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臺灣產松藻科之分類及生態研究

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報告人：黃淑芳 研究員

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臺灣產松藻科之分類及生態研究

The taxonomy and distribution of the Family Codiaceae (Chlorophyta, Bryopsidophyceae) from Taiwan

黃淑芳 (Huang Su-fang)

國立臺灣博物館 研究組

摘要：

在本研究旨在調查研究臺灣海產綠藻松藻科內成員之分類及地理分佈，以建立臺灣海藻完整分類資料庫。結果共鑑定出臺灣松藻科1屬13種，其13種分別為：*Codium arabicum*阿拉伯松藻、*Codium barbatum*纖細松藻、*Codium cylindricum*長松藻、*Codium edule*食用松藻、*Codium formosanum*台灣松藻、*Codium geppiorum*杰氏松藻、*Codium intricatum*交織松藻、*Codium latum*扁平松藻、*Codium mamillosum*球松藻、*Codium nanwanensae*南灣松藻、*Codium papillatum*瘤狀松藻、*Codium reediae*芮氏松藻、*Codium saccatum*囊狀松藻。在本報告中除完整探究及詳述臺灣產綠藻松藻科種類之間分類特徵，並附上各種之間分類檢索表、以及各種類的形態特徵、生活史、生態習性、臺灣分佈、世界地理分佈及經濟利用情形。

關鍵詞：松藻科、松藻屬、綠藻植物門、分類學、植物地理、臺灣

Abstract:

This study aims to understand the morphology, taxonomy and phytogeography of Codiaceae in Taiwan. There are 1 genera and 13 taxa for the Codiaceae in Taiwan reported, the 13 species are: *Codium arabicum*, *Codium barbatum*, *Codium cylindricum*, *Codium edule*, *Codium formosanum*, *Codium geppiorum*, *Codium intricatum*, *Codium latum*, *Codium mamillosum*, *Codium nanwanensa*, *Codium papillatum*, *Codium reediae*, *Codium saccatum* °. An illustrated key is provided based on the workers of the species. The morphology, life cycle, habitat, distribution and world phytogeography and uses of species are also given.

Key words: Codiaceae, *Codium*, Chlorophyta, taxonomy, phytogeography, Taiwan

一、前言：

海藻是海洋生態系的基礎生產者，除對漁業資源保育有重大影響力之外，本身也具有極高之經濟價值，如食用、藥用、餌料、飼料、提煉海藻膠、能源代用品等，是極具開發潛力之資源。然國內有關海藻之形態、分類、產量、生態分佈及養殖等基本資料仍相當貧乏，亟待進一步調查研究。

松藻科 (Codiaceae) 屬於綠藻植物門(Chlorophyta)，羽藻綱(Bryopsidaphyceae)，羽藻目(Bryopsidales)。松藻科有二個屬~ Codium 及 Ostreobium，松藻科的特徵為：藻體是一個多分枝的管狀多核細胞體，海綿質，外形有圓柱形分枝、不規則球形、扁平葉狀等，體內由許多管狀絲狀體交織而成，下部以假根固定在基質上。只含一個類葉綠體。生活史屬於二倍體單世代型。

松藻可以食用，其用途據「本草綱目」，上載有“味甘、咸、寒、無毒”；「本草綱目拾遺」記有“主水腫、催生”；「本草經集注」記有療溪毒、用來治療水腫、小便不利、驅蛔蟲和作消暑飲料等功用。

過去曾有不少的中外學者在臺灣進行海藻的採集及調查研究 (Chiang, 1973,1973; Chiang & Chen, 1982; Lewis & Chiang, 1987; Shen & Fan, 1950; Wang & Chiang, 1977; Yang & Chiang, 1982; Yang, 1995; Huang, 1999, 2000)，然而目前，在臺灣這一屬海藻成員尚無人進行其形態分類、生態分佈、季節性消長或植物地理之研究，並且所使用名稱也相當混亂，種間分類模糊不清，殊為可惜。事實上，這一科海藻外觀容易受到棲息環境的影響，如水溫、光照、波浪、鹽度與地理區域之不同都會造成其外形的變化，故以傳統的形態分類法常造成鑑定上之困難。

