

The Green Oasis in the Maximum City Mumbai

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Introduction

Author Suketu Mehta has bestowed a moniker to the bustling Metropolis Mumbai, the “Maximum City”, the “city which never sleeps”. Mumbai, the capital city of Maharashtra holds the largest population of any city in the country. Standing at 4th place, it is one of the most populated cities in the world. According to the 2011 census (which is the last census conducted), Mumbai’s Urban Agglomeration is at 20,748,395, while the city itself was recorded at 12,478,447. It is estimated that Mumbai’s population is over 22 million. It is the country’s largest, not only in terms of population but also trade and business. The city has seen a tremendous spike in population in the last two decades. This meteoric rise in population is said to have brought about by migration of people from other parts in the country for employment and business opportunities. This rapid influx of migrants, leading to the rise in population has also led to serious civic and health issues that are being addressed by the government. A matter of concern is that a large fraction of the Mumbai populace dwell in the teeming city slums. These slums are devoid of open and green spaces and usually have poor ventilation and hygiene.

With a major metropolitan area that covers 4,355 square kilometers (1,681.5 square miles) that cramps a bustling population within it and with population densities

of approximately 73,000 per square miles, Mumbai is definitely a megacity. As land and housing is at such a premium, a major chunk of people often resort to residing in cheap, cramped up housing a long way from their work place, resulting in long commutes on the city's busy public transport systems of buses and trains.

The city of Mumbai is fortunate enough to have an emerald crown at its northern reaches in the form of the vast forest of Sanjay Gandhi National Park (SGNP). With an area of around 107 sq km, SGNP is the largest national park in the world to be located inside a bustling urban metropolis. The park is identified as a carbon sink for the city and is often termed as the green lungs of Mumbai. Being the largest open space in the city, SGNP attracts a lot of citizens who want to get away from the hustle and bustle of the daunting city that engulfs this beautiful landscape. It is of significant recreational importance. In recent times a large number of locals go for walks in the Krishnagiri upvan zone of the park every morning. The park plays host to over 2 million annual visitors, who flock to experience the invigorating flora and fauna and its habitat. The two lakes in the park, Tulsi and Vihar, contribute to the city's water supply.

Through the SGNP's nature information center in the Krishnagiri upvan, the park reaches out to the city's people by conducting nature trails, nature education and awareness programs and other fun activities within the park. The presence of 2400-year-old Kanheri caves, carved out in a large basaltic rock outcrop, in the hills of SGNP is an added attraction of this place. The fascinating greenery of this park encourages great moments of meditation and self-reflection. The gorgeous sight of the lakes, river, valleys and hills provide a green oasis like experience to Mumbaikars.

The park also conducts a tiger and lion safari which attracts about 2 million tourists every year. Special buses equipped with safety precautions are provided for the twelve-hectare long crisscross roads for the safari. With Thane district in the north, Aarey Milk Colony in the south, Borivali in the west, and Mulund in the east, the main entrance to SGNP is at Borivali. All these areas, with exception of Thane, come under the Mumbai Metropolitan Region. The park is well-connected to the rest of the city with other gates such as the gate at Manpada and gate for Nagla block at Bhyander. National Highway 8 passes by the main entrance

of the park. It is a short walk/rickshaw ride from the nearest train station. The international and domestic airports are a few kilometers to the south of SGNP.

SGNP has included Indian Institute of Technology-Bombay and the Wildlife and WE Protection Foundation, an NGO for the assessment of the park's ecosystem services. These provide well-being to humans and to develop a revenue generation model for these services, a catchment treatment plan and a carbon sequestration plan with an aim to quantifying the monetary value of these services.

Evolution of SGNP

To better understand the evolution of our city forest, it is imperative to analyse how the city was shaped into existence first. The western coast of India is said to have formed back over 135 million years ago. During the early Cretaceous, when the Indian continental shelf detached itself completely from Gondwanaland and started moving north east towards Eurasia, north of the equator. Some 67 million years ago, while the big chunk of land lumbered its way northwards crossing the equator, it passed a region called the Reunion hotspot which in the present day, houses the French islands of Reunion. This period where the Indian continental shelf was over Reunion, marked the beginning of a cataclysmic phenomenon that shaped the future of the biogeography and life on the Indian subcontinent. Over the next 5-6 million years, a series of volcanic eruptions inundated the lands of prehistoric India with molten lava. An estimated total of 1.5 million km³ of lava spewed onto the crust from the depths of the earth, pooling onto the surface of the continent and eventually solidifying into unending sheets of basaltic igneous rocks called flood Basalt and forming one of the largest volcanic features known in the present day called the Deccan volcanic province. Mumbai was also part of Deccan and its geological crafting also started during this time. Waves of chronologically dispersed violent eruptions separated by periods of dormancy are attributed to the shaping of Mumbai. 65 million years ago, eruptions around most of the Deccan volcanic province had come to a halt. Mumbai's eruptions continued long after, lasting till as recently as 60 million years ago. The nature of these eruptions and its geographic position gave rise to many geological

quirks such as the presence of non-basaltic igneous rocks such as Rhyolites and Trachytes and features like volcanic pillows, breccia and tuffs. These features set Mumbai's geology apart from the rest of the province.

The present-day coastal Mumbai came into existence relatively recently in the geological timeline. For the longest time, there was land to the west of Mumbai. It was only at the end of the Pleistocene ice age some 12,000 to 15,000 years ago that water level started to rise and in the subsequent years drowned much of the coastal lands around India. Water rushed into the various river valleys of the city, forming creeks and lagoons. The sea level kept on rising, reaching its peak at about 3000-4000 years ago. Mumbai was soon turned into a group of hilly islands separated by shallow tidal lagoons. One of the earliest mentions of the forests in Mumbai can be dated back to 4th century BC, where a major trade route that connected busy ports of the city like Sopara and Kalyan passed through these dense coastal forests. It is noted in history, that the ancient Buddhist caves of Kanheri served as a rest house for traders and travelers commuting through these forests.

