

## **CHAPTER – 2**

### **BACKGROUND INFORMATION AND ATTRIBUTES**

#### **2.1. Boundaries :**

##### **EXTERNAL :**

The details of external boundary of Satkosia Gorge Sanctuary has been described in the Notification No.12727/FFAH Dt.19.05.1976 of Government of Orissa, Forest, Fisheries and Animal Husbandry Department vide Appendix-1. However this boundary was initially proposed to protect the Gharials and their habitat i.e. Mahanadi Gorge Ecosystem and its catchment forests. Subsequently its wildlife potential was recognized and a flagship species conservation approach has been put forth, considering the ecological requirements of mega herbivores viz. Elephant and mega carnivore viz. Tiger. In keeping with this, the new boundary has been proposed in chapter 10. However, the present boundary of this Sanctuary has been notified keeping in view of ecological requirement of Gharials & Muggers.

As the sanctuary covers portions of four civil districts, there are difficulties in administrative and legal complications which arises in determining rights etc. for final notification under section 26-A of Wildlife (Protection) Act, 1972. Mainly because the district administrations of four districts view the portions of sanctuary in their jurisdiction in different perceptions. Moreover, the mighty river Mahanadi divides the sanctuary area in to a greater northern half and a lesser southern half, accessible respectively from Angul or Nayagarh and Boudha by road, necessitating management of the sanctuary by two administrations.

##### **External Boundary :**

The total length of Sanctuary boundary is 215.2 Kms. It runs along either on road, nalla, village boundary or RF boundary. Details of boundary length are as follow:

Along the Road	27.5 Kms.
Along the River / nalla	14.0 Kms.
Along the Village Boundary	63.9 Kms.
Along Reserved Forests	109.8 Kms
Total	215.2 Kms.

The boundary is not maintained for long time. In most of the cases pillars / cairns are either damaged or absent. It is also difficult to make out the boundary line, where it passes along the RF boundary line. In last two years, 1440 RCC pillars have been posted along 120 Kms of the boundary of the sanctuary after surveying the same. Further survey, line clearance and pillar postings are required to complete the balance 95.2 Kms.

**Internal boundary :**

Length of Northern bank of river Mahanadi within the sanctuary is 33.75 Kms and that of southern bank is 36.25 Kms. Total length of RF and other forest boundary is 169.4 Kms out of which, natural boundary is 18.58 Kms and artificial boundary is 150.82 Kms and a common boundary of 147.5 Kms. Length of village boundary within the sanctuary is 322 Kms. Internal boundary line is lying un maintained.

The length of R.F. & DPF boundary length have been given in **(Appendix-5)**.

**ECOLOGICAL BOUNDARY :**

The ecological boundary of the wild animals is quite different from the administrative boundary. In case of elephant, it is a vast area comprising of boundaries of several divisions. Ecological boundary of the wild animals of this

sanctuary includes the forests of Athgarh, Athmallik, Angul, Nayagarh and Boudh Forest Divisions.

Mahanadi Elephant Reserve, consisting of forests along with other areas of 9 forest Divisions viz. Satkosia, Mahanadi, Boudha, Nayagarh, Athgarh, Athmallik, Dhenkanal, Angul and Cuttack, over an area of 8036.32 sq km. is the Ecological boundary for the elephants of the sanctuary. But the ecological boundary of all other animals, including tiger, is restricted to the buffer zone of the sanctuary, the boundary of which is described as bellow:

### **BOUNDARY DESCRIPTION OF BUFFER ZONE**

The outer boundary of the buffer zone starts from the meeting point of Suhagi nalla and the river Mahanadi in Cutack District. From that point moves in a north ward direction till it meets Maradamukha village boundary. Then it runs along the southern & eastern boundary of that village till it reaches the boundary of Sisupathar P.F. Then it follows the southern boundary of Sisupathar P.F. in a north-east direction till it meets Balikiary RF. From then it follows the southern boundary of Balikiary RF, Nuagarh R.F. till it meets the inter-district boundary of Cuttack and Dhenkanal, running in a northwesterly direction from there along the Northern boundary of Nandinia R.F. of Dhenkanal District, northern boundary of Nuakheta R.F. of Angul District it meets Nukheta Revenue Village. Then it follows the northern boundary of Nuakheta Revenue village, after meeting Balang R.F, it runs along the northern boundary of Balang R.F. in a westward direction. Then following the northern boundary of Bhogapal R.F., northern boundary of Hidisinga Revenue village, it follows the northern boundary of Krushnachakra R.F. There after it follows the northern boundary of Kulsar Revenue village, northern boundary of Krushnachakra R.F. till it meets the eastern boundary of Tabada R.F. Then it follows the southern boundary of Tabada R.F. in a northwesterly direction till it meets the sub-division boundary of Athmallik Sub-Division. Running along the sub-Division boundary on a southwesterly direction, it meets Hatidhara R.F. boundary of Athmallik Division. Then it follows the northern, western and southern boundary of Hatidhara R.F. till it meets the Chanagudi nalla.

From there it follows the western boundary of the sanctuary and the southern boundary of sanctuary, till it meets the inter-district boundary of Boudh and Nayagarh District. Then it follows the northern and eastern boundary of Baisipalli R.F. till it touches the road between Badasilinga to Makarprasad where it runs easternly along the southern boundary of Makarprasad R.F. up to Champadali village. From there it follows the Brutang nalla on a easternly direction till it meets river Mahanadi where it crosses the river Mahanadi to reach the starting point at Odasinga nalla.

## **2.2. Geology, Rock and Soil :**

The rocks of southern tract, where bulk of the forests of the sanctuary occur are of eastern ghat group of Archean age. The main rocks are gneiss, quartz schist, Khondalite, Charnokites and Granite. Towards Tulka and Raigoda, Ferruginous quartz, Mica schist occur with Quartzite gneiss, Granite Gneiss which extends up to Katrang. In Raigoda, Bolong and Jocub area, Khondalite is commonly met with, yielding very good quality of sandy loam and it is usually associated with pure sal crop, some times found on hill top, as in Jocub.

