



*Original Article*

## Bryophytes of beach forests in Chon Buri Province, Thailand

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Received: 3 November 2013; Accepted: 12 August 2014

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### Abstract

An investigation of bryophyte diversity of three beach forests including Had Tung Prong, Had Tein Talay, and the beach forest in Thai Island and Sea Natural History Museum in Chon Buri Province, Thailand, was carried out. From 137 enumerated specimens, 16 species (6 mosses, 10 liverworts) in 12 genera (5 mosses, 7 liverworts) and eight families (5 mosses, 3 liverworts) were found. Among those the most common families of mosses are Fissidentaceae (2 species) and the most common families of liverwort are Lejeuneaceae (8 species). A comparison of species richness among the three areas revealed that the highest species richness of bryophytes was found in Had Tung Prong. Moreover, of all bryophyte species found, *Weissia edentula* Mitt. was the most common one.

**Keywords:** beach forest, bryophytes, Chon Buri Province

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### 1. Introduction

Chonburi Province is situated in eastern part of Thailand between 12° 30' and 13° 43' N and 100° 45' and 101° 45' E covering a total area of 4,363 square kilometers. Under the phytogeographical scheme (Smitinand, 1958), Chonburi Province falls within the South-Eastern Floristic Region, which mainly has Indochinese, Burmese, and Malesian floristic elements. The province is covered by highlands, lowlands, islands, and coastal and beach areas. According to Whitmore (1984), two beach vegetation types are recognized, *viz.* the *Barringtonia* association and the *pes caprae* association. In Chon Buri Province, the *Barringtonia* association-like is found in Thai Island and Sea Natural History Museum area (Figure 1D), where a rocky and steep shore is and no sand has been accumulated. The *pes caprae* association-like type is found in Had Tung Prong (Figures 1A-B) and Had Tein Talay (Figure 1C); here the sand may be of quartz com-

position. *Ceriops decandra* (Griff.) W.Theob. and *Casuarina equisetifolia* L. are common tree species in Had Tung Prong and Had Tein Talay, respectively.

Bryophytes are non-vascular and spore producing land plants. There are three groups including mosses, liverworts, and hornworts. They include about 17,900 species worldwide (12,500 mosses, 5,250 liverworts, and 100 hornworts) (Frey and Stech, 2009). Based on Lai *et al.* (2008) and He (1995-2014) with updates (Akiyama, 2006, 2010; Tan *et al.*, 2006; Inuthai, 2007; Pollawatn *et al.*, 2008; Chantanaorrapint, 2009; Wongkuna *et al.*, 2009; Akiyama and Tsubota, 2009; Akiyama *et al.*, 2010; Kornochalert *et al.*, 2010; Nathi *et al.*, 2010; Akiyama and Goffinet, 2011; He *et al.*, 2012; Printarakul *et al.*, 2012, 2013), 1,101 species of bryophytes (708 mosses, 380 liverworts, 13 hornworts) are known in Thailand. In the framework of the bryophyte studies in Thailand, the bryophytes of plant communities at high elevation have been well-studied. In contrast, few studies have been conducted in beach forest (Sukkharak and Chantanaorrapint, 2014). Only Inuthai (2007) reported 26 species of liverworts and 11 species of mosses on coastal sandbars in Chumphon Province. It is of interest to explore bryophyte diversity in beach forests in

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Chon Buri Province. A list of the bryophytes found in area is presented in this paper.

## 2. Material and Methods

Investigations of the bryophyte diversity of three beach forests, Had Tung Prong, Had Tein Talay, and the beach forest in Thai Island and Sea Natural History Museum in Chon Buri Province were carried out during November 2012 to March 2013. Both morphological and anatomical features were studied. Bryophyte specimens were identified using both keys and descriptions from various taxonomic literatures previously reported. The classification system of the families and genera used in this list are followed Goffinet *et al.* (2008) and Crandall-Stotler *et al.* (2008) for mosses and liverworts, respectively. The specimens are kept in Department of Biology, Faculty of Science, Burapha University.

