Discussion:

Western Ghats is considered to be unique in ecological conditions supporting to the variety of wild animal. Overall, the Western Ghats region is having unique floral and faunal diversity with high endemism. The ecological parameters of the Western Ghats are responsible for these uniqueness.

The Chandoli National Park (previous Chandoli Wildlife Sanctuary) is the part of the Western Ghats with typical evergreen and semi evergreen ecological conditions harboring dominating semi evergreen vegetation mixed with variety of grass species in patches which supporting to the variety of herbivorous and carnivorous group of animals from Vertebrate and Invertebrate groups.

The distribution of flora and fauna is strongly intermingled with the different physical, chemical and biological parameters. The wildlife from the Chandoli National Park (previous Chandoli Wildlife Sanctuary) was protected by employing different wildlife conservative practices and wildlife management practices.

In the conservation and management of protected area specifically the ecological parameters of terrestrial ecosystem are of great significance. Hence, the detailed study of physico-chemical and biological parameters is necessary.

In the present investigation the work of studying the different wildlife conservative measures adopted by the Sanctuary/National Park authority of Chandoli National Park was undertaken. In the study physical parameters of the terrestrial ecosystem and chemical parameters were studied in detail for about four years from the selected study area. Whereas the biological parameters were studied about six to seven years for their occurrence and some functions and enlisted in checklist.
5.1 Study of Ecological Parameters:

The terrestrial ecosystem’s parameters of Chandoli National Park were studied. Different meteorological parameters such as rainfall, relative humidity, air temperature, wind velocity and water evaporation rate of study area were studied during the study period. It was found that rainfall affect the air temperature which changes the water temperature. It also changes humidity. The wind velocity changes the air temperature, evaporation rate, humidity and also affects on rainfall.

These meteorological parameters decide the climate of the area and climatic conditions decides the type and biota of the forest. In present study of Chandoli National Park (previous Chandoli Wildlife Sanctuary), reveals that the protected area consist the semi-evergreen, evergreen and deciduous type of vegetation distributed in different altitudes in sanctuary area.

5.2 Study of Water Resources

The water is an important environmental parameter in terrestrial ecosystem. The presence of the water resource in an area decides the type of terrestrial ecosystem. Being an important basic component, it is necessary for the survival of wild animal species in forest ecosystem. Most of the terrestrial ecosystems it requires for survival of plants and animals and for natural ecological phenomena.

In forest ecosystem also water has great importance. The demand of water is increasing along with increasing population and type of use (Porter, 1978). In wildlife survival and propagation of their population good quality water is essential. But limited quantity of good fresh water is available on earth, yet the demand of water is continuously increasing (Dunne & Leopold, 1978).

5.2.1 Survey of Water Resources

The study area, Chandoli National Park is part of Western Ghats, which is covered by thick vegetation. The hills of Chandoli National Park receive heavy rainfall up to 4764 mm per annum. The rainwater is drained away very fast by streams and rivers and some water percolates in top soil and rocks. The small streams and rivulets of hilly area become dry during summer and create shortage
of water to wildlife and people. Similar problems were observed by Basak et al. (1986) and reported that thickly vegetated high range hills of Western Ghats were sparsely populated and facing water shortage problem.

In the study of water resources in relation to man and wildlife, it was observed that the factors such as climate, geology, drainage, rainwater absorption, vegetation, soil and man-environmental relationship etc. are related to the water problems. The water supply in hilly area to the wild animals is one of the important problems and that is availability of water in summer. Therefore people have to find new fresh water resources or develop existing water resource for wildlife (Basak et al., 1986).

In Chandoli National Park the south west monsoon season sets in June to September. Pre-monsoon showers started some times in April, mostly it continued until the mid of September. During the period of October to May there was either no rain at all or it was in small quantities. The protected area received the major rainfall during the months of July and August when the area remains covered with fogs. Chandoli National Park received the total rainfall ranged from 2001 to 4764 mm. during study period.

The approximate percentage of rainfall received during the various period of the year was June to September- 96 %; October to January- 3 %; February to May- 1%. Number of rainy days was approximately in the range of 110 to 120 every year.

During the study period it was observed that the important water source in Chandoli National Park was Vasantsagar reservoir. The spread of water is 45 Sq.Km and extended up to 30 km. deep in the heart of sanctuary. Along with this Warana, the main river and its tributaries Ram, Bhogiv and Karade are perennial rivers originate in protected area. In addition to this, there were 18 perennial and 35 seasonal streams drained in to Vasantsagar reservoir. 34 perennial, 48 seasonal and 74 artificial water holes were recorded in protected area.
The protected Park area had originally 32 villages located within with 7894 human population. Currently, it was observed that only 4 villages of that remained within forest area, named Gothane village of Ratnagiri district and Male, Kolane and Patharpunj villages from Satara district as per the record of forest department, the rest of villages have been rehabilitated. But we observed the some villages with few huts in the area of Khundalapur, Sonarli, Dhakale, Durgewadi etc. in the park area were with their livestock. The source of water to these remained villages was appropriate in rainy and winter season as the source of waters were full but in summer season it was observed that there was scarcity of water in some parts. The 80% of protected area is effectively covered with water facility remaining 20% of park area in higher reaches of Gave, Chandoli Khurd, Male, Patharunj, Rundiv, Javali were facing the problem of water source by local people, domestic animals and wildlife. In present study the demand of water was high during summer season but the supply was limited. Thus, the development and management of water resources at Chandoli National Park is essential.

5.2.2 Selection of important resources for seasonal monitoring of water quality:

The water quality is an important factor which decides its utility. For the good health of wildlife there is need of good quality water. Hence, the study of water quality has been undertaken for the quality assessment. The representative sampling sites from the Chandoli National Park area were identified for quality study. For the quality study of water resources from Chandoli National Park, four representative sampling sites were selected.

The sampling site A was the back water of Vasantsagar reservoir. The water of which was used by wild animals, domestic animals and humans for drinking. The sampling site B was the pond near hide at Zolambi. The water of this resource was used by wild animals and domestic animals for drinking. The sampling site C was the spring near Zolambi temple. The water of this resource was used by wild animals, domestic animals and humans for drinking. The
sampling site D was stream near Ukhalu village. The water of this stream was used by villagers for drinking and other purposes as well as by the domestic animals for drinking purpose. Hence, the quality study of these representative sites has been undertaken.

5.3 Physico-chemical parameters:

The quality of water varies according to type of use and purpose, because water having certain composition may be useful for particular use only and may not be for other. Therefore, the quality of water is essentially important, in deciding the waters suitability for some important uses. It must be free from chemical substances and microorganisms which are hazardous to health.

To decide the line of treatment of water resource for purification, present data of seasonal physico-chemical parameters will be helpful. Safety of drinking water is decided by the quality and quantity of dissolved chemicals. Water is a good solvent; number of water soluble toxicants is rapidly transferred to natural water resources by leaching. Presence of toxic chemicals in drinking water may create threat to living organism and human. Rao & Paranjape (1991) studied the drinking water resource and reported occasional increase of toxic contents. The water quality of different water resources were studied by various workers (Saikia et al., 1986; Dora & Ray, 1987; Sengupta et al., 1988; Kakati and Bhattacharya, 1990; Sivakumar et al., 1990; and Srikant, 1993).

The result of present water quality study indicates that water is of good quality for use of wild animals. The similar results of water quality from hilly area were reported by Bharadwaj et al. (1993). The river water quality from Doon Valley forest was studied by Omkumar (1995) and reported analogous results and found better quality of water and physico-chemical parameters were in permissible limits.

Any organic and inorganic impurities if mixed with water and remain suspended and dissolved form it makes water unfit for domestic use. In the present study of physico-chemical parameters of stream and pond water, it was found that
the quality of water was better and can consume by wild life and human. Similar results were reported by some workers in India (Towhead et al., 1988 and Pandey et al., 1992).

There is single man-made reservoir, Vasantsagar reservoir in study area. The physico-chemical parameters of back water were more or less stable and there was no drastic change in water quality during seasonal study, because the input water was of better quality. Similar results were reported by Antwi & Danson (1993) in Kpong reservoir from Ghana.

Place to place variations in physico-chemical parameters were recorded in seasonal study of water resources from Chandoli Forest area. The parameters such as external appearance and colour, temperature, pH, total solids, total dissolved solids, total suspended solids, dissolved oxygen, carbon-dioxide, acidity, alkalinity, chlorides, hardness, calcium, magnesium, residual chlorine, hydrogen sulphide, sodium, potassium, nitrates and phosphates were studied and found that parameters were in range of permissible limits.

5.3.1 Physical parameters:

The physical parameters such as external appearance, temperature, pH, total solids, total dissolved solids and total suspended solids of selected water resources were studied.

5.3.1.1. External appearance:

External appearance and colour of water of different water resources were studied in study area; it was observed that, the first few rains in rainy season caused erosion of soil from the slope of hilly region. The clay and other suspended particle caused turbid water and appeared reddish–brown colour. In rainy season, after the growth of grass and vegetation on the top soil, input of suspended soil decreased in water bodies. In rest of the year it appeared crystal clear. In the present study the results are in agreement with published literature on water quality of hilly ecosystem (Bharadwaj et al., 1993).

5.3.1.2 Temperature:
Temperature is an important factor which affects the physical, chemical and biological condition of water. High temperature accelerates the chemical reaction and reduces solubility of dissolved oxygen. In the present seasonal study temperature of different water resources was ranged between 19.10 ºc to 28.25 ºc. The variation of temperature in different water bodies may be due to depth, type of water body and surrounding vegetation. Such variations were recorded by various workers (Adholia, 1986 and Joshi, 1996). The minimum temperature was recorded during winter season. Khan & Chowdhury (1994) have reported similar results. Singh (2000) has reported water temperature range from 16.1ºc to 33.2 ºc and 15 ºc to 34 ºc during 1982 and 1983 in Ox-Bow Lake.

5.3.1.3 pH:

pH value of water is an important index of acidity and alkalinity, which results due to acid-base interaction of minerals and organic compounds. In the present study variation in pH was recorded at various sampling sites in different seasons. Slight higher pH values were observed during winter and ranged annually within 7.23 to 7.69, which are closer to the standard limit (6.8 to 7.3). Ramana Murthy et al. (1994) recorded pH of river water range 7 to 7.5. According to Murugesan et al. (1994) the river water seems to possess high buffering capacity and that maintain pH in certain limit. Similar buffering mechanism may be responsible for maintaining pH in particular range, as observed in present study.

The seasonal changes in pH of the water bodies have been noticed by many research workers (Angadi, 1986; Sathe et al., 2000; Bhosale et al., 1994; Goel et al., 1985; Kadam, 1999; Tiwari, 1999; Pandey et al., 1999).

5.3.1.4 Total Solids, Total Dissolved Solids and Total Suspended Solids:

A total solid is an important factor in water. It is formed by dissolved and suspended particles in water (Kudesia, 1985). If the content of total solids is excess in water it is harmful to aquatic biota. The striking feature of the water resource at study area was average low total solids, total dissolved solids & total suspended solids content except early rainy season. It was because of vegetation
cover and type of rock, as discussed by Wright (1982). The total solid in ground water was low, similar results were reported by Bhavanishankar & Muthukrishnan (1994); Bhosale et al. (1994).

5.3.2 Chemical Parameters:

The chemical parameters such as dissolved oxygen, carbon-dioxide, acidity, alkalinity, chlorides, hardness, calcium, magnesium, residual chlorine, hydrogen sulphide, sodium, potassium, nitrates and phosphates of selected water resources were studied.

5.3.2.1 Dissolved Oxygen:

Dissolved oxygen (DO) assists in various oxidative biochemical processes and is one of the important factor in quality of water. The minimum DO was observed during summer may be due to increased temperature and utilization of oxygen for decomposition as mentioned by Nautiyal (1985) and Chauhan (1991). Some workers (Pandey et al., 1993, Khan & Chowdhury, 1994; Jain & Seethapati, 1996 and Chetanasuverna & Somashekar, 1997) have reported similar results.

The content of dissolved oxygen reported between 5.51 to 9.85 mg/lit. for Ped water reservoir (Sathe et al. 2000). Bhosale et al. (1994) has given lower range of DO between 3.1 to 5.7 mg/lit. for water bodies from Sangli district. Bahura (1998) has reported dissolved oxygen values of 2.82 to 9.97 mg/lit. during summer for Eutrophic temple tank at Bikaner. Pandey et al. (1999) have reported seasonal variations in dissolved oxygen content from fresh water tropical lake. Bhatt et al. (1999) have reported lowest dissolved oxygen values during winter from Taudaha Lake in Nepal.

5.3.2.2 Free Carbon-dioxide:

In present study carbon-dioxide content of various water resources was high during summer because of low photosynthesis and presence of aquatic animals. Haniffa et al. (1994) observed and reported similar variations in concentrations of carbon-dioxide at different sites in water resources.
Free CO$_2$ varied from nil to 10 mg/lit. in Badkhal lake (Kaushal & Sharma, 2001). The value of CO$_2$ in water is changing inversely by presence of carbonates and aquatic plants. Singh (2000) has reported range of CO$_2$ from nil to 32.2 mg/lit. and nil to 51.0 mg/lit. during 1982 and 1983, in Ox-Bow lake.

