

BIODIVERSITY RESEARCH AND CONSERVATION IN PERMANENT FOREST ESTATE (PFE) SARAWAK

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ABSTRACT

Sarawak encompasses an area of 12.4 million ha with 3.9 million hectares designated as Permanent Forest Estates (PFEs) as of 2023. In-line with Sarawak's Post-COVID Development Strategy (PCDS) 2030, the forestry sector aims to achieve global recognition for its sustainable management of tropical forests and biodiversity conservation, while promoting the rapid growth of the timber industry. Under Sarawak Government funded project (12th Malaysian Plan), Forest Department Sarawak has been allocated a total of RM13.9 million to carry out in PFEs areas. In addition, the Department also received funding from Federal Government under RMK-12 and international agencies such as JICA (SATREPS- PUBS), and GEF-IFAD. The aim of these research projects is to support environmental sustainability, biodiversity conservation, and to gain world recognition in sustainable forest management. In conclusion, the findings from these activities will significantly contribute to big data and reference collections for biodiversity. This will facilitate the development and implementation of policies and accelerate the process of gazetting PFEs.

Keywords: research, biodiversity conservation, sustainability

1 INTRODUCTION

Sarawak, with a total land mass of 12.4 million hectares, retains 62% of its area under forest cover. Recognizing the important role of forests in environmental sustainability, the state has implemented policies to safeguard these natural assets. This commitment is reflected in the Sarawak Forest Policy 2019, which have led to 51% of the state's forested land – comprising forest reserves, protected forests, and communal forests – being gazetted as Permanent Forest Estates (PFEs). Currently, there are 118 PFEs with a total area of 3,960,381 ha. PFEs are important to Sarawak's efforts to conserve its rich biodiversity. Covering vast forest areas across the state, the PFEs serve as crucial habitats for a wide variety of flora and fauna, highlighting their importance for biodiversity conservation. As Sarawak advances toward the objectives outline in its Post-Covid 19 Development Strategy (PCDS) 2030, the sustainable management of these natural resources is the key to balancing both environmental preservation and economic growth.

In line with this, the Forest Department Sarawak (FDS) has been working on emphasizes sustainable forest management and aims to achieve global recognition for its conservation efforts. Through this, the Department has been allocated RM13.9 million under the 12th Malaysian Plan project to conduct biodiversity research and conservation within the PFEs. Additional support comes from federal and international agencies such as JICA (SATREPS-PUBS) and GEF-IFAD. These research initiatives are designed to enhance environmental sustainability, advance biodiversity conservation, and contribute to Sarawak's global reputation for sustainable forest management. This paper outlines the ongoing biodiversity conservation efforts within Sarawak's PFEs, emphasizing data curation, research, and research collaboration to meet conservation goals, while also aligning with the Sustainable Development Goals (SDG), the Kunming-Montreal Global Biodiversity Framework (KMGBF), and PCDS 2030.

2 BIODIVERSITY RESEARCH AND CONSERVATION

Effective biodiversity research and conservation ensures the protection of species diversity, habitats, and ecosystem services, aligning with Sarawak's goals for sustainable development. To achieve these goals, the Department employs a variety of approaches, including data curation, research, and the integration of technologies for conservation.

2.1 Biodiversity Research

Comprehensive data curation and management are essential for biodiversity conservation efforts. The establishment and maintenance of biodiversity reference collections, alongside digitization, provide invaluable resources for monitoring species, assessing ecosystem health, and guiding conservation practices. The reference collections, which include the herbarium, fungarium, insectorium, and xylarium, are crucial for documenting Sarawak's rich biodiversity. These reference collections have expanded significantly since forest research began in 1800s, driven by documentation of flora and fauna by early explorers. Ongoing curation efforts ensure that specimens, particularly valuable TYPE specimens, are preserved and maintained in good condition. As to date, there are approximately 300,000 plant voucher specimen, 6,000 fungi specimens, 550,000 insect collections and 16,000 wood samples. To enhance accessibility and usability of these biodiversity data, FDS has adopted digitization via the TEAMS platform, aiming to create a centralized database. The Forest Information System Sarawak (FORISS) has already digitized 25,812 insects' data, 1,890 fungi specimen, and 33 datasheets for soils.

Ongoing biodiversity research in Sarawak does not only focus on reference collections but also on the species diversity and richness in PFEs to underline the significant of ongoing conservation effort. One aspects of this research are involving camera trappings surveys of birds and wildlife that were conducted in FMUs. Camera trapping across different FMUs has recorded a wide range of mammals and birds, including endangered and vulnerable RTE species such as the Clouded Leopard, Sun Bear, Bay Cat, Sunda Pangolin, Great Argus, and Bulwer's Pheasant. Surveys on plants and macrofungi also conducted in support of conservation efforts such as the Integrated Management Plan (IMP) and UNESCO Biosphere Reserve. While biodiversity research conducted during scientific expeditions support conservation efforts and assisting in gazettelement of PFEs.

