator diversity and abundance have been reported across different regions, with implications for the reproductive success of plant species. However, research has focused primarily on pairwise plant-pollinator interactions, largely overlooking community-level dynamics. Yet species do not interact in isolation, they are embedded within larger networks whose structure can affect pollinator functional roles and, ultimately, the pollination services they deliver to plants. Here, we present one of the first efforts linking pollinator visitation to plant reproduction from a community-wide perspective using a well-replicated dataset encompassing 16 well-resolved plant-pollinator networks and data on reproductive success for 19 plant species from Mediterranean shrub ecosystems. We find that models including information on simple visitation metrics alone are good in explaining the variability in reproductive success observed. However, insights into the mechanisms through which differences in pollinator diversity translate into changes in reproductive success require additional information on network structure, particularly that reflecting niche complementarity between pollinators. Specifically, we find a positive effect of increasing niche complementarity between pollinators on plant reproductive success.

**Introduction**

Pollinators provide key services to plants by facilitating pollen flow between individuals. The recent declining trends found for some pollinator species in some regions of the planet ((Potts *et al.* 2010; Bartomeus *et al.* 2019)) have led many researchers to focus on the functional impacts of these changes in pollinator diversity, with a major focus being placed on the consequences for plant reproductive success (Biesmeijer *et al.* 2006).

Many research efforts have targeted the reproductive success of individual plant species (**???**; Thomson 2019), and used relatively simple visitation metrics (e.g., the number of pollinator species that visit a plant or the number of visits they perform) to explain the differences observed across different plant individuals. Contrastingly, community-level analyses remain scarce (Bennett *et al.* 2018). Yet plants and pollinators do not interact in isolation, but rather are embedded within larger networks of interactions encompassing other plant and pollinator species. We are thus missing an important part of the picture, which includes the direct interactions between the whole ensemble of plants and pollinators, but also the indirect interactions between species within one guild (e.g., plants) through their shared resources (Pauw 2013; Carvalheiro *et al.* 2014; Lázaro *et al.* 2014; Mayfield & Stouffer 2017; Johnson & Bronstein 2019). Understanding how changes in pollinator diversity and interaction structure affect whole community assemblages is thus a major challenge that requires attention.

The few pollination studies that have analysed the effects of changing pollinator diversity for reproductive success at the community level have done so using mainly experimental setups. As an example, a study that experimentally recreated a plant community with 9 plant species and differing levels of pollinator diversity across different enclosures, found that not only pollinator species diversity had an effect for average reproductive success, but that plant-pollinator interaction structure also had an important effect (Fründ *et al.* 2013). In particular, these authors found that niche complementarity between pollinators, in terms of plant species and temperature coverage (a measure of the overlap in the use of plant resources and optimum temperature activity) had a positive effect for average seed set at the community level (Fründ *et al.* 2013). This provides added information on the effects of biodiversity for ecosystem functioning, suggesting that not only the diversity of species present, but also the diversity of roles and ways in which a community is structured, are determinant factors.

Indeed, theoretical research has long suggested that the structure of multitrophic communities has an effect for ecosystem functioning (reviewed in (Thompson *et al.* 2012)). This line of research, rooted in niche theory and revamped by food-web studies (Macarthur & Levins 1967; May & MacArthur 1972; Tilman 1982; Godoy *et al.* 2018), has greatly advanced theory, but these ideas have not yet been tested using empirical data (but see (Poisot *et al.* 2013)). Specifically, a major knowledge gap resides in understanding which aspects of structure determine which aspects of function (Thompson *et al.* 2012). This is because although a network perspective has promised to encapsulate complex ecological mechanisms occurring at the community level – such as indirect interactions (Holt 1977; Abrams *et al.* 1998) or niche overlap (Woodward & Hildrew 2002)- less attention has been given to the ways in which these mechanisms relate to observed ecosystem processes (Blüthgen 2010). In contrast, we are now at a point in which there is considerable understanding on the attributes characterizing mutualistic interaction networks (**???**). Especially, in the case of pollination, we have ample knowledge on the attributes that shape these mutualistic interactions at the community level. Amongst them is the prevalence of nested structures, i.e., arrangements where specialist species interact with a subset of the species that generalists interact with (Bascompte *et al.* 2003) and which is thought to promote species diversity (Bastolla *et al.* 2009); or the relatively high extent of complementary specialization at the community scale, which may be directly related to key ecosystem functions (Blüthgen & Klein 2011). However, the mechanisms by which these potential pathways affect plant reproduction remain to be understood (Winfree 2013). The time is thus ripe to use the existing knowledge around plant-pollinator network structures to explore the relationship between network structure and ecosystem functioning empirically, with special emphasis being placed on the underlying ecological mechanisms that drive these relationships.

Here, we present one of the first efforts linking pollinator visitation and plant reproductive success at the community level using empirical data on plant-pollinator interaction networks and plant reproductive success. To this end, we use a well-replicated dataset encompassing 16 well-resolved plant-pollinator interaction networks coupled with data on the reproductive success of 19 plant species recorded in Mediterranean shrub ecosystems. Our study focuses on understanding whether adding information on selected interaction network structure indices to previously used simple visitation metrics (e.g., the number and diversity of pollinator species visiting a plant species) aids in better explaining the differences observed in community-wide reproductive success. In doing so, we conducted our analyses focusing on reproductive success at two different levels: (i) at the species level by considering the effect of the position of a focal species within the larger network and its impact on its individual reproductive success, and (ii) at the site level, by evaluating how attributes that describe the whole site might affect average values of reproductive success. Specifically, our study focuses on how the interplay between niche complementarity and redundancy determines reproductive success. Plant reproductive success requires of the delivery of conspecific pollen and thus of a certain degree of niche complementarity (Blüthgen & Klein 2011). Yet, greater values of nestedness, which imply redundancy in species functions, are thought to promote species diversity (Bastolla *et al.* 2009) and stability (Thébault & Fontaine 2010) within plant-polllinator networks. At present, we do not know how either of these network characteristics affects the functions performed by pollinators. Finally, in addition to average values, we also evaluate whether network structure helps explain differences in equity in reproductive success across species within a community, as a measure of evenness in the pollination service delivered.

Our results suggest that models including information on simple visitation metrics alone are good in explaining the variability observed in reproductive success. However, insights into the mechanisms through which differences in pollinator diversity translate into changes in reproductive success require additional information on network structure, notably information on the complementarity between the functions performed and the niches occupied by different pollinator species. Specifically, we find a positive effect of increasing niche complementarity between pollinators on plant reproductive success.

**Methods**

*Plant pollinator interactions*

Our study was conducted in SW Spain within the area of influence of Doñana National Park, i.e., within the limits of the Natural Space of Doñana as defined by the local government (Junta de Andalucía, Fig. 1). All sites were located within similar elevations (ranging from 50 to 150 m a.s.l.), similar habitat and soil types, and presented similar plant compositions (plant mean Sørensen beta-diversity among sites = 0.87), reducing potential confounding factors. Here, we surveyed 16 Mediterranean woodland patches with an average distance of 7 km between them (min= 3 km, max= 46.5 km). Each site was surveyed 7 times during the flowering season of 2015 (from February to May) following a 100-m x 2 m transect for 30 mins. Along each transect, we identified all plant species and recorded all the floral visitors that landed on their flowers during each 30-min period. Only floral visitors (from now on referred to as pollinators) that could not be identified in the field were captured, stored and identified in the laboratory by FPM with the aid of experts in the different taxonomic groups (see acknowledgements). In addition, at each round we conducted 3 minutes of focal observations recording all floral visitors observed on 3 plant individuals per species belonging to the 19 most common (based on previous surveys) plant species across the study area (mean SD: 6.25 1.73 species per site). Furthermore, we included some interactions between plant and pollinator individuals that were not observed during the sampling but that were opportunistically recorded immediately before or after the sampling periods, as some of these interactions are difficult to document and might be important to define network structure (Jordano 2016). These opportunistic interactions represented 22.96 of all interactions recorded. All surveys were done under similar weather conditions, avoiding windy or rainy days. Surveys were done during mornings and afternoons with the sampling order being established randomly.

*Plant reproductive success*

Within each site, we marked between 3 and 12 individuals (mean SD: 6.49 2.37) belonging to 1 to 6 plant species (mean SD:4.06 1.69), depending on the availability and presence of flowers during the sampling events. For each individual, at the end of the season, we recorded fruit set (i.e. the proportion of flowers that set fruit), the average number of seeds per fruit and the average fruit and seed weight per fruit (1-36 fruits subsampled, mean SD: 11.17 6.85). Our survey included a total of 19 different plant species across our 16 sites. Plants species were selected based on their availability, with sampling being focused on the most abundant plant species. The values at the species level were then averaged per site to calculate unique reproductive success measures at the site level. X % of the plant species depend on pollinators to maximize their reproduction (Table SX).

*Data analyses*

In order to evaluate the completeness of our sampling of the pollinator and plant community as well as that of their interactions, we estimated the asymptotic number of species present (Chao *et al.* 2009), a non-parametric estimator of species richness for abundance data. This estimator includes non-detected species and allowed us to calculate the proportion detected with our original sampling data. We used Chao 1 asymptotic species richness estimators (Chao *et al.* 2009) and estimated the richness of pollinators, plants and plant–pollinator links accumulated as sampling effort increased up to 100% sampling coverage using package iNEXT (Hsieh *et al.* 2016) within the R environment (R Development Core Team 2011). We then extracted the values covered by our sampling.

In order to analyse how differences in network structure might affect plant reproductive success, we constructed plant-pollinator interaction networks by pooling the data for the 7 rounds of sampling. We thus obtained one interaction network per site, representing the incidence of visits by different pollinator species to different plant species. For each network, we then proceeded to extract a series of relevant network metrics at the species and site levels.

In addition, we checked for potential spatial autocorrelation in our data by means of Mantel correlograms. Autocorrelation values were low for all variables included in our analyses (Figure S1).

*Species-level network analysis*

At the species level, we focused on attributes defining the position of a focal plant species within the larger community. As such, we considered two metrics providing complementary non-redundant information: (i) average niche overlap in terms of pollinators between a focal plant species and each of the other plant species in the community, which estimates the potential indirect interactions between different plant species through shared resources (in this case pollinators), and (ii) centrality, which depicts the importance of the role played by a plant species within the larger community (as resource for a large number of pollinator species) and its contribution to network cohesiveness. Niche overlap was calculated as the average overlap in pollinator species visiting a focal plant and each of the other plants in the community using the Morisita overlap index, a measure of similarity between two sets of data (Zhang 2016). As a measure of centrality, we used weighted closeness centrality, which represents the number of shortest paths going through a focal plant based on a unipartite projection of the bipartite plant-pollinator network using a weighted representation of the network (Dormann *et al.* 2009). Here, links between plant species represent shared pollinator species.

*Site-level network analysis*

At the site level, we followed the same logic as the one presented at the species level. Thus, we also calculated two network metrics providing complementary non-redundant information. In this case we focused on (i) nestedness and (ii) pollinator niche complementarity.

Nestedness is the property by which specialists interact with a subset of the species that generalists interact with (Bascompte *et al.* 2003). Although there is an ongoing debate in the literature, some studies have found that nested networks are more stable and resilient to perturbations because nestedness promotes a greater diversity by minimizing competition among species in a community (Bastolla *et al.* 2009). However, many network attributes vary with network size and complexity (Blüthgen *et al.* 2006). In the case of nestedness, we know it can be affected by network size and connectance (**???**). An approach that is often used to correct for this, is to use null models and to compare null-model corrected nestedness values across different networks. However, this approach has been recently shown to present the same issues, as z-scores also change with network size and connectance (**???**). We thus followed the advice provided by Song et al. (2017) by using a normalized value of the widely-used nestedness metric NODF (Almeida-Neto & Ulrich 2011), . This normalized value is calculated as , where C is connectance and S is network size. is calculated as , which is independent of network size and thus comparable across different networks (**???**). To calculate max(NODF) we used a recently corrected version of the algorithm (Simmons *et al.* 2019) in all but three sites, where the condition that the number of links>number of species was not met and thus precluded us from using this new version.

