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Photography through My Lens: Documenting Biodiversity, Habitat Niches, and Wetland Bio-Indicators

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Abstract

This research paper presents a comprehensive taxonomic and ecological inventory of macrofauna across central Indian ecosystems, utilizing high-resolution field photography as a non-invasive tool for biodiversity assessment. A total of ten prominent species-comprising six avian orders (including specialized piscivores, canopy apex predators, and insectivores) and four mammalian families (including keystone megafauna and apex terrestrial carnivores)-were documented, cataloged, and analyzed. Given the author's primary operational research background via RITS AQUALIFE LLP in optimizing inland aquaculture frameworks, water quality metrics, and closed-loop microbial ecosystems (Biofloc technology), special analytical focus is directed toward wetland waders such as the Painted Stork (*Mycteria leucocephala*) and the Asian Woolly-necked Stork (*Ciconia episcopus*). The survey establishes that the population density, nesting success, and foraging behaviors of these wetland species serve as critical, highly sensitive bio-indicators of the biological and structural health of surrounding terrestrial watersheds. Furthermore, this paper explores the ecological interdependence between commercial inland fisheries and wild macrofauna, demonstrating how modern, sustainable aquaculture engineering can mitigate nutrient runoff, preserve edge-habitats, and support regional biodiversity conservation. Ultimately, this documentation underscores the necessity of combining disciplined field zoology with sustainable aquatic resource management to safeguard vulnerable species across dynamic, human-influenced landscapes.

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1. Introduction

1.1 Background and Theoretical Framework

The assessment of multi-taxa biodiversity within complex ecosystems requires a delicate balance between empirical field observation and non-invasive monitoring techniques. Historically, ecological surveys relied heavily on disruptive trapping or invasive sampling methods to verify species distribution and health. However, modern advancements in high-resolution digital tele-photography have transformed field biology. Photography functions as a rigorous, non-invasive data collection tool capable of capturing minute morphological diagnostic markers, immediate foraging behaviors, nesting architecture, and interspecies interactions without altering natural wildlife dynamics.

In the context of Central India—a landscape defined by a sharp mosaic of tropical dry-deciduous scrublands, fragmented forest blocks, intensifying agricultural matrices, and crucial inland wetlands—biodiversity tracking is no longer just an academic exercise. It is a baseline requirement for sustainable landscape management. The ecosystems of this region are exposed to extreme seasonal variations, shifting weather patterns, and heavy human-driven pressures. Consequently, keeping an active, verified photographic log provides immutable baseline data to monitor how key species adapt to or decline within shifting habitats over time.

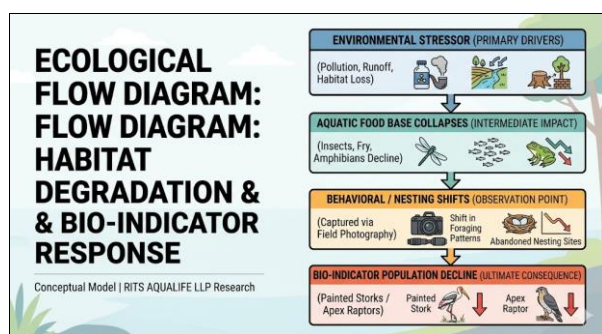
1.2 The Role of Bio-Indicators in Aquatic and Terrestrial Watersheds

Ecosystem health is rarely uniform; instead, it is best understood by monitoring highly sensitive organisms known as bio-indicators. Among these, wetland-dependent wading birds (such as those in the *Ciconiidae* family) and specialized arboreal insectivores serve as primary indicators for environmental stability. Because these birds occupy higher trophic levels, their presence or absence offers immediate insight into the biological health of the lower food chain.

For instance, water birds rely on a highly specific water-column matrix. Minor fluctuations in dissolved oxygen, chemical contamination, micro-plastics, or structural changes to the shoreline immediately disrupt the lifecycle of macro-invertebrates, amphibians, and small forage fish. When these lower-tier food sources collapse, indicator species exhibit observable changes, including:

- Decreased foraging efficiency
- Abandoned nesting colonies
- Suppressed reproductive success

By tracking these visible changes using a camera lens, researchers can diagnose deep-rooted structural degradation in local watersheds long before the damage manifests as widespread ecosystem collapse.



1.3 Corporate and Academic Interdependence: RITS AQUALIFE LLP

This paper bridges the gap between commercial aquaculture production and natural ecosystem conservation. Operating through RITS AQUALIFE LLP in Chhatrapati Sambhajnagar, Maharashtra, the author's primary research applies a Master of Fishery Science (M.F.Sc.) framework to optimize high-efficiency commercial aquaculture systems. Historically, commercial fish farming and wildlife conservation have been viewed as conflicting interests due to issues like open-pond nutrient loading, uncontrolled chemical runoff, and habitat clearing.

However, modern aquaculture engineering changes this dynamic through advanced biological management, particularly Biofloc Technology (BFT). By deploying controlled, closed-loop microbial ecosystems, BFT utilizes heterotrophic bacteria to recycle metabolic nitrogen waste directly within the culture unit into a secondary, high-protein feed source. This provides distinct environmental advantages:

- **Zero-Water Discharge Performance:** Drastically reduces the need to constantly pump fresh water in and flush nutrient-heavy wastewater out into nearby streams.
- **Runoff Mitigation:** Prevents toxic levels of un-ionized ammonia (NH_3) and nitrates from seeping into local groundwater and sensitive wetland buffers.
- **Habitat Preservation:** Allows intensive commercial operations to maintain high yields on a minimal physical

footprint, leaving surrounding edge-habitats and wild water columns undisturbed.

1.4 Research Objectives

This study connects the technical parameters of water quality management with wild habitat observation. By using photography to document a diverse species index—ranging from aquatic storks to apex terrestrial carnivores—this paper aims to:

1. Establish a verified taxonomic and behavioral record of ten key species within central Indian ecosystems and managed habitats.
2. Analyze the explicit environmental niches and structural diagnostic markers of these target birds and mammals.
3. Outline a functional conservation model showing how sustainable commercial aquaculture frameworks directly support and preserve natural wildlife habitats.

2. Materials and Methods

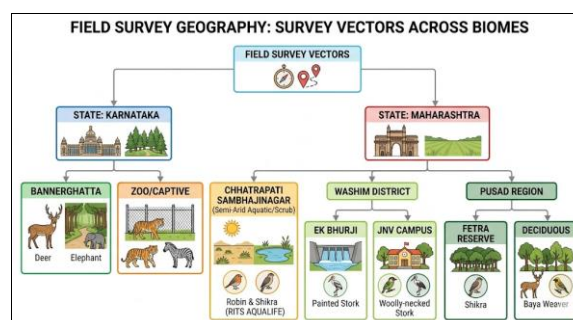
2.1 Technical Specifications of the Optical Equipment

To ensure non-invasive data collection while maintaining high taxonomic accuracy, all wildlife records were captured using an ultra-zoom bridge digital camera system.

