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Basic Taxonomic and Nomenclatural Notes for Applied Research with Cuban Representatives of Salicornioideae

Isidro E. Méndez Santos[1], Julio C. Rifa Tellez[2] & Miguel E. Gómez Calderín[3]

[1]ORCID https://orcid.org/0000-0002-0437-8057, The Ignacio Agramonte Loynaz University of Camaguey, Center for Environmental Management Studies, Camagüey, Cuba, [2]ORCID https://orcid.org/0000-0002-4187-1342, The Ignacio Agramonte Loynaz University of Camaguey, Center for Environmental Management Studies, Camagüey, Cuba, [3]ORCID https://orcid.org/0009-0008-1952-4660, The Ignacio Agramonte Loynaz University of Camaguey, Center for Environmental Management Studies, Camagüey, Cuba.

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Email: iemendezs58@gmail.com, isidro.mendez@reduc.edu.cu

Abstract

Context: The research is framed in the interest of some producers in economically exploiting native halophytic plants that grow spontaneously in Cuban salt marshes.
Aim: To update the taxonomy and nomenclature of Cuban representatives of Salicornioideae Dumortier, in light of phylogenetic relationships revealed to date, and to assess the implications this will have for managing the information needed for applied research.
Methods: From the theoretical level of knowledge, the historical-logical, analytical-synthetic, and inductive-deductive methods were used to evaluate empirical data from document analysis.
Results: Changes in the systematics of Cuban representatives of Salicornioideae Dumortier have been influenced regarding their family placement, generic delimitation, and the nomenclature of one of the taxa.
Conclusions: According to the updated taxonomic system, these plants belong to the family Amaranthaceae A. L. de Jussieu, subfamily Salicornioideae Dumortier, and the genus *Salicornia* L., with the species *S. bigelovii* Torr. and *S. ambigua* Michx. represented in Cuba.

Keywords: *Systematic botany, flora of Cuba, Amaranthaceae, halophytic plants, alternative crops.*

Introduction

Currently, numerous taxa of Salicornioideae Dumortier (Amaranthaceae / Chenopodiaceae) have garnered significant interest globally due to their economic potential (Rueda, 2012; Ventura & Sagi, 2013). Cuba has also shown interest, at least promoted by the Geomining-Salt Business Group (Geominsal), which is keen on diversifying its productions and utilizing the available spaces in salt processing facilities.

Fostering the economic exploitation of these plants will inevitably require applied research in the fields of agronomy and food processing, as well as in sales and quality certification of these products, to mention just a few of the most important aspects. Accordingly, precise taxonomic and nomenclatural information will be essential.

This subfamily comprises 11 genera and around 100 species, distributed worldwide in saline, coastal, and inland habitats. They possess multiple morphological, anatomical, and physiological adaptations typical of halophytic plants, among which the most visible are succulence and articulated stems, as well as reduced leaves and flowers (Piirainen et al., 2017).

Two of these species have been recorded in Cuba: *Salicornia bigelovii* Torr. and *Sarcocornia perennis* (Mill.) A. J. Scott (Acevedo & Strong, 2012; Greuter & Rankin, 2022). However, none of the sources referring to them in the national territory (Richard, 1850; Grisebach, 1866; Sauvalle, 1873; León & Alain, 1951; Acevedo & Strong, 2012; Greuter & Rankin, 2022) include the taxonomic and

nomenclatural precisions that have been achieved internationally in the last 25 years (Stevens, 2001; Kadereit et al., 2003; Alonso & Crespo, 2008; Ogundipe & Chase, 2009; Piirainen et al., 2017).

The purposes of this contribution are to update the taxonomy and nomenclature of Cuban representatives of Salicornioideae Dumortier, in light of phylogenetic relationships revealed to date, and to assess the implications this will have for managing the information needed for applied research.

Materials and methods

The research is conducted within the framework of the business project titled *Sustainable production and commercialization of halophytic plants at UEB Salinera El Real*, implemented as part of the collaboration between the Geomining-Salt Business Group (Geominsal) and the Ignacio Agramonte Loynaz University of Camagüey.

From the theoretical perspective, the historical-logical, analytical-synthetic, and inductive-deductive methods were used to evaluate empirical data from document analysis.

The use of scientific names is based on the International Code of *Nomenclature for Algae, Fungi, and Plants* (Turland et al., 2018). The family subdivision data within Amaranthaceae were taken from Stevens (2001). The generic delimitation follows Piirainen et al. (2017) and the species nomenclature follows Alonso & Crespo (2008), with the abbreviations and symbols proposed by Greuter & Rankin (2022).