"BomBaia" was the name given by the Portuguese for these islands when they first arrived on these lands. A land that was predominantly inhabited by the *Kohli* fishing communities along with communities such as *Warlis* of the hills, farming communities such as *Aagris*, *Kunbis*, *Thakurs*, *Bhandaris* and a few others. Just north of the well-known seven islands of "BomBaia", separated by the shallow Mahim Bay, lay the land that hosted the forest that is now our national park, the larger islands of Sasashti or Salsette as it was referred to as by the Portuguese. Salsette was also an island complex and consisted of one large water locked landmass surrounded by numerous smaller islets. It comprised what is now called Mumbai Suburban, parts of Greater Mumbai and Thane district.

By the end of the 18th century, the Mumbai archipelago, was gradually turning into a bustling port town under the British raj. On the other hand, Salsette was still sparsely populated and a recent addition to the British empire. Much of it was forest covered hills and connected plains that were surrounded by rather unexploited shores. Its population during that time consisted mostly of local communities living in rural settlements and small townships. The construction

of Sion causeway by the British in 1803 linked Salsette to the Islands of Mumbai which by that time were welded together through land reclamation projects. This fortified Mumbai's trade connection with the mainland and opened new avenues for the British raj at the time. Thereafter the Salsette also started seeing a steady rise in population and northward expansion of Mumbai beyond the 7 islands. This is would eventually spark the creation of the Greater Mumbai Metropolitan region in the future. The mid-19th century saw the golden era in trade and commerce in Mumbai. It became the first Indian town to undergo drastic economical and societal advancement. Industrialization meant new job opportunities, which led to migrants pouring into the city.

This marked rise in population catalyzed the depletion of the meager hydrological resources of Mumbai. As a result, a series of water crises took place during the mid-1800s, prompting some mitigative steps. The first piped water supply scheme of Mumbai was constituted with the inception of Vihar Lake in 1960. Three earthen dams were built on the Tasso River near the Vihar village in the forested plains of Salsette to store the monsoon runoff from the catchment area of the Tasso. Consecutively, another event of water scarcity in 1885 called for the creation of another Dam on river Tasso, this time further upstream, causing the formation of another reservoir in the form of the Tulsi Lake by 1897. These lakes were nestled in the heavily forested region of Salsette. Both the lakes were fed by the monsoon runoffs from the Krishnagiri-Powai range of hills. These hills and its associated forest play a pivotal role in the hydrological systems of Mumbai to this date.

Soon after their completion, the ranges and adjoining plains surrounding the lakes were then privately owned. These were secured by the Bombay municipal corporation as their catchment area to safeguard these valuable sources of water. This land was a tiny fraction of the present-day park, with an area of just 10 sq kms. Nevertheless, this development marked the very beginning of the city's forest. Forests all around the nation were under tremendous pressure during the beginning of the 20th century. Exploitation of forests under the pretext of industrialization and urbanization, unsustainable agricultural practices, forest fires, etc. were eating away at these precious habitats. Natural resources from many nations were getting drained due to the unfortunate circumstances of World War 2 and India was no exception. Growing population of the country

meant this would only worsen if laws were not implemented. Hence the series of measures starting with the formation of Indian forest services in 1865, to the nationalization of the remaining pockets of forests of India by 1947 were of utmost importance for the survival of these habitats and its flora and fauna. Under the Indian Forests Act of 1927, laws were put in place that bolstered the security of these green spaces. This granted the forests around the lakes of Salsette, and national forests, protection by the relatively newly formed Indian forest services.

In 1939 the local government handed over the control of the 10 sq kms catchment area of Tulsi and Vihar Lake to the Maharashtra state forest department. The momentum in the growth of the National Park towards the forest we know today was seen post-independence. In 1947 under the governance of the state forest department an additional 21 sq kms was added to the already existing land making it a sizable total of around 32 sq kms of protected forest land. The year 1950 brought an important milestone in the form of the Bombay National Park Act. Under the provision of this act 20.26 sq kms of privately owned land was pieced together to form the Krishnagiri National Park. This development was different as its purpose was not only fortification of the catchment area but also preservation of the green pockets in the rapidly expanding city. The management of this area was briefly assigned to the department of parks and gardens of Bombay. It was assigned to the state forest department soon after. The following years were marked by several haphazard land acquisitions where the government incorporated privately owned lands and added them into the park. Just like Mumbai came to be an integration of islands, SGNP was quickly becoming an integration of privately owned lands. The notable benchmark in these following years was 1968, when the park was given an additional 47 sq kms under its protection. It was then renamed to Borivali National Park by a special committee presided by the chief minister of Maharashtra. Areas of the Nagla block situated north of the Bassein creek along with Yeoor and Chena areas in the Thane district were brought into the park's folds.

Conservation of Environment saw a lot of political tailwinds in the last quarter of the 20th century. The implications of these were seen at Borivali national park too. In 1975, with the Maharashtra Private Forests (Acquisition) Act, more privately owned land was added to the park. Though beneficial this was not without its own

set of problems. Most times these acquired lands were inhabited by tribals and non-tribals alike. This overlap of city and forest caused tension between the forest department and the inhabitants. This would be the cause of many problems in the future but more about that will be covered later. In 1980 with the passing of the Forest conservation Act prohibiting the de-reservation of forest land for any non-forest purpose caused a complicated situation in the light of the several inherent issues with the park. On 23rd June 1981 the park's name was changed one last time to Sanjay Gandhi National Park. Regardless of all the aforementioned issues, the Maharashtra Forest Department was now managing 93 sq kms of which 10 sq kms was set aside as a buffer zone. Subsequently, the state government added 20 sq kms more to the existing land, making the total size of the park to be a staggering 103 sq kms within the city of Mumbai.

Despite the political willingness to protect these habitats across India, the efforts fell short. The late 1900s brought about a challenging time for all the actors associated with this unique forest of SGNP. The ever-increasing pressure of population from the city and the porous boundaries of the park caused several issues. To better handle such challenges faced across the country, the Wildlife Protection Act of 1972 was amended in 1991. Thereafter, SGNP was declared by the state government as per the provisions of the amended act. There was immense tension between the city and the forest during this time. Encroachment was at its highest. These complications between the forest department, the inhabitants of the previously private lands, environmental activist groups and the forest's very own wildlife carried on into the 21st century. The repercussions of these affect the forest to this day. Yet, due to efforts and cooperation of the many individuals and communities the forest has finally found a footing in ever-growing Mumbai. In the most recent development 800 acres of land that was initially a part of Aarey milk colony was handed over to the forest department to be included as a part of SGNP, increasing the park's size to 106 sq kms.

