Article

Islands are key for protecting the world's plant endemism

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Islands are renowned as evolutionary laboratories and support many species that are not found elsewhere[1,2]. Islands are also of great conservation concern, with many of their endemic species currently threatened or extinct[3]. Here we present a standardized checklist of all known vascular plants that occur on islands and document their geographical and phylogenetic distribution and conservation risk. Our analyses of 304,103 plant species reveal that 94,052 species (31%) are native to islands, which constitute 5.3% of the global landmass[4]. Of these, 63,280 are island endemic species, which represent 21% of global plant diversity. Three-quarters of these are restricted to large or isolated islands. Compared with the world flora, island endemics are non-randomly distributed within the tree of life, with a total of 1,005 billion years of unique phylogenetic history with 17 families and 1,702 genera being entirely endemic to islands. Of all vascular plants assigned International Union for Conservation of Nature conservation categories[5], 22% are island endemics. Among these endemic species, 51% are threatened, and 55% of all documented global extinctions have occurred on islands. We find that of all single-island endemic species, only 6% occur on islands meeting the United Nations 30×30 conservation target. Urgent measures including habitat restoration, invasive species removal and ex situ programmes are needed to protect the world's island flora. Our checklist quantifies the uniqueness of island life, provides a basis for future studies of island floras, and highlights the urgent need to take actions for conserving them.

Islands have served as natural laboratories for studying assembly processes, speciation and ecological adaptation[2]. The evolution of life in isolation has led to unique species assemblages and remarkable examples of diversification and adaptive radiations, including morphological oddities and island syndromes such as the tendency of herbaceous plants to become woody or the loss of defence mechanisms[6,7]. In particular, islands support many species that are not found anywhere else[1,8] and are hotspots of phylogenetic endemism[9]. Extrapolations have suggested that as many as 70,000 plant species worldwide could be endemic to islands[1]. These include species such as the New Caledonian endemic *Amborella trichopoda*, a lineage that forms the extant sister to all other angiosperms[10] or the palm genus *Howea*, which consists of two species that evolved sympatrically on Lord Howe Island, Australia[11]. Island endemics also feature classic examples of species radiations, such as the 63 extant members of the *Aeonium* alliance in Macaronesia[12] or the 126 species of lobeliads that are endemic to Hawaiʻi[13], both of which radiated from single ancestors. Islands also harbour some of the rarest and most threatened taxa worldwide. Examples include *Brighamia insignis*, a species that is endemic to the Kauaʻi and Niʻihau islands in Hawaiʻi, was last seen in the wild in 2012[14] and is now considered extinct[5], or the rare ebony tree *Diospyros egrettarum*, whose only known viable population is from the 25-ha Île aux Aigrettes near Mauritius[15]. Despite their value for evolutionary and ecological research and conservation, and their many uses for humans, great uncertainty remains around estimates of the total number of plants native and endemic to islands and their global distribution. Thus, the current lack of a working list of all plant species that are known to be native or endemic to islands and their distribution status, which should form the basis of such a global assessment, presents a major knowledge gap. This is concerning because islands are at the forefront of biodiversity loss. Many of their unique species are threatened by extinction, which also endangers crucial services that are provided by island ecosystems, including cultural and spiritual values, and increases the vulnerability of Indigenous people and local communities[3,16,17].

Here we provide a comprehensive assessment of all vascular plant species native and endemic to marine islands worldwide and highlight their conservation risk. Based on 5,243 taxonomically standardized checklists and floras for 1,967 island and 1,010 mainland regions covering the

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whole globe from the Global Inventory of Floras and Traits database[18] and the World Checklist of Vascular Plants[19], we provide a standardized species list[20]. Extending previous research[1,9,21], this enabled us to identify all species that are native and endemic to islands and currently known to science following several alternative approaches, and to analyse the distribution of island plant species across scales (single island, archipelago and global). We investigated the conservation status of these species and quantified their phylogenetic history. For the main results reported here, we treated species that occur on only one island as single-island endemics, and species that occur on more than one island but not on any mainland as island endemics in general. Alternative approaches and numbers are discussed in the Methods—they lead to similar overall numbers for global island plant endemism.

Island plant endemism

We find that 63,280 plant species globally are endemic to islands. We adopt the conventional definition of an island as any landmass that is not one of the seven recognized continents[2]. Island endemics comprise 21% of the 304,103 species in our dataset or 67% of all species that are native on islands. Of these, 44,147 species (70% of all island endemics) only occur on a single island. These numbers exclude species from genera prone to asexual reproduction via apomixis[22]. Reasons for this exclusion are discussed in detail in the Methods, but, in brief, the documentation of apomictic genera is highly skewed towards well-sampled floras in Europe and North America that are likely to represent a geographical bias in taxonomic treatment and coverage[9,22]. If apomixis-prone genera are included, our species list increases to 350,707 species, which is similar to global vascular plant diversity described in other datasets[19]. Among these, 107,580 species are native and 71,695 (20%) are endemic to islands. Differences in ways to count endemics (Methods) affect these numbers only marginally, by up to 3% of the world's flora. Considering that islands contribute only 5.3% of the world's land area[4], these high percentages highlight the uniqueness and disproportionate contribution of island floras to global biodiversity.

A large share of island endemism is concentrated on a few large tropical islands, notably Madagascar (9,318 species), New Guinea (8,793), Borneo (5,765), Cuba (2,679) and New Caledonia (2,493) (Fig. 1 and Extended Data Table 1). This is both because these islands are very species-rich—New Guinea[23] tops the list with 12,647 native species, closely followed by Borneo (12,014 native species) and Madagascar (11,149 native species)—and because of high proportions of endemics (Madagascar highest with 83%, followed by New Caledonia with 74% and New Guinea with 69%). At the same time, many islands in our dataset do not have endemic species (1,328 islands (68%); Extended Data Fig. 1) and the largest islands without endemics, such as Baffin Island (507,451 km^2), are situated at high latitudes that were glaciated until recently. The flora on these islands generally comprises comparatively few widespread species that are adapted to rapid colonization via high dispersibility from the mainland or nearby islands[24].

At the level of archipelagos, the Greater Sunda Islands (Borneo, Java, Sumatra, Sulawesi and surrounding islands) support the largest number of archipelago endemics with 10,769 species (51% of their total flora) followed by Madagascar (9,318; 84%), New Guinea and surrounding islands (9,314; 68%), Greater Antilles (5,609; 61%) and the Philippines (4,528; 46%). These archipelagos collectively support 60% of all island endemics. Their tropical origin, large area size, topographic complexity and complex geological and evolutionary history promote speciation and species persistence by lowering the risk of extinctions leading to high endemism[23,25].

Oceanic archipelagos renowned for their high endemism, such as Hawai'i, the Canary Islands or the Mascarene Islands, account for a total of 13,716 (21%) endemic species. They are not the leading contributors to total island endemism because of their overall lower species richness compared with the much larger tropical continental land-bridge or fragment islands. However, species restricted to these oceanic archipelagos contribute high proportions of endemic plant diversity—83% for Hawai'i, 50% for the Mascarene Islands and 42% for the Canary Islands. Also, oceanic archipelagos contribute only 5.8% of all island landmass in our dataset, further emphasizing their high concentration of endemic plants. The flora of remote oceanic islands results from rare long-distance dispersal events from other islands or the distant mainland. Species reaching these archipelagos can radiate allopatrically or fill vacant niche space leading to some of the highest speciation rates observed among plants[26], increasing the proportion of island endemics[27]. Notably, high proportions of endemics on oceanic islands become prevalent mainly at the level of archipelagos rather than at single islands. Maui (Hawai'i) has only 14% and Tenerife (Canary Islands) has only 12% of single-island endemics in their native floras. The reason is that islands belonging to the same archipelago often share a similar geological origin, such as originating from hotspot volcanism (for example, Mascarene Islands, Hawai'i and Galápagos) or ocean floor uplift (for example, Nicobar and Andaman Islands). This leads to clusters of closely connected islands that share similar climatic and environmental conditions, which allows frequent inter-island dispersal and establishment[27]. Large geographical distances and climates and environments that are often different from those of other archipelagos or mainland regions prevent species colonization beyond their original archipelagos. One example is the 63 species from the *Aeonium* clade (Crassulaceae), most of which are endemic to Macaronesia[12].

The centres of insular plant endemism identified for single islands and archipelagos are mirrored at the level of 30 out of 35 terrestrial floristic regions that include islands[28]. Here, Malesia, comprising both the Greater Sunda Islands and New Guinea (26,363 endemics, 69%), and the Madagascan region, including Madagascar and surrounding oceanic archipelagos (10,217 endemics, 82%), had the highest numbers of endemics. These regions belong to the global centres of plant diversity characterized by their stable and tropical climate and high habitat diversity[25]. For large geographical regions, such as floristic regions, the number of endemics is higher than the sum from each individual island or archipelago from that region. This is because larger regions include species that occur on multiple islands or archipelagos but are still endemic to the island region. Examples include many of the laurel forest species that are endemic to Macaronesia[29], or the genera *Metrosideros* and *Cyrtandra*, which are spread widely across the Pacific[30,31].

Island endemics occur in at least 358 out of 476 plant families (75%) and in 5,413 out of 15,030 genera (36%) in our dataset (Extended Data Fig. 2). Seventeen families (3.6%) and 1,702 genera (11%) are entirely endemic to islands. All endemic island families occur on continental fragments with Sarcolaenaceae (78 species) and Sphaerosepalaceae (20) from Madagascar and Phellinaceae (10) from New Caledonia having the most species. At the genus level, this pattern changes with seven out of the ten most species-rich endemic genera occurring on continental or oceanic islands in Malesia and the Pacific (for example, *Dimorphanthera* and *Riedelia*) and only two occurring in Madagascar and surrounding islands (*Dypsis* and *Oncostemum*) and one in New Caledonia (*Pycnandra*). The globally most species-rich families also contribute most island endemics (Extended Data Fig. 2a). Of all plant families, Orchidaceae contributes the largest number of island endemics with 8,446 species (32% of total orchid diversity), followed by Rubiaceae (4,890 species; 34%) and Asteraceae (2,676 species; 11%). Remarkably, although these three families combined contributed 25% of all island endemics, their relative proportion differs greatly within these families and is much higher than expected in Orchidaceae and Rubiaceae and lower in Asteraceae, based on the average across all families[32]. The macroevolutionary mechanisms behind why some plant families contribute disproportionately to island endemism are not yet fully understood but may involve specific traits enabling dispersal and establishment, together with family-specific speciation rates[33,34].

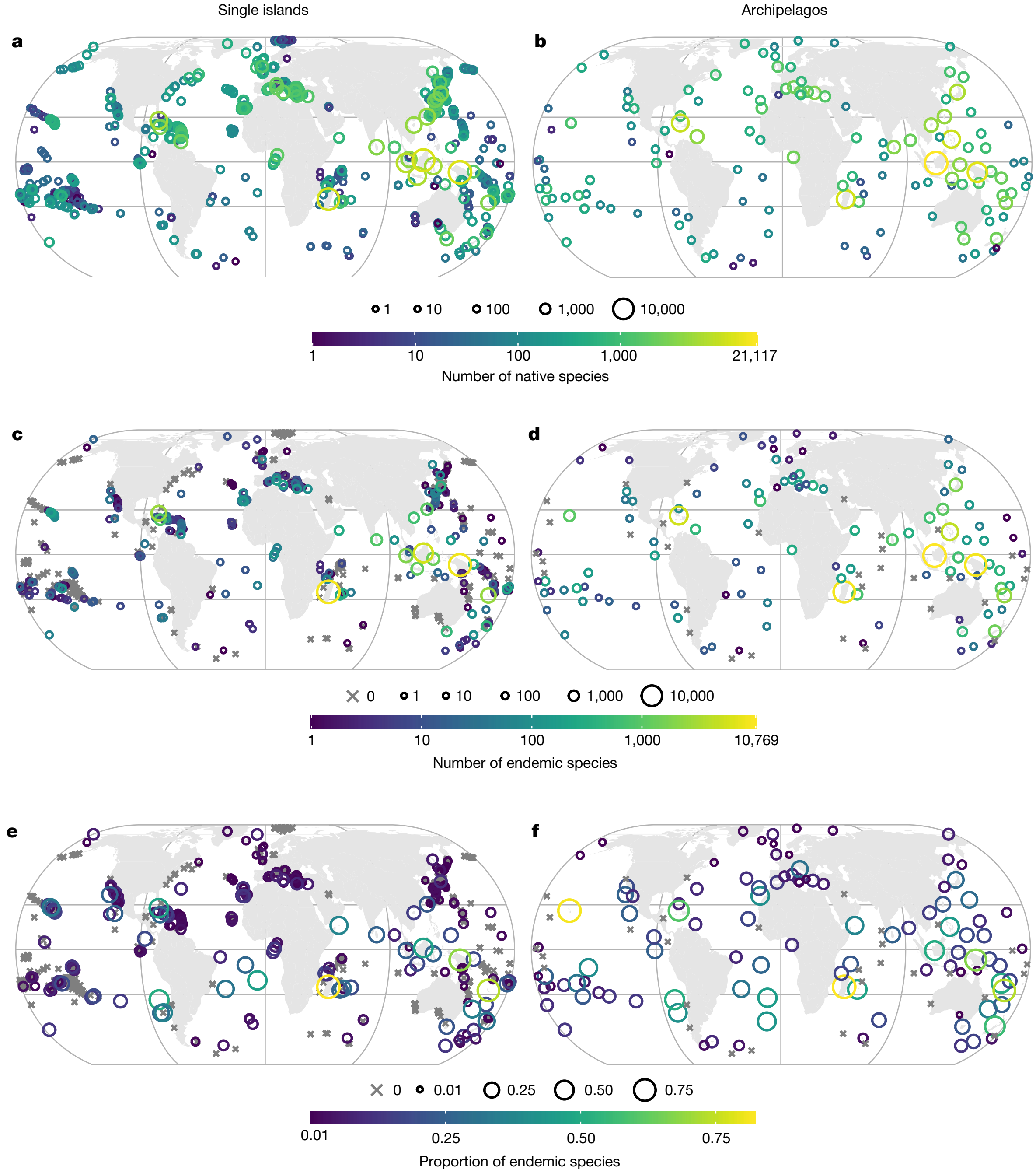

Fig. 1 | Global distribution of native and endemic vascular plant diversity across 1,651 islands and 141 archipelagos. a,**c**,**e**, Species numbers and proportions for single islands. **b**,**d**,**f**, Species numbers and proportions for archipelagos. **a**,**b**, Numbers of native species. **c**,**d**, Number of endemic species. **e**,**f**, Numbers of endemic species as a proportion of total island richness.

At genus level, the genera that contribute most to island endemism were also very species-rich globally, although with large variation among genera (Extended Data Fig. 2b). The orchid genera *Bulbophyllum* (1,424 species; 68% of the whole genus) and *Dendrobium* (1,175; 74% of the genus) and the Rubiaceae genus *Psychotria* (849; 52% of the genus) have the highest numbers of island endemic species.

Island endemism in plant families is spread unevenly across island types (Extended Data Fig. 3). Orchids, for instance, reach the highest endemism on large continental and fragment islands with the richness of endemics peaking on the Greater Sunda Islands and Madagascar. Despite their dust-like seeds that are suitable for long-distance dispersal, orchids are under-represented on oceanic islands, probably because of low co-colonization by their obligate mycorrhizae and their often specialized pollinators[34]. Some lineages belonging to the Asteraceae, however, radiated vigorously on oceanic islands, such as on Galápagos, the Canary Islands, Juan Fernández Islands or Hawai'i, possibly because of their long-distance seed dispersal capacity coupled with high evolutionary rates[35]. Fern and lycophyte families achieve high proportions of endemism mainly on tropical and mountainous islands such as New Guinea and Borneo. By contrast, pteridophyte endemism is comparatively low whereas species richness is high on oceanic and Mediterranean islands[33].

Island endemics contribute 21% to global phylogenetic diversity amounting to 1,005 billion years of unique phylogenetic history (35.8% or 1,645 billion years for all island natives). These numbers mirror those of global island endemism richness[9] highlighting the enormous

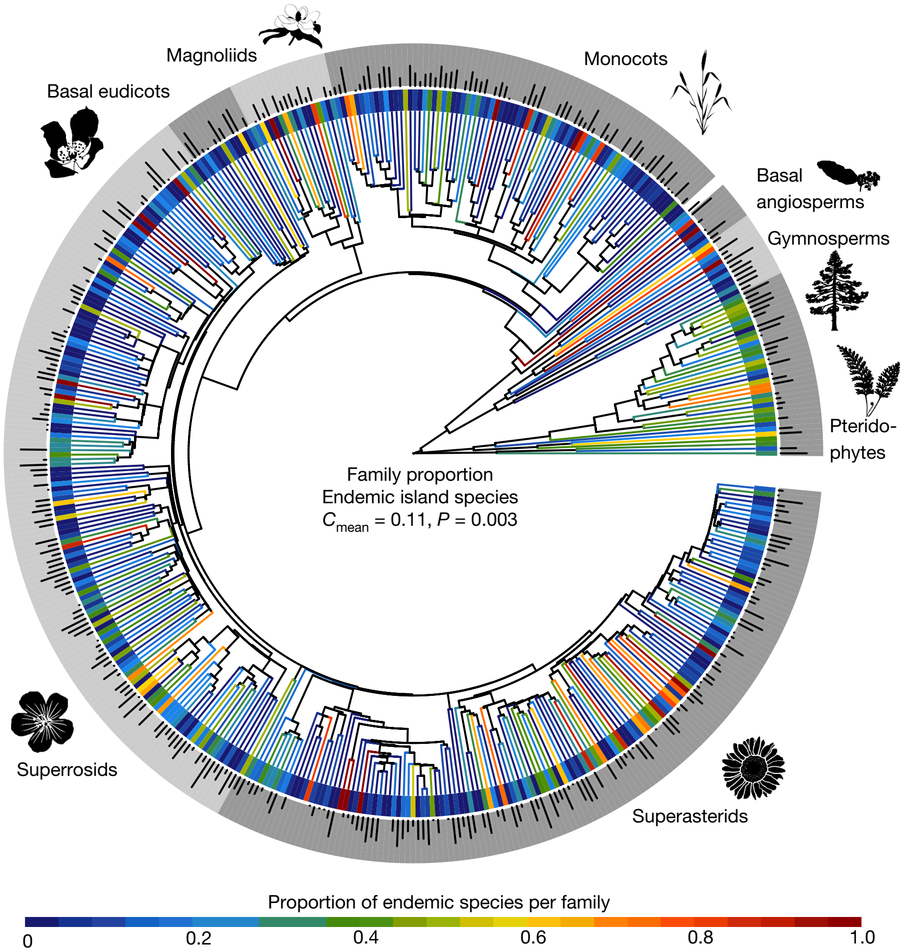

Fig. 2 | Proportion of endemic island plants at family level. Colours indicate proportions of endemic species per family. Tip and inner ring colours indicate coverage of endemic island plants at family level and the outer ring delimits major clades. Bar heights in the outer ring are proportional to $\log_{10}$-transformed richness of endemic species per family. Proportions of island endemics are significantly different between families. Phylogenetic signal down to family level is expressed as Abouheif's C_{mean}, a measure of phylogenetic autocorrelation that is calculated by summing the squared differences between values of adjacent tips in the phylogeny; the significant P value indicates that families closer to each other in the phylogeny tend to be more similar in their proportion of island endemics. Plant silhouettes were created with PhyloPic.org.

contribution of islands to the plant tree of life. However, island endemics are non-randomly distributed across families compared to the world flora. Families that are phylogenetically closer tended to have more similar percentages of island endemics (C_{mean} = 0.11, P = 0.003; Fig. 2). This means that the tendency to colonize islands and to radiate there is to some degree phylogenetically conserved both at family level and above.

Endemism on islands is hypothesized to increase with island area and isolation through their combined effect on speciation rates[36–38]. Larger islands have lower extinction rates due to larger population sizes and lower vulnerabilities to catastrophic events, increasing the lineages' survival long enough to become differentiated from the mainland populations, thus enhancing the chances of lineages to evolve into a new species[37]. Larger islands also provide a wider variety of habitats and feature more barriers to gene flow, which further increases speciation rates[39]. Smaller islands, which support smaller population sizes, have higher natural extinction rates[40], making in situ speciation less likely. Isolation limits gene flow via inter-island dispersal and colonization from the mainland, leading to higher speciation rates[41], and increases endemism by having fewer arrivals of new competitors compared with islands near mainlands[35]. Although other factors such as island age, ontogeny and past climate are also hypothesized to be important influences on island endemism[21,42], area and isolation show the highest predictive power[21,43].

Endemism on islands and archipelagos globally is best explained by the interaction of island area and isolation (Fig. 3a), especially when accounting for island type and archipelago configuration (R^2 = 0.74; see Methods for model details). Considerable variation in the numbers of endemics is explained by island area alone (continental: R^2 = 0.55; complex and fragment: R^2 = 0.54; oceanic: R^2 = 0.19; Extended Data Fig. 4a,c), since larger islands carry more species in total, including endemics[43]. At island and archipelago level, isolation alone had only a weak influence (R^2 values ≤ 0.05; Fig. 3 and Extended Data Fig. 4b,d). For oceanic archipelagos, this is probably because the most isolated ones, such as Hawai'i, Galápagos or Fiji, share many endemic species with other islands of the same archipelago owing to intra-archipelago dispersal, limiting the total numbers and proportions of single-island endemics. At the archipelago level (Fig. 3b), many of the most isolated archipelagos comprise small atolls, such as Tuamotu, Gilbert and Line Islands in the Pacific, or the Maldives and Chagos Archipelago in the Indian Ocean, which support a widespread and largely non-endemic strand flora[44]. This diminished the overall effect of isolation on endemism.

