



Orthopteran diversity of Bhavnagar: A baseline study from the semi-arid region of Gujarat, India

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Abstract

The orthopteran fauna of Bhavnagar, Gujarat, was surveyed to assess species diversity and distribution across various habitats. A total of 18 orthopteran species were recorded, representing two suborders, *Caelifera* (short-horned grasshoppers) and *Ensifera* (crickets and katydids), and five families: *Acrididae*, *Pyrgomorphidae*, *Gryllidae*, and *Tettigoniidae*. *Acrididae* was the most dominant family, contributing 11 species, followed by *Pyrgomorphidae* (3 species), *Gryllidae* (2 species), and *Tettigoniidae* (2 species). The study found that *Caelifera* dominated the orthopteran community, representing 77.8% of species, while *Ensifera* accounted for 22.2%. Species were primarily associated with open grasslands, agricultural fields, and scrublands, with *Acrididae* being abundant in disturbed and open habitats. This research provides a baseline for monitoring orthopteran biodiversity in semi-arid ecosystems and highlights the importance of habitat heterogeneity in maintaining orthopteran diversity. Future studies should include seasonal sampling and functional trait analysis to better understand the ecological role of orthopterans in these ecosystems.

Keywords: Orthoptera, species diversity, Bhavnagar, caelifera, ensifera

Introduction

Insects represent the most diverse group of organisms on Earth, playing vital ecological roles in pollination, nutrient cycling, and food-web dynamics. However, mounting evidence suggests that global insect diversity is under severe threat due to anthropogenic pressures such as habitat loss, urbanization, and climate change (Wagner *et al.*, 2021; Khatsuriya *et al.*, 2024) [3, 10]. The order Orthoptera, comprising grasshoppers, locusts, crickets, and katydids, is particularly sensitive to these environmental changes, as their abundance and species richness closely track vegetation structure and microclimatic variation (Weiss *et al.*, 2013) [11]. Consequently, orthopterans are often regarded as reliable bioindicators for assessing habitat quality and ecological integrity (Gerlach *et al.*, 2013) [1].

Across India, orthopterans form a significant component of grassland and agricultural ecosystems. Studies have documented their importance not only as herbivores influencing primary productivity but also as prey supporting avian and reptilian diversity (Saha & Haldar, 2014; Chandra *et al.*, 2010) [9]. Yet, despite India's broad ecological heterogeneity, regional checklists remain incomplete, particularly in semi-arid and rapidly urbanizing landscapes such as Bhavnagar, located along the Gulf of Khambhat, Gujarat. The city and its surrounding areas are undergoing intensifying urban expansion and industrial growth, leading to fragmentation of natural habitats and transformation of open grasslands and scrublands i.e. prime habitats for orthopteran assemblages (Makwana *et al.*, 2024a; Makwana *et al.*, 2024b) [5, 6].

Climate variability, characterized by erratic monsoons, prolonged dry spells, and rising temperatures in Gujarat (Nath *et al.*, 2020), further influences orthopteran community composition. Previous research indicates that grasshoppers exhibit shifts in distribution and phenology under changing climatic regimes (Löffler *et al.*, 2019) [4], with xerophilous species tending to dominate under warmer, drier conditions. Hence, studying orthopteran diversity in Bhavnagar can provide early ecological insights into the

combined impacts of urbanization and climate stress on insect assemblages in semi-arid environments.

The present study therefore aims to document the species richness and taxonomic composition of orthopterans in Bhavnagar and to analyse their distribution across families and suborders (*Caelifera* and *Ensifera*). This baseline documentation will not only contribute to the regional faunal inventory but also serve as a reference for long-term biodiversity monitoring under accelerating urban and climatic pressures.

Materials and Methods

Study Area

The study was conducted in the Bhavnagar, located in the semi-arid region of Gujarat, India. The region is characterized by open grasslands, scrub vegetation, and agricultural landscapes, with a tropical climate and distinct wet and dry seasons. Sampling was carried out during the dry season (from October to March 2022), when orthopteran activity is generally at its peak.

