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Occasional Paper 26

Suitability of key Central American agroforestry species under future climates: an atlas

Kauê de Sousa, Maarten van Zonneveld,
Pablo Imbach, Fernando Casanoves,
Roeland Kindt and Jenny C. Ordoñez

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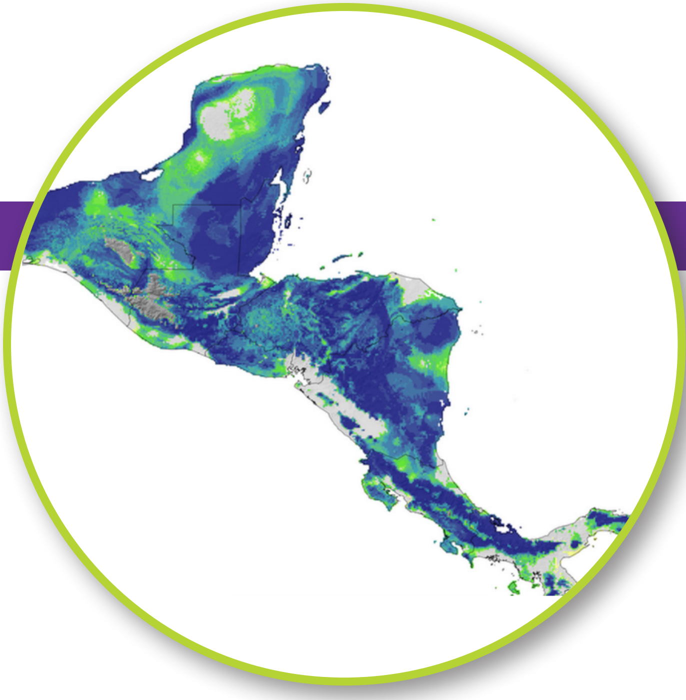

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Contents

Summary

Agroforestry practices, such as integrating trees with cocoa, coffee and other crops, silvopastoral systems, wind breaks, live fences, woodlots, fallows, etc., are key to the development of strategies for climate-smart agriculture for Central America and other regions. However, there is a paucity of information about the suitability of various agroforestry tree species under future climates. This atlas addresses this knowledge gap by providing information on the suitability in Central America of 54 species widely used for shade and specific products. It does so by (i)increasing the number of locations that previously available (for the most common species), (ii) including species for which information is not available and (iii) applying novel ensemble suitability methods to model species distribution under current and two future climates (Representative Concentration Pathways RCP4.5 and RCP8.5 for the 2050s).

Ensemble suitability methods were applied using the *BiodiversityR* package to model and map the species' distribution—using information on presence locations in Latin America and the Caribbean and bioclimatic variables obtained from WorldClim—for the baseline climate (1960–1990) and for 2050 future climates generated by 17 global climate change models for each RCP. Our ensemble maps, forecasting future suitabilities, integrate the results of an ensemble of 17 climate models for RCP 4.5 and 8.5. Future distribution maps were compared with the current distribution maps to evaluate the potential changes in the distribution of each species.

The 54 species selected include 24 species of fruit trees (main use), 24 timber trees and six species widely used to improve soil conditions. Modelled results show a >10 percent decrease in suitable areas for 29 species under RCP4.5 and for 30 species under RCP 8.5. From these species, five species present large losses under RCP4.5 (>30 percent of the suitable area in the baseline scenario) and seven species presented large losses under RCP8.5—in decreasing order: *Inga jinicuil, Annona cherimola, Persea americana, Inga oerstediana* and *Handroanthus ochraceus* (in both scenarios) plus *Alvaradoa amorphoides* and *Psidium guajava* in RCP 8.5. There were 14 species under RCP4.5 and RCP 8.5 that had minor reductions (one to 10 percent loss from areas under the baseline scenario). The species that showed increases in suitable areas include 11 species under scenario RCP4.5 and 10 species under scenario 8.5. From these species, five presented an increase ≥10 percent—in decreasing order: *Averrhoa bilimbi, Cocos nucifera, Chrysobalanus icaco, Melicoccus bijugatus* and *Albizia saman.*

The results presented in the atlas give a first approximation to assess which species are vulnerable or tolerant to expected climate change. Its results can be used in combination with other information sources to fine-tune the selection of species for design of agroforestry practices or diversification strategies.

Keywords:
Agroforestry, distribution maps, tree species, climate change, scenarios, ensemble suitability modelling.

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List of acronyms and abbreviations

AUC	Area under the curve
BZ	Belize
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza (Tropical Agricultural Research and Higher Education Center)
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CGIAR	A Global Partnership that Unites Organizations Engaged in Research for a Food-Secure Future
CIAT	International Centre For Tropical Agriculture
CR	Costa Rica
FAO	Food And Agriculture Organization of the United Nations
FG	Forage (uses of agroforestry species)
FR	Production of fruit, nuts or other products for human consumption (uses of agroforestry species)
FTA	CGIAR Research Program on Forests, Trees and Agroforestry
G0	Occupied niche
GA	Fundamental niche
GADM	Global Administrative Areas
GBIF	Global Biodiversity Information Facility
GCM	Global Circulation Model

GHG	Greenhouse gas
GI	Biotically reduced niche
GRIN	Germplasm Resources Information Network
GT	Guatemala
HN	Honduras
ICRAF	World Agroforestry Centre
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
MAPFORGEN	Atlas for the conservation of genetic forestry resources
NI	Nicaragua
PA	Panama
RCP	Representative Concentration Pathways
SO	Improving soil conditions (uses of tree species)
SV	El Salvador
TI	Timber
TNC	The Nature Conservancy
USDA	United States Department Of Agriculture
VIF	Variance inflation factor
WorldClim	Set of global climate layers (gridded climate data) with a spatial resolution of 1 km^2

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Introduction

In Central America—Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama— 30 million ha (~40 percent of its total area) are used for agricultural production (FAO (Food and Agriculture Organization of The United Nations 2015). This agricultural land has, on average, >45 percent tree cover (Zomer et al 2016). Trees (defined here as woody perennial species including species such as palms [Arecaceae family] and Musaceae are a common feature of agricultural landscapes in Central America. Trees are present in a large part of the agricultural landscape of this region, either dispersed or in lines; supporting the production of coffee, cocoa, fruits, pastures and livestock in various agroforestry practices and providing countless products that contribute to food security (Jamnadass et al 2013); household income (Rice 2011, Cerda et al 2014, Amores 2015); and ecosystem services such as carbon storage (Somarriba et al 2013, Pinoargote 2014, Caicedo 2016), regulation of climate and water cycles (Lin 2010, van Noordwijk et al 2014), control of pests and diseases (Soto-Pinto et al 2000, Avelino et al 2004, Navas et al 2008, Vega et al 2009, Haggar et al 2011) and maintenance of soil fertility (Beer et al 2003, Notaro et al 2014). Because of these multiple goods and services, agroforestry practices are considered one of the key strategies for the development of climate-smart agriculture (McCarthy 2014, van Noordwijk et al 2014).

However, like annual and perennial crops, agroforestry species can also be affected by climate change, something that is not typically taken into account in the design of agroforestry-based climate-smart practices. Different niche prediction models show that the distribution of various tree species may change over the next 50 to 100 years (Vetaas 2002, McKenney et al 2007, Gutiérrez and Trejo 2014, Zolkos et al 2015). Current knowledge about the suitability of tree species in the tropics under different climate change scenarios is limited. The present publication responds to this information gap by providing information on the suitability under different climate change scenarios of 54 species used in agroforestry practices in Central America. For this purpose, we used ecological niche modelling methods (ensemble methods expected to provide more robust models of species suitability than results from single models) to model the current and future distribution of tree species at present and for the most recent climate-change projections. We created a database that collates a substantial number of known presence locations of tree species to reduce bias in suitability modelling. This atlas is a tool that can be used to assess which geographic areas would be suitable for different tropical agroforestry species now and under different scenarios of climate change (Araújo and Peterson 2012). We hope that the information generated can support the design of diversified agroforestry practices that are adapted to the climate, thereby increasing the adaptive capacity of rural households and farms in the region.

Methodology

Species selection

A great diversity of species is used in agroforestry practices in Central America. Since the focus of this study is to provide information to support the design of diversified agroforestry practices that contribute to farm production and family use, we based the selection of species on their potential to provide specific products (e.g. timber, fruits) as well as improve soil and provide shade. Several databases with information on agroforestry species products and services were consulted and used for selection of species considering four criteria (table 1).

Under the first four criteria, 38 agroforestry species were selected. Since the representation of fruit species was low in this group, we added 16 economically important fruit species of wide importance in the region, rendering a total of 54 species (table 2).

Table 1. Criteria for the selection of the agroforestry species for which suitability maps were developed

Criteria	How the criteria were evaluated
Uses	≥One known use (timber, fruit, N-fixation or forage)
Information availability	At least basic information about ecology, uses and management (i.e. sufficient to populate the species descriptions in each atlas entry) is available on the species. Species must be described in relevant databases that describe useful (agro) forestry species, such as *Trees of Central America* (Oxford Forestry Institute et al 2003), *Germplasm Resources Information Network-GRIN* (USDA (United States Department of Agriculture 2014), *Edible Plants of Central America* (Chízmar-Fernández et al 2009), Commercial Timbers: Descriptions, Illustrations, Identification, and Information Retrieval (Richter and Dallwitz 2000).
Abundance in common agroforestry practices of the region	Only species among the most abundant species in Central American agroforestry practices were considered. Abundance was assessed with information from a database derived from several inventories of shade species in four agroforestry practices (coffee, cocoa, forest-grazing systems and hedgerows) from six Central American countries (database compiled by ICRAF and CATIE).
Species origin	The preference was for native species because they are expected to have broad genetic diversity for planting material; in addition, for some native species, information regarding impacts of climate change is less known than for widely distributed exotics. This criterion was not strictly applied in the case of fruit species.
Presence data	We required that each species have ≥60 observations of presence in Latin America and the Caribbean to ensure good niche modelling results (Varela et al 2014).

Table 2. The 54 agroforestry species selected for niche modelling

Scientific botanical name	Family	Main uses	Local names[a]
Albizia saman (Jacq.) Merr.	Leguminosae	TI/FG	Carreto negro (SV, HN), Cenizo (PA), Cenízaro (CR, SV, HN), Genízaro (CR, SV, GT, NI)[c]
Alvaradoa amorphoides Liebm.	Picramniaceae	TI	Ardilla (CR), Caratillo (NI), Cola de ardilla (GT), Zorra (HN)
Anacardium excelsum (Bertero ex Kunth) Skeels	Anacardiaceae	TI	Espavel (CR, SV, PA, GT, HN, NI)
Anacardium occidentale L.	Anacardiaceae	FR	Marañón (CR, SV, HN, GT, NI, PA, MX), Cashew (BZ),
Andira inermis (Wright) DC.	Leguminosae	TI	Almendro (SV, CR, NI, HN), Angelin (BZ)
Annona cherimola Mill.	Annonaceae	FR	Cherimoya
Artocarpus altilis (Parkinson ex F.A.Zorn) Fosberg[b]	Moraceae	FR	Fruta de pan
Astronium graveolens Jacq.	Anacardiaceae	TI	Ron-ron (CR, HN, NI), Ciruelillo (HN), Culinzis (GT), Zorro (PA), Uruco (NI)
Averrhoa bilimbi L.[b]	Oxalidaceae	FR	Vinagrillo, Pepino de Indias, Grosella china
Averrhoa carambola L.[b]	Oxalidaceae	FR	Carambola
Bactris gasipaes Kunth.	Arecaceae	FR	Pejibaye (CR), Pixbae (PA), Supa (HN), Jaquacté (GT)
Byrsonima crassifolia (L.) Kunth	Malpighiaceae	FR	Nance, Nancito (HN, SV), Yuco (BZ)
Carapa guianensis Aubl.	Meliaceae	TI	Caobilla (CR, NI), Cedro macho (CR, NI, HN) Warawere (BZ)
Cassia grandis L.f.	Leguminosae	TI	Carao (CR, GT, SV, HN, NI), Carago, Caragua (HN, SV), Cañafistula (CR), bBef-feed (BZ)
Cedrela odorata L.	Meliaceae	TI	Cedro, Cedro amargo
Chrysobalanus icaco L.	Chrysobalanaceae	FR	Ciruela de algodón, Coco-plum
Chrysophyllum cainito L.	Sapotaceae	FR	Caimito
Citrus sinensis (L.) Osbeck[b]	Rutaceae	FR	Naranja, Naranja dulce
Cocos nucifera L.[b]	Arecaceae	FR	Coco, Coconut
Cordia alliodora (Ruiz & Pav.) Oken	Boraginaceae	TI	Laurel (PA, CR, NI, GT, SV, HN), Bohum (BZ, HN)
Cordia collococca L.	Boraginaceae	TI	Muñeco (NI), Buriogre (CR), Chaparillo (HN)
Dalbergia glomerata Hemsl.	Leguminosae	TI	Granadilla (NI), Granadillo (CR, SV, HN)
Diphysa americana (Mill.) M.Sousa	Leguminosae	TI	Guachipilín (SV, GT, HN, NI), Guachipelín (CR), Guachipelí (CR, NI)
Enterolobium cyclocarpum (Jacq.) Griseb.	Leguminosae	TI/FG	Guanacaste (CR), Conacaste (GT, SV), Guanacaste negro (NI, HN), Arbol de orejas (SV)

Scientific botanical name	Family	Main uses	Local names[a]
Erythrina berteroana Urb.	Leguminosae	SO	Coralillo (GT), Helequeme (NI), Gallito (PA), Pito (GT, HN, SV), Poró (CR)
Eugenia stipitata McVaugh[b]	Myrtaceae	FR	Arazá
Genipa americana L.	Rubiaceae	FR	Jagua (SV, HN, NI, PA), Genipop (HN), Guaitil (CR, NI), Brir (CR), Crayo (GT), Irayol (SV, GT, HN)
Gliricidia sepium (Jacq.) Walp	Leguminosae	SO /FG	Madero negro (CR, PA, NI), Madreado (HN), Matarratón (CR, GT), Madrecacao (SV, GT, HN)[c]
Handroanthus ochraceus (Cham.) Mattos	Bignoniaceae	TI	Cortez amarillo
Hymenaea courbaril L.	Leguminosae	TI	Guapinol (CR, GT, HN, NI), Copinol (SV)
Inga jinicuil Schltdl.	Leguminosae	SO	Guaba (CR, NI, PA), Paterno (SV, GT, HN)
Inga oerstediana Benth.	Leguminosae	SO	Guaba (CR, NI, PA), Guama (GT, HN, SV)
Inga punctata Willd.	Leguminosae	SO	Guaba (CR, NI, PA), Pepeto (SV, GT, HN), Pepeto negro (SV, GT, HN)
Inga vera Willd.	Leguminosae	SO	Guaba, Guama (CR, NI, PA), Pepeto (SV, GT, HN)
Maclura tinctoria (L.) D.Don ex Steud.	Moraceae	TI	Mora, Palo amarillo (CR, SV, HN, GT, NI, PA)
Mammea americana L.	Calophyllaceae	FR	Mamey (CR, HN, GT, NI, PA); Abrico
Mangifera indica L.[b]	Anacardiaceae	FR	Mango
Manilkara zapota (L.) P.Royen	Sapotaceae	FR	Chicozapote (GT), Níspero (CR, SV, NI, PA), Sapodilla (BZ), Zapote (SV, GT, HN)
Melicoccus bijugatus Jacq.	Sapindaceae	FR	Mamón (CR, NI, SV, HN, PA)
Pachira quinata (Jacq.) W.S.Alverson	Malvaceae	TI	Pochote (NI, CR), Cedro espino (HN, PA), Ceibo (PA)
Pentaclethra macroloba (Willd.) Kuntze	Leguminosae	TI	Gavilán (CR, NI, PA), Oil bean tree (BZ), Quebracho (CR), Palo de aceite (NI)
Persea americana Mill.	Lauraceae	FR	Aguacate
Platymiscium dimorphandrum Donn.Sm.	Leguminosae	TI	Coyote (NI), Hormigo (HN), Granadillo (BZ, SV, NI)
Pouteria sapota (Jacq.) H.E.Moore & Stearn	Sapotaceae	FR	Zapote (PA, CR, NI, HN, GT), Sapote (CR), Mamey (SV), Sapotillo (NI)
Psidium friedrichsthalianum (O.Berg) Nied.	Myrtaceae	FR	Cas (CR), Arrayán (SV), Guayaba agria (NI)
Psidium guajava L.	Myrtaceae	FR	Guayaba, Guava
Roseodendron donnell-smithii (Rose) Miranda	Bignoniaceae	TI	Cortez blanco (SV), Guayape (HN), Palo blanco (GT)
Schizolobium parahyba (Vell.) S.F.Blake	Leguminosae	TI	Copté (GT), Gallinazo (CR), Zorra (HN)
Spondias mombin L.	Anacardiaceae	FR	Ciruelo (HN), Jobito (PA), Jobo (CR, NI, HN, PA)

Scientific botanical name	Family	Main uses	Local names[a]
Spondias purpurea L.	Anacardiaceae	FR	Jocote, Ciruela, Jocote de corona (ES)
Swietenia macrophylla King	Meliaceae	TI	Caoba, Mahogany (BZ)
Syzygium malaccense (L.) Merr. & L.M.Perry[b]	Myrtaceae	FR	Manzana de agua, Marañón japonés (ES)
Tabebuia rosea (Bertol.) Bertero ex A.DC.	Bignoniaceae	TI	Matilisguate (GT, HN, SV), Maquilishuat (SV), Macualizo (HN), Roble de sabana (CR), Macuelizo (NI)
Terminalia oblonga (Ruiz & Pav.) Steud.	Combretaceae	TI	Guayaba de montaña (CR), Guayabo (HN, NI), Volador (SV, GT)

a Source (Oxford Forestry Institute et al 2003)
b Exotic species
c Countries: PA=Panama, CR=Costa Rica, NI=Nicaragua, HN=Honduras, GT=Guatemala, SV= El Salvador, BZ=Belize

Niche modelling

Niche models (species distribution models) predict the locations where a species might occur according to the environmental conditions at those locations, in other words how well-suited a given location is for a given species. Niche models use statistical models (algorithms) to estimate the probability of occurrence of a species based on the similarity of the environmental conditions in that location with the calibrated environmental niche of the species. The calibration is based on the environmental conditions in the areas where the species is known to occur. The more similar the conditions at a given location are to those of the calibrated niche, the higher the probability value (‘suitability’) for species occurrence in a particular location. There are many niche models available, each using different algorithms for definition of environmental niches and probability values in a study area. Besides data on environmental conditions, the main inputs for niche modelling are georeferenced species locations (presence locations) from inventories and herbaria.

We stress that the modelled distributions of our selected species are an approximation of areas that may be occupied by the species, based solely on environmental conditions, i.e. approximation of the fundamental niche: see box 1 for key definitions. The niche models that we used employ only bioclimatic data as explanatory variables. The current analysis does not consider other abiotic variables such as soil characteristics, fire frequency or topography or biotic effects such as competition and predation and limitations in seed dispersal. Neither did we consider genetic differentiation between populations of the same species because georeferenced presence information for different population was not available. In reality, agriculture alters the natural distribution of species directly (i.e. by planting them and introducing them in places where they did not occur), by changing environmental conditions (e.g. changing soil fertility), and through its regulation of biotic interactions (e.g. control of weeds and pests).

Box 1: Key Definitions

Ecological niche modeling: Analysis that uses mathematical algorithms to represent the distribution of the species in an environmental space (ecological niche). This relationship is then used to predict the distribution of species in a geographical space (places with suitable environmental conditions). The environmental conditions most commonly used for modelling are related to weather but may also include other environmental variables such as soil pH, forest cover, etc., if the information is available.

Ensemble modelling: A modelling technique based on the combination (assembly) of the results of several mathematical algorithms (for niche modelling) to predict the distribution of species in a geographical area. One may consider ensemble modelling as a consensual approach where various experts are consulted as to the ability of a species to fit certain environmental conditions. There is greater confidence that a species occurs in a region when several 'experts' agree that the species is suitable in that region.

Niche: The range of (biotic and abiotic) conditions and resources required for an organism to survive and reproduce.

Fundamental niche: The environmental conditions that allow a species to survive and reproduce. They determine the distribution of an organism in the absence of competitors and restrictions on seed dispersal. The fundamental niche is impossible to measure, but it can be approximated by physiological experiments or biophysical principles. In terms of distribution of the species, it corresponds to all suitable areas (abiotic conditions) where the species can survive and reproduce (GA, fig, Box1).

Biotically reduced niche: The set of conditions that allow a species to survive and reproduce, including environment as well as interactions with competitors, facilitators and predatory species. The concept includes areas where the species currently occurs naturally [GO] and areas where the species could occur and even invade if limitations on the dispersion [GI] are removed. In terms of distribution, it corresponds to the potential range of the species.

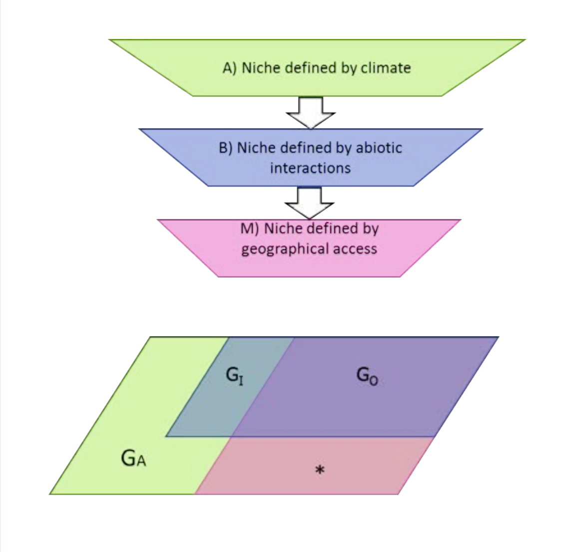


Figure Box1. Schematic representation of how environmental factors (A), biotic interactions (B) and geographical access (M) determine species niches and therefore its geographic distribution (areas G_A, G_I, G_0, *). Modified from (Peterson et al 2011). Read text definitions to understand G_A, G_I, G_0 and *

Occupied niche: The set of environmental conditions that allow a species to survive and reproduce considering also the impact of interactions with predators and competing species and the impact of limitations on dispersion. It determines the observed distribution of an organism [GO].

Impact of agriculture on the distribution of species: Agriculture alters the natural distribution of species directly by changing environmental conditions, by introducing species in environments where previously they did not occur [GI], and through its regulation of biotic interactions (e.g. control of weeds and pests) [*], so that selected species proliferate. Agroforestry species can occur in natural and managed systems; therefore, the observations used in the modelling of agroforestry species, can come from any of the [GI] [G0] or [*] areas. These observations have been used to model suitable areas for the species (estimation of the fundamental niche based solely on climate information).

Agroforestry species can occur in both in natural and managed systems, and therefore the observations used in the modelling of agroforestry species can come from any of these habitats, but we currently lack the information about the habitat so that, we cannot separate them in the analysis. Considering these factors, our analysis focused on assessing whether future bioclimatic conditions correspond to those where we expect the selected species to be suitable—without considering the impacts of management. As such, the results of the atlas can be used as a first approximation to assess species that can potentially tolerate changes in climatic variables. For the selection of species (e.g. for design of agroforestry practices or diversification strategies), the information from distributions maps must be complemented and fine-tuned with information on other environmental requirements (e.g. soils), management of species, availability of planting material and other contextual factors such as farmers' preferences and market options.

The reliability of the models depends heavily on the quality and quantity of species observations available. Records can be biased towards specific climates in areas that were more accessible for collection and inventories compared to other areas. Models may therefore miss some important areas of species occurrence (false negatives). A model may also predict presence of a species in places where the species is not known to be present. This may be due to local environmental constraints not captured in the niche modelling because of limitations on seed dispersal or because of human disturbance. In order to reduce the effect of these factors, we took a number of specific measures. First, data on climatic variables were used only for areas with presence of locations (see 'Ensemble niche modelling'). Second, the autocorrelation of geographic information was reduced by randomly selecting one presence point in each grid cell from which climate data were extracted (Fourcade et al 2014) (see 'Collection of presence locations'). Third, we did an extensive search for additional point locations for three high-value timber species of the Meliaceae family (*Swietenia macrophylla, Cedrela odorata* and *Carapa guianensis*) and three native fruits widely used in the region (*Annona cherimola, Bactris gasipaes* and *Persea americana*) to improve the results from their niche modelling (see appendix 1).

Collection of presence locations

Species presence locations were compiled from following sources: the *Global Biodiversity Information Facility*–GBIF (GBIF (Global Biodiversity Information Facility 2015), tree inventories from different agroforestry systems in Central and South America and the Caribbean (see maps of observed locations for each species), Species Link portal *MAPFORGEN* (SpLink (Species Link 2015), as well as other publications and unpublished databases (appendix 1). No distinction was made between locations from natural and anthropogenic systems.

Records with obvious errors in coordinates (such as incomplete coordinates, wrong locations, locations in the ocean) and records with no geographic information were excluded. For this, we compared the collected passport data and information on administrative boundaries with information from the *Database of Global Administrative Areas* (GADM) (Robert Hijmans et al 2014). Records with coordinates that did not match the administrative information were eliminated. Moreover, presence locations that erroneously were located in the ocean were revised: geographical locations near the coastal boundary up to 30 arc-sec (~ 1 km), whose passport data coincided with the nearby administrative unit, were maintained and their coordinates were adjusted so that they were located on land; other points were eliminated. To reduce the effects of autocorrelation, a systematic sampling technique was applied (Fourcade et al 2014) to remove duplicate presence point in grid cells of 2.5 arc-min (~ 5 km at the equator, (Ranjitkar et al 2016)) using the R-package Alphahull (Pateiro-Lopez and Rodriguez-Casal 2016).

After eliminating erroneous and superfluous locations, only species with at least 60 presence locations were modelled (see appendix 2). We used this minimum to make sure that during the modelling process (see section "Consensus modelling"), each model run (four in all) would include a minimum of 15 locations used to evaluate model performance, which is considered the minimum needed to guarantee good model performance (Varela et al 2014). Species absence points (background locations) are rare because it is difficult to determine whether a species is really absent from a given location or it has simply not been recorded. Absence points were approximated using randomly selected pseudo-absence points within the species range.

Selection of bioclimatic variables

The 19 bioclimatic variables are available from *WorldClim* version 1.4 (Hijmans et al 2005) for the current climate conditions (representative of 1960–1990) as well as for all available climate change scenarios for 2050 (average for 2041-2060) for CRP4.5 and CRP8.5 were used. This database is freely accessible at http://www.worldclim.org/.

Multicollinearity (multiple correlations between variables) of bioclimatic predictors may result in overfitting or bias in the resulting suitability models. To avoid this problem, variance inflation factors (VIFs) were generated to select a subset of the least correlated predictors of the 19 climatic variables. The VIF values were calculated using 10 000 random background locations generated within the range of presence points of the 54 species to extract values from the 19 bioclimatic layers, using the *ensemble.test* function from the BiodiversityR statistical package in R (Kindt and Coe 2016). After the first run, variables with a VIF value of infinity (meaning a high correlation) were excluded. In our case, the variables BIO5, BIO6 and BIO7 were excluded from analysis in the first step. Using *the ensemble.test* function in an iterative procedure, the variable with the highest VIF was removed from the subset of bioclimatic variables. The procedure ended when all variables had VIF values smaller than 10, resulting in nine variables (table 3).

RCP[1] climate change scenarios

For modelling the changes in suitability between the baseline (current) climate and 2050, we used the Representative Concentration Pathways (RCPs) scenarios from IPCC that describe four different 21st century pathways of greenhouse gas (GHG) emissions and atmospheric concentrations, air pollutant emissions and land use (http://ar5-syr.ipcc.ch/topic_futurechanges.php). These scenarios are defined by the value of radiative forcing (ability to absorb or release heat) from the atmosphere to 2050, ranging from 2.6 to 8.5 Watts m-2 (van Vuuren et al 2011) (table 4). For the modelling, we selected the intermediate scenario RCP4.5 and a scenario with very high emissions, RCP8.5. The scenario 2.6 was not chosen because it represents the most effective mitigation scenario, i.e. aiming to keep temperature below 2°C. Currently this scenario is unlikely with projections of current policies (expected temperature increase of from 3.3°C to 3.9°C) and pledges plus Intended Nationally Determined Contributions (INDCs) to reduce emissions (expected temperature increase of from 2.5°C to 2.8°C) http://climateactiontracker.org/global.html.

For RCP4.5 and RCP8.5 scenarios, downscaled bioclimatic data for a subset of 17 Global Circulation Models (appendix 3) were sourced from WorldClim version 1.4 (Hijmans et al 2005). We modelled the 2050 distribution areas for all 17 GCM models from each scenario because there are no criteria to assess which of the 17 GCM models best predict future climate (IPCC recommends treating all of these models equally). By incorporating all 17 GCM models in modelling, we expect to capture all plausible changes in the distribution of species according to the available information and modelling scenarios.

[1] Representative Concentration Pathway RCPs are four greenhouse gas concentration (not emission) trajectories adopted by the IPCC for its fifth Assessment Report (AR5) in 2014.

Table 3. Bioclimatic variables available in WorldClim

Abbreviation	Bioclimatic variable	Selected for modelling
BIO1	Annual Mean Temperature	
BIO2	Mean Diurnal Range (Mean of monthly (max temp - min temp))	√
BIO3	Isothermality (BIO2/BIO7) (* 100)	√
BIO4	Temperature Seasonality (standard deviation *100)	
BIO5	Max Temperature of Warmest Month	
BIO6	Min Temperature of Coldest Month	
BIO7	Temperature Annual Range (BIO5-BIO6)	
BIO8	Mean Temperature of Wettest Quarter	√
BIO9	Mean Temperature of Driest Quarter	√
BIO10	Mean Temperature of Warmest Quarter	
BIO11	Mean Temperature of Coldest Quarter	
BIO12	Annual Precipitation	
BIO13	Precipitation of Wettest Month	√
BIO14	Precipitation of Driest Month	√
BIO15	Precipitation Seasonality (Coefficient of Variation)	√
BIO16	Precipitation of Wettest Quarter	
BIO17	Precipitation of Driest Quarter	
BIO18	Precipitation of Warmest Quarter	√
BIO19	Precipitation of Coldest Quarter	√

Source: WorldClim (www.worldclim.org/bioclim)
Note: The variables are derived from the monthly values of temperature and precipitation to generate biologically representative variables. Bioclimatic variables represent the average annual trends, seasonality and extreme environmental conditions.

Table 4. Main characteristics of climate change scenarios considered for niche modelling

Scenario	Radiative forcing	GEI concentration by year 2100	Temperature change (°C) in global superficies (2046–2065)	
			Mean	Probable range
RCP 2.6	2.6 W m^{-2}	421 ppm	1.0	0.4 – 1.6
RCP 4.5	4.5 W m^{-2}	538 ppm	1.4	0.9 - 2.0
RCP 6	6.0 W m^{-2}	670 ppm	1.3	0.8 - 1.8
RCP 8.5	8.5 W m^{-2}	936 ppm	2.0	1.4 - 2.6

Fuente: IPCC (2013)

Ensemble niche modelling

Ensemble niche modelling combines the results from different algorithms; in our case, the different algorithms corresponded to 17 different niche modelling procedures (appendix 4). As previously mentioned, the ensemble technique has the potential to provide better accuracy in modelling than single niche modelling (Thuiller et al 2009) (for this reason, it is used in different application domains such as weather forecasting where the methodology was initially applied).

A three-step method was applied using the BiodiversityR package in R (Kindt and Coe 2016). The first step was the algorithm calibration of weights (used to calculate the suitability for the ensemble model) using the *ensemble.test.splits* function. This function applies an internal cross-validation procedure wherein k subgroups are prepared (k = 4 in our script, so a fourfold cross-validation) by first randomly assigning location data to the k subgroups. In four following model calibration runs, models were assessed by using one of the subgroups to evaluate models that were calibrated by using the remaining three subgroups. The performance of each algorithm to correctly predict species presence-absence was evaluated with the criterion of area under the curve (AUC) (Bradley 1997). The AUC is equivalent to the probability that a randomly selected presence point is located in a cell with a higher probability value compared to an absence point. In our modelling exercise, we used algorithms that can distinguish between eligible and non-eligible areas without requiring absence locations. Absence locations for species are rare because it is difficult to determine whether a species is really absent in a particular location. As an alternative, 1000 randomly selected background locations—pseudo-absence locations—were used in the niche modelling. AUC values normally vary between 0 and 1, where higher values indicate the model's ability to correctly predict presence. In the first step of the calibration process, an AUC> 0.77 (default parameter ENSEMBLE.min) threshold was used to select the best-performing algorithms. The other algorithms were excluded in this first step and therefore were not used to calculate the suitability of the ensemble model. The selected algorithms can therefore be different for each species and each calibration run.

In the second step, the ensemble.test function was used, only with the algorithms selected during the first calibration step, also applying the fourfold cross-validation. This procedure generated AUC values for each algorithm and the parameters of the response functions (model training) to estimate the probability values of species occurrence based on the climate of each grid cell of the study area. The ensemble map combines the results of all models by calculating for each the weighted average (weighted by AUC of each model) of the probability values from each model (fig 1).

The third step created the distribution maps (probability maps and presence-absence maps) of the species under the current climate using the *ensemble.raster* function and the calibrated models and weights generated during the model training. The presence-absence maps were created from the probability maps. For this conversion from probability into presence-absence maps, during step 2 (in function ensemble.test), a probability threshold (argument: *threshold.method*) was calculated. We used the recommended threshold method of maximum sensitivity (true positive) + specificity (true negative) (Liu et al 2013, Ranjitkar et al 2016). The thresholds were calculated with the PresenceAbsence package by using the *"threshold.PresenceAbsence =TRUE"* option in the BiodiversityR package (Freeman and Moisen 2008).

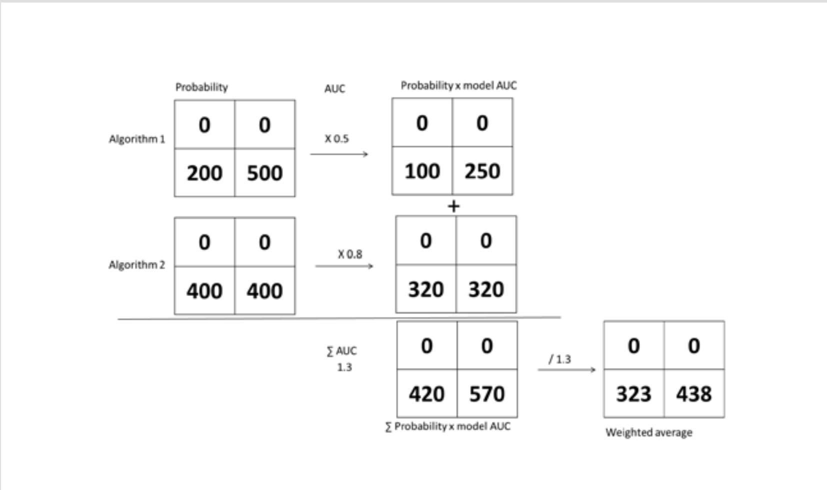


Figure 1. Representation of the integration of probability values (multiplied by 1000) for each cell obtained from different algorithms selected by the criterion of AUC> 0.5. Probabilities of species occurrence are weighted by the AUC of each algorithm.

To create species distribution maps for future bioclimatic conditions, we used the same procedure used for the baseline suitability and presence-absence maps, but utilizing the climate information from each future GCM model (17 GCM models, see appendix 3) for the RCP4.5 and RCP8.5 scenarios. The functions required the following packages: rJava (Urbanek 2016), maxent (Jurka and Tsuruoka 2013), gbm (Ridgeway and Southworth 2015), earth (Milborrow 2016), gam (Hastie 2015), rpart (Therneau et al 2015), vegan (Oksanen et al 2016), MASS (Ripley et al 2016), mgcv (Wood 2016), cluster (Maechler et al 2016), RODBC (Ripley and Lapsley 2016), multcomp (Hothorn et al 2008), maptree (White and Gramacy 2016), splancs (Bivand et al 2015), akima (Akima et al 2015), nnet (Ripley and Venables 2016), randomForest (Breiman et al 2015), mda (Hastie et al 2015), kernlab (Karatzoglou et al 2016), e1071 (Meyer et al 2015), sem (Fox et al 2016a) and car (Fox et al 2016b). For the full script used in the modelling, see appendix 5.

Creation of the maps that combine results of 17 climate scenarios

Modelled results cover the entire area of Central and South America, but in this atlas, we present the projected species distribution areas in Mesoamerica, which correspond to Central America (Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama) and the Yucatan Peninsula in Mexico.

Map layers generated by the ensemble models were processed with the R-packages raster (Hijmans et al 2015), dismo (Hijmans et al 2016), sp (Pebesma et al 2016), rgeos (Bivand et al 2016c), maptools (Bivand et al 2016b) and rgdal (Bivand et al 2016a). To create the map of current species distribution (probability map), we first created a mask layer based on a map of presence and absence (1-0, see "Ensemble nichemodelling" to see how this is defined) for each modelled species (fig 2). This mask defines the map area where the gradient of distribution probabilities is shown.

In order to create the maps of future species distribution under each scenario (RCP4.5 and RCP8.5), 17 presence-absence layers were created for each of the 17 future climate models. The results of these 17 layers were integrated in a single map where presence (1) and absence (0) were added. Next, an ensemble presence map was created for each species and each scenario, based on a criterion under which at least 66 percent of the models (Mastrandrea et al 2010) agreed on the presence of the species in the cell (i.e. a criterion of summed values ≥ 12 (fig 3).

To identify the change in suitability under future climate, we compared the presence-absence map under current climate with maps of future climates (ensemble maps integrating results of 17 models for RCP4.5 and RCP8.5). The comparison was carried out by subtracting from the future presence-absence map the baseline presence-absence map. The new layer (after the subtraction) shows areas where a given species maintains its current distribution (persistence), areas where the species appears in new areas (potential new habitat) and areas where the species disappears (loss). All maps were created using the packages ggplot2 (Wickham 2009), png (Urbanek 2013) and ggsn (Santos Barquero 2016) in R (see appendix 6 for the full script used in the generation of the maps).

We also determined the percentages of area corresponding to the range of niche persistence, potential new habitat and loss, both in the dry forest and the rainforest ecological zone in Mesoamerica, using a layer developed by TNC (TNC (The Nature Conservancy 2012) (fig 4). Together with the maps, we present a table that summarizes these results per forest type and for the whole region.

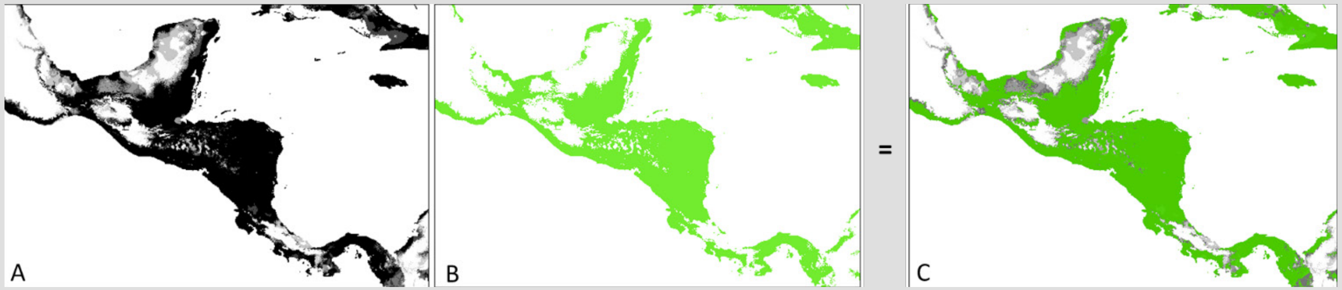


Figure 2. Representation of the methodology used to create the species distribution map under current climatic conditions for each modelled species. A: species distribution layer showing probabilities of occurrence; B: layer of presence and absence based on the calculated absence-presence threshold value (green indicates presence); C: overlays—gray areas outside the green layer are below the threshold of the species and thus eliminated from the final map.

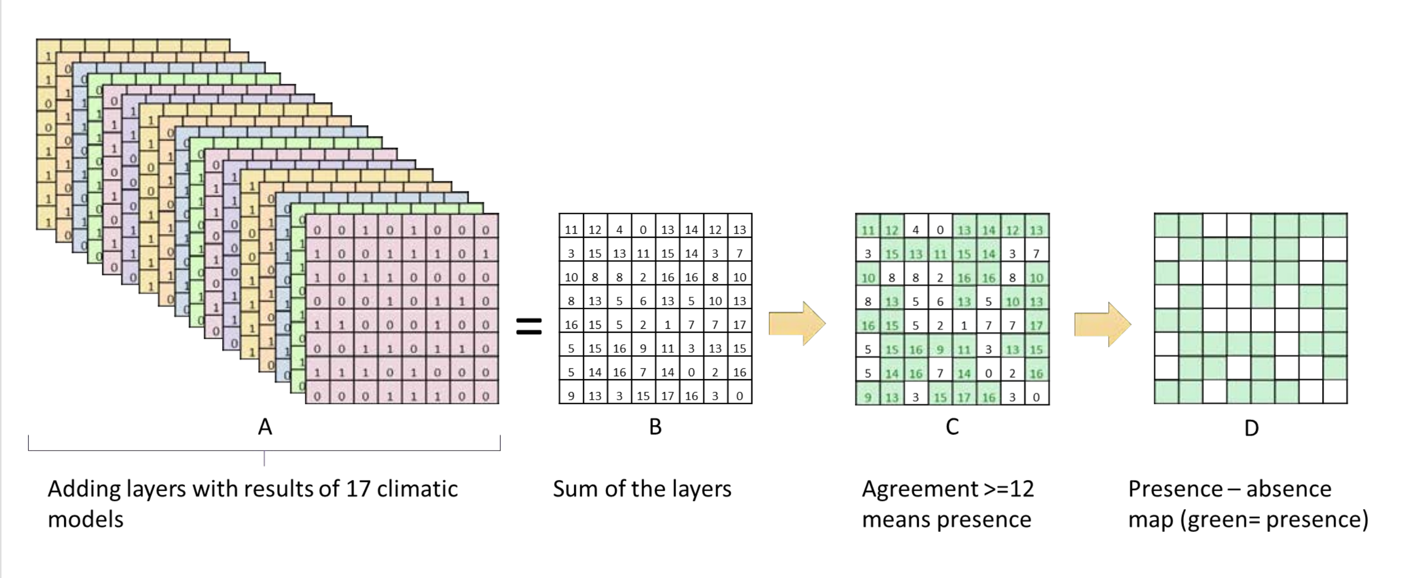


Figure 3. Representation of the methodology used for creating the future presence-absence map layer. A: projected presence (1) and absence (1) of the 17 layers of climate models RCP (4.5 or 8.5); B: layer obtained with the sum of the layers of climate models-model-agreement map; C: final layer (mask) of species distribution under future scenario of climate change, cells <12 represent absence.

Collection of information about species functional attributes

In addition to passport information (information on locations), we collected information on various tree attributes that determine the adaptation of tree species to different environments (tolerances) and their management, as well as information on the potential uses of each species.

This additional information is key for the selection and management of agroforestry species on farms. The attributes were classified into four groups: attributes of the whole plant, reported uses, reproduction and tolerance of adverse environmental conditions (table 5). Information was gathered from various published and unpublished primary and secondary sources (appendix 5). The information presented in the table includes the mean and ranges (minimum and maximum) found in different sources. When there was only one source available, that value has been reported.

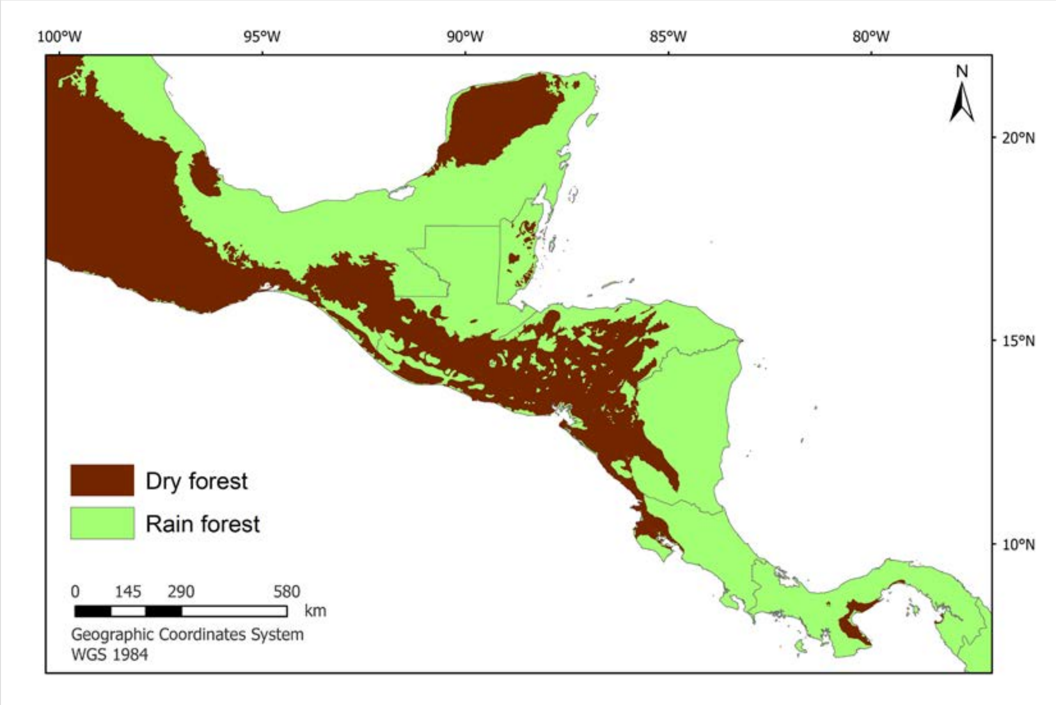


Figure 4. Map of ecological zoning in Mesoamerica (dry forest [bosque seco] and rain forest [bosque lluvioso]). Source: TNC (2012)

Table 5. List of species' functional attributes considered in the atlas

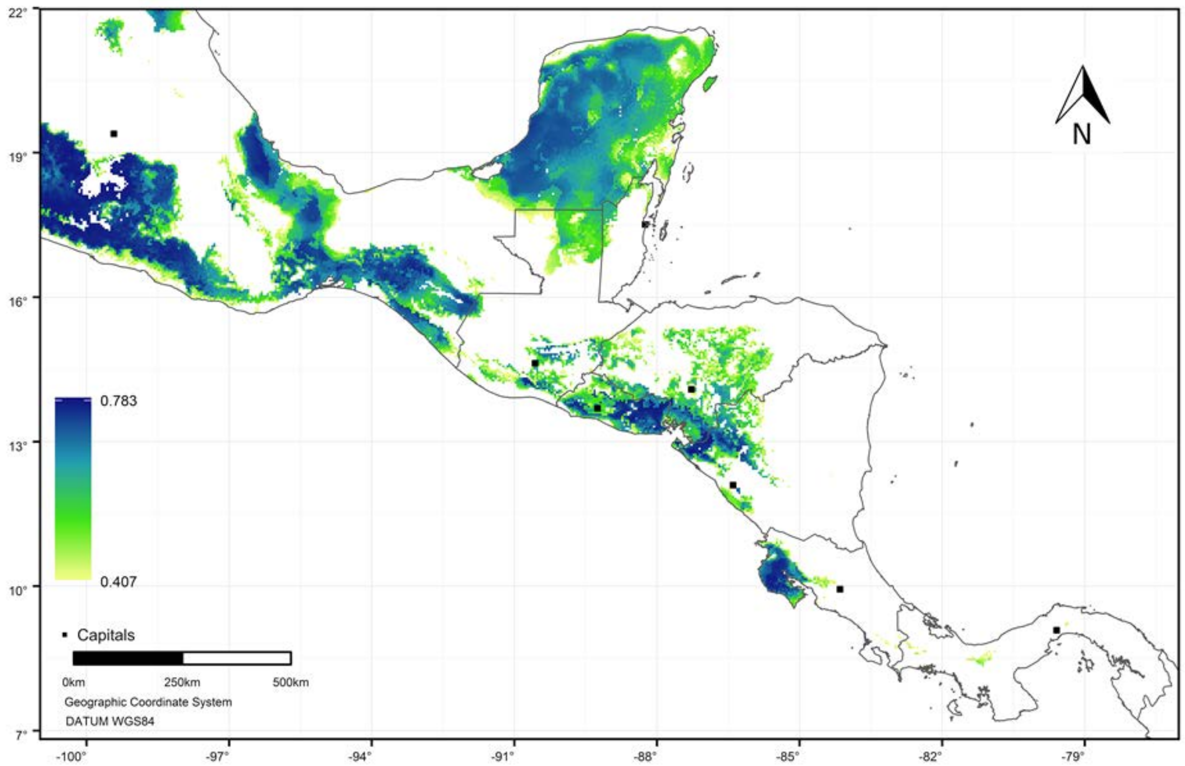
Whole plant characteristics	
Growth form	Categorical. Determined by the direction and extent of individual-plant growth. Classified as (i) **tree**, woody species with an easily identifiable main stem; (ii) **shrub**, a woody species of small size that does not have one single main stem but several stems; (iii) **palm**, species of the Arecaceae family.
Plant height (m)	Continuous. Height of the mature plant from the stem base to the tip of the canopy (values derived from data reported in the literature). We present minimum and maximum height reported.
Spinescence	Categorical. Whether species has spines, thorns or prickles. In species where spinescence has been removed by breeding, the classification refers to wild populations.
N-fixing	Categorical.Whether species can fix atmospheric nitrogen (N).
Wood density (g cm^{-3})	Continuous. Density of dry wood. Minimum and maximum values reported in literature.
Leaf phenology	Categorical. Whether a species loses all leaves in certain periods of the year or retains its leaves year-round. There are two classes: (i) evergreen, the species maintains leaves year-round; (ii) deciduous, the species loses its leaves during a particular season.
Uses	
Commercial timber	Whether the species is listed in "The international timber trade: the working list of commercial timber tree species" (Mark et al 2014). This working list, covering 1575 species, was produced by combining 17 contemporary open-access resources that list commercial timbers, including trade reports and publications from conservation organizations.
Timber uses	List of timber end uses including: SM = suitable for sawmill; CS = engineering and structural construction; CL = light construction; MB = furniture; HF = farm tools; PS = flooring; DT = railway sleepers; CH = veneer; AR = handicrafts.
Firewood	The species is traditionally used as an energy source (combustion).
Fruit	The species produces fruit or nuts for human consumption.
Forage	The species produces leaves, fruits or roots that can be used as livestock feed.
Other uses	Other uses include medicinal, cosmetic, beekeeping and ornamental.

Reproduction	
Flower reproductive system	Describes the reproductive system of tropical trees according to three classes (Kernick 1961, MAPFORGEN 2013): (i) **dioecious**, individuals have either only male or only female flowers and therefore must outcross to reproduce; (ii) **monoecious** have both sexes in the same plant and **outcrossing**; (iii) **monoecious** with a **mixed system** allows both outcrossing and selfing. Since tropical trees are in general outcrossing, no tree species with a selfing system were observed.
Pollination vector	The main pollen vectors, classified as (i**) insects**, (ii) birds, (iii) **bats**, (iv) **wind**.
Weight of 1000 seeds (g)	The minimum and maximum weight reported in literature.
Seed storage type	The seed behavior under storage conditions aimed at prolonging its physiological viability: (i) **orthodox seeds** tolerate dehydration (up to 5%) and low temperature or freezing (<5°C) storage; (ii) **recalcitrant seeds**, do not tolerate dehydration or storage at low temperatures and freezing; (iii) **intermediate seeds** tolerate dehydration from 10% to 12.5% but do not tolerate freezing.
Seed dormancy	Condition that prevents seed germination even under conditions ideal for germination: (i) **physical**, characterized by the impermeability of the membrane that protects the seed, can be broken artificially through scarification with sandpaper, abrasive agents or hot water; (ii) **mechanical**, seeds with a tough membrane that allows entry of water but prevents the emergence of the radicle—It breaks with the removal of the membrane; (iii) **physiological**, prevents embryo growth and seed germination until chemical changes occur.
Seed dispersal	This is an indicator of the plant's ability to colonize new sites. Depends on different vectors for seed dispersal such as **autochory**, seeds dispersed by their own means, mainly through gravity; **anemochory**, small seeds with structures such as hairs or wings to be dispersed by the wind; **zoochory**, seeds dispersed by animals that eat fruit (exo-zoochory) or ingest fruit and seeds (endo-zoochory), in this atlas no distinction is made between - and exo-zoochory; **hydrochory**, seeds dispersed by water; **ballistichory**, seeds mechanically dispersed when the fruit opens explosively (Salgado-Negret 2015).
Tolerance to stressful environmental conditions	
Drought	Whether the species tolerates drought—the duration of the drought period is generally not reported, although in some cases sources refer explicitly to seasonal drought.
Flooding	Whether the species tolerates flooded conditions—the duration of the flooding period is variable, spanning 10 days up to a month. In some cases the flooding period is not reported.
Frost	Whether the species tolerates frost.
Shade	Whether the species tolerates shade during juvenile stages of growth.
Salinity	Whether the species tolerates saline soils.
Fire	Whether the species survives fire.

Interpretation of the maps

Species-suitable areas under current climate

This is a distribution map of the species, showing all suitable areas under current climatic conditions. The difference in color variations represents the degree of suitability, in a range from 0.407 to 0.7831, where 0.7831 (blue) indicates places where there is a greater likelihood that the species is present (suitable places). Values in yellow represent the lowest probability of occurrence of the species (less suitable places), with 0.407 corresponding to the estimated threshold value that distinguishes between presence and absence. Areas with no color (white) represent areas that are not suitable for the species.

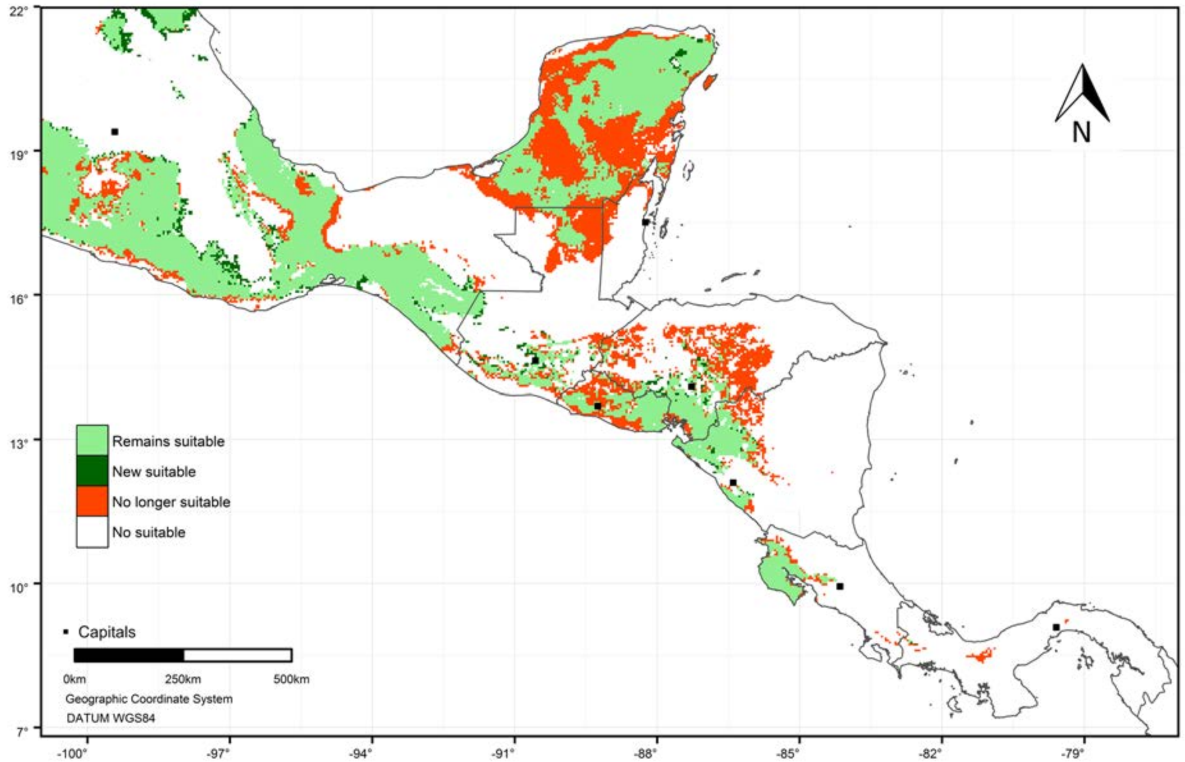


Projected changes in suitability under future (2050) climates

This map, created by comparing the future with the current species distribution, describes suitability changes under future climate conditions (scenarios RCP4.5 or RCP8.5). Orange cells represent areas that will probably no longer be suitable for the species. Light green cells represent areas where the species is predicted to maintain its current distribution. Dark green cells represent areas that could be potentially suitable for the species in the future (the species appears in areas where it does not now exist).

Climate models for RCP4.5 scenario, project for 2050 (2046–2065) an increase in average global temperature of 1.4°C (0.9 °C–2.0°C).

The RCP8.5 scenario, projects for 2050 (2046–2065) an increase in average global temperature of 2.0°C (1.4°C–2.6°C).

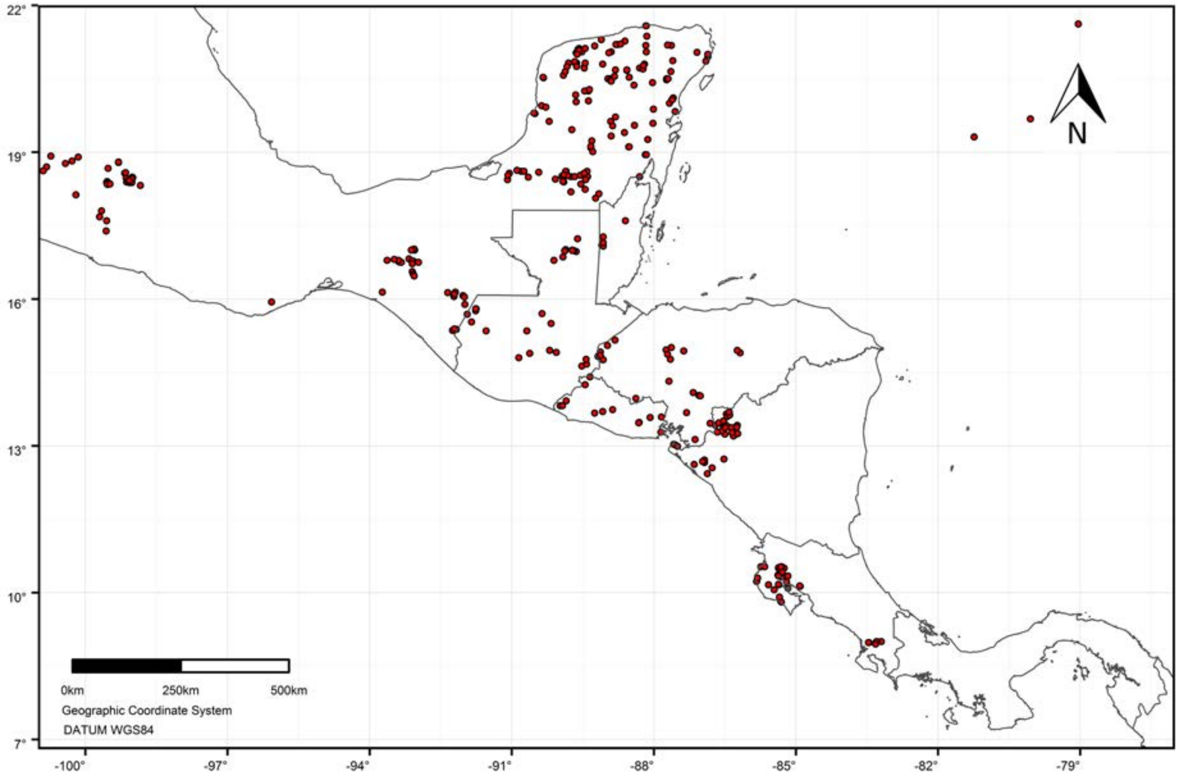


Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	62 906	75%	5%	25%	-20%
Rainforest	39 112	54%	4%	46%	-42%
Entire region	102 018	67%	4%	33%	-29%

This table indicates the modelled current distribution area (km²) in the dry forest, rainforest ecological zone and the entire Central American region (fig 4). The percentage of the area under future climate conditions, where the suitability of the species is predicted to persist, to increase (colonization) and no longer be suitable (loss) are also presented, considering the dry forest, the rainforest and the entire region. The net change indicates the balance between colonization and loss. A positive net balance indicates an increase in the areas suitable for the species, while an increase and negative net balance indicate a reduction in areas suitable for the species.

Locations of observed presence

The maps with points-locations of observed presence indicate the geographical locations where the species has been observed (this collection) in Mesoamerica. These observations constitute the basis for niche modelling. The map shows all locations available. During modelling, not all are considered; some were eliminated in order to reduce bias caused by oversampling (small areas with high densities of presence locations; see "Methodology").



General trends in species distribution under current climate and future climate scenarios

Fruit species

Of the 24 fruit species, modelled results showed a higher suitability in the rainforest ecological region for all species with exception of *Annona cherimola*, for which suitable areas were higher in the dry forest (fig 5).

For 11 species—mainly native but also including species introduced long ago, such as mango and *Citrus* spp.—there are large areas with suitable climatic conditions under the baseline scenario, i.e. 50–76 percent of the area considered in Central America (fig 6, wide distribution). For

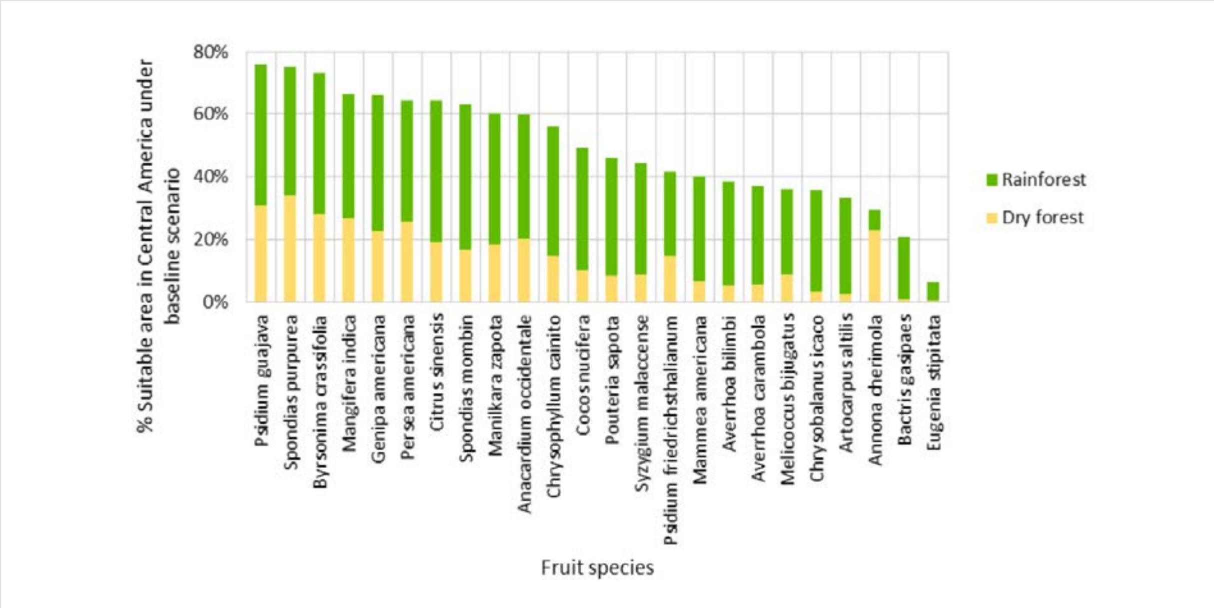


Figure 5. Percentage of area with suitable areas for 24 fruit species, according to modelled results under baseline—current—climatic conditions. Suitable areas include the dry and rainforest ecological zones.

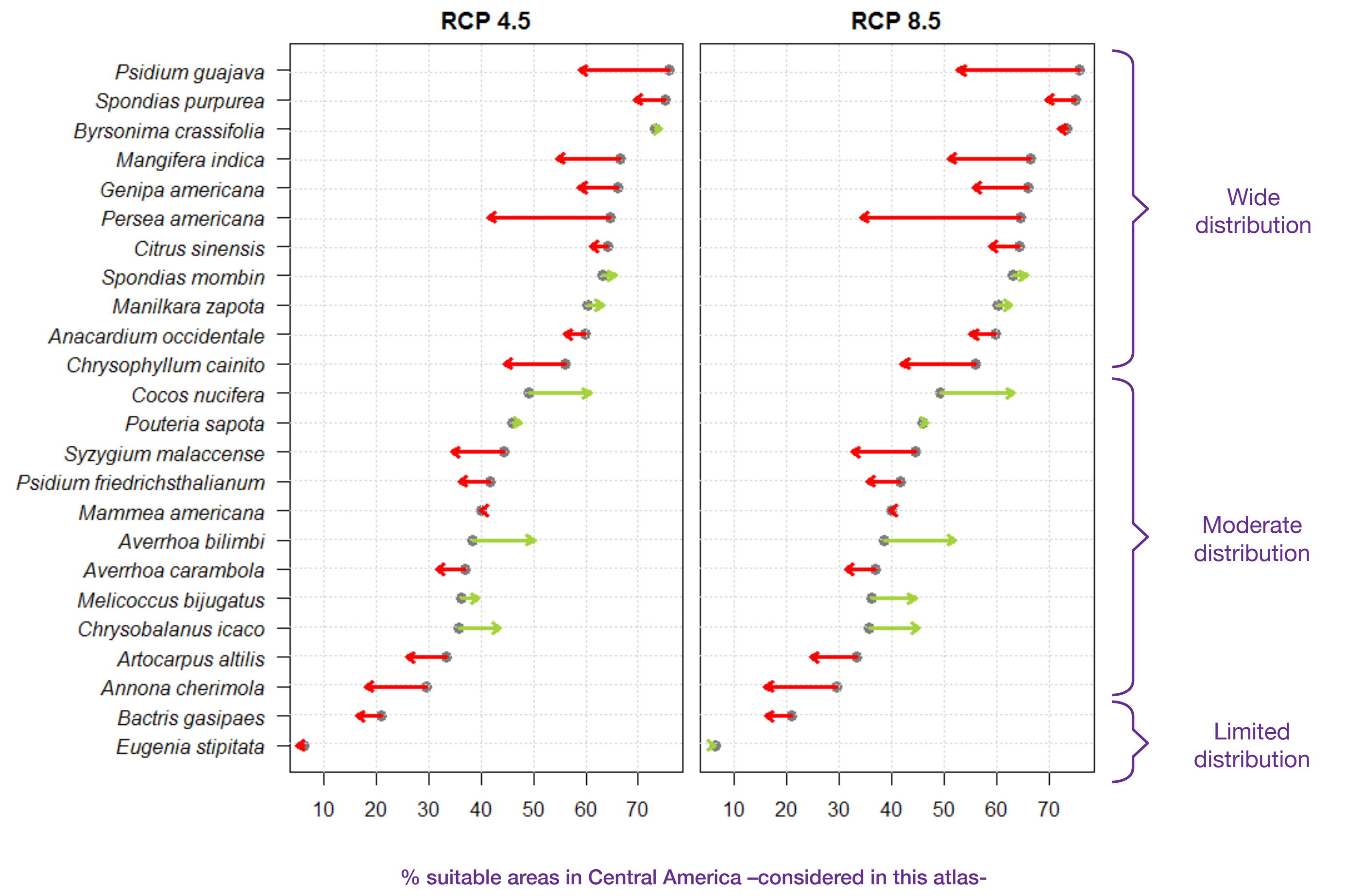


Figure 6. Expected changes in the suitable area (expressed as percentage of area considered in Central America under current atlas) for 24 fruit species under two climate-change scenarios: RCP 4.5, and RCP 8.5. Grey dots represent distribution of a given species under current climatic conditions, red arrows—left direction—represent decreases in suitable areas, and green arrows—right direction—represent increases in suitable areas.

most species with wide distribution, there are losses in suitable areas and a few species with no changes or marginal gains. More specifically, modelled results suggest that large areas (23–47 percent considering both climate change scenarios) will not be suitable under future climates for *Persea americana* (avocado) and *Psidium guajava* [guava), both in the dry forest and the rainforest. Moderate losses are suggested (11–25 percent considering both climate change scenarios) for *Chrysophyllum cainito* (caimito); *Mangifera indica* (mango)—higher in the dry forest (23–38 percent) than in the rainforest (12–23 percent); and *Genipa americana* (jaguar), both in the dry forest and the rainforest. For *Spondias purpurea* (red mombin), *Anacardium occidentale* (cashew) and *Citrus x sinensis* (sweet orange group), minor losses, on average, are expected in the region (5–9 percent considering both climate change scenarios—higher in the dry forest (10–24 percent) than in the rainforest (1–5 percent). Finally, *Byrsonima crassifolia* (nance) shows little change from current conditions and *Spondias mombin* (hog plum) and *Manilkara sapota* (níspero), show marginal gains (4–5 percent considering both climate change scenarios)—gains are more pronounced in the dry forest region (19–21 percent).

Species whose distribution covers moderate areas under the baseline scenario (30–50 percent) of the area considered in Central America, fig 6) included 11 species. The most important losses in suitable area are predicted for *Annona cherimola* (cherimoya) (39–47 percent of the baseline area, considering both RCP scenarios), the only species occurring mostly in the dry-forest ecological region. Moderate losses (14–27 percent considering both RCP scenarios) are expected mainly for non-native species such as *Syzygium malaccense* (malay apple), *Artocarpus altilis* (breadfruit), *Averrhoa carambola* (carambola) and the only native in this group, *Psidium friedrichsthalianum* (cas). For these species, losses are higher in the dry forest (22–57 percent) than in the rainforest (7–25 percent). *Mammea americana* (mammee apple) and *Pouteria sapota* (mamey sapote) have marginal changes from the current area of distribution in both scenarios of climate change. An increase in suitable area (22–36 percent considering both scenarios) is predicted for *Averrhoa bilimbi* (bilimbi), *Cocos nucifera* (coconut) and *Chrysobalanus icaco* (cocoplum), with higher increases in the dry forest than in the rainforest. *Melicoccus bijugatus* (Spanish lime) also increases (10–23 percent considering both scenarios), mainly in the rainforest region.

Finally *Bactris gasipaes* (peach palm, 21 percent) and *Eugenia stipitata*—a native from the Amazon region (araza, 6 percent)—have a limited modelled distribution under baseline climate conditions in Central America, almost exclusively in the rainforest. For *B. gasipae*s, there is an expected moderate decrease in suitable areas (22–24 percent net loss). For *E. stipitata*, trends are opposite in different scenarios, but given small areas suitable for the species, the changes seem almost negligible.

Timber species

For most of the 24 timber species considered, the rainforest ecological zone had wider suitable areas than the dry-forest ecological zone, with exception of *Alvaradoa amorphoides* (ardilla, caratillo) with larger suitable areas in the dry forest and *Enterolobium cyclocarpum* (guanacaste), *Hymenaea courbaril* (guapinol), *Roseodendron donnell-smithii* (cortez blanco) and *Handroanthus ochraceus* (cortez amarillo), which are equally distributed in both ecological zones. Suitable areas for *Pentaclethra macroloba* (gavilan) and *Carapa guianensis* (caobilla) are almost exclusively present in the rainforest ecological zone (fig 7).

Trends for 21 of the 23 timber species show a decrease in suitable areas in both climate change scenarios and only three show a marginal increase in suitable areas. 13 timber species have large areas with suitable climatic conditions under the baseline scenario (52–69 percent of the area considered in Central America, fig. 8—wide distribution). Of these timber species with wide distribution, modelled results suggest moderate reductions in suitable areas (11–23 percent, considering both scenarios)

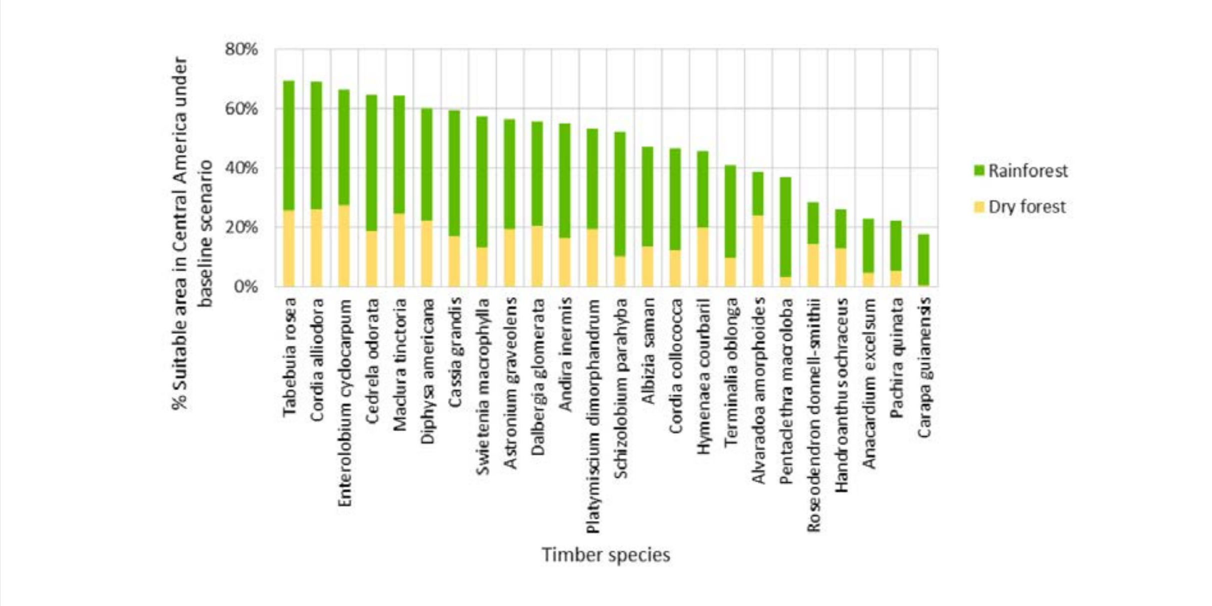


Figure 7. Percentage of area with suitable areas for 24 timber species, according to modelled results under baseline—current—climatic conditions. Suitable areas are also given for the dry-forest and rainforest ecological zones.

for six species: *Cedrela odorata* (cedro amargo), *Swietenia macrophylla* (caoba), *Dalbergia glomerata* (granadillo), *Cordia alliodora* (laurel), *Platymiscium dimorphandrum* (coyote) and *Astronium graveolens* (ron-ron). For *C. alliodora* and *D. glomerata*, losses in suitable areas in the dry forest and the rainforest are similar, while for the rest of the species, losses in the dry forest are higher (20–43 percent considering both scenarios) than in the rainforest (7–18 percent considering both scenarios). Small losses (7–10 percent considering both scenarios) are expected for *Diphysa Americana* (guachipilin) and *Schizolobium parahyba* (gallinazo), mainly in the dry forest, while *Tabebuia rosea* (macuelizo, roble sabana) (the timber species with the widest modelled distribution), *Maclura tinctoria* (mora), *Andira inermis* (almendro) and *Cassia grandis* (carao) remain practically the same (±3 percent). *Enterolobium cyclocarpum* (guanacaste) is the only species in this group that shows an increase in suitable areas under climate change, albeit in low percentage (5–6 percent considering both scenarios).

There were six species with a moderate modelled distribution under baseline conditions (30–50 percent of the area considered in Central America, fig 8). Large losses (29–41 percent) are suggested for *Alvaradoa amorphoides* (ardilla, caratillo), mostly in the rainforest (42–54 percent considering both scenarios). Moderate losses (18–27 percent considering both scenarios) are suggested for *Hymenaea courbaril* (guapinol) and

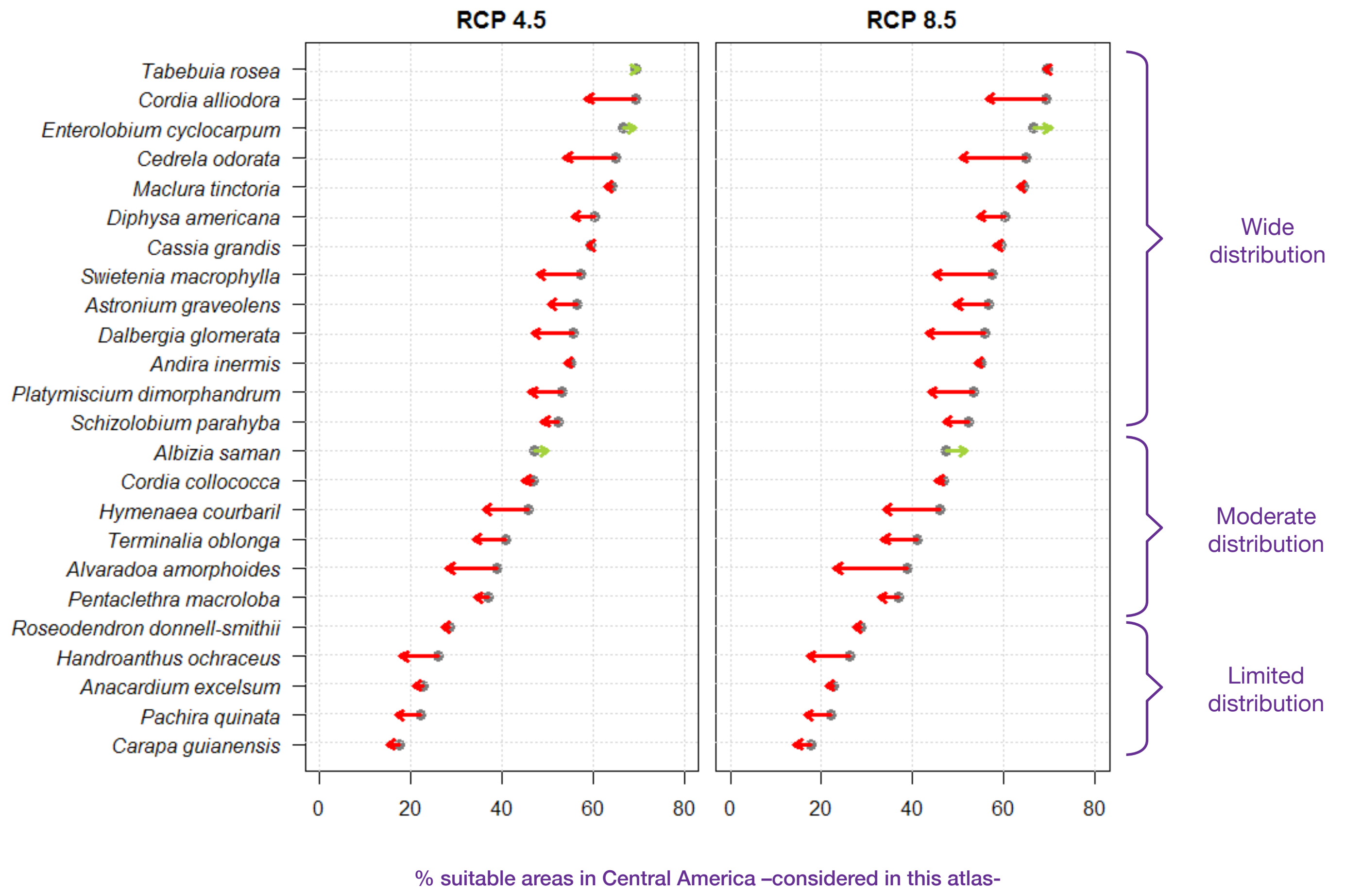


Figure 8. Expected changes in the suitable area (expressed as percentage of area considered in Central America under current atlas) for 24 timber species under two climate change scenarios: RCP 4.5 and RCP 8.5. Grey dots represent distribution of a given species under current climatic conditions, red arrows—left direction—represent decreases in suitable areas and green arrows—right direction—represent increases in suitable areas.

Terminalia oblonga (guayabo), while for *Pentaclethra macroloba* (gavilan) and *Cordia collococca* (muneco), small losses are suggested under both climate scenarios (5–12 percent). *Albizia saman* (genízaro) is the only species with a small increase in suitable areas (7–10 percent considering both scenarios).

Finally, for five timber species, modelled results show a limited suitable area in Central America (18–29 percent, fig 8) under baseline conditions. Modelled results for all these species show a decrease in suitable areas, more specifically, large losses for *Handroanthus ochraceus* (cortez amarillo) (33–36 percent considering both scenarios); moderate losses (8–26 percent considering both scenarios) for *Pachira quinata* (pochote), *Carapa guianensis* (caobilla) and *Anacardium excelsum* (espavel) and small losses for *Roseodendron donnell-smithii* (cortez blanco) (6 percent considering both scenarios).

Species that improve soil conditions

According to modelled results, the six species (all legumes) commonly used in the region for their positive impacts on soil fertility and soil conservation have more suitable areas in the rainforest ecological zone than in the dry forest (fig 9).

For all of these species, modelled results indicate small to moderate reduction in suitable areas under both scenarios of climate change. Three species have large areas with suitable climatic conditions under the baseline scenario (58–75 percent of the area considered in Central America, fig 10—wide distribution). Of these species with wide distribution, *Inga vera* (guama) and *Inga punctata* (guaba, pepeto negro) are expected to have moderate losses (12–22 percent considering both scenarios), while *Gliricidia sepium* (madero negro), one of the species with the widest distribution in the region under current climatic conditions, has a small reduction (5–6 percent considering both scenarios). The remaining three species had moderate areas with suitable climatic conditions (37–46 percent of the area considered in Central America). Of these, *Inga jinicuil* (paterno) (both in the dry forest and the rainforest) and *Inga oesteridana* (guaba, guama) (mainly in the dry forest) are expected to have large losses in suitable areas (34–56 percent considering both scenarios), practically moving the species to the range of the "limited distribution species." Finally, from this group, suitable areas for *Erythrina berteroana* remain practically the same, with only small losses (5–6 percent, considering both scenarios).

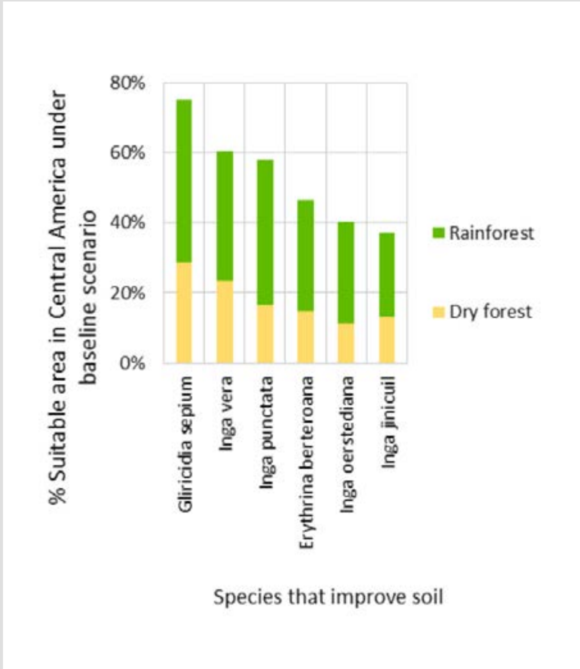


Figure 9. Percentage of area in Central America with suitable areas for six species used to improve soil conditions according to modelled results under baseline—current—climatic conditions. Suitable areas are given for the dry forest and rainforest ecological zones.

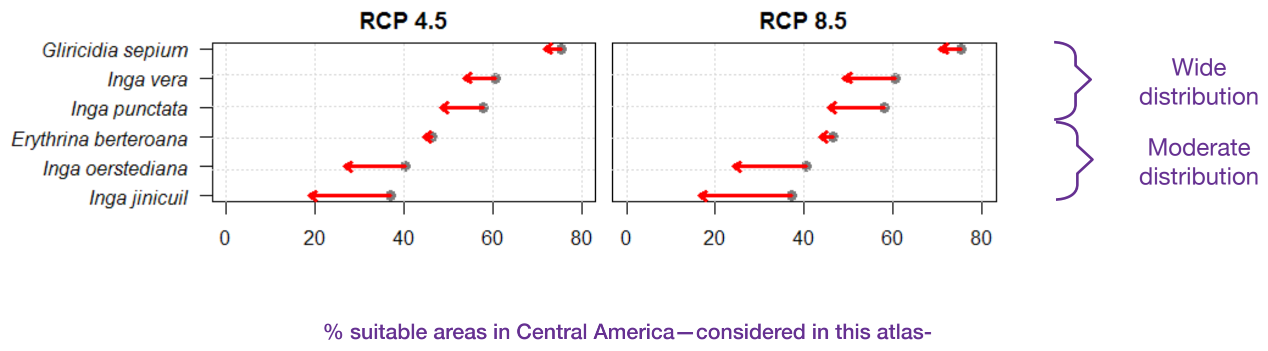


Figure 10. Expected changes in the suitable area (expressed as percentage of area considered in Central America under current atlas) for six species used to improve soil conditions, under two scenarios of climate change: RCP 4.5, and RCP 8.5. Grey dots represent distribution of a given species under current climatic conditions, red arrows—left direction—represent decreases in suitable areas.

Concluding remarks

Our results indicate that a wide range of tree options for agroforestry systems losses in suitable areas under climate change for most fruit and timber species and high losses for species that improve soil conditions. The predicted high losses in suitable niches for species that improve soil conditions is a main threat for agroforestry systems in Central America because these species are widely used to sustain soil fertility and crop productivity. It is therefore urgent to identify less vulnerable species that improve soil conditions, perhaps from lowland forests that might be better adapted to the changing climate conditions and evaluate their compatibility with cocoa and coffee systems.

Our recommendations are limited by the accuracy and precision of our modelling exercise and data input. Environmental niche modelling, however, has proven to be a good tool to reduce uncertainty in identifying climate change impacts on agroforestry systems in Central America and to support policymakers in making decisions for adaptation to climate change. The purpose of our analysis is to reduce uncertainty in decision making for choosing agroforestry options. Therefore, despite the limitations of environmental niche modelling, we believe that our results and recommendations can support private and public organizations in decision making to increase the resilience of agroforestry systems in Central America under climate change scenarios.

In this atlas, only species of native and widely used trees or those such as mango and orange that have a long established history in the region were selected, mainly because native tree species have a low risk of invasiveness in comparison with exotic species. As a result, this first analysis limits the number of economically valuable agroforestry options. However, it is important to consider that the Central American region harbours a large number of underutilized agroforestry species that can become a valuable resource in the design of climate-smart production systems. As such, the direction of future research on agroforestry options should consider the inclusion of these lesser-known tree species, such as wood species that can be used as alternatives for high-quality timber (WWF and GFTN 2013) and, particularly, for species that improve soil conditions.

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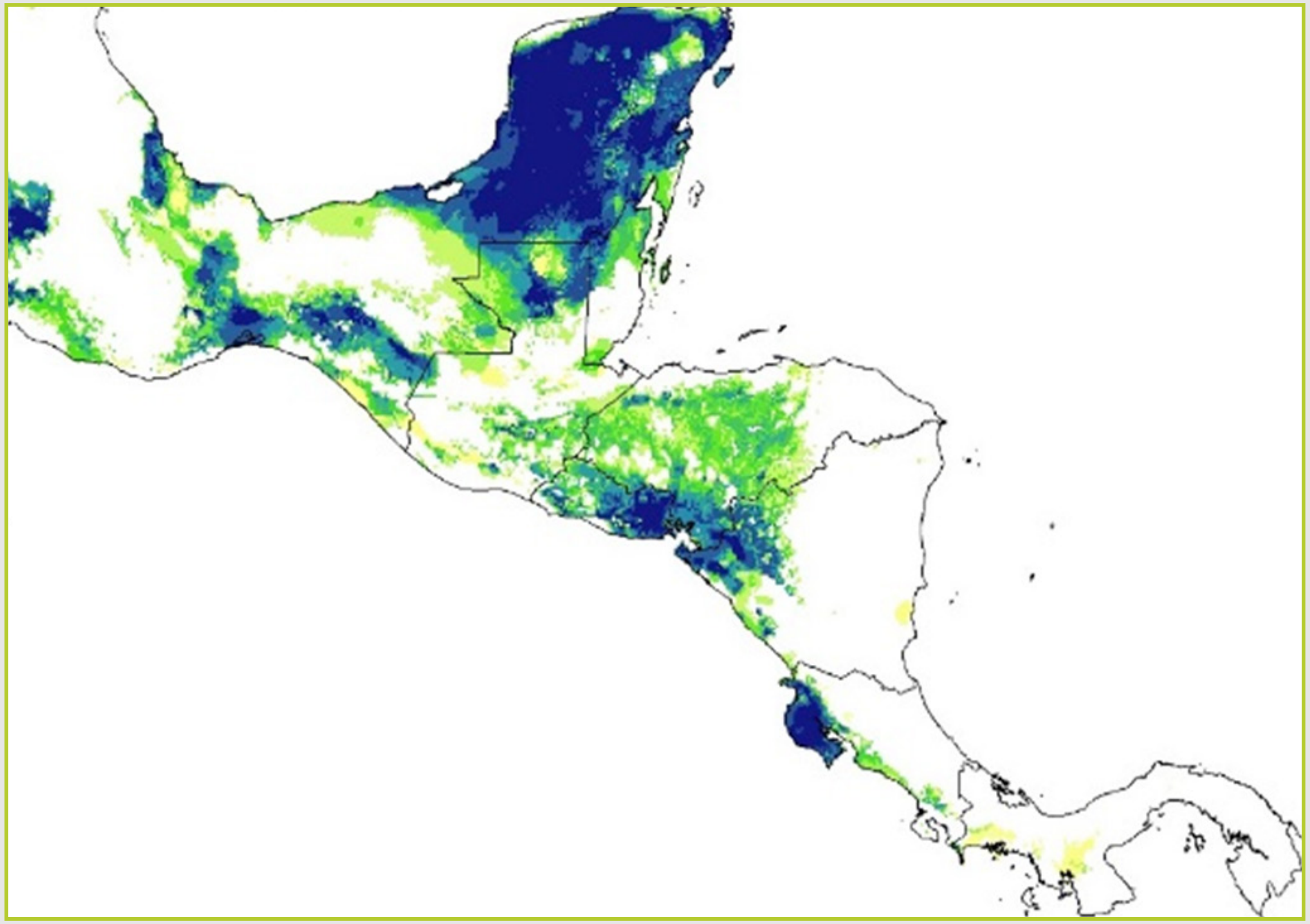
Suitability maps



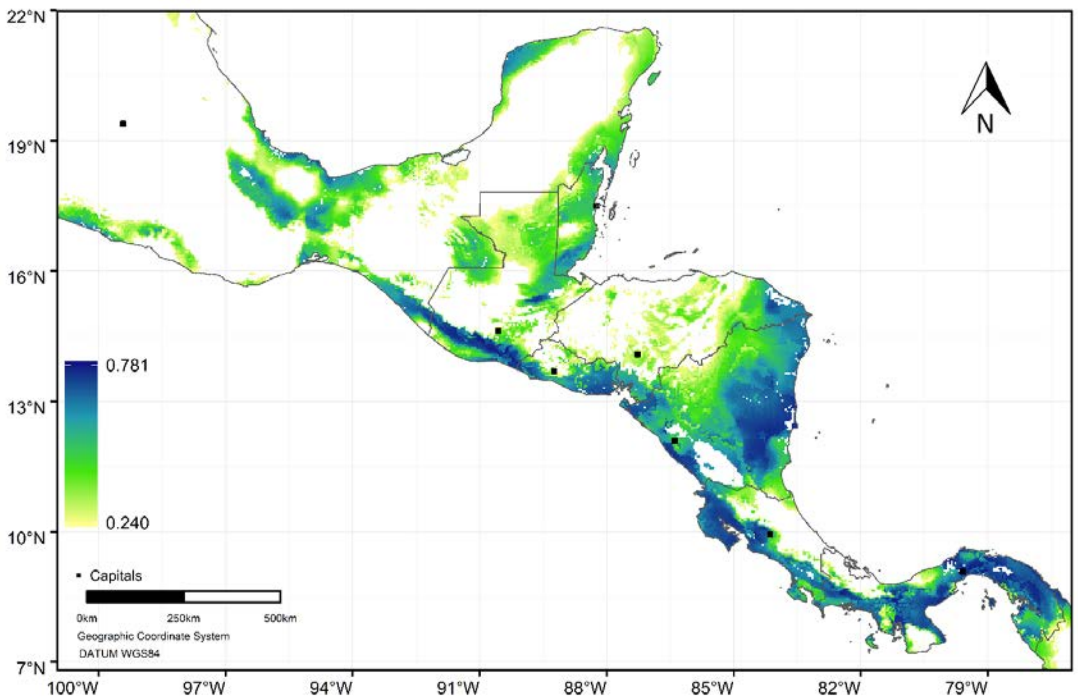
Albizia saman (Jacq.) Merr.

Family:
Leguminosae
Sinonimia:
Samanea saman (Jacq.) Merr.
Vernacular names:
Carreto negro (SV, HN),
cenizo (PA),
cenízaro (CR, SV, HN),
genízaro (CR, SV, GT, NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious self-pollination	**Drought**	Yes
Plant height (m)	35 (15 – 50)	**Timber uses[1]**	MB, CH, AR	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (g)**	173.8 (125.6 – 236.4)	**Frost**	No
N fixer	Yes	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.49 (0.42 – 0.60)	**Forage**	Yes	**Seed dormancy**	Physical	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Apiculture	**Seed dispersal**	Zoochory	**Fire**	Unknown

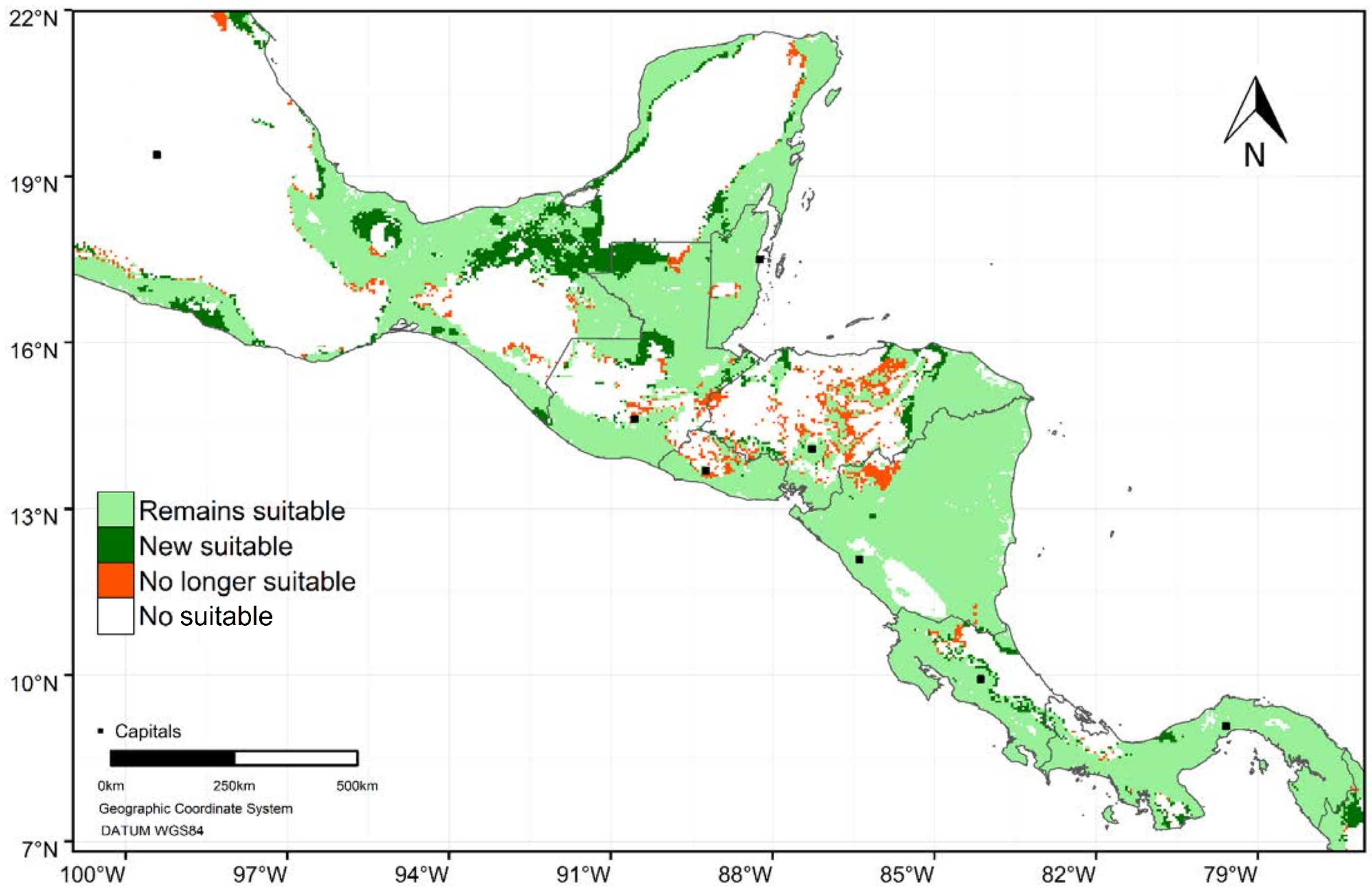
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



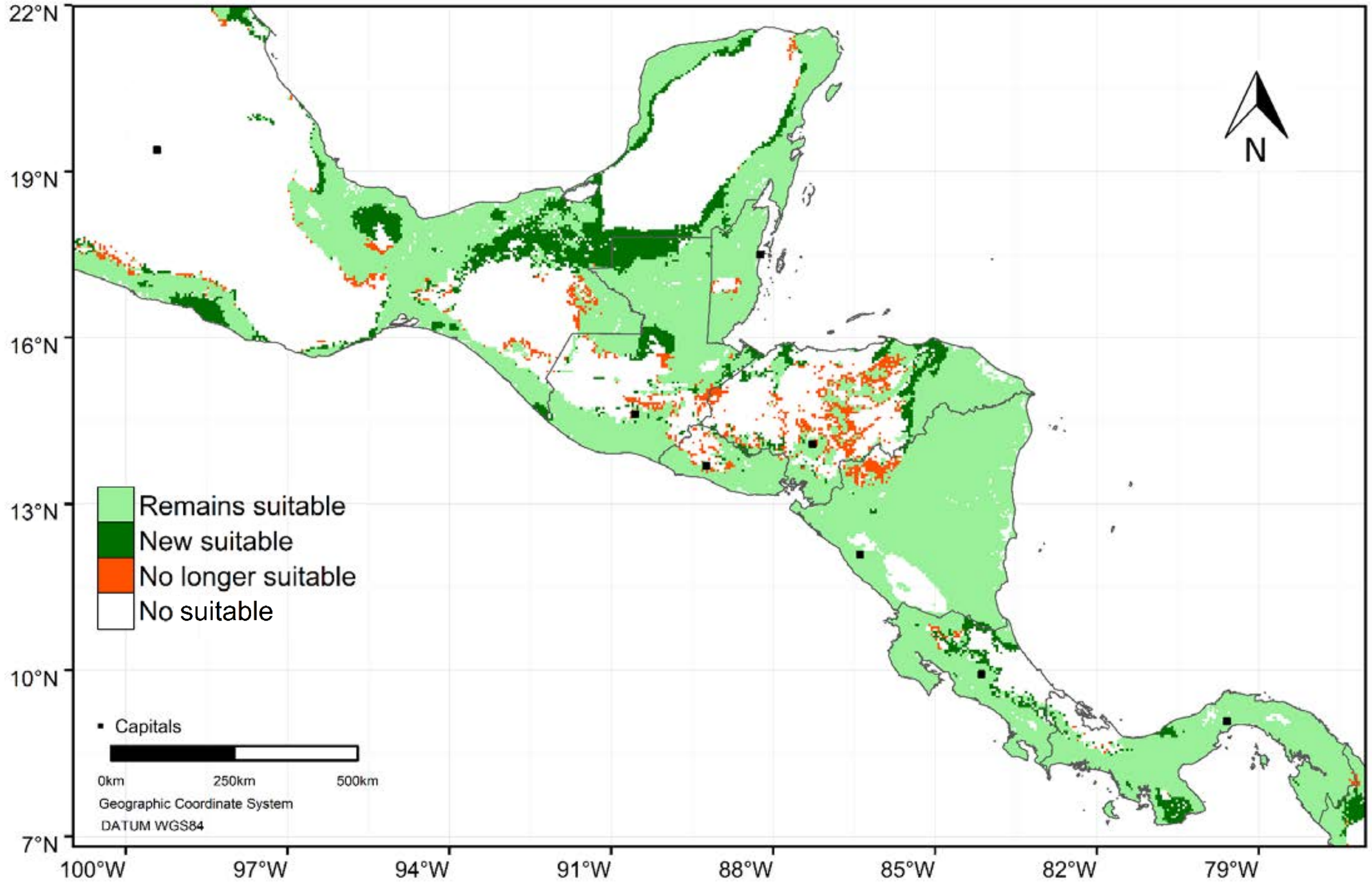
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



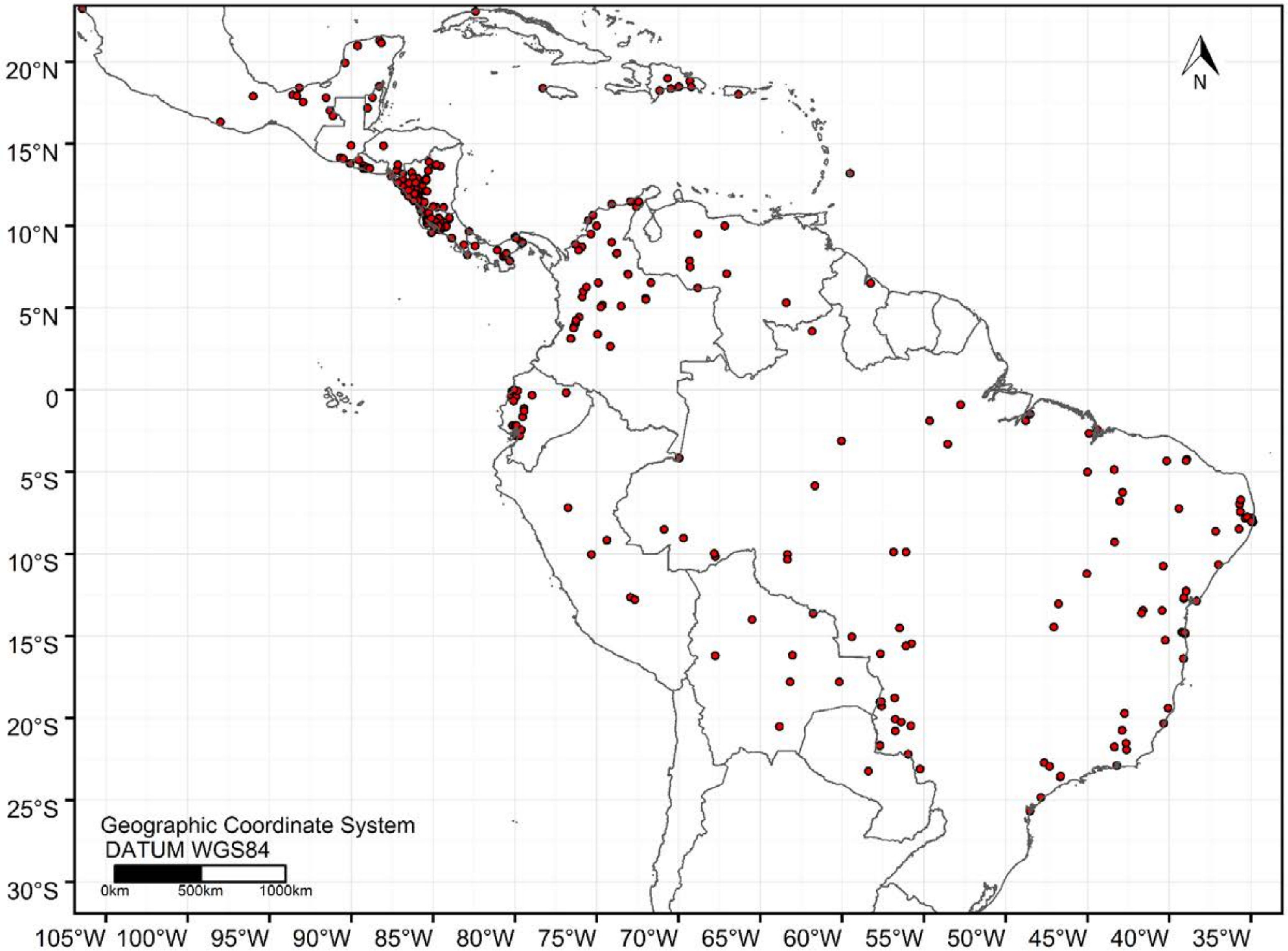
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	35,667	88%	9%	12%	-3%
Rain forest	88,171	97%	14%	3%	11%
Whole region	123,838	94%	12%	6%	7%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	35,667	87%	12%	13%	-1%
Rain forest	88,171	97%	18%	3%	15%
Whole region	123,838	95%	16%	5%	10%

Points of observed presence



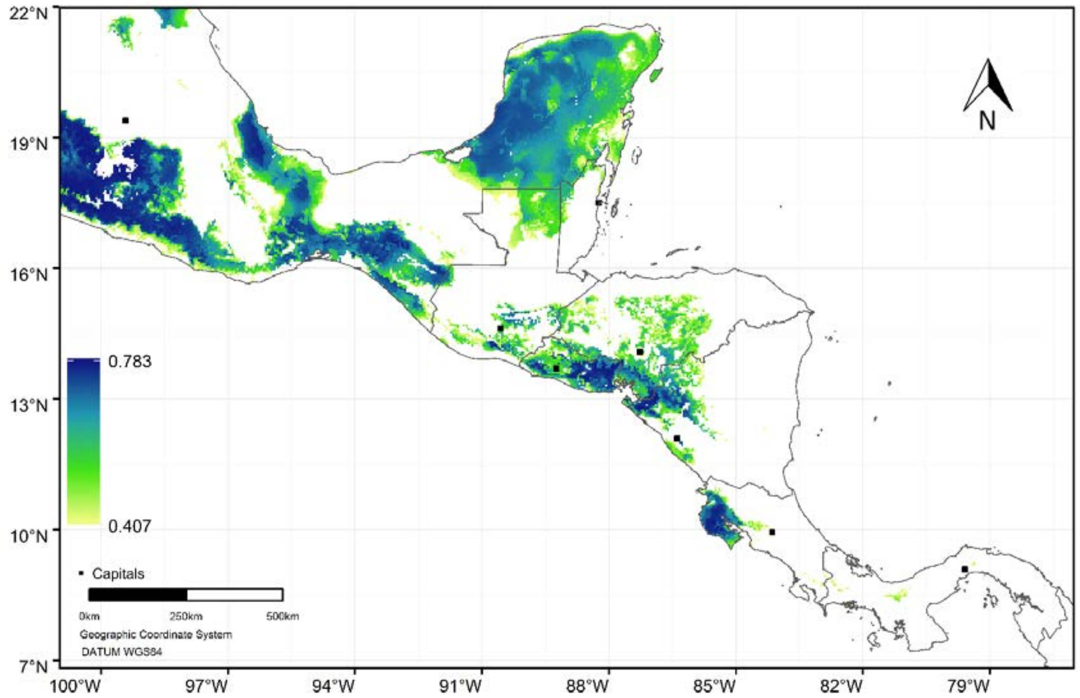
Alvaradoa amorphoides Liebm.

