Stem Abundance, Basal Area and Species Richness of Intact and Degraded *Kerapah* Forest Plots in Lumut, Brunei Darussalam

Wardah Tuah[1], Salwana Md. Jaafar[1], Hazimah Din[1], Faizah Metali[2], Rahayu Sukmaria Sukri[1]*

[1]Institute for Biodiversity and Environmental Research, Universiti Brunei Darussalam
[2]Environmental and Life Sciences Programme, Faculty of Science, Universiti Brunei Darussalam

**corresponding author email: salwana.jaafar@ubd.edu.bn*

Abstract

Kerapah forests are a rare form of permanently waterlogged tropical heath forest that develop on highly acidic, nutrient-poor soils and support a distinctive flora adapted to harsh edaphic conditions. In Brunei Darussalam, these forests are increasingly threatened by deforestation and degradation, yet quantitative information on their forest structure and species composition remains limited. This study presents baseline structural and floristic data by comparing stem abundance, basal area, and species richness between intact *Kerapah* forest stands and areas that were completely cleared in 2012 and allowed to regenerate naturally for five years prior to sampling in Lumut, Brunei Darussalam. Six plots (three intact and three cleared), each measuring 15 × 50 m, were established, and all trees with diameter at breast height (DBH) ≥ 6 cm were measured and identified to species level. Forest structural attributes, diameter class distribution, and species composition were analysed and compared between forest conditions. Intact forest plots exhibited substantially higher stem abundance, basal area, and species richness per plot than cleared forest plots (101.3 ± 14.3 vs. 2 stems, 41.9 ± 7.7 vs. 0.08 m^2 ha^{-1}, and 27.7 ± 1.9 vs. 2 species, respectively). Diameter class distribution in intact forests was characterised by a high proportion of pole-sized and young adult trees, indicating ongoing regeneration, whereas cleared plots contained only pole-sized individuals, reflecting severe structural simplification and limited recovery. The intact plots supported multiple tree species listed on the IUCN Red List, including Critically Endangered (*Gonystylus bancanus*), Endangered (*Dryobalanops rappa*, *Rubroshorea pachyphylla*), and Vulnerable species (*Lithocarpus andersonii*, *Madhuca curtisii*, *Rubroshorea albida*), underscoring the high conservation importance of intact *Kerapah* forests. In contrast, cleared plots lacked threatened species and characteristic dominants, possibly because 5 years was too short to observe any meaningful regeneration. This study provides an important ecological baseline to inform evidence-based rehabilitation, conservation planning, and long-term management of *Kerapah* forests in Brunei Darussalam.

Index Terms: conservation ecology; diameter class distribution; forest structure; IUCN Red List; threatened tree species; tropical heath forest

1. Introduction

Heath forests are a distinctive type of tropical lowland rainforest that develop on acidic, nutrient-poor, sandy soils and are commonly known in Borneo as *Kerangas* forests.[1] These forests occur in small and fragmented patches across Brunei Darussalam, Sabah, Sarawak, and Kalimantan.[2-4] Due to extreme edaphic conditions, heath forests support specialised plant communities adapted to low nutrient availability, acidic soils, and water stress.[2,3,5] Structurally, heath forests are characterised by relatively short trees, predominantly pole-sized individuals, and lower basal area compared to mixed dipterocarp forests.[2,3,6,7] Floristically, they are often dominated by Myrtaceae and include distinctive taxa such as *Nepenthes* spp. and other sclerophyllous species.[3,8]

In Brunei Darussalam, heath forests occupy a limited area and are mainly distributed in coastal and lowland regions of the Brunei-Muara, Tutong, Belait, and parts of the Temburong districts.[2,3,9] Under permanently waterlogged conditions, some heath forests develop where an impervious iron hardpan beneath sandy topsoils restricts drainage, giving rise to *Kerapah* forests.[10-11] *Kerapah* forests are transitional ecosystems between heath and peat swamp forests and are characterised by shallow peat layers, poor drainage, and highly acidic, nutrient-poor soils.[4,12] These permanently waterlogged heath forests are of high conservation value in Brunei Darussalam due to the presence of threatened tree species, including *Agathis borneensis* (Endangered), *Rubroshorea albida* (Vulnerable), and *Rubroshorea pachyphylla* (Endangered).[3,8,13]

