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CONSERVATION STATUS AND HABITAT PREFERENCES OF PTERIDOPHYTES IN SANJAY GANDHI NATIONAL PARK, MAHARASHTRA

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ABSTRACT

There is a vast diversity of habitats to be found in the Sanjay Gandhi National Park (SGNP), which is located in the state of Maharashtra in India. This park is an excellent area for observing wildlife. It is surprising that there has not been more in-depth research conducted on the pteridophytic plants that are found in the park, given the significance of these species to the environment. This knowledge gap will be addressed by our study, which will involve conducting a thorough survey of the pteridophytic variety that exists within SGNP. In order to document the distribution and abundance of pteridophytes, field surveys were carried out in a variety of habitats within the park. These habitats included grasslands, semi-evergreen woods, and moist deciduous forests, among others. Conventional methods in botany were utilized in the preparation of the specimens, which included processes such as collection, identification, and storage. During the course of the investigation, 87 species of pteridophytes belonging to 27 distinct families were discovered. The ferns and their allies were found to contain a wide range of taxa, which included both native and non-native species with varying degrees of diversity. Every single species that was discovered had its own unique set of ecological preferences, which were documented. These criteria included things like the type of substrate and the amount of moisture present. The findings of this study draw attention to the significance of continuing conservation efforts in order to safeguard the pteridophytic diversity of SGNP and the plants that they contain. In addition, the information that is gathered will serve as a foundation for future research that will investigate the distribution, ecology, and conservation status of pteridophytes in urban areas such as SGNP.

Keywords: *Conservation, Habitat, Pteridophytes, SGNP.*

INTRODUCTION

In addition to being the largest subcontinent in the world overall, India is also one of the twelve countries that meet the criteria for the megabiological category. As a result of India's biogeographic location, which places it at the junction of the Indo-Malayan, Paleo-Arctic, and Afro-tropical ranges, all three of these kingdoms interact with India. As a consequence of the convergence of these three domains, the biological diversity experienced by the nation is not only rich but also distinct. The biodiversity legacy of this region is particularly abundant and diverse, having a wide range of ecosystems, ranging from temperate forests to

coastal marshes, as well as tropical rainforests and alpine flora. This region is home to a vast variety of ecosystems. There are a considerable number of native, endangered, and endangered species that are of significant ecological and economic importance that find sanctuary there. These species are of enormous importance to the environment. The Indian Ocean, the Himalayan mountain ranges, the Western Ghats, and the Sindhi deserts are all strong impediments that have the effect of encircling the subcontinent. The entire subcontinent is surrounded by these mountains. There are twelve distinct biogeographic zones that make up the nation. These regions include the Trans-Himalayan, Himalayan, Indian desert, semi-arid zone(s), Western Ghats, Deccan Peninsula, Gangetic Plain, North-East India, and the islands and beaches dotted across the country. The Eastern Himalayas and the Western Ghats are two of the hotspots that can be found in these regions. The total number of hotspots that have been identified all over the world is 18, and these regions are located in their respective regions. India is home to some of the highest levels of biodiversity in the world. This is likely due to the fact that these hotspots are characterized by their unique climatic conditions as well as the extensive range of flora and fauna that can be discovered there. It is claimed that eight percent of all plant species in the world are classified as vascular plant species. These vascular plant species include angiosperms, gymnosperms, pteridophytes, and other vascular plant species with vascular characteristics. It is estimated that there are around 4,900 native species of flowering plants in the country. These plants are categorized into 141 distinct genera and 47 different families depending on their classification. These can be found in the Andaman and Nicobar Islands, the Western Ghats, the North-West Himalayas, and the regions of North-East India that are abundant in flora. These are the most common places to find them.The term "biodiversity" refers to the entirety of all species, including bacteria, plants, and animals that coexist in the biosphere as a system that interacts with one another. Over fifty million species make up the world's biodiversity, with two hundred and seventy thousand of those species being plant-based. Approximately two hundred countries are home to between ten thousand and twelve thousand kinds of ferns and fern-like plants. As a result of the fact that plants are able to convert solar energy into electrical energy through the process of photosynthesis, humans and the vast majority of other organisms are completely reliant on plants for their energy needs, either directly or indirectly. Plants have been a source of provisions for humans for the entirety of recorded human history, including food, fuel, fodder, medicine, shelter, and other necessities. What determines whether or not humanity will continue to exist is the degree to which we are able to effectively manage genetic resources and biodiversity within the carrying capacity of the ecosystem that is supporting us.

