

*A Checklist of Major Flora and Fauna and A
Study on Conservation Strategy of Jokai
Reserve Forest cum Botanical Garden,
Dibrugarh, Assam, India*

Puja Sarmah

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A Checklist of Major Flora and Fauna and A Study on Conservation Strategy of Jokai Reserve Forest cum Botanical Garden, Dibrugarh, Assam, India

Puja Sarmah*¹

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ABSTRACT

Jokai reserve forest is a habitat of various flora and fauna as it is a major biodiversity spot in upper Assam but to date, the diversity and conservation strategy of the forest is very poorly studied. Therefore, a field survey was carried out using various techniques and equipment on the conservation strategy and major flora and fauna of the Forest cum botanical garden, was conducted for three months from March 2022 to May 2022. A total of 120 species of flora and fauna were recorded. Out of which 37 species were flora of mainly evergreen, deciduous and grassland type. The remaining 83 species are belonging to fauna. With 45 different species, Aves is the most diverse class of fauna. On the other hand, with only 12 species recorded during the study period reptiles shows the lowest diversity. Out of these 12 species, 11 species are herpetofauna. 26 different types of mammals are also found in this forest. Besides these, the forest also has ex-situ conservation strategies like- The germplasm centre and Botanical Garden. Although this area is rich in biodiversity governments need to develop some more strategies to preserve this forest as this forest cum botanical garden is poorly maintained.

Key words: Checklist, Ex-situ, In-situ, Reserve-forest, Flora, Fauna

Biodiversity is “The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered important and desirable. Humans should conserve biodiversity because of its benefits, such as services and biological resources, which are essential to living on earth. However, it also provides spiritual benefits as well as a social benefits. Government can form Reserve forests on any forest land or wasteland, the most restricted forests for the preservation of biodiversity. A botanical garden or botanic garden is a garden dedicated to the collection, cultivation, preservation and display of an especially wide range of plants. One of the botanical garden's main objectives is collecting and conserving plants, local or exotic, and protecting endangered species. Other goals are the protection of biodiversity and the transmission of natural heritage. Furthermore, it enhances research about plants.

One such reserve forest cum botanical garden is the Jokai reserve forest located 12 kilometres from Dibrugarh town and covers an area of approximately 11,000 square meters. It was evident from various sources and extensive literature search that the reserve forest is rich in its flora and fauna but they are very

poorly studied to date. Many additions have been made to the forest to attract tourists and the reserve forest has been developed into a recreational hub. There are erashuti along the margin of the forest. One can have a glimpse of different migratory birds during the winter season. Soon this region is going to be a tourist hotspot if the government gives concern.

Severe ecological destructions are suspected to be accelerated in the next 10 to 30 years [34], [38]. The IPCC Assessment Report 6 confirms the findings of a growing body of research that maintaining ecosystem integrity and its biodiversity is essential to an effective response to a changing climate [42]. Wild plant diversity is quickly declining due to the unprecedented rise in human population, development, and habitat destruction [25].

Conserving biodiversity in an ecosystem is also important since it is not always evident which species and what quantity of those species is necessary to maintain the ecosystem functioning [11]. Information on the composition of a forest is essential for its wise management in terms of economic value and regeneration potential [42], but very scanty information is available on the composition of this forest. The lack of information hampers our ability to comprehend the magnitude of biodiversity loss and formulate a sustainable alternative to resource depletion. Therefore, we chose this area to explore so that new and well-developed protection strategies can be imposed to make this area richer in biodiversity.