5.3.2.3 Acidity and Alkalinity:

Acidity and alkalinity is due to salts of weak base, weak acid and bi-carbonates. Highly acidic and alkaline water is not potable. In present study at all sampling sites have recorded moderate alkalinity and acidity, keeping parameter in permissible limit as reported by Kant and Raina (1990).

5.3.2.4 Chlorides:

In the present study the concentration of chloride was in the permissible range and has shown slight variation at different sites, as reported by Khan & Chowdhury (1994). The increase in chloride content was recorded in summer season, which may be due to wildlife excreta. Jain & Seethapati (1996) have reported similar increase in chloride content of lake in the month of March and concluded that increase was due to low inflow of water.

Human and animal excreta are rich in chlorides. For public health, chlorides up to 250 mg/lit. are not harmful but increase of chlorides beyond this are indication of organic pollution (Kudesia, 1985). Chlorides are generally present in low quantity in water (Bond & Straub, 1973).

5.3.2.5 Calcium, Magnesium and Hardness:

The presence of Ca and Mg along there carbonates, sulphates and chlorides make water hard, which is not suitable for domestic use. In present study the moderate Ca, Mg and hardness was observed in stream and reservoir water. Similar results were recorded by Jain and Seethapati (1996) in fresh water. The Ca, Mg and hardness of pond water was high during rainy and winter season, which may be due to excreta of wildlife and leaching.

According to Sathe et al. (2000) Ped reservoir water ranged between 134 to 155 mg/lit. Bhosale et al. (1994) has reported 83 to 100 mg/lit. values of hardness.
for few water bodies from Sangli district. Bahura (1998) has reported range of 68 to 1482 mg/lit. of hardness for water of eutrophic temple lake of Bikaner. In Bada Talab, Singh & Rai (1988) reported high calcium content, may be due to sewage pollution.

5.3.2.6 Residual Chlorine:

The residual chlorine content of selected water resources were measured during study period. It was found that the residual chlorine was absent at all sampling sites during the study period.

5.3.2.7 Hydrogen Sulphide:

Trace amount of sulphides are present in ground and surface waters due to reduction of sulphate. It is found in higher concentration when organic matter is high and redox potential is low (reducing condition). Microorganisms use sulphate as electron acceptor to decompose organic matter and convert sulphate in to sulphide. Certain microorganisms are also capable of reducing elemental sulphur in to sulphide. It is therefore considered as indicative of organic pollution and prevailing reducing conditions.

In present study the value of $H_2S$ content of different water resources was noted low, which indicate the absence of any organic pollution. U.S. Environmental Protection Agency has put a limit of 0.05 mg/lit. $H_2S$ considering minimum level for production taste (Trivedy & Goel, 1986). The $H_2S$ content in lakes was studied by Frey (1967); Boyko (1978); Jhingran (1983).

5.3.2.8 Sodium:

Sodium is present in all natural waters and its salts impart water with softness (in contrast to hardness). This element plays a minor role in aquatic systems and its importance to all organisms has not been fully understood except the role it plays in ion exchange and transport.

The average minimum and maximum values of sodium as 14.80 and 43.60 mg/lit. respectively was reported in Ped water reservoir by Sathe et al. (2000).
Tiwari (1999) has also worked on water quality at Upper Lake water in Bhopal and reported same results.

5.3.2.9 Potassium:

Potassium is an important element present in water and plays role in the metabolism of fresh water environment. It is found in smaller amounts than sodium. Due to its importance as enzyme activator, cell membranes continuously pump in potassium and pump out sodium, consuming large amount of energy (Adoni et al. 1985).

The monthly variations of potassium were studied by Sathe et al. (2000) and Tiwari (1999) in fresh water reservoirs and reported same results.

5.3.2.10 Nitrate:

Nitrate content in water is received from atmosphere and fertilizer runoff from agricultural field, generally the nitrate content in natural water resource, such as spring, stream and river is very low. The prescribed limit of nitrate in drinking water is given 45 mg/lit by ISI (1983). In present study, higher nitrate was recorded in winter and summer season in sampling site B. The nitrate content exhibits significant inverse relationship with dissolved oxygen. Similar observations were made by Munawar (1970) and concluded that water rich in particulate organic matter and suspended soil particle is rich in nitrates, though the input is not from sewage. The nitrate content in river was studied by (Shivakumar et al. 1990) and reported similar trace of nitrate at all sampling sites.

In present observation nitrate content of different running water bodies was noted low as compared to other pond and reservoir water. Little increase in nitrate content of stagnant water body may be due to release of nitrogenous waste by wild and domestic animals as reported by Joshi (1996).

5.3.2.11 Phosphates:

Phosphorus in the natural fresh water is present mostly in inorganic forms such as $\text{H}_2\text{PO}_4$, $\text{HPO}_4$ and $\text{PO}_4$ ions. Phosphorus being an important constituent of biological system may also be present in the organic forms.
In the majority of fresh water systems it is found that phosphate is generally the limiting factor. This is due to the presence of blue-green algae, which are common in fresh water systems. It is a major plant nutrient (Black, 1977).

In natural water, Phosphorus is present in very small quantity. Phosphorus in water body occurs in both organic and inorganic forms. The occurrence and abundance of phosphorus largely depends upon the geochemical changes. The sediment flora is important in increasing concentration of phosphorus dissolved in interstitial water of sediment (Flescher, 1978). It leads to algal growth and eutrophication.

The values of phosphates are below 1mg/lit. for Ped water reservoir (Sathe et al. 2000). Khatavkar et al. (1989) have reported lower values of 1 mg/lit. for water bodies in Kolhapur and Aundh. Krishnan et al. (1999) have also reported very small concentration (0.01 to 0.02 mg/lit.) for water of eutrophic temple tank in Bikaner. Singh (2000) has reported value of phosphate 0.12 mg/lit. in January to 0.26 mg/lit. in July 1982 and 0.1 mg/lit. in December to 0.25 mg/lit. in July 1983.

Overall, the physico-chemical parameters of most of the sampling sites are in permissible limit and can be used by wildlife.

**5.4 Vertebrate (Tetrapoda) Fauna of Chandoli National Park:**

Western Ghats region is rich with floral and faunal biodiversity with high endemism. The floral and faunal diversity is essential to the mankind for the future development. The occurrence of floral and faunal diversity is necessary for the balanced environmental conditions. Hence, the conservation of diversity is necessary to the mankind.

The Western Ghat’s region is being exploring by man for various purposes and exploiting various kinds of the natural resources for the development. The different kinds of developmental activities such as modern agricultural practices, mining activities, road constructions and construction of major dams etc. are being carried out. The adjoining area of Chandoli National Park (previous Chandoli Wildlife Sanctuary) area is not an exception for the same, degrading the
surrounding environment. It is evident that, the human’s developmental activity degrades the surrounding environment and creates certain problems. The degraded environmental conditions exert the pressure over the biotic components of ecosystem. Ultimately the degraded environment causes stress and pressure on the wild flora and fauna. Hence, to recover the degraded biotic components of environment, implementation of wildlife conservative measures and management practices are necessary.

The Western Ghat’s region is full with biodiversity, there is need to understand the existing biodiversity accurately along with there status in their habitat, because various kinds of human developmental activities are going on in Ghats region. The Chandoli National Park area is one of the luxurious vegetation covered area from Western Ghat’s with variety of flora and fauna. The occurrence of endangered species (Tiger) highlights the importance of this area as a probable tiger reserve in future. Hence, there is an urgent need to study the animal diversity of the region.

In the present investigation the preparation of checklist of Vertebrate (Tetrapoda) species from the Chandoli National Park (previous Chandoli Wildlife Sanctuary) has been undertaken and compared with earlier publish checklist. The fauna from amphibia, reptiles, aves and mammals were studied for the preparation of checklist.

5.4.1 Amphibia:

An analysis of total faunastic wealth of amphibians is expressed as the presence of 16 species belonging to 13 genera distributed over 4 families. Among these, Ranidae was found to be most dominant family with 8 species. Pande & Pathak (2005) have reported only five species of Amphibians from the Chandoli forest area. The outcome of present study about amphibian diversity when compared with Pande & Pathak’s (2005) observations, eleven additional species of amphibians were found in the same study area.
Ravichandran and Pillai (1990) reported 14 species of Amphibians from Periyar wildlife sanctuary with the discovery of a new species of Amphibia, Torent toad. They also reported 14 species of Amphibia from Sabargiri forest, Kerala (Pillai & Ravichandran, 1990). Dahanukar & Padhye (2005) while working on Amphibian diversity and distribution in Tamhini, northern Western Ghats, India have reported 23 species of Amphibians with Ranidae family as a dominant group.

5.4.2 Reptilia:

A total of 57 species of reptiles were encountered in the Chandoli National Park during the study period. They belong to 41 genera distributed over 14 families. Among these, family Colubridae was recorded to be most dominant family representing 23 species. Ahemad & Dasgupta (1991) enumerated 21 species of lizards and snakes of north Bihar. 13 species of reptiles have been reported from Namdapha National Park (Sanyal & Goyen, 1985). The herpatofaunal updated checklist of Isla de Margarita, Venezuela presented 5 Amphibians and 43 Reptiles with some new taxonomic comments on the meagerly known species with 6 new records (Gilson et al. 2005).

In present study total 57 species of reptiles were observed in the study area where as Pande & Pathak (2005) reported only 21 species. The study area is rich in reptilian diversity.

5.4.3 Aves:

The birds are the good indicators of environmental conditions. Most of the bird species prefer to live in better environmental conditions. They are indicators degraded environment specifically if there is any kind of imbalance in environmental parameters then, birds may change their habits or they may migrate to better environmental condition habitat. For example if there is a scarcity of food in their habitat then, they may alter in reproductive cycles and shifts breeding period for specific time.
In present study, the avifauna from Chandoli National Park area was screened meticulously for their presence. The existence of species was confirmed by direct observation, from vocal display and from nests and art effects.

Indian subcontinent represents about 2094 forms belonging to 1200 species of avifauna (Ali & Ripley, 1983 and Ripley, 1982). Out of which 203 species of birds belonging to 141 genera from 47 families were recorded in Chandoli National Park (previous Chandoli Wildlife Sanctuary) area. Among these, family Accipitridae was recorded to be most dominant family representing 18 species. This abundance and diversity of avian community obviously indicate the high ecological diversity of the National Park. The number of species richness comparable to other National Park and wildlife sanctuaries in Maharashtra Pande and Pathak (2005) have reported 134 species of birds from Koyana wildlife sanctuary, 204 species from Radhanagari wildlife sanctuary and 114 species from Sagareshwar wildlife Sanctuary.

Among the bird species reported in the present investigation, 23 of 203 species of birds are winter visitors. Pasha et al. (2004) had listed 262 species of birds from Pench tiger reserve with 162 resident, 70 winter visitors, 3 summer visitors, 25 local migrants and 2 vagrant/straggler species. 124 species of birds were listed from Calicut University campus by Muhamed & Pramod (2000).

Reginald et al. (2007) have reported 116 species of birds belonging to 44 families and 17 orders with Passeriformes as dominated family including 43 species of birds from Singanalore Lake, Coimbtore, Tamil Nadu.

Anand Mohan (2000) in his case report on birds in and around Sri Benkateshwara wildlife sanctuary has reported total of 178 species of birds belonging to 49 families.

The complex and high altitude hilly region and all the topographical and climatic conditions have great influence on the biotic diversity and their distribution which affect the life of birds inhabiting the various altitudinal belts. Various studies have been made on the distribution of birds from the tropical and
temperate zones of the Indian subcontinent. The diversity studies on the birds of Talra wildlife sanctuary in lower western Himalaya revealed the presence of 61 species of birds belonging to 19 families. Among them 32 species were resident and confined (endemic) only to Himalayan ecosystem (Mahabal, 2000). Previous studies of Pande & Pathak (2005) report 125 species of birds from Chandoli National Park. As compared to Pande & Pathak’s report about 78 additional species of birds were found in present investigation, which indicates the high avifaunal diversity in an area.

Among the bird species reported in the present investigation, red Pycnonotus cafer, Acridotheres tristis, Megalaima heamacephala, Corvus macrorhynchos, Chrysomma sinense, Dicrurus macrocercus, Lanius schach, Myiophonus horsfieldii, Merops orientalis etc were most common species found in Chandoli National Park and Gyps indicus, Gyps benghalensis, Haliaeetus leucogaster, Bucuros bicornis, Ocyceros griseus, Treron pompadora, Treron phoenicoptera, Psittacula columboides, Columba elphainstonii were rarely observed. The appearance of birds in Chandoli National park was observed throughout the park area.

5.4.4 Mammals:

Different regional studies on the mammals from India have been extensively surveyed by many workers with respect to their diversity, abundance and distribution. Our studies on Mammals of Chandoli National Park revealed 34 species of mammals belonging to 30 genera distributed over 19 families. Among these, family Felidae was recorded to be most dominant family representing 4 species. The earlier report given by Pande & Pathak (2005) from present study area reveals the presence of 26 species of Mammals. In present study eight additional species of mammals were found in Chandoli National Park area.