Family:
Picramniaceae
Vernacular names:
Ardilla (CR),
caratillo (NI),
cola de ardilla (GT),
zorra (HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Dioecious	**Drought**	Unknown
Plant height (m)	18 (15 – 20)	**Timber uses[1]**	CL-HF	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	9.96 (7.6 – 11.76)	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Intermedia	**Shade**	Unknown
Wood density (g cm-^{3})	0.58 (0.56 – 0.59)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	Anemochory	**Fire**	Unknown

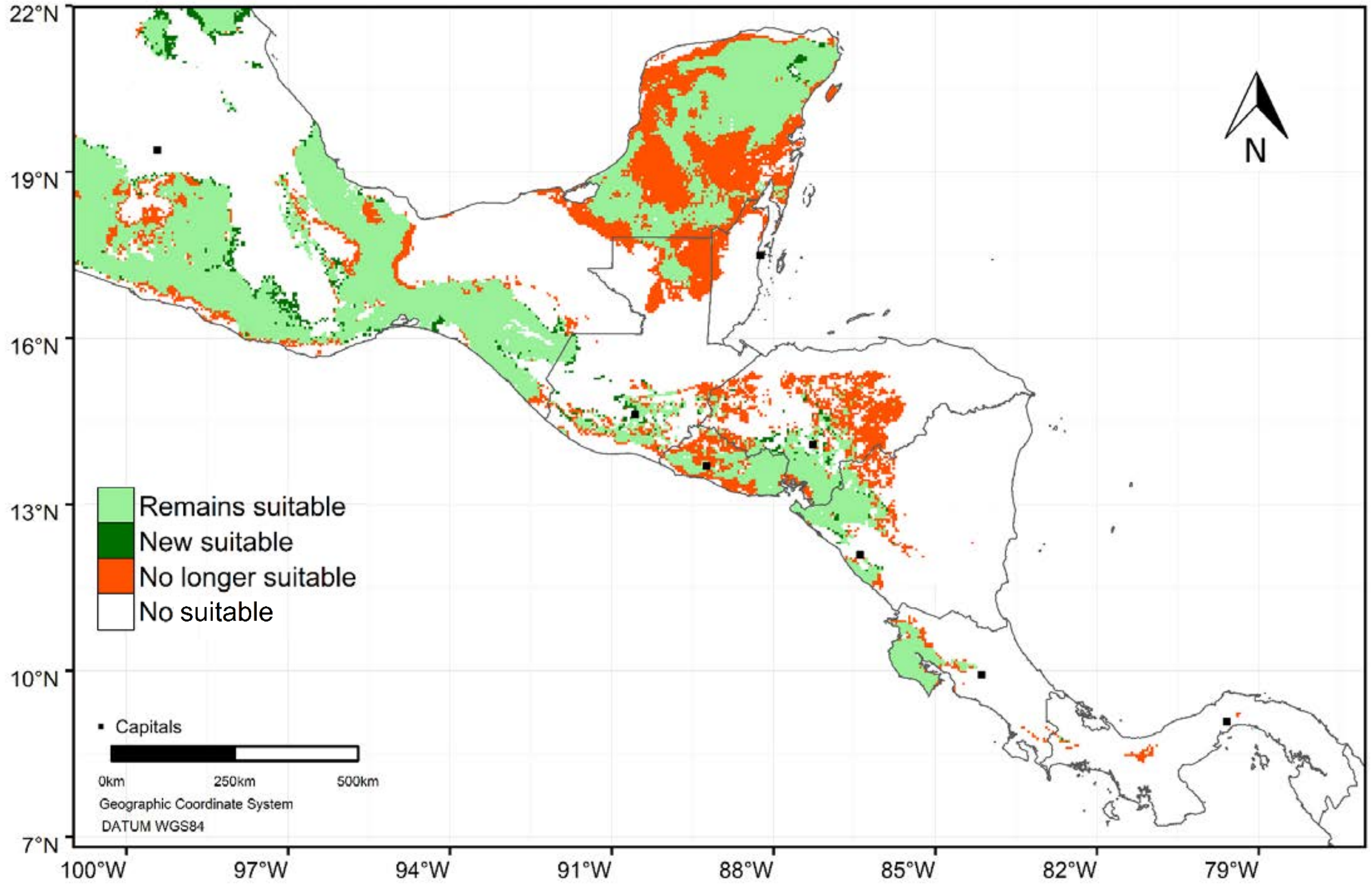
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



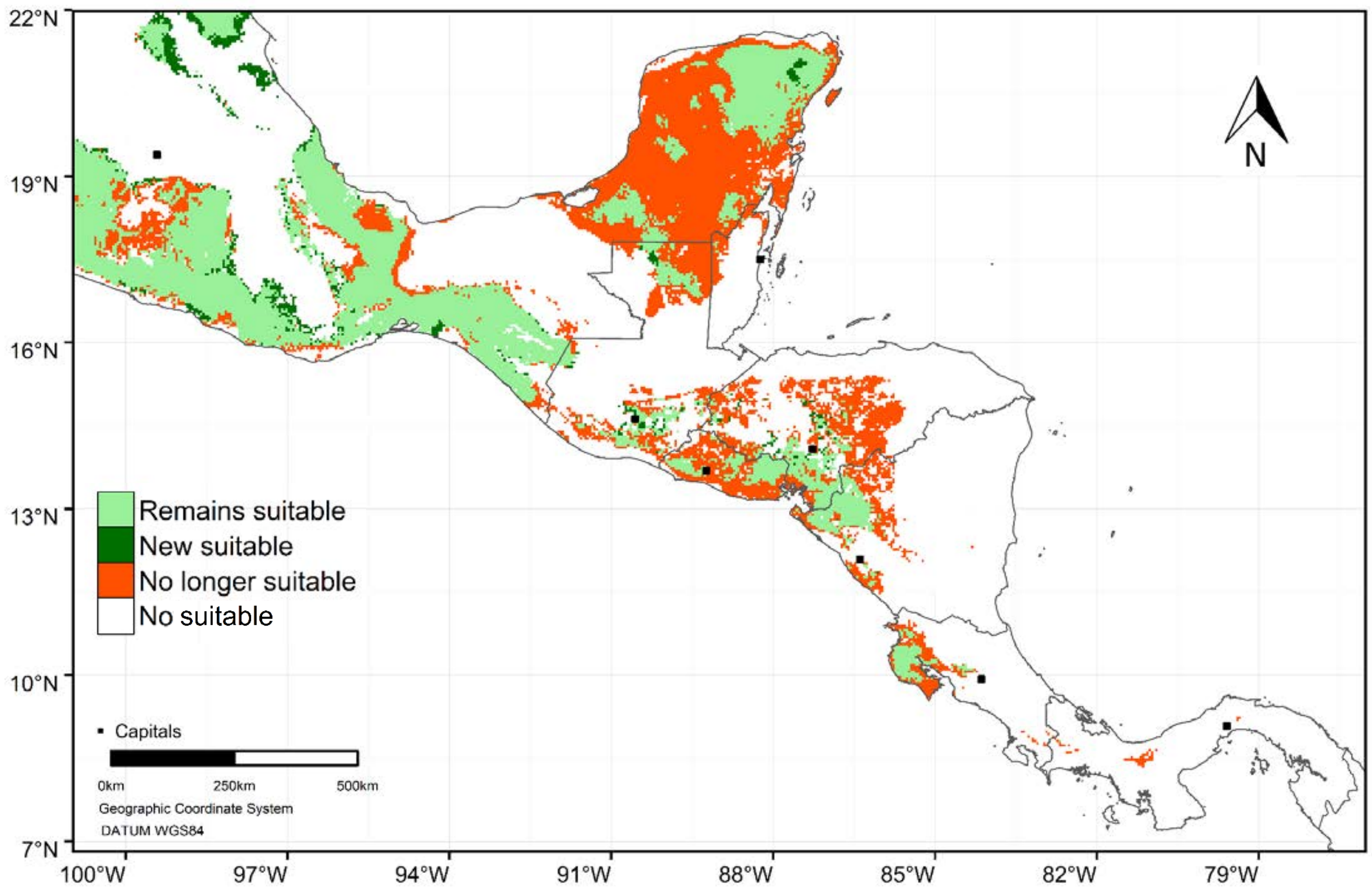
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



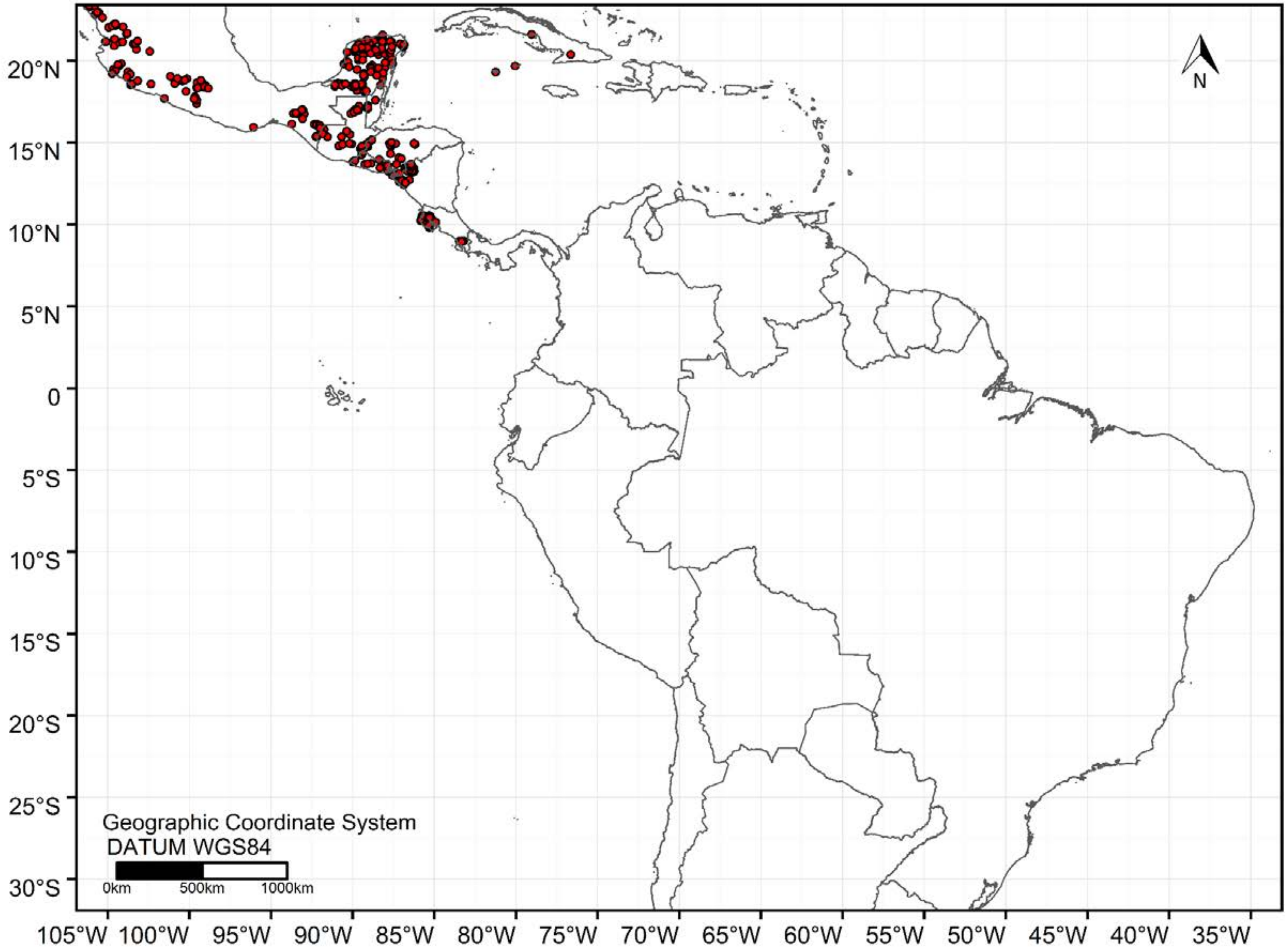
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	62,906	75%	5%	25%	-20%
Rain forest	39,112	54%	4%	46%	-42%
Whole region	102,018	67%	4%	33%	-29%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	62,906	75%	5%	25%	-20%
Rain forest	39,112	54%	4%	46%	-42%
Whole region	102,018	67%	4%	33%	-29%

Points of observed presence



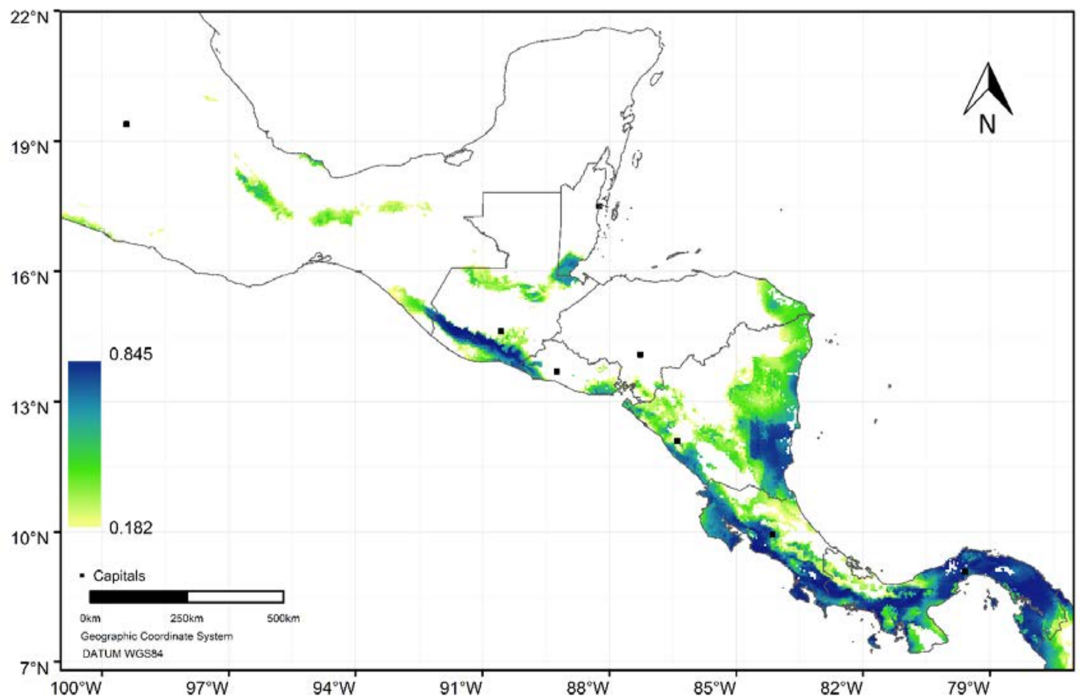
Anacardium excelsum (Bertero ex Kunth) Skeels

Family:
Anacardiaceae
Vernacular names:
Espavel (CR, SV, PA, GT, HN, NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Mixed monoecious	**Drought**	Unknown
Plant height (m)	41 (35 – 45)	**Timber uses**[1]	SM, CL, HF, CH	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	3692 (4,524 – 2,703)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.44 (0.32 – 0.68)	**Forage**	No	**Seed dormancy**	Unknown	**Salinity**	Unknown
Leaf phenology	Semi-evergreen	**Other uses**	Medicinal	**Seed dispersal**	Zoochory	**Fire**	Unknown

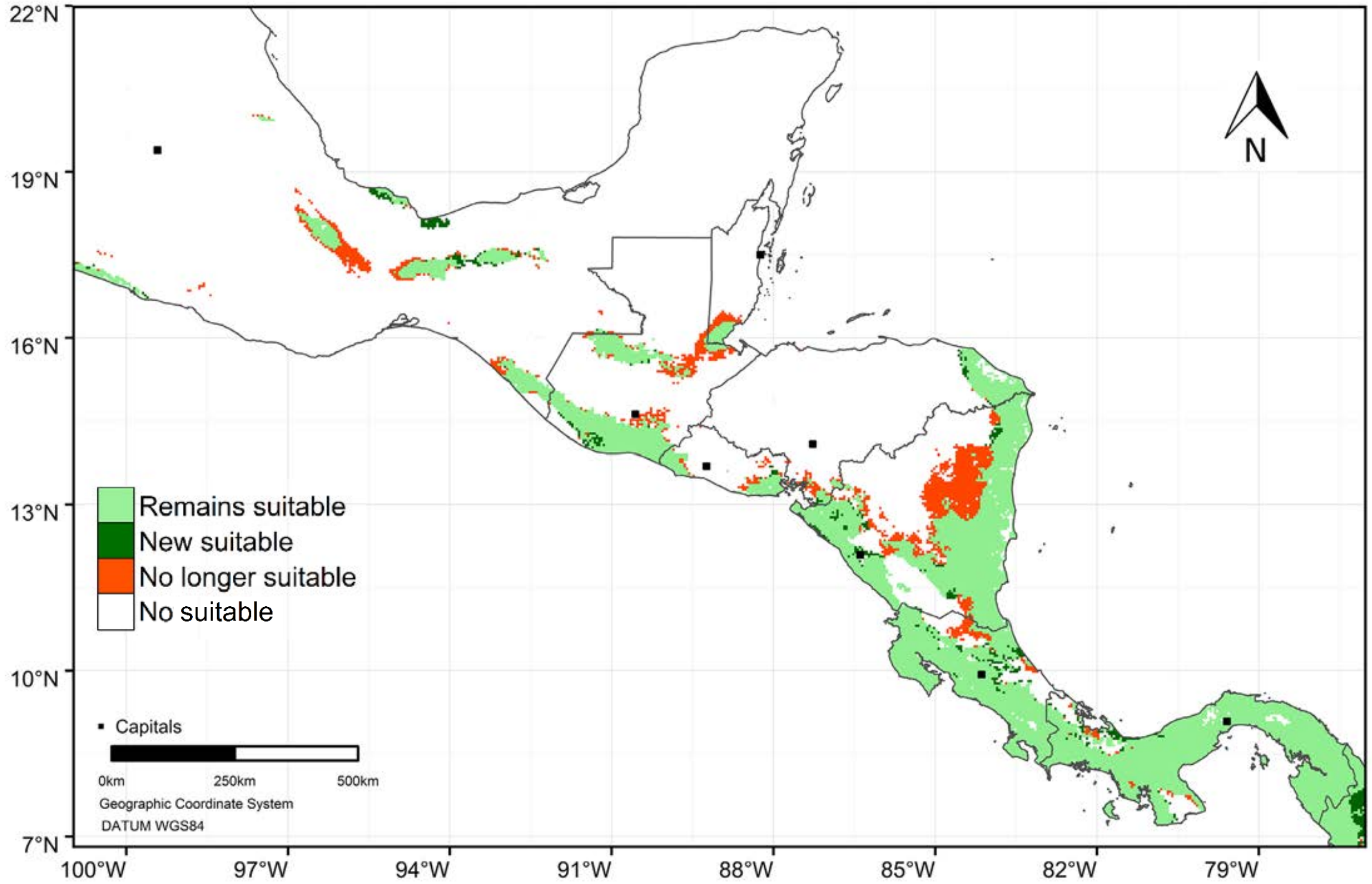
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



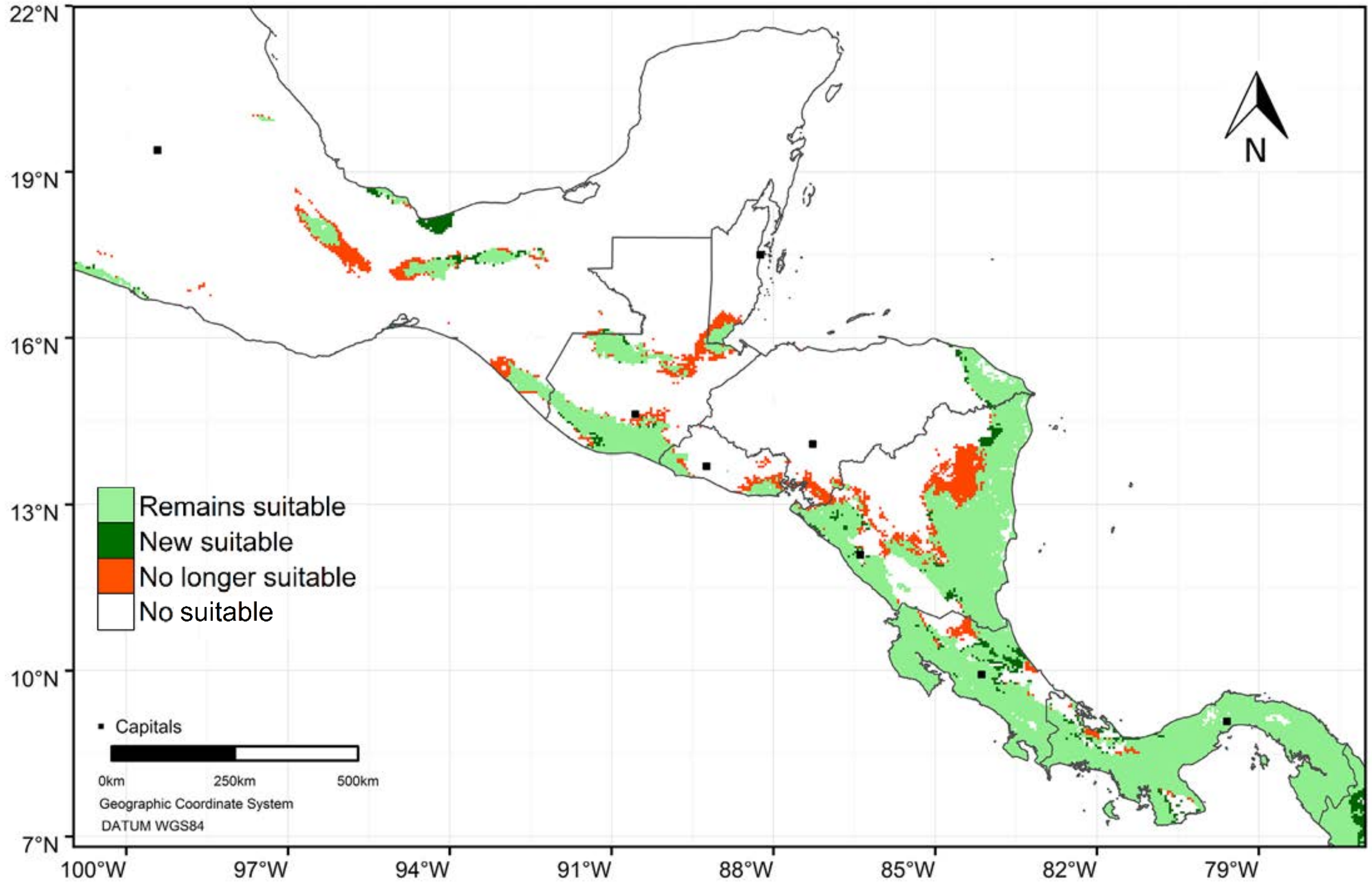
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



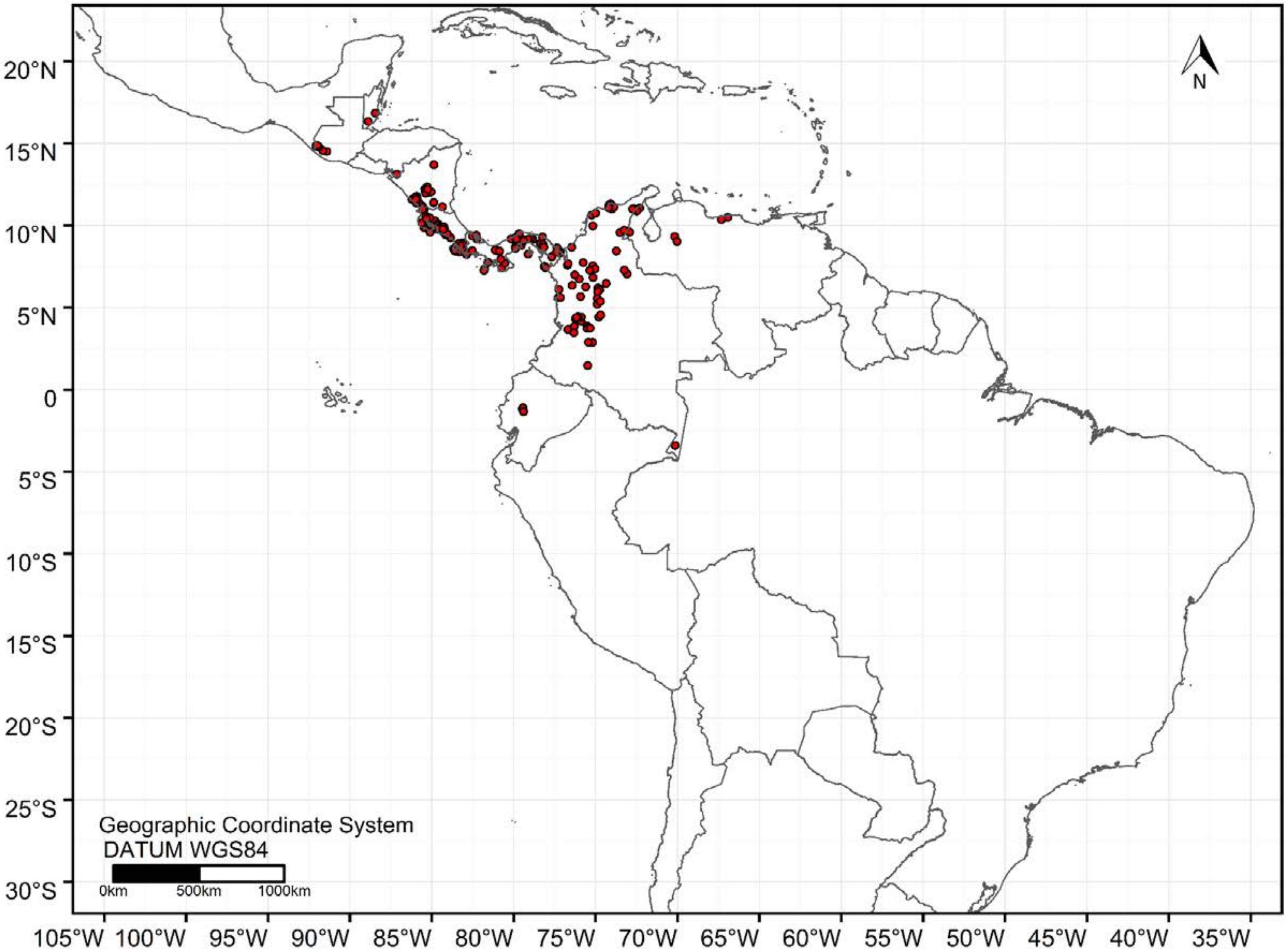
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	12,240	84%	5%	16%	-11%
Rain forest	47,461	85%	5%	15%	-9%
Whole region	59,702	85%	5%	15%	-10%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	12,240	79%	4%	21%	-17%
Rain forest	47,461	88%	7%	12%	-6%
Whole region	59,702	86%	6%	14%	-8%

Points of observed presence



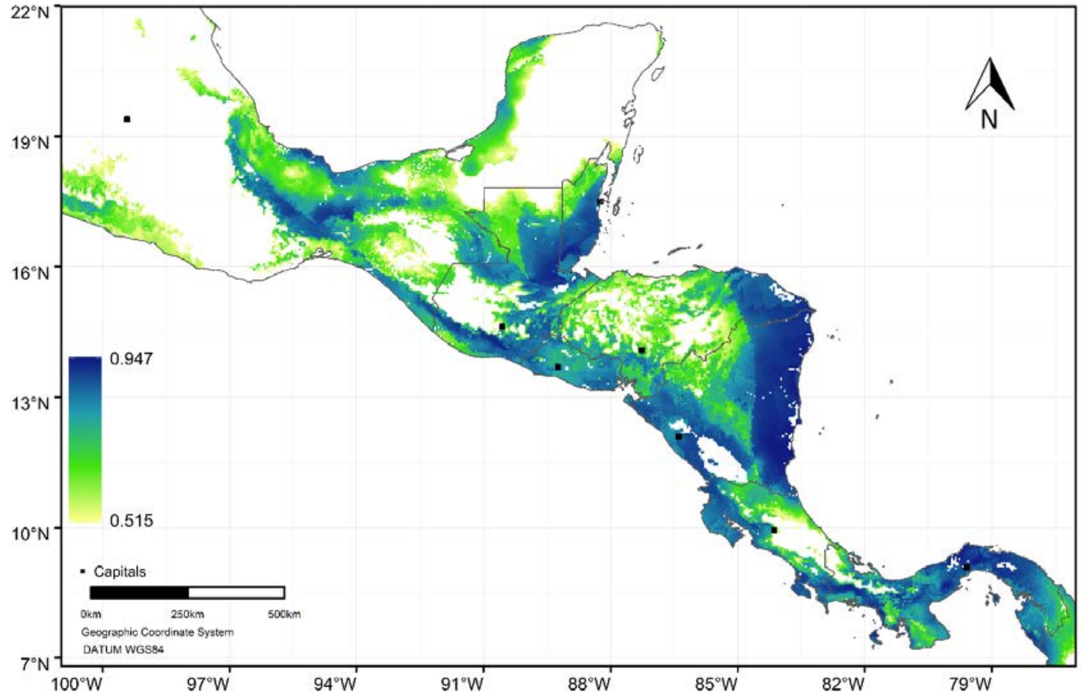
Anacardium occidentale L.

Family: Anacardiaceae
Vernacular names: Marañón (CR, SV, HN, GT, NI, PA, MX), cashew (BZ)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	monoecious self-pollinating	**Drought**	Yes
Plant height (m)	13 (8 – 20)	**Timber uses**[1]	CS, MB, HF	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	4,087 (3,500 – 4,673)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes (fruit and nuts)	**Seed storage type**	Orthodox	**Shade**	Moderate
Wood density (g cm^{-3})	0.47 (0.41 – 0.50)	**Forage**	Yes (fruit)	**Seed dormancy**	Mechanical	**Salinity**	Yes
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	Zoochory	**Fire**	No

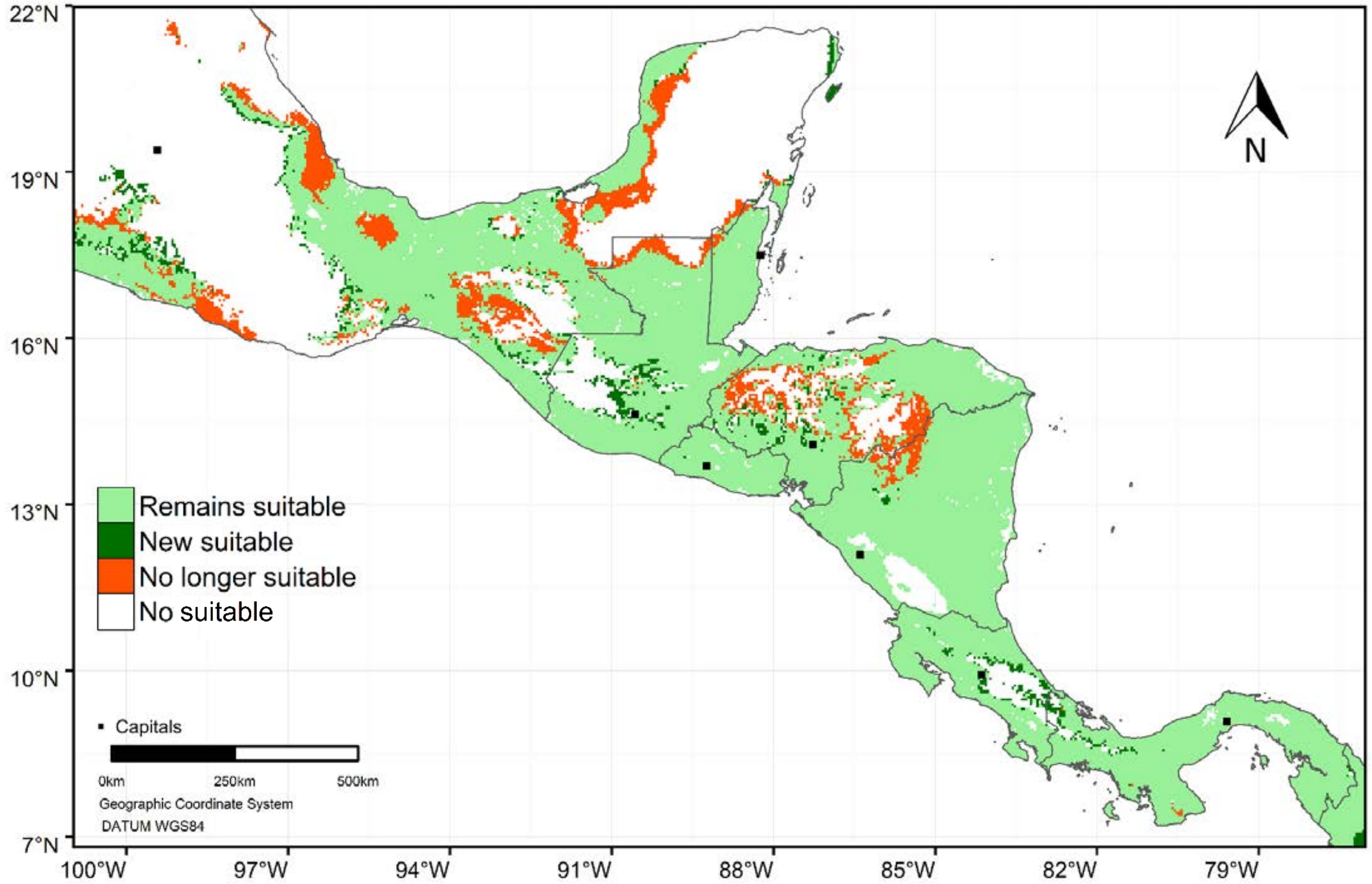
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Floorig; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



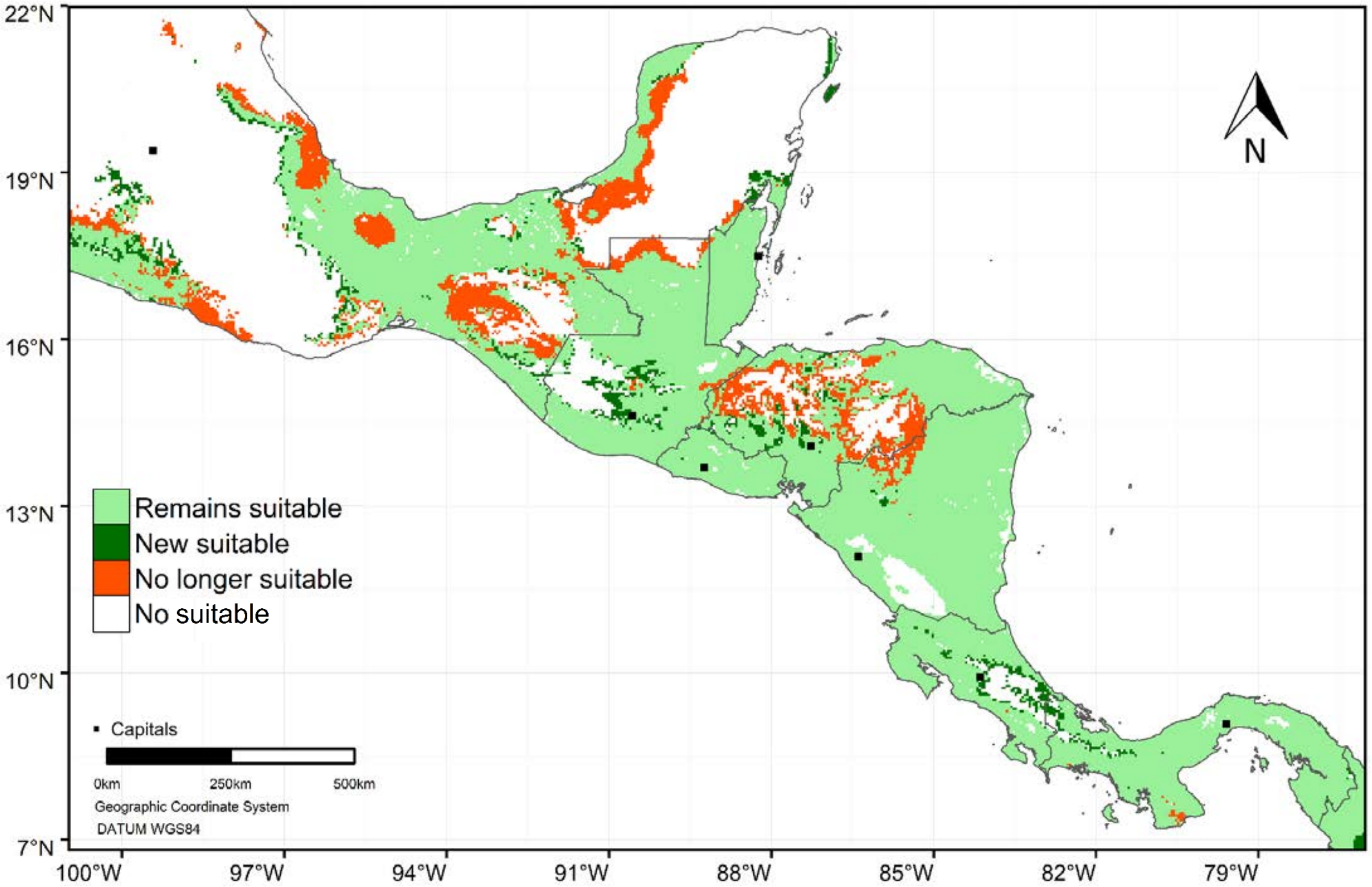
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



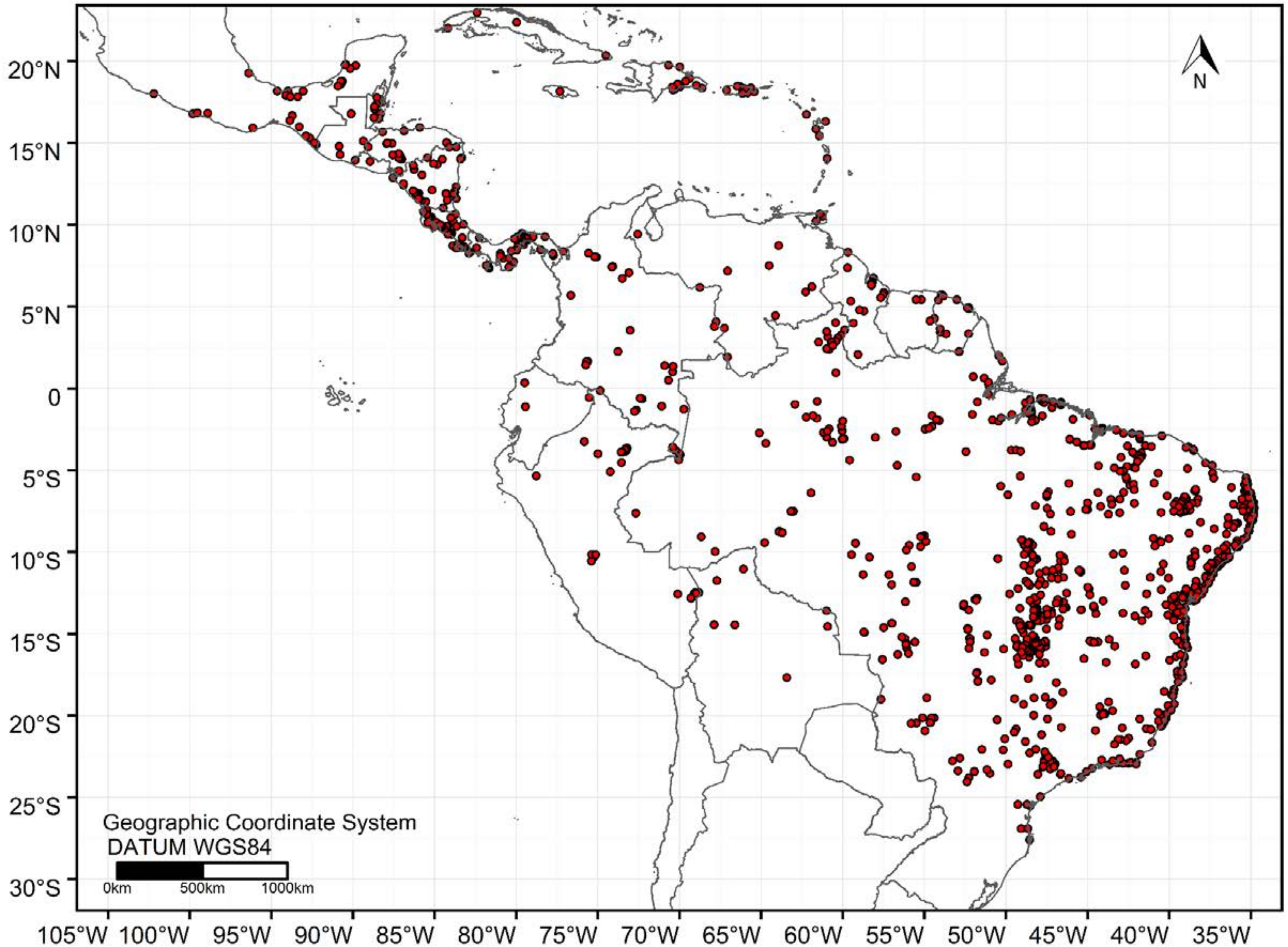
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	52,940	83%	7%	17%	-10%
Rain forest	104,287	92%	3%	8%	-5%
Whole region	157,226	89%	4%	11%	-7%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	52,940	78%	8%	22%	-14%
Rain forest	104,287	90%	4%	10%	-5%
Whole region	157,226	86%	5%	14%	-8%

Points of observed presence



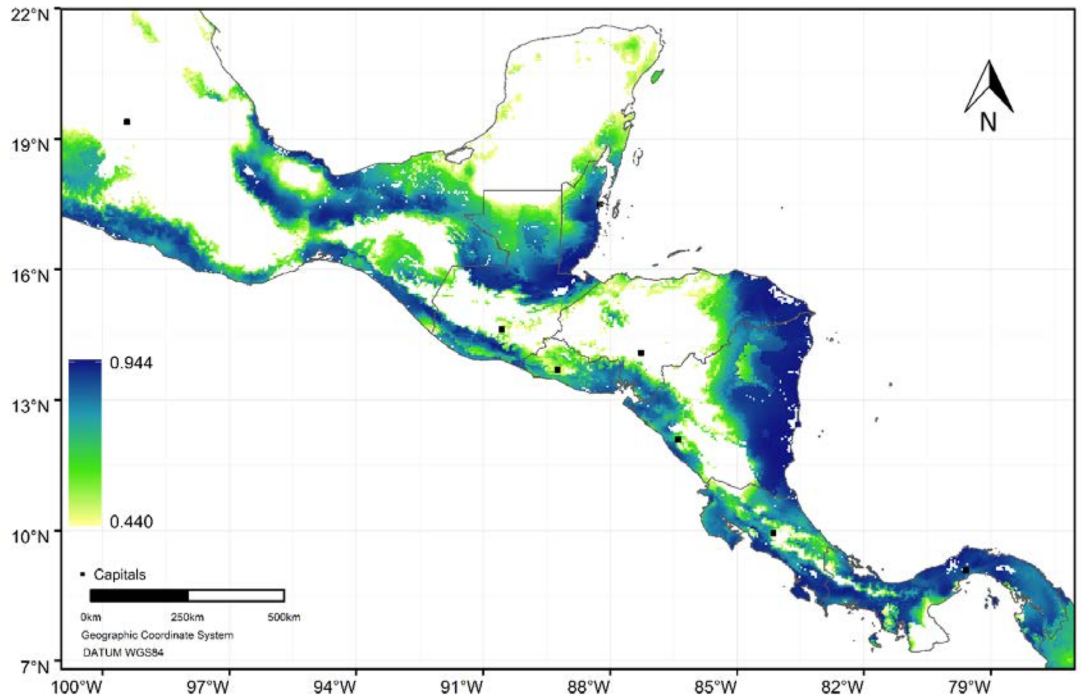
Andira inermis (Wright) DC.

Family:
Leguminosae
Vernacular names:
Almendro (SV, CR, NI, HN), angelin (BZ)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	31 (25 – 35)	**Timber uses[1]**	CS, CL, MB, HF, CH	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	792	**Frost**	No
N fixer	Yes	**Fruit**	No	**Seed storage type**	Recalcitrant	**Shade**	No
Wood density (g cm^{-3})	0.64 (0.46 – 0.75)	**Forage**	Yes	**Seed dormancy**	Mechanical	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	Zoochory, Autochory	**Fire**	Unknown

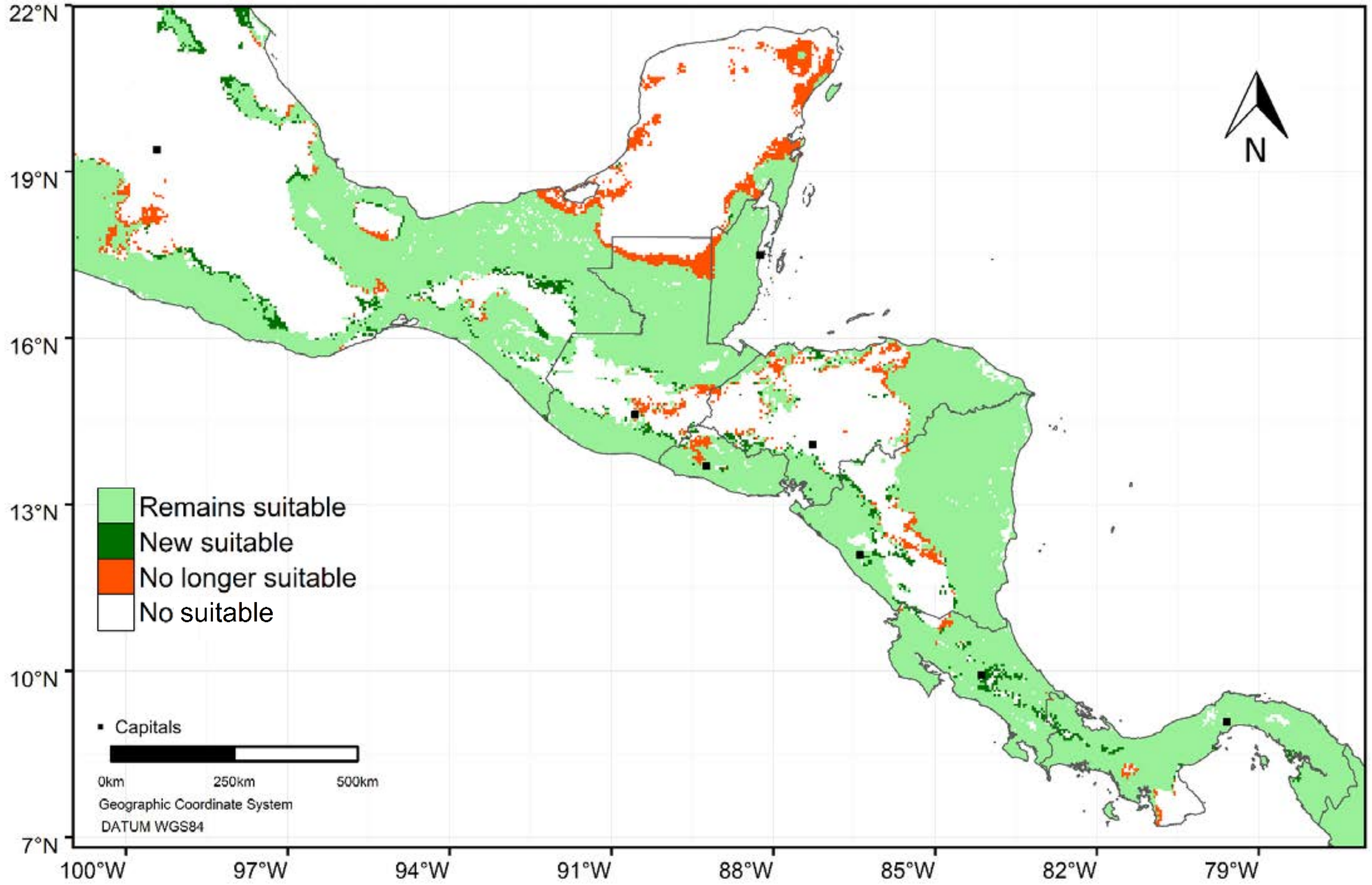
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



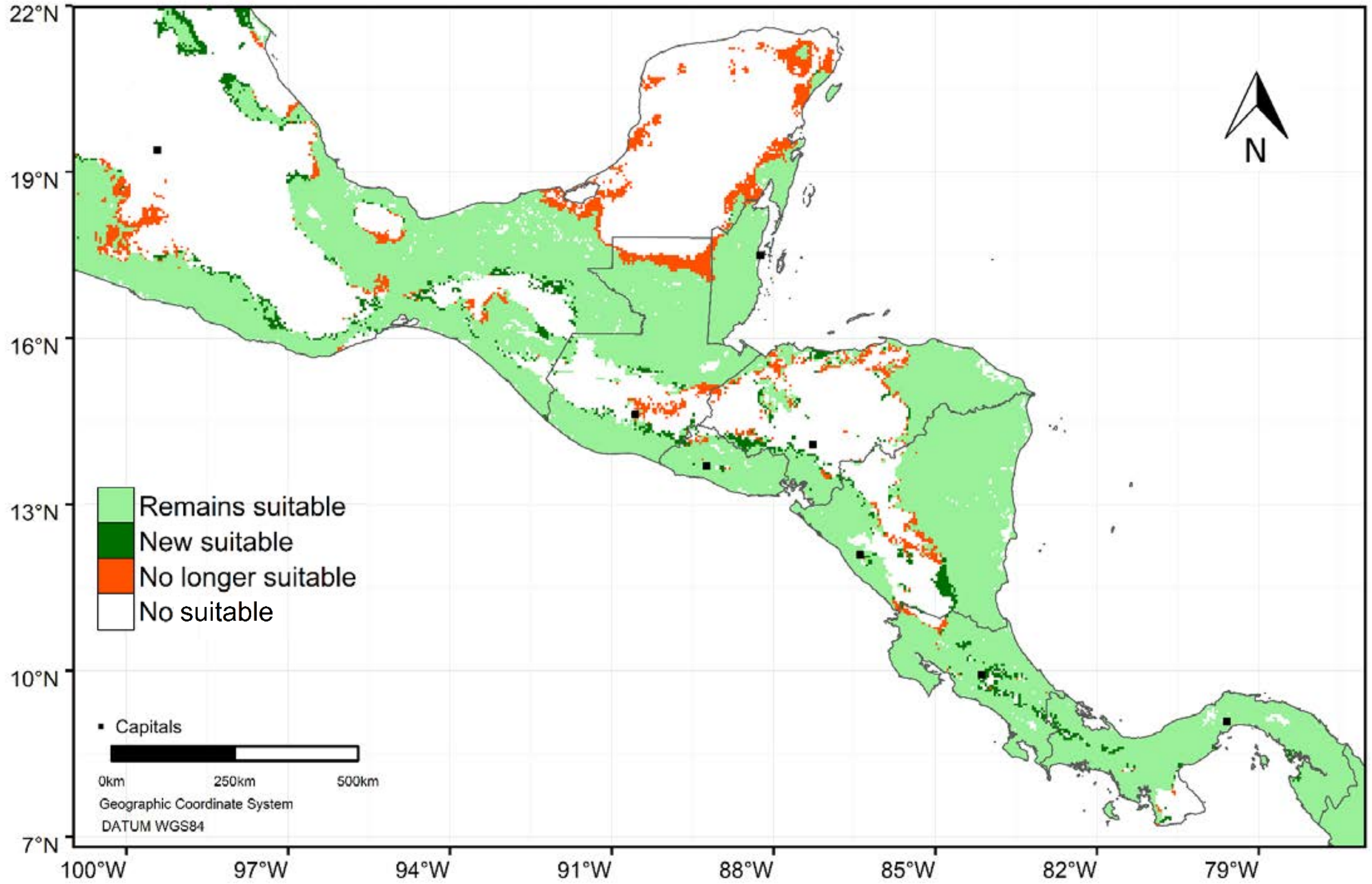
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



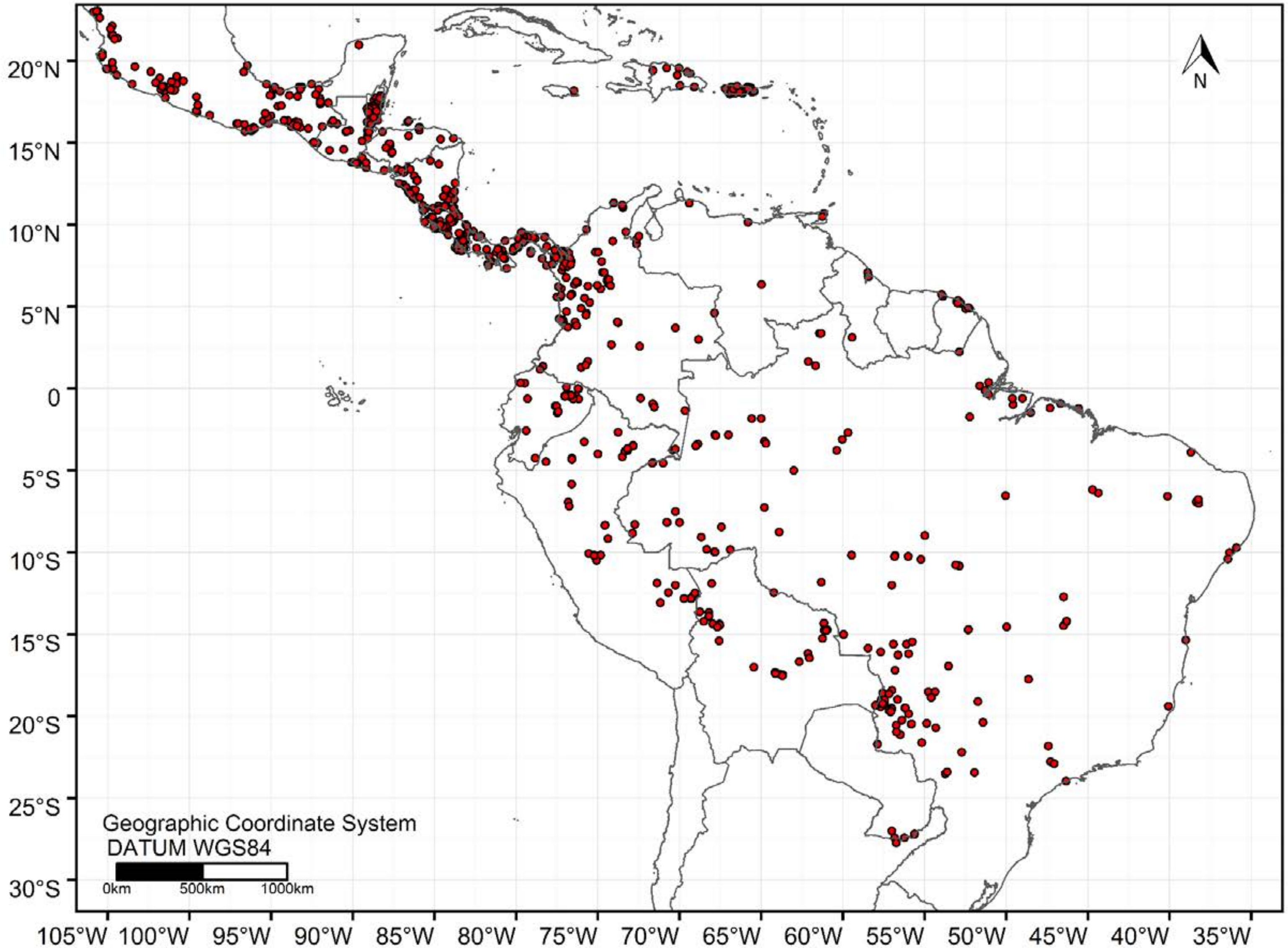
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	42,361	90%	7%	10%	-2%
Rain forest	102,317	94%	3%	6%	-3%
Whole region	144,677	93%	5%	7%	-3%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	42,361	88%	8%	12%	-4%
Rain forest	102,317	93%	4%	7%	-3%
Whole region	144,677	92%	5%	8%	-3%

Points of observed presence



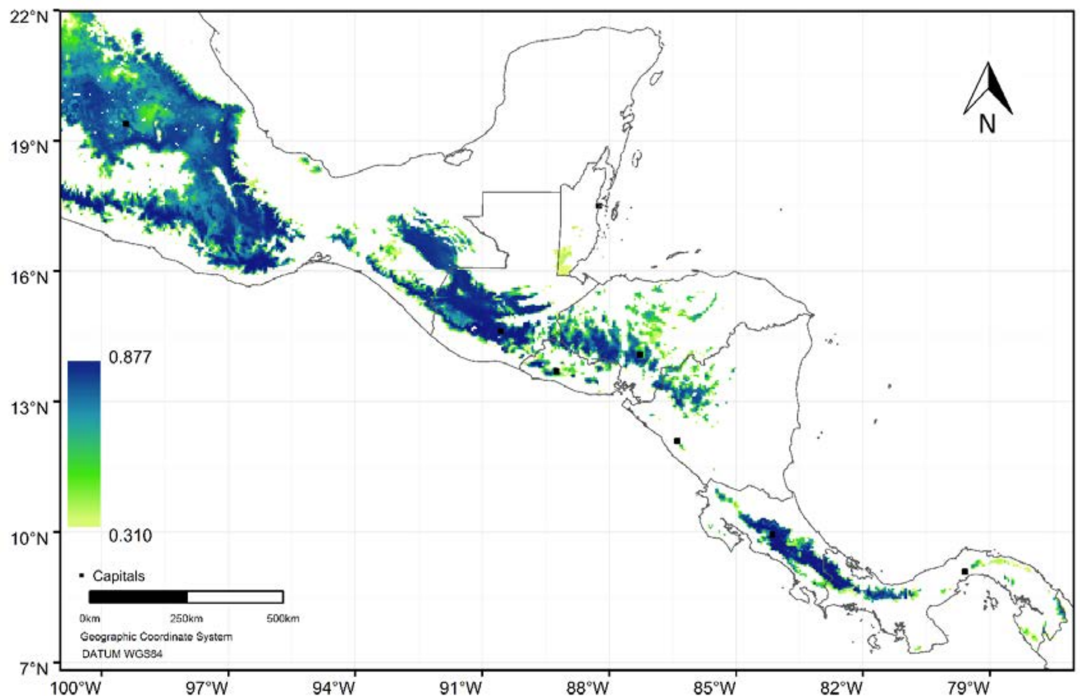
Annona cherimola Mill.

Family: Annonaceae
Vernacular names: Cherimoya

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	7 (5 – 9)	**Timber uses**[1]	HF	**Pollination vector**	Insects	**Flooding**	No
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	350.1 (328.4 – 370.1)	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	Unknown
Wood density (g cm^{-3})	0.48 (0.32 – 0.57)	**Forage**	No	**Seed dormancy**	Unknown	**Salinity**	No
Leaf phenology	Evergreen	**Other uses**	Unknown	**Seed dispersal**	* Domesticated, human mediated	**Fire**	No

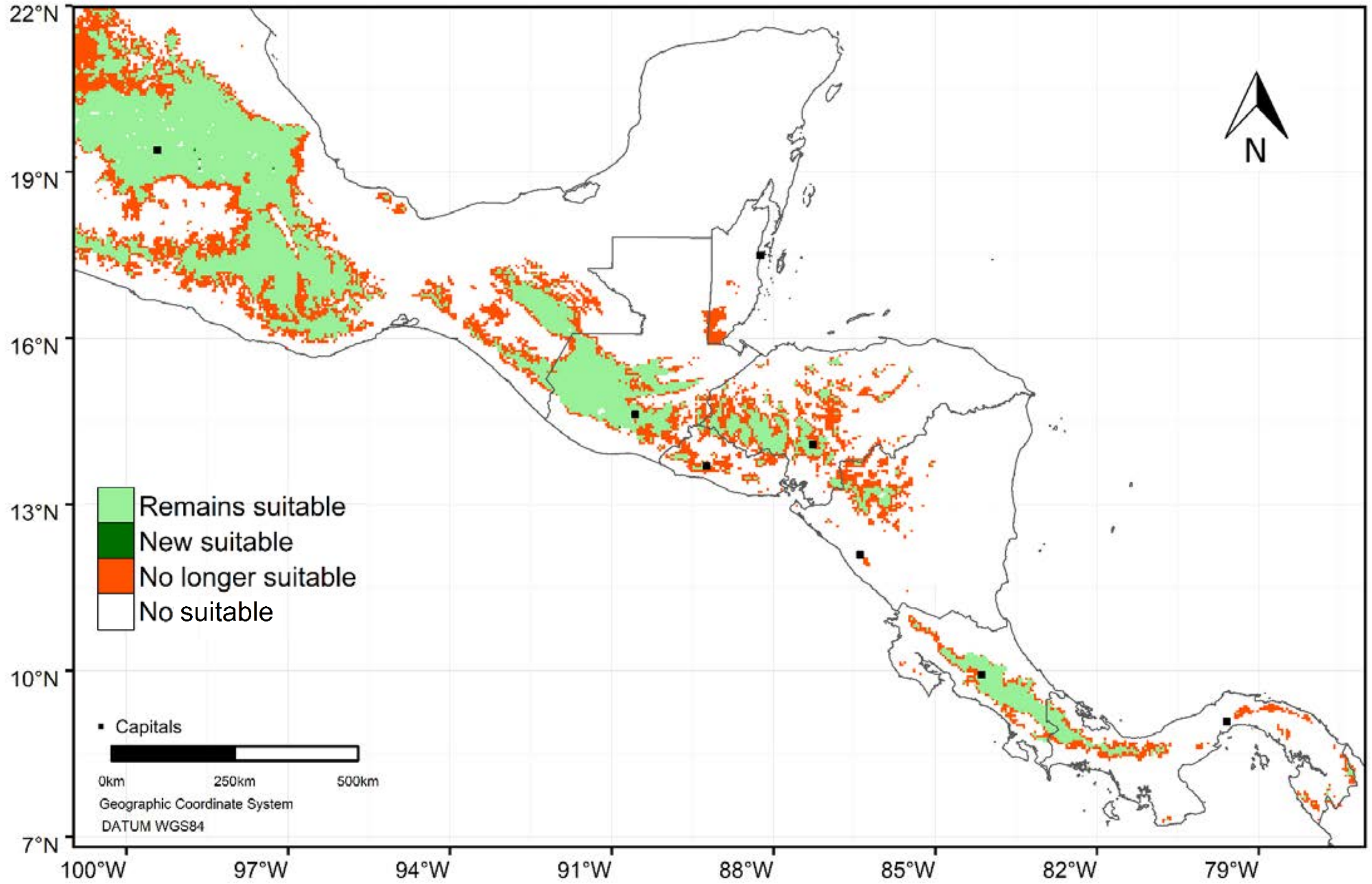
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



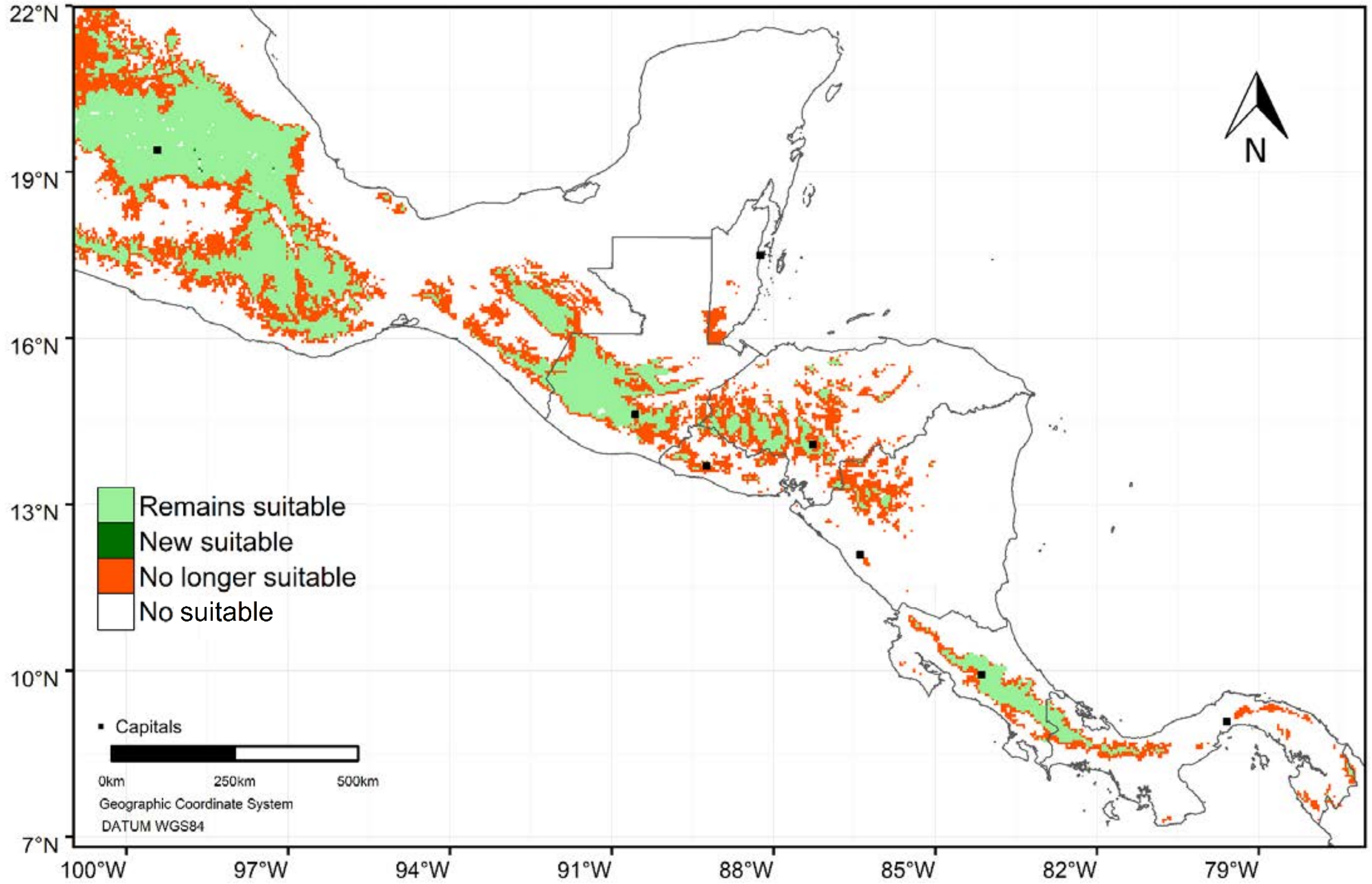
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



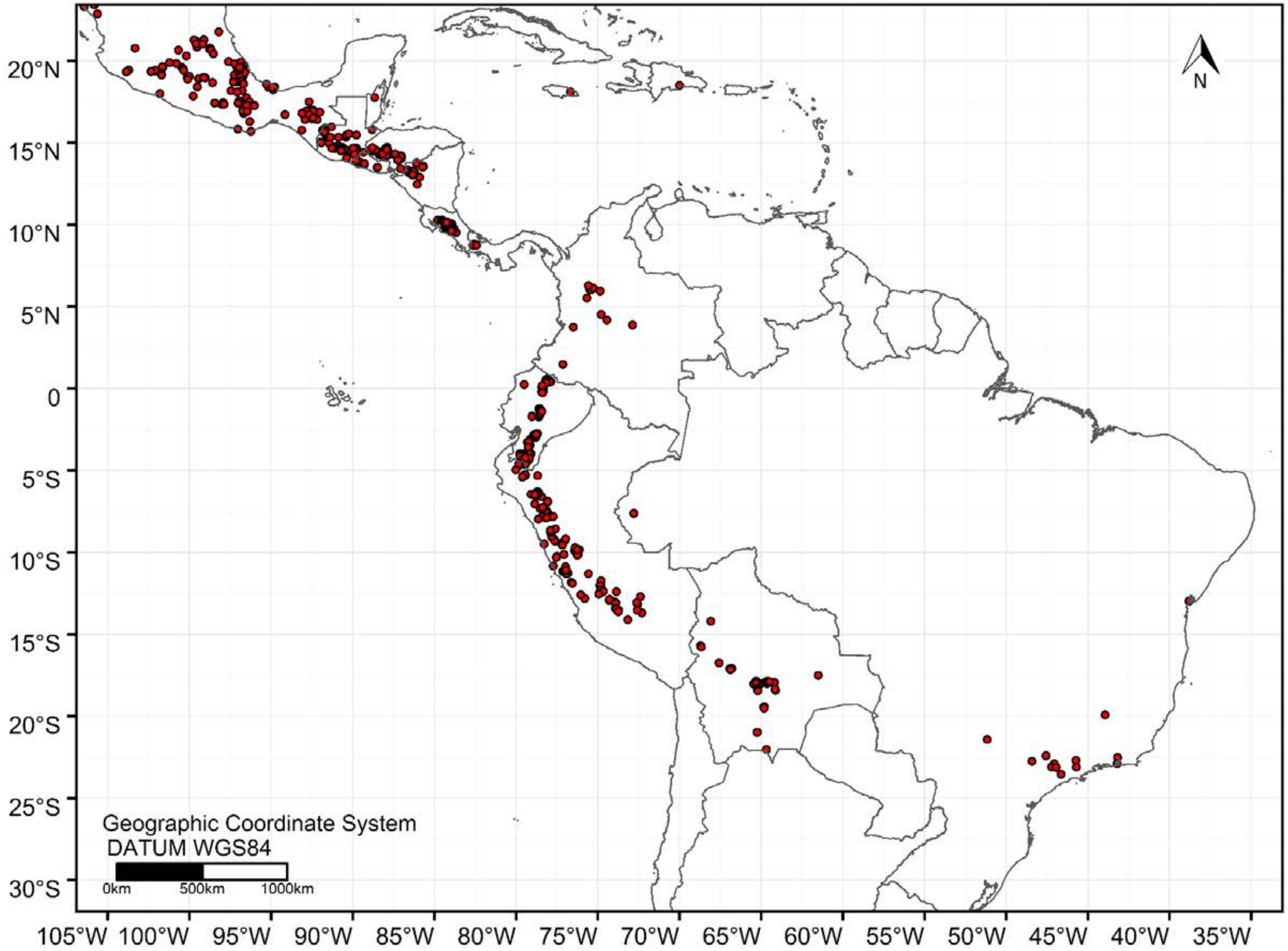
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	60,402	64%	0,04%	36%	-36%
Rain forest	17,444	49%	0,00%	51%	-51%
Whole region	77,846	61%	0,03%	39%	-39%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	60,402	57%	0,04%	43%	-43%
Rain forest	17,444	42%	0,00%	58%	-58%
Whole region	77,846	53%	0,03%	47%	-47%

Points of observed presence



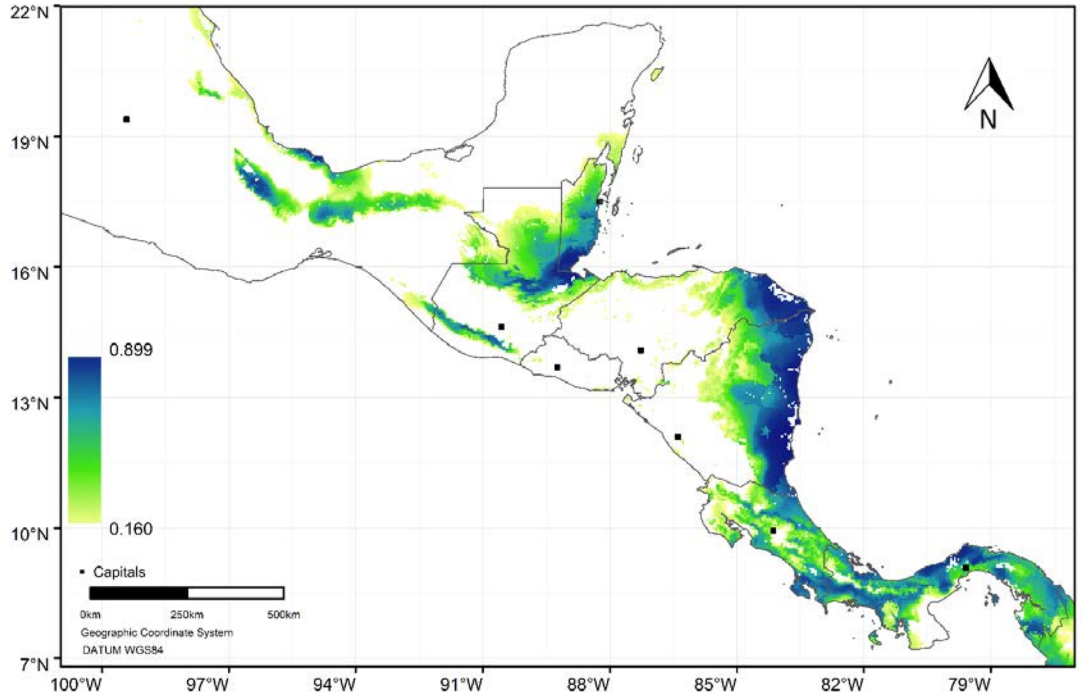
Artocarpus altilis (Parkinson ex F.A.Zorn) Fosberg

Family:
Moraceae
Vernacular names:
Fruta pan
Exótica

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Unknown	**Drought**	Yes
Plant height (m)	15 (10 – 20)	**Timber uses**[1]	CS, CL, HF, AR	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	5,898 - 7,700	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	Yes
Wood density (g cm^{-3})	0.43 (0.27 – 0.70)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	Yes
Leaf phenology	Evergreen	**Other uses**	Resin, Medicinal	**Seed dispersal**	* Domesticated- human mediated, Zoochory	**Fire**	Unknown

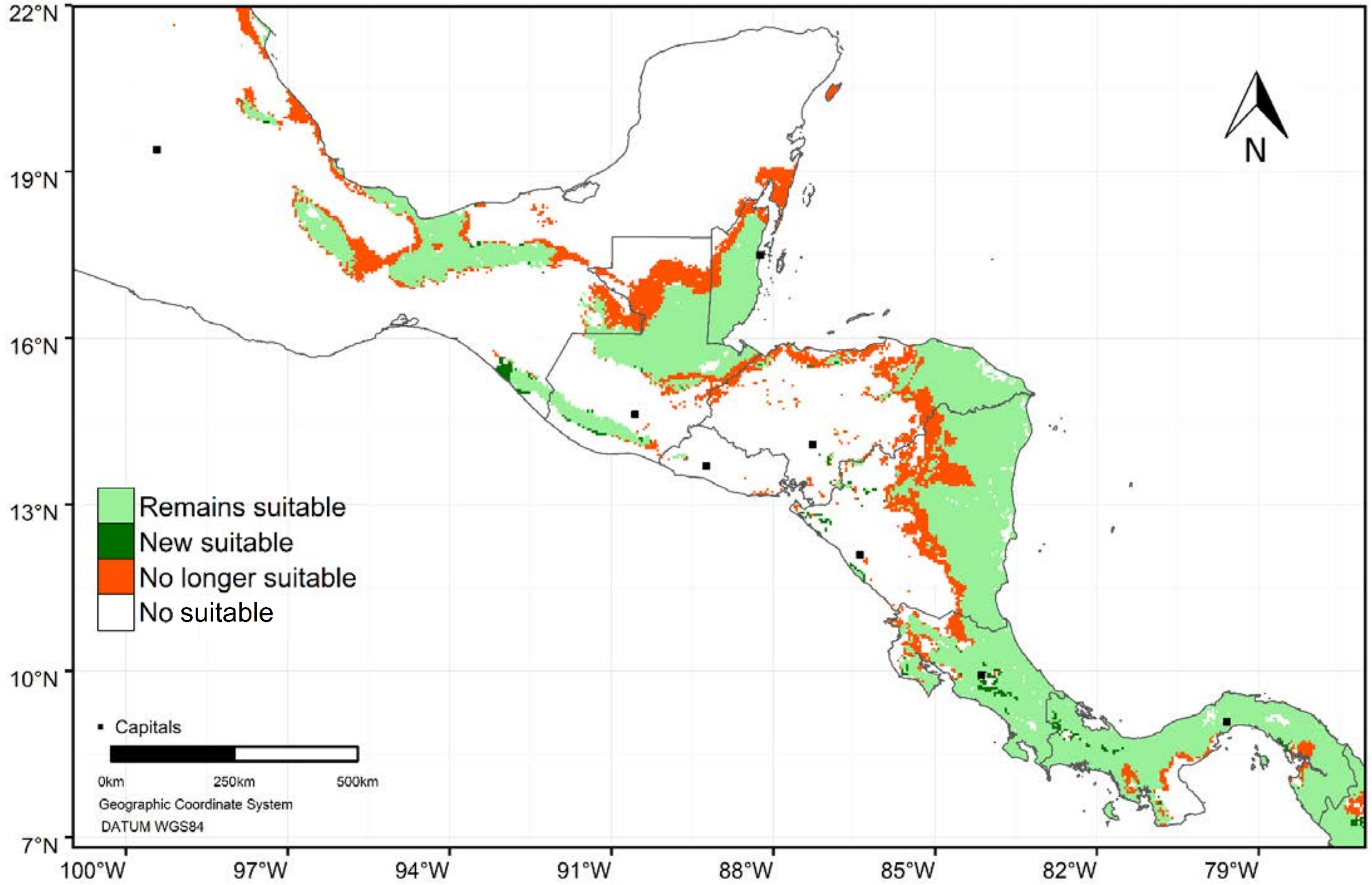
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



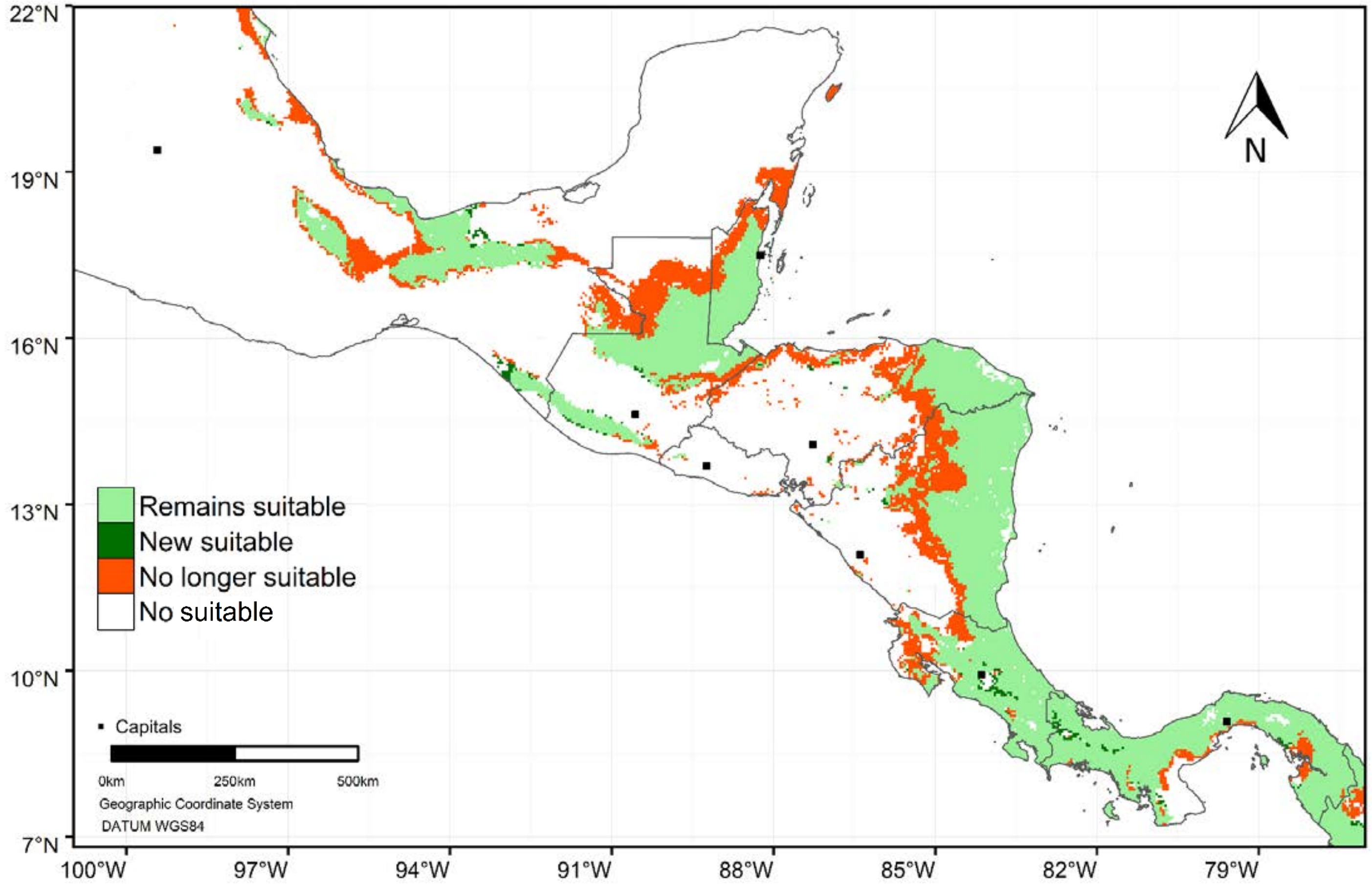
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



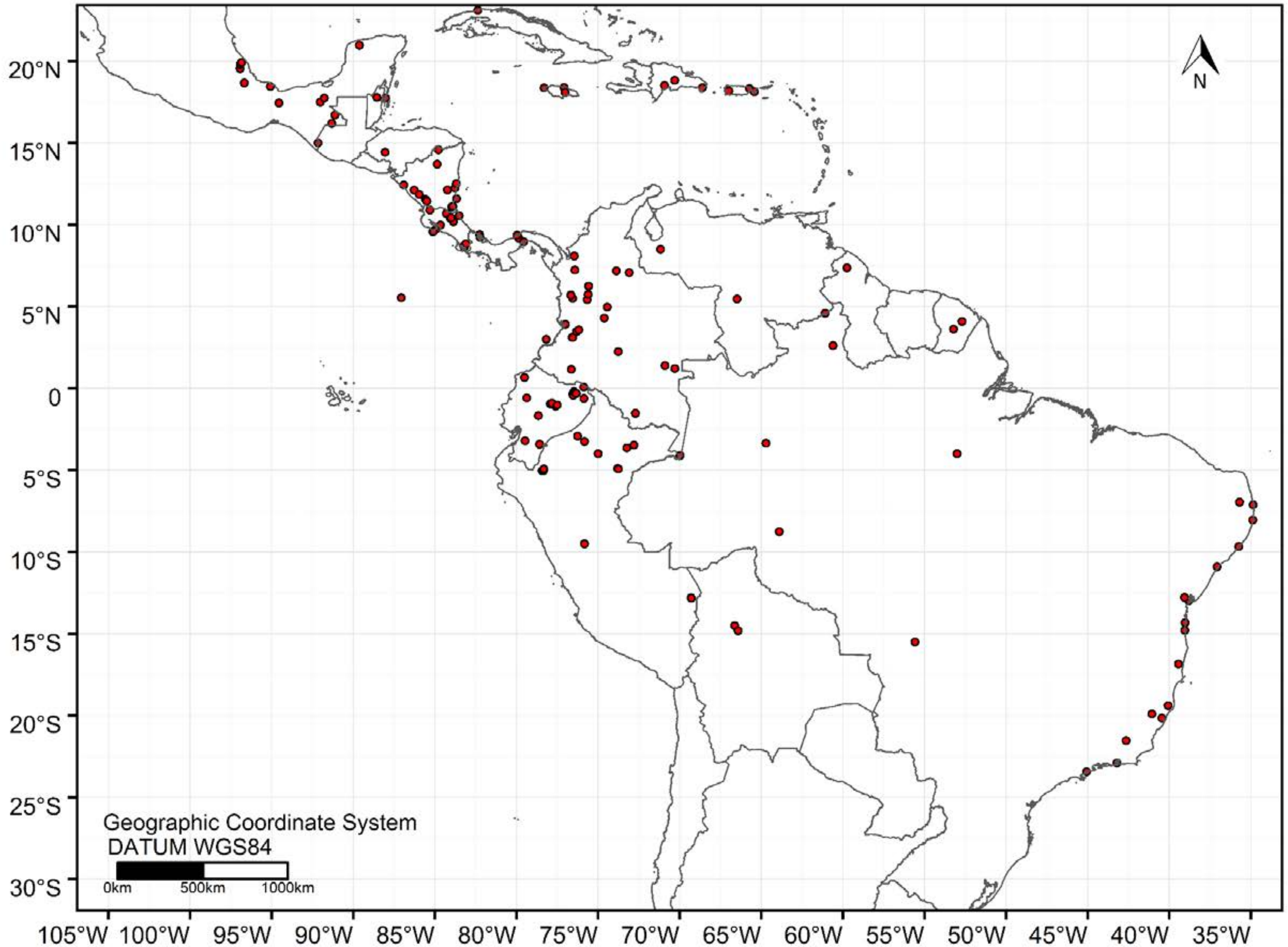
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	6,512	52%	9%	48%	-40%
Rain forest	81,124	77%	1%	23%	-21%
Whole region	87,637	76%	2%	24%	-23%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	6,512	42%	4%	58%	-54%
Rain forest	81,124	74%	1%	26%	-25%
Whole region	87,637	72%	2%	28%	-27%

Points of observed presence



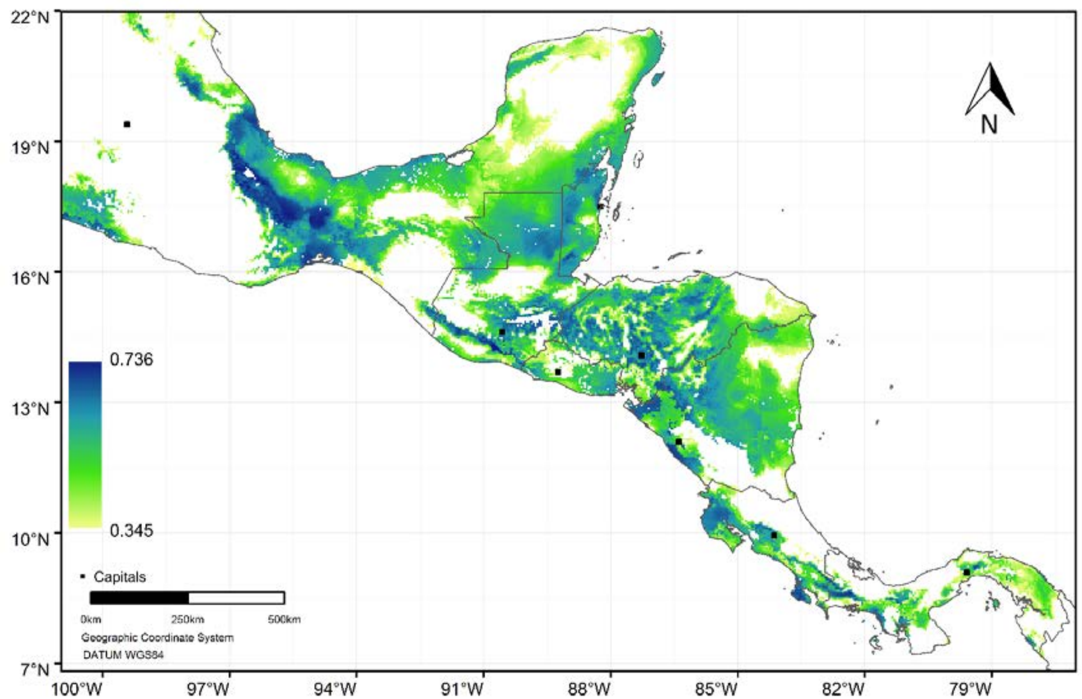
Astronium graveolens Jacq.

Family:
Anacardiaceae
Vernacular names:
Ron-ron (CR, HN, NI),
ciruelillo (HN),
culinzis (GT),
zorro (PA),
uruco (NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Dioecious	**Drought**	Yes
Plant height (m)	33 (30 – 35)	**Timber uses**[1]	SM, CS, MB, HF, PS, AR	**Pollination vector**	Insects	**Flooding**	No
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	32.5 (24.9 – 56.0)	**Frost**	Moderate
N fixer	No	**Fruit**	No	**Seed storage type**	Intermedia	**Shade**	No
Wood density ($g\ cm^{-3}$)	0.86 (0.61 – 1.28)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Medicinal, Apiculture	**Seed dispersal**	Anemochory, Zoochory	**Fire**	Unknown

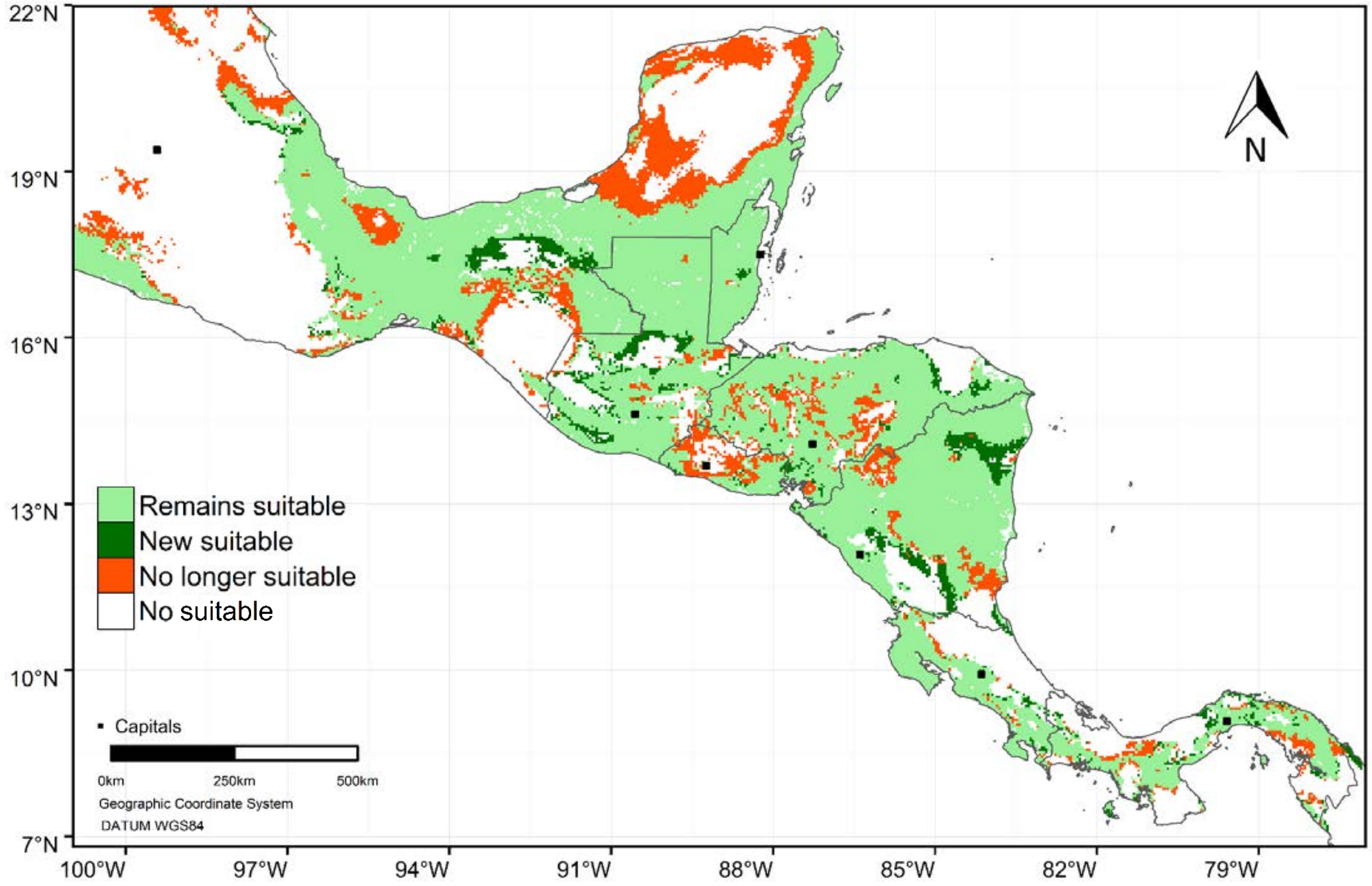
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



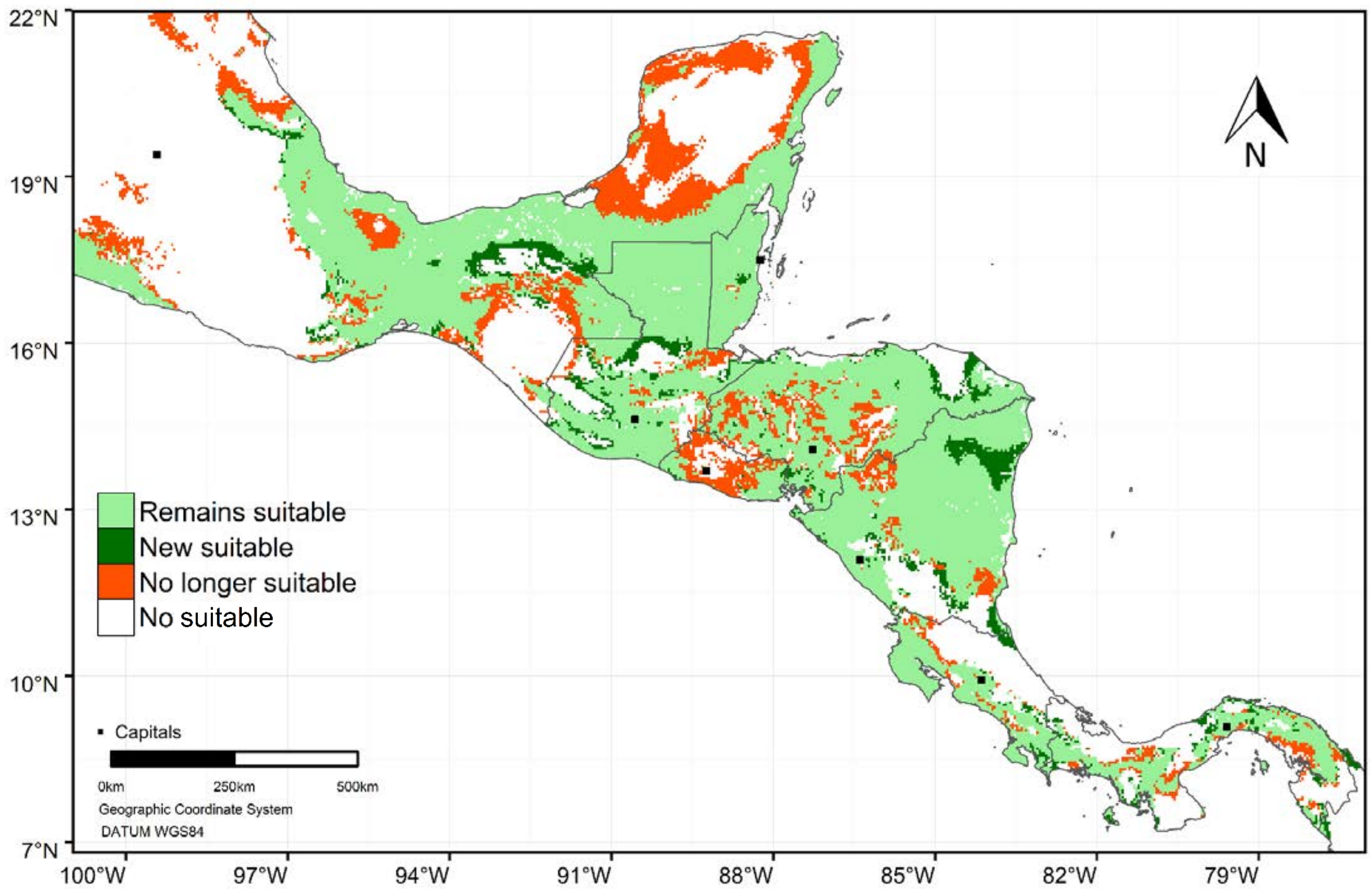
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



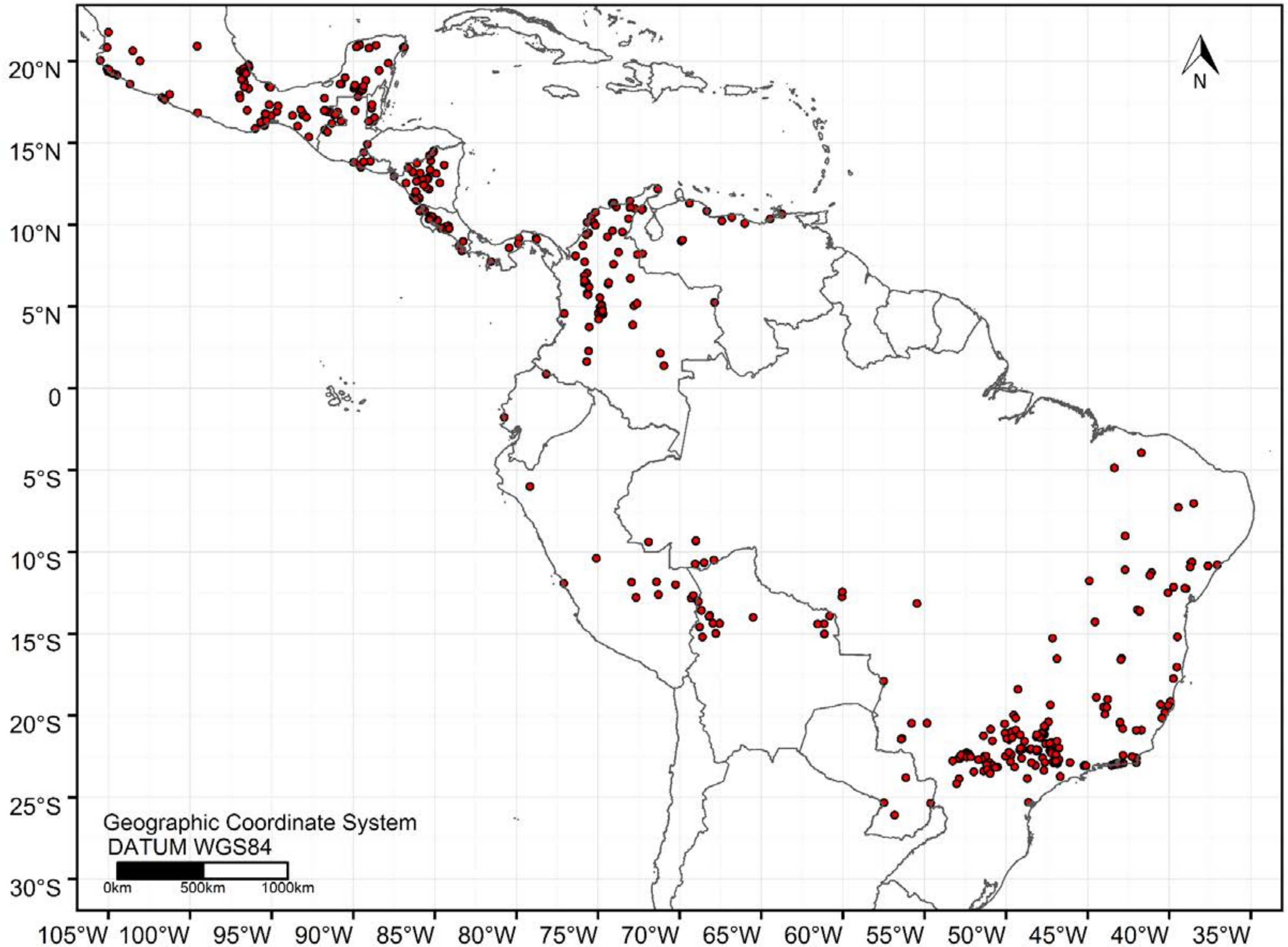
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	50,994	74%	6%	26%	-20%
Rain forest	97,388	86%	7%	14%	-7%
Whole region	148,382	82%	7%	18%	-11%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	50,994	69%	5%	31%	-25%
Rain forest	97,388	85%	9%	15%	-7%
Whole region	148,382	79%	8%	21%	-13%

Points of observed presence



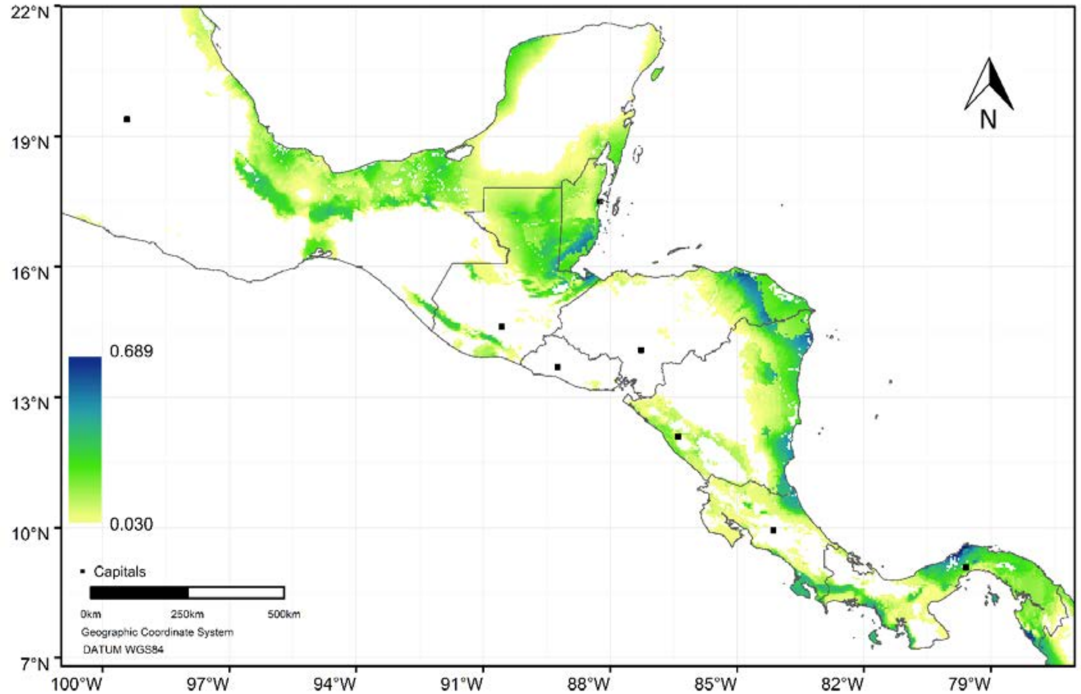
Averrhoa bilimbi L.

Family: Oxalidaceae
Vernacular names: Vinagrillo, pepino de Indias, grosella china,
Exótica

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree/Shrub	**Commercial timber**	No	**Reproductive system**	Unknown	**Drought**	Unknown
Plant height (m)	7 (5 – 10)	**Timber uses**[1]	None	**Pollination vector**	Unknown	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	11.2 (7.1 – 15.6)	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Intermedia	**Shade**	No
Wood density ($g\ cm^{-3}$)	0.5 (0.42 – 0.56)	**Forage**	No	**Seed dormancy**	Physical	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	* Domesticated- human mediated; Hydrochory	**Fire**	Unknown

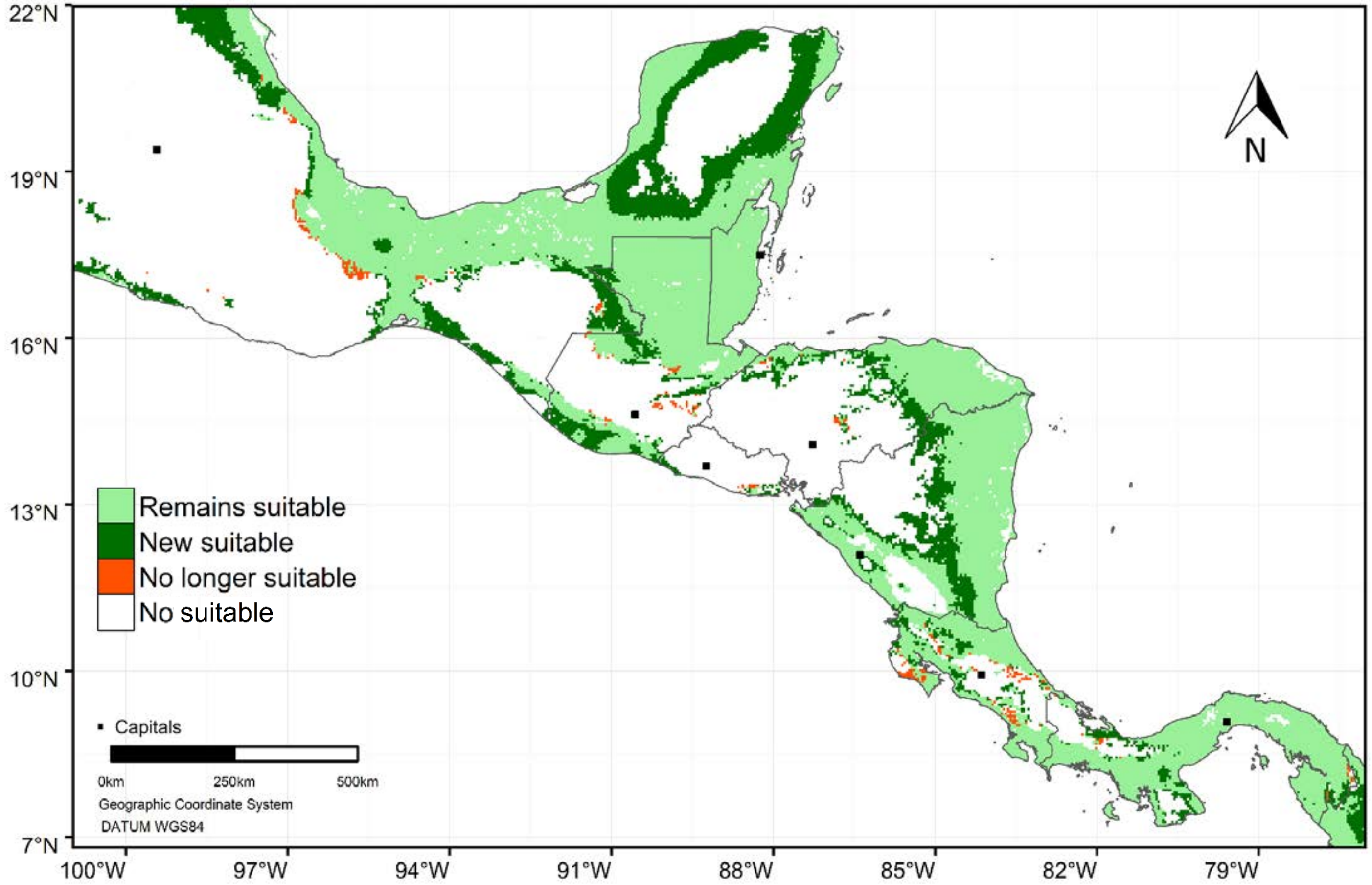
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



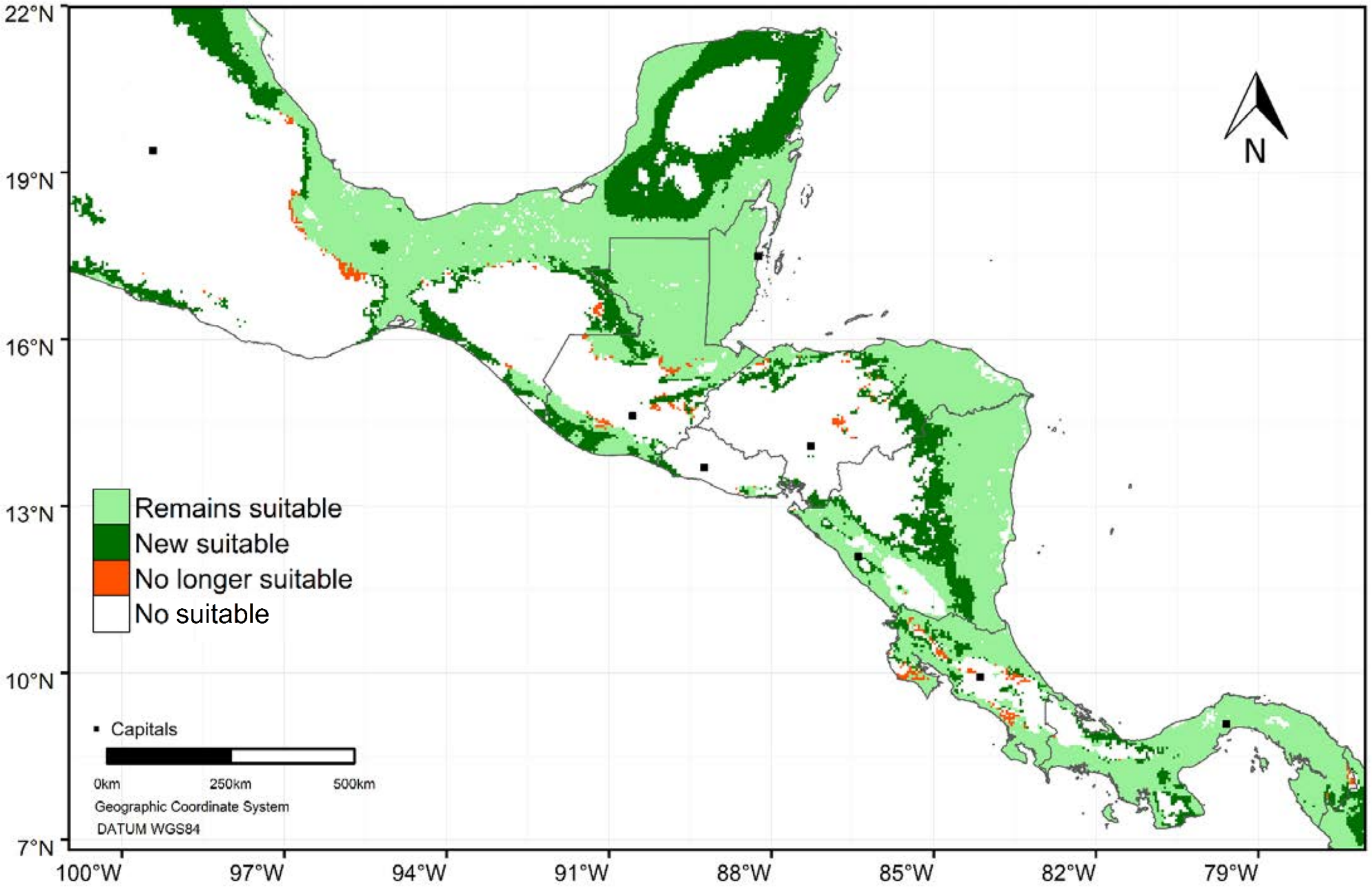
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



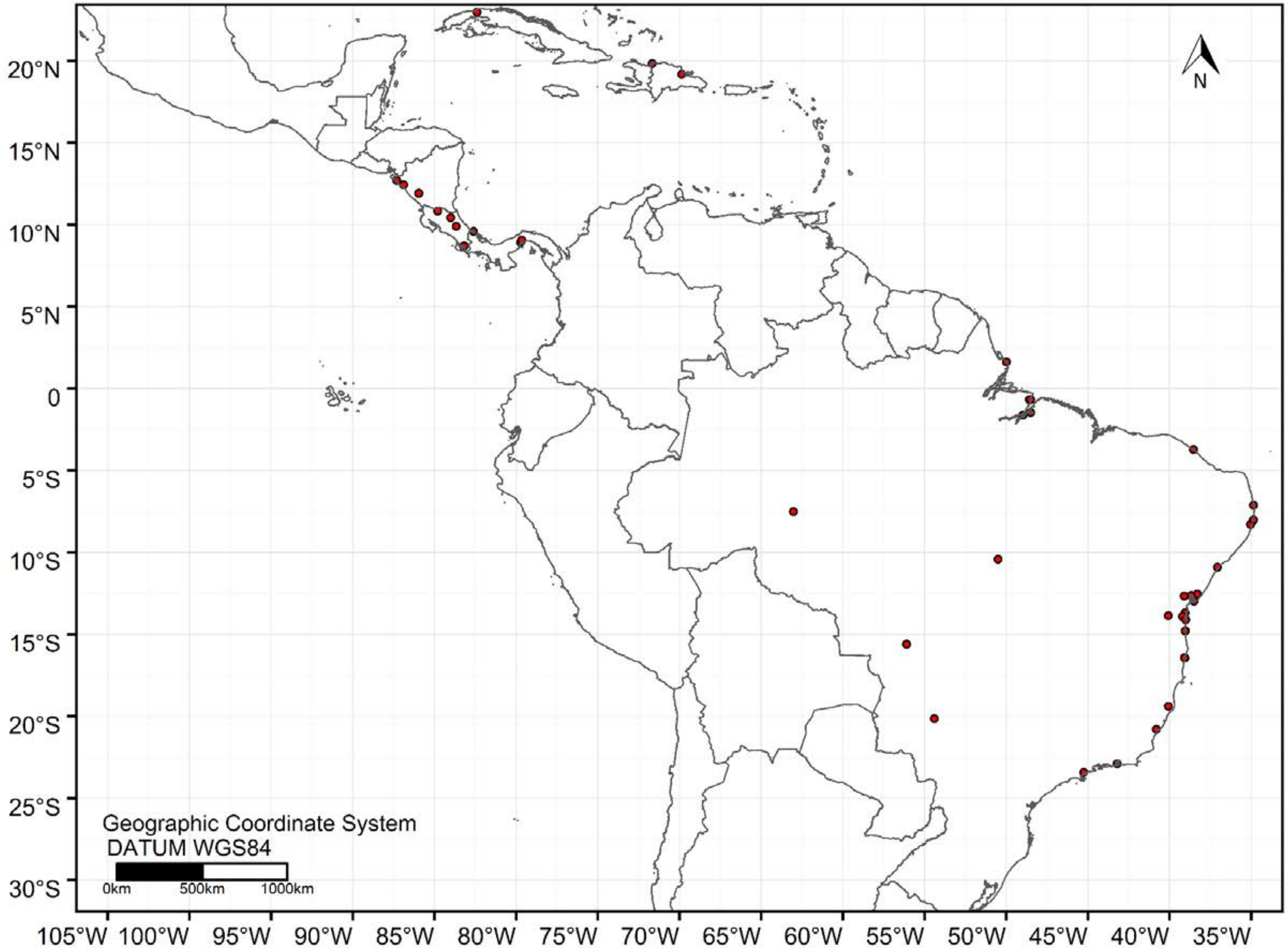
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	13,882	96%	67%	4%	63%
Rain forest	87,196	98%	27%	2%	25%
Whole region	101,077	98%	32%	2%	30%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	13,882	96%	87%	4%	83%
Rain forest	87,142	98%	30%	2%	28%
Whole region	101,023	98%	38%	2%	36%

Points of observed presence



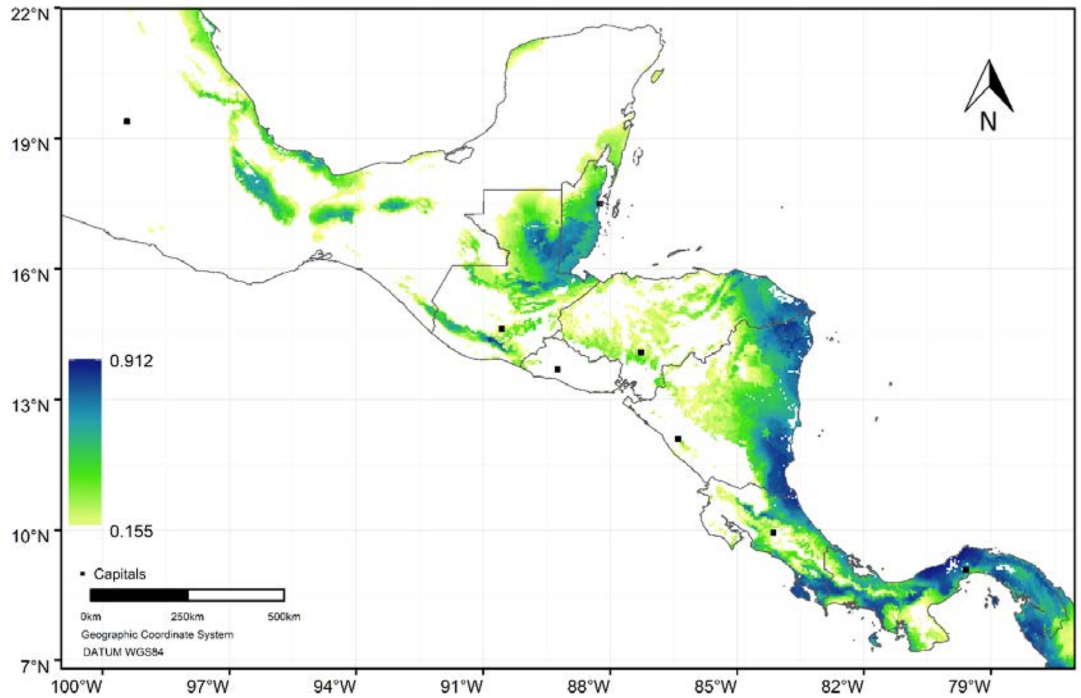
Averrhoa carambola L.

