April–May 1997 that was found to originate from vortex depletions[5].

Figure 1d incorporates the trends in Fig. 1b, c, and this combination accounts for a large fraction of the longitudinal trend variations. From 30°–60° N, it explains 81% of the variance (correlation, 0.90), whereas the height trend alone explains only 35% of depletion during the April–May periods of 1979–97. Figure 1e shows the trends of the residuals from the latter regression. The remaining downward trend is about 3% per decade and is caused by factors such as local ozone depletion outside the vortex. The remaining longitudinal variation could be due to failure to take vortex depletions in other years into account.

In the Southern Hemisphere, the vortex is much more circumpolar and breaks up about two months later in the season than in the Northern Hemisphere. Depletion of the Antarctic vortex therefore has little influence on southern mid-latitudes in spring, and this helps to explain why the downward ozone trend in northern mid-latitudes is much larger than in their southern counterparts in spring[1].

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1. World Meteorological Organization *Glob. Ozone Res. Monitor. Proj. Rep.* **44,** Ch. 4 (1999).
2. Hood, L. L., Rossi, S. & Beulen, M. *J. Geophys. Res.* **104,** 23321–24339 (1999).
3. Entzian, G. & Peters, D. *Proc. Quad. Ozone Symp.*, Sapporo, 3–8 July 2000.
4. McPeters, R. D., Hollandsworth, S. M., Flynn, L. E., Herman, J. R. & Seftor, C. J. *Geophys. Res. Lett.* **23,** 3699–3702 (1996).
5. Knudsen, B. M. & Grooβ, J.-U. *J. Geophys. Res.* **105,** 6885–6890 (2000).
6. Morcrette, J.-J. *J. Geophys. Res.* **96,** 9121–9132 (1991).
7. Larsen, N., Knudsen, B., Mikkelsen, I. S., Jørgensen, T. S. & Eriksen, P. *Geophys. Res. Lett.* **21,** 1611–1614 (1994).
8. Knudsen, B. M. *et al. Geophys. Res. Lett.* **25,** 627–630 (1998).
9. Müller, R. *et al. Nature* **389,** 709–712 (1997).
10. Zerefos, C. S., Bais, A. F., Ziomas, I. C. & Bojkov, R. D. *J. Geophys. Res.* **97,** 10135–10144 (1992).

Plant genetics

Ancient wild olives in Mediterranean forests

Early domestication and extensive cultivation[1] have meant that staple Mediterranean fruit crops such as olives, grapes and dates exist in wild-looking forms that are secondary derivatives produced by sexual reproduction among cultivated plants (cultivars), which were initially propagated vegetatively[2]. By using genetic markers associated with characters that render plants unsuitable for domestication, we show here that genuinely wild olive trees, which cannot be distinguished morphologically from feral forms, still survive in a few Mediterranean forests. These wild stocks are genetically distinct and more variable than either the crop strains or their derived feral forms, a finding that has important implications for the conservation of these ancient lineages.