The treasure trove of Wilderness

Sanjay Gandhi National Park lies on the Konkan coast of the Indian subcontinent. Nestled between the mighty Sahyadris to its east and the vast Arabian sea to its

west, it represents the moist broadleaf deciduous and semi evergreen forests of the Malabar coast. This ecoregion is typically observed extending from the coast up to the foothills of the Sahyadris about 250 m above the sea level, stretching from Mumbai right up to the southern tip of India. Unfortunately, throughout history the majority of this ecoregion has been cleared out due to the density of population along the Malabar coast. In the present day only a few patches of these forests remain in the form of scattered nature reserves. One of these is SGNP, along with others such as Phansad Wildlife Sanctuary and Mollem National Park. From *Euphorbia antiquorum* strewn grassy basaltic rock outcrops, to tall deciduous trees segueing into estuarine mangrove forest and scrubs, SGNP hosts a spectacular array of habitats within it. Topographically one can observe an amalgamation of hills, valleys, lakes and open areas. Due to the windward side of the ghats, the forests and its denizens are greatly influenced by the yearly downpour they receive, brought about by the westerly monsoon winds. Hence, a year in the park can be broadly demarcated into the wet and the dry seasons. Monsoons arrive at the park roughly around the end of May and within a few weeks, the forest comes alive with new luxuriant growth of greenery. A web of forest streams emerges, originating in the hill of SGNP and flow down through the maze of tall deciduous trees, enriching the wildlife in the process. The Monsoons reach their peak around July, usually flooding the lakes of SGNP which spill into the Mithi river drainage. After the monsoons pass, the dry season starts to establish itself with each passing day. The summer months paint a very different picture of the park. The vegetation of the monsoons recedes by this point; most trees have shed their leaves and created carpets of dried leaves. The forest becomes dry and water sources become concentrated in selected areas. Large herbivores such as Chitals (*Axis axis*) and large herds of the usually less seen Sambar (*Rusa unicolor*) are observed near the lakes in the valleys during this time.

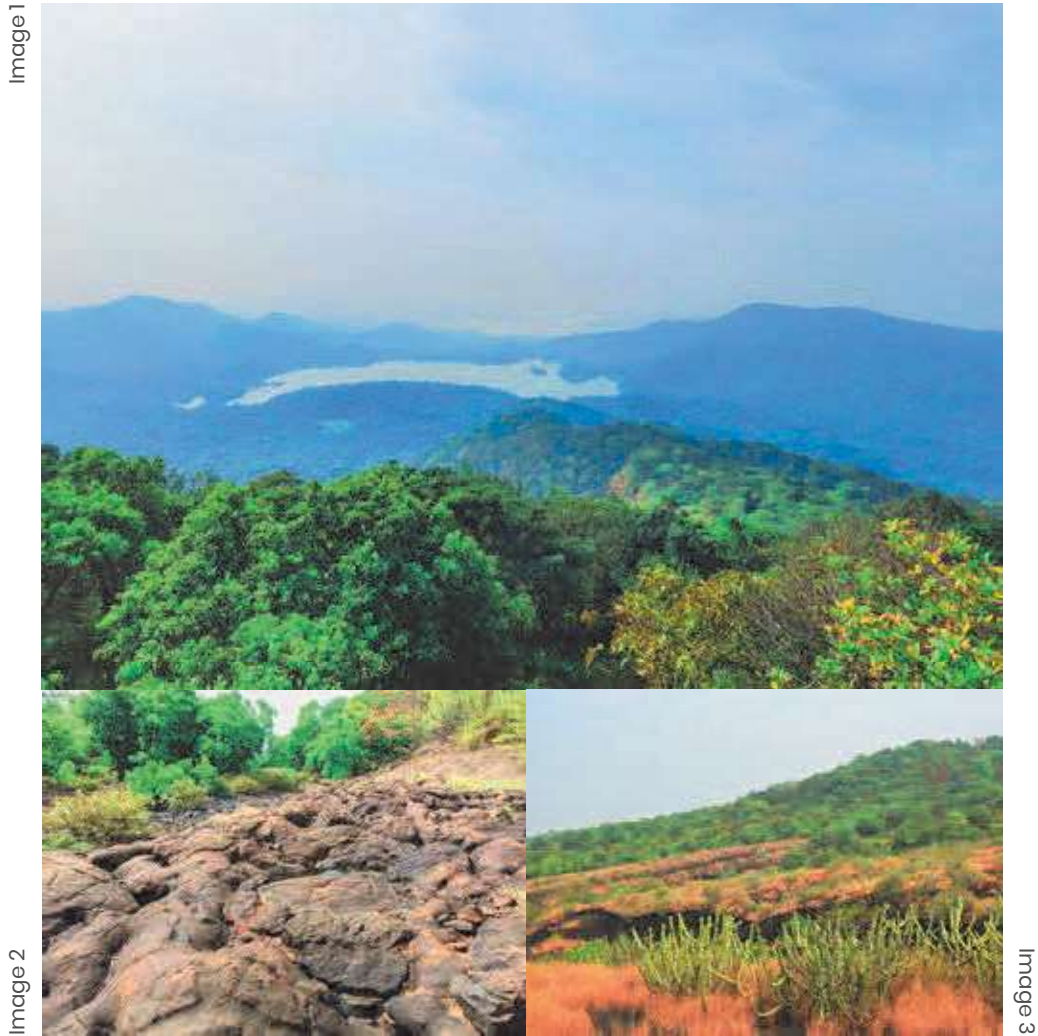


Image 1: Pillow lava seen around the streams in SGNP, Photo credit: Naman Kaji

Image 2: Valleys of the Krishnagiri-Powai range of hills harboring the Tulsi and Vihar Lakes, Photo credit: Shantanu Majumdar

