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# Floral Diversity of Bhitarkanika, East Coast of India and its potential uses

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**Abstract:** Bhitarkanika is one of the spectacular National Park of India endowed with largest biodiversity of mangrove species and their associates. There are about 71 species of mangrove with their associates found in Bhitarkanika. In present observation a total of 28 families of 59 species mangrove with their associated flora was observed out of which the family *Rhizophoraceae* occurs in highest number ( 16.95%) followed by *Leguminosae* (8.47%) and families like *Plumbaginaceae*, *Cyperaceae*, *Avicenniaceae* contributing ( 5.08%) each having 24 species together representing 40.66% of total species. Rest 35 species of different families contributing 59.32% of abundance in study area. The local communities inhabited the mangrove areas along with their periphery depends in mangrove forest for their day today requirements such as food, fodder, timber , fuel, medicine etc. This paper provide field information on potential uses of mangrove and their associated flora during study period .The flower and fruit bearing seasons of some of the mangrove associated flora were recorded with the help of local people.

**Key words:** Floral, diversity, Bhitarkanika, East Coast, Potential uses,

## INTRODUCTION

Mangroves are the tidal forests of coastal wetland, existing in the intertidal zones of sheltered shores, estuaries, tidal creeks, backwaters, lagoons, marshes and mud flats of the tropical and sub-tropical regions of the world. The Bhitarkanika mangrove forest is the second largest mangrove in India. Mangroves of Bramhani and Baitarani delta of Kendrapara district have been declared as Bhitarakanika Wild life sanctuary in April 1975 covering an area of 145 sq. km. bordering the

Bhitarakanika sanctuary /National park, an area of 1435 sq. km. has been declared as Gahirmatha Marine Wildlife Sanctuary in September 1997. Bhitarakanika is endowed with very complex sub-ecosystem of freshwater, marine and terrestrial, which intricately mixed with each other. The maintenance of such an ecosystem depends on regular influence of fresh water from the adjoining land and tidal inflow from the sea. The horizontal and vertical zonation of the mangrove plant communities influenced by fresh water influx, tidal inflow, degree of inundation, seasonal rainfall and salinity gradient etc. have its influence on the wildlife and their occurrence. Mangrove swamps are one of the richest and most productive areas from the base of the food chain in the sea and coastal waters. The mangroves, wetlands and coral reefs, which are fragile ecosystems, face threat due to various anthropogenic activities. It does over exploitation will certainly hamper the existence of many communities of plants and animals in this fragile ecosystem. The mangrove ecosystem plays a very vital role in contributing to the food web in general and detritus food chain in particular supporting rich estuarine and adjacent marine fisheries [1]. The litter falls of mangrove trees amount to a large quantity of nutrients, which circulated both within the mangrove forest and in the surrounding marine ecosystem. The leaf material utilized by bacteria and fungi and forms the base of an aquatic food web [2]. The mangroves play a very significant role in protecting the hinterland against cyclones and the ingress of seawater during tidal surge. Mangroves stabilize coastal landmass against sea erosion. They are repositories of immense biological diversity and are the nursery and breeding ground of several marine life forms like shrimps, crabs, fishes, and mollusks. Mangroves sustain the ecological security of the coastal zones .They also provide livelihood to thousands of fishermen and other villagers who resides in and around the areas. Mangrove forest acts as a buffer against any natural disaster. Depending on the recommendations of national committees on wetlands, mangroves and coral reefs, 24 wetlands, 33 mangroves and 4 coral reefs in the country have been identified for conservation and management by the ministry for conservation and management[3] .Several works have been done on distribution of mangroves in India and Bhitarkanika by various authors [4-14]. Little work has been done in economic uses of mangroves in respect to floral diversity of Bhitarkanika so the present work is an attempt to study the present status of floral diversity of Bhitarkanika and its potential use and flower and fruit bearing seasons of mangroves and associated flora in Bhitarkanika.