Family:
Oxalidaceae
Vernacular names:
Carambola
Exótica

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree/Shrub	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Moderate
Plant height (m)	6 (3 – 10)	**Timber uses**[1]	None	**Pollination vector**	Insects	**Flooding**	Short periods (<month)
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	42.4 (37.6 – 47.2)	**Frost**	Yes
N fixer	No	**Fruit**	Yes	**Seed storage type**	Intermedia	**Shade**	No
Wood density (g cm^{-3})	0.57 (0.55 – 0.60)	**Forage**	No	**Seed dormancy**	Unknown	**Salinity**	No
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	Autochory, * Domesticated-human mediated	**Fire**	Unknown

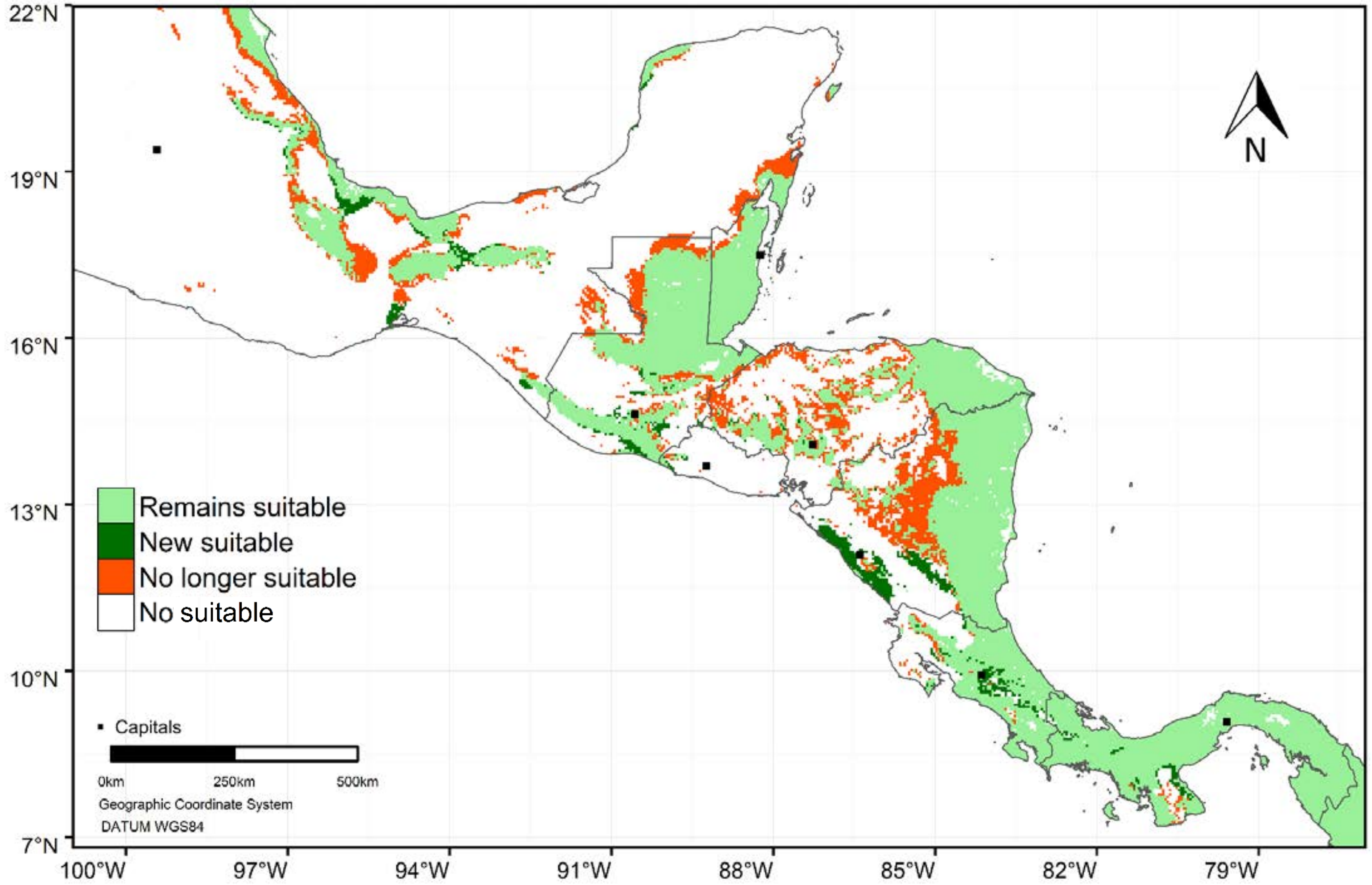
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



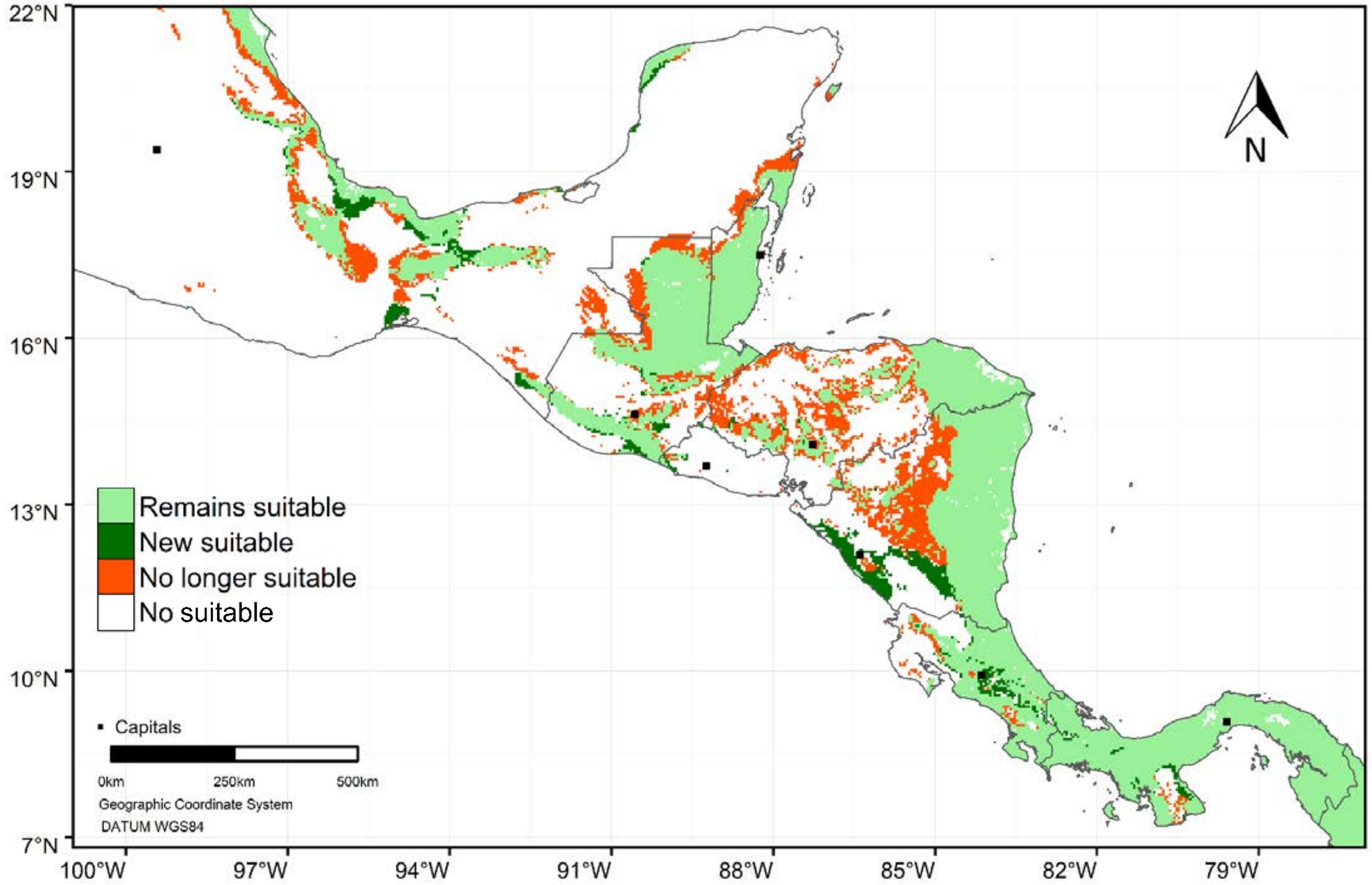
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



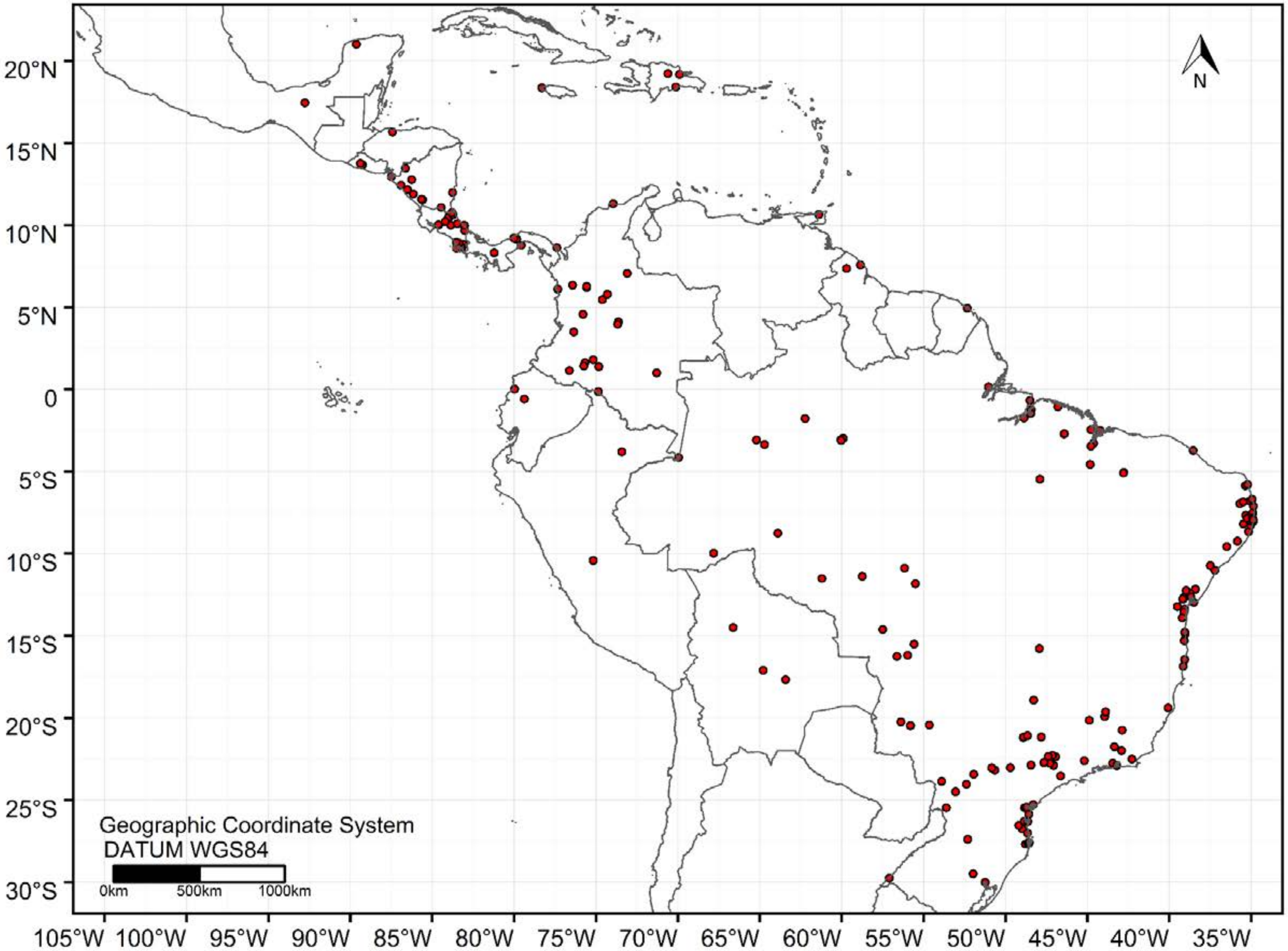
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	14,592	58%	20%	42%	-22%
Rain forest	82,501	84%	3%	16%	-13%
Whole region	97,094	80%	6%	20%	-15%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	14,592	49%	24%	51%	-26%
Rain forest	82,501	82%	4%	18%	-14%
Whole region	97,094	77%	7%	23%	-16%

Points of observed presence



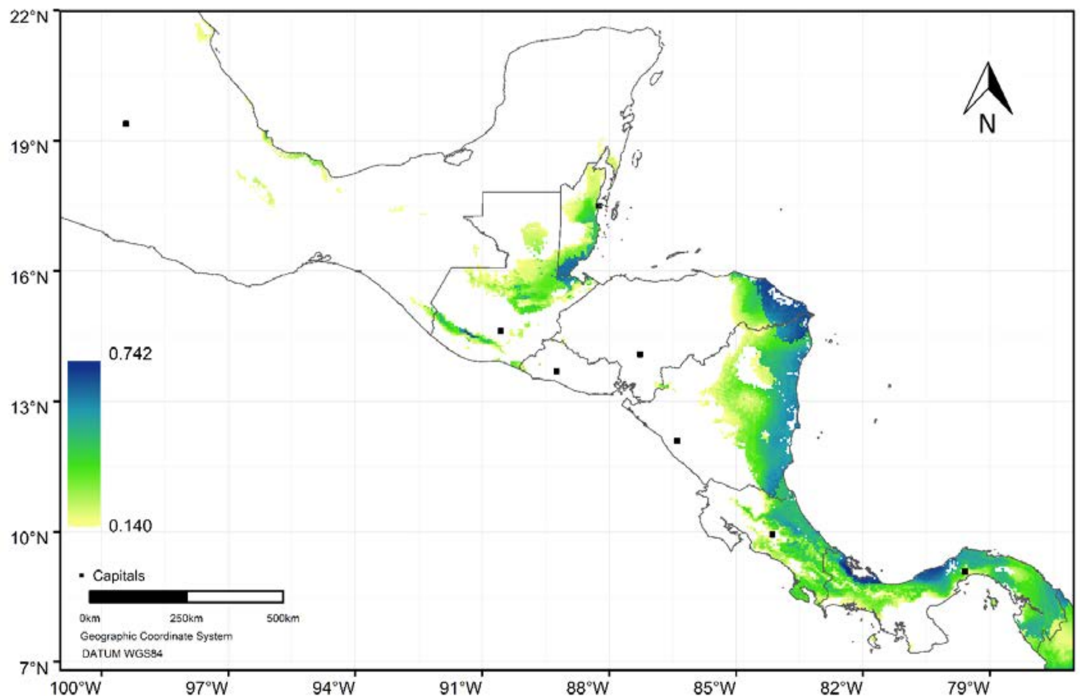
Bactris gasipaes Kunth.

Family: Arecaceae
Vernacular names: Pejibaye (CR), pixbae (PA), supa (HN), jaquacté (GT)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Palmera	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Moderate on non-sandy soils
Plant height (m)	21 (15 – 25)	**Timber uses**[1]	CS, CL, MB, HF, PS, AR	**Pollination vector**	Insects/Wind	**Flooding**	No
Spinescence	Yes	**Firewood**	No	**Weight 1000 seeds (g)**	1.382 (1.085 – 1.680)	**Frost**	No
N fixer	No	**Fruit**	Yes [2]	**Seed storage type**	Recalcitrant	**Shade**	No
Wood density (g cm^{-3})	1.07	**Forage**	Yes (fruits)	**Seed dormancy**	Physiological	**Salinity**	Moderate
Leaf phenology	Evergreen	**Other uses**	Apiculture Medicinal	**Seed dispersal**	Zoochory	**Fire**	No

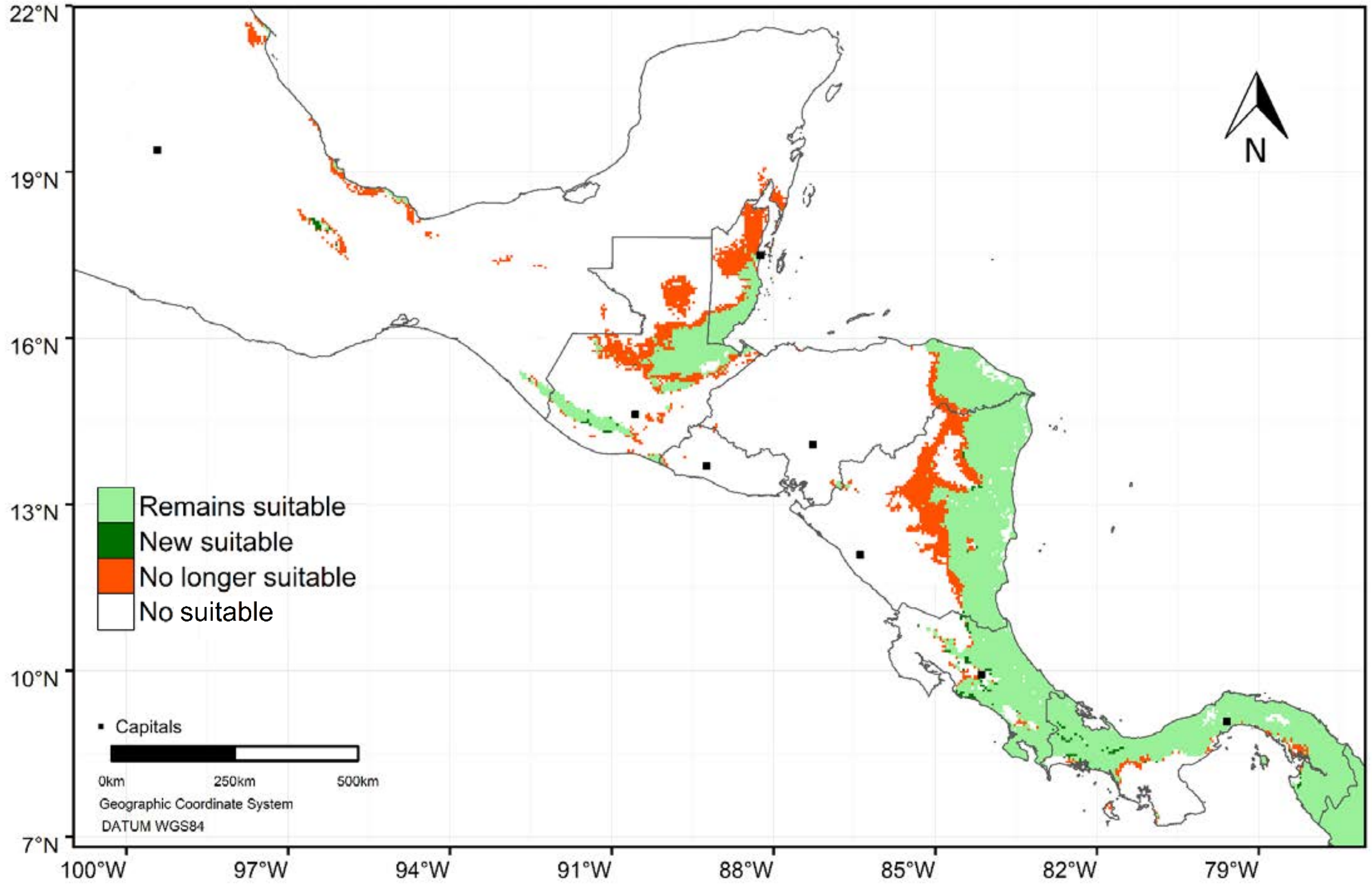
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
[2] Peach palm stems are also edible

Species suitable areas under current climate



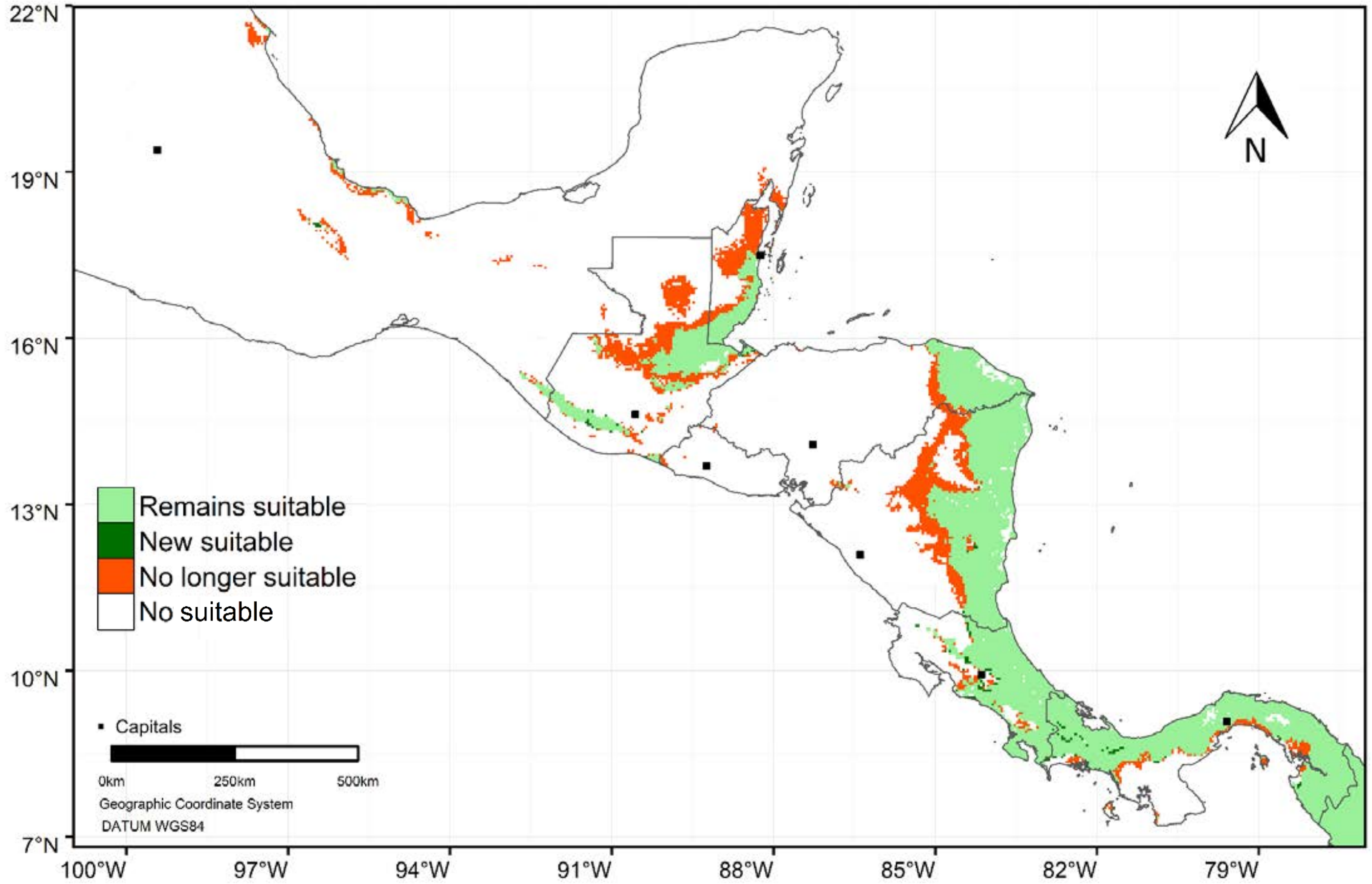
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



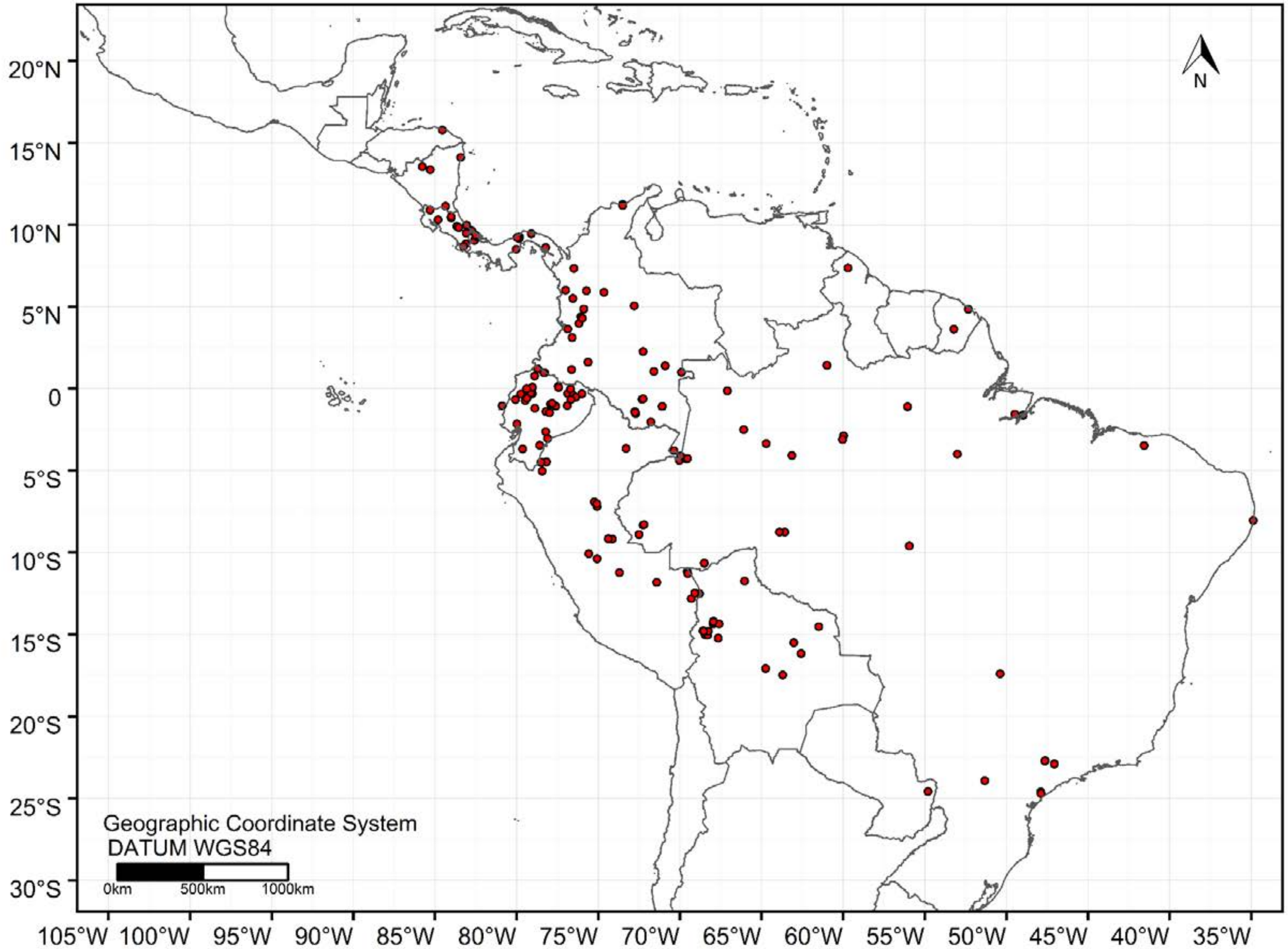
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	2,303	41%	1%	59%	-57%
Rain forest	52,861	78%	1%	22%	-21%
Whole region	55,164	76%	1%	24%	-22%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	2,303	37%	1%	63%	-62%
Rain forest	52,861	76%	1%	24%	-23%
Whole region	55,164	75%	1%	25%	-24%

Points of observed presence



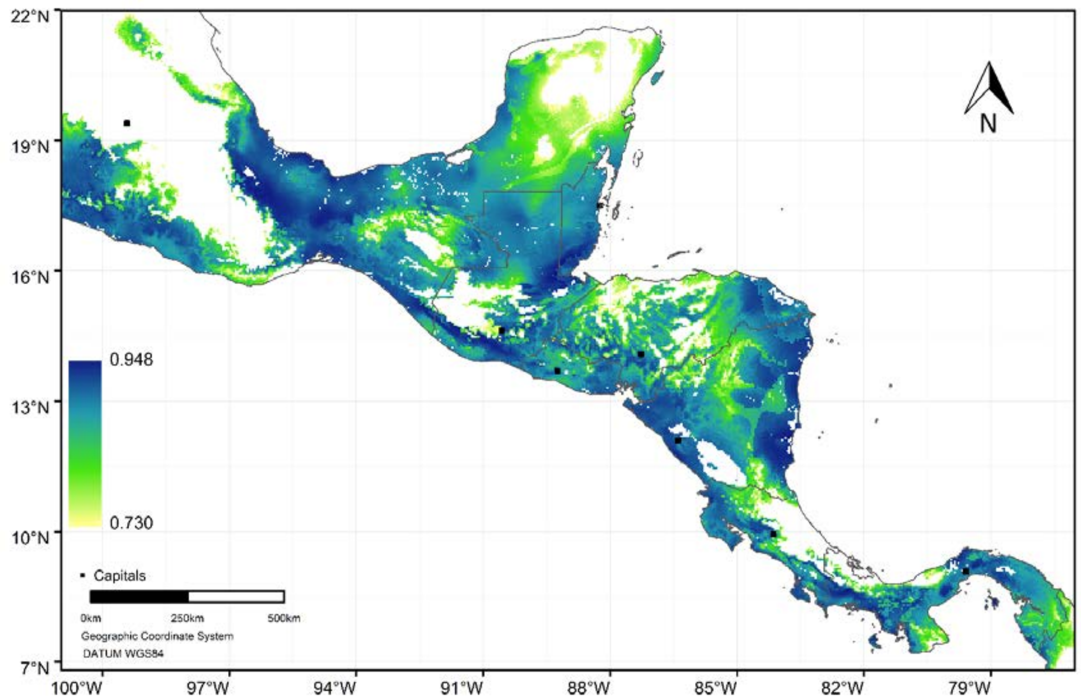
Byrsonima crassifolia (L.) Kunth

Family:
Malpighiaceae
Vernacular names:
Nance, nancito (HN, SV), yuco (BZ)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious self-pollinating	**Drought**	Yes
Plant height (m)	12 (7 – 20)	**Timber uses**[1]	CL	**Pollination vector**	Insects	**Flooding**	No
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	2.94	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.66 (0.52 – 0.83)	**Forage**	No	**Seed dormancy**	Mechanical	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	Zoochory	**Fire**	Yes

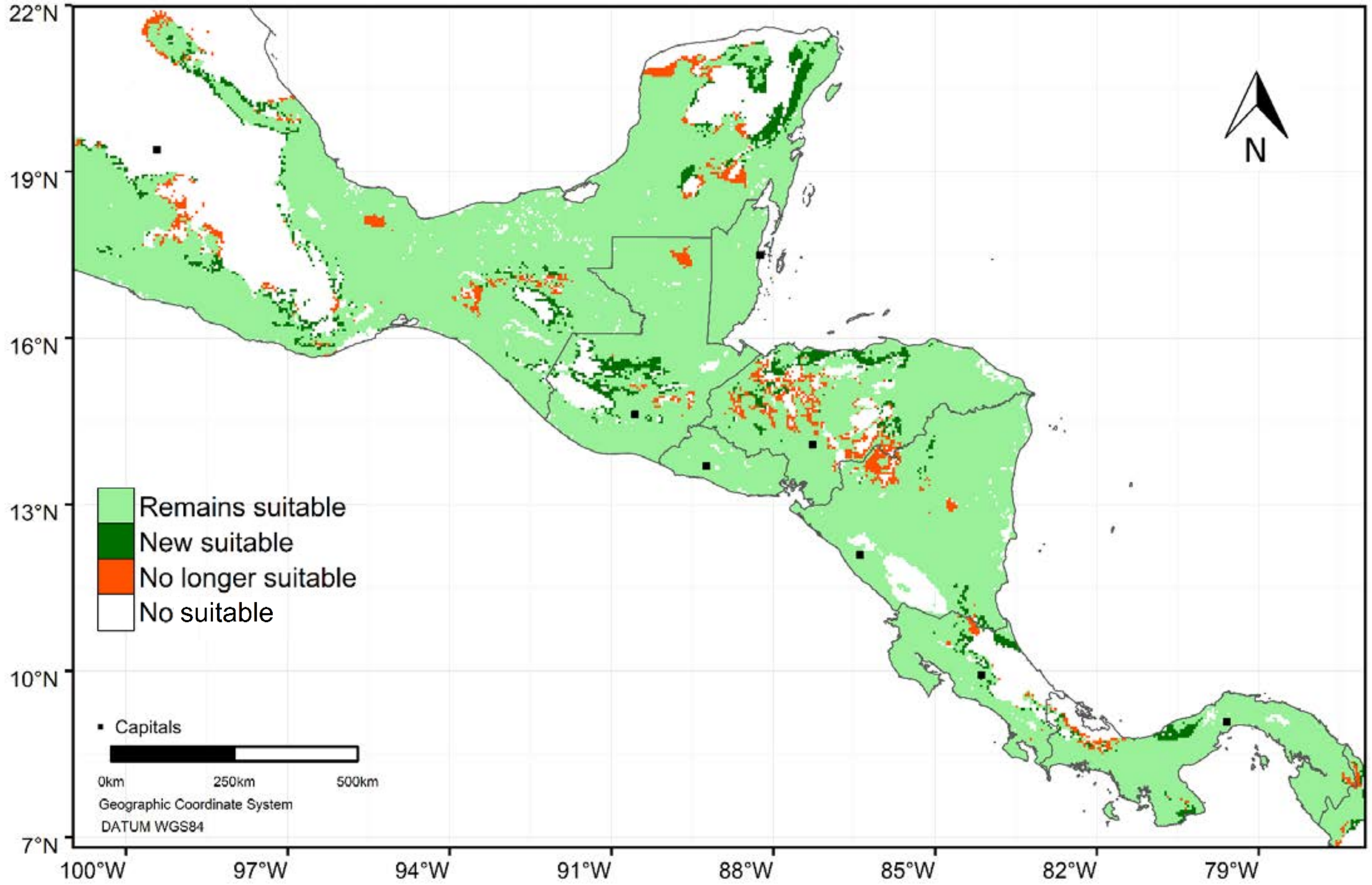
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



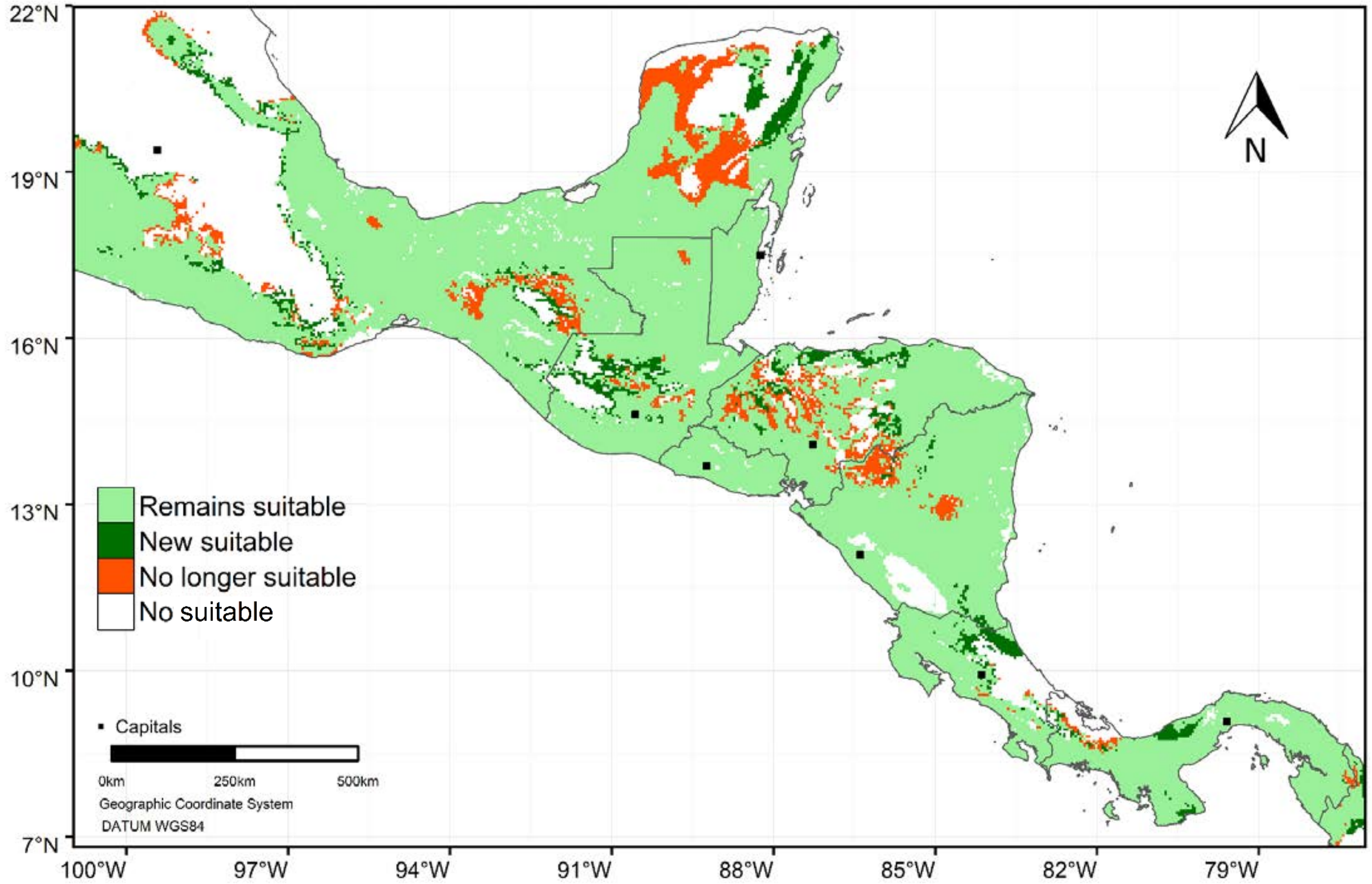
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



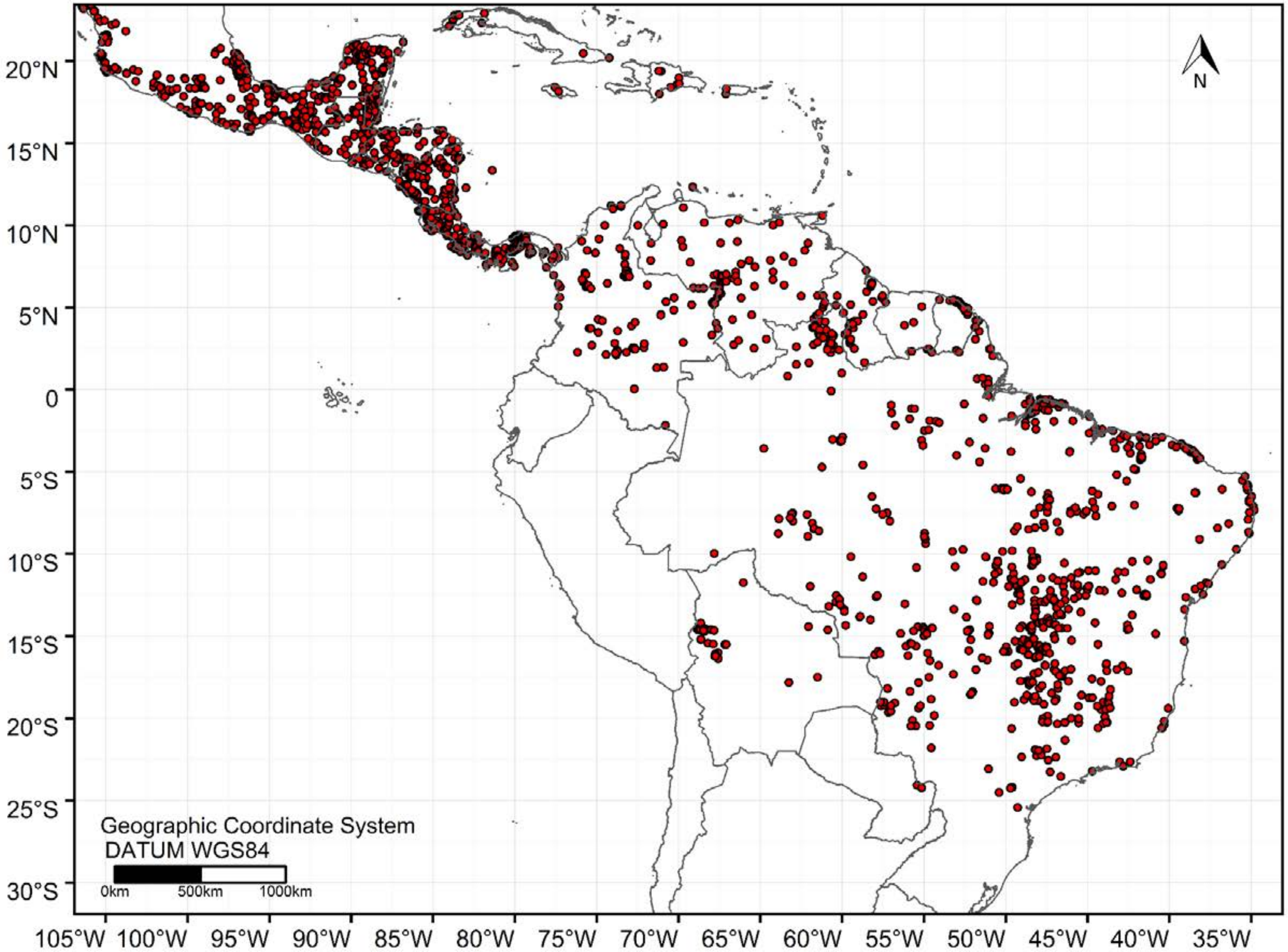
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	74,211	94%	7%	6%	1%
Rain forest	118,139	97%	5%	3%	2%
Whole region	192,350	96%	6%	4%	2%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	74,211	88%	7%	12%	-5%
Rain forest	118,139	94%	6%	6%	0%
Whole region	192,350	92%	6%	8%	-2%

Points of observed presence



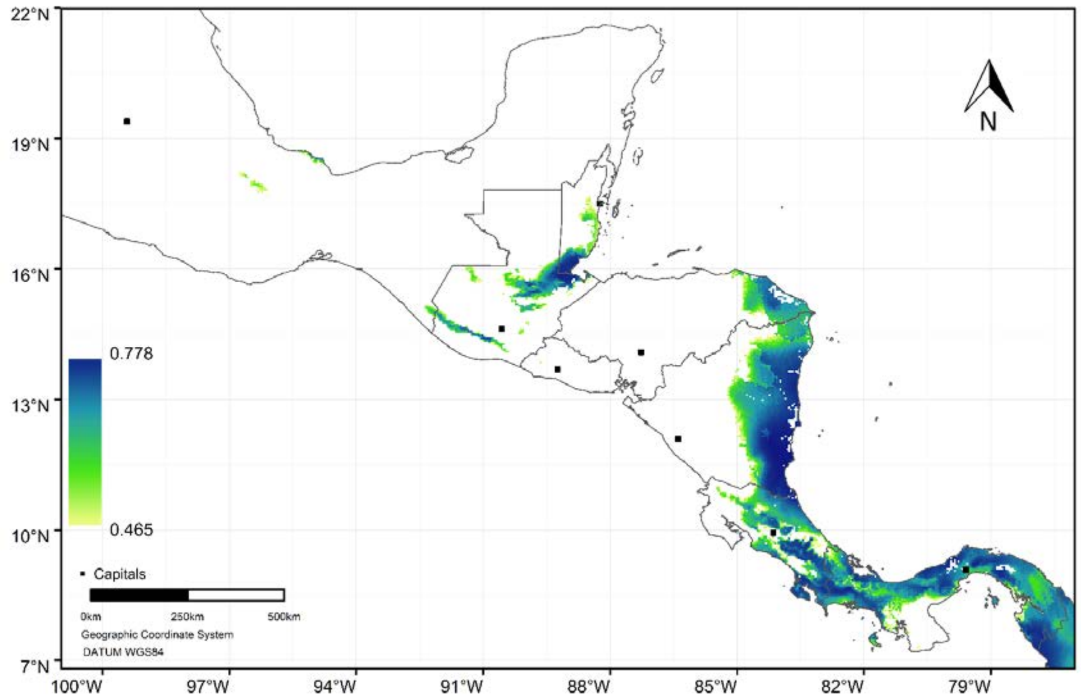
Carapa guianensis Aubl.

Family:
Meliaceae
Vernacular names:
Caobilla (CR, NI),
cedro macho (CR, NI, HN)
warawere (BZ)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	46 (30 – 60)	**Timber uses**[1]	CS, CL, MB, HF, PS, CH, AR	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (kg)**[2]	36.59 (27.51 – 47.62)	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Recalcitrant	**Shade**	Moderate
Wood density (g cm^{-3})	0.57 (0.49 – 0.74)	**Forage**	No	**Seed dormancy**	Mechanical	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Medicinal, Cosmetics	**Seed dispersal**	Autochory, Zoochory, Hydrochory	**Fire**	Unknown

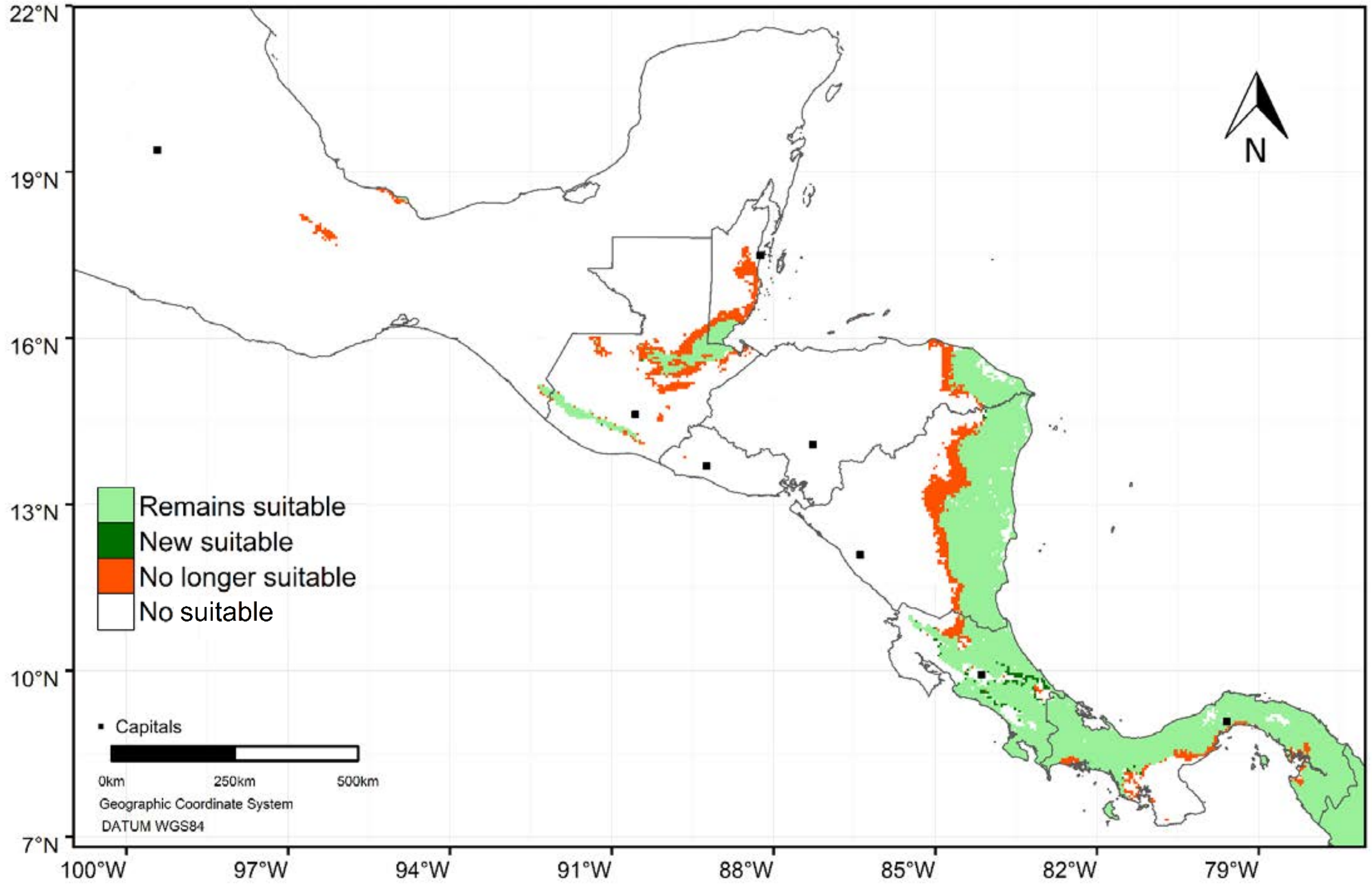
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
[2] Given the large size of the seed, seed weight is reported in kg.

Species suitable areas under current climate



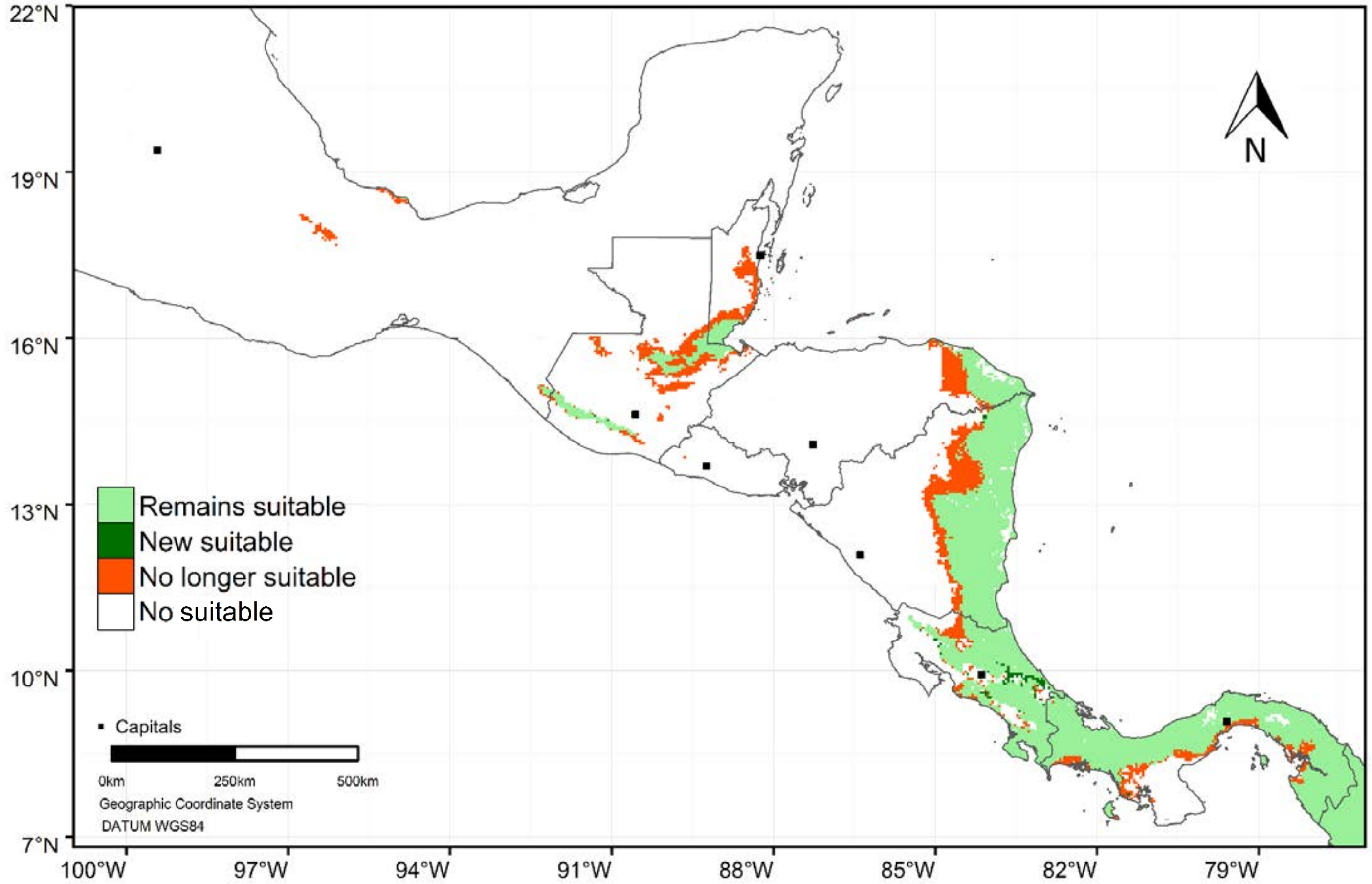
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



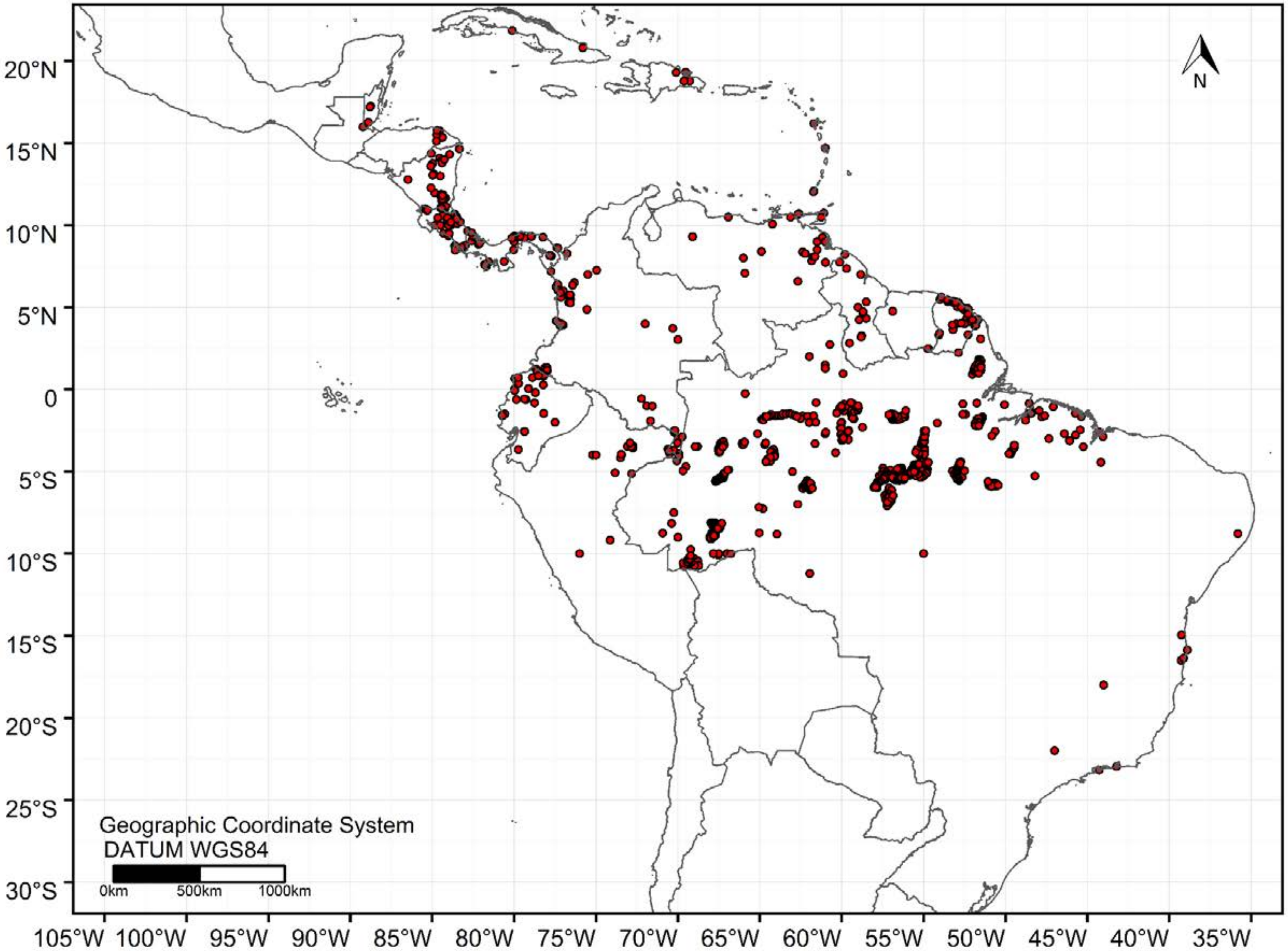
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	1,068	34%	0%	66%	-66%
Rain forest	44,977	84%	1%	16%	-15%
Whole region	46,045	83%	1%	17%	-16%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	1,068	33%	1%	67%	-66%
Rain forest	44,977	80%	1%	20%	-19%
Whole region	46,045	79%	1%	21%	-20%

Points of observed presence



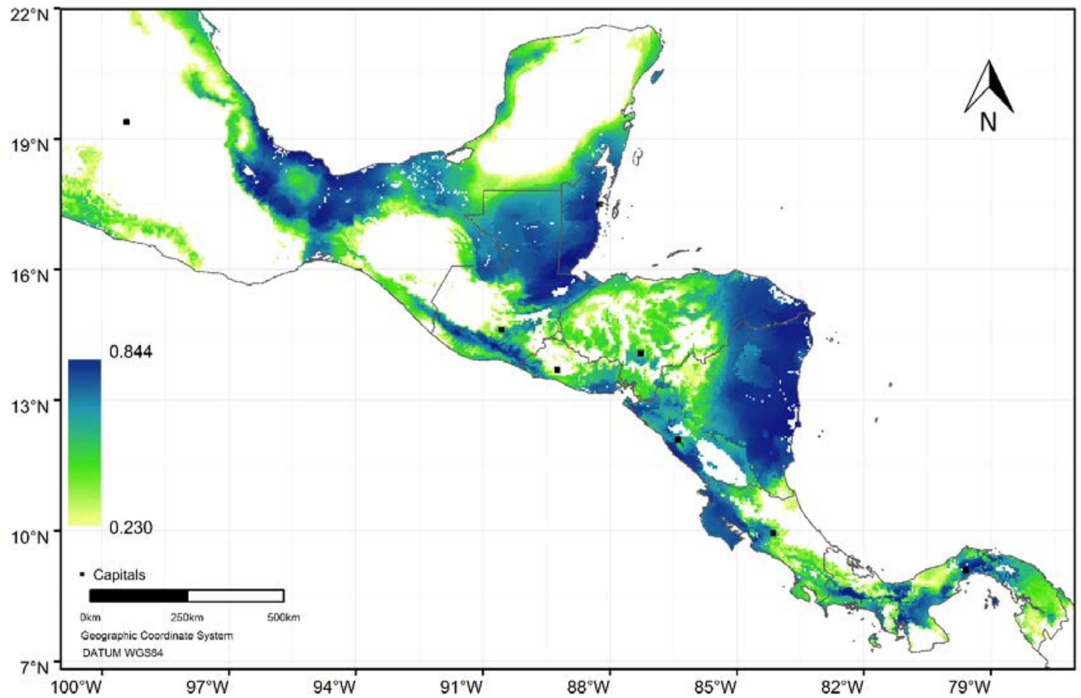
Cassia grandis L.f.

Family:
Leguminosae
Vernacular names:
Carao (CR, GT, SV, HN, NI), carago, caragua (HN, SV), cañafistula (CR), beef-feed (BZ)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Unknown	**Drought**	Unknown
Plant height (m)	19 (15 – 30)	**Timber uses[1]**	CL, MB, HF, PS	**Pollination vector**	Unknown	**Flooding**	Yes
Spinescence	Yes	**Firewood**	Yes	**Weight 1000 seeds (g)**	557 (474 – 832.6)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.8 (0.74 – 0.92)	**Forage**	Yes	**Seed dormancy**	Physical	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Medicinal	**Seed dispersal**	Zoochory	**Fire**	Unknown

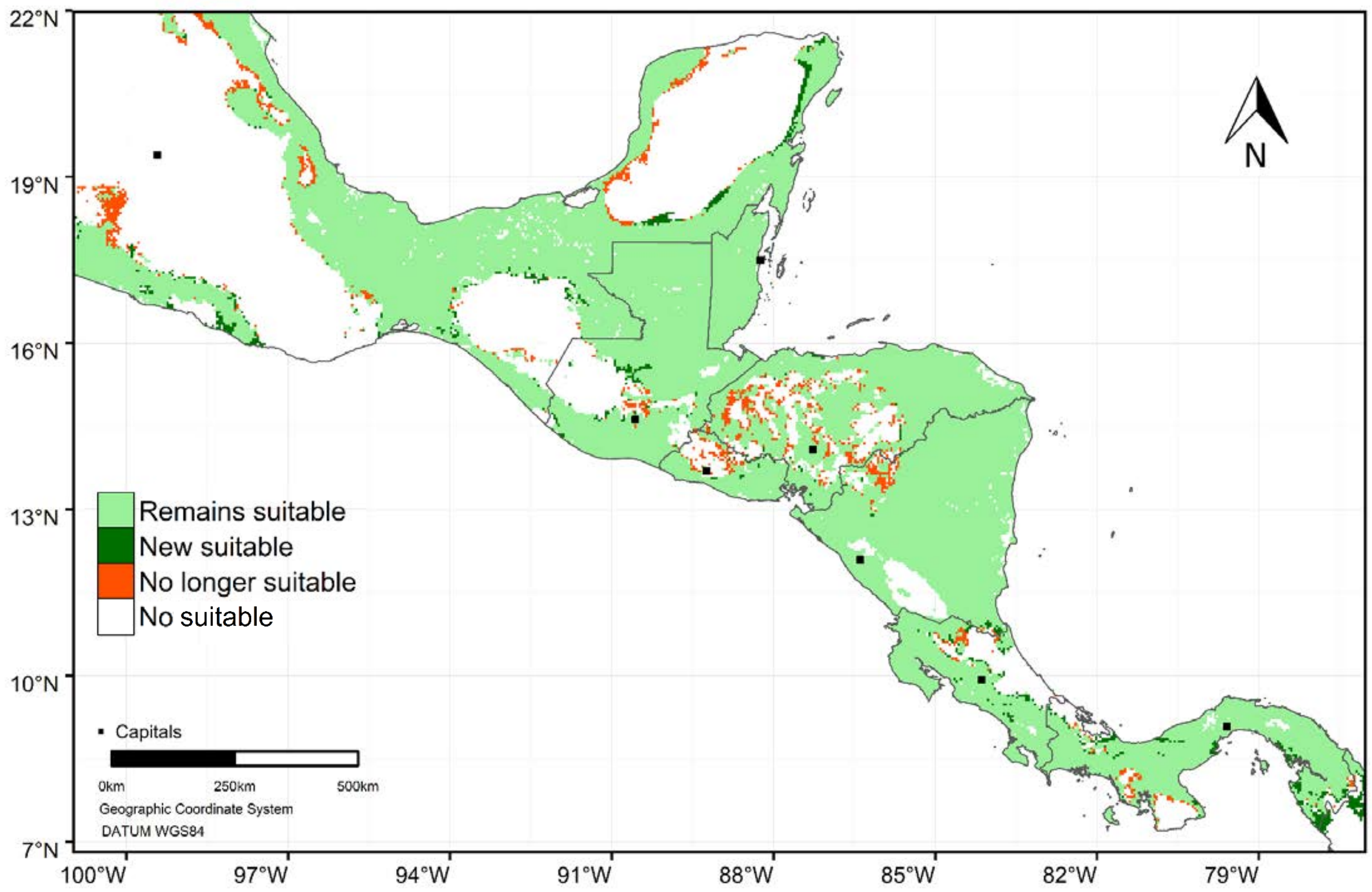
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



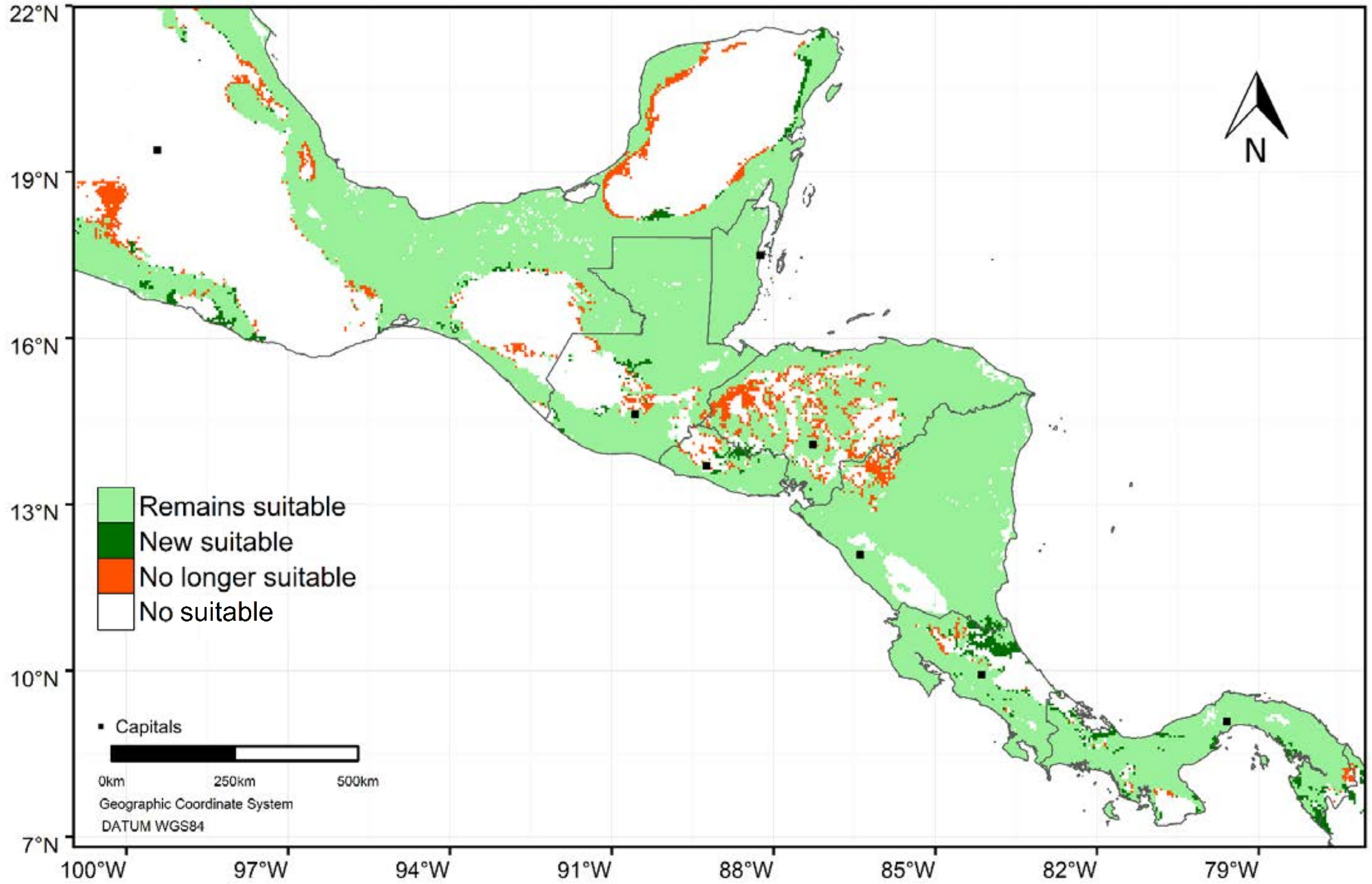
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



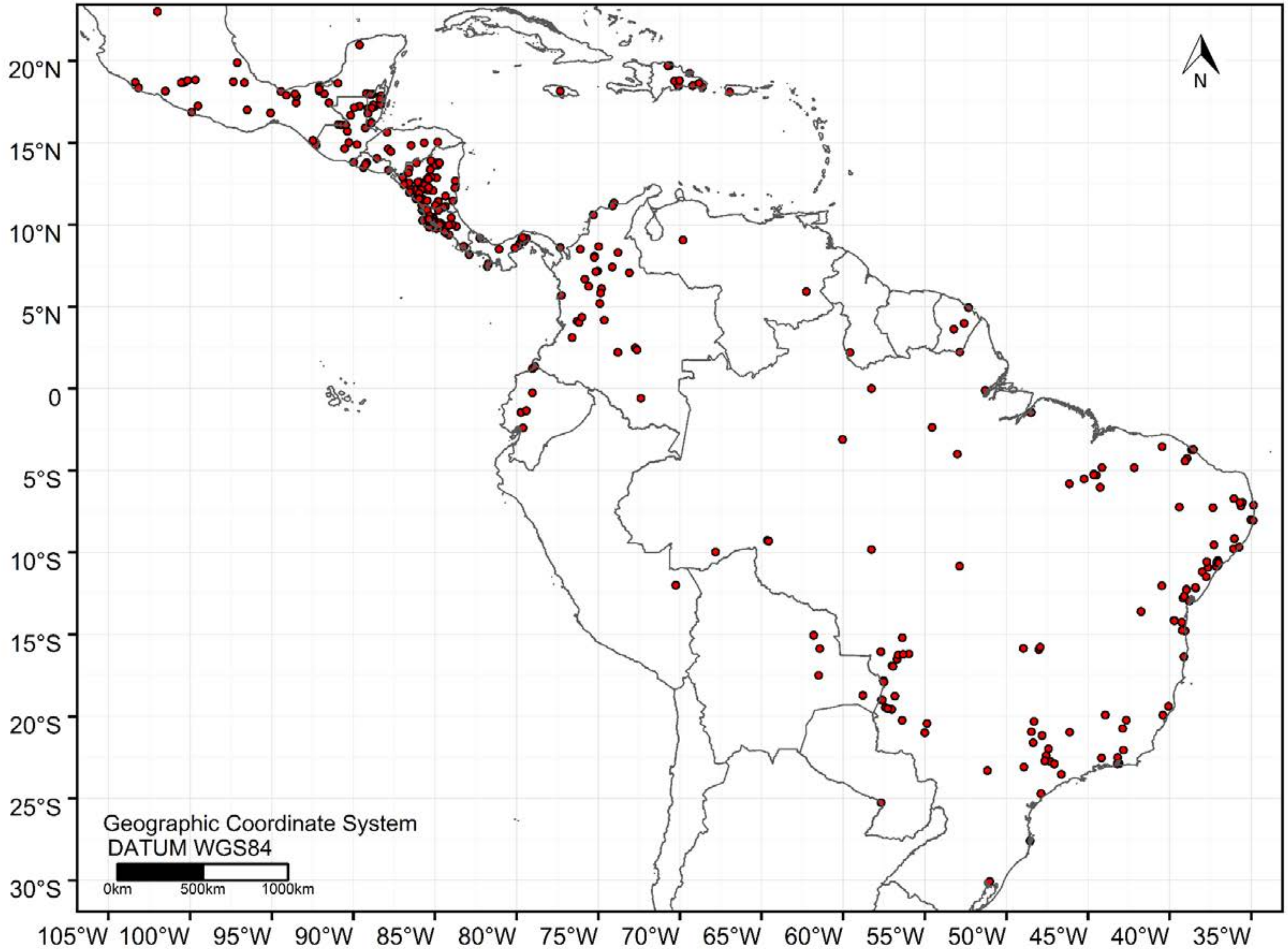
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	44,791	90%	3%	10%	-7%
Rain forest	111,127	98%	3%	2%	1%
Whole region	155,918	96%	3%	4%	-1%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	44,791	86%	3%	14%	-11%
Rain forest	111,127	97%	4%	3%	1%
Whole region	155,918	94%	3%	6%	-3%

Points of observed presence



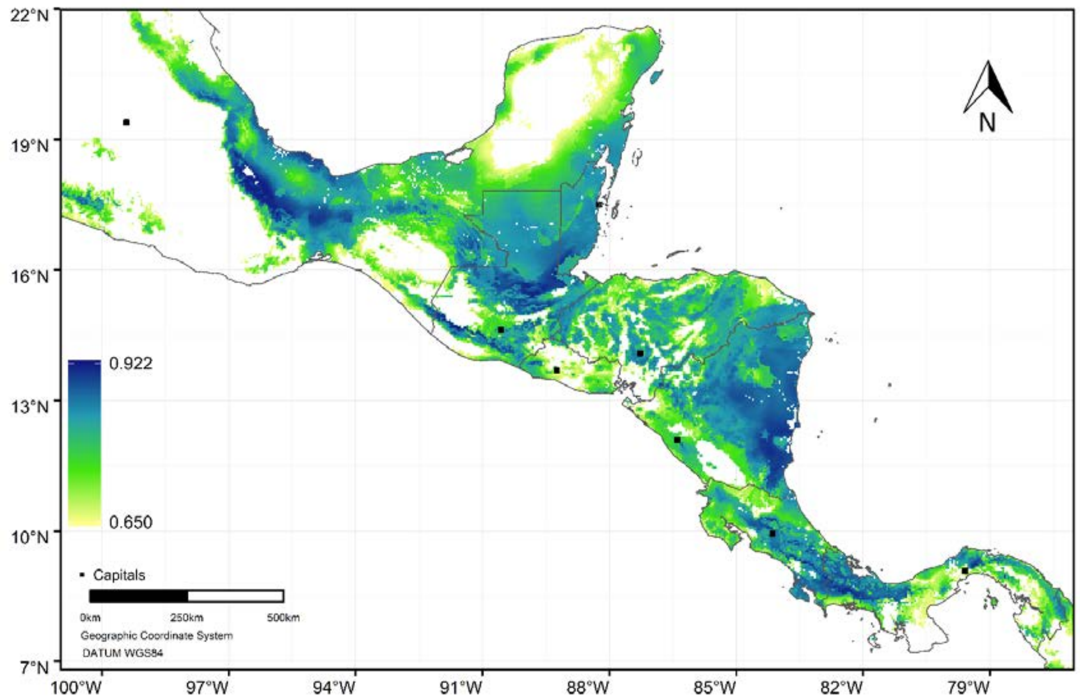
Cedrela odorata L.

Family:
Meliaceae
Vernacular names:
Cedro, cedro amargo

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	41 (35 – 60)	**Timber uses**[1]	SM, CL, MB, PS, CH, AR	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	20.36 (9.6 – 47.85)	**Frost**	Yes
N fixer	No	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.43 (0.23 – 0.66)	**Forage**	No	**Seed dormancy**	No	**Salinity**	No
Leaf phenology	Deciduous	**Other uses**	Apiculture, Medicinal	**Seed dispersal**	Anemochory	**Fire**	Unknown

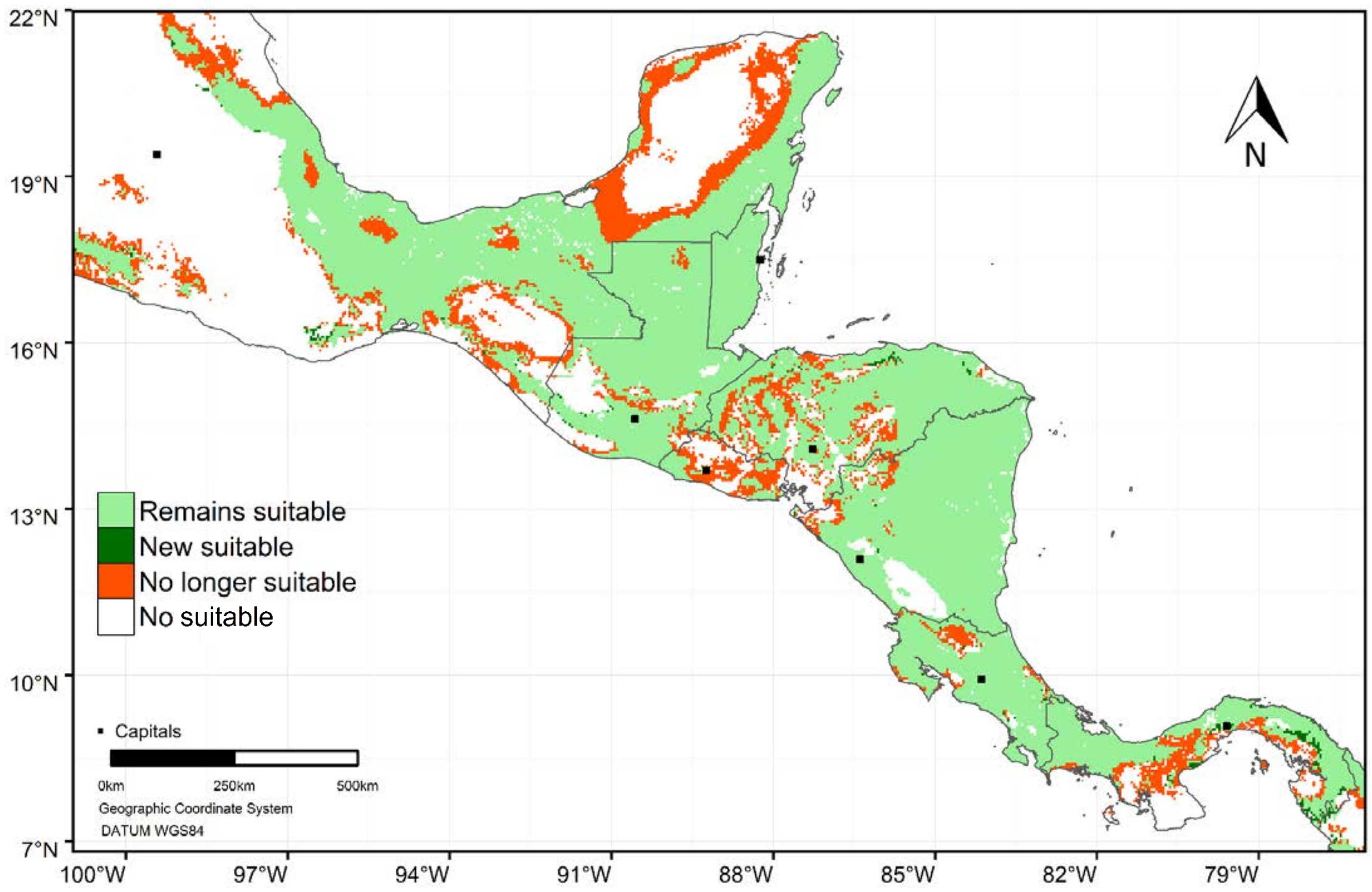
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



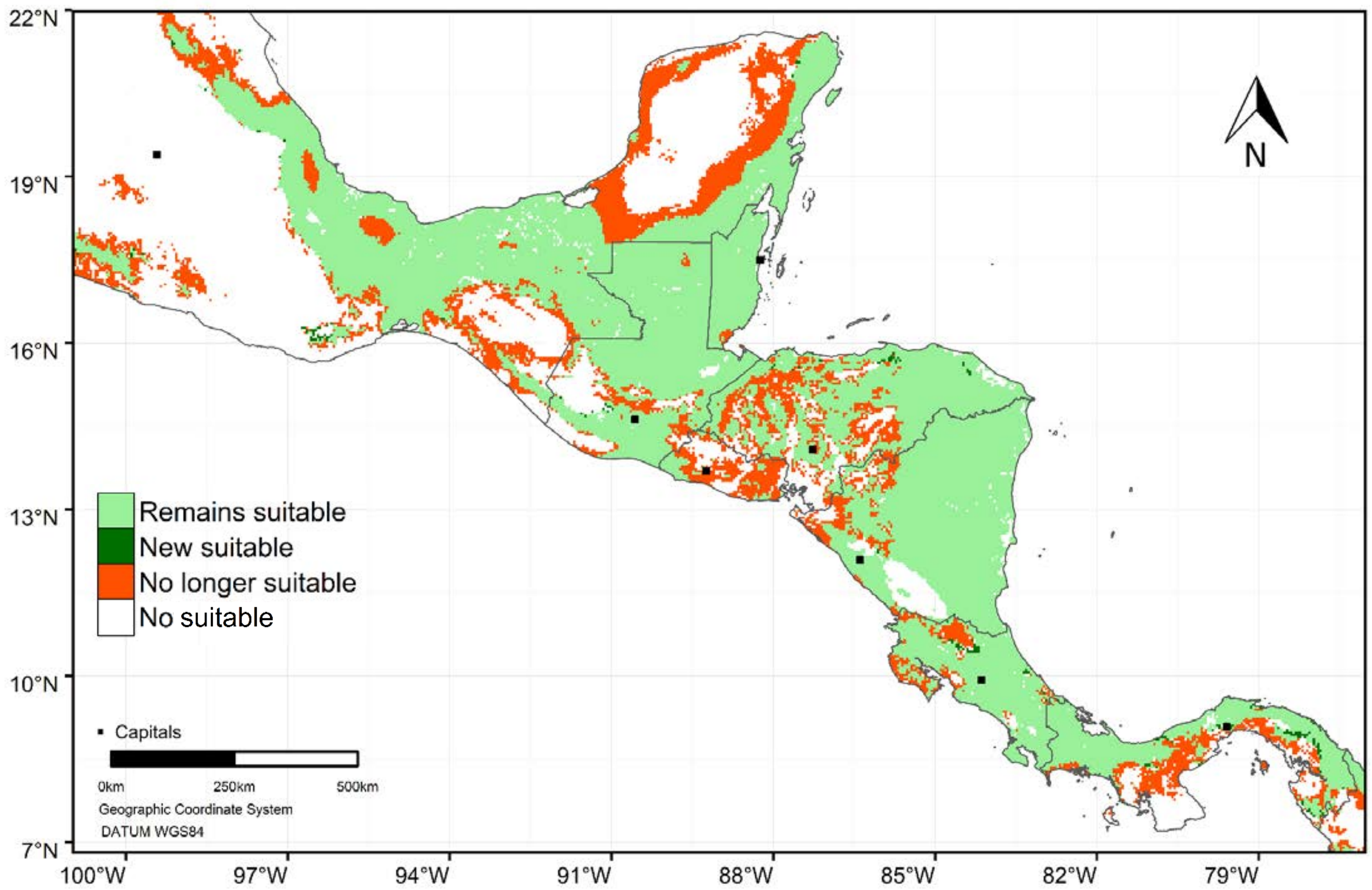
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



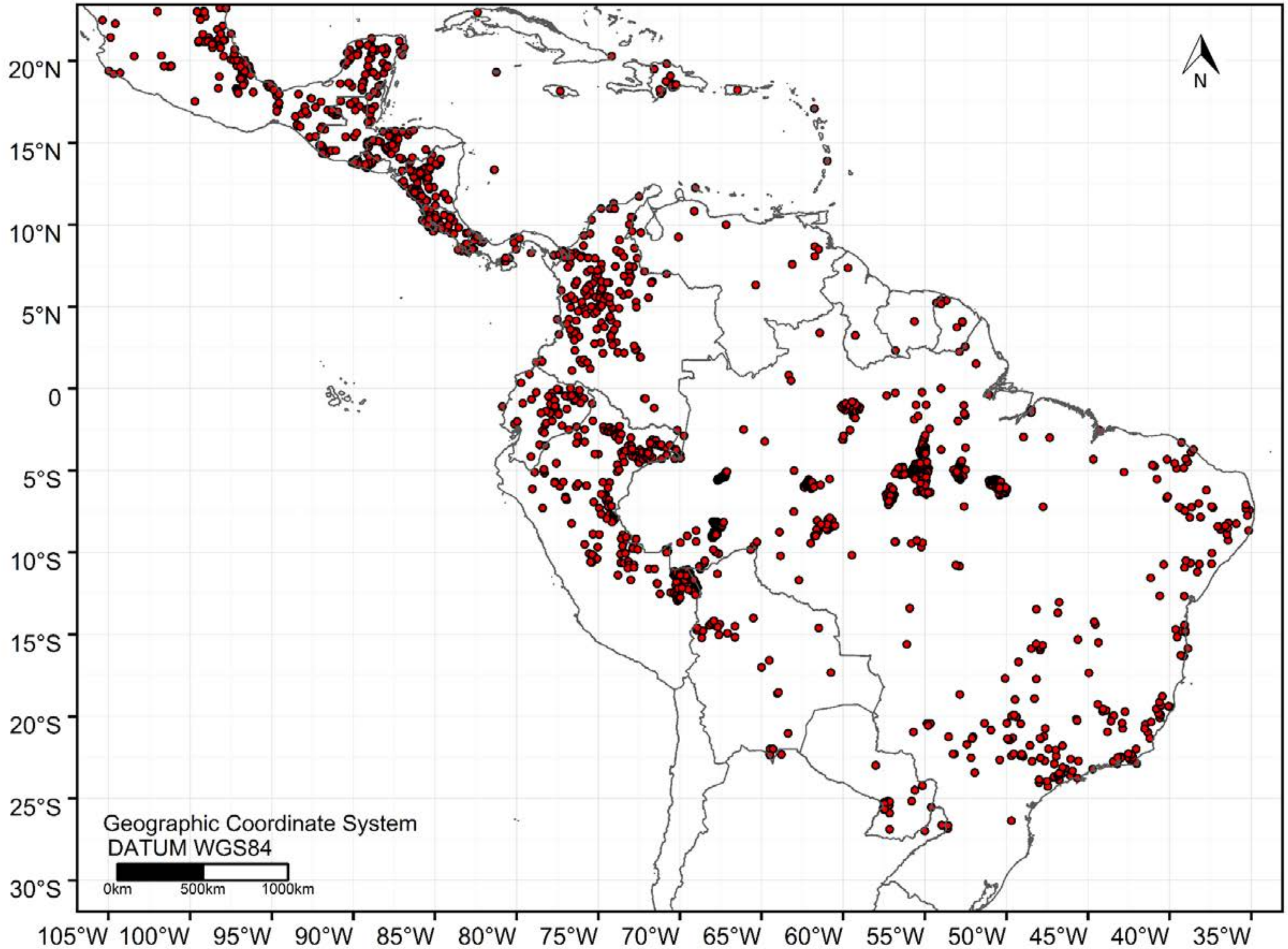
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	48,976	67%	1%	33%	-32%
Rain forest	121,349	88%	1%	12%	-11%
Whole region	170,324	82%	1%	18%	-17%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	48,976	56%	1%	44%	-43%
Rain forest	121,349	85%	1%	15%	-14%
Whole region	170,324	77%	1%	23%	-22%

Points of observed presence



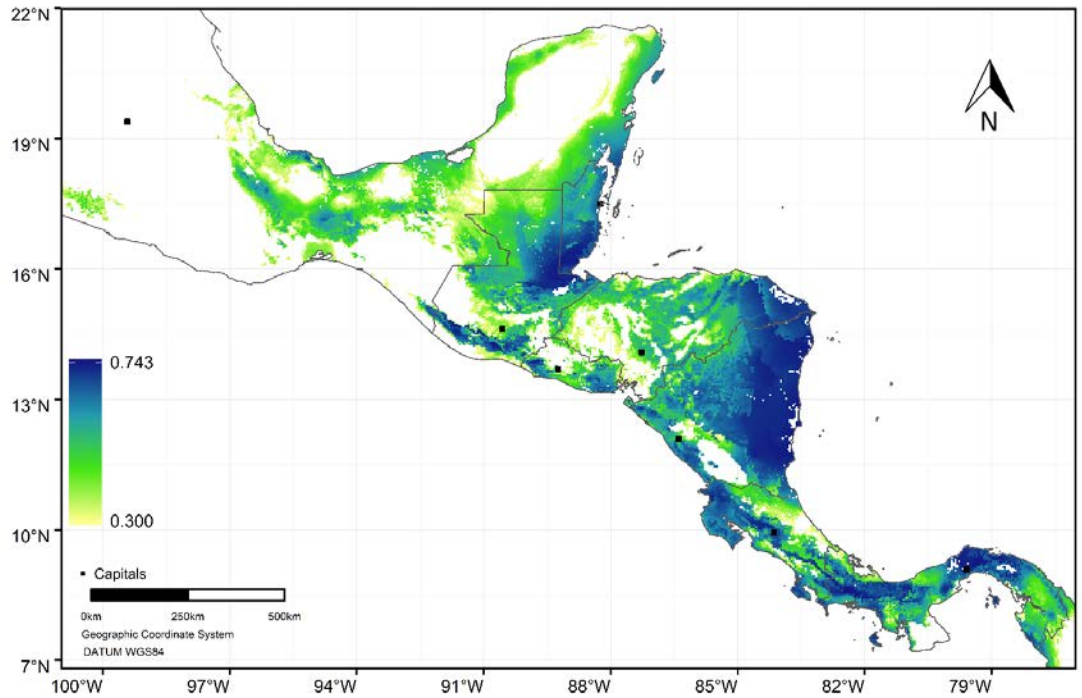
Chrysophyllum cainito L.

Family: Sapotaceae
Vernacular names: Caimito

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	17 (5 – 30)	**Timber uses[1]**	CS, MB, HF, DT	**Pollination vector**	Insects	**Flooding**	No
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	297.3 (210 – 384.6)	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Intermedia	**Shade**	No
Wood density (g cm^{-3})	0.65 (0.57 – 0.74)	**Forage**	No	**Seed dormancy**	No	**Salinity**	No
Leaf phenology	Evergreen	**Other uses**	Apiculture Medicinal	**Seed dispersal**	Zoochory, Autochory	**Fire**	Unknown

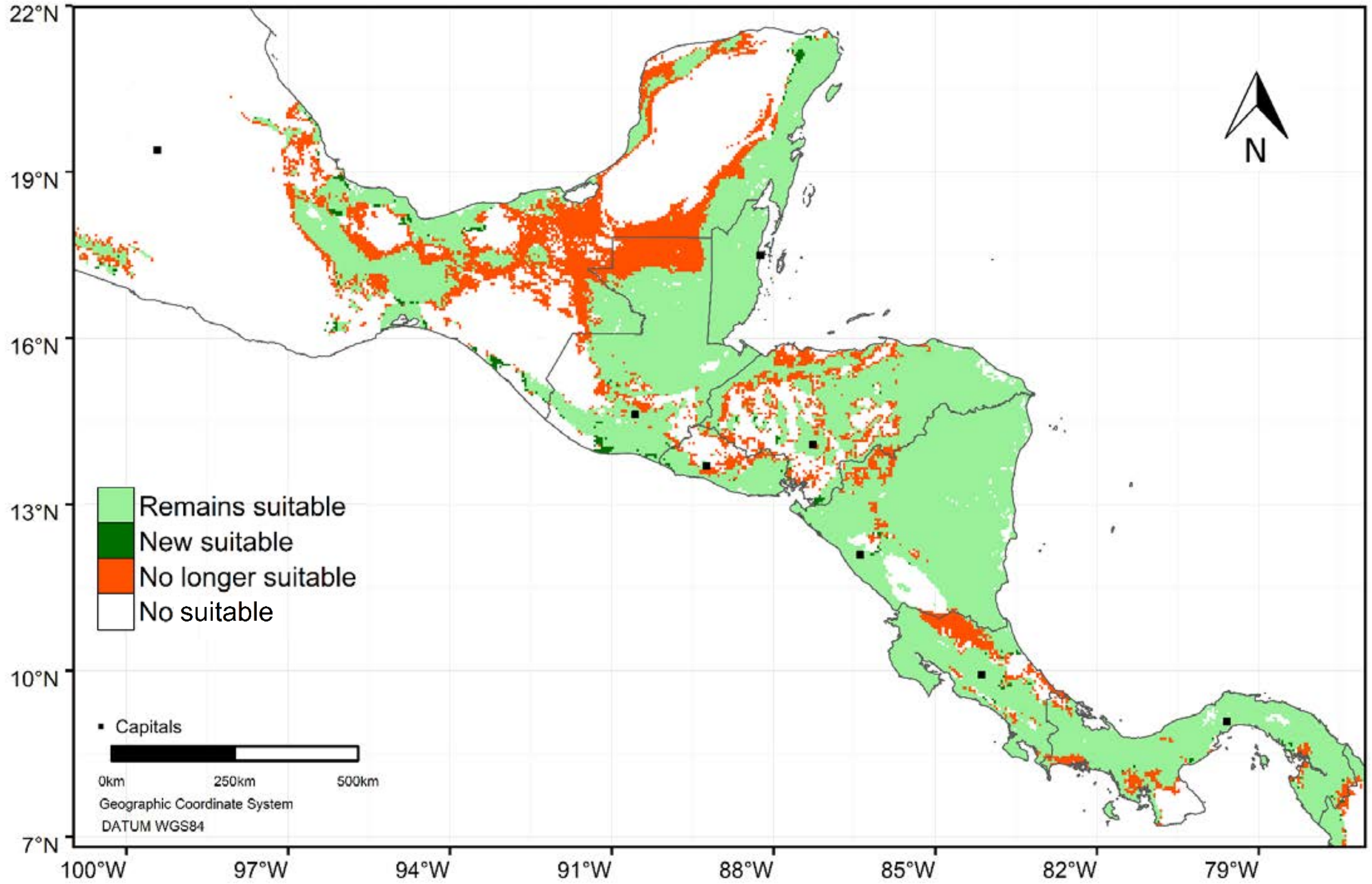
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



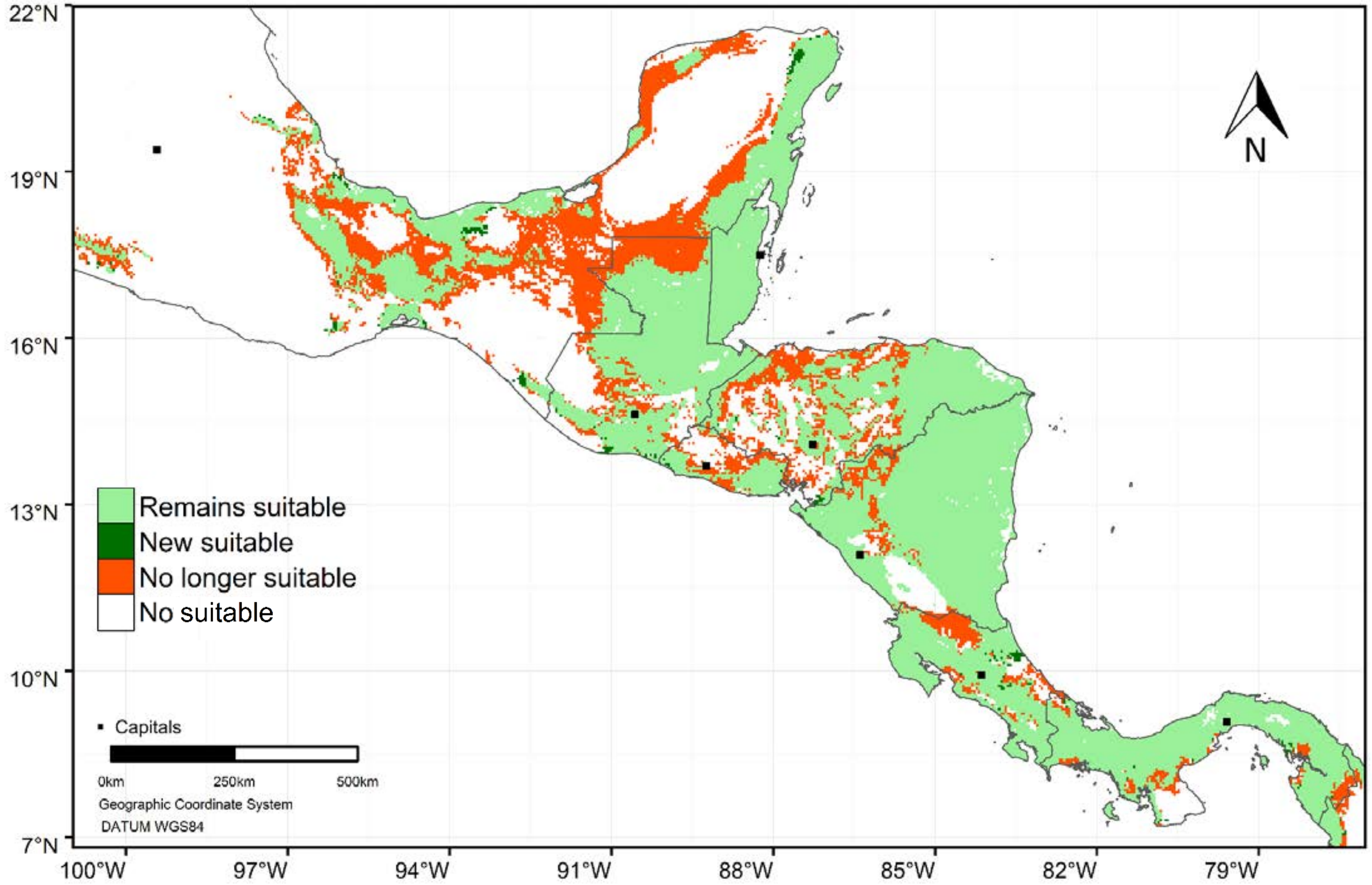
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



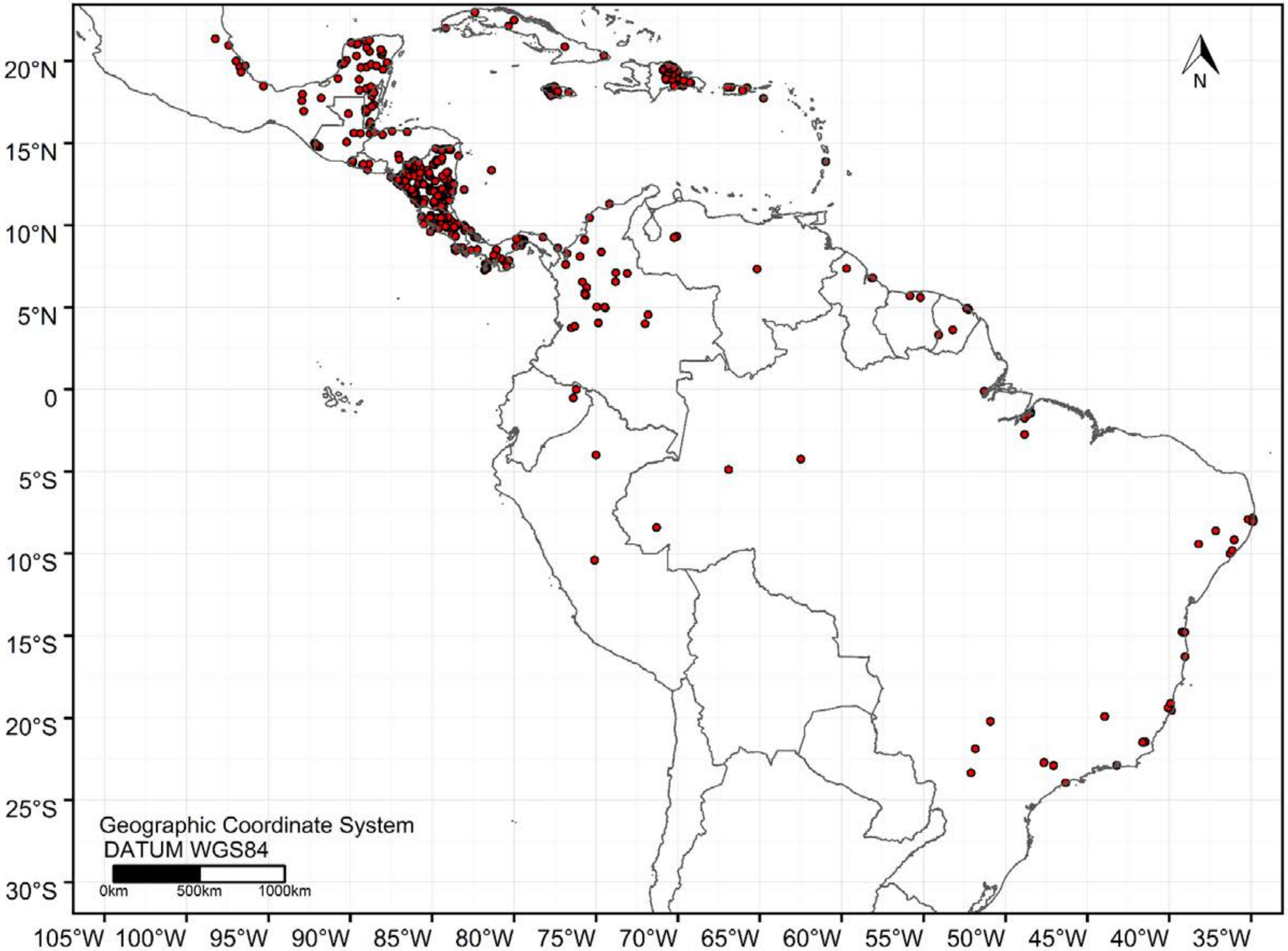
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	38,387	75%	2%	25%	-23%
Rain forest	108,711	79%	1%	21%	-20%
Whole region	147,098	78%	1%	22%	-21%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	38,387	65%	1%	35%	-34%
Rain forest	108,711	77%	1%	23%	-23%
Whole region	147,098	74%	1%	26%	-25%

Points of observed presence



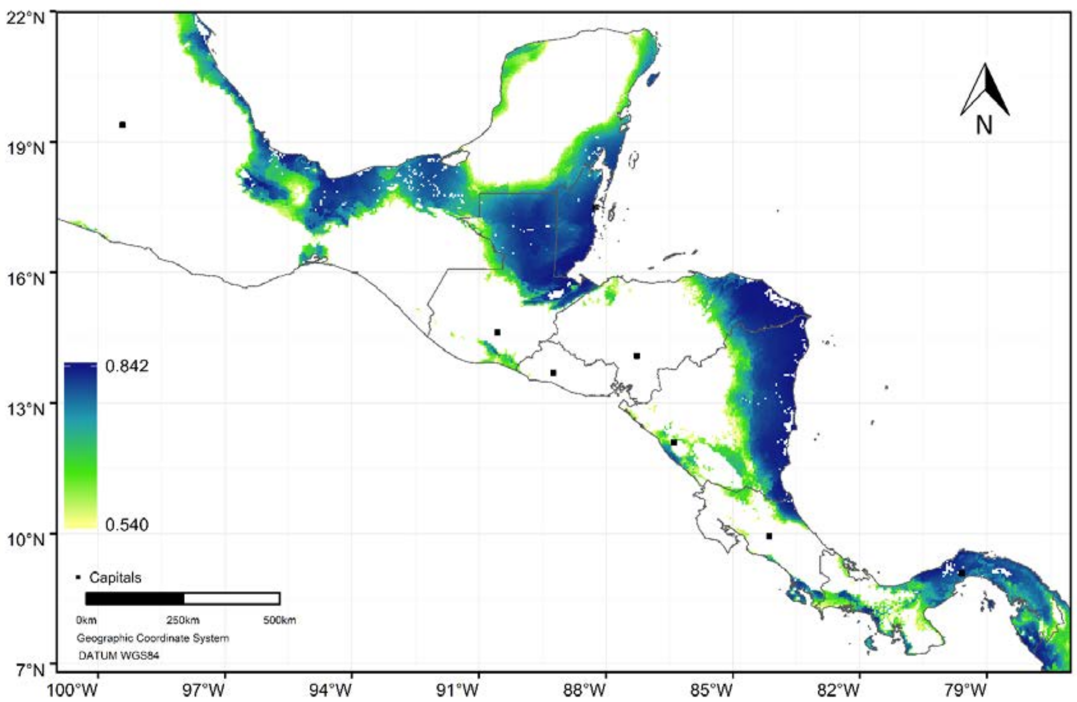
Chrysobalanus icaco L.

