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1Degial environmental heterogeneity and complex historical biogeography explain the wide variety of landscapes and vegetation in the Mediterranean, one of the hot spots for biodiversity in the world (Médail & Myers, 2004). The associated high levels of biodiversity and ecological complexity have fostered the emergence of functional uniqueness in several ecosystems and plant communities that occur nowhere else. With about 10,000 islands and islets (about 250 inhabited by humans), the Mediterranean sea can be considered one of the largest archipelagos in the world. Its islands contain an important component of Mediterranean biodiversity, in particular a number of species with limited range and specific types of vegetation (e.g. Médail, 2013, in the press). The richness of Mediterranean island nature is associated with the long-term influence of people as landscape designers who have shaped the dynamics of vegetation by burning, cutting, grazing and plowing (Blondel, 2008). Newer threats of global environmental change (climate and marine change, biological invasions) undermine biodiversity and the functioning of these ecosystems. 2Uch as a variety of Mediterranean islands Mediterranean islands are a kaleidoscope of environmental and biotic conditions. This is due to the wide range of sizes (from the largest island of Sicily covering 25 700 km2 to small islets of tens of square meters), height (from Mt. Etna, 3342 m above sea level to flat islets only by a meter a.s.l) and in the devotion, all of which represent key parameters in the biogeography of the islands. There are a total of 157 large islands in the Mediterranean with an area exceeding 10 km2 (1000 ha), of which 86 (55%) located in Greece (Médail, in the press). Forty-nine islands cover more than 100 km2, of which 36 cover more than 200 km2. Small islands (less than 10 km2, www.initiative-pim.org) are the most common, and there are several thousand such islands (Photos 1). Most islands belong to the Greek archipelago with around 7600 islands and islets in the Aegean Sea, more than 90% of which cover less than 10 km2 (Triantis & Mylonas, 2009). There are about 300 Greek islands and islets in the Female Sea. Croatia is the second largest country by number of islands (n = 1246), including 79 islands comprising more than 1 km2 and 653 small islands and islets with vascular vegetation (Nikolic et al., 2008). Photos 1E example of small rocky islands. Left: Capense Island, N. Corsika (Cap Corse, Centuri), V. 2015 Right: Island of Es Vedrà, a small (640 ha) island with an impressive peak (384 m) emerging from the SE sea of Ibiza Island, IV. 2014 (F. Médail). 3As that all ecosystems of the Mediterranean islands are influenced by the Mediterranean climate (Figure 1), with the exception of certain parts of the high Mountains of Corsi which contain and alpine alpine belts with Eurosiberian and even Arctic-Alpine plants. Insular types of vegetation usually considered typically Mediterranean are evergreen and sclerophyllous shrubs and forests in semi-achid bioclimatic conditions. Deciduous trees were widespread during the glacial period, especially in the northern Mediterranean, but these forests were severely affected by humans and their livestock. Figure 1Mittent distribution of the main types of vegetation in the Mediterranean, in accordance with phyto-ecological and bioclimatic criteria, in particular the average minimum temperature of the coldest month (m) of the year (see médail, 2008). 4The existence of endemic or limited plant species may define specific patterns of vegetation types and landscapes. On large islands, plant endemism ranges from 8% to 17%, while the total number of taxa is greater than expected, usually between 1600 and 2800 species and subspecies (Table 1). In the island mountain ranges, the level of endemism is higher: endemics above 1700 m a.s.l. account for 35%-40% of vascular flora in Corsica and Crete. Each island has its own vegetation specificity, even if the main physiological structures may seem similar from one island to another. These include vegetation typical of low and medium altitudes, while the upper levels of vegetation are limited to the peaks of the largest islands, especially Corsiot, Sicily, Crete, Cyprus and Samos. Table 1. The indigenous level of plant wealth and endemism of the six largest Mediterranean islands (Médail unpublished data, various sources). Insular plant biodiversity in the face of the current global environmental change 5 Mediterranean climate, in particular the drastic, sometimes unpredictable nature of climate patterns and the availability of resources, places a serious and contrasting emphasis on species and communities. The effects of climate change in the 20th century are less well documented than direct human impacts, but the situation is now changing rapidly and is expected to have a serious impact on island ecosystems and biodiversity. Widespread effects on man and land use change 6Thouserst of changes in Mediterranean ecosystems are associated with