Threat status of island plants

Of 36 recognized global biodiversity hotspots[45], 9 are located exclusively on islands and 3 others include a substantial share of islands.

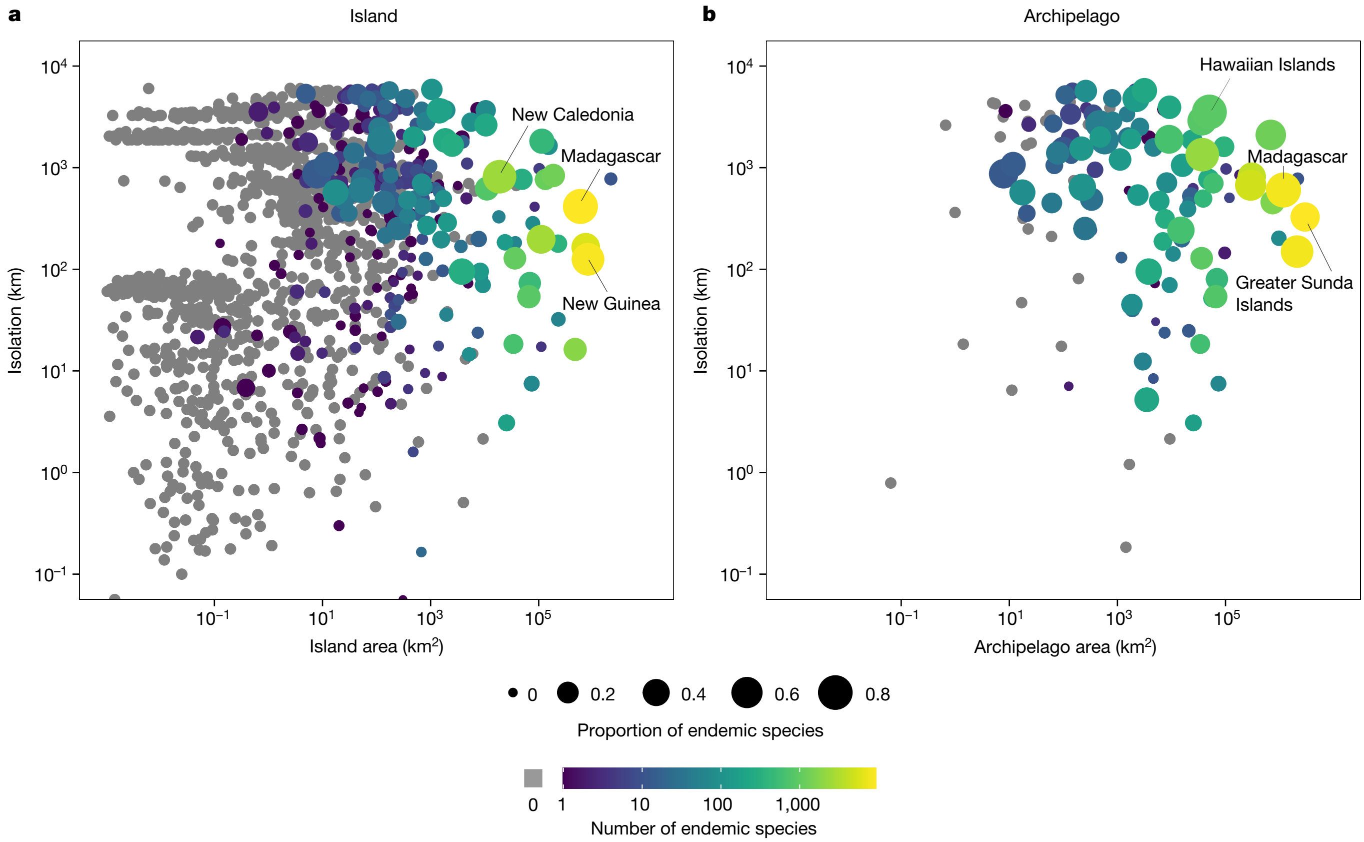

Fig. 3 | Number and proportion of endemic species on islands and archipelagos in relation to island and archipelago area and isolation. Number (colour) and proportion (dot size) of plant species endemic to islands and archipelagos plotted against area and isolation. **a**, Each dot represents one of 1,651 islands including 336 islands with endemic species (coloured dots) and 1,315 islands without endemic species (grey dots). **b**, Each dot denotes one of 141 archipelagos. Area is the summed area of all islands within each archipelago; isolation is the mean distance to the nearest mainland from all islands within each archipelago.

Besides contributing a large proportion of the world's endemics and many phylogenetically unique species[9], species on islands are also disproportionately threatened by habitat degradation, invasive species and climate change[3]. Small population sizes and unique functional adaptations of island species, such as loss of defence mechanisms or low competitive ability, can augment their risk of extinction[33,46].

Island species—both natives and endemics—are overrepresented in all conservation categories of the International Union for Conservation of Nature (IUCN) compared with species native to the mainland (Fig. 4). Globally, we find that 31% of all IUCN-assessed species are native to islands, but 57% of all island endemics fall into one of the four IUCN Red List conservation categories[5], with 14% being critically endangered, 23% endangered, 14% vulnerable and 6% near threatened. Further, 0.6% (176) of all island endemics are classified as extinct, which represents 55% of all extinct plant species worldwide. Together with non-endemic island species, this number increases to 77% for all extinct species. These percentages are considerably higher than the extinctions of species native to mainlands (<0.1% (52) extinct species and 39% threatened species). Similarly, of all critically endangered species, 48% are island endemics and 25% are native non-endemic on islands, compared with the 27% of species that are endemic to mainlands.

The proportion of IUCN-assessed native species that are threatened on islands is distributed somewhat differently from the proportion of IUCN-assessed island endemics (Extended Data Fig. 5 and Extended Data Table 2). High proportions of threatened island endemics are concentrated especially on islands in the central Atlantic (Ascension, St Helena and Cape Verde), the Seychelles, the Caribbean and Hawai'i. The impacts of land degradation, climate change and invasive species are likely to be higher on smaller islands that usually support smaller species populations[47,48]. Under future global change scenarios, including the continuing spread of exotic species and rising sea levels[49], it can be expected that the risk level of island species will continue to increase[3].

Concerningly, only a few islands currently meet the United Nations 30×30 conservation target, according to which by 2030 at least 30% of all land and ocean should be protected. Of all single-island endemics, only 2,744 (6%) occur on islands that already meet the conservation target (Fig. 4c), highlighting the continuing conservation risk to island plants. Islands with high endemism, such as New Caledonia (only 5% of total land area protected), New Guinea (12%) and Madagascar (14%), feature relatively low protected area coverage. Although existing protected areas may overlap with the range of some endemic species, case studies from these endemic-rich islands suggest that current networks of protected areas are often unbalanced and do not cover the range of endemics adequately[50–52].

For the future, it will be important to assess how well conservation networks cover the actual ranges of island endemics. Many island endemics have very restricted ranges and survive in specific locations and habitats—for example, located on mountain tops or along ridges that providing distinct microclimates or protection from human influences and invasive herbivores[53]. Priority should be given to islands with a high richness of endemic species but low overall coverage of protected areas (Fig. 4d). The United Nations 30×30 conservation target can serve as a guideline. To protect the outstanding floral diversity of islands, protected area networks should ideally also consider the full breadth of habitats that island endemics need in the future. To this

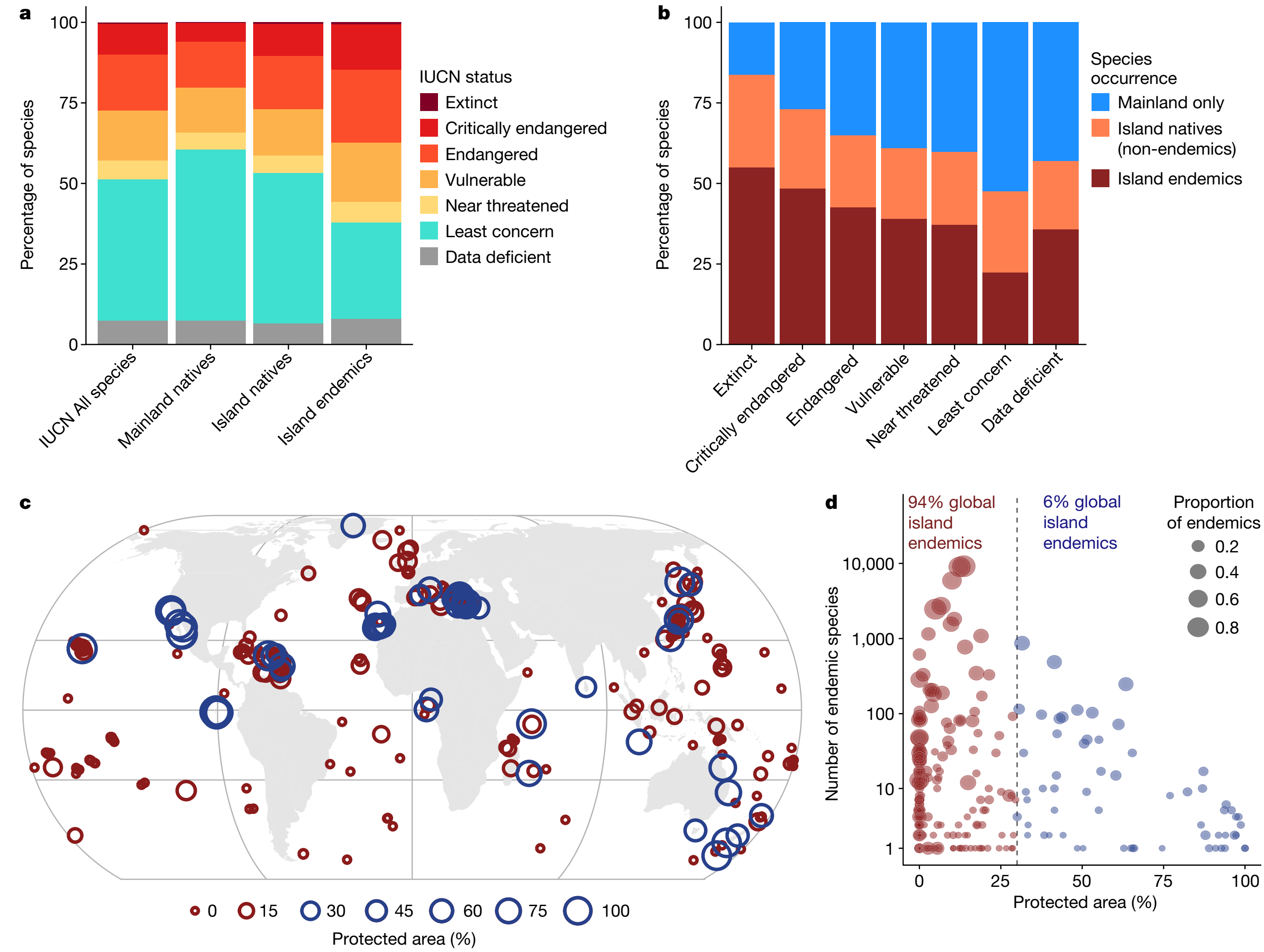

Fig. 4 | Global risk to native and endemic island species and coverage of protected areas on islands. a, Percentage of all IUCN-assessed plant species for seven IUCN threat categories and divided into mainland native, island native and island endemic species. **b**, Percentage of mainland, non-endemic island and endemic island species in each IUCN threat category. **c**, Proportion of protected areas for 1,651 single islands. Islands that fall below the United Nations 30×30 conservation target (by 2030 at least 30% land area protected) are indicated by red dots; islands that meet the target are indicated by blue dots. **d**, Percentage of island area that is protected and number and proportion of single-island endemic species for all islands that support endemics. The 30% protected area conservation target of the United Nations is indicated by a dashed black line.

end, identifying and protecting important plant and key biodiversity areas on islands rich in endemic species can guide the selection of protected areas as these significantly lower species extinction risk and are effective in reducing biodiversity loss[54,55]. However, on many islands and habitats, extensions of protected area networks alone may be too late or insufficient, such as for the highly endangered dry forest of Hawaiʻi or thermophilous woodlands of the Canary Islands[56,57]. Here, protected areas need to be coupled with habitat restoration as the availability of high-quality habitats for many island endemics may have shrunk to non-viable levels[3]. Population sizes of many island endemics in the wild are so small that ex situ conservation measures and seed banks are necessary for their protection. Also, Indigenous peoples and local communities need to be better integrated into or lead conservation management and participate in decision-making as this enhances sustainable and long-lasting protection of both nature and human wellbeing[16]. Conservation of island plants will therefore be even more challenging in the future, highlighting the need to integrate local stakeholders, assess the distribution of island endemics, monitor their trends and build up ex situ collections and seed banks to safeguard much of the phylogenetically unique plant diversity of our planet.

Conclusion

Islands not only have great value for biologists and conservation, but their flora also provides essential ecosystem services for Indigenous peoples and local communities and tourism. The data made available here can help future studies unravel the underlying ecological, biogeographical and evolutionary mechanisms of island endemism. Integration with geo-environmental data, speciation types and functional trait data will shed light on the origin and drivers of island endemism. Via the Global Inventory of Floras and Traits (GIFT) database, we provide a framework for continuously enhancing and validating occurrences and the status of island plant diversity worldwide. This is of crucial importance, as our results underline how strongly islands contribute to global biodiversity and how island endemics contribute disproportionately to species that are threatened. Together with the large number of species that are already extinct on islands, this calls for stronger conservation action, especially on those islands that support high levels of endemism but with low coverage of protected areas. Actions should include increasing coverage of conservation reserves, especially on islands that support endemic species, integrating local human populations into conservation management and decision-making, rigorous monitoring efforts on island floras and threats to them, and targeted and internationally supported monitoring and conservation schemes, including ex situ collections and seed banks as well as habitat restoration and invasive species removal on islands that are currently poorly protected.

Online content

Any methods, additional references, Nature Portfolio reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at https://doi.org/10.1038/s41586-024-08036-1.

1. Kier, G. et al. A global assessment of endemism and species richness across island and mainland regions. *Proc. Natl Acad. Sci. USA* **106**, 9322–9327 (2009).
2. Whittaker, R. J., Fernández-Palacios, J.-M. & Matthews, T. J. *Island Biogeography: Geo-environmental Dynamics, Ecology, Evolution, Human Impact, and Conservation* (Oxford Univ. Press, 2023).
3. Fernandez-Palacios, J. M. et al. Scientists' warning—The outstanding biodiversity of islands is in peril. *Glob. Ecol. Conserv.* **31**, e01847 (2021).
4. Weigelt, P., Jetz, W. & Kreft, H. Bioclimatic and physical characterization of the world's islands. *Proc. Natl Acad. Sci. USA* **110**, 15307–15312 (2013).
5. *IUCN Red List of Threatened Species*, version 2022-2 (IUCN, 2022); https://www.iucnredlist.org
6. Zizka, A. et al. The evolution of insular woodiness. *Proc. Natl Acad. Sci. USA* **119**, e2208629119 (2022).
7. Burns, K. C. *Evolution in Isolation: The Search for an Island Syndrome in Plants* (Cambridge Univ. Press, 2019).
8. Gallagher, R. V. et al. Global shortfalls in threat assessments for endemic flora by country. *Plants People Planet* **5**, 885–898 (2023).
9. Cai, L. et al. Climatic stability and geological history shape global centers of neo- and paleoendemism in seed plants. *Proc. Natl Acad. Sci. USA* **120**, e2300981120 (2023).
10. Amborella Genome Project. The *Amborella* genome and the evolution of flowering plants. *Science* **342**, 1241089 (2013).
11. Savolainen, V. et al. Sympatric speciation in palms on an oceanic island. *Nature* **441**, 210–213 (2006).
12. Mort, M. E., Soltis, D. E., Soltis, P. S., Francisco-Ortega, J. & Santos-Guerra, A. Phylogenetics and evolution of the Macaronesian clade of crassulaceae inferred from nuclear and chloroplast sequence data. *Syst. Biol.* **27**, 271–288 (2002).
13. Givnish, T. J. et al. Origin, adaptive radiation and diversification of the Hawaiian lobeliads (Asterales: Campanulaceae). *Proc. R. Soc. B* **276**, 407–416 (2009).
14. Walsh, S. K. et al. Pollination biology reveals challenges to restoring populations of *Brighamia insignis* (Campanulaceae), a critically endangered plant species from Hawai'i. *Flora* **259**, 151448 (2019).
15. Venkatasamy, S., Khittoo, G., Nowbuth, P. & Vencatasamy, D. R. Phylogenetic relationships based on morphology among the *Diospyros* (Ebenaceae) species endemic to the Mascarene Islands. *Bot. J. Linn. Soc.* **150**, 307–313 (2006).
16. Dawson, N. M. et al. The role of Indigenous peoples and local communities in effective and equitable conservation. *Ecol. Soc.* **26**, 19 (2021).
17. Kueffer, C. & Kinney, K. What is the importance of islands to environmental conservation? *Environ. Conserv.* **44**, 311–322 (2017).
18. Weigelt, P., König, C. & Kreft, H. GIFT—A Global Inventory of Floras and Traits for macroecology and biogeography. *J. Biogeogr.* **47**, 16–43 (2020).
19. Govaerts, R., Lughadha, E. N., Black, N., Turner, R. & Paton, A. The World Checklist of Vascular Plants, a continuously updated resource for exploring global plant diversity. *Sci. Data* **8**, 215 (2021).
20. Schrader, J., Weigelt, P. & Kreft, H. Plant list. *Figshare* https://doi.org/10.6084/m9.figshare.24448108 (2023).
21. Weigelt, P., Steinbauer, M. J., Cabral, J. S. & Kreft, H. Late Quaternary climate change shapes island biodiversity. *Nature* **532**, 99–102 (2016).
22. Hojsgaard, D., Klatt, S., Baier, R., Carman, J. G. & Horandl, E. Taxonomy and biogeography of apomixis in angiosperms and associated biodiversity characteristics. *Crit. Rev. Plant Sci.* **33**, 414–427 (2014).
23. Camara-Leret, R. et al. New Guinea has the world's richest island flora. *Nature* **584**, 579–583 (2020).
24. Alsos, I. G. et al. Long-distance plant dispersal to North Atlantic islands: colonization routes and founder effect. *AoB Plants* **7**, plv036 (2015).
25. Cai, L. et al. Global models and predictions of plant diversity based on advanced machine learning techniques. *New Phytol.* **237**, 1432–1445 (2023).
26. Baldwin, B. G. & Sanderson, M. J. Age and rate of diversification of the Hawaiian silversword alliance (Compositae). *Proc. Natl Acad. Sci. USA* **95**, 9402–9406 (1998).
27. Gillespie, R. G. et al. Long-distance dispersal: a framework for hypothesis testing. *Trends Ecol. Evol.* **27**, 47–56 (2012).
28. Takhtajan, A. *Floristic Regions of the World* 1st edn (UC Press, 1986).
29. Fernández-Palacios, J. M. et al. A reconstruction of Palaeo-Macaronesia, with particular reference to the long-term biogeography of the Atlantic island laurel forests. *J. Biogeogr.* **38**, 226–246 (2011).
30. Wright, S. D., Yong, C. G., Dawson, J. W., Whittaker, D. J. & Gardner, R. C. Riding the Ice Age El Nino? Pacific biogeography and evolution of *Metrosideros* subg. *Metrosideros* (Myrtaceae) inferred from nuclear ribosomal DNA. *Proc. Natl Acad. Sci. USA* **97**, 4118–4123 (2000).
31. Johnson, M. A., Clark, J. R., Wagner, W. L. & McDade, L. A. A molecular phylogeny of the Pacific clade of *Cyrtandra* (Gesneriaceae) reveals a Fijian origin, recent diversification, and the importance of founder events. *Mol. Phylogenet. Evol.* **116**, 30–48 (2017).
32. Roeble, L. et al. Island biogeography of the megadiverse plant family Asteraceae. *Nat. Commun.* **15**, 7276 (2024).
33. Schrader, J., Wright, I. J., Kreft, H. & Westoby, M. A roadmap to plant functional island biogeography. *Biol. Rev.* **96**, 2851–2870 (2021).
34. Taylor, A., Weigelt, P., Konig, C., Zotz, G. & Kreft, H. Island disharmony revisited using orchids as a model group. *New Phytol.* **223**, 597–606 (2019).
35. Cerca, J. et al. Evolutionary genomics of oceanic island radiations. *Trends Ecol. Evol.* **38**, 631–642 (2023).
36. Givnish, T. J. Ecology of plant speciation. *Taxon* **59**, 1326–1366 (2010).
37. Mayr, E. *Populations, Species, and Evolution: An Abridgment of Animal Species and Evolution* Vol. 19 (Harvard Univ. Press, 1970).
38. Kisel, Y. & Barraclough, T. G. Speciation has a spatial scale that depends on levels of gene flow. *Am. Nat.* **175**, 316–334 (2010).
39. Losos, J. B. & Ricklefs, R. E. Adaptation and diversification on islands. *Nature* **457**, 830–836 (2009).
40. MacArthur, R. H. & Wilson, E. O. *The Theory of Island Biogeography* 1st edn, Vol. 1 (Princeton Univ. Press 1967).
41. Steinbauer, M. J. et al. Topography-driven isolation, speciation and a global increase of endemism with elevation. *Global Ecol. Biogeogr.* **25**, 1097–1107 (2016).
42. Whittaker, R. J., Triantis, K. A. & Ladle, R. J. A general dynamic theory of oceanic island biogeography. *J. Biogeogr.* **35**, 977–994 (2008).
43. Kreft, H., Jetz, W., Mutke, J., Kier, G. & Barthlott, W. Global diversity of island floras from a macroecological perspective. *Ecol. Lett.* **11**, 116–127 (2008).
44. König, C., Weigelt, P. & Kreft, H. Dissecting global turnover in vascular plants. *Glob. Ecol. Biogeogr.* **26**, 228–242 (2017).
45. Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. & Kent, J. Biodiversity hotspots for conservation priorities. *Nature* **403**, 853–858 (2000).
46. Pimm, S. L., Jones, H. L. & Diamond, J. On the risk of extinction. *Am. Nat.* **132**, 757–785 (1988).
47. Pyšek, P. et al. Naturalized alien flora of the world. *Preslia* **89**, 203–274 (2017).
48. Harter, D. E. V. et al. Impacts of global climate change on the floras of oceanic islands—projections, implications and current knowledge. *Perspect. Plant Ecol. Evol. Syst.* **17**, 160–183 (2015).
49. Cazenave, A. & Cozannet, G. L. Sea level rise and its coastal impacts. *Earth's Future* **2**, 15–34 (2014).
50. Parsch, C. et al. Papua at the crossroads: a plea for systematic conservation planning in one of the largest remaining areas of tropical rainforest. *Front. For. Glob. Change* **5**, 763131–763131 (2022).
51. Jaffre, T., Bouchet, P. J. & Veillon, J. M. Threatened plants of New Caledonia: is the system of protected areas adequate? *Biodivers. Conserv.* **7**, 109–135 (1998).
52. Ralimanana, H. et al. Madagascar's extraordinary biodiversity: threats and opportunities. *Science* **378**, eadf1466 (2022).
53. Fernández-Palacios, J. M. et al. Evolutionary winners are ecological losers among oceanic island plants. *J. Biogeogr.* **48**, 2186–2198 (2021).
54. Smith, R. J. et al. Synergies between the key biodiversity area and systematic conservation planning approaches. *Conserv. Lett.* **12**, e12625 (2018).
55. Darbyshire, I. et al. Important Plant Areas: revised selection criteria for a global approach to plant conservation. *Biodivers. Conserv.* **26**, 1767–1800 (2017).
56. Otto, R. et al. Diversity and distribution of the last remnants of endemic juniper woodlands on Tenerife, Canary Islands. *Biodivers. Conserv.* **21**, 1811–1834 (2012).
57. Sato, A. Y. et al. Biocultural restoration of Hawaiian tropical dry forests. *Pac. Conserv. Biol.* **27**, 362–375 (2021).

