A PHYLOGENETIC APPRAISAL OF THE GENUS *PLATOMA* (NEMASTOMATALES, RHODOPHYTA), INCLUDING LIFE HISTORY AND MORPHOLOGICAL OBSERVATIONS ON *P. CYCLOCOLPUM* FROM THE AZORES

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INTRODUCTION

The red algal genus *Platoma* Schmitz (1894) (Schizymeniaceae, Nemastomatales) was established based on the type, *Platoma cyclocolpum* (Montagne) Schmitz from the Canary Islands, and currently comprising nine species. The genus belongs in the family Schizymeniaceae (Schmitz & Hauptfleisch) Masuda & Guiry, which, together with Nemastomataceae Schmitz, comprise the Nemastomatales Kylin.

Platoma can be separated from superficially similar groups by a combination of vegetative and reproductive characters, such as the location, shape, presence or absence of certain cells. Tetrasporophytes are unknown in nature, but culture studies revealed that carpospores originated crustose plants, although tetraspore development has never been observed.

The reproductive morphology in most of these species has been well documented. Some species have been rarely recollected since their description, and are poorly characterized in what concerns their reproductive structures (Norris & Bucher 1977).

The present study highlights a combination of vegetative and reproductive characters not described before for *Platoma cyclocolpum* (Fig. 1). Life history studies were conducted and the development of tetrasporophytes in culture is described. A phylogenetic tree inferred from chloroplast-encoded *rbc*L sequence analysis shows the position and the relationships of four *Platoma* species within the Schizymeniaceae (*Schizymenia*, *Titanophora*) and Nemastomataceae (*Predaea*, *Nemastoma*). An assessment of the diagnostic characteristics of *Platoma* is provided and comparisons made among the different species of the genus.

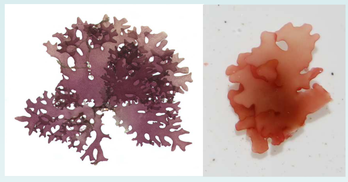

Fig. 1. Habit of erect thalli of *P. cyclocolpum* from the Azores.

MATERIAL AND METHODS

Algal material was collected since 1990 at different sites in the Azores, Madeira, Canary Islands and Gulf of Mexico. Collections at both intertidal and subtidal levels, the latter by SCUBA diving or dredging. Additional samples were provided by NHM, London and Ghent University Herbarium.

Life history studies were conducted on *P. cyclocolpum* from the Azores under 15ºC / 16:8 L:D and 23ºC / daylight regimes, using von Stosch culture medium.

MP trees were inferred from heuristic searches of 5000 replications of random sequence addition, using only the phylogenetically informative characters. Support for the nodes of the MP trees was assessed by bootstrap analysis on the dataset using 5000 replicates, as implemented in PAUP*. Consistency (CI) and retention (RI) indices were calculated excluding uninformative characters.

RESULTS AND DISCUSSION

The Azorean vouchers of *Platoma cyclocolpum* are in agreement with the description and illustrations provided by Masuda & Guiry (1994) for Canary Isls samples. Differences were found with respect to variation in thallus shape, colour and texture as well as cell sizes, indicating that plants going that name in different parts of the world may be comprise different species (Fig. 2).

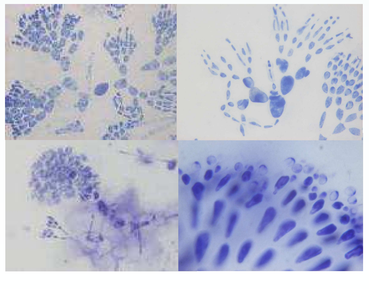

Fig. 2. Squashed portions of *P. cyclocolpum*. **A.** Regular pseudichomotous branching of cortical filaments, with intercalary gland cell. **B.** Three-celled carpogonial brach with terminal carpogonium, and trichogyne. **C.** Auxiliary cell showing incoming and outgoing connecting filament auxiliary, bearing cluster of young gonimoblasts, and linked to darkly staining cortical cell. **D.** Spermatangia borne terminally on surface cortical cells.

