

IMPACTS OF CLIMATE CHANGE ON WILDLIFE

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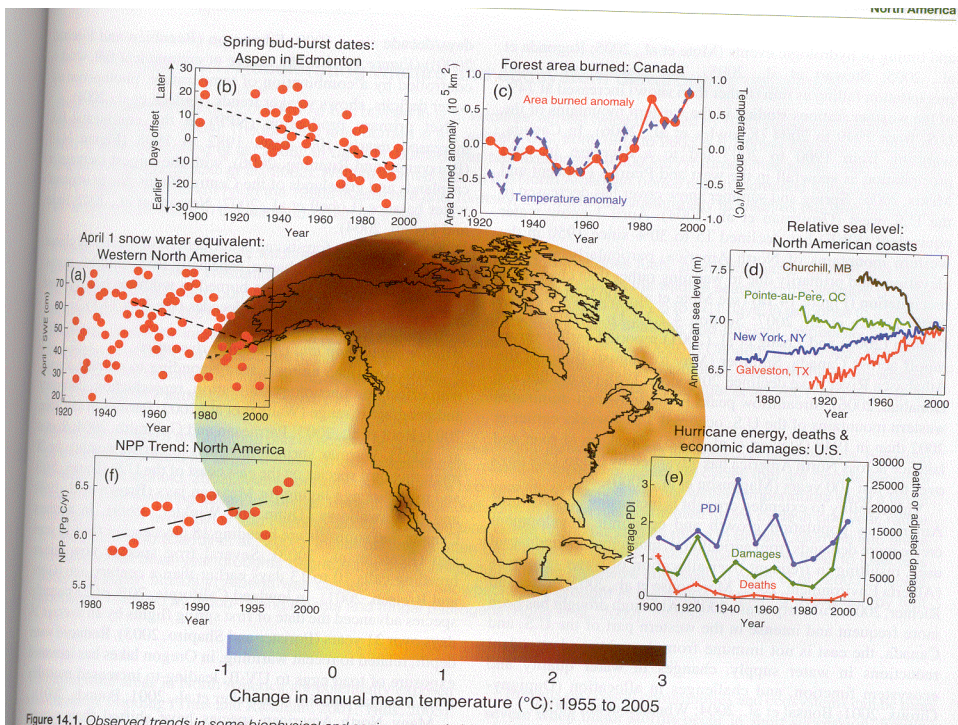


Figure 14.1. Observed trends in some biophysical and socio-economic indicators.

Volume 1, Issue 1 of
Ecology (1920),
first 2 articles:

“The control of pneumonia and influenza by the weather”

“Evidence of climatic effects in the annual rings of
trees.”

**CLIMATE CHANGE EFFECTS ON
WILDLIFE:
ADAPT IN PLACE, MOVE,
OR DIE**

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Examples of Adapting In Place

- Red squirrels in northern CA breed 18 days earlier than 10 years ago.
- Frogs initiating calls 10-13 days earlier than century ago.
- 70% of 23 butterfly spp. Advanced date of 1st spring flights by 24 days over 31 year period.
- Also: bud burst, egg laying, emergence, etc.

Two ways that organisms adapt in place:

- Phenotypic plasticity (a.k.a. "acclimation").
 - Adjust morphology, behavior, or physiology
- Evolution by natural selection
 - Genetic changes

Example of plasticity: Yukon red squirrels

1989-2003, 664 marked females.

2 degrees C temp increase,
Less precip.,
Increase in white pine cones.

18 days (6 days/generation)
advance
Of mean lifetime parturition date.

62%: plasticity
(proximal drivers unknown)

Fitness maintained .



Evolution in place via natural selection

- Can happen on ecological scales, when:
- Large population size and/or rapid population growth.
 - short generation times.
 - Directional and constant selection.
 - Medium levels of gene flow.

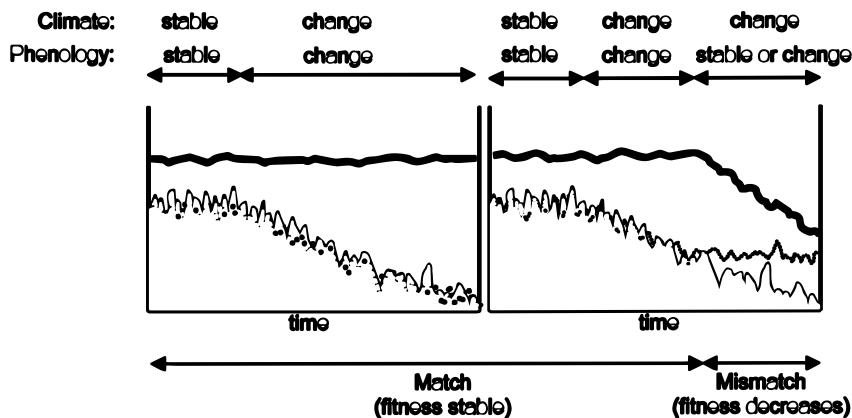


Example of Evolution in Place: guppies and predators

| Trait | Time interval (years) | Number of generations |
|----------------------------------|-----------------------|-----------------------|
| Male coloration* | 2.5 | 4.4 |
| Male age and size at maturity† | 4 | 7.0 |
| Female age and size at maturity† | 7.5 | 13.0 |
| Offspring number and size‡ | 11 | 19.1 |
| Reproductive effort‡ | 11 | 19.1 |
| Predator escape‡ | 20 | 35.0 |
| Schooling/predator inspection§ | 34 | 59.2 |

