We are screwing it!

*By Camilo Mora, Ph.D.*
CLIMATE AFFECTS SPECIES AND PEOPLE

How vulnerable are we to climate change?

Mitigation

<table>
<thead>
<tr>
<th>Temperature ↑</th>
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<tbody>
<tr>
<td>Rainfall ↓ ↑</td>
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<tr>
<td>Sea level ↑</td>
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<tr>
<td>Ocean pH ↓</td>
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<td>...</td>
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<td>...</td>
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</tbody>
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Food
Water
Air

Move
Adapt
Go extinct

Damages
Health
Displacement
...
Case 1: Impacts of climate change on marine biodiversity and people

Surface change

Goods and services?
Food, Jobs, Revenue

Biodiversity?

Deep sea change?

°C
pH
Oxygen?
Productivity?
Case 1: Impacts of climate change on marine biodiversity and people

Measuring Climate Change

Global average temperature change compared to 2000 (°C)

× 3 scenarios
× ~100 years
× 12 months
× 365 days

Over 60 million global maps

For each of 12 climate variables

www.soc.hawaii.edu/mora/
The impacts of climate change on marine biodiversity and people

High Emission Scenario

2.02 billion people live in high climate change stress areas
(i.e. cumulative climate change scores > 2.3)

Scaled from 0 to 1

~1.12 billion have high ocean dependence
(i.e. over 60% of the animal consumption, working force and domestic product comes from ocean resources)

~870 million are poor
(i.e. less than US$4,000 annual per capita GDP)

Low Emission Scenario

1.4 billion people live in high climate change stress areas
(i.e. cumulative climate change scores > 2.3)

~690 million have high ocean dependence
(i.e. over 60% of the animal consumption, working force and domestic product comes from ocean resources)

~470 million are poor
(i.e. less than US$4,000 annual per capita GDP)

Mora et al. PlosBiology 2013

0
No change in any variable
ENDEEP – Census of Marine Life (23 scientists from every continent)
Case 2: Impacts of climate change on plant growth and people

Statement: “...climate change will be good for plants...”

Definition of growing season: “days in a year above freezing”

Mid-latitudes are warming leading to more days above freezing; and thus, more days for plants to growth

Linear Trend in Temperature, 1980-2008 (sd)

Lobell et al., Science 2011
Case 2: Impacts of climate change on plant growth and people

Climate conditions for plant growth

Net Primary Production
Temperature
Radiation
Soil moist

Suitable growing days

Cumulative NPP (% yearly)

Temperature (°C)

Solar radiation (W m-2)

Volumetric soil water content (fraction)
Difference between contemporary and 2100 climates

Days below freezing

Days above freezing but below upper thermal threshold

Suitable days in temperature, radiation and soil moist

Growing period

Global percent change

Year
Impacts of changing in growing periods in ecosystems

- Over 400 Pg of carbon
- Climate change feedbacks
- Respiration
- Die-offs
Impacts of changing in growing periods on people

3.6 billion people live in high climate change stress areas (i.e. Countries loosing six or more weeks suitable for plant growth)

~3 billion have high dependence (i.e. over 66% of the animal consumption, working force and domestic product comes from agriculture)

~2.3 billion are poor (i.e. less than US$4,000 annual per capita GDP)
The output and the team

Class project for “methods on macro-ecology”

Nature in review

Disappearing suitable days for plant growth under projected climate change

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Ongoing climate change can alter conditions for plant growth12, in turn affecting ecological and social systems4. While there have been considerable advances in understanding the physical aspects of climate change, comprehensive analyses integrating climate, biological and social sciences are less common. Here we use climate projections under alternative mitigation scenarios to show how changes in factors that limit plant growth could impact ecosystems and people. We show that by 2100, while the global mean number of days above freezing will increase by 2.7%, suitable plant growing days will actually decrease globally by 1.22% when a broader range of climate thresholds for plant growth are considered. These changes will impact most of the world's terrestrial ecosystems (potentially triggering climate change feedbacks) and humanity (e.g., ~0.5 to ~2.4 billion of the poorest people in the world will be highly vulnerable to changes in the supply of plant-related goods and services). Our study found critical contrasts among outcomes of different mitigation scenarios, revealing the urgency for even minimal reductions in greenhouse gas emissions. The expected doubling demand for plant production resulting from human population increase and consumption further highlights the need for improving climate change mitigation and adaptation strategies.
Case 3: when can we expect all these things to start happening?

How much time we have left to act

The Year of Climate Departure

The year of climate departure

Mora et al. Nature 2013
What is the Timing of Climate Departure Globally?

RCP4.5
(Aggressive Mitigation)
Average=2069, S.D.=18 years

RCP8.5
(Business As Usual)
Average=2047, S.D.=14 years

Mora et al. Nature 2013
Poor capacity to respond

The societies first impacted may have the least economic capacity to respond

Mora et al. Nature 2013
2020 for tropical areas, 2047 for the average location on Earth is not that far!

34 years in the future!

We will live to see this
The endeavor is global yet locally relevant

www.soc.hawaii.edu/mora/
The output and the team

Class project for “methods on macro-ecology”
...what to do? First, it is to recognize what is at stake...

Alternative equilibrium states

Habitat loss
Overexploitation
Invasive species
Climate change

Extinction vortex
Mal-Adaptations
Allee effect = low offspring
Low genetic diversity = low resilience

Some of the damages can be definitive

Bellwood et al, Nature 2004
...what to do?. First, it is to recognized what is at stake...

Habitat loss
Overexploitation
Invasive species
Climate change

Some of the damages can be definitive

Global patterns of extinction

Mora et al. Science 2013
...what to do?. First, it is to recognized what is at stake...

Some 20,000 species a year
many of which we will never know
...what to do?. First, it is to recognized what is at stake...

Habitat loss
Overexploitation
Invasive species
Climate change

Loss of goods and services

Loss of human welfare

~1 billion people going hungry every day

("FAO, The State of Food Insecurity in the World, 2008.")
...second, there is nowhere else to go...

If something goes wrong here, we will have nowhere else to go!!!
“We are all born ignorant, but one must work hard to remain stupid”
Benjamin Franklin

Thank you very much...

...and have a good day...