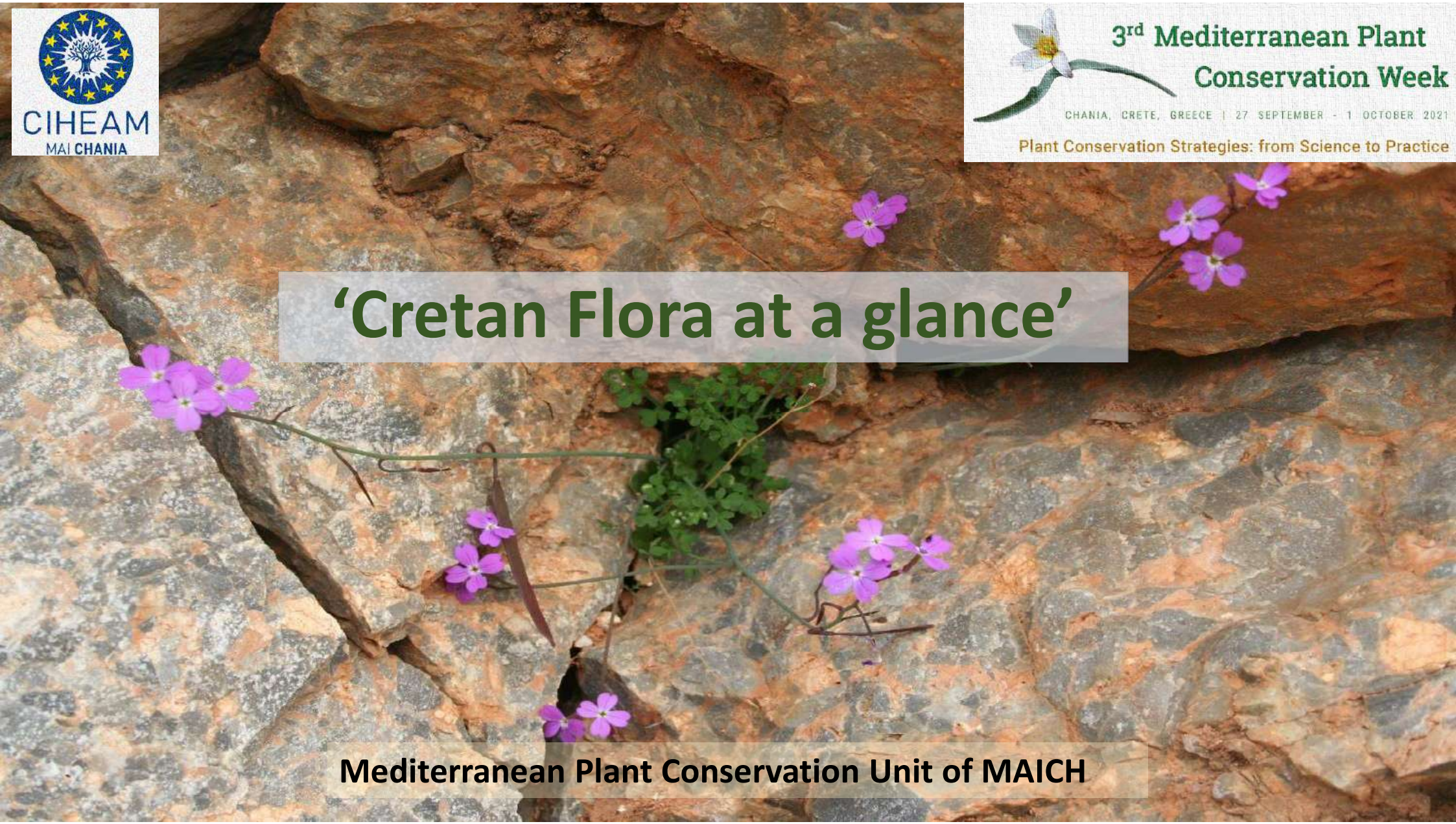
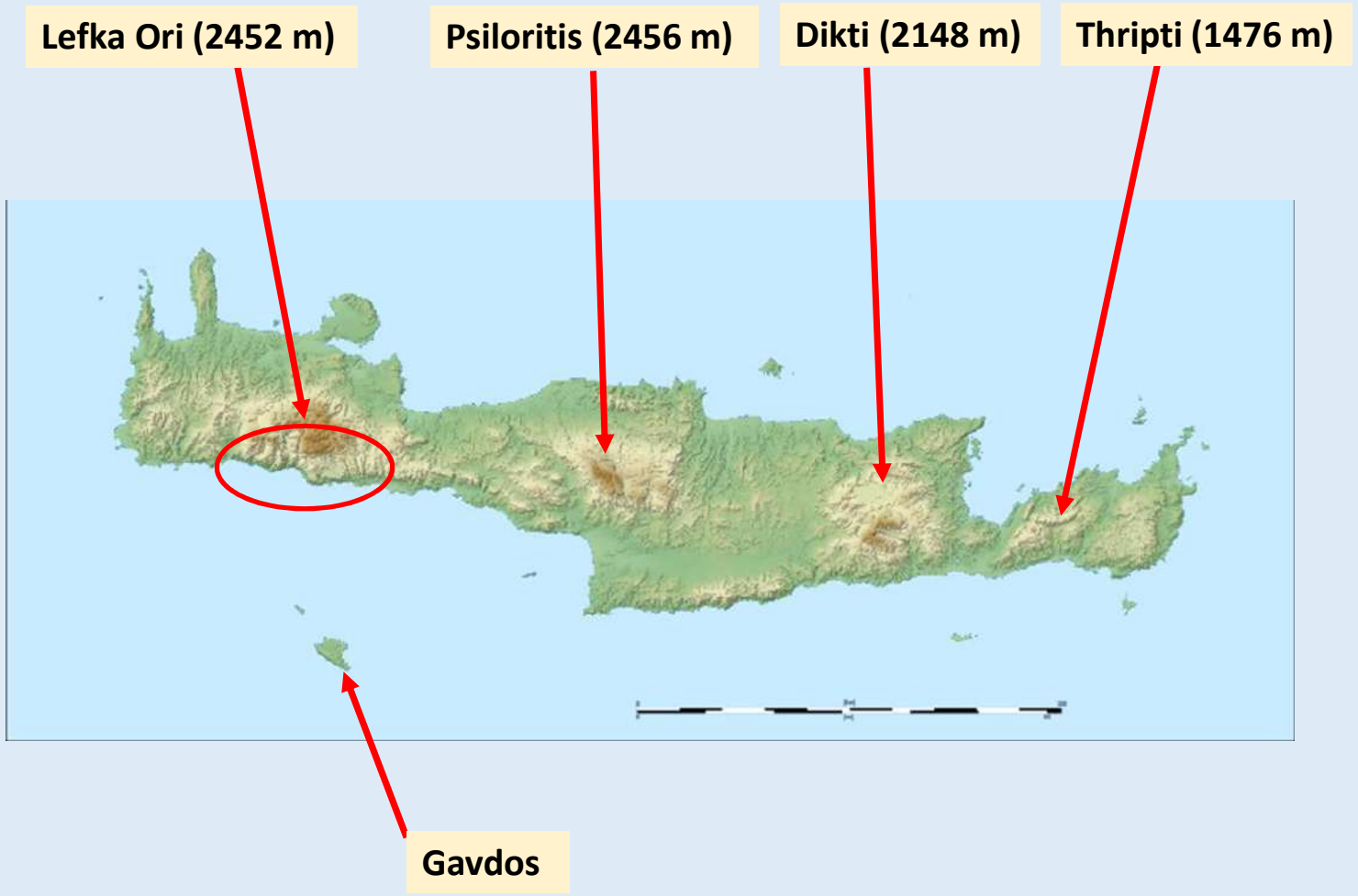
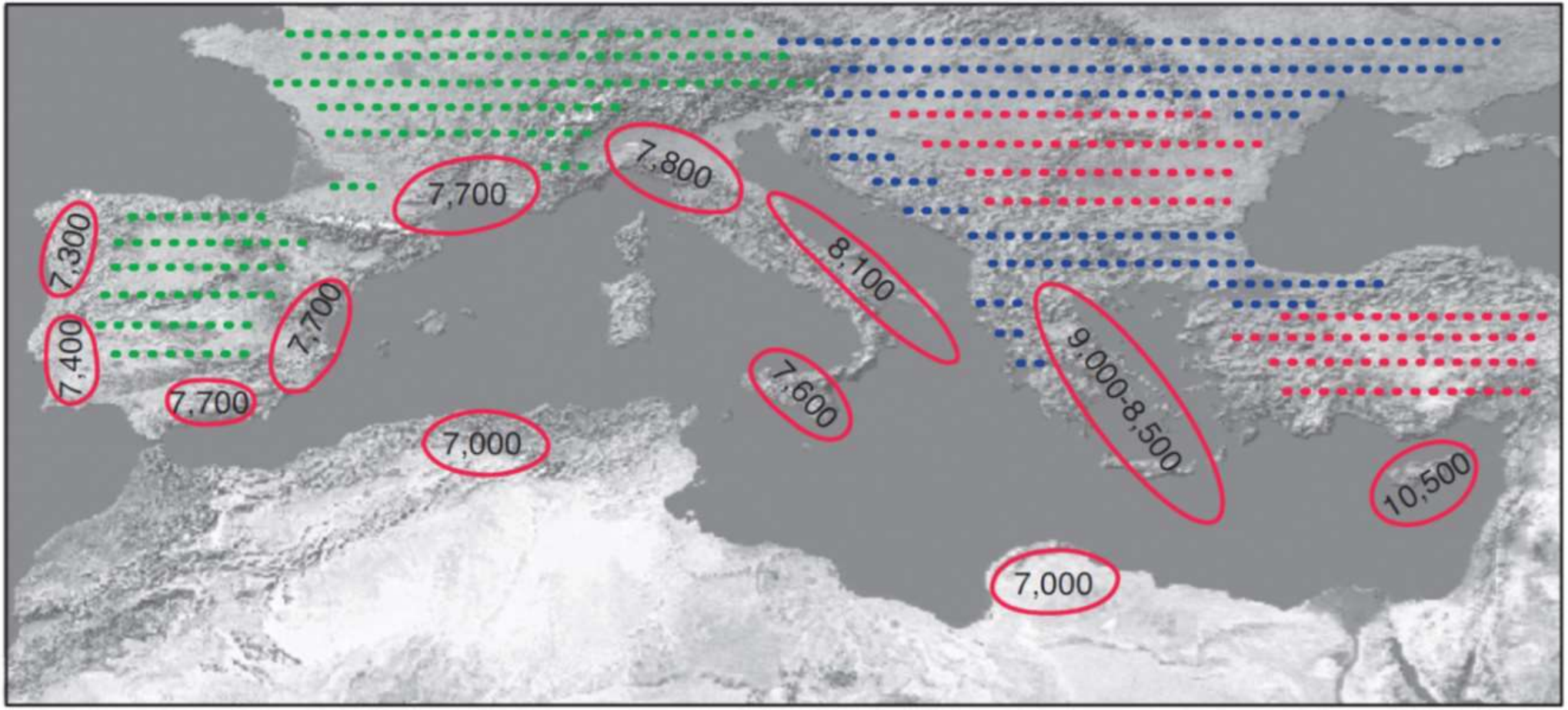

CIHEAM
MAI CHANIA
3rd Mediterranean Plant Conservation Week
CHANIA, CRETE, GREECE | 27 SEPTEMBER - 1 OCTOBER 2021
Plant Conservation Strategies: from Science to Practice
‘Cretan Flora at a glance’
Mediterranean Plant Conservation Unit of MAICH

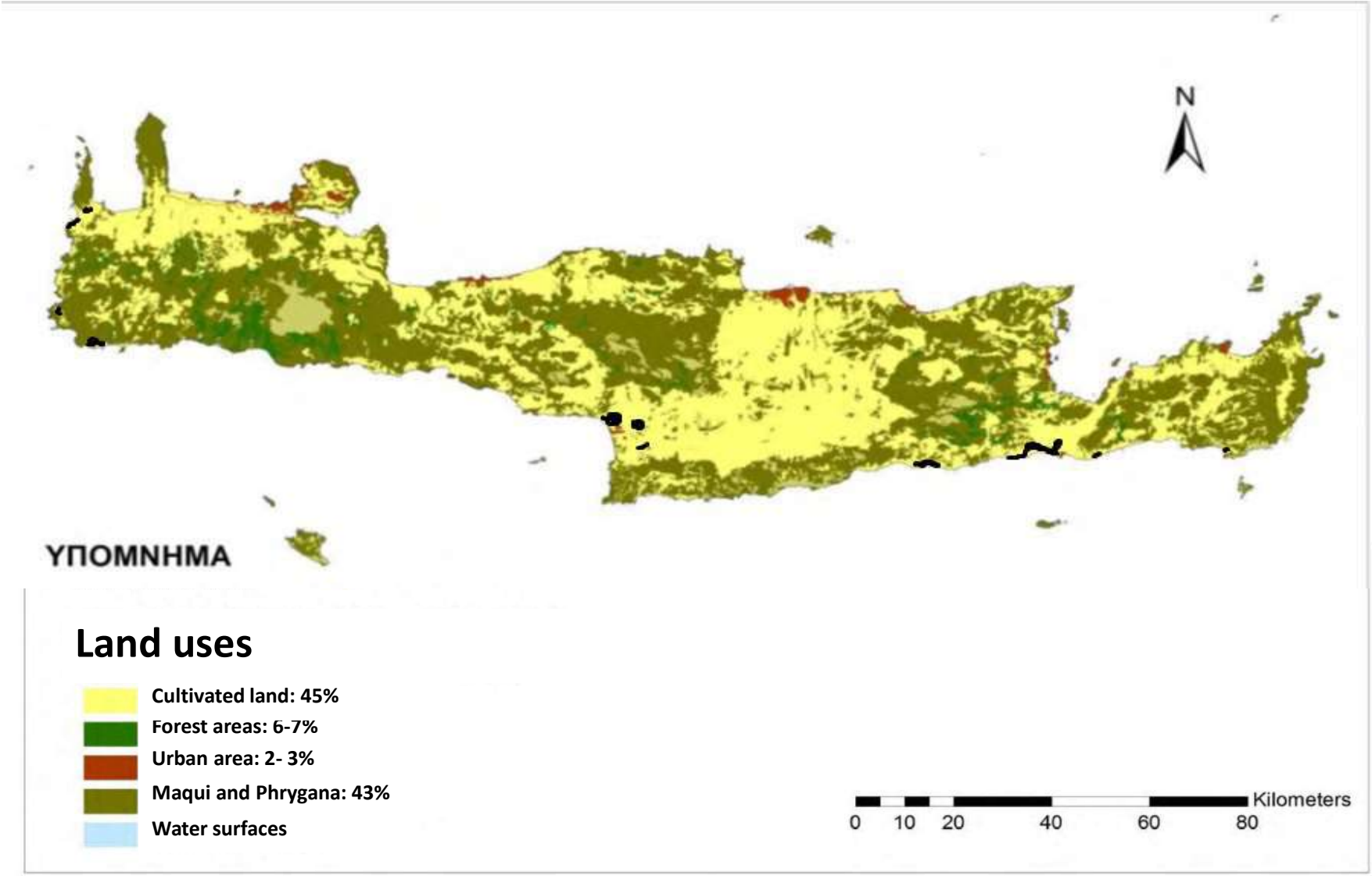
Island	Area in km²
Sicily	25 462
Sardinia	23 818
Cyprus	9 251
Corsica	8 680
Crete	8 259
Evia	3 655
Mallorca	3 618
Lesbos	1 630
Rhodes	1 401
Chios	840


