

# Is science as global as we think?

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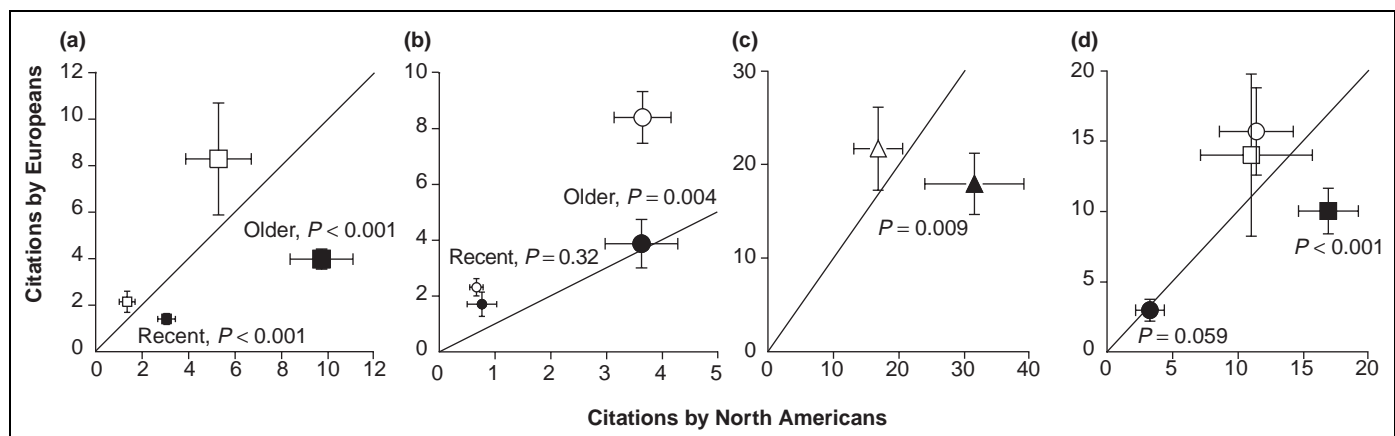
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A cornerstone of scientific practice is the perceived freedom with which knowledge is disseminated. But does the scientific community make good use of all that is available? Researchers have, on occasion, been accused of preferentially citing the work of colleagues close to home while ignoring those from other parts of the world [1,2]. Such practices, if true, raise serious concerns about the free flow of scientific information [1]. Recently, Leimu and Koricheva [3] showed that ecological papers written by authors from the USA attracted significantly more citations than did those by authors based in Europe. They suggested that such differences could be due to parochial citation practices; papers by USA-based authors could receive more citations if they are attracting not only their fair share of European citations, but also a disproportionate share of citations from the USA ([3], see also [1,4]). In one journal (*Oecologia*), such a pattern was indeed found [5]. Here, we test if such a geographical citation bias extends to other journals and different types of papers, and if biases diminish over time as important research results become more widely known.

For our analysis, we compared publications from two major geographical regions: Europe (Norway, Switzerland and European Union countries) and North America (USA and Canada). Focal (cited) papers and citing papers were only included in the analysis if the affiliations of authors

were all inside one of these regions. Citing articles were included irrespective of the journal in which they were published, and were found using the 'citation search' service of Web of Science (INC information; <http://wos.mimas.ac.uk/>) up to those published in the year 2003. Self-citations (citing papers that had authors in common with the cited paper) were excluded from analysis.

Parochial citing practices could arise through differences in the readership of American versus European journals (i.e. if Americans do not read European journals and vice versa, [1]). But if papers published in the same journal are cited differently depending on the continent in which the citing author resides, evidence for parochial practices becomes stronger. We therefore tracked the fate of papers by North American- and European-based authors publishing in the same journal, focusing on recent (2000) and relatively older (1997) papers appearing in *Ecology* (published in the USA;  $n=60$  during 1997 and 75 during 2000) and *Journal of Animal Ecology* (published in Europe;  $n=61$  during 1997 and 73 during 2000). We also included a random sample of 24 papers published in *Nature* during 1997. Our results indicate that geographical 'over-citing' occurs on both sides of the Atlantic; papers were cited relatively more if the citing and cited authors resided in the same geographical region (Figure 1a–c).



