

Conserving the previously reported extinct tree species *Dipterocarpus cinereus*: An ex-situ approach for the species conservation strategy

Pelestarian jenis yang dilaporkan sudah punah *Dipterocarpus cinereus* (Dipterocarpaceae): Sebuah pendekatan ex situ

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Abstrak. Rachmat HH, Subiakto A. 2015. Pelestarian jenis yang dilaporkan sudah punah *Dipterocarpus cinereus* (Dipterocarpaceae): Sebuah pendekatan ex situ. *Pros Sem Nas Masy Biodiv Indon 1*: 560-564. *Dipterocarpus cinereus* (Dipterocarpaceae) merupakan salah satu jenis dipterokarpa yang dilaporkan telah punah berdasarkan daftar merah IUCN (IUCN Red List). Ekspedisi Tim LIPI pada kuartal pertama tahun 2013 memastikan bahwa jenis ini masih bisa ditemukan di habitat aslinya, yaitu Pulau Mursala. Namun demikian, sampai dengan saat ini baru informasi ketersediaannya saja yang ada, aksi lanjutan berupa multiplikasi maupun konservasi jenis di luar habitatnya yang sangat tinggi gangguan di Pulau Mursala masih belum ada. Penelitian ini bertujuan untuk mengumpulkan materi genetik tumbuhan baik berupa anakan alam maupun bahan setek untuk dikembangkan di persemaian sebagai upaya strategi pelestarian jenis secara ex-situ. Eksplorasi ke P. Mursala berhasil mengidentifikasi adanya anakan alam dan membawa 12 di antaranya keluar dari habitat aslinya untuk dikembangkan lebih lanjut di persemaian. Selain itu, sebanyak 49 bahan setek dari anakan alam tingkat pancang juga berhasil dibawa ke persemaian di Puslit Konservasi dan Rehabilitasi Bogor. Anakan alam diperlakukan di dalam ruangan tertutup berkelembapan tinggi dan naungan penuh, sementara perbanyakan vegetatif melalui pembuatan 49 setek dilakukan dengan menggunakan teknik KOFFCO. Hasil penelitian menunjukkan bahwa jenis ini sangat sensitif terhadap perubahan lingkungan, sampai dengan 16 bulan pengamatan, kemampuan hidup anakan sebesar 58%, sedangkan material setek tidak ada satupun yang menunjukkan kemampuan berakar meskipun sudah ditunggu sampai dengan minggu ke-36. Kemelimpahan cahaya diprediksi sebagai faktor yang menyebabkan kegagalan perbanyakan vegetatif dengan setek, hal ini didukung dengan kondisi anakan alam yang sampai saat ini masih juga belum bisa dilepas ke tempat yang lebih terbuka.

Kata kunci: *Dipterocarpus cinereus*, punah, IUCN Red List, ex-situ, Pulau Mursala

Abstract. Rachmat HH, Subiakto A. 2015. Conserving the previously reported extinct tree species *Dipterocarpus cinereus*: An ex-situ approach for species conservation strategy. *Pros Sem Nas Masy Biodiv Indon 1*: 560-564. *Dipterocarpus cinereus* (Dipterocarpaceae) is a dipterocarp species which is previously reported extinct based on IUCN Red list. Exploration conducted by Indonesian Science Institute (LIPI) in early 2013 confirmed that this species is still growing naturally in their habitat in Mursala Island, North Sumatra. Despite the Mursala Island is experiencing a high risk of habitat alteration, there has not been any information available related to their regeneration and or their conservation strategy. This study was aimed to collect genetic materials of the species both available as wildings and or cutting materials to be transplanted and propagated in the nursery as ex-situ conservation effort of the species. Exploration in Mursala Island identified the occurrence of the wildings in their natural habitat and took 12 of them out of the site to be transplanted in the nursery. Fouty nine cuttings materials originated from saplings stage were also taken to the nursery at CRDCC for vegetative propagation experiment. Wildings were kept in a shaded chamber with high humidity, while vegetative propagation was conducted using KOFFCO (Komatsu-Forda Fog Cooling System) technique. The result showed that the species was very sensitive to environmental changes, until 16 months of observation the wildings survival rate was 58%, while none of cutting materials was rooted until weeks 36th. Light abundance was predicted as the key factor for the failure of the vegetative propagation, which is also reflected from their wildings that still require much shading and cannot yet be released to the more open area.

