Spider Biodiversity in Central India: A Critical Status Review of Taxonomic Knowledge, Spatial Coverage, Ecological Patterns and Conservation Priorities

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Abstract

Central India contains an extensive mosaic of deciduous forests, plateaux, river basins, wetlands, agricultural land and rapidly expanding settlements, yet the status of its spider fauna remains difficult to interpret. This critical narrative review evaluates the taxonomic baseline, spatial coverage, habitat associations, functional evidence and conservation significance of spiders in Madhya Pradesh and Chhattisgarh, while placing the Central Indian Highlands in their wider landscape context. Literature published from 1990 to 31 May 2026 was identified through accessible scholarly indexes, publisher platforms, institutional sources, taxonomic catalogues and citation tracking; older foundational works were retained when methodologically or historically necessary. State checklists report at least 336 species in Madhya Pradesh and 222 species in Chhattisgarh, but these figures are not additive regional estimates because nomenclatural change, duplicate records, unequal survey effort and unverified identifications remain substantial. Apparent family dominance by Araneidae, Thomisidae, Salticidae, Lycosidae and Gnaphosidae is biologically plausible, yet is also shaped by search methods that favour conspicuous web builders and vegetation-dwelling hunters. Most site studies are short, geographically restricted and weakly standardised, with limited reporting of sampling effort, specimen vouchers, adult-stage verification, completeness estimators or molecular confirmation. Consequently, local richness values are best treated as provisional inventories rather than comparable measures of community structure. Evidence from other regions supports spider sensitivity to habitat complexity, agricultural intensification, pesticides and climatic extremes, but Central Indian bioindicator and pest-suppression claims remain largely inferential. A defensible regional programme requires stratified multi-season sampling, integrative taxonomy, curated voucher collections, DNA barcodes, georeferenced occurrence data and repeated monitoring across forest–agriculture–urban gradients. Central India is therefore a biodiversity-rich regional focus rather than a formally designated global biodiversity hotspot, and its spider diversity is simultaneously substantial, under-documented and methodologically uncertain.

Keywords: *Araneae; Central Indian Highlands; Chhattisgarh; faunal inventory; functional guilds; Madhya Pradesh; sampling completeness; spider conservation.*

1. Introduction

Spiders (order Araneae) are among the most diverse and functionally important terrestrial predators. They occupy vegetation, bark, litter, soil surfaces, caves, buildings, crop canopies and wetland margins, and their evolutionary diversification has produced marked variation in web architecture, hunting behaviour, dispersal, sensory ecology and microhabitat use. The World Spider Catalog recorded 53,689 valid species in 139 families in its Version 26.0 archive, while continuing taxonomic revision demonstrates that species totals and generic placements remain dynamic rather than final (World Spider Catalog, 2026). Global phylogenetic evidence indicates repeated radiations across major terrestrial habitats, but geographical knowledge is strongly biased towards regions with sustained taxonomic institutions and standardised inventories (Dimitrov & Hormiga, 2021). For species-rich tropical countries, a high published count can therefore coexist with major gaps in locality coverage, specimen verification and ecological interpretation. Recent phylogenomic synthesis further shows that genomic datasets have clarified many higher-level relationships while leaving several lineages in need of targeted systematic revision, reinforcing the provisional nature of current classifications (Kulkarni et al., 2023).

India illustrates this tension. The national checklist compiled by Siliwal et al. (2005) listed 1,442 species in 59 families and simultaneously exposed synonymies, doubtful records and uneven documentation. Subsequent barcoding of Indian material revealed cryptic lineages, deep intraspecific divergence and species complexes that cannot be resolved safely by superficial image matching (Tyagi et al., 2019). The central problem is consequently not only how many species have been named, but how reliably names are attached to specimens, how evenly habitats have been sampled and whether occurrence records can support ecological or conservation inference. State-level lists remain indispensable, yet they combine observations produced under different taxonomic concepts, field methods and levels of evidential scrutiny. A recent analysis of a large national spider-record dataset likewise demonstrated that fine-scale assemblage knowledge can remain poor despite extensive historical collecting, because sampling completeness varies markedly with spatial and taxonomic scale (van der Mescht et al., 2024).

Central India is an especially important test case because its landscape links the Vindhyan, Satpura and Maikal systems with the northern Deccan and eastern forest tracts. The region contains dry and moist deciduous forests, sal- and teak-dominated stands, riparian corridors, rocky plateaux, grasslands, reservoirs, paddy landscapes and intensively managed crop mosaics. These environments potentially accommodate web-building, ambush-hunting, cursorial and burrowing guilds at several vertical strata. At the same time, protected areas of the Central Indian Highlands experience interacting anthropogenic, climatic and species-related vulnerabilities, and broad-scale connectivity has been disrupted by roads, settlement, mining, agriculture and other land-use change (Dutta et al., 2016; Singh & Moharir, 2024). Most landscape planning has centred on large vertebrates; the status of smaller predatory arthropods has rarely been incorporated into management baselines. Evidence from the Ganga riparian zone further indicates that anthropogenic habitat disturbance can influence the taxonomic and functional dimensions of Indian spider communities, underscoring the need for locally measured disturbance gradients (De et al., 2023).

The phrase 'Indian hot spot Central India' needs conceptual care. The global biodiversity-hotspot framework identifies regions through exceptional vascular-plant endemism combined with severe habitat loss, and Central India is not a formally designated hotspot under that framework (Myers et al., 2000). It is more defensible to describe Central India as a biodiversity-rich regional landscape or a regional focus of conservation concern. This distinction is not semantic pedantry: formal hotspot language carries particular thresholds and policy implications, whereas the present review addresses a biogeographical and administrative region defined principally by Madhya Pradesh and Chhattisgarh. Evidence from adjoining states is used only when it clarifies methods, landscape processes or national taxonomic context.

Published spider work in the region has expanded from broad checklists towards district inventories, crop surveys and isolated distributional records. The early joint checklist for Madhya Pradesh and Chhattisgarh reported 186 species in 69 genera and 24 families (Gajbe, 2003). A later Madhya Pradesh synthesis increased the state total to 336 species in 136 genera and 30 families, while an updated Chhattisgarh list reported 222 species in 96 genera and 23 families (Choudhury et al., 2024; Singh & Sharma, 2022). These increases demonstrate active discovery and literature consolidation, but they should not be interpreted as equivalent rates of biological accumulation. Administrative separation, rediscovery of previously published records, changes in nomenclature, newly sampled districts and genuinely new state records all contribute to rising totals.

Ecological studies provide a second, less coherent evidence stream. Surveys around Jabalpur, Gariyaband, Rajnandgaon, Raipur and reservoir environments report between a few dozen and several dozen species, often with Araneidae, Salticidae, Thomisidae or Lycosidae among the most conspicuous families (Dubey et al., 2021; Nichat et al., 2025; Pandey & Agrawal, 2026; Upadhyay et al., 2018). Yet richness values are not directly comparable when survey duration, area, observer effort, season, trapping intensity, taxonomic resolution and treatment of juveniles differ. One recent multi-habitat study also contains an internal inconsistency between its stated regional total and the richness attributed to one district, illustrating why numerical results require source-level scrutiny before synthesis (Chandrakar & Jha, 2026).

The ecological importance of spiders is nevertheless well established at broader scales. They collectively consume very large quantities of prey, participate in energy transfer and nutrient cycling, and may contribute to suppression of agricultural pests (Cardoso et al., 2025; Nyffeler & Birkhofer, 2017; Nyffeler & Sunderland, 2003). Their responses to vegetation structure, disturbance, management and toxic exposure make them promising components of biodiversity monitoring, although indicator performance depends on explicit reference conditions and repeatable sampling (Pearce & Venier, 2006; Pekár, 2012; Prieto-Benítez & Méndez, 2011). Central Indian publications frequently invoke these functions, but direct regional tests of prey removal, crop protection or indicator validity remain scarce. Recent urban-gradient research also found that increasing urban density filters foliage-dwelling spider assemblages at both taxonomic and functional levels, supporting cautious use of spiders in landscape monitoring (Piquet et al., 2025).