Methods

Species distributions and status

We sourced all species occurrences from the GIFT v.3.2[18] using the GIFT R package[58]. GIFT is a collection of regional plant inventories from published checklists, floras and reports for around 3,400 geographical regions. GIFT integrates other large aggregated species distribution databases, such as the World Checklist of Vascular Plants[19] and the integrated assessment of the vascular plant species of the Americas[59]. We consider a species list for a geographical entity as comprehensive if the original author(s) of the lists do not state otherwise. However, it is important to note that in most, if not all, geographical regions worldwide new species are being described continuously[60], so higher species numbers are to be expected in future studies.

Species names in GIFT are standardized according to the World Checklist of Vascular Plants[19]. Species name standardization can lead to slightly different richness counts compared with those given in original references due to synonyms and infra-specific taxa. Name standardization can also affect species status if, for example, a species was formerly considered endemic to an island but is now merged with a species from the mainland. For instance, for New Guinea, 13,634 native vascular plant taxa were counted in the original list[23], whereas after name standardization we counted 13,401 native species.

As status we consider whether a species is native in a region, and whether it was considered endemic by the authors of the original publication. We derived whether a species belongs to mainland, spans mainland and islands or is found only on islands (whether part of an island, a whole island or an island group).

We obtained information for 350,707 species from 1,967 island and 1,010 mainland regions from around 5.5 million species-by-region records with global geographical coverage (Extended Data Fig. 6) from 423 references (see reference list for details on all references included) including the World Checklist of Vascular Plants[19]. We focused on finding and including species lists of all islands known to support endemic plants. As a consequence, the list reported here is much more comprehensive than those used in previous studies on island plant endemism[1,8,9,21] in both species completeness and geographical coverage. The coverage of our checklist is globally comprehensive (Extended Data Fig. 6a). Via the GIFT database[18], we provide a mechanism for continuing enhancements including the integration of new checklists for both island and mainland regions. The complete list of all 350,707 species as well as their geographical status is available online[20].

Island definition and origin

We use the conventional definition of islands as any landmass that is not one of the seven recognized continents (that is, all landmasses smaller than Australia)[2]. This broad grouping includes different types of island origin, and correspondingly their biotas are formed by different processes[61]. Oceanic islands such as Hawaiʻi, the Canary Islands or Galápagos have formed volcanically over mantle hotspots within the past millions of years[61]. Most continental islands were connected to the mainland during the last glacial maximum (around 21,000 years ago) and have now been separated by sea-level rise. Some landmasses such as Cuba and New Zealand are of highly complex origin and have been separated for tens of millions of years. They were formed by plate tectonics as fragments of continents but are traditionally called islands rather than continents[61].

Accordingly, we attributed each island to (1) oceanic; (2) continental shelf or land-bridge; or (3) complex origin including continental fragments (following ref. 2). We considered an island as a continental shelf island if it was connected to the mainland around 21,000 years ago before present using ETOPO1 global bathymetry data at 1-arcmin resolution[62]. At that time, the sea level was approximately 122 m lower than today, which we used as a threshold. The continental category included 560 islands (note that this list only includes continental islands for which separate species lists are available). Islands of complex origin include fragments once connected to continents or part of continental crust, which broke away during plate tectonic drift many million years ago, taking with them ancestors of their modern biodiversity. However, not all land area belonging to these islands has once been part of a mainland. Some islands in this category are of highly complex geological origin including ocean floor uplifts (for example, Cyprus), plate tectonics (for example, many islands of the Greater Antilles) or volcanic activity (for example, large Japanese islands)[63]. Further, not all islands located on continental fragments should biogeographically be attributed to this category. Some islands, like Jan Mayen, are located on continental crust but emerged from volcanic disruptions and are treated here as oceanic. For other islands on continental crust, it is not clear whether they have been submerged below sea level at some point of their ontogeny. Examples are Timor and Sumba[63] in Southeast Asia, which we included as oceanic. Small islands surrounding fragments, such as the numerous small islands off New Zealand or Cuba, are included as oceanic as they resulted from recent sea-level rises but their flora is likely sourced from the main islands more so than from what we are here considering mainlands. A special case in the category of fragments is New Caledonia, which, as part of a continental fragment once belonging to Gondwana, may have been submerged during its geological history[64]. However, evidence for this is contentious. Occurrence of many old and endemic lineages suggest that biogeographically it rather acts as a fragment[64], which we call it here. We attributed 31 islands to complex origin including continental fragments. All other islands (1,060) are considered oceanic. These islands have never been part of or connected to any mainland and their biota result from long-distance dispersal and speciation. All island data, including island names and categories, can be found online[20].

Apomictic taxa

Apomictic taxa that reproduce asexually have independently emerged in various genera[65]. Detecting apomixis and defining it in terms of species concepts is contentious. The inclusion of apomicts in GIFT varies, leading to a skewed global representation[9]. In northern European floras, apomictic taxa are often treated as distinct species, while most tropical floras do not describe them at all. This bias results in an overestimation of endemic species in temperate European and North American regions. To address this, we removed all angiosperm taxa from genera listed in the Apomixis Database[22], excluding 46,604 species, mostly from the northern hemisphere. The dataset without apomictic taxa (304,103 species) is used for the main analyses. The numbers and global distribution of endemic species, including apomictic ones, is shown in Extended Data Table 1 and Extended Data Fig. 7.

Counting all species endemic to islands

Integrating species lists across large scales is challenging due to variations in data completeness and taxonomy[66]. In GIFT, species are categorized as native, endemic, or naturalized, but this classification can be inaccurate due to limited data or taxonomic changes. Relying solely on author opinions from the primary resources in GIFT for island endemism counts has two potential flaws: it may underestimate endemics due to regions without expert opinion or overestimate due to taxonomic issues. To address this, mainland species lists from GIFT were also used to decide what species are occurring only on islands or on islands and the mainland, leading to two counting approaches (expert-based and exclusion; see below and Supplementary Fig. 1 for workflow).

Each species list included information whether a list covers: (1) a mainland region; (2) a mainland and island region; or (3) only islands. We excluded all lists for combined mainland and island regions where a list is also available for the mainland region specifically. However, to reach global geographical coverage we included 42 lists for which species information is only available for certain mainlands combined with islands. Examples are Tanzania (including Mozambique Channel

Islands), Denmark (including Danish islands) and Saudi Arabia (including Farasan, Tiran and Sanafir). Next, we grouped all native vascular plants available in the overall species list to occur either: (1) only on the mainland; (2) only on islands (island endemics); or (3) on both islands and mainlands.

To identify species endemic on islands (both numbers and species list), we applied and compared four different methods based on combinations of the two approaches (expert and exclusion based) explained above. These probably represent lower and upper bounds of numbers of island endemism.

Expert-based. Most checklists in GIFT hold information on whether a species was assessed as endemic in a specific geographical region by the original author(s). Only taxa at the species level were considered, excluding infra-specific endemics. Next, we counted the total number of species considered endemic on islands according to the original author's assessments. Using this method, we counted 58,182 species endemic to islands (65,979 species including apomictic taxa). The advantage of this approach is that only species are included that are considered endemic by experts of the regional floras. However, we consider this number likely to underestimate the total number of island endemics because most lists in GIFT cover a single island or archipelago and species endemic to several islands or archipelagos may not have been indicated as island endemics. On the other hand, for single-island endemics, this method may overestimate species endemism, as species could have been labelled as endemic that were later also located on other islands or the mainland or were later taxonomically standardized to species found also elsewhere (all species also occurring on the mainland or other islands are indicated in a Figshare repository[20]).

Exclusion. For the second method, we identified all species as endemic to islands that were native on islands but absent in any mainland region. For this method, we used the global geographical coverage of GIFT (Extended Data Fig. 6a), which was important to determine whether a species did not occur in any mainland region. This exclusion method has the advantage of identifying species occurring on multiple islands (not necessarily indicated as endemic by the authors but not occuring on the mainland). It can be applied to any geographical subset, such as archipelagos or floristic regions (see below). It can also be applied to islands without information on endemism provided by the authors. However, this method may underestimate island endemism as species from lists for mainland and island regions combined (especially in regions shown in Extended Data Fig. 6b) were excluded due to unclear geographical affiliation. Using this method, we counted 58,993 species endemic to islands (66,595 species including apomictic taxa).

Expert-based AND exclusion. This method only considered species endemic to islands if they were considered endemic by the authors of each list (expert-based) and did not occur in any mainland region (exclusion). For 72 islands with no expert information on species endemism available we used the lists produced by method 2 (exclusion) only. Using this method 53,895 species were identified as endemic to islands (60,879 species including apomictic taxa). This represents the most conservative count.

Expert-based OR exclusion. This method combined method 1 (expert-based) and method 2 (exclusion) but considered a species endemic to an island if it was included in at least one of the two methods. For this method, we based the exclusion counting on a dataset that omitted all regions in GIFT that included both islands and mainland. We did this in order to include species endemic to islands identified by the expert method which were part of a mainland-plus-island region. This method counted 63,280 species endemic to islands (71,695 species including apomictic taxa). This may represent an overestimation, as it can include species considered endemic by authors of the original list but later confirmed to also occur on the mainland. Nevertheless, we regard this number as the most comprehensive count of species endemic to islands as it includes all species considered endemic by the expert list and the exclusion approach.

All four methods yielded similar numbers of island endemics, differing only by 3.1% as a percentage of the global diversity of vascular plants when using the dataset including as well as excluding apomictic taxa. When comparing the methods directly to each other, the lowest and highest counts differed by only 14.9%, which we consider low, especially since the expert-based AND exclusion method (3) is likely to produce a highly conservative count. In other words, none of the methods severely over- or underestimated the total number of species endemic to islands. For the main text, we report numbers and species identified endemic on islands by the fourth method excluding apomictic taxa. Data for all species native and endemic to islands from all four methods is provided online via ref. 20.

Endemism at the level of single islands

To identify species endemic to single islands, we used the lists of species endemism resulting from the four methods described above and tested which species only occur on any of the single islands we had data for. To maximize the coverage of single islands, we also included species lists for island groups where: (1) the largest island was much larger than all other islands of the group; or (2) had a much larger geographical extent. First, we included an island group if the largest island contributed >50% area of all islands combined in a list. Examples were lists for Cuba or New Caledonia that included the main islands (island of Cuba, Terra Grande) as well as numerous offshore islands with relatively small area. Second, an island group was included if the linear distance between the main island's outer edges was >50% of the total extent. Examples include tropical atolls where many islands are clustered closely together, such as Caroline or Aitutaki Atolls, but one had by far the largest extent of the group. Our final list included 1,651 islands.

To compare the number of endemic species on an island to the number of natives we also extracted information from GIFT for all species native on each island. However, species lists including all species native to islands (1,454 out of 1,651 lists) were not available for all islands we had endemism data for.

Endemism at the level of archipelagos

Island groups and archipelagos are meaningful entities for endemism due to their shared geological and biogeographical history[2]. We attributed each island to an archipelago based on common geological origin, such as atolls (for example, Maldives, many islands in the tropical Pacific), volcanic hotspot islands (for example, Hawai'i, Galápagos or the Azores) or geographic proximity and connectedness during the last glacial maximum, such as for continental islands (for example, Greater Sunda Islands, Patagonian Islands). Based on these criteria we attributed each island to one of 141 archipelagos. For some archipelagos, especially for those on continental shelves, delineation is traditional but somewhat arbitrary. Next, we identified all endemic species for each archipelago based on the four methods described above. We also assessed species native to an archipelago by summarizing all species found in any of the islands included in each archipelago.

Endemism at the level of floristic regions

Floristic and biogeographical regions are areas delineated by a shared floristic composition. One of the most commonly used floristic regionalizations, proposed by Takhtajan[28], has the advantage of accounting also for island regions. Of the 35 floristic regions identified by Takhtajan, 22 include islands and 11 are exclusively composed of islands. To assess the number of species endemic to these regions we assigned each island to its corresponding floristic region and identified all island species occurring in this region and endemic to this region using all four methods described above. To assess species native to islands of each floristic region, we summarized all species found in any of the islands included in each floristic region. Results for island species native and endemic in each floristic region are in Extended Data Fig. 8. All maps in Fig. 1 and Extended Data Figs. 5–8 were drawn using the ne_countries function from the R package rnaturalearth (v.1.0.1).

Endemism at family and genus level and phylogenetic signal

To assess whether island endemism is over- or under-represented in certain families, we calculated the proportion of all endemic island species (based on method four) found in each of the 476 families in our dataset. We also tested for a phylogenetic signal in the proportion of endemic species per family using a family-level phylogeny using Abouheif's C_{mean} (ref. 67); a significant P value indicates that families closer to each other in the phylogeny tend to have more similar proportions of island endemics. We repeated the analyses for each of the three island categories (continental, complex origin including fragments, oceanic; Extended Data Fig. 3).

To calculate how much global phylogenetic plant diversity was provided by island endemics, we matched all species in our dataset to a dated species-level phylogeny for seed plants with 353,185 tips[68]. Nearly all species (except 8 species out of 350,707) could be matched or added to their genera on the phylogeny. Next, we calculated phylogenetic diversity for: (1) all species in our dataset; (2) all island natives; and (3) all island endemics using the function PD from the R package picante (v.1.8.2)[69].

Island area, isolation and latitude

Island area and isolation are important factors influencing species diversity in major island biogeographical models[2,41,43] and were available for all islands in our dataset. To test whether numbers and proportion of island endemism scale with area and isolation we extracted information on island area (km^2) and isolation (km; distance to nearest mainland) for each single island as well as for each archipelago. For the archipelago area, we used the summed area of all islands within an archipelago, and for archipelago isolation the mean distance of all islands to the mainland. To test for their individual effects on endemism richness, we constructed a linear model for each island category and island area, isolation, and endemism richness (all $\log_{10}$-transformed). Additionally, we tested whether the richness and the proportion of island endemic species are also related to the latitude of the islands. Latitude is often a strong predictor of species diversity across biogeographical scales through many biological variables being associated with latitude, such as temperature or solar energy[70]. However, it is important to note that latitude itself is not a biological variable and has no direct effects on species diversity. For the full model, we used a linear mixed effects model with island area and isolation as well as their interaction and island category as fixed effects and archipelago as a random effect using the lmer-function in the R package lme4 (v.1.1-35.10)[71]. Conditional R^2 values were calculated using MuMin-package (v.1.47.5)[72]. The island category was included to account for differences in geological history and connectedness. Archipelago was included as a random effect to account for any biogeographical differences among archipelagos[2,38,73]. All information on islands including island area, isolation, archipelago, floristic region and numbers of native and endemic species is deposited in a Figshare repository[20].

IUCN data

We sourced information about species threat status from the International Union for Conservation of Nature (IUCN) List of Threatened Species[5] for all vascular plants assessed (downloaded on 8 August 2023), yielding information for 62,666 species. Next, we matched IUCN species names with those from GIFT by standardizing the IUCN species names using the World Checklist of Vascular Plants[19]. We found matching names for 61,727 species (98.5%) in IUCN. Names not matched were mostly hybrids or absent in GIFT. We then matched all species with IUCN Red List categories to: (1) all species that are native on the mainland; (2) all species that are native on islands; and (3) all species that are endemic to islands. The IUCN Red List category 'extinct in the wild' was grouped with 'extinct'.

To test the proportion of IUCN-assessed species from all species native and endemic on islands, we only used islands included in the list of single islands as described above, and where complete inventories of native species were available.

The United Nations 30×30 conservation target is an internationally agreed target by which governments aim to designate 30% of their land and ocean areas worldwide as protected areas by 2030[74]. While area-based conservation is not free of criticism[75] and cannot be the only solution for the global biodiversity crisis, the 30×30 conservation target represents a tangible and quantifiable framework for measuring conservation efforts across geographical entities. We therefore used the United Nations 30×30 conservation target as a proxy for assessing conservation efforts across islands worldwide. Data from protected areas worldwide were sourced from The World Database on Protected Areas (https://www.protectedplanet.net/; accessed August 2023). Using only the terrestrial protected areas, we overlaid these with all islands in our dataset to calculate the proportion of protected areas from the total island area for all islands.

All species occurrence data was sourced from refs. 19,23,59,76–489.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

The standardized checklist of the world flora including information for all species on their geographic status—for example, if a species is native and/or endemic to islands, archipelagos or islands of floristic regions and/or native to the mainland—is available in a Figshare repository: https://doi.org/10.6084/m9.figshare.24448108 (ref. 20). Note that all data made available here are based on GIFT v.3.2. In future, newer versions may be available and accessible using the GIFT R package[58].

Code availability

Code to download data from GIFT and generate species lists for all species native and endemic to islands and the mainland based on all four counting methods including flagging of species belonging to genera prone to asexual reproduction via apomixis is available in a Figshare repository: https://doi.org/10.6084/m9.figshare.24448108 (ref. 20).

58. Denelle, P., Weigelt, P. & Kreft, H. GIFT—an R package to access the Global Inventory of Floras and Traits. *Methods Ecol. Evol.* **14**, 2738–2748 (2023).
59. Ulloa Ulloa, C. et al. An integrated assessment of the vascular plant species of the Americas. *Science* **358**, 1614–1617 (2017).
60. Antonelli, A. et al. Why plant diversity and distribution matter. *New Phytol.* **240**, 1331–1336 (2023).
61. Ali, J. R. & Meiri, S. Biodiversity growth on the volcanic ocean islands and the roles of in situ cladogenesis and immigration: case with the reptiles. *Ecography* **42**, 989–999 (2019).
62. Amante, C. & Eakins, B. W. *ETOPO1 1 Arc-Minute Global Relief Model: Procedures, Data Sources and Analysis*. NOAA Technical Memorandum NESDIS NGDC-24, 19-19 (Pangaea, 2009); https://doi.org/10.1594/PANGAEA.769615.
63. Ali, J. R. Islands as biological substrates: continental. *J. Biogeogr.* **45**, 1003–1018 (2018).
64. Grandcolas, P. et al. New Caledonia: a very old Darwinian island? *Phil. Trans. R. Soc. B* **363**, 3309–3317 (2008).
65. Majeský, Ľ., Krahulec, F. & Vašut, R. J. How apomictic taxa are treated in current taxonomy: a review. *Taxon* **66**, 1017–1040 (2017).
66. König, C. et al. Biodiversity data integration—the significance of data resolution and domain. *PLoS Biol.* **17**, e3000183 (2019).
67. Abouheif, E. A method for testing the assumption of phylogenetic independence in comparative data. *Evol. Ecol. Res.* **1**, 895–909 (1999).
68. Smith, S. A. & Brown, J. W. Constructing a broadly inclusive seed plant phylogeny. *Am. J. Bot.* **105**, 302–314 (2018).
69. Kembel, S. W. et al. Picante: R tools for integrating phylogenies and ecology. *Bioinformatics* **26**, 1463–1464 (2010).