Kankar formation of Nodular limestone, which produces heavy impermeable clay are also met with in Majhipara and to a less extent in Tikarpara, Katrang, and in north-west area of Baghmunda blocks. This formation bears poor crops. This is not met with in other areas. Alluvial soil of lesser extent are met with on the banks of nalas and rivers.

## **Soil Erosion :**

Soil erosion is not a perceptible feature in sanctuary. But felling that has taken place in past years during commercial exploitation as per working plan prescriptions and indiscriminate illicit felling, has caused soil erosion to some extent. Extensive forest fire and grazing has further accelerated the problem to certain extent. Due to steep hill slopes and undulating ground on the plains, the drainage systems have not only removed the top soil rendering the soil infertile but also cut up the grounds badly year after year forming gullies.

### **2.3. Terrain :**

The extensive forests of Pampasar and Purunakote Ranges, comprising of vast tract of high hills, steep to very steep slopes and deep valleys extend from Athmallik in west to Narsinghpur and Hindol (Athgarh Sub-Division of Cuttack district and Hindol Sub-Division of Dhenkanal district respectively) to the east. The ranges of hills lie approximately parallel to Mahanadi valley having a south-east north-west strike. The slopes of the hills are generally very steep more especially in the forest lying east of Angul – Tikarpara road. In west of this road i.e. in Baghmunda and Majhipara blocks, slopes are more moderate and the valleys more open. In the East i.e. on Jocab, Bolong of Pampasar Range, Tulka of Purunakote range and Raigoda blocks of newly created Raigoda range, the slopes are very steep and occasionally precipitous, while the valleys are usually deep and narrow forming rocky ravines in many places.

On southern side near Satkosia Gorge, the precipitous high hills descend north-ward to the bank of river Mahanadi leaving little or no room for agriculture except for two tiny patches of cultivation at Sitalpani and Marda.

The elevation varies from 37 mtr. to 932 meters. The lowest point is 37 mtr above MSL on the bank of river Mahanadi in Katrang RF and two highest peaks are Sunakhania (932 mtr) in Padmatola RF and (842 mtr.) in Jocab RF separately.

### **2.4- Climate :**

#### **General Climate :**

Three distinct seasons are experienced in the sanctuary area. The winter starts from November and lasts till middle of February when summer starts and it continues up to middle of June. This is followed by rainy season which continues up to September. The month of October and first half of November may be treated as post-monsoon season when some rains are occasionally experienced.

### 2.4.1. Rainfall pattern, Distribution and Flood :

The bulk of precipitation occurs during the rainy season through south-west monsoon. Usually monsoon breaks in the third week of June and continues up to middle or end of September. Pre-monsoon showers are also experienced in first or second week of June, but not very common. Post monsoon showers are also experienced in month of October and November. Thunder storm usually occurs during April and May. The average number of rainy days in a year is 100 out of which, 70 are confined to the period between June to September. The annual average rainfall varies from 1250 mm to 1700 mm.

High floods are not common in Angul. Flood occurred in river Mahanadi during 1934 and 1940 when water level rose up to Hatibari village, 5 kms from Tikarpara ghat and it caused tremendous loss of cultivation in under low lying areas. Flood also occurred during 1955 and crossed all the previous record. In the flood which occurred during 1982, 1986 and 2003, water level of river Mahanadi rose up to the road leading to erstwhile GRACU (Gharial Research & Conservation Unit) Centre below the Forest Rest House and caused enormous damages to crocodile enclosures too. Artificial flood is also experienced when Hirakud Dam Authority opens their Sluice gates to discharge excess water of the dam during rainy season.

Rainfall in m.m. at Tikarapada

<b>Month</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Jan</b>	12.8	15.0	-
<b>Feb</b>	18.8	1.0	-
<b>Mar</b>	1.8	33.6	21.6
<b>Apr</b>	85.0	16.4	9.9
<b>May</b>	48.0	32.8	35.6
<b>June</b>	150.6	170.0	106.2
<b>July</b>	423.8	628.2	224.1
<b>Aug</b>	120.2	480.4	597.1
<b>Sept</b>	132.4	440.6	180.6
<b>Oct</b>	130.0	242.9	11.8
<b>Nov</b>	0	1.0	11.4



<b>Jan</b>	29.2	19.5	31.1	18	31.3	11.8	33.1	8.5	34.1	16.6	35.5	9.2
<b>Feb</b>	32.3	20.5	36.5	18.6	36.1	12.8	39.5	14	36.7	20.2	38.1	11.2
<b>Mar</b>	37.8	13.1	40.1	NA	38.7	15	22.5	15.6	38.9	11.2	41.7	16.6
<b>Apr</b>	39.8	10.6	41.1	NA	41.7	21.2	46.1	21	43.3	23.1	45.1	19.6
<b>May</b>	41.6	12.5	43	NA	46.7	21.8	45.7	20	42.9	21.8	45.5	20.6
<b>June</b>	34.9	12.9	43.1	NA	46.7	22.6	40.7	22.4	38	26	39.2	21.4
<b>July</b>	32.1	13.4	29.5	NA	36.9	23	36.7	20.4	31	25	34.7	20.2
<b>Aug</b>	31.7	12.7	43.7	15.6	35.1	23.6	35.3	21.6	33	24	33.5	22.4
<b>Sept</b>	34.2	13.2	29.1	23.6	35.9	21.8	35.1	21.2	33	24	34	25
<b>Oct</b>	33.2	10.1	34.9	20	35.5	20.6	35.1	20	34	23	35.1	19.8
<b>Nov</b>	31.9	5.5	35.1	19	34.1	13	33.7	14	32	17	35.1	15.4
<b>Dec</b>	28.1	<b>6.7</b>	30.3	14.6	32.1	9.8	30.1	12	28	10	30.9	10

