



**NATURAL
HISTORY
MUSEUM**
LOS ANGELES COUNTY

DISCO



Diversity Initiative for the Southern California Ocean

*Dr. Regina Wetzer, rwetzer@nhm.org
Associate Curator Marine Biodiversity Center*



Overview of *DISCO* in NHM context
Review of DNA and molecules
DNA purification – Animal Tissue protocol
Collection Tour

USING DNA BARCODING AND ENVIRONMENTAL DNA TO STUDY URBAN MARINE ECOSYSTEMS

NHM's *DISCO* Project

Greatly accelerate our ability
to discover and document
marine biodiversity
using modern genetic tools

DISCO Core Team at NHM



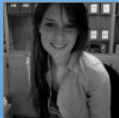
Adam Wall

Collections Manager of Crustacea



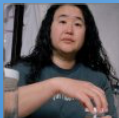
Dean Pentcheff

DISCO Program Coordinator



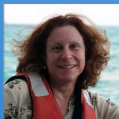
Jenessa Wall

Assistant Collections Manager of the Marine Biodiversity Center



Kathy Omura

Collections Manager of the Marine Biodiversity Center



Leslie Harris

Collections Manager of Polychaetes



Regina Wetzer

Associate Curator and Director of the Marine Biodiversity Center

What's in the water?

Regina Wetzer @ Dean Pentcheff

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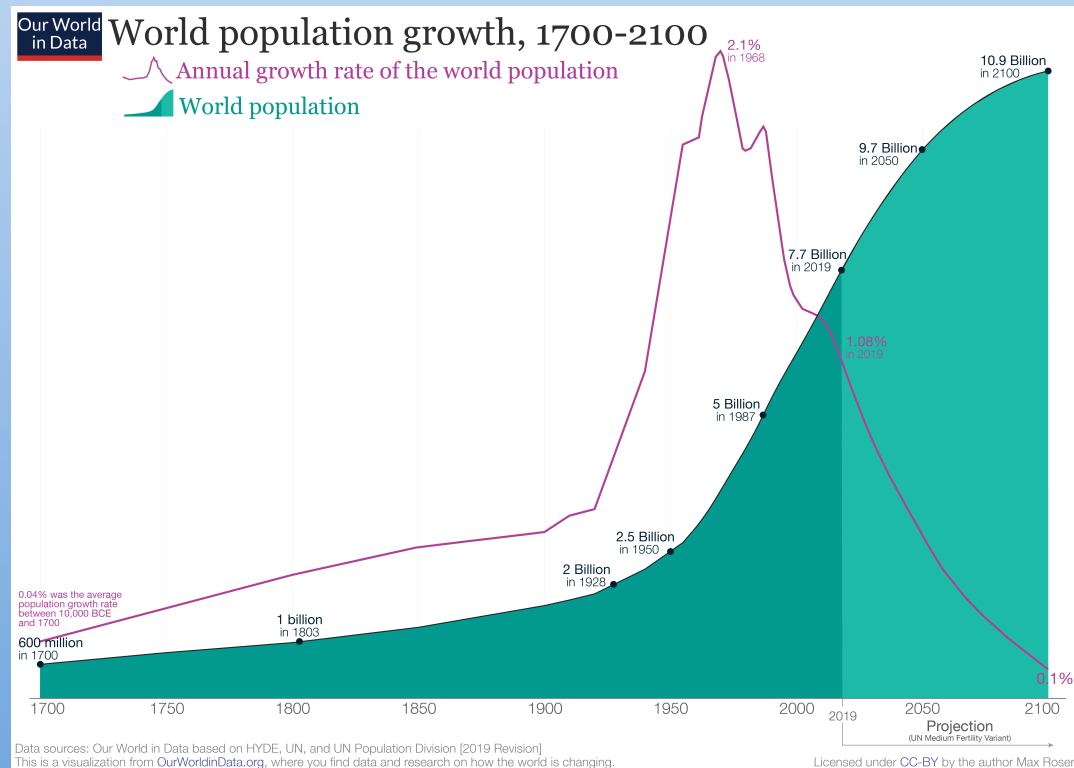
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Why do we care what's in the ocean?

What are we doing about it?