分類學是基礎學科，生物學之研究得判明材料正確方具可重複性，研究成果才有意義。不論生物相調查、生理生態、天然物化學、資源的經營與利用等研究，均需有堅實的分類學作基礎，方能有效達成和推展。本研究目的是調查和採集臺灣全省各地海岸所產之松藻科的海藻種類，並進行種之描述。包括以幻燈片傳真記錄海藻的形態、生長狀況、內部構造及組織發生，以建立各種海藻之基本檔案。瞭解這些海藻的種類組成、群聚結構與消長現象，並探討其與主要棲地因子間之相關性。比較其他相關區系之松藻科

之結構與組成，分析、探討臺灣的海藻植物地理之相關性和意義。

二、研究方法及步驟：

1. 先進行國內外相關文獻資料之蒐集與分析。
2. 進行全省各地松藻科成員之調查研究，現場拍照，並觀察記錄海藻的形態外觀、分佈、生長實況，與其他生物之相互關係。同時記錄不同時間、地點、水深下之環境因子之變化，以探討藻類生長與環境之關係，並完成海藻的垂直分佈表及季節性變化。
3. 將所採得海藻部份材料做成蠟葉標本、浸液標本及活體培養，以供進一步進行種類之鑑定、微細構造之檢視、有性生殖生成過程之觀察、孢子體與配子體之形態比較、以及藻體組成成份之分析等研究工作。並與國外相關機構交換標本，並進行標本比對工作。

三、結果：

(一)、松藻科的分類體系及形態特徵：

松藻科 (Codiaceae) 為 Kützing 於 1843 年創始命名，屬於綠藻植物門 (Division Chlorophyta)，羽藻綱 (Bryopsidophyceae)，羽藻目 (Bryopsidales) 之下的成員。在臺灣，松藻科只發現一個屬~松藻屬 (Codium)，其主要特徵為：

1. 藻體海綿質，由多分枝的管狀多核細胞所組成，細胞核小，數目多。
2. 外形變化很大，有匍匐的皮殼狀、中空球狀、圓柱狀分枝、扁平葉狀等。
3. 體內由許多無色的管狀絲狀體疏鬆地交織成髓部，髓部側生的棒狀小枝叫做囊胞，圍繞在髓部四周，緊密排列形成光合作用的柵狀皮曾。囊胞的形狀及其上毛的有無，是分類上的一個主要特徵。
4. 藻體基部假根組成盤狀或皮殼狀的固著器上。
5. 囊胞的形狀及其上毛的有無，是分類上的一個主要特徵。囊胞的中央有一個大

液泡，在液泡和細胞壁間有一層較厚的原生質層。


6. 葉綠體小盤形，不含澱粉核。
7. 只有有性生殖，生活史屬於二倍體單世代型。松藻藻體為二倍體，成熟時，由囊胞的側面突起形成配子囊，多數為雌雄異體，少數為雌雄同體，
8. 進行有性生殖時，囊胞上可產生一至數個棒形的配子囊，配子囊成熟時基部會產生環形加厚，產生隔壁，隔開囊胞及配子囊。雄配子囊為黃綠色或金褐色，雌配子囊為深綠色。在成熟後，吸水膨脹，配子囊頂端裂開，擠壓出膠質團塊的配子。配子在囊內無鞭毛，放散後，立即產生 2 條頂生鞭毛而游動。
9. 雌雄配子同形交配 (Isogamy) 或異形交配 (Heterogamy)。

臺灣產的松藻科共鑑定出 1 屬 13 種，其 13 種分別為：*Codium arabicum* 阿拉伯松藻、*Codium barbatum* 纖細松藻、*Codium cylindricum* 長松藻、*Codium edule* 食用松藻、*Codium formosanum* 台灣松藻、*Codium geppiorum* 杰氏松藻、*Codium intricatum* 交織松藻、*Codium latum* 扁平松藻、*Codium mamillosum* 球松藻、*Codium nanwanensae* 南灣松藻、*Codium papillatum* 瘤狀松藻、*Codium reediae* 芮氏松藻、*Codium saccatum* 囊狀松藻。

