


Topic 25: Anthropogenic Changes: Oceans





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Test #9: due today
HW #9: due tomorrow
Test #10: Dec 9 = final exam

student stories – submit by Friday!

4 pm last discussion session
5 pm last Zoom office hour

please participate in SET
course evaluation by 12/7

Humpback Whale

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Earth's Oceans

- 70.8% of Earth's surface
- hold 95% of Earth's water
- 60% of population live along coasts

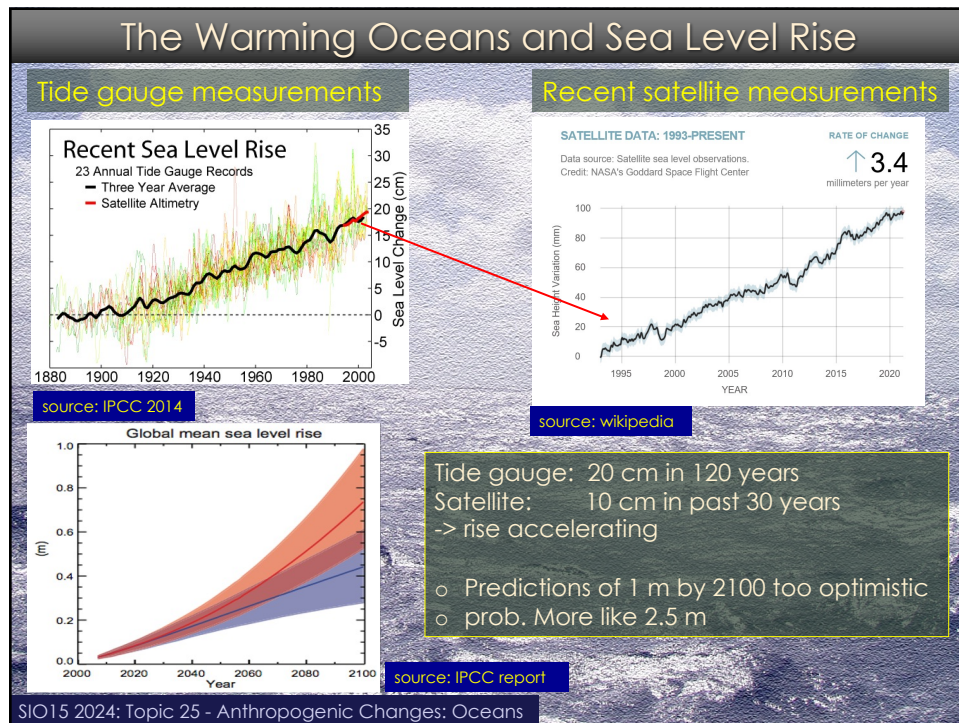
- food source
(200 Mio people depend on fishing)
- cheap shipping routes
- oil fields/resources

- take up heat – slows global warming but sea level rise
- take up CO₂ – slows global warming but acidification