70. Brown, J. H. Why are there so many species in the tropics? *J. Biogeogr.* **41**, 8–22 (2014).
71. Bates, D., Maechler, M., Bolker, B. M. & Walker, S. lme4: linear mixed-effects models using Eigen and S4. R package version 1.1-23 https://cran.r-project.org/web/packages/lme4/index.html (2013).
72. Bartoń, K. MuMIn: multi-model inference. R package version 1.40.4 https://cran.r-project.org/web/packages/MuMIn/index.html (2018).
73. Schrader, J. et al. Species–area relationships on small islands differ among plant growth forms. *Global Ecol. Biogeogr.* **29**, 814–829 (2020).
74. Dinerstein, E. et al. A Global Deal For Nature: guiding principles, milestones, and targets. *Sci. Adv.* **5**, eaaw2869 (2019).
75. Maxwell, S. L. et al. Area-based conservation in the twenty-first century. *Nature* **586**, 217–227 (2020).
76. Jaramillo Díaz, P., Guézou, A., Mauchamp, A. & Tye, A. *CDF Checklist of Galapagos Flowering Plants* (Charles, 2018).
77. Niedringhaus, R., Haeseler, V. & Janiesch, P. *Die Flora und Fauna der Ostfriesischen Inseln. Artenverzeichnisse und Auswertungen zur Biodiversität* (Nationalparkverwaltung Niedersächsisches Wattenmeer, 2008).
78. Crossley, J. A Checklist of the Flora of Orkney (Botanical Society of Britain & Ireland, 2013).
79. González-Román, R. D., López-Victoria, M. & Silverstone-Sopkin, P. A. Flora terrestre de la isla Malpelo (Colombia), Pacífico Oriental Tropical. *Rev. Biol. Trop.* **62**, 327–336 (2014).
80. Velayos Rodríguez, M. et al. *Flora de Guinea. Base de Datos de Flora de Guinea* (2021).
81. Niering, W. A. Bioecology of Kapingamarangi Atoll, Caroline Islands. Terrestrial Aspects. *Atoll Res. Bull.* **49**, 1–32 (1956).
82. Fosberg, F. R., Groves, E. W. & Sigee, D. C. List of Addu vascular plants. *Atoll Res. Bull.* **116**, 75–92 (1966).
83. Brownsey, P. J. & Perrie, L. R. A revised checklist of Fijian ferns and lycophytes. *Telopea* **13**, 513–562 (2011).
84. Woinarski, J., Brennan, K., Cowie, I., Kerrigan, R. & Hempel, C. *Biodiversity Conservation on the Tiwi Islands, Northern Territory. Part 1. Environments and Plants* (Natural Heritage Trust & Department of Infrastructure, Planning and Environment, Northern Territory Government, 2003).
85. Thaman, R. R. *Vascular Plants and Vegetation of Makaluva Reef Islet, Rewa Province, Viti Levu, Fiji islands* (South Pacific Regional Herbarium, Institute of Applied Science, Univ. of the South Pacific, 2005).
86. Thaman, R. R. & Tye, A. Flora of Kiritimati (Christmas) Atoll, Northern Line Islands, Republic of Kiribati. *Atoll Res. Bull.* **608**, 1–73 (2015).
87. Huang, T.-C. *Flora of Taiwan* 2nd edn, Vol. 1–6 (National Taiwan *Univ.*, 1994).
88. Sykes, W. R. The vegetation of Late, Tonga. *Allertonia* **2**, 323–353 (1981).
89. Carlson, M. L., Trammell, E. J., Nawrocki, T. & Noongwook, E. Additions to the vascular plant flora of St Lawrence Island, Alaska. New records, rare species, and phytogeographic patterns. *Rhodora* **120**, 1–41 (2018).
90. Boullet, V., Hivert, J. & Gigord, L. D. B. An updated account of the vascular flora of the Iles Eparses (Southwest Indian Ocean). *Atoll Res. Bull.* **614**, 1–64 (2018).
91. Meades, S. J., Hay, S. G. & Brouillet, L. *Annotated Checklist of the Vascular Plants of Newfoundland and Labrador* (The Provincial Museum of Newfoundland and Labrador, 2005).
92. Barnes, R. W., Duncan, F. & Todd, C. S. *The Native Vegetation of King Island, Bass Strait. A Guide to the Identification, Conservation Status, and Management of the Island's Native Vegetation and Threatened Plant Species* (Natural Heritage Trust, Tasmania, 2002).
93. Fosberg, F. R. & Sachet, M.-H. Wake Island vegetation and flora, 1961–1963. *Atoll Res. Bull.* **123**, 1–15 (1969).
94. Hassler, M. World Ferns. *A Complete, Synonymic Checklist of the Ferns and Lycophytes of the World* (2020); www.worldplants.de/ferns/.
95. Papanikolaou, A. & Panitsa, M. Plant species richness and composition of a habitat island within Lake Kastoria and comparison with those of a true island within the protected Pamvotis Lake (NW Greece). *Biodivers. Data J.* **8**, e48704 (2020).
96. Rembold, K., Mangopo, H., Tjitrosoedirdjo, S. S. & Kreft, H. Plant diversity, forest dependency, and alien plant invasions in tropical agricultural landscapes. *Biol. Conserv.* **213**, 234–242 (2017).
97. Hutchinson, J., Dalziel, J. M., Keay, R. W. J. & Hepper, N. *Flora of West Tropical Africa* (Crown Agents for Overseas Governments, 2014).
98. Fall, P. L. & Drezner, T. D. Vascular plant species of the Kingdom of Tonga by vegetation type, species origin, growth form, and dispersal mechanism. *Ecology* **101**, e02902 (2020).
99. Kluge, J. et al. Elevational seed plants richness patterns in Bhutan, Eastern Himalaya. *J. Biogeogr.* **44**, 1711–1722 (2017).
100. Jongbloed, M., Feulner, G. R., Böer, B. & Western, A. R. *The Comprehensive Guide to the Wild Flowers of the United Arab Emirates* (Environmental Research and Wildlife Development Agency, 2003).
101. Newman, M. *A Checklist of the Vascular Plants of Lao PDR* (Royal Botanic Garden Edinburgh, 2007).
102. Muer, T., Sauerbier, H. & Cabrera Calixto, F. *Die Farn—Und Blütenpflanzen der Kanarischen Inseln. Über 2.000 Pflanzenarten, Mehr Als 2.600 Fotos* (Margraf Publishers, 2016).
103. *Catalogue of the Vascular Plants of Madagascar* (Tropicos, 2020); http://legacy.tropicos.org/Project/Madagascar.
104. Yena, A. V. *Prirodnaja Flora Krymskogo Poluostrova* (Orianda, 2012).
105. Garroutte, M. D. *Species Richness, Community Compositon and Species Distribution Patterns in Aleutian Plants.* Master of Science Thesis (Univ. of Alaska Fairbanks, 2016).
106. Zizka, G. Flowering plants of Easter Island. *Palmarum Hortus Francofurtensis* **3**, 3–108 (1991).
107. *Euro+Med PlantBase—The Information Resource for Euro-Mediterranean Plant Diversity* (2006); http://ww2.bgbm.org/EuroPlusMed/.
108. Backer, C. A. & Bakhuizen van den Brink, R. C. *Flora of Java (Spermatophytes Only)* (Noordhoff, 1963).
109. Yonekura, K. & Kajita, T. *BG Plants Japanese Name and Scientific Name Index* (YList, 2013); http://ylist.info.
110. *Ecological Traits of New Zealand Flora* (Landcare Research New Zealand, 2018); https://ecotraits.landcareresearch.co.nz/.
111. Breckle, S.-W., Hedge, I. C. & Rafiqpoor, M. D. *Vascular Plants of Afghanistan. An Augmented Checklist* (Scientia Bonnensis, 2013).
112. Khanina, L., Zaugolnova, L., Smirnova, O., Shovkun, M. & Glukhova, E. *Flora of Vascular Plants in the Central European Russia* (Institute of Mathematical Problems of Biology, 2016); http://www.impb.ru/eco/index.php?l=en.
113. Tamis, W. L. M. et al. Standard list of the flora of the Netherlands 2003. *Gorteria* **30**, 101–195 (2004).
114. Buchwald, E. et al. Hvilke planter er hjemmehørende i Danmark? *Jydsk Naturhistorisk Forening* **118**, 72–96 (2013).
115. Whistler, W. A. Botanical survey of the Ringgold Islands, Fiji. *Allertonia* **11**, 1–28 (2012).
116. Pandža, M. & Milović, M. Flora of the Veliki Lagan and Mali Lagan islets (Dugi Otok island, Croatia). *Nat. Croat.* **24**, 215–222 (2015).
117. Pandža, M., Milović, M., Kripina, & Tafra, D. Vascular flora of the Vrgada islets (Zadar Archipelago, Eastern Adriatic). *Nat. Croat.* **20**, 97–116 (2011).
118. Pandža, M. & Milović, M. Flora of the islets near Pakoštane (Dalmatia, Croatia). *Nat. Croat.* **24**, 19–35 (2015).
119. Pandža, M. Flora of the island of Zirje and the small islands around it (eastern Adriatic coast, Croatia). *Acta Botica Croatia* **62**, 115–139 (2003).
120. Pandža, M. Flora of the small islands of Murter. *Nat. Croat.* **11**, 77–101 (2002).
121. Pandža, M. & Skvorc, Z. The flora of some uninhabited Sibenik Archipelago islands (Dalmatia, Croatia). *Nat. Croat.* **11**, 367–385 (2002).
122. Jasprica, N., Dolina, K. & Milović, M. Plant taxa and communities on three islets in south Croatia, NE Mediterranean. *Nat. Croat.* **24**, 191–213 (2015).
123. Abbott, I. & Black, R. Changes in species composition of floras on islets near Perth, Western Australia. *J. Biogeogr.* **7**, 399–410 (1980).
124. Amerson, A. B. Jr Species richness on the nondisturbed northwestern Hawaiian islands. *Ecology* **56**, 435–444 (1975).
125. Luna-Jorquera, G., Fernández, C. E. & Rivadeneira, M. M. Determinants of the diversity of plants, birds and mammals of coastal islands of the Humboldt current systems. Implications for conservation. *Biodivers. Conserv.* **21**, 13–32 (2012).
126. Woodroffe, C. D. Vascular plant speciesarea relationships on Nui Atoll, Tuvalu, Central Pacific: a reassessment of the small island effect. *Aust. J. Ecol.* **11**, 21–31 (1986).
127. *Bundesamt für Naturschutz* (Floraweb, 2016); https://www.floraweb.de.
128. Fischer, M. A., Adler, W. & Oswald, K. *Exkursionsflora für Österreich, Liechtenstein und Südtirol. Bestimmungsbuch für alle in der Republik Österreich, im Fürstentum Liechtenstein und in der Autonomen Provinz Bozen*, 3rd edn (Oberöstereichisches Landesmuseum, 2008).
129. *Peru Checklist* (Tropicas, 2015); http://www.tropicos.org/Project/PEC.
130. *Lista de Planta de Costa Rica*. With updates by E. Chacón (INBIO, 2000).
131. *Sistema Nacional de Información sobre Biodiversidad* (CONABIO, 2016); https://www.gob.mx/conabio.
132. *Flora of Victoria* (VicFlora, 2016); http://vicflora.rbg.vic.gov.au.
133. Hyde, M. A., Wursten, B. T., Ballings, P. & Coates Palgrave, M. *Flora of Caprivi* (CapriviFlora, 2016); http://www.capriviflora.com/.
134. Hyde, M. A., Wursten, B. T., Ballings, P. & Coates Palgrave, M. *Flora of Malawi* (MalawiFlora, 2016); http://www.malawiflora.com/index.php.
135. Hyde, M. A., Wursten, B. T., Ballings, P. & Coates Palgrave, M. *Flora of Mozambique* (MozambiqueFlora, 2016); http://www.mozambiqueflora.com/.
136. Hyde, M. A., Wursten, B. T., Ballings, P. & Coates Palgrave, M. *Flora of Zimbabwe* (2016); http://www.zimbabweflora.co.zw/.
137. Bingham, M. G., Willemen, A., Wursten, B. T., Ballings, P. & Hyde, M. A. *Flora of Zambia* (ZambiaFlora, 2016); http://www.zambiaflora.com/.
138. Hyde, M. A., Wursten, B. T., Ballings, P. & Coates Palgrave, M. *Flora of Botswana* (BotswanaFlora, 2016); http://www.botswanaflora.com/.
139. Cochard, R. & Bloesch, U. *Electronic Plant Species Database of the Saadani National Park, Coastal Tanzania* (R. D. Baldus, 2007); http://www.wildlife-baldus.com/saadani.html.
140. Dimopoulos, P. et al. *Vascular plants of Greece. An Annotated Checklist* (Botanischer Garten und Botanisches Museum Berlin-Dahlem, Freie Universität Berlin; Hellenic Botanical Society, 2013).
141. Karlsson, T. & Agestam, M. *Checklist of Nordic Vascular Plants. Sweden Checklist* (Euphrasia, 2014); http://www.euphrasia.nu/checklista/index.eng.html.
142. Silaeva, T. B. et al. *Flora of the National Park "Smolny". Mosses and Vascular Plants: Annotated List of Species* (Commission of RAS for the Conservation of Biological Diversity, 2011).
143. Singh, A. Observations on the vascular flora of Banaras Hindu University Main Campus, India. *Int. J. Mod. Biol. Med.* **6**, 48–87 (2015).
144. Jiménez, J. E., Juárez, P. & Díaz, A. Checklist of the vascular flora of Reserva Biológica San Luis, Costa Rica. *Check List* **12**, 1859 (2016).
145. Lorite, J. An updated checklist of the vascular flora of Sierra Nevade (SE Spain). *Phytotaxa* **261**, 1–57 (2016).
146. Al Khulaidi, A. W. A. *Flora of Yemen* (Sustainable Environmental Management Program, 2000).
147. Thomas, J. *Flora Checklist* (Plant Diversity of Saudi Arabia, 2011).
148. Kuzmenkova, S. M. *Plants of Belarus* (Central Botanical Garden of the NAS of Belarus, 2015); http://hbc.bas-net.by/plantae/eng/default.php.
149. Danihelka, J., Chrtek, J. & Kaplan, Z. Checklist of vascular plants of the Czech Republic. *Preslia* **84**, 647–811 (2012).
150. *Base de Données des Trachéophytes de France Métropolitaine (bdtfx)* (Tela Botanica, 2015); http://www.tela-botanica.org/bdtfx.
151. Flora do Brasil 2020 em Construção (Institute of Research Rio de Janeiro Botanical Garden, 2016); http://floradobrasil.jbrj.gov.br/.
152. Bernal, R., Gradstein, S. R. & Celis, M. *Catálogo de Plantas y Líquenes de Colombia* (Universidad Nacional de Colombia, 2015).
153. *The Flora of China v. 5.0* (Chinese Virtual Herbarium, 2016).

154. Medjahdi, B., Ibn Tattou, M., Barkat, D. & Benabedli, K. La flore vasculaire des Monts des Trara (Nord Ouest Algérien). *Acta Bot. Malacitana* **34**, 57–75 (2009).
155. Conti, F. & Bartolucci, F. *The Vascular Flora of the National Park of Abruzzo, Lazio and Molise (Central Italy)* (Springer, 2015).
156. Rakov, N. S., Saksonov S. V., Senator S.A. & Vasjukov V. M. *Vascular plants of Ulyanovsk Region* (Russian Academy of Sciences, 2014).
157. Хапугин, А. А. *Сосудистые Растения Ромодановского Района Республики Мордовия (Конспект Флоры)* (Saransk, 2013).
158. Notov, A. A. *National Park "Zavidovo": Vascular Plants, Bryophyte, Lichens* (Delovoj Mir, 2010).
159. Zvyagintseva, K. O. *An Annotated Checklist of the Urban Flora of Kharkiv* (Kharkiv National Univ., 2015).
160. *Panama Checklist* (Tropicos, 2015); http://www.tropicos.org/Project/PAC.
161. *Catalogue of the Vascular Plants of Ecuador* (Tropicos, 2015); http://www.tropicos.org/Project/CE.
162. *Catálogo de las Plantas Vasculares de Bolivia* (Tropicos, 2015); http://www.tropicos.org/Project/BC.
163. *Flora de Nicaragua* (Tropicos, 2015); http://www.tropicos.org/Project/FN.
164. Pandža, M. Flora parka prirode Papuk (Slavonija, Hrvatska). *Šumarski List* **134**, 25–43 (2010).
165. Lazkov, G. A. & Sultanova, B. A. *Checklist of Vascular Plants of Kyrgyzstan* (Botanical Museum, Finnish Museum of Natural History, 2011).
166. Evarts-Bunders, P., Evarte-Bundere, G., Bāra, J. & Nitcis, M. The flora of vascular plants in nature reserve "Eglone". *Acta Biol. Univ. Daugavpiliensis* **13**, 21–38 (2013).
167. Евстигнеев, О. И. & Федотов, Ю. П. *Флора Сосудистых Растений Заповедника "Брянский Лес"* (Гос. Природ. Биосфер. Заповедник Брян. Лес, 2007).
168. Vanderplank, S. E. *The Vascular Flora of Greater San Quintín, Baja California, Mexico*. Master's Thesis (Claremont Graduate Univ., 2010); https://doi.org/10.5642/cguetd/2.
169. Kumar, A. et al. A checklist of the flowering plants of Katerniaghat Wildlife Sanctuary, Uttar Pradesh, India. *J. Threat. Taxa* **7**, 7309–7408 (2015).
170. Catarino, L., Martins, E. S., Basto, M. F. & Diniz, M. A. An annotated checklist of the vascular flora of Guinea-Bissau (West Africa). *Blumea* **53**, 1–222 (2008).
171. Hauenstein, E. et al. Flora y vegetación de la Reserva Nacional Lago Peñuelas, Reserva de la Biósfera, Región de Valparaíso, Chile. *Bosque* **30**, 159–179 (2009).
172. *Biotics Web Explorer* (Parks Canada, 2015).
173. *NPSpecies: Information on Species in National Parks* (US Department of the Interior, 2015); https://irma.nps.gov/NPSpecies/.
174. Masharabu, T. *Flore et Végétation du Parc National de la Ruvubu au Burundi: Diversité, Structure et Implications pour la Conservation*. PhD Thesis (Univ. Libre de Bruxelles, 2011).
175. Lee, R.-Y. et al. Flora of vascular plants in the Chilgapsan Provincial Park, Korea. *J. Asia-Pac. Biodivers.* **7**, 237–247 (2014).
176. Kraaij, T. The flora of the Bontebok National Park in regional perspective. *S. Afr. J. Bot.* **77**, 455–473 (2011).
177. Cascante-Marín, A. & Estrada-Chavarría, A. Las plantas vasculares de El Rodeo, Costa Rica. *Brenesia* **77**, 71–128 (2012).
178. Oggero, A. J. & Arana, M. D. Inventario de las plantas vasculares del sur de la zona serrana de Córdoba, Argentina. *Hoehnea* **39**, 171–199 (2012).
179. Stalmans, M. *Tinley's Plant Species List for the Greater Gorongosa ecosystem, Moçambique* (International Conservation Services to the Carr Foundation and the Ministry of Tourism, 2006).
180. van Vreeswyk, A. M. E., Payne, A. L., Leighton, K. A. & Hennig, P. An Inventory and Condition Survey of the Pilbara Region, Western Australia (Department of Agriculture, Government of Western Australia, 2004).
181. Rossetto, E. F. S. & Vieira, A. O. S. Vascular Flora of the Mata dos Godoy State Park, Londrina, Paraná, Brazil. *Check List* **9**, 1020–1034 (2013).
182. Vogt, C. Composición de la flora vascular del Chaco Boreal, Paraguay. I. Pteridophyta y Monocotiledoneae. *Steviana* **3**, 13–47 (2011).
183. Viciani, D., Gonnelli, V., Sirotti, M. & Agostini, N. An annotated check-list of the vascular flora of the "Parco Nazionale delle Foreste Casentinesi, Monte Falterona e Campigna"(Northern Apennines Central Italy). *Webbia* **65**, 3–131 (2010).
184. *The PLANTS Database* (USDA and NRCS, 2015); http://plants.usda.gov.
185. Selvi, F. A critical checklist of the vascular flora of Tuscan Maremma (Grosseto province, Italy). *Fl. Medit* **20**, 47–139 (2010).
186. *Plants of Southern Africa. An Online Checklist* (SANBI, 2014); http://posa.sanbi.org.
187. *Rote Liste und Artenliste Sachsen. Farn- und Samenpflanzen* (Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie, 2015).
188. Rundel, P. W., Dillon, M. O. & Palma, B. Flora and vegetation of Pan de Azúcur National Park in the Atacama desert of northern Chile. *Gayana Bot.* **53**, 295–315 (1996).
189. *Census of the Queensland Flora 2014* (Queensland Government, 2014); https://data.qld.gov.au/dataset/census-of-the-queensland-flora-2014.
190. *Catalogue de la flore vasculaire de Rhône-Alpes* (Pôle Flore Habitats, 2015).
191. Peña-Chocarro, M. d. C. *Updated Checklist of Vascular Plants of the Mbaracayú Forest Nature Reserve (Reserva Natural del Bosque Mbaracayú), Paraguay* (Magnolia Press, 2010).
192. Pal, D., Kumar, A. & Dutt, B. Floristic diversity of Theog Forest Division, Himachal Pradesh, Western Himalaya. *Check List* **10**, 1083–1103 (2014).
193. Norton, J. et al. *An Illustrated Checklist of the Flora of Qatar* (Browndown Publications, 2009).
194. *Artenliste Farne und Blütenpflanzen* (Nationalpark Eifel, 2015); http://www.nationalpark-eifel.de/go/artenliste.html.
195. Marticorena, C., Squeo, F. A., Arancio, G. & Muñoz, M. In *Libro Rojo de la Flora Nativa y de los Sitios Prioritarios para su Conservación: Región de Atacama* (eds Squeo, F. A., Arancio, G. & Gutiérrez, J. R.) 105–142 (Ediciones Univ. de La Serena, 2008).
196. Luke, Q. Annotated checklist of the plants of the Shimba Hills, Kwale District, Kenya. *J. East Afr. Nat. Hist.* **94**, 5–120 (2005).
197. Lipkin, R. *Aniakchak National Monument and Preserve, Vascular Plant Inventory: Final Technical Report* (National Park Service, 2005).
198. Le Houerou, H. N. Plant diversity in Marmarica (Libya & Egypt): a catalogue of the vascular plants reported with their biology, distribution, frequency, usage, economic potential, habitat and main ecological features, with an extensive bibliography. *Candollea* **59**, 259–308 (2004).
199. Kelloff, C. L. & Funk, V. A. *Preliminary Checklist of the Plants of Kaieteur National Park, Guyana* (National Museum of Natural History, 1998).
200. Zuloaga, F. O., Morrone, O. & Belgrano, M. *Catálogo de las Plantas Vasculares del Cono Sur* (Instituto de Botánica Darwinion, 2014); http://www.darwin.edu.ar/Proyectos/FloraArgentina/fa.htm.
201. *Artenliste Schweiz 5 × 5 km* (InfoFlora, 2014); https://www.infoflora.ch/de/daten-beziehen/artenliste-5x5-km.html.
202. Harris, D. J. *The Vascular Plants of the Dzanga-Sangha Reserve, Central African Republic* (Royal Botanic Garden Edinburgh, 2002).
203. Funk, V. A., Hollowell, T., Berry, P., Kelloff, C. & Alexander, S. N. *Checklist of the Plants of the Guiana Shield (Venezuela: Amazonas, Bolivar, Delta Amacuro; Guyana, Surinam, French Guiana)* (Department of Botany, National Museum of Natural History, 2007).
204. Fischer, E. et al. Annotated checklist of the vascular plants of Kakamega Forest, Western Province, Kenya. *J. East Afr. Nat. Hist.* **99**, 129–226 (2010).
205. Figueroa-C, Y. & Galeano, G. Lista comentada de las plantas vasculares del enclave seco interandino de La Tatacoa (Huila, Colombia). *Caldasia* **29**, 263–281 (2007).
206. Doroftei, M., Oprea, A., Ştefan, N. & Sârbu, I. Vascular wild flora of Danube Delta Biosphere Reserve. *Sci. Ann. Danube Delta Inst.* **17**, 15–52 (2011).
207. Domínguez, E., Marticorena, C., Elvebakk, A. & Pauchard, A. Catálogo de la flora vascular del Parque Nacional Pali Aike. XII Región, Chile. *Gayana Bot.* **61**, 67–72 (2004).
208. Clark, J. L., Neill, D. A. & Asanza, M. Floristic checklist of the Mache-Chindul mountains of Northwestern Ecuador. *Contr. US Natl. Herb.* **54**, 1–180 (2006).
209. Chiapella, J. & Ezcurra, C. La flora del parque provincial Tromen, provincia de Neuquén, Argentina. *Multequina* **8**, 51–60 (1999).
210. Brundu, G. & Camarda, I. The flora of Chad: a checklist and brief analysis. *Phytokeys* **23**, 1–17 (2013).
211. Brennan, K. *An Annotated Checklist of the Vascular Plants of the Alligator Rivers Region, Northern Territory, Australia* (Department of Climate Change, Energy, the Environment and Water, 1996).
212. *BioScripts* (Flora Vascular, 2014); http://www.floravascular.com/.
213. Belhacene, L. Catalogue 2010 des plantes vasculaires du département de la Haute-Garonne. *Suppl. Isaatis* **10**, 1–145 (2010).
214. Kim, H.-J. et al. Flora of vascular plants in Deokjeokdo (Ongjin-gun) and its adjacent regions, Korea. *Kor. J. Plant Resour.* **28**, 487–510 (2015).
215. Senterre, B., Chew, M. Y. & Chung, R. C. K. Flora and vegetation of Pulau Babi Tengah, Johor, Peninsular Malaysia. *Check List* **11**, 1714 (2015).
216. Velayos, M. et al. Checklist of the vascular plants of Annobón (Equatorial Guinea). *Phytotaxa* **171**, 1–78 (2014).
217. Figueiredo, E., Paiva, J., Stevart, T., Oliveira, F. & Smith, G. F. Annotated catalogue of the flowering plants of São Tomé and Príncipe. *Bothalia* **41**, 41–82 (2011).
218. Pandey, R. P. & Diwakar, P. G. An integrated checklist flora of Andaman and Nicobar Islands, India. *J. Econ. Taxon. Bot.* **32**, 403–500 (2008).
219. Skelin, M., Ljubičić, I., Skelin, I., Vitasović Kosić, I. & Bogdanović, S. The flora of Zečevo (Hvar Archipelago, Croatia). *Agric. Conspectus Sci.* **79**, 85–91 (2014).
220. Morrison, C., Keppel, G., Thomas, N., Rounds, I. & Harlow, P. S. Critically endangered Fijian crested iguana (*Brachylophus vitiensis*) shows habitat preference for globally threatened tropical dry forest. *Pac. Sci.* **63**, 223–242 (2009).
221. Keppel, G. *Summary Report on Forests of the Mataqali Nadicake Kilaka, Kubulau district, Bua, Vanua Levu* (Biology Department, Univ. of the South Pacific, 2005).
222. Velarde, E., Wilder, B. T., Felcer, R. S. & Ezcurra, E. Floristic diversity and dynamics of Isla Rasa, Gulf of California—a globally important seabird island. *Bot. Sci.* **92**, 89–101 (2014).
223. Strahm, W. A. *The Conservation and Restoration of the Flora of Mauritius and Rodrigues*. PhD Thesis (Univ. of Reading, 1993).
224. Smith, A. C. *Flora Vitiensis Nova. A new Flora of Fiji (Spermatophytes only)* (Pacific Tropical Botanical Garden, 1996).
225. Borges, P. A. V. et al. *A List of the Terrestrial and Marine Biota from the Azores* (Princípia, 2010).
226. Parris, B. S. & Latiff, A. Towards a pteridophyte flora of Malaysia. A provisional checklist of taxa. *Malay. Nat. J.* **50**, 235–280 (1997).
227. Iwatsuki, K., Yamazaki, T., Boufford, D. E. & Ohba, H. *Flora of Japan, Vol. 1—Pteridophyta and Gymnospermae* (Kodansha, 1995).
228. Proctor, G. R. *Ferns of Puerto Rico and the Virgin Islands* (New York Botanical Garden, 1989).
229. Proctor, G. R. *Ferns of Jamaica. A guide to the Pteridophytes* (British Museum (Natural History), 1985).
230. Roux, J. P. *Synopsis of the Lycopodiophyta and Pteridophyta of Africa, Madagascar and Neighbouring Islands* (South African National Biodiversity Institute, 2009).
231. Raulerson, L. Checklist of plants of the Mariana Islands. *Univ. Guam Herb. Contr.* **37**, 1–69 (2006).
232. Gerlach, J. The biodiversity of the granitic islands of Seychelles. *Phelsuma* **11**, 1–47 (2003).
233. Russian Far East Flora Database (Burke Museum of Natural History and Culture, 2012); http://biology.burke.washington.edu/herbarium/okhotskia/search.php.
234. Case, T. J., Cody, M. L. & Ezcurra, E. *A New Island Biogeography of the Sea of Cortés* (Oxford Univ. Press, 2002).
235. Levin, G. A. & Moran, R. The vascular flora of Socorro, Mexico. *Mem. San Diego Soc. Nat. Hist.* **16**, 1–71 (1989).
236. Kamari, G., Phitos, D., Snogerup, B. & Snogerup, S. Flora and vegetation of Yioura, N Sporades, Greece. *Willdenowia* **17**, 59–85 (1988).
237. Burton, R. M. A check-list and evaluation of the flora of Nisyros (Dodecanese, Greece). *Willdenowia* **20**, 15–38 (1991).
238. Christodoulakis, D. The flora of Ikaria (Greece, E. Aegean Islands). *Phyton* **36**, 63–91 (1996).