(二)、各論：


1. *Codium arabicum* 阿拉伯松藻

Scientific name (學名)	<i>Codium arabicum</i>
Author(命名者)	Kutzing
Chinese name (中文名)	阿拉伯松藻
Synonym	<i>Codium coronatum</i>
Class	Bryopsidophyceae
Family	Codiaceae
Morphology	Plant firm, compressed or recumbent, adherent to substrate, often convoluted or with rounded superficial knobs 1-3 cm in diameter on upper surface or along margins; utricles cylindrical or clavate, developed in clusters joined near bases by plugged connections, variable in size among plants and from margin to center of individual plants, 400-1440 μm in length, 40-250 μm in diam., with subtruncate or slightly rounded

	<p>apices. Secondary utricles arising as buds from lower parts of primary utricles and forming large groups of closely related utricles. Hairs and hair scars abundant on older utricles.</p> <p>Picture:</p> 
Ecological and/or biological significances	Commonly occurred in subtidal rocky shore and coral reefs, sometimes to epiphyte on larger seaweeds, such as <i>Sargassum</i> .
Geographical Distribution (locality)	Taiwan, Penhu, Green Island and Orchid Island. Cosmopolitan in Pacific area.
Selected reference	Shen and Fang (1950), Silva in Egerod (1952), Silva et al (1996), Yoshida (1998), Huang (2000), Abbott and Huisman (2004)


2, *Codium barbatum* 纖細松藻

Scientific name (學名)	<i>Codium barbatum</i>
Author(命名者)	Okamura
Chinese name (中文名)	纖細松藻
Synonym	<i>Codium tenue</i>
Class	Bryopsidophyceae
Family	Codiaceae
Morphology	Plants erect, bushy, to 3-8 cm high, arising from a discoid holdfast. Branches dichotomously, 2-4 mm in diam. Utricles obvoid, 270-350 μm in length, and 130-300 μm abroad. Hairs and hair scars occurred incidentally. Gametangia ovate, attached at lower part of utricle, 160-185 μm in length, 60-80 μm in diameter. Picture:

	
Ecological and/or biological significances	Occurred in rocky shore and coral reefs.
Geographical Distribution (locality)	Hengchun Peninsula of Taiwan, Peng-chia Yu, Japan.
Selected reference	Yang et al. (1993), Yoshida (1998)

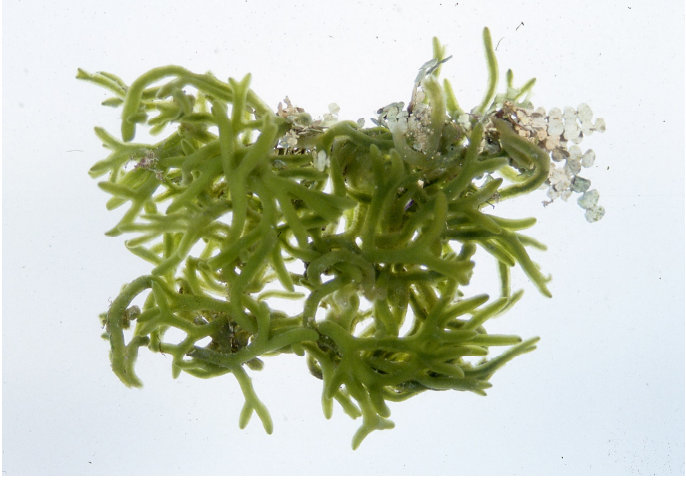
3. *Codium cylindricum* 長松藻

Scientific name (學名)	<i>Codium cylindricum</i>
Author(命名者)	Holmes
Chinese name (中文名)	長松藻
Synonym	<i>Codium divaricatum</i>
Class	Bryopsidophyceae
Family	Codiaceae
Morphology	<p>Plant erect, slender, 15-40 cm in length, with a discoid holdfast. Branches cylindrical, dichotomously, 2.5-5.5 mm in diameter. Utricles clavate, cylindrical, 850-1200 μm in length, 175-500 μm in diameter, with truncate or subtruncate apices. Hairs and hair scars abundant. Gametangia ovoid or elliptic, 220-310 μm long, 110-130 μm broad.</p> <p>Picture:</p>

