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Review on the enigmatic Data deficient Bombay sea snake *Hydrophis mamillaris* Daudin (1803) from India

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Abstract

Marine reptiles like sea snakes thrive in tropical and subtropical waters globally. The Bombay sea snake, scientifically identified as Hydrophis mamillaris Daudin *1803, is recognized for its unique traits. This review paper aims to illuminate this enigmatic serpent's unique biology and ecology. This venomous species, native to the Indian Ocean, has been inadequately studied and documented, with sparse records and an uncertain type specimen. The IUCN classifies its population as 'Data Deficient,' reflecting insufficient specimens and unclear distribution patterns. The most recent verified collection of this species occurred in 1926. A comprehensive review of research papers, available field guides, and articles in the English language was compiled from search engines such as Google Scholar, Research Gate, and Academia, research papers and websites such as Inaturalist, Indian Snakes, India Biodiversity Portal, along with non-electronic literature such as pictorial field guides, monographs available in the English language from 1917 to 2024, N=30 encompassed various countries while ensuring no bias towards India websites using keywords like Hydrophis, Arturia, Chitulia, sea snakes. This comprehensive review, compiled from various sources, provides a detailed overview of the current knowledge of this species' taxonomy, habitat, morphology, distribution, reproductive biology, and venom.*

Keywords: Broad-banded Sea snake, Indian ocean, Hydrophinae, data deficient.

Introduction

Studies on marine elapid snakes indicate that 9% face extinction risk, and 6% are categorized as near-threatened[1]. Many sea snakes feature paddle-like tails and flattened bodies, giving them an eel-like appearance[2]. These snakes are among the most aquatic of all air-breathing animals.Sea snakes inhabit marine environments[3]. They belong to three families: hydrophiinae, laticaudinae and acrochordidae[4,5]. Sea snakes have many different adaptations that help them survive within their habitats. The majority of sea snakes possess venom, with the exception of Little file sea snake (*Acrochordus granulatus*)[6]. Sea snakes are highly specialized for a fully aquatic lifestyle and are incapable of terrestrial movement, with the exception of sea kraits, which exhibit restricted mobility on land. Sea snakes are generally reluctant to bite and are usually considered mild-tempered[3]. Sea snakes appear active day and night[7]. Their diet primarily consists of small fish, with occasional consumption of juvenile octopuses[7]. Sea snakes are frequently linked with the sea snake barnacle (*Platylepas ophiophila*), which adheres to their skin[4]. All sea snakes are ovoviviparous. One exception species is the sea krait genus *Laticauda*, oviparous[7].

Hydrophis mamillaris is called the bombay sea snake, broad-banded sea snake, or Vizag sea snake[8]. The meaning of the species name *mamillaris* is mammalian nipple and was given due to its appearance like mammalian nipples of dorsal scale due to the presence of central keel/tubercle at the centre of each scale[5]. This species is global data deficient (DD) according to the IUCN Red List of Threatened[9]. It is safeguarded under Schedule II of the Wildlife (Protection) Amendment Act of India 2022. This is a rare species, with only a few specimens reported from India[10,11] (Figure-1,2). This comprehensive review aims to compile the literature on the *Hydrophis mamillaris* snake, particularly emphasizing existing information and their distribution. This study hopes to support future research by providing a comprehensive information baseline.

Methodology

A comprehensive review of research papers, available field guides, and articles in the English language was compiled from search engines such as Google Scholar, Research Gate, and Academia, research papers and websites such as Inaturalist, Indian Snakes, India Biodiversity Portal, along with non-electronic literature such as pictorial field guides, books available in the English language from 1921 to 2024 (104 years) n=30 encompassed various countries while ensuring no bias towards Indian websites using keywords like *Hydrophis, Arturia, Chitulia,* sea snakes. This paper discussed the species from n = 20 research articles, n = 8 field guides and books, n = 2 web sources. This literature is primarily composed of web resources (7%), books and field guides (26%), and journal articles (67%).

A pie chart represents the percentage of topic-wise information about the species (Figure-4). Another stacked column graph represented the compiled literature from the nine-year range (Figure-5) to summarise and interpret research gaps.

