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Title: **Prioritizing Mangrove Conservation Across Mexico to Facilitate 2020 NDC Ambition**

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Supplementary Information Text

1.1 Carbon Sequestration and Carbon Stock Data Sources and Manipulation

Municipio boundaries and polygons representing mangrove coverage in 2005 and 2015 throughout Mexico were obtained from layers in CONABIO's geoportal (CONABIO 2013; CONABIO 2016) and projected into North American Equal Area Projection. *Municipios* were first intersected with mangrove polygons and then dissolved based on the government ID for each *municipio*. Next the area that fell outside of the *municipio* boundaries were spatially joined to the closest municipio, dissolved, and added to the intersected mangroves to calculate the total area of mangroves in each *municipio*. Data from Simard et al. 2019 and Sanderman et al. 2018 were downloaded and projected into the same projection as the area calculations. The tool Zonal Statistics as Table was used to summarize the mean value of aboveground biomass and soil carbon for each *municipio*. Seven *municipios* had no values reported due to differing base mangrove layers in each study. For these *municipios* values from the closest *municipio* with data was used.

1.2 Mangrove Deforestation

Datasets detailing changes in mangrove area within a 5 km buffer between 2005 and 2015 were downloaded from CONABIO (2013-2016). Each set of five shapefiles describing mangrove changes from 2005 to 2010 and 2010 to 2015 were merged together to create two files describing changes in mangrove area over all ten years. Next, both layers were projected into North American Equal Areas Conic projection and area in hectares was calculated. Categories of mangroves that were converted from mangroves to non-mangrove were selected. The two datasets were then joined together to produce a new layer representing total deforestation between 2005 and 2015. To aggregate these data to the *municipio* level, the government ID was joined to each polygon and then the layer was dissolved based on the ID, summing the total area of mangrove deforestation in each *municipio*. Finally, the mangrove area in each *municipio* was joined to the final layer and the yearly relative deforestation was calculated compared to the 2005 mangrove distribution. No polygons of area < 0.5 ha were considered as we are focusing on large areas of deforestation and many small polygons (<.001 ha) were in the database most likely resulting from geoprocessing steps and the original spatial resolution of the satellite imagery was 0.5ha.

We did not consider the appearance of mangrove forest in areas previously not covered by mangroves in our deforestation estimates. A mature mangrove ecosystem is not equivalent in ecosystem services and carbon stocks to mangroves that have been established for less than 5 years (Field, 1999). Therefore, the loss of established mangrove ecosystems should not be seen as equivalent to new mangrove area registered in satellite imagery.

An ecological assumption made in this study is that, if there is no deforestation, mangroves will continue to sequester carbon without reaching a maximum capacity. This assumption is supported by research showing that Caribbean mangroves have kept sequestering carbon throughout the Holocene, accumulating carbon-rich peat at a rate that compensated for relative sea level rise. Instead of assuming that carbon sequestration occurs indefinitely, an alternative way to model future carbon sequestration is to assume that its maximum equals the present-day belowground carbon stock. If this approach were used, in most *municipios* the avoided damages would decrease by <1%, with the greatest decrease of any *municipio* being 4%. Thus, this assumption has relatively little influence on the results as it impacts carbon sequestration values hundreds of years in the future, when the discount factor is near zero.

1.3 Prioritization Schemes

Four schemes were developed and assessed by their cumulative avoided damages for conservation priority. First, we plotted for all *municipios* the yearly deforestation rate against the economic impact of carbon sequestration (Figure S1). Median values of these variables were used to divide the *x* and *y* axes into quadrants. In schemes 1, 2, and 4, these plots were divided into four quadrants and *municipios* were first grouped by assessing into which quadrant of the *x*-*y* plot they fell. The top ranked quadrant is always the top-right where both deforestation rate and local economic impact is high, and the last ranked quadrant is the bottom-left. In scheme 1 the top-left quadrant is given higher-priority than the bottom-right, meaning that a greater importance is given to carbon sequestration economic impact than deforestation rate, while the opposite is true in Schemes 2 and 4. Secondly, *municipios* were then ranked within each group according to mangrove area or total carbon at a finer scale. In schemes 1 and 2 this detailed ranking is based on total carbon. In scheme 4 it is based on total mangrove area. Scheme 3, included in the main text, does not use thresholds but rather assigns priority according to the product of deforestation rate and local economic impact.

