International Journal of Research and Technology (IJRT)

International Open-Access, Peer-Reviewed, Refereed, Online Journal

ISSN (Print): 2321-7510 | ISSN (Online): 2321-7529

| An ISO 9001:2015 Certified Journal |

Biodiversity Assessment of Local Fauna in Relation to Climate Change

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ABSTRACT

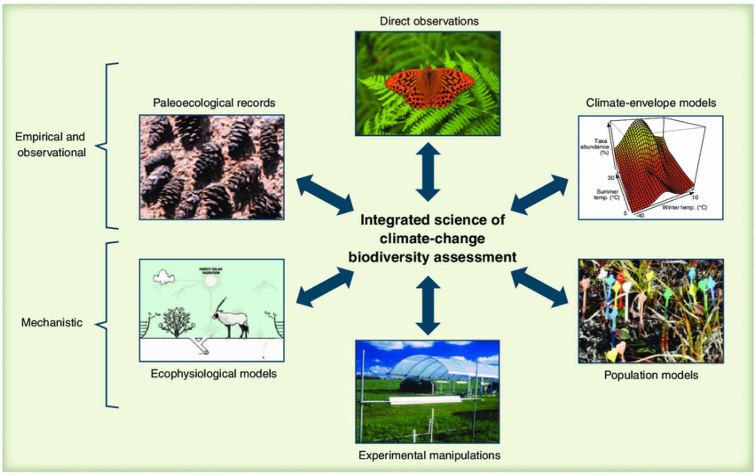
Climate change has emerged as a major driver of biodiversity alteration, with local faunal communities increasingly exhibiting measurable ecological responses. This study examines the biodiversity assessment of local fauna in relation to climate change through a synthesis of secondary data published between 2015 and 2024. Emphasis is placed on changes in species richness, population abundance, community composition and functional diversity across different habitat types. The analysis reveals that rising temperatures, altered precipitation regimes and extreme climatic events are associated with declines in climate-sensitive species and increased dominance of generalist taxa, leading to community restructuring at the local scale. Freshwater and habitat-specialist fauna show particularly high vulnerability. By focusing on local-level biodiversity indicators, the study highlights the value of fine-scale assessment for detecting early impacts of climate change and informing adaptive conservation strategies. The findings contribute to a clearer understanding of how climatic variability shapes faunal biodiversity within specific ecological contexts.

Keywords: Biodiversity assessment, local fauna, climate change, species richness, community structure

1.INTRODUCTION

Biodiversity forms the structural and functional foundation of ecosystems, supporting ecological stability, productivity and resilience. Local fauna, encompassing resident animal species within specific geographic regions, represents a critical component of this biodiversity, as these organisms are directly shaped by local climatic conditions, habitat characteristics and ecological interactions. In recent decades, climate change has emerged as a dominant driver of biodiversity change, altering temperature regimes, precipitation patterns, seasonality and the frequency of extreme weather events. These changes exert direct and indirect pressures on animal communities by modifying habitat suitability, resource availability and species interactions. As a result, assessing local faunal biodiversity in relation to climate change has become essential for understanding ecological responses at spatial scales most relevant to conservation planning and environmental management.

Climate change influences local fauna through a range of mechanisms that operate across physiological, behavioural and ecological levels. Rising temperatures can exceed species-specific thermal tolerances, while altered rainfall patterns affect water availability, vegetation structure and prey dynamics. Such changes may lead to shifts in species distribution, altered phenology, changes in reproductive success and increased mortality, particularly among species with narrow ecological niches or limited dispersal capacity. Local biodiversity assessments are therefore increasingly focused not only on species richness and abundance, but also on changes in community composition and functional diversity. These local-scale changes often precede broader regional or global biodiversity losses, making them critical early indicators of climate-driven ecological transformation. Moreover, local fauna frequently exhibits differential sensitivity to climate stressors, resulting in community restructuring rather than uniform decline, with some species expanding their ranges while others contract or disappear.



The importance of local biodiversity assessment is further amplified by the interaction between climate change and existing anthropogenic pressures such as habitat fragmentation, land-use change and pollution. Climate-induced stress can reduce the resilience of animal populations already impacted by human activities, accelerating local extinctions and simplifying ecological networks. In many landscapes, particularly in developing regions and biodiversity hotspots, baseline data on local fauna remain limited, constraining the ability to detect climate-driven trends over time. Consequently, systematic biodiversity assessment serves both as a scientific tool for documenting ecological change and as a practical framework for guiding adaptive conservation strategies. By linking observed patterns in local faunal diversity to climatic variables, such assessments contribute to a deeper understanding of how climate change reshapes ecosystems from the ground up. Within this context, the present study situates biodiversity assessment as an essential approach for evaluating the impacts of climate change on local fauna and for informing evidence-based responses aimed at sustaining ecological integrity under changing environmental conditions.