Additionally, the Indian subcontinent is surrounded by formidable obstacles, including as the Himalayan range, the Indian Ocean, and the Sindh deserts, which all contribute to the country's unique flora. A wide variety of climatic and physiographic conditions have resulted in the existence of a wide variety of ecological zones. These zones include tropical, subtropical, temperate, alpine, and desert environments. The flora is both varied and abundant in this area. There are currently about 1,15,000 plant and animal species that have been recognized and described. There are 48,000 species in the country, which accounts for fifteen percent of the entire plant population that is known to exist anywhere in the planet. According to Nayar (1996) and SaratBabu and Arora (1999), these species consist of around 17,000 angiosperms, 23,000 fungi, 2700 bryophytes, 5,000 algae, 1,000 lichens, and 1132 pteridophytes. There are eighteen megadiversity hotspots in the world, and India is one of them. Among the most important places for biodiversity, the Himalayas, the Gangetic plains, the Western and Southern Ghats, and the Thar Desert are the most important. Since the beginning of the Mesozoic era, around 360 million years ago, when they first appeared in the vegetation of the earth, pteridophytes have been an indispensable component of the flora

of the entire planet. They are the first terrestrial plants to have a fundamental organization, and their method of reproduction is cryptogrammatic, which sets them apart from other terrestrial plants species. Due to the feathery or pennate leaves of these plants, Haeckel (1866) was the first person to give this group of plants the name Pteridophyta. Embryophyta, which Takhtajan (1953) and Cronquist et al. (1966) had previously identified as Telomobionta, was elevated to the status of division subkingdom by Englar (1886), who categorized pteridophyta as a division of Embryophyta. They are classed as vascular cryptogams, ferns, or fern allies. Pteridophytes are seedless vascular plants that are classified as vascular cryptogams. An example of what sets them apart is the self-regulating heteromorphic alternation of generation that they exhibit. This particular species is a member of the paraphyletic group of seed-bearing plants, which favors moist and shady environments. On the other hand, there are some of them that thrive in open, dry habitats, notably those that are xeric or aquatic and epiphytic. There are approximately 10,000 species of 305 different genera of pteridophytes that are found in the natural flora of the world. Of these, approximately 191 genera and 1080 species are dispersed across the numerous biogeographical regions that make up India. The Western Ghats, Eastern Ghats, and Himalayas are responsible for the majority of this diversity. Pteridophytes have been essential to the development of the early terrestrial flora since they contribute to the progression of land plants in their evolutionary history. Pteridophytes are closely linked to angiosperms in terms of diversity and distribution; nonetheless, they have virtually replaced the current flora with seed-bearing plants. Pteridophytes are classified as invertebrates. In spite of this, they play a big and essential part in the evolutionary history of the plant world. Consequently, due to the evolutionary relevance of the pteridophytic flora as well as the conservation issues that have arisen in order to prevent its general erosion, which is mostly caused by the removal of forests and other habitats, it has become important to conduct a complete examination of the pteridophytic flora.

When it comes to the unique pteridophyte diversity that it possesses, the Indian subcontinent is certainly among the most abundant. Both the Northwestern and Eastern Himalayan regions, which include Sikkim, West Bengal, Arunachal Pradesh, Assam, Nagaland, Manipur, Meghalaya, Mizorum, and Tripura, as well as the Southern and Western Ghats, which include the Nilgiri hills, Palni hills, Palghat gap, and Salient Valley, are home to the majority of the country's pteridophytic variety. In the central parts of Madhya Pradesh (Pachmarhi and Amarkantak), Chhattisgarh (Bailadilla hills), and Orissa (Parasnath hills), there is a significant abundance of pteridophytic species. Within the Gangetic plains, the Aravalli hills, and the Northwest region, the percentage of pteridophytic diversity is far lower than it should be, with the exception of a few species. From sea level to the highest alpine elevations, the physiography and highly different climatic conditions—such as the arid nature of rainfall, temperature, humidity, terrain, and altitudinal ranges—are what feed the luxuriant growth of pteridophytes. This is because pteridophytes are sensitive to changes in temperature and humidity.

Plants belonging to the pteridophytes family, which includes ferns and fern-allies, are among the earliest groupings of land plants that exists on Earth. Not only do these vascular cryptograms not blossom, but they also carry spores and are the second largest of their kind. They are placed second only to angiosperms in terms of diversity and distribution, which is a notable accomplishment. As a result of its position as an intermediary between higher vascular plants and lesser cryptogams, this group has become increasingly fascinating and interesting in recent years. In a general sense, they can be discovered in significant abundance in humid tropical and temperate forests all over the world, including in India.

Prior to around 250 million years ago, pteridophytes were the predominant type of vegetation on the surface of the globe. They have been replaced, however, by plants that produce seeds in the flora that is currently there. Since ancient times, ferns have been a subject of fascination for naturalists and scientists due to the fact that their leaf fronds are so beautiful, they hold a special evolutionary place within the plant kingdom, and they are found in areas that are particularly vulnerable to environmental degradation.