Despite their ecological significance, *Kerapah* forests remain poorly studied in Brunei Darussalam. Most existing work have focused on floristic descriptions rather than quantitative assessments of forest structure.[10,14,15] Their limited distributions, mostly in unprotected areas, increase threats from deforestation and degradation caused by fire, land clearing, infrastructure development, and biological invasion.[3,16,17] Severe disturbances such as complete vegetation clearance often lead to reduced stem density, basal area, and species richness, as well as loss of characteristic heath forest species, yet quantitative information on how forest structure and species composition differ between intact and degraded stands remains limited.

This study aims to investigate differences in stem abundance, basal area, and species richness differ between intact and cleared *Kerapah* forests in a selected location at Lumut, Brunei Darussalam. By providing a direct structural and compositional comparison, this study establishes baseline ecological information that is essential for assessing forest condition and informing future conservation and management of *Kerapah* forests in Brunei Darussalam.

2. Material and Methods

2.1 Study site

The study was conducted in 2015-2017 in a *Kerapah* forest located in Lumut, Belait District, Brunei Darussalam (4°35′ N, 114°25′ E; elevation 20 - 40 m; see ***Figure 1***). The climate of the study area is humid tropical, with a mean annual rainfall of 180 mm month^{-1}, mean relative humidity of 85% and mean annual temperature of approximately 27–28°C, with mean daily maximum temperature of 33°C during the study period.[18] Using a rainfall threshold of >150 mm month^{-1} to define wet months[19], the wet season generally occurred from June to December, while drier conditions prevailed from January to August.

Within the study site, a 16-km water pipeline constructed in 2012 by the Brunei Liquiefied Natural Gas (BLNG) Company Sdn. Bhd. resulted in the complete clearance of vegetation along a 20-m-wide corridor passing through *Kerapah* and peat swamp forests. Vegetation removal exposed bare peat soils and increased fire risk in adjacent forest areas, particularly during dry periods (Jonathan Davies, *personal communications*). The removal of canopy cover and surface vegetation likely altered local hydrological dynamics, soil moisture regimes, and microclimatic conditions within the cleared corridor compared to adjacent intact forests. Following clearance, the corridor was left to regenerate naturally and became dominated by non-woody vegetation such as sedges, ferns, and grasses. After the vegetation was cleared during pipeline construction in 2012, no active vegetation suppression or maintenance was conducted within the study plots, and the corridor was allowed to regenerate naturally. At the time of sampling (2015–2017), the cleared areas were dominated primarily by non-woody vegetation. We classified areas within the pipeline corridor that were completely cleared of vegetation in 2012 and left to regenerate naturally as severely degraded *Kerapah* forest. At the time of sampling (2015–2017), these areas represented five years of post-clearance regeneration. Previous soil analyses from the study area indicate strongly acidic conditions (mean pH ≈ 3.1), low nutrient concentrations, and high waterlogging typical of *Kerapah* forest soils.[12]

2.2 Plot establishment

Plot establishment and vegetation surveys were conducted between December 2015 and February 2017. Six rectangular plots were established: three plots located in intact forest and three plots located in cleared forest (see ***Figure 1***). Each plot measured 15 × 50 m (0.075 ha) and plots were separated by at least 20 m. Intact forest plots were located approximately 50 m from the forest edge, while cleared forest plots were established within 5 m of the corridor edge. Three cleared forest plots were established within the cleared corridor. Two of these plots contained no trees with DBH ≥ 6 cm at the time of sampling, while one plot contained two trees meeting the DBH threshold. Structural attributes for cleared forests are based on all three plots (n = 3), including zero values where no trees were recorded.