## MATERIAL AND METHODS

**Study area:** The bhitarkanika wildlife sanctuary is situated on East Coast of India in the state Odisha and coming under Rajnagar sub-division in the district of Kendrapara. This sanctuary lies between 20°4’ to 20°8’ North latitude and 86° 45’ to 87° 5’ East longitude covering geographical area of approximately 672 square kilometer of which about 150 square kilometers under mangrove forest [15] **( Figure 1).** The status of this wild life sanctuary has been upgraded to the level of National park during October 1988 by inclusion of a portion of mangrove forest area of Bhadrak district. This purposed National Park was located between 20°30’ to 21°0’ North latitude and 86°45’to 87°6’East longitude. It includes the wheeler island in south and was bounded by Bay of Bengal in east and south, which covers an area of approximately 367 square kilometers. As far as 1998 notification , the finally notified national park extend from 86°45’ to 87°3’ East longitude and 20°48’North latitude covering forestlands, rivers , creeks , estuary and back waters. The river Dhamara ,Maipura , Patsala , Hansua , and Hansina are important river of Bhitarkanika which are distributaries of 2 main mother river’s namely Brahmani and Baitarani ,main islands namely Kalibhanjadian ,Wheelers group, Bagulidian, Manakudian and udabali island with mangroves. The climate of Bhitarkanika is tropical-humid experiences mainly 3 seasons namely summer, rainy and winter. The summer start from mid February up to mid June, the occasional rain and cyclones are met towards the end of the summer and April is the hottest month.

