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# Newly reported marine red alga, *Neosiphonia savatieri* (Hariot) M.S. Kim et I.K. Lee 1999 (Rhodophyta Rhodomelaceae) from Thailand

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**ABSTRACT** *Neosiphonia savatieri* (Hariot) Myung Sook Kim et In Kyu Lee, 1999 is reported for the first time from Thailand based on specimens collected from the Gulf of Thailand and Andaman sea. We herein describe the vegetative and reproductive morphology of the specimens. Important features for species identification include the thallus configuration, number of pericentral cells, cortication, branching pattern, origin of rhizoids, origin of branches, occurrence of trichoblasts and reproductive characteristics. Our results expand the known geographic distribution of this species and confirm its taxonomic features.

**KEY WORDS** Marine red alga; Morphology; *Neosiphonia savatieri*; Rhodomelaceae; Thailand.

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## INTRODUCTION

The genus *Neosiphonia* Myung Sook Kim et In Kyu Lee, 1999 was segregated from *Polysiphonia* Greville, 1823 based on the generitype, *N. flavimarina* M.S. Kim et I.K. Lee, 1999 from Bangpo on the western coast of Korea (Kim & Lee, 1999). Currently, there are 30 assigned species (Guiry & Guiry, 2012) of which 15 species have been recorded for South East Asia region (Hô, 1969; Silva et al., 1987; Abbott et al., 2002; Kim et al., 2008).

*N. savatieri* (Hariot) M.S. Kim et I.K. Lee, 1999 was originally described based on collected material from Kanagawa Prefecture, Japan and subsequently it has been reported from Philippine, Korea, Malaysia, Norfolk Island, Hawaiian Island and Samoan Archipelago (Silva et al., 1987; Abbott, 1999; Millar, 1999; Masuda et al., 2001; Kim, 2005; Skelton & South, 2007; Kim et al., 2008).

In Thailand, only generic level of the genus *Neosiphonia* has been currently reported (Coppejans et al., 2010). During the collections under the project of the biodiversity inventory and information management in biodiversity hotspots, the tufting red alga, *Neosiphonia* sp. was collected in both Andaman Sea and the Gulf of Thailand.

Eventually we identified those specimens as *N. savatieri* and confirmed the taxonomic features based on morphological and anatomical characteristics of vegetative and reproductive plants.

## MATERIALS AND METHODS

Specimens examined were hand-collected during October 2010 at sand dune area around the estuary of Pak Bara, Satun province, Andaman Sea (99°43’2’’E; 6°51’27’’N).

Additional material examined was from Ao Len, Trat Province, Gulf of Thailand (102°32'57''E; 12°4'13''N). Algal samples for morphological investigation were fixed and stored in 5% formalin/seawater or pressed onto herbarium sheets. Voucher specimens were deposited in the herbarium of Laboratory of Applied Research for Aquatic Plant and Plankton, Biodiversity and Aquatic Environmental Research Unit of Faculty of Fisheries, Kasetsart University, Bangkok, Thailand.

Specimens were stained with 1% aniline blue, acidified with 1N HCl and mounted in a 40% Karo®corn syrup on glass microscope slides. Digital images were photographed by microscope digital camera Olympus DP20 (Olympus, Tokyo, Japan) and eventually edited using Photoshop Elements 6 (Adobe, San Jose, CA, USA). Species identification was based on the literatures of *N. savatieri* from Japan, Korea and Malaysia (Hariot, 1891; Masuda et al., 2001; Kim, 2005; Kim et al., 2008).

## RESULTS AND DISCUSSION

Based on diligent observations on morphological features of gametophytic and tetrasporangial thalli, we conclude that this is the first record of *N. savatieri* (Figs. 1-13) from Thailand.

Our Thai materials are in agreement with descriptions of previous studies of *N. savatieri* from other localities. The description below is based on the Thai materials.

***Neosiphonia savatieri*** (Hariot) Myung Sook Kim et In Kyu Lee, 1999

Basionym: *Polysiphonia savatieri* Hariot, 1891: 226-227.

Habitat: Plants from Andaman Sea grew epiphytically on *Gracilaria minuta* Lewmanomont, 1994 and *G. salicornia* (Agardh) Dawson, 1954, which inhabited the lower intertidal on the sand dune nearby the river mouth. The specimens from the Gulf of Thailand were found on the thallus of *Hydropuntia changii* (Xia et Abbott) Wynne, 1989 at 1 m depth (Fig. 1).

The specimens of *N. savatieri* are erect, grow individually, and reach up to 5-10 mm high. Axes with 4 pericentral cells ecorticate, 90-180 µm in diameter (Figs. 2-3).

