MARINE CONSERVATION

THREATS *and* APPROACHES

Marine Conservation - THREATS

Marine Conservation - APPROACHES

FISHERIES = Principal Threat

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U.S. NATURE

Sardine Fishing Off the U.S. West Coast Could Be Banned As Stocks Are So Low

David Stout @david_m_stout | 5:16 AM ET

The phrase "packed like sardines" could soon sound obsolete

Overfishing along the U.S. Pacific coast has decimated sardine populations to the point that authorities are considering imposing a widespread ban on harvesting the species.

According to the Pacific Fishery Management Council, chronic overfishing has caused sardine numbers in U.S. waters to fall by an estimated 90 percent since 2007.

As a result, malnourished sea lions are struggling to find food and washing up on Californian shores in records numbers, while predatory birds, like the brown pelican, are also suffering.

FISHERIES = Principal Threat

Science News

Food limitation linked to record California sea lion pup strandings

New research shows a decade-long decline of sardines and anchovy associated with poor condition of sea lion pups

Date: March 3, 2015

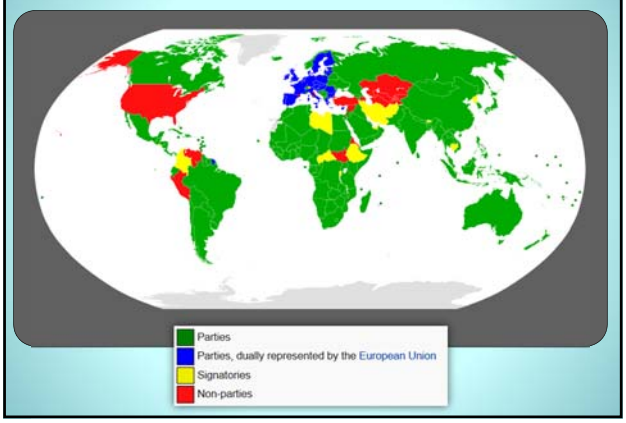
Source: NOAA Fisheries West Coast Region

Summary: Large numbers of California sea lion pups have flooded animal rescue centers in Southern California in the past few years. Now, as part of an ongoing investigation into the Unusual Mortality Event of California sea lions, researchers may have an explanation.

Related Stories

Julia Stewart Lowndes is sorting the catch during a Rockfish Recruitment and Ecosystem Assessment Survey off the coast of California. The survey provided information about the composition of fish species that is helping scientists make sense of the record strandings of sea lions.

VIDEO: UNCLOS and the USA



International Fisheries Management

RECALL:
National Approaches:
Fisheries Management Councils

global predatory fish (tuna, billfish, *etc.*) ▼90%
shark populations ▼50% in only 10 years
** *need for collaboration* **

1995 UN Agreement on Straddling and Highly Migratory Fish Stocks (+ 2002 amendments):

- standards for responsible management
- "precautionary principle"
- limit bycatch
- value of marine biodiversity

White Marlin range
(Tetrapturus albidus)

International Fisheries Management - Tuna

International Commission for the Conservation of Atlantic Tuna (ICCAT) -- 1969

- *"International Conspiracy to Catch All Tuna" ?*
- closed meetings, data unpublished
- dominated by fisheries -- Spain; Portugal, England, France
- 2008: Scientists ► 15,000 tons; quota ► 22,000

International Fisheries Management - Tuna

Inter-Tropical Tuna Commission (ITTC) ... *better?*

- Central and South America
- *voluntary* -- but meetings transparent, data published
- 2012: capped Pacific Bluefin catches *(overfished)*
  - USA blocked mgmt of FAD's

International Fisheries Management - Whaling

Precipitous Decline of Stocks:

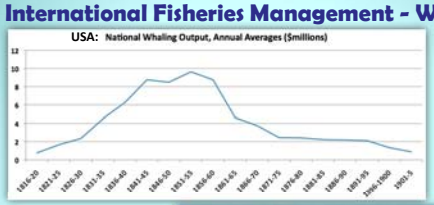
- Atlantic Gray Whale: extinct by 1900
- Blue Whales: 1930-31 = 25,000 1963-64 =112 *(0.45%)* *Now 10-000 -14,000*
- Fin Whales: 1960 = 25,000 1974-5 = 1000 *(4.0%)* *Now 20,000*
- N. Right Whale 19th C =100,000 2012 = <1,000