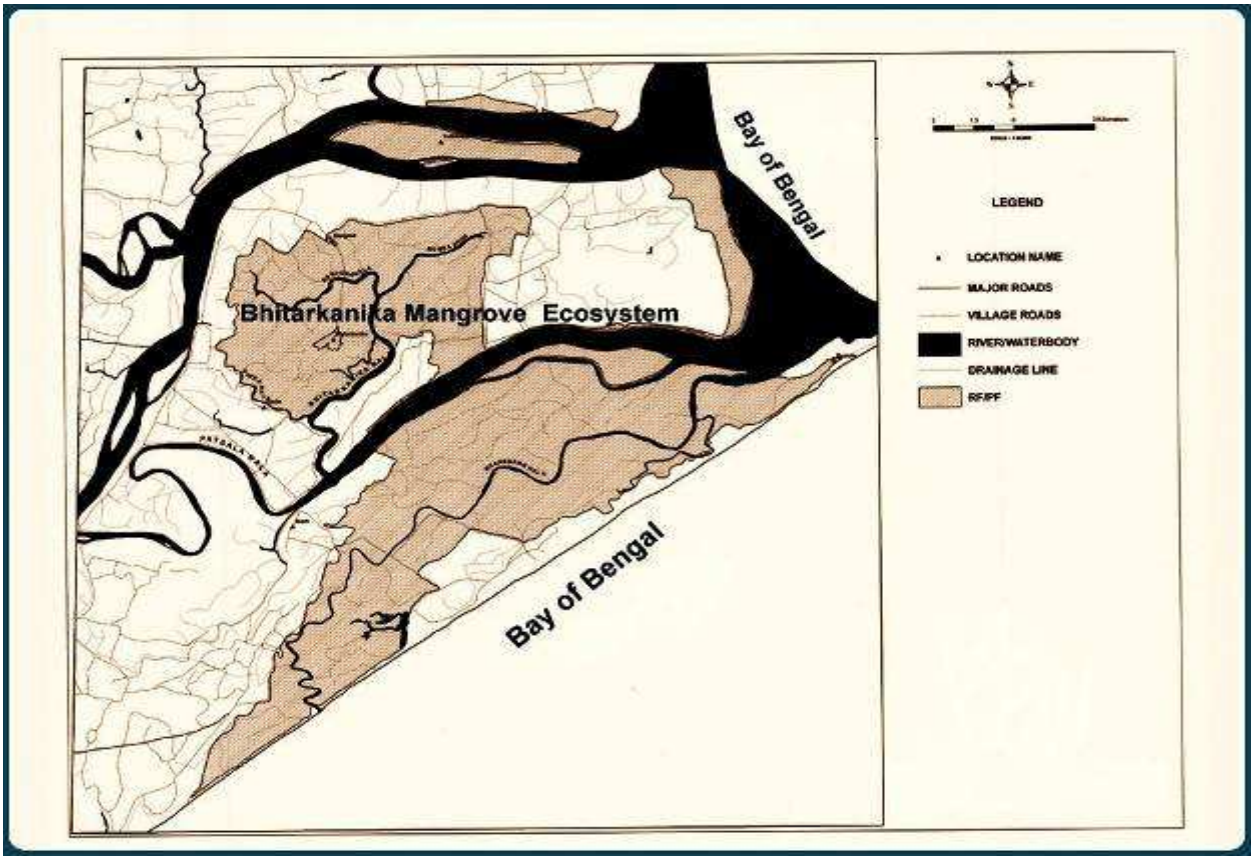


**Fig.1:** Maps showing the study area.

After summer, the rainy season begins which extend up to the end of October. Due to the influence of the south-west monsoon, maximum amount of rainfall is received during this period. The winter start from November, which continues up to February and January, is the coldest month. The temperature of Bhitarkanika rises up to 45°c, which is maximum during summer and comes down up to 10°c minimum during winter. The average annual rainfall is 1200 mm based on data collected at Gahirmatha sea-turtle research and conservation centre and Dangamal salt-water crocodile and conservation centre during last 23 years. The main monsoonal months are July to September, there is prone to severe cyclone storms and occasional tidal bores. The storms and oceanic cyclones are usually experienced during the transitional periods of rainy and winter season i.e. April/may and October / November almost every year and there are occasional tidal bores[16].Due to high prone severe cyclones it brings about the catastrophic damage to the plant community and various life forms.

**Methodology:** The detail studies were conducted depending on information collected from the local people who depend mostly on mangrove forest for their day-to-day needs. A survey of these mangrove forest along with its adjoining area were conducted during January2011 to December 2011.The plant specimen were collected for taxonomic identification from the different part of the region. The mangrove plants were identified use different literature like regional flora – *The Botany of Bihar and Orissa*[17-18]

## RESULTS AND DISCUSSION

According the status report of mangroves (1992) the total area of mangrove is estimated to be 6.740 km² which is about 7% of world mangrove forest out of these the Sundarban of West Bengal has the largest area under the mangroves forest being 4200km² followed by Andaman-Nicobar island being

1.190km² both accounting 80% of mangroves of the country. The 20% are scattered in state of Tamil nadu, Andhra Pradesh , Odisha, Gujarat, Maharastra, Goa, and Karnataka . The estuarine mouth and deltaic zone of the east coast of India have about 70% of total Indian mangals. Dominating mangrove area- 4267 km and major mangrove Eco-system 66% along with of Indian Sundarbanas. About 18% mangroves areas – 1152 km² and 90% of mangrove species are distributed in Andaman and Nicobar Island but most of these mangroves Eco-system is very much degraded and threatened condition due to the anthropogenic pressure[19] which is represented in **Table-1.**

**Table-1:** Status of Mangroves both in East and West coast of India

| Sl | Delta/Estuaries/Coast | Area in Km$^2$ |
|---|---|---|
| 1 | Delta of Ganga /Sundarban (W.B.) | 4267 |
| 2 | Andaman & Nicobar of Island | 1152 |
| 3 | Mahanadi & BhitarKanika of Orissa | 120 |
| 4 | Krishna, Godavari Deltas and Coringa | 184 |
| 5 | Cauvery Delta Muthapet Pichavanam | 26 |
| 6 | Keral Coast / Cochine Estuary | Negligible |
| 7 | Karnataka Coast Coondapur | 60 |
| 8 | Goa Coast Mandavi Zuari Coast | 20 |
| 9 | Maharastra Coast / Ratnagiri | 330 |
| 10 | Gujarat /Gilf of Cambay and Kuch | 260 |
| 11 | Lakshadweep &Minicoy Island | Negligible |