In India, Sharma (1992) studied the mammals of Haryana and enlisted 30 species of Mammals among the 172 species of vertebrates from Sanjay Gandhi National Park.
The mammalian diversity reported by Pande & Pathak (2005) declares 25 species of mammals from Koyana wildlife sanctuary, 44 species from Radhanagari wildlife sanctuary and 17 from Sagareshwar wildlife sanctuary.

Tiwari & Mukharjee (1992) have given the status of Rhesus Macaque and Hanuman Langur from India. But the information regarding the rodents, bats is still meager from this region.

Among the mammal species reported from Chandoli National Park *Panthera tigris*, *Hyaena hyeana*, *Tetracerus quadricornis* and *Canis aureus* were sited very rare. The *Bos gaurus*, *Sus scrofa* and *Meleurus ursinus* were observed throughout the park area with increase in their population comparatively.

5.4.5 Food species of wild animals:

The occurrence of important carnivorous species highlights the importance of Chandoli National Park area as a future tiger reserve. The presence of prey species in an area in specific number is essential one. The prey species carrying capacity is decided by the occurrence of food species. Overall in ecosystem’s function there is a need of the organisms in appropriate number so as to sustain the ecosystems function through food chain and food web. Hence, there is need to assess the availability of food species for the prey animals. Therefore, the occurrence of variety of food plant species of selected eleven wild animal (mammal) species was worked out.

The natural distribution of herbivores is ultimately governed by the natural distribution of the vegetation. The mammals are dependent on the primary production of organic matter by the plants. Finally the productivity of mammals of any habitat would therefore, be related to the primary productivity of the vegetation. The food plants of all herbivores and omnivores vary according to the species and their respective habitats. The mammalian fauna would depend critically on the specific form in which plant productivity is canalized. Thus, grazing herbivores would not be able to sustain them in an evergreen forest with almost no growth of grass on the forest floor. Frugivores dependent on fleshy
fruits would on the other hand find abundant food in an evergreen forest. It is therefore more instructive to compare the major natural vegetation of Chandoli National Park.

Field observations on food plants of mammals in the Chandoli National Park indicate that total 41 herbs, shrubs, climber and tree species preferred as a food by the animals.

Studies on the grasses as food of grazing herbivores yielded, 15 species of grasses were preferred as a food (mostly by deer and bison). Gad & Shyama (2009) studied on food and feeding habits of *Bos gaurus*. It is considered as a major herbivore and it is treated as a parental stock for domestic animals. They reported that, gaur feeds on 32 species of different herbs, shrubs and trees. It indicates that gaur prefer variations in their feeding habit.

The record of feeding habit of gaur in present study area exhibit that, gaur feed on grasses and 7 species of herbs viz. *Carvia callosa*, *Acacia concina*, *Atlantia racemosa*, *Atlantia monophylla*, *Zizyphus rugosa*, *Carrisa carandus*, *Grewia spps*. As far as concerned to the trees, it feeds on the leaves of 19 tree species throughout the year. Out of which most commonly observed food plants of gaur are *Butea monosperma* (tender leaves), *Syzigium cuminii*, *Ficus racemosa* (fruits), *Cassia fistula* (fruits).

But the regular food plant of gaur is not confirmed because it changes its food plants according to the seasons in the year. During the monsoon season, it feeds on the grasses and especially on the tender leaves of *Carvia callosa*, in winter season it feeds on *Acacia concina*, Bamboo and others and in summer season it feeds on the fig, roseapple, dry grasses etc. These observations on food plants are confirmatory with the Gad & Shyma (2009) and Shulka & Khare (1998). They have also reported that the gaur grazed and browsed on much wider variety of plants than any other ungulate species in India with a preference for the upper portions of plants such as leaf blades, stem, seeds and flowers of grass species. But in contrast to this, some earlier studies revealed that gaur fed
selectively in grass dominated areas and primarily grass eaters (Krishnan, 1972; Peden et al. 1974; Reynolds & Hawley, 1987; Sathyanarayana & Murthi, 1995).

Srivastava et al. (1996) carried out the microhistological studies on the food habit of Sambar, Gaur and cattles in Periyar Tiger reserve. Although, Sathyanarayana & Murthy (1995) reported that gaur prefer both finer and coarser grasses. We experienced the same observations.

According to Janzen (1984) the foliage of small seeded plants may function ecologically as a fruit, attracting large herbivores just as arils and fleshy berries attract and reward frugivores. The large herbivores ingest and pass small seeds in the fecal matters. It may help in the seed dispersal of the plants and it would support to the natural vegetation.

While the studies on the probable food plants of deers, squirrels, wild boar, bats, Langur and macaque revealed that the food preference varies according to seasons and availability of plant species. Sambar, barking deer, chital and four horned antelope were found to be feed on the grasses during the rainy (late) season. Chital are known to feed on more than 160 species of plants (Schaller, 1967 and Johnsing & Sankar, 1991). But Mishra (1982) considered chital primarily a grazer. According to the Hofmann (1985) chital is an intermediate or mixed feeder. Rodgers (1988) reported that chital is generalized feeder with a diet consisting of grasses, forbs and leaves of woody plants.

Zheng and Bao (2007) studied on the seasonal food habits of the black muntjack (Muntiacus crinifrons). They have reported that, it feeds on 43 different plant species in Gutianshan and Jiulongshan natural reserve.

Sambar has larger population in southern Asia. Primarily, during the study period, it was found to feed on the grasses. It also feeds on the coarse vegetation. Padmalal et al. (2003) studied on the food habits of sambar at Horton Plains National Park, in Sri Lanka and reported that, it feeds on the leaves of dicotyledons, ferns, twigs, bark, bamboos, Pennisetum sp., Agrotis sp., etc. Hare was found to be feed on grasses.
During the field observation on the food plants of squirrel indicates that it feeds on the fig in summer and also found to feed on the fruits of *Acacia concina*. Deng *et al.* (2004) reported that stripped squirrel (*Tamiops swinhoei hainanus*) was found robbing nectar from ginger plants in tropical forests of south Yunnan, China. Squirrels also visit the inflorescence.

The giant squirrel prefers fresh fruits of *Bombax ceiba* and jackfruit in the present study area. Kuo & Lee (2002) studied on the food habits and availability of Indian Giant flying squirrel in Taiwan. They reported that giant flying squirrel consumes 79 species specific parts belonging to 30 plant species from 19 families.

Wild bores live in groups called sounders. They eat almost anything they come across, including grass, nuts, berries, roots, tubers, fugue, insects, small reptiles (Prater, 2005).

The studies of Omnivores in the National Park revealed the presence of wild boars, sloth bears, porcupines and bats. Sloth bear was found to feed on the termites, fruits of golden shower, honey, fruits of roseapple, fig and ants in Chandoli National Park. The common Indian porcupine was found to feed on the decayed bones, roots, on the fallen horns of sambar, chital, etc.

A total 5 members were found from the order chiroptera in the study region, of which only one is found to be omnivores that feed on grasshoppers and other insects and the rest are herbivores, prefers flowers of *Bombax ceiba* and fruits of various plants.

House mouse and house rat were found to feed on nuts and dried fallen seeds of the plants.

Studies on the food plants of bonnet macaque and hanuman langur indicates that, they feed on fruits and leaves of fig, belleric myrobalan, roseapple, jackfruit, mango and guava, flowers of *Bombax ceiba, Bombax monosperma* and on the leaves of Atlantia.

**5.4.6 Threatened Species:**
During the present investigation the study was carried out for checking the status of different threatened species found in Chandoli National Park. It has been found that 26 different species of Vertebrate (Tetrapoda) found in protected area comes under different categories. Studies on Vertebrate (Tetrapoda) of Chandoli National Park indicate the presence of high number of vertebrates in study area.

From the class amphibia, 1 species in endangered and 5 species are in vulnerable category. From the class reptilia, 3 species in vulnerable and 1 species in rare category. In earlier reports of threatened fauna of India, 33 species of reptiles have been declared as threatened species. As far as amphibians are concerned, 148 species are declared as threatened species (IUCN, 2008).

Among the bird species reported in the present investigation, 2 are critically endangered, 5 are endangered and one is vulnerable (IUCN, 2008). Out of 34 species of mammals from the present study region, 5 species found to be vulnerable, 1 species is threatened, 1 is near threatened and 1 is endangered (IUCN, 2008). Mouse deer and Indian Pangolin are included in schedule-I (Indian Wildlife Protection Act-1972). Nameer et al. (2001) studied the mammals of Western Ghat’s. They have reported 135 species of mammals in 77 genera scattered over 29 different families in their result. Among them, 16 species are endemic to Western Ghat’s and 13 are threatened.

5.4.7 Endemic Species:

Western Ghats is one of the world’s 25 biodiversity hotspots with many species of plant and animals endemic to the region (Myers, et al., 2000). Many workers have worked on the endemic animals of Western Ghats. Dahanukar & Padhye (2005) reported 89 species of amphibians; Daniel (2001) reported 97 species of reptiles; Praveen & Nameer (2009) reported 16 species of birds and Nameer et al. (2001) reported 16 species of mammals endemic to the Western Ghats. In the present investigation four species of amphibians, five species of birds and one species of mammals endemic to the Western Ghats found in Chandoli National Park.
5.5 Conservative Measures at Chandoli National Park (previous Chandoli Wildlife Sanctuary):

According to FAO’s definition, if more than 50% of the area of country falls within the tropics, it is designated as tropical country. Thus India situated between latitude 8 degree 4 minute and 37 degree 6 minute N, is a tropical country but has a substantial area out side the tropics.

While tropical deforestation was thus progressive steadily the environmental value of tropical forest was also being slowly recognized worldwide, particularly after the 1960s. The role of natural forests in maintaining the climate, soil, hydrological regime, biodiversity, the global carbon balance and the overall security of the local people’s livelihood was recognized. Campaigns against the indiscriminate destruction of tropical forests gathered momentum. The large number of local and international voluntary organizations was established to push the cause of conservation, with particular emphasis on tropical forests. Although, many of them had a negative agenda, opposing all sorts of developmental activities, their dramatic and emotional campaigns helped to create wide public awareness of the ecological importance of tropical forests. As a result, National governments and international bodies such as UN agencies took initiative in conservation action. For example, roughly 10% of the world’s tropical forest is now set aside as National Parks or undisturbed reserves. In some cases like hilly state of Kerala in India, for instance, as much as 25% of about 1 million ha of forest has been designated as wildlife sanctuaries and national parks. In spite of this awareness, deforestation in the tropics continues for various purposes. As Whitmore (1998) observed, ‘logging proceeds as fast ever and moves on to fresh countries’. The tropical forests of south and southeast Asia have been heavily depleted (Nair, 2007).

Although the progress of deforestation was concomitant with the growth of the human population, and some of it was essential to ensure civilization, recent
decades have witnessed and unprecedented destruction of tropical forests with the growth of pulp and paper industry. Can we continue to destroy the tropical forests as the current rate of 17 million ha annually, and degrade much of the remaining area, without endangering our own future survival? Can we manage the remaining tropical forest, of atlas a reasonable chunk of it, in a sustainable manner? So we will continue to be sustained by it (Nair, 2007).

Evans (1992) has estimated that, tropical and subtropical forest plantations covered about 6.7 million ha in 1965, about 21 million ha in 1980 and 43 million ha 1990. A recent study by the FAO (Pandey, 1997) puts this figure at 55.4 million ha for 1995, representing nearly 45% of the global area of forest plantation.

Conservation not merely means the protection but it includes sustainable use, preservation, protection and proper management of resources. Conservation of biodiversity can attempt at three levels: genes, species and ecosystem. Maintenance of ecosystem diversity implies conservation of species which constitute that ecosystem conservation of species diversity will take care to some extent of both ecosystem and genetic maintainace and hence mainly people consider in pivotal to the conservation of biodiversity. Some people however, lay emphasis on ‘habitat or ecosystem’ based approaches for conservation (Krishnamurthy, 2004). So it is essential to target on the species or biodiversity conservation and habitat conservation
5.5.1 Species Conservation:

The species conservative measures are principally employed for the improvement of specific species status from threatened to abundant species. Generally in the species specific conservation programme the habitat of identified endangered species is improved and the specific requirement of the species such as salt requirement or the protection from hunter and any other specific requirements are provided in their habitat. In the Chandoli National Park (previous Wildlife Sanctuary) to some of the wild species specific conservative programmes were implemented. As a National Park, now day’s holistic conservative programmes for all wild specie are implemented.

5.5.1.1 Awareness among the students and villagers

Many scientists have worked on the decline in different species of plants and animals. The different anthropogenic activities caused the stress on biodiversity. Hence, it is very essential to understand everyone, the activities causing the adverse effect on the biodiversity and the role to be performed by them to conserve the biodiversity. For this biodiversity conservation and awareness programmes about the same are required. The awareness among the students and common people is essential one. Zhang et al. (2008) have also reported the effectiveness of awareness activity in conservation programme rather than the implementation of laws, rules and regulations.

The conservation of biodiversity is impossible without the support and participation of the people associated with forest. Mishra & Sherpa (1987) have reported such type of simple, effective and affordable measures taken by people to preserve their natural resources in Nepal.

