Agroforestry and biodiversity

Reference 2

Bohada-Murillo, M; Castano-Villa, GJ; Fonturbel, FE. 2019 The effects of forestry and agroforestry plantations on bird diversity: A global synthesis. Frontiers in Sustainable Food Systems 3, 83. doi: 10.1002/ldr.3478

Background and objective

Despite many studies that have compared bird diversity between natural and productive systems, a global synthesis is still missing and important for understanding how biodiversity is being altered. 1)what is the global effect of forestry and agroforestry plantations on bird diversity? and 2) are those effects on bird richness and abundance consistent among zoogeographic zones, biodiversity hotspots and islands?

Search strategy and selection criteria

Available literature search by topic, using the ISI Web of Science, Scopus, and ScienceDirect databases (January 1995–March 2018) using the search terms: cacao + avi*, cacao* + bird*, coffee*+ avi coffee* + bird*, oil palm* + avi*, oil palm* + bird*, plantation* + avi*, and plantation* + bird*. 1)Comparing a native forest stand (i.e., control) with either a native or an exotic productive land (forestry or agroforestry) composed by plantation of trees, palms, or other type of cultures; 2) Reporting bird species richness or abundance for the native forest and the forestry or agroforestry plantations; 3) Reporting the mean, sample size, and a dispersion measure of the dependent variables (standard error or standard deviation).

Data and analysis

Moderator variables were used, which are categorical variables contrasting two or more situations, to test if there are effect size differences among them and detect contrasting responses. Six moderator variables were defined: (a) plantation type (forestry tree plantations, oil palm plantations, or agroforestry plantations based on cacao or coffee); (b) latitudinal zone (tropical or temperate), (c) geographical context (mainland or island), (d) zoogeographic region in which the plantations occur, and (e) if plantations occur within a biodiversity hotspot (i.e., areas with significant level of biodiversity or endemism). Authors also extracted eographical coordinates from each study case included in order to conduct a meta-regression between effect size and latitude (as an absolute value, considering north and south as equal in terms of latitudinal variation). Mixed-effects models were used to examine effects using moderator variables. To examine the heterogeneity among moderator levels, it was estimated the between-group heterogeneity Qbetween statistic, a heterogeneity measure that uses a $\chi 2$ -distributed statistics to compare the variation between and within moderator levels. All analyses were conducted using Comprehensive Meta-Analysis 3.0 software.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
50	Forestry and agroforestry plantations.	Forestry, oil palm plantations, agroforestry with coffee and cacao	Native forest stand.	Hedges' d (standardized difference) of birds species-richness and abundance between forestry/agroforestry plantations and native forest.	100%

Results

- Relative to native forest, oil palm plantations showed more negative effects on bird species-richness, followed by forestry plantations, whereas coffee and cacao agroforestry plantations had no significant effects.
- Relative to native forest, coffee plantations showed no effect on bird abundance. Negative effects resulted instead for forestry plantations.
- Relative to native forest, negative effects of forestry plantations and palm oil plantations were mainly found at sites within biodiversity hotspots.
- Overall, effects on species richness were more pronounced than those on bird abundance.
- South East Asia, tropical South America, and the Mediterranean Basin identified as the most threatened regions because of the sensitivity of their bird communities and the increasing rates of native forest replacement.

Factors influencing effect sizes

The negative effects found for species richness were independent of the latitude (slope = 0.006, p = .597), the effects on bird abundance varied with the latitude (slope – 0.074, p = .001), indicating that the effects of forestry and agroforestry plantations on bird abundance became more negative as we move toward the poles. The negative effects were highly variable depending on the species planted and on the geographical context in which these productive systems occur. South East Asia, tropical South America, and the Mediterranean Basin identified as the most threatened regions because of the sensitivity of their bird communities and the increasing rates of native forest replacement.

Conclusion

Agroforestry plantations (coffee and cacao) have no effects on bird species richness and abundance worldwide, compared to native forests. Productive plantations (Palm oil) reduce both species richness and abundance of bird species, being insular species particularly susceptible.