STATE OF FAUNAL STATUS WITH SPECIAL REFERENCE TO BENGAL TIGER (Panthera tigris tigris) IN SUNDARBAN DELTA

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ABSTRACT : The mangrove ecology of Sundarban delta is one of the global biodiversity hotspots. The ecology harbours the Bengal Tiger (Panthera tigris tigris) besides other. The species is highly threatened as per Red Data Book. The ecology has suffered huge degradation over the years by many known and unknown forces of varying magnitude. Though various efforts are being made to conserve the ecology but yet the degradation could not be checked up to expectation. The effect of degradation is clearly reflected through the status of Panthera tigris tigris in its natural habitat. Hence the different aspects of faunal status with special reference to Bengal Tiger in Sundarban ecology during about last two decades has been searched and discussed briefly.

INTRODUCTION: Sundarban the largest delta on globe in the estuarine phase of the river Ganges is a unique bioclimatic zone in a typical geographical situation in the coastal region of Bay of Bengal. This southern most part of Bengal which is a land mark of ancient heritage of mythological and historical events and bestowed with magnificent scenic beauty and internationally recognized for its wide bio-diversity of mangrove flora and fauna-both on land and in water and is of immense scientific, anthropological and archaeological interest. The Royal Bengal Tiger is the flagship species of this forest and Sundarban is the only mangrove tiger land in the world. In this article, the state of faunal status with special reference to Bengal Tiger (Panthera tigris tigris) in Sundarban Delta has been discussed.

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MANGROVES: Mangroves are trees and shrubs that grow in saline coastal habitats in the tropics and subtropics - mainly between latitudes 25° N and 25° S. The saline conditions tolerated by various species range from brackish water, through pure seawater (30 to 40 ppt), to water of over twice the salinity of ocean seawater, where the salt has become concentrated by evaporation (up to 90 ppt) (Mildred).

SUNDARBAN DELTA: Sundarban Delta is situated in the Longitude: 30° 24' - 30° 28' N and Latitude: 77° 40' - 77° 44' E. Altitudinal Range: 0-10 m above sea level (Raha 2004). As per Biogeographic Classification of India, Sundarban Delta falls in the 8B: Coast-East Coast Region. The Sundarban (Photo-1) is an intricate web of tidal waterways, seawater, rivers, creeks and mudflats, formed by the gradual deposition of alluvial silt, at the merger of the Ganga and Brahmaputra rivers in the Bay of Bengal (Chowdhury et al. 2007)

The Sundarban, named after the Sundari

(Heritiera fomes) and the Bani *(Avicennia officinalis)* mangroves, is a unique ecosystem-the largest delta and estuarine mangrove forest in India, and a habitat of the Bengal Tiger *(Panthera tigris tigris)* (Chowdhury et al. 2007) (Photo-2).

The Sundarban was first designated as a protected forest in 1878, and subsequently declared as a Reserve Forest in 1928, under the Indian Forest Act, 1927. On 18th December,1947, Indian part of Sundarban Forests with an area of 9630 km^2 was partitioned from that of the then Pakistan (East) bounded by Dampier Hodges line in the North from Kakdwip to Basirhat, Hoogly river in the West and Kalindi, Raimangal and Harinbhanga rivers in the East. The Indian component constitutes 106 islands, of which 54 are inhabited, located in 13 blocks in 24 Parganas South District and six blocks in 24 Parganas North District. The Project Tiger was implemented in 1973 as a centrally sponsored scheme of the Government of India, with the objective of ensuring a viable population of tigers, for scientific, economic, aesthetic, cultural and ecological value. The Sundarban became one of the first tiger reserves to be notified under the Project Tiger Scheme. The Wild Life (Protection) Act 1972 Amendment in 2006 legally recognized tiger reserves as a Protected Area (PA) category, and the 'Core or Critical habitat' of the Sundarban Tiger Reserve (Photo-3) was notified in 2007. The forest is of more than 1600 km^2 falling out side the STR and known as 24 Parganas Forest Division is worked for meeting human needs. There are two small sanctuaries at the Halliday Island and Lothian Island with in that area.

