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CHAPTER 9

Wild *Durio* (Malvaceae) of Malaysia: Diversity and conservation priorities

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Abstract: Malaysia is one of the centres of diversity for the genus *Durio* (Malvaceae), which comprises 31 species distributed throughout Southeast Asia. While *Durio zibethinus* dominates global durian cultivation and trade, Malaysian forests harbour critical assemblage of wild *Durio* species occupying ecological niches from lowland dipterocarp forests to lower montane systems. These wild species represent critical crop wild relatives with potential value for durian improvement, climate resilience, and disease resistance. Despite this, many wild *Durio* species remain taxonomically unresolved and have received little attention in conservation planning. This review synthesises the current status on wild *Durio* in Malaysia, covering their taxonomy, distribution, ecology, reproductive biology, and conservation status. To date, wild *Durio* species have been documented across Peninsular Malaysia, Sabah, and Sarawak, including edible species such as *D. oxleyanus*, *D. graveolens*, *D. kutejensis*, *D. dulcis*, *D. kinabaluensis* and *D. malaccensis*. Major threats include habitat loss, fragmentation, restricted endemism, and limited *ex situ* conservation efforts. Significant research gaps were identified in pollination ecology, climate vulnerability assessment, and long term population monitoring. Strengthening integrative taxonomy and coordinated conservation strategies is urgently required to safeguard Malaysia's wild durian diversity.

INTRODUCTION

The genus *Durio* is among the most distinctive tree genera of Southeast Asian tropical forests (Kostermans 1958). While Durio is best known for the cultivated durian, *Durio zibethinus*, the genus encompasses a far broader diversity of wild species distributed across Thailand, Peninsular Malaysia, Sumatera, Borneo, and the Philippines (Alponsin *et al.* 2026). Malaysia represents a major centre of species richness and endemism within the distributional range (Salma 2011, 2015; Ghazalli *et al*. 2022). Numerous species occur exclusively in Borneo, underscoring the island's importance as a hotspot of diversification within the Sundaic region (Kostermans 1958; Soepadmo 1995).

Wild *Durio* species are ecologically significant canopy or emergent trees that contribute seasonally to forest food source (Brown 1997). Their large, often nocturnally anthesing flowers are adapted to vertebrate pollination, particularly by bats, reflecting specialised reproductive strategies characteristic of Malesian rainforests (Nawa 1990) (Figure 1). The production of sizeable, fleshy-aril fruits provides food resources for a diversity of frugivorous vertebrates and facilitates seed dispersal, thereby contributing to forest regeneration (Soepadmo 1995) (Figure 2). These ecological roles position wild *Durio* as important structural and functional components of lowland and hill dipterocarp forest ecosystems (Primack 2005).

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Figure 1. Variation in floral morphology. **A.** *Durio griffithii*; **B.** *Durio oxleyanus*; **C.** *Durio singaporensis* var. *singaporensis*; **D.** *Durio lowianus*; **E.** *Durio kutejensis*; and **F.** *Durio malaccencis*