239. *Cook Islands Biodiversity and Ethnobiology Database* (Univ. of Kent, 2012); http://cookislands.pacificbiodiversity.net/cibed/dbs/search.html (2012).
240. Conti, F., Abbate, G., Alessandrini, A. & Blasi, C. *Annotated Checklist of the Italian Vascular Flora* (Palombi Editori, 2005).
241. Jahn, R. & Schönfelder, P. *Exkursionsflora für Kreta* (Ulmer, 1995).
242. Kerguelen, M. *Base de Données Nomenclaturales de la Flore de France* (Tela Botanica, 2005); https://www.tela-botanica.org.
243. Stace, C. A., Ellis, R. G., Kent, D. H. & McCosh, D. J. *Vice-County Census Catalogue of the Vascular Plants of Great Britain, the Isle of Man and the Channel Islands* (Botanical Society of the British Isles, 2003).
244. Lester-Garland, L. V. *A Flora of the Islands of Jersey With a List of the Plants of the Channel Islands in General, and Remarks upon their Distribution and Geographical Affinities* (West, Newman & Co., 1903).
245. Marquand, E. D. *Flora of Guernsey and the Lesser Channel Islands, Namely Alderney, Sark, Herm, Jethou, and the Adjacent Islets* (Dulau & Co., 1901).
246. Thaman, R. R. et al. Nasoata mangrove island, the PABITRA coastal study site for Viti Levu, Fiji Islands. *Pac. Sci.* **59**, 193–204 (2005).
247. St John, H. Flora of Eniwetok Atoll. *Pac. Sci.* **14**, 313–336 (1960).
248. Fosberg, F. R. Flora of Johnston Island, Central Pacific. *Pac. Sci.* **3**, 338–339 (1949).
249. Wester, L. Checklist of the vascular plants of the northern Line Islands. *Atoll Res. Bull.* **187**, 1–38 (1985).
250. Walker, T. A., Chaloupka, M. Y. & King, B. R. Pisonia Islands of the Great Barrier Reef. Part II. The vascular floras of Bushy and Redbill islands. *Atoll Res. Bull.* **350**, 24–30 (1991).
251. Walker, T. A. Pisonia Islands of the Great Barrier Reef. Part III. Changes in the vascular flora of Lady Musgrave Island. *Atoll Res. Bull.* **350**, 31–41 (1991).
252. Stoddart, D. R. & Fosberg, F. R. Flora of the Phoenix Islands, central Pacific. *Atoll Res. Bull.* **393**, 1–60 (1994).
253. Proctor, G. R. Checklist of the plants of Little Cayman. Geography and ecology of Little Cayman. *Atoll Res. Bull.* **241**, 71–80 (1980).
254. Fosberg, F. R. & Sachet, M. H. Flora of Maupiti, Society Islands. *Atoll Res. Bull.* **294**, 1–70 (1987).
255. Fosberg, F. R., Stoddart, D. R., Sachet, M.-H. & Spellman, D. L. Plants of the Belize cays. *Atoll Res. Bull.* **258**, 1–77 (1982).
256. D'Arcy, W. G. The island of Anegada and its flora. *Atoll Res. Bull.* **139**, 1–21 (1971).
257. Clapp, R. B. & Sibley, F. C. The vascular flora and terrestrial vertebrates of Vostok Island, South-Central Pacific. *Atoll Res. Bull.* **144**, 1–10 (1971).
258. Byrd, G. V. Vascular vegetation of Buldir Island, Aleutian Islands, Alaska, compared to another Aleutian Island. *Arctic* **37**, 37–48 (1984).
259. Butler, B. J., Barclay, J. S. & Fisher, J. P. Plant communities and flora of Robins Island (Long Island), New York. *J. Torrey Bot. Soc.* **126**, 63–76 (1999).
260. Esler, A. E. Botanical features of the Mokohinau Islands. *TANE* **24**, 187–197 (1978).
261. de Sloover, J. R. & Liégeois, S. Eagle Island flora and vegetation (Queensland, Australia). *Bull. Jardin Bot. Natl Belgique* **66**, 347–383 (1997).
262. Dowhan, J. J. & Rozsa, R. Flora of Fire Island, Suffolk County, New York. *Bull. Torrey Bot. Club* **116**, 265–282 (1989).
263. Easley, M. C. & Judd, W. S. Vascular flora of Little Talbot Island, Duval County, Florida. *Castanea* **58**, 162–177 (1993).
264. Hill, S. R. An annotated checklist of the vascular flora of Assateague Island (Maryland and Virginia). *Castanea* **51**, 265–305 (1986).
265. Kelly, L. The vascular flora of Huggins Island, Onslow County, North Carolina. *Castanea* **71**, 295–311 (2006).
266. de Lange, P. J. & Cameron, E. K. The vascular flora of Aorangi Island, Poor Knights Islands, northern New Zealand. *NZ J. Bot.* **37**, 433–468 (1999).
267. Ogle, C. C. Checklist of vascular plants of Sugar Loaf Islands (2002).
268. Searle, J. & Madden, S. *Flora Assessment of South Stradbroke Island* (Gold Coast City Council, 2006).
269. Stalter, R. & Lamont, E. E. The historical and extant flora of Great Gull Island, New York. *J. Torrey Bot. Soc.* **132**, 628–634 (2005).
270. de Lange, P. J., Heenan, P. B. & Rolfe, J. R. *Checklist of Vascular Plants Recorded from Chatham Islands* (Department of Conservation, Wellington Hawke's Bay Conservancy, 2011).
271. Hill, M. J. (ed.). *Biodiversity Surveys and Conservation Potential of Inner Seychelles Islands* (Smithsonian Institution, 2002).
272. McClatchey, W., Thaman, R. & Vodonaivalu, S. A preliminary checklist of the flora of Rotuma with Rotuman names. *Pac. Sci.* **54**, 345–363 (2000).
273. Thaman, R. R., Fosberg, F. R., Manner, H. I. & Hassall, D. C. The flora of Nauru. *Atoll Res. Bull.* **392**, 1–233 (1994).
274. Franklin, J., Keppel, G. & Whistler, W. A. The vegetation and flora of Lakeba, Nayau and Aiwa islands, central Lau Group, Fiji. *Micronesica* **40**, 169–225 (2008).
275. Tatewaki, M. Geobotanical studies on the Kurile Islands. *Acta Horti Gothob.* **21**, 43–123 (1957).
276. Takahashi, H. et al. A floristic study of the vascular plants of Kharimkotan, Kuril Islands. *Bull. Hokkaido Univ. Mus.* **3**, 41–66 (2006).
277. Takahashi, H. et al. A preliminary checklist of the vascular plants of Chirinkotan, Kuril Islands. *J. Phytogeogr. Taxon.* **47**, 131–137 (1999).
278. Sachet, M.-H. Flora and vegetation of Clipperton Island. *Proc. Calif. Acad. Sci.* **31**, 249–307 (1962).
279. *Vascular Plants of Kent Island* (Bowdoin Scientific Station, 2011).
280. Johnson, P. N. & Campbell, D. J. Vascular plants of the Auckland Islands. *NZ J. Bot.* **13**, 665–720 (1975).
281. *Herbario Virtual del Mediterráneo Occidental* (Universitat de les Illes Balears, 2007); https://herbarivirtual.uib.es.
282. Chong, K. Y., Tan, T. W. H. & Corlett, R. T. *A Checklist of the Total Vascular Plant Flora of Singapore. Native, Naturalised and Cultivated Species* (Raffles Museum of Biodiversity Research, 2009).
283. Martínez-Laborde, J. B. A new report on the vascular flora of the island of Alborán (Spain). *Flora Mediterrania* **8**, 37–39 (1998).
284. Convey, P., Lewis Smith, R. I., Hodgson, D. A. & Peat, H. J. The flora of the South Sandwich Islands, with particular reference to the influence of geothermal heating. *J. Biogeogr.* **27**, 1279–1295 (2000).
285. Florence, J., Chevillotte, H., Ollier, C. & Meyer, J.-Y. *Base de Données Botaniques Nadeaud de l'Herbier de la Polynésie Française (PAP)* (2007).
286. Stalter, R. & Lamont, E. E. The historical and extant flora of Sable Island, Nova Scotia, Canada. *J. Torrey Bot. Soc.* **133**, 362–374 (2006).
287. Alves, R. J. V. *Ilha da Trindade & Arquipélago Martin Vaz. Um ensaio geobotânico* (Serviço de Documentação da Marinha, 1998).
288. Gabrielsen, G. W., Brekke, B., Alsos, I. G. & Hansen, J. R. *Natur-og Kulturmiljøet på Jan Mayen* (Norsk Polarinstitutt, 1997).
289. Acevedo-Rodríguez, P. & Strong, M. T. *Catalogue of the Seed Plants of the West Indies* (Smithsonian Institution, 2007); http://botany.si.edu/antilles/WestIndies/catalog.htm.
290. Releford, J. S., Stevens, J., Bridges, K. W. & McClatchey, W. C. Flora of Rongelap and Ailinginae atolls, Republic of the Marshall Islands. *Atoll Res. Bull.* **572**, 1–13 (2009).
291. *New Zealand's Flora* (New Zealand Plant Conservation Network, 2011); https://www.nzpcn.org.nz.
292. Wagner, W. L. & Lorence, D. H. *Flora of the Marquesas Islands* (Smithsonian Institution, 2002); http://botany.si.edu/pacificislandbiodiversity/marquesasflora/index.htm.
293. Koltzenburg, M. *Checkliste der Gefässpflanzen Irlands* (Büro für Botanik und Landschaftsökologie, 2011).
294. Robinson, A. C., Canty, P. D. & Fotheringham, D. Investigator group expedition 2006. flora and vegetation. *Trans. R. Soc. S. Aust.* **132**, 173–220 (2008).
295. Ferreira, A. L., Coutinho, B. R., Pinheiro, H. T. & Thomaz, L. D. Composição florística e formações vegetais da Ilha dos Franceses, Espírito Santo. *Bol. Mus. Biol. Mello Leitao* **22**, 25–44 (2007).
296. Kristinsson, H. *Checklist of the Vascular Plants of Iceland* (Náttúrufræðistofnun Íslands, 2008).
297. Wagner, W. L., Herbst, D. R. & Lorence, D. H. *Flora of the Hawaiian Islands* (Smithsonian Institution, 2005); http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/.
298. Kenneally, K. F. *Ashmore Reef and Cartier Island. Species lists* (Department of Climate Change, Energy, the Environment and Water, 1993); http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/50/index.html.
299. Kubota, Y., Shiono, T. & Kusumoto, B. Role of climate and geohistorical factors in driving plant richness patterns and endemicity on the east Asian continental islands. *Ecography* **38**, 639–648 (2015).
300. Hinoma, A. & Hinoma, H. Flora of Hokkaido. Distribution Maps of Vascular Plants in Hokkaido, Japan. *hinoma.com* https://www.hinoma.com/maps/index.shtml (2013).
301. Directorate of Wrangel Island Reserve. *Natural System of Wrangel Island Reserve. Nomination for Inscription into the World Cultural and Natural Heritage List of UNESCO* (UNESCO, 2003).
302. Burton, F. J. Red List Assessment of Cayman Islands' Native Flora for Legislation and Conservation Planning (Royal Botanic Gardens Kew, 2007).
303. Alsos, I. G. et al. Long-distance plant dispersal to North Atlantic islands. colonization routes and founder effect. *AoB Plants* **7**, plv036 (2015).
304. Joyce, E. M. et al. Checklist of the vascular flora of the Sunda-Sahul Convergence Zone. *Biodivers. Data J.* **8**, e51094 (2020).
305. Sykes, W. R. *Flora of the Cook Islands* (National Tropical Botanical Garden, Kalaheo, 2016).
306. Benito, B. M. et al. Forecasting plant range collapse in a mediterranean hotspot. When dispersal uncertainties matter. *Divers. Distrib.* **20**, 72–83 (2014).
307. Ornduff, R. & Vasey, M. C. The vegetation and flora of the Marin Islands, California. *Madrono* **42**, 358–365 (1995).
308. Al-Abbadi, G. A. & El-Sheikh, M. A. E. Vegetation ecology and diversity of six Kuwait Islands. Factors influence on species composition and richness. *Rend. Fis. Acc. Lincei* **28**, 117–131 (2017).
309. Taylor, G. A., Lovegrove, T. G., Miskelly, C. M., McFadden, I. & Whitaker, A. H. An ecological survey of small islands in the Mercury Group. *TANE* **32**, 151–167 (1987).
310. Keppel, G., Gillespie, T. W., Ormerod, P. & Fricker, G. A. Habitat diversity predicts orchid diversity in the tropical south-west Pacific. *J. Biogeogr.* **43**, 2332–2342 (2016).
311. Lord, J. M. Patterns in floral traits and plant breeding systems on Southern Ocean Islands. *AoB Plants* **7**, plv095 (2015).
312. Dauby, G. et al. RAINBIO. A mega-database of tropical African vascular plants distributions. *PhytoKeys* **74**, 1–18 (2016).
313. Chang, C.-S., Kim, H. & Chang, K. *Provisional Checklist of the Vascular Plants for the Korea Peninsular Flora (KPF)* Version 1.0 (Smithsonian Libraries, 2014).
314. Tonkov, S., Pavlova, D., Atanassova, J., Nedelcheva, A. & Marinova, E. *Floristis Catalogue of the Nature Reserve Rilomanastirska Gora (Central Rila Mountains). I. The locality Kirilova* (Univ. of Sofia, 2004).
315. Kirchner, F., Gigord, L., Goldhaber, F. & Gourvil, J. *Flore vasculaire de Mayotte* (Conservatoire Botanique National de Mascarin, 2014).
316. Keppel, G. *Vascular Plants, Vegetation and Conservation Perspectives of Monuriki Island, Southern Mamanucas, Republic of the Fiji Islands* (Biology Department, SPAS, Univ. of the South Pacific, 2004).
317. Price, J. P. & Wagner, W. L. A phylogenetic basis for species–area relationships among three Pacific Island floras. *Am. J. Bot.* **98**, 449–459 (2011).
318. Morat, P. et al. The taxonomic reference base "Florical" and characteristics of the native vascular flora of New Caledonia. *Adansonia* **34**, 179–221 (2012).
319. Egorova, E. M. Flora of Shiashkotan Island. *Bull. Main Bot. Gard.* **54**, 114–120 (1964).
320. Chernyaeva, A. M. Flora of Onekotan Island. *Bull. Main Bot. Gard.* **87**, 21–29 (1973).
321. Shaw, J. D., Spear, D., Greve, M. & Chown, S. L. Taxonomic homogenization and differentiation across Southern Ocean Islands differ among insects and vascular plants. *J. Biogeogr.* **37**, 217–228 (2010).
322. Directorate of Wrangel Island Reserve. *Natural System of Wrangel Island Reserve* (The World Heritage Committee, 2003).
323. Heads, M. Seed plants of Fiji. an ecological analysis. *Biol. J. Linn. Soc.* **89**, 407–431 (2006).
324. Athens, J. S., Blinn, D. W. & Ward, J. V. Vegetation history of Laysan Island, Northwestern Hawaiian Islands. *Pac. Sci.* **61**, 17–37 (2007).