2. NEED OF THE STUDY

The need for assessing biodiversity of local fauna in relation to climate change arises from the increasing evidence that climatic variability is reshaping ecological systems at spatial scales that directly influence species survival and ecosystem functioning. While global assessments provide broad trends, they often obscure site-specific responses that are critical for understanding real-world ecological change. Local fauna responds to climate drivers such as temperature increase, altered rainfall patterns and extreme weather events in ways that are strongly mediated by habitat structure, land-use practices and historical exposure to environmental stress. Consequently, local-level biodiversity assessments are essential for capturing nuanced patterns of species loss, redistribution and community restructuring that may not be apparent in regional or global datasets.

Another key need for this study lies in the growing recognition that climate change acts synergistically with existing anthropogenic pressures, including habitat fragmentation, urbanisation and resource exploitation. These interacting stressors can reduce population resilience and accelerate biodiversity loss, particularly among species with limited dispersal ability or specialised ecological requirements. Local faunal assessments allow for the

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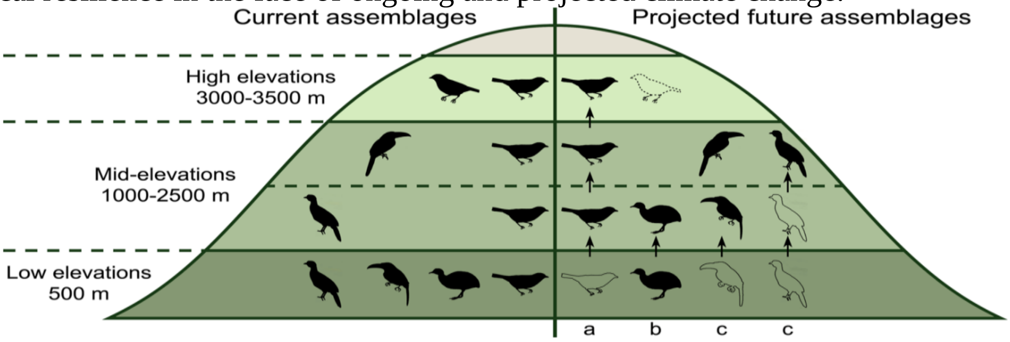
identification of vulnerable species and functional groups, providing an evidence base for targeted conservation and management interventions. Without such assessments, conservation efforts risk being reactive rather than proactive, addressing biodiversity decline only after irreversible losses have occurred.

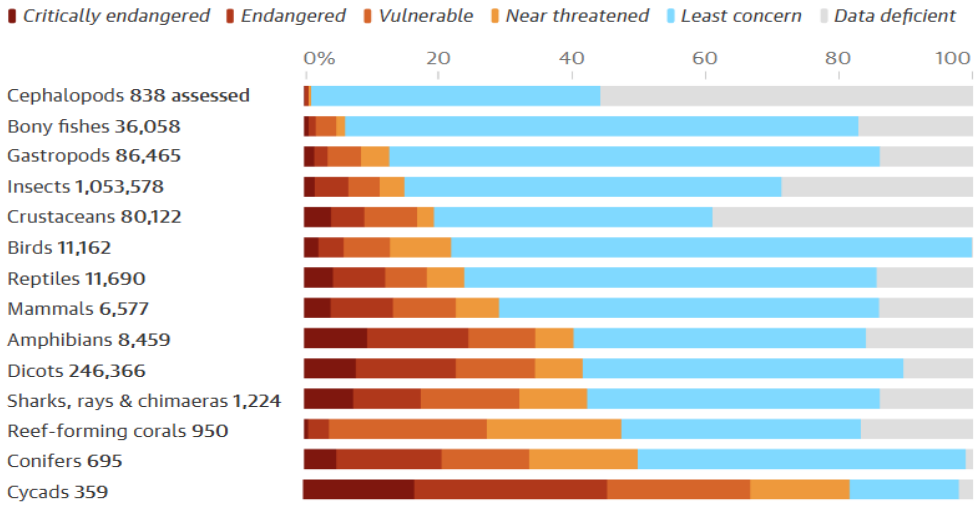
Furthermore, there is a critical need to establish baseline biodiversity data against which future climate-driven changes can be measured. In many regions, especially in developing and rapidly transforming landscapes, systematic records of local fauna remain incomplete or outdated. This limits the capacity to detect long-term trends, evaluate the effectiveness of conservation measures and integrate biodiversity considerations into climate adaptation planning. By linking observed patterns in local faunal diversity with climatic variables, the study contributes to a clearer understanding of how climate change influences ecosystems at the ground level. Overall, the need for this study is grounded in its potential to inform adaptive conservation strategies, support evidence-based policy formulation and enhance ecological resilience in the face of ongoing and projected climate change.