Food Security



**World population
is increasing**

Food Security

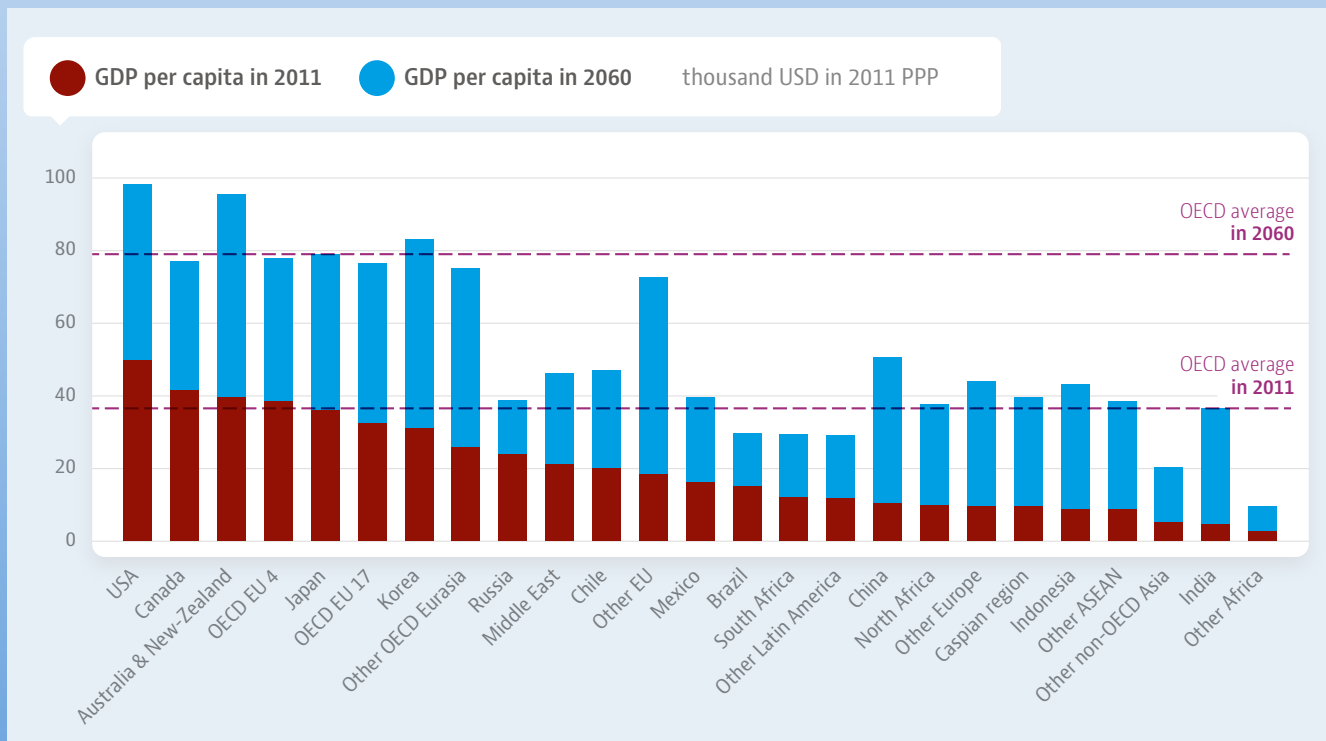
Increasing population + increasing wealth



The world is getting richer

Food Security

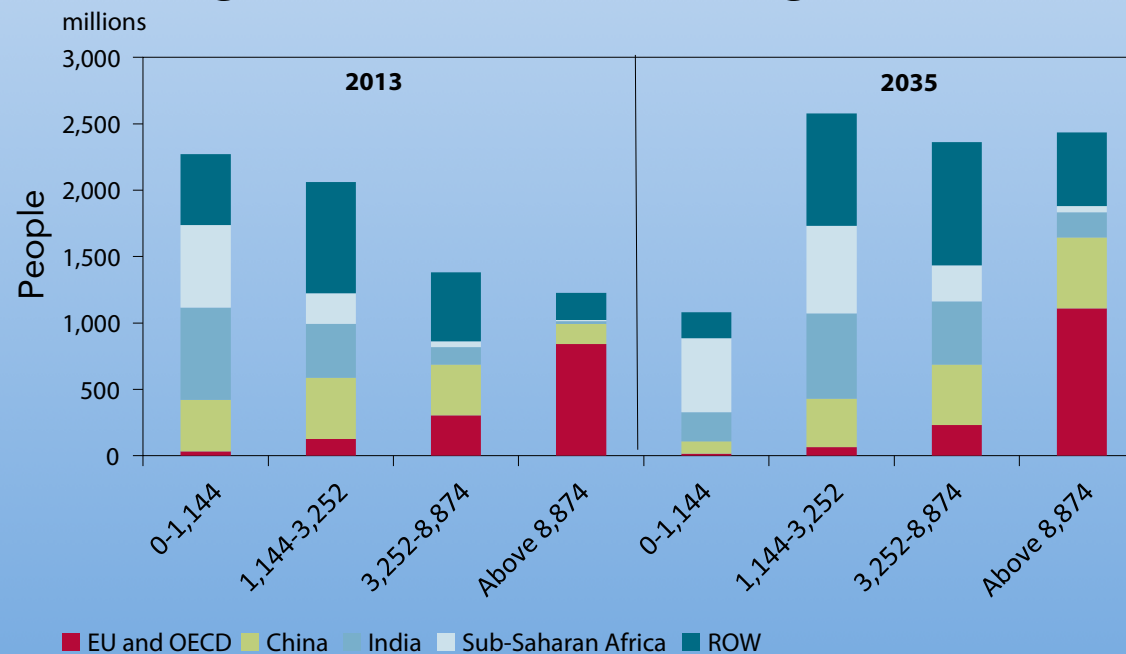
Increasing population + increasing wealth