Results and Discussion

The comprehensive review of research papers on *H. mamillaris* examined a range of facets of the species. The analysis unveiled that the highest proportion of papers, N=13 (36%), concentrated on documenting the distribution of the species, shedding light on their Indian coastline reports (n=7) 20% and geographical range n=6 (17%) and Taxonomy and etymology n=2, 6%. Investigations into colouration n=7 (19%), morphology n=3, (9%), habitat preference, n=2 (6%) followed, assessing scalation n=2 (6%) and reproduction n=2, 6% venom n=2 (6%), population n=3 (9%), contributing significantly to a deeper understanding (Figure-4). The highest number of papers was published between 1983 and 2013 in India (Figure-5).

Taxonomy and etymology: French zoologist François Marie Daudin first described the Bombay sea snake in 1803, based on a specimen from Visakhapatnam on India's eastern coast[5]. Initially classified under the genus *Anguis*, it was subsequently reclassified as *Hydrophis*[5]. Each scale features a central tubercle, thought to resemble a mammalian nipple[12]. Certain experts question the authenticity of Daudin's type specimen, citing the description as vague and inadequate. Subsequent specimens gathered at Visakhapatnam were good, and the majority of existing research confirms that the Bombay sea snake is a legitimate species. Over the past two centuries, the Bombay sea snake has been assigned to various genera, such as *Aturia, Chitulia*, and *Leioselasma*[5]. In 1943, it was reclassified under *Hydrophis*, a designation that remains unchanged.

Geographical distribution: It is reported from the coast of Pakistan, India, Sri Lanka, China, Indonesia, Malaysia, Myanmar, New Caledonia, Thailand and Vietnam[8,13-17].

Indian distribution: Specimens have been recorded along the Indian coastline, with a significant concentration near Mumbai on the western coast[18]. Reports originated from Visakhapatnam on the eastern coast, Saurashtra, Bhavnagar coast, Gulf of Khambhat in the southwestern region of Gujarat, Digha Beach en route to Paddapur in Midnapur district, West Bengal, and the Gulf of Mannar in Tamil Nadu[4,18-23]. They were also reported from Bassein Fort in Vasai, Alibaug, and Maharashtra[23,24] (Figure-3).

Habitat: They were generally located in soft substrates like sand or mud, primarily near the seabed and in shallow coastal waters[20]. The species was also observed in shallow sandy tide pools, areas with rocky substrata, and mangrove creeks[25].

Morphology: The descriptions of the morphology have been compiled from studies that have personally collected specimens to provide descriptions of freshly dead specimens and a few details from ZSI specimen collections. The Bombay sea snake is relatively small, with an average length of approximately 60.96 cm [20]. In males, the body length can extend up to 870 cm, while females may grow up to 895cm [20]. The juvenile specimen from Digha measured 62 cm in total length, with an SVL of 55 cm and the remainder being tail length[22]. The head is small, with a rostral broader than tall, superior nostrils, and nasal scales in contact; the prefrontal is slightly elongated or triangular, connecting to the second supralabial[24]. In one case, the prefrontal was fused with the nasal; the frontal exceeded the distance from the rostral, and the temporals were 2+2, though two specimens had only one anterior temporal[24].

Colouration: The upper part of their body is a dark shade of brown or black, while the lower side is a vibrant yellow or cream colour. The color of the head is black[26]. The animal possesses a dark head, diminutive eyes, and an elongated, rounded snout[4]. The overall colouring is dark olive green on the upper side, with yellowish crossbars and a whitish portion on the lower side[17]. The colour is usually white for the young, while it is a light grey for adults. The body is marked with 42-57 wide black bands that encircle it[20]. These bands are slightly wider on the upper side and thinner on the sides. The head, chin, and throat exhibit a consistent black colouration, while the temporal area displays a yellow streak[20]. The dorsal coloration appears yellowish or brownish, featuring 44-55 broad black bands along the body and two groups of nine bands on the tail, as noted in the ZSI museum specimen[17]. The head is predominantly black, with a distinct yellow streak located on the temporal region[20].

Scalation: The neck has 25–29 scale rows, while the body features 35–43 rows[20]. Ventral shields number between 302 and 390, are distinct and bicarinate, and are not twice the width of adjacent scales[25]. According to the museum specimen, there are 25–30 scales around the neck, 33–45 scales around the midbody, and 260–350 ventral scales, which are distinct throughout.