**Figure 1.** Observed citation patterns for empirical papers published in (a) *Ecology*; (b) *Journal of Animal Ecology*; and (c) *Nature*; and (d) theoretical papers published in *Ecology* (squares) and *Journal of Animal Ecology* (circles). Mean  $\pm$  s.e. for cumulative citation sums ( $\Sigma$ EUR,  $\Sigma$ NA) to each focal paper are given (European authors, open symbols; North American authors, filled symbols).  $P$  values indicate geographical over-citing within a journal, derived from one-tailed rank sum tests for a difference in the angle through origin. The citation sums to each focal article provide one data point for the angle. If the papers differ in the total citation numbers, the pattern can arguably be explained by the superior quality of papers originating from a given geographical area, but there are no consistent differences of this type between articles from Europe and North America. Instead, we found systematic differences in the angle through origin, which indicates geographical over-citing.

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Available online 18 July 2005

Although evidence for local over-citing is strong, our results do not reveal whether researchers in one region are more to blame than the other. This is because it is impossible to judge what an unbiased rate of citation for European or North American papers should be [5]. For example, if North Americans truly produced better science, the signature of over-citing in that part of the world would be justified, and the European bias would then be a sign of parochial practices (and vice versa). Notwithstanding such a possibility, however, the strength of geographical over-citing still raises concerns that both sides of the Atlantic could be engaging in parochial citation practices.

It is particularly alarming that differences do not diminish for older papers that should have had more time to become known by both Americans and Europeans regardless of who originally published the work. Of course, for empirical studies, differences could, to some extent, reflect acceptable patterns of local citing because they concern local natural history. Yet, theoretical papers (defined as no original data presented in the paper) published between 1984 and 2002 showed similar fates (Figure 1d;  $n=59$  for *Ecology*,  $n=42$  for *Journal of Animal Ecology*). However, in theoretical papers published in *Journal of Animal Ecology*, significant geographical over-citing is, intriguingly, replaced by papers of European origin being cited more by researchers on both sides of the Atlantic.

Our results, together with those reported in [5], suggest

that the empirical and theoretical advancement of ecology in Europe differs significantly from that in North America. To a certain degree, this could reflect relatively neutral factors, such as differences in the topics that ecologists from different regions choose to specialize in. If, however, researchers are overlooking or ignoring the work of colleagues from elsewhere [1], fair recognition of the efforts of individual scientists is far from guaranteed, and the advancement of science itself is considerably hampered.

#### Acknowledgements

We thank Michael Jennions for statistical advice. An Australian Postgraduate Award and a Sir Keith Murdoch Fellowship (to B.B.M.W.) and the Academy of Finland (to H.K.) provided funding.

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doi:10.1016/j.tree.2005.07.003

## It's a puzzle all right: the hippocampus and food hoarding

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In their recent *TREE* article, Healy *et al.* [1] paint, with a broad brush, critics of their view that variation in the size of the hippocampus results from natural selection for spatial learning. For instance, they claim that such criticism 'is essentially directed to all those scientists who have proposed species-specific or problem-specific differences in cognitive abilities and the putative brain regions underlying those abilities, from...to song learning and the song control nuclei of song birds'. Although I am more skeptical than are Healy *et al.* of the evidence presented to date for such adaptive species-specific cognition [2], I expect natural selection to influence cognition and behavior and, by extension, their neural substrates. An example of such an adaptive neural specialization is the high vocal center (HVC) song nucleus of songbirds, the size of which varies (across populations and species) with the size or complexity of the vocal repertoire. Given the obvious parallels, the HVC provides a useful yardstick against which to measure

evidence that natural selection has caused an increase in hippocampal size in food-storing birds and mammals to enhance spatial memory.

As 'the HVC of spatial memory', the hippocampus is lacking in three important respects: (i) the degree of task specialization (song learning versus episodic memory); (ii) evidence that gross size differences in the relevant neural substrates are associated with specific behavioral and/or cognitive differences (the brain–behavior link); and (iii) assuming (ii), evidence that the neural difference causes the behavioral difference and not the reverse (the causal arrow). Owing to space limitations, I focus on (iii).

If hippocampal volume determines the ability to learn and remember spatial information, we would expect an increase in volume to precede spatial learning. Called 'experience-expectant' change by neurobiologists [3], the causal arrow points from brain to behavior. HVC volume increases in an experience-expectant way [4], whereas hippocampal volume does not. Instead, the only developmental studies conducted to date indicate that the hippocampus changes in an experience-dependent

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Available online 14 July 2005