The Sundarban Biosphere Reserve (SBR) comprises a larger area, and includes the STR and the Reserve Forests around the STR, as well as human settlement areas. The Sundarban National Park and the Sanjnekhali Sanctuary are located within the STR boundaries. Thus, of the total forest coverage of 4,277 km^2 in the Indian Sundarban, 2,585 km^2 is designated as STR. There is no human habitation within the STR area and in the Reserve Forests. Villages are located only in the fringe areas. The SBR area is spread across 24 Parganas North and South Districts, while the STR is located mainly in the 24 Parganas South and partly in 24 Parganas North District. The STR, National Park, the Sajnekhali Sanctuary and the SBR are managed by the Conservator of Forests and Field Director of the STR, under the Directorate of Forests, Government of West Bengal.

FLORAL DIVERSITY : Sundabans is very rich in floral diversity (Photo-4: A,B,C,D,E,F & G). The main floral species are: Excoecaria sp., Heritiera sp., Phoenix sp., Sonneratia sp., Rhizophora sp., Xylocarpus sp., Bruguiera sp., Aegiceras sp., Ceriops sp., Avicennia sp., etc.

FAUNAL DIVERSITY : Faunal diversity of Sundarban is very amazing and changing its status over centuries due to various causes.According to Hunter's statistical account of Sundarban written in 1878, 'tigers, leopards, rhinoceros, wild buffaloes, wild hogs, wild cats, barasinga, spotted deer, hog deer, barking deer, and monkeys are the principal varieties of wild animals found in Sundarbans'. However, over the last 100 years or so, due to habitat degradation and ecological changes, the faunal compositions in Indian Sundarbans have undergone sea change. Some of these animals in Sundarbans which became extinct during the last two centuries are Javan rhino, wild buffalo, swamp deer and barking deer (Raha 2004).

PRESENT STATUS OF FAUNAL RESOURCES : Presently there are 481 vertebrate species, 1 hemichordate species, 1104 invertebrate species, and 106 protozoan species in Sundarban Forests. Total species included in Schedules I and II of Wildlife (Protection) Act, 1972 are 40 that has 15

mammals, 8 birds and 17 reptiles. Total species included in Appendix I of CITES Regulation are 14 (Raha 2004). Sundarban is also the only mangrove forest in the world having the tiger as its indigenous population. As per 2004 census, the tiger population in Indian Sundarban is around 274, out of which Sundarban Tiger Reserve has 249 tigers and South 24-Parganas forest division has 25 tigers (Raha 2004). Besides, six species of shark and ray, which are found here, are included in Schedule I of Wildlife (Protection) Act. These indicate that Sundarban Reserved Forest is a natural biodiversity hot spot.

SOME RARE, ENDANGER AND GLOBALLY THREATENED SPECIES ARE FOUND IN SUNDARBAN (Photo- 5: A,B,C,D,E,F,G, H,I,J,K,L,M): Sundarban harbours a good number of rare, endangered and globally threatened animals viz.

Mammals: Bengal tiger *(Panthera tigris tigris),* fishing cat *(Felis viverrina Bennett),* common otter *(Lutra lutra),* Gangetic dolphin *(Platinista gangetica),* snubfin dolphin *(Orcella brevirostris),* wild boars *(Sus scrofa),* spotted deer *(Axis axis),* porcupines *(Hystrix indica)* and rhesus macaque *(Macaca mulata),* little porpoise *(Neomeris phocaenoides),* Indian fox *(Vulpes bengalensis),* jungle cat *(Felis chaus),* small Indian civet *(Viverricula indica),* common grey mongoose *(Herpestes edwardsii),* Indian flying fox (Pteropus giganteus) and pangolin *(Manis crassicaudata)* (Bhattacharya 2001).

Birds: Herons, egrets, cormorants, storks, green pigeons, sand pipers, large and small spoonbills, darters, seagulls, teal, partridges, wood peckers and a great variety of wild geese and ducks. Migratory species include goliathheron, etc. (Bhattacharya 2001).

