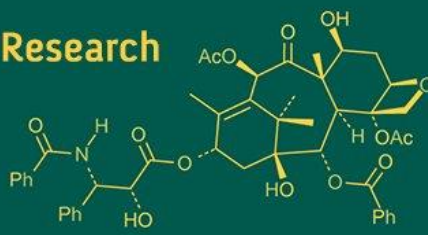


## International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693  
 ISSN Online: 2617-4707  
 NAAS Rating (2026): 5.29  
 IJABR 2026; 10(8): 389-396  
[www.biochemjournal.com](http://www.biochemjournal.com)  
 Received: 09-06-2026  
 Accepted: 12-07-2026

Names and their affiliations are given below the references.

## Apex predators and Avian Scavengers (*Panthera tigris*, *Panthera pardus*, *Acinonyx jubatus* and *Gyps* species) of Madhya Pradesh state in India

SD Audarya, R Sharma, Y Chatur, AK Niranjana, K Walwadkar, R Sikrodia, R Gangil, AK Jha, B Dixit and A Tewari

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i8e.9570>

### Abstract

The state of Madhya Pradesh in India is often recognised as the "Tiger State" of India. Subsequently, it has evolved into a global megafauna epicentre for conservation. The state is endowed with a unique geography for biodiversity conservation. Indian independence followed by habitat fragmentation, localised extinctions and reintroduction of wildlife species in the context of bioconservation in the state. The present paper discusses the current status of the following "Four Ace" species found in Madhya Pradesh state, along with their general as well as unique features: 1) the Tiger (*Panthera tigris*), 2) the Leopard (*Panthera pardus*), 3) the Vulture (*Gyps* species) and 4) the Cheetah (*Acinonyx jubatus*).

**Keywords:** Tiger, Leopard, Vulture, Cheetah, Madhya Pradesh, India

### Introduction

The state of Madhya Pradesh in India is the heartland of the Indian subcontinent due to its unique geographical position. Mother Nature has bestowed the state with a forest covering vast plateaus and river basins. These vast landscapes serve as a significant corridor for wildlife movements. In recent years, the state has moved from traditional preservation to active, high-stakes conservation ecology. The status of the Tiger as an apex predator, like the Leopard, the Vulture as a vital scavenger and the Cheetah as a re-established ecological outlier form what is now termed the "Four Ace" species of Madhya Pradesh's bioconservation strategy. Madhya Pradesh tops the country in terms of forest area. Wildlife has several aspects of value, such as a) commercial, b) biological, c) recreational and game, d) scientific and educational, e) aesthetic, f) social and ethical, as well as e) negative values too. Wildlife distribution is found in three important systems in India: The Himalayan mountainous, the Peninsular Indian sub-region and the Tropical evergreen forest systems<sup>[1]</sup>. In this paper, the progress in bioconservation of the "Four Ace" species in Madhya Pradesh, as well as their unique features, will be presented to spark curiosity and interest amongst readers, promoting a deeper understanding of these species.

### Post Independence

After independence, India experienced a dual path regarding wildlife: initial decadal losses of habitat and hunting for medals, followed by the maturation of legislative protection in the form of the Wildlife (Protection) Act of 1972. Madhya Pradesh, situated on the central Indian plateau, has been the epicentre of this shift (Fig 1). The state's unique physiography—with extensive dry deciduous forests and protected core areas—has allowed the survival and resurgence of the Tigers (Bengal), maintenance of the Leopards, the stabilisation of the Vulture colonies and the extraordinary, high-stakes reintroduction of the Cheetah (African) into Kuno National Park (KNP)<sup>[2]</sup>. Fig 2 to Fig 5 present identifying photographs of these species along with their numbers/population in India and the Madhya Pradesh state.

**Corresponding Author:**  
 SD Audarya  
 Associate Professor,  
 Department of Veterinary  
 Microbiology, College of  
 Veterinary Science and Animal  
 Husbandry, Nanaji Deshmukh  
 Veterinary Science University,  
 Kuthuliya, Rewa, Madhya  
 Pradesh, India