Image 3: Rocky plateaus in the park covered with grasses and euphorbia, Photo credit: Shantanu Majumdar

Flora

According to the Botanical Survey of India, Sanjay Gandhi National Park houses 1082 different species of plants and 31 infraspecific taxa within its limits. Four basic forest types are found in the park: moist Teak bearing forest, southern moist mixed deciduous forests, mangrove scrubs and western subtropical hill forest. Of the four, the most dominant forest type is the moist mixed deciduous. A walk through the low-lying areas of the park's forests will acquaint one with the key species that form the majority of the forest. Trees like Haldu (*Adina cordifolia*), Vat (*Ficus benghalensis*), Kandol (*Sterculia urens*), Karanj (*Pongamia pinnata*), Ain (*Terminalia Elliptica*), KaateSaavar (*Bombax ceiba*), Pangara (*Erythrina variegata*),

Kalam (*Mitragyna parvifolia*), Pandra kuda (*Holarrhena pubescens*), Shisham (*Dalbergia latifolia*), Bartondi (*Morinda tinctoria*), Kakad (*Garuga pinnata*), Kheir (*Senegalia catechu*), Bor (*Ziziphus sp.*), Koshimb (*Schleichera oleosa*) etc form the high canopies and understory of the forest. Teak is a rare tree in this type of forest. These trees are typically accompanied by Bamboo thickets, of species such as Manvel bamboo (*Dendrocalamus strictus*) and Katas Bamboo (*Bambusa arundinacea*), oftentimes forming dense curtains in the forest. Many large shrubs such as Murud sheng (*Helicteres isora*), Karvanda (*Carissa carandas*), Karkani (*Leea indica*), etc. are seen making up the undergrowth of these forests. Along the stream beds in the valleys of the park one can find an abundant presence of Karanj or the Pongam oil tree. These trees, with their greasy seeds, have evolved to be hydrochorous, that is, they use the flowing water of the streams to disperse their seeds, explaining their abundance. Another interesting characteristic of this forest type is the healthy presence of Lianas or woody climbers. These sturdy plants form a network of branches that connect the trees in the forests to one another in a way that helps many small arboreal animals to commute through the forest without leaving the safety of the trees. Ukshi (*Getonia floribunda*) is the most frequently encountered liana in SGNP and can be seen flowering profusely during the warmer months. The upper reaches of the hills of SGNP show a distinct resemblance in biota to the western ghats. One such place would be the highest point of Mumbai, sitting at about 468m above the sea level, often called Jambulmal, in the Krishnagiri range that also houses the famous Kanheri caves. Many species that are also well represented in the ghats can be seen here such as Anjani (*Memecylon umbellatum*), Gorbale (*Ixora brachiata*), Amba (*Mangifera indica*), Jambul (*Syzygium cumini*), the threatened Sita Ashoka (*Saraca asoca*), etc. Most of these plants are evergreen and form the subtropical hill forest patches of the park. Towards the north, the Bhayander-Naigaon (Vasai) creek separates the forest into two zones of unequal area, the northern or Nagla block and the larger southern block. It is only in the forests around the creek that one can find mangrove scrubs and its associated vegetation. Here, Tivar (*Avicennia marina*) is the most ubiquitous plant but one can also observe other halophytic species such as *Avicennia officinalis*, Kajala (*Aegiceras corniculata*), Chaura (*Ceriops tagal*), Marandi (*Acanthus ilicifolius*), Pilu (*Salvadora persica*), etc.

Image 4



Image 6



Image 5



Image 7



Image 8



Image 9



Image 4: The Beautiful flowering of Karvi (*Strobilanthes callosus*): A plant that flowers once in every eight years, Photo credit: Aditya Gadkari

Image 5: The Bridl Veil Stinkhorn Mushroom (*Phallus indusiatus*): one of the many bizarrely beautiful mushrooms seen during the monsoons in SGNP, Photo credit: Shantanu Majumdar

Image 6: Flowering a Foxbrush Orchid (*Aerides maculosa*): an epiphytic orchid species frequently seen in the park on rocks and trees, Photo credit: Aditya Gadkari

Image 7: Vinca-Leaved Ceropogia (*Ceropegia vincifolia*): A rare climbing shrub that traps insects to ensure pollination, found on the hills of the park, Photo credit: Naman Kaji

Image 8: Gibson's Hebanaria (*Hebanaria gibsonii* var. *foetida*): A rarely encountered orchid that is seen blooming in the park during late monsoons, Photo credit: Naman Kaji

Image 9: *Zingiber nimmonii*: A beautiful, strongly aromatic medicinal plant that is endemic to the western ghats that grows in certain areas of the park, Photo credit: Naman Kaji

One can witness many floral spectacles in SGNP. One such event is the gregarious flowering of Karvi (*Strobilanthes callosus*) that carpets many of the hill slopes in the park. These plants burst into beautiful violet blossoms only once every eight years, making them a novelty. In SGNP, the last mass flowering of Karvi was noted in 2016. The vegetation of SGNP is very dynamic and always seems to keep changing. Come summer, the forest loses a lot of its greens while dramatic hues of red can be seen popping up in the forest. This is caused by trees of Palash (*Butea monosperma*), Pangara (*Erythrina variegata*), Kaatesaawar (*Bombax ceiba*), Devsawar (*Bombax insigne*), Kaushi (*Sterculia colorata*), Dhayati (*Woodfordia fruticosa*), the exotic Gulmohar (*Delonix regia*), etc that go into flowering and are inundated with large flashy red and orange inflorescence during the period of March to May. Most of these trees have evolved to utilize ornithophily as a mode of pollination and hence have such big conspicuous inflorescence, so as to attract birds from far away distances. These trees are a hotspot for bird activity during summers in the park with the arrival of rains. The seemingly lifeless, leaf litter covered grounds are soon replaced by a myriad of ephemeral herbs, grasses, pteridophytes and mosses. One can come across beautiful lush carpets of Maiden's hair Fern (*Adiantum* sp.) covering wet walls and humus rich areas near streams. The battered bushes of Karvi slowly start coming back to life and swirly stocks of the Spiral ginger (*Hellenia speciosa*) start to spring up all across the park. Various fantastical looking mushrooms, which are actually fruiting bodies of the many species of fungi trying to propagate, can be seen popping up on plant matter and the ground. Beautiful splashes of colors start to decorate the forest floor, as much of the early ephemeral growth goes into flowering within a short duration of their first appearance. The Purple, white and yellow inflorescence of Raan halad or the Hill turmeric (*Curcuma pseudomontana*) becomes a common sight. Just like the hill turmeric, many unique plants start to blossom in the park in this period. The stunning Crinum Lilies (*Crinum latifolium*) are amongst the first plants to flower during the monsoons. Plants such as the diminutive Kali Musli (*Curculigo orchioides*), groups of Kuli (*Chlorophytum tuberosum* and *Chlorophytum borivilianum*), Pankusum (*Pancratium triflorum*), Khajkanda (*Ledebouria revoluta*), etc. can be seen growing abundantly in the park. As the monsoons progress, these early monsoon ephemerals are replaced by a new cast of species. The odd flower bearing stocks of the Wild yam (*Amorphophallus commutatus*) start to sprout out of the rain enriched forest soils, making their

