FIRST RECORD OF *PECTODICTYON PYRAMIDALE* (CHLOROPHYTA, SPHAERODICTYACEAE) IN THE NEW WORLD

James K. WETTERER * and *Roman E. ROMANOV* **

* Florida Atlantic University, Wilkes Honors College, 5353 Parkside Drive, Jupiter, Florida, USA, FL-33458, wetterer@fau.edu, ORCID: 0000-0002-8914-8073, (J.K.W.).
** Dobra Voda, Bar, Montenegro, ME-85356, streptophytes@gmail.com, ORCID: 0000-0002-6137-3586, (R.E.R.)

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ABSTRACT

Pectodictyon pyramidale Akiyama and Hirose is a microscopic alga currently placed in the family Sphaerodictyaceae with just three other species, *Pectodictyon cubicum* Taft, *Dictyastrum mirabile* Beck, and *Sphaerodictyon coelastroides* Jao. *Pectodictyon pyramidale* was originally described from Japan, and has been reported from additional sites in Asia, Europe, and Africa. Here, we report *P. pyramidale* for the first time in the New World. We collected this species at six artificial bodies of water (five freshwater retention ponds and one canal) in Martin County, Florida during summer 2025. This species probably established in the region as a result of accidental introduction, possibly accompanying imported aquatic ornamentals, such as the sacred lotus, *Nelumbo nucifera* Gaertn.

RÉSUMÉ: Premières traces de *Pectodictyon pyramidale* (Chlorophita, Sphaerodictyaceae) dans le Nouveau Monde.

Pectodictyon pyramidale Akiyama et Hirose est une algue microscopique actuellement classée dans la famille des Sphaerodictyaceae, qui ne compte que trois autres espèces: *Pectodictyon cubicum* Taft, *Dictyastrum mirabile* Beck et *Sphaerodictyon coelastroides* Jao. *Pectodictyon pyramidale* a été initialement décrite au Japon et a depuis été signalée dans d'autres régions d'Asie, d'Europe et d'Afrique. Nous signalons ici la présence de *P. pyramidale* pour la première fois dans le Nouveau Monde. Cette espèce a été collectée dans six plans d'eau artificiels (cinq bassins de rétention d'eau douce et un canal) du comté de Martin, en Floride, durant l'été 2025. Son implantation dans la région est probablement due à une introduction accidentelle, possiblement liée à des plantes aquatiques ornementales importées, comme le lotus sacré *Nelumbo nucifera* Gaertn.

REZUMAT: Primele înregistrări pentru *Pectodictyon pyramidale* (Chlorophita, Sphaerodictyaceae) în Lumea Nouă.

Pectodictyon pyramidale Akiyama și Hirose este o algă microscopică plasată în prezent în familia Sphaerodictyaceae, alături de doar alte trei specii, *Pectodictyon cubicum* Taft, *Dictyastrum mirabile* Beck și *Sphaerodictyon coelastroides* Jao. *Pectodictyon pyramidale* a fost descrisă inițial din Japonia și a fost semnalată și în alte situri din Asia, Europa și Africa. Aici, raportăm *P. pyramidale* pentru prima dată în Lumea Nouă. Am colectat această specie în șase corpuri artificiale de apă (cinci iazuri de retenție a apei dulci și un canal) în comitatul Martin, Florida, în vara anului 2025. Această specie s-a stabilit probabil în regiune ca urmare a introducerii accidentale, posibil însoțind plante ornamentale acvatice importate, cum ar fi lotusul sacru, *Nelumbo nucifera* Gaertn.

INTRODUCTION

The unintentional introduction of algae is a world-wide phenomenon (Li et al., 2023). Mass development of invasive algae can result in deterioration and transformation of aquatic ecosystems and cause significant economic damage, e.g., the charophyte *Nitellopsis obtusa* (Desvaux) J. Groves is displacing native species of macrophytes in North American freshwater lakes (Glisson et al., 2022) and the diatom *Didymosphenia geminata* (Lyngbye) Mart. Schmidt is changing benthic habitats and food webs in streams and rivers of the New World and New Zealand (Brand and Grech, 2020; Kilroy et al., 2009). Invasions of microscopic algae can remain inconspicuous until they undergo major blooms (Macêdo et al., 2022). However, they are traceable in cases of long-term monitoring of phytoplankton (Korneva, 2014; Kaštovský et al., 2010; Smucker et al., 2008; Kulizin et al., 2023). Records of species new for major regions can be useful for early tracing of spread of non-indigenous species.

For example, Whitford (1956) described microscopic green alga *Helicodictyon planctonicum* (L. A. Whitford) L. A. Whitford et G. J. Schumacher (Ulotrichales, Chlorophyta), from North Carolina. Biebel (1968) reported this species from Virginia, South Carolina, Alabama, and Pennsylvania. Clewell and Friedman (1969) found *H. planctonicum* in Florida in a small pond and suggested "perhaps this alga recently appeared in the United States and is undergoing a rapid range expansion". In 1971, Meyers and Cox (1972) found *H. planctonicum* in College Station, Texas, writing "Since algal samples have been collected in this area for over 10 years, we suggest that *H. planctonicum* is a new inhabitant and that the most recent advances of its rapidly expanding range are westward".

