SEMINAR NASIONAL

PENGELOLAAN SUMBERDAYA LAUT DAN PESISIR BERKELANJUTAN

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PROGRAM STUDI ILMU KELAUTAN
FAKULTAS PERIKANAN DAN ILMU KELAUTAN
UNIVERSITAS SAM RATULANGI

SEMINAR NASIONAL ILMU KELAUTAN
"PENGELOLAAN SUMBERDAYA LAUT DAN PESISIR BERKELANJUTAN"

Run Down Seminar Nasional ini adalah sebagi berikut:

Waktu	Judul	Pembicara	Moderator
Registrasi			
08.00 – 08.30			
Pembukaan			
08.30-08.45	Doa	Pelayan Tuhan	
08.45-09.00	Pembukaan	Dekan	
Key Note Speaker			
09.00 – 09.30	Pengelolaan Sumberdaya di Coral Triangle	Dr. Hendra Yusran Siry, S.Pi, MSc. Director CTI-CFF	Moderator
09.30 – 10.00	Prospek Ekonomi Farmakognosi Sumber Daya Laut di Indonesia	Prof. Dr. Ir. Rizald M. Rompas, MAgr Korptodi S3 Ilmu Kelautan	Moderator
Rehat			
Sesi - I			
1.00 – 11.15	Reproduksi, penempelan, pertumbuhan, dan mortality Siput abalone, *haliotis varia*, di pantai likupang dan sekitarnya, kabupaten minahasa utara, sulawesi utara	Medy Ompi	Moderator
11.15 – 11.30	Mangrove flora in the north and south coasts of the northern part of sulawesi island, indonesia	Rignolda Djamaludin	Moderator
11.30 – 11.45	Identifikasi senyawa bioaktif dari karang lunak *nephthea* sp dari perairan pulau bunaken sulawesi utara	Nickson J Kawung	Moderator
11.45 – 12.00	Coastal community based artificial rees variation in the frame of increasing the coral reefs associated organisms biodiversity and as fish agrregating devices (fad)	Janny D. Kusen	Moderator
Makan Siang			
Sesi-II			
13.00 – 13.15	Pengembangan daya saing produk-produk kemaritiman sulawesi utara mengantisipasi pasar tunggal asean	Carolus P. Paruntu	Moderator
13.15 – 13.30	Inkonsistensi perkembangan nacre pada cangkang dan mutiara dari mantel hasil regenerasi	N. Gustaf F. Mamangkey	Moderator
13.30 – 13.45	Foraminifera, potensinya sebagai bioindikator	Jane Mamuaja	Moderator
13.45 – 14.00	Antibacterial activity ods fractions of marine sponges against *mycobacterium smegmatis*	Deiske Adeliene Sumilat	Moderator
14.00 – 14.15	Identifikasi molekuler bakteri proteolitik termofilik dari perairan hidrotermal pantai moinit, sulawesi utara	Elvy L. Ginting,	Moderator
14.15 – 14.30	Eksplorasi potensi molekuler *prochloron didemnii* yang berasosiaisi dengan ascidia, *lissoclinum patella* di eluk manado sulawesi utara	Inneke F. M. Rumengan	Moderator

Waktu	Judul	Pembicara	Moderator
14.30 – 14.45	Hubungan antara kandungan logam dan struktur sel pada alga *padina australis* dari beberapa perairan sulawesi utara	Desy M.H. Mantiri*,	
14.45 – 15.00	Mitigasi karbondioksida (co_2) oleh rumput laut budidaya	Calvyn F.A. Sondak	
15.00 – 15.15	Sensitifitas ikan nila laut (*oreochromis niloticus*) yang terekspos merkuri dalam *hardness* bervariasi	Wilmy Etwil Pelle,	
15.15 – 15.30	Terrein and butyrolacton vii, antibiotically active compounds from symbiotic fungus *aspergillus terreus* isolated from ascidian *didemnum molle*	Robert A. Bara,	

THE MANGROVE FLORA IN THE SOUTH AND NORTH COASTAL AREAS OF THE NORTHERN PART OF SULAWESI ISLAND, INDONESIA: AN IMPLICATION FOR SPECIES CONSERVATION

Rignolda Djamaluddin
Faculty of Fishery and Marine Science, Sam Ratulangi University
rignolda@unsrat.ac.id; rignolda@gmail.com

