CHAPTER 3
FINDINGS

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3.1 Mangrove Habitat on Maharashtra Coast

The important characteristic of mangrove ecosystem is that the variety of land and aquatic organisms share the habitat and interdependent and interact with each other. Mangrove provides food and shelter for most of the organisms.

The mangrove species found during the study are *Acanthus ilicifolius, Aegiceras corniculatum, Aeluropus logopoides, Avicenia marina, Avicenia offincinalis, Ceriops tagal, Clerodendron inerme, Derris heterophylla, Excoecaria agallocha, Candelia candel, Rhizophora apiculata, Rhizophora mucronata, Salvadora persica, Salicornia bracheata, Sonneratia alba, and Sonneratia apetala.*

Occurrence and frequency percentage of the 26 mangroves species reported from the five districts in Maharashtra (Chaphekar and Deshmukh, 1998) is given in Table No. 3.1.

Table No. 3.1 Occurrence of mangrove species in five Districts of Maharashtra.

Name Of Species	Thane	Mumbai	Raigad	Ratnagiri	Sindhudurg	Frequency (%)
Acanthus ilicifolius	p	p	p	p	p	100
Acrostichum aureum	a	a	p	p	P	60
Aegiceras corniculatum	p	p	p	p	p	100
Aelupropus logopoides	p	p	p	p	p	100
Avicennia alba	p	a	a	p	p	60
A. marina	p	p	p	p	p	100
A. offincinalis	p	p	p	p	p	100
Bruguiera cylindrica	p	p	p	a	a	60
B. parviflora	a	a	a	a	p	20

Ceriops tagal	p	p	p	p	p	100
Clerondendron inerme	p	p	p	p	p	100
Derris heterophylla	p	p	p	p	p	100
Excoecaria agallocha	p	p	p	p	p	100
Kandelia candel	p	p	p	p	p	100
Lumnitzera racemosa	p	a	p	p	p	80
Pandanus tectorius	p	a	p	p	p	80
Porteresia coarctata	p	a	a	p	p	60
Rhizophora apiculata	p	a	p	p	p	80
R. mucronata	p	p	p	p	p	100
Salvadora persica	p	p	p	p	p	100
Salicornia brancheata	p	p	p	p	p	100
Sesuvium protulacastrum	p	p	p	p	a	80
Suaeda maritima	p	p	p	a	a	60
Sonneratia alba	p	p	p	p	p	100
S. apetala	p	p	p	p	p	100
S. caseolaris	a	a	a	p	a	20
Total	**23**	**18**	**22**	**23**	**22**	

(a = absent, p= present)

From above table, it is clear that out of 26 mangrove species Thane Contain 23 species 88%. Mumbai Contain 18 species 69% Raigad contain 22 species 84%, Ratnagiri contain 23 species 88% And Sindhudurg contain 22 species 84%.

The mass of invertebrates such as cockles, mussels, hydrobiids and nerids in estuaries provide source of food for large numbers of birds. Open expanses of sand and mud, with an almost uniform fauna or little or no cover for the approach of

predators, are ideal feeding grounds. In winter large flocks of birds assemble in estuaries and feed on the dense populations of vertebrates.

Some of the birds, which overwinter in estuaries, change their habits completely in the summer. Many species of waders become inland birds. In addition to the winter assemblages there are also resident populations, which feed on estuarine invertebrate during the summer, and there is resident population of fish eaters such as cormorants, herons and the kingfishers, although these may supplemented by migrants during winter. A notably variety of waders are found in the mangrove few of them are Curlew, Avocet, Little ringed Plover, are commonly found but there number is decreasing as mangroves are vanishing at alarming rate. Earlier study on the West Coast shows In contrast to the East Coast on the West Coast mangrove forest is distributed in patches. Number of different mammals, reptiles, and bird species recorded by Upadhyay. et.al., (2002) and amphibians by Seidensticker (1987 b) is given in Table no. 3.2

Table No 3.2 Faunal diversity of the four taxa in the mangroves in the India and on the west coast.

Taxonomic group	India	West coast
Mammals	36	2
Reptiles	39	3
Amphibians	5	1
Birds	117	119

However, this list appears to be much inadequate. Similarly there is very scanty and fragmented information about the higher vertebrate fauna from the mangroves of Maharashtra. Though mangrove constitutes a unique wildlife habitat, as it provides roosting and breeding places for so many birds and other animals, mangrove vegetation is continuously been degraded all over the coast due to increasing anthropogenic impact.

3.2 Site wise Description of Mangroves in Maharashtra

Site wise record of the species belonging to the four vertebrate taxa, associated with the identified mangrove habitat in all the 30 sites, based on the information collected from local people and personal observations made is given below. The list of the mammal, reptile, amphibian and bird species recorded is given in Annexture I, II, III and IV at the end along with the English name and scientific name of each of the species.

3.2.1 Sindhudurg District

Vengurla

Near Vengurla town, Nawabag (Ubha danda) is a small village having mangrove area of about 7.8 ha. *Acanthus ilicifolius, Avecennia offincinalis* are the common mangrove species observed here. Nest of White bellied Sea Eagle *Heliateetus lucogaster* was reported from the area. Olive Redley turtles *(Lepidochelys olivacea*) are often seen on the nearby sandy seashore.

Total of 8 mammal species mainly Common Palm Civet *Paradoxurus hermaphroditus,* Small Indian Civet *Viverricula indica,* Common Mongoose *Herpestes edwardsi,* Jackal *Canis aureus,* Indian Flying Fox *Ptreropus giganteus,* Three striped Palm Squirrel *Funambulus palmarum* , Grey Musk Shrew *Suncus murinus* and Bandicoot Rat *Bandicota indica* are recorded at this site. Among the 11 reptilian species reported are Olive Redley Turtle *Lepidochelys olivacea,* Rat Snake *Ptyas mucosus,* Whip snake *Ahaetulla nasutus,* Sea Snake *Hydrophis cyanocinctus,* Common Krait *Bungarus caeruleus,* Banded Krait *Bungarus fasciatus,* Indian Cobra *Naja naja,* Common Skink *Mabuya carinata,* Common Indian Monitor *Varanus bengalensis,* Garden Lizard *Calotes versicolor* and House Gecko *Hermidactylus flaviviridis.* Two amphibians, Indian Toad *Bufo melanostictus* and Indian Bull Frog *Rana tigrina,* were recorded from the site.

Avian fauna was represented by 32 species such as Little Cormorant *Phalacrocorax niger,* Pond Heron *Ardeola grayii,* Black Kite *Milvus migrans,* Brahminy Kite *Haliastur indus,* White bellied sea eagle *Haliaeetus leucogaster,* Coot *Fulica atra,* Red wattled lapwing *Vanellus indicus,* Common Redshank *Tringa totanus,* Koel *Eudynamys scolopacea,* House Swift *Apus offinis,* Pied Kingfisher

Ceryle rudis, Small Blue Kingfisher *Alcedo atthis*, White throated Kingfisher *Halcyon smyrnensis*, Black Drongo *Dicrurus macrocercus*, Indian Myna *Acridotheres tristis*, Small green bee-eater *Merops orientalis*, Malbar Pied Hornbill *Anthracoceros coronatus*, House Swallow *Hirundo tahitica*, Roufous-backed shrike *Lanius schach*, Indian Ring Dove *Streptopelia decaota*, Rose Ring Parakeet *Psittacula krameri*, House Crow *Corvus splendens*, Jungle Crow *Corvus macrorhynchos*, Common Iora *Aegithina tiphia*, Red whiskered Bulbul *Pycnonotus leucogenys*, Red vented bulbul *Pycnonotus cafer*, Indian Robin *Saxicoloides fulicata*, Magpie Robin *Copsychus saularis*, Large Pied wagtail *Motacilla maderaspatensis*, House sparrow *Passer domesticus* and Purple Rumped Sunbird *Nectarinia zeylonica.*

Peoples in this village use the mangrove site for anchoring their fishing boats during off-seasons. The younger generation is absolutely unaware of the various uses and importance of mangrove ecosystems. Peoples living near the mangroves consider it as an important source for fuelwood. Elder persons knew different uses of mangroves such as it plays important role in the increase of fish and shellfish production, prevention of soil erosion and also serves as anti cyclone in the coastal zone.

Kelus

A patch of 59 ha mangroves is seen near Kelus village. However, Kharland development board has constructed a wall (embankment) in the mangroves to prevent entry of sea water in the adjoining fields. Due to this, mangroves are under serious threat. Olive Redley turtles are seen nesting in winter on the adjoining sandy shore. *Exocaeria agallocha, A. offincinalis* are the dominant mangrove species present.

A total of 9 mammals comprising of Common Palm Civet, Common Langur *Presbytis entellus*, Common Mongoose, Jackal, Hare *Lepus nigricollis*, Indian Flying Fox, Three Stripped palm Squirrel, Bandicoot Rat and Porcupine *Hystris indica* have been reported. Reptiles were represented by 14 species, in and around this mangrove area, namely Rat snake, whip Snake, Chequered Keelback *Xenochrophis piscator*, common Indian Monitor, Garden Lizard and House Gecko are common.

A total of 26 species of birds are reported at this site which include Little cormorant, Pond heron, Cattle egret *Bubulcus ibis*, Black kite, Brahminy kite, White bellied sea eagle, White breasted waterhen *Amaurornis phonicurus*, Red wattled lapwing, common shank, Koel, White throated kingfisher, Black drongo, Malbar Pied Hornbill *Anthracoceros coronatus*, Roufous backed Shrike, Indian Ring Dove, Crow Pheasant *Centropus sinensis*, Rose Ring Parakeet, House Crow, Common Iora, Red Whiskered Bulbul, Red vented Bulbul, Common Babler, Indian Robin, Magpie Robin, House Sparrow, and Purple Rumped Sunbird. Two amphibians, Indian Toad and Indian Bull Frog, were reported from this area.

