Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 12(6): 2024, 30 December 2016 doi: https://doi.org/10.15560/12.6.2024
ISSN 1809-127X

First record of *Parvodinium umbonatum* (Stein) Carty (Peridiniaceae, Dinophyta) for northeast Brazil

Geraldo José Peixoto Ramos[1, 3] **Carlos Eduardo de Mattos Bicudo**[2] & **Carlos Wallace do Nascimento Moura**[1]

[1] Programa de Pós-Graduação em Botânica, Universidade Estadual de Feira de Santana, Av. Transnordestina, s/nº, Novo Horizonte, CEP 44036-900, Feira de Santana, BA, Brazil
[2] Instituto de Botânica, Núcleo de Ecologia, Av. Miguel Estéfano 3687, 04301-902, São Paulo, SP, Brazil
[3] Corresponding author. E-mail: geraldojpr@gmail.com

Abstract: This paper presents the first record of the freshwater dinoflagellate *Parvodinium umbonatum* (Stein) Carty (Peridiniaceae, Dinophyta) for northeast Brazil, based on samples collected in 2015 from a tank bromeliads at Serra da Jiboia, Bahia. This species was an important component in the local phytotelm community and categorized as frequent in the bromeliads of the area. A description based on morphometrical features, illustrations (LM and SEM), abiotic conditions of the stored water, and geographic distribution of *P. umbonatum* in Brazil are provided.

Key words: algae; dinoflagellates; phytotelm habitat; tropical

Phytotelmata are small-water habitats formed by vegetal structures and are capable of maintaining diverse associated organisms, including algae (Kitching 2000). Dinoflagellates are a group of algae found in both marine and freshwaters and are considered important components of ecosystem being; next to diatoms, they are the most important aquatic primary producers (Carty 2008; Sophia 1999; Graham et al. 2009; Sahu et al. 2014).

Little is known about the diversity of dinoflagellates in Brazilian continental waters (Gomes et al. 2010), especially in northeast Brazil, where there are just a few records: Araújo et al. (2000) in Rio Grande do Norte; Moschini-Carlos et al. (2008) in Maranhão; Lira et al. (2009) in Pernambuco; Severiano et al. (2012) in Bahia; Oliveira et al. (2011) in semi-arid regions of Alagoas, Bahia, Pernambuco and Sergipe; and recently, Aragão-Tavares et al. (2015) at Itaparica and Xingó Reservoirs, São Francisco River. In total, 13 taxa, but only five are to specific level, were cited. However, except Oliveira et al. (2011), none of these works has detailed information on the species, such as descriptions, measurements or figures, to confirm their identifications or to compare them with taxonomic studies.

The genus *Parvodinium* Carty (2008) was proposed to accommodate representatives of *Peridinium* Ehrenberg presenting an apical pore, two apical intercalary plates, and six cingular plates. *Parvodinium* consists of 10 species (Guiry & Guiry 2016), and the occurrence of four species was recorded in Brazil: *Parvodinium africanum* (Lemmermann) Carty; *P. inconspicuum* (Lemmermann) Carty; *P. pusillum* (Penard) Carty; and *P. umbonatum* (Stein) Carty. From these, only *P. pusillum* was cited for the Northeast Region of Brazil (Moschini-Carlos et al. 2008; Menezes et al. 2015). *Parvodinium umbonatum* is the only known dinoflagellate inhabiting tank bromeliads in Brazil (Sophia 1999); however, its role, as well as the conditions in the phytotelm habitats, are unknown.

This study presents the first record of *Parvodinium umbonatum* from the northeast Brazil. This record is a result of a floristic survey of the algae and cyanobacteria from bromeliad phytotelmata in Serra da Jiboia, Bahia state.

The study area is located at Monte da Pioneira, northern Serra da Jiboia (12°51′S, 039°28′W), 850 m altitude, in the municipality of Santa Teresinha, Bahia, Brazil. This area is characterized by a great population of the bromeliads *Alcantarea nahoumii* (Leme) J.R.Grant, which inhabits the tops of rock outcrops (Figure 1).

