

Building evidence for conservation globally

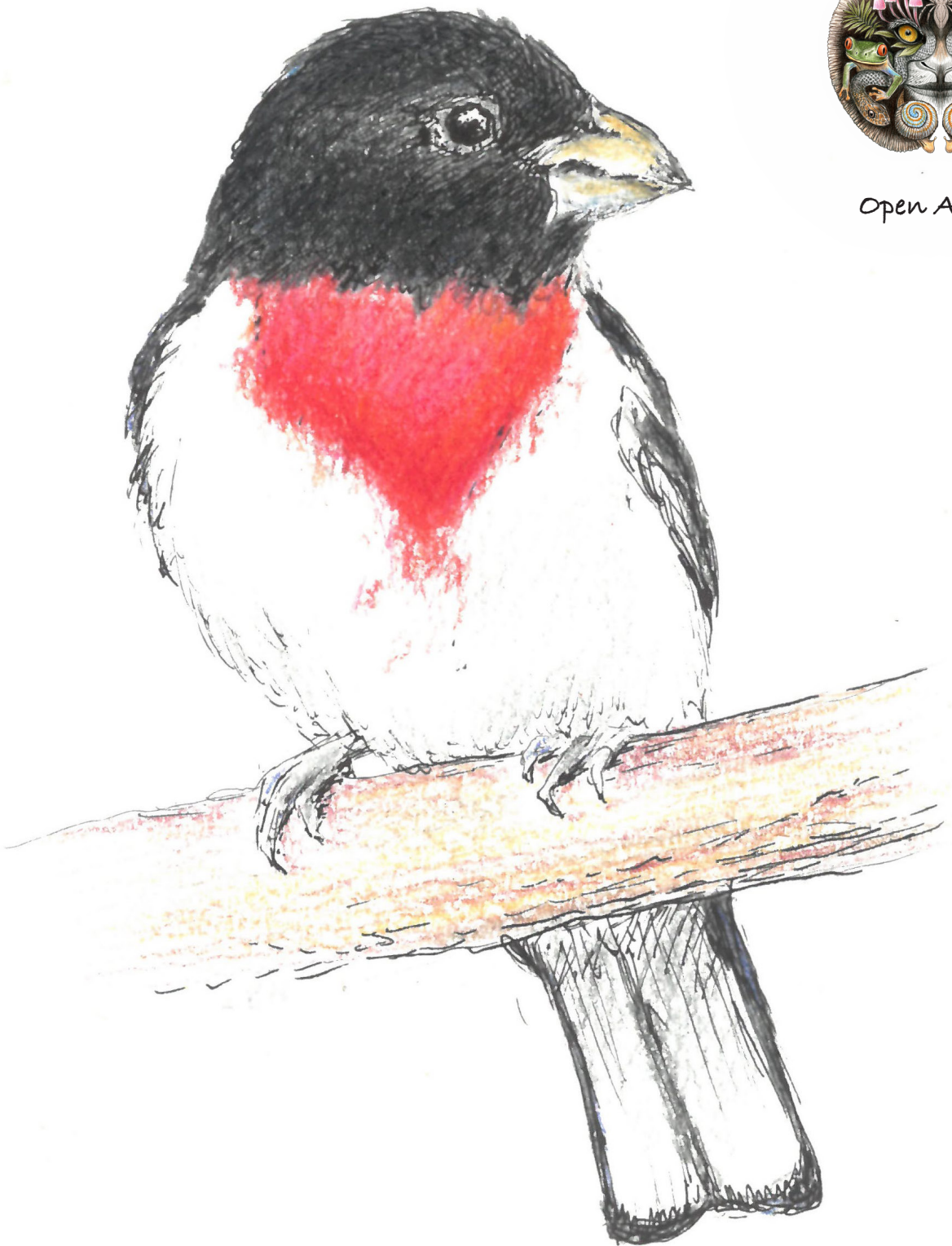
Journal of
Threatened
Taxa

10.11609/jott.2024.16.5.25119-25282
www.threatenedtaxa.org

26 May 2024 (Online & Print)
16(5): 25119-25282
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)



Open Access





ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

43/2 Varadarajulu Nagar, 5th Street West, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

EDITORS

Founder & Chief Editor

Dr. Sanjay Molur

Wildlife Information Liaison Development (WILD) Society & Zoo Outreach Organization (ZOO),
43/2 Varadarajulu Nagar, 5th Street West, Ganapathy, Coimbatore, Tamil Nadu 641006, India

Deputy Chief Editor

Dr. Neelesh Dahanukar

Noida, Uttar Pradesh, India

Managing Editor

Mr. B. Ravichandran, WILD/ZOO, Coimbatore, Tamil Nadu 641006, India

Associate Editors

Dr. Mandar Paingankar, Government Science College Gadchiroli, Maharashtra 442605, India

Dr. Ulrike Streicher, Wildlife Veterinarian, Eugene, Oregon, USA

Ms. Priyanka Iyer, ZOO/WILD, Coimbatore, Tamil Nadu 641006, India

Dr. B.A. Daniel, ZOO/WILD, Coimbatore, Tamil Nadu 641006, India

Editorial Board

Dr. Russel Mittermeier

Executive Vice Chair, Conservation International, Arlington, Virginia 22202, USA

Prof. Mewa Singh Ph.D., FASC, FNA, FNASC, FNAPsy

Ramanna Fellow and Life-Long Distinguished Professor, Biopsychology Laboratory, and Institute of Excellence, University of Mysore, Mysuru, Karnataka 570006, India; Honorary Professor, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore; and Adjunct Professor, National Institute of Advanced Studies, Bangalore

Stephen D. Nash

Scientific Illustrator, Conservation International, Dept. of Anatomical Sciences, Health Sciences Center, T-8, Room 045, Stony Brook University, Stony Brook, NY 11794-8081, USA

Dr. Fred Pluthero

Toronto, Canada

Dr. Priya Davidar

Sigur Nature Trust, Chadapatti, Mavinhalla PO, Nilgiris, Tamil Nadu 643223, India

Dr. Martin Fisher

Senior Associate Professor, Battcock Centre for Experimental Astrophysics, Cavendish Laboratory, JJ Thomson Avenue, Cambridge CB3 0HE, UK

Dr. John Fellowes

Honorary Assistant Professor, The Kadoorie Institute, 8/F, T.T. Tsui Building, The University of Hong Kong, Pokfulam Road, Hong Kong

Prof. Dr. Mirco Solé

Universidade Estadual de Santa Cruz, Departamento de Ciências Biológicas, Vice-coordenador do Programa de Pós-Graduação em Zoologia, Rodovia Ilhéus/Itabuna, Km 16 (45662-000) Salobrinho, Ilhéus - Bahia - Brasil

Dr. Rajeev Raghavan

Professor of Taxonomy, Kerala University of Fisheries & Ocean Studies, Kochi, Kerala, India

English Editors

Mrs. Mira Bhojwani, Pune, India

Dr. Fred Pluthero, Toronto, Canada

Mr. P. Ilangovan, Chennai, India

Ms. Sindhura Stothra Bhashyam, Hyderabad, India

Web Development

Mrs. Latha G. Ravikumar, ZOO/WILD, Coimbatore, India

Typesetting

Mrs. Radhika, ZOO, Coimbatore, India

Mrs. Geetha, ZOO, Coimbatore India

Fundraising/Communications

Mrs. Payal B. Molur, Coimbatore, India

Subject Editors 2020–2022

Fungi

Dr. B. Shivaraju, Bengaluru, Karnataka, India

Dr. R.K. Verma, Tropical Forest Research Institute, Jabalpur, India

Dr. Vatsavaya S. Raju, Kakatiya University, Warangal, Andhra Pradesh, India

Dr. M. Krishnappa, Jnana Sahyadri, Kuvempu University, Shimoga, Karnataka, India

Dr. K.R. Sridhar, Mangalore University, Mangalagangothri, Mangalore, Karnataka, India

Dr. Gunjan Biswas, Vidyasagar University, Midnapore, West Bengal, India

Dr. Kiran Ramchandra Ranadive, Annasaheb Magar Mahavidyalaya, Maharashtra, India

Plants

Dr. G.P. Sinha, Botanical Survey of India, Allahabad, India

Dr. N.P. Balakrishnan, Ret. Joint Director, BSI, Coimbatore, India

Dr. Shonil Bhagwat, Open University and University of Oxford, UK

Prof. D.J. Bhat, Retd. Professor, Goa University, Goa, India

Dr. Ferdinando Boero, Università del Salento, Lecce, Italy

Dr. Dale R. Calder, Royal Ontario Museum, Toronto, Ontario, Canada

Dr. Cleofas Cervancia, Univ. of Philippines Los Baños College Laguna, Philippines

Dr. F.B. Vincent Florens, University of Mauritius, Mauritius

Dr. Merlin Franco, Curtin University, Malaysia

Dr. V. Irudayaraj, St. Xavier's College, Palayamkottai, Tamil Nadu, India

Dr. B.S. Kholia, Botanical Survey of India, Gangtok, Sikkim, India

Dr. Pankaj Kumar, Department of Plant and Soil Science, Texas Tech University, Lubbock, Texas, USA.