The anterior scales are larger than the next dorsal scales, while the posterior scales are narrower. The preanal scales are small, and the dorsal scales exhibit no keels or just mild keeling[24].

Reproduction: Limited information exists regarding the mating behaviors of this snake, as only one gravid female has been observed; similar to other sea snakes, it is viviparous. The brood size varied from three to four, and the length of the offspring was roughly 30 centimeters at birth[20]. Pregnant females attain a larger size of around 91 centimeters[27].

Population: The population of Bombay sea snakes is unknown[9]. The IUCN classifies *H. mamillaris* as data poor on the Red List of Threatened Species[9]. This uncommon species has not been reported after 1932[25].

As per Dabhi et al. it is restricted to the Bhavnagar coast, Gulf of Khambhat, with a dense population[4].

Venom, Snakebite and Toxinology: Venom characteristics are unknown, but they probably have potent neurotoxins and myotoxins[28]. The potency of venom is unknown[11]. There are no well-documented bites or envenomation of humans and no reported fatalities due to bites by this species[11].

Table-1: Distributional records of *Hydrophis mamillaris*, Daudin (1803) in India.

Species	Latitude	Longitude	State	Reference
Hydrophis mamillaris	18.9230556 N	72.8230556 E	Maharashtra	4
Hydrophis mamillaris	19.32784334 N	72.8174200 E	Maharashtra	23
Hydrophis mamillaris	17.68611111 N	83.248611 E	Andhra Pradesh	17
Hydrophis mammilaris	21.93944444 N	72.372500 E	Gujarat	18,29
Hydrophis mammilaris	21.76861111 N	72.210833 E	Gujarat	9
Hydrophis mammilaris	21.62777501 N	87.5368147 E	West Bengal	22
Hydrophis mammilaris	8.841642163 N	79.7121778 E	Tamil Nadu	19