presence known after a year of dormancy. Throughout suitable habitat in the park, pretty flowering herbs such as various species of *Begonias*, *Commelinas*, *Balsams*, etc. start to sprout up. The rocky basaltic hills of Krishnagiri and Yeoor are an exceptional place to observe this transient vegetation. During this time one can find many rare and endemic species of plants in the park which includes various seasonal ground orchids of genres such as *Hebenaria* and *Eulophia*. The waning monsoon covers the side of the forest trails with the bright yellow flowers of the Sensitive Smithia (*Smithia sensitiva*). Plants such as the Spiral ginger, Pin-cushion plant (*Neuracanthus sphaerostachyus*), Wild Sesame (*Sesamum indicum*), Takla (*Senna tora*), etc are commonly seen flowering at this time too.

Due to the loss of green cover because of encroachment and the resultant lapses in conservation, many of the degraded areas were converted into plantations. These can still be seen flourishing in the park. The fast-growing leguminous tree *Gliricidia* has been extensively planted in the western part of the park and is a common sight now. This tree is directly competing with the native flora of the park and is usually considered to be a pest. Due to its accessibility SGNP has been studied by many renowned botanists very early on. Hence, a number of species of plants have SGNP as their type locality i.e., place of first discovery and specimen collection. This includes plants such as the mysterious *Ipomea salsettensis*, the critically endangered *Ceropegia odorata*, the highly medicinal *Chlorophytum borivillianum*, the rare perennial herb of *Dipcadi saxorum*, amongst others.

Fauna

Being part of an immensely rich biogeographical zone, SGNP mirrors its sheer diversity with the myriad of life forms within its lands. Throughout the years, a plethora of different species have been reported from the park. These include over 240 species of birds, around 40 species of mammals, 61 species of reptiles, about 14 species of frogs and an innumerable assortment of invertebrates. It is astounding to think that just a century ago, Tigers used to roam these city jungles. Unfortunately, the rapidly growing populace of Mumbai couldn't cohabit with these large felines and the last of the tigers was shot near Vihar Lake in 1939. If one looks at the history of SGNP, it can be clearly seen that the park saw a great

deal of loss in its biodiversity during the 20th century. Many species depleted considerably in numbers, while some completely disappeared from the forest altogether. The most obvious effect was seen on the park's macrofauna. It is said that even Gaurs were present in these forests in the distant past but vanished with the formation of the city. Animals such as the Bengal fox and the striped hyena, although historically present, have been lost in time. Hyenas were often considered to be vermin and killed due to superstitions surrounding the species. The last photographic evidence of the presence of the striped hyena in the park is a tragic one, where you can see two individuals lying lifeless with large bullet wounds on their head, clicked by naturalist and author Sanjay Monga, around 1986 in the outskirts of the park, in Goregaon.

Although the Tigers couldn't survive in SGNP, the highly adaptable Indian Leopard (*Panthera pardus fusca*) managed to not only survive but eventually even thrive in this confluence of two worlds that is SGNP. At present the Leopard is the undisputable flagship species of the park. The city forest has one of the densest populations of leopards of any place in the world. At a mind-boggling density of 26.34 individuals/100 sq kms, it is astounding to think how well these big cats are doing in a forest that is surrounded by two of the world's most densely populated metropolitan cities. They have not only adapted to living near humans but are even exploiting the new resources that these human dominated landscapes bring. A part of their success can be attributed to the lack of other large predators in the park along with the presence of abundant food sources. They are the apex predator in these lands. Apart from deer and langurs, leopards living near human habitation across India have taken to hunting stray dogs and domestic animals. Mumbai's leopards are no different, with stray dogs comprising 31% of their total diet according to recent studies. Secretive and reclusive, these felines are seldom encountered in the park but if one is fortunate enough to see one, these cats promptly disappear out of sight. Man-leopard conflict has been a major complication in the park, some of these took place in the past decades. A string of attacks during 2002 to 2004 caused multiple deaths and injuries. Although things have improved in the recent years, there have been occasional spates of attacks and some fatalities, especially in the human modified forests of Aarey Milk colony, on the western fringe of the park in Goregaon. It is noted that leopards that have grown up around humans usually avoid them. It is usually stressed,

injured or relocated leopards that are more prone to attacking. Relocation of these animals from suburbs like the Aarey milk colony is definitely not a solution as other individuals will eventually move in to fill the space. Education and awareness about these animals along with precautions to avoid confrontational encounters is the key to coexist with them with minimal mishaps. With the growing population of leopards in the park as well the ever-increasing pressure of the human population of suburbs around the park, this becomes even more vital to hold the fragile relationship of Mumbai's citizens and SGNP's leopards in good stead in the future.

