frontiers | Frontiers in Forests and Global Change

TYPE Editorial
PUBLISHED 26 September 2022
DOI 10.3389/ffgc.2022.1021784

Check for updates

Editorial: Functional ecology and conservation of palms

Gerardo Avalos[1,2]*, Thaise Emilio[3], Kelly M. Andersen[4] and Silvia Alvarez-Clare[5]

[1]Escuela de Biología, Universidad de Costa Rica, San José, Costa Rica, [2]The School for Field Studies, Center for Sustainable Development Studies, Beverly, MA, United States, [3]Plant Biology Department, Biology Institute, State University of Campinas, Campinas, Brazil, [4]Nanyang Technological University, Singapore, Singapore, [5]Morton Arboretum, Lisle, IL, United States

KEYWORDS

functional traits, palm ecology, leaf economic spectrum, palm *ex-situ* conservation, living palm collections, trait-based ecology, trait evolution

OPEN ACCESS

EDITED AND REVIEWED BY
Heather R. McCarthy,
University of Oklahoma, United States

*CORRESPONDENCE
Gerardo Avalos
gerardo.avalos@ucr.ac.cr

SPECIALTY SECTION
This article was submitted to Forest Ecophysiology, a section of the journal Frontiers in Forests and Global Change

RECEIVED 17 August 2022
ACCEPTED 05 September 2022
PUBLISHED 26 September 2022

CITATION
Avalos G, Emilio T, Andersen KM and Alvarez-Clare S (2022) Editorial: Functional ecology and conservation of palms.
Front. For. Glob. Change 5:1021784.
doi: 10.3389/ffgc.2022.1021784

Editorial on the Research Topic
Functional ecology and conservation of palms

With more than 2,600 species and 181 genera, palms (Arecaceae) are one of the most diverse and widely distributed plant families in tropical environments (Baker and Dransfield, 2016). Although they make up a modest portion of the above-ground biomass in most neotropical forests (DeWalt and Chave, 2004), their contribution increases in places where palms are dominant (Muscarella et al., 2020). In the Amazon forests, palms are hyperdominant elements (ter Steege et al., 2013). Their sheer abundance secures them a key role in forest function and forest structure (Boukili and Chazdon, 2017).

Palms provide food for a wide variety of animal species (Onstein et al., 2017), including key resources for frugivores, which in turn disperse canopy trees that store most of the carbon in mature forests (Bello et al., 2015). Many human groups value palms and use them as raw material for building, food, drink, clothing, fuel, and medicine (Sylvester et al., 2012).

Palms tissues stretch the limits of plant cells to reach tree-like heights while preserving mechanical stability and long-term function using only apical meristems (Tomlinson, 2006). Little is known about the functional mechanisms governing palms' adaptation to environmental gradients, despite their ecological significance and distinctive morphological and physiological structure. Here, we summarize the functional role of palms from a variety of perspectives, which concentrate on the analysis of functional traits and their influence on adaptation to environmental gradients. Contributions are grouped into the analysis of functional traits and conservation issues.

How functional traits influence palm distribution and performance

Five articles analyzed how functional traits influence adaptation to environmental gradients, successional stages, hydrological conditions, differences in rainfall and nutrients, and habitat fragmentation. Functional trait analysis in palms is fragmentary and biased toward the most common species. The articles compiled here make significant contributions, but more remains to be done. Future studies should examine the ontogenetic, intraspecific, and geographic variation influencing the adaptive value of these traits.

The work by Lauder et al. is the first to analyze simultaneously the effect of successional stage on palm diversity, species and functional trait composition using an altitudinal gradient. Secondary forests were less diverse than mature forests and had less shade-tolerant species. With increasing elevation there was a decrease in juvenile abundance and changes in adult species composition. Sensitive adult species were increasingly confined to small fragments of mature forests which are essential to the long-term maintenance of species diversity and functional diversity.

Emilio et al. analyzed intraspecific variation (and co-variation) in seven leaf functional traits in 14 palm species distributed along a hydro-topographic gradient in central Amazonia. Most studies in tropical plants look at average values of functional traits per species. The role of intraspecific variation in adaptation to environmental gradients is little understood in general, and nearly unknown for palms. Intraspecific variation accounted for 23–74% of the total variation, with significant species effects. Intraspecific variation was unrelated to height above the nearest drainage. Palm species showed well-defined hydrological niches, but large intraspecific variation did not contribute to individual adjustment to the hydrological gradient.

Portela et al. combined functional traits with palm demography using *Astrocaryum aculeatissimum*, *Euterpe edulis*, and *Geonoma schottiana* within the context of habitat fragmentation. The population growth of *A. aculeatissimum* was stable in small and large fragments. *E. edulis* showed a decline in population growth in large fragments due to intense seed predation by monkeys but had stable lambda in smaller fragments. *G. schottiana* had stable population growth in large fragments but declined in smaller fragments. Functional traits showed that *G. schottiana* is a shade-adapted species, whereas *E. edulis* and *A. aculeatissimum* are habitat generalists; the first is affected by fragment size, the second is not. Differences in functional performance were linked to demographic variation.

Trujillo et al. used soil data to explore trait-environment relationships among palm communities in western Amazonia. They linked functional traits to soil gradients and forest types. They found significant trait-environment relationships. Palms with large leaves and fruits, and acaulescent and erect stems, were associated with fertile soils, while palms with unarmed leaves were associated with non-inundated forests. Functional traits varied with soil gradients on a regional scale following soil fertility.