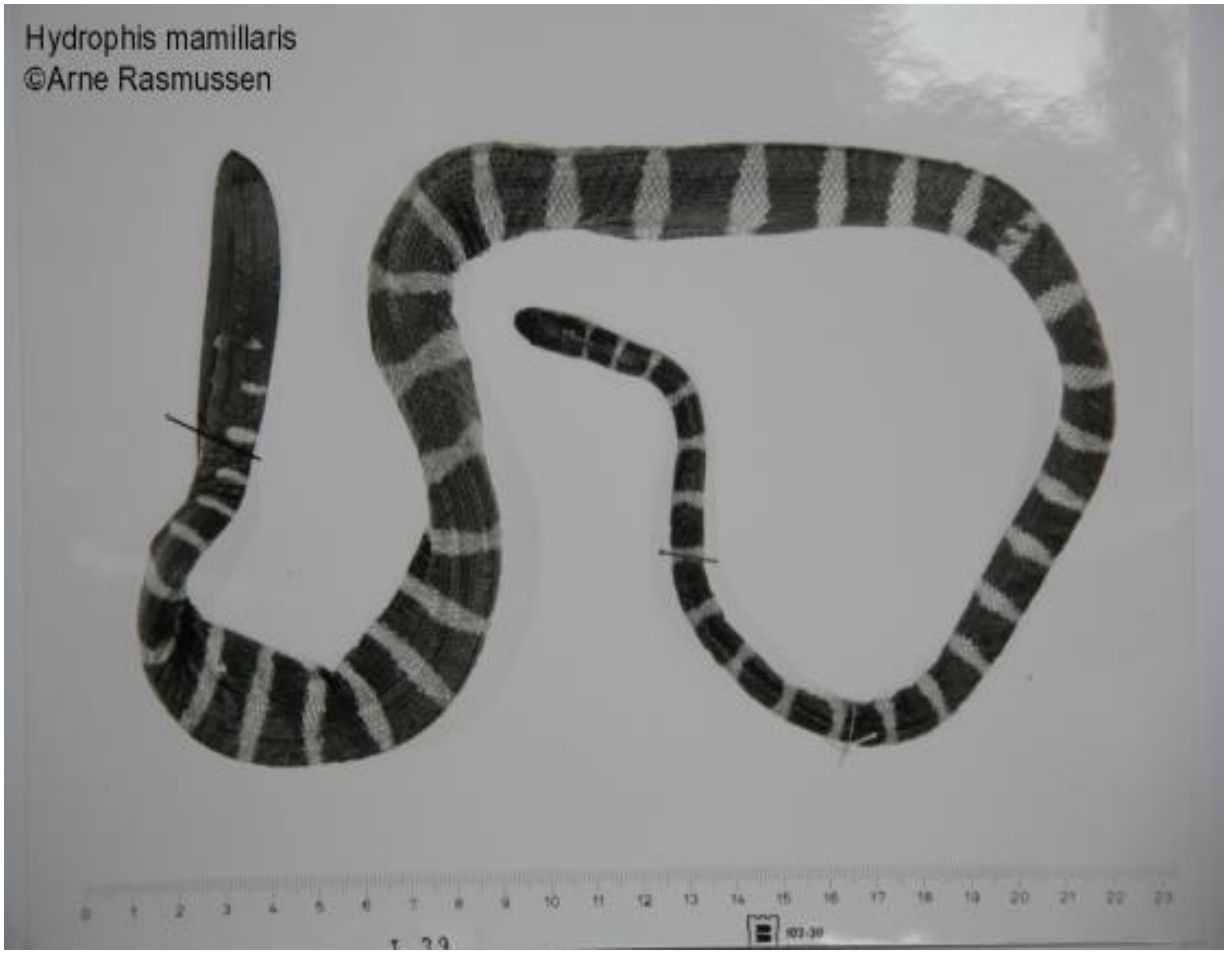

Figure-1*:* Musuem specimen of *Hydrophis mamillaris* Daudin (1803) (Photo credits: Arne Rasmussen).

