

Effects of Climate Change on the Biodiversity of Family Acrididae (Orthoptera) in District Matiari, Sindh, Pakistan

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ABSTRACT

Climate change has become one of the most significant environmental challenges affecting insect biodiversity across the world. Grasshoppers of the family Acrididae are ecologically and economically important insects whose populations are strongly influenced by temperature, rainfall, humidity, and habitat changes. The present study investigated the biodiversity, abundance, and distribution of Acrididae species in District Matiari, Sindh, Pakistan, during 2022–2023. A total of 1,436 specimens were collected from agricultural and semi-agricultural habitats using insect nets and random sampling techniques. The collected specimens belonged to 12 species distributed among different subfamilies of Acrididae. The highest abundance was recorded for *Oxya hyla hyla* (13.07%), while *Anacridium rubrispinum* showed the lowest occurrence (5.0%). Climatic variables such as temperature, rainfall, and humidity significantly influenced species richness and seasonal occurrence. The study demonstrates that climate variability, especially extreme rainfall and temperature fluctuations, affects grasshopper biodiversity, distribution, and population dynamics in Matiari. The findings contribute to understanding the ecological responses of grasshoppers to climate change and provide baseline information for biodiversity conservation and pest management strategies in Sindh, Pakistan.

Keywords: Climate change, Biodiversity, Acrididae, Grasshoppers, Matiari, Pakistan, Orthoptera

Introduction

Biodiversity represents the diversity of living organisms and ecosystems that sustain

ecological balance on Earth. Insects play an essential role in ecosystem functioning through nutrient cycling, pollination, herbivory, and food-web interactions. Among insects, grasshoppers belonging to the family Acrididae are important herbivorous organisms that significantly influence agricultural ecosystems and natural habitats.

Climate change has emerged as a major threat to biodiversity worldwide due to increasing global temperatures, irregular precipitation patterns, floods, droughts, and habitat degradation. These environmental changes directly affect insect populations, particularly grasshoppers, by altering their life cycles, phenology, abundance, and geographical distribution (Bale et al., 2002). Pakistan is considered highly vulnerable to climate change despite contributing relatively little to global carbon emissions. During 2022, Pakistan experienced unprecedented floods and extreme weather conditions that severely affected ecosystems and agricultural productivity.

Grasshoppers are highly sensitive to environmental changes because they are ectothermic organisms whose growth, reproduction, and survival depend largely on climatic conditions. Variations in rainfall and temperature influence vegetation growth and food availability, which subsequently affect grasshopper abundance and diversity (Schneider et al., 2022). Some species become agricultural pests under favorable climatic conditions and may cause severe damage to crops and rangelands.

The family Acrididae is one of the largest and most diverse groups of short-horned grasshoppers within the order Orthoptera. Members of this family occur worldwide and are particularly abundant in semi-arid and grassland ecosystems (Nakano et al., 2020). Acrididae species exhibit considerable ecological diversity and occupy a variety of habitats including forests, agricultural lands, deserts, river belts, and grasslands.

District Matiari in Sindh Province provides suitable environmental conditions for agricultural activities; however, limited research has been conducted on grasshopper biodiversity and the effects of climate change in this region. Therefore, the present study aimed to investigate the diversity, occurrence, and climatic relationships of Acrididae species in District Matiari during 2022–2023.

Literature Review

Several studies have documented the biodiversity and ecological significance of grasshoppers globally. Suhail et al. (2019) studied the subfamily Cyrtacanthacridinae and highlighted the destructive nature of locust-forming species capable of damaging crops and vegetation. Oku et al. (2014) investigated grasshopper distribution in Nigeria and reported that habitat disturbance and human activities strongly influence species abundance.

Antonatos et al. (2018) examined the effects of temperature on feeding behavior in *Calliptamus barbarus barbarus* and found that temperature significantly affected leaf consumption rates. Similarly, Muzaffar et al. (2015) observed that the abundance of *Oxya* species was highly dependent on favorable temperatures and food availability.

In Pakistan, various researchers have investigated grasshopper biodiversity and pest status. Usman et al. (2010) and Arya et al. (2012) reported that grasshoppers are serious pests of paddy crops. Nazir et al. (2013) studied grasshopper morphology in Azad Jammu and Kashmir and emphasized their harmful effects on vegetation.

