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Diversity and Distribution of Snakes in Adjoining Areas of Panvel, Navi Mumbai, West Coast of India

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Abstract: In this study, impact of over-exploitation of natural resources on diversity and distribution of snakes in adjoining areas of Panvel, Navi Mumbai was assessed. The present work was carried out for one year (from June 2019 to May 2020). Study sites were visited during dawn and dusk hours, one day in each month. Also, data on snakes was collected from local snake friend NGOs and reports of accidental road kills. This study observed 25 species of snakes representing 10 families and 23 genera out of which 10 species belong to family Colubridae, 3 species each to Elapidae and Viperidae, 2 species each to Erycidae and Natricidae and 1 species each to Homalopsidae, Lamprophiidae, Pythonidae, Sibynophiidae and Typhlopidae. During present study, 19 species of non-venomous snakes and 6 species of venomous snakes were observed. The study shows that, ecological conditions in area adjoining to Panvel, Navi Mumbai supports moderate snake density. It can be concluded that over-exploitation of natural resources in Panvel region due to ongoing construction of Navi Mumbai International Airport (NMIA) are the key factors affecting the diversity and distribution of snakes. Also, mortality of snakes in residential complexes is due to lack of awareness regarding ecological role of snakes and fear of snake bite. It is recommended to create awareness among general public about role of snakes in ecological food chain and also sustainable utilization of natural resources. Since no earlier reports are available, data presented here can be taken as a baseline data in knowing the status of snakes from adjoining area of Panvel, Navi Mumbai.

Keywords: Diversity, Natural resources, Navi Mumbai International Airport, Panvel, Reptilia, Snakes

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Introduction

Interest in conservation of biodiversity increased due to population declines and extinctions throughout the world by reasons like habitat loss and degradation, unsustainable use, invasive species, environmental pollution, disease and global climate change (Masood, 2012). Asia was considered among most diversity-rich continents; however, increase in human population has adversely affected the diversity due to agriculture intensification, urbanization, industrialization, and pollution (Gibbons *et al.*, 2000; Altaf *et al.*, 2018).

Species are the backbone of biology (Uetz, 2010). Among vertebrates, reptiles are still poorly known and are highly threatened. Decline in population of reptiles is a major concern and causes of catastrophic decline are habitat loss, environmental pollution, lethal diseases, unsustainable use of natural resources and global climate change (Rodrigues *et al.*, 2010; Koirala *et al.*, 2016; Vignoli *et al.*, 2017; Luiselli *et al.*, 2020).

With more than 3000 species known so far, snakes are a successful group of predatory vertebrates that occupy tropical and temperate areas, from deserts and mountain summits to oceans (Pauwels *et al.*, 2008). Snakes are important groups of reptiles to conquer the terrestrial ecosystem and play an important role in the ecosystem as links in food webs, predators and prey, bio-monitors in controlling insect pests and ecological indicators owing to their high degree of sensitivity to even a slight change in the environment (Koirala *et al.*, 2016; Bohm *et al.*, 2017).

India harbours 518 species of reptiles which include 279 species of snakes belonging

to 28 families. All over the world, near about 3783 snake species are found, out of which 279 species of snakes are found only in the India (Janani *et al.*, 2016). They constitute approximately 10 per cent of the total snake species found in the world and 80% of them are non-poisonous (Kale *et al.*, 2019). The venomous snakes include only about 58 species and there are only 4 species of snakes that are dangerous to man, namely, Cobra, Krait, Russell's viper and Saw-scaled viper (Jadhav *et al.*, 2018).

Coastal environment of Navi Mumbai (Panvel, Uran, Vashi) has been under considerable stress since the ongoing construction of Navi-Mumbai International Airport (NMIA) by the City and Industrial Development Corporation (CIDCO). Construction of NMIA has resulted into deforestation, encroachment, reclamation and urbanization in the study area. It has affected the livelihood of local fishermen and coastal community along with ecology of fauna from Panvel, Navi Mumbai (Pawar, 2013, Pawar *et al.*, 2019 a, b).

