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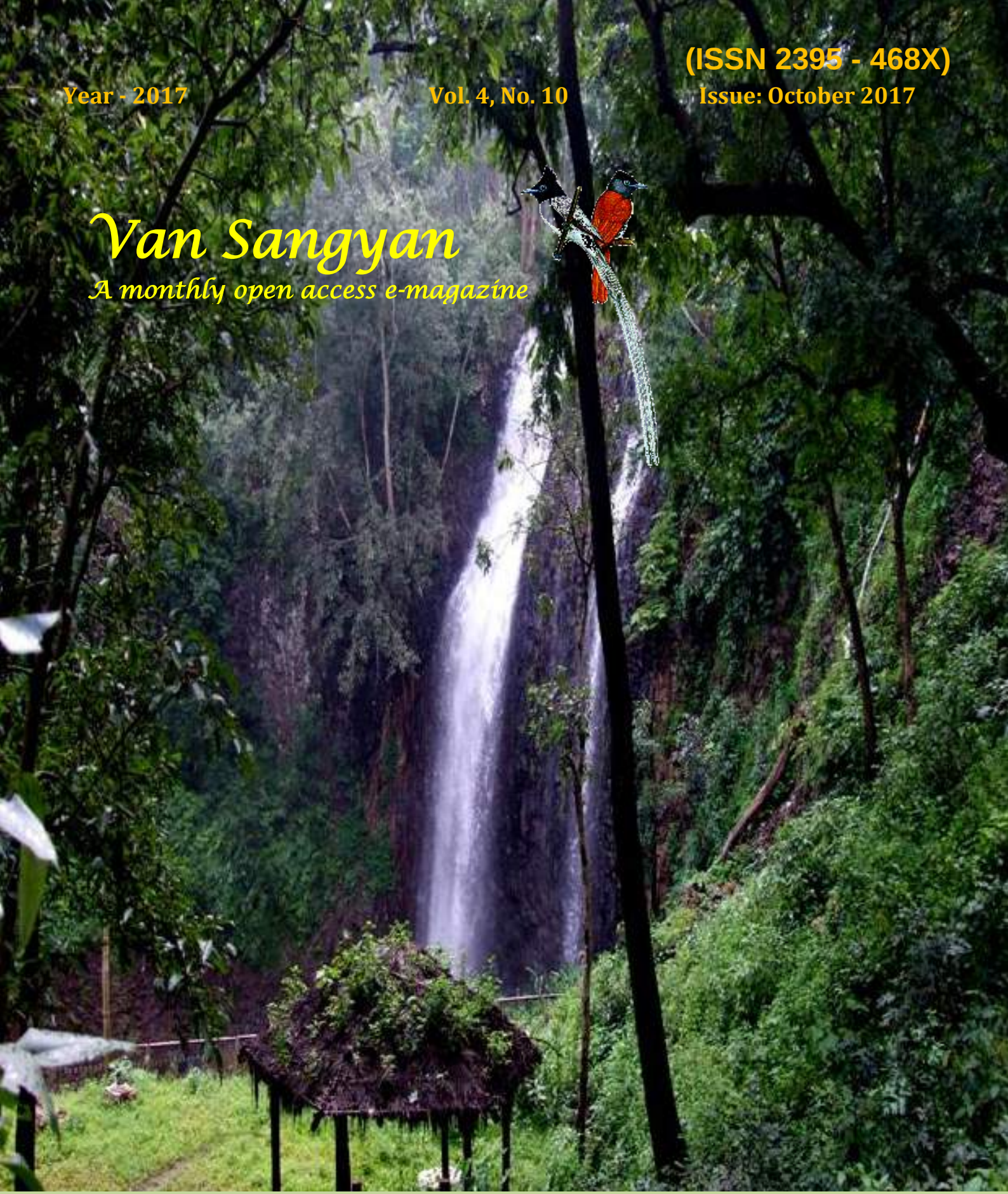

# Van Sangyan

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**Tropical Forest Research Institute**
(Indian Council of Forestry Research and Education)
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PO RFRC, Mandla Road, Jabalpur – 482021. India

# Van Sangyan

## Editorial Board



## Note to Authors:

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

by e-mail to vansangyan_tfri@icfre.org

or, through post to The Editor, Van Sangyan,
Tropical Forest Research Institute,
PO-RFRC, Mandla Road,
Jabalpur (M.P.) - 482021.

The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number.

TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

**Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve**
**Photo credit: Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)**

# From the Editor's desk

*Mangroves are the plant communities occurring in inter-tidal zones along the coasts of tropical and sub- tropical countries. They are one of the most productive ecosystems. Mangroves represent a rich and diverse living resource and are valuable to both the economy and protection of coastal environments. Mangroves have been variously described as "coastal woodland" and "inter - tidal forest". Globally mangroves have an estimated cover of 15.2 million hectares and are found in 123 countries world wide.The mangrove flora of the world is represented by about 65 species. Since there is little confusion about the true mangroves and the mangrove associates, it is difficult to give the exact number of mangrove species in the world. If the vivipary and breathing roots were taken into consideration, there would be 55 species in the world. Most of the species are strongly represented in South East Asia and the Eastern coast of Africa.*

*The floral diversity of mangroves in India is great. The Indian mangroves are represented by approximately 59 species (inclusive of some mangrove associates) from 29 families. Of the 59 species, 34 species belonging to 21 families are present along the west coast. There are a few species of which are indigenous to the west coast, e.g., Sonneratia caseolaris, Sueda fruticosa, Urochondra setulosa etc. The East coast of India and the Andaman and Nicobar islands show a higher species diversity as well as unique distribution of mangrove flora. The east coast is represented by 48 species belonging to 32 genera.The most extensive is present in Asia 39%. At present there are about 4,87,100 hectares of I ndian mangrove wetlands remains of fwhich 2,75,800 (56.7%) hectares is spread along the east coast reguib abd 1,14,700 hectares (23.5%) in the west coast region and the remaining 96,600 hectares (19.8%) is found in Andaman and Nicobar islands. Mangrove ecosystem plays an important role in preventing cyclones and tsunamis at estuaries from entering into interior land and in the economic development of local inhabitants. They have peculiar adaptations such as strong supporting interlocking and breathing root system called pneumatophores, vivipary mode of reproduction, salt regulation and nutrient retention. They flourished well in pulicat lake till 18th century. Now mangrove vegetation remains as small pat ches only in the pulicat lake. They are largely destroyed by human induced activities such as Urbanisation and Agriculture.*

*Plant species that are exclusive to the inter-tidal mangrove habitats are known as true mangrove species while those that occur in mangrove and other wetland habitats are called the mangrove associated species. Distribution of mangrove species within a mangrove area depends largely on availability and distribution of seeds/seedlings, tolerance of species for inundation as well as soil salinity and thus resulting zonation of species. Mangroves occur as a thin belt of less than 10 m in width along the small rivers that drain this area and they are composed mainly of Rhizophora apiculata, R. mucronata, and Avicennia alba which are 7-10 m tall while those in the periphery of the abandoned ponds and were found to be consisted of trees with low stature (3-4 m) and dominated by pioneer species such as Avicennia marina, A. alba, Rhizophora apiculata and R. mucronata mixed to a lesser extent with species such as Bruguiera gymnorrhiza, Excoecaria agallocha, Heritiera littoralis, Aegiceras corniculatum and associated species such as Thespesia populnea, Premna integrifolia occupy the area interior to the water-front zones, which are part of former shrimp ponds.*

*This issue of Van Sangyan contains an article on Floral diversity in mangrove forests of Bhitarkanika, Odisha. There is also useful articles viz. Timber forensics, Flood disaster, Diversity of macro-fungi in central India-VIII: Astraeus hygrometricus, Couroupita guianensis: A potential medicinal tree, Mitragyna parviflora - a new host plant record for defoliator, Phazaca theclata, नीम के असामान्य बीजांकुर (in Hindi) and Biodiversity of Cycas circinalis and Platanitsa gangetica.*

*I hope that readers would find all information in this issue relevant and valuable. Van Sangyan welcomes articles, views and queries on various issues in the field of forest science.*

*Looking forward to meet you all through forthcoming issues.*

**Dr. N. Roychoudhury**
Scientist G & Chief Editor

# Contents

# Floral diversity in mangrove forests of Bhitarkanika, Odisha

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**Abstarct**

The present article reports the diversity of flora in Bhitarkanika mangrove forests located in Rajnagar (Mangrove) Forest Division, Kendrapara, Odisha. There are 94 plant species, out of which 30 species are true mangroves, 28 species are mangrove associates, 30 species are back mangroves and six species are beach flora. Recently, strychnine tree, *Strychnos nux-vomica* has documented in Kanika Range of Bhitarkanika National Park.

**Introduction**

Mangroves are salt tolerant plant community found in tropical and sub-tropical intertidal region of the world. Mangroves in India account for about three per cent of the world's mangrove vegetation covering an area of 4,628 sq km, which is 0.14 per cent of the country's total geographical area (Anon, 2013). They exhibit a variety of adaptation in morphology, anatomy and physiology to survive in a hostile environment which is marked with water logged soils and high salinity regime frequented by storm and tidal surge (Roychoudhury et al., 2015). Prominent among these adaptations are presence of pneumatophores, buttress, stilt roots, vivipary, etc. (Figs. 1-3).

The mangroves of the Odisha coastal area occupy an area of 222 sq km are distributed in the three zones, namely Mangroves of Mahanadi Delta, Mangroves of the Brahmani and Baitarani Delta, i.e. Bhitarkanika Mangrove, Mangroves of the Balasore coast and located in the five districts of the state, such as Baleshwar (2 sq km), Bhadrak (21 sq km), Jagatsinghpur (7 sq km), Kendrapara (183 sq km) and Puri (0 sq km) (Anon, 2013). Odisha is a home to about 700 plant species including 120 orchid species and 63 species of mangrove trees, such as *Rhizospora, Bruguiera, Ceriops, Avicennia, Sonneratia, Heritiera, Kandelia, Excoecaria, Phoenix, Tamarix, Brownlowia, Clerodendrum, Scirpus, Tylophora and Intsia*, etc. which make the state second largest mangrove ecosystem in India. Natural calamities and biotic pressures, including insects are the main enemies of mangrove ecosystems. It is noteworthy to mention the recent experience of cyclonic disaster, "HUD HUD", occurred in Odisha and Andhra Pradesh.

**Mangrove Forest (Wildlife) Division, Rajnagar, Kendrapara, Odisha**

Mangrove Forest Division (Wildlife), Rajnagar has jurisdiction over part of two revenue districts, Kandrapara and Jagatsinghpur (Fig. 4). The forest vegetation is mostly mangrove, which is unique in Odisha (Fig. 5) and one of the largest in India after Sundarbans. The mangrove forest of this Division is about 200 sq. km distributed from Dhamra estuary in the north, down to Devi river mouth in the south. Major part of mangroves is located in Brahmani, Baitarani delta (Bhitarkanika Wildlife Sanctuary) and Mahanadi delta. Mangroves of Mahanadi delta is highly

degraded due to heavy anthropogenic pressure like unauthorized aquaculture, agriculture and betel farming.