Niche complementarity metrics are important because plant reproductive success depends on the delivery of conspecific pollen and thus of a certain level of specialization or niche divergence (reviewed in (Brosi 2016)). To calculate niche complementarity, we used a community-level measure defined as the total branch length of a functional dendrogram based on qualitative differences measured using a Euclidean distance in visitor assemblages between plants (Petchey & Gaston 2007; Devoto *et al.* 2012). All network metrics were calculated using package bipartite (Dormann *et al.* 2009).

All of these metrics were calculated using all the data as well as for the subset of the data excluding interactions observed outside of sampling periods. Differences between results are minimal for both and thus we will only present results for the analysis using the full dataset (see Table S11A-H for results removing observations out of transect).

*Statistical analyses*

In order to evaluate whether adding information on network structure improves our ability to explain differences in reproductive success - both at the species and the site level - we used generalized linear (GLMs) and generalized linear mixed models (GLMMs). In both cases (species and site-level models) we fit two types of models: (i) model 1, that only included simple visitation metrics and (ii) model 2 that additionally included information on network structure. These models are meant to be additive, so that the network metrics included are intended to complement rather than substitute the simple metrics traditionally used.

At the species level, response variables included the fruit set for different individuals of each species analyzed using a binomial distribution, the average number of seeds per fruit analyzed using a normal distribution, and the average values of fruit and seed weight fitted to Poisson distributions. The number of seeds per fruit was centered and scaled (i.e., we subtracted column means and divided by standard deviation) to allow meaningful comparisons across species with contrasting life histories. As explanatory variables, model 1 included pollinator richness, and the total number of visits received by each plant species; while model 2 added the two network attributes calculated at the species level: average plant niche overlap and centrality. For both models, we included plant species nested within site and site as random effects to account for the non-indepedence of several individuals measured per species and site.

At the site level, we upscaled our species-level analyses. As response variables we had the average reproductive success per site (i.e., average fruit set analyzed using a binomial distribution, average number of seeds per fruit and average fruit and seed weight using a normal distribution). We thus had a single value per site and no random effects are needed in this case. In this case, model 1 included total pollinator richness and total pollinator abundance (i.e. number of visits received by all plants within the community) as explanatory variables. Model 2, in turn, added information on network structure by including nestedness and pollinator niche complementarity as explanatory variables.

Average values of reproductive success at the site level can be driven to a large extent by a single plant species. Yet, what will determine the persistence of a diverse plant community, is the presence of some sort of “equity” or evenness in reproductive success across the whole community. We therefore calculated a measure of equity in reproductive success at the site level as the proportion of species with normalized (between 0 and 1) average fruit set values that were above the 50^th percentile. As any selected threshold is arbitrary, we repeated this using the 25^th and 75^th percentile thresholds (Byrnes *et al.* 2014). We then used the same framework as that used for species and site-level analyses and fit the same models 1 and 2 GLMs but using equity in reproductive success as the response variable and fitting a binomial distribution.

In all cases, we used variance inflation factors to check for collinearity between explanatory variables. Additionally, we ran residual diagnostics to check if model assumptions were met. Then, we used the Akaike Information Criterion (AIC) to compare model performance and complexity. Whenever the difference between the AIC of both models was < 2 (), we considered that both models were equally good (Burnham *et al.* 2011). All predictor variables were standardized prior to analysis. For every model we also calculate the R2 value using the approximation suggested for generalized mixed models when necessary (Nakagawa *et al.* 2017).

Finally, we tested whether the importance of network structure in explaining differences in equity in reproductive success within communities increases with the number of plant species being considered. We expect that when only one plant species is considered, then the importance of network structure will be negligible, while we expect this importance to increase as more plant species are considered (up to a maximum number of 6 species which is the maximum we have measured in our study at a particular site).

To test this, we ran a simple simulation in which the number of species considered increased at each step and for each step we re-calculated equity in reproductive success. Instead of drawing plant species randomly for each step, we tested all possible combinations for each plant number level and network, as the number of combinations is small (e.g. for n = 3 plant selected out of 6 there is only 20 possible combinations). Then, we tested if the relationship between equity in reproductive success and functional complementarity (given its importance in determining differences in reproductive success, see Results section) changes as a function of the number of plants considered within our simulated communities. To this end, for each level of species number considered, we randomly selected one of the generated equity values across each of the 16 communities and regressed these 16 values against our network level predictor and extracted the model slope estimates. We repeated this process 1,000 times and averaged all slope estimates. We expect that the more plants considered, the larger the resulting average estimates will be. Note that we only interpret the mean effects, as the variance among different plant number of species considered depends on the initial number of combinations.

**Results**

Within our sampling we recorded 1472 plant-pollinator interactions involving 277 pollinator species and 57 plant species. Within the pollinator community the distribution of individuals in different orders was: 87.84% Hymenoptera, 6.78% Diptera, 4.05% Coleoptera and 1.09% Lepidoptera.

Our sampling completeness analyses revealed that with our survey we were able to capture 18-62% of pollinator species (average = 35%), 47-98% for plant species (average = 78%) and 13-41% for plant-pollinator links (average = 27%), in line with that obtained with other studies (e.g., (Chacoff *et al.* 2012), Fig. S2). Our values of sampling completeness are slightly smaller in the case of pollinators, probably as a consequence of the great diversity found in the Mediterranean region and within our study area in particular, a hotspot of insect diversity (**???**). In addition, the fact that we include an extra effort to capture rare interactions observed outside of our main sampling might also increase the number of singletons which directly affect richness estimates.

