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REVIEW ARTICLE

A Comprehensive Review on the Status, Distribution, and Threats of Striped Hyena (*Hyaena hyaena* Linnaeus, 1758) in India

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ABSTRACT
The Striped Hyena (Hyaena hyaena Linnaeus, 1758) is a unique and fascinating species found in India. It is a medium-sized carnivore that plays an important ecological role in maintaining the balance of the ecosystem. Despite its significance, the status and distribution of the Striped Hyena in India have not been comprehensively studied. This review paper targets to provide a comprehensive information of the Striped Hyena's status, distribution, and threats in India. The paper is divided into seven main sections: Introduction to Striped Hyena, Status and Distribution of Striped Hyena in India, Diet and Foraging behavior, breeding biology, Threats to Striped Hyena in India, Conservation Measures for Striped Hyena in India, and Future Directions for Striped Hyena Research in India. Each segment provides a comprehensive analysis of the topic, including the current distribution, population size and trend, breeding biology, major threats, conservation measures, research gaps, and future directions. By providing a comprehensive overview of the Striped Hyena in India, the purpose of this paper is to increase awareness and promote effective conservation strategies for this important species.

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INTRODUCTION

The Striped Hyena (*Hyaena hyaena*) is a large-bodied scavenger that is found in a wide range of environments, including open savannahs, grass and woodlands, and arid, mountainous areas. It is a facultative nocturnal animal, and occurs mostly in open habitats within arid to semi-arid environments [15,19]. They are the only existing species in the genus *Hyaena* [9]. The species is native to North Africa, the Middle East, and Western Asia. Both male and female Striped Hyenas are similar in appearance, with males being slightly larger and heavier. Striped hyenas have tan fur with vertical black stripes along their body and legs, and a long tress running along the whole of their spine, ending in a thick, bushy tail [18,19]. With its lengthy, black nose and wide, pointed ears, the Striped Hyena resembles a dog. It has a sloping build, strong and shorter hind legs and a robust neck. Their front legs are longer than their back legs, similar to spotted hyenas, allowing them to move with a loping gait that conserves energy while covering vast distances in pursuit of food [43]. The Striped Hyena is a scavenger and generalist predator that preys on goats, sheep, dogs, and birds. It is also a creature that has been known to scavenge larger animals and is occasionally accused of killing livestock. The majority of striped hyena assaults take place in areas with low densities; however, a sizable number also happen in Egypt, Ethiopia, India, Iraq, and Morocco. The largest striped hyenas are found in the Middle East, Asia Minor, Central Asia, and the Indian subcontinent, whereas those from East Africa and the Arabian Peninsula are smaller than those from other areas [9]. Striped hyenas are regionally diverse creatures.

Habitat: Deserts, semi-deserts, woodlands, scrub forests, acacia bushlands, grasslands, tropical savannas, and rocky terrains are the typical habitats for these species. Usually found in Africa, West India, the Middle East, and the Arabian Peninsula. It is known that the family groups live in dens, which

are often caverns with small entrances. Large boulders are also seen in these caverns. The burrows where these creatures' dwell in families can extend over a four to five-meter space.

Distribution of Striped Hyena found in India

India, especially the Indian subcontinent and Central and South Asia, are home to the Striped Hyena [9,26]. Updates on the Striped Hyena's distribution throughout its range, including India, is being continued. The south area of the Damodar River is the last remaining refuge for striped hyenas in West Bengal, India, as their current range has been drastically reduced. Historically, Bengal was the name given to the region that comprised all of Bangladesh and West Bengal, India, up to the southern tributaries of the Brahmaputra River [26]. Striped hyenas can be found throughout India in places like Sariska Tiger Reserve, Velavadar National Park, Panna National Park, and Jhalana near Jaipur [44]. These animals can be found in open, semi-arid areas of India [42]. The historical sightings of the striped hyena in Bengal, and they are accompanied with observational guidelines. The Indian Subcontinent, which encompasses several regions of North India, represents the striped hyena's current distribution in India [26,44].