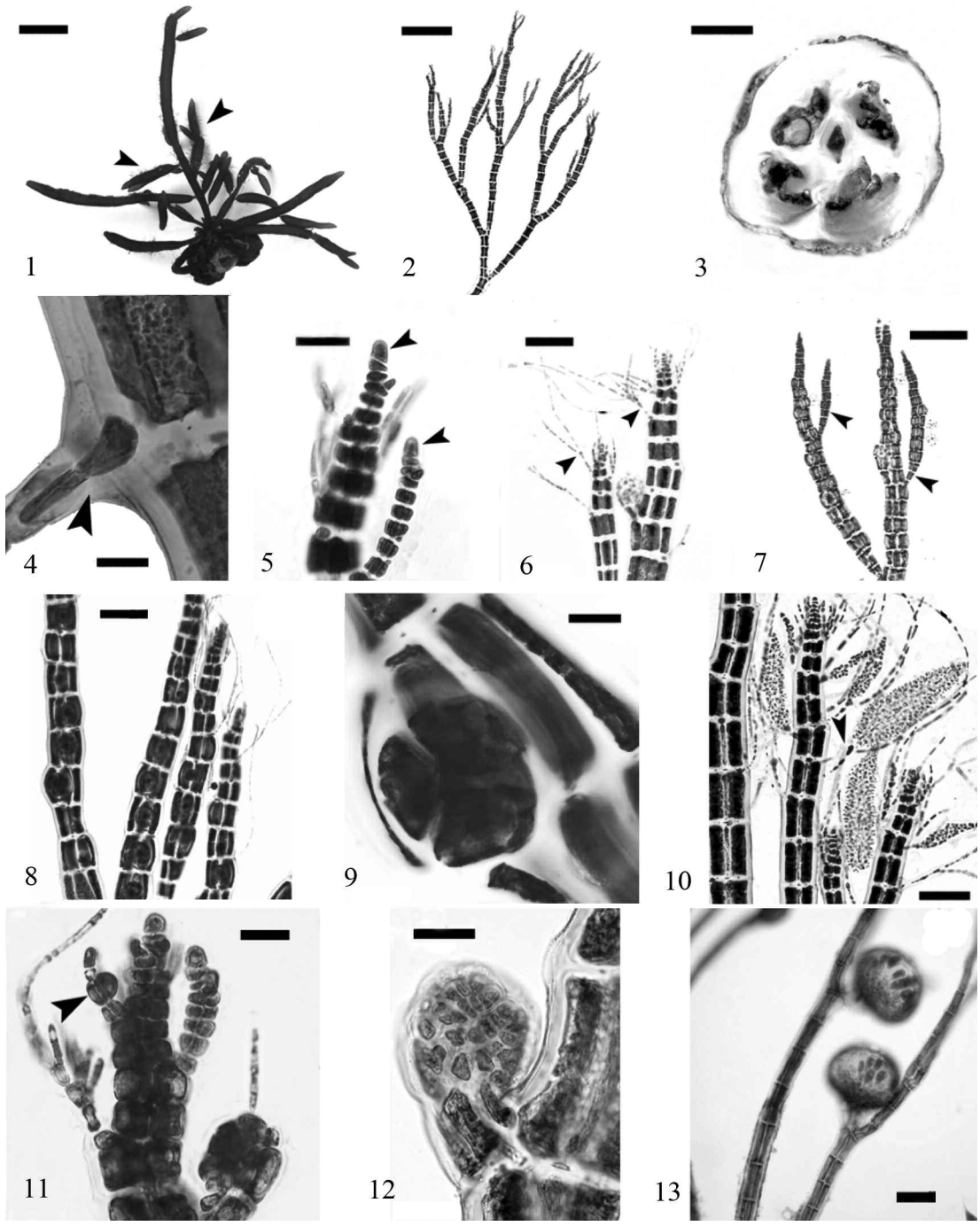
Specimens pseudodichotomously branched, showing a Y-shaped ramification with an angle of approximately 50 degrees (Fig. 2). Rhizoids aggregated in tufts in the lower segment of the axes, cut off from pericentral cells (Fig. 4), they penetrate into the tissue of *G. minuta*. Trichoblasts or branches are produced on successive segments (Fig. 5). Trichoblasts formed on every segment in a spiral arrangement and deciduous, leaving persistent scar cells (Fig. 6). Trichoblasts are abundant only at the apical part (Fig. 6). Lateral branches are exogenous, replacing trichoblasts (Fig. 5). Exogenous branches develop at various spots on the axis and grow from scar cells of the trichoblasts (Fig. 7).