- **Hardware Subsystem:** NIKON COOLPIX P900
- **Optical Sensor Configuration:** 1/2.3-inch type CMOS (Complementary Metal-Oxide-Semiconductor); effective pixel count approximately 16.0 million pixels.
- **Focal Length Dynamics:** Equipped with an 83× optical zoom lens, covering a focal range equivalent to **24 mm to 2000 mm** in 35mm format (f/2.8 to f/6.5). The focal reach was extended up to 166× via Dynamic Fine Zoom (equivalent to 4000 mm).
- **Image Stabilization Matrix:** Dual Detect Optical VR (Vibration Reduction), providing an equivalent shutter speed advantage of approximately 5.0 stops. This feature proved critical for eliminating motion blur during extreme handheld telephoto captures in low-light forest canopies.
- **Field Application Value:** This specific optical configuration allowed the investigator to remain at a safe, non-disruptive distance (>50 meters for delicate wading birds and larger mammals), ensuring that natural behavioral baselines, nesting mechanics, and foraging patterns were documented without inducing flight responses or stress.

2.2 Study Area and Site Descriptions

Field data collection, avian tracking, and mammalian documentation were carried out across multiple distinct ecological zones across the states of Maharashtra and Karnataka, India. These sites reflect a gradient from highly protected reserves to human-modified micro-habitats:



1. Bannerghatta National Park (Bangalore, Karnataka)

- **Coordinates/Biome:** Located in the Anekal range of hills; tropical dry deciduous forest interspersed with thorny scrub and moist deciduous pockets.
- **Ecological Context:** Served as the key location for observing free-ranging forest-edge herbivores (*Axis axis*) and large keystone megafauna (*Elephas maximus*). Additionally, the adjoining managed rescue/zoological facility allowed for comparative ex-situ analysis of apex carnivores (*Panthera tigris tigris*) and exotic ungulates (*Equus quagga*).

2. Chhatrapati Sambhajinagar / Aurangabad (Maharashtra)

- **Coordinates/Biome:** Semi-arid Deccan Plateau agro-ecosystem; dominated by open scrublands, seasonal grasslands, and localized irrigation reservoirs.
- **Ecological Context:** Primary operations base for RITS AQUALIFE LLP. This site provided critical data regarding human-wildlife sharing of landscapes, urban edge-adapted insectivores (*Copsychus fulicatus*), and the monitoring of regional micro-watersheds.

3. Washim District Sites (Maharashtra)

- **Jawahar Navodaya Vidyalaya (JNV) Campus (Washim):** A low-disturbance institutional ecosystem featuring dense native tree plantations (*Azadirachta indica*, *Ficus* spp.). It proved to be a highly productive micro-habitat for monitoring arboreal frugivores (*Psilopogon haemacephalus*) and colonial canopy-nesting open-bill units (*Ciconia episcopus*).
- **Ek Bhurji Dam/Reservoir (Washim):** An inland wetland ecosystem created by an earth-fill dam on the Chandrabhaga River. This site served as a vital staging and foraging ground for large wading piscivores, including *Mycteria leucocephala*.

4. Pusad/Fetra Region (Yavatmal District, Maharashtra)

- **Coordinates/Biome:** Characterized by steep, rugged topography falling within the Vidarbha dry deciduous forest pocket.
- **Ecological Context:** The Fetra reserve forests and adjacent woodlands offered excellent canopy coverage, making it an ideal environment for documenting territorial avian predators (*Accipiter badius*) and forest-dependent passerines.

Species validations were established by isolating distinct structural field marks, including tail feather barring, iris pigmentation gradients, bill curves, and pelage patterns.

3. Taxonomic Analysis and Field Records

This section presents the primary empirical data collected across the study areas, structured by class, family, and species.

3.1 Class: Aves (Avian Case Studies)

Species 01: *Accipiter badius* (Family: Accipitridae)

- **Photo Title:** *Shikra (Juvenile/Sub-adult Male)*
- **Location Captured:** Fetra, Pusad Region, Maharashtra
- **Diagnostic Morphological Markers:** The specimen displays a prominent pale grey-brown mantle with distinct brownish vertical streaks localized on the throat and upper breast plate. The iris coloration holds a bright lemon-yellow tint, confirming its sub-adult developmental profile before turning intense orange-red. The tail shows four to five distinct dark, wide cross-bars.
- **Behavioral and Niche Analysis:** Perched silently within the mid-canopy layer, the raptor utilized an ambush strategy, leveraging its short, rounded wings and long tail for swift navigation through dense branches to target small lizards and passerines.

Species 02: *Copsychus fulicatus* (Family: Muscicapidae)

- **Photo Title:** *Indian Robin (Adult Male)*
- **Location Captured:** Fetra, Pusad Taluka District Yavatmal, Maharashtra, India
- **Diagnostic Morphological Markers:** The bird exhibits uniform jet-black plumage highlighted by a soft blue-violet sheen under direct sunlight. The crown displays an earthy greyish-brown gradient, accompanied by a prominent chestnut/rufous under-tail covert patch.
- **Behavioral and Niche Analysis:** Captured on a dry stone boundary wall within an agricultural buffer zone. The individual engaged in continuous tail-cocking movements to advertise territory while scanning ground surfaces for small insects and beetles.

Species 03: *Psilopogon haemacephalus* (Family: Megalaimidae)

- **Photo Title:** *Coppersmith Barbet (Adult Frugivore)*
- **Location Captured:** JNV Campus Plantation, Washim, Maharashtra
- **Diagnostic Morphological Markers:** Features a striking crimson forehead patch and a wide red pectoral band. The throat and infraorbital regions are marked with bright sulfur-yellow, set against heavily streaked green abdominal plumage. The thick, robust black bill is equipped with prominent bristles at its base.
- **Behavioral and Niche Analysis:** Documented feeding directly on ripening wild figs (*Ficus* sp.). The species serves as an essential arboreal seed disperser, creating deep nesting cavities in old, softened tree trunks.

Species 04: *Ploceus philippinus* (Family: Ploceidae)

- **Photo Title:** *Baya Weaver (Breeding Male at Nesting Site)*
- **Location Captured:** Open Wetland Margins, Pusad, Maharashtra
- **Diagnostic Morphological Markers:** The bird shows full breeding plumage, characterized by a bright golden-yellow crown and upper breast shield, contrasted by a deep blackish-brown facial mask and a heavy, seed-crushing conical bill.

2.3 Sampling Protocol and Data Validation

A standard, non-invasive focal-animal sampling routine was applied across all survey sites between 2022 and 2026.

