

MACROBENTHIC MARINE ALGAE AND SEAGRASSES OF THE ANAMBAS EXPEDITION 2002

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ABSTRACT. – A biological expedition jointly organized by the National University of Singapore-Raffles Museum of Biodiversity Research and the Indonesian Institute of Sciences collected marine algae and seagrasses in the Anambas and Natuna Islands (Kepulauan Anambas and Kepulauan Natuna), Indonesia. A total of 23 taxa of red algae, 22 taxa of brown algae and 29 taxa of green algae are listed. All except *Hormophysa cuneiformis* are new records for the area. Two families, two genera and three species of seagrasses are also reported.

KEY WORDS. – Marine algae, seagrass, Anambas, Natuna, Indonesia.

INTRODUCTION

The Anambas Islands (Kepulauan Anambas) and the Natuna Islands (Kepulauan Natuna, also known as Kepulauan Bunguran Besar) are two small neighboring archipelagos situated in the extreme southern part of the South China Sea. They are scattered between the southeastern coast of peninsular Malaysia and the westernmost edge of Borneo, approximately 400 km north of the Equator. The islands fall under the political jurisdiction of Indonesia, within the province of Riau. Two of the largest islands therein, Natuna Besar (formerly known as Bunguran) and Anambas, as well as some tiny satellite islets were explored for their marine biodiversity in 2002 using the Indonesian research vessel Baruna Jaya VIII. Expedition Anambas jointly organized by the National University of Singapore-Raffles Museum of Biodiversity Research (RMBR) and the Indonesian Institute of Sciences (LIPI) involved scientists from China, Indonesia, Malaysia, the Philippines, Singapore, Chinese-Taipei, Thailand and Vietnam. Records of marine plants from the regions in the immediate vicinity of the two archipelagos are few and sporadic. Some reports were made from small islands off the eastern coast of the Malaysian state of Johor, about 200 km southwest of Kepulauan Anambas. For example, marine algae from Pulau Sibul were recorded by Ismail & Samsuri (1989), Ismail & Mamat (1991), and Phang (1994). Additional records of marine algae were made from other islands such as Pulau Tinggi, Pulau Apil and the popular

Malaysian tourist island of Pulau Tioman (Masuda et al., 2000, 2001). During the 1965 Expedition of the M/V Te Vega of Stanford University in the western Pacific Ocean, some floating species of the brown seaweed *Sargassum* and its associated epiphytes collected near Kepulauan Anambas were studied by Taylor (1977).

A search for marine algal records from the region under study yielded only a single entity. M.R. Henderson collected a specimen from Tandjong Padang on the island of Anambas on April 16, 1928 that was first identified as *Cystoseira latifrons* (Kützing) De Toni. The same specimen (UC 341496) was identified and published by Taylor (1966) as *Hormophysa triquetra* (Linn.) Kützing. This specimen is deposited in the herbarium of the University of California, Berkeley, and was examined by the senior author. This species is now known as *Hormophysa cuneiformis* (J.F. Gmelin) P.C. Silva. The synonymy of this species is outlined in Silva et al. (1987) and Liao et al. (1997).

A total of 74 taxa of marine algae and three species of seagrasses are herein reported from Kepulauan Anambas and Kepulauan Natuna, all of which represent new records for the locality, except for *H. cuneiformis*, the earlier record of which is herein confirmed. The marine algae are broken down into 23 taxa of red algae, 22 brown algae and 29 green algae. The checklist follows the classification of Silva et al. (1996). All specimens examined are deposited in RMBR, Singapore, and LIPI, Jakarta.

MATERIALS AND METHODS

Marine macroalgae and seagrasses were collected from the islands of Anambas and Natuna during an expedition dated March 11 – 20, 2002. This is a one-time collection organized by RMBR and LIPI. A total of eight islands (pulau) and four bays (teluk) were sampled for marine macroalgae and seagrasses. Detailed information on specific sites, GPS readings, and brief habitat descriptions were culled by field notes made available to the authors. Sampling was done in freshwater, reef, and littoral areas of the said islands. Trawls were also used in deeper habitats. All specimens were sorted out after sampling and were directly dried and mounted in prepared wooden pressers. No specimens were preserved in alcohol for DNA studies. Hand sections were done to identify many specimens. Some *Sargassum* and *Padina* specimens remained unidentified because they were either juvenile or devoid of parts diagnostic for species identification (e.g. holdfast, reproductive structures). Specimens were listed following the classification of Silva et al. (1996). Station numbers are indicated in brackets after each taxon.

