



BIODIVERSITY AND ECOLOGICAL SIGNIFICANCE OF NIYAMGIRI HILL RANGES



ABSTRACT

*Ecological status of a particular region is determined by assessing its biodiversity, prevailing conditions of the environment and their interactions with the species. Such an assessment is carried out by estimating the no. of species, their relative abundance, habitat preference of keystone species and prevailing threats to them which might helps to evaluate the protection needs of a habitat, considering its local and global distribution,. This is the first and preliminary attempt to document the biodiversity along with habitat conditions and possible management strategies considering the socio-economic-ecological linkages in the Niyamgiri hill ranges. Niyamgiri hill ranges lying between 19° 26' to 19° 43' N latitude and 83° 18' to 83 ° 28' E longitudes with a maximum elevation of 1516 meters within the districts of Rayagada and Kalahandi is an important biodiversity rich area in the Eastern Ghats of India (Fig-1). A total of 721.323 ha of land including 672.018 ha of forest land and 49,305 ha of non forest land (Table-1) harbours high altitude flora and fauna with Himalayan/North Indian and Nilgiri/South Indian elements. Niyamgiri is also known as the 'Land of Dongrias'. Dongria Kondha, which is one of the most primitive tribes of the State, enjoys a critical and symbiotic relation with the Niyamgiri forests. The census for 2001 reveals that the total population of this tribe is limited to only 7952. The Dongria Kondha's economy and their socio-cultural life are directly linked with Niyamgiri Forests as 40 to 50 % of their annual income derived from the selling of minor forest products. As per Champion and Seth (1968), the vegetation of Niyamgiri comes under Tropical moist deciduous type. Eight distinct types of vegetation are seen in Niyamgiri, depending on the local microclimate, plant density, species association and composition and effect of biotic and edaphic factors, among which deciduous forests covers more than 75 % of the landmass of Niyamgiri hills. The flora of the hill range exhibits a very rich and varied assemblage of plant species owing to its diversified topography with high mountain peaks and innumerable deep valleys and gorges, abundant springs and diverse vegetation resources. Two major rivers (namely Vamsadhara and Nagavali) originate from Niyamgiri Hills. More than 100 streams which include 25 major streams flow from the Niyamgiri hills and most of these are perennial. These rivers and nallahs provide drinking water as well as water to the agricultural fields of millions of people in Andhra Pradesh and Orissa. The floral diversity of the hill ranges includes 602 plant species distributed over 114 families of angiosperms, gymnosperms, and pteridophytes have been reported during the study that includes 15 high altitude plants of both north and south Indian elements, 50 species medicinal plants (including 15 species of rare/threatened/conservation dependant plants), 31 species of Orchids (including 15 rare species with medicinal uses) and 20 species of wild ornamental plants. More than 26 species are used as major NTFP'S by the Dongrias. The other important findings include and over 10 species of wild relatives of crop. The threatened medicinal plant species found in the area are *Atylosia cajanifolia*, *Ceropegia hirsuta*, *Chirita hamosa*, *Costus speciosus*, *Gloriosa superba*, *Rauwolfia serpentina*, *Rubia cordifolia*, *Exacum bicolor*, *Pureria tuberosa*, *Oroxylum indicum*, *Stemona tuberosa*, *Melasma thomsonii*, *Persea macrantha* etc. In addition to it, there is a distinctive representation of orchids and ferns. The faunal diversity of the hills include 25 species of*

mammals most of which are enlisted under different categories of IUCN red list. The herpetofaunal diversity of Niyamgiri consists of 20 species of amphibians, 19 species of lizards and 22 species of snakes. Discovery of two new species of frogs of the genus *Duttaphrynus* (Family: *Bufonidae*) and *Philautus* (Family: *Rachophoridae*) are new record for the state. Range extension of the frog species *Hydrophylax malabaricus* (Family *Ranidae*) is very much interesting from the biogeography point of view. The species was thought to be endemic to the Western Ghats and after its discovery in the Eastern Ghats from the Niyamgiri forest; it emphasizes the theory of landmass link between the two geographic regions of India. Apart from the frogs, a skink of genus *Scincella* sp. was recorded for the first time from Orissa. Niyamgiri forest havens a very good population golden gecko; the endangered species of gecko is placed under Schedule I of WPA. Presence of golden gecko is characterized by the typical microclimate with high humidity, dark and cool place is an indicator of healthy ecosystem. Finding of the Cantor's black-headed snake (*Sibynophis sagitaria*) and St Johns keel back (*Xenochrophis sanctijohannis*) are first reports from Orissa. Rediscovery of Travancore Wolf Snake (*Lycodon travancoricus*) from the area has confirmed its distribution in the Eastern Ghats. Another most important discovery of the survey was the cat snake (*Boiga* sp.), which deserves another species status. This shows Niyamgiri is one of the least studied habitats from herpetofaunal point of view. In order to assess the ecological status of the forests a survey was conducted in three RF'S of the hill ranges. Plant species richness and density of 152 trees were estimated in three proposed RF'S using random plots of 100×100 m² on each site which are divided into 20×20 m sub-plots and were systematically surveyed for all trees having girth at breast height (gbh) ≥10 cm. Species diversity was found to be maximum at Khambesi reserve forest and minimum at Niyamgiri reserve forest. Significant correlation of species diversity with species evenness and species richness were observed while significant negative correlations were marked between species diversity, concentration of dominance, beta diversity and maturity index. During the study period we have identified of 125 species of plants that are reported to be consumed by elephants, 10 species by Sambar, 5 species by barking dears, 50 species by Giant squirrels and 7 species by Bear is another critical finding which support a good population of wild animals in and around the hill ranges. This is one of the reasons of Niyamgiri being a major path of Migration Corridor of Elephants, and comes within the territory of Royal Bengal Tiger.

Considering the ecological significance and rich biodiversity, this region can be declared as an Eco-sensitive region as per sub-section (1) with clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) and clause (d) of sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986 in concurrence with the provisions of the Indian Forests Act, 1927 (16 of 1927) and Forest (Conservation) Act, 1980 (69 of 1980) the Wildlife (Protection) Act, 1972 (53 of 1972).

INTRODUCTION

Lying between 19°26' to 19°43' N latitudes and to 83°18' to 83°28' E longitudes, the Niyamgiri hill range acts as a natural boundary between Rayagada and Kalahandi districts extending over several miles in NE-SW direction. The mountain system comprises irregular and undulating lofty hills ranging from 400 m to 1516 m above MSL, the highest point being at 'Niyamgiri-1516 m'. The noticeable feature is the existence of two flat plateaus on its crest, one in the North West flank adjoining Niyamagiri Dangar and the other in the south east flank at Bhatikiri Dangar and Bendali Ghati standing at an average elevation of 1306 m & 1218 m above MSL respectively having rich deposit of bauxite. The entire hill range is wonderfully well watered by numerous springs from all sides, which contribute to the formation of about 100 streams (of which 25 are major streams) out of which Sakata, Paniamunda, Baminimundi in the east and Kansarikhil and Chatikana in the west are significant. The highest point in the peak of the hill is Niyamagiri 1516 m is considered to be very sacred owing to its presiding deity Niyam Raja Penu or Amla Dongar, an important NTFP producing plateau. Both culturally and ecologically, the Niyamgiri hills are extremely rich and significant. Most importantly Niyamgiri Hills are the watershed of Vansadhara river as well as a major tributary of Nagavali river. It forms a distinct phytogeographical zone because of its height and its highly precipitous topography.