Dr. V. Sampath Kumar, Botanical Survey of India, Howrah, West Bengal, India

Dr. A.J. Solomon Raju, Andhra University, Visakhapatnam, India

Dr. Vijayasankar Raman, University of Mississippi, USA

Dr. B. Ravi Prasad Rao, Sri Krishnadevaraya University, Anantpur, India

Dr. K. Ravikumar, FRLHT, Bengaluru, Karnataka, India

Dr. Aparna Watve, Pune, Maharashtra, India

Dr. Qiang Liu, Xishuangbanna Tropical Botanical Garden, Yunnan, China

Dr. Noor Azhar Mohamed Shazili, Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia

Dr. M.K. Vasudeva Rao, Shiv Ranjani Housing Society, Pune, Maharashtra, India

Prof. A.J. Solomon Raju, Andhra University, Visakhapatnam, India

Dr. Mandar Datar, Agharkar Research Institute, Pune, Maharashtra, India

Dr. M.K. Janarthanam, Goa University, Goa, India

Dr. K. Karthigeyan, Botanical Survey of India, India

Dr. Errol Vela, University of Montpellier, Montpellier, France

Dr. P. Lakshminarasimhan, Botanical Survey of India, Howrah, India

Dr. Larry R. Noblick, Montgomery Botanical Center, Miami, USA

Dr. K. Haridasan, Pallavur, Palakkad District, Kerala, India

Dr. Analinda Manila-Fajard, University of the Philippines Los Baños, Laguna, Philippines

Dr. P.A. Sinu, Central University of Kerala, Kasaragod, Kerala, India

Dr. Afroz Alam, Banasthali Vidyapith (accredited A grade by NAAC), Rajasthan, India

Dr. K.P. Rajesh, Zamorin's Guruvayurappan College, GA College PO, Kozhikode, Kerala, India

Dr. David E. Boufford, Harvard University Herbaria, Cambridge, MA 02138-2020, USA

Dr. Ritesh Kumar Choudhary, Agharkar Research Institute, Pune, Maharashtra, India

Dr. A.G. Pandurangan, Thiruvananthapuram, Kerala, India

Dr. Navendu Page, Wildlife Institute of India, Chandrabani, Dehradun, Uttarakhand, India

Dr. Kannan C.S. Warriar, Institute of Forest Genetics and Tree Breeding, Tamil Nadu, India

Invertebrates

Dr. R.K. Avasthi, Rohtak University, Haryana, India

Dr. D.B. Bastawade, Maharashtra, India

Dr. Partha Pratim Bhattacharjee, Tripura University, Suryamaninagar, India

Dr. Kailash Chandra, Zoological Survey of India, Jabalpur, Madhya Pradesh, India

Dr. Ansie Dippenaar-Schoeman, University of Pretoria, Queenswood, South Africa

Dr. Rory Dow, National Museum of Natural History Naturalis, The Netherlands

Dr. Brian Fisher, California Academy of Sciences, USA

Dr. Richard Gallon, Llandudno, North Wales, LL30 1UP

Dr. Hemant V. Ghate, Modern College, Pune, India

Dr. M. Monwar Hossain, Jahangirnagar University, Dhaka, Bangladesh

For Focus, Scope, Aims, and Policies, visit https://threatenedtaxa.org/index.php/JoTT/aims_scope

For Article Submission Guidelines, visit <https://threatenedtaxa.org/index.php/JoTT/about/submissions>

For Policies against Scientific Misconduct, visit https://threatenedtaxa.org/index.php/JoTT/policies_various

continued on the back inside cover

Cover: Rose-breasted Grosbeak *Pheucticus ludovicianus*, pen & ink with colour pencil. © Lucille Betti-Nash.



Tree architecture model of Sumatran Orangutan *Pongo abelii* Lesson, 1827 (Mammalia: Primates: Hominidae) nests at Soraya Research Station, Leuser Ecosystem, Indonesia

Anugrah Gilang Permana Lubis¹ & Nursahara Pasaribu²

^{1,2}Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan 20155, North Sumatra, Indonesia.

¹anugrahgilangp.lubis@gmail.com, ²nursahara@usu.ac.id (corresponding author)

Abstract: The relationship between tree architectural models and the nesting behavior of the Sumatran Orangutan *Pongo abelii* Lesson, 1827 at the Soraya Research Station, Sumatra, Indonesia was determined by examining the preference for particular nest tree architectural models in relation to the frequency of nest occurrence. This investigation included the study of tree architectural models, tree types, nest profiles, vegetation, environmental factors, and geospatial data, collected within a 20 × 1,000 m (2 ha) observational area during a nest survey. A total of 59 orangutan nests were identified across 47 trees, categorized into 31 species and nine varied tree architectural models. Among these, the most prevalent models observed were Cook, Scarrone, and Attims, which exhibit features assumed to enhance orangutan nesting behaviors. Based on the Neu approach to nest qualities, the analytical test findings show a correlation between the preference ratings for nesting trees. Our results are expected to serve as a reference for selecting tree species in rehabilitation or habitat restoration programs and the development of separated forest block corridors as conservation efforts for orangutans.

Keywords: Animal behavior, arboreal animal, conservation, forest, habitat restoration, preferences, primate.

Bahasa Abstrak: Hubungan model arsitektur pohon dengan perilaku bersarang Orangutan Sumatera *Pongo abelii* Lesson, 1827 di Stasiun Penelitian Soraya, Sumatra, Indonesia ditentukan dengan memeriksa preferensinya terhadap model arsitektur pohon sarang tertentu dalam kaitannya dengan frekuensi kehadiran sarang. Penelitian ini mencakup studi model arsitektur pohon, jenis pohon, profil sarang, vegetasi, faktor lingkungan, dan data geospasial, yang dikumpulkan dalam area observasi seluas 20 × 1.000 m (2 ha) selama survei sarang. Sebanyak 59 sarang orangutan teridentifikasi di 47 pohon, dikategorikan ke dalam 31 spesies dan sembilan model arsitektur pohon yang bervariasi. Di antara model-model tersebut, model yang paling umum diamati adalah Cook, Scarrone, dan Attims, yang menunjukkan fitur-fitur yang diasumsikan meningkatkan perilaku bersarang orangutan. Berdasarkan pendekatan Neu terhadap kualitas sarang, hasil analisis menunjukkan adanya korelasi antara tingkat preferensi terhadap model pohon sarang tertentu. Hasil penelitian ini diharapkan dapat menjadi acuan awal dalam memilih jenis pohon yang sesuai untuk program rehabilitasi atau restorasi habitat dan pengembangan koridor blok hutan terpisah sebagai upaya konservasi orangutan.

Editor: Murali Krishna Chatakonda, Amity University, Noida, India.

Date of publication: 26 May 2024 (online & print)

Citation: Lubis, A.G.P. & N. Pasaribu (2024). Tree architecture model of Sumatran Orangutan *Pongo abelii* Lesson, 1827 (Mammalia: Primates: Hominidae) nests at Soraya Research Station, Leuser Ecosystem, Indonesia. *Journal of Threatened Taxa* 16(5): 25119–25128. <https://doi.org/10.11609/jott.8818.16.5.25119-25128>

Copyright: © Lubis & Pasaribu 2024. Creative Commons Attribution 4.0 International License. JoTT allows unrestricted use, reproduction, and distribution of this article in any medium by providing adequate credit to the author(s) and the source of publication.

Funding: Leuser Conservation Forum, Aceh Province, Indonesia.

Competing interests: The authors declare no competing interests.

Author details: ANUGRAH GILANG PERMANA LUBIS has recently completed his bachelor's degree in plant ecology at the Department of Biology, Universitas Sumatera Utara. He currently works at the Leuser Ecosystem Foundation (YEL) as a staff monitoring and scientific surveyor for biodiversity conservation (In situ conservation). NURSAHARA PASARIBU holds a Ph.D. in Pandanaceae biosystematics in the Malesian region, focusing on Freycinetia spp. of Sumatra. She is dedicated to her work in the fields of plant taxonomy, plant ecology, and ethnobotany and is a senior lecturer at Universitas Sumatera Utara.

Author contributions: AGPL—designed the project, analyzed the data, and wrote the first draft of the manuscript. NP—proofread and assisted in the project and final editing of the manuscript.

Acknowledgements: We wish to acknowledge the Forestry and Environmental Agency of Aceh Province, Indonesia and the Leuser Conservation Forum for facilitating this project and providing field assistance.



INTRODUCTION

Tree architecture refers to the morphological progression observed in tree-like plant development. It characterizes a sequence of structural stages of trees (Halle et al. 1978). Various species are identified by distinct architectural models, presenting 24 different models. Architecture significantly influences the ecological role of trees in the environment and plays a vital role in understanding their interactions with other life forms, particularly arboreal animals (Halle et al. 1978; Turner 2004).

Arboreal animals, particularly certain primate species, are often observed on trees with specific architectural features (Larson 2018). For instance, Javan Langurs *Trachypitecus auratus* have been seen using trees with the Schoute and Cook architectural models while feeding (Ayunin et al. 2014). When moving, resting, and seeking shelter, they were observed using trees with the Cook and Leeuwenberg models (Hendrawan et al. 2019). The Schoute model involves growth from meristems, producing orthotropic or plagiotropic trunks with equal dichotomy at regular but distant intervals, and lateral inflorescences. The Leeuwenberg model consists of equivalent orthotropic modules determined by terminal inflorescence production, while the Cook model results from continuous growth with spiral or decussate phyllotaxis, producing phyllomorphic branches (Halle et al. 1978). Proboscis Monkeys *Nasalis larvatus* favor the Rauh or Attims architectural models, where the Rauh architecture involves rhythmic growth of a monopodial trunk with tiered branches, and the Attims model is characterized by continuous growth with lateral flowering that does not affect shoot construction. These architectural models are distinguished by perpendicular branches suitable for resting or sleeping (Widiastuti et al. 2017).

Orangutans are arboreal mammals that highly rely on trees, particularly for nesting. They select a new tree for nesting and resting each day, considering specific characteristics and types of trees. Orangutans strategically place their nests to maintain a clear view of the surrounding forest. Trees with dense horizontal branches and a compact crown with uniformly spread leaves (a ball crown) are commonly preferred, as these features facilitate nest building. This preference is related to the tree's architectural model (Nowak 1999; Muin 2007; Nasution et al. 2018). Understanding the architectural models of orangutan nest trees is crucial to identify trends in the prevalence of specific models and their association with nest characteristics. Such

knowledge can serve as a guideline for selecting tree species in habitat restoration initiatives, especially in creating distinct forest block corridors as part of orangutan conservation efforts.