The samples were taken in January, July, September and November 2015. In each of these months, 20 tank bromeliads were sampled totalizing 80 sampling units.

The material was collected using a 50-mL syringe coupled to a polyethylene hose. Abiotic parameters of the water, such as temperature, pH, electric conductivity (EC), and total dissolved solids (TDS), were obtained during sampling with a multiparameter probe (Hanna HI98130). Dissolved oxygen (DO) was measured with a portable digital dissolved oxygen Meter (Instrutherm MO-910).

The species was identified using specialized literature (Carty 2008; Lewis & Dodge 2011; Carty 2014), and plate designation was based on Kofoid (1909). Samples of *P. umbonatum,* fixed in Transeau's solution, were observed using an Olympus light microscope (LM; model BX-43), and the digital images were taken with a 5.0-MP QImaging camera using the software Image-Pro Premier 9.1.4.

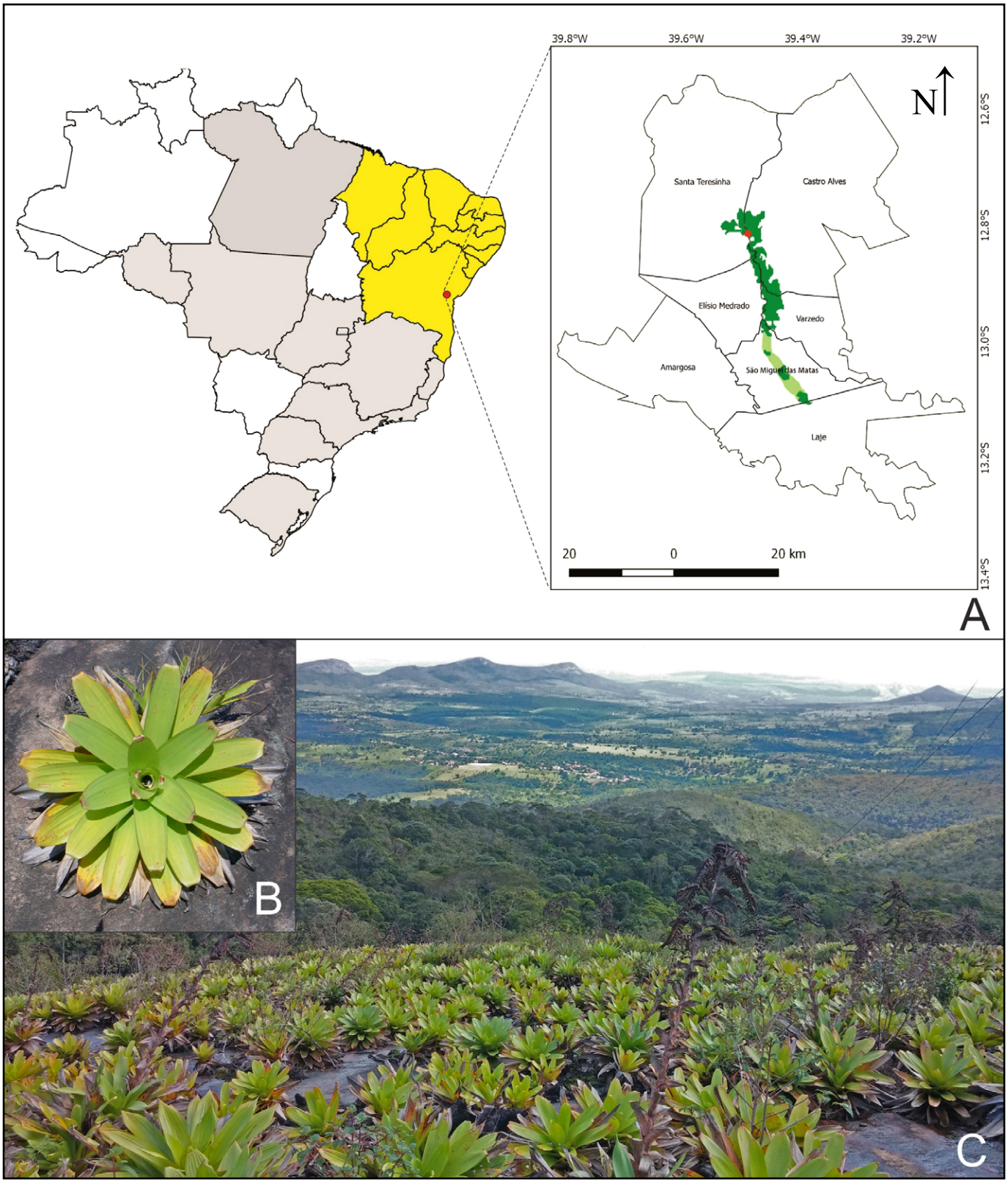

Figure 1. A. Map of study area and Brazilian states where *Parvodinium umbonatum* have been previously recorded (grey areas). Red dot represents the local of the new record for the northeast Brazil (yellow area). Detail of the Serra da Jiboia (green area), highlighting the Monte da Pioneira, municipality of Santa Teresinha (red dot) (adapted from Ramos et al. 2011). **B.** *Alcantarea nahoumii.* **C.** Habitat of *Alcantarea nahoumii.*

The fine external morphology was observed under scanning electron microscopy (SEM). For SEM preparations, the Transeau's-fixed cells were adhered to a glass coverslip with poly–L–lysine (Sigma, 1:10 in distilled water) to ensure better adhesion of the dinoflagellates. Coverslips with material adhered were dehydrated in acetone series (30, 50, 70, 85, 95, 100, 100%, 10 min each). Finally, the material was dried to critical-point in a Leica EM CPD030 critical point dryer; the stubs were mounted and coated with gold and observed with a JEOL 6390 LV SEM (JEOL Ltd., Tokyo, Japan).