There are five ranges, viz. Kanika, Rajnagar, Mahakalpada, Kujang and Gahirmatha (Wildlife) range. This Division assumes great importance from the wildlife point of view because it consists of three protected areas, such as Bhitarkanika Wildlife Sanctuary, Bhitarkanika National Park and Gahirmatha (Marine) Wildlife Sanctuary.

**Bhitarkanika: the paradise of nature**

Bhitarkanika is named as per two Odia words 'Bhitar' meaning interior and 'Kanika' meaning extraordinarily beautiful (Chadha and Kar, 1999). The Bhitarkanika mangroves were Zamindari forests until 1952. Then the Govt. of Odisha abolished the Zamindari system and put the Zamindari forests in the control of the State Forest Department. In 1975, an area of 672 sq. km. was declared as Bhitarkanika Wildlife Sanctuary. It is in this period wildlife management started and initiated Crocodile Conservation Project and mass nesting of sea turtles on the Gahirmatha coast. The Gahirmatha (Marine) Wildlife Sanctuary, which bounds the Bhitarkanika Wildlife Sanctuary to the east, was created in 1997 and encompasses Gahirmatha beach in adjacent portion of the Bay of Bengal. An area of 145 sq. km, the core area of Bhitarkanika Wildlife Sanctuary was declared as Bhitharkanika National Park in 1998. Bhitarkanika was designated as Ramsar Site, a wetland of international importance in 2002. Bhitarkanika comprises of Bhitarkanika Natinal Park and Bhitarkanika Wildlife Sanctuary. It lies in the north eastern coast of Odisha in between $20^0$30' to $20^0$50' N latitude and $86^0$30' to $87^0$06' E longitude in Kendrapara district. It is mainly confined to the deltaic regions of river Brahmani and Baitarani. Bhitharkanika Conservation Area (BCA) has been proposed to be declared as World Heritage site by UNESCO.

**Ramsar definition**

Ransar, a city in Iran hosted the first World Convention on Wetlands on 2nd February, 1971. The Ramsar Convention defines wetlands as "Wetlands are area of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters.

**Mangroves**

Mangrove is a compound word formed by Portuguese "Mangue' and English 'Grove'. In Portuguese 'Mang-ue' is used for individual species of mangrove habitat and thus the word mangrove can be said to be group of mangrove species (trees, shrubs, herbs, etc.). In other words mangroves are known as 'tidal forests' or deltaic swamp forests' or 'littoral swamp forests'. Mangroves are also described as 'coastal woodland', 'Mangals' or 'Mangrove forests'. The mangrove ecosystem is a highly dynamic ecosystem, which provides exploring flora and fauna.

**Floral diversity**

Bhitahrkanika has richest diversity of mangroves in India (Nayak, 2004) (Fig. 6). There is total number of 94 plant species. Based on the classification of mangroves given by Ghosh *et al*. (2003), there is 30 species of true mangroves (Table 1), 28 species of mangrove associates (Table 2), 30 species of back mangroves (Table 3) and six species of beach flora (Table 4)

(Anon, 2015). The major mangrove species include three species of *Avicennia*, four species of *Bruguiera*, three species of *Heritiera*, three species of *Rhizophora*, three species of *Xylocarpus* and many more along with the rare mangroves like *Aglaia cucullata* and *Cerbera odollam* (Figs. 7-15). Recently, Roychoudhury et al. (2017) have documented strychnine tree, *Strychnos nux-vomica* in Kanika Range of Bhitarkanika National Park (Fig. 16).

## Acknowledgements

Authors are thankful to Shri Sidhant Das, IFS, the then Principal Chief Conservator of Forests (Wildlife) and Chief Wildlife Warden, for permitting to carry out the field survey for documentation of flora in Bhitarkanika National Park and Shri Bimal Prasanna Acharya, OFS Group-A (SB), Divisional Forest Officer, Mangrove Forest Division (Wildlife), Rajnagar, Kendrapara, for field facility. Authors also extend their thanks to Dr. U. Prakasham, Director and Shri P. Subramaniam, the then Group Coordinator Research, Tropical Forest Research Institute, Jabalpur-482021 (M.P.) Special thanks are due to Shri Ram Bhajan Singh, Research Officer-II and Shri Asish Pandey, Field Assistant, Forest Entomology Division and Shri Bijay Kumar Das, Research Assistant, Mangrove Forest Division for field assistance.

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**Table 1. True mangroves in Bhitarkanika mangrove forests of Odisha**

| Species | Family | Common name |
|---|---|---|
| *Aegialitis rotundifolia* Roxb. | Plumbaginaceae | Banarua |
| *Aegiceras corniculatum* (L.) Blanco | Myrsinaceae | Kharsi |
| *Avicennia alba* Blume | Avicenniaceae | Dhala Bani |
| *A. marina* (Forsk.) Vierh. | Avicenniaceae | Singala Bani |
| *A. officinalis* L. | Avicenniaceae | Bada Bani |
| *Brownnlowia tersa* (L.) Kosterm. | Tiliaceae | Lati Sundari |
| *Bruguiera cylindrica* (L.) Blume | Rhizophoraceae | Kaliachua |

| | | |
|---|---|---|
| *B. gymnorrhiza* (L.) Lamk. | Rhizophoraceae | Bandari |
| *B. parviflora* Wt. & Arn. | Rhizophoraceae | Dot |
| *B. sexangula* (Lour.) Poir. | Rhizophoraceae | Bandari |
| *Ceriops decandra* (Griff.) Ding Hou | Rhizophoraceae | Garani (Yellow mangrove) |
| *C. tagal* (Perr.) C.B. Robinson | Rhizophoraceae | Garani (Yellow mangrove) |
| *Excoecaria agallocha* L. | Euphorbiaceae | Guan |
| *Heritiera fomes* Buch.-Ham, | Sterculiaceae | Bada Sundari |
| *H. kanikensis* Majumdar &Banerjee | Sterculiaceae | Kanika Sundari |
| *H. littoralis* Dryand ex Ait. | Sterculiaceae | Dhala Sundari |
| *Kandelia candel* (L.) Druce | Rhizophoraceae | Sinduka |
| *Lumnitzera racemosa* Wild. | Combretaceae | Churunda |
| Nypa fruticans (Thunb.) Wurmb. | Arecaceae | Nypa Palm |
| *Phoenix paludosa* Roxb. | Arecaceae | Hental |
| *Rhizophora apuculata* Blume | Rhizophoraceae | Rai |
| *R. mucronata* Lamk. | Rhizophoraceae | Rai |
| *R. stylosa* Griff. | Rhizophoraceae | Rai |
| *Sonneratia alba* J.Smith | Sonneratiaceae | Orua |
| *S. apetala* Buch.-Ham. | Sonneratiaceae | Keruan |
| *S. caseolaris* (L.) Engler | Sonneratiaceae | Orua |
| *S. griffithii* Kurz | Sonneratiaceae | Orua |
| *Xylocarpus granatum* Koenig | Meliaceae | Sisumar |
| *X. mekongensis* Pierre | Meliaceae | Pitamari |
| *X. moluccensis* (Lamk.) Roem. | Meliaceae | Pitakorua |

**Table 2. Mangrove associates in Bhitarkanika mangrove forests of Odisha**

| **Species** | **Family** | **Common name** |
|---|---|---|
| *Acanthus ilicifolius* L. | Acanthaceae | Harakancha |
| *A. volubilis* Wall. | Acanthaceae | Harakancha |
| *Acrostichum aureum* L. | Acrostichaceae | Kharkhari |
| *Aglaia cucullata* (Roxb.) Pellegrin | Meliaceae | Ooanra |
| *Cerbera odollam* Gaertn. | Apocynaceae | Paniamba |
| *Cleridendrum inerme* (L.) Gaertn. | Verbenaceae | Chiani |
| *Cynometra iripa* Kostel | Caesalpiniaceae | Singada |
| *C. ramiflora* L. | Caesalpiniaceae | Singada |
| *Dalbergia candenatensis* (Dennst.) Prain | Fabaceae | Katha Katira Nai |
| *D. spinosa* Roxb. | Fabaceae | Gohirakanta |
| *Derris scandens* (Roxb.) Benth | Fabaceae | Dhala Katira Nai |
| *D. trifoliate* Lour | Fabaceae | Kala Katira Nai |
| *Intsia bijuga* (Colebr.) Kuntz. | Caesalpiniaceae | Maasitha |
| *Ipomea tuba* (Sch.) G. Don | Convolvulaceae | - |
| *Myriostachya wightiana* (Nees ex Steud.) Hook.f. | Poaceae | Nalia grass |
| *Pentatropis capensis* (L.f.) Bullock | Asclepiadaceae | Raigidi |
| *Phragmites karaka* (Retz.) Trin. | Poaceae | Nala |
| *Porteresia coarctata* (Roxb.) Tateoka | Poaceae | Dhani Dhana |
| *Salacia prinoides* DC | Hippocrateaceae | Batra |
| *Salicornia brachiata* Roxb. | Chenopodiaceae | Batula |
| *Sarcolobus carinatus* wall. | Asclepiadaceae | Lata Rai |

| | | |
|---|---|---|
| *S. globosus* Wall. | Asclepiadaceae | Katukula |
| *Scirpus litoralis* Schr. | Cyperaceae | Sipal |
| *Sesuvium portulacastrum* (L.) L. | Aizoacae | Goda Bani |
| *Suaeda maritime* (L.) Dumort | Chenopodiaceae | Giria |
| *S. monoica* Forssk. Ex Gmel. | Chenopodiaceae | Giria/Ninia |
| *S. nudiflora* (Wild.) Moq. | Chenopodiaceae | Giria |
| *Trianthema portulacastrum* L. | Aizoaceae | Puruni |

