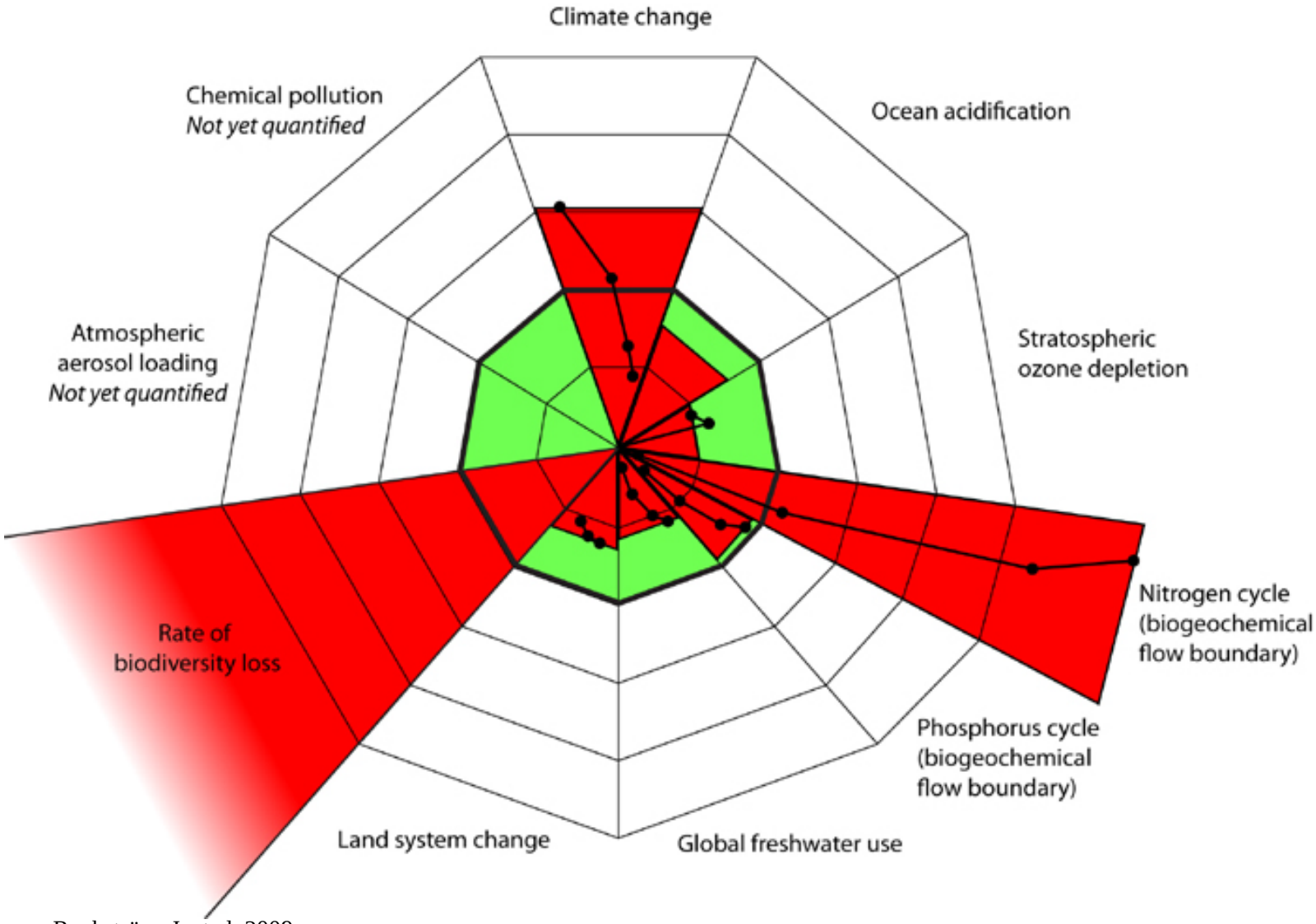
Climate Change and Biodiversity Problems and Solutions
International Congress of Conservation Biology
Baltimore, Maryland
June 22, 2013

Thomas E. Lovejoy
University Professor
Environmental Science and Policy
George Mason University
Biodiversity Chair, The Heinz Center