**Flora of Bhitarkanika:** The flora of Bhitarkanika mainly includes mangroves and their associates .The mangroves are the salt marsh of the tropics covered by herbs, shrubs, and trees. Total 71 numbers of mangrove and their associates were found in Bhitarkanika along its fringe area. The detailed list of mangrove species, which has been identified in this area, given in **Table -2.** The most and predominant species are *Avicennia officinalis* (Badabani), *Avicennia alba* ( Kalabani), *Excoecaria agallocha* (Guan),*Heritiera littoralis* (Sundari),*Sonneratia apetala*(Keoruan), *Rhizophora apiculata* ( Rai ), *Rhizophora mucronata* ( Rai ),*Kandelia candel* ( Sindhuguan ) *Ceriops decandra* ( Garani), *Phoenix paludosa* (Hental) , *Aegiceras corniculatum*(Kharasi). The less frequent and rare endangered plant include *Acanthus volubilis* (Harkanch), *Dolichandrone spathacea* (Gosinga), *Intsia bijuga* (Massitha), *Lumnitzera littorea* (Churanda), *Pandanus fascicularis* (Lunikia), *Rhizophora stylosa* (Rai) *Sapium indicum* (Batula), *Sonneratia caseolaris* (Orua), *Xylocarpus moluccensis* (Pitamari), *Xylocarpus mekongensis* (Pitakorua). The dominant plant communities in the wet land against the salinity prudent plant are *Avicennia* forest(BaniJungle), *Exoecaria* forest(Guan Jungle),*Sonneratia* forest(Keruan Jungle), *Phoenix* forest(Hental Jungle),*Rhizophora* forest(Rai Jungle), *Heritlera* forest(Sundari Jungle),*Feriops* forest,(Garani jungle).These species are most common and found in the wet land and play an important role in building land mass, arresting soil erosion and controlling flood damage.Occurrence of new mangrove species kanika sundari (*Heritiera kanikensis*) has been reported[20]. Among the associated plant's Karanta (*Pongamia glabara*),kochila(*Strychnus nux-vomica*),Hintala(*Barringtonia racemosa*) , Bania (*Hibiscus tilaceus*) , Habali (*Thespesia populnea*), Miriga (*Salvadora persica*) , etc are conspicuous . Some of the above mangrove and their associates

in Bhitarkanika having flower and fruit in different season of the year which have been observed during study period and were represented in **Table 3.** During the survey, 60 plant species were collected and identified during the field investigation under 38 genera and 28 families. Tree has highest diversity( 30 species) followed by herb (11 species) , shrubs ( 2 species ) Creeper (9 species), Grass ( 6 species), Fern ( 1 species).The family with most species was *Rhizophoraceae* (10 species), second largest families were *Leguminosae* ( 5 species ) and third largest families was *Avicenniaceae, Cyperaceae, Plumbaginaceae* ( 3 species each ) . The above 5 families all together represent 40.66% of total species and rest 35 species of different families contributing 59.32% of abundance in study area.