**Table 3. Back Mangroves in Bhitarkanika mangrove forests of Odisha**

| Species | Family | Common name |
|---|---|---|
| *Allophylus serratus* (Roxb.) Kurtz | Sapindaceae | Khandakoli |
| *Azima tetracantha* Lam. | Salvadoraceae | Mistle Toe |
| *Caesalpinia bonduc* (L.) Roxb. | Caesalpiniaceae | Gilo |
| *C. crista* L. | Caesalpiniaceae | Nentei |
| *Crinum defixum* Ker Gawl. | Amaryllidaceae | Pani Kenduli |
| *Cyperus conglomerates* Rottb. | Cyperaceae | Hanshi Grass |
| *C. corymbosus* Rottb. | Cyperaceae | Keuti Grass |
| *Dendrophthoe falcata* (L.f.) Etting. | Loranthaceae | Malanga |
| *Dolichandrone spathacea* (L.f.) K. Schum | Bignoniaceae | Gisinga |
| *Fimbristylis ferruginea* (L.) Vahl | Cyperaceae | Luni Grass |
| *Finlaysonia obovata* Wall. | Asclepiadaceae | Khasai Lata |
| *Flagellaria indica* L. | Flagellariaceae | Bahumruga |
| *Heliotropium curassavicum* L. | Boraginaceae | Salt Heliotrope |
| *Hibiscus tiliaceus* L. | Malvaceae | Bania |
| *Hoya parasitica* (Roxb.) Wall | Asclepiadaceae | Hoya |
| *Lannea coromandelica* (Houtt.) Merr. | Anacardiaceae | Mahi |
| *Merope angulata* (Wild.) Swingle | Rutaceae | Bana Lembu |
| *Mucuna gigantean* (Wild.) DC. | Fabaceae | Luna Baidanka |
| *Pandanus fascicularis* Lam. | Pandanaceae | Ketaki Kia |
| *P. foetidus* Roxb. | Pandanaceae | Luni Kia |
| *Pongamia pinnata* (L.) Pierre | Fabaceae | Karanja |
| *Salvadora persica* L. | Salvadoraceae | Miriga |
| *Sapium indicum* Wild. | Euphorbiaceae | Ghigidi |
| *Solanum trilobatum* L. | Solanaceae | Nabhiankuri |
| *Tamarix dioica* Roxb. | Tamaricaceae | Jagula |
| *T. troupii* H. | Tamaricaceae | Jagula |
| *Terminalia catappa* L. | Combretaceae | Pesta Badam |
| *Thespesia populnea* (L.) Sol. Ex Corr. | Malvaceae | Habali |
| *Tylophora indica* (Burm.f.) Merr. | Asclepiadaceae | Anantamula |
| *T. tenuissima* (Roxb.) Wt. & Arn. Ex Wt. | Asclepiadaceae | Anantamula |

**Table 4. Beach flora in Bhitarkanika mangrove forests of Odisha**

| Species | Family | Common name |
|---|---|---|
| *Canavalia maritime* (Aubl.) Thouars | Fabaceae | - |
| *Cyperus arenarius* Retz. | Cyperaceae | Luni Mutha |
| *Hydrophylax maritime* L.f. | Rubiaceae | - |

| | | |
|---|---|---|
| *Ipomoea pes-caprae* (L.) R. Br. | Convolvulaceae | Kansarilata |
| *Launaea sarmentosa* (Wild.) Schultz-Bip. Ex Kuntze | Asteraceae | - |
| *Spinifex littoreus* (Burm.f.) Merr. | Poaceae | Rabana |

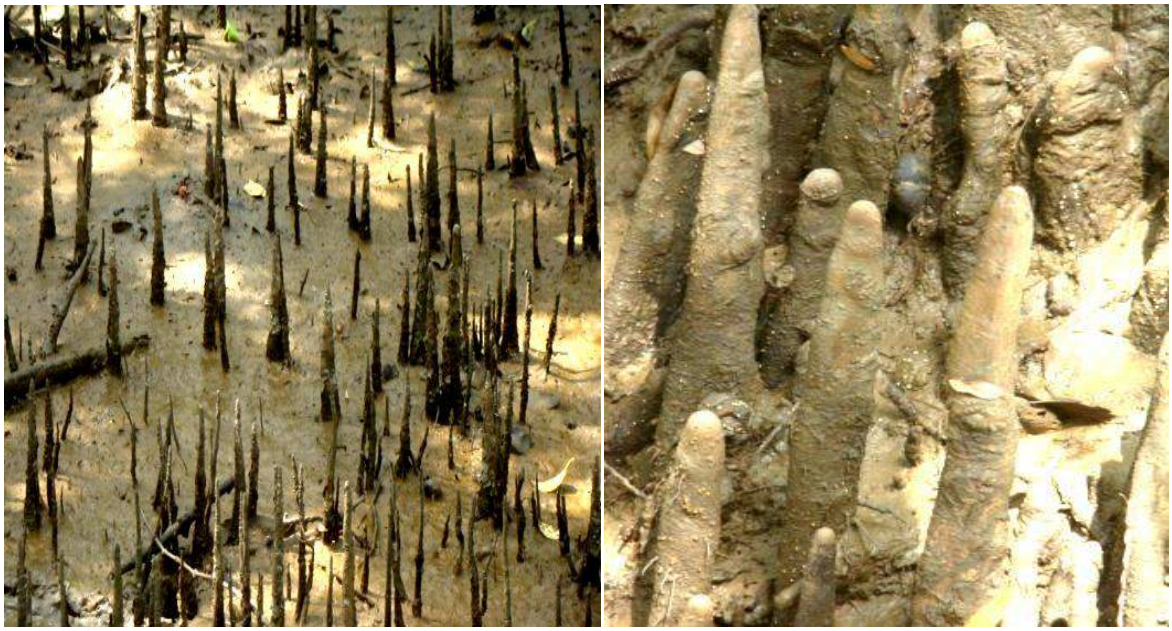

**Fig. 1- Pneumatophores**

**Fig. 2- Buttress**

**Fig. 3- Stilt roots**


**Fig. 4- Mangrove Forest Division, Rajnagar, Kendrapara, Odisha**

**Fig. 5- Mangrove forests in Bhitarkanika, Rajnagar, Kendrapara, Odisha**

**Fig. 6- Flowering in mangrove forests of Bhitarkanika, Rajnagar, Kendrapara, Odisha**

**Fig. 7-*Avicennia alba***

**Fig. 8-*Avicennia officinalis***

**Fig. 9-*Rhizophora stylosa***

**Fig. 10-*Nypa fruticans***

**Fig. 11-*Xylocarpus mekongensis***

**Fig. 12-*Phoenix paludosa***

**Fig. 13-*Acanthus ilicifolius***

**Fig. 14-*Cerbera odollam***

**Fig. 15-*Caesalpinia crista***

**Fig.16-*Strychnos nux-vomica***

# Timber forensics

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## Introduction

Forensic science is the application of science to criminal and civil laws. One of its branches is forensic botany, which is the application of plant sciences to criminal investigations. Plant material present at a crime scene can provide significant supporting evidence during legal investigations.

Various techniques are used for the forensic identification of plant samples. The study of morphology and anatomy is particularly useful to identify the plant species in case of flower, fruit or even pollen samples. It can also be used to ascertain the probable habitat or geographic origin of the sample and thereby identify other species associated to the habitat. This in turn can be used to relate a convict to the scene of crime.

Many plant materials cannot be identified and differentiated to the species level by traditional morphological characteristics, especially when botanical specimens are degraded and lack physical features. In such cases, chemical or biochemical analysis is being used, as in the case of marijuana (*Cannabis sativa*) identification. Nevertheless, forensic botany still remains an under-utilised field of investigation, as it is limited to identifying specific or suspected illegal plants. The absence of an accurate identification system is a major obstacle to routinely and correctly identify trace botanical evidence.

## Timber rorensics

Timber forensics is an emerging field of forensic botany. It is the application of forensics and technology in timber identification, in other words, to identify the source of an evidentiary wood sample. It is mainly useful in crimes related to illegal felling of trees (theft & trafficking). It can also be used for identification of wood samples associated with other crimes, and also to authenticate wood and its products.

During the forensic identification of timber samples, various questions need to be addressed, such as:

- Which part of wood does the sample belong to (heartwood / sapwood / bark)?
- What species does the sample belong to?
- Where has the sample come from?
- To which individual of a species does the sample belong to?
- What is the age of the tree from which the sample came?
- What is the period after felling of the sample from the tree?
- In case of plantations established with source material from a different geographical location, inheritance of the sample is also questionable.

## Approaches used in timber forensics

There are various approaches to determine the taxonomic, geographic and individual source of timber material, as well as its age.

Visual approaches used for wood identification are the study of morphology, wood anatomical characters and dendrochronology. The different chemical approaches available for use in timber forensics include mass spectrometry, near infrared spectroscopy, stable isotope ratio analysis and radiocarbon dating. Alternatively, genetic approaches like karyotyping and DNA profiling can also be used.

The level of identification achieved using each of these techniques is different. For example, macroscopic as well as microscopic *anatomical characters* can be studied for identification up to genus level. In very few cases, as with teak (*Tectona grandis*), identification up to species level is easily done using only macroscopic anatomical characters.

*Dendrochronology* is the study of tree growth increments and has the potential to give specific information on tree age and provenance. But this is subject to the presence of annual growth rings in the species under question.

*Mass spectrometry* is a phytochemical characterisation technique which can be used to cluster together taxonomically related individuals - genera, species, and wild vs. cultivated. Also, phytochemical analysis for identification using mass spectrometry can be done quickly and cheaply.

*Near-infrared spectroscopy* is a non-destructive analytical technique that provides chemical and physical information used to characterise samples. Though it is at the prototype stage at present, accurate timber identification to the family and species levels are possible using this technique. Moreover, the time required for the process ranges from just a few seconds to minutes.

*Stable isotope ratio analysis* can be used to identify or rule out particular regions of timber provenance. This technique may also be useful in determining age of the tree and period after felling, based on the various tree rings from the desired species.

*Radiocarbon dating* is used to determine the time that a given portion of the tree/timber was formed. It is particularly useful in determining whether a CITES listed tree species was felled before or after implementation of legislation. But the cost of identification is higher than any other technique used.

*Karyotyping* is the study of chromosomal banding patterns which can be used for species identification. But the technique may not be particularly useful for timber samples, as it requires the presence of cells in the metaphase stage of cell division for accurate identification.

*DNA barcoding* and *DNA profiling* techniques can be used to identify the species, as well as provenance, wild vs. cultivated and for individual identification. Though they are used extensively for species identification in a wide range of taxa, its application to wood is limited at present.

The choice of a specific technique for use in timber forensics depends on the purpose and the level of identification required, cost per sample, time taken for analysis, cost/ availability of equipments, prior research, reference material and obstacles, if any.

**General requirements**

The wide range of techniques available for use in timber forensics can be used individually or synergistically. However, there are some requisites prior to the use of

any of these techniques to address specific timber identification queries.

Some of the prerequisites are:

(i) identification of a suitable technique,

(ii) process development and its validation (including reference data generation),

(iii) economic support for the research,

(iv) necessary expertise,

(v) laboratory accreditation/certification etc.

These essentials certainly need to be fulfilled before the existing methods can be used for wood identification and to produce its result as valid evidence during an investigation in a court.

**Summary**

The prominence of wood and progress in its identification technologies have been of great importance in the development of wood science and forest resource protection. The identification of the origin of wood is particularly important in identifying illegally harvested and traded timber and wood products. To serve this purpose, various techniques are available for use in timber forensics.

