

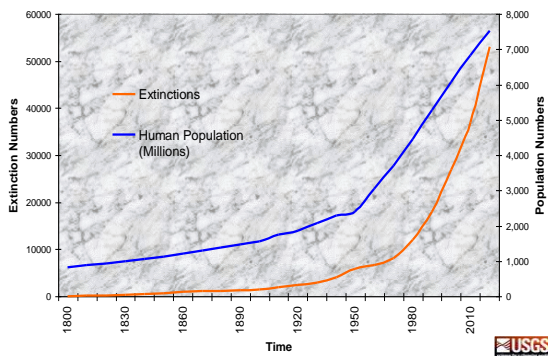
Threats to Biological Diversity: Global, Continental, Local

J. Michael Scott

USGS, Idaho Cooperative Fish and Wildlife
Research Unit, University Of Idaho



Species Extinction and Human Population



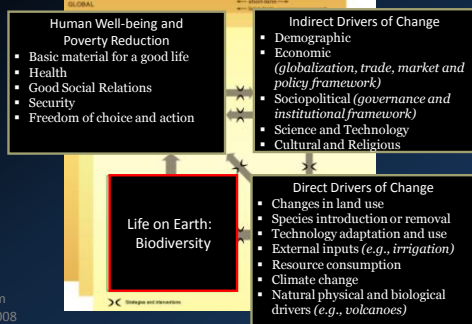
GDP 2005 - 2050

Country	GDP 2005	GDP 2050
United States	9.9 trillion	35 trillion
Canada	1.2 trillion	n/a
United Kingdom	1.4 trillion	3.8 trillion
Germany	1.9 trillion	3.6 trillion
France		3.1 trillion
Japan	4.0 trillion	6.7 trillion
Italy	1.2 trillion	2.1 trillion
Russia	.4 trillion	5.9 trillion
China	1.7 trillion	44 trillion
India	1 trillion	27 trillion

G8 65% of world
GDP



Examined the consequences of ecosystem change for human well-being



Finding

- Human actions are fundamentally, and to a significant extent irreversibly, changing the diversity of life on Earth, and most of these changes represent a loss of biodiversity.
- Changes in important components of biological diversity were more rapid in the past 50 years than at any time in human history. Projections and scenarios indicate that these rates will continue, or accelerate, in the future.



Millennium Ecosystem Assessment (MEA) 2008

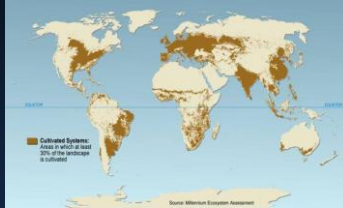
“We estimate that organic material equivalent to about 40% of the present net primary production in terrestrial ecosystems is being co-opted by human beings each year.”



Vitousek et al. 1986

Unprecedented change: Ecosystems

- More land was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850.
- 20% of the world's coral reefs were lost and 20% degraded in the last several decades
- 35% of mangrove area has been lost in the last several decades
- Amount of water in reservoirs quadrupled since 1960

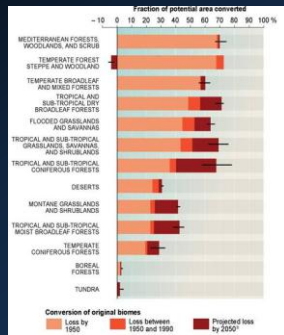


Cultivated Systems in 2000 cover 25% of Earth's terrestrial surface

Adapted from Reid, MEA 2008

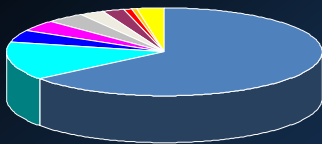
Unprecedented change: Ecosystems

- More than two thirds of the area of two biomes and more than half of the area of four others had been converted by 1990
- Further 10-20% loss of grassland and forestland by 2050



Adapted from Reid, MEA 2008

Major Groups of Described Species

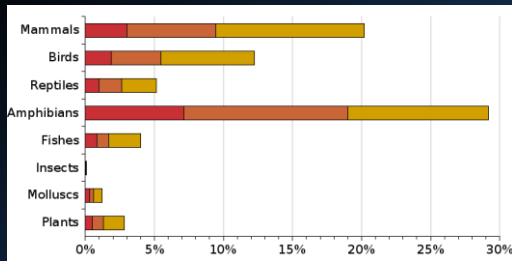


- Arthropods (64.5%)
- Plants (14.3%)
- Fungi (4.2%)
- Molluscs (4.2%)
- Other Inverts (4.0%)
- Algae (2.4%)
- Protozoans (2.4%)
- Nematodes (0.9%)
- Viruses & Bacteria (0.5%)
- Vertebrates (2.7%)

Vertebrates included for comparison.