SOCIO-CULTURAL IMPORTANCE OF NIYAMGIRI

Niyamgiri is better known as the 'Dongria Kondh country, one of the primitive tribes of the State and enjoys a critical and symbiotic relation with the Niyamgiri forests. The census for 2001 reveals that the total population of this tribe is limited to only 7952 which include 3458 males and 4529 females. This rare indigenous tribes Dongrias believe that the hill country belongs to Niyam Raja Penu, a male deity represented by a sword and worshipped during Dussera and Jura parab. They claim themselves to be descendants of the Niyam Raja. The Dongrias have a distinguished heritage, because of their dress style, mode of living, indigenous skills, cultural pattern, social system and ecological relation interlinked with nature and forests. The Dongria Kondhas economy and its major sources of livelihood are directly related with Niyamgiri Forests. Around 40 to 50% of their annual income derived from by selling of forest products like siali leaves, myrobalans, amla, sal seeds, wild edible fruits, leafy vegetables etc. They grow fruit crops like pineapple under the thick forests. Dongria Kondhs are not at all known for hunting. No literature developed in vernacular or in English suggests that the Dongrias were hunters at any point of time in history. Conservation of wild varieties of agricultural crop seeds is another socio-cultural and ecofriendly tradition of the Dongrias which prevails since many years.

METHODOLOGY

We carried out a rapid survey to record the biodiversity and ecological significance of the flora, fauna of Niyamgiri in different phases. The team comprised of six-members with two local assistants. Though it was not possible to cover the whole forest, we trekked the different vegetation types and plateau tops along with documentation of traditional practices extensively for the survey. The survey was essentially aimed at gathering evidence of presence/absence data of flora,

mammals, birds, reptiles and amphibians, whenever possible, rough indices of abundance/density were also attempted to be collected. The following methods were followed:

Flora

Prominent species of trees, shrubs and shrubs were identified in the field; whenever this was not possible, photographs were taken, especially of flowering species for later identification. The rare, threatened and endangered species were identified as per their distribution and abundance with the help of local informants. The ethnobotanical information was gathered by interviewing the disharies, baidyas and healers. The ecological assessment of tree flora was carried out by quadrant/line transect methods as per the available standard methods.

Mammals and Birds

1. Walk along trails, foot-paths, river banks, existing roads etc. for direct sightings of animals and birds. 8x40 Binoculars was used.
2. Intensive searches for locating Indirect evidences like pugmarks, spoor, scats, scratch marks, pellets, molted skins, dropped feathers etc.

Reptiles and amphibians

3. Intensive searches during dusk and night to locate crepuscular, nocturnal species.
4. Special methods were applied to search the cave dwelling and arboreal animals.
5. Calls of frogs were used for identification; doubtful / unidentified ones were recorded for subsequent confirmation / identification.

Cultural and ethnical aspects

6. Exhaustive interviews were carried out with local tribal people and other natives of the area.
7. Data was also collected from secondary sources like reports, scientific papers etc. (please see Bibliography).

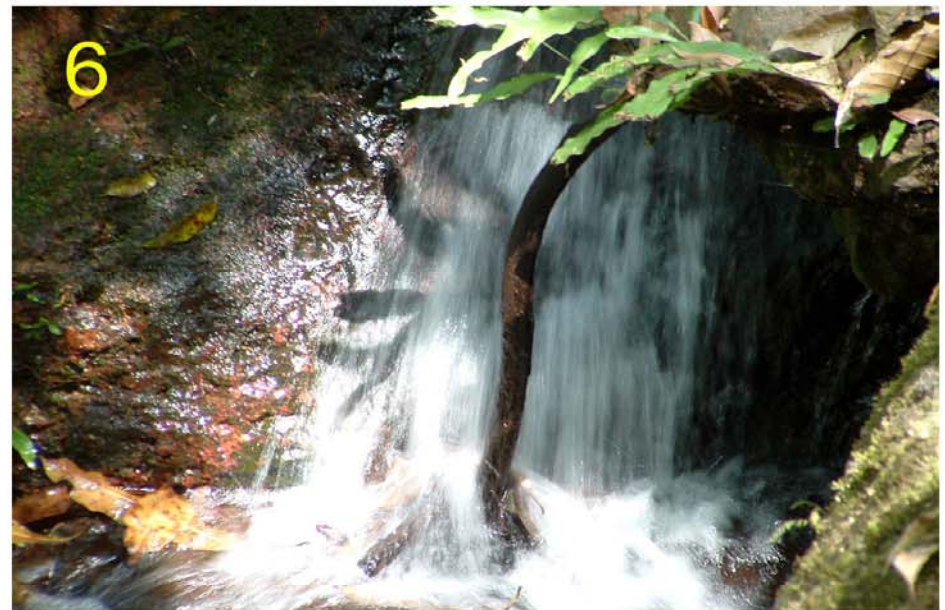
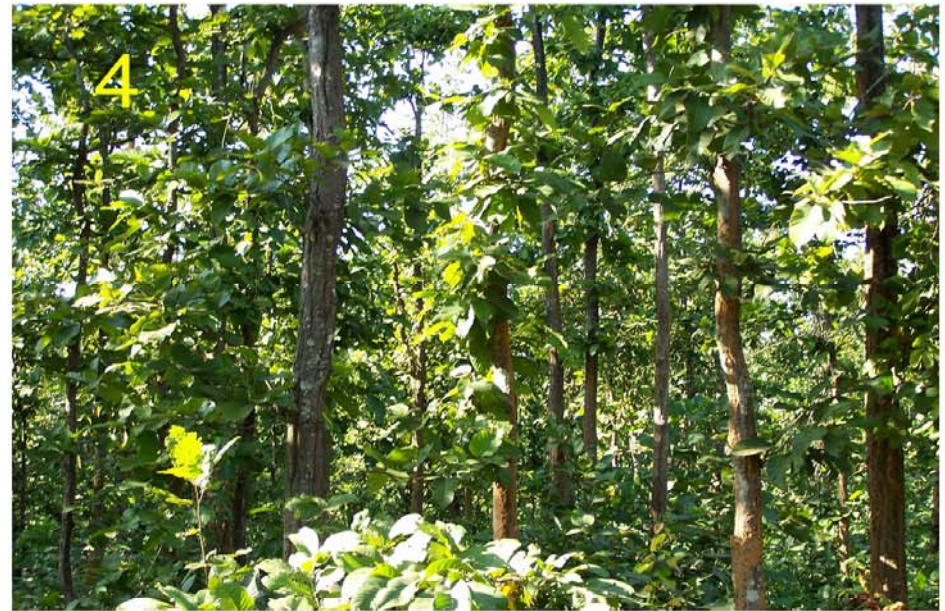
Data gathered was entered in prescribed formats in pre-prepared data-sheets with details on habitat, behavioral and ecological variables. Extensive photo documentation was done, especially for flora and groups like herpetofauna and insects. All significant sightings were immediately recorded by GPS readings for later geo-referencing; a Garmin – 72 GPS was used for this purpose.

RESULTS AND DISCUSSION

ECOLOGICAL RICHNESS OF NIYAMGIRI HILLS

FOREST / VEGETATION TYPES AND FLORAL DIVERSITY:

While conducting floristic explorations to Niyamagiri hills, the vegetation types of the region were studied on the spot in conjunction with Survey of India topographical maps. Field notes were recorded about vegetation types, landform, altitude, forest physiognomy, plant association and density and species dominance in each vegetation type. The vegetation of the hill range, in general falls under the category of tropical moist deciduous forests but depending on the local microclimate, plant density, species association and composition and effect of biotic and edaphic factors, the vegetation of the region can be divided into 8 distinct types, which are mentioned below.