Month	2002		2003		2004		2005		2006	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
<b>Jan</b>	28	12	31.2	13.3	27	11.5	29	11	26.48	14.40
<b>Feb</b>	32	16	33.2	16.4	23.5	16	36	14	32.10	14.30
<b>Mar</b>	40.4	18.2	41.6	18.2	37	20.5	42	21	35.79	22.58
<b>Apr</b>	39	26	43.7	24.7	43	27.5	45	24.5	42.08	27.71
<b>May</b>	42	27	44.6	22.4	43	29.5	<b>49</b>	25	40.14	28.08
<b>June</b>	39	26	42.8	26.4	40	29	47.5	25	36.33	27.78
<b>July</b>	35	26	36.6	25.6	36	26.5	38	25	32.54	26.03
<b>Aug</b>	33	25	32.2	21.1	35	24	37	24	29.91	25.37
<b>Sept</b>	34	24	35.2	22.2	35.5	27	37	24.5	30.63	25.56
<b>Oct</b>	33.9	22.4	34.6	23.3	33	21	30	15	30.80	23.96
<b>Nov</b>	33	20.6	34.4	19.6	30	14	30	14	27.75	20.03
<b>Dec</b>	29.8	9.6	30.4	11	29	11	29	11	18.19	15.90

Data for 2004 to 2006 have been collected from Central Water Commission, Tikarapada.

Lowest temperature 11° C has been recorded on 28<sup>th</sup> January,2006

Highest temperature 44° C has been recorded on 1<sup>st</sup>. May,2006

#### **2.4.3. Humidity; a summary of year round pattern :**

The humidity is generally high in the sanctuary. Maximum humidity is seen in the month of October and minimum in April and May. It generally crosses 80

percent in August, September, and October, in other months it varies between 75 – 77%. But the humidity reduces towards March, April, and May and is minimum in April and May. The details are given in Table.

<b>AVERAGE RELATIVE HUMIDITY OF ANGUL DISTRICT</b>												
<b>Year</b>	<b>Jan</b>	<b>Feb</b>	<b>Mar</b>	<b>Apr</b>	<b>May</b>	<b>June</b>	<b>July</b>	<b>Aug</b>	<b>Sept</b>	<b>Oct</b>	<b>Nov</b>	<b>Dec</b>
1994	85	82	73	66	73	79	82	82	81	87	78	88
1995	73	80	52	49	70	71	77	81	78	81	73	66
1996	84	66	63	67	68	75	77	78	76	78	70	75
1997	64	82	<b>41</b>	46	58	68	72	82	74	77	62	58
1998	85	56	90	88	72	72	78	77	88	<b>89</b>	85	74
1999	76	81	71	68	68	71	81	84	80	79	73	74
2000	76	72	80	77	71	78	82	82	81	79	88	78
2001	77	86	82	78	69	73	86	83	81	82	78	73
2002	83	85	78	74	69	74	81	83	84	83	86	84
2003	81	85	79	81	78	81	83	84	80	86	84	83
<b>AVG.</b>	78	78	71	<b>69</b>	<b>70</b>	74.2	79.9	<b>82</b>	<b>80</b>	<b>82</b>	78	75

Source: Directorate of Meteorology, Bhubaneswar

#### **2.4.4. Wind speed- a summary of year round pattern :**

No data is available on this score. Normally during the month of April to May, thunderstorm followed by high velocity wind is experienced. It causes uprooting of trees, breaking of branches, sweeping away of roofs of asbestos, thatched houses resulting in loss of lives and properties.

#### **2.4.5. Drought and its periodicity :**

Drought in Angul District is quite common due to inadequate and badly distributed rains. Drought is the main natural calamity which causes failure of agricultural crops. Drought affects growth of forest species too. Less survival percentage is noticed in respect of plantations raised in drought year. Drought also creates the problem of unemployment of villagers residing in an around the sanctuary area, who in turn resort to illicit felling for their livelihood. The poor economic condition is compounded as there is absolutely no irrigation facility.

Some of the years in which severe drought was experienced in past are given below along with loss of agricultural crop:

<b>Year</b>	<b>Approx. loss of agricultural production in % of total land under cultivation.</b>
1887-88	63 %
1888-89	50 %
1897	50 %
1908-09	50 %
1918-19	50 %
1954-55	60 %
1982-83	50 %
1987-88	50 %

**SOURCE :** Dhenkanal Gazetteer, 1981.

## **2.5. Water sources :**

The major river which drains water of the sanctuary is river Mahanadi, it flows on southern boundary of Satkosia Wildlife Division draining water of Purunakote, Pampasar, Jilinda, Kusanga and Chhamundia Ranges through its tributaries (nalas). Mahanadi separates both the Wildlife Divisions, viz. Satkosia Wildlife Division and Mahanadi Wildlife Division comprising the Sanctuary. The tributaries slowly become dry after monsoon and fully dry in summer, except Halua nalla of Raigoda block. However, river Mahanadi and nalas like Brutanga, Chanagodi, Khalakhala, Suhagi carry some perennial water even in summer. The forests of the sanctuary provide catchments for these streams. Good drainage systems are provided by these rivers and no where any water logging is noticed. Drainage map of the sanctuary is enclosed .

The contributing factors for non availability of water in the nalas during summer can be categorized as follows:

- a) Less water holding capacity of soil due to peculiar geological condition.
- b) Rapid runoff of precipitated water from hill slopes during rainy season due to steep slopes.
- c) Insufficiency of water harvesting structures.
- d) Surface water level of River Mahanadi is very low compared to the topographic features.
- e) The soil formation in most of the areas is due to sedimentation, which does not hold water for long time.

To improve the supply of water, a large number of wells and tanks have been constructed but most of them dry up during summer. There is one huge reservoir at Sisoopathar in Jilinda Range and 24 water bodies in different R.Fs of the sanctuary, a list of which is given in Appendix-3 with their location.

## **2.6. Range of Wildlife, status, distribution and habitat :**

### **2.6.1. Vegetation :**

#### **2.6.1.1. The bio-geographic classification :**

According to Rodgers and Panwar (1988) biogeographic classification, Satkosia Gorge Sanctuary forms the meeting point of two biotic provinces of *Deccan Peninsula biogeographic Zones*(6). The area North of Mahanadi is classed under *Garhjat hills* and that of South under Eastern Ghats. This sanctuary is in fact the meeting point of *Chhotnagpur plateau* (6B) and *Eastern Ghats* (6C) biotic Provinces. Ecologically, the vegetation of Satkosia largely conforms to Northern tropical moist deciduous forests and Moist Peninsular low level sal. However, five different plant associations are discernible including the dry type. More than 400 species of plants have been recorded here.

