

# Assessment of ecosystem integrity and service gradients across Europe using the LTER Europe network

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ELSEVIER

Better integration of knowledge from ecological, social and economic science is necessary to advance the understanding and modelling of socio-ecological systems. To model ecosystem integrity (EI) and ecosystem services (ES) at the landscape scale, assessment matrices are commonly used. These matrices assign capacities to provide different services to different land cover types. We revised such an existing matrix and examined the regional heterogeneity in EI and ES provision in Europe and searched for spatial gradients in their provision to elucidate their suitability for large-scale EI and ES mapping in Europe. Overall, 28 sites belonging to the Long-Term Ecological Research network in Europe participated in this study, covering a longitudinal gradient from Spain to Bulgaria and a latitudinal gradient from Italy to Sweden. As a primary outcome, an improved and consolidated EI and ES matrix was achieved with 17.5% of all matrix fields updated. For the first time, this new matrix also contains measures of uncertainty for each entry. EI and ES provision assessments were more variable for natural and semi-natural than for more anthropogenically dominated land cover classes. Among the main types of EI and ES, cultural service provision was rated most heterogeneously in Europe, while abiotic provisioning services were more constant. Longitudinal and latitudinal EI and ES gradients were mostly detected in natural and semi-natural land cover types where temperature and precipitation are major drivers. In anthropogenically determined systems in which cultural services play a dominant role, temperature and precipitation gradients were less important. Our results suggest that this matrix approach to assess EI and ES provision principally works on broad spatial scales; however, local assessments for natural systems seem to be less generalizable than assessments from anthropogenically determined systems. Provisioning and regulating services are more generalizable than cultural services. Particularly in natural and semi-natural systems, spatial gradients need to be considered. We discuss uncertainties associated with this matrix-based EI and ES assessment approach and suggest that future large-scale studies should include additional land cover information and ecosystem disservices and may determine ES fluxes by differentiating between ES provision and consumption.