

# Charophyceae, Charales, Characeae, *Chara drouetii* R.D. Wood, 1965: First record from the state of Quintana Roo, Mexico

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**ABSTRACT:** *Chara drouetii* R.D. Wood, 1965 was recently collected during floristic surveys of aquatic macrophytes in the Yucatán Peninsula, Mexico. This discovery represents the first documented record for this species from the state of Quintana Roo, Mexico. This report extends the range of *Chara drouetii* by approximately 300 km east of the nearest known occurrence of this species in Mexico and approximately 6,000 km northwest of the type locality (municipality of Fortaleza, state of Ceará, Brazil). Comparative morphometric data on diagnostic taxonomic characters of this species are presented.

The genus *Chara* Linnaeus, 1753 comprises a diverse and complex group of macrophytic green algae that occurs on every continent, excluding Antarctica, (Wood and Imahori 1959; Wood 1964; 1965; Mann *et al.* 1999; Martin *et al.* 2004). Members of this genus are found in a variety of natural and man-made aquatic habitats, which include fresh and brackish water systems, permanent lakes and ponds, rivers and streams, swales and ditches, and seasonal pools (Wood 1965; Moore 1986; Martin *et al.* 2004), where they are often important components in the structure and function of aquatic ecosystems (*e.g.*, see Hutchinson 1975; Jeppesen *et al.* 1998; Van den Berg *et al.* 1998; Coops 2002). Despite their ecological importance and their collection for over two centuries in North America, many *Chara* species appear to remain both under-collected during floristic assessments of water bodies (Alix and Scribailo 2010) and under-represented in regional floras (Scribailo and Alix 2010). *Chara drouetii* R.D. Wood, 1965 is a primary example of a charalean alga species of the Americas of which little is known regarding its range or ecology.

*Chara drouetii* is in the subsection *Willdenowia* R.D. Wood, 1962 and was first described by Wood (1962) as *Chara zeylanica* var. *sejuncta* forma *drouetii* based on a single specimen collected in 1935 from a dune pond, Urubu, municipality of Fortaleza, state of Ceará, northeastern Brazil (Figure 1). Although *Chara drouetii* is included in the *Lista de espécies Flora do Brasil* (Araújo *et al.* 2010), this species has not been recorded from Brazil since its collection from the type-locality (Thamis Meurer, State University of West Paraná, personal communication). On a world-wide basis, *Chara drouetii* has only been collected and properly documented from two additional habitats in Mexico: 1) a calcareous stream within the state of San Luis Potosí, approximately 50 km south of Ciudad Mante, collected in 1961 by Donald R. Tindall, Arland T. Hotchkiss, and Richard H. Goodyear, University of Louisville, DHL 61-9-9-5; and 2) wetlands