The most important task in timber forensics is to identify a suitable technique based on the questions that need to be answered. Based on this, a methodology has to be developed and validated so that the sample in question can be used as evidence which is valid enough in a court of law.

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# Flood disaster

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**Assam flood**

Heavy floods, especially during rainy seasons, have been the most common and frequent disasters in India. Adverse impacts of floods in agriculture are also a major concern. Floods can lead to widespread damage to crops and loss of life and livestock. Crop losses through rain damage, waterlogged fields, and delays in harvesting are further intensified by transport problems due to flooded roads. And, this situation leads to hike in prices due to infrastructure damage and thereby interruptions in supply of essential goods and services. The major cause of heavy floods includes disturbances of surrounding vegetation to meet the enhanced needs of fuel fodder and timber for ever increasing population. Degradation of vegetation covers in and around the towns for settlements, parking lots, driveways, roads, industries etc. has an imbalanced impact on landscapes, watersheds and also on receiving streams or lakes. These disturbances to the landscape not only increase the volume of

- In Tripura, 9917 families took shelter in 75 relief camps. 250 houses were damaged in the flood with some casualties. *(Tripura Disaster Management Authority, Govt. of Tripura. Accessed on 13-08-2017)*
- In Assam, 1497 villages/localities were affected and suffered a great loss. 1,15,179 ha of croplands were affected by the flash flood. *(Assam State Disaster Management Authority, Govt. of Assam. Accessed on 20-08-2017)*

- A single deciduous tree can intercept from 500 to 760 gallons per year
- A mature evergreen tree can intercept more than 4,000 gallons per year
- A single mature oak tree can consume (transpire) over 40,000 gallons of water in a year.
- A single small tree (callery pear- 9 years old, was able to intercept 58 gallons of storm water from a ½ inch rain event (67% of the rain that fell within the canopy).

water that goes to the stream, but it also shortens the runoff time it takes to get to the streams and other water bodies overflow with an increased intensity.

Recently this rainy season of year 2017, several States in India suffered a great loss

**Tripura flood**

economically by disturbing the livelihood activities of the people of all communities. Floods became alarming leading to road blocks, shortage of food supply, causalities in human and animals. In Northeastern hilly areas, the problems and their effects are multiple when the forest-covers on hill slopes are disturbed. This may not only lead to soil runoff on exposed aspects but will also intensify the speed of rain water in the valleys. Felling trees or clearing forest canopy to meet agriculture and timber demands also has an instant impact on flood disaster due to decreased interception of rain water by degraded vegetation cover and increased siltation due to erosion of soils.

With the increased amount of impervious surfaces, water runs off the land by traveling on the surface towards the streams and other water bodies. This storm like water-runoff travels along with surface pollutants to the streams with an increased velocity. This leads to flooding, stream bank erosion, widening of streams, sediment deposition in streams, a loss of fish habitat and decline in water quality. A greater amount of rain water running off through the hill slopes accumulates in a catchment and absorbed into the soil that covered with vegetation. Densely populated large urban areas do not allow rainwater to percolate into the soil due to the obstructions with buildings, roads and other infrastructure. Whereas, expansion of vegetation covers in the same town

- The rainforests acting as giant umbrella intercept the maximum
- Tree canopy cover of 54% alone is able to reduce storm water runoff by 11%.
- Forests made up of needle-leaf trees captured 22% of the rainfall, while broad-leaf deciduous forests intercepted 19% and evergreen forests came in at 13%.

- Evaporation drops to 14 inches and stream flow increases to receive 26 inches of the annual 40 inches of precipitation with the removal of forests.
- An average of 24”out of 40” of annual rainfall is taken up by trees through evapo-transpiration in Pennsylvania Forest.
- Average interception of rainfall by a forest canopy ranges from 10-40% depending on species composition.

allows interception of greater amount of rain water and controls floods by reducing the volume of rain water accumulation. Management of rain water for instant disposal is the most important task in controlling floods among the many other control measures. Due to the interception and evaporation of rain water by such vegetation covers, a small fraction of the water reaches the forest floor without coming into contact of the canopies or stems – this is known as "direct throughfall". And some rainwater flows down the tree trunks as "stemflow". As a result only a small fraction of the total rainfall reaches the soil surface and enters into the soil.

**Manipur flood**

Obviously, tree canopies and ground vegetation play a major role in capturing some amount of rain water over their leaves of the tree canopies or in the ground flora whereas the remainder joins the waterways as flow. It may contribute to ground water recharge, and subsequently revive the ponds, streams and rivers. Tree canopies also minimize the soil runoff by intercepting rainfall and allowing its percolation into the soil beneath.

Any vegetation cover, mixed with trees absorbs and uses tremendous amounts of storm water for its growth. Deforestation also has an unfavorable impact on evaporation, precipitation and streams in the watershed. Interception of rainfall by a forest canopy depends on species composition, season and precipitation rates per storm event. Even young, small trees can be of great importance in intercepting the rainwater. A recent study revealed that a single small tree could intercept gallons of storm water from rain that fell over its canopy. Similarly, a single mature oak tree could transpire large gallons of water in a year. In Pennsylvania forests, it was observed that evapo-transpiration through trees serves to cool and modify surrounding summer temperatures. According to another study, an existing tree canopy reduced the storm water runoff by 7% which could be increased to 12% by planting more trees. In a more recent hydro study conducted in a watershed, the tree canopy cover was able to reduce storm water runoff significantly. Many researchers have found that planting large canopy trees over impervious surfaces, such as a parking lot or street, has much greater impact on the reduction of storm water by about eight times. Such canopies serve to reduce peak flows in urban settings too. Forests made up of needle-leaf trees captured more amount of rainfall than broad-leaf deciduous forests and evergreen forests. With billions of overlapping leaves, stretching sometimes for hundreds of feet above the ground, these canopies act like giant umbrellas – catching rain water before it reaches the forest floor. These arboreal umbrellas intercept gallons of rain water every year.

Afforestation on degraded lands and protection of natural regeneration would prove to be the most efficient measure in mitigating floods in plains. Also, best practices of soil and water conservation in agriculture and management of water

harvesting and drainage systems must be encouraged among the general public in the country.

(Note: The authors have drawn various facts and figures from govt. websites Tripura Disaster Management Authority, Govt. of Tripura information dated 13-08-2017, Assam State Disaster Management Authority, Govt. of Assam information dated 20-08-2017 and Articles "Role of Trees and Forest in Healthy Watershed" published by Vincent Cotrone Extension Urban Forester, Northeast Region, Pennsylvania, "World Rainforest Acts as Rain Collecting Umbrellas" by Michelle Bryner, "Stormwater Quantity and Rate Control Benefits of Trees in Uncompacted Soil" by Leda Marritz).

# Diversity of macro-fungi in central India-VIII: *Astraeus hygrometricus*, an ectomycorrhizal and neutraceutical mushroom from sal forests

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The present article reports occurrence and diversity an ectomycorrhizal and edible mushroom, *Astraeus hygrometricus*, from sal forests of central India. The article includes taxonomic description of the fungus and discussion on host range, distribution, ectomycorrhizal association, collection of mushroom and nutraceutical properties. This mushroom is collected by local/ tribal people of central India for their consumption and sale in local market along with other mushrooms (*Lentinus*, *Pleurotus*, *Russula*, *Termitomyces*) Information on collection and selling of this mushroom in local market of Dindori district, Madhya Pradesh is also provided.

**Introduction**

The gasteroid fungus *Astraeus hygrometricus* had described for the first time in 18th century as *Geastrum* by Persoon (1801). Morgan (1889) confirmed its identity as a distinct taxon followed by more precise descriptions by many investigators (Lloyd 1902, Coker & Couch 1928, Cunningham 1944). Until now, up to 10 species have been described worldwide namely, *Astraeus asiaticus*, *A. hygrometricus*, *A. morganii*, *A. odoratus*, *A. pteridis*, *A. sirindhorniae*, *A. smithii* and *A. thailandicus* (Petcharat 2003, Phosri et al. 2013, Hembrom et al. 2014). Although *Astraeus* is superficially similar to *Geastrum*, but it differs in certain characters, especially lack of peristome, columella and consists of larger basidiospores than *Geastrum* and possesses highly branched long capillitial hyphae (Phosri et al. 2004).

**Materials and methods**

Specimens were collected from sal forests of Dindori and Anuppur districts of Madhya Pradesh; Achanakmar, Chhattisgarh and Jharsaguda, Odisha. Identification of fungus was done with the help of literature (Ahmad ,1950; Butkrachang et al., 2007; Christensen et al., 2008; Coker and Couch, 1928; Cunningham, 1944; Dell et al., 2005; Dring , 1964; Fangfuk et al., 2010; Hembrom et al., 2014; Karun and Sridhar , 2014; Lloyd , 1902; Manna et al., 2014; Manna and Roy, 2014; Massee , 1889; Mohanan, 2011; Morgan, 1889; Pavithra et al., 2015; Phillips, 2006; Pradhan et al., 2013a, b; Pyasi et al., 2011; Semwal et al., 2014; Surcek, 1998). The immature fruit bodies of *A. hygrometricus* was collected from forests during early monsoon (June) to late monsoon (September). Under sal trees careful observation were made to locate cracks on soil surface and with white matrix. The scratching of soil surface was done below the crack surface to locate the immature fruit bodies. The immature basidiomata were solitary or in cluster of 4–10, fully or partially buried (0.5–1 cm deep) in soil and/or sometimes visible along with pebbles of laterite soil

as bone-white mycelial mass. The immature and mature fruit bodies with wings were collected and brought to laboratory. The slides were prepared in lacto-phenol and cotton blue and observed under advance Research Microscope, make Leica, Germany and photomicrographs were taken with a digital camera attached to microscope. The specimens were deposited in the Mycology Herbarium, Tropical Forest Research Institute, Jabalpur and got accession numbers.

**Results**

**Taxonomy**

***Astraeus hygrometricus* (Pers.) Morgan**

(Diplocistaceae, Boletales, Agaricomycitidae, Agaricomycetes, Agaricomycotina, Basidiomycota)

≡*Grastrum hygrometricum* Oers. 1801

=*Geastrum fibrillosum* (Schwein,1822);

=*Geastrum stellatum* (Scop. Wettst, 1885);

=*Lycoperdon stellatus* (Scop., 1772);

=*Astraeus stellatus* (E. Fisch., 1900).