Details on diversity and distribution of snakes in India have been studied by Ganesh *et al.* (2013), Fellows (2014), Pradhan *et al.* (2014), Raut *et al.* (2014), Yadav *et al.* (2014), Bansode *et al.* (2016), Bawaskar and Bawaskar (2016), Janani *et al.* (2016), Manhas *et al.* (2016), Mukadam and Kadam (2016), Sirsat *et al.* (2016), Tambre and Chavan (2016), Joshi *et al.* (2017), Baishya and Das (2018), Bansode and More (2018), Jadhav *et al.* (2018), Lalremsanga *et al.* (2018), Sulabh and Shivahre (2018) and Kale *et al.* (2019).

Although many studies have been undertaken to evaluate the species diversity

and distribution of snakes in India, barring the work of Walmiki et al (2012), no scientific studies have been carried out on the species composition and distribution of snakes of Mumbai and Navi Mumbai; hence, the present study is undertaken. In the present study, an attempt has been made to document the diversity and distribution of snakes in Panvel, Navi Mumbai and its adjoining area to assess the impact of anthropogenic activities.

Materials and Methods

Study Area:

Navi Mumbai is basically a satellite township on the west shore of Maharashtra. It was made in 1971 to be another urban township of Mumbai by Government of Maharashtra. As per Census India 2011, it had a population of 1,119,477. Panvel is located in Raigad district of Maharashtra in Konkan region and is a node of Navi Mumbai city. Geographically, Panvel is near Panvel creek which opens up in Thane creek. Kalundre river flows across the city in the south-west region and opens up into Panvel creek. Panvel with a population of 180,464 (Census India 2011) is a highly populated city due to its closeness to Mumbai. It is located in the Mumbai Metropolitan Region. Panvel is situated on the banks of Panvel Creek. It is also surrounded by mountains on 2 sides (Fig. 1).

Study Location:

The present ecological study on diversity and distribution of snakes was carried out for the period of one year, from June 2019 to May 2020. Area adjoining to Panvel was visited during dawn and dusk hours, one day in each month and 4 h were spent at each site at both times. Also, data of snakes was collected from local snake friend NGOs as well as from the

reports of accidental road kills. All snakes were photographed using Cannon 1100 D Zoom camera. For correct identification of snakes, field guides and books of Daniel (2002), Whitaker (2006) and Petty (2019) were followed.

Results and Discussion

Varied diversity of snakes with 25 species representing 10 families and 23 genera were observed. Number of species of snakes distributed in each family reveals that 10 species belongs to family Colubridae, 3 species each to Elapidae and Viperidae, 2 species each to Erycidae and Natricidae and 1 species each to Homalopsidae, Lamprophiidae, Pythonidae, Sibynophiidae and Typhlopidae. During present study, 19 species of non-venomous snakes and 6 species of venomous snakes were recorded (Figs. 2, 3; Tables 1, 2).

Masood (2012) reported that though the venomous snakes may be harmful to human life in some cases, they are also useful to human in many aspects of life and are required to be conserved by maintaining suitable natural habitat. Koirala *et al.* (2016) noted that protection of forest habitats are significantly important for conservation of herpetofauna diversity. According to Bohm *et al.* (2017), factors like altitude, habitat breadth and body size of snakes are also to be considered for effective conservation of reptiles.

Luiselli *et al.* (2020) observed a positive correlation between habitat and abundance of venomous snakes and factors like human population density, dominant agricultural techniques and land use severely affects the relative abundance of venomous snake species. Vignoli *et al.* (2017) recorded

Fig. 1. Location map of study area representing Panvel creek.

distribution and diversity of reptiles in a species-rich protected area of central Italy and stated that natural land use supports the whole reptile community where as urban and agricultural environments hosted about half of the species.

Pawar *et al.* (2019 a, b) correlated the depletion of coastal marine diversity from Panvel creek to the loss of habitat due to deforestation, overexploitation of natural resources for ongoing construction of Navi-Mumbai International Airport (NMIA), habitat fragmentation due to construction and widening of roads and rampant urbanization

and industrialization of the area adjoining Panvel.