man-made land use and dynamics over time, and these are likely to continue to play an important role (Blondel & Médail, 2009). Starting in the 19th century and with continuous acceleration throughout the 20th century, major land use changes on large and medium-sized islands were characterized by the widespread decline of the traditional Mediterranean tryptic ager-saltus-sylva (agriculture, pastoralism, forestry), which shaped island landscapes for millennia. Until the mid-20th century, natural resources were crucial for island populations, especially for food, livestock, nutraceutic and medicinal. For example, in one year (1867) more than 7,000 metric tons of wood and coal were consumed in Palma Majorca for Home and Craft Use (Mayol, 1995). The end of economies on most islands has led to a reduction in pressure on natural resources and thus to an overall increase in matorral and forestry areas, as well as to the abandonment of cultivated terraces, which were formerly rivets of agricultural landscapes on steep and mountainous islands (e.g. Petanidou et al. 7Thouser trends cannot be generalised on all islands. For example, the link between succession processes and increased grazing pressure after leaving the land is still uncertain in many Mediterranean islands (e.g. Schaich and Others 2015). In some cases, the end of traditional agricultural activity has led to severe soil erosion or the rapid extinction of many ruder endemics and several specific archaeophytes. Throughout the Aegean archipelago, the collapse of farming practices on terraces in the early 20th century led to major landscape changes and led to the near disappearance of traditional crops since the 1960s: lentils in Samos and, wheat on Chios, beans in the Cyclades. On most of these islands, the unique terraced landscapes have disappeared. In western Crete, human emigration from dry mountains reduced the area of agricultural land by almost 40% between 1945 and 1990, thus favouring the restoration of forest ecosystems dominated by coniferous cupressus sempervirens and Pinus brutia. The same process took place in the Balearic Islands, such as Majorca, where the reach of Aleppo's pine forests has more than fivefold over the past century (Marull and Others 2015). Similarly, holm oak forests have increased from 5,000 hectares to more than 10,000 hectares in Majorca and from 900 hectares to 2,600 hectares in Menorca since 1860 (Mayol, 1995). By contrast, the tall shrubs and natural forests of eastern Sardinia decreased by 35% between 1955 and 1996, while pastures, burnt shrubs and afforestation progressed. The dynamics of the landscape are more contrasting in Corsios. Since the beginning of the 20th century, the instolation of the area has led to the growth of shrubs and wooded areas. Forest cover, which stood at only 17.6% in 1866 (153 775 hectares), is now 58%, an increase of 3.3% over a 150-year period (Panaïotis et al. 2015). This increase can be locally balanced by frequent fires, often associated with illegal pastoral practices. Rural areas in Corsi conurbation still account for 80% of land, and traditional summer old grazing consumes more than 130,000 hectares across the mountain range (source: Parc Naturel Régional de Corse, PNRC). Grazing is an obstacle to the expansion and revitalisation of forests, they have been practiced on Mediterranean islands for millennia, shaping both landscapes and their biodiversity. Grazing is intense on most Greek islands. Uncontrolled practices can over-grazing and even land degradation in dry and semi-achy climates (e.g. 8Xeven on larger islands there is a slight increase in the permanent human population, while medium-sized islands – with the exception of some hot spots of tourism such as Corfu and Jeerba – are declining. Even on large islands, there are significant disparities between densely populated islands such as Malta (1330 people/km2) and less populated ones such as Corsios (36 people/km2). Since the 1960s, island tourism has grown everywhere, with paroxysm in the two Balearic Islands (Majorca and Ibiza), where the peak was reached between 2000 and 2001 with 11 million tourists. This pressure has led to major urban development along the coasts, threatening fragile ecosystems such as dunes, wetlands and, to a lesser extent, rocky habitats. For example, on the Greek island of Skiathos (N. Sporades), the development of tourism since the 1970s has led to an 80% reduction in these coastal ecosystems (Economidou, 1995). The impact of climate change 9W expected temperature rise from 3 ° to 5 ° C in the Mediterranean in the 21st century, potential evapotranspiration is expected to reach an average of 200 mm per year, which corresponds to the loss of 50 mm in annual rainfall (Le Houérou, 1990). The expected changes in vegetation belts due to increased dryness and a temperature increase of 3 °C will be an upward shift of about 545 m (almost amplitude of the plant belt) and a shift of latitude by 50-80 km to the north (Médail & Quézel, 2003). These effects will be exacerbated in islands where there are no (or insufficient) areas available for such changes. The flora and vegetation of alpine areas (i.e. mainly oro-and alti-Mediterranean belts) and areas with limited spatial range of mountain ranges, such as in the Lefka Ori massif in Crete (Kazakis et al., 2007) will be most at risk. In Corsi cones, this is especially the case for arctic-alpine species (about 25 taxa) in the Alpine plant belt (Contandriopoulos & Gamisans, 1974). 