

LECTURE 2\_6:

JAN. 23, 2014

# **OCEANS & FISHERIES**

## **MANAGEMENT CHALLENGES**

### **& MAP LITERACY 2 (MQ.2)**

Text Reference: Dearden and Mitchell (2012), Ch. 8, pp. 245-**????**.

# Outline



From: Dearden and Mitchell (2012)

**“Huxley Error Led to Cod Calamity”** writes Brian Thomas (<http://www.icr.org/article/4790/>) of Thomas Huxley, a prominent 19<sup>th</sup> Century Biologist who is attributed to *“that probably all the great sea fisheries are inexhaustible”*

- Activity: Map Literacy List #2
- Fisheries Management Challenges
  - ▣ {}
- Fisheries (mis)Management collapse
  - ▣ Case Study: Northern Cod Fishery, Atlantic Canada



# Map Literacy 2

Oceans & Fisheries lectures  
January 23, 2014



# Map Literacy (list 2, January 23, 2014)

## Communities, Jurisdictions

1. St John's, NL
2. Quebec
3. Labrador

## Natural Features

1. Grand Banks
2. Vancouver Island
3. Haida Gwaii
4. Gulf Stream
5. Labrador Current
6. Alaskan Current
7. Cape Breton Island
8. Beaufort Sea