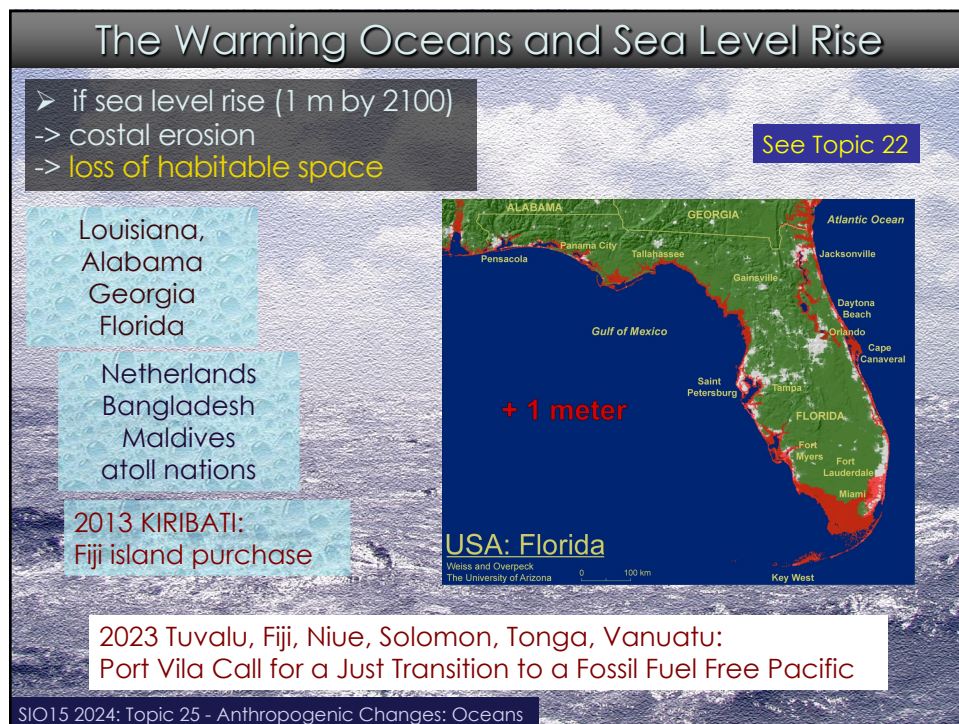
sea level rise!
melting land ice & thermal expansion
-> affecting 4.6 B people

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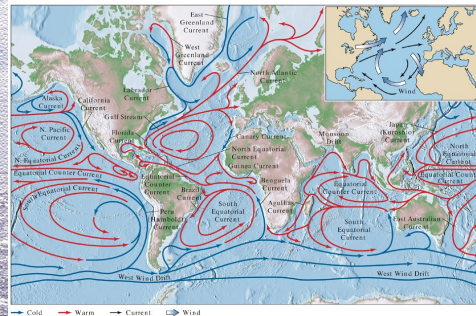
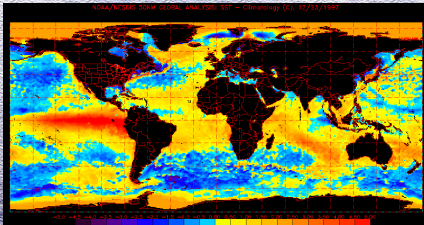


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The Warming Oceans – Food, Hurricanes

El Nino:

warm/freshwater on top -> stable layering -> no upwelling -> **no food**
(e.g. Peru during El Nino as example of things to come)



California:

- * weakening Cali current -> no upwelling -> **no food**
- * **hurricanes advance** north (2023 TS Hilary first since 1858)

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The Warming Oceans – Coral Reefs

- **coral bleaching** if T rises 1-2°C
- corals face multiple threats

2003: 25% gone compared to 1980s

affected by

- sedimentation
- pollution/pathogens
- physical damage
- freshwater runoff
- predators
- exploitation
- global warming
- acidification

coral reefs:


"the rain forest of the ocean"
(high biodiversity!)



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California's Kelp Forest



Garibaldi
Cali state fish

giant brown algae
(kingdom protista)

- grows up to 30cm/day to 60m
- needs water < 20°C (68°F)



- important habitat
- resource (iodine, alkali)
- used for things from soap to glass
- alginate thickens ice cream, jelly, toothpaste

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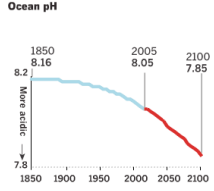
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Ocean Acidification

Sea change

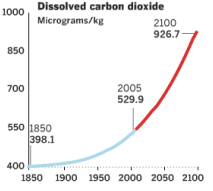
Since the Industrial Revolution began, the ocean's chemistry has been changing at a pace 100 times faster than in the previous 650,000 years.

Ocean pH



1850 8.16
2005 8.05
2100 7.85

Dissolved carbon dioxide
Micrograms/kg



1850 398.1
2005 529.9
2100 926.7

Note: 100 micrograms represents a 10,000th of one gram for each thousand grams of seawater.