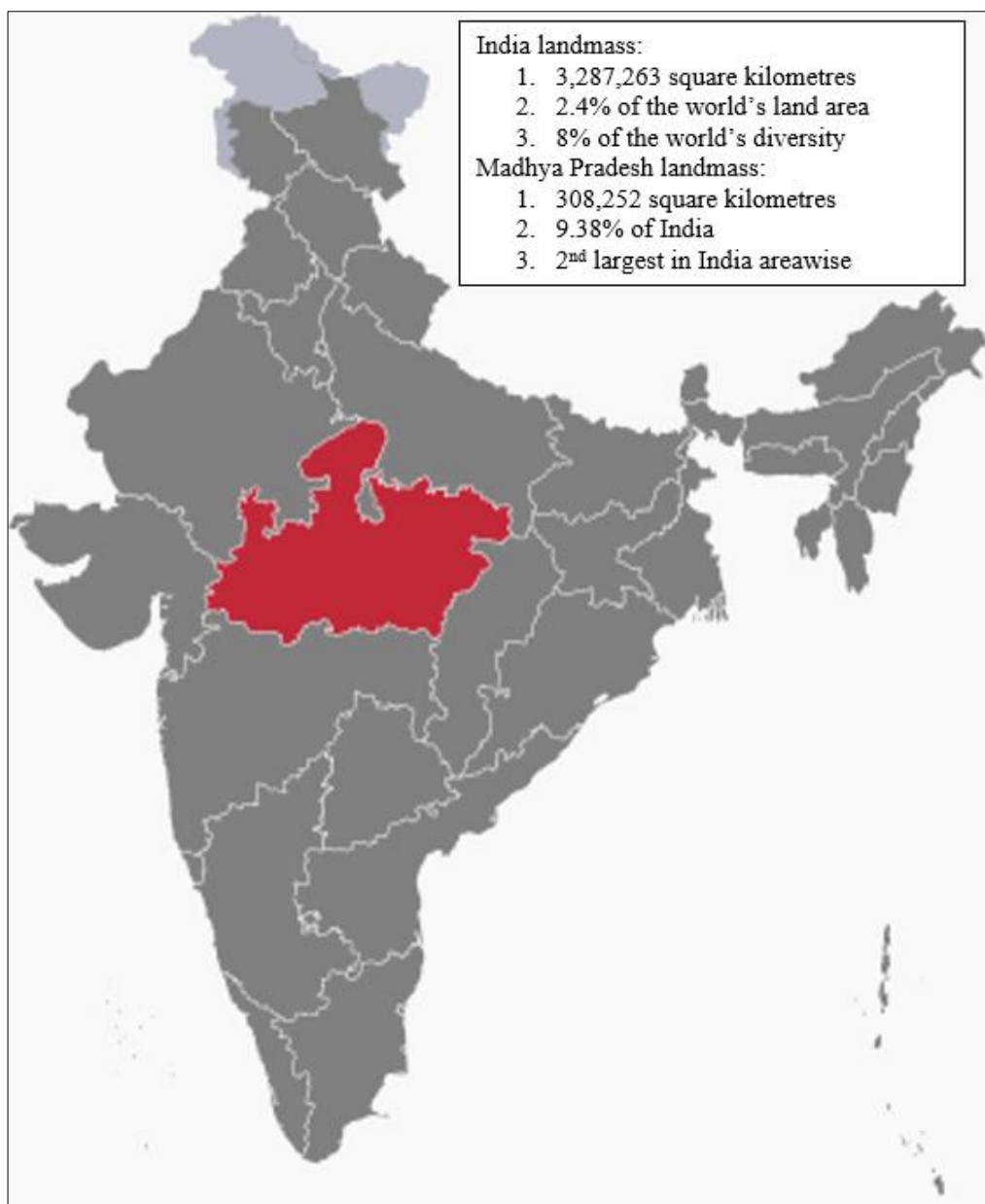
### Comparative Analysis

Ecological functions of “Four Ace” species, the Tiger, the Leopard, the Vulture and the Cheetah and primary threats to them in the Indian state of Madhya Pradesh, along with conservation status, are presented (Table 1). The two carnivore species (the Tigers and the Leopards) sit at the top of the ecological pyramid as apex or near-apex predators.

The vultures clean up biological waste in jungles. The Cheetahs are adapted for running and grasslands. Conservation status declared by the International Union for Conservation of Nature (IUCN) for the Tiger as endangered (E), critically endangered (CE) for the vultures and vulnerable (V) for the Leopards and the Cheetahs. Features of these species are presented in Table 2.

**Table 1:** Comparative analysis of wildlife species

| Species               | Ecological function         | Primary threat                |
|-----------------------|-----------------------------|-------------------------------|
| Tiger <sup>E</sup>    | Apex predation              | Habitat destruction           |
| Leopard <sup>V</sup>  | Apex or near apex predation | Vehicular collisions          |
| Vulture <sup>CE</sup> | Scavenging/Sanitation       | Veterinary drugs (Diclofenac) |
| Cheetah <sup>V</sup>  | Grassland and Cursorial     | Adaptation/Prey density       |



([https://en.wikipedia.org/wiki/Madhya\\_Pradesh#/media/File:IN-MP.svg](https://en.wikipedia.org/wiki/Madhya_Pradesh#/media/File:IN-MP.svg))