Fact about the Striped Hyenas

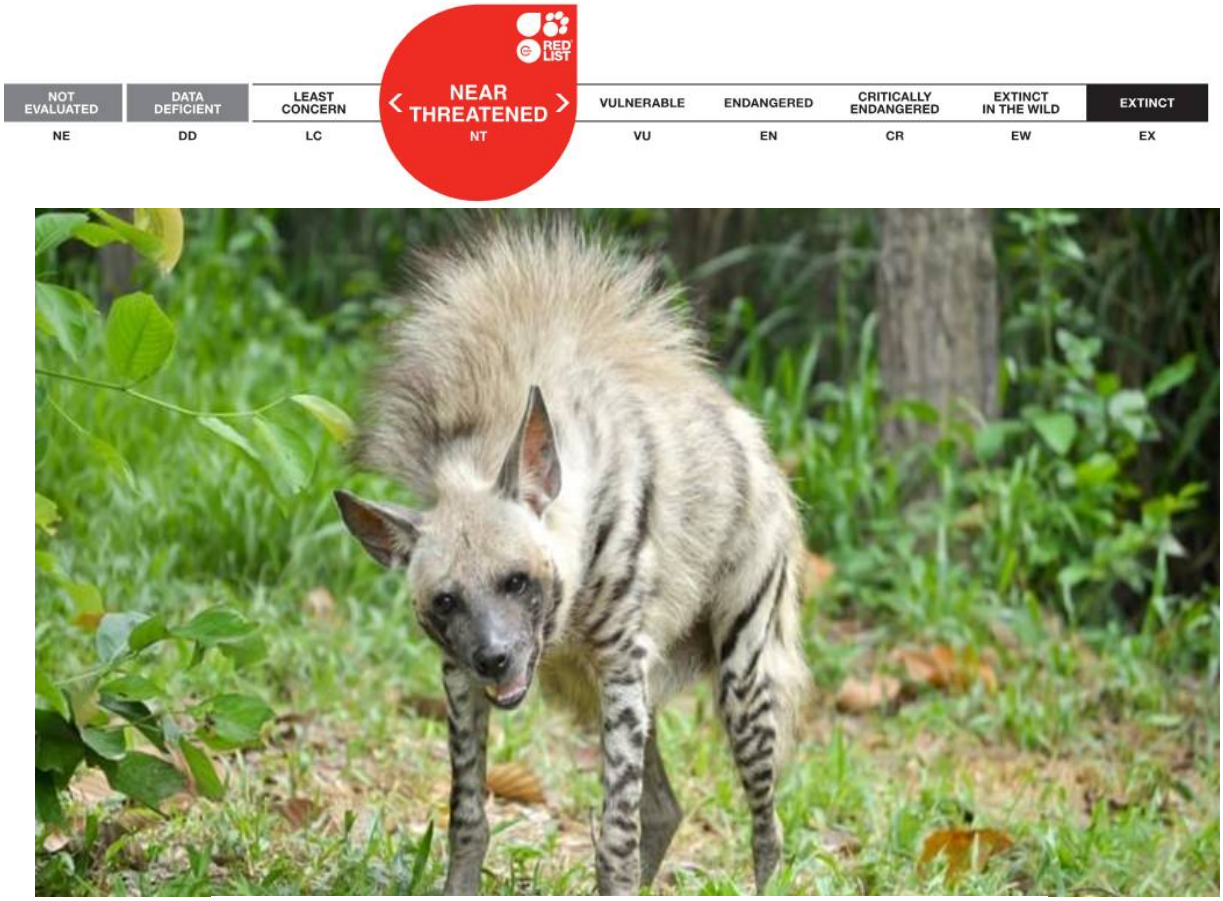

Fig.1 Striped Hyena (Source: © Dr. Meet Poddar/Shutterstock.com)

Scientific Classification

Kingdom- Animalia
Phylum- Chordata
Class- Mammalia
Order- Carnivora
Family- Hyaenidae
Genus- *Hyaena*
Scientific Name- *Hyaena hyaena*

Type: Mammal
Common Name: Striped Hyena
Location: Africa, West India, the Middle East, and the Arabian Peninsula
Group: Solitary or in pairs
Physical Characteristics: Their coat might be golden yellow, brown, or grey with black stripes on the

body and legs, but they have a completely black muzzle, ears, and throat. Along the back, a mane of long hair grows. The hyena's legs are its most distinctive trait; the front legs are substantially longer than the back legs. Hyenas' characteristic movement patterns, which give the impression that they are always limping uphill, are a result of this. Hyenas can easily run, trot, and walk due to their agility.
Skin Type: Fur
Top Speed: 5 mph
Lifespan: 24 years in captivity and 10-12 years in wild
Weight: 57 to 90 pounds
Height: 1 – 1.15 meters in length. Their tail measures about 12.5 inches
Age of Sexual Maturity: 2-3 years old
Age of Weaning: 8 months to 1 year
Prey: Small insects and small animals
Name of Young: Cub or pup
Group Behavior: Small families
Fun Fact: The striped hyenas usually mark their territories with the help of the scent gland secretions from their anal pouch.
Estimated Population Size: 5,000 to 14,000 worldwide and 1,000-3,000 in India
Biggest Threat: Habitat loss and human activities
Most Distinctive Feature: Stripes on their bodies
Gestation Period: 90-92 days
Litter Size: 2 to 4 cubs

