2. LITERATURE REVIEW

2.1 Global Scenario

Herbal medicine is the oldest form of healthcare known to mankind. Herbs had been used by all cultures throughout the history. Much of the medicinal uses of plants seems to have been developed through observations of wild animals, and by trial and error. As time went on, each tribe added more information to the knowledge base on medicinal properties of herbs. Eventually information was methodologically collected on herbs and documented in the form of well-defined herbal pharmacopoeias. Indeed, discovery of herbal drugs is originated from the herbal lore of native peoples. Large number of herbal crude drugs such as belladonna (*Atropa belladona*) Cascara (*Rhamnus purshina*), Digitalis (*Digitalis purpurea*), Ipecae (*Cephaelis ipecacuana*), Opium (*Papaver somniferum*), Rouvolfia (*Rouvolfia serpentina*) and Veratrum (*Veratum viride*) were discovered and introduced in modern pharmacopeias during 1850-1950.

Stuart (1911) prepared Chinese Materia Medica of vegetable kingdom in which their therapeutic uses were discussed. Chevallier (1962) prepared the encyclopedia of Chinese medicinal plants in which 550 key herbs and their healing properties were discussed. Iwu Maurice (1993) compiled the information of 162 medicinal plants of Africa in which their main therapeutic uses, distribution, biological activity and chemical constitutes were discussed. Anderson and Higby (1995) prepared the first U.S. Pharmacopeia which included an authoritative listing of herbal drugs, with descriptions of their properties, uses, dosages, and tests of purity. It was periodically revised and became the legal standard for medical compounds.
González-Tejero *et al.* (1995) carried out ethnobotanical and phytotherapeutic research in Spain and reported that 267 taxa were used in folk medicine out of which 34 uses were newly recorded. Novy (1997) reported sixty-eight plants used in the traditional medicinal practices of the Betsimisaraka and Tanala people of the eastern region in Madagascar. The author states that Ethnopharmacological information is in danger of being lost in Madagascar as slash and burn agriculture destroys much of the forest, and the elder traditional healers, often illiterate, pass away without handing down their knowledge.

Caniago and Sibert (1998) documented abundance, distribution and knowledge of medicinal plant species in Ransa Dayak village in west Kalimantan, Indonesia. They reported 250 medicinal plant species utilized by local healers. It was highlighted that commercial logging and loss of traditional knowledge through acculturation pose twin challenges to persistence of traditional medicinal plants used in this Ransa village and throughout much of Kalimantan.

Ivancheva and Stantcheva (2000) reported 73 medicinal plants that are traditionally used in Bulgarian phytotherapy. Hamill *et al.* (2000) enumerated one-hundred four medicinal plants species used by herbalists from three southern Ugandan tribes. Balleroa *et al.* (2001) carried out an ethnobotanical survey in the territory of Fluminimaggiore south-western Sardinia and recorded sixty-five medicinal plant species used for different ailments pertained to skin and the gastro-intestinal system. In an ethnobotanical study of medicinal plants used by the Zay people in Ethiopia, Giday *et al.* (2003) reported 33 species and found that the main cause for the depletion of medicinal plants in the area was environmental degradation and intense deforestation. The study also alarmed that loss of these plants would hamper the existing health care system in the area as the Zay people partly depend on medicinal plants. The study conducted by El-Hilaly *et al.* (2003) demonstrates that the medicinal plant sector in the Northern Morocco is a promising economic resource for developing the region; it needs a planned exploitation, and that the tribes should continue to master the folk-medicine.

In spite of the socioeconomic welfare and well-developed medicinal facilities, people in Turkey from Kyrklareli Province still use traditional medicine for the treatment of different diseases (Kultur 2007). Addo-Fordjour *et al.* (2008) studied
diversity and conservation of medicinal plants in Brong Ahafo region and reported 52 plant species based on the use by local herbalists. Their study concluded that harvesting methods employed by some of the herbalists were destructive.

Through a study carried on diversity and distribution of medicinal plants in North Sinai, Egypt (Abd EI-Wahab et al. 2008) reported 281 species and stated that North Sinai habitats support about 100 to 120 medicinal plant associations. They remarked that about 60% of medicinal plants are threatened due to intensive collection and other human activities. It was, thus, concluded that public and private involvement in management and utilization of medicinal plants in sustainable way is essential to combat human pressures on these valuable natural resources.

