Climate Change, Protected Areas and Biodiversity

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Bangkok, 08 October 2014
Climate change impacts across sectors

Changes in:
- Temperature (highest daytime; lowest night-time, # hot days; # cool nights)
- Precipitation (evaporation, transpiration, infiltration, run-off)
- Frequency & intensity of extreme weather
- Sea level, Ocean circulation and Acidity

PUBLIC HEALTH
- Infectious, respiratory, water-borne, vector-borne diseases, heat

AGRICULTURE
- Less predictability, changing yields, changing irrigation demand, pest infestations

FORESTRY
- Forest composition, range, health & productivity

WATER RESOURCES
- More variability in water supply, changes in water quality/distribution, competition

COASTAL SYSTEMS
- Erosion, inundation, salinisation, acifidication, stress on mangroves, marshes, wetlands, sea-grass and corals

ECOSYSTEM SERVICES
- Loss of habitat & species, migration

Source: OECD, 2009
climate change impacts on the coast
What impact will climate change have on the coastal zone?

- Sea level rise
- Higher sea temperatures
- Changes in precipitation patterns and run off (water flow)
- Changed oceanic conditions; pH, warming upper layers, changes in ocean currents
- Changes in storm tracks, frequencies & intensities of storms
What will this lead to?

- Displacement of coastal lowlands & wetlands
- Increased coastal erosion
- Increased flooding & drought conditions
- Saline intrusion
- Impacts on habitats & species
**Mangroves**

**Sensitivity:**
- Mangroves have the potential to be affected by both rising sea and air temperatures
- Processes such as respiration, photosynthesis and productivity will be affected by changes in both water and air temperature
- Mangrove systems particularly vulnerable to rising sea levels
- Likely consequences of SLR on coastal systems in the region include landward migration of mangroves, salt marsh and salt flats up slope and changes in vegetation structure
Adaptive capacity of Mangrove systems:
- Mangroves likely to retreat landward to maintain their preferred hyrdoperiod
- Presence of barriers behind mangroves is largest limitation to adaptation
- Filling sizable knowledge gaps in our understanding of how these environments change with rising sea level and other environmental changes should be made priority
Coral reef systems

**Sensitivity:**
- Corals are extremely sensitive to temperature change. Small increases (1/2°C) in sea temperature above the long-term summer maxima destabilises the relationship between host corals and their symbiotic dinoflagellate algae (zooxanthellae), on which they rely for energy and growth.
- ‘Bleaching’ is a stress response by corals experiencing unfavourable conditions such as high or low irradiance, high or low temperatures, reduced salinity, and the presence of toxins such as herbicides and bacterial infections.
Sensitivity cont.
- Coral reef systems also highly vulnerable to severe weather such as cyclones, which cause extensive physical destruction as well as reduced light conditions which affect coral ability to photosynthesize
- Corals will also very likely be severely affected by low pH by severely impacting their ability to accrete calcium carbonate
Adaptive capacity of coral reef systems:

- Three potential responses
  - **to acclimatise** (a phenotypic change within the individual) - possible as corals can acclimatise to changes in their environment including seasonal temperature fluctuations
  - **to adapt** (a genetic response at the population level) - very little evidence has been shown to prove this is possible and it is thought the rate of change is too quick for it to happen
  - **to shift latitudes** - geographic differences in temperature tolerances have evolved over much longer time frames than the decadal scale of current changes in climate
Seagrass habitats

- **Sensitivity:**
  - Vulnerable to any climate change factor which limits light availability (e.g. storms, rain, flooding events, flood plumes from coastal run off, sedimentation, algal blooms) as they are photosynthesizing plants
  - Also highly sensitive to decreased water quality as a result of pollutants, with a significant sensitivity to herbicides
Adaptive capacity of seagrass species:

- Many examples of seagrass recovering from tropical cyclones/storm damage
- Some studies suggest that seagrasses respond and recover at different rates when exposed to herbicides both in laboratory and natural settings- so lab studies cannot be taken as a completely accurate prediction of what seagrasses will do in situ
- All seagrasses are capable of adapting by altering their physiological capacity and morphological structure however whether they can adapt fast enough to climate change is unknown
Adaptive capacity of coral reef systems:
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Landward migration of barrier beach and mangrove devastation, increasing vulnerability of human settlements
Rate of Beach migration in PKWS – speeding up
Deltas particularly vulnerable to climate change