Collins et al. used two specialist (*Chamaedorea tepejilote* and *Geonoma congesta*) and two generalist species (*Geonoma cuneata* var. cuneata and *Chamaedorea pinnatifrons*), to measure seedling performance in a shade house and in a field transplant experiment among soil types varying in nutrient availability to test how species distribution were correlated with soil phosphorus and rainfall. In the shade house, leaf functional traits changed with species rather than with soil nutrients, whereas biomass allocation and relative growth rate were determined by species-soil interactions. In the transplant experiment, survival was related to dry season rainfall. Seedling performance was determined by species-specific responses to soil nutrient and rainfall. While soil nutrients influence biomass allocation, dry season rainfall influences both specialist and generalist seedling survival and therefore their distributions along the nutrient and moisture gradient.

Avalos et al. advance our understanding of allometric relations in palms, a functional group critical for improving carbon stocks estimates in tropical forests. They presented allometric models for estimating total carbon content and aboveground carbon (AGC) using seven of the most common neotropical palm species. This analysis improves carbon stocks estimates in tropical forests. The general palm model estimating total carbon content accounted for 92% of the variation across species. The model estimating AGC showed a 91% fit, and was compared with two other models used to estimate carbon content: Goodman et al. (2013)'s and Chave et al. (2014)'s. All three converged on the estimation of AGC. It is crucial to include more palm species, a wider size range, a greater sample size, and more geographic areas to increase the accuracy of allometric models.

Carrete et al. show that palm-parrot biotic interactions are mediated by their traits. They combined field data, the literature, and citizen science to identify 1,189 interactions between 135 parrots and 107 palm species. Of these, 427 were unique parrot-palm interacting pairs. Pure antagonistic interactions were less common (5%) than mutualistic ones (89%). After controlling for phylogeny, the size of consumed seeds and parrot body mass were positively correlated. Seed dispersal distances varied among palm species, with larger parrots dispersing seeds at greater distances. Social behavior, predation, food availability, and seasonality may affect the nature of these interactions.

Palm conservation

Elshibli and Korpelainen examine the genetic diversity of the endangered palm *M. argun* of the Nubian desert where the harsh field conditions preclude the collection of data on the conservation status and genetic variation of this species. The seasonal river floodplains, essential for the survival of this palm, are disappearing due to climate change. The authors report low genetic diversity and lack of intergenerational genetic diversity. Seed collection from genetically diverse populations for *ex-situ* gene banks could prevent species extinction in this case.

Griffith et al. examine the role of botanical gardens in palm conservation. Living palm collections are essential for the ex-situ survival of many species that are endangered or extirpated from the wild. The authors highlight effective ex-situ conservation programs, whose value increase when genetic diversity is managed. This could guide restoration projects through collaborative research between botanical gardens. More than half (1,380 of 2,566 known species) of the world's palm species are grown in botanical gardens. Promoting palm conservation involves collection, cultivation, communication, and collaboration.

Author contributions

GA proposed the Research Topic. All authors looked for contributors and editors and served as editors and reviewers.

Acknowledgments

We thank all the contributors to this special issue as well as the researchers who served as editors and reviewers for their valuable input. We thank the editorial department of Frontiers in Forest and Global Change for their patience and guidance throughout the process.

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

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Baker, W. J., and Dransfield, J. (2016). Beyond Genera Palmarum: progress and prospects in palm systematics. *Bot. J. Linn. Soc.* 182, 207–233. doi: 10.1111/boj.12401

Bello, C., Galetti, M., Pizo, M. A., Magnago, L. F. S., Rocha, M. F., Lima, R. A., et al. (2015). Defaunation affects carbon storage in tropical forests. *Sci. Adv.* 1, e1501105. doi: 10.1126/sciadv.1501105

Boukili, V. K., and Chazdon, R. L. (2017). Environmental filtering, local site factors and landscape context drive changes in functional trait composition during tropical forest succession. *Perspect. Plant Ecol. Evol. Syst.* 24, 37–47. doi: 10.1016/j.ppees.2016.11.003

Chave, J., Réjou-Méchain, M., Búrquez, A., Chidumayo, E., Colgan, M., Delitti, W., et al. (2014). Improved allometric models to estimate the aboveground biomass of tropical trees. *Glob. Change Biol.* 20, 3177–3190. doi: 10.1111/gcb.12629

DeWalt, S. J., and Chave, J. (2004). Structure and biomass of four lowland Neotropical forests. *Biotropica* 36, 7–19. doi: 10.1111/j.1744-7429.2004.tb00291.x

Goodman, R., Phillips, O. L., Torres, D., Freitas, L., Tapia-Cortese, S., Monteagudo, A., et al. (2013). Amazon palm biomass and allometry. *Forest Ecol. Manage.* 310, 994–1004. doi: 10.1016/j.foreco.2013.09.045

Muscarella, R., Emilio, T., Phillips, O. L., Lewis, S. L., Slik, F., Baker, W. J., et al. (2020). The global abundance of tree palms. *Glob. Ecol. Biogeogr.* 29, 1495–1514. doi: 10.1111/geb.13123

Onstein, R. E., Baker, W. J., Couvreur, T. L., Faurby, S., Svenning, J. C., and Kissling, W. D. (2017). Frugivory-related traits promote speciation of tropical palms. *Nat. Ecol. Evol.* 1, 1903–1911. doi: 10.1038/s41559-017-0348-7

Sylvester, O., Avalos, G., and Chávez-Fernández, N. (2012). Notes on the ethnobotany of Costa Rica's palms. *Palms*. 56, 190–201.

ter Steege, H., Pitman, N. C. A., Sabatier, D., Baraloto, C., Salomão, R. P., Guevara, J. E., et al. (2013). Hyperdominance in the Amazonian tree flora. *Science* 342, 325–342. doi: 10.1126/science.1243092

Tomlinson, P. B. (2006). The uniqueness of palms. *Bot. J. Linn Soc.* 151, 5–14. doi: 10.1111/j.1095-8339.2006.00520.x