

A tribute to Heliodoro Sánchez-Páez and his lasting legacy towards mangrove conservation and management in Colombia

Ricardo Álvarez-León¹, Juan F. Blanco-Libreros², Sara R. López-Rodríguez², Gloria F. Pérez-Vega², Ana M. Valencia², Yéssica De Los Ríos² & Karla Ramírez-Ruíz²

¹*Fundación Verdes Horizontes, Manizales, Caldas (Colombia);* ²*Instituto de Biología, Universidad de Antioquia, Medellín, Antioquia (Colombia)*

Background

On 11 February 2017, with real surprise and sadness, we learned of the sudden death of Forest Engineer Heliodoro Sánchez-Páez, who led *Proyecto Manglares de Colombia* [Mangroves of Colombia Project (MCP), 1995-2001], the largest inventory devoted to country-wide mapping the extent and conservation status of mangrove ecosystems. This project was funded by the International Tropical Timber Organization (ITTO) and coordinated by the Ministry of the Environment and the Colombian Association of Foresters. Under the project, all mangroves of the country including the insular area in the Caribbean Sea were surveyed. Two major volumes were published with nation-wide zoning maps that supported drafting the first mangrove conservation and sustainable use policy (reviewed by Blanco-Libreros & Álvarez-León, 2019). Heliodoro Sánchez-Páez also dedicated his life to the research and management of protected areas within the National Natural Park System, where mangroves were a central part of his interest and actions, leaving an important legacy to the conservation practice in Colombia. In addition, to his outstanding professional career, Heliodoro stood out for his warm and kind personality as a part-time university professor, and as a private citizen. Those who had the privilege of knowing him as a friend, colleague and family man, trust that his legacy will continue to be fruitful in generating nature conservationists, and in serving as a foundation for new research areas in mangrove ecology.

Education and career highlights

Heliodoro Sánchez-Páez obtained his professional degree as a Forest Engineer in 1968 from the “Francisco José de Caldas” City University, Bogotá, Colombia. In 1983, he obtained a faculty position as part-time professor at the same university, where he was recognized by his colleagues and students as an outstanding teacher and researcher. He also founded the scientific journal *Colombia Forestal* (<https://revistas.udistrital.edu.co/index.php/colfor>), and served as editor and member of the editorial board.

Heliodoro also worked part-time in the National Institute of Renewable Natural Resources (INDERENA) that was transformed into the Ministry of Environment since 1993. During his term at the Division of National Parks at INDERENA, Heliodoro was responsible for the delimitation processes of protected areas as well as of several national natural parks together with Jorge Hernández-Camacho, also known as “El Mono Hernández”. Heliodoro was a fierce defendant of the Isla Salamanca National Natural Park, who devoted to preserve and restore barrier-island mangroves affected by the construction of a highway connecting Barranquilla and Santa Marta in the 1960s. Later, he also served as Director of INDERENA’s Division of National Parks (1977-1985). Together with other colleagues, he wrote pioneering documents on the need for research on national mangroves, and to stop irrational uses by various companies, particularly in the *Ciénaga Grande de Santa Marta*. Such documents would serve as the basis of discussions, policies and national projects formulated and developed with FAO (Project INDERENA/UNDP/FAO-COL/74/005, 1975). While at INDERENA, he also co-edited or advised scientific journals such as *Trianea* and *Divulgación Pesquera* (Fisheries Transactions). He was a member of the World Commission on Protected Areas (WCPA) and one of the creators of the Colombian Committee of International Union for the Conservation of Nature (IUCN).

During his career, Heliodoro gained important recognitions, which included the Manobi Order of the System of National Natural Parks of Colombia (1998), the Alfred Kotschwar Forest Merit Distinction to the Forest Engineer of the “Francisco José de Caldas” City University (2002 and 2009), the Recognition for Academic and Cultural Work (2005), and the Academic Excellence Distinction (2009). Most importantly, in 2007, he was the first recipient of the Kenton Miller Award for Innovation for the Sustainability of Protected Areas, awarded by the IUCN (Parques Nacionales Naturales de Colombia, 2021).

Standing on the shoulders of a giant

Heliodoro contributed to mangrove conservation and management, as author and co-author of numerous articles and books (mostly in Spanish) describing the natural heritage of Colombia, the National Natural Park System, and the ecological and social features of mangroves along the coasts on the Caribbean Sea and the Pacific Ocean. He also presented numerous talks in scientific conferences and organized many meetings on mangrove management.