There are vast number of lower plants occur in the sanctuary seasonally. These plants are prominent in the wet season. The cryptogams of Nostoc, and other

micro organisms are prevalent in the nallas where stagnant water is accumulating. In certain areas Bryophytes, Pteridophytes and Gymnosperms are very common. In Bryophytes Riccia, Cyathidium and general liver worts are very common. In pteridophytes ferns of different genera are seen in the sanctuary in the villages. In Gymnosperms cycas cerinalis ver. Orixensis is very prevalent throughout the sanctuary. In addition to this the smallest angiosperm plant like wolfia and camera are seen in Kantrasingha game tank. Thus the sanctuary comprises the vast biodiversity stratification.

#### **2.6.1.2. The forest types, cover and food for wild animals :**

According to Champion & Seth in their Revised Survey of Forest types in India ,(1962), the forests of the sanctuary can be divided in to the following types and sub-types.

Sub-group – 3C – North Indian Moist Deciduous Forests- 3C/C2e(ii)- Moist Peninsular Low level Sal.

Subgroup-5B-Northern Tropical Dry Deciduous Forests.

- (i) 5B/C 1c Dry Peninsular Sal bearing forests.
- (ii) 5B/C2 Northern Dry Mixed Deciduous Forests.
- (iii) 5/DS1 Dry Deciduous & Scrub forest.
- (iv) 5/E9 Dry Bamboo brakes Seral types.
- (v) 5/S1-Dry Tropical riverain forests.

The details of each types and sub-types are described below:

#### **Moist Peninsular Low level Sal-3C/C2e(ii) :**

The moist sal is viewed as a climax (climatic, edaphic, bio-edaphic) formation throughout and in some forms which might be considered seral types have also been included in the climax type as they are sufficiently stable under prevailing conditions of management.

**Distribution :**

This subtype of forests is seen in the Reserved Forest of Raigoda, Bolong, Jocab, Tulka, Takarsingha, Purunakote, Chhotmunda, Tainsi, Kuru and Baghamunda blocks of the Satkosia Wildlife Division along with adjoining Protected Forests of Purunakote.

**Floristic composition :**

Floristic composition changes in different site and frequency of the species also varies. However to describe the composition, area covered under this forest sub-type has been divided in to two categories namely, (a) valley areas; where moisture retention capacity of soil is better, humus is more and area is comparatively cooler; (b) other areas consisting of slopes and plains, which is comparatively drier. In these two categories too; the frequency of species varies, however average crop composition of these two categories are described below:

**a) In the valley areas :**

- I. Shorea robusta, Dillenia pentagyna, Bridelia squamosa, Terminalia alata, Terminalia arjuna, Syzygium cuminii, Adina cordifolia, Mitragyna parviflora, Lagerstroemia parviflora, Mangifera indica, Bursera serrata, Pterocarpus marsupium, Terminalia bellerica, Anthocephalus cadamba, Bombax ceiba, Gmelina arborea, Garuga piñnata.
- II. Suzygium cuminii, Miliusa velutina, Polyalthia cerasioides, Lannea coromandelica, Pterospermum xylocarpum, Macaranga peltata, Diospyrus Montana, Derris indica, Mallotus philippensis, Careya arborea, Glochidion lanceolarium.
- Ila. Bambusa arundinacea.
- III. Ardisia solanacea, Grewia helicterifolia, Flemingia chapper, Flemingia strobilifera, Cycas circinalis, Leea asiatica, Cipadessa

baccifera, *Strobilanthes scaber*, *Helicteres ixora*, *Clerodendrum viscosum*, *Woodfordia fruticosa*.

IV. *Thysanolaena maxima*, *Panicum* species.

V. *Bauhinia vahlii*, *Combretum decandrum*, *Butea monosperma*, *Zizyphus oenoplia*, *Millettia extensa*, *Acacia torta*, *Entada phaseoloides*, *Smilax zeylanica*, *Dioscoria* species.

b) **In other areas :**

I. *Shorea robusta*, *Terminalia alata*, *Terminalia Chebula*, *Adina cordifolia*, *Mitragyna parviflora*, *Lagerstroemia parviflora*, *Anogeissus latifolia*, *Bridelia squamosa*, *Albizia procera*, *Albizia lebbeck*, *Hymenodictyon excelsum*, *Pterocarpus marsupium*, *Bombax ceiba*, *Gmelina arborea*, *Dalbergia paniculata*, *Schleichera oleosa*, *Madhuca indica*, *Lanea coromandelica*, *Diospyrus melanoxyton*, *Sterculia urens*.

II. *Cleistanthus collinus*, *Dalbergia latifolia*, *Ougenia oogenensis*, *Syzygium cuminii*, *Dillenia pentagyna*, *Careya arborea*, *Diospyrus* species, *Mallotus philippensis*, *Wendlandia heynei*.

Ila. *Dendrocalamus strictus*.

III. *Cipadessa baccifera*, *Woodfordia fruticosa*, *Clerodendrum viscosum*, *Zizyphus oenoplia*, *Indigofera pulchella*.

IV. *Thysanolaena maxima*, *Panicum* species, *Eulaliopsis binnata*.

V. *Bauhinia vahlii*, *Millettia extensa*, *Combretum decandrum*, *Butea monosperma*, *Acacia torta*, *Zizyphus oenoplia*, *Entada phaseoloides*, *Smilax zeylanica*, *Dioscorea* species.