According to estimates provided by the World Health Organization (WHO), as many as eighty percent of people all over the world rely on plants as their primary source of medical care. Cancer, rhumatism, bowel problems, ulcers, coughs, fevers, leprosy, gastrointestinal disorders, worm eradication in infants, and venereal infections are some of the conditions that are treated with pteridophytes as a kind of medicine in China, South Africa, Malaya, the United States of America, Europe, and Canada. Different types of pteridophytes are utilized in the traditional medical practices of India and the nations that are located in close proximity to it. It is common practice in the field of horticulture to cultivate them as indoor plants. In addition to their function in medicine, they are also responsible for the production of oxygen, the stabilization of soil, the regulation of climate, and the essential role they play in ecosystems. As a consequence of this, scientists and botanists have been conducting extensive research on pteridophytes ever since Linnaeus's 1753 publication.

Objectives of the research

1. Information on traditional, indigenous, ethanomedicin.al, ethanobotanical and other uses of pteridophytes.
2. To assess the conservation status of pteridophytes in Sanjay Gandhi National Park.
3. To identify the habitat preferences of different pteridophyte species within the park.

METHODOLOGY

Field and herbarium method: We present the most recent taxonomic report on the pteridophytes that are found in Maharashtra. This description is based on a comprehensive and methodical field examination, as well as the frequent collecting of pteridophytic samples from a variety of regions inside Sanjay Gandhi National Park, including those that have been examined and those that have not been explored. These locations make up a diverse assortment of ecosystems that are found in the region.

Field survey: Following aspects were studied.

1. Geographical features of the study area.
2. Its climate, geology, topography and soil types.
3. Biotic and anthropogenic influence on the pteridophytic flora.
4. Study of floristic diversity and vegetation type.

Details of fieldwork: For the purpose of this inquiry, the materials that were used came from the large and exhaustive field collections of specimens that were obtained from the region that was being investigated. Following the wet season, which lasted from September to November, a significant amount of fieldwork

was carried out throughout the months of September through November. In the first year, there was one field trip that took place during the months of October and November. In the second year, there were two field trips that took place during the months of February and March and September and October. In the third year, there were two more field trips that took place during the months of February and March and October and November. The collection of field numbers amounted to more than 50 during the course of that time period.

Collection of samples: The pteridophytic diversity of a number of locations in the state of Maharashtra was investigated, and samples were obtained in a way that did not have any effect on any other species. The investigation was carried out in the state of Pune. It was decided to carry out the sampling in order to establish a thorough herbarium that may be exploited in the future. All of the following components of the issue have been taken into consideration.

- In most cases, two to three individuals of each species were collected while they were in the vegetative or productive stage.
- In terrestrial species, such as Diplaziumesculentum (Retz.) Sw, fertile fronds with intact upper and lower pinnae are present. Rhizomes are found throughout the entire plant.
- In most cases, epiphytic, climbing, and lithophytic plants are characterized by the presence of creeping rhizomes that have gathered alongside vegetative and fertile leaves. The host trees and species that are usually associated to them, such as Lepisorusnudus (Hook), were particularly noteworthy. Ching is generally found growing on branches of the Mangiferaindica plant in Pachmarhi.
- It is possible to press certain xerophytic species, such as Selaginellabryopteris (L.) Bak, in order to release the contracted portion. This can be accomplished by submerging the species in water for a few hours.
- In the case of aquatic species like Marsileaminuta L., fruiting bodies, also known as sporocarps, become grouped together.

PHENOLOGY

For the purpose of gaining a deeper comprehension of the phenology of pteridophytes, records of the numerous life phases, including the natural development of gametophyte and sporophyte, were meticulously documented.

DATA ANALYSIS

PHENOLOGY OF PTERIDOPHYTE

It is common practice in the study of plant life cycles to employ a term derived from the Greek word "phainein," meaning "to show or appear," in this context. For a better understanding of plant ecology and the development of effective conservation and restoration methods, it is an important trait of a species that shows how the environment affects plant behavior. Phenology, the study of seasonal changes in plant and animal life, is among the most well-studied examples of cyclical processes in nature. Its life cycle may be dissected into its component parts to learn more about things like seed dispersal, germination, flowering, fruiting, and leaf development. All of these occurrences occur at specific times of the year due to the changing of the seasons. Nobody is paying any attention to these happenings since they are all too common.

Understanding the biology and ecology of pteridophytes requires knowledge of their phenology, which includes factors like when spores germinate, when gametophytes mature, and how much biomass accumulates in the field. Thus far, most phenological research have concentrated on flowering plants, ignoring the lower species that make up the forest understory. Seasonality and the effects of weather on fern life cycle events, such as the emergence and growth of leaves and the maturity of spores, have been shown in earlier research. A sporophyte's vegetative and reproductive fronds can be studied for phenological events in pteridophyte phenology studies. From their emergence until their death, fronds go through a series of life-history stages. These acts can also dictate the stages that a fertile frond goes through, from being an immature son to releasing its spores. The phenology of pteridophytes, however, is notoriously difficult to investigate. Pteridophytes, with the exception of fern allies and certain ferns, are perennial plants, meaning they will continue to grow in streams until the water supply runs out. Additionally, it was discovered that numerous ferns will develop sori, or reproductive fronds, when the soil moisture reduced. This study focuses on the seasonal changes experienced by eighty-seven different types of pteridophytes found in Sanjay Gandhi National Park. The duration of the vegetative and reproductive stages in that region can be observed and recorded. Fertile leaves appear in most pteridophytes from September to December, however a few arrive as early as August (Fig 1-4).