Ongoing construction of NMIA covers an area of 1,160 hectares (4.5 Sq miles) in the vicinity of Panvel creek. The airport project has relocated 2,786 households located across 10 villages. Villages like Chinchpada, Kopar, Kolhi, Ulve, Upper Owale, Waghivalipada, Vaghivali, Ganeshpuri, Targhar and Kombadbhunje are relocated in the nearby area of creek. The airport area has to be filled with an average of 14 feet. For filling the airport area, nearby mountain resources were excavated at an alarming rate, without

Ahaetulla nasuta

Archelaphe bella

Boiga forsteri

Boiga trigonata

Coelognathus helenus

Lycodon aulicus

Oligodon arnensis

Platyceps gracilis

Ptyas mucosa

Xenochrophis piscator

Eryx conicus

Eryx johnii

Gerarda prevostiana

Psammophis longifrons

Amphiesma stolatum

Fig. 2: Snakes recorded in & around Panvel, Navi Mumbai during June 2019 to May 2020

Macropisthodon plumbicolor

Python molurus

Sibynophis subpunctatus

Indotyphlops braminus

Trimeresurus gramineus

Naja naja

Calliophis melanurus

Daboia russelii

Echis carinatus

Bungarus caeruleus

Fig. 3: Snakes recorded in & around Panvel, Navi Mumbai during June 2019 to May 2020

Spectacled Cobra

Checkered Keelback

Indian Rock Python

Russell's Viper

Common Wolf Snake

Banded Kukari

Rat Snake

Indian Rock Python

Fig. 4: Anthropogenic impact & accidental road kills of snakes from Panvel, Navi Mumbai

Table 1: Preliminary checklist of snakes (Order: Squamata) recorded in and around Panvel

No.	Family	Scientific Name	Common name
	Non-Venomous Snakes (NV)		
1	Colubridae	<i>Ahaetulla nasuta</i> (Bonnaterre, 1790)	Long-nosed Tree Snake, Green Vine Snake
2		<i>Archelaphe bella</i> (Stanley, 1917)	Bella's Trinket Snake
3		<i>Boiga forsteni</i> (Dumeril, Bibron and Duméril, 1854)	Forsten's cat snake
4		<i>Boiga trigonata</i> (Schneider, 1802)	Common Cat Snake, Indian Gamma Snake
5		<i>Coelognathus helenus</i> (Daudin, 1803)	Common Trinket Snake
6		<i>Lycodon aulicus</i> (Linnaeus, 1758)	Common Wolf Snake
7		<i>Oligodon arnensis</i> (Shaw, 1802)	Banded Kukri Snake
8		<i>Platyceps gracilis</i> (Gunther, 1862)	Slender Racer Snake, Gunther's Racer
9		<i>Ptyas mucosa</i> (Linnaeus, 1758)	Rat Snake
10		<i>Xenochrophis piscator</i> (Schneider, 1799)	Checkered Keelback, Asiatic Water Snake
11	Erycidae	<i>Eryx conicus</i> (Schneider, 1801)	Common Sand Boa
12		<i>Eryx johnii</i> (Russell, 1801)	Red Sand Boa, Indian Red Sand Boa
13	Homalopsidae	<i>Gerarda prevostiana</i> (Eydoux and Gervais, 1837)	Glossy Marsh Water Snake, Gerard's Water Snake, Gerard's Mud Snake
14	Lamprophiidae	<i>Psammophis longifrons</i> (Boulenger, 1890)	Stout Sand Snake, Stocky Sand Snake
15	Natricidae	<i>Amphiesma stolatum</i> (Linnaeus, 1758)	Striped Keelback, Buff-striped Keelback
16		<i>Macropisthodon plumbicolor</i> (Cantor, 1839)	Green Keelback, Lead Keelback
17	Pythonidae	<i>Python molurus</i> (Linnaeus, 1758)	Indian Rock Python
18	Sibynophiidae	<i>Sibynophis subpunctatus</i> (Dumeril, Bibron and Dumeril, 1854)	Dumerils Black-headed Snake, Jerdon's Many-toothed Snake
19	Typhlopidae	<i>Indotyphlops braminus</i> (Daudin, 1803)	Brahminy Worm Snake