Frequency of occurrence (FO) of *Parvodinium umbonatum* in the bromeliads was categorized according to Matteucci & Colma (1982). Four samples (one of each period) were deposited in the Herbarium of the State University of Feira de Santana (HUEFS).

Parvodinium umbonatum (Stein) Carty

This species has cells ovoid to elliptical, 19.5–25 µm long, 15.5–18 µm wide, with the epitheca broadly rounded or slightly conical and longer than hypotheca. There is an apical pore covered by a cover plate and surrounded by a pore plate, and a canal plate runs ventrally to the apex of the 1′ plate. Plate formula: Po, x, 4′, 2a, 7″, C6, S5, 5‴, 2⁗ (Figure 2). The antapical plates and six cingular plates are not neatly aligned with pre- or post-cingular plates. The cell wall is composed of thecal plates, with slightly reticulate ornamentation, and have large pores towards plate edges. The chloroplasts pale brown; the eyespot was not observed.

Material examined: BRAZIL: Bahia: Santa Teresinha, Serra da Jiboia, Monte da Pioneira 12°51′07.4″ S, 039°28′36″ W, 14 January 2015, *G.J.P. Ramos et al. s.n.* (HUEFS 155295); 12°51′06.8″ S, 039°28′35″ W, 18 July 2015, *G.J.P. Ramos et al. s.n.* (HUEFS 155347); 12°51′07.1″ S, 039°28′35.9″ W, 11 September 2015, *G.J.P. Ramos et al. s.n.* (HUEFS 155348); 12°51′07.1″ S, 039°28′36″ W, 20 November 2015, *G.J.P. Ramos et al. s.n.* (HUEFS 220176).

Habitat: Tank bromeliad (*Alcantarea nahoumii*); bromeliads exposed to intense solar irradiance; acidic pH, low conductivity, high level of dissolved oxygen. Abiotic parameters (pH, water temperature, electric conductivity, total solids dissolved, dissolved oxygen) are represented in Figure 3.

Note: *Parvodinium umbonatum* was recorded in 63 bromeliads.