Family: Chrysobalanaceae
Vernacular names: Ciruela de algodón, coco-plum

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Shrub	**Commercial timber**	No	**Reproductive system**	Unknown	**Drought**	Yes
Plant height (m)	4 (1.5 – 6)	**Timber uses**[1]	None	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (g)**	2.495 (208.3 – 5.555)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes (fruits and seeds)	**Seed storage type**	Unknown	**Shade**	Unknown
Wood density (g cm^{-3})	0.75 (0.67 – 0.80)	**Forage**	No	**Seed dormancy**	Unknown	**Salinity**	Yes
Leaf phenology	Evergreen	**Other uses**	Apiculture	**Seed dispersal**	Zoochory, Hydrochory	**Fire**	Unknown

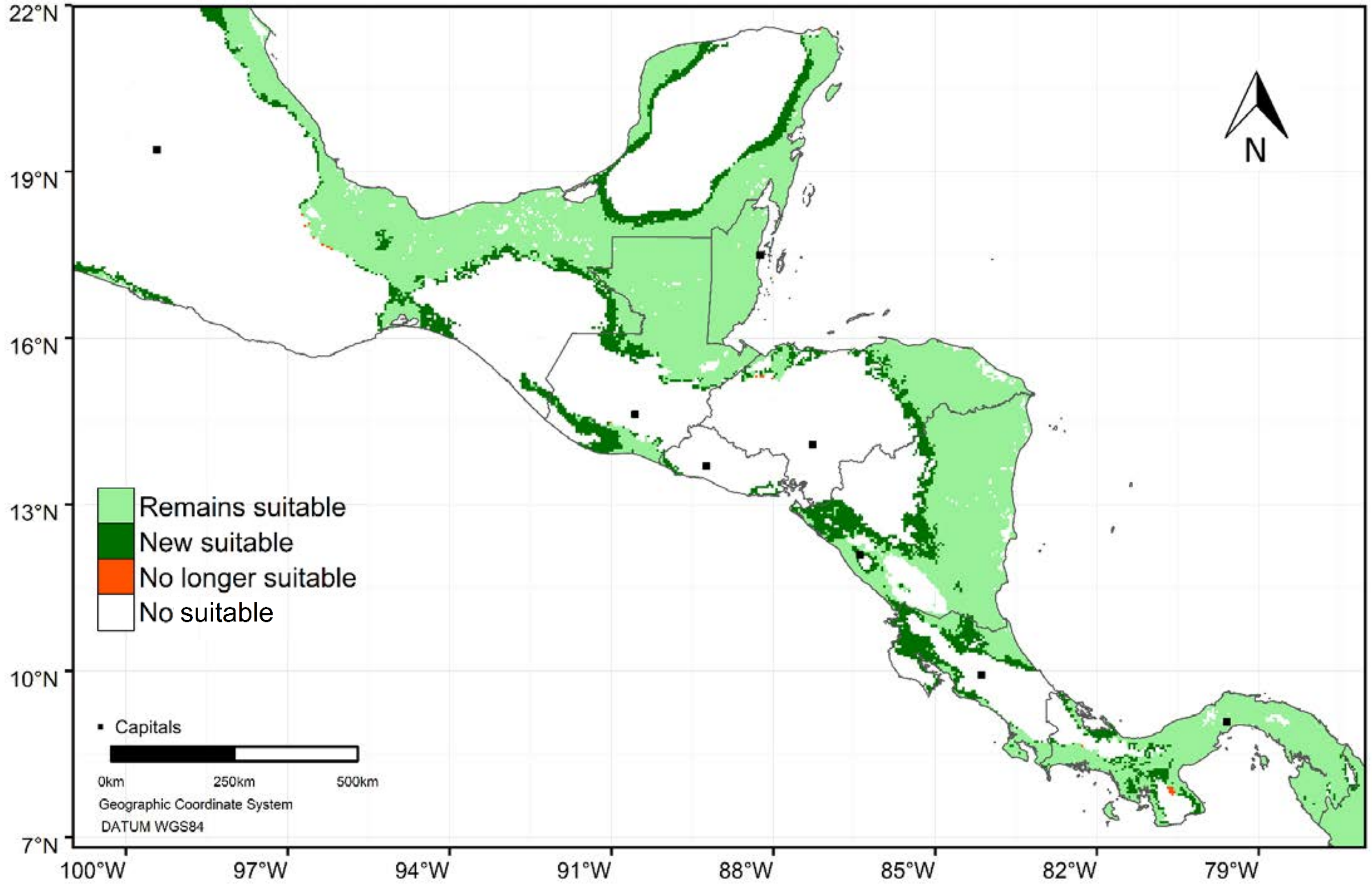
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



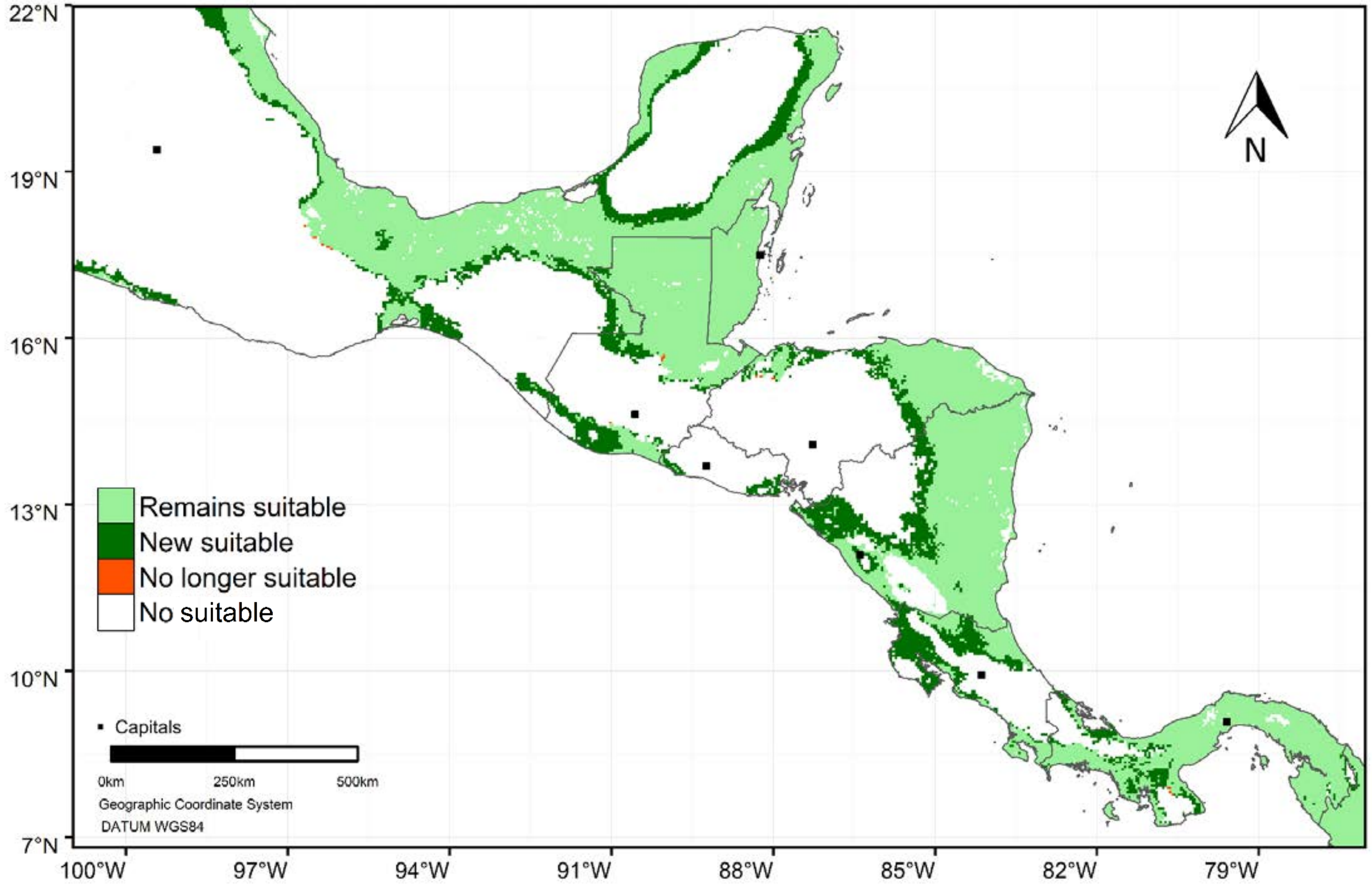
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



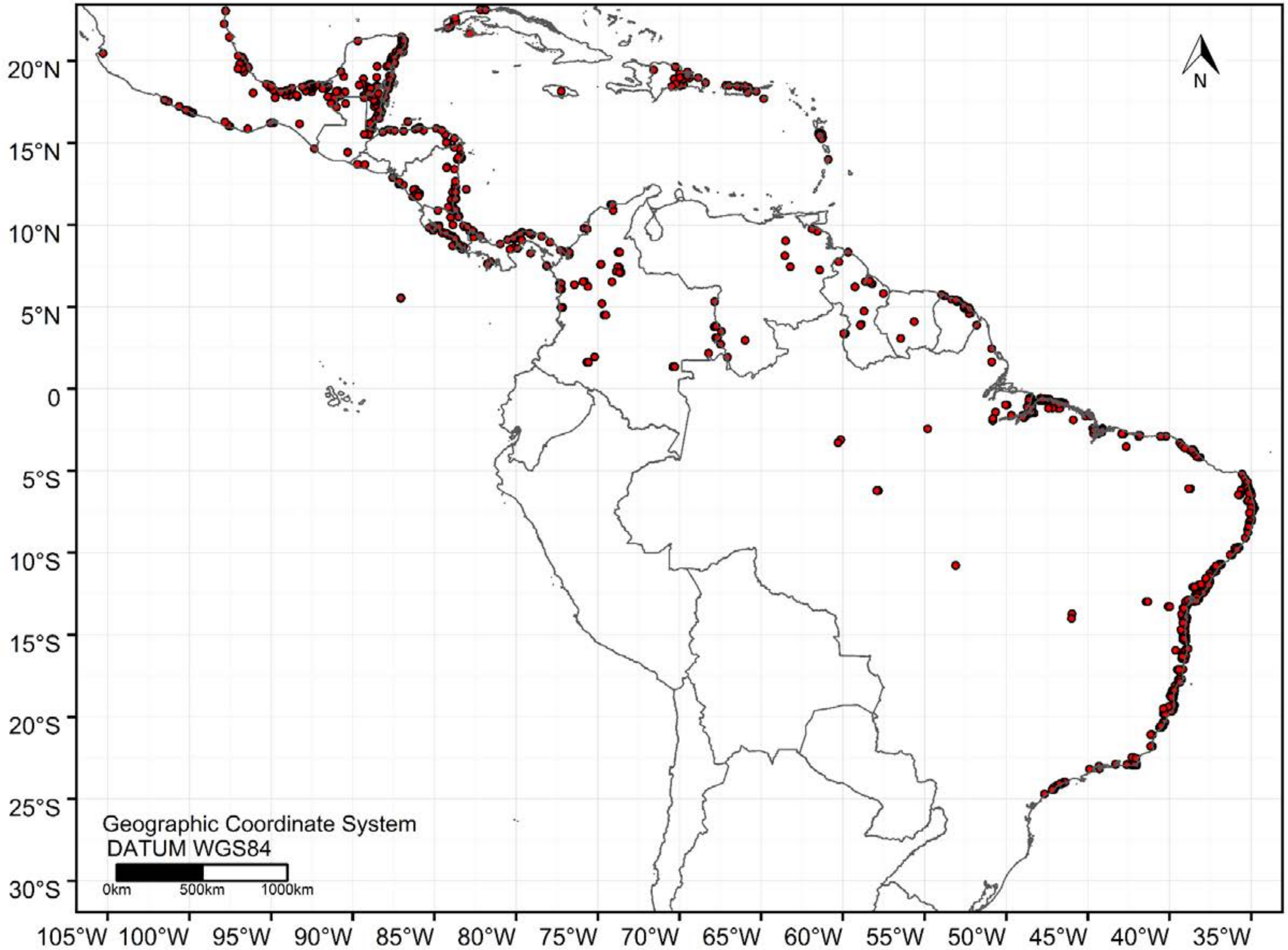
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	8,668	99%	88%	1%	87%
Rain forest	85,392	100%	16%	0%	16%
Whole region	94,060	100%	22%	0%	22%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	8,668	99%	102%	1%	102%
Rain forest	85,392	100%	19%	0%	19%
Whole region	94,060	100%	26%	0%	26%

Points of observed presence



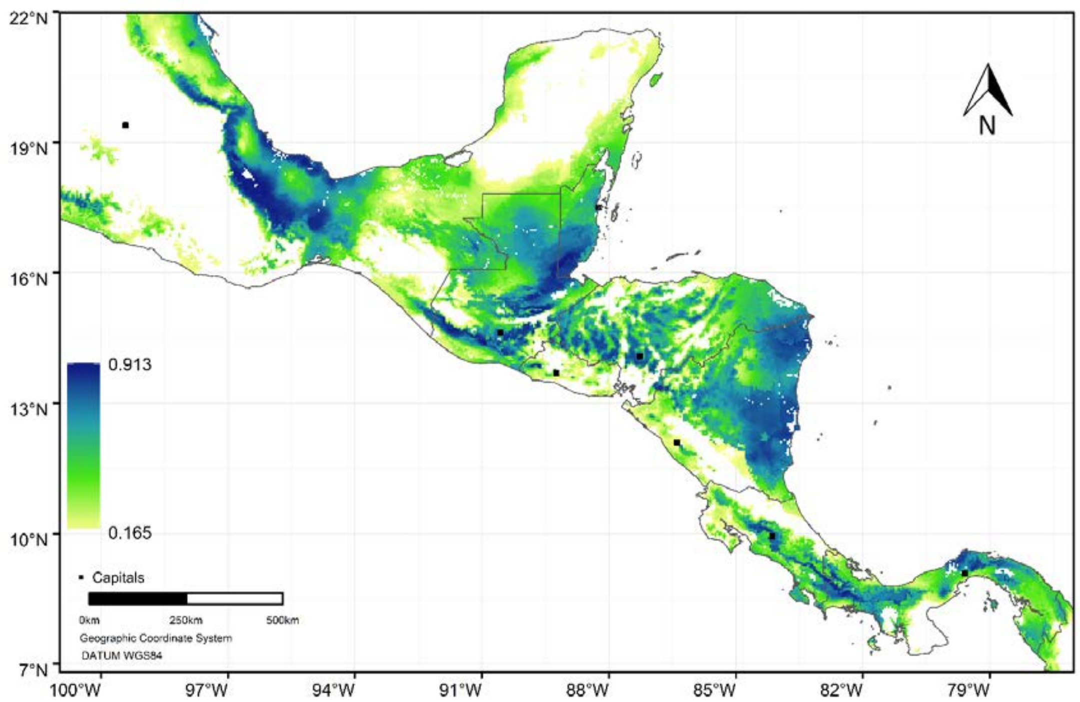
Citrus sinensis (L.) Osbeck

Family:
Rutaceae
Vernacular names:
Naranja,
naranja dulce
Exótica

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious self-pollination	**Drought**	No
Plant height (m)	10 (7 - 13)	**Timber uses[1]**	None	**Pollination vector**	Insects	**Flooding**	No
Spinescence	Yes	**Firewood**	Yes	**Weight 1000 seeds (g)**	104.9 (30.6 – 285.7)	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Intermedia	**Shade**	No
Wood density (g cm^{-3})	0.84 (0.72 – 0.88)	**Forage**	No	**Seed dormancy**	No	**Salinity**	No
Leaf phenology	Evergreen	**Other uses**	Medicinal, Cosmetics	**Seed dispersal**	* Domesticated-human mediated, Zoochory	**Fire**	No

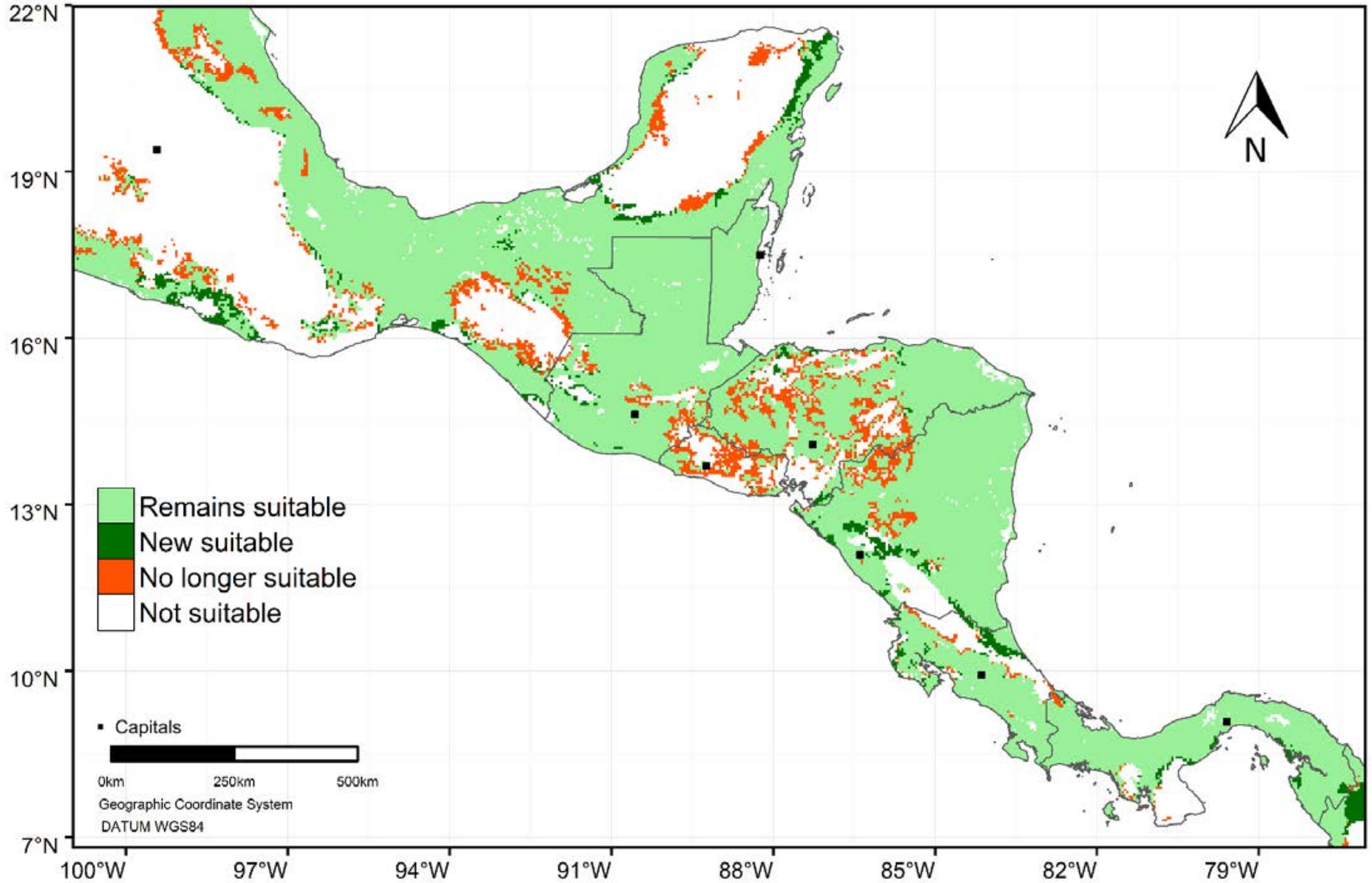
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



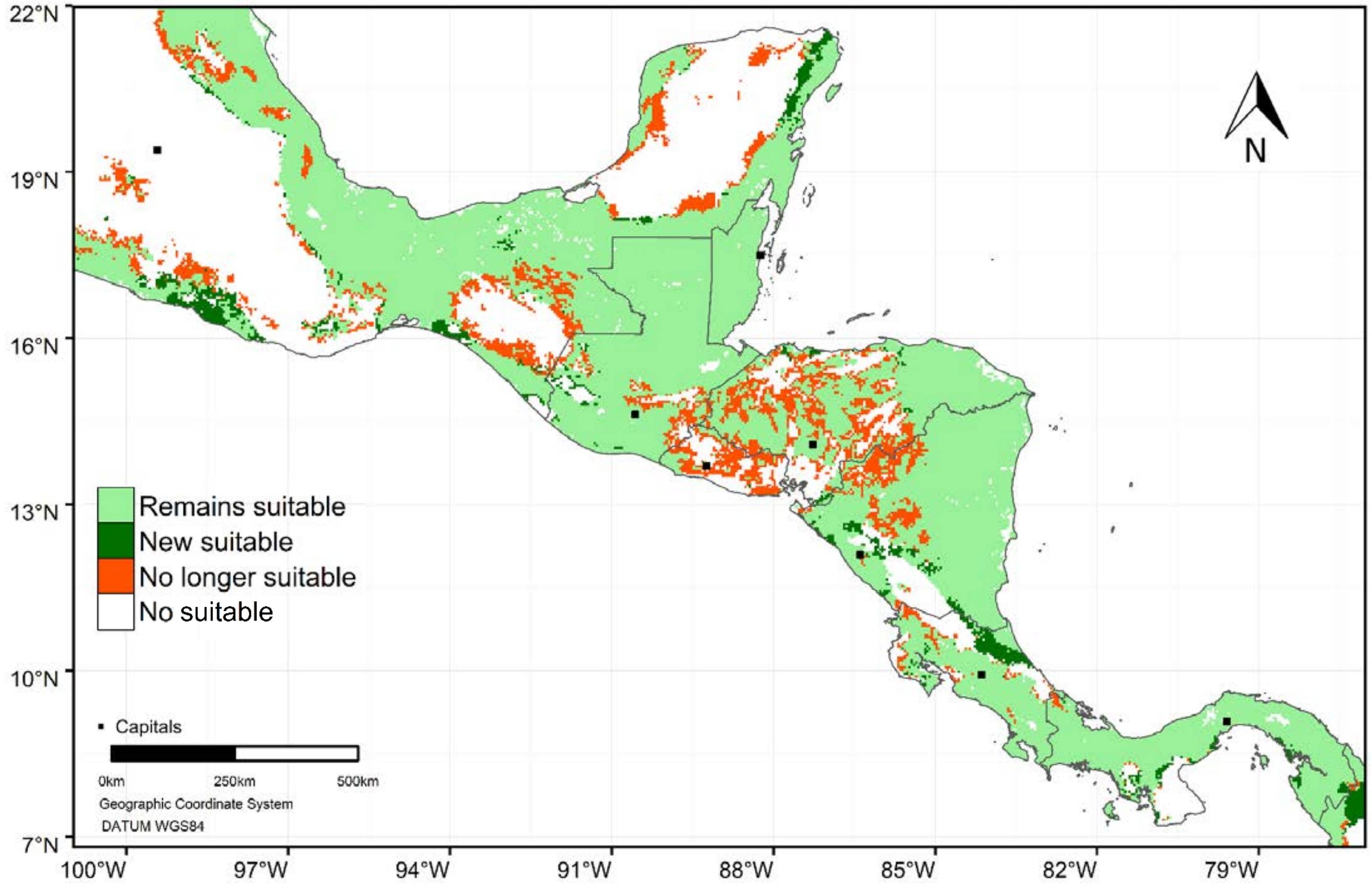
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



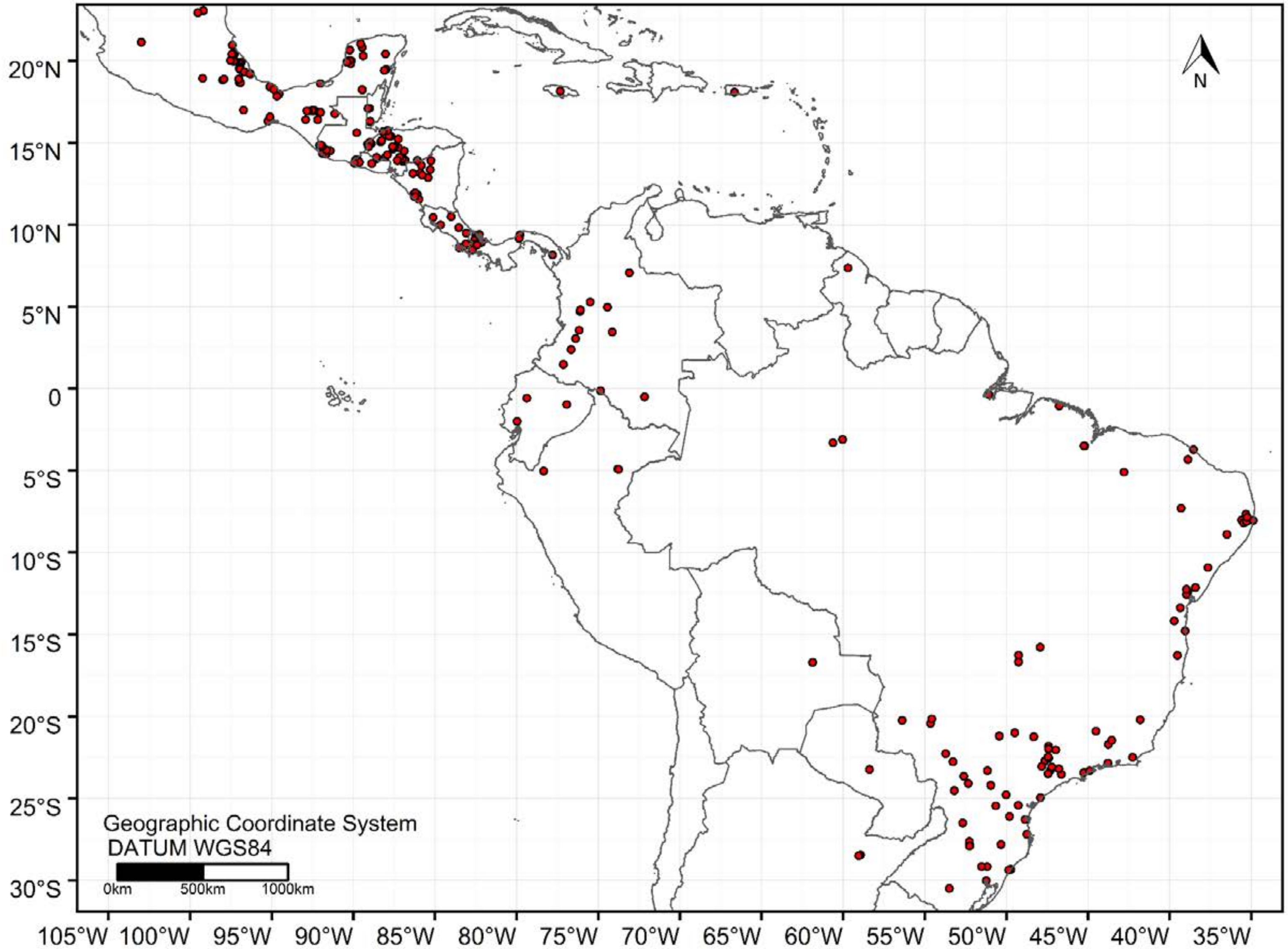
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	50,132	77%	8%	23%	-16%
Rain forest	118,629	95%	4%	5%	-1%
Whole region	168,761	90%	5%	10%	-5%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	50,132	68%	8%	32%	-24%
Rain forest	118,629	94%	4%	6%	-2%
Whole region	168,761	86%	5%	14%	-9%

Points of observed presence



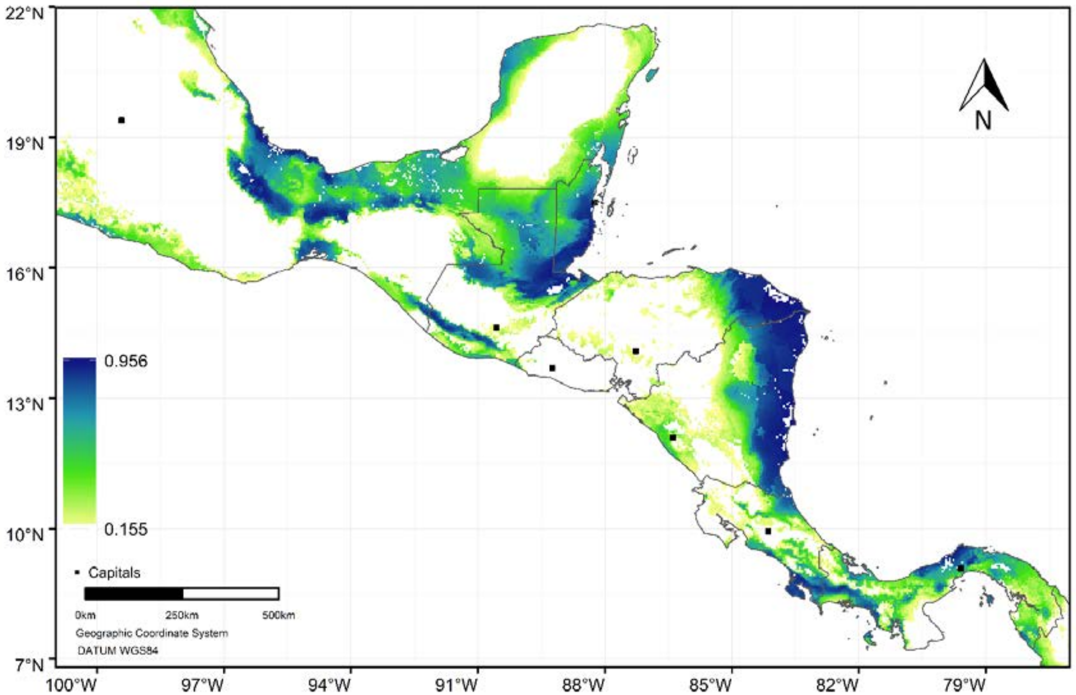
Cocos nucifera L.

Family:
Arecaceae
Vernacular names:
Coco, coconut
Exótica

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Palm	**Commercial timber**	No	**Reproductive system**	Mixed monoecious	**Drought**	No
Plant height (m)	16 (5 – 40)	**Timber uses[1]**	CS, CL, MB, PS	**Pollination vector**	Insects	**Flooding**	No
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (kg)[2]**	576.8 (167 – 1,276)	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	No
Wood density ($g\ cm^{-3}$)	0.56 (0.3 – 0.9)	**Forage**	No	**Seed dormancy**	Morpho – physiological[3]	**Salinity**	Yes
Leaf phenology	Evergreen	**Other uses**	Oil, Cosmetics	**Seed dispersal**	Hydrochory, Autochory	**Fire**	Moderate

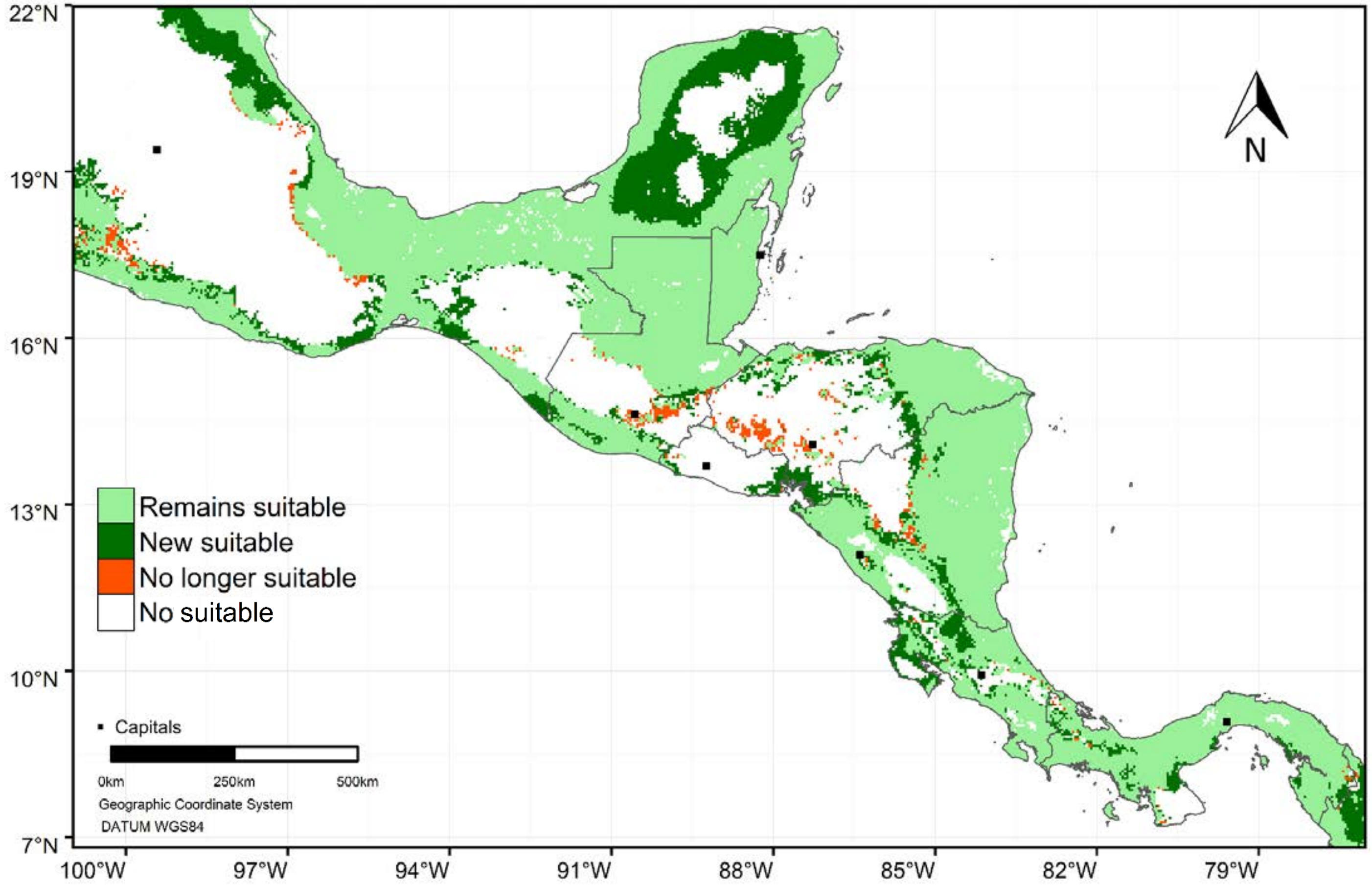
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
[2] Given the large size of the seed, seed weight is reported in kg.
[3] Morphophysiological dormancy: family has underdeveloped embryos and germination is initiated after 4 or more weeks of incubation.

Species suitable areas under current climate



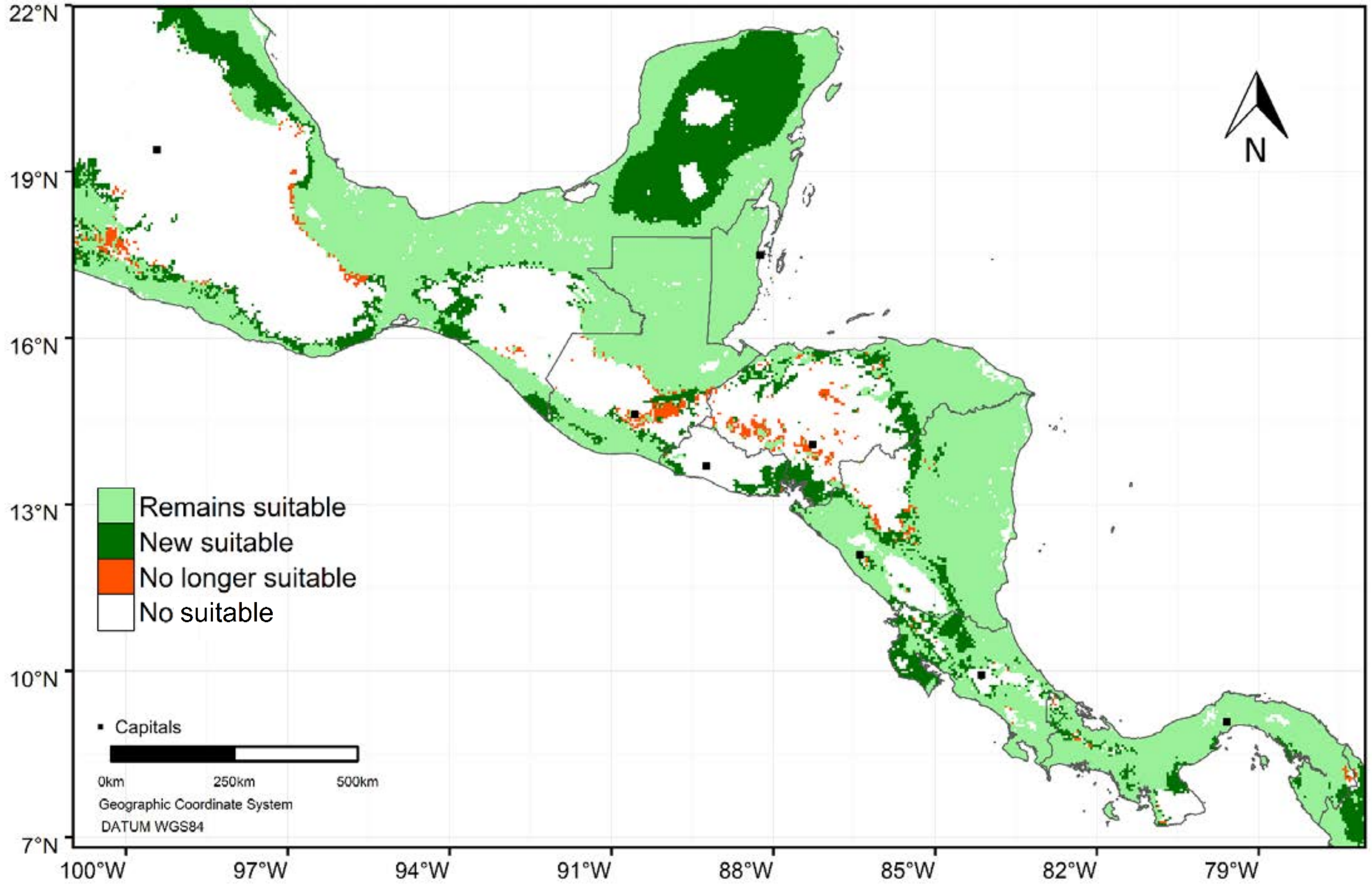
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



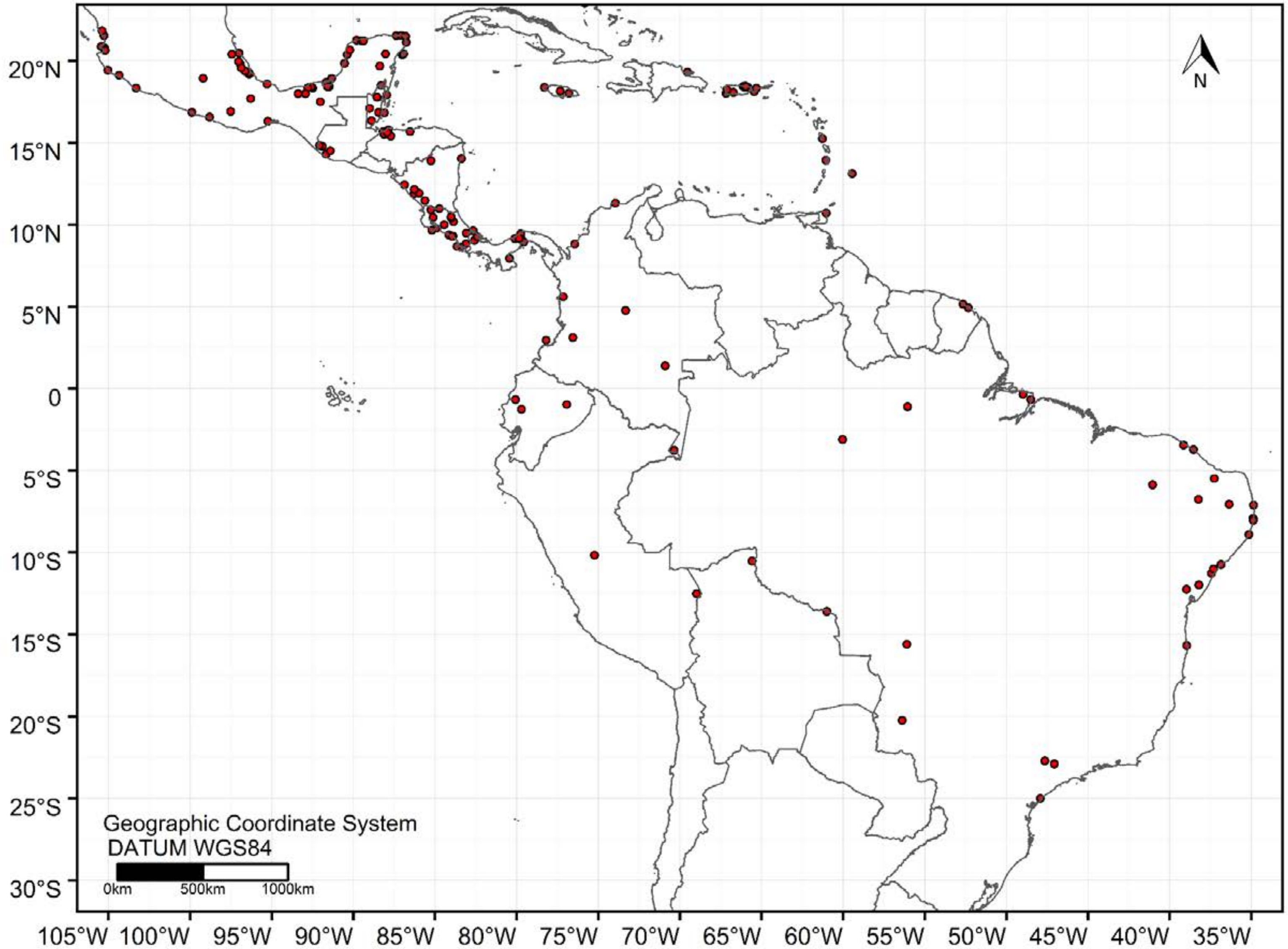
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	26,759	91%	53%	9%	43%
Rain forest	102,557	99%	20%	1%	19%
Whole region	129,316	97%	26%	3%	24%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	26,759	90%	69%	10%	59%
Rain forest	102,557	99%	22%	1%	21%
Whole region	129,316	97%	32%	3%	29%

Points of observed presence



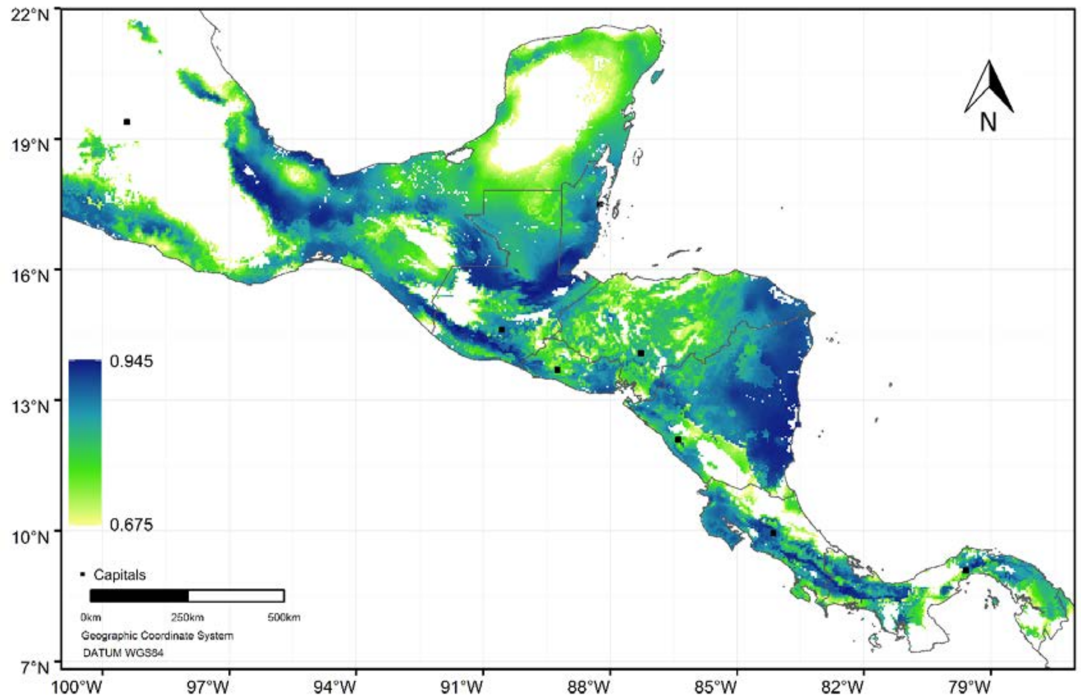
Cordia alliodora (Ruiz & Pav.) Oken

Family:
Boraginaceae
Vernacular names:
Laurel (PA, CR, NI, GT, SV, HN),
bohum (BZ, HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	30 (25 – 40)	**Timber uses[1]**	SM, MB, PS, CHAR	**Pollination vector**	Insects	**Flooding**	No
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	20.82 (2.90 – 68.45)	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density ($g\ cm^{-3}$)	0.62 (0.33 – 0.98)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Apiculture, Medicinal	**Seed dispersal**	Anemochory	**Fire**	No

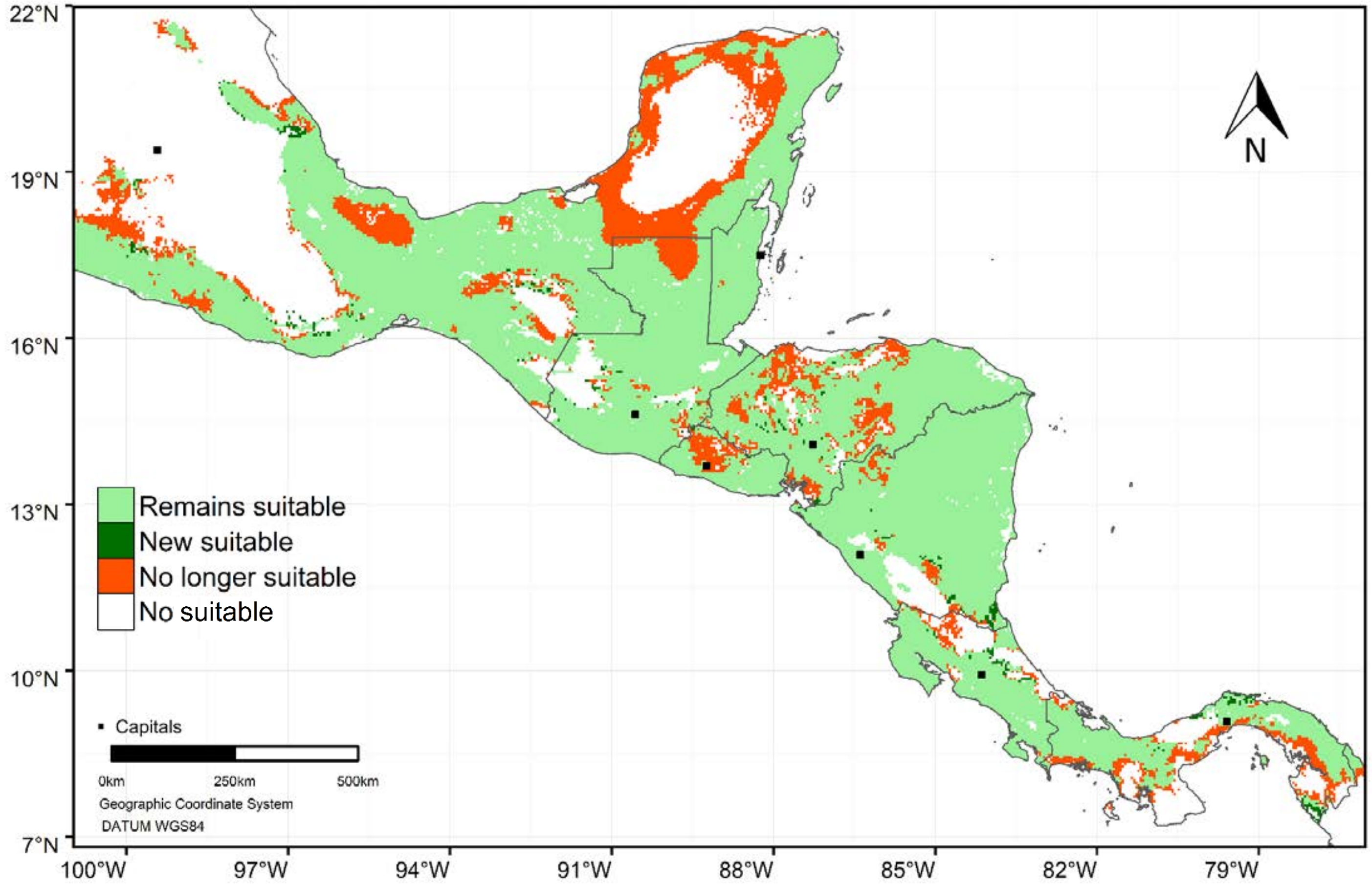
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



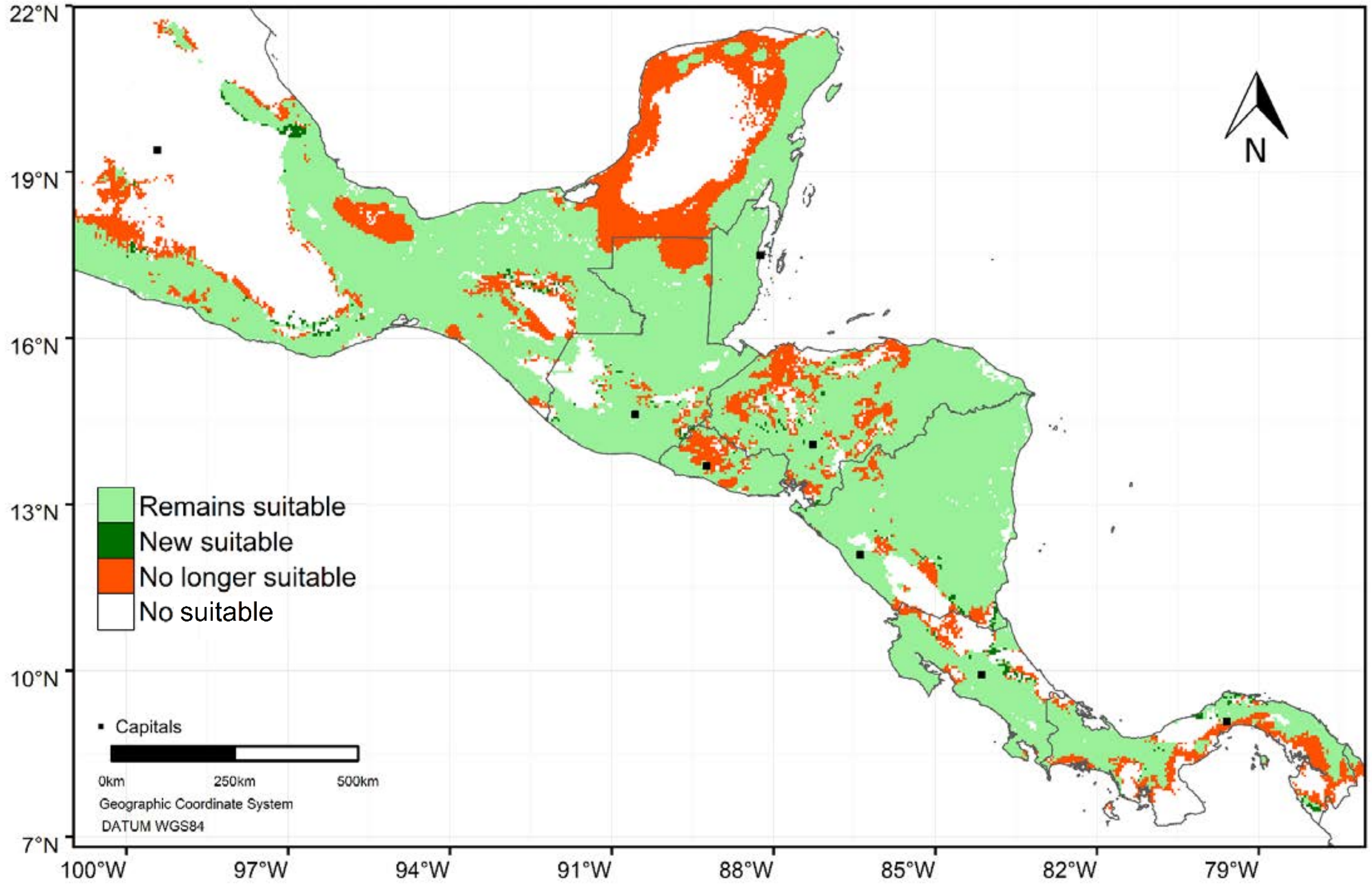
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



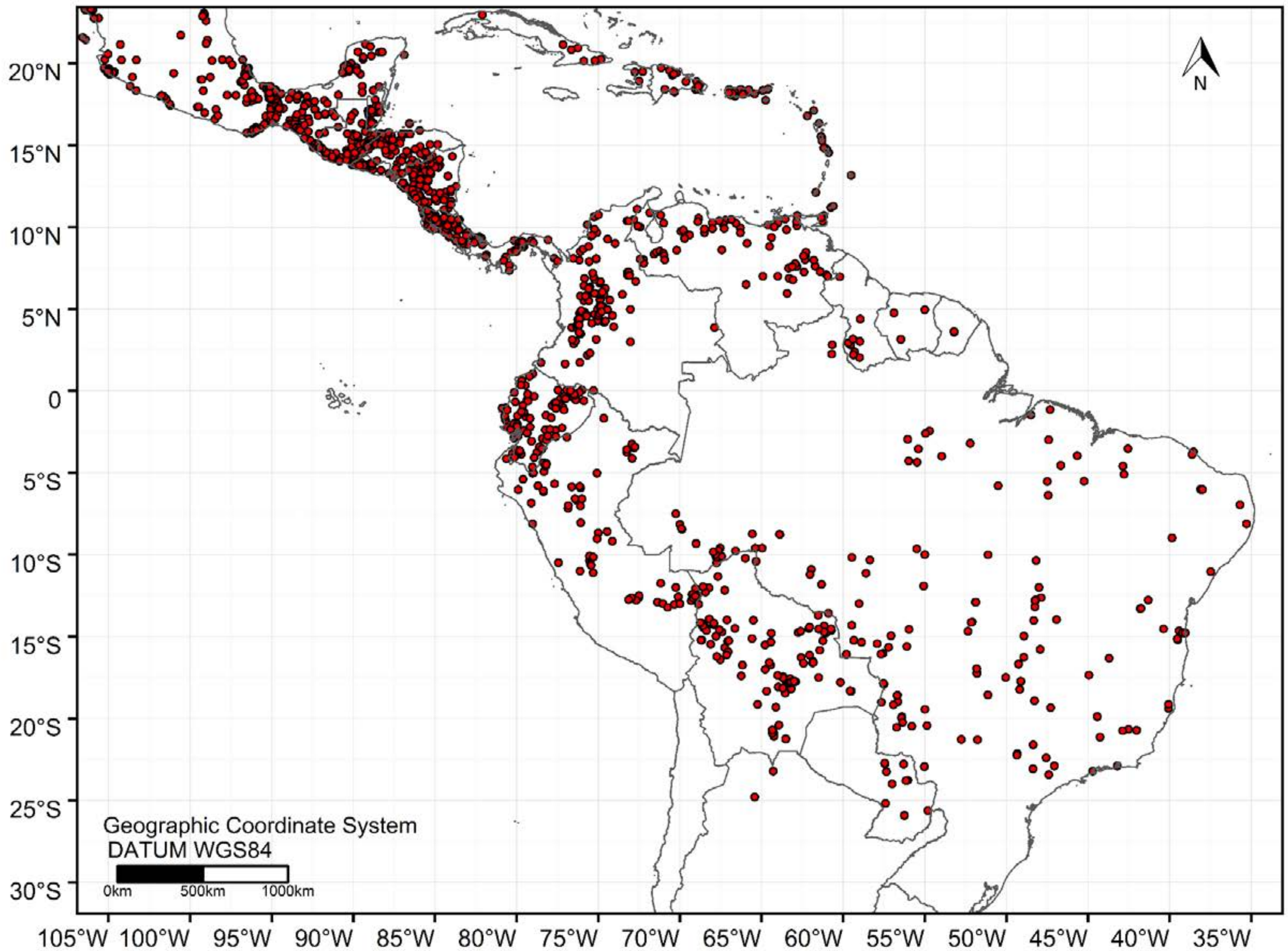
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	68,071	79%	1%	21%	-20%
Rain forest	113,866	85%	1%	15%	-14%
Whole region	181,937	83%	1%	17%	-16%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	68,071	74%	1%	26%	-25%
Rain forest	113,866	83%	1%	17%	-16%
Whole region	181,937	80%	1%	20%	-19%

Points of observed presence



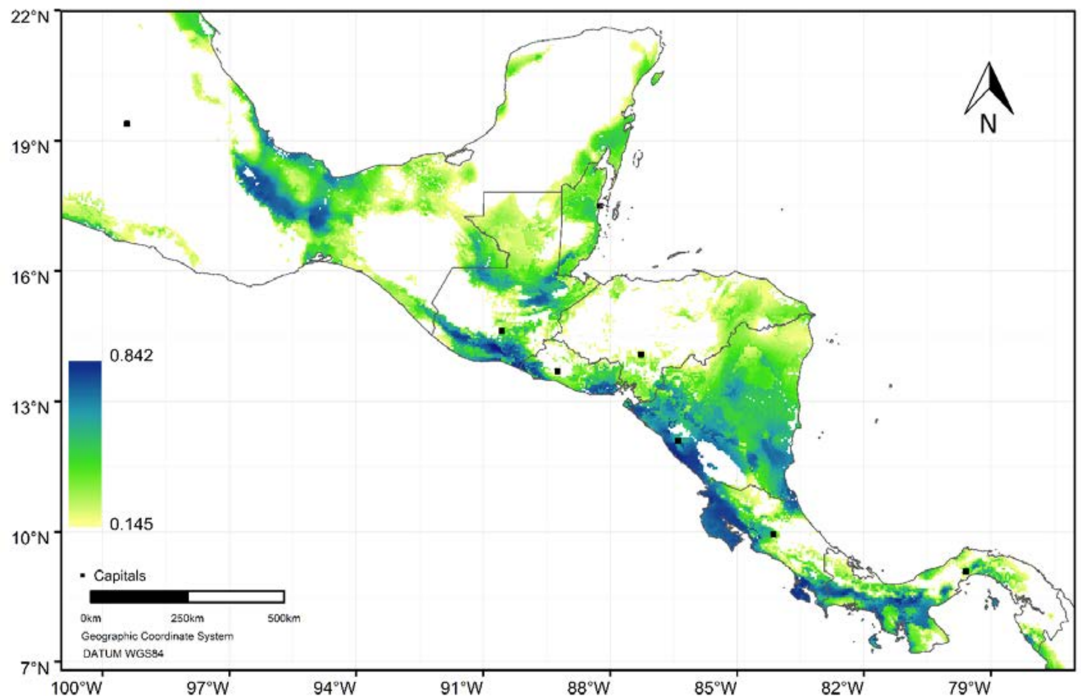
Cordia collococca L.

Family:
Boraginaceae
Vernacular names:
Muñeco (NI),
buriogre (CR),
chaparillo (HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Dioecious	**Drought**	Yes
Plant height (m)	12 (8 – 17)	**Timber uses[1]**	CL, MB	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	95.85 (61.10 – 128.96)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	Unknown
Wood density ($g\ cm^{-3}$)	0.43 (0.38 – 0.47)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Unknown	**Seed dispersal**	Zoochory	**Fire**	Unknown

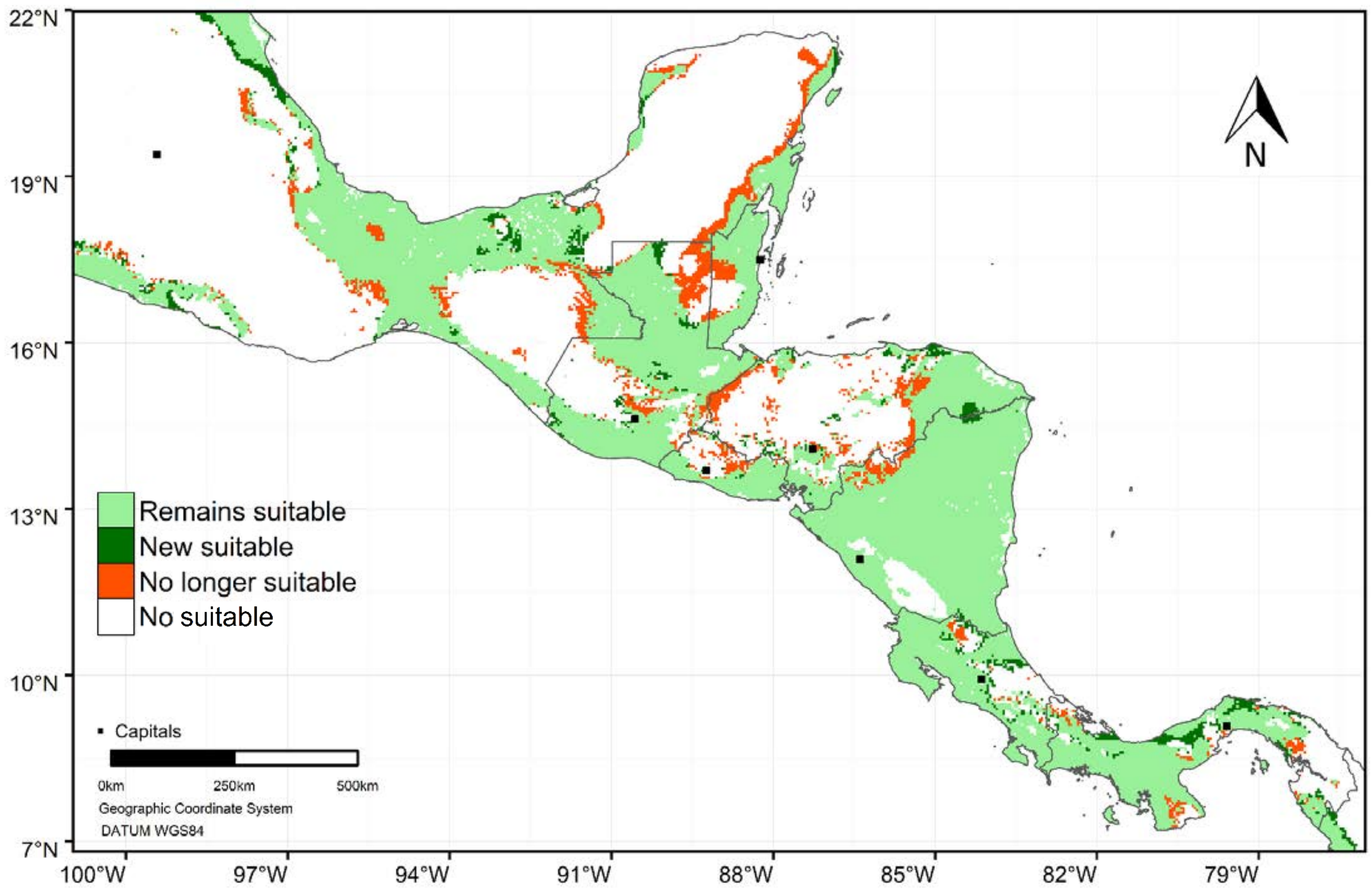
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



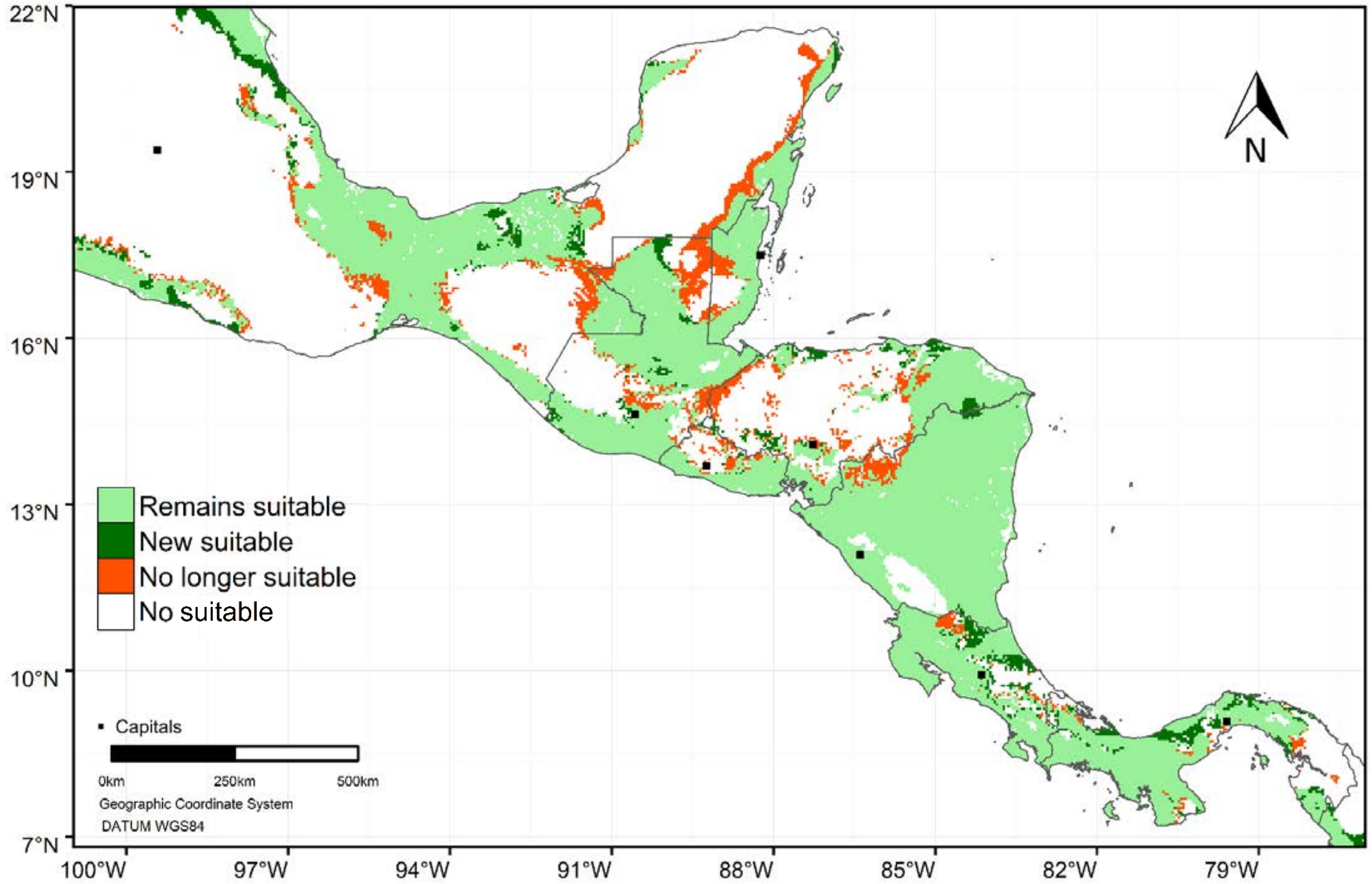
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



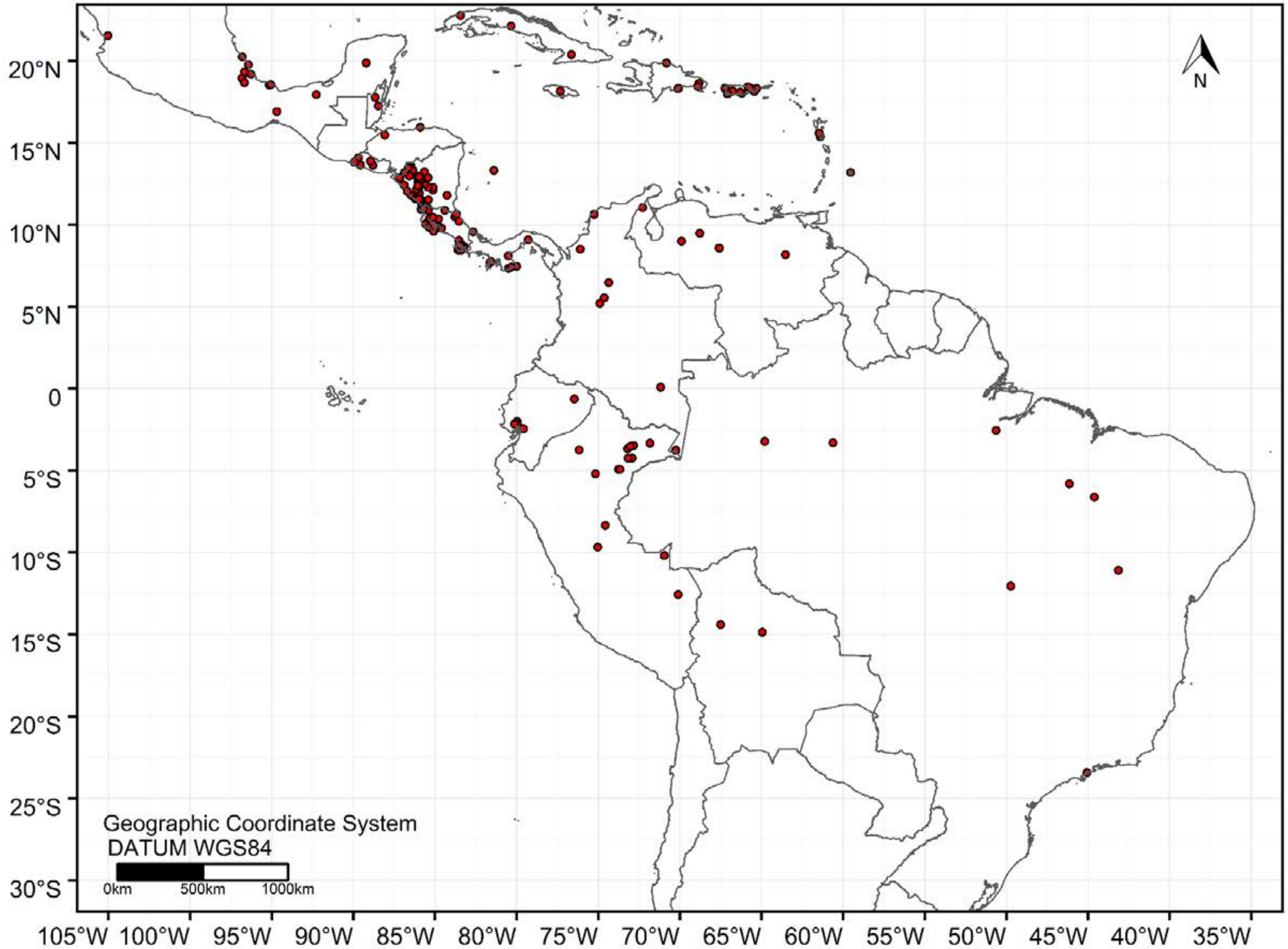
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	31,767	86%	4%	14%	-10%
Rain forest	90,978	91%	6%	9%	-3%
Whole region	122,745	89%	6%	11%	-5%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	31,767	84%	5%	16%	-11%
Rain forest	90,978	90%	9%	10%	-1%
Whole region	122,745	88%	8%	12%	-4%

Points of observed presence



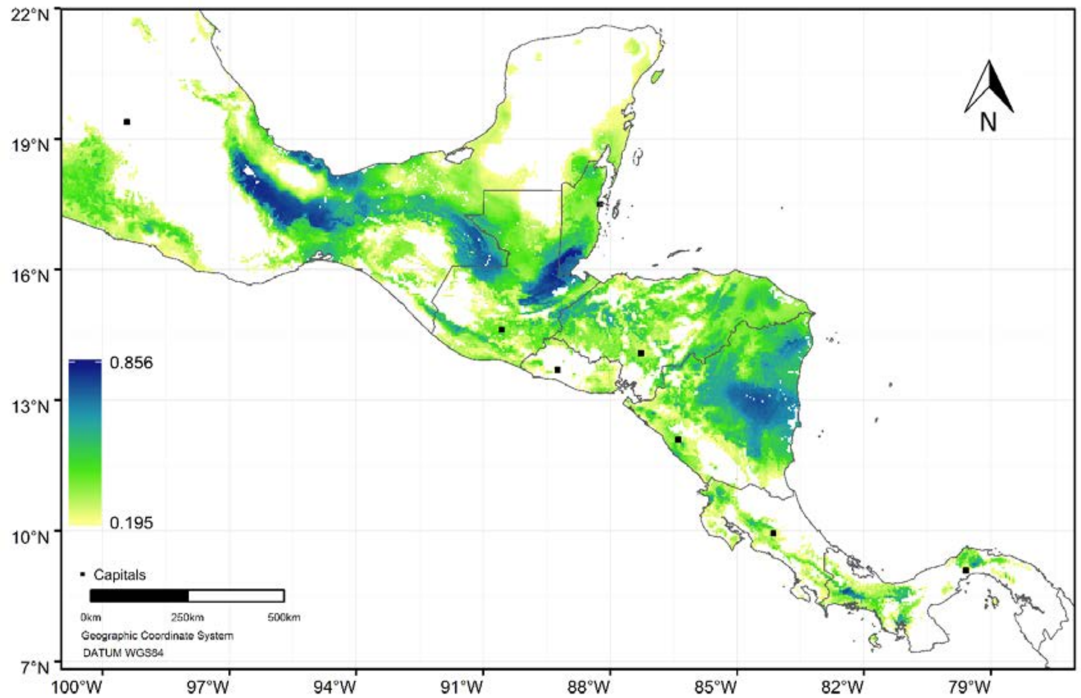
Dalbergia glomerata Hemsl.

Family:
Leguminosae
Vernacular names:
Granadilla (NI),
granadillo (CR, SV, HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	**CITES	**Reproductive system**	Unknown	**Drought**	Unknown
Plant height (m)	22 (18 – 30)	**Timber uses[1]**	Yes	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (g)**	45.4 (39.8 – 50.1)	**Frost**	Unknown
N fixer	Yes	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.79 (0.53 – 1.2)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Unknown	**Seed dispersal**	Anemochory	**Fire**	Unknown

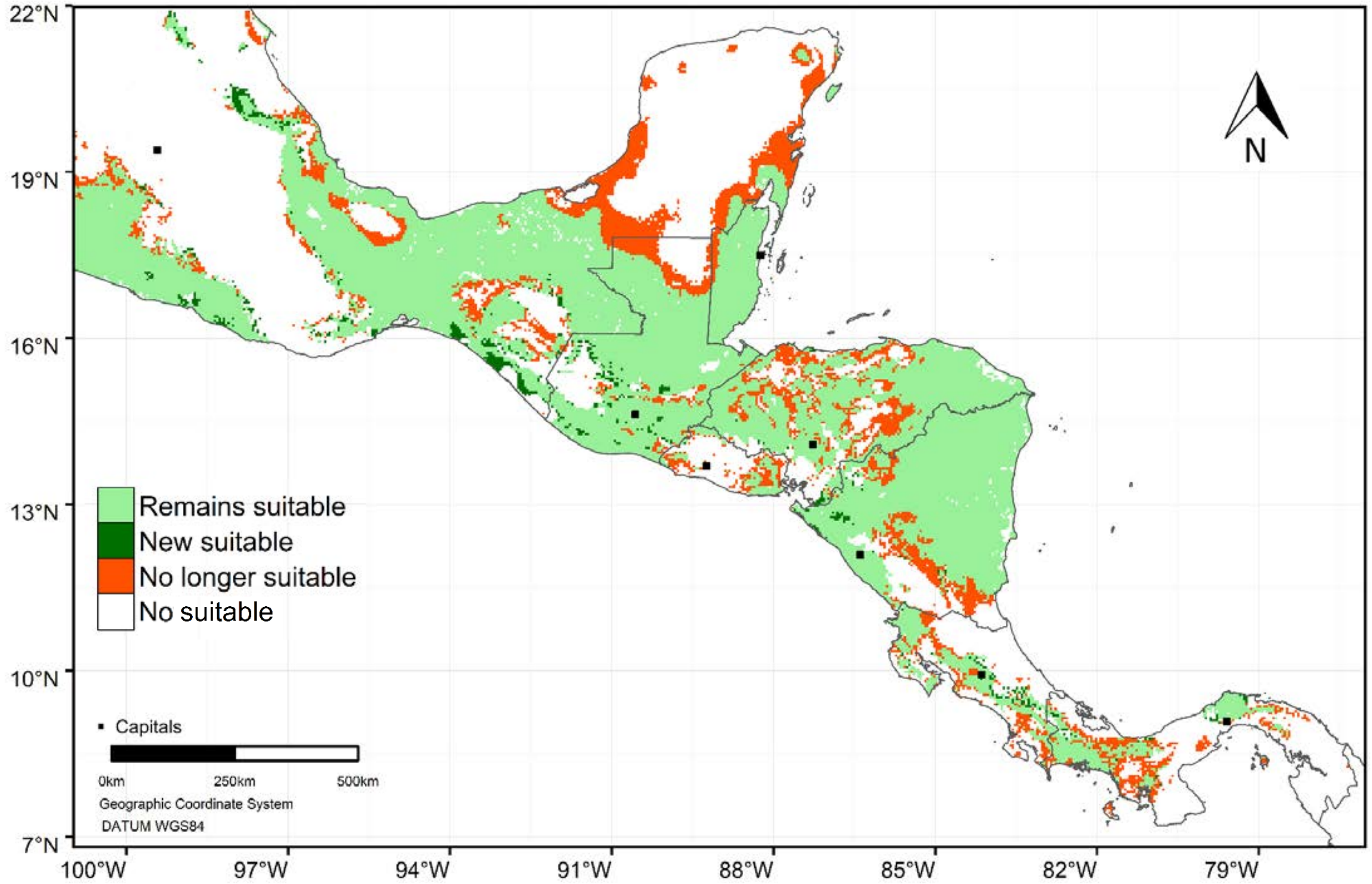
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
**CITES - (Convention on International Trade in Endangered Species of Wild Fauna and Flora) the species has been listed in appendix III, Guatemala

Species suitable areas under current climate



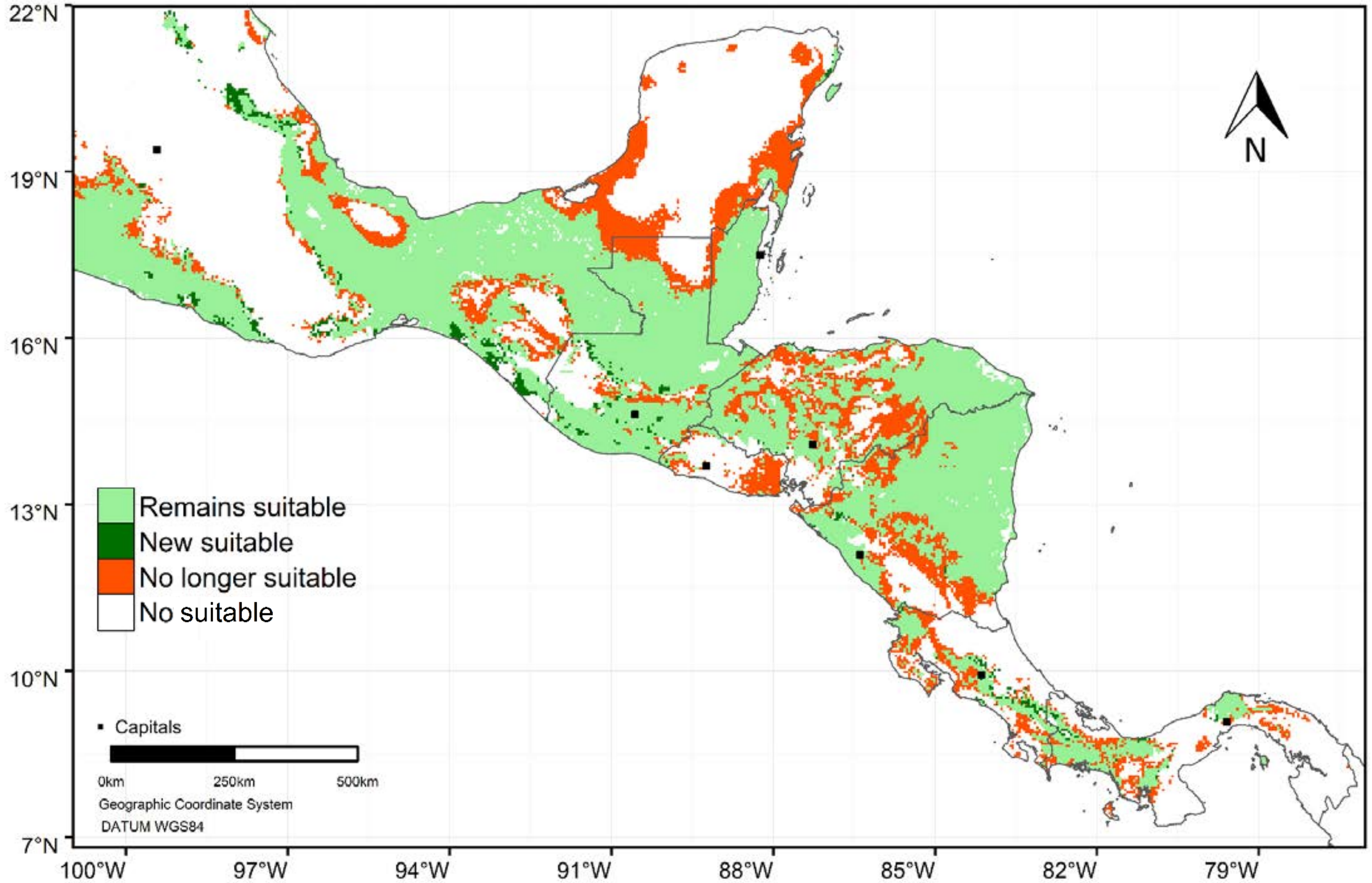
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



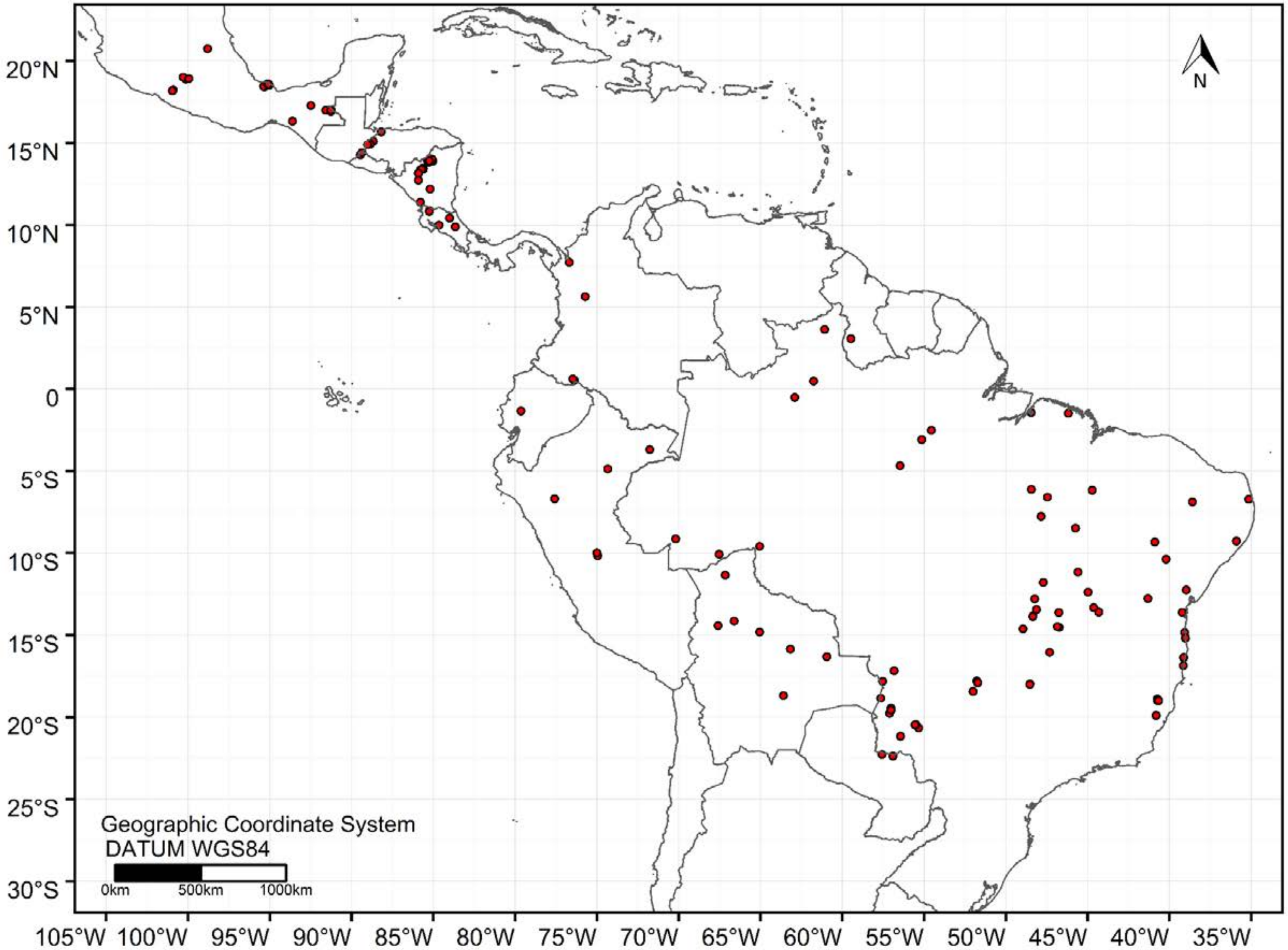
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	53,361	80%	4%	20%	-16%
Rain forest	92,860	81%	2%	19%	-17%
Whole region	146,221	81%	3%	19%	-17%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	53,361	69%	4%	31%	-27%
Rain forest	92,860	77%	2%	23%	-20%
Whole region	146,221	75%	3%	25%	-23%

Points of observed presence



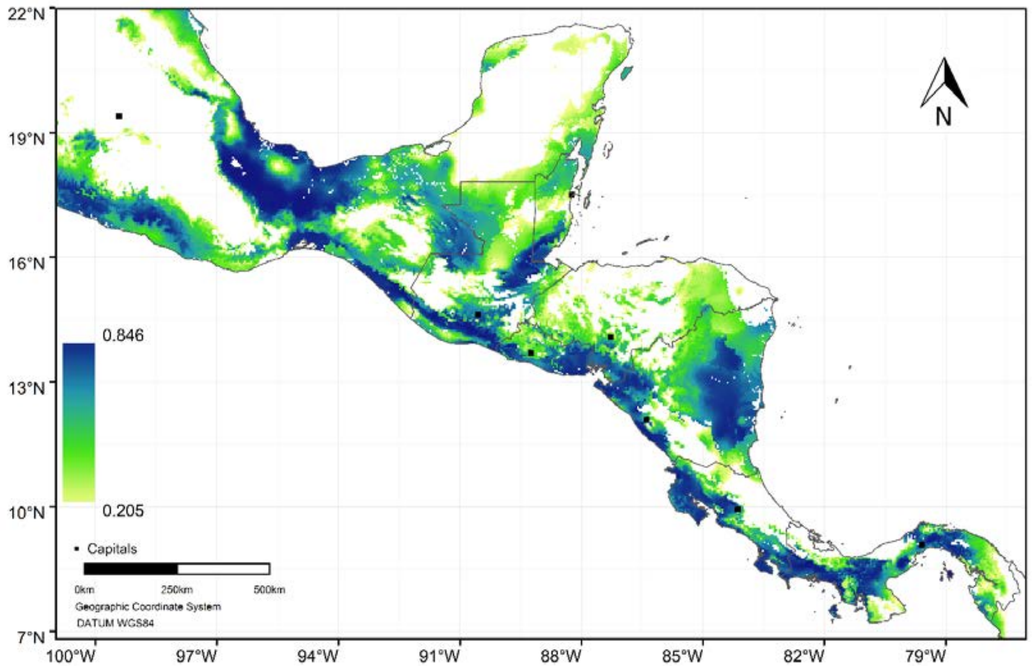
Diphysa americana (Mill.) M.Sousa

Family:
Leguminosae
Vernacular names:
Guachipilín (SV, GT, HN, NI), guachipelín (CR), guachipelí (CR, NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Unknown	**Drought**	Unknown
Plant height (m)	18 (15 – 20)	**Timber uses[1]**	CS, MB, HF, DT, AR	**Pollination vector**	Unknown	**Flooding**	No
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	335.2 (45.5 – 625.0)	**Frost**	Unknown
N fixer	Yes	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.84 (0.62 – 1.0)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Unknown	**Seed dispersal**	Anemochory	**Fire**	Unknown

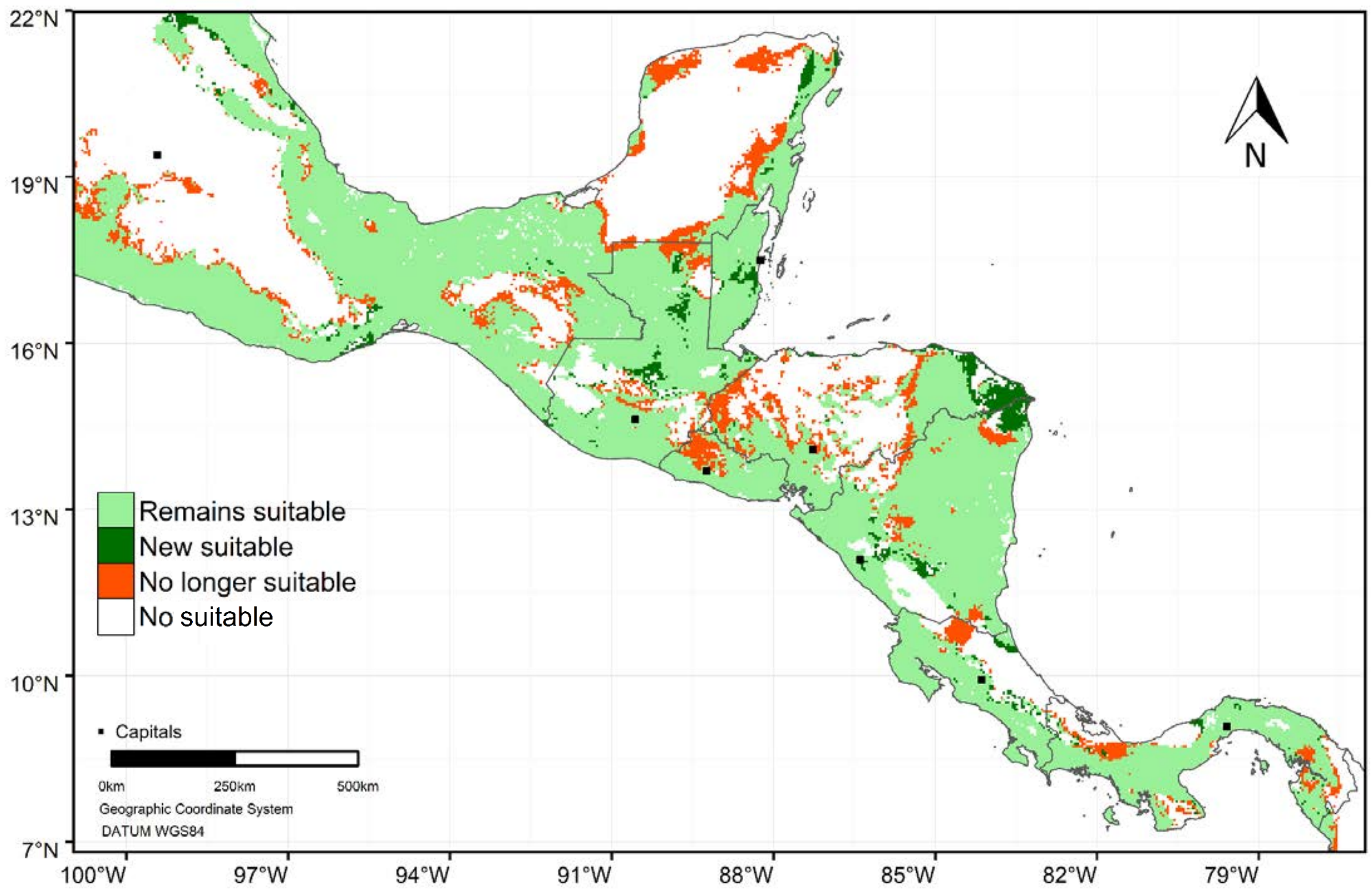
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



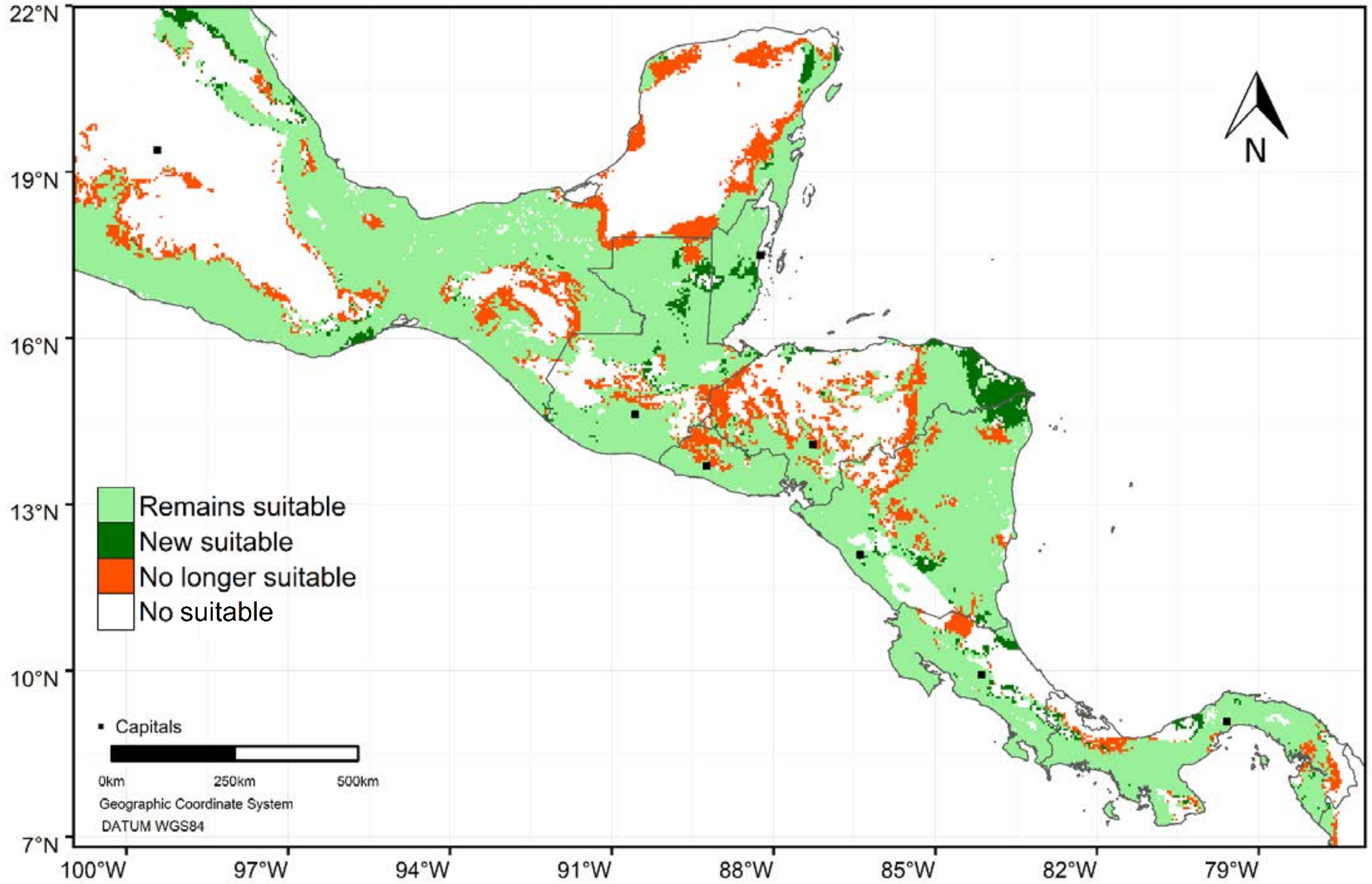
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



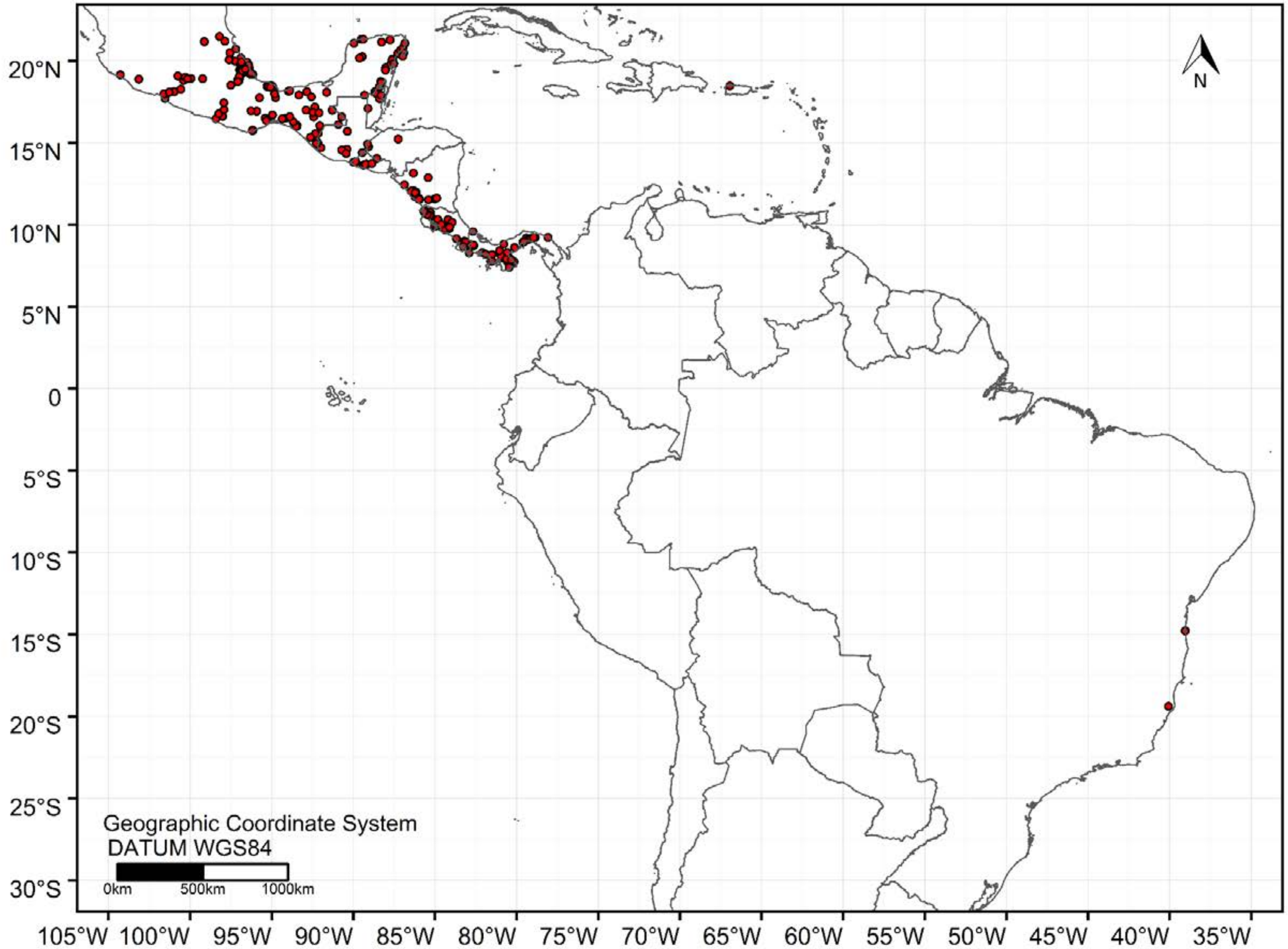
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	57,815	81%	2%	19%	-16%
Rain forest	100,479	90%	6%	10%	-4%
Whole region	158,295	87%	5%	13%	-8%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	57,815	76%	2%	24%	-22%
Rain forest	100,479	89%	7%	11%	-4%
Whole region	158,295	84%	6%	16%	-10%

Points of observed presence



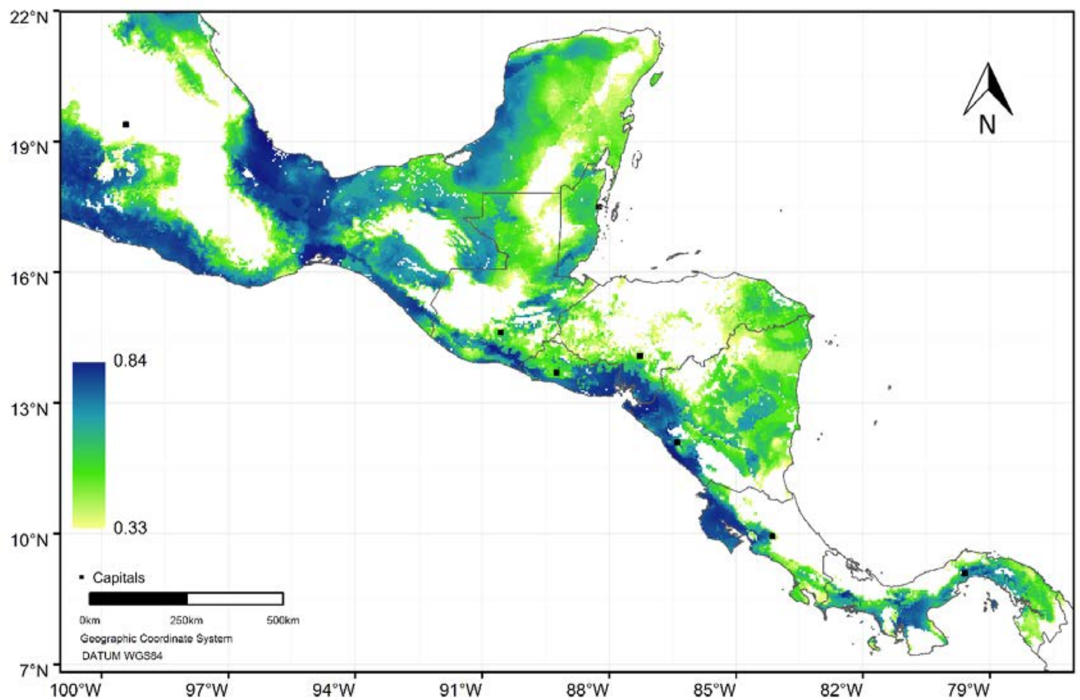
Enterolobium cyclocarpum (Jacq.) Griseb.

Family:
Leguminosae
Vernacular names:
Guanacaste (CR), conacaste (GT, SV), guanacaste negro (NI, HN), Tree de orejas (SV)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	26 (10 – 45)	**Timber uses[1]**	SM, CS, MB, CH	**Pollination vector**	Insects	**Flooding**	No
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	800.8 (500 – 1,550)	**Frost**	No
N fixer	Yes	**Fruit**	Yes (pods-cooked)	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.51 (0.3 – 0.81)	**Forage**	Yes (fruits)	**Seed dormancy**	Physical	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Medicinal	**Seed dispersal**	Zoochory, Hydrochory	**Fire**	Unknown

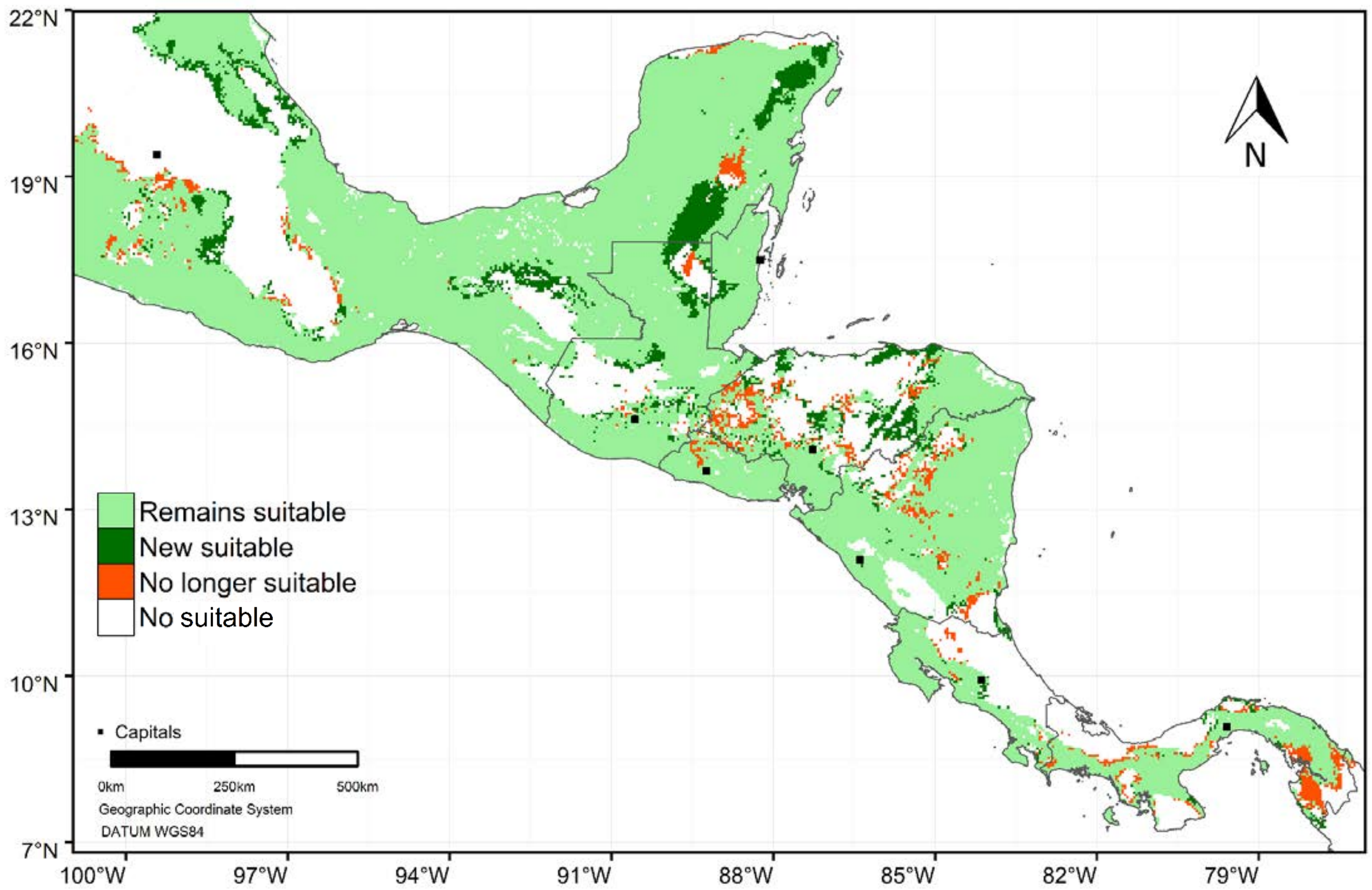
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



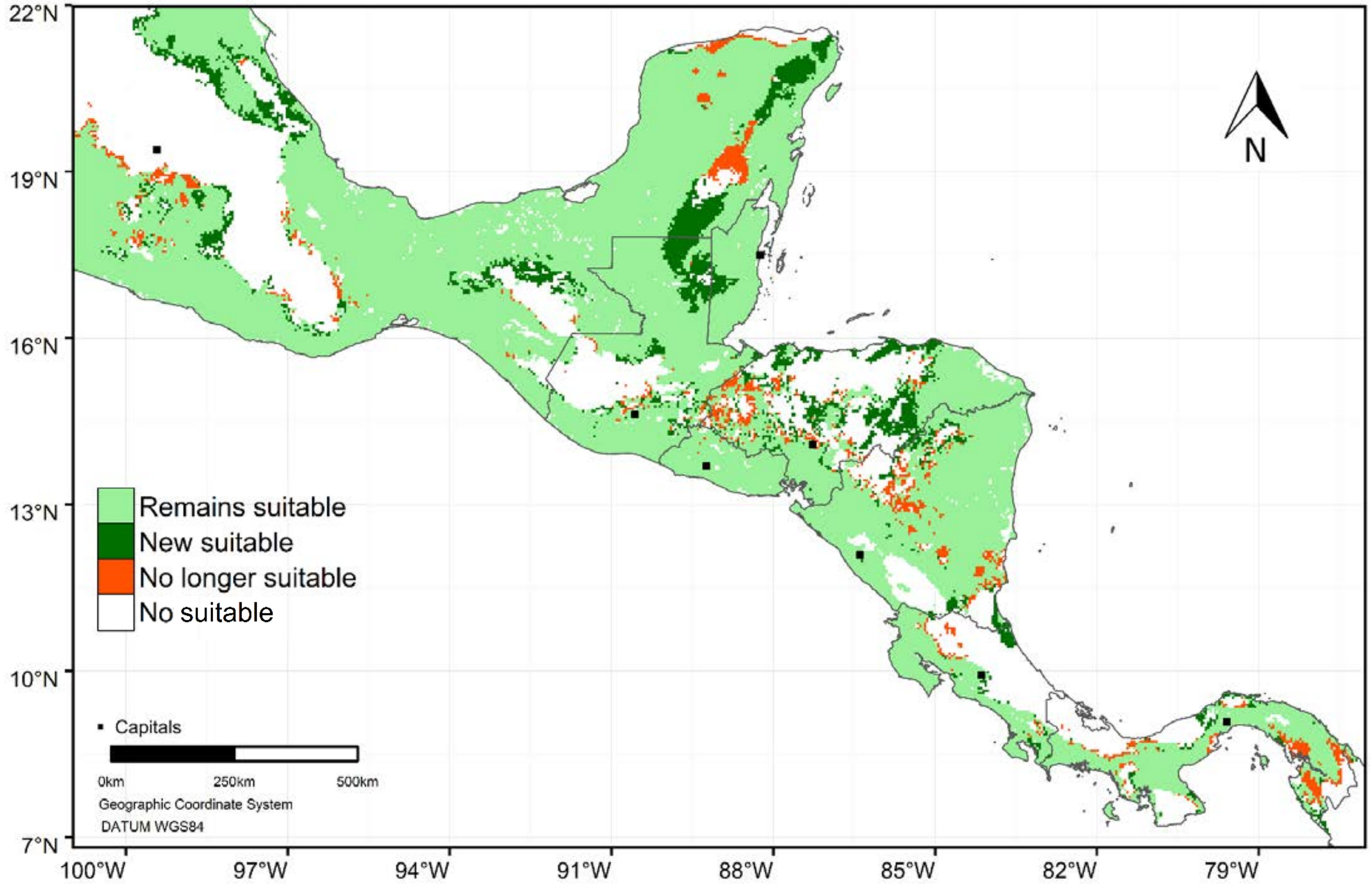
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



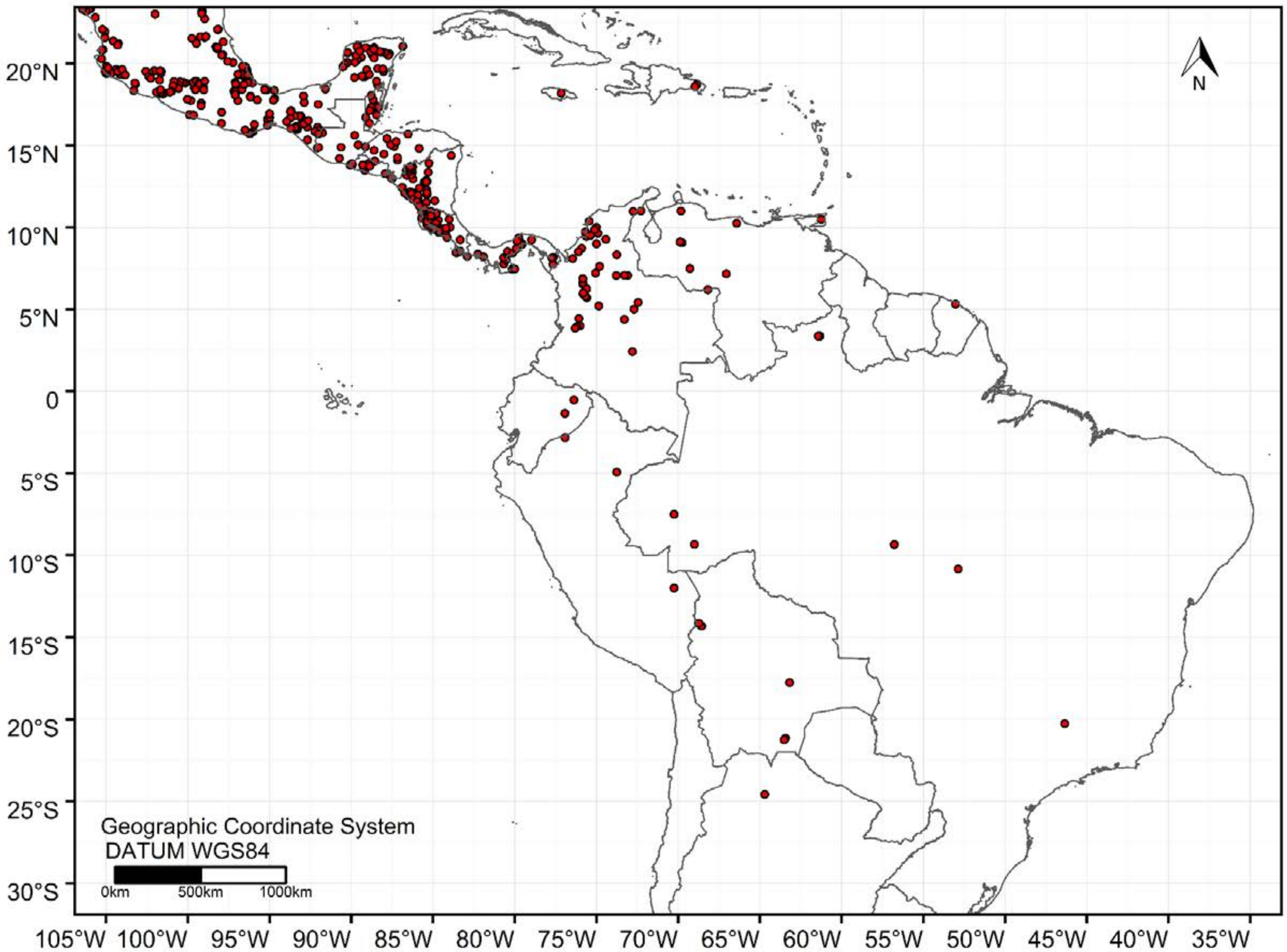
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	71,339	95%	8%	5%	3%
Rain forest	103,258	95%	10%	5%	5%
Whole region	174,597	95%	9%	5%	4%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	71,339	94%	9%	6%	4%
Rain forest	103,258	95%	12%	5%	8%
Whole region	174,597	95%	11%	5%	6%

Points of observed presence



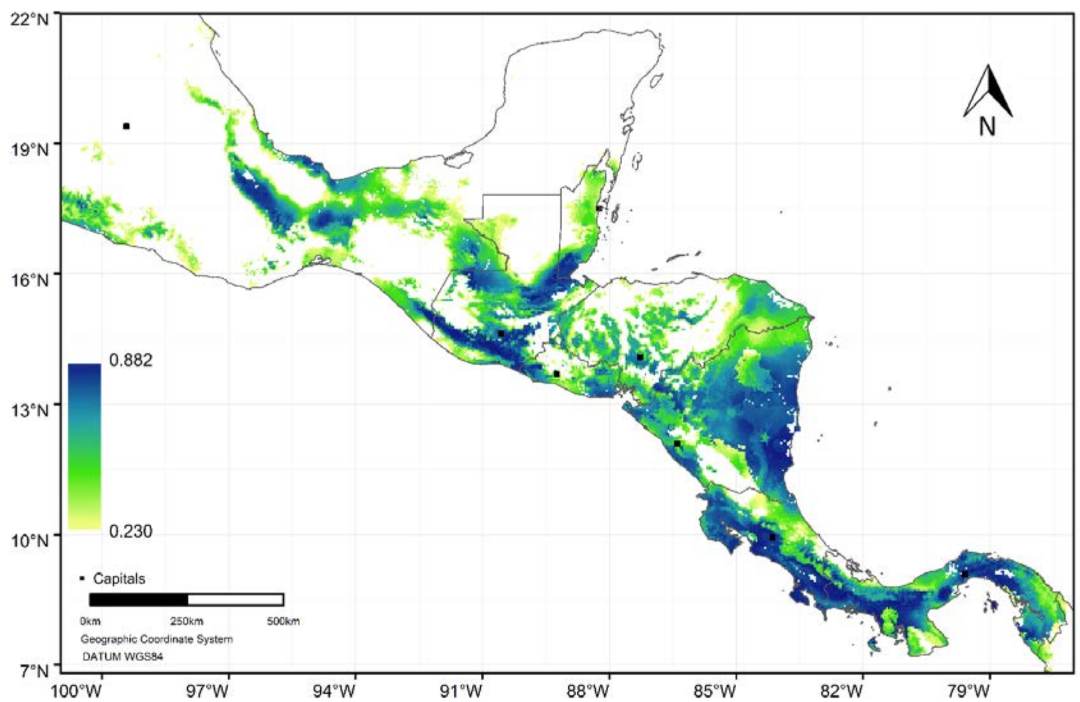
Erythrina berteroana Urb.