THE HEINZ CENTER

THE H. JOHN HEINZ III CENTER FOR SCIENCE, ECONOMICS AND THE ENVIRONMENT

Planetary Boundaries

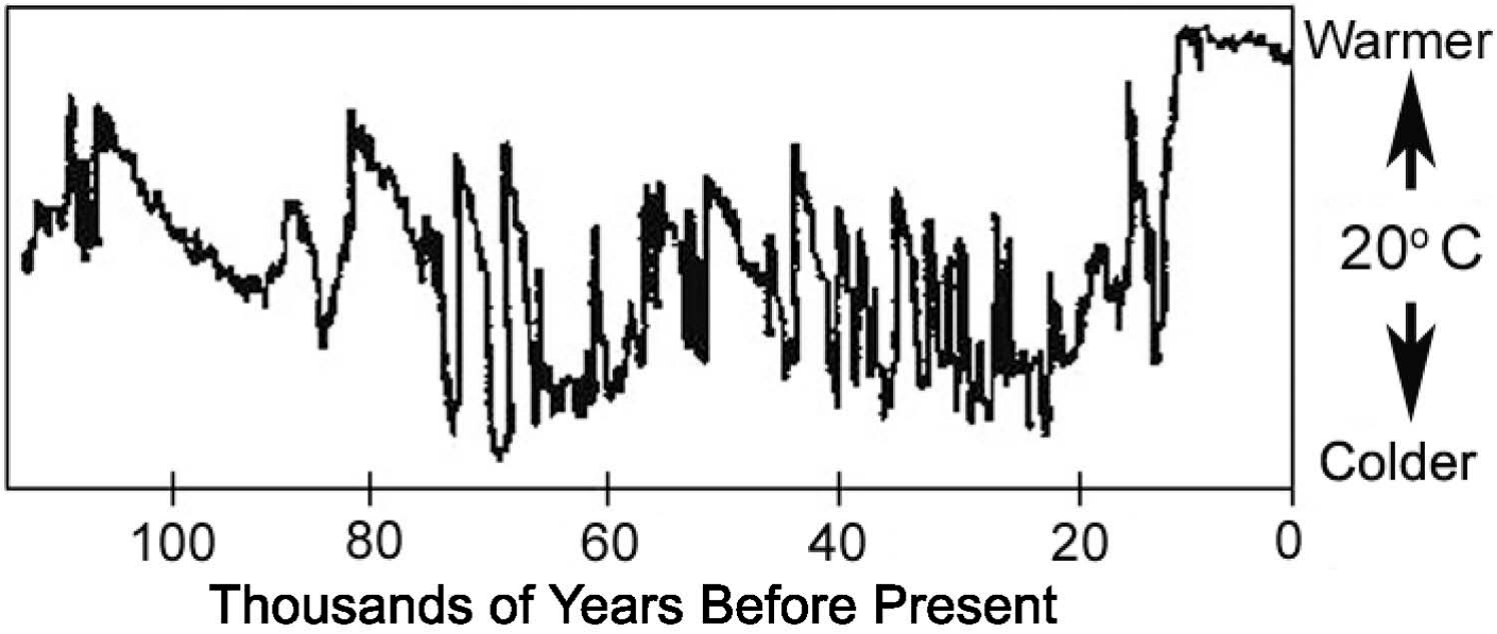


Source: Rockström, J. et al. 2009

Dr. Svante August Arrhenius

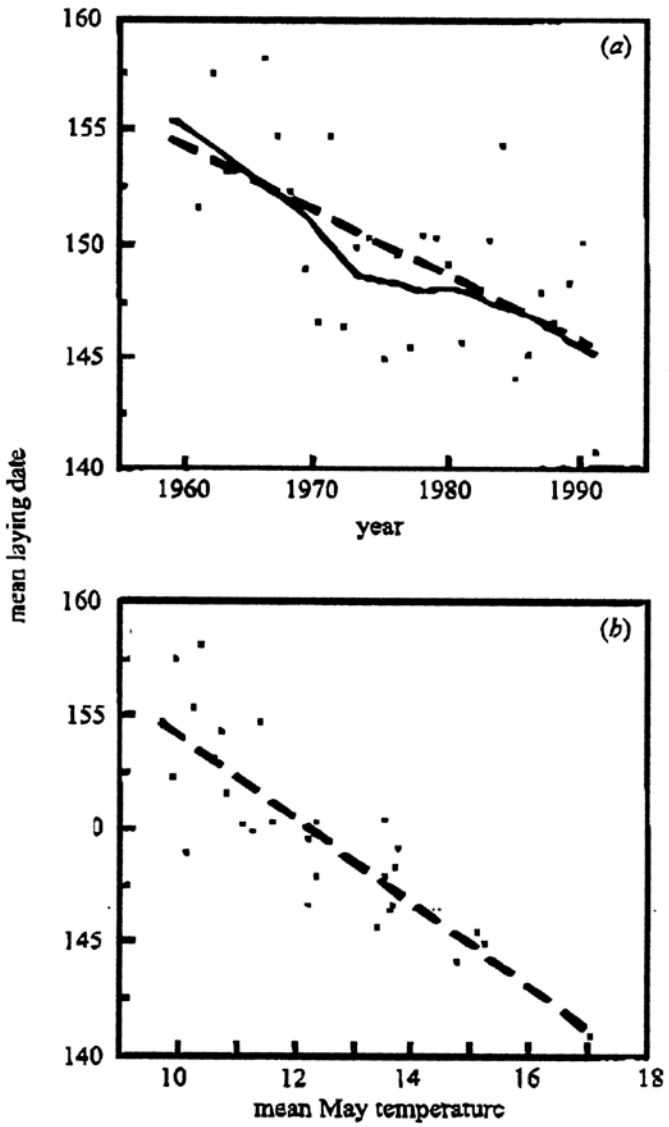
1859-1927