* Puja Sarmah

✉ rs_pujasarmah@dibru.ac.in

¹ Department of Life Sciences, Dibrugarh University,
Dibrugarh - 786 004, Assam, India

MATERIALS AND METHODS

The Jokai Reserve Forest is a protected small broadleaf forest area situated 12 km to the south of Dibrugarh town. The reserve forest is spread over an area of 11000 sq. meters. At the entrance of the reserve forest is the Jokai Botanical Garden cum Germplasm centre. The garden is spread over 12 hectares of land amid Jokai Reserved Forest. Apart from being a storehouse of germplasm, the garden also has an orchid house, a rest house, and a lake. The germplasm centre has some storehouse facilities. To display the flora diversity and richness of the region germplasm of some rare species of flora are stored. The center is divided into different zones like the medicinal and aromatic plants, orchid houses, rainforest specimens and so on, the plants of these zones or categories are stored along with their germplasm. Numerous low-altitude tropical and sub-tropical plant species are found in this area. Flora species like the medicinal tree, oil-bearing plants, aromatic plants, and fruit trees are abundant in the reserve forest along with fauna species like leopard black panthers, civets, flying squirrels, and various butterfly's species reptiles and fishes.

Geographical and climatic features of Jokai reserve forest

Geographical location	: The reserve forest lies in the district of Dibrugarh, 12 km towards the south of Dibrugarh town, and 16 km by road from Dibrugarh University
Longitude	: 94°54'25" E
Latitude	: 27°21'48" N
Altitude	: 115 m above MSL
Area	: 11000 sq. m.
Soil type	: Rocky, sandy and share
Temperature	: Ranges from 5°C to 37°C
Average rainfall	: 3300 mm
Biogeographical province	: Burma monsoon forest
Seasonal conditional	: The area has a typical subtropical monsoon climate and the seasons are: <ul style="list-style-type: none"> ▪ Pre-monsoon (March-May) ▪ Monsoon (June-September) ▪ Post monsoon (Oct-Nov) ▪ Winter (December-February)



Fig 1 Satellite map showing location of Jokai reserve forest

Field surveys on the Jokai reserve forest cum botanical garden were conducted for 3 months from March 2022 to May 2022. Major plant species were collected during the study period and following Das (2021) these species were processed

and mounted into herbarium [15]. Identification of the flora has been done with the help of several regional and local floras [2-3], [5], [7-9], [14], [16], [27], [32-33] and matched at ASSAM-Herbarium and with available online herbarium specimens deposited in K, L, AMES, NY, etc. For up-to-date nomenclature of the taxa recent floras, literature and websites such as IPNI, Tropicos and www.plantsoftheworldonline.org were consulted. In (Table 1), different taxa are added along with scientific and common names [4]. For reptiles, observations and collections were made at night and during the day to maximize the documentation of the herpetofauna. Active searching was carried out at all study sites with a focus on suitable microhabitats for both diurnal and nocturnal species [30]. Bird counts were carried out in the early morning as birds' activity is highest just after sunrise [37]. A trail of 350 meters in selected habitats until no new addition of birds was confirmed. Thus, each trail was walked 10 times during the study period. While walking at a constant pace species recorded on each side within 30 meters were recorded. Birds flying overhead and flew from behind the observer were not recorded to avoid double count [12]. Opportunistic surveys were also carried out during the study period so as not to miss any species. The birds were observed with a field binocular (8×40) and the method of Grimmett [21] was used to identification of the bird. A comprehensive checklist of birds was prepared to add these species along with the species recorded in the fixed trail. The common and scientific names of the birds are given in the checklist as per Birds of The World [13].

