

Exploration, collection, and conservation of dipterocarps in Riau Islands

Eksplorasi, koleksi dan konservasi jenis-jenis dipterokarpa di wilayah Riau Kepulauan

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Abstrak. Subiakto A, Rachmat HH. 2015. Eksplorasi, koleksi dan konservasi jenis-jenis dipterokarpa di wilayah Kepulauan Riau. *Pros Sem Nas Masy Biodiv Indon 1: 428-433*. Kekayaan dan keragaman jenis-jenis dipterokarpa di daratan Sumatera sudah terdokumentasi dengan baik dan dikenal di seluruh dunia. Namun demikian, keberadaan dan kekayaan jenis dipterokarpa pada rentetan pulau-pulau kecil sisi timur daratan Sumatera yang berbatasan dengan Negara tetangga Malaysia dan Singapura belum tergalikan secara optimal, padahal dari segi *phylogeography* keberadaan jenis-jenis dimaksud pada pulau-pulau tersebut akan sangat menarik terutama dalam menggali sejarah evolusi dan penyebaran. Penelitian ini bertujuan untuk mencatat jenis-jenis dipterokarpa yang tumbuh di masing-masing lokasi dan mengumpulkan materi genetik tumbuhan dari lokasi tersebut untuk dikembangkan di persemaian sebagai upaya koleksi dan pelestarian jenis-jenis dipterokarpa secara *exsitu*. Kegiatan eksplorasi dilakukan di wilayah Kepulauan Riau mencakup P. Lingga, P. Singkep, P. Bintan, P. Batam dan P. Bunguran (Kep. Natuna). Dari hasil eksplorasi tersebut tercatat jumlah jenis dipterokarpa yang ditemukan untuk masing-masing pulau adalah 13 jenis di P. Lingga, 2 jenis di P. Singkep, 7 jenis di P. Batam, 10 jenis di P. Bintan, dan 21 jenis di P. Bunguran-Kepulauan Natuna. Jumlah material genetik berupa anakan alam yang terkoleksi bervariasi untuk setiap pulau, masing-masing berturut-turut untuk Pulau Lingga, Bintan, Batam dan Bunguran-Kepulauan Natuna adalah 5900, 329, 25, 160. Anakan alam diperlakukan di dalam sungkup berkelembapan tinggi dan memakai naungan yang selanjutnya pemberian naungan dikurangi secara bertahap setelah hari ke-90.

Kata kunci: Eksplorasi, konservasi, dipterokarpa, Riau kepulauan

Abstract. Subiakto A, Rachmat HH. 2015. *Exploration, collection and conservation of dipterocarps in Riau Islands. Pros Sem Nas Masy Biodiv Indon 1: 428-433*. The diversity and richness of dipterocarps in Sumatera mainland have been well documented and known throughout the world. On the other hand, the existence and the diversity of dipterocarps in small islands along the eastern part of Sumatera mainland, which is directly bordered with neighboring countries of Malaysia and Singapore have not been thoroughly studied. Phylogeography of dipterocarps species from small islands particularly in the eastern part of Sumatra region is important information to reveal evolution history and their distribution. The aim of this research was to record the dipterocarps species growing naturally in each islands surrounding eastern part of Sumatra mainland and to collect genetic materials for preservation and ex-situ conservation effort. Exploration was carried out in the island of Lingga, Singkep, Bintan, Batam, and Bunguran (Natuna Islands). A total number of the species found for each of the islands was as follow Lingga 13 species, Singkep 2 species, Batam 7 species, Bintan 10 species, and Bunguran 21 species. A number of genetic materials taken for each of the islands were 5900, 329, 25, 160 consecutively for the island of Lingga, Bintan, Batam and Bunguran. Wildlings were kept and treated in shaded-high humidity nursery chamber and after 90 days of care, the shading was gradually decreased.