In the Serra da Jiboia, *Parvodinium umbonatum* was commonly found in the bromeliads exposed to bright sunlight. This species had the highest frequency of occurrence of all species of algae (unpublished data) inhabiting these tank bromeliads (FO = 78.7%, frequent). Thus, *P. umbonatum* is probably an important primary producer in the local phytotelm community.

Although freshwater dinoflagellates are tolerant of wide range of environment conditions, they are commonly found in well-oxygenated water bodies with oligotrophic conditions (Rosen 1981; Pollingher 1988; Oda & Bicudo 2006; Gomes et al. 2010). Although the nutrient concentrations were not measured in the present study, Ngai & Srivastava (2006) and Lopez et al. (2009) demonstrated that bromeliad tanks might have oligotrophic conditions.

The abiotic water conditions, such as acidic pH, low conductivity, and high level of dissolved oxygen probably are favorable for the occurrence of *P. umbonatum* in the bromeliad tanks. This species also was recorded in a phytotelm habitat in bromeliads of the Rio de Janeiro state (as *Peridinium umbonatum*; Sophia 1999), but neither detailed information on this species nor abiotic data of the bromeliad tanks were provided.

In the specimens analyzed, we observed some morphological variations such as epitheca slightly conical to (more commonly) rounded (Figure 2). Our material is morphologically like those described by Carty (2014), who also described cells with rounded epitheca. This polymorphism can be explained by changes in water temperature (Popovský & Pfiester 1990). Despite this phenotypic plasticity, we consider it more appropriate to identify our material as *P. umbonatum*.

There are two species morphologically related to *Parvodinium umbonatum* recorded from Brazil: *P. africanum* and *P. inconspicuum* (Menezes et al. 2015). The former differs from *P. umbonatum* by having thecal plates with vertical surface striations whereas *P. inconspicuum* has cells are approximately pentagonal, the cingulum is more equatorial, and the apical pore is prominent (Carty 2008; Tardio et al. 2009; Lewis & Dodge 2011; Carty 2014).

The occurrence of *Parvodinium umbonatum* was recorded in the following Brazilian regions: North (Menezes et al. 2015), Midwest (Nabout & Nogueira 2007), Southeast (Delazari-Barroso et al. 2007; Silva 1999; Sophia 1999; Ferragut et al. 2005; Fonseca & Bicudo 2010) and South (Perbiche-Neves et al. 2007; Garcia & Vélez 1995; Cardoso & Torgan 2007). Our new records expand the geographic distribution of this species to the Northeast Region (Figure 1A), and thus, all regions of Brazil, showing the wide distribution of the species.

The Serra da Jiboia is considered one of the 182 priority areas for conservation of the Brazilian Atlantic Forest biodiversity and one of the 99 areas of extreme biological importance (MMA 2002). Thus, it is necessary to preserve the bromeliads that inhabit the Monte da Pioneira, especially *Alcantarea nahoumii*, a vulnerable species (Martinelli & Moraes 2013), that harbors also other interesting algae such as desmids (Ramos et al. 2011). Finally, we recommend expanding taxonomic studies of freshwater dinoflagellates in Brazil, especially in the Northeast Region, where almost all records are only restricted to checklists.

ACKNOWLEDGEMENTS

We are grateful to reviewers by the valuable suggestions of the manuscript; to the "Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)", "Fundação de Amparo à Pesquisa do Estado da Bahia (FAPESB)", and the "Programa de Pós-Graduação em Botânica (PPGBot/UEFS)" for their logistic support; to the "Serviço de Microscopia Eletrônica do Centro de Pesquisas Gonçalo Moniz (CPqGM/Fiocruz)" for SEM use; as well as to Alana Araújo dos Santos, Camila dos Anjos Ribeiro, Daniela Dias Silva dos Reis, and Maria Aparecida dos Santos for precious help while collecting samples. The first author thanks FAPESB for Doctoral fellowship (Nº BOL0513/2014).