Kalhor et al. (2017) surveyed District Dadu, Sindh, and documented 20 species of

short-horned grasshoppers from agricultural lands, deserts, and river belt zones. Memon and Panhwar (2018) described the destructive impact of Acrididae species on forests, vegetables, orchards, and agricultural crops.

Climate change has also been recognized as a major factor affecting insect biodiversity. Bourque et al. (2001) suggested that rising temperatures generally promote insect expansion and population growth. The International Union for Conservation of Nature (IUCN, 2004) reported alarming rates of biodiversity loss worldwide due to habitat destruction, climate change, and overexploitation.

Previous studies indicate that climatic changes influence grasshopper distribution, phenology, feeding behavior, and population dynamics. However, limited information is available regarding the effects of climate variability on Acrididae biodiversity in District Matiari, Sindh.

Materials and Methods

Study Area

The study was conducted in District Matiari, Sindh, Pakistan, located between 25°35'59.99"N and 68°26'59.99"E. The district experiences a semi-arid climate characterized by hot summers and mild winters. Summer temperatures range from 35°C to 45°C, whereas winter temperatures range from 10°C to 20°C. Rainfall primarily occurs during the monsoon season from July to September.

Sampling Design

A time-series longitudinal survey approach was adopted during 2022–2023. Multiple field visits were conducted across 12 localities of District Matiari, including agricultural fields, grasslands, deserted areas, and semi-agricultural habitats.

Collection of Specimens

Grasshopper specimens were collected using insect nets and forceps during sunny conditions between 10:00 and 15:00 PST. A total of 1,436 specimens were collected. Captured insects were euthanized using ethyl acetate or chloroform and preserved in 70% ethanol.

Identification and Examination

Specimens were pinned, labeled, and examined under a stereoscopic binocular microscope. Morphological features including antennae, pronotum, tegmina, wings, femur, tibia, and genital structures were used for taxonomic identification.

Data Analysis

The collected data were analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Biodiversity indices including Shannon-Wiener and Simpson's Diversity Index were calculated to determine species richness and abundance.

Results

Species Diversity of Acrididae

The study recorded 12 species belonging to the family Acrididae from District Matiari. These species included:

Acrida cinerea

Oxya hyla hyla

Oxya velox

Heteracris notabilis

Ochrilidia geniculata

Glestorhinus semipictus

Scintharista notabilis pallipes

Calliptamus barbarus barbarus

Truxalis fitzgeraldi

Truxalis nasuta

Aulacobothrus luteipes

Anacridium rubrispinum

Among these species, *Oxya hyla hyla* was the most abundant species, accounting for 13.07% of the total population, whereas *Anacridium rubrispinum* showed the lowest abundance at 5.0%.

Seasonal Distribution

Species abundance varied considerably throughout the year. The highest population density was observed during the monsoon and post-monsoon seasons due to increased vegetation growth and food availability. Heavy rainfall during 2022 created favorable ecological conditions for several species.

The summer season also supported higher grasshopper activity due to elevated temperatures, whereas lower abundance was recorded during winter months.

Climatic Influence on Biodiversity

Temperature, humidity, and rainfall strongly influenced grasshopper diversity and occurrence patterns. Increased rainfall promoted vegetation growth, thereby increasing food availability and habitat suitability for Acrididae species.