Qureshi and Bhatti (2008) reported 51 medicinal plant species used by the Thari people in Pakistan. Recording 69 species used by local people of Phlegraean Fields Regional Park in Southern Italy, Motti et al. (2009) confirm the persistence of traditional plants uses in regions of central and southern Italy. The ethnobotanical investigation on Sardinia area reported uses of 72 species (Signorini et al. 2009). Idolo et al. (2010) carried out an ethnobotanical study and phytomedical knowledge in one of the oldest European Parks in Central Italy and reported 145 species out of which 90 species were used for medical application. The study remarked the relationship existing between the high plant diversity and the rich ethnobotanical knowledge.

2.2 Indian Scenario

There are several studies from India on medicinal plants and their indigenous uses. Chopra et al. (1956) compiled exhaustive data on more than 1,500 medicinal plants providing their botanical names, commonly used synonyms, distribution and medicinal uses. Dastur (1964) discussed 249 useful plants of India and Pakistan with their local name, English name and their uses. Billore (1989) carried out a study on some threatened medicinal plants of Rajasthan and their conservation. Kirtikar and Basu (1993) compiled information on Indian medicinal plants in four volumes. Rastogi and Mehrotra (1991-1998) designed a companion volume of Glossary of Indian medicinal plants (Chopra et al. 1956) in which each plant’s chemical and biological aspects were discussed in detail with their distribution in India. A
compendium of 500 Indian medicinal plants was prepared (Anonymous 1993-1996) in which the species are arranged alphabetically with their description, parts used, their properties and uses. Nadkarni (1998) described 419 Indian medicinal plants and drugs providing their habitat, properties, uses and preparation of drug.

Regarding the distribution status and conservation of medicinal plants, Kala (2000) provided an account on 23 rare and endangered medicinal plants in Indian trans- Himalaya. Distribution status of each species in each zone of the area was recorded and recommendations were made for their conservation. Parrotta (2001) compiled information on 545 medicinal plant species, providing their botanical name, common name, morphology, distribution, habitat, medicinal properties and uses in traditional medicinal practices. Uniyal et al. (2002) estimated the population status and biomass availability of 14 threatened medicinal and aromatic plants which are extracted and traded from the higher altitude of Kumaon, Himalaya in Uttaranchal and highlighted the habitat specific distribution.

Samant and Pal (2003) provided a comprehensive account of 700 medicinal plants, based upon literature and field survey, along brief information on the diversity, distribution pattern along altitude gradient, nativity, rarity, endemism, conservation status, prioritization of species for cultivation and action plan for the conservation and management of medicinal plants in Uttaranchal. They highlighted the need for exploring the potential value of such species. Sharma (2003) prepared an encyclopedia wherein nearly 600 species with their nomenclature, description, distribution, mode of propagation, parts used and active constituents of large section of plants are included. Based on field surveys, Das and Chattopadhyay (2003) made a checklist of 75 medicinal plants of Nayagram range in Southwest Bengal. Jain et al. (2005) listed 243 species of medicinal plants in Sitamata wildlife sanctuary, being utilized in curing different ailments, out of which 34 remedies based on 24 medicinal plants were new. Pullaiah (2006) prepared an encyclopedia of medicinal plants in which botanical name, synonyms, family, and description, distribution, propagation, and medicinal uses are briefed.

Giradkar and Yeragi (2006) enumerated 91 medicinal plants through a field survey from Tadoba National park based on local utility. Recording traditional uses, Uniyal et al. (2006a) carried out a quantitative assessment of high value medicinal
plants in Chota Bhangal area of Himachal Pradesh and stated that as compared to other alpine areas of western Himalaya this area supported higher population of medicinal plants. They observed maximum similarity, in terms of species distribution, between steep slopes and undulating meadows. Laloo et al. (2006) studied the status of medicinal plants in the disturbed and the undisturbed sacred forest of Meghalaya and reported 80 medicinal plant species. The study found that species richness was adversely affected by anthropogenic activities. Paulsamy et al. (2007) studied ecological status of medicinal and other economically useful plants based upon the field survey and reported 131 medicinal plants from Shola.