## Basics (4):

- Gulf of St. Lawrence, Baffin Island, Northwest Territories, Bay of Fundy





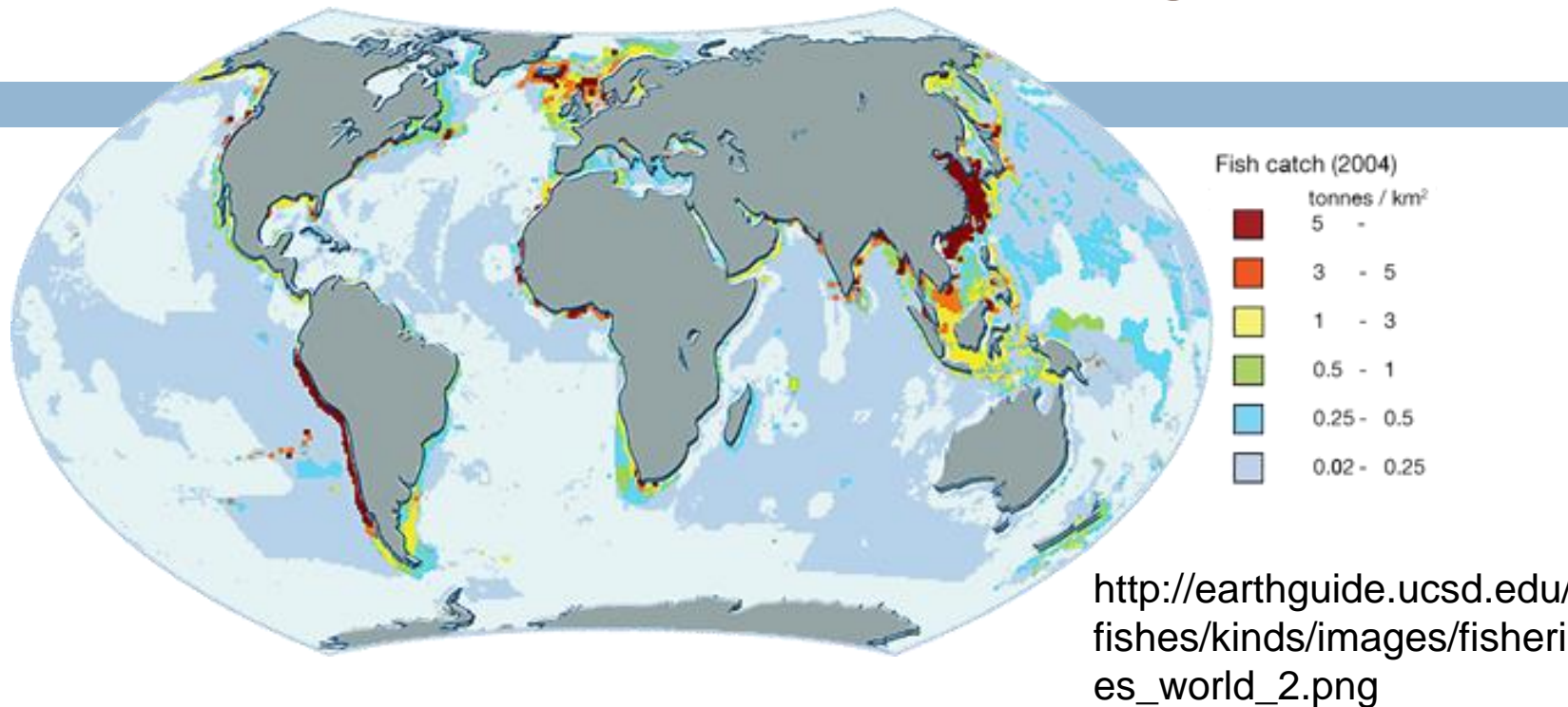
## Recall from Last Lecture

Major fishing areas of the world

Leading fishing producers & consumers



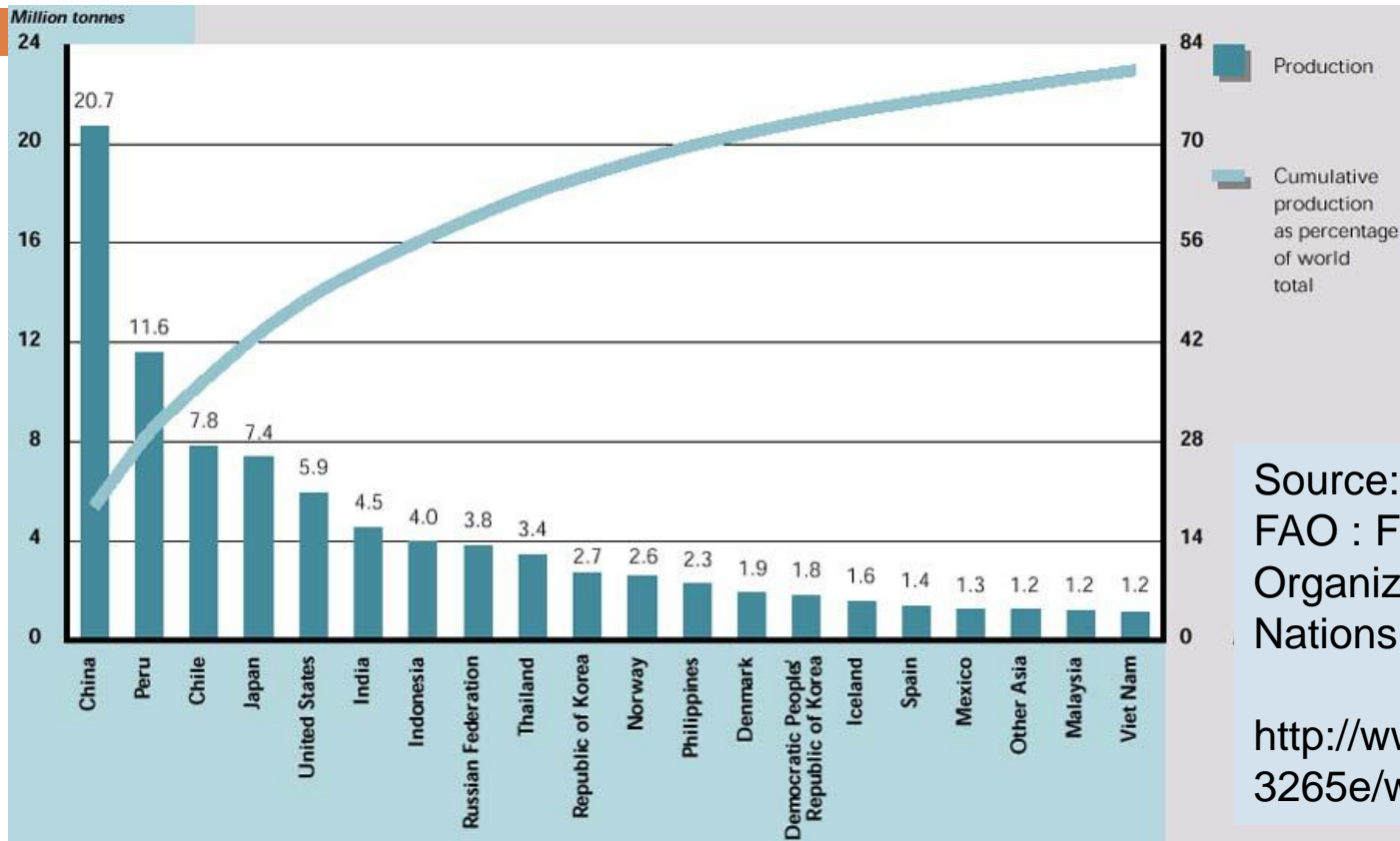
# Production for principal major fishing areas