2.2 Biodiversity Conservation

Ecological study in Sarawak is often associated with efforts to monitor biodiversity, forest dynamics, and ecosystem processes over extended periods. Currently, several permanent plots have been established in PFEs under the project "Establishment and Assessment of Permanent Sample Plot (PSP) Network in Sarawak". Since the start of 12th Malaysian Plan, 11 new plots and 6,352 new trees have been recorded, adding to the 25 plots previously established. As part of this initiative, FDS plans to use LiDAR and hyperspectral imaging technology to map forest structures and create a comprehensive database of tree growth. This data will be instrumental in supporting forest management and conservation efforts, including the review of harvesting cycles and cutting limits.

From 2016 to 2018, the Forest Resources Inventory (FRI) project, in collaboration with the Forest Research Institute of Malaysia (FRIM) under Phase 1, covered 2.1 million hectares of the Heart of Borneo (HoB) area. Its scope expanded beyond timber growth and stock assessment to include biomass, carbon stock, non-timber forest products, and wildlife. In Phase 2 (2019-2020), the project extended into the HoB Extension area, adding 0.565 million hectares, with a stronger emphasis on biodiversity conservation and sustainable development. Together, Phases 1 and 2 cover a total of 2.6 million hectares within the HoB initiative. Currently, FRI Phase 3 (2021-2025), under the 12th Malaysian Plan, is ongoing, focusing on targeted activities within Sarawak's PFEs.

Biodiversity conservation also involves the sustainable use of natural resources. Thus, identifying High Conservation Value Areas (HCVA) within Sarawak's permanent forests is crucial for forest management, particularly in timber harvesting operation areas. The concept of HCV in Sarawak focuses on safeguarding areas that hold significant biodiversity, forest ecosystems, social, and cultural values. Under the requirement of Malaysian Criteria and Indicators (MC&I Natural Forest), assessment and listing of rare, threatened, and endemic species (RTE) of flora and fauna are listed under Principles 6 (Environment Impact) and 9 (Maintenance of High Conservation Value Forests). Thirty-four (34) Forest Management Units (FMUs) with a total forest area covering 2,277,697 hectares have been certified, and all these certified FMUs have undergone HCVA assessment.

2.3 Research Collaboration

Biodiversity conservation in Sarawak is strengthened by key collaborations with local and international institutions. FDS has embarked on a collaborative project with the Faculty of Engineering at Universiti

Malaysia Sarawak (UNIMAS) under a MoU signed on December 10, 2021. This five-year project aims to develop a bolted timber connection database for Sarawak hardwood species to improve the Malaysia timber design standard and optimize the use of heavy hardwoods in construction. Seven timber species have been verified for testing, and the project has also facilitated technology transfer and capacity building, benefiting students and researchers in the field.

In 2021, the State Government has approved an allocation of RM10,950,265.00 for the “Projek Penyelidikan Perhutanan Sarawak”, a collaboration between Forest Department Sarawak and Universiti Putra Malaysia Kampus Bintulu (UPMKB), encompassing 32 research projects, of which 25 focus on natural forest management and 7 on plantation forests. The project, is currently in its second phase, will be implemented in three phases: Phase I, II, and III. The research is multidisciplinary, supporting areas such as forest management certification, landscape restoration, carbon studies, biodiversity studies, ecotourism, and more. As part of this collaboration, the potential of drone seeding technology for restoring degraded forest areas, particularly in inaccessible regions, is being explored. The collaboration enhances this effort through the development of effective pods that are suited for UAV dispersal and identifying the best planting method approach using drone seeding.

Other than that, in January 2024, FDS signed a Memorandum of Agreement (MoA) with the National Institute for Environmental Studies (NIES) of Japan, formalized during the symposium on ‘Bilateral Collaboration Research Towards Sustainable Forest Management (SFM) in Sarawak.’ This agreement, building on a previously signed MoU, sets the framework for collaborative research on Forest Volume Modelling using UAV-derived metrics and Permanent Sample Plot methods. This MoU is also expected to further contribute to joint data analysis, and capacity building through workshops, conferences, and training sessions.

3 OUTCOMES

Sarawak's biodiversity conservation efforts within its PFEs have resulted in significant research contributions and practical applications. These achievements not only enhance Sarawak's environmental sustainability but also support broader national and international commitments to biodiversity and ecosystem conservation.

Findings from biodiversity research and scientific expeditions have been crucial in the conservation efforts including in guiding decisions for the gazettelement of PFEs in Sarawak. This research provides essential baseline information, particularly on RTE species, which strengthens the basis for gazettelement. These research activities have also contributed to the Department vision towards international recognition through sites like the Sarawak Delta Geopark (SDGp) and UNESCO Biosphere Reserve. These studies have identified various RTE species, highlighting the conservation value of these areas. Recent surveys in the SDGp area have documented at least 10 endemic plant species, emphasizing the area's rich biodiversity.