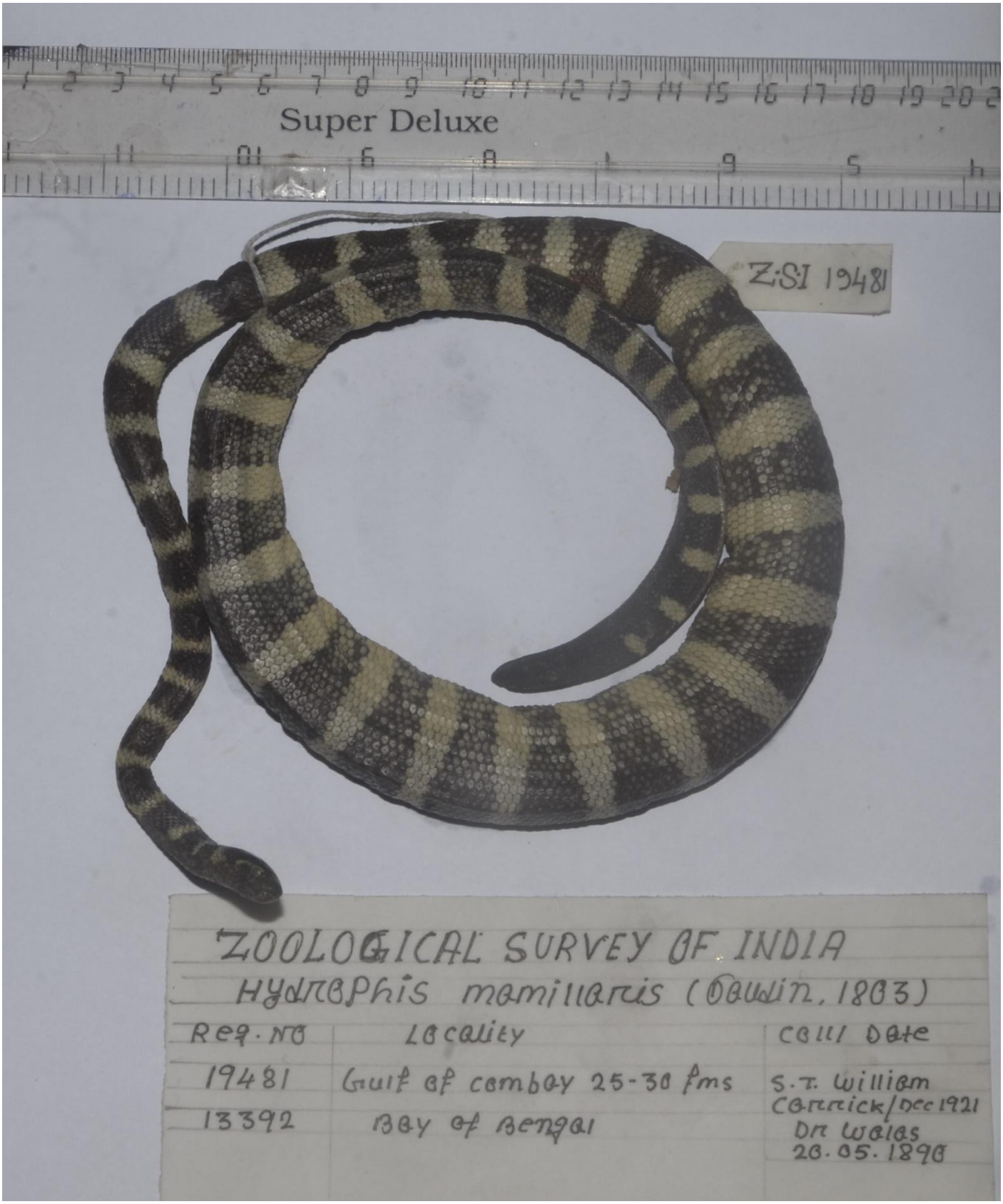

Figure-2*:* *Hydrophis mamillaris* (ZSI specimen Photo credits: Sonia Mondal).