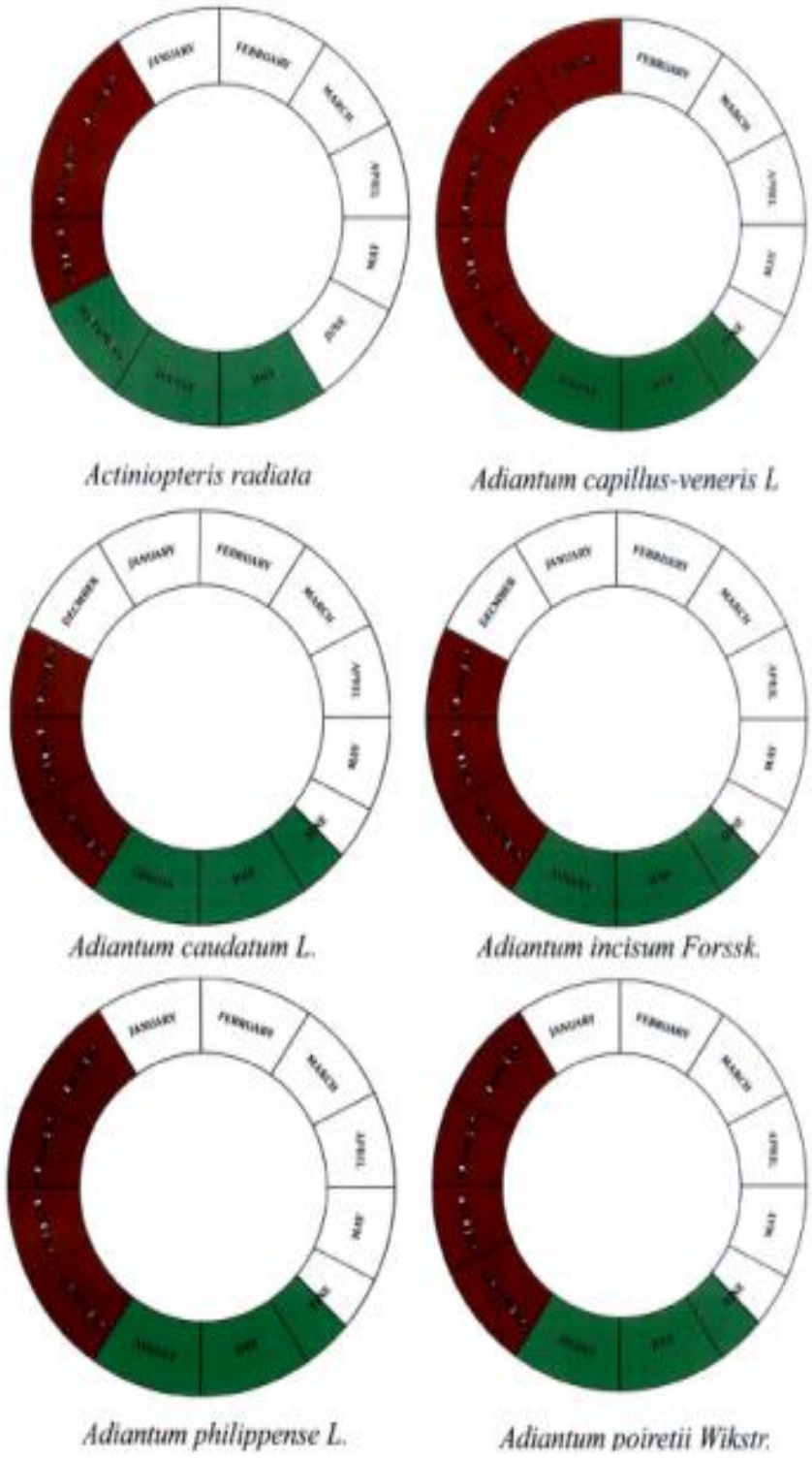
Actiniopteris radiata
Adiantum capillus-veneris L.
Adiantum caudatum L.
Adiantum incisum Forssk.
Adiantum philippense L.
Adiantum poiretii Wikstr.