10It is too simplistic to consider shifting one range of plant communities in response to global warming. As suggested for Mediterranean mammals, the effects of climate change on the distribution of species and communities may be based on changes in the structure of the community (Maiorano et al., 2011). The extent to which many organisms will be able to cope with climate change is still largely an open question, especially as climate change is currently taking place at an unprecedented rate. Microvolue changes can occur rapidly in fitness-related characteristics such as flowering time of plants (Peñuelas et al., 2002). Differential reaction of organisms interacting in complex food chains or symbiotic associations may also interfere with interactions that are necessary for the functioning of the such as pollination pollination dispersion of seeds. 11 Climate change also poses a threat to island plant populations and communities associated with wet habitats or mesophilic conditions, including certain endemic ones, which are the cornerstone of Mediterranean plant diversity. This is the case with two endemic species of the Apiaceae family, limited to the Balearic Islands. Apium bermejoi, a narrow endemic Menorca located in one area of 50 m2, where about 100 individuals occupy only one square meter. As this critically endangered plant is prone to prolonged drought, its current decline is probably partly linked to a series of dry years (Moragues & Mayol, 2013). The narrow ecological niche palaeoendemic Naufraga balearica, distributed only along a short stretch (about 15 km) of the northern slopes of majorca's northern coast (Figure 2), explains its current extreme rarity (Fernández-Mazuecos et al. 2014)-rapid climate change could threaten its survival. In Cyprus, several populations of narrow endemics (Onosma caespitosa, Salvia veneris, Sideritis cypria) are also threatened by rainfall reduced by 20% to 40%, and warming, both of which can change their window germination in the fall (Kadis & Georghiou, 2010). Figure 2Bardzka threatened by the narrow endemic balearic Naufraga (Apiaceae) located in the north-west of Majorca, with the distribution of three plastype haplotypes in the five populations included in the sample (a), the phylogenetic consensus tree (b) and the statistical network of parsimony (c) DNA plasticide haplotypes showing the concentration of ancestral haplotype A (Fernández-Mazuecos et al. 2014). 12 So far, there is only little solid evidence of direct population depletion or death due to climate change. It is known that about 10 endemic species are extinct on the Mediterranean islands, with about 40 Mediterranean plants presumed to be completely extinct in the region (Blondel & Médail, 2009). Recent research focused on the Cretan endemic tree Zelkova abelicea (Fazan et al. in prep.) and on some plant communities (e.g. local durability of Mediterranean plants, especially perelin, in various microhabitats may be due to many demographic strategies sustainability through longevity or regeneration, depending on local or regional conditions (García & Zamora, 2003). This confirms the important role played by icy refugia on the islands (Médail & Diadema, 2009). However, most plants interact with bioclimatic characteristics at the physiological rather than macroclimatic level (Curtis and Others 2016). Differences in small habitats in the landscape can therefore explain the ability of species to cope with a drastic and changing climate. High heterogeneity of habitats ecosystems can therefore provide ecological insurance for the future sustainability of plant species on a local scale, enabling local migration of species in more favourable ecological niches. Nevertheless, on the scale of small islands, this may not be enough to ensure the survival of highly specialized plants. The future durability of islet specialists such as the small annual Nananthea perpusilla (Asteraceae) in some shady and moist spots of islets around Corsinia and Sardinia may be at risk (photo 2). 13 Photos 2Such granite rocks on some small islands surrounding Corsinia and Sardinia form a highly specialized ecological niche, in the paleoendemic composition of The Asteraceae Nananthea perpusilla in temporary moist and granite soils with a shaved exposure; Cavallo Island (Lavezzi Archipelago, S. Corsiek) III. 2014 (F. Médail). Another important element of climate change is the 1400 m (SLR) sea level rise. At the end of the last glacial period, the main consequence of the climate oscillation from cold to warm conditions was the melting of the northern hemisphere ice sheet causing continuous sea level rise around the world. In the Mediterranean, the main part of this maritime offense took place before about 60.00 points. Some inside the island filogeographies, such as for the narrow Balearic Islands endemic Senecio rodriguezii (Molins et al., 2009)-point to the island under the island syndrome, that is, the division of the population into several isolated and genetically divergent lines, which are explained by repeated cycles of sea level changes on Thursday. 