## Site\_id plant.sps poll.sps  
## 1 <NA> <NA> NA  
## 2 Aznalcazar Teucrium fruticans 14  
## 3 Aznalcazar Rosmarinus officinalis 3  
## 4 Aznalcazar Asphodelus fistulosus 12  
## 5 Aznalcazar Cistus ladanifer 6  
## 6 Aznalcazar Ulex australis 0  
## 7 Aznalcazar Halimium commutatum 1  
## 8 Aznalcazar Erica scoparia 0  
## 9 Aznalcazar Cistus salvifolius 5  
## 10 Aznalcazar Astragalus lusitanicus 0  
## 11 Aznalcazar Lavandula stoechas 3  
## 12 Aznalcazar Leontodon sp 0  
## 13 Aznalcazar Retama sp 0  
## 14 Aznalcazar Cerinthe gymnandra 0  
## 15 Aznalcazar Cistus crispus 27  
## 16 Aznalcazar Lavandula pedunculata 1  
## 17 Aznalcazar Diplotaxis virgata 0  
## 18 Aznalcazar Spartium junceum 0  
## 19 Aznalcazar Cistus albidus 2  
## 20 Aznalcazar Calendula arvensis 0  
## 21 Aznalcazar Lupinus angustifolius 0  
## 22 Aznalcazar Tuberaria guttata 0  
## 23 Aznalcazar Andryala integrifolia 1  
## 24 Aznalcazar Cistus libanotis 0  
## 25 Aznalcazar Linaria viscosa 0  
## 26 Aznalcazar Cistus monspeliensis 7  
## 27 Aznalcazar Linum bienne 0  
## 28 Aznalcazar Raphanus raphanistrum 0  
## 29 Aznalcazar Ranunculus sp 0  
## 30 Aznalcazar Genista hirsuta 0  
## 31 Aznalcazar Erica umbellata 0  
## 32 Aznalcazar Leontodon longirostris 0  
## 33 Aznalcazar Erica ciliaris 0  
## 34 Aznalcazar Echium plantagineum 3  
## 35 Aznalcazar Halimium halimifolium 0  
## 36 Aznalcazar Armeria velutina 0  
## 37 Aznalcazar Thapsia villosa 0  
## 38 Aznalcazar Convolvulus arvensis 0  
## 39 Aznalcazar Carduus sp 0  
## 40 Aznalcazar Arctotheca calendula 0  
## 41 Aznalcazar Phlomis purpurea 0  
## 42 Aznalcazar Chamaemelum fuscatum 0  
## 43 Aznalcazar Anchusa azurea 0  
## 44 Aznalcazar Lavatera cretica 2  
## 45 Aznalcazar NA NA 2  
## 46 Aznalcazar Taraxacum vulgare 0  
## 47 Aznalcazar Thymus mastichina 0  
## 48 Aznalcazar Scabiosa atropurpurea 0  
## 49 Aznalcazar Retama sphaerocarpa 0  
## 50 Aznalcazar Malva sp 0  
## 51 Aznalcazar Erodium sp 0  
## 52 Aznalcazar Convolvulus althaeoides 0  
## 53 Aznalcazar Chamaerops humilis 0  
## 54 Aznalcazar Cirsium vulgare 0  
## 55 Aznalcazar Mirtus communis 11  
## 56 Aznalcazar Scolymus hispanicus 1  
## 57 Aznalcazar Mentha pulegium 0  
## 58 Aznalcazar Acacia adealbata 0  
## 59 Villamanriquesur Teucrium fruticans 0  
## 60 Villamanriquesur Rosmarinus officinalis 3  
## 61 Villamanriquesur Asphodelus fistulosus 0  
## 62 Villamanriquesur Cistus ladanifer 7  
## 63 Villamanriquesur Ulex australis 0  
## 64 Villamanriquesur Halimium commutatum 4  
## 65 Villamanriquesur Erica scoparia 0  
## 66 Villamanriquesur Cistus salvifolius 18  
## 67 Villamanriquesur Astragalus lusitanicus 0  
## 68 Villamanriquesur Lavandula stoechas 11  
## 69 Villamanriquesur Leontodon sp 0  
## 70 Villamanriquesur Retama sp 0  
## 71 Villamanriquesur Cerinthe gymnandra 0  
## 72 Villamanriquesur Cistus crispus 6  
## 73 Villamanriquesur Lavandula pedunculata 0  
## 74 Villamanriquesur Diplotaxis virgata 0  
## 75 Villamanriquesur Spartium junceum 0  
## 76 Villamanriquesur Cistus albidus 0  
## 77 Villamanriquesur Calendula arvensis 0  
## 78 Villamanriquesur Lupinus angustifolius 0  
## 79 Villamanriquesur Tuberaria guttata 0  
## 80 Villamanriquesur Andryala integrifolia 4  
## 81 Villamanriquesur Cistus libanotis 0  
## 82 Villamanriquesur Linaria viscosa 0  
## 83 Villamanriquesur Cistus monspeliensis 0  
## 84 Villamanriquesur Linum bienne 0  
## 85 Villamanriquesur Raphanus raphanistrum 0  
## 86 Villamanriquesur Ranunculus sp 0  
## 87 Villamanriquesur Genista hirsuta 1  
## 88 Villamanriquesur Erica umbellata 0  
## 89 Villamanriquesur Leontodon longirostris 0  
## 90 Villamanriquesur Erica ciliaris 0  
## 91 Villamanriquesur Echium plantagineum 0  
## 92 Villamanriquesur Halimium halimifolium 4  
## 93 Villamanriquesur Armeria velutina 3  
## 94 Villamanriquesur Thapsia villosa 0  
## 95 Villamanriquesur Convolvulus arvensis 1  
## 96 Villamanriquesur Carduus sp 0  
## 97 Villamanriquesur Arctotheca calendula 0  
## 98 Villamanriquesur Phlomis purpurea 0  
## 99 Villamanriquesur Chamaemelum fuscatum 0  
## 100 Villamanriquesur Anchusa azurea 0  
## 101 Villamanriquesur Lavatera cretica 0  
## 102 Villamanriquesur NA NA 0  
## 103 Villamanriquesur Taraxacum vulgare 0  
## 104 Villamanriquesur Thymus mastichina 0  
## 105 Villamanriquesur Scabiosa atropurpurea 0  
## 106 Villamanriquesur Retama sphaerocarpa 0  
## 107 Villamanriquesur Malva sp 0  
## 108 Villamanriquesur Erodium sp 0  
## 109 Villamanriquesur Convolvulus althaeoides 0  
## 110 Villamanriquesur Chamaerops humilis 0  
## 111 Villamanriquesur Cirsium vulgare 0  
## 112 Villamanriquesur Mirtus communis 5  
## 113 Villamanriquesur Scolymus hispanicus 0  
## 114 Villamanriquesur Mentha pulegium 0  
## 115 Villamanriquesur Acacia adealbata 0  
## 116 Villamanriqueeste Teucrium fruticans 0  
## 117 Villamanriqueeste Rosmarinus officinalis 5  
## 118 Villamanriqueeste Asphodelus fistulosus 1  
## 119 Villamanriqueeste Cistus ladanifer 15  
## 120 Villamanriqueeste Ulex australis 0  
## 121 Villamanriqueeste Halimium commutatum 0  
## 122 Villamanriqueeste Erica scoparia 0  
## 123 Villamanriqueeste Cistus salvifolius 23  
## 124 Villamanriqueeste Astragalus lusitanicus 0  
## 125 Villamanriqueeste Lavandula stoechas 2  
## 126 Villamanriqueeste Leontodon sp 0  
## 127 Villamanriqueeste Retama sp 0  
## 128 Villamanriqueeste Cerinthe gymnandra 0  
## 129 Villamanriqueeste Cistus crispus 17  
## 130 Villamanriqueeste Lavandula pedunculata 0  
## 131 Villamanriqueeste Diplotaxis virgata 0  
## 132 Villamanriqueeste Spartium junceum 1  
## 133 Villamanriqueeste Cistus albidus 0  
## 134 Villamanriqueeste Calendula arvensis 0  
## 135 Villamanriqueeste Lupinus angustifolius 0  
## 136 Villamanriqueeste Tuberaria guttata 0  
## 137 Villamanriqueeste Andryala integrifolia 0  
## 138 Villamanriqueeste Cistus libanotis 0  
## 139 Villamanriqueeste Linaria viscosa 0  
## 140 Villamanriqueeste Cistus monspeliensis 0  
## 141 Villamanriqueeste Linum bienne 0  
## 142 Villamanriqueeste Raphanus raphanistrum 0  
## 143 Villamanriqueeste Ranunculus sp 0  
## 144 Villamanriqueeste Genista hirsuta 1  
## 145 Villamanriqueeste Erica umbellata 0  
## 146 Villamanriqueeste Leontodon longirostris 0  
## 147 Villamanriqueeste Erica ciliaris 0  
## 148 Villamanriqueeste Echium plantagineum 0  
## 149 Villamanriqueeste Halimium halimifolium 0  
## 150 Villamanriqueeste Armeria velutina 0  
## 151 Villamanriqueeste Thapsia villosa 0  
## 152 Villamanriqueeste Convolvulus arvensis 0  
## 153 Villamanriqueeste Carduus sp 0  
## 154 Villamanriqueeste Arctotheca calendula 0  
## 155 Villamanriqueeste Phlomis purpurea 0  
## 156 Villamanriqueeste Chamaemelum fuscatum 0  
## 157 Villamanriqueeste Anchusa azurea 0  
## 158 Villamanriqueeste Lavatera cretica 0  
## 159 Villamanriqueeste NA NA 0  
## 160 Villamanriqueeste Taraxacum vulgare 0  
## 161 Villamanriqueeste Thymus mastichina 0  
## 162 Villamanriqueeste Scabiosa atropurpurea 0  
## 163 Villamanriqueeste Retama sphaerocarpa 0  
## 164 Villamanriqueeste Malva sp 0  
## 165 Villamanriqueeste Erodium sp 0  
## 166 Villamanriqueeste Convolvulus althaeoides 0  
## 167 Villamanriqueeste Chamaerops humilis 0  
## 168 Villamanriqueeste Cirsium vulgare 0  
## 169 Villamanriqueeste Mirtus communis 11  
## 170 Villamanriqueeste Scolymus hispanicus 0  
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## 172 Villamanriqueeste Acacia adealbata 0  
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## 175 PinaresdeHinojos Asphodelus fistulosus 0  
## 176 PinaresdeHinojos Cistus ladanifer 0  
## 177 PinaresdeHinojos Ulex australis 1  
## 178 PinaresdeHinojos Halimium commutatum 0  
## 179 PinaresdeHinojos Erica scoparia 0  
## 180 PinaresdeHinojos Cistus salvifolius 16  
## 181 PinaresdeHinojos Astragalus lusitanicus 0  
## 182 PinaresdeHinojos Lavandula stoechas 0  
## 183 PinaresdeHinojos Leontodon sp 0  
## 184 PinaresdeHinojos Retama sp 0  
## 185 PinaresdeHinojos Cerinthe gymnandra 0  
## 186 PinaresdeHinojos Cistus crispus 2  
## 187 PinaresdeHinojos Lavandula pedunculata 0  
## 188 PinaresdeHinojos Diplotaxis virgata 4  
## 189 PinaresdeHinojos Spartium junceum 4  
## 190 PinaresdeHinojos Cistus albidus 0  
## 191 PinaresdeHinojos Calendula arvensis 0  
## 192 PinaresdeHinojos Lupinus angustifolius 0  
## 193 PinaresdeHinojos Tuberaria guttata 0  
## 194 PinaresdeHinojos Andryala integrifolia 1  
## 195 PinaresdeHinojos Cistus libanotis 8  
## 196 PinaresdeHinojos Linaria viscosa 0  
## 197 PinaresdeHinojos Cistus monspeliensis 0  
## 198 PinaresdeHinojos Linum bienne 0  
## 199 PinaresdeHinojos Raphanus raphanistrum 0  
## 200 PinaresdeHinojos Ranunculus sp 0  
## 201 PinaresdeHinojos Genista hirsuta 0  
## 202 PinaresdeHinojos Erica umbellata 0  
## 203 PinaresdeHinojos Leontodon longirostris 0  
## 204 PinaresdeHinojos Erica ciliaris 0  
## 205 PinaresdeHinojos Echium plantagineum 0  
## 206 PinaresdeHinojos Halimium halimifolium 2  
## 207 PinaresdeHinojos Armeria velutina 2  
## 208 PinaresdeHinojos Thapsia villosa 0  
## 209 PinaresdeHinojos Convolvulus arvensis 0  
## 210 PinaresdeHinojos Carduus sp 0  
## 211 PinaresdeHinojos Arctotheca calendula 0  
## 212 PinaresdeHinojos Phlomis purpurea 0  
## 213 PinaresdeHinojos Chamaemelum fuscatum 0  
## 214 PinaresdeHinojos Anchusa azurea 3  
## 215 PinaresdeHinojos Lavatera cretica 0  
## 216 PinaresdeHinojos NA NA 0  
## 217 PinaresdeHinojos Taraxacum vulgare 0  
## 218 PinaresdeHinojos Thymus mastichina 0  
## 219 PinaresdeHinojos Scabiosa atropurpurea 0  
## 220 PinaresdeHinojos Retama sphaerocarpa 1  
## 221 PinaresdeHinojos Malva sp 0  
## 222 PinaresdeHinojos Erodium sp 0  
## 223 PinaresdeHinojos Convolvulus althaeoides 0  
## 224 PinaresdeHinojos Chamaerops humilis 0  
## 225 PinaresdeHinojos Cirsium vulgare 0  
## 226 PinaresdeHinojos Mirtus communis 3  
## 227 PinaresdeHinojos Scolymus hispanicus 0  
## 228 PinaresdeHinojos Mentha pulegium 8  
## 229 PinaresdeHinojos Acacia adealbata 0  
## 230 Esparragal Teucrium fruticans 0  
## 231 Esparragal Rosmarinus officinalis 0  
## 232 Esparragal Asphodelus fistulosus 0  
## 233 Esparragal Cistus ladanifer 0  
## 234 Esparragal Ulex australis 0  
## 235 Esparragal Halimium commutatum 5  
## 236 Esparragal Erica scoparia 0  
## 237 Esparragal Cistus salvifolius 16  
## 238 Esparragal Astragalus lusitanicus 0  
## 239 Esparragal Lavandula stoechas 5  
## 240 Esparragal Leontodon sp 0  
## 241 Esparragal Retama sp 0  
## 242 Esparragal Cerinthe gymnandra 0  
## 243 Esparragal Cistus crispus 4  
## 244 Esparragal Lavandula pedunculata 3  
## 245 Esparragal Diplotaxis virgata 1  
## 246 Esparragal Spartium junceum 0  
## 247 Esparragal Cistus albidus 0  
## 248 Esparragal Calendula arvensis 0  
## 249 Esparragal Lupinus angustifolius 0  
## 250 Esparragal Tuberaria guttata 0  
## 251 Esparragal Andryala integrifolia 0  
## 252 Esparragal Cistus libanotis 2  
## 253 Esparragal Linaria viscosa 3  
## 254 Esparragal Cistus monspeliensis 0  
## 255 Esparragal Linum bienne 0  
## 256 Esparragal Raphanus raphanistrum 0  
## 257 Esparragal Ranunculus sp 0  
## 258 Esparragal Genista hirsuta 0  
## 259 Esparragal Erica umbellata 0  
## 260 Esparragal Leontodon longirostris 0  
## 261 Esparragal Erica ciliaris 0  
## 262 Esparragal Echium plantagineum 0  
## 263 Esparragal Halimium halimifolium 4  
## 264 Esparragal Armeria velutina 7  
## 265 Esparragal Thapsia villosa 0  
## 266 Esparragal Convolvulus arvensis 0  
## 267 Esparragal Carduus sp 0  
## 268 Esparragal Arctotheca calendula 0  
## 269 Esparragal Phlomis purpurea 0  
## 270 Esparragal Chamaemelum fuscatum 1  
## 271 Esparragal Anchusa azurea 0  
## 272 Esparragal Lavatera cretica 0  
## 273 Esparragal NA NA 0  
## 274 Esparragal Taraxacum vulgare 0  
## 275 Esparragal Thymus mastichina 0  
## 276 Esparragal Scabiosa atropurpurea 1  
## 277 Esparragal Retama sphaerocarpa 0  
## 278 Esparragal Malva sp 0  
## 279 Esparragal Erodium sp 0  
## 280 Esparragal Convolvulus althaeoides 0  
## 281 Esparragal Chamaerops humilis 0  
## 282 Esparragal Cirsium vulgare 0  
## 283 Esparragal Mirtus communis 0  
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## 285 Esparragal Mentha pulegium 0  
## 286 Esparragal Acacia adealbata 0  
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## 288 LaCunya Rosmarinus officinalis 6  