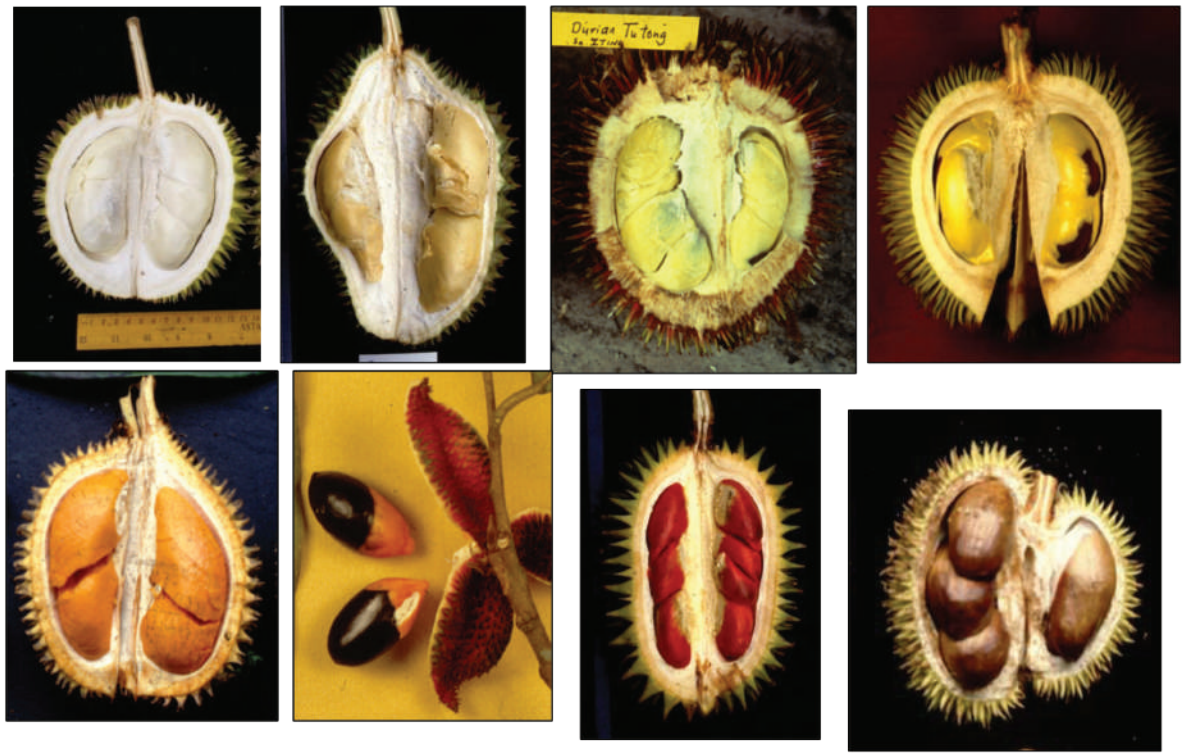

Figure 3. Variation in aril appearance. **A.** *Durio lowianus*; **B.** *Durio zibethinus*; **C.** *Durio dulcis*; **D.** *Durio graveolens*; **E.** *Durio kutejensis*; **F.** *Durio griffithii*; **G.** *Durio carinatus*; and **H.** *Durio singaporensis* var. *singaporensis*

From an agricultural perspective, wild species constitute an underutilised reservoir of genetic diversity. Traits such as resistance to soil-borne pathogens, tolerance to abiotic stress, variation in fruit morphology and flavour, and adaptation to environmentally-challenging conditions are of potential value for crop improvement. Incorporating genetic resources from wild relatives into breeding programmes for *Durio zibethinus* could strengthen their resilience in the face of emerging diseases and climatic variability, while also broadening the commercial fruit portfolio beyond existing cultivars (Salma *et al.* 2011) (Figure 3).

Despite their ecological and agronomic relevance, wild *Durio* species remain under-studied compared cultivated durian varieties. Taxonomic ambiguities persist, particularly among Bornean species where morphological variation is high and herbarium representation is uneven. Not just that, population-level genetic data remain sparse, thereby limiting the understanding of gene flow, demographic history, and conservation status of this genus. Comprehensive conservation assessments are incomplete, with several species yet to undergo formal risk evaluation. Hence, this review consolidates the state of knowledge up to 2026 and identifies priority directions for future research, systematics, and conservation planning for *Durio*.