Keywords: *Dipterocarpus cinereus*, extinct, IUCN Red List, ex-situ, Mursala Island

INTRODUCTION

Indonesia is known for its mega biodiversity, a home for a large number of rare, endangered and endemic plant species. Its tropical rain forest own thousands of plants species from small lichen to a giant dominant tree of

Dipterocarpaceae. *Dipterocarpus cinereus* is one tree species in the dominant family of Dipterocarpaceae. In general, trees in *Dipterocarpus* species are well known and highly targeted for its timber as excellent materials for boat or construction. *D.cinereus* is a dipterocarp categorized as Extinct in the IUCN Red List since 1998. According to

Ashton (1998), *D. cinereus* was determined endemic only to Mursala, a small island in Tapanuli Tengah, North Sumatera. It was first collected in 1916 asserted to be *Dipterocarpus cinereus* in 1928 by Peter Ashton.

D. cinereus was rediscovered in March-April 2013 by a team from Indonesian Science Institute, and reported to be very few mature trees left inside the forest (Kusuma et al, 2013). However, there is so little information available related to this species and further information regarding its niche requirements and population status are unknown. Furthermore, in September 2013 a team from Conservation and Rehabilitation Research and Development Center - Forestry Research and Development Agency carried out a mission for transplanting the species outside their natural habitat and initiate an ex-situ conservation technique.

The objectives of the study were as follow: a) to map detailed location of the remaining mother trees and their juveniles; b) to take out propagation materials (cutting, seed, seedlings, whatever available) and observe their survival rate and growth outside its natural habitat; and c) to propose a proper conservation technique of the species..

MATERIALS AND METHODS

Research area

Mursala is a 8,000 ha island on the west coast of the province of North Sumatera. It is a serene island covered

with green trees and famous for its waterfall which is directly fall into ocean. The island is popularly also known as Mansalaar Island and a home for many plant families, including Dipterocarpaceae. Based on the report from LIPI team, it is inhabited by various species of dipterocarps, including the reportedly extinct *D. cinereus* (Kusuma et al. 2013). To get to Mursala Island, we first reach the town of Sibolga, approximately 350 Km from Medan, and go to the island by renting boat.

Methods

Genetic source collection

Field visits were conducted for 8 days in September 2013 to document the remaining populations of *D. cinereus*. Before going to the forests, discussion and interview were held with several key local persons in the islands to determine the most probable area for conducting exploration. Based on the discussion and interview, we delineated the route for exploration and determined three routes needed to be explored during our visit. We ask the head of local custom to guide our route of exploration, each transect was started from the area near the coast and climbed up to the hill top of the island. In average 2 days trip was needed for every route unless the last route which is the shortest. 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 route. The length of each route was varied to 3-5 km. In this case, we only noted detailed information of the