METHODS

Study Area

The Leuser Ecosystem Area (KEL) is a critical natural environment characterized by its unique flora and fauna, forming a balanced ecosystem essential for maintaining biodiversity. This ecosystem supports several Critically Endangered species, including the Sumatran Orangutan *Pongo abelii*, Sumatran Rhinoceros *Dicerorhinus sumatranus*, Sumatran Tiger *Panthera tigris sumatrae*, and Sumatran Elephant *Elephas maximus sumatranus*. A notable protected area within the Leuser Ecosystem is the Soraya Research Station, which is recognized for its importance as an orangutan habitat. According to Mariana et al. (2020), the quality of orangutan habitat is primarily determined by the availability of food and nesting trees. In 2016, the Leuser Conservation Forum (FKL), in collaboration with the Aceh Forestry Environmental Service (DLHK), undertook the management of the Soraya Research Station (SRS), situated in a tropical environment with an annual rainfall of 2,450 mm. The temperature in this location ranges between 25–30 °C, with humidity averaging 98% in the morning and 95% in the afternoon. The SRS region has a hilly topography and is located at an elevation of 75–350 m. This research station area is classed as lowland tropical rainforest. Dipterocarpaceae, such as *Shorea* spp. and 'keruing' (Bahasa: Dipterocarp trees), *Dipterocarpus* spp., dominate the vegetation of the SRS. Other plant families that dominate at this location include Euphorbiaceae, Meliaceae, Lauraceae, Moraceae, and Anacardiaceae (Iqbar 2015).

Sampling Procedure

This study was conducted at the SRS from November to December 2020 using the principle of purposive sampling and an observation approach in the form of a nest survey on the path/trail. Strip transects with plots were used for observations and data gathering. The transect length was 100 m, with a single plot running the length and a width of 20 m at 10 observation locations (stations), for a total observation area of 2 ha (Figure 1).

Nest Survey

Nest surveys are conducted by strolling slowly down the trail, paying attention to the canopy at a 180° viewing angle, as well as direct surveys at the locations of nest trees discovered and recorded at the SRS (Atmoko & Rifqi 2012). The discovery of orangutan nest trees serves as the foundation for establishing observation locations. The nest tree is any tree that has an orangutan nest in a condition that allows for observation and collection, such as when practically all of the leaves have fallen or the structure of the twigs is evident.

Nest Tree Profile

Orangutan nest tree profile data, including tree type, diameter, total tree height, free branch height, and canopy area were observed with recordings featuring both common and scientific names, along with essential characteristics for identification. The diameter at breast height (DBH) was used to estimate the diameter of the tree, i.e., approximately 110–120 cm or 30 cm from the top of the buttress. A rangefinder was used to determine the total height of the tree as well as the free height of its branches. The crown area was calculated by measuring the distance between the outermost diagonal line and the tree canopy.

Nest Profile

Height of the nest was measured with a rangefinder, as was the position of nest and canopy of orangutan nest on tree. Orangutan nest position category included (Atmoko & Rifqi 2012):

- Position 1, nest is at base of main branch of tree.
- Position 2, nest is in middle or end of a tree branch.
- Position 3, nest is at top of tree.
- Position 4, nest is between two or more trees.
- Position 0, nest is on the ground.

Type of orangutan nest canopy category (Atmoko & Rifqi 2012):

- Opened canopies,
- Semi-opened canopies, and
- Closed canopies.

Vegetation Analysis

Vegetation analysis is an approach to quantify the composition, diversity, and richness of plant community with some parameters described as follow:

- Density and Frequency (Rahman 2010):

$$\text{Density} = \frac{\text{Total number of individuals of the species in all sampling units}}{\text{Total number of sampling units studies}}$$

$$\text{Frequency} = \frac{\text{Number of sampling units in which species occur}}{\text{Total number of sampling units employed for the study}}$$

$$\text{Relative Density} = \frac{\text{Total number of individuals of the species in all sampling units}}{\text{Total number of all species}} \times 100\%$$

$$\text{Relative Frequency} = \frac{\text{Number of occurrences of the species}}{\text{Total number of occurrences in all sampling units}} \times 100\%$$

b. Species diversity index (H') analysed using Shannon-Wiener formula:

$$H' = -\sum P_i \ln P_i \quad (P_i = n_i/N)$$

Where:

- P_i = Proportion number of individuals to number of individuals all species,
- \ln = Natural logarithm.

Criteria for diversity index (Magurran 1988):

- $H' > 3$, species diversity is high
- $1 < H' \leq 3$, species diversity is medium
- $H' < 1$, species diversity is low

c. Margalef species richness index (D_{mg}) analyzed using the formula:

$$D_{mg} = (S-1)/\ln N$$

Where, S = Number of species observed,

N = Total number of individuals of all species.

Criteria for richness index (Magurran 1988):

- $D_{mg} \leq 3.5$, richness index is low
- $3.5 < D_{mg} < 5$, richness index is medium
- $D_{mg} \geq 5$, richness index is high

Preference Test

The analysis employs the Neu approach, which is based on the frequency of habitat utilization in certain proportions. The assumption is that preference for nest tree type is exactly related to the frequency of nest presence in that tree type. Table 1 includes preference index criteria for data processing to generate preferences for nest tree architectural models (Neu et al. 1974; Bibby et al. 1998; Muin 2007):

- $w < 1$, not too likely
- $w \geq 1$, likely

Correlations test

The Statistical Package for the Social Science (SPSS) software was used to conduct quantitative data analysis to investigate the link between nest tree architectural model preferences and nest characteristic data in the form of nest profiles and nest tree profiles (Cantrell et al. 2016). Pearson correlation testing was performed

on the assumption of correlation coefficient value (r), correlation coefficient criteria (Sarwono 2009), specifically:

- a. $r = 0$, uncorrelated
- b. $0 > r > 0.25$, very weak
- c. $0.25 > r > 0.5$, enough
- d. $0.5 > r > 0.75$, strong
- e. $0.75 > r > 0.99$, very strong
- f. $r = 1$, perfect

RESULTS AND DISCUSSION

Orangutan Nest Survey

During the observation at the Soraya Research Station, a total of 59 orangutan nests were identified in 47 distinct trees. Numerous individual nest trees contained more than one orangutan nest.

Distribution of trees encountered along the transects is illustrated in Figure 2. The density of individual trees is a crucial factor in the preference test. The highest number of individual trees was observed at an altitude of 90 m with gentle to steep slope conditions. The vegetation in this area is quite dense, with tree heights ranging from 7–33 m and canopy widths varying from 1–19 m. Due to its proximity to a river, the canopy is partially open. Factors such as height, slope, canopy, and proximity to a river significantly affect orangutan nest establishment (Rijksen 1987; Muin 2007; Prayogo et al. 2016).

Nest Architecture Model

Nests were discovered in 31 of the 103 tree species that were studied (Table 2). Nine of the sixteen tree architectural models that were seen included the kind of tree that contained the nest. The Attims model had the most types (20) among the various nest tree types (six), while the Stone model had nine types with several nest tree variations (Figure 3). The Stone model was observed in all surveyed locations within

the lowland rainforests, while the Cook, Fagerlind, and Prevost models were challenging to locate in some observation areas. Seven architectural models where no orangutan nests were discovered are listed in Appendix 8, including Leeuwenberg, Aubreville, Massart, Nozeran, Rauh, Champagnat, and Troll. The number of nest tree species is more influenced by tree attributes such as trunk diameter, tree height, canopy area, and tree architectural model rather than the number of tree species. The architectural models of discovered nest trees feature robust trunks, multiple branches, and are compactly arranged. These features support their suitability as orangutan nest trees. Architectural models of trees without nests exhibit weaker trunks with few poorly organized branches, making them unsuitable as orangutan nest trees due to their inability to support the orangutan’s weight. The main factor influencing the selection of nest trees is the stem character, with orangutan nests being predominantly located in large, sturdy trees (Rijksen 1978; Muin 2007; Putro et al. 2019; Mardiana et al. 2020).

The number of tree species suitable for nesting is influenced more by specific tree attributes—such as trunk diameter, tree height, canopy area, and tree

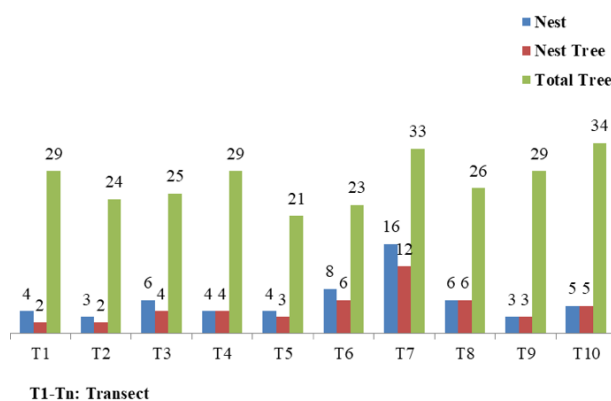


Figure 1. Profile of orangutan nests at Soraya Research Station.

Table 1. Summary of nest tree data in preferences index formula.

Nest Tree	P	N	u	e	w	b
1						
2						
...						
k	Pk	Nk	uk	ek	wk	bp
Total	1000	Σn	1000	Σe	Σw	1000

p—individual proportion of tree architecture models | n—frequency of nest’s presence | u—proportion of nests presence (n/Σn) | e—expected value (p × Σn) | w—preference index (u/p).