Figure 1

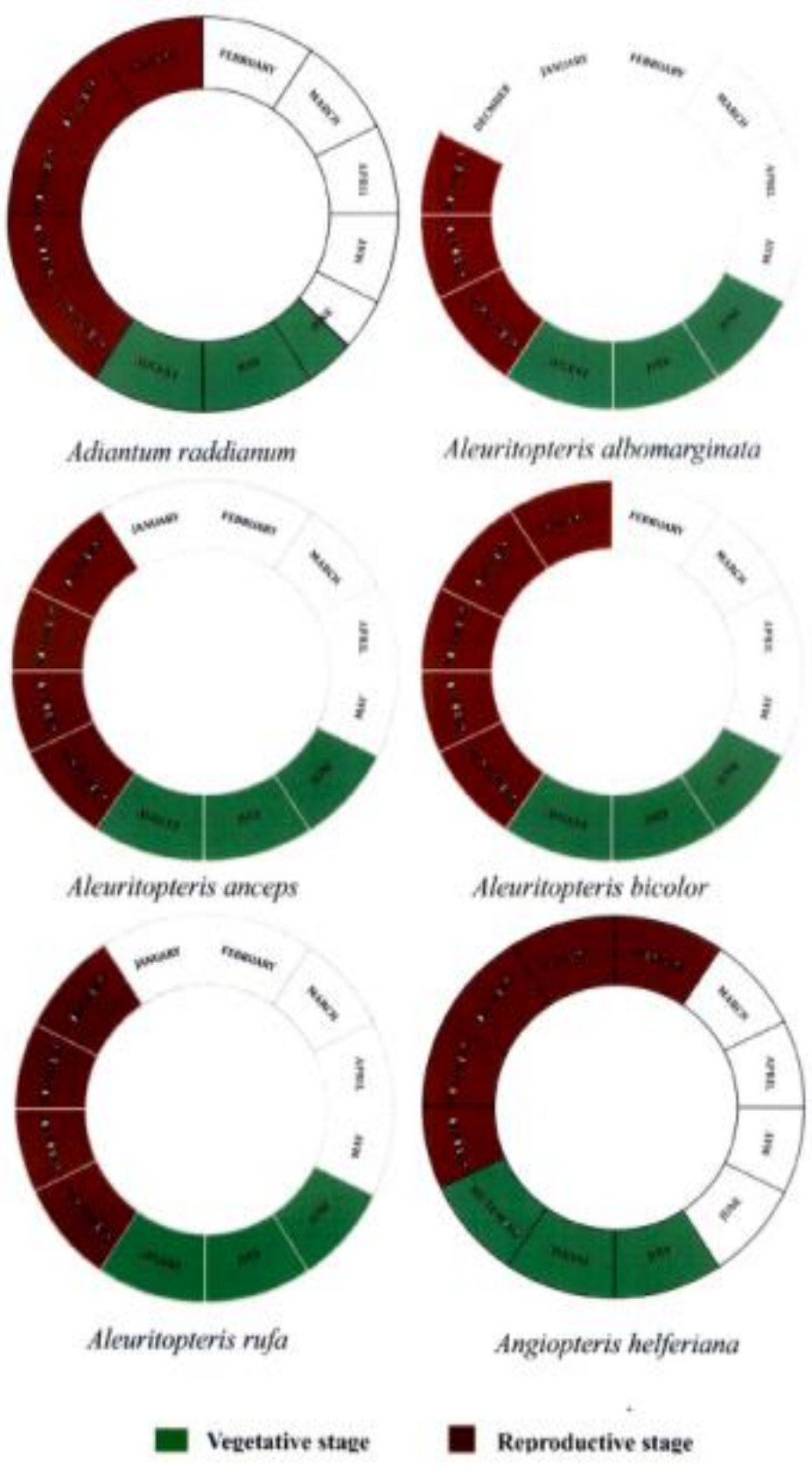
Adiantum raddianum
Aleuritopteris albomarginata
Aleuritopteris anceps
Aleuritopteris bicolor
Aleuritopteris rufa
Angiopteris helferiana
Vegetative stage
Reproductive stage