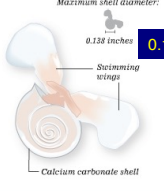
Source: NOAA's Pacific Marine Environmental Laboratory. Graphic by Leslie Carlson Los Angeles Times

Fragile link

Food chains could collapse if rising levels of carbon dioxide deplete the oceans of calcifying plankton, including small snails called pteropods.

Pteropod facts

- Critical part of food chain in polar and near-polar seas
- Favorite food of herring, pollock, cod, salmon and baleen whales
- Large masses of pteropods reflect a healthy environment
- Research has shown that their calcium carbonate shells dissolve when placed in water acidified by carbon dioxide



Maximum shell diameter:
0.138 inches
0.138" = 3.5 mm

Graphic by Julie Sheer and Leslie Carlson Los Angeles Times

- ocean chemistry changes 100 times faster than in last 650,000 yrs
- acidity increased by 30% in 150 years (pH from 8.16 to 8.05)
- projected decrease to pH 7.85 by 2100 (150%)

- cannot produce protecting carbonate shell -> dies ??
- interruption of base of food chain -> mass extinction??

alkaline ← → acidic

'clean rain' - pH 5.6
 'normal rain' - pH 5.5-5.0

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Other Types of Assault

- dredging
- draining
- development

- sewage
- waste disposal
- unregulated disposal from cruise ships



SE Asia



San Diego



SoCal

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Plastic, the Wonder Resource ... or is it?

- made from petroleum
- plastic not bio-degradable
- plastic difficult to recycle
- only small fraction is recycled (3.5%)
- it takes sunlight a long time to break down plastic
- plastic now finds its way to remotes oceans
- ocean fish and birds mistake plastic for food



a plastic bottle takes 450 years to degrade
 plastic bag 45 years
GREAT PACIFIC GARBAGE PATCH

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Countries Debating – 12/2/24

Agreement on plastic pollution falls short

The New York Times

Diplomats at a United Nations conference in Busan, South Korea, failed to reach agreement on the world's first treaty to tackle plastic pollution Sunday. They said they would reconvene in future months to try again.

At what was supposed to be the final round of talks, nations struggled to bridge wide differences that remained over critical issues, including whether the treaty should include limits on plastics production itself.

Busan, S. Korea:

- diplomats meet to come up with treaty
- discuss: reduction in plastic pollution
- maybe reduction in production?
- oil-producing countries strictly against this
- "rather invest in recycling"

does this remind you of something?
like the Kyoto Protocol???

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Over 200,000 Laysan Albatross Chicks/year Die Loaded w/plastic



The collage includes four small images on the left: a chick in flight, a chick on a beach at sunset, a chick on a nest, and a chick in front of a red and white checkered flag. The main image on the right shows a dead chick lying on a sandy beach, its body covered in a large amount of plastic debris, including bottle caps, small pieces of plastic, and a small blue container.

SD Tribune 11/29/08: "...98% of Albatross chicks have plastic in their stomach..."

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An Increasing Fishing Industry – A Healthy Ocean?

1972: The Club of Rome: The "Limits of Growth"