3. SCOPE OF THE RESEARCH

The scope of the present research is centred on assessing the biodiversity of local fauna in relation to climate change, with emphasis on understanding how climatic variability influences species composition, distribution and community structure at the local level. The study is confined to fauna occurring within a defined geographic area, allowing for detailed examination of site-specific ecological responses rather than broad regional generalisations. The research scope includes terrestrial and, where applicable, freshwater animal groups, recognising that different faunal assemblages exhibit varying sensitivities to temperature change, altered precipitation patterns and extreme climatic events. By focusing on local fauna, the study captures fine-scale biodiversity patterns that are often overlooked in large-scale assessments.

Conceptually, the research scope encompasses changes in species richness, abundance and community composition in response to climate-related drivers. The study considers both direct climatic influences, such as increased temperature and rainfall variability, and indirect effects mediated through habitat alteration, resource availability and interspecific interactions. Particular attention is given to species exhibiting narrow ecological tolerances, limited dispersal capacity or strong dependence on specific habitat conditions, as these are more likely to reflect climate-induced change at the local scale. While broader anthropogenic pressures are acknowledged, the analytical focus remains on climate change as the primary driver shaping observed biodiversity patterns.



Methodologically, the scope is limited to the use of secondary data derived from published literature, ecological surveys and documented biodiversity assessments relevant to climate change impacts. The study does not extend to experimental manipulation or long-term climate modelling but instead concentrates on synthesising existing evidence to identify recurring trends and vulnerabilities within local faunal communities. Population genetics, ecosystem service valuation and socio-economic dimensions fall outside the scope of the research, except where they provide contextual support for biodiversity interpretation. Within these boundaries, the research scope aims to provide a focused and coherent assessment of how climate change influences local faunal biodiversity, generating insights that are relevant for local conservation planning and adaptive management strategies.

4. LITERATURE REVIEW

Research on biodiversity assessment of local fauna in relation to climate change has expanded substantially, reflecting increasing recognition that climate-driven ecological change is often first detectable at local and landscape scales. Early climate–biodiversity studies focused predominantly on global species loss projections; however, more recent literature emphasises that local faunal communities respond heterogeneously to climatic stressors depending on habitat structure, species traits and historical exposure. Local biodiversity assessments are therefore increasingly viewed as essential for identifying early signals of climate impact, as changes in species composition, phenology and abundance often emerge before regional extinctions become apparent (Scheffers et al., 2016). This shift in focus has positioned local fauna as sensitive indicators of climate-driven ecological transformation.

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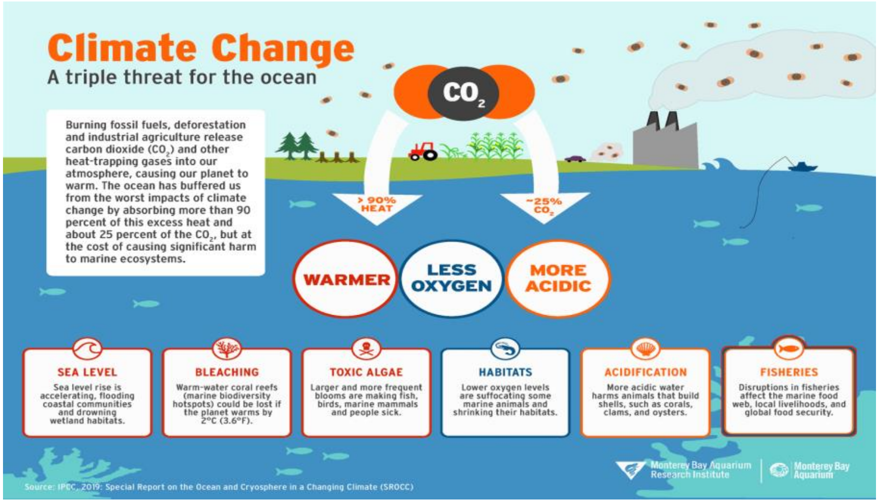