In present investigation it was observed that the forest department has carried out some awareness programmes in and in vicinity of the Chandoli National Park area. But such activities are required to enhance in the adjoining area by taking the support of Governmental and Non-Governmental organizations.

5.5.1.2 Introduction/Reintroduction of Species:
Zoo-born offsprings have been reintroduced when habitat was available and geo-political conditions offered hope of future management in the recipient states or countries. Ryder (1991) reported on the biological and political problems encountered during an attempt to arrange the reintroduction of the Mongolian wild horse in to its country of origin.

In some cases, reintroduction has had notable success – witness the return of the Pere David’s deer to the wild in China. However, not all projects reported that only 16 could be considered a complete success (with a minimum of 500 free – ranging animals in a population), although several projects had partial success and some were in the early stages of reintroduction (Beck et al., 1994).

In the present study, area we observed the well acquisition and propagation of crocodile species in Vasantsagar reservoir that released before the start of our work in last decade Very recently another species chital was introduced in 2009 by Forest Department in the Zolambi area of Park on the practical basis. Further continuous observations are needed in future to understand the status of the released species as it acts as the prey base of most of the carnivores.

5.5.1.3 Hunting and Poaching:

The forest department has claimed no hunting from the area. During the study period, the direct incidence of hunting was not but while visiting the study area the indirect evidences of hunting were observed i. e. Gunmen’s and Bullets in the park area were sited. This claims the existence of illegal hunting in the study area.

By discussion with the different associated people with forest it was noticed that, the illegal hunting of mouse-deer, barking deer, sambar, porcupine, wild boar, varanus and many birds are yet going on in the park. No doubt the density (occurrence) of such events is decreased since 2005’s the Narkya’s illegal cutting issue. Arunachalam et al. (2004) have reported hunting and trapping of wild fauna like tiger, barking deer, sambar, wild boar, bear, wild cat and a variety of birds by local inhabitants for bush meat and hide from Namdapha nature reserve in the
Indian Eastern Himalayas. He also reported illegal fishing and catching of *Pyxidea mpuhotii* (Kachho, a terrestrial turtle) for a meat.

In Chandoli National Park, the fishing activity from Vasantsagar reservoir is totally banned by the forest department and they achieved the maximum success in the same, but the collection of fishes yet carried out by the local inhabitants (Gothane) in the streams and nalas. The turtles at Kasavi nala are in threat from catching by the local people. We observed the local people using the same water body for collection of fishes and crabs in our recent studies of September, 2009.

Though the collection of fish was ignorable, the collection of fish in turtle habitat is quite worrisome as is the only habitat and area where the turtles are occurred in park.

Human developmental activities have posed increasing threats to the biodiversity of forest zones all over the world (McCool & Kruger, 2003). So the first activity in conservation required is to be the minimizing human interference in forest. But it is not applicable to all cases. The park is also associated with human interference by the local people within park and around the park. The similar reasons were given by Arunachalam *et al.* (2004). Even though as the existence of human being is depends upon the existence of plants and animals; the conservation of forest is becoming need.

**5.3.2 Habitat Conservation:**

Habitat of any animal provides essential and basic components which acts as a life supporting system to that animal. Therefore, in general habitat provides all basic needs such food, water, shelter and mates for the propagation of their race along with optimum environmental conditions. Thus, the habitat of wild animals should be in good conditions. If there is a degradation of habitat, it imparts stress to the wild species. Hence, to avoid the stress condition and degradation there is need to implement habitat conservative measures which keeps habitat in good conditions and it provides optimum environmental parameters to the wildlife.
The water development, afforestation, protection to the forest, prohibition of grazing of domestic animals in forest and propagation of food grass species etc. carried out in Chandoli National Park (previous Chandoli Wildlife Sanctuary) were carried out by forest department. In present study, the different habitat conservative measures taken by forest department were studied.

**5.3.2.1 Afforestation:**

The establishment of a forest by artificial means on degraded land, waste land and on mountain slopes to save forest cover is done by afforestation. The forest cover is also achieved by implementation of reforestation, social forestry programmes and agro-forestry. The human activities such as deforestation, grazing of livestock, forest fire as well as forest pest and diseases, increase in height of dam causes decrease in forest cover and it should be avoided or mitigated.

In the last decade the forest department has stepped towards the plantation programmes under the heading of afforestation for soil conservation, industrial and commercial plantation, Western Ghats development programme, forestry, wildlife and fruit plantation, forestry and wildlife fodder development and compensatory afforestation. In the present study planted trees were observed at Nandoli, Nivale, Vetti, Takale, Zolambi, Rundiv, Siddheswar, Pethlond, Dhakale, Chandel, Sonarli, Tanali and Wadihudumb plantation carried out by forest department. In recent years after 2006 the rate of plantation was declined comparatively. Shyamsundar *et al.* (1986) have reported the afforestation programmes run with the classification of zones depending on the elevation and suggested that in the one zone afforestation must be kept with the immediate needs of the people for fire wood, fodder, small timber etc.

To date, most forest plantations have been established as even aged monocultures, mainly using exotic rapidly growing species (e.g. Eucalyptus, Acacias and Pines). In present study, same practice of monoculture was also observed in some parts of forest area. These species appear to be technically easier to manage and control and more profitable (for wood production) in short term.
The result of this trend were the restoration of productivity in some forest areas at the cost of a drop in biodiversity and heightened vulnerability to disease, pests and fire. In contrast to single species plantation, mixed forests have fewer pest problems as well as fire is inhibited due to their multi-layered composition. They can restore and maintain soil fertility and they present a more varied range of development possibilities (Dupuy et al. 1999).

Bavappa & Mandal (1986) recommended the cultivation of cash crops like Cocoa, Cardamom and pepper as well as medicinal plants such as *Rauwolfia*, *Dioscorea* are suited for planting under existing forest canopy of Western Ghat’s. From the biodiversity conservation point of view we recommend the use of trees for plantation which are being used by the herbivores and omnivores. The list of the food plant species of different wild animals is enlisted.

5.3.2.2 Forest protective actions:

The study of forest protective actions taken by forest department reveals that the actions taken are supporting to the conservation of species and habitat of Chandoli National Park as well as to minimize the habitat degradative activities in the Park area. The efficiency of these activities can be enhanced after fulfilling the human resource in the Park area as well as by involving the local people’s participation in the conservation activities.

5.3.2.3 Prohibition on livestock grazing:

The study of prohibition on livestock grazing reveals that the livestock of the people mostly included cows, buffalows, sheeps and goats. Forest department has taken action against livestock grazing by registering FIR against responsible persons and punished them with warnings. Though the forest department has taken the action against livestock grazing, it was observed that the livestock of local and adjoining villagers was found while grazing their livesock in the region of Udgiri, Nivale, Dhakale, Chandel, Male, Kolane and Patharpunj. The cattles grazing in peripheral, buffer and core zone was continuously posing a stress. The cattles of the local inhabitants and the cattles of people’s from the surrounding
area of park as well as of the people’s who have been rehabilitated from the park area, distributed throughout the park area, grazing in herds. No doubt, the forest is an important source of fodder for the cattles of that area during scarcity of food period. But the area of forest land available in this region has no relation with the number of cattles. Hence, maximum control and regulation on forest grazing is essential (Gholap & More, 1986).

5.3.2.4 Propagation of grass species:

The study reveals that the propagation of grass species was carried out to increase the grassland area for grazing wild animals. The selective species of grasses such as *Pancium ductylon* and *Heteropogon contarius* were used for propagation by the forest department. This activity was carried out to produce the abundant food for the herbivores. Considering the preference of the food grass species of herbivore wild animals of Chandoli National Park, the extensive work is necessary in this field in the study area. The preference of grass species by wild animals can be understood by studying the checklist of food species of wild animal from the present investigation. It will support to provide the basic need of park area to enhance the biodiversity as well as to solve the problem of forest fragmentation in the Park area.

5.3.3 Habitat degradation factors in Chandoli National Park:

The human society conducting various kind of developmental activities in vicinity of Sanctuary/National Park area. In general the developmental activity degrades the local and remote areas environmental component. Hence, the present investigation was carried out to observe the various kinds of anthropogenic activities such as minings, intentional forest fires, agricultural practices, domestic livestock grazing and illegal cutting of trees in and in vicinity of Chandoli National Park (previous Chandoli Wildlife Sanctuary).

5.3.3.1 Mining:

Logging, shifting cultivation, frequent burning and mining are the main causes for disturbance of forest in many parts of the world. It can degrade forest resulting
in loss of future benefits. The degraded and often eroding areas can also contribute to off-site impacts to adjacent land and water resources. Impact of open-cast mining can be environmentally detrimental. For example degradation of forest land, interference of human activity and sound pollution created during mining activity have been found to be causing disturbance to the wildlife than those associated with other land use changes (such as deforestation, agricultural intensification, road buildings). The mining activity also increases the sediment level in mining related streams (Brown, 1974; Jackson, 1982; Bruijnzeel, 1990, 1993).

Near Chandoli National Park it was observed the bauxite mining activity in the region of Udgiri forest which is very closer to the boundary of park area. It affects on the integrity of forest. We experienced the loud blasting sounds far deep in the various regions of park area. They have prepared the earthen roads for transportation which causes air contamination (mostly in summer season). More than 300 trips of different vehicles were observed adding the sound and air contaminants in environment. Occasionally killing of reptiles mostly snakes was observed due to vehicles. The area cleared by digging was totally degraded. The wild animals in the surrounding area could be disturbed by the loud sounds produced during mining activity. It was observed very less occurrence of wildlife in the same area. Further the effect of mining on flora, fauna, aquatic ecosystem and surrounding environment is required to study in detail.

There is need of prohibition of mining activity in vicinity of Chandoli National Park area. From biodiversity conservation point of view, Krshnaswamy et al. (2006) have reported that mining and associated activities such as road construction in high rainfall areas of the Western Ghats may disrupt hydrological and sediment linkages in the previously forested and grassland ecosystems. While working on the impact of iron ore mining from tropical catchment in Kudremukh, Western Ghats of India, the use of surface mining method removes the forest cover and deposits the silts in small and large open pits. Akabzaa & Darimani
(2001) reported the similar observations from the Ghana rainforest gold minings. After mining, the land is typically no longer usable for agriculture (Akapalu & Parks, 2007).

Bauxite mining, which is performed by open pit mining, is land extensive, dusty and noisy. It proceeds as careful removal of the top soil which is then stored and replaced following the depletion of the mine. The problem with this is that the mining itself can reduce the soil’s water retention capability. When the top soil is replaced, it is thus less capable of retaining water, resulting in that mined lands are sometimes difficult to restore to its original state (American University, 2002). However, what by many are considered as the most significant cause of deforestation linked to the mining of bauxite are the access roads. Not only are forests cleared in order to make way for the access of roads, but also once it exist, loggers move in and illegally remove trees in and around mining areas (Johansson, 2003). Peterson & Heemskerk (2001) studied on the gold mining in the Amazon and concluded that the massive repeated soil movement that accompanies mining greatly slows regeneration and produces vegetative cover is qualitatively different from that in near by old-growth forest.

So the bauxite mining from the near by area of Chandoli National Park must be stopped or the mining areas must be undertaken with strict regulatory conditions to minimize the impact of noise generated from occasional blastings and vehicular movement on the wildlife including avifauna in the area. In addition to this the forest department shall take up compensatory afforestation with suitable indigenous species and shall declare as ‘Protected forest’. The precautions must be taken for the scientific management of overburden dumps through soil conservation measures so as to avoid wash outs. Shinde et al (1986) have also reported the adverse effect of minings on vegetation, soil and environment.

5.3.3.2 Intentional Forest Fires:

The most common hazard in forest is forest fire. Forest fires are as old as the forest themselves. They pose a threat not only to the forest wealth but also to the
entire regime to fauna and flora, seriously disturbing the biodiversity, the ecology and environment of a region. In a country wide study, the forest surveys of India (2003) estimated that about 1.45 Mha of forest are affected by fire annually. According to the ministry of environment and forest, Government of India 3.73 Mha of forests is affected by fires annually in India (Bahuguna & Singh, 2002). The normal fire season extending from January to June but the peak fire season varies from region to region (Prasad et al. 2008). About 90% of fire is caused by people and the reasons mainly involve grazing, shifting cultivation and collection of minor forest products. Trecking, camping and carelessness of picknickers may also cause forest fires.

During the study period in Chandoli National Park it was observed that, the forest fires purposely caused by local inhabitants. No single report or evidence was found about the natural forest fire such as heat generation in the litter, lightning during thunderstorm, rolling of stones and rubbing of bamboos with each other. The type of forest fire was ground fire. No single evidence was with surface crown and sub-surface fires.

The upgraded Chandoli National park area consist four villages. The local people practiced the agricultural activities and also depend on livestock for their livelihood. In park area forest fire was common observation every year during summer season. The study interprets that the intentional fires were carried out by the local people with the intention to get the fresh grass for their livestock during summer season, but there was no control of them on fire. The core zone was also not the exception for these incidences. It caused the threat to the flora and fauna of the park area.

However, there is no comprehensive data on different dimensions of fire such as area burned, ecological and economic loss and regeneration status, on regular basis in India (Bahuguna & Singh, 2002).