**Fig 1:** Position of Madhya Pradesh in India

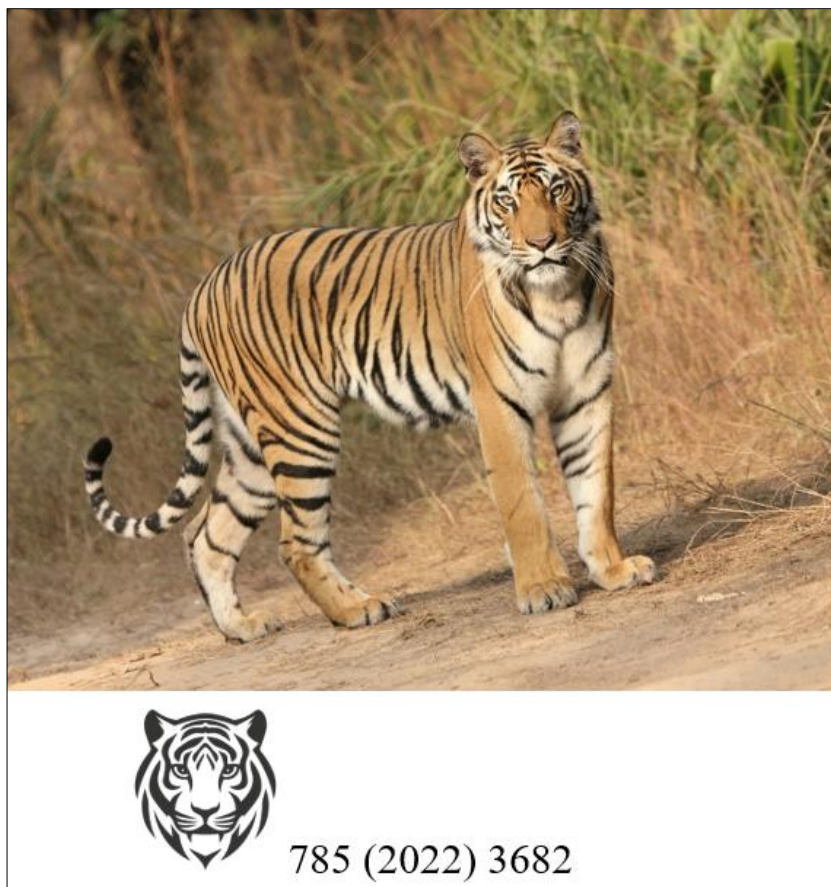


**Fig 2:** Tiger identified by bodily stripes (Photo by Lakshmi Narasimha on Unsplash)

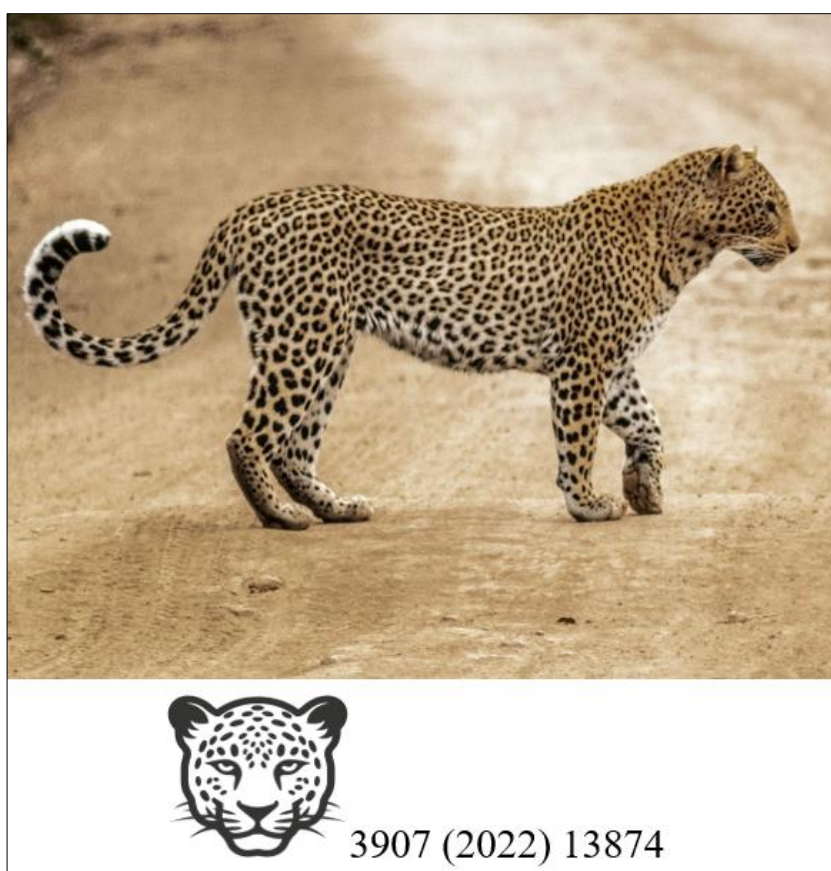


