



TIME U.S. NATURE

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

David Stout @dstout_m_about 5:50 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 From research organizations

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, 2016
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.

Share: Facebook, Twitter, Google+, LinkedIn, Email, Print

RELATED TOPICS

- Plants & Animals
- Fish
- Endangered Animals
- Marine Biology
- Earth & Climate
- Oceanography
- Global Warming
- Environmental Awareness

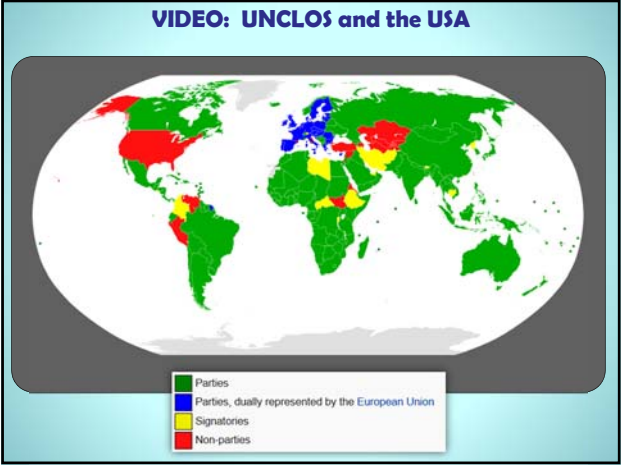
RELATED TERMS

- Sea Lion
- San Andreas Fault
- U.S. Navy Marine Mammal Program
- Gray Whale

Related Stories

- Sea Lion Strandings: The View from the Roostery
- May 6, 2015 — Wildlife biologists are describing conditions at the sea lion roosteries on the Channel Islands, where pups are going hungry because consistently warm water along the Pacific coast has made it more... read more
- Deadly Fur Seal Identified: Ending 5-decade-long 'Great Unraveling'
- Feb. 11, 2015 — The oldest known fur seal has been discovered by a geology PhD student at New Zealand's University of Otago, providing a missing link that helps to resolve a more than 5-million-year gap in fur... read more
- New Zealand Sea Lion Is a Relative Newcomer!
- July 14, 2014 — The modern New Zealand sea lion is a relative newcomer to the mainland, replacing a now-extinct, unique predecessor: New Zealand sea lion that once lived here, according to a new study. A team of... read more

FISHERIES = Principal Threat




International Fisheries Management

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

RECALL: National Approaches: Fisheries Management Councils



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 (ITT) ... 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

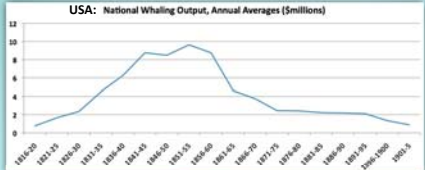
International Whaling Commission (IWC) -- 1986:

- 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


USA: National Whaling Output, Annual Averages (Millions)



Gray Whale Population



CA Gray Whale :)



Japan's Antarctic Whaling

850 Minke Whales / year

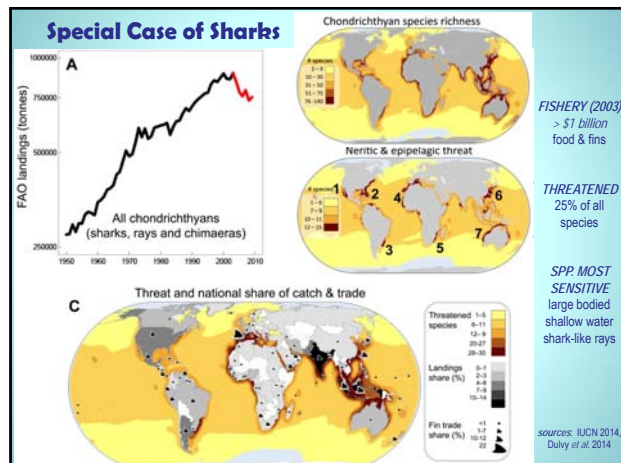
10,000 whales since IWC

2005-2015: two papers

Australia: "non-scientific," for meat only

Meat unpopular: 4600 tons uneaten (2012)

ICJ: 12-4 ruling immediate halt



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

Threatened Marine Species - National Approaches (USA)

Extension of terrestrial laws:

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

US Endangered Species Act (ESA) - 1973:

- 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")

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")
- 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
 - 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.