1.1 Scope, Research Gap and Objectives

This review focuses on the documented spider fauna of Madhya Pradesh and Chhattisgarh and interprets it within the ecological setting of the Central Indian Highlands. It examines state and district inventories, selected habitat-level studies, taxonomic revisions, sampling methodology, functional-guild interpretation, molecular identification, threats and conservation applications. The review does not attempt a complete species-by-species catalogue, re-identify published specimens, or extend formal regional boundaries to every adjoining district. Records from outside Central India are used comparatively when they demonstrate relevant inventory standards, ecological mechanisms or methodological advances.

The principal knowledge gap is the absence of a critical regional synthesis that separates accumulated taxonomic records from comparable ecological evidence. Existing state checklists summarise names and localities, while site studies provide fragmented snapshots. Neither evidence stream alone establishes inventory completeness, spatial representativeness, temporal change or functional significance. The objectives are therefore to assess the current taxonomic baseline; identify spatial, habitat and seasonal biases; evaluate methodological and nomenclatural reliability; distinguish demonstrated ecological functions from extrapolated claims; analyse threats and management relevance; and define a prioritised, reproducible research agenda for Central Indian spider biodiversity.

2. Methods for Literature Selection

2.1 Review Design and Rationale

A critical narrative review was selected because the available evidence comprises heterogeneous state checklists, taxonomic treatments, brief natural-history records, local inventories, ecological surveys, global syntheses and methodological studies. These sources do not share a common sampling frame, intervention, comparator or outcome suitable for meta-analysis. Nor would a simple scoping inventory adequately address the reliability of names, comparability of richness estimates or transferability of ecological claims. The review was structured around the quality dimensions promoted by the Scale for the Assessment of Narrative Review Articles, including a justified importance, explicit aims, transparent literature selection, appropriate referencing, scientific reasoning and relevant presentation of evidence (Baethge et al., 2019). Narrative synthesis was not treated as an exemption from transparent search or critical appraisal.

2.2 Information Sources

Sources were identified through live scholarly web searching of PubMed and PubMed Central, the Directory of Open Access Journals, Semantic Scholar, publisher and journal platforms, DOI and bibliographic landing records, the World Spider Catalog, institutional publication pages, and accessible zoological repositories. The official pages of journals publishing regional records were searched directly when available. Backward citation checking was applied to major Indian checklists, taxonomic revisions and methodological reviews, and forward searching was used to locate later regional updates and studies that cited the foundational Central Indian checklists. Subscription-only databases were not represented as comprehensively searched because complete exported records were not available.

2.3 Search Strategy and Search Period

The principal search period was 1 January 1990 to 31 May 2026. The starting year captures the modern expansion of biodiversity inventory, quantitative community ecology and digital taxonomic consolidation, while selected older concepts were considered only when indispensable. Search concepts combined spider terms (‘spider’, ‘Araneae’, ‘araneofauna’, ‘arachnid’) with geographical terms (‘Central India’, ‘Central Indian Highlands’, ‘Madhya Pradesh’, ‘Chhattisgarh’, district and protected-area names) and analytical terms (‘diversity’, ‘checklist’, ‘inventory’, ‘new record’, ‘guild’, ‘habitat’, ‘seasonality’, ‘agroecosystem’, ‘forest’, ‘urban’, ‘DNA barcode’, ‘taxonomy’, ‘bioindicator’, ‘pesticide’, ‘conservation’). Representative strings included: (spider* OR Araneae OR araneofauna) AND (‘Madhya Pradesh’ OR Chhattisgarh OR ‘Central India’) AND (diversity OR checklist OR inventory); and (spider* OR Araneae) AND (sampling OR guild* OR barcode* OR bioindicator* OR pesticide*) AND (India OR tropical). Exact article titles and DOI strings were searched during reference verification.

2.4 Eligibility Criteria

Peer-reviewed journal articles, authoritative taxonomic catalogues and verifiable institutional records were eligible when they addressed Central Indian spider occurrences, Indian taxonomic context, inventory methodology, spider guilds, habitat relationships, ecological functions, threats or conservation interpretation. Regional studies were prioritised even when descriptive, because they constitute much of the available baseline; their design limitations were appraised rather than concealed. Global studies were included only when they supported a clearly transferable methodological or mechanistic proposition. English-language full texts or sufficiently detailed official abstracts were required for claim-level use. Sources were excluded when bibliographic identity could not be confirmed, the locality was ambiguous, a record was supported only by an informal image post, or claims could not be traced to an accessible scholarly source. Papers published after 31 May 2026 were outside the review window.

2.5 Screening, Duplicate Handling and Study Selection

Titles and abstracts were screened for regional and thematic relevance, after which full texts, journal pages or official bibliographic records were examined. Duplicate citations were reconciled by DOI, title, author combination and publication details. When a checklist repeated an earlier record, the later compilation was used for the current total and the earlier source was retained only when historically or methodologically informative. No numerical screening flow is reported because searches were iterative and platform outputs were not exported into a single deduplicated database. Unverifiable citations and records that could not be associated with stable metadata were not used. Taxonomic names were interpreted against the World Spider Catalog where feasible, but the review did not independently validate every specimen-level identification.

2.6 Critical Appraisal and Evidence Synthesis

Evidence was appraised according to geographical coverage, survey duration, seasonality, habitat stratification, sampling effort, method diversity, specimen maturity, identification authority, voucher deposition, nomenclatural currency, molecular support, statistical appropriateness and internal consistency. State checklists were treated as cumulative occurrence syntheses, not abundance studies. Site inventories were compared only qualitatively unless effort and design were sufficiently similar. Ecological mechanisms were considered strongly supported when replicated or meta-analytical evidence existed, but locally untested applications were labelled plausible rather than established. Themes were developed iteratively around the regional baseline, spatial completeness, habitat and guild patterns, methodological reliability, ecological functions, threats and future infrastructure. Contradictions were examined for differences in scale, method, taxonomic resolution and source quality before biological explanations were proposed.

3. Central India as a Biogeographical and Taxonomic Review Unit

3.1 Geographic Boundaries and the Meaning of “Hot Spot”

For this review, Central India is operationalised primarily as Madhya Pradesh and Chhattisgarh, with emphasis on the Central Indian Highlands and associated plains. This boundary is administratively reproducible and corresponds to the principal state checklists, but it is not a closed biogeographical system. River catchments, hill chains and forest corridors extend into Maharashtra, Uttar Pradesh, Jharkhand, Odisha and Telangana. Spider distributions are unlikely to follow state borders, especially for ballooning species and habitat generalists. Administrative checklists therefore describe knowledge jurisdictions rather than natural faunal provinces.

The region's environmental heterogeneity is likely to promote beta diversity. Elevational transitions, rainfall gradients, contrasting forest types, lateritic and basaltic substrates, reservoir margins and crop mosaics produce different combinations of vegetation architecture, humidity, litter depth and prey availability. Evidence from other regions shows that local spider richness can be influenced more strongly by vegetation structure than by altitude alone, while complex habitats often support more diverse natural-enemy assemblages (Jiménez-Valverde & Lobo, 2007; Langellotto & Denno, 2004). These mechanisms are relevant to Central India, but the regional literature seldom quantifies canopy openness, litter depth, plant-layer complexity or prey biomass alongside spider data.

Calling Central India a formal biodiversity hotspot would misapply the global framework of Myers et al. (2000). Nevertheless, the Central Indian Highlands are of high conservation value, and recent protected-area analysis indicates overlapping anthropogenic and climatic vulnerability (Singh & Moharir, 2024). A regional 'hot spot' interpretation can therefore be retained only in the non-technical sense of a landscape expected to contain substantial, unevenly known biodiversity. The distinction matters because spider conservation priorities should arise from evidence on range restriction, habitat association, endemism and threat, not from rhetorical elevation of the entire region.