**Fig 3:** Leopard recognized by its body circles (Photo by Rajit Galaiya on Unsplash)

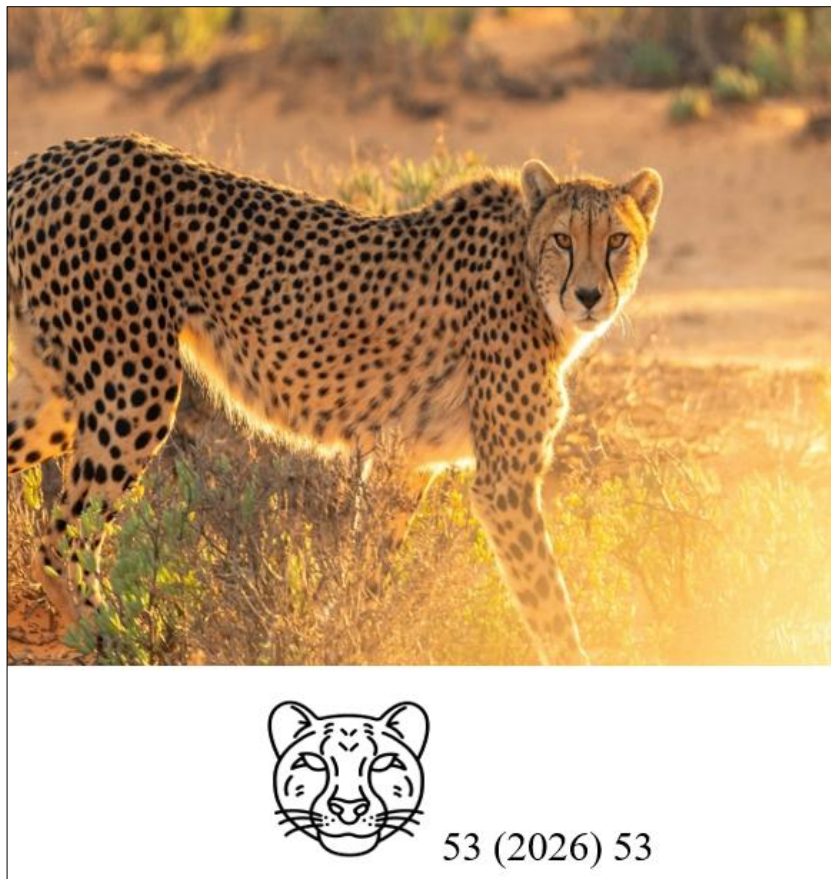
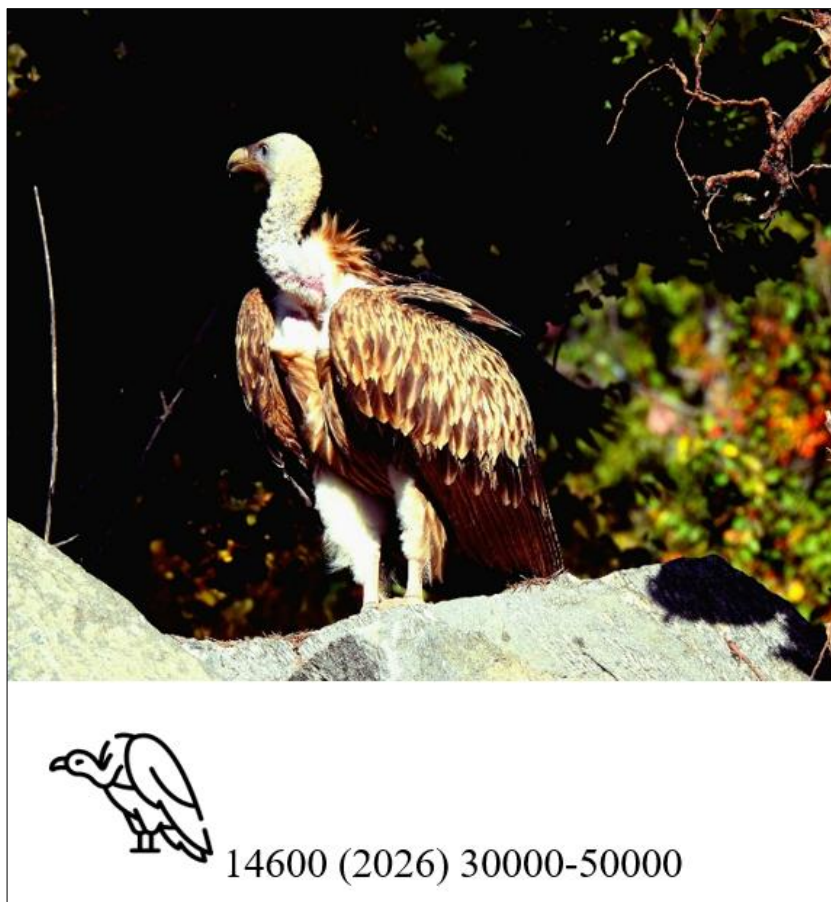