International Fisheries Management - Whaling

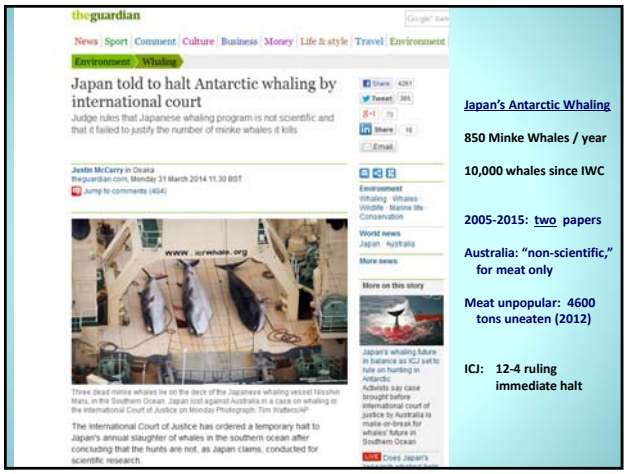
International Whaling Commission (IWC) -- 1986:

- 20 y commercial whaling ban (now indefinite)
- + limited "indigenous" hunting, + limited "collection for scientific purposes"
  - loopholers: Japan (200-1000), Norway (1000), Iceland (250)

International Fisheries Management - Whaling



CA Gray Whale :)



Japan's Antarctic Whaling

850 Minke Whales / year

10,000 whales since IWC

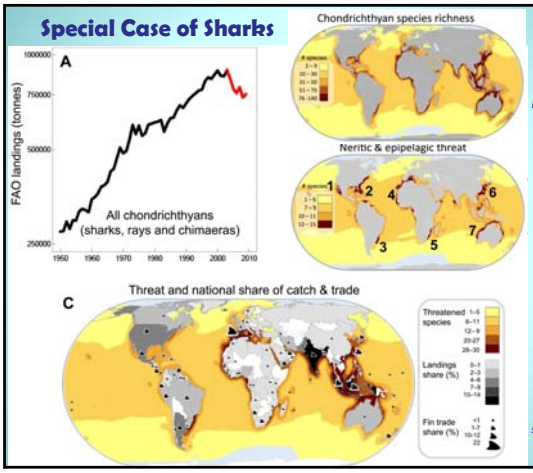
2005-2015: two papers

Australia: "non-scientific," for meat only

Meat unpopular: 4600 tons uneaten (2012)

ICJ: 12-4 ruling immediate halt

Special Case of Sharks



FISHERY (2003) *> $1 billion* food & fins

THREATENED 25% of all species

SPP. MOST SENSITIVE large bodied shallow water shark-like rays

sources: IUCN 2014, Dulvy *et al.* 2014

Threatened Marine Species - National Approaches (USA)

Extension of *terrestrial* laws:

- benefits: established legal framework
- shortcomings: marine systems differ (larval migration, no boundaries, etc.)

US Endangered Species Act (ESA) - 1973:

- population recovery plans + habitat protection

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- population recovery plans + habitat protection
- Hawaiian Monk Seal, all sea turtles & cetaceans in US waters
- Black & White Abalone (harvest), Elkhorn & Staghorn Coral (bleaching)
- 2002: *refused* to list Atlantic White Tuna, Bocaccio -- despite pop at 3.6%!
- shortcomings: single-spp. focus, fisheries conflicts, no regional plans

Threatened Marine Species (USA) - Marine Mammals

Public Outcry:

- dolphin intelligence ... the *Flipper* effect ... impetus for new legislation

US Marine Mammal Protection Act (MMPA) -- 1972

- for dolphins -- "backing down", other techniques
- extended (1984) -- Harp Seal pups ("whitecoats")

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- extended (1984) -- Harp Seal pups ("whitecoats")
- no protection for habitat (unlike ESA)
  - 2004: Congress & DoD exemption: Low-Freq. Active Sonar
- National Marine Fisheries Service (NMFS)

Threatened Marine Species - International Laws

Convention on Trade in Endangered Species (CITES) -- 176 signatory nations

- sea turtles, cetaceans, corals
- Bluefin Tuna proposed -- blocked (2010, 2013) by Japan, Canada

Jan 6, 2013: Single Bluefin Tuna Fetches $1.76 million in Japan !!