3.2 Regional Taxonomic Baseline

The earliest widely cited consolidated baseline for the two states listed 186 species, 69 genera and 24 families (Gajbe, 2003). That checklist was valuable for converting dispersed literature into a regional reference, but it predates two decades of taxonomic revision, digital cataloguing and intensified local collecting. It should consequently be read as a historical floor, not a stable estimate. The national synthesis of Siliwal et al. (2005) similarly highlighted that Indian spider records included synonymies, nomenclatural problems and uncertain identifications, a warning that remains directly relevant to state-level accumulation.

The updated Madhya Pradesh checklist reported 336 species in 136 genera and 30 families, distributed across records from 36 of 52 districts (Singh & Sharma, 2022). Araneidae and Thomisidae were each represented by 55 species, followed by Lycosidae, Salticidae and Gnaphosidae. The numerical expansion reflects both genuine knowledge growth and intensified compilation. Because sixteen districts lacked reported species in the checklist, even this much larger total cannot be considered close to a saturated inventory. The concentration of records in Jabalpur, Mandla, Balaghat, Chhindwara, Damoh, Betul and Indore also reveals a strong association between apparent diversity and where specialists or institutions have worked.

For Chhattisgarh, Choudhury et al. (2024) synthesised 222 species in 96 genera and 23 families. Araneidae was the richest family in the compilation, followed by Thomisidae and Gnaphosidae. The authors combined literature with contemporary field observations and documented many species not previously reported from the state. This is an important update, but it also illustrates the mixed ontology of regional checklists: some entries represent historical literature records, some recent field identifications, and some nomenclatural reinterpretations. Without specimen-linked occurrence data, the confidence attached to individual records cannot be assumed uniform.

The state totals should not be summed to claim 558 unique Central Indian species. Species shared between the states, synonyms, changed combinations and repeated historical records would inflate such a number. A reliable regional total requires reconciliation at the currently accepted species level, explicit handling of doubtful records, and a specimen- or publication-level provenance field for every occurrence. The World Spider Catalog provides the nomenclatural backbone, but regional curators must still determine whether a cited name was correctly applied to material from a given locality (World Spider Catalog, 2026).

Table 1 summarises the principal taxonomic baselines and their interpretive value. The progression from 186 species in a joint checklist to separate totals of 336 and 222 demonstrates substantial knowledge accumulation, yet it does not measure ecological change. The strongest conclusion is that Central India supports a large and still incompletely documented fauna; claims about exact richness, endemism or state differences remain provisional until records are reconciled and under-sampled districts are surveyed.

Table 1. Principal taxonomic baselines for spider diversity in Central India

Geographic Scope	Reported Richness	Primary Contribution	Critical Limitation	Supporting References
Madhya Pradesh and Chhattisgarh (joint historical baseline)	186 species; 69 genera; 24 families	First widely used consolidated regional checklist	Predates extensive recent collecting and nomenclatural revision; not a current regional total	Gajbe (2003)
Madhya Pradesh	336 species; 136 genera; 30 families	Updated state synthesis with district-level distribution	Records available for only 36 of 52 districts; effort strongly concentrated	Singh and Sharma (2022)
Chhattisgarh	222 species; 96 genera; 23 families	Updated literature and field-based checklist with new state additions	Mixed provenance and uneven record confidence; district completeness not demonstrated	Choudhury et al. (2024)
India	1,442 species; 59 families (2005 baseline)	National context and exposure of synonymy and identification problems	Now dated; not a denominator for present completeness	Siliwal et al. (2005)
Global catalogue (Version 26.0)	53,689 species; 139 families	Current nomenclatural reference and taxonomic authority	Catalogue validity does not verify regional specimen identification	World Spider Catalog (2026)

Note. Counts are those reported by the cited sources and should not be added across overlapping geographic units. "Richness" denotes documented taxonomic records, not estimated true richness

4. Spatial Patterns and Inventory Completeness

4.1 Madhya Pradesh

Madhya Pradesh currently has the larger published state total, but record density is highly uneven. Singh and Sharma (2022) reported the greatest district-level richness for Jabalpur, followed by Mandla and Balaghat, with substantial records also from Chhindwara, Damoh, Betul and Indore. These districts include a mixture of research institutions, protected forests, accessible campuses and frequently visited collecting localities. Their rank therefore reflects both environmental heterogeneity and observer effort. A district with few records may be genuinely species-poor, but the present evidence more often indicates that it has not been surveyed intensively enough to distinguish low richness from low detection.

Jabalpur illustrates how institutional proximity can amplify the known fauna. Upadhyay et al. (2018) recorded 28 species from post-rainy-season crops at an agricultural university, whereas Dubey et al. (2021) reported 36 species from the Central Ordnance Depot estate using pitfall traps and sweep-netting over four months. These studies add useful habitat observations, but their spatial footprints, seasons and collection effort differ. The crop survey emphasised vegetation-associated species in managed fields, while the depot study sampled a secured green estate. Neither can be interpreted as a district-wide inventory, and neither offers the completeness diagnostics needed to estimate how many species remained undetected.

The concentration of records in eastern and south-eastern forested districts may also be biologically meaningful. Mandla, Balaghat, Chhindwara and Betul intersect major forest blocks and elevational gradients, offering diverse vegetation strata and relatively continuous habitat. Yet rigorous separation of environment from effort would require equal-area, equal-effort sampling across environmental gradients. No regional occupancy analysis or spatial rarefaction currently provides that control. Distribution maps based only on presence records would risk reproducing the geography of arachnological activity rather than the geography of spider diversity.

Protected areas are conspicuous gaps. Central India contains numerous tiger reserves, national parks, wildlife sanctuaries and forest divisions, but publicly accessible spider inventories are sparse or inconsistent. Vertebrate-focused protected-area datasets cannot substitute for arthropod baselines. In comparison, the Chinnar Wildlife Sanctuary inventory in the Western Ghats demonstrated the value of a protected-area checklist linked to explicit local sampling, even though a preliminary checklist remains incomplete (Adarsh & Nameer, 2016). Similar protected-area programmes in Madhya Pradesh would permit repeated monitoring and clearer attribution of records to habitats and management regimes.

4.2 Chhattisgarh

Chhattisgarh's updated list confirms substantial diversity but also exposes the early stage of spatial documentation. The state spans northern plateaux, the Maikal and Chota Nagpur transition, the central Mahanadi basin and the Bastar plateau, yet recent site-level studies cluster around Gariyaband, Raipur, Rajnandgaon and Sarangarh-Bilaigarh. Northern and southern forest districts remain comparatively weakly represented in accessible peer-reviewed literature. This imbalance is consequential because Bastar and Surguja contain extensive forest and topographic heterogeneity that may support lineages absent from central plains.

A three-month survey in north-eastern Gariyaband reported 55 species in 42 genera and 11 families, with Araneidae and Salticidae prominent (Nichat et al., 2025). The result is a useful locality checklist, but August–October sampling disproportionately captures monsoon and early post-monsoon activity. Species with dry-season adult phenology, litter-dwelling taxa requiring extraction methods, and canopy taxa beyond visual reach are likely underrepresented. The reported richness cannot therefore be compared directly with annual surveys or state compilations.

Rajnandgaon was surveyed across urban, forest and agricultural habitats using several collection methods, yielding 25 species from 20 genera and nine families (Sahu & Gautam, 2025). Methodological breadth is a strength, but some reported identifications and habitat associations require voucher-based re-examination because the study includes taxa whose known biogeography raises questions. This does not justify rejecting the entire inventory; it shows why regional biodiversity data need archived specimens, diagnostic images and transparent identification pathways before unusual records are reused in distribution models.