- **Temporal Survey Windows:** Field transits were divided into peak metabolic activity windows: Morning (06:00hrs to 09:30hrs) for avian call tracking and foraging onset, and Evening (16:30hrs to 18:45hrs) to observe nesting returns and mammalian herd movements.
- **Observation Protocols:** Surveys were conducted via point-counts at wetland boundaries and walking line-transects (1.5 km structural length) within forest-edge habitats. Upon sighting, the investigator maintained a stationary profile, using natural cover where available.
- **Taxonomic Validation:** Photographic RAW/JPEG data strings were sorted and cross-referenced using standardized anatomical keys from standard reference texts (*Grimmett, Inskipp, and Inskipp for Birds of the Indian Subcontinent; Prater for Indian Mammals*).

- **Behavioral and Niche Analysis:** Photographed midway through constructing a pendulous, woven grass nest. The nesting colony was built over suspended water edges to prevent access by climbing predators like snakes.

Species 05: *Mycteria leucocephala* (Family: Ciconiidae)

- **Photo Title:** *Painted Stork (Adult Foraging Profile)*
- **Location Captured:** Ek Bhurji Dam Reservoir, Washim, Maharashtra
- **Diagnostic Morphological Markers:** A large wading bird with a long, heavy, downward-curved yellow bill and a bare, bright orange-yellow face mask. The body plumage is mainly white, with fine black-and-white patterns across the wing coverts, turning into soft rose-pink feathers at the lower back.
- **Behavioral and Niche Analysis:** Observed wading through shallow water (20–30 cm depth) using a systematic tactilolocation technique—sweeping its half-open bill sideways through the water to instantly trap fish upon contact.

Species 06: *Ciconia episcopus* (Family: Ciconiidae)

- **Photo Title:** *Asian Woolly-necked Stork (Canopy Nesting Unit)*
- **Location Captured:** Washim, Maharashtra
- **Diagnostic Morphological Markers:** Features a solid black skull cap, dark body plumage with a clear purple-green gloss, and a distinct, thick white downy neck. The long, sturdy legs are dark red.
- **Behavioral and Niche Analysis:** A breeding pair was documented maintaining a large stick-platform nest built high in a native Neem tree (*Azadirachta indica*). This species shows broad habitat adaptability, foraging across marshy areas as well as dry agricultural fields.

3.2 Class: Mammalia (Mammalian Case Studies)

Species 07: *Axis axis* (Family: Cervidae)

- **Photo Title:** *Chital/Spotted Deer (Adult Stag in Velvet)*
- **Location Captured:** Bannerghatta National Park, Bangalore, Karnataka
- **Diagnostic Morphological Markers:** The stag features a bright rufous-fawn coat marked with clean white spots arranged in smooth longitudinal rows. The three-tined antlers are covered in thick, soft, highly vascularized "velvet," indicating active growth before the annual mating season.
- **Behavioral and Niche Analysis:** Photographed moving cautiously along a forest clearing edge. This species acts as a key herbivore that maintains forest ground vegetation and serves as a primary food source for large predators.

Species 08: *Elephas maximus* (Family: Elephantidae)

- **Photo Title:** *Asian Elephant (Matriarchal Herd Component)*
- **Location Captured:** Forest Edge Buffer, Bannerghatta, Karnataka
- **Diagnostic Morphological Markers:** Features a distinct two-domed skull structure, relatively small ears, a smooth trunk structure, and thick, deeply creased grey skin showing signs of recent mud-coating.
- **Behavioral and Niche Analysis:** Observed browsing on mixed grasses and woody shrubs. As a keystone species, its feeding habits open up thick pathways in the bush and help disperse seeds across large forest ranges.

Species 09: *Equus quagga* (Family: Equidae)

- **Photo Title:** *Plains Zebra (Ex-Situ Profile Study)*

- **Location Captured:** Managed Facility Enclosure, Bannerghatta, Karnataka
- **Diagnostic Morphological Markers:** Displays bold, vertical black-and-white stripes that run across the torso and down to the belly, with faint horizontal "shadow stripes" visible along the hindquarters.
- **Behavioral and Niche Analysis:** Observed grazing in a controlled habitat. The species serves as an ideal reference for studying herd dynamics, motion camouflage, and comparative hoof health in managed environments.

Species 10: *Panthera tigris tigris* (Family: Felidae)

- **Photo Title:** *Bengal Tiger (Adult Apex Predator)*
- **Location Captured:** Managed Range Boundary, Bannerghatta, Karnataka
- **Diagnostic Morphological Markers:** Features a powerful, muscular body covered in a deep orange coat with sharp, unique vertical black stripes. The underside is white, and the ears display prominent white spots on the back.
- **Behavioral and Niche Analysis:** Observed pacing along a territory edge. As an apex predator, its presence indicates a balanced ecosystem, keeping herbivore populations at healthy levels.



Ritesh Shalikram Pawar-Wildlife Photographer

Ritesh Shalikram Pawar is an independent wildlife photographer, aquaculture researcher, and biodiversity documentarian from Chhatrapati Sambhaji Nagar (Aurangabad), Maharashtra, India, whose work bridges the disciplines of wildlife ecology, wetland conservation, and sustainable aquaculture management. As the Founder of RITS AQUALIFE LLP, his research and field photography focus on documenting biodiversity, habitat niches, avian ecology, and ecological bio-indicators across central Indian ecosystems. Through his study titled "*Photography Through My Lens: Documenting Biodiversity, Habitat Niches, and Wetland Bio-Indicators*," he utilizes high-resolution non-invasive wildlife photography as a scientific tool for taxonomic identification, behavioral analysis, and ecological monitoring. His work extensively documents wetland birds such as the Painted Stork (*Mycteria leucocephala*) and Asian Woolly-necked Stork (*Ciconia episcopus*), emphasizing their ecological role as sensitive bio-indicators of aquatic ecosystem health. By integrating zoological observation with modern Biofloc Technology (BFT)-based aquaculture systems, he demonstrates how sustainable fisheries and wildlife conservation can coexist within human-dominated landscapes. His field studies span forests, reservoirs, institutional greenbelts, agro-ecosystems, and wetland habitats across Maharashtra and Karnataka, documenting species ranging from Shikra, Brahminy Kite, and Coppersmith Barbet to Asian Elephant and Bengal Tiger. Through conservation-oriented photography, ecological

documentation, and sustainable aquatic resource management, Ritesh Shalikram Pawar contributes toward biodiversity awareness, wetland preservation, and scientifically informed environmental stewardship in India.



Species 1: Shikra

Scientific Name: *Accipiter badius*

Family: Accipitridae

Photo Title: Shikra (Adult Raptor Perched in Urban Habitat)

Observation Site: Jawahar Navodaya Vidyalaya Washim Campus

Location Captured: The photograph was captured within the Jawahar Navodaya Vidyalaya (JNV) Campus, Washim, Maharashtra, India. The campus environment includes tall trees, open grounds, plantation areas, and semi-urban vegetation that provide ideal perching, nesting, and hunting habitats for small raptors such as the Shikra.