Results and discussion

The contributions of phylogenetic studies conducted over the last 25 years have influenced changes in the systematics of Cuban representatives of Salicornioideae Dumortier regarding their family placement, generic delimitation, and the nomenclature of one of the taxa.

Regarding family placement, all literature on Cuban flora (except Richard, 1850) has unanimously classified the group within Chenopodiaceae. However, modern systems, which assign a predominant role to molecular phylogeny, have demonstrated that the latter is monophyletic with the remaining subfamilies of Amaranthaceae (Stevens, 2001; Kadereit et al., 2003; Ogundipe & Chase, 2009). Therefore, they include the former within the latter, as a subfamily.

This taxonomic decision has not yet been generalized in international scientific literature, so the genera of Salicornioideae Dumortier are sometimes placed in Chenopodiaceae (Redondo-Gómez et al., 2005; Shepherd et al., 2005; Kadereit et al., 2007; Alonso & Crespo, 2008; Beltrán et al., 2017) and sometimes in Amaranthaceae (Medina et al., 2008; Steffen et al., 2015; Piirainen et al., 2017; Coc-Coj et al., 2020; Custódio et al., 2021).

For the purposes of the project aimed at the sustainable production and commercialization of halophytic plants, treating Salicornioideae Dumortier within Amaranthaceae is recommended, despite influential authors for Cuban flora studies (such as Acevedo & Strong, 2012; Greuter & Rankin, 2022) not yet having assumed this taxonomic decision. Obviously, not all former Chenopodiaceae passed as a single subfamily to Amaranthaceae s.l., as while Chenopodioideae Burnett exists within the latter, the genera analyzed in this article are not included in it. If it is necessary to refer to the subfamily rank for the plants under investigation, it should be Salicornioideae Dumortier.

Regarding the genera, as already mentioned, Acevedo & Strong (2012), Greuter & Rankin (2022) include one of the species represented in Cuba in *Salicornia* L. and the other in *Sarcocornia* Scott. Actually, the latter was described in 1977, before which both were included in the taxon originally established by Linnaeus in 1753.

But the independence of *Sarcocornia* Scott from *Salicornia* L. has been questioned since the moment the name of the taxon was made effective. A significant group of researchers maintains that the morphological characters commonly used to differentiate them (the woody, perennial habit and the arrangement of flowers at the same level in *Sarcocornia* Scott, versus the herbaceous, annual consistency and the flowers at two levels of *Salicornia* L.) do not constitute sufficient taxonomic evidence (Alonso et al., 2006).

Recently, Piirainen et al. (2017), using molecular phylogeny, established that the taxa of Sarcocornia Scott are intercalated within the monophyletic clade of Salicornia L., making both unequivocally congeneric, with the priority for nomenclature logically belonging to the latter.

Therefore, within the framework of the project in which the research is conducted, it is necessary to consider that, in light of current knowledge, the two species represented in Cuba should be treated within *Salicornia* L.

Regarding the nomenclature of Cuban species, it is only necessary to establish precisions related to the taxon, which has been indistinctly named as *Salicornia ambigua* Michx. (= *Sarcocornia ambigua* (Michx.) M.A. Alonso & M.B. Crespo), by Grisebach (1866) and Sauvalle (1873) or as *Salicornia perennis* Mill.(= *Sarcocornia perennis* (Mill.) A. J. Scott.) by León & Alain (1951),

Acevedo & Strong (2012), Greuter & Rankin (2022).

Alonso & Crespo (2008) demonstrated that the taxon growing in America (and therefore also in Cuba), characterized by being perennial plants, erect or decumbent, only woody at the base, with slender stems, very long and narrow inflorescences, small seeds with appressed hairs, but generally limited to the edges, is *Salicornia ambigua* Michx. (≡ *Sarcocornia ambigua* (Michx.) M.A. Alonso & M.B. Crespo).

Actually, *Salicornia perennis* Mill. (≡ *Sarcocornia perennis* (Mill.) A. J. Scott.) grows only in the Mediterranean region, characterized by shorter inflorescences and larger seeds, entirely covered with long, hooked hairs (Alonso & Crespo, 2008).