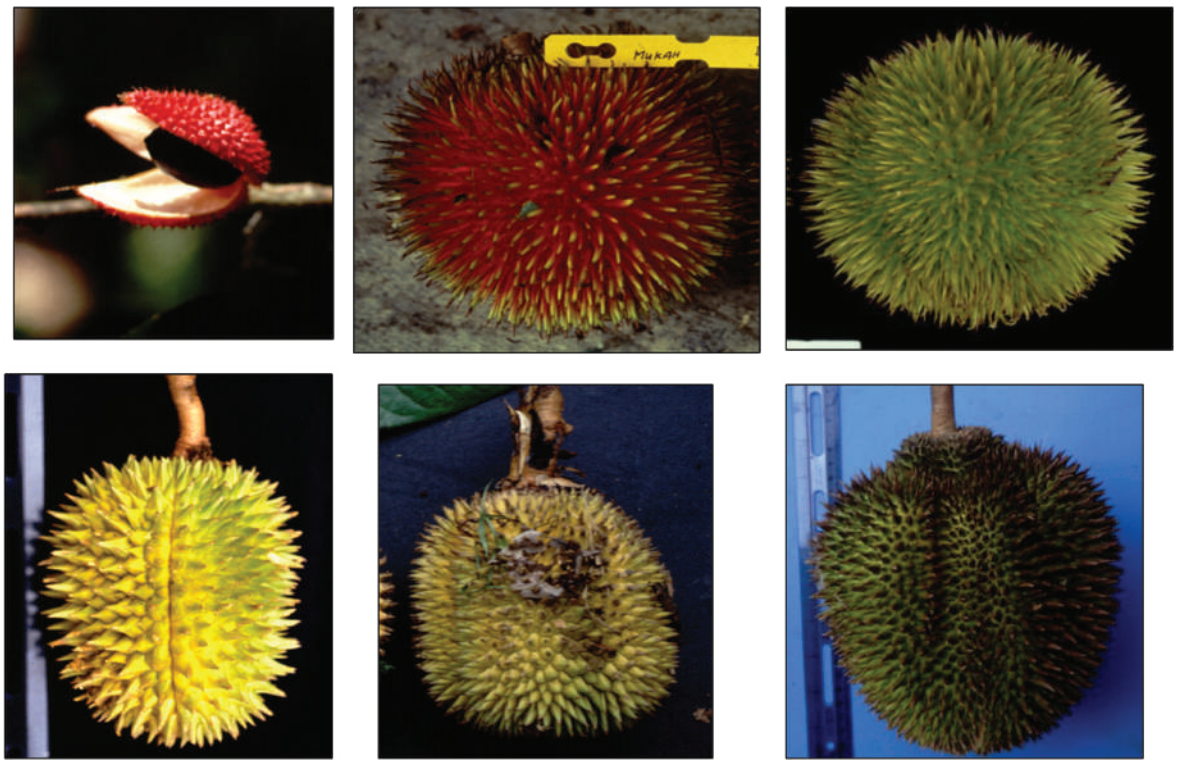

Figure 3. Variation in fruit morphology. **A.** *Durio griffithii*; **B.** *Durio dulcis*; **C.** *Durio lowianus*; **D.** *Durio carinatus*; **E.** *Durio malaccencis*; and **F.** *Durio zibethinus*

TAXONOMIC HISTORY AND SYSTEMATICS

The genus *Durio* was first described in the 18th century with its early taxonomic treatment based primarily on cultivated materials of *D. zibethinus* (Kostermans 1958; Brown 1997). Subsequent taxonomic revisions, particularly those undertaken in the mid-20th century, established much of the current taxonomic framework. Species delimitation relied on floral morphology, fruit spine structure, indumentum characteristics, and leaf venation patterns. However, several challenges complicate taxonomic resolution including overlapping

vegetative characters among sympatric species and incomplete type material (Kostermans 1958; Soepadmo 1995). Integrative taxonomy combining morphology, palynology, wood anatomy, and phylogenomics is increasingly recognised as necessary for resolving species boundaries. As of 2026, Malaysia recorded 25 species of wild *Durio*. Species richness of *Durio* is particularly higher in Sabah and Sarawak than in Peninsular Malaysia.

In Peninsular Malaysia, 14 species recorded include *D. malaccensis*, *D. oxleyanus*, *D. griffithii* and *D. wyatt-smithii*. These species typically inhabit lowland and hill dipterocarp forests, with some population extending into riparian and alluvial habitats (Salma 2011). In Sabah and Sarawak, 13 and 16 species were recorded, respectively, including *D. graveolens*, *D. kutejensis*, *D. dulcis*, *D. kinabaluensis*, and *D. crassipes*.

