FARMING PRACTICE
ORGANIC FARMING SYSTEMS

IMPACT: BIODIVERSITY

Reference 23

Crowder, DW; Northfield, TD; Gomulkiewicz, R; Snyder, WE. 2012 Conserving and promoting evenness: organic farming and fire-based wildland management as case studies. Ecology 93: 2001–2007. 10.1890/12-0110.1

Background and objective

Ecosystem health would benefit from conservation schemes capable of increasing the number of species while equalizing their relative abundances. High species richness can be maintained relatively simply by targeting the needs of particular endangered species. The conservation and promotion of greater evenness has received less attention, although it is clear that particular land-use practices affect evenness. The lack of a broad synthetic treatment of the richness–evenness relationship during conservation has made it difficult to determine whether their simultaneous promotion is an achievable goal. The objective of the study is to explore whether richness and evenness responded in tandem, in opposition, or independently, following implementation of two common land-use practices thought to benefit biodiversity: the adoption of organic practices in farming systems and the use of controlled burns to manage natural plant communities.

Search strategy and selection criteria

Search in the ISI Web of Knowledge using the terms "conventional" and "organic." Searches were last updated on 31 December 2011. To be included, each study had to report on the abundance of at least three taxonomic groups (at the species, genus, family, or order level) from replicated surveys.

Data and analysis

Data from each paper were obtained from figures or tables or directly from authors. They recorded the abundance and the observed number of taxonomic groups (richness) in the paired conventionally farmed vs. organically farmed sites. Data were averaged across sample points. They used rarefaction to eliminate sampling bias in all estimates of richness and evenness. To calculate richness for each management type in each study, they used 1000 Monte Carlo simulations in Microsoft Visual Basic to construct rarefaction curves. The simulated accumulation of taxa directly provided the rarefied richness estimates for comparison. Evenness was calculated using the rarefaction technique, where the accumulation of individuals in taxonomic groups was used to calculate evenness. Rarefied richness and evenness values were used to calculate log response-ratio effects. The log response-ratio effects were nonnormal (P , 0.05), and therefore determined if they differed from 0 using Wilcoxon signed-rank tests. Next they tested whether changes in richness and evenness were independent using Pearson's correlation test. In addition, they used mixed-effect models to determine if richness and evenness effects, and richness–evenness relationships, were affected by eco-taxonomic group membership or level of taxonomic resolution.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
52	Studies assessing the performance of organic systems in comparison to conventional systems.	Organic managed farms	Conventional managed farms	Metric: 1) Richness; 2) total abundance (arthropods, birds, non-bird vertebrates, plants, soil organisms); Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control.	75

Results

- Organic agriculture significantly increased overall abundance across taxonomic classifications (arthropods, birds, non-bird vertebrates, plants, soil organisms).
- No significant overall change in richness.
- Results demonstrate the importance of rarefaction. Raw data (i.e., without rarefaction) exhibit misleadingly strong benefits of organic agriculture on richness, an underestimation of benefits for evenness, and a negative relationship between richness and evenness.
- Organic farming favored species that were not numerically dominant, re-balancing communities as uncommon species gained individuals.
- Results support the assertion that richness and evenness capture separate facets of biodiversity, each needing individual attention during conservation.

Factors influencing effect sizes

- Taxon : Relatively uncommon taxa experienced disproportionate density gains when shifting from conventional to organic agriculture.

Conclusion

Total organism abundance of a broad range of organisms (arthropods, birds, non-bird vertebrates, plants, soil organisms), significantly increased following implementation of organic farming. Change in richness was not predictive of change in eveness.