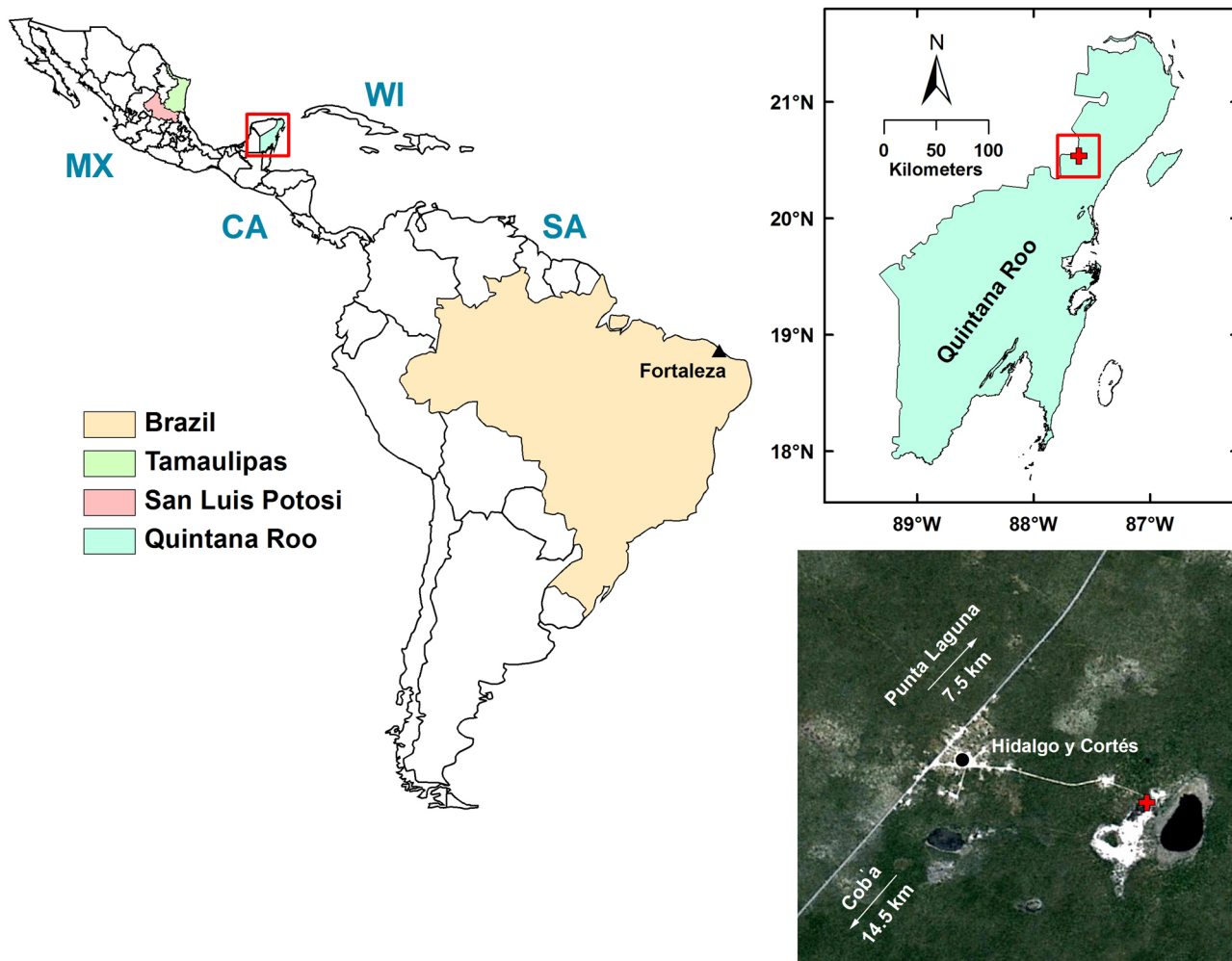
23 km north of Manuel, state of Tamaulipas, collected by Jeremy D. Pickett-Heaps (collection date absent), United States National Herbarium, US TAMPS-14. It is one of an estimated 17 *Chara* species found in Mexico (Scribailo and Alix 2010). In this paper, we present an additional confirmed occurrence of *Chara drouetii* from a wetland habitat, which represents the first record of this species from the state of Quintana Roo, Mexico. Specimens were collected and have been deposited in the United States National Herbarium at the Smithsonian Institution (US 3615816), the Friesner Herbarium at Butler University (BUT, *s.n.*), and the Aquatic Plant Herbarium of Purdue University North Central (indicated here as PUNC, *s.n.*). Morphological measurements were taken from dried material, using a Nikon Optiphot-2 light microscope equipped with an eyepiece micrometer, and compared with those provided by Tindall (unpublished data) and with those reported by Wood and Imahori (1964), and Bicudo (1974). Identifications are based on Wood (1965) and have been confirmed by Vernon W. Proctor (Professor Emeritus, Texas Tech University).

On 19 January 2003, during field work to catalogue aquatic macrophytes of the Yucatán Peninsula, Mexico, *Chara drouetii* was discovered in shallow ephemeral pools (20°35'39" N, 87°39'46" W, 11 m above sea level) near Hidalgo y Cortés, state of Quintana Roo (Figures 1 and 2). These shallow depressions (*ca.* 40 cm maximum depth) are located below limestone outcrops to the northeast and northwest of this site (Figure 2), which are consistent with the karst topography of this region. *Chara drouetii* was widespread among these ephemeral pools, but patchily distributed within each depression. Plants were attached by rhizoids to a fine layer of silt substrate, heavily encrusted with calcium carbonate, and fertile. The largest plants at this location were up to 15 cm in length, having a similar growth form to that indicated in Figure 3A. Like other members of the subsection *Willdenowia*, *Chara drouetii*, possesses two tiers of well-developed

stipulodes (diplosthephanous) at axial nodes (Figure 3B), basal branchlet segments that are ecorticate (Figure 3C), and 3-corticate (triplostichous) stem axes (Figure 3D) and branchlets. Stipulodes of the upper tier range from 366 to 500  $\mu\text{m}$  in length, whereas those of the lower tier range from 233 to 367  $\mu\text{m}$  in length (Table 1). Stem axes are up to 256  $\mu\text{m}$  in diameter (Table 1) and cortical spine cells are globular (Figure 3D) and highly reduced in size compared to other species within this subsection. Plants

are monoecious with sejoined gametangia (*i.e.* occurring at separate branchlet nodes, Figures 3C and 3E) typically having distal antheridia and proximal oogonia (Figure 3C). The branchlets of this species are up to 4 mm in length and often terminate with 1-2 ecorticate segments (Figure 3F).