Whale sanctuaries



Legend: Southern Ocean Sanctuary (blue), Indian Ocean Sanctuary (yellow)

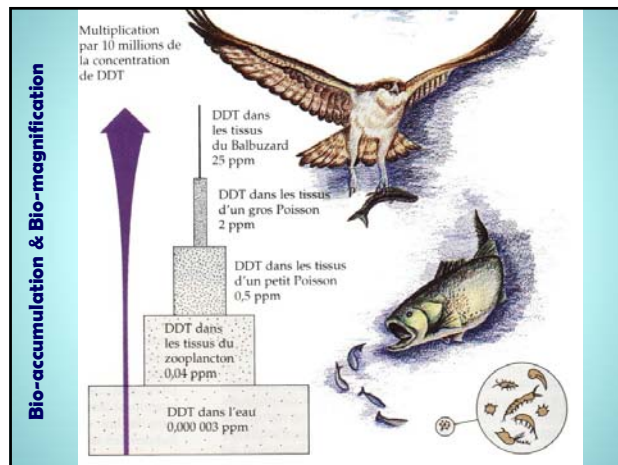
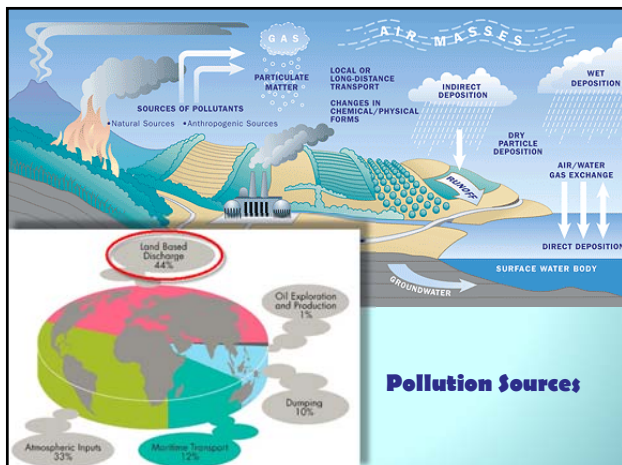
Source: International Whaling Commission

Pollution - THREATS

Effects & Pathways:

- adhere to particulate matter --> filter feeders, plankton
- contaminants bound by O₂ --> 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

National Atmospheric Hg Deposition

USGS

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

PCBs

Concentration of PCBs* in beached plastic resin pellet (ng/g-pellet)

*sum of concentrations of CB#66, 101, 110, 149, 118, 105, 153, 138, 126, 187, 180, 170, 206

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

80% of Earth's sewage is untreated

Mobro 4000

MARINE PLASTICS

highly persistent

80% Land-based Sources

20% Ocean Vessels

8 million metric tons / year

~50% from: China, Indonesia, Philippines, Thailand, Vietnam



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

CLEAN WATER. ACT NOW.
 swim drink fish

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

Jessica spill (San Cristobal, 2001) - 240,000 gals fuel

- 79 oiled sea lions, 1 dead pup
- marine iguanas: elevated corticosteroid

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 km² shrimping
40% Gulf fishing
- dead zone: 210 km²

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




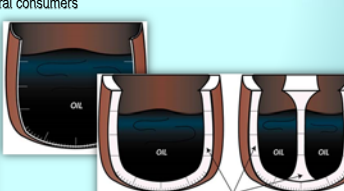
Oil Spills - APPROACHES

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

Slick Solution: How Microbes Will Clean Up the Deepwater Horizon Oil Spill

Bacteria and other microbes are the only thing that will ultimately clean up the ongoing oil spill in the Gulf of Mexico

By David Beres on May 01, 2010

"If the oil is in very small droplets, microbial degradation is much quicker," says microbial ecologist Kenneth Lee, director of the Center for Oilshore Oil, Gas and Energy Research with Fisheries and Oceans Canada, who has been monitoring the oil droplets in the Gulf of Mexico to determine the effectiveness of the dispersant use. "The dispersants can also stimulate microbial growth. Bacteria will then eat the dispersants as well as the oil."