Analysis of a Greenland ice core oxygen isotope proxy



Source: Wallace Broecker

Spring comes about 2 weeks earlier

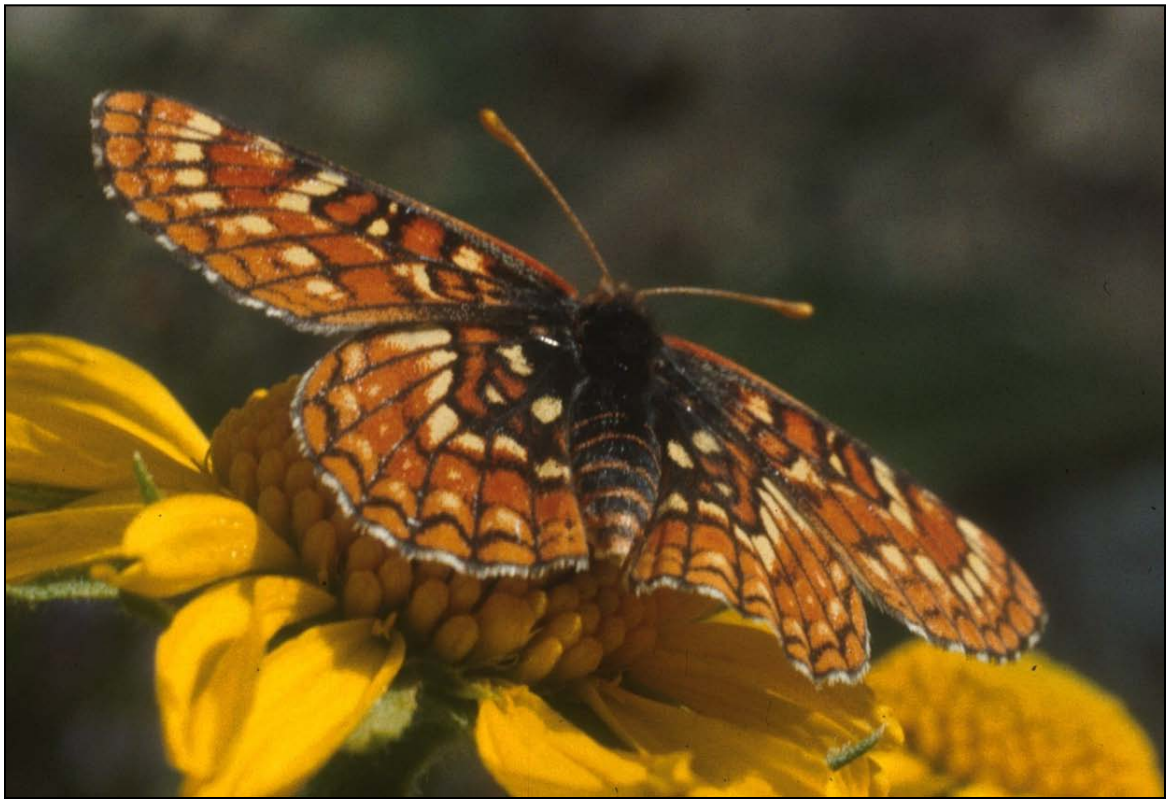


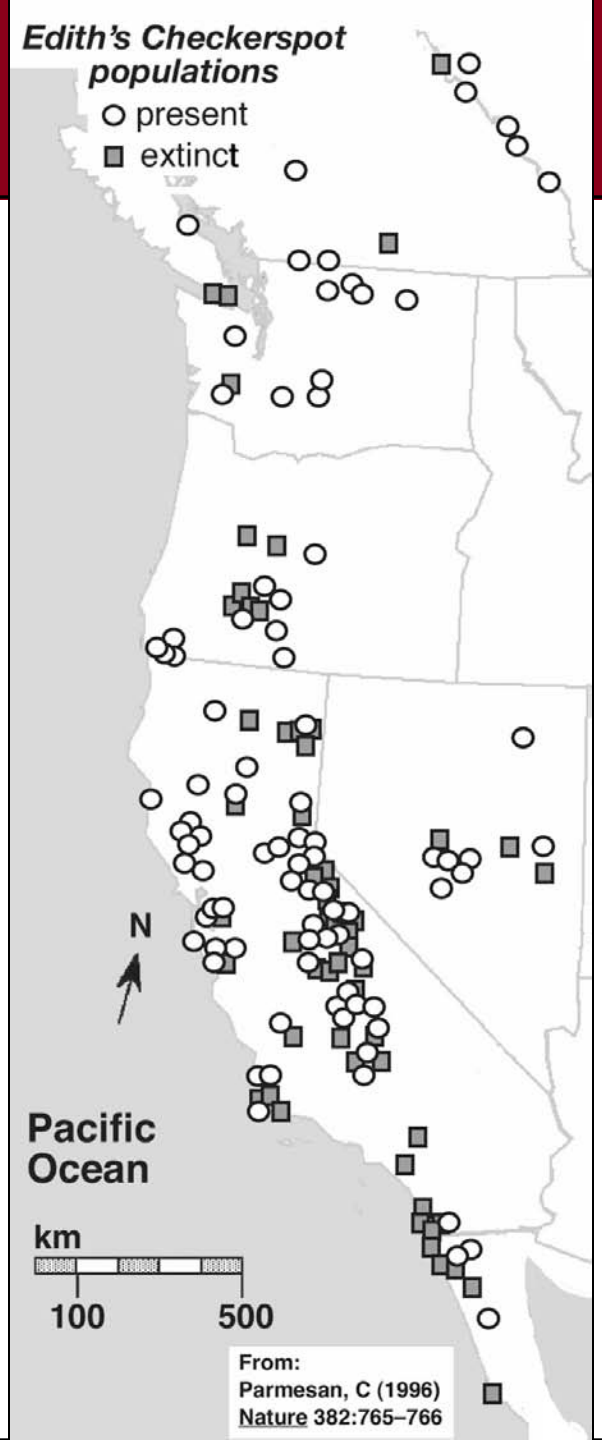
- Across the USA, tree swallows are nesting 9 days earlier than 40 years ago