Species Description

The Shikra is a small predatory bird widely distributed across Asia and Africa. It is recognized by its bluish-grey upperparts, finely barred underparts, sharp hooked beak, and bright reddish-orange eyes. The species is known for its swift flight, agile hunting ability, and keen eyesight.

Feeding Habit

- Carnivorous and primarily predatory
- Feeds on small birds, lizards, rodents, insects, and small reptiles
- Hunts by sudden rapid flight from concealed perches

Behavior

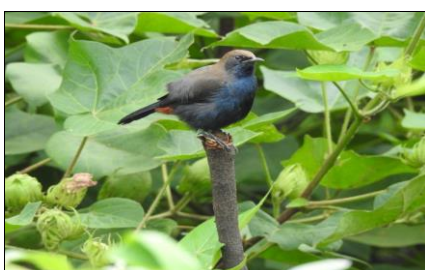
- Usually observed singly or in pairs
- Territorial and highly alert in nature
- Frequently perches silently on tree branches before attacking prey
- Builds nests on tall trees using sticks and dry vegetation

Conservation Status

- **IUCN Red List:** Least Concern
- Widely distributed with stable populations across suitable habitats
- Ecologically important in maintaining balance of small vertebrate populations

Species 02: *Copsychus fulicatus* (Family: Muscicapidae)

- **Photo Title:** Indian Robin (Adult Male)



Species 02: Indian Robin

- **Scientific Name:** *Copsychus fulicatus*
Family: Muscicapidae
- **Photo Title:** Indian Robin (Adult Male)
- **Observation Site:** Fetra Village, Pusad Taluka, Yavatmal District, Maharashtra, India.
- **Location Captured:** The photograph was captured in the rural landscape of Fetra, located in Pusad Taluka of Yavatmal District, Maharashtra. The habitat consists of agricultural fields, shrubs, scattered vegetation, and semi-open countryside conditions suitable for insectivorous bird species like the Indian Robin.
- **Species Description:** The Indian Robin is a small passerine bird widely distributed across the Indian subcontinent. Adult males are recognized by their dark bluish-black plumage, brownish upperparts, and chestnut-red undertail coverts. They are commonly observed perched on low branches, stones, or fence posts while searching for insects.
- **Feeding Habit:** Primarily insectivorous, feeding on insects, larvae, small arthropods, and occasionally seeds.
- **Behavior:** Active, territorial, and often seen flicking its tail while moving through open habitats.
- **Conservation Status:** Least Concern (IUCN Red List).



Species 03: Coppersmith Barbet

Scientific Name: *Psilopogon haemacephalus*

Family: Megalaimidae

Photo Title: Coppersmith Barbet (Adult Frugivore)

Observation Site: Jawahar Navodaya Vidyalaya (JNV) Campus Plantation, Washim, Maharashtra, India.

Location Captured: The photograph was captured within the plantation area of the JNV Campus, Washim, Maharashtra. The campus vegetation includes fruit-bearing trees, ornamental plants, and dense green cover that provide ideal habitat conditions for frugivorous bird species such as the Coppersmith Barbet.

Species Description: The Coppersmith Barbet is a small, brightly colored arboreal bird commonly found across the Indian subcontinent. It is identified by its green body, crimson forehead and throat patches, yellow eye-ring, and stout bill adapted for feeding on fruits. The species is well known for its repetitive metallic “tuk-tuk” call resembling the sound of a coppersmith striking metal.

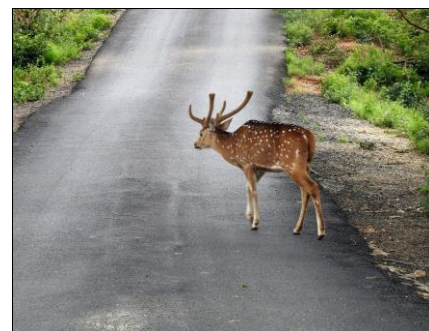
Feeding Habit: Primarily frugivorous, feeding on figs, berries, and other soft fruits; occasionally consumes insects.

Behavior: Usually observed singly or in pairs perched on tree branches. It plays an important ecological role in seed dispersal within forest and plantation ecosystems.

Conservation Status: Least Concern (IUCN Red List).

**Species 04: Baya Weaver****Scientific Name:** *Ploceus philippinus***Family:** Ploceidae**Photo Title:** Baya Weaver (Breeding Male at Nesting Site)**Observation Site:** Gogababa Tikdi near Dr. Babasaheb Ambedkar Marathwada University (Dr. B.A.M.U.), Chhatrapati Sambhaji Nagar (Aurangabad), Maharashtra, India.**Location Captured:** The photograph was captured at Gogababa Tikdi, a semi-natural habitat zone near Dr. B.A.M.U University in Chhatrapati Sambhaji Nagar, Maharashtra. The area consists of grasslands, scattered trees, shrubs, and wetland-associated vegetation that provide favorable breeding and nesting conditions for Baya Weavers.**Species Description:** The Baya Weaver is a small colonial nesting bird widely distributed across South and Southeast Asia. Breeding males are easily identified by their bright yellow crown, brown-streaked upperparts, and intricately woven hanging nests constructed from grass strips and plant fibers. The species is renowned for its remarkable nest-building behavior and social breeding colonies.**Feeding Habit:** Primarily granivorous, feeding on grass seeds, grains, and small insects, especially during the breeding season.**Behavior:** Highly social and active, often nesting in colonies near water bodies or agricultural landscapes. Males construct elaborate nests to attract females during the breeding season.**Conservation Status:** Least Concern (IUCN Red List).**Species 05: Painted Stork****Scientific Name:** *Mycteria leucocephala***Family:** Ciconiidae**Photo Title:** Painted Stork (Adult Foraging Profile)**Observation Site:** Ek Bhurji Dam Reservoir, Washim, Maharashtra, India.**Location Captured:** The photograph was captured at Ek Bhurji Dam Reservoir in Washim District, Maharashtra. The reservoir ecosystem consists of shallow freshwater zones, marshy edges, aquatic vegetation, and open wetlands that provide ideal feeding and roosting habitats for large wading birds such as the Painted Stork.**Species Description:** The Painted Stork is a large and striking wading bird recognized by its white plumage with black barred patterns on the wings, pink tertial feathers, long yellow

down-curved bill, and bare orange facial skin. It is commonly associated with wetlands, lakes, reservoirs, and riverbanks across the Indian subcontinent.