Family:
Leguminosae
Vernacular names:
Coralillo (GT),
helequeme (NI)
gallito (PA),
pito (GT, HN, SV),
poró (CR)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Unknown	**Drought**	Unknown
Plant height (m)	11 (3 – 15)	**Timber uses[1]**	None	**Pollination vector**	Unknown	**Flooding**	Yes
Spinescence	Yes	**Firewood**	No	**Weight 1000 seeds (g)**	225.0	**Frost**	Unknown
N fixer	Yes	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	Unknown
Wood density (g cm^{-3})	0.30	**Forage**	Yes	**Seed dormancy**	Physical	**Salinity**	Unknown
Leaf phenology	Unknown	**Other uses**	Medicinal	**Seed dispersal**	Autocoria	**Fire**	Unknown

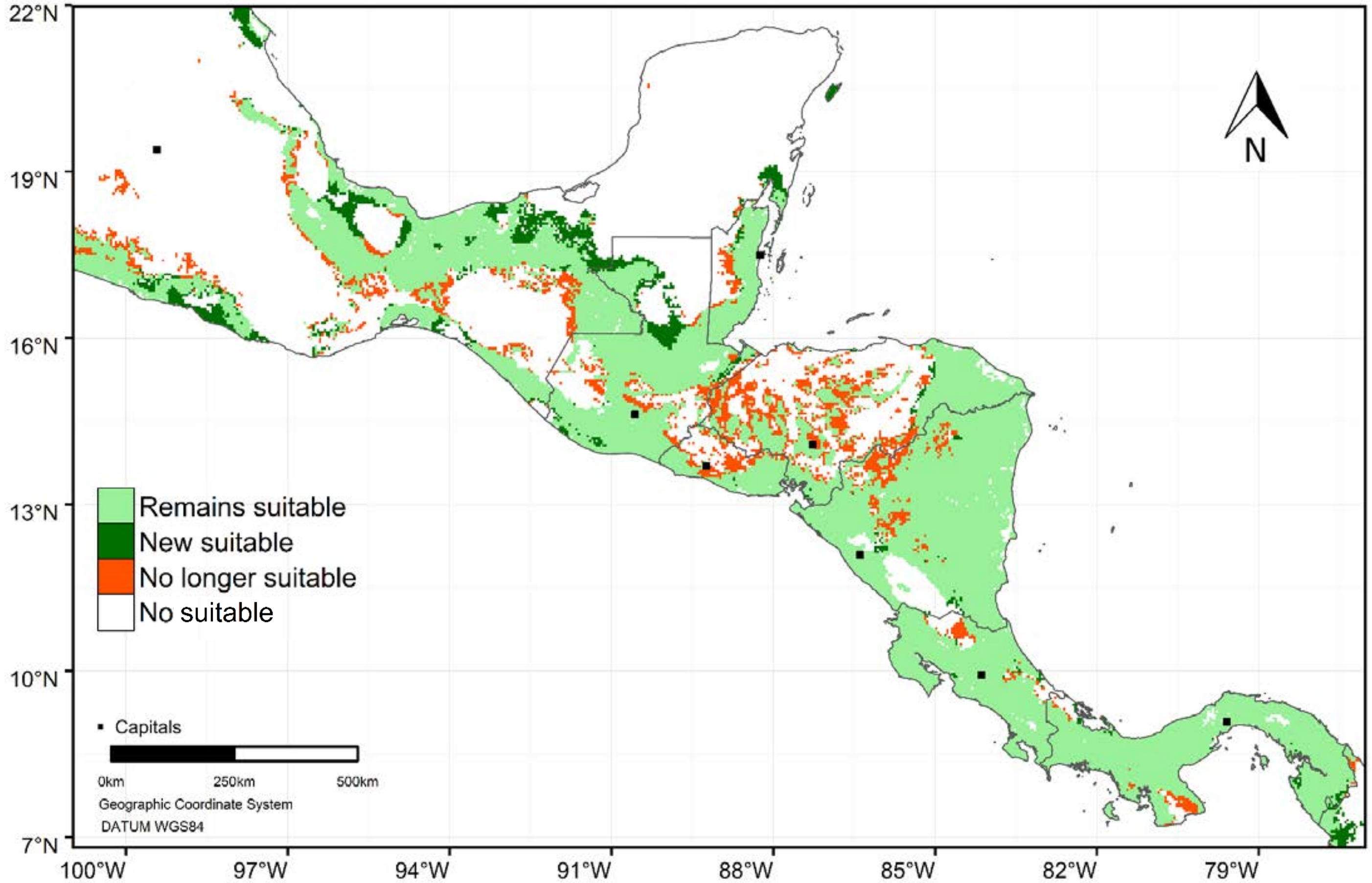
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



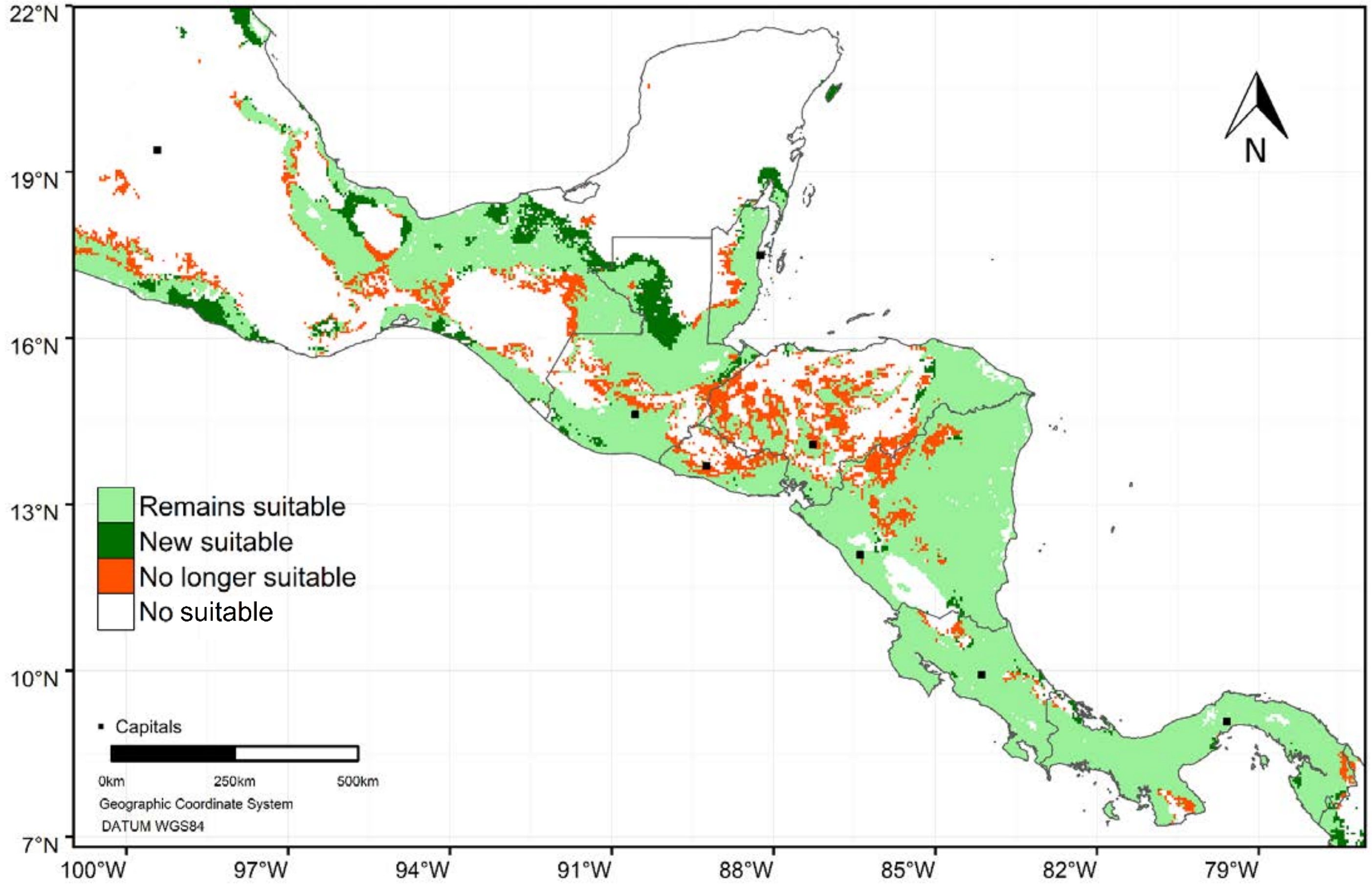
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



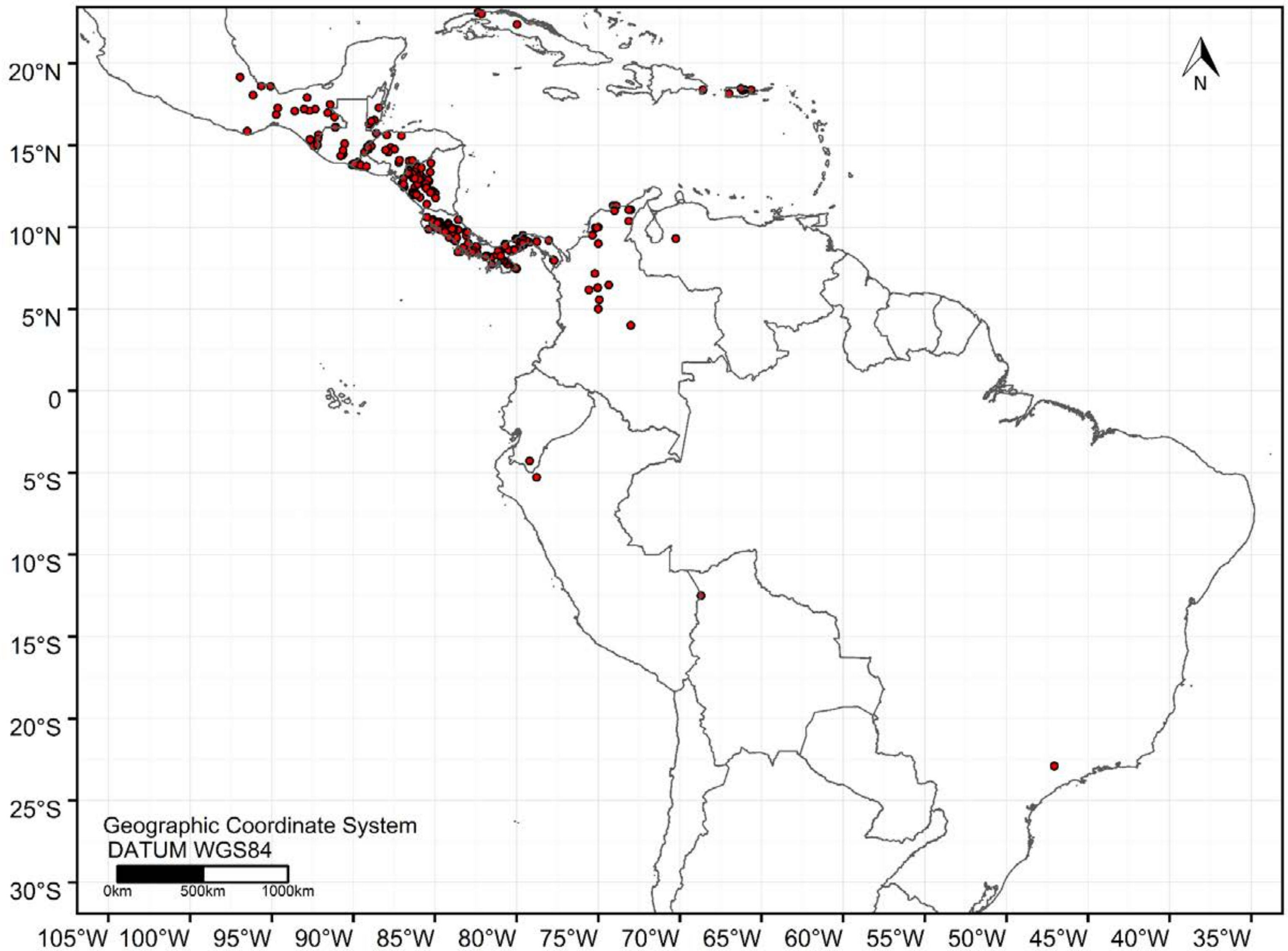
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	38,156	75%	5%	25%	-19%
Rain forest	83,663	93%	9%	7%	2%
Whole region	121,819	87%	8%	13%	-5%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	38,156	69%	6%	31%	-25%
Rain forest	83,663	91%	11%	9%	2%
Whole region	121,819	84%	9%	16%	-6%

Points of observed presence



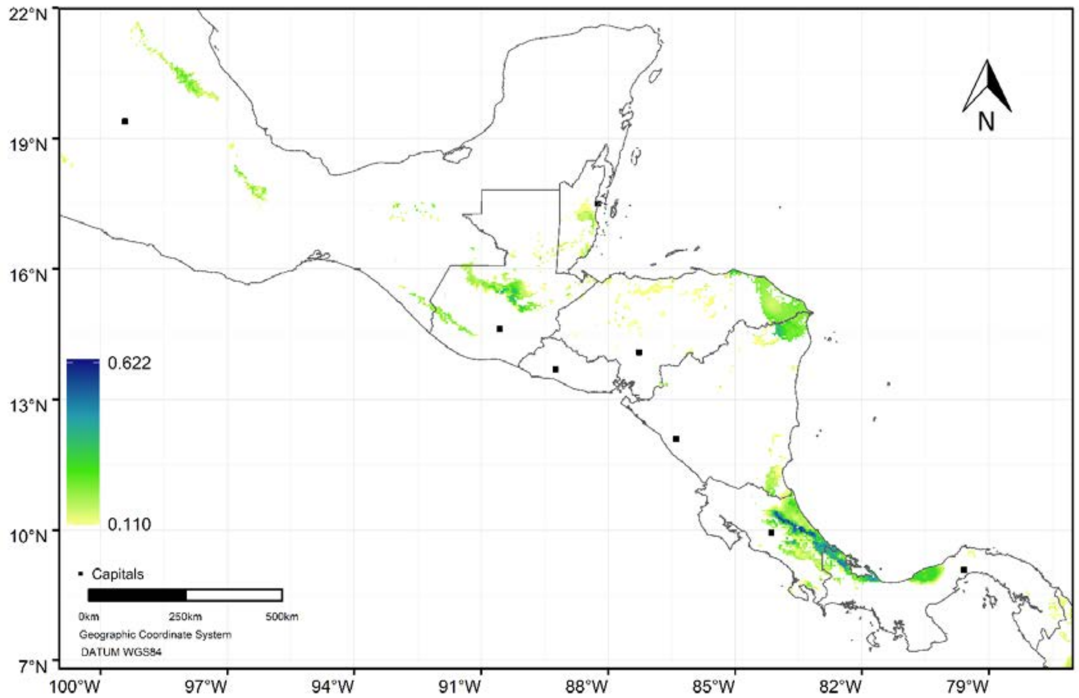
Eugenia stipitata McVaugh

Family:
Myrtaceae
Vernacular names:
Arazá
Exótica

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Shrub	**Commercial timber**	No	**Reproductive system**	Unknown	**Drought**	Yes
Plant height (m)	4 (2 – 15)	**Timber uses[1]**	None	**Pollination vector**	Bats, Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (g)**	2,835 (700 – 4,300)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	Unknown
Wood density ($g\ cm^{-3}$)	Unknown	**Forage**	No	**Seed dormancy**	Unknown	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Unknown	**Seed dispersal**	Zoochory, Autochory	**Fire**	Unknown

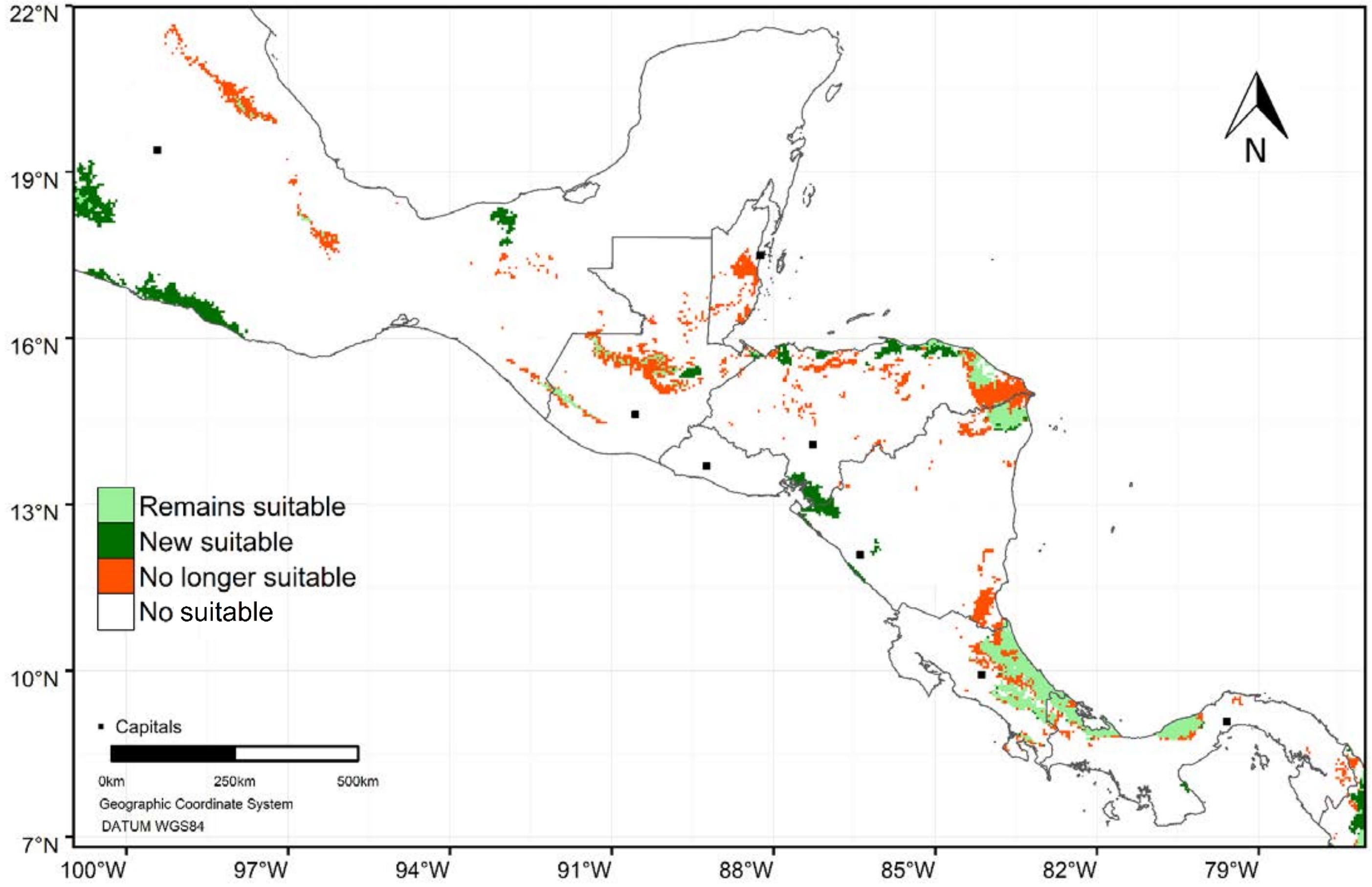
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



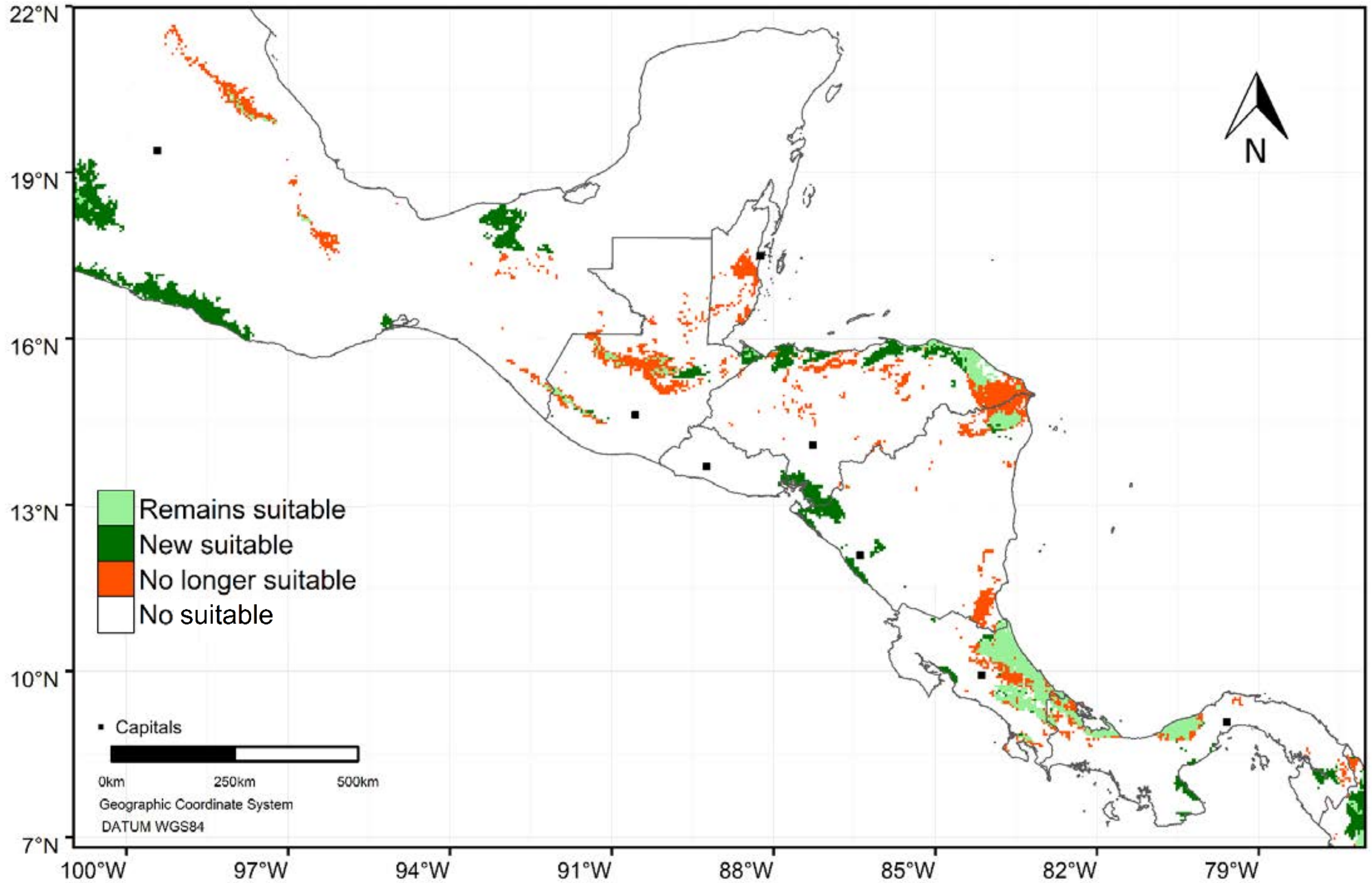
* Áreas en blanco en el mapa indican las áreas que no son aptas para la especie.

Suitability changes in year 2050 - scenario RCP4.5



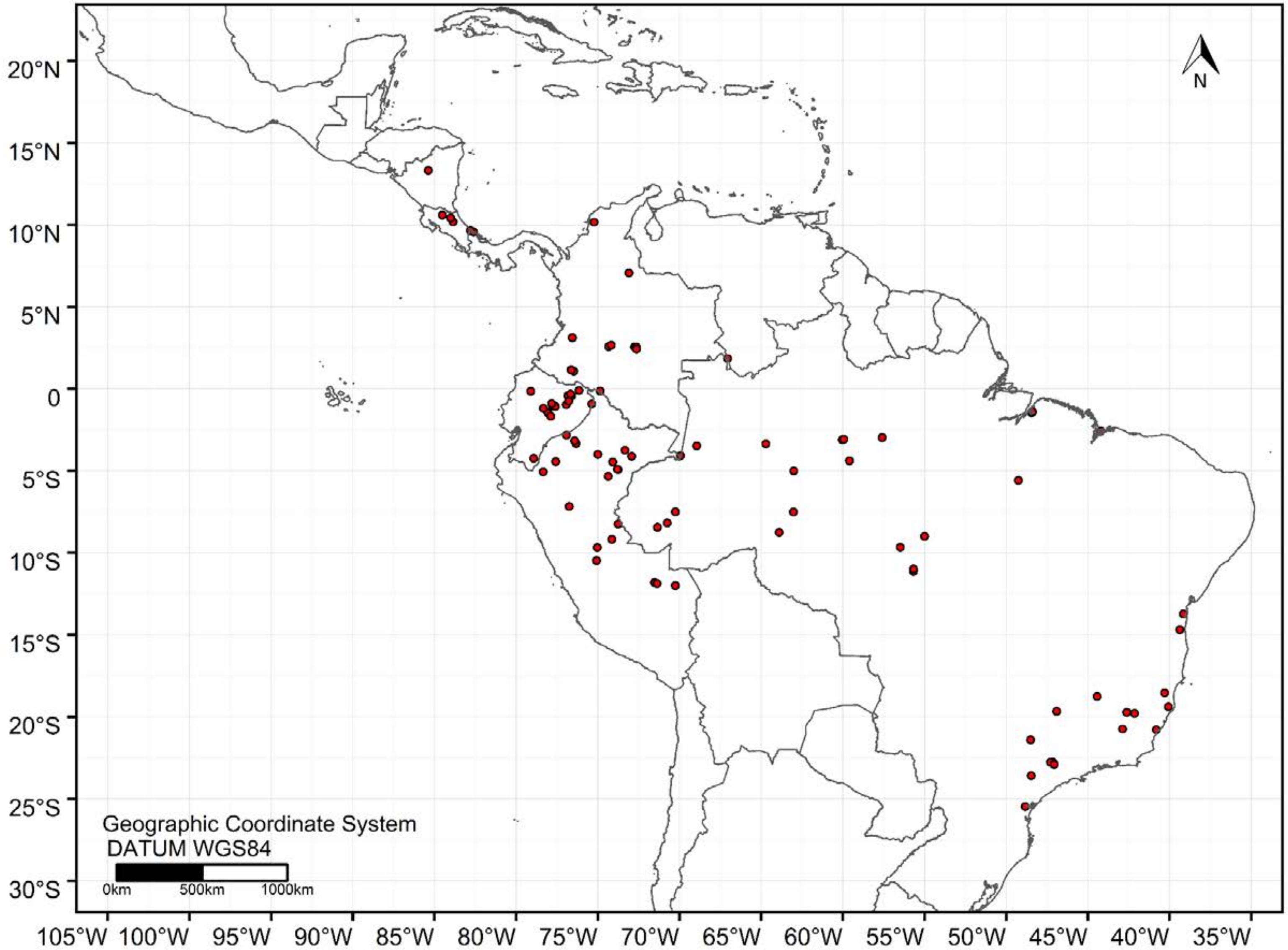
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	1455	17%	255%	83%	172%
Rain forest	15,170	42%	16%	58%	-42%
Whole region	16,626	40%	37%	60%	-23%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	1455	16%	391%	84%	307%
Rain forest	15,170	41%	31%	59%	-28%
Whole region	16,626	39%	63%	61%	2%

Points of observed presence



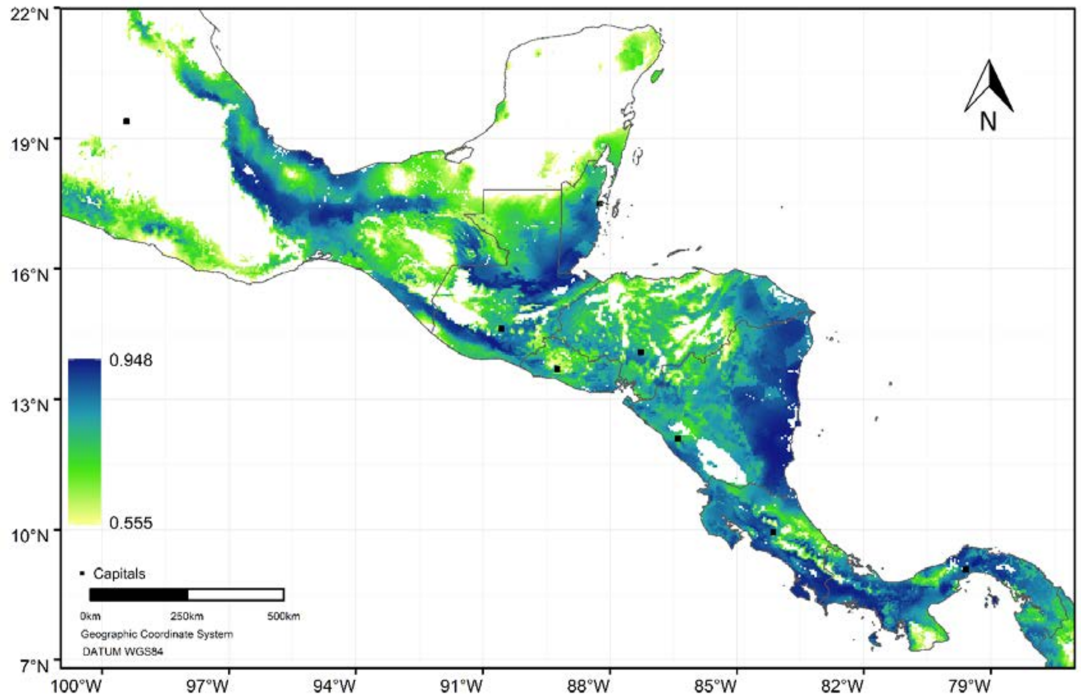
Genipa americana L.

Family:
Rubiaceae
Vernacular names:
Jagua (SV, HN, NI, PA),
genipop (HN),
guaitil (CR, NI),
brir (CR),
crayo (GT),
irayol (SV, GT, HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Dioecious	**Drought**	Yes
Plant height (m)	15 (10 – 25)	**Timber uses**[1]	CL, MB, HF, CH	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	113.94 (75 – 150)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.62 (0.5 – 0.87)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Apiculture, Dye	**Seed dispersal**	Zoochory, Autochory	**Fire**	Unknown

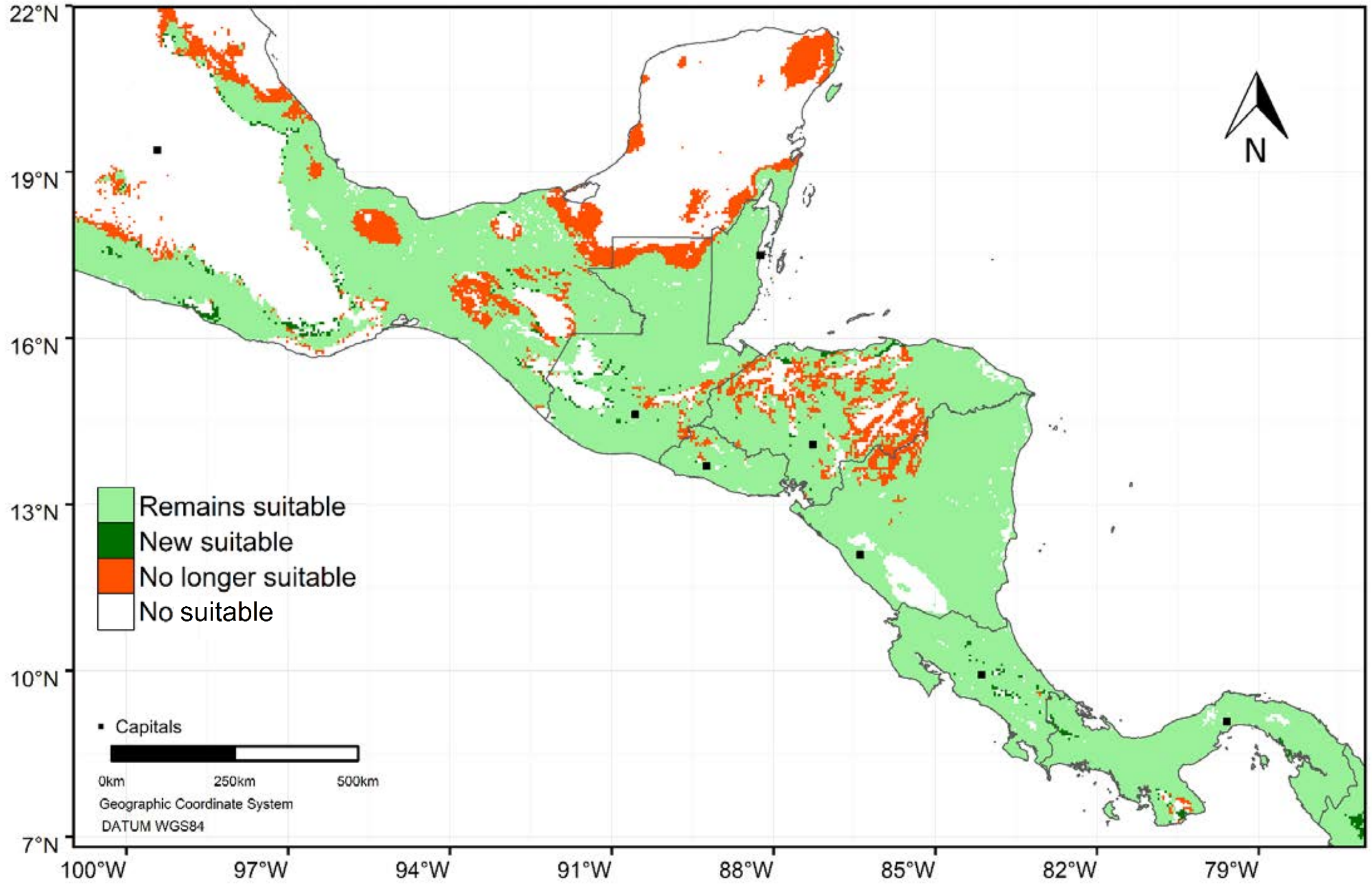
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



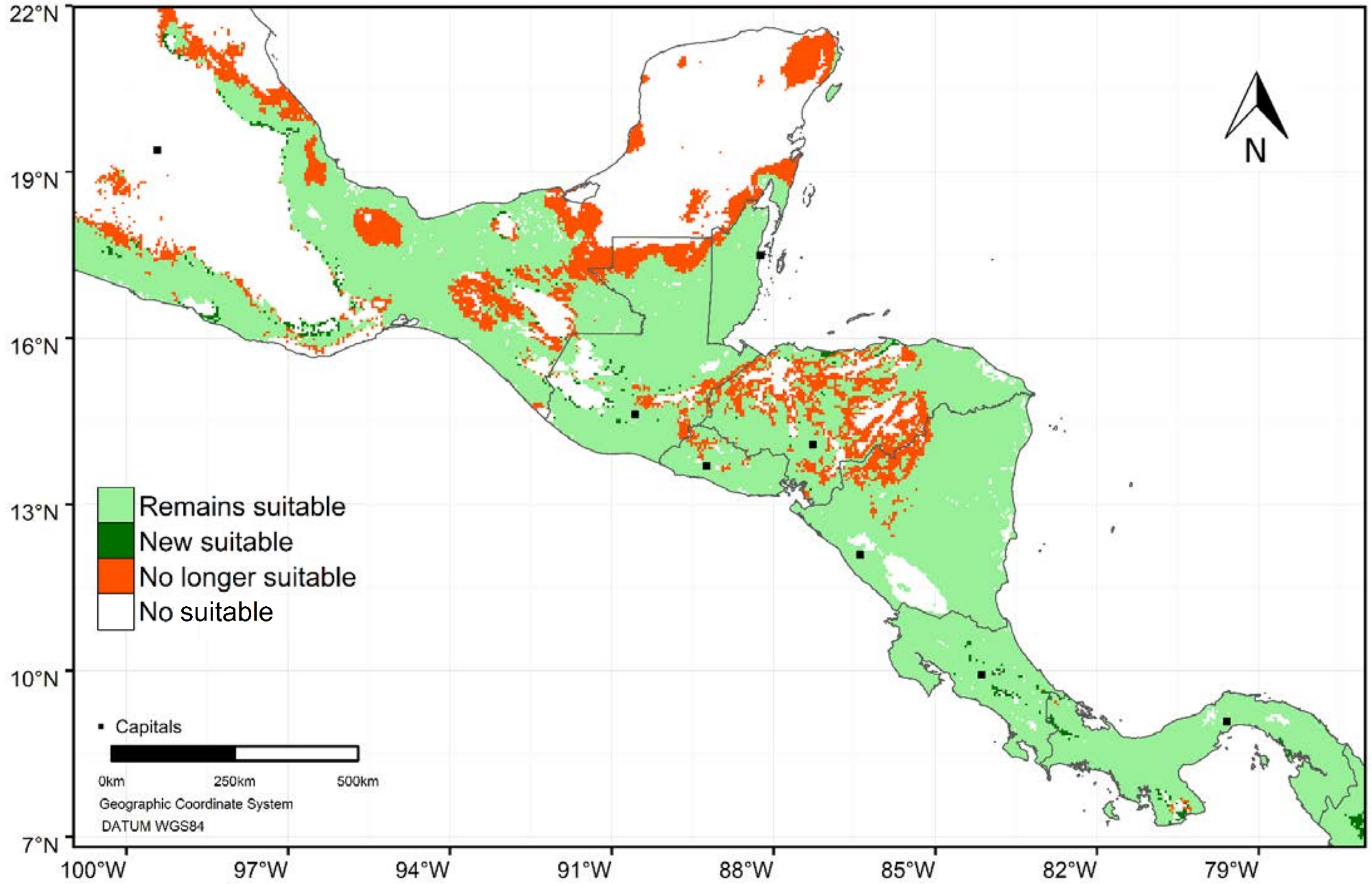
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



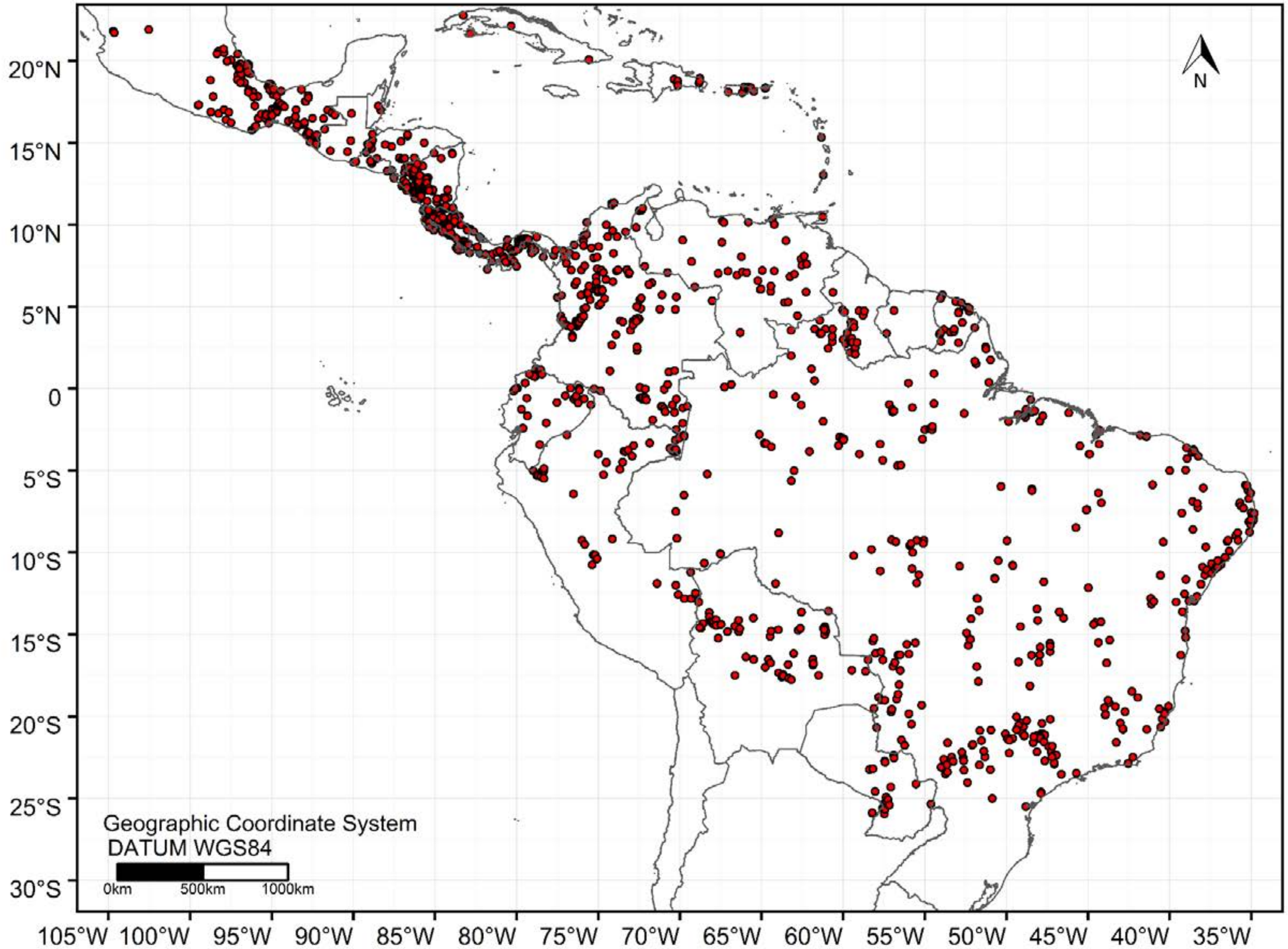
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	59,324	86%	2%	14%	-12%
Rain forest	114,072	88%	1%	12%	-11%
Whole region	173,396	87%	2%	13%	-11%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	59,324	78%	2%	22%	-20%
Rain forest	114,072	85%	1%	15%	-14%
Whole region	173,396	82%	1%	18%	-16%

Points of observed presence



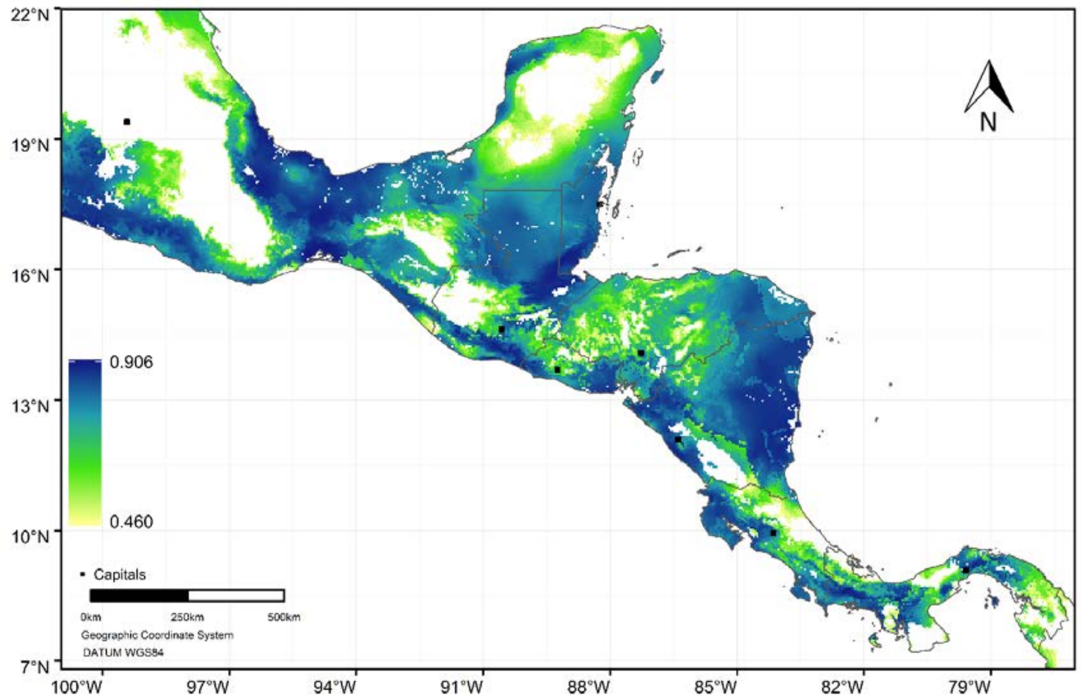
Gliricidia sepium (Jacq.) Walp.

Family:
Leguminosae
Vernacular names:
Madero negro (CR, PA, NI), matarratón (CR, GT), madrecacao (SV, GT, HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	15 (10 – 20)	**Timber uses**[1]	SM, CS, MB, HF, DT, AR	**Pollination vector**	Insects	**Flooding**	No
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	131.8 (78.9 – 212.8)	**Frost**	No
N fixer	Yes	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.69 (0.41 – 1.12)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	Yes
Leaf phenology	Deciduous	**Other uses**	Medicinal	**Seed dispersal**	Ballistichory	**Fire**	Yes

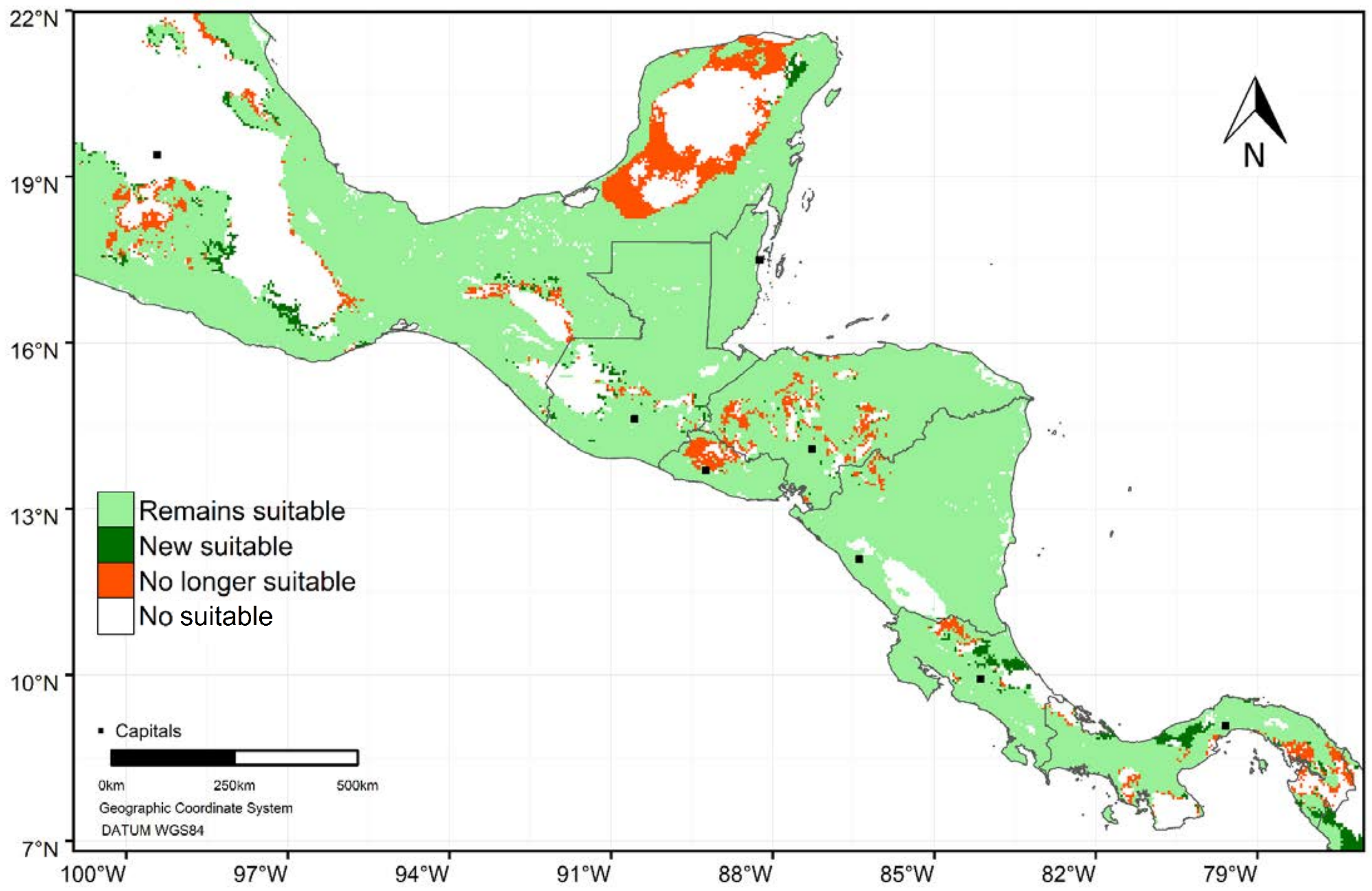
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



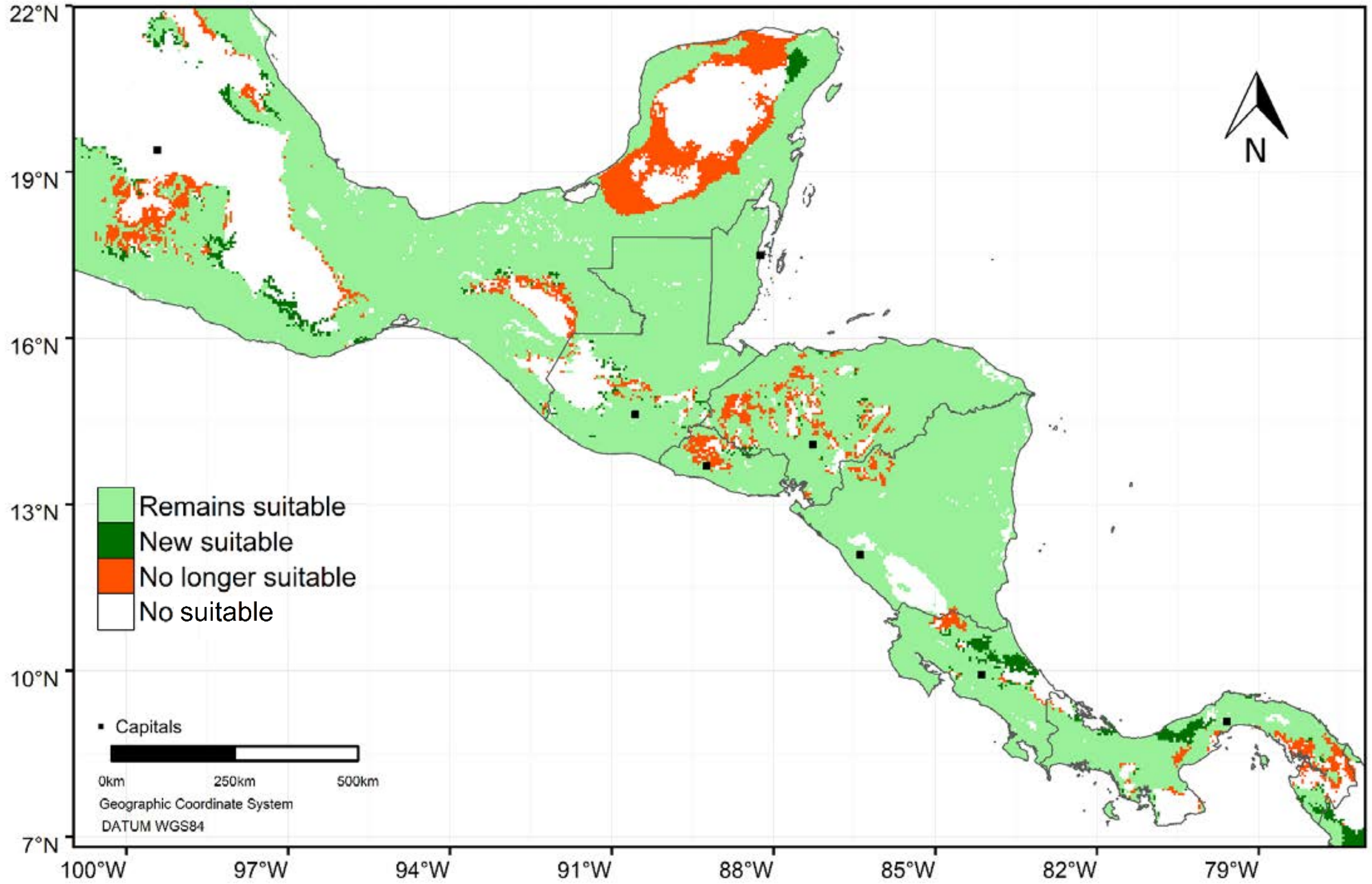
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



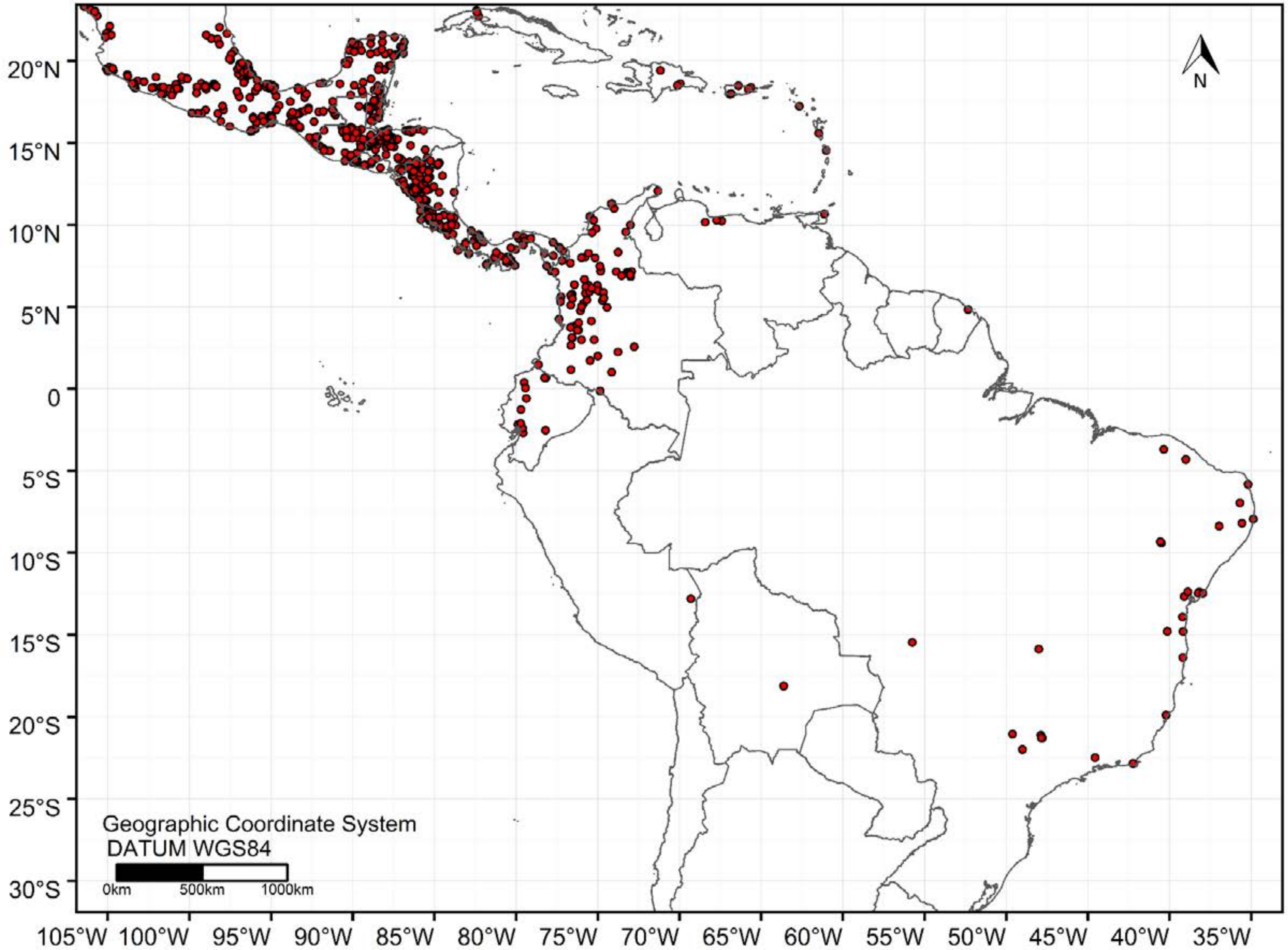
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	75,156	89%	3%	11%	-8%
Rain forest	122,588	94%	3%	6%	-3%
Whole region	197,744	92%	3%	8%	-5%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	75,156	86%	3%	14%	-11%
Rain forest	122,588	93%	3%	7%	-4%
Whole region	197,744	90%	3%	10%	-6%

Points of observed presence



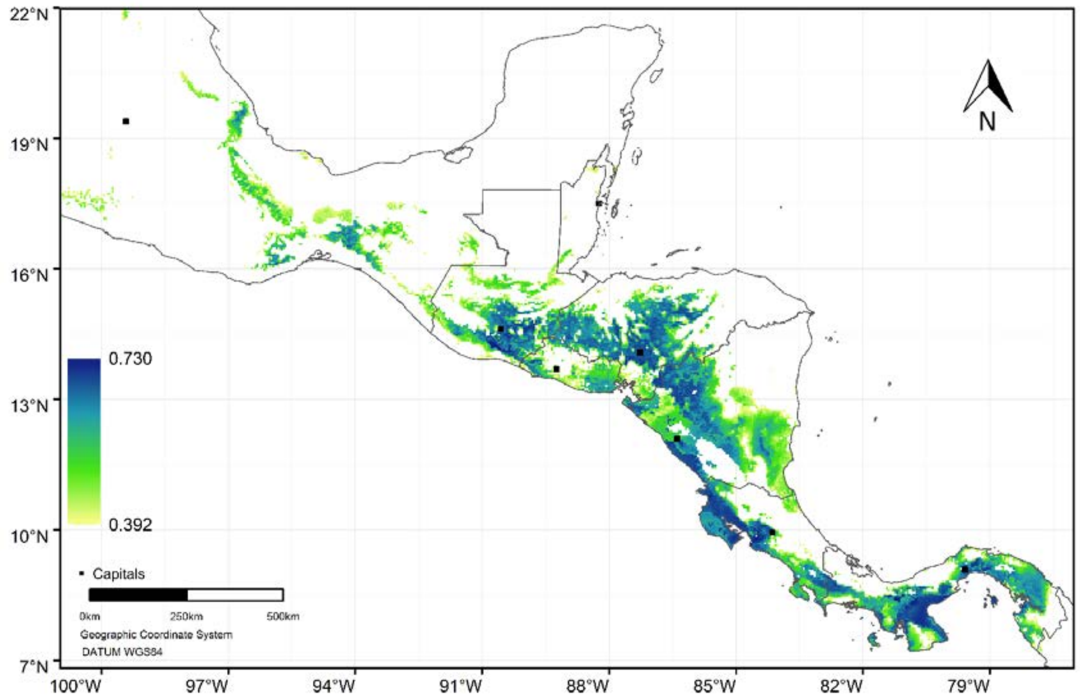
Handroanthus ochraceus (Cham.) Mattos

Family: Bignoniaceae
Vernacular names: Cortez amarillo

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	15 (10 – 25)	**Timber uses**[1]	CS, MB	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	35	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0,87 (0,78 – 1,01)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Ornamental	**Seed dispersal**	Anemochory	**Fire**	Unknown

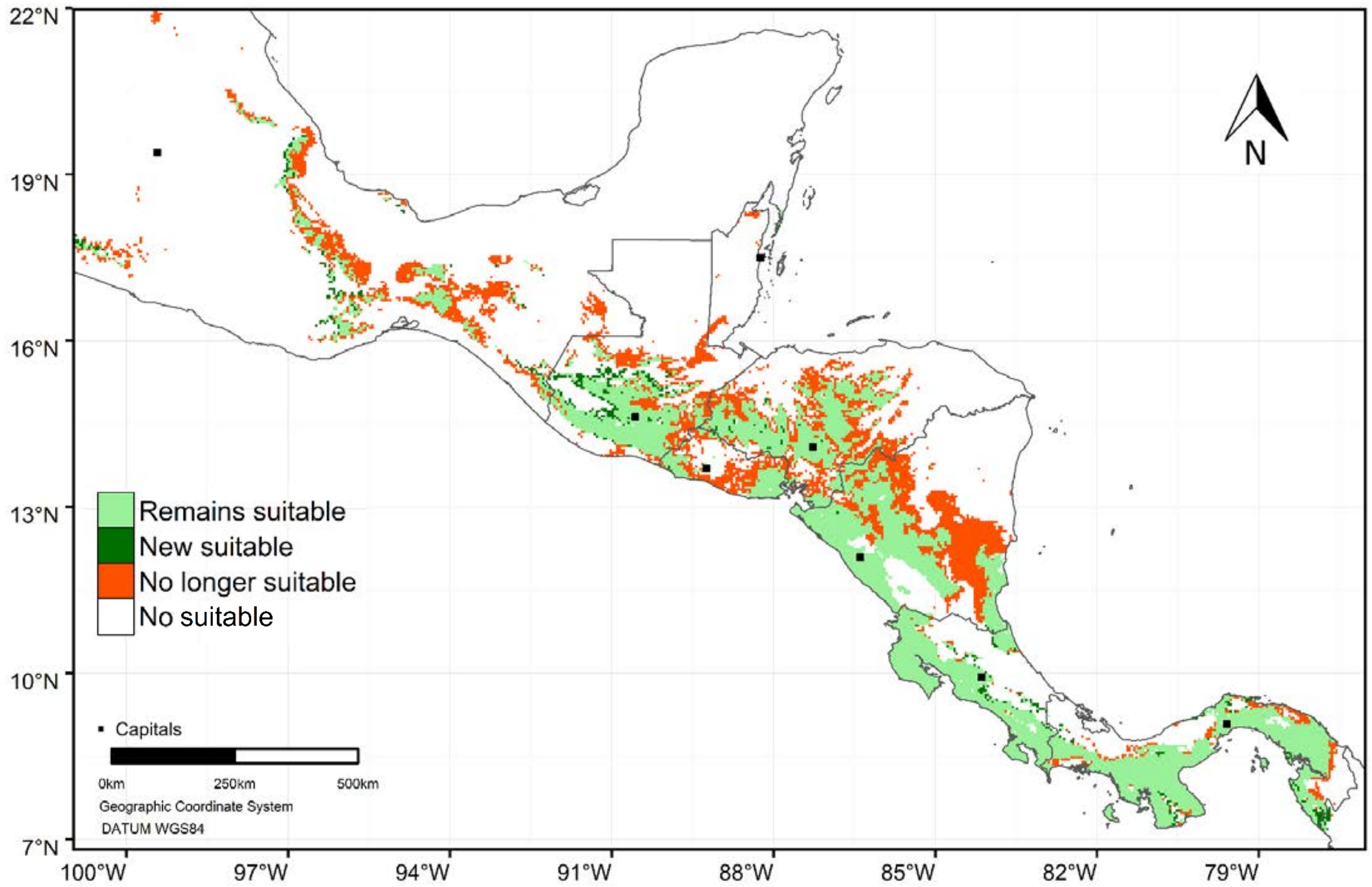
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



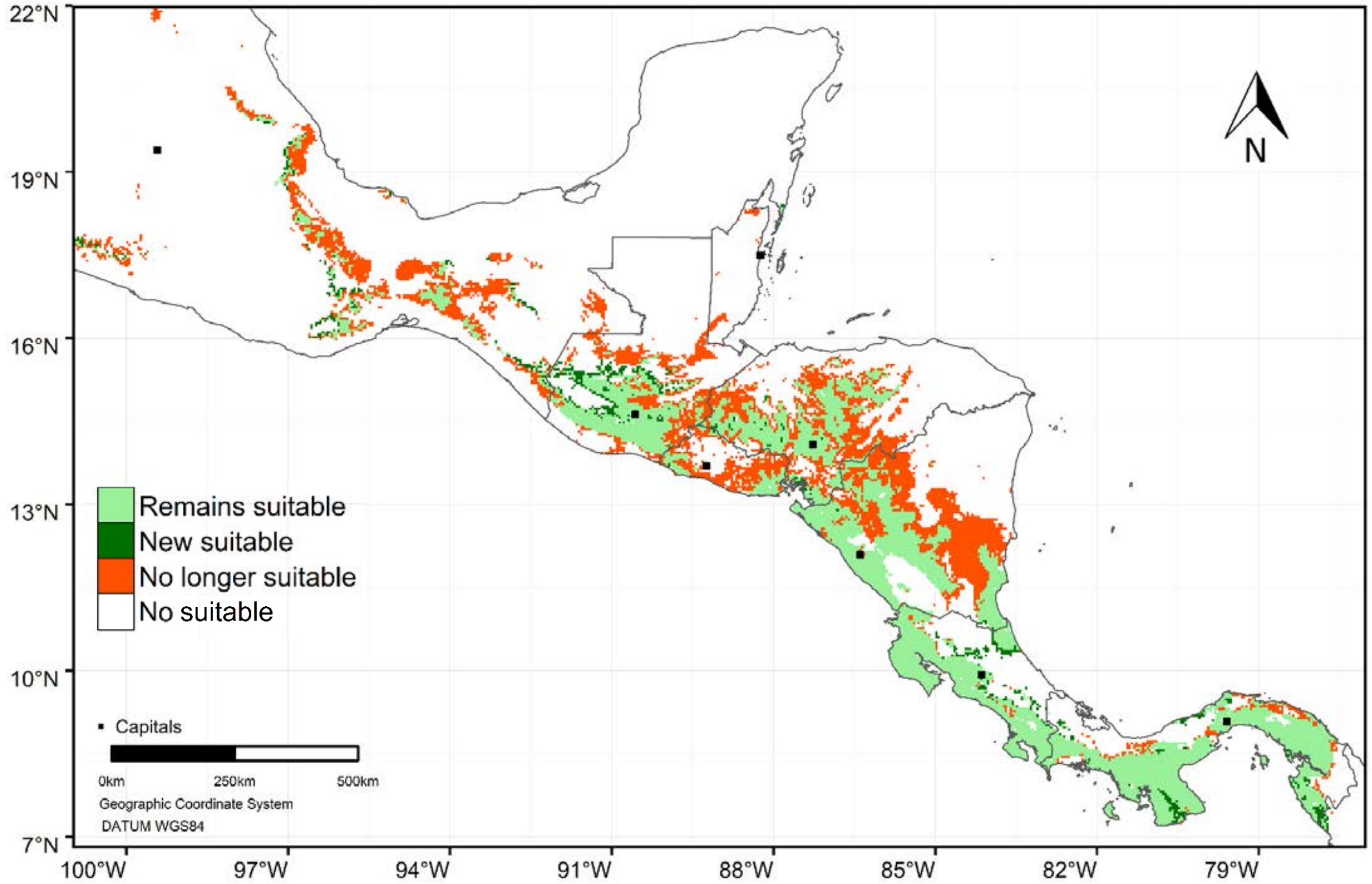
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



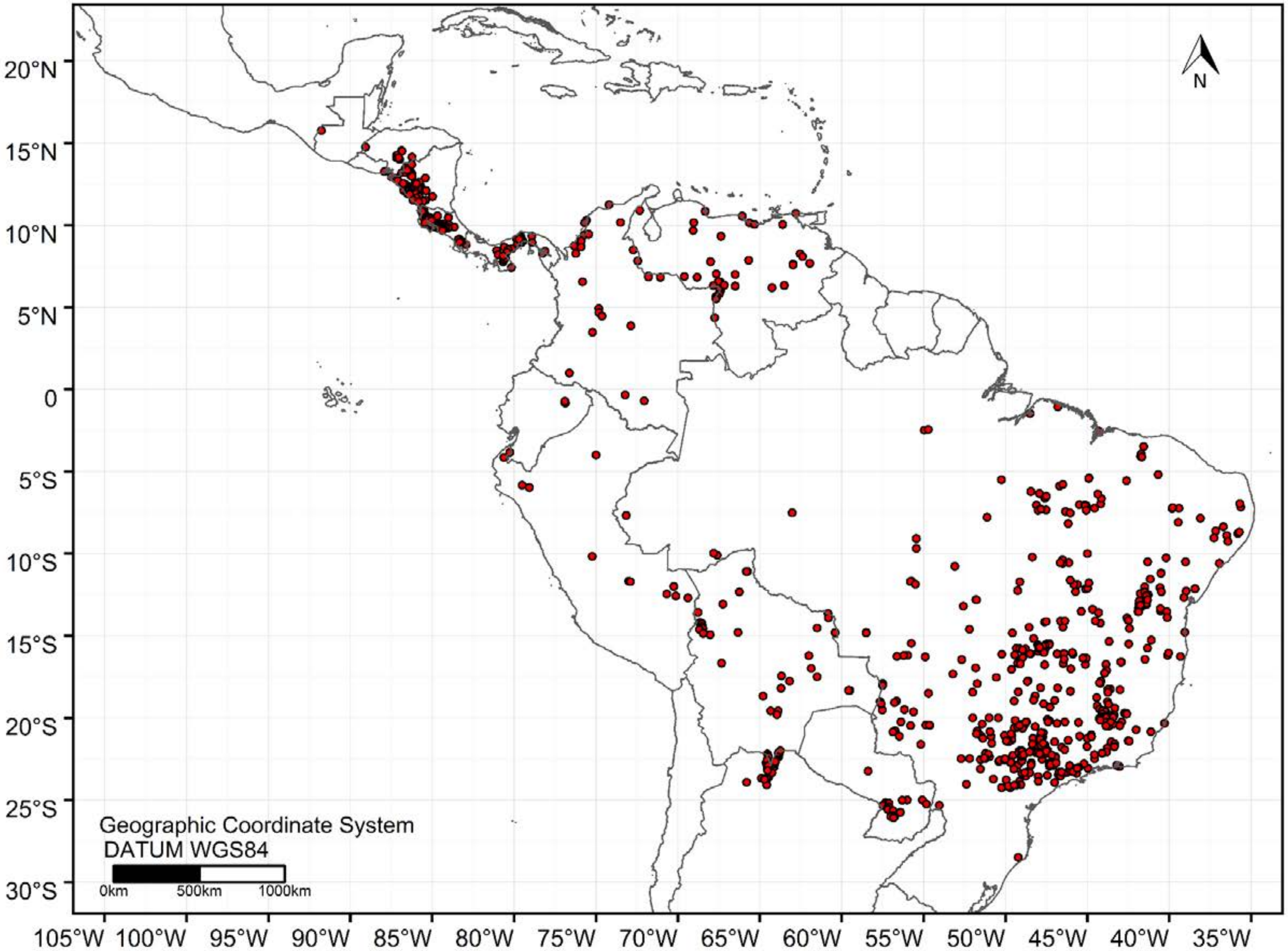
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	33,732	65%	4%	35%	-31%
Rain forest	34,829	62%	4%	38%	-34%
Whole region	68,561	64%	4%	36%	-33%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	33,732	58%	5%	42%	-37%
Rain forest	34,829	59%	6%	41%	-35%
Whole region	68,561	59%	5%	41%	-36%

Points of observed presence



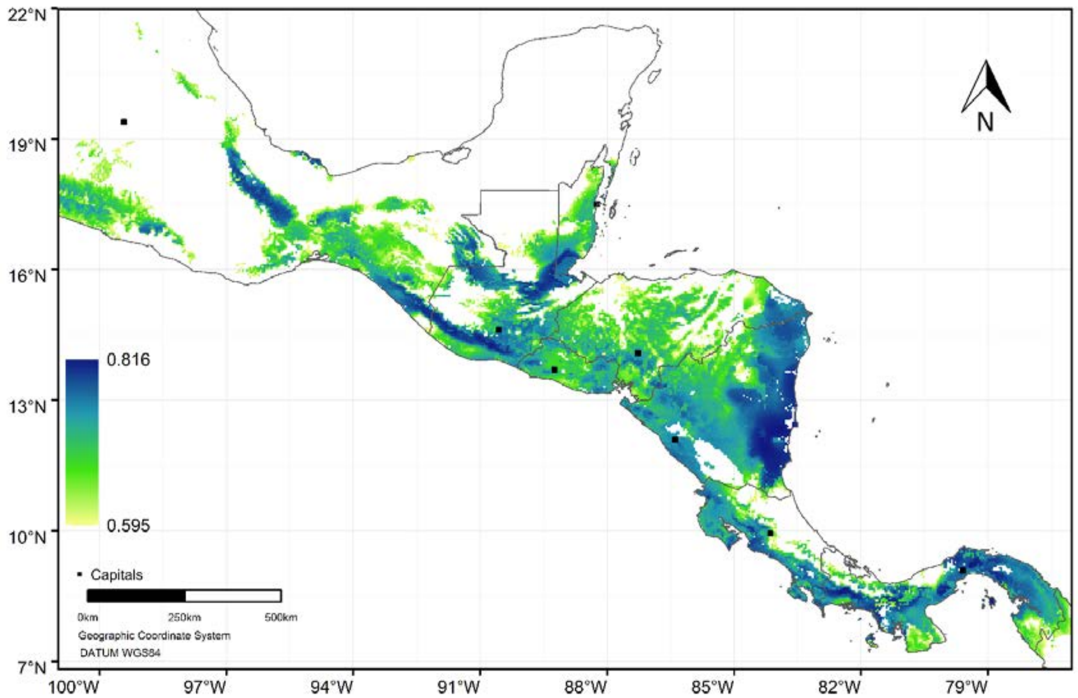
Hymenaea courbaril L.

Family: Leguminosae
Vernacular names: Guapinol (CR, GT, HN, NI), copinol (SV)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	25 (10 – 40)	**Timber uses**[1]	SM, CS, MB, HF, PS, DT, CH, AR	**Pollination vector**	Bats	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	4,077 (921 – 5,418)	**Frost**	Unknown
N fixer	Yes	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.82 (0.54 – 1.0)	**Forage**	Yes	**Seed dormancy**	Physical	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Medicinal, Resin	**Seed dispersal**	Zoochory	**Fire**	Unknown

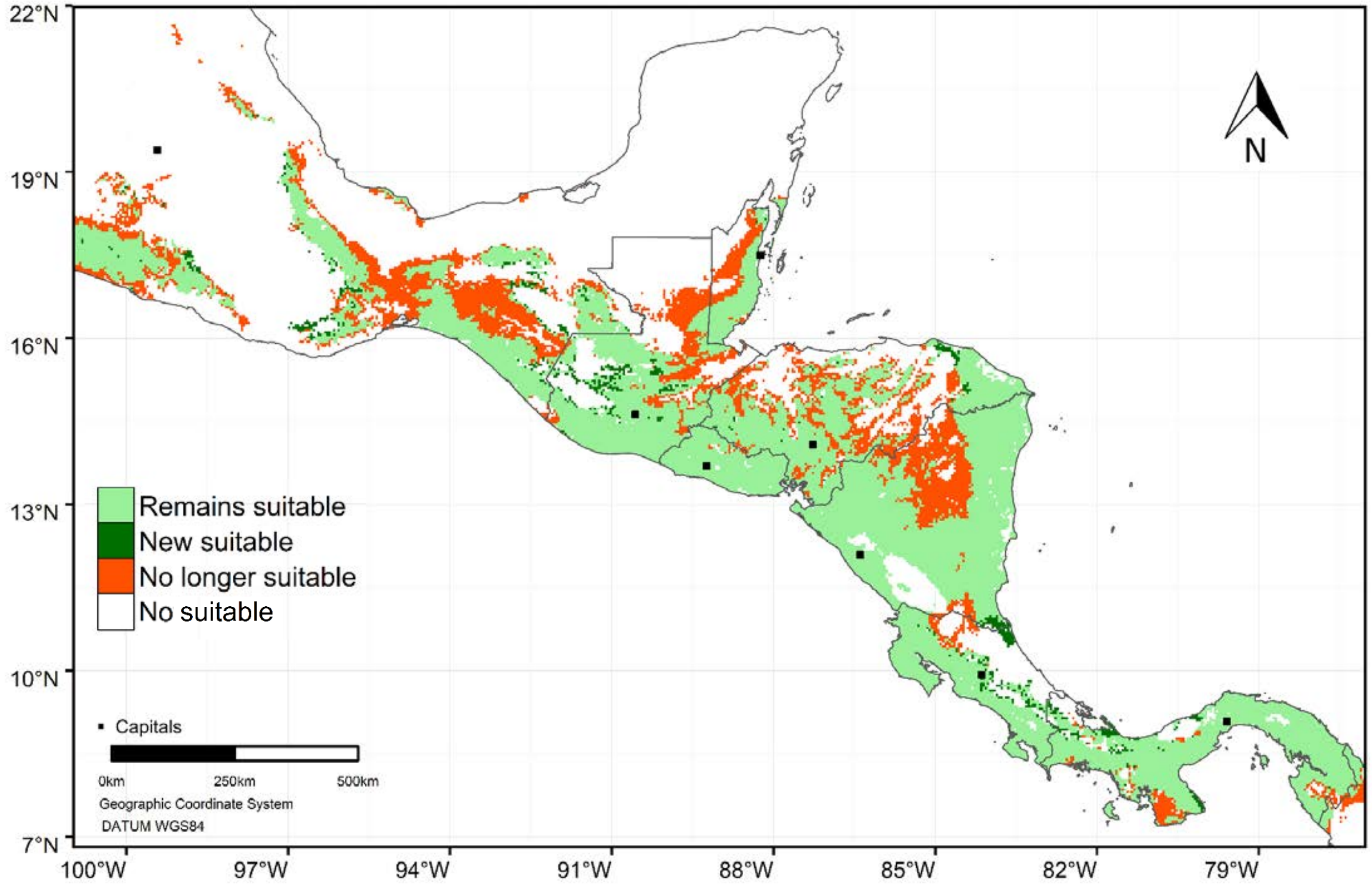
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



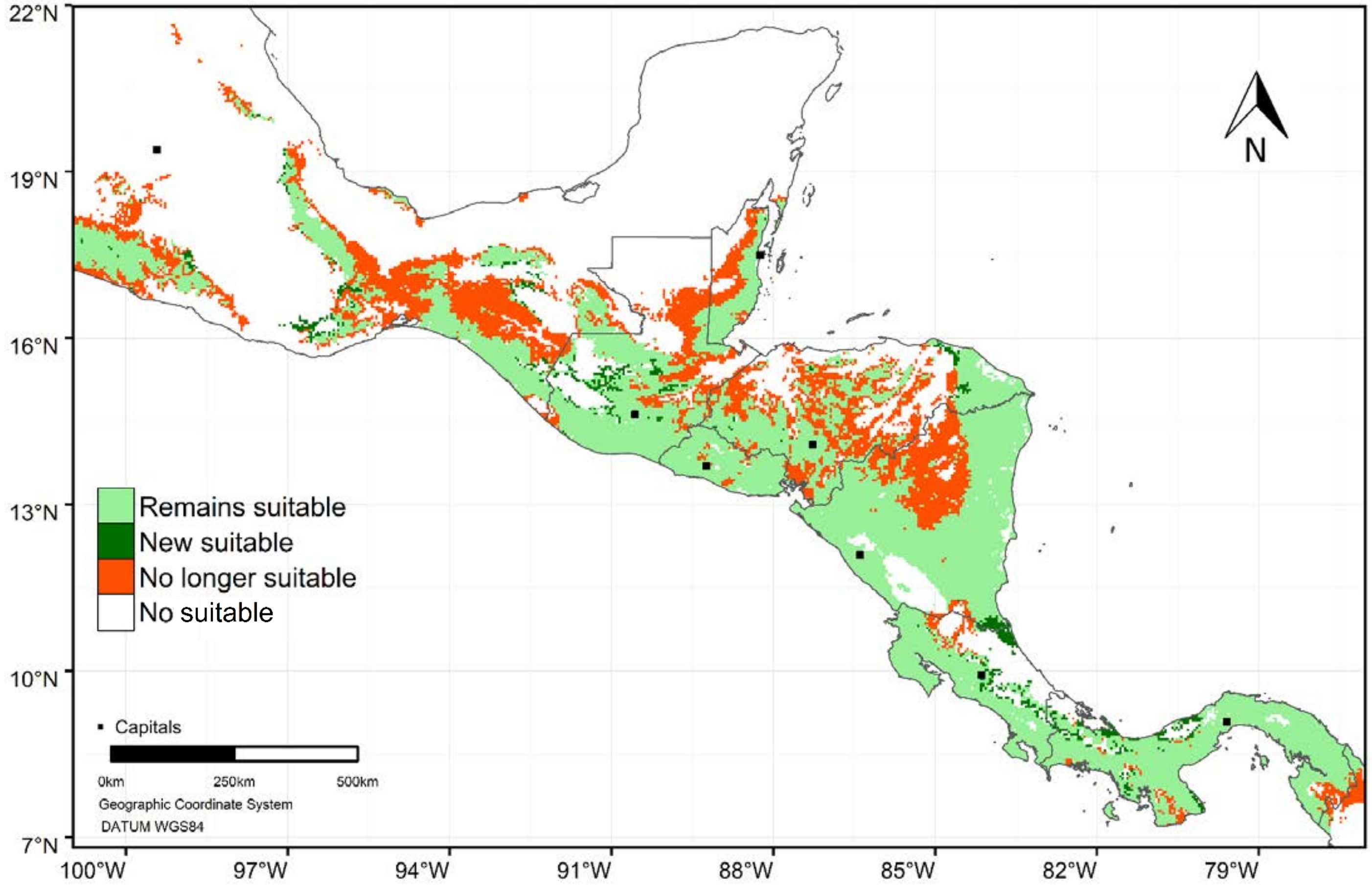
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



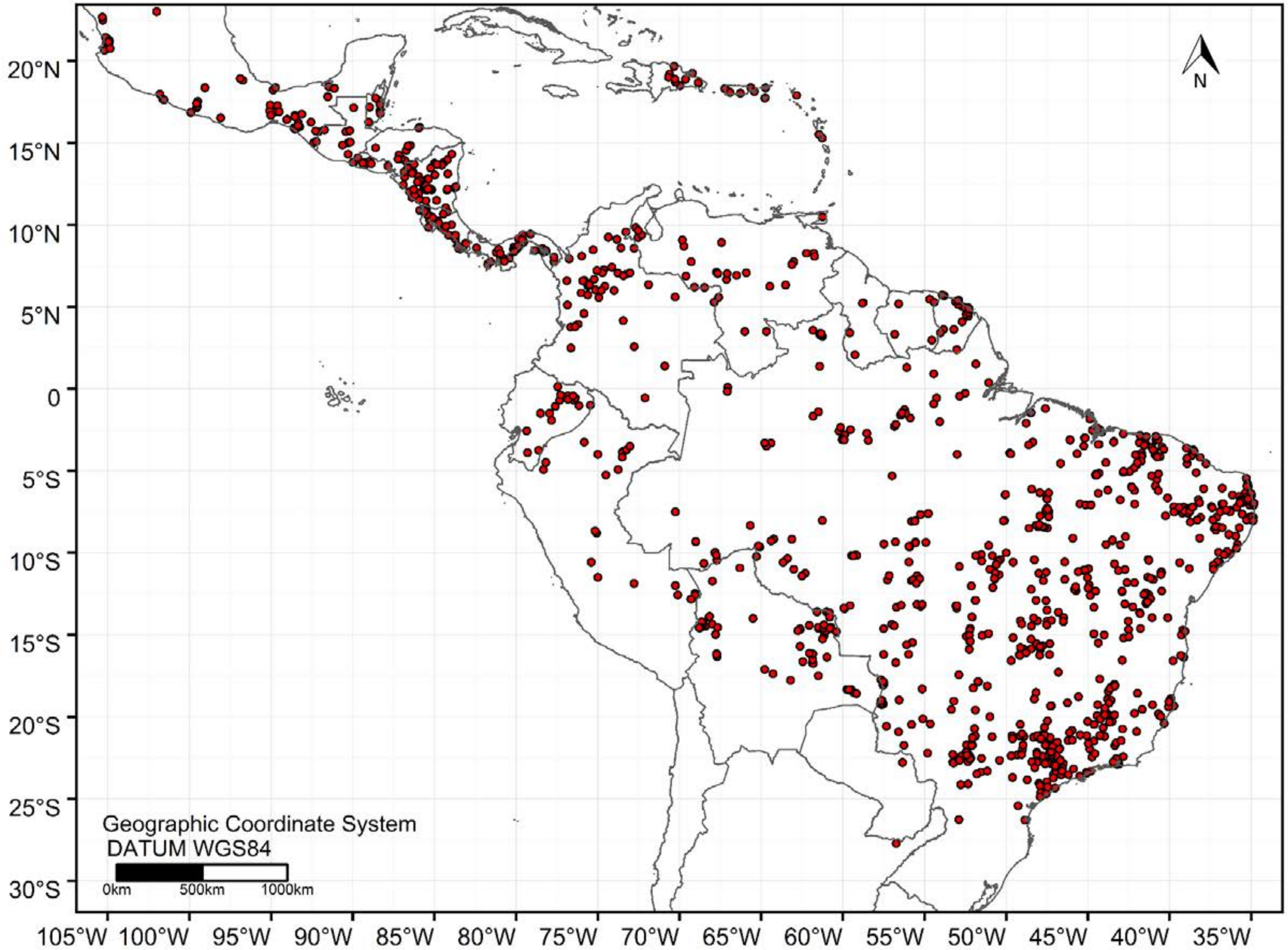
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	52,224	75%	3%	25%	-22%
Rain forest	68,125	74%	4%	26%	-22%
Whole region	120,349	75%	3%	25%	-22%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	52,224	67%	3%	33%	-30%
Rain forest	68,125	72%	4%	28%	-24%
Whole region	120,349	70%	4%	30%	-27%

Points of observed presence



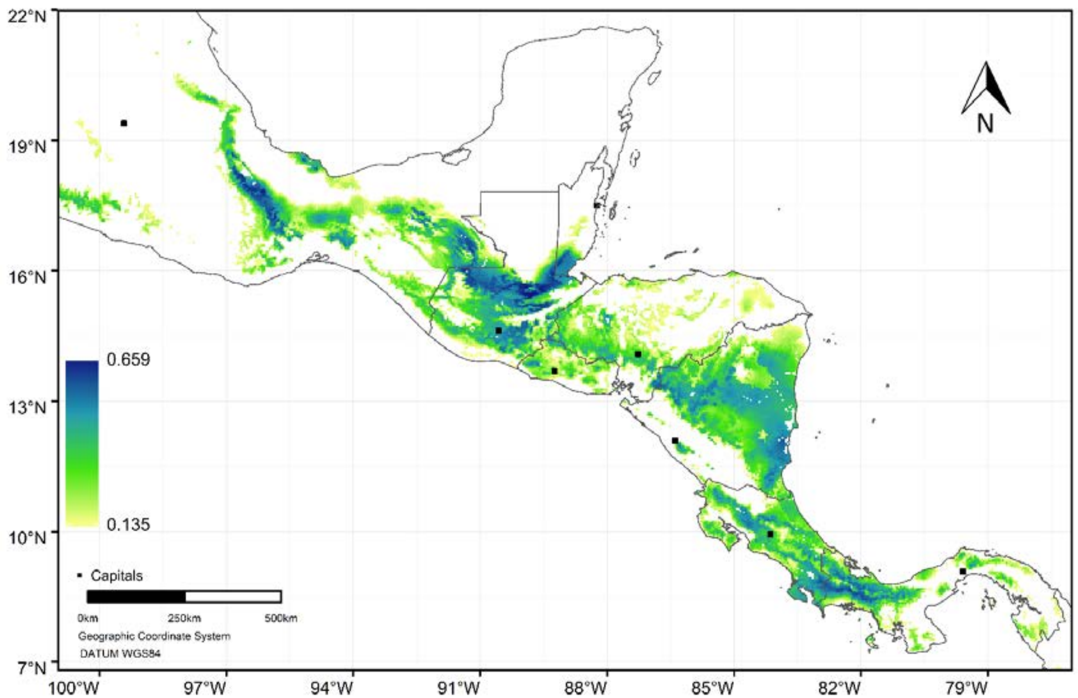
Inga jinicuil Schltdl.

Family:
Leguminosae
Vernacular names:
Guaba (CR, NI, PA),
paterno (SV, GT, HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious self-pollination	**Drought**	Unknown
Plant height (m)	9 (7 – 20)	**Timber uses**[1]	CL	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	656.5 - 812.0	**Frost**	Yes
N fixer	Yes	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	Unknown
Wood density (g cm^{-3})	0.58	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Unknown	**Seed dispersal**	Autochory, Zoochory	**Fire**	Unknown

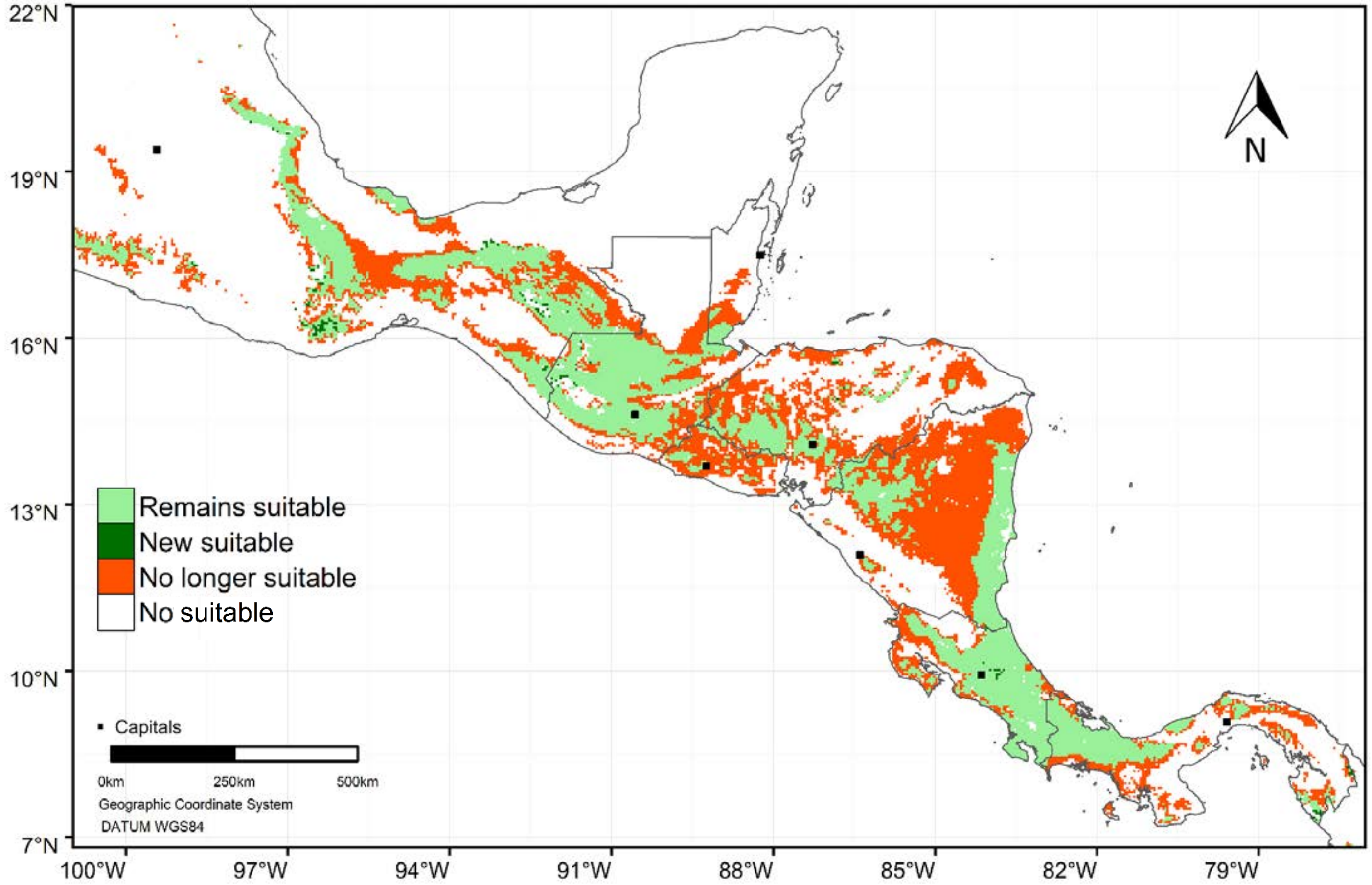
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



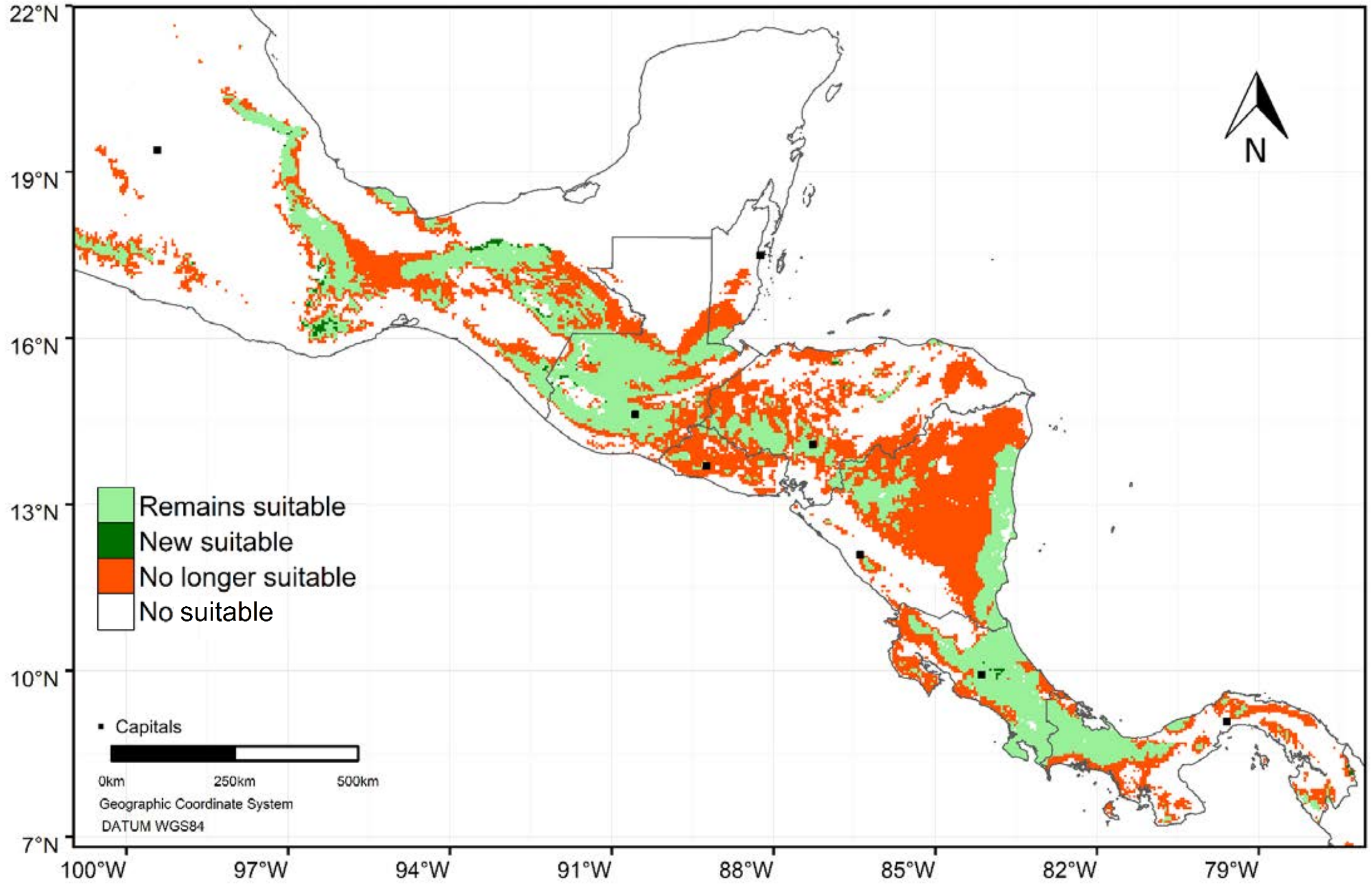
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



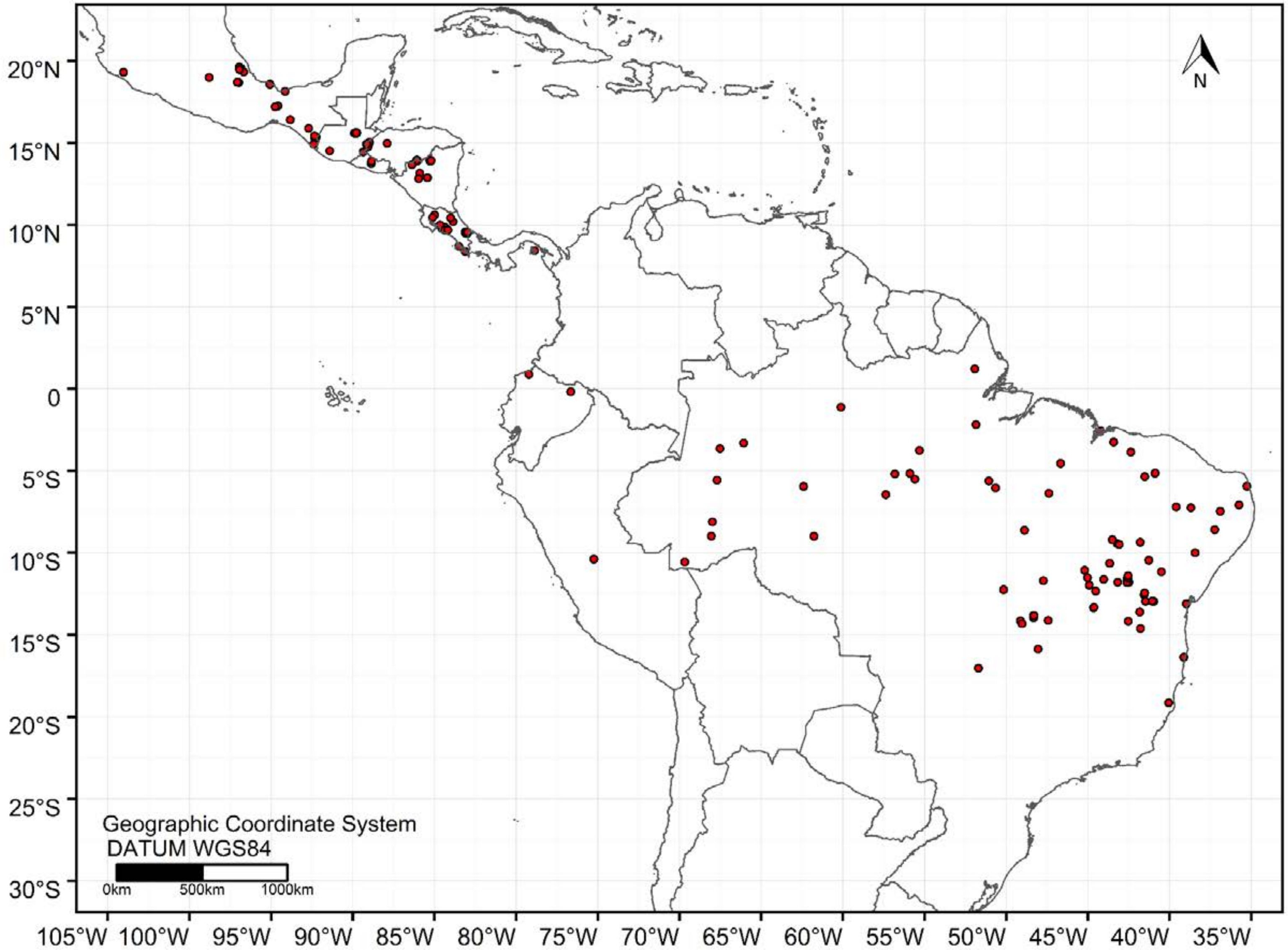
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	34,457	48%	1%	52%	-51%
Rain forest	62,828	50%	0%	50%	-49%
Whole region	97,285	50%	1%	50%	-50%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	34,457	41%	1%	59%	-58%
Rain forest	62,828	45%	1%	55%	-55%
Whole region	97,285	43%	1%	57%	-56%

Points of observed presence



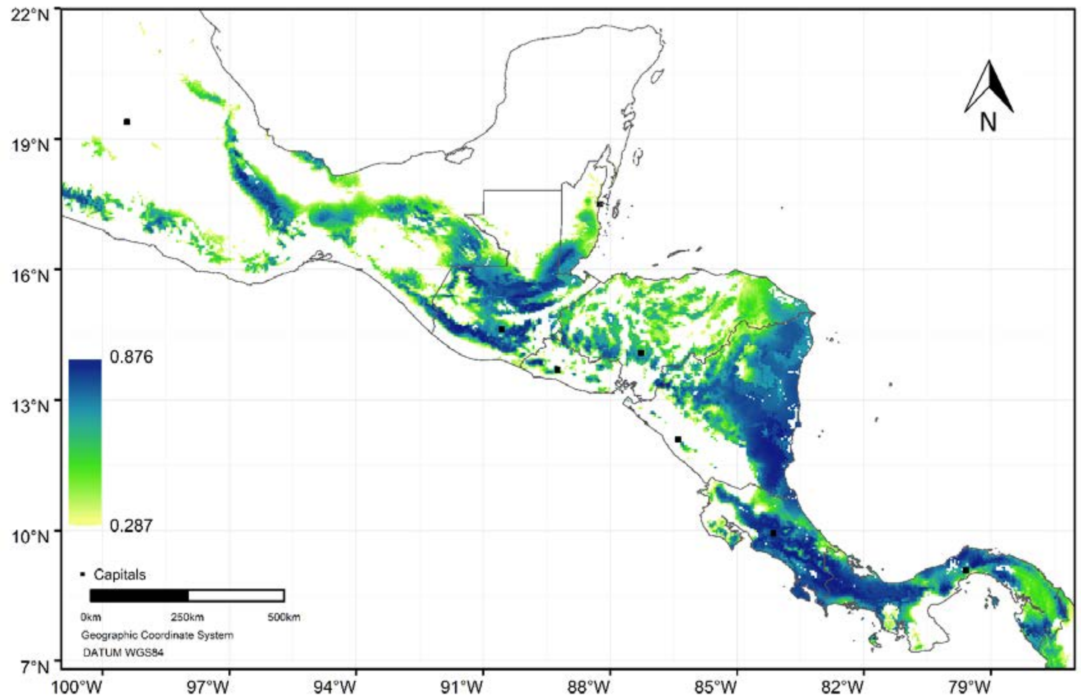
Inga oerstediana Benth.