The world is converging to OECD levels of wealth

Food Security

Increasing population + increasing wealth



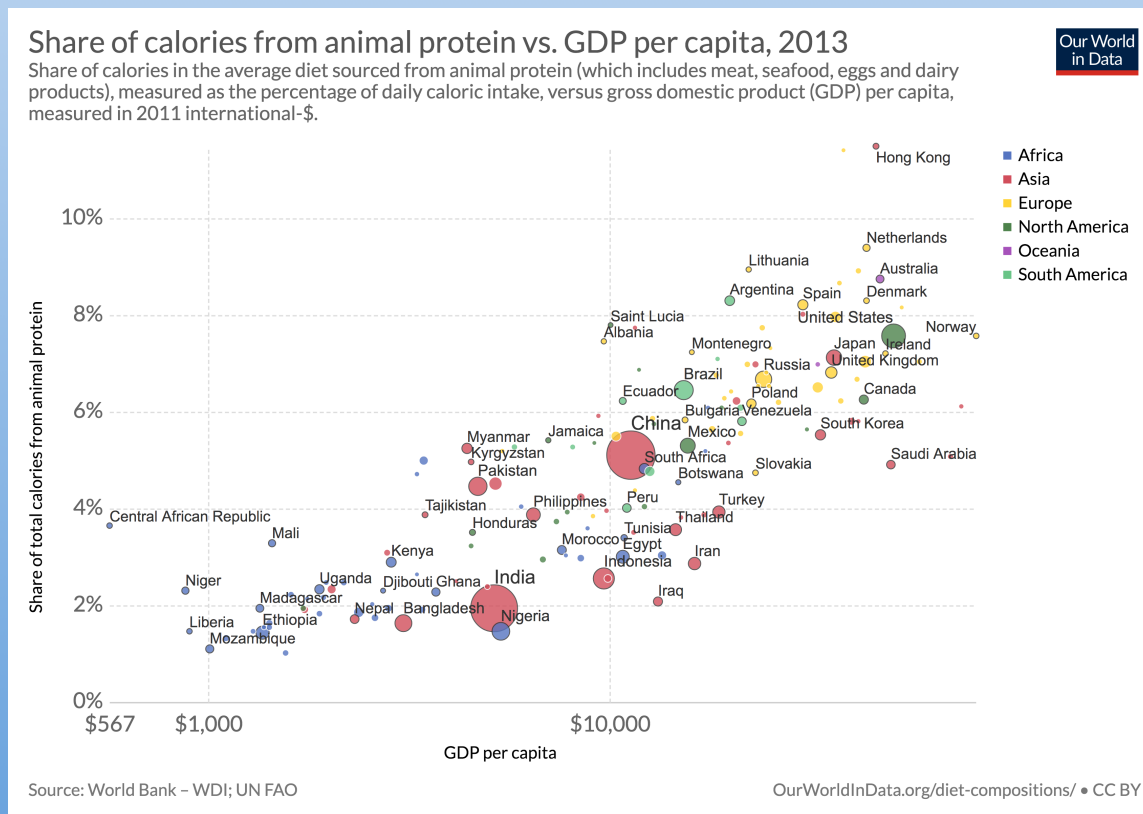
Not only is there more money, more people are better off

ROW = rest of the world; EU = European Union; OECD = Organization for Economic Cooperation and Development
 Notes: Ranges on the horizontal axis are expressed in 2011 international US dollars and correspond to those used by the World Bank in its Global Consumption Database. Income thresholds have been converted into 2013 prices and are expressed in annual terms.

Source: WP-17: *The Future of Worldwide Income Distribution*. Peterson Institute for International Economics.

Food Security

Increasing population + increasing wealth = increased protein demand



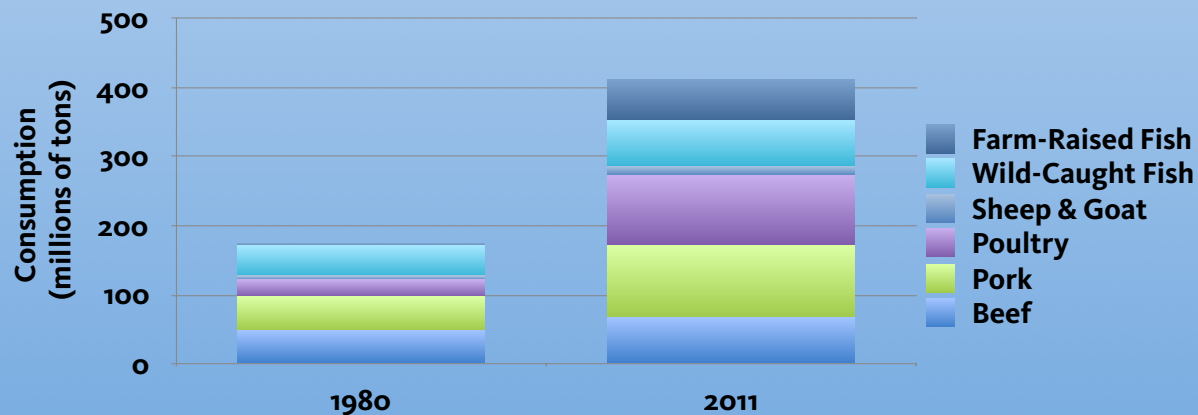
What happens when people get richer?

