First record of the green alga *Ulva meridionalis* R.Horimoto & S.Shimada (*Ulvaceae, Ulvophyceae*) in the Philippines

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The *Ulvaceae* is one of the most common and widely distributed green algal families. Species of the type genus, *Ulva,* when distromatic, generally have a blade-like thalli but when monostromatic have tubular thalli (Hayden & al. 2015).

Morpho-anatomy-based species delimitation, on the other hand, is important with freshly collected samples of *Ulva* in which size, shape, and alignment of the cells as well as the number and shape of the pyrenoids are conspicuous. However, these morphological features can vary greatly with different environmental conditions, and delimitation solely relying on these characters has been shown to be very difficult with the absence of molecular evidence (e.g. Loughnane & al. 2008). Consequently, molecular-based species delimitation is now considered essential (O'Kelly & al. 2010). In addition, molecular studies also aid in an understanding of biogeographic history, cryptic species diversity, introduction of species in different regions and detection of green-tide-forming taxa (Heesch & al. 2009; Hofmann & al. 2010; Kraft & al. 2010; Wolf & al. 2012; Kazi & al. 2016). Despite recent taxonomic study on *Ulva* undertaken in some regions in south-eastern Asia (Tran & al. 2023), the diversity of the genus remains poorly known in other regions such as the Philippines, and most records should be treated as provisional.

Presently, an on-going preliminary assessment on the taxonomy of *Ulva* species in the Philippines has resulted in the discovery of some overlooked, tubular *Ulva* taxa based on molecular analyses, including an interesting species from Cebu Island. This species, collected from the locality of Compostela, northern-eastern Cebu, superficially resembled *U. meridionalis* R.Horimoto & S.Shimada originally described from brackish waters in Japan (Horimoto 2011: 161, figs 3-17; type locality: Ishigaki Island, Okinawa Prefecture). Our *rbc*L dataset of the genus *Ulva* was 1300 bp in length and produced an ML phylogeny like previous studies (Spalding & al. 2016; Lagourgue & al. 2022). *Ulva meridionalis* samples from Compostela, north-eastern Cebu, were closest to specimens from the type locality with 0.005-0.007% genetic distances. Thus, the plants from north-eastern Cebu are thus identified as *U. meridionalis*, which is here reported as a species new to the Philippines.

Ulva meridionalis R.Horimoto & S.Shimada (Fig. 1 A-D)

Description: Plants form a dense, dark green hair-like mass of hollow, slightly compressed except for the compressed apices, delicate fronds up to 15 cm long and 1-1.4 mm in diameter; filaments are rarely ramified and only in the basal region. In surface view, cells are squarish to obscurely polygonal, cell dimensions were 93.79 (±1.87) µm, in a mosaic arrangement and forming cohesive, circular assemblages. Fronds composed of one layer of cells in transverse section. At the compressed apices cells are squarish and truncate, 29.67 (±1.50) µm thick, 20 (±1.08) µm in width. In the hollow, sub-compressed, basal region are rectangular, 32.40 (±1.22) µm thick. Chloroplasts are spherical to slightly granule-like. Pyrenoids 5-6 (sometimes more) per cell.

Specimens examined: Compostela, Cebu Island, Philippines, 10.4659° N, 123.9806° E, 12.ii.2022, attached to *Kappaphycus* culture platform, CCV0054; CCV0055; CCV0056.

Morphologically, *Ulva meridionalis* from the Philippines bears morphological resemblance to several tubular species by having a basally distinct tubular thalli and a compressed apical region of the thallus. Some of these include *U. tepida* Masakiyo & Shimada, *U. partita* Ichihara and *U. chaugulei* Kavale & Kazi (as '*chaugulii'*). However, only *U. tepida* and *U. partita* exhibit basal ramification among these morphologically similar species a character also of *U. meridionalis*. Although previous studies documented several specimens of *U. meridionalis* from China and Japan that exhibit ramification from the base towards the apex, Philippine specimens characteristically develop basal ramification which then becomes fewer or less developed when the plants mature. However, Horimoto & al. (2011) distinguishes *U. meridionalis* from other tubular species of *Ulva* in their study based on branching pattern, number of pyrenoids per cell, chloroplast positions in the cell, life history and developmental pattern. Recent studies such as that of Xie & al. (2020) showed obovate cells with roundish apices in the basal region of the thallus in Chinese specimens. This is different from the rectangular cells with truncate apices in the basal region of Philippine *U. meridionalis*. Also, unlike the type specimens which were collected from brackish water of Todoroki River, the Philippine specimens were collected from the intertidal zone of the coast of Compostela. In general, tubular *Ulva* spp. are euryhaline species (Rybak, 2018).