Description of Striped Hyena in Mythologies and Cultures

Many African and Asian folklores dwelling a great deal of cultural value on the striped hyena. Villagers in Rajasthan call striped hyenas "the horses of witches". The striped hyena's prominence in these civilizations stem from its connection to witchcraft and dark magic. Witches are said to travel on the backs of these animals, consuming the souls of the deceased [26,44]. Some Arab tribes believe that striped hyenas are tomb robbers and witchcraft practitioners. Additionally, according to certain stories, striped hyenas are ferocious predators or have been touched by the devil. Striped hyena body parts are hunted after for healing and potency-increasing purposes in some traditional medical practices [26]. Sadly, social culture has transformed the animal into a monster despised by people, frequently demonized in films as cunning, evil sidekicks to renegade lions [44]. The striped hyena, despite being portrayed negatively in numerous mythologies and films, plays a crucial role in the ecology as a scavenger, keeping the surroundings safe and sanitary [42]. These mythologies do not acknowledge the ecological services provided by hyenas, their place in the food chain, or their intricate social structures [19].

Ecological role of Striped Hyena

Outside of national parks, the striped hyena's population is declining in India for a variety of reasons. The loss of habitat and food sources brought on by rising human activity, which has reduced their natural prey, is one of the main causes of their decline. As a result, they are now forced to compete for shelter with other predators, like leopards. Poaching has also contributed to their population's decline [29]. Although people viewed hyenas as scavengers, locals in the research area had good views of them and reported no conflicts or aggressive livestock predation. They are simple prey for residential trash in poultry farms, garbage dumps, and slaughterhouses. Hyenas can cohabit with people in a shared landscape, making them a low-risk species when compared to other large carnivores [29]. While striped hyenas are protected within conservation areas, their populations are still declining outside of these protected areas, underscoring the need for additional conservation measures to secure the survival of this significant species. [9].

STATUS AND DISTRIBUTION OF STRIPED HYENA IN INDIA

The striped hyena inhabits India's several states in diverse numbers. Zone 2's western portion, which is the easternmost point of the Chota Nagpur plateau, features open savannah systems that were created on highlands made of dry, lateritic, and red soil. However, there have been no reports of the striped hyena in the eastern portion of Zone 2, the Presidency Division, which extends farther west into the states of Odisha and Jharkhand. This is due to the Sundarbans, which hyenas have never called home, and the regions that have seen significant changes since the 1900s. However, the striped hyena can be found in the majority of West Bengal's southern regions. Consequently, it is implied that the distribution of striped hyenas is not uniform across India and varies regionally [26,9].

There has been diminutive study on the current distribution of striped hyenas in India, i.e. only West Bengal. In Bengal, primarily the state of West Bengal, India, the study looked into the historical and current distribution of striped hyenas [26]. The sole hyena species present in India is the striped hyena, and it lives in a variety of environments, including agricultural areas, deciduous woods, and dry, open scrub [17]. Hyenas' current home range in West Bengal has shrunk, and the region south of the Damodar River is now their only remaining haven in Bengal. In reality, striped hyena populations are dropping unevenly and at low levels across their habitat, including in India. There were just 15 recent recordings of the striped hyena in West Bengal between 2010 and 2021, according to the study, which compiled geo-referenced occurrence events of the animals in the area. Out of these cases, only two dealt with hyena encounters in the wild; the other 13 dealt with human-hyena conflict. The western portion of West Bengal (Midnapore Division) is the only region in Bengal where the striped hyena still lives, and all of these reported events took place in south of the Damodar River [26]. The text does not specifically address the present distribution of striped hyenas in India outside of the Bengal region, despite the fact that the striped hyena's distribution range has just been updated to include the Bengal region [26,9].

Population size and trend of Striped Hyena in India

Due to their nocturnal habits and the requirement for expensive equipment to observe them, estimating the striped hyena's population number and trend in India is a difficult operation. Currently, India's population of the species is being evaluated by the International Union for Conservation of Nature (IUCN). But outside of India and a few African nations, the population of striped hyenas is alarmingly low and, on the decline, [39]. Numerous factors contribute to this reduction, including the scarcity of food and human-related hunting activities [39]. In order to ensure their protection, it is critical to research and evaluate the population size and trend of striped hyenas in India and factors that have contributed to their population decline.