Three non-reproductive modes of thallus development were observed in this species from germinating carpospores: a crustose phase growing directly from carpospores, an erect thallus growing from carpospores, and an erect thallus originating from the crust (Fig. 3). Whereas the formation of the crust was similar to that reported by Masuda & Guiry (1994), the latter two growth modes observed have not been described before.

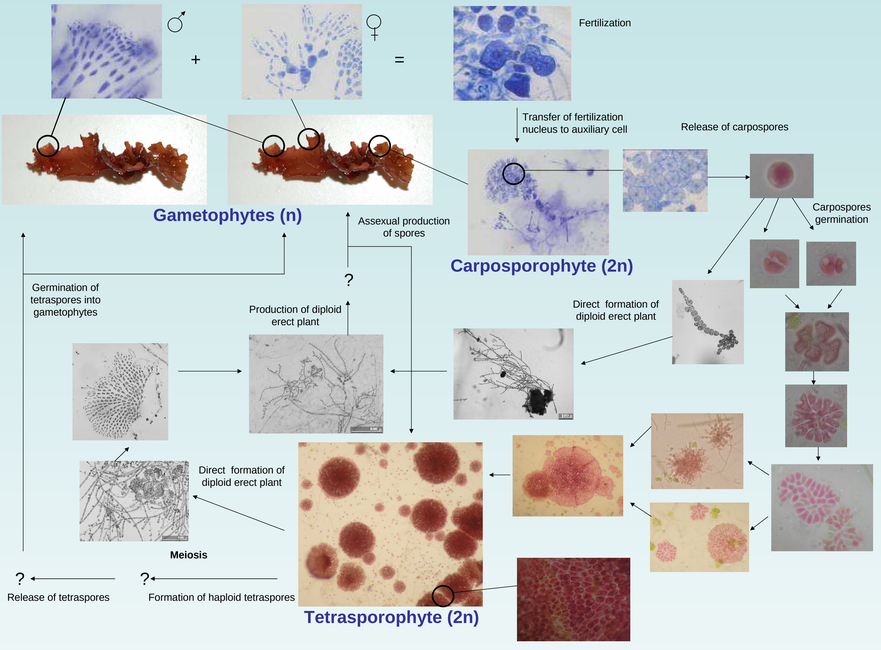

Fig. 3. Life history of *P. cyclocolpum* from the Azores.

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Platoma cyclocolpum has been reported in the literature to have a wide distribution (Fig. 4).

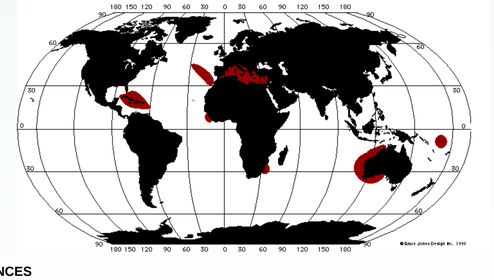
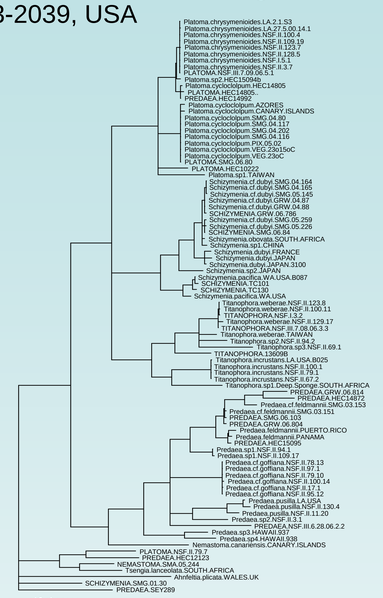


Fig. 4. World distribution of *P. cyclocolpum.*



However, material going under that species' name in the Indian Ocean (Madagascar) instead belongs to *Platoma chrysymenioides* Gavio, Hickerson & Fredericq described from offshore Louisiana in the Northern Gulf of Mexico. New records of the latter species is now reported from offshore the Dry Tortugas and the Florida Middleground, as well as in the Campeche Banks, in the SW Gulf of Mexico (Fig. 5).

The genus *Platoma* comprises nine species, mostly differentiated by vegetative features such as type of branching pattern, stipe presence or absence, extent of fusion of branches, presence or absence of surface proliferation or habit color. These characters may not bear much taxonomic weight (Kajimura 1997). Table 1 provides information to differentiate all *Platoma* species.