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Food Security

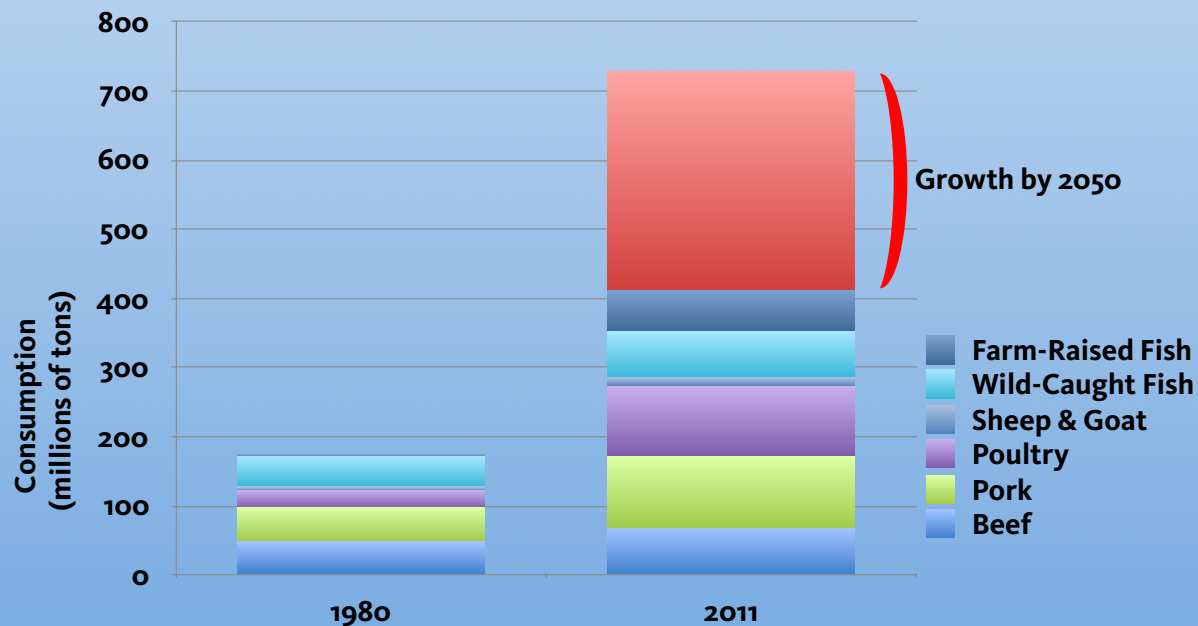
Increasing population + increasing wealth = increased protein demand



Where does
our animal
protein
come from?

Food Security

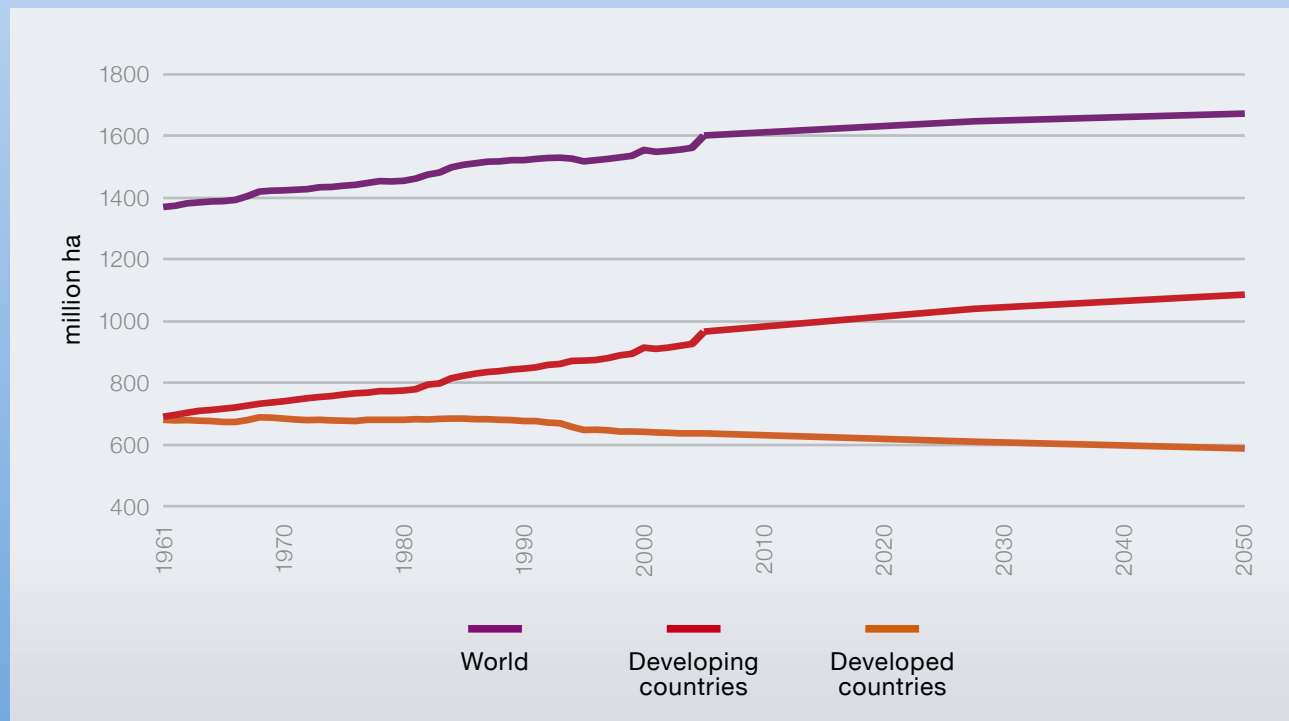
Increasing population + increasing wealth = increased protein demand



Where will
more animal
protein
come from?