DIET AND FORAGING BEHAVIOR OF STRIPED HYAENA

Diet: As nocturnal omnivores, these creatures typically eat fruits, melons, dates, tiny insects, and small mammals. Typically, they are scavengers and eat the carcasses of dead animals. Their strong jaws are used to gnaw and break bones. The striped hyenas are well recognized for being active scavengers who spend more time scavenging than hunting. In addition, they can consume many kinds of water. They thrive in both fresh and salt water, as well as soda water. Striped hyenas drink water every night if it is available. They can, however, go for extended periods of time without water if necessary.

In India, the striped hyena consumes a wide variety of foods, including both plant and animal debris. According to studies, the striped hyena mostly eats larger mammals, insects, reptiles, and rodents. Various plant species' fruits and seeds are also consumed [2]. Scavengers by nature, this omnivorous species has adapted to the Rajasthan region of India's human-dominated landscape. The striped hyena has been seen to adapt to feeding on human waste disposal and to gain from it. In India, protected areas have been the main setting for studies on the striped hyena diet. The species that the striped hyena primarily consumes depend on the number of those species in the area. The striped hyena can also eat almost any organic material, even decomposing human carrion, and it has no preference for any particular species of prey [18]. Indian striped hyenas eat small mammals, birds, insects, and plants as part of their diet. The striped hyena's diet consists primarily (56.54%) of livestock, including cows, buffaloes, sheep, camels, and dogs, whereas domestic prey makes up 20.94% of its diet. In India, wild prey made up 63.91% of the diet of striped hyenas, while plant material and insects made up 9.92% and 1.93%, respectively and Shannon-Weiner Index (H), the striped hyena's diet diversity was 2.64 [2]. The majority of their food species depended on the local availability of available prey, and the striped hyena's diet variety, as determined by the Shannon-Weiner Index (H), was 3.28 [18].

Foraging behavior of Striped Hyena in India &other parts of the world

In several semi-arid and dry areas of the world, including the Indian subcontinent [40], the striped hyaena (*Hyaena hyaena*) is a huge carnivore. The population structure and diet of the species were investigated using data collected from the observation of nine hyaenas in the study region of West Bengal (India) [13]. It was discovered that the diets of adult and young hyaenas were largely the same [2]. The study area also included a variety of ecosystems, from semi-arid to arid regions [14]. The habitats also reflected a variety of landscapes, which allowed the researchers to examine how the striped hyaena foraged in relation to its surrounding environment [13]. The striped hyaena was shown to have distinct habitat preferences compared to those found in other areas [21], which were also found to be associated with variations in the species' densities in other zones [1]. In order to analyse the overlap in niches between the two species, the habitat patch quality of the striped hyaena and the Indian grey wolf was also assessed [1]. The first comprehensive study, which was carried out to investigate the differences in food and foraging between males and females, included visual observations of nine hyaenas [8]. Finally, the habitat preferences and food patterns of the species revealed that the foraging behaviour of striped hyaenas in India differed from that in other areas of the world.

Factors that influence the diet and foraging behavior of Striped Hyena

The nutrition and foraging habits of *striped hyenas*, which differ from those of *spotted hyenas* [23], have been thoroughly examined in studies done in India [21,18]. Such studies have demonstrated that the presence of tigers have a negative impact on the quantity, length, and total eating time of striped hyenas [30]. The Striped Hyena and Indian Grey Wolf, both of which are threatened by habitat loss, prey shortages, and conflicts with humans [1]. An extensive study of the animal's nutrition and foraging habits have done in the semi-arid Gir National Park and Sanctuary [2, 8]. It has been shown that the striped hyena's diet consists of a variety of seasonal foods [18, 8]. In addition, it is known that striped hyenas live in the Caucasus, Central Asia, and the Indian subcontinent [40]. The distribution and population density of the animal have also been the main focuses of investigations carried out in India [13]. Therefore, further study is necessary to comprehend the foraging habits and food of the Indian striped hyena.