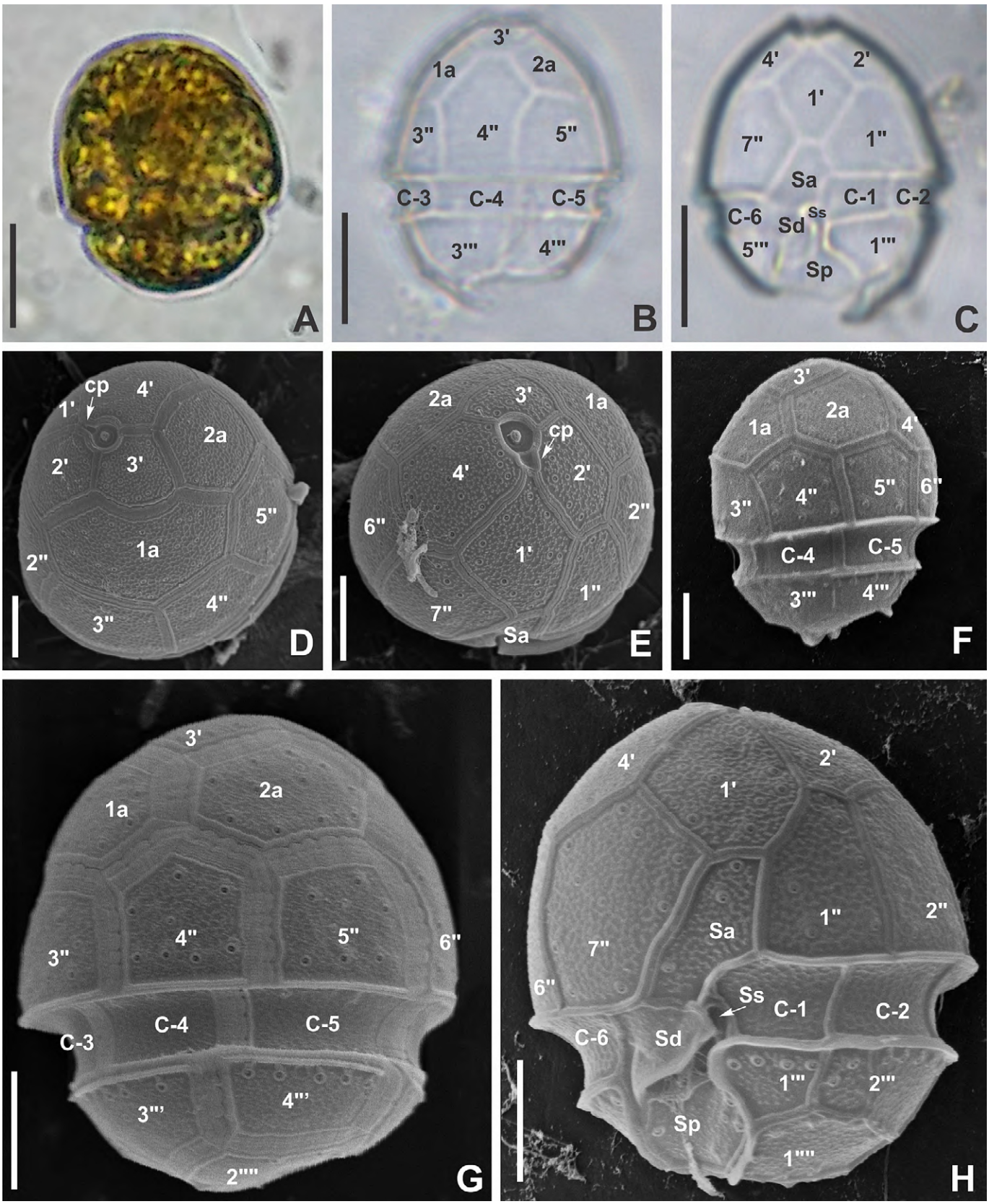

Figure 2.*Parvodinium umbonatum*. **A–C.** Light microscopy images. **A.** Detail of pale brown chloroplast. **B.** Dorsal view. **C.** Ventral view. **D–H.** SEM images. **D–E.** Apical view, cp = canal plate (arrow). **F–G.** Dorsal view. **H.** Ventral view. Scale bars: A–C, 10 µm; D–H, 5 µm.