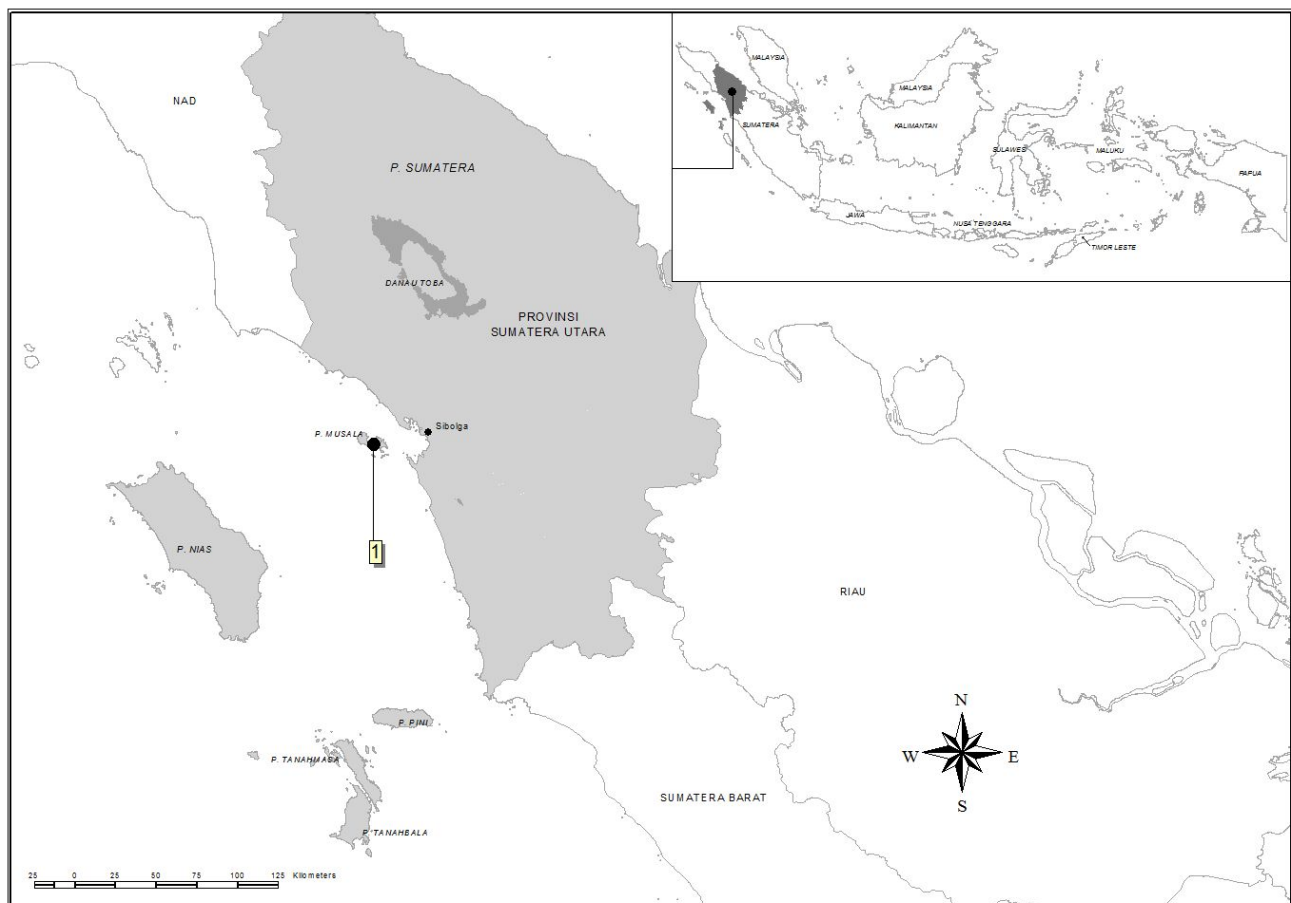


Figure 1. Research site of Mursala Island, North Sumatera

D. cinereus's existence. However, we still briefly recorded the data of others dipterocarps (species, abundance) and took some genetic materials to be raised in nursery whatever available (seed, wildings, cutting materials). For the existence of *D. cinereus*, the trees were geographically marked with global positioning system (GPS) and the number of mature trees, saplings and seedlings was recorded. However, we do not publish their exact GPS position due to consideration for its conservation objective.

Vegetative propagation and tending of wildings

Cutting materials were taken from the 1 m-height or more wildings. We cut 15-20 cm of ortotroph and plagiotroph branches and stored them immediately into zipped plastic bag and sprayed periodically once in an hour during transport from forest to the camp. Due to heavy rain and storm at the time of collection, there were no cutting materials taken from mature trees because of the impossibility for climbing up the trees. For generative materials, we took 12 seedlings among 30s those available on site. Only those less than 20 cm were taken to be transplanted at our nursery in Bogor. Seedlings were pulled carefully to avoid the breakage of their roots. To minimize the stress during transport to the camp, we pulled out the wildings together with the attached soil.

Transporting from forest to camp was a quite risky because it triggered stressful condition for seedlings. Thus, we covered all seedlings and cutting materials by many layers of paper sheet and wrapped carefully by plastic bag to avoid heavy rain and wind together with splashing sea water coming into small boat and destroy all the specimens during 2 hour trip in the ocean. After arriving to the camp, we minimize evapotranspiration by cutting their leaves until it remained about 3-4 leave with only 1/3 to its original size. We packed all the materials into stereo foam box together with moist coco peat powder to maintain the moisture during transport.

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). Wildings were kept in shaded nursery chamber of 1-meter high shade. The high shade consists of 2 layers black netting roofing that would be able to reduce the light intensity to about 50%. Every week the seedlings conditions were checked to determine the proper time for further treatment. After keeping them under the shade for a period of 12 months the seedlings and wildings were moved out to a new shaded nursery chamber of 3-meter high with 1 layer black netting roofing that would be able to reduce the light intensity to about only 25%. Watering was done twice daily, preferably once in the morning before 10.00 a.m. and once in the late afternoon after 4.00 p.m to ensure the seedlings and wildings receive enough water during their initial growing stage.

Data analysis

The successful rate of cutting propagation was delivered by the percentage of rooted cutting while for wildings were described by the percentage of survived wildings. Factors those affecting the percentage of rooted cutting and survived wildings were reported descriptively.