325. Cheffings, C. M. & Farrell, L. (eds.) *The Vascular Plant Red Data List for Great Britain* (Joint Nature Conservation Committee, 2005).
326. Abe, T. Threatened pollination systems in native flora of the Ogasawara (Bonin) Islands. *Ann. Bot.* **98**, 317 (2006).
327. Brofas, G., Karetsos, G., Panitsa, M. & Theocharopoulos, M. The flora and vegetation of Gyali Island, SE Aegean, Greece. *Willdenowia* **31**, 51–70 (2001).
328. Panitsa, M. et al. Contribution to the study of the flora and vegetation of the Kithira Island Group. Offshore islets of Kithira (S Aegean, Greece). *Willdenowia* **34**, 101–115 (2004).
329. Edwards, J. A. An experimental introduction of vascular plants from South Georgia to the maritime Antarctic. *Br. Antarct. Surv. Bull.* **49**, 73–80 (1980).
330. Takahashi, H. et al. A floristic study of the vascular plants of Raikoke, Kuril Islands. *J. Hattori Bot. Lab.* **53**, 17–33 (2002).
331. Kemenes, A. Distribuição espacial da flora terrestre fanerogâmica do Parque Nacional Marinho de Abrolhos, BA. *Revista Brasil. Bot* **26**, 141–150 (2003).
332. Charters, M. Flora of Bermuda *Calflora.net* http://www.calflora.net/floraofbermuda/ (2007).
333. Takahashi, H., Barkalov, V. Y., Gage, S. & Zhuravlev, Y. N. A preliminary study of the flora of Chirpoi, Kuril Islands. *J. Hattori Bot. Lab.* **48**, 31–42 (1997).
334. *Native Vascular Plants of Great Barrier Island* (Wellington Botanical Society, 2008).
335. Cronk, Q. C. B. The past and present vegetation of St Helena. *J. Biogeogr.* **16**, 47–64 (1989).
336. Greene, S. W. & Walton, D. W. H. An annotated check list of the sub-Antarctic and Antarctic vascular flora. *Polar Rec.* **17**, 473–484 (1975).
337. CARMABI. Dutch Caribbean Biodiversity Explorer (CARMABI, 2009).
338. Christophersen, E. Vascular plants of Johnston and Wake Islands. *Occas. Pap. Bernice P. Bishop Mus.* **9**, 1–20 (1931).
339. Yuncker, T. G. Plants of Tonga. *Bishop Mus. Bull.* **220**, 1–283 (1959).
340. *Census of the flora of the Gambier Islands, Polynesia* (H. St John, 1988).
341. Fosberg, F. R. et al. *Vascular Plants of Palau with Vernacular Names* (Smithsonian Institution, 1980).
342. Ashmole, P. & Ashmole, M. *St Helena and Ascension Island. A Natural History* (Anthony Nelson, 2000).
343. Exell, A. W. *Catalogue of the Vascular Plants of S. Tome (with Principe and Annobon)* (Trustees of the British Museum, 1944).
344. Sykes, W. R., West, C. J., Beever, J. E. & Fife, A. J. *Kermadec Islands Flora—Special Edition. A Compilation of Modern Material about the Flora of the Kermadec Islands* (Manaaki Whenua Press, 2000).
345. Trusty, J. L., Kesler, H. C. & Delgado, G. H. Vascular flora of Isla del Coco, Costa Rica. *Proc. Calif. Acad. Sci.* **57**, 247–355 (2006).
346. Niering, W. A. Terrestrial ecology of Kapingamarangi Atoll, Caroline Islands. *Ecol. Monogr.* **33**, 131–160 (1963).
347. Sykes, W. R. *Contributions to the Flora of Niue* (New Zealand Department of Scientific and Industrial Research, 1970).
348. Fosberg, F. R., Renvoize, S. A. & Townsend, C. C. *The flora of Aldabra and Neighbouring Islands* (HMSO, 1980).
349. Miller, A. G. & Morris, M. *Ethnoflora of the Soqotra Archipelago* (Royal Botanic Garden, Edinburgh, 2004).
350. Wace, N. M. The vegetation of Gough Island. *Ecol. Monogr.* **31**, 337–367 (1961).
351. Stone, B. C. The flora of Namonuito and the Hall Islands. *Pac. Sci.* **13**, 88–104 (1959).
352. Taylor, R. *The Antipodes and Bounty Islands, New Zealand* (Heritage Expeditions, 2006).
353. Moran, R. *The Flora of Guadalupe Island, Mexico* (California Academy of Sciences, 1996).
354. Johnston, I. M. The flora of the Revillagigedo Islands. *Proc. Calif. Acad. Sci.* **20**, 9–104 (1931).
355. Renvoize, S. A. A floristic analysis of the western Indian Ocean coral islands. *Kew Bull.* **30**, 133–152 (1975).
356. Sandbakk, B. E., Alsos, I. G., Arnesen, G. & Elven, R. *The Flora of Svalbard* (Svalbardflora, 1996); http://svalbardflora.no/.
357. Nakamura, K., Suwa, R., Denda, T. & Yokota, M. Geohistorical and current environmental influences on floristic differentiation in the Ryukyu Archipelago, Japan. *J. Biogeogr.* **36**, 919–928 (2009).
358. Kingston, N., Waldren, S. & Bradley, U. The phytogeographical affinities of the Pitcairn Islands – a model for south-eastern Polynesia? *J. Biogeogr.* **30**, 1311–1328 (2003).
359. Kirchner, F., Picot, F., Merceron, E. & Gigot, G. *Flore Vasculaire de La Réunion* (Conservatoire Botanique National de Mascarin, 2010).
360. Broughton, D. A. & McAdam, J. H. A checklist of the native vascular flora of the Falkland Islands (Islas Malvinas). New information on the species present, their ecology, status and distribution. *J. Torrey Bot. Soc.* **132**, 115–148 (2005).
361. *Third Christmas Island National Park Management Plan* (Parks Australia North, 2002).
362. *The National Red List 2012 of Sri Lanka. Conservation Status of the Fauna and Flora* (Sri Lanka Ministry of Environment, 2012).
363. Vander Velde, N. The vascular plants of Majuro atoll, Republic of the Marshall Islands. *Atoll Res. Bull.* **503**, 1–141 (2003).
364. Stephens, K. Comparative floristic analysis of vegetation on the Dune Islands of South-East Queensland. *Proc. R. Soc. Queensland* **117**, 141–180 (2011).
365. Graveson, R. A pictorial flora of wild and cultivated vascular plants. *Plants of Saint Lucia* http://www.saintlucianplants.com/index.html (2019).
366. Ghazanfar, S. A., Keppel, G. & Khan, S. Coastal vegetation of small islands near Viti Levu and Ovalau, Fiji. *NZ J. Bot.* **39**, 587–600 (2001).
367. Rodriguez, R. et al. Catálogo de las plantas vasculares de Chile. *Gayana Bot.* **75**, 1–430 (2018).
368. Salleh, N., Azeman, S., Kiew, R., Kamin, I. & Kong, R. C. C. Plant checklist of the Bukit Nanas Forest Reserve, Kuala Lumpur, Malaysia. *One Ecosyst.* **2**, e13708 (2017).
369. Brown, E. A. Vegetation and flora of Ponui Island, Hauraki Gulf, New Zealand. *TANE* **25**, 5–16 (1979).
370. Batianoff, G. N., Naylor, G. C., Dillewaard, H. A. & Neldner, V. J. Plant strategies, dispersal and origins of flora at the northern Coral Sea Islands Territory, Australia. *Cunninghamia* **11**, 97–106 (2009).
371. Batianoff, G. N., Neldner, V. J., Naylor, G. C. & Olds, J. A. *Mapping and Evaluating Capricornia Cays Vegetation and Regional Ecosystems* (Department of Science, Information Technology, Innovation and the Arts, Queensland Government, 2012).
372. Fosberg, F. R. Vegetation of Bikini Atoll. *Atoll Res. Bull.* **315**, 1–28 (1985).
373. Taylor, G. A. Flora and fauna of Plate (Motunau) Island, Bay of Plenty. *TANE* **33**, 113–120 (1991).
374. Atkinson, I. A. E. Vegetation and flora of Sail Rock, Hen and Chickens Islands. *NZ J. Bot.* **10**, 545–558 (1972).
375. Taylor, G. A. & Lovegrove, T. G. Flora and vegetation of Stanley (Atiu) Island, Mercury Islands. *TANE* **36**, 85–111 (1997).
376. Cameron, E. K. Vascular plants of an unclassified islet, Cape Brett Peninsula, northern New Zealand. *TANE* **28**, 213–220 (1982).
377. Cameron, E. K. Vascular flora and vegetation of Rimariki and associated islands, Mimiwhangata, north-east New Zealand. *TANE* **31**, 47–74 (1985).
378. Newhook, F. J., Dickson, E. M. & Bennett, K. J. A botanical survey of some offshore islands of the Coromandel Peninsular. *TANE* **17**, 97–117 (1971).
379. Cameron, E. K., de Lange, P. J., McCallum, J., Taylor, G. A. & Bellingham, P. J. Vascular flora and some fauna for a chain of six vascular flora and some fauna for a chain of six Hauraki Gulf islands east and southeast of Waiheke Island. *Auckland Bot. Soc. J.* **62**, 136–156 (2007).
380. Cameron, E. K. Vascular plants of the main northern Mokohinau Islands, North-East New Zealand. *TANE* **32**, 113–130 (1990).
381. Taylor, G. A. Flora and fauna of Needle Rock, eastern Coromandel. *TANE* **35**, 51–56 (1995).
382. Taylor, G. A. & Cameron, E. K. Kauwahaia Island, Te Henga, West Auckland. *Auckland Bot. Soc. J.* **45**, 71–77 (1990).
383. Forester, L. J. & Anderson, P. J. Vascular plants, vegetation and wildlife of Matapia Island, Far North, New Zealand. *TANE* **34**, 39–50 (1995).
384. de Lange, P. J., Cameron, E. K. & Taylor, G. A. Flora and fauna of Tatapihi (Groper) Island, Mokohinau Islands. *TANE* **35**, 69–94 (1995).
385. Cameron, E. K. & Taylor, G. A. Flora and fauna of Sentinel Rock, Mangawhai Heads, Northern New Zealand. *TANE* **36**, 15–25 (1997).
386. Lynch, P. A., Ferguson, E. J. & Hynes, P. The vegetation of Red Mercury Island. Part I: The plant communities and a vascular plant species list. *TANE* **18**, 21–29 (1972).
387. Wright, A. E. The vegetation of Great Mercury Island. *TANE* **22**, 23–49 (1976).
388. Cameron, E. K. Vascular plants of the three largest Chickens (Marotere) islands: Lady Alice, Whatupuke, Coppermine: North-East New Zealand. *TANE* **30**, 53–75 (1984).
389. Court, D. J., Hardacre, A. K. & Lynch, P. A. The vegetation of the aldermen islands: a reappraisal. *TANE* **19**, 41–60 (1973).
390. PlantNET—The NSW Plant Information Network System (Royal Botanic Gardens and Domain Trust, 2017); http://plantnet.rbgsyd.nsw.gov.au.
391. Western Australian Herbarium. *FloraBase—The Western Australian Flora* (Department of Biodiversity, Conservation and Attrractions, Government of Western Australia, 2017); https://florabase.dpaw.wa.gov.au/ (2017).
392. Turner, I. M. *A Catalogue of the Vascular Plants of Malaya* (Gardens' Bulletin, 1995).
393. Nikolić, T. *Flora Croatica Database* (FCD, 2016); http://hirc.botanic.hr/fcd.
394. de Egea, J., Peña-Chocarro, M., Espada, C. & Knapp, S. Checklist of vascular plants of the department of Ñeembucú, Paraguay. *Phytokeys* **9**, 15–179 (2012).
395. Barker, W. R., Barker, R. M., Jessop, J. P. & Vonow, H. P. Census of South Australian vascular plants. *J. Adelaide Bot. Gard. Suppl.* **1**, 1–396 (2005).
396. Gray, A., Pelembe, T. & Stroud, S. The conservation of the endemic vascular flora of Ascension Island and threats from alien species. *Oryx* **39**, 449–453 (2005).
397. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Mer Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
398. Byeon, J.-G., Yun, J.-E., Jung, S.-Y., Ji, S.-J. & Oh, S.-H. Flora of Jeokgeunsan Mountain in the Civilian Control Zone, Gangwon-do, South Korea. *J. Asia-Pac. Biodivers.* **7**, 471–483 (2014).
399. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Ugar Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
400. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Badu Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
401. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Boigu Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
402. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Dauan Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
403. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Erub Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
404. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Iama Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
405. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Mabuiag Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
406. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Masig Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
407. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Mua Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
408. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Poruma Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).

409. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Saibai Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
410. 3D Environmental. *Profile for Management of the Habitats and Related Ecological and Cultural Resource Values of Warraber Island* (Torres Strait Regional Authority Land and Sea Management Unit, 2013).
411. 3D Environmental. *Vegetation Communities and Regional Ecosystems of The Torres Strait Islands, Queensland, Australia* (Torres Strait Regional Authority Land and Sea Management Unit, 2008).
412. Imada, C. T. (ed.) *Hawaiian Native and Naturalized Vascular Plants Checklist* 2nd edn (Hawaii Biological Survey, Bishop Museum, Honolulu, Hawai'i, 2012).
413. Robinson, A. C., Canty, P. D., Wace, N. M. & Barker, R. M. The encounter 2002 expedition to the isles of St Francis, South Australia. flora and vegetation. *Trans. R. Soc. S. Aust.* **127**, 107–128 (2003).
414. Baker, M. L. & Duretto, M. F. *A Census of the Vascular Plants of Tasmania* (Tasmanian Herbarium, Tasmanian Museum and Art Gallery, 2011).
415. Gage, S., Joneson, S. L., Barkalov, V. Y., Eremenko, N. A. & Takahashi, H. A newly compiled checklist of the vascular plants of the Habomais, the Little Kurils. *Bulletin of the Hokkaido Univ. Mus.* **3**, 67–91 (2006).
416. Whistler, W. A. *Botanical survey of Diego Garcia, Chagos Archipelago, British Indian Ocean Territory*, Appendix E1 (Isle Botanica, 1996).
417. Whistler, W. A. *A Study of the Rare Plants of American Samoa* (US Fish and Wildlife Service, 1998).
418. Whistler, W. A. Vegetation and flora of the Aleipata Islands, Western Samoa. *Pacific Science* **37**, 227–249 (1983).
419. Marticorena, C., Stuessy, T. F. & Baeza, C. M. Catalogue of the vascular flora of the Robinson Crusoe or Juan Fernández islands, Chile. *Gayana Bot.* **55**, 187–211 (1998).
420. Jackes, B. R. *Plants of Magnetic Island* 3rd edn (James Cook Univ., 2010).
421. Arechavaleta, M., Zurita, N., Marrero, M. C. & Martín, J. L. *Lista Preliminar de Especies Silvestres de Cabo Verde (Hongos, Plantas y Animales Terrestres)* (Consejería de Medio Ambiente y Ordenación Territorial, Gobierno de Canarias, 2005).
422. Borges, P. A. V. *et al*. *Listagem dos Fungos, Flora e Fauna Terrestres dos Arquipélagos da Madeira e Selvagens* (Direcção Regional do Ambiente da Madeira and Universidade dos Açores, Funchal and Angra do Heroísmo, 2008).
423. de Miranda Freitas, A. M. *A Flora Fanerogâmica Atual do Arquipélago de Fernando de Noronha—Brasil* (Univ. Estadual, 2007).
424. Wace, N. M. & Dickson, J. H. The terrestrial botany of the Tristan da Cunha Islands. *Philos. Trans. R. Soc. B* **249**, 273–360 (1965).
425. Arechavaleta, M., Rodríguez, S., Zurita, N. & García, A. *Lista de especies silvestres de Canarias. Hongos, plantas y animales terrestres* (Consejería de Medio Ambiente y Ordenación Territorial, Gobierno de Canarias, 2009).
426. Junak, S., Philbrick, R., Chaney, S. & Clark, R. *A Checklist of Vascular Plants of Channel Islands National Park* 2nd edn (Southwest Parks and Monuments Association, 1997).
427. Hnatiuk, R. J. *Subantarctic Islands. Species Lists* (Department of Climate Change, Energy, the Environment and Water, 1993); http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/50/index.html.
428. Director of National Parks. *Second Pulu Keeling National Park Management Plan* (Pulu Keeling National Park, Parks Australia North, 2004).
429. Green, P. S. *Norfolk Island. Species Lists* (Department of Climate Change, Energy, the Environment and Water, 1994); http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/49/index.html.
430. Green, P. S. *Lord Howe Island. Species Lists* (Department of Climate Change, Energy, the Environment and Water, 1994); http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/49/index.html.
431. Telford, I. R. H. *Cocos (Keeling) Islands. Species Lists* (Department of Climate Change, Energy, the Environment and Water, 1993); http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/50/.
432. McCrea, J. *Inventory of the Land Conservation Values of the Houtman Abrolhos Islands* (Department of Fisheries, Government of Western Australia, Perth, Australia, 2003).
433. Telford, I. R. H. *Coral Sea Islands Territory. Species Lists* (Department of Climate Change, Energy, the Environment and Water, 1993); http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/50/.
434. Du Puy, D. J. *Christmas Island. Species Lists* (Department of Climate Change, Energy, the Environment and Water, 1993).
435. Sáez, L. & Rosselló, J. A. *Llibre Vermell de la Flora Vascular de les Illes Balears* (Direcció General de Biodiversitat, Conselleria de Medi Ambient, Govern de les Illes Balears, 2001).
436. Rhind, M. *Terrestrial Biozones. Endemic Floras* (2020).
437. Carrington, C. M. S., Edwards, R. D. & Krupnick, G. A. Assessment of the distribution of seed plants endemic to the Lesser Antilles in terms of habitat, elevation, and conservation status. *Caribb. Nat.* **Special Issue 2**, 30–47 (2018).
438. *Living National Treasures* http://lntreasures.com/index.html (2020).
439. Foggi, B., Viciani, D., Baldini, R. M., Carta, A. & Guidi, T. Conservation assessment of the endemic plants of the Tuscan Archipelago, Italy. *Oryx* **49**, 118–126 (2015).
440. Shetland Bird Club. *Endemic Flora* (Nature in Shetland, 2020); https://www.nature-shetland.co.uk/shetland-endemics.
441. *Pemba's Unique Species* (Kwanini Foundation, 2019).
442. Villanueva, E. L. C. & Buot, I. E. Jr Threatened plant species of Mindoro, Philippines. *IAMURE Int. J. Ecol. Conserv.* **14**, 168–190 (2015).
443. Mifsud, S. *MaltaWildPlants.com: An Online Flora of Malta* http://www.maltawildplants.com/ (2020).
444. Greenway, P. J., Rodgers, W. A., Wingfield, R. J. & Mwasumbi, L. B. The vegetation of Mafia Island, Tanzania. *Kirkia* **13**, 197–238 (1988).
445. Takahashi, H. *Plants of the Kuril Islands* (Hokkaido Univ. Press, 2015).
446. Kim, C.-S. Vascular plant diversity of Jeju Island, Korea. *Korean J. Plant Resour.* **22**, 558–570 (2009).
447. Francisco-Ortega, J. et al. Endemic seed plant species from Hainan Island: a checklist. *Bot. Rev.* **76**, 295–345 (2010).
448. Flora of Cyprus: endemic plants of Cyprus. *Virtual Biodiversity Museum of Cyprus* http://www.naturemuseum.org.cy/lang1/endemic_plants.html (2020).
449. Fried, E., Francisco-Ortega, J. & Jestrow, B. Endemic seed plants in the Bahamian Archipelago. *Bot. Rev.* **80**, 204–230 (2014).
450. Latiff, A. et al. On the vegetation and flora of Pulau Tioman, Peninsular Malaysia. *Raffles Bull. Zool.* **6**, 11–72 (1999).
451. Keith, P., Abdou, A. & Labat, J. N. *Inventaire Faunistique des Rivières des Comores et Inventaire Botanique* (Museum National D'Histoire Naturelle, 2006).
452. Costion, C. & Lorence, D. The endemic plants of Micronesia. A geographical checklist and commentary. *Micronesica* **43**, 51–100 (2012).
453. *GlobalTreeSearch Online Database (Version 1.4)* (BCGI, 2021); https://tools.bgci.org/global_tree_search.php.
454. Ter Steege, H. et al. Towards a dynamic list of Amazonian tree species. *Sci. Rep.* **9**, 3501 (2019).
455. Keppel, G., Rounds, I. A. & Thomas, N. T. The flora, vegetation, and conservation value of mesic forest at Dogotuki, Vanua Levu, Fiji Islands. *NZ J. Bot.* **44**, 273–292 (2006).
456. Plunkett, G. M., Ranker, T. A., Sam, C. & Balick, M. J. Towards a checklist of the vascular flora of Vanuatu. *Candoella* **77**, 105–118 (2022).
457. Zietsman, P. C. & Bezuidenhout, H. Flowering plant biodiversity of Augrabies Falls National Park. A comparison between Augrabies Falls National Park, Kalahari Gemsbok National Park, Vaalbos National Park and Goegap Nature Reserve. *Koedoe* **42**, 95–112 (1999).
458. Henschel, J. R., Pallett, J., Berry, C., Griffin, M., Hachfeld, B., Makuti, O. & Seely, M. K. Checklists of the flora and vertebrates of Gobabeb. *J. Namibia Scientific Soc.* **54**, 31–58 (2006).
459. Shaw, R. J. *Annotated Checklist of the Vascular Plants of Great Basin National Park and Adjacent Snake Range* (Utah State Univ., 1993).
460. Atashgahi, Z., Ejtehadi, H., Mesdaghi, M. & Ghassemzadeh, F. Plant diversity of the Heydari Wildlife Refuge in northeastern Iran, with a checklist of vascular plants. *Phytotaxa* **340**, 101–127 (2018).
461. Batooli, H. Introduction of the flora, life form and chorology of Aran & Bidghol deserts area in Isfahan province. *J. Plant Res.* **31**, 258–278 (2018).
462. Ilyas, M., Qureshi, R., Arshad, M. & Mirza, S. N. A. Preliminary checklist of the vascular flora of Kabal Valley, Swat, Pakistan. *Pak. J. Bot.* **45**, 605–615 (2013).
463. Rechinger, K. H. & Wendelbo, P. *Plants of the Kavir Protected Region, Iran* (Iran Journal of Botany, 1976).
464. Pond, U., Beesley, B. B., Brown, L. R. & Bezuidenhout, H. Floristic analysis of the Mountain Zebra National Park, Eastern Cape. *Koedoe* **45**, 35–58 (2002).
465. Feulner, G. R. The Flora of the Ru'us al-Jibal—the mountains of the Musandam peninsula: an annotated checklist and selected observations. *Tribulus* **19**, 4–153 (2011).
466. Bruneau de Miré, P. & Gillet, H. Contribution à l'étude de la Flore du Massif de l'Aïr (Sahara méridional). *J. Agric. Tradit. Bot. Appl.* **3**, 221–247 (1956).
467. Thorne, R., Moran, R. & Minnich, R. Vascular plants of the High Sierra San Pedro Mártir, Baja California, Mexico. An annotated checklist. *Aliso* **28**, 1–50 (2010).
468. Ghollasimod, S. Study on flora of Lut in Southern Khorasan. *Desert Manag.* **8**, 137–152 (2021).
469. Steyn, H. M., Bester, S. P. & Bezuidenhout, H. An updated plant checklist for Tankwa Karoo National Park, South Africa. *S. Afr. J. Bot.* **88**, 247–251 (2013).
470. Abbasi, S., Afsharzadeh, S. & Mohajeri, A. Study of flora, life forms and chorotypes of plant elements in pastural region of Yahya Abad (Natanz). *Iran. J. Plant Biol.* **4**, 1–12 (2012).
471. Encina-Domínguez, J. A. et al. Floristic richness of the Sierra de Zapalinamé, Coahuila, Mexico. *Phytotaxa* **283**, 1–42 (2016).
472. Noori, S., Sephery, A., Barani, H. & Fadaie, F. Floristic studies, life forms and chorotype of plants in the transitional zone of Irano-Turanian and Sahara-Sindian phytochoria in Sistan and Baluchestan Province.Iran. *J. Plant Res.* **31**, 436–452 (2018).
473. Abbas, A. M., Al-Kahtani, M. A., Alfaifi, M. Y., Elbehairi, S. E. I. & Badry, M. O. Floristic diversity and phytogeography of JABAL Fayfa: a subtropical dry zone, south-west Saudi Arabia. *Diversity* **12**, 345 (2020).
474. Maire, R. & Monod, T. *Etudes sur la Flore et la végétation du Tibesti* (Larose, 1950).
475. Fertig, W. F., Massatti, R. T., Nelson, B. E. & Hartman, R. L. Annotated checklist of the vascular flora of the Wind River Range, Wyoming (U.S.A.). *J. Bot. Res. Inst. Texas* **7**, 905–939 (2013).
476. Léonard, J. Flore et végétation du jebel Uweinat (désert de Libye: Libye, Egypte, Sudan): quatrième partie considérations générales sur la flore et la végétation. *Syst. Geogr. Plants* **70**, 3–73 (2000).
477. Shomurodov, K. F. & Adilov, B. A. Current state of the flora of Vozrozhdeniya island (Uzbekistan). *Arid Ecosyst.* **9**, 27–34 (2019).
478. Shaltout, K. H., Sheded, MohammedG. & Salem, AshrafI. Vegetation spatial heterogeneity in a hyper arid biosphere reserve area in North Africa. *Acta Bot. Croatica* **69**, 31–46 (2010).
479. Juergens, N., Oldeland, J., Hachfeld, B., Erb, E. & Schultz, C. Ecology and spatial patterns of large-scale vegetation units within the central Namib Desert. *J. Arid. Environ.* **93**, 59–79 (2013).
480. Al-Qthanin, R. & Al-Yasi, H. Progress towards an updated checklist of the Farasan Archipelago flora. *J. Arid. Environ.* **189**, 104488 (2021).
481. Chauvier, Y. et al. Influence of climate, soil, and land cover on plant species distribution in the European Alps. *Ecol. Monogr.* **91**, e01433 (2021).
482. Shreve, F. & Wiggins, I. L. *Vegetation and Flora of the Sonoran Desert* (Stanford Univ. Press, 1964).
483. Abbas, J. A., Saleh, M. A. & Mohammed, S. A. Plant communities of a protected area in the desert of Bahrain island. *J. Arid. Environ.* **20**, 31–42 (1991).
484. El-Ghanim, W. M., Hassan, L. M., Galal, T. M. & Badr, A. Floristic composition and vegetation analysis in Hail region north of central Saudi Arabia. *Saudi J. Biol. Sci.* **17**, 119–128 (2010).
485. Liu, Y. X. *Flora in Desertis Reipublicae Populorum Sinarum* (Science Press, 1992).
486. FLORAPYR consortium. FLORAPYR—Atlas de la flore des Pyrénées. *FloraPyr* http://www.atlasflorapyrenaea.eu (2023).
487. Baasanmunkh, S. et al. Flora of Mongolia: an annotated checklist of native vascular plants. *Phytokeys* **192**, 63–169 (2022).