REPRODUCTIVE BREEDING BIOLOGY OF STRIPED HYENA IN INDIA & OTHER PARTS OF THE WORLD

India has contributed much less research on the striped hyaena's (*Hyaena hyaena*) reproductive cycle than other countries. East and North-east Africa, the Middle East, the Caucasus, Central Asia, and the Indian subcontinent are all home to the species [27]. It can live for 10 to 12 years in the wild [27] and studies have been shown to pick denning sites and others details like area, depth, height and temperature of den [22]. There is evidence that the species exists in the semi-arid region of western India, where it coexists with other animals, including striped hyenas and leopards [35]. Along with details on life-history variables including body size and reproduction rates, a density estimate for the striped hyaena has also been given [5]. A study sought to compare the reproductive biology of striped hyenas in India to that of other regions of the globe [5]. There were two districts included in the Indian state of West Bengal: Purulia and Bankura where wild animals found include tigers, leopards, sloth bears, wild dogs, Indian foxes, jackals, and striped hyenas [35]. In the semi-arid wilderness, the *striped hyaenas* can hunt nilgai, sambar, wild boar, and chital [18]. More frequently than in most other parts of the world, striped hyaenas can be seen in the south west Iran [7, 3]. The largest premolars among living carnivores belong to striped hyaenas [47]. The Indian subcontinent, Central Asia, and the Levant make up the striped hyaena's habitat range [40]. Spotted and striped hyaenas have similar reproductive biology [21]. According to the study, the striped hyaena's diet is dependent on the availability of large wild prey, which in turn affects their reproductive biology [47]. Overall, the research has improved our knowledge of the reproductive biology of the striped hyaena in India [35].

Influence of environmental factors on the reproductive biology of striped hyaena in India

A native of the Old World, the striped hyena (*Hyaena hyaena*) has a large geographic range that extends from eastern and south-central Africa to India. The majority of research on food habits is done in India's protected regions, where they are located in arid and semiarid settings. The IUCN Red List of Threatened Species classifies these animals as Near Threatened, suggesting a diminishing population. Striped hyenas are primarily found in rural areas of India, where there are few people. They prefer open spaces with little vegetation. The availability of food, the presence of an appropriate habitat, and the accessibility of water are environmental factors that affect the reproductive biology of striped hyenas in India. These elements affect the size of the group, the success of mating, and the survival of the young. For instance, striped hyena populations in India may become less dense, leading to lower

social group sizes, which may have an impact on cooperative breeding populations' ability to reproduce [36]. Furthermore, the size of the group, the number of breeding females, and the success of reproduction can all be impacted by the availability of food supplies. A suitable habitat is also necessary for the survival of the progeny and the successful reproduction of the species. Last but not the least, striped hyenas depend on water supplies to survive. Consequently, it is crucial to study the environmental conditions in India that affect the reproductive biology of striped hyenas in order to conserve this species.

Social organization and Interactions of Striped Hyena in India compare to other parts of the world

The density of the striped hyena in various regions of India has been investigated. The major populations of striped hyenas per 100 km^2 are found in Kumbhakgarh and Esrana, with 6.5 and 3.7, mean number respectively. Striped hyena densities in the Sawai Mansingh Wildlife Sanctuary and Ranthambore Tiger Reserve are 5.5 and 12.0 per 100 km^2, respectively. Striped hyena densities range from 0.45/100 km^2 in Central India to 0.7/100 km^2 in Gir National Park in Gujarat. The social structure of the striped hyena is unknown, despite study on this species being done in India. The striped hyena forms close social relationships and coexist in groups over most of the world; thus, it is quite likely that its social structure is the same in India [26]. Hyena packs range in size from two to twenty animals, and the pack is led by an alpha male and alpha female. Usually the matriarch, or alpha female, is in charge of steering and defending the group. In contrast to other species, hyena groups are regarded as having a distinctive social structure because they are known to hunt together and make selections as a group.

Understanding the evolutionary growth of the hyaena family is crucial to comparing the social interactions of striped hyaenas in India to those in other parts of the world [40]. Comparatively speaking to other carnivores, *striped hyaenas* exhibit a distinctive social structure. Their distribution is used to determine their status globally [12]. They are found in Central Asia and the Indian subcontinent [40]. Pumas are less likely than striped hyenas to scavenge at dog carcasses [30], and interactions between these animals and dogs have been observed in peri-urban areas of India and other parts of Asia [11]. In various parts of the world, including India [4] and an administrative county [5], the *striped hyaena* and its range have been studied. A comparison of seven models within an information theoretical framework [12] demonstrates the social interactions of striped hyaenas in India in contrast to other regions of the world. Devils and hyenas have distinctive Eco morphologies. Additionally, striped hyaena habitats in India are thought to be open country [21], and their gregarious foraging behaviour may have an impact on striped hyaena acquisition [30].