Farmers near the coastal village thought that mangrove vegetation is spreading continuously and it would causes threat to their agriculture land. However, the human impact on mangroves at this site is marginal.

Kolamb

Kolamb estuary lies adjacent to Malvan town in the north. Mangrove area in Kolamb is around 1.26 ha. and in village Kandalgaon 5.35 ha. In mangrove *Sonneratia alba, Rhizophora mucronata* and *Avicenia marina* are the common species found. Mangroves in this area are extensively used for fuel purpose by the local peoples and therefore are shrinking.

A total of 10 species of mammals such as Common Palm Civet, Smooth Indian Otter *Viverricula indica*, Common Langur *Presbytis entelus*, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped palm Squirrel, Grey Musk Shrew and Bandicoot Rat were recorded. Eleven reptilian species namely, Rat Snake, Whip snake, Chequered keelback, Russell's Viper *Vipera ruselli*, Common Krait, Common Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko. Rock Gecko *Hermidactilus maculatus* and 2 amphibians Indian Bull Frog and Common Toad were reported common from the site. Dolphin *Delphinus delphis* seen near sea shore in plate 10 (a) mangrove in the backyard.

A total of 27 bird species i.e. Little cormorant, Grey Heron *Ardea cinera*, Pond Heron, Black Kite, Brahminy Kite, Marsh Harrier *Circus aeruginosus*, Coot, Red wattled lapwing, Common Redshank, Koel, Spotted Owlet *Athene brama*, Small

Blue Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green bee-eater, Spotted Dove *Streptopelia chinensis*, Rose Ring Parakeet, House Crow, Common Iora, Red whiskered Bulbul, red vented bulbul, common Babler *Turdoides caudatus*, Indian Robin, Magpie Robin, House sparrow and Purple Rumped Sunbird are the birds recorded.

This is one of the good mangrove sites, Villages around the Kolamb have good mangroves Plate No 3(a). Villages name like Kandalgaon itself indicate village contains very good mangrove. However, people were complaining that increase in mangrove area is the cause for the increase in the salinity in the agriculture land. To convert these fallow saline land into cultivable land villagers, with the help from Kharland department, are preparing khraland bunds. These embankments since are constructed by government and are free most villages want them and are becoming the root cause for decline in the local mangroves.

Achara

Achara is known for the excellent mangrove patch, which is still in good condition. The site has an estimated area of 273 ha. of mangroves. *Rhizophora mucronata, Sonneratia alba, Avicenia offincinalis, Avicenia marina, Exocharia agallocha, Bruguira gymnorhiza* are some of the dominant species observed here. Achara mangroves are considered sacred as this land belongs to local deity of Shri Rameshwar and thus enjoys protection.

A total of 5 mammalian species, Common Langur, Common Mongoose, Indian Flying Fox, Three striped Palm Squirrel, Porcupine were recorded. In reptiles 13 species namely Olive Redley Turtle, Leathery Turtle *Dermochelys coriacea*, Rat Snake, Whip snake, Chequered Keelback, Green Keelback *Macropithodon plumbicolor*, Sea Snake, Russell's Viper, Common Krait, Common Cobra, Common Skink, Common Indian Monitor, Garden Lizard were recorded. While 2 amphibians Indian Bull Frog and common Toad were reported from this area.

A total 28 bird species, Little cormorant, Large egret *Casmerodius albus*, Pond Heron, Cattle Egret, Indian Reef Heron *Egretta gularis*, Black Kite, Brahminy Kite, Marsh Harrier, coot, Red wattled lapwing, Common Redshank, Koel, White throated

Kingfisher, Black Drongo, Indian Myna, Small green bee-eater, Roufous backed shrike, Spotted Dove, Crow Pheasant, Rose Ring Parakeet, House Crow, Common Iora, Red whiskered Bulbul, red vented bulbul, Indian Robin, Magpie Robin, House sparrow and Purple Rumped Sunbird are the birds recorded.

Devgad

Devgad site has relatively good mangroves. *Rhizophora mucronata* is the dominant mangrove species in this area. Mangrove is formed due to the Vaghotan river. It was observed that Jamsande village Near Devgad and small villages like Kate, were having good mangrove patches. Jamsande had mangrove area of about 15.3 ha

A total of 5 mammalian species namely Common Palm Civet, Small Indian Civet, Common Langur, Indian Flying Fox, Three striped Palm Squirrel were recorded. Out of the 11 reptile species Olive Redley Turtle, Indian Pond Terrapin *Melanochelys trijuga*, Rat Snake, Whip snake, Chequered Keelback, Green Keelback, Sea Snake, Russell's Viper, common Cobra, Common Skink, and Garden Lizard were found. The two amphibians, Common Toad and Indian Bull frog were also reported from Jamsande area. Three stripped Palm Squirrel *(Funambulus palmarum)* caught by locals in mangroves in Jamsande during the field visit is shown in Plate 3(b).

Birds species (n =28) recorded were Little Cormorant, Pond Heron, Cattle Egret, Median or Smaller Egret *Egretta intermedia*, Little egret, Black Kite, Brahminy Kite, Marsh Harrier, Red Wattled Lapwing, Little Stint *Calidris minuta*, Little Tern *Sterna albifrons* , Koel, House Swift, Common Swift *Apus apus*, Pied Kingfisher, White Throated Kingfisher Black Drongo, Indian Myna, Small green bee-eater, Roufous backed Shrike, Spotted Dove, Rose ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered bulbul, Red vented bulbul, Indian Robin, Magpie Robin, House Sparrow, and Purple Rumped Sunbird.

Mangroves in this area are mainly along Vaghotan River. People in this area depend on paddy cultivation and the mango plantations. Therefore they are neither much aware about the importance and the significance of the mangrove ecosystem or are they concerned about its conservation.

Plate 3 (a) Undisturbed mangroves at Kolamb.

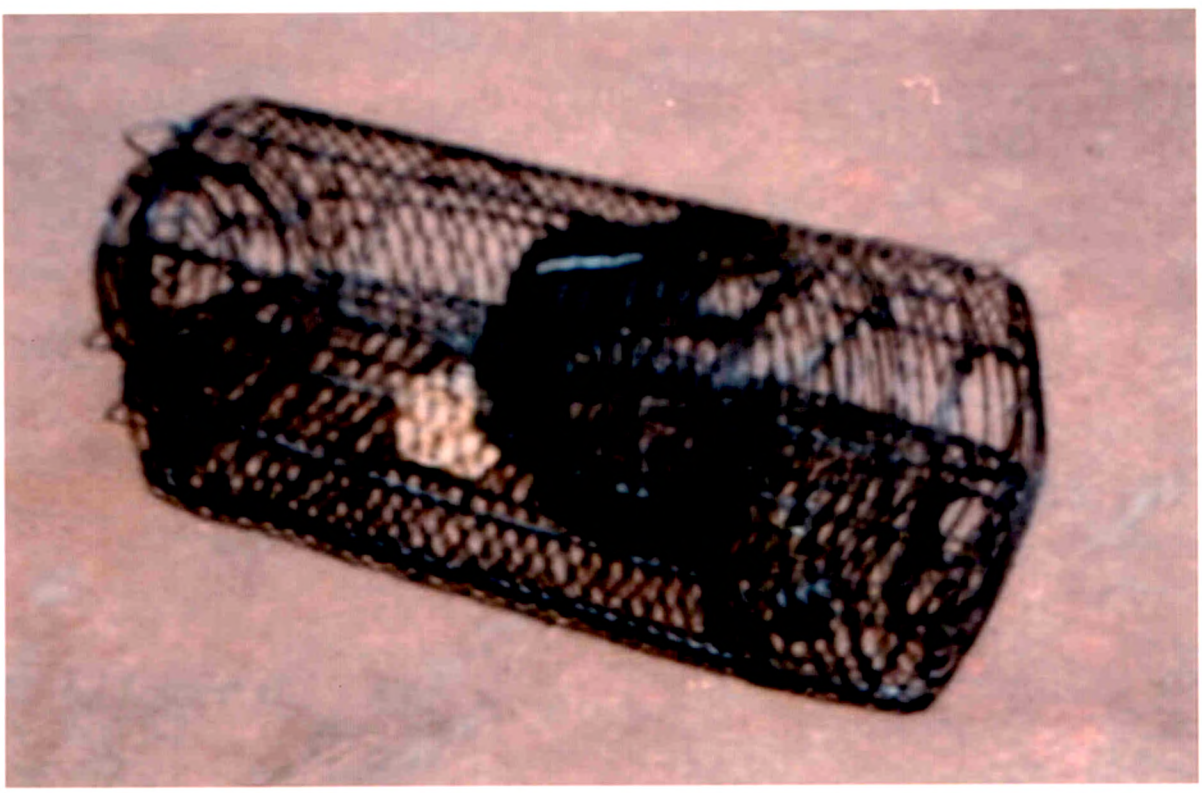


Plate 3 (b) Three Stripped palm Squirrel *Funambulus palmarum* from Jamsande Village.

Vijaydurg

In Vijaydurg site Girye and Tirlot villages have mangrove vegetation. Girye having had 1.79 ha. while Tirlot had significant i.e. 23.0 ha. of mangrove.

A total of eight mammalian species i.e. Common palm Civet, Small Indian Civet, Common Langur, Common Mongoose, Hare, Indian Flying Fox, Three striped Palm Squirrel and Fox *Vulpes bengalensis*. Twelve reptilian species, Olive Redley Turtle, Indian Pond Terrapin, Rat Snake, Whip snake, Chequered keelback, Green keelback, Sea Snake, Russell's Viper, Common Cobra, Common Skink, Garden Lizard and Banded rock Gecko *Cyrtodactylus decanensis*. Two amphibians Common Toad, Indian Bull Frog were reported from Girye (Vijaydurg) area.