List of Collecting Stations

EA-D01 - 02°52'54.4"N, 105°47'38.5"E, Anambas: Pulau Jemaja, Teluk Tiru, northern coast of Pulau Punisan, fringing reef, 12 Mar.2002.
 EA-D02 - 02°53'10.0"N, 105°48'30.1"E, Anambas: Pulau Jemaja, Teluk Tiru, northern edge of bay, near southern tip of Tanjung Linang, fringing reef, 13 Mar.2002.
 EA-D03 - 02°57'13.6"N, 105°50'47.4"E, Anambas: east coast of Pulau Jemaja, northeastern corner of Teluk Jebung, off Tanjung Jebung, reef slope with signs of reef damage by dynamite, 13 Mar.2002.
 EA-D04 - 02°57'13.6"N, 105°50'47.4"E, Anambas: east coast of Pulau Jemaja, northeastern corner of Teluk Jebung, off Tanjung Jebung, reef slope with white coral sands, boulders, and branching corals, 13 Mar.2002.
 EA-D07 - 03°17'45.3"N, 106°12'09.8"E, Anambas: south of Pulau Mubur, Teluk Air Bandung, east coast of Pulau Mantas, reef crest with lots of living corals and a steep wall with algae (>30 m), 15 Mar.2002.
 EA-D08 - 03°18'05.5"N, 106°12'29.4"E, Anambas: southeastern peninsular of Pulau Mubur, Teluk Air Bandung, off Tanjung Kran, fringing reef, 15 Mar.2002.
 EA-D10 - 04°37'39.8"N, 107°58'18.1"E, Natuna: rocky islet southeast of Pulau Laut, fringing reef with lots of *Porites*, *Acropora*, and soft corals, 16 Mar.2002.
 EA-D12 - 04°13'57.0"N, 108°11'05.3"E, Natuna: Pulau Panjang, northwest of Pulau Natuna Besar, fringing reef with extensive reef flats and white fine sand, 17 Mar.2002.
 EA-D13 - Natuna: northeastern coast of Pulau Salor, west of Pulau Natuna Besar, patch reef with reef flat at 4-5 m depth and steep slope, 18 Mar.2002.
 EA-D14 - 03°06'16.9"N, 106°17'53.5"E, Anambas: off the southwestern tip of Pulau Bajau, Teluk Dumang, fringing reef with branching *Acropora* and *Porites*, 19 Mar.2002.
 EA-DW10 - 04°42.86'N, 107°57.79'E, Natuna: Pulau Laut, Teluk Air Payang, Desa Air Payang, Kecamatan Bunguran Barat, Kabupaten Natuna, Province Riau,

mudflats with seagrass and coral rubbles, 16 Mar.2002.
 EA-JL06 - Natuna: Pulau Laut, south coast, coastal fringe mangrove with extensive sand spit to the east, 16 Mar.2002.
 EA-TT02 - 02°52.43'N, 105°50.97'E, Anambas: southern coast of Pulau Jemaja, northern mouth of Teluk Tiru and northwards, night trawl, 12 Mar.2002.
 EA-ZJ01 - Anambas: Pulau Jemaja, northern edge of Teluk Tiru opposite Pulau Punisan, sandy mudflat with coral rubbles and rocks, 12 Mar.2002.
 EA-ZJ02 - Anambas: Pulau Jemaja, Teluk Tiru, northern coast of Pulau Punisan, sheltered bay having small patches of mangroves, shallow reefs, and sandy beaches, 12 Mar.2002.
 EA-ZJ03 - 02°57.83'N, 105°49.92'E, Anambas: east coast of Pulau Jemaja, northeastern shore of Teluk Jebung, sheltered bay with fringing mangroves, 13 Mar.2002.
 EA-ZJ04 - Anambas: east coast of Pulau Jemaja, northeastern shore of Teluk Jebung, western most of a pair of islands off Tanjung Jebung, open waters with fringing reefs, 13 Mar.2002.
 EA-ZJ05 - 03°13.67'N, 106°15.95'E, Anambas: Pulau Matak, southeastern coast of the Niulwan Peninsular, off Selat Peninting, shallow reefs and sandy shore with coral rubbles, 14 Mar.2002.
 EA-ZJ06 - 03°17.95'N, 106°13.11'E, Anambas: southwestern Pulau Mubur, Teluk Air Bandung, eastern shore of Pulau Kecil, sandy beach with big rocks, coral rubbles, and shallow reefs, 15 Mar.2002.
 EA-ZJ08 - Natuna: southern coast of Pulau Laut, sand/mudflats east of sand spit linking to the small island Pulau Sengat, and offshore coral reefs, extensive sandflats and reef flats with sparse corals and fishes, 16 Mar.2002.
 EA-ZJ09 - 04°15.90'N, 108°12.27'E, Natuna: northeastern coast of Pulau Panjang (northwest of Pulau Natuna Besar), rocky headlands with small sandy bays and reefs offshore, 17 Mar.2002.
 EA-ZJ11 - 03°53.73'N, 107°55.20'E, Natuna: northeastern coast of Pulau Salor (off the west coast of Pulau Natuna Besar), rocky sandy shore adjacent to a small village, 18 Mar.2002.
 EA-ZJ12 - 03°56.26'N, 107°57.50'E, Natuna: southern tip of Pulau Batubilis (off the west coast of Pulau Natuna Besar), sandy beaches with beach vegetation, 18 Mar.2002.