Semwal et al. (2007) evaluated distribution pattern, population structure and conservation status of ten rare and endangered medicinal plants in Kedarnath wildlife sanctuary. They found that most of the species were restricted to 2-3 habitats, while few of them were widely distributed. Accordingly, an implication and management strategy has been suggested. Acharya et al. (2009) explored distribution pattern of medicinal plants richness along an elevation gradient in Nepal and effectiveness of existing protected area for their conservation.

2.3 Sampling Inventories

There are numerous ecological studies, which focused over the time, either on community structure or dynamics of a specific species/vegetation etc. However ecological studies quantifying the medicinally important species are very scarce. The quadrat method is the best method; and largely employed in ecological studies. Depending upon the nature of study and extant of sampling area, different sizes of quadrats were used by different ecologists, ranging from 1metre to 1hectare.

Jha et al. (1997) assessed the species diversity pattern, using remotely sensed data in the Western Ghats of India, by laying rectangular plots of 0.1 ha in their stratified random sampling. Dixit (1997) employed 0.1 ha (50m x 20m) as sampling plot size to carry out an ecological evaluation of dry tropical forest vegetation in the catchment area of Narmada river and around the proposed site of Narmada valley project of Madhya Pradesh. Dixit and Rao (2000) laid circular plots of 0.1 ha size to study the distribution and habitat characteristics of Gugal (*commiphora wightii*), a rare and endangered medicinal plants, in the arid region of Kachchh.
Laying 20m x 2m belt transect, Uniyal et al. (2002) carried out a study on the distribution of 14 commercially exploited medicinal and aromatic plants in upper Gori valley of Kumaon Himalaya, Uttaranchal. The study provided the necessary implication for the conservation of these 14 commercially exploited medicinal and aromatic plants based on their distribution pattern. In different landscape elements (LSE) of the Rohtang Pass, Western Himalaya, Singh et al. (2008) studied species diversity and population status of 50 threatened plants, out of which 24 are medicinally important. Quadrats of 25m$^2$ for shrubs and 1m x 1m for herbs were randomly laid down. The study concluded that most of the landscape elements of species diversity were found at the elevation of 3624 m and 4332 m.

Arjunan et al. (2005) and, Mohandass and Davidar (2009) used 30m x 30m (0.09 ha) quadrats for their vegetation analysis of tropical montane evergreen forest of the Nilgiri Mountains of southern India. Through species area curve, Tripathi and Singh (2009) fixed the quadrat size to 15m x 20 m for studying species diversity and vegetation structure across various strata in natural and plantation forests in Katerniaghat Wildlife Sanctuary. Prathasarathy and Karthikeyan (1997) studied biodiversity and population density of woody species in a tropical evergreen forest in Courtallum reserve forest, Western Ghats; Panchal and Pandey (2004) analysed the vegetation of Rampara forest in Saurashtra region of Gujarat state and Shukla (2009) studied species diversity across Terai landscape in northeastern Uttar Pradesh. In all these works 10m x 10m quadrats were employed. Quadrats of 1m x 1m size were employed by Dixit (1997); Uniyal et al. (2002); Uniyal et al. (2006a); Singh et al. (2008) and Shukla (2009) for studying ground cover in different regions of India. Using remote sensing and GIS, Srivastava and Anitha (2010) adopted 25m x 25m quadrats in Pune forest division in Maharashtra for mapping non timber forest products.

2.4 Mapping of Medicinal Plants

Mapping the diversity of important medicinal and rare plants using Geographical Information System (GIS) and remote sensing (RS) has already been initiated in different parts of India, but there is a lot to go in this direction. In an exhaustive study carried out by Ved et al. (1998) in Karnataka, Kerala and Tamil nadu of South eco-distribution maps for 300 medicinal plants were prepared. Using GIS and RS techniques Udaylakshmi et al.
(1998) recognized the sites of biological importance and plant bio-prospecting zones. Utilizing forest maps and field floristic data, they deduced areas with rich biological diversity. Depending on the presence of species of importance, different sites on maps were flagged as biologically important. Using GIS and multivariate statistical tools Murali et al. (1998) attempted to offer an objective method of classifying the vegetation at three layers - trees, shrubs and herbs. Prasad et al. (1998) used GIS for locating biodiversity hot spots in Western Ghats. Semwal and Saradhi (2006) carried out mapping of 39 threatened medicinal and aromatic plants of Himalayan region through GIS.