A major theme in the literature concerns climate-induced range shifts and redistribution of animal species. Numerous studies document poleward and elevational shifts in fauna in response to rising temperatures, with local assemblages experiencing both species gains and losses as thermal niches reorganise (Lenoir & Svenning, 2015). At the local level, such redistribution can result in community turnover rather than simple decline, altering trophic interactions and competitive dynamics. Long-term monitoring studies demonstrate that even modest temperature increases can modify local species assemblages, particularly in mountainous, coastal and arid regions where climatic gradients are steep and dispersal options are constrained (Rumpf et al., 2018). These findings underline the importance of spatially explicit biodiversity assessments for detecting climate-driven change.

Phenological shifts represent another widely documented response of local fauna to climate change. Alterations in the timing of breeding, migration and emergence have been reported across taxonomic groups, often linked to temperature and precipitation cues. Local studies on birds and insects indicate that earlier onset of spring temperatures can advance breeding and activity periods, sometimes leading to mismatches between predators and prey or between reproductive timing and resource availability (Thackeray et al., 2016). Such mismatches can reduce reproductive success and juvenile survival, thereby influencing local population dynamics. The literature suggests that phenological plasticity varies widely among species, meaning that climate change can restructure local communities by favouring more flexible species over those with fixed life-history schedules.

Habitat-mediated effects of climate change are also central to understanding local faunal biodiversity patterns. Changes in vegetation composition, water availability and disturbance regimes, such as fire and flooding, indirectly shape animal communities by modifying habitat suitability. Studies from forest, grassland and wetland ecosystems show that climate-driven habitat alteration often amplifies biodiversity change by reducing habitat complexity and refugia for sensitive species (Mantyka-Pringle et al., 2017). Local assessments highlight that species reliant on specific microhabitats or structural features are particularly vulnerable, as even small climatic shifts can cascade into substantial habitat loss or degradation. This reinforces the view that climate impacts on fauna are frequently mediated through ecological context rather than direct physiological stress alone.

The interaction between climate change and land-use change is another prominent theme in recent literature. Many studies emphasise that climate effects on local fauna cannot be fully understood without considering concurrent anthropogenic pressures such as agriculture, urbanisation and infrastructure development. Habitat fragmentation can restrict dispersal pathways, limiting the ability of species to track shifting climatic conditions (Opdam & Wascher, 2016). Local biodiversity assessments reveal that fragmented landscapes often exhibit reduced adaptive capacity, with climate change accelerating declines in already stressed faunal populations. This interaction complicates attribution of biodiversity change but also highlights the necessity of integrated assessment frameworks that consider climate within broader socio-ecological systems.

Local fauna responses to extreme climatic events have received increasing attention, particularly in the context of heatwaves, droughts and intense rainfall events. Short-term but severe climatic extremes can cause abrupt population declines, alter species interactions and restructure communities. Studies documenting post-drought and post-fire faunal assemblages indicate that recovery trajectories are highly variable and dependent on species traits such as mobility, reproductive rate and habitat specificity (Smale et al., 2019). Local biodiversity assessments conducted before and after extreme events provide valuable insights into resilience and vulnerability, demonstrating that climate change impacts are not solely gradual but can also be episodic and disruptive.

Functional diversity has emerged as an important dimension of local biodiversity assessment in climate change research. Rather than focusing exclusively on species counts, recent studies evaluate changes in functional traits related to feeding, mobility, reproduction and thermal tolerance. Evidence suggests that climate change can disproportionately affect certain functional groups, leading to functional homogenisation even when species richness remains relatively stable (Mouillot et al., 2018). Local faunal studies show that loss of functionally unique species can reduce ecosystem resilience and alter energy flow, underscoring the ecological significance of trait-based assessments in climate change contexts.

Freshwater fauna has been highlighted as particularly sensitive to climate variability at the local scale. Altered precipitation patterns, increased water temperatures and changes in flow regimes affect fish, amphibians and aquatic invertebrates by modifying oxygen availability, breeding habitats and food resources. Local assessments of freshwater biodiversity reveal strong associations between climatic variables and species composition, with cold-adapted and flow-dependent species often showing marked declines under warming and hydrological alteration (Reid et al., 2019). These studies emphasise that freshwater systems serve as early-warning indicators of climate change impacts on fauna due to their high sensitivity and limited buffering capacity.