5.3.3.3 Agricultural Practices
In present investigation it was observed that the local people have removed the vegetation from their own land and area brought under cultivation of crop plants. For getting the high yield of rice and Nachani crops the people burn dry twigs of plant on soil surface in summer season and latter on area brought under cultivation. The twigs are collected by cutting the trees from there lands and used for burning purpose after drying. Such types of practices may leads to the decline the forest cover from private land and at the time of burning biomass there is threat of spreading the fire in surrounding forest, which may adversely affect the floral and faunal diversity.

5.3.3.4 Domestic Livestock Grazing:

The Park area except to the western side is surrounded by number of villages with large population of humans with their livestock. The type of agricultural methods used by them may not fulfill the fodder need of their livestock. People are depending on forest for grazing their livestock. The livestock of local people and the remained livestock of the people rehabilitated from the park area may cause the stress and scarcity of the fodder to the wildlife of forest.

However, the number of domestic livestock dependent on forest for food is exactly not known. But it was observed that, the number of herds of cattles was feeding in the forest area.

Livestock grazing was more pronounced during summer months when there were competition for fodder between the wild herbivores and domestic cattles and buffalows in the study area. Livestock grazing not only limits the availability of food for wild herbivores, but also possibly expose the wild herbivores to the risk of livestock born diseases. The results observed are similar with that of report given by Bhowmik (2002).

5.3.3.5 Illegal Cutting of Trees:

During the study period it was observed that forest department was quite succeeded in controlling illegal cutting of trees after the incidence of illegal cutting of ‘Narkya’ in April, 2005. While the study it was observed that the local
people and the people from adjoining area are depends on forest for fuel and other
domestic uses like construction of huts, for farm instruments etc.

The collection of fuel wood from forest has become an important factor in
ecological degradation world wide, especially in developing countries. In many
rural areas, fuel wood is an important energy source for cooking and heating
(Chomitz & Griffiths, 2008; An et al. 2002). Fuel wood collection through cutting
down trees can lead to fragmentation and degradation of wildlife habitat (Liu et al.
2001), reduction of wildlife populations (Aigner et al. 1998; Hall & Farrell, 2001),
and loss of biodiversity (Rosenstock, 1998; Sagar & Singh, 2004). Approximately,
three billion people, half of the world’s population, are still using fuel wood in

Liu et al. (2003) have reported that many protected areas in China were under
the impacts of human activities majority fuel wood collection. Linderman et al.
(2005) demonstrated that over net 30 years collection of wood from forest would
result in the loss up to 30% of the habitat in the event of bamboo die-offs.

The practice of use of biogas plant and other non-conventional sources of
energy can minimize the stress on forest but during study period it was observed
that no such use of non-conventional sources of energy practiced in park as well as
adjoining area.

During study period it was observed that the local people were depends on the
monsoon rain for agricultural practice and domestic livestock for their survival.
While practicing the agricultural activities, people were used to cut trees from
private land, use the same timber for their purpose. The litter was burnt in the
same soil, where the agricultural practices were run by them in monsoon season.
The same land was used by them for 3 to 5 years. Then they shifted to other region
by repeating the same practice. But the farmers didn’t grow the trees in the
earlierly practiced land. It led to the destruction of habitat by fragmenting the
continuous forest area.
In present investigation it was observed that, the people living in park area as well as the adjoining area, beside the collection of fuel wood for themselves, they use it to sell for earning monetary benefits. They were use to sell the bundle of wood in the nearby villages like Manadur, Arala etc. The cutting of trees from private and protected forest may affect on the density of forest tree and eventually on the diversity of wildlife in near future by degrading habitat.

Gray & Teels (2006) have reported the wildlife and fish conservation through the farm bill. In that he highlighted on fish and wildlife habitat management along with the management of soil and water at non-degradation levels.

In present investigation it was observed that, many trees on the bank of the back water of reservoir were dried and dead. These trees were merged under the water during rainy season. It was due to the rise in water level of back water of the dam. So in future it is needed to not to increase the height of dam and water to protect the large number of trees on the bank of reservoir.

5.4 Wildlife Management Practices

Wildlife management is an important practice carried out to restore the degraded wildlife by adopting various species management practices in their habitat.

5.4.1 Species Management:

The specific endangered species found in natural protected forest were identified and the probable reasons for threatening the species were identified correctly. The corrective measures are employed to restore the degraded environmental components to their natural limits. So the wild animals can flourish their population and display optimum activity in restored habitat. There are many environmental components which can be restored by species specific management practices such as shortage of salts can be restored by applying the salt lick, shortage of food can be overcome by plantation of food species or introduction of food animals. By this way the scared environmental components can be restored by management practices.
In the present study the endangered wildlife found in Chandoli National Park (previous Chandoli Wildlife Sanctuary) were protected by employing different wildlife management practices carried out by forest department/park authority regularly. The different wildlife management practices such as use of salt lick, vaccination programme for domestic life to avoid the spread of disease etc. carried out by Park authority were observed meticulously during the study period.
5.4.1.1 Use of Salt Licks:
The forest department/park authority had applied salt bricks in protected area for licking purposes to wild animals in different part of the forest specifically near to the water resources. It was with the intention to fulfill the mineral deficiency in wild animals. During the present investigation it was observed that, with considering the misuse of same activity by hunters for hunting the animals was noticed by forest department and because of which recently the practice was stopped.

5.4.1.2 Wild life Health Management:
The study of health of wild life is an important aspect from the conservation of wildlife point of view. The various diseases can spread from domestic animals to wildlife and vice versa. So the regular monitoring of wild and domestic animals is required. Dakshinkar (2002) has explained the different types of diseases that may spread from domestic animals to wild herbivores, carnivores and birds and vice versa. He described the diseases like mata, foot and mouth diseases, rabies, contagious ecthyma, malignant catarrhal fever, bovine virus diarrhea, canine distemper, ranikhet, devi, infectious laryngotrachitis, ghatsarp (diphtheria), anthrax, brucellosis, foot rot, bird tuberculosis, Jones disease, parntrajwar, leptospirosis, botulism, haemoproteus, babesiasis, Rick fever, thileriasis in animals.

Parasitic diseases constitute one of the major problems causing even mortality in wild animals in captivity (Rao & Acharjyo, 1984). Our study reveals no such monitoring carry out by forest department recently. Previously the forest department used to run the periodic check up and essential vaccination to the domestic animals of local people. Since the major villages relocated from the park, such programmes are ignored in the park area. The monitoring of wildlife health is not at all practiced in park area. During the wildlife census (2009), we came across the death of wild boar due to severe infection. So it is requisite to attend on the health of wildlife even.
The status of wildlife health can be monitored by using the individual animal species as a sample. Sample may consist of dead or live animals (Berwick and Sahariya, 1995). Pythal (1993), Varadharajan and Pythal (1999) while working on parasites of wild animal mentioned that in herbivores strongyle and amphistome infections were to be higher in Bovidae and in certain species of Cervidae. Other infections observed in a variety of herbivores were ascarid, strongyloides, spiruroid and fasciola. Among carnivores, Ancylostema and Toxascaris were the major infections found in lions, leopards, tigers and jackal. Diphyllobothrium and Paragonimus infections were also present in a male leopard, isospora and Balantidial cysts were found along with helminthic infections in lions and leopards respectively. In the case of omnivores, strongyle, strongyloides, spirurid, fasciola and Hyenolepis were the major helminthic infection. Entamoebic and Balantidial cysts and coccidial oocyst were also observed.

The occurrence of Ancylostomae and ascarid infections in wild carnivores like lion, leopard, tiger and jackal has been reported by many workers (Gaur et al. 1979; Chauhan et al. 1973; Adkali et al. 1986; Muraleedharan et al. 1990). The presence of paragonimus infection in leopard has been reported by Pythal et al. (1993). Occurrence of strongyle, fasciola, as well as amphistemic in herbivores like deers, mithun, hippopotamus, Nilgiri tahr, giraffe and also strongyle, Strongylorides and coccidial infections in omnivores like wild boar, porcupines, macques and bears have also been reported in earlier surveys (Gupta, 1974; Tripathi et al. 1971; Muraleedharan et al. 1990; Reddy et al. 1992).

On the health diseases of birds, Stabler (1951) and Locke & James (1962) reported the trichomoniasis disease in feral pyrogens (Columba livia) and columbiform birds due to the Trichomonas. The expansion of the disease in the population of birds may impair or reduce population growth, or even put the population at risk (Cooper & Petty, 1988; Boal et al. 1998). Real et al. (2000) have described some cases of trichomoniasis in wild Bonelli’s eagle nesting, to quantity the prevalence of infection of T.gallinae.
Staphylococcus intermedium is part of normal micro flora of skin and mucosal surfaces of the upper respiratory tract of dogs, horses, cats and minks (Biberstein et al, 1984; Koneman et al, 1977). The bacterium has also been isolated from anterior nares of dogs and pigexons (Futagawa et al. 2006) and from infected dog bite wound in humans (Talan et al. 1989). *S. intermedius* may cause cutaneous, urinary tract, bone and central nervous system infections in several animal species (Biberstein *et al.* 1984 and Koneman *et al.* 1977).

In dogs, *S. intermedius* is one of leading pus forming bacterial and causes infections such as pyoderma and otitis externa (Cox, 1998 and Medleau *et al.* 1986). *Staphylococcus*, so does not occur cenerahl appear to cause any major disease in cats but causes superficial dermatitis, bacterial folliculate and superficial pyoderma by *S. intermedius*, have been reported (Scott, 1980). He has described an episode of a Siberian tiger (*Panthera tigris altaica*) kept at the Korea National Arboreta with Pyelonephritis caused by *S. intermedius*. Tella *et al* (2000) collected louse flies from 401 birds of 32 species captured in autumn of 1996 in Bajar California.

Toledo *et al.* (2006) have reported the infection of fungus *Batrachochytrium dendrobatidis* in Brazilian Anuran species, *Hylodes magalhaesi* (Leptodactylidae).

Stoner (1996) has studied the prevalence and intensity in Mantled howling monkeys (*Alouatta palliata*) in north eastern Costa Rica.

In present study it was observed that, there is a need to assess and employ the vaccination programme in domestic life as per need, to avoid the spread of communicable disease in wild animals.
5.4.1.3 Wildlife Translocation:

Occasionally, a single animal or a group of animal may be moved from one part of its range to another and may create problem such as cattle lifting, attacking to man or damage to crop. Superficially, translocation appears a straight forward exercise in trapping and releasing the largest number of problematic animals in natural habitat/forest. Kramer (1988) and O’Farrell (1993) have reported the translocation study of the federally endangered Stephen’s Kangaroo rat (Dipodomys stephensi) in western Riverside Country, California.

In the present investigation the translocation of problematic animal, leopard from villages around the forest to thick forest or some times captured animals such as snakes and birds are to be moved to the safe area were observed. Forest department lacking the well equipped and well skilled staff to handle such kinds of situations properly in Chandoli National Park area.

5.4.1.4 Wildlife Monitoring (Census)

To understand the status and fate of wildlife and the impact of hunting and poaching in the area, it is essential to carry out the monitoring of population of different species. Currently in the park the wildlife census programme is run by forest department at the ending of summer season per year. The drawbacks of the programme are many volunteers enter simultaneously in different zones of park area. They remain within park for a week or more with their mostly all usual activities, it causes forceful disturbance to the wildlife. During this programme the most emphasis is laid on the tiger and leopard sighting or the occurrence of indirect signs of them in park area mostly. But in actual there is need of the monitoring the species and their population of different trophic levels as it decides the future of ecosystem. It is recommend using the remote sensing and trapping camera system for monitoring the population of different species. Certainly it will not cause any disturbance to wildlife and ecosystem. Along with biodiversity/species conservation, the conservation of habitat/ecosystem is also essential.
5.4.2 Habitat Management:

Habitat of any wild animal consist the surrounding environmental parameters in optimum level which fulfils the basic need of wild animal or it is an area where organism flourishes there population with optimum activity. The habitat component consist the food, shelter and other essential requisites containing environmental conditions where the probability of getting that wild animal. In the present study it was observed that different habitat component of wild animals were manipulated by Chandoli National Park authority and are observed frequently.

5.4.2.1 Grass species Propagation:

Grass species having tremendous food value as compared to the tree vegetation to grazing wild animals. The grazing animals provide the base to the entire carnivorous and omnivorous group of organisms in forest ecosystem. Ultimately, the plant species which have high food values to the browsing animals are acting as a base to the entire food chain in forest ecosystem.

In the present study it was observed that as an important wildlife management practice forest departmental officials have propagated the grass species by employing grass propagation programme at Chandel village.

5.4.2.2 Water Resource Management:

Water is an important environmental resource. Chandoli National Park receives heavy rainfall up to 4764 mm per annum. Even though, the park area faces the problem of scarcity of water mostly during the summer season. The demand of water is increasing along with increasing population and type of use (Porter, 1978). The received rainwater is drained away very fast by streams and rivers and some water percolates in top soil and rocks. So the small streams and rivulets of hilly area become dry during summer and create shortage of water to wildlife and people (Basak et al. 1986). So the management of water resource in the park area is need of for the conservation of park.
The terrain of entire protected area is undulating with different dimensions so the distribution and availability of water is uneven in this park. The 80% of total protected area is effectively covered with water facility and remaining 20% of the park area in higher reaches in the region of Gave, Chandoli khurd, Male, Patharpunj, Rundiv, and Jawali were facing the problem of water source for local people, domestic animals and wild animals.