A total of 33 bird species were recorded. Little cormorant, Pond Heron, Cattle Egret, Smaller Egret, Little Egret *Egretta garzetta*, Black Kite, Brahminy Kite, Marsh Harrier, Red wattle lapwing, Little Stint, Little Turn, Koel, Spotted Owlet, House Swift, Common Swift, Pied Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small Green Bee-eater, House Swallow, Roufous-backed shrike, Spotted Dove, Rose Ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red vented Bulbul, Indian Robin, Magpie Robin, House sparrow and Purple Rumped Sunbird are the common birds species.

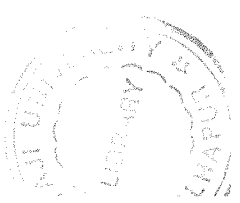
The local people depended on mangroves for fuelwood purpose. Due to which though the mangrove in this area at present looks in a good condition, it will vanish rapidly within next few years.

3.2.2 Ratnagiri District

Jaitapur

Jaitapur site has good mangroves in estuarine region covering over 78.8 ha. The major mangrove species are *Sonneratia alba*, and *Avicenia offincinalis*.

A total of 7 mammals Common Palm Civet, Common Mongoose, Jackal *Canis aureus*, Hare, Indian Flying Fox, Three striped Palm Squirrel, and Fox were reported. Around 12 reptilian species i.e. Olive Redley Turtle, Leathery Turtle, Rat



Snake, Chequered Keelback, Green Keelback, Russell's Viper, Common Krait, Indian Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko were noticed. The two common amphibians were Common Toad an Indian Bull Frog.

Bird species (n=32) were recorded which included Little cormorant, Pond Heron, Cattle Egret, Median or Smaller Egret, Indian Reef Heron, White bellied sea eagle, Marsh Harrier, Red wattled lapwing, Common Redshank, Koel, Spotted Owlet, House Swift, Common Swift, Pied Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Roufous-backed shrike, Spotted Dove, Crow Pheasant, Rose Ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red vented Bulbul, Indian Robin, Magpie Robin Grey wagtail *Motacilla cineria*, House sparrow and Purple Rumped Sunbird.

Awareness among locals about mangrove protection and conservation is very limited. Mangrove cutting is commonly observed for fuelwood purpose. Locals believed that mangroves are useless and due to them their agriculture land is threatened. This attitude needs to be changed for conservation of mangroves and to protect ecology of the region. Earlier reports suggest that this area had very good mangrove vegetation. Continuously the mangrove area is declining as locals use it also as dumping ground for the solid waste generated in the village. Most of the public toilets constructed by the Grampanchayat are along the mangrove ecosystem further polluting the vital system.

Purngad:

Purngad and Gaonkhadi have small mangrove patches. Purngad having mangrove area of 6.0 ha. *Rhizophora mucronata, Aviccenia offincinalis,* and *Sonneratia alba* are the dominant species found here. Traditional fishermen in this area know the importance of mangroves, they were aware of mangroves as the nursery ground for small fish. As well as provide conditions for the growth of fish yield in estuary.

As many as 7 mammals namely Common Palm Civet, Small Indian Civet, Common Langur, Common Mongoose, Hare, Indian Flying Fox, and Three striped

Palm Squirrel were recorded. Six reptile species, Olive Redley Turtle, Rat Snake, Green Keelback, Russell's Viper, Common Krait, Indian Cobra, Garden Lizard. and two amphibians Common Toad and Indian Bull Frog were reported.

A total of 26 bird species like Little cormorant, Pond Heron, Cattle Egret, Smaller Egret, Black Kite, Brahminy Kite, Marsh Harrier, Red wattled lapwing, Brownheaded Gull *Larus rudibundus*, Koel, White throated Kingfisher, Black Drongo, Indian Myna, Small Green Bee-eater, Roufous-backed shrike, Spotted Dove, Crow Pheasant, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red vented Bulbul, Indian Robin, Magpie Robin, Grey wagtail, House sparrow are the birds recorded.

As discussed earlier, though the local fishermen know the importance and role of mangroves in increasing fish productivity, due to the lack of awareness regarding socio-economic importance and conservation responsibility, the mangroves continue to degrade.

Pawas

In between village Pawas and Golap mangrove patch having area of 2.5 and 7.6 ha. respectively. *Rhizophora mucronata, Avicenia. offincinalis, Sonneratia alba* are the dominant species.

In all 8 species of mammals, Common Palm Civet, Smooth Indian Otter, Common Mongoose, Jackal, Indian Flying Fox, Three striped Palm Squirrel and Bandicoot Rat 9 reptile species Olive Redley Turtle, Rat Snake, Chequered Keelback, Green Keelback, Russell's Viper, Common Krait, Indian Cobra, Common Skink, Common Indian Monitor, Garden Lizard. 2 amphibians Common Toad, Indian Bull Frog were reported from this area.

A total of 25 bird species such as Little cormorant, Large Egret, Cattle Egret, Black Kite, Brahminy Kite, Red wattled lapwing, Koel, Spotted Owlet, Pied Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, House Swallow, Spotted Dove, Rose Ring Parakeet, House Crow, Jungle Crow,

Crow, Common Iora, Red whiskered Bulbul, Red vented Bulbul, Indian Robin, Magpie Robin Large Pied wagtail, House sparrow were recorded.

As a common practice the local people heavily depend on mangrove vegetation for fuelwood purpose. The locals mainly rely on fishing activity in the open sea for their livelihood. And only few fishermen collect fish in the mangrove or estuary. At the time of monsoon large fishing boats are anchored in the mangrove area, for this purpose mangrove vegetation is cleared.

Bhatye

Bhatye is a small village south of Ratnagiri. In Bhatye creek one island has a good mangrove patch of 10.0 ha. *Rhizophora mucronata, Sonneretia apetala, A. offincinalis* are the dominant species. From Bhatye and Phansop area. total 8 mammalian species, Common Palm Civet, Common Langur, Common Mongoose, Hare, Indian Flying Fox, Three striped Squirrel, Badicoot Rat and Porcupine. Ten reptiles Olive Redley Turtle, Rat Snake, Whip snake, Chequered Keelback, Russell's viper, Indian Cobra, Common Skink, Common Indian Monitor, Garden Lizard. Two amphibians Common Toad and Indian Bull Frog were recorded.

Bird species (n=33) were represented by Little cormorant, Pond Heron, Cattle Egret, Smaller Egret, Black Kite, Brahminy Kite, White bellied sea eagle, Marsh Harrier, Little Ring Plover, Black headed Gull *Larus brunnicephalus*, Brown Headed Gull,Common Redshank, Koel, House Swift, Palm Swift, Pied Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green bee-eater, House Swallow, Roufous-backed shrike, Spotted Dove, Crow Pheasant, Rose Ring Parakeet, House Crow, Jungle Crow, Red whiskered Bulbul, Red vented Bulbul, Indian Robin, Magpie Robin, Tickell's Flowerpecker *Dicaeum erythrorhynchos* and Purple Rumped Sunbird.

A diverse invertebrate fauna is also abundant in this area. Crabs and gastropods are seen in Plate no 4 (a) while crabs exposed on mangrove mudflat at low tide is seen Plate no 4(b). Local people on the mangrove edge cut mangrove trees for fuel wood and timber. They also use them for anchoring their boats during monsoon. Mangroves are also used for repairing the boats. Mangrove area is used as a dumping

Plate 4 (a) Crab and gastropods in mangroves at Bhatye.

Plate 4 (b) Crabs swarm on mangrove mudflat.

site for the solid waste. Destruction of mangrove by human activities can be clearly seen in Plate No. 5(a).

Shirgaon

Shirgaon creek has good mangroves representing seven species. Mangrove area is around 92.0 ha. The Social Forestry Department had planted *Sonneratia alba* and *Rhizophora mucronata* in 1986.

During the present study 6 mammal species namely Common Palm Civet, Smooth Indian Otter, Common Mongoose, Jackal, Indian Flying Fox, Three striped Palm Squirrel and 10 reptilian species, Olive Redley Turtle, Rat Snake, Chequered Keelback, Sea Snake, Russell's Viper, Common Krait, Indian Cobra, Common Skink, Common Indian Monitor, Garden Lizard. and 2 amphibian species were recorded. Sand Skink *Mabuya bibroni* seen in this mangrove is shown in Plate No.9(a).

Total 33 bird species such as Little cormorant, Cattle Egret, Smaller Egret, Indian Reef Heron, Black Kite, Brahminy Kite, Indian Long billed Vulture *Gyps indicus*, Marsh Harrier, Red wattled lapwing, Common Redshank, Koel, Spotted Owlet, House Swift, Common Swift, Palm Swift, Pied Kingfisher, White throated Kingfisher, White Collared Kingfisher *Halcyon chloris*, Black Drongo, Indian Myna, Small green Bee-eater, Crimson brested Barbet *Megalaima rubricapilla*, Spotted Dove, Rose Ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red vented Bulbul, Indian Robin, Magpie Robin, Large Pied wagtail, House sparrow and Purple Rumped Sunbird are the birds recorded. In earlier studies on the birds of mangroves around Ratnagiri over 121 bird species have been reported (Samant, 1986).

Though the social forestry Dept. has done mangrove plantation in Shirgaon, people in general are unaware of the importance of mangrove. Economically weaker families fulfil their daily requirements use mangrove as the main resource for fuel wood.

Jaigad

Kasari village has very good mangrove having an area around 284 ha. *Rhizophora mucronata, Avicennia offencinalis,* and *Sonneratia alba* are being the dominant mangroves

Total 9 mammals namely Common Palm Civet, Small Indian Civet, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Palm Squirrel, and Bandicoot Rat and nine reptile species, Olive Redley Turtle, Leathery turtle, Rat Snake, Russell's Viper,Common Krait, Indian Cobra, Snake Skink, Garden Lizard and Fan Throated Lizard *Sitana ponticeriana* with two amphibians were reported based on the information collected from local people and personal observations during field visit.