His long-term legacy towards mangrove conservation is the establishment of the National Natural Park System, covering 66,710 hectares in Bahía Portete, Flamencos Lagoon, Tayrona, Isla de Salamanca, Corales del Rosario and San Bernardo, El Corchal "Mono Hernandez", Ciénaga Grande de Santa Marta, Old Providence-Mac Bean Lagoon, Utría, Uramba (Bahía Málaga), and Sanquianga. Recently, a new large area has been declared under a co-management scheme in the Southern Pacific coast (Cabo Manglares) close to the border with Ecuador.

Scientists and conservationists will also remember Heliodoro or 'Helio' during the International Day for the Defence of Mangroves, celebrated on 26 July each year. In 2018, nearly one year after his demise, the National Natural Park Unit paid homage to him with a documentary called the "Mangrove Man" (Parques Nacionales Naturales de Colombia, 2018). His colleagues and friends at *Universidad Distrital* also remembered him and his career. The passing of Heliodoro prompted us to release the mangrove database to the public as an open access product: HELIO_SP.CO v.1, Hierarchical, Entity-based and Landscape-level Information Observatory for Mangrove Species in Colombia, version 1 (Blanco-Libreros & Álvarez-León, 2018). Later, we formally introduced the database through a peer-reviewed article published in the Proceedings of the Colombian Academy of Sciences (Blanco-Libreros & Álvarez-León, 2019).

In this paper, we highlighted the important contributions of the MCP and showed the potential uses of the HELIO_SP.CO v.1 database for a better understanding of national-level mangrove biogeography, macroecology and ecosystem ecology. We also pointed to some applications in natural resource management, socio-economic development, and impact evaluations of global change. We believe in the power of information as well as in the moral need of knowing the history for understanding the present and planning for the future. New generations of national and international scholars are invited to look at past mangrove research with fresh eyes to address old and new questions, combining traditional, and cutting-edge methods and technologies (see review by Castellanos-Galindo *et al.*, 2021). For instance, Colombia hosts the largest extent of the vulnerable *Piñuelo* (*Pelliciera* spp.), the only true-mangrove tree endemic to the Neotropics, now proposed to be two species (Duke, 2020). Surely, updating their conservation status assessment will require new field inventories, and protection would need field-based actions. However, understanding the past and the present of their occurrences and the landscape context will contribute to a better decision-making process. We recently conducted a nation-wide assessment on the urbanization of the coastal-scape of *Pelliciera* combining information from the MCP, published field-studies, database in the Global Biodiversity Information Facility (GBIF), and open dataset in government repositories (Figure 1; Blanco-Libreros & Ramírez-Ruíz, 2021). We concluded that mangroves as habitats for *Piñuelo* in the Caribbean thrive as small patches in highly fragmented neighborhoods as the result of urbanization, in high contrast to most of the Pacific coast.

The HELIO_SP.CO v1 database is a good example of open data in the field of natural resources (Osorio-Sanabria *et al.*, 2021). It is also needed for mangrove ecosystem modelling at regional or sub-continental scales (Rovai & Twilley, 2021). Finally, it has been recently used in the Colombian Coastal Ecosystem Red List Assessment (Uribe *et al.*, 2020), as well as in summaries about the state research and ecological condition of Colombian mangroves (Castellanos-Galindo *et al.*, 2021; Chacón-Abarca *et al.*, 2021). As first, second and third generation of mangrove scientists, we are currently estimating the nation-level above-ground mangrove carbon, updating the mangrove map, and providing decision-making protocols for blue-carbon investments (Figure 2), to support national and international challenges (e.g., Resolución MADS 1263, 2018; Paris Agreement, Aichi Targets, and Bonn Challenge). None of these undertakings would be possible without the shoulders of the 'Mangrove Man'. After celebrating the World Mangrove Conservation Day 2021, and close to the fifth memorial of Heliodoro in February 2022, we invite Colombian and Latin American mangrove ecologists to look at his legacy and the many volumes of the MCP. A historical account of the use of MCP data beyond the original technical reports is shown in Table 1.