Lefka Ori (2452 m)
Psiloritis (2456 m)
Dikti (2148 m)
Thripti (1476 m)
Gavdos

Domestication and early agriculture in the Mediterranean Basin

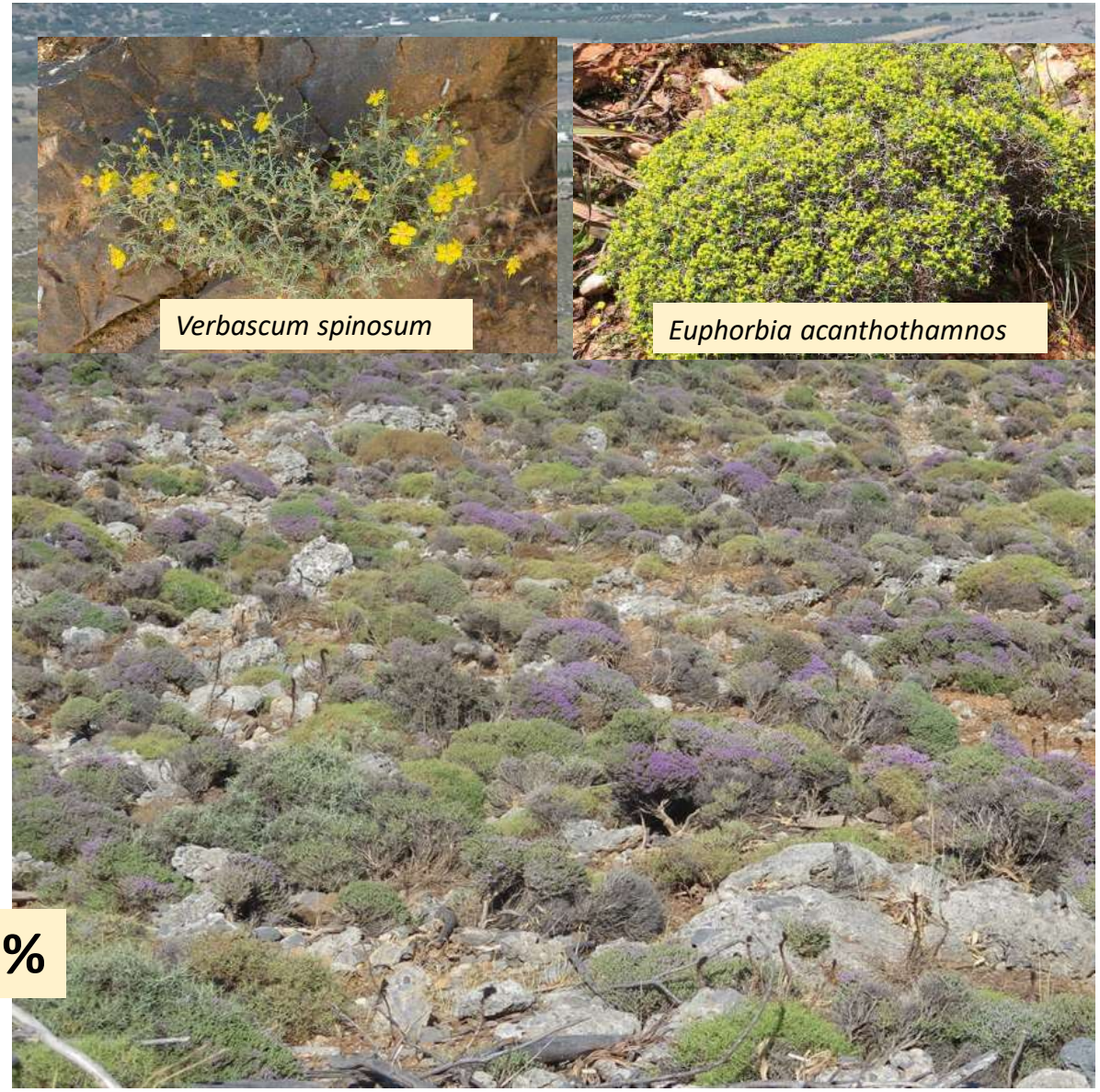


Zeder, M. A. (2008). Domestication and early agriculture in the Mediterranean Basin: Origins, diffusion, and impact. Proceedings of the national Academy of Sciences, 105(33), 11597-11604.



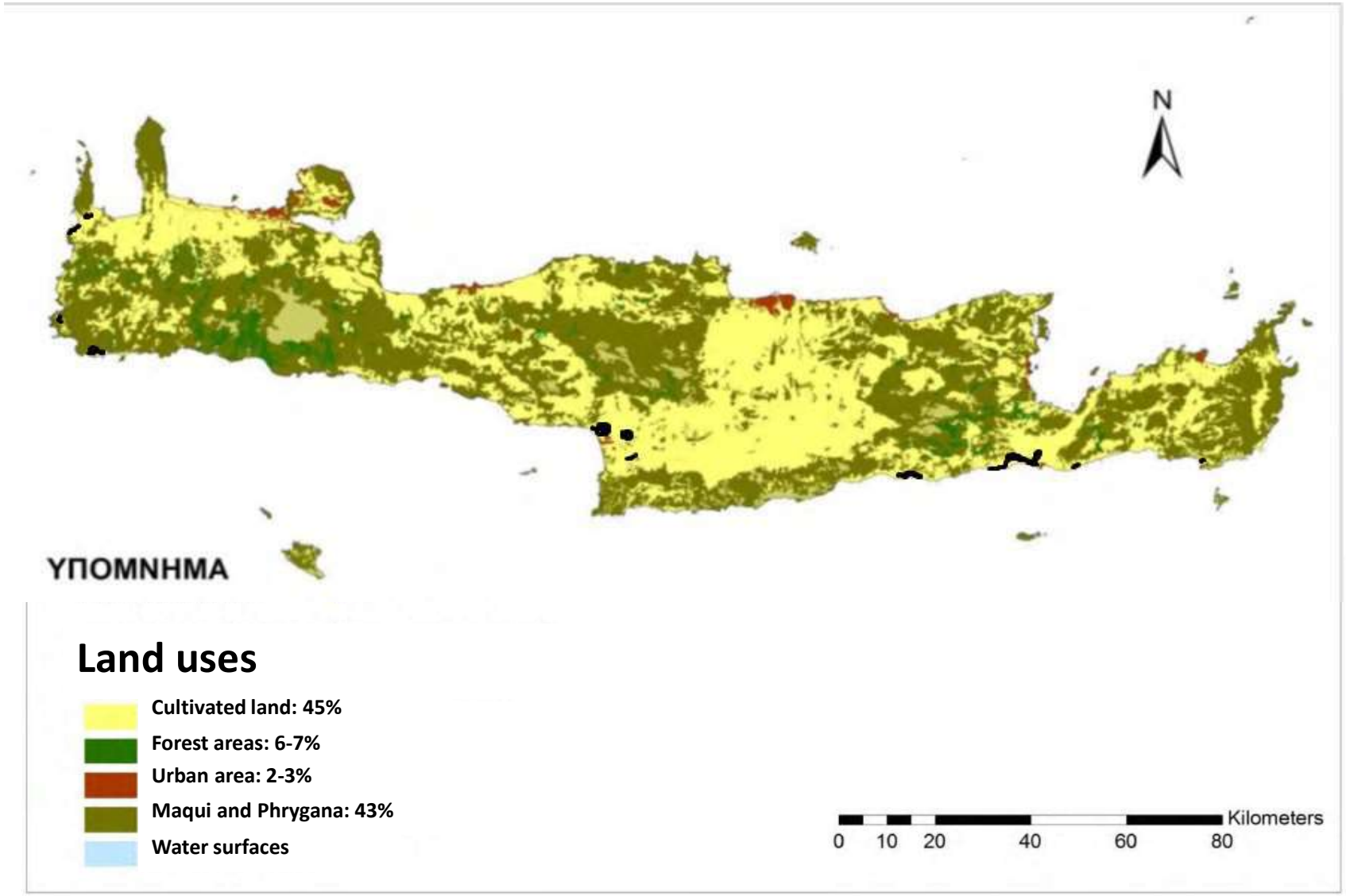
Map modified from: Mamalakis s. 2013. Evolution of land use in Region of Crete. Bsc Thesis. University of Thessaly

43%



Verbascum spinosum

Euphorbia acanthothamnos



Map modified from: Mamalakis s. 2013. Evolution of land use in Region of Crete. Bsc Thesis. University of Thessaly

Botanical history of Crete

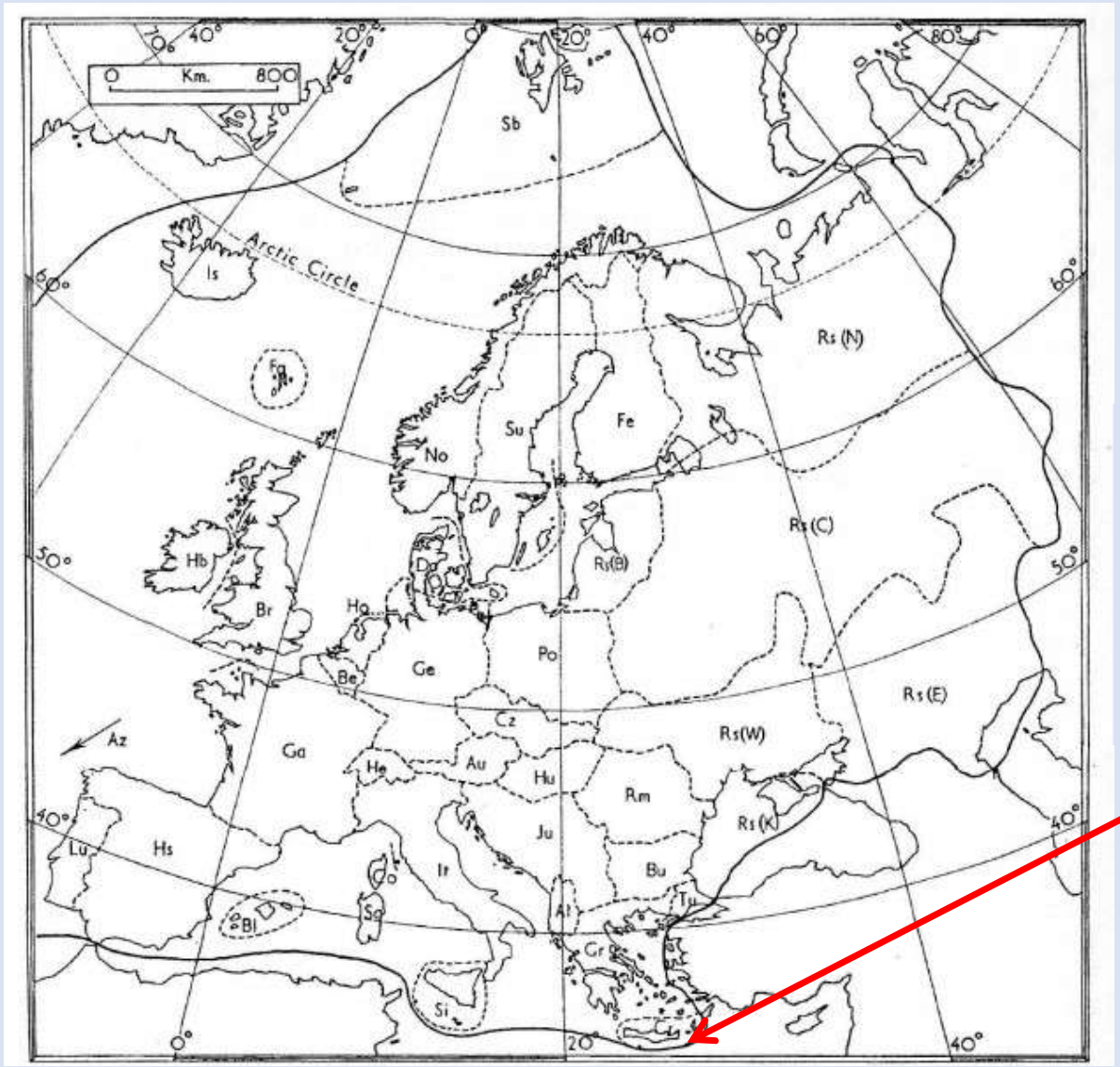
- ✓ **1420:** *Liber insularum Arcipelagi*
- ✓ **Cristoforo Buondelmonti** (c. 1385 – c. 1430):

- ✓ **1553:** *Les observations de plusieurs singularitez et choses memorables trouvées en Grèce, Asie, Judée, Egypte, Arabie et autres pays étrangèrs.*
- ✓ **Pierre Belon (1517–1564**):
- ✓ **…….**
- ✓ **…….**
- ✓ **…….**
- ✓ **…….**
- ✓ **2021: FLORA OF GREECE WEB**

Theophrastus (c. 371 – c. 287 BC)
Περὶ φυτῶν ἱστορία - Historia Plantarum - **Enquiry into Plants**

Dioscorides Pedanius (c. 40–90 AD)
Περὶ ὕλης ἰατρικῆς –
On Medical Material

Πλατάκης Κ.Ε. 1955 : Το ιστορικόν των εν Κρήτη βοτανικών ερευνών από της αναγεννήσεως μέχρι των καθ' ημάς χρόνων. Κρητικά Χρονικά. 9: 119-148
Γκανιάτσας Κ. 1974. Η χλωρίς της Κρήτης. Αμάλθεια. Περιοδικό της Ιστορικής-Λαογραφικής εταιρείας νομού Λασιθίου. Ανάτυπον εκ των τευχών 20-21.


