CHAPTER 2
REVIEW OF LITERATURE
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2.1: PROLOGUE:

Protected areas are those in which human occupation or at least the exploitation of resources is limited. The definition that has been widely accepted across regional and global frameworks has been provided by the International Union for Conservation of Nature (IUCN) in its categorization guidelines for protected areas. There are several kinds of protected areas, which vary by level of protection depending on the enabling laws of each country or the regulations of the international organizations involved. Review of literature was carried out in context as per the objectives of the study.

It has been estimated that around two billion people world-over are facing the shortage of fuel-wood (Lean et.al., 1990). According to Brown et.al (1996), phytosociological data are often designed for vegetation classification.

To minimize the degradation of natural ecosystems, protected areas (PAs) have been established that cover about 5% of the world’s land area (Groombridge, 1992; Singh, 1997). Banerjee et al. (2003) have worked on the response of conservation measures on the growth of planted species and its impact on improvements in soil properties. Pandit et.al (2005) carried out biodiversity measurement of Jessore Sloth Bear sanctuary.


There is a conspicuous gap in our knowledge of the flora (Giri et.al, 2006), and therefore assessment of taxa belonging to rare, endemic and threatened categories is not yet complete. Formerly many explorers have explored the flora and vegetation of India and
Bombay Presidency. Graham (1837) was the first to publish a ‘Catalogue of Bombay Plants’ which was followed by the ‘Flora of Bombay’ (Dalzell and Gibson, 1861). Nairne (1894) has published the ‘Flowering Plants of Western India’. The Cooke’s ‘Flora of the Presidency of Bombay’ (1901-1908) continued till today to be the most important floristic work for identification of the species (Gaikwad and Datar, 2015). Later many workers explored the Presidency and supplemented Cooke’s work. Naik (1998) prepared the ‘Flora of Marathwada’. Some district floras also have been published and worked out by research workers of Pune in BSI (Laxminarsimhan, 1986; Patil, 2003; Sharma et.al, 1996; Almeida, 1996; and Singh et.al, 2000, 2001). Patil (1990) detected exotic elements in the flora of Dhule district (Maharashtra). Varghese et.al, (1990) during the extensive and intensive botanical explorations, rare and little known plants of Maharashtra were collected from Dhulia forests. Rastogi and Rastogi (2007) have worked on phyto-sociological analysis of the restored Sal (Shorea robusta) plantations and natural Sal forest of Tripura. Mahajan (2001) studied forest ecology of Akkalkuwa Tahsil using remote sensing and ecological methods. In addition some wildlife sanctuaries and national parks have been explored. Malhotra and Rao (1980, 1981) explored the Nagzira wildlife sanctuary (174 species) and Nawegaon national park (301 species) in Bhandara district.

Studies were also carried out on different aspects of Mayureshwar Wildlife Sanctuary (MWS) and Rehekuri Blackbuck Sanctuary (RBS) and associated areas (Rahmani and Manakadan, 1990; and Bharucha and Asher, 1993) Bhagat et.al, (2008) recorded 994 taxa consisting of 938 species, 14 subspecies and 42 varieties belonging to 577 genera and 136 families of flowering plants from Baramati Tehsil of Pune. Abhang (2004), Ben et.al (2013), Vanak et.al (2014), Panwar et.al (2014), and Janakiraman and Jalal (2015) have studied angiosperm diversity of the Great Indian Bustard wildlife sanctuary (Maharashtra) and reported that the semi-arid grassland of Nanaj and its associated zones like Rehekuri, harbor several endemic species by forming habitat for rare species in the sanctuary and suggested to prioritize the conservation measures at potential areas.

2.2: WILDLIFE SANCTUARIES STATUS IN INDIA:

India is one of the 25 mega diverse countries of the world. With only 2.4% of the world’s land area, 16.7% of the world’s human population and 18% livestock, it contributes about 8% of the known global biodiversity. India is home to world’s largest wild tigers population and has got unique assemblage of globally important endangered species like Asiatic Lion, Asian Elephant, One-horned Rhinoceros, Gangetic River Dolphin, Snow
Leopard, Kashmir Stag, Dugong, Gharial, Great Indian Bustard, Lion Tailed Macaque, etc. (http://www.indiaenvironmentportal.org.in/files/file/protected-area-network.pdf). National parks and sanctuaries are legally protected areas. In India, protected areas have existed since the 4th Century BC with the establishment of Abhayaranyas. Wildlife sanctuaries provide an ideal habitat for varied animal life.