Pectodictyon Taft is a genus of green algae (Chlorophyta, Sphaerodictyaceae) with two species, *P. cubicum* Taft and *P. pyramidale* Akiyama and Hirose. Akiyama and Hirose (1962) diagnosed the genus as follows "Coenobium cubical or pyramidal, meshy, and gelatinous, composed of several cells that are arranged to form a cube or a pyramid, with a single cell at each corner of a cube or a pyramid, respectively. Each cell globose or pyramidal, with a single parietal or crateriform chloroplast, capable of giving rise to a new coenobium which remains attached to a corner of mother coenobium". In contrast with *P. cubicum* cells, which are globose, *P. pyramidale* cells are pyramidal (Fig. 1) resulting in distinct general appearance of coenobia. Four-celled colonies have the shape of a tetrahedral pyramid, whereas eight-celled colonies have the shape of a cube (Komárek and Fott, 1983). During reproduction, the daughter colonies are connected to each other by the remnants of the mother cell wall forming large syncoenobia (Fig. 1). *Pectodictyon* is currently placed in the Sphaerodictyaceae, together with two other species, *Dictyastrum mirabile* Beck and *Sphaerodictyon coelastroides* Jao.

Taft (1945) described *P. cubicum* from a quarry pool in Kelleys Island, Ohio, and there are subsequent published records of this species from other parts of North America, as well as from South America, North Asia, and Europe (Guiry, 2025a; Komárek and Fott, 1983; Safonova and Ermolaev, 1983). Akiyama and Hirose (1962) described *P. pyramidale* from Ukinuno Pond, Sanbe, Shimane Prefecture, Japan. There are additional published records from Japan (Guiry, 2025b), China (Bi and Hu, 2004), South Korea (Kim, 2013), South Africa (Krienitz et al., 2003), and Spain (Confederación Hidrográfica del Ebro, 2015).

The freshwater algae flora of Florida has been a focus of much research since the 19th century (e.g., Brown, 1972; Davis and Gworek, 1972; Lackey and Lackey, 1967; McCoy, 1966; Ehrenberg, 1853; Bailey, 1851; Madsen and Nielsen, 1950), especially in the Everglades (Smith, 2020; Rosen et al., 2019; Dvorak et al., 2017; Rosen and Mareš, 2016; Lee et al., 2014; Smith, 2010). Pope and Rhoads (1968) made the first report of *P. cubicum* from Florida. Here, as part of our ongoing surveys of algae in the Martin County, Florida, we report the first records of *P. pyramidale* from the New World.

MATERIAL AND METHODS

In May-August 2025, the first author surveyed Martin County (Florida) freshwater photographed the algae through a microscope using an iPhone 13 in portrait 3x mode, and posted the photos to the iNaturalist website. A voucher sample stored in 100% ethanol was deposited in the collection of algae of the Natural History Museum of Montenegro (NHMM).

RESULTS

On 9 June 2025, the first author posted to iNaturalist photographs an alga (Fig. 1) that we recognized as closely matching on-line photos of *P. pyramidale* (see protist.i.hosei.ac.jp/pdb/images/chlorophyta/pectodictyon/pyramidale_1.html). Going back through photographs posted earlier to iNaturalist.org, we recognized this species from two additional sites. Subsequently, we found this species in three more site. All six sites are in Stuart, Martin County, Florida, USA:

1. Retention pond next to Southeast Pomeroy Street; from dead floating *Thalia geniculata* L. leaves (27.1463N, 80.2425W; 25 May and 16 July 2025; inaturalist.org/observations/297820122 & 298493041);

2. Canal west of Pratt-Whitney Road, from dead floating *Nuphar advena* (Aiton) W. T. Aiton leaves (26.9972N, 80.2746W; 4 June 2025; inaturalist.org/observations/286944845);

3. Retention pond next to Southeast Willoughby Road, from dead floating *N. advena* leaves (27.1312N, 80.2265W; 9 June 2025; inaturalist.org/observations/288346064 and 288361110);

4. Retention pond between Southeast Chiles Court and Southeast Graham Drive, from dead floating *Nelumbo nucifera* Gaertn. leaves (27.1468N, 80.2414W; 16 July 2025; inaturalist.org/observations/298577574 & 298603135);

5. Retention pond between Salerno Road and Martin South Hospital; from dead floating vegetation; 27.1346N, 80.2236W; 13 August 2025; inaturalist.org/observations/306078253);

6. Retention pond between Salerno Road and Indian River State College; from dead floating vegetation; 27.1358N, 80.2217W; 13 August 2025; inaturalist.org/observations/306054709).