Table 1 List of flora of the area

Scientific names	Category
<i>Aphanamixis polystachya</i>	Evergreen forest species
<i>Anthocephalus chinensis</i>	-do-
<i>Cyanthea gigantea</i>	-do-
<i>Syzygium cumini</i>	-do-
<i>S. formosum</i>	-do-
<i>S. oblatum</i>	-do-
<i>Bauhinia purpurea</i>	-do-
<i>Mallotus philippensis</i>	-do-
<i>Cinnamomum tamala</i>	-do-
<i>Actinodaphne obvata</i>	-do-
<i>Bombax ceiba</i>	Deciduous forest species
<i>Sterculia villosa</i>	-do-
<i>Dillenia indica</i>	-do-
<i>D. pentagyna</i>	-do-
<i>Careya arborea</i>	-do-
<i>Lagerstroemia parviflora</i>	-do-
<i>L. speciosa</i>	-do-
<i>Terminalia bellirica</i>	-do-
<i>T. chebula</i>	-do-
<i>Trewia polycarpa</i>	-do-
<i>Gmelina arborea</i>	-do-
<i>Oroxylum indicum</i>	-do-
<i>Bridelia</i> spp.	-do-
<i>Saccharum naranga</i>	Grassland species
<i>Phragmites karka</i>	-do-
<i>Arundo donax</i>	-do-
<i>Dillenia pentagyna</i>	-do-
<i>Bombax ceiba</i>	-do-
<i>Phyllanthus emblica</i>	-do-
<i>Clerodendrum</i>	-do-
<i>Leea</i> spp.	-do-
<i>Grewia</i> spp.	-do-
<i>Premna</i> spp.	-do-
<i>Mussaenda</i> spp.	-do-
<i>Sonchus</i> spp.	-do-
<i>Osbekia</i> spp.	-do-
<i>Blumera</i> spp.	-do-

The mammalian species were recorded in and around by using hired vehicle Gypsy to reach different localities of the study area. Binocular (10mm × 25mm) and DSLR Camera with Telelens attachment 80-400mm was used to record the mammal species in the field. The presence of some mammal species is ascertained on the basis of interviews with forest officials, guides and villagers residing around the reported locality, from earlier literature and record of the forest department. The identification of mammalian species was also done by studying pugmarks on the forest track and near the water body [36].

RESULTS AND DISCUSSION

A total of 37 major flora species were recorded during the study period. They mostly belong to Evergreen, Deciduous and grassland species (Table 1). The species we have experienced during our about three months of observation gives us an idea that the broad-leaved forest with the tropical tree has very high biodiversity. Such forest which is high in biodiversity gives crucial ecosystem services such as raw materials, reservoirs of biodiversity, soil protection, sources of timber, medicinal plants, carbon sequestration, and watershed protection [6]. This region experienced high precipitation. So, the forest is mostly moist. Trees like Nahar (*Mesua ferrea*), and various orchids are dominant in this place. Moreover, a very primitive type “Tree fern” is found here which gives us an idea about the age of the forest. Ferns, as a key component of tropical and temperate vegetation, play significant roles in ecosystem functioning in the both canopy and forest floor by moderating the light intensity reaching the understory, making it suitable for better growth of seedlings of other trees and epiphytes [23-24]. Gurung (1992) mentioned the fascinating afforestation value of tree ferns with their rhizome holding in barren lands in waterlogged areas due to its good adaptability [22]. Physiological evidence has confirmed the ability of tree ferns in carbon fixation at high rates at light intensities approximating 10% of full sunlight [40]. Moreover, in Northeast India Tree fern makes a good substrate for orchid growth therefore it is also used in orchid cultivation [29]. Besides, it has been used as ornamental species due to its superfluous appearance. The trunks are also carved into statues and other handcrafted items as souvenirs for tourists [35]. 83 faunal species were recorded from the study area and it was found that it occupies around 69% of total living objects found in the forest. This implies the remaining 31% is occupied by plant species (Fig 2).

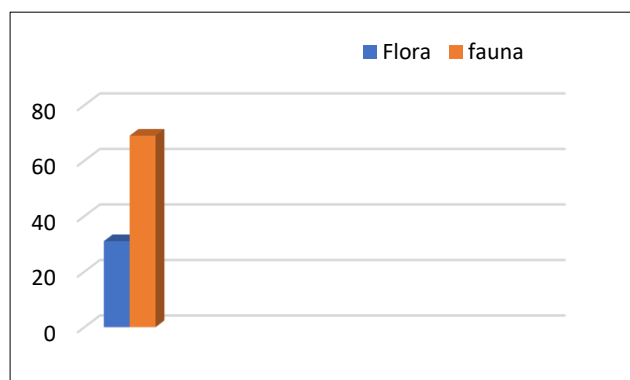


Fig 2 Comparison of various types of flora and fauna in percentage

The total number of faunal species recorded was 120 and out of which, we found 12 reptile species. Except for *Kachuga sylhetensis* which is a turtle species 11 species are herpetofauna (Table 2). Reptiles are highly sensitive species compared to

other fauna species, i.e., they become more vulnerable due to land use change, i.e., habitat alteration [10] This might be because they have a small home range, which is adversely affected by habitat loss and degradation [26], [28], [30]. Jokai reserve forest shows decent diversity of reptiles therefore it can be concluded that the forest has a good range for their habitat. The huge water body - which is known as Erashuti in the local language is attached to the reserve forest and these are home to various types of indigenous fishes.