No specific survey has been carried out to find frequency of grasses in different site of this forest subtype. However a list of grasses which generally get associated with this forest type are furnished below :

### **Perennial grasses**

Aristida setacea, Bothriochloa pertusa ,B.bladhii ,Cymbopogon martini, Chrysopogon gryllus, Chrysopogon gryllus C.montanus, Dicanthium annulatum ,Dicanthium annulatum, D.Carricosum ,Eragrostic coarctata, Eulaliopsis binata, Iseilema prostratum, Imperata cylindrical, Ichaemum rugosum Panicum species, Pseudosorghum fasciculare, Sporobolus indicus, Cyndon dactylon,, Heteropogon contortus, Thysanolaena maxima Themeda triendra, Arundinella khasiana, A.Setosa, Sachharum spontaneum

### **Annual grasses**

Arthraxon species, Arundinella pumila Eragrostis unioloides,E.viscosa Setaria glauca, Rottboellia, cochinehinensis, Themeda quadrivalvis, Dimeria species, Eulaliopsis species

### **Herbs**

Desmodium species, D.Latifolium ,Triumfettarhomboidea

## **5B/C1c Dry Peninsular Sal bearing forests :**

### **Distribution :**

This subtype is fairly distributed in this sanctuary. It is seen in the R.F. blocks of Majhipara, Tikarpara, Katarang & P.F. blocks of Tikarpara and Katrang.

### **Floristic Composition :**

This subtype contains a vast number of species many of which are of little importance. Composition starting from important species is furnished below:

- I. Shorea robusta, Terminalia alata, Bridelia squamosa, Pterocarpus marsupium, Anogeissus latifolia, Schleicheria oleosa, Lagerstroemia parviflora, Albizia species, Adina cordifolia, Mitrgyna parvifolia, Terminalia bellerica, T.Chebula, Madhuca indica, Acacia catechu, Buchanania lanzan, Lannea coromandelica, Boswellia serrata, Dalbergia paniculata, Ougenia oogenenses, Dalbergia latifolia, Gmelina arborea, Syzigium cuminii, Terminalia arjuna, Stereospermum chelonoides, Bombax ceiba, Dillenia pentagyna, Dyospyrus melanoxylon.
- II. Cleistanthus collinus, Chloroxylon swietenia, Emblica officinalis, Cassia fistula, Aegle marmelos, Wendlandia tinctoria, Gardenia species, Symplocos racemosa, Morinda tinctoria, Cochlospermum religiosum.
- Iia. Hollarrhena antidysentrica, Ixora arborea, Woodfordia fruticosa, Antidesma acidum, Aristida setacea, Indigofera pulchela, Phoenix ecaulis.
- III. Eulaliopsis binata, Themeda species, Heteropogan contortus, Cynodon dactylon.
- IV. Combretum roxburghii, Butea superba, Smilax species, Zizyphus oenoplia, Bauhinia vahlii.

### **5B/C2-Northern Dry Mixed Deciduous Forests:**

#### **Distribution :**

The forests in Tainsi R.F. block comes under this forest type.

#### **Floristic Composition :**

- I. Anogeissus latifolia, Lagerstroemia parviflora, Haldina cordifolia, Terminalia alata, Mitrgyna parvifolia, Dalbergia latifolia, Hymenodictyon excelsum, Bridelia squamosa,

Albizia species, Bombax ceiba, Shorea robusta (less than 5%), Pterocarpus marsupium, Dalbergia paniculata, Lannea coromandelica, Dyospyrus melanoxylon, Diospyrus species, Cleistanthus collinus, Melia composite, Terminalia bellerica, Stereospermum chelonoides, Bursera serrata, Boswellia serrata, Acacia leucopholea.

- II. Ougenia oogenensis, Cassia fistula, Alangium lamarkii, Careya arborea, Hollarrhena antidysentrica, Casearia elliptica, Mallotus phillippensis, Catunargegam mutans, Limonia acidissima, Acacia leucophloea, Zizyphus glaberrima, Chloroxylon swietenia, Gardenia latifolia, Gardenia gummifera (It occurs sub-gregariously on many of the dried hills with clay soil derived from quart & zscist, H.H.haines), Ixora arborea.
- Iia. Dendrocalamus strictus.
- III. Helicteres iora, Strobilanthes species, Woodfordia fruticosa, Indigofera cassiodes, Cipadessa baccifera.
- IV. Cymbopogon martini, Aristida setacea, Eulaliopsis binnata.
- V. Combretum decandrum, Zizyphus oenoplia, Butea monnosperma, Butea parviflora, Milletia extensa, Smilax species, Grewia tiliaefolia.

### **Seral types 5/S1-Dry Tropical Riverain Forests :**

Immature soil on the bank of larger nallahs or river which is in the process of development supports forest of this type. The occurrence of Sahada trees and Phasi (*Anogeissus acumminata*) on bank of nallahs and occurrence of Phasi and Kuchila trees on bank of river Mahanadi represent seral stage ecologically. These areas may be taken as a secondary succession as constant erosion and re-deposition of soil is a regular feature associated with this subtype.

Satkosia Gorge Sanctuary is one of the best habitats for Elephants, Tigers, Sambar, Barking Deer, Gaur etc. The riparian vegetation provides excellent habitat condition for Giant Squirrels. Abundance of Nux Vomica trees provide good food for horn bills. The different forest types provide required cover for all types of wild animals. The list of plants with their vernacular and scientific names are given in (**Appendix-6**).

### **2.6.1.3 Species and communities of conservation importance; key areas :**

One of the key areas of conservation is the riparian vegetation . Riparian areas in Satkosia are many. Their number have not been enumerated. It is first and foremost responsibility to identify such key areas with reference to latitude and longitude taken by GPS. One such area has been located in compartment no.7 of Tikarpara RF having longitude 84 ° 48.963' E and latitude 20° 25.297' N which is the origin place of Ramagaon nalla. The important plant species available there are Mankada kendu (*Diospyros embryopteris*), Karanja (*Pongamia pinnata*), Jamun (*Syzygium cumini*), Arjuna (*Terminalia arjuna*). This area is totally undisturbed. All types of animals use this area very often. The species living in riparian forest is giant squirrel. The Hinjal trees (*Barringtonia acutangula*), Phasi tree (*Anogeissus acuminate*), Arjun (*Terminalia arjuna*) and Kochila (*Strychnus noxvomica*) are found endemic to the Mahanadi river bank and they are of great conservation value. The Malabar pied hornbill likes kochila fruits very much. Hence all riparian fringe forest must be protected as they often serve as crucial corridor link for migration of elephant herds due to presence of perennial water source.

