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[Note]

First Record of *Scytosiphon gracilis* Kogame (Scytosiphonaceae, Phaeophyceae) for the Pacific coast of Mexico

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In this work we report the occurrence of *Scytosiphon gracilis* Kogame (Scytosiphonaceae, Phaeophyceae) on the Pacific coast of Mexico. This is the first report of *S. gracilis* outside its previously known distribution in the western North Pacific (Korea and Japan). The identification was based on a morphological revision and a comparison of the plastid-encoded RuBisCO spacer sequences determined for Korean and Mexican algal material. Thalli were collected from the intertidal zone of Saldamando Beach, Baja California, in January 2003. The vegetative structure, as well as habitat and geographic distribution of the species are described. Reproductive structures were not found in our specimens. The poor presence/absence of *S. gracilis* in previous floristic studies of the area could be due to its small size and low frequency.

Key Words: Brown algae, Pacific Mexico, RuBisCO spacer region, *Scytosiphon gracilis*, Scytosiphonaceae

Scytosiphon gracilis Kogame (1998: 39)

Holotype: SAP 059720 (collected on 1 February 1990).

Type locality: Ohma, Aomori Prefecture, Japan.

Distribution: Japan (Kogame 1998), Korea (Cho *et al.* 2001; Cho *et al.* 2002) and Mexico (this paper).

Japanese name: Usukayamo.

Korean name: Ganeunmiyeoksil.

Specimens examined: Playa Saldamando, Baja California, Mexico (Raul Aguilar Rosas & Luis E. Aguilar Rosas, CMMEX 4438, 31.I.2003).

The brown alga *Scytosiphon gracilis* Kogame was initially described from Japan by Kogame (1998), and it was subsequently reported only from Korea (Cho *et al.* 2001, 2002). In this study we report the occurrence of this species in Mexican waters (eastern Pacific Ocean).

Plants of *S. gracilis* were collected from the upper to the middle intertidal zone of Saldamando Beach, Baja California, Mexico (Fig. 1), during January 2003. Some specimens were fixed and preserved in 4% formaldehyde-seawater for further observations. For DNA extractions, specimens were air-dried and preserved in silica crystals. The preserved material was stained with 1% aqueous aniline blue acidified with diluted HCl for light microscopy. Photographs were taken with a digital camera (Sony DSC-S85, Tokyo, Japan) attached to a Zeiss light microscope (Axioscop 40, Goettingen, Germany). Specimens were deposited in the Herbarium CMMEX of the Faculty of Marine Science of the Autonomous University of Baja California, in Ensenada, Baja California, Mexico (Holmgren *et al.* 1990).

The protocol established by Cho *et al.* (2001) was followed for the DNA extraction, sequencing and data analyses. To determine the best model for the maximum likelihood analysis, the MODELTEST program (V3.04, Posada and Crandall 1998) was used with *Scytosiphon* and related species from Korea and Japan to compare with two Mexican species of *Scytosiphon* collected from Saldamando Beach and Popotla (Baja California, Mexico) in January 2003. Under the GTR + I + Γ model, the phylogenetic tree was constructed using heuristic searches with 10 random addition sequence replicates and tree bisection-reconnection (TBR) branch swapping. Bootstrap analyses (Felsenstein 1985) were undertaken with 1,000 replicates using the same parameters for each phylogenetic analysis.

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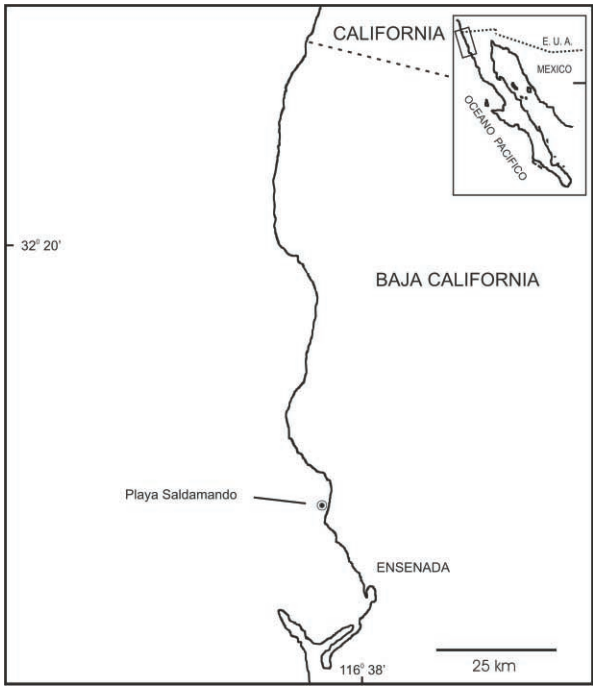