488. Liu, Y. et al. Influence of elevation on bioregionalisation: a case study of the Sino-Himalayan flora. *J. Biogeogr.* **48**, 2578–2587 (2021).
489. IRD, Msiri & Royal Botanical Gardens Kew (eds). *Flore des Mascareignes, la Réunion, Maurice, Rodrigues* (IRD, Msiri and Royal Botanical Gardens Kew, 1980–2018).

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Additional information
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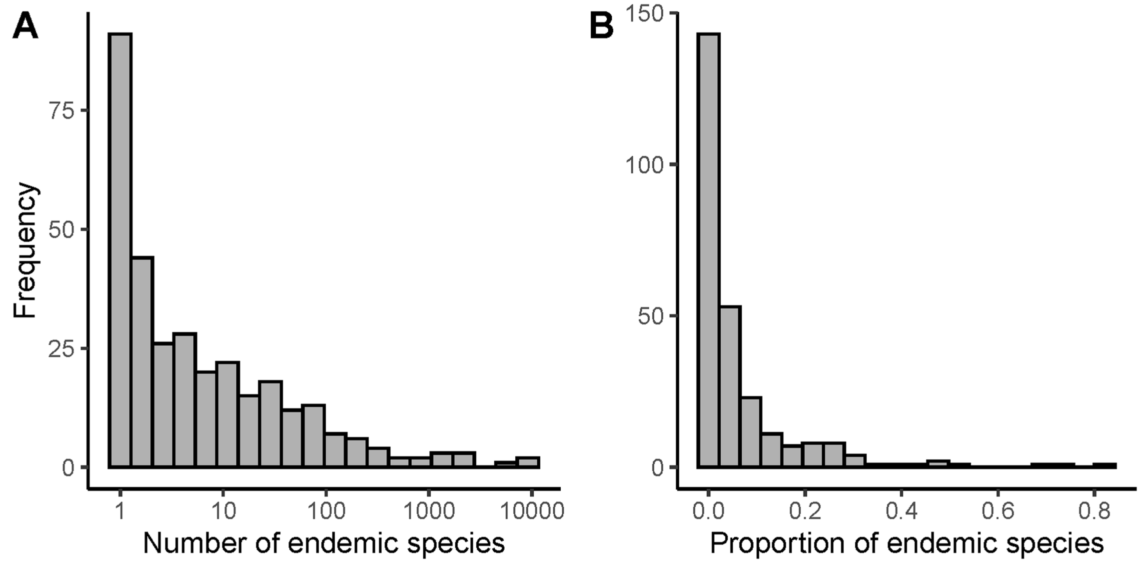
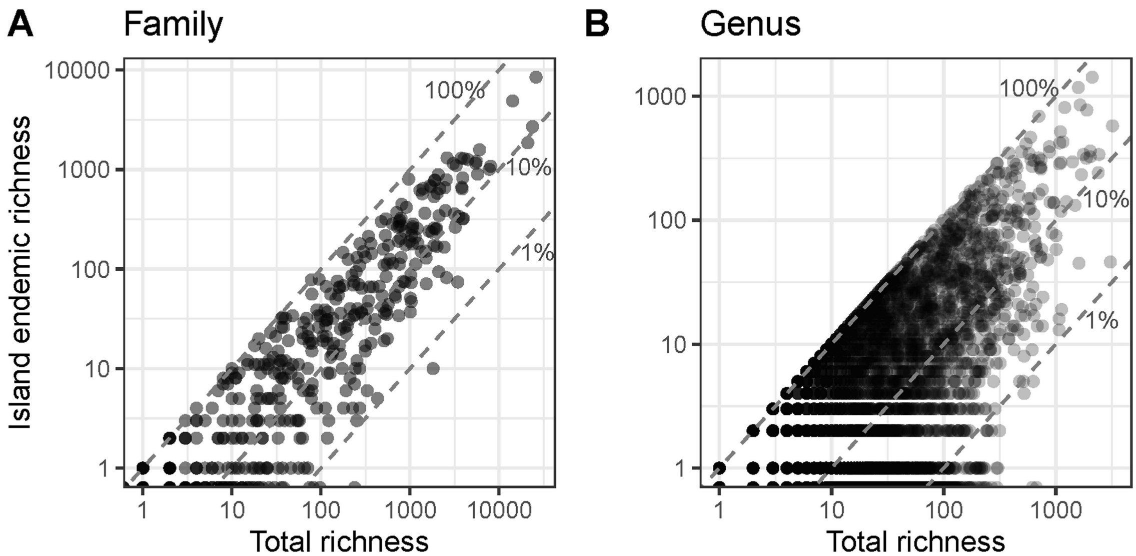
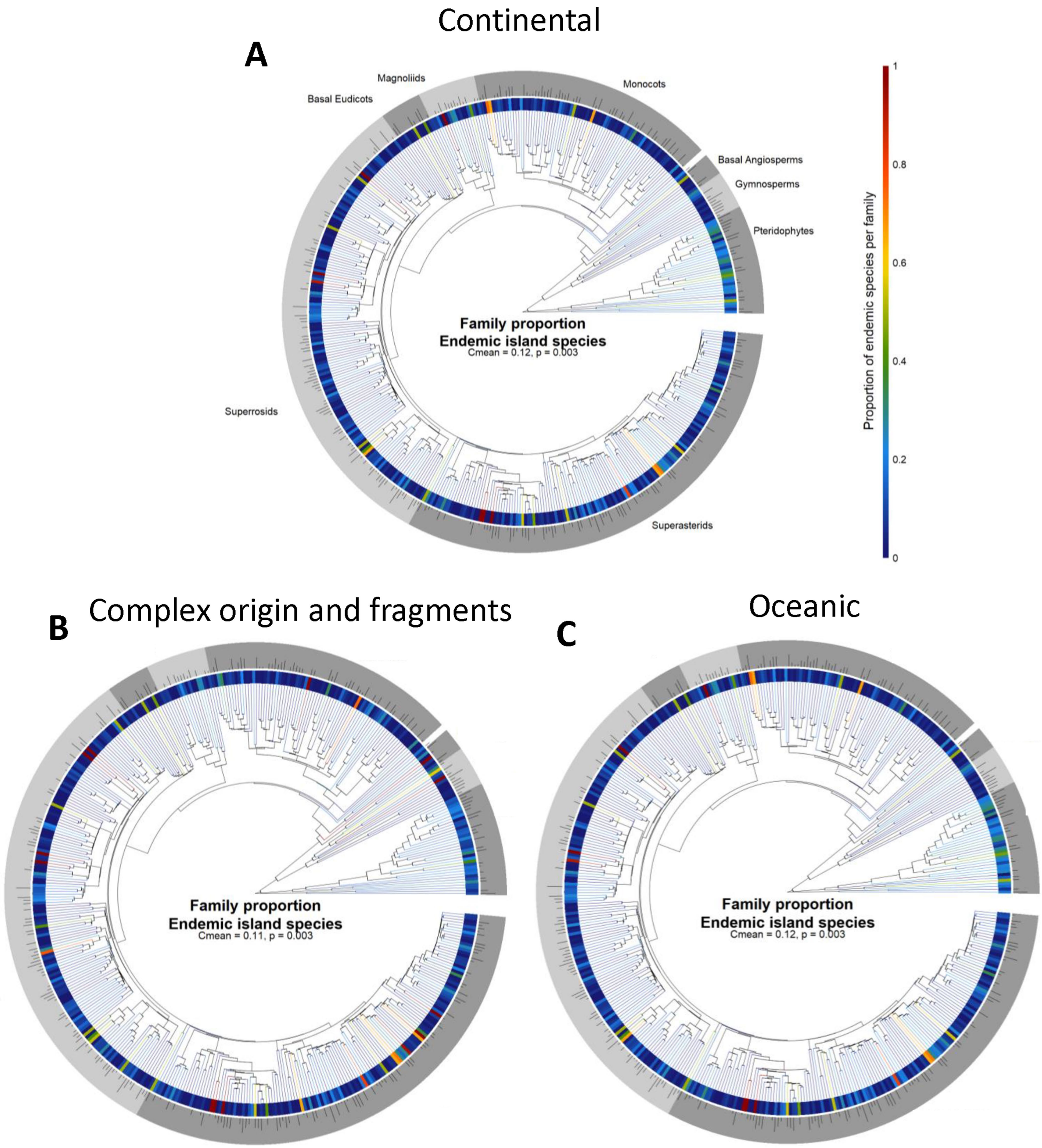


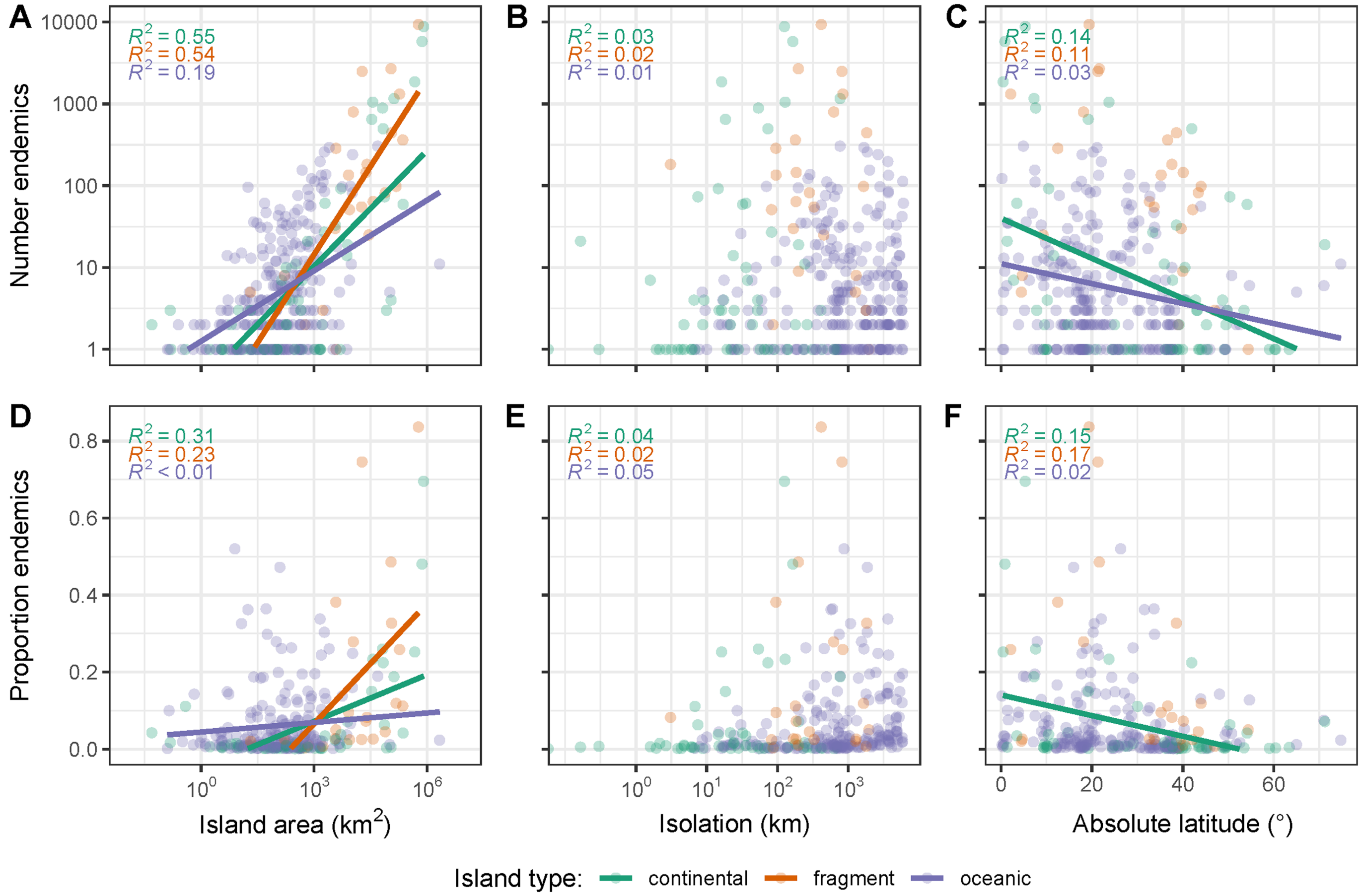
Extended Data Fig. 1 | Frequency distribution of number of endemic species. (A) number and (B) proportion of endemic species across single island floras (n = 323 islands). 1,328 islands with no single-island endemic species have been excluded.



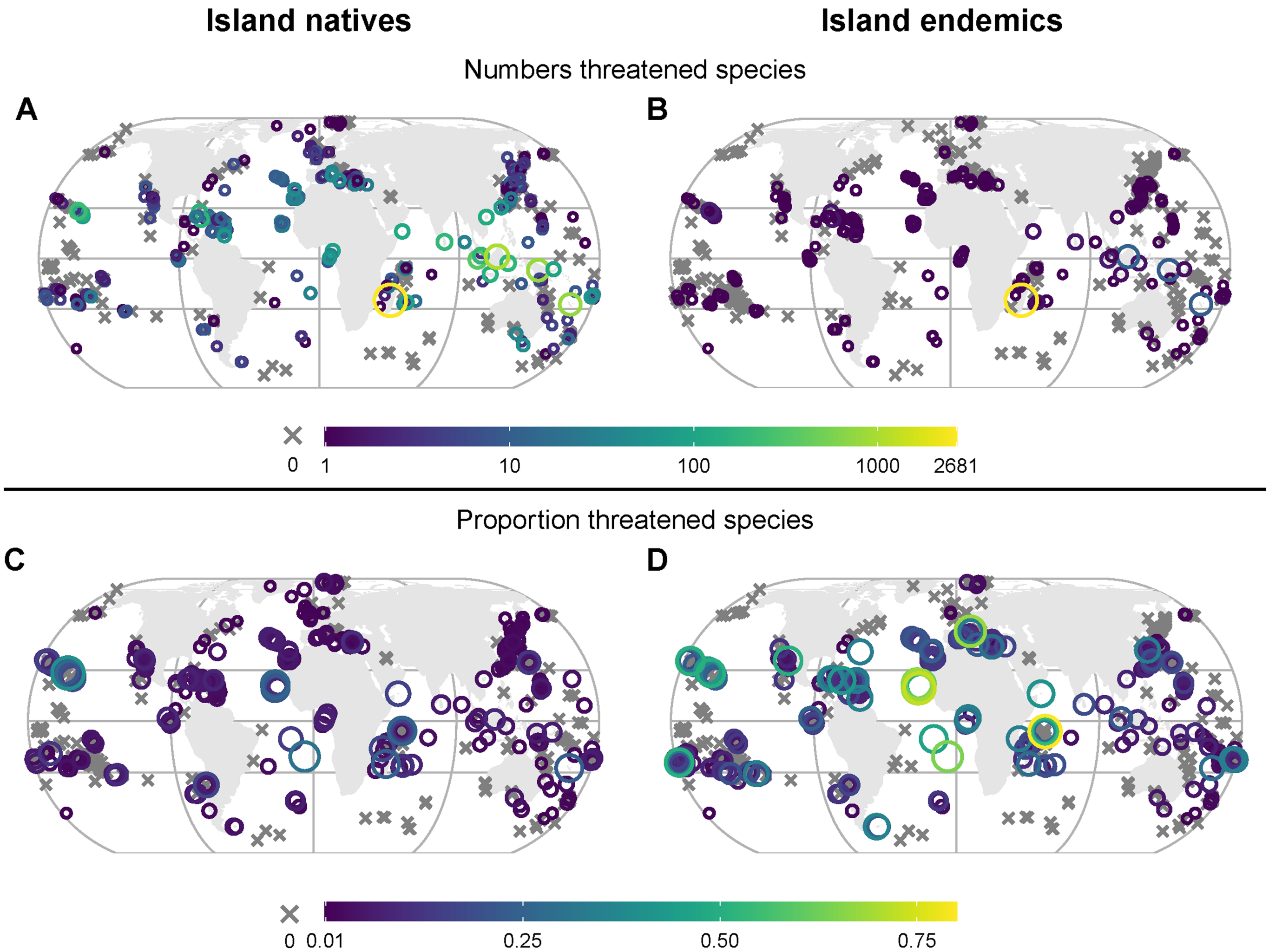
Extended Data Fig. 2 | Relationship between the total global species richness of all known families (A; n = 476) and genera (B; n = 15,030) and the richness of species endemic to islands in each family and genus. A&B: Grey dashed lines indicate 100%, 10% and 1% of species in each family and genus endemic to islands. The five most species-rich families both in overall richness and richness of island endemic species are: Asteraceae, Orchidaceae, Fabaceae, Rubiaceae and Apocynaceae. The five most species-rich genera in terms of island endemic species are: *Bulbophyllum*, *Dendrobium*, *Psychotria*, *Syzygium* and *Begonia*.



