Biodiversity loss

It's not just Pandas and Tigers ...

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Outline

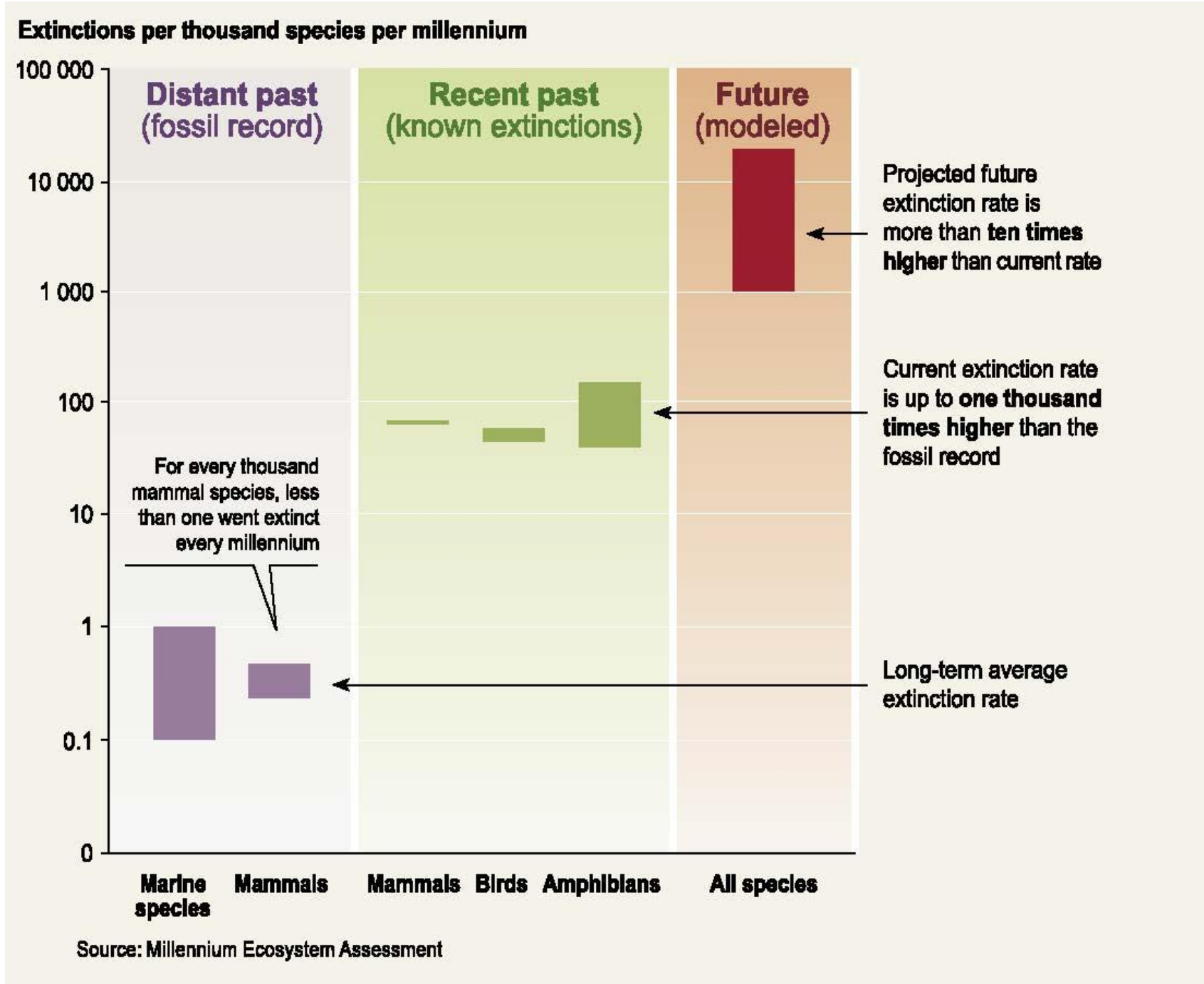
1. What is biodiversity and where does it come from?
2. Threats to biodiversity
3. Why is loss a real problem? --> "ecosystem functions and services"
4. Conclusions

What is biodiversity?