Several species exhibit restricted distributions, particularly montane endemics associated with the Crocker Range and Kinabalu region (Parris 1992; Soepadmo 1995; Salma, 2011). Endemism is especially pronounced in Sabah, where elevational gradients and geological heterogeneity may have promoted speciation.

Wild *Durio* species are typically large trees (20 – 50 m) with buttressed trunks and dense canopies. Diagnostic features include alternate, entire, often with scaly or lepidote undersurfaces ranging from silvery to golden-brown. Venation density and indumentum are taxonomically informative; cauliflorous or ramiflorous; large, fleshy petals; abundant nectar; nocturnal anthesis in many species and fruits with considerable interspecific variation in size, rind thickness, spine morphology, aril colour, and dehiscence pattern. Variation also observed in aril pigmentation ranges from white and pale yellow to deep orange and red.

CONSERVATION STATUS AND THREATS

Major threats to wild *Durio* populations in Malaysia are primarily driven by habitat loss and landscape modification. Infrastructure development including highways, hydroelectric projects, and urban expansion further accelerates habitat conversion and ecological isolation (FAO 2020). The cumulative effect of these pressures is increasing forest fragmentation, which disrupts pollinator movement, reduces gene flow, and limits natural regeneration processes (Corlett 2016). Restricted-range and endemic species are especially vulnerable under these conditions. Many wild *Durio* species are confined to specific ecological niches, such as riverine forests, limestone outcrops, or hill dipterocarp zones in Peninsular Malaysia, Sabah, and Sarawak (Sodhi *et al.* 2010). Habitat contraction in these specialised environments will rapidly translate into population decline. Regeneration outside intact forest is often poor, as seedlings require shaded microhabitats and stable soil moisture conditions.

Ex situ conservation efforts remain disproportionately focused on cultivated durian varieties, particularly *Durio zibethinus*, while wild species still in limited representation in field gene banks and seed repositories. Existing germplasm collections, including those maintained by institutions such as Malaysian Agricultural Research and Development Institute, prioritise agronomically valuable cultivars. As a result, the genetic diversity of wild relatives critical for breeding resilience traits such as disease resistance, abiotic stress tolerance, and novel fruit characteristics remains under-secured.

To address these challenges, several conservation measures are recommended. First, wild *Durio* species should be formally integrated into protected area management plans to ensure that habitat conservation strategies explicitly recognise their ecological and genetic importance. Then, comprehensive national Red List assessments aligned with International Union for Conservation of Nature (IUCN) criteria are also needed to evaluate extinction

risk and guide prioritisation. The establishment of dedicated field gene banks and living collections will strengthen *ex situ* safeguarding of threatened wild *Durio* species. Complementary research on seed biology including storage behaviour and cryopreservation potential is essential, given that many *Durio* species exhibit recalcitrant seed traits (Lah *et al*. 2023). Finally, community-based stewardship initiatives that engage Indigenous Peoples and local communities in monitoring, sustainable utilisation, and habitat protection can enhance long-term conservation outcomes while aligning biodiversity goals with rural livelihoods.

Table 1. The species in Malaysia, their distribution and the IUCN conservation categories.