Ecological significance of Niyamgiri: 1. Moist deciduous forest, 2. Semi evergreen forest, 3. Amla pad (40 plants per 10 met²) in the top plateau, 4. Dense Sal forest, 5. Moist valleys, 6. Origin of Vansadhara, 7. Fishing practices at Vansadhara by the communities, 8. Perennial hill streams

1. Tropical Semi-Evergreen Forest:

The semi-evergreen forests are found along the stream courses, narrow gorges and spring points. The area near Khambesi, Jarapa, between Bana Denguri and Monda and other damp localities present the physiognomy of this type of forest characterized by tall evergreen tree canopy, heavy lianas covering the trees having buttressed trunks dense epiphytes and matted herbaceous undergrowth. The semi-evergreen forest is the climatic climax of the hill range and is found almost in undisturbed state. Trees like *Persea macrantha*, *Dillenia pentagyna*, *Michelia champaka*, *Diospyros embryopteris*, *Toona ciliata*, *Ficus benjamina* etc form the luxuriant cover of the top storey. The middle storey is composed of small trees or large shrubs like *Ardisia solanaceae*, *Ficus cunia*, *Litsea monopetala*, *Persea macrantha* and few others. Along the stream courses and margin of jheels the species like *Homonoia riparia*, *Phrynium placentarium*, *Hedychium coronarium*, *Calamus guruba*, *Alocasia fornicate*, *Melastoma malabatarica*, along with many species of ferns occur together which enhances the beauty of surroundings. The ground flora is rich in herbaceous species content throughout the year. Of these, *Costos speciosus*, *Centella asiatica*, *Curcuma reclinata*, *Globba orixensis*, *Hedychium coronarium*, *Zingiber casumunar* etc need special mention. This marshy habitat of herbaceous plant community with moss-covered forest floor forms a very beautiful mesh.

2. Tropical Moist Deciduous Mixed Forest:

This forest type is found in large patches all over the hills having favorable edaphic conditions around Kesharpada, Serkapali, Golgola and in Khambesi reserve forest (south). The deep damp valleys with high moisture content characterize this type of vegetation. The top storey in this type consist of predominantly deciduous species such as *Pterocarpus marsupium*, *Xylia xylocarpa*, *Haldina cordifolia*, *Bridelia retusa*, *Shorea robusta*, *Syzygium cumini*, *Litsea glutinosa*, *Hymenodictyon excelsum* etc but the middle storey has some evergreens like *Glochidion multiloculare*, *Polyalthya suberosa*, *Leea macrophylla*, *Mallotus philippensis*, *Desmodium pulchellum*, *Calamus guruba*, *Smilax zelanica* and few others. The herbaceous flora consists of *Curcuma sps*, *Zingiber sps*, *Phrynium placentarium*, *Hedychium sps*, many ferns and orchids.

3. Dry Deciduous Mixed Forest:

The extensive hill slopes, foot hills and greater part of the region in the north Khambesi, north sarambi RF, north of Kansarikhola, Sarambi RF and north west of the hill range are occupied by dry deciduous type of vegetation. Sal (*Shorea robusta*) grows at lower elevation but does not occur in pure formation. Both upper and lower storeys are composed of deciduous species and the stand is open with longer periods of leaflessness during the summer. The tree species like *Terminalia alata*, *Anogeissus latifolia*, *Buchanania lanzan*, *Dalbergia latifolia*, *Diospyros melanoxylon*, *Kydia calycina*, *Madhuca longifolia var. latifolia*, *Schleichera oleosa* and *Trema orientalis* are predominant in respect of their abundance. The shrubs like *Helecteres isora*, *Holarrhena antidysenterica*, *Lagestroemia parviflora*, *Indigofera cassoides*, *Toddalia asiatica*, *woodforbida fruticosa* are commonly encounter in the middle storey. The ground cover consists the under shrub or herbs like *Ageratum conyzoides*, *Andrographis paniculata*, *Cassia tora*, *Desmodium pulchellum*, *Petalidium barlerioides*, *Rungia pectinata* and *Sida cordata* with many grass species.



Threatened biodiversity of Niyamgiri: 1. *Stemona tuberosa*, 2. *Tylophora fasciculata*, 3. *Rhapsidophora hookeri*, 4. *Persea macrantha*, 5. *Clematis gouriana*, 6. *Cycas circinalis* var. *orissansis*, 7. *Gnetum scandens*, 8. *Laggera alata*, 9. *Gloriosa superba*, 10. *Calodactyloides aureus*, 11. *Ratufa indica*, 12. *Hemidactylus subtredus*, 13. Green pit viper, 14. *Hemidactylus* sp., 15. *Philaotus* sp.

4. Moist Peninsular Sal Forest:

The forest sub type occupies dominantly in the North West and south west of hill range up to an elevation of 500 m above mean sea level. This forest is characteristically composed of more than 60 per-cent of Sal coverage; however the establishment of regeneration becomes difficult due to influence of biotic interference such as forest fire & shifting cultivation. High-level Sal is also found in the higher elevation and hill plateau above 800 m from MSL with stunted growth and poor quality. This condition has resulted in the formation of open areas with vast tract of grass land on the hill top which indicates the retrogression of the sub type.

5. Dense Bamboo Forest:

Dendrocalamus strictus with *Bambusa tulda* and *B. arundinacea* at some places form a thorny stand on hill slopes and valleys especially in Kanasaralu RF, Parmal, Kansarikhhol and Jamapadar in the southwest flank. Few deciduous trees and shrubs such as *Chloroxylon swietenia*, *Diospyros melonoxylon*, *Gardenia latifolia*, *Holarrhena antidysenterica*, *Helecteres isora* etc are the common associates of bamboo. The spices like *Curculigo orchoides*, *Costos speciosus*, *Capparis zeylanica*, *Triumfetta pentandra* and several orchids are the major components of the ground cover.

6. Scrub Woodland:

The foothill and other exposed dry areas near Khajuri, Jamapadar, Kansarikhhol and Chatikana are under this type of vegetation. Under the influence of destructive factors, such as cutting, forest fire & shifting cultivation the tree cover has reduced much and become less dense. The under growth contains shrubby, spiny and unpalatable species such as *Cipadessa baccifera*, *Flacourtia indica*, *Lantana camara*, *Mimosa rubicaulis*, *Woodfordia fruticosa*, *Ziziphus oenoplia* and few others. *Cuscuta reflexa* and *Cassytha filiformis* form tangled mass among the shrubs at few places.

7. Open Scrub:

This type of vegetation is found at lower elevations, pediments and plains adjoining the hill range around Giriagurha, Nuagan, Radong, Chatikana, Basanta parha, Asuraparha in the forest periphery. It has originated as a result of recurrent forest fire, over-grazing by domesticated animals and over-exploitation of wild plants. The tree species either have altogether disappeared or reduced to shrubby stature. Few stunted trees like *Alangium salvifolium*, *Cassia fistula*, *Cleistanthus collinus*, *Phyllanthus emblica* and shrubs like *Clerodendron infortunatum*, *Lantana camara*, *Carissa spinarum*, *Vitex negundo* are notable in respect of their abundance. At some places, the herbaceous cover is completely removed from the surface probably due to forest fire and over-grazing.

8. Grass Land:

Laterite/ bauxite occurs principally as a cap on the plateau mainly at two places near Niyamgiri, Niyamgiri Dangar and Bandali ghati at an elevation of 1516m, 1306 m and 1218m respectively from MSL with limited steep escarpments on almost all sides. The flat summits are clothed with grassland interspersed with stunted trees and shrubs. The dominant plant community in the grassland is *Cymbopogon martinii* which occurs in association with other species like *Themeda laxa*, *T. arundinacea*, *Phoenix acaulis*, *Stachytarpheta indica*, *Eusteralis stellata*, *Tephrosia roxburghiana*,

Exacum perottetii, *Bidens pilosa*, etc. Few stunted trees like *Shorea robusta*, *Buchanania lanzan*, *Syzygium cumini*, *Phyllanthus emblica* are found sporadically.