Fig. 1. Map showing the sampling site on the western coast of Baja California, Mexico.

Fig. 2. *Scytosiphon gracilis* Kogame. Thalli collected on 31 January 2003 from the intertidal zone of Playa Saldamando, Baja California, Mexico. Scale = 2 cm.

The following observations were based on field collected plants and molecular analysis (plastid-encoded RuBisCO spacer sequences). Plants have many clustered, erect thalli that grow on rocks in the upper and middle intertidal zones of moderately exposed or sheltered areas. They are flattened, unbranched, hollow, twisted in the upper part, up to 10 cm tall and 1-1.2 mm wide (Fig. 2), and yellowish-brown in color. Thalli consist of a cortex composed of 1-3 layers of small, angular to rectangular, pigmented cells and a medulla composed of 2-3 layers of large colorless cells. In cross-section, medullary cells were round to oval, 25-34 x 24-42 μm in size. Thalli attached to substrate with rhizoidal filaments arising from the outer cortical cells near the base of the thallus. Phaeophycean hairs were solitary or grouped on the surface. Reproductive structures were not found in the specimens examined.

The genus *Scytosiphon* is distinguished by cylindrical to compressed hollow thalli, sori with unicellular paraphyses and abundant phaeophycean hairs (Kogame 1998), and currently includes seven species: *S. canaliculatus* (Setchell and Gardner) Kogame, *S. complanatus* (Rosenvinge) Doty, *S. crispus* Skottsberg, *S. dotyi* Wynne, *S. gracilis* Kogame, *S. lomentaria* (Lyngbye) Link and *S. tenellus* Kogame (Kogame 1998; Cho *et al.* 2002). Prior to this study, only *S. dotyi* and *S. lomentaria* have been reported for the Pacific coast of Mexico (Abbott and Hollenberg 1976; Aguilar-Rosas 1982; Stewart and Stewart 1984; Aguilar-Rosas and Aguilar-Rosas 1994).

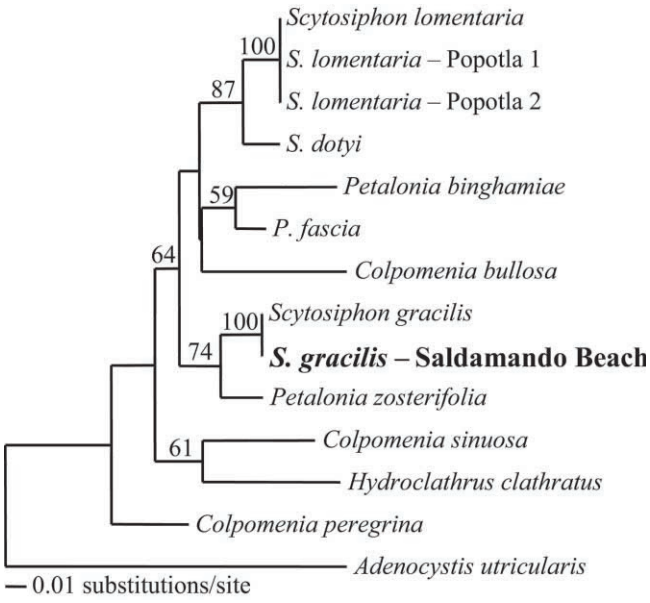

Fig. 3. Maximum likelihood tree for *Scytosiphon* and relatives estimated from the RuBisCO spacer data (GTR + I + Γ model, -Log likelihood = 2027.6458; I = 0.585178; Γ = 2.64104; A $\leftrightarrow$ C = 2.304107, A $\leftrightarrow$ G = 3.696195, A $\leftrightarrow$ T = 1.088289, C $\leftrightarrow$ G = 1.905198, C $\leftrightarrow$ T = 6. 521173, G $\leftrightarrow$ T = 1). Bootstrap values (1,000 replicates) are on the branches.