**Table-2**: Mangrove and their associate flora of Bhitarkanika ecosystem.

| Sl-No | Species | Local Name | VegetationType | Family |
|---|---|---|---|---|
| 1 | *Acanthus illcifolius* | Harakancha | Herb | Acanthaceae |
| 2 | *Acanthus solubilis* | Harakancha | Herb | Acanthaceae |
| 3 | *Acrostichum aureum* | Kharkhari | Fern | Polypodiaceaae |
| 4 | *Aegialities rotundifilia* | Banarua | Tree | Plumbaginaceae |
| 5 | *Aegiceras corniculatum* | Kharsi | Tree | Plumbaginaceae |
| 6 | *Aegialities majus* | Kharsi | Tree | Plumbaginaceae |
| 7 | *Amoora cucullata* | Ooanra | Tree | Meliaseae |
| 8 | *Avicennia alba* | Dhala bani | Tree | Avicenniaceae |
| 9 | *Aviceennia marina* | Singala bani | Tree | Avicenniaceae |
| 10 | *Aviceennia officinalis* | Bani | Tree | Avicenniaceae |
| 11 | *Brownlowis tersa* | Lati sundari | Herb | Tiliaceae |
| 12 | *Brugueiera cylindrika* | Bandari | Tree | Rhizophoraceae |
| 13 | *Brugueiera gymnorrhiza* | Bandari | Tree | Rhizophoraceae |
| 14 | *Brugueiera parviflora* | kaliachua | Tree | Rhizophoraceae |
| 15 | *Brugueiera sexangula* | Bandari | Tree | Rhizophoraceae |
| 16 | *Caesaipinia cristata* | Nentei | Creeper | Caesalpiniacaea |
| 17 | *Caesaipinia bondoc* | Nentei | Creeper | Caesalpiniacaea |
| 18 | *Cerbera odallum* | pani amba | Tree | Apocynaceae |
| 19 | *Ceriops decandra* | Garani | tree | Rhizophoraceae |
| 20 | *Ceriop tangal* | Garani | Tree | Rhizophoraceae |
| 21 | *Clerodendrom inerme* | Chiani | Creeper | Verbanaceae |
| 22 | *Crinum asiaticum* | Pani kenduli | Herb | Amarylidacear |
| 23 | *Crinum defixum* | Pani kenduli | Herb | Amarylidacear |
| 24 | *Cynometra ramiflora* | Singada | Tree | Leguminosae |
| 25 | *Cynometra iripa* | Singada | Tree | Leguminosae |

| | | | | |
|---|---|---|---|---|
| 26 | *Cyperus compactus* | Tianshi | Grass | Cyperaceae |
| 27 | *Cyperus corymbosis* | Keutia ghasha | Grass | Cyperaceae |
| 28 | *Dalbergia spinosa* | Goera kanta | Creeper | Papilonaceae |
| 29 | *Derris hetrophylla* | Katria nai | Creeper | Leguminosae |
| 30 | *Derris scandens* | Katria nai | Creeper | Leguminosae |
| 31 | *Dolichandrone spathacea* | Gosinga | Tree | Bignoniaceae |
| 32 | *Excoecaria agallocha* | Guan | Tree | Euphorbiaceae |
| 33 | *Fimbristylis ferruginea* | Luni ghasha | Grass | Cyperaceae |
| 34 | *Finlaysonia obovata* | Latirai | Creeper | Peripocaceae |
| 35 | *Flagellaria indica* | Bahumruga | Creeper | Flagellaricee |
| 36 | *Heritier fomes* | Sundari | Tree | Sterculiaceae |
| 37 | *Heritiera kanikensis* | Kanika Sundari | Tree | Sterculiaceae |
| 38 | *Hibiscus tiliaceus* | Bania | Herb | Malvacee |
| 39 | *Intsia bijuga* | Masitha | Tree | Leguminosae |
| 40 | *Kandelia candel* | sindhu guan | Tree | Rhizophoraceae |
| 41 | *Lumnitzera racemosa* | Churanda | Tree | Combretaceae |
| 42 | *Lunitzera littorea* | Churanda | Tree | Combretaceae |
| 43 | *Merope angulata* | Bana lembu | Herb | Rutaceae |
| 44 | *Myriostachya wightiana* | Nalia ghasa | Grass | Poaceae |
| 45 | *Nypa frticans* | | Tree | Nypa |
| 46 | *Pandanus fascicularis* | Nuni kia | Herb | Pandanaceae |
| 47 | *Phoenix paludosa* | Hentala | Tree | Palmae |
| 48 | *Phragmites karka* | Nala | Grass | Gramineae |
| 49 | *Iprteresoa cparctata* | Dhani dhana | Grass | Poaceae |
| 50 | *Rizophora apiculata* | Rai | Tree | Rhizophoraceae |
| 51 | *Rizophora mucuronata* | Rai | Tree | Rhizophoraceae |
| 52 | *Rizophora stylosa* | Rai | Tree | Rhizophoraceae |
| 53 | *Salacia chinesia* | Batara lata | Creeper | Hippocrateaceae |
| 54 | *Saliconia brachita* | - | Herb | Chenopodiaceae |
| 55 | *Saladora persica* | Meriga | Herb | Salvadoraceae |
| 56 | *Sapium indicum* | Batula | Shrub | Euphrobiaceae |
| 57 | *Sarcolobus carinatus* | Raigidi | Shrub | Asciepiadaceae |
| 58 | *Sesuvium profulacastrum* | | Herb | Aizoaceae |
| 59 | *Sonneratia apetela* | Kerua | Tree | Sonneratieceae |
| 60 | *Sonneratia caseolaris* | Orua | Tree | Sonneratieceae |
| 61 | *Sonneratia griffithii* | Orua/Chakada | Tree | Sonneratieceae |
| 62 | *Suaeda maritime* | Giria saga | Herb | Chenopodiaceae |