0 Km. 800
Arctic Circle
Sb
Is
Fa
No
Su
Fe
Rs (N)
Rs (C)
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Hb
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Po
Cz
Rs(W)
Rs (E)
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Ga
He
Au
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Ju
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80°
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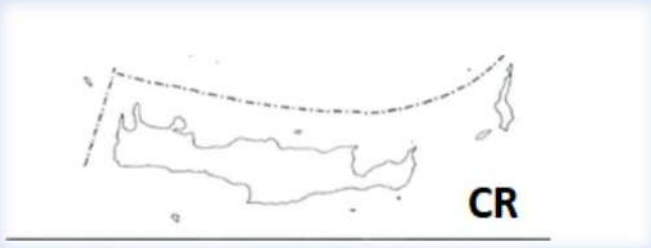
40°


CR

Flora of Crete - Recent floras and checklists

Global Floras

POWO (2021). "**Plants of the World Online**. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet; http://www.plantsoftheworldonline.org/Retrieved 08 September 2021."

Mediterranean Flora

Euro+Med (2006-): **Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity**. Published on the Internet http://ww2.bgbm.org/EuroPlusMed

European Flora

Tutin T.G. et al. (eds.) (1964-1993). **Flora Europaea**, vol.1-5, 1(1964, 1993 2nd ed.); 2(1968); 3(1972); 4(1976); 5(1980). Cambridge University Press.

Greek Floras

Strid, A., & Tan, K.(Eds). 1997. **Flora Hellenica Vol. I :** Published by Koeltz Scientific Books

Strid, A., & Tan, K. (2002). **Flora Hellenica Vol 2**: Published by Koeltz Scientific Books

Strid A., 1986. **Mountain Flora of Greece Vol.1.** Cambridge University Press

Strid, A., and Tan, K. 1991. **Mountain flora of Greece. Vol.2**. Edinburgh University Press.

Strid, A. 2016. **Atlas of the Aegean Flora. (Part 1: Texts and plates & 2: Maps).** Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin. Englera 33.

Dimopoulos, P., Raus, T., Bergmeier, E., Constantinidis, T., Iatrou, G., Kokkini, S., Strid, A., & Tzanoudakis, D. (2013). **Vascular plants of Greece: An annotated checklist**. Englera, 31, 1-372.

Dimopoulos, P., et. al. (2021). **FLORA OF GREECE WEB** - **Vascular plants of Greece: An annotated checklist**. http://portal.cybertaxonomy.org/flora-greece/intro

Local Floras

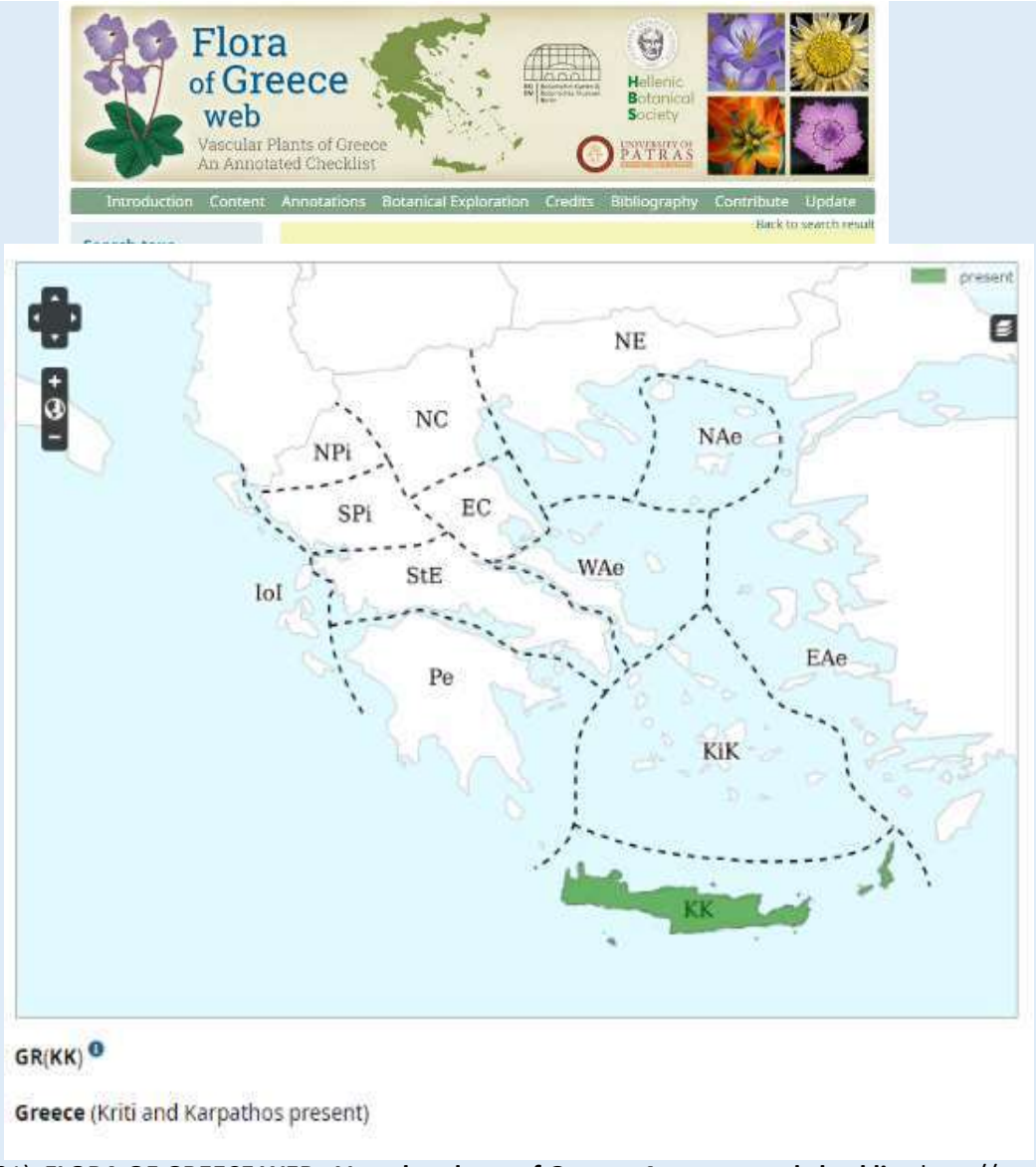
Barclay Sir C. 1986. **Crete: Checklist of the vascular plants**. Englera 6.

Turland N.J., Chilton L., Press J.R. 1993. **Flora of the Cretan Area. Annotated Checklist & Atlas**. The Natural History Museum. St Edmundsbury Press, Bury St. Edmunds, Suffolk, England.

Jahn, R., Schönfelder, P., 1995**. Exkursionsflora für Kreta**. Ulmer, Stuttgart, pp. 446

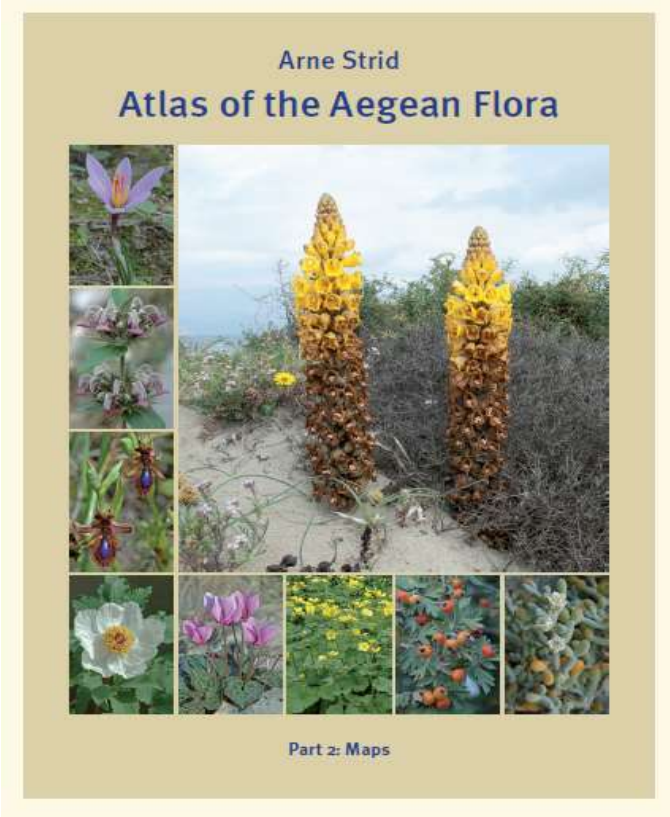
Chilton L., Turland N.J. 1997. **Flora of Crete: a supplement**. Marengo Publications, Retfort.

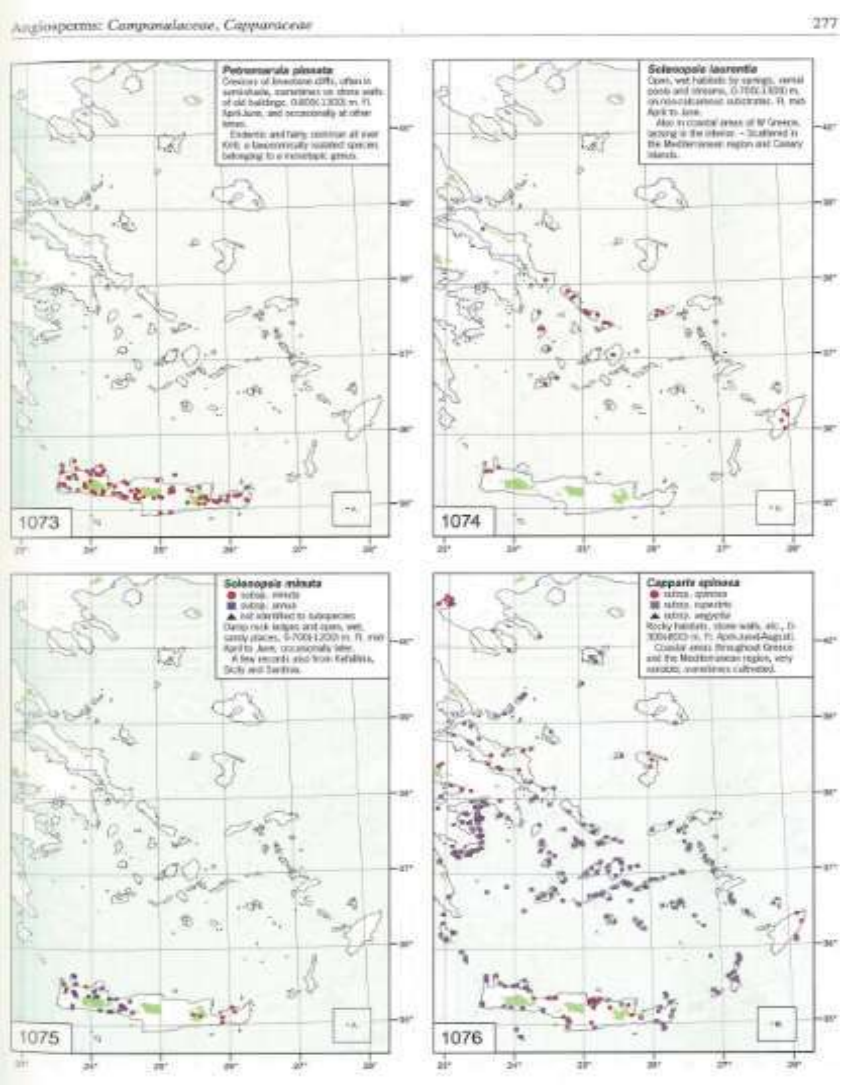
Fielding, J., Turland, N.J., 2005. **Flowers of Crete**. Royal Botanic Gardens, Kew, London, pp. 650.



http://portal.cybertaxonomy.org/flora-greece/intro

Dimopoulos, P., et. al. (2021). **FLORA OF GREECE WEB - Vascular plants of Greece: An annotated checklist**. http://portal.cybertaxonomy.org/flora-greece/intro





Strid, A. 2016. **Atlas of the Aegean Flora. (**Part 1: Texts and plates & 2: Maps). Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin. Englera 33.

Flora of Cretan area

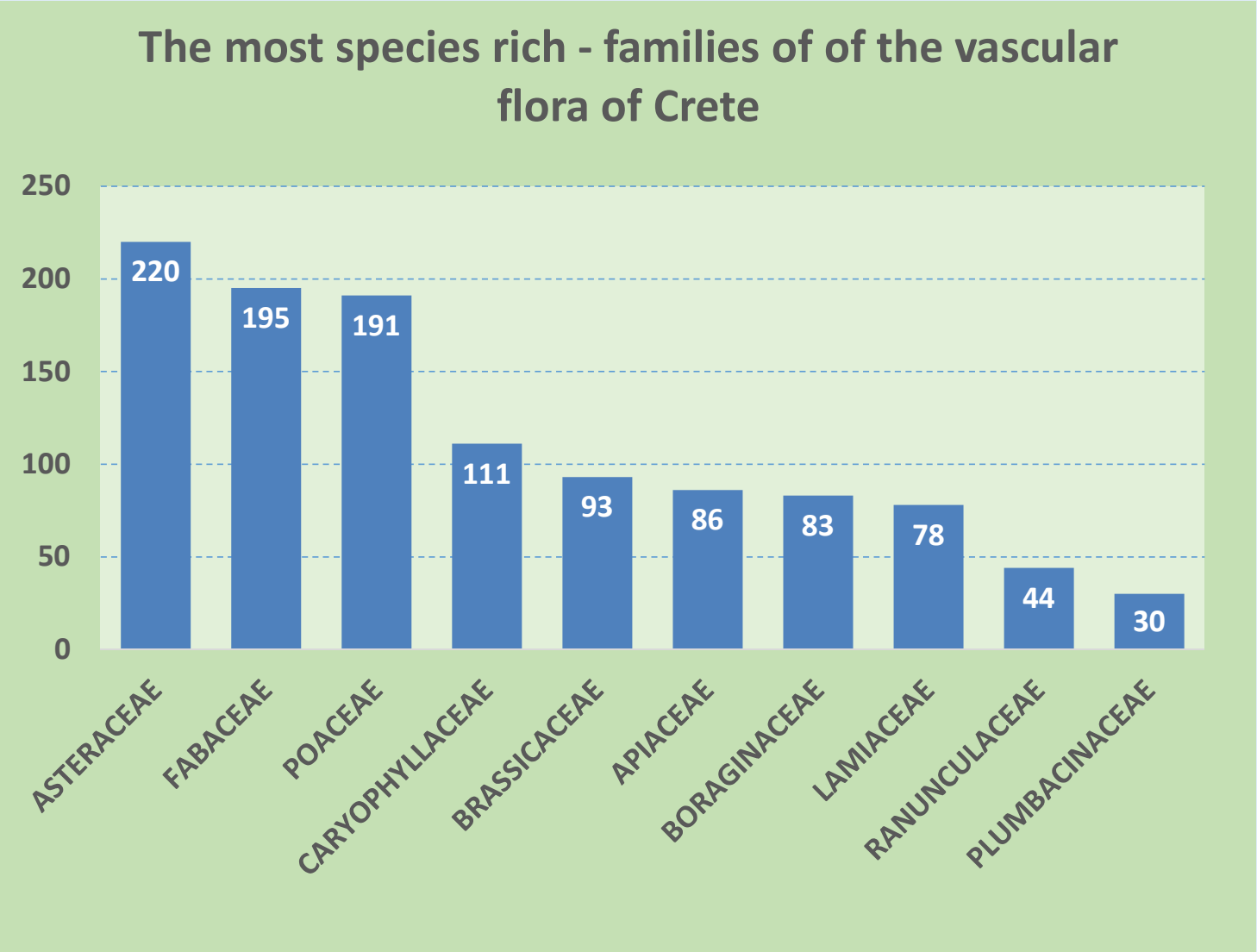
	Families	Genera	Species	subspecies	taxa
Crete and Karpathos (KK)	146	703	2079	571	**2214**