- Coastal zones (incl. continental shelves) supply 90% of global fish catch;
- ~~ 50% of the world's population live within 100 km of a coast; → projected to increase to 75% by 2100 (mega-cities)



# Leading Fish Producing Nations (wide catch and aquaculture)



Source:  
FAO : Food and Agricultural  
Organization of the United  
Nations.

<http://www.fao.org/docrep/003/w3265e/w3265e02.htm>

# Canada's Oceans

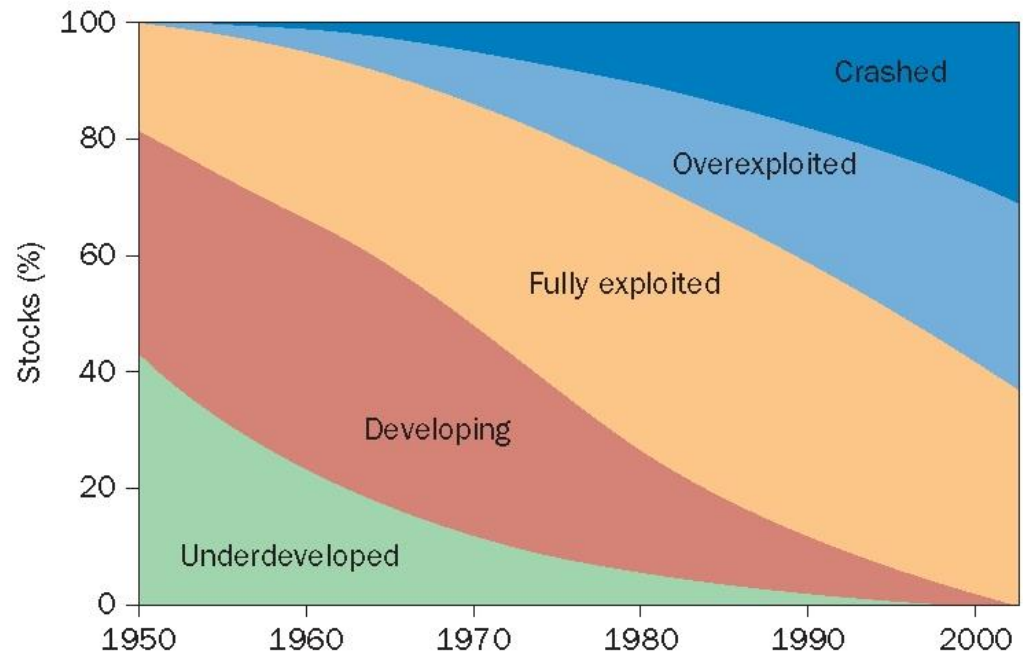
(Figure 8.10) From: Dearden and Mitchell (2012)



Figure 8.10 | Canada's coastline and continental shelf.