Environmental factors influence the social structure and interactions of striped hyena

Studies have been conducted to determine how the environment affects the interactions and social organization of striped hyenas in India. The conservation of the species across its whole range could greatly benefit from such studies [33]. The study concentrated on two locations in India's Rajasthan State's Sawai Mansingh Wildlife Sanctuary (SMS WLS) [13]. Based on the various topographies and levels of anthropogenic disturbance, the sites were chosen. The study put forth theories on how topographic factors and livestock densities can affect hyena abundances. It was anticipated that hyena concentrations would be higher in locations with more livestock available. Hyena densities were also predicted to benefit from the availability of food in the form of animal corpses. Hyena concentrations were predicted to be higher at the location with a higher percentage of hyena denning refugia. The prediction that larger livestock densities maintain higher hyena numbers, however, was not supported by the study. Instead, a study revealed that denser hyena populations can survive on steep denning refugia [33]. This is so because the striped hyena tolerates human presence and is regarded as a low-risk species in India. This is primarily because of its scavenging behaviour, which enables it to easily eat domestic waste at slaughterhouses, landfills, livestock carcasses, and poultry farms. In addition, people in the agricultural landscape of Rajasthan reported no conflict and no livestock predation, and they had a favourable attitude towards hyenas [30]. This is primarily due to hyenas' tolerance for humans in the area [33], who clean up human organic waste and lower illness risk. Additionally, agriculture is the main source of income for the residents in the study area, and raising animals is a secondary source of income. Finally, ecological and anthropogenic variables support striped hyena persistence in the agricultural landscape of Rajasthan dominated by humans [30]. In order to achieve coexistence between humans and animals, the study highlights the need for more protected hyena refuges in dry regions [33] as well as the importance of people's favourable attitudes towards hyenas [30].

MAJOR THREATS TO STRIPED HYENA

Numerous threats exist for the striped hyena population in India, making it difficult for them to survive. One of the biggest obstacle is habitat loss brought on by an increase in human influence on the terrain, which is reducing hyena habitat across. Since the Striped Hyena is already endangered throughout its range in Asia and Africa, including India, this is highly concerning . Carnivores in India are also significantly impacted by growing tourism, human population growth near interface zones, and human-wildlife conflict. Although decreasing grasslands influence striped hyenas' distribution and biological requirements in the region, habitat degradation is a major concern for them in India. Another serious danger to the striped hyena is retaliatory massacres. Field surveys and regular surveillance have been carried out to determine the threats impacting the striped hyena population. The evaluation of dangers to the population of striped hyenas, focal group interviews with nearby populations were performed. A jackal was captured on camera trap footage following a Hyena cub, showing the direct and indirect factors driving the local Hyena population decline [38]. Since expanding roads and highways are leading to an increase in hyena sightings and accidents involving hyenas in India, the lack of information regarding hyena mortalities due to road accidents is also a concerning problem. In India, striped hyenas are seriously threatened by traffic collisions and accidents [41]. In order to analyse the current status of the hyena population, monitor the wellness of the remaining population, and determine the rate of habitat disturbance, a rapid assessment should have conducted. The purpose of the awareness of important conservation concerns pertaining to the area where wildlife and humans coexist is to know about the ecological importance of species. A suitable mitigation strategy should be offered to lessen the pressure on the current Hyena population in striped hyena prone areas [38].

Impact of habitat loss and fragmentation on the survival of Striped Hyena

A study in Israel's Central District explored how striped hyena behaviour is impacted by habitat loss and fragmentation. The study categorised the environment into different land-use classifications, including farmland, forest, riverine habitat, and scrubland using recent satellite shots. Through a reconnaissance survey, the extent of the hyena distribution in various land-use classes was determined. By using a camera-trap technique, to gather information about striped hyena detection in various types of landscape land use. Camera traps were set up with a minimum sensitivity value and placed 6-7m apart from the animal trail for full images [29]. Due to the fact that striped hyenas' behavioural states have been shown to alter depending on the kind of land cover, the investigation reveals that habitat loss and fragmentation may have an effect on their ability to survive. Multinomial logistic regression has been used in the study to calculate the likelihood that striped hyenas will exhibit each behavioural condition. The behaviour of male and female striped hyena was compared to the association between land cover and behaviour. The study focused on how anthropogenic disturbances affect striped hyenas' behaviour rather than whether they can survive directly [6,29]. More specifically, the study discovered that different types of land cover might affect how striped hyenas behave, indicating that habitat loss and fragmentation may be detrimental to their survival.