A total of 30 bird species, Little cormorant, Pond Heron, Cattle Egret, Little Egret, Indian Reef Heron, Black Kite, Brahminy Kite, Marsh Harrier, White-Rumped Vulture *Gyps bengalensis*, Red wattled lapwing, Common Redshank, Koel, Pied Kingfisher, Small blue Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Roufous-backed shrike, Spotted Dove, Rose Ring Parakeet, House Crow, Red whiskered Bulbul, red Vented bulbul, Magpie Robin, House sparrow and Purple Rumped Sunbird were recorded.

Within last one year Kharland development department completed several embankments to 'save' agriculture land due to which mangrove area of around 284 ha. is in trouble. Mangrove area now does not receive sufficient brackish water leading to destruction of mangrove. This area supports rich biodiversity. Collection of bivalves by local people is shown in Plate No. 5(b). If this mangrove area is not protected, it will cause direct threat as habitat loss of different species of organisms and would thus adversely affect the livelihood of the locals.

Plate 5 (a) Destruction of mangrove trees at Bhatye.

Plate 5 (b) Bivalve collections at low tide in mangrove, village Malgund.

Veldur

Mangrove area of 15.7 ha. is located behind the local Panchayat office. *Sonneratia alba, Avicenia offincinalis, Rhizophora mucronata* are the dominant species. River Vashishthi joins Arabian sea in Veldur. Very good mangrove patch is present all along side of the river.

A total 10 mammal species were recorded, Small Indian Civet, Smooth Indian Otter, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Palm Squirrel, Grey Musk Shrew and Bandicoot. Seven reptile species, Olive Redley Turtle, Rat Snake, Russell's Viper, Common Krait, Banded Krait, Indian Cobra, Common Skink, Garden Lizard and House Gecko. Two amphibian species Indian Bull Frog and Common Toad were recorded.

Avian fauna represents (n=27) species like Little cormorant, Large Egret, Pond Heron, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, Red wattled lapwing, Common Redshank, Koel, Spotted Owlet, House Swift, White throated Kingfisher, Black Drongo, Indian Myna, Spotted Dove, Crow Pheasant, Rose Ring Parakeet, House Crow, Common Iora, Red whiskered Bulbul, Red vented bulbul, Indian Robin, Magpie Robin, Grey wagtail, House sparrow and Purple Rumped Sunbird.

Still good mangroves are present in this village. During site visit almost 15 ladies were noticed cutting mangrove trees for fuelwood purpose Villagers also use the mangrove area as dumping ground for the solid waste generated in the village. If this continues for few more years, all mangrove will be damaged beyond repairs as the area will be cleared for the fuel wood and reclaimed by village waste. Plate No. 6(a).

Dabhol

Dabhol has good mangrove patch having area of 42.1 ha. Near to sea shore the dominant species is *Avicennia offincinalis*. Mangrove have one old monument where roosting site of Indian flying fox was seen.

During the field study 11 mammals were recorded i.e. Small Indian Civet, Common Otter, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying

Fox, Three striped Palm Squirrel, Grey Musk Shrew and Bandicoot Rat, Indian Field Mice *Mus budooga*. Twelve reptilian species, Olive Redley Turtle, Rat Snake, Whip snake, Chequered Keelback, Sea Snake, Russell's Viper, Common Krait, Indian Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko and two amphibians Common Toad, Indian Bull Frog were recorded.

A total 32 bird species like Little cormorant, Pond Heron, Cattle Egret, Smaller Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, White breasted waterhen, Crab Plover *Dromas ardeola*, Red wattled Lapwing, Common Redshank, Green Shank, Spotted Owlet, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Roufous-backed shrike, Spotted Dove, Crow Pheasant, House Crow, Jungle Crow, Red whiskered Bulbul, Red Vented Bulbul, Indian Robin, Magpie Robin, House sparrow and Purple Rumped Sunbird, Hoopoe *Upupa epops*, Heart spotted Woodpeaker *Hemicircus canente* are recorded.

This mangrove is away from the nearest village, due to which pressure on it as compare to other mangrove areas is much less. However, cattle grazing were observed around the mangroves.

Adakhal

This village is situated on the bank of Jog River. Mangrove patch is seen near the river. Adakhal village having mangrove area 16.5 ha. On sea shore White bellied Sea eagle, Brown headed gulls, Black headed Gulls were seen, Common mongoose, common Indian Monitor are regularly seen in this area.

In all 8 species of mammals, Small Indian Civet, Common Langur, Common Mongoose, Hare, Indian Flying Fox, Three striped Palm Squirrel, Grey Musk Shrew and Bandicoot Rat were recorded. Ten species of reptiles, Olive Redley Turtle, Rat Snake, Chequered Keelback, Sea Snake, Russell's Viper, Banded Krait, Indian Cobra, Little Skink *Mabuya macularia*, Common Indian Monitor, Garden Lizard. two species of amphibians Common Toad, Indian Bull Frog were recorded.

Avian fauna represented (n=33) species such as Little cormorant, Large Egret, Pond Heron, Cattle Egret, Smaller Egret, Little Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, White breasted Waterhen, Oystercatcher

Haematopus ostralegus, Crab Plover, Red wattled lapwing, Common Redshank, Marsh sandpiper, Koel, Pied Kingfisher, Small Blue Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small Green Bee-eater, Spotted Dove, Rose Ring Parakeet, House Crow, Red whiskered Bulbul, Red Vented Bulbul, Indian Robin, Magpie Robin, House sparrow and Purple Rumped Sunbird.

Development activity like construction of bridge in the mangroves and over the estuary is bound to increase adverse human impact on the ecology of this area. The site is shown in Plate No.6(b). Though the fishermen apparently partially knew the importance of mangroves for increase in the fish production, their families contribute in cutting the mangrove vegetation for the fuelwood.

Anjarle

Anjarle has a patch of mangrove measuring 7.5 ha. Small vegetation of mangrove especially *Sonneratia alba*, and *S. offincinalis* is dominant there. In all 8 species of mammals, Small Indian Civet, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying fox, Three striped Palm Squirrel, and Bandicoot Rat were recorded. Eight species of reptiles, i.e. Olive Redley Turtle, Chequered Keelback, Russell's Viper, Common Krait, Common Cobra, Common Indian Monitor, Garden Lizard were recorded. Two species of amphibians, Common Toad and Indian Bull Frog were found. Information collected from local people confirmed the records.

Bird species (n=28), including Little cormorant, Pond Heron, Cattle Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, White brested Waterhen, Red wattled lapwing, Common Redshank, Marsh sandpiper *Tringa stagnatilis*, Wood sandpiper *Tringa glariola*, Koel, Spotted owlet, House swift Pied Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small Green Bee-eater, Crow Phesant, House Crow, Common Iora, Red whiskered Bulbul, Red Vented Bulbul, Indian Robin, Magpie Robin, and Purple Rumped Sunbird were recorded.

Human impact in this mangrove patch is significantly more as the construction of the bridge is in progress on the estuarine area in between Anjarle and Adakhal. Earlier this estuarine area was known as nursery ground for fish but now a days local

Plate 6 (a) Mangrove used as fuel wood by locals, village Veldur.

Plate 6 (b) Construction of bridge in mangrove at Adakhal.

people, mainly fishermen, are complaining that fish production is drastically reduced. This could be related to decline in the mangrove habitat.

Kelshi

Mangrove area of Kelshi is 28.7 ha. Kelshi is a famous tourist and religious spot. Before Kelshi new bridge has been constructed between Ade and Kelshi. Roosting site of Indian flying fox is easily seen from this bridge. Plate No 7(a). Now a days fish farm projects are also under construction which has created threat to the mangroves. Nesting site of Olive Redley turtle is on the sandy beach of Kelshi.

A total of 11 species of mammals, Small Indian Civet, Smooth Indian Otter, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Palm Squirrel, Grey Musk Shrew and Bandicoot Rat, Indian Wild Boar *Sus scofa* were recorded. Eleven species of reptiles i.e. Rat Snake, Whip snake, Russell's Viper, Saw Scaled Viper, Common Krait, Indian Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko and two species of amphibians were recorded during the field study. .

A total of 29 Bird species such as Pond Heron, Cattle Egret, Smaller Egret, Little Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White brested Waterhen, Crab Plover, Red wattled lapwing, Common Redshank, Marsh Sandpiper, Koel, Spotted Owlet, House Swift, Pied Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Roufous-backed shrike, Spotted Dove, Crow Pheasant, House Crow, Jungle Crow, Red whiskered Bulbul, red vented bulbul, Indian Robin, Magpie Robin House sparrow and Purple Rumped Sunbird were recorded.

Local people cut mangrove trees for fuel wood in the area. This is the famous religious place attracting many people, Fish farms are being developed rapidly in this area. Earlier Olive Redley Turtles and its nests were seen regularly on the sandy beach. Due to increase in the human impact these turtles are not very common now. Conservation programs and the awareness programs had been conducted by the forest department and the local NGO's in the past. The NGOs are working for environment protection.

Veshavi

Veshavi and village Shipole are having good mangrove area of 60.0 ha. and 3.4 ha respectively, as at this location river Sawitri joins Arabian sea. *Sonneratia alba, Rhizophora mucronata, Acanthus iliciffolius, Avicennia. offincinalis* are the locally dominant species.

During the field survey 9 species of mammals i.e. Small Indian Civet, Common Otter, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Palm Squirrel, Grey Musk Shrew and Bandicoot Rat were recorded. In all 13 species of reptiles, Olive Redley Turtle, Rat Snake, Whip snake, Green Keelback, Sea Snake, Russell's Viper, Saw Scaled Viper, Common Krait, Indian Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko. two species of amphibians Common Toad, Indian Bull Frog were recorded.

A total of 37 species of birds such as Pond Heron, Cattle Egret, Little Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, White Breasted Waterhen, Red wattled lapwing, Common Redshank, Greenshank, Marsh Sand Piper, Koel, Spotted Owlet, House Swift, Small Blue Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater Malbar Pied Hornbill, Roufous-backed shrike, Spotted Dove, Rose Ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red vented bulbul, Common Babler, Indian Robin, Magpie Robin Grey wagtail, House sparrow and Purple Rumped Sunbird, Tree-pai are the birds recorded. People cut mangrove for fuelwood. *Sonneretia alba* is used as fodder for cattle. Embankments (bunds) have been constructed for the protection of agriculture land in the mangroves.