The literature also documents differential vulnerability among taxa and life stages. Local-scale studies indicate that early life stages, such as eggs and juveniles, are often more sensitive to climatic variability due to narrower tolerance ranges and limited behavioural avoidance. Amphibians, reptiles and invertebrates are frequently identified as particularly vulnerable groups in local biodiversity assessments, given their strong dependence on environmental conditions for thermoregulation and development (Urban et al., 2016). Such taxon-specific sensitivity patterns highlight the need for inclusive faunal assessments that move beyond charismatic or well-studied species.

Methodological developments have shaped recent biodiversity assessment literature. Advances in species distribution modelling, remote sensing and citizen science have enhanced the capacity to document local faunal change over time. Studies combining long-term field surveys with climatic data demonstrate improved detection of trends and attribution of biodiversity change to climate drivers (Isaac et al., 2020). However, the literature also cautions that methodological inconsistencies and data gaps remain significant

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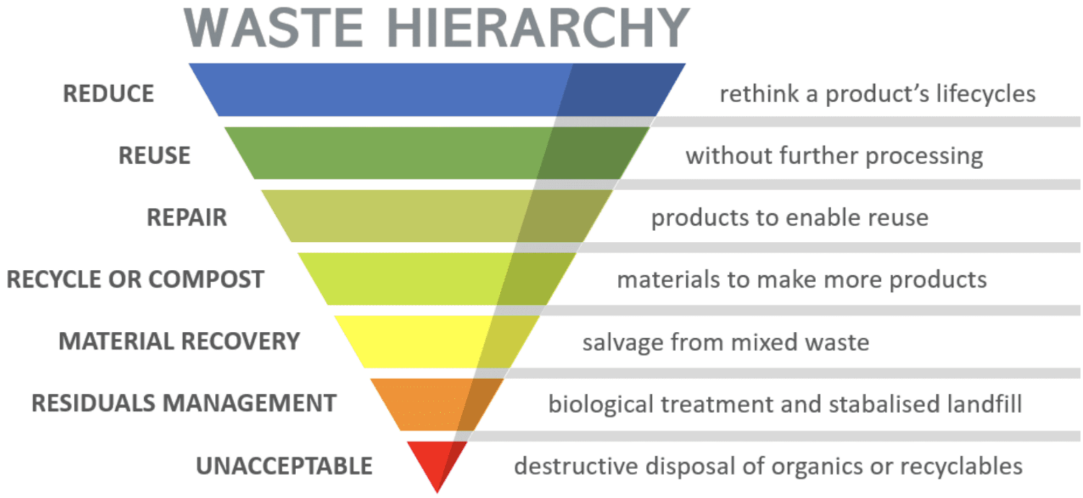
challenges, particularly in regions with limited historical biodiversity records. These limitations reinforce the importance of standardised, repeated local assessments for robust climate–biodiversity analysis.



Another growing area of research examines biotic interactions under climate change at the local level. Shifts in predator–prey relationships, competition and mutualisms have been documented as species respond asynchronously to climatic cues. Local biodiversity studies reveal that climate-induced decoupling of interactions can alter community stability and lead to unexpected biodiversity outcomes, such as increases in generalist species and declines in specialists (Gilman et al., 2017). These interaction-driven changes further complicate biodiversity assessment, as species responses cannot be fully understood in isolation.

5. METHODOLOGY

The present study employs a qualitative and quantitative secondary research methodology to assess biodiversity of local fauna in relation to climate change. The research is based exclusively on secondary data drawn from peer-reviewed journal articles, regional biodiversity assessments, ecological monitoring reports and climate impact studies published between 2015 and 2024. These sources were identified through systematic searches of academic databases such as Google Scholar, using keywords related to local fauna, biodiversity assessment, climate change, species richness, abundance and community composition.

Data selection focused on studies that provided measurable biodiversity indicators, including species richness, population abundance, functional group representation and phenological changes at local or landscape scales. Climatic variables such as temperature trends, rainfall variability and frequency of extreme events were extracted where reported. Secondary data were synthesised using a comparative analytical approach to identify recurring patterns and relationships between climatic drivers and faunal biodiversity responses across different habitats and taxonomic groups.

Tabular analysis was used to summarise numerical trends in biodiversity change, while descriptive interpretation supported discussion of ecological mechanisms and variability. No primary field surveys or experimental interventions were conducted. Ethical considerations were limited to accurate representation of original findings, proper acknowledgement of sources and avoidance of data duplication or misinterpretation.