Reptiles: Estuarine crocodile *(Crocodilus porosus),* water monitor lizard *(Varanus salvator);* river terrapin *(Batagur baska),* marine turtles like olive ridley *(Lepidochelys olivacea),* green sea turtle *(Chelonia mydas),* hawksbill turtle *(Eritmochelys imbricata);* venomous snakes like king cobra *(Ophiophagus hannah),* common cobra *(Naja naja),* common krait, Russel's viper *(Vipera russelli)* etc.; non-venomous snakes like python *(Python sp.),* checkered keelback *(Xanochrophis piscator),* dhaman *(Ptyas mucousus),* green whip snake and several other species; Homalopsid snakes adapted in water like Cereberus rhynchops etc.(Bhattacharya 2001).

Fishes: 15 species of shark and ray like whale shark, tiger shark, hammer headed shark etc; saw fish, guitar fish, amphibious mud-skipper fish such as Peripthalmus and Boleopthalmus.

Crustaceans: Commonly found are the one armed fiddler crab *(Uca spp)* and other species of crabs like trilobite *(Tache pleursgygus),* horseshoe crab *(Carcinoscropius rotundicauda)* and giant crab etc.

Molluscs: A good number of molluscs like different snails, oysters etc. are found. Huge number of oyster colonies is formed in river shores.

Insects: Honey bee *(Apis dorsata)* in honeycombs .

HABITAT OF TIGER IN SUNDARBAN: Tigers of Sundarbans are found through out the length and breadth of the forests. But tiger occurance definitely varies from place to place based on its own likings. Within its habitat the tiger has its own liking for particular places. It is very striking to know that degree of salinity does not play any major role in choosing its favourite habitat. It is a fact that tigers do not have any particular place for day to day living in the forest and thus it is often a question as to what are the characteristics of the places liked by the tiger in Sundarban. The tiger being a solitary and territorial animal with a big territory roams from one place to other with in a territory.

FACTORS AFFECTING TIGER

POPULATION IN SUNDARBANS: It is estimated in other forests in India that average area of territory per tiger is 10 km^2. Whereas, in Sundarban such huge area of territory can not be maintained by tiger due to inundation of forests area twice daily with tide water causing shrinkage of territories. However, in choosing the territory and the places of its hunting, following factors play determining roles (Bhattacharya 2001):

*** Abundance of prey animals,**
*** Relative ease in movement and hunting animals,**
*** Safety from tide and flow water,**
*** Presence of cover bush,**
*** Security from human interferences, and**
*** Availability of drinking water.**

MAN EATING HABIT OF THE TIGER OF SUNDARBAN AND ITS CAUSES : Though all the tiger of Sundarban are not considered to be man eater, very often some tigers turn to be man eater in some part of the forests and almost in all such instances gets killed illegally.

Man eating records dating as far back as 1670 is available. Curtis in his working plan has given a record of 427 men being killed during a period from1912 to1921. According to him 452 tigers were killed by hunters during the same period in Sundarban. From the records, number of human being killed by the tiger during the period from 01.04.1998 to 31.03.2010 in Sundarban Tiger Reserve was 101(Table 1) while media reports indicate a much larger number. From behavioral study of the tiger and analysis of the circumstantial factors affecting the territories of them, the reason behind a tiger turning to be a man eater can be assumed. Different authors have different theories about tigers turning to be man eaters. Hendrichs (1975) suggested that salinity is the cause of tigers becoming man eater in Sundarbans. According to him the more the salinity is the more incidences of tigers are there to become man eater (Bhattacharya 2001). Salter (1984) suggested a direct correlation between the man killing behaviour and availability of easy prey, i.e. the man. Frequency of man - tiger contacts is the cause of man killing (Bhattacharya 2001). It has been seen that cubs of a man eater tigress turn to be man eater by learning from their mother. More or less, in Sundarban the cause of tigers turning man eaters may be summarized as follows:

*** Tigress when with young cubs,**
*** When cornered,**
*** When disturbed while the tiger eating its kill or protecting it,**
*** When incapable due to old age or injury or otherwise, and**
*** When accustomed through man eater mothers.**

From the information gathered from the affected forest villagers and records, it has been observed that the man eaters have an uncanny understanding of human nature as they kill men between 7 a.m. to 8 a.m. (Morning), 3 p.m. to 5 p.m.(Afternoon) when the workers are either enroute to their work site or are preparing to return to their camps in the evening (80% human casualties). Some of the most notorious and cunning man eaters swim to boats, clamber in, choose their victim and jump into water with its prey and get back to the forest. This usually occurs after 11 p.m. when the boatmen are fast asleep. Middle aged man (35 to 45 years) form about 80% of human casualty figures. The maximum casualty occurs just before full moon and new moon.