Sporophore globose to sub-globose, creamish-grey, shining, 1.7-2.3cm in diam, epigeous, number of rays in each fruit body varied from 8-13, flame shaped or stellate, expanded or revolute, light brown-grey, bent inwardly and showed permanent dark reticulate cracks on ventral sides, measuring 1.2-2.1cm long, dried fruit bodies when dipped in water absorbed considerable amount of water, rehydrate and swelled up within 10-15 min, rays open outwardly to expose the spore bearing sac in the atmosphere to release more spores, rays open when moisture content is high in air and vice-versa (Figs.1-2). Immature edible fruit bodies, hypogeous, creamish-brown, develop from small mycelial mass, globose-subglobose or irregular, 1.6-2.7cm in diam (Fig. 3-5). Hyphae light yellow brown, thick walled or incrusted, branched, septate, 2.5-5.0µm wide. B*asidia*, 4 spored, 15–20 x 8–12µm, sterigmata very short (Fig. 6). Basidiopores spherical, rough surfaced, echinulate or warty (warts more longer in immature spores, Fig. 7), light purple brown, 8.7-11.3µm in diam (Fig. 7-8), growing solitary or gregarious in groups of 8-12 developing near base in association with mycorrhiza of sal (Figs. 1-2).

**Specimen examined**

On forest floor of sal forest Bajag, Chada; Gadasarai, Dindori (Madhya Pradesh) and Jharsaguda (Odisha), Mycology Herbarium, Tropical Forest Research Institute, Jabalpur TF 2018 and TF 3972.

**Fig. 1:** Open fruit bodies of *Astraeus hygrometricus* growing under sal forest

in Jharsaguda, Odisha

**Fig. 2:** Open fruit bodies of *Astraeus hygrometricus* growing in open space in sal forest, Chada, Dindori, Madhya Pradesh

**Fig. 3:** Immature, fruit body of *Astraeus hygrometricus* cut open, showing spore bearing sac

**Fig. 4:** Fruit body of *Astraeus hygrometricus* collected by local tribal people for their use as well as for selling in local market at Tarach in Dindori, Madhya Pradesh

**Fig. 5:** Local woman selling *Astraeus hygrometricus* with other mushrooms and leafy vegetables at Bajag, Dindori, Madhya Pradesh

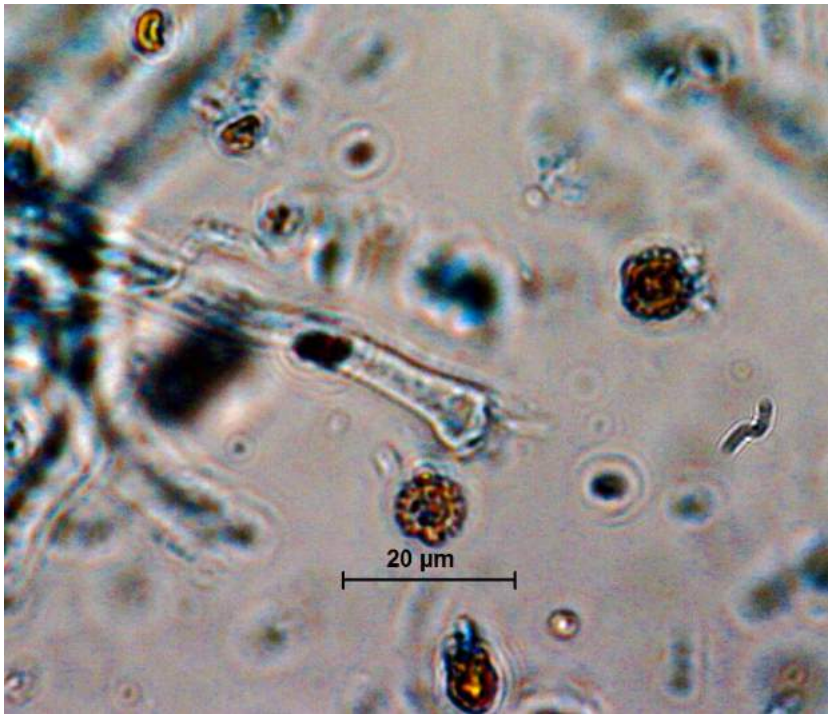


**Fig. 6:** *Astraeus hygrometricus*, basidium

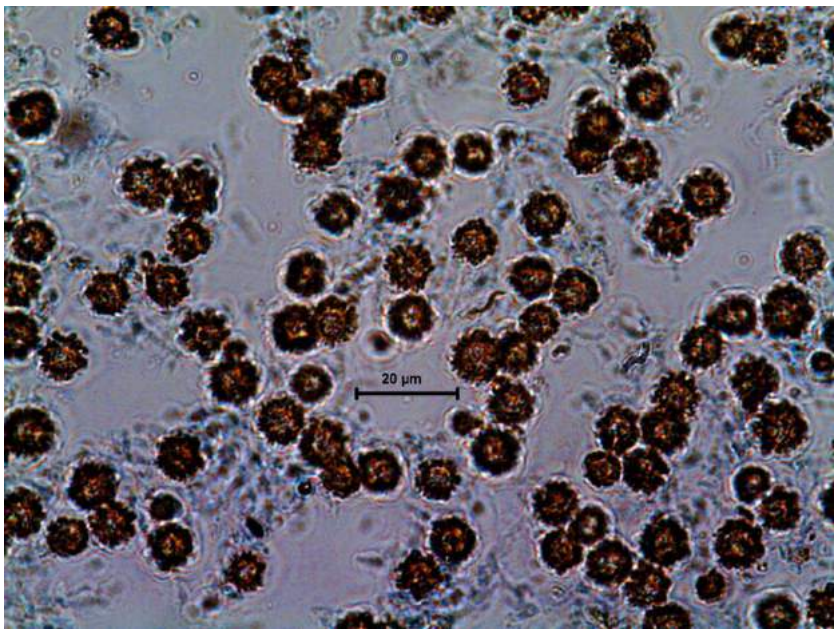


**Fig. 7:** *Astraeus hygrometricus*, basidiospores from immature, edible fruit body

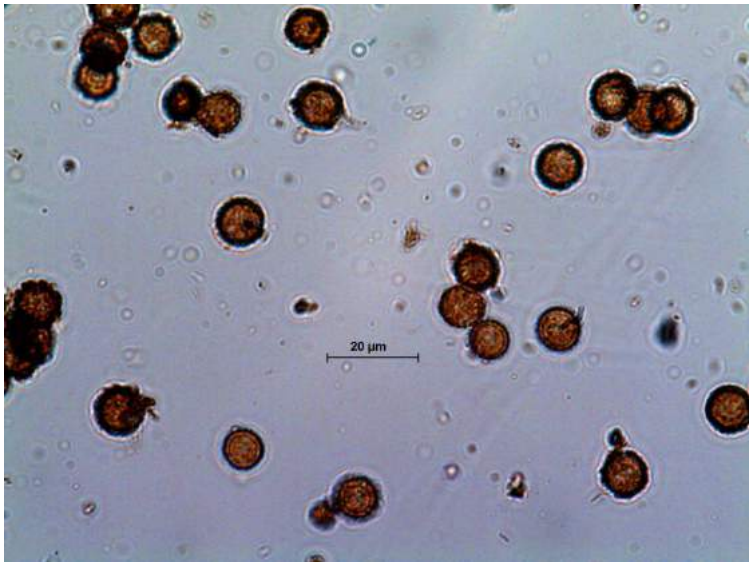


**Fig. 8:** *Astraeus hygrometricus*; basidiospores from mature fruit body

## Discussion

### Host range

In the present study the fungus was collected from sal forest. In general habitats and hosts of *A. hygrometricus* in India as well as in far-east countries are mainly confined to lateritic soils in natural forests and their adjacent open places (grass lands and abandoned paddy fields, etc). Collection of this mushroom has been reported from Karnataka, Kerala, Odisha and West Bengal (Pradhan et al. 2010, 2013a, b, Mohanan 2011, Karun and Sridhar 2014, Manna and Roy 2014). These were also occasionally found amidst *Areca* mixed plantation in lateritic soils of Mangalore (Karun and Sridhar 2014), Rajmahal Hills and Dalabari region of Jarkhand (Hembrom et al. 2014). Burning generally reduces the diversity of saprophytic macrofungi, but ectomycorrhizal fungi survive in subsoil along with roots. Sysouphanthong et al. (2010) opined that burning stimulates the growth of selected macrofungi especially *A. hygrometricus*.

### Distribution

*Astraeus* spp., are widespread especially in the sandy soils of forests of tropical, sub-tropical and temperate regions especially in Africa, Asia, Australia, Europe, Mexico, North America and South America (Lloyd 1902, Coker & Couch 1928, Cunningham 1944, Dring 1964, Nouhra & Toledo 1998, Phosri et al. 2004, Fangfuk et al. 2010). These are distributed widely in the Indian subcontinent including Chhattisgarh, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Odisha, Punjab, Uttarakhand, Uttar Pradesh and West Bengal (Ahmad 1950, Phosri et al. 2004, 2013, Pradhan et al. 2010, 2013a, b, Mohanan 2011, Pyasi et al. 2011, Hembrom et al. 2014, Karun & Sridhar 2014, Semwal et al. 2014) (Fig. 9). Recently two species namely, *Astraeus hygrometricus* and *A. odoratus* were reported from foothill region of Karkala forests (Udupi, Karnataka), Western Ghats (Pavithra et al., 2015).

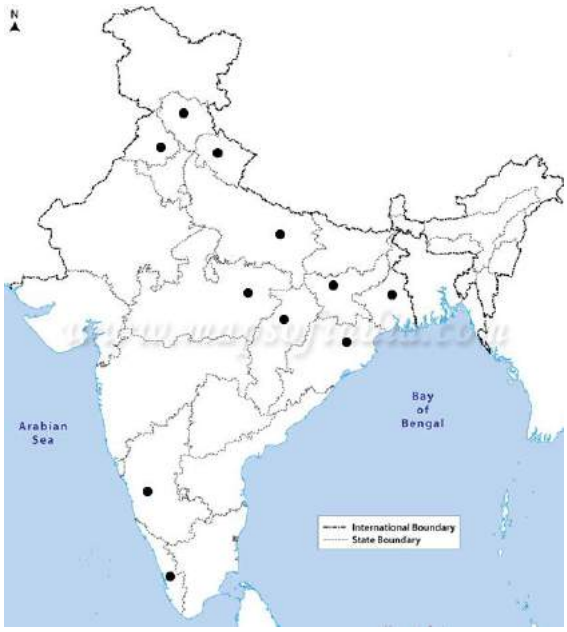


**Fig. 9.** Distribution of *Astraeus hygrometricus* in 11 different states shown on map of India with black dots

**Ectomycorrhizal association**

*Astraeus hygrometricus* is an ectomycorrhizal fungus and grows in association with a broad range of tree species (Harley et al., 1997). It colonizes a wide variety of forest tree species belonging to families: Betulaceae, Dipterocarpaceae, Ericaceae, Fagaceae, and Pinaceae, (Fangfuk et al. 2010, Hibbett et al. 2000, Karun and Sridhar 2014, Phosri et al. 2004, Pyasi et al. 2011, Wilson et al. 2012). Common reported trees species are: *Acacia auriculiformis*, *Anacardium occidentale*, *Artocarpus hirsutus*, *Holigarna arnottiana*, *Hopea parviflora*, *H. ponga*, *Phyllanthus emblica*, *Shorea robusta* and *Syzygium cumini*. It also predominant in oak and pine forests (Surcek 1998) and were ectomycorrhizal with *Pinus densiflora* in Japan (Fangfuk et al. 2010). *Alnus*, *Castanea*, *Eucalyptus* and *Pseudotsuga* were also reported as hosts of *A. hygrometricus* (Trappe 1967, Molina 1979, Malajczuk et al. 1982, Nouhra & De Toledo 1998). In vitro inoculation of spores of *A. hygrometricus* to *Pinus densiflora* resulted in formation of sheath, rhizomorphs and Hartig net in roots (Fangfuk et al. 2010). *A. odoratus* is ectomycorrhizal with *Dipterocarpus tuberculatus* var. *tuberculatus* and *D. obtusifolius* var. *obtusifolius* and *Hopea ponga* in Northern Thailand (Kennedy et al. 2012).