Food Security

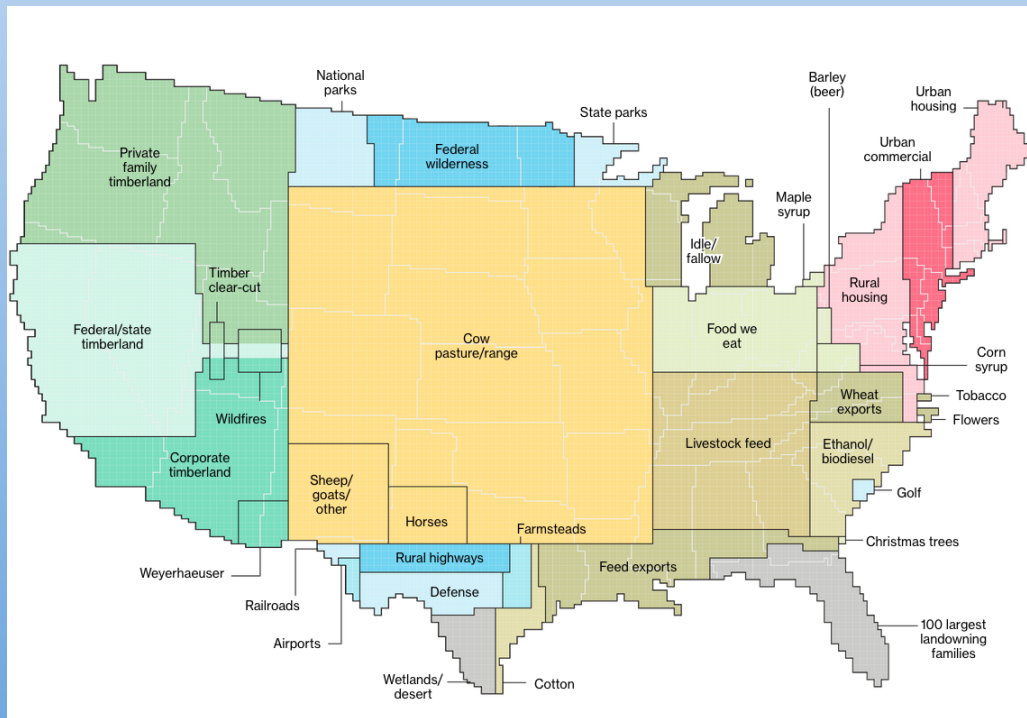
Increasing population + increasing wealth = increased protein demand



Are we going to get more protein from the land?

Food Security

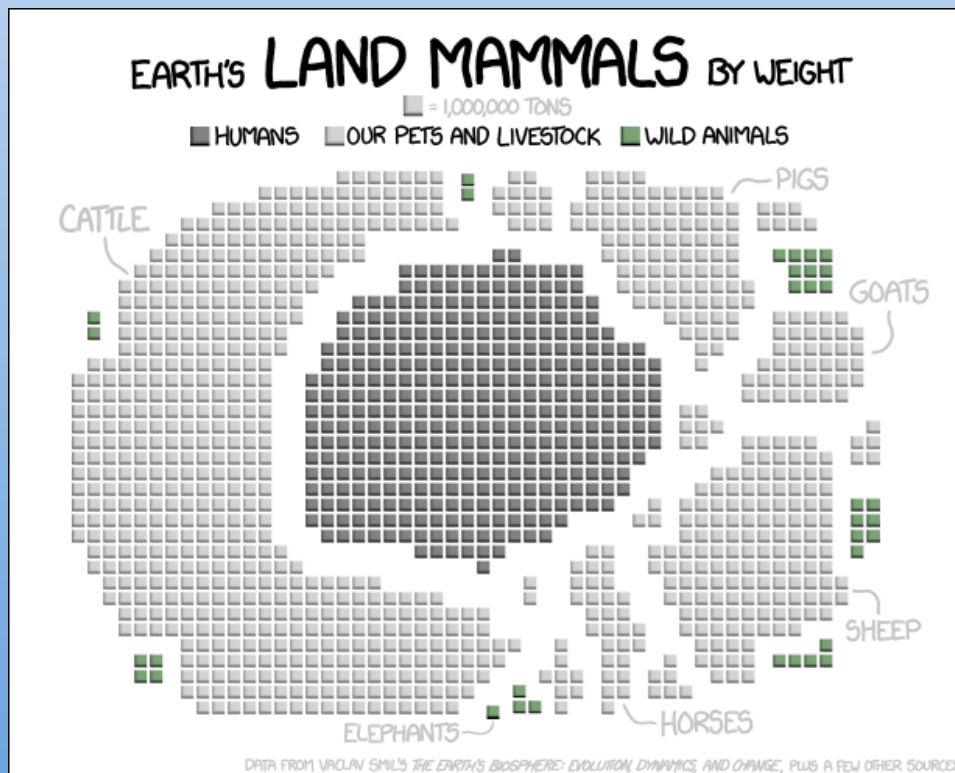
Increasing population + increasing wealth = increased protein demand