Reinforcing conservation efforts, the HCVA assessments have further enhanced sustainable forest management by mapping critical areas. These include regions with high RTE concentrations, such as *Agathis* sp., *Shorea woodii*, and *Shorea rotundifolia* in Anap Muput FMU, and *Rafflesia pricei* in Ravenscourt FMU. The assessment also identifies key habitats and threatened ecosystems, like terrain with slopes exceeding 35 degrees (classified as terrain class IV), Kerangas Forest, riparian buffers for water protection, and saltlicks for wildlife. Additionally, vital forest services such as water catchment areas and natural fire barriers are included. These HCVA mappings are integrated into forest management plans to safeguard these areas from degradation.

FDS's continuous efforts in biodiversity conservation have led to the Premier's commitment to fund orchid conservation. During the International Day of Forests 2022, the Premier of Sarawak, Right Honourable Datuk Patinggi Tan Sri (Dr.) Abang Haji Abdul Rahman Zohari Bin Tun Datuk Abang Haji Openg, directed the Forest Department Sarawak (FDS) to assess the feasibility of creating an orchid garden to showcase the unique Borneo orchid species. This initiative aims to establish the Sarawak Model Orchid Garden, which will serve both as a conservation centre and a research hub, focused on preserving orchid diversity while promoting public education and eco-tourism. In recognition of the Premier's support for orchid conservation, a newly discovered species, *Bulbophyllum abangjoei* Go, Besi and Pungga sp. nov, was named in his honour (Go *et al.*, 2022).

Other than the orchid species, botanical research has also added a new species, *Hexatheca longipedunculata* S. Julia & Kiew, to the genus *Hexatheca*, increasing the total number of known species to four (Julia *et al.*, 2022a). Additionally, sixteen new species of *Begonia* have been reported (Julia *et al.*, 2022b; Ling & Julia, 2023). Meanwhile, entomological discoveries have expanded our knowledge of insect diversity with the identification of six new species: *Sakaiomenimus croceus*, *Lycidioides notatipennis*, *Lycidioides osawai*, *Eucorydiahalus Yanagisawa*, *Bolitonaeus dannyi*, and *Bolitonaeus semiyangensis* (Ando *et al.*, 2022a; Ando *et al.*, 2022b; Yanagisawa *et al.*, 2023; Ando *et al.*, 2024). The SATREPS-PUBS partnership with Japanese researchers has contributed significantly to these discoveries, particularly in the insect species identification. By leveraging knowledge sharing and technology transfer, including the application of next-generation sequencing, significant advancements is expected to be achieved not only in the discovery of new species but also in other areas of biodiversity conservation.

Additionally, Sarawak's commitment to biodiversity conservation has enabled the region to explore emerging carbon trading initiatives. Biomass inventories are actively being carried out via lidar and ground truthing to establish baseline data for future carbon trading activities. The Department also established a MoU with Kyushu University, Japan in July 2024 to enhance the research on forest carbon and ecosystem. To date, the department has issued a total of 4 carbon permits to the private sector for carry out the carbon study at designated area.

Through the extensive study and inventories of the biodiversity, the Department also serves as a key agency providing species identification services. One notable area is in cases of mushroom poisoning, where the Sarawak State Health Department refers to FDS for species identification, and there were 34 cases addressed since 2014. The department also assists in identifying and verifying wood species for the local authorities, construction companies and the public, in compliance to certain standards and specifications. A wood identification system, which leverages the Internet of Things (IoT) and Artificial Intelligence (AI) is being developed with the aim to provide a rapid and cost-effective tool for ground enforcement officers, customs officials, and timber industry stakeholders. Additionally, engagement with stakeholders such as with FMUs and local communities are conducted to create awareness on the biodiversity conservation in their area.

The findings from these research activities and conservation efforts have been disseminated through numerous publications and presentations at local and international seminars and conferences. Between 2022 and 2024, about 61 publications and presentations have been shared so far on topics related to biodiversity research. Among recent books published are the Sarawak Orchid Memoirs: Discovery of *Bulbophyllum abangjoei*, *Menyekak Gu'un Jemoreng*, The Heart of Borneo Series, Wildlife of Gerenai FMU, Caught in the Act: Through Camera Traps: Unveiling the Wildlife of Mujong Melinau FMU, and Birds of Permanent Forests of Sarawak: Series 1.

5 CONCLUSIONS

Sarawak's biodiversity conservation within its PFEs has advanced through research, innovative technologies like AI and LiDAR. These efforts, supported by international collaborations and partnerships with academic institutions, have led to the discovery of new species, protection of endangered species, and progress in carbon trading. Moving forward, FDS aims to continue integrating advanced technologies, expand collaborations, and empower local communities to balance conservation with economic development, and contributing to global sustainability goals.

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