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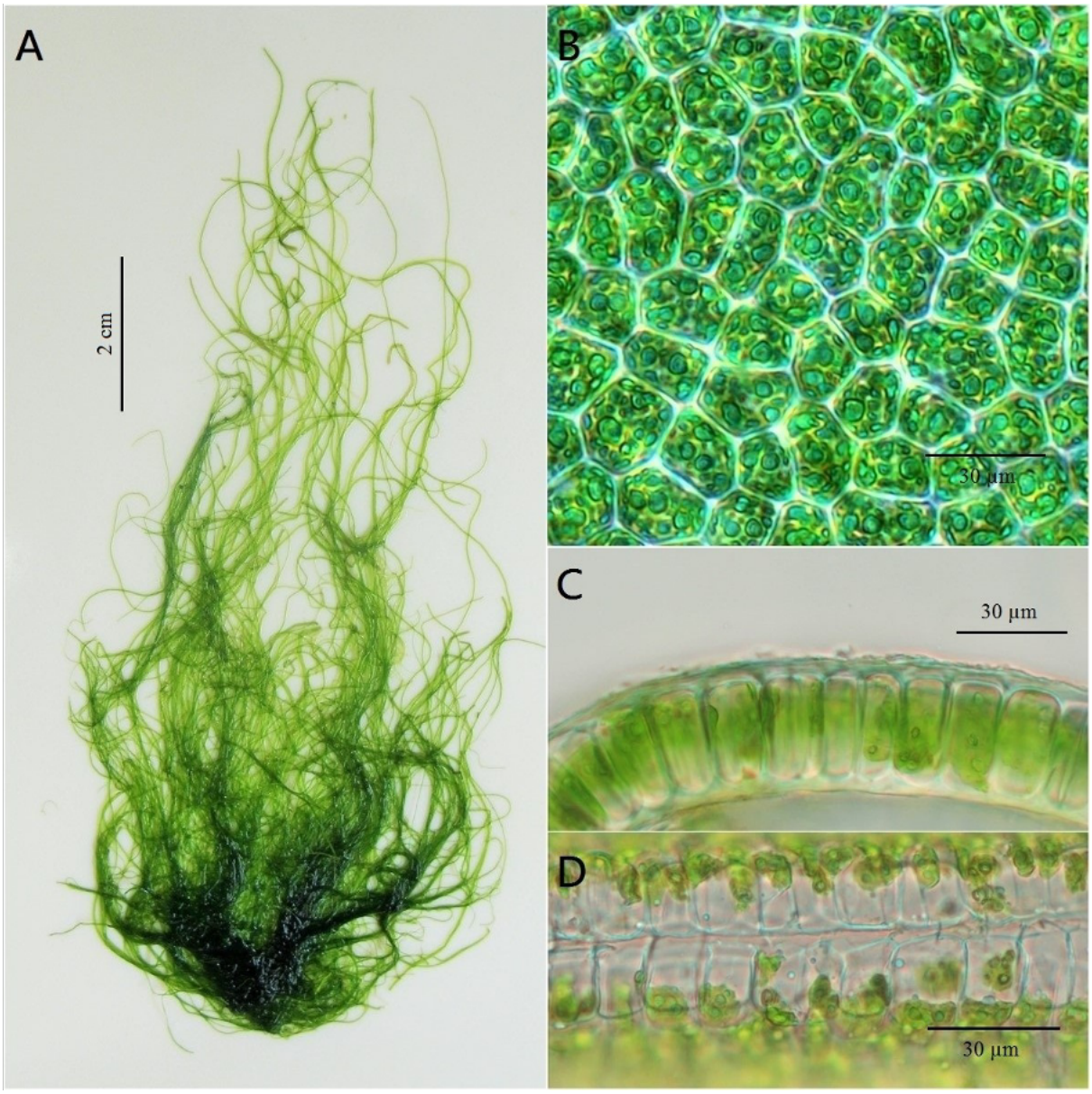

Fig. 1. *Ulva meridionalis.* A) Habit of the plant; B) Surface view of the cells; C) Transverse section of the basal region; D) Transverse section of the apical region.

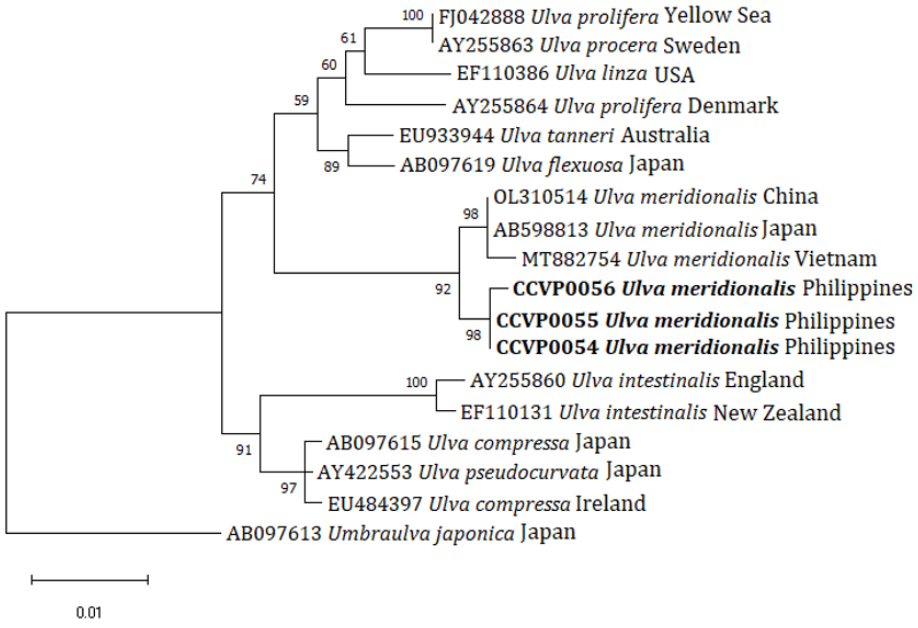

Fig. 2. Phylogenetic relationships based on RaxML analysis of the 18 partial *rbc*L sequences of *Ulva*. Bootstrap values are indicated at the nodes while branch lengths are provided. New sequences are in bold.