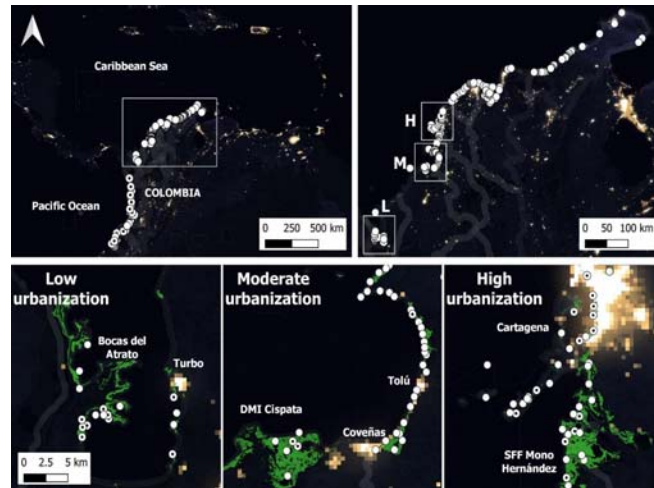


Figure 1. Mangroves of Colombia revisited in an era of coastal urbanization. Sampling points of the MCP collated with other reports in the literature containing neotropical endemic *Pelliciera* spp. (Tetrameristaceae) (filled circles: present; open circles: absent; modified from Blanco-Libreros & Ramírez-Ruíz (2021). Mangrove layer from INVEMAR (SIGMA: <http://sigma.invemar.org.co/geovisor>) and nightlights from NASA’s Black Marble 2016 (Earth at night; <https://svs.gsfc.nasa.gov/30876>).

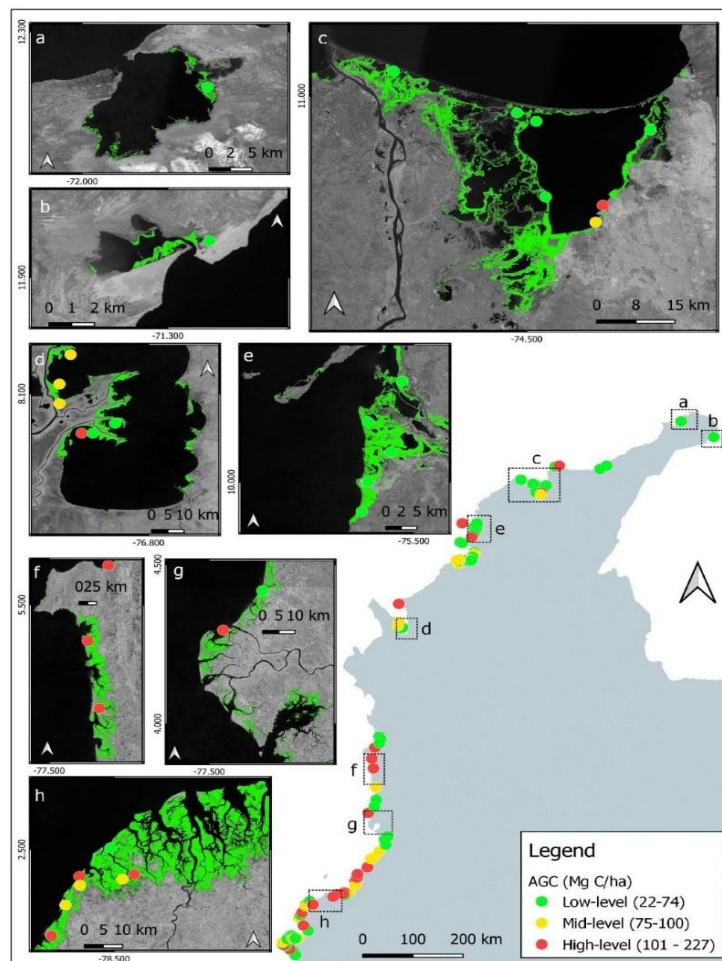


Figure 2. Mangroves of Colombia in an era of blue carbon. Scenes of the new mangrove layer (2019-2020) constructed using Google Earth Engine and collated with plot-scale biomass estimations from the MCP. Data are from Valencia-Palacios & Blanco-Libreros (2021), and Pérez-Vega (2017).

Table 1. Historical account of the use of MCP data beyond the original technical reports.