DISCUSSION

Pectodictyon pyramidale appears to be thriving locally in Stuart, Florida. Additional research is needed to evaluate how widespread *P. pyramidale* is in the region. It is surprising that such a distinctive species is recorded here for the first time in the New World, a great distance from any other known populations. This, combined with the fact that all *P. pyramidale* observed in Florida came from artificial bodies of water, suggests that this species may not be native to the area. It is possible that *P. pyramidale* were brought to Florida accidentally along with imported aquatic ornamentals, e.g., the sacred lotus, *Nelumbo nucifera*. Very little is known about the ecology of *P. pyramidale*. It is unclear whether will it become more common in the study area under continued climate change. The probability about rapid extension of its distribution range appears not supported any data available at the moment. However, considering its low abundance world-wide, the possibility of its becoming a nuisance in Florida appears to be unlikely.

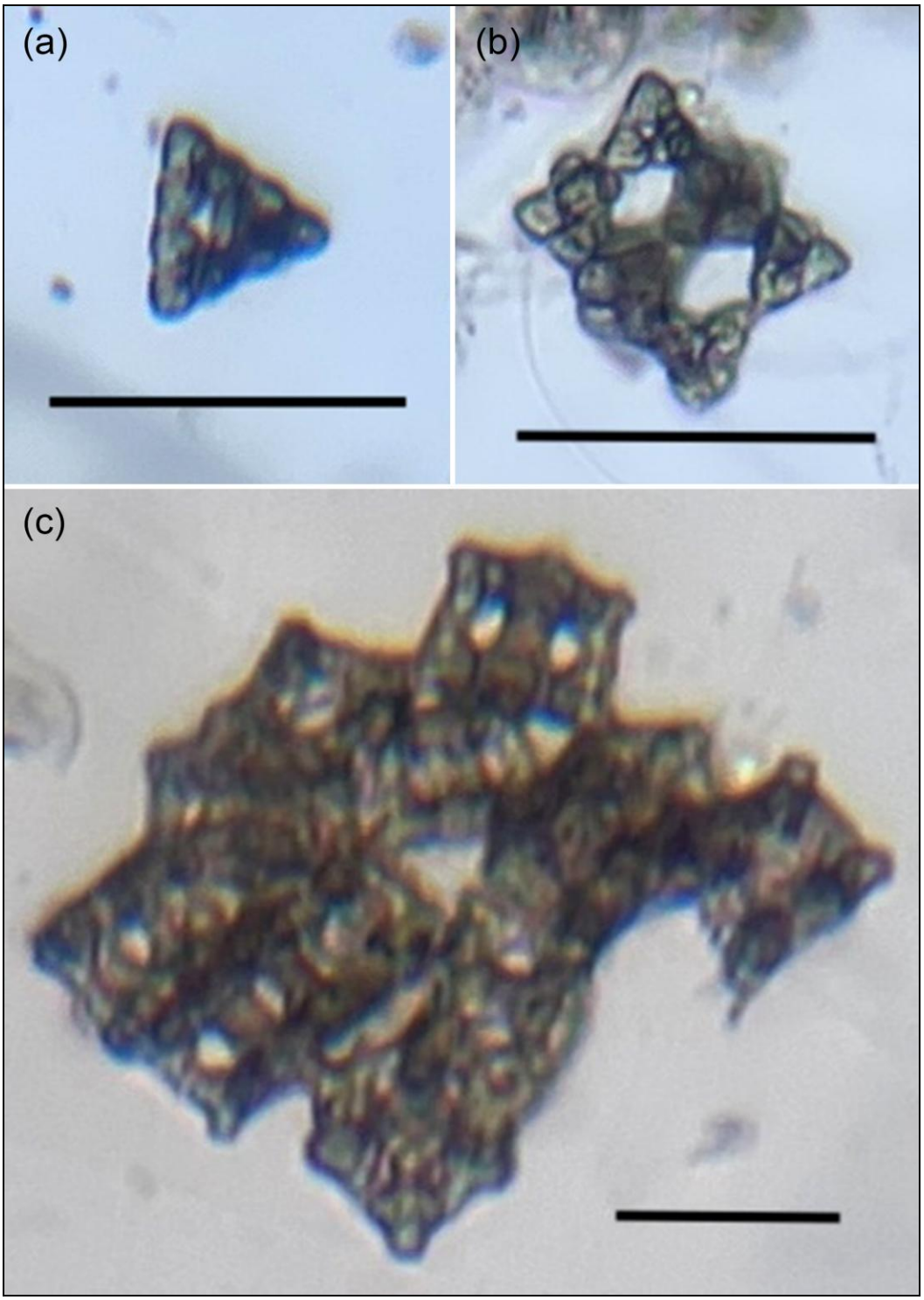

Figure 1: *Pectodictyon pyramidale* from Stuart, Florida: a – coenobia arranged as a pyramid, b – coenobia arranged as a cube, c – coenobia arranged as a cluster of connected cubes (lower) (9 June 2025; inaturalist.org/observations/288346064 & 288361110; photos by J. K. Wetterer). (scale bar: 50 µm).

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