## 289 LaCunya Asphodelus fistulosus 0  
## 290 LaCunya Cistus ladanifer 0  
## 291 LaCunya Ulex australis 1  
## 292 LaCunya Halimium commutatum 4  
## 293 LaCunya Erica scoparia 0  
## 294 LaCunya Cistus salvifolius 18  
## 295 LaCunya Astragalus lusitanicus 0  
## 296 LaCunya Lavandula stoechas 0  
## 297 LaCunya Leontodon sp 0  
## 298 LaCunya Retama sp 0  
## 299 LaCunya Cerinthe gymnandra 1  
## 300 LaCunya Cistus crispus 0  
## 301 LaCunya Lavandula pedunculata 2  
## 302 LaCunya Diplotaxis virgata 0  
## 303 LaCunya Spartium junceum 0  
## 304 LaCunya Cistus albidus 0  
## 305 LaCunya Calendula arvensis 0  
## 306 LaCunya Lupinus angustifolius 0  
## 307 LaCunya Tuberaria guttata 1  
## 308 LaCunya Andryala integrifolia 2  
## 309 LaCunya Cistus libanotis 0  
## 310 LaCunya Linaria viscosa 0  
## 311 LaCunya Cistus monspeliensis 0  
## 312 LaCunya Linum bienne 0  
## 313 LaCunya Raphanus raphanistrum 2  
## 314 LaCunya Ranunculus sp 0  
## 315 LaCunya Genista hirsuta 0  
## 316 LaCunya Erica umbellata 0  
## 317 LaCunya Leontodon longirostris 1  
## 318 LaCunya Erica ciliaris 1  
## 319 LaCunya Echium plantagineum 4  
## 320 LaCunya Halimium halimifolium 0  
## 321 LaCunya Armeria velutina 0  
## 322 LaCunya Thapsia villosa 0  
## 323 LaCunya Convolvulus arvensis 1  
## 324 LaCunya Carduus sp 0  
## 325 LaCunya Arctotheca calendula 0  
## 326 LaCunya Phlomis purpurea 0  
## 327 LaCunya Chamaemelum fuscatum 0  
## 328 LaCunya Anchusa azurea 0  
## 329 LaCunya Lavatera cretica 0  
## 330 LaCunya NA NA 0  
## 331 LaCunya Taraxacum vulgare 0  
## 332 LaCunya Thymus mastichina 0  
## 333 LaCunya Scabiosa atropurpurea 0  
## 334 LaCunya Retama sphaerocarpa 0  
## 335 LaCunya Malva sp 0  
## 336 LaCunya Erodium sp 0  
## 337 LaCunya Convolvulus althaeoides 0  
## 338 LaCunya Chamaerops humilis 0  
## 339 LaCunya Cirsium vulgare 0  
## 340 LaCunya Mirtus communis 0  
## 341 LaCunya Scolymus hispanicus 0  
## 342 LaCunya Mentha pulegium 0  
## 343 LaCunya Acacia adealbata 0  
## 344 LaRocina Teucrium fruticans 0  
## 345 LaRocina Rosmarinus officinalis 12  
## 346 LaRocina Asphodelus fistulosus 0  
## 347 LaRocina Cistus ladanifer 2  
## 348 LaRocina Ulex australis 2  
## 349 LaRocina Halimium commutatum 12  
## 350 LaRocina Erica scoparia 0  
## 351 LaRocina Cistus salvifolius 2  
## 352 LaRocina Astragalus lusitanicus 0  
## 353 LaRocina Lavandula stoechas 1  
## 354 LaRocina Leontodon sp 0  
## 355 LaRocina Retama sp 0  
## 356 LaRocina Cerinthe gymnandra 0  
## 357 LaRocina Cistus crispus 0  
## 358 LaRocina Lavandula pedunculata 19  
## 359 LaRocina Diplotaxis virgata 3  
## 360 LaRocina Spartium junceum 1  
## 361 LaRocina Cistus albidus 0  
## 362 LaRocina Calendula arvensis 0  
## 363 LaRocina Lupinus angustifolius 0  
## 364 LaRocina Tuberaria guttata 0  
## 365 LaRocina Andryala integrifolia 1  
## 366 LaRocina Cistus libanotis 0  
## 367 LaRocina Linaria viscosa 1  
## 368 LaRocina Cistus monspeliensis 0  
## 369 LaRocina Linum bienne 0  
## 370 LaRocina Raphanus raphanistrum 0  
## 371 LaRocina Ranunculus sp 0  
## 372 LaRocina Genista hirsuta 0  
## 373 LaRocina Erica umbellata 0  
## 374 LaRocina Leontodon longirostris 0  
## 375 LaRocina Erica ciliaris 0  
## 376 LaRocina Echium plantagineum 0  
## 377 LaRocina Halimium halimifolium 1  
## 378 LaRocina Armeria velutina 0  
## 379 LaRocina Thapsia villosa 0  
## 380 LaRocina Convolvulus arvensis 0  
## 381 LaRocina Carduus sp 0  
## 382 LaRocina Arctotheca calendula 0  
## 383 LaRocina Phlomis purpurea 0  
## 384 LaRocina Chamaemelum fuscatum 0  
## 385 LaRocina Anchusa azurea 29  
## 386 LaRocina Lavatera cretica 0  
## 387 LaRocina NA NA 0  
## 388 LaRocina Taraxacum vulgare 0  
## 389 LaRocina Thymus mastichina 0  
## 390 LaRocina Scabiosa atropurpurea 0  
## 391 LaRocina Retama sphaerocarpa 0  
## 392 LaRocina Malva sp 1  
## 393 LaRocina Erodium sp 3  
## 394 LaRocina Convolvulus althaeoides 0  
## 395 LaRocina Chamaerops humilis 0  
## 396 LaRocina Cirsium vulgare 0  
## 397 LaRocina Mirtus communis 8  
## 398 LaRocina Scolymus hispanicus 0  
## 399 LaRocina Mentha pulegium 0  
## 400 LaRocina Acacia adealbata 0  
## 401 Lasmulas Teucrium fruticans 0  
## 402 Lasmulas Rosmarinus officinalis 4  
## 403 Lasmulas Asphodelus fistulosus 0  
## 404 Lasmulas Cistus ladanifer 17  
## 405 Lasmulas Ulex australis 0  
## 406 Lasmulas Halimium commutatum 1  
## 407 Lasmulas Erica scoparia 0  
## 408 Lasmulas Cistus salvifolius 6  
## 409 Lasmulas Astragalus lusitanicus 0  
## 410 Lasmulas Lavandula stoechas 13  
## 411 Lasmulas Leontodon sp 0  
## 412 Lasmulas Retama sp 0  
## 413 Lasmulas Cerinthe gymnandra 0  
## 414 Lasmulas Cistus crispus 12  
## 415 Lasmulas Lavandula pedunculata 0  
## 416 Lasmulas Diplotaxis virgata 0  
## 417 Lasmulas Spartium junceum 0  
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## 419 Lasmulas Calendula arvensis 0  
## 420 Lasmulas Lupinus angustifolius 0  
## 421 Lasmulas Tuberaria guttata 0  
## 422 Lasmulas Andryala integrifolia 1  
## 423 Lasmulas Cistus libanotis 0  
## 424 Lasmulas Linaria viscosa 0  
## 425 Lasmulas Cistus monspeliensis 3  
## 426 Lasmulas Linum bienne 0  
## 427 Lasmulas Raphanus raphanistrum 0  
## 428 Lasmulas Ranunculus sp 5  
## 429 Lasmulas Genista hirsuta 0  
## 430 Lasmulas Erica umbellata 0  
## 431 Lasmulas Leontodon longirostris 0  
## 432 Lasmulas Erica ciliaris 0  
## 433 Lasmulas Echium plantagineum 1  
## 434 Lasmulas Halimium halimifolium 0  
## 435 Lasmulas Armeria velutina 0  
## 436 Lasmulas Thapsia villosa 1  
## 437 Lasmulas Convolvulus arvensis 0  
## 438 Lasmulas Carduus sp 0  
## 439 Lasmulas Arctotheca calendula 0  
## 440 Lasmulas Phlomis purpurea 0  
## 441 Lasmulas Chamaemelum fuscatum 0  
## 442 Lasmulas Anchusa azurea 0  
## 443 Lasmulas Lavatera cretica 0  
## 444 Lasmulas NA NA 0  
## 445 Lasmulas Taraxacum vulgare 0  
## 446 Lasmulas Thymus mastichina 0  
## 447 Lasmulas Scabiosa atropurpurea 0  
## 448 Lasmulas Retama sphaerocarpa 0  
## 449 Lasmulas Malva sp 0  
## 450 Lasmulas Erodium sp 0  
## 451 Lasmulas Convolvulus althaeoides 0  
## 452 Lasmulas Chamaerops humilis 0  
## 453 Lasmulas Cirsium vulgare 0  
## 454 Lasmulas Mirtus communis 5  
## 455 Lasmulas Scolymus hispanicus 0  
## 456 Lasmulas Mentha pulegium 0  
## 457 Lasmulas Acacia adealbata 0  
## 458 Elpozo Teucrium fruticans 0  
## 459 Elpozo Rosmarinus officinalis 8  
## 460 Elpozo Asphodelus fistulosus 0  
## 461 Elpozo Cistus ladanifer 7  
## 462 Elpozo Ulex australis 1  
## 463 Elpozo Halimium commutatum 0  
## 464 Elpozo Erica scoparia 4  
## 465 Elpozo Cistus salvifolius 16  
## 466 Elpozo Astragalus lusitanicus 0  
## 467 Elpozo Lavandula stoechas 2  
## 468 Elpozo Leontodon sp 0  
## 469 Elpozo Retama sp 0  
## 470 Elpozo Cerinthe gymnandra 0  
## 471 Elpozo Cistus crispus 1  
## 472 Elpozo Lavandula pedunculata 0  
## 473 Elpozo Diplotaxis virgata 0  
## 474 Elpozo Spartium junceum 1  
## 475 Elpozo Cistus albidus 0  
## 476 Elpozo Calendula arvensis 0  
## 477 Elpozo Lupinus angustifolius 0  
## 478 Elpozo Tuberaria guttata 0  
## 479 Elpozo Andryala integrifolia 0  
## 480 Elpozo Cistus libanotis 0  
## 481 Elpozo Linaria viscosa 0  
## 482 Elpozo Cistus monspeliensis 0  
## 483 Elpozo Linum bienne 0  
## 484 Elpozo Raphanus raphanistrum 0  
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## 486 Elpozo Genista hirsuta 0  
## 487 Elpozo Erica umbellata 2  
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## 489 Elpozo Erica ciliaris 0  
## 490 Elpozo Echium plantagineum 0  
## 491 Elpozo Halimium halimifolium 0  
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## 493 Elpozo Thapsia villosa 0  
## 494 Elpozo Convolvulus arvensis 0  
## 495 Elpozo Carduus sp 0  
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## 500 Elpozo Lavatera cretica 0  
## 501 Elpozo NA NA 0  
## 502 Elpozo Taraxacum vulgare 0  
## 503 Elpozo Thymus mastichina 0  
## 504 Elpozo Scabiosa atropurpurea 0  
## 505 Elpozo Retama sphaerocarpa 0  
## 506 Elpozo Malva sp 0  
## 507 Elpozo Erodium sp 0  
## 508 Elpozo Convolvulus althaeoides 0  
## 509 Elpozo Chamaerops humilis 0  
## 510 Elpozo Cirsium vulgare 0  
## 511 Elpozo Mirtus communis 3  
## 512 Elpozo Scolymus hispanicus 0  
## 513 Elpozo Mentha pulegium 0  
## 514 Elpozo Acacia adealbata 0  
## 515 Pinodelcuervo Teucrium fruticans 0  
## 516 Pinodelcuervo Rosmarinus officinalis 6  
## 517 Pinodelcuervo Asphodelus fistulosus 11  
## 518 Pinodelcuervo Cistus ladanifer 8  
## 519 Pinodelcuervo Ulex australis 3  
## 520 Pinodelcuervo Halimium commutatum 7  
## 521 Pinodelcuervo Erica scoparia 0  
## 522 Pinodelcuervo Cistus salvifolius 7  
## 523 Pinodelcuervo Astragalus lusitanicus 0  
## 524 Pinodelcuervo Lavandula stoechas 11  
## 525 Pinodelcuervo Leontodon sp 0  
## 526 Pinodelcuervo Retama sp 0  
## 527 Pinodelcuervo Cerinthe gymnandra 0  
## 528 Pinodelcuervo Cistus crispus 15  
## 529 Pinodelcuervo Lavandula pedunculata 1  
## 530 Pinodelcuervo Diplotaxis virgata 0  
## 531 Pinodelcuervo Spartium junceum 0  
## 532 Pinodelcuervo Cistus albidus 0  
## 533 Pinodelcuervo Calendula arvensis 0  
## 534 Pinodelcuervo Lupinus angustifolius 0  
## 535 Pinodelcuervo Tuberaria guttata 0  
## 536 Pinodelcuervo Andryala integrifolia 2  
## 537 Pinodelcuervo Cistus libanotis 0  
## 538 Pinodelcuervo Linaria viscosa 0  
## 539 Pinodelcuervo Cistus monspeliensis 0  
## 540 Pinodelcuervo Linum bienne 0  
## 541 Pinodelcuervo Raphanus raphanistrum 0  
## 542 Pinodelcuervo Ranunculus sp 1  
## 543 Pinodelcuervo Genista hirsuta 0  
## 544 Pinodelcuervo Erica umbellata 0  
## 545 Pinodelcuervo Leontodon longirostris 0  
## 546 Pinodelcuervo Erica ciliaris 0  
## 547 Pinodelcuervo Echium plantagineum 0  
## 548 Pinodelcuervo Halimium halimifolium 0  
## 549 Pinodelcuervo Armeria velutina 1  
## 550 Pinodelcuervo Thapsia villosa 1  
## 551 Pinodelcuervo Convolvulus arvensis 0  
## 552 Pinodelcuervo Carduus sp 0  
## 553 Pinodelcuervo Arctotheca calendula 0  
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## 555 Pinodelcuervo Chamaemelum fuscatum 1  
## 556 Pinodelcuervo Anchusa azurea 0  
## 557 Pinodelcuervo Lavatera cretica 0  
## 558 Pinodelcuervo NA NA 0  
## 559 Pinodelcuervo Taraxacum vulgare 0  
## 560 Pinodelcuervo Thymus mastichina 0  
## 561 Pinodelcuervo Scabiosa atropurpurea 0  
## 562 Pinodelcuervo Retama sphaerocarpa 0  
## 563 Pinodelcuervo Malva sp 0  
## 564 Pinodelcuervo Erodium sp 0  
## 565 Pinodelcuervo Convolvulus althaeoides 0  
## 566 Pinodelcuervo Chamaerops humilis 0  
## 567 Pinodelcuervo Cirsium vulgare 0  
## 568 Pinodelcuervo Mirtus communis 2  
## 569 Pinodelcuervo Scolymus hispanicus 0  
## 570 Pinodelcuervo Mentha pulegium 0  
## 571 Pinodelcuervo Acacia adealbata 0  
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## 573 Bonares Rosmarinus officinalis 0  
## 574 Bonares Asphodelus fistulosus 0  
## 575 Bonares Cistus ladanifer 7  
## 576 Bonares Ulex australis 0  
## 577 Bonares Halimium commutatum 6  
## 578 Bonares Erica scoparia 0  
## 579 Bonares Cistus salvifolius 15  
## 580 Bonares Astragalus lusitanicus 0  
## 581 Bonares Lavandula stoechas 5  
## 582 Bonares Leontodon sp 0  
## 583 Bonares Retama sp 0  
## 584 Bonares Cerinthe gymnandra 0  
## 585 Bonares Cistus crispus 6  
## 586 Bonares Lavandula pedunculata 4  
## 587 Bonares Diplotaxis virgata 0  
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## 589 Bonares Cistus albidus 0  
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## 592 Bonares Tuberaria guttata 0  
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## 595 Bonares Linaria viscosa 0  
## 596 Bonares Cistus monspeliensis 0  
## 597 Bonares Linum bienne 0  
## 598 Bonares Raphanus raphanistrum 0  
## 599 Bonares Ranunculus sp 0  
## 600 Bonares Genista hirsuta 0  
## 601 Bonares Erica umbellata 0  
## 602 Bonares Leontodon longirostris 0  
## 603 Bonares Erica ciliaris 0  
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## 606 Bonares Armeria velutina 0  
## 607 Bonares Thapsia villosa 15  
## 608 Bonares Convolvulus arvensis 0  
## 609 Bonares Carduus sp 3  
## 610 Bonares Arctotheca calendula 0  
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## 612 Bonares Chamaemelum fuscatum 0  