15In the coming decades, the world's sea level is expected to rise rapidly. Regional sea level change rates may increase by 1 to 6 compared to observed long-term rates (Galassi & Falls, 2014). Coastal ecosystems and small islands are particularly vulnerable. The effects include the tightening of coastal erosion, the immersion of low-altitude islands and flat coasts, and the salinity of coastal wetlands (Nicholls and Others 2016). The diversity of the islands generally depends not only on the dynamics of immigration and extinction, but also on changes in the island region, isolation and connectivity (Weigelt et al. 2016). On a small Mediterranean island (Cavallo, S. Corsicon) sea level changes in the Holocene have played a significant role in the loss of wetland biodiversity and ecosystem changes due to increased salinity caused by sea intrusion (Poher et al. submitted). Analysis of coleopteran fossils preserved in a 7,000-year sedimentary record showed that 60% of the fauna of beetles from wetlands in the past had gone extinc locally as a result of regime change in this freshwater pond. The greatest depletion occurred 3,700 years ago, when the relative level of the Mediterranean increased by more than -1.5± 0.3 m. 16 Gabes Bay, in Tunisia, it is mediterranean areas, which are most threatened by sea level rise, estimated locally at 5.7 mm per year. Archaeological geoe studies mention significant coastal flooding and historic remains, up to two meters 2000 years ago (Slim et al. 2004). This has had a huge impact on the biodiversity of the flat and innosible islands of Jebba, Kneiss and Kerkennah (Médail et al., 2015) (Photo 3). In the latter case, land salinity led to a sharp increase in sebkhas (+ 20% between 1984 and 2011) and a 27% decrease in palm groves, equivalent to 26 km2 (Etienne et al., 2012). Photos 3Pamina vegetation of the large satellite islands of the Kerkennah archipelago (E. Tunisia). Left: open steppe with Lygeum spartum (Poaceae); On the right: halophilic vegetation of shrubs on sebkhras with Arthrocnemum macrostachyum and Sarcocornia fruticosa (Amaranthaceae) (F. Médail). 17SLR's guidelines may be less harmful to the biodiversity of plants on rocky island or coasts, as there may be a slight increase in halophilic communities and species towards salt-resistant habitats that occur just above that. However, this change may be limited by disturbed habitats on land. In pocket beaches in Provence (France), Brunel and Sabatier (2007) found 12.1 ± 3.5 m retreat in the coastline between 1896 and 1998, of which 5.8 ± 3.5 m was caused by SLR. On small islands such as Porquerolles (Port-Cros National Park), pocket beaches can almost completely disappear (from 75% to 97% of the regression of their current area) by 2100. Due to the frequent coastal cliffs or rocky slopes blocking land migration, typical plant communities and species of solid sea sands (e.g. psammophytes Eryngium maritimum, Otanthus maritimus, Pancratium maritimum grey dunes) can become locally extinct on various islands. Growing forest fires 18Like grazing, forest fires is the main driver of the dynamics of the Mediterranean ecosystem since the ad emergence of the Mediterranean climate, 3.2 Ma ago. For the characteristic Corsican pine (Pinus nigra subsp. laricio), fires have played a key role in the functioning of these mountainous forests, as the tree has survived average fire return intervals of 80 years over the last 13,200 years (Leys et al. 2014). The fires contributed to the frequent domination of shrubs on the islands in the middle of the Holocene (approx. 8000-7000 years of BP) in dry conditions, as is the case with pistacia matorrals in Sicily and Malta (Djamali et al. 2013), and the dense Erica scoparia and E. arborea stands in northeastern Sardinia (Beffa et al. 2016). 19 Fires may slow down the expansion of forest cover, as a result of the general collapse of traditional human practices on the islands, in particular on persistent terraces which promote the rapid recovery of vegetation. So forest stages are limited due to repeated fires, fires, xenophobic meadows, island landscapes still often dominate. In Greece, this situation has been particularly worrying over the past few decades, given the increase in frequent intense fires. On Thasos Island, for example, a series of fires has reduced forest cover from 61.6% to almost 20% since 1984 (Ranis et al., 2015). In addition, spatial convergence often occurs between the micro-regions most affected by fires and the main cattle breeding regions, such as corsica. There were 28,000 fires (i.e. ≈,1000 fires per year) on this fire-prone island between 1973 and 2004, and a third of Corsika's total area was burned in 30 years. 