TIGER DEATH/ POACHING: Though no organized poaching of tiger has been detected in recent years, 8 tigers suffered unnatural death during the period from 1990 to 1999 (Table-2). In most of the cases strayed tigers were killed by the outraged villagers. Some of the killings were due to poisoning. Seizure of few tiger skins in Kolkata and vicinity gives indication poaching of tiger though the source could be either Indian part of Sundarban or adjacent Sundarban area of Bangladesh.

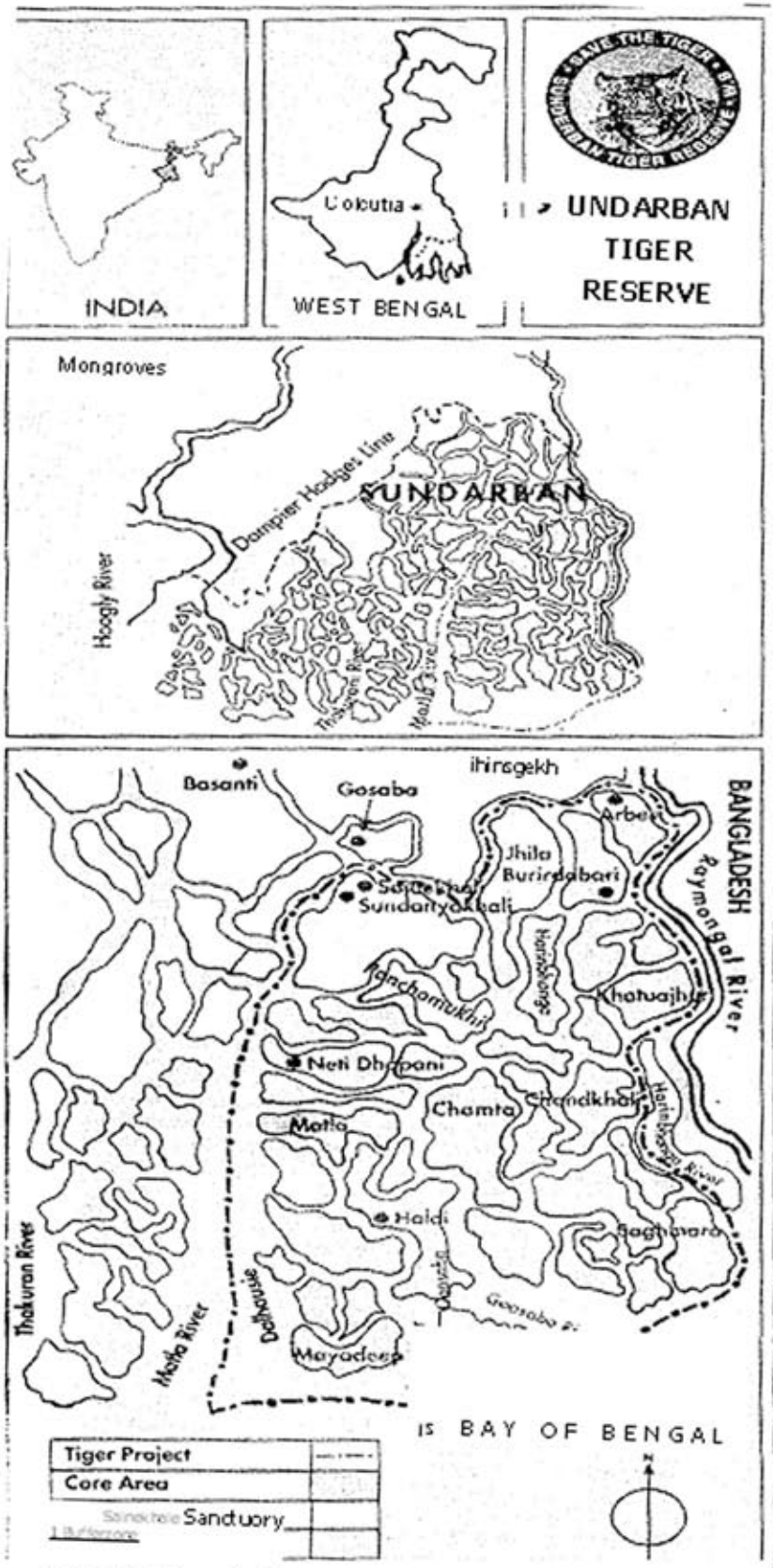


Photo-3: Schematic diagram of Sundarban Forests A. Location of Sundarban in India (Upper part) B. Sundarban Biosphere Reserve (Middle part) C. Sundarban Tiger Reserve (Lower part) Source: Presentation of Sundarban Tiger Reserve)

Photo-2: The Royal Bengal Tiger (*Panthera tigris tigris*) Forests in

Photo-1: A continuous canopy of Mangrove Sundarban

Photo- 4: SOME OF THE MANGROVE PLANTS OF SUNDARBAN

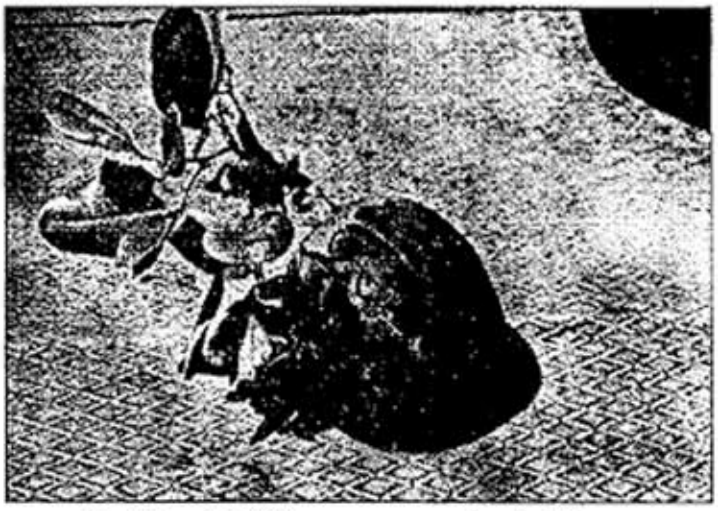
A. Genwa (Excoecaria agollocha)

B. *Sundari [fferitiera forms*

C. *Keora* (Sonneratia apetala) with fruits

D. Garjan (Rhizophora sp.) with stilt roots

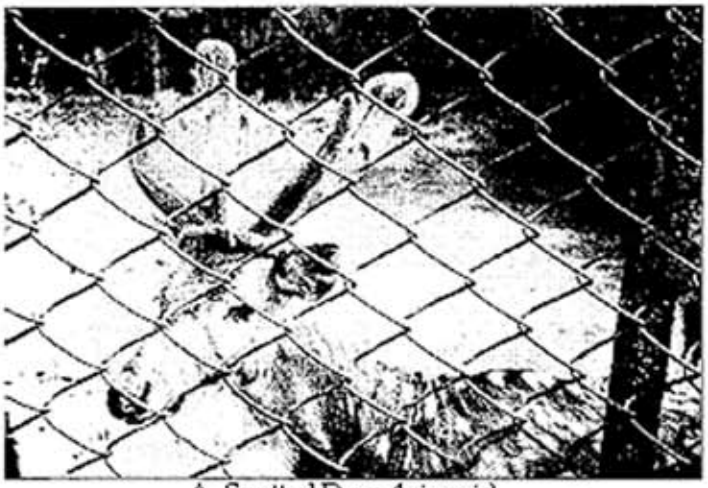
E. *Kankra (Bruguiera* sp.) with flowers



F. *Dhundul (Xylocarpus granatum)* with viviparous germination

G Pneumatophores(Breathing roots)