**Fig 4:** Cheetah's distinctive black eye lines (Photo by David Groves on Unsplash)



**Note:** Numbers represented are for: Madhya Pradesh (Year) India

**Fig 5:** Vulture with hairless neck (Photo by Harish Bharti on Unsplash)

**Table 2:** Features of wildlife species

|                                          | <b>Tiger</b>                                                | <b>Leopard</b>                              | <b>Vulture</b>                                                  | <b>Cheetah</b>                         |
|------------------------------------------|-------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------|----------------------------------------|
| Kingdom                                  | Animalia                                                    | Animalia                                    | Animalia                                                        | Animalia                               |
| Phylum                                   | Chordata                                                    | Chordata                                    | Chordata                                                        | Chordata                               |
| Class                                    | Mammalia                                                    | Mammalia                                    | Aves                                                            | Mammalia                               |
| Order                                    | Carnivora                                                   | Carnivora                                   | Accipitriformes Cathartiformes                                  | Carnivora                              |
| Family                                   | <i>Felidae</i>                                              | <i>Felidae</i>                              | Old world: <i>Accipitridae</i><br>New world: <i>Cathartidae</i> | <i>Felidae</i>                         |
| Genus                                    | <i>Panthera</i> sp.                                         | <i>Panthera</i> sp.                         | <i>Gyps</i> sp., 13 others                                      | <i>Acinonyx</i> sp.                    |
| Term origin                              | Greek                                                       | Greek                                       | Latin                                                           | Sanskrit                               |
| Weight (Kg)                              |                                                             |                                             |                                                                 |                                        |
| Male                                     | 100-261                                                     | 37-90                                       | 12                                                              | 21-72                                  |
| Female                                   | 75-177                                                      | 28-60                                       |                                                                 |                                        |
| Body Length (Feet)                       |                                                             |                                             |                                                                 |                                        |
| Male                                     | 6.2-10                                                      | 3-6.3                                       | 1.8-4.6                                                         | 3.93 - 4.92                            |
| Female                                   | 4.79-5.81                                                   |                                             |                                                                 |                                        |
| Wingspan (Feet)                          |                                                             |                                             | 5-8                                                             |                                        |
| Identified/Recognised Subspecies/Species | 2                                                           | 8                                           | 23                                                              | 4                                      |
| Gestation Period (Days)                  | 103-106                                                     | 90-106                                      |                                                                 | 90-98                                  |
| Egg incubation period (Days)             |                                                             |                                             | 30-68                                                           |                                        |
| Litter Size/Clutch (Average)             | 2-3 cubs                                                    | 1-3 cubs                                    | 1 chick                                                         | 3-4 cubs                               |
| Lifespan (Years)                         |                                                             |                                             |                                                                 |                                        |
| Wild                                     | 12-16                                                       | 12-15                                       | 18-50 for large sp.                                             | 8-12                                   |
| Captivity                                |                                                             |                                             |                                                                 | 12-20                                  |
| Sociability                              | Solitary                                                    | Solitary                                    | Solitary as well as form groups depending on sp.                | Solitary (Female)<br>In groups (Males) |
| Active                                   | Nocturnal (During night),<br>Crepuscular (At dawn and dusk) | Nocturnal                                   | Diurnal (During the day)                                        | Diurnal                                |
| Groups                                   | Ambush, Streak                                              | Leap, Prowl                                 | Kettle in sky, Committee on ground or trees, Wake while feeding | Coalitions                             |
| Sounds                                   | Roars, Growls, Chuffs, Moans                                | Sawing, Growls, Meow, Snarls, Purrs, Hisses | Hisses, Cackles, Croaks, Grunts                                 | Chirps, Purrs, Barks, Growls, Hisses   |
| World population                         | 5,578                                                       | 50,000-1 lakh                               | 20 to 30 lakhs                                                  | 6,500-7,100                            |
| Chromosome number, 2n                    | 38                                                          | 38                                          | Typically, 80, Vary                                             | 38                                     |

The state of Madhya Pradesh in India counted only 257 tigers in the year 2010, but in 2023 their numbers increased to 785, claiming its status as the Tiger state of India. Madhya Pradesh tops in India with 9 Tiger Reserves, namely Kanha, Bandhavgarh, Pench, Satpura, Panna, Sanjay-Dubri, Ratapani, Veerangna Durgavati and Madhav. The Bandhavgarh Tiger Reserve recorded one of the highest Tiger densities in the country. Kanha Tiger Reserve landscapes inspired Rudyard Kipling, the author of The Jungle Book. The Pench Tiger Reserve boasts a living habitat for wild canines and felines. Panna Tiger Reserve (PTR) has now restored its Tiger status to a stable one. Veerangna Durgavati, Ratapani and Madhav are new additions to the Tiger Reserves of the State. Unique features of the bodily parts of striped tigers are discussed below. Tigers have up to 10 cm long retractable claws in their front paws. These retractable claws remain hidden when the animal is not preying to maintain sharpness and effectiveness. Tigers have a robust skull with a bony ridge (the sagittal crest). The sagittal crest provides anchorage for powerful jaw muscles, enabling them to make a lethal and impactful bite force on their prey. The presence of dark

vertical stripes helps them to camouflage in the forests and tall grasslands. Tiger stripes are identical to fingerprints in such a way that no two tigers have identical stripe patterns. A white spot at the back of dark ears makes an illusion of watching eyes. This resists predators from attacking Tigers from behind. Tigers possess highly sensitive facial whiskers (15 cm long). These whiskers detect changes in air pressure, which helps to aid navigation in the dark and select a spot on the prey to bite. Long, thick tail of 2.5 to 3.5 feet, acts as a counterbalance, helpful in sharp turns and sudden leaps [3-11].

