# Ecological Design Theory & Practice

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# Glimpses of the Planetary Crisis

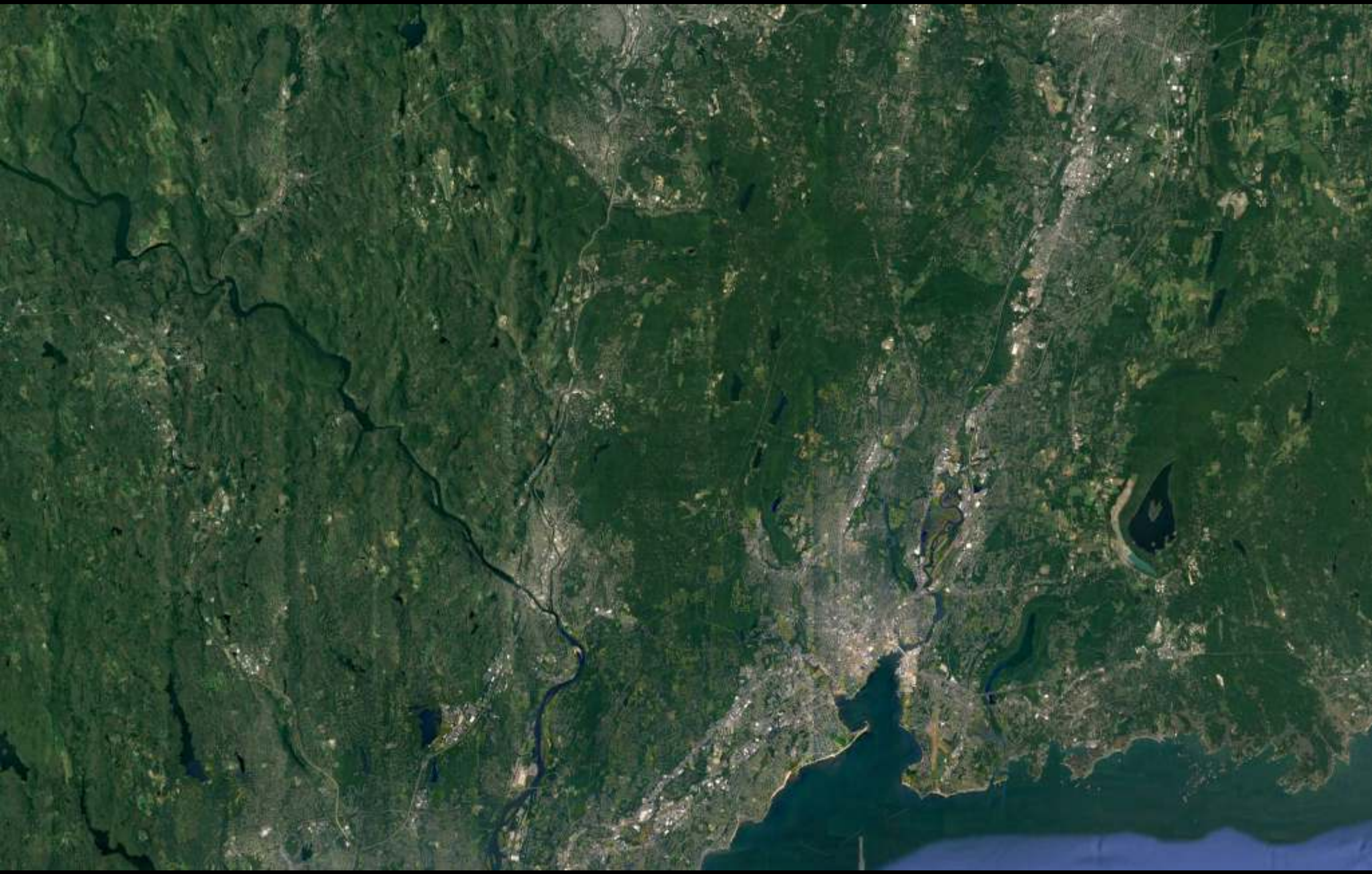
- 50% loss of global fish populations in past 50 years
- 90% loss of Monarch Butterfly population in past 20 years
- Between 40-70% of all insect species worldwide are rapidly declining
- 50% of Great Barrier Reef has died in past 3 years
- The *majority* of surplus greenhouse gases since 1800 have been emitted since 1980.