Obviously, the name *Salicornia perennis* Mill. (≡ *Sarcocornia perennis* (Mill.) A. J. Scott.) was misapplied by a group of authors to the taxon growing in Cuba. However, it is still necessary to consider it when managing information needed for ongoing research, as a certain volume of data was previously shared using that name for the plant, though incorrectly. If it needed to be used in the documentation generated as a result of the project, it would be accompanied by a symbol indicating its incorrect application (in quotes, according to Greuter & Rankin, 2022).

In this context, it is necessary to consider that all information referring to *Salicornia perennis* Mill. (≡ *Sarcocornia perennis* (Mill.) A. J. Scott.) obtained from plants originating from the American continent has a high probability of being attributed to the taxon growing in Cuba (although it will always be necessary to verify it through a contextualized analysis). Conversely, if it was obtained from specimens growing in the Mediterranean region, it should not be attributed to the taxon represented in the country, unless it is something inherent to the genus.

Conclusions

The updated classification system, available for applied research with Cuban representatives of Salicornioideae Dumortier, is as follows:

Family: Amaranthaceae A. L. de Jussieu

Subfamily: Salicornioideae Dumortier

Genus: *Salicornia* L.

Species:

Salicornia bigelovii Torr.

Salicornia ambigua Michx. ≡ *Sarcocornia ambigua* (Michx.) M.A. Alonso & M.B. Crespo

– *"Salicornia perennis* Mill. ≡ *Sarcocornia perennis* (Mill.) A. J. Scott*"* sensu auct.

Author contribution statement

The three authors jointly worked on the compilation and evaluation of the information and on the writing of the article.

Conflict of interest statement

The authors declare the absence of conflicts of interest

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References

Acevedo, P., & Strong, M. (2012). *Catalogue of seed plants of the West Indies*. Smithsonian Institution Scholarly Press, Washington D.C. https://repository.si.edu/bitstream/handle/10088/17551/SCtB-0098.pdf?sequence=2&isAllowed=y

Alonso, M., & Crespo, M. (2008). Taxonomic and nomenclatural notes on South American taxa of *Sarcocornia* (Chenopodiaceae). *Ann. Bot. Fennici* *45*(4), 241-254. https://bioone.org/journals/annales-botanici-fennici/volume-45/issue-4/

Alonso, M., Juan, A., & Crespo, M. (2006). *Salicornia-Sarcocornia*: ¿una pesadilla o una realidad taxonómica? *Cuadernos de Biodiversidad*, *23*(3), 18-20. https://doi.org/10.14198/cdbio.2007.23

Beltrán, C., Arce, M., Oscar, B, López, G., Vargas, J., Hernández-Montiel, L., Reyes-Pérez, J., Nieto-Garibay, A., Ruiz-Espinoza, F. H., Ayala Alvarez, F., Cisneros Almazán, R. R., Wong Corral, F. J., Borboa Flores, J., Rueda-Puente, E. (2017). *Salicornia bigelovii* (Torr.): un sistema modelo para incorporarse como cultivo agrícola en zonas

árido-desérticos. *Revista de Ciencias Biológicas y de la Salud* (Universidad de Sonora), *XIX* (E3), 46-50. https://doi.org/10.18633/biotecnia.v19i0.413

Coc-Coj, O., Cámara-Mota, A., González-Cortés, N., & Jiménez-Vera, R. (2020). La salicornia: una planta halófila con propiedades funcionales. *Revista Iberoamericana de Ciencias*, *7*(1), 26 – 38. http://www.reibci.org/publicados/2020/jul/3800103.pdf

Custódio, L., Rodrigues, M., Pereira, C., Castañeda-Loaiza, V., Fernandes, E., Standing, D., Neori, A., Shpigel, M., & Sagi, M. (2021). A Review on *Sarcocornia* Species: Ethnopharmacology, Nutritional Properties, Phytochemistry, Biological Activities and Propagation. *Foods*, *10*(2778), 1-23. https://doi.org/10.3390/foods10112778

Greuter, W., & Rankin, R. (2022). *Plantas Vasculares de Cuba. Inventario*. (Tercera edición, actualizada, de Espermatófitos de Cuba). Berlin: Botanischer Garten und Botanisches Museum. https://doi.org/10.3372/cubalist.2022.1

Grisebach, A. (1866). Catalogus plantarum cubensium exhibens collectionem Wrightianam aliasqueminores ex insula Cuba missas. – Engelmann, Lipsiae

Kadereit, G., Ball, P., Beer, S., Mucina, L., Sokoloff, D., Teege1, P., Yaprak, A., & Freitag, H. (2007). A taxonomic nightmare comes true: phylogeny and biogeography of glassworts (*Salicornia* L., Chenopodiaceae). *TAXON*, *56*(4), 1143–1170. https://doi.org/10.2307/25065909