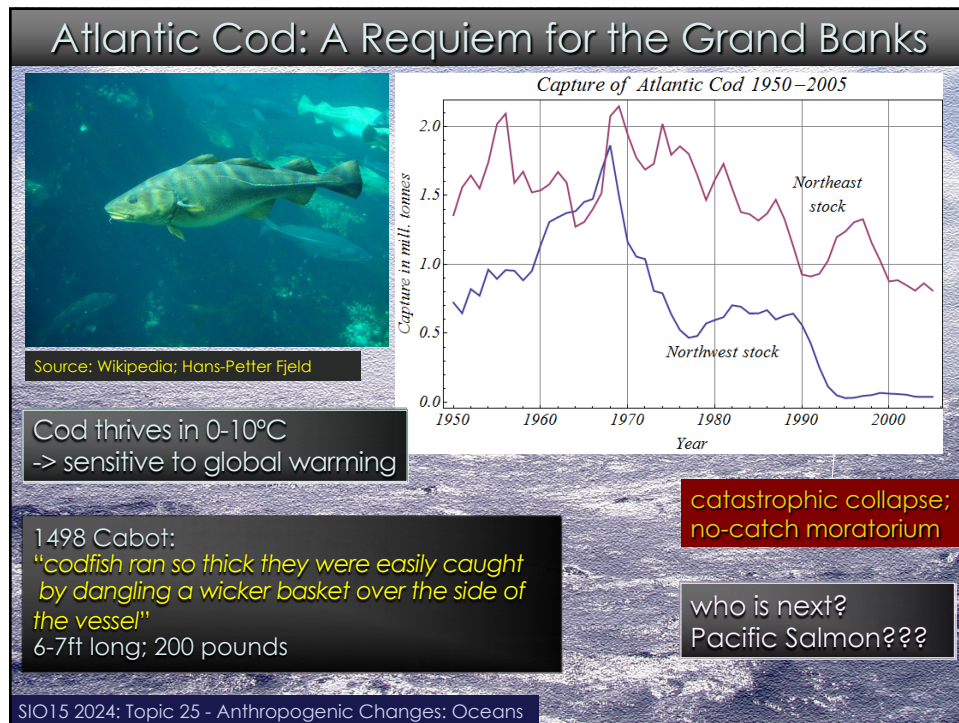
"with current limited (food) resources, current increase in world population unsustainable"

1970s: 4 billion people

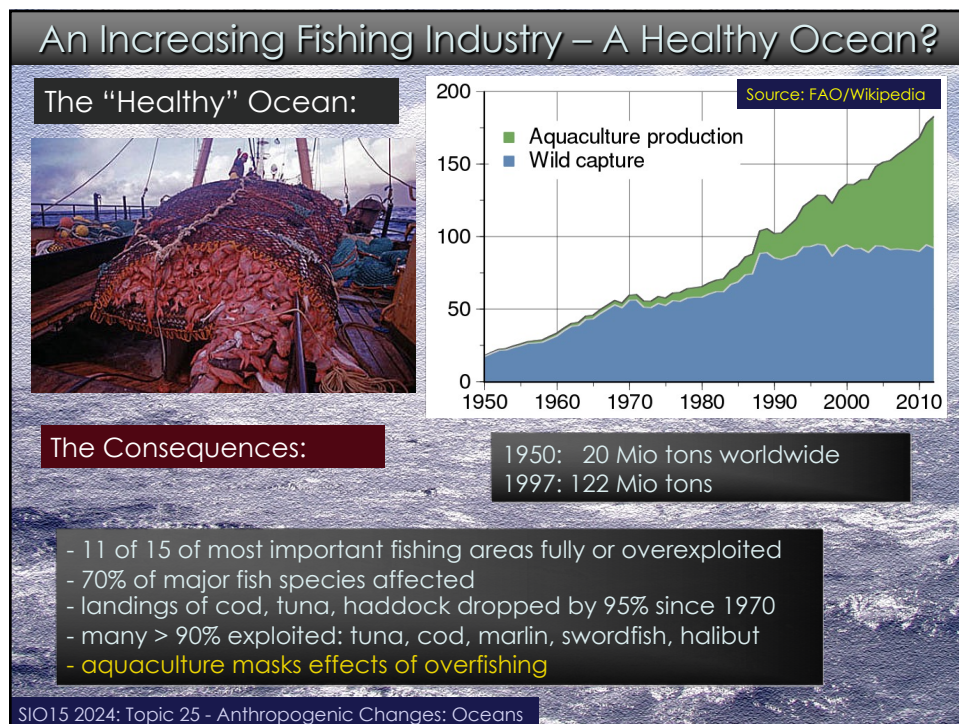
Nov 2019: > 7.7 billion people
Nov 2022: 8.0 billion people
Nov 2024: 8.2 billion people

