Bioaccumulation of DDT, PCBs, Hg, and other toxins

Campbell, p. 1218

Clear water state:

* nutrient sequestration in long-lived top predators;
* upslope vectoring of nutrients by mobile scavengers and predators (salmonids, birds, bats, bears);
* terrestrial vegetative cover;
* frequent scour and flushing that maintain edible taxa at lower trophic levels

Eutrophic state stabilized, maintained by:

* internal nutrient cycling enhanced by hypoxia;
* loss of higher trophic levels due to hypoxia and inedible algae
* more bank erosion with loss of rooted terrestrial vegetation;
* nitrogen fixation by cyanobacteria that dominate under high P

Coastal Zone Color Scanner
Nimbus-7 satellite

Pfiesteria piscicida, N.C.

Sewage and volatilized NH3 from industrial pig farms
Burkholder and Glasgow 1997

Dinoflagellate

Scaling issue—if floodplain area too small, and subsidized by agricultural imports by waterfowl—eutrophication. How large (or flushed) must it be?

Snowgeese (and cranes) in Bosque del Apache reserve, NM—Post et al. 1998—avian cholera and botulism
La Perouse Bay, East Shore Hudson Bay (Jefferyes 1999)
Blue-water
Green-graminoid vegetation
Red—had veg in 1973, mudflat in 1993)
Canadian Arctic irreversibly feeds as goose grubbing converts marsh to salinated mudflat...

Spahini et al. Science 2005
Vostok (Antarctic) ice core archived climate and atmospheric composition over past four glacial cycles over past 420 Kyr.
New Antarctic Core spans 8 cycles, (4 more than previously available) over past 740 Kyr.
This ice is about 491,000 years old

CO₂ concentration and isotopic temperature proxies in ice cores are strongly correlated
Siegenthaler et al. 2005
δ deuterium proxy for temperature

The concentration of CO₂ in air today is higher than it has been in the last 650,000 years, and probably since it has been in the last 50 my.

CO₂ (ppm)
Before 1850 274
1958 (Keeling) 316
2005 370
2075 (est.) 540

Global Temperatures
CO₂ (ppm)
Before 1850 274
1958 (Keeling) 316
2005 370
2075 (est.) 540
Positive fdbks destabilizing Earth’s response to global warming:

- "The clathrate surprise": Methane clathrates on the ocean floor release more methane (the clathrate gun hypothesis).
- * Oxidation of ancient carbon stored in arctic ecosystems with melt of permafrost terrestrial ecosystems, leading to an increase of atmospheric CO2 levels
- * Higher albedo of sea ice and seasonal snow cover. Darker earth and sea surfaces absorb more sunlight, leading to further warming.
- *Moulins, deep holes in continental glaciers, allow melt water to lubricate base, accelerating slippage of ice shelfs off continents (e.g. Greenland) into the ocean.
- *Acidification of the ocean—elevating CO2 concentration will lower ocean pH, interfering with the ability of ocean biota to produce calcium carbonate. E. Colbert, New Yorker Nov. 20 2006, pp. 67-76.

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Methane clathrate degassing—hypothesis for Paleocen-Eocene thermal maximum

http://en.wikipedia.org/wiki/Methane_clathrate

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Human roles in the Pleistocene (Flannery*, Zimov et al.)

- 25-15 K y bp: last ice age began (how rapidly? Over a century? Decades?)
- Ice covered latitudes north of Wales, New England, Washington state
- Sea level fell 160 m, land bridges exposed
- Ice age grip loosened about 15 K y bp, physical world like today’s by 9 K bp.
- HUGE worldwide mega fauna extinctions—lost 75% of taxa in N. and S. America, 45% in Europe. Why?

* books: The Future Eaters: The Weather Makers

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THE WEATHER MAKERS
How Man Is Changing the Climate and What It Means for Life on Earth.
By Tim Flannery.

FIELD NOTES FROM A CATASTROPHE
Man, Nature, and Climate Change.
By Elizabeth Kolbert.

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Evidence of global warming
- Glacier shrinkage on mountains around the globe.
- Satellite, balloon measurements show lower atmosphere is warming at similar rate to surface
- Permafrost melting in Arctic
- Acceleration of Greenland deglaciation due to moulins
- Warming of upper layers of the ocean

Elizabeth Colbert, New Yorker series on global warming

http://www.newyorker.com/fact/content/?050425fa_fact3tt

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Four hypotheses

- Climate change (prevailing view until recently)
- Human predation (Pleistocene overkill (Paul Martin))
- Climate stressed mega fauna, and humans finished them off
- Humans killed mega fauna, and ecosystem feedbacks changed climate (not generally accepted...)

Observations
- Last ice age only most recent of 17 that have gripped the Earth over the past 2 million years, and it was not the most severe. Why did mega faunal extinctions occur primarily in this one?
- The last ice age was roughly contemporaneous (25-15 ky bp) over the entire globe. Why were the timings of extinction so different on different continents?
- N. America 10-12 ky bp lost 75 % of its megaherbivores
- Australia 35K bp lost Diprotodon, giant 2 ton wombat
- New Zealand lost 12 spp of giant Moas less than 1 ky bp!
12 ky bp, vegetation changed across all of Beringia from steppe grass to mossy tundra. Assumed this due to climate change, but no record of this in ocean sediment or ice cores.

Zimov et al. hypothesize overkill of megafauna by Pleistocene hunters.

Siberian ponies pastured downslope from grass refuges on hills extend steppe grasses over tundra...trampling and grazing kills moss.

Moss tundra is a good insulator, so permafrost shallow, soils waterlogged and hypoxic. Grasses dry up soils, support more productivity and floral diversity, and might change (decrease?) runoff to the Arctic Ocean.

Could species impacts change global climate? change in continental scale burning, or freshwater runoff from Beringia?

Evidence of global warming (K. Cuffey)
• Glacier shrinkage on mountains around the globe
• Permafrost melting in Arctic
• Satellite, balloon measurements show lower atmosphere is warming at similar rate to surface
• Warming of upper layers of the ocean

Sea temperatures > 26.5 h (red, orange, yellow) will sustain hurricanes.

Bayou, Mangroves, Ecosystem Services
4 miles forested wetlands removes 80 feet of storm surge...