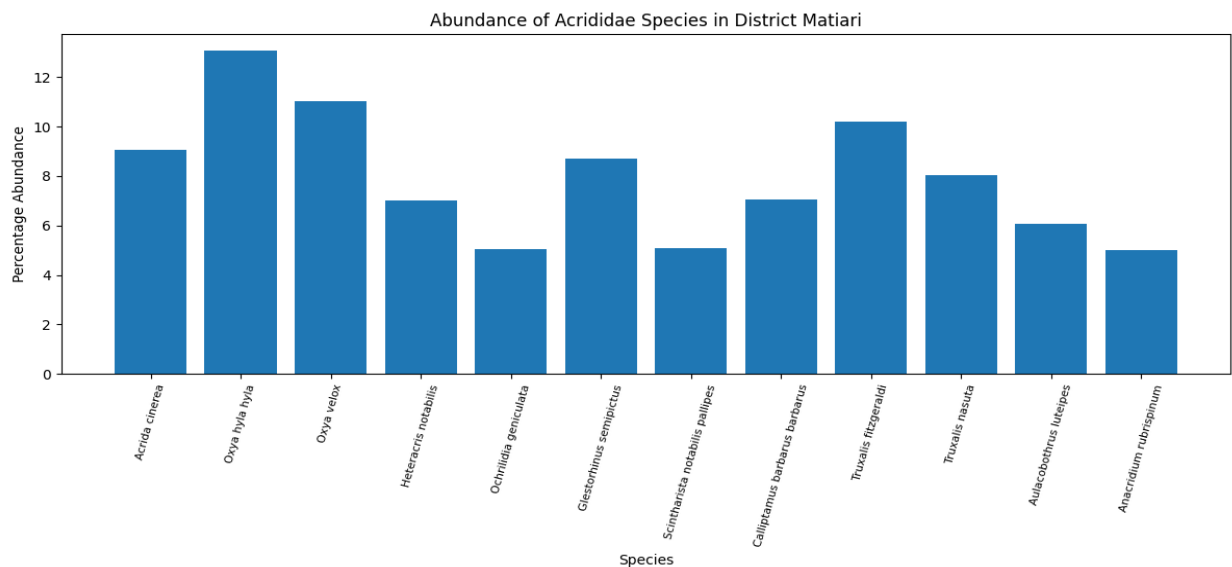
Extreme weather conditions such as floods and irregular precipitation altered habitat structure and distribution patterns. Some species exhibited phenological shifts and changes in geographical occurrence in response to climatic variability

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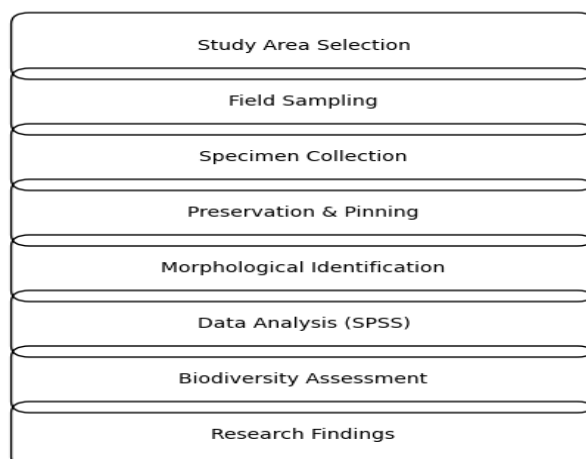
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Taxonomic Observations

Detailed morphological descriptions and taxonomic keys were developed for all recorded species. Species identification was based on body coloration, pronotum structure, antennae morphology, tegmina development, and genital characteristics.

The genus *Truxalis* was represented by two species: *Truxalis fitzgeraldi* and *Truxalis nasuta*. Both species showed elongated bodies and distinct morphological adaptations for camouflage in grassland habitats.



Discussion

The present study revealed considerable biodiversity of the family Acrididae in District Matiari. The occurrence of 12 species indicates that the district provides favorable ecological conditions for grasshopper populations.

The abundance of *Oxya hyla hyla* may be associated with its adaptability to agricultural habitats and favorable climatic conditions during the monsoon season. Similar findings were reported by Muzaffar et al. (2015), who observed increased abundance of *Oxya* species under suitable temperature and food conditions.

Climate change played a major role in shaping species distribution and population dynamics. Elevated temperatures and increased rainfall promoted vegetation growth, thereby enhancing food resources for grasshoppers. However, extreme climatic events such as floods also disrupted habitats and altered bio

