Humboldt's enigma

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Explorers and naturalists have been finding the factors leading to biodiversity concentration in mountains with **Humboldt's enigma**, defying the rule of biodiversity in tropical areas.



[Ref- The Hindu]

About Humboldt's enigma:

- It refers to the puzzle surrounding **biodiversity in mountainous regions**, challenging the expectation that diversity decreases away from the tropics.
- Alexander von Humboldt, a 19th-century explorer, noted the relationship between temperature, altitude, humidity, and species distribution in mountains.
- The enigma arises from the fact that mountains, despite being **outside the tropics**, exhibit high biodiversity.
- The world's tropical areas, receiving more energy from the sun, are known for their biodiversity.
- However, mountains have been **exceptions to the general rule of decreasing diversity** away from the tropics.
- **Geological processes**, such as uplifts, create new habitats for species to arise (cradles), while climatologically stable mountains act as museums, preserving species over time.

A Humboldt's depiction of elevational habitat layering



B Climate volume

C Climate heterogeneity



[[]Ref- Science]

Importance for India:

- The **eastern Himalayas**, considered the **second-most diverse area** for perching birds, challenges the conventional understanding of biodiversity distribution.
- Factors like geological heterogeneity and climate dissimilarity contribute to biodiversity in mountainous regions.
- For example, **Coastal tropical sky islands** (mountains surrounded by lowlands), like the Shola Sky Islands in **the Western Ghats.**
- Old lineages have persisted on the mountaintops as climates and habitats fluctuated around them in the lower elevations.

- As a result, some of the **oldest bird species in the Western Ghats**, such as the Sholicola and the Montecincla, are housed on the Shola Sky Islands.
- Sometimes, the same mountain can be both cradle for some species and museum for others, depending on the **species' ecologies**.
- Research on biodiversity patterns is limited due to a **lack of fine data on species occurrences**, especially using modern tools like genetics.
- Ongoing national programs **aim to address these gaps** and strengthen **research on mountain** biodiversity.
- These include:
 - National Mission on Himalayan Studies: It is a grant-in-aid scheme implemented across the Indian Himalayan Region (IHR) since 2015-16 for conservation and sustainable management.
 - National Mission for Sustaining the Himalayan Ecosystem: It is a multi-pronged, crosscutting mission to protect the Himalayas and develop long-term policy measures under National Climate Change Action Plan (NAPCC).
 - National Mission on Biodiversity and Human Wellbeing: It integrates biodiversity, ecosystem services, climate change, agriculture, health, bio-economy, and capacity building.