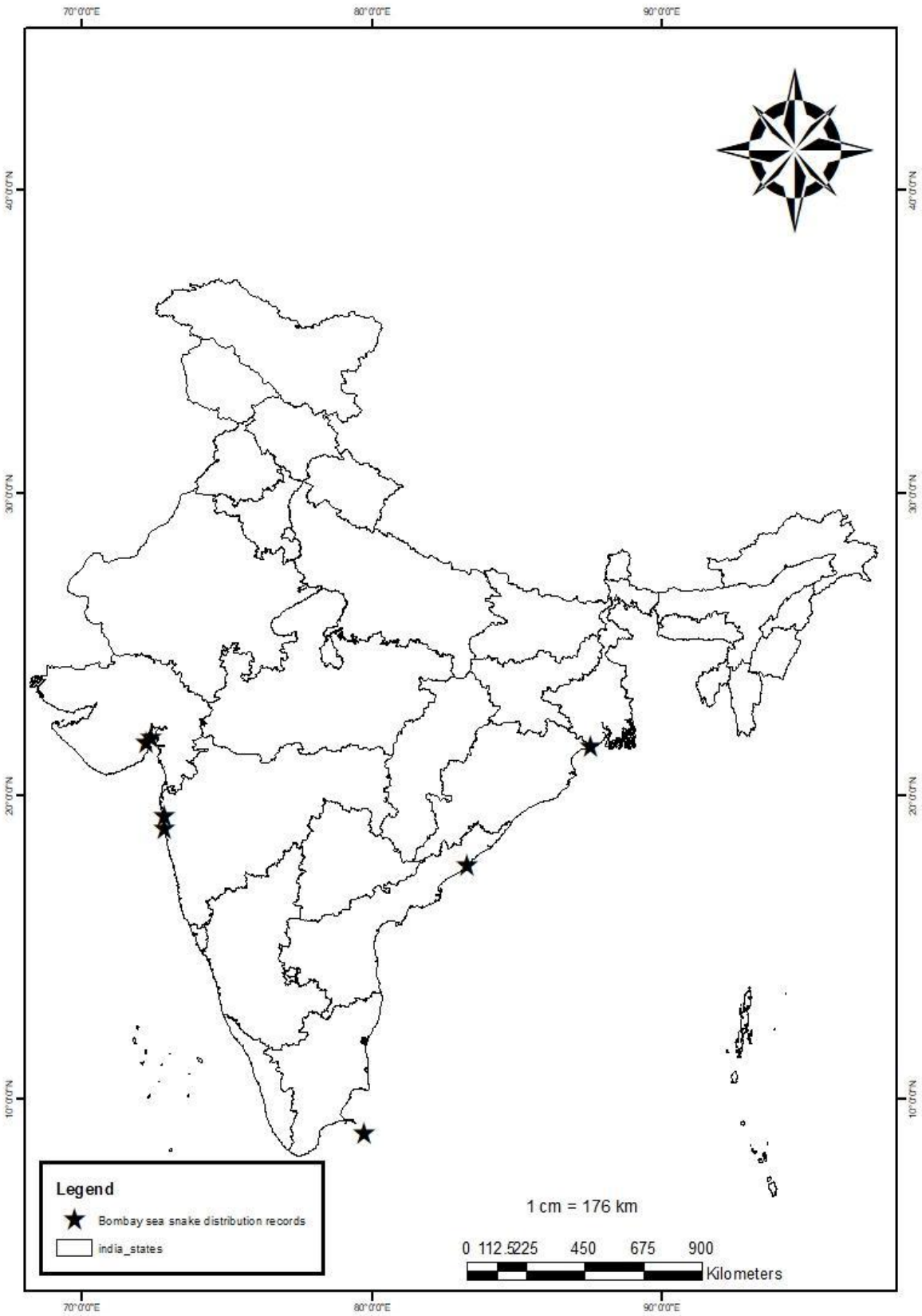

Figure-3*:* Distribution of *Hydrophis mamillaris*, Daudin (1803) in India.

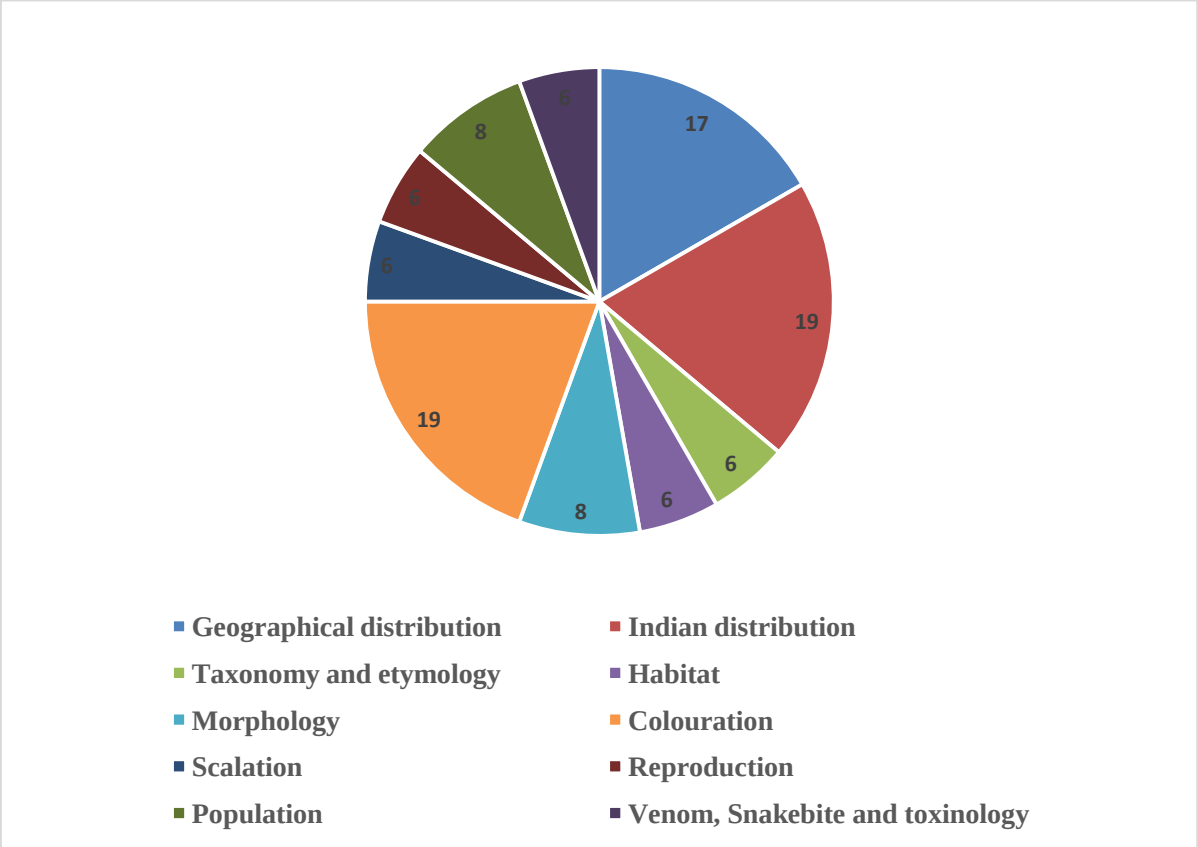

Figure-4*:* Proportions of different areas of study from past research papers on *Hydrophis mamillaris*.