2.3: PROTECTED AREA NETWORK IN INDIA:

A National Board for Wildlife (NBWL), chaired by the Prime Minister of India provides for policy framework for wildlife conservation in the country. The National Wildlife Action Plan (2002-2016) was adopted in 2002, emphasizing the people’s participation and their support for wildlife conservation. India’s conservation planning is based on the philosophy of identifying and protecting representative wild habitats across all the ecosystems. The Indian Constitution entails the subject of forests and wildlife in the concurrent list.

Wildlife Sanctuaries of India has the second largest base of biodiversity in the world. These calm and peaceful wildlife sanctuaries are the home for some very giant animals and rare species of birds. India has some of the biggest National Parks like Hemis, Sundarbans and Gangotri National Park. Rann of Kutch, also known as the Indian Wild Ass sanctuary is the largest wildlife sanctuary in India.

2.4: WILDLIFE SANCTUARIES:

There are 530 existing wildlife sanctuaries in India covering an area of 117,590.81 km², which is 3.58 % of the geographical area of the country (National Wildlife Database, July, 2015).

Sanctuary is an area which is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance. The Sanctuary is declared for the purpose of protecting, propagating or developing wildlife or its environment. Certain rights of people living inside the sanctuary could be permitted. Further, during the settlement of claims, before finally notifying the sanctuary, the Collector may, in consultation with the Chief Wildlife Warden, allow the continuation of any right of any person in or over any land within the limits of the Sanctuary (http://www.moef.nic.in/downloads/public-information/protected-area-network.pdf).
2.5: WILDLIFE SANCTUARIES STATUS IN MAHARASHTRA:

There are 35 wildlife sanctuaries in Maharashtra. Rich in natural beauty, Maharashtra is a paradise for nature lovers. There are many wildlife sanctuaries and wildlife parks within the state, having a wide range of vegetation. Wildlife parks are the home to a number of animals and birds. They offer an outstanding opportunity to view animals in their natural habitat. Apart from the existing wildlife sanctuaries, steps are taken by the state government to set up many new sanctuaries and parks. National parks are habitat oriented while sanctuaries are species oriented (Almeida, 1996).

Mayureshwar Wildlife Sanctuary, Supa represents the biodiversity of drought prone areas of Baramati Tehsil of Pune District. The reserve forest in charge of the forest department which was afforested under different schemes covered in this sanctuary. The sanctuary was declared vide Government Notification No. WLP/1094/CR-510 F-1 dated 19th Aug. 1997 having total area of 5 14.46 ha. of reserved forests of Supa Village from Baramati Tehsil-of Pune District. Sanctuary was having 30-40 Chinkaras at the initial stage, now the number has gone up to 200-250 (MWS Management Plan, 2003-2004 to 2012-2013).

2.6: MAYURESHWAR WILDLIFE SANCTUARY:

2.6.1: Flora:

The sanctuary consists of dry deciduous scrub forest with interspersed grasslands. Ben et al. (2013) reported that forest department planted (since 1983) species of Acacia torta (Roxb.) Ctsib., Gliricidia sepium (Jacq.) Kunth. ex Walp., Azadirachta indica A. Juss. and Prosopis cineraria (L.) Druce., P. juliflora (Sw.) DC. Due to protection, natural floristic elements are well established. The documentation of floristic account by them revealed total 185 species belong to 155 genera and 55 families. Two pteridophytes namely, Actiniopteris dichotoma Bedd, and Ophioglossum gramineaum Wild., and gymnosperm Thuja occidentalis L. were recorded here. Some algae and bryophytes are Chara, Hydrodictyon, Chlorella and Riccia respectively.

The main plant species are Acacia tortolis, Acacia nilotica ssp., Acacia catechu (Khair), Acacia leucophloea (Hivar), Azadirachta indica (Neem) Dalbergia latifolia (Shisav), LImonia acidissima (Kavath) Leucaena latisiliqua (Subabhol), Gliricidia sepium, Ziziphus mauritiana (Ber), Aristida sp., Alysicarpus hupleurifolius, Heteropogon contortus, Indigofera cordifolia, Merremia emarginata, Cucumis melo, Cyperus kyllingia, Striga

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2.6.2: Fauna:

The main animal species are *Gazelia bennetti* (Chinkara), *Hyaena hyaena* (Hyaena), *Canis lupus* (Wolf), and *Vulpes bengalensis* (Indian Fox), etc. The sanctuary is protected by Forest Department of Maharashtra Government. However due to lack of sufficient fodder in dry seasons, animals migrate sometimes outside Sanctuary area.