- 2013 Thailand CITES: Manta Ray + 5 Sharks added
  - o Oceanic Whitetip, Porbeagle Shark, and Scalloped, Smooth, Great Hammerheads

Convention on Biodiversity (CBD)

- diversity protection targets
- terrestrial + *marine and coastal*

Threatened Marine Species - National Laws

Extension of Terrestrial Laws

- protect areas of biological, cultural, historical value (e.g., National Monuments)
- pollution & discharge controls (Clean Air, Clean Water Acts)

National Marine Sanctuaries Act (NMSA) - 1972

- benefit: President can create, w/out Congress
- problems: NOAA = Dept. of *Commerce* (not *Interior*)
  overlapping jurisdiction - FMCA *(fish)* vs. NMSA *(habitat)*
  priority: diversity protection? production?

USS Monitor National Marine Sanctuary

Threatened Marine Species - National Laws

System of National Marine Sanctuaries (NOAA)

- 2000: Clinton calls for comprehensive protection of marine habitats
  created Northwest Hawaiian Islands Coral Reef Ecosystem Reserve (337,000 km²)
  upgraded to Nat'l Monument (*D. Interior*) by Bush (2006)
- by 2010: 14 sanctuaries -- 150,000 mi² -- e.g., Channel Islands (CA)
- *2008:* Bush - several Pacific Islands monuments (500,000 km²)

Protection of Marine Locations - International Laws

Benefits: migratory species, large-scales, multiple habitats
Shortcomings: enforcement & sovereignty

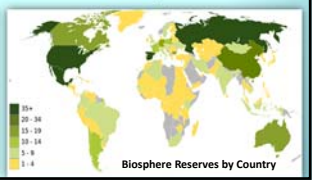
Protocol on Environmental Protection to the Antarctic Treaty (1991)

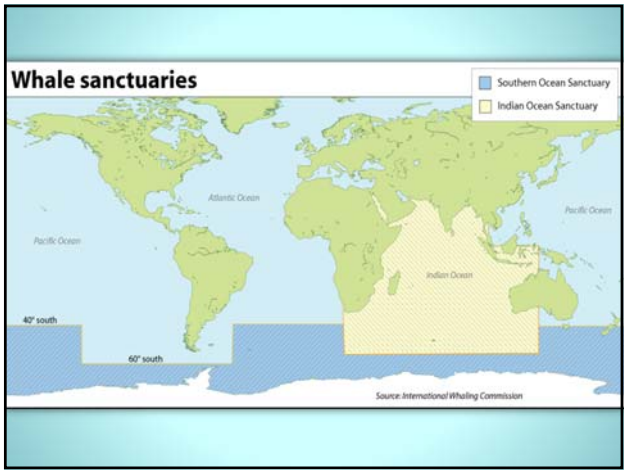
Whale Sanctuaries:

- Antarctic, Australian, Indian, Southern Oceans
  Southern Pacific (underway - 2009), but Japan blocked Southern Atlantic

Biosphere Reserves:

- Man & Biosphere Programme (MAB, 1971): human, not wildlife, focus
- Galapagos, Sian Ka'an (MX), Aleutian Islands, Channel Islands, Virgin Islands, etc.