20Eivals and the occurrence of extreme fire events (or megafires) are linked to both land use change and climate change, and involve many biotic and socio-economic factors (e.g. it is difficult to repel their relative importance, as the management of Mediterranean landscapes plays an important role. In the western Mediterranean, there has been a change in the fire system, and fires are now less fuel-constrained and more caused by drought than before 1970 (Pausas & Fernández-Muñoz, 2012). In the future, increased drought may increase fire activity on most Mediterranean islands, which may result in secondary effects of land degradation and erosion. 21The connection between the multi-factor approach is illustrated by the case of Abies cephalonica on the Greek island of Kefalonia (Politi et al., 2011). The decline of these fir populations has been attributed to various causes such as root damage, invasion of echinoe, pathogens or insects, and more intense and more frequent extreme drought events possibly due to the warming trend of the climate. Extreme droughts are contributing to the recent increase in the number of fire episodes spreading at high altitudes and threaten non-fire-resistant species whose future sustainability is threatened in such island situations. Conclusions 22 Physico-forming and philographic studies have shown the complex historical biogeography of the Mediterranean basin, as well as the importance of islands as reservoirs of unique genetic lines, especially for most endemic and narrowly dispersed plants (Médail & Diadema, 2009). Nevertheless, the time frame and evolutionary consequences of biogeographical events associated with repeated cycles of island connections and isolation, with regard to marine regression- transgressions, remain largely unknown (Mansion et al., 2008). This is particularly worrying for the effective evolutionary protection of these heterogeneous island flora. 23 In the wake of the Mediterranean biomical crisis (Hoekstra and Others 2005), the islands constitute key ecological systems ensuring the protection of the biodiversity of coastal plants. I island systems continue to be a fascinating fascinating they are also key actors that distinguish the role of environmental and human pressures in the long-term preservation of these flashpoints in biodiversity. Given the increased risks in the Mediterranean and the complex consequences of climate change (Klausmeyer & Shaw, 2009), it is crucial to observe, monitor and analyse plant vegetation and biodiversity changes in ecological and biogeographical gradients. The Mediterranean islands, especially the small ones, are beneficial places for such long-term observations, as well as for monitoring at different spatial scales. These natural island microcosms are indeed suitable systems for the study of adaptation to climate change by species or communities, and the functional biogeography approach (Violle et al. 2014) is undoubtedly an interesting topic that needs further research. 24 The diversity of situations in which the Mediterranean islands are located must facilitate their integration as laboratories or testing ground for extinction due to global change and human pressure. To this end, it would be useful to combine a reactive approach on the most endangered (often largest) islands and proactive approaches on relatively less endangered islands (especially small islands and islets). Multidisciplinary collaboration between prehistors, archaeologists, paleoecologists, historians, socio-economists, soil scientists, ecologists and biogeographers is needed to distinguish complex interactions between ancient human societies and island environments. Strengthening these interdisciplinary research efforts is a prerequisite for developing robust policies and practices for the protection of these unique and fragile island flora and plant communities (Médail, 2013). The smallest islands should not be underestimated, as they are often isolated territories with microsection processes, offering modern areas of refuge for diversity, which are threatened by the effects of human activities on the shores of the neighbouring mainland. 25 In view of their high biotic originality and susceptibility to global change, Mediterranean islands and islets urgently require an integrated and ambitious conservation plan aimed at preserving their unique biodiversity and cultural heritage in the long term. Thanks 26Some data on small islands off the coast of East Tunisia and Corsiot were obtained during field missions funded by the PIM (Small Mediterranean Islands Initiative) initiative of the French Conservatoire du Littoral and the Tunisian agency APAL (Agence de protection et d'aménagement du littoral) between 2014 and 2015. Inititiative d'excellence Amidex

from the University of Aix-Marseille also participated in the of these off-road trips as part of the MedNet project (2013-2015). 27Addd my colleague Pr. Wolfgang Cramer (IMBE) for inviting him to write this short review and for his on the manuscript. Manuscript.