- "Richness of nature"
- Variation in species, genes, and biological traits
- Diversity in ecosystems
- About 10^7 types of plants, animals, protists, funghi inhabit the Earth
- Origin of biodiversity: Evolution/specialization starting about 540 million years ago ("Cambrian explosion")
  - Competition for limited resources (Gause-Volterra principle)
  - Niches in food webs

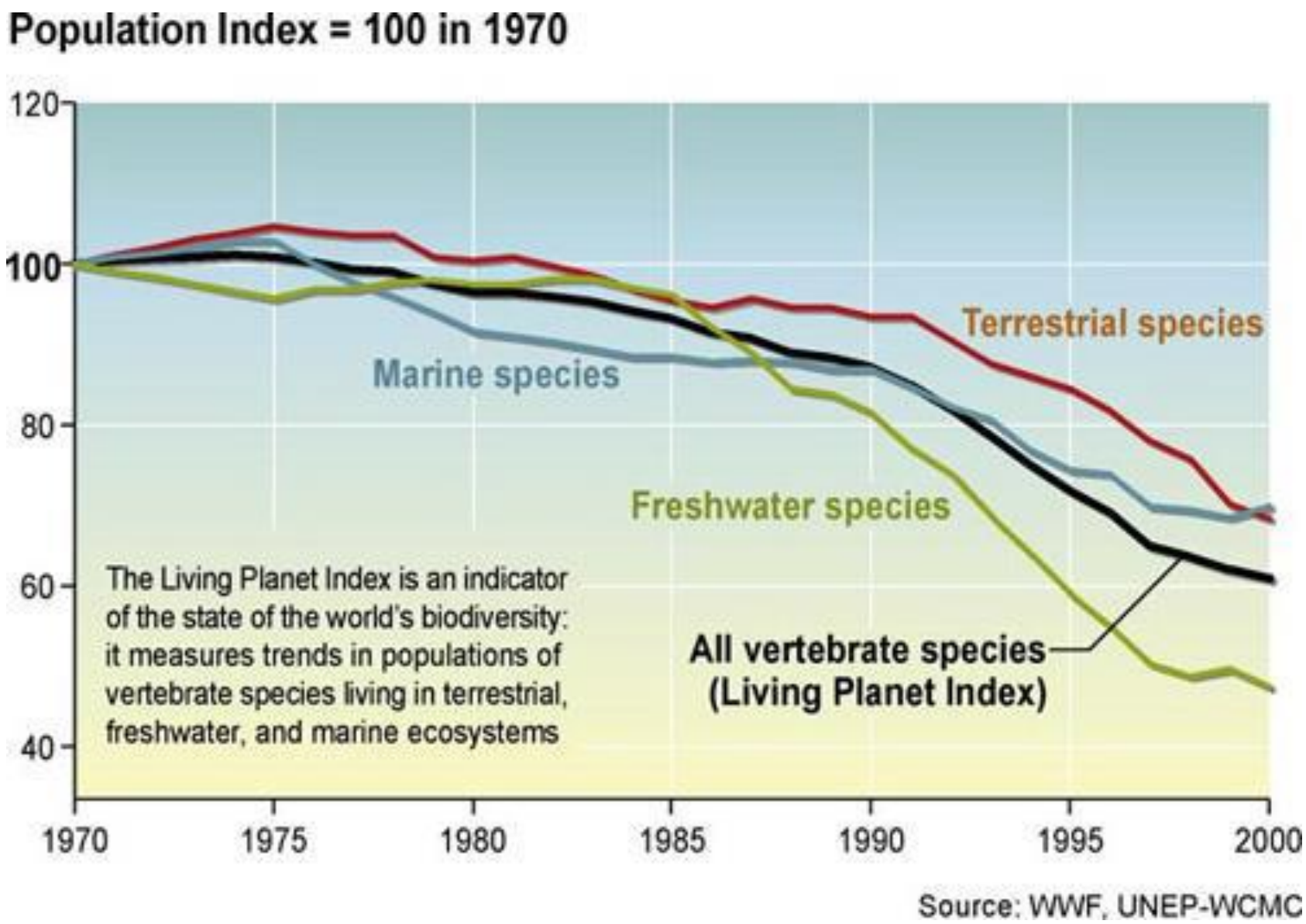
Dangers and threats to biodiversity

- "Modern" life forms have existed for roughly 540 million years
- 5 major extinction events ("mass extinctions")
- The last one about 66 million years ago (meteorite impact; climate change)
- Holocene (starting ca. 12k years ago), "Anthropocene" (since colonialization?) --> 6^{th} mass extinction (ongoing)


Extinctions per thousand species per millennium
100 000
10 000
1 000
100
10
1
0.1
0
Distant past
(fossil record)
Recent past
(known extinctions)
Future
(modeled)
Projected future extinction rate is more than ten times higher than current rate
Current extinction rate is up to one thousand times higher than the fossil record
For every thousand mammal species, less than one went extinct every millennium
Long-term average extinction rate
Marine species
Mammals
Mammals
Birds
Amphibians
All species
Source: Millennium Ecosystem Assessment

Some numbers/recent examples

- Decline of insects in Europe; e.g. butterflies count has dropped by more than 97% in CH since 1900
- Birds: Passenger pigon, Corncrake, Waldrapp, ...
- Megafauna: Giraffe, Cheetah, great apes (W/E Gorilla, Orangutan), ... -- 60% are threatened with extinction
- Collapse of fish stocks in the 1980/90 (Cod)