Avifauna of the Mangroves Around Ratnagiri, Maharashtra.

A detail long term study of the avifauna of mangroves around Ratnagiri was done by Samant (1986). This can be considered indicative for the mangroves on the cost of Maharashtra. The findings of the study are given below. The 121 bird species recorded belonged to 82 genera, 7 sub families, 39 families and 13 orders shows significant species diversity in the avifauna of mangroves around Ratnagiri.

Table no. 3.3 Number of species of Resident /Migratory birds and their percent composition in mangroves around Ratnagiri.

Type	Number of Species	Percentage
Vagrant/Occasional Stray	3	2.47
Resident and local migrants	66	54.54
Resident with migratory population	28	23.14
True Migrant	24	19.83

From table it is clear that the resident and local migrant birds dominate the avifauna of mangroves around Ratnagiri. The diversity of bird life i.e. 121 species recorded around Ratnagiri mangroves appeared to be quite significant as compared to the avifauna from the different mangrove ecosystems around the world.

Table No. 3.4 Number of species of birds recorded in the different mangrove ecosystems.

Sr.No.	Place	No. of Species	Author
1	Gambia-Africa	45	Cawkell (1964)
2	Surinam-S. America	87	Haverschmidt (1965)
3	Sierra Leone-Africa	76	Field (1968)
4	Malaya- Asia	121	Nisbet (1968)
5	Trinidad- C. America	137	Bacon (1970)
6	Florida-N. America	181	Odum et.al. (1982)
7	Trinidad- C. America	94	Ffrench (1966)

Status of White Bellied Sea Eagle *Haliaeetus leucogaster* In Ratnagiri District

The White bellied Sea- Eagle *Haliaeetus leucogaster* is thinly, but widely distributed raptor and is listed as vulnerable in the Indian Red Data Book. No information on the status and population of this species is available. However, its present status, along the 164 km coastline in Ratnagiri district is given on the basis of survey undertaken in the district during 1996-97 and 1997-98. Katdare and Mone (2003) reported 62 nests during their survey. Which is as follows.

Particulars	Activity in the year	
	19996-97	1997-98
1) Total nests observed	58	62
2) Total Birds seen	80	67
3) Total Chicks seen	20	12
4) Adult birds seen on the nest	49	52
5) Cheeks seen on the nest	20	12
6) Number of nest with adult and cheeks	15	10
7) Number of inactive nests	03	06

Status of Marine Turtles on Ratnagiri coast:

Also a local NGO Sahayadri Nisarg Mitra, Chiplun undertook a study on sea turtles in Oct 2002 on 3 km beach along Velas, Tal: Mandangad, Dist Ratnagiri. Velas is about 130 km. from Chiplun Total 50 turtle nests were located and eggs were protected in the hatcheries. Out of 5372 eggs 2734 hatchlings were released from 50 nests with the hatching success of 50.89%. All the nests were of Olive Redley Turtle (*Lepidochelys olivacea)* Table 3.5 shows detail month wise nests and hatching.

Table No. 3.5 Month wise nests, eggs and hatching of Olive Redley Turtles (*Lepidochelys olivacea)* along Velas beach.

Month	No. Nests	No. of eggs	Hatching
Dec.2002	25	2906	0
Jan. 2003	19	1975	179
Feb.2003	6	491	1210
Mar.2003	Nil	0	1157
Apr. 2003	Nil	0	188
Total	**50**	**5372**	**2734**

The Major threats to the marine Turtles of Maharashtra is from Poaching of eggs and adults and incidental catches of the adults in the fishing nets. This problem

has aggravated due to the increased fishing activity in near shore region as well as enhanced developmental activities along the coast.(Giri, 2003).

3.2.3 Raigad District

Shriwardhan

In Shriwardhan creek mangrove has good patch in village Harihareshwar. Village is famous for religious tourism through out the year. Mangrove patch is observed near sea shore. *Avicennia offincinalis*, *Sonneratia alba* are the dominant species. During field visit White bellied Sea Eagles were seen. Maximum villagers are dependent on tourism. Per year 2,50,000 tourists visit this village.

Despite of disturbance from tourism around 11 mammal species, such as Common Palm Civet, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Palm Squirrel, Bandicoot Rat, Indian wild Boar, Indian Field Mice *Mus booduga*, Porcupine and 13 reptile species, Olive Redley Turtle, Leathery Turtle, Rat Snake, Whip snake, Chequered Keelback, Green Keelback, Sea Snake, Russell's Viper, Common Krait, Common Cobra, Common Skink, Common Indian Monitor, Garden Lizard with two amphibian species are reported .

A total of 34 bird species namely Little cormorant, Grey Heron, Pond Heron, Cattle Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, Marsh Harrier, Oystercatcher, Red wattled lapwing, Black headed gull, Common Redshank, Koel, House Swift, Small Blue Kingfisher, White throated Kingfisher, Black Drango, Indian Myna, Small green bee-eater, Crimson throated barbet, Roufous-backed shrike, Crow Pheasant, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red Vented bulbul, Taylor bird *Orthotomus sutorius*,Indian Robin, Magpie Robin Great tit *Parus major*, House sparrow and Purple Rumped Sunbird are the birds recorded. Waders on the beach near mangrove are shown in Plate No.7(b).

Harihareshwar, being a famous tourist spots, large number or devotees and tourists visit Harihareshwar every year. This has resulted into developmental activities and construction. This stress and urbanisation will soon cause damage to the mangrove area. Recent destruction seen in Plate No. 8(a)

Plate 7 (a) Roosting site of Indian Flying Fox *Pteropus giganteus* in heart of mangrove forest, Kelashi village.

Plate 7 (b) Waders on the beach near mangroves at Harihareshwar.

Murud-Rajpuri

Diveagar village near Murud is a good mangrove patch having an area of 32.4 ha, During field visit scavenging by Indian long billed Vultures was seen. Plate No. 8(b) these birds being considered as threatened, this siting is very important. This mangrove patch is in trouble because of fish farming activity near the mangrove site. *Avicennia offincinalis, Sonneratia apetala, S. alba* are the major floral species observed. Village Dhighi has also good mangrove but awareness among the peoples about their conservation is lacking. Village Agardanda has good patch of mangrove. Black winged stilt were seen during field visit.

A total 12 mammals i.e. Common Palm Civet, Small Indian Civet, Common Langur, Common Mongoose, Jackal *Canis aureus*, Indian Flying Fox, Three striped palm Squirrel, Bandicoot Rat, Field Mice, and House rat *Mus musculus* and twelve reptile species, Rat Snake, Chequered Keelback, Whip snake, Sea Snake, Russell's Viper, Common Krait, Banded Krait, Common Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko and two amphibian were reported during field visit.

Bird species (n=34) like Little cormorant, Pond Heron, Cattle Egret, Little Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, Indian Long billed Vulture, Black winged stilt *Himantopus himantopus*, Red wattled lapwing, Little ring Plover *Charadrius dubius*, Common Redshank, Koel, House Swift, Palm Swift, small Blue Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green bee-eater, Crimson throated Barbet, Roufous-backed shrike, Spotted Dove , Rose Ring Parakeet, Crow Pheasant, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red vented bulbul, Indian Robin, Magpie Robin, House sparrow and Purple Rumped Sunbird were recorded.

Construction, levelling and digging for fish farms were observed during the field visit which is visible in Plate No. 10(b). This indicates that local people are not concerned about mangrove protection as they seem to be unaware about importance of the mangrove. Government is also encouraging fish-farming in mangroves by providing necessary permissions and subsidies,

Plate 8 (a) Recent destruction for firewood of mangrove at Harihareshwar.

Plate 8 (b) Scavenging by of Indian long billed vulture *Gyps indicus* in the mangrove at Diveagar.

Revdanda

In Revdanda good mangrove patch having an area of 51.4 ha, was noticed. People collect bivalves, fish, prawns, in the mangroves. Fishermen are aware of the importance of mangroves, as mangrove prevents soil erosion, increases fish production, provides necessary fuelwood etc. *Sonneratia alba* and *Acanthus illicifolius* are the locally dominant mangrove species.

A total 8 species of mammals, Common palm Civet, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Palm Squirrel, and Bandicoot Rat were recorded. Eleven species of reptiles, Olive Redley Turtle, Rat Snake, Chequered Keelback, Trinket, Sea Snake, Common Krait, Common Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko and two species of amphibians Common Toad and Indian Bull Frog reported during field visit and information collected from the local people.

A total of 31 bird species namely Little cormorant, Pond Heron, Cattle Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, Red wattled lapwing, Common Redshank, Koel, House Swift, Palm Swift, Pied Kingfisher, small Blue Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green bee-eater, Crimson Throated Barbet, Roufous-backed shrike, Crow Pheasant, Rose Ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, red vented bulbul, Indian Robin, Magpie Robin, House sparrow and Purple Rumped Sunbird were the birds recorded.

Revdanda has good mangrove vegetation. The mangrove was earlier reported to be more than present. Fuelwood is the main threat to the mangrove. Due to the continuous developmental activities mangrove area is declining rapidly.

Alibag

About 3 to 4 km from Alibag in villages Akshi and Navedar Belli large area of mangrove 40.0 ha. and 104.6 ha. Are present respectively. *Sonneratia alba* is the dominant local mangrove species.

Total 9 species of mammals namely Common Palm Civet, Common Otter, Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Palm Squirrel, and Bandicoot Rat were recorded. Ten species of reptiles i.e. Olive Redley Turtle, Rat Snake, Chequered Keelback, Sea Snake, Common Krait, Common Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko and two species of the common amphibians were recorded during field visit.