	Venomous Snakes (V)		
20	Elapidae	<i>Bungarus caeruleus</i> (Schneider, 1801)	Common Indian Krait
21		<i>Naja naja</i> (Linnaeus, 1758)	Spectacled Cobra, Common Indian Cobra
22		<i>Calliophis melanurus</i> (Shaw, 1802)	Slender Coral Snake
23	Viperidae	<i>Daboia russelii</i> (Shaw and Nodder, 1797)	Russell's Viper, Chain Viper
24		<i>Echis carinatus</i> (Schneider, 1801)	Indian Saw-scaled Viper
25		<i>Trimeresurus gramineus</i> (Shaw, 1802)	Indian Bamboo Pit Viper, Green Pit Viper

Table 2: List of families with number of genera and species of snakes recorded from Panvel

Sr. No.	Order	Family	Genera	Species
1	Squamata	Colubridae	09	10
2	Squamata	Elapidae	03	03
3	Squamata	Erycidae	01	02
4	Squamata	Homalopsidae	01	01
5	Squamata	Lamprophiidae	01	01
6	Squamata	Natricidae	02	02
7	Squamata	Pythonidae	01	01
8	Squamata	Sibynophiidae	01	01
9	Squamata	Typhlopidae	01	01
10	Squamata	Viperidae	03	03
Total	01	10	23	25

considering its impact on biodiversity. As a result, the herpatofauna from the study area is facing stress and are victimized to accidental road kills (Pawar *et al.*, 2019 a, b).

Present study reveals the mortality of Russell's Viper, Common Wolf Snake, Banded Kukari, Rat Snake and Indian Rock Python is of serious concern noted in this study (Fig. 4). High rate of mortality recorded for snakes is attributed to the attraction of the snakes on the roads for thermoregulation and warmth during early morning when the air temperature is cool. It is also correlated to the sluggish nature of pythons and sand boas to make them more susceptible to mortality (Baskaran and Boominathan, 2010).

Mortality of snakes noted in this study is also correlated to the loss of habitat due to deforestation, overexploitation of natural resources for ongoing construction of Navi-Mumbai International Airport (NMIA), habitat fragmentation due to construction and widening of roads and rampant urbanization and industrialization of the area adjoining Panvel (Bonaudo *et al.*, 2005). Results of the study are in agreement with the findings regarding anthropogenic impact on snake diversity by Pradhan *et al.* (2014), Janani *et al.* (2016), Joshi *et al.* (2017), Lalremsanga *et al.* (2018) and Kale *et al.* (2019).

At present, ecological conditions in area adjoining Panvel, Navi Mumbai supports moderate density of snakes but due to over-exploitation of natural resources for ongoing construction of Navi Mumbai International Airport, deforestation, intense industrialization and urbanization, coastal pollution will affect the diversity and distribution of snakes in future. Therefore,

data presented in this paper can be taken as a base line data for future study.

Conclusion

The study shows that, at present, ecological conditions in area adjoining Panvel, Navi Mumbai supports moderate snake density. It can be concluded that over-exploitation of natural resources and deforestation in Panvel region due to ongoing construction of Navi Mumbai International Airport (NMIA) are the key factors affecting the diversity and distribution of snake species. Also, mortality of snakes in residential complexes is due to lack of awareness regarding ecological role of snakes and fear of snake bite. It is recommended to create awareness among general public about role of snakes in ecological food chain and also sustainable utilization of natural resources. Since no earlier reports are available, data presented here can be taken as a baseline data in knowing the status of snakes from adjoining area of Panvel, Navi Mumbai and effect of industrial development on it.

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