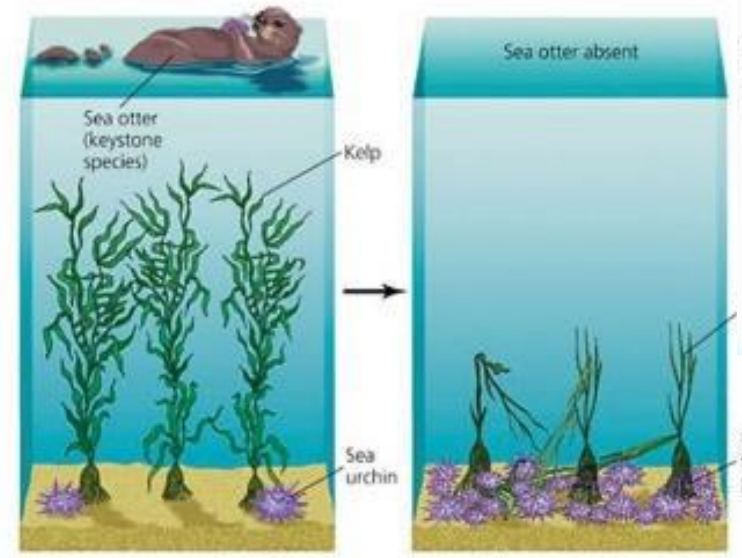

Population Index = 100 in 1970
120
100
80
60
40
1970
1975
1980
1985
1990
1995
2000
Terrestrial species
Marine species
Freshwater species
All vertebrate species
(Living Planet Index)
The Living Planet Index is an indicator of the state of the world's biodiversity: it measures trends in populations of vertebrate species living in terrestrial, freshwater, and marine ecosystems
Source: WWF, UNEP-WCMC

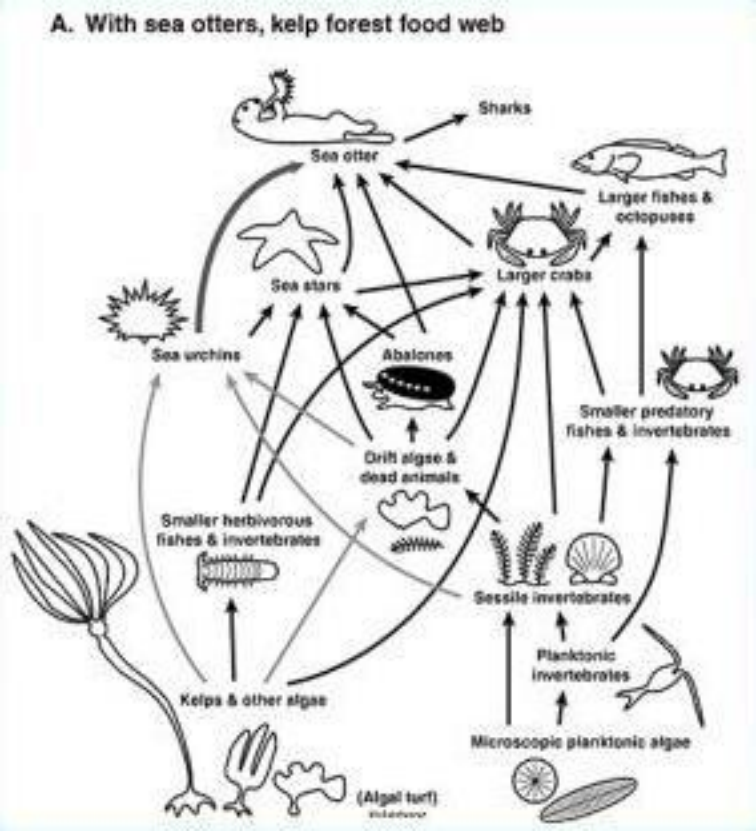
Main drivers of ongoing mass extinction

- 10^{10} humans vs 10^{7} species --> 1k humans per specie
- Major drivers of biodiversity loss
  - Agriculture (expansion, intensification); fertilizers
  - Habitat destruction and fragmentation
  - Overexploitation/hunting
  - Invasive species
  - Climate change