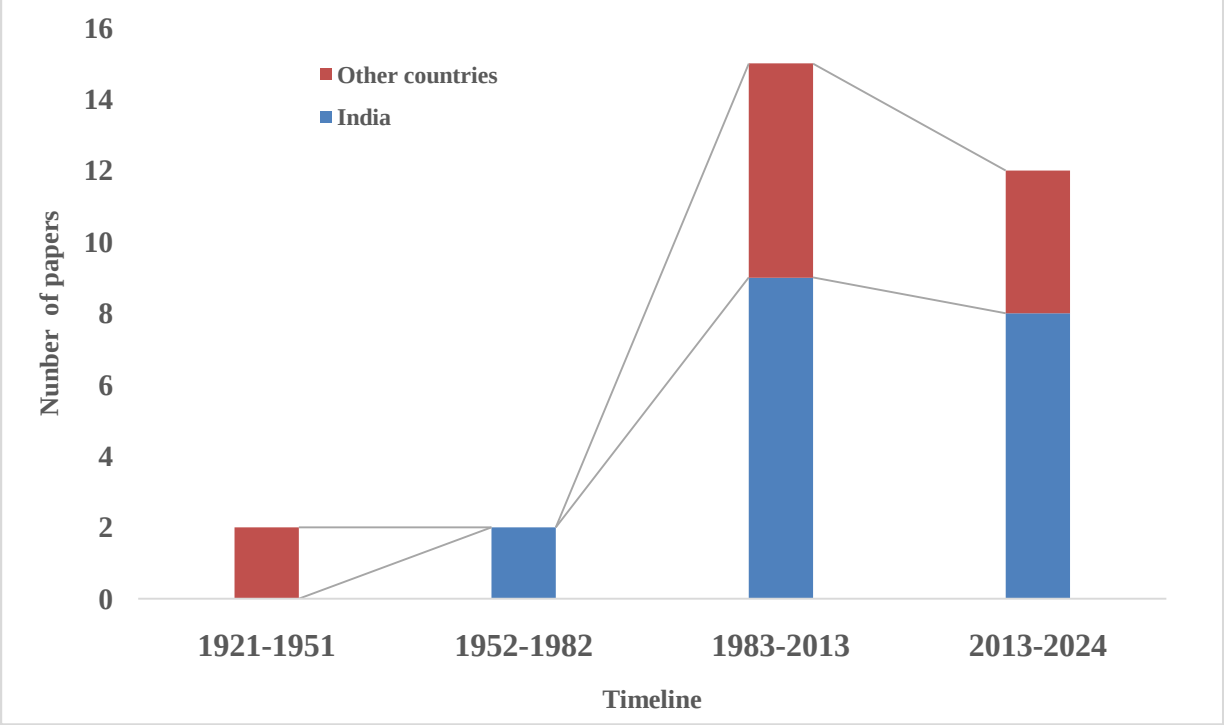

Figure-5*:* Literature published with mentions of *Hydrophis mamillaris* since its discovery in 1921 to 2024.

Conclusion

Hydrophis mamillaris is an understudied and rarely surveyed species, characterized by limited records and an uncertain type specimen. The paper provides a comprehensive overview of the current knowledge of this species's taxonomy, morphology, distribution, ecology, and venom. Since no specimens were collected post its discovery, there is still much to learn about its ecology, population dynamics, and interactions with other marine species. The last specimen was collected by Humayun Abdulali on 01.07.1917 in Kihim, Alibaug, Raigad district, Maharashtra[24]. The research conducted thus far has provided valuable insights into this elusive creature's distribution and research gaps. This review paper highlights the current knowledge of *H. Mammilaris*, a venomous sea snake native to the coastal waters of the Indian Ocean. The Bombay Gulf Sea snake remains a mystery, with insufficient data to determine its current status.

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