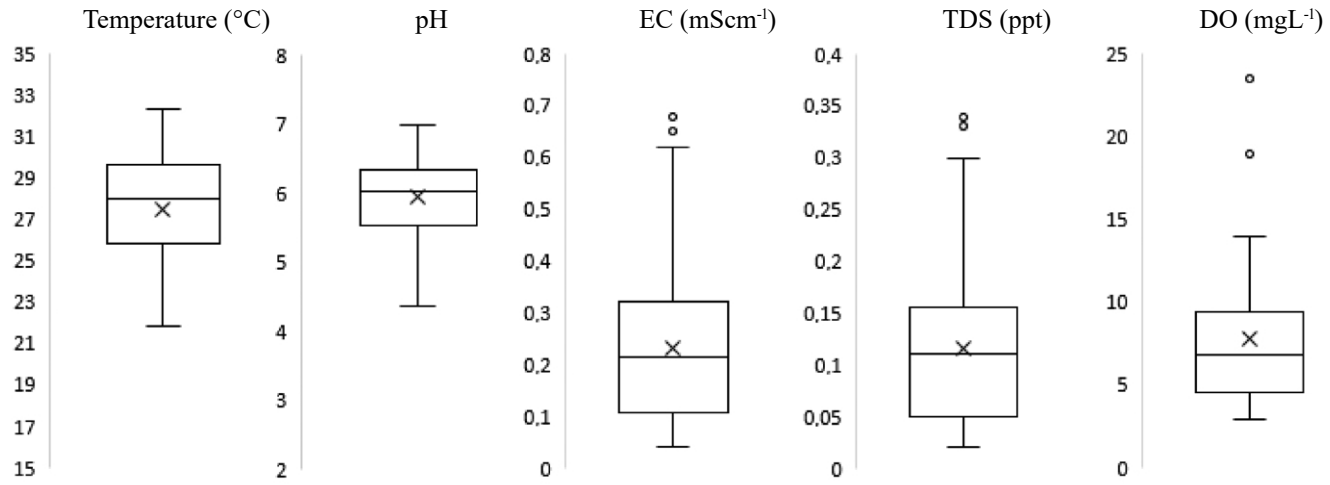

Figure 3. Box graph of temperature, pH, electric conductivity (EC), total dissolved solids (TDS) and dissolved oxygen (DO) of water in the bromeliad tanks in the Serra da Jiboia. Boxes show the 25% (bottom), 50% (middle), and 75% (top). Cross indicates the mean value.

LITERATURE CITED

Aragão-Tavares, N.K.C, J.S. Severiano & A.N. Moura. 2015. Phytoplankton composition of the Itaparica and Xingó reservoirs, São Francisco River, Brazil. Brazilian Journal of Biology 75(3): 616–627. doi: 10.1590/1519-6984.19413

Araújo, M.F.F., I.A.S. Costa, & N.T. Chellappa. 2000. Comunidade fitoplanctônica e variáveis ambientais na Lagoa de Extremoz, Natal-RN, Brasil. Acta Limnologica Brasiliensia 12: 127–140.

Cardoso, L.S. & L.C. Torgan. 2007. Dinoflagelados em diversos habitats e hidroperíodos na zona costeira do sul do Brasil. Acta Botanica Brasilica 21(2): 411–419. doi: 10.1590/S0102-33062007000200015

Carty, S. 2008. *Parvodinium* gen. nov. for the umbonatum group of *Peridinium* (Dinophyceae). Ohio Journal of Science 108: 103–107.

Carty, S. 2014. Freshwater dinoflagellates of North America. Ithaca/London: Comstock Publishing Associates. 260 pp.

Delazari-Barroso, A., C.L. Sant'Anna, & P.A. Senna. 2007. Phytoplankton from Duas Bocas reservoir, Espírito Santo state, Brazil (except diatoms). Hoehnea 34(2): 211–229. doi: 10.1590/S2236-89062007000200006

Ferragut, C., M.R.M. Lopes, D.C. Bicudo, C.E.M. Bicudo & I.S. Vercellino. 2005. Ficoflórula perifítica e planctônica (exceto Bacillariophyceae) de um reservatório oligotrófico raso (Lago do IAG, São Paulo). Hoehnea 32(2):137–184.