The Indian gazelle is most common animal seen in the Sanctuary. The other species which come across are Hare, and Wild cat. The wild cat or ran-manjar (*felis Chaous*) is found in large number as it can thrive in open grass pastures dotted with bushes, and in scrub jungle around human habitations. One striped hyena or Taras (*Hyaena hyaena*) is found in the sanctuary in open grass pastures. It's often mistaken, for a small tiger due to its striped coat, by the local villagers. Jackal (*Cannis aureus*) and Fox or Khokad (*Vulpes hengalensis*) are quite common in this area. Fox is, however, regarded as a friend of the farmer as it destroys rats, which are harmful to the agricultural crops. Indian mongoose (*Harpases edwardsi*) is common all over this region Pea-fowl is also seen in the sanctuary and in the fields, around. The identified bird species are hawks, owls, bulbul, pantridges, quails, cuckoos, drongoes, larks, Mynas, Sunbirds, Kingfishers and pea-cocks.

**Antelopes:** Form sub-division of the family Bovidae. As a group they cannot be classified either with the oxen or with the sheep and goat. They bear characters common to both. There is the usual characteristic white streak down each side of the face, and a dusky patch above the nose. The horns of the male appear almost straight when seen from the front; in profile they take a slightly "S" shaped curve. They have 15 to 25 rings. Horns of female are smooth.

Distribution- The plains and low hills of north western and central India extending through the open lands of the Deccan to a little South of the Krishna river (Prater, 1971).

**Chinkara: Indian Gazelle** (*Gazella gazelle bennetti*): The Chinkara is a slender bodied antelope. It measures about 65cm in height at the shoulder. The horns, in male, are relatively longer than in the female, slightly curved and closely ringed; they measure about 25-30 cm in the female. Its coat colour varies from sandy brown to light chestnut.

**Chinkara (Indian gazelle):** It is a shy animal and avoids human habitation. It can go without water for long periods and can get sufficient fluids from plants and dew. The life expectancy of a Chinkara is between 12 to 15 years, less than that of many other deer.
species. The Chinkara (Gazelle bennetti) or Indian Gazelle is a species of gazelle found in south Asia. It lives in grasslands and desert areas in India. This gazelle stands at 65 centimeters and weighs about 23 kilograms. Its summer coat is a reddish-buff colour, with smooth, glossy fur. In winter the white belly and throat fur is in greater contrast. There are currently 80,000 gazelles left.

**Distribution:** It occurs in the plains and low hills of north western and central India, extending southwards to a little south of Krishna River. It is also found in Pakistan, Middle East Asian countries and westwards in northern Africa.

Chinkara is a wild animal present in 11 states of India. The Chinkara (Gazella gazelle) can be seen in various protected areas across India. This animal was recorded in IUCN category as L Rnt (lower risk near threatened) in 2000. In Maharashtra state Mayureshwar wildlife Sanctuary (MWS) has declared for conservation of Chinkara. (Ben et.al, 2013).

The Chinkara or Indian Gazelle (Gazella gazella-pallas) is associated with the Indian culture since ancient times. Indian gazelle was perhaps the commonest wild animal in India. Being in close proximity to human habitations, no animal in the sub-continent has suffered such a steep decline in number and reduction in areas of assurance, as has the Indian gazelle or the Chinkara. Government of Maharashtra realized the significance of conservation of Chinkara, i.e. Indian gazelle, and declared the area of 5.14 km² of reserved forests in Supa village of Baramati Tehsil as Mayureshwar Wildlife Sanctuary vide Notification No. WLP/1094/CR-510/F-1 dt 19th Aug 1997 (Abhang, 2004).