A Checklist of the Marine Algae and Seagrasses of the Anambas Expedition 2002

Marine Algae

Class Rhodophyceae

Subclass Florideophycidae

Order Nemaliales

Family Galaxauraceae

Actinotrichia fragilis (Forsskål) Børgesen [EA-D12, EA-ZJ04]

Galaxaura marginata (Ellis & Solander) Lamouroux [EA-D01, EA-DW10]

Tricleocarpa cylindrica (Ellis & Solander) Huisman & Borowitzka [EA-D10]

- Family Liagoraceae
Ganonema farinosum (Lamouroux) Fan & Wang [EA-D02]
Liagora divaricata C.K. Tseng [EA-ZJ08]
- Order Gracilariales
 Family Gracilariaceae
Gracilaria edulis (S. Gmelin) P.C. Silva [EA-ZJ03]
Gracilaria salicornia (C. Agardh) Dawson [EA-ZJ06]
- Order Cryptonemiales
 Family Peyssonneliaceae
Peyssonnelia distenta (Harvey) Yamada [EA-ZJ05]
 Family Rhizophyllidaceae
Portieria hornemannii (Lyngbye) P.C. Silva [EA-D12]
- Order Gigartinales
 Family Hypneaceae
Hypnea spinella (C. Agardh) Kützing [EA-D03]
 Family Solieriaceae
Kappaphycus striatum (Schmitz) Doty ex P.C. Silva [EA-D14]
 Family Wurdemanniaceae
Wurdemannia miniata (Sprengel) J. Feldmann & G. Hamel [EA-ZJ04]
- Order Rhodymeniales
 Family Rhodymeniaceae
Gelidiopsis variabilis (Greville ex J. Agardh) Schmitz [EA-ZJ01]
- Order Ceramiales
 Family Ceramiaceae
Spyridia filamentosa (Wulfen) Harvey [EA-ZJ03]
 Family Dasyaceae
Dasya pilosa (Weber-van Bosse) Millar [EA-ZJ04]
 Family Rhodomelaceae
Acanthophora spicifera (Vahl) Børgesen [EA-ZJ03, EA-ZJ04, EA-ZJ06]
Chondrophycus thuyoides (Kützing) G. Furnari [EA-ZJ01, EA-ZJ09]
Laurencia caduciramulosa Masuda & Kawaguchi [EA-ZJ09]
Laurencia obtusa (Hudson) Lamouroux [EA-ZJ01]
Laurencia obtusa var. *glandulifera* (Kützing) Rabenhorst [EA-ZJ01]
Laurencia surculigera C.K. Tseng [EA-ZJ05]
Leveillea jungermannioides (Hering and Martens) Harvey [EA-ZJ09]
Tolypocladia glomerulata (C. Agardh) Schmitz [EA-JL06]
- Class Phaeophyceae
 Order Dictyotales
 Family Dictyotaceae
Dictyota cervicornis Kützing [EA-D01, EA-D02]
Dictyota crispata Lamouroux [EA-D01]
Dictyota dentata Lamouroux [EA-ZJ08]
Dictyota divaricata Lamouroux [EA-D02, EA-D03, EA-ZJ04]
Dictyota linearis (C. Agardh) Greville [EA-ZJ09]
Lobophora variegata (Lamouroux) Womersley ex Oliveira [EA-D03, EA-D07, EA-D14]
Padina australis Hauck [EA-ZJ01, EA-ZJ02, EA-ZJ03, EA-ZJ04, EA-ZJ06, EA-ZJ08, EA-ZJ11]
Padina boergesii Allender & Kraft [EA-D01]
Padina boryana Thivy ex W.R. Taylor [EA-ZJ08]
Padina crassa Yamada [EA-ZJ09]