- Recently deposited sediments – naturally prone to compact
- Easily eroded by intense storms and wave energy
- Transgression and regression are intimately linked with sea level
- Changes in precip/temp/runoff alter the delivery of water and sediments

Funded by European Union
Deltas already impacted by human activity

1. Drainage and subsidence
2. Destruction of protective deltaic wetlands and barrier islands
3. Dams on major rivers reduce sediment supply
4. Dykes and polders systems
5. Dredging of waterways
6. Deepening and straightening of river channels
## Climate Change Impacts on Species

<table>
<thead>
<tr>
<th>Factor</th>
<th>Condition</th>
<th>Impacts</th>
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</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Mean; extremes; variabality; seasonality; sea level rise</td>
<td>Changing phenology; changing triggers to migration and dispersal; predator-prey, parasite-host, mutualisms; new invasives; changes in distribution; loss of habitat</td>
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<td>Rainfall</td>
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</tr>
<tr>
<td>Extreme Events</td>
<td>Frequency and intensity of storms, floods, droughts, fires</td>
<td>Direct mortality; increased physiological stress leading to decreased fecundity and/or disease susceptibility and increased mortality</td>
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<tr>
<td>CO2 concentration</td>
<td>Atmosphere; ocean; ocean pH</td>
<td>Reduced ability to form calcareous structures</td>
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</tbody>
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1.
Climate Change Impacts on Species

Not all species equally susceptible to climate change depends on life-history, ecology, behaviour, physiology, genetic make-up, etc.

- IUCN study assessed 9,856 birds, 6,222 amphibians, 799 corals
- 35% of birds, 52% amphibians and 71% corals susceptible
- Birds 10% threatened, 25% non-threatened species susceptible
- Amphibians 24% threatened, 28% non-threatened species susceptible
- Corals 19% threatened, 51% non-threatened susceptible
• Mackerel sensitive to temperature, rely on currents for dispersal – may shift range to cooler seas
• Mud crab sensitive to temp, pH, ocean circulation - can shift range by 1,000km
• Squid very adaptable, may grow faster and replace other species
• Seabass more tolerant of higher temp than grouper snapper – up to 32°C
• Prawns may grow faster but be more susceptible to disease
Nature-Based Solutions
Protected Area Zoning e.g. in Peam Krassop Wildlife Sanctuary, Cambodia
CO-MANAGEMENT

<table>
<thead>
<tr>
<th>State management</th>
<th>Co-management</th>
<th>Community management</th>
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<tbody>
<tr>
<td>Control by Government Agency</td>
<td>Shared control (government agency and stakeholders)</td>
<td>Community control</td>
</tr>
<tr>
<td>Negotiating specific agreements</td>
<td>Sharing authority and responsibility in a formal way</td>
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- Local communities and local authorities **share responsibility and authority** for the management of a given area through a **negotiated** agreement.
- Provide local communities with some benefits through **legal and secured** access while ensuring effective **protection**.
Restoration/rehabilitation – e.g. beach re-vegetation
Promoting Local Innovation (PLI)

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Protected Areas
Ecosystem & community

1. Understand ecosystem context

Ecosystem
- Habitats
- Species

Ecosystem goods and services

Support food security and livelihoods

Community

Use and manage (exploit)

Human intervention

2. Understand community context
Protected Areas
Ecosystem & community under pressure

1. Understand pressure from climate changes

2. Support food security and livelihoods

3. Use and manage (exploit)

4. Human intervention

5. Ecosystem goods and services

6. Development/socioeconomic change

Climate variability & change

Ecosystem - Habitats - Species

Community

Development/socioeconomic change

Ecosystem from other changes

Climate from other changes
Protected Areas

Ecosystem & community adaptation

9. Assess how the ecosystem is likely to change under pressure, and how the flow of goods and services to communities will change because of this.

8. What can be done to optimize long-term benefits (especially for the most vulnerable) through community-based management.

10. What can be done to help maintain species, habitats and ecosystem functions?

7. Assess how the community reliance on ecosystems will change under pressure, and how patterns of use and management will change as a result.

Ecosystem
- Habitats
- Species

Climate variability & change

Development/
socioeconomic change

Use and manage (exploit)

Human intervention

Change?
Over exploitation?

Community

Ecosystem goods and services

Support food security and livelihoods

Loosing integrity??

Development/
socioeconomic change

Climate variability & change

Human intervention

Use and manage (exploit)
www.iucn.org/building-coastal-resilience

Thank You!