The other lesser-known carnivores and omnivores present in the park include two species of elusive small cats: the Jungle cat and the Rusty spotted cat; two species of civets: the Asian palm civet and the Indian small civet; and two species of mongoose: Indian gray mongoose and the Ruddy mongoose. SGNP is also home to a wide array of herbivores such as the spotted deer, Sambar deer, Barking deer, Indian spotted chevrotain, Wild boar, Indian crested porcupine, Bonnet macaque, Black footed gray langur, Rhesus macaque and the Indian hare. It also has a wide variety of smaller rodents and many species of bats, most conspicuous of which are big colonies of the Indian fruit bat, one of the largest bats in the world. Many of these herbivores saw a population decline but the forest department has been relatively successful in boosting their numbers through introduction of new individuals into the park in the late 1900s and early 21st century. This can be seen for species such as Chital, Sambar and the wild boar. Out of the three monkey species, the bonnet macaque and the langurs are native and the most numerous. The Rhesus macaque is introduced and is restricted to only certain parts of the park such as the tourism area of Krishnagiri Upvan. Many of these Mammals are nocturnal and are seldom encountered. The best way to reliably observe mammals such as the civets, small cats, porcupines and the mouse deer is through setting up camera traps or waiting near sources of water during summers. Although, one can know of their presence through footprints, scat, scratch markings, etc.

The avifauna of the park can be described as typical of mixed deciduous forests of low-lying areas and foothills of western Ghats. Regularly noted resident bird species of the park include some of the very vocal birds like the Brown headed

barbet, Common lora, Greater racquet tailed drongo, White rumped Shama, Crested serpent eagle, Rufous woodpecker, Grey junglefowl, various sunbirds, Jungle owlet and Indian scimitar babbler amongst various others. These birds breed and nest in the park and can be seen calling/singing throughout the summers. Around the early 1900s the park's population of Grey Jungle fowl has gone down alarmingly and only two doomed individuals were recorded. Hence in 1950, 3 cocks and 15 hens were released into the park by the forest department, hence saving this species from being lost. The pre-monsoons bring a special set of birds to the park. The park comes alive with calls of various different species of cuckoos that are looking to find a mate. On a good morning, one can hear around 7 different types of these brood parasitic birds vocalizing in the park. Birds such as the Indian Pitta, Pied crested cuckoo and the photogenic Oriental dwarf kingfisher migrate to the park at this time. The Oriental dwarf kingfisher comes here to nest and can be seen along various seasonal forest streams in the park, often detected by its distinctive high-pitched calls. One can also notice small numbers of the Shaheen Falcon, a scarce resident Peregrine, nesting in the higher reaches of the hills in SGNP. The months starting from late September bring a large influx of winter migrants in the park. A plethora of warblers and flycatchers, many of which have summered in the Himalayas can be seen in the park. SGNP has a very large diversity of birds of prey, many of which are winter migrants too. The most commonly seen ones include the Greater spotted eagle, Booted eagle, Eurasian Kestrel, Black eared kite etc. A few waterfowl have also been observed utilizing the lakes of SGNP during the winter migration.

There are many species of snakes and lizards that can be seen well during the monsoons in the park. They stay well hidden in the lush growth and one must have a keen eye to detect their presence. It is not very uncommon for people to miss an 8 feet long Indian rock python lying motionless in the undergrowth right beside a forest trail. Form the tree dwelling masters of camouflage like the Long-nosed vine snake (*Ahaetulla oxyrhyncha*) to the large agile terrestrial generalists like the Indian rat snake (*Ptyas mucosa*), snakes come in all shape and form to fill particular niches in the city forest. Commonly sighted snakes of the park include species such as the Indian rock python, Checkered keelback, Buff striped keel back, Common Bronzeback, Spectacled cobra, Bamboo pit viper, amongst others. During monsoons one can find the occasional Large

Scaled shield tail. A fossorial snake that stays burrowed during most of the year. The Indian monitor is one of the largest lizards in India with adults reaching to sizes close to 175cms, they can be found in the park with relative ease in certain areas. Many other interesting lizards also inhabit the various habitats of the park such as the ubiquitous Oriental Garden lizard, the Deccan banded gecko, Roux's forest lizard, the recently split *Giris geckoella*, gigantic Spotted rock gecko, etc. Lots of endemism is observed in many of these species of reptiles. The Indian Chameleon, once a common sight in SGNP, has now essentially vanished from many parts of the forest. During late winters, around February one can see the forest floor come alive with juvenile skinks of the genus *Riopa* and *Eutropis*, scurrying around in the dense leaf litter. These must have hatched in September and are usually just a few months old. One can also observe the Indian marsh crocodiles or Muggers basking by the banks of the park's lakes. Rains bring out the amphibians of the forest. Streams and stagnant pools come alive with the calls of frogs. From the tiny Ornate narrow mouthed frog of the leaf litter, no larger than the nail of your thumb to the massive Indian bull frog that can grow as big as both of your palms, the forests of SGNP harbor all a great diversity of ranids. By the end of monsoons many pools of stagnant water are full of tadpoles. The caecilians are probably the most mysterious amphibians in the park. They are a group of legless vermiform amphibians of the family Ichthyophidae which appear like an oversized earthworm in the first glance, closer inspection would reveal a set of eyes which gives their actual identity away.

Out of the massive diversity of invertebrates found in the park the *Lepidopterans*, which are butterflies and moths, are the most noticeable. There are around 172 species of butterflies found in the park which also includes the Blue Mormon, the state butterfly of Maharashtra. The diversity of Moths in the park is even greater, with some moths that aren't even described till the species level. One can find some exceptional species of moths in the park including the elegant Moon moth and the colossal Atlas moth, a genus which contains the largest moths in the world. Massive termite hills are a common sight in the park. One can also notice balls like nests that have patterns resembling a roof of a *Pagoda*, these are the crafty nests of the acrobat ants, a highly defensive, eusocial arboreal ant. If one comes across a concentric maze of walls on the ground it can be safely assumed that they are the handy work of the harvester ants. What is visible is just the surface of

the nest, below the ground is an intricate subterranean palace with a network of tunnels connecting multiple chambers serving different utilities. All insect families are very well represented in the park but are quite poorly studied due to extensive diversity. Arachnids, especially spiders are also equally well represented. Massive, waterdrop-covered webs, big enough to trap birds, can be seen woven amongst the forest trees, shimmering with the monsoon winds, come august. These are the handiwork of the conspicuous and beautiful Giant wood spiders, the largest orb weaving spider of the park. These spiders start out really small at the beginning of the monsoon season and reach their full size by the end of it. Other common spider families of the park include- The jumping spiders of the family Salticidae, Wolf spiders of the family Lycosidae, Lynx spiders of the family Oxyopidae, Orb weavers of the family Araneidae, Crab spiders of the family Thomisidae, etc. In certain parts of the park, good population of the beautiful Indian violet terentula can also be observed. The Indian red scorpion (*Hottentotta tamulus*) is one of the few scorpions in the world with medically significant venom that can be found under rock in the rocky areas of the park. Freshwater crabs become extremely numerous during the monsoons and the forest trails such as Shilonda are usually teeming with them. Many species of stream dwelling and estuarine fish species are also known from the park.