RESULT AND DISCUSSION

Results

Existence and distribution of the remnant trees and their juveniles

During 5 days of field exploration in 3 different probable routes, we only found three individual of mother tress left in the island. This finding was congruent with previous exploration team of Indonesian Science Institute that stated only few trees left. However, for conservation purposes we avoid to publish the GPS position of the trees and their juvenile. Detailed position can be delivered upon request. *D. cinereus* are grown in forest after mangrove formation in the coastal line, along the hillock slopes with rich in moisture and no open canopy. Their juveniles were quite difficult to find for the first time because they were all grown inside the shade of cover plants. Removal of the cover plants were needed to expose the existence of the seedlings. At the time of exploration, we discovered total number of 30s seedlings and saplings and all were located not far from the mothers trees (5-30 meter radial distance from the nearest mother trees) with the biggest sapling was 2 cm in diameter and 1.6 m in height. Vegetative mode of propagation was collected from such juvenile individuals. The most common aggregated seedling populations were found within 5-10 m radial distance. However, there was no seedling or sapling population beyond 30 m radial distance of the mother trees. Based on the existence of their juvenile, the population was characterized by the absence of the pole generation.

Rooted cutting

The successful rate of cutting propagation was described by the percentage of rooted cutting in the end of observation. In general, for most of the dipterocarps the rooting ability were checked and counted in the 12nd week after cuttings materials planted. However the rooting ability period was varied among species. In several cases, at the end of observation or in the end of certain period, the condition of cutting materials might appeared to be green and fresh but never rooted. The similar case seemed to happen for *D. cinereus*, where all materials were un-rooted even after 24 weeks of observation period. Figure 1 showed the result of cutting propagation experiment by weekly observation.

Survived wildings

Proper and careful tending of the potted wildings is very important in order to ensure high survival percentage. Potted wildings of dipterocarp species require protection

from strong sunlight. Weekly monitoring were carried out to monitor further necessary tending since it was the first experience for the species without any background information available for their silvicultural technique. Nursery conditions were checked every week to determine the proper time for out planting of the first shaded chamber. It usually takes 3 months for common dipterocarps species to be transplanted in shaded chamber before out planting to more open area. However, the similar condition could not be applied for *D. cinereus* wildings. It needed much longer period for wildings to be kept in shady moist chamber. Even after 12 months of storage in first 50%-blocked-sunlight chamber, it still needed to go to a second 25%-blocked-sunlight chamber. At month 12th when transplanting from 1st chamber to 2nd chamber (leveling up the sunlight intensity) executed, the wildings survival declined from 10 to 7. Figure 2 showed numbers of wilding survived by monthly observation.

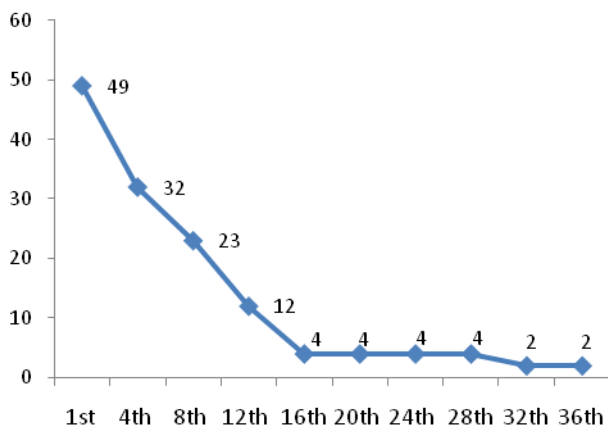


Figure 1. Numbers of cutting showing fresh and green leaves performance at every 4 weeks interval of observation