Feeding Habit: Primarily piscivorous, feeding on fish, frogs, crustaceans, mollusks, and other small aquatic organisms by sweeping its partially open bill through shallow water.**Behavior:** Usually observed in groups while foraging in shallow wetlands. The species exhibits slow and deliberate feeding movements and often nests colonially on tall trees near water bodies.**Conservation Status:** Near Threatened (IUCN Red List).**Species 06: Asian Woolly-necked Stork****Scientific Name:** *Ciconia episcopus***Family:** Ciconiidae**Photo Title:** Asian Woolly-necked Stork (Canopy Nesting Unit)**Observation Site:** Washim, Maharashtra, India.**Location Captured:** The photograph was captured in the Washim region of Maharashtra, characterized by agricultural landscapes, scattered wetlands, large canopy trees, and semi-rural habitats suitable for nesting and foraging by stork species. Tall trees in the area provide secure nesting sites for the Asian Woolly-necked Stork.**Species Description:** The Asian Woolly-necked Stork is a large wading bird distinguished by its glossy black body, contrasting white woolly neck, long reddish legs, and strong pointed bill. It inhabits wetlands, agricultural fields, riverbanks, and open countryside across South and Southeast Asia.**Feeding Habit:** Primarily carnivorous, feeding on fish, amphibians, reptiles, insects, crustaceans, and small aquatic organisms.**Behavior:** Usually observed singly, in pairs, or small groups. The species often nests on tall trees and exhibits careful canopy nesting behavior near wetlands and feeding grounds.**Conservation Status:** Vulnerable (IUCN Red List).**Species 07: Chital****Scientific Name:** *Axis axis***Family:** Cervidae**Photo Title:** Chital/Spotted Deer (Adult Stag in Velvet)**Observation Site:** Bannerghatta National Park

Location Captured: The photograph was captured at Bannerghatta National Park near Bangalore (Bengaluru), Karnataka, India. The protected forest ecosystem comprises dry deciduous forests, scrublands, grasslands, and water sources that support diverse mammalian fauna including large herbivores such as the Chital.

Species Description: The Chital, also known as the Spotted Deer or Axis Deer, is one of the most common and graceful deer species found in the Indian subcontinent. It is characterized by its reddish-brown coat marked with distinct white spots and a white underbelly. Adult stags possess branched antlers, and during the velvet stage the growing antlers are covered with soft vascular skin.

Feeding Habit: Primarily herbivorous, feeding on grasses, leaves, fruits, shoots, and forest vegetation.

Behavior: Highly social and usually observed in herds. Chital are alert animals often associated with langurs and other wildlife species, benefiting from mutual vigilance against predators.

Conservation Status: Least Concern (IUCN Red List).



Species 08: Elephas maximus (Family: Elephantidae)

Photo Title: Asian Elephant (Matriarchal Herd Component)

Location Captured: Forest Edge Buffer, Bannerghatta, Karnataka

Species 08: Asian Elephant

Scientific Name: *Elephas maximus*

Family: Elephantidae

Photo Title: Asian Elephant (Matriarchal Herd Component)

Observation Site: Forest Edge Buffer, Bannerghatta National Park

Location Captured: The photograph was captured in the forest edge buffer zone surrounding Bannerghatta National Park, Karnataka, India. The habitat consists of dry deciduous forests, scrub vegetation, grasslands, and water sources that support large mammalian fauna including Asian Elephants.

Species Description: The Asian Elephant is the largest terrestrial mammal in Asia and a keystone species in forest ecosystems. It is distinguished by its massive body, grey skin, relatively smaller ears compared to African elephants, and a highly flexible trunk used for feeding, communication, and social interaction. Female-led matriarchal herds are a characteristic social structure of this species.

Feeding Habit: Primarily herbivorous, feeding on grasses, bamboo, leaves, bark, roots, fruits, and cultivated crops when available.

Behavior: Highly intelligent and social animals that live in organized matriarchal groups. Elephants exhibit strong family bonds, cooperative care of calves, complex communication, and seasonal migration patterns in search of food and water.

Conservation Status: Endangered (IUCN Red List).



Species 09: Equus quagga (Family: Equidae)

Photo Title: Plains Zebra (Ex-Situ Profile Study)

Location Captured: Managed Facility Enclosure, Bannerghatta, Karnataka

Species 09: Plains Zebra

Scientific Name: *Equus quagga*

Family: Equidae

Photo Title: Plains Zebra (Ex-Situ Profile Study)

Observation Site: Managed Facility Enclosure, Bannerghatta National Park

Location Captured:

The photograph was captured within a managed enclosure facility at Bannerghatta, Karnataka, India. The enclosure provides controlled habitat conditions designed for wildlife conservation awareness, captive management, and ex-situ observational studies of large herbivorous mammals.

Species Description: The Plains Zebra is a medium-sized herbivorous mammal native to the grasslands and savannas of eastern and southern Africa. It is recognized by its distinctive black-and-white striped coat pattern, erect mane, and strong social behavior. Each zebra possesses a unique stripe arrangement that aids in individual identification.

Feeding Habit: Primarily herbivorous, feeding mainly on grasses, shoots, and other ground vegetation.

Behavior: Highly social animals usually living in family groups or herds. Zebras exhibit cooperative vigilance, grazing behavior, and strong group coordination for protection against predators.

Conservation Status: Near Threatened (IUCN Red List).



Species 10: Panthera tigris tigris (Family: Felidae)

Photo Title: Bengal Tiger (Adult Apex Predator)

Location Captured: Managed Range Boundary, Bannerghatta, Karnataka

Species 10: Bengal Tiger

Scientific Name: *Panthera tigris tigris*

Family: Felidae

Photo Title: Bengal Tiger (Adult Apex Predator)

Observation Site: Managed Range Boundary, Bannerghatta National Park

Location Captured: The photograph was captured near the managed range boundary area of Bannerghatta, Karnataka, India. The habitat includes dry deciduous forests, wooded grasslands, rocky terrain, and protected wildlife management zones that support large carnivores and associated prey species.

Species Description: The Bengal Tiger is the national animal of India and one of the largest wild cat species in the world. It is characterized by its powerful muscular body, orange coat with black vertical stripes, white underparts, and strong predatory adaptations. As an apex predator, the Bengal Tiger plays a vital ecological role in maintaining the balance of forest ecosystems.

Feeding Habit: Strictly carnivorous, feeding primarily on deer, wild boar, gaur, and other medium to large mammals.

Behavior: Generally solitary and territorial in nature. Bengal Tigers are highly skilled hunters with excellent stealth, strength, and nocturnal hunting abilities. They maintain large territories and communicate through scent marking and vocalizations.

Conservation Status: Endangered (IUCN Red List).