Two 2026 studies broaden the evidence. Chandrakar and Jha (2026) sampled forest/hilly, mixed forest–agriculture and urban/semi-urban settings across Gariyaband, Mahasamund and Raipur for a year using pitfall traps, sweep-netting and visual searches. The multi-habitat, multi-method design is valuable, but the abstract reports 57 species overall while attributing 59 species to Gariyaband, an internal impossibility that weakens confidence in derived diversity indices until corrected against the underlying species matrix. Pandey and Agrawal (2026) documented 60 species in 53 genera and 16 families around Kedar Dam over twelve months. Its annual coverage improves seasonal representation, yet the lack of a standard effort denominator still limits comparison with other sites.

Recent distributional notes have recorded the zodariid genus *Storenomorpha*, theridiid spiders and the salticid *Epocilla aura* from additional Chhattisgarh localities (Nayak et al., 2025; Nayak, Nichat, et al., 2026; Nayak, Warte, et al., 2026). Such notes are valuable because range extensions can reveal overlooked habitat continuity and direct attention to under-collected families. Their evidential weight depends on adult diagnostic characters, deposited vouchers and explicit comparison with similar species. Distributional increments should be integrated into the state checklist only after nomenclatural and specimen-level verification.

4.3 District Coverage, Protected Areas and Survey Voids

The regional evidence is best visualised as a network of well-sampled nodes within a much larger unsampled matrix. Districts containing universities or active collectors accumulate records, whereas remote forest divisions, mining landscapes, dry rocky systems, caves and seasonal wetlands remain poorly represented. The absence of records is particularly uninformative for small sheet-web builders, litter specialists, mygalomorphs and canopy species because common rapid methods have low detection probability for these groups.

Spatial completeness should be assessed with more than a checklist map. Priority analyses include sampling-coverage estimators, distance-to-road and distance-to-institution bias, environmental representativeness, species accumulation by district and family, and occupancy models based on repeated visits. When occurrence coordinates are made available, grid-based coverage can reveal whether apparent richness centres persist after controlling for sampling intensity. Until such analyses are performed, district rankings should be described as documented richness, not biodiversity value.

Table 2 compares representative regional studies. It shows that local totals range from 25 to 60 species, but that duration and methods vary substantially. The analytical implication is not that one site is richer than another; rather, the studies collectively confirm a diverse fauna across agriculture, institutional green space, forest and reservoir margins while failing to establish a common quantitative baseline.

Table 2. Representative site-level inventories and their implications for spatial completeness

Locality and Habitat	Period and Methods	Reported Richness	Interpretive Value and Principal Caution	Supporting References
Jabalpur agricultural fields, Madhya Pradesh	Two post-rainy crop seasons; field searches/collection	28 species; 14 families	Shows crop-associated diversity; restricted season and managed-site focus	Upadhyay et al. (2018)
Central Ordnance Depot estate, Jabalpur	Four months; pitfall traps and sweep-netting	36 species; 11 families	Adds secured green-space inventory; limited temporal and district coverage	Dubey et al. (2021)
North-east Gariyaband forest region	August–October 2024; mixed field collection	55 species; 11 families	Useful monsoon/post-monsoon locality list; short duration and uneven detectability	Nichat et al. (2025)
Rajnandgaon urban, forest and agricultural sites	Random multi-method sampling	25 species; 9 families	Broad habitat intent; unusual records require strong voucher verification	Sahu and Gautam (2025)
Gariyaband, Mahasamund and Raipur gradient	July 2023–June 2024; pitfall, sweep and visual surveys	57 species stated overall	Year-round multi-habitat design; internal richness inconsistency requires correction	Chandrakar and Jha (2026)
Kedar Dam vicinity, Sarangarh-Bilaigarh	July 2024–June 2025; multiple collection methods	60 species; 16 families	Annual wetland-edge baseline; effort standardisation and completeness remain unclear	Pandey and Agrawal (2026)

Note. Reported values are not directly comparable because sampling area, effort, season and taxonomic verification differ

5. Habitat Associations, Guild Structure and Seasonality

5.1 Forest and Woodland Assemblages

Forest spider assemblages are structured by vertical strata, vegetation architecture, litter properties and microclimate. Orb-web spiders require attachment points and open flight paths for prey interception; sheet-web builders depend on humid, structurally suitable spaces; ambush hunters use foliage or bark; cursorial hunters exploit ground and litter; and burrowers respond to soil texture and disturbance. The global guild framework of Cardoso, Pekár, et al. (2011) is useful for comparing functional composition, but assigning Central Indian species to guilds does not substitute for measuring local behaviour or resource use.

Central Indian forests vary from dry teak-dominated stands to moister sal forests and riparian patches. Such contrasts should generate turnover, yet published studies rarely compare matched forest types with replicated plots. Forest-rich Gariyaband produced high documented richness in short surveys, and state checklists contain many Araneidae, Thomisidae and Gnaphosidae, but dominance may partly reflect detectability (Choudhury et al., 2024; Nichat et al., 2025). Visual searches and beating readily recover large orb-webs, crab spiders and jumping spiders; they are less effective for minute litter taxa, nocturnal hunters and cryptic ground dwellers.

Habitat complexity is a plausible driver. Regional-scale work elsewhere found strong relationships between vegetation structure and richness in Araneidae and Thomisidae, and meta-analysis indicates that structurally complex habitats tend to enhance natural-enemy abundance (Jiménez-Valverde & Lobo, 2007; Langellotto & Denno, 2004). In Central India, this predicts greater guild diversity in multilayered forest and ecotones than in simplified plantations, but the prediction remains weakly tested. Studies should record basal area, canopy closure, shrub density, herb cover, litter depth, coarse woody debris, humidity and prey abundance so that habitat associations can be evaluated rather than inferred from site labels.

Fire is an additional regional determinant that is largely absent from spider studies. Recurrent dry-season burning alters litter depth, vegetation structure and refuge availability, with likely guild-specific effects. A single post-fire census could confuse temporary activity shifts with population decline. Before-after-control-impact designs across burn intensities would be more informative, especially when combined with litter extraction, pitfall traps and vegetation sampling.

5.2 Agroecosystems and Pest-Suppression Potential

Agricultural habitats are among the best represented Central Indian environments, particularly around Jabalpur. The presence of diverse spiders in post-rainy crops confirms that cultivated systems support multiple predator guilds (Upadhyay et al., 2018). Yet species presence alone does not establish pest control. Demonstrating biocontrol requires evidence linking spider abundance or identity to predation rates, pest suppression, crop damage or yield, while accounting for intraguild predation and non-pest prey.

The broader literature provides a credible mechanism. Spiders consume a wide range of herbivorous insects, and diversified agricultural habitats can increase their abundance and distribution (Nyffeler & Sunderland, 2003; Sunderland & Samu, 2000). A global meta-analysis found context-dependent biocontrol efficacy rather than uniform benefit, with predator and prey traits, crop system and experimental design influencing outcomes (Michalko et al., 2019). Central Indian claims should therefore avoid treating all spiders as interchangeable pest-control agents. Web builders, stalkers and ground hunters encounter different pest stages and respond differently to tillage, residue, field margins and insecticide exposure.

Pesticides can reduce spiders directly through mortality and sublethal behavioural effects and indirectly through prey depletion or habitat change. The magnitude depends on compound, dose, application method, species and guild, and standardised sublethal testing remains limited (Pekár, 2012). Meta-analysis of land management also indicates that intensive practices can reduce spider abundance and richness, although effects vary among systems (Prieto-Benítez & Méndez, 2011). A regional research programme should compare conventional, integrated and low-input fields while documenting active ingredients, application dates, residue management and surrounding non-crop habitat.

Management recommendations must remain evidence-calibrated. Maintaining vegetated margins, reducing unnecessary broad-spectrum insecticides and retaining structural refuges are mechanistically defensible, but their benefits to Central Indian yields and target-pest suppression require replicated local experiments. The most useful outcomes would combine spider community composition with sentinel-prey removal, molecular gut-content analysis, pest density and crop loss.