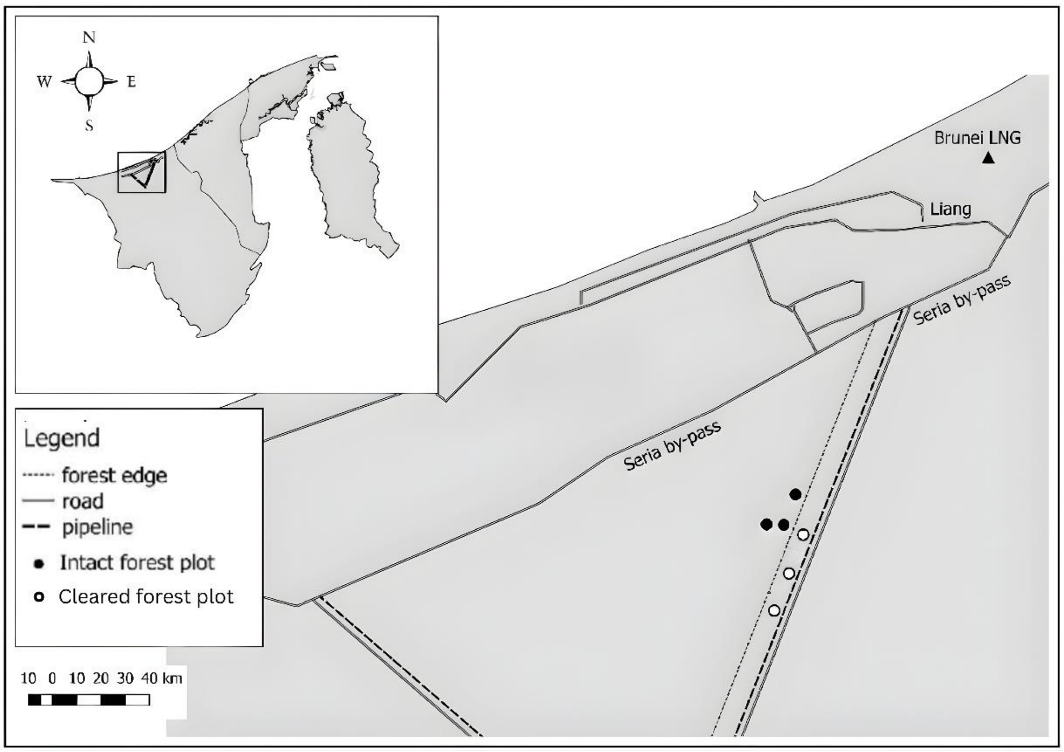

Figure 1. Location of the study site at *Kerapah* forest in Lumut, Belait District (4°35' N, 114°25' E). The location of the study site within Brunei Darussalam is marked in square box and shown in the inset. Three plots were set up in intact *Kerapah* forest and three plots in cleared *Kerapah* forest.

2.3 Vegetation survey and data analysis

Within each plot, all trees with diameter at breast height (DBH) ≥ 6 cm were tagged, counted, and identified to species level. The ≥ 6 cm threshold was selected to align with the original field inventory protocol and to focus on established woody stems; this threshold was applied consistently across all plots. DBH was measured at 1.3 m above ground using a diameter tape, following standard forest inventory protocols.[20] For multi-stemmed individuals, all stems with DBH ≥ 6 cm were measured separately, and a single representative DBH value per individual tree was calculated by averaging the DBH measurements of all stems. For buttressed trees, DBH was measured 50 cm above the buttress, and for trees with stem swellings at breast height, measurements were taken immediately below the swelling. Trees were grouped into diameter size classes of 6 - 9 cm, 10 - 29 cm, 30 - 49 cm, 50 - 69 cm, and ≥ 70 cm DBH for analysis of size-class distributions. Trees with DBH between 6 and 9 cm were categorised as pole-sized trees.