	
Ecological and/or biological significances	Occurred in subtidal of rocky shores where the growing depth is more than 10m.
Geographical Distribution (locality)	Taidon, Green Island(Taiwan), Japan, Korea, Philippines.
Selected reference	Yoshida (1998)


4. *Codium edule* 食用松藻

Scientific name (學名)	<i>Codium edule</i>
Author(命名者)	Silva
Chinese name (中文名)	食用松藻
Synonym	
Class	Chlorophyceae
Family	Codiaceae, Bryopsidales
Morphology	The species forms spongy masses of intertwined light green to grass green branches, with the alga often growing to more than 1 meter in diameter. The dichotomous to trichotomous branches are terete and tapering to the tip, 3-5 mm in diameter, and attached to each other or to the substrate by small, cushion-like rhizoidal structures. The branches under the imbricating hummocky thallus are always arched. Filaments of the medulla are 30-80 μm broad, separated from the utricles by deep constrictions. The utricles at mid branches are clavate or subcylindrical, slightly tapering towards the base and with rounded tips. Some utricles have slight swellings just below the apex. The utricles are 100-360 μm (some up to 600 μm) in diameter, 830-1200 μm long. The utricles at

	<p>branch tips are obconical or obpyriform, 70-145 μm in diameter, 275-450 μm in length. Gametangia ellipsoidal to elongateovate, 65-85 μm diameter, 270-330 μm long, 1 or 2 per utricle, issued 275-360 μm below apex, not extending to apex of utricle. Hairs or hair scars usually present, 2 to 6 per utricle and located 55-75 μm below apex.</p> <p>Picture:</p> 
Ecological and/or biological significances	Commonly occurred in coral reef.
Geographical Distribution (locality)	Hengchun Peninsula Taiwan. Hawaii(type locality), Philippines and Maldives.
Selected reference	In Egerod (1952), Silva et al. (1996), Chang et al.(2002), Abbott and Huisman (2004)


5. *Codium formossanum* 台灣松藻

Scientific name (學名)	<i>Codium formossanum</i>
Author(命名者)	Yamada
Chinese name (中文名)	台灣松藻
Synonym	
Class	Bryopsidophyceae
Family	Codiaceae
Morphology	Thalli green, erect and robust, to about 8-15cm. Thalli subdichotomously branched, often unilateral. Utricles subcylindrical or obvoid, 860-1200 μm in length, 250-300 μm in diameter., apices truncate or subtruncate. Apical cell wall thickened, about 10 μm thick, hairs or hair scars present, 1 to 5 per utricle. Gametangia subfusiform or subovoid, 240-260 μm

	<p>long, 60-80 μm broad.</p> <p>Picture:</p> 
Ecological and/or biological significances	occurred in shallow coral reefs.
Geographical Distribution (locality)	Kenting(Taiwan). Vietnam.
Selected reference	Yamamda(1950)


6. *Codium geppiorum* 杰氏松藻

Scientific name (學名)	<i>Codium geppiorum</i>
Author(命名者)	Schmidt
Chinese name (中文名)	杰氏松藻
Synonym	<i>Codium divaricatum</i>
Class	Chlorophyceae
Family	Codiaceae, Bryopsidales
Morphology	<p>Thallus repent, branching dense, regular or irregularly dichotomous; branches terete, about 0.8-2.5 mm in diameter, attached to the substrate by means of irregularly disposed rhizoids, light to olive green.</p> <p>Thallus composed of individual utricles that are clavate, ovate or elongate obpyriform. Mature utricles are 83-310 μm in diameter and 330-570 μm long, apices rounded or truncate, utricular wall 2 μm thick, and slightly thinner at the apices. Hairs or hair scars in small number: 0-3 per utricle, borne 70-80 μm below the apex. Gametangia fusiform to elliptical, 50-75 μm in diameter, 165-190 μm long, generally borne singly on a pedicel produced on a protuberance around 255-375 μm below the apex. Medullary filaments mostly 20-35 μm in diameter.</p>