Keywords: Exploration, conservation, dipterocarps, Riau Islands

INTRODUCTION

The tropical rainforests in Southeast Asia are characterized by a high species diversity of trees (Whitmore 1984). Dipterocarpaceae is a tree family with more than 450 species in 13 genera in Asia (Ashton 1982; Londoño et al. 1995; Morton 1995). They confine to tropical climates with a mean annual rainfall exceeding 1000 mm and/or dry season of less than six months. They usually grow in mixed stands (Ashton 1988). The highest

species diversity of dipterocarps is observed in evergreen rainforests in Peninsular Malaysia, Sumatera and Borneo (Ashton 1982; Symington 1943; Whitten et al. 1987). In particular, Borneo is the main center of dipterocarps with the highest number of endemic species (155 species). Many different species of dipterocarps can be found on entirely different soil types and in nearly all of the different forest types of Southeast Asia (Lamprecht 1989). Based on the observation of herbarium collection in Herbarium Bogoriense (Purwaningsih 2004), in Indonesia most

dipterocarps were distributed in the altitude of 0-500 m and 500-1000 m.

The Sundaland biogeographic region of South-East Asia covers Malay Peninsula, the large islands of Sumatera, Java, Borneo and smaller islands surrounding them. Due to repeated sea level rises and falls, plant species in Sundaland are likely to have experienced major cycles of range expansion, vicariance and, probably, speciation. Gathorne-Hardy et al. (2002) divided the rainforests in this region into two geographic units: the Indian Ocean side of Sumatera and the eastern part of Borneo. The importance of the Sunda Shelf as a migration pathway for plants by serving a savannah corridors have been proposed by a number of previous authors (e.g. Morley 2000; Bird et al. 2005; Wurster et al. 2010). Several phylogeographic analyses have been carried out as a powerful tool to infer past demographic. Even though many studies have been carried out to dipterocarps population in Borneo and Sumatera for various research objectives, which include population expansion as well as population structure and migration, there is lack information to those dipterocarps growing in the small islands surrounding Sumatera and Borneo or known as Riau Islands. The objectives of the

study were: (i) to identify dipterocarps species growing in the Riau Islands; (ii) to collect genetic materials of the species and transplant them at the Bogor nursery for conservation purposes.

MATERIALS AND METHODS

Research area

Riau islands have thousands of islands with scenic beaches and various forest formations. Several important islands in this area are The Islands of Bintan, Batam, Lingga, Singkep, and Natuna. The island of Batam and Bintan lies within the central core group of islands, while Lingga and Singkep are to the south of the main archipelago. Up to the northeast between Borneo and mainland Malaysia lies the Natuna Islands. The islands are supposed to be important for the distribution and migration of many plants and animals including dipterocarps. Exploration and collection activities were carried out in those 5 main islands of the archipelago.