Our specimens of *S. gracilis* from Baja California fit the descriptions of this species from Japan (Kogame 1998) and Korea (Cho *et al.* 2002). Moreover, the DNA extraction and sequencing results for *S. gracilis* from Baja California are identical to the sequences shown by Cho *et al.* (2001) for Korean samples (BP = 100) (Fig. 3). The maximum-likelihood analysis revealed the close relationship between *S. gracilis* and *Petalonia zosterifolia* (Reinke) Kuntze (BP = 74); however, these two species differ in the structure of the thallus and the presence/absence of paraphyses (Cho *et al.* 2002). Overall topology of the other members of Scytosiphonaceae was similar to those of Kogame *et al.* (1999) and Cho *et al.* (2001). Detailed discussion about the phylogenetic relationship at the genus level is beyond of this study.

Scytosiphon gracilis may be a winter-spring species at Saldamando Beach, as in Japan (Kogame 1998) and Korea (Cho *et al.* 2002). Until now, *S. gracilis* has been reported only from Japan and Korea, but the population found in Mexican waters extends its distribution to the eastern Pacific Ocean. Detailed field collections may extend the areas of distribution along the Baja California coastline. Due the active shipping between Asia and Mexico and the proximity of study area to Ensenada port, the occurrence of *S. gracilis* on the Pacific coast of Mexico suggests a recent introduction (Hommersand 1972).

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REFERENCES

Abbott I.A. and Hollenberg G.J. 1976. *Marine Algae of California*. Stanford University Press, California.

Aguilar-Rosas L.E. 1982. Ocurrencia de algas cafes (Phaeophyta) en la bahia de Todos Santos, B.C., México. *Ciencias Marinas* **7:** 85-101.

Aguilar-Rosas R. and Aguilar-Rosas M. 1994. Floristic study of benthic marine algae from Ejido San Jose, Baja California, Mexico. *Ciencias Marinas* **20:** 511-534.

Cho G.Y., Yoon H.S., Choi H.-G., Kogame K. and Boo S. M. 2001. Phylogeny of the family *Scytosiphon*aceae (Phaeophyta) from Korea based on sequences of plastid-encoded RuBis spacer region. *Algae* **16:** 145-150.

Cho G.Y., Yang E.C., Lee S. H. and Boo S.M. 2002. First description of *Petalonia zosterifolia* and *Scytosiphon gracilis* (Scytosiphonaceae, Phaeophyceae) from Korea with special reference to nrDNA ITS sequence comparisons. *Algae* **17:** 135-144.

Felsenstein J. 1985. Confidence limits on phylogenies: an approach using the bootstrap. *Evolution* **39:** 783-791.

Holmgren P.K., Holmgren N.H. and Barnett I.C. 1990. *Index Herbariorum, Pt 1: The Herbaria of the World*, 8th ed. New York, Bronx, New York Botanical Garden, x + 693 p. [*Regnum Vegetabile*, vol. 20].

Hommersand M.H. 1972. Taxonomic and phytogeographic relationships of warm temperate marine algae occurring in Pacific North America and Japan. *Proc. Int. Seaweed Symp.* **7:** 66-71.

Kogame K. 1998. A taxonomic study of Japanese *Scytosiphon* (*Scytosiphon*ales, Phaeophyceae), including two new species. *Phycol. Res.* **46:** 39-56.

Kogame K., Horiguchi T. and Masuda M. 1999. Phylogeny of the order *Scytosiphon*ales (Phaeophyceae) based on DNA sequences of *rbc*L, partial *rbc*S, and partial LSU nrDNA. *Phycologia* **38:** 496-502.

Posada D. and Crandall K.A. 1998. MODELTEST: testing the model of DNA substitution. *Bioinformatics* **14:** 817-818.

Stewart J.G. and Stewart J.R. 1984. Marine algae of Guadalupe Islands, Mexico, including a check list. *Ciencias Marinas* **10:** 135-148.

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