	Picture: 
Ecological and/or biological significances	Commonly occurred in coral reef.
Geographical Distribution (locality)	Hengchun Peninsula of southern Taiwan, Green Island, Orchid Island. Common in the tropical Indian and Pacific Oceans.
Selected reference	Wang and Chiang (1993), Silva et al. (1996), Chang et al. (2002)

7. *Codium intricatum* 交織松藻

Scientific name (學名)	<i>Codium intricatum</i>
Author(命名者)	Okamura
Chinese name (中文名)	交織松藻
Synonym	
Class	Bryopsidophyceae
Family	Codiaceae
Morphology	<p>Plants creeping, compressed with broader segment, irregularly and divaricately dichotomous, deep-green, intricated by attaching to each other with root-fibers. Branches little flattened, 1.5-4 mm in diameter. Utricles cylindrical to clavate, 520-700 μm in length, 80-250 μm in diameter. Hairs or hair scars 1-2 per utricle. Gametangia ovate, 250-310 μm in length, 75-175 μm broad, attached at middle site of a utricle</p> <p>Picture:</p>


	
Ecological and/or biological significances	Occurred in rocky shore and coral reefs.
Geographical Distribution (locality)	Hengchun Peninsula of Taiwan, Peng-chia Yu, Japan.
Selected reference	Chiang (1962), Yang et al. (1993), Yoshida (1998)

8. *Codium latum* 扁平松藻

Scientific name (學名)	<i>Codium latum</i>
Author(命名者)	Suringar
Chinese name (中文名)	扁平松藻
Synonym	
Class	Bryopsidophyceae
Family	Codiaceae
Morphology	<p>Plants flat and erect, grass green, soft texture, with a discoid holdfast, 2.5-3 cm in height, 1.5-2 cm in width. Utricles cylindrical or truncate clavate, 350-550 μm in length, 50-200 μm in diameter. Gametangia ellipse, 135-150 μm, 50-75 μm in diameter.</p> <p>Picture:</p> 
Ecological and/or biological significances	Accidentally occurred at 10 m depth of rocky substrate.
Geographical Distribution (locality)	Northerneast of Taiwan, Japan, Korea


Selected reference	Yoshida (1998)
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9. *Codium mamillosum* 球松藻

Scientific name (學名)	<i>Codium mamillosum</i>
Author(命名者)	Harvey
Chinese name (中文名)	球松藻
Synonym	
Class	Bryopsidophyceae
Family	Codiaceae
Morphology	<p>Plant globose, attached by central turf of rhizoids. Utricles cylindrical or clavate, slightly flattened or rounded at apex, thickened to 40 μm, 3-3.5 mm in length, 310-440 (-730) μm in diameter. Hairs and hair scars common. Gametangia obvoid, 150-200 μm in diameter, 460-520 μm in length, 1-8 attached at upper site of per utricle.</p> <p>Picture:</p> 
Ecological and/or biological significances	occurred in rocky shore and wall of artificial ponds.
Geographical Distribution (locality)	Northern east of Taiwan, Peng-chia Yu.
Selected reference	Yang et al. (1993), Huang (2000), Abbott and Huisman (2004)
Contributor	Jui-Sheng Chang
Related database	None


10. *Codium nanwanensae* 南灣松藻

Scientific name (學名)	<i>Codium nanwanensae</i>
Author(命名者)	Chang
Chinese name (中文名)	南灣松藻
Synonym	

Class	Chlorophyceae
Family	Codiaceae, Bryopsidales
Morphology	<p>Thallus repent, branches terete and sparse, 2.7-4.6 mm in diameter, dichotomous or subdichotomous, with rounded branch tips, attached at irregular intervals to the substratum and anastomosing by rhizoidal filaments, branches turgid when living, deep dark green in color. Utricles slender, cylindrical, 600-960 μm in length, 90-160 μm in diameter, apices rounded or truncate, thin at the apices. Medullary filaments 20-42 μm in diameter, often arising in pairs from the base of each utricle, with a plug formed close to point of departure. Hair scars occasionally issued from portions near apex of utricles. Gametangia ellipsoidal, 230-310 μm long, 50-85 μm wide, borne on a short pedicel in the middle portion of utricles, one per utricle.</p> <p>Picture:</p> 
Ecological and/or biological significances	Rarely occurred in coral reef.
Geographical Distribution (locality)	Hengchun Peninsula of southern Taiwan (type locality).
Selected reference	Chang et al. (2002)