Tetrasporangia arranged in slightly spiral series on the upper branches (Fig. 8). A single tetrasporangium is formed in each segment (Fig. 9). Mature tetrasporangia are prominent, 60-80 µm in diameter. Spores are tetrahedrally organized. Spermatangial branches are formed at the first dichotomy of fertile trichoblasts (Fig. 10). Mature spermatangial branches are lanceolate, 180-260 µm long and 60-80 µm wide, and lack sterile apical cells (Fig. 10).

An initial of carpogonial branch is formed on the second segment of the fertile trichoblast near the tip of lateral branches (Fig. 11). Procarp consists of a three-celled carpogonial branch and two sterile cells borne on the supporting cell. After fertilization, the gonimoblast gradually develops from the auxiliary cell (Fig. 12). Mature cystocarps are spherical with a slightly protruding ostiole, 180-220 µm in diameter (Fig. 13).

Based on the specimen collected from Kanagawa, Japan, Hariot (1891) originally assigned *N. savatieri* to the genus *Polysiphonia*, which is characterized by its four pericentral cells, unicellular rhizoids cut off by a cross wall from the proximal end of the pericentral cells and spermatangial branches arising as a primary branch of a trichoblast. Kim & Lee (1999) later assigned species with rhizoids cut off from pericentral cells, spiral arrangement of tetraspores, three-celled carpogonial branches and spermatangial branches on the primary dichotomy of trichoblast filament to a new genus, *Neosiphonia*.

The Thai specimens reported here agree well with the original description of *N. savatieri* and confirm the important identifying characteristics of this genus. Our Thai specimens were morphologically very similar to *N. savatieri* described from the




Figures 1-13 *Neosiphonia savatieri* from Thailand. Fig.1: plants epiphytic on *Hydropuntia changii* (arrows), Scale bar, 1 cm. Fig. 2: thalli pseudodichotomously branched with an angle of about 50 degree, Scale bar, 500 µm. Fig. 3: transverse section of the middle portion of a branch with 4 pericentral cells and a axial cell, Scale bar, 50 µm. Fig. 4: rhizoid (arrow) cut off from pericentral cells, Scale bar, 10 µm. Fig.5: apical portion of a branch showing oblique divisions of apical cells (arrows), Scale bar, 100 µm. Fig.6: trichoblasts (arrows) and scar cells of deciduous trichoblast arranged in spiral manner in the apical part of a cystocarpic plant, Scale bar, 100 µm. Fig.7: exogenous branches (arrows) of a tetrasporic plant, Scale bar, 200 µm. Fig.8: tetrasporic plants showing the spiral arrangement of tetrasporangia, Scale bar, 200 µm. Fig.9: mature tetrasporangium bearing one per segment, Scale bar, 20 µm. Fig.10: spermatangial branches arising on a branch of the fertile trichoblasts (arrow), Scale bar, 100 µm. Fig.11: procarp (arrow) developing on the second segment of a fertile trichoblasts at the tip of branches, Scale bar, 20 µm. Fig.12: post-fertilization stage, Scale bar, 50 µm. Fig.13: mature cystocarps, Scale bar, 70 µm.

Philippines, Hawaii, Malaysia, and Japan and Korea; all were relatively small epiphytic algae and have spermatangial branches formed on a branch of trichoblasts, spiraled tetrasporangia and an approximately 50 degree angle in the Y-shaped branching pattern (Silva et al., 1987; Abbott, 1999; Masuda et al., 2001; Kim, 2005; Kim et al., 2008).

Furthermore, Thai specimens of *N. savatieri* appear to be prevalent in river deltas surrounded by mangroves and grow specifically on gracilarioid algae. Our study shows that *N. savatieri* occur in both marine and brackish waters and that the distribution of this species extends to Thailand.

Additionally, Thai specimens of *N. savatieri* showed that young lateral branches are formed by replacing trichoblats, while Kim (2005) and Masuda et al. (2001) described branches that are not associated with trichoblasts in *N. savatieri* from Korea and Malaysia. According to Stuercke & Freshwater (2008), the origin of branches has been used as one of the important characteristics to separate species in *Polysiphonia* sensu lato.

It is important to take into account whether the relationship of branches and trichoblasts or other specific morphological characters are useful for species delineation of *N. savatieri*. Additional molecular and morphological analyses of *N. savatieri* will be needed in order to gain more insights into the species delimitation and differentiation among closely related species, especially in South East Asian region.

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