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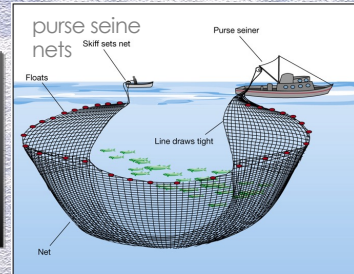


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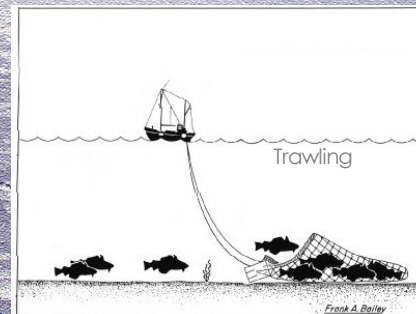
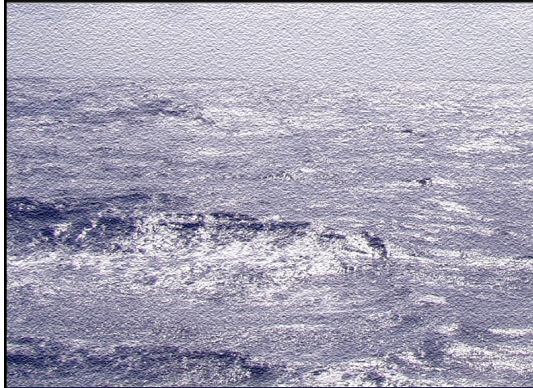
Oceans as Food Source – Careless Fishing Practices

Source: World Watch Institute

- poisoning with sodium cyanide (S.E. Asia)
- dynamite (Mediterranean; abandoned?)
- gillnets/drift nets (trap/drown large mammals)
- trawling (all shelves at least once in 2 years)
150 x area of clearcutting global forest



from: "Essential of Oceanography" by Trujillo



source: wikipedia

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Oceans as Food Source – By Catch

* 20 Mio tons (~20%) thrown away as by-catch

Source: World Watch Institute

- fish too small
- not marketable
- lack of permit
- this number does not include killed mammals and birds

Dall's Porpoise (NOAA)



Shrimp fisheries:

- use fine nets
- 5 kg unwanted species for every 1 kg shrimp

Shrimp By-Catch (NOAA)



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Oceans as Food Source – By-Catch Victims

Loggerhead Turtle



- up to 450 kg
- lifespan up to 67 years
- maturity: 17-33 years
- Loggerhead and Leatherback migrate across oceans (need international protection!)

source: wikipedia




Turtle excluder device



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Gulf of California– By-Catch Victims

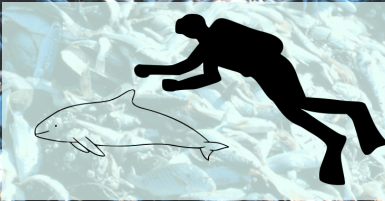
Totoaba



The totoaba is prized for its large bladder.
Richard Hermann/Wikidrop Photo via Corbis

- Illegally fished
- for Chinese meds
- Gulf of California
- Mexico banned harvest in 1975
- **CRITICALLY ENDANGERED**

Vaquita



source: wikipedia

By-Catch

- world's smallest dolphin
- Gulf of California
- 2017: less than 30 left
- **CRITICALLY ENDANGERED**
- catch-to-protect FAILED! (2019 < 10)
- 6/2024: 6-8 left, no babies

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Sharks




Whale Shark Georgia Aquarium (Zac Wolf, wikipedia)

Whitetip Shark (OldakQuill, wikipedia)

- true fish
- whale shark largest fish
- has lived on Earth for 450 Mio yrs

2016
Lifespan Greenland shark > 400 years



Thresher Shark (Paul Ester, wikipedia)

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Shark Fin Soup – Most barbaric of all fishing?