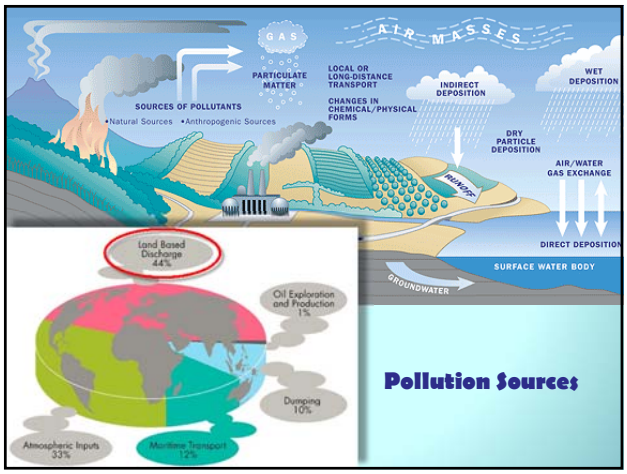


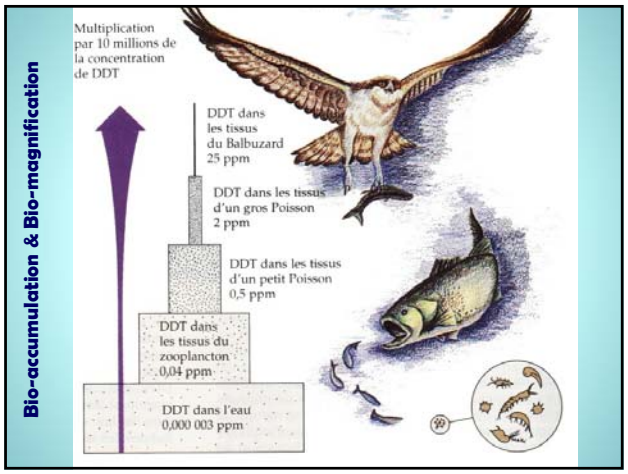


Pollution - THREATS

Effects & Pathways:

- adhere to particulate matter --> filter feeders, plankton
- contaminants bound by O_2 --> anoxia
- toxins & breakdowns -- bioaccumulate & biomagnify
- *rivers*: industrial & agricultural chemicals *(ca. 44% of inputs)*
- Point vs. Non-Point sources

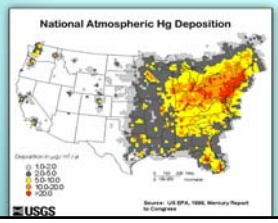




Pollution - METALS

Mercury (Hg)

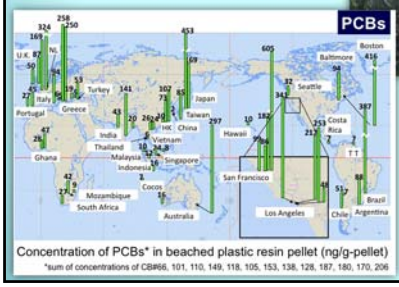
- atmospheric Hg levels ▲3X since 1950s <-- incinerated waste
  - *(+ landfill leaching, domestic & commercial)*
- Gulf of Mexico (2006): many sport fish >1ppm
- Florida Dolphins (2016): 20X legal limit --> *tumors, papilloma*
- Minamata Disease (Japan): industrial Hg --> shellfish --> humans
  - but ... Hawaiian yellowfin tuna: mercury unchanged 27y
- melting polar ice --> ▲▲marine Hg



Pollution - PERSISTENT ORGANIC POLLUTANTS (POPs)

DDT, PCBs, chlordane, etc. ... and byproducts

- many industrial sources
- non-digestible ... *long half life*
- *lipophilic* & bioaccumulation
- ***effects:*** *cancer / developmental / nervous*