5.3 Urban, Peri-urban, Wetland and Reservoir Environments

Institutional campuses, defence estates, settlements and reservoir margins are recurrent survey sites because they are accessible and contain habitat mosaics. Such areas can support high local diversity through gardens, old trees, buildings, unmanaged patches and artificial lighting. The Jabalpur depot and Kedar Dam inventories demonstrate that non-protected sites can contribute substantial records (Dubey et al., 2021; Pandey & Agrawal, 2026). They also risk becoming convenience samples that dominate regional knowledge while remote natural habitats remain unstudied.

Urbanisation filters spider communities through loss of vegetation, altered temperature and humidity, light pollution, prey redistribution and building-associated niches. Some salticids, theridiids and pholcids tolerate or exploit buildings, whereas litter and forest-interior specialists may disappear. The three-district Chhattisgarh comparison was designed to address a forest–mixed–urban gradient and reported lower diversity for the urban/semi-urban district, but the internal inconsistency in richness counts prevents strong numerical interpretation (Chandrakar & Jha, 2026). Replicated urban gradients should distinguish impervious cover, vegetation volume, pesticide use and night-light intensity rather than relying on broad habitat categories.

Reservoir and wetland edges add humidity gradients, emergent vegetation and aquatic-insect prey subsidies. The Kedar Dam study provides a useful annual checklist, while an urban-lake survey from Chennai shows how small water bodies can harbour taxonomically varied assemblages even in modified landscapes (Caleb, 2020; Pandey & Agrawal, 2026). Central Indian wetland studies should sample shoreline vegetation, adjacent fields and upland reference plots to test whether assemblages are driven by aquatic prey, plant structure or general habitat heterogeneity.

Table 3. Habitat and functional interpretations requiring targeted testing in Central India

Habitat or Process	Current Regional Signal	Plausible Mechanism	Evidence Needed for Stronger Inference	Supporting References
Deciduous forest structure	High documented richness in several forested localities	Vegetation layers and litter create web sites, refuges and prey niches	Replicated plots with quantified structure, microclimate and prey; multi-stratum sampling	Cardoso, Pekár, et al. (2011); Jiménez-Valverde and Lobo (2007); Nichat et al. (2025)
Agricultural diversification	Multiple families occur in post-rainy crops	Margins, residues and crop heterogeneity can support complementary guilds	Matched management comparisons plus pest, predation and yield outcomes	Michalko et al. (2019); Sunderland and Samu (2000); Upadhyay et al. (2018)

Habitat or Process	Current Regional Signal	Plausible Mechanism	Evidence Needed for Stronger Inference	Supporting References
Pesticide exposure	Regional application effects rarely measured directly	Lethal, sublethal and prey-mediated effects differ by compound and guild	Active-ingredient records, residue gradients, behavioural and demographic endpoints	Pekár (2012); Prieto-Benítez and Méndez (2011)
Urbanisation	Urban/semi-urban assemblages appear filtered	Impervious cover, heat, light and vegetation simplification favour tolerant taxa	Replicated gradients with land-cover, lighting and vegetation metrics	Caleb (2020); Chandrakar and Jha (2026)
Reservoir and wetland margins	Annual inventories indicate substantial local richness	Humidity, emergent vegetation and aquatic prey subsidies may elevate diversity	Shoreline-to-upland transects and prey-subsidy measurements	Pandey and Agrawal (2026)
Monsoon seasonality	Short wet-season surveys produce many records	Phenology, activity and detectability change with rainfall and vegetation	Fixed-effort repeated sampling with detection models	Nichat et al. (2025); Pandey and Agrawal (2026)

Note. Guild assignments should follow explicit behavioural criteria and should not be used as proxies for measured ecological function

5.4 Seasonality and Detectability

Central India has pronounced monsoon seasonality, so adult activity, web visibility, prey abundance and vegetation cover vary through the year. Short surveys during the monsoon or post-monsoon period may record many conspicuous species but miss taxa maturing in the dry season. Conversely, dry-season sampling can under-detect web builders whose populations or webs expand with humidity and prey. Seasonal differences in catches are therefore mixtures of phenology, activity and detection, not necessarily changes in population size.

Annual coverage is an improvement but not sufficient unless effort is repeated consistently. A robust design would sample the same plots at fixed intervals, use the same person-hours and trap-nights, and record rainfall, temperature, humidity and vegetation condition. Juveniles should be retained as morphospecies or molecular units rather than forced into species names, because many spiders cannot be identified reliably without adult genital characters. Repeated occupancy models can then separate detection probability from true seasonal occurrence.

Table 3 links major habitat questions with appropriate evidence and cautions. It emphasises that guild structure and ecosystem function are not self-evident from a species list. The next phase of Central Indian research needs paired measurements of habitat, prey, disturbance and sampling completeness.

6. Methodological Quality and Taxonomic Reliability

6.1 Sampling Design and Comparability

The largest obstacle to regional synthesis is inconsistent effort. Common methods include visual searching, hand collection, sweep-netting, beating and pitfall trapping, but studies often omit person-hours, sweep counts, trap spacing, trap-nights, plot area or weather interruptions. Without effort denominators, a richness difference may reflect time spent collecting rather than habitat quality. Dubey et al. (2021) provide more operational detail than many regional studies, yet even relatively detailed protocols need replication and sample-completeness analysis before sites can be compared.

No single method samples the full spider community. Pitfall traps measure activity-density of ground-active taxa, not absolute abundance. Sweep-netting targets low vegetation, beating samples shrubs and branches, litter sifting or Winkler extraction recovers small cryptic taxa, and nocturnal searches detect eye-shine and species inactive by day. Canopy fogging or elevated beating may be required for upper strata, although logistical and ethical constraints apply. Standardised inventories combine complementary methods because method-specific assemblages overlap incompletely (Cardoso, 2009; Cardoso et al., 2009; Sørensen et al., 2002).

Comparability also requires spatial replication. A list generated from opportunistic searches across a large area cannot be analysed as if it arose from replicated plots. Site selection should be stratified by habitat, disturbance and elevation, with independent sampling units separated sufficiently to reduce pseudoreplication. Where rare or conservation-important species are the focus, targeted microhabitat searches can supplement but should not be merged uncritically with standardised abundance data.

Species richness alone is sensitive to sample size. Rarefaction and extrapolation based on Hill numbers permit comparison at common sample coverage and integrate richness, Shannon diversity and Simpson diversity within a coherent framework (Chao et al., 2014). Central Indian studies frequently report Shannon or Simpson indices without first demonstrating comparable effort or correcting richness inconsistencies. Diversity indices should not lend false precision to incomplete or taxonomically uncertain matrices.

6.2 Identification, Vouchers and Nomenclature

Species-level spider identification commonly depends on adult genital morphology, supported by somatic characters and distribution. Juveniles can be distinctive at family or genus level yet remain unsafe for species assignment. Field photographs are valuable for documenting colour and behaviour, but image-only records are especially vulnerable to confusion among closely related taxa. A high-quality regional study should state the keys and revisions used, identify the determiner, report the sex and life stage, and deposit representative specimens in a recognised collection.

Voucher deposition is central to reproducibility. It allows later workers to re-examine unusual records, update names and test cryptic diversity. The rapid appearance of new state records in Chhattisgarh, including *Storenomorpha*, theridiids and *Epocilla aura*, is scientifically useful only if future researchers can trace diagnostic evidence (Nayak et al., 2025; Nayak, Nichat, et al., 2026; Nayak, Warte, et al., 2026). Range extensions based on correctly identified adults can fill genuine gaps; unvouchered or misidentified records can persist through checklists and ecological analyses.

Nomenclature changes as genera are revised and species synonymised. Sankaran et al. (2020), for example, re-evaluated Indian species formerly placed in *Storena* and established a new generic framework, demonstrating how regional records can become outdated even when original identifications were made carefully. Checklist maintenance must therefore distinguish accepted names, original combinations, synonyms, misidentifications and doubtful records. A date-stamped taxonomic backbone is preferable to static tables copied between publications.