Dimopoulos, P., Raus, T., Bergmeier, E., Constantinidis, T., Iatrou, G., Kokkini, S., Strid, A., & Tzanoudakis, D. (2013). Vascular plants of Greece: An annotated checklist. Englera, 31, 1-372 AND UPDATES

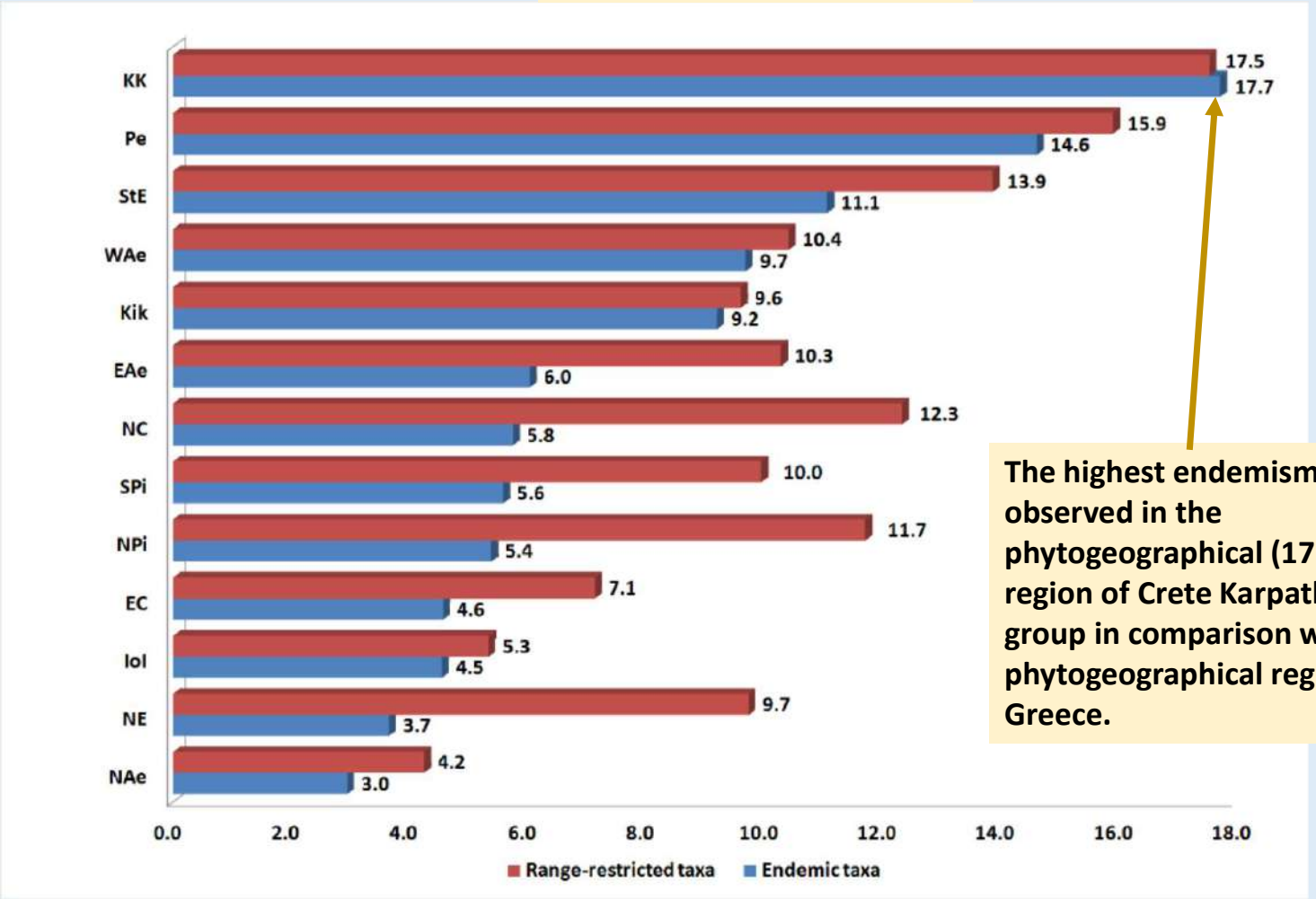
Flora of Crete including small islets and Gavdos

2159 taxa

MPCU data base


The most species rich - families of of the vascular flora of Crete
250
200
150
100
50
0
220
195
191
111
93
86
83
78
44
30
ASTERACEAE
FABACEAE
POACEAE
CARYOPHYLLACEAE
BRASSICACEAE
APIACEAE
BORAGINACEAE
LAMIACEAE
RANUNCULACEAE
PLUMBACINACEAE

Endemism rate

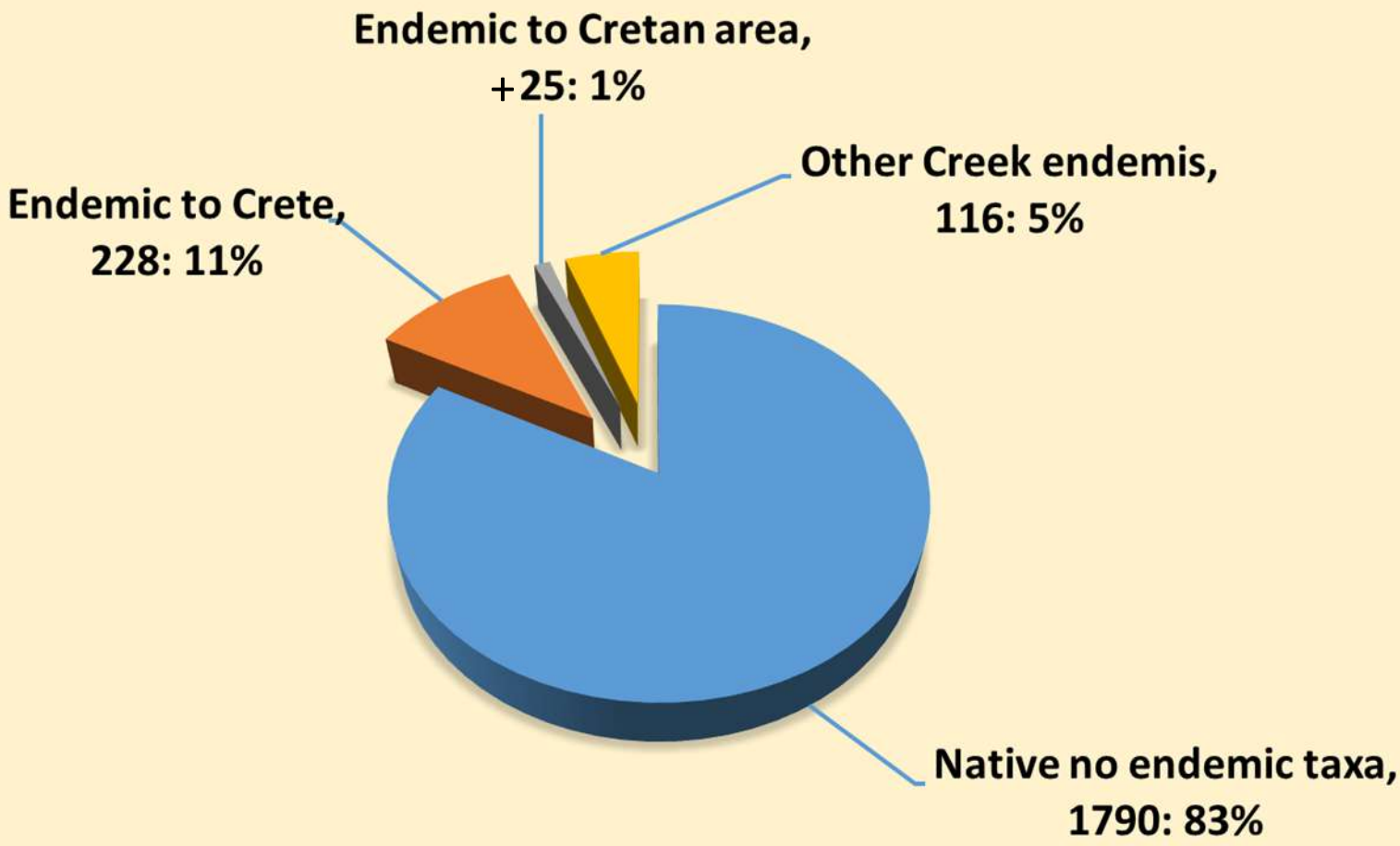


The highest endemism rate is observed in the phytogeographical (17.7%) region of Crete Karpathos group in comparison with 12 phytogeographical regions of Greece.

Dimopoulos, P., Raus, T., Bergmeier, E., Constantinidis, T., Iatrou, G., Kokkini, S., Strid, A., & Tzanoudakis, D. (2013). Vascular plants of Greece: An annotated checklist. Englera, 31, 1-372.

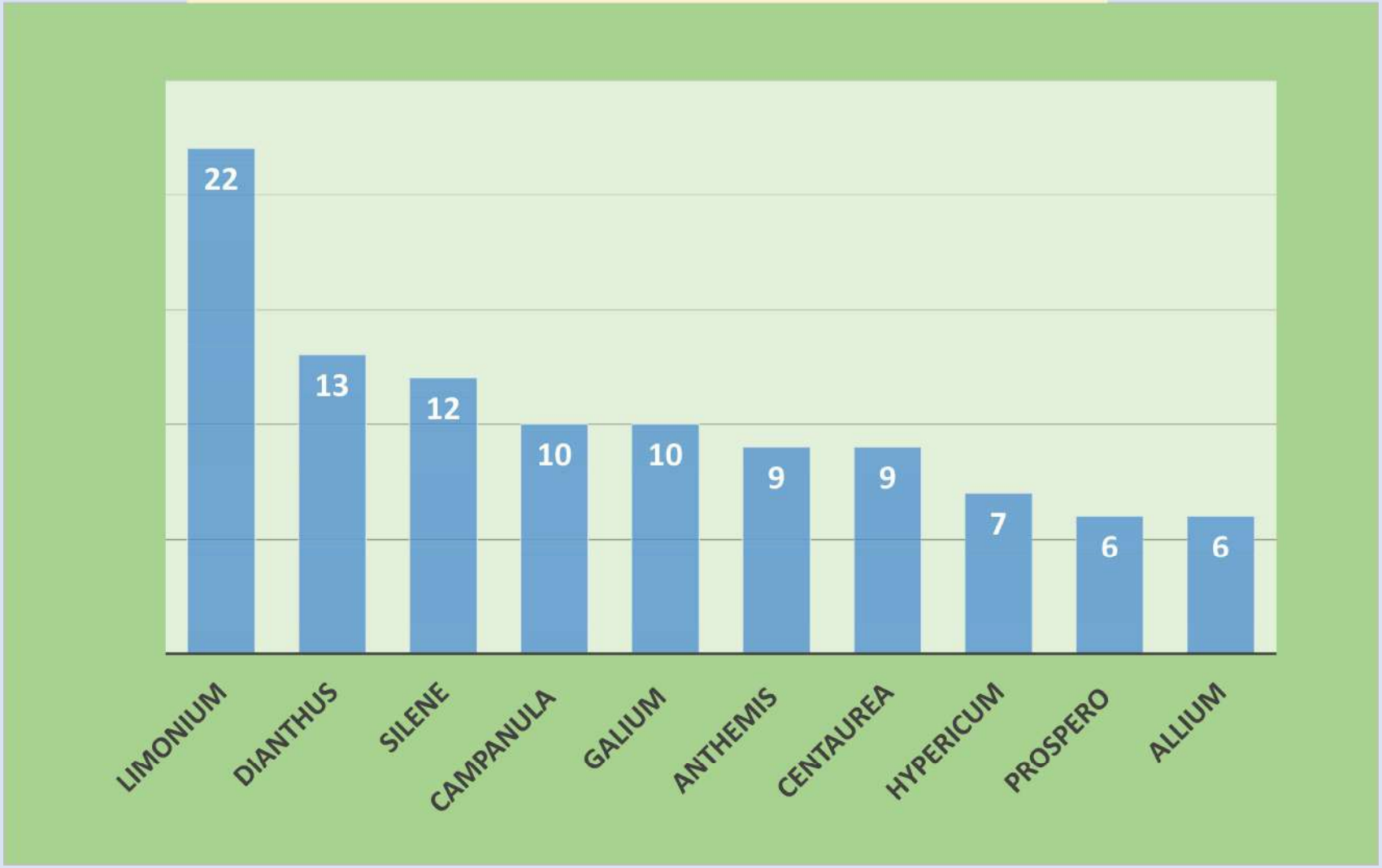
Georghiou, K., & Delipetrou, P. (2010). Patterns and traits of the endemic plants of Greece. Botanical Journal of the Linnean society, 162(2), 130-153.