Piasal (*Pterocarpus marsupium*) is localized in Baghamunda RF comp. no. 5,9,12,13. Similarly Pahadi sissou (*Dalbergia latifolia*) and Bandhan (*Oogenia oogenensis*) are seen in Mahanadi RF comp. no. 1 & 2, near Dhipisahi. A patch of *Dalbergia latifolia* is seen in between Rasanda and Kuadoli area of Raigoda range.

Sal (*Shorea robusta*) patches are localized to Raigoda Forest and in Mahanadi RF comp. 17. Raigoda sal is of best quality.

All existing mesic sites with little grass land have to be conserved by appropriate habitat manipulation as the herbivores often congregate.

The list of threatened plant species are given below which requires protection.

1.	Hinjal -	<i>Barringtonia acutangula</i> .
2.	Kochila -	<i>Strychnos nox vomica</i> .
3.	Rosewood / Pahadi Sissoo -	<i>Dalbergia latifolia</i> .
4.	Patala garuda -	<i>Raulfia serpentine</i> .
5.	Gila -	<i>Entada phaseoloides</i> .
6.	Mirigichara -	<i>Grewia elastica</i> .
7.	Kangada -	<i>Xylia xylocarpa</i> .
8.	Patuli -	<i>Sterespermum chelonoides</i> .
9.	Sami / Kanta china -	<i>Acacia fennugimea</i> .

### **Unique habitats :**

A large number of caves, rocks, crevices, shelves, over hangs are existing inside the sanctuary. Some of these such unique habitats are located in compartment no.7, Tikarpara RF having longitude 84 ° 49.041' E and latitude 20° 35.245' N, second in compartment no.10 of Tainsi RF on Transect line 24 having longitude 84 ° 51' E and latitude 20° 42' N, third in Baigani pahad in Jorum R.F. 20° 30' 47.6" N, 84° 53' 4.8"E. Fourth place is in Katrang Chunaghati chhak area along the forest road with Latitude 20° 34' 58.4" N, long 84° 52' 15.8 ", Alti 183 mtre . These areas are being used by the porcupines. Again the following caves/dens are noticed in this sanctuary:

Jhinkadari in Baghmunda Compt. No. 5, Satkunjia in Baghmunda Compt. No. 6, Badakheta in Baghmunda Compt. No. 2, Karadabani in Baghmunda Compt. No. 11, Places in Purunakote Compt. No. 4 & 5, Khusara pahad, Jhinkadara, Dabakhhol, Sissoo khol in Raigoda Compartment No.12 in Bhukundi Beat, Hatikunda khola in Tulka Compt. No.7, Places in Raigoda R.F. Compartment No.1,2,8,9,10,11,12,13, Places in Katrang Compt.No.5 and 7.

## **GRASS LAND:**

Following meadows of small area have been noticed in this sanctuary, viz. Karadabani in Baghmunda Compt. No.11, Andeikunjia in Baghmunda Compt. No.6, Karadabani in Baghmunda Compt. No.8, Khalikani in Katranga Compt.No.3, Rangamatia in Katrang compt.No.2, Kadua mada in Katranga Compt.No. 3, Chadheikhola in Katrang Beat, In Tikarpada R.F. Compt.no.3 ,7, Asurakhola nala in Purunakote Compt.No. 11, In Chhotamunda Compt.No.3, In Kuru Compt. No. 5, Satidhara in Tulka Compt. No.9, Telibahal in Bolong Compt. No.12, Magunibhugra in Katrang Compt.No. 4 , 5

### **2.6.2. Animals:**

#### **2.6.2.1. Vertebrates, their status, distribution and habitats :**

##### **Habitat quality, quantity and key areas :**

There are carnivorous animals such as Tigers, Leopard, Jungle cat, Civet, Small Indian mongoose, Wolf, Jackal, Stripped Hyaena, Wild dog found in Purunakote, Tikarapada, Pampasar, Raigoda, Jillinda and Chhamundia and Kusanga Ranges of the sanctuary.

There are herbivorous animals such as Elephants, common Langur, Sloth bear, Sambar, Chital, Chausingha, Mouse deer, Barking deer, Wild pig, Gaur (Gayal), Fruit bats, rodents like Malabar Giant squirrels, Five striped palm squirrel, Common hare and Percupines in the sanctuary. Nilgai was noticed some years back in Satkosia Wildlife Division. But Nilgai locally called Ghudian are seen in Mahanadi RF Comp. No. 15 & 16 of Mahanadi WL Division. **Chowsingha are seen in compartment No.17 of Majhipada ,R.F., Compartment No. 4 of Raigoda R.F. & Compartment No. 11 of Tulka R.F in the Sanctuary. Sighting locations are indicated in the map.**

The locality like Labangi, Tulka and Raigoda are very congenial for wild animals. All the above animals are sighted frequently in these areas. Elephant play grounds are Raigoda, Kuadoli, Halua nalla, Nandini nalla, Hatigirija, Tulka, Baghmunda, Katranga, Purunakote, Chhotmunda, Kuru,

Labangi, Karadapada, Majhipara blocks of the sanctuary. Quite a number of animals are noticed in the forest of Purunakote, Raigoda, Tikarapada and Pampasar Ranges. Many animals are sighted in game tank areas like Kantarsingha, Hatigirija, Kandhaida, Kadalikhola, Takarsingha, Buchhundabhogra, Nadapathar, Ranibandha, Paintiri, Khajurinallia and on forest roads passing from one side of the forests to the other. List of mammals with their sighting locations in Satkosia Gorge Sanctuary is given in (**Appendix-7**).