Family:
Leguminosae
Vernacular names:
Guaba (CR, NI, PA), guama (GT, HN, SV)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	9 (8 – 18)	**Timber uses[1]**	None	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	4,759.6	**Frost**	Unknown
N fixer	Yes	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	Unknown
Wood density (g cm^{-3})	0.42 (0.40 – 0.43)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Unknown	**Seed dispersal**	Zoochory	**Fire**	Unknown

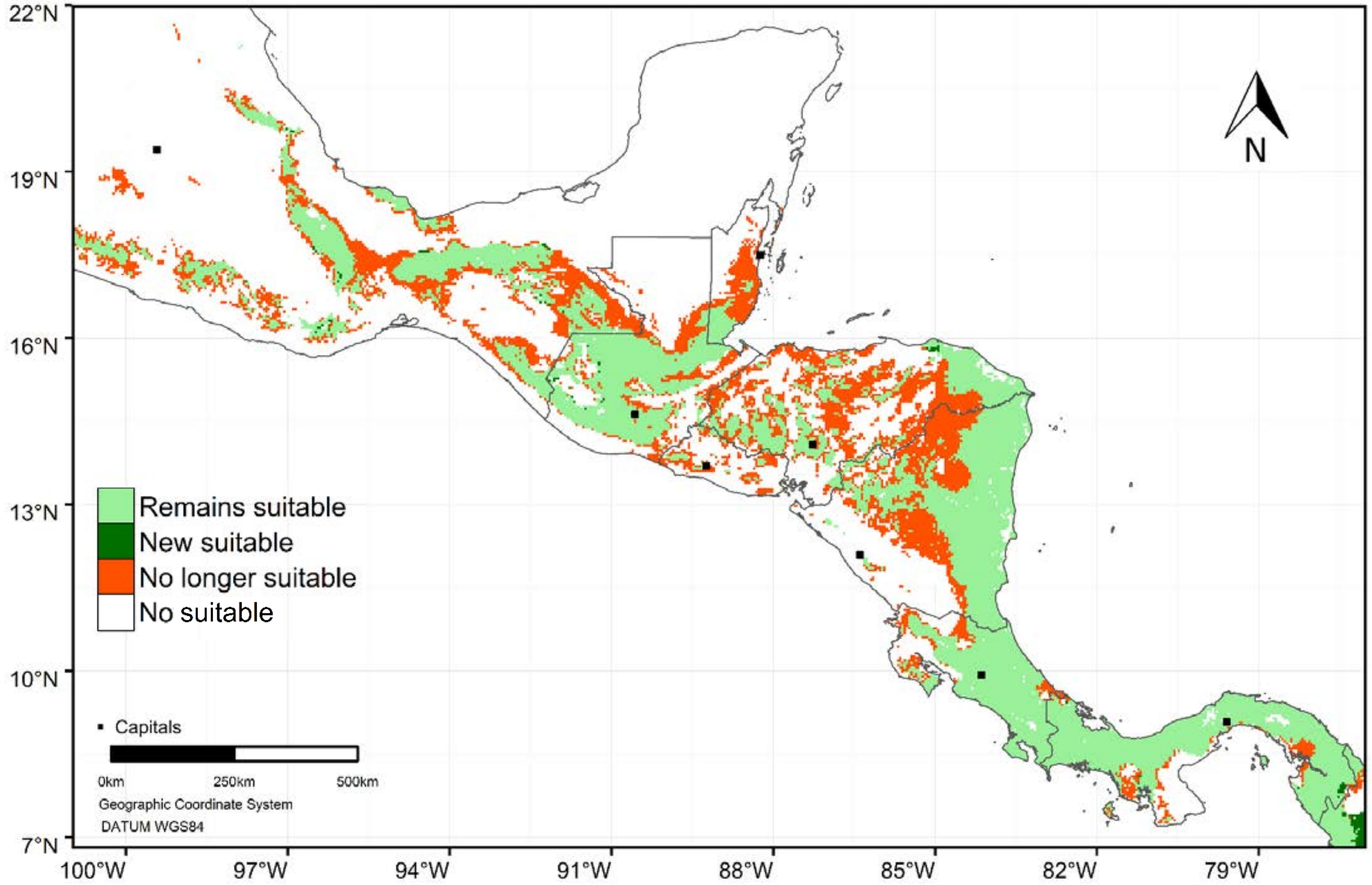
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



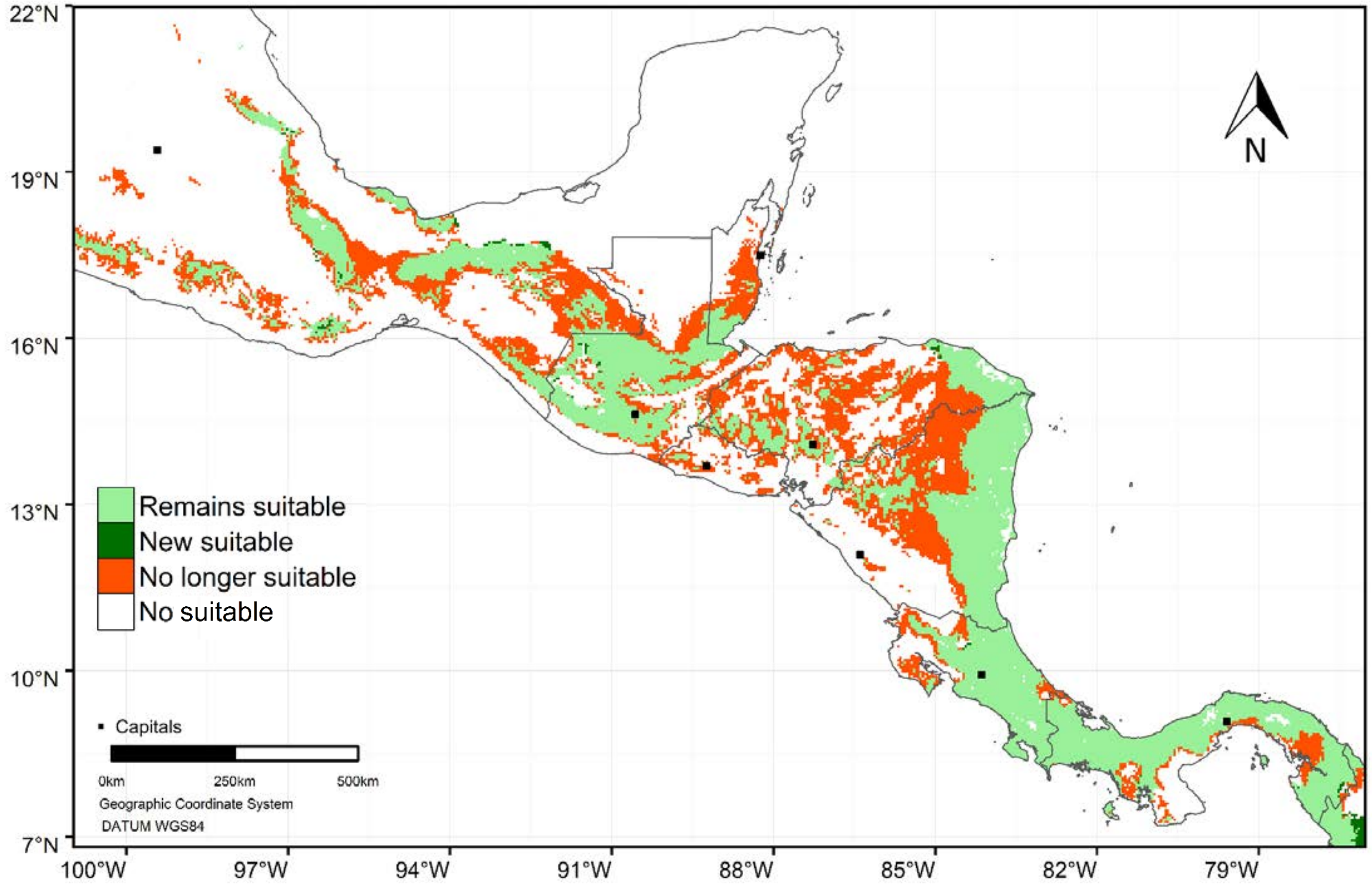
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



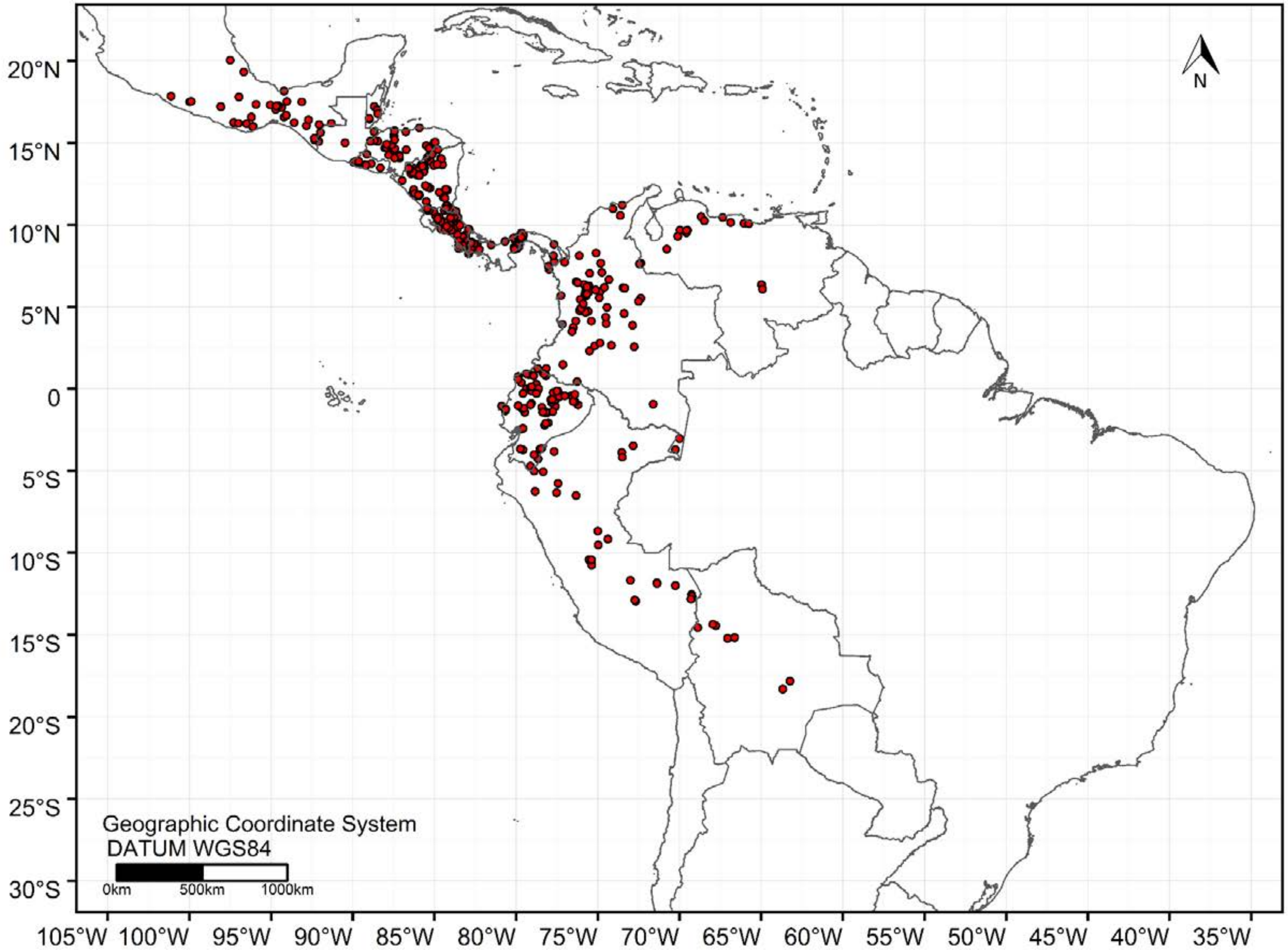
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	29,650	48%	1%	52%	-51%
Rain forest	76,220	72%	1%	28%	-28%
Whole region	105,869	65%	1%	35%	-34%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	29,650	37%	1%	63%	-62%
Rain forest	76,220	67%	1%	33%	-33%
Whole region	105,869	58%	1%	42%	-41%

Points of observed presence



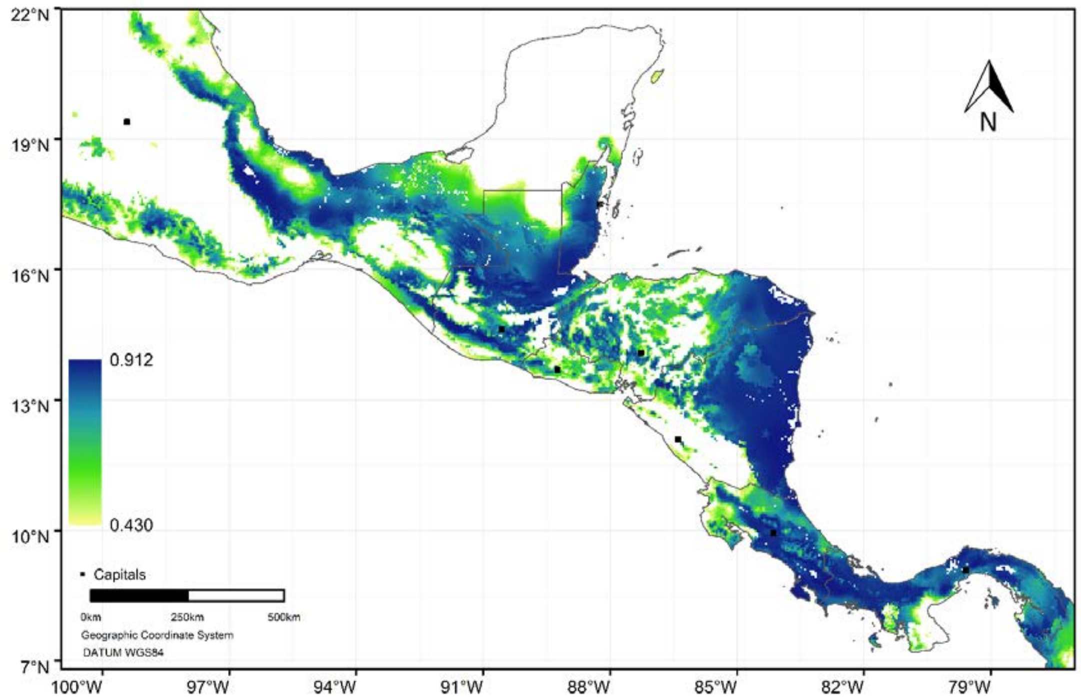
Inga punctata Willd.

Family:
Leguminosae
Vernacular names:
Guaba (CR, NI, PA),
pepeto (SV, GT, HN),
pepeto negro (SV, GT, HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	15 (5 – 20)	**Timber uses[1]**	None	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	Unknown	**Frost**	Unknown
N fixer	Yes	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	Unknown
Wood density (g cm^{-3})	0.54 (0.51 – 0.58)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Yes
Leaf phenology	Evergreen	**Other uses**	Unknown	**Seed dispersal**	Zoochory	**Fire**	Unknown

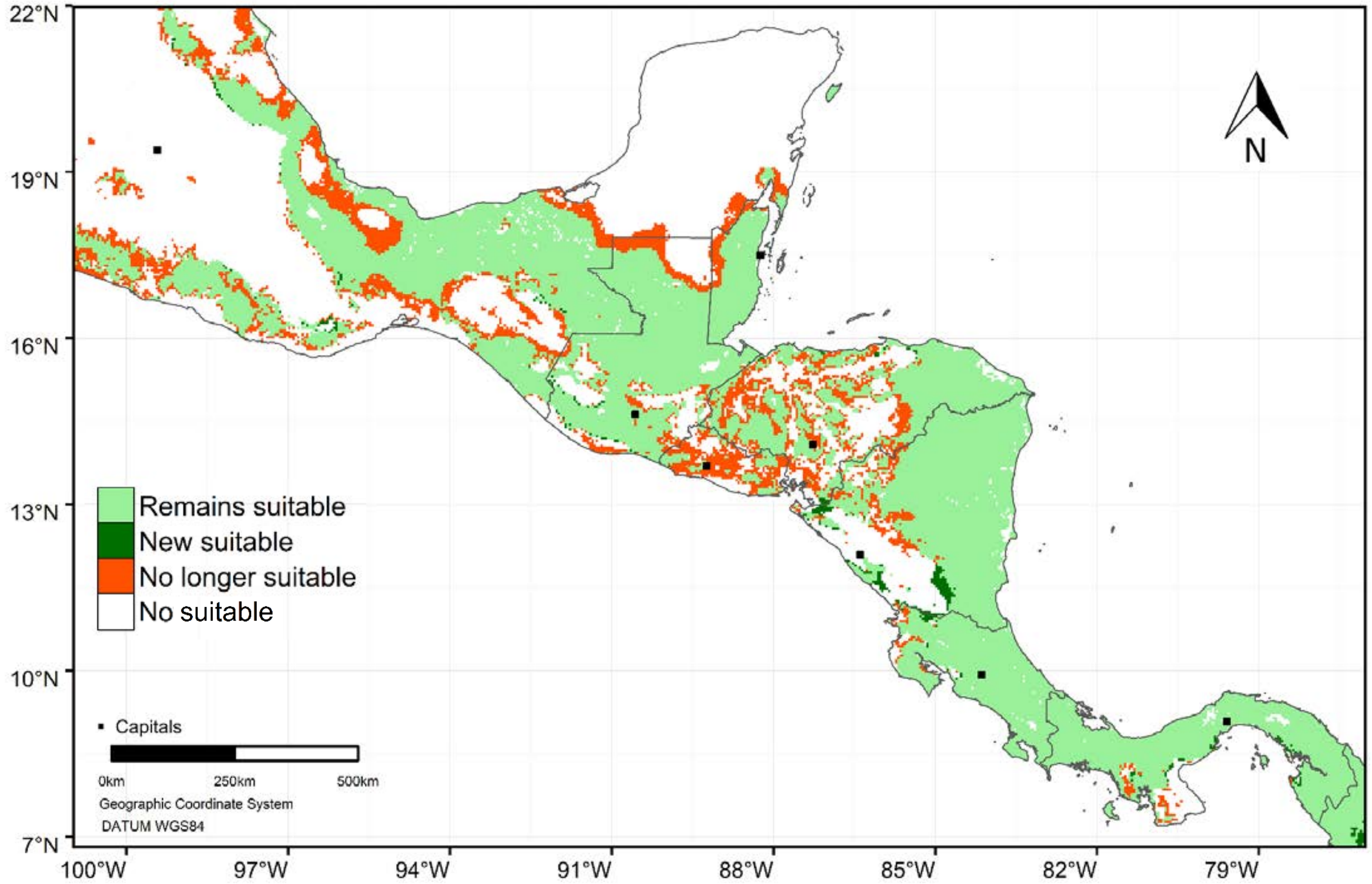
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



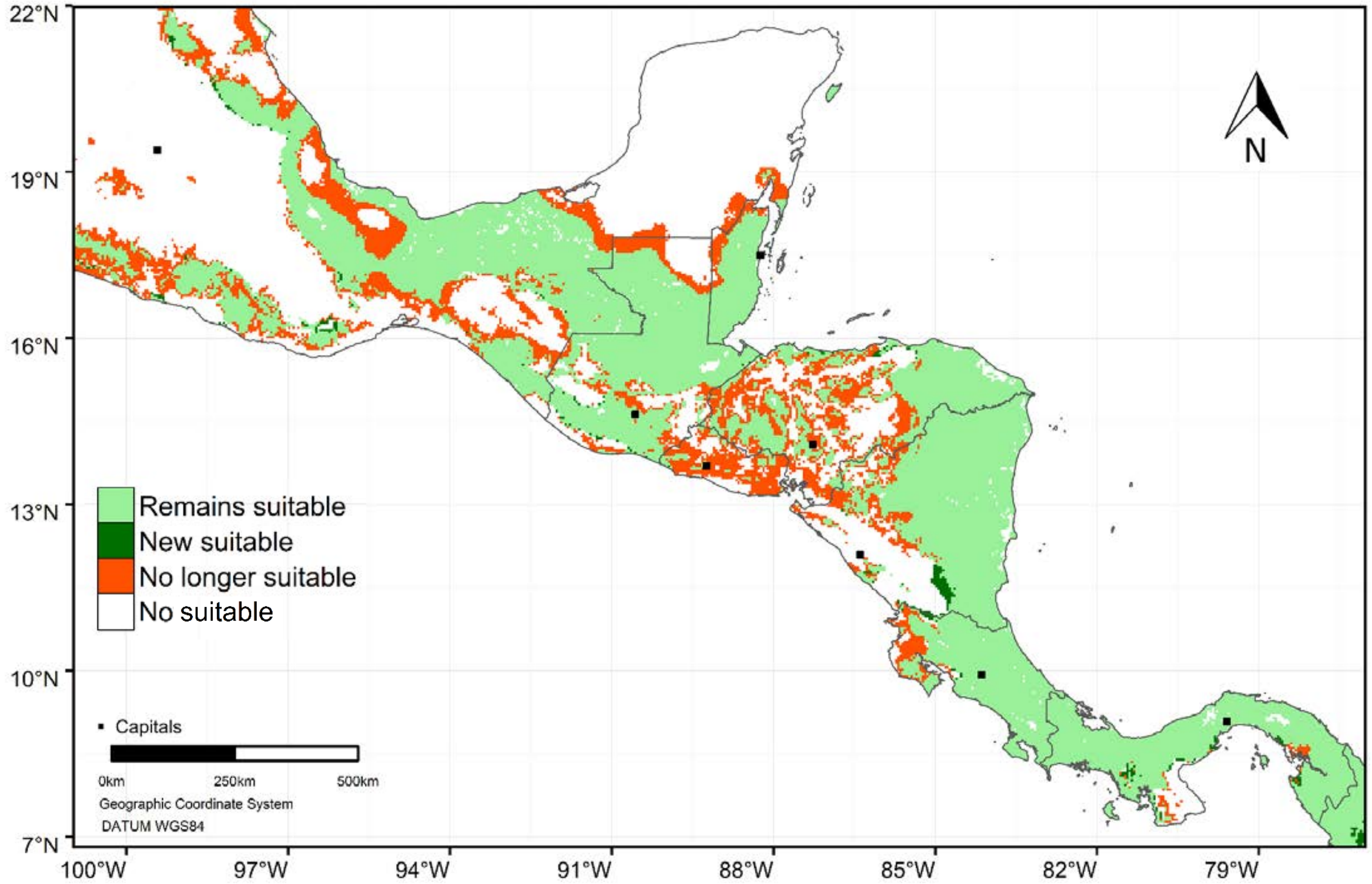
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



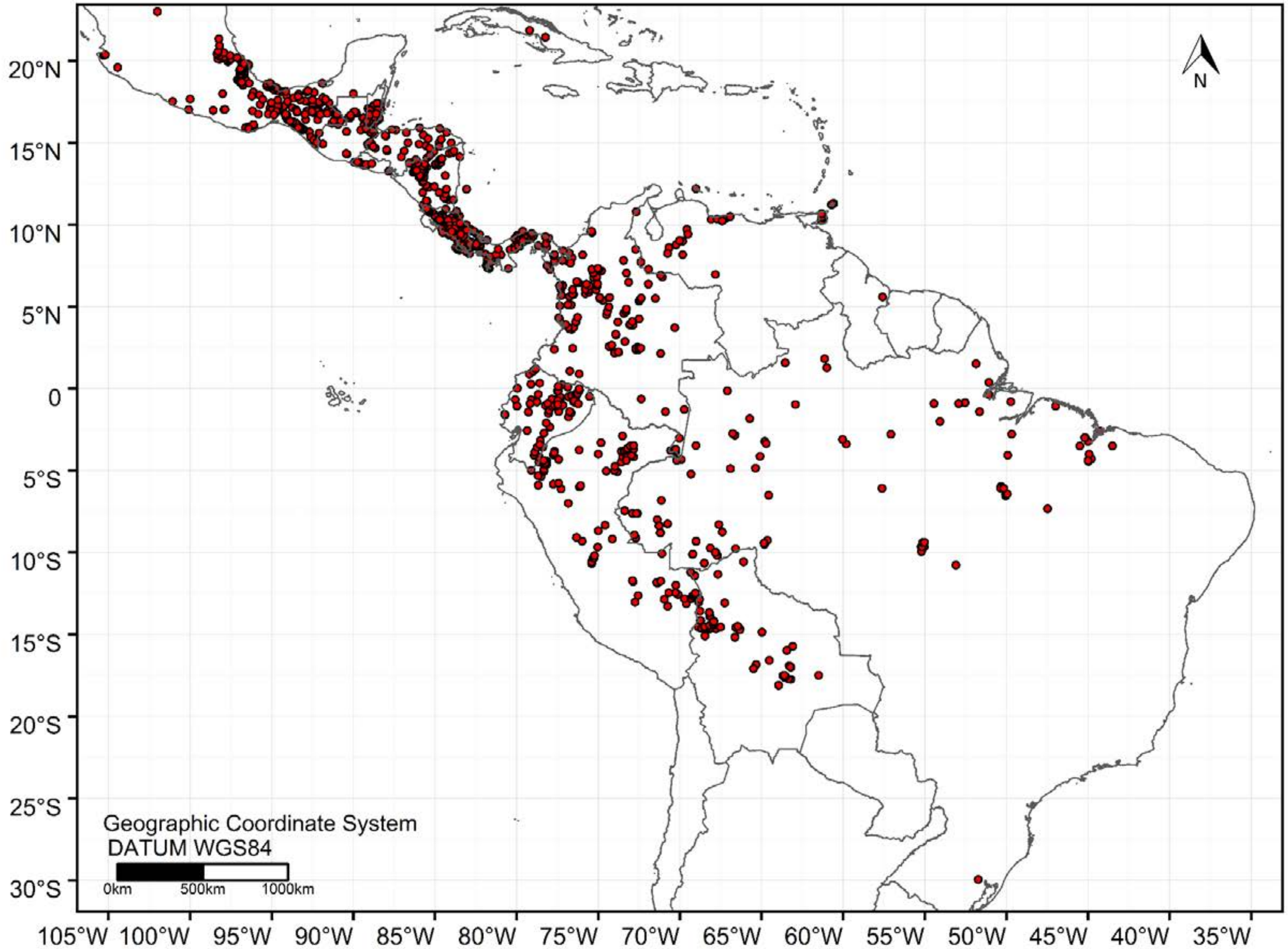
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	43,630	63%	3%	37%	-35%
Rain forest	108,560	90%	1%	10%	-9%
Whole region	152,189	82%	1%	18%	-17%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	43,630	50%	2%	50%	-48%
Rain forest	108,560	88%	1%	12%	-11%
Whole region	152,189	77%	1%	23%	-22%

Points of observed presence



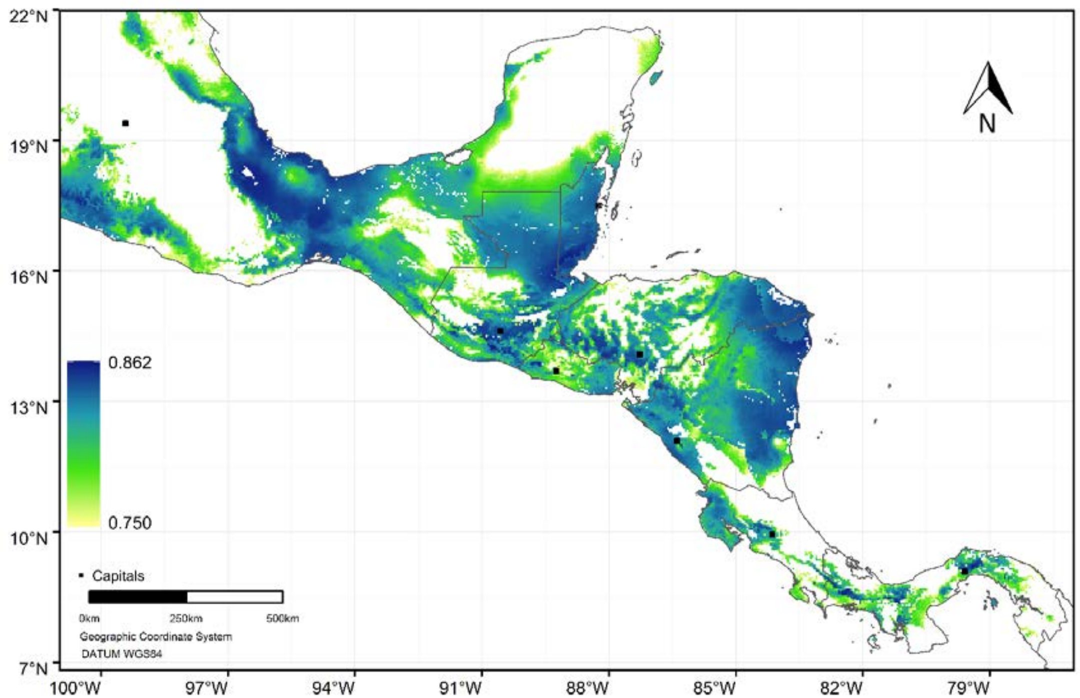
Inga vera Willd.

Family:
Leguminosae
Vernacular names:
guaba, guama (CR, NI, PA), pepeto (SV, GT, HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	20 (5 – 50)	**Timber uses[1]**	CL	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	250	**Frost**	Unknown
N fixer	Yes	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	No
Wood density (g cm^{-3})	0.62 (0.56 – 0.75)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Apiculture	**Seed dispersal**	Zoochory	**Fire**	Unknown

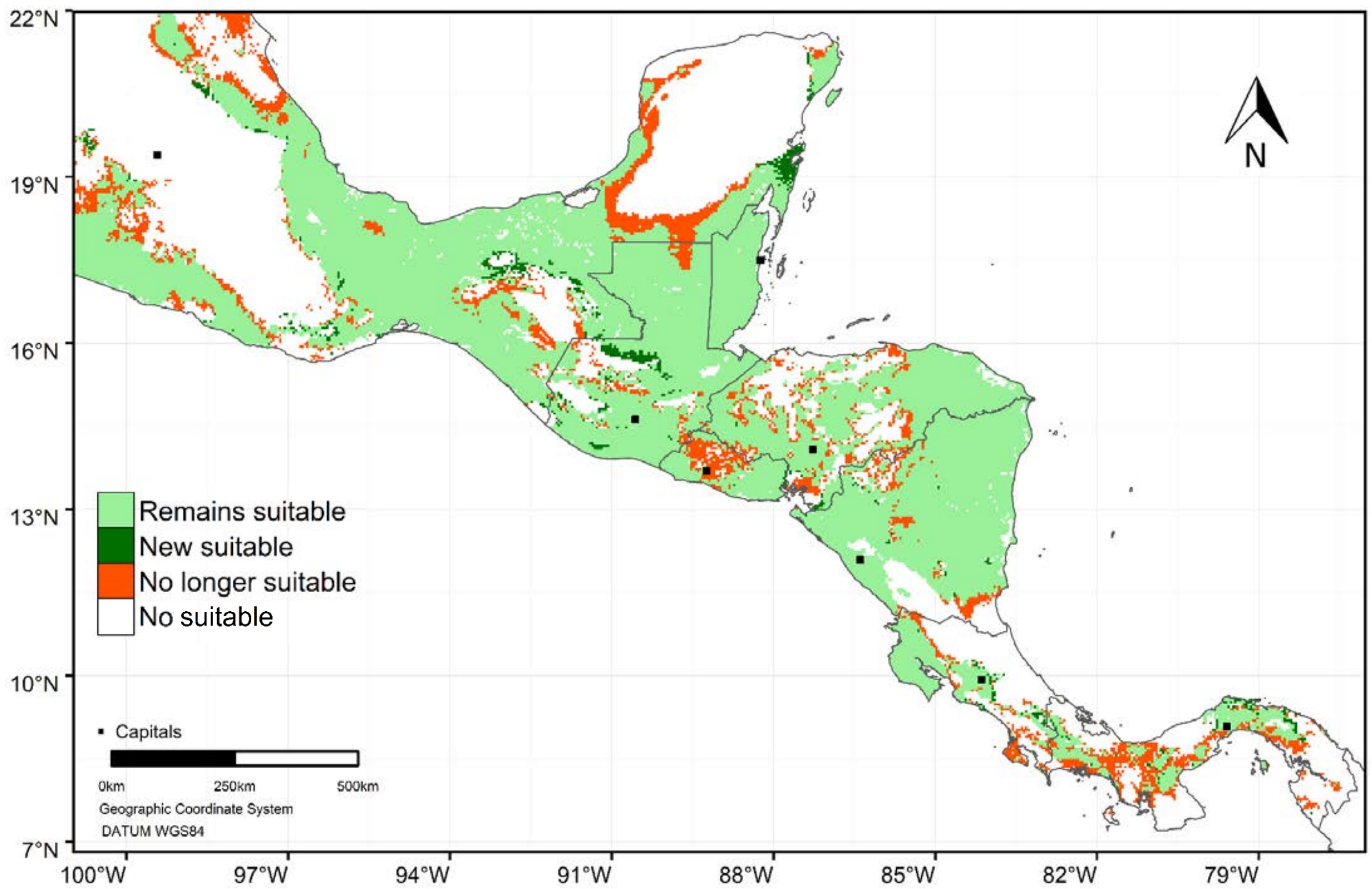
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



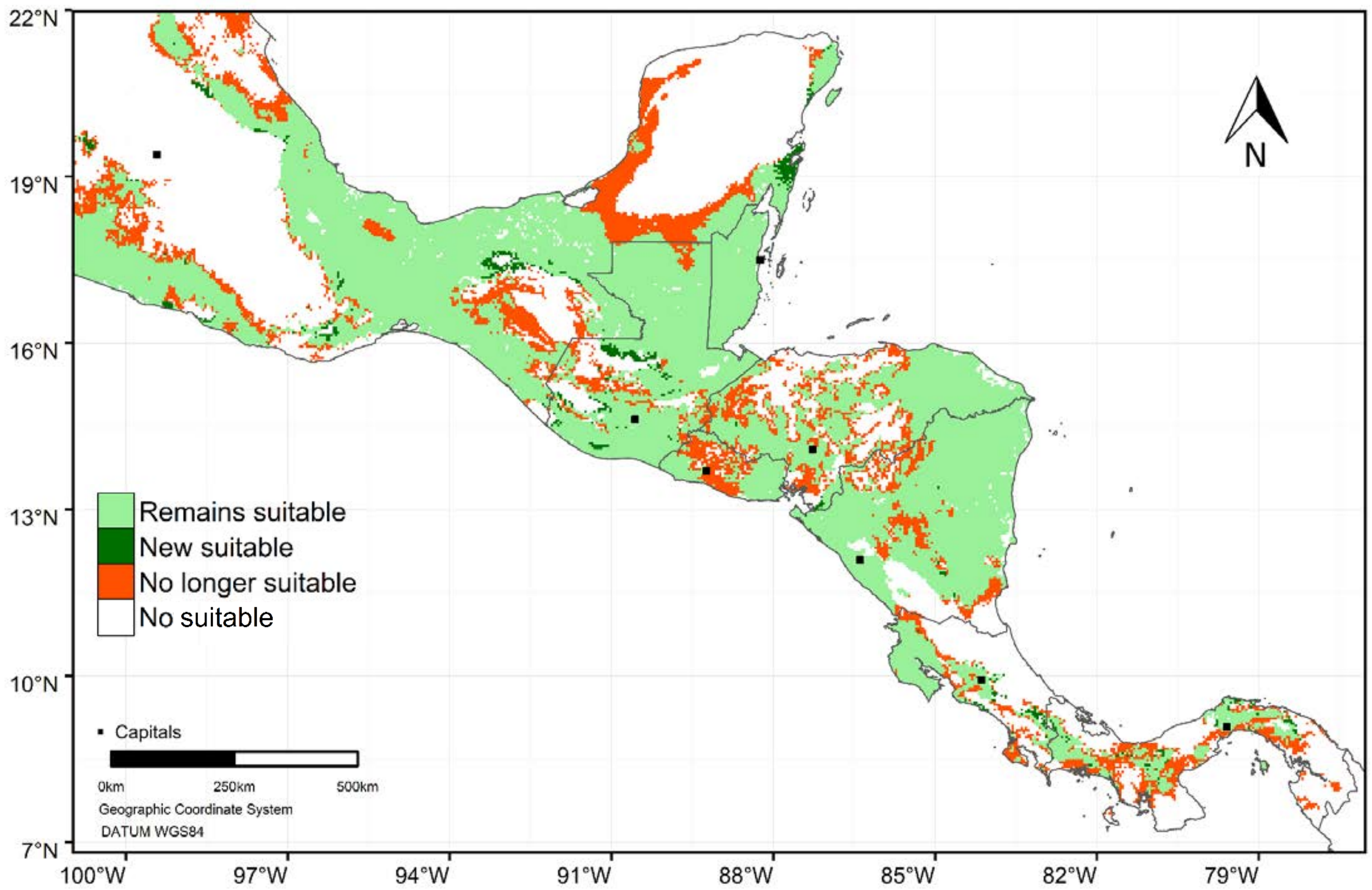
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



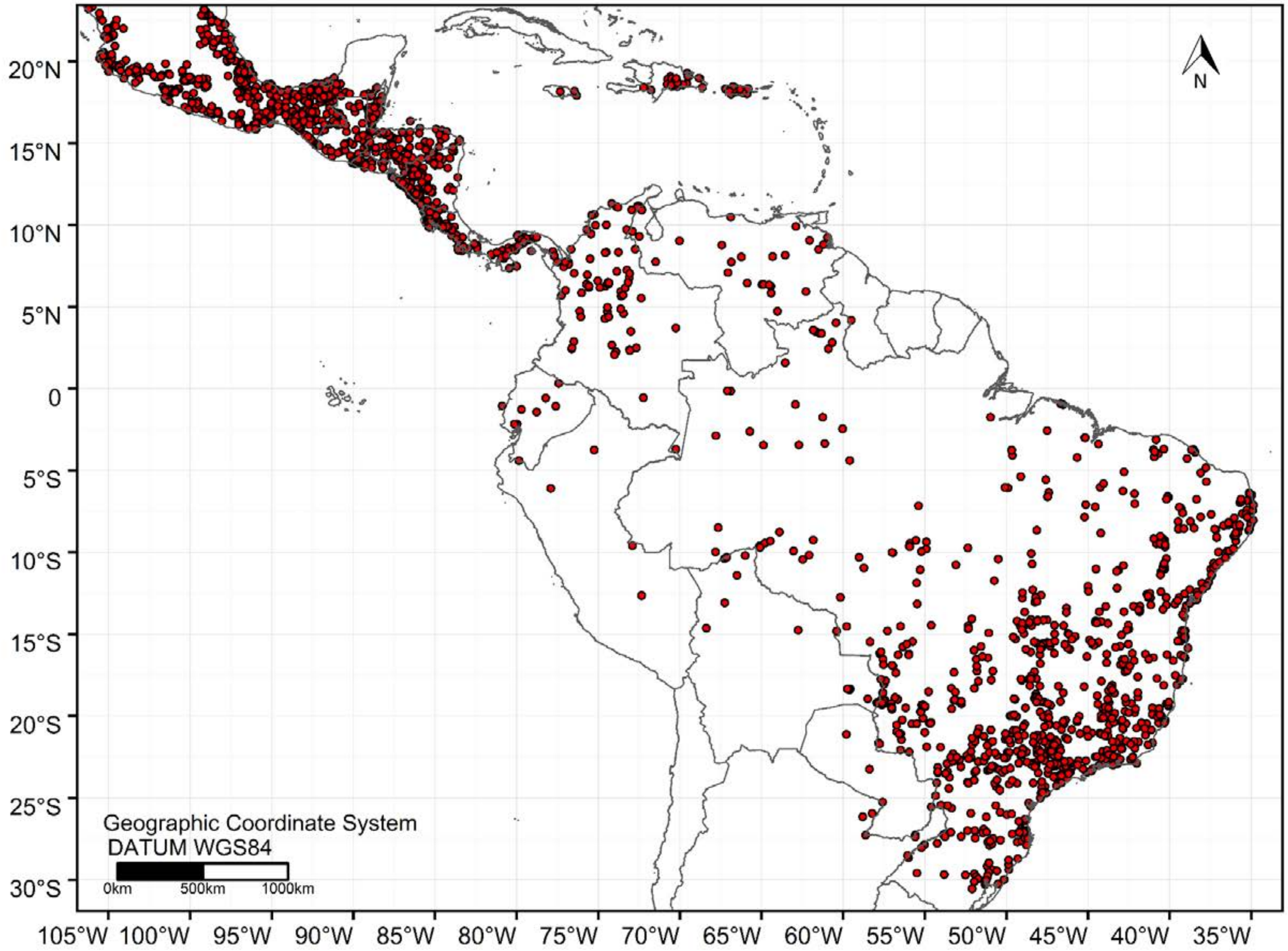
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	61,230	83%	2%	17%	-15%
Rain forest	97,848	87%	3%	13%	-10%
Whole region	159,079	85%	3%	15%	-12%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	61,230	72%	2%	28%	-26%
Rain forest	97,848	82%	2%	18%	-15%
Whole region	159,079	78%	2%	22%	-20%

Points of observed presence



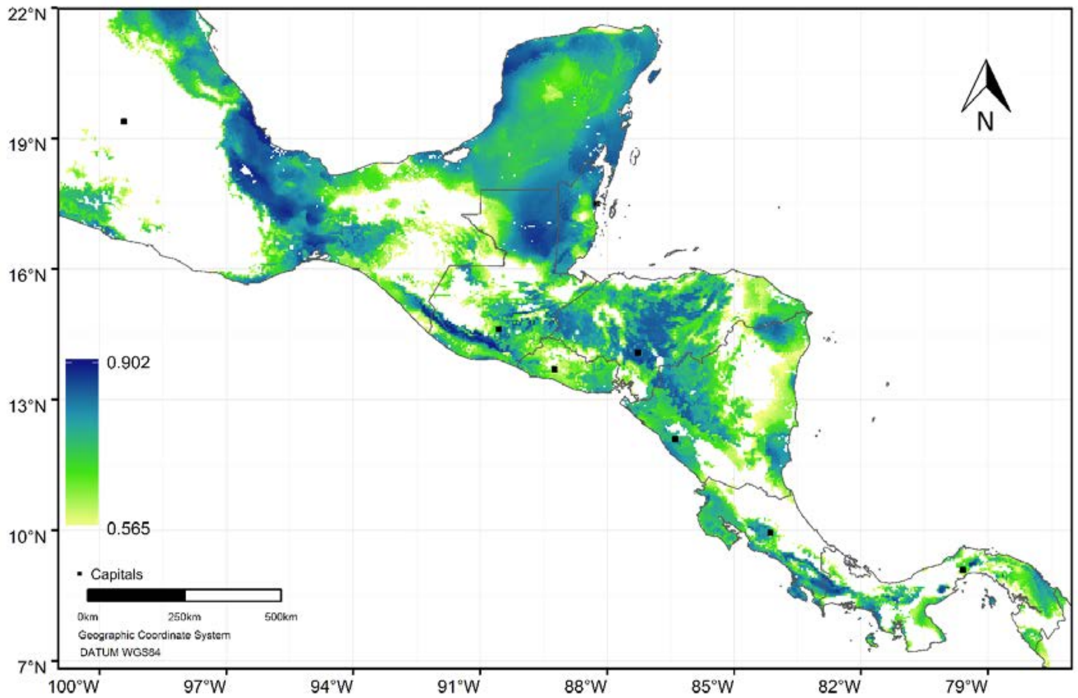
Maclura tinctoria (L.) D.Don ex Steud.

Family:
Moraceae
Vernacular names:
Mora, palo amarillo
(CR, SV, HN, GT, NI, PA)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Dioecious	**Drought**	Unknown
Plant height (m)	28 (25 – 31)	**Timber uses**[1]	SM, CS, MB, HF, PS, DT, CH	**Pollination vector**	Unknown	**Flooding**	Yes
Spinescence	Yes	**Firewood**	Yes	**Weight 1000 seeds (g)**	3.81 (5.0 – 2.63)	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	Moderate
Wood density (g cm^{-3})	0.82 (0.71 – 1.02)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Tinte	**Seed dispersal**	Zoochory	**Fire**	Unknown

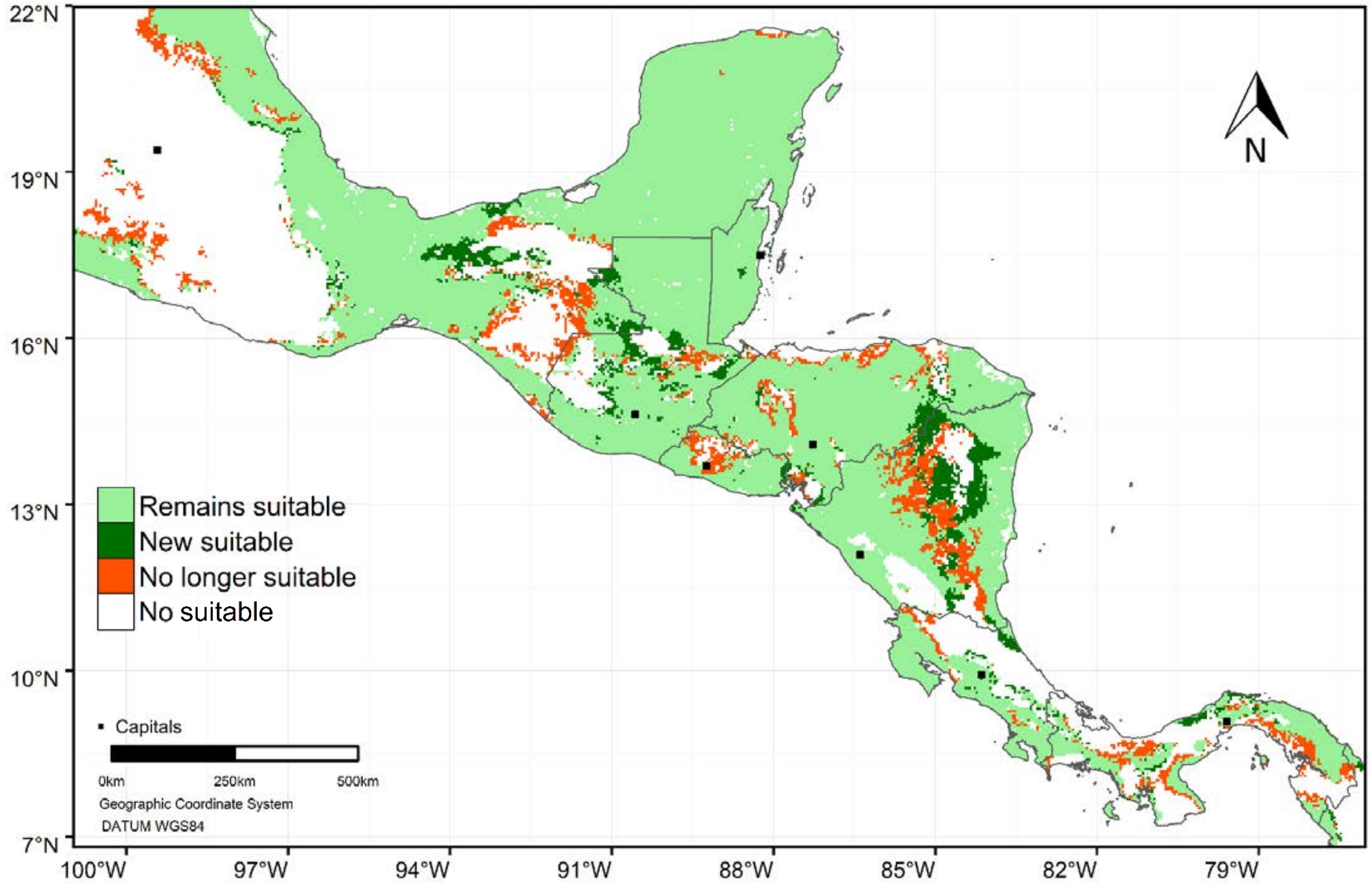
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



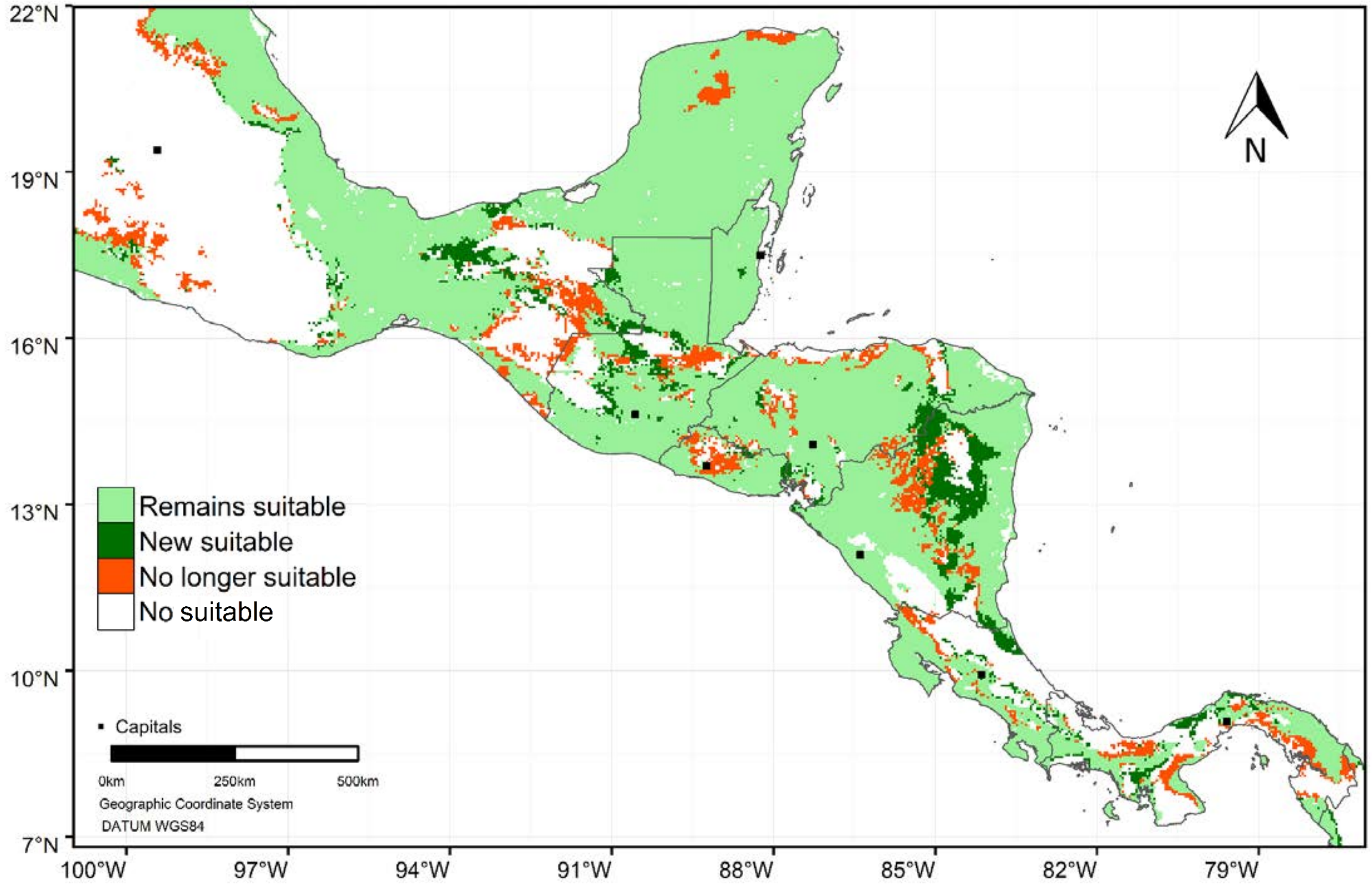
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



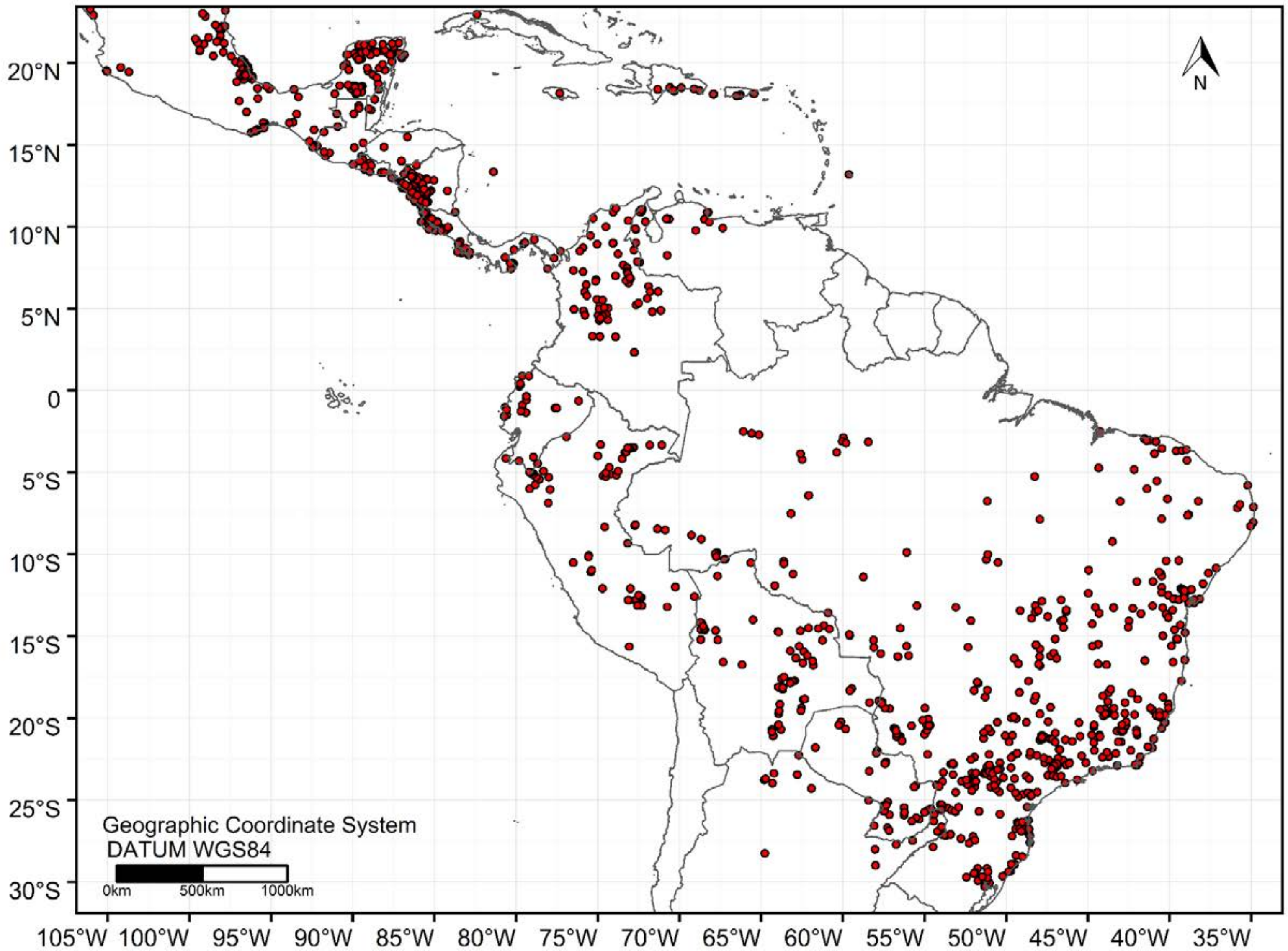
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	64,719	90%	3%	10%	-7%
Rain forest	104,012	90%	10%	10%	0%
Whole region	168,732	90%	7%	10%	-3%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	64,719	88%	4%	12%	-8%
Rain forest	104,012	90%	11%	10%	1%
Whole region	168,732	89%	8%	11%	-2%

Points of observed presence



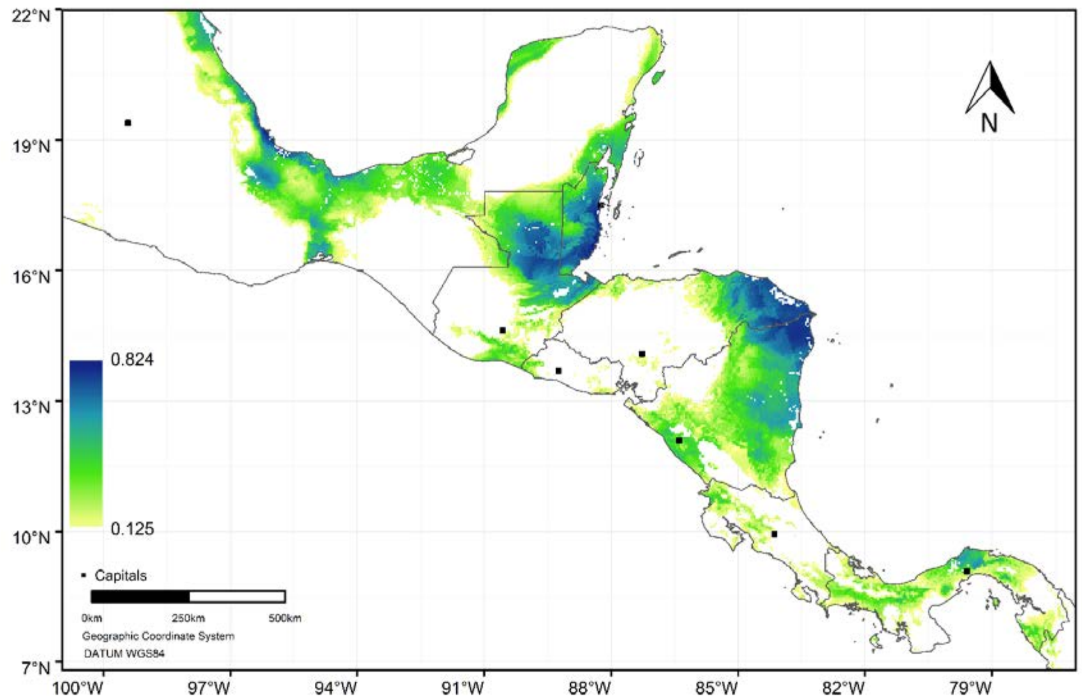
Mammea americana L.

Family:
Calophyllaceae
Vernacular names:
Mamey (CR, HN, GT, NI, PA); abrico

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Dioecious	**Drought**	Unknown
Plant height (m)	15 (12 – 25)	**Timber uses**[1]	CS, MB, AR	**Pollination vector**	Unknown	**Flooding**	No
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (kg)**[2]	69.9 (48-103)	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	Unknown
Wood density (g cm^{-3})	0.74 (0.62 – 0.98)	**Forage**	No	**Seed dormancy**	Unknown	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	Zoochory, Hydrochory	**Fire**	Unknown

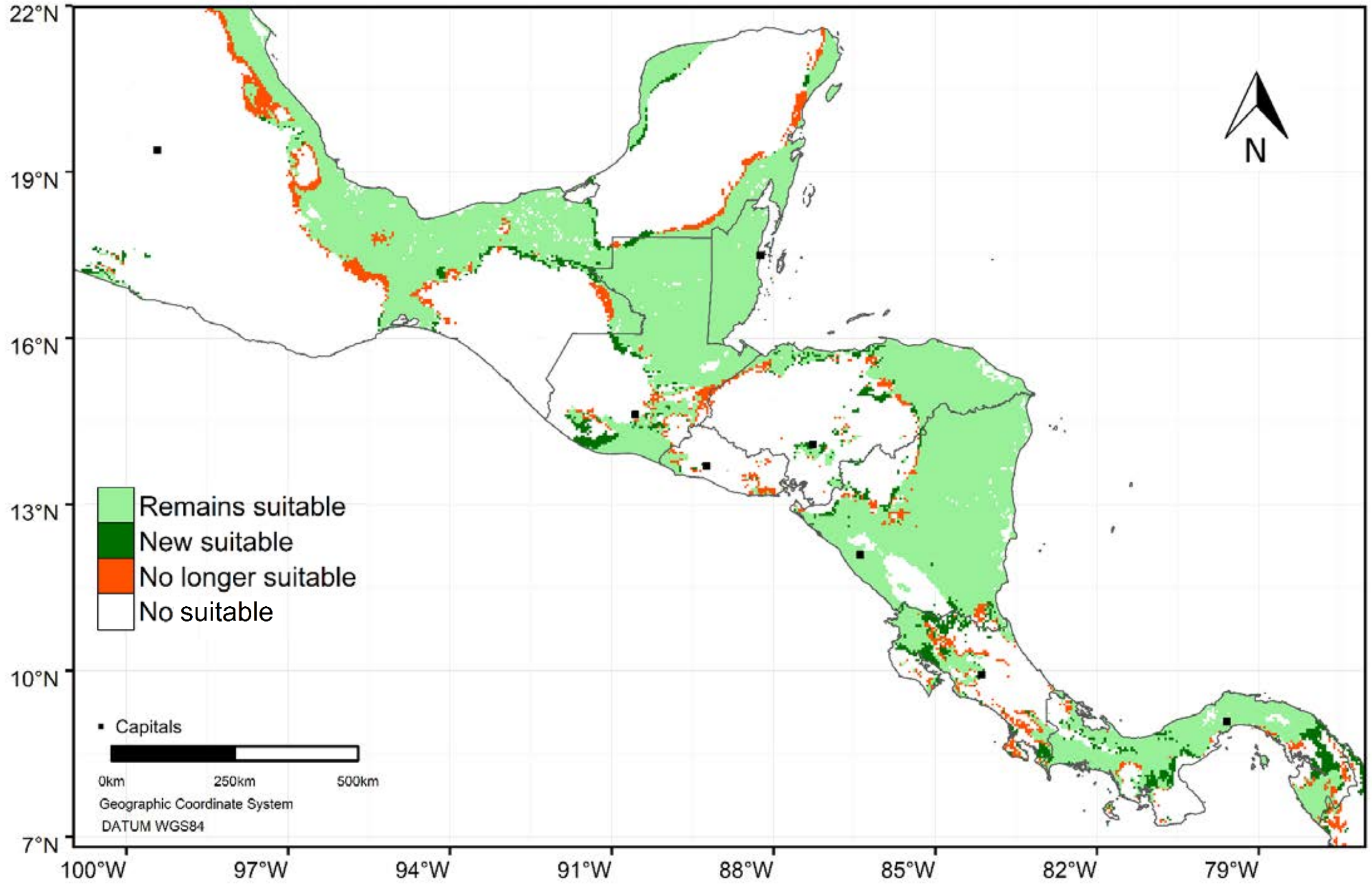
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
[2] Given the large size of the seed, seed weight is reported in kg.

Species suitable areas under current climate



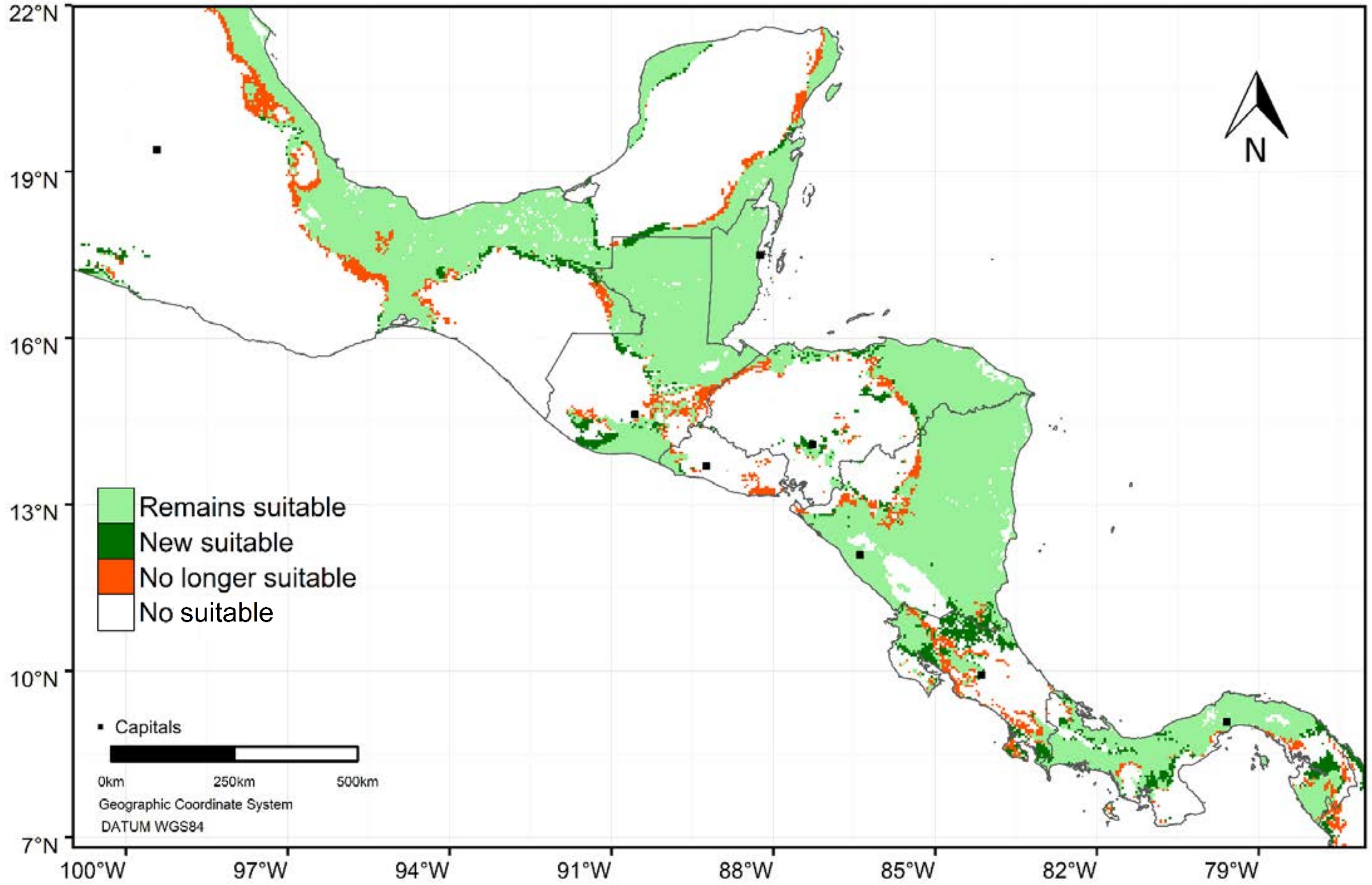
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



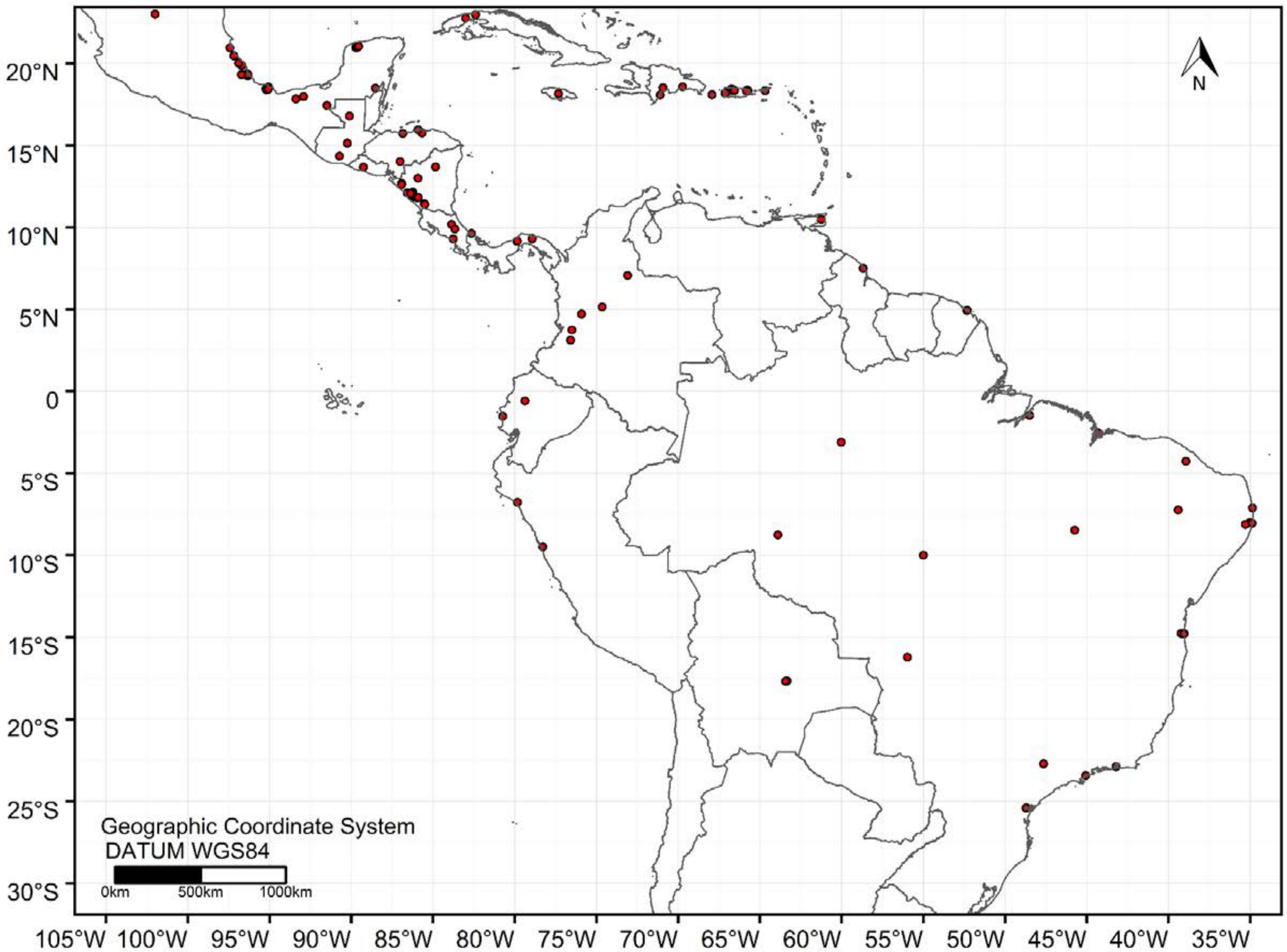
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	17,665	88%	16%	12%	4%
Rain forest	87,588	92%	6%	8%	-2%
Whole region	105,252	91%	8%	9%	-1%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	17,665	83%	14%	17%	-3%
Rain forest	87,588	92%	7%	8%	-1%
Whole region	105,252	90%	9%	10%	-1%

Points of observed presence



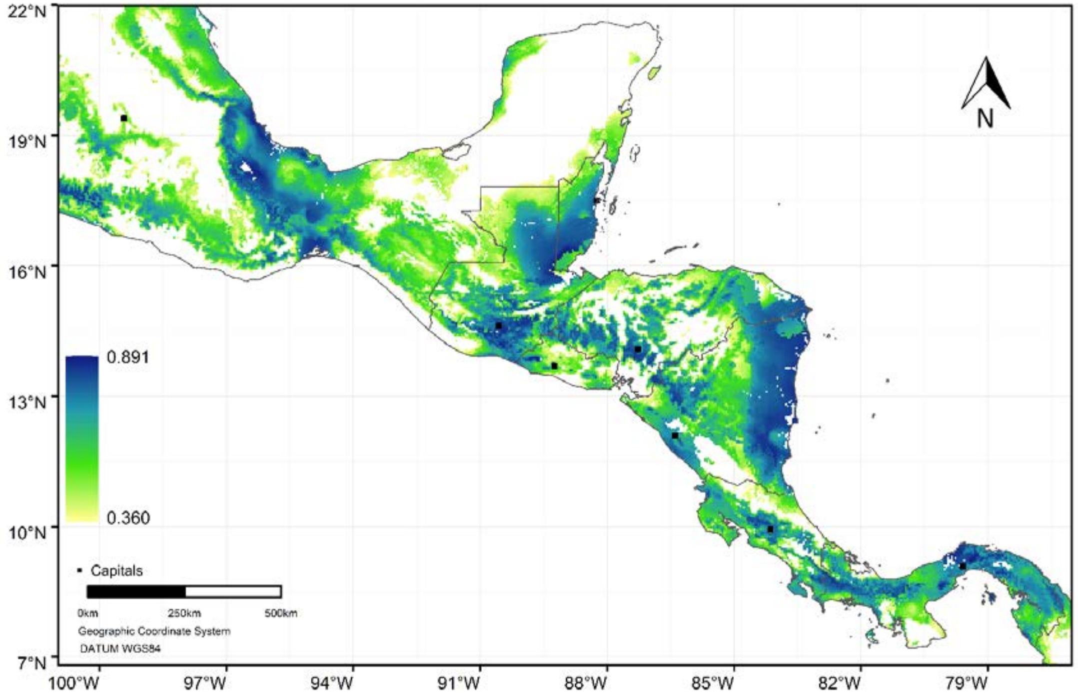
Mangifera indica L.

Family: Anacardiaceae
Vernacular names: Mango
Exótica

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	11 (5 – 30)	**Timber uses**[1]	CL, MB, HF, PS, AR	**Pollination vector**	Insects	**Flooding**	Moderate
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (kg)**[2]	21.3 (18.2 – 25)	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	Moderate
Wood density ($g\ cm^{-3}$)	0.62 (0.48 – 0.82)	**Forage**	No	**Seed dormancy**	No	**Salinity**	No
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	* Domesticated, human mediated, Zoochory, Hydrochory, Autochory	**Fire**	No

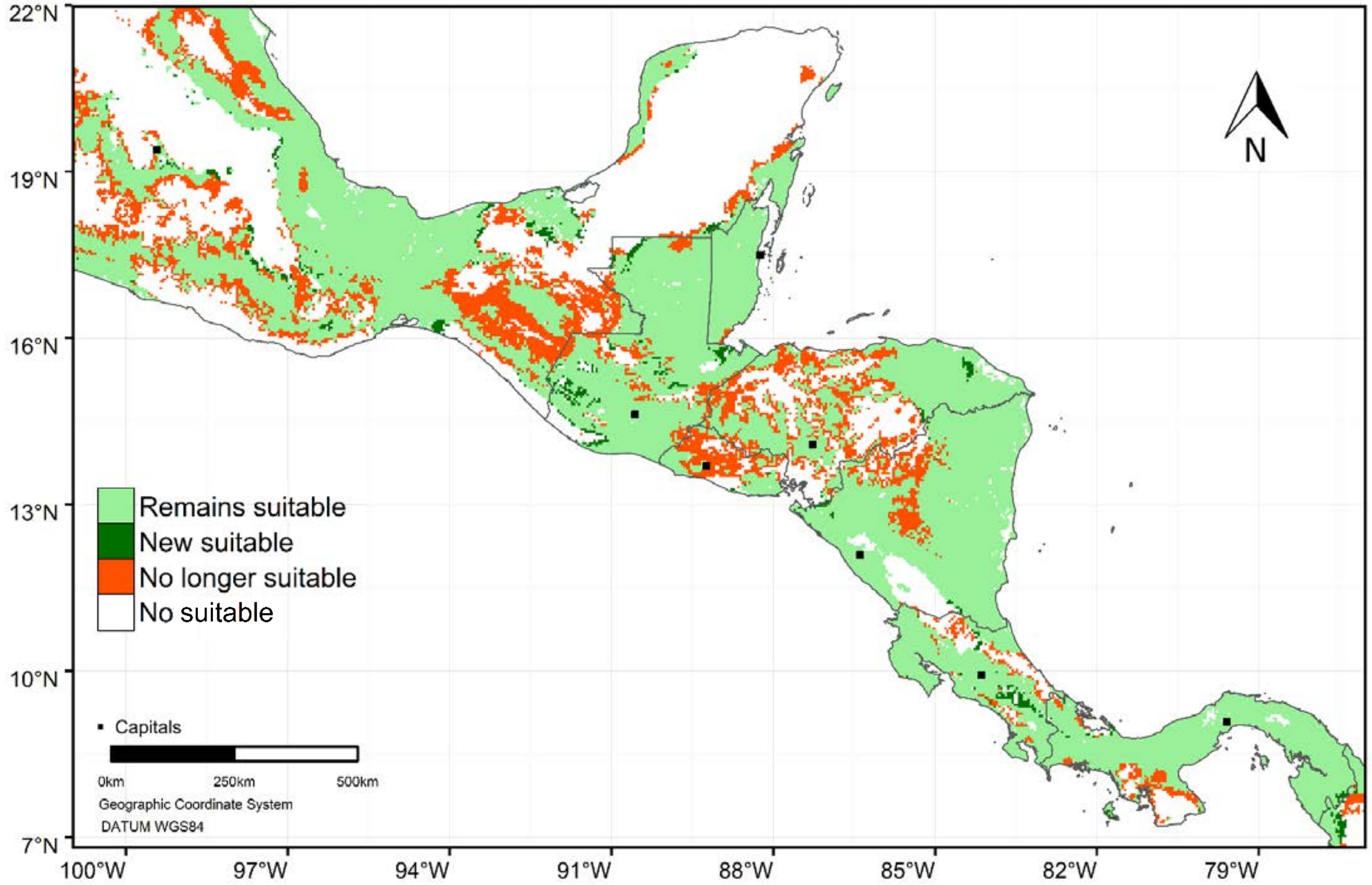
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
[2] Given the large size of the seed, seed weight is reported in kg.

Species suitable areas under current climate



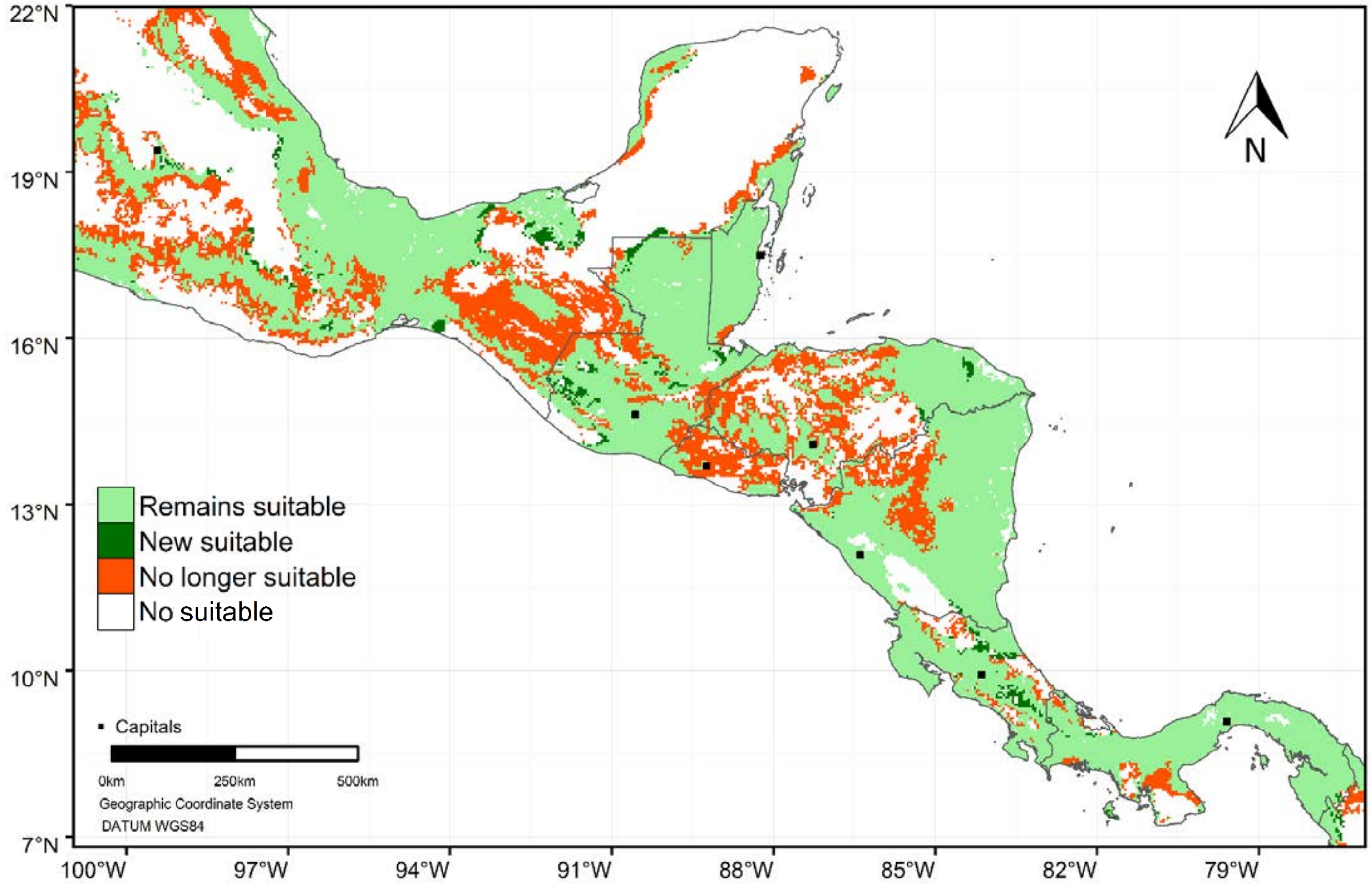
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



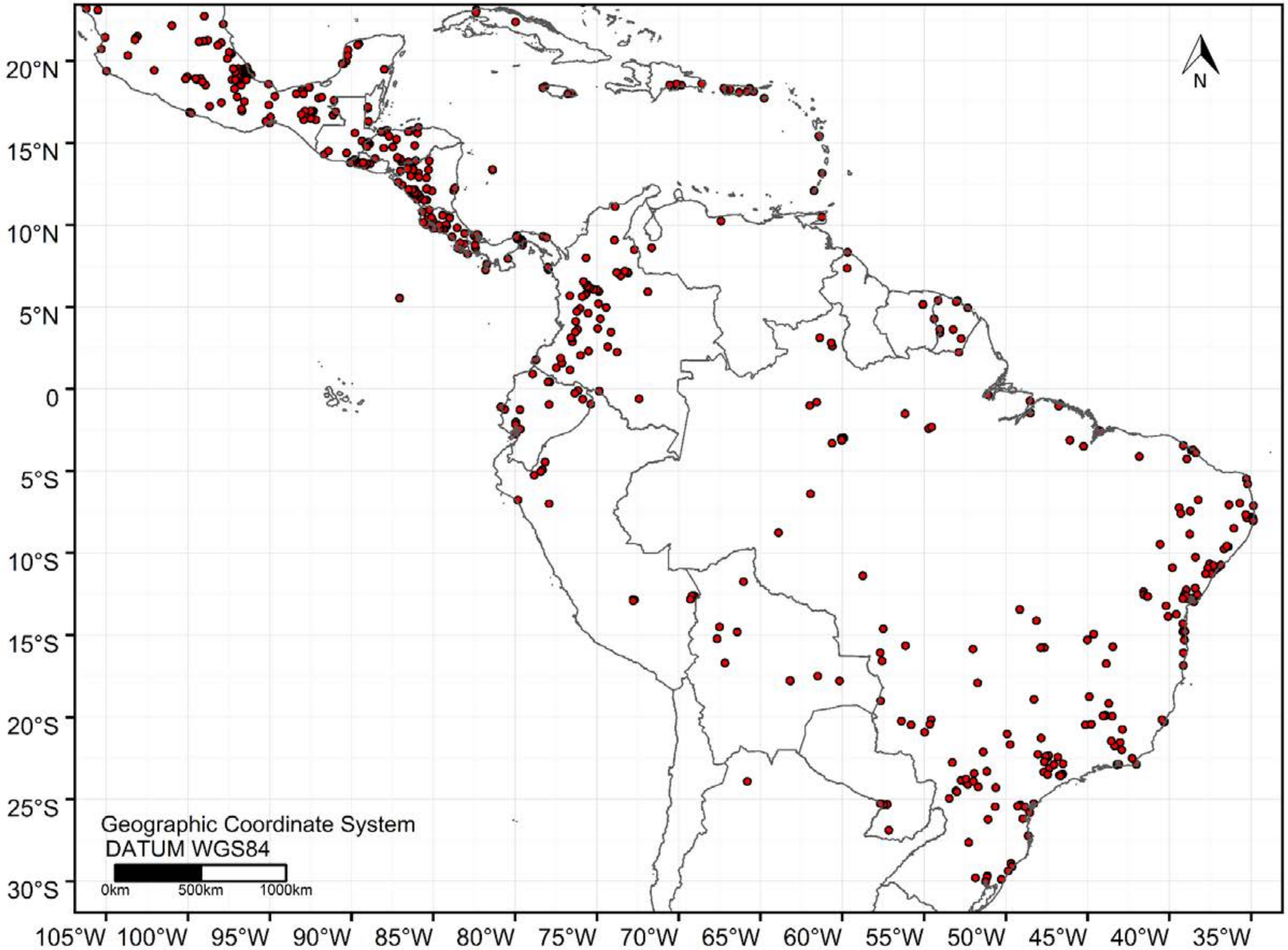
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	70,036	70%	2%	30%	-28%
Rain forest	104,693	86%	3%	14%	-12%
Whole region	174,729	79%	2%	21%	-18%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	70,036	60%	2%	40%	-38%
Rain forest	104,693	83%	3%	17%	-14%
Whole region	174,729	74%	2%	26%	-24%

Points of observed presence



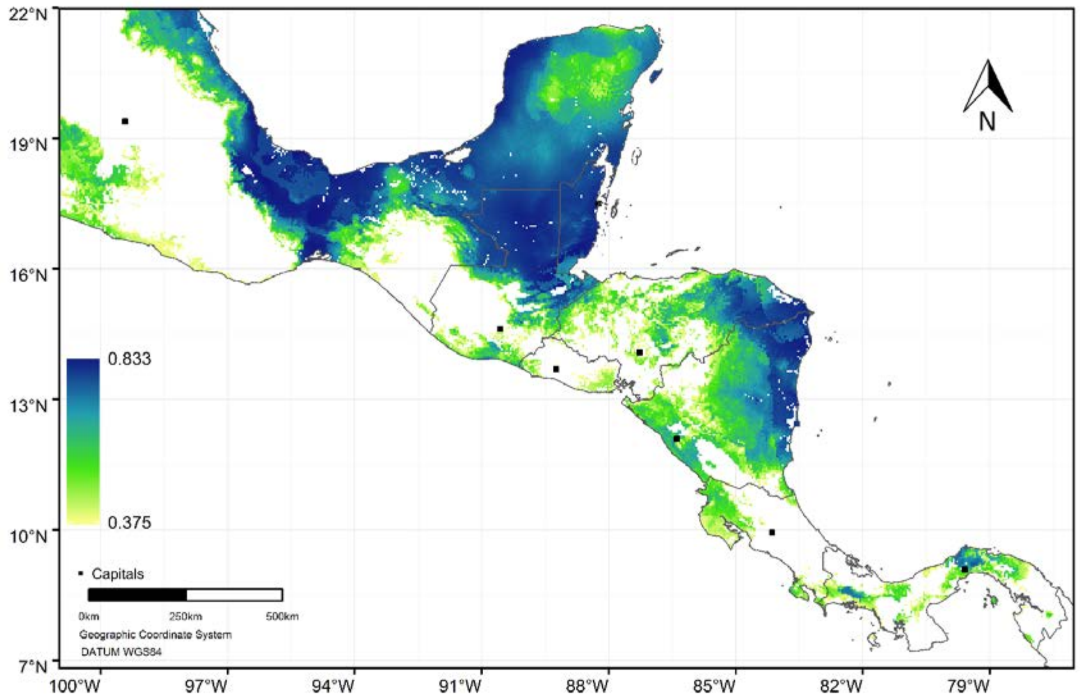
Manilkara zapota (L.) P.Royen

Family:
Sapotaceae
Vernacular names:
Chicozapote (GT),
níspero (CR, SV, NI, PA),
sapodilla (BZ),
zapote (SV, GT, HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	No
Plant height (m)	7 (5 – 20)	**Timber uses**[1]	SM, CS, MB, HF, PS, DT, AR	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (g)**	420.4 (126.6 – 714.3)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Unknown	**Shade**	Unknown
Wood density (g cm^{-3})	0.79 (0.72 – 0.86)	**Forage**	No	**Seed dormancy**	Unknown	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Apiculture, Medicinal	**Seed dispersal**	Zoochory	**Fire**	Unknown

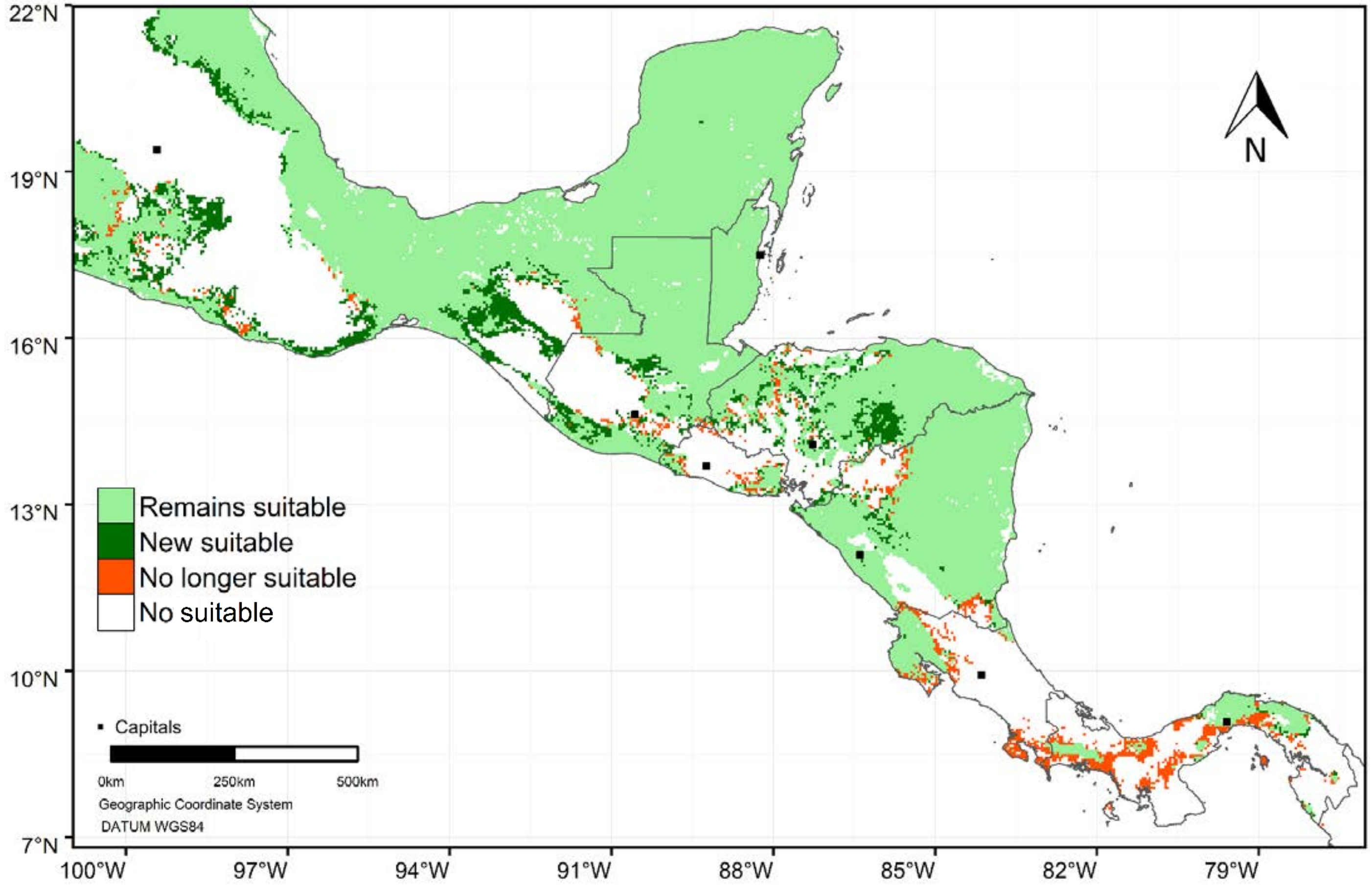
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



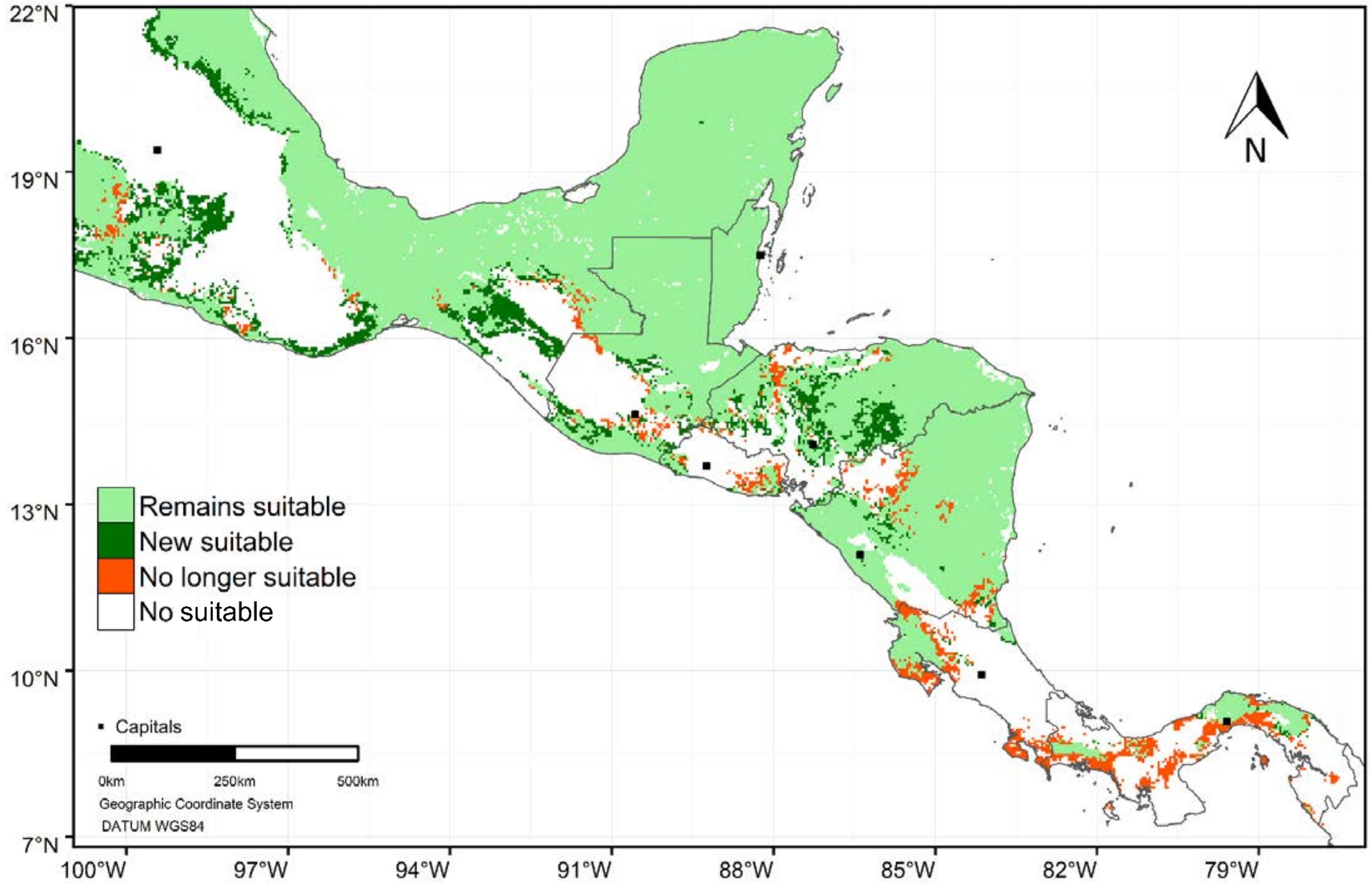
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



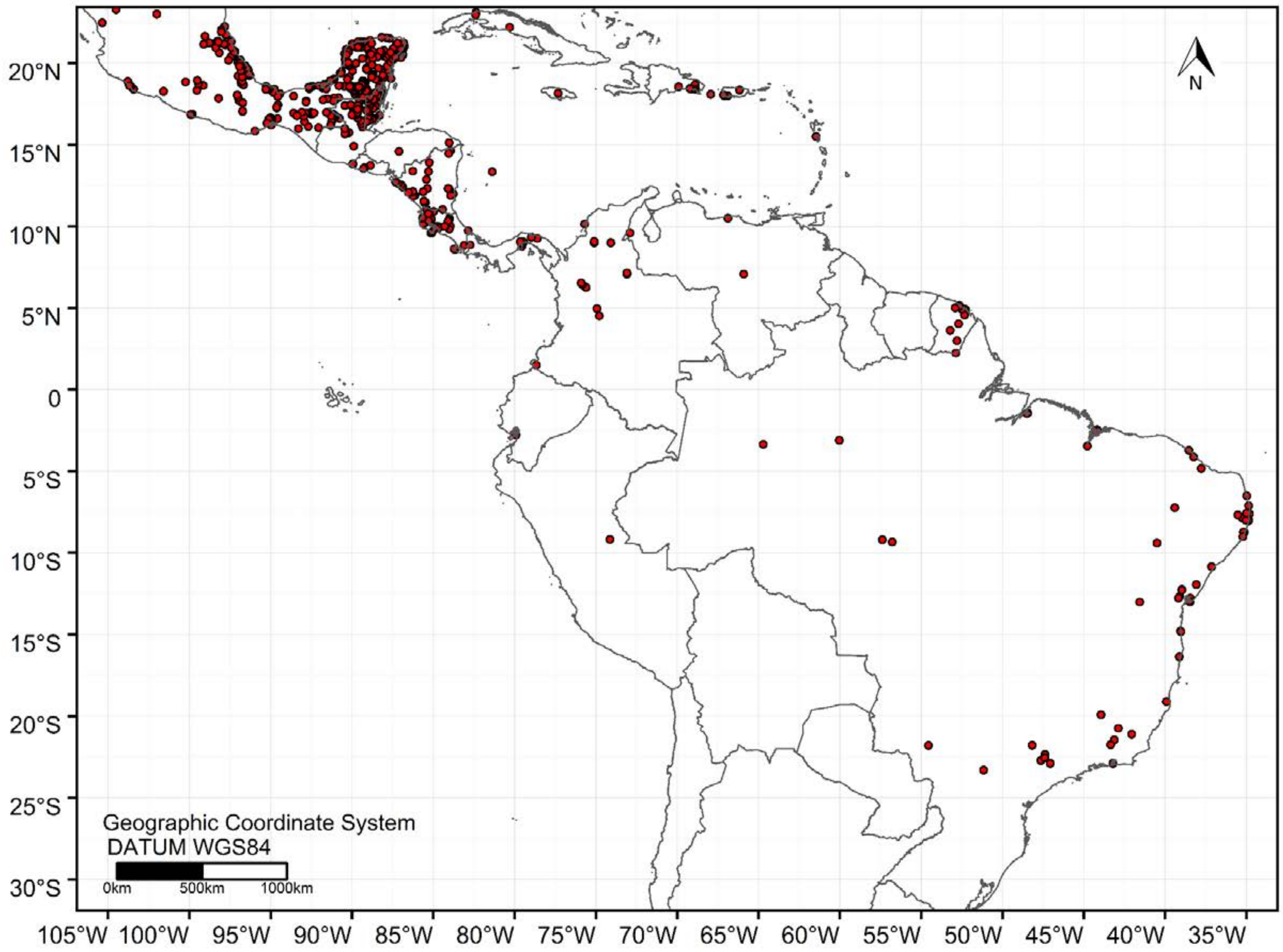
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	48,657	95%	24%	5%	19%
Rain forest	109,647	95%	3%	5%	-1%
Whole region	158,304	95%	10%	5%	5%

Cambios de aptitud al año 2050-escenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	48,657	93%	28%	7%	21%
Rain forest	109,647	94%	3%	6%	-3%
Whole region	158,304	94%	11%	6%	4%

Points of observed presence



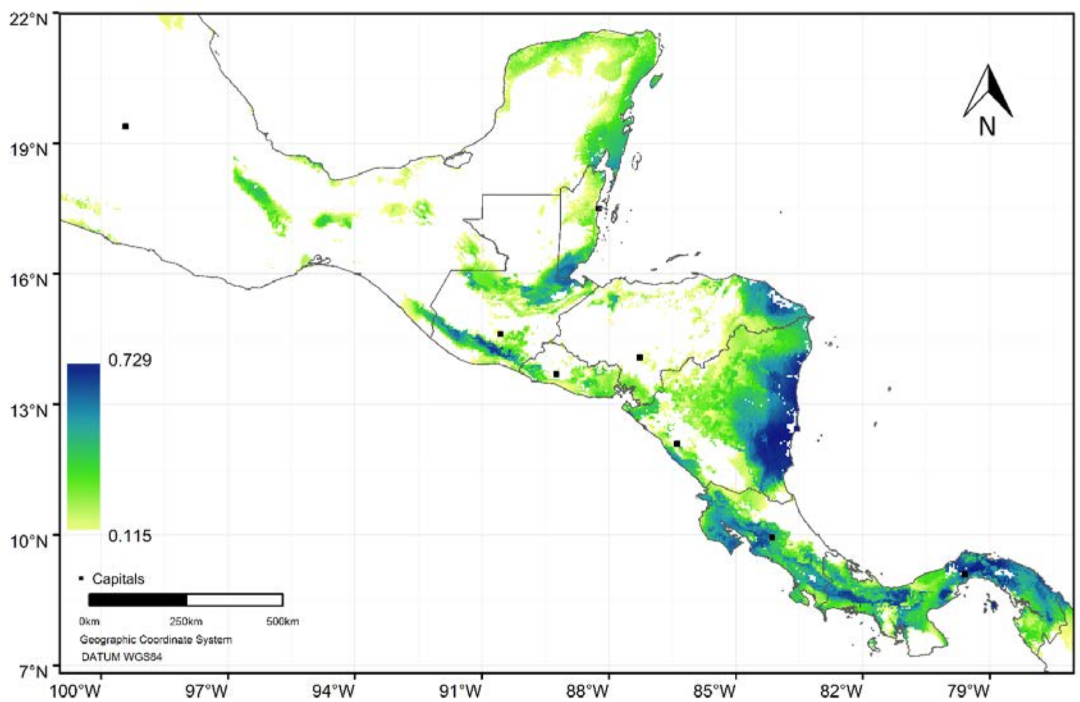
Melicoccus bijugatus Jacq.