Year	Activity of Mangroves of Colombia Project (MCP)
1998-1999	An idea of ‘Expanding the use of MCP data to a broader context in mangrove ecology in Colombia’ was conceived (JFBL & RAL).
2003	First exploration of Pacific data in a term paper at MSc course in “Tropical Forest Topics” at University of Puerto Rico, Río Piedras Campus (SRLR & JFBL).
2004-2006	First use of the Caribbean data for a BSc thesis in Marine Biology, University of Bogotá, Jorge Tadeo Lozano (co-supervised by RAL & JFBL). A manuscript submitted to <i>Biotropica</i> was rejected.
Phase 1 (University of Antioquia)	
2009-2015	<ul style="list-style-type: none"> • Class projects with students of biology and coastal ecology. • Oral presentations at the National Seminar in Marine Science 2010 with first publication of extended abstracts. • Exploration data on <i>Piñuelo</i> (<i>Pelliciera rhizophorae</i>) by JFBL together with undergraduate & graduate students.
Phase 2 (University of Antioquia)	
2017	First academic output to be submitted to scientific journals for publication: <ul style="list-style-type: none"> • Pérez-Vega, G.F. 2017. Mangroves of Colombia: Quantification and spatial representation of the ecosystem service “blue carbon” (in Spanish: Los manglares de Colombia: Cuantificación y representación espacial del servicio ecosistémico “carbono azul”). Geo-informatics for Environmental Sciences, University of Antioquia, Medellín.
2018-2019	The establishment of HELIO_SP.CO v1 database and supporting papers.
2018-2021	Manuscript in progress on mangrove macroecology.
2019-2020	Findings from BSc theses to be submitted to scientific journals for publication: <ul style="list-style-type: none"> • De los Rios-Olarte, Y. 2020. Identification of potential sites for REDD+ project investment in mangrove forests of Colombia (in Spanish: Identificación de sitios potenciales para la inversión de proyectos REDD+ en manglares de Colombia). University of Antioquia, Medellín. • Ramírez-Ruiz, K. 2020. Natural and anthropogenic factors affecting the occurrence of <i>Pelliciera</i> spp. (Ericales: Tetrameristaceae), an endemic and vulnerable mangrove in the coastalscape of Colombia (In spanish: Factores naturales y antropogénicos que afectan la ocurrencia de <i>Pelliciera</i> spp. (Ericales: Tetrameristaceae), un mangle endémico y vulnerable, en el paisaje costero de Colombia.). University of Antioquia, Medellín.
2021	Blanco-Libreros, J.F. & Ramírez-Ruiz, K. 2021. Threatened mangroves in the anthropocene: Habitat fragmentation in urban coastalscapes of <i>Pelliciera</i> spp. (Tetrameristaceae) in Northern South America. <i>Frontiers in Marine Science</i> 8: 670354. Doi:10.3389/fmars.2021.670354.
2020-2021	A new layer of mangroves of Colombia from satellite data by Valencia-Palacios & Blanco-Libreros (2021). Launched on 26 July 2021 and findings to be published in a scientific journal.

Abbreviations: JFBL = J.F. Blanco-Libreros, MCP = Mangroves of Colombia Project, RAL = R. Álvarez-León, and SRLR = Sara R. López-Rodríguez.