Padina japonica Yamada [EA-ZJ02, EA-ZJ12]
Padina minor Yamada [EA-D12, EA-ZJ03, EA-ZJ04]
Padina sanctae-crucis Børgesen [EA-D02, EA-D07, EA-D08, EA-ZJ12]
- Padina* spp. [EA-D12, EA-ZJ08]
Styopodium flabelliforme Weber-van Bosse [EA-D02, EA-D03]
- Order Scytosiphonales
 Family Scytosiphonaceae
Hydroclathrus clathratus (C. Agardh) Howe [EA-DW10, EA-ZJ12]
- Order Fucales
 Family Cystoseiraceae
Hormophysa cuneiformis (J. Gmelin) P.C. Silva [EA-ZJ01, EA-ZJ11]
 Family Sargassaceae
Sargassum crassifolium J. Agardh [EA-D04]
Sargassum polycystum C. Agardh [EA-ZJ01, EA-ZJ08]
Sargassum spp. [EA-D04, EA-D12, EA-ZJ01, EA-ZJ02, EA-ZJ03, EA-ZJ05, EA-ZJ09, EA-ZJ11, EA-ZJ12]
Turbinaria conoides (J. Agardh) Kützing [EA-D04, EA-DW10, EA-ZJ01, EA-ZJ02, EA-ZJ06, EA-ZJ09, EA-ZJ11]
Turbinaria conoides f. *laticuspidata* W.R. Taylor [EA-ZJ02]
Turbinaria luzonensis W.R. Taylor [EA-ZJ02, EA-ZJ03, EA-ZJ12]
Turbinaria ornata (Turner) J. Agardh [EA-ZJ01]
- Class Chlorophyceae
 Order Cladophorales
 Family Siphonocladaceae
Dictyosphaeria cavernosa (Forsskål) Børgesen [EA-ZJ05]
Ventricaria ventricosa (J. Agardh) Olsen & J. West [EA-D07]
- Order Bryopsidales
 Family Caulerpaceae
Caulerpa lentillifera J. Agardh [EA-ZJ08]
Caulerpa mexicana Sonder ex Kützing [EA-D12]
Caulerpa racemosa (Forsskål) J. Agardh [EA-D12, EA-ZJ01, EA-ZJ05, EA-ZJ09]
Caulerpa racemosa var. *clavifera* (Turner) Weber-van Bosse [EA-D13]
Caulerpa racemosa var. *lamourouxii* (Turner) Weber-van Bosse [EA-D13]
Caulerpa racemosa var. *macrophysa* (Kützing) W.R. Taylor [EA-D01]
Caulerpa serrulata (Forsskål) J. Agardh [EA-D03, EA-D08, EA-ZJ03, EA-ZJ09]
Caulerpa sertularioides (S. Gmelin) Howe [EA-ZJ01, EA-ZJ08]
- Family Codiaceae
Codium geppiorum O. Schmidt [EA-ZJ03, EA-ZJ04]
- Family Halimedaceae
Halimeda copiosa Goreau and Graham [EA-D01, EA-D07, EA-D12, EA-D13]
Halimeda cylindracea Decaisne [EA-D12]
Halimeda discoidea Decaisne [EA-D14]
Halimeda gracilis Harvey ex J. Agardh [EA-D04, EA-ZJ02]
Halimeda incrassata (Ellis) Lamouroux [EA-ZJ04]
Halimeda macroloba Decaisne [EA-D12, EA-TT02, EA-ZJ01, EA-ZJ06, EA-ZJ08]
Halimeda macrophysa Askenasy [EA-D07, EA-D13]
Halimeda melanesica Valet [EA-D04]
Halimeda opuntia (Linnaeus) Lamouroux [EA-D12, EA-ZJ01, EA-ZJ02, EA-ZJ03, EA-ZJ04, EA-ZJ05, EA-ZJ06, EA-ZJ08, EA-ZJ12]
Halimeda simulans Howe [EA-D12]
Halimeda tuna (Solander) Lamouroux [EA-D10, EA-ZJ03, EA-ZJ04]