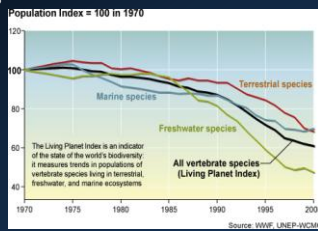
2007 IUCN Species at Risk



The percentage of species in several groups which are listed as critical, endangered or vulnerable on the 2007 IUCN Red List.

Significant and largely irreversible changes to species diversity

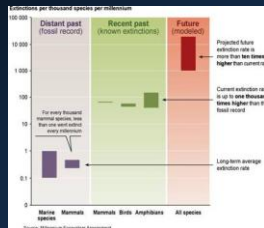
- Distribution of species is becoming more homogenous
- Population size or range (or both) of the majority of species across a range of taxonomic groups is declining



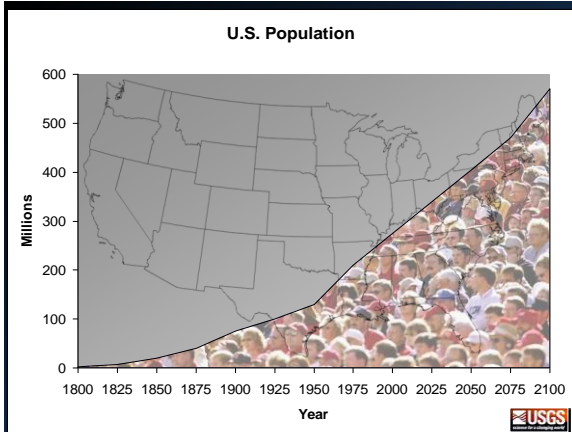
Adapted from Reid, MEA 2008

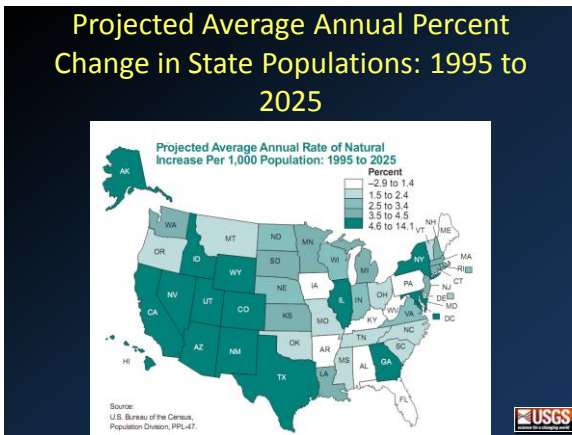
Significant and largely irreversible changes to species diversity

- Current extinction rate as much as 1,000 times higher than background rates.
- 10% to 50% of mammals, birds, amphibians, conifers, and cycads are threatened with extinction
- Expect loss of roughly 10-15% of plant species as a result of habitat loss over the period 1970-2050 in the MA scenarios