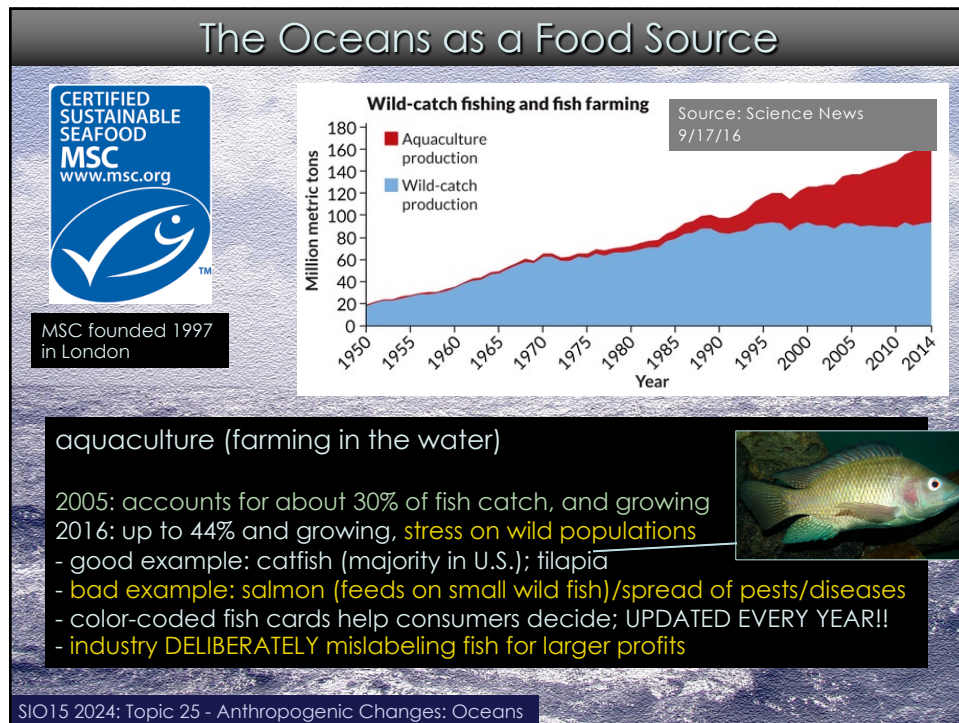


- sharks fished, then thrown out to die (most 'economical')
- shark fin soup booming industry
- 100 Mio sharks caught each year -> 8000 tons of fins
- many shark species decline by 80%+ in only 15 years
- now banned in Atlantic and Mediterranean

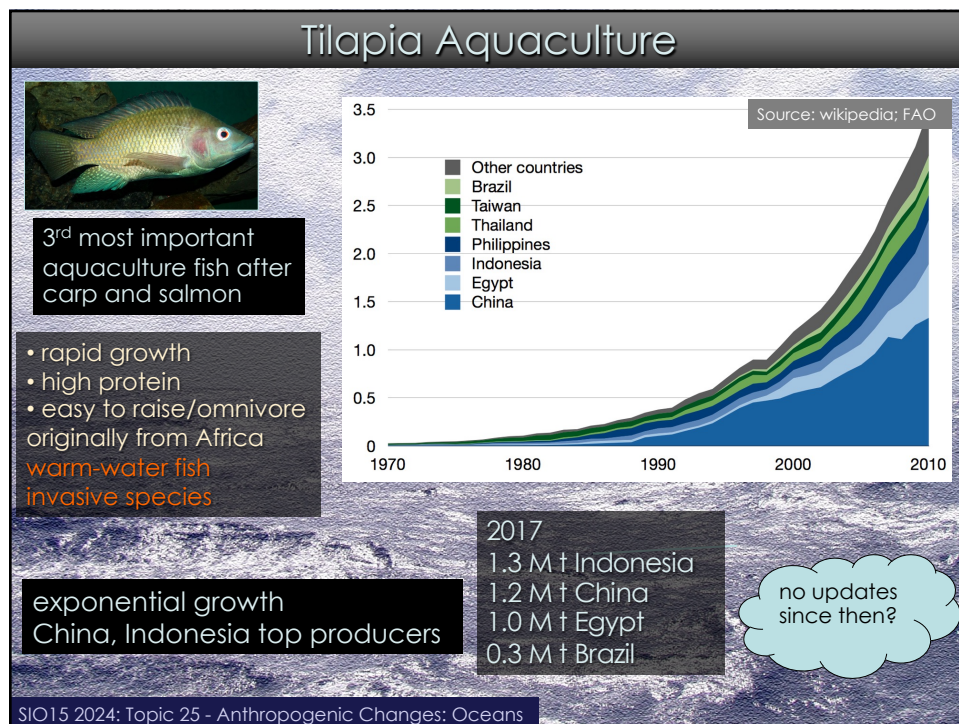
Nov 2022 - CITES – fishing of 54 shark species should be regulated