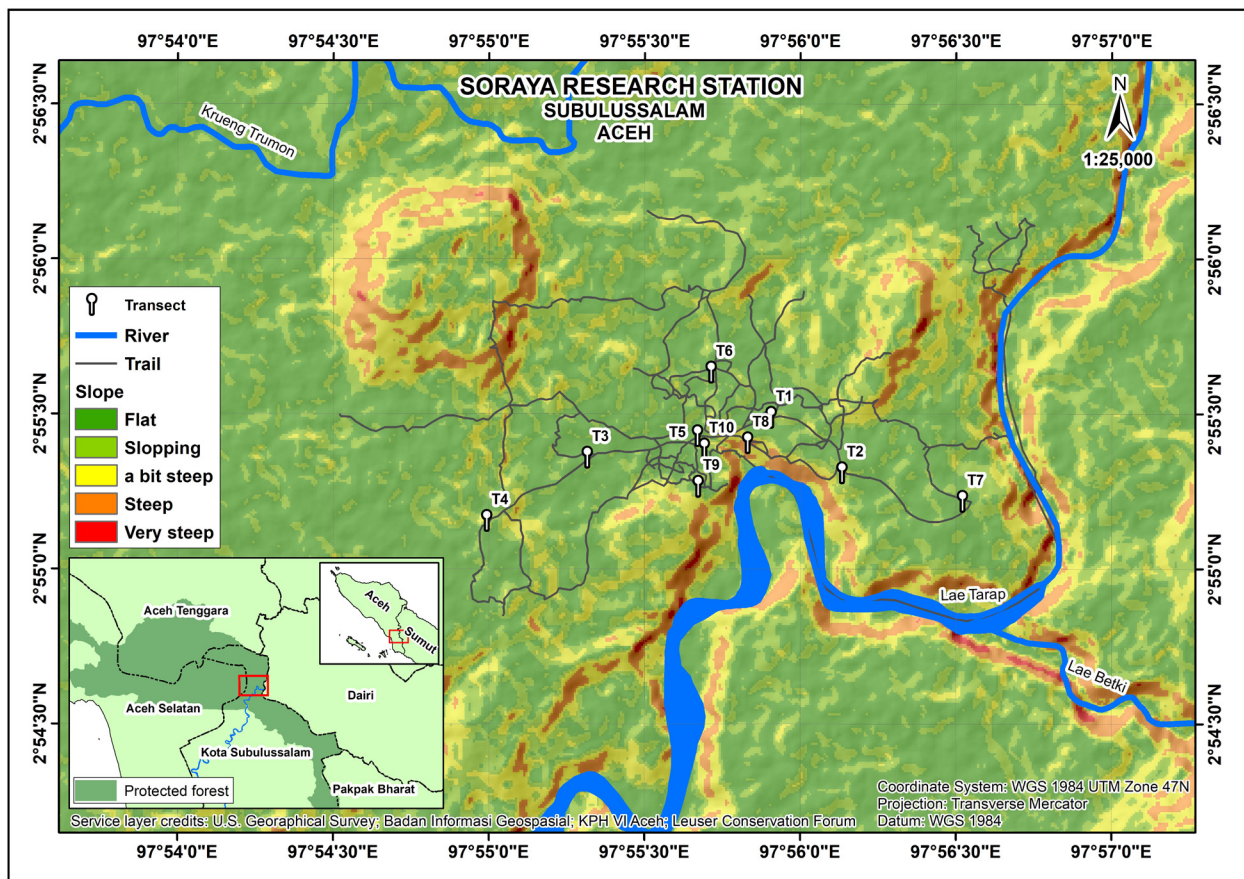


Figure 2. Map of Soraya Research Station showing sampling point of nest survey.

architectural model—rather than merely the number of tree species available. Trees exhibiting the appropriate nest architectural model typically feature strong trunks, numerous well-organized branches, and close compactness, making them well-suited as orangutan nest trees. Conversely, trees lacking these nest features present weaker trunks and fewer, disorganized branches, rendering them unsuitable as orangutan nest trees due to their inability to support the orangutan's weight. Consequently, the main factor in nest tree selection is the tree's physical structure, with orangutan nests most frequently found in larger, sturdier trees (Rijksen 1987; Prayogo et al. 2016).

Vegetation composition and ecology

The assessment of 103 identified species revealed 10 species with the highest RD and RF values (Table 3). Of these, nests are found in eight species. *Shorea multiflora* (Burck) Symington boasted the highest RD value (10.57%), while *Streblus elongatus* (Miq.) Corner, *Shorea leprosula* Miq., and *Palaquium rostratum* (Miq.) Burck exhibited the highest RF value (3.33%). These four tree species are

frequently used by orangutans for nesting purposes. The region exhibits a rich diversity of tree species (H') with a Shannon-Wiener diversity index of 4. Moreover, the richness of tree species in the region is substantial with a Margaleff Index (D_{mg}) of 15.96. As a critical element of the orangutan habitat, vegetation plays a significant role. The diversity and richness of plant species impact various aspects of orangutan survival, including feeding, migration, and nesting behaviors. A habitat containing a wide array of food and nest trees improves significantly with the high diversity and richness of plant species. Conducting a vegetation analysis helps understand the composition of the vegetation in a given area. It helps differentiate land cover types and habitat variations based on the most relevant plant species (Rahman 2010; Kuswanda 2014b; Regina et al. 2020).

Preference Test

The findings from the preference test suggest that three tree architectural models are highly favored (Figure 4). Orangutans exhibit a tendency to construct nests based on various factors such as tree height, diameter,

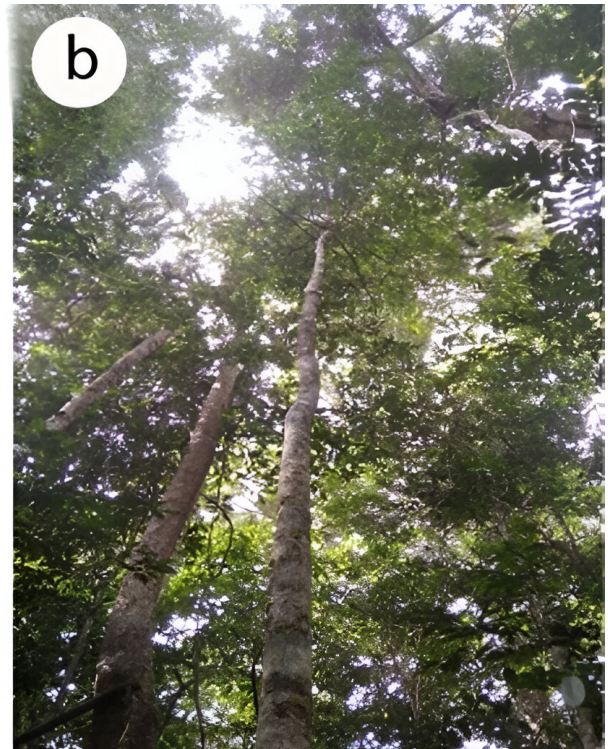
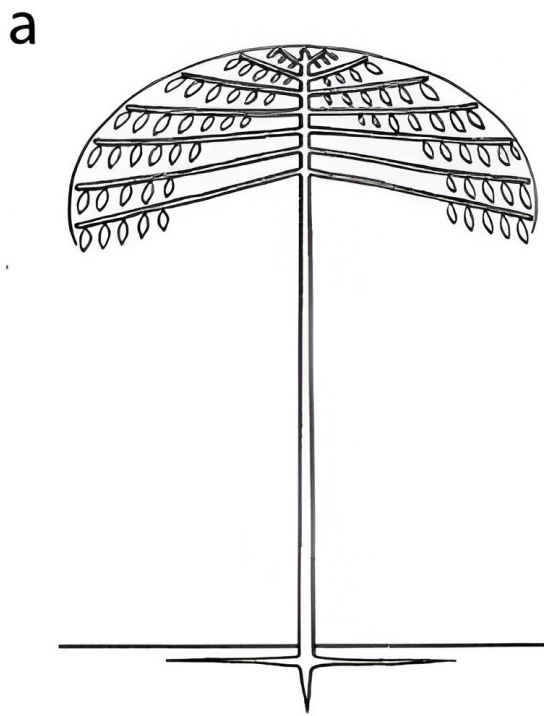


Image 1. a—Illustration of Cook architectural model (Halle et al. 1978) | b—*Monocarpia maingayi* (Hook.f. & Thomson) I.M. Turner. © Anugrah Gilang Permana Lubis.

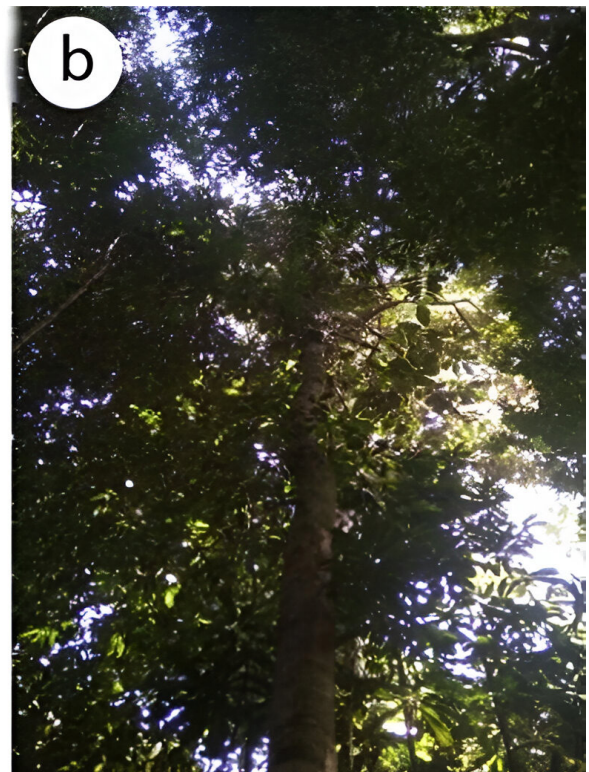
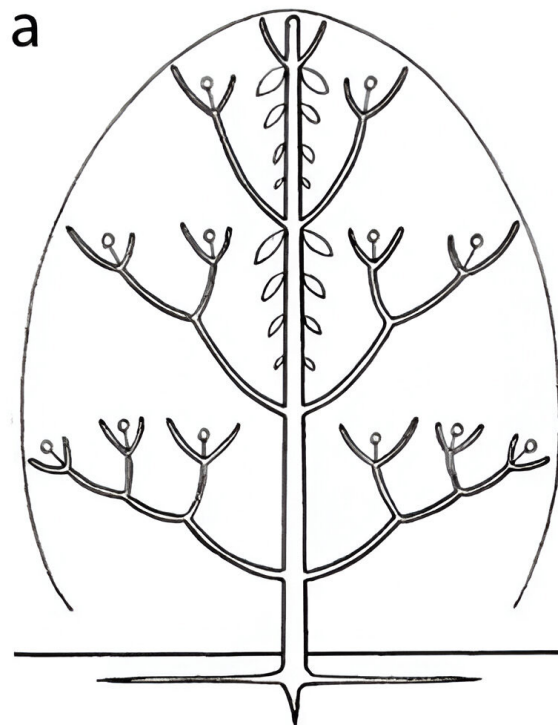


Image 2. a—Illustration of the Scarrone architectural model (Halle et al. 1978) | b—*Lithocarpus javensis* Blume. © Anugrah Gilang Permana Lubis.