Image 10



Image 11



Image 12



Image 10: Barking Deer: A shy, small and ancient species of deer known for giving its diagnostic loud barks at the slightest sign of danger, Photo credit: Shantanu Majumdar

Image 11: Bonnet Macaque: One of the common species of monkeys in the park, endemic to the park that are known to live in large troops with complex social structures, Photo credit: Shantanu Majumdar

Image 12: Jungle Owlet: A small diurnal owl who's far carrying call can be heard throughout the park, Photo credit: Shantanu Majumdar

Image 13: Vigors Sunbird: A small colorful nectarivore bird endemic to the Northern western ghats, often found in the open forests of the park, Photo credit: Shantanu Majumdar

Image 14: Shaheen Falcon: A resident subspecies of the peregrine falcon often seen flying around the hills showing off its aerial prowess, Photo credit: Shantanu Majumdar

Image 15: Oriental Dwarf Kingfisher: A very colorful diminutive forest Kingfisher that is a monsoon migrant to SGNP, Photo credit: Shantanu Majumdar

Image 16: Verditer Flycatcher: A pretty Flycatcher that is a winter visitor in the park from the Himalayas, Photo credit: Shantanu Majumdar



Image 13



Image 14



Image 15



Image 16

The conflict between the city and the forest

As stated earlier, what makes SGNP so unique is that it is wedged between two bustling cities of Mumbai and Thane. This distinction has given the National Park a somewhat turmoil ridden history strewn with demolitions, litigations, conflicts, calamities and most importantly, loss of biodiversity. The perpetual human presence in and around the park over the years has been the bone of contention of a lot of complications since the very inception of the park. SGNP made out of stitching *inam* lands, private lands, villages and the catchment of the lakes together. This meant, even though it was being protected, the populations of tribals were not accounted for. As the populations of the city increased, landlords started leasing lands to immigrants which in turn started creating slum pockets. Hence at one point, the area protected for the preservation of biodiversity, had a population of tribals as well as immigrants living within its limits. As seen from the above predicament, it was inevitable that encroachment would become an inherent problem with the park.

In 1950, Krishnagiri national park notified protected forest under the Mumbai National Park Act, the population of Mumbai stood at 30,88,811 and the park had a

meager size of 20.26 sq.km. At the time of writing this article, the city's population has reached an astounding 2,06,67,656, approx. 7 times the 1950 figure and the park has also 107 sq.km under the more fortified pretext of being a national park under the Indian wildlife act. Mumbai that had started as just the tip of the peninsula had expanded northwards and become the metropolitan within a century, with an area of 4738 sq. kms. As seen from the numbers above, the challenges over the years for the management of this unique forest has only increased. Referring to the past, managing SGNP is not only managing the affairs of the forest's welfare but also the burdens of the populace of the city. Hence, policy making and implementation for the welfare of the forest has always been complicated. The never-ending need of human development juxtaposed by the undeniable need of biodiversity and green spaces shows us the global dilemma we humans are facing and it shows even better in the story of SGNP due to its strategic placement. The bias towards development and immediate human needs is apparent by the decrease in natural habitats in major cities across the globe.

As stated in the evolution of SGNP, the park reached what it is now in various stages. Over the span of its evolution, the city evolved with it too and in the process the boundaries of where the city ends and the forest begins, became blurry. Mumbai rose as a major trade center of the

time; the population grew exponentially due to migrants flocking in for employment and business opportunities. Poverty, lack of planning, loose enforcement of laws, ill-planned land acquisitions and political motives all gave rise to one of the biggest issues for the city's forest, encroachment.

It was during the 1970s when encroachment started to really show. There was an accelerated growth of illegal hutments inside the park that at one point reached an unfortunate figure of 78,000 to 80,000 hutments. This had disastrous implications on ecology as biodiversity couldn't cope up with the anthropogenic activities in the park. Pollution of all kinds was rampant around the settlements. Loss of soil cover and its compositional integrity, logging activities for firewood, introduction of pest species and man-made forest fires destroyed the biodiversity these encroached sites and other parts of the park. Quarrying was rampant in

the park. Factories were leased land close to the city forest. Such fragmentation caused changes in interactional and mating behavior in animals and a plummet in many large mammal's populations such as the Barking deer, wild boar, sambar, amongst many other species. Unchecked movements of people in the park cause many social problems like illegal brewing of alcohol in the park. This overlap of the city and forest culminated in violence and the high court had to intervene.

The Bombay Environmental action group's (BAEG) Public Interest Litigation (PIL) was what changed a lot of dynamics in the tale of struggles of coexistence between the forest and the city. The PIL and the following court ruling started a different chapter for SGNP, where wildlife conservation got a strong footing. They invoked the Wildlife protection act (1972), The Indian Forest Act (1977) and the Forest conservation act (1977) in the PIL, urging the court to order the eviction of all illegal encroachers and the demolition of all illegal structures in the park. It also asked that the encroachers were not regularized and given amenities. They were met with a resounding victory as the court gave the forest department a strong mandate to evict the encroachers from the park and relocate them outside. Many committees were also formed to oversee its smooth execution. The resultant situation for the management was a complex one. Although the court's ruling gave them resources, it also made them dependent on the cooperation of the various actors in the forest city's socio-political landscape. The eviction of the enormous amount of people and their resettlement were murky waters and caused a big deal of controversy. After the initial violent confrontation, the forest department successfully evicted 60,000 encroacher families. About 25000 other families were offered free resettlement by the government of Maharashtra. Directly involving the Nivara Hakk Suraksha Samiti (NHSS), an organization that safeguarded the interests of the slum dwellers from the very beginning, in the relocation scheme was an important juncture that made the process smoother. With the big encroachment problem more or less out of the way, the forest needed time to heal and the management could again focus on the direct welfare of the forest's wildlife. Although things are not perfect, the following years have brought some semblance to the city forest. It is imperative that with the growth in population of the city, along with the park management, we the citizens of Mumbai give our best to conserve this astounding gem that is Sanjay Gandhi National Park.

