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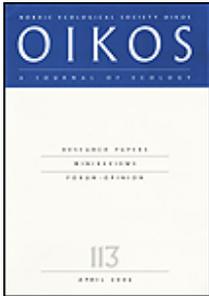
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Expert Estimates about Effects of Biodiversity on Ecosystem Processes and Services

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FORUM is intended for new ideas or new ways of interpreting existing information. It provides a chance for suggesting hypotheses and for challenging current thinking on ecological issues. A lighter prose, designed to attract readers, will be permitted. Formal research reports, albeit short, will not be accepted, and all contributions should be concise with a relatively short list of references. A summary is not required.

Expert estimates about effects of biodiversity on ecosystem processes and services

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Attempts to assess the functional importance of biodiversity in ecosystems continue to stimulate debate on the potential impacts of biodiversity losses. However, finding experimental setups to realistically simulate current and anticipated species loss turns out to be surprisingly difficult. Uncertainties concern the relevance of the present empirical evidence for large-scale natural and agricultural situations and the relation between observed specific processes and “ecosystem services” that provide a basis for human life support. Since ecosystem effects of biodiversity loss may be experimentally less tractable than other global change issues we were interested in current expert opinions. The resulting survey provides what might be the best-available answers to urgent questions regarding the certainties and uncertainties of the functional role of biodiversity in ecosystems. The respondents generally expected that: (1) ecosystem process rates are strongly correlated with biological diversity, and (2) these same processes are (although to a varying extent) important for the delivery of humanly defined “ecosystem services” by natural systems. The survey thus suggests caution in reducing ecosystem-level biodiversity, but it also underscores the opportunities for land management that may arise from the recognition of biodiversity effects in ecosystems. A caveat regards the possible bias of participants toward scientists who are particularly concerned about environmental change.

Naeem et al. 1994, Tilman and Downing 1994, Naeem et al. 1996, Tilman 1996, Tilman et al. 1996, 1997a, Hooper and Vitousek 1997, McGrady-Steed et al. 1997, Naeem and Li 1997). Due to the presence of better performing individual species or complementary resource use of functionally different species, species-rich experimental ecosystems have outperformed less diverse systems in about half of nearly one hundred reported field and laboratory trials. The opposite was observed in very few cases (Schläpfer and Schmid in press).

The relevance of these studies depends on whether these small-scale experiments are good representatives of the large-scale natural systems and on how the examined ecosystem properties and processes relate to broader categories of ecosystem services that form a basis for human life support (de Groot 1992, Costanza et al. 1997, Daily 1997). There is a balance of arguments as to whether species loss may be less or rather more detrimental to ecosystem functioning and humanly defined ecosystem services than the evidence of recent experiments suggests. Less severe consequences may be expected because species are not usually reduced (in natural communities) or planted (in agriculture) at random. A “sampling” effect of diversity (Tilman et al. 1997b, Loreau 1998) – the increased chance of having the best performing species present in a diverse system – may therefore not be effective in most real systems. On the other hand there may exist additional diversity-dependent processes on spatial and

Although the material services provided by natural systems represent only one aspect relevant to choices between competing alternative human uses of ecosystems, they have recently attracted considerable attention. This attention is not surprising considering that the trade-offs between alternative uses are being increasingly perceived. Moreover, material services of

ecosystems satisfy the criteria to be relevant to economic decisions even under a purely utilitarian value concept. Today conversion of natural systems for productive use usually involves strong reduction of the systems' organismic diversity. Accordingly, a growing number of recent studies address the functional relationship between the biological diversity of ecosystems and specific ecosystem properties and processes (e.g.,

temporal scales not represented in the recent experiments. Also, ecologists have mostly experimented with systems in relatively constant environments (Bertness and Leonard 1997). Effects of disturbances have often been observed only by chance. Dynamics of microbial populations observed in aquatic communities may shed a light on possible long-term importance of higher taxa species diversity in resource utilization under changing

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Abstract:

Attempts to assess the functional importance of biodiversity in ecosystems continue to stimulate debate on the potential impacts of biodiversity losses. However, finding experimental setups to realistically simulate current and anticipated species loss turns out to be surprisingly difficult. Uncertainties concern the relevance of the present empirical evidence for large-scale natural and agricultural situations and the relation between observed specific processes and "ecosystem services" that provide a basis for human life support. Since ecosystem effects of biodiversity loss may be experimentally less tractable than other global change issues we were interested in current expert opinions. The resulting survey provides what might be the best-available answers to urgent questions regarding the certainties and uncertainties of the functional role of biodiversity in ecosystems. The respondents generally expected that: (1) ecosystem process rates are strongly correlated with biological diversity, and (2) these same processes are (although to a varying extent) important for the delivery of humanly defined "ecosystem services" by natural systems. The survey thus suggests caution in reducing ecosystem-level biodiversity, but it also underscores the opportunities for land management that may arise from the recognition of biodiversity effects in ecosystems. A caveat regards the possible bias of participants toward scientists who are particularly concerned about environmental change.

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