Latest findings on biodiversity & climate change – links to zoonotic disease ?

Overview

- How anthropogenic climate change has impacted on biodiversity and is changing the goalposts for successful conservation into the future.
- What are the links to zoonotic disease (including pandemic risk) ?
- What solutions can we consider ?

How climate change impacts biodiversity

- Evidence of impacts – many
  - Impacts of anthropogenic climate change have been documented in plants and animals across marine, terrestrial and freshwater realms.
  - They span all principal biomes, from rainforests and deserts to wetlands, and from coastal marine to the deep ocean

  - Climate change impacts on species →
    - at a range of scales (from genes and individuals to populations),
    - at habitat and ecosystem scales,
    - they may occur through changes in interspecies interactions (e.g., competition, predation or disease),
    - Through community composition, ecosystem function and ecosystem structure

- Climate impacts → may differ among the subregions of large or continent/ocean scale areas.
- The spatial patterning of subregional to local climates and ecosystems, and natural corridors for migration of species, affect how effectively they will be able to track shifting climates.

- Biodiversity *hotspots* & *isolated ecosystems* such as islands, mountains, lakes, enclosed seas and seamounts are particularly challenged
  - Why? may have few or no corridors facilitating migration of species, and they are spatially limited along latitudinal or altitudinal gradients

A seamount is an underwater mountain formed by volcanic activity – very NB ecologically

What might we lose?

- Species range shifts in response to climate changes are a primary multigenerational adaptation response to climate change.
- The consequences of this locally may be extirpation of species in some parts of a species range and addition of species at another, on aggregate leading to changing patterns of species richness (extirpation – organisms or groups of organisms cease to exist)
- Habitat fragmentation, such as through land-use conversion→ may turn hotspots or protected areas into islands and accelerate climate-related biodiversity loss within them
- Isolated ecosystems – such as mountains and islands – may become ‘evolutionary traps’, where the migration of climate zones off the top of mountains or off of islands makes it impossible for species to migrate to new locations with suitable climatic conditions

Interactions between climate change and other pressures on biodiversity

- Other anthropogenic pressures and direct drivers (including land/sea-use change, direct exploitation of organisms, pollution and invasive alien species) may interact with climate change, resulting in complex and nonlinear responses in biodiversity
- Increasing habitat fragmentation due to expanding infrastructural

development is a key risk, including the development of mining, cities, roads and railways, transformation of coastlines into ports, coastal protection, etc. aquaculture, and energy facilities (including solar and wind farms), amongst others

What are the links to zoonotic disease ?

- **Pandemics emerge from the microbial diversity found in nature**
- The majority (70%) of emerging diseases (e.g. Ebola, Zika, Nipah encephalitis), and almost all known pandemics (e.g. influenza, HIV/AIDS, COVID-19), are zoonoses – i.e. are caused by microbes of animal origin.

- These microbes 'spill over' due to contact among wildlife, livestock, and people → e.g. aforementioned habitat fragmentation/climate change interactions – or acting alone

- • An estimated 1.7 million currently undiscovered viruses are thought to exist in mammal and avian hosts. Of these, 631,000-827,000 could have the ability to infect humans.
- The most important reservoirs of pathogens with pandemic potential are mammals (in particular bats, rodents, primates) and some birds (in particular water birds), as well as livestock (e.g. pigs, camels, poultry).

IPBES #PandemicsReport: Escaping the 'Era of Pandemics'

Human ecological disruption, and unsustainable consumption drive pandemic risk

- The risk of pandemics is increasing rapidly, with more than five new diseases emerging in people every year, any one of which has the potential to spread and become pandemic.
- Risk driven by exponentially increasing anthropogenic changes.

- Blaming wildlife for the emergence of diseases is thus erroneous, → emergence is caused by human activities and the impacts of these activities on the environment.

- Unsustainable exploitation of the environment due to land-use change, agricultural expansion and intensification, wildlife trade and consumption, and other drivers, disrupts natural interactions among wildlife and their microbes, increases contact among wildlife, livestock, people, and their pathogens

- *Climate change* has been implicated in disease emergence → will likely cause substantial future pandemic risk by driving movement of people, wildlife, reservoirs, and vectors, and spread of their pathogens, in ways that lead to new contact among species, increased contact among species, or otherwise disrupts natural host-pathogen dynamics.

- Biodiversity loss associated with transformation of landscapes can lead to increased emerging disease risk in some cases, where species that adapt well to human-dominated landscapes are also able to harbour pathogens that pose a high risk of zoonotic transmission

Solutions? Reducing anthropogenic global environmental change may reduce pandemic risk

- Pandemic risk could be significantly lowered by promoting responsible consumption and reducing unsustainable consumption of commodities from emerging disease hotspots, and of wildlife and wildlife-derived products, as well as by reducing excessive consumption of meat from livestock production (but tread carefully – wild meat bans)

- Conservation of protected areas, and measures that reduce unsustainable exploitation of high biodiversity regions will reduce the wildlife-livestock-human contact interface and help prevent the spillover of novel pathogens

- notion of ‘climate smart’ conservation