## 613 Bonares Anchusa azurea 0  
## 614 Bonares Lavatera cretica 0  
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## 617 Bonares Thymus mastichina 5  
## 618 Bonares Scabiosa atropurpurea 1  
## 619 Bonares Retama sphaerocarpa 0  
## 620 Bonares Malva sp 0  
## 621 Bonares Erodium sp 0  
## 622 Bonares Convolvulus althaeoides 0  
## 623 Bonares Chamaerops humilis 0  
## 624 Bonares Cirsium vulgare 0  
## 625 Bonares Mirtus communis 0  
## 626 Bonares Scolymus hispanicus 0  
## 627 Bonares Mentha pulegium 0  
## 628 Bonares Acacia adealbata 0  
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## 631 Niebla Asphodelus fistulosus 6  
## 632 Niebla Cistus ladanifer 8  
## 633 Niebla Ulex australis 0  
## 634 Niebla Halimium commutatum 0  
## 635 Niebla Erica scoparia 0  
## 636 Niebla Cistus salvifolius 0  
## 637 Niebla Astragalus lusitanicus 5  
## 638 Niebla Lavandula stoechas 6  
## 639 Niebla Leontodon sp 2  
## 640 Niebla Retama sp 0  
## 641 Niebla Cerinthe gymnandra 0  
## 642 Niebla Cistus crispus 3  
## 643 Niebla Lavandula pedunculata 7  
## 644 Niebla Diplotaxis virgata 0  
## 645 Niebla Spartium junceum 0  
## 646 Niebla Cistus albidus 0  
## 647 Niebla Calendula arvensis 2  
## 648 Niebla Lupinus angustifolius 2  
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## 650 Niebla Andryala integrifolia 4  
## 651 Niebla Cistus libanotis 0  
## 652 Niebla Linaria viscosa 2  
## 653 Niebla Cistus monspeliensis 8  
## 654 Niebla Linum bienne 3  
## 655 Niebla Raphanus raphanistrum 0  
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## 658 Niebla Erica umbellata 0  
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## 660 Niebla Erica ciliaris 0  
## 661 Niebla Echium plantagineum 0  
## 662 Niebla Halimium halimifolium 0  
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## 665 Niebla Convolvulus arvensis 7  
## 666 Niebla Carduus sp 1  
## 667 Niebla Arctotheca calendula 1  
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## 671 Niebla Lavatera cretica 0  
## 672 Niebla NA NA 0  
## 673 Niebla Taraxacum vulgare 2  
## 674 Niebla Thymus mastichina 0  
## 675 Niebla Scabiosa atropurpurea 0  
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## 677 Niebla Malva sp 0  
## 678 Niebla Erodium sp 0  
## 679 Niebla Convolvulus althaeoides 6  
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## 682 Niebla Mirtus communis 0  
## 683 Niebla Scolymus hispanicus 0  
## 684 Niebla Mentha pulegium 0  
## 685 Niebla Acacia adealbata 0  
## 686 ConventodelaLuz Teucrium fruticans 11  
## 687 ConventodelaLuz Rosmarinus officinalis 3  
## 688 ConventodelaLuz Asphodelus fistulosus 0  
## 689 ConventodelaLuz Cistus ladanifer 8  
## 690 ConventodelaLuz Ulex australis 3  
## 691 ConventodelaLuz Halimium commutatum 0  
## 692 ConventodelaLuz Erica scoparia 0  
## 693 ConventodelaLuz Cistus salvifolius 11  
## 694 ConventodelaLuz Astragalus lusitanicus 0  
## 695 ConventodelaLuz Lavandula stoechas 3  
## 696 ConventodelaLuz Leontodon sp 0  
## 697 ConventodelaLuz Retama sp 3  
## 698 ConventodelaLuz Cerinthe gymnandra 0  
## 699 ConventodelaLuz Cistus crispus 1  
## 700 ConventodelaLuz Lavandula pedunculata 0  
## 701 ConventodelaLuz Diplotaxis virgata 0  
## 702 ConventodelaLuz Spartium junceum 1  
## 703 ConventodelaLuz Cistus albidus 0  
## 704 ConventodelaLuz Calendula arvensis 0  
## 705 ConventodelaLuz Lupinus angustifolius 0  
## 706 ConventodelaLuz Tuberaria guttata 0  
## 707 ConventodelaLuz Andryala integrifolia 1  
## 708 ConventodelaLuz Cistus libanotis 0  
## 709 ConventodelaLuz Linaria viscosa 0  
## 710 ConventodelaLuz Cistus monspeliensis 0  
## 711 ConventodelaLuz Linum bienne 0  
## 712 ConventodelaLuz Raphanus raphanistrum 0  
## 713 ConventodelaLuz Ranunculus sp 0  
## 714 ConventodelaLuz Genista hirsuta 0  
## 715 ConventodelaLuz Erica umbellata 0  
## 716 ConventodelaLuz Leontodon longirostris 0  
## 717 ConventodelaLuz Erica ciliaris 0  
## 718 ConventodelaLuz Echium plantagineum 0  
## 719 ConventodelaLuz Halimium halimifolium 4  
## 720 ConventodelaLuz Armeria velutina 0  
## 721 ConventodelaLuz Thapsia villosa 0  
## 722 ConventodelaLuz Convolvulus arvensis 0  
## 723 ConventodelaLuz Carduus sp 0  
## 724 ConventodelaLuz Arctotheca calendula 0  
## 725 ConventodelaLuz Phlomis purpurea 0  
## 726 ConventodelaLuz Chamaemelum fuscatum 0  
## 727 ConventodelaLuz Anchusa azurea 0  
## 728 ConventodelaLuz Lavatera cretica 0  
## 729 ConventodelaLuz NA NA 0  
## 730 ConventodelaLuz Taraxacum vulgare 0  
## 731 ConventodelaLuz Thymus mastichina 0  
## 732 ConventodelaLuz Scabiosa atropurpurea 0  
## 733 ConventodelaLuz Retama sphaerocarpa 0  
## 734 ConventodelaLuz Malva sp 0  
## 735 ConventodelaLuz Erodium sp 0  
## 736 ConventodelaLuz Convolvulus althaeoides 0  
## 737 ConventodelaLuz Chamaerops humilis 0  
## 738 ConventodelaLuz Cirsium vulgare 0  
## 739 ConventodelaLuz Mirtus communis 0  
## 740 ConventodelaLuz Scolymus hispanicus 0  
## 741 ConventodelaLuz Mentha pulegium 0  
## 742 ConventodelaLuz Acacia adealbata 3  
## 743 Urbanizaciones Teucrium fruticans 0  
## 744 Urbanizaciones Rosmarinus officinalis 9  
## 745 Urbanizaciones Asphodelus fistulosus 0  
## 746 Urbanizaciones Cistus ladanifer 0  
## 747 Urbanizaciones Ulex australis 2  
## 748 Urbanizaciones Halimium commutatum 3  
## 749 Urbanizaciones Erica scoparia 0  
## 750 Urbanizaciones Cistus salvifolius 9  
## 751 Urbanizaciones Astragalus lusitanicus 0  
## 752 Urbanizaciones Lavandula stoechas 12  
## 753 Urbanizaciones Leontodon sp 0  
## 754 Urbanizaciones Retama sp 0  
## 755 Urbanizaciones Cerinthe gymnandra 0  
## 756 Urbanizaciones Cistus crispus 8  
## 757 Urbanizaciones Lavandula pedunculata 6  
## 758 Urbanizaciones Diplotaxis virgata 0  
## 759 Urbanizaciones Spartium junceum 0  
## 760 Urbanizaciones Cistus albidus 0  
## 761 Urbanizaciones Calendula arvensis 2  
## 762 Urbanizaciones Lupinus angustifolius 0  
## 763 Urbanizaciones Tuberaria guttata 1  
## 764 Urbanizaciones Andryala integrifolia 0  
## 765 Urbanizaciones Cistus libanotis 0  
## 766 Urbanizaciones Linaria viscosa 0  
## 767 Urbanizaciones Cistus monspeliensis 0  
## 768 Urbanizaciones Linum bienne 0  
## 769 Urbanizaciones Raphanus raphanistrum 0  
## 770 Urbanizaciones Ranunculus sp 0  
## 771 Urbanizaciones Genista hirsuta 0  
## 772 Urbanizaciones Erica umbellata 0  
## 773 Urbanizaciones Leontodon longirostris 0  
## 774 Urbanizaciones Erica ciliaris 0  
## 775 Urbanizaciones Echium plantagineum 0  
## 776 Urbanizaciones Halimium halimifolium 0  
## 777 Urbanizaciones Armeria velutina 0  
## 778 Urbanizaciones Thapsia villosa 0  
## 779 Urbanizaciones Convolvulus arvensis 0  
## 780 Urbanizaciones Carduus sp 0  
## 781 Urbanizaciones Arctotheca calendula 0  
## 782 Urbanizaciones Phlomis purpurea 0  
## 783 Urbanizaciones Chamaemelum fuscatum 0  
## 784 Urbanizaciones Anchusa azurea 0  
## 785 Urbanizaciones Lavatera cretica 0  
## 786 Urbanizaciones NA NA 0  
## 787 Urbanizaciones Taraxacum vulgare 0  
## 788 Urbanizaciones Thymus mastichina 0  
## 789 Urbanizaciones Scabiosa atropurpurea 0  
## 790 Urbanizaciones Retama sphaerocarpa 0  
## 791 Urbanizaciones Malva sp 0  
## 792 Urbanizaciones Erodium sp 0  
## 793 Urbanizaciones Convolvulus althaeoides 0  
## 794 Urbanizaciones Chamaerops humilis 0  
## 795 Urbanizaciones Cirsium vulgare 3  
## 796 Urbanizaciones Mirtus communis 0  
## 797 Urbanizaciones Scolymus hispanicus 0  
## 798 Urbanizaciones Mentha pulegium 0  
## 799 Urbanizaciones Acacia adealbata 0  
## 800 CotitodeSantaTeresa Teucrium fruticans 0  
## 801 CotitodeSantaTeresa Rosmarinus officinalis 2  
## 802 CotitodeSantaTeresa Asphodelus fistulosus 2  
## 803 CotitodeSantaTeresa Cistus ladanifer 0  
## 804 CotitodeSantaTeresa Ulex australis 0  
## 805 CotitodeSantaTeresa Halimium commutatum 0  
## 806 CotitodeSantaTeresa Erica scoparia 0  
## 807 CotitodeSantaTeresa Cistus salvifolius 6  
## 808 CotitodeSantaTeresa Astragalus lusitanicus 6  
## 809 CotitodeSantaTeresa Lavandula stoechas 14  
## 810 CotitodeSantaTeresa Leontodon sp 0  
## 811 CotitodeSantaTeresa Retama sp 0  
## 812 CotitodeSantaTeresa Cerinthe gymnandra 0  
## 813 CotitodeSantaTeresa Cistus crispus 6  
## 814 CotitodeSantaTeresa Lavandula pedunculata 1  
## 815 CotitodeSantaTeresa Diplotaxis virgata 0  
## 816 CotitodeSantaTeresa Spartium junceum 0  
## 817 CotitodeSantaTeresa Cistus albidus 12  
## 818 CotitodeSantaTeresa Calendula arvensis 0  
## 819 CotitodeSantaTeresa Lupinus angustifolius 0  
## 820 CotitodeSantaTeresa Tuberaria guttata 0  
## 821 CotitodeSantaTeresa Andryala integrifolia 0  
## 822 CotitodeSantaTeresa Cistus libanotis 0  
## 823 CotitodeSantaTeresa Linaria viscosa 0  
## 824 CotitodeSantaTeresa Cistus monspeliensis 0  
## 825 CotitodeSantaTeresa Linum bienne 0  
## 826 CotitodeSantaTeresa Raphanus raphanistrum 0  
## 827 CotitodeSantaTeresa Ranunculus sp 0  
## 828 CotitodeSantaTeresa Genista hirsuta 0  
## 829 CotitodeSantaTeresa Erica umbellata 0  
## 830 CotitodeSantaTeresa Leontodon longirostris 0  
## 831 CotitodeSantaTeresa Erica ciliaris 0  
## 832 CotitodeSantaTeresa Echium plantagineum 0  
## 833 CotitodeSantaTeresa Halimium halimifolium 0  
## 834 CotitodeSantaTeresa Armeria velutina 0  
## 835 CotitodeSantaTeresa Thapsia villosa 14  
## 836 CotitodeSantaTeresa Convolvulus arvensis 0  
## 837 CotitodeSantaTeresa Carduus sp 0  
## 838 CotitodeSantaTeresa Arctotheca calendula 0  
## 839 CotitodeSantaTeresa Phlomis purpurea 0  
## 840 CotitodeSantaTeresa Chamaemelum fuscatum 0  
## 841 CotitodeSantaTeresa Anchusa azurea 0  
## 842 CotitodeSantaTeresa Lavatera cretica 0  
## 843 CotitodeSantaTeresa NA NA 0  
## 844 CotitodeSantaTeresa Taraxacum vulgare 0  
## 845 CotitodeSantaTeresa Thymus mastichina 0  
## 846 CotitodeSantaTeresa Scabiosa atropurpurea 0  
## 847 CotitodeSantaTeresa Retama sphaerocarpa 0  
## 848 CotitodeSantaTeresa Malva sp 0  
## 849 CotitodeSantaTeresa Erodium sp 0  
## 850 CotitodeSantaTeresa Convolvulus althaeoides 0  
## 851 CotitodeSantaTeresa Chamaerops humilis 1  
## 852 CotitodeSantaTeresa Cirsium vulgare 0  
## 853 CotitodeSantaTeresa Mirtus communis 0  
## 854 CotitodeSantaTeresa Scolymus hispanicus 0  
## 855 CotitodeSantaTeresa Mentha pulegium 0  
## 856 CotitodeSantaTeresa Acacia adealbata 0  
## 857 Elpinar Teucrium fruticans 0  
## 858 Elpinar Rosmarinus officinalis 7  
## 859 Elpinar Asphodelus fistulosus 0  
## 860 Elpinar Cistus ladanifer 0  
## 861 Elpinar Ulex australis 0  
## 862 Elpinar Halimium commutatum 1  
## 863 Elpinar Erica scoparia 0  
## 864 Elpinar Cistus salvifolius 4  
## 865 Elpinar Astragalus lusitanicus 0  
## 866 Elpinar Lavandula stoechas 3  
## 867 Elpinar Leontodon sp 0  
## 868 Elpinar Retama sp 0  
## 869 Elpinar Cerinthe gymnandra 0  
## 870 Elpinar Cistus crispus 1  
## 871 Elpinar Lavandula pedunculata 0  
## 872 Elpinar Diplotaxis virgata 1  
## 873 Elpinar Spartium junceum 0  
## 874 Elpinar Cistus albidus 6  
## 875 Elpinar Calendula arvensis 0  
## 876 Elpinar Lupinus angustifolius 0  
## 877 Elpinar Tuberaria guttata 0  
## 878 Elpinar Andryala integrifolia 1  
## 879 Elpinar Cistus libanotis 0  
## 880 Elpinar Linaria viscosa 0  
## 881 Elpinar Cistus monspeliensis 0  
## 882 Elpinar Linum bienne 0  
## 883 Elpinar Raphanus raphanistrum 0  
## 884 Elpinar Ranunculus sp 1  
## 885 Elpinar Genista hirsuta 0  
## 886 Elpinar Erica umbellata 0  
## 887 Elpinar Leontodon longirostris 0  
## 888 Elpinar Erica ciliaris 0  
## 889 Elpinar Echium plantagineum 0  
## 890 Elpinar Halimium halimifolium 0  
## 891 Elpinar Armeria velutina 0  
## 892 Elpinar Thapsia villosa 0  
## 893 Elpinar Convolvulus arvensis 10  
## 894 Elpinar Carduus sp 0  
## 895 Elpinar Arctotheca calendula 0  
## 896 Elpinar Phlomis purpurea 0  
## 897 Elpinar Chamaemelum fuscatum 2  
## 898 Elpinar Anchusa azurea 0  
## 899 Elpinar Lavatera cretica 0  
## 900 Elpinar NA NA 0  
## 901 Elpinar Taraxacum vulgare 0  
## 902 Elpinar Thymus mastichina 0  
## 903 Elpinar Scabiosa atropurpurea 0  
## 904 Elpinar Retama sphaerocarpa 0  
## 905 Elpinar Malva sp 0  
## 906 Elpinar Erodium sp 0  
## 907 Elpinar Convolvulus althaeoides 0  
## 908 Elpinar Chamaerops humilis 0  
## 909 Elpinar Cirsium vulgare 0  
## 910 Elpinar Mirtus communis 0  
## 911 Elpinar Scolymus hispanicus 0  
## 912 Elpinar Mentha pulegium 0  
## 913 Elpinar Acacia adealbata 0