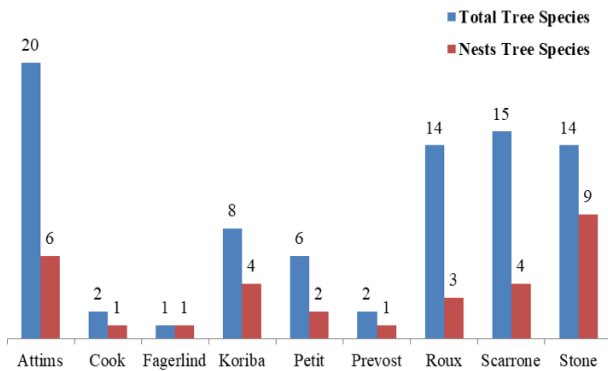


Figure 3. Number of species with nest each architecture models.

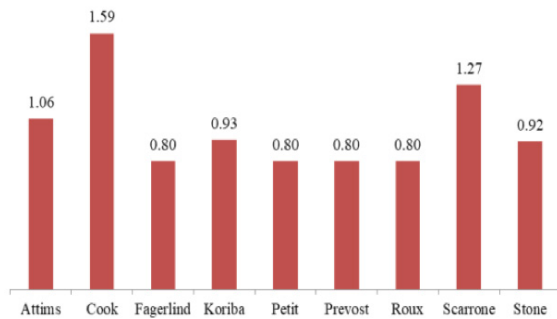


Figure 4. Diagram of preference test result.

crown size, and crown shape, nest height, nest position, and nest canopy. These aspects have a direct bearing on the appearance of the nest. The branch shape and tree size are key characteristics of tree architecture (Muin 2007; Nababan et al. 2021).

The Cook tree model represents a branching structure with a central trunk and multiple branches (Image 1). This type of architecture results from continuous branching originating from the main stem, showing either spiral or crossing (decussate) phyllotaxis. The phyllomorphic branching structure resembles compound leaves and is a subset of plagiotropic branching that includes non-modular or equivalent monopodial or sympodial branches. In this model, branches are closely spaced and leaves are evenly distributed, giving rise to a robust architectural design (Halle et al. 1978).

Scarrone is a branching tree architectural form (Polyaxial) with a vegetative axis divided into trunks and branches (Image 2). Growth takes the form of rhythmic ramification from orthotropic monopodial stems. Sympodial branching consists of non-equivalent orthotropic branches. This model has a strong architectural style and several branches (Halle et al.

Table 2. Distribution of species across tree architecture models that orangutan nest exist in Soraya Research Station.

Tree architecture models	Species		
Attims	<i>Aglaia</i> sp.		
	<i>Dacryodes costata</i> (A.W.Benn.) H.J. Lam.		
	<i>Palaquium rostratum</i> (Miq.) Burck		
	<i>Payena lucida</i> A.DC.		
	<i>Shorea glauca</i> King		
Cook	<i>Shorea multiflora</i> (Burck) Symington		
	<i>Monocarpia maingayi</i> (Hook.f. & Thomson) I.M.Turner		
	Fagerlind	<i>Cyathocalyx sumatranus</i> Scheff.	
		Koriba	<i>Aglaia korthalsii</i> Miq.
			<i>Aglaia speciosa</i> Blume
<i>Aporosa antennifera</i> (Airy Shaw) Airy Shaw.			
Petit	<i>Streblus elongatus</i> (Miq.) Corner		
	<i>Diospyros pyrrocarpa</i> Miq.		
	<i>Durio oxleyanus</i> Griff.		
Prevost	<i>Knema cinerea</i> (Poir.) Warb.		
	Roux	<i>Garcinia celebica</i> L.	
<i>Shorea leprosula</i> Miq.			
<i>Syzygium</i> spp.1			
Scarrone	<i>Barringtonia scortechinii</i> King		
	<i>Lithocarpus javensis</i> Blume		
	<i>Mangifera foetida</i> Lour.		
	<i>Xanthophyllum vitellinum</i> (Blume) D.Dietr.		
Stone	<i>Aporosa lunata</i> (Miq.) Kurz		
	<i>Diospyros bangkana</i> Bakh.		
	<i>Garcinia dioica</i> Blume		
	<i>Gluta renghas</i> L.		
	<i>Lithocarpus</i> sp.		
	<i>Lithocarpus wrayi</i> (King) A.Camus		
Total	<i>Mischocarpus sundaicus</i> Blume		
	<i>Rinorea sclerocarpa</i> (Burgersd.) Melch.		
	<i>Syzygium</i> spp.2		
nine models	31 Species		

1978).

Attims is a tree architectural model that belongs to the branching tree (Polyaxial) category, with a vegetative axis that is separated into trunk and branches (Image 3). Continuous ramification from orthotropic monopodial stems drives growth. Monopodial branching is equivalent to orthotropic growth direction. The branches are grouped tightly together with the same size, and the leaves are evenly distributed with many twigs, resulting

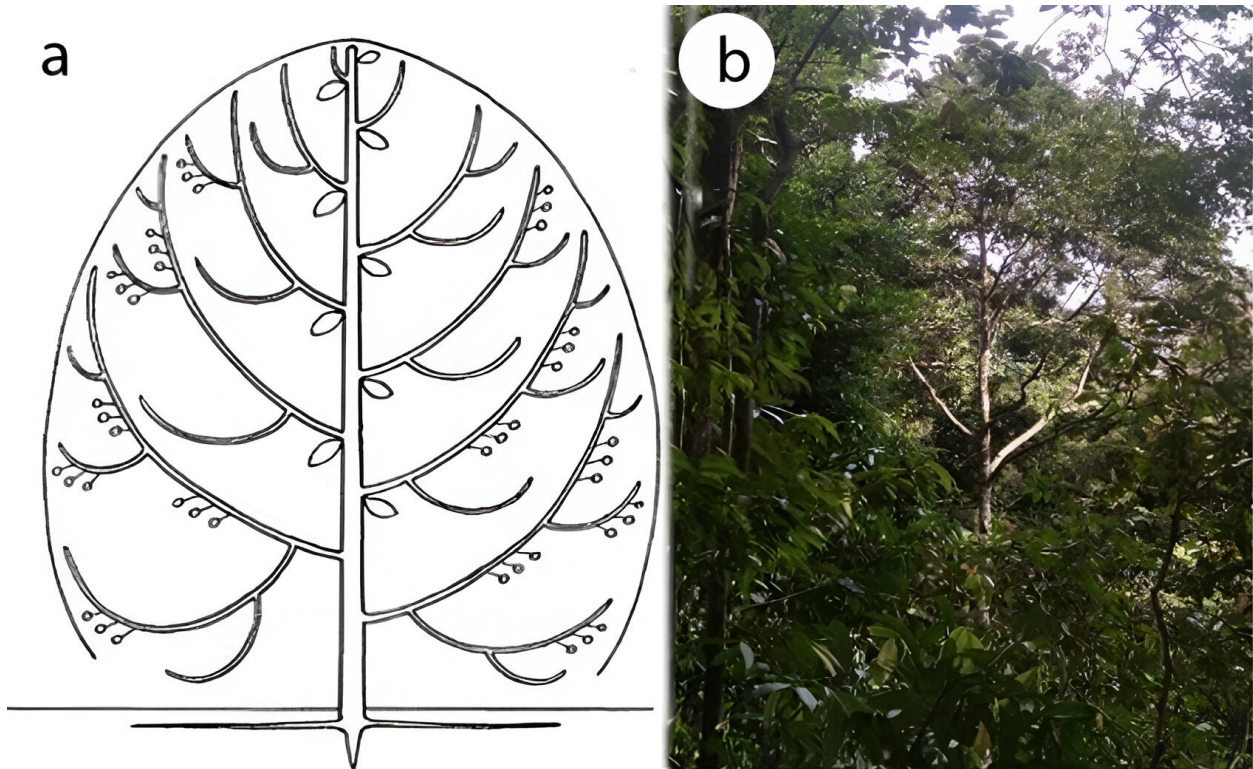


Image 3. a—Illustration of the Attims architectural model (Halle et al. 1978) | b—*Parashorea lucida* Kurz. © Anugrah Gilang Permana Lubis.

Table 3. Major tree species utilized by orangutan and its ecological indices in Soraya Research Station.

