The conservation and management of biodiversity are crucial for achieving poverty reduction and sustainable development. India is a biodiversity-rich nation that supports 18% of the world's population on only 2.4% of the world's total land area. Remarkably, it holds parts of four global biodiversity hotspots that have high concentrations of endemic taxa and some of the biggest remaining wild populations of large, wide-ranging mammals. India faces unique and difficult challenges in balancing the conservation of its great biological wealth with the enhancement of human development and well-being. Climate change adds an overarching dimension to this challenge. Climate change is widely expected to have multiple adverse impacts on biodiversity, with negative consequences for human well-being. However, biodiversity, through the ecosystem services it supports, is essential to both climate change mitigation and adaptation. Preserving biological diversity at every level, from genes to biomes, is the most effective way of facilitating the rapid changes necessary for human societies to adapt to future climate change. Owing to its tremendous diversity of human and biological systems, India is well-positioned to meet this challenge.

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Biodiversity and Climate Change: An Indian perspective

सत्यमेव जयते

Ministry of Environment, Forest and Climate Change

Biodiversity and Climate Change

An Indian Perspective

Edited by

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Butterflies in a Changing Climate

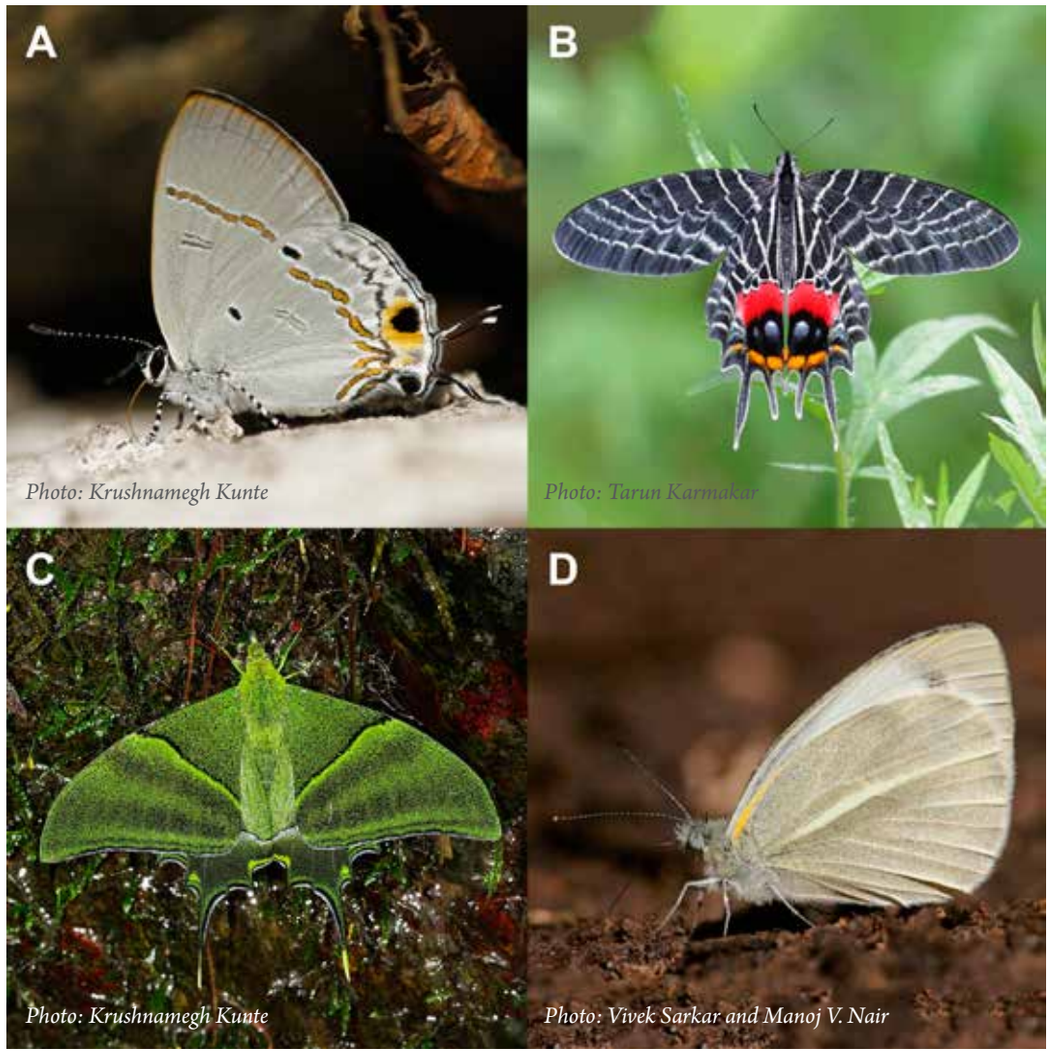
Krushnamegh Kunte

Photo: Krushnamegh Kunte

Changing climate and associated ecological factors have contributed to great episodes of species diversification in the history of life on Earth. These factors have led to such spectacular species radiations as flowering plants and butterflies, through cycles of glacial and interglacial periods (Peña and Wahlberg 2008). And yet, plants and animals are largely failing to cope with the pace at which human activities are altering and destroying habitats and fuelling long-term changes in climatic conditions. For cold-blooded insects such as butterflies, vulnerability to climate change stems from shifting, contracting ranges and local extinctions (Chen et al. 2011; Devictor et al. 2012), and species-specific traits related to host plant use and diet breadth, early-stage diapause, and range sizes (Diamond et al. 2011; Radchuk et al. 2013). These are complex biological problems that are tightly linked to the survival of a large number of species.