Leopards are found in higher numbers in India compared to Tigers and Cheetahs. Leopards are also experts in camouflaging. They have a robust but slender body built for agility. Its golden-yellow coloured coat is like that of Tigers and has unique rosettes (black spots with unspotted centres). The head of the leopard is broad and powerful. The face, head and throat of leopards are covered with black spots rather than rosettes. Lengthy tail (often 58 to 110 cm) functions as a counterbalance for climbing trees swiftly and sprinting in the field. Short, stocky and muscular limbs enable the animal to leap as far as 20 feet on grounds. Like

Tigers, broad paws of Leopards are padded with sharp, retractable claws. The claw helps as an anchor when the animal drags heavy prey up into the canopy or trees. The slender but strong chest of the leopard is patterned with rosettes<sup>[11-14]</sup>.

Vultures have highly specialised body parts adapted for scavenging, such as featherless heads to prevent bacteria buildup, corrosive stomach acids for digestion and broad wings for soaring. The above-mentioned adaptations make them nature's clean-up crew. Bald heads and necks without feathers in vultures are due to a lack of feathers. This prevents blood, tissue and fluids from soiling the plumage when the bird feeds on the carcasses deep inside. It also aids in temperature regulation. Vultures have a hooked beak (a strong, sharp bill—sheathed in hard keratin) which is designed to puncture thick hides and tear away tough flesh. Corrosive stomach acid has a highly acidic pH of just over zero, neutralising lethal bacteria and parasites (such as those of botulism and anthrax) found in the rotting meat. A broad wingspan provides vultures with the lift needed to fly high for hours while searching vast areas for carrion/carcasses/dead animals to feed on. Weaker, flatter feet of vultures are adapted for walking on the ground or perching. They often urinate on their own legs (urohidrosis) to cool down and kill bacteria. Vultures (Old World) have extraordinary eyesight, enabling them to catch carcasses. Vultures (New World) possess a sophisticated olfactory bulb to smell rotting meat from a distance. Madhya Pradesh is known to possess 7 out of 9 vulture species found in India. Most Indian vultures are found in PTR, KNP, Satpura Tiger Reserve, Gandhi Sagar Wildlife Sanctuary (GSWS) and Van Vihar NP (VVNP). The state also implements a successful vulture conservation and breeding program. A strict ban on hazardous veterinary drugs also helped the cause of conservation. In Madhya Pradesh, out of 7 recorded vulture species, 4 are resident (Indian Long-billed, White-rumped, Egyptian and Red-headed) and the remaining 3 are migratory (Himalayan Griffon, Eurasian Griffon and

Cinereous)<sup>[15-28]</sup>.

The Cheetah is the world's fastest land mammal. The Cheetah's body is slender and long-legged. Their claws are semi-retractable. A distinctive black tear mark for both eyes in Cheetah runs from the inner corner of each eye to the mouth. Their top speed can be between 96 and 112 kilometres per hour, but only for 274 meters. Short sprints of Cheetah may reach 72 kilometres per hour in just 2.5 seconds, the fastest amongst land mammals because of its specially adapted respiratory system (normal rate of 60 to 150 breaths/minute). Cheetahs with short teeth kill their prey by suffocation. Cheetahs with small heads and ears have no or poorly developed sagittal crests in contrast to tigers. Being recognised as a Tiger state in the country is not enough for the state of Madhya Pradesh, so it aspires to extend its conservation endeavours for the restoration of the Cheetah in the country. By doing so, the state of Madhya Pradesh aims to expand the concept of bioconservation to restore the total ecosystem's health. KNP emerges as the frontrunner for the conservation of the Cheetah. GSWS and Veerangna Durgavati (Nauradehi) landscapes are other sites for the Cheetah translocation. The Cheetah population peaked at 57 but stabilised at 53 in the state. From 2023 to 2026, after the reintroduction of the Cheetah in 2022, the Cheetah restoration phase can be considered a consolidation phase, recognised by the birth of multiple litters after successful breeding. Surviving litters in Indian grasslands proves the African Cheetah's adaptability to the prevalent ecosystems in India. Presently, a total of 50 Cheetahs are at KNP and 3 in GSWS.

Dedicated corridors are envisioned for the safe movement of wildlife across landscapes. However, multiple challenges in wildlife bioconservation, including poaching, hunting and human-animal conflicts, are notably prevalent. Institutions and organisations are working in tandem to conserve these wildlife species in the state and the country (Fig. 6). Enthusiasts can also explore the wildlife and hospitality offered by safari companies<sup>[11, 29-33]</sup>.



