Data availability for macroecology: how to get more out of regular ecological papers

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ABSTRACT

There is an urgent need to discover global ecological principles. Similarly, known ecological rules should be checked for generality across biogeographical and climatic regions. Summarizing a large number of ecological papers can successfully reveal this macroecological information. Nowadays, however, ecological journals do not provide much suitable data for such generalizations. In a literature meta-study about the relationship between plant diversity and soil acidity, 22 papers from the Journal of Ecology were used, besides papers from other journals. Here I analyzed the dates and geographical coverage of these papers. Most of papers with usable data were from 1960s and 1970s, although the popularity of soil pH–plant diversity topic has generally increased in time. In the more recent studies the actual data were rarely available. Papers from exotic regions peaked in 1970 and from 1988 there were no articles from outside Europe or North America. This is indicating a shift in publishing tradition in ecology. Nowadays small-scale works from well-studied regions predominate and very little broader descriptive data have been provided in regular ecological papers. This will make it difficult to perform good global generalizations in the future. We can, however, have more ecological data for large-scale generalizations if more background data are put in Electronic Archives or Supplementary Appendices on the Internet. I strongly suggest it for most regular ecological papers.

There is an increasing need to discover ecological principles at the global scale and the new discipline—macroecology—has such ambitions (Brown and Maurer, 1989; Clarke, 2002; Felizola Diniz-Filho et al., 2005). One important task of macroecology is to test the limits of ecological rules, which may differ across climatic and biogeographical regions (Francis and Currie, 2003; Knapp et al., 2004). Specific ecological experiments can rarely be repeated in different continental regions (but see Reader et al., 1994), but much valuable information can be gleaned from summarizing large numbers of local descriptions from literature. There is serious work going on to make ecological data sets available on the internet (Helly et al., 2002), but this cannot compete with the amount of data used for regular ecological papers. In medicine the term “meta-study” has been used as a research approach involving analysis of the theory, methods, and findings of research and the synthesis of these insights into new ways of thinking about phenomena (Paterson et al., 2001; Glasmeier and Farrigan, 2005). Meta-study is similar but not overlapping with the term meta-analysis, where a large number of

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similar experimental studies are reanalyzed in the aggregate (Osenberg et al., 1999; Kerstiens, 2001).

A literature meta-study can successfully reveal consistency of a relationship between species diversity and an environmental parameter at the global scale. For example—in Europe and North America, plant diversity tends to increase with soil pH (Whittaker, 1972; Grime, 1979). In a literature meta-study, it became evident that a positive relationship between plant diversity and soil pH is not a global ecological rule, since the relationship is reversed in the tropics (Pärtel, 2002). This can be explained by geological-evolutionary reasons: high temperature and plentiful precipitation leached out carbonates from tropical soils making them acid. This process was interrupted in higher latitudes by glaciations, which exposed new geological layers often characterized by high pH. Consequently, at a given latitude, plant diversity is higher for the soil pH conditions (high or low) that was historically the more common. Therefore, as a practical conclusion for nature conservation, if in the temperate zone we should place the majority of plant conservation areas in high pH soils (Pärtel et al., 2004), in the tropics we should prefer acid soils.

For this meta-study I summarized 85 published local-scale works. It was, however, difficult to find recent case-studies where plant diversity and soil pH were actually reported. Additionally, compared to Europe and North America, large areas in Asia, Africa, South-America and elsewhere had very few data points. I have found that these are common problems for other literature studies, too (e.g. Xiong and Nilsson, 1999). The Journal of Ecology provided the highest number of case studies (22) for the particular meta-study. Other most useful journals were the Journal of Vegetation Science (7), Ecology (5), and Ecological Monographs (4). I used the case-studies from the Journal of Ecology for simple statistics that are not biased by journal identity. These studies were from 1951 to 2000, but the distribution was not equal in time, peaking in 1960s and 1970s (Fig. 1). Considering the continuous increase in the number of articles published annually, the relative number of articles with data for the particular meta-study decreased even more dramatically: from 17% in 1960s to 13% in 1970s and 3% in both 1980s and 1990s. The works outside Europe or North America peaked around 1970, none of them appeared after 1988.

The soil pH–plant diversity relationship in general has not been gone out of vogue since the end of the 1970s. In the Journal of Ecology this topic was considered in 2–3% of the papers in 1950s–1980s, and in 5% of papers in 1990s. In the majority of case-studies, the soil pH–plant richness relationship was not the main topic, but I was able to extract data from a variety of tables and figures. It means that my results are not likely affected by the publication bias where a result concordant with the prevailing theory is more likely published. The observed pattern indicates merely that the traditions in ecological science have changed a great deal during the last century (Graham and Dayton, 2002). Before 1960s works were philosophical and data were provided mainly for illustration. Replication was rarely applied. From 1960s quantitative plant ecology has been flourished and during the first decades results were accompanied by large tables of raw or descriptive background data. Detailed ecological descriptions with some theoretical considerations were also common. Now experimental and small-scale works greatly predominate over descriptive and larger-scale ones. Raw or background data are almost never presented and even means are sometimes not reported besides statistics like F and P. Similarly, soil pH is often presented on an ordination diagram of species composition but without raw data tables it is impossible to obtain the richness data. This scarcity of data are partly due to reluctance on the part of publishers to allocate journal space for descriptive background material. In addition, current works are most frequently from well-studied regions, i.e. from Europe and North America. There are large cultural differences, too. For example, I specifically looked for papers in Russian and Spanish, but absolutely no data sets were available.

Are there any possibilities to perform good literature meta-studies with current data in the future? I am still optimistic. In recent years, it has been possible in most eco-
The ecological Society has opened a Data Paper section in the Journal of Ecology. In addition, the American Ecological Society has opened a Data Paper section in the Supplementary Appendixes. The number of papers with such Supplementary material, however, is low (3-13% from papers published annually). Concerning the particular meta-study, no Supplementary Appendix of the papers published annually. Concerning the particular meta-study, no Supplementary Appendix of the particular journal, too. In addition, other journals beside the main papers, it would increase the impact of the Electronic Archives than are absolutely necessary for particular papers. I am going further and encouraging ecologists to make the use of the Electronic Archive a norm for their publishing. Even larger amounts of background and methodological data should be deposited in the Electronic Archives than are absolutely necessary for particular papers. Especially data sets with several environmental measurements and with many replicates are very welcome. It should be possible to associate measured ecological values to site and environmental conditions. Similarly to the Data Papers of Ecology, only abstracts need to appear in printed issues, but the data could be available on the Internet. Standards for quality must be set and data collection from less-studied regions should be encouraged.

Such measures would make it much easier to reveal patterns and processes in macroecology. In addition, temporal trends could be revealed if recent descriptions are compared with previous ones. Knowing how general are ecological relationships, we can also be much more successful in nature conservation at the global scale.

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References