Sampling Design

A systematic survey was conducted to assess orthopteran diversity across a variety of habitats within Bhavnagar. The sampling locations were selected to represent a range of ecological settings, including

- 1. Open grasslands:** Dominated by herbaceous vegetation.
- 2. Agricultural fields:** Primarily paddy and cereal crops.
- 3. Scrubland:** Semi-arid areas with scattered shrubs and low trees.
- 4. Woodland edges:** Transitional areas between agricultural fields and woody vegetation.

Sampling points were chosen based on accessibility and the presence of typical orthopteran habitats, with a focus on areas likely to host species from both suborders *Caelifera* and *Ensifera*.

Sampling Method

Orthopteran species were sampled using a combination of visual observations and hand collection techniques. The methods employed include

- **Visual Surveys:** Observations were made by walking through each habitat type, scanning the vegetation at 5-10m intervals for active orthopterans. Species identification was confirmed through binoculars for distant individuals.
- **Hand Collection:** Orthopterans were collected by direct hand-picking from vegetation, particularly in grassland and scrub areas. In some cases, sweep nets were used to capture flying or jumping specimens.

Results

A total of 18 orthopteran species belonging to two suborders, *Caelifera* and *Ensifera*, were recorded from

various habitats in the Bhavnagar region, Gujarat, India. These species were distributed across five families and 15 genera, indicating a moderate level of taxonomic richness for the region’s semi-arid and grassland ecosystems.

Taxonomic Composition and Diversity

The suborder *Caelifera* dominated the orthopteran assemblage, contributing 14 species (77.78 % of total species richness), distributed among two families: *Acrididae* and *Pyrgomorphidae*. Within *Caelifera*, the family *Acrididae* exhibited the greatest diversity, accounting for 11 species across ten genera (*Schistocerca*, *Pachyacris*, *Indomerus*, *Hieroglyphus*, *Spathosternum*, *Xenocatantops*, *Trilophidia*, *Truxalis*, *Cyrtacanthacris*, and *Eyprepocnemis*). The *Pyrgomorphidae* family was represented by three species under the genera *Poecilocerus*, *Atractomorpha*, and *Pyrgomorpha*, which are characteristic of xerophytic and open grassland habitats (Figure 1, Table 1).

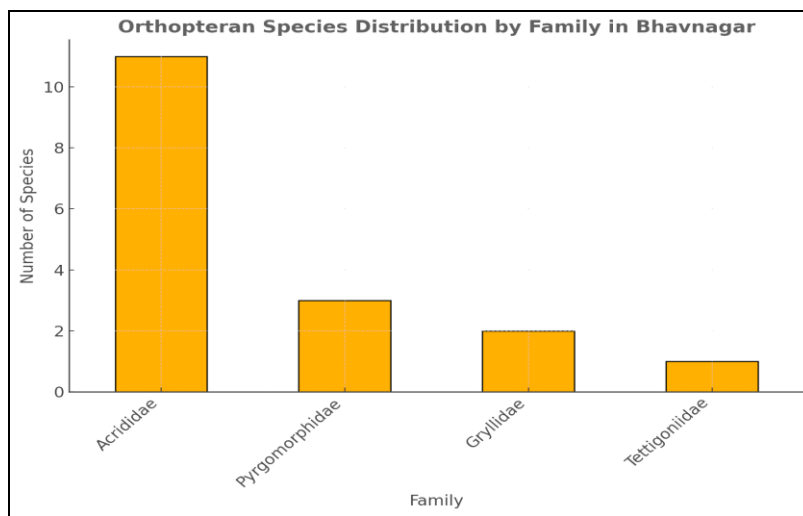


Fig 1: Orthopteran Specie Distribution by Family in Bhavnagar, Gujarat

The suborder *Ensifera* was represented by four species (22.22 %), distributed among two families: *Gryllidae* and *Tettigoniidae* (Table 1, Figure 2). The *Gryllidae* (true crickets) contributed two species (*Gryllus bimaculatus* and *Gryllodes sigillatus*),

while *Tettigoniidae* (katydids) were represented by two genera (*Parasanaa* and *Himertula*). The presence of both *Ensiferan* families highlights the structural and acoustic complexity of the local vegetation, supporting diverse acoustic niches.