**Fig 6:** Logos related to wildlife bioconservation in India and the state of Madhya Pradesh

A-National Tiger Conservation Authority, B-International Big Cat Alliance  
C-Bombay Natural History Society, D-Madhya Pradesh Tiger Foundation Samiti

### Conclusion

The state of Madhya Pradesh has transitioned from traditional conservation of species protection to the management of complex ecosystems. The Tiger signifies the

landscape umbrella, the Leopard ensures survival in fragmented habitats, the Vulture preserves sanitary balance, and the Cheetah symbolizes a forward-looking attempt to restore lost ecological history. Together, these "Four Ace" species' comprehensive bioconservation strategy in Madhya Pradesh forms a unique global model for striking stability between economic development and ecological preservation when we are living in the ever-developing world. Madhya Pradesh is setting a global benchmark in a sustainable

bioconservation model in India, the success of which is measured by long-term ecological resilience. In addition to restoring and maintaining habitats for bioconservation and reintroduction programs, the state also promotes sustainable eco-tourism.

### Acknowledgements

Images/Sketches:

<a href="https://www.flaticon.com/free-icons/tiger" title="tiger icons">Tiger icons created by Delwar018 - Flaticon</a>

<a href="https://www.flaticon.com/free-icons/cheetah" title="cheetah icons">Cheetah icons created by Icongeek26 - Flaticon</a>

<a href="https://www.flaticon.com/free-icons/panthera-pardus" title="panthera pardus icons">Panthera pardus icons created by Delwar018 - Flaticon</a>

<a href="https://www.flaticon.com/free-icons/vulture" title="vulture icons">Vulture icons created by Freepik - Flaticon</a>

### References

- Santra AK. Handbook of wild and zoo animals. A treatise for students of veterinary, zoology, forestry and environmental science. Lucknow: International Book Distributing Company; 2008.
- Anonymous. MP emerges as a model for tiger and wildlife conservation and management: CM Dr Yadav. 2025 Jul 29. <https://www.mpinfo.org/Home/TodaysNews?newsid=%C2%B2%C2%B0%C2%B2%C2%B5%C2%B0%C2%B7%C2%B2%C2%B9%C3%8E%C2%B3%C2%B3%C2%B1&fontname=%C3%86%C3%AF%C3%AE%C3%B4%C3%85%C3%AE%C3%A7%C3%AC%C3%A9%C3%B3%C3%A8&LocID=32&pubdate=07/29/2025>.
- Quaiyumi N. A review of the tiger state - Madhya Pradesh. Sci Rep Life Sci. 2025 Jun 15;6(2):62-66.
- Qureshi Q, Jhala YV, Yadav SP, Tiwari VR, Garawad R, Mallick A, editors. Status of leopards in India, 2022. New Delhi: National Tiger Conservation Authority, Government of India, and Wildlife Institute of India, Dehradun; 2024.
- National Tiger Conservation Authority. Tiger reserves. 2026 Jun 3. <https://ntca.gov.in/tiger-reserves/#tiger-reserves-2>.
- Anonymous. Discovering the majesty of tigers. 2023 May 1. [https://www.digibooks.in/learning\\_point/view/74](https://www.digibooks.in/learning_point/view/74).
- Anonymous. Madhya Pradesh: Tiger state of India. 2024 Jun 27. <https://www.drishtiiias.com/state-pcs-current-affairs/madhya-pradesh-tiger-state-of-india>.
- Nautiyal JP, Lone AM, Ghosh T, Mallick A, Yadav SP, Ramesh C, et al. An illustrative profile of tiger reserves of India. Dehradun: Environmental information, awareness, capacity building and livelihood programme centre, Ministry of Environment Forest and Climate Change, Wildlife Institute of India; 2023. p. 314. [https://ntca.gov.in/assets/uploads/Reports/TR\\_profile/Illustrative\\_profile\\_tiger\\_reserves.pdf](https://ntca.gov.in/assets/uploads/Reports/TR_profile/Illustrative_profile_tiger_reserves.pdf).
- Ramadurai C. Where the jungle book comes to life. 2022 Feb 25. <https://www.bbc.com/travel/article/20150714-where-the-jungle-book-comes-to-life>.
- Will P. Tiger facts. 2024 Mar 12. <https://www.bbcearth.com/factfiles/animals/mammals/tiger>.
- Anonymous. Know your big cats. 2026 Jul 15. <https://ibca.world/>.
- Anonymous. Shri Bhupinder Yadav releases report on status of leopards in India. India conducts fifty cycle leopard population estimation. 2024 Feb 29. <https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2010001&reg=3&lang=2>.
- Anonymous. Leopard (*Panthera pardus*) Fact sheet. San Diego (CA): San Diego Zoo Wildlife Alliance; c2014-2025. <http://ielc.libguides.com/sdzc/factsheets/leopard>.
- Singh A. Roads and highways biggest killers of leopards in Madhya Pradesh. 2026 Apr 18. <https://www.newindianexpress.com/xplore/2026/Apr/17/roads-and-highways-biggest-killers-of-leopards-in-madhya-pradesh>.
- Anonymous. State with the highest number of vultures in the country: Madhya Pradesh. 2025 Feb 23. [https://www.galaxyclasses.co.in/details?res\\_type=ca&res\\_id=7928](https://www.galaxyclasses.co.in/details?res_type=ca&res_id=7928).
- Choudhury RN. Vulture population in MP doubled in last decade. 2026 Mar 6. <https://www.deccanchronicle.com/nation/vulture-population-in-mp-doubled-in-last-decade-1941941>.
- Agrawal N. Vulture a lost magnificence. 2026 Jul 15. <https://snhcjournal.com/sep-nov-2024/vulture-a-lost-magnificence/>.
- Laghate A, Joshi S. Vultures of Madhya Pradesh. 2026 Jul 15. <https://snhcjournal.com/favorite/vultures-of-madhya-pradesh/>.
- Anonymous. This Indian state is home to one of endangered species of the world. 2025 Mar 10. <https://timesofindia.indiatimes.com/etimes/trending/this-indian-state-is-home-to-one-of-endangered-species-of-the-world/articleshow/118833288.cms>.
- Singh U. Conservation efforts strengthen the state's identity as the vulture state. 2026 Apr 13. <https://english.swadeshnews.in/national/madhya-pradesh-successful-vulture-conservation/157081>.
- Frank E, Sudarshan A. The social costs of keystone species collapse: evidence from the decline of vultures in India. University of Chicago, Becker Friedman Institute for Economics Working Paper No. 2022-165. 2023 Jan 5. <http://dx.doi.org/10.2139/ssrn.4318579>.
- Anonymous. Vulture. 2026 Jul 11. <https://www.britannica.com/animal/vulture>.
- Anonymous. Madhya Pradesh becomes the state with highest number of vultures in the country. 2025 Feb 22. <https://newsonair.gov.in/madhya-pradesh-becomes-the-state-with-highest-number-of-vultures-in-country/?noshow=1>.
- Anonymous. CM releases 5 endangered vultures into wild, reaffirms resolve to conserve wildlife. 2026 Feb 24. <https://theprint.in/india/mp-cm-releases-5-endangered-vultures-into-wild-reaffirms-resolve-to-conserve-wildlife/2862254/>.
- Anonymous. Vultures. Get to know Europe's vulture species. 2026 Jul 11. <https://4vultures.org/vultures/>.
- Anonymous. Vultures. 2026 Jul 11. <https://seaworld.org/animals/facts/birds/vultures/>.