Photo -5: SOME FAUNAL DIVERSITY OF SUNDARBAN



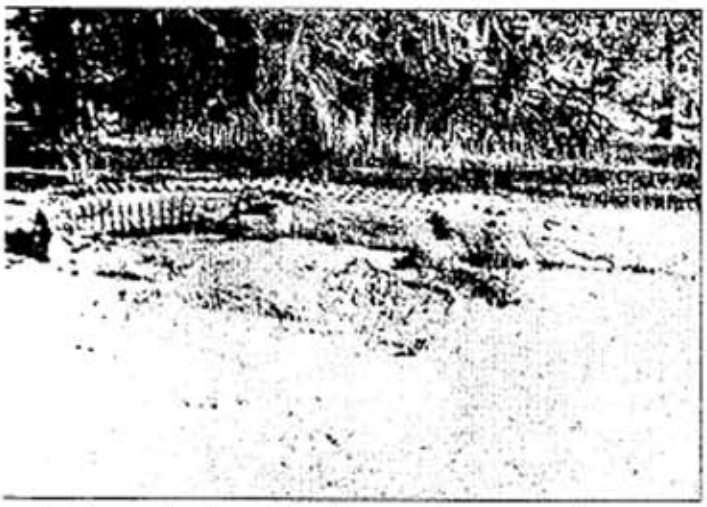
A. Spotted Deer *Axis axis)*

B. Fishing Cat *(Felis viverina)*

C. Mother's love of Wood Pecker

D. Horseshoes Crab
(Carcinoscropius rotundicauda)

E. Migratorybirds



F. Estuarine Crocodile (Crocodylus porosus)

G Water Monitor (Varanus *salvator)*

Phote-5: SOME FAUNAL DIVERSITY OF SUNDARBAN(Contd.)

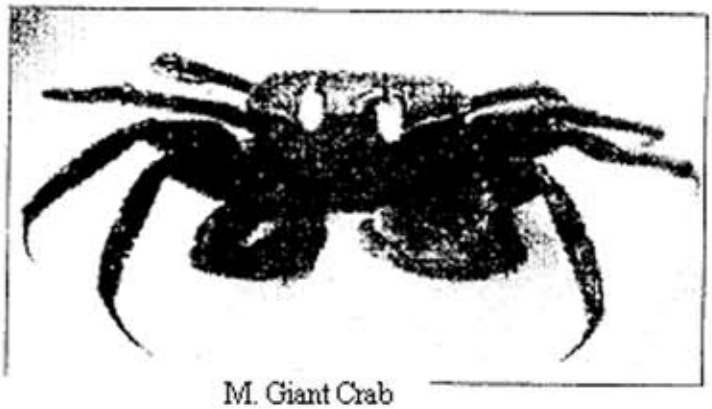
H. River Terrapin *(Batagur baska)*

I. Olive Ridley Marine Turtle

J. Oysters

K. Oyster Colony

L. Apiculture Bee culture in nature



M. Giant Crab

Photo-6: A Strayed Tiger on the roof after chasing bypeople(Source: Web site of S.B.R.)

Photo-7: Human-Masks to avoid Tiger's attacking (Source: Circulation from S.T.R.)

As per Bangladesh's Country Paper on Tiger (2000)6, in Sundarban of their part, the common method of tiger killing was by poisoning the bait. One very prevalent method of killing tiger was to kill a prey animal, commonly a deer and in rare case a wild boar and then to poison the carcass lethally and keep the same in a probable place of tiger's path. The poacher would keep track of the dead animal. The tiger after eating the poisoned carcass would meet its agonized and tragic death. The poacher then recovered the dead tiger and took away the skin and other body parts. Sometimes particularly when a domestic animal was lifted by a tiger and eaten partially, the poacher would try very carefully to insert an Endrin (used in agricultural pest management) loaded condom in the muscles of the dead animal and keep watching. The tiger having eaten the poison loaded condom along with the meat felt in to death and captured by poachers. However, this technique of poaching was also followed to kill tiger in Sundarban of our country in some occasions. Now a day, not only the skin but, the bones, skulls, canines and paws of the tiger are also smuggled by the poachers. The bones are usually taken either after slicing off the meat from the bones or after decomposing the meat of the carcass buried underneath the soil.