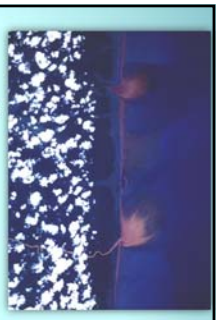
Garbage & Sewage - THREATS

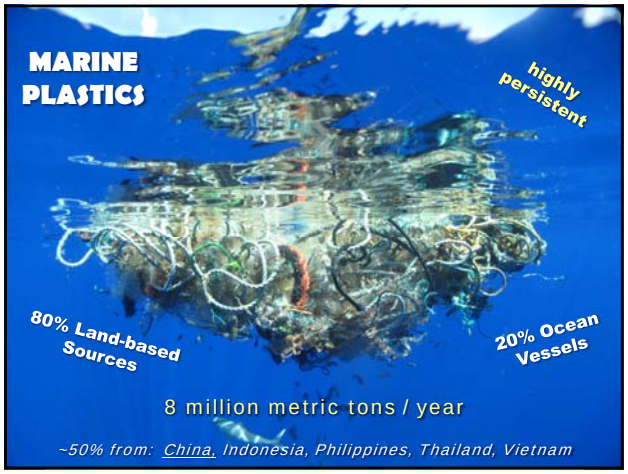
Sewage

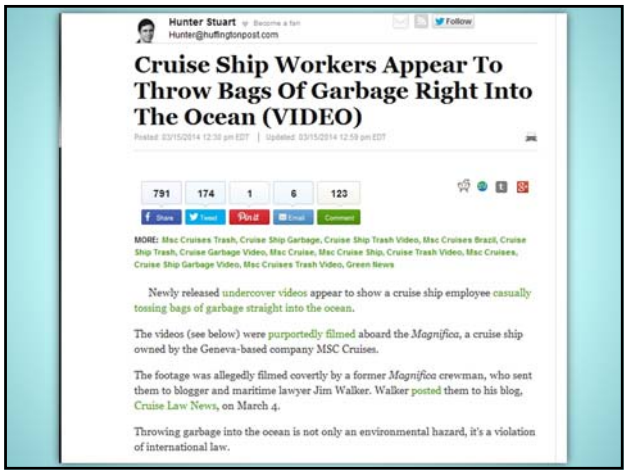
- SoCal: 330 million gals/day -- ▼▼ kelp beds
- Kaneohe Bay: 10x pop. incr. --> sewage --> reef destruction
  - ➢ 1978: discharge eliminated; 1983 coral recovering
- NY Harbor: 460 discharges = 75 million gals/day
  - ➢ treatment plants: by 1986
    - ➢ 2003 power outage: 490m gals *untreated* sewage
  - ➢ fish & shellfish mortality, contamination; anoxic bottom

Garbage

- barges used to be towed past 12 mile limit, dumped
- "garbage barge" -- *raised awareness, recycling interest*







VIDEO: The Pacific Garbage Patch

Pollution, Garbage & Sewage - APPROACHES

Public Behavior:
- reduce / re-use / recycle
- cloth shopping bags

National Legislation:
- developed countries
- integrated coastal mgmt
- Clean Air Act, Clean Water Act
- US Ocean Dumping Ban Act (1991)

Loopholes:
- "pollution outsourcing"
- *open-ocean* dumping

Pollution, Garbage & Sewage - INT'L APPROACHES

London Dumping Convention (UN Agreement) -- 1972
- 1996 Protocol: *"precautionary principle"* + *"polluter pays"*
- banned: plastic pellets, industrial waste, chemicals, landfill trash
  - exemptions: sewage, dredge waste, fish waste, "bulky items"

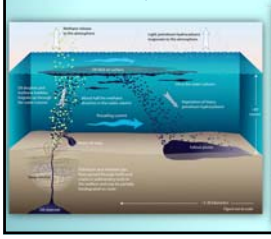
International Convention for the Prevention of Pollution from Ships (MARPOL) -- 1973
- ballast blows -- pollution *and* invasive species


Parties to London Convention

Oil Spills - SOURCES

Sources of Marine Oil:
- ~700 million gallons / y (1995 data)
  - land-based sources ≈ 50%
  - non oil-industry vessels ≈ 15%
  - oil industry spills ≈ 15% *(*but highly variable)*
    - *BP spill (2010): 206 million gallons!*
  - atmospheric fallout ≈ 10%
  - natural seeps ≈ 10%


1/3 of oil & gas production is offshore



Oil Spills - HARM

Damage to Marine Organisms

- diesel & fuel: skin burns, conjunctivitis, population declines
- oiling of sea mammals, seabirds: hypothermia
- oiling of fish gills: suffocation
- consumption: poisoning, developmental problems
- sinking oil: fouls benthic food sources
- slow breakdown = chronic exposure

Oil Spills - BP's Deepwater Horizon (2010)

April - June 15: wellhead blowout

- spill ≈ 206 million gals
- coastline > 510 km oiled
- closed: 11,000 km^2 shrimping
  40% Gulf fishing
- dead zone: 210 km^2

Long-term Impacts:

- ecosystem wide mortality
  - dolphins = 4X normal
  - 12% of Pelicans, 32% of Gulls
- long term effects (fish populations)
- lost fisheries & tourism revenue
  - ~ $8.7b impact (2010-2017)

virtually no Congressional action

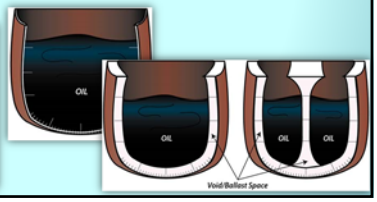
Oil Spills - APPROACHES

National Legislation (**no binding global standards*):