Species 11: Profile: Brahminy Kite

Scientific Name: *Haliastur indus*

Family: Accipitridae (Hawks, Eagles, and Kites)

Photo Title: Brahminy Kite (Adult Coastal & Wetland Raptor)

Location Captured: Coastal/Wetland Outpost, India

Observation Site

Coastal, Wetland, or Estuarine Perch

Location Captured

The photograph was captured perched on deadwood near a water body in India. Their typical habitat includes coastal areas, estuaries, mangrove swamps, large rivers, lakes, and flooded rice fields. They are highly adaptive raptors frequently seen near human-dominated coastal wetlands and fishing ports.

Species Description

The Brahminy Kite is a medium-sized bird of prey easily distinguished by its striking, contrasting plumage. Adults feature a pristine white head, neck, and chest, which contrast sharply with a rich, chestnut-brown body and wing coverts. The tips of their wings are black, and they possess a strongly hooked, pale beak and bright yellow feet with sharp talons. In Indonesian and Indian folklore, this bird holds significant cultural importance, often associated with the mythical bird Garuda.

Feeding Habit

Opportunistic scavenger and carnivore. Its diet is highly varied, consisting of dead fish, crabs, small mammals, amphibians, reptiles, and insects. They are also notorious for

kleptoparasitism, frequently stealing food and prey mid-air from other fish-eating birds.

Behavior

Primarily diurnal and solitary, though they can occasionally be seen in loose groups around abundant food sources like fish markets or dumps. They are superb gliders, often seen soaring effortlessly over water or open ground looking for food. When hunting or scavenging, they drop down to snatch prey directly from the water surface or ground with minimal effort.

Conservation Status

Least Concern (IUCN Red List). While their populations are generally stable across their widespread range in South and Southeast Asia and Australia, they face localized threats from habitat destruction, wetland pollution, and pesticide usage.



Species 12: Blackbuck

Scientific Name: *Antilope cervicapra*

Family: Bovidae

Photo Title: Blackbuck (Ex-Situ Profile Study)

Observation Site: Managed Facility Enclosure, Bannerghatta National Park

Location Captured: The photograph was taken within a managed enclosure facility at Bannerghatta, Karnataka, India. The enclosure provides controlled habitat conditions designed for wildlife conservation awareness, captive management, and ex-situ observational studies of large herbivorous mammals.

Species Description

The Blackbuck is a medium-sized antelope native to the Indian subcontinent. Males are distinguished by their striking dark brown to black coats, contrasting white underbellies, and long spiraled horns. Females and juveniles are lighter in color, usually yellowish-fawn, and typically lack horns. Known for their speed and agility, Blackbucks are among the fastest animals in South Asia.

Feeding Habit

- Primarily grazers, feeding on short grasses
- Occasionally browse shrubs and herbs when grass is scarce
- Adapted to open plains and semi-arid grasslands

Behavior

- Highly social, forming herds that may include females, juveniles, and bachelor males
- Males establish territories and engage in lekking behavior to attract females
- Diurnal, active during the day and resting in shade during peak heat
- Known for swift running and coordinated group movements to evade predators

Conservation Status

- **IUCN Red List:** Least Concern, though populations are fragmented in several regions
- **Major Threats:** Habitat loss, hunting, and human encroachment
- **Conservation Efforts:** Protected under Schedule I of the Wildlife Protection Act, 1972 (India)
- **Cultural Significance:** Revered and protected by communities such as the Bishnoi community in India



Species 13: Indian Palm Squirrel

Scientific Name: *Funambulus palmarum*

Family: Sciuridae

Photo Title: Indian Palm Squirrel (Foraging Individual)

Observation Site: Urban Greenbelt/Campus Vegetation Area, Maharashtra, India.

Location Captured: The photograph was captured in a semi-urban habitat consisting of trees, gardens, plantation areas, and human-associated green spaces in Maharashtra, India. Such environments provide abundant food resources and nesting sites for Indian Palm Squirrels.

Species Description

The Indian Palm Squirrel is a small striped rodent commonly distributed across the Indian subcontinent. It is recognized by its greyish-brown fur, bushy tail, and three distinctive white dorsal stripes running from head to tail. The species is highly adaptable and frequently observed in gardens, campuses, agricultural lands, and forest edges.

Feeding Habit

- Omnivorous in nature
- Feeds on fruits, seeds, nuts, grains, insects, and tender plant material
- Occasionally consumes human food scraps in urban environments

Behavior

- Highly active and agile, especially during daytime
- Excellent climber commonly seen on trees, walls, and rooftops
- Produces sharp chirping calls as alarm or communication signals
- Builds nests using dry grass, leaves, and fibers in tree cavities or branches

Conservation Status

- **IUCN Red List:** Least Concern
- Widely distributed with stable populations across suitable habitats
- Plays an important ecological role in seed dispersal and maintaining urban biodiversity

Study Area and Site Description

The present biodiversity documentation and ecological assessment were conducted across multiple ecologically diverse regions of Maharashtra and Karnataka, India. These study locations represented a gradient of natural forests, inland wetlands, institutional greenbelts, agro-ecosystems, semi-urban habitats, and managed wildlife conservation facilities. Each site provided distinct ecological niches supporting different avian and mammalian taxa.

Bannerghatta National Park, Karnataka

Bannerghatta National Park

Geographic and Ecological Profile

Bannerghatta National Park is located in the southern part of Karnataka near Bengaluru city within the Anekal forest range. The landscape primarily consists of tropical dry deciduous forests interspersed with thorn scrub vegetation, rocky outcrops, grassland patches, and seasonal water bodies.

Ecological Significance: The protected habitat supports diverse faunal assemblages including large herbivores, carnivores, reptiles, and avifauna. The park functions as an important biodiversity corridor within the fragmented forest systems surrounding Bengaluru.

Species Documented: The site served as the principal mammalian observation zone where the following species were documented

- Chital
- Asian Elephant
- Plains Zebra
- Bengal Tiger
- Blackbuck

Habitat Characteristics

- Dry deciduous woodland ecosystem
- Forest-edge grazing zones
- Managed ex-situ wildlife enclosures
- Seasonal grassland vegetation
- Rocky terrain with scrub vegetation

The combination of natural and managed habitats allowed comparative observations between free-ranging wildlife and captive conservation units.

Chhatrapati Sambhajnagar (Aurangabad), Maharashtra

Chhatrapati Sambhajnagar

Geographic and Ecological Profile

The Chhatrapati Sambhajnagar region lies within the semi-arid Deccan Plateau ecosystem characterized by dry scrublands, agricultural landscapes, seasonal wetlands, and fragmented vegetation patches.

Ecological Significance

The region represents a dynamic interface between urban development and remnant natural habitats. Despite increasing anthropogenic activity, several bird species continue to utilize plantation belts, open scrublands, and wetland margins.

Institutional and Research Importance

This region serves as the operational research base of RITS AQUALIFE LLP, where sustainable aquaculture and Biofloc Technology-based fish farming systems are implemented and studied.