Species	Distribution	IUCN Conservation Category*
Durio affinis	Peninsular Malaysia and Borneo	Not Evaluated (NE) / Data unavailable
D. carinatus	Peninsular Malaysia, Sumatera and Borneo	Not Evaluated (NE) / Data unavailable
D. crassipes	Borneo, endemic	Not Evaluated (NE) / Data unavailable
D. dulcis	Borneo, endemic	Vulnerable (VU) (Wikipedia)
D. excelsus	Borneo, endemic	Not Evaluated (NE) / Data unavailable
D. grandiflorus	Borneo, endemic	Not Evaluated (NE) / Data unavailable
D. graveolens	Peninsular Malaysia and Borneo	Vulnerable (VU)
D. gerikensis	Peninsular Malaysia, endemic	Not Evaluated (NE) (recently described species)
D. griffithii	Peninsular Malaysia, Sumatera and Borneo	Not Evaluated (NE) / Data unavailable
D. kinabaluensis	Borneo, endemic	Not Evaluated (NE) / Data unavailable
D. kutejensis	Borneo, endemic	Not Evaluated (NE) / Data unavailable
D. lanceolatus	Borneo, endemic	Not Evaluated (NE) / Data unavailable
D. lowianus	Peninsular Malaysia and Sumatera	Not Evaluated (NE) / Data unavailable
D. macrophyllus	Peninsular Malaysia, endemic	Not Evaluated (NE) / Data unavailable
D. perakensis	Peninsular Malaysia, endemic	Not Evaluated (NE) / Data unavailable
D. macrolepis	Peninsular Malaysia, endemic	Not Evaluated (NE) / Data unavailable
D. malaccensis	Peninsular Malaysia and Sumatera	Not Evaluated (NE) / Data unavailable
D. johoricus	Peninsular Malaysia, endemic	Not Evaluated (NE) / Data unavailable
D. oblongus	Borneo, endemic	Not Evaluated (NE) / Data unavailable
D. oxleyanus	Peninsular Malaysia, Sumatera and Borneo	Not Evaluated (NE) / Data unavailable
D. pinangianus	Peninsular Malaysia, endemic	Not Evaluated (NE) / Data unavailable
D. singaporensis	Peninsular Malaysia, endemic	Not Evaluated (NE) / Data unavailable
D. testudinarius	Borneo, endemic	Not Evaluated (NE) / Data unavailable
D. wyatt-smithii	Peninsular Malaysia, endemic	Not Evaluated (NE) / Data unavailable
D. zibethinus	Peninsular Malaysia, Myanmar, Thailand, Sumatera and Borneo	Data Deficient (DD) / widely cultivated taxon

RESEARCH PRIORITIES

Priority research areas for advancing knowledge and conservation of wild *Durio* in Malaysia begin with integrative taxonomic revision. Many species remain poorly delimited due to overlapping morphological characters, limited type material, and uneven sampling across Peninsular Malaysia, Sabah, and Sarawak. A comprehensive revision that synthesises classical morphology, micromorphology including pollen and trichome characters, herbarium studies, ecological data, and genomic evidence is essential to resolve species boundaries, clarify synonymies, and stabilise nomenclature. Such integrative approaches will reduce taxonomic ambiguity and provide a robust baseline for conservation prioritisation.

Population-level genetic assessments are also critical, particularly in landscapes increasingly fragmented by agricultural expansion and infrastructure development. Analyses of genetic diversity, population structure, gene flow, and demographic history using SNP-based markers or whole-genome resequencing can reveal levels of inbreeding, bottlenecks, and connectivity among remnant populations. Such information is indispensable for designing in situ conservation strategies, identifying priority populations for *ex situ* germplasm banking, and guiding assisted gene flow or restoration programmes.

Pollination network studies represent another key important character, especially given the predominantly bat-involvement pollination observed in many *Durio* species. Detailed investigations of floral phenology, nectar production, visitor assemblages, and plant pollinator interaction networks will illuminate the ecological characters that sustain reproductive success. Understanding how habitat fragmentation and declines in pollinator populations will affect fruit set and genetic diversity will further strengthen ecosystem -based conservation planning.

Climate vulnerability modelling should also be prioritised to anticipate the impacts of future climatic shifts on species distributions. Species distribution models integrating current occurrence data with downscaled climate projections can identify potential refugia, range contractions and areas of climatic suitability under different emissions scenarios. These projections can help inform long-term conservation zoning and assisted migration strategies, particularly for narrow endemics or montane species with limited adaptive capacity.

Finally, it is also essential to systematically integrate wild *Durio* genetic resources into national agrobiodiversity and food security frameworks. Aligning research outputs with national policies on plant genetic resources, sustainable agriculture, and food security will ensure that wild relatives are recognised as strategic assets for crop improvement and resilience breeding. Strengthening linkages between academic and research institutions, forest management authorities, and germplasm repositories will facilitate the conservation, characterisation, and sustainable utilisation of wild *Durio* for future agricultural innovation.