| | | | | |
|---|---|---|---|---|
| 63 | *Suaeda monaecia* | Giria saga | Herb | Chenopodiaceae |
| 64 | *Suaeda nudiflora* | Giria saga | Herb | Chenopodiaceae |
| 65 | *Tamirix dioica* | Jagula | Herb | Tamaricaceae |
| 66 | *Tramirix indica* | Jagula | Herb | Tamaricaceae |
| 67 | *Tramirix troupii* | Jagula | Herb | Tamaricaceae |
| 68 | *Thespesia populnea* | Habili | Tree | Malvaceae |
| 69 | *Xylocarpus granutum* | Shshumar | Tree | Meliaceae |
| 70 | *Xylocarpus mekongensis* | Pita karua | Tree | Meliaceae |
| 71 | *Xylocarpus molluccensis* | Pita karua | Tree | Meliaceae |

**Table-3:** Flower and Fruit bearing season of some mangrove and their associates in Bhitarkanika ecosystem.

| **Sl. No** | **Species** | **Local Names** | **Flower** | **Fruit** |
|---|---|---|---|---|
| 2 | *Heritiera fomes* | Bada Sundari | May | Jun |
| 3 | *Brownlowia tersa* | Lati Sundari | Apr | May |
| 5 | *Avicennia alba* | Kala Bani | May | Jun |
| 7 | *Avicennia marina* | Singali Bani | May | Jun |
| 8 | *Xylocarpus molluccensis* | Pitamari | Jun | July |
| 9 | *Xylocarpus mekongensis* | Pitakuar | Jun | July |
| 10 | *Xylocarpus granutum* | Sishumar | Apr | May |
| 11 | *Dolichandrone spathacea* | Guan | Jun | July |
| 12 | *Phoenix paludosa* | Hental | Mar | Apr |
| 13 | *Thespesia populnea* | Habali | Jun | July |
| 14 | *Tamirix dioica* | Jagula | Aug | Sep |
| 16 | *Ceriop tangal* | Garani | May | Jun |
| 17 | *Clerodendrom inerme* | Chiani | Jan | Feb |
| 18 | *Aegialitis rotundifolia* | Banrua | Oct | Nov |
| 19 | *Sonneratia apetela* | Keruan | Apr | May |
| 20 | *Cerbera odallum* | Pani Amba | Apr | May |
| 21 | *Merope angulata* | Bana lemba | Sep | Oct |
| 22 | *Amoora cucullata* | Oanra | Feb | Mar |
| 23 | *Lumnitzera racemosa* | Churunda | Oct | Nov |
| 24 | *Acanthus illcifolius* | Harkanch | May | Jun |
| 25 | *Caesaipinia cristata* | Nentei | Jun | July |
| 26 | *Sarcolobus carinatus* | Ragidi | Jun | July |
| 27 | Intsia bijuga | Masitha | Jun | July |
| 28 | *Rizophora apiculata* | Rai | Mar | Apr |
| 29 | *Aegiceras corniculatum* | Kharsi | Mar | Apr |
| 30 | Hibiscus tiliaceus | Bania | Feb | Mar |
| 31 | *Dalbergia spinosa* | Gohira kanta | Mar | Apr |