Species Documented

The following avian species were recorded from this region:

- Baya Weaver
- Indian Palm Squirrel

Habitat Characteristics

- Semi-arid scrub vegetation
- Agricultural buffer zones
- Wetland-associated grasslands
- Urban plantation corridors
- Human-modified ecological landscapes

These habitats support both resident and migratory species adapted to moderate environmental disturbance.

Washim District, Maharashtra**Washim**

Washim district formed one of the most significant ecological study regions in the present investigation due to its mixture of wetlands, plantation habitats, institutional campuses, and agro-rural landscapes.

Jawahar Navodaya Vidyalaya (JNV) Campus, Washim**Jawahar Navodaya Vidyalaya Washim**

Ecological Profile: The JNV campus contains dense plantation cover composed of native and ornamental tree species including *Azadirachta indica*, *Ficus* spp., and other shade-providing vegetation.

Ecological Importance: The relatively low human disturbance, abundant canopy cover, and availability of food resources create an ideal microhabitat for arboreal birds, insectivores, and small raptors.

Species Documented

- Shikra
- Coppersmith Barbet

Habitat Characteristics

- Plantation ecosystem
- Semi-urban canopy habitat
- Tree cavity nesting zones
- Open grounds and edge vegetation

The site proved highly suitable for documenting nesting behavior, frugivory, and avian predation dynamics.

Ek Bhurji Dam Reservoir, Washim**Ecological Profile**

Ek Bhurji Dam Reservoir represents an inland freshwater wetland ecosystem formed by reservoir impoundment and associated shallow-water zones.

Ecological Importance

The reservoir supports aquatic productivity and functions as an important feeding and staging habitat for wetland-dependent avifauna.

Species Documented

- Painted Stork

Habitat Characteristics

- Shallow freshwater margins
- Marshy vegetation belts
- Aquatic macrophyte growth
- Seasonal fish breeding zones

The wetland ecosystem supported rich piscivorous bird activity and served as an important bio-indicator site for aquatic ecosystem health.

Pusad-Fetra Region, Yavatmal District, Maharashtra
Yavatmal**Geographic and Ecological Profile**

The Fetra region of Pusad Taluka is characterized by rugged terrain, dry deciduous vegetation, rocky scrublands, agricultural edges, and fragmented woodland patches.

Ecological Significance

The region supports a diverse assemblage of insectivorous birds, small raptors, and ground-associated passerines adapted to semi-arid environments.

Species Documented

- Indian Robin
- Shikra

Habitat Characteristics

- Agricultural mosaics
- Dry scrub vegetation
- Stone boundary structures
- Canopy perching zones
- Open countryside ecosystems

The site proved valuable for observing territorial avian behavior, predatory strategies, and adaptation to rural landscapes.

Wetland and Coastal Observation Zones**Ecological Profile**

Additional opportunistic observations were conducted across wetland-associated landscapes and aquatic buffer zones supporting piscivorous and scavenging raptors.

Species Documented

- Brahminy Kite

Habitat Characteristics

- Estuarine vegetation
- Wetland perching structures
- Reservoir and river margins
- Fishing-associated ecological zones

These habitats demonstrated the ecological linkage between aquatic productivity and higher trophic-level avian predators.

Overall Ecological Importance of the Study Area

Collectively, the selected study sites represented highly interconnected ecological systems spanning:

- Wetlands and reservoirs
- Forest-edge habitats
- Semi-urban greenbelts
- Grassland ecosystems
- Agro-ecosystems
- Managed wildlife conservation facilities

The Diversity of Habitats Enabled Documentation of Multiple Trophic Guilds Including:

- Apex predators
- Herbivores
- Insectivores
- Frugivores
- Piscivorous waders
- Scavenging raptors

These ecosystems collectively illustrate the ecological complexity and conservation significance of central Indian biodiversity landscapes under increasing human influence.

4. Results and Discussion**4.1 Overall Biodiversity Assessment**

- The present field investigation documented a total of thirteen macrofaunal species representing two major vertebrate classes—Aves and Mammalia—across multiple ecological landscapes of Maharashtra and Karnataka, India. The photographic records revealed significant ecological diversity distributed across wetlands, forest-edge habitats, agricultural matrices, institutional greenbelts, semi-arid scrublands, and

managed ex-situ conservation enclosures.

- Among the documented species, avian taxa represented the highest ecological sensitivity to habitat quality, particularly wetland-associated birds such as the Painted Stork and Asian Woolly-necked Stork. Their consistent presence within inland reservoirs and agro-wetland interfaces strongly indicated relatively stable trophic structures and productive aquatic ecosystems. Similarly, arboreal and insectivorous bird species such as the Coppersmith Barbet and Indian Robin reflected the importance of semi-urban vegetation corridors and plantation habitats in supporting biodiversity persistence within human-modified landscapes.
- The mammalian assemblage revealed a wide ecological spectrum ranging from grazing herbivores to apex predators. Large mammals such as the Asian Elephant and Bengal Tiger demonstrated the structural ecological integrity of protected forest ecosystems surrounding Bannerghatta National Park. Herbivorous species including Chital and Blackbuck highlighted the importance of grassland and open scrub ecosystems in sustaining prey biomass and ecological energy transfer.
- The study further demonstrated that high-resolution wildlife photography provides a scientifically valuable, non-invasive biodiversity monitoring approach capable of preserving authentic behavioral baselines while minimizing anthropogenic disturbance.

4.2 Avian Diversity and Habitat Niche Analysis

4.2.1 Raptor Ecology and Predatory Regulation

The documentation of the Shikra and Brahminy Kite revealed the ecological importance of mid-level avian predators within both terrestrial and wetland ecosystems.

The Shikra exhibited classic ambush-predator behavior characterized by silent canopy perching and rapid short-distance attacks. The species demonstrated strong adaptation to fragmented semi-urban habitats, indicating that moderate vegetation cover within institutional campuses and rural tree corridors still supports functional predatory bird populations. Its presence indirectly suggests adequate populations of small vertebrates and insects, thereby serving as a biological indicator of prey-base stability.

In contrast, the Brahminy Kite displayed highly opportunistic scavenging and aerial foraging strategies closely associated with aquatic ecosystems. Its frequent occurrence near wetland buffers, reservoirs, and fishery-associated landscapes suggests strong ecological connectivity between inland fisheries, estuarine food webs, and scavenger guilds. Because raptors occupy high trophic levels, they remain extremely vulnerable to bioaccumulation of toxins, pesticides, and heavy metals. Their stable occurrence therefore reflects comparatively lower levels of ecological contamination in surveyed areas.

4.2.2 Insectivorous and Frugivorous Bird Communities

The Indian Robin and Coppersmith Barbet represented two ecologically distinct avian feeding guilds that contribute significantly to ecosystem stability.