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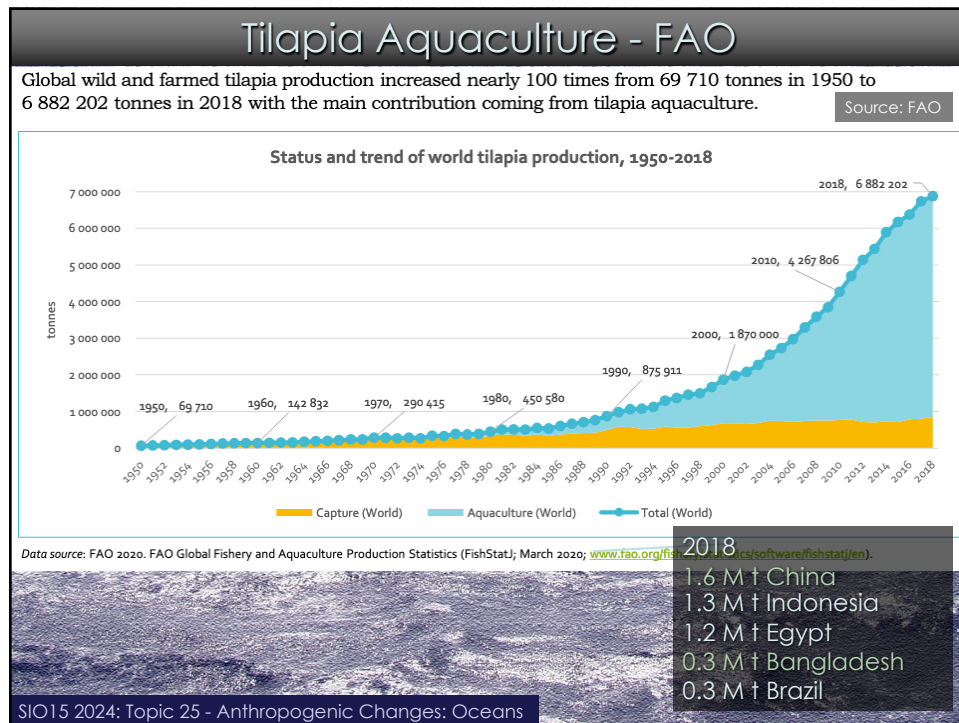
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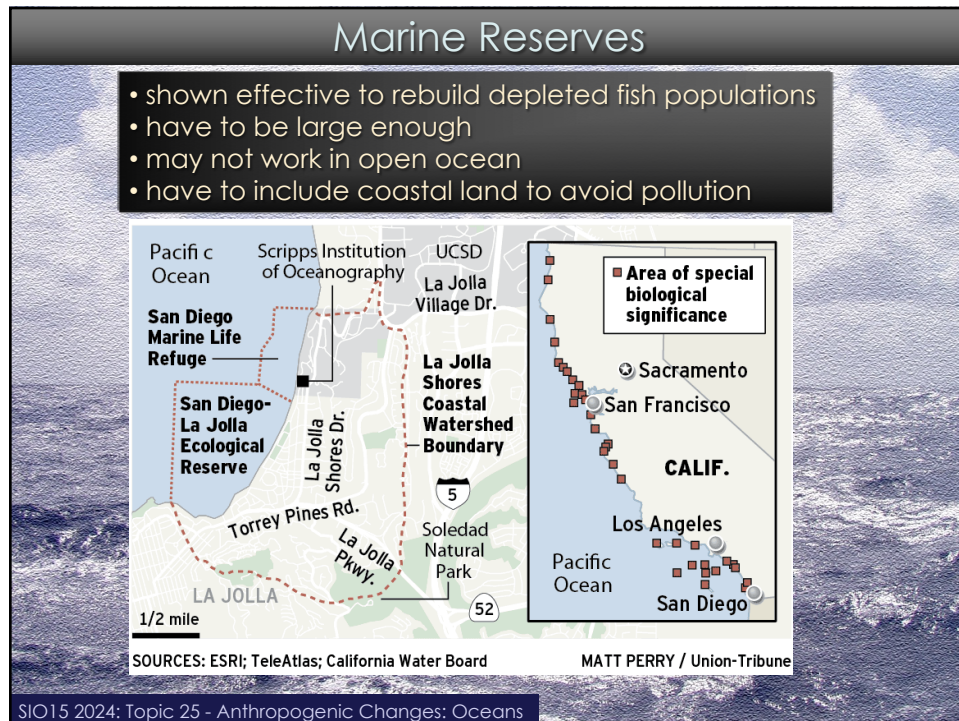
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Protected in the Reserve: The Giant Sea Bass