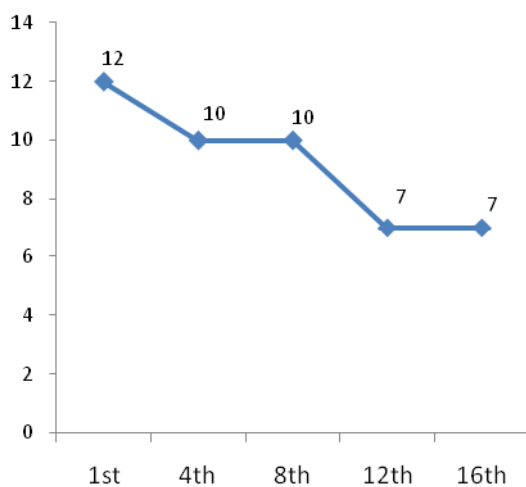


Figure 2. Numbers of survived wildings by months

Discussion

Based on direct exploration, we can conclude that the species is somehow still existed regardless their *Extinct* status in IUCN Red List. This give us two-faced coin facts, first is the relieving fact that actually *D. cinereus* is still existed and second is the very high responsibility to assure their existence in future. Both facts are pointed on the same conclusion that is the urgent strategy for its conservation. Mursala islands are divided into two statuses, the inner forest are determined as limited production forest while outer forest along its coastal lines are designated as reserved forest. When delineated the GPS position for *D. cinereus*, all trees are grown inside the reserved forest. This condition automatically gave the protection status for all trees grown in reserved forest. However, we should bear in our mind that area adjacent to coastal lines of an islands usually receive higher pressure on their future existence. As we observed during our field exploration, opening up the forest along the coastal lines were somehow extensive. The island villagers have been starting to open up the forest for timber extraction, establish garden and develop rubber plantation. The reduction of forest cover is leading directly to the endangerment and local extinction of many plant and animal species, including many ecologically and economically timber trees within the family Dipterocarpaceae (Sodhi et al. 2010). This is exactly the serious threats for *D. cinereus* grown endemically in the island. The consequences of reducing forest cover could be more severe in Mursala as Trainor (2007) determined islands are inherently vulnerable to habitat loss and modification.

The condition has forced us to think about alternative strategy for the species conservation. When in situ conservation was not good enough to assure the species sustainability, ex-situ conservation become an urgent task to do. This is the reason for why the study needs to be carried out, to assure the existence of the species by cultivating and transplanting the trees outside their natural range. Similar to those of conservation strategy for highly commercial and endangered conifer *Taxus sumatrana* (Hidayat et al. 2014), the compulsory in-situ conservation strategy must be followed by ex-situ conservation program. As those *T. sumatrana* can be collected from several populations and or localities, it will be different for *D. cinereus* where genetic materials could only be collected to those of remnant trees and juveniles for vegetative propagation and it will be really necessary to monitor the fruiting season to collect and germinate as many seed as it can for generative propagation.

The study showed that both cutting technique and nursery tending for wildings of *D. cinereus* require excessive shading for their successfulness. Even though none of cutting materials was rooted, the initial study showed that common procedure that applied for cutting propagation of others dipterocarps (Sakai et al. 2002) was needed to modify for *D. cinereus*, especially in light intensity. Several studies also determined coexistence through niche diversification along light (Condit et al. 2006, Russo et al. 2008) and agreed to be important in

contributing to the maintenance of tropical diversity across multiple spatial scales (Wright 2002; Leigh et al. 2004).

Most of studies (Ashton et al. 1995; Ashton et al. 1997; Barker et al. 1997) reported better growth of Dipterocarp seedlings in partial shade or in moderate light intensity. However, niche diversification is prominent among dipterocarps and it explains the tropical rain forest diversity. A standard KOFFCO (Sakai et al. 2002) only applies one sheet of shaded netting to cover the propagation box at the earliest time of transplanting, however *D. cinereus* is proposed to have 2-3 sheets of shaded nets to be applied. The condition was also supported by wildings condition. Based on our nursery experience, common dipterocarps wildings in general only need 3 months to be kept in moist-shaded-chamber before transplanting into open space at nursery, but *D. cinereus* is still need to be kept at shaded moist chamber even they reached almost their 2nd year after transplanted. Contrary to those of *D. cinereus*, the faster growing species, *Shorea argentifolia*, *Shorea leprosula* and *Shorea parvifolia*, tended to be more vulnerable to high soil moisture in terms of mortality (Born et al. 2015), while Kenzo et al. (2007, 2011) determined that light conditions is one of success-determining factors for planted dipterocarp seedlings. Moist is also factors that is determined to be important for wilding survival. To keep the chamber maintain enough moisture, we do watering. However watering might be a bit tricky. The amounts of watering were needed to be controlled to ensure wildings receive the right amount of water. Too much water may be harmful because too moist soil condition in the polybags will be conducive for the growth of certain damping-off fungi which may pose health hazard to the wildings, while insufficient watering will lead to wilting and stunted growth of the potted wildings.

Considering the available number of mature and juvenile individuals of *D. cinereus*, in situ conservation strategy is a compulsory. The need to increase the conservation status of the island to higher status such as natural reserved may act as one of in-situ conservation strategy. Since the forest in Mursala island is facing high threats of modification and conversion, ex-situ conservation strategy must be initiated also as soon as possible. Propagating trees in nursery is needed to carry out as produced stock piles can be replanted into their natural habitat and or other sites which are ecologically suitable. Our study also concluded that *D. cinereus*' wildings can be transplanted out of its habitat with careful tending during their initial adaptation stage in the nursery. Not like other common dipterocarps, the wildings could require longer period with more intensive caring since the species seems to be very sensitive to the excess light. Initial study on vegetative propagation by cutting also shed a light for further experiment on their vegetative propagation. KOFFCO system might be successful to propagate the species by means of cutting; however there will be some

procedure need to modify especially for reducing light intensity of the propagation box.

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