ABSTRACT

Biogeographically, the mangrove flora in the northern part of Sulawesi Island may include two regions, Indo-Malesia and Asia, Australasia and the Western Pacific, supporting the high diversity of mangrove species. Collections of mangrove specimens have been integrated in various mangrove surveys since 1995, using transect quadrate and spot check methods. As the result, at least 31 species of mangrove were collected from this study area. Three species, *Avicennia alba* Blume, *Camptostemon philippinense* (Vidal) Becc, *Sonneratia ovata* Baker seemed to be a typical species in the north coast, explaining its distribution limit in Indo-Malesia region. Three other species of *Aegiceras floridum* Roemer & Schultes, *Heritiera globulus, and Osbornia octodonta* F. *Muell occurred only in the south coast, confirming its disjunctive distribution. Among all collected species in the two coastal areas, stands of several species including A. alba* Blume, *Ceriops zeppiliana* Blume, *Bruguiera cylindrica,* (Linnaeus) Blume, *S. ovata* Backer, appeared to be uncommon species. This study confirmed that the coastal areas are floristically rich, and there is a concern of species conservation at certain locations.

Keyword*: Australasia, conservation, Indo-Malesia, mangrove, Sulawesi*

ABSTRAK

Berdasarkan aspek biogeografi, tumbuhan mangrove di bagian utara Pulau Sulawesi termasuk dalam dua wilayah, yakni: Indo-Malesia dan Asia, Australasia dan Pacific Bagian Barat, dimana kondisi di wilayah ini mendukung diversitas spesies mangrove yang tinggi. Pengumpulan spesimen mangrove telah diintegrasikan dalam berbagai survei mangrove sejak tahun 1995 menggunakan metode kuadrat transek dan pengecekan poin. Hasilnya, terkoleksi paling sedikit 31 spesies mangrove di wilayah tersebut. Tiga spesies yakni *Avicennia alba* Blume, *Camptostemon philippinense* (Vidal) Becc, *Sonneratia ovata* Baker merupakan spesies tipikal pantai Utara dan kehadirannya juga menjelaskan batas distribusi spesies tersebut di wilayah Indo-Malesia. Tiga spesies lainnya yakni *Aegiceras floridum* Roemer & Schultes, *Heritiera globulus*, and *Osbornia octodonta* F. Muell terdapat hanya di pantai Selatan. Dari semua spesies yang telah terkoleksi beberapa species yakni *A. alba* Blume, *Ceriops zeppiliana* Blume, *Bruguiera cylindrica,* (Linnaeus) Blume, *S. ovata* Backer, semua merupakan spesies yang tidak umum. Studi ini mengkonfirmasi bahwa spesies mangrove di wilayah pantai bagian Utara Pulau Sulawesi kaya akan spesies mangrove, juga hasil studi mengindikasikan pentingnya konservasi spesies pada beberapa lokasi tertentu.

INTRODUCTION

The origin of the term of mangrove remains ambiguity. It may be related to the old Malay word of '*mangi*' or '*manggi-manggi*', or '*mangle*' in *Rhizophora mangle* Linnaeus (Claridge & Burnett, 1993), or according to Vannucci (1998) '*mangue*' - the national language of Senegal. In practice, this term is used for the species of higher plants which have been uniquely successful in inhabiting intertidal habitats of tropical and sub-tropical regions (Clough, 1979; Duke, 1992; Maxwell, 2015). Mangrove is halophytic, tolerance to salty environment (Spalding *et al*., 1997), includes a variety of functional forms/ growth habits, such as trees, shrubs, a palm and a ground fern (Duke *et al*., 1998). According to Srikanth *et al*. (2015), the survival and success of mangrove vegetation in colonizing high tress

habitats is due to its successful adaptation in morphology, anatomy, physiology, and molecule.

In several reports (e.g. Gieasen *et al*. 2006; Spalding *et al*. 2010; Richards & Friess, 2015; Hamilton & Casey, 2016) the world distribution of mangrove are widely explained. The largest areas of mangrove is in Southeast Asia, encompassing over 5.1 million ha, representing 33.5% of the world's total (Spalding *et al.*, 2010). Indonesia has the largest areas of mangrove in Southeast Asia with almost 60% of Southeast Asia's total (Gieasen *et al*., 2006). Estimation given by Richard & Friess (2015) that the total mangrove area over this Country was at approximate 2,788,683 ha in 2000, and the rate of mangrove loss between 2000 and 2012 was calculated at level of 1.72%.