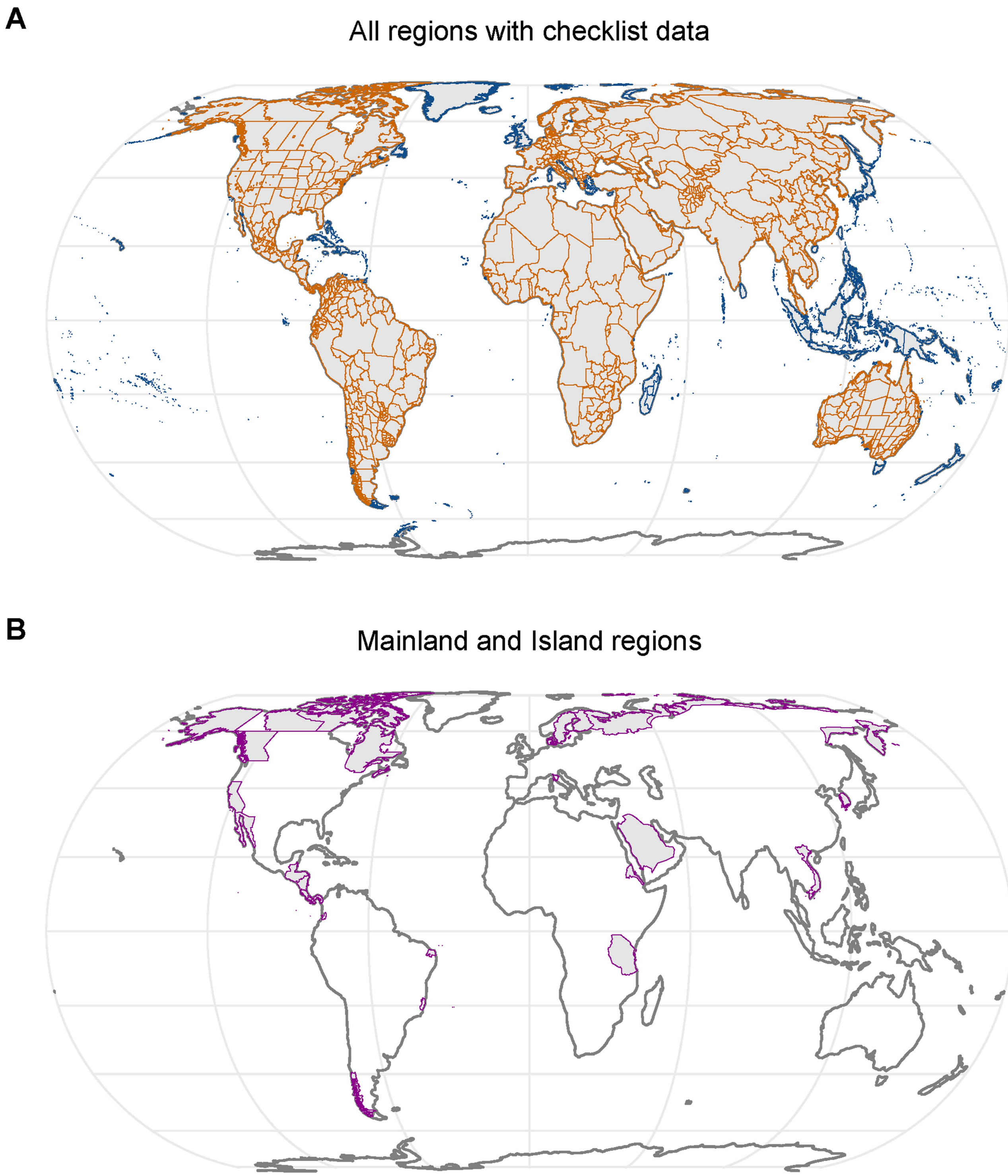
Extended Data Fig. 3 | Phylogenetic distribution of insular plant endemism. Shown is the proportion of endemic island plants at family level and for three different island categories: A) continental islands (560); B) islands of complex origin including continental fragments (31 islands); C) oceanic islands (1,060 islands). Tip and inner ring colours indicate coverage of endemic island plants at family level, outer ring delimits major clades. Bar heights in the outer ring are proportional to $\log_{10}$ richness of endemic species per family. Proportions of island endemics are significantly different between families. Phylogenetic signal down to family level is expressed as Abouheif's Cmean, a measure of phylogenetic autocorrelation calculated by summing the squared differences between values of adjacent tips in the phylogeny; the significant p-values indicate that families closer to each other in the phylogeny tend to be more similar in their proportion of island endemics.



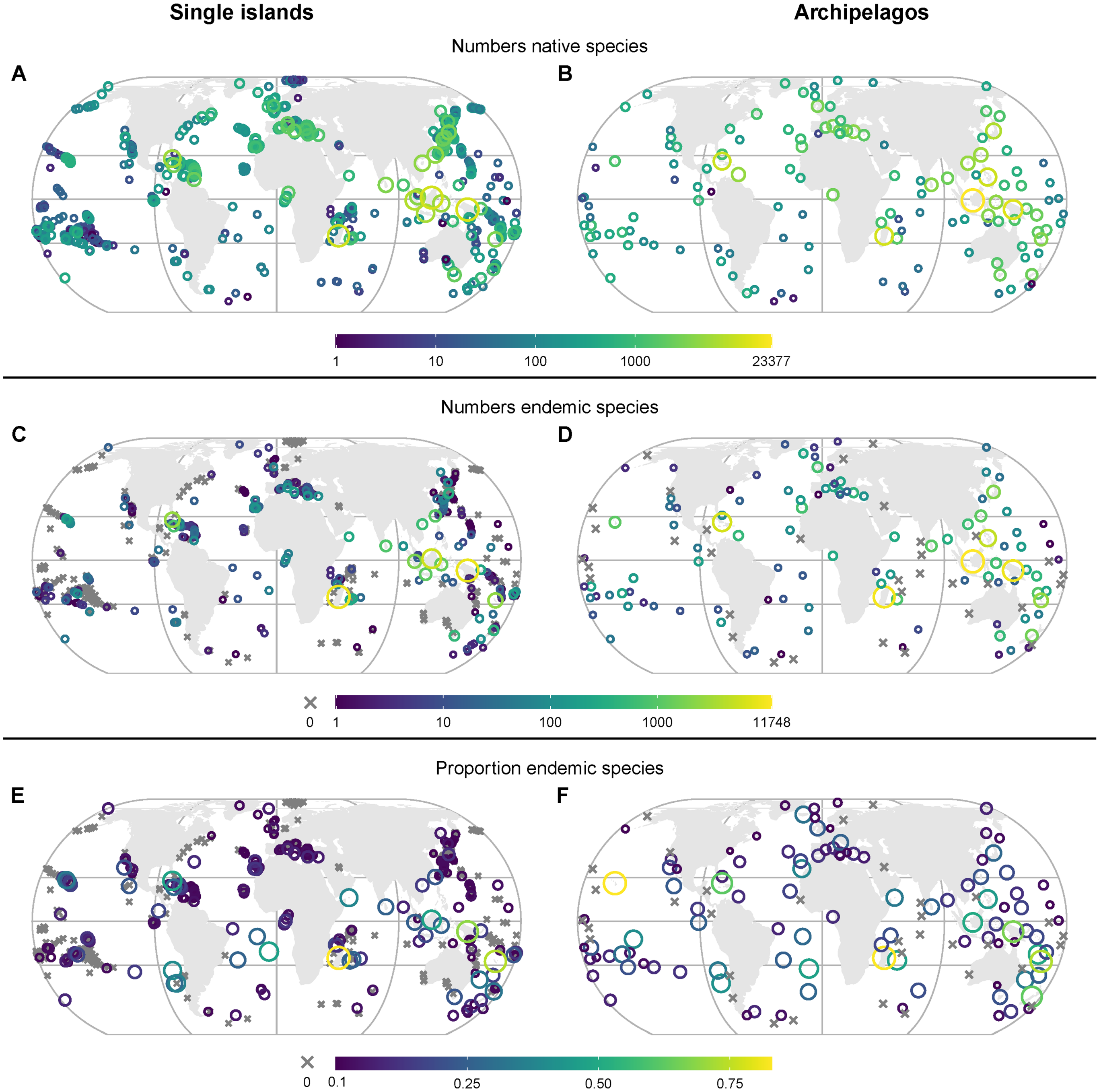
Extended Data Fig. 4 | Numbers and proportion of endemic vascular plants on islands in relation to island area, isolation and absolute latitude across all islands in each category. Islands are grouped into continental (560 islands), complex origin and fragment (31) and oceanic (1,060). Only significant relationships are shown. Latitude is shown in absolute degrees. Species-area relationship z-values (A, D) are as follows: (A) continental islands: z = 0.47; complex origin and fragment islands: z = 0.72; oceanic islands: z = 0.28. (D) continental islands: z = 0.02; complex origin and fragment islands: z = 0.05; oceanic islands: z = 0.01.



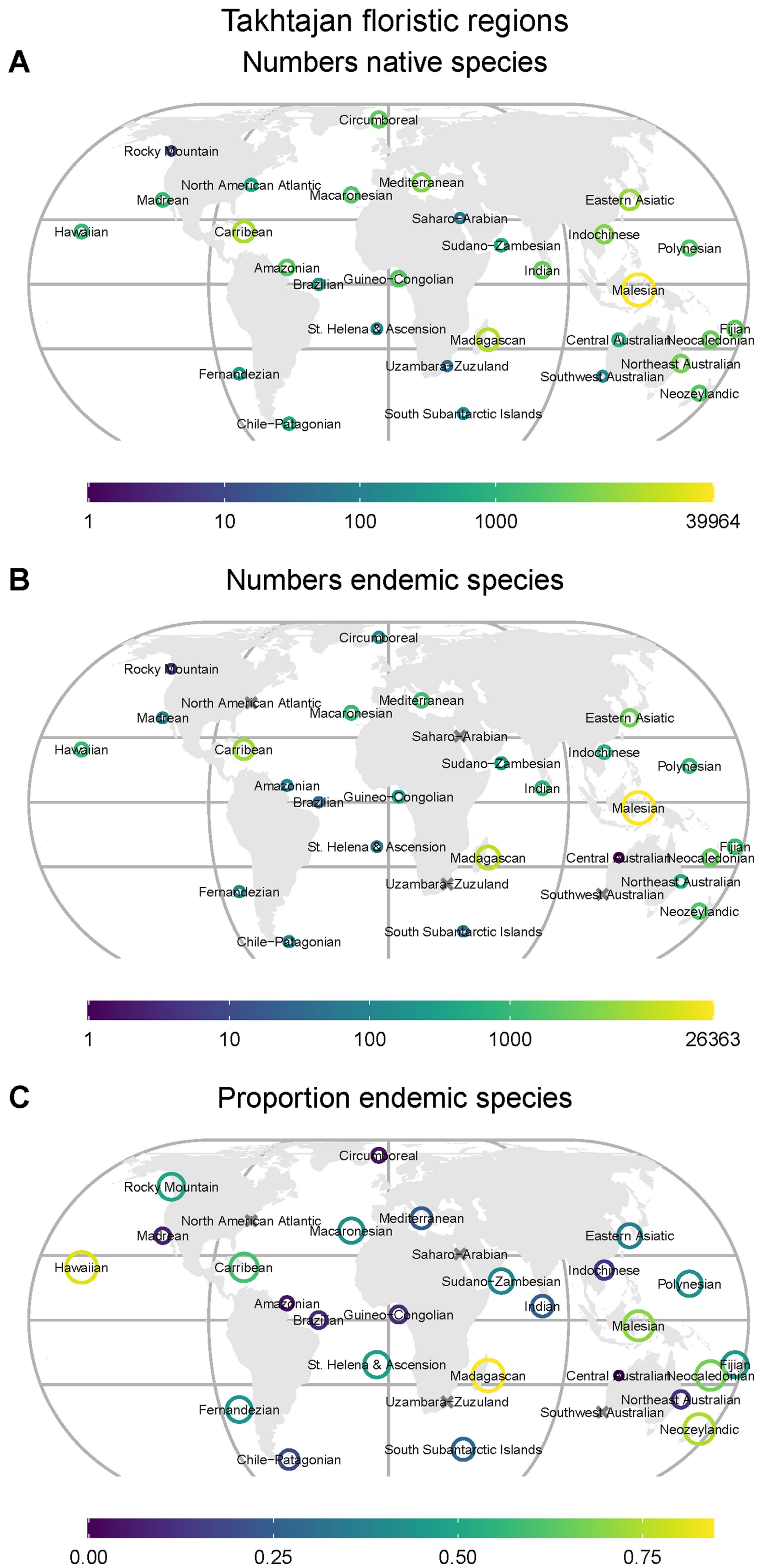
Extended Data Fig. 5 | Proportion of non-endemic island and endemic island species in the IUCN categories. Near Threatened, Threatened, Endangered, Critically Endangered, Extinct in the Wild and Extinct. A – D: Global distribution of the numbers (A, B) and proportion (C, D) of island natives (right row) and endemics (left row) falling into one of these IUCN threat categories (Extinct species excluded).



Extended Data Fig. 6 | Regions with checklist data extracted from GIFT database. A: Global coverage with mainland regions in orange and islands in blue. This dataset was used for the counting method #2; exclusion method. B: All regions with checklists that include both mainland and islands (purple), which were included as mainland regions. This step can lead to underestimation of island endemism based on the exclusion method, as also species potentially endemic to some of those islands included are now listed as mainland species. However, this step was necessary to reach global coverage of the dataset used for the exclusion method.



Extended Data Fig. 7 | Global distribution of native and endemic vascular plants. The distribution includes species from genera with apomictic species across 1,651 islands and 141 archipelagos. In the main text species from genera with apomictic species have been excluded as documentation of apomictic genera is highly skewed towards well-sampled floras in Europe and North America likely representing a geographical bias in taxonomic treatment and coverage. Left column indicates numbers for single islands, right column for archipelagos. Numbers of natives are shown in first row (A, B), endemic in second row (C, D) and endemics as proportion of total island richness in last row (E, F). Difference from Fig. 1 in main text is mainly in higher numbers of native and endemic island species. Some islands and archipelagos where many species have been recognized within apomictic genera (e.g., Great Britain, Spitsbergen) have proportionally higher endemism compared to Fig. 1 in main text.



Extended Data Fig. 8 | Global distribution of native and endemic vascular plants to floristic regions based on the classification from Takhtajan. (Takhtajan, A. *Floristic Regions of the World*. 1986). Only floristic regions including islands are shown (33 out of 35).

Extended Data Table 1 | The top five islands, archipelagos and floristic regions globally in terms of numbers of native and endemic vascular plant species and their proportions

Island		Archipelago		Floristic Region	
		Number of natives			
New Guinea	12,647 (13,695)	Greater Sunda Islands	21,117 (23,377)	Malesian	39,964 (43,984)
Borneo	12,014 (13,389)	New Guinea & surrounds	13,631 (14,794)	Madagascan	12,414 (13,670)
Madagascar	11,149 (12,192)	Madagascar and satellites	11,149 (12,192)	Caribbean	10,920 (12,694)
Sumatra	7,378 (8,180)	Philippines	9,947 (11,122)	Eastern Asiatic	8,785 (10,236)
Java	6,168 (6,934)	Greater Antilles	9,144 (10,605)	Mediterranean	5,519 (7,105)
		Number of endemics			
Madagascar	9,318 (10,152)	Greater Sunda Islands	10,769 (11,748)	Malesian	26,363 (28,705)
New Guinea	8,793 (9,467)	Madagascar and satellites	9,318 (10,152)	Madagascan	10,217 (11,195)
Borneo	5,765 (6,337)	New Guinea & surrounds	9,314 (10,018)	Caribbean	6,401 (7,586)
Cuba	2,679 (3,187)	Greater Antilles	5,609 (6,642)	Eastern Asiatic	3,006 (3,545)
New Caledonia	2,493 (2,733)	Philippines	4,528 (5,031)	Neocaledonian	2,540 (2,791)
		Proportion of natives that are endemic			
Madagascar	0.83 (0.84)	Madagascar and satellites	0.84 (0.83)	Hawaiian	0.83 (0.83)
New Caledonia	0.74 (0.75)	Hawaii	0.83 (0.83)	Madagascan	0.82 (0.82)
New Guinea	0.69 (0.70)	New Caledonia	0.74 (0.75)	Neocaledonian	0.71 (0.71)
Cuba	0.49 (0.50)	New Guinea & surrounds	0.68 (0.68)	Malesian	0.65 (0.66)
Borneo	0.47 (0.48)	Greater Antilles	0.61 (0.63)	Neozeylandic	0.60 (0.59)

Counts of endemic species per island and archipelago are based on method 4 – Expert-based OR exclusion – described in the Methods section. Numbers including apomictic taxa are indicated in brackets.

Extended Data Table 2 | The top-five islands globally with most species in IUCN conservation categories

Island		Island	
	Number native species in IUCN conservation **categories**		**Proportion native species in IUCN** conservation **categories**
Madagascar	2,681	Kaua'i, Hawaii	0.40
Borneo	1,031	St. Helena	0.31
New Caledonia	789	O'ahu, Hawaii	0.27
New Guinea	785	Raso, Cape Verde	0.26
Sumatra	352	Madagascar	0.24
	Number endemic species in IUCN conservation **categories**		**Proportion endemic species in IUCN** conservation **categories**
Madagascar	2,666	Fregate Island, Seychelles	0.79
Borneo	832	Santiago, Cape Verde	0.72
New Caledonia	786	Brava, Cape Verde	0.68
New Guinea	761	São Nicolau, Cape Verde	0.68
Kaua'i, Hawaii	231	São Vicente, Cape Verde	0.64

(Near Threatened, Threatened, Endangered, Critically Endangered, Extinct species excluded) for native and endemic vascular plants. Counts of numbers of endemic species per island and archipelago are based on method 4 – Expert-based OR exclusion – described in the Methods section. Note that not all islands and species have been IUCN-assessed and may be missing from this table.

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☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒	A description of all covariates tested
☐	☒	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒	For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☐	☒	Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	All data is sourced from the Global Inventory of Floras and Traits database (https://gift.uni-goettingen.de). A targeted literature research was conducted to fill in gaps on plant endemism on islands so far not covered in GIFT.
Data analysis	We performed all statistical analysis and data visualization using open-source R software version 4.1.0. Main R packages used were GIFT, picante (version 1.8.2), lme4 (version 1.1-35.10) and MuMin (version 1.47.5).

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

All species occurrences were sourced from the Global Inventory of Floras and Traits database (https://gift.uni-goettingen.de). Species red list status was sourced from https://www.iucnredlist.org. Coverage of protected areas for each island worldwide was sourced from https://www.protectedplanet.net/en. The standardised checklist of the world flora including information for all species on their geographic status, e.g., if a species is native and/or endemic to islands, archipelagos or islands of floristic regions and/or native to the mainland, is available in a Figshare repository. Note that all data made available here is based on GIFT v.3.2. In the future, newer versions may be available, and accessible using the GIFT R package.

Research involving human participants, their data, or biological material

Policy information about studies with human participants or human data. See also policy information about sex, gender (identity/presentation), and sexual orientation and race, ethnicity and racism.

Reporting on sex and gender	NA
Reporting on race, ethnicity, or other socially relevant groupings	NA
Population characteristics	NA
Recruitment	NA
Ethics oversight	NA

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	Based on 5,169 taxonomically standardized checklists and floras for 1,967 island and 1,010 mainland regions covering the whole globe from the Global Inventory of Floras and Traits database, we provide a standardized species list that allowed us to identify all native and endemic species to islands.
Research sample	350,707 vascular plant species from 1,010 mainland and 1,967 island regions from >5M species-by-region records with global geographical coverage. Data source was the Global Inventory of Floras and Traits database (v.3.0; https://gift.uni-goettingen.de/home), which is a collection of regional plant inventories from published checklists, floras, and reports for c. 3,400 geographical regions.
Sampling strategy	No sampling strategy was needed.
Data collection	Publicly available floras and checklists integrated in the Global Inventory of Floras and Traits database. All data can be downloaded via the R package GIFT.
Timing and spatial scale	Recent and global occurrences of 350,707 vascular plant species.
Data exclusions	No data was excluded.
Reproducibility	All numbers and occurrences of species native and endemic to islands are reproducible using the freely available data used from the GIFT database. All analyses can be reproduced using the data made available via figshare.
Randomization	Species were grouped into native and endemic on islands as well as occurring on different island types. Mapping of species on global seed plant phylogeny tested for phylogenetic signal in proportion of island endemism per family.
Blinding	Our analysis did not required blinding.

Did the study involve field work? ☐ Yes ☒ No

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Plants

Seed stocks	NA
Novel plant genotypes	NA
Authentication	NA