Two of the most prominent negative impacts of climate change on butterflies are: (1) poleward and upward shifts in distributional ranges of butterflies, which reduce available habitat for the species and cause local population extinctions (Chen et al. 2011; Devictor et al. 2012), and (2) changes in breeding phenology, i.e., the timing of egg-laying, pupal diapause, emergence of adult butterflies, etc., and their impacts on survival of different life stages and reproduction (Diamond et al. 2011; Radchuk et al. 2013). They may also deprive butterflies of critical larval host plants even though other climatic conditions may be suitable (Parmesan 2006; Radchuk et al. 2013). Thus, impacts of climate change on butterflies manifest through several ecological interactions and other biological factors.

Butterfly populations are particularly vulnerable to effects of climate change across India's biodiversity hotspots. These hotspots contain prominent altitudinal gradients (Himalaya, NE India, and Western Ghats) and oceanic islands (Andaman and Nicobar Islands) that host high levels of species diversity and endemism. Plant and animal communities associated with these ecological conditions are particularly vulnerable to climate-driven disruptions in species interactions, and eventual population extinctions (Parmesan 2006). However, there is little work on the impacts of climate change on the biology and conservation of Indian butterflies. It is critical that such studies are urgently integrated into national biodiversity and climate change programmes as implemented by various scientific research and conservation agencies of the Government of India, and non-governmental agencies.



*Indian butterflies are vulnerable to impacts of climate change. Changing rainfall patterns and temperature regimes in the Himalaya and NE India likely affect distributional ranges, activity periods and breeding biology of butterflies. A: The banded tit (*Hypolycaena narada*) has a single, short flight period of less than three weeks. B: The Bhutan glory (*Bhutanitis lidderdalii*) has specific host plant associations, and its reproductive bouts are heavily dependent on specific climatic envelopes. C: Kaiser-i-Hind (*Teinopalpus imperialis*) is a mid-elevation specialist and, like the Bhutan glory, a legally protected species in India. D: Asian cabbage white (*Pieris canidia*) is commonly seen around agricultural fields in the Himalaya. Darkening of its wings during pupal development is a key thermal adaptation for seasonally fluctuating and altitudinally changing climatic conditions.*

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