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DOI
10.1016/j.biocon.2023.110054

Publication date
2023

Document Version
Final published version

Published in
Biological Conservation

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CC BY

Link to publication

Citation for published version (APA):
Morpurgo, J., Kissling, W. D., Tyrrell, P., Negret, P. J., van Bodegom, P. M., & Allan, J. R. (2023). Response letter to correspondence letter: "Tropical deforestation: elections vs. bad governance". *Biological Conservation*, *283*, Article 110054. https://doi.org/10.1016/j.biocon.2023.110054

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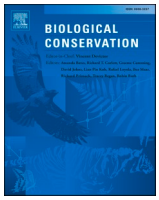
Download date:10 Oct 2026

Biological Conservation 283 (2023) 110054

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon



Letter to the editor

Response letter to correspondence letter: "Tropical deforestation: elections vs. bad governance"

We welcome the thoughtful correspondence by Troumbis (2023) on our recent analysis on the effect of elections on tropical deforestation. The correspondence raised three comments on the study: 1) whether bad governance or social bargain for votes during elections is the driving force of deforestation; 2) the homogeneity of the included countries in our analysis; and 3) hypotheses about an alternative model including the Environmental Kuznet Curve (EKC) where deviations in deforestation are explained through governance instead of elections. Below we summarize methods from our article and then address each comment in turn.

Assessing the role of elections on deforestation at a global scale is challenging due to the tremendous heterogeneity in governance aspects, national economies and intra-annual variation in deforestation events, among others. We tackled this challenge by using Hierarchical Generalized Additive Models to model non-linear relationships between proportional deforestation (relative to 2000) and a trinary election variable (uncompetitive, competitive and no election), while including covariates on governance aspects (media integrity and control of corruption), human population density, seasonality and agricultural contribution to GDP. We also accounted for country-level mean differences through random effects, and for variability between countries over time through a country (year) smooth.

The first point made by Troumbis (2023), questions whether elections or bad governance are the key driver impacting deforestation. We agree that bad governance is a key issue to stopping deforestation, but elections are the moment when those weaknesses in governance are amplified. Elections are a critical moment and parties and politicians utilize natural resources in illegal or illegitimate ways to gain political favor during these periods. Therefore we studied elections since they are focal events where these actions should be particularly common.

While the exact effects of elections may be understood better in the future, we highlight two aspects of the analysis that support the hypothesis that elections play a role in deforestation. First, the deforestation rates are different between competitive and uncompetitive elections, and these characteristics can also be indicative of a different governance style. Second, over the 18 years of data, the competitiveness of elections changed within about a third of the included countries (from competitive to uncompetitive or vice versa). Both aspects combined make it unlikely that governance is solely responsible for deviations from "normal" deforestation during elections, because the election effect is also based on countries where governance changes. While the results from it indicate that elections still impact deforestation rates when competitiveness changes.

The second point raised in the correspondence letter reflects on the countries included in the analysis. Troumbis (2023) states that the group is rather homogeneous across the two major axes of interest, namely, governance and forest biomes. While true, it is also the primary reason why these countries were selected for the analysis, as we suspect them to have the strongest link between deforestation and election cycles compared to other countries. Additionally, we chose for the tropical biome because drivers of deforestation often differ among biomes (Curtis et al., 2018).

Conceptually, during election cycles politicians in tropical countries are more often willing to use private and public resources to sway the electorate to vote for them. Importantly, these resources do not need to be forests or land, but rather anything that is perceived to be of value in regard to swaying the electorate. For example, political resources could be spent towards approving popular policies or promising to do so when politicians expect these tactics to be more effective in swaying the electorate. Such spending can also be directed to projects that impact forest or promote land use change (Shi and Svensson, 2006).

The implication of this flexibility is that in countries where forests and land are not valuable for the electorate, politicians could use different resources to sway the electorate. This implies that including different forest biomes and countries with more mature (i.e. well established) governments, and potentially less forest cover, in the analysis are likely to show a lesser election cycle effect on deforestation compared to similar countries in the tropics. However, election cycles might not necessarily become weaker, but their effect may move from deforestation and land giving to other resources that are disposable to politicians.