Fonseca, B.M. and C.E.M. Bicudo. 2010. How important can the presence/absence of macrophytes be in determining phytoplankton strategies in two tropical shallow reservoirs with different trophic status? Journal of Plankton Research 32(1): 31–46. doi: 10.1093/plankt/fbp107

Garcia, M. & E. Vélez. 1995. Algas planctônicas da Lagoa Emboaba, Planície Costeira do Rio Grande do Sul: avaliação qualitativa. Boletim do Instituto de Biociências da Universidade Federal do Rio Grande do Sul 54: 75–114.

Gomes, P.P., M.S.R. Ibañez & J.S. Freitas. 2010. Spatial and temporal variation of *Peridinium umbonatum* F. Stein, 1883 (Dinophyceae) and its relationship with total phytoplankton of a shallow, oligotrophic lake in central Brazil (Lagoon Bonita, Distrito Federal). Acta Limnologica Brasiliensia 22(3): 317–324. doi: 10.4322/actalb.02203008

Graham, L.E., J.J. Graham & L.W. Wilcox. 2009. Algae, 2nd edition. San Francisco: Benjamin Cummings. 616 pp.

Guiry, M.D. & G.M. Guiry. 2016. AlgaeBase. Galway: National University of Ireland.. Accessed at http://www.algaebase.org, 4 March 2016.

Kitching, R.L. 2000. Food webs and container habitats: the natural history and ecology of Phytotelmata, Vol. 89. Cambridge: Cambridge University Press. 448 pp.

Kofoid, C.A. 1909. On *Peridinium steini* Jorgensen, with a note on the nomenclature of the skeleton of the Peridinidae. Archiv für Protistenkunde 16: 25–47.

Lewis, J.M. & J.D. Dodge 2011. Dinophyta (Dinoflagellates), pp. 250–274, in: D.M. John, B.A. Whitton & A.J. Brook (eds.). The freshwater algal flora of the British Isles. An identification guide to freshwater and terrestrial algae, 2nd edition. Cambridge: Cambridge University Press.

Lira, G.A.S.T., M.C. Bittencourt-Oliveira & A.N. Moura. 2009. Structure and dynamics of phytoplankton community in the Botafogo reservoir-Pernambuco-Brazil. Brazilian Archives of Biology and Technology 52(2): 493–501. doi: 10.1590/S1516-89132009000200029

Lopez, L.C.S., R.R.N. Alves, & R.I. Rios. 2009. Micro-environmental factors and the endemism of bromeliad aquatic fauna. Hydrobiologia 625: 151–156. doi: 10.1007/s10750-009-9704-1

Martinelli, G. & M.A. Moraes. 2013. Livro Vermelho da flora Brasileira. Rio de Janeiro: Andrea Jakobson Estúdio/Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. 1100 pp.

Matteucci, S.D. & A. Colma. 1982. La metodologia para el estudo de la vegetacion. Collecion de Monografias Científicas, Série Biologia 22: 1–168. http://www.mma.gov.br/estruturas/chm/_arquivos/biodivbr.pdf

Menezes, M., C.E. M. Bicudo, C.W. N. Moura, A.M. Alves, A.A. Santos, et al. 2015. Update of the Brazilian floristic list of algae and Cyanobacteria. Rodriguésia 66(4): 1047–1062. doi: 10.1590/2175-7860201566408; supplementary material, doi: https://dx.doi.org/10.6084/m9.figshare.1538646.v1

Moschini-Carlos, V., D. Pereira, M.J.S. Wisniewski & M.L.M. Pompêo. 2008. The planktonic community in tropical interdunal ponds (Lençóis Maranhenses National Park, Maranhão state, Brazil). Acta Limnologica Brasiliensia 20(2): 99–110.