Adapted from Reid, MEA 2008







United States Interstate Highways

Highway Miles in 1958	Highway miles present (2004)
4,831 miles	46,837 miles



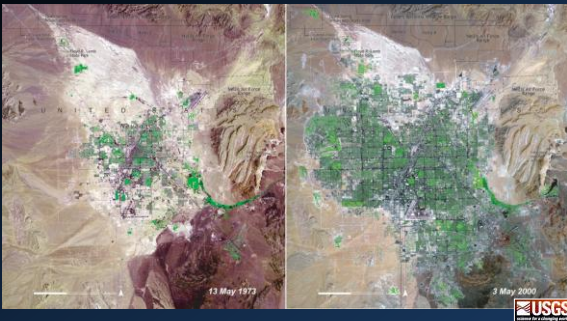
USDOT, 2005



Las Vegas

1973

2000



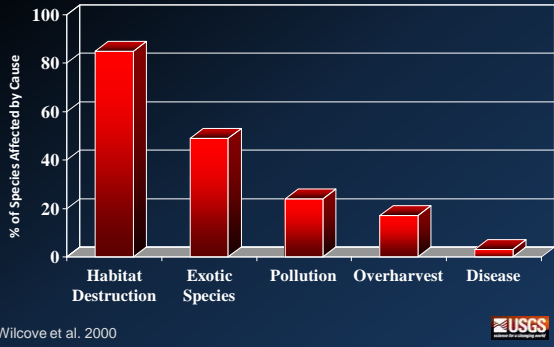
Hetch Hetchy

1911

2000



Major Threats to Biodiversity



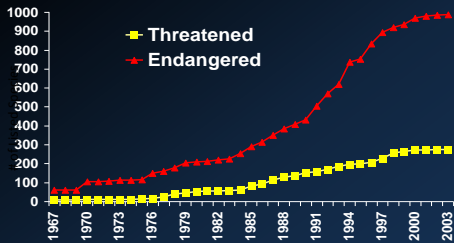
Wetlands Loss

- In the previous decade, from 1975 to 1985, wetland losses amounted to nearly three million acres.
- United States Fish and Wildlife Service estimated that during the decade 1985-1995, wetlands continued to disappear at an average rate of 117,000 acres a year.



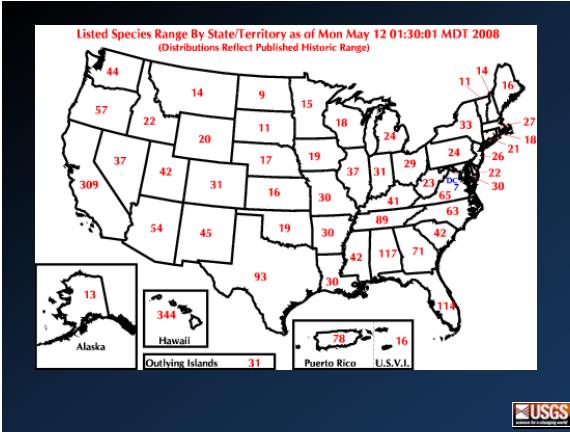
USGS logo and citation: NY Times 1997

Status



All listed species were threatened before being endangered... We are not getting ahead of the curve!

(As of Oct. 31 2003, N=1260) USGS logo



Loss of CRP lands 9/30/2007 – 3/30/2008

Year	Acres	Change	
9/30/2007	36,770,984		US
3/30/2008	34,697,697	-2,073,287	

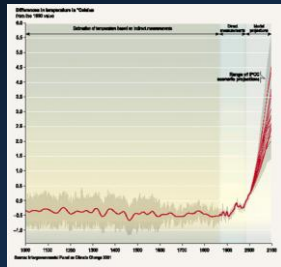
State	Acres 2007	Acres 2008	Change	
Washington	1,557,212	1,542,153	-15,059	11 western states
Oregon	567,565	561,496	-6,069	
Idaho	825,102	778,179	-45,923	
California	148,899	129,297	-19,602	
Nevada	n/a	n/a	n/a	
Montana	3,480,851	3,313,131	-167,720	
Utah	208,664	199,074	-9,590	
Colorado	2,472,094	2,435,201	-136,893	
Arizona	n/a	n/a	n/a	
New Mexico	590,399	565,749	-24,650	
Wyoming	284,287	272,596	-11,691	

USDA FSA, Conservation Reserve Program Statistics



Changes in direct drivers: Climate Change

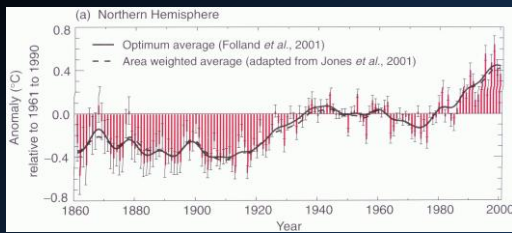
- By the end of the century, climate change and its impacts may be the dominant direct driver of biodiversity loss and changes in ecosystem services globally
- Harm to biodiversity will grow worldwide with increasing rates of change in climate and increasing absolute amounts of change



Climate Change

Adapted from Reid, MEA 2008

Northern Hemisphere Temperature Anomaly



Adapted from Hughes 2000, TREE 15:56-61; Mann et al. 1998, GRL

Climate Change Review

- In the next 100 years:
 - The global temperature predicted to rise **3.2 – 7.2 F**;
 - Sea-level predicted to rise **0.91 – 1.41 feet**;
 - Tropical storms increased in number and intensity.