We're pretty much done with getting animal protein from land

Food Security

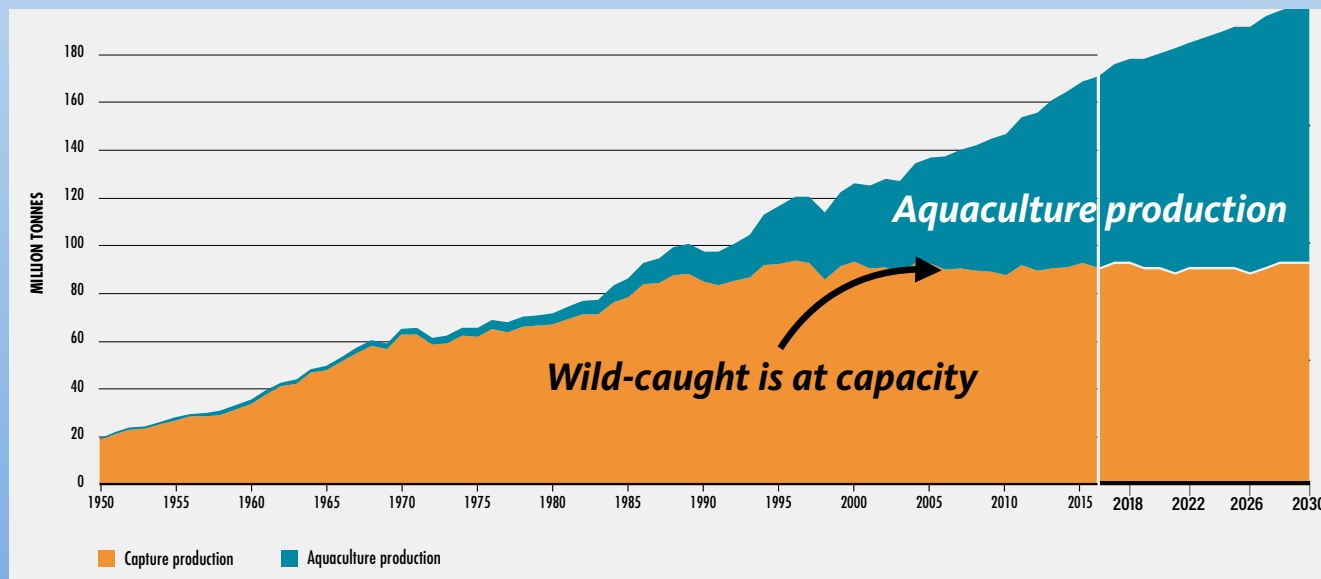
Increasing population + increasing wealth = increased protein demand



We're pretty much done with getting animal protein from land

Food Security

Increasing population + increasing wealth = increased protein demand



It's going to come from the ocean — specifically, aquaculture

We are entering the age of ocean agriculture

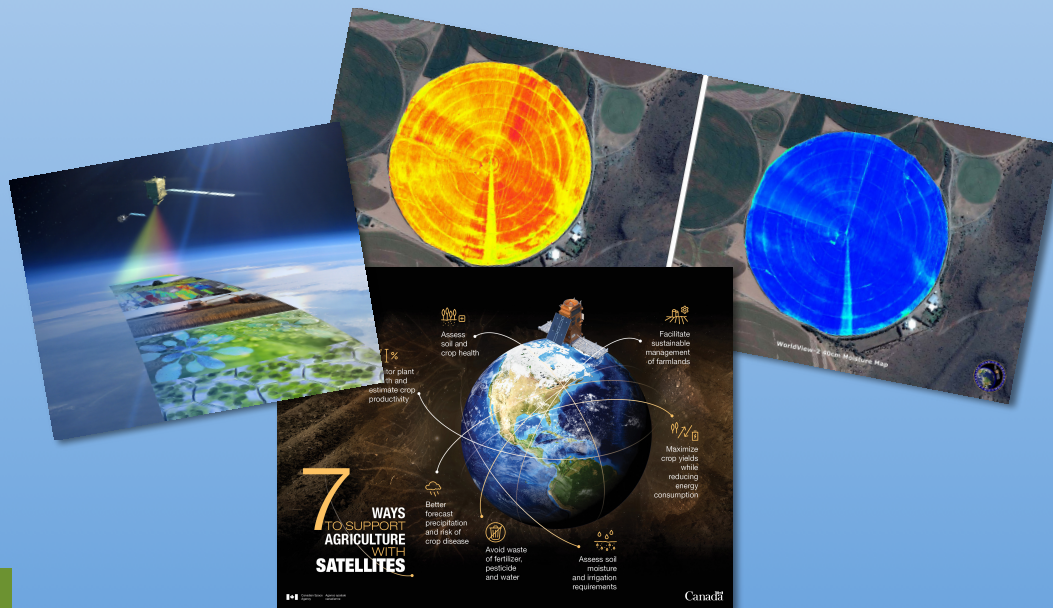


Measuring biodiversity is critical

- **Prospecting: What to farm in the ocean?**
We learn that by measuring biodiversity
- **Managing: How is our farming going?**
We learn that, too, by measuring biodiversity

How to measure biodiversity?

Terrestrial agriculture has many technologies available — even satellite data



Marine data can be more challenging to acquire



Classical marine biodiversity tools



Slow



Demanding



Expensive

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Novel technology:

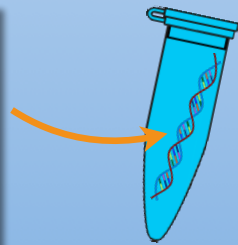
Environmental DNA (eDNA)

- **We can determine an organism's species from its DNA sequence**
- **We can use DNA shed into the environment to inventory entire communities**

Creating a DNA “barcode”