# State of the World's Fishing Stock

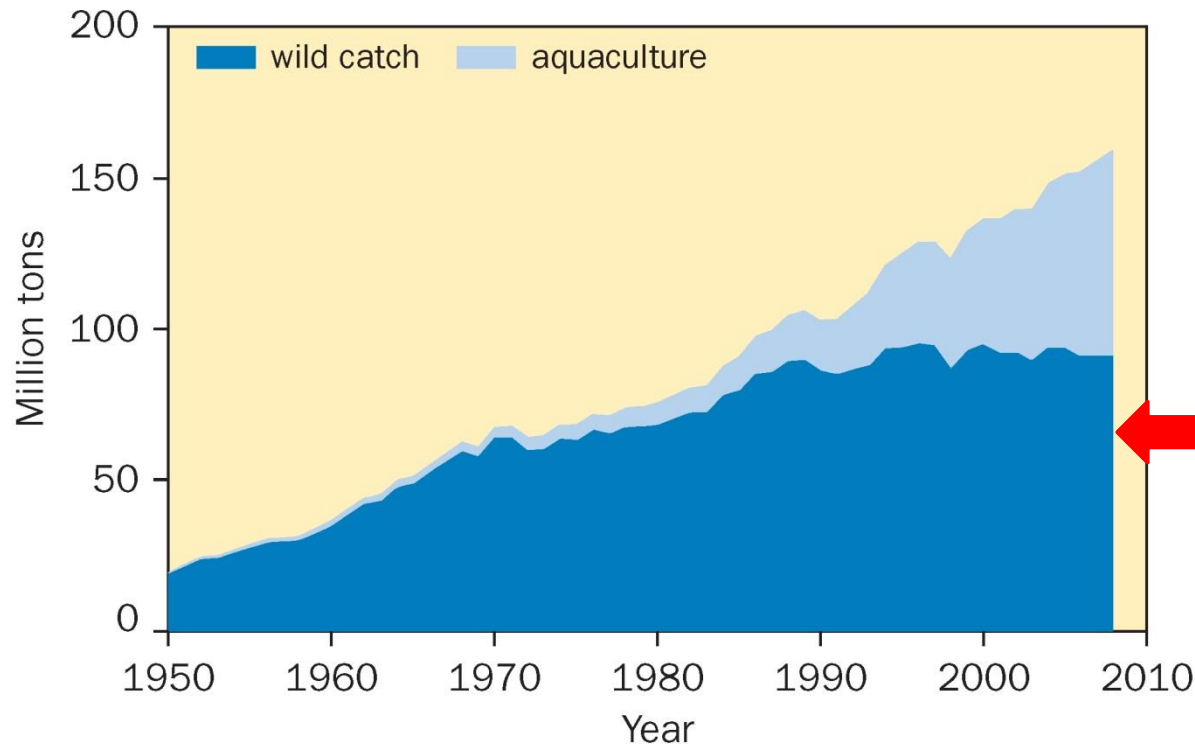
- Fisheries provide ~20% of the world's annual animal protein supply (virtually all of protein requirements in some parts of Asia and Oceania);
- **>80% of the world's fisheries** are now (~2008) fully utilized or over-exploited.



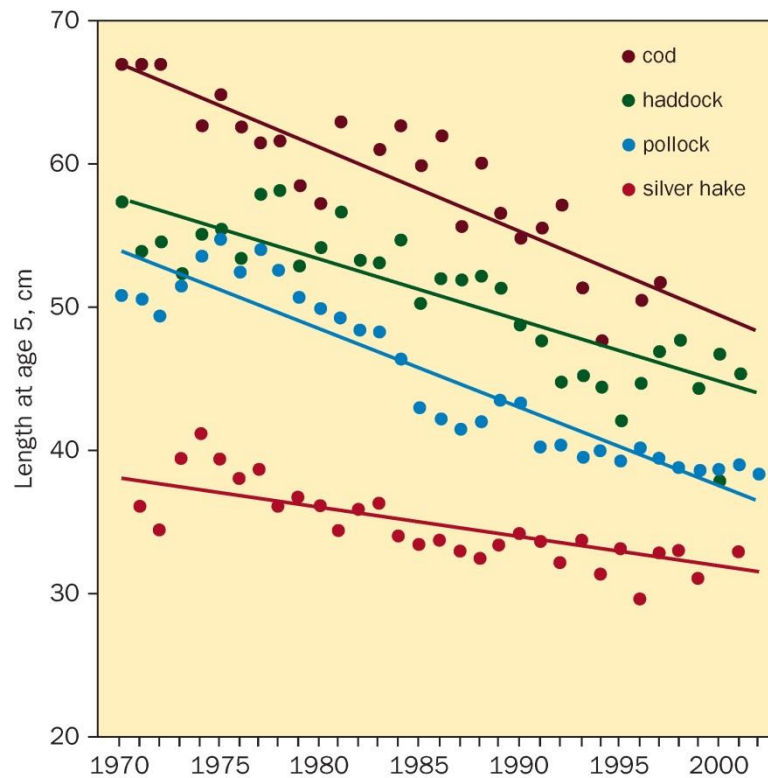
**Figure 8.5** | State of the world's fishery stocks. Source: Nellemann et al. (2008: 17).