Kadereit, G., Borsch, T., Weising, K. & Freitag, H. (2003). Phylogeny of Amaranthaceae and Chenopodiaceae and the evolution of C_4 photosynthesis. *Int. J. Plant Sci.*, 164 (6), 959–986. https://www.journals.uchicago.edu/doi/abs/10.1086/378649?journalCode=ijps

León, Hno., & Alain, H. (1951). Flora de Cuba 2. *Contribuciones Ocasionales del Museo de Historia Natural del Colegio "De La Salle"* 10. La Habana.

Linnaeus, C. (1753). *Species plantarum*. Holmiae, Impensis Laurentii Salvii.

Medina, E., Francisco, A., Wingfield, R., & Casañas, O. (2008). Halofitismo en plantas de la costa caribe de Venezuela: halófitas y halotolerantes. *Acta Botánica Venezuelica*, *31* (1), 49-80. http://www.redalyc.org/articulo.oa?id=86211471005

Ogundipe, O., & Chase, M. (2009). Phylogenetic Analyses of Amaranthaceae Based on matK DNA Sequence Data with Emphasis on West African Species. *Turkish Journal of Botany*, *33*, 153-161. https://doi.org/10.3906/bot-0707-15

Piirainen, M., Liebisch, O., & Kadereit, G. (2017). Phylogeny, biogeography, systematics and taxonomy of Salicornioideae (Amaranthaceae/Chenopodiaceae) – A cosmopolitan, highly specialized hygrohalophyte lineage dating back to the Oligocene. TAXON, *66* (1), 109-132. https://doi.org/10.12705/661.6

Redondo-Gómez, S., Wharmby, C., Moreno, F., De Cires, A., Castillo, J., Luque, T., Davy, A. J., & Figueroa, M. (2005). Presence of internal photosynthetic cylinder surrounding the stele in stems of the tribe Salicornieae (Chenopodiaceae) from SW Iberian Peninsula. *Photosynthetica*, *43*(1), 157-159. https://ps.ueb.cas.cz/pdfs/phs/2005/01/21.pdf

Richard, A. (1850). Salsolaceae. En *Historia física política y natural de la Isla de Cuba* (pp. 179-181, R. de la Sagra, 11na. ed.). París.

Rueda, E. (2012). *Las halófitas en la agricultura de zonas áridas*. Editorial Académica Española, Berlin.

Sauvalle, F. A. (1873). *Flora cubana. Enumeratio nova plantarum cubensis vel revisio catalogi Grisebachaini*. Imprenta La Gran Antilla, La Habana.

Scott, A. (1977). Reinstatement and revision of Salicorniaceae J. Agardh (Caryophyllales). *Bot. J. Linn. Soc.*, 75, 357-374. https://doi.org/10.1111/j.1095-8339.1977.tb01493.x

Shepherd, K., Macfarlane, T., & Colmer, T. (2005). Morphology, Anatomy and Histochemistry of Salicornioideae (Chenopodiaceae) Fruits and Seeds. *Annals of Botany*, *95*, 917–933. https://doi.org/10.1093/aob/mci101

Steffen, S., Ball, P., Mucina, L., & Kadereit, G. (2015). Phylogeny, biogeography and ecological diversification of Sarcocornia (Salicornioideae, Amaranthaceae). *Annals of Botany*, *115*, 353–368. https://doi.org/10.1093/aob/mcu260

Stevens, P. F. (2001 onwards). Angiosperm Phylogeny Website. Version 14, July 2017 [and more or less continuously updated since]. http://www.mobot.org/MOBOT/research/APweb/

Turland, N. J., Wiersema, J. H., Barrie, F. R., Greuter, W., Hawksworth, D. L., Herendeen, P. S., Knapp, S., Kusber, W.-H., Li, D.-Z., Marhold, K., May, T. W., McNeill, J., Monro, A. M., Prado, J., Price, M. J. & Smith, G. F. (eds.) (2018). *International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017*. Regnum Vegetabile 159. Glashütten:

Koeltz Botanical Books. https://doi.org/10.12705/Code.2018

Ventura, Y., & Sagi, M. (2013). Halophyte crop cultivation: The case for *Salicornia* and *Sarcocornia*. *Environmental and Experimental Botany*, 92, 144-153. http://dx.doi.org/10.1016/j.envexpbot.2012.07.010