The Indian Robin occupied open scrublands and agricultural edge-zones where it actively controlled insect populations. Its persistent territorial behavior and successful adaptation to disturbed landscapes demonstrate the ecological resilience of some native passerines under moderate anthropogenic pressure. However, the dependence of the species on low-intensity vegetation cover indicates vulnerability to excessive land clearing and urban expansion.

The Coppersmith Barbet played a much deeper ecological role through frugivory and seed dispersal. Direct observations of feeding on *Ficus* species demonstrated its contribution to natural forest regeneration processes. The repeated utilization of mature trees for cavity nesting further emphasized the ecological value of preserving older tree stands within educational campuses and urban plantations. Such findings indicate that institutional greenbelts can function as important biodiversity refuges even within semi-urban landscapes.

4.2.3 Colonial Nesters and Wetland Bio-Indicators

Among all avian taxa surveyed, the strongest ecological significance emerged from wetland-associated wading birds, particularly the Painted Stork and Asian Woolly-necked Stork.

The Painted Stork demonstrated highly specialized tactile foraging behavior in shallow wetlands. Its successful feeding activity within the Ek Bhurji Reservoir strongly indicated healthy fish recruitment, adequate dissolved oxygen concentration, and stable shallow-water trophic productivity. Since storks require abundant forage fish populations to maintain breeding colonies, their persistence serves as a direct indicator of wetland ecosystem productivity.

The Asian Woolly-necked Stork exhibited broader habitat plasticity by utilizing both wetlands and agricultural landscapes. Nesting activity documented in mature *Azadirachta indica* trees revealed the critical importance of tall canopy trees within rural ecosystems. The coexistence of nesting pairs near agricultural systems further suggests that moderate agro-ecosystems can remain compatible with wildlife conservation when excessive chemical loading and habitat destruction are minimized.

Importantly, both species function as ecological sentinels. Any deterioration in water quality—including eutrophication, ammonia toxicity, pesticide runoff, or wetland shrinkage—would immediately reduce prey availability and reproductive success among these large wading birds.

4.3 Mammalian Ecology and Trophic Dynamics

4.3.1 Herbivore Dynamics and Vegetation Regulation

The herbivorous mammals documented in this study represented foundational trophic components responsible for regulating vegetation structure and nutrient cycling.

The Chital displayed herd-based anti-predator strategies and selective grazing behavior within forest-edge ecosystems. By consuming grasses and undergrowth vegetation, the species contributes to maintaining open forest structure while simultaneously supporting predator populations.

Similarly, the Blackbuck reflected ecological adaptation to semi-arid grassland ecosystems. Observations of coordinated herd movement and territorial lekking behavior demonstrated complex social organization. However, fragmented populations observed in many parts of India suggest increasing habitat isolation caused by urbanization and agricultural expansion.

The Asian Elephant represented the most influential ecological engineer documented during the study. Its browsing and migratory movements facilitate large-scale seed dispersal, vegetation restructuring, and creation of forest pathways used by numerous secondary species. Elephants therefore function as keystone megafauna whose decline would trigger cascading ecological instability across entire forest ecosystems.

4.3.2 Apex Predators and Ecosystem Stability

The presence of the Bengal Tiger holds exceptional ecological importance because apex predators regulate prey populations and maintain trophic equilibrium.

The observed territorial pacing behavior reflected strong spatial awareness and habitat utilization patterns typical of large carnivores. Healthy tiger populations require large, uninterrupted prey-rich landscapes. Consequently, the survival of apex predators indirectly confirms the ecological stability of lower trophic levels including herbivore populations, vegetation structure, and freshwater availability. A decline in apex predator density often initiates trophic cascades characterized by uncontrolled herbivore expansion, vegetation degradation, and eventual habitat collapse. Thus, tiger conservation represents not merely species protection, but preservation of entire ecological networks.

4.4 Role of Sustainable Aquaculture in Biodiversity Conservation

One of the most significant outcomes of this study lies in demonstrating the ecological compatibility between sustainable aquaculture systems and wildlife conservation frameworks.

Historically, conventional aquaculture practices contributed substantially to nutrient loading, eutrophication, and wetland degradation due to excessive water exchange and poor waste management. However, observations associated with the operational framework of RITS AQUALIFE LLP indicate that advanced microbial aquaculture systems such as Biofloc Technology (BFT) can significantly reduce ecological stress on surrounding environments.

Within BFT systems, heterotrophic bacterial communities convert toxic nitrogenous waste into microbial protein biomass, thereby reducing external discharge of harmful metabolites.

The nitrogen conversion process can be represented as:

$$\text{NH}_3 + \text{Organic Carbon} \rightarrow \text{Microbial Biomass} + \text{NH}_3 + \text{Organic Carbon} \rightarrow \text{Microbial Biomass}$$

This closed-loop microbial recycling framework offers several ecological benefits:

Reduction of ammonia and nitrate pollution entering nearby wetlands

Lower freshwater extraction pressure on local reservoirs

Preservation of natural aquatic food chains supporting wetland birds

Reduced habitat encroachment due to high-density production efficiency

Improved coexistence between commercial fisheries and wild biodiversity

The study therefore supports the hypothesis that scientifically managed aquaculture systems can function not as ecological threats, but as integrated components of sustainable watershed management.

4.5 Ecological Significance of Photography-Based Monitoring

The application of wildlife photography proved exceptionally effective for long-term biodiversity assessment. Unlike invasive trapping or tagging techniques, photographic documentation preserved authentic behavioral responses and allowed repeated verification of morphological field markers.

- Photographic analysis enabled:
- Accurate species-level taxonomic confirmation
- Behavioral interpretation without physical interference

- Temporal comparison of habitat utilization patterns
- Permanent digital archival records for future ecological monitoring
- Public awareness generation for conservation education
- Moreover, the portability and affordability of ultra-zoom systems such as the Nikon COOLPIX P900 demonstrate that advanced biodiversity documentation is increasingly accessible to independent researchers and field ecologists.

Conclusion

The present investigation confirms that central Indian ecosystems continue to support diverse avian and mammalian fauna despite increasing anthropogenic pressures. Wetlands, institutional plantations, forest-edge buffers, and semi-arid grasslands collectively function as interconnected ecological units essential for sustaining regional biodiversity.

The Study Highlights that:

- Wetland birds act as highly sensitive ecological bio-indicators
- Large mammals maintain trophic and structural ecosystem balance
- Semi-urban green spaces possess significant hidden conservation value
- Sustainable aquaculture can reduce environmental degradation
- Photography provides a scientifically reliable conservation-monitoring methodology
- Ultimately, the integration of wildlife documentation, wetland ecology, and sustainable aquaculture engineering offers a practical multidisciplinary framework for future biodiversity conservation in rapidly changing human-dominated landscapes.

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