*From: Dearden and Mitchell (2012)*

# Increasing amounts of farmed fish / aquaculture



- **Wild capture versus aquaculture production**, in million tonnes 1950–2010 Source: Theobald (2009) in Dearden and Mitchell (2012)
- Recent years ... a leveling off of wild capture
- Scientists at UBC estimate rates of wild capture may be substantially over-estimated (due to inflated catches reported by China), thus the decline in natural fisheries much more serious;

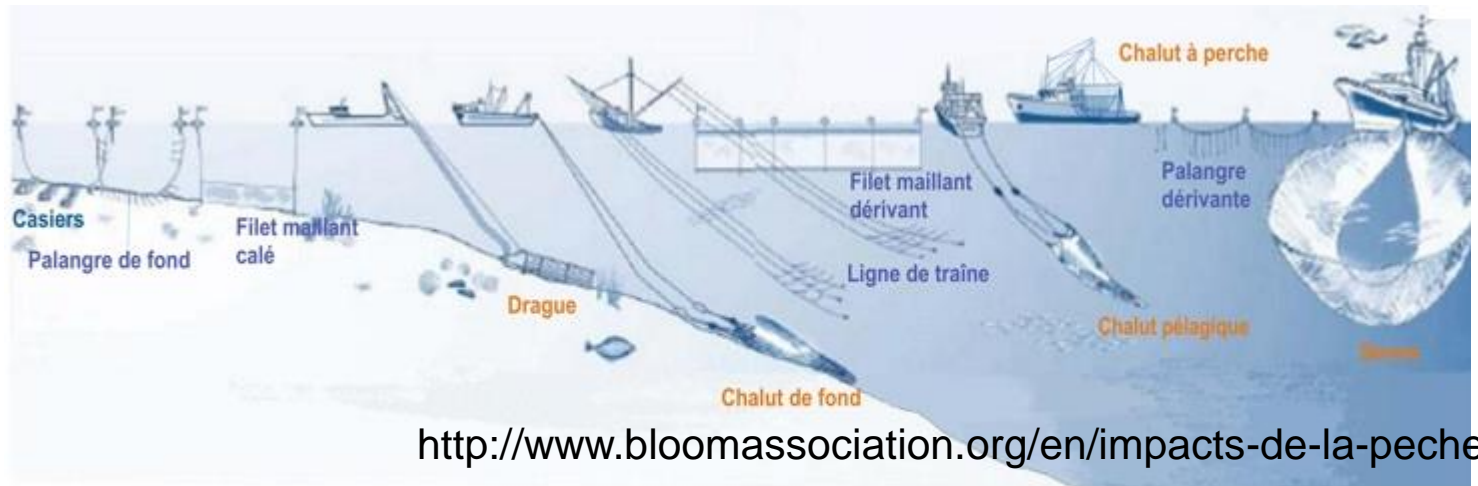


**Figure 8.7** | Fish size decline, 1970–2000. Source: Fisheries and Oceans Canada 2003. Source: DFO (2010: 25). Reproduced with the permission of the Minister of Public Works and Government Services Canada, 2011.

- ❑ Decreasing volume of catch ... also **decrease is average size of fish caught**; (Figure 8.7 from Dearden and Mitchell, 2012)
- ❑ Recent research suggests leaving old individuals in a population actually assists with stock replenishment; - contradicts earlier thinking;
- ❑ **Fishing (and thus eating) “down the food chain”** (small species like anchovies, squid, sardines rather than tuna) would open up protein sources that could feed more people (tuna a top oceanic species)