**Collection of mushroom**

Generally, *A. asiaticus*, *A. hygrometricus*, *A. odoratus* and *A. thailandicus* are edible while *A. koreanus* and *A. pteridis* are inedible. Edibility of rest of the species (*A. morganii*, *A. sirindhorniae*, *A. smithii* and *A. telleriae*) is yet to be established. In central India the mushroom is collected by local tribal people for their consumption and sale in local market along with other mushrooms including species of *Lentinus*, *Pleurotus*, *Russula*, *Termitomyces*, etc. (Fig.5). The local people collect immature fruit bodies during June-September and the highest yield obtained during July-August. In mushroom dominant regions (forests,

buffer zones and grass lands in laterite fields), local people identify troops of *A. hygrometricus* by scratching the surface of soil and looking for white matrix. Wherever white matrix seen on the surface or subsurface, it is a perfect indication that troops of immature fruit bodies prevail in its surroundings. Entire families of some tribes in and around Karkala region harvests tender *A. hygrometricus* throughout the day during rainy season for their livelihood. Harvesters find it easy to fetch more mushrooms in open and buffer zones than in typical forest locations. If bulk quantity of mushrooms is harvested, it can be preserved without processing under soil up to 3-4 days and desired quantity will be fetched for daily use. This indigenous method of preservation is also in practice in Eastern lateritic parts of India and the highest yield was during July (Manna et al., 2014; Manna and Roy 2014). Harvested mushrooms should be cleaned in water to remove debris and hairy structures on the surface, wrapped in clean wet cloth and preserved as such or in refrigerators. Usually cleaned mushrooms will be cooked and consumed on the same or subsequent day. Collected tender mushroom reaches to the local markets on the same day and sold in bulk or retail depending on the demand or reaches the nearby distribution centres. Before cooking, each immature basidium will be cut and ascertain its tenderness having white flesh inside (Fig. 3). Those having fully white part or a small spec of black spot in the margin will be considered for eating and those having extended black regions will be discarded. In vernacular language this mushroom is called 'Kall-anabe' in Kannada meaning 'stone mushroom', it is called ‘Sehula’ in Uttar Pradesh meaning mushroom from sal forest and ‘Puttu’ in Madhya Pradesh. This is one of the highly prized mushrooms costing Rupees 300–500 per kg. In Northern Thailand, yield of *A. odoratus* was significantly increased in burnt floors of dipterocarp-oak forests and serve as an important culinary delicacy as well as household income (Kennedy et al. 2012).

**Nutraceutical properties**

Fruit bodies of *A. hygrometricus* are regularly consumed in Asia, including Nepal and South Bengal, where "local people consume them as delicious food". They are collected from the wild and sold in the markets of India (Fig. 4-5). The fungus contained an abundance of volatile eight-carbon compounds (including 1-octanol, 1-octen-3-ol, and 1-octen-3-one) that imparted a "mushroom-like, earthy, and pungent odour that was evident as an oily and moss-like smell upon opening the caps". Volatile compounds detected after cooking the mushroom samples included furfural, benzaldehyde, cyclohexenone, and furanyl compounds. The regional differences in opinions on edibility are from sources published before it was known that North American and Asian versions of *A. hygrometricus* were not always the same; in some cases Asian specimens have been identified as new species, such as *A. asiaticus* and *A. odoratus*. *Astraeus* constitutes one of highly prized edible mushrooms in several parts of Asia (Mortimer et al. 2012). Tender basidiomata of *Astraeus* spp. are harvested in wild and marketed in India, Japan, Laos and Thailand (Ogawa 1992, Sanmee et al. 2003, Phosri et al. 2004, 2007, Dell et al. 2005, Butkrachang et al. 2007, Karun and Sridhar 2014). Due to meagre information on *Astraeus* spp.

especially in the Southern India (Bhagwat et al. 2005, Karun and Sridhar 2014), traditional knowledge of its edibility in the foothill regions of the Western Ghats and their association with a variety of forest tree species stimulated the present study. *Astraeus* spp. are regularly consumed in Asia and neighbouring countries, including Nepal (Christensen et al., 2008). In South Bengal, where local people consume them as delicious food (Maiti et al., 2008). They are collected from the wild and sold in the markets of India serve as traditional nutritional delicacy and sold in local markets during rainy season. In the west coast occurrence of *A. hygrometricus* in *Areca* plantation was reported and it is consumed as traditional source of food (Karun and Sridhar 2014). In Thailand, *A. hygrometricus* has a long history of edibility and available in the rural markets (Phosri et al. 2013). This mushroom along with *A. asiaticus* and *A. odoratus* were harvested in wild from the Northern and North-Eastern part of Thailand for marketing (Dell et al. 2005, Butkrachang et al. 2007, Fangfuk et al. 2010). Another most edible species include *A. thailandicus*, which will also be collected and sold in the markets of Thailand (Petcharat 2003).

Indigenous knowledge *Astraeus* spp. are known for several economic values especially edibility and medicinal properties. It serves as herbal medicine in China and India (Mallick 2010). Ethnic tribes of Odisha use *Astraeus* traditionally for medicinal purposes (Panda and Tayung 2014). Immuno-enhancing activity of *A. hygrometricus* has been reported by Chakraborty et al. (2004) and Mallick (2010). The ethanolic extract possesses significant free radical scavenging, lipid peroxidation inhibition and also possesses excellent anti-inflammatory activity comparable to the standard drug diclofenae (Biswas et al. 2010). Ethanolic extract of *A. hygrometricus* also showed cardioprotective, chemoproventive, hepatoprotective and hypoglycemic potential (Biswas et al. 2011a, b, 2012, Biswas and Acharya 2013). Anti-candidal and leishmanicidal activities of *A. hygrometricus* have been reported by Lai et al. (2012)

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# *Couroupita guianensis* : A potential medicinal tree

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*Couroupita guianensis* Aubl. belong to family Lecythidaceae and commonly known as cannon ball tree, locally known as 'Kailashpati'. It is distributed throughout India as ornamental treeand its native to Central and South America (Brazil, Colombia, French, Guyana, Peru and Venezuela), where it grows in the thick humid forests, often along the river belts and low altitude. In India, it is considered as a sacred tree by Hindus which is the reason why it is generally grown in Lord Shiva temple because of its special featured flowers which look like hood of Naga (snake) protecting the Shivalinga, hence, it is called as "Nagalinga Pushpa". Traditionally, Kailashpatiis widely used for its medicinal properties and also extensively research for its pharmacological properties. The leaves of this plant have been used in the treatment of skin infections including protozoan disease in human.

**Description**

Kailashpatiis a very beautiful and remarkable tree with 35 m height in tropical forest and bark not fissured. The massive trunk is intertwined with a mass of thick long stalks bearing large showy flowers and large rounded fruits, with the latter looking very much like cannon balls. This is unusual as most trees bear their flowers and fruits on the branches, rather than along the trunk. The leaves in clusters at ends of branches, lamina 8-30 cm long, usually narrowly obovate to obovate, base cuneate, margin entire; apex generally acute or acuminate. The red-yellow flowers are bisexualabout 5-6 centimetres wide and spread a scent to attract bees, especially during the night. Petals 6 in colour pink to red. The androecium is prolonged on one side into a flat hood, with a stamen-free area between the staminal ring and the hood proper. The hood is white or pale yellow tinged with pink externally whereas, the ring stamens with white filaments and white or pale yellow anthers, the hood staminodes often white at the very base, pink for most of length, and yellow at apex, sometimes white for most of length and yellow at apex. After pollination, 25 cm large, round fruits are produced. Fruits develop in 18 months, remaining on the tree for a year. Fruits are heavy and fall like a cannon ball from the tree when they are ripe. It is widely cultivated for its large showy flowers and reddish brown woody capsular fruits up to 20 cm in diameter.Old fruits disintegrate slowly to liberate the many seeds. The ripe flesh has an unpleasant smell. It was noted that the tree seems to be self-sterile as isolated trees would not fruit. On the ground, they burst open, and the fruit flesh is eaten by animals. Seeds get embedded in pulp, the pulp oxidizing bluish-green when exposed to air.


**Figure 1: *Couroupita guianensis* Aubl. Tree Species: A.** Phenology of Kailashpati tree; **B.** Fruits of Kailashpati tree; **C.** Leaves of Kailashpati; **D to F.** Floral structure of Kailashpati tree

**Present status**

Considerable number of medicinal importance's, traditional pharmacological activities and habitat destruction may cause it to be threatened in its native range and India. Although the Govt. of India, Thailand and United States have extensively planted itas ornamental tree. Eventhough, it comes under classification of 'Least Concern' in the IUCN Red List of Threatened Species (2013). Hence there is anurgent need of conservation strategies forthe species.

**Nursery propagation**

It is generally propagated by seed and due to high rate of germination rate (80%) percentage, there is no need of any pretreatments. The seed can be sown directly in nursery bed or containers under semi-shade condition. The seedlings will be ready for planting in any afforestation programme when its 6-7 months old.