Endemic taxa to the total native flora of Crete

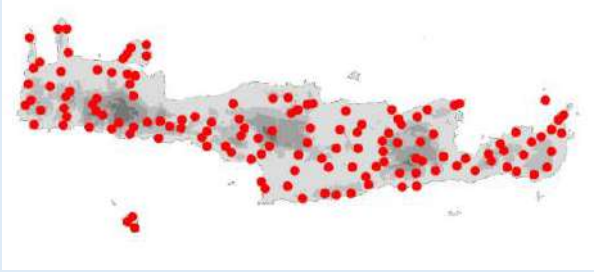


Crete alone (including small islets and Gavdos) has **369 Greek endemics**

The richest genera in Greek Endemic taxa

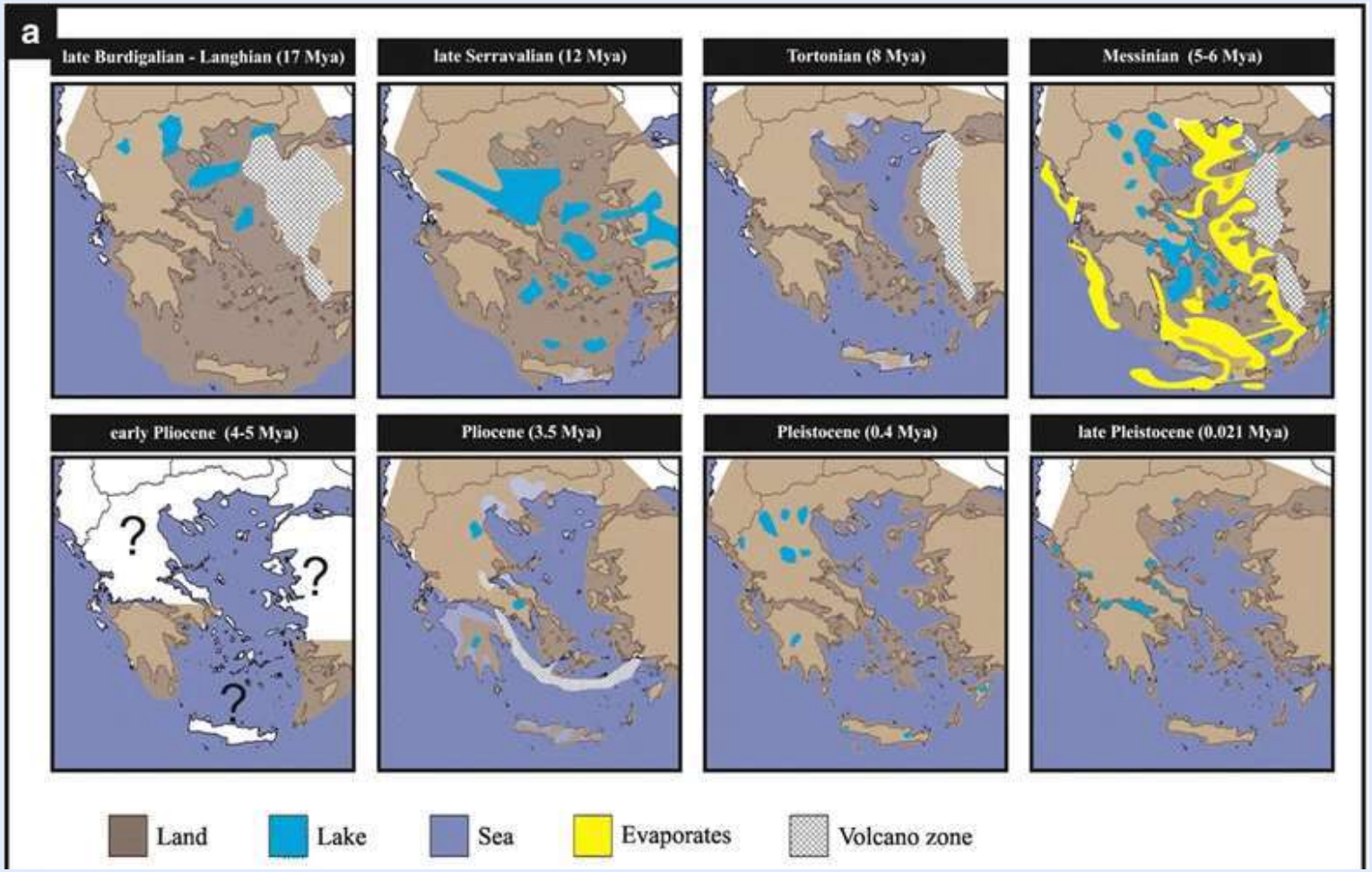


The most widespread Cretan endemic is the small shrub *Asperula rigida*



Jahn, R., 2003. The phytodiversity of the flora of Kriti (Greece) - a survey of the current state of knowledge. Bocconea 16, 845–851. http://www.herbmedit.org/bocconea/ 16-0845.pdf.

Greece from the Miocene to present, drawn based on the present geography.



Crete has existed as an island for some 5 million years ago

Sfenthourakis, S., & Triantis, K. A. (2017). The Aegean archipelago: a natural laboratory of evolution, ecology and civilisations. Journal of Biological Research-Thessaloniki, 24(1), 1-13.

***Zelkova abelicea* a relict endemic tree**

Relictual character of the Flora of Crete

The flora of Crete is characterized by the presence of relict plant taxa with a long paleobotanical history (Greuter, 1972).

They are considered taxonomically isolated taxa, with no close relatives in the current flora.

Cytotaxonomy studies (De Montmollin, 1986), as well as molecular studies (Cellinese et al., 2009) on the endemic flora of Crete, concluded that **the geographical isolation of Crete**, as a separate island, did **not seem to have played a significant role in the evolution** of the endemic flora but played an important role in avoiding competition with plants from other regions.

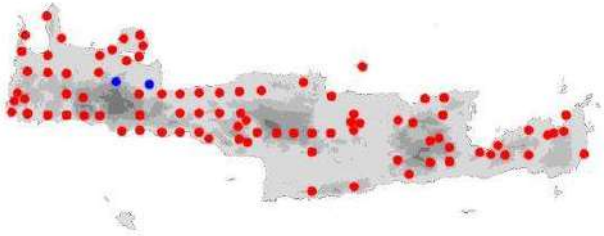
Greuter, W. (1972). The relict element of the flora of Crete and its evolutionary significance. In D. H. Valentine (Ed.), Taxonomy, phylogeography and evolution (pp. 161–177). Academic Press. Braun-Blanquetea.

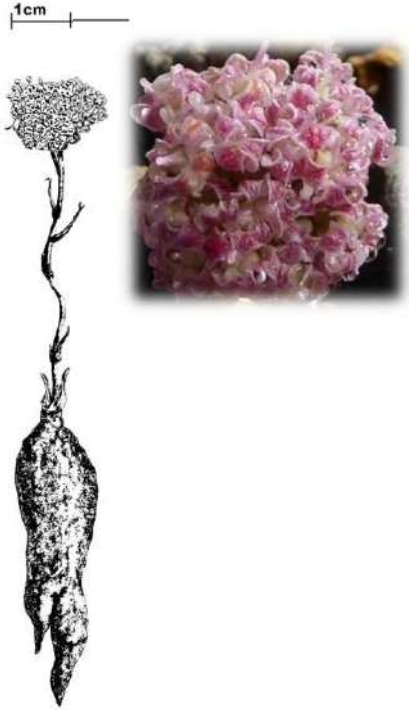
Montmollin De P. (1987). Contribution a l'etude cytotaxonomique de la flore cretoise et en particulier de ses endemiques. These presentee a la Faculte des Sciences de l' Universite de Neuchatel pp.194

Cellinese, N., Smith, S. A., Edwards, E. J., Kim, S. T., Haberle, R. C., Avramakis, M., & Donoghue, M. J. (2009). Historical biogeography of the endemic Campanulaceae of Crete. Journal of Biogeography, 36(7), 1253-1269.

Two endemic genera of Crete

Petromarula pinnata





Horstrissea dolinicola

Important studies on endemism and phytogeography in Crete

Turrill, W. B. 1929. The plant-life of the Balkan Peninsula. A phytogeographical study. – Oxford.

Rechinger, K. H. (1943a). Flora Aegaea. Flora der Inseln und Halbinseln des ägäischen Meeres. Denkschriften, Akademie der Wissenschaften in Wien. Mathematisch-Naturwissenschaftliche Klasse, 105(1), 1-924.

Rechinger, K. H. (1943b). Neue Beiträge zur Flora von Kreta. Akademie der Wissenschaften in Wien, 105, 1-184.

Runemark, H., Snogerup, S. & Nordenstam, B. 1960. Studies in the Aegean flora I. Floristic notes. Bot. Notiser 113: 421-450

Greuter, W. (1971). Betrachtungen zur Pflanzengeographie der Südägäis. In: Strid, A. (ed.), Evolution in the Aegean, Opera Botanica, 30, 49-64.

Greuter, W. (1972). The relict element of the flora of Crete and its evolutionary significance. In D. H. Valentine (Ed.), Taxonomy, phylogeography and evolution (pp. 161–177). Academic Press. Braun-Blanquetea.

Greuter, W. (1979). The origins and evolution of island floras as exemplified by the Aegean archipelago. In: D. Bramwell (Ed.), Plants and Islands (pp. 87-106). Academic Press, London.

Runemark, H. (1980). Studies in the Aegean Flora XXIII. The Dianthus fruticosuscomplex (Caryophyllaceae). Botaniska Notiser, 133, 475–490.

Snogerup, S. (1967). Studies in the Aegean Flora, XVI. Erysimum sect. Cheiranthus. B. Variation and Evolution in the small – population system. Opera Botanica, 14, 1-86.

Snogerup, S. (1971). Evolutionary and plant geographical aspectsof chasmophytic communities. In P. A. Davis, P. C. Har -per, and I. C. Hedgel (Eds.), Plant life of south-west Asia (pp.157-169). Edinburgh, Botanical Society of Edinburgh.

Snogerup, S. 1978. The Aegean endemics, distribution and present situation. I. Preliminary list of some of the most suitable sites for conservation. unpublished preliminary report, for distribution to specialists only. p.22

Runemark, H. 1980. Studies in the Aegean Flora XXIII. The Dianthus fruticosus complex (Caryophyllaceae). Bot. Notiser, Vol.133, p.475-490

And more recently …….

Strid, A. (1986). The mountain flora of Greece with special reference to the Anatolian element. Proceedings of the Royal Society of Edinburgh, Section B: Biological Sciences, 89, 59-68.

Montmollin De P. 1987. Contribution a l'etude cytotaxonomique de la flore cretoise et en particulier de ses endemiques. These presentee a la Faculte des Sciences de l' Universite de Neuchatel pp.194

Georghiou, K., & Delipetrou, P. (2010). Patterns and traits of the endemic plants of Greece. Botanical Journal of the Linnean society, 162(2), 130-153.

Trigas P, Panitsa M, Tsiftsis S (2013) Elevational Gradient of Vascular Plant Species Richness and Endemism in Crete – The Effect of Post-Isolation Mountain Uplift on a Continental Island System. PLoS ONE 8(3): e59425. doi:10.1371/journal.pone.005942

Panitsa, M., Kagiampaki, A., & Kougioumoutzis, K. (2018). Plant diversity and biogeography of the Aegean Archipelago: A New Synthesis. Biogeography and biodiversity of the Aegean, 279-290.

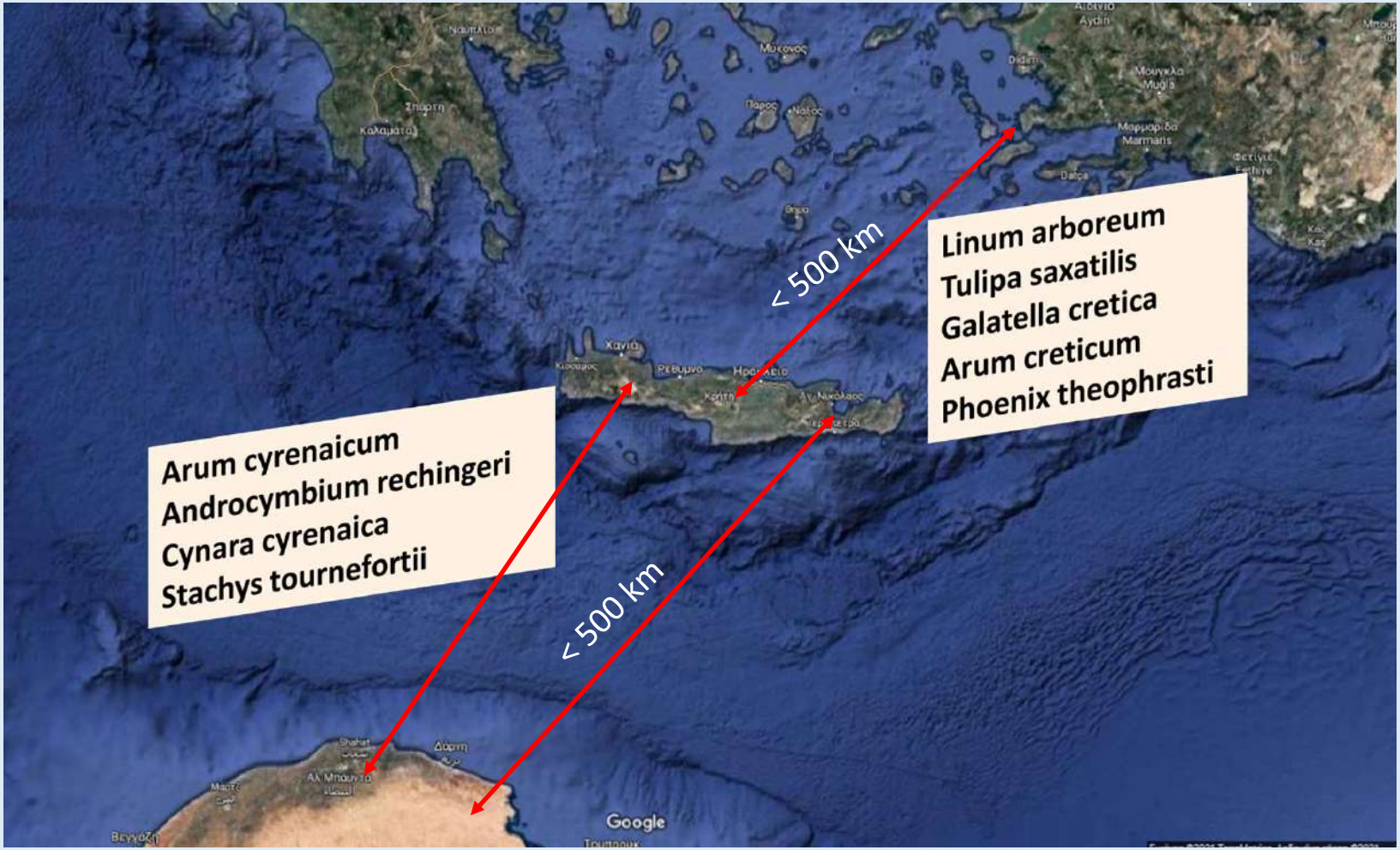
Kougioumoutzis, K., Valli, A. T., Georgopoulou, E., Simaiakis, S. M., Triantis, A. & Trigas, P. (2017). Network biogeography of a complexisland system: the Aegean Archipelago revisited. Journal of Biogeography, 44, 651–660.

Lazarina, M., Kallimanis, A. S., Dimopoulos, P., Psaralexi, M., Michailidou, D. E., & Sgardelis, S. P. (2019). Patterns and drivers of species richness and turnover of neo-endemic and palaeo-endemic vascular plants in a Mediterranean hotspot: The case of Crete, Greece. Journal of Biological Research-Thessaloniki, 26(1), 1-13.