In the context of biogeographic regions, mangroves in Indonesia are part of Indo-Malesia and Asia, Australasia and the Western Pacific (Duke *et al*., 1992). There are 50 mangrove species in Indo-Malesia and 47 species in Australasia, including several putative hybrids (Duke *et al*., 1998). In both biogeographic regions, the total number of species is estimated at 57 species, since there is an overlap of 39 species and several species definitely occur either in Indo-Malesia or Australasia (Djamaluddin, 2004). Gieasen *et al*. (2006) claims that Indonesia is the more species diversity of the Southeast Asia countries with 48 species of mangrove. With particular concern to mangroves of the northern part of Sulawesi Island, some 34 true mangrove species may be found (Tomlinson, 1986).

Two factors, oceanic circulation and climate condition, according to Thom (1982), may influence the distribution of mangrove. The marine environment of the north coast is under influence by dominant seawater mass approaching from the northern Pacific Ocean, flowing through Makasar Strait (Van Bennekom, 1988). Bingham & Lukas (1994) explains that Mindanao Current from the coastal areas in the southeast of the Philippines archipelago strengthen the flow of seawater mass from the northern Pacific. Another significant seawater mass is approaching from the western Pacific flowing through the Maluku Sea. So that, in the view of seawater circulation, the two coastal areas in the northern part of Sulawesi Island seems to be affected by these two different flows of seawater mass. These may influence the distribution patterns of mangrove propagules and seeds in the northern coastal areas of Sulawesi Island.

Two wind systems, north-westerly and south-easterly winds, are reported to have strong influence on rainfall in northern part of Sulawesi Island (Davie *et al*., 1996; Djamaluddin, 2004). During September and April the north-westerly wind brings moisture after blowing over the South China Sea. This wind arrives in the North Sulawesi in November through the Sulawesi Sea. From the wintery Australian land the south-easterly wind blows towards eastern Sulawesi. This wind causes a short dry season in Manado from August to October. According to data released by Manado Meteorology and Geo-physic Office, the total annual rainfall ranges from 2,501 to 3,000 mm. Within the period from 1973 to 2016, the annual temperature of North Sulawesi varies between 25.5^{o} C and 27.0^{o} C (Djamaluddin, 2018).

The high diversity of mangrove forests in the northern coast in particular the area of Bunaken National Park seems to be unique and unusual in Southeast Asia (Davie *et al*. 1996; Djamaluddin, 2004). Indication of difference in species composition between the north and south coastal areas has been indication in report of Tomini Bay mangrove survey (Djamaluddin, 2015). The interplay between factors of geo-physic, geomorphic and biology is believed to support the mangrove distribution and diversity in the intertidal environments of both coastal areas.

A long-term investigation on mangrove species within the northern coast of Sulawesi Island provides ample time and opportunity to collect and to record any detailed information of mangrove flora in this specific region of Indo-Malesia and Asia, Australasia and the Western Pacific. Geographical distribution limits and patterns as well as population status of certain species may also be clarified from this investigation. Moreover, results from this study may be

important in the context of species conservation.

METHOD

Almost all mangrove forests in the north coast and south coasts have been visited since 1995, and some 235 locations were observed deeply for community structure including collection of mangrove specimens. Two methods of transect quadrate and spot check were used during the observation. At any locations where a new specimen was found, geographical position was marked. Field determination of mangrove specimens was made *in situ* for well-known mangrove species, and other specimens were collected for further identification for uncommon or expected new mangrove species. Identification of mangrove specimens were based on morphological characteristics by using a number of references of systematic reviews such as Stennis (1955-58), Ding Hou (1958), Percival & Womersley (1975), Blasco (1984), Fernando & Panco (1980), Tomlinson (1986), Mabeberley *et al*. (1995), Noor *et al.* (2006). All the specimens used for determination of the flora were photographed and documented. In Figure 1 mangrove areas in the north and south coast covered by the survey are presented.

Figure 1. Surveyed coastal areas in the north and south coasts of the Northern Sulawesi Island.

RESULTS AND DISCUSSION

Mangrove flora

In total, there were at least 31 species of 13 families were identified to occur in the north and south coast of the northern part of Sulawesi Island. Considering the list of Tomlinson (1986) for the biogeographic region between 120º and 135º E, three species of *Aegialitis annulata* R. Brown, *Bruguiera exaristata* Ding Hou, and *Bruguiera hainesii* C.G. Rodgers were not found. It is also clear that several species are typical north or south coasts in term of their range of distribution. All collections of specimen for both coastal areas are presented in Table 1.