**Identified
specimen**



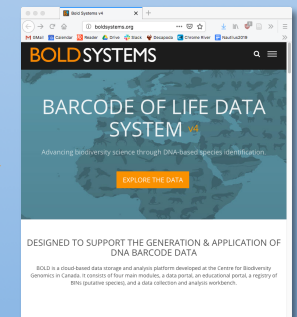
**Extract
DNA**



**Amplify
“barcode” gene**



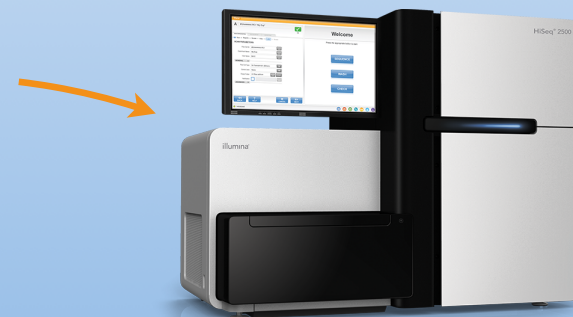
**Sequence
amplified gene**



**File reference
“barcode”**

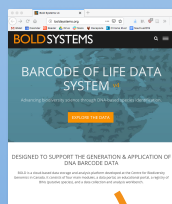
Using barcodes with eDNA

Collect eDNA



High-throughput sequencing

Bioinformatic analysis



Schizoporella inarmata
Diodora aspera
Eulalia subtilis
Lumbrinerides platypygus
Pteropurpura macroptera
Harbansus mayeri
Paracalanus parvus
Neanthes succinea
Dorvillea (Dorvillea) sp
Anatoma kelseyi
Hoplonemertea sp A
Elithusa californica
Ophiocten sp
Euchone rosea
Salvatoria mediodentata
Ampelisca cf brevisimulata
Hesperato columbella
Ophioglycera sp
Caesia delosi
Ampithoe plumulosa
Magelona berkeleyi
Erichthonius sp SD1
Ophiophthalma jolliense
Pinnixa occidentalis Cmplx
Stenothoe estacola
Phyllodoce hartmanae
Samytha californiensis
Phisidia sanctaemariae
Teinostoma supravallatum
Pugettia venetiae
Tenonia priops
Haliathella sp A
Tubificoides parapectinatus
Nucula carlottensis
Hippomedon sp A
Leucon declivis
 ...