**Potential uses of mangroves:** The mangroves and it associates found in Bhitarkanika ecosystem are being utilized dfferent purpose by the local community which are described below and represented in **Figure 3** ( A-L)

**House construction:** It has been observed that Hental( *Phoneix paludosa*) is the most important useful plant species which serves multiple role in house construction. Like the Trunk/Stem of Hental is used for house, roofing and the leaves are used for thatching, fencing, brooms and ropes.

**Timber production:** The stems of *Avicennia marina* , *Bruguiera cylindrical*, *Bruguiera parviflora*,*Xylocarpus granatum* and *Sonneratia apetala* used for construction of house.,*Bruguiera gymnorhiza*,*Aeigiceras corniculatum* and *Hibiscus tiliaceous* used for boat construction . The wood of Sundari (*Heritiera fomes*) Bani(*Avicennia officinalis*) offers good timber species mainly used for furniture and as house construction materials.

**Firewood:** The stem of *Rhizophora*, *Bruguiera*, *Ceriops* and *Sonneratia* species widely used for source of fire wood and cooking.

**Nursery ground:** The leaves of Kharakhari*(Acrostichum*) are used by crocodiles for hatching their eggs. The pneumatophore of mangrove trees acts as an nursery ground for various fin fish and shell fish.

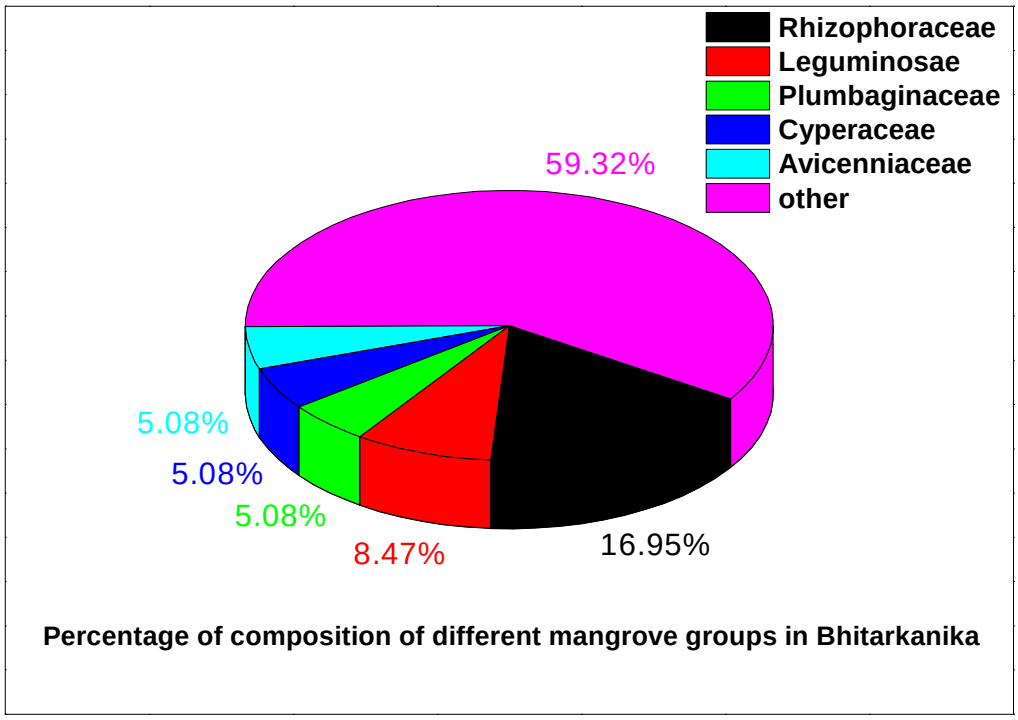


**Fig. 2:** Percentage of Composition of different Mangrove and their associates in Bhitarkanika.

A. *Bruguiera sexangula*

B. *Rhizophora mucronata*

C. *Xylocarpus granatum*

D. *Hibiscus tiliaceus*

E. *Brownlowia tersa*

F. *Dentropthoe falcate*

G. *Suaeda maritime*

H. *Sesuvium portulacastrum*

I. *Phoenix paludosa*

J. *Fimbristylis ferruginea*

K. *Hereteria littoris*

L. *Cerbera odallum*

**Fig.3 (A-L):** Figures showing some mangrove and their associate of Bhitarkanika.

**Lively wood for local community:** The Nalia Grass (*Myiostachya wightiana* / *Urochondra setulosa* ) has been used by poor people of this area for making various products and it is the a major income source during the agricultural lean season.

**Source of food and fodder:** Some species of Mangroves such as *Porteresia coarctata* used as source of food during the scarcity of food. The species like *Phragmites karka*, *Porteresia coarctata* , *Myriostachya wightiana* used as source fodder for buffalo and cattle's in this area.

**Medicinal:** The Mangrove species of Bhitarkanika are as source of medicine for different diseases. The experimental study indicated and conformed that[11] there are certain species of mangrove and their associated flora having high medicinal value, which are as follows

1. The species *Sesuvium portulacastrum* used to remove excess salt from the body