The construction of ponds and tanks are best means to store the surface water for domestic purpose. People have to use surface water during monsoon and subsurface water during post-monsoon period (Pitchaiah, 1991). The temporary springs and streams must be converted in to temporary or seasonal ponds by construction of an embankment across the flow. Under the habitat improvement, development of new springs and new water bodies should be included (Thakur et al. 1993).

In present investigation it was observed that, there was construction of nala bundings in certain areas which is insufficient. Vamdevan & Vasu (1986) suggested the following water management techniques for the Western Ghat’s. Bench terracing, nala bunding, nala training, contour staggered trenches, micro irrigation including drip irrigation using flexible pvc pipes and bamboos, mini sprinklers, subsoil injector and indigenous drip irrigation using earthen pots as well as diaphragm wall, hydraulic rams, storm water harvest warping, bordered gardens, development of micro catchments, eco-mulching cum irrigation for plantation crops and use of wind breaks and shelter. Giles and Wunderlich (1981) have suggested the similar techniques for the water resource management.

5.4.2.3 Forest Fire Management:

The observations in the past 20 years show that the increasing intensity and spread of forest fires in Asia were largely related to rises in temperature and declines in precipitation in combination with increasing intensity of land uses (IPCC, 2007). It is known generally that the forest fire cause damage to the trees, wild animals, regeneration power, soil, productive power of the forest, protective
power of the forest and recreational and scenic value of forest. Forest fires leave a devastating impact on the landscape, affecting flora, fauna, human livelihoods and the local climate (Negi, 2007). So the management of forest fire is urgent issue in the conservation of forest.

The present study reveals that, the practice of fire line belt for prevention of spread of forest fire as a direct forest fire preventive measure used in protected area. In recent past, the same practices were meagerly observed in the Chandoli National Park (previous Chandoli Wildlife Sanctuary) area.

The forest fire was commonly observed during the period of summer season in the different regions of park area. It is observed that forest department has very weak system of fire control by using of wet twigs of trees directly by beating on fire with trained people and staff.

The absence of enough fire controlling staff and equipment leads to develop precondition for spread of fire. Shijo et al. (2009) have suggested the development of forest fire indicators viz. bioindicators, biophysical indicators, meteorological indicators, historical indicators and socio-economic indicators. In the adaptive management be focused on strengthening present fire fighting programmes, development of precautionary measures, integrated institutional efforts, publicity, extension and training, legal measures and funding.

To prevent the forest fire in National Park area, there is a need of restriction of entry in the forest. The local public should aware about the impact of forest fire.

The clearing camping sites and areas along paths and road as well as early burning of inflammable material such as grass, fallen leaves and broken branches before the commencement of hot weather to prevent the occurrence of fire with proper care. Somashekar et al. (2008) have explained the spread of fire has been stimulated mainly by the dead bamboo distributed in considerable areas within the range. A similar study has been carried out on forest fire prone areas in Mudumalai and Mukurti wildlife sanctuaries and Rajiv Gandhi National Park (Ranganath et al. 1994). Fire breaks are significant obstacle to the spread of fires.
They acts as a barrier to prevent the spread of fire to a particular area, the spread of fire from a fire source to other areas and break up large fuel areas in to smaller ones it can be maintained by mechanically, chemically, vegetatively and burning.

5.4.2.4 Zonation:

Zonation is an important component in wildlife conservation and management practices. In present investigation it was observed that to perform the specific conservative practices in Chandoli National Park, the area was properly categorized in different zones such as core zone, eco-restoration zone and developmental zone. Recently to enhance the curiosity, awareness and conservative approach among the students and society for wildlife conservation, forest department has declared two different areas (Zolambi and associated area to north and Nivale-Tambave and associated area to south) as tourism zone.

5.4.2.5 Tourism Management

Protected areas and nature protection in developing countries are often seen as a luxury since there are generally few opportunities to earn income from them (Tisdell, 1999). In addition governments of developing countries are finding increasingly difficult to provide sufficient funding for the maintenance of their national parks (Krug, 2000). Tourism offers the potential to provide economic development through the provision of increased income and employment and funding for maintenance of National Parks, simultaneously conserving nature. Many developing countries, for example Kenya, successfully used the attractions of nature in promotion of tourism in protected and non protected areas (Mc Neely et al. 1992; Nepal, 2000; Tosun, 1998).

Chandoli National park is less attracted the tourist as compared to other forest areas of Kolhapur district due to the inaccessibility of area, devoid of roads and transport facility. Even though, approximately two to three thousands tourists, trackers, pilgrims visits the park area per year. Recently forest department has declared the ‘Zolambi’ and Nivale-Tambve areas as a tourism zone. But mostly
the trackers and visitors are interested to visit the ‘Prachitgad fort, Bhairavgad and kandhar doh and falls, Tanhali water fall, konkan darshan etc.

All above mentioned regions are either included in core zone or required to cross the core zone to reach. It creates disturbance to wildlife habitat and wild animals, littering, vandalism, threats of fires. It also affect on soil organic matter, soil water content, soil structure, soil section and soil erosion (Settergren & Cole, 1970; Liddle & Smith, 1975; Guang et al. 1999; Feng, 1999; Guang et al. 2000; Tian et al. 2004).

Shi (2006) has also reported the adverse effect of tourism on soil. The increasing tourists bring negative impacts on air, soil, vegetation, water body, animal, sight (Wang and Hao, 1988; Shi et al. 2002 a). Therefore, it is important that the tourism in these areas is to be sustainable. The world tourism organization (WTO) defines sustainable tourism as one that improves the quality of life of host communities, provide high quality experiences for guest and maintains the quality of the environment on which they both depend (WTO, 1993).

Present study reveals that forest department should distinguish the trekkers, pilgrims and wild life viewers and treat them accordingly. The entry passes should different to them and records should be maintained properly.

During the study, it was observed that the forest department has very limited accommodation facility. It is necessary to have at least few dormitories with the potential of 25 individuals and some suits should be developed under tourism management. The transportation facility requires improving the earthen roads and repairing them frequently. The watch towers required to maintain properly. The boards directing the areas and roads should be raised for proper direction to the visitors in the tourism zone.

The tourist visiting to the Prachitgad travels though Chandel, Ram nadi, Rundiv, Javali and to Bhairavgad enters though kolane, Patharpunj villages causes disturbance to the core zone of park area. It is observed that the two wheeler bikes as well as the four wheeler vehicles were entering in the area through the Kolane,
Patharpunj area. It is necessary to develop an alternative route from the koken sides to avoid the impact on core zone of Chandoli National Park.

The park area consist large water body named ‘Vasantsagar reservoir’ in the central region of park. The available launches with forest department are limited, which has less people carrying capacity. There is a need of large sized launches with more carrying capacity (25 to 30 persons). The launch must not produce much noise. Then it has wide scope for flourishing the eco-tourism. At the time of using launch care should be taken to prevent the disturbance to the aquatic fauna and wildlife from forest.

The tourists or trekkers allowed in park area must have at least one staff member with them to monitor the adverse impact of tourism on forest, for the same job the selective staff should be properly trained from ecotourism management point of view.

In Chandoli National Park, the visits of pilgrims are ignored by forest department. It is required to be considered them seriously and follow the pilgrimage activity without disturbing/degrading surrounding environment. The pilgrims cause comparatively more problems than wild life tourist and if authorities will continue to ignore them the natural values of park will continue to deteriorate (Buultjens et al. 2005).

Spreading of environmental awareness amongst tourist and other people, imposition of penalties for deliberate destruction of forests, biodiversity, heritage sites, littering and causing noise pollution should be implemented.

5.4.2.6 Management of Transportation:

For the smooth wildlife conservation and management practices there is need of better temporary road network towards the periphery of Chandoli National Park and need its regular maintainace in winter and summer seasons.

5.4.2.7 Human Resource of Chandoli National Park:

For the effective conservation of biodiversity from Chandoli National Park the management practices are required to be following very sincerely. For
effective management the adequate staff is to be required (Arunachalam et al., 2004).

Currently, in Chandoli National Park eighteen official employees are working instead twenty one are sanctioned by Government. Considering all the conditions of the park area it is required at least 60 employees to be deployed immediately. It must include the post of two RFOs, seven foresters, 35 forest guards, one driver (jeep), one launch driver, one attendant, one head clerk, three clerks, three peons, twenty trackers, one radio mechanic, one radio operator, one security guard. Such 79 posts are required to fulfill. Along with this the number of temporary labors is required for mechanical works in the forest.

By considering the total area, geography and climatic conditions of the present study area it is found that the availability of staff in Chandoli National Park was insufficient. Due to which the staff members were faced the problem of additional charges. By considering the importance of biodiversity of Chandoli National Park the conservation and management of species diversity and habitat conservation and management is essential. For the same more staff members are required to be employed immediately for effective management. The Chandoli National Park should be divided into tow ranges as naturally divided by ‘Vasantsagar Reservoir’. The one region including the area of villages from Kolhapur and Ratnagiri Districts and other region including the villages of Sangli and Satara Districts. The similar practices are observed in adjoining forest area of Radhanagari and Koyana wildlife sanctuaries.

According to the requirement of the duties to perform in park area, such as forest fire management, wildlife health management, afforestation, patrolling, rescue operations against animal’s attacks, snake bites, translocation of animals, the staff is required to be trained properly and the effectiveness of them must be monitored periodically.

5.5 Human-Wildlife Conflict:
In the protected forest the certain boundaries are adopted by the authorities by considering the available luxuriant vegetation or the habitat of the endangered species to be protected in that forest. The demarked boundaries are for the human societies for activities. The wildlife doesn’t have any restrictions for their movement until it is a closed system. Generally the National Parks and Sanctuaries are open type of ecosystems where, wildlife can move freely from protected areas to private areas by crossing adopted boundaries. The entrance of wildlife in human territory creates the problem and causes loss to the health and wealth.

The human society by entering in the protected areas carry out their activities such as hunting, poaching, killing, capturing or destruction of habitat of wildlife and deforestation for various purposes. The human’s activity caused threat to wild animals and creates conflicts.
5.5.1 Impact of Wildlife on Human:

The study illustrate that, human-wildlife conflict is growing global problem, which is not restricted to particular geographical region of climatic conditions, but it is common to all protected areas where wildlife and human population coexist and share limited resources. Dense human populations in close vicinity to protected areas seem to pose the greatest challenges in many countries. Human-wildlife conflict becomes more intense where livestock holding and agriculture are an important part of rural livelihoods. Competition between rural communities and wild animals over natural resources is more intense in developing countries, where local human population tends to suffer higher costs.

Conflict with human is a major issue in carnivore conservation (Nowell & Jackson, 1996). Conflict can have multiple implications ranging from fear evoked the presence of carnivore to fatal attacks on human (Loe & Roskaft, 2004). Such conflict is seen with tigers in Indonesia and India (Nyhus & Tilson, 2004) and lions in Africa and India (Paterson et al. 2004 and Saberwal et al. 1994). Even in the absence of attacks on humans, livestock depredation by carnivores can hamper the livelihoods of people and affects their economic conditions (Ogada et al. 2003). Human-carnivore conflict in terms of livestock depredation is perhaps more common and is seen in several reported cases across the world. Studies on wild dogs and leopards (Romanach et al. 2007) in Africa, Leopards and tigers in Bhutan (Wanga & Macdonald, 2006) exemplify this.

Considering the current human population growth rate, increasing demand for resources and the growing demand for access to land, it is clear that human-wildlife conflict will not be eradicated in the near future. For this reason a better understanding of conflict management options is crucial. In the present study, we have studied the different cases of human-wildlife conflict. Such number of cases is studied by different researchers and suggested the management practices. By considering the conditions of park area, some of them are listed in the end part of this topic.
India is rich in carnivore diversity. There are 58 species of carnivores in India of which about 17 are large bodied (Prater, 1971). India is the second most populous country in the world with an average population density of above 267 people/sq. km. (Government of India, 2001 Census). With such a high population density there are hardly any inviolent places for wildlife outside protected areas. Not surprisingly, there is a great potential for human-carnivore conflict in India, as seen with lions, wolfs, snow leopard, tiger and leopards (Saberwal et al. 1994; Jhala & Sharma, 1997; Rao et al. 2002; Madhusudan & Mishra, 2003 and Namgail et al. 2006).

The sloth Bear is omnivores (Gopal, 1991). However, food resources for bears have diminished because of extensive damage to its habitat (Murthy & Sankar, 1995) from timber and fire-wood harvesting (Cowan, 1972 and Servheen, 1990) and burning. Additionally, human compete directly with bears by consuming the bears food resources (Rajpurohit, 1996). Consequently, human-bear conflict arises because bears enter crop fields and consume agricultural crops (eq. sweet potatoes, onion and groundnuts) (Rajpurohit & Krausman, 2000).