Basal area for individual trees was calculated following Hedl et al.[21] as $\pi(d/2)^2$, where d is DBH in cm. Basal area values were summed for each plot and scaled to a per-hectare basis based on plot area (0.075 ha). Species identifications were conducted in the field with assistance from staff of the Brunei Forestry Department Herbarium (BRUN), and voucher specimens were collected where necessary for verification against the BRUN collections.

DBH size-class distribution, total stem abundance across replicate plots, mean stem abundance per plot, mean basal area per hectare, mean species richness per plot, and total stem abundance per species were calculated for trees with DBH ≥ 6 cm in intact and cleared forests.

2.4 Statistical analysis

Two cleared plots contained no trees with DBH ≥ 6 cm, and one plot contained two trees. Structural attributes for cleared forest are presented as mean ± standard error across three plots (including zeros). Due to low replication and zero inflation, inferential statistical comparisons were not performed. Descriptive statistics were used to summarise stem abundance, basal area, and species richness for trees with DBH ≥ 6 cm for all intact forest plots and one cleared forest plot. For intact forest plots, values are presented as mean ± standard error based on three replicate plots. All data processing and analyses were conducted in R version 4.5.2.[22]

3. Results and Discussions

Differences in forest structure and composition were observed between intact and cleared *Kerapah* forest plots in Lumut. Intact forest plots recorded a total of 304 trees with DBH ≥ 6 cm, whereas only two trees meeting this threshold were recorded in only one of the cleared forest plots (see ***Table 1***). The two trees in cleared plots were pole-sized individuals (6 - 9 cm DBH), with no trees exceeding 9 cm DBH. In contrast, intact forest plots contained a large number of pole-sized trees and young adult trees (10 - 29 cm DBH), with stem abundance declining as DBH size class increased. This size-class structure, characterised by dominance of smaller diameter classes, is typical of many undisturbed tropical forests, including heath forests.[23,24]

In intact forest plots, basal area was largely contributed by pole-sized and young adult trees, with relatively few mature trees (≥ 30 cm DBH; see ***Table 1***), a structural pattern characteristic of heath forests, which typically exhibit lower canopy stature and limited representation of large-diameter trees. This pattern aligns with previous studies showing that heath forests typically exhibit low basal area and a dominance of smaller diameter classes compared to mixed dipterocarp forests.[7,25,26] Similar diameter distributions have also been reported for waterlogged heath forests in Brunei.[27]

Intact plots recorded a mean basal area of 41.92 ± 7.77 $m^2\ ha^{-1}$ and mean species richness of 27.7 ± 1.86 species per plot, while cleared forest plots recorded extremely low mean basal area per hectare and mean species richness (n = 3 plots), with two of the three plots containing no trees meeting the DBH threshold (***Table 2***). Such strong contrasts indicate that regeneration of trees in cleared forest proceeds slowly, a pattern that may be especially true for the nutrient poor and water-logged areas studied here. Suppression of seedlings or seed germination failure may also play a role because of the dense layer of herbs covering the area.

A total of 29 tree families and 58 species were recorded across intact forest plots, compared to only two families and two species in cleared plots (see ***Table 3*** and ***Figure 2***). Myrtaceae was the most species-rich family in intact plots, followed by Anacardiaceae, Dipterocarpaceae, and Sapotaceae. The dominance of Myrtaceae and the presence of Dipterocarpaceae and Sapotaceae are consistent with previous descriptions of intact heath and *Kerapah* forests in Brunei and Borneo.[2,10,23] Only two families (Fabaceae and Sapindaceae) were shared between intact and cleared plots, each represented by a single species in cleared forest, indicating substantial loss of floristic complexity following complete vegetation clearance.[4]