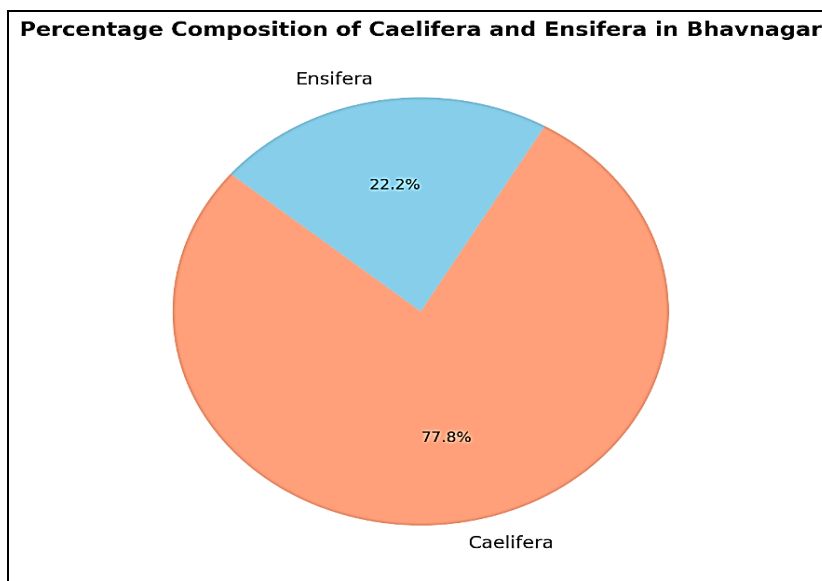


Fig 2: Composition of *Caelifera* and *Ensifera* in Bhavnagar

Dominance and Genera Distribution

Among the recorded taxa, *Hieroglyphus* and *Gryllus* were the most species-rich genera, each represented by two species, suggesting their ecological adaptability and wider habitat preference in Bhavnagar. The genus *Hieroglyphus* is particularly notable as it includes phytophagous species often associated with paddy and other cereal crops (*H. oryzivorus* and *H. nigrorepletus*), indicating potential agro-ecological

importance and interactions with cultivated fields.

The genera *Schistocerca* and *Truxalis* represent widely distributed grasshopper taxa adapted to dry grassland and scrub environments, reflecting the semi-arid nature of Bhavnagar's landscape. The detection of *Poeciloceris pictus*, a conspicuous and chemically defended grasshopper, underscores the prevalence of Pyrgomorphidae elements adapted to arid and toxic-plant-dominated ecosystems.

Table 1: Checklist of Orthopteran Species Recorded in Bhavnagar, Gujarat

Sr. No.	Suborder	Family	Genus	Species
1	Caelifera	Pyrgomorphidae	Poeciloceris	<i>Poeciloceris pictus</i>
2	Caelifera	Acrididae	Schistocerca	<i>Schistocerca gregaria</i>
3	Caelifera	Acrididae	Pachyacris	<i>Pachyacris vinosa</i>
4	Caelifera	Acrididae	Indomerus	<i>Indomerus noxius</i>
5	Caelifera	Acrididae	Hieroglyphus	<i>Hieroglyphus oryzivorus</i>
6	Caelifera	Acrididae	Xenocatantops	<i>Xenocatantops karnyi</i>
7	Caelifera	Acrididae	Truxalis	<i>Truxalis nasuta</i>
8	Caelifera	Acrididae	Eyrepocnemis	<i>Eyrepocnemis alacris</i>
9	Caelifera	Acrididae	Spathosternum	<i>Spathosternum prasiniferum</i>
10	Caelifera	Acrididae	Cyrtacanthacris	<i>Cyrtacanthacris tatarica</i>
11	Caelifera	Pyrgomorphidae	Atractomorpha	<i>Atractomorpha crenulata</i>
12	Caelifera	Pyrgomorphidae	Pyrgomorpha	<i>Pyrgomorpha conica</i>
13	Caelifera	Acrididae	Trilophidia	<i>Trilophidia annulata</i>
14	Caelifera	Acrididae	Hieroglyphus	<i>Hieroglyphus nigrorepletus</i>
15	Ensifera	Gryllidae	Gryllus	<i>Gryllus bimaculatus</i>
16	Ensifera	Tettigoniidae	Parasanaa	<i>Parasanaa donovani</i>
17	Ensifera	Tettigoniidae	Himertula	<i>Himertula kinneari</i>
18	Ensifera	Gryllidae	Gryllodes	<i>Gryllodes sigillatus</i>