In present study area it was found that, the reason for human-bear conflict was the interference of the human in bear’s habitat. The nature of damage caused by bear was injury to human. While the study it was came to know that, only single casualty to human who was residing within the park area at Male village. This event led to create the sense of threat in the local people and the people of adjoining area. Rajpurohit (1999) observed such 50 human casualties during their study. In the forest of Central India, the sloth bear is one of the most dangerous wild animals (Pillarisett, 1993 and Rajpurohit, 1996). They are unpredictable especially females with cubs, which will attack humans readily, if they perceive their cubs to be threatened (Prater, 1980 and Pillarisett, 1993).

Rajpurohit & Krausman (2000) have reported 71 casualties in protected areas and 664 causalities in forest division from Madhya Pradesh, 67 causalities in forest division from Orissa, 40 causalities from protected areas and 7 causalities in
forest divisions from Bihar, 37 causalities in protected areas and 15 in forest divisions from Uttar Pradesh, 24 causalities in protected areas and five in forest divisions from Rajasthan during the period of April, 1989 to March, 1996.

The human-wild boar conflict though not serious concern with human and livestock killing but considerable with respect to agricultural damage. The local people from park area are totally depends upon the agricultural yield which further depends upon the monsoon raining. They grow rice and nachani in their fields. Livestock supports their economy. The herds of wild boar enter in the field mostly during night and damage the crops. It leads to economical loss to local people.

Kotulski & Konig (2008) have reported the type of damage by wild boar as destroyed parks and green belts, destroyed roads, destroyed stadiums and backyards, damaged fences, car accidents and injuries to people in Berlin.

Frequent interference of wild boar in human habitation may leads to spread disease in livestock and humans. The comprehensive study is required to be done in the park and adjoining area.

As far as the agricultural damage is concerned the studies of human-gaur conflict one can’t be ignore. During the study period it was observed that, the wide distribution of gaur in core, buffer as well as adjoining area of park. The social behavior of gaur caused damage to agricultural crops on large scale. It was noticed that along with the agricultural crop damage the injury to human was also recorded in the park area. Killing of human and livestock was not observed in human-gaur conflict in the Chandoli National Park (previous Chandoli Wildlife Sanctuary) area. The earlier reports on the human-gaur conflict in Madhya Pradesh revealed that, total 21 causalities were occurred from April, 1989 to March, 1994, which was 1.9% of total human-wildlife conflict of that area (Rajpurohit & Krausman, 2000).

India has a history of human-large cat conflict (Seidensticker & Lumpkin, 1991) but increasingly, it is the leopard which is most often implicated in attacks on people (Athreya et al. 2004). Leopards have always lived on the fringes of
human habitation (Prater, 1948; Gee, 1964; Santiapillai et al. 1982; Tikader, 1983; Daniel, 1996; Johnsingh, 1992; WWF- India, 1997). Especially in India the interface between forest and rural inhabitations is a continuum. This is possibly because leopards are a highly adaptable species capable of eating a wide variety of prey and are not dependent on free water like their larger cousins, tiger (Prater, 1948; Bertram, 1982; Daniel, 1996; Edgaonkar & Ravi, 1997; Stander et al. 1997; Mukherjee & Mishra, 2001; Kulkarni, et al. 2004).

The Indian states, Maharashtra, N. Bengal and Gujarat have reported high human-leopard conflict levels for at least a decade (WWF- India, 1997; Chauhan & Goyal, 2000; Vijayan & Pati, 2001; Athreya et al. 2004; Pati et al. 2004). These areas also report high densities of leopard in human dominated areas and the principle reason put forward, essentially without evidence is the decreasing natural habitat that compels the highly resident leopard to move in to human-modified habitat like tall crops, orchards (in Gujarat), tea gardens (in N. Bengal) and sugarcane fields (in Maharashtra) (Junnar Forest Division). Within these human-modified habitats, which provide good cover, it is thought that livestock and feral domestic animals provide an abundant supply of food in contrast to the depleting wild prey base (WWW-India, 1997; Chauhan & Goyal, 2000; Vijayan & Pati, 2001).

In the present study area the human-leopard conflict is mainly concerned with the lifting of goats and sheeps, which led to threat in the local people. The conflict was not restricted in particular region. The cases were observed within the park as well as peripheral human community regions.

During the study period it was observed that, the human-leopard conflict was most common in park area. Such four causalities from the study area came across during study at Chandoli National Park area. Rajpurohit & Krausman (2000) have reported 138 causalities of human-leopard conflict with second most conflict cases during April, 1989 to March, 1994 from Madhya Pradesh.
Marker & Sivamani (2009) have reported total 218 causalities from 2001 to 2005 in the state of Gujarat, in which 50 people were killed by leopard. Out of 642 total conflict causalities, 219 causalities with death of human were reported from 2000 to 2007 from the state of Uttranchal.

Human Killing is an important issue for tiger conservation because; it creates negative attitudes towards tiger and drives retribution killing (Mishra, 1997; Rajpurohit & Krausman, 2000; Stahl et al. 2001; Treves et al. 2004; Bauer & De Iongh, 2005; Graham et al. 2005; Michalski et al. 2006; De Azevedo & Murray, 2007).

As human population expand and encroach ever further in to natural habitats, human and wildlife increasingly has to compete over living space and food. Asian big cats are suffering not only from significant habitat loss, but also from a decline in their prey species within the habitat that remains. As a result cats are moving in to more marginal areas searching for food, finding easy prey in domestic livestock and also attacking humans. Many communities in Asia are heavily dependent on their livestock for sustenance and income, and therefore when livestock predation occurs, cats capture and kill them to prevent similar events repetition, in the future.

Tiger attacks on humans increased between 1975 and 1999 in Indians Sundarban region. Tiger attack caused 544 deaths. Last year more than 20 people were killed by tigers and leopards in the Terai region of Nepal and India (www.panda.org/species/).

The conflict is generally manifested in the loss of livestock of human society, which in turn leads to retaliatory persecution that can imperil the carnivore species question (Sabarwal et al. 1974; Woodroffe et al. 2005; Treves et al. 2006; Baker et al. 2008).

The danger of tigers in the wild area is well known (Tilson & Nyhus, 1998). Historically, thousands of people have been killed by wild tigers in Asia (Mc Dougal, 1997; Boomgard, 2001) and even today tens to hundreds of people...
are killed by wild tigers annually in tiger-range states. Little is known, however, about the number of people killed or injured by tigers and other large cats in captivity even, and no central database tracks these attacks as the most serious incidents are frequently reported by local, national and even international press (Nyhus et al. 2003).

In the present study at Chandoli National Park area the killing of human was not observed in human-tiger conflict. The only single case of kill of livestock is recorded during the study period. Adam (2009) has reported 57 human deaths from Sundarban of Bangladesh. He also added the casualty may be driven in part by unsafe human behavior. The maximum death were reported in December, January and April and low in June, July and August. The maximum death was due to human activity peaks in December, January months. The most human killed were fisherman, wood cutters and honey gatherers.

Rajpurohit & Krausman (2000) reported 121 casualities (11%) from Madhya Pradesh during the period of April 1989 to March 1994.

Sekhar (1998) while studying the wildlife-carnivore conflict with tiger and leopard of Sariska Tiger Reserve, Rajasthan, has reported tiger and leopards as the main wild carnivore predator of livestock. The former is preying large domestic animals such as cattles and buffalows. The later on smaller animals like goats, sheep and calves. Tiger were reported to be a major threat in villages located inside and close to the reserve. Leopards instead, avoided competition with tigers and frequented areas further outside the villages. The calculations of economic impact revealed that between 1994 and 1996, the annual family loss amounted to Rs. 270 to 610.

During the present investigation it was observed that there was rare appearance of wild dog in open areas. The direct and indirect evidences about appearance of wild dog came across while visiting the Chandoli forest area depicts the wide distribution of species. A single casuality of buffalows kill was reported during study period. The herd of about 12 to 15 wild dogs hunted the buffalows in
the region of Dhakale. Mulonga et al. (2003) has reported the single incidence of wildlife-human conflict from Caprivi region of Namibia. However, observations of present investigation reveal that, there was not a single evidence of agricultural damage and human death by wild dog.

The animals which are less considered in the conflict with human are Jackal and Hyena. Appearance of these two animals actually in park area was reported very rare. The adjoining area of park from the Sangli district was visited rarely by them. Kill of livestock or agricultural loss was not observed during the study period. In fact these animals are prone to threat from this region. In contrast Yom-Tov et al. (1995) have reported the highest damage to the livestock of farmers from Golan grassland plateau of Israel. He also added the farmers who produced cereals, fruits, turkeys, hens and dairy products, claimed the loss of an average of 1.5 to 1.9 % calves born each year to jackal predation. The economic value of the total cattle lost in 1993 was estimated about US $ 42,000.

The Chandoli National Park surrounds the ‘Vasantsagar’ reservoir, which acts as good habitat for the crocodiles. However, the information about the number of crocodiles from park area is still meager. During the span of research period it was observed that, the crocodiles basking the bank of reservoir. The study revealed that no any incidence of killing humans and livestock was recorded from the study area by crocodiles. But there is a threat during the accident of launch if any. Mulonga et al. (2003) have reported 13 incidences of crocodile-livestock conflict. They mentioned the second most problematic conflict accounting for 20% of reports and 30% of stock losses were due to crocodile.

In addition to the species discussed in this report there are some known groups of invasive vertebrates such as rodents, birds, porcupines (agricultural damage) and snakes causing problems in rural areas. They have not been mentioned because numerous comprehensive overviews of conflict, technical information and management of option have been recently published (Fall & Jackson, 2002). Out of that, rodents in park area were observed to cause the
damage to agriculture crops and household damage. It may spread the disease in the livestock.

Chandoli National Park harbors 40 different types of snakes including cobra, vipers and kraits as the venomous snakes. As the area has no facilities of transportation, and very poor and primitive availability of hospitals, the chance of death of human and livestock are more.

5.5.2 Impact of Human on Wildlife:

As people continue to occupy more and more forest land for settlement, agriculture, building dams and other forms of development, it shrink the habitat area which compresses the wildlife populations to levels beyond its carrying capacity. When the carrying capacity exceeds the interaction between people and wildlife, is intensified in many ways.

Human exploitation of the forest for timber, fuel wood and fodder may also degrade the habitat and enhances the human-wildlife interactions considerably. For example bamboo stocks have been over exploited forest for paper manufacturing which leads in shortage of fodder for grazing wilds in their habitat and results in crop reid in near by areas of forest. Ultimately to protect the crop people kill the wild animals and results in development of human-wildlife conflict (Prasad & Gadgil, 1981).

Competition between domestic life and wildlife for grazing resources leads the human-wildlife conflict when any cattle lift by the carnivore organism during grazing. Large number of domestic livestock held in vicinity of wildlife areas competes with the herbivores for forage. There have been no quantitative studies about the evaluation of the impact of livestock on wildlife populations in India. But this is being carried out by referring subjective observations. Foraging by livestock, affect directly and indirectly by causing adverse changes to soil properties through trampling. Ungulates such as deer, antelopes and gaur which have a high degree of food niche overlaps with livestock, seen to be most affected.
by this population. Reduction in ungulates prey for the carnivorous would force them to hunt domestic livestock.

Generally in near by villages of protected area, collection of grass, fire wood and other forest product etc. along with cattle grazing and human movement with vehicles were causing the disturbance in the park area. The activities like tourism and cultural activities added the disturbance in park area.

5.5.2.1 Hunting and Poaching:

Though the forest department claimed clear cut stop of hunting from the area the illegal hunting was observed in the area. The indirect evidences of gun-mans and bullets found in park area support the same. The indirect help of local people and the people from the adjoining area can’t be denied in this activity, but no such enough proof was found during the study period.

Bhowmik (2002) while working on the causes of decline of hog deer discussed that, the garden labours were usually indulged in deer hunting throughout the year. Hunting of deer was also reported as tradition of tribals of fringe villages during festivals. The decreasing number of large carnivores might be result of the same.

Dabson & Lynes (2008) discussed about huge changes over the last 50 years in the intensity of poaching in the Serengeti National Park, Tanzania. A series of earlier papers by different researchers used theoretical work based on economic studies of ‘Crime and Punishment’ to examine the cost-benefit analysis of poaching for rhino and elephant in the Luangwa Valley, Zambia (Milner-Gulland & Leader-Williams, 1992; Leader-Williams & Milner-Gulland, 1993; Becker, 1968 and Sutinen & Anderson, 1985).

In India the tigers are hunted for bones, skin, nails; leopards are hunted for skin; peacock for feather and meat; deer for antler, musk and meat; wild pig for meat & turtles for meat, leather and eggs (WWF). Overall the world hunting and poaching is serious subject affecting adversely on the biodiversity.

5.5.2.2 Fishing Activity:
The complete ban on fishing activity from ‘Vasantsagar’ reservoir is great success achieved by Chandoli Forest Department. It might be due to the threat of existence of crocodiles in dam. Even though, the collection of small fishes, crabs from different streams of park area at Kasavi nala, Chandel odha, Ram nadi were observed during study period. The study of aquatic ecosystem particularly reservoir was not carried out. It has been supported for maintaining the number of the different type of fishes, crocodiles, turtles (Kasavi nala) and snakes.