Table 1. All mangrove species found in the north and south coastal areas in the northern part of Sulawesi Island.

Family	Species	Common Name
Achanthaceae:	1. *Acanthus ilicifolius* Linnaeus[1,2]	Holly mangrove
	2. *Avicennia alba* Blume[1]	Api-api putih
	3. *Avicennia marina* (Forssk.) Vierh[1,2]	Grey/white mangrove
Arecaceae:	4. *Nypa fruticans* (Thunb.) Wurmb.[1,2]	Mangrove palm
Bombacaceae:	5. *Camptostemon philippinense* (Vidal) Becc.[1]	Gapas gapas
Combretaceae:	6. *Lumnitzera littorea* (Jack) Voigt.[1,2]	Red-flowered black mangrove
	7. *Lumnitzera racemosa* Willd[1,2]	White-flowered black mangrove
Euphorbiaceae:	8. *Excoecaria agallocha* Linnaeus[1,2]	Milky mangrove, Blind-your-eye
Meliaceae:	9. *Xylocarpus granatum* König[1,2]	Cannonball mangrove
	10. *Xylocarpus molucensis* Pierre[1,2]	Cedar mangrove
Primulceae:	11. *Aegiceras corniculatum* (Linnaeus) Blanco[1,2]	River mangrove, Black mangrove
	12. *Aegiceras floridum* Roemer & Schultes[2]	-
Pteridaceae:	13. *Acrosticum aureum* Linnaeus[1,2]	Golden mangrove fern
	14. *Acrosticum speciosum* Wildenow[1,2]	Showy mangrove fern
Myrtaceae	15. *Osbornia octodonta* F. Muell[2]	Myrtle mangrove
Rhizophoraceae:	16. *Bruguiera cylindrica* (Linnaeus) Blum[1,2]	Large-leafed orange mangrove
	17. *Bruguiera gymnorrhiza* (Linnaeus) Lamk.[1,2]	Large-leafed orange mangrove
	18. *Bruguiera parviflora* Weight & Arnold ex Griffith[1,2]	Small-leafed orange mangrove
	19. *Bruguiera sexangula* (Lour.) Poir.[1,2]	Upriver orange mangrove
	20. *Ceriops* zippeliana Blume[2]	Tengat merah
	21. *Ceriopa tagal* (Perr.) C.B. Robinson[1,2]	Rib-fruited yellow mangrove
	22. *Rhizophora apiculata* Blum[1,2]	Corky stilt mangrove
	23. *Rhizophora mucronata* Lamk.[1,2]	Upstream stilt mangrove
	24. *Rhizophora stylosa* Griffith[1,2]	Long-styled stilt mangrove
Rubiaceae:	25. *Scyphiphora hydrophyllacea* Gaertn.f.[1,2]	Yamstick mangrove
Lythraceae:	26. *Pemphis acidula* Forst &Forst [1,2]	Bonsai mangrove
	27. *Sonneratia alba* J. Smith[1,2]	White-flowered apple mangrove
	28. *Sonneratia caseolaris* (Linnaeus) Engler[1,2]	Red-flowered apple mangrove
	29. *Sonneratia ovata* Backer[1]	Ovate-leafed apple mangrove
Sterculiaceae:	30. *Herritiera littoralis* Dryand[1,2]	Looking-glass mangrove
	31. *Heritiera globulus* [2]	-

Notes: [1)] species found in the north coast, [2)] species found in the south coast

There are several changes in species listed in Tabel 1 comparing to the previous species lists for the north coast (Davie *et al*., 1996; Djamaluddin, 2004) and the south coast (Djamaluddin, 2015). Part of these changes in particular for the mangrove flora in Bunaken National Park has been explained in Djamaluddin (2018). Species of *Avicennia marina* var. *rumphiana* (Hall. F.) Bakhuizen was excluded from the previous

list and corrected as *Avicennia marina* (Forssk.) Vierh. Specimen that was identified as *Avicennia officinalis* Linnaeus (in the list of Davie *et al.*, 1996) was verified as *Avicennia alba* Blume. Detail check of specimen previously identified as *Kandelia candel* (Linnaeus) Druce confirmed that the specimen was *Bruguiera cylindrica* (Linnaeus) Blum. Following the development in mangrove species taxonomy, changes were made to the names of two species, *Ceriops decandra* (Griff.) Ding Hou and *Xylocarpus mekongensis* Pierre; changed as *Ceriops zippeliana* and *Xylocarpus molucensis* respectively.