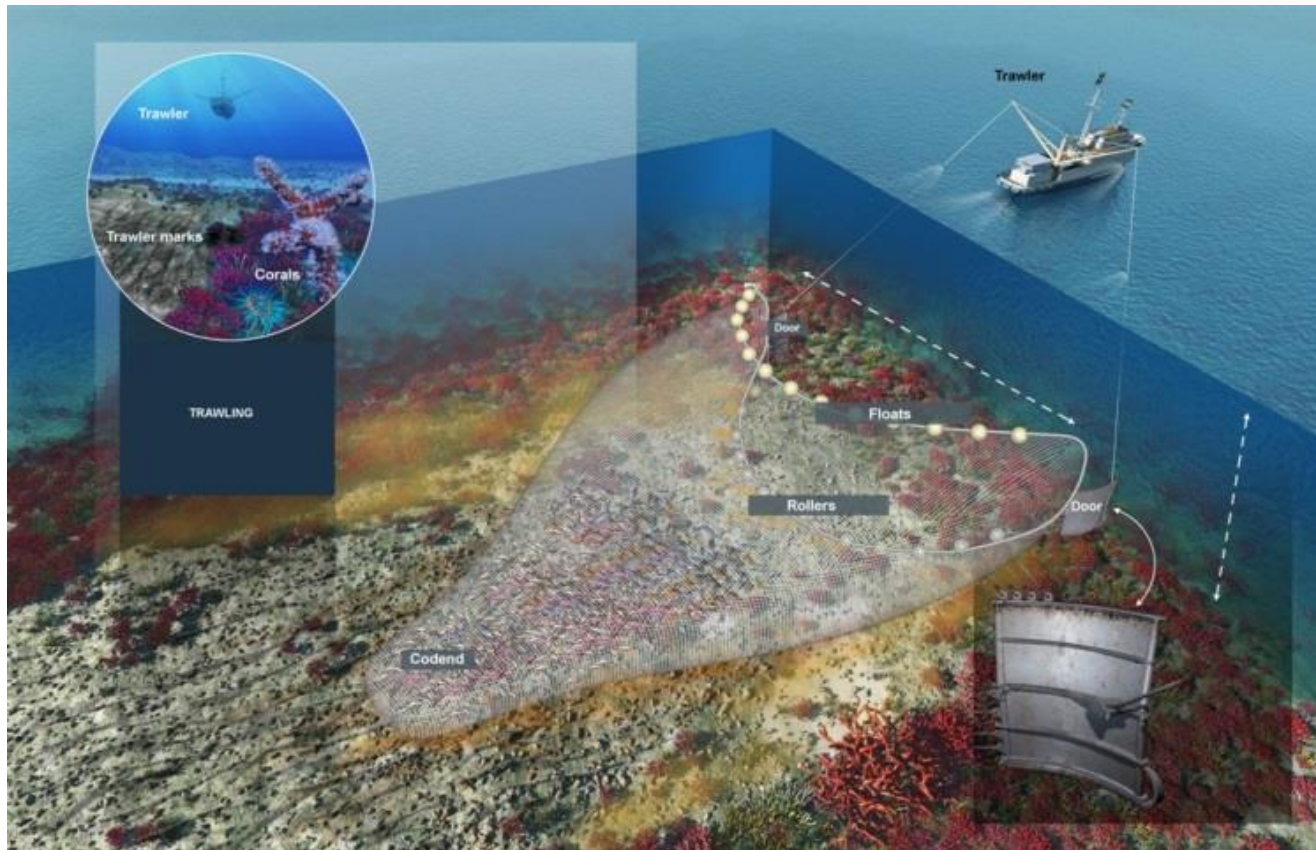
# Ocean Management Challenges

- **Fishing down the food chain:** harvesting at progressively lower trophic levels as higher trophic levels become depleted
- **Bycatch:** Non-target organisms caught or captured in the course of catching a target species
- **Longline fishing:** a type of commercial fishing using lines with many baited hooks
- **Bottom trawling:** one of the most destructive means of fishing in which heavy nets are dragged along the sea floor scooping up everything in their path





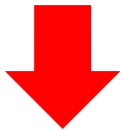
# Ocean trawling – destructive tendencies



<http://oceana.org/en/eu/our-work/responsible-fishing/dirty-fishing/bottom-trawling/images>