Crocodiles (both Gharial and Mugger) are found in Satkosia Gorge of river Mahanadi. Threatened species of the area are Crocodiles, Tiger, Elephant and Chousingha. Tiger population during 1979 was 26, it reduced during 1984 to 22. During 2004 it came down to 17. Elephant population during 1979 was 133, it reduced during 1988 to 118, during 2005 only 98 elephants were noticed in the sanctuary but in the last census of 2007, 195 elephants were counted showing an upward trend. Leopard population during 1984 was 15 and during 2004 it was 34. Total 801 Gharials and 295 Muggers of different sizes have been released in Mahanadi river from 1975 to 2001. During the census of 2006, 2 nos. of Gharials and 68 nos. of Muggers were noticed in river Mahanadi. In rainy season during high flood, it is seen that only Muggers escape from river Mahanadi to important nalas for their survival while Gharials are unable to adopt this. They are swept away by high flood and die out resulting in decline of their number. This is corroborated from the fact that Gharials are rescued from Kendrapara areas. 6 Muggers are seen in village ponds of Jamudoli, Beherasahi and in Kadalikhola game tank. It is observed that Muggers move along nalas in opposite direction of water flow up to certain distance during rainy season and survive from high flood.

Wild animals are well distributed in the sanctuary but concentration of wild animals in certain sheltered or favoured pockets are there also. These pockets are forests near Kuadoli khol, Raigoda, Tulka, Purunakote, Tikarpara,

Kuru, Tainsi, Baghmunda, Majhipara and Chhotmunda forest blocks. In Raigoda and Tulka more concentration of Elephant and Indian Bison population is observed. Deer population appears more in comparatively level areas of Kuru, Baghmunda, Tainsi, Majhipara, Purunakote and Katrang than hilly areas of Raigoda, Tulka, Jokub and Bolong. Wildlife population is seen to be less abundant in forests of Nuakheta, Bolong, Krushnachakra, Burti, Kurudu, Antulia-Tabada and Katada blocks of Angul Forest Division which are adjacent to the Sanctuary area. The species wise habitat wise distributions of important species are furnished below:

**Elephant habitat zone-5:** Satkosia – Baisipali and adjoining areas have been taken in the elephant habitat zone-5. It lies between 20° 25' to 20° 50' N latitude and 84° 25' to 85° 25' E longitude. It comprises forest blocks of Tikarpara, Katranga, Purunakote, Tulka, Baghmunda, Tainsi, Chotamunda, Kuru, Majhipada of Satkosia Wildlife Division and Krushnachakra under Angul Forest Division. Besides Baisipalli, Mahanadi, Padmatola Reserve Forests come under Nayagarh Division. The Reserve Forests like Balikiari, Deobhuin, Olab, Nuagarh come under Athagarh Forest Division. Hatidhara, Northern block and Teleipathar come under Athmallik Division. The forests of this zone are mainly dense mixed forest, dense sal and Teak forests etc. The slope of this area lies within gentle sloping (3-5%) to very steep sloping (35%) with a maximum elevation of 932 mtr. in Sunakhania.

**Satkosia-Khalasuni Corridor :**

Satkosia-Khalasuni corridor comes within Sambalpur and Angul districts. Elephants from Sastkosia and Baisipalli Wildlife sanctuary used to migrate to Khalasuni sanctuary via Hatidhara, Teleipathar and Northern forest blocks of Athmallik Forest Division and Hatidhara and Landakot forest blocks of Rairakhol Forest Division and vice versa. During the migration, the elephants turn to Rail

Reserve Forest from Hatidhara Reserve Forest, because of plenty of water sources in Rail. During the summer, instead of proceeding further they return and proceed either to Satkosia or to Khalasuni sanctuary. This migrational route is disturbed due to National Highway 42 and due to lot of encroachment enroute. The important forests of this route are mainly dense sal, dense mixed forest, open sal forest and bamboo. The slope of this route varies from gentle sloping (3-5%) to moderately steep to steep sloping (15-35%) with maximum elevation of 971 m. at Teleipathar Reserve Forest of Athmallik Division.

#### **Athmallik-Chhendipada-Kamakshyanagar-South Keonjhar Corridor :**

The migration route of Athmallik-Chhendipada-Kamakshyanagar-South Keonjhar route lie within Angul, Dhenkanal and Keonjhar districts. The elephants migrate from Satkosia Wildlife sanctuary through Taleipathar Reserve Forest and then Ghosar Reserve Forest via Himitira and finally reach Kalapat Reserve Forest of Keonjhar district through Anantapur Reserve Forests of Dhenkanal District. The migration route of this region is mainly composed of different forests like dense sal forest, open sal forest, dense mixed forest, open mixed forest, degraded / scrub bamboo forest etc. The slope of this region varies from gentle sloping (3-5%) to moderate sloping (10-15%).

#### **South Keonjhar-Kapilas-Satkosia :**

This was the earlier migrational route between two largest elephant habitats of Orissa i.e. Similipal and Satkosia. In course of time this has been fragmented and it does not exist now. The migrational route covers the districts of Angul, Dhenkanal, Cuttack and Keonjhar. The elephants of south Keonjhar used to migrate to Kapilas via Sukinda forest by crossing over the river Brahmani. Earlier

the elephants from Kapilas used to migrate to Chandaka and Satkosia through the forests of Athgarh Division. Elephants from Chandaka used to cross river Mahanadi near the hillock Sushasan to move to the forests of Athgarh Division and then migrate to either Kapilas or Satkosia. Such migration perhaps has ceased since long. The forests of this route are mainly dense sal forest, open sal forest, dense mixed forest and degraded / scrub forest. The slope percentage of this route varies from gentle sloping (3-5%) to moderate sloping (10-15%) with the maximum elevation of 750 mt. at Raigoda Reserve Forest.

**a) Preservation of habitat integrity:**

The Satkosia – Baisipalli and adjoining area with a contiguous forest area of over 1000 Sq. Km offers one of the best prospects for the long-term conservation of the elephant sub-population. Habitat continuity has to be maintained throughout this region. Any future land-use should ensure that corridors are available for the free movement of elephants.

**b) Maintenance of habitat quality :**

Not only sufficient area be set apart for elephants, the quality of the habitat should also be maintained to optimum conditions. It is also important to maintain a diversity of habitat types. The following zones need special attention viz. riparian zone, dense mixed deciduous forest and bamboo forest. The water in river Mahanadi is the life line for the elephants of this area.