Table 2 List of reptile fauna

Common name	Scientific name
Gecko	<i>Sphaerodophorus parthinopion</i>
Monitor lizard	<i>Varanus griseus</i>
Cobra	<i>Naja naja</i>
Viper	<i>Viper russelli</i>
Cat snake	<i>Boiga nigriceps</i>
Vine snake	<i>Ahaetulla nasutas</i>
Rat snake	<i>Zaamenis mucosus</i>
Trinklet snake	<i>Elaphe frenata</i>
Flying snake	<i>Chrysopelea ornate</i>
Water snake	<i>Natriu piscator</i>
Python	<i>Python molurus mor</i>
Assam roofed turtle	<i>Kachuga sylhetensis</i>

Table 3 List of avian fauna

Common name	Scientific name
Ashy Drongo	<i>Dicrurus leucophaeus</i>
Asian Koel	<i>Eudynamys scolopacea</i>
Asian Palm Swift	<i>Cypsiurus balasienis</i>
Black Drongo	<i>Dicrurus macrocerus</i>
Black Kite	<i>Milvus migrans</i>
Black-crested Bulbul	<i>Pycnonotus melanicterus</i>
Brahminy Kite	<i>Haliastur indus</i>
Cattle Egret	<i>Bubulcus ibis</i>
Common Hill Myna	<i>Gracula religiosa</i>
Common Iora	<i>Aegithina tiphia</i>
Common Kingfisher	<i>Alcedo atthis</i>
Common Myna	<i>Acridotheres tristis</i>
Crested Kingfisher	<i>Megaceryle lugubris</i>
Eurasian Collared Dove	<i>Streptopelia decaocto</i>
Eurasian Tree Sparrow	<i>Passer montanus</i>
Great Barbet	<i>Megalaima virens</i>
Great Cormorant	<i>Phalacrocorax carbo</i>
Great Egret	<i>Casmerodius albus</i>
Greater racket-tailed drongo	<i>Dicrurus paradiseus</i>
Green Bee-eater	<i>Merops orientalis</i>
Grey Wagtail	<i>Motacilla cinerea</i>
Grey-headed Woodpecker	<i>Picus canus</i>
House Crow	<i>Corvus splendens</i>
House Sparrow	<i>Passer domesticus</i>
Indian Peafowl	<i>Pavo cristatus</i>
Indian Pond Heron	<i>Ardeola grayii</i>
Jungle Myna	<i>Acridotheres fuscus</i>
Lesser Adjutant	<i>Leptoptilos javanicus</i>
Little Cormorant	<i>Phalacrocorax niger</i>
Little Egret	<i>Egretta garzetta</i>
Oriental Magpie Robin	<i>Copsychus saularis</i>
Oriental Turtle Dove	<i>Streptopelia orientalis</i>
Pied Kingfisher	<i>Ceryle rudis</i>
Purple Heron	<i>Ardea purpurea</i>
Red Collared Dove	<i>Streptopelia tranquebarica</i>
Red Junglefowl	<i>Gallus gallus</i>
Red-vented Bulbul	<i>Pycnonotus cafer</i>
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>
Rock Pigeon	<i>Columba livia</i>

Rosy Pipit	<i>Anthus roseatus</i>
Spotted Dove	<i>Streptopelia chinensis</i>
Spotted Owlet	<i>Athene brama</i>
White Wagtail	<i>Motacilla alba</i>
Yellow Wagtail	<i>Motacilla flava</i>
Yellow-footed green pigeon	<i>Treron phoenicoptera</i>

