Ecosystems’ health = 1 ∕ people ∗ consumption

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Global socio-ecological feedbacks of climate change

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Temperature ↑
Rainfall↓ ↑
Sea level ↑
Ocean pH ↓

...
Climate change in the ocean

**Difference between today and 2100 under business-as-usual**

<table>
<thead>
<tr>
<th>Difference</th>
<th>Temperature (°C)</th>
<th>Oxygen (mg L⁻¹)</th>
<th>pH</th>
<th>Phytoplankton (mg C L⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change</td>
<td>1.2</td>
<td>0.02</td>
<td>0.001</td>
<td>0.01</td>
</tr>
<tr>
<td>Change</td>
<td>1.5</td>
<td>0.03</td>
<td>0.001</td>
<td>0.02</td>
</tr>
<tr>
<td>Change</td>
<td>1.8</td>
<td>0.04</td>
<td>0.001</td>
<td>0.03</td>
</tr>
<tr>
<td>Change</td>
<td>2.1</td>
<td>0.05</td>
<td>0.001</td>
<td>0.04</td>
</tr>
</tbody>
</table>

All marine ecosystems will be challenged in their tolerance to changes in many climatic variables.

~870 million people vulnerable

Number of people that could lose jobs, food and revenue; and are poor.

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**Climate change impacts on land: a case example about plants**

Temperature

Water

Sunlight

Cumulative NPP (% yearly)

Suitable growing days

Mora et al. PlosBiology 2013

Mora et al. PlosBiology 2015
Difference in suitable plant growing season between 2005 and 2100 climates

Suitable plant growing season: number of days in a year with suitable climates for plant growth

~2.3 billion people vulnerable
Number of people that could lose jobs, food and revenue; and, are poor

Mora et al. PlosBiology 2015

...what about direct impacts on people...

The lethal heatwave project

- Solar radiation
- Wind
- Humidity
- Temperature

Compounding factors: medications, drugs, alcohol, lifestyle

Compounding factors: age, respiratory illness, hypertension

Vital organ

Death

Respiratory failure
Heart failure
Liver damage
Pancreas damage
Blood poisoning

Compounding factors:

- Social isolation, low income
- Medications, drugs, alcohol, lifestyle
...how many ways can you die from climate change? ...25 at least...

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Ischemia</th>
<th>Disseminated intravascular coagulation (DIC)</th>
<th>Inflammatory response</th>
<th>Rhabdomyolysis</th>
<th>Heat cytotoxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organ ↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidneys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lungs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intestines</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Liver</td>
<td></td>
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</tr>
<tr>
<td>Pancreas</td>
<td></td>
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</tr>
</tbody>
</table>

...How common are deadly climates...

Paris 2003, ~2 000 people die in two weeks (>14 000 people in France, >50 000 in Europe)
Moscow 2010, ~1 000 people die in two weeks (>10 000 people in Russia alone)
Chicago 1995, >700 people die in one week

Places where people have die in the last 20 y because it got too hot
Climate projections by 2100

Climate change triple whack

The Team

Class project for “methods on macro-ecology”

Class of 2012

Class of 2013

Class of 2014-2015

Win-Win

Students get training
Students get paper
Professor gets paper
Professor gets excellent evaluations
Professor gets lots of FREE LABOR!

Nature to submit
How much time we have left? When is climate change arriving?

The Year of Climate Departure

Mora et al. Nature 2013

What is the Timing of Climate Departure Globally?

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

Between 1 and 5 billion people will live in areas facing novel climates by 2050

Mora et al. Nature 2013
We will live to see this

2047 is just 33 years in the future!

...the other component of climate...

Creative Commons Photo by Neil Howard, Flickr
Around the world, some 20,000 species are gone a year (Mora et al. Science 2013)

The solutions:
1. reduce natality

Earth’s biocapacity: 11 billion ha/y = 1.3 Earth’s a year

Mora & Sale, MEPS 2011
Mora, Ecology & Society 2014
For our generation will be the choice between a crowded world or a better world.

Mora & Sale, MEPS 2011
Mora, Ecology & Society 2014

The solutions: 2. reach carbon neutrality

CO2 sequestered = CO2 produced
(No one place in the world)

Native forest (reforestation)

HOW?

7-12 billion people
~1.3 planets (Mora & Sale 2011)
My pathway to CO2 neutrality

1 Tree
TO BE NEUTRAL

40 CO2 tones
STILL TO SEQUESTER

Plant a tree

My consumption

Where do I rank?

Compared to friends

to all users

Pedro Perez
10 tns deficit

Ricardo Rodriguez
11 tns deficit

Me
12 tns deficit

Paola Reyes
13 tns deficit

Paolo Reyes
14 tns deficit

Where do we plant trees?

Conservation areas

Guava distribution

We have lost over 80% of the native Hawaiian forest

There is plenty of space in Hawaii and the world to plant trees!
...how to take care of our trees?...

Water independence for 15 days $15 dollars

Who will do the work?
God will save us!

<table>
<thead>
<tr>
<th>Civilizations</th>
<th>Gone Year(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clovis</td>
<td>~10000BC</td>
</tr>
<tr>
<td>Minoans</td>
<td>~700BC</td>
</tr>
<tr>
<td>Cucuteni</td>
<td>~3000BC</td>
</tr>
<tr>
<td>Aksumite</td>
<td>~3500BC</td>
</tr>
<tr>
<td>Indus</td>
<td>~5000BC</td>
</tr>
<tr>
<td>Anasazi</td>
<td>~3000AD</td>
</tr>
<tr>
<td>Olmec</td>
<td>~400BC</td>
</tr>
<tr>
<td>Nazca</td>
<td>~800AD</td>
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<tr>
<td>Rapa Nui</td>
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**Few things to learn:**

1. Those who tamper with the basic supply of things like food and water are doomed
2. No, God will not hear us

**Something has to be done...**

If something goes wrong here, we will have nowhere else to go!

We will all be stuck in here!!!

- As many as 100 billion earth-like planets
- ~10 meet Earth's life conditions
- Probability of another similar planet = 0.0000000001
“We are all born ignorant, but one must work hard to remain stupid”
Benjamin Franklin

Thank you very much...

...and have a good day...