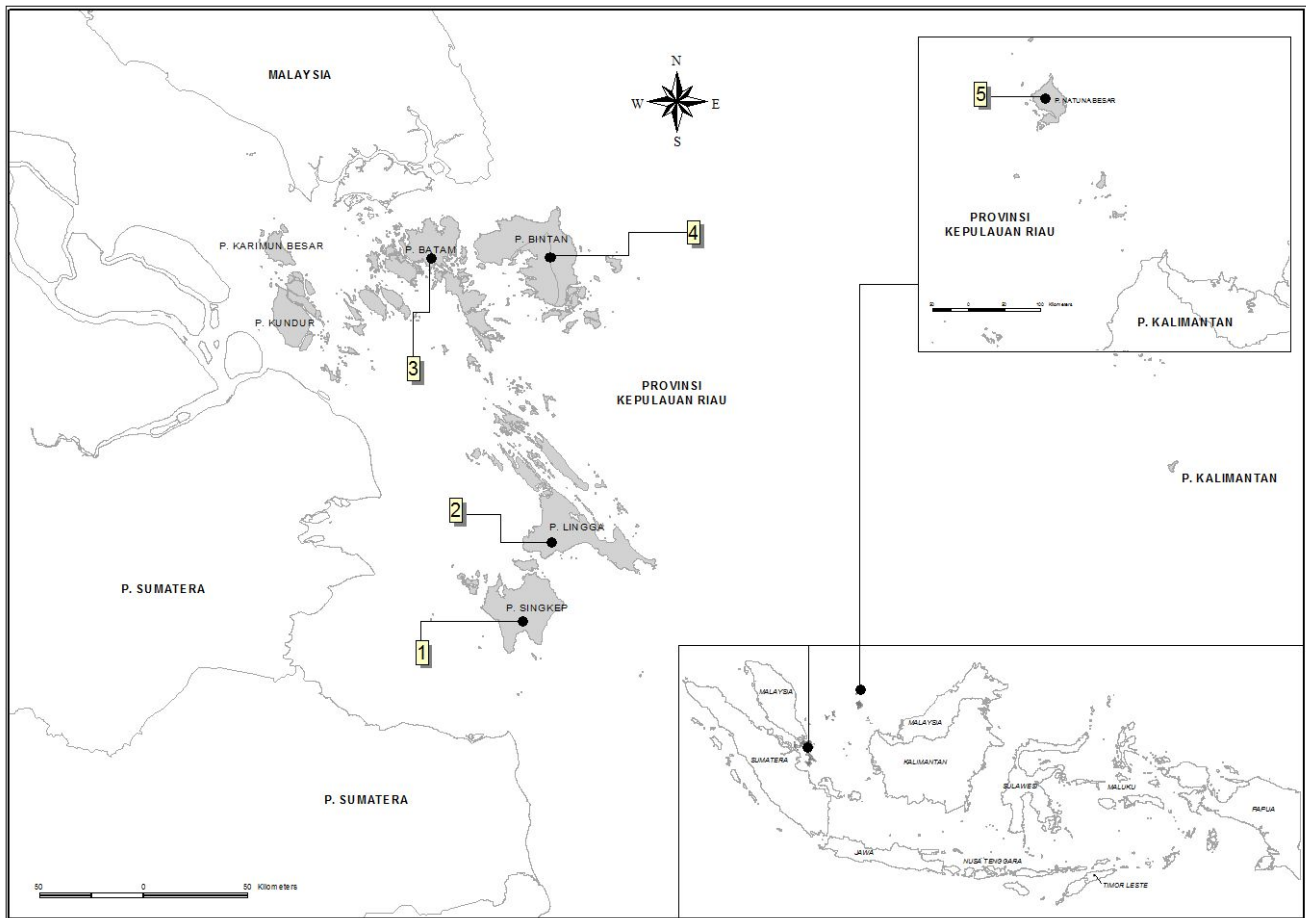


Figure 1. Research site in Riau Islands: 1. Singkep, 2. Lingga, 3. Batam, 4. Bintan, and 5. Bunguran (Natuna Besar)

Methods

Species exploration

Field visits were conducted during January to December 2013 to five main islands in Riau, namely; Bintan, Batam, Lingga, Singkep, and Bunguran/Natuna Besar (Natuna Islands). Each exploration routes in every island was determined purposively based on the discussion and interview result with key local forester. The discussion result would determine the most probable area for dipterocarps exploration and collection in each of the island. We ask a local forestry officer to guide our route of exploration. In average, we spent 3-7 days of field visit in each island and generally 2 days trip was needed for every delineated route. Routes taken at each islands are as follow:

Since our objectives was to explore the presences of dipterocarps species growing naturally in each island, we did not conduct detailed and comprehensive analysis of vegetation to identify the composition and abundance of the species. We briefly recorded the data for the species those were found along our designated transect line. We explore at about 20 m to the right and 20 m to the left at every 20 m interval of the transect axes in each line route for each of the island. The length of each route was varied to 3-7 km. We noted our finding on species and estimate of number available and took some genetic materials to be raised in nursery whatever available (seed, wildings, cutting materials).