Figure 2

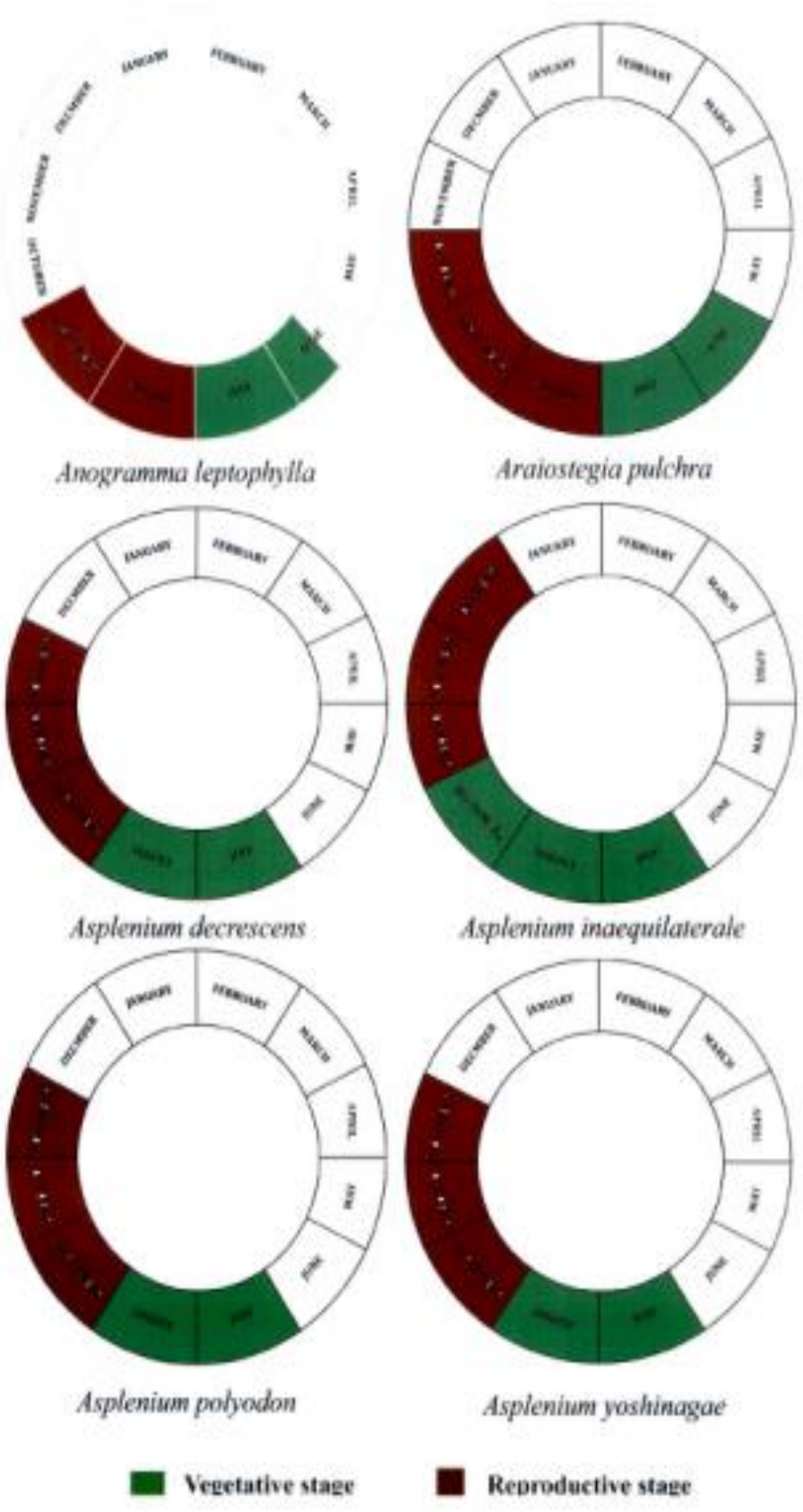
Anogramma leptophylla
Araiostegia pulchra
Asplenium decrescens
Asplenium inaequilaterale
Asplenium polyodon
Asplenium yoshinagae
Vegetative stage
Reproductive stage

Figure 3

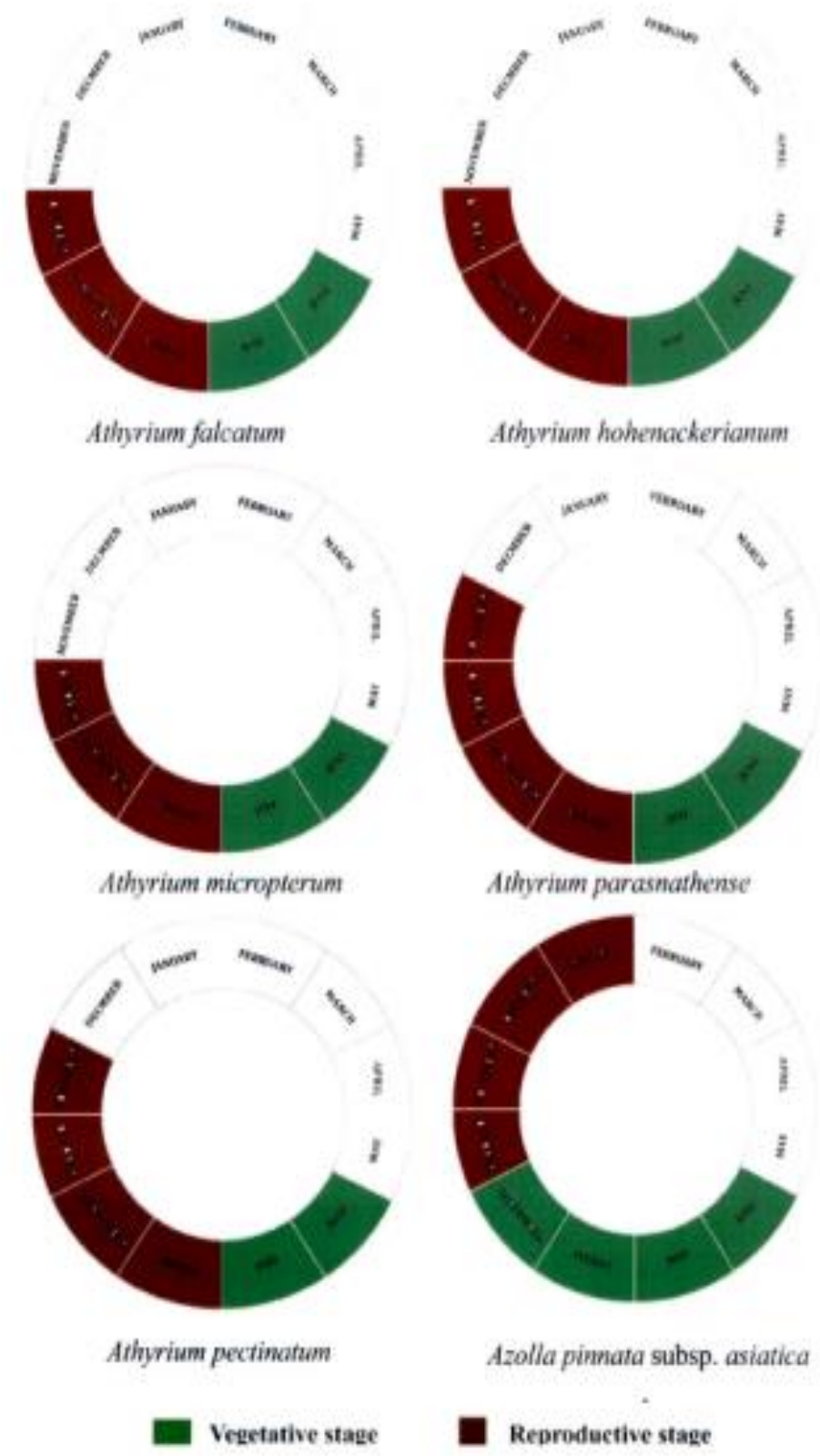
Athyrium falcatum
Athyrium hohenackerianum
Athyrium micropterum
Athyrium parasnathense
Athyrium pectinatum
Azolla pinnata subsp. asiatica
Vegetative stage
Reproductive stage