The correlation of species with ecological factors has been documented by Chavan and Sabnis (1960) in their study of vegetation along the banks of river Vishwamitri. It concluded that upper and middle storey vegetation is not affected by water current but is edaphically controlled; whereas lowermost storey consists of ephemeral vegetation which is solely controlled by the water current. Dhar (2002) studied various aspects of plant endemism in the Himalaya. The study revealed that high altitude Himalaya is rich in plant endemic diversity. Kharkwal et al. (2005) noted Phytodiversity and growth form in relation to altitudinal gradient in the Central Himalayan (Kumaun) region of India. The study concluded that the distribution and species richness pattern in this region largely depended on the altitude and climatic variables like rainfall and temperature.

### 2.5 Studies on The Utility of Medicinal Plants

Documentation of local uses of plants in the name of ‘Ethnobotany’ was initiated in India in 1954. Since then more than 9000 plant species used by tribals or aboriginals for different purposes from different regions have been recorded.

In an official program of Botanical Survey of India; Ammal (1955) studied subsistence of food plants of certain tribes of South India. Dr. S. K. Jain, the former Director of Botanical Survey of India took the lead and streamlined the subject with his numerous books and research articles on the subject. He contributed a lot to our present knowledge on Indian Ethnobotany. Bibliography of Ethnobotany (Jain et al. 1984) includes 2000 references covering almost all the earlier publications on ethnomobotany. The Dictionary of Indian Folk Medicine and Ethnobotany (Jain 1991) provides comprehensive information gathered from published literature. A Manual of Ethnobotany (Jain 1993, 1995) provides the detailed methodology to carry out ethnobotanical work.
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Contributions to Indian Ethnobotany (Jain 1997) deals with the ethnobotanical works in different states and other uses of plants among tribals. The publications of several other scholars like Saklani and Jain (1994); Joshi (1995); Maheshwari (1996); Pal and Jain (1998) and many more give supplementary information on Ethnobotany.

Jain (2001) presented the status of ethnobotanical work in India. He stated that till 2001 over 30 books had been published which contained the term ethnobotany or tribal medicine in their titles and over 275 papers were published related to specific ethnic groups. About 150 papers dealt with over 60 kinds of ailments and injuries. Other 150 papers dealt with only one or two particular species in detail.

In spite of many such attempts, a large number of medicinal plants and their associated indigenous uses still await for proper documentation which are limited to local tribes residing in different areas of India.

2.6 Studies on Medicinal Plants of Gujarat State

As compared to a numerous publications appeared on floristics of Gujarat, detailed studies on medicinal plants are scarce. Thaker (1910) documented 613 medicinal plants and their properties from Saurashtra region. Ahluwalia (1964 &1965) listed medicinal plants of Jamnagar. Santapau (1962) carried out floristic study of Saurashtra region in which medicinal uses of each species are cited in the flora, covering families from Ranunculaceae to Rubiaceae. Bole and Pathak (1988) continued the unfinished work of Santapau and documented 750 plants with their medicinal utility, covering the families from Asteraceae to Poaceae.

Umadevi et al. (1989) revealed that out of ca. 2000 plant taxa occurring in Gujarat, 760 are medicinal and 450 are of economical importance, and most of these plants are used by tribals. Anjaria, (2002) carried out a floristic study of Anand district in which he reported 212 medicinally important species.