Collection and conservation effort

Collection and conservation of the species for each of the island were conducted by propagating the species out of their habitats, both vegetatively and generatively. For generative materials, we took the available wildings present at the exploration sites. Only those less than 20 cm were taken to be transplanted at our nursery in Bogor, except for *D. aromatica* in Lingga those size in average were 25-30 cm. Seedlings were pulled carefully to avoid the breakage of their roots. We applied cutting propagation for vegetative materials. Cutting materials were taken from the 50 cm-height or more dipterocarps wildings. We cut 10-15 cm of orthotropic branches and stored them immediately into zipped plastic bag and sprayed periodically once in an hour during transport from forest to hotel.

Cutting experiments and nurturing of the wildings were conducted in the nursery of CRRDC, Bogor - Indonesia. Cutting experiment was carried out based on the previous KOFFCO technique that was proven to be successful for many species of dipterocarps (Sakai et al. 2002; Subiakto et al. 2005). Wildings were kept in shaded nursery chamber of 1-meter high shade. The shade consists of 1 layer black netting roofing that would be able to reduce the light intensity to about 25 %. Every week the seedlings conditions were checked to determine the proper time for further treatment. After keeping them under the closed-shaded chamber for a period of 12 weeks, the plastics cover were opened and a month later the wildings were moved out to a more open area in nursery. Watering was done twice daily during their acclimatization stage in

the chamber, done once in the morning before 10.00 a.m. and once in the late afternoon after 4.00 p.m to ensure wildings receive enough water during their initial growing stage.

Data analysis

The occurrence of dipterocarps in each island was described by species by islands. Total numbers of survived cutting and wilding for the conservation purposes was described by definite numbers by genus.

RESULT AND DISCUSSION

Results

Species occurrence by island

Sumatera mainland has been known for its rich biodiversity on dipterocarps. Historically, the area was forested and owned enormous numbers of dipterocarps species. Compare to those the mainland, small islands surrounding Sumatera and Borneo (hereinafter refer to Riau islands), is still lacking information for its potency and biodiversity for their dipterocarps. Our exploration has opened up the fact that those islands still maintain various dipterocarps species grown naturally in their limited forest cover. Species occurrence is shown in Table 2.

Collection and conservation effort

The study was not only carried out to explore the dipterocarps grown naturally in each of island but also to collect genetic materials to be transplanted outside their natural habitat. This is necessary because deforestation and or forest conversion were serious threats occurred in islands. Table 3 showed numbers of genetic materials collected in each of the islands by genus. The numbers indicated current genetic materials survived and or grow well in the nursery after 1-1.5 years of acclimatization. All genetic materials have already been ready-to-plant stock piles.

Discussion

Singkep is an island in the Lingga Archipelago. It is separated from the east coast of Sumatera by the Berhala Strait. Singkep has undergone vegetation destruction due to extensive tin mining. Previous study by Sambas et al. (1999) identified the forest in island as mixed dipterocarps forest dominated by *Dipterocarpus rigidus* at higher crown level. At that time it was also predicted that *Dryobalanops sumatrensis* (known also as *Dryobalanops aromatica*) that was relatively abundant at sapling level would become the dominant species in the future. However, current exploration found that forest cover had extremely changed and only small patchy of forested land remained. We did not observe the previous estimation of the domination of *D. sumatrensis*. Other than *D. sumatrensis*, *Shorea falcifera* and *Shorea singkawang* are the dipterocarps that still can be found at the island but have no natural regeneration at the time of exploration.

Lingga is the closest neighbor island of Singkep. Compare to Singkep, Lingga maintain wider forested area with better condition of flora and fauna. The biggest reserved forest in Lingga known as GunungDaik (Mt. Daik) with reach 1206 masl and become the highest point in the island. Among four localities explored, we found 13 species with high abundance both for mature and their juveniles. Similar to those other neighboring islands, Lingga is also facing serious threats for illegal logging, mining, and encroachment. Our observation during field trip recorded that illegal logging may be the cause for species scarcity. With current exploitation rate, we might not see any mature dipterocarps in the next 5-10 years.