- Laying date is highly correlated with May temperature

Source: Camille Parmesan

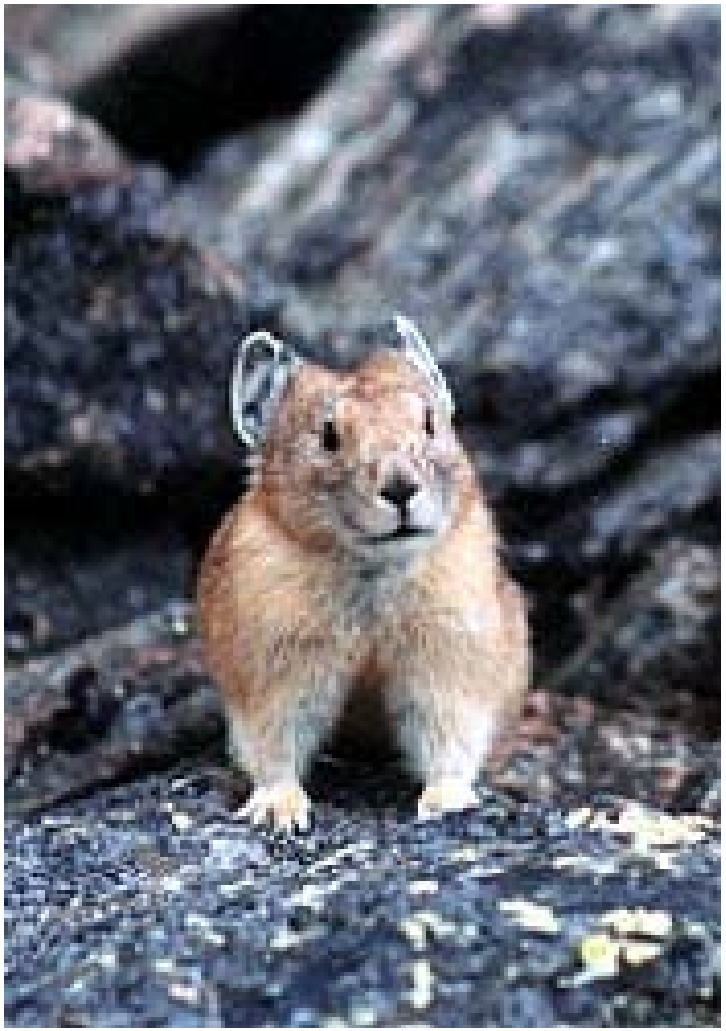
Edith's Checkerspot

- **Range shift northward and upward during the 20th century**
- **Most extinctions in south and low elevations**