Quality control should be proportional to biogeographical surprise. Records of cosmopolitan synanthropic species may be plausible across broad areas, but a species known from a distant continent or restricted biome requires stronger evidence. The Rajnandgaon report includes some taxa that warrant such scrutiny (Sahu & Gautam, 2025). Critical review does not presume error; it asks whether the available specimen, image, diagnosis and distributional context are sufficient for reuse.

Table 4. Recurring methodological limitations and minimum corrective standards

Domain	Recurring limitation	Consequence	Minimum corrective standard	Supporting references
Sampling effort	Person-hours, sweeps, trap-nights or sampled area omitted	Richness and abundance cannot be compared	Report effort by method, plot, visit and season; retain raw sample data	Cardoso (2009); Cardoso et al. (2009)
Method coverage	Reliance on visual search or one collection method	Systematic under-detection of litter, ground, nocturnal or canopy taxa	Use complementary standardised methods matched to strata	Sørensen et al. (2002)
Completeness	Indices reported without coverage or accumulation analysis	False precision and unstable rankings	Use sample-coverage curves, rarefaction/ extrapolation and Hill numbers	Chao et al. (2014)
Identification	Juveniles or photographs assigned to species without diagnostic evidence	Misidentification propagates through checklists	Prioritise adults, genital examination, expert review and diagnostic images	Siliwal et al. (2005); Tyagi et al. (2019)
Vouchers	Specimen repositories and catalogue	Records cannot be re-examined after revision	Deposit vouchers in recognised collections	Sankaran et al. (2020)

	numbers absent		and publish identifiers	
Nomenclature	Static or outdated names copied from earlier lists	Duplicate or invalid regional records	Reconcile with a dated World Spider Catalog version and record synonym history	World Spider Catalog (2026)
Data access	No georeferenced occurrence matrix or metadata	Weak reproducibility and limited spatial analysis	Publish machine-readable occurrence and effort data with confidence fields	Tyagi et al. (2019)

Note. The standards are intended as a regional minimum reporting package rather than a substitute for taxon-specific expertise

6.3 Molecular Tools and Data Standards

DNA barcoding can connect juveniles, sexes and damaged specimens to adult reference material and can flag cryptic lineages. Indian barcoding has already shown that morphologically assigned species may contain deep genetic structure or species complexes (Tyagi et al., 2019). Yet barcoding is not a replacement for taxonomy. Misidentified reference sequences, contamination, mitochondrial introgression and incomplete lineage sorting can mislead, particularly when public databases lack curated regional vouchers.

An integrative workflow should link a specimen identifier, high-resolution images, sex and life stage, collection coordinates, date, collector, habitat, preservation method, morphological determination, voucher repository and sequence accession. Cytochrome c oxidase subunit I is a useful standard marker, but difficult groups may require nuclear loci and formal revision. DNA should be extracted in ways that preserve diagnostic structures, and sequence clusters should be reported cautiously as operational units until taxonomic evidence justifies species status.

Occurrence data need equal attention. Coordinates should be precise enough for ecological analysis but generalised publicly when disclosure could threaten sensitive taxa or sites. Darwin Core-compatible fields would allow integration with biodiversity infrastructures. Every record should carry an identification-confidence field and a citation or voucher link. Such infrastructure would transform checklists from static end products into auditable, updatable datasets.

Table 4 identifies recurring weaknesses and corrective standards. The regional literature is not devoid of value; rather, its cumulative utility is constrained because studies rarely use the same minimum reporting package. Adoption of a shared protocol would make even modest student-led surveys more useful for long-term synthesis.

7. Ecological Functions and Applied Relevance

7.1 Predation, Food Webs and Ecosystem Processes

Spiders are predominantly predators and can reach high densities across terrestrial ecosystems. Global synthesis estimates that the spider community consumes hundreds of millions of tonnes of prey annually, although the estimate is necessarily model-based and not a measure of Central Indian consumption (Nyffeler & Birkhofer, 2017). The defensible regional inference is that spiders represent a substantial predatory component, not that a specific tonnage can be assigned locally without biomass and feeding data.

Predation effects vary among guilds. Orb-webs intercept flying insects, sheet webs capture small aerial and surface-active prey, crab spiders ambush pollinators and herbivores, jumping spiders stalk visually, and wolf and ground spiders forage on soil surfaces. These roles overlap and include intraguild predation, cannibalism and consumption of beneficial insects. Functional diversity is therefore more informative than total richness when predicting ecological effects (Cardoso, Pekár, et al., 2011).

Spiders also serve as prey for birds, reptiles, amphibians, wasps and other arthropods, and their silk and webs create microhabitats or capture nutrient subsidies. A recent synthesis describes regulating, supporting and cultural services that extend beyond pest suppression (Cardoso et al., 2025). Central Indian studies rarely quantify these pathways, so ecosystem-service language should be treated as a research framework rather than a measured regional account.

Stable isotopes, molecular gut-content analysis, metabarcoding of web-caught prey and exclusion experiments could resolve local trophic roles. Such studies should include agricultural and forest systems because prey composition and food-web position are likely to differ. Seasonal sampling is essential where monsoon pulses alter insect emergence and spider reproduction.

7.2 Biological Control in Cropping Systems

The proposition that spiders contribute to pest regulation is supported by extensive agroecological literature, but effect sizes are context-dependent. Reviews document abundant spider communities in crops and plausible suppression of herbivores, while meta-analysis indicates that biocontrol efficacy differs with hunting mode, pest identity and experimental conditions (Michalko et al., 2019; Nyffeler & Sunderland, 2003). A Central Indian crop list containing diverse families is therefore compatible with pest-control potential, but it does not quantify service delivery (Upadhyay et al., 2018).

Interventions intended to conserve spiders may also produce trade-offs. Dense vegetation can support predators but may harbour pests or compete with crops; reduced pesticide use may benefit natural enemies but requires integrated thresholds and farmer acceptance. The correct unit of evaluation is the production system, including pest damage, yield, input cost and non-target biodiversity. Trials should compare management packages over multiple seasons rather than short-term spider abundance alone.

Species identity matters. Generalist predators may stabilise control across pest species, but they can switch to alternative prey when pests are scarce, and intraguild predation can reduce combined effects. Trait-based analyses should consider body size, hunting mode, vertical stratum, phenology and dispersal. Regional candidate species should be selected from verified, common crop-associated taxa rather than from broad family-level assumptions.

7.3 Bioindication and Environmental Monitoring

Spiders have attributes desirable in bioindicators: taxonomic and functional diversity, sensitivity to habitat structure, occurrence across strata and manageable sampling with complementary methods. Reviews of forest monitoring suggest that spiders can respond to management, but indicator use requires standardisation, reference conditions and sufficient taxonomic resolution (Pearce & Venier, 2006). Their usefulness is therefore conditional rather than automatic.

A valid Central Indian indicator programme should first establish baseline variability. Sites must be sampled repeatedly across seasons and years, and responses should be compared with independent measures of disturbance such as canopy loss, fire intensity, pesticide residues, mining proximity or urban cover. An index derived from one district cannot be assumed transferable across sal forest, teak forest, paddy fields and dry scrub. The internal inconsistency in the recent three-district study is especially relevant because an indicator claim is only as reliable as the underlying species matrix (Chandrakar & Jha, 2026).

Functional composition may be more robust than individual species where identification capacity is limited, but guilds can conceal turnover among ecologically distinct species. A tiered approach is preferable: family or guild metrics for rapid surveillance, species-level vouchers for periodic audits, and focal taxa for mechanistic studies. Indicator thresholds should be validated against known disturbance gradients before being used for management decisions.

8. Threats, Conservation Significance and Management Implications

8.1 Habitat Loss, Fragmentation and Infrastructure

Central Indian conservation landscapes are increasingly fragmented by agriculture, roads, railways, mines, settlements and linear infrastructure. Tiger-connectivity analyses demonstrate the scale of landscape subdivision, although their species models cannot be transferred directly to spiders (Dutta et al., 2016). For spiders, fragmentation effects will depend on body size, ballooning ability, habitat specialisation and microclimatic sensitivity. Small aerial dispersers may cross open areas, while litter specialists and burrowing taxa may be isolated by dry, compacted or polluted matrices.