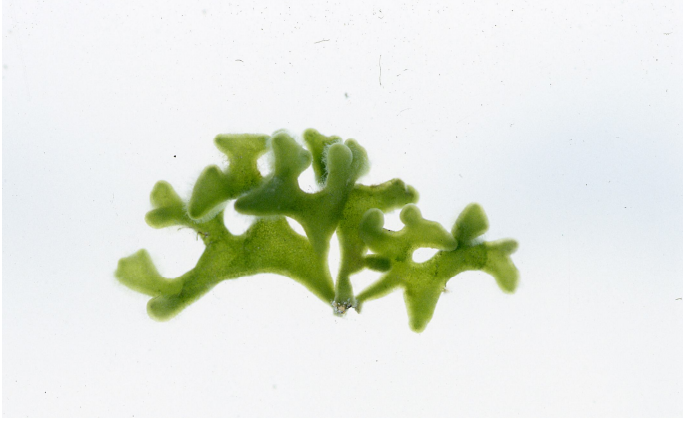
11. *Codium papillatum* 瘤狀松藻

Scientific name (學名)	<i>Codium papillatum</i>
Author(命名者)	Tseng <i>et</i> Gilbert
Chinese name (中文名)	瘤狀松藻
Synonym	

Class	Bryopsidophyceae
Family	Codiaceae
Morphology	<p>Thalli green, spongy-like, large and robust, to about 8 cm. Thalli subdichotomously branched, often unilateral. Utricles 650-950 μm in length, 150-300 μm in diam., subcylindrical or obvoid, some with few conical papillae at vertical view, apices truncate or subtruncate. Apical cell wall thickened, about 15-30 μm thick, clearly stratified and foveolate, and hairs or hair scars present.</p> <p>Picture:</p> 
Ecological and/or biological significances	Growing on lower intertidal coral reefs.
Geographical Distribution (locality)	Kenting(Taiwan), Hainan Island(China)
Selected reference	Tseng and Gibert (1942), Tseng (1983), 江等人(1990)


12. *Codium reediae* 芮氏松藻

Scientific name (學名)	<i>Codium reediae</i>
Author(命名者)	Silva
Chinese name (中文名)	芮氏松藻
Synonym	
Class	Chlorophyceae
Family	Codiaceae, Bryopsidales
Morphology	Plant erect, to 2-2.5 cm, with a disk holdfast, branches basally terete to about 2-5 mm in diameter, becoming compressed to flattened near base. Branching

	<p>subdichotomous, irregular to unilateral. Utricles near branch tips are clavate to pyriform, 350-550 μm long, 100-220 μm in diameter, with depressed and slightly rounded apices. Mature utricle at middle branches are larger, 640-1160 μm long, 130-230 μm in diameter. Hairs and hair scars present. Gametangia ellipsoidal, 260-330 μm long, 80-130 μm in diameter, 1 to 3 per utricle.</p> <p>Picture:</p> 
Ecological and/or biological significances	Occurred in shallow coral reef.
Geographical Distribution (locality)	Hengchun Peninsula of Taiwan (船帆石), Hawaii.
Selected reference	Silva in Egerod (1952), Chiang (1973),

13. *Codium saccatum* 囊狀松藻

Scientific name (學名)	<i>Codium saccatum</i>
Author(命名者)	Okamura
Chinese name (中文名)	囊狀松藻
Synonym	
Class	Bryopsidophyceae
Family	Codiaceae
Morphology	<p>Plant hollow, saclike, 5-7 diameter, thin, membranous. Utricles 80-100(-140) μm in diameter, 250-280 μm long, cylindrical to slightly clavate, mostly about 3 times as long as broad.</p> <p>Picture:</p>

	
Ecological and/or biological significances	Seldom occurred in coral reefs.
Geographical Distribution (locality)	Hengchun Peninsula of southern Taiwan, Green Island, Japan(type locality), Hawaiian Is., Micronesia, Marshall Is, Tonga. .
Selected reference	Okamura (1915), Abbott and Huisman (2004)

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