Notably, several tree species recorded exclusively in intact forest plots are listed on the IUCN Red List (see ***Appendix 1***), including Critically Endangered (*Gonystylus bancanus*), Endangered (*Dryobalanops rappa*, *Rubroshorea pachyphylla*), and Vulnerable species (*Madhuca curtisii*, *Lithocarpus andersonii*, *Rubroshorea albida*, *Mezzettia umbellata*). The absence of pole-sized and larger individuals (DBH ≥ 6 cm) of these threatened taxa in cleared plots highlights the critical role of intact *Kerapah* forests as refugia for conservation-priority species and underscores the loss of established tree structure following complete vegetation clearance, although it remains possible that smaller seedlings or saplings (< 6 cm DBH) may be present but were not captured in this study due to the chosen diameter cutoff of 6 cm dbh.[30,31]

Table 1. Size class distributions and total stem abundance of trees in different diameter at breast height (DBH in cm) classes in all replicate plots of intact and cleared *Kerapah* forests (n = 3 plots per forest type). Trees with 6-9 cm DBH were categorised as pole-sized trees.

DBH class (cm)	**Total stem abundance**	
	Intact	**Cleared**
6-9	119	2
10-29	143	0
30-49	37	0
50-69	4	0
≥ 70	1	0
Total	304	2

Madhuca curtisii (Sapotaceae), a Vulnerable species on the IUCN Red List, was the most dominant species in intact forest plots, accounting for 64 stems (see ***Appendix 1***), and strongly influenced both stem abundance and basal area. This species has been previously recorded as a characteristic tree of swampy heath forests in Brunei, often occurring in association with *Rubroshorea albida*.[32] Other abundant species in intact plots, including *Alphonsea johorensis*, *Gymnostoma nobile*, *Mezzettia umbellata* and *Tetractomia tetrandrum* have also been reported from waterlogged heath and peat swamp forests in Brunei and neighbouring regions.[2,10,32]

The absence and very low abundance of pole-sized and larger threatened tree species (DBH ≥ 6 cm) in cleared plots, representing five years of natural regeneration following complete vegetation clearance, indicates slow short-term recovery of forest structure and established tree diversity. Smaller seedlings or saplings (< 6 cm DBH) may be present but were not assessed in this study, and longer-term monitoring will be necessary to determine whether natural regeneration can ultimately restore the structural and conservation value of *Kerapah* forests.[33] Many threatened species recorded in intact plots are slow-growing and may experience constraints in establishment and recruitment under altered hydrological and edaphic conditions following vegetation clearance[4,34], reinforcing the need to prioritise protection of remaining intact stands. Additionally, the absence of larger trees and extremely low stem density in cleared plots are likely a consequence of complete vegetation clearance associated with the establishment of the fire corridor along the Brunei LNG pipeline in 2012. Five years after disturbance, the presence of only two pole-sized trees (DBH ≥ 6 cm) across the three cleared plots suggests slow recovery of forest structure. Given the nutrient-poor and waterlogged conditions characteristic of *Kerapah* forests, five years may be insufficient for many regenerating individuals to reach the ≥ 6 cm DBH threshold, and therefore our findings primarily reflect early stages of structural recovery. Recovery trajectories in Bornean forests vary with disturbance type and severity; while selectively logged forests often recover relatively rapidly, slower structural recovery is more typical following stand-replacing disturbances such as complete vegetation clearance.[35,36] These findings emphasise the vulnerability of *Kerapah* forests to degradation and underscore the importance of conserving remaining intact stands in Brunei Darussalam.

Table 2. Structural attributes of trees with DBH ≥ 6 cm in intact and severely cleared *Kerapah* forest plots five years after disturbance. Values are presented as mean ± standard error (n = 3 plots per forest type). Two cleared plots contained no trees meeting the DBH threshold; zero values were included in calculations. Inferential statistical comparisons were not performed due to low replication and zero inflation in cleared plots.