Major Implications

- Change in ecosystem drivers
 - Fire
 - Hydrology
 - Temperature and weather events
- Changes in species' distributions and phenologies
- Regime shift in ecological communities



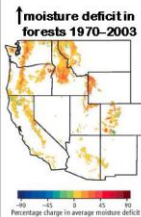
Effects of Global Climate Change

- Climate change likely to surpass habitat loss as the leading threat to biodiversity (Thomas et al. 2004)
- Climate change acts synergistically with all other stressors



Altered Disturbance Regimes

Larger, more frequent wildfires since 1980s in West



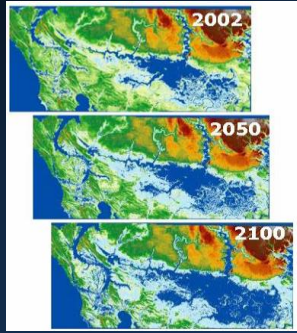
- More large wildfires
- Longer wildfire durations
- Longer wildfire seasons
- Strongly associated with increased spring and summer temperatures and earlier spring snowmelt

Running 2006, Westerling et al. 2006



Sea Level Rise

Blackwater NWR
 Sea level projected to rise 3mm/yr:
 1 foot rise by 2050
 2 feet rise by 2100



Increase in the intensity and frequency of tropical storms



<http://visual.usgs.gov/hurricanes/rtainages/hurricane-rita-01.jpg> http://www.ecwr22.de/apex.com/hurricane_01a_damage/hurricane_01a_050904_Latino_LA.jpg



Altered Species Distributions

90% decline in pop. of Sooty Shearwater (1967 - 1994) (Veit et al. 1997)



CA shoreline species shifting northwards (Barry et al. 1995)



Uncompahgre fritillary butterfly on brink of extinction (Britten et al. 1994)



Edith's checkerspot butterfly shifted range northward (Parmesan 1996, McLaughlin et al. 1999)



Polar bears increasingly using coastal areas as sea ice melts earlier and freezes later (Gleason et al. 2006, Schliebe et al. 2006)



Altered Phenologies



89 of 100 flowering plants in DC area blooming 4.5 days earlier in 2000 vs. 1970.

Egg laying date of NA tree swallows ~ 9 days earlier (1959 to 1991) (Dunn & Winkler 1999)



Earlier arrival of migrants (Root et al. 2004)

Lilac blooming ~4 days earlier (NE)





You've got to know when to hold 'em

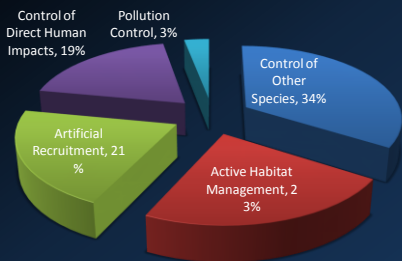
Know when to fold 'em

Know when to walk away

And know when to run.



Conservation Reliant Species

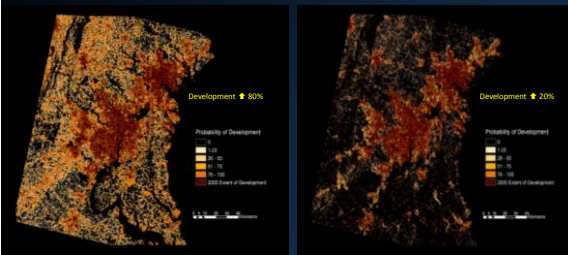


“The harmful effects of the degradation of ecosystem services (the persistent decrease in the capacity of an ecosystem to deliver services) are being borne disproportionately by the poor, are contributing to growing inequities and disparities across groups of people, and are sometimes the principal factor causing poverty and social conflict.”



Millennium Ecosystem Assessment, 2008

Forecast of Development Patterns in 2030 for Washington D.C./Baltimore



Current Trend

Ecologically Sustainable



Claire Jantz