27. Anonymous. Vultures. 2026 Jul 11. [https://www.desertmuseum.org/books/nhsd\\_vultures.php](https://www.desertmuseum.org/books/nhsd_vultures.php).
28. Anonymous. Fact sheet. 2026 Jul 11. <https://vultureday.org/resources/fact-sheet/>.
29. Anonymous. Four cheetah cubs die at Kuno National Park. 2026 Jul 11. <https://newsarenaindia.com/nation/four-cheetah-cubs-die-in-kuno-national-park/77154>.
30. Smithsonian's National Zoo and Conservation Biology Institute. Cheetah. 2026 Jul 15. <https://nationalzoo.si.edu/animals/cheetah>.
31. Anonymous. Physical characteristics. 2026 Jul 15. <https://seaworld.org/animals/all-about/cheetah/characteristics/>.
32. Anonymous. Physical characteristics. 2026 Jul 15. <https://seaworld.org/animals/all-about/tiger/characteristics/>.
33. Anonymous. Vultures of India: Guardians of Skies. 2026 Jul 15. <https://www.pugdundeesafaris.com/blog/indian-vulture-species/>.

### Names and their Affiliations

#### **S.D. Audarya**

Associate Professor, Department of Veterinary Microbiology, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Kuthuliya, Rewa, Madhya Pradesh, India.

#### **R. Sharma**

College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Kuthuliya, Rewa, Madhya Pradesh, India.

#### **Y. Chatur**

Assistant Professor, Department of Veterinary Public Health and Epidemiology, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Kuthuliya, Rewa, Madhya Pradesh, India.

#### **A.K. Niranjana**

Assistant Professor, Department of Veterinary Microbiology, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Kuthuliya, Rewa, Madhya Pradesh, India.

#### **K. Walwadkar**

Assistant Professor, Department of Veterinary Medicine, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Kuthuliya, Rewa, Madhya Pradesh, India.

#### **R. Sikroodia**

Assistant Professor, Department of Veterinary Microbiology, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Dr. Ambedkar Nagar-Mhow, Indore, Madhya Pradesh, India.

#### **R. Gangil**

Assistant Professor, Department of Veterinary Microbiology, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science

University, Dr. Ambedkar Nagar-Mhow, Indore, Madhya Pradesh, India.

#### **A.K. Jha**

Assistant Professor, Department of Animal Genetics and Breeding, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Kuthuliya, Rewa, Madhya Pradesh, India.

#### **B. Dixit**

Associate Professor, Department of Veterinary Public Health and Epidemiology, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Kuthuliya, Rewa, Madhya Pradesh, India.

#### **A. Tewari**

Assistant Professor, Department of Veterinary Public Health and Epidemiology, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Kuthuliya, Rewa, Madhya Pradesh, India.