**Birds :**

While water birds are noticed along the bank of river Mahanadi and around damp paddy fields near nallah, other birds are also seen in good number in the sanctuary. Among water birds mention may be made to Chakwa-Chakwi (Bramhiny duck), Cattle egret, Duck, Brown fish fowl. The Jungle Babbler, Bulbul, Blue jay, Common Hawk cuckoo, House crow, King crow or Black

drongo, Dove, Lesser whistling teal, Titar, Peacock, Grey jungle fowl, Common Myna, Grey partridges, Common Peafowl, Jungle Myna, Golden oriole, Rose ringed Parakeets, Spotted dove, Grey Hornbill, Brahminy Kite, Pariah kite, Paradise fly catcher, Vulture, White backed vulture, Common Indian nightjar, Crow Pheasants are the other land birds noticed in this sanctuary.

Some birds like Parakeets, Myna are captured by local people using nylon ropes for sale. Poaching of birds is a menace to be dealt with strictly. List of birds of Satkosia Gorge Sanctuary is given in (**Appendix-8**).

### **Reptiles :**

The monitor lizard (Godhi), Chameleon are quite common in this sanctuary. Fresh water tortoise is seen in the water of river Mahanadi. The common snakes found in the sanctuary are Tampa (Naja Naja Kaouthia), Naga (Naja-Naja-Naja), Saw Scale riper (Echi Carinatus), Chandra boda (Viper russelli), Chiti – common krate (Bungarus caeruleus), Rana-Banded, Krait (Bungarus fasiatus), Pani Dhanda (Natrix piscator), Bamhuni (Nabix stolata), Dhamana (Ptyas musosus), Domundia (Eryx stolata), King cobra (Ophioptagus Hannah). The snake Ajagara (Python molurus) is noticed in Baghmunda , Tikarapara and Katranga R.Fs.

Apart from the above reptiles, the important reptiles for which the sanctuary is famous are Gavialis gangeticus (Gharial or Thantia) and Crocodylus palustris (Mugger). Gharial is the sole member of family Gavialidae and only found in Indian sub-continent. Mugger is a member of family Crocodile. The habitat of these two crocodiles in Satkosia Gorge is ideal where these two species survive in perfect harmony. Until 1950 this habitat was having the best population in India. Their population became less later on and there were only 3 adult Gharials (Two 22' long and one 18" long), 4 Juvenile Gharials and some Muggars left during 1975 within the Gorge and 50 kms upstream of river Mahanadi in this sanctuary. Nesting sites of gharial are seen on the Mahanadi river bank at Jharjhari near to Binikei temple at its down stream is seen from March to April.

The factors responsible for their depletion may be shooting for the costly hides, use of gill nets for fishing, collecting eggs for consumption. The need for conservation of the species in this habitat which is ideal for it is due to the following reasons; it had best population, deep flowing water through out the year, good sand banks for nesting and basking, excellent fishing reserve, short winter suitable for multiplication and less disturbance. Gharial Conservation Project started during 1974 at Tikarpara with the objective of future conservation of crocodiles and release of crocodile by artificial breeding. List of Reptiles noticed are given in (**Appendix-9**).

#### **Fish Population :**

The common fish of this sanctuary include Rohi, Bhakura, Pohala, Serana, Chitala, Phali, Balia, Magura, Jalanga, Seula, Chenga, Gadisa, Kau, Balligirada, Baunsapatia, Paabata, Singi, Kantia, Kerandi, Mahurali, Jallha, Kuchia etc. Fishing is quite common in Mahanadi. List of Fish is given in (**Appendix-10**).

#### **Ambhibian :**

Arboreal frogs (Tree frogs) like *Hyla arborea* and *Rhacophorus maculatus* are seen near the Rasanda tank area of Raigoda range. Nesting is noticed during June, *i.e.* just before monsoon. Nests appear as whitish spongy wet mass on bottom of medium grasses on bank near to water line, on dead stumps inside water. They are also found on overhanging tree branches of Sinsapa (*Ficus sp.*) trees on the bank of the tank as whitish spongy cricket ball size masses resembling as fruiting bodies of the tree. These ball shaped nests fall directly on water beneath releasing the tadpoles in to water.

List is given in (**Appendix-11**).

#### **2.6.2.2. Limiting factor :**

Scarcity of water during summer days is one of the limiting factors for all the wild animals. Non-availability of large grassland due to invasion of (Eupatorium) *Chromolaena odoratum* is also a limiting factor for the herbivores like Chital. Strong water current and flood in river Mahanadi is a limiting factor for Gharial population. Other limiting factors are:

- Fire – Forest fire mostly ground fire, is noticed in some areas of the sanctuary during the summer. It starts after 15<sup>th</sup> February and continue till the onset of monsoon. Fire leads to shortage of fodder and destruction of habitat.
- Grazing – Livestock population in the sanctuary far exceeds the threshold capacity. They exert tremendous pressure on forest and compete with the wild herbivores. Goat population is increasing day by day causing threat to browsers like Sambar, Barking deer and Chousingha.
- Weed – Weed like (Eupatorium) *Chromolaena odoratum* is encroaching upon the open grass land or open forest causing loss of forage to the herbivores.

**Threat :**

1. Illicit felling – Smugglers in groups enter in to the sanctuary, illicitly fell Teak and Sal trees causing destruction of habitat.
2. Poaching – Poaching of animals by trapping, netting, poisoning for meat, ivory, feather, hide are the biggest and most visible threat, though stringent measures have been taken to curtail the menace.
3. Fishing – The population of crocodiles is declining probably due to shortage of fish population, though there is controlled fishing in the river Mahanadi in the sanctuary.

### **2.6.2.3. Important invertebrates, their status, distribution and habitat :**

Some terrestrial invertebrates gradually vanishing are Earthworms, Crickets, Termites, Snails etc. Their status is threatened due to increased use of chemical fertilizers, insecticides and pesticides in the agricultural field for better production. More-over the micro habitat are being lost due to increased human interference. Unless organic farming is stressed upon, these animals will soon disappear. Plenty of butterflies of various family are sighted in Rasanda, Kuadoli areas of the sanctuary. The detail list is given in (**Appendix-12**).