Habitat loss can eliminate not only area but also structures required for web attachment, retreats and reproduction. Removal of old trees, dead wood, shrubs and litter simplifies vertical and horizontal complexity. Edge effects alter temperature, humidity, wind and prey flux. These mechanisms support conserving microhabitat heterogeneity within forest blocks and corridors, but regional thresholds for patch size or corridor width are unknown.

Protected areas cannot be assumed secure. Singh and Moharir (2024) found that many protected areas in the Central Indian Highlands face overlapping anthropogenic and climatic vulnerability. Spider monitoring could complement vertebrate programmes by detecting changes in vegetation and litter communities at finer scales. This requires baseline plots before major management interventions, not opportunistic collecting after disturbance.

8.2 Agricultural Intensification and Chemical Exposure

Agricultural expansion replaces heterogeneous vegetation with seasonal monocultures, while tillage, residue removal and pesticide use alter refuges and prey. Global evidence indicates that land management can reduce spider richness and abundance, although responses differ among guilds and practices (Prieto-Benítez & Méndez, 2011). Central Indian crop systems range from irrigated intensive fields to mixed rain-fed farms, so a single regional effect cannot be assumed.

Chemical risk is especially under-documented. Laboratory and field literature shows lethal and sublethal effects on locomotion, web construction, predation, development and reproduction, with acaricides and insecticides often posing greater direct risk (Pekár, 2012). Real landscapes involve mixtures, repeated applications and indirect food-web effects. Monitoring should therefore record pesticide identity and timing and include residue or exposure proxies rather than classifying fields simply as ‘treated’ or ‘untreated’.

Conservation in working landscapes should prioritise avoidance of unnecessary broad-spectrum applications, retention of field-edge vegetation and temporal refuges during disturbance. These measures are supported mechanistically and by wider agroecology, but local adoption should be evaluated alongside pest pressure and farmer outcomes.

8.3 Climate Change, Heat, Drought and Fire

Climate change is expected to alter temperature extremes, rainfall timing, drought duration and fire regimes in Central India. Spiders may respond through phenology, development, body size, sex-specific survival and range shifts. Experimental and review evidence indicates that extreme temperature effects can differ between sexes and species, complicating simple predictions from mean climate (Harvey & Dong, 2023).

Table 5. Threats, confidence of regional inference and proportionate management responses

Pressure	Regional Evidence Status	Likely Pathways	Priority Response	Supporting References
Habitat loss and fragmentation	Strong landscape evidence; spider-specific response data limited	Loss of area, microclimate and connectivity; edge effects	Protect heterogeneous forest, riparian and corridor microhabitats; establish baseline plots	Dutta et al. (2016); Singh and Moharir (2024)
Agricultural simplification	Moderate regional occurrence evidence; limited causal tests	Reduced vegetation, refuges and prey diversity	Compare management systems; retain margins and structural refuges	Prieto-Benítez and Méndez (2011); Upadhyay et al. (2018)
Pesticides	Strong global mechanism; weak Central Indian exposure data	Mortality, sublethal behaviour and prey-mediated effects	Document active ingredients and exposure; evaluate integrated pest management	Pekár (2012)
Climate extremes and drought	Plausible and landscape-relevant; few regional spider studies	Thermal and desiccation stress, phenological mismatch	Microclimate monitoring, refugia protection and long-term repeated surveys	Harvey and Dong (2023); Singh and Moharir (2024)
Fire	High regional relevance; direct evidence sparse	Litter loss, vegetation simplification and mortality	Before-after-control-impact studies across fire severity	Singh and Moharir (2024)
Taxonomic and	Strongly evident	Undetected species,	Training, curated	Cardoso, Erwin, et

institutional neglect	from uneven inventories and verification gaps	unrecognised decline and unusable records	vouchers, open data and periodic checklist reconciliation	al. (2011); Siliwal et al. (2005)

Note. Evidence status distinguishes direct regional data from plausible transfer of mechanisms established elsewhere

Microclimate mediates exposure. Deep litter, shaded ravines, riparian vegetation, burrows and tree hollows can buffer heat and desiccation, whereas fragmented edges and simplified farms amplify extremes. Conservation of microrefugia is therefore a plausible no-regret strategy, but regional sensitivity curves and thermal limits are largely unknown. Long-term monitoring should link community change to local sensors rather than coarse climate grids alone.

Fire interacts with drought and land management. Frequent burning may repeatedly reset litter and understorey communities, while complete suppression may also change habitat structure in fire-adapted systems. Spider responses should be studied across fire frequency and severity using pre-fire baselines and unburned controls.

8.4 Conservation Neglect and Public Perception

Invertebrates face well-described taxonomic, distributional, biological, societal, political, legal and institutional impediments to conservation (Cardoso, Erwin, et al., 2011). A global expert assessment further identifies habitat loss, agricultural change, pollution and climate change as major pressures on spiders, while emphasising severe knowledge deficits (Branco & Cardoso, 2020). Central Indian spiders display nearly all of these impediments: few specialists, incomplete maps, uncertain natural history, limited public visibility and minimal integration into protected-area planning. The consequence is not necessarily immediate extinction of documented taxa, but a high probability that declines or local losses occur before baselines exist.

Public attitudes also matter. Fear and indiscriminate killing can affect synanthropic spiders, while sensational reporting may obscure their low general risk and ecological roles. Education should avoid claiming that every spider is harmless or beneficial in every context; it should promote safe coexistence, medically appropriate caution and recognition of ecological diversity. The cultural and educational services reviewed by Cardoso et al. (2025) provide a broader basis for engagement than pest-control messaging alone.
Table 5 ranks major pressures by the strength of Central Indian evidence. Habitat alteration is strongly plausible and supported by landscape context, whereas pesticide, climate and fire effects remain under-measured locally. Management should combine immediate precautionary measures with explicit monitoring capable of testing whether those measures work.

9. Integrated Status Assessment and Major Knowledge Gaps

The status of Central Indian spider biodiversity can be summarised as high documented diversity under low-to-moderate evidential certainty. State checklists establish that hundreds of species occur, and repeated local surveys continue to add records. The fauna spans major web-building and hunting families and occupies forest, crop, urban and wetland-associated habitats. These conclusions are robust at a broad level because they recur across independent sources. The exact number of unique regional species, the proportion endemic or range-restricted, and the relative richness of states or districts are not robust because taxonomic reconciliation and sampling completeness remain inadequate.

Spatial bias is the most visible gap. Madhya Pradesh records cover only part of the district network, and Chhattisgarh studies cluster around a small set of accessible districts. Protected areas, Bastar, Surguja, dry rocky landscapes, caves, upper forest strata and soil-litter communities require focused sampling. A map of publication localities would almost certainly show institutional and road-access bias. Until environmental coverage is quantified, conservation prioritisation based on raw species counts risks directing attention to places already studied.

Taxonomic confidence is the second gap. Checklists inevitably inherit historical names and identifications, while site surveys often do not provide vouchers or adult diagnostic evidence. DNA barcoding has demonstrated cryptic diversity in Indian spiders, but reference libraries remain incomplete (Tyagi et al., 2019). Integrative taxonomy is especially urgent for species complexes, unusual range extensions and families poorly represented in conventional searches.

Ecological inference is the third gap. Habitat labels are commonly used without measured environmental variables, and guild assignments are rarely linked to local prey, web placement or activity. Seasonal studies seldom model detection. The regional evidence therefore supports statements about occurrence more strongly than statements about habitat preference, ecosystem service or bioindicator performance.

Temporal change is almost unknown. Rising checklist totals indicate increased documentation, not population recovery or range expansion. Conversely, the absence of old records from a recent survey does not demonstrate decline unless methods, locations and seasons are comparable. Detecting change requires permanent or relocatable plots, archived protocols and specimen-linked datasets repeated over years.

