The Effect of a Changing Climate on Trophic Interactions
A Brief Overview

- impacts of climate change
- components of an ecosystem
- food webs and trophic levels
- changes in phenology
- range shifts
- ecosystem responses
- what’s in it for me
Impacts of Climate Change

- warmer temperatures
- changing precipitation
- rising sea level
- ocean acidification
# Biotic and Abiotic Components of Ecosystems

<table>
<thead>
<tr>
<th>Biotic</th>
<th>Abiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>plants and animals</td>
<td>temperature</td>
</tr>
<tr>
<td>any living organism</td>
<td>humidity &amp; precipitation</td>
</tr>
<tr>
<td>that interacts with its</td>
<td>pH</td>
</tr>
<tr>
<td>environment</td>
<td></td>
</tr>
</tbody>
</table>
Food Webs and Trophic Levels

- Food webs, an accumulation of interacting food chains
- Trophic levels are functional classification of a community according to feeding relationships
Phenological Changes

- cues
- timing mismatches
- trophic implications
  - indirect consequences
  - direct Consequences
- changes in migrations
Phenological Changes: Cues

climatic

- precipitation
- temperature

non-climatic

- photoperiod
- prey (or nutrient) abundance
Phenological Changes: observed changes

- earlier bud burst and longer growing season
- altered breeding seasons
- timing mismatches between predators and prey
- differential immersgence from hibernation
Phenological Changes: trophic implications of timing mismatches

- changes in primary production effects all trophic levels
- increased competition for breeding grounds and resources
- the early newt gets the frog
Phenological Changes: trophic implications

- predators can influence prey population composition
  - cursorial predators
  - ambush predators
Phenological Changes: impacts on migrations

- resources for the migrating species
- predators of the migrants
Range Shifts

- altered migration routes
- up, up and away
- housing crisis
- king for a day (dominance shifts)
Range Shifts: altered migration routes

- new passages may open or old ones close
- physiological threshold tolerances
- shifts in food source ranges
Range Shifts: up, up and away

- general trend of polewards range shifts
- also upwards movement in elevation
- increased biodiversity in high latitude is predicted
- greatest number of species loss in tropics
adapted from Lawler, J, et al, fig. 1, 2009
Range Shifts: housing crisis

- habitat fragmentation
- overcrowding
- areas of greatest impact
Range Shifts: dominance shifts

- generalist vs. specialist predators
- king for a day
- impacts of top predators for food webs

adapted from Wilmers, C, et al, 2005, fig 4
Ecosystem Responses

- different responses from different areas and different species
- varying responses within species
- contrasting trophic sensitivities
- undisturbed ecosystems are less sensitive to change
adapted from Voigt, W, et al, 2007, fig 1

adapted from Voigt, W, et al, 2007, fig 5
What's In It For Me

- better management of ecosystems
- food resources
- pest control
Conclusions

- ecosystems are dynamic
- trophic interactions are influenced by biotic and abiotic factors
- impacts of climate change are seen in altered phenology and range shifts
- there is greater adaptability in more complex ecosystems
- impacts of climate change elicit different responses in different areas, trophic levels and even within species.
- disturbed ecosystems are more susceptible to impacts.
- better understanding of trophic interactions is vital for better resource management
References

- Brook, BW 2009, Global warming tugs at trophic interactions. JOURNAL OF ANIMAL ECOLOGY, 78 (1): 1-3
- Lawler, J; Shafer, S; White, D; Kareiva, P; Maurer, E; Blaustein, A; Bartlein, P, 2009, Projected climate-induced faunal change in the Western Hemisphere, Ecology, 90(3), 588-597
- Parmesan, C, 2006, Ecological and evolutionary responses to recent climate change. ANNUAL REVIEW OF ECOLOGY EVOLUTION AND SYSTEMATICS, 37: 637-669
- Voigt, W; Perner, J; Jones T, 2007, Using functional groups to investigate community response to environmental changes: two grassland case studies. Global Change Biology, 13, 1710-1721
- Walther, G; Post, E; Convey, P; Menzel, A; Parmesan, C; Beebee, T; Fromentin, J; Hoegh-Guldberg, O; Bairlein, F, 2002, Ecological responses to recent climate change. NATURE, 416: 389-395
- Wilmers, CC; Getz, WM 2005, Gray wolves as climate change buffers in Yellowstone, PLOS BIOLOGY, 3 (4): 571-576
Picture References

- pic 1: www.animals.nationalgeographic.com
- pic 2: www.canada.com
- pic 3: www.bigcats.com
- pic 4: www.safaridrive.com
- pic 5: www.kenya-advisor.com
- pic 6: research.usm.maine.edu
- pic 7: www.allposters.co.uk
- pic 8: www.umt.edu
- pic 9: www.guardian.co.uk
- pic 11: www.earthforce.org
- pic 12: www.valleyfloor.org
- pic 13: www.cordis.europa.eu