Batam is located in the crossroad of international trade which consequently makes the are as one of the centers of economic developments in Indonesia. The development is so fast that can give negative impacts on ecosystems because its fast economic growth and development have becoming a particular pressure for floral and faunal diversity. As the result, we found very heavily patched and fragmented forest area in the island of Batam. *Shoreacurtisii* and *Shoreaparvifolia* are among the most common species to meet in the area. However, as the intact forested land is quite difficult to find, both species are more common to see along road side in sub-urban area. Whenever there is wider development of the city, the dipterocarps of the island might disappear.

There are several reserved forests in Bintan Island, however most of the area have been facing serious threats of destruction caused by illegal logging, encroachment, forest conversion, mining, oil palm plantation, rubber plantation, and establishment of housing and villages. Forested area of Bintan Island determined to be only 22%. In Bintan, the good forest cover was in a limited area on the hills namely GunungBintan (Mt. Bintan). Extensive deforestation was occurred since long time ago where

Table 1. Exploration routes conducted in each of island

Name of Islands	Localities
Singkep	Muncung reserved forest
Lingga	Sungai Resun Sunngai Besar Mt. Daik track Tandawaterfalls
Batam	MukaKuning Sungai Ladi Bukit Bagi
Bintan	Bukit Enau (Mt. Bintan North entry) Bekapur (Mt. Bintan South entry) Lagoi
Bunguran (Natuna Besar)	Mt. Ranai reserved forest Sekunyam Semedang Secondary forest in Bunguran Barat and Bunguran Timur

Table 2. The occurrence of dipterocarps species in each of island

Island	Naturally growing species	Abundance
Singkep	<i>Shoreafalcifera</i>	++
	<i>Shoreasingkawang</i>	+
Lingga	<i>Shoreasingkawang</i>	++
	<i>Shoreacurtisii</i>	++++
	<i>Shoreafalcifera</i>	++++
	<i>Shore sp.1</i>	+++
	<i>Dipterocarpusgraclis</i>	+
	<i>Dipterocarpaceurincus</i>	+++
	<i>Dipterocarpuscoreacius</i>	+++
	<i>Dipterocarpusrigidus</i>	+
	<i>Dipterocarpuselongatus</i>	++++
	<i>Vaticaubonata</i>	++++
Batam	<i>Dryobalanopsaromatica</i>	++++
	<i>Hopeamirtifolia</i>	++++
	<i>Cotylelobiummelanoxynon</i>	++++
	<i>Shoreacurtisii</i>	+++
	<i>Shoreaacuminata</i>	+
	<i>Shoreabracteolata</i>	+
	<i>Shoreaparvifolia</i>	+
	<i>Dipterocarpu</i> sp.	+++
<i>Vaticasp.1</i>	+	
Bintan	<i>Hopeabeccariana</i>	+
	<i>Shoreacurtisii</i>	+++
	<i>Shoreafalcifera</i>	++++
	<i>Shorealeprosula</i>	+
	<i>Shoreamacroptera</i>	+
	<i>Dipterocarpu</i> sp.1	+
	<i>Dipterocarpu</i> sp.2	+
	<i>Vaticasp.2</i>	+
	<i>Vaticasp.3</i>	+
	<i>Hopeamengerawan</i>	+
Bunguran (Natuna Besar)	<i>Hopea sp.</i>	+
	<i>Shoreaovalis</i>	+
	<i>Shoreafalcifera</i>	++++
	<i>Shoreaparvifolia</i>	+
	<i>Shoreaatrinervosa</i>	+
	<i>Shoreascaberrida</i>	+
	<i>Shoreacurtisii</i>	+
	<i>Shoreasingkawang</i>	++
	<i>Shoreamaterialis</i>	++
	<i>Shoreasp.2</i>	++
<i>Shoreasp.3</i>	++	
	<i>Dipterocarpusvagineus</i>	++
	<i>Dipterocarpuspalembanica</i>	+
	<i>Dipterocarpaceurincus</i>	++
	<i>Dipterocarpuscrintitus</i>	++
	<i>Dipterocarpuscostulatus</i>	+
	<i>Dipterocarpu</i> sp.	+
	<i>Vaticaubonata</i>	+
	<i>Vaticateysmaniana</i>	+
	<i>Hopeabeccariana</i>	++
	<i>Hopeamirtifolia</i>	+++
<i>Cotylelobiumlanceolatum</i>	+	