TIGER CENSUS: "Tiger Census" is in fact an exercise for the estimation of tiger population. The estimation of wildlife or wildlife monitoring is extremely important to the management to ascertain how the species are responding to the management to ascertain how the species are responding to the current management practices. Based on monitoring results the necessary changes are made in the management practices to make them more effective.

The technique of estimating tigers by using pugmarks was developed by S.R. Chowdhury in Orissa. The practice has been since adopted all over India for counting the tigers. In Sundarban, the technique has been slightly modified and instead of taking pugmark on tiger tracer, fresh left hind leg pugmarks are obtained by taking plaster of Paris cast. Each cast is duly indexed. The cast is subsequently translated on the graph paper by using pugmark tracer (Raha 2004).Thereafter, several distinguishable morphological features of tiger pugmarks are obtained and analyzed, based on field knowledge as well as by computer software, to arrive at the estimated tiger population. Tiger census usually was held in Sundarban every two years .The Pugmark method for Tiger census was adopted till 2004(Table-3).

Tiger population in Sundarban habitat is with in the range of 274 - 298 as per 1997 to 2004 census. The population seems to have become stable over the last decade (Table-3) and appears to have reached a stage of saturation attaining the carrying capacity for an area of 2585 km^2 of the STR of which only 60% land and the rest is water. Tiger is a solitary animal and it has been estimated that average requirement of land territory for a tiger is about 10 km^2. A detailed assessment of prey base as well as continuous monitoring of the predator will be required to determine the status of such stability in terms of prey and predator relationship and its future trend.

The Pugmark method was field friendly but due to some of the drawbacks, Project Tiger developed a new methodology for the "Monitoring of Tigers, Co-predators, Prey and Habitat".

TIGER CENSUS-2006 IN SUNDARBAN: The Monitoring of Tiger, Co-predators, Prey and Habitat Exercise in Sundarban was conducted from 5th January 2006 to 10th January 2006, as a part of All India estimation of Tiger, Co-predators, Prey and Habitat exercise as prescribed by Project tiger, Ministry of environment & Forests.

First time the methodology of Tiger Census was

changed from traditional "Plaster Cast method" to a four Phase elaborate process in which it was the responsibility of PA managers to collect the signage and other information as part of Phase -I. A three-phase training programme was organised at Sajnekhali and Namkhana, in which team leaders, staff and NGOs were provided repeated extensive training in field. More than 28000 data have been collected by the 42 teams. The same has already been computerized and sent to Wildlife Institute of India, Dehradun, for further analysis. Two national observers, the IGF & Director, Project Tiger, the Wildlife Institute of India's representative and 22 Nos. representatives from different NGOs participated in this monitoring exercise. WII deputed one Research Scholar to carry out "Camera Trapping" in Sundarban Tiger Reserve from July to September 2006. Then the Wildlife Institute has carried out the task as per the protocol and but due to some technical reasons the results on their findings was not conclusive.

According to IANS / India eNews, the number, based on pugmarks of individual tigers, was contested by an analysis of the same pugmarks by the Indian Statistical Institute (ISI). ISI experts said in July 2006 there were only 75 tigers left in

Table 1: Number of human casualties by the tiger during the period from 01.04.1998 to 31.03.2010 in Sundarban Tiger Reserve and 24- Parganas (South) Division (Source: Wildlife Wing, Directorate of Forest, Govt. of West Bengal)

Year	Sundarban	24-Parganas(S)	Total	Year	Sundarban	24-Parganas(S)	Total
1998-99	2	1	3	2004-05	2	2	4
1999-00	13	2	15	2005-06	-	1	1
2000-01	15	2	17	2006-07	-	-	-
2001-02	12	3	15	2007-08	6	3	9
2002-03	14	1	15	2008-09	4	2	6
2003-04	8	1	9	2009-10	7	-	7
Total:	64	10	74	Total:	19	8	27
Grand Total (1998-99 to 2009-2010) : 101							