There are a number of threatened medicinal plant species are found in the area like *Atylosia cajanifolia*, *Ceropegia hirsuta*, *Chirita hamosa*, *Costus speciosus*, *Gloriosa superba*, *Rauwolfia serpentina*, *Rubia cordifolia* etc. In addition to it, there is a distinctive representation of orchids and ferns. Majority among them depends on shifting cultivation and domestic animal husbandry for their livelihood. Around 40-50% of their annual income is derived from large number of non-timber forest products (NTFP) collection such as siali leaves (*Bauhinia vahlii*), amla (*Phyllanthus emblica*), Harida (*Terminalia chebula*), Bahada (*Terminalia bellirica*), char seeds (*Buchanania lanzan*), sal seed (*Shorea robusta*), mohua flower (*Madhuca longifolia*), mango kernel (*Mangifera indica*), simul cotton (*Bombax ceiba*), Bael (*Aegle marmelos*) and hill broom (*Thysanolaena maxima*) etc. The detailed report is available at **Conservation proposal to save the biodiversity of Niyamgiri hill range, Orissa by Chiranjibi Pattanaik¹ and Sudhakar Reddy, 2009**

Estimation of species diversity helps in understanding the ecological significance of the species in the moist deciduous forest. Species diversity and stem density were observed to decrease with increasing girth class and altitude. The tree species of Niyamgiri hill ranges comprises of 152 tree species belonging to 114 genera and 41 families. Thirteen species were recorded under Euphorbiaceae followed by 11 species in Mimosaceae and 10 species each in Moraceae and Fabaceae. The genus *Ficus* is the largest one having 7 species followed by *Diospyros* and *Acacia* with 5 species to each. *Shorea robusta* possess the highest IVI in all the study sites showing an absolute dominance in the tree layer leading to lower species diversity. It is followed by *Mangifera indica*, *Buchanania lanzan*, *Protium serratum*, *Anogeissus latifolia*, *Terminalia alata* and *Diospyros melanoxylon*. The other dominant species in terms of IVI are *Madhuca latifolia*, *Dillenia pentagyna*, etc. Species diversity was found to be maximum at Khambesi reserve forest and minimum at Niyamgiri reserve forest. Significant correlation of species diversity with species evenness and species richness were observed while significant negative correlations were marked between species diversity, concentration of dominance, beta diversity and maturity index (The detailed report is available at **Indian Forester, Vol.135, No.7. "Diversity and distribution pattern of tree species in Niyamgiri hill ranges, Orissa, India by P.K.Dash, P.P.Mohapatra and Y.Giri Rao, July, 2009**).

Significance of Floristic Diversity:

➤ The flora of the hill range exhibits a very rich and varied assemblage of plant species owing to its diversified topography with high mountain peaks and flat plateaus, innumerable deep valleys and gorges, abundant springs and diverse vegetation resources. It remains unexplored or explored with very little sporadic surveys, but there is no detailed flora to assess the plant wealth of the region.

➤ The preliminary floristic survey reveals the occurrence of 602 species of vascular plants distributed over 117 families of angiosperms, gymnosperms and pteridophytes. The vascular flora of Niyamagiri shows the systematic arrangements of families with number of genera and species under each family according to Bentham and Hookers system of plant classification (Checklist-Appendix 1)

➤ The study has been able to yield 15 plant species appearing to be rare / endangered/ conservation dependent though they occur in neighboring geographical region. Repeated survey will ensure the inventory of rare/endangered plants of the region (Checklist-Appendix 1).

➤ It is interesting to note that the flora of Niyamagiri hills is of great phytogeographical importance that the hill top harbors high altitude plants of Himalayan/ north Indian and Nilgiri/ south Indian elements considering acting as bridge for migration of species from Himalayas to southwards or in some cases the vice-versa (Checklist-Appendix 1).

➤ More than 70 species of important medicinal and potentially economic plants including 26 major NTFP species were recorded which are of paramount importance would not only help to build up a plant based pharmaceutical industry for commercial exploitation but also will stimulate tribal people to utilize the minor forest produce for establishment of forest-based cottage industry (Checklist-Appendix 1).

➤ The ethno-botanical data in respect of 50 species of medicinal plants (including 15 species of rare/threatened/conservation dependant plants), 31 species of Orchids (including 15 rare species with medicinal uses) were collected and compiled deserve merit as it provides new sources of herbal drugs/ edible plants or other aspects of plant utilization, which may serve as guide to the practitioners of Ayurvedic / Unani medicines (Checklist - Appendix 1). An ethnobotanical survey of Orchids of the hills reveals the use of 20 species of orchids including 16 epiphytes and 4 terrestrials that are by the Dongarias to treat 33 kinds of diseases. This paper also discusses some of the threats to the orchids of this hill region, as well as some very serious problems regarding their conservation (The detailed report is available at ***Ethnobotanical Leaflets 12: 70-77 on Ethnobotanical Studies on Orchids of Niyamgiri Hill Ranges, Orissa, India by P.K.Dash, Santilata Sahoo and Subhasisa Bal, 2008***).

➤ In addition, 23 species of wild relatives of crop plants were recorded which are of considerable importance as germplasm materials for conservation & use in crop improvement programme. Further survey may enhance several other species of wild relatives of crop plants/ wild races/ wild food plants (Checklist-Appendix 1).

STREAMS AND RIVERS

The Niyamgiri hill range abounds with streams. More than 100 streams flows from the Niyamgiri hills and 36 streams originate from Niyamgiri plateau (Just bellow the Niyam Raja) and most of the streams are perennial. Niyamgiri hills have been receiving high rainfall since centuries and drought is unheard of in this area. Some of the major streams originated from Niyamgiri include Vamsadhara, Nagavali, Sakta nallha, Barha nalla etc. The Niyamgiri Hill forms the source of Vamshadhara as well as major tributary of the Nagaveli. The 1:50,000 toposheet (Exhibit I) shows that 36 streams originate from within the mining lease site. Out of these 11 streams drain out into the Nagaveli basin from the South East and South West part of Niyamgiri, 12 streams on the east drain out into Sakata Nala and 13 streams from the west and North-west drain out into the Vamshadhara directly which then drains into Vamshadhara. Most of these streams are perennial

due to springs originating just below the bauxite escarpment. For example, Rajajharan spring, which is said to be the origin of Vamshadhara by locals, is located at a height of approximately 1000 m. just below the escarpment (exhibit II). The location of the Rajajharan spring is provided on satellite map and toposheet as per GPS readings (Exhibit III, IV). Another spring which merges into Rajajharan is located at a height of 990 meters (Exhibit V). Similarly there are a large number of springs, which originate just below the bauxite layer, creating a perennial flow of water in the streams mentioned above. Almost all the streams flowing from the western flank into Vamshadhara are used for irrigation as well as drinking sources by the people living in villages of Tentulipadar, Balabhadrapur, Semilibhata, Patloma, Kendubardi, Kaleijhula, Narangapur, Dongijhula, Rengopali, Basantparha, Sindhebahail, Kansari, Belamba and Bundel directly. Apart from this the water in Vamshadhara is used by a large number of villages down streams. The villagers in these areas use the flowing water for irrigating small-scale winter and summer crops, especially vegetables. At the same time, the profusion of perennial drinking water sources in the Niyamgiri is one of the key reasons for the concentration of mammalian and other fauna. At the same time the perennial streams provide unique micro-climatic niches where rare species like Golden Gecko, termite hill gecko, blue keelback snakes and many other undiscovered and unrecorded species flourish. These micro niches also provide feed for herbivores and other animals as many tree species like wild mango, champa etc. flourish along the streams. The detailed list of streams originated from the hills is as follows.