American pika (*Ochotona princeps*)



Key Deer

National Key Deer Refuge

Big Pine Key, Florida

•84,000 acres, Established 1957

Population Low:

27 in 1957

Population today:

Between 700 and 800

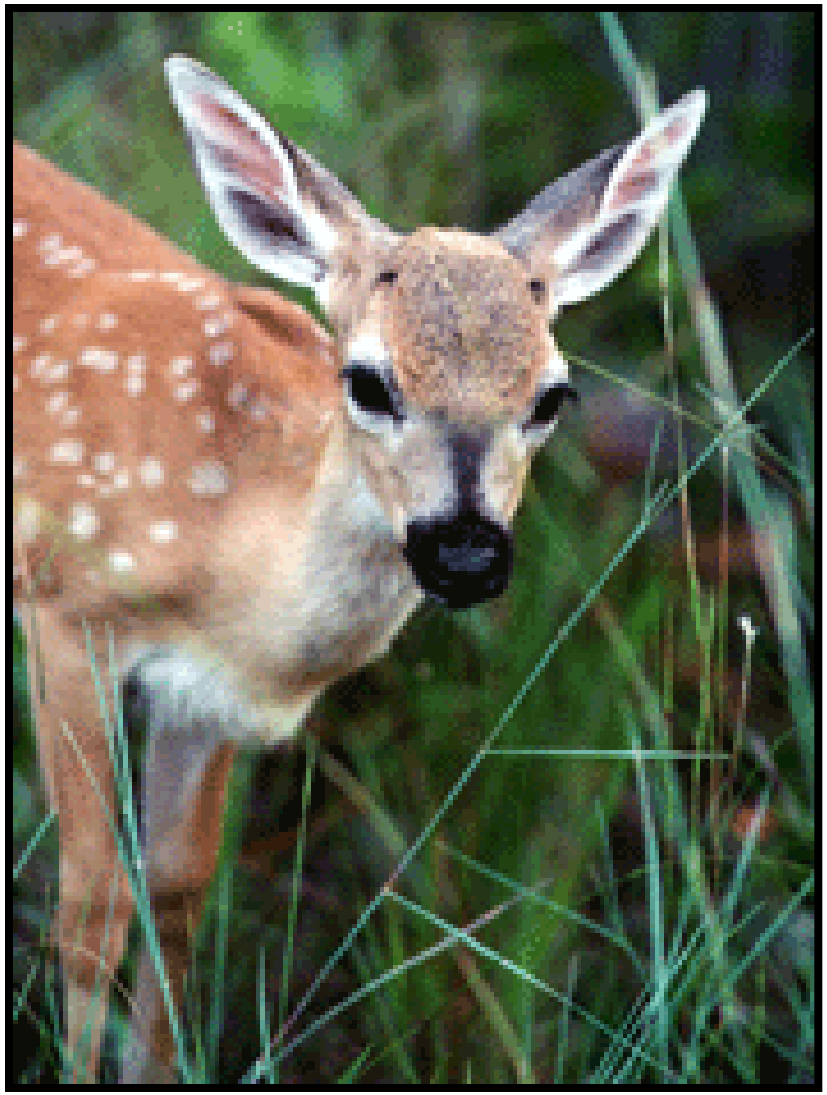


Photo courtesy of National Key Deer Refuge

Elevated night time temperatures magnify bark beetle impact

The Washington Post
Wednesday, March 1, 2006

‘Rapid Warming’ Spreads Havoc in Canada’s Forests

QUESNEL, B.C. -- Millions of acres of Canada's lush green forests are turning red in spasms of death. A voracious beetle, whose population has exploded with the warming climate, is killing more trees than wildfires or logging.

Source: D. Struck 3/1/2006, *Washington Post*, pA1

INTERNATIONAL Herald Tribune
PUBLISHED BY THE NEW YORK TIMES
Wednesday, June 7, 2006

Oceans II ▪ By Thomas E. Lovejoy

Rising acidity threatens marine life

WASHINGTON

The problems of acid rain and acid lakes, which came to public attention in the 1980s, have been addressed to a considerable degree. Today we face a far more profound challenge: increasingly acid oceans.

It is little known outside of scientific circles that a fundamental change has already taken place in the chemistry of the two thirds of the earth's surface occupied by oceans. The change, of 0.1 of a pH unit, sounds trivial when expressed in the logarithmic scale that science uses, but it translates to the upper layers of the oceans already being 30 percent more acid than in preindustrial times.