Habitat and Ecological Observations

The majority of the recorded Caeliferans were observed in open grasslands, agricultural margins, and scrublands, where they were seen feeding on herbaceous vegetation. *Eyrepocnemis alacris* and *Cyrtacanthacris tatarica* were frequent in moderately disturbed habitats, reflecting their ecological tolerance. Conversely, *Atractomorpha crenulata* and *Pyrgomorpha conica* were typically confined to xerophytic vegetation, aligning with earlier records from arid western India.

Ensiferan species such as *Parasanaa donovani* and *Himertula kinneari* were predominantly encountered in bushy and semi-wooded areas, preferring shaded microhabitats and suggesting that even small woodland patches within the district serve as important microrefugia for katydid diversity. The crickets (*Gryllidae*) were widespread, with *Gryllodes sigillatus* found commonly in peri-urban habitats, reflecting its synanthropic tendencies.

Comparative Analysis and Species Richness

The observed species richness aligns with findings from comparable studies conducted in other regions of Gujarat and western India, which typically report between 15–25 orthopteran species in semi-arid landscapes. The higher proportion of Acrididae species in Bhavnagar corroborates global patterns where short-horned grasshoppers dominate open dry habitats due to their efficient thermoregulation and broad dietary breadth.

The co-occurrence of both xerophilous (e.g., *Poeciloceris pictus*, *Pyrgomorpha conica*) and mesophilous (e.g., *Hieroglyphus oryzivorus*, *Gryllus bimaculatus*) taxa suggests that Bhavnagar supports a transitional assemblage reflecting both arid and mesic influences. This transitional composition highlights the ecotonal character of

Bhavnagar's landscape, situated between coastal plains and inland dry zones.

Significance

The checklist presented here forms the first consolidated record of orthopteran fauna from the Bhavnagar region, expanding the known distribution of several genera within Gujarat. The documented diversity underscores the ecological heterogeneity of the district and emphasizes the importance of continued surveys integrating temporal sampling and microhabitat-level analysis. Such data are essential for understanding the role of Orthoptera as bioindicators of habitat quality, trophic dynamics, and climate sensitivity in semi-arid ecosystems.

Discussion

Taxonomic composition and regional comparison

The dominance of the family Acrididae in your study (along with representation of Pyrgomorphidae, Gryllidae, and Tettigoniidae) is consistent with patterns reported in Indian surveys. For example, Humayoon Akhtar & Kamil Usmani (2014) [2] recorded 21 Acrididae species from paddy fields in Uttar Pradesh, India, where Acrididae dominated. Similarly, a survey in the Taranga Hills region of Gujarat documented 23 orthopteran species under six families, with Acrididae numerically dominant. This congruence suggests that open-grassland and agricultural margin habitats in semi-arid Gujarat, such as Bhavnagar, are favourable for Acrididae.

Habitat-association and ecological interpretation

Your findings indicate many Caeliferan species (short-horned grasshoppers) are associated with open grassland, scrub and cultivation margins. This aligns with Saha & Haldar's (2014) [9] observations in a dry-deciduous forest of

West Bengal where weedy fields hosted higher acridid species-richness compared to rock or road habitats. The presence of both xeric-adapted genera (e.g., those in Pyrgomorphidae) and more generalist Acrididae suggests Bhavnagar provides a mosaic of micro-habitats ranging from semi-arid scrub to disturbed agricultural margins. In the Ensifera (crickets/katydids) component, their representation in bushy or semi-wooded patches highlights the importance of retaining structurally complex vegetation even in predominantly open landscapes.