Table.1: Some of the major streams that originate from Niyamgiri

Sl. No.	Local name	Origin of the stream	Nearby village/settlements
1.	Kadituni	Surgabata- Parapabata	Karjodi
2.	Bamanadeu	Bata Karjodi	Karjodi
3.	Mutkeni narengasus	Priskudi Horu	Priskudi
4.	Latikanu	Lakdatarga	Khambesi
5.	Dumberihua	Adanaka	Khambesi
6.	Ambagorada	Purgi Dongar	Munduavali
7.	Bijahua	Baplakata	Hundi Jhali
8.	Kaman	Neba Horu	Arisakani
9.	Baming jadi	Batigari	Thuaguda
10.	Dindenihua	Tudangapadi	Dindeni
11.	Panche jadi	Sraledong	Ghartuli
12.	Satahua	Kupdingapatra	Ghartuli
13.	Jambusua	Papibangeni	Ghartuli
14.	Banjipanche	Kajapadi	Khajuri
15.	Latikanu	Mundepambu	Khajuri
16.	Kdaninga pambu	Madangkala	Khajuri
17.	Panchejadi	Bengdavali	Talaguma
18.	Biamnghua	Parang Kuda	Uparaguma
19.	Kayukakadi	Tudangpadi	Uparaguma
20.	Kakadipau	Kdangar jala	Uparaguma

21.	Takusua	Hergi Haru	Kadraguma
22.	Derukuta	Sapta Amba	Kadraguma
23.	Bamanadeu	Kumaravali	Kadraguma
24.	Bijanghua	Madabasa	Khajuri
25.	Taddali	Paklakaska	khajuri

(Source- Forest Tribes of Orissa, Volume –1: The Dongaria Kondha, Page No. 164)

FAUNAL DIVERSITY OF NIYAMGIRI HILLS

Niyamgiri hills is the natural habitat for many endangered, threatened and conservation dependant fauna including tiger, leopards, sloth bear, pangolin, palm civet, giant squirrel, mouse deer, languor Small clawed Otters and sambhar, etc. because of its diversified topography with high mountain peaks, plain plateaus at hill tops, innumerable deep valleys and gorges, abundant springs, diverse vegetation resources and it's distance from so called mainstream development. Apart from the wild animals, Niyamgiri hills are also home for rare birds like Hill Myna and pied hornbill. Besides these Jungle Fowls, Partridges, Peacock, Owls, green pigeon etc., are also found. No detailed ornithological study has ever been taken up, and it is expected that these mountain fastnesses may yield previously unrecorded species. It is also on the path of migration corridor of elephants, and comes within the territory of Royal Bengal Tiger. In view of its ecological importance, it was declared as nature conservation / game sanctuary and also was proposed as a Wild Life Sanctuary in the working plan of Kalahandi Forest Division. The State Wildlife organization has a proposal to declare this area as South Orissa Elephant Reserve a mentioned in the vide memo no. 4643/ 3WL (Cons) 34/04 dated 20.08.2004. The faunal diversity of the hills include 30 species of mammals most of which are enlisted under different categories of IUCN red list and 80 species of birds. The herpetofaunal diversity of Niyamgiri consists of 20 species of amphibians, 19 species of lizards and 22 species of snakes. Discovery of two new species of frogs of the genus *Duttaphrynus* (Family: Bufonidae) and *Philautus* (Family: Rachophoridae) are new record for the state. Range extension of the frog species *Hydrophylax malabaricus* (Family Ranidae) is very much interesting from the biogeography point of view. The species was thought to be endemic to the Western Ghats and after its discovery in the Eastern Ghats from the Niyamgiri forest; it emphasizes the theory of landmass link between the two geographic regions of India (The detailed report is available at **Sanctuary Asia XXV (5): Niyamgiri unravelled, by S.K.Dutta, B Mohanty and P.P. Mohapatra, 2005**). Apart from the frogs, a skink of genus *Scincella* sp. was recorded for the first time from Orissa. Niyamgiri forest havens a very good population golden gecko; the endangered species of gecko is placed under Schedule I of WPA. Presence of golden gecko is characterized by the typical microclimate with high humidity, dark and cool place is an indicator of healthy ecosystem. Finding of the Cantor's black-headed snake (*Sibynophis sagittarius*) and St Johns keel back (*Xenochrophis sanctijohannis*) are first reports from Orissa. Rediscovery of Travancore Wolf Snake (*Lycodon travancoricus*) from the area has confirmed its distribution in the Eastern Ghats. Another most important discovery of the survey was the cat snake (*Boiga* sp.), which deserves another species status. This shows Niyamgiri is one of the least studied habitats from herpetofaunal point of view.

It has been observed that Niyamgiri forest comprises of a high diversity of mammalian fauna, due to the favorable macro and micro-climatic condition requirements for the animals. The habitat suitability for many endangered and threatened fauna makes it an important area from conservation point of view. Presence of the supreme predators like Royal Bengal Tiger and Leopards in the forest indicates a healthy ecosystem. We observed frequent indirect evidences of leopards in and around the proposed mining area at the hill top of Niyamgiri. We came across leopard scat, and scent markings in Khambesi Reserve Forest during the same night when we were staying inside a cave. Apart from the predatory animals, Niyamgiri forest also has a good population of elephants. Though the elephant population residing at Jarapa forest had moved down to other forest area, we could observe the dried dung around the forest. The faecal deposits of herbivores like Sambar, Chital, Barking deer, Mouse deer, Porcupine etc. were quite abundant on the forest floor. We also came across the body parts of fish, regurgitated by otters near the hill streams. During night searches, we were thrilled to see a wide variety of species including porcupine, barking deer, mouse deer, civets and leopard cat, all of which boosted up our enthusiasm many folds (Supplementary information is available at **Biodiversity assessment in some selected hill forests of south Orissa, India**, www.vasundharaorissa.org/.../Report%20of%20Biodiversity%20of%20South%20Orissa.pdf, 2010).

Table.1: Check list of the mammalian fauna of Niyamgiri

SL. NO.	SCIENTIFIC NAME	COMMON NAME	LOCAL NAME	IUCN STATUS	WPA STATUS
1	<i>Panthera tigris</i>	Tiger	Bada bagh	Endangered	Schedule-I
2	<i>Panthera pardus</i>	Leopard	Druka bagh	Lower risk	Schedule-I
3	<i>Prionailurus bengalensis</i>	Leopard cat	Bana bhuan	Lower risk	Schedule-I
4	<i>Felis chaus</i>	Jungle cat	Bhuan	Lower risk	Schedule-II
5	<i>Elephas maximus</i>	Elephant	Hati	Endangered	Schedule-I
6	<i>Melursus ursinus</i>	Sloth Bear	Bhalu	Venerable	Schedule-I
7	<i>Bos gaurus</i>	Gaur	Gayala	Venerable	Schedule-I
8	<i>Cervus unicolor</i>	Sambar	Sambhari	Lower risk	Schedule-III
9	<i>Axis axis</i>	Chital	Jiada	Lower risk	Schedule-III
10	<i>Muntiacus muntjak</i>	Barking Deer	Rekad kutura	Lower risk	Schedule-III
11	<i>Tetracerus quadricornis</i>	Chousingha	Bhutel kutura	Vulnerable	Schedule-I
12	<i>Moschiola meminna</i>	Mouse Deer	Kebada	Lower risk	Schedule-I
13	<i>Lepus nigricollis</i>	Hare	Khudar	Common	Schedule-IV
14	<i>Hystrix indica</i>	Porcupine	Sai	Lower risk	Schedule-IV
15	<i>Manis crassicaudata</i>	Indian Pangolin	Sarakati	Lower risk	Schedule-I
16	<i>Cuon alpinus</i>	Wild Dog	Kok	Vulnerable	Schedule-II
17	<i>Canis lupus</i>	Wolf	Kuliha	Data deficient	Schedule-I
18	<i>Canis aureus</i>	Jackal	Rama siali	Lower risk	Schedule-II
19	<i>Hyaena hyaena</i>	Striped hyena	Gedha	Lower risk	Schedule-III
20	<i>Viverricula indica</i>	Small Indian civet	Patni musa	Lower risk	Schedule-II
21	<i>Paradoxurus hermaphroditus</i>	Common palm civet	Patni musa	Lower risk	Schedule-II
22	<i>Herpestes edwardsii</i>	Grey mongoose	Sap katara musa	Common	Schedule-II
23	<i>Herpestes smithii</i>	Ruddy mongoose	Sap katara musa	Common	Schedule-II
24	<i>Petaurista philippensis</i>	Indian giant flying squirrel	Masana chadhei	Un common	Schedule-II
25	<i>Ratufa indica</i>	Indian giant squirrel	Udanta	Uncommon	Schedule-II

			gunduchi		
26	<i>Mellivora capensis</i>	Honey badger (Ratel)	Gada bhalu	Uncommon	Schedule-I
27	<i>Macaca mulatta</i>	Rhesus monkey	Mankada	Lower risk	Schedule-II
28	<i>Sus scrofa</i>	Wild pig	Baraha	Lower risk	Schedule-III
29	<i>Semnopithecus entellus</i>	Hanuman langur	Hanu mankada	Lower risk	Schedule-II
30	<i>Lutrogale perspicillata</i>	Smooth Indian Otter	Pani odha	Uncommon	Schedule-II