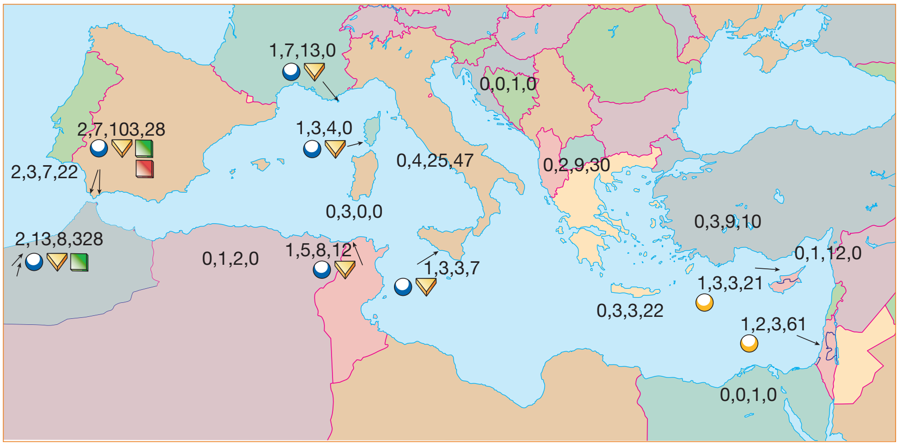

Figure 1 Geographical distribution of forests tested for the presence of genuinely wild olive trees. Five different alleles (each represented by a different symbol) peculiar to these trees were found to be present at frequencies of 4–32%, 8–14%, 20–24%, 10–22% and 4–15%, respectively; these were present exclusively in the 10 forests suspected of containing genuinely wild olives. Arrows, population locations tested. For each country, the sequence of four numbers indicates populations of wild oleasters, feral oleasters, formal cultivars and locally cultivated clones, respectively, that were scored genetically.

We surveyed ten forests in seven countries around the Mediterranean basin (Fig. 1) to identify any surviving genuinely wild olive trees. These forests were selected as the most likely to contain these rare trees, according to whether they were exposed to past and present climatic conditions suitable for oleaster growth[3], and from consideration of their past and present isolation from areas of cultivated olive trees. We also assessed whether the large oleaster populations (wild and feral forms are collectively known as oleasters) in these forests might have offset the influence of occasional pollen and seed flow from cultivated areas. In the eastern part of the basin, where olive trees have been extensively cultivated for longer periods[1], we used less restrictive criteria, but still found no candidate forests in Egypt, Syria, Turkey, Crete or Greece.

In each selected forest, we sampled 40 trees and scored them for allozyme markers, particularly at loci that are known to be genetically linked to regions that control the juvenile phase[4] which, if prolonged, is unsuitable for olive domestication. We compared our results to those obtained at the same loci from 802 olive clones representing the main domesticated olive[5–7] and from 1,395 feral olives from 62 sites[4,8], including forests throughout the Mediterranean basin that did not satisfy our selection criteria.

Of the 26 alleles identified at eight loci, two alleles at each of the two loci associated with characters unsuitable for domestication, as well as another allele at another locus, were present exclusively in the populations of the 10 selected forests considered most likely to contain genuinely wild olives (Fig. 1). The other alleles were common to cultivated olives and oleasters, whatever their origins. In the occidental area, the average genetic differentiation values (F_{st}) are 6% between the eight putative wild populations and 22% between these and other nearby oleaster populations.

Our results provide evidence of the survival of indigenous oleaster populations, particularly in the western part of the basin, as suggested previously[1]. Genetic-diversity values over cultivars, feral olives and the wild olives of the selected forests were 0.286, 0.414 and 0.506, which is consistent with our interpretation that the domesticated olive represents a sample of the genetic variation in genuinely wild olive populations that persist today. Owing to their very long lifespan, these wild trees should be closely related to the neolithic olives recognized as the crop progenitor. Our discovery will encourage the preservation of environmental conditions that favour the survival of large populations of oleasters that are properly isolated from cultivated olive trees.

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1. Zohary, D. & Spiegel-Roy, P. *Science* **187,** 319–327 (1975).
2. Turrill, W. B. *Kew Bull.* **3,** 439–442 (1951).
3. Terral, J. F. & Mengüal, X. *Palaeogeogr. Palaeoclim. Palaeoecol.* **153,** 71–92 (1999).
4. Ouazzani, N., Lumaret, R., Villemur, P. & Di Giusto, F. *J. Hered.* **84,** 34–42 (1993).
5. Ouazzani, N., Lumaret, R. & Villemur, P. *Agronomie* **15,** 31–37 (1995).
6. Trujillo, I., Rallo, L. & Arùs, P. *J. Am. Soc. Hort. Sci.* **120,** 318–324 (1995).
7. Ouazzani, N., Lumaret, R. & Villemur, P. *Euphytica* **91,** 9–20 (1996).
8. Lumaret, R., Ouazzani, N., Michaud, H. & Villemur, P. *Bocconea* **7,** 39–42 (1997).