**Habits and habitat:** Chinkara generally preferred habitat of Acacia dominated species to feed on different food items. Chinkara feed on Acacia torta leaves and pods (Ghosh et.al, 1987). Jaipal (2015) observed that Chinkara was grazing highest (63.12%) during monsoon season followed by winter (38.77%) and summer (26.49%). Moving, resting, playing and all other routine activities are influenced by the availability of food. Survival of the Indian gazelle depended on the natural vegetation those are found in harsh desert condition. The food preferences are depend upon availability of food (Jaipal, 2015). The Chinkara lives in small herds of 10 to 20 individuals or less, sometimes just two or three animals together. It is an animal of thin forested areas, preferring ravings, broken country, rocky areas and scrub-covered hills. It is also common in the sand-dunes of the desert zone. It is very shy animal. Its sense of sight, scent and hearing is equally well developed. When alarmed, the Chinkara runs at a wild place till it finds a cover behind the bushes or in ravines. The food consists of
grass, leaves, succulent fruits such as pumpkins, melons etc. It is to meet its water requirements from the sap of the vegetation it takes and from dew. However, it drinks freely when water is available. The female is often seen accompanied by one or two fawns.

**Status:** The population of the Chinkara in India is highly affected due to high rate of predation, random killing for its flesh and skin, and habitat-destruction for human settlements and agro-industrial use.

**The Indian wolf** has a very short, dense coat that is typically reddish, tawny, or buff colored. It reaches 60-95 centimeters (24-37 inches) in height, and typically weighs 18-27 kilograms (40-60 pounds), making it smaller than the gray wolf. Breeding generally occurs in October, after the rains – early compared to the gray wolf. The Indian wolf, because it lifts children and preys on livestock, has long been hunted, though it is protected as an endangered species in India under schedule 1 of the Indian Wildlife (Protection) Act of 1972.

**Indian Fox** is a relatively small fox with an elongated muzzle, long pointed ears, and a bushy tail ca. 50 to 60% length of head and body. Lack of habitat protection is perhaps the greatest threat to the Indian fox. For example, in southern India, <2% of potential Indian fox habitat is covered under the existing protected area network of the states of Karnataka and Andhra Pradesh.

**Stripped Hyena:** Unlike the spotted hyena, the striped hyena is primarily a scavenger, and will readily consume carrion and the remains of kills of other predators, using its powerful jaws to gnaw and crush bones. It does occasionally feed on live prey, though it has been suggested that only individuals from the three larger subspecies present in Northwest Africa, the Middle East and India kill large prey animals (httpwww.punemate.com200909 mayureshwar-wildlife sanctuary.html).

### 2.7: REHEKURI BLACKBUCK SANCTUARY:

#### 2.7.1: Flora of RBS:

The natural vegetation in and around Rehekuri consist of grasses, forbes, shrubs and thorny trees. Most of the area around Rehekuri is used for growing crops. There are more than 15 common grass species found in these grasslands. However a large proportion of grass species have become less common due to overgrazing by livestock. Several species of plants which are affected by overgrazing by cattle and blackbuck could well become locally extinct. Others do not tolerate repeated fires that are lit by people and will thus disappear.
The common tree species in this ecosystem are: *Acacia nilotica* ssp., *A. chundra*, *A. leucophloea*, *Azadirachta indica*, *Balanites aegyptiaca*, *Capparis decidua*, *Delonix regia*, *Ficus benghalensis*, *Hardwickia binata*, *Leucaena latissiliqua*, *Millingtonia hortensis*, *Mimosa hamata*, *Tamarindus indica*, and *Ziziphus mauritiana*. The common herbs include *Aeschynomene indica*, *Alysicarpus vaginalis*, *Biophytum sensitivum*, *Cleome viscosa*, *Glossocardia bosvallia*, *Indigofera cordifolia* and *Indigofera linifolia*. The common grasses are *Apluda mutica*, *Chrysopogon fulvus*, *Dichanthium annulatum*, *Heteropogon contortus*, and *Setaria pumila*. Factors such as poor soil quality, fire and erosion contribute to the lack of regeneration of the main species and deterioration of native vegetation.

**2.7.2: Fauna of RBS:**

This wildlife sanctuary is dedicated to *Antelope cervecarpa* (Blackbucks) and Great Indian bustard. There are Blackbucks and Great Indian Bustards in this Sanctuary. Other wildlife includes hyenas, pythons, monkeys, jackals, wolves, and peacocks.

The Great Indian Bustard (*Ardeotis nigriceps*) is also known as Maldhok occurs in 7 states in India. This species is listed as Endangered in IUCN Red List of Threatened species in the Bustard family, with a very small declining population. The Bustard is protected legally and there has been extensive research in to its status, distribution, ecology and conservation. Despite this there is a need to establish new protected areas and to promote a conservation strategy.