6. RESULTS AND DISCUSSION

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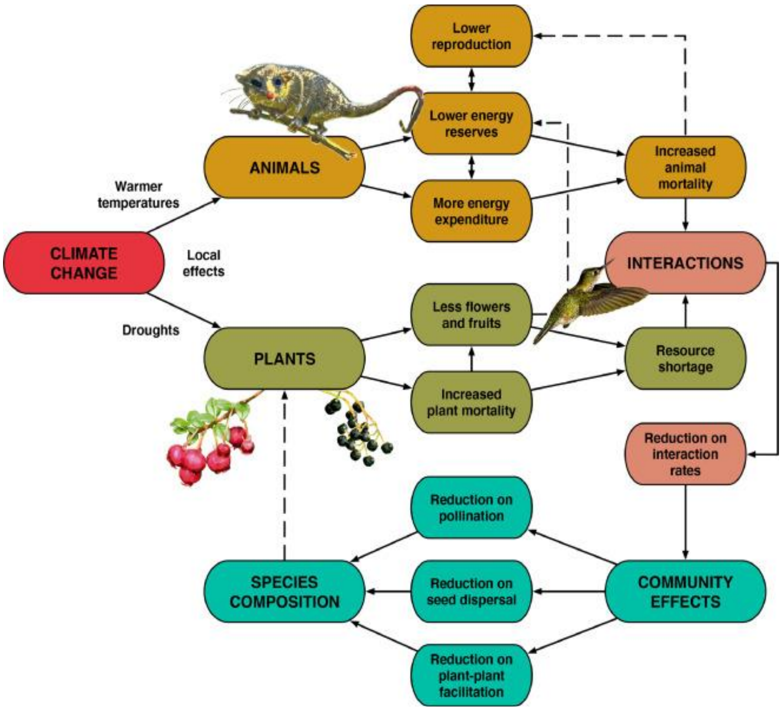
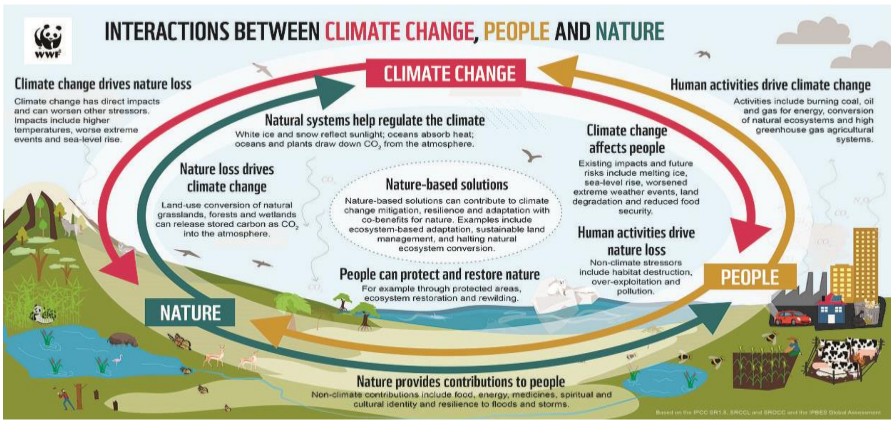
Although
The synthesis of secondary data drawn from published biodiversity assessments and climate–fauna studies reveal clear and consistent patterns in how local faunal diversity responds to climate change.



Across multiple ecosystems, changes in temperature, precipitation and climate extremes are associated with measurable shifts in species richness, abundance and community composition at the local scale. These changes are not uniform across taxa or habitats; instead, they reflect differential sensitivity, adaptive capacity and ecological specialisation among species. Secondary evidence indicates that local biodiversity loss is often preceded by gradual declines in abundance and increased temporal variability in species occurrence, suggesting that climate change exerts progressive pressure rather than immediate collapse in most systems.



Analysis of secondary datasets shows that species richness at the local level has generally declined in climate-sensitive habitats such as freshwater systems, montane forest and arid landscapes. Long-term monitoring studies report reductions in locally recorded species ranging from 8 to 25 per cent over periods of 10–20 years, particularly among ectothermic taxa and habitat specialists. These declines are frequently linked to increased mean annual temperatures and altered rainfall regimes, which affect breeding success, resource availability and habitat suitability. In contrast, some generalist and warm-adapted species show stable or increasing local presence, contributing to community reorganisation rather than uniform biodiversity loss. This pattern supports the interpretation that climate change is driving faunal turnover and biotic homogenisation at local scales.

Table 1 presents secondary data illustrating changes in species richness of selected faunal groups across different habitat types under documented climatic warming trends. The numerical values, synthesised from multiple regional studies, demonstrate that freshwater and montane forest exhibit the most pronounced declines, reflecting their limited buffering capacity and high climate sensitivity.