	Species	Models	RF (%)	RD (%)	H	D _{mg}
1	<i>Shorea multiflora</i> (Burck) Symington	Attims	2.59	10.57	4	15.96
2	<i>Streblus elongatus</i> (Miq.) Corner	Koriba	3.33	7.89		
3	<i>Artocarpus kemando</i> Miq. *	Champagnat	2.96	5.37		
4	<i>Shorea leprosula</i> Miq.	Roux	3.33	4.7		
5	<i>Palaquium rostratum</i> (Miq.) Burck	Attims	3.33	3.86		
6	<i>Barringtonia scortechinii</i> King	Scarrone	2.96	2.35		
7	<i>Gluta renghas</i> L.	Stone	2.22	3.02		
8	<i>Syzygium</i> sp. 1	Roux	2.59	1.51		
9	<i>Monocarpia maingayi</i> (Hook.f. & Thomson) I.M.Turner	Cook	2.22	1.85		
10	<i>Macaranga pruinosa</i> (Miq.) Müll. Arg. *	Rauh	1.85	2.18		

*—non-nest tree

in a solid architecture (Halle et al. 1978).

Three tree architectural models—Cook, Scarrone, and Attims—demonstrate a structure with trunks and branches. While Scarrone displays a sympodial growth form, both Cook and Attims exhibit monopodial growth. These models are characterized by robust branches and a closely spaced design, enabling the trunk, branches, and twigs to support the orangutan’s weight. Cook’s

architectural design features a circular crown with horizontal branches, whereas Attims and Scarrone present a ball-shaped crown with vertical branches.

Correlation test

In terms of the correlation test, the preference index for the nest tree architecture model displays a sufficient, yet statistically insignificant correlation with parameters

Table 4. Pearson's correlation coefficient (r) of related parameters.

Parameter	Correlation coefficient (Pearson correlation)							
	w	PS	KS	TS	TPS	TBC	LT	LB
w	1	0.108	0.161	0.348	0.350	0.305	0.264	0.289
PS	0.108	1	0.954**	0.794*	0.930**	0.409	0.819**	0.616
KS	0.161	0.954**	1	0.658	0.909**	0.306	0.752*	0.659
TS	0.348	0.794*	0.658	1	0.779*	0.665	0.710*	0.419
TPS	0.350	0.930**	0.909**	0.779*	1	0.339	0.899**	0.695*
TBC	0.305	0.409	0.306	0.665	0.339	1	0.358	-0.079
LT	0.264	0.819**	0.752*	0.710*	0.899**	0.358	1	0.780*
LB	0.289	0.616	0.659	0.419	0.695*	-0.079	0.780*	1

w—preference index | PS—nest position | KS—nest canopy | TS—nest height | TPS—nest tree height | TBC—free branch height | LT—canopy area | LB—basal area | **—significant at the 0.01 level | *—significant at the 0.05 level.

tested. The factors correlating in descending order are nest tree height, nest height, branch free height, basal area, and crown area (Table 4). On the other hand, there is a weak correlation between nest position and nest canopy. A moderate to extremely strong and significant association exists between nest profile parameters and the nest tree profile. The primary aim of this investigation was to explore the relationship between nest tree selection and the preference index value for the nest tree profile.

The architectural structure of trees, encompassing branching forms and crown shapes, significantly influences orangutan nesting preferences, as evidenced by the adequate correlation between the preference index and nest features. These elements, including the nest site, canopy, and height, play pivotal roles in defining the nest qualities (Muin 2007). Nest profile and nest tree profile stand as influential determinants of orangutan nesting behavior. The correlation test findings strongly demonstrate a positive and substantial association between the nest profile and the nest tree profile. The height of the nest correlates directly with the height of the nest tree, while the position of the nest is governed by the dimensions of the nest tree, such as basal area and crown area (Khoetiem et al. 2014). Moreover, the tree's architectural model, particularly characterized by a canopy shielding the orangutan's nest, affects the selection of nest trees. Previous research has suggested that orangutan nests are more commonly found in trees with a canopy structure and area sufficiently large to shelter the nest or canopy (Nasution et al. 2018).

CONCLUSION

The preference index value was determined by calculating the proportion of the frequency of orangutan nests across eight architectural models of trees observed during the study. Among these models, the Cook, Scarrone, and Attims architectures emerged as the most preferred for nesting activities. This preference is supported by the correlation coefficient results, which indicate a significant relationship between orangutan nesting behaviors and specific tree architecture models. These findings highlight the importance of these models in shaping habitat components critical for the conservation of orangutans.

REFERENCES

- Atmoko, S.S.U. & M.A. Rifqi (2012). *Guidebook for Orangutan Nest Surveys*. Forum Orangutan Indonesia, Bogor, 42 pp.
- Ayunin, Q., S. Pudyatmoko & M.A. Imron (2014). Habitat selection of Javan Langur *Trachypithecus auratus* E. Geoffroy Saint-Hilaire, 1812 in Mount Merapi National Park. *Jurnal Penelitian Hutan dan Konservasi Alam* 11(3): 261–279. <https://doi.org/10.20886/jphka.2014.11.3.261-279>
- Bibby, C., M. Jones & S. Marsden (1998). *Expedition Field Techniques Bird Surveys*. Expedition Advisory Centre, London, 137 pp.
- Cantrell, A., L. Lei, Y. Wang, J. Li & Z. Zhang (2016). Evaluation of nest site preferences of a nest dismantler, the Hair-crested Drongo (*Dicrurus hottentottus*) in Dongzhai National Nature Reserve of central China. *Avian Research* 7(1): 8. <https://doi.org/10.1186/s40657-016-0042-5>
- Halle, F., R.A.A. Oldeman & B.T. Philip (1978). *Tropical Trees and Forests: An Architectural Analysis*. Springer-Verlag, New York, 441 pp.
- Hendrawan, R., D. Sumiyati, A. Nasrudin, S.G. Nasution & R. Millah (2019). Characteristics of habitat Langurs (*Trachypithecus auratus* E. Geoffroy, 1812) on lowland forest vegetation block of Cipalawah, Leuweung Sancang Nature Reserve, Garut District, West Java. *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia* 5(2): 399–405. <https://doi.org/10.13057/psnmbi/m050243>

- Iqbar (2015). Diversity of trees at Soraya Station in the Leuser Ecosystem. *Prosiding Seminar Nasional Biotik* 3(1): 214–220.
- Khoetiem, M., I. Lovadi. & A. Tjiu (2014). Initial study on the characteristics of orangutan nesting trees and orangutan nests (*Pongo pygmaeus pygmaeus*: Linnaeus 1760). *Protobiont* 3(2): 193–200.
- Kuswanda, W. (2014a). *Batang Toru Orangutan: Critically Endangered*. Forda Press, Bogor, 185 pp.
- Kuswanda, W. (2014b). Hunting levels, community knowledge, and policy protection of pangolins (*Manis javanica* Desmarest, 1822) around conservation forests in North Sumatra. *Jurnal INOVASI Media Litbang Provinsi Sumatera Utara* 11(2): 120–130.
- Larson, S.G. (2018). Nonhuman primate locomotion. *American Journal of Physical Anthropology* 165: 705–725. <https://doi.org/10.1002/ajpa.23368>
- Magurran, A.E. (1988). *Ecological Diversity and its Measurement*. Princeton University Press, New Jersey, 179 pp.
- Mardiana, M., E. Rahmi & R. Andini (2020). Characteristics of Sumatran Orangutan (*Pongo abelii*) Nest at the Soraya Research Station, Leuser Ecosystem. *Jurnal Ilmiah Mahasiswa Pertanian* 5(3): 50–59. <https://doi.org/10.17969/jimfp.v5i3.14857>
- Muin, A. (2007). Analysis on typology of orangutan nesting tree and the nest characteristic (*Pongo pygmaeus wurmbii*, Groves 2001) in Tanjung Puting National Park, Central Kalimantan. PhD Thesis. Graduate School, IPB University, xvi + 67 pp.
- Nababan, B.R.R., S.P. Harianto & A. Setiawan (2021). Diversity of bird species in determining the quality of open green space at Lampung University. *Jurnal Hutan Tropis* 9(1): 30–42.
- Nasution, A., Farajallah, D.P. & S.S.U. Atmoko (2018). Nesting characteristics of the Tapanuli Orangutan (*Pongo tapanuliensis*) in two unprotected forests of Batang Toru, North Sumatra. *IOP Conference Series: Earth and Environmental Science* 197: 012027. <https://doi.org/10.1088/1755-1315/197/1/012027>
- Neu, C.W., C.R. Byers & J.M. Peek (1974). A technique for analysis of utilization—availability data. *The Journal of Wildlife Management* 38(3): 541–545. <https://doi.org/10.2307/3800887>
- Nowak, R.M. (1999). *Walker's Primates of The World*. The John Hopkins University Press, Baltimore, 224 pp.
- Prayogo, H., Thohari, A. Machmud, Solihin, D. Duryadi, Prasetyo, L. Budi, Sugardjito & Jito (2016). Habitat suitability models of Bornean Orangutan (*Pongo pygmaeus pygmaeus* Linn, 1760) in Wildlife Corridor, Kapuas Hulu, West Kalimantan. *Jurnal Penelitian Hutan dan Konservasi Alam* 13(2): 137–150. <https://doi.org/10.20886/jphka.2016.13.2.137-150>
- Putro, H.R., D. Rinaldi, H. Arief, R. Soekmadi & W. Kuswanda (2019). *The Ecology of Tapanuli Orangutans*. Batang Toru Landscape Management Working Group", Bogor, 52 pp.
- Rahman, D.A. (2010). Habitat characteristics of orangutan's and nest tree preferences in Tanjung Puting National Park (Case study in Camp Leakey). *Jurnal Primatologi Indonesia* 7(2): 37–50. <https://doi.org/10.55285/bonita.v2i1.429>
- Regina, I., E. Rahmi & Iqbar (2020). Diversity of Sumatran Orangutan feed plants (*Pongo abelii* Lesson 1827) based on standing growth strata at Soraya research station in the Leuser ecosystem. *Jurnal Ilmiah Mahasiswa Pertanian* 5(3): 78–86. <https://doi.org/10.17969/jimfp.v5i3.14857>
- Rijksen, H.D. (1987). *A Field Study on Sumatran Orang Utans (Pongo pygmaeus abelii Lesson 1827) Ecology, Behaviour and Conservation*. H. Veenman & Zonen B.V, Wageningen, 421 pp.
- Sarwono, J. (2009). *Statistics Made Easy: A Comprehensive Guide to Learning Computerized Statistics Using SPSS 16*. Andi, Yogyakarta, 345 pp.
- Turner, I.M. (2004). *The Ecology of Trees in the Tropical Rain Forest*. Cambridge University Press, Cambridge, 298 pp.
- Widiastuti, F. & S. Rifanjani (2017). The habitat of proboscis monkey (*Nasalis larvatus* Wurmb) in and around the area of IUPHHK-HT PT. Bina Silva Nusa, Batu Ampar District Kubu Raya Regency West Kalimantan Province. *Jurnal Hutan Lestari* 5(3): 610–617. <https://doi.org/10.26418/jhl.v5i3.20927>