Impact of human-wildlife conflict on Striped Hyena

In some areas where they have become human commensals, striped hyenas are tolerated due to their pleasant demeanour and non-threatening behaviour towards people. Organic waste is produced by agricultural and industrial intensification in arid areas, which hyenas feed on. The rapid increase of hyena populations in India could be attributed to the rapidity of human development, including the establishment of new towns and cities, the expansion of roads and other infrastructure, and the extension of agricultural and forestry lands. With limited intra-specific concurrence since the leopard's disappearance, the hyena is now the largest carnivore in the country. Hyenas have access to an abundance of domestic prey because Bedouins let their livestock forage in semi-arid areas. However, it is necessary to ensure additional investigation [25] to determine whether hyenas' tolerance for humans has resulted in a decrease in the animal's perception of risk. One of the major causes of the striped hyena's habitat loss has been identified as human settlements. In addition, the striped hyena showed much less fragmentation than the grey wolf in suitable regions, suggesting that the latter might be more resistant to human disturbance. To reduce the negative effects of human-wildlife conflict on striped hyenas in India, the study recommends assigning priority to suitable patches and corridors for conservation and management [25]. Furthermore, habitat loss and an increase in carnivore-human conflicts have been linked to anthropogenic pressure in the semi-arid wildlands of India's West Bengal state.

CONSERVATION MEASURES FOR STRIPED HYENA IN INDIA

Identification of canid conservation units (CCUs) is a key step in achieving the conservation of the striped hyena in India. Distribution, diversity, ecosystems, and places with relatively low human population densities and poverty levels are just some of the criteria used to identify these units. The survival of the striped hyena population in India depends on CCUs, which are high-priority sites for conservation activities [16]. Conservationists can guarantee that the Indian striped hyena population is healthy and sustainable for years to come by concentrating on their locations. The efforts being made to preserve the striped hyena population in India through CCUs are a crucial step in safeguarding the biodiversity of the area. The protection of other species that share their habitats by conserving the striped hyena population, which is essential for protecting the ecosystem's equilibrium. Future generations can appreciate these amazing species in their native environments by maintaining conservation efforts and carefully managing their ecosystems.

Effect of conservation measures in protecting the Striped Hyena population

The Striped Hyena is a necessary species that helps to keep the ecosystem healthy by acting as pest management and preventing the spread of diseases. Concerns about the potential effects on the ecosystem are raised when the population of these animal's declines. Man-animal conflicts, poisoning, habitat loss, hunting, and poaching for body parts are the main hazards to this species in India. The Striped Hyena was added to Schedule III of the Wildlife Protection Act, of 1972 by the Indian government in order to provide some level of legal protection for these species. In order to ensure their existence and stop them from going extinct, this species' conservation effort require additional resources and funds. To help protect the habitats and range of Striped Hyenas, organizations like Safari West have teamed up with conservation partners like the Sahara Conservation Fund and the Ruaha Carnivore Project in Tanzania [44,45]. To determine how well conservation efforts are succeeding in protecting the Striped Hyena population, more study is required.

The challenges and limitations of implementing conservation measures for Striped Hyena

Implementing conservation actions for Striped Hyenas in India confronts difficulties and restrictions, even though they are listed by the IUCN as "near threatened" [39,46]. Due to the hyena's Schedule III classification, little research has been done on it and no official estimate of its population exists. In India, the Striped Hyena faces a serious problem with habitat loss, particularly in relation to denning locations, which could result in population reduction. Hyenas have special characteristics that make them difficult to study. For example, because they are primarily nocturnal, expensive equipment is needed to observe them. Since it is not a specified animal, the government has not set aside much money for its conservation. Additionally, there aren't many people in India who work on hyena conservation, and the species is frequently ignored. Finding a suitable environment for the Striped Hyena is difficult since it requires particular breeding locations, such as rocky dens, thickets, or Himalayan slopes [39]. In addition, breeding striped hyenas effectively in captivity is difficult. Attempts at captive breeding have been hindered by mother Striped Hyenas killing their litters after turning hostile. There have been difficulties in the captive breeding programs for Striped Hyenas [46]. The least that can be done to ensure their conservation, given all these difficulties and restrictions, is to map their distribution. To preserve this top predator in India from the Carnivora order and the Hyaenidae family, scientists must develop more tangible remedies.

FUTURE DIRECTIONS FOR STRIPED HYENA RESEARCH AND CONSERVATION

Although striped hyenas are widely dispersed throughout India, not much is known about their fundamental biology and feeding preferences [28,31]. The majority of dietary studies have mostly concentrated on protected areas without looking at how much wild or domestic prey is consumed in anthropogenic situations [31]. Natural marking identification can be integrated with other methods, including scat analysis, to create unique datasets that potentially fill in some of the knowledge gaps about Indian striped hyenas. Due to their low density and nocturnal habits, striped hyenas are challenging to locate. Residents in places where they are allegedly present can be photographed using techniques like camera traps. The density, area utilisation, movement, and activity patterns of striped hyenas in India could be evaluated if adequate data could be gathered using video traps. However, there is still a lack of understanding about the fundamental biology of striped hyenas in India, especially given that their population lives in dense forests and challenging terrain there [28]. More research is required to bridge this information gap.