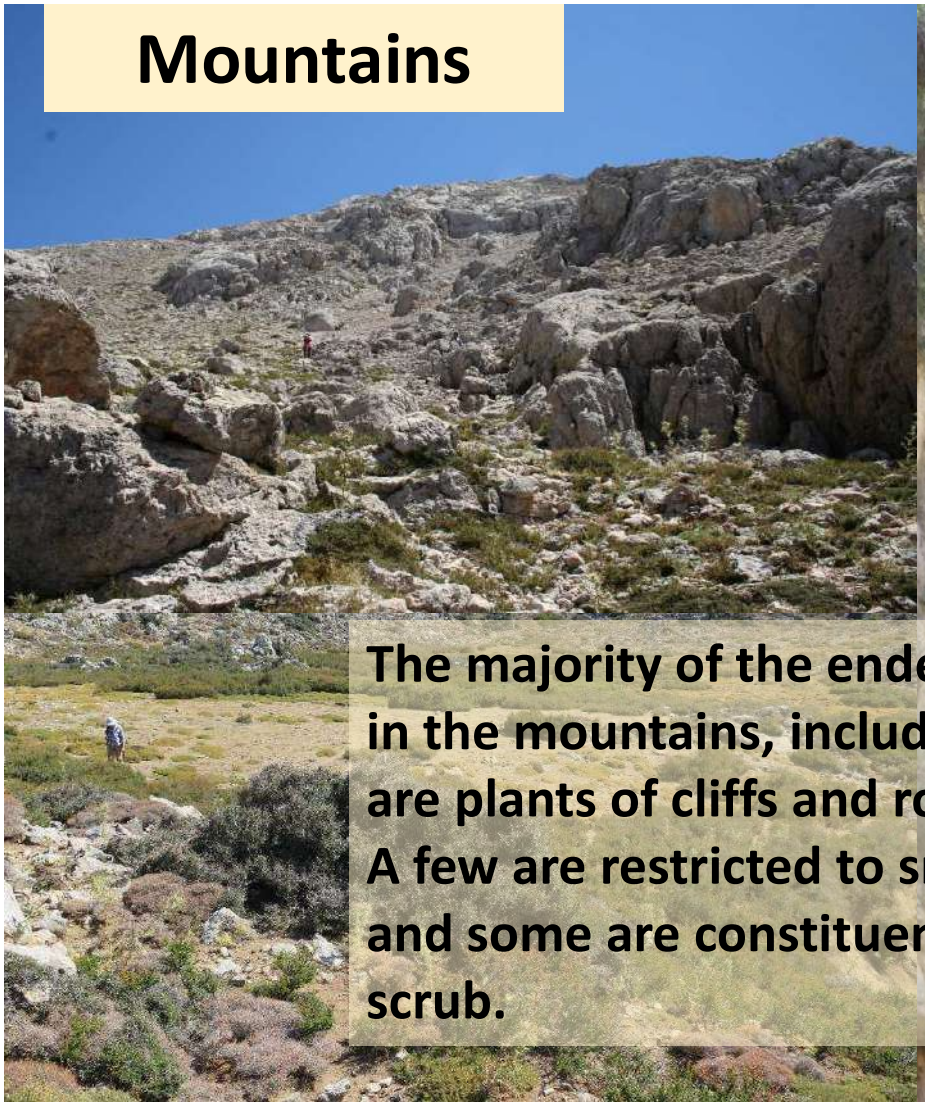
Kougioumoutzis, K., Kokkoris, I. P., Panitsa, M., Trigas, P., Strid, A., & Dimopoulos, P. (2020a). Spatial phylogenetics, biogeographical patterns and conservation implications of the endemic flora of Crete (Aegean, Greece) under climate change scenarios. Biology, 9(8), 199.

Kougioumoutzis, K., Kokkoris, I. P., Panitsa, M., Trigas, P., Strid, A., & Dimopoulos, P. (2020b). Plant diversity patterns and conservation implications under climate-change scenarios in the mediterranean: The case of Crete (Aegean, Greece). Diversity, 12(7), 270.

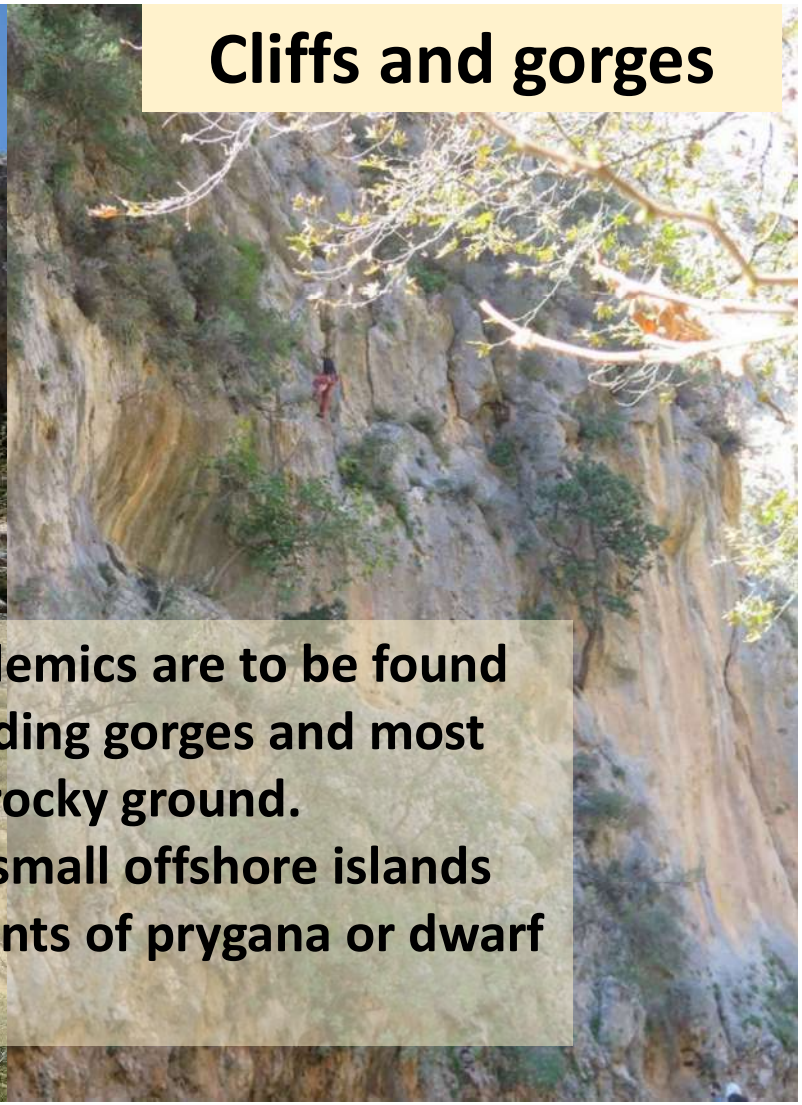
Other range restricted non-endemic to Greece



Mountains



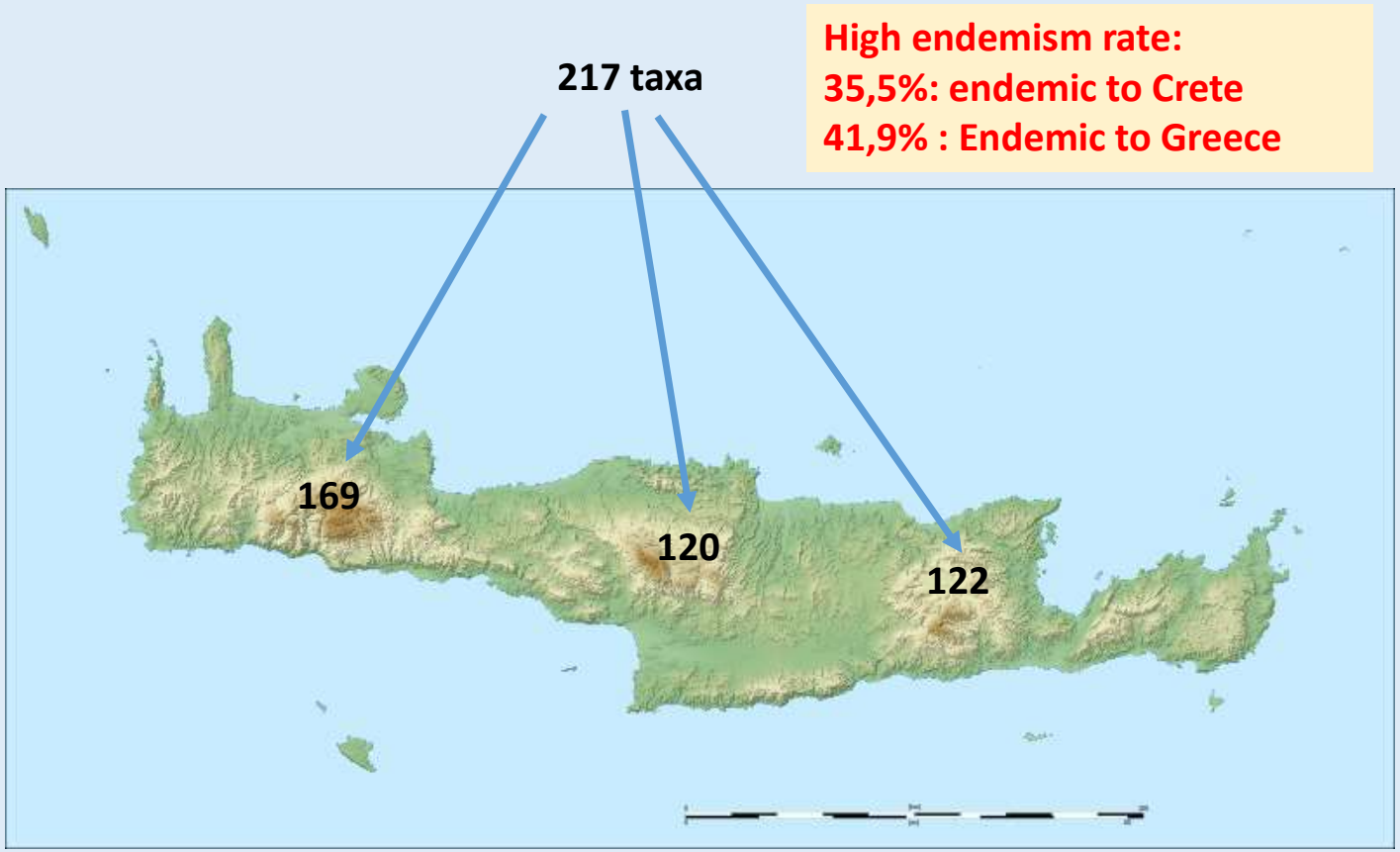
Cliffs and gorges



The majority of the endemics are to be found in the mountains, including gorges and most are plants of cliffs and rocky ground.
A few are restricted to small offshore islands and some are constituents of prygana or dwarf scrub.

Mountain flora

High endemism rate:
35,5%: endemic to Crete
41,9% : Endemic to Greece



Strid, A. (1995). The Greek mountain flora, with special reference to the Central European element. - Bocconea 5: 99-112. - ISSN 1120-4060.

Bergmeier, E. (2002). The vegetation of the high mountains of Crete-a revision and multivariate analysis. *Phytocoenologia*, *32*(2), 205-250.
Strid, A. (1995). The Greek mountain flora, with special reference to the Central European element. - Bocconea 5: 99-112. - ISSN 1120-4060.

Colchicum cretense

Viola fragrans

Noccaea cretica

Draba cretica

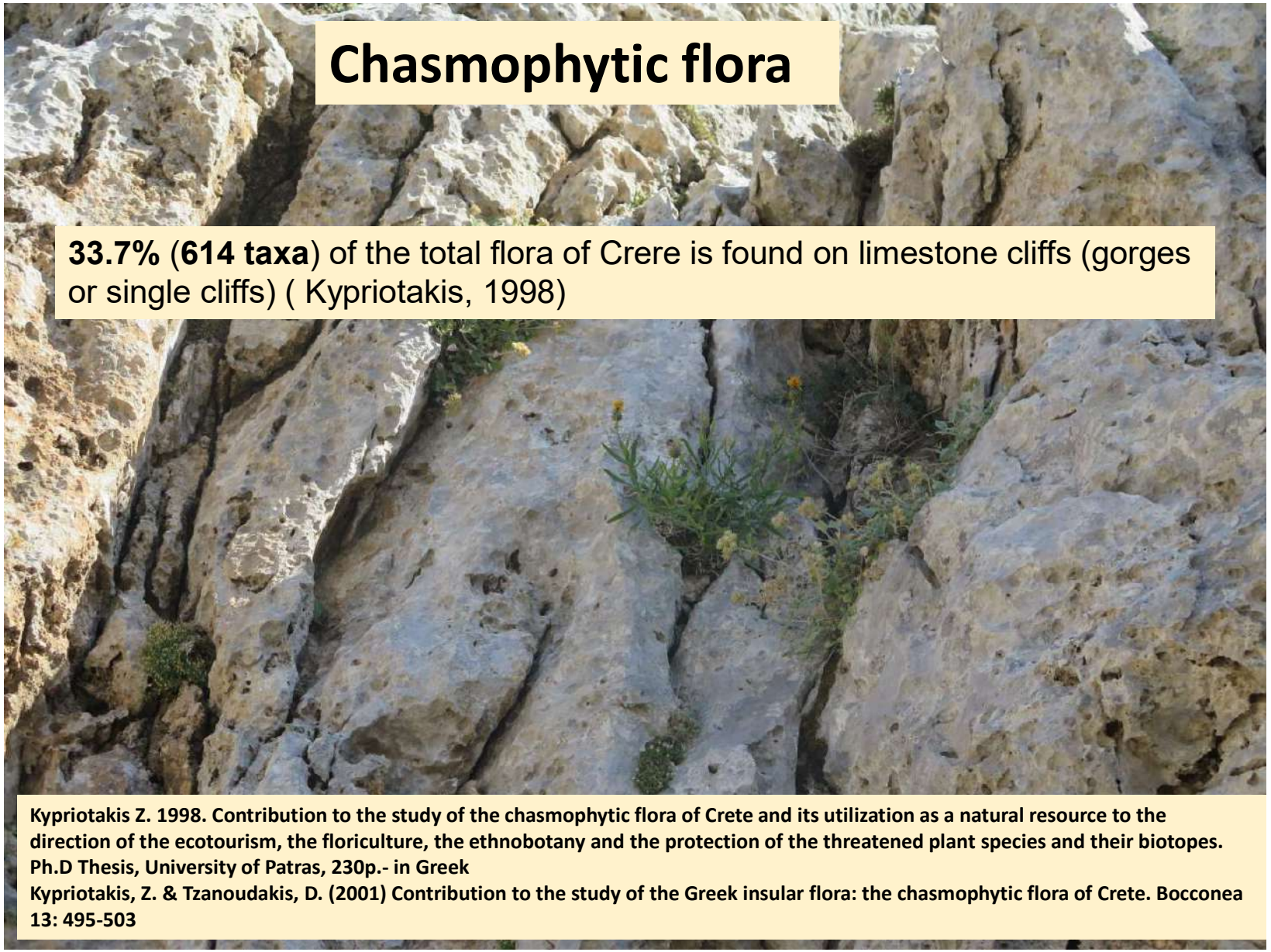
Nepeta sphaciotica *Myosotis solange*

Astragalus idaeus

Horstrissea dolinicola

The high endemism of the Cretan mountains has co-existed with the human presence. Mountains are inaccessible places, but they were important to the Cretans regarding their religious and economic life and functioned as shelters in times of political unrest. From ancient times until today, summer pastoralism with sheep and goats is practiced.