Mr. Jatishwor Singh Irungbam, Biology Centre CAS, Branišovská, Czech Republic.
Dr. Ian J. Kitching, Natural History Museum, Cromwell Road, UK
Dr. George Mathew, Kerala Forest Research Institute, Peechi, India
Dr. John Noyes, Natural History Museum, London, UK
Dr. Albert G. Orr, Griffith University, Nathan, Australia
Dr. Sameer Padhye, Katholieke Universiteit Leuven, Belgium
Dr. Nancy van der Poorten, Toronto, Canada
Dr. Kareen Schnabel, NIWA, Wellington, New Zealand
Dr. R.M. Sharma, (Retd.) Scientist, Zoological Survey of India, Pune, India
Dr. Manju Siliwal, WILD, Coimbatore, Tamil Nadu, India
Dr. G.P. Sinha, Botanical Survey of India, Allahabad, India
Dr. K.A. Subramanian, Zoological Survey of India, New Alipore, Kolkata, India
Dr. P.M. Sureshan, Zoological Survey of India, Kozhikode, Kerala, India
Dr. R. Varatharajan, Manipur University, Imphal, Manipur, India
Dr. Eduard Vives, Museu de Ciències Naturals de Barcelona, Terrassa, Spain
Dr. James Young, Hong Kong Lepidopterists' Society, Hong Kong
Dr. R. Sundararaj, Institute of Wood Science & Technology, Bengaluru, India
Dr. M. Nithyanandan, Environmental Department, La Ala Al Kuwait Real Estate. Co. K.S.C., Kuwait
Dr. Himender Bharti, Punjabi University, Punjab, India
Mr. Purnendu Roy, London, UK
Dr. Saito Motoki, The Butterfly Society of Japan, Tokyo, Japan
Dr. Sanjay Sondhi, TITLI TRUST, Kalpavriksh, Dehradun, India
Dr. Nguyen Thi Phuong Lien, Vietnam Academy of Science and Technology, Hanoi, Vietnam
Dr. Nitin Kulkarni, Tropical Research Institute, Jabalpur, India
Dr. Robin Wen Jiang Ngiam, National Parks Board, Singapore
Dr. Lionel Monod, Natural History Museum of Geneva, Genève, Switzerland.
Dr. Asheesh Shivam, Nehru Gram Bharti University, Allahabad, India
Dr. Rosana Moreira da Rocha, Universidade Federal do Paraná, Curitiba, Brasil
Dr. Kurt R. Arnold, North Dakota State University, Saxony, Germany
Dr. James M. Carpenter, American Museum of Natural History, New York, USA
Dr. David M. Claborn, Missouri State University, Springfield, USA
Dr. Kareen Schnabel, Marine Biologist, Wellington, New Zealand
Dr. Amazonas Chagas Júnior, Universidade Federal de Mato Grosso, Cuiabá, Brasil
Mr. Monsoon Jyoti Gogoi, Assam University, Silchar, Assam, India
Dr. Heo Chong Chin, Universiti Teknologi MARA (UiTM), Selangor, Malaysia
Dr. R.J. Shiel, University of Adelaide, SA 5005, Australia
Dr. Siddharth Kulkarni, The George Washington University, Washington, USA
Dr. Priyadarsanan Dharma Rajan, ATREE, Bengaluru, India
Dr. Phil Alderslade, CSIRO Marine And Atmospheric Research, Hobart, Australia
Dr. John E.N. Veron, Coral Reef Research, Townsville, Australia
Dr. Daniel Whitmore, State Museum of Natural History Stuttgart, Rosenstein, Germany.
Dr. Yu-Feng Hsu, National Taiwan Normal University, Taipei City, Taiwan
Dr. Keith V. Wolfe, Antioch, California, USA
Dr. Siddharth Kulkarni, The Hormiga Lab, The George Washington University, Washington, D.C., USA
Dr. Tomas Ditrich, Faculty of Education, University of South Bohemia in Ceske Budejovice, Czech Republic
Dr. Mihaly Foldvari, Natural History Museum, University of Oslo, Norway
Dr. V.P. Uniyal, Wildlife Institute of India, Dehradun, Uttarakhand 248001, India
Dr. John T.D. Caleb, Zoological Survey of India, Kolkata, West Bengal, India
Dr. Priyadarsanan Dharma Rajan, Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Bangalore, Karnataka, India

Fishes

Dr. Neelesh Dahanukar, IISER, Pune, Maharashtra, India
Dr. Topiltzin Contreras MacBeath, Universidad Autónoma del estado de Morelos, México
Dr. Heok Hee Ng, National University of Singapore, Science Drive, Singapore
Dr. Rajeev Raghavan, St. Albert's College, Kochi, Kerala, India
Dr. Robert D. Sluka, Chiltern Gateway Project, A Rocha UK, Southall, Middlesex, UK
Dr. E. Vivekanandan, Central Marine Fisheries Research Institute, Chennai, India
Dr. Davor Zanella, University of Zagreb, Zagreb, Croatia
Dr. A. Biju Kumar, University of Kerala, Thiruvananthapuram, Kerala, India
Dr. Akhilesh K.V., ICAR-Central Marine Fisheries Research Institute, Mumbai Research Centre, Mumbai, Maharashtra, India
Dr. J.A. Johnson, Wildlife Institute of India, Dehradun, Uttarakhand, India
Dr. R. Ravinesh, Gujarat Institute of Desert Ecology, Gujarat, India

Amphibians

Dr. Sushil K. Dutta, Indian Institute of Science, Bengaluru, Karnataka, India
Dr. Annemarie Ohler, Muséum national d'Histoire naturelle, Paris, France

Reptiles

Dr. Gernot Vogel, Heidelberg, Germany
Dr. Raju Vyas, Vadodara, Gujarat, India
Dr. Pritpal S. Soorae, Environment Agency, Abu Dhabi, UAE.
Prof. Dr. Wayne J. Fuller, Near East University, Mersin, Turkey
Prof. Chandrashekhar U. Rivonker, Goa University, Taleigao Plateau, Goa, India
Dr. S.R. Ganesh, Chennai Snake Park, Chennai, Tamil Nadu, India
Dr. Himansu Sekhar Das, Terrestrial & Marine Biodiversity, Abu Dhabi, UAE

Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64

Birds

Dr. Hem Sagar Baral, Charles Sturt University, NSW Australia
Mr. H. Byju, Coimbatore, Tamil Nadu, India
Dr. Chris Bowden, Royal Society for the Protection of Birds, Sandy, UK
Dr. Priya Davidar, Pondicherry University, Kalapet, Puducherry, India
Dr. J.W. Duckworth, IUCN SSC, Bath, UK
Dr. Rajah Jayapal, SACON, Coimbatore, Tamil Nadu, India
Dr. Rajiv S. Kalsi, M.L.N. College, Yamuna Nagar, Haryana, India
Dr. V. Santharam, Rishi Valley Education Centre, Chittoor Dt., Andhra Pradesh, India
Dr. S. Balachandran, Bombay Natural History Society, Mumbai, India
Mr. J. Praveen, Bengaluru, India
Dr. C. Srinivasulu, Osmania University, Hyderabad, India
Dr. K.S. Gopi Sundar, International Crane Foundation, Baraboo, USA
Dr. Gombobaatar Sundev, Professor of Ornithology, Ulaanbaatar, Mongolia
Prof. Reuven Yosef, International Birding & Research Centre, Eilat, Israel
Dr. Taej Mundkur, Wetlands International, Wageningen, The Netherlands
Dr. Carol Inskipp, Bishop Auckland Co., Durham, UK
Dr. Tim Inskipp, Bishop Auckland Co., Durham, UK
Dr. V. Gokula, National College, Tiruchirappalli, Tamil Nadu, India
Dr. Arkady Lelej, Russian Academy of Sciences, Vladivostok, Russia
Dr. Simon Dowell, Science Director, Chester Zoo, UK
Dr. Mário Gabriel Santiago dos Santos, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, Vila Real, Portugal
Dr. Grant Connette, Smithsonian Institution, Royal, VA, USA
Dr. P.A. Azeez, Coimbatore, Tamil Nadu, India