The preceding descriptions and measurements are consistent with those provided by Wood and Imahori (1964), Bicudo (1974), and Tindall (unpublished data) for *Chara drouetii*, with a few exceptions (see Table 1). For



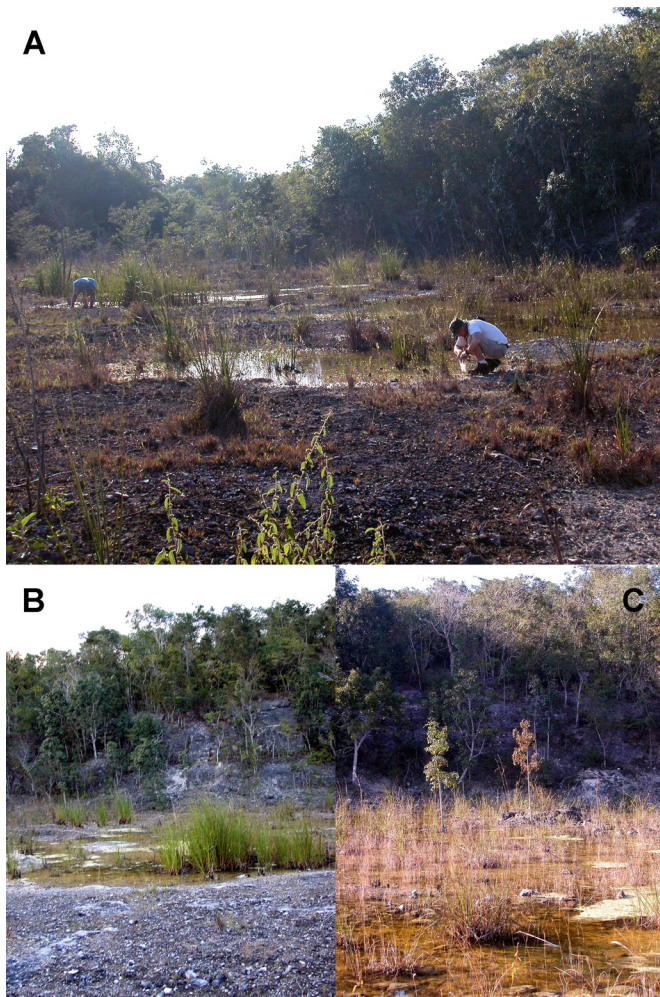
**FIGURE 1.** Geographic distribution of *Chara drouetii*. CA = Central America; MX = Mexico; SA = South America; WI = West Indies; triangle ( $\blacktriangle$ ) = type locality; cross ( $\oplus$ ) = new locality. Satellite image courtesy of the National Oceanic and Atmospheric Administration (NOAA).

**TABLE 1.** Morphometrics of *Chara drouetii*. Parenthetical values = sample size; dagger ( $\dagger$ ) = unpublished data on specimens collected from San Luis Potosi, Mexico; double dagger ( $\ddagger$ ) = sample size not available

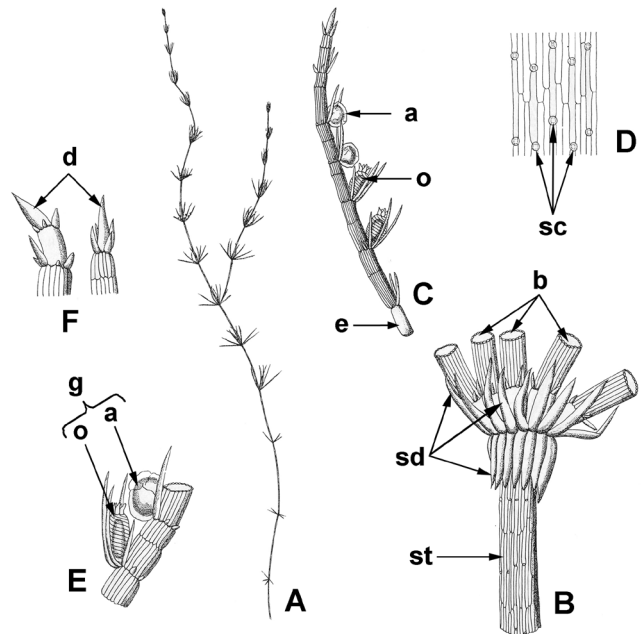
MORPHOMETRIC MEASUREMENTS	THIS STUDY	TINDALL $\dagger$	WOOD AND IMAHORI (1964) $\ddagger$	BICUDO (1974)
Stem diameter ( $\mu\text{m}$ )	200-256 (10)	225-300 $\ddagger$	$\leq 255$	240-260 (25)
Upper stipulode length ( $\mu\text{m}$ )	367-566 (10)	225-360 $\ddagger$	$\leq 600$	400-600 (25)
Lower stipulode length ( $\mu\text{m}$ )	233-400 (10)	165-285 $\ddagger$	$\leq 450$	390-450 (25)
Branchlet length (mm)	2.3-4.0 (10)	3-9 $\ddagger$	$\leq 8$	6-8 (25)
Antheridia diameter ( $\mu\text{m}$ )	200-300 (10)	240-292 (25)	$\leq 300$	$\leq 300$ (25)
Oogonia length ( $\mu\text{m}$ )	393-525 (27)	560-622 (11)	525-560	525-560 (25)
Oogonia width ( $\mu\text{m}$ )	295-367 (27)	330-360 (11)	365-410	365-400 (25)
Oospore length	334-377 (20)	335-390 (25)	405-435	405-435 (25)
Oospore width	220-281 (20)	210-255 (25)	260-285	280-285 (25)
Number of striae	11-12 (20)	10-12 (25)	11-12	11-12 (25)
Number of scute cells	8 (10)	8 (25)	4	4 (25)