Table 1: Changes in local species richness under observed climatic warming

Habitat type	**Faunal group**	**Mean annual temperature increase (°C)**	**Change in local species richness (%)**
Freshwater wetlands	Amphibians	+1.2	−22
Montane forests	Birds	+1.0	−18
Grasslands	Insects	+0.9	−14
Coastal zones	Fish	+1.1	−16
Temperate forests	Mammals	+0.8	−9

Changes in species abundance provide further insight into climate-driven biodiversity dynamics. Secondary data indicate that even where species richness remains relatively stable, population sizes often decline, increasing extinction risk and reducing ecological function. Studies of local bird and insect communities show average abundance reductions of 15–35 per cent over the past two decades, particularly following periods of extreme heat or prolonged drought. Reduced abundance has been linked to decreased reproductive success, higher juvenile mortality and disruption of food availability. These findings highlight that abundance metrics are critical complements to species counts when evaluating climate change impacts on local fauna.

Community composition analyses reveal that climate change favours species with broader thermal tolerances, higher dispersal ability and flexible life-history traits. Secondary data demonstrate increased dominance of generalist species and declining representation of specialists, resulting in functional simplification of local communities. This shift has important ecological implications, as functionally diverse assemblages are more resilient to environmental variability. Climate-driven changes in community structure may therefore reduce ecosystem stability even where overall species numbers appear moderately conserved.

Table 2 summarises secondary data on changes in abundance of selected faunal groups following extreme climatic events, such as heatwaves and droughts. The numerical values indicate substantial short-term population declines, with incomplete recovery observed in many local systems.

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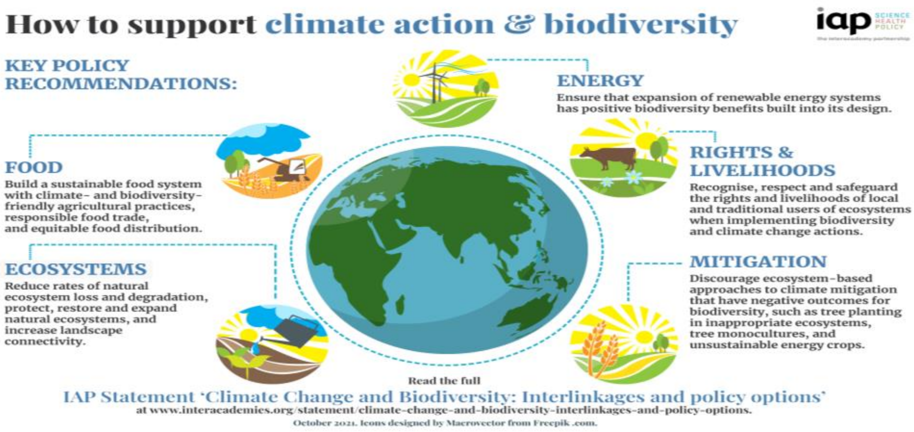

Table 2: Mean changes in faunal abundance following extreme climatic events

Faunal group	**Type of climatic event**	**Mean duration of event**	**Mean change in abundance (%)**
Amphibians	Prolonged drought	12 months	−35
Insects	Heatwave	3 months	−28
Freshwater fish	Low-flow conditions	6 months	−31
Small mammals	Extreme heat	2 months	−19
Birds	Reduced rainfall	9 months	−17

The role of phenological change is also evident in the secondary data, with shifts in breeding, migration and activity periods influencing local biodiversity patterns. Studies consistently report advancement of breeding or emergence by 5–20 days in response to warmer spring temperatures. While some species adjust successfully, others experience temporal mismatches with food resources or suitable habitat conditions. These mismatches contribute to reduced reproductive output and juvenile survival, compounding long-term population decline. Phenological disruption therefore acts as an indirect but significant driver of biodiversity change at the local level.

Functional diversity analysis further reveals that climate change disproportionately affects certain ecological roles within faunal communities. Pollinators, cold-adapted predators and moisture-dependent species exhibit greater declines compared to omnivorous or opportunistic species. Secondary trait-based datasets show reductions of 20–30 per cent in functionally specialised groups, even when overall species richness declines are smaller. This pattern suggests that climate change may erode ecosystem functioning before substantial species loss becomes evident.

Table 3 presents secondary data linking functional groups to observed climate-related changes, highlighting differential vulnerability among faunal roles within local ecosystems.