Table. 2: Checklist of avifauna of niyamgiri

Sl. no.	COMMON NAME	Scientific name	Status
1	Indian Peafowl	<i>Pavo cristatus</i>	Endemic/ common
2	Pied hornbill	<i>Anthracoceros albirostris</i>	Resident / fairly common
3	Indian gray hornbill	<i>Ocyrceros birostris</i>	Endemic/ fairly common
4	Greater flame back	<i>Chrysocolaptes lucidus</i>	Resident / Fairly Common
5	Black rumped flame back	<i>Dinopium benghalensis</i>	Near endemic/ Common
6	Coppersmith barbet	<i>Megalaima haemocephala</i>	Resident / abundant
7	Common Whoopee	<i>Upupa epops</i>	Resident / common
8	Indian roller	<i>Coracias bengalensis</i>	Resident / common
9	Common kingfisher	<i>Alcedo atthis</i>	Resident / abundant
10	White throated kingfisher	<i>Halcyon smynensis</i>	Resident / abundant
11	Green bee eater	<i>Merops orientalis</i>	Resident / abundant
12	Blue tailed bee eater	<i>Merops philippinus</i>	Resident / fairly common
13	Chestnut headed bee eater	<i>Merops leschenaulti</i>	Resident / fairly common
14	Pied cuckoo	<i>Clamator jacobinus</i>	Migratory / uncommon
15	Common Hawk cuckoo	<i>Hierococcyx varius</i>	Resident / common
16	Asian koel	<i>Eudynamys scolopacea</i>	Resident / abundant
17	Greater coucal	<i>Centropus sinensis</i>	Resident / abundant
18	Alexandrine parakeet	<i>Psittacula euptria</i>	Resident / fairly common
19	Rose ringed parakeet	<i>Psittacula krameri</i>	Resident / abundant
20	Plum headed parakeet	<i>Psittacula cyanocephala</i>	Endemic/ common
21	House swift	<i>Apus affinis</i>	Resident / abundant
22	Crested tree swift	<i>Hemiprocne coronata</i>	Resident / fairly common
23	Barn owl	<i>Tyto alba</i>	Resident / fairly common
24	Collared Scops owl	<i>Otus bakkamoena</i>	Resident / uncommon
25	Spotted owlet	<i>Athene brama</i>	Resident / abundant
26	Indian Nightjar	<i>Caprimulgus asiaticus</i>	Resident / abundant
27	Rock pigeon	<i>Columba livia</i>	Resident / abundant
28	Spotted dove	<i>Streptopelia chinensis</i>	Resident / abundant
29	Eurasian collared dove	<i>Streptopelia decaocta</i>	Resident / abundant
30	Emerald dove	<i>Calcophaps indica</i>	Resident / common
31	Yellow footed green pigeon	<i>Treron phoenicoptera</i>	Resident / common
32	White breasted water hen	<i>Amaurornis phoenicurus</i>	Resident / abundant
33	Red wattle lapwing	<i>Vanellus indicus</i>	Resident / abundant
34	Yellow wattle lapwing	<i>Vanellus malabaricus</i>	Endemic/ fairly common
35	Black shouldered kite	<i>Elanus caerulens</i>	Resident / common
36	Black kite	<i>Milvus migrans</i>	Resident / abundant
37	Shikra	<i>Accipiter badius</i>	Resident / common
38	Oriental Honey Buzzard	<i>Pernis ptilorhyncus</i>	Resident / common
39	Steppe Eagle	<i>Aquila nipalensis</i>	Winter/ common
40	Crested serpent eagle	<i>Spilornis cheela</i>	Resident / common
41	Little cormorant	<i>Phalacrocorax niger</i>	Resident / common
42	Little egret	<i>Egretta garzetta</i>	Resident / common
43	Cattle egret	<i>Bubulcus ibis</i>	Resident / abundant
44	Indian pond heron	<i>Ardeola grayii</i>	Resident / abundant
45	Golden fronted leaf bird	<i>Chloropsis aurifrons</i>	Resident / fairly common
46	Rufus tree pie	<i>Dendrocitta vagabunda</i>	Resident / common
47	House crow	<i>Corvus splendens</i>	Resident / abundant
48	Large billed crow	<i>Corvus macrorhyncos</i>	Resident / common
49	Eurasian golden oriole	<i>Oriolus oriolus</i>	Resident / common
50	Black hooded oriole	<i>Oriolus xanthornis</i>	Resident / common
51	Scarlet minivet	<i>Pericrocotus flammeus</i>	Resident / common
52	White throated fantail	<i>Rhipidura albicollis</i>	Resident / common
53	Black drongo	<i>Dicrurus macrocercus</i>	Resident / abundant
54	White bellied drongo	<i>Dicrurus caerulescens</i>	Endemic / fairly common
55	Asian paradise flycatcher	<i>Terpsiphone paradisi</i>	Resident / fairly common
56	Common Iora	<i>Aegithina tiphia</i>	Resident / common

57	Oriental magpie robin	<i>Copsychus saularis</i>	Resident / abundant
58	White rumped shama	<i>Copsychus malabaricus</i>	Resident / fairly common
59	Indian robin	<i>Saxicoloides fulicata</i>	Endemic / abundant
60	Brahminy starling	<i>Sturnus pagodarum</i>	Resident / fairly common
61	Asian pied starling	<i>Sturnus contra</i>	Resident / common
62	Common mynah	<i>Acridotheres tristis</i>	Resident / abundant
63	Jungle mynah	<i>Acridotheres fuscus</i>	Resident / abundant
64	Hill mynah	<i>Gracula religiosa</i>	Resident / fairly common
65	Red whiskered bulbul	<i>Pycnonotus jocosus</i>	Resident / abundant
66	Red vented bulbul	<i>Pycnonotus cafer</i>	Resident / abundant
67	Plain prinia	<i>Prinia inornata</i>	Resident / common
68	Zilting cisticala	<i>Cisticala juncidis</i>	Resident / common
69	Common tailor bird	<i>Orthotomus sutorius</i>	Resident / abundant
70	Dark necked tailor bird	<i>Orthotomus atrogularis</i>	Resident / fairly common
71	Jungle babbler	<i>Tordoides striatus</i>	Endemic / abundant
72	Purple rumped sunbird	<i>Nectarinia zeylonica</i>	Resident / common
73	Purple sunbird	<i>Nectarinia asiatica</i>	Resident / abundant
74	House sparrow	<i>Passer domesticus</i>	Resident / abundant
75	Indian Pitta	<i>Pitta brachyura</i>	Endemic / fairly common
76	Paddy field pipit	<i>Anthus rufulus</i>	Resident / fairly common
77	Baya weaver	<i>Ploceus philippinus</i>	Resident / common
78	White rumped munia	<i>Lonchura striata</i>	Resident / common
79	Orange headed thrush	<i>Zoothera citrina</i>	Resident/Fairly common
80	Scaly breasted munia	<i>Lonchura punctulata</i>	Resident / common
81	Common Quail	<i>Coturnix coturnix</i>	Resident/ fairly common
82	Red jungle fowl	<i>Gallus gallus</i>	Resident / common