example, oogonia lengths are consistently smaller in the Quintana Roo specimens than those recorded from other collections (Table 1). In addition, plants collected from the Quintana Roo locality possess octoscutate rather than the tetrascutate antherida reported by Wood and Imahori (1964) and Wood (1965) for the type specimen of this species (NY 1351) and Bicudo (1974) for the isotypes in the herbarium at the Instituto de Botânica, São Paulo (SP 96227, SP 114667, and SP 114669). It should be noted that a letter attached to the holotype indicates that this specimen was examined in 1991 by Vernon W. Proctor and determined to possess octoscutate antheridia. Although we have not examined the isotypes, it is reasonable to presume they also contain octoscutate antheridia. Observations of tetrascutate versus octoscutate antheridia in the aforementioned specimens may be a consequence of the difficulties associated with determining the number of antheridial scutes from dried herbarium specimens. The presence of only octoscutate antheridia in *Chara drouetii* would support an earlier claim by Proctor and Wiman (1971) that tetrascutate antheridia have not been found on a species having sejoined gametangia within the subsection *Willdenowia* and lends credence to the idea that these species should be recognized as taxonomically distinct from those having conjoined gametangia and tetrascutate antheridia. As such, this line of reasoning refutes Wood's (1962, 1965) taxonomic placement of *Chara drouetii*

within the species complex of *Chara zeylanica* Klein ex Willdenow, 1805 because members of this complex typically possess both of the latter characteristics (Proctor *et al.* 1971). Although Wood (1962, 1965) subsumed many previously recognized species to varieties and forms under a small number of highly variable "macrospecies", such as *Chara zeylanica*, he recognized the possibility that future studies might clarify the taxonomy of some of these taxa and provided a microspecies appendix to his 1965 revision of the Characeae in which many of those taxa, including *Chara zeylanica* var. *sejuncta* forma *drouetii* (= *Chara drouetii*), were given specific rank and thus are validly published names with Wood as the Authority.



**FIGURE 2.** Panoramic view of the collection site of *Chara drouetii*. (A) Overview of pond; (B) Northeast ridge; (C) Northwest ridge. Photographs by R. W. Scribailo.



**FIGURE 3.** Morphology of *Chara drouetii*. (A) Habit  $\times 1$ ; (B) Axial node, showing stipulodes  $\times 40$ ; (C) Overview of branchlet with distal antheridia and proximal oogonia  $\times 23$ ; (D) Triplostichous axial cortex  $\times 90$ ; (E) Branchlet section with sejoined gametangia  $\times 40$ ; (F) Apices of branchlets, showing dactyls  $\times 40$ . Abbreviations: a = antheridium; b = branchlet; d = dactyls; e = ecoticate basal branchlet segment; g = gametangia; o = oogonium; sc = spine cell; sd = stipulodes; st = stem. Modified and reprinted with permission from Wood and Imahori (1964). Line drawing based on holotype (NY 1351).

This report fills in one of potentially many distributional gaps for *Chara drouetii* within Mexico and extends the range of this species approximately 6,000 km (straight-line distance) northwest of the type locality and approximately 300 km (straight-line distance) east from its nearest documented occurrence within the state of Tamaulipas, Mexico. Although the distributional information on *Chara drouetii* is sparse and primarily limited to Mexico, this species is likely more common than what is indicated by collection records. For example, *Chara drouetii* has been observed in wetlands in Guatemala along Highway 5 between the Sarstún River and Lago de Izabal (Vernon Proctor unpublished data); however, because no voucher specimens were collected, this report remains undocumented. Nevertheless, further investigation throughout Mexico and across Central and South America and the West Indies should be carried out to better assess the distributional range, abundance, habitat preference, and overall ecology of *Chara drouetii*.

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