## 3. Result and Discussion

From 137 enumerated specimens, 16 species (6 mosses, 10 liverworts) in 12 genera (5 mosses, 7 liverworts) and 8 families (5 mosses, 3 liverworts) were found (Table 1). Some species are shown in the Figure 2.

### 3.1 Species richness

The most common families of mosses are Fissidentaceae (2 species) and families of liverwort are Lejeuneaceae (8 species). Of all bryophyte species found, *Weissia edentula* (Figure 2D) of the Pottiaceae is the most common. A comparison of species richness among three areas reveals that the highest species richness of bryophytes was found in Had Tung Prong (14 species), where *Cheilolejeunea intertexta* (Figure 2E) is the most common species. However, no liverwort has been found in the beach forest of the Thai Island and Sea Natural History Museum area.

### 3.2 Habitats

Gradstein and Pócs (1989) subdivided terrestrial species into terricolous species growing on soil and saxicolous species growing on rocks. The most common terrestrial bryophytes in the studied areas are saxicolous. Epiphytic species are divided into corticolous (growing on bark of trees), epiphyllous (growing on leaf surfaces), lignicolous (growing on rotten logs), and ramicolous (growing on branches) (Gradstein and Pócs, 1989). The majority of epiphytic bryophytes in these areas are corticolous, while the epiphyllous bryophyte has not been founded.

### 3.3 Morphological adaptation of bryophytes

Bryophytes are poikylhydric plants. In dry environment, the plants dry up and may become dormant. However,

when wetted, plants take up water rapidly and photosynthesis is resumed (Gradstein *et al.*, 2002). Most of bryophytes found in these areas are drought and salt-spray tolerant



Figure 1. Beach forests in Chonburi Province and leaf cell papillae in some mosses found in the area (A, B) Had Tung Prong; (C) Had Tein Talay; (D) beach forest in Thai Island and Sea Natural History Museum area; (E) papillae in *Fissidens ceylonensis* Dozy & Molck.; (F) papillae in *Weissia edentula* Mitt.

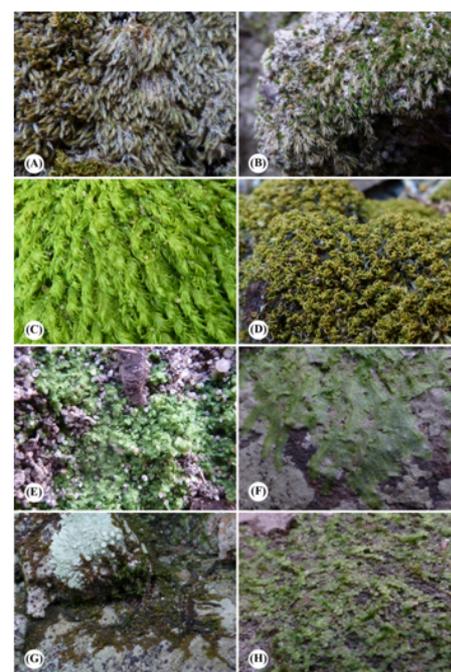


Figure 2. Some bryophytes found in the beach forests (A) *Brachymenium acuminatum* Harv.; (B) *Calymperes tenerum* Müll.Hal.; (C) *Fissidens hollianus* Dozy & Molck.; (D) *Weissia edentula* Mitt.; (E) *Cheilolejeunea intertexta* (Lindenb.) Steph.; (F) *Cololejeunea planissima* (Mitt.) Abeyw.; (G) *Frullania ericoides* (Nees ex Mart.) Mont.; (H) *Lejeunea anisophylla* Mont.

Table 1 Alphabetical list of bryophytes of beach forests in Chonburi Province.