**Medicinal properties**

The Kailashpatitree components have many various medicinal properties such as antibacterial and antifungal activities (Kavitha*et al.,* 2011), exert of cytotoxic activity against certain cancer cell lines *i.e* 'Isatin' used in chemo therapeutic agents (Premanathan*et al.,* 2012), decoction of flower has been used to boost the immune system to fight a number of diseases in Orissa (Boyum, 1968), flower extracts of this plant had been screened for immune modulatory activity (Pradhan *et al.,* 2009) and larvicidal activity against vector (Desal*et al.,* 2003), 'flavonoids' (extract from plant) have a wide range of uses due to itsbiochemical and pharmacological effects specially against pathogenic bacteria (Akther*et al.,* 2017) and antibacterial activity of fruit pulp oil extracts was demonstrated against gram positive and gram negative

bacteria.Amazonian basin people used the infusion or tea obtained from leaves, flower and bark of *C. guianensis* to treat hypertension, tumors, pain, and inflammatory processes (Sanz-Biset*et al.*, 2009). The fragrance of flowers is used for curing asthma and the shell of fruits is used as a utensil. The clinical approaches of antioxidants increased multifold during the recent time for the management and therapeutic implication of neurodegenerative disorders, aging and chronic degenerative diseases. There are several other importance which have been described by other researchers such as Antibacterial (Sivakumar*et al.*, 2015), Antimicrobial (Al-Dhabi*et al.*, 2012), Antioxidant/ Antinociceptive (Pinheiro et al., 2010), Antimicrobial/ wound healing (Umachigi*et al.*, 2007), Anthelmintic and Antioxidant/ skin fibroblast proliferation (Martinez *et al.*, 2011; Regina and Uma Rajan, 2012), Antidepressant (Juvekar*et al.*, 2009), Antiinflammatory (leaves-Pinheiro*et al.*, 2013; flower and bark-Gupta *et al.*, 2012a), Neuropharmacological effects (Gupta *et al.*, 2012b; Gupta *et al.*, 2012c), Antiulcer (leaves-Elumalar*et al.*, 2012) and Anticancer (flower-Premanathan*et al.*, 2012).

**Silvicultural practice**

Kailashpati is fast growing tree species but for better growth performance a fertilizer dosage is needed including all micro nutrients and trace elements. It can tolerate low light but prefer full sun light.The heartwood is light yellow; it is not clearly demarcated from the sapwood. The wood texture is medium to coarse and the grain is straight or interlocked. The wood is light weight, very soft, no durable, susceptible to fungi, and there is an unpleasant odour from the green wood. The wood works easily with ordinary tools, though there is a tendency to woolliness and filling is recommended in order to obtain a good finish; nailing and screwing are poor; gluing is correct. The wood is used to manufacture various lower value purposes including toys, boxes, parquet blocks, rackets, casting moulds, fibre boards and light artefacts.

**Edible plant parts and uses**

Fruits are edible, vinous and pleasant and are occasionally eaten whereas the pulp of the fruit colour is white, acidic and not agreeable. The fresh pulp is used by natives to prepare a cooling medicinal drink as well as to feed animals such as chickens, ducks, muscovy and pigs. The flowers of Kailashpati tree can be used to manufacture scent, perfumes an
d cosmetics due to itswonderful smell in nature.

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# *Mitragyna parviflora* - A new host plant record for defoliator, *Phazaca theclata* (*Dirades theclata*) Guen. (Lepidoptera: Uraniidae)

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*Mitragyna parvifolia* Korth (family Rubiaceae) is a tree species found in Asia. It is native to India and Sri Lanka. Fresh leaves sap is used by the tribals in treatment of jaundice, alleviate pain, swelling and for better healing from wounds and ulcers. The bark and roots used to treat fever, colic, muscular pain, burning sensation, poisoning, gynecological disorders, cough, edema and as an aphrodisiac. The fruit juice augments the quantities of breast milk in lactating mothers and also work as lactodepurant (Anon., 1959). Literature pertaining to *M. parviflora* entomology is very scanty fragmentary and incomplete. According to Beeson (1941) and Browne (1968) reported the larvae of *Phazaca theclata* (syn. *Dirades theclata*) on the host plants - *Adina cardifolia* and *Burttavya nyasica.* Senthil Kumar and Murgesan (2015) reported the larva of *Spodoptera litura* (Fab.) on *M. parviflora*. Another species *M. speciosa* is attacked by a caterpillar of commander butterfly, *Moduza (Limenitis) procris* Cram (Anon. 1959). The present study is a new addition in this regard and account is based on the field and laboratory observations of authors.

Recent survey was conducted during July 2017 in natural forest area, East Mandla Forest Division, Madhya Pradesh. It was observed that the trees of *M. parviflora* commonly known as Mundi were severely attacked by some lepidopterous larvae (defoliator). These larvae were then collected and reared on its host plant *M. parviflora* in laboratory under the prevailing environmental conditions until pupation. These pupae were then allowed to emerge the adult moth stage.

The study revealed that *M. parviflora* suffers seriously from the attack of a defoliator, identified as *Phazaca theclata* (syn *Dirades theclata*) Gue. (Lepidoptera:Uraniidae) after comparing the morphology of adult moth with determined specimen preserved under accession No. 271 (syn *Dirades theclata*) in TFRI Insect Repository for Insects. It was observed that a violoceous grey moth with brown-whitish head and thorax abdomen chreous except at base, forewing biolaceous grey, a large triangular patch out lined with double brown lines on the costa beyond the middle, a similar oval spot with darker centre on marginal fuscous lumules. Hind wing with basal half violaceous grey, darkest at inner margin, the outer half pale chreous brown.

The greyish, larval frequently appears over large area as a defoliator of *M. prviflora* from July or August. It was recorded that the young larvae are gregarious in habit. The leaf is eaten from the margins towards the midrib but only superficially so that it appears coarsely skeletonize and defoliate the trees (Figs.1-4). Pupation takes place

on the ground or on the dead leaf. The cocoon is covered with particles of soil of dust of dry leaf. The life cycle is about a month and has a pupal period of 4-5 days towards the end of September.

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4 a 

b

**Figs.: 1. Damaged tree of *Mitragyna parviflora*; 2. Larvae of defoliator *P. theclata* feed es of *M. parviflora*; 3. Damaged leaves of *P. theclata*; 4. Adult moths (a) male and (b)female of *P.theclata***

# नीम के असामान्य बीजांकुर

ममता पुरोहित एवं राजेश कुमार मिश्रा

उष्णकटिबंधीय वन अनुसंधान संस्थान,
(भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार)
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**छाया चित्र 1: नीम वृक्ष**

नीम मीलिएसी कुल का मध्यम से वृहद आकारीय पतझड़ी वृक्ष है (छाया चित्र 1) । इसका वानस्पतिक नाम *अजाडिरेक्टा इंडिका* है । बहुउपयोगी नीम का कृषि वानिकी में भी उपयोग किया जा रहा है। भारत के मूल निवासी नीम का आयुर्वेद में विस्तृत औषधीय उल्लेख है । इसके प्रत्येक भाग जैसे जड़, तना, छाल, शाखा, पत्ती, फूल एवं फल आदि के औषधीय उपयोगों की जानकारी दी गई है। नीम का वृक्ष प्रकाश प्रेमी व अनावृष्टी (सूखा) को सहन करने वाला होता है। परन्तु दलदली या पानी भरे रहनेवाले स्थानों पर इसकी वृद्धि नहीं हो पाती है। यह पाला व आग के प्रति भी संवेदनशील होता है। नीम की लकड़ी पर दीमक व अन्य कीड़ों का प्रकोप नहीं होता है जिससे इसकी इमारती लकड़ी मकान, फर्नीचर, बैलगाड़ी, कृषि उपकरण, नाव, नक्काशी व खिलौने आदि बनाने के काम आती है। लकड़ी उत्तम ईंधन भी है। पत्तियाँ चारे के रूप में काम आती हैं तथा बीजों में पाया जाने वाला 40 प्रतिशत मार्गोसा तेल साबुन, टूथपेस्ट, केश तेल, त्वचा संबंधी क्रीम व लोशन तथा कीटनाशी आदि के निर्माण में व्यापारिक स्तर पर उपयोग किया जाता है। खली से खाद प्राप्त होती है। छाल से प्राप्त रेशों में 12.14 प्रतिशत उत्तम गुणवत्ता का टेनिन होता है।

सामाजिक वानिकी के अन्तर्गत नीम के पौधों का वृक्षारोपण किया जाता है । प्राकृतिक रूप से इसका पुनरुत्पादन बहुत अच्छा होता है तथा पौधे सफलतापूर्वक वृद्धि करते हैं। इसके बीजों में कोई सुप्तावस्था नहीं होती है। मातृ वृक्ष से झड़े हुए ताजे बीजों में 30 से 70 प्रतिशत तक नमी होती है तथा ये शीघ्रता पूर्वक अंकुरित होकर वृद्धि करने लगते हैं। बीज कुछ हफ्तों तक ही जीवित रहते हैं । इसलिए अधिक समय तक इनका भंडारण नहीं किया जा सकता है। बीजों की उत्तरजीविता बढ़ाने के लिए शीत भंडारण भी प्रभावशाली नहीं है । प्रस्तुत लेख में नीम के असामान्य बीजांकुरों का वर्णन किया गया है।

**प्रयोग विधी**

नीम के बीजों का अंकुरण प्रतिशत व अंकुरण क्षमता का अवलोकन करने के लिए जबलपुर के विभिन्न स्थानों से परिपक्व फलों का माह सितम्बर 2014 में एकत्रीकरण किया गया । एकत्रण के पश्चात फलों से बीज प्राप्त करने के लिए जूट की

बोरी पर फलों को फैलाकर तथा हाथ से रगड़कर गूदा अलग किया गया। तत्पश्चात नल के पानी से धोकर साफ-स्वच्छ बीज प्राप्त किये गये। प्राप्त बीजों को अच्छी तरह सुखाकर अंकुरण संबंधी अध्ययन करने के लिए 100-100 बीजों के चार


**छाया चित्र 2: नीम के नवोदभिद्**

समुच्चय बनाये गये। प्रत्येक समुच्चय के बीजों को नम जर्मीनेशन पेपर पर बराबर-बराबर दूरी पर रखा गया तथा जर्मीनेशन ट्रे को 30° C ±1°C पर सीड जर्मीनेटर में रखा गया (आई. एस.टी.ए. 1986) इसके साथ ही दूसरे 100-100 बीजों के चार समुच्चयों को रूट ट्रेनर में मिट्टी, गोबर की पकी खाद व रेत के 1:1:1 के अनुपात में बने मृदा मिश्रण में बोया गया तथा सूर्य के प्रकाश में प्राकृतिक दशाओं में रखा गया। अंकुरण पूरा होने तक (28 दिन) प्रत्येक दिन नियत समय पर सीड जर्मीनेटर में जर्मीनेशन ट्रे में रखे (छायाचित्र 2) व रूट ट्रेनर में बोये गये बीजों को आवश्यकतानुसार पानी से सिंचित किया गया तथा अंकुरित हुए बीजों की सँख्या दर्ज की गई।

**अवलोकन**

जर्मीनेशन पेपर पर रखे बीजों को उस समय अंकुरित माना गया जब मूलांकुर की लम्बाई लगभग 1 से.मी. हो गई तथा रूट ट्रेनर में बोये गये बीजों को उस समय अंकुरित माना गया जब प्रांकुर मृदा मिश्रण की सतह से लगभ 1 से.मी. ऊपर आ गया। जर्मीनेशन पेपर पर सामान्य बीजांकुरों के साथ-साथ निम्नलिखित प्रकार के असामान्य बीजांकुर भी देखे गये।