Table 2: Death or killing of tigers in Sundarban Tiger Reserve from 1990 to 1999 (Source: Records from STR)

Sl. No.	Tiger Sex	No. of Tiger	Date of Death	Remarks
1	Male	1	12.06.1990	At Dayapur, killed by villagers.
2	Male	1	23.01.1993	At Hemnagar, killed by villagers.
3	Male	1	25.01.1994	Detected by private launch floating in Sudhanyakhali.
4	Male	1	26.09.1994	Dead tiger found in paddy field at Hemnagar.
5	Male	1	05.11.1994	Dead tiger found in paddy field at Jesuspur.
6	Male	1	03.08.1995	killed by villagers near Central Satjelia School.
7	Male	1	29.08.1998	killed by villagers at Kalitala village.
8	Male	1	06.03.1999	Detected by fisherman in Raimangal River.

the Sundarbans after the analysis with the help of new software. The forest department was quick to rubbish the figure and the software.

According to the latest tiger census released by the government, the total number of tigers across the country stands at 1411, a dramatic fall from 3642 in the 2001-02 census (© IANS / India eNews, 2009).

reducing man-eating, use of Human masks (Photo-7), electric human-dummies is believed to have some contribution. Tranquilisation and capture of the straying animal and their subsequent release into the forest, is also frequently resorted to. Making the fringe villagers aware of the need for conservation of tiger through the FPC/EDCs has been extremely effective.

Straying of tigers from the reserved forests into

Table- 3: Census figure of Tiger in Sundarban Tiger Reserve from 1976 to 2004 (Source: Records from STR and SBR).

Year of Census	Tiger Population		
	In STR	In South 24Parganas	Total
1976	181	Not Available	181
1977	205	Not Available	205
1983	264	Not Available	264
1989	269	Not Available	269
1992	251	Not Available	251
1996	242	Not Available	242
1997	263	35	298
1999	254	30	284
2001	245	26	271
2004	249	25	274
2006*	?	?	?

(*Non conclusive)

MANAGEMENT PLAN OF SUNDARBAN ADMINISTRATIONS: As per Patel and Rajagopalan 2007, Management plans and working plans have been developed regularly for the STR, with clear-cut guidelines on what activities need to be regulated and restricted. The management plan was operational from 2001 and valid up to 2010-2011. The focus of these plans was on preserving a viable population of tigers.

REDUCTION OF MAN - ANIMAL CONFLICT: In order to prevent straying of tiger into villages (Photo 6), nylon net as well as goran chita fencing are being erected along the forest-village interface. For the habitations along the northern and western fringes of Sunderban forest occasionally result into death of cattle/human beings as well as tiger. Illegal entry of fishermen into core areas as well as entry of honey-collectors into the forest also leads to killing of a number of people by the tigers. An ex-gratia relief of Rs 30,000/= is paid for human casualty.

Training of the staff in use of tranquilizer gun, use of capture cage/net, quick officials' response at the time of straying and generating support of the villagers are part of capacity building initiatives to tackle tiger straying. These efforts, coupled with ecodevelopment activities are paying dividend.

Between 1994-95 and 2001-02, there had been 25 recorded cases of tiger straying, leading to death of 10 tigers whereas during 2002-03 to 2003-04, there had been 16 cases of tiger straying with only one tiger getting killed. This is definitely an example of people-forester partnership towards conservation, the process being initiated more than half-a-decade back.

CONCLUSION: Being a hotspot of biodiversity Sundarban represents several number of rare, endanger and globally threatened species including Bengal Tiger. The management plan and programmes adopted by West Bengal Forest Department in association with wildlife veterinarians has been established itself to preserving a viable population of tigers and other valuable fauna as well as the ecology of Sundarban delta and protect them from extinction for sake of the next generations in greener earth.

[N.B.: Some part of this article was an integrated part of the Research Thesis named ***Assessment of Mangrove Ecology of Sundarban Delta with special reference to Bengal Tiger (Panthera tigris tigris)*** *- Submitted to the Sikkim Manipal University of Health, Medical and Technological Sciences, for partial fulfillment of the Degree of Master of Science in Ecology and Environment M.Sc.EE).]*

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