Family:
Sapindaceae
Vernacular names:
Mamón (CR, NI, SV, HN, PA)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Dioecious	**Drought**	Yes
Plant height (m)	18 (6 – 30)	**Timber uses[1]**	SM, CL, MB	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (g)**	Unknown	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	No
Wood density (g cm^{-3})	0,61	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Colorants	**Seed dispersal**	Zoochory	**Fire**	Unknown

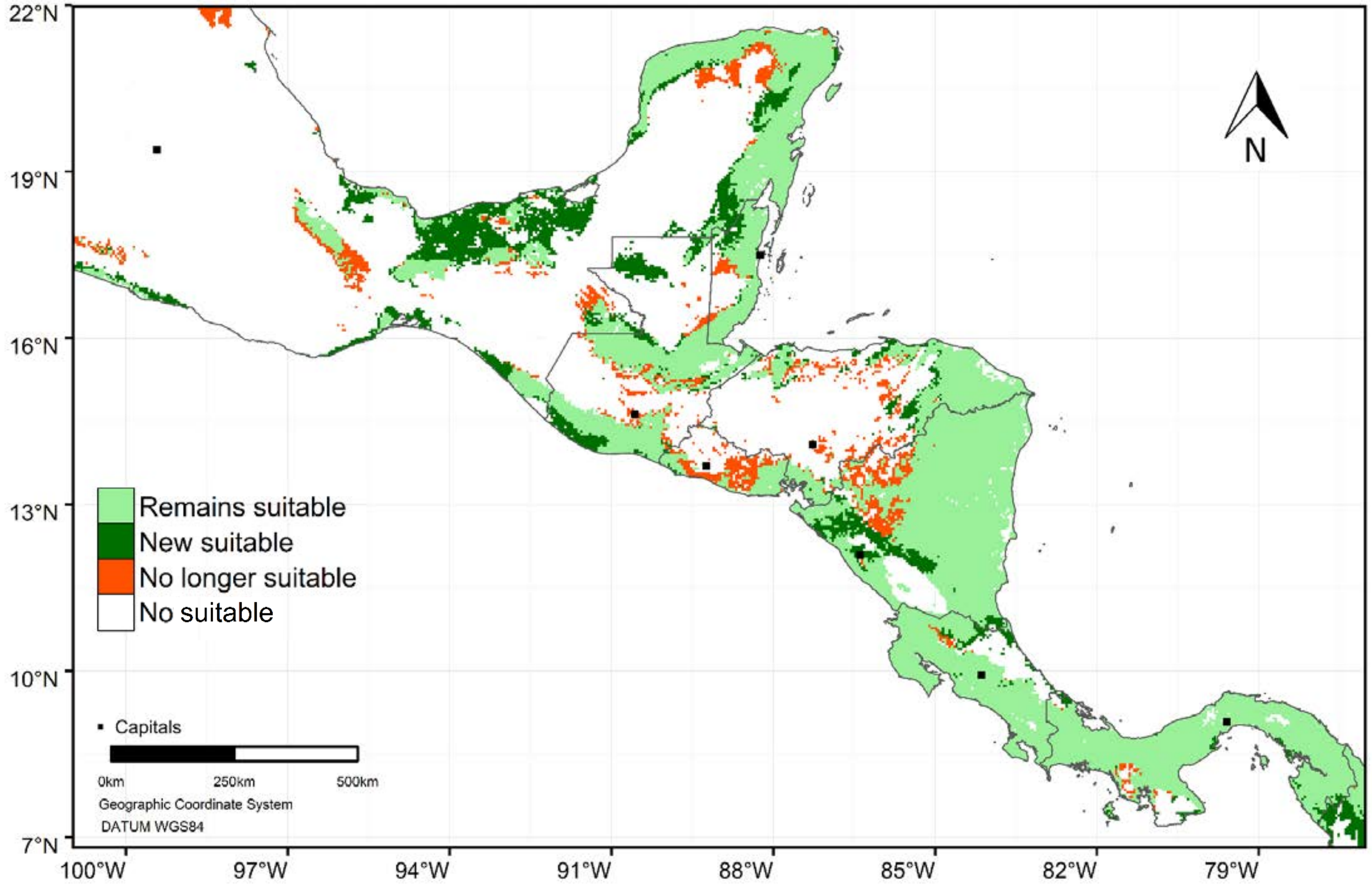
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



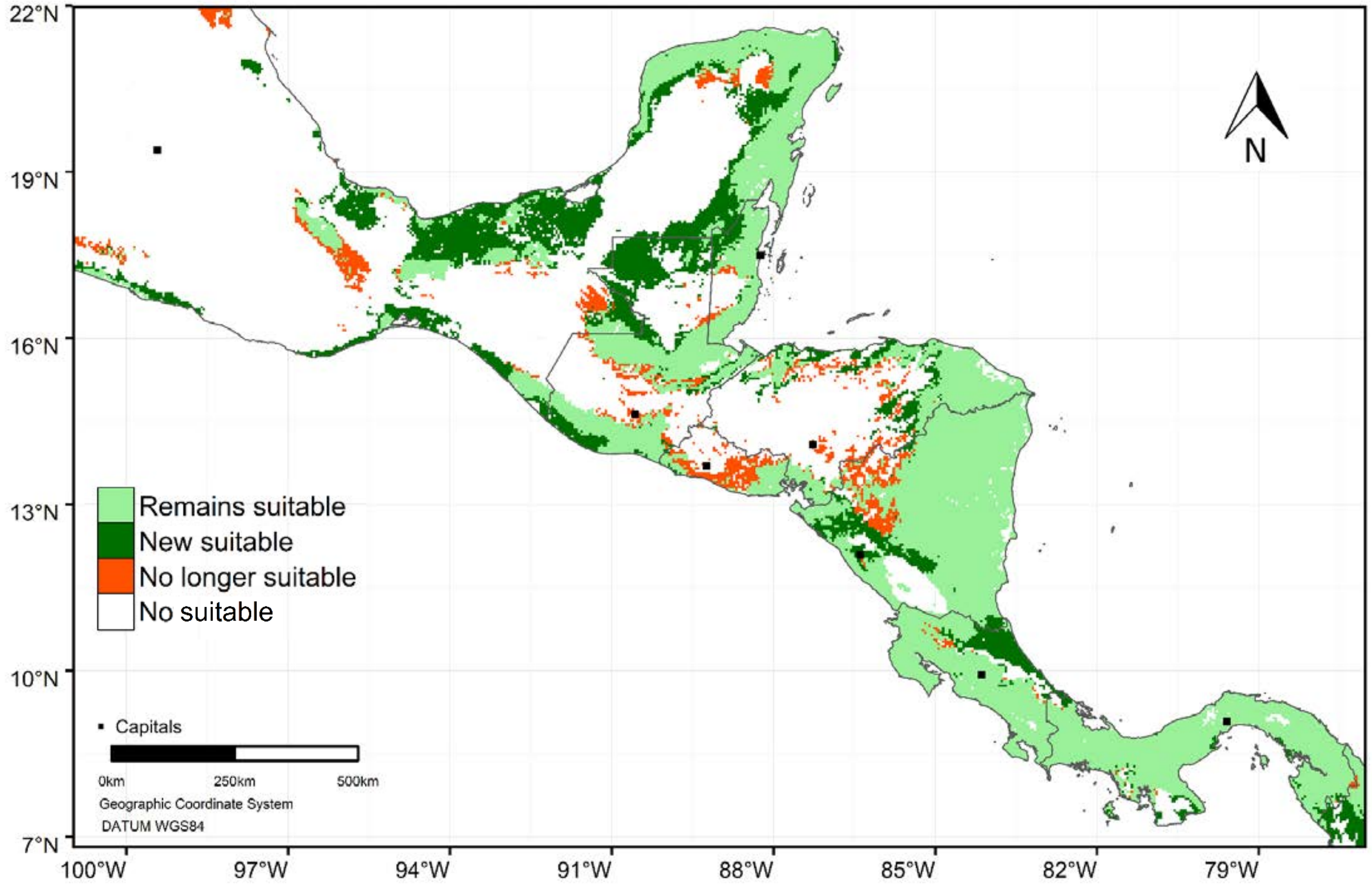
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



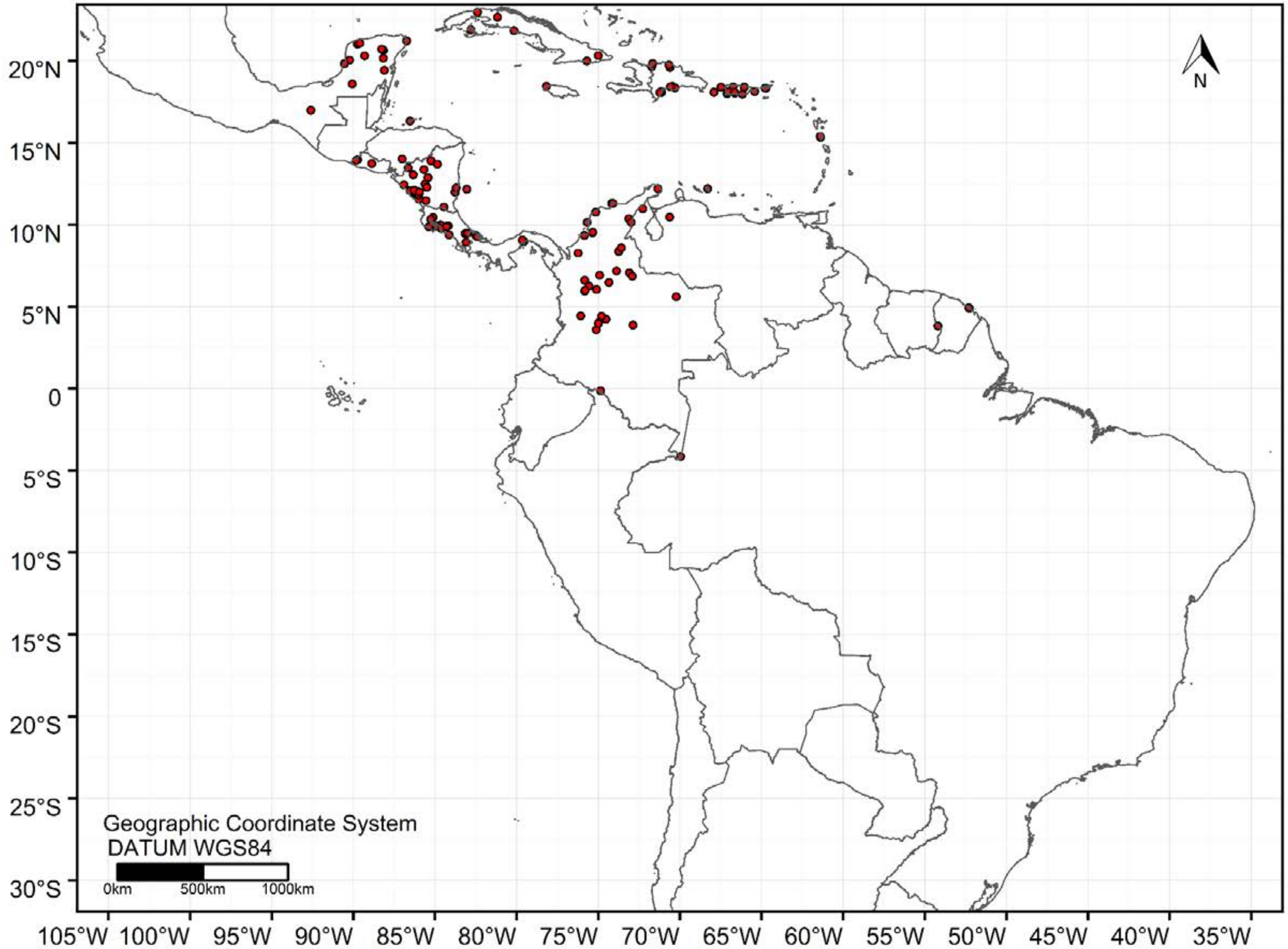
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	23,221	72%	22%	28%	-6%
Rain forest	71,932	93%	21%	7%	15%
Whole region	95,153	88%	21%	12%	10%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	23,221	74%	33%	26%	7%
Rain forest	71,932	94%	34%	6%	29%
Whole region	95,153	89%	34%	11%	23%

Points of observed presence



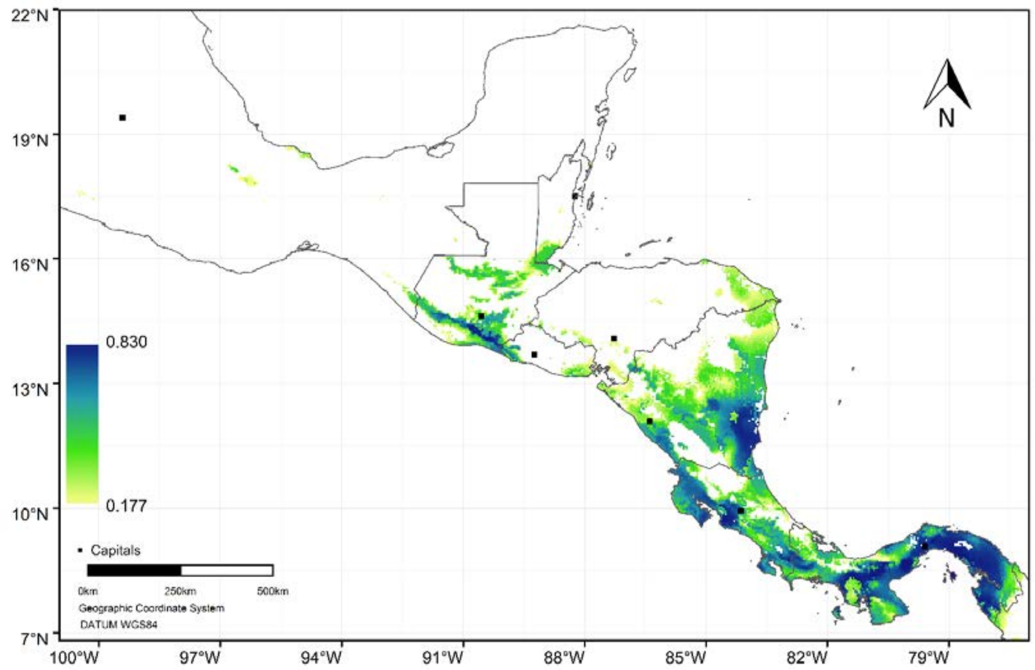
Pachira quinata (Jacq.) W.S.Alverson

Family:
Malvaceae
Sinonimia:
Bombacopsis quinata (Jacq.) Dugand
Vernacular names:
Pochote (NI, CR), cedro espino (HN, PA), ceibo (PA)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	33 (25 – 40)	**Timber uses[1]**	SM, CS, MB, CH, AR	**Pollination vector**	Bats	**Flooding**	Unknown
Spinescence	Yes	**Firewood**	Yes	**Weight 1000 seeds (g)**	31.28 (22.84 – 40)	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.51 (0.35 – 0.7)	**Forage**	No	**Seed dormancy**	Unknown	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Medicinal	**Seed dispersal**	Anemochory	**Fire**	Unknown

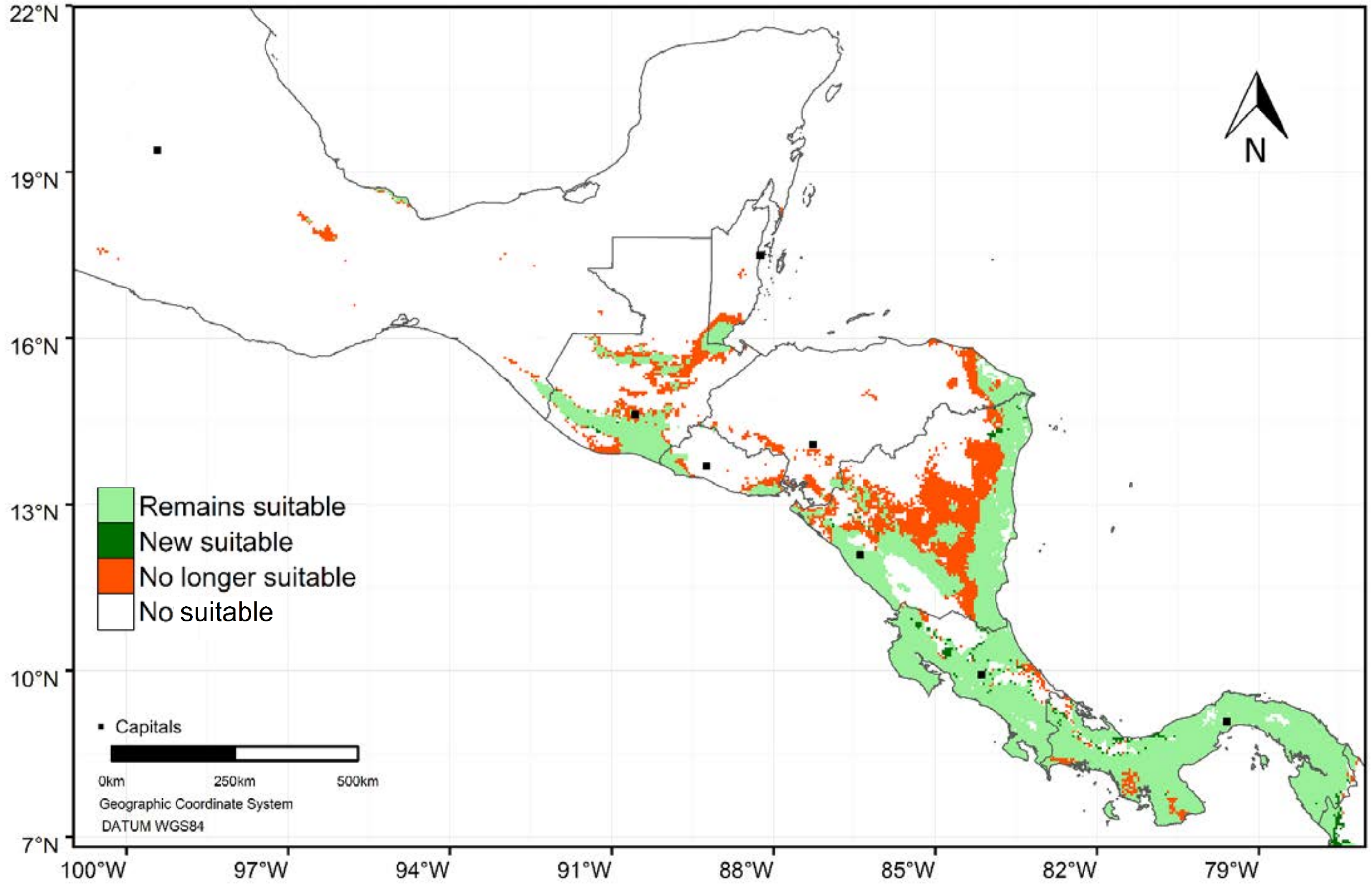
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



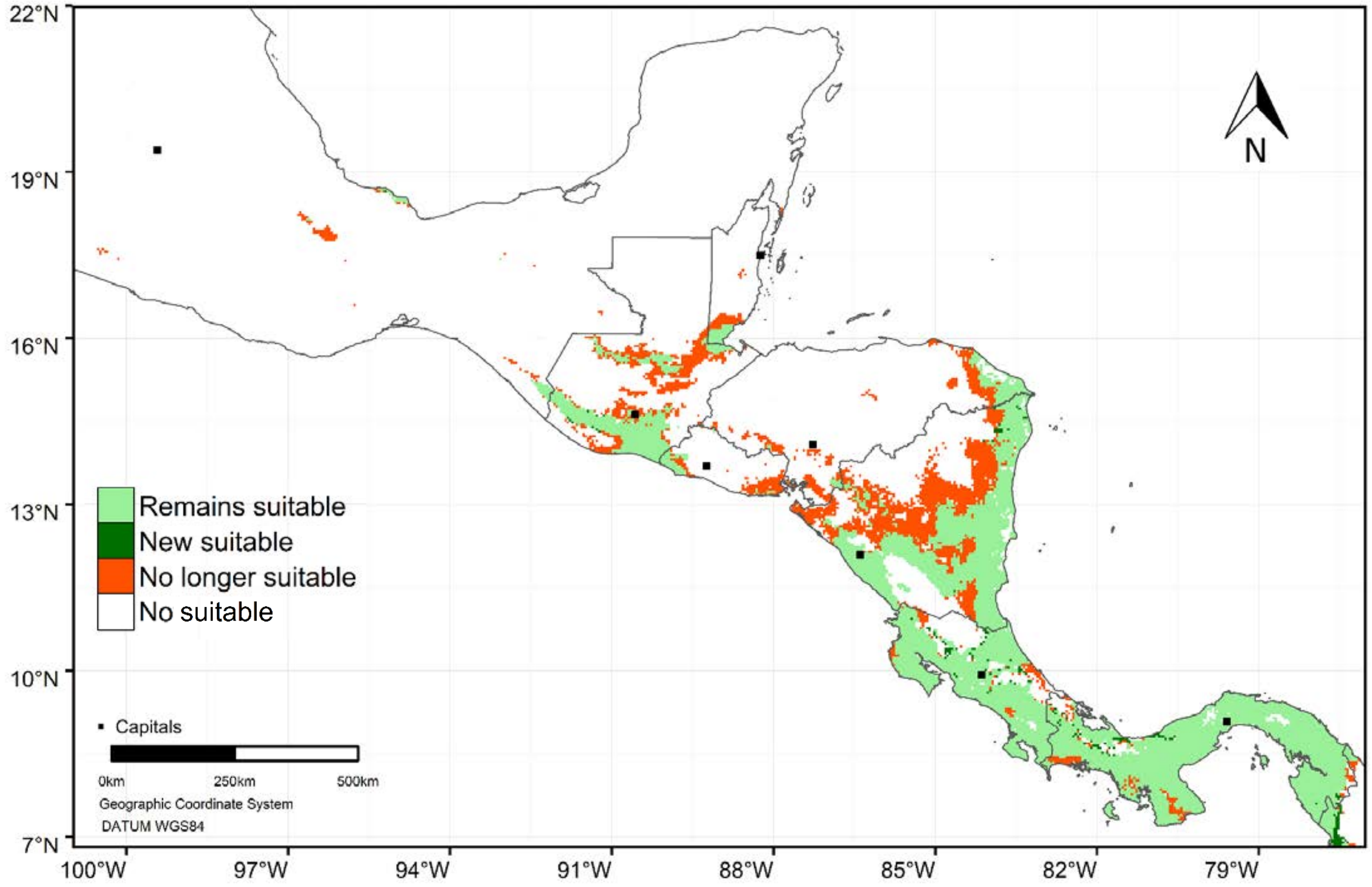
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



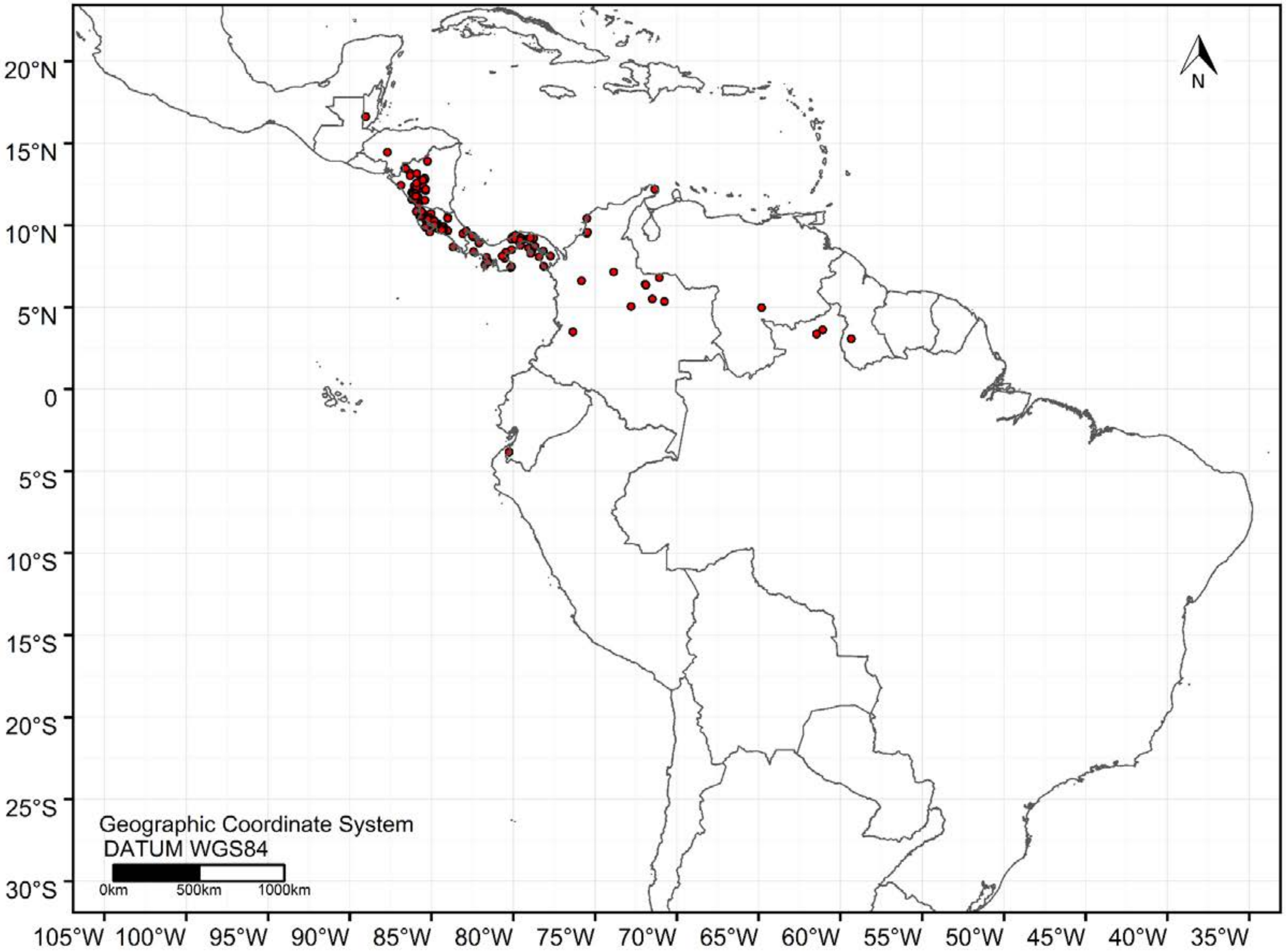
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	13,872	66%	1%	34%	-33%
Rain forest	44,090	75%	2%	25%	-22%
Whole region	57,962	73%	2%	27%	-25%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	13,872	59%	0%	41%	-41%
Rain forest	44,090	77%	2%	23%	-21%
Whole region	57,962	72%	2%	28%	-26%

Points of observed presence



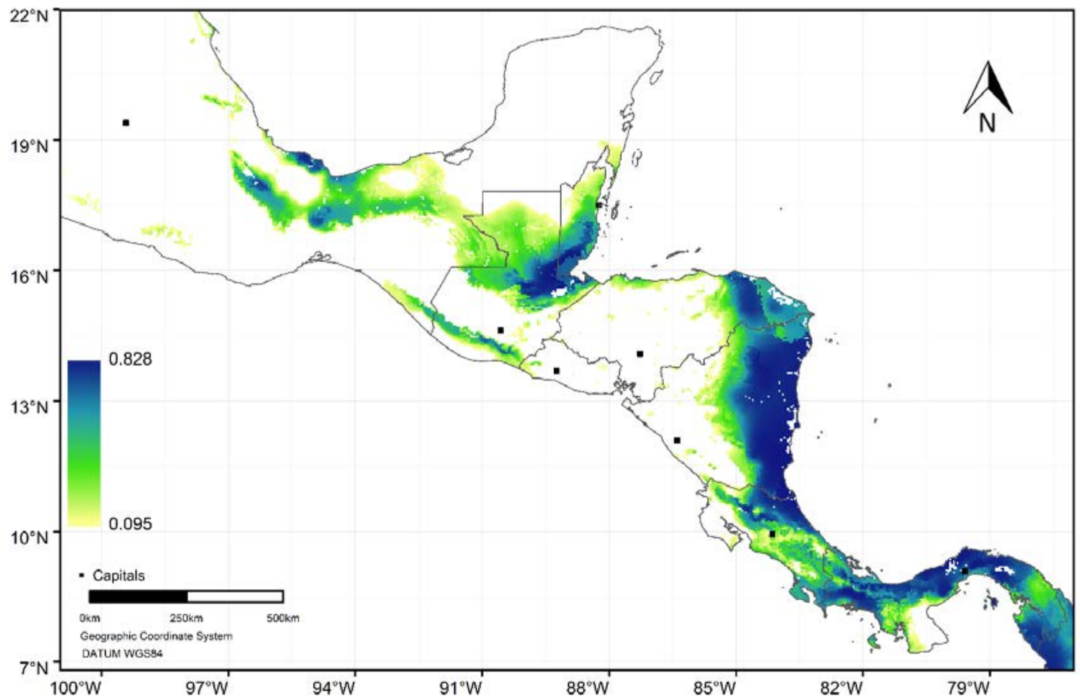
Pentaclethra macroloba (Willd.) Kuntze

Family: Leguminosae
Vernacular names: Gavilán (CR, NI, PA), oil bean tree (BZ), quebracho (CR), palo de aceite (NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	21 (10 – 40)	**Timber uses**[1]	CS, MB, PS, CH	**Pollination vector**	Unknown	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	5,847 (5,190 – 6,510)	**Frost**	Unknown
N fixer	Yes	**Fruit**	No	**Seed storage type**	Recalcitrant	**Shade**	Yes
Wood density (g cm^{-3})	0.63 (0.43 – 0.88)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	Ballistichory, Hydrochory	**Fire**	Unknown

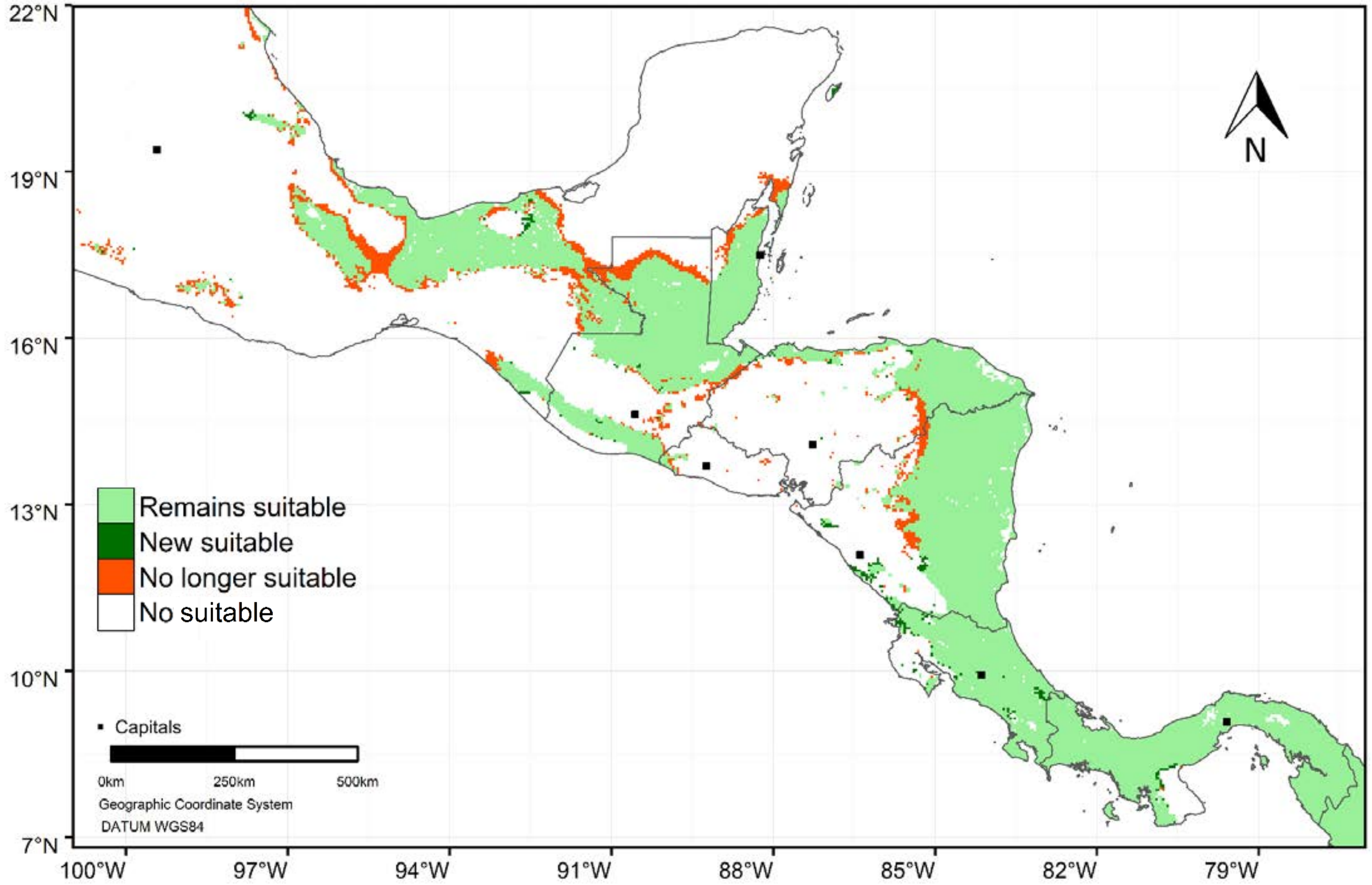
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



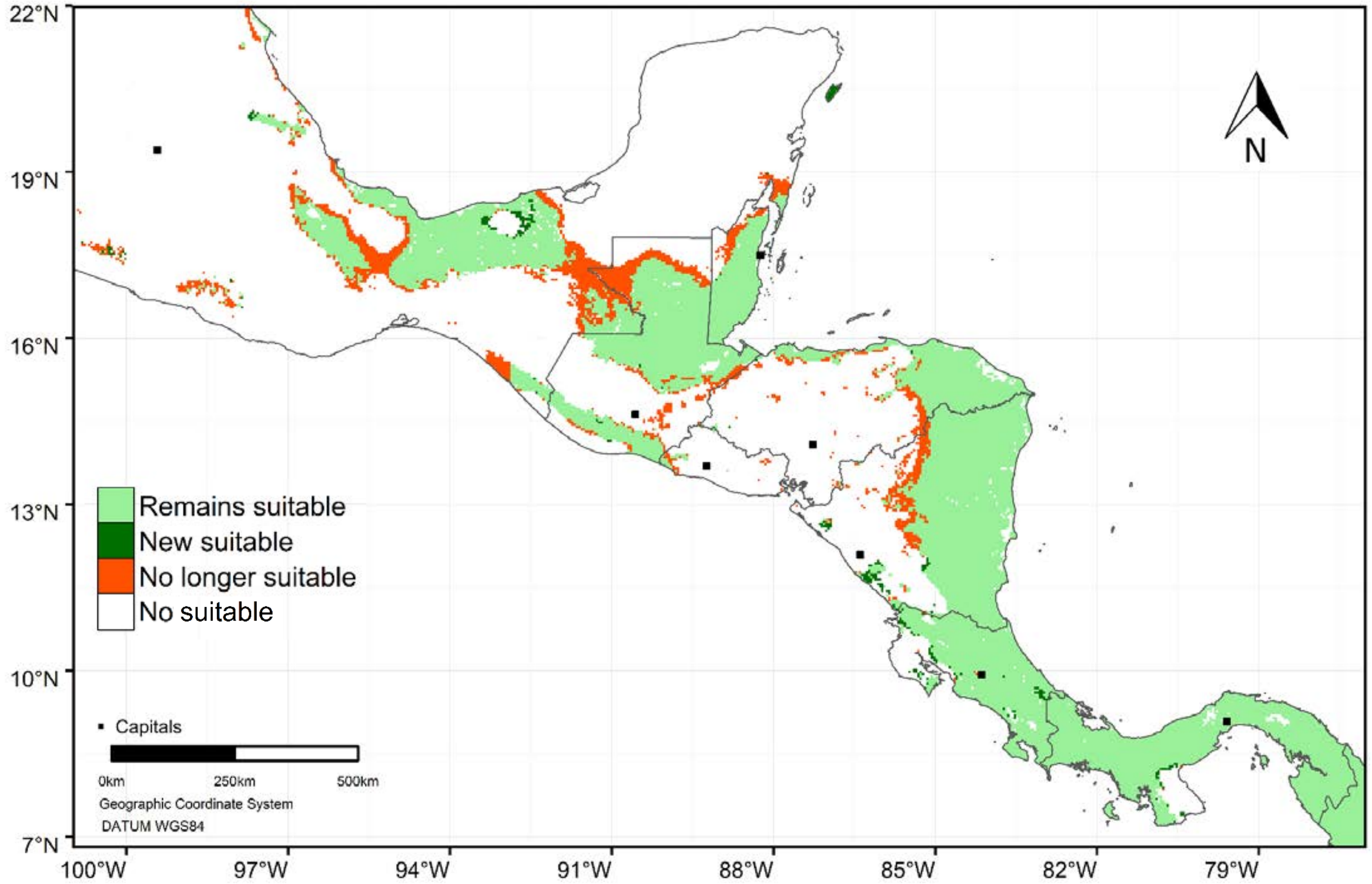
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



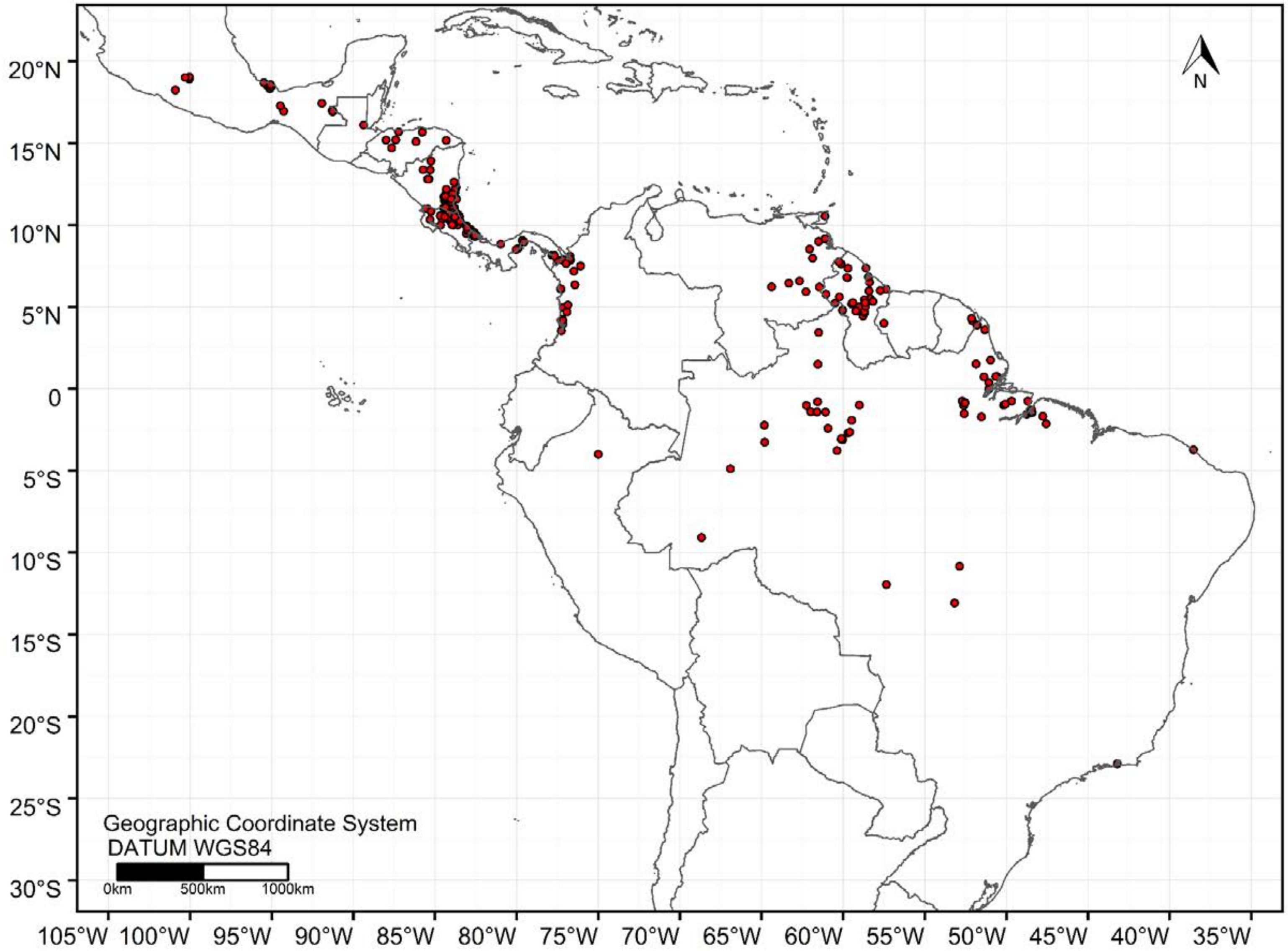
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	8,257	74%	7%	26%	-18%
Rain forest	88,621	92%	1%	8%	-7%
Whole region	96,878	90%	1%	10%	-8%

Cambios de aptitud al año 2050 - escenario RCP 8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	8,257	62%	7%	38%	-31%
Rain forest	88,621	89%	1%	11%	-10%
Whole region	96,878	86%	2%	14%	-12%

Points of observed presence



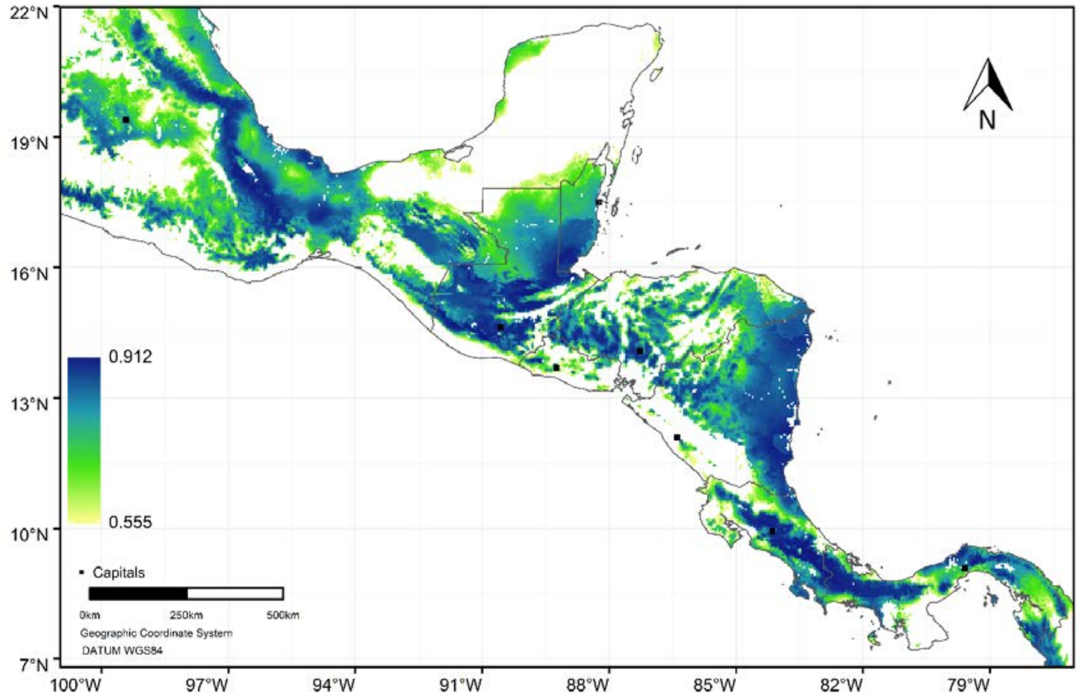
Persea americana Mill.

Family: Lauraceae
Vernacular names: Aguacate

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Moderate, yes depending on cultivar
Plant height (m)	11 (5 – 20)	**Timber uses[1]**	CL, MB, PS, AR	**Pollination vector**	Insects	**Flooding**	Low
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (kg)***	15.31 (9.95 – 20.67)	**Frost**	High in Mexican types, low in others
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	No
Wood density ($g\ cm^{-3}$)	0.62 (0.52 – 0.76)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	High in West-Indian types, low in others
Leaf phenology	Deciduous	**Other uses**	Cosméticos	**Seed dispersal**	* Domesticated, human mediated	**Fire**	No

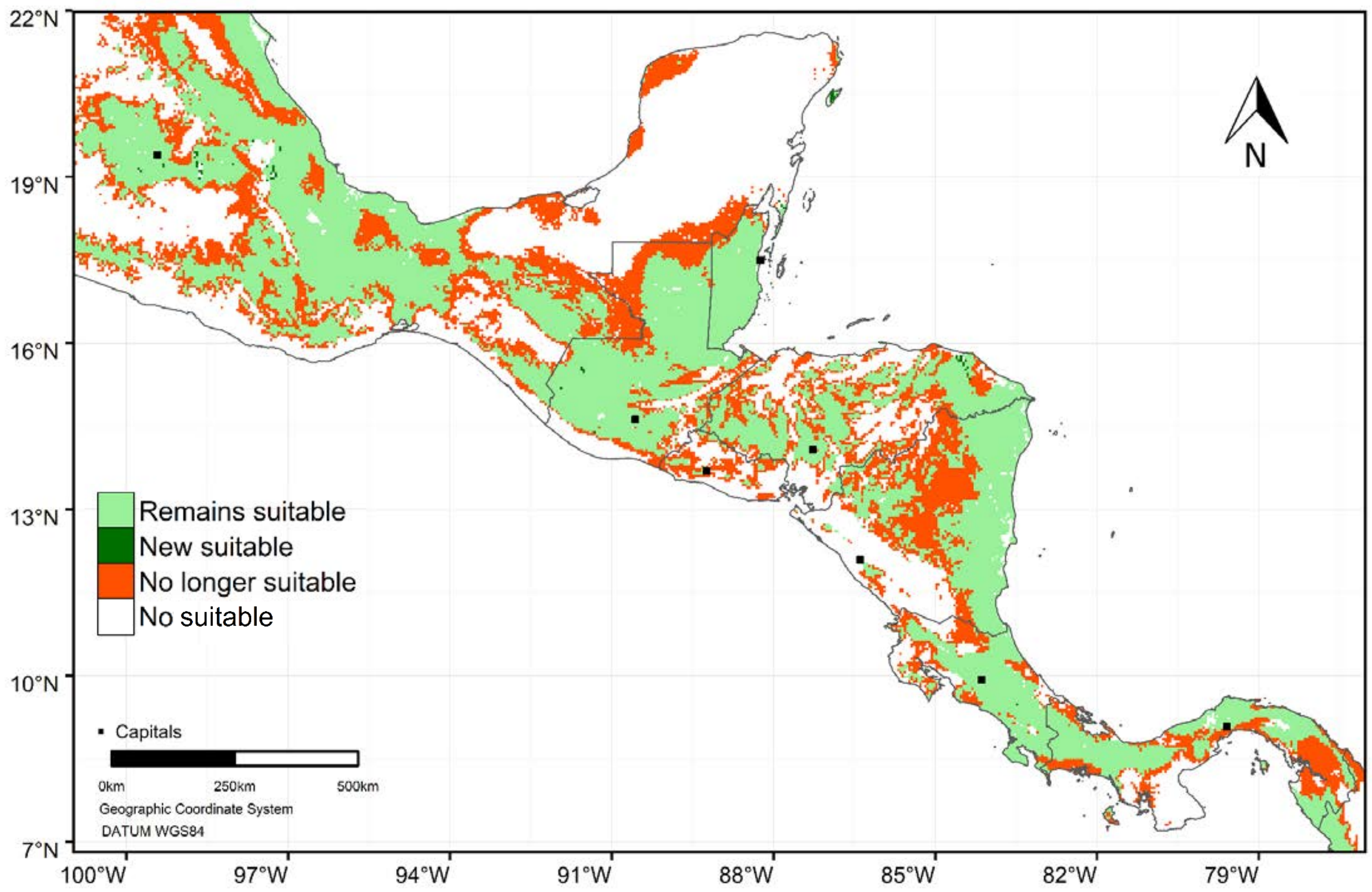
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



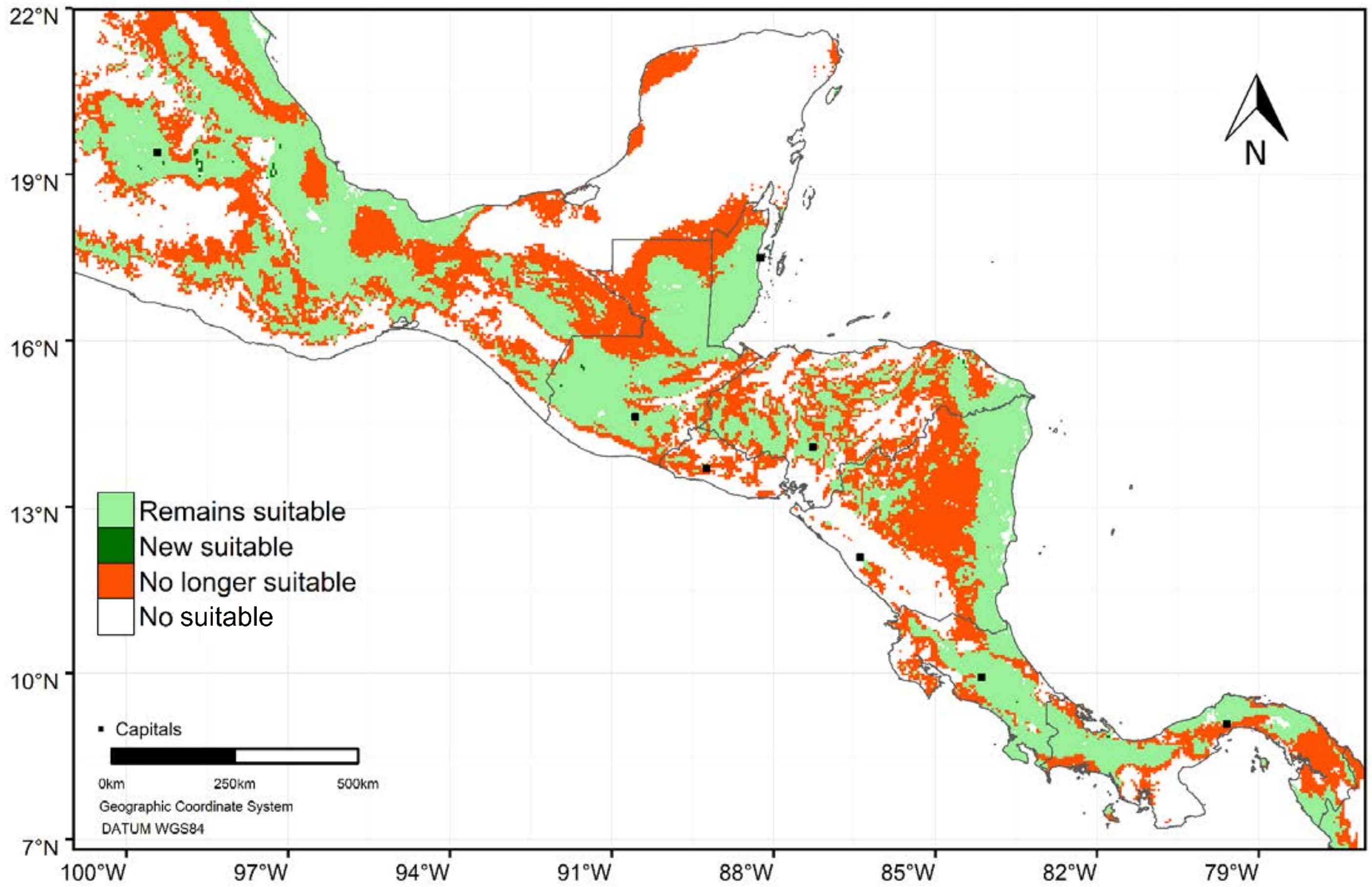
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



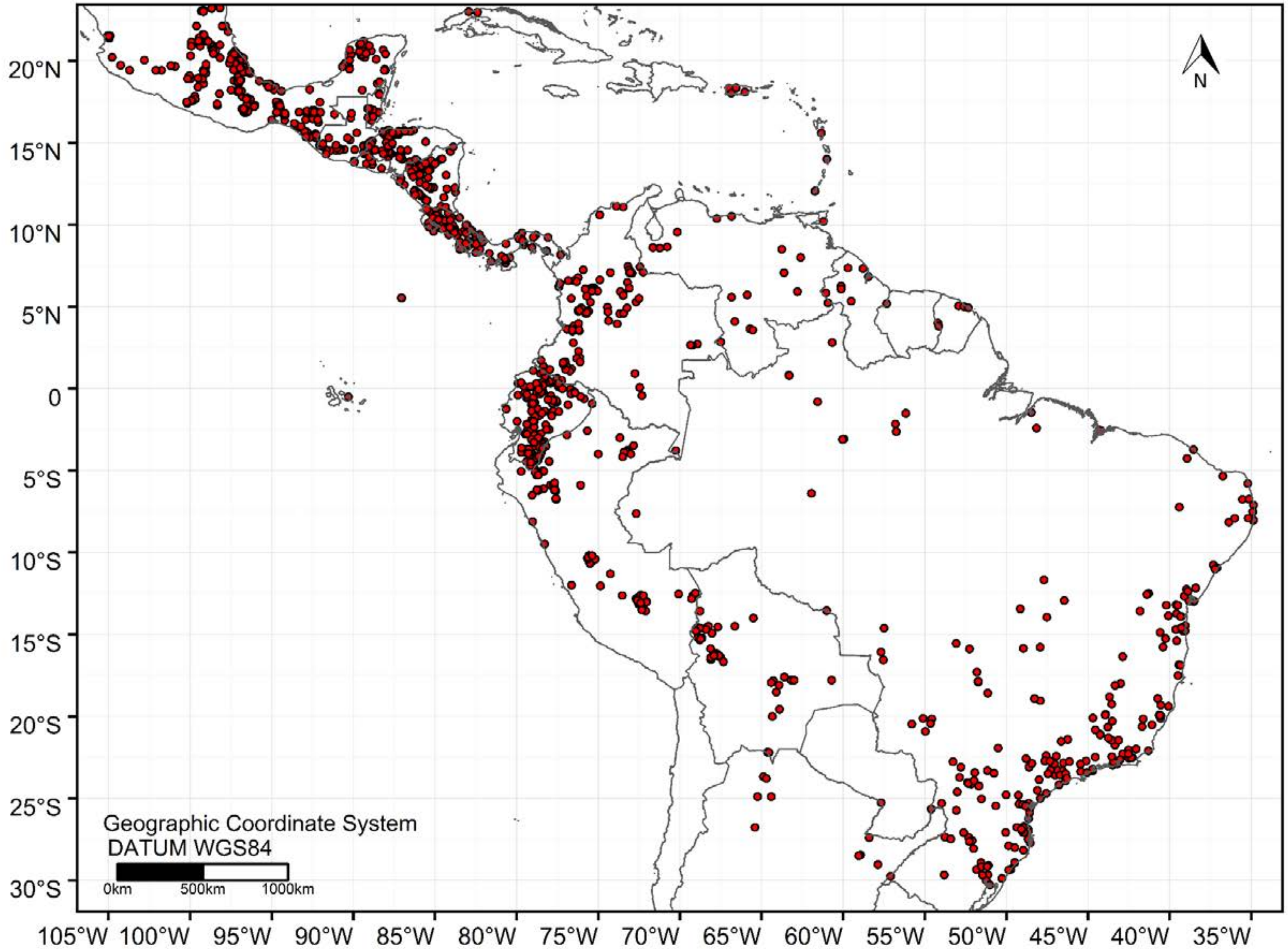
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	67,032	61%	0%	39%	-39%
Rain forest	102,444	66%	0%	34%	-34%
Whole region	169,476	64%	0%	36%	-36%

Cambios de aptitud al año 2050 - escenario RCP 8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	67,032	52%	0%	48%	-48%
Rain forest	102,444	53%	0%	47%	-47%
Whole region	169,476	53%	0%	47%	-47%

Points of observed presence



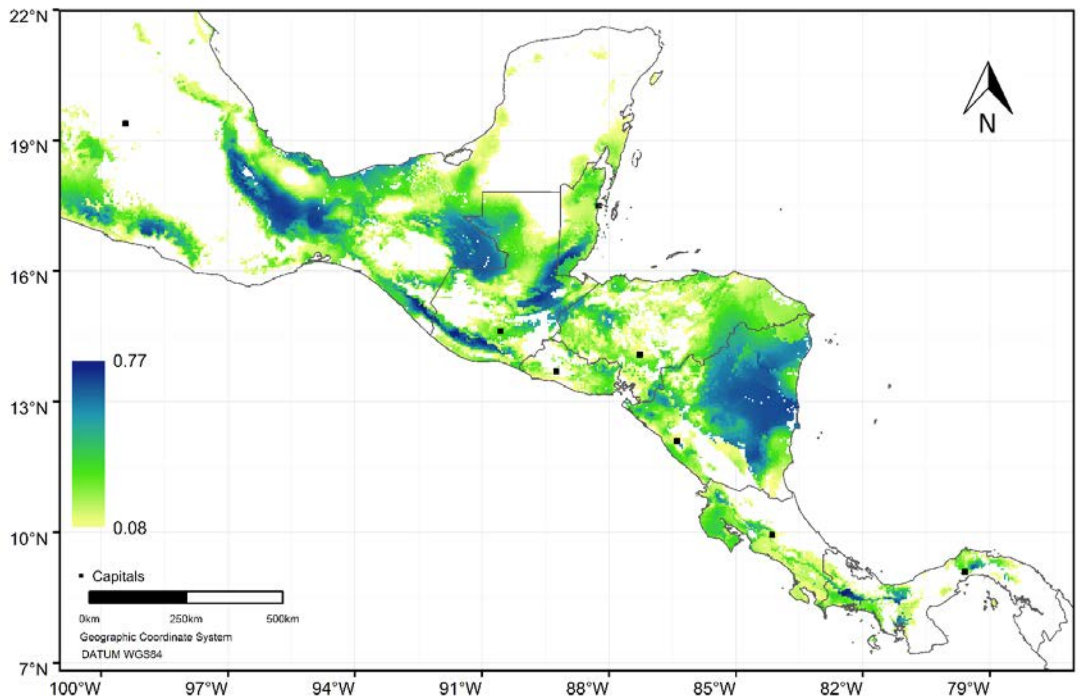
Platymiscium dimorphandrum Donn.Sm.

Family: Leguminosae
Vernacular names: Coyote (NI), hormigo (HN), granadillo (BZ, SV, NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Unknown	**Drought**	Unknown
Plant height (m)	18 (11 – 30)	**Timber uses**[1]	CS, MB, HF, CH, AR	**Pollination vector**	Unknown	**Flooding**	Unknown
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (g)**	Unknown	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Recalcitrant	**Shade**	Unknown
Wood density ($g\ cm^{-3}$)	0.72 (0.69 – 0.75)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Unknown	**Seed dispersal**	Zoochory, Anemochory	**Fire**	Unknown

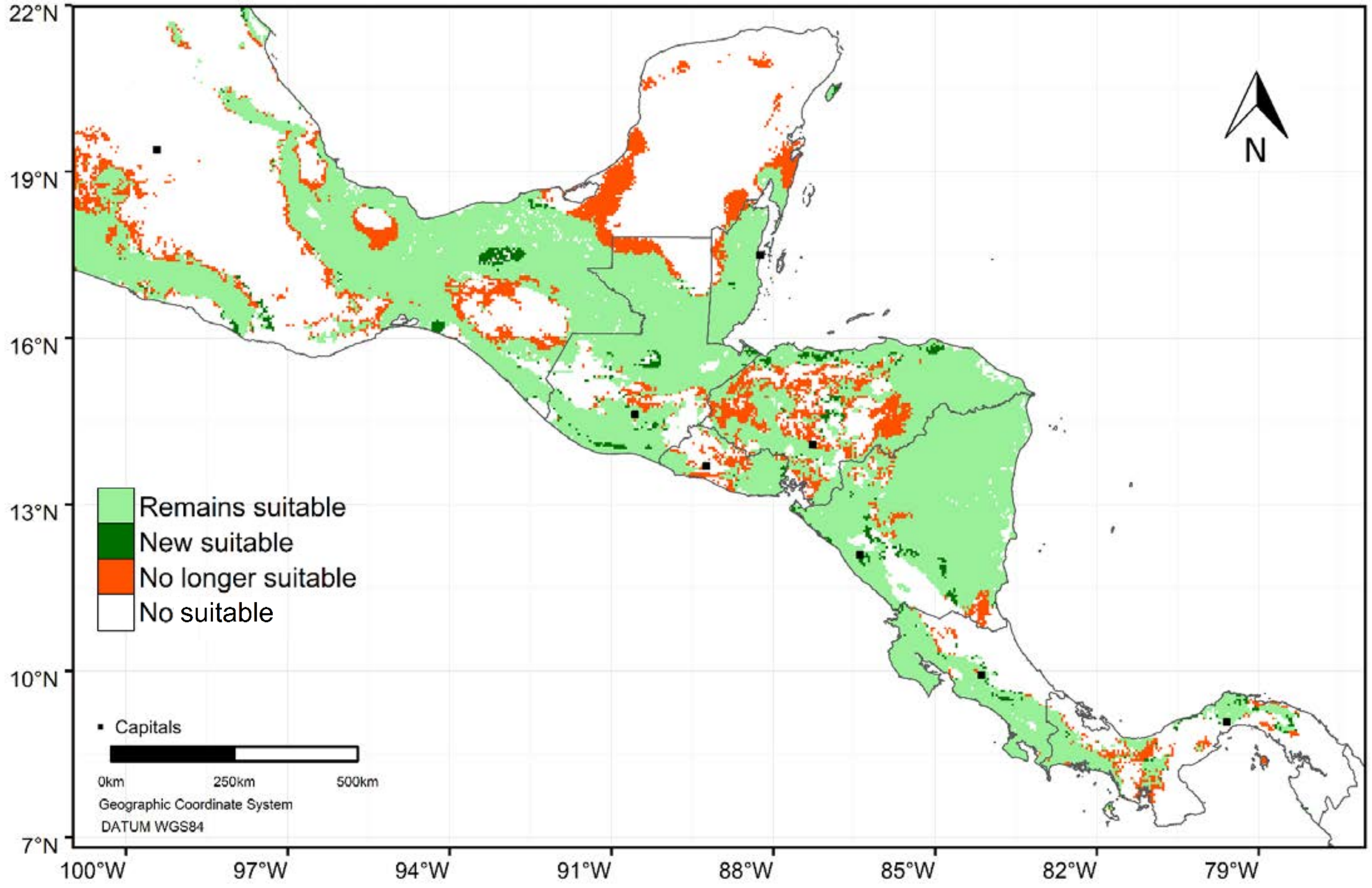
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



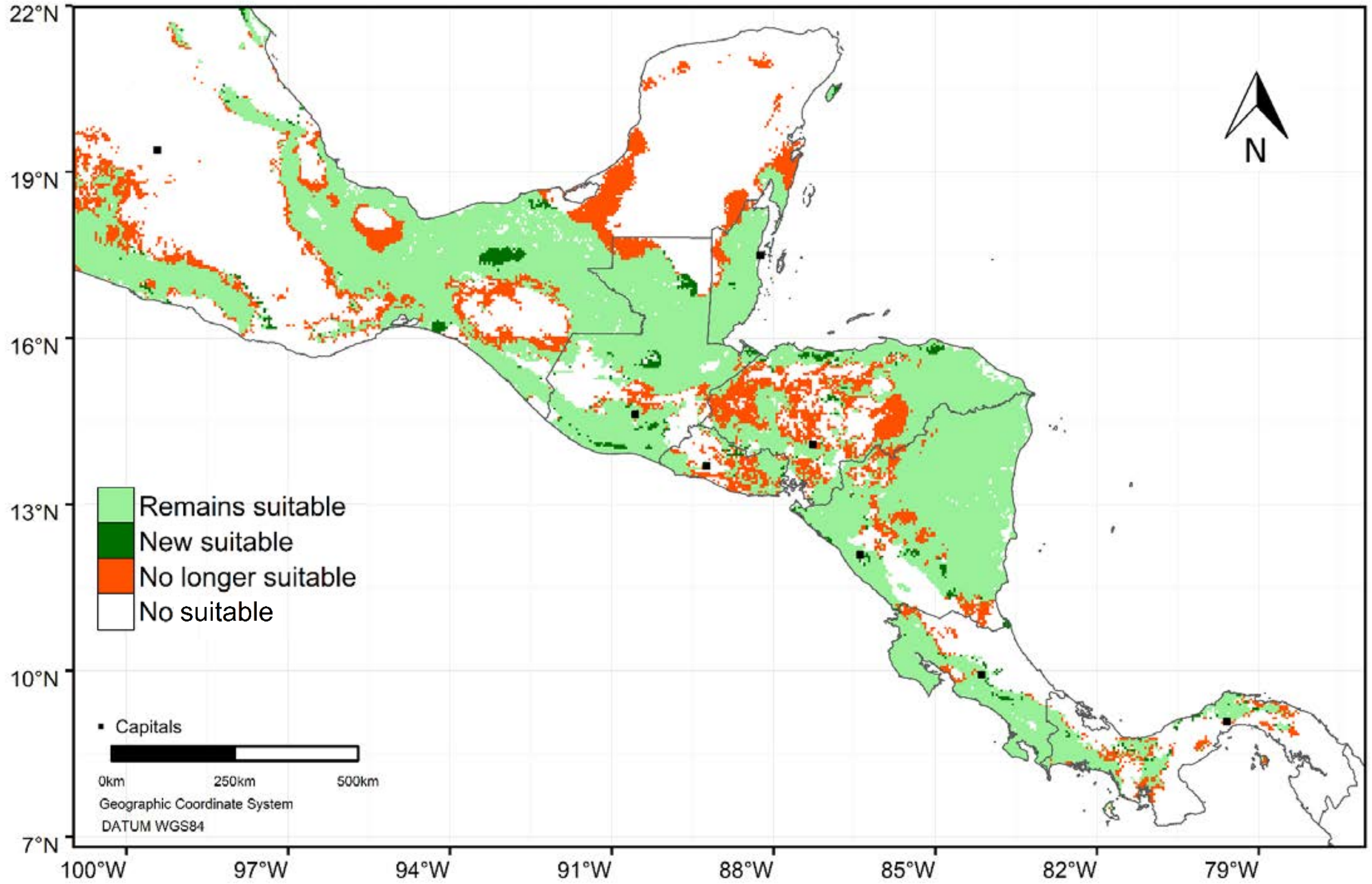
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



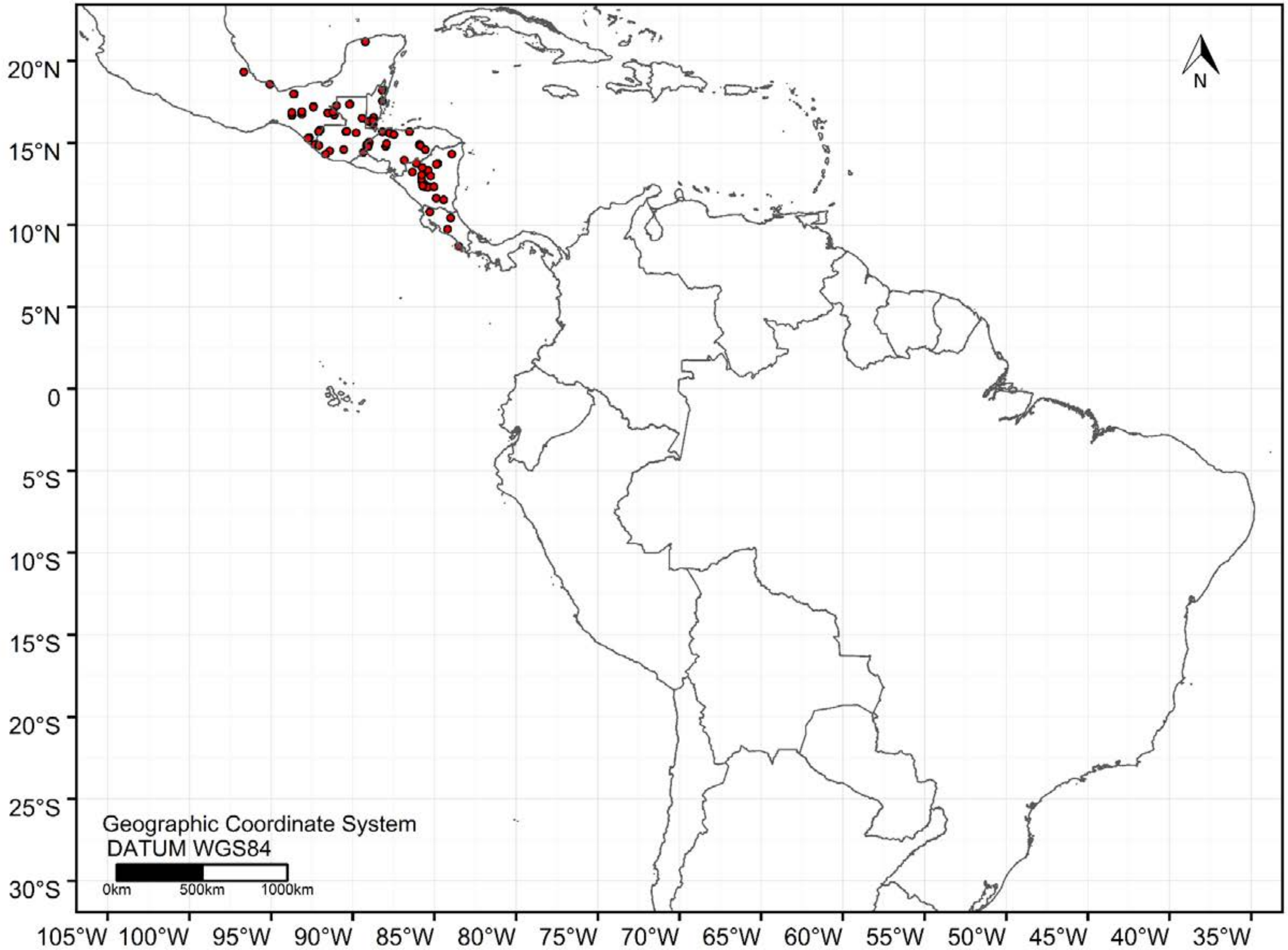
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	50,852	73%	3%	27%	-23%
Rain forest	89,077	89%	3%	11%	-9%
Whole region	139,929	83%	3%	17%	-14%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	50,852	65%	3%	35%	-33%
Rain forest	89,077	87%	3%	13%	-10%
Whole region	139,929	79%	3%	21%	-18%

Points of observed presence



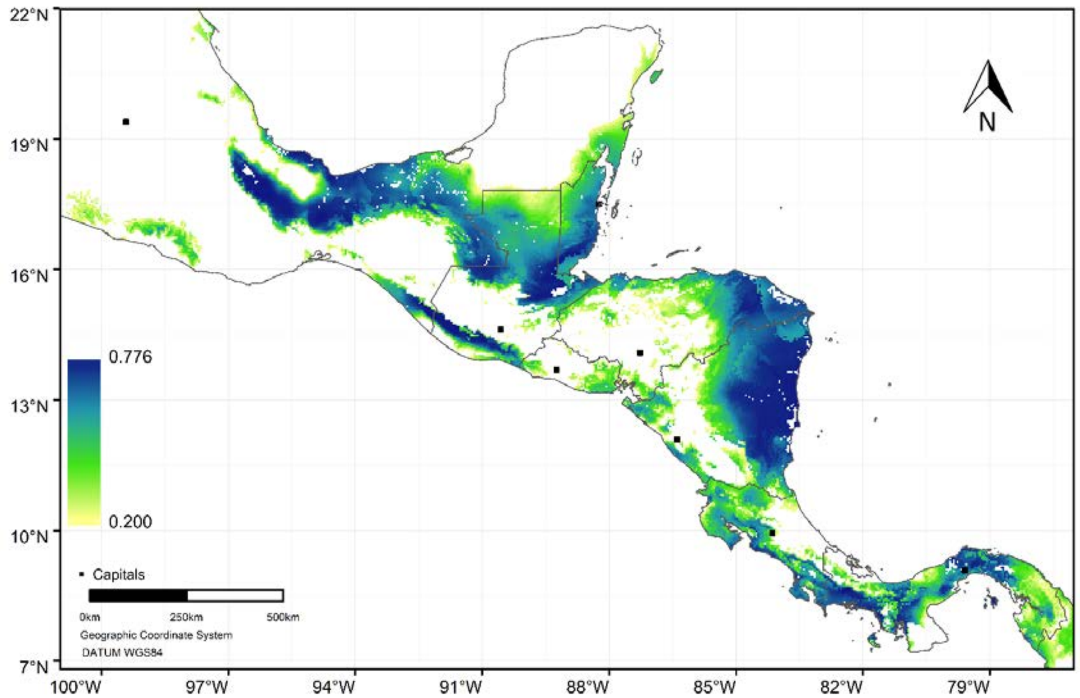
Pouteria sapota (Jacq.) H.E.Moore & Stearn.

Family:
Sapotaceae
Vernacular names:
Zapote (PA, CR, NI, HN, GT),
sapote (CR)
mamey (SV),
sapotillo (NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	18 (12 – 55)	**Timber uses**[1]	CS, CL, MB, PS	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (kg)**[2]	35.15 (22.5-41.9)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	No
Wood density (g cm^{-3})	0.85 (0.81 – 0.9)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Yes
Leaf phenology	Deciduous	**Other uses**	Apiculture, Cosmetics	**Seed dispersal**	Zoochory	**Fire**	Unknown

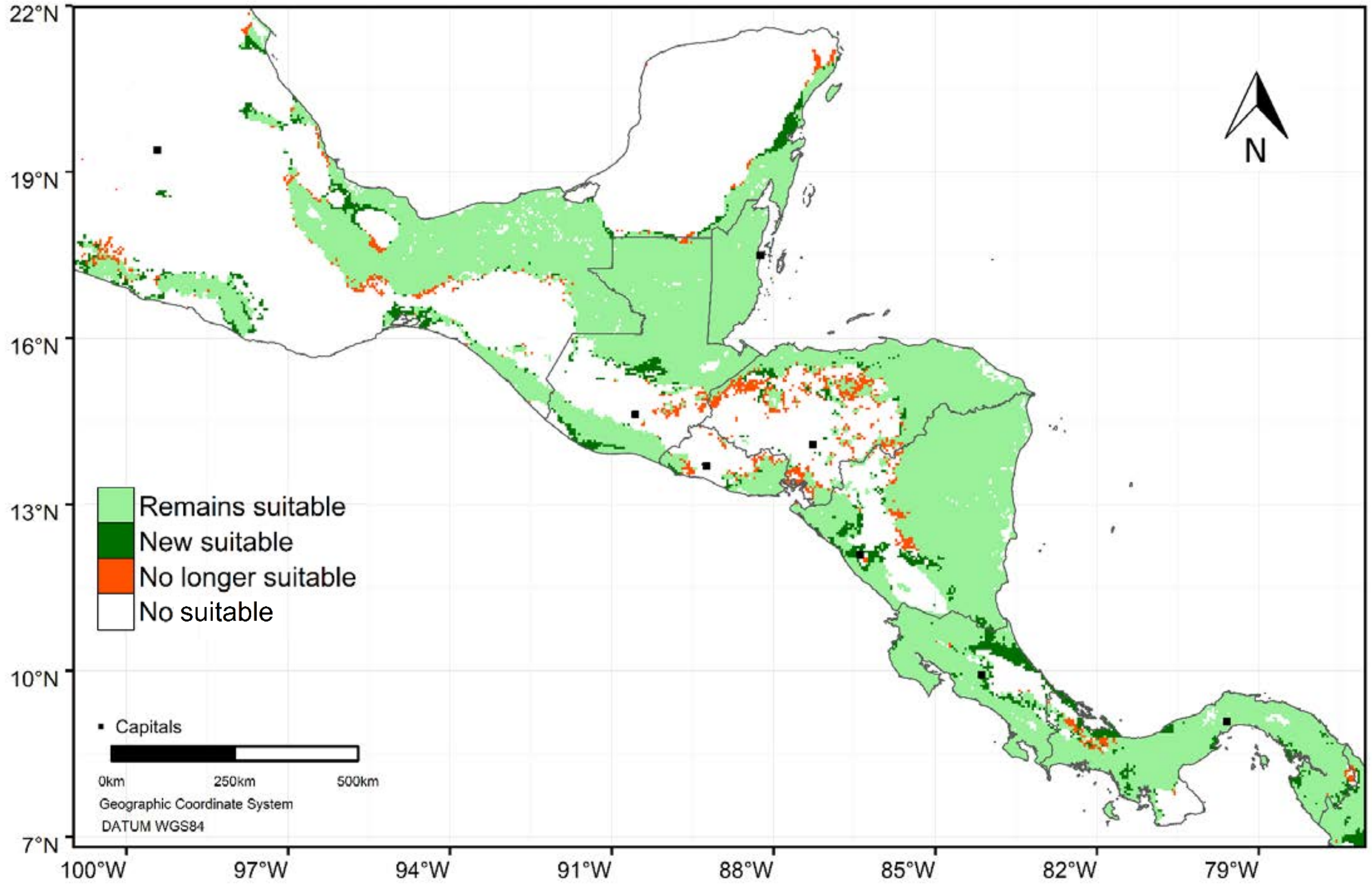
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
[2] Given the large size of the seed, seed weight is reported in kg.

Species suitable areas under current climate



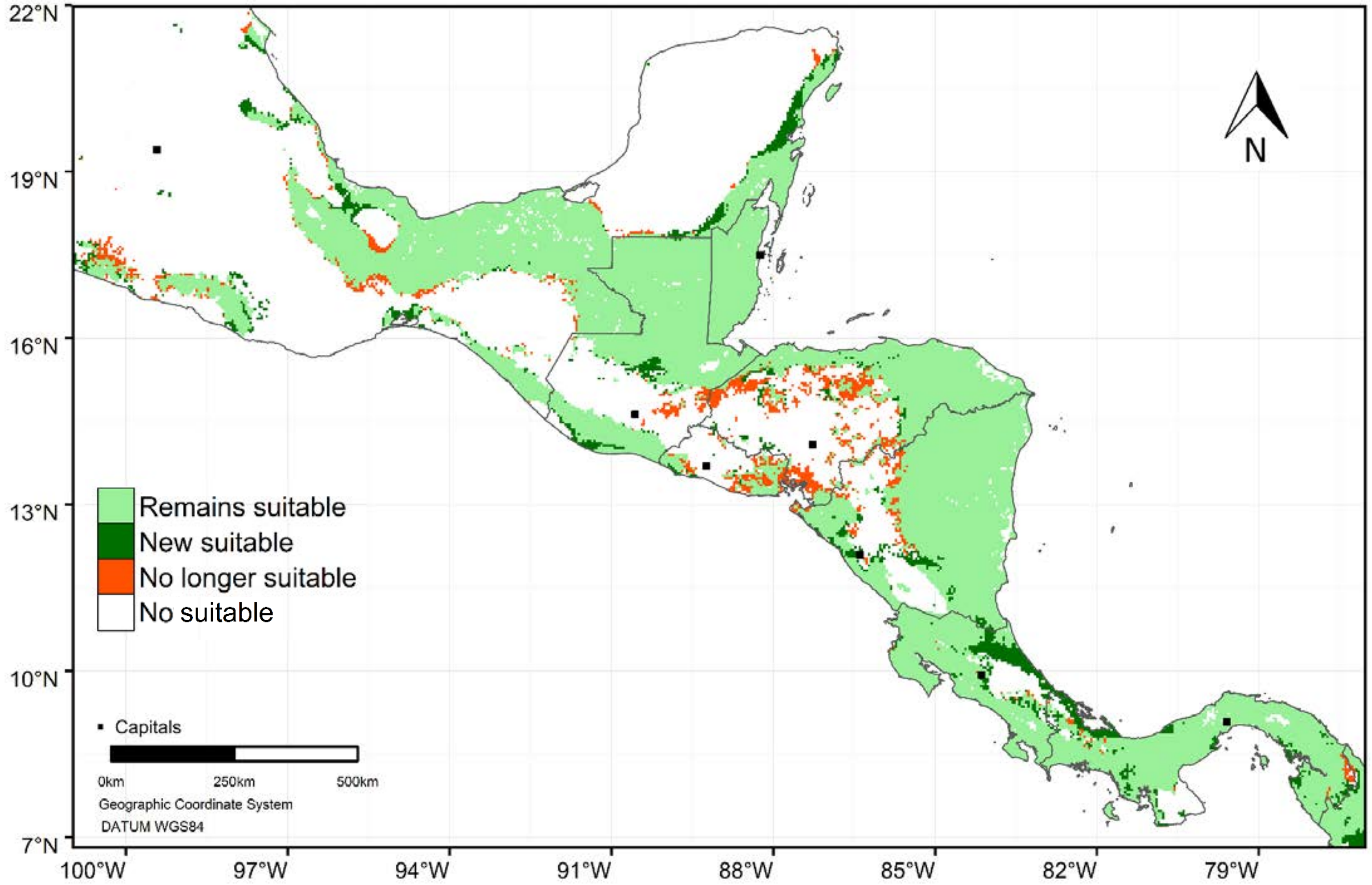
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



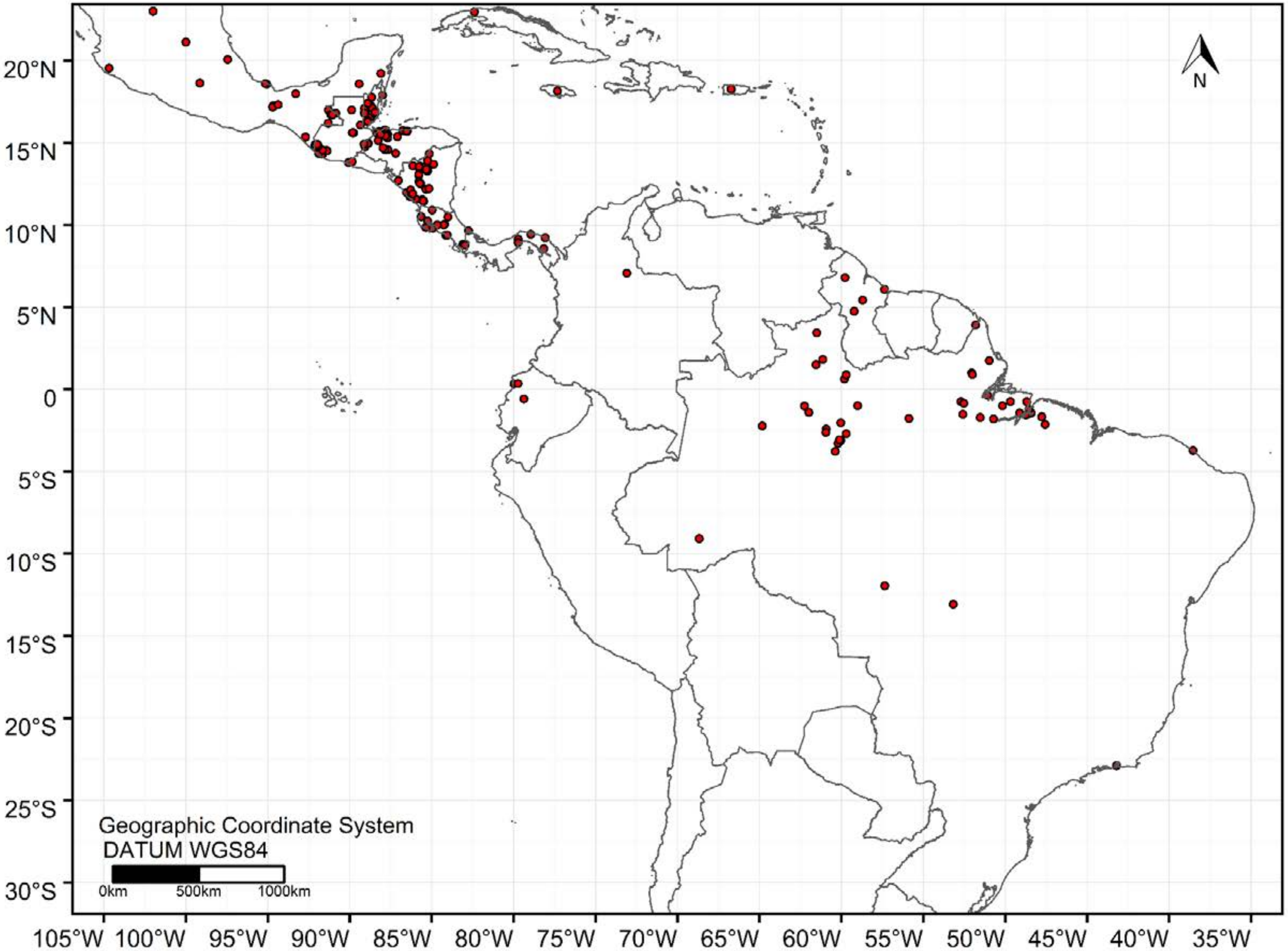
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	22,035	85%	16%	15%	1%
Rain forest	98,598	98%	7%	2%	4%
Whole region	120,633	95%	8%	5%	4%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	22,035	78%	13%	22%	-9%
Rain forest	98,598	97%	8%	3%	5%
Whole region	120,633	94%	9%	6%	2%

Points of observed presence



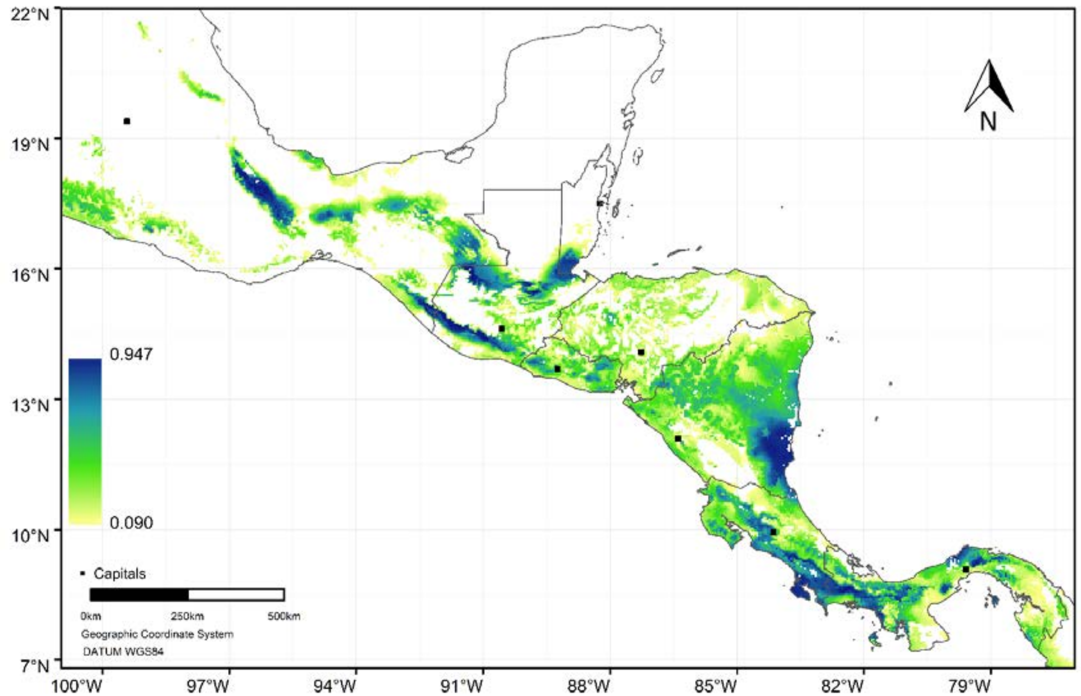
Psidium friedrichsthalianum (O.Berg) Nied.

Family:
Myrtaceae
Vernacular names:
Cas (CR),
arrayán (SV),
guayaba agria (NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Monoecious	**Drought**	No
Plant height (m)	8 (6 – 10)	**Timber uses[1]**	None	**Pollination vector**	Unknown	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	47.5	**Frost**	No
N fixer	No	**Fruit**	Yes	**Seed storage type**	Unknown	**Shade**	Unknown
Wood density ($g\ cm^{-3}$)	0.67 (0.65 – 0.7)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Unknown	**Seed dispersal**	Zoochory, Hydrochory**	**Fire**	Unknown

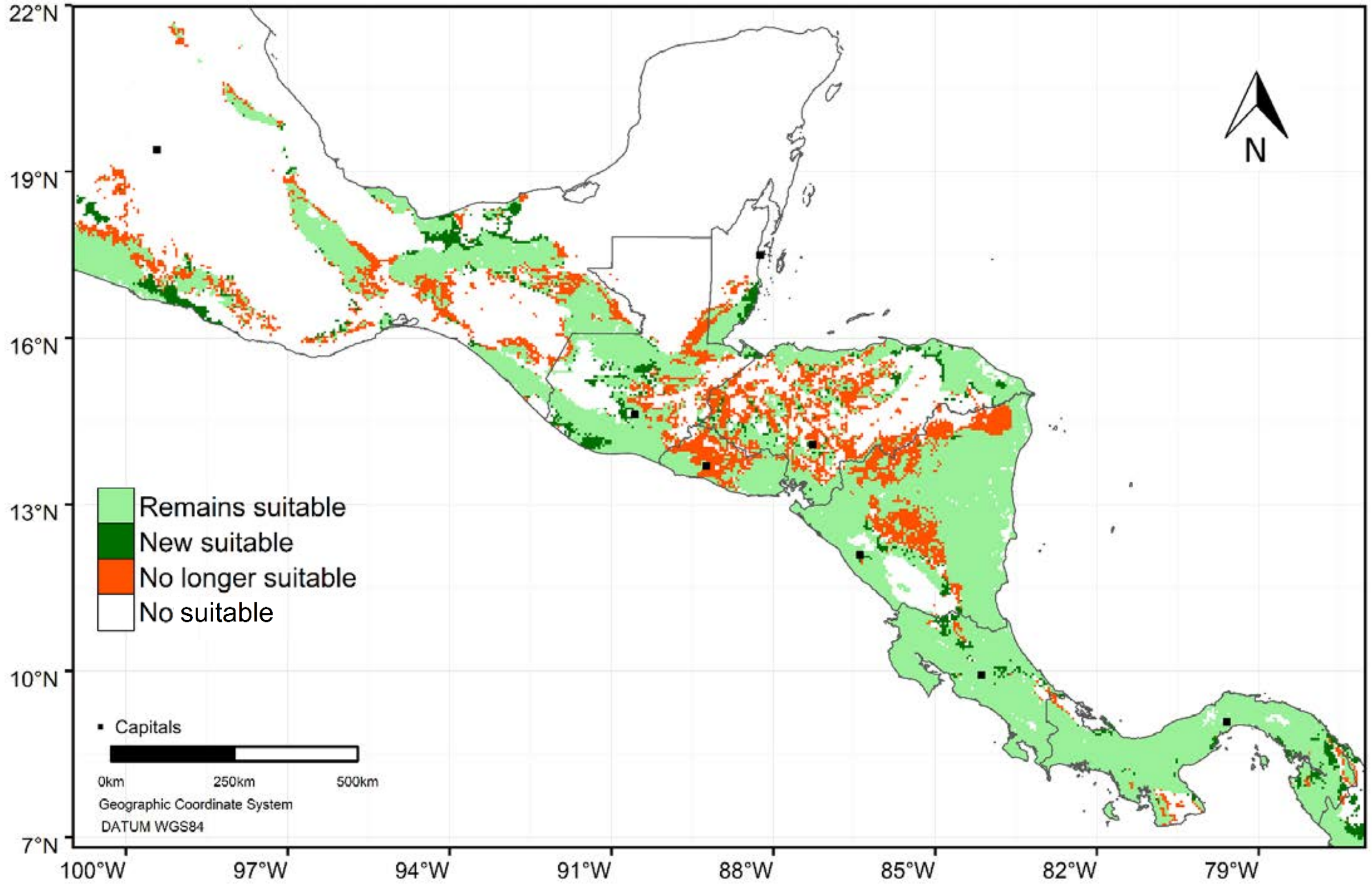
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
**Information on seed dispersal is derived from P. guajava.

Species suitable areas under current climate



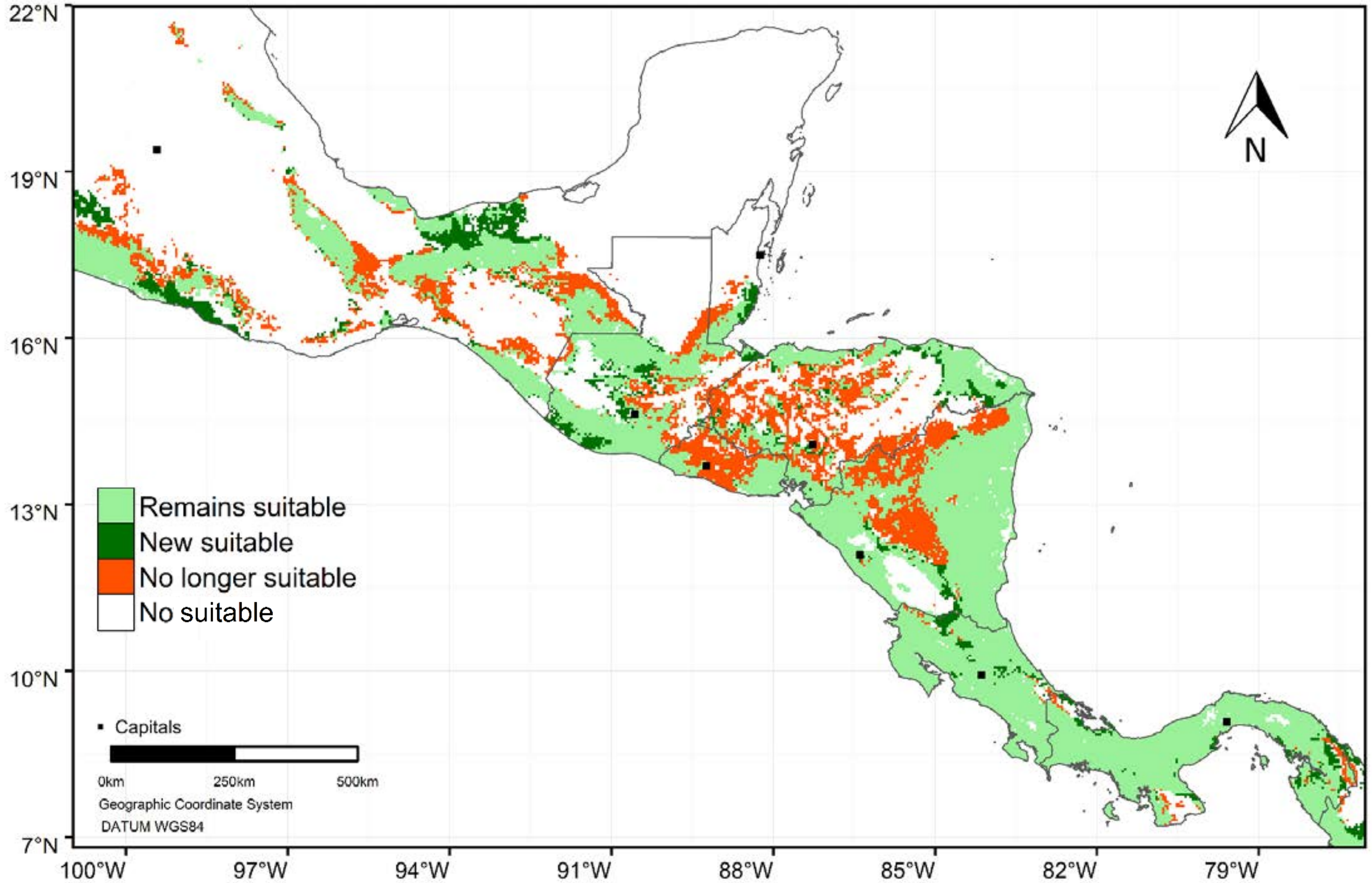
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



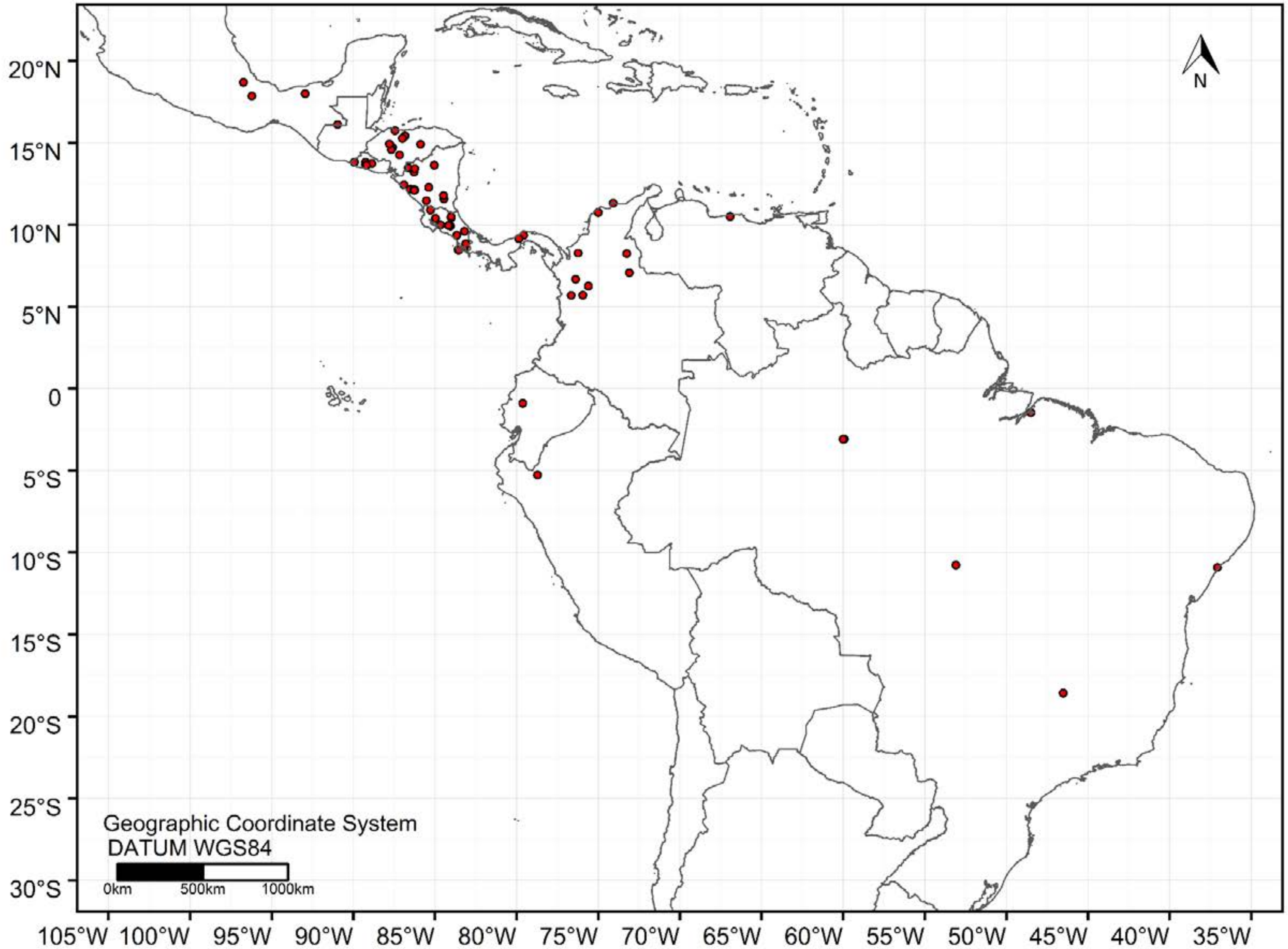
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	37,941	64%	9%	36%	-27%
Rain forest	71,589	86%	7%	14%	-7%
Whole region	109,530	78%	8%	22%	-14%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	37,941	57%	12%	43%	-31%
Rain forest	71,589	83%	10%	17%	-7%
Whole region	109,530	74%	10%	26%	-16%

Points of observed presence



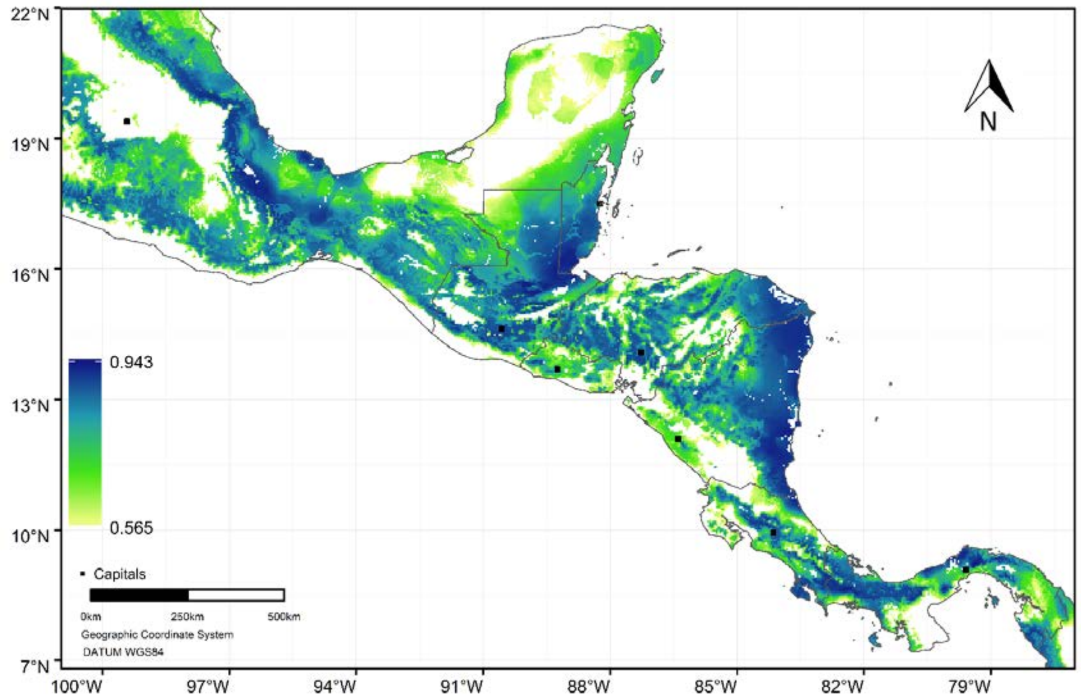
Psidium guajava L.

Family:
Myrtaceae
Vernacular names:
Guayaba

Yes (Fruits)		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree/Shrub	**Commercial timber**	No	**Reproductive system**	Mixed monoecious	**Drought**	Yes
Plant height (m)	6 (3 – 10)	**Timber uses**[1]	None	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	8.82 (7.15 – 12.62)	**Frost**	Yes
N fixer	No	**Fruit**	Yes	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.77 (0.58 – 0.96)	**Forage**	Yes (Fruits)	**Seed dormancy**	No	**Salinity**	No
Leaf phenology	Evergreen	**Other uses**	Medicinal	**Seed dispersal**	Zoochory, Hydrochory	**Fire**	Unknown

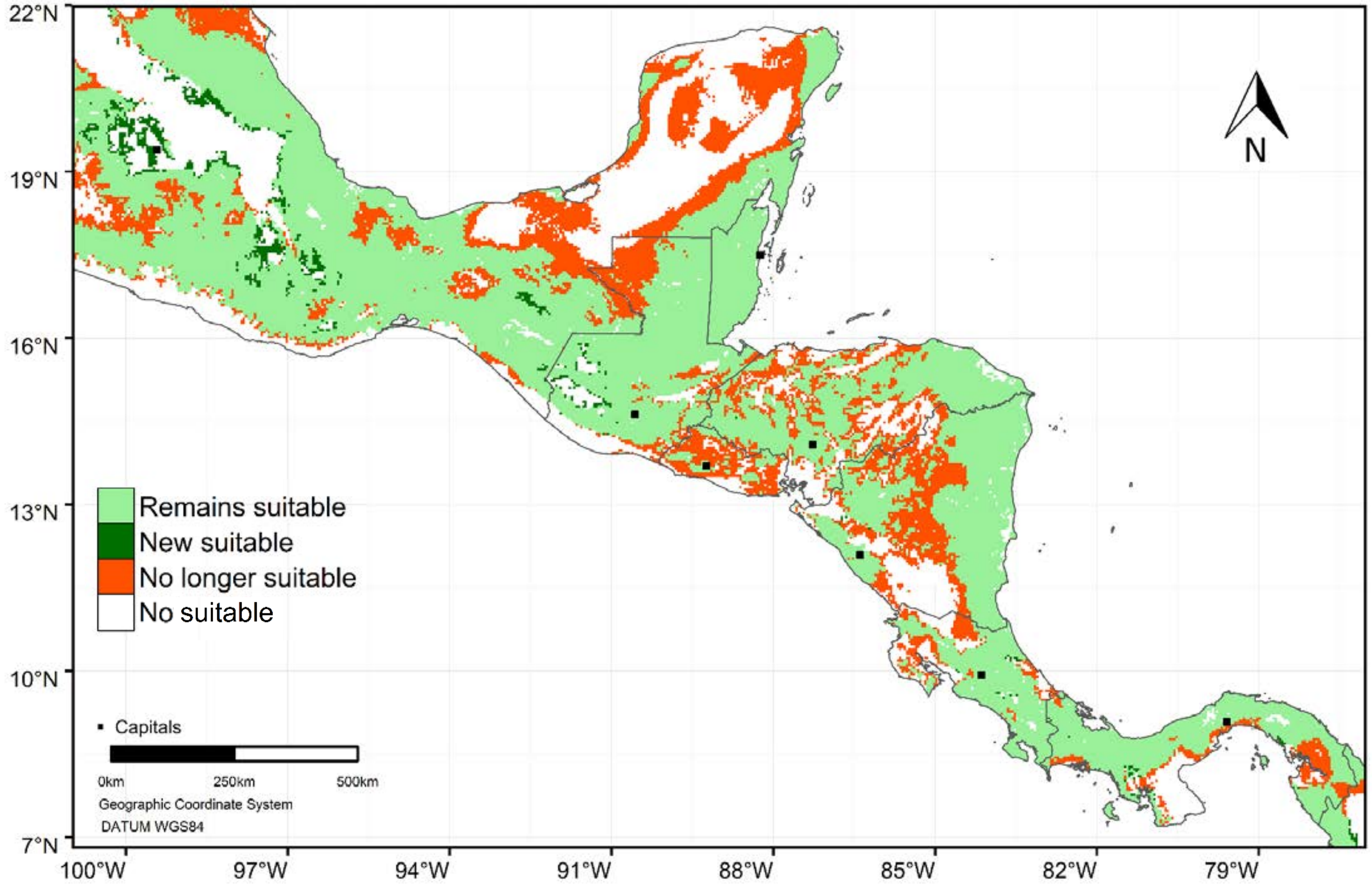
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



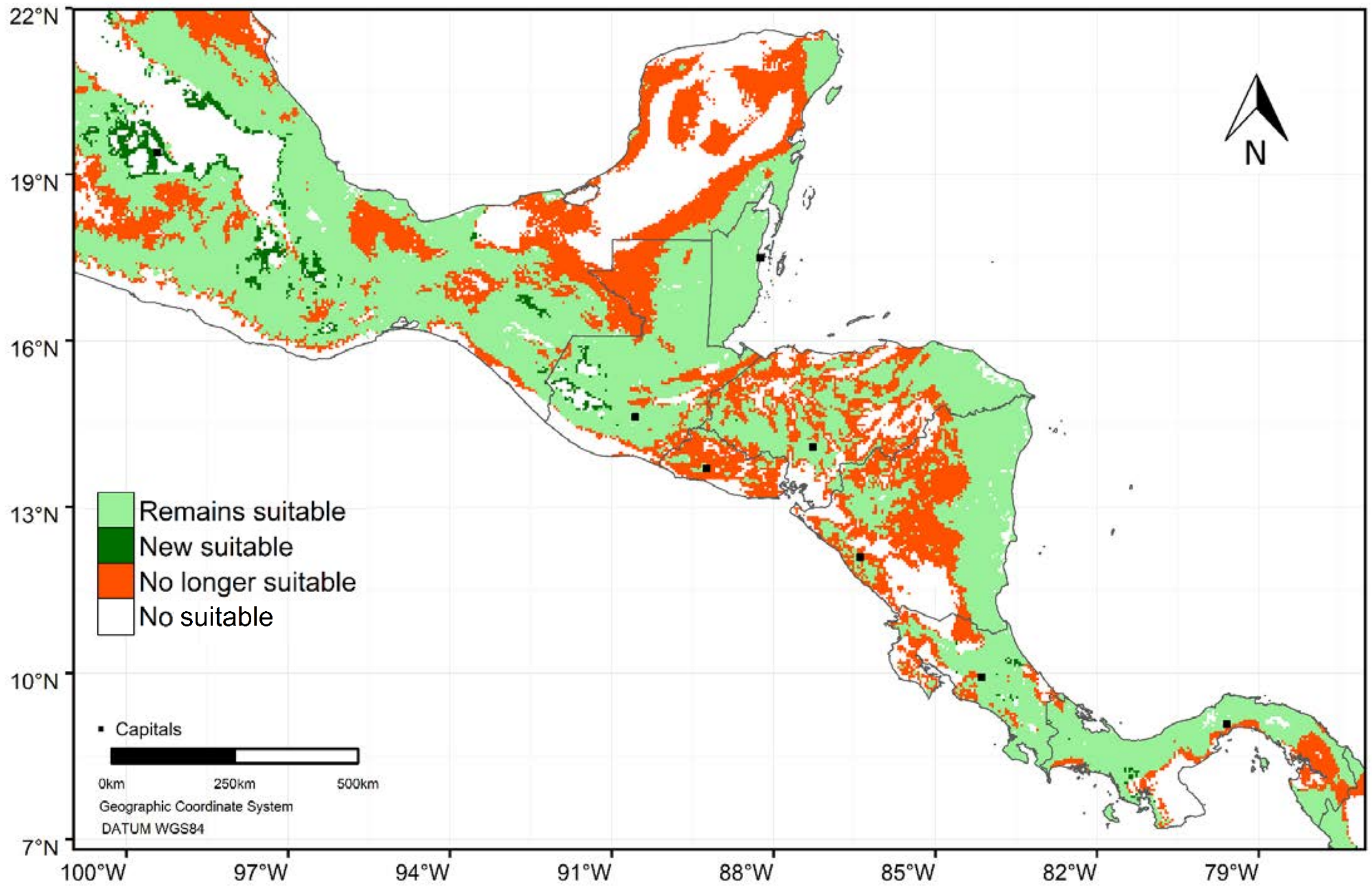
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



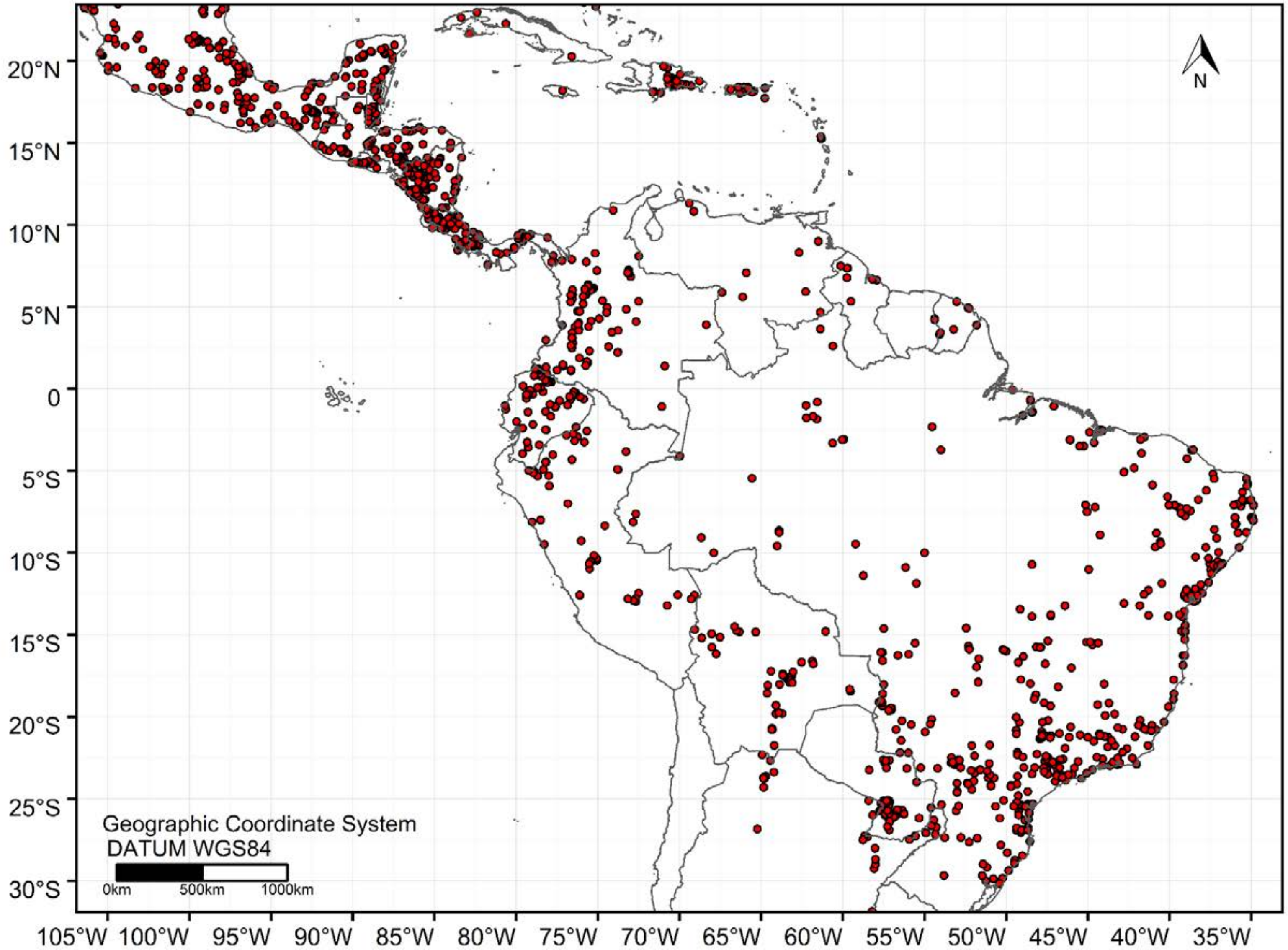
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	80,884	73%	5%	27%	-21%
Rain forest	118,080	76%	0%	24%	-23%
Whole region	198,965	75%	2%	25%	-23%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	80,884	64%	6%	36%	-30%
Rain forest	118,080	68%	0%	32%	-31%
Whole region	198,965	67%	3%	33%	-31%

Points of observed presence



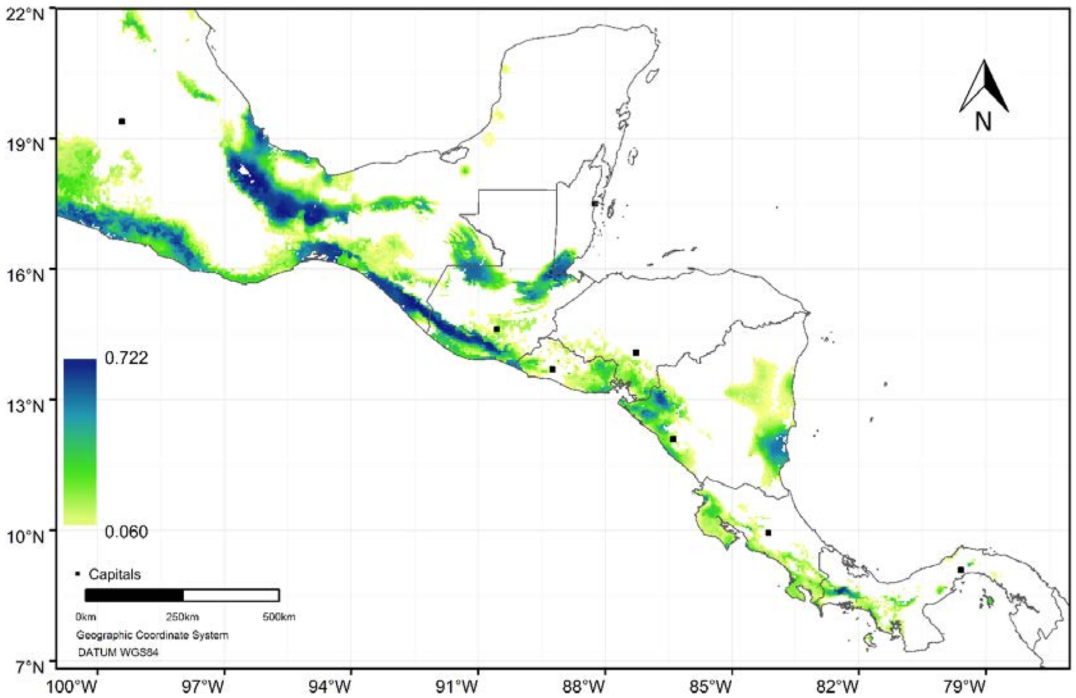
Roseodendron donnell-smithii (Rose) Miranda

Family:
Bignoniaceae
Sinonimia:
Tabebuia donnell-smithii Rose
Vernacular names:
Cortez blanco (SV),
guayape (HN),
palo blanco (GT)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	20 (13 – 27)	**Timber uses**[1]	CL, MB, PS, CH	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	5.88	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.45 (0.38 – 0.53)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Ornamental	**Seed dispersal**	Anemochory	**Fire**	Unknown