- Exxon Valdez spill (*1989 - 10.8 million gals*)
  - herring crashed *4 years after* Valdez ... no recovery *20 years later !*
- Oil Pollution Act (USA, 1990)
  - double hulls; cleanup plan; vessel responsible
- Oil Spill Liability Trust Fund: $1 billion/spill

Dispersants & Bioremediation

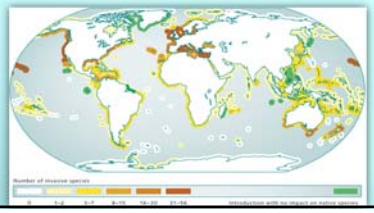
- break up slicks -- droplets less harmful, more bio-degradable
- oil degraders (bacteria) -- natural consumers

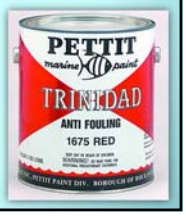


Invasive Species - THREATS

Sources:

- ship movement: ▲▲ in last 100y
  - Panama Canal (1914)
- ballast flushing
- bottom "fouling", sloughing
- oil platforms - ballast, frequent ships
- aquarium & bait industries
- tourism



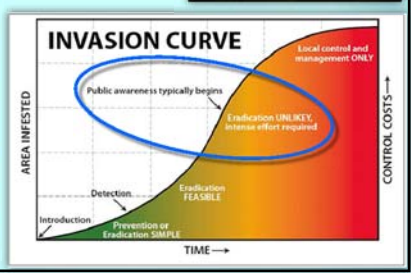


Invasive Species - THREATS

Types & Effects:

- common organisms:
  - snails, seagrass, barnacles
  - algae, sea squirts, isopods
- shift native communities -- *subtly or severely*
- threats recognized *too late*

Barnacle



Invasive Species - Examples (- / + / ?)

(-) Mangrove Boring Isopod - W. Atlantic (1890s):

- burrow in Red Mangrove roots
- root tips break off
- pushed mangrove back from water
- affects 1000's of km

(+/-) Chinese Clam - San Francisco Bay (1986):

- dominates > 95% of bottom; ~ 2,000/m^2
- ▲ clarity: filters water 1X/day (deep), 13X/day (shallow)
- ▼ phytoplankton: for mysid shrimps, small fish
- ▲ visibility --> ▼ diatom blooms

Invasive Species - Examples (- / + / ?)

(+) Green Crab - Chesapeake Bay:

- overfishing of crab predators -->
  - *Sesarma* (native) boom -- overgraze Bay seagrass beds
  - *Carcinus* (European invasive) -- displace *Sesarma* from burrows
  - grasses recover
  - high density inhibits Green Crab burrowing -- they decline -- *Sesarma* returns

Purple Marsh Crab *(Sesarma)*

European Green Crab *(Carcinus)*

VIDEO: Jolly Fun Smiley Time with Crabby

Invasive Species - Lionfish (in New World)

Lionfish from Western Pacific:

- Popular fish tank species
- introduced to Caribbean (& W. MX)
- fish tank dumping, etc.
- poisonous, no local predators

Negative Impacts:

- Piscivore: huge amounts of fish / day
- live in high density
- devastating impact on reef fish

New Problems:

a] exotic species from mariculture
b] MPAs: tourism (baitfish, ballast)
c] Nicaragua sea-level canal

Invasive Species - APPROACHES

National Approaches:

- Terrestrial legislation
- Great Lakes - zebra mussels, etc.

International Approaches:

- Convention on Ballast Water Management (MARPOL):
  - ➢ keep log record, follow standards
  - ➢ standards weak: technology vs. achievability

Biological Control:

- *Mnemiopsis* (zooplankton eater) --> Black Sea (1980s)
  - ➢ 95% of all biomass ... fisheries decline
- *Beröe* (*Mnemiopsis* eater) -- invades Black Sea (1997)
- *Mnemiopsis* crashes, then *Beröe* crashes

Mnemiopsis (ctenophore)

Marine Diseases - THREATS

Viruses:

- 10s of *billions* / L sea water
- can ▼phytoplankton productivity 78%

+ bacteria, fungus, cyanobacteria ...
new pathogen inputs *+ suppressed immune systems*

California Sea Otters (2016):

- microcystin poisoning (cyanobacteria)
- liver failure
- *freshwater* algae blooms --> ocean