(i) Future directions for Striped Hyena conservation in India

There are currently 5,000 striped hyenas living in the wild worldwide, and this number has been rapidly and dramatically declining over the past 20 years. The Parvathipuram forest area, Chodavaram,

and Devarapalle are the major striped hyena hotspots in India. However, the document says nothing about how to conserve the striped hyena in the country in the future. There is a need for rapid conservation actions to protect the striped hyena species because their wild population is in decline [46]. It is critical to pinpoint the precise problems facing the Indian striped hyena population and to create conservation plans that take these threats into account. These strategies may consist of habitat restoration, community education initiatives, captive breeding initiatives, and stringent anti-poaching legislation enforcement. Many observations provide a thorough analysis of the Striped Hyena's condition, geographic range, and threats in India. According to the study, the Striped Hyena lives in a variety of habitats, including open savannahs, grasslands, wooded areas, and desert highland regions. It is a generalist predator and scavenger. The important ecological factors that affect striped hyena numbers in India, such as food availability and access to refugees in the form of steep hills. The striped hyena's diminishing wild population, which is seriously threatened by habitat degradation and retaliatory killings. The IUCN Red List classifies this species as being near Threatened, and the research findings can assist in leading conservation efforts for it. Therefore, more investigation is required to identify particular threats to the striped hyena population in India and create efficient conservation plans to counteract these concerns. Government organizations, conservation groups, and local populations must work together to save the striped hyena population in India. Striped hyenas can serve as a flagship species for raising India's conservation potential and highlighting the significance of developing more protected hyena refugia across dry regions as a crucial conservation need. There is a urgent need for conservation efforts to protect the Striped Hyena in India and offers insightful information on its ecology and conservation.

(ii) Contribution of research findings in the conservation of Striped Hyena in India

Due to persecution, habitat loss, and loss of prey made worse by game hunting, the striped hyena population in India is in danger of going extinct silently. However, new information gained from research about the hyena's present and past range in India may lead to initiatives that help the species be conserved, like the recent systematic survey on the striped hyena in West Bengal by the Zoological Survey of India. When examining the conservation status of hyenas in India, it is imperative to take historical neglect into account. The most common historical accounts about game mammals on the Indian subcontinent do not include striped hyenas [26]. Consequently, using historical, verified local records can enhance range maps and contribute to hyena and other wildlife conservation measures. Indian striped hyenas reside in a habitat at the Sawai Mansingh Wildlife Sanctuary, and research findings can be used to investigate how human-dominated landscapes affect striped hyena conservation [29]. Higher hyena numbers can be sustained in denning refugia in mountainous terrain, according to research, which may be crucial for the species' conservation across its whole range. In addition, food accessibility and the availability of shelter in the form of rocky, steep terrain are the main ecological factors affecting striped hyena numbers in India. Another important discovery is that higher hyena densities do not always correspond to increased livestock densities. This knowledge can guide attempts to conserve the species [34]. The conservation understanding of this particular species by using the generalised linear model to assess the environmental and human-caused factors influencing striped hyena utilisation on-site [29]. Hyena densities can be higher in protected areas with restrictions on human use. Therefore, a crucial conservation need indicated by this study [34] is the need to increase protected hyena shelter throughout arid regions. The IUCN Red List classifies the striped hyena as a Near Threatened species, and studies on densities in India can assist in guiding conservation efforts for this species. Additionally, striped hyenas have the ability to increase India's conservation potential [29,16].

CONCLUSION

The unique markings of Striped Hyena are indispensable in ongoing research and have greatly enhanced our understanding of the species. We have highlighted numerous interesting studies that represent this, but this is by no means a comprehensive review of the literature made on individual identification of Striped Hyena. The review article may be useful regarding the information about the Striped Hyena including distribution, population, mythology, morphology, behavior, ecology, threats and conservational management. It is concluded that field surveys and verifications are needed to provide rational data on the current status of the Striped Hyena. Striped Hyena is known for its coexistence with human vicinity and adaptive nature, factors responsible for its extended and cherished association with the masses in India. The diverse culture and religions of India as well in other parts of world has valued the absolute charisma, negative image as horse of witches of the Striped Hyena. Conservation of the Striped Hyena is important ecologically and ethically.

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CONFLICT OF INTEREST
On behalf of all authors, the corresponding author states that there is no conflict of interest.

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