	Forest type	
	Intact	**Cleared**
Stem abundance (number of stems)	101.3 ± 14.3	0.67 ± 0.67
Basal area per hectare (m^2 ha^{-1})	41.92 ± 7.77	0.03 ± 0.03
Species richness (number of species)	27.7 ± 1.86	0.67 ± 0.67

This study was limited to a single *Kerapah* forest site in Lumut, Belait District, Brunei Darussalam, and the findings therefore reflect conditions at this locality only. In addition, the number of plots established in each forest condition was limited (three intact and three completely cleared plots), which constrains the generality of the results to other sites and to less severe forms of forest disturbance in Brunei and Borneo. Despite this, the pronounced contrasts observed between intact and completely cleared *Kerapah* forest plots indicate that the structural and compositional differences reported here are ecologically meaningful and warrant further investigations with increased within- and between-site replication. Future studies should therefore aim to replicate similar plot-based comparisons across additional *Kerapah* forest sites in Brunei Darussalam and Borneo to assess whether the patterns observed in Lumut are consistent across this rare forest type. Increasing plot replication and incorporating longer-term monitoring via repeated censuses would also improve understanding of forest recovery trajectories following complete vegetation clearance. Further integration of environmental variables, such as soil properties and hydrological conditions, may help to clarify mechanisms underlying differences in forest structure and species richness between intact and completely cleared *Kerapah* forest areas.

The results of this study highlight the ecological vulnerability of *Kerapah* forests to deforestation and degradation. The very low stem abundance, basal area, and species richness recorded in plots that were completely cleared and allowed to regenerate for five years emphasise the importance of conserving remaining intact *Kerapah* forest stands in Brunei Darussalam as critical reservoirs of biodiversity and forest structure.

It is important to note that the cleared plots represent areas that were completely cleared of vegetation in 2012 and thus reflect a severe disturbance type. The five-year recovery period at the time of sampling is relatively short for tropical forest regeneration, particularly under permanently waterlogged and nutrient-poor conditions in *Kerapah*. Therefore, the patterns observed in this study should not be generalized to all forms of forest disturbance, but rather interpreted within the context of severe, recent clearance.

The use of a DBH threshold of ≥ 6 cm may also underestimate early regeneration in recently cleared areas, as many regenerating individuals may not yet have reached this size class. Future studies incorporating smaller size classes (e.g., seedlings and saplings < 6 cm DBH) would provide a more complete understanding of post-disturbance recovery trajectories. Although many tropical forest inventories adopt a ≥ 5 cm DBH threshold, the use of ≥ 6 cm in this study reflects the original sampling design and ensures internal consistency across forest types.

Table 3. Family distribution of trees with diameter at breast height (DBH) ≥ 6 cm in *Kerapah* forests: (A) families recorded exclusively in intact *Kerapah* forest plots, and (B) families recorded in both intact and cleared *Kerapah* forest plots. Values indicate number of species pooled across three plots per forest type.

A.	**Family exclusive to intact *Kerapah* forest**	**Number of species**
	Myrtaceae	7
	Anacardiaceae, Dipterocarpaceae, Sapotaceae	4
	Annonaceae, Olacaceae	3
	Calophyllaceae, Ebenaceae, Elaeocarpaceae, Fagaceae, Phyllanthaceae, Rubiaceae	2
	Anisophyllaceae, Burseraceae, Casuarinaceae, Celastraceae, Centroplacaceae, Chrysobalanaceae, Crypteroniaceae, Dilleniaceae, Hypericaceae, Myristicaceae, Penaeaceae, Picrodendraceae, Rutaceae, Stemonuraceae, Thymelaeaceae	1

		Number of species	
B.	**Families common in both forest types**	**Intact**	**Cleared**
	Fabaceae	2	1
	Sapindaceae	2	1

4. Conclusion

This study provides preliminary evidence of substantial differences in forest structure and tree species composition between intact and cleared *Kerapah* forest plots in Lumut, Brunei Darussalam. Intact *Kerapah* forest plots exhibited substantially higher stem abundance, basal area, and species richness compared to plots that were cleared 5 years earlier, which were characterised by very low tree density and severely simplified forest structure. The dominance of characteristic heath and peat swamp species, particularly *Madhuca curtisii*, in intact plots reflects the specialised composition of *Kerapah* forests and contrasts clearly with the simplified structure of the recently cleared areas. The occurrence of multiple IUCN Red List tree species exclusively in intact plots further highlights the critical role of remaining *Kerapah* forests as refugia for threatened taxa in Brunei Darussalam. Together, these findings highlight the slow short-term structural recovery following complete vegetation clearance and emphasise the importance of prioritising protection of remaining intact *Kerapah* forest stands, alongside longer-term monitoring and rehabilitation strategies for this rare and understudied forest type.