Table.4: Herpetofauna of Niyamgiri

ANURANS

	Scientific Name	Common Name	Habitat
Bufonidae			
1	<i>Duttaphrynus melanostictus</i>	Common toad	Near human habitation and hill streams
2	<i>Bufo fergusonii</i>		Agricultural fields
3	<i>Bufo</i> species	Toad (unidentified)	Near hill stream
Ranidae			
4	<i>Fejervarya sp</i>	Unidentified	Paddy fields, swamps, ditches and near hill streams
5	<i>Fejervarya sihyadrensis</i>	Paddy field frog	Paddy fields, near hill streams, swamps and ditches
6	<i>Fejervarya orissaensis</i>	Paddy field frog	Paddy fields, swamps, ditches and near hill streams
7	<i>Hoplobatrachus tigerinus</i>	Indian bull frog	Paddy fields, swamps, ditches and near hill streams
8	<i>Hoplobatrachus crassus</i>	Jerdon's bull frog	Paddy fields, swamps, ditches and near hill streams
9	<i>Euphlyctis cyanophlyctis</i>	Skipper frog	Swamps, ditches and near hill streams
10	<i>Ramanella variegata</i>		Paddy fields, swamps, ditches and near hill streams
11	<i>Rana malabarica</i>		Hill streams, inside caves and tree holes near hill streams
12	<i>Spaerotheca rolandae</i>		Paddy fields, swamps, ditches and near hill streams
13	<i>Spaerotheca breviceps</i>	Burrowing frog	Paddy fields, swamps, ditches, hill streams and forest floor.
14	<i>Spaerotheca dobsonii</i>	Burrowing frog	Paddy fields, swamps, ditches, hill streams and forest floor
Microhylidae			
15	<i>Microhyla ornata</i>	Ornate frog	Paddy fields, swamps, ditches, hill streams, grass lands and forest floor
16	<i>Uparodon systema</i>	Balloon frog	Ditches, ponds and temporary water deposit areas

17	<i>Uparodon globulosum</i>	Balloon frog	Ditches, ponds and temporary water deposit areas
18	<i>Calaula pulchra</i>	Painted frog	
Rachophoridae			
19	<i>Polypedates maculatus</i>	Tree frog	Busy forest, on trees and near hill streams
20	<i>Philaotus</i> sp.	Bush frog (unidentified)	Busy forest and near hill streams

LIZARDS

	SCIENTIFIC NAME	COMMON NAME	Habitat searched	IUCN STATUS
1	<i>Calodactylus aureus</i>	Golden gecko	Caves and rock boulders near hill streams	EN
2	<i>Geckoella nebulosus</i>	Leopard gecko	Forest floor and leaf litters	VU
3	<i>Geckoella jeyporensis</i>	Jaipur hill gecko	Forest floor and leaf litters	DD
4	<i>Eublepharis hardwickii</i>	Fat tailed Gecko	Forest floor and leaf litters	DD
5	<i>Hemidactylus brookii</i>	Brook's gecko	Forest floor, trees and leaf litters	Lr- lc
6	<i>H. leschenaulti</i>	Bark gecko	Forest floor, trees and leaf litters	Lr- lc
7	<i>H. frenatus</i>	Southern House Gecko	Forest floor, trees and leaf litters	Lr- lc
8	<i>H. subtraidrus</i>	Termite Hill Gecko	Forest floor and boulder deposit areas.	EN
9	<i>Sitana ponticeriana</i>	Fan throated lizard	Forest floor, open field	Lr- lc
10	<i>Calotes versicolor</i>	Garden Lizard	Bush forest and trees	Lr- nt
11	<i>Calotes rouxi</i>	Forest Calotes	On trees	Lr- nt
12	<i>Psamophilus blanfordanus</i>	Rock lizard	Rocky terrine	Lr- nt
13	<i>Chamaeleon zeylanicus</i>	Indian Chameleon	Bush and shrub forest	VU
14	<i>Mabuya macularia</i>	Little Skink	Forest floor, leaf litter, bellow rock boulder and rocky terrine	Lr- lc
15	<i>Mabuya carinata</i>	Common Brahmin Skink	Forest floor, leaf litter, bellow rock boulder and rocky terrine	Lr- nt
16	<i>Lygosoma albopunctata</i>	Snake Skink	Forest floor, leaf litter and bellow rock boulder	Lr- lc
17	<i>Riopa punctatus</i>	Snake Skink	Forest floor, leaf litter and bellow rock boulder	Lr- lc
18	<i>Scincella</i> sp.	Skink	Forest floor, leaf litter, near hill streams	
19	<i>Varanus bengalensis</i>	Common Indian Monitor	Caves, tree holes, termite mounds and forest floor.	VU

SNAKES

1	<i>Ramphotyphlops braminus</i>	Brahminy Worm Snake	Forest floor, leaf litter and bellow rock boulder	Lr- nt
2	<i>Grypotyphlops acutus</i>	Beaked Worm Snake	Forest floor, leaf litter and bellow rock boulder	
3	<i>Python molorus</i>	Indian Rock Python	Caves, trees, forest floor near hill streams.	Lr- nt
4	<i>Eryx conica</i>	Common Sand Boa	Forest floor, leaf litter and bellow rock boulder	Lr- nt
5	<i>Ahaetulla nasutus</i>	Common Vine snake	Bush forest, shrub forest and trees	Lr- nt
6	<i>Dendrelaphis tristis</i>	Common Bronzeback Tree Snake	Bush forest, shrub forest and trees	Lr- lc
7	<i>Ptyas mucosus</i>	Indian Rat Snake	Forest floor, near human settlement, termite mound and bellow rock boulder	Lr- nt
8	<i>Lycodon aulicus</i>	Common Wolf Snake	Forest floor, caves, leaf litter and bellow rock boulder	Lr- lc
9	<i>Lycodon striatus</i>	Barred Wolf Snake	Forest floor, caves, leaf litter and bellow rock boulder	Lr- nt
10	<i>Lycodon travancoricus</i>	Travancore Wolf Snake	Forest floor, caves, leaf litter and bellow rock boulder	Lr- nt
11	<i>Dryocalamus nympha</i>	Bridal Snake	Forest floor, caves, leaf litter and bellow rock boulder	VU
12	<i>Boiga trigonatus</i>	Common Cat Snake	Bush and shrub forest, bellow rocks.	Lr- lc
13	<i>Boiga</i> sp (Undescribed)	Cat Snake	This species was found at a height of 27' inside a Sal tree hole.	
14	<i>Boiga forsteni</i>	Forsten's Cat Snake	Tree holes, mostly in Sal forest	Lr- nt

15	<i>Boiga ochraceous</i>	Tawny Cat Snake	Tree holes, mostly in Sal forest	VU
16	<i>Sibynophis sagittaria</i>	Black Headed Snake	Forest floor, leaf litter and bellow rock boulder	Lr- nt
17	<i>Xenocrophis piscator</i>	Checkered Keelback	Water holes and near hill streams	Lr- lc
18	<i>Xenocrophis sanctijohannis</i>	St. John's Keelback	Water holes and near hill streams	Lr- nt
19	<i>Macropisthodon plumbicolor</i>	Green Keelback	Water holes, bellow rocks and forest floor	
20	<i>Ophiophagus hannah</i>	King Cobra	Near hill stream	Lr- nt
21	<i>Naja naja</i>	Monocellate Cobra	Forest floor, degraded termite mound, near human habitation	Lr- nt
22	<i>Triemeresurus gramineus</i>	Bamboo pit Viper	Bush forest, shrub forest, tree holes and caves.	Lr- nt

EN- A Taxon facing high risk of extinction in the near future; VU- A Taxon facing high risk of extinction in the medium term future; LR-nt- A Taxon lower risk and not threatened; LR-lc- A Taxon in lower risk and not threatened; DD- Data deficient

Diversity of Bioindicators in Niyamgiri hills

Bioindicators are species used to monitor the health of an environment or ecosystem. They are any biological species or group of species whose function, population, or status can be used to determine ecosystem or environmental integrity. Depending on the organism selected and their use, there are several types of bioindicators such as plant indicators, animal indicators and microbial indicators. Irrespective of ongoing impact of climate change, species invasion and degradation of critical habitat in different parts of the state, Niyamgiri hill ranges are supporting several keystone, flagship and indicator species of plants, animals and microorganisms that indicates the status of forest and environment. The indicators are as follows



Plant indicators

Healthy population of Epiphytes, Bryophytes, Fungi and lichens

Epiphytes include vascular and non vascular plants which include ferns, bromeliads, orchids, mosses, liverworts, and lichens which are indicators of high annual rainfall, short dry seasons, and the presence of year-round moisture. They contribute to nutrient cycles, and they provide food, water, and habitat for a variety of wildlife species including mammals, birds, reptiles, amphibians, and invertebrates. Epiphytes also act as bio-indicators because of their sensitivity to disturbance and environmental changes.