Mammals

Dr. Giovanni Amori, CNR - Institute of Ecosystem Studies, Rome, Italy
Dr. Anwaruddin Chowdhury, Guwahati, India
Dr. David Mallon, Zoological Society of London, UK
Dr. Shomita Mukherjee, SACON, Coimbatore, Tamil Nadu, India
Dr. Angie Appel, Wild Cat Network, Germany
Dr. P.O. Nameer, Kerala Agricultural University, Thrissur, Kerala, India
Dr. Ian Redmond, UNEP Convention on Migratory Species, Lansdown, UK
Dr. Heidi S. Riddle, Riddle's Elephant and Wildlife Sanctuary, Arkansas, USA
Dr. Karin Schwartz, George Mason University, Fairfax, Virginia.
Dr. Lala A.K. Singh, Bhubaneswar, Orissa, India
Dr. Mewa Singh, Mysore University, Mysore, India
Dr. Paul Racey, University of Exeter, Devon, UK
Dr. Honnavalli N. Kumara, SACON, Anaikatty P.O., Coimbatore, Tamil Nadu, India
Dr. Nishith Dharaiya, HNG University, Patan, Gujarat, India
Dr. Spartaco Gippoliti, Socio Onorario Società Italiana per la Storia della Fauna "Giuseppe Altobello", Rome, Italy
Dr. Justus Joshua, Green Future Foundation, Tiruchirappalli, Tamil Nadu, India
Dr. H. Raghuram, The American College, Madurai, Tamil Nadu, India
Dr. Paul Bates, Harison Institute, Kent, UK
Dr. Jim Sanderson, Small Wild Cat Conservation Foundation, Hartford, USA
Dr. Dan Challender, University of Kent, Canterbury, UK
Dr. David Mallon, Manchester Metropolitan University, Derbyshire, UK
Dr. Brian L. Cypher, California State University-Stanislaus, Bakersfield, CA
Dr. S.S. Talmale, Zoological Survey of India, Pune, Maharashtra, India
Prof. Karan Bahadur Shah, Budhanilakantha Municipality, Kathmandu, Nepal
Dr. Susan Cheyne, Borneo Nature Foundation International, Palangkaraja, Indonesia
Dr. Hemanta Kafley, Wildlife Sciences, Tarleton State University, Texas, USA

Other Disciplines

Dr. Aniruddha Belsare, Columbia MO 65203, USA (Veterinary)
Dr. Mandar S. Paingankar, University of Pune, Pune, Maharashtra, India (Molecular)
Dr. Jack Tordoff, Critical Ecosystem Partnership Fund, Arlington, USA (Communities)
Dr. Ulrike Streicher, University of Oregon, Eugene, USA (Veterinary)
Dr. Hari Balasubramanian, EcoAdvisors, Nova Scotia, Canada (Communities)
Dr. Rayanna Hellem Santos Bezerra, Universidade Federal de Sergipe, São Cristóvão, Brazil
Dr. Jamie R. Wood, Landcare Research, Canterbury, New Zealand
Dr. Wendy Collinson-Jonker, Endangered Wildlife Trust, Gauteng, South Africa
Dr. Rajeshkumar G. Jani, Anand Agricultural University, Anand, Gujarat, India
Dr. O.N. Tiwari, Senior Scientist, ICAR-Indian Agricultural Research Institute (IARI), New Delhi, India
Dr. L.D. Singla, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India
Dr. Rupika S. Rajakaruna, University of Peradeniya, Peradeniya, Sri Lanka
Dr. Bahar Baviskar, Wild-CER, Nagpur, Maharashtra 440013, India

Reviewers 2021–2023

Due to pausivity of space, the list of reviewers for 2021–2023 is available online.

The opinions expressed by the authors do not reflect the views of the Journal of Threatened Taxa, Wildlife Information Liaison Development Society, Zoo Outreach Organization, or any of the partners. The journal, the publisher, the host, and the partners are not responsible for the accuracy of the political boundaries shown in the maps by the authors.

Print copies of the Journal are available at cost. Write to:
The Managing Editor, JoTT,
c/o Wildlife Information Liaison Development Society,
43/2 Varadarajulu Nagar, 5th Street West, Ganapathy, Coimbatore,
Tamil Nadu 641006, India
ravi@threatenedtaxa.org



www.threatenedtaxa.org

OPEN ACCESS



The Journal of Threatened Taxa (JoTT) is dedicated to building evidence for conservation globally by publishing peer-reviewed articles online every month at a reasonably rapid rate at www.threatenedtaxa.org. All articles published in JoTT are registered under [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/) unless otherwise mentioned. JoTT allows unrestricted use, reproduction, and distribution of articles in any medium by providing adequate credit to the author(s) and the source of publication.

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

May 2024 | Vol. 16 | No. 5 | Pages: 25119–25282

Date of Publication: 26 May 2024 (Online & Print)

DOI: 10.11609/jott.2024.16.5.25119-25282

Articles

Tree architecture model of Sumatran Orangutan *Pongo abelii* Lesson, 1827 (Mammalia: Primates: Hominidae) nests at Soraya Research Station, Leuser Ecosystem, Indonesia

– Anugrah Gilang Permana Lubis & Nursahara Pasaribu, Pp. 25119–25128

Diet of Rusty-spotted Cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) (Mammalia: Carnivora: Felidae) in Sanjay Gandhi National Park, Mumbai, India

– Shomita Mukherjee, Arati Ramdas Gawari, Kartik Pillai, Pankaj Koparde, P.V. Karunakaran & Nayan Khanolkar, Pp. 25129–25136

An avifaunal checklist of the Bani Wildlife Sanctuary, Jammu & Kashmir, India

– Iyaz Quyoom, Bilal A. Bhat, Wasim Sajad Malik, Taslima Sheikh & Arif Nabi Lone, Pp. 25137–25146

Traditional harvesting practices employed for freshwater turtles by the indigenous communities along Shilabati River, West Bengal, India

– Prasun Mandal, Pathik Kumar Jana, Priyanka Halder Mallick, Shailendra Singh & Tanmay Bhattacharya, Pp. 25147–25156

Diversity and abundance of mayflies (Insecta: Ephemeroptera) in Achenkovil River, southern Western Ghats, Kerala, India

– S. Sujitha, R. Sreejai & C. Selvakumar, Pp. 25157–25165

Legumes (Angiosperm: Fabaceae) of Birbhum District, West Bengal, India

– Shamim Alam & Adani Lokho, Pp. 25166–25187

Floristic diversity of mangroves and mangrove associate species of Kali River Estuary, Karwar, Karnataka, India

– Amruta G. Hondappanavar, Shivanand S. Bhat & Praveen Kumar Verma, Pp. 25188–25197

Reproductive biology of *Senna spectabilis* (DC.) H.S. Irwin & Barneby (Fabaceae) - an invasive tree species in the tropical forests of the Western Ghats, India

– K. Muraleekrishnan, Sanal C. Viswanath & T.K. Hrideek, Pp. 25198–25208

Communications

Diversity and status of butterfly fauna at Kurukshetra University campus, Haryana, India

– Vidisha Gupta & Parmesh Kumar, Pp. 25209–25219

First report of *Lutevula hortensia* (Distant) (Heteroptera: Reduviidae: Emesinae) from India

– Vijay Anand Ismavel & Hemant V. Ghate, Pp. 25220–25226

Diversity of mosses (Bryophyta) in Pangi valley (Himachal Pradesh, India): an unexplored domain of northwestern Himalaya

– Anshul Dhyani, Kumar Shantanu, Rajender Kumar Sharma & Prem Lal Uniyal, Pp. 25227–25234

Morphological characterization and distribution of four corticioid fungi species (Basidiomycota) in India

– Tanya Joshi, Ellu Ram, Avneet Kaur & Avneet Pal Singh, Pp. 25235–25242

Taxonomy and molecular systematics of marasmioid fungi occurring (Basidiomycetes: Agaricales: Marasmiaceae) in Puducherry, India

– Yuvarani Krishnan, Thokur Sreepathy Murali, Gunasekaran Senthilarasu & Vadivelu Kumaresan, Pp. 25243–25251

Short Communications

First photo evidence of Siberian Weasel *Mustela sibirica* Pallas, 1773 (Mammalia: Carnivora: Mustelidae) in Gaurishankar Conservation Area, Nepal

– Madhu Chetri, Purna Bahadur Ale & Morten Odden, Pp. 25252–25255

Post-tsunami status, distribution, and way forward for the conservation of Andaman Teal *Anas albogularis* Hume, 1873 (Aves: Anatidae) in the Andaman Islands

– Anoop Raj Singh, Gaurav Sirola, Sipu Kumar & Nehru Prabakaran, Pp. 25256–25260

A preliminary checklist of Copepoda in the mangrove areas of Munroe Island, adjacent to Ashtamudi estuary, Kerala, India

– M.S. Arya, A. Biju & Dani Benchamin, Pp. 25261–25264

Notes

First photographic record of Asiatic Brush-tailed Porcupine *Atherurus macrourus* Linnaeus, 1758 from Sonai Rupai Wildlife Sanctuary, Assam, India

– B. Piraisoodan, Asish Immanuel Baglary & Bibhuti Mazumder, Pp. 25265–25267

New country record of *Trimeresurus uetzi* Vogel, Nguyen & David, 2023 (Reptilia: Squamata: Viperidae) from India

– Lal Biakzuala, Lal Muansanga, Fanai Malsawmdawngliana, Lalrinnunga Hmar & Hmar Tlawmte Lalremsanga, Pp. 25268–25272

New record of Giant Redeye *Gangara thyrsis thyrsis* (Fabricius, 1775) (Lepidoptera: Hesperidae) from Garhwal region of western Himalaya, India

– Ankita Singh Sajwan & Arun Pratap Singh, Pp. 25273–25275

***Strobilanthes khasyana* (Acanthaceae): an addition to the flora of Nagaland, India**

– Pfüchüpe-ü Mero, Kazhuhrii Eshuo & Neizo Puro, Pp. 25276–25278

***Sonerila konkanensis* Resmi & Nampy (Melastomataceae)**

– an addition to the flora of Karnataka, India

– Prashant Karadakatti & Siddappa B. Kakkalameli, Pp. 25279–25282

Publisher & Host



Threatened Taxa