Rao (2002) prepared distribution maps of 20 rare species of Gujarat, out of which 13 are medicinal plants. Though mapping of all the medicinal plants at the state level is a very huge task, efforts should be made for mapping of either some important/prioritized medicinal plants or some selected areas known for concentrated distribution of medicinal plants.
Several ethnobotanical works have been carried out at different regions in Gujarat state and on different tribes of the state. Bedi (1978) carried out ethnobotany of Ratanmahal hills and reported utility of 72 species; Joshi et al. (1980) worked on folk medicine of Dangs region and documented medicinal utility of 82 species; Shah et al. (1981) worked on Tribals of Saurashtra and provided ethnobotanical information of 133 plants; Shah and Gopal (1982) recorded 145 species on ethnobotanical profile of Dangies; Shah and Gopal (1985) mentioned the ethnobotanical uses for 59 species through a survey carried among Bhils, Rabaries, Gharashia and Dubla in north Gujarat. Bhatt and Sabnis (1987) described ethnobotanical uses of 41 plants used by Bhil, Nayak and Dubada tribes from Khedbrahma region. Joshi (1988) discussed 139 plants of medicinal value from the state; Punjani (2002) carried out ethnobotanical aspects of some plants of Aravalli hills in North Gujarat; Ishnava et al. (2004) carried out ethnobotany of Little Rann of Kutch and reported 19 species. Punjani (2006) carried out a study of 35 ethnomedicinal species used by Kathodi tribe of Sabarkantha and 27 ethnomedicinal plants used by Maldharis of Junagadh district (Punjani 2007). Jadeja et al. (2008a) reported 90 plant species used in indigestion and 63 plant species used in curing paralysis (Jadeja et al. 2008b). Patel (2008) reported 32 ethnomedicinal species from Patan district. Jadeja et al. (2009) reported 32 plants used in migraine in Porbandar district.

For the last 2-3 decades many scholars focused their studies on documentation of ethnobotanical uses of plants in different zones of Gujarat, either exclusively on ethnobotany or ethnobotany as a part of floristic inventories for Ph.D. programmes. Gopal (1983); Contractor (1986); Reddy (1987); Bhatt (1987); Punjani (1998); Patel (2002); Mistry (2005) are few of them to cite.

2.7 Studies Pertaining to Shoolpaneshwar Wildlife Sanctuary

There were few attempts made by earlier botanists to study the phytodiversity of Shoolpaneshwar Wildlife Sanctuary. Shah (1967) carried out a preliminary study on Rajpipla forest which also covered Shoolpaneshwar Wildlife Sanctuary wherein 200 species are recorded. Shah and Singh (1970) further worked on the flora of Rajpipla forest and recorded 365 species out of which 274 are dicotyledons, 88 are monocotyledons and 3 are pteridophytes. Shah and Gopal (1986) studied folklore...
medicine of Vasava tribe of Rajpipla and reported ethnobotanical uses of 21 medicinal plants. In a floristic account on Shoolpaneshwar Wildlife Sanctuary (Kumar 1993) it was reported that out of 571 species recorded for the sanctuary, 50 are medicinally important. Pradeepkumar and Prathapasenan (2001&2003) studied tree diversity and ethnomedicinal plants of Shoolpaneshwar Wildlife Sanctuary and reported 115 dicot trees, 03 monocot trees and 50 other ethnomedicinal plants.

Listing ethnomedicinal uses for 250 plants from Dediapada region, which is a part of the study area, D’ cruze (2002) carried out phytochemical screening of 99 ethnobotanically useful plants. Based on the rapid and random field surveys conducted in six different zones of Gujarat and literature survey Pandey et al. (2005) compiled the information in the form of a book “Medicinal plants of Gujarat”. D’ cruze (2007) studied on ethnobotanical uses of 23 leguminous plants in Dedipadapa forest and reported new uses for 17 species. Christian and Krishnayya (2007) employed imaging spectrometry to study spectral reflectance characteristics of teak (Tectona grandis L.) growing in Shoolpaneshwar Wildlife Sanctuary. The reflectance spectra so derived were compared with raw data spectra. Sharp variations were seen in the spectral signatures of teak with reference to the variation in the girth class and slope of the area, indicating the high sensitivity associated with the Hypersion sensor.

Neither of these studies throws light on the total number of medicinal species available in Shoolpaneshwar Wildlife Sanctuary. These studies are also not much of use if one wants to know in which range or compartment a particular species is highly/sparsely populated. The present study, thus, is an attempt to bring more information on traditional medicinal plants of the Shoolpaneshwar Wildlife Sanctuary. It provides detailed information on quantum of availability and distribution pattern of medicinal plants in the entire sanctuary along with their local utility.