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Editorial: Mesoamerican paleoecology

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Editorial on the Research Topic
Mesoamerican paleoecology

Mesoamerica covers a vast area of Central America and Mexico, with different eco-geographical patterns and a highly variable climate and vegetation. This megadiverse area is characterized by tropical forests, high mountain vegetation, and a long history of human occupation since the middle Holocene. The present climate in Mesoamerica varies from moist to dry and warm to cool conditions. The complexity of all biological and physical settings makes it difficult to decipher Mesoamerica's past, present, and future from a paleoecological point of view.

Since the European Discovery of America in 1492, environmental change and human activity have shaped Mesoamerican vegetation, but ancient cultures changed the natural environment over at least 4,000 years under different climate and landscape conditions (Hodell et al., 1995; Islebe et al., 2019). Our Research Topic "*Mesoamerican paleoecology*" analyzes past ecological dynamics in this important region for biodiversity conservation. Nature–human interaction is a relevant aspect of this topic, and participating authors have contemplated the role of the climate in the demise of the ancient Maya civilization. The articles in this Research Topic include different proxies, methodological approaches (Ford; García-Arriola et al.; Lentz et al.), and views that we hope will foster further discussion, insights, and methods to improve our understanding of Mesoamerican paleoecology and its relevance to conservation.

Records of Mesoamerican paleoecology

García-Arriola et al. analyze paleoecological and paleohydrological change based on records from Lake Coatetelco, located at 960 m altitude in Central Mesoamerica, southwest Mexico. These records cover hydrological change from 11.5–2.1 cal ka BP, spanning early to late Holocene vegetation and human occupation. Sub-millennial-scale variations and precipitation/evaporation feedback in global and/or regional climate change were inferred from the carbon isotope composition (δ^{13}Corg) and C/N ratio of bulk organic matter. The abundance and chemical compositions of clastic and antigenic minerals, estimations of sediment-water interactions, and provenances of siliciclastic fractions under the varying regimes of insolation, ITCZ position, and ENSO activity are also analyzed. This paleohydrological record of Central Mesoamerica provides insight into two intervals

between 10.2–6 cal ka BP and 6–4.2 cal ka BP. These periods were affected by low summer insolation, high autumn insolation, and a southward shift of the ITCZ, strengthening dry conditions and increasing middle Holocene drought.

Lentz et al. analyze pollen, environmental DNA, and macrobotanical remains from the archaeological site of Yaxnocah in the southern Yucatan Peninsula. The authors discuss how ancient Maya settlements managed water in an area of pronounced dry and wet seasons. Agricultural adaptation, agroforestry, and water management were key for the ancient Maya to guarantee wellbeing and survival. During the Preclassic Maya occupation, upland and scrub vegetation were present in the area, though with fluctuating cover and distribution over time. Pine savanna may have been induced by anthropogenic burning or by a successional pathway to open vegetation types in drier times during the Preclassic period. The authors present evidence of the presence of mature upland and *bajo* forests during the Maya occupation, which is in line with other paleoecological studies on the ancient Maya in the area. Using environmental DNA as additional evidence for fossil pollen helps with detecting additional plant species, which could have been used by the ancient Maya. The use of environmental DNA in Mesoamerican paleoecological studies is still rare.

The paper by Ford discusses how environmental change relates to human influence, i.e., how the landscape was shaped and transformed by Mesoamerican culture, in this case, the Maya. The effects of active management by the ancient Maya over centuries on forest composition are analyzed from the perspective of imprinting the human factor on the ecosystem's history. Swidden agriculture and the milpa cycle can be analyzed from different points of view, but the ancient Maya influence on their natural environment was profound, as suggested by our knowledge of plants, inherited from the ancient Maya. The Maya milpa forest garden was a productive system, adapted to local environmental conditions and available plant resources. Agriculturists, archaeologists, paleoecologists, etc. have recognized the milpa subsistence system as part of the tropical forest. The milpa forest garden guaranteed sufficient food production and land use adapted to local conditions and reduced strong soil erosion.

Conclusions and future directions

The papers included in this Research Topic offer valuable information from different parts of Mesoamerica where climate change and human influence affect the surrounding environment. All papers help to further our understanding of the human footprint over different time scales (Ford; García-Arriola et al.; Lentz et al.). The results of these studies strengthen the knowledge of ancient cultures till present times and offer hints for achieving sustainable forest management and biodiversity conservation. The understanding of how the forests of Mesoamerica were managed over the last 3,000 years is essential for effective future management and planning.

Author contributions

GI and AA-M wrote the editorial. Both authors approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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