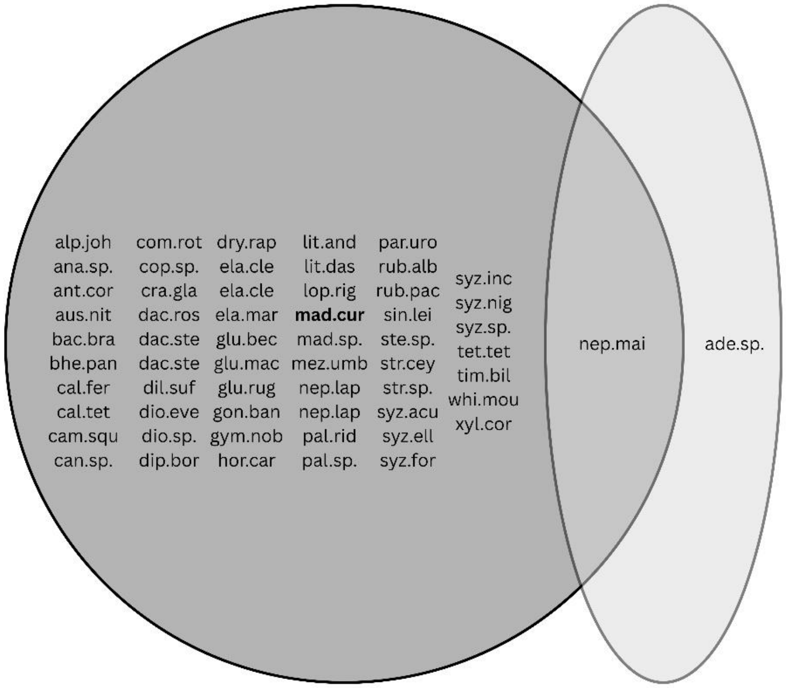

Figure 2. Venn diagram showing species codes of trees with diameter at breast height (DBH) ≥ 6 cm recorded in intact and cleared *Kerapah* forest plots. Species codes are shown for taxa recorded exclusively in intact forest, exclusively in cleared forest, and those common to both forest types.

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Appendix 1. The species code, family name, species name and stem abundance (n) of tree species with ≥ 6 cm DBH found in intact and cleared *Kerapah* forests. Superscript labels indicate the conservation status of the species according to The IUCN Red List Species (2026; ^{LC} Least Concern, ^{NT} Near Threatened, ^{VU} Vulnerable, ^{EN} Endangered, ^{CR} Critically Endangered).