The change is being causes by increased atmospheric levels of greenhouse gases, in particular carbon dioxide. In addition to forcing climate change, more carbon dioxide combines with water and produces carbonic acid.

The consequences for marine ecosystems are only beginning to be understood but are bound to be far-reaching.

Tom Ondway/Jean-Michel Cousteau Productions via AP

- At today's level of 387ppm CO_2, reefs are seriously declining and time-lagged effects will result in their continued demise with parallel impacts on other marine and coastal ecosystems.

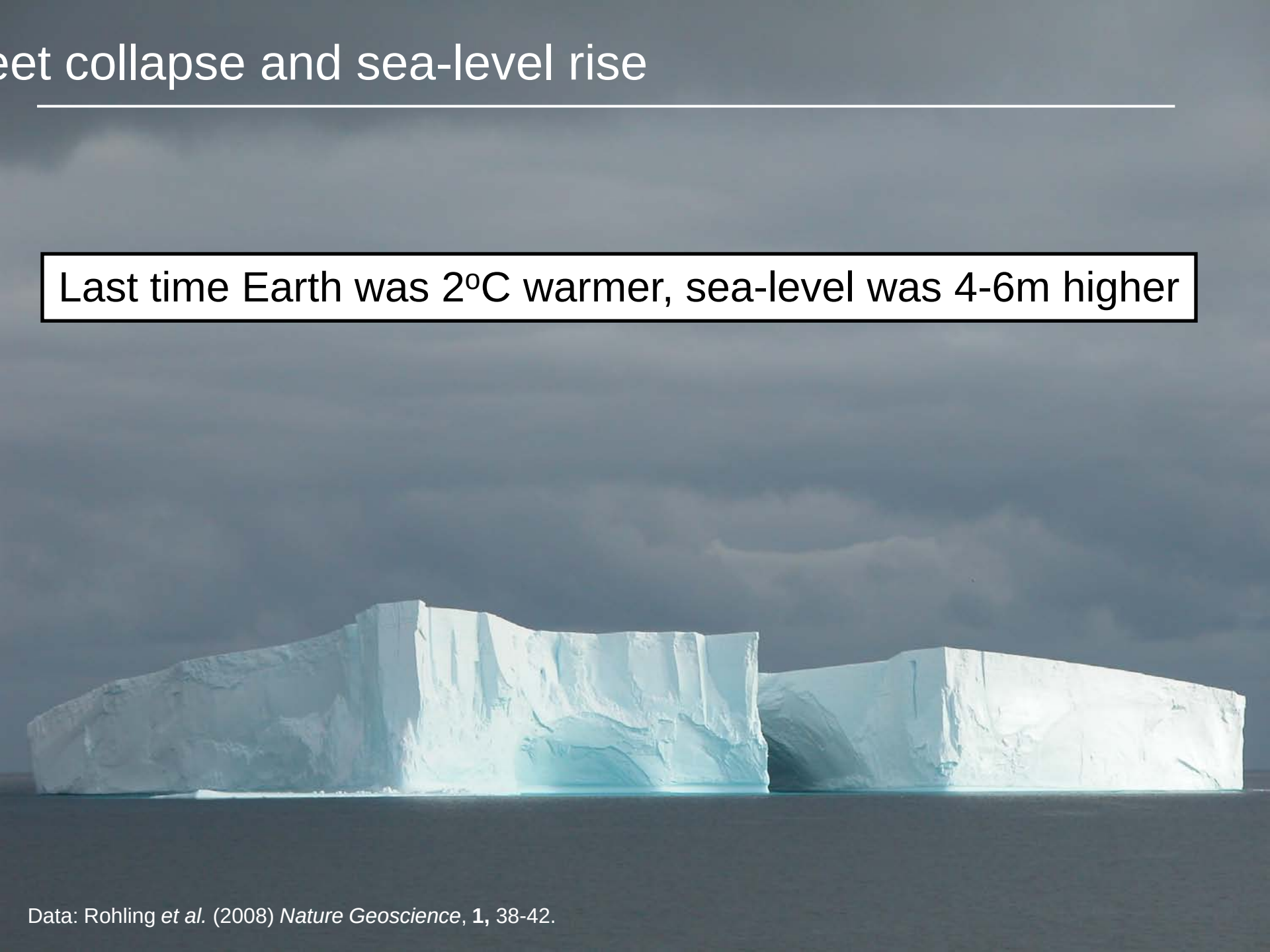
- Proposals to limit CO_2 levels to 450ppm will not prevent the catastrophic loss of coral reefs from the combined effects of climate change and ocean acidification.

