

Plants at risk from climate change

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The popular garden flower *Cyclamen* grows natively in the Mediterranean. Climate change could make the region unsuitable for eighteen out of twenty-one species in 50 years time. Ant-dispersed *Cyclamen* can't hope to migrate to suitable new areas without human intervention. This pattern of change and loss could be typical for European plant species.

Background

The impact of global climate change on plant distribution, speciation and extinction is of current concern. Examining species climatic preferences via bioclimatic niche modelling is a key tool to study this impact. There is an established link between bioclimatic niche models and phylogenetic diversification. A next step is to examine future distribution predictions from a phylogenetic perspective. We present such a study using *Cyclamen* (Myrsinaceae), a group which demonstrates morphological and phenological adaptations to its seasonal Mediterranean-type climate. How will the predicted climate change affect future distribution of this popular genus of garden plants?



C. hederifolium naturalised in the UK.
Photo: A. Culham

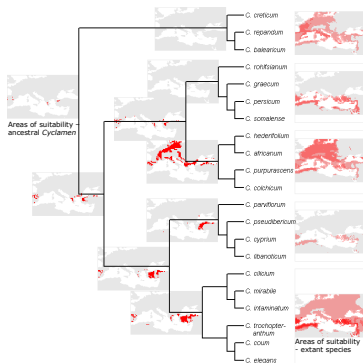


Fig 1: Ancestral reconstructions of environmental preferences in *Cyclamen*.

References

- Phylogeny from Compton, J.A. et al. (2004) *Bot.J. Lin. Soc.* **146**: 339-349
 Distribution data from Grey-Wilson, C. (2003). *Cyclamen: a guide for gardeners...* Batsford, London.
 Poster adapted from Yesson, C. & Culham, A. (2006) *BMC Evolutionary Biology* **6**:72

Acknowledgments

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Media Interest

Daily Mail, Telegraph, Mirror, BBC Radio 4 – The Leading Edge & Gardeners' Question Time

Awards

Highly commended at 2006 BioMedcentral Biology Awards

Results

We demonstrate phylogenetic patterns for some climatic characteristics, and show that most *Cyclamen* have distinct climatic niches, with the exception of several wide-ranging, geographically expansive, species. We reconstruct climate preferences for hypothetical ancestral *Cyclamen* (fig 1). The ancestral *Cyclamen* lineage has a preference for the seasonal Mediterranean climate characteristic of dry summers and wet winters. Future bioclimatic niches, based on BIOCLIM models, are examined with reference to a future climate scenario for the 2050s (fig 2&3). Over the next 50 years we predict a northward shift in the area of climatic suitability, with many areas of current distribution becoming climatically unsuitable. The area of climatic suitability for every *Cyclamen* species is predicted to decrease. For many species, there may be no areas with a suitable climate regardless of dispersal ability, these species are considered to be at high risk of extinction. This risk is examined from a phylogenetic perspective (fig 4).

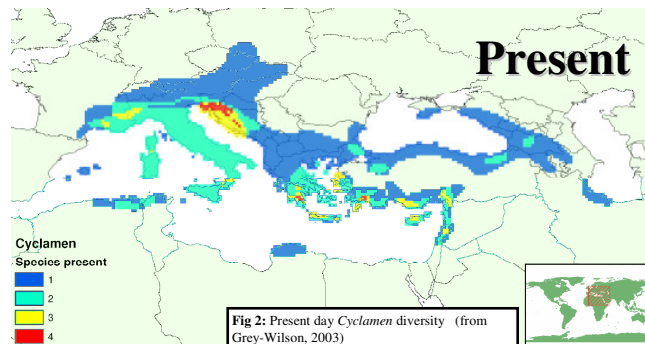


Fig 2: Present day *Cyclamen* diversity (from Grey-Wilson, 2003)

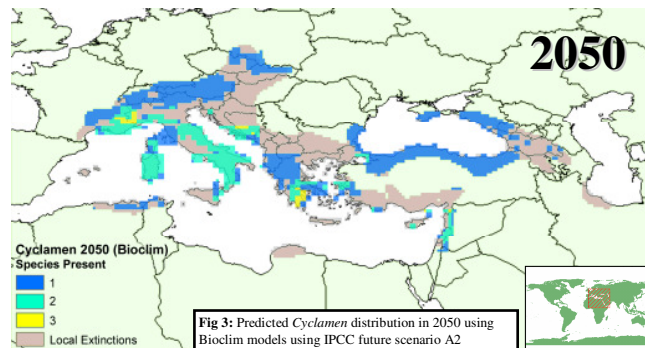


Fig 3: Predicted *Cyclamen* distribution in 2050 using Bioclim models using IPCC future scenario A2

Conclusions

Examining bioclimatic niches from a phylogenetic perspective permits novel interpretations of these models. In particular, reconstruction of ancestral niches can provide testable hypothesis about the historical development of lineages. In the future we can expect a northwards shift in climatic suitability for the genus *Cyclamen*. If this proves to be the case then dispersal is the best chance of survival, which seems highly unlikely for ant-dispersed *Cyclamen*. Human-assisted establishment of *Cyclamen* species well outside their native ranges offers hope and could provide the only means of dispersal to potentially suitable future environments. Even without human intervention the phylogenetic perspective demonstrates that major lineages could survive climate change even if many species are lost.

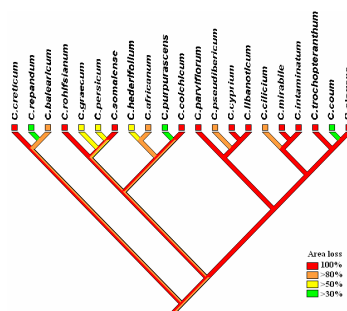


Fig 4: Extinction risk in *Cyclamen*, a phylogenetic perspective. Phylogeny from Compton et al., (2004)



A modern garden cultivar of *C. persicum*
Photo: C. Yesson