Each of these schemes were then assessed by their efficiency in avoiding 50 and 80 percent of damages relative to baseline deforestation (Figure S2). We compared the number of *municipios* needed to be completely protected from mangrove deforestation to reach these thresholds. Starting with the top ranked *municipio* to the last, cumulative avoided damages were calculated. The fewer *municipios* needed to reach 50 or 80 percent of cumulative avoided damages, the more efficient the scheme is. Scheme 2 and 4 are the least efficient as it takes almost twice the number of *municipios* to avoid 80% of damages compared to the other two schemes, which preform similarly. Scheme 3 takes the least number of *municipios* to reach 50% (26) but the second lowest to reach 80% (62). Scheme 4 and scheme 2 give a major slowdown in additional avoided damages around 60% compared to the other schemes, due to the large number of *municipios* with little area of mangroves ranked ahead of others in the cumulative curve.

Prioritizing *municipios* with high local economic impact over those with high deforestation (Scheme 1) results in an efficient approach similar to valuing both variables equally. Overall, Scheme 2 and 4 are similar in terms of their damage avoidance trajectory. If one all of these schemes is chosen, we suggest using scheme 3, which ranks *municipios* using the product of yearly deforestation and carbon sequestration economic impact, to prioritize *municipios* for mangrove conservation. Taken together these schemes should be viewed as guidelines, where different schemes can be used to decide where to implement focused conservation efforts. Depending on which factors decision-makers wish to prioritize, they can use combinations of the schemes to choose sets of *municipios* on which to focus initial efforts.