Bird species (n=30) recorded were Little cormorant, Pond Heron, Cattle Egret, Smaller Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, Red wattled lapwing, Common Redshank, Koel, House Swift, Pied Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Crymson breasted barbet, Roufous-backed shrike, Crow Pheasant, Rose Ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, red vented bulbul, Indian Robin, Magpie Robin Large Pied wagtail, House sparrow and Purple Rumped Sunbird.

The mangrove area is 3-4 km away from the city. Mainly shrubs are present in this wetland and therefore it is considered as wasteland and ignored. Thus there is not much human impact on the habitat.

Uran

Mangroves are 6-7 km away from Uran city. As this patch is away from habitation it is relatively untouched and undisturbed. Near to this mangrove patch industrial zone is developed.

A total of 7 species of mammals such as Common Palm Civet, Small Indian Civet, Common Langur, Common Mongoose, Indian Flying Fox, Three striped Palm Squirrel, and Bandicoot Rat were recorded. Nine species of reptiles, Rat Snake, Green Keelback, Sea Snake, Common Krait, Common Cobra, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko. Two species of amphibians Common Toad, Indian Bull frog are recorded during field visit.

Total 30 bird species, Little cormorant, Pond Heron, Cattle Egret, Smaller Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, Red wattled lapwing, Common Redshank, Koel, Pied Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Crimson Throated

Barbet, Roufous-backed shrike, Blue Rock Pigeon *Columba livia*, Crow Pheasant, Rose Ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red vented bulbul, Indian Robin, Magpai Robin, House sparrow and Purple Rumped Sunbird are the birds recorded.

As this area is away from villages and the city, human interference is much less. However, the Industrial zone of Uran is being developed by MIDC with increasing activities which is bound to pose a serious threat in the near future to the mangrove habitat.

3.2.4 Thane District:

Thane

Mangrove patch is seen in between Kalawa and Thane in the highly polluted creek. *Sonneratia alba,* and *Avicennia offincinalis* are the dominant mangrove species.

Only four species of mammals i.e. Common Mongoose, Indian Flying Fox, Three striped Palm Squirrel and Indian Wild Boar were reported from this region. Three species of reptiles Rat Snake, Common Skink, Garden Lizard and the two species of and common amphibians were recorded as information collected during field visit. The restricted number of the species indicates the level of pollution in the region.

A total of 17 species of birds namely Pond Heron, Cattle Egret, Indian Reef Heron, Black Kite, Brahminy Kite, Common Redshank, Common Sandpiper, Little Stint, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Crimson Throated Barbet, House Crow, red vented bulbul, House sparrow and Purple Rumped Sunbird were the birds recorded.

The Mangrove patch in between Kalawa and Thane, being highly polluted is seriously threatened. Toxic effluents from various industries makes the creek mangrove habitat in general and biodiversity in it in particular, highly vulnerable.

Mumbra

Mumbra has a vast mangrove area in good condition. During winter season many migratory birds are seen in this mangrove. Eurasian Curlew *Numenius arquata* were seen only in this mangrove. The dominant mangrove species was *Sonneratia apetala.*

A total of 7 mammal species, such as Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Squirrel and Bandicoot Rat, Indian Field Mice were recorded. . Nine species of reptiles, i.e. Rat Snake, Green Keelback, Russell's Viper, Common Krait, Indian Cobra, Common Skink, Little Skink Common Indian Monitor, and House Gecko. Two species of amphibians Common Toad, Indian Bull Frog were recorded .

Total 32 species of birds, Little cormorant, Grey Heron, Pond Heron, Indian Reef Heron, Black Kite, Brahminy Kite, Avocet, Red wattled lapwing, Common Redshank, Koel, House Swift, Common Swift, Pied Kingfisher, small Blue Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Roufous-backed shrike, Blue Rock Pigeon, Crow Pheasant, Rose Ring Parakeet, House Crow, Jungle Crow, Common Iora, Red whiskered Bulbul, Red vented bulbul, Common Babler, Tickell's Flycatcher, Taylor Bird, Indian Robin, Magpie Robin Large Pied wagtail, House sparrow and Purple Rumped Sunbird were the birds recorded. The mangrove expanse being vast and quite diverse a large number of birds were reported from this site.

Diwa

Diwa has good mangrove area of over 21 ha. However, this area is under serious threat due to urbanisation.

Total of 9 Species of Mammals namely Common Langur, Common Mongoose, Jackal, Hare, Indian Flying Fox, Three striped Palm Squirrel, Grey Musk Shrew, and Bandicoot Rat, Indian Field Mice were recorded. Ten species of Reptiles included Rat Snake, Chequered Keelback Green Keelback, Russell's Viper, Common Krait, Indian Cobra, Common Skink, Little Skink Common Indian Monitor, and House Gecko., the two Amphibians were Common Toad and Indian Bull Frog.

Bird species, (n=34) were Little cormorant, Cattle Egret, Smaller Egret, Little Egret, Pond Heron, Indian Reef Heron, Black Kite, Brahminy Kite, Black winged stilt, Avocet *Recurvirostra avocetta*, Red wattled lapwing, Little Ringed Plover, Common Redshank, Koel, House Swift, Palm Swift, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Crimson Brested Barbet, Blue Rock Pigeon, Rose Ring Parakeet, House Crow, Common Iora, Red whiskered Bulbul, Red vented bulbul, Taylor Bird, Indian Robin, Magpie Robin, Large Pied wagtail, House sparrow and Pied Myna.

Diwa has still large area under the mangrove . However, this area lies in New Mumbai and due to the pressure for new land for expansion and urbanisation the mangrove is likely to be cleared off by reclamation in the near future years to come.

Vikroli

Vikroli is located towards western side of Thane. This area is an excellent example of conservation and management of mangrove forest by private ownership. Vikroli has about 1750 ha. of mangrove area owned by Godrej Pvt. Ltd. They area is well protected and has therefore no human interference. *Avicennia marina, Rhizophora mucronata, Sonneratia apelata,* and *Acanthus ilicifolius* are the common mangrove species. Jackal, common Mongoose, Jungle cat is regularly seen in this area. Over 185 species of birds and 30 species of reptiles are reported in the area during long term monitoring by experts. The researcher did not get sufficient time to move in the area for field observation due to restrictions. However, the reported diversity of birds and reptiles is an excellent indication of rich biodiversity.

Vasai

Village Bhuigaon having small mangrove patch. *Avicennia marina, Avicennia offincinalis* are dominant species. A total of 4 mammal i.e. common mongoose, Hare, Indian flying fox and Three stripped palm squirrel species were recorded. Seven species of Reptiles included Rat Snake, Chequered Keelback, Sea snake, Common Krait, Indian Cobra, Common Skink and Garden lizard., the two Amphibians were Common Toad and Indian Bull Frog.

Bird species, (n=23) were Little cormorant, Pond heron, Cattle Egret, Black Kite, Brahminy Kite, Red wattled lapwing, Koel, House Swift, Palm Swift, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater,

Crimson Breasted Barbet, Roufous backed shrike, Crow Pheasant, Rose Ring Parakeet, House Crow, Common Iora, Red vented bulbul, Indian Robin, Magpie Robin, Large Pied wagtail and House sparrow.

Some mangrove area declining rapidly in this area. People cleared mangrove for agriculture practice.

Vaitarna

Village Chikhaldongari is situated near mangrove having only area of 1.9 ha. Peoples living in this village are mainly fisherman they are well aware of the importance of mangrove. *Avicennia marina, Avicennia offincinalis, Avicennia. ilicifolius*, are the locally dominant mangroves.

A total 5 species of mammals, namely Common Mongoose, Jackal, Hare, Indian Flying Fox and Three striped Palm Squirrel.; eight species of reptiles Rat Snake, Chequered Keelback, Russell's Viper, Common Krait, Common Skink, Common Indian Monitor, Garden Lizard and House Gecko and two amphibians i.e. Common Toad, and Indian Bull Frog were recorded.

A good number of bird species (n= 31)species such as Little cormorant, Grey Heron, Pond Heron, Cattle Egret, Smaller Egret, Black Kite, Brahminy Kite, Indian Long Billed Vulture, Red wattled lapwing, Little Stint, Common Redshank, Koel, House Swift, Palm Swift, Small Blue Kingfisher, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Crimson Breasted Barbet, House Swallow, Roufous-backed shrike, Crow Pheasant, Rose Ring Parakeet, House Crow, Red whiskered Bulbul, Red vented bulbul, Taylor Bird, Indian Robin, Magpie Robin, Large Pied wagtail, House sparrow and Purple Rumped Sunbird were recorded.

Vaitarna site has still good mangrove vegetation. Manly fishermen are living in this area and they do not have much pressure, as compared to other sites, on mangroves.

Dahanu

Under Dahanu Forest Division Bhoisar Range Office has taken a project of mangrove plantation under the initiative of the Range Officer Shri. Godbole in village Pam-Tembhi a mangrove nursery has been created. Mangrove plantation has been made in over 100 ha. In the estuarine area. owned by forest department. *Avicennia marina, Avicennia offincinalis, Rhizophora mucronata,* and *Candelia candel* are the species common in the region. This is a successful example of creation of good mangrove forest, which needs to be replicated.

A total of 5 species of mammals i.e. Common Mongoose, Jackal, Hare, Indian Flying Fox, and Three striped Palm Squirrel.; four species of reptiles, i.e. Chequered keelback, Indian Cobra, Common Skink, Common Indian Monitor and two species of amphibians were recorded from this area.. Chequered keel Back seen in the area is shown in Plate No 9(b).

Bird species (n=24), included Little cormorant, Pond Heron, Cattle Egret, Indian Reef Heron, Black Kite, Brahminy Kite, White bellied sea eagle, Common Redshank, Koel, House Swift, White throated Kingfisher, Black Drongo, Indian Myna, Small green Bee-eater, Crimson Breasted Barbet, Roufous-backed shrike, Blue Rock Pigeon, Crow Pheasant, Rose Ring Parakeet, House Crow, Red vented bulbul, Indian Robin, Magpie Robin, House sparrow and Purple Rumped Sunbird.