The importance of SGNP to the city of Mumbai

SGNP like other urban forests provides valuable ecosystem services, it provides a green getaway to Mumbai's citizens along with buffering air pollution, carbon sequestration in large quantum, oxygen release etc. It has the right foliage cover to provide apt habitats to various lifeforms including insects, birds, reptiles and mammals.

It is well established that the urban forests provide key ecosystem services, like filtering air and water, it binds communities and is a resource for water management. The forest is like a green oasis in the urban concrete and tar landscape. It also provides conducive refuge habitat to several visiting migratory species of fauna. Research has found that proximity to green space can be correlated with improved physical and mental well-being along with healthy lifestyles. Green areas like SGNP are therapeutic for the urban lifestyle fraught citizens. Urban forests like SGNP aids in building social networks and strengthening community efforts to protect and promote forest resources. Exemplary SGNP facilitates awareness and understanding between urban population and nature. SGNP can be a learning ground for urban children and the young populace to understand inclusive living with nature and other species. Moreover, urban forest getaways like SGNP facilitates sensitizing the population to the ecological requirements of other lifeforms. A wonderful example of mutual co-existence within the maximum city.

Forestry studies has unraveled that urban forest can be key to prevent genesis of climate change and also mitigate its impact. The urban forests like SGNP have faster rates of carbon sequestration than other thickets of forest cover in the urban landscapes. It has been noted that the presence of large trees as witnessed in forests in or around urban ecosystems facilitate communities inhabiting these areas to better deal with threats that are brought about by climate change. They do so by shielding the area in case of heat waves and thereby reducing the ambient temperature. Trees are also known to reduce flood risks, limiting ground level ozone and hence preventing their adverse effects. Bolstering such forests that are in close proximity to civilization is imperative as it not only mitigates the

consequences of human actions but also makes the ecosystem more resilient to environmental change.

Forest tribes viz. *Chena*, *Yeoor*, *Warli* tribes and so on of the western part of the park extract livelihoods from the forest resources.

Moreover, urban forests like SGNP can also be beneficial for the urban ecosystem. In particular, they can mitigate the heat island effect, improve the water infrastructure, intercept rainfall and surface runoff thereby maintaining the ground water tables. They are also responsible for abating erosion and sedimentation, enhance agricultural production in urban and peri-urban areas, and increase property values. SGNP is a green oasis in the metropolis Mumbai that phenomenally contributes by reducing air temperature, sequestering carbon, providing habitat for forest flora and fauna, and also protecting Mumbaikars from environmental hazards, such as pollution. It's a cluster of green, tranquility and wild in the midst of urban milieu, a rarity even amongst global examples. The Mumbai Climate Action Plan 2022 gives a 30-year roadmap of short term, medium term and long-term climate goals which includes urban greening and biodiversity. SGNP will be the master orchestrator in achieving some of the goals.

Conclusion

Sanjay Gandhi National Park is a highly valued urban forest in the Maximum city Mumbai, analogous to a green oasis in the teeming urban landscape. SGNP and IIT-Bombay's evaluation will certainly help in quantifying equity of the forest to the city and its dwellers. It will help the administrators to put forth a revenue generation model for the park's services, a catchment treatment plan and a carbon sequestration plan. Urban forests are a strategy all over the world to combat the ramifications of climate change, greenhouse gases and pollution. Mumbai's relationship with the park is similar to what corals of the Great barrier reef of Australia have with the algae. Without the nourishment from the algae all that remains of the coral is a white husk. Without SGNP our city will turn into something not much dissimilar. Mumbaikars are lucky to have the green wealth of SGNP which needs further nurturing and conserving. It can exemplify sustainable city living with inclusion of urban forests. We Mumbaikars should be committed to the wellbeing of SGNP and our City, Mumbai.



“Say NO to Single Use Plastics”

Image 17



Image 18



Image 19



Image 17: *Ahetulla oxyrynchha*: A long nosed vine snake, an elegant species of lowland forests and wooded areas, perfectly evolved to lead a life on trees, Photo credit: Shantanu Majumdar

Image 18: Deccan Banded Gecko (*Cyrtodactylus deccanensis*): A beautiful terrestrial gecko endemic to part of deccan and Northern western ghats, Photo credit: Shantanu Majumdar

Image 19: Spotted Rock Gecko (*Hemidactylus maculatus*): A large rock dwelling gecko commonly found in the caves and between rocky crevices in the park, Photo credit: Shantanu Majumdar

Image 20



Image 21



Image 22



Image 23



Image 20: The very interesting looking, snake mimicking caterpillar of the Great Orange Tip Butterfly (*Hebomoia glaucippe*) on a Maastodi (*Capparis sepiara*) shrub in the park, Photo credit: Shantanu Majumdar

Image 21: The loud calls of the adult Cicadas (*Lemuriana apicalis*) echo throughout the forest during the warmer months, Photo credit: Shantanu Majumdar

Image 22: Giant Wood Spider (*Nephila pilipes*) with an Asiatic Blood Tail Dragonfly (*Lathrecista asiatica*) prey: Giant wood spiders with their massive webs are found abundantly during late monsoon in the park, Photo credit: Shantanu Majumdar

Image 23: An Indian Red Scorpion (*Hottentotta tamulus*) mother piggy backing its offspring, a behaviour commonly seen in many arachnids which was observed in the rocky outcrops of the park, post monsoon, Photo credit: Shantanu Majumdar

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