# Economic & Social Implications

- Without rapid decarbonization in next 8-10 years:
  - Projected climate refugees by 2050: 200 million+
  - Projected price increases in staple crops by 2050:
    - Wheat: +67%
    - Rice: +80%
    - Corn: +130%
- Projected # of people in China affected by water scarcity by 2100: 1 billion+
- Projected minimum global economic damage/losses from climate change by 2100: $600 *trillion*

# Ecological Design Lineages

# Understanding Place



# Biogeochemical Cycles

- Carbon
- Water
- Nitrogen
- Phosphorous
- Ecological Communities

# Carbon Cycle

- Gross ~10.5 billion tons C *emitted* globally per year: ~9.5 billion tons from fossil fuels, ~1 billion tons from land degradation.  Gross ~6 billion tons C *sequestered* into land and oceans per year. (*www.co2.earth)*

- This = NET ~4.5 billion tons C added to atmosphere/year, or ~0.57 ppm CO2 increase/year.

- US gross emissions increased 2.8-3.4% from 2017 to 2018. *(New York Times)*

- Historically, land degradation from agriculture alone has emitted ~130 billion tons C, or ~25% of total surplus emissions. (*Lorenzo & Lal, 2018)*

Climate
Adaptation

Emissions
Reduction

Carbon Sequestration

| Ranking (of 80) | Agricultural Solutions within *Plausible* Scenario | Gt CO2-eq 2020-2050 | Gt CO2-eq/yr in 2050 |
|---|---|---|---|
| 9 | Silvopasture | 31.2 | 1.3 |
| 11 | Regenerative agriculture (annual cropping) | 23.1 | 1.1 |
| 14 | Tropical staple trees | 20.2 | 1.1 |
| 16 | Conservation agriculture | 17.3 | 0.5 |
| 17 | Tree intercropping | 17.2 | 1.0 |
| 19 | Managed grazing | 16.3 | 0.9 |
| 23 | Farmland restoration | 14.1 | 0.8 |
| 24 | Improved rice cultivation | 11.3 | 0.6 |
| 28 | Multistrata agroforestry | 9.3 | 0.5 |
| 51 | Perennial biomass crops | 3.3 | 0.2 |
| 53 | System of Rice Intensification | 3.1 | 0.2 |
| 62 | Women smallholders | 2.1 | <0.1 |
| 65 | Nutrient management | 1.8 | <0.1 |
| 67 | Farmland irrigation (efficiency) | 1.3 | <0.1 |
| 72 | Biochar | 0.8 | <0.1 |

*Data adapted from Eric Toensmeier and Project Drawdown*

# Water Cycle

- Over 50% of all global wetlands have been destroyed since 1900.

- Complex climate change effects on water cycle - amount, intensity, seasonality of rainfall & snowpack all changing differently in different regions, while many wetlands & aquifers being both depleted and polluted.

- Connecticut - 15% increase in annual precipitation since 1970; *another* 15% increase coming by 2050; more frequent & intense tropical storms & hurricanes in the North Atlantic = more large storm events.

- Water vapor is a positive feedback loop greenhouse gas with effects of CO2 - warmer air holds more H2O & therefore more heat.

- Working in ecological design paradigms requires a deep engagement with local and regional water systems.

# Keyline Design

# Beaver Restoration

# Dam Removals

# Rain Gardens & Infiltration Basins

# Living Machines


Design at
Rocky Corner

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