5.5.2.3 Collection of Non-wood forest products

Non wood forest products consist of goods of biological origin other than wood, derived from forests, other wooded lands and tree outside forests (FAO, 1999). Non timber forest products include wood for uses other than timber and hence cover a wider category of products. Non-wood forest products have been used by man and continue to play an important role in livelihood support. NWFPs are of three main groups’ rural populations who have traditionally used these items for livelihood, social and cultural purpose, urban consumers and traders/product-processors (FAO, 1999). NWFPs usually provide essential food and nutrition, medicine, fodder and other related domestic requirement to rural populations as well as urban consumers. NTFPs are often common property like fuel wood, fodder charcoal, medicinal plants and variety of food stuffs such as fruits and nuts, mushrooms, fibers and resins (Arnold, 1995). They are particularly important in releaving hunger periods in the agricultural cycle, can provide employment during slack periods and acts as buffer against risk and household emergence (FAO, 1999) Wilson, 1993).

During the present investigation it was observed that, after the issue of ‘Narkya cutting’ the illegal removal of non wood products was minimized up to the considerable limits. The little collection of different foods, spices, medicinal plants, bark as well as the collection of the crabs and fishes from different nala were observed in the park area.
The dependence of local communities on NTFPs and NWFPs to the proposition that enhancing incomes from sustainable NTFP and NWFP harvesting can help to maintain local livelihoods as well as provide local communities with economic incentives to conserve biodiversity (Nepstad and Schwartzman, 1992; Panayotou and Ashton, 1992).

Non-timber forest products constitute a critical component of food security and it is an important source of income for the poors in many developing countries. Several opportunities for improvement of rural development are linked to NTFP. In many areas, rural populations are traditionally depends on local forest resources to provide additional income through collection and marketing of NTFP’s. There employment opportunities from traditional industries are declining and workers looking for alternative income sources are often turn to collection of these products from nearby forests (Adepoju and Salau, 2007).

To implement the sustainable exploitation of NTFP and NWFP is required at first to monitor the resources based on standard ecological approaches and then to establish the model for harvesting the wild NTFP and NWFP. *Terminalia tomentosa*, *T. arjuna*, *Piper nigrum* and *Cinnamomum tamal/nitidum* are used as medicinal plants as well as spices. All these plants are evenly distributed throughout the park area. Forest department can manage the growth of the same plants in the buffer zone of park by involving the mechanical power of local people. The controlled harvesting of these plants will boost up the economy of the local people and subsequently they will involve in conservation programme. Setty *et al*. (2008) have reported the two species of medicinal plants for their fruit, *Phyllanthus emblica* (Linn) and *Phyllanthus indofischeri* (Bennet). These species locally known as Amla or Nelli, from the Biligiri Rangaswamy temple Wildlife Sanctuary of Karnataka, by developing participatory resource management techniques.

Asfaw and Tadesse (2001) have reported the prospects for sustainable use and development of wild food plants in Ethiopia. Additionally they mentioned the
processing of edible wild foods to stimulate their use and interest in their conservation and promotion. Along with this there is also need to develop regulations that would allow for community access, with collective responsibilities that can ensure judicial use of products while caring for nature and respecting community interests.

Murthy et al. (2005) have reported 55 different plants used as a medicinal plants food, spices as well as leaf to make plates, leaf for roofing, leaf for building household articles and shampoos as a NWFPs collection from Uttara Kannada district of Western Ghats of Karnataka. Along with this we recommend the practices of Apiculture and Sericulture to strengthen the economy of tribal people. The forest department has to manage the supervision of bee keeping and sericulture practices to be run with proper skills. The vantage point is an availability of the flowering trees and wild host plants of tasar, muga and eri silkworms in the park area. In addition to this forest department can manage the mulberry plantation in selected areas to earn the silk from mulberry silkworm (Bombyx mori). Bees are responsible for the pollination of many flowering plants and are therefore important in sustaining biodiversity (Hertz, 2002). The economic importance of the pollination to agriculture and forestry is very high.

From the above discussion it is clear that NTFPs and NWFPs contribute more than timber to domestic and international economies on a per hectare basis (Pofenberg, 1990). Conversely, faulty techniques of harvest may result in loss of natural stock and affect regeneration as in the case of Mahua in West Bengal and Central India (RMLP, 1992). The extensive loss of gulmava (Persea macarantha) in Malnad and Kurg districts was reported due to debarking of trees (Parameswarappa, 1992).

In order to avoid the drastic consequences mentioned above, information about NTFP/NWFP yields as well as extraction rates needs to be generated, for taking decisions on whether a given practice is sustainable or not in the long run. Research is also required on the ecological regeneration pattern, growth rates,
yield in different types and silvicultural techniques for managing multiple products. The extraction and utilization rates overtime and different seasons used to be assessed over a period to identify trends or patterns in yield and use of NTFPs/NWFPs (Murthy, 2005).

5.5.2.4 Contamination of Environment:

During study period it was observed that many people visits the park by one or other reason. They carry the plastic bags, plastic and glass bottles and plastic pouches. The dumping of this non-biodegradable substance is increased day by day. The Prachitgad and Bhairavgad are the forts where the visit flow of young tourist and trackers was observed more. The entrance of vehicles such as motor bikes and motor vehicles were commonly observed to enter through the region of Male-Kolane of Satara district and Udgiri of Kolhapur district. Trackers were also used to enter through Kundi Ghat to enter in the park in the area of Chandel to Prachitgad fort. The sound created by vehicles was observed occasionally which may disturb the habitat and wildlife. The road kills of animals mostly reptiles by vehicles were noticed occasionally.

Paoletti et al. (2007) have worked on impacts of air pollution and climate change on forest ecosystem and concluded that two topics are required to focus. First one is changes in plant phenology due to climate change and second is plant competitive response to contaminate environment.

5.5.2.5 Encroachment:

The problem of encroachment was not observed in park area but the extensive activities of agricultural practices on the private land of local people may create the problem in future. Tribals are often considered responsible for forest degradation (Salam et al. 1999). Iftekhar & Hoque (2005) studied the causes of forest encroachment from Bangladesh and concluded that the forest encroachment inappropriate forest policy response, unfavorable market economy, unfavorable political decisions and population pressure and persistent poverty.
Jadhav (1995) has mentioned the most serious problem is caused by illegal encroachment of forest land for hutments in Sanjay Gandhi National Park.

An increase in population in the adjoining area of park is also serious threat to the integrity of forest. It is also one of the causes of forest degradation and deforestation (Flint, 1994; Capistrano & Kiker, 1995; Rasheed et al. 1995; Kamal et al. 1999; Salam et al. 1999; ADB, 2002; Ali, 2003; BBS, 2004; Rasul et al. 2004 and GoB, 2005).

5.5.3 **Management of Human-wildlife Conflict:**

The study reveals that ‘Chandoli National Park’ consist of four villages within with 2,829 population and 78 villages around with 86,759 human population (Human population Census, 1991), their livestock and agricultural practices. So the human-wildlife conflict is obligatory in this region. The animals involved in human-wildlife conflict were mostly tiger, leopard, gaur, sloth bear, wild dog, wild boar and different venomous snakes.

In case of impact of wildlife on humans of this area includes damage to agriculture, killing of livestock and injuries to local residents. In future, the animals like leopard, gaur and sloth bear will create serious issues in the conflict in this area. In case of impact of human on wildlife, mostly includes hunting and poaching of wild animals, encroachment, intentional forest fires, and collection of NTFPs/NWFPs. So the management of human-wildlife conflict is essential in this region.

Considering the actual population growth rate of human and the growing pressure for accessing land, it is clear that the human-wildlife conflict will not be eradicated in the near future, however it needs to be managed urgently. A wide range of different management tools has been developed worldwide to address HWC, but most of these are strongly site and species specific and are not widely or easily accessible (IUCN, World Conservation Union, 2003).

Currently in Chandoli National Park financial compensation system is adapted for mitigating the human-wildlife conflict. The forest department gives
the financial compensation in case of conflict depends upon the nature of damage. In this system the compensation paid for agricultural damage is not sufficient. Many sufferers are not satisfied on the monitory compensation given to them in case of agricultural damage. The financial compensation is very contentious issue and least popular due to its inefficiency and low rate of reimbursement. This is reality in many developing countries which face budget constraints and usually pay on an irregular basis and to a limited extent.

For voluntary human population resettlement from Chandoli National Park, the alternative land and incentives were made available to them for relocation of local communities. Majority of villages are settled in different villages of Kolhapur, Sangli and Satara districts but the people rehabilitated from park area are not fully satisfied as their demands are not fulfilled by Government. So the remaining people from the park area are not ready to relocate.

Where, alternative land and incentives are available, relocation of local communities to area offering better access to natural resources and socio-economic opportunities can be adequate solution to HWC (Madhusudan, 2003).

Madhusudan (2003) has reported ineffective financial compensation scheme from Karnataka state. In this he elaborated that the process of claiming compensation and verification and approval procedures were very bureaucratic and often resulted in only a small portion of the under values of losses and delay in refund to sufferers. Mishra (1997) has also reported the same from state of Himachal Pradesh.

However, there is some concern about improving and enforcing this system because it is suspected that a well developed compensation scheme would result in inflated claims and attract people from outside the affected areas, thus increasing the pressure and the problem (Sekhar, 1998). In addition, this is not a sustainable solution as it depends heavily on the final budget of the local governing bodies and it does not encourage villagers to protect their holdings and to co-exist with wild animals.
Many researchers have worked on the management practices for the human-wildlife conflict all over the world. These are enlisted as follows.
5.5.3.1 Preventive strategies:

A. Guarding:

The HWC can be managed by guarding with the help of human guards, dogs as studied by Paterson et al. (2004) from Kenya and Ogada et al. (2003) from northern Kenya. Sekhar (1998) while studying in Sariska Tiger Reserve, Rajasthan, observed the majority of farmers ranked guarding as the most efficient and common measure to protect their crops, despite requiring additional labors at night.

B. Alternative High-cost Livestock Husbandry Practices:

Movement activated guard (MAG) devices and electronic training collars (EC) are deterrent system based on aversive stimuli, they are very high-cost and cutting edge techniques. However, the usefulness of MAG and EC is still limited (Shivik et al. 2003).

C. Relocation:

Where, alternative land and incentives are available, relocation of local communities to area offering better access to natural resources and socio-economic opportunities can be adequate solution to HWC (Madhusudan, 2003).

5.5.3.2 Mitigative Strategies:

A. Compensation System:

Currently, in Chandoli National Park, compensation system is utilized to manage HWC. The drawbacks of compensation system were described by Madhusudan (2003) from Karnataka state and Mishra (1997) from the state of Himachal Pradesh. It was also rejected by Sekhar (1998).

B. Insurance Programmes:

Livestock and crop insurance is often proposed as an innovative solution for mitigating the impact of HWC but it is yet to be experimented broadly. It signifies the local governing bodies or the forest department relieved of financial expenses, from not having to administer compensation scheme (Madhusudan, 2003). Mishra et al. (2003) also recommended the same system.
C. **Incentive Programmes:**

Incentive programmes are based on subsidies. They offset the cost of conservation and demand the adoption of conservation-friendly practices creating tolerance towards wildlife through the exchange of benefits. In India in the state of Himachal Pradesh the programme succeeded in reducing the forage overlap among wild herbivores and livestock through the clearance of an area five hundred ha from livestock grazing and other human use.

D. **Community based Natural Resource Management Schemes:**

In this the ecotourism industry and hunting concessions are potentially valuable for developing a local economy based on wildlife related revenues but in this it is expected to have a real potential in mitigating the conflict (O’Connell-Rodwell *et al.*, 2000).

E. **Regulated Harvest:**

This is a low cost technique and has the potential to raise public tolerance towards the wildlife. In many regions HWC is managed by hunting. But it need to be based on scientific monitoring, that ensures sustainable harvest and must be regulated by policies that address the timing, location and methods of hunting, as well as the distribution of benefits to stock holders. It is assumed that regulated harvest is not effective in reducing crop and livestock losses and it is also likely to increase the risk of further losses when dangerous carnivores are wounded instead of being killed (Treves & Karanth, 2003b).

F. **Wildlife Translocation:**

It consists of moving a certain number of animals from a problematic zone to a new site. It may be a practical and acceptable approach in some cases and where there is the availability of suitable habitat with territorial vacancies (Treves & Karantha, 2003b).

Apart from all above measures the potential conservation benefits of crop such as chili are considerable. Growing chili as a cash crop can produce raw material for community-based wildlife deterrents (Osborn & Parker, 2002).
Introducing unpalatable crops will not only reduce the costs of conflict borne by the farmer, but may also improve livelihood security. Reducing the cost of wildlife conservation to communities will enhance the conservation of wild animals outside protected area (Leader-Williams & Hutton, 2005; Walpole & Thouless, 2005).

From the above mentioned methods of preventive strategies and mitigative strategies of management of human-wildlife conflict, artificial and natural barriers, relocation, settlement of rights compensation system, insurance programme and wildlife translocation methods can be employed to manage the human-wildlife conflict from Chandoli National Park area.