TASTY!

critically endangered;

- up to 2.5m, 255 kg; lives in kelp forest;
- reproduction slow; no young have been caught
- once common in 1800s, faced local extinction in 1980s



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Blackfish: PETA vs. Seaworld – The world is not B/W



It's bad to keep Shamu in a small pen
... and there are no more Shamu shows...

...but ...

Seaworld is the #1 place in San Diego to rescue marine wildlife!
Nov 2019: de-entangled a humpback whale from fishing net off La Jolla

To notify SeaWorld about a possible stranded animal please call (800) 541-SEAL (7325)



image: voiceofsandiego.org

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4 Month old Laysan Albatross Bolus from Kure Atoll 2002

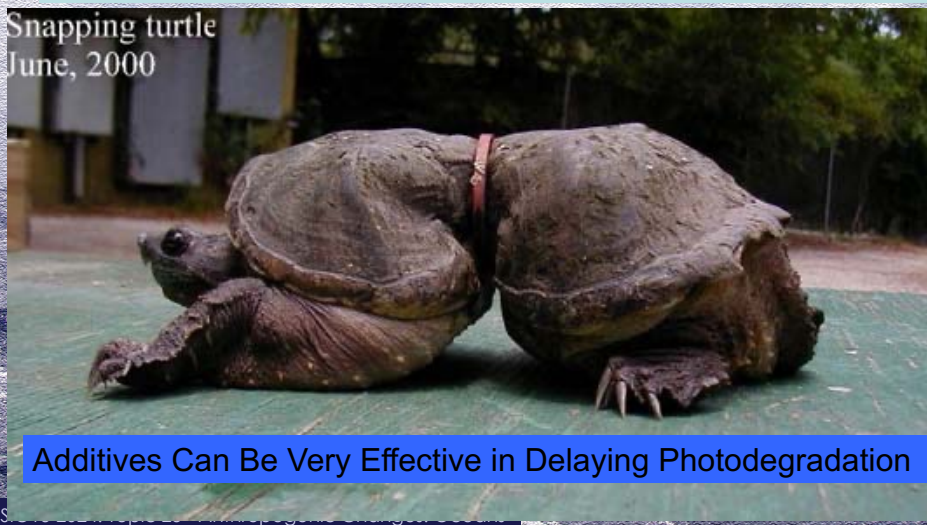


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Common snapping turtle, at least 15 years old. Crawled into a plastic bottle ring as young, her shell then constricted by the ring. Spinal cord partly unprotected. Photo: ©Dino Ferri. Web site: <http://www.auduboninstitute.org/zoo/index.htm>

Snapping turtle
June, 2000



Additives Can Be Very Effective in Delaying Photodegradation

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