**छाया चित्र 3: नीम के असामान्य बीजांकुर (क्र. सँख्या 2 से 7 तक)**

क्र. सँख्या 1: सामान्य बीजांकुर जिसमें एक मूलांकुर व एक प्रांकुर की स्पष्ट वृद्धि दिख रही है।

क्र. सँख्या 2: बीजांकुर में केवल मूलांकुर की वृद्धि दिख रही है।

क्र. सँख्या 3: बीजांकुर में एक मूलांकुर की जगह दो मूलांकुर दिखाई दे रहे हैं।

क्र. सँख्या 4: बीजांकुर में एक अल्प विकसित मूलांकुर दिख रहा है, प्रांकुर की वृद्धि हुई है।

क्र. सँख्या 5: बीजांकुर में एक मूलांकुर की जगह दो अल्प विकसित मूलांकुर दिख रहे हैं। प्रांकुर की वृद्धि हुई है।

क्र. सँख्या 6: बीजांकुर में एक मूलांकुर की जगह तीन मूलांकुर दिख रहे हैं तथा प्रांकुर भी अल्प विकसित है।

क्र. सँख्या 7: बीजांकुर में एक मूलांकुर की जगह चार मूलांकुर दिख रहे हैं तथा प्रांकुर भी अल्प विकसित है।


**छाया चित्र 4: नीम के असामान्य बीजांकुर (क्र. सँख्या 3 से 7 तक)**

क्र. सँख्या 1 एवं 2: सामान्य बीजांकुर जिसमें एक मूलांकुर व एक प्रांकुर की स्पष्ट वृद्धि दिख रही है।

क्र. सँख्या 3: बीजांकुर में केवल प्रांकुर में वृद्धि दिख रही है दोनों बीज पत्र खुल गये हैं परन्तु सामान्य मूलांकुर की जगह दो अल्प विकसित मूलांकुर दिखाई दे रहे हैं।

क्र. सँख्या 4 एवं 5: बीजांकुर में प्रांकुर की सामान्य वृद्धि दिख रही है परन्तु एक मूलांकुर की जगह चार मूलांकुर दिखाई दे रहे हैं।

क्र. सँख्या 6 एवं 7: बीज पत्र खुल गये हैं, अल्प विकसित प्रांकुर दिख रहा है परन्तु सामान्य मूलांकुर अनुपस्थित है।

**स्पष्टीकरण**

बीजों की अंकुरण क्षमता का परीक्षण करने के लिए सामान्य बीजांकुरों की पहचान करना एक महत्वपूर्ण कार्य है क्योंकि सामान्य बीजांकुर ही आगे वृद्धि करके पूर्ण विकसित वृक्ष बनता है। असामान्य बीजांकुर आगे वृद्धि करने में असमर्थ होते हैं। असामान्य बीजांकुर का कारण बहुभ्रूणता, युग्मनज का विषम विदलन या आनुवांशिक विषमता आदि है। बिरिंगा एवं लीनडरटज (1928); साबलिन (1929); जमालुद्दिन एवं पुरोहित (1990) तथा पुरोहित एवं मिश्रा (2016) द्वारा विभिन्न वन प्रजातियों में असामान्य नवोदभिद देखे गये हैं।

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# Know Your Biodiversity

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***Cycas circinalis***

*Cycas circinalis* belongs to the cycads, which are among the world's most threatened plant groups. It is commonly known as Queen Sago and False Sago. In different regions of India it is known by various vernacular names *viz.*, Jangli Madanmast ka Phul, Kamkshi, Canningay, Madangama and Todda Panna. *Cycas wallichii, Cycas undulata, Cycas undulatea* and *Cycas squarrosa* are its synonyms. It belongs to order Cycadales and Family Cycadaceae. *Cycas circinalis* is the type species of Cycas and its specific name points to the circinate vernation in young foliage.

The species *Cycas circinalis* L., is an important multiuse plant for indigenous (adivasi) communities in India's Western Ghats, a biodiversity hotspot (Myers *et al.* 2000). It is found from sea levels to 1070 m, in the states of Kerala, Karnataka, Tamil Nadu and may also occur in Maharashtra. A form with stunted habit and narrower leaflets is also found around Bangalore but is not common. It is also seen in Sri Lanka, Maldives near Mala, East Tropical Africa, Madagascar, Comora Islands, Sumatra and Java. The False Sago occurs in dense, dry, scrubby woodland in hilly areas and sheds its foliage in extremely dry seasons.

False Sago is an evergreen palm-like tree which can attain height up to 4-8 m. Trunk is cylindrical in shape, with a crown of glossy, fern like and contains an edible, starchy material. This trunk is covered with compacted woody bases of petioles. Bark of *Cycas circinalis* is brown in colour, smooth from below with diamond shaped scars of fallen leaves and is covered with old leaf bases. Leaves are pinnate, glossy and 1.5-2.5 m long with 170 leaflets. They are bright green in colour and flat on hairy stalks. Male cones are shortly peduncled and have diameter approximately 7.6 cm, narrowly ovoid. These orange pollen cones are covered with matted woolly hairs. Microsporphylls are 3.7-5 cm long and 1.2-1.9 cm wide, ovate-deltoid in shape and prolonged into an upcurved subdulate spine. Megasporphylls are brown, tomentose, 15-20 cm long. Margin of Megasporphylls are crenate or spinous toothed. Ovules are 6-12 in number. Fruits are yellow, nearly round. Seeds are ovoid in shape, pale reddish yellow in colour and have 3.8 cm diameter. Flowering of *Cycas circinalis* occurs from February to March whereas fruits ripen from August to October. It is pollinated by a type of beetle known as weevil.

*Cycas circinalis* is harvested throughout its zone of occurrence. These are harvested for subsistence and commercial purposes, including for horticultural, ornamental, medicinal and food uses. The young leaves of this species are used as food by indigenous and local communities, and the mature leaves are sold to the floriculture industry. The juice of tender leaves is useful in the treatment of flatulence and vomiting. A decoction of the leaves is drunk to soothe cough.The pith and male cone are collected for their medicinal value. Pith is rich in carbohydrates and *sago* can be made from it. Seeds are used as food and medicine. In raw form seeds are poisonous, but after being cut into thin slices, dried and then steeped in water for a few minutes and dried again becomes edible. These seeds then ground into flour and used to make tortillas, tamales, soup and porridge. The bark and the seeds are ground to a paste with oil and used as a poultice on sores, cuts, wounds, ulcers and swellings. The plant also yields gum which is also edible. The gum resembles tragacanth. Tragacanth is a high quality gum that is used as a thickener in confections, salad dressings, sauces etc. The plant contains alkaloids of carcinogens and also an amino acid that can cause chronic nervous disorders.

*C. circinalis*' is endemic to South India and also listed as 'Endangered' in IUCN Red List threat category. According to Foundation for Revitalisation of Local Health Traditions it is declared critically endangered (in the states of Karnataka and Tamil Nadu) or vulnerable (in Kerala) and thus special attention is required for its conservation. Habitat destruction and their harvest from the wild is one of the main threats to this species. There is dire need to stop the distructive harvesting and conservation of its natural habitat as approximately 50% of the habitat have already been lost in past 60 years. Thus out planting within wild populations and in nurseries is needed to increase the feasibility of sustainable harvest in cultivation and preservation of this species in the wild. Beside these communities based conservation programmes should be promoted for the conservation and sustainable utilization of this endemic species.

***Platanitsa gangetica***

*Platanista gangetica* commonly known as Ganges River Dolphin, South Asian River Dolphin, Blind Dolphin and Susu with many local names in India such as Susuk, Hiho, Seho, Bhoolan and Sunsar. A large sneeze-like blow gives it its common name in Hindi viz., Susu. It belongs to Order Artiodactyla and Family Platanistidae.

*Platanista gangetica* inhabits at River Ganga, Brahmaputra and their Tributaries like Meghna and Karnaphuli-Sangu river systems. It is best seen at Vikramshila Wild Life Sanctuary (Bihar) and at Kaziranga National Parka (Assam). Aparts of India it is also seen in the rivers of Nepal and Bangladesh. Ganges River Dolphin lives in fresh water and shares its habitat with crocodiles, freshwater turtles and wetland birds, many of the habitats are

fish eaters and are potential competitors with dolphins.

The only true freshwater cetacean in India, this rare dolphin is easily recognized by its long beak, bearing a row of sharp, interlocking teeth designed to trap its prey. A long thin snout, rounded belly, stocky body and large flippers are the characteristics of *Platanista gangetica.* When viewed closely, its mouth curves upward at the end of its snout, giving it a menacing leer. Its flexing neck enables to turn its head at right angles and scan the area with echo locating pulses. Other distinguishing features are large, paddle-shaped flippers and a low hump on the back. The colour of its stocky body may vary from slate-blue to muddy brown. The calves and young ones are generally dark in colour but as animals grow in size, the colour lightens. Although its eyes lack a lens, this Dolphin still uses its eye to locate itself. The Indus River Dolphin (*Platanista minor*) appears identical to Ganges River Dolphin but genetic studies show it to be a different species inhabiting the river Indus and its tributaries.

*Platanista gangetica* is very active and continuously vocal, this river dolphin is highly visible at its sticks its beak out of the water. It swims a few inches above the river bed on its side, with its head bobbing sideways and its right flippers trailing in the mud and this behaviour help the Dolphin to find food. Avergae total body length is about 1.7-2.5 m and weighs approximately 70-85 Kg. Females are larger than males in size and attains maximum size of 2.67 m. The gestation period is from 9-11 month and one calf is born once ever 2 to 3 years. Although there is no specific birth period, but it is observed that females usually give birth from October to March, with a peak in December and January at the onset of dry season. Ganges River dolphins eats a variety of fish and invertebrates, like prawns, clams, catfish, freshwater sharks, mahseers (except in India), gobies and carp. Normally they chase for surface dweller fishes and grovel mud dweller fishes in shallow water with the help of their long snout. They cannot chew and usually swallow their prey.

According to data, in 1982, the population of *Platanista gangetica* in India was estimated to be between 4,000 and 5,000 individuals. But at present scenario, it is difficult to sight a dolphin in the rivers. The Ganges River Dolphin or Susu lives in one of the most densely populated regions of the world. According to IUCN Redlist *Platanista gangetica* is considered as an endangered species. One of the main threats to the species is loss of habitat due to large part to the creation of dams and irrigation projects. The survival of the Ganges River dolphin is threatened by unintentional killing while fishing, direct harvest for dolphin oil, which is used as a fish attractant and also for medicinal purposes. Not only these reasons but also industrial waste and pesticides, municipal sewage discharge and noise from vessel traffic are the major factor for its decline. Although according to Wildlife Protection Act of India mandates dolphin conservation as a prioroty but unfortunately public awareness and support for conservation of Susu is virtually non existent. Also little efforts have been done by government to implement or enforce the law for its protection. Thus it becomes necessary to spread knowledge more and more among common people fot its conservation.

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