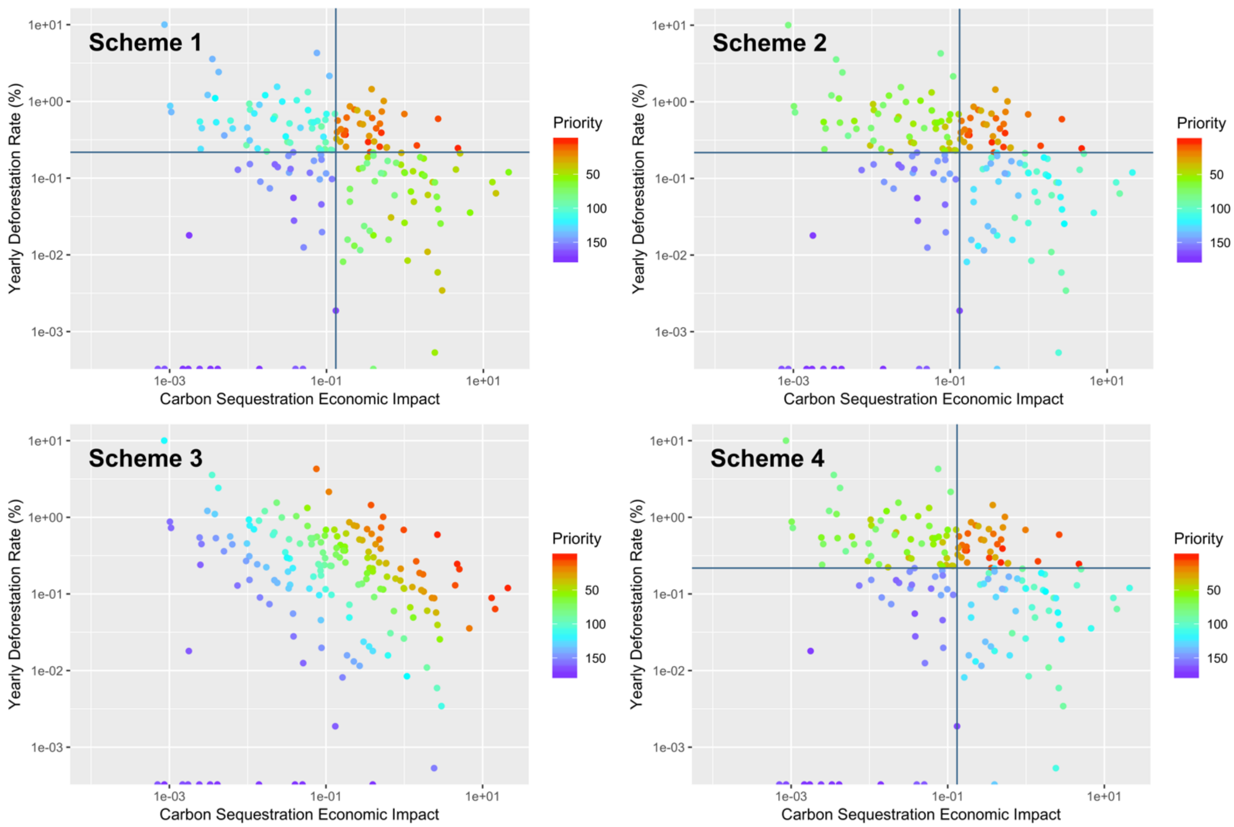

Fig. S1: Four different prioritization schemes, with each point representing a priority-ranked *municipio*, are shown. In scheme 1, greater importance is given to deforestation rates than local economic impacts from conservation, and priority within each quadrant is based on total carbon. In scheme 2, greater importance is given to local economic impacts than deforestation rates, and priority is based on total carbon. In scheme 3, deforestation rates and local economic impacts are given equal weight. In scheme 4, greater importance is given to local economic impacts, and priority is based on mangrove area. Blue lines drawn to separate quadrants are positioned at the medians of the variables shown on the x- and y-axes. Axes are displayed on a log scale.

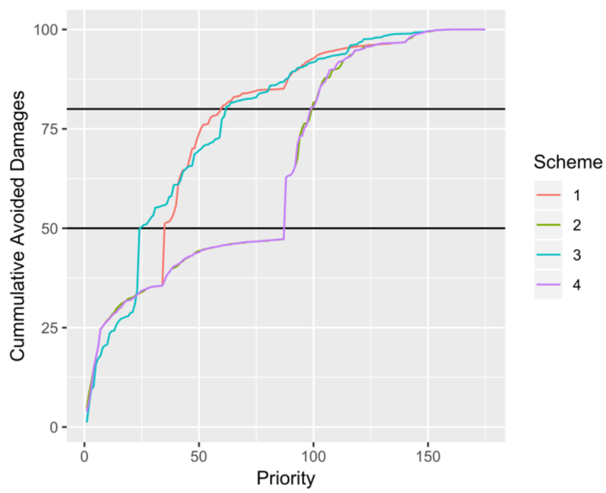

Fig. S2: Cumulative avoided damages curves, with *municipios* given ranks from the four prioritization schemes. The *x*-coordinates of the intersections of the curves and the black lines indicate the numbers of *municipios* needed to be conserved to avoid 50 and 80 percent damages.

Table S1. The number of *municipios* needed to stop deforestation to avoid 50 or 80 percent of damages from baseline deforestation for the next 25 years as determined by each scheme.

Scheme	Number of *Municipios* for 50% Cumulative Damages	Number of *Municipios* for 80% Cumulative Damages
1	35	60
2	88	100
3	26	62
4	88	99

Table S2: The regional carbon sequestration values used to estimate the investment and damages

Region	Carbon Sequestration (MgC ha^{-1} yr^{-1})	Papers
Gulf of California	1.36	Ezcurra et al. 2016
Mexican Pacific	2.49	Ezcurra et al. 2016; Adame et al. 2015
Gulf of Mexico	0.61	Gonneea et al. 2004
Mexican Caribbean	0.71	Gonneea et al. 2004

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