Some mangrove area in this is decline rapidly due to conventional anthropogenic pressures. However, on the other hand The Forest Department is taking efforts to conserve mangroves habitat which is promising good results. If this experiment is successful perhaps we can conserve mangrove biodiversity in the future in other areas as well.

3.3 Comparative Study of Mangrove Biodiversity

An attempt was made to compare the vertebrate biodiversity in the four coastal districts of Maharashtra by comparing the biodiversity observed during the study in all the field sites. Tables 3.6, 3.7, 3.8, and 3.9 give the number of species observed at each site in the districts of Sindhudurg, Ratnagiri, Raigad and Thane.

Plate 9 (a) Sand Skink *Mabuya bibroni* at Shirgaon mangroves.

Plate 9 (b) Checkered keelback *Xenochrophis piscator* at Pam-Tembhi.

Plate 10 (a) Dolphin *Delphinus delphis* near seashore, mangroves in the background.

Plate 10 (b) Construction of fishfarm in mangroves, village Diveagar.

Table No. 3.6 Faunal Diversity of the four Taxa in Sindhudurg District

Site	Mammals	Reptiles	Amphibians	Birds	Total
Vengurla	12	11	2	32	57
Kelus	9	14	2	26	51
Kolamb	10	11	2	28	51
Achara	7	13	2	28	50
Deogad	5	9	2	28	44
Vijaydurg	8	12	2	33	55
Average	**8**	**12**	**2**	**29**	**51**

Figure 1 Comparison of the four vertebrate taxa diversity at the six sites in Sindhudurg district.

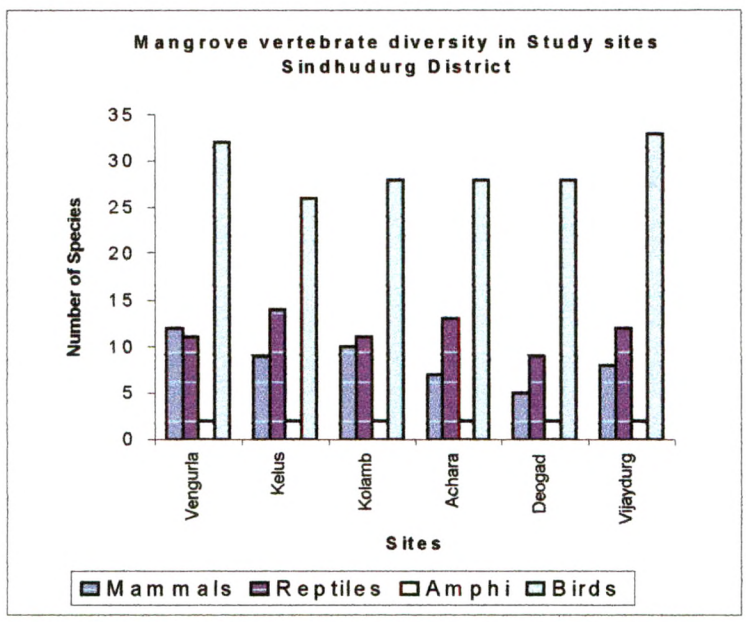


Table No. 3.7 Faunal Diversity of the Four Taxa in Ratnagiri District.

Site	Mammals	Reptiles	Amphibians	Birds	Total
Jaitapur	7	12	2	32	53
Purngad	7	6	2	26	41
Pawas	8	9	2	25	44
Bhatye	6	10	2	33	51
Shirgaon	8	10	2	33	53
Jaigad	9	9	2	30	50
Veldur	10	7	2	27	46
Dabhol	11	12	2	32	57
Adakhal	8	10	2	33	53
Anjarle	8	8	2	28	46
Kelashi	11	11	2	33	57
Veshavi	9	13	2	36	60
Avarage	**8**	**10**	**2**	**31**	**51**

Figure 2 Comparison of the four vertebrate taxa diversity at the twelve sites in Ratnagiri district.

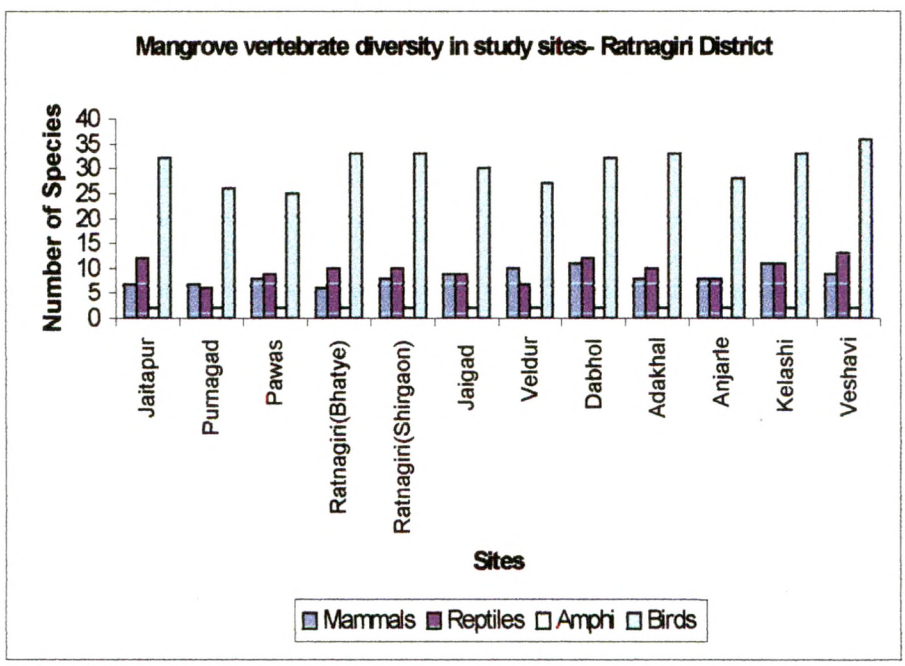


Table No. 3.8 Faunal Diversity Of The Four Taxa In Raigad District.

Site	Mammals	Reptiles	Amphibians	Birds	Total
Shrivardhan	11	13	2	34	60
Murud /Rajpuri	12	12	2	35	61
Revdanda	8	11	2	31	52
Alibag	9	10	2	30	51
Uran	7	9	2	30	48
Avarage	**9**	**11**	**2**	**32**	**57**

Figure 3 Comparison of the four vertebrate taxa diversity at the five sites in Raigad district.

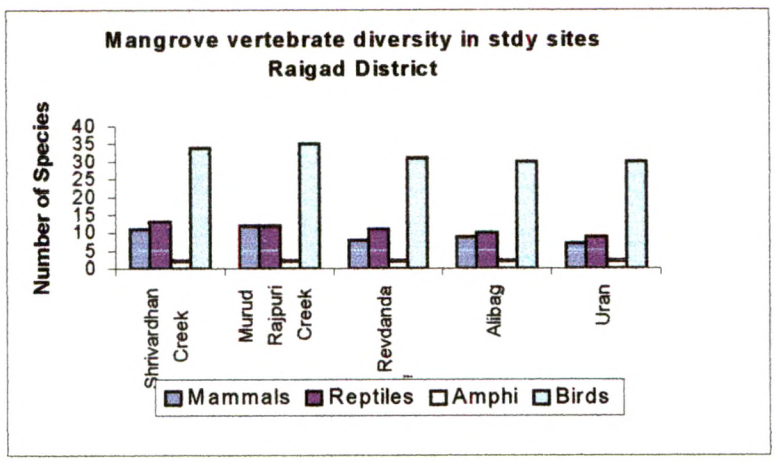


Table 3.9 Faunal Diversity Of The Four Taxa In Thane District

Site	Mammals	Reptiles	Amphibians	Birds	Total
Thane	4	3	2	17	26
Diwa	9	10	2	32	53
Mumbra	7	9	2	34	52
Vikroli	-	-	-	-	-
Vasai	4	7	2	23	36
Vaitarna	5	8	2	31	46
Dahanu	5	4	2	24	35
Avarage	**5**	**6**	**2**	**23**	**35**

Figure 4 Comparison of the four vertebrate taxa diversity at the seven sites in Thane district.

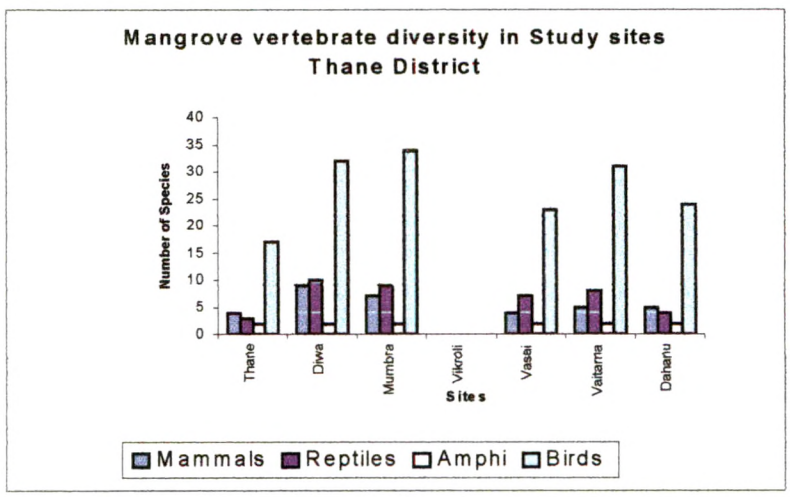


Table No.3.10 Average number of species per site in four districts

District	Mammals	Reptiles	Birds	Amphibians
Sindhudurg	8	12	29	2
Ratnagiri	8	10	31	2
Raigad	9	11	32	2
Thane	5	6	23	2
Average	8	10	35	2

Table No. 3.11 Number of orders, Families, Genera and Species in the four vertebrate taxa.

Taxa	Orders	Families	Genus	Species
Mammals	6	11	13	13
Reptiles	2	8	11	11
Birds	16	27	39	41
Amphibians	1	2	2	2

Table No. 3.12 Number of bird species with Resident/ Resident Migrant/ and Migrant status and their percentage composition.