Notes: + = < 5 individuals; ++ = 6-10 individuals; +++ = 11 -15 individuals; ++++ = > 15 individuals

Table 3. Number of genetic materials collected by genus

Island	Genus	Collection of genetic materials (wilding, cutting, seeds)	Notes
Singkep	-	-	None juveniles available at the time of exploration
Lingga	<i>Shorea</i>	200	Juveniles for particular species were abundant at the time of exploration
	<i>Vatica</i>	60	
	<i>Dryobalanops</i>	100	
	<i>Hopea</i>	100	
	<i>Cotylelobium</i>	100	
	<i>Dipterocarpus</i>	30	
Batam	<i>Shorea</i>	10	The forested lands were patchy and fragmented, mothers trees were often found along the side of the road
	<i>Vatica</i>	5	
	<i>Hopea</i>	10	
Bintan	<i>Shorea</i>	300	Mt. Bintan was still in good condition however the juveniles were abundant only for <i>Shorea</i> species at the time of exploration
	<i>Vatica</i>	10	
	<i>Dipterocarpus</i>	9	
	<i>Hopea</i>	10	
Bunguran (Natuna Besar)	<i>Shorea</i>	120	Juveniles of most species were abundant, however they were already too big (height > 50 cm) to be transplanted to nursery in Bogor
	<i>Dipterocarpus</i>	10	
	<i>Hopea</i>	20	
	<i>Cotylelobium</i>	10	

forest were cleared for *Uncaria gambier* plantation followed by rubber plantation. Secondary forests are now developed into denser canopy with the vegetation type of mixed dipterocarps forest (Gossling 2003). Among 5 reserved forests in the island, GunungBintan (Kecil and Besar) reserved forests are remained the best in term of biological condition. Even though there are fewer disturbances to GunungBintan, the remaining small fragmented forest cover have been put the species into serious threats for the extinction. Our study recorded at least there are 10 species of dipterocarps grown naturally in Bintan. Considering its small forested land, the numbers is somehow quite interesting with *Shorea falcifera* seemed to be the most abundance species occurred in the island.

Natuna Island in the South China Sea, retain considerable pristine forest habitats, which support an enormous diversity of flora and fauna. Comprehensive surveys of its faunal diversity have been carried out and determined the area as one of the biodiversity hotspot. Our study focused to explore the diversity of dipterocarps species in the biggest island namely Natuna Besar or Bunguran. Bunguran Island is famous for its unspoiled forested hill slopes of GunungRanai, the island's highest topographical feature. The occurrence of forested area together with its biodiversity is better compare to other four explored islands. The condition might happen due to its geographic position which is remote and difficult to be accessed. Its remote and less access have been an effective constrain for commercial timber activities by companies. In the island, we found at least 21 species of dipterocarps with the availability of natural regeneration. However we could

not bring many of the genetic because in average the available wildings were more than 30 cm in height and it would be too big to be transplanted in Bogor nursery. Bigger wilding will have lower survival rate during acclimatization.

Beyond our expectation, the forests in Riau Islands are still keeping an enormous numbers of naturally growing dipterocarps, however the future of dipterocarps remain uncertain due to forest conversion. For all five explored islands, we can collect and tend more than 1000 stock piles in our nursery even though it doesn't cover all existed species from all the islands visited. Since the rate of habitat change and modification are in the alarming level, collecting and transplanting species out of its natural habitat might be one of the conservation efforts to be done.

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