CONTAINING AND CLEANING UP THE DEEPWATER OIL RIG DISASTER

1. Did BP's Oil Spill Busting Boats Really Close to the Oil? Research: BP Plans to Use Crabs of Norway
2. Gulf Spill: Will BP's Deepwater Disaster Change the Oil Industry?
3. Clash and Brawl: Building Sand Barriers off Louisiana's Coast to Hold Back Oil Spill Has Low Probability of Success
4. Depleted and in danger: Gulf oil spill threatens brown pelicans months after they are dropped from endangered species list



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





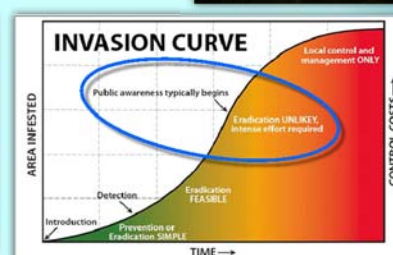


Invasive Species - THREATS

Types & Effects:

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







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/m²
- ▲ 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
- *Beroe* (*Mnemiopsis* eater) -- invades Black Sea (1997)
- *Mnemiopsis* crashes, then *Beroe* 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



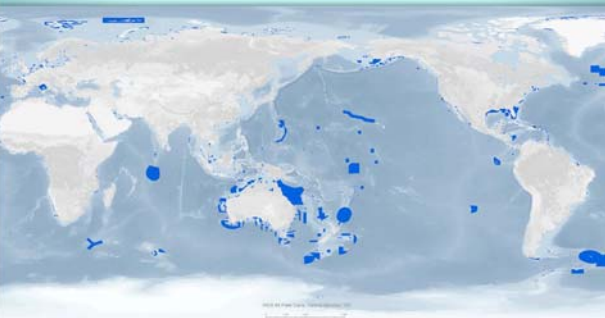

Mountaintop Mining: river sediment





Marine Protected Areas

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



source: UNEP 2013

Success Stories: Bag Bans

Plastic Bag Bans Work

There is a huge amount of plastic trash floating in the ocean which endangers wildlife that eats or gets tangled in it. Reducing the amount of plastic trash in the ocean doesn't seem that hard, people just need to use less plastic, such as packaging, drinking straws and plastic bags. But it can be very hard to break people's habits.

In 2002, Ireland made a simple change: they started charging a 15 cent tax on plastic bags at stores, which used to be given away free of charge. They hoped having to pay for bags would make shoppers bring their own reusable bags from home, so that there would be less plastic litter along the coasts and in the countryside.

And it worked! After the tax was put in place, plastic bag use went down 90 percent, and the number of areas that were mostly litter-free went up 20 percent. Remarkably, it was also hugely popular with shoppers. "We are not aware of another tax that induces such an enthusiasm and affection from those who are liable to pay it," wrote the researchers.

Credit:
(c) Gavin Parsons / www.gavinparsons.co.uk / Marine PhotoBank

source: Smithsonian Institute (2016)

Success Stories: Bag Bans

THE SACRAMENTO BEE

California says farewell to the plastic bag

Capitol Alert
The go-to source for news on California policy and politics



source: Sacramento Bee (2016)

Success Stories: Herbivorous Fishes



Surgefish: Indicators of a Healthy Reef


To maintain a healthy coral reef, you need one essential but often-forgotten ingredient: herbivores. Fish and other animals that eat plants and algae keep that greenery from growing over corals, picking sunlight, and killing them. But herbivorous fish are tasty and often fished by people, sometimes until there are none left.

At the Kahikiki Herbivore Fisheries Management Area (KHFA) in West Maui, fishing for herbivorous fishes andurchins has been banned—and now they are making a comeback to protect the reef from becoming smothered by algae. Read more about helpful herbivores at the Ocean Portal blog.

Credit: Michael Webster

source: Smithsonian Institute (2016)

Success Stories: Puffins



The Return of the Puffins

Atlantic puffins (*Fregata aetiva*) used to be quite common along the Maine coast until the late 19th century, when hunters killed them to collect their feathers and eat their eggs and meat. With the puffins gone from Maine, their habitat was taken over by large, bossy gulls, scaring away any puffins that dared to venture too near.

But in 1973, a biologist named Stephen Kress began a bold experiment. He and a group of scientists brought puffin chicks from a large colony in Canada back to one of the Maine colonies. They raised them as their own, feeding the chicks fish twice a day, until they left their nests to go to sea. They hoped that the puffins would remember their birth colony and return to raise their own chicks there someday.

The scientists waited for nine years, not knowing if their experiment worked. In 1981, Kress saw a pair of puffins and their chick nesting on the old abandoned colony—and they kept coming. Today 100 chicks pairs there, and they have spread to other colonies in the area for around 600 puffin nests along the Maine coast.

Credit: (c) Nancy Rynes

source: Smithsonian Institute (2016)