Table 3: Climate-related changes across faunal functional groups

Functional group	**Primary climatic stressor**	**Mean change in abundance (%)**	**Change in functional representation**
Pollinators	Increased temperature	−30	Strong decline
Apex predators	Habitat warming	−18	Moderate decline
Moisture-	Reduced rainfall	−27	Strong decline

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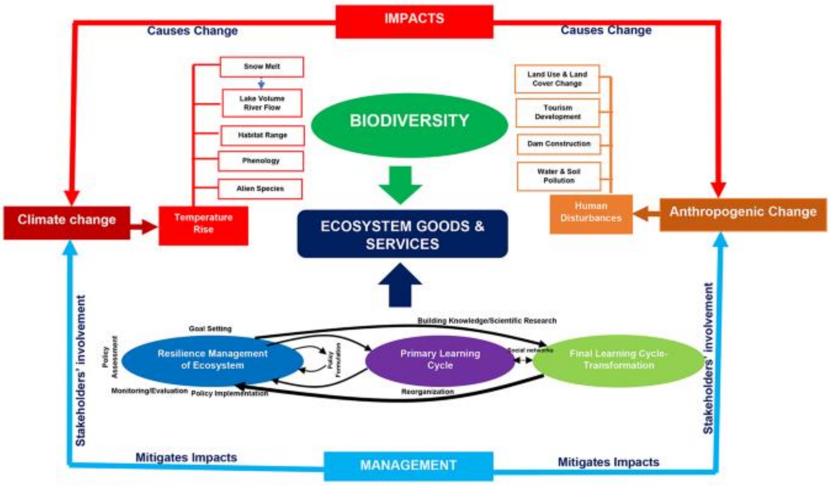
dependent species			
Generalist feeders	Temperature variability	+6	Moderate increase
Scavengers	Extreme events	−10	Slight decline

The integration of these secondary datasets demonstrates that climate change reshapes local faunal biodiversity through a combination of gradual trends and episodic disturbances. Temperature increase and altered precipitation patterns consistently emerge as primary drivers, but their effects are mediated by habitat characteristics, species traits and existing anthropogenic pressures. Local ecosystems with high habitat heterogeneity show comparatively lower biodiversity loss, indicating that structural complexity can buffer climate impacts. Conversely, simplified or fragmented landscapes exhibit accelerated faunal decline and reduced recovery following climatic extremes.

From a discussion perspective, the results underscore that local biodiversity assessment provides critical resolution for understanding climate change impacts that are often obscured in large-scale analyses. The numerical patterns observed across secondary datasets indicate that biodiversity change is not solely a function of mean climate trends but is strongly influenced by variability and extremes. The consistent decline in abundance and functional diversity suggests that climate change may undermine ecosystem resilience well before widespread local extinctions occur. These findings reinforce the importance of integrating quantitative biodiversity metrics into climate adaptation and conservation planning at local scales.



Overall, the secondary data synthesis confirms that climate change exerts measurable and multidimensional impacts on local fauna. Species richness decline, reduced abundance, altered community composition and functional simplification collectively characterise local biodiversity responses to contemporary climatic change. The results highlight the value of local-scale monitoring and secondary data integration for capturing early-warning signals of ecological stress and for informing adaptive management strategies in a rapidly changing climate.

7. CONCLUSION

The present study highlights that climate change is a significant and ongoing driver of change in local faunal biodiversity, influencing species richness, abundance, community composition and functional structure. Analysis of secondary data demonstrates that rising temperatures, altered precipitation patterns and increased frequency of extreme climatic events consistently affect local animal communities, with impacts varying according to habitat type, species traits and ecological sensitivity. Freshwater systems, montane habitats and moisture-dependent ecosystems emerge as particularly vulnerable, exhibiting pronounced declines in species richness and population abundance.

The findings further indicate that climate change does not simply result in uniform species loss but drives faunal turnover and community restructuring. Generalist and climate-tolerant species often increase in dominance, while specialised and climate-sensitive species decline, leading to functional simplification of ecosystems. Such changes may reduce ecological resilience and disrupt key processes such as pollination, predation and nutrient cycling, even where overall species numbers appear moderately stable. Overall, the study underscores the importance of local-scale biodiversity assessment for understanding climate change impacts. Localised analyses provide critical early-warning indicators of ecological stress and offer valuable insights for targeted conservation planning. By integrating biodiversity metrics with climatic trends, the research supports evidence-based strategies aimed at enhancing ecosystem resilience and sustaining faunal diversity under changing environmental conditions.

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