*Species-level analyses*

At the species level, in the case of fruit set, our results show that model 2 shows the best fit to our data (lowest AIC value), explaining 4% of the variability observed. In this case, we find a positive effect of a network structure metric, the centrality of a focal plant within the overall network on its fruit set (Table 1, Fig. 2A).

For the average number of seeds per fruit, our results show again that model 2 shows the best fit, explaining 4% of the variability observed in our data. In this case, we find a positive effect of the niche overlap between plant species on the number of seeds produced (Table 1B, Fig. 2B).

For all other measures of reproductive success considered (i.e., fruit and seed weight), both models had very similar fits, with () and 2, respectively. However, none of the variables included within our model explain the differences observed (Tables S4-S5).

*Site-level analyses*

At the site level, we find different patterns for fruit set and the number of seeds per fruit as compared to those for fruit and seed weight. In the case of fruit set and the number of seeds per fruit, we find that both model 1 and 2 are equally good in describing the differences observed when penalizing for model complexity (i.e.,; (**???**)). This suggests model 2 is a good model despite its added complexity, and actually shows a substantially better predictive ability than model 1 (R^2 = 0.59 for model 2 versus 0.47 for model 1 in the case of fruit set and R^2 = 0.52 for model 2 versus 0.31 for model 1 in the case of the number of seeds per fruit) and therefore we will comment results for this model only. In particular, we find that both fruit set and the number of seeds per fruit are positively related to niche complementarity between pollinators (Tables 2, Fig. 3). Additionally, we find a negative effect of site-level pollinator richness on average fruit set (Table 2A, Fig. 3).

Contrastingly, in the case of weight variables (fruit and seed weight), in both cases we find that the best model is model 1, i.e., that only including simple visitation metrics (R^2 = 0.29 in the case of fruit weight and 0.51 in the case of seed weight). Here, we find a consistent positive effect of site-level pollinator richness for both weight descriptors (Tables S6-S7, Fig. 4).

*Equity in fruitset*

When evaluating the effect of differences in community composition and network structure for equity in reproductive success across the different species within a community we find that model 1 is the best model for all the thresholds considered (50^th, 25^th and 75^th percentiles). Here, none of the variables considered are able to explain differences observed in equity across sites (Tables S8, S9, S10).

Within our simulation evaluating the effect of niche complementarity on equity in reproductive success as more plants within the community are considered, we find that the effect of complementarity becomes more important as the reproductive success of more species is considered (Fig. 5). This importance seems to reach some sort of plateau at 6 species. However, this should be further evaluated, as this is the maximum number of species simultaneously observed in a community for our study, which precludes us from simulating further numbers of species.

**Discussion**

The existence of relationships between interaction network structure and ecosystem function have been long hypothesized, yet, the specific mechanisms by which structure influences function have remained elusive until now (Thompson *et al.* 2012). Our results show that different aspects of network structure affect different dimensions of ecosystem functioning. In particular, we find that the centrality of a plant species within a community, which measures the number of connections it receives from other species in the community, has a positive effect for its fruit set. At the site level, we find that greater values of niche complementarity between pollinators result in larger average fruit sets and number of seeds per fruit.

One of the first conclusions we can extract from the fact that in most cases both of the models we considered (i.e., the simple model based on visitation metrics and the more complex one including network structure metrics) were equally good, is that the added complexity of measuring the full network of interactions may not pay off for rapid assessments. Hence, simple visitation metrics, such as pollinator richness, might be enough (Garibaldi *et al.* 2013, 2015). Yet, adding network level information may inform us of the potential ecological mechanisms underlying the processes driving these observed patterns.

Consistent with previous experimental (Fontaine *et al.* 2005; Fründ *et al.* 2013), theoretical (Pauw 2013), and empirical studies (Poisot *et al.* 2013; Valdovinos *et al.* 2016), we find that niche complementarity is key in determining differences in reproductive outputs. Indeed, we find that communities where there is less overlap in the niches occupied by pollinator species had greater values of reproductive success, both greater fruit set and larger numbers of seeds per fruit. This therefore reflects the fact that reproductive success in plant species requires the delivery of conspecific pollen and thus of a certain degree of specialization amongst pollinator species on a particular plant resource in order to avoid the negative effects of inter-specific pollen deposition (e.g., pollen loss (Flanagan *et al.* 2009) or interference with conspecific pollen (Morales & Traveset 2008)). However, we also find that some level of redundancy in these functions is needed as revealed by the positive effect of plant niche overlap on the number of seeds per fruit at the species level.

In our study, we did not find an effect of nestedness for reproductive success in any case. This metric, widely used across network analysis, and which is deemed to stabilize natural communities ((Bastolla *et al.* 2009) but see (James *et al.* 2012)), does not seem to play a direct role in ecosystem function measured as plant reproductive success. However, our study is limited to a maximum of six common plant species per community, and including more species, including rare species, might reveal different patterns, in which nestedness and the redundancy it implies might play a more important role.