References

- Blanco-Libreros, J.F. & Álvarez-León, R. 2018. HELIO_SP.CO v.1: Hierarchical, entity-based and landscape-level information observatory for mangrove species in Colombia, version 1. Doi: 10.7910/DVN/GGLRXW.
- Blanco-Libreros, J.F. & Álvarez-León, R. 2019. Mangroves of Colombia revisited in an era of open data, global changes, and socio-political transition: Homage to Heliodoro Sánchez-Páez. *Rev. la Real Acad. Ciencias Exactas, Fis. y Nat.* 43, 84-97. Doi:<http://dx.doi.org/10.18257/raccefyn.780>.
- Blanco-Libreros, J.F. & Ramírez-Ruiz, K. 2021. Threatened mangroves in the anthropocene: Habitat fragmentation in urban coastalscapes of *Pelliciera* spp. (Tetrameristaceae) in Northern South America. *Frontiers in Marine Science* 8, 670354. Doi:10.3389/fmars.2021.670354.
- Castellanos-Galindo, G.A., Kluger, L.C., Camargo, M.A., Cantera, J., Mancera Pineda, J.E., Blanco-Libreros, J.F., et al. 2021. Mangrove research in Colombia: Temporal trends, geographical coverage and research gaps. *Estuarine, Coastal and Shelf Science* 248, 106799. Doi:<https://doi.org/10.1016/j.ecss.2020.106799>.
- Chacón-Abarca, S., Serrano, M.C., Bolívar-Anillo, H.J., Villate Daza, D.A., Sánchez Moreno, H. & Anfuso, G. 2020. Mangrove forests on the Northern Colombian Caribbean coast: Analysis, evolution and management tools (in Spanish). *Rev. Latinoam. Recur. Nat.* 16: 31-54. Available at: <http://revista.itson.edu.mx/index.php/rlrn/article/view/289>.
- De los Ríos-Olarte, Y. 2020. Identification of potential sites for REDD+ project investment in mangrove forests of Colombia (in Spanish: Identificación de sitios potenciales para la inversión de proyectos REDD+ en manglares de Colombia). Unpublished BSc thesis, University of Antioquia.
- Duke, N.C. 2020. A systematic revision of the vulnerable mangrove genus *Pelliciera* (Tetrameristaceae) in equatorial America. *Blumea* 65: 107-120. Doi:10.3767/blumea.2020.65.02.04.
- Osorio-Sanabria, M.A., Amaya-Fernández, F.O. & González-Zabala, M.P. 2021. Policies, regulations and strategies to promote open data in Colombia: A literature analysis (in Spanish). *Rev. Virtual Univ. Católica del Norte*, 155-188. Doi:www.doi.org/10.35575/rvucn.n62a7.
- Parques Nacionales Naturales de Colombia 2018. Heliodoro Sánchez: The mangrove man. Colombia: Parques Nacionales Naturales de Colombia. Available at: https://www.youtube.com/watch?v=yBhNxxiSN7M&ab_channel=ParquesNacionalesNaturalesdeColombia.
- Parques Nacionales Naturales de Colombia. 2021. Parques Nacionales Naturales lamenta el fallecimiento de Heliodoro Sánchez-Páez, quien deja un importante legado para la conservación de los ecosistemas de manglar del país. Available at: <https://www.parquesnacionales.gov.co/portal/es/parques-nacionales-naturales-de-colombia-lamenta-el-fallecimiento-de-heliodoro-sanchez-paez-quien-deja-un-importante-legado-para-la-conservacion-de-los-ecosistemas-de-manglar-en-el-pais/>
- Pérez-Vega, G.F. 2017. Mangroves of Colombia: Quantification and spatial representation of the ecosystem service “blue carbon” (in Spanish: Los manglares de Colombia: Cuantificación y representación espacial del servicio ecosistémico “carbono azul”). Unpublished specialization’s thesis, University of Antioquia.
- Ramírez-Ruiz, K. 2020. Natural and anthropogenic factors affecting the occurrence of *Pelliciera* spp. (Tr & Pl) (Ericales: Tetrameristaceae), an endemic and vulnerable mangrove in the coastalscape of Colombia (In Spanish: Factores naturales y antropogénicos que afectan la ocurre. Unpublished BSc thesis, University of Antioquia.
- Rovai, A.S. & Twilley, R.R. 2021. Gaps, challenges, and opportunities in mangrove blue carbon research: a biogeographic perspective. In: *Dynamic Sedimentary Environments of Mangrove Coasts*, eds. F. Sidik & D.A. Friess (Elsevier), 295-334. Doi:<https://doi.org/10.1016/B978-0-12-816437-2.00001-X>.
- Universidad Distrital Francisco José de Caldas. Colombia Forestal magazine. Available at: <https://revistas.udistrital.edu.co/index.php/colfor>.
- Uribe, E., Etter, A., Luna-Acosta, A., Diazgranados, M.C., Acosta, A., Alonso, D., et al. 2020. Red List of Marine and Coastal Ecosystems of Colombia - Version 1 (in Spanish). Conservación Internacional, Pontificia Universidad Javeriana & INVEMAR. Bogotá D.C. 63 pp.
- Valencia-Palacios, A.M. & Blanco-Libreros, J.F. 2021. Mangroves of Colombia 2019-2020. [In Spanish: Manglares de Colombia 2019-2020]. Doi:<https://doi.org/10.7910/DVN/SJ2S0H>, Harvard Dataverse, V2.