Figure 4

Amongst the order Pteridales and Aspidiales had maximum number of genera (Table 1). It was also the most speciose order (Fig. 5).

Table 1 Distribution of genera and species of Pteridophyte from SGNP

Sr.No	Orders	Families	Genera	Species
1	Lycopodiales	1	1	1
2	Selaginelles	1	1	5
3	Isoetales	1	1	4
4	Equisetales	1	1	1
5	Ophioglossales	1	2	8
6	Marattiales	1	1	1
7	Osmundales	1	1	1
8	Marsileales	3	3	3
9	Schizaeles	1	1	1
10	Pteridales	4	9	24
11	Dicksoniales	2	3	4
12	Hymenophyllales	1	1	1
13	Aspidiales	6	8	22
14	Davalliales	2	3	5
15	Blachnales	1	1	1
16	Polypodiales	1	4	5
	Total			

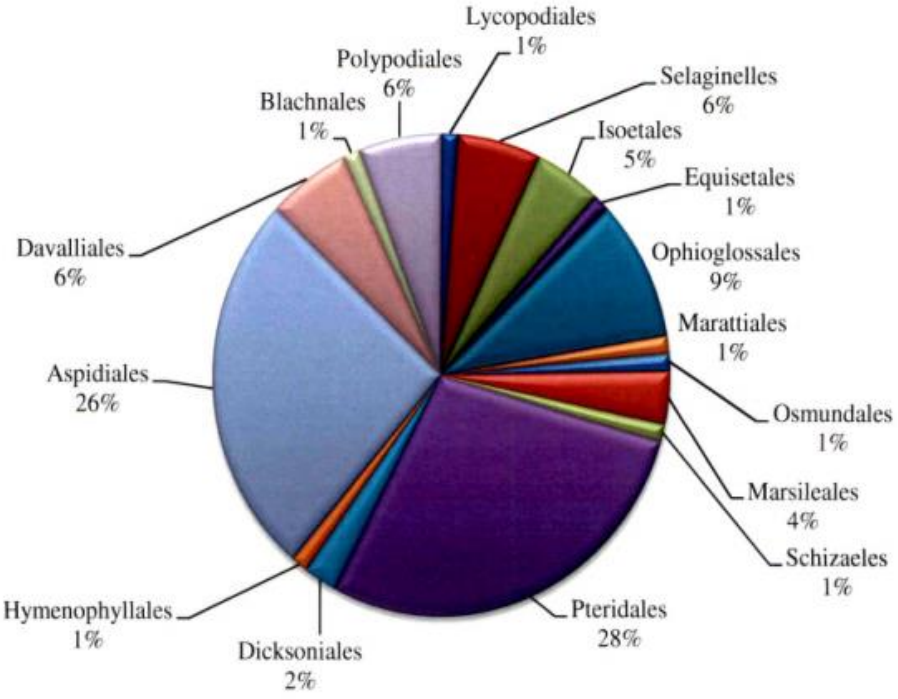

Fig. 5 Pie chart showing number (in %) ofspecies in various orders of Pteridophytes