Fig. 5. MP tree for the Nemastomatales and other Rhodophyta inferred from *rbc*L sequences. Bootstrap values given above branches. Dashes indicate < 70% values.

Table 1. Diagnostic characters separating the species of *Platoma.*

Feature	*P. abbottianum* Norris et Bucher 1977	*P. ardreanum* Kraft et Abbott 1997	*P. chrysymenioides* Gavio, Hickerson & Fredericq 2005	*P. cyclocolpum* (Montagne) Schmitz 1889	*P. fanii* E.Y. Dawson 1961	*P. heteromorphum* Schils 2002	*P. incrassatum* Schousboe et De Toni 1905	*P. izunosimense* Sewaga 1938	*P. tenue* Howe et Taylor 1931
Branching pattern	Dichotomous, often with forked branch apices	Broadly lobed, with deep incisions	Subcilindrical elongated irregularly lobed	Irregularly dichotomous or pinnate, with rounded bifurcations at the apices, some with deep incisions	Irregularly and sparingly lobed	Flattened subcylindrical irregularly lobed	Irregularly lobed, thickened margins, non-undulate	Irregularly pinnate, often with forked branch apices, also palmate or irregular and surfaces undulate	Subordicular or subreniform, subentire or sparingly lobed, undulate-crenulate
Thallus shape	Foliose	Foliose with apparent calluses, blunt lobes, and dentate to narrowly proliferous margins or ruffles	Foliose	Foliose to subcylindrical, with marginal proliferations	Foliose	Foliose, occasionally with proliferations	Foliose	Foliose, with or without proliferations	Foliose
Stipe	Present	Absent	Present	Absent	Absent	Present	Absent	Present or absent	Present
Anastomose of branches	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent
Thallus color and texture	Rose red, gelatinous but firm	Deep redish-brown, soft	Bright pink, mucilagenous	Light pink to reddish-brown, fleshy but firm	Pale reddish, exceedingly gelatinous	Deep red, gelatinous	Yellowish brown to purple	Reddish-brown to pinkish-red, fleshy and gelatinous	Purplish-vinaceous, extremely soft and gelatinous
Gland cells	Absent	Present, Intercalary	Present, Intercalary	Present, Intercalary	Absent	Present, Intercalary	Absent	Present, Intercalary, singly or in adjacent pairs	Absent
X-shaped medullary cell	Present	?	Present	?	?	?	?	Present	?
Carpogonial branch	3-celled	3 (4)-celled	3-celled	3-celled	3-celled	3-celled	?	3-celled	?
Sterile cells on carpogonial branch	Absent	Present, 1 or 2	Absent	Probably absent	Absent	Occasionally present	?	Absent	?
Shape of trichogynes	Straight	Straight	Straight	Straight	Coiled	Straight	?	Straight	?
Division of fertilized carpogonium	?	Yes	Yes	No, direct fusion to one subsidiary auxiliary cell and secondary pit-connection to the other	?	Yes	?	No, direct fusion to one subsidiary auxiliary cell and secondary pit-connection to the other	?
Origin of connecting filament initiation	?	One contacted subsidiary auxiliary cells	Both subsidiary auxiliary cells	One or both subsidiary auxiliary cells and the cortical cell distal to it	?	One contacted subsidiary auxiliary cells and the cortical cell distal to it	?	One or both subsidiary auxiliary cells	?
Diameter of mature carposporophytes	130-195 µm	80-120 µm	?	140-200 µm	c. 60 µm	90-210 µm	?	60-140 µm	c. 50 µm
Spermatangia per spermatangial mother cell	?	2-3	?	1-2	?	?	?	1-2 (4)	?
Distribution	French Polynesia, Gulf of California	Fiji, Hawaiian Islands	Gulf of Mexico	Mediterranean, North Atlantic Islands, Caribbean Islands, West and South Africa, Western Australia, Fiji	Gulf of California	Arabian Sea (Oman)	South Spain, Egypt, West Coast of Morocco	Southern Japan, New South Wales	Caribbean Islands, Brazil

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