Implications for biodiversity monitoring and agro-ecosystems

Orthopterans are frequently proposed as bio-indicators of habitat quality and disturbance because they respond rapidly to vegetation structure and land-use change (Saha & Haldar 2014)^[9]. In this region, the current assemblage provides a baseline against which future changes (e.g., intensification of agriculture, conversion of grassland to monocultures, or shrub encroachment) may be gauged. Furthermore, given that some of your recorded taxa (e.g., in genus Hieroglyphus) are known cereal pests in India (Akhtar & Usmani 2014), your dataset may hold dual relevance: for biodiversity indices and agro-ecosystem management.

Conservation and Management Considerations

In the semi-arid, mixed agricultural-grassland setting of Bhavnagar, maintaining habitat heterogeneity such as retaining grassland patches, field margins, scrub remnants and minor woodland is likely key to sustaining orthopteran diversity (and thus the broader invertebrate food web). The coexistence of 'pest' and 'non-pest' taxa highlights the need for integrated management strategies that balance biodiversity conservation with agricultural productivity. Monitoring orthopteran assemblages over time could function as an early-warning system for ecosystem changes (e.g., frequent mowing, herbicide use, conversion to monocropping) and guide adaptive land-use planning.

References

1. Gerlach J, Samways M, Pryke J. Terrestrial invertebrates as bioindicators: an overview of available taxonomic groups. *Journal of insect conservation*,2013;17(4):831-850.
2. Humayoon Akhtar M, Kamil Usmani M. Taxonomic studies on the grasshopper fauna (Orthoptera: Acrididae) recorded from paddy fields in Uttar Pradesh, India. *Journal of the Bombay Natural History Society (JBNHS)*,2014;111(3):180-192. <https://doi.org/10.17087/jbnhs/2014/v111i3/82371>
3. Khatsuriya PA, Makwana VM, Dodia PP. Biodiversity Resilience Amidst Climate Shifts: A Global Perspective. In *Global Challenges for the Environment and Climate Change*. IGI Global, 2024, 75-99. <https://doi.org/10.4018/979-8-3693-2845-3.ch005>
4. Löffler F, Poniatowski D, Fartmann T. Orthoptera community shifts in response to land-use and climate change—Lessons from a long-term study across different grassland habitats. *Biological Conservation*, 2019;236:315-323.
5. Makwana VM, Khatsuriya PA, Matli AG, Dodia PP. Composition and Conservation Status of Avifauna in Urban Non-protected Important Bird Area (IBA) Site of Western India. *Journal of Tropical Biodiversity and*

Biotechnology,2024a;9(2):87311.

<https://doi.org/10.22146/jtbb.87311>

6. Makwana VM, Patel FP, Dodia PP. Urbanization's Ecological Toll: Exploring Its Role in Biodiversity Decline. In *Impact of Societal Development and Infrastructure on Biodiversity Decline*. IGI Global Scientific Publishing, 2024b, 245-270. <https://doi.org/10.4018/979-8-3693-6950-0.ch014>
7. Nath S, Mathew A, Khandelwal S, Shekar PR. Rainfall and temperature dynamics in four Indian states: A comprehensive spatial and temporal trend analysis. *HydroResearch*,2023;6:247-254.
8. PARMAR BM. STUDY OF ORTHOPTERA FROM TARANGA HILLS, GUJARAT, INDIA. *LIFE SCIENCES LEAFLETS*,2021:137:6-9. RETRIEVED FROM <https://petsd.org/ojs/index.php/lifesciencesleaflets/article/view/1612>
9. Saha S, Haldar P. Habitat association and diversity of Acridids (Orthoptera: Acrididae) in a dry deciduous forest of West Bengal, India. *Heritage Journal of the Department of Zoology, Bethune College*,2014;1:89-97.
10. Wagner DL, Grames EM, Forister ML, Berenbaum MR, Stopak D. Insect decline in the Anthropocene: Death by a thousand cuts. *Proceedings of the National Academy of Sciences*,2021;118(2):2023989118.
11. Weiss N, Zucchi H, Hochkirch A. The effects of grassland management and aspect on Orthoptera diversity and abundance: site conditions are as important as management. *Biodiversity and Conservation*,2013;22(10):2167-2178.