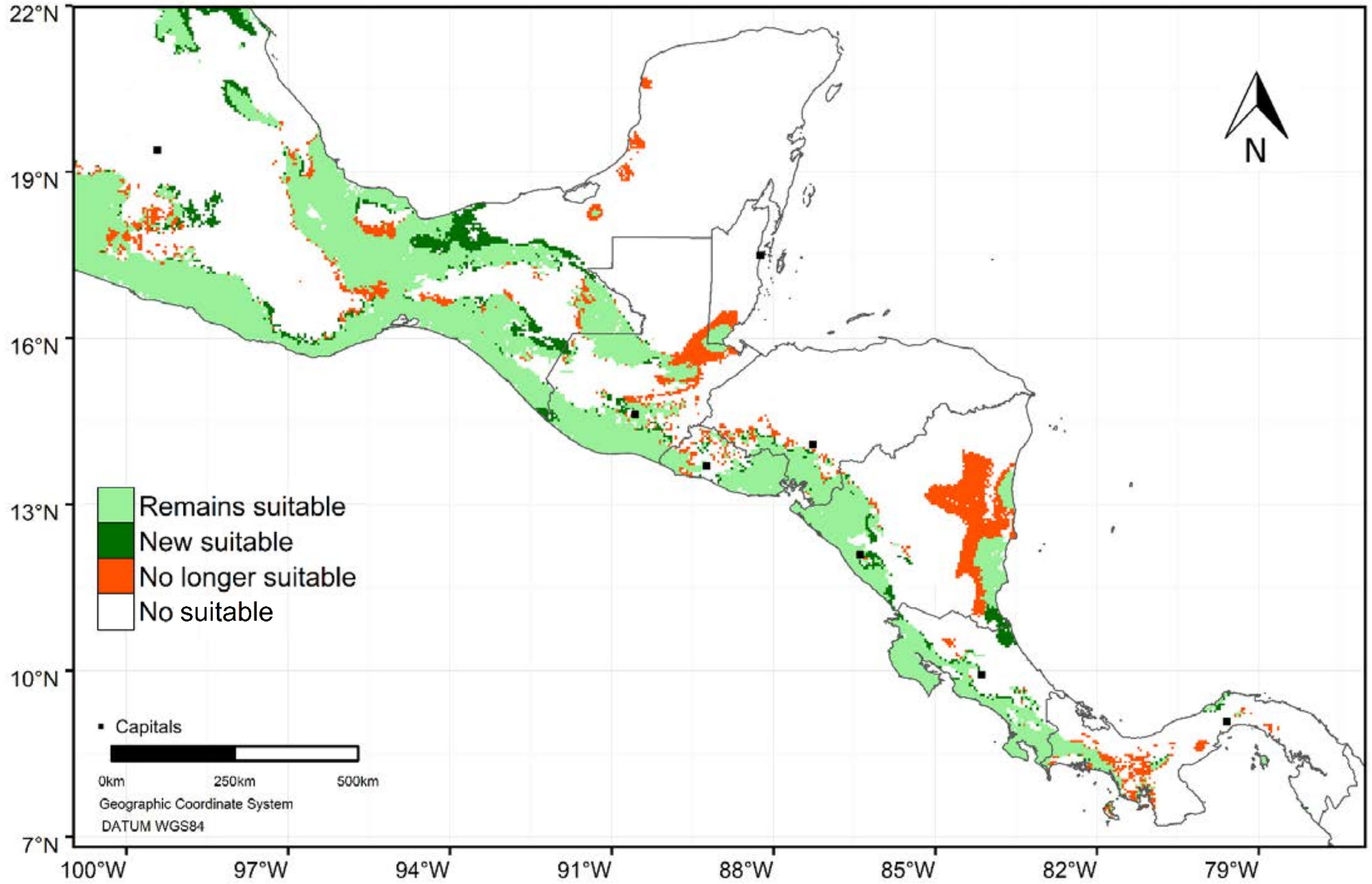
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



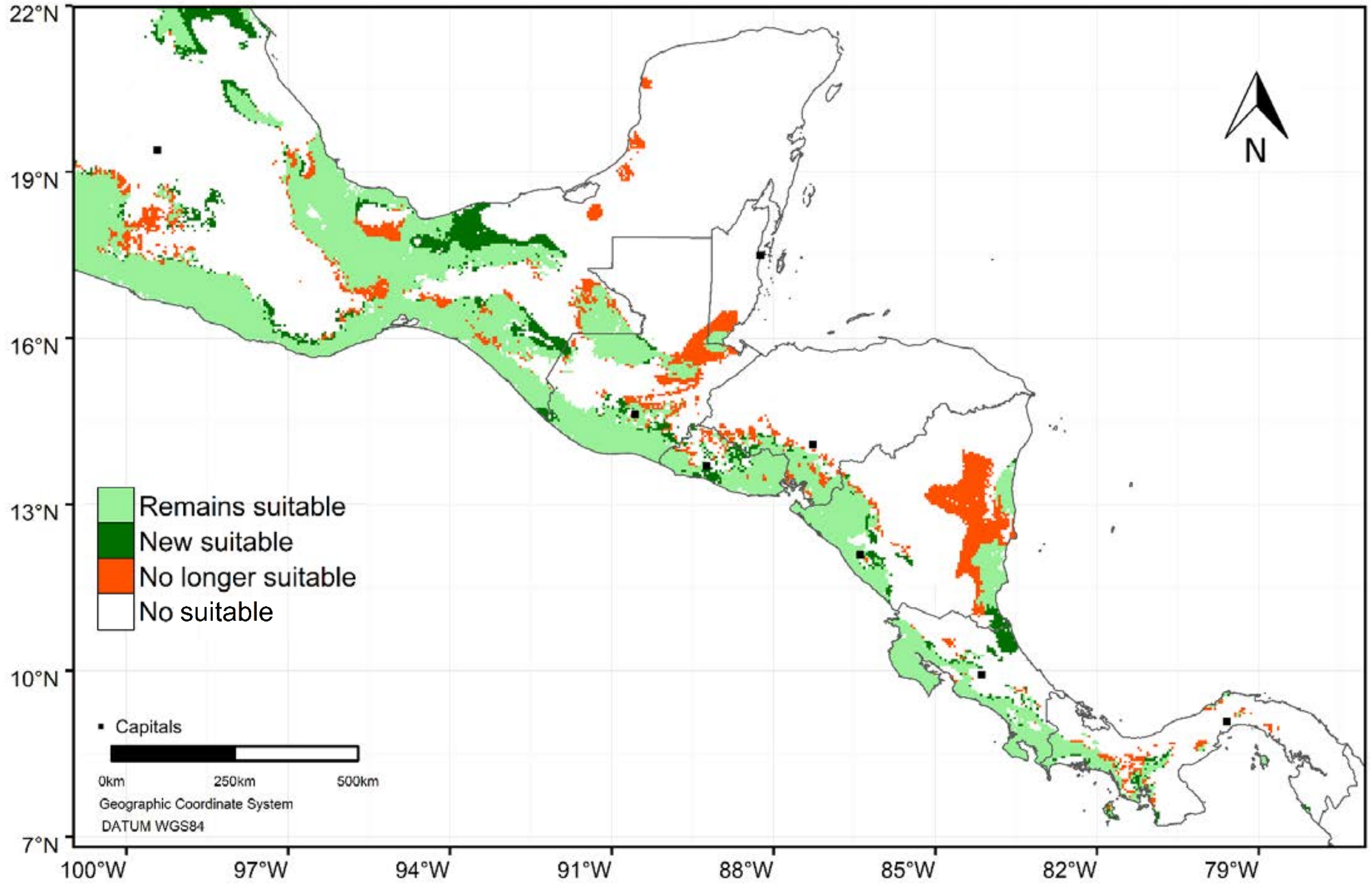
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



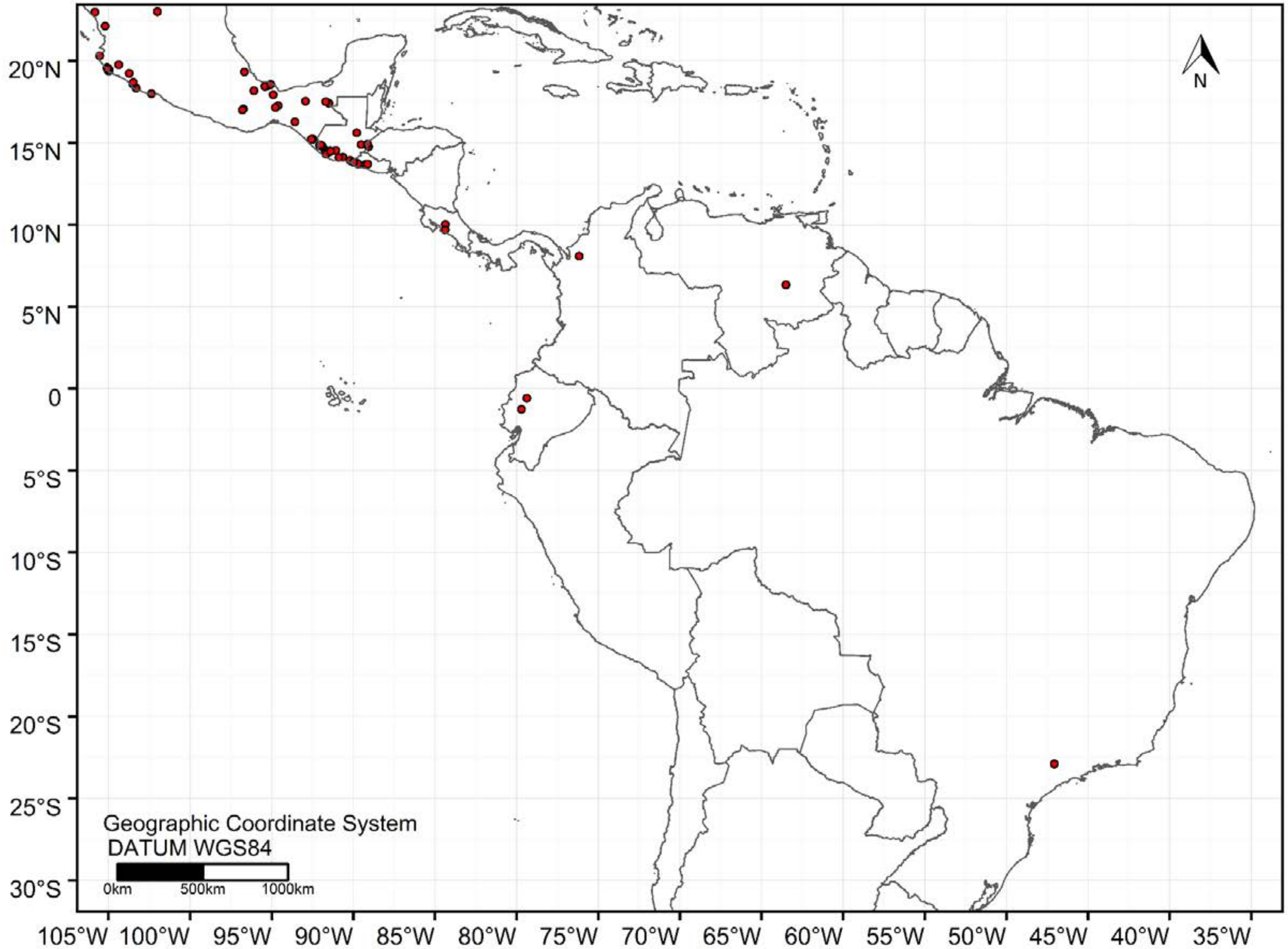
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	37,495	90%	9%	10%	-1%
Rain forest	37,461	75%	14%	25%	-11%
Whole region	74,955	82%	11%	18%	-6%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	37,495	86%	11%	14%	-3%
Rain forest	37,461	75%	17%	25%	-9%
Whole region	74,955	81%	14%	19%	-6%

Points of observed presence



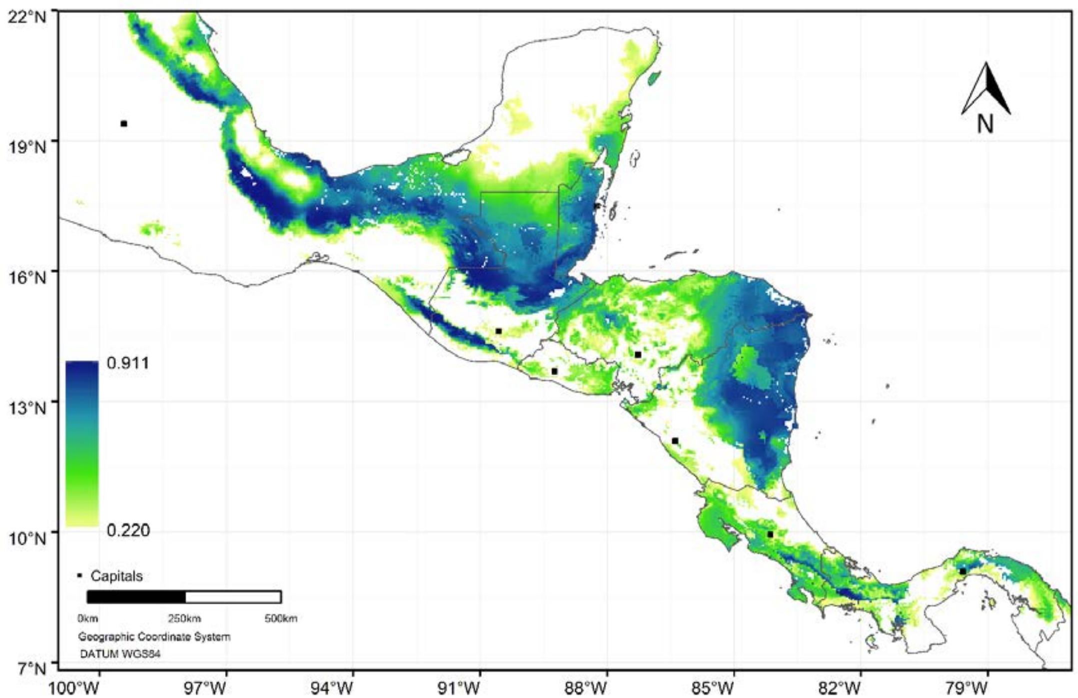
Schizolobium parahyba (Vell.) S.F.Blake

Family:
Leguminosae
Vernacular names:
Copté (GT),
gallinazo (CR),
zorra (HN)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Yes
Plant height (m)	33 (30 – 35)	**Timber uses[1]**	CL, MB, HF, AR	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	No	**Weight 1000 seeds (g)**	824.33 (709.75 – 930.23)	**Frost**	No
N fixer	Yes	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density ($g\ cm^{-3}$)	0.4 (0.24 – 0.7)	**Forage**	No	**Seed dormancy**	Physical	**Salinity**	No
Leaf phenology	Deciduous	**Other uses**	Apiculture, Paper	**Seed dispersal**	Anemochory	**Fire**	Unknown

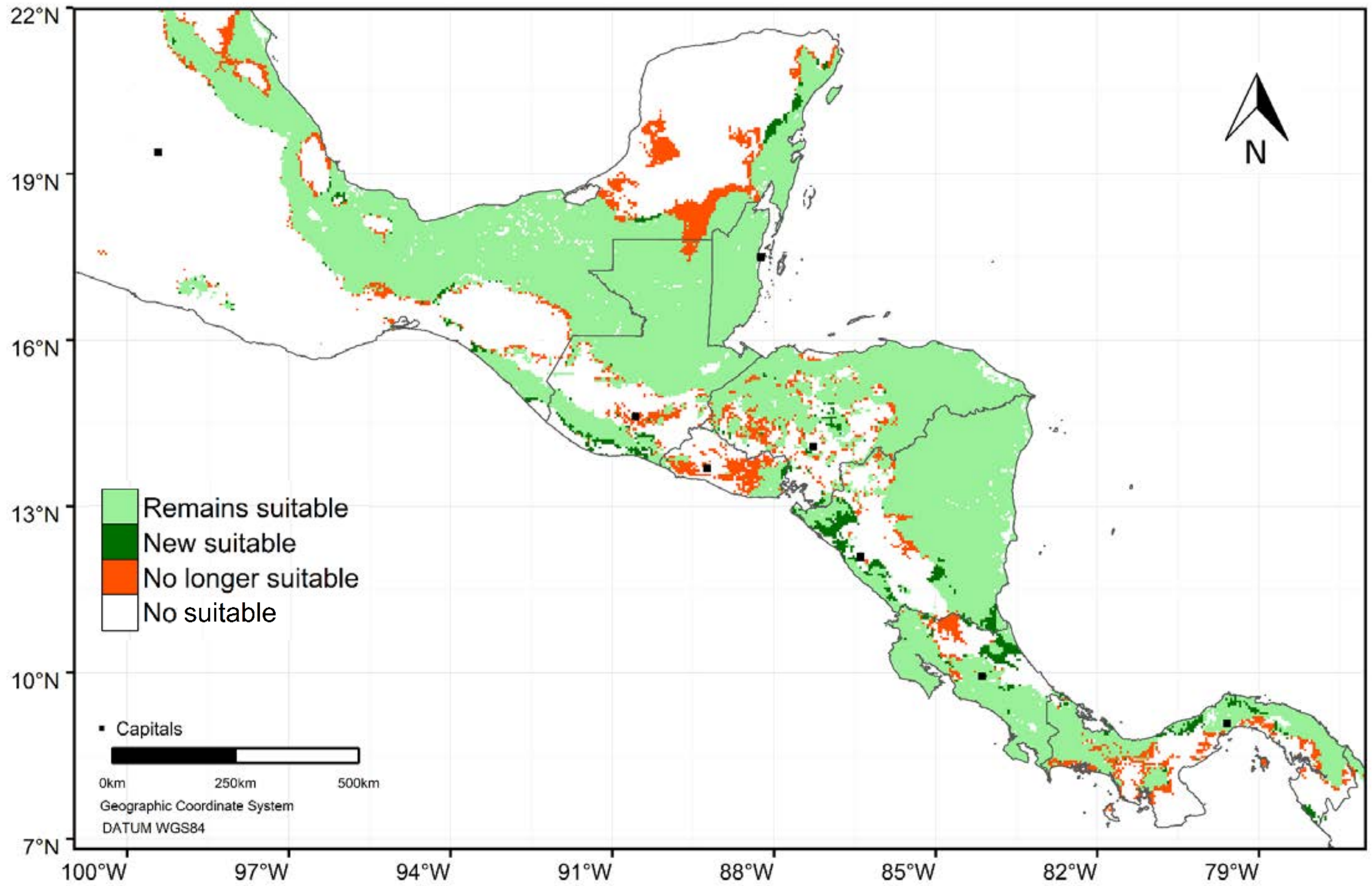
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



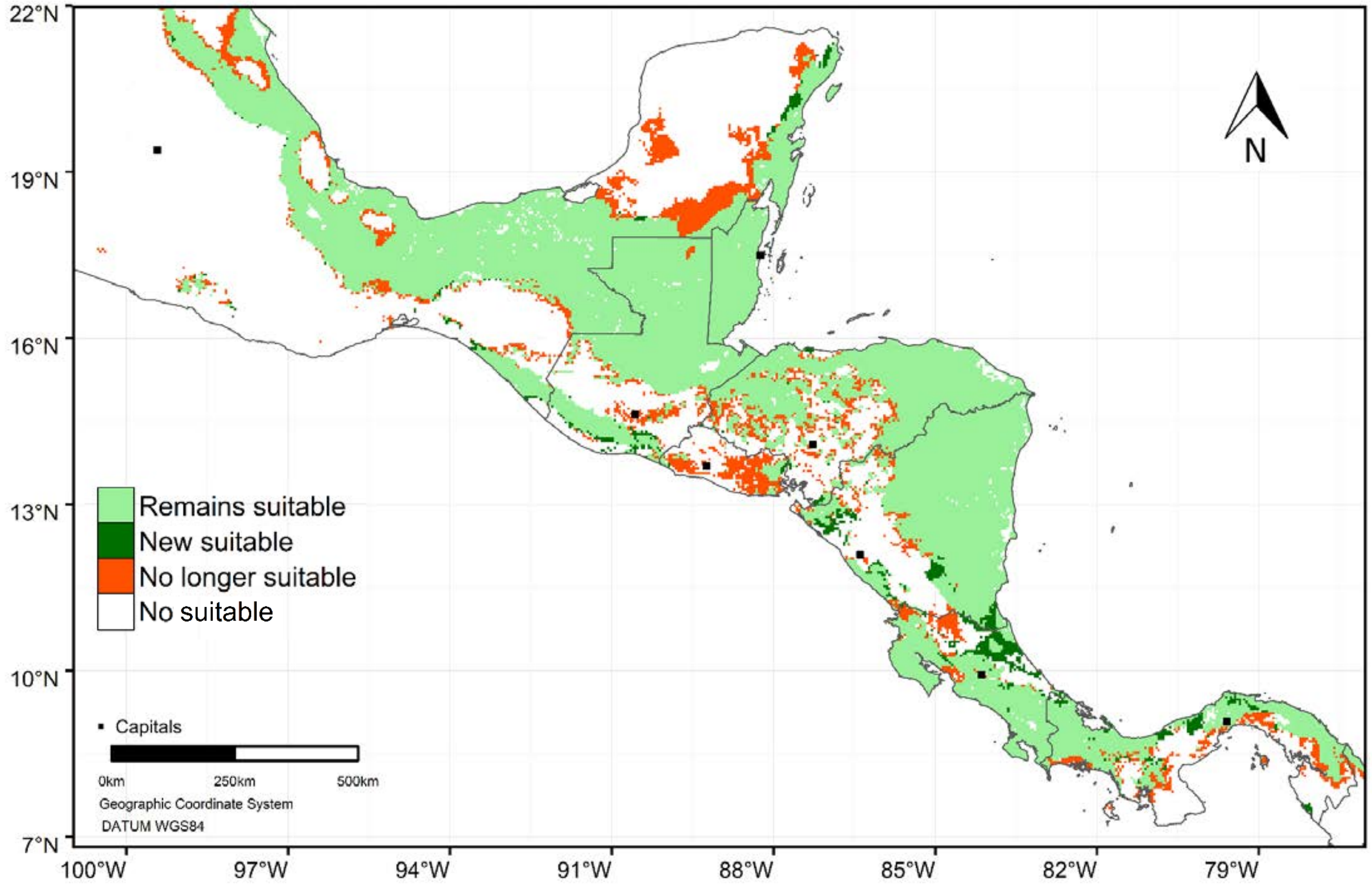
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



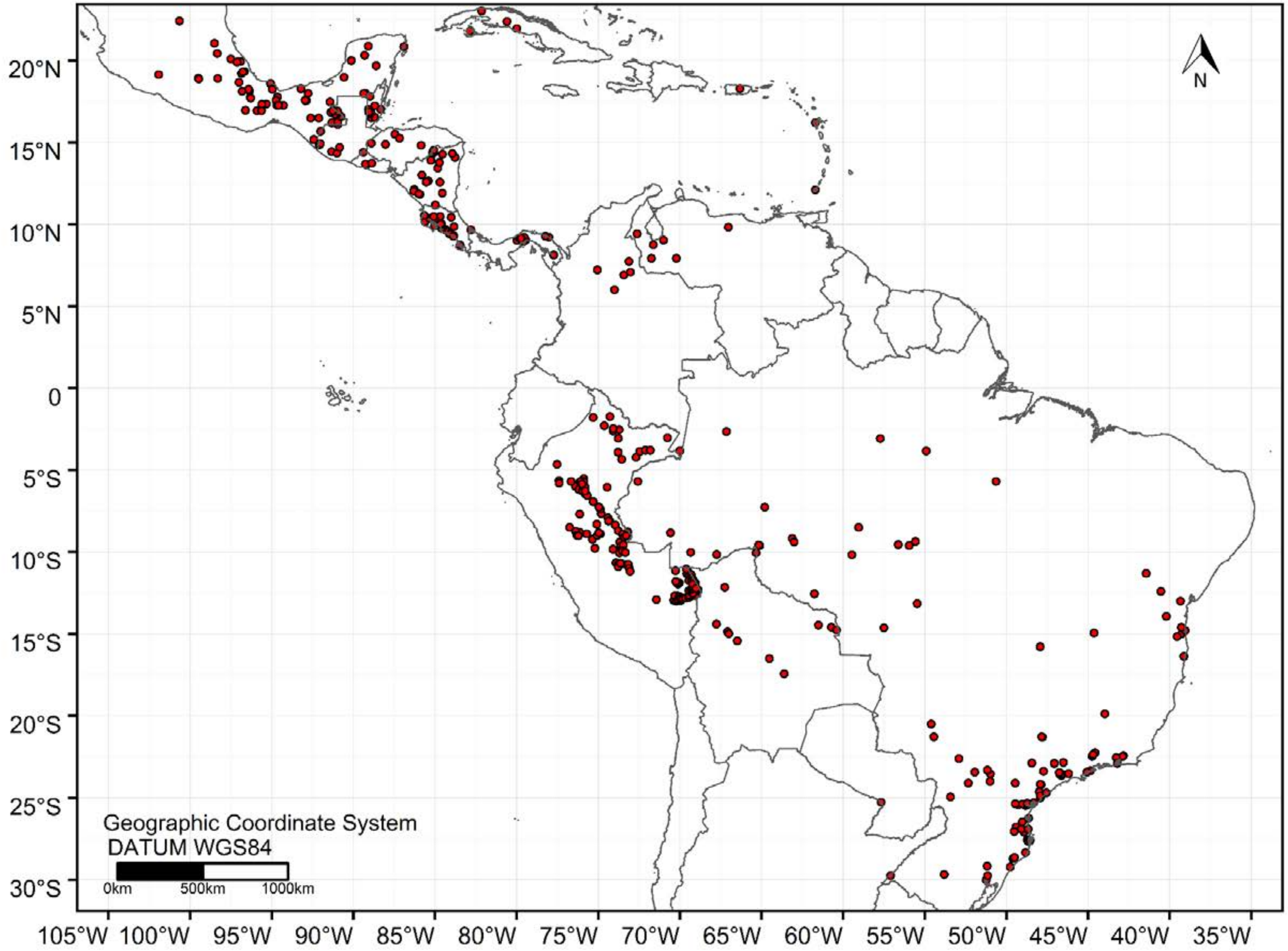
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	26,323	75%	9%	25%	-17%
Rain forest	110,765	93%	3%	7%	-5%
Whole region	137,087	89%	4%	11%	-7%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	26,323	66%	5%	34%	-29%
Rain forest	110,765	91%	3%	9%	-6%
Whole region	137,087	86%	4%	14%	-10%

Points of observed presence



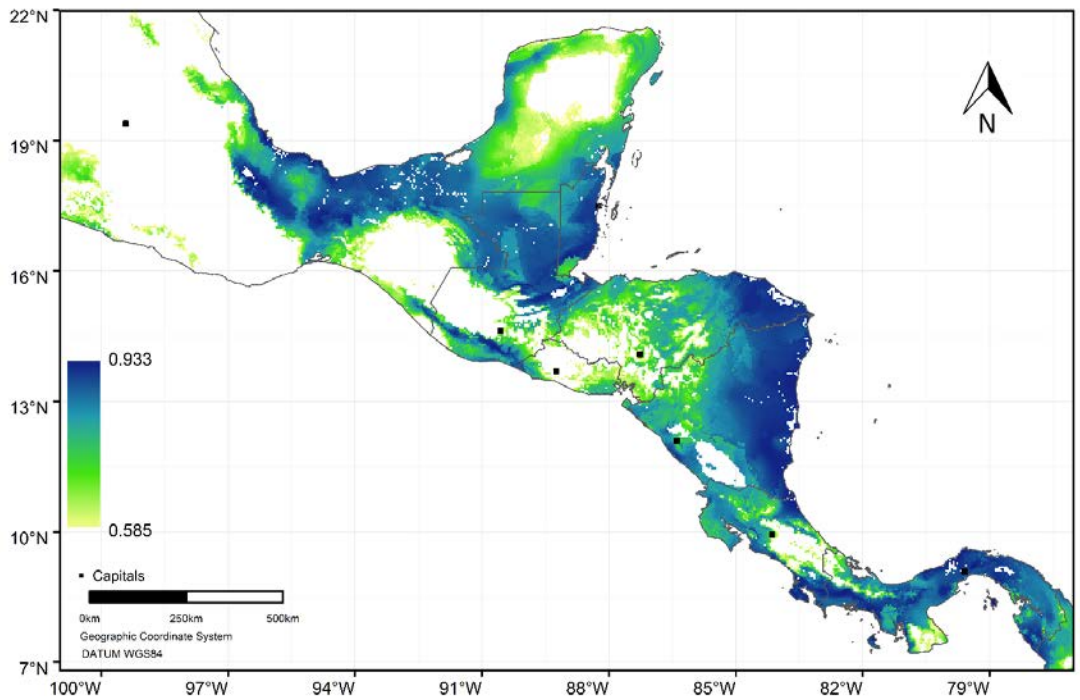
Spondias mombin L.

Family:
Anacardiae
Vernacular names:
Ciruelo (HN),
jobito (PA),
jobo (CR, NI, HN, PA)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	26 (20 – 30)	**Timber uses[1]**	SM, CL, MB, HF, AR	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	2,375.6 (1,097 – 3,980)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Intermedia	**Shade**	No
Wood density ($g\ cm^{-3}$)	0.37 (0.29 – 0.50)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Medicinal	**Seed dispersal**	Zoochory	**Fire**	Unknown

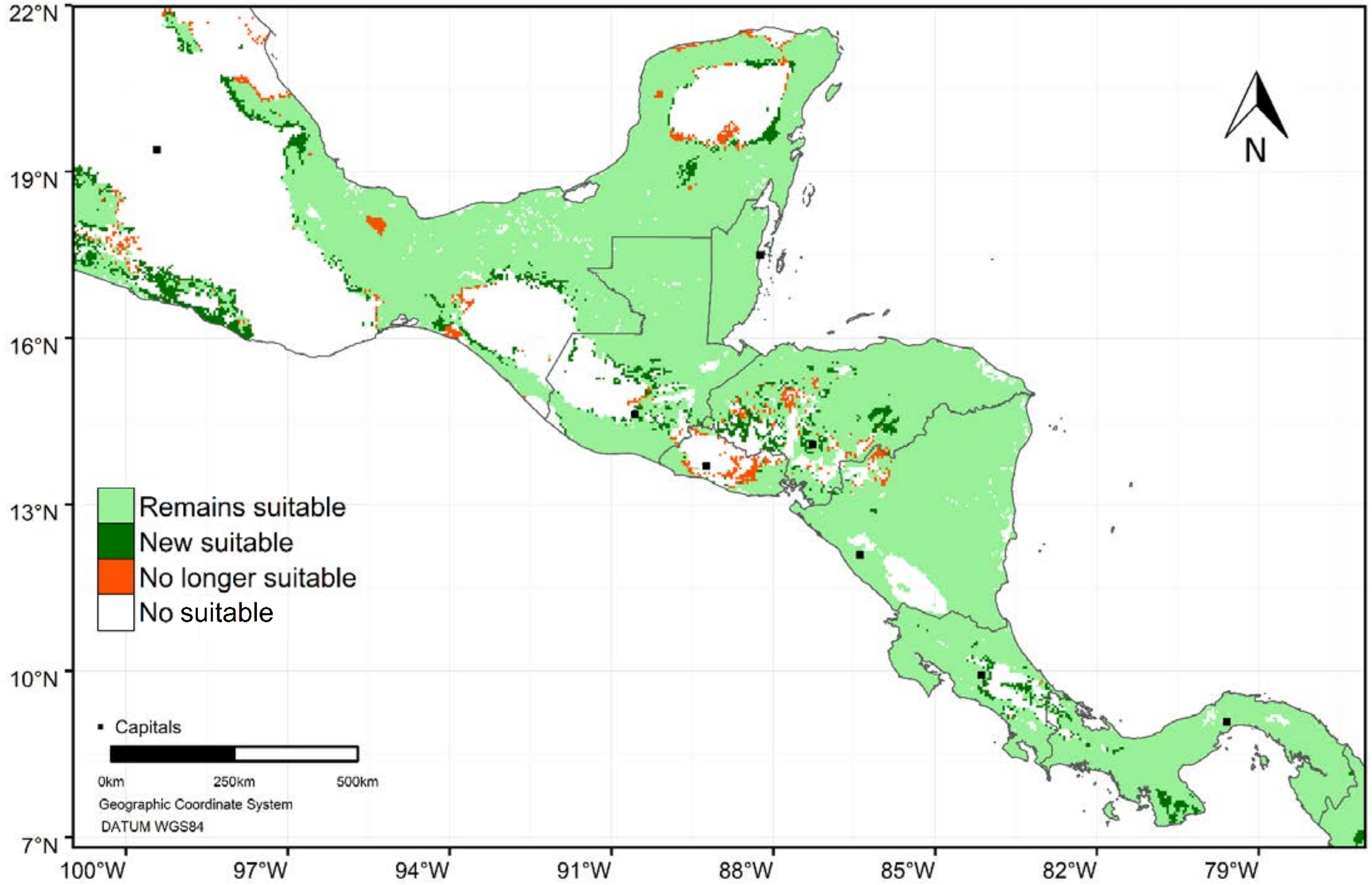
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



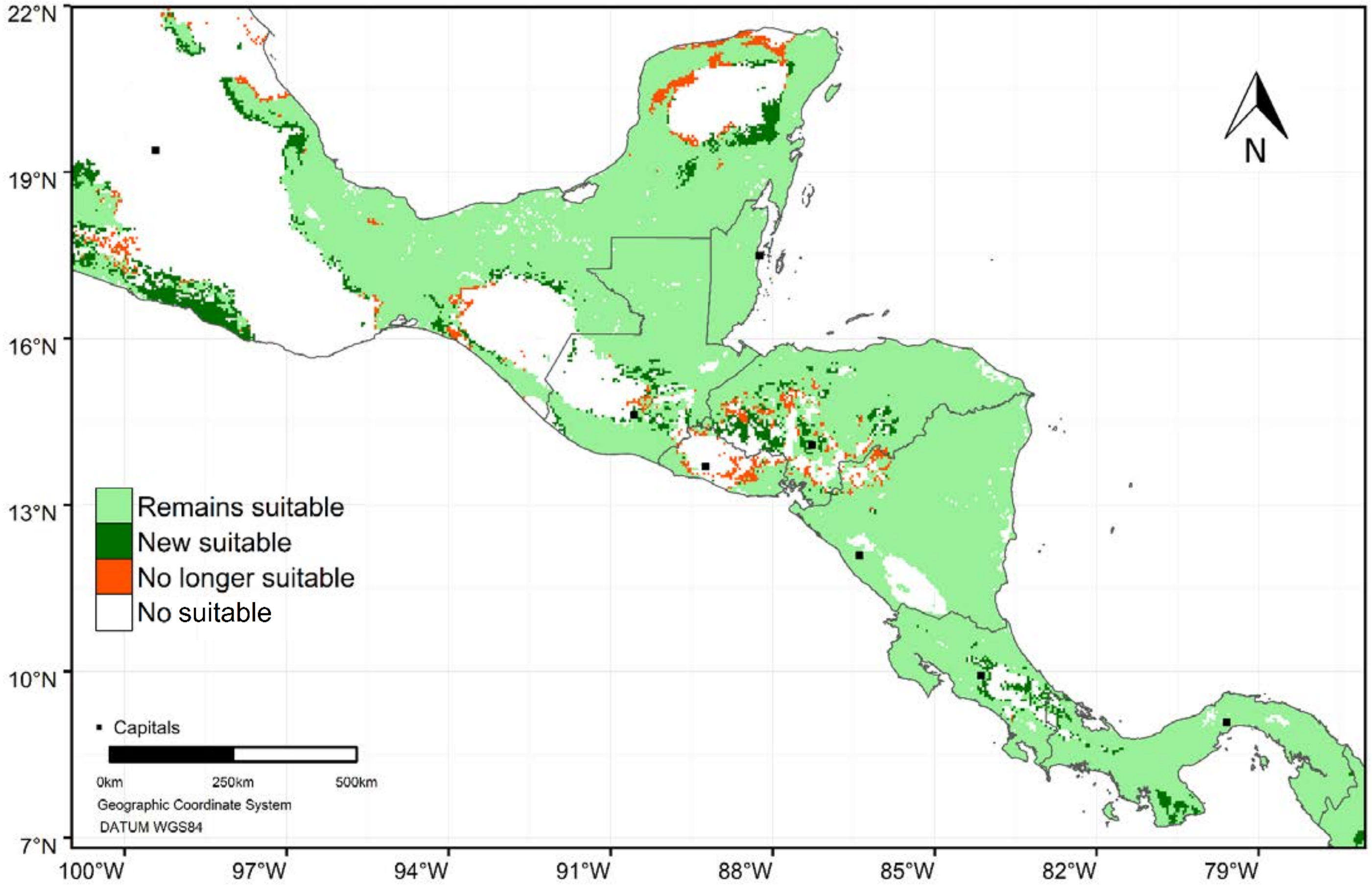
* Areas in white in the map, indicate areas where the species is not suitable.

Cambios de aptitud al año 2050 - escenario RCP 4.5



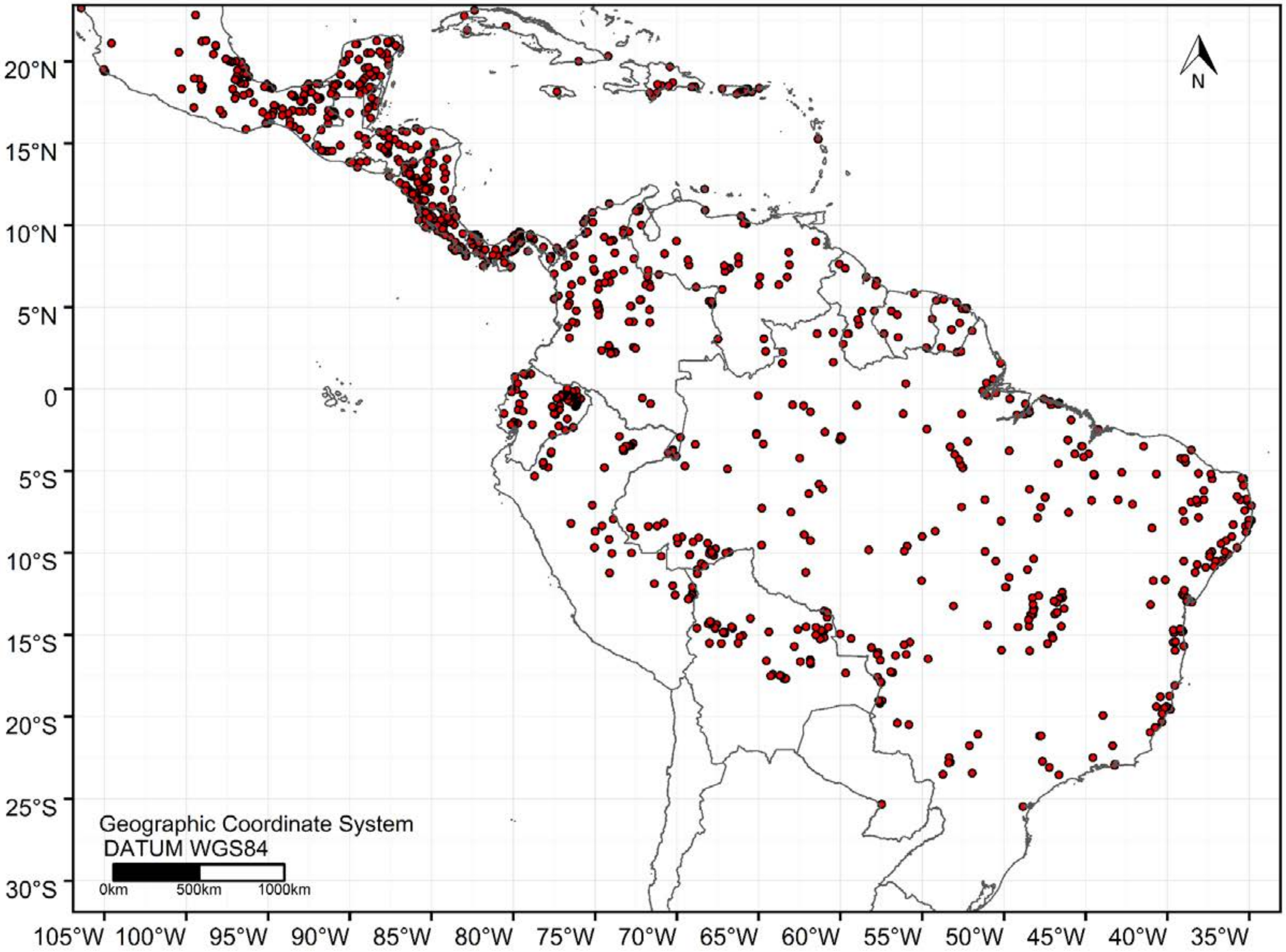
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	43,777	94%	15%	6%	9%
Rain forest	122,015	99%	4%	1%	2%
Whole region	165,792	97%	7%	3%	4%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	43,777	90%	16%	10%	6%
Rain forest	122,015	99%	5%	1%	4%
Whole region	165,792	97%	8%	3%	4%

Points of observed presence



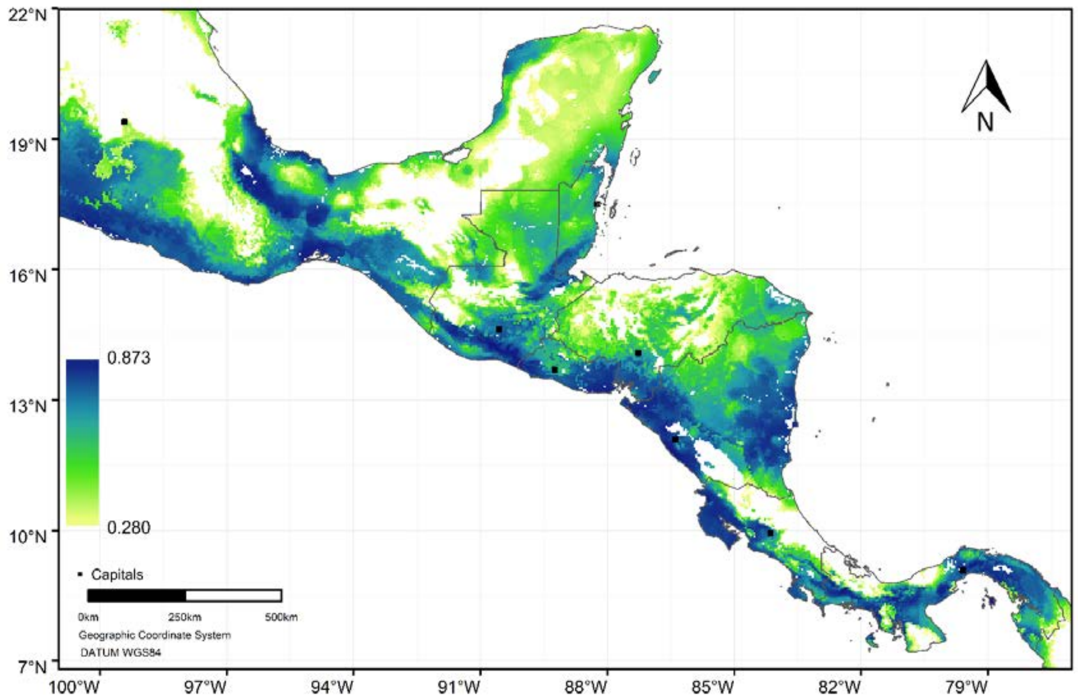
Spondias purpurea L.

Family:
Anacardiae
Vernacular names:
Jocote, ciruela,
jocote de corona (ES)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Dioecious/Monoecious[2]	**Drought**	Yes
Plant height (m)	13 (8 – 15)	**Timber uses**[1]	None	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	4,875 (3,640 – 6,110)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Intermedia	**Shade**	Moderate
Wood density (g cm^{-3})	0.33 (0.31 – 0.35)	**Forage**	Yes	**Seed dormancy**	No	**Salinity**	No
Leaf phenology	Deciduous	**Other uses**	Papel	**Seed dispersal**	Zoochory	**Fire**	Unknown

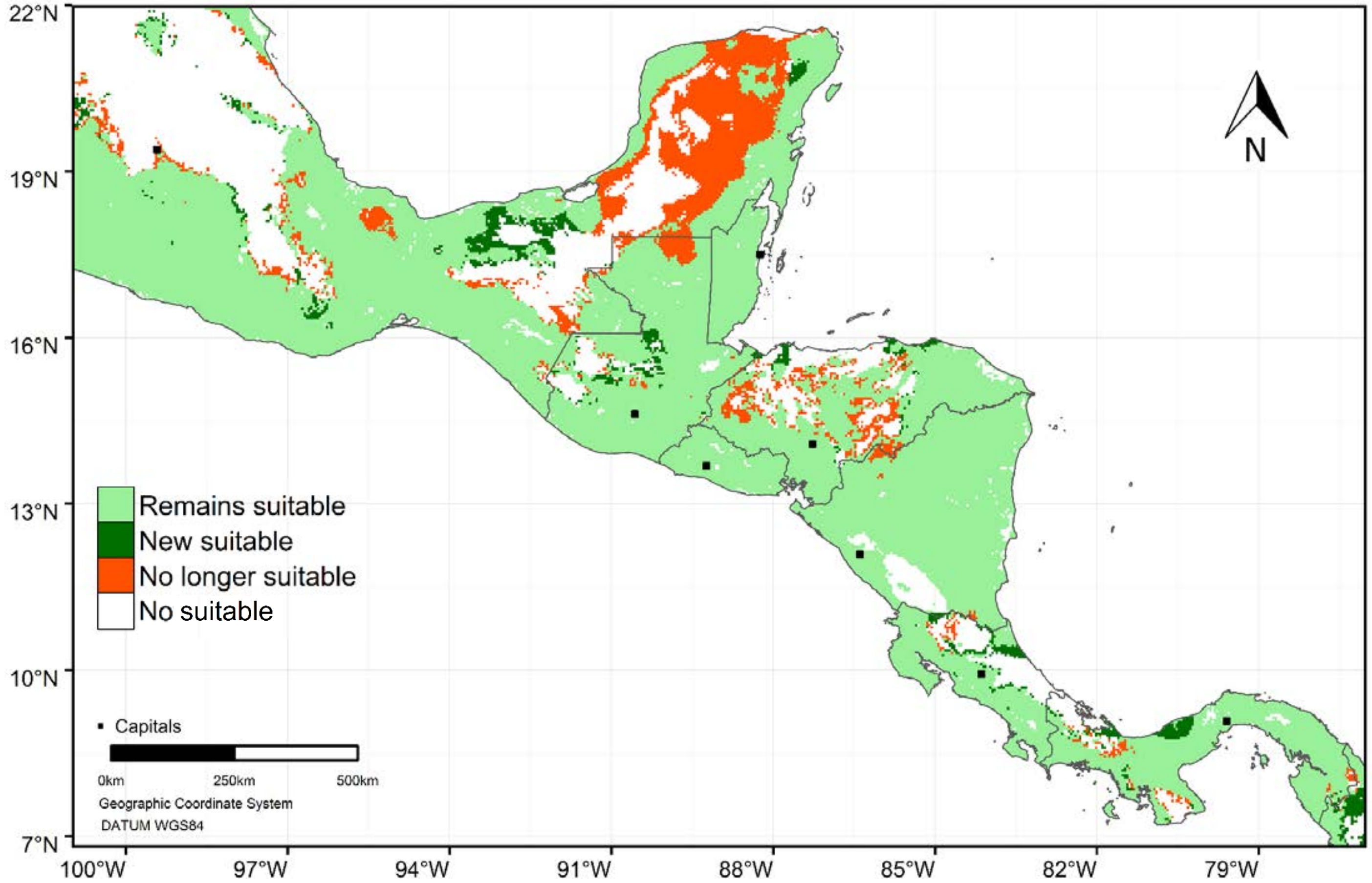
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts
[2] Not clear information regarding reproductive system.

Species suitable areas under current climate



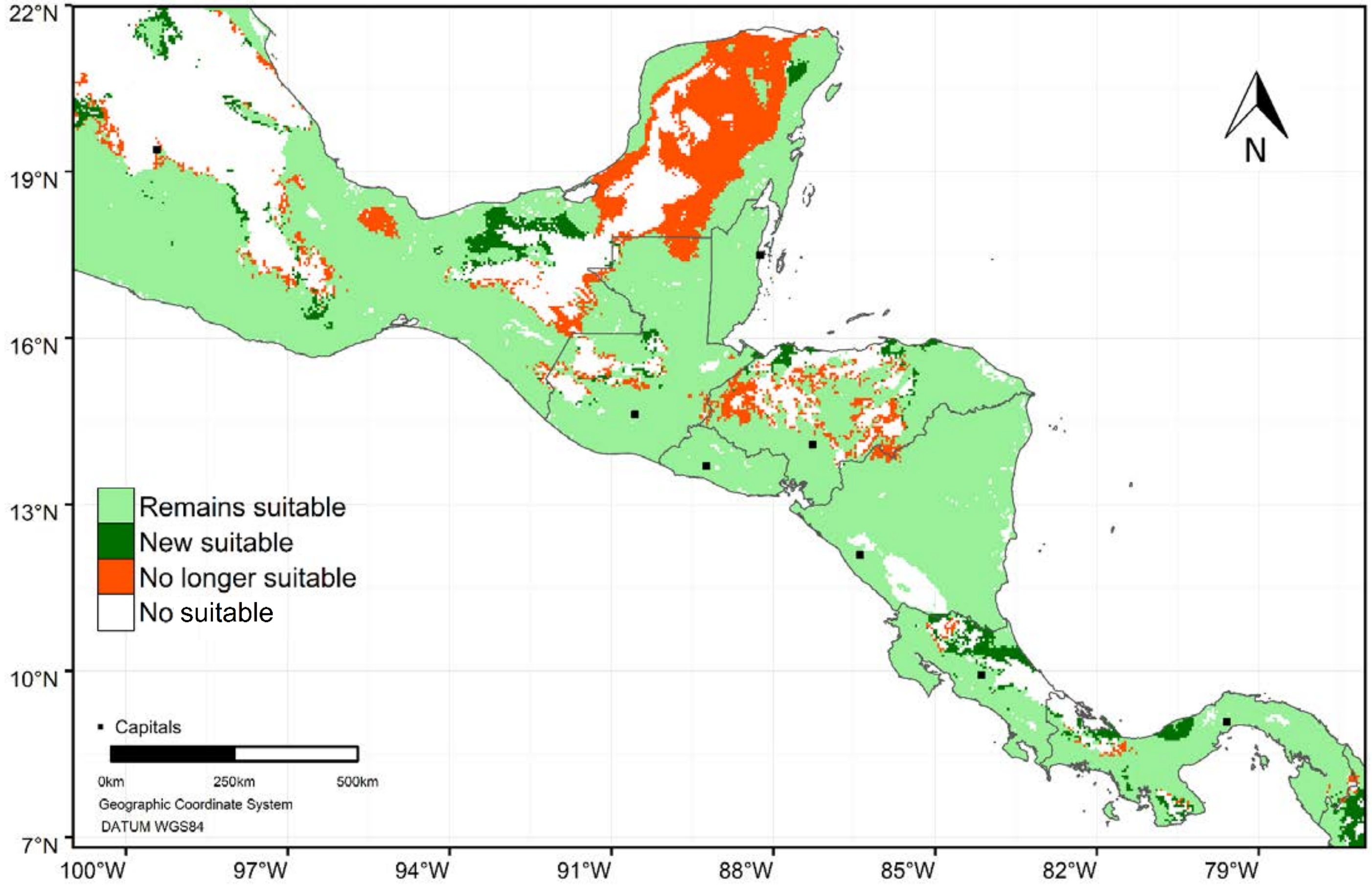
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



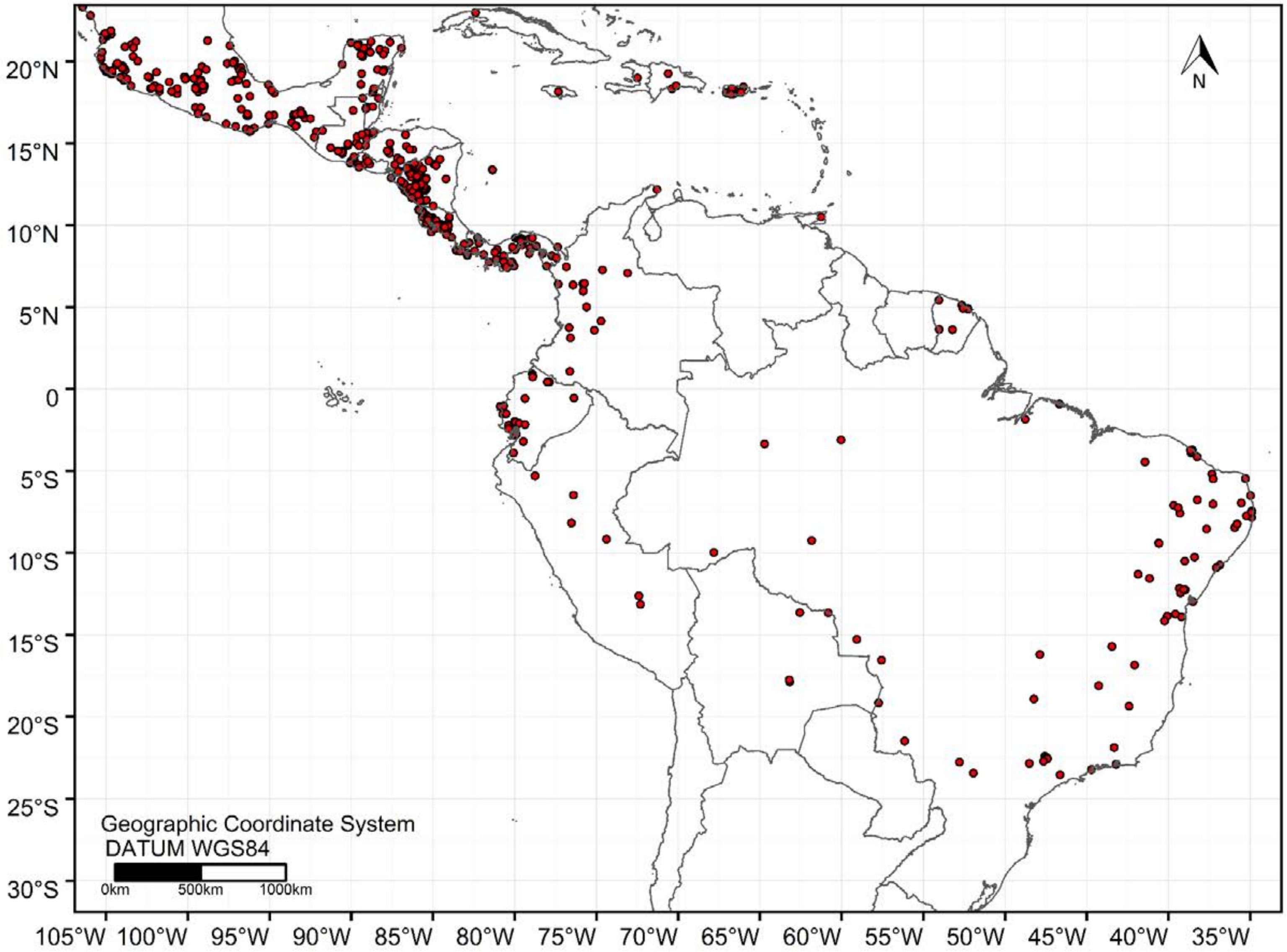
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	89,151	87%	2%	13%	-11%
Rain forest	107,913	89%	6%	11%	-5%
Whole region	197,063	88%	4%	12%	-8%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	89,151	85%	2%	15%	-12%
Rain forest	107,913	88%	8%	12%	-4%
Whole region	197,063	87%	5%	13%	-8%

Points of observed presence



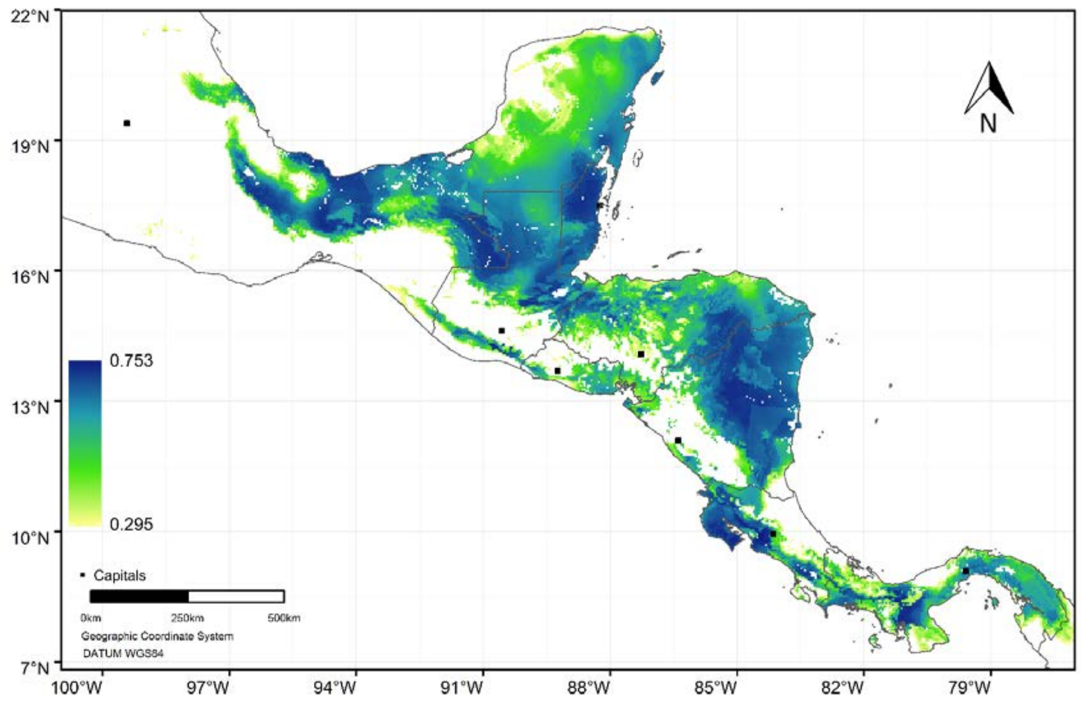
Swietenia macrophylla King

Family:
Meliaceae
Vernacular names:
Caoba, mahogany (BZ)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	33 (25 – 40)	**Timber uses**[1]	SM, CL, MB, AR	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	Yes	**Firewood**	No	**Weight 1000 seeds (g)**	477.5 (357.4 – 617.3)	**Frost**	No
N fixer	No	**Fruit**	No	**Seed storage type**	Intermedia	**Shade**	No
Wood density (g cm^{-3})	0.51 (0.35 – 0.70)	**Forage**	No	**Seed dormancy**	No	**Salinity**	No
Leaf phenology	Deciduous	**Other uses**	Apiculture	**Seed dispersal**	Anemochory	**Fire**	Unknown

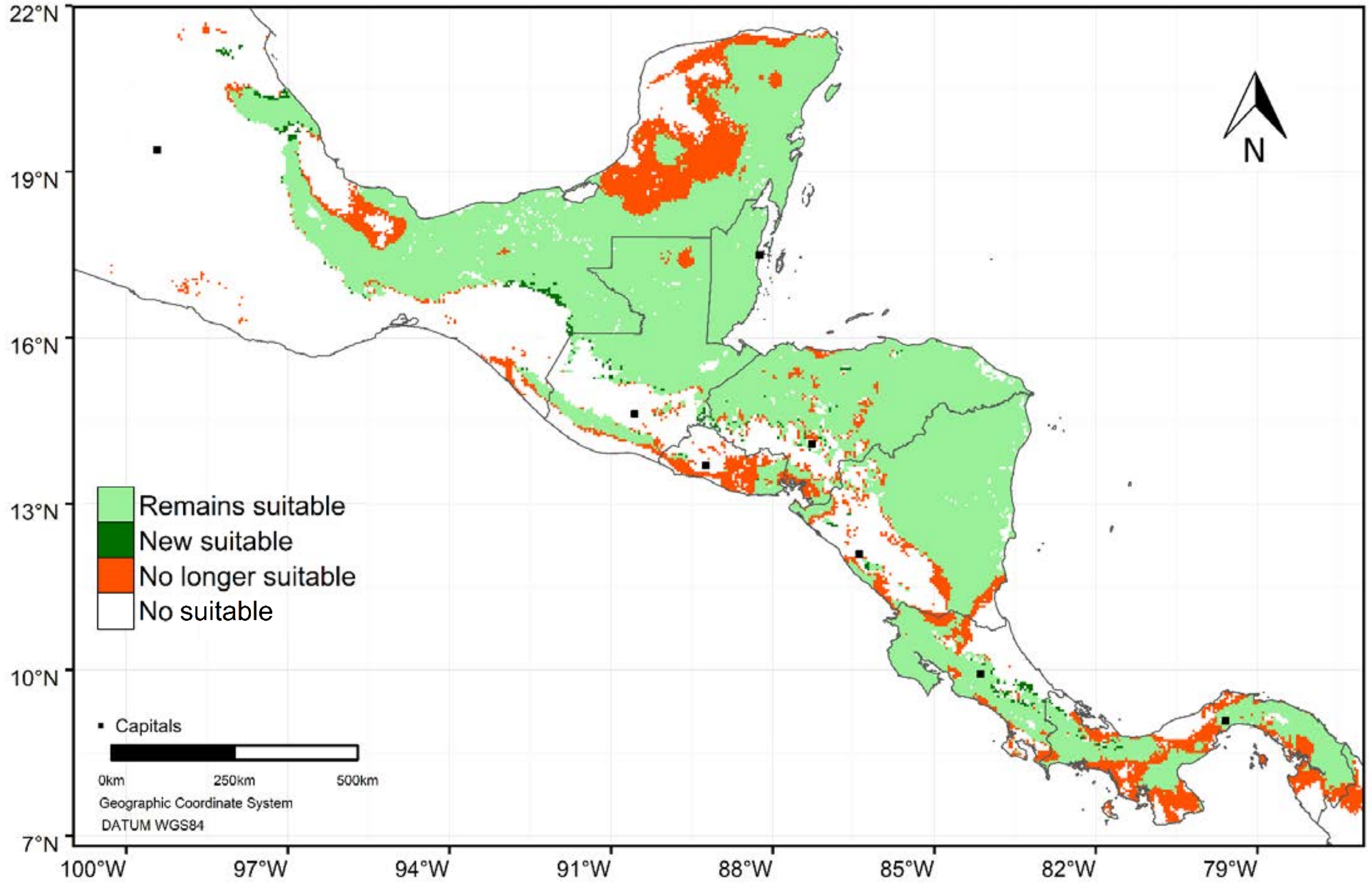
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



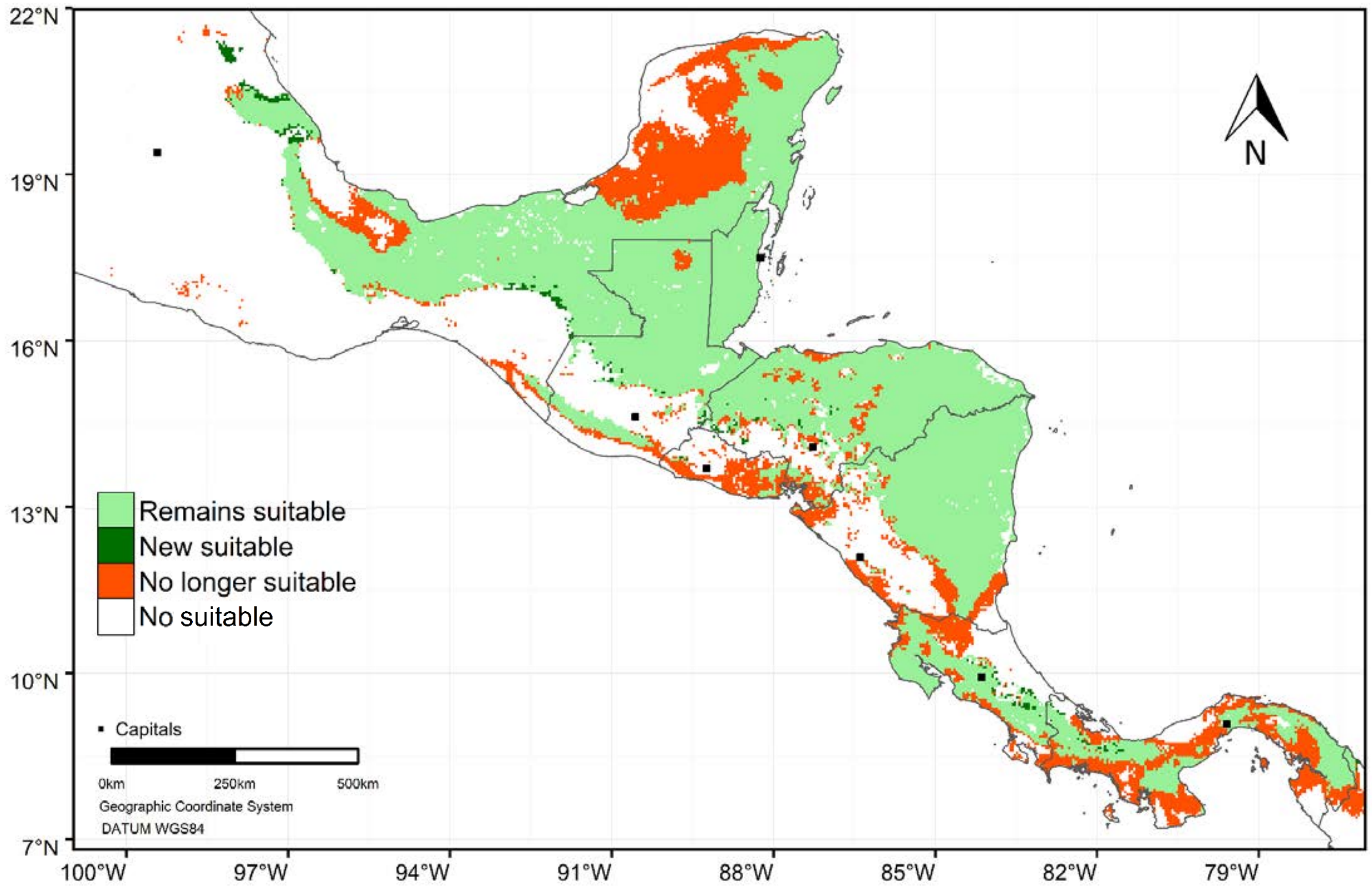
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



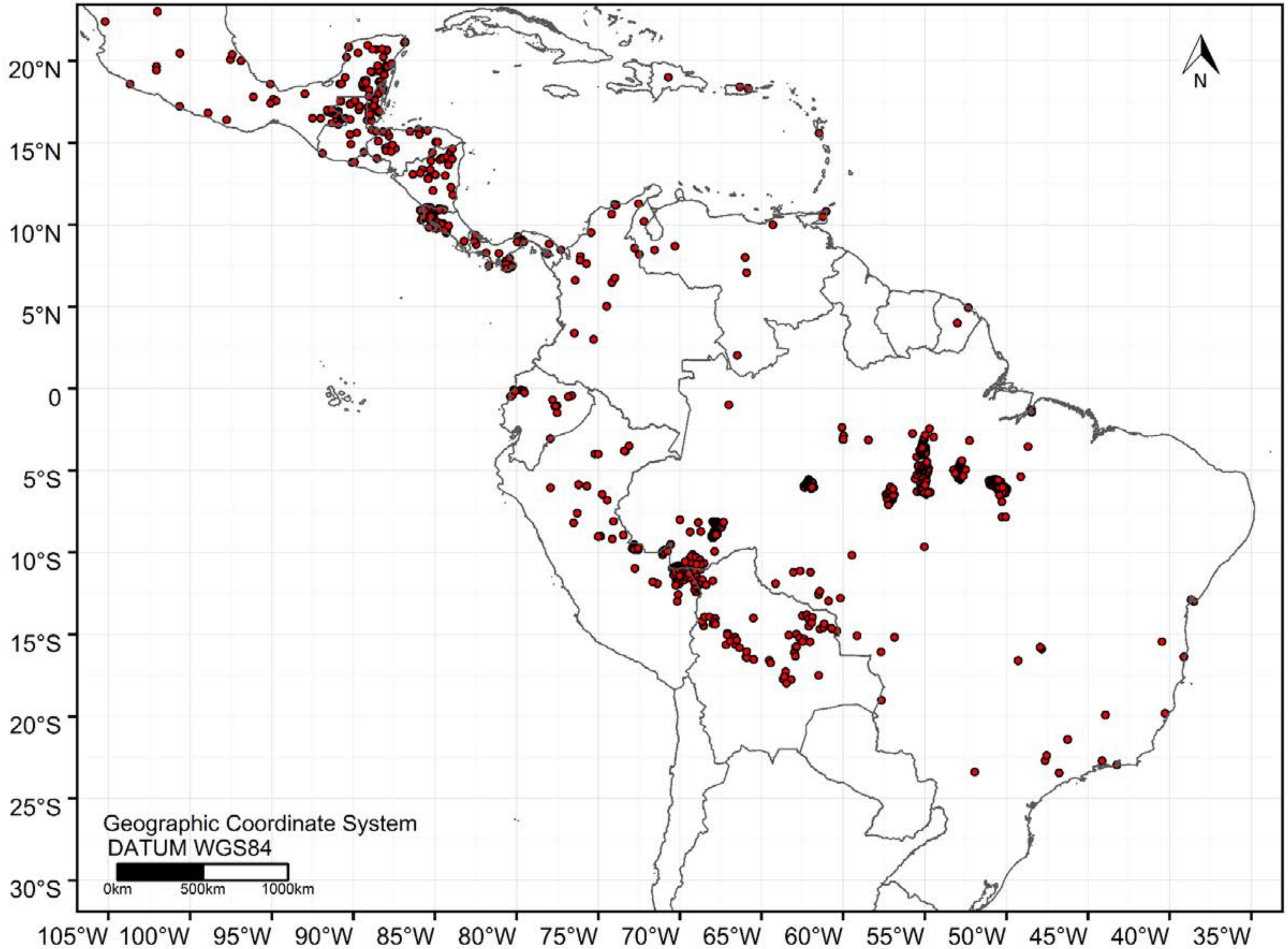
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	34,476	71%	2%	29%	-27%
Rain forest	116,150	85%	1%	15%	-14%
Whole region	150,626	82%	1%	18%	-17%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	34,476	60%	2%	40%	-38%
Rain forest	116,150	81%	1%	19%	-18%
Whole region	150,626	76%	1%	24%	-23%

Points of observed presence



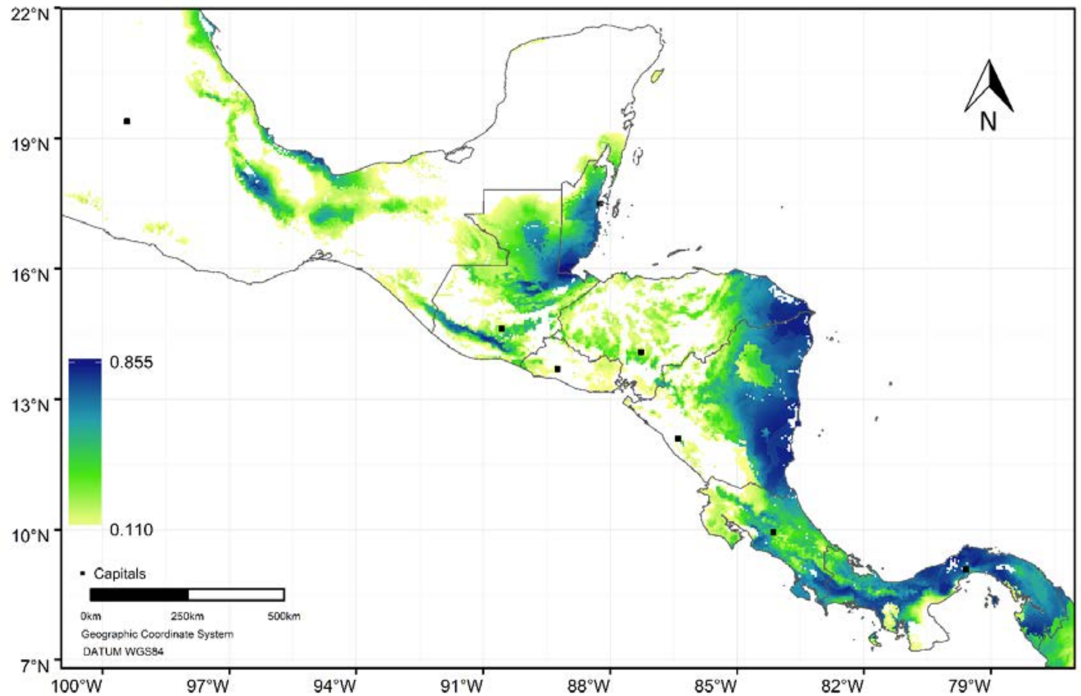
Syzygium malaccense (L.) Merr. & L.M.Perry

Family:
Myrtaceae
Vernacular names:
Manzana de agua,
marañón japonés (ES)
Exotic

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	No	**Reproductive system**	Mixed monoecious	**Drought**	No
Plant height (m)	14 (10 – 20)	**Timber uses**[1]	None	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	3,027 (1,293 – 4,761)	**Frost**	Unknown
N fixer	No	**Fruit**	Yes	**Seed storage type**	Recalcitrant	**Shade**	Moderate
Wood density (g cm^{-3})	0.56 (0.52 – 0.60)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Evergreen	**Other uses**	Medical	**Seed dispersal**	Zoochory	**Fire**	Unknown

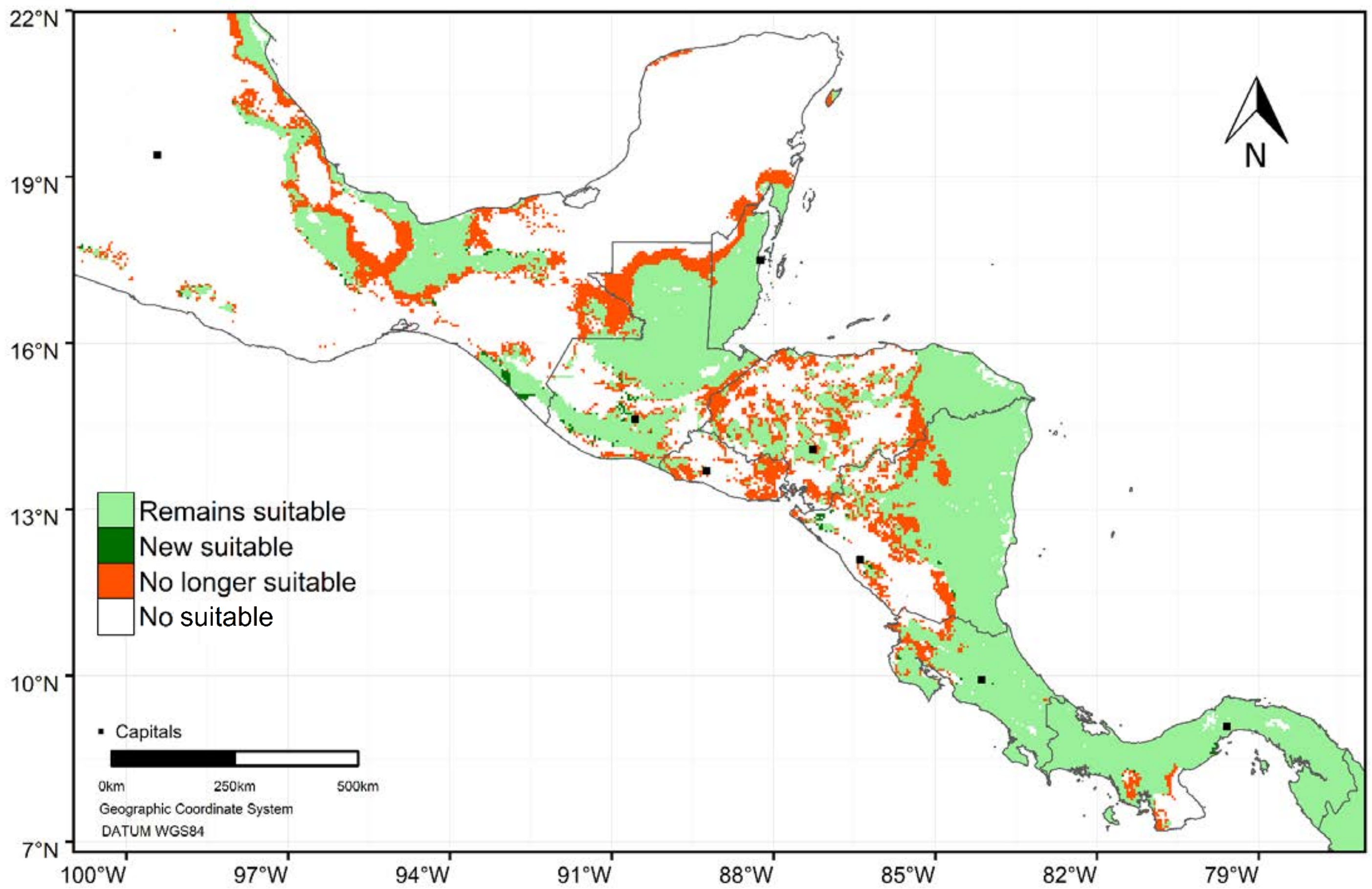
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



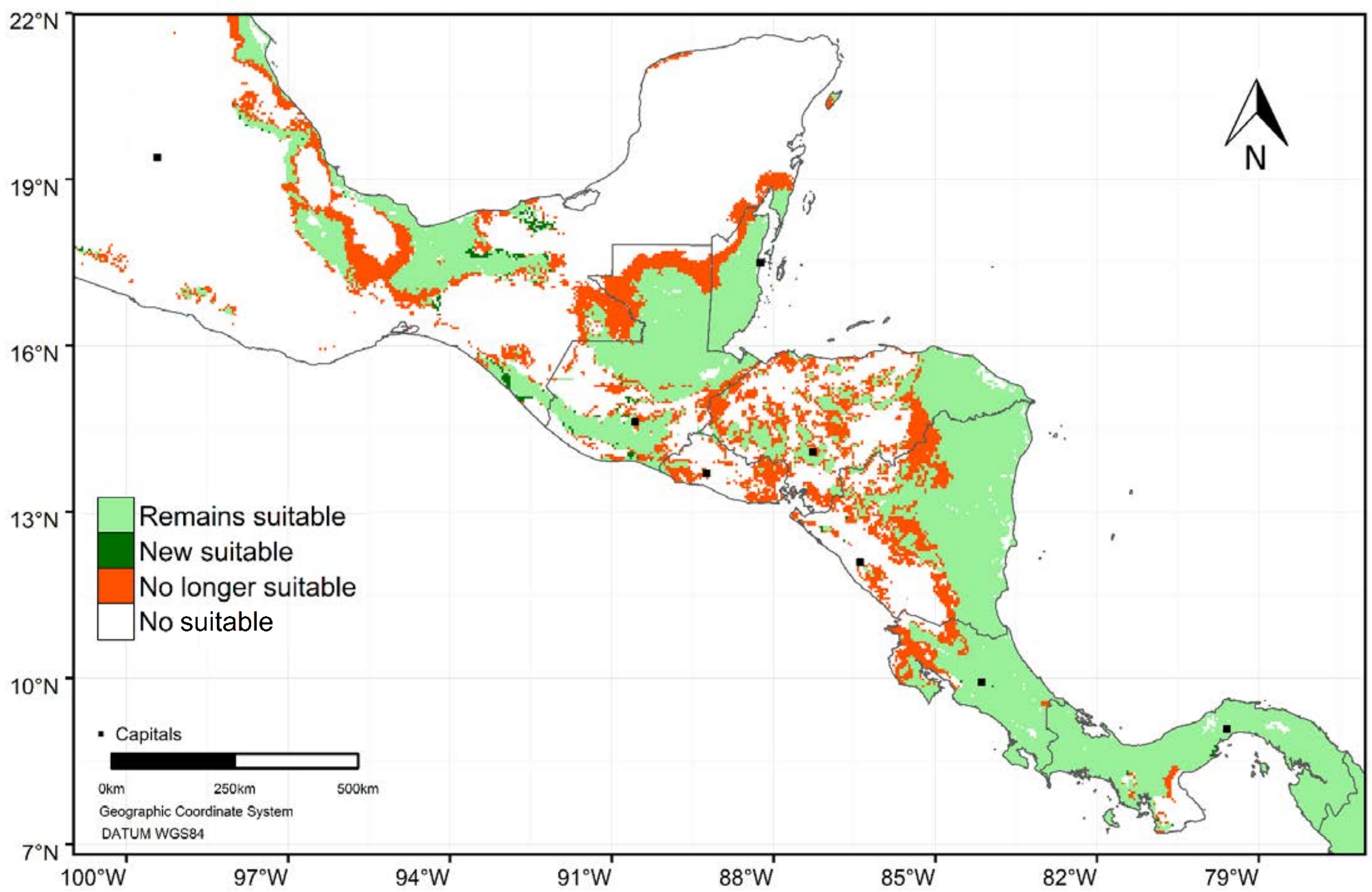
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



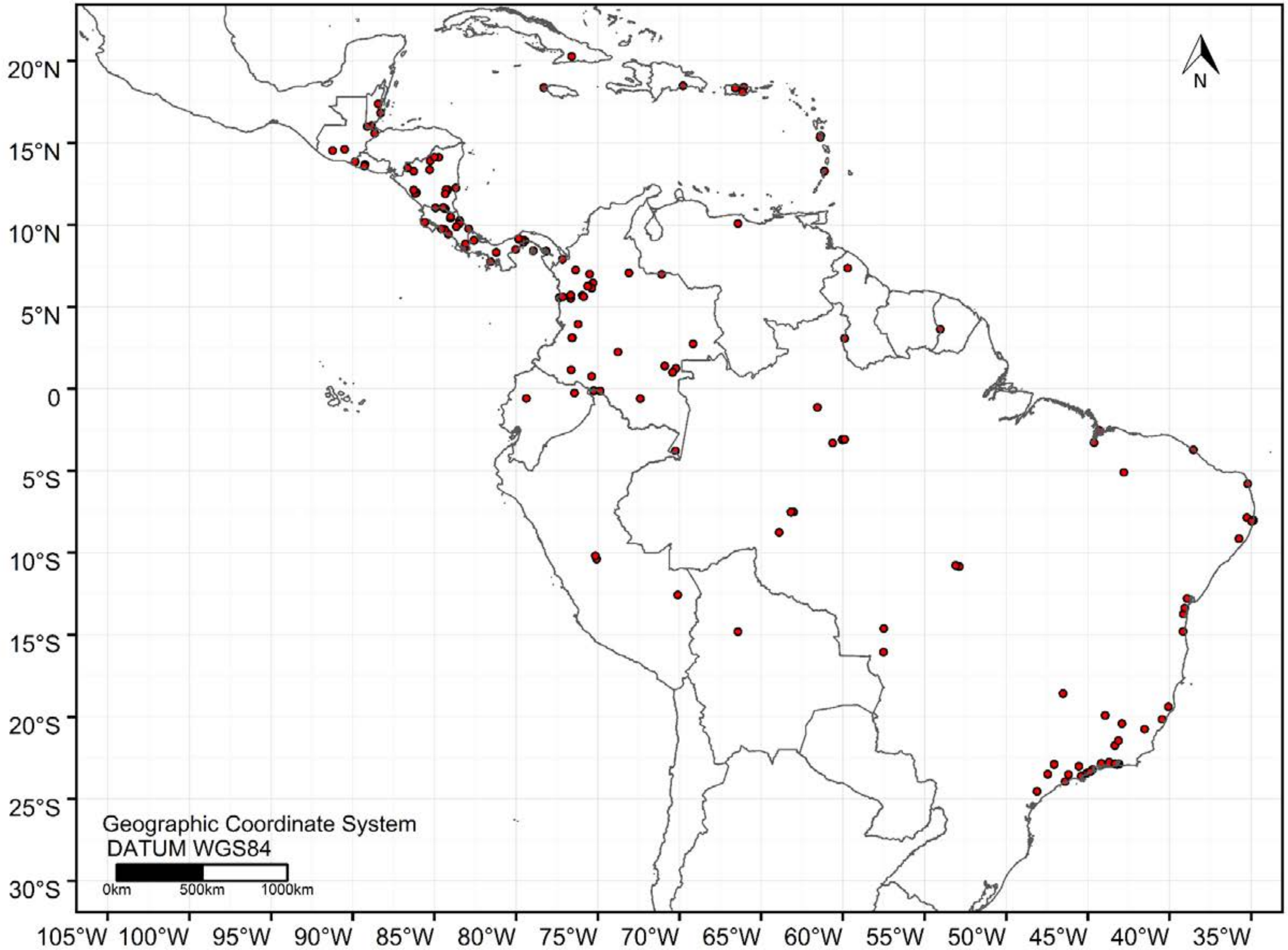
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	23,108	52%	2%	48%	-45%
Rain forest	93,747	82%	1%	18%	-17%
Whole region	116,855	76%	1%	24%	-23%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	23,108	42%	1%	58%	-57%
Rain forest	93,747	79%	1%	21%	-20%
Whole region	116,855	72%	1%	28%	-27%

Points of observed presence



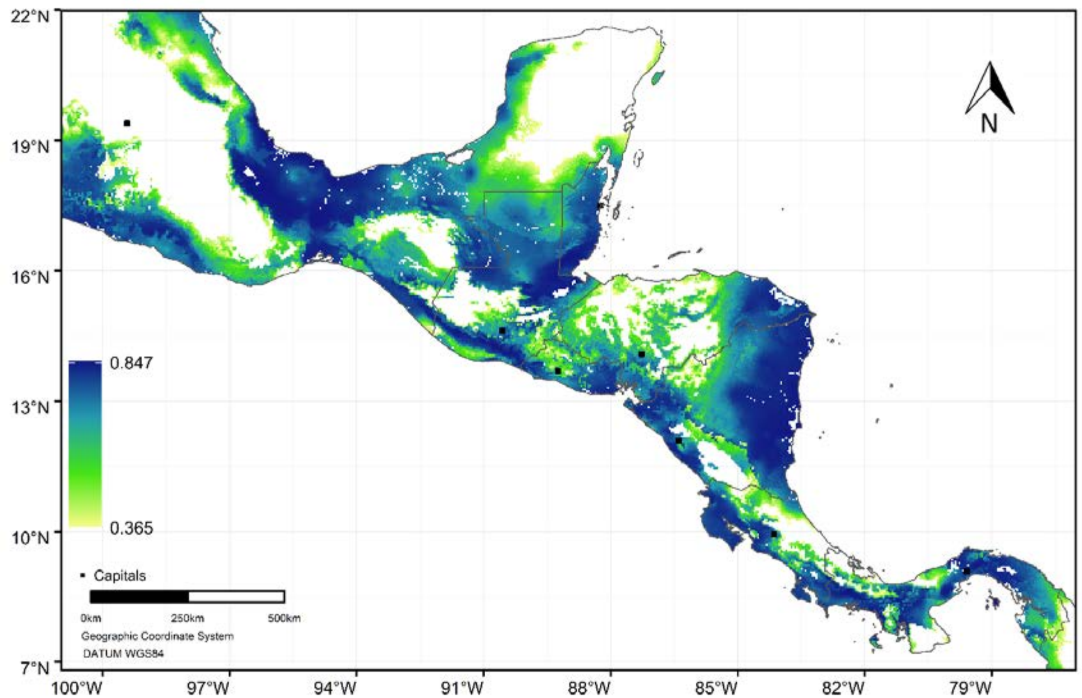
Tabebuia rosea (Bertol.) Bertero ex A.DC.

Family: Bignoniaceae
Vernacular names: Matilisguate (GT, HN, SV), maquilishuat (SV), macualizo (HN), roble de sabana (CR), macuelizo (NI)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Monoecious cross-pollinating	**Drought**	Unknown
Plant height (m)	20 (9 – 40)	**Timber uses[1]**	SM, CS, MB, HF, CH, AR	**Pollination vector**	Insects	**Flooding**	Yes
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	32,13 (17,86 – 106,2)	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.55 (0.40 – 0.75)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Ornamental	**Seed dispersal**	Anemochory	**Fire**	Unknown

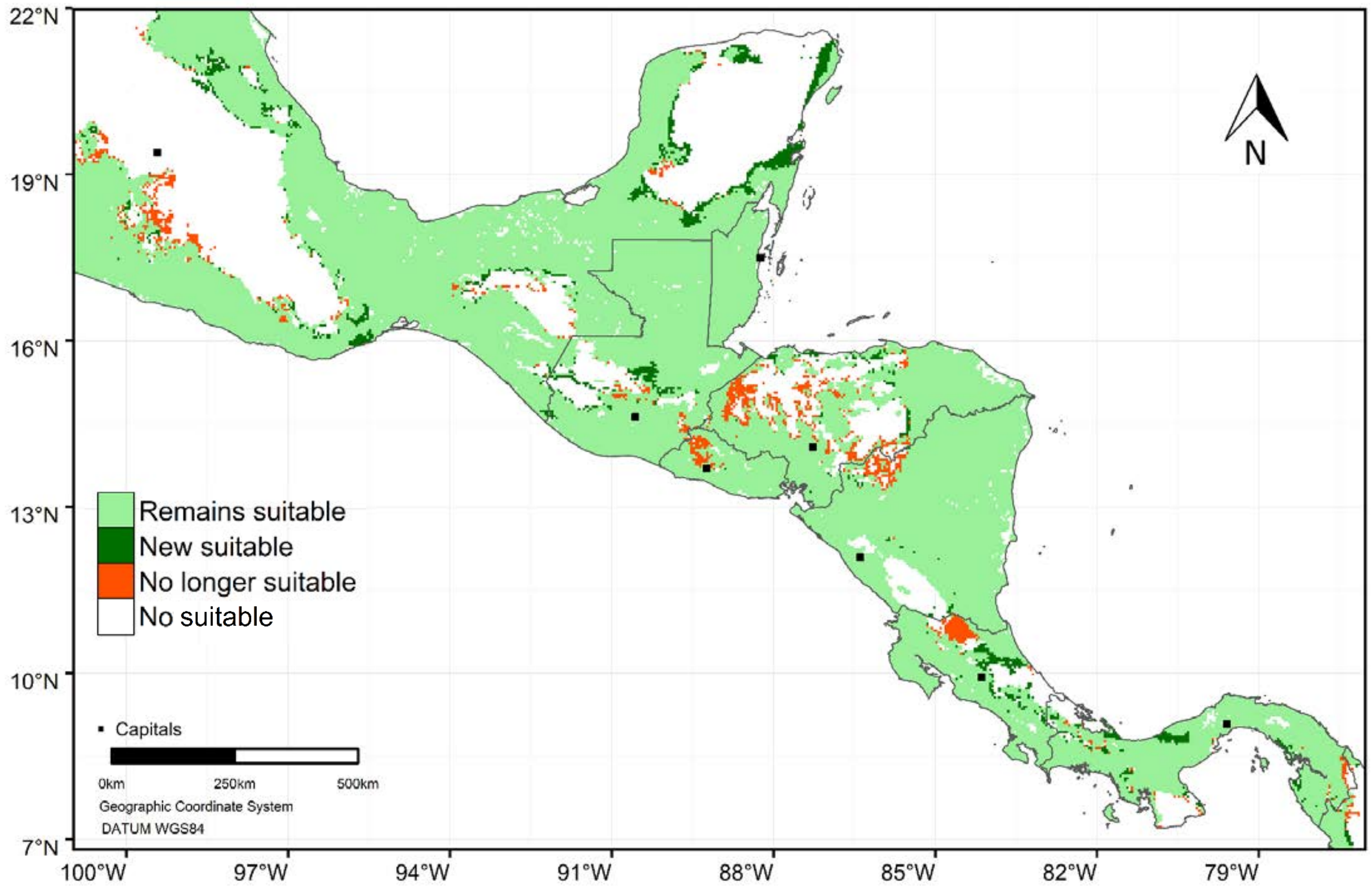
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



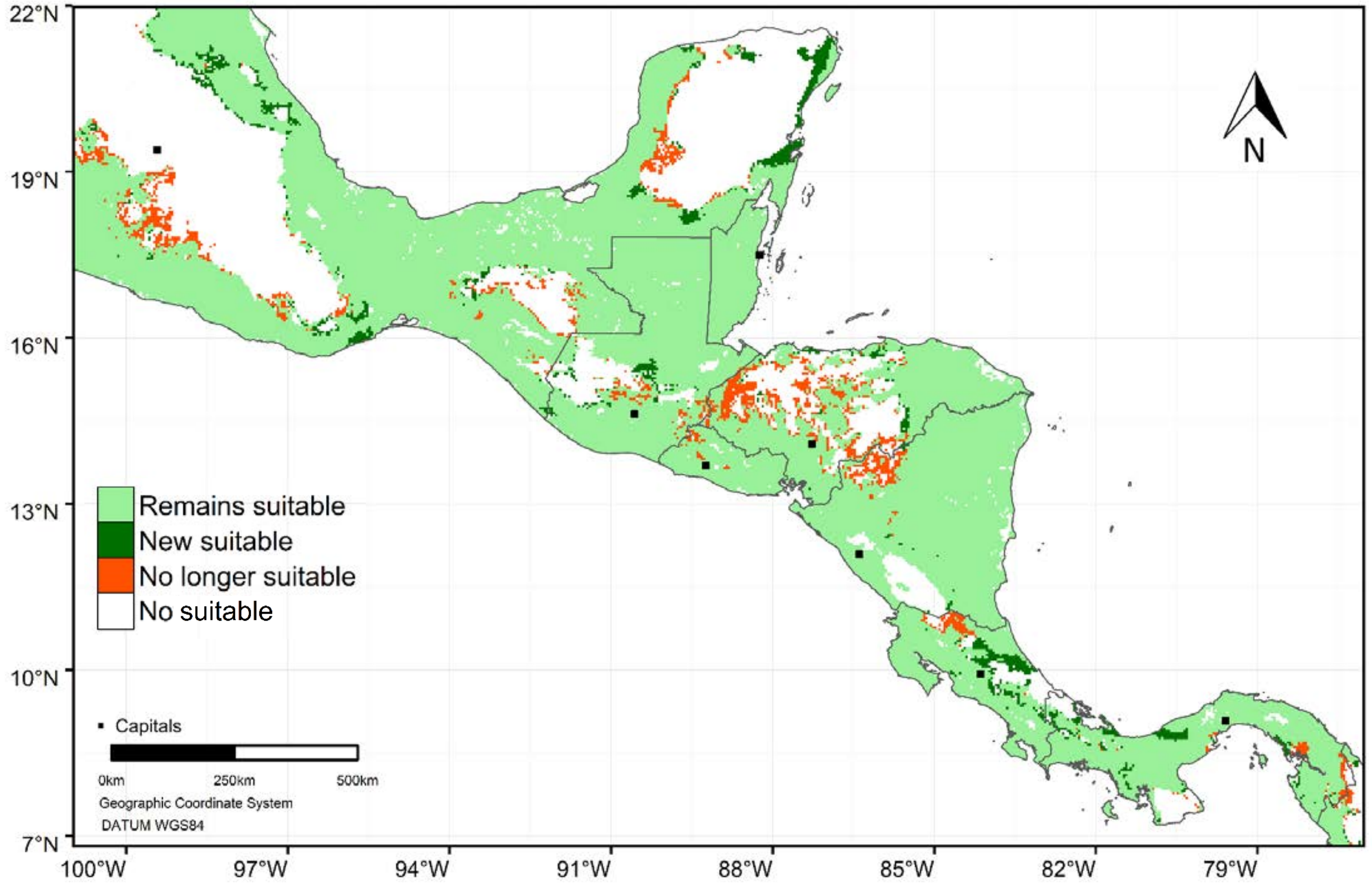
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



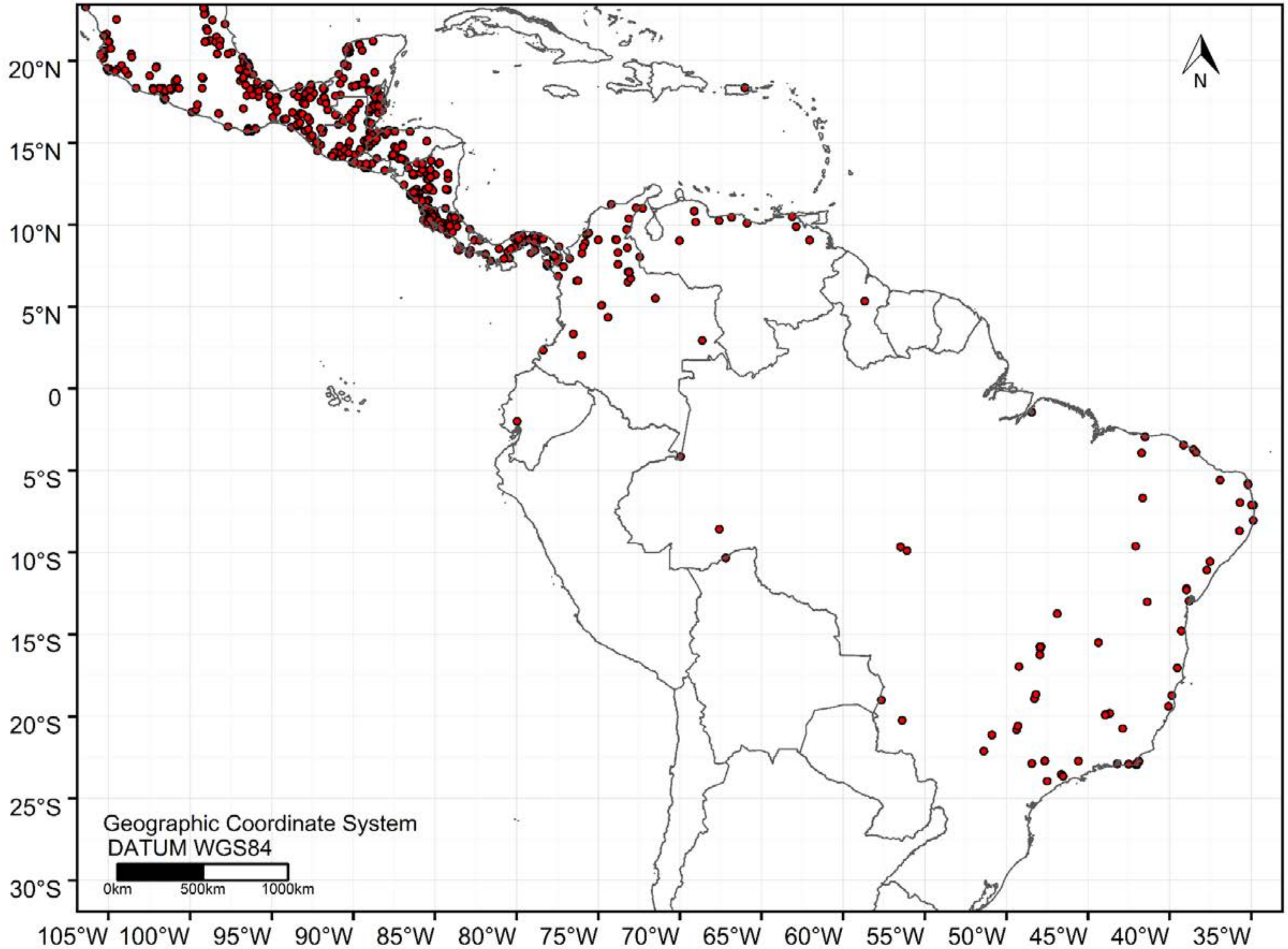
Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	66,905	94%	4%	6%	-2%
Rain forest	115,464	98%	5%	2%	3%
Whole region	182,368	96%	5%	4%	1%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	66,905	90%	3%	10%	-7%
Rain forest	115,464	97%	5%	3%	2%
Whole region	182,368	94%	4%	6%	-1%

Points of observed presence



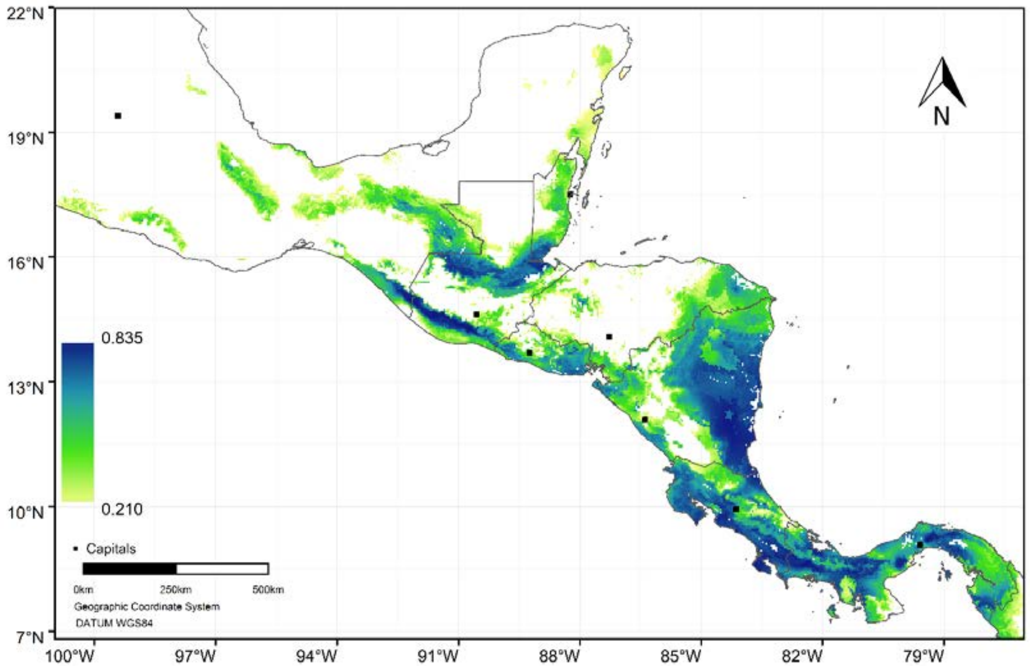
Terminalia oblonga (Ruiz & Pav.) Steud.

Family:
Combretaceae
Vernacular names:
Guayaba de montaña (CR), guayabo (HN, NI), volador (SV, GT)

Whole plant attributes		Uses		Reproductive attributes		Stress tolerance	
Growth form	Tree	**Commercial timber**	Yes	**Reproductive system**	Unknown	**Drought**	Unknown
Plant height (m)	40 (35 – 45)	**Timber uses[1]**	CS, PS, AR	**Pollination vector**	Insects	**Flooding**	Unknown
Spinescence	No	**Firewood**	Yes	**Weight 1000 seeds (g)**	51.87 (41,3 – 68,8)	**Frost**	Unknown
N fixer	No	**Fruit**	No	**Seed storage type**	Orthodox	**Shade**	No
Wood density (g cm^{-3})	0.68 (0.37 – 0.91)	**Forage**	No	**Seed dormancy**	No	**Salinity**	Unknown
Leaf phenology	Deciduous	**Other uses**	Unknown	**Seed dispersal**	Anemochory	**Fire**	Unknown

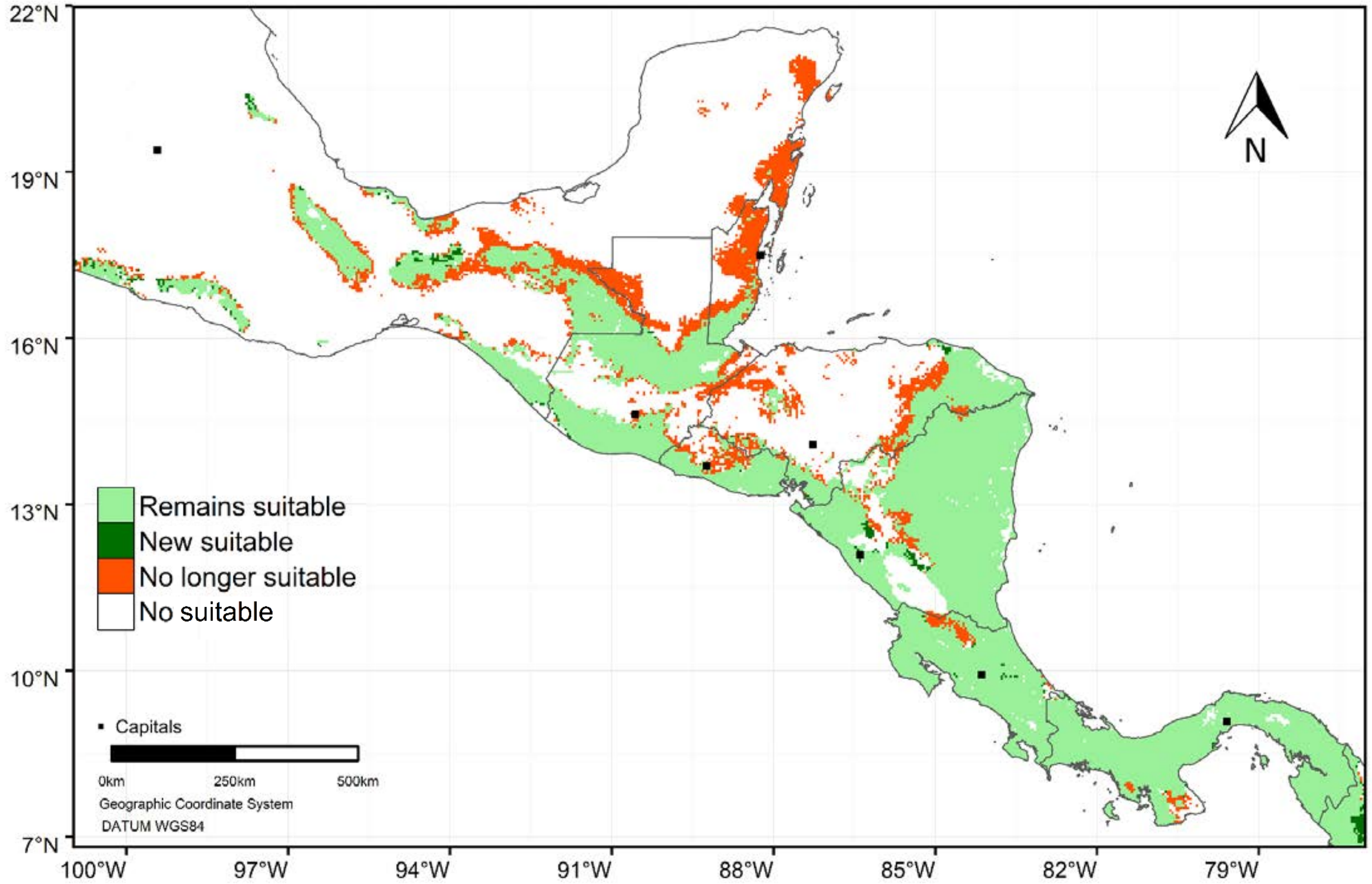
[1] SM= Suitable for Saw Mill; CS= Engineering and Structural Construction; CL= Light Construction; MB= Furniture; HF= Farm Tools; PS= Flooring; DT= Railway Sleepers; CH= Veneer; AR= Handicrafts

Species suitable areas under current climate



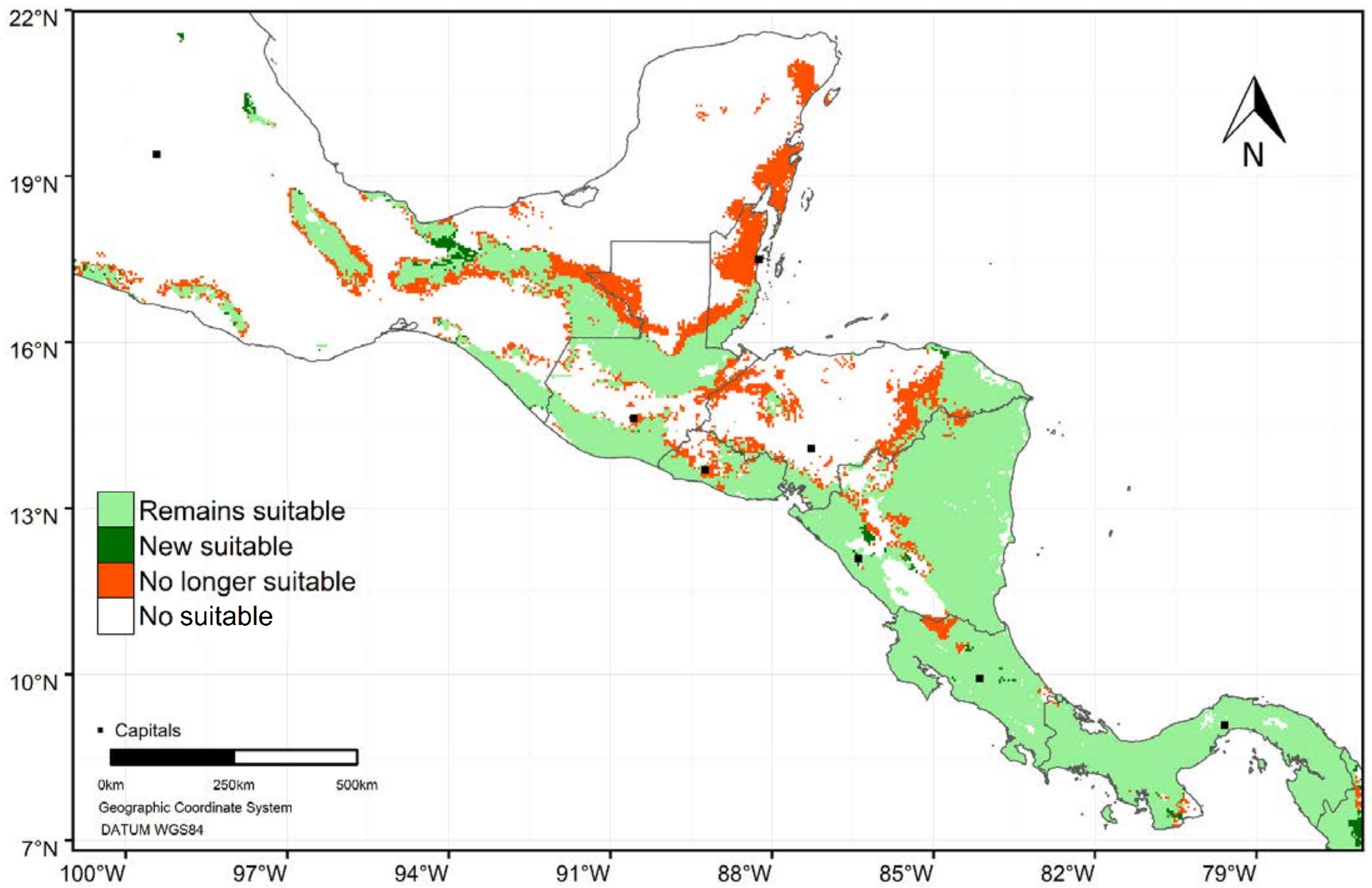
* Areas in white in the map, indicate areas where the species is not suitable.

Suitability changes in year 2050 - scenario RCP4.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	25,436	76%	3%	24%	-22%
Rain forest	81,923	82%	1%	18%	-17%
Whole region	107,359	80%	2%	20%	-18%

Suitability changes in year 2050 - scenario RCP8.5



Zone	Current distribution per zone (km²)	Remains suitable	Potential new habitat	No longer suitable	Net change
Dry forest	25,436	72%	2%	28%	-26%
Rain forest	81,923	81%	2%	19%	-17%
Whole region	107,359	79%	2%	21%	-19%

Points of observed presence