- To ensure the long-term viability of coral reefs atmospheric carbon dioxide level must be reduced significantly below 350ppm.

Royal Society Meeting,
July 6th 2009

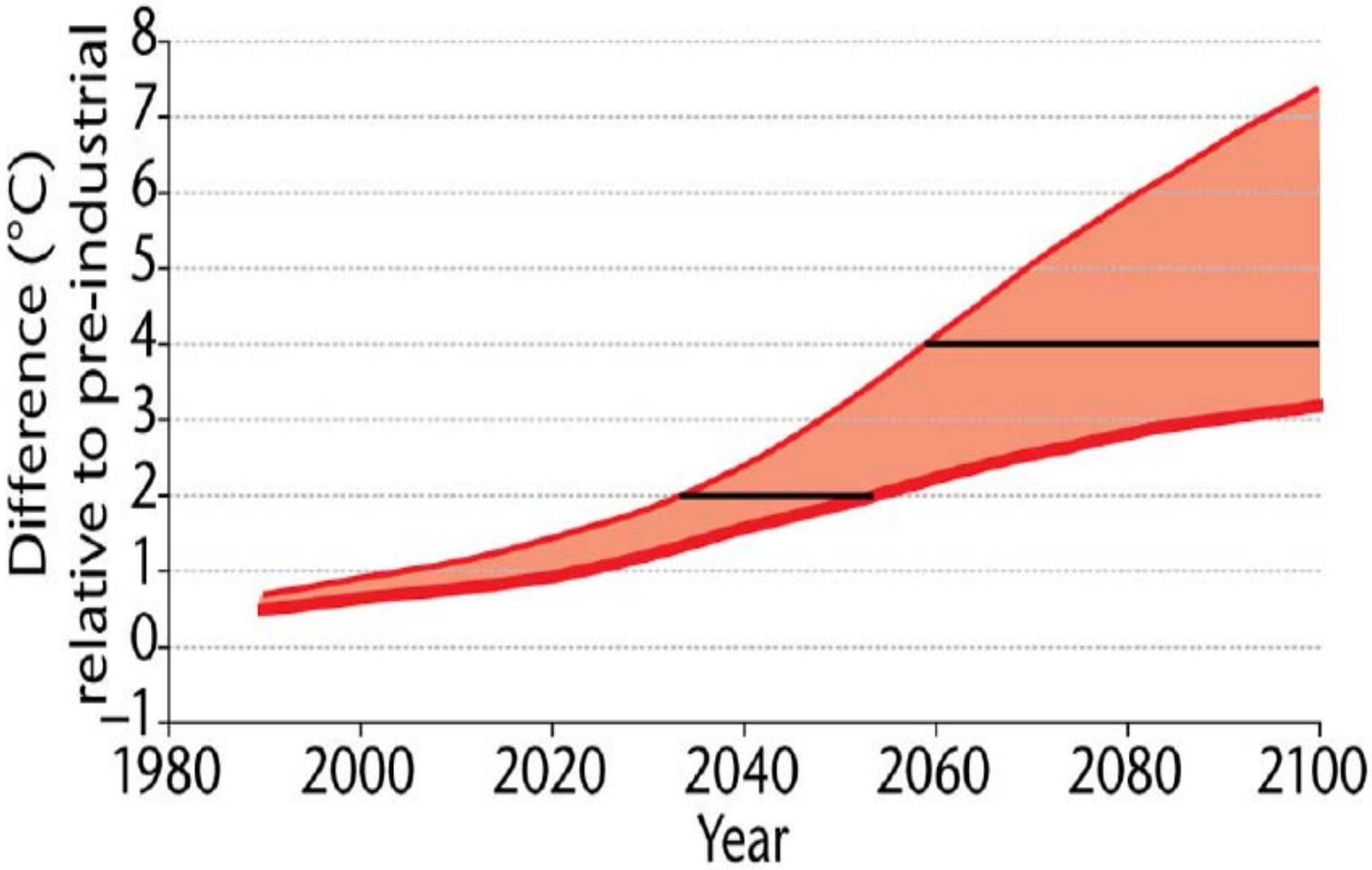
eet collapse and sea-level rise

Last time Earth was 2°C warmer, sea-level was 4-6m higher



Data: Rohling *et al.* (2008) *Nature Geoscience*, **1,** 38-42.