Out of all the flora and fauna during the three months of our study period 45 species of birds were recorded (Table 3). Some nearly extinct species of flora and fauna are also found in the Jokai Reserve Forest which is making this place a treasure. Various types of butterflies are also seen in the Reserve Forest. Butterflies of Nymphalidae, Pieridae, and Papilionoideae are dominant in this area. Although during our 3 months of study we could spot 45 species of birds as this place has a lot of fruit-bearing trees that attract a large number of migratory birds every year. If a study can be conducted throughout the year about 100 species of birds can be recorded. Birds are conspicuous and an important component of reserve forests with high floral diversity, often exhibiting distinction associated with vegetation structure and composition. They are sensitive to habitat alteration and landscape modification [19], [39]. Therefore, it can be said that the reserve forest has good health it has relatively high avian diversity.

We traced 26 major species of mammals from the reserve forest (Table 4). This dense forest is adjacent to 6 villages, where the villagers experienced the leopard's presence, which indicates the good health of the forest. In the case of fauna, we observed species of *Macaca* including *Macaca assamensis*, *Macaca mulatta* etc. Some of the commonly found animals are leopards, elephants, deer, wild buffaloes, slow loris, civet cats, etc.

Table 4 List of mammals

Common name	Scientific name
Asiatic elephant	<i>Elephas maximus</i>
Asiatic Water Buffalo	<i>Bubalus arnee</i>
Assamese Macaque	<i>Macaca assamensis</i>
Bay Bamboo Rat	<i>Cannomys badius</i>
Black Panther	<i>Panthera pardus</i>
Clouded Leopard	<i>Neofelis nibcelosa</i>
Common Mongoose	<i>Herpestes edwardsii</i>
Common Otter	<i>Lutra perspicillata</i>
Fishing Cat	<i>Prionailurus viverrinus</i>
Golden Cat	<i>Catopuma temminckii</i>
Greater yellow Bat	<i>Scotophilus heathii</i>
Indian Fox	<i>Vulpes bengalensis</i>
Indian Porcupine	<i>Hystrix hodgsoni</i>
Jackal	<i>Canis aureus</i>
Large Indian civet	<i>Viverra zibetha</i>
Leopard Cat	<i>Panthera pardus</i>
Little Indian Field Mouse	<i>Mus booduga</i>
Malayan giant squirrel	<i>Ratufa bicolor</i>
Rhesus Macaque	<i>Macaca mulatta</i>
Short nosed Fruit Bat	<i>Cynopterus brachyotis</i>
Small Indian Civet	<i>Viverricula indica</i>
Small Indian Mongoose	<i>Herpestes javanicus</i>
Smooth Indian Otter	<i>Lutrogale perspicillata</i>
The Gaur (Indian Bison)	<i>Bos gaurus</i>
Three-Stripped Palm Squirrel	<i>Funambulus palmarum</i>
Wild Cat	<i>Felis silvestris</i>

On a comparison among the faunas, it was found that the birds have the highest variety of species followed by Mammals which is 31%. The reptiles show the lowest abundance with 15% (Fig 3). Mammals are a versatile group of animals and a

major component of forests, i.e., they serve a wide range of ecosystem functions; such as pollination, seed dispersal, pest control, herb control, food source for other animals and nutrient cycling. The mammals also provide a wide array of benefits to human beings, such as food, recreation, and source of income, i.e., various byproducts such as bush meat, skin, oil, musk, fur, etc. [1,18]. Unfortunately, these rich mammal communities are facing severe threats from human activities such as over-exploitation (intensive hunting), land-use change (habitat loss and degradation), and climate change.