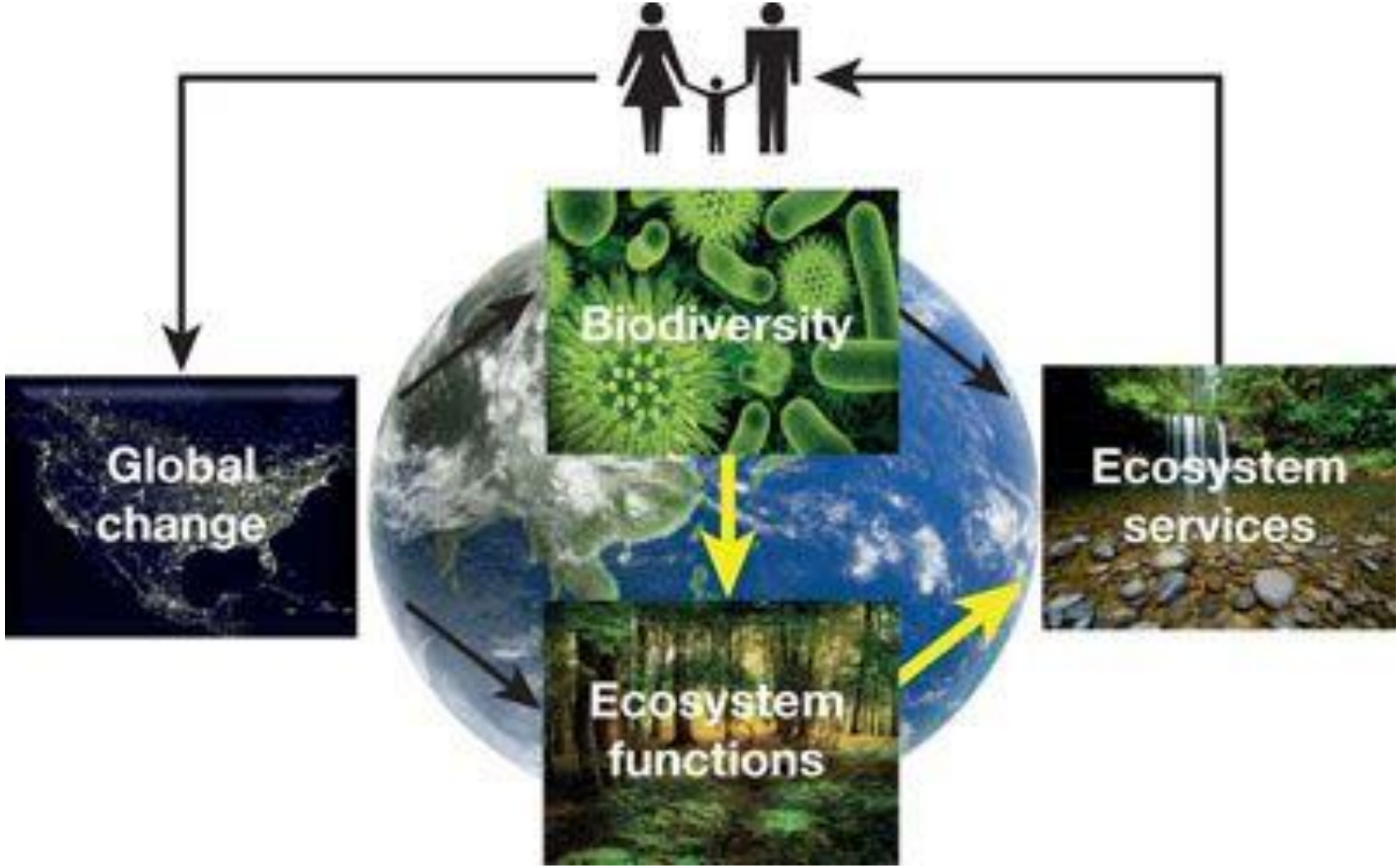
Why is loss of species a problem?

- Morally bad, but is it a real problem?
- Implies damage/loss of entire ecosystems
- Example: Sea otter, kelp food web





Ecosystems and humanity



Major ecosystem services

- Provisioning:
  - Purification of water & air, absorption of poisons
  - Food (Seafood, game, ...)
  - Wood and fiber
  - Fuel
- Regulation:
  - Climate/Carbon sink (plants; wood, peat, ...)
  - Flood regulation
  - Disease regulation
- Supporting:
  - Soil formation, erosion prevention
  - Pollination (agriculture)
  - Nutrient cycle
- Cultural:
  - Recreational
  - Aesthetic
  - Educational

Conclusions

- Biodiversity loss is not "just" about a few enigmatic species
- It concerns entire ecosystems --> paramount to human survival
- Implies tremendous costs (monetary and moral) to humanity
- Time is running, but we can still act!

References

- Lecture by M. Dittmar: http://ihp-pc47.ethz.ch/energy21
- Biodiversity loss and its impact on humanity, Cardinale et al., Nature 486, 59 (2012).
- Slides by Ch. Küffer: http://tinyurl.com/ho4h59h
- Millennium Ecosystem Assessment: https://www.millenniumassessment.org