Projected temperature rise for A1B & A1F1 scenarios (Hadley, 2009)



What can be done

Adaptation

-Revise Conservation Strategies

Limit Greenhouse Gas Concentrations

-Reduce and eliminate emissions

--revise energy base for society

--reduce/eliminate deforestation

Over the past three centuries, ecosystems have lost 250 billion tons of carbon

What can be done

<u>Lower Atmospheric CO_2</u>

- **Restore ecosystems**

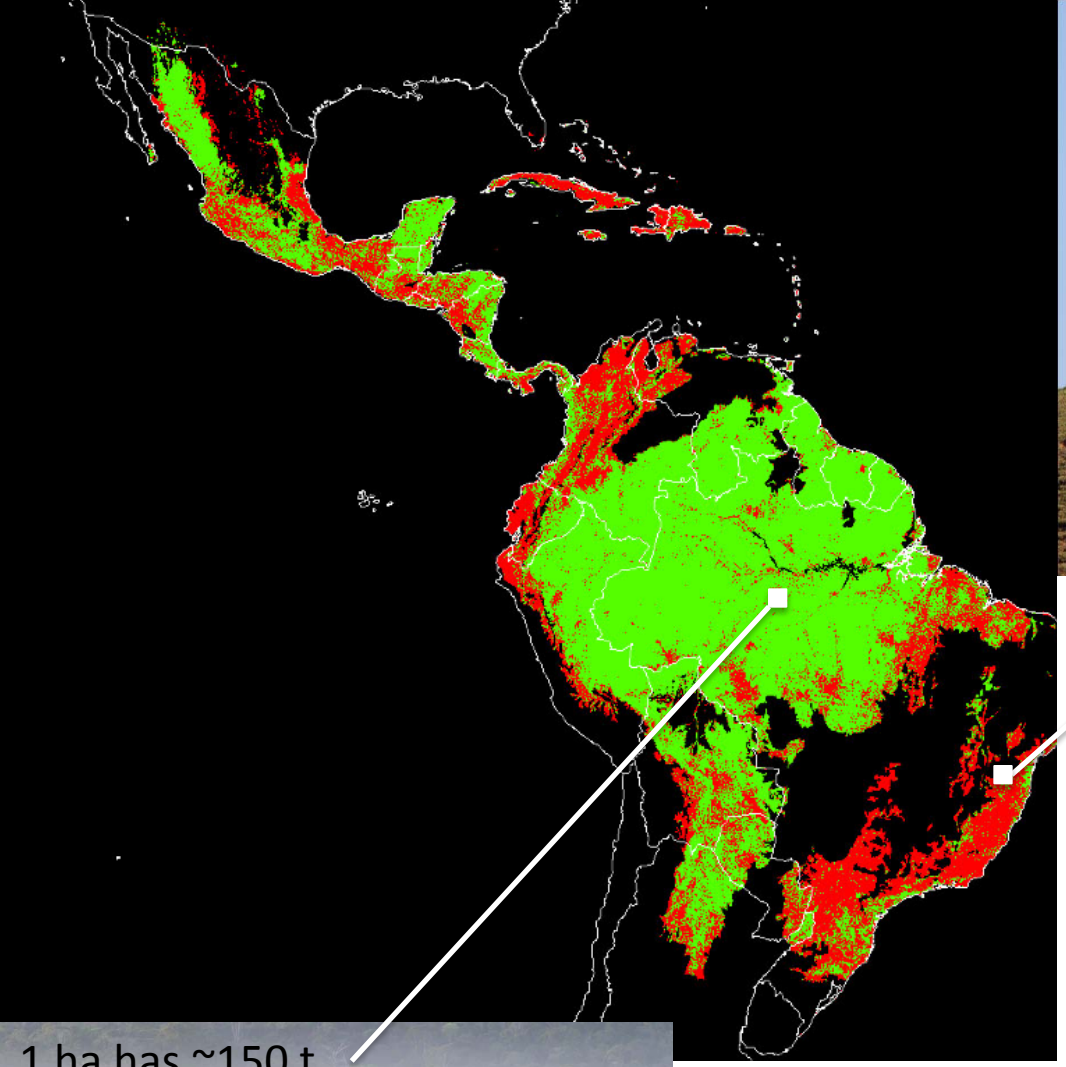
  (*biodiversity and carbon*)

- **Non-biological CO_2 removal**

The Role of Forests

estoring Grazing Land

Photo courtesy USDA NRCS



Globally 7 million km^2 cleared
2 million km^2 for crops, 5 million km^2 for cattle pasture.

Globally, restoring cattle pastures would sequester
$5 \times 10^6 \times 10^2 \times 7.5 =$
3.75 Gigatons C per year for 20 years +

Modify Agriculture to Build up Soil Carbon

Photos: United States Department of Agriculture—Natural Resources Conservation Service.

Re-Greening the Emerald Planet