Families with the largest genera were Pteridaceae and Polypodiaceae (Fig. 6). Similarly, most speciose families found in Satara district were Pteridaceae, Polypodiaceae and Woodsiaceae. Pteridaceae is the dominant family in the Satara district, followed by Polypodiaceae, Woodsiaceae, Dryopteridaceae, and Davalliaceae,

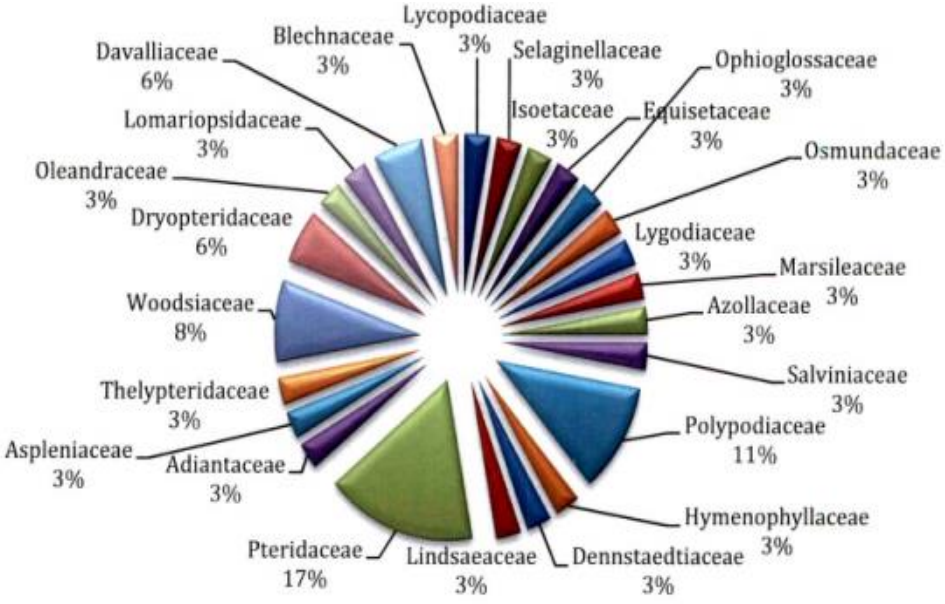

Fig. 6 Species diversity (in %) in various families of Pteridophytes

The species like *Adiantumphilippense, Actiniopterisradiata, Aleuritopteris bicolor, Pteridium revolution, Pityrogrammacalomelanos, P. biaurita, Pterisvitata, and Tectariacoadunata* were collected from

throughout the area and were supposed to be abundant in the area while some species like *Adiantumpoiretii, Aspleniumpolyodon, Athyriumpectinatum, Bolbitis angustipinna, Bolbitis x prolifera, Botrychiumlanuginosum, Crepidomaneslatealatum, Ceratopteristhalictroides, Depariapetersenii, Dryopterissparsa, Equisetum ramosissimum, Isoetessahyadriensis, I. panchganensis, Leucostegia truncate, Pterisheteromorpha, and Selaginellarepanda* were collected from a single locality and they are presumably rare in the area. In addition to this, some economically important species, viz. *Actiniopterisradiata, Diplaziumesculentum, Lygodiumflexuosum, Ophioglossumnudicaule, Osmundahuegeliana, Pterisbiaurita and Tectariacoadunata* have also been collected. The earlier reported 9 species, viz. *Adiantumhispidulum, Aspleniumtrichomanes, Ctenopterissubfalcata, Isoetespanchananii, Lycopodiumjaponicum, Pterisensiformis, Selaginellabrachystachya, S. involvens and S. panchghaniana*, were not collected during present investigation.

Conclusion

The study of pteridophytes in Sanjay Gandhi National Park (SGNP), Maharashtra, underscores the critical importance of these ancient vascular plants within the park's diverse ecosystem. Through detailed assessment and analysis, several key conclusions can be drawn regarding their conservation status and habitat preferences SGNP hosts a significant diversity of pteridophytes, reflecting the park's varied habitats and microclimates. This diversity is indicative of the park's ecological richness and the crucial role it plays in preserving plant biodiversity within an urban setting. Despite their abundance and diversity, pteridophytes in SGNP face numerous threats, including habitat destruction, pollution, and the impacts of climate change. These threats underscore the need for targeted conservation efforts to protect these vulnerable species. Pteridophytes in SGNP show distinct habitat preferences, with many species thriving in moist, shaded areas such as forest floors and along streams, while others are adapted to rocky outcrops and more open environments. Understanding these preferences is essential for effective conservation management. The distribution and abundance of pteridophytes in SGNP are influenced by several factors, including light availability, moisture levels, soil type, and altitude. These factors must be considered in any conservation strategy to ensure the protection of these species.

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