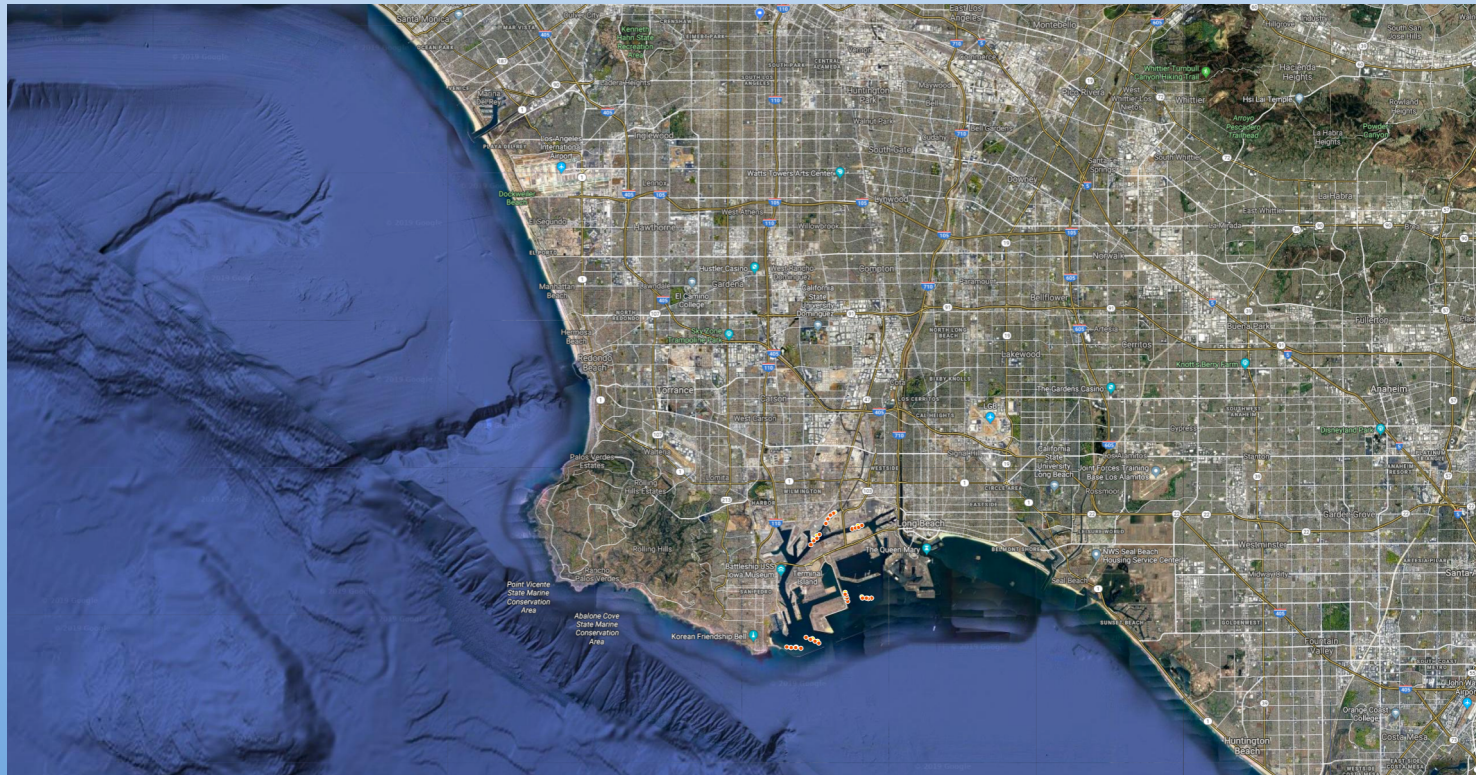
Community inventory



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Example: Port study



Example: Port study

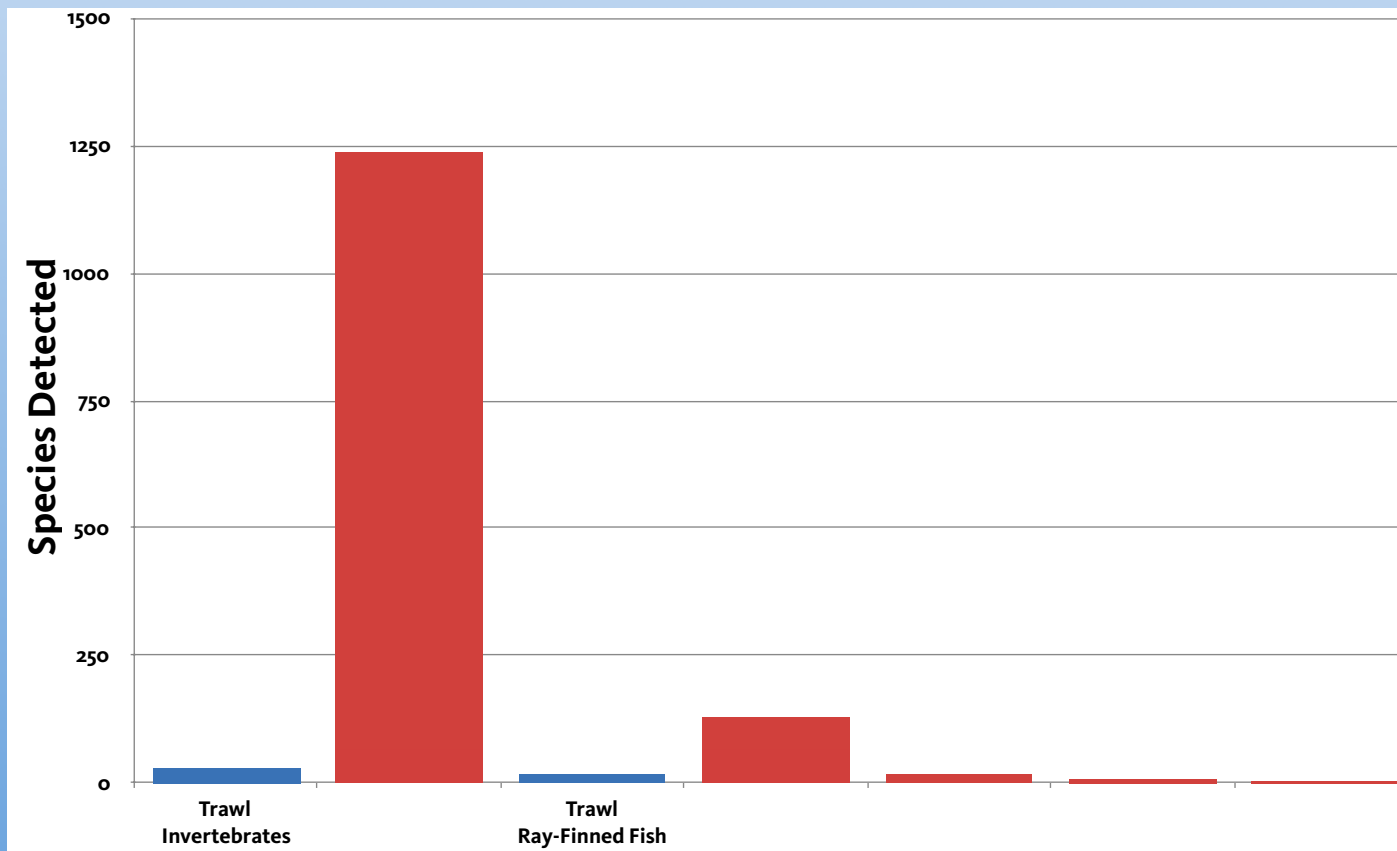
Classical sampling



eDNA sampling



Classical vs eDNA



eDNA challenges

- Technical challenges:
biases, determining quantities
- Reference database challenges:
*of thousands of local marine species,
only a few hundred have reference “barcodes”*

L.A. Urban Ocean Expedition 2019

- **August 19 – September 2 at AltaSea**
- **Dozens of taxonomists and collectors**
- **Collaboration with partners:**

*AltaSea, California Science Center,
Aquarium of the Pacific,
Cabrillo Marine Aquarium,
Ocean Exploration Trust,
Los Angeles Maritime
Academy, ...*



The background image shows a coastal scene with a rocky shore in the foreground where two men are standing. In the middle ground, there is a body of water with waves. In the background, a steep cliff rises from the water's edge, topped with several houses and palm trees under a blue sky with scattered clouds.

NHM's *DISCO* program is developing cutting-edge biodiversity technology,
applying the Museum's expertise in collections

That's why we want to know

What's in the water?

<https://research.nhm.org>

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