Forest type	**Code name**	**Family**	**Species**	**n**
Intact	mad.cur	Sapotaceae	*Madhuca curtisii*^{VU}	64
	tet.tet	Rutaceae	*Tetractomia tetrandra*	38
	alp.joh	Annonaceae	*Alphonsea johorensis*^{NT}	22
	syz.ell	Myrtaceae	*Syzygium elliptilimbum*	18
	syz.for	Myrtaceae	*Syzygium formosum*	9
	mez.umb	Annonaceae	*Mezzettia umbellata*^{VU}	9
	gym.nob	Casuarinaceae	*Gymnostoma nobile*	9
	syz.sp.	Myrtaceae	*Syzygium* sp.	8
	sin.lei	Fabaceae	*Sindora leiocarpa*	8
	ela.cle	Elaeocarpaceae	*Elaeocarpus clementis var. clemensiae*	8
	mad.sp.	Sapotaceae	*Madhuca* sp.	7
	bac.bra	Phyllanthaceae	*Baccaurea bracteata*	7
	syz.inc	Myrtaceae	*Syzygium incarnatum*	7
	dio.eve	Ebenaceae	*Diospyros evena*	5
	can.sp.	Rubiaceae	*Canthium* sp.	4
	dry.rap	Dipterocarpaceae	*Dryobalanops rappa*^{EN}	4
	glu.bec	Anacardiaceae	*Gluta beccarii*^{NT}	4
	aus.nit	Picrodendraceae	*Austrobuxus nitidus*	4
	par.uro	Chrysobalanaceae	*Parastemon urophyllus*	4
	whi.mou	Myrtaceae	*Whiteodendron moultonianum*	3
	lop.rig	Celastraceae	*Lophopetalum rigidum*	3
	ela.mar	Elaeocarpaceae	*Elaeocarpus marginatus*	3
	com.rot	Anisophylleaceae	*Combretocarpus rotundatus*	3
	glu.rug	Anacardiaceae	*Gluta rugulosa*	3
	ste.sp.	Stemonuraceae	*Stemonurus* sp.	3
	syz.acu	Myrtaceae	*Syzygium acuminatissimum*	2
	syz.nig	Myrtaceae	*Syzygium nigricans*	2
	nep.lap	Sapindaceae	*Nephelium lappaceum var. lappaceum*	2
	lit.das	Fagaceae	*Lithocarpus dasytachyus*	2
	gon.ban	Thymelaeaceae	*Gonystylus bancanus*^{CR}	2
	lit.and	Fagaceae	*Lithocarpus andersonii*^{VU}	2
	cop.sp.	Fabaceae	*Copaifera* sp.	2
	xyl.cor	Annonaceae	*Xylopia coriifolia*^{VU}	2
	cra.gla	Hypericaceae	*Cratoxylum glaucum*	2
	hor.car	Myristicaceae	*Horsfieldia carnosa*^{NT}	1
	dac.ste	Crypteroniaceae	*Dactylocladus stenostachys*	1

Forest type	**Code name**	**Family**	**Species**	**n**
Intact	glu.mac	Anacardiaceae	*Gluta macrocarpa*	1
	pal.sp.	Sapotaceae	*Palaquium* sp.	1
	pal.rid	Sapotaceae	*Palaquium ridleyi*	1
	dac.ros	Burseraceae	*Dacryodes rostrata*	1
	cal.fer	Calophyllaceae	*Calophyllum ferrugineum*	1
	cal.tet	Calophyllaceae	*Calophyllum tetrapterum var. tetrapterum*	1
	nep.lap	Sapindaceae	*Nephelium lappaceum var lappaceum*	1
	bhe.pan	Centroplacaceae	*Bhesa paniculata*	1
	tim.bil	Rubiaceae	*Timonius bilitonensis*	1
	dip.bor	Dipterocarpaceae	*Dipterocarpus borneensis*[NT]	1
	dil.suf	Dilleniaceae	*Dillenia suffruticosa*	1
	ant.cor	Phyllanthaceae	*Antidesma coriaceum*	1
	dac.ste	Penaeaceae	*Dactylocladus stenostachys*	1
	str.sp.	Olacaceae	*Strombosia* sp.	1
	str.cey	Olacaceae	*Strombosia ceylanica*	1
	ana.sp.	Olacaceae	*Anacolosa* sp.	1
	rub.alb	Dipterocarpaceae	*Rubroshorea albida*[VU]	1
	rub.pac	Dipterocarpaceae	*Rubroshorea pachyphylla*[EN]	1
	dio.sp.	Ebenaceae	*Diospyros* sp.	1
	ela.cle	Elaeocarpaceae	*Elaeocarpus clementis*	1
	cam.squ	Anacardiaceae	*Campnosperma squamatum*	1
Cleared	ade.sp.	Fabaceae	*Adenanthera* sp. *1*	1
Both intact & cleared	nep.mai	Sapindaceae	*Nephelium maingayi*	6 (intact forest), 1 (cleared forest)