Type	No. of Species	Percentage
Resident	31	70.45
Resident / Migrant	10	22.72
Migrant	3	6.81

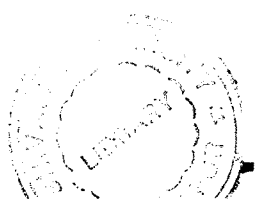
From above table it is clear that 70.45% bird species are resident in mangrove ecosystem while 22.72% are resident migrant and only 6.81% are migrant. Therefore any damage to mangrove habitat is going to affect a large number of resident and resident-local migrant species.

3.4 Human Activities in Mangrove Ecosystem

Almost 80% of the population in the coastal belt in the country depends on the near shore and backwater fish and shellfish. All sites of mangrove ecosystem in the study area provide nursery ground for the growth of fish, bivalves and prawns which is an important source of high quality protein food in local diet. Unfortunately due to over fishing, pollution and loss of nursery grounds like mangroves, there has been serious decline in fish and shellfish production on the coast of Maharashtra.

Observations during the survey indicated steady decline in the rate of fish production over the past few years. Mangrove habitat destruction in the estuaries has been considered as the major root cause for this. Local people depend on the mangrove forest for several of their daily needs. Example fuel wood needs, which is the basic need for the peoples who live bellow poverty line. During the low tide period ladies from local families cut mangrove trees for daily requirements. Mangrove site Veldur and Kelshi in Ratnagiri district are a good example, where mangroves are under tremendous threat due to fuelwood extraction.

Mumbra and Diwa mangrove forests are famous and are located along the Thane creek. This creek is known for carrying huge quantity of effluent from nearby MIDC area and sewage from New Mumbai in Thane- Belapur area. In Maharashtra,



due to increase in the developmental activities on the coast such as industrialisation, construction, harbour and road construction directly cause destruction of mangroves. Due to the industrial effluents discharged in the river Vashisthi the estuarine fish have vanished. Thus seriously resulting decline in the estuarine biodiversity.

Fish farms, mainly for prawn culture, in and around mangrove areas also create problems for fragile vegetation type due to habitat loss and change in the hydrodynamics. Mangrove area in Diveagar in Raigad district is a good example where mangroves are decreasing rapidly due to construction of tanks for prawn culture. Some prawn culture tanks are build very close to the mangroves in village Ade in Ratnagiri district where it was recorded that several colonies of Indian flying fox *Pteropus giganteus* are threatened.

Social studies

Through interview schedule information was collected, during the study from the field sites, to assess the awareness level among local people about the importance of mangrove ecosystems. The English translation of Marathi interview schedule administered during the study is given in the Annexture-VII.

It was revealed from the site study, about ownership of the mangrove/ Kharland area, that in Thane district 30% mangrove were under the ownership of forest department, 50% under the revenue department and 20% land owned by the private owners. However, In Raigad district most mangrove area belonged to revenue department. In Ratnagiri district 24% mangrove area belonged to forest department, while major portion i.e. 59% mangrove area belonged to revenue department. About 12% people gave mixed response while 3% people didn't answer this question. In Sindhudurg district, the major i.e. 68% mangrove area belonged to revenue department, 16% belonged to forest department and 8% mangrove land belongs to private owners.

Almost 100% mangrove sites in Thane were having religious places/ temples in the mangrove area such as Sarveshvara, Maruti, and Khamdev. In Raigad district 35% mangrove sites had temples while 64% mangroves did not have temples or devraies. In Ratnagiri, 80% interviewed people confirmed that the mangroves were without temples and only 15% mangrove area had temples. While 5% people could

not answer this question. While in Sindhudurg 40% mangrove area had religious sites or devraai while 60% mangrove were without any such entity.

As mangroves are extensively used as cremation site by the locals, data was collected on this aspect from all the sites studied. In Thane districts almost 90% mangroves had cremation site of particular village in the mangrove ecosystem or near to it. While in Raigad district, over 50% mangrove ecosystems had cremation site of particular village. Ratnagiri district had in 32% of the mangroves visited cremation sites. Sindhudurg had in 40% mangrove areas studied cremation site of local villages in mangrove ecosystem.

Most local residents in Thane, Raigad, Sindhudurg districts mentioned that they casually observe birds, reptiles, mammals and amphibians in the mangrove ecosystems while In Ratnagiri only 61% confirmed that they indulge in this activity.

In Thane districts 10 % people told that only 10 % animals use to visit sea shore as they lay down eggs in sandy beaches, The entire site which is close to sea shore having the Rocky shore, sandy beaches Horticulture, cultivable land and sand dunes near to the villages. Mangrove sites which are away from the sea shore having forests,

In Thane people replied maximum species of animals in the winter season. While 78% people in Raigad districts, replied maximum number of species in the winter season only. In Ratnagiri, 39% people answered maximum number of species in winter, 17% people replied they seen animals through out the year. 12% people answered animals seen in summer and winter while 5% people replied they seen the animals in summer and monsoon season, About 27% people are not able to answer this question. In Sindhudurg district 50% people answered they had seen different animals, birds in winter only while remaining are unaware of these things.

Regarding cutting of old trees, In Thane 40% people are in favour of cutting the old trees while 40% people told that they are against it. 20% people not able to answer this question. In Raigad 57% replied that they use to cut old trees, while 43%

people told they never cut the trees. In Ratnagiri 23% peoples replied positively. While in Sindhudurg 48% people are in favour of cutting the old trees.

Plantation of new horticulture species is increasingly done in all the coastal districts mainly new varieties of mango, coconut, cashew nuts etc. In Thane districts 50% people answered positively, while in Raigad 100% people confirmed that introduction of new varieties of mango, coconut, cashew nuts etc is done. In Ratnagiri 39% people answered new plantations were done, at the same time 46% people answered against it while remaining 17% ere not able to answer this question. In Sindhudurg 52% people were of the change, 44% replied against it, while 4% don't have idea regarding plantation of new species.

One of the main objectives of the study was to assess the increasing threat to mangroves. The perception was tested by the personal observations as well as from the response of the locals. The six common major parameters responsible for degradation of mangrove and thus biodiversity of the unique ecosystem at each study site were studied to evaluate the present status of the mangrove. The threat values and present status of mangrove based on them at each site is given in the Table No. 3.13

Table No.3.13 Showing threats to mangrove ecosystem at each site in the study area.

District	Site	Status			Threats					
		*	**	***	1	2	3	4	5	6
Sindhudurg	Vengurla		✓		✓	✓			✓	
	Kelus		✓		✓	✓		✓		
	Kolamb		✓		✓	✓		✓		
	Achara									
	Deogad		✓		✓	✓	✓		✓	
	Vijaydurg	✓			✓	✓				
Ratnagiri	Jaitapur		✓		✓	✓			✓	
	Purnagad		✓		✓	✓			✓	
	Pawas		✓		✓	✓			✓	
	Ratnagiri (Bhatye)		✓		✓	✓		✓	✓	
	Ratnagiri (Shirgaon)	✓			✓	✓				
	Jaigad		✓		✓	✓		✓	✓	
	Veldur		✓		✓	✓			✓	

	Dabhol	✓			✓	✓				
	Adakhal		✓		✓	✓		✓		
	Anjarle		✓		✓	✓	✓	✓		
	Kelashi			✓	✓	✓	✓	✓	✓	✓
	Veshavi		✓		✓	✓		✓	✓	
Raigad	Shrivardhan		✓		✓	✓			✓	
	Murd-Rajpuri		✓		✓	✓		✓		
	Revdanda		✓		✓	✓		✓	✓	
	Alibag	✓				✓		✓		
	Uran		✓			✓		✓	✓	
Thane	Thane		✓		✓	✓		✓	✓	
	Diwa		✓		✓	✓		✓	✓	
	Mumbra		✓		✓	✓			✓	
	Vikroli		✓		✓	✓			✓	
	Vasai		✓		✓	✓		✓	✓	
	Vaitarna	✓			✓	✓				
	Dahanu		✓		✓	✓		✓	✓	

Note: 1.Tree cutting, 2. Habitat Loss, 3. Hunting and Poaching, 4.Habitat fragmentation (construction of bridge, fishfarm, embankments), 5.Pollution and 6. Encroachment.
* Less Threatened, ** Threatened, and *** Seriously Threatened.

It was revealed during the study that out of the 29 sites studied in the four districts almost all are threatened at different degree depending on the local pressures. Among these 76.66% (n= 23) are threatened and 16.66% (n=5) are relatively less threatened, However, 3.33% i.e. one Kelashi can be considered as seriously threatened.

Table No. 3.14 Major threats to mangroves and their percentage in the study area.

Sr.No.	Threat	Percentage
1	Tree Cutting	90.00
2	Habitat Loss	96.66
3	Hunting and Poaching	10.00
4	Habitat Fragmentation	53.33
5	Pollution	63.33
6	Encroachment	3.33

It can be seen from the table 3.14 that habitat loss (96.66), as a cumulative impact of several minor factors, is the major threat to mangroves on the coast of Maharashtra. This is bound to erode the quality and quantity of biodiversity

associated with the fragile ecosystem. The second threat witnessed in most mangroves is tree cutting (90%), mainly for fuelwood purpose. The third place is taken by pollution (63.33%) which was rather surprising as its presence in most of the remote sites was initially considered to be non existent or insignificant.

Habitat fragmentation (53.33%) as a result of developmental activities indicates potentially serious threat as it is leading to total habitat loss due to construction of roads, fish farms, salt pans, Kharland bunds, and settlements. Hunting and Poaching along with over exploitation of commercial over exploitation of mangroves organisms (10%) poses a direct and serious threat to mangrove biodiversity. Though it was difficult to establish encroachment at the village level by locals or other agencies , as no proof, record or document for the same was available locally for the researcher the threat (3.33%) seems to be gross underestimate. In reality it must be much more.