Site-level plant reproductive success measured as average fruit or seed set across all the species considered, is an important part of the functions delivered by pollinators to plants. However, these average values might be masking a great deal of variability amongst plant species, and thus a nuanced view of the effect of pollinators on whole-plant ensembles is needed. This can be captured by the effect of pollinators on equity in reproductive success across plant species. This aspect ensures that reproductive success is equally distributed amongst a larger number of species, thus contributing to the maintenance of greater species diversity values in natural populations. Indeed, we know that plant species diversity within a community is largely driven by different types of direct and indirect interactions including those amongst plant species (e.g., resource competition (Goldberg & Barton 1992) or facilitation (Bruno *et al.* 2003)), as well as those defining antagonistic (e.g., involving pathogens (Bagchi *et al.* 2010), or mutualistic interactions (e.g, pollinators (Benadi *et al.* 2013; Lanuza *et al.* 2018)). However, equitability in reproductive success across species is seldom taken into account, despite its importance in maintaining genetic diversity and ensuring the resilience of populations to further change.

In the case of equity, we did not find a significant effect of either simple visitation or network structure metrics. However, the results of our simulation on the importance of network structure as the number of plant species considered increases, shows us that this effect increases when more than four plant species are considered. This implies that if we were able to measure reproductive success for all the plant species in all the communities (which is not feasible given constraints in sampling effort), we might find that the effects of network structure on equity might be more prevalent.

One of the unexpected results of our analyses is the strong negative effect of pollinator richness for fruit set at the site level. An explanation to this might be the fact that pollinator richness here includes all the pollinators recorded during our sampling efforts, i.e., it includes species that do not pollinate some of the species whose reproductive success was measured. More complex communities with more pollinators, but also with more plant species (Pearson correlation between plant and pollinator richness = 0.42 in our case) may require stabilizing mechanisms that reduce the competition exerted by the dominant plant species. A way to reduce the competition exerted by these dominant species, which are precisely those evaluated in this study, is by reducing their reproductive success (Lanuza *et al.* 2018; Stavert *et al.* 2019). These ideas open the door to exploring the positive or negative effects of the complete pollinator community on full plant species coexistence, which may be determined by density-dependence effects (Benadi & Pauw 2018). In our case, while fruit set is negatively related to pollinator richness, it is important to note that fruit and seed weight show the opposite relationship, indicating that this density-dependent effect might only be limiting fruit quantity and not fruit quality. Thus, taking into account the densities of co-flowering plant species may be the next step (Vanbergen *et al.* 2014).

Our study illustrates the complexity of linking network structure to ecosystem function empirically, because measuring both structure and function is challenging. For example, there is an ongoing debate as to which network metrics better reflect classic ecological mechanisms, such as niche partitioning or competition (Delmas *et al.* 2019). Here, we focus on testing two specific hypotheses, but other structural properties can be explored when more data becomes available. Furthermore, the structure of plant-pollinators networks is dynamic due to ecological and evolutionary reasons, but so far, we are only able to characterize it for single snap-shots. Moreover, different aspects of functioning may be important, such as the presence of non-linear relationships or the need to consider the functioning of both trophic levels (Godoy *et al.* 2018). In terms of plant reproductive success and the functions performed by pollinators we can measure different aspects, ranging from pollen deposition (the direct pollinator function), to its final effects on plant fitness. Here, we focus on an intermediate stage including fruit quantity and quality, which is of clear ecological importance.

In summary, our findings show that the analysis of natural communities of interacting species using network analysis not only represents an ideal way of visualizing and grasping the complexity present within these communities. Rather, it also represents a manner of mechanistically understanding differences observed across the reproductive success of individuals and/or species while linking them to potential ecological mechanisms. Future studies could build on this body of research by focusing on the long-lasting effects of network structure for plant fitness, by evaluating the consequences of different network structures on other stages of a plant´slife cycle (e.g., seed viability) and whether these differences are passed on to later generations (e.g., though different survival rates).

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## Tables

**Table 1**. Results of GLMM showing the effect of simple visitation and network structure metrics on A) species-level fruit set and B) average number of seeds per fruit based on best model selected. Bold letters indicate variables with large effects.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std..Error | z.value |
| (Intercept) | 1.72 | 0.21 | 8.16 |
| Pollinator richness | -0.01 | 0.21 | -0.07 |
| Total number of visits | 0.14 | 0.25 | 0.57 |
| Centrality | 0.46 | 0.25 | 1.81 |
| Plant niche overlap | 0.05 | 0.24 | 0.20 |

**Table 2**. Results of GLM showing effect of simple visitation and network structure metrics on A) site-level average fruit set and B) site-level average number of seeds per fruit based on best model selected. Bold letters indicate variables with large effects.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std..Error | t.value |
| (Intercept) | 0.05 | 0.14 | 0.36 |
| Pollinator richness | 0.14 | 0.15 | 0.90 |
| Total number of visits | -0.01 | 0.16 | -0.04 |
| Centrality | -0.15 | 0.15 | -1.00 |
| Plant niche overlap | 0.22 | 0.17 | 1.32 |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | z value |
| (Intercept) | 1.22 | 0.13 | 9.18 |
| Pollinator richness | -0.75 | 0.17 | -4.35 |
| Total number of visits | -0.16 | 0.16 | -1.03 |
| Nestedness | 0.11 | 0.16 | 0.72 |
| Pollinator niche complementarity | 0.29 | 0.18 | 1.57 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | t value |
| (Intercept) | 45.36 | 8.55 | 5.31 |
| Pollinator richness | 3.26 | 12.18 | 0.27 |
| Total number of visits | 8.38 | 9.99 | 0.84 |
| Nestedness | -10.94 | 10.21 | -1.07 |
| Pollinator niche complementarity | 29.51 | 13.31 | 2.22 |
|  |  |  |  |

**Figure legends**

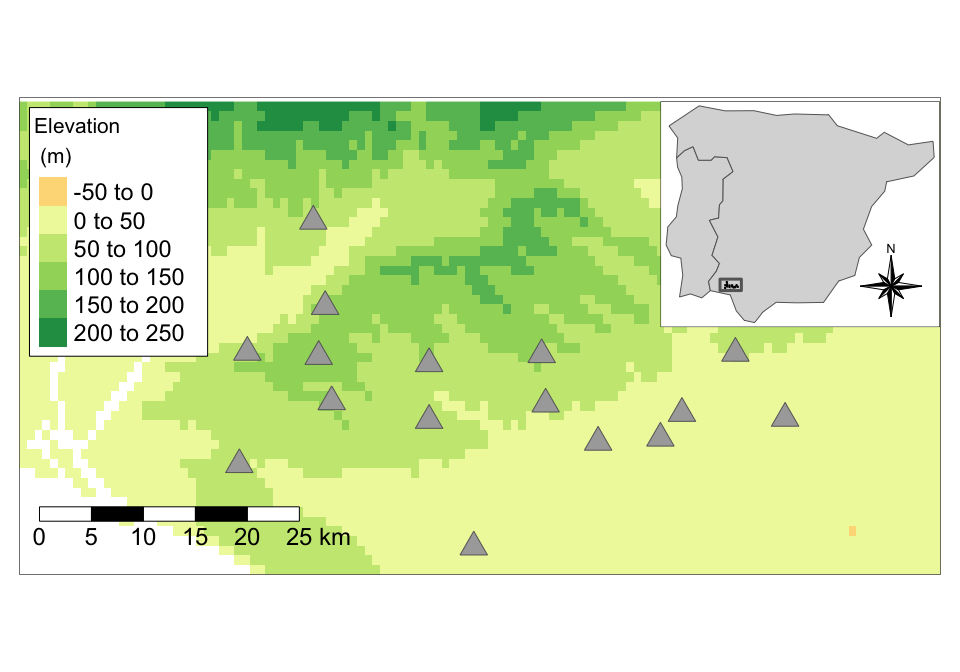
**Figure 1.** Map showing location of 16 study sites. Inset shows location of study area within SW Spain.

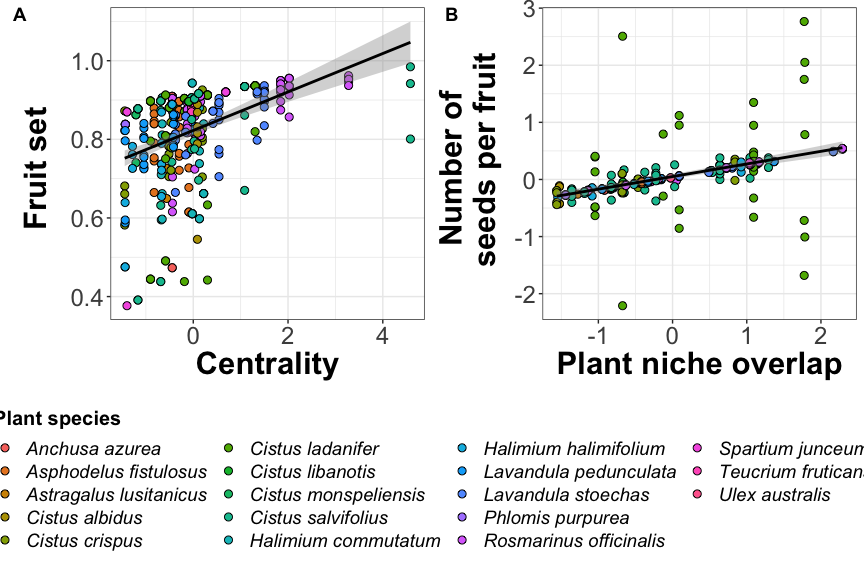
**Figure 2**. Partial residual plot showing the effect of a single predictor for the relationship between A) plant species centrality and fruit set for each of the plant species considered and B) plant niche overlap and average number of seeds per fruit. Dots represent each of the individuals sampled for each species within each site.

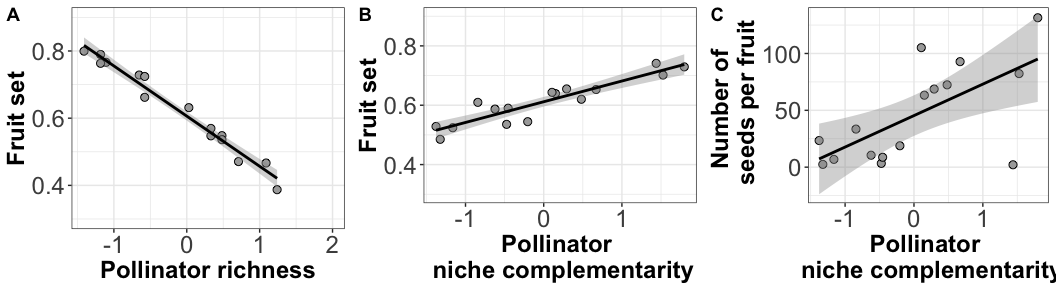
**Figure 3.** Partial residual plots showing the effect of A) pollinator richness, and B) niche complementarity between pollinator species on site-level average fruitset and C) niche complementarity between pollinator species on the average number of seeds per fruit at the site level. Dots represent average values of fruit set at the level of the community for all plant species considered (N=16 sites).

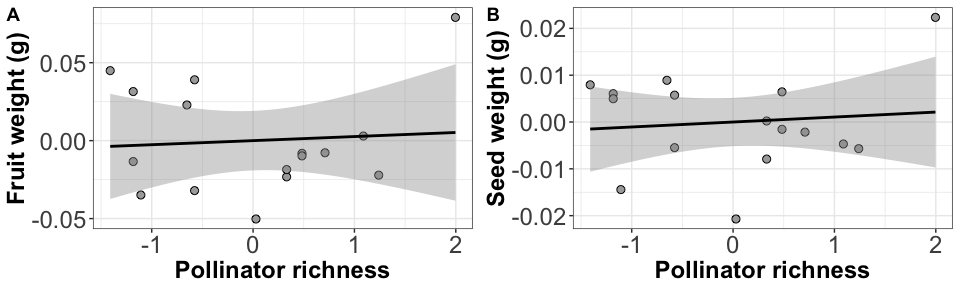
**Figure 4.** Partial residual plots showing the effect of pollinator richness on site-level average A) fruit and B) seed weight. Dots represent values for each site (N=16 sites).