Chasmophytic flora

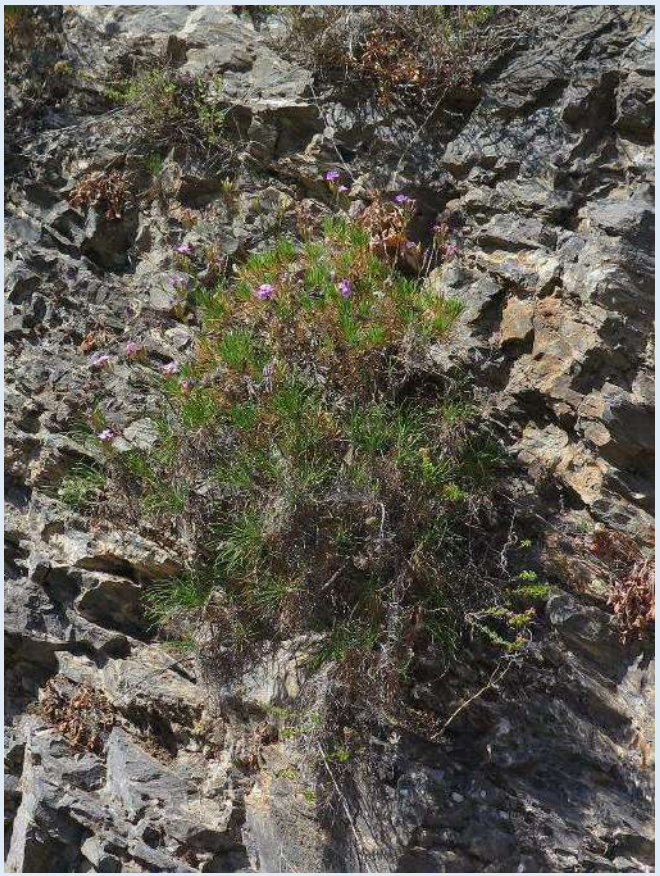


33.7% (**614 taxa**) of the total flora of Crere is found on limestone cliffs (gorges or single cliffs) (Kypriotakis, 1998)

Kypriotakis Z. 1998. Contribution to the study of the chasmophytic flora of Crete and its utilization as a natural resource to the direction of the ecotourism, the floriculture, the ethnobotany and the protection of the threatened plant species and their biotopes. Ph.D Thesis, University of Patras, 230p.- in Greek

Kypriotakis, Z. & Tzanoudakis, D. (2001) Contribution to the study of the Greek insular flora: the chasmophytic flora of Crete. Bocconea 13: 495-503

Helichrysum heldreichii



Dianthus juniperinus

The **endemism rate of plant taxa** specialized on cliffs and gorges (chasmophytes) exceeds **60%**

The richest area of Crete in local Endemic plant taxa

Taking into consideration both of the important biotopes, high mountain peaks, gorges, and cliffs, the area of **Lefka Ori gathers** the largest percentage of endemic plant taxa of Crete. Moreover, Lefka Ori Massif hosts an extremely **large number of local endemic plants that today number 24 taxa** and many more with great phytogeographical interest.

The Natura 2000 areas of Crete

Moreover Lefka Ori:

National Park	**Biosphere Reserves (UNESCO, Man and Biosphere)**
World Heritage Sites (UNESCO)	**Eurodiploma Sites (Council of Europe)**
Biogenetic Reserves (Council of Europe)	

Neophytes

(doubtfully native, naturalized, possibly naturalized, casual)

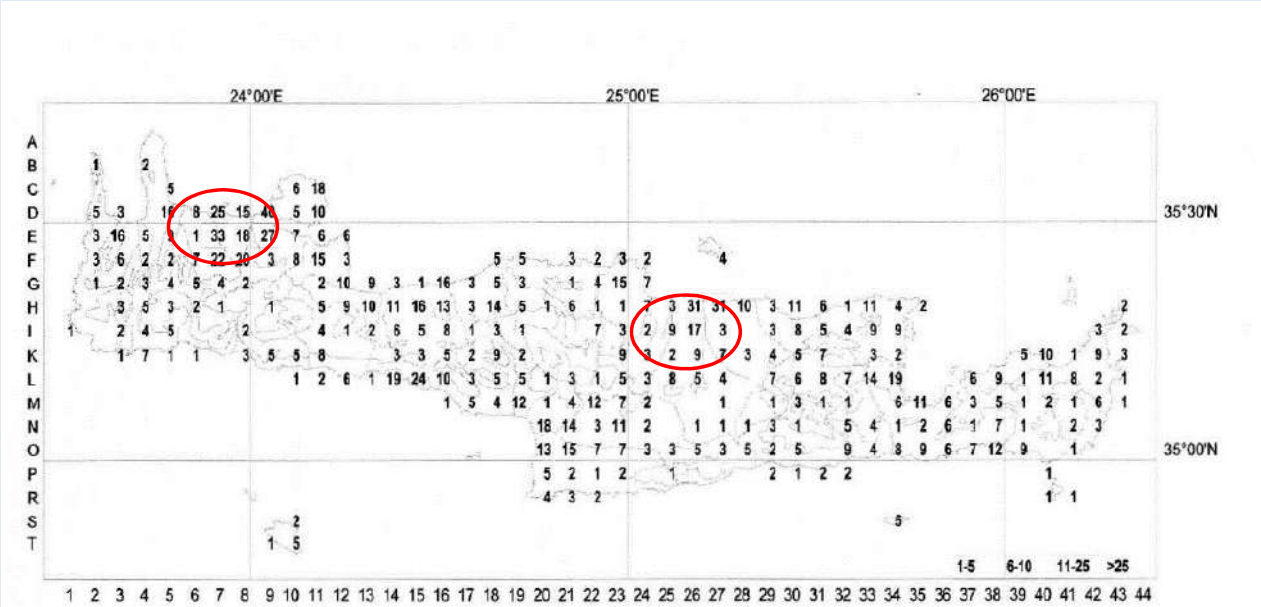
	Doubtfully native	Naturalized	Possible naturalized	Casual	TOTAL
Yannitsaros (**1991**)		70	20	29	119
Jahn & Schonfelder (**1995**)	16	82	28	36	162
Dal Cin D'Agata, C. & al. (**2009**)		91	10	49	150*
MPCU (**2020**)					196

*** The authors refer in addition 95 taxa as 'planted-only'**

Yannitsaros, A. (1991): Adventive flora of Crete: history, phytogeography, ecology and agricultural aspects. Bot. Chron. 10: 299-307.

Jahn, R., & Schonfelder, P. (1995). Exkursionsflora fur Kreta. Ulmer, Stuttgart.

Dal Cin D'Agata, C., Skoula, M. & Brundu, G.(2009). A preliminary inventory of the alien flora of Crete (Greece). — Bocconea 23 : 301-315. 2009. — ISSN 1120-4060.

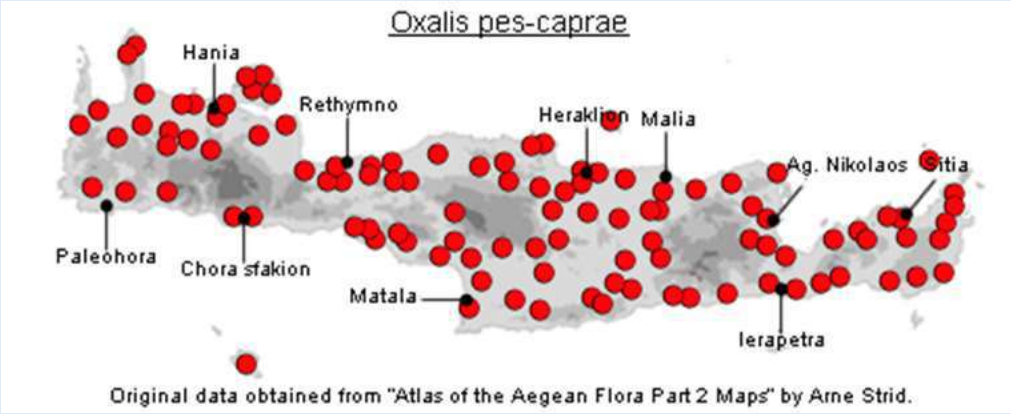


Map 4. Numbers of neophytes per 4'×3' grid cell (143 taxa mapped).

- ✓ The northern coast is more sensitive to invasion of Alien species , as it has the highest levels of urbanization and tourist development, as well as intensive cultivations.
- ✓ The number of species is declining on satellite islets as well as in natural habitats and with the increase of altitude.

Jahn, R., 2003. The phytodiversity of the flora of Kriti (Greece) - a survey of the current state of knowledge. Bocconea 16, 845–851. http://www.herbmedit.org/bocconea/16-0845.pdf.

The most widespread alien species in Crete is *Oxalis pes-caprae*.



Edible plants

Petromarula pinnata

~145 plant taxa

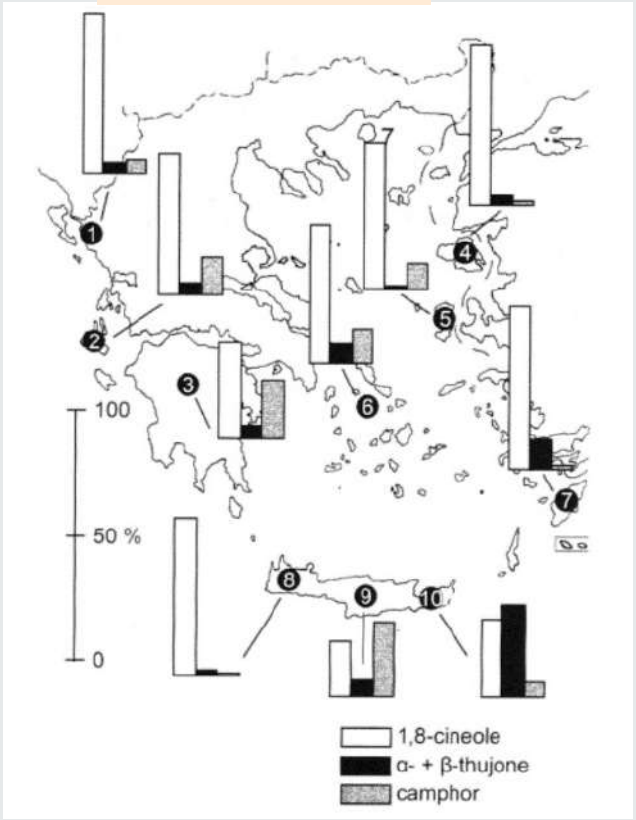
Aromatic and Medicinal plant important to local communities

***Mentha pulegium* L.**
***Origanum dictamnus* L. (E)**
***Origanum microphyllum* (Benth.) Vogel (E)**
***Origanum onites* L.**
***Origanum vulgare* L. subsp. *hirtum* (Link) Ietsw.**
***Origanum x intercedens* Ietswaart**
***Salvia fruticosa* Mill.**
***Satureja thymbra* L.**
***Sideritis syriaca* L. subsp. *syriaca* (E)**
***Thymbra capitata* (L.) Cav.**
***Laurus nobilis* L.**
Cistus creticus* L. subsp. *creticus

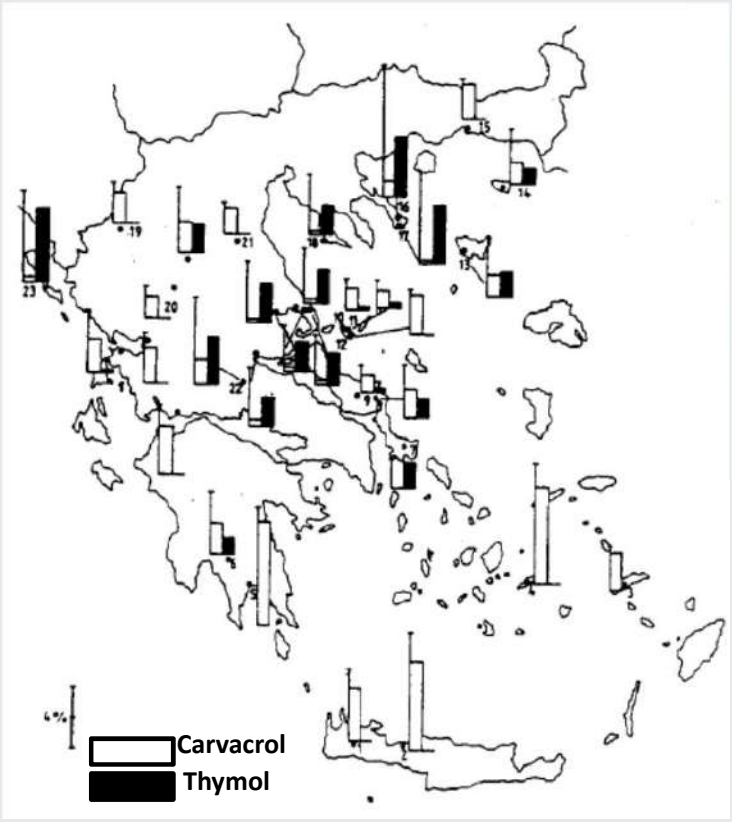
More than 200 plants

Chemotaxonomy of plants of Crete

Salvia fruticosa



Origanum vulgare* subsp. *hirtum



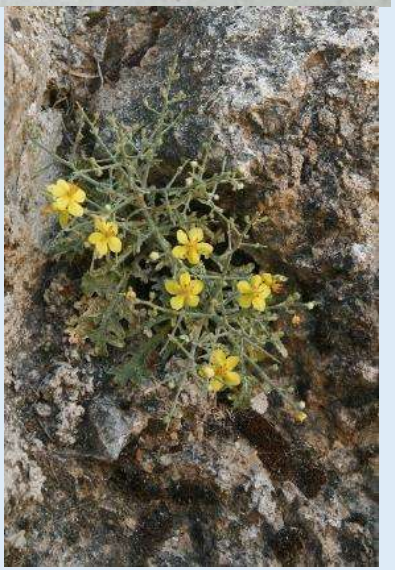
Karousou, R., Hanlidou, E., Kokkini, S. 2000. The sage plants of Greece: Distribution and infraspecific variation: Sage. The genus Salvia 27-53

Vokou, D., S. Kokkini and J.M. Bessiere. 1993. Geographic variation of Greek oregano (*Origanum vulgare* ssp. *hirtum*) essential oils. Biochem. Systematics and Ecol. 21 (2):287-295.