Reznick et al. 2008

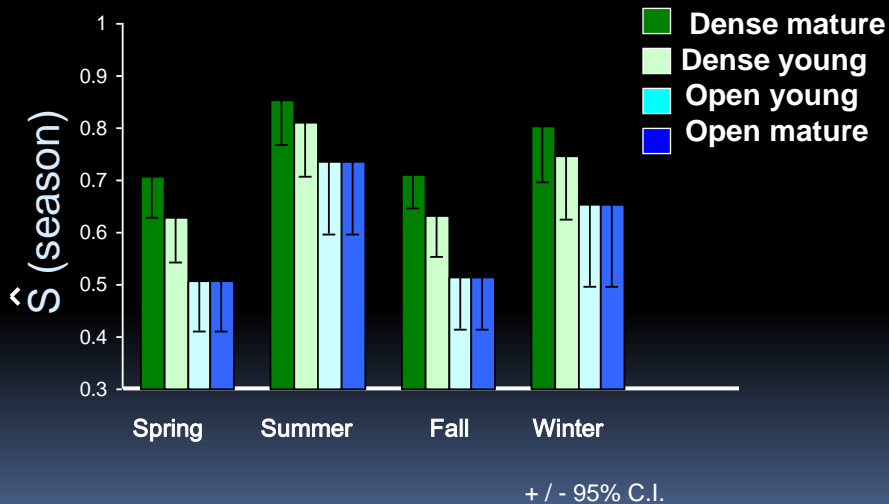
The question becomes whether adaptation in place can maintain fitness as climate changes:



→ One example we're beginning to explore: snowshoe hare coat color



Hares are most vulnerable in spring & fall



Snowshoe hares

- Major food item in northern forests, for lynx and many other predators.
- Molt is controlled in large part by daylength.
- Briefer snowpack season is a strong signal of climate change.
- > Can hares evolve appropriate changes?



So some species will adapt
in place...
Others will move.

Lots of examples of “adaptation” via range shifts or
other changes in animal movement:

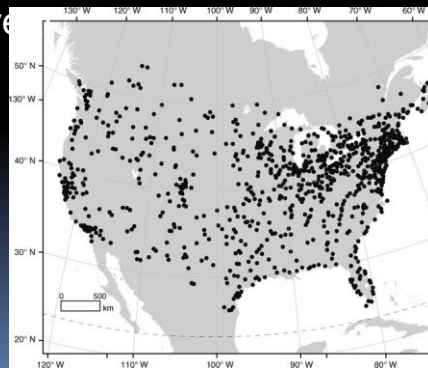
e.g. 254 spp N. Am. Birds [Christmas Bird Count]:

Northern boundary : 1.5 km/year

Center of occurrence: 0.5 km/year

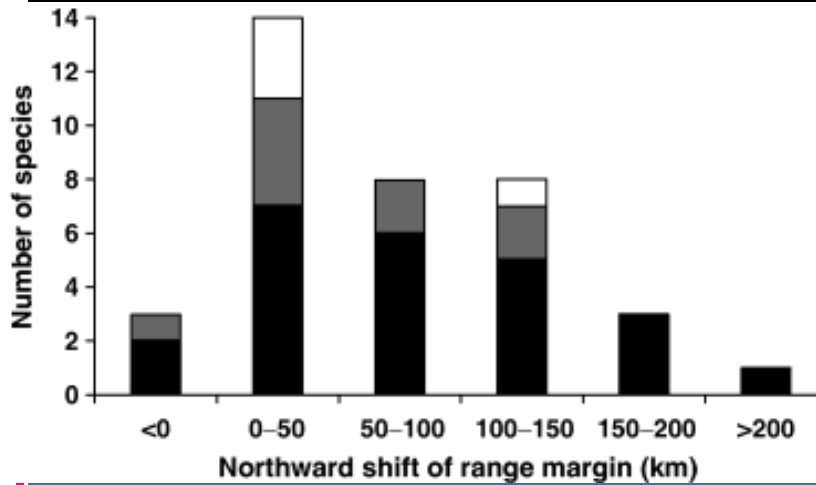
Center of abundance 1 km/year

(La Sorte and Thompson 2007):



Dragonflies and damselflies are shifting northwards too.

Comparing 1960-70 to 1985-95; white = northern; hatched = ubiquitous; black = southern



Hickling et al. 2005

Populations that can't move, deal with it, or adapt

... will die

Pied Flycatchers

- Caterpillars peak in abundance earlier in year
- Flycatchers have decreased time between breeding ground arrival and laying eggs.
- But daylength trigger for migration = mismatch.
- Mismatch = population decline.



Both and Visser 2001, Both et al. 2006

Temperature-dependent sex determination:
lots of reptiles, amphibians, fish

Tuatara

- 100 MY old lineage.
- 1 degree C shift → All males