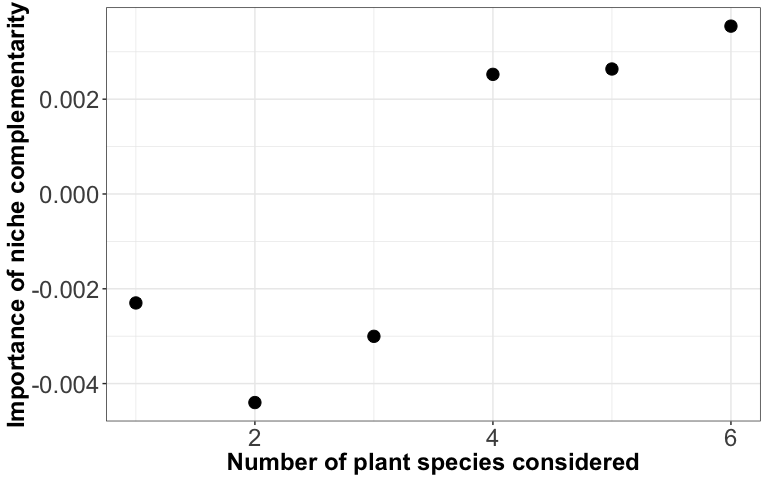
**Figure 5.** Results of simulation evaluating the importance of niche complementarity in determining differences in equity in reproductive across communities harboring from one to six species. Points represent average values across 1,000 simulated combinations.

 **Figure 1**

 **Figure 2**

 **Figure 3**

 **Figure 4**

 **Figure 5.**

# Supplementary material

**Figure S2.** Accumulation curves of pollinator, plant and plant-pollinator link richness with increasing sampling effort up to 100% sample coverage. Solid lines and points indicate observed richness while dashed lines show expected richness at increasing sample size, (i.e., extrapolated).

Table S1. Number of species sampled at each site.

|  |  |
| --- | --- |
| Site | Number of plant species |
| Aznalcazar | 4 |
| Bonares | 6 |
| ConventodelaLuz | 6 |
| CotitodeSantaTeresa | 5 |
| Elpinar | 1 |
| Elpozo | 2 |
| Esparragal | 4 |
| LaCunya | 3 |
| LaRocina | 5 |
| Lasmulas | 5 |
| Niebla | 6 |
| PinaresdeHinojos | 3 |
| Pinodelcuervo | 6 |
| Urbanizaciones | 4 |
| Villamanriqueeste | 1 |
| Villamanriquesur | 4 |

Table S2. Number of individuals per plant species sampled at each site.

|  |  |  |
| --- | --- | --- |
| Site | Plant species | Number of individuals |
| LaRocina | Anchusa azurea | 6 |
| Aznalcazar | Asphodelus fistulosus | 9 |
| Niebla | Asphodelus fistulosus | 9 |
| Pinodelcuervo | Asphodelus fistulosus | 6 |
| CotitodeSantaTeresa | Astragalus lusitanicus | 2 |
| CotitodeSantaTeresa | Cistus albidus | 6 |
| Bonares | Cistus crispus | 6 |
| Niebla | Cistus crispus | 5 |
| Pinodelcuervo | Cistus crispus | 6 |
| Villamanriquesur | Cistus crispus | 3 |
| Aznalcazar | Cistus ladanifer | 6 |
| Bonares | Cistus ladanifer | 12 |
| ConventodelaLuz | Cistus ladanifer | 9 |
| Lasmulas | Cistus ladanifer | 6 |
| Niebla | Cistus ladanifer | 9 |
| Pinodelcuervo | Cistus ladanifer | 9 |
| Villamanriquesur | Cistus ladanifer | 7 |
| Lasmulas | Cistus libanotis | 6 |
| PinaresdeHinojos | Cistus libanotis | 6 |
| Niebla | Cistus monspeliensis | 3 |
| Aznalcazar | Cistus salvifolius | 9 |
| Bonares | Cistus salvifolius | 9 |
| ConventodelaLuz | Cistus salvifolius | 6 |
| CotitodeSantaTeresa | Cistus salvifolius | 5 |
| Esparragal | Cistus salvifolius | 3 |
| LaCunya | Cistus salvifolius | 6 |
| Lasmulas | Cistus salvifolius | 7 |
| PinaresdeHinojos | Cistus salvifolius | 6 |
| Urbanizaciones | Cistus salvifolius | 6 |
| Villamanriqueeste | Cistus salvifolius | 3 |
| Bonares | Halimium commutatum | 6 |
| Esparragal | Halimium commutatum | 7 |
| LaRocina | Halimium commutatum | 3 |
| Lasmulas | Halimium commutatum | 2 |
| Pinodelcuervo | Halimium commutatum | 6 |
| Urbanizaciones | Halimium commutatum | 6 |
| ConventodelaLuz | Halimium halimifolium | 3 |
| Esparragal | Halimium halimifolium | 3 |
| LaRocina | Halimium halimifolium | 3 |
| Villamanriquesur | Halimium halimifolium | 6 |
| Aznalcazar | Lavandula pedunculata | 4 |
| Esparragal | Lavandula pedunculata | 6 |
| LaCunya | Lavandula pedunculata | 5 |
| Niebla | Lavandula pedunculata | 9 |
| Bonares | Lavandula stoechas | 9 |
| ConventodelaLuz | Lavandula stoechas | 3 |
| CotitodeSantaTeresa | Lavandula stoechas | 3 |
| Lasmulas | Lavandula stoechas | 9 |
| Urbanizaciones | Lavandula stoechas | 9 |
| Villamanriquesur | Lavandula stoechas | 3 |
| Niebla | Phlomis purpurea | 6 |
| PinaresdeHinojos | Retama sphaerocarpa | 1 |
| ConventodelaLuz | Rosmarinus officinalis | 9 |
| CotitodeSantaTeresa | Rosmarinus officinalis | 6 |
| Elpinar | Rosmarinus officinalis | 8 |
| Elpozo | Rosmarinus officinalis | 6 |
| LaCunya | Rosmarinus officinalis | 6 |
| LaRocina | Rosmarinus officinalis | 1 |
| Pinodelcuervo | Rosmarinus officinalis | 9 |
| Urbanizaciones | Rosmarinus officinalis | 9 |
| Elpozo | Spartium junceum | 6 |
| LaRocina | Spartium junceum | 3 |
| ConventodelaLuz | Teucrium fruticans | 9 |
| Bonares | Ulex australis | 6 |
| Pinodelcuervo | Ulex australis | 3 |

Table S3. Number of fruits per plant species sampled at each site.

|  |  |  |
| --- | --- | --- |
| Site | Plant species | Number of fruits |
| Aznalcazar | Asphodelus fistulosus | 22 |
| Aznalcazar | Cistus ladanifer | 4 |
| Aznalcazar | Cistus salvifolius | 10 |
| Aznalcazar | Lavandula pedunculata | 10 |
| Bonares | Cistus crispus | 15 |
| Bonares | Cistus ladanifer | 12 |
| Bonares | Cistus salvifolius | 14 |
| Bonares | Lavandula stoechas | 23 |
| Bonares | Ulex australis | 21 |
| ConventodelaLuz | Cistus ladanifer | 4 |
| ConventodelaLuz | Cistus salvifolius | 5 |
| ConventodelaLuz | Halimium halimifolium | 6 |
| ConventodelaLuz | Lavandula stoechas | 13 |
| ConventodelaLuz | Rosmarinus officinalis | 23 |
| ConventodelaLuz | Teucrium fruticans | 16 |
| CotitodeSantaTeresa | Astragalus lusitanicus | 2 |
| CotitodeSantaTeresa | Cistus albidus | 8 |
| CotitodeSantaTeresa | Cistus salvifolius | 11 |
| CotitodeSantaTeresa | Lavandula stoechas | 11 |
| CotitodeSantaTeresa | Rosmarinus officinalis | 16 |
| Elpinar | Rosmarinus officinalis | 23 |
| Elpozo | Rosmarinus officinalis | 36 |
| Elpozo | Spartium junceum | 13 |
| Esparragal | Cistus salvifolius | 4 |
| Esparragal | Halimium halimifolium | 7 |
| Esparragal | Lavandula pedunculata | 16 |
| LaCunya | Cistus salvifolius | 8 |
| LaCunya | Lavandula pedunculata | 11 |
| LaCunya | Rosmarinus officinalis | 18 |
| LaRocina | Anchusa azurea | 10 |
| LaRocina | Halimium commutatum | 6 |
| LaRocina | Halimium halimifolium | 1 |
| LaRocina | Rosmarinus officinalis | 8 |
| LaRocina | Spartium junceum | 10 |
| Lasmulas | Cistus ladanifer | 5 |
| Lasmulas | Cistus libanotis | 10 |
| Lasmulas | Cistus salvifolius | 7 |
| Lasmulas | Halimium commutatum | 3 |
| Lasmulas | Lavandula stoechas | 23 |
| Niebla | Asphodelus fistulosus | 19 |
| Niebla | Cistus crispus | 10 |
| Niebla | Cistus ladanifer | 2 |
| Niebla | Cistus monspeliensis | 4 |
| Niebla | Lavandula pedunculata | 15 |
| Niebla | Phlomis purpurea | 23 |
| PinaresdeHinojos | Cistus libanotis | 9 |
| PinaresdeHinojos | Cistus salvifolius | 9 |
| PinaresdeHinojos | Retama sphaerocarpa | 2 |
| Pinodelcuervo | Asphodelus fistulosus | 10 |
| Pinodelcuervo | Cistus crispus | 18 |
| Pinodelcuervo | Cistus ladanifer | 10 |
| Pinodelcuervo | Halimium commutatum | 7 |
| Pinodelcuervo | Rosmarinus officinalis | 11 |
| Pinodelcuervo | Ulex australis | 5 |
| Urbanizaciones | Cistus salvifolius | 10 |
| Urbanizaciones | Halimium commutatum | 8 |
| Urbanizaciones | Lavandula pedunculata | 8 |
| Urbanizaciones | Lavandula stoechas | 16 |
| Urbanizaciones | Rosmarinus officinalis | 22 |
| Villamanriqueeste | Cistus salvifolius | 6 |
| Villamanriquesur | Cistus crispus | 11 |
| Villamanriquesur | Cistus ladanifer | 4 |
| Villamanriquesur | Cistus salvifolius | 4 |
| Villamanriquesur | Halimium halimifolium | 10 |
| Villamanriquesur | Lavandula stoechas | 8 |

Table S4. Results of GLMM showing effect of simple visitation metrics on species-level average seed weight based on best model selected.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | z value |
| (Intercept) | -3.85 | 0.41 | -9.46 |
| Pollinator richness | 0.22 | 0.36 | 0.62 |
| Total number of visits | 0.10 | 0.35 | 0.27 |

Table S5. Results of GLMM showing effect of simple visitation metrics on species-level average fruit weight based on best model selected.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | z value |
| (Intercept) | -2.60 | 0.22 | -12.06 |
| Pollinator richness | 0.11 | 0.21 | 0.51 |
| Total number of visits | 0.08 | 0.20 | 0.43 |

Table S6. Results of GLM showing effect of simple visitation metrics on site-level average fruit weight based on best model selected.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | t value |
| (Intercept) | 0.08 | 0.01 | 8.91 |
| Pollinator richness | 0.02 | 0.01 | 2.34 |
| Total number of visits | 0.01 | 0.01 | 1.26 |

Table S7. Results of GLM showing effect of simple visitation metrics on site-level average seed weight based on best model selected.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | t value |
| (Intercept) | 0.02 | 0 | 9.27 |
| Pollinator richness | 0.01 | 0 | 3.82 |
| Total number of visits | 0.00 | 0 | 1.84 |

Table S8. Results of GLM showing effect of simple visitation metrics on equity in reproductive success across plant species within a site based on best model selected (0.50 threshold).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | z value |
| (Intercept) | 1.37 | 0.67 | 2.04 |
| Pollinator richness | -0.61 | 0.70 | -0.87 |
| Total number of visits | 0.09 | 0.90 | 0.10 |

Table S9. Results of GLM showing effect of simple visitation metrics on equity in reproductive success across plant species within a site based on best model selected (0.75 threshold).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | z value |
| (Intercept) | -0.71 | 0.71 | -1.00 |
| Pollinator richness | -0.61 | 0.93 | -0.65 |
| Total number of visits | -0.04 | 0.56 | -0.08 |

Table S10. Results of GLM showing effect of simple visitation metrics on equity in reproductive success across plant species within a site based on best model selected (0.25 threshold).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimate | Std. Error | z value |
| (Intercept) | 1.37 | 0.67 | 2.04 |
| Pollinator richness | -0.61 | 0.70 | -0.87 |
| Total number of visits | 0.09 | 0.90 | 0.10 |

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