Nabout, J.C. & I.S. Nogueira. 2007. Spatial and temporal dynamics of phytoplankton functional group in a blocked valley (Brazil). Acta Limnologica Brasiliensia: 19(3): 305–314.

Ngai, J.T. & D.S. Srivastava. 2006. Predators accelerate nutrient cycling in a bromeliad ecosystem. Science 314: 963. doi: https://doi.org/10.1126/science.1132598

Oda, A.C.R. & C.E.M. Bicudo. 2006. Ecology of *Peridinium gatunense* and *Peridinium umbonatum* (Dinophyceae) in a shallow, tropical, oligotrophic reservoir (IAG Pond), São Paulo, southeast Brazil.

Acta Limnologica Brasiliensia 18(2): 165–180.

Oliveira, H.S.B, A.N. Moura & M.K. Cordeiro-Araújo. 2011. First record of *Ceratium* Schrank, 1973 (Dinophyceae: Ceratiaceae) in freshwater ecosystems in the semiarid region of Brazil. Check List 7(5): 626–628. doi: 10.15560/7.5.626

Perbiche-Neves, G., M. Ferrareze, A.R. Ghidini, L. Brito & M.T. Shirata. 2007. Assembléias microfitoplanctônicas num lago urbano da cidade de Curitiba: Estado do Paraná, Brasil. Estudos de Biologia 29(66): 43–51.

Pollingher, U. 1988. Freshwater armored dinoflagellates: growth, reproduction, strategies, and population dynamics; pp. 134–174, in: C.G. Sandgren. (ed.). Growth and reproductive strategies of freshwater phytoplankton. Cambridge: Cambridge University Press.

Popovský, J. & L.A. Pfiester. 1990. Dinophyceae (Dinoflagellida); pp. 1–272, in: H. Ettl, J. Gerloff & D. Mollenhauer (eds.). Süswasserflora von Mitteleuropa. Jena/Stuttgart: Gustav Fisher Verlag.

Ramos, G.J.P., I.B Oliveira & C.W.N. Moura. 2011. Desmídias de ambiente fitotelmata bromelícola da Serra da Jiboia, Bahia, Brasil. Revista Brasileira de Biociências 9(1): 103–113.

Rosen, G. 1981. Phytoplankton indicators and their relations to certain chemical and physical factors. Limnologica 13: 236–296.

Sahu, G., A.K. Mohanty, M.K. Samantara & K.K. Satpathy. 2014. Seasonality in the distribution of dinoflagellates with special reference to harmful algal species in tropical coastal environment, Bay of Bengal. Environmental Monitoring and Assessment 186(10), 6627–6644. doi: 10.1007/s10661-014-3878-3

Severiano, J.S., Moura, A.N., Oliveira, H.S.B., Cordeiro-Araújo, M.K. & E.W, Dantas. 2012. Micro-phytoplankton richness in Contas River, state of Bahia, northeastern Brazil. Check List 8(2): 218–223. doi: 10.15560/8.2.218

Silva, L.H.S. 1999. Fitoplâncton de um reservatório (Lago Monte Alegre), Ribeirão Preto, São Paulo, Brasil. Revista Brasileira de Biologia 59(2): 281–303. doi: 10.1590/S0034-71081999000200012

Sophia, M.G. 1999. Desmídias de ambientes fitotélmicos bromelícolas. Revista Brasileira de Biologia 59(1): 141–150. doi: 10.1590/S0034-71081999000100018

Tardio, M., M. Ellegaard, N. Lundholm, F. Sangiorgi & G. Di Giuseppe. 2009. A hypocystal archeopyle in a freshwater dinoflagellate from the *Peridinium umbonatum* group (Dinophyceae) from Lake Nero di Cornisello, South Eastern Alps, Italy. European Journal of Phycology 44: 241–250. doi: 10.1080/09670260802588442

Authors' contributions: All authors have made considerable contributions to the work and approved it for publication.

Received: 22 March 2016
Accepted: 22 December 2016
Academic editor: Sandra Costa-Böddeker