2. The leaves and twigs of *Tamarix troupii* and *Avicennia officinalis* used for ulcer and throat problem.
3. Leaves of *Sonneratia caseolaris*, *Rhizophora apiculata*, and *Heritiera littoralis* are *used* for solve the dysentery problem in stomach.
4. Leaf paste of *Caesalpinia bonduc* used for curing of jaundice, which is a dreadged disease.
5. Some of the other species like *Rhizophora apiculata* ( For Nausea and Skin disease ), *Lumnitzera recemosa* ( for asthma ), *Rhizophora mucronata* ( for diabetes), *Pongamia pinnata* ( for piles and scabies), *Ceriops tagol* ( For Malaria fever ), *Cerbera odollum* ( for rheumatism ).

**Value added Product:** Some species of mangrove-associated flora used as value added product in the Bhitarkanika area such as the flower of *Pandanus facicularis* used for perfume production. The species like *Terminalia catappa* used for gum production. The species like *Rhizophora mucronata*, *Xylocarpus molluccensis* and *Bruguiera cylindrical* used for tannin production. The species like Jagula(*Tamarix indica*), Khalisi(*Aegiceras corniculatum*), Harakancha( *Pongamia pinnata*),Bahni and Hengula are abundant from which honey bees collect nectar from the flower of these trees. The bees visit to this area from other parts of Orissa during summer months i.e March to May to get rid of the heat and forest fires. It believed that these bees mostly migrate from the Similipal forest. The climate in this region is favorable for the bees due to a less temperature as compared to other areas of Odisha and availability sufficient food due to flowering of quite a good number of trees during this period.

## CONCLUSION

Recognizing the importance of mangroves in coastal stabilization, food cycle, protection of natural disasters, aquaculture and other types of utilisation, national and international organizations like UNESCO, UNEP, FAO, UNDP, IUCN, ESCAP/SACEP, World Wildlife Fund and the governments of various countries have begun to encourage research activities to gain scientific knowledge on the different processes in mangroves. In India, the National Mangrove Committee has initiated some projects on mangroves of Sunderbans, Pichhavaram on the east coast and some places on the west coast. It may be concluded that comprehensive measures are required to evolve strategies for utilisation of the resources without disturbing the ecological balance. Proper management strategies, protection of mangroves and observation of mangroves and for creating a scientific awareness among the people is to be taken up by the central, state government and NGOS.

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