The Great Indian Bustard (GIB) Sanctuary (8496 km²) lies in Solapur and Ahmednagar Districts (Maharashtra). The Indian Government recognized the urgent need to conserve dry lands to ensure the survival of Bustards. It includes forests, agricultural fields, and grasslands, and is the largest protected area in the country.

The Maharashtra forest department conducts a Bustard census every year in July, figures from 1998 to 2008 (In Rehekuri (1998), only 8 birds, while in 2008 not a single Bustard recorded) show that few birds remain (Jha and Rao, 2008). The disappearance of Bustard from the forest range of Rehekuri is mainly due to habitat degradation and other disturbances. Bustard prefer grassy plains and open scrubland with scattered trees and nest in open areas with short grass or on well drained stony ground. They forage in scrubland, grassland, stony wasteland and crop fields. For day roost Bustard prefer to sit or stand in the shade of small trees or shrubs, while for night roost they prefer bare ground. A large number of species share the Great Indian Bustards habitat including Blackbuck and Chinkara.
Bustard species can be considered as indicators of grassland ecosystems and by conserving Bustard and their habitats a large number of species dependent on healthy grasslands will also be protected. It is essential that sanctuaries created for the Great Indian Bustard be managed in a way to ensure their continued survival (Jha and Rao, 2008).

2.8: RESTORATION OF WLS:

In recent years many arid zone sanctuaries were artificially afforested with non-indigenous plant species to produce shed and hides for fauna. Such species produce short term benefits for faunal components and can become long term pest against local species by dominating them in all respect. They also alter normal ecological and ecosystem balance. Humans have been directly or indirectly dependent on biodiversity for sustenance to a considerable extent. However, increasing population pressure and developmental activities have led to large scale depletion of the natural resources.

Conservation is the protection, preservation, management, or restoration of wildlife and natural resources such as forests and water. Through the conservation of biodiversity and the survival of many species and habitats which are threatened due to human activities can be ensured. There is an urgent need, not only to manage and conserve the biotic wealth, but also restore the degraded ecosystems.

Different floristic diversity studies have been conducted in many parts of world. Ultimate of the floristic studies emphasizes on inventory (Whittaker and Niering, 1965; Risser and Rice, 1971; Gentry, 1988; Linder et.al., 1997; Chittibabu and Parthasarathy, 2000; Sagar et.al, 2003; Padalia et.al, 2004; Appolinario et.al, 2005). In addition to inventory, disturbance intensity on regeneration (Kennard et.al, 2002; Denslow, 1995), phenological assessment (Frankie et.al, 1974), resemblance of tree species diversity (Pitman et.al, 2002), monitoring (Sukumar et.al, 1992), species area and species individual relationship (Condit et.al, 1996) have also been studied through floristic analysis. Many researchers working on floristic studies worldwide in different levels using variety of sampling and measurement techniques based on their objectives. Recently a critical review of floristic inventory and diversity assessment was worked out by Jayakumar et.al (2011). In their study it also concluded that comparable inventory dataset is required to locate areas for In-Situ conservation and to efficiently allocate available scarce resources. As the sampling techniques, sample size and measurements taken in the fields vary considerably between studies, it is very difficult to use and to compare all the data that are available through inventory and diversity studies (Jayakumar et.al, 2011).
Kier et al. (2005) provided the first global map of vascular plant species richness by eco-region; the results were also compared with the published literature on global priorities for plant conservation. While doing this, the state of floristic knowledge across eco-regions as described in floras, checklists, and other published documents was also assessed and thus pointed out the lacunae in understanding of the global vascular plant flora. Ultimately, they explored the relationships between plant species richness by eco-region and our knowledge of the flora.

Floristic, plant exploration and ethno-botanical studies have been carried out on the neighboring regions of MWS and RBS. Salave et al. (2011) explored some unreported ethno-botanical uses from Karanji Ghat areas of Pathardi tehsil in Ahmednagar district and indicated that our prime duty becomes to protect and conserve these plants via ex-situ or in-situ means urgently in a proper way. Mulay et al. (2014) studied some underutilized plant resources as a source of food from Ahmednagar District, and stated that the wild edible plants occurring in the nearby areas are also taken as supplementary food. Ganorkar and Kshirsagar (2013) in their Floristic Study of Shirur Region of Pune revealed that the vegetation pattern of the area alters, and flora gets affected adversely due to loss of potential habitat and climatic changes hence there is urgent need for conservation and protection by Government as well to aware the peoples about the plant biodiversity.