Comment on "Changes in Climatic Water Balance Drive Downhill Shifts in Plant Species' Optimum Elevations"

Adam Wolf and William R. L. Anderegg

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Adam Wolf[1]* and William R. L. Anderegg[2]

Crimmins *et al*. (Reports, 21 January 2011, p. 324) presented a study that purports to show that plants in California are shifting downslope to maintain a constant water deficit. We argue that the results are limited in scope to just a handful of woody species in one part of the state and are confounded by methodological errors.

We admire the effort of Crimmins *et al*. (*1*) to tackle the important and complex issue of species' ranges shifts, particularly in California, a floristically rich state. We have worked with some of these same data and appreciate the difficulty of drawing firm conclusions from them, particularly given the quality of historical data and profound underlying sampling biases. However, the title of their paper overstates the scope and importance of the findings presented. The study concerns shifts in 69 of the 1703 species reported in the Wieslander surveys (*2*, *3*), which is less than 5% of the surveyed taxa. Furthermore, the abstract of (*1*) indicates that the results apply to plant species in general. But the study is almost exclusively restricted to woody species, including just three herbaceous species. Yet only 20% of the 8889 species native to California recognized on the Calflora species list (*4*) are woody. Together, these would seem to limit the importance and generality of these results.

The study also suffers from methodological issues. First, the Wieslander surveys (*2*, *3*) covered the central Sierra Nevada and the Central Coast regions; the late-period surveys almost wholly exclude these survey regions. Because treeline declines ~100 m for every degree of latitude (*5*), we question whether Crimmins *et al*. measured a temporal shift or simply a change in survey locales, as sampling intensity was transferred from the Central Coast northward to the Klamath range. Second, the authors corrected for bias by stratifying sampling along the moisture deficit gradient and subsequently applied this stratification to temperature and elevation shifts. Strictly speaking, bias correction along one dimension does not lead to bias correction along another (*6*). Third, the Wieslander surveys were not in fact true presence-absence surveys but rather summarized the dominant species in 800-m^2 plots (*7*). Although this could be loosely interpreted as presence-absence for woody perennials, it is not clear that true absence of herbaceous species could be inferred from these data. Finally, the evidence that these species are tracking a moisture deficit envelope is weak to nonexistent. Crimmins *et al*. infer that because the mean difference in moisture deficit was not different from zero that these species must be tracking their moisture deficit niche. However, the correlation between elevation shifts and water-deficit shifts, using the data provided in the supporting online material for (*1*), is 0.26 and is statistically nonsignificant. This could just as easily be used as evidence to argue the opposite of what is claimed in the paper's title (*1*). Because species' range shifts with climate change hold numerous implications, especially for conservation, we urge great caution in the detection of such shifts with historical data, attribution to climate factors, and suggested generality across species.

[1]Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544, USA. [2]Department of Biology, Stanford University, Stanford, CA 94305, USA.

*To whom correspondence should be addressed. E-mail: adamwolf@princeton.edu

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