As can be seen from data in Table 1, there were three species of *A. alba*, *C. philippinense*, and *S. ovata* were typical for mangrove forests in the north coast. Trees of *A. alba* occurred along the mainland coast of the northern part of Bunaken National Park. Trees of this species shared the same habitat with trees of *A. marina*. Trees of *S. ovata* were collected from three locations at Pungkol (southern section of Bunaken National Park) in a dense population, mangrove forest near Tiwoho Village and Mantehage Island in individual trees. Type of habitat of this species is 'seasonally or regularly freshwater influenced landward fringe' (Djamaluddin, 2018). The presence of freshwater seems to be a limiting factor for this species survival at landward fringe. Trees of *C. Philippinese* were found only at small isolated location in Mantehage Island (1°42'59.4" N; 124°45'31.2" E). This species is very common in the Philippines (Giaesen *et al*., 2006). It is also reported to occur in Eastern Kalimantan (Mukhlisi & Sadiyasa, 2014) and western coast of Central Sulawesi (Wahyuningsih *et al*. 2012). However, this species may be absent in the south coast of northern Sulawesi (Damanik and Djamaluddin, 2012; Djamaluddin, 2015), as well as in the West Papua (Prawiroatmodjo & Kartawinata, 2014).

Typical species of the south coast included *A. floridum, H. globulus*, and *O. octodonta*. Trees of these species were not common in this area, and each of these inhabited very special and isolated habitat.

Detail explanations of the distribution pattern for all mangrove species in the northern coast of Sulawesi island may need further investigation. However, the distribution limit of *C. philippinese* in the biographic region of Indo-Malesia can be explained from the presence of this species in Mantehage Island. It is expected that Mantehage Island is probably the distribution limit of this species in the eastern part of Indonesia. A question that needs to be answered is that why trees of this species were being isolated in a small area in Mantehage Island. Domination of seawater circulation from the northern Pacific Ocean flowing through the southeast of the Philippines may be a significant factor that relates to the presence of *C. philippinese* in Mantehage Island. The arrival of seeds of this species in Mantehage Island may be under influence of this seawater circulation. Another question is for the presence of *O. octodonta* in Panua Reserved (0°27'45.3" N; 121°58'54.5" E) in the south coast. This species shows a disjunctive distribution, since it occurs in considerably separated places in the Philippines, Kalimantan, eastern Malaysia, Palau, and northern Australia.

Implication for species conservation

In the International Union for Conservation of Nature (IUCN) Red List 2010, the species of *C. philippinese* was categorized as "*an endangered species*", the second most severe conservation status for wild population, meaning that this species is more likely to become extinct. In Mantehage Island where this species was found there were only small population of this species, and they were subjected to logging. As an endangered species, trees of this species as well as the habitat needed to be protected. Trees of *S. ovata* were found in three locations in Bunaken National Park, but they were very rare growing in an individual tree at landward areas subjected to sedimentation. This species was categorized as "*a near threatened*" species in the IUCN Red List, so that this needed to be protected. Another species that was categorized as "*a near threatened*" species was *A. floridum*, occurring only at Pulau Pondang (0°25'00.3" N; 124°20'59.8" E) in the south coast. Although its conservation status in the

IUCN Red List was categorized as "a least *concern*", trees of *B. cylindrica* were rare, so that this species needed to be protected locally.

CONCLUSION

The mangrove flora in the northern coast of Sulawesi Island was floristically rich with at least 31 species of 13 families. In the context of species composition, there was difference between the north and south coasts. Three species occurred only in the north coast including *A. alba, C. philippinense*, and *S. ovata*, meanwhile three other species were only found in the south coast including *Aegiceras floridum, H. globulus*, and *O. octodonta*. The presence of *C. philippinense* in Mantehage Island confirmed its distribution limit in the geographic region of Indo-Malesia. Protection was needed for several species including *A. floridum, C. philippinese*, and *S. ovata*, due to their conservation status, and for *B. cylindica, H. globules*, and *O. octodonta* due to their locally rare population.

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Sertifikat

diberikan kepada:

Dr. Ir. Rignolda Djamaluddin, MSc

sebagai PEMAKALAH Seminar Nasional
"PENGELOLAAN SUMBERDAYA LAUT DAN PESISIR BERKELANJUTAN"
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Universitas Sam Ratulangi

Prof. Ir. Farnis B. Boneka, M.Sc.