ORCHIDS OF NIYAMGIRI



Aerides sp.



Rhyncostylis retusa



Dendrobium sp.



Dendrobium aphyllum



Dendrobium sp.



Dendrobium sp.



Dendrobium sp.

The present orchid flora of Niyamgiri accounts for thirty one species comprising of nineteen epiphytic species and twelve terrestrial species.

FLORA OF NIYAMGIRI



Amorphophallus sp.



Saraca indica



Bracket fungus



Curcuma sp.



Raouwolfia serpentina

Fourty plant species of ethno-botanical importance are reported from Niyamgiri, provides new sources of herbal drugs/ edible plants or other aspects of plant utilization.

Twentythree species of wild relatives of crop plants were recorded which are of considerable importance as germplasm materials for conservation & use in crop improvement programme

During the survey we encountered 31 species orchids including 19 epiphytic and 12 terrestrial species. The orchids growing in Niyamgiri hills are mostly elements of moist deciduous forests. *Vanda tessellata*, *Vanda testacea*, *Acampe praemorsa* and *Pelatantheria insectifera* etc., are considered as hardy species. *Luisia zeylanica* is a semi-succulent species. There are only a few inhabitants of the semi-evergreen forests, like the epiphytic *Acampe ochracea*, *Bulbophyllum polyrhizum*, *Dendrobium bicameratum* and the terrestrial *Habenaria stenopetala*, and *Seidenfia rheedii*. *Dendrobium herbaceum* found here is an Indian endemic recorded elsewhere in peninsular India. *Dendrobium macrostachyum* is another peninsular species recorded herer is found outside India only in Sri Lanka; such a species is termed as a wide endemic. *Habenaria stenopetala* is the only species among these, which inhabit the semi-evergreen forests of Dhenkanal, Mayurbhanj and Sundargarh districts. On Niyamgiri it is quite at home with a good population on the hills around Gologola. *Habenaria panigrahiana* is a rare and endemic species known only from Orissa (Gajapati, Koraput), Andhra Pradesh and Tamil Nadu was also recorded here. *Habenaria diphylla* is a very rare species occurring in Orissa in Rebana (Kendujhar) and Similipal (Mayurbhanj) and *Habenaria digitata* likewise is an uncommon species known in the State from the Bargarh – Sambalpur region are also encounter during the survey. A few epiphytic species like *Dendrobium aphyllum*, *Dendrobium bicmeratum*, *Dendrobium herbaceum* and *Rhyncostylis retusa* were found growing on rocks, showing that the atmosphere remained moist here.

Bryophytes are widely used as bioindicators of environment for their unique and very specific responses as some species are extremely sensitive to pollutants and exhibit visible injury symptoms

even in the presence of very minute quantities of pollutants. Presence of good cover of mosses in forest floor and stones is an indicator of healthy moist condition of the forest. During the survey we encountered 15 species of bryophytes for the first time from Niyamgiri. They are *Bryium argentium*, *Riccardia liverii*, *Heteroschypus argutus*, *Plagiochasma appendiculatum*, *Funaria hygrometrica*; *Herpetoneuron toccoi* etc. which needs further investigation. This needs further investigations.

Lichens are widely used as bioindicators of forest health, biodiversity and ecological status of the forest. The structure of a lichen community in a forest (i.e., species presence and abundance) intrinsically provides a wealth of information about forest health, function, and local climatic conditions. During the survey we encountered 15 species of lichens. But due to lack of expertise we could be able to identify only three species which are very common to Niyamgiri. They are *Parmelia sulcata*, *Parmelia saxitilis* and *Heterodermia didemata*. This needs further investigations.

Forest fungi are also valued for medicine, for their aesthetics, as bio-indicators of environmental quality and for bio-remediation. During the survey we sighted 15 species of wild varieties of fungi excluding the wild edible fungus consumed by the Dongarias as food. Due to lack of expertise the identification of those fungi could not be done. This needs further investigations.

Animal indicators

Apart from plants, animals both terrestrial and aquatic (both vertebrates and invertebrates) are widely used as bioindicators of forest ecosystem. Abundance of Giant squirrel indicates the canopy density in a forest ecosystem as they prefer to nest in top canopies of tall and matured old trees. Similarly being at the top of the food chain, Otters are indicators of good water quality in aquatic ecosystem. Golden gecko, an endemic lizard to Eastern Ghats is an important animal whose presence and absence indicates the nature of habitat in many forest ecosystems. Similarly abundance of herpetofauna (amphibians, reptiles and lizards) in any ecosystem is used as an important tool in assessing the health of the forest. During the survey we sighted healthy population of *Ratufa indica* and their nest in top canopies of 30 species of trees. In total 50 species of plants were identified as food and nesting plants that are used by the mammal in the Niyamgiri hill ranges. Similarly several footmarks, tracks and spraints of Otter were spotted along the hill streams of the hill is another indication of nature of the streams and their surrounding habitat. The discovery of rarest lizards like Golden gecko (*Calodactyloides aureus*), Large Termite Hill Gecko (*Hemidactylus subtriedrus*), unrecorded variety of Pit viper, Travancore Wolf snake (*Lycodon travancoricus*), and a skink (*Scincella spp.*) are some of the key indicators of healthy ecosystem in Niyamgiri hill ranges. The Golden gecko (*Calodactyloides aureus*) is of special interest to world herpetologists as it represents one of two known genus *Calodactylodes*, who are considered as Gondwana relics. This gecko is one of the rarest lizards of India, and is endemic to the Eastern Ghats of India and was previously located at only one location in AP. Large colonies of the Golden Gecko were found in Niyamgiri hills. Experts say that they are adapted to vertical rock surfaces near hill streams and their breeding places are localized on these rock surfaces. Any habitat disturbance (loss of rock faces or perennial streams) would lead to their rapid extinction. In addition there is a species of large termite hill gecko (*Hemidactylus cf. subtriedrus*), which shares the same habitat. This again is the first record from Orissa from this place. No photo of this species is available so far in any published book in India so far. These species were recorded in the preliminary visits and it is expected that a more detailed study would yield other rare and undiscovered species. Apart from the

above other reptiles like Monitor lizards, Chamelion, King cobra, Krait, Indian cobra, Banded Krait, Rat snake keel back, sand boa, python and etc., are common in the hill ranges of Niyamgiri.

THREAT TO ECOLOGY OF NIYAMGIRI ENVIRONMENT

Bauxite mining at Niyamgiri hill will bring several changes in the forest environment causing serious loss of biodiversity. Some of the major points are mentioned below.

- Destruction of forest due to drilling, blasting, transportation and crushing operations leads to loss of habitat of many endangered wildlife.
- Many threatened plant species, including valuable medicinal plants would disappear even before documentation.
- The movement of elephants and other wildlife will be hampered due to loss of corridors between hills.
- The dangerous heavy metals and toxic chemicals from the mining area may leach the ground water and destroy all the plant life that comes in contact with it.
- Mining on this mineralized plateau will drastically reduce the water retention capacity of the hills, which ultimately make the riverbed drier and reduce its potential for productivity and biodiversity.
- Red mud and other polluting matters from the mines will be let into the local streams, rivers causing serious water pollution, which is mostly used by the local tribes for irrigation and daily uses.
- The primitive tribe (*Dongria Kondh*), which are very less number in the world will be down-and-out from their motherland if the mining activity goes on.

The biodiversity in many parts of the hill range is still under explored to determine their full potential, though preliminary surveys has already given promising results. Therefore, conservation efforts with detailed biodiversity study must become a part of comprehensive plan to ensure the viability of these irreplaceable resources. If we fail to achieve the muchneeded co-ordinated approach we may find ourselves at the point of no return! Let us share the planet Earth with other species too