Bee plants in Crete

~100 native plants

Cretan endemic and rare plants are important
for the detection of **honey local geographical origin** through pollen analysis (**melissopalynology**), such as for the local honey ‘pefkothymaromelo’(pine thyme honey) that recently obtained the EU Protected Denomination Origin (PDO)

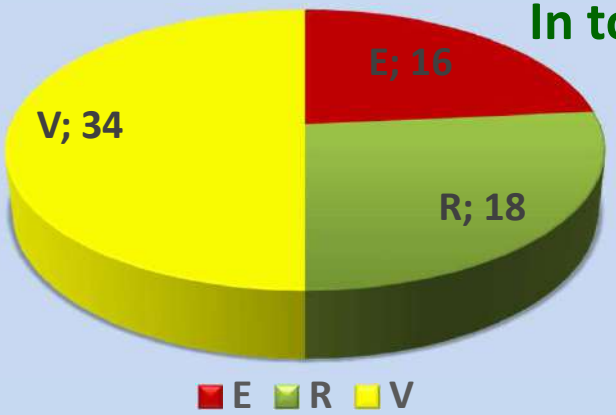


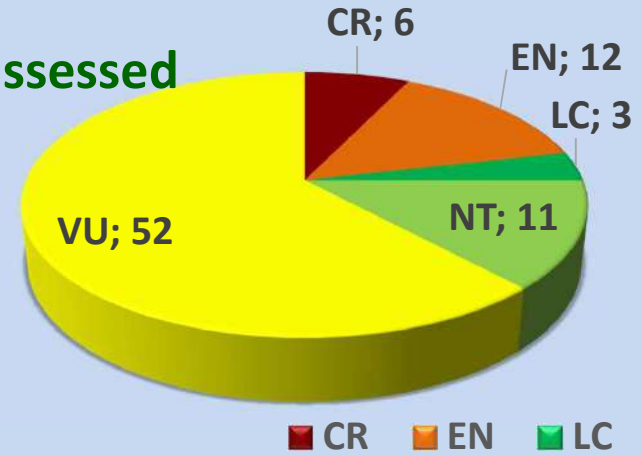
The Red Data Book of Rare and Threatened Plants of Greece
2 publications

1995 **2009** (2 vol.)

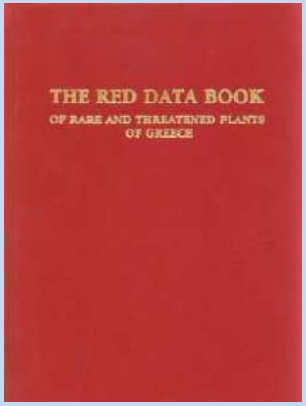
67 taxa ← In Crete → **84 taxa**

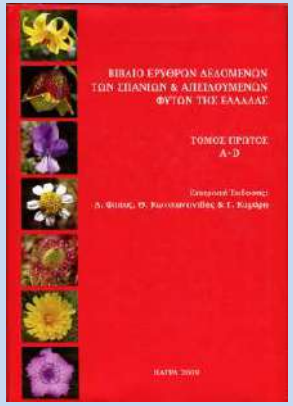
In total 111 taxa assessed





40 in both Books





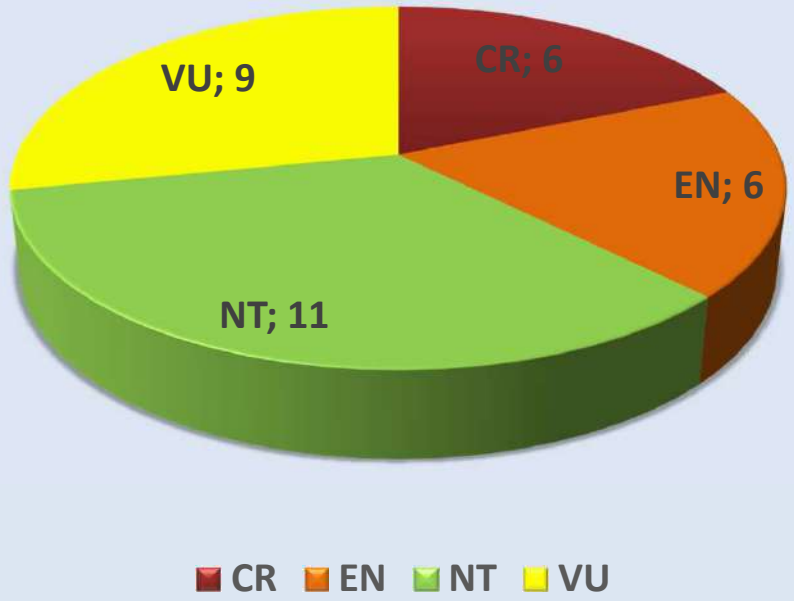
Phitos D., Strid A., Snogerup S., Greuter W. (eds) 1995. The Red Data Book of Rare and Threatened Plants of Greece. World Wide Fund for Nature, Athens.

Φοίτος Δ., Κωνσταντινίδης Θ., Καμάρη Γ. (επιτροπή έκδοσης) 2009. Βιβλίο Ερυθρών Δεδομένων των Σπανίων & Απειλουμένων Φυτών της Ελλάδας. Τόμοι Α και Β. Ελληνική Βοτανική Εταιρεία και Υπουργείο Περιβάλλοντος, Ενέργειας και Κλιματικής Αλλαγής, Πάτρα.

THE IUCN RED LIST OF THREATENED SPECIES™

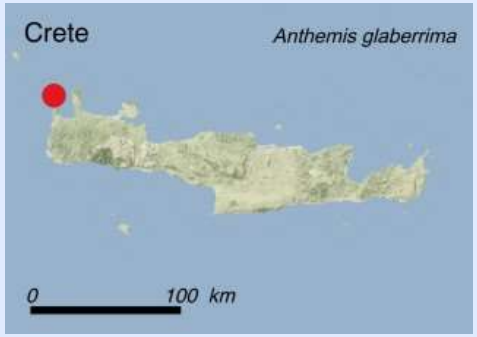
278 taxa assessed for Crete

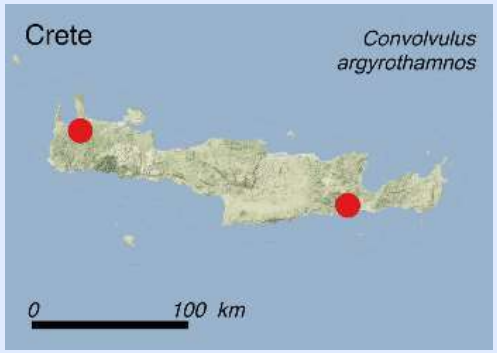
32 threatened



IUCN 2021. *The IUCN Red List of Threatened Species. Version 2021-2*. https://www.iucnredlist.org. Downloaded on [10/09/2021].

The Top 50 Mediterranean Island Plants UPDATE 2017





Pasta S., Perez-Graber A., Fazan L. and Montmollin B. de (Eds). 2017. The Top 50 Mediterranean Island Plants UPDATE 2017. IUCN/SSC/Mediterranean Plant Specialist Group. Neuchâtel (Switzerland). E-book and on line. 141 pp.

Priority list for plant conservation in Crete

According to the Greek legislation (article 10 of Law 3937/2011 on "Conservation of biodiversity') the important species of flora (and fauna) that need action plans for their conservation are:

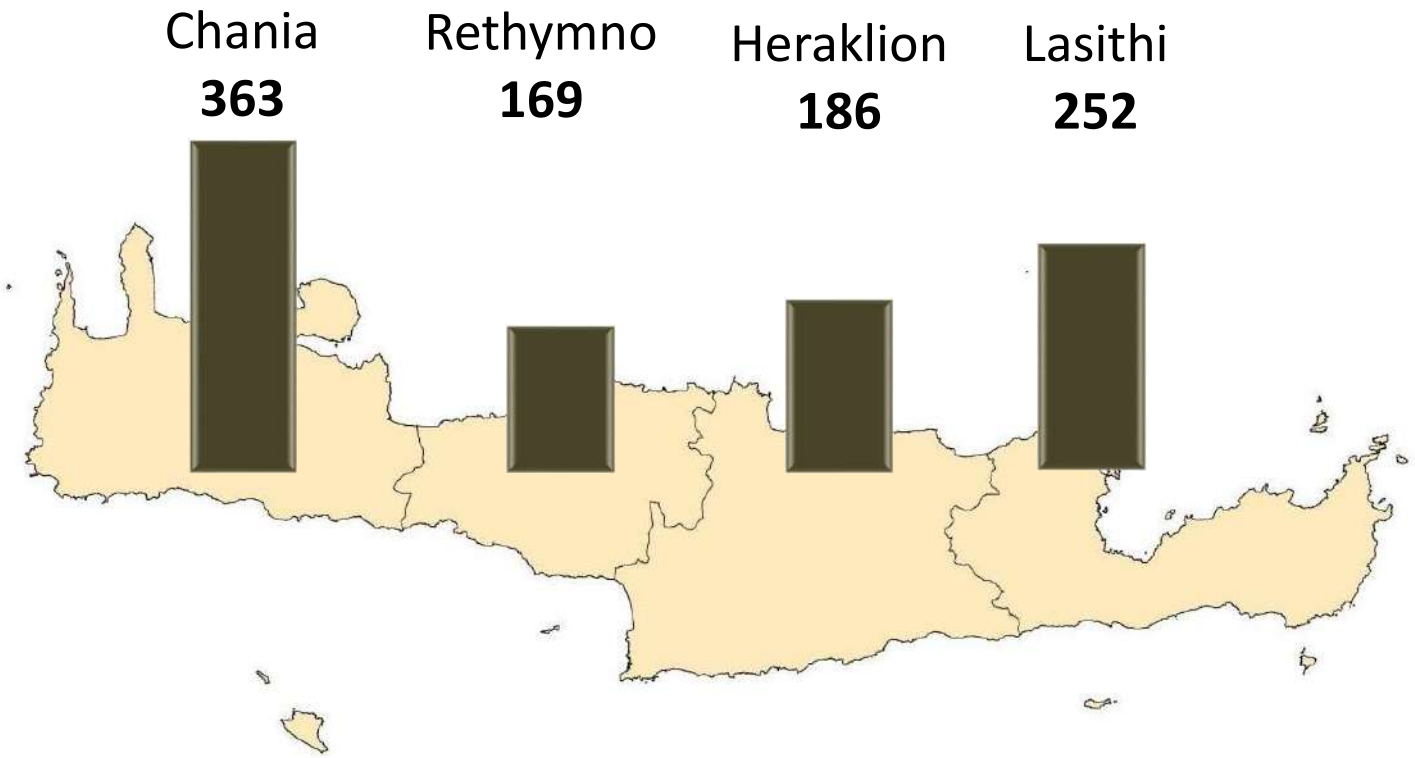
- ✓ All plants endemic to Greece (**369 taxa**)
- ✓ Species listed in the Habitat Directive (**16 taxa**) and of the Bern Convection (**23 taxa***)
- ✓ Plants protected by Greek legislation (PD 67/81) (**252 plant taxa** of which:157 Greek Endemics**)**
- ✓ The threatened plants according to various Red Lists (**171**)
- ✓ The range restricted plants (**11**)

Total in Crete: 491 taxa

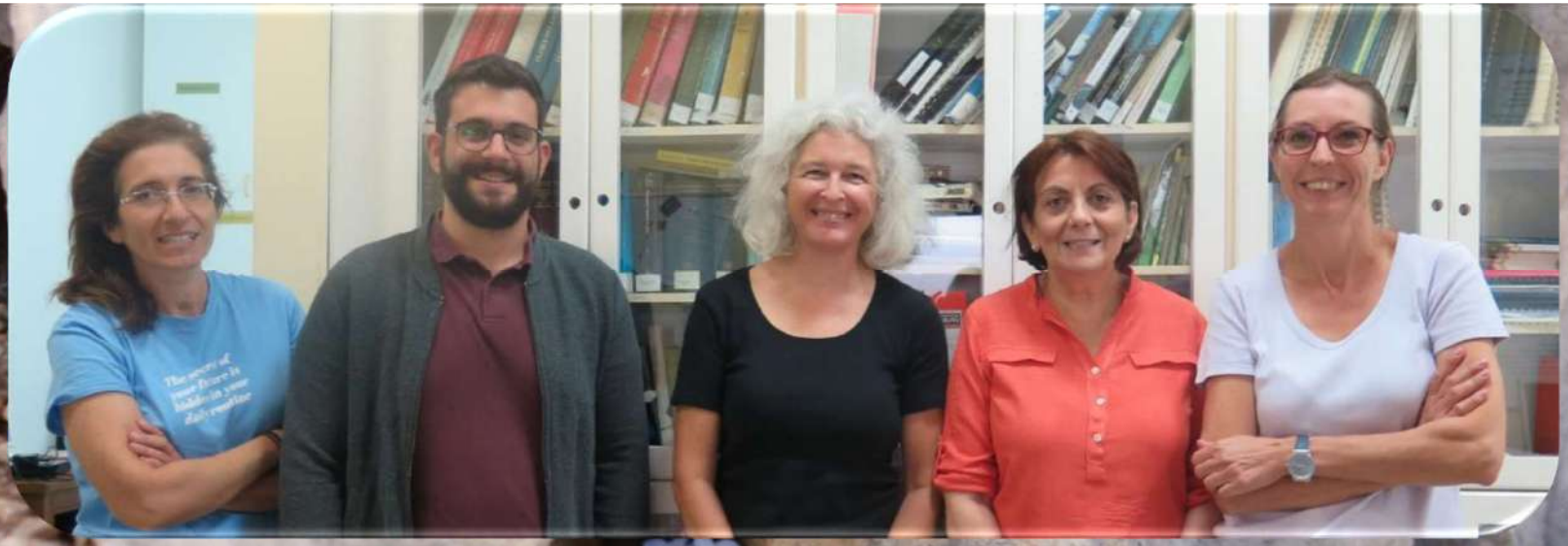
(not including the CWR, other economic plants etc.)

*including 3 marine angiosperms

Number of plant species in need of conservation according to Greek legislation



Project: **Development of a methodology for the enhancement and protection of populations of endangered plant species in Crete. Pilot implementation in the Prefecture of Chania**. Funded by the national Programme “Protection and Upgrading of Forests 2019” of the Green Fund - Special Forest Entity. Partners: MSPU-MAICh- and Decentralized Administration of Crete - Forest Directorate of Chania. Duration: Jan 2020 – Dec 2022



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Panagiota Gotsiou

Thank you!! and welcome to Crete!