Applied relevance is promising but preliminary. Global evidence supports predatory and monitoring functions, yet Central Indian policy should not assume quantified pest suppression or universal indicator value. The most productive strategy is to embed hypothesis-driven spider modules within existing forest, agricultural and climate-monitoring programmes. This would reduce logistical costs while generating the covariate data needed for interpretation.

A final gap is governance. No clearly visible regional mechanism currently coordinates checklist revision, voucher curation, taxonomic training, molecular reference building and open occurrence data. Individual studies can add records, but cumulative knowledge will remain fragile unless institutions agree on minimum standards and a shared update cycle.

10. Future Directions

The immediate priority is a reconciled Central Indian occurrence backbone. Existing Madhya Pradesh and Chhattisgarh checklists should be converted into a specimen- or source-linked database using currently accepted names, original combinations, synonym histories, locality precision and identification-confidence categories. Doubtful records should be retained as explicit flags rather than silently deleted. Annual or biennial reconciliation against the World Spider Catalog would prevent nomenclatural drift. The output should be versioned so that changes in totals can be attributed to new records, taxonomic revision or correction.

A second priority is a stratified regional inventory designed around environmental coverage rather than convenience. Sampling frames should represent major forest types, elevation and rainfall zones, protected and unprotected land, agricultural intensity, urbanisation, wetlands, rocky systems and caves. Within each stratum, independent plots should be sampled during pre-monsoon, monsoon, post-monsoon and winter periods using fixed person-hours, trap-nights, sweep counts, beating effort, litter extraction and nocturnal searches. Rarefaction, sample coverage and Hill-number diversity should be reported for every site and method.

Taxonomic infrastructure should develop in parallel. Regional universities and Zoological Survey of India collections could coordinate voucher deposition, imaging and specialist verification. Priority should be given to adult specimens, genital preparations, type-comparison where necessary and preservation compatible with DNA extraction. A curated barcode library should link sequences to deposited vouchers and diagnostic morphology. Sequencing of juveniles and opposite sexes can then expand ecological datasets without encouraging unsupported species names.

Long-term ecological monitoring is the next immediate need. Sentinel landscapes should include protected forest, community forest, mining or infrastructure fronts, crop mosaics and urban gradients. Repeated annual sampling over at least five years would permit separation of interannual weather variability from directional change. Microclimate sensors, vegetation structure, litter, prey abundance, pesticide exposure and fire history should be measured alongside spiders. Occupancy and community models should incorporate imperfect detection.

Applied agricultural research should progress from occurrence lists to experiments. Candidate management practices include vegetated margins, reduced broad-spectrum insecticide use, residue retention and diversified crop rotations. Replicated farm-scale trials should measure spider guilds, pest abundance, predation, crop damage, yield and farmer costs. Molecular gut-content or prey-DNA methods can test whether common spider species consume target pests. The aim should be integrated pest management that quantifies both benefits and trade-offs, not promotion of spiders in isolation.

Bioindicator development is a medium-term priority that depends on baseline quality. Candidate metrics might include coverage-standardised richness, functional-guild proportions, occupancy of disturbance-sensitive taxa and community turnover. These metrics must be validated against independent disturbance measures across multiple habitat types. A simple family-level index may be useful for rapid screening, but species-level voucher audits are necessary to prevent taxonomic coarsening from masking ecological change.

Climate and fire research should focus on mechanisms and refugia. Experiments can estimate thermal and desiccation tolerance for widespread and habitat-restricted species, while field studies relate community change to near-ground temperature and humidity. Before-after-control-impact designs around planned burns or wildfires can test recovery trajectories. Riparian strips, ravines, deep litter, dead wood and shaded rocky crevices should be evaluated as microclimatic refuges with direct management relevance.

Data governance and capacity building are longer-term enabling priorities. Open, machine-readable occurrence and effort datasets should be published with persistent identifiers, while sensitive localities are appropriately generalised. Training should combine field sampling, genital morphology, nomenclature, statistics and molecular methods. Citizen observations can assist discovery and phenology, but expert validation and voucher pathways are essential for records used in formal checklists. A regional consortium could coordinate protocols, annual data audits and priority taxonomic workshops.

Success should be evaluated by measurable improvements: increased environmental and district coverage; higher proportions of records linked to vouchers and coordinates; reduced numbers of unresolved or doubtful names; replicated estimates of occupancy and trend; and management experiments with ecological and economic outcomes. These indicators would move the field from accumulating names towards explaining and conserving regional diversity.

11. Conclusions

Central India supports a substantial and taxonomically varied spider fauna, but its documented diversity remains an uneven record of research activity rather than a complete regional inventory. Madhya Pradesh and Chhattisgarh checklists together demonstrate sustained discovery across major spider families, while site studies confirm rich assemblages in forests, crop systems, institutional green spaces, urbanising landscapes and reservoir margins. These are defensible status statements. Exact regional richness, district rankings, endemism and temporal trends cannot yet be established reliably because records overlap, nomenclature changes, geographical coverage is incomplete and study methods are weakly standardised.

The central analytical distinction is between occurrence evidence and ecological evidence. Species lists establish presence when identifications are sound, but they do not by themselves demonstrate habitat preference, pest suppression, bioindicator validity or conservation trend. Broader spider research provides strong mechanistic reasons to expect responses to habitat structure, pesticide exposure, climate and disturbance, yet these mechanisms require regional testing with measured covariates, replicated designs and transparent effort.

A coherent status programme should therefore combine a reconciled taxonomic backbone with stratified, multi-season inventories; curated vouchers and molecular reference material; open georeferenced data; completeness-aware diversity analysis; and long-term monitoring across forest–agriculture–urban gradients. Conservation action need not wait for perfect knowledge: protection of structural heterogeneity, litter, riparian refuges and landscape connectivity is consistent with current evidence. Nevertheless, claims of formal hotspot status or quantified ecosystem services should remain restrained. The most accurate present conclusion is that Central Indian spider biodiversity is demonstrably rich, scientifically under-resolved and highly suitable for a coordinated transition from descriptive collecting to reproducible biodiversity assessment.

12. Limitations

As a critical narrative review, this synthesis is intrinsically vulnerable to selection and interpretive bias despite an explicit search, eligibility framework and source-level appraisal. The search relied on accessible scholarly platforms and did not include complete exported records from all major subscription databases. English-language availability and discoverability may have excluded relevant regional literature, theses or older institutional publications. Search outputs were iterative rather than captured in a single prospectively registered database, so numerical screening counts were not generated.

The underlying evidence is heterogeneous. State checklists, taxonomic revisions, distributional notes and local community studies address different questions and cannot be combined quantitatively. Sampling effort, season, method, habitat definition and identification practice vary, and several studies provide limited voucher or completeness information. The review could assess internal consistency and bibliographic authenticity but could not independently re-identify specimens or verify every historical locality. Consequently, reported species totals were interpreted as documented minima rather than estimates of true richness.

Geographical representation is uneven, with accessible districts and institutional sites contributing disproportionately. Evidence on abundance trends, climate responses, fire, pesticide exposure and ecosystem services is scarce for Central India, so broader studies were used to evaluate mechanisms while local transferability was explicitly limited. The search end date also means that later taxonomic changes and records are not incorporated. These constraints prevent formal meta-analysis and require cautious interpretation of apparent differences among states, districts and habitats.

Declaration of AI Use

This manuscript was prepared through the combined contributions of all author(s), including contributions to the study design, data, content development, results, interpretation, and related scholarly work. The author(s) acknowledge the use of Grammarly and ChatGPT to assist with grammar checking, language refinement, reference formatting. These AI-assisted tools were not used as authors and did not replace the intellectual contributions or scholarly judgment of the author(s). All AI-assisted outputs, including content, references, and interpretations, were carefully reviewed, revised, verified, and approved by the author(s). The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

Competing Interests

Authors have declared that no competing interests exist.

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