Family Udoteaceae

- Chlorodesmis fastigiata* (C. Agardh) Ducker [EA-ZJ09]
Tydemania expeditionis Weber-van Bosse [EA-D01,
 EA-D02, EA-D07, EA-D14]

Order Dasycladales

Family Dasycladaceae

- Chlorocladus australasicus* Sonder [EA-DW10, EA-
 ZJ08]
Neomeris bilimbata Koster [EA-ZJ01]
Neomeris vanbosseae Dickie [EA-ZJ12]

Family Polyphysaceae

- Acetabularia ryukyuensis* Okamura & Yamada [EA-
 ZJ08]
Halicoryne wrightii Harvey [EA-DW10]

Seagrasses

Family Hydrocharitaceae

- Halophila ovalis* (R. Brown) Hooker f. [EA-JL06]

Family Potamogetonaceae

- Halodule pinifolia* (Miki) den Hartog [EA-JL06, EA-
 ZJ03]
Halodule uninervis (Forsskål) Ascherson [EA-DW10]

DISCUSSION

The present study represents a significant contribution to the knowledge of marine floral diversity, particularly of the southernmost region of the South China Sea. The marine flora of the different island groups farther north have been previously studied mainly by the Chinese (e.g., Tseng, 1983), and to a limited extent, by Vietnamese biologists (e.g., Le Nhu Hau, 2001).

Within the vast Indonesian archipelago, the data presented in this study constitute an important addition to the poorly documented flora of the northwestern part of the country. Compared to the central and eastern fringes of Indonesia, the northwestern corridor is disproportionately sampled despite the apparently rich flora present there. The Dutch Siboga Expedition of 1899-1900 collected and documented marine algae from the coasts of eastern Java, Sulawesi and several other smaller islets to the east, extending to as far north as the Sulu archipelago in the Philippines. The phycological results were published in several monographs by Weber-van Bosse (1913, 1921, 1923, 1928), Weber-van Bosse & Foslie (1904), Gepp & Gepp (1911) and De Clerck & Coppejans (1997).

In recent years, the Indonesian-Dutch Snellius-II Expedition of 1984 collected from several sites in the Lesser Sunda Islands to the south and southeast of Sulawesi. Some results have been published by Coppejans & Prud'homme van Reine (1989a, b) and De Clerck & Coppejans (1999).

Of the total number of species recorded from the Kepulauan Anambas and Kepulauan Natuna, three appear to be of limited distribution, i.e., reported only within the vicinity of the South China Sea, and therefore of some phytogeographic importance: the recently described red alga *Laurencia caduciramulosa* Masuda & Kawaguchi, the brown alga *Turbinaria luzonensis* Taylor, and the green alga *Neomeris*

bilimbata Koster. The South China Sea region is noted for its rich marine flora including many newly described entities that are considered to be endemic. These include, to name a few, *Chlorodesmis sinensis* Tseng and Dong, *Turbinaria parvifolia* Tseng and Lu, and scores of *Sargassum* species.

Laurencia caduciramulosa Masuda & Kawaguchi was first described from Hon Tre Island, off the coast of Nha Trang in central Vietnam by Masuda et al. (1997). The present report of *L. caduciramulosa* from the Kepulauan Anambas represents the first record outside the type locality. On the other hand, *Turbinaria luzonensis* Taylor (1964) was only recorded from the Pacific coast of south-central Luzon in the Philippines. This new record from the Kepulauan Anambas represents a western range extension of this species. *Neomeris bilimbata* Koster (1937) was first described from one of the atolls of the Spratley Islands in central South China Sea, and has since been reported from some islands south of Sulawesi (Coppejans & Prud'homme van Reine 1989b) and from the Tubbataha reefs in the Sulu Sea (Liao & Young, 2002). Its presence in the Kepulauan Anambas is therefore not totally unexpected. However, there are unsubstantiated reports of *N. bilimbata* from the southwest Pacific, specifically New Caledonia (Berger & Kaefer, 1992). These reports have not been confirmed by recent studies from the region (Payri et al., 2000; Littler & Littler, 2003).

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