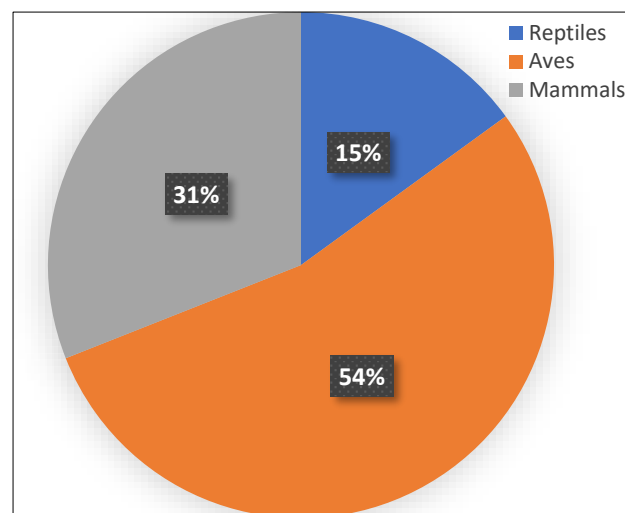


Fig 3 Comparison of the percentage of various types of fauna

Aside from the storage facility of germplasm of a portion of this locale's profitable and imperilled types of vegetation, the middle features the district's flower biodiversity. The different zones of this middle incorporate an Orchid house, a Medicinal and sweet-smelling plants plot, a Rainforest example plot, a water lake and so on. Elephant rides to have a diagram of the extravagance of Jokai Reserve Forest is one of the most important attractions. Jokai Reserve Forest is famous for transitory winged animals.

Conservation strategies of Jokai reserve forest

Ex-situ strategies

1. **Germ plasm centre-** Germplasm conservation helps preserve knowledge about extinct, wild, and other living species of a crop plant since human interference has led to the erosion of genetic diversity by increasing favored genes and totally eliminating the less desirable, effecting the extinction of the historic genetic material. It is mainly concerned with ensuring the secure handling and proper preservation of germplasm of commercially valuable plants by collecting each taxon's propagules [20]. According to official sources, at present, there are no funds available for the preservation and conservation of the Jokai Botanical Garden-cum-Germplasm Centre. He said there are seven officials to look after an area of 1.2 hectares, which is not enough to carry out the day-to-day activities involving timely security checks.
2. **Botanical garden-** Botanical Garden plays a central role in the ex-situ conservation and exploration of global plant biodiversity [31]. Botanical gardens also have an important role in the preservation of species necessary for human use and well-being [40-41, [17]. Jokai is a reserve forest as well as a botanical garden, with some exotic species and well-planned management. New plants which are on the verge

of extinction are planned to be planted inside the preserved area.

In-situ strategies

1. *As reserve forest-*

- a. *Mammals-* Jokai Forest is blessed with a number of mammals, some of them are common to Assam whereas some are on the verge of extinction. Some of the commonly found animals are the Assamese macaque, leopards, elephants, deer, wild buffaloes, slow loris, civet cats, etc.
- b. *Birds-* A large number of migratory birds are also observed in this forest along with residential birds one of the main reasons for this is the presence of fruit-bearing trees. Every year and around 100 species of these migratory along with residential birds had are recorded in the reserve forest.
- c. *Reptiles-* There are around 17 species of reptiles found out of which 12 species were recorded during our study period.
- d. *Floras-* However, this area is rich in flora. It has around 20-25 varieties of orchids and other than that tree fern, hollock etc. are found which need utmost conservation.

2. *The huge water body-* Which is known as Erashuti in the local language- attached to the reserve forest is home to various types of indigenous fishes, turtles, etc.

CONCLUSION

Even though flora and faunas are a crucial component of reserve forests, detailed information on different aspects of fauna community parameters such as species composition, distribution, diversity, richness and population trend, the impact of anthropogenic activities, associated with microclimate and habitat variables was still lacking. The current research highlighted status of different flora and fauna in the forest. This forest has a great area to explore. This area was declared a tourist place which can make this area economically well-developed and will allow making its place on the national level. Government should take the necessary steps to make Assam a tourist place by improving the areas with such high biodiversity. Jokai Botanical Garden is being neglected by the authorities concerned. Indiscriminate felling of trees has severely degraded the forests. In the long run, it will lead to severe deforestation. The botanical garden, if maintained well, can be of great use to students and could even be turned into a conservation-cum-educational centre.

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