EX SITU CONSERVATION EFFORTS

MARDI Serdang, Serdang

MARDI Serdang, Selangor maintains an important *ex situ* conservation collection of wild and cultivated *Durio* species, comprising 139 accessions representing 12 species. The collection includes both the economically important and underutilised durian relatives, such as *Durio zibethinus*, *D. lowianus*, *D. graveolens*, *D. oxleyanus*, *D. pahangensis*, *D. singaporensis*, *D. malaccensis*, *D. kutejensis*, *D. dulcis*, *D. testudinarius*, *D. gerikensis* and *D. acutifolius*. The largest holdings are *D. zibethinus* and *D. lowianus*, with 40 accessions each, followed by *D. graveolens* (23 accessions) and *D. oxleyanus* (13 accessions). These living collections serve as a valuable genetic reservoir for conservation, research, characterisation, and future

breeding programmes. The collection also safeguards several rare and endemic taxa represented by limited accessions, highlighting the importance of continued germplasm exploration and enrichment to enhance genetic representation and ensure the long-term conservation of Malaysia's native durian diversity.

MARDI Jerangau, Terengganu

The *Durio ex situ* germplasm collection at MARDI Jerangau, Terengganu comprises 84 accessions representing at least eight species and several locally named landraces or unidentified accessions. The collection is dominated by *Durio zibethinus* (24 accessions) and *D. lowianus* (18 accessions), followed by *D. graveolens* (12 accessions), *D. dulcis* (7 accessions), and *D. oxleyanus* (11 accessions, including accessions recorded under the local name *Isu*). Other species conserved include *D. oblongus* (2 accessions), *D. testudinarius* (2 accessions), and *D. kutejensis* (2 accessions, including accessions recorded under the local name *Nyekak*). In addition, several accessions are maintained under local names such as *Sempa* and *Sangka*, which require further taxonomic verification. This living collection serves as an important genetic resource for the conservation of wild durian diversity, supporting taxonomic research, genetic studies, crop improvement programmes, and the long-term safeguarding of valuable germplasm that may possess traits for disease resistance, climate resilience, and fruit quality improvement.

In addition to *ex situ* conservation, MARDI also contributes to the *in situ* conservation of durian diversity through the protection of naturally occurring populations within its research stations. A notable example is *Durio singaporensis* var. *jerangauensis*, a recently described variety that is currently known only from MARDI Jerangau, Terengganu. This variety is considered endemic to the station and represents a unique component of Malaysia's durian biodiversity. The conservation of its natural habitat within MARDI Jerangau ensures the continued survival of this taxon in its native ecological setting, allowing natural evolutionary and ecological processes to continue. Together, these *ex situ* and *in situ* conservation efforts strengthen MARDI's role as a national custodian of *Durio* genetic resources and support the long-term conservation and sustainable utilization of Malaysia's rich durian diversity.

Private *Durio* orchard of Dr. Abdul Aziz Zakaria

Apart from institutional conservation efforts, significant contributions have also been made through individual initiatives. Dr. Abdul Aziz Zakaria has established and maintained a private conservation orchard in Ketereh, Kota Bharu, Kelantan, using his own resources to protect several wild *Durio* species. The collection includes *Durio graveolens*, *D. testudinarium*, *D. dulcis*, *D. kutejensis*, *D. lowianus* and *D. oxleyanus*. This initiative serves as an important *ex situ* conservation effort for wild durian genetic resources, particularly for species that are uncommon, geographically restricted, or increasingly threatened by habitat loss. The orchard functions as a living repository for the preservation of genetic diversity and provides valuable material for future research, breeding, and conservation programmes. Such individual-led conservation efforts complement national germplasm conservation activities and highlight the importance of collaborative approaches involving researchers, institutions, and private stakeholders in safeguarding Malaysia's rich *Durio* biodiversity.

CONCLUSION

Malaysia represents a global hotspot of wild *Durio* diversity. These species are ecologically integral components of tropical forests and valuable genetic resources for future durian improvement. Despite increasing research attention, substantial systematic and conservation gaps remain. Coordinated national strategies integrating taxonomy, genomics, ecology, and conservation planning are essential to secure the long-term persistence of Malaysia's wild durians.

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