Marine Diseases - THREATS

Black Abalone, *Haliotis* (So. Cal.):
- Rickettsia (1990s) - "withered foot" syndrome
- formerly abundant ... virtually extirpated
- commercial harvest collapsed

California Sea Lions, *Zalophus*:
- El Niño ▼ juvenile growth, vigor
- susceptible to *Leptospira* (bacterial kidney disease)
- >60% fatality rate (renal failure)

Marine Diseases - APPROACHES

Limit Transmission:
- controls on moving species
- captive breeding programs
- same methods for ▼invasive species

Reduce Stresses:
- pollutants
- sea warming
- food shortages

Marine Veterinarians:
- emergency interventions
- effective in Marine Reserves
  - **but note MPA risks*

Mining - THREATS & APPROACHES

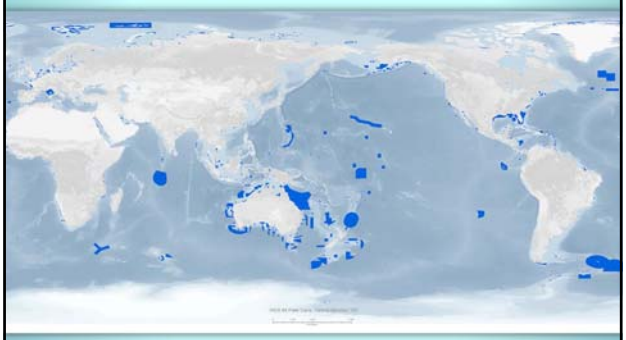
Seabed Mining:
- Manganese nodules
- coastal & inshore sand, coral:
  - ➢ beaches, gravel, landfill, lime, cement, calcium
- Diamonds: Orange River outlet (Namibia) 90-140 m
- Gold: Ghana marine concession 140 x 40 km

Near-shore Mining:
- sand, coral, gravel
- Red (~~CITES 2010~~) & Black Coral: jewelry

Mountaintop Mining: river sediment

Marine Protected Areas

Single best solution to marine threats: overfishing, *pollution, eutrophication, mining*



source: UNEP 2013

Success Stories: Bag Bans

source: Smithsonian Institute (2016)

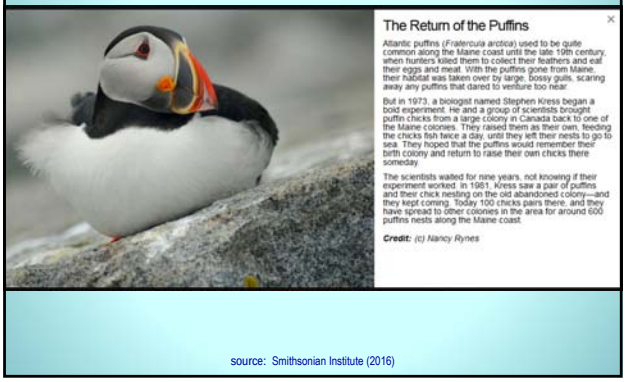
Success Stories: Bag Bans

source: Sacramento Bee (2016)

Success Stories: Herbivorous Fishes

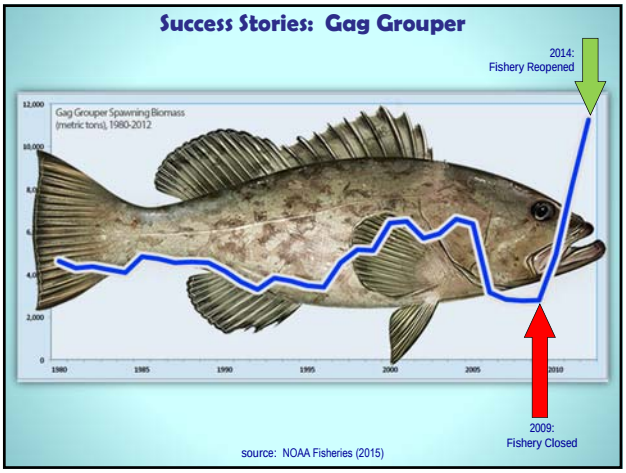
source: Smithsonian Institute (2016)

Success Stories: Puffins



source: Smithsonian Institute (2016)

Success Stories: Gag Grouper



source: NOAA Fisheries (2015)