References

- Bale, J. S., Masters, G. J., Hodkinson, I. D., et al. (2002). Herbivory in global climate change research: Direct effects of rising temperature on insect herbivores. *Global Change Biology*, 8(1), 1–16.
- Bernays, E. A., & Chapman, R. F. (1994). *Host-plant selection by phytophagous insects*. Chapman & Hall.
- Bourque, A., & Simonet, G. (2007). Québec. In D. S. Lemmen, F. J. Warren, J. Lacroix, & E. Bush (Eds.), *Vivre avec les changements climatiques au Canada* (pp. 171–226).
- Chapman, R. F. (1990). Food selection. In R. F. Chapman & A. Joern (Eds.), *Biology of grasshoppers* (pp. 39–72). Wiley.
- Dadd, R. H. (1963). Feeding behaviour and nutrition in grasshoppers and locusts. *Advances in Insect Physiology*, 1, 47–109. [https://doi.org/10.1016/S0065-2806\(08\)60174-5](https://doi.org/10.1016/S0065-2806(08)60174-5)
- Hosseyni, S. A. (2013). *Faunistic and taxonomy of (Hexapoda: Orthoptera), Kurdistan Province* (Master's thesis). Payam-e Noor University, Tehran, Iran.
- International Union for Conservation of Nature. (2008). *World Conservation Congress* (4th ed.).
- Joern, A. (1979). Feeding patterns in grasshoppers (Orthoptera: Acrididae): Factors influencing diet specialization. *Oecologia*, 38, 325–347. <https://doi.org/10.1007/BF00345192>
- Joern, A. (2004). Variation in grasshopper (Acrididae) densities in response to fire frequency and bison grazing in tallgrass prairie. *Journal of Environmental Entomology*, 33(6), 1617–1625.
- Khan, Z., Ikhtiar, Z., Sadiq, A., Rahman, W., Rahman, H. U., Ali, I., Mehmood, S. A., Alam, A., & Khan, F. (2022). Diversity of grasshopper in the piedmont of Mount Elum, Buner, 11(1), 217–225.
- Lakho, H. (2024). *Effects of climate change on the biodiversity of family Acrididae (Orthoptera) from District Matiari, Sindh, Pakistan* (M.Phil thesis). University of Sindh, Jamshoro.
- Memon, P. R., & Panhwar, W. A. (2021). Study on some selected species of Acrididae (Orthoptera) from District Dadu, Sindh, Pakistan, 9(1), 6–11.
- More, S., & Nikam, K. (2016). Studies on grasshoppers (Orthoptera) in Tilari forest,

Online ISSN

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Print ISSN

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<http://amresearchreview.com/index.php/Journal/about>

- Chandgad, Kolhapur district of Maharashtra (India). *International Journal of Recent Scientific Research*, 7(3), 9457–9460.
- Nakano, M., Morgan-Richards, M., Trewick, S. A., & Clavijo-McCormick, A. (2022). Chemical ecology and olfaction in short-horned grasshoppers (Orthoptera: Acrididae). *Journal of Chemical Ecology*, 48(2), 121–140. <https://doi.org/10.1007/s10886-021-01333-3>
- Prihar, D. R. (1987). *Grasshopper pest of grazing land vegetation and their management in Indian desert central*. Ari Zone Research, Jodhpur, India.
- Reid, W. V., Mooney, H. A., Cropper, A., Capistrano, D., Carpenter, S. R., Chopra, K., et al. (2005). *Ecosystems and human well-being: Synthesis*. Millennium Ecosystem Assessment.
- Schneider, L., Rebetez, M., & Rasmann, S. (2022). The effect of climate change on invasive crop pests across biomes. *Current Opinion in Insect Science*, 50.
- Shishodia, M. S., Chandra, K., & Gupta, S. K. (2010). *An annotated checklist of Orthoptera (Insecta) from India*. Zoological Survey of India.
- Shishodia, M. S., Mehta, H., Mattu, V., & Thakur, S. (2003). Orthoptera (Insecta) from Pong Dam wetland, District Kangra, Himachal Pradesh, India. *Zoos' Print Journal*, 18(3), 1047–1048.
- Soomro, F., Sultana, R., Wagan, M. S., & Abbasi, A. R. Fauna of Acrididae (Orthoptera: Acridoidea) from Nara Desert District Khairpur. *Sindh University Research Journal*.
- Sultana, R., Lal, M., Soomro, S., & Kumar, S. (2022). Biodiversity and systematics status of band-winged grasshoppers, Oedipodinae Walker, 1871 (Orthoptera: Acrididae) from Thar Desert, Pakistan, 1–15.
- Swingland, I. R. (2013). Biodiversity, definition of. In *Levin Encyclopedia of Biodiversity* (Vol. 1, pp. 399–410). <https://doi.org/10.1016/B978-0-12-384719-5.00009-5>