The final point put forward by Troumbis (2023) suggests that the countries included are: A) in the lower limb of an Environmental Kuznets Curve (EKC), and B) deviations from the EKC are not originating from elections but from bad governance. While this is an interesting hypothesis, we see several problems with it. The position of a country along the EKC is irrelevant as the main point is the deviation from the background rate of deforestation. The EKC hypothesis could be relevant if Troumbis (2023) proposed that along the EKC forest loss deviations would be stronger or weaker in elections years, but this does not seem to be the case. Yet, there is some evidence that election cycles become weaker when democracies and their controlling institutions mature (i.e. governance moderates strengths of election cycles; see Canes-Wrone and Ponce de Leon, 2015; Akhmedov and Zhuravskaya, 2003; Shi and Svensson, 2006). Therefore, we agree with Troumbis (2023) that governance likely plays a role in deforestation, but rather than bad governance being the source of forest loss deviations, we hypothesize that "bad" governance enhances the effect of election cycles and "good" governance decreases the effect of election cycles (Fig. 1).

We thank Troumbis (2023) for the thought provoking response and for taking the time to share their ideas. There is clearly work to do in better understanding how elections and bad governance interact to threaten natural resources. Our analysis represents the first pan-tropical assessment on this topic, which we believe is an important step towards understanding election cycle effects on natural resources. We

https://doi.org/10.1016/j.biocon.2023.110054

Available online 23 May 2023
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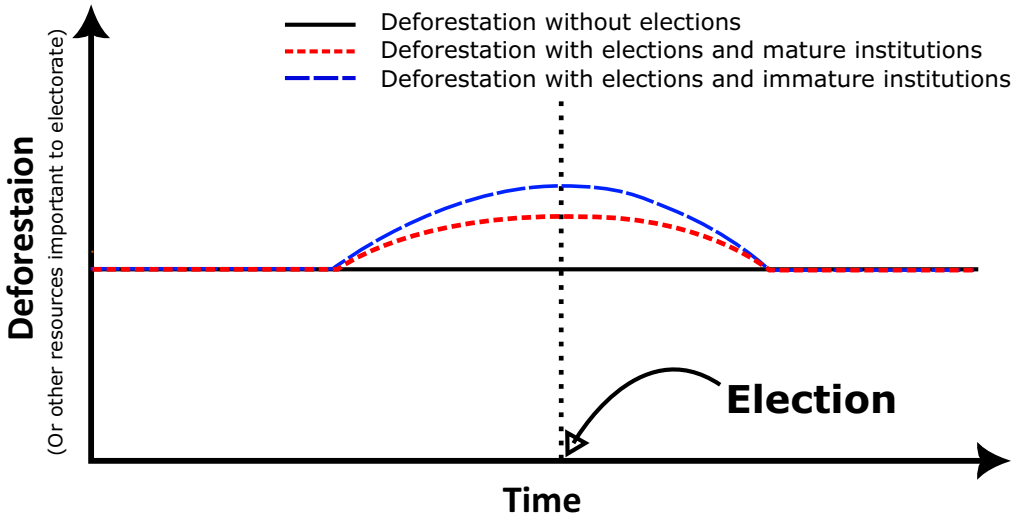

Fig. 1. Hypothesis of governance influencing the strength of election cycles. Assuming a constant rate of deforestation, this figure shows the expected election cycle effect on deforestation. We propose that bad governance or immature institutions are not driving deforestation, but rather enhance the election cycle effects. For simplicity, we show an identical strength and duration of this enhancement pre-/post-election.

recommend, acknowledging Troumbis (2023), to further scrutinize the influence of governance on election cycles. These efforts require compilation of novel datasets with monthly resolution (see discussion Morpurgo et al., 2023). Such an analysis is likely to better elucidate the role of elections as a driver of natural resource use (e.g. deforestation) and its potential enhancement by "bad" governance.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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