Taxa	Studied areas			Habitats	Collector No. (Sukkharak, Tongma, & Chatutan)
	1	2	3		
Bryophyta (mosses)Bryaceae					
1. <i>Brachymenium acuminatum</i> Harv. (Figure 2A)			✓	s, t	9, 11, 14, 49, 52, 57, 59, 61, 62-1, 66-1, 72
Calymperaceae					
2. <i>Calymperes tenerum</i> Müll.Hal. (Figure 2B)	✓			s	27, 31, 83, 100
Fissidentaceae					
3. <i>Fissidens ceylonensis</i> Dozy & Molk.	✓	✓	✓	t	3, 8, 15, 16, 18, 22, 23, 40, 43, 44, 54, 103, 104-1, 105-1
4. <i>Fissidens hollianus</i> Dozy & Molk. (Figure 2C)	✓	✓		s, t	2, 5, 21, 24, 26, 28, 30, 78, 79, 82, 85, 96, 98, 106, 115, 118-1, 136
Pottiaceae					
5. <i>Weissia edentula</i> Mitt. (Figure 2D)	✓		✓	t	1, 6, 7-2, 10, 12, 13, 17, 37, 38, 39, 41, 42, 45, 46, 47, 48, 50, 51, 53, 55, 60, 62-2, 63, 64, 65, 66-2, 67, 68, 69, 70, 71, 73, 74, 75, 76, 84, 88, 92, 93, 120, 124, 125
Thuidiaceae					
6. <i>Claopodium prionophyllum</i> (Müll.Hal.) Broth.			✓	c	56, 58
Marchantiophyta (liverworts)Frullaniaceae					
7. <i>Frullania ericoides</i> (Nees ex Mart.) Mont. (Figure 2G)	✓	✓		s	20, 118-3, 126, 127-2
Geocalycaceae					
8. <i>Heteroscyphus argutus</i> (Nees) Schiffn.	✓			s	102-1
Lejeuneaceae					
9. <i>Cheilolejeunea intertexta</i> (Lindenb.) Steph. (Figure 2E)	✓			c, s, t	7-1, 25, 29, 32, 34, 90, 97, 99, 108, 109, 110, 111, 116, 117-2, 119, 121, 123, 131, 133
10. <i>Cololejeunea planissima</i> (Mitt.) Abeyw. (Figure 2F)	✓			c, r, s	35, 77, 80, 89, 107-1, 112-1, 113, 132
11. <i>Cololejeunea raduliloba</i> Steph.	✓			c, s	4, 81, 91-1, 96, 101, 114, 115, 129, 130, 134, 137
12. <i>Lejeunea anisophylla</i> Mont. (Figure 2H)	✓			c, s	86, 87, 94, 95, 102-2, 104-2, 105-2, 107-2, 112-2, 117-1
13. <i>Lejeunea wightii</i> Lindenb.	✓	✓		c, s	19, 36, 91-2, 135
14. <i>Lopholejeunea nigricans</i> (Lindenb.) Steph.	✓			c	122
15. <i>Mastigolejeunea indica</i> Steph.	✓			s	128
16. <i>Mastigolejeunea replata</i> (Taylor) A.Evans	✓			c, s	33, 118-2, 127-1

Notes. Studied areas: 1 = Had Tung Prong, 2 = Had Tein Talay, 3 = beach forest in Thai Island and Sea Natural History Museum area, Habitats: c = corticolous, l = lignicolous, r = ramicolous, s = saxicolous, t = terricolous.

species. In addition, some of them bear papillae on their cell surfaces, for example *Fissidens ceylonensis* and *Weissia edentula*, which have the exceptionally densely pluripapillose lamina cells (Figure 1E-F). The function of papillae may be to increase the absorption surface, therefore accelerating hydration when water is available, and to create capillary spaces to hold excess water, delaying dehydration and prolonging photosynthesis (Bell, 1982; Vanderpoorten and Goffinet, 2009). In addition, the leaves of *W. edentula* are

closely incurved and crisped when dry (Figure 2D) and have involute leaf margins (Figure 1F). Curling and contorting the leaves creates small air spaces and presumably decreases air movement across the leaf surface. In addition, rolling their leaves helps reducing the exposed surface area (Bell, 1982; Glime, 2007).

The results of the study increase the data of bryophytes in the beach vegetation, where only few studies have been conducted until now.

## Acknowledgments

The research was supported by National Research Universities, Office of Higher Education Commission, Thailand. The authors thank T. Pócs (Hungary) for *Cheilolejeunea*, *Cololejeunea*, and *Lejeunea* specimen verification and S. Chantanaorrapint (Thailand) for providing literature.

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