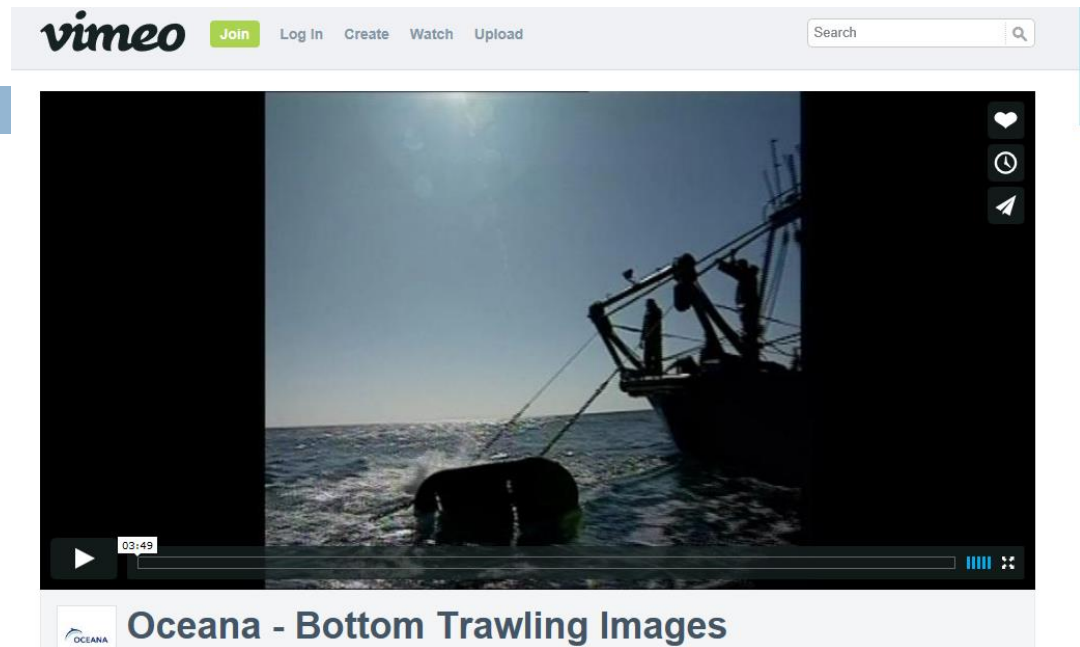


Video (3.5 min.) (images, bottom trawling) – click link

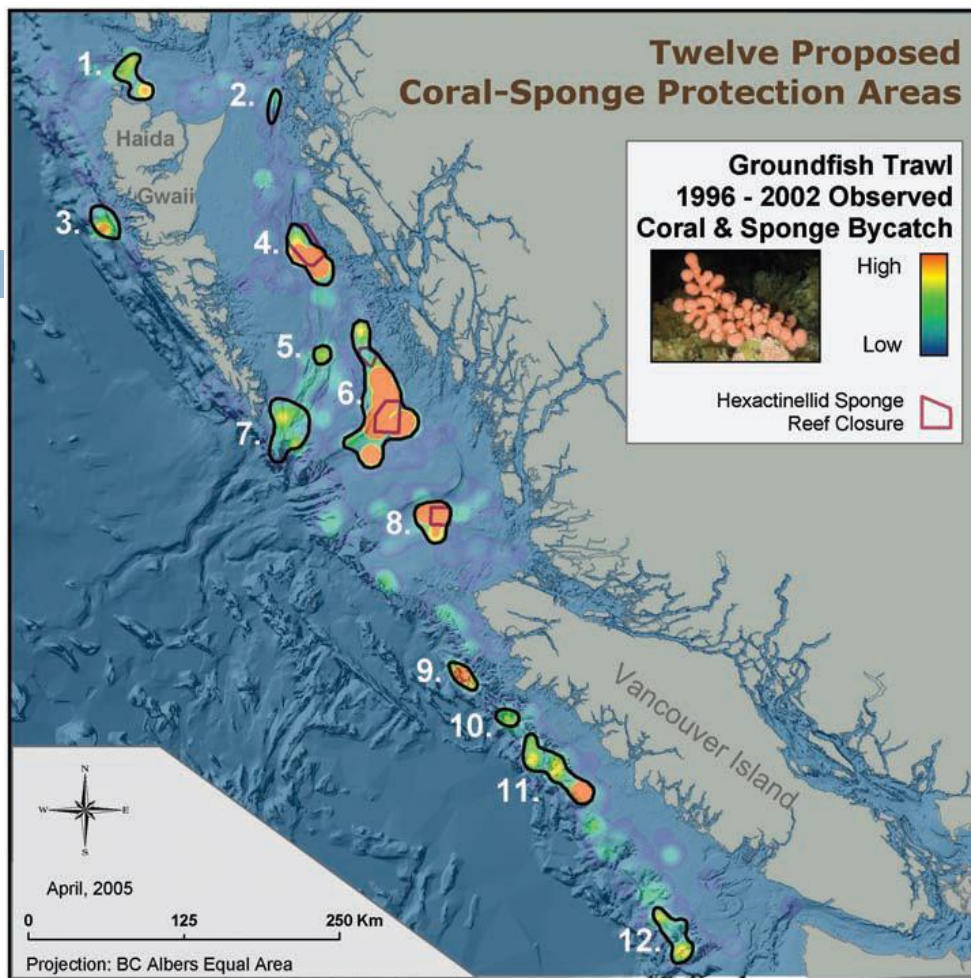


<http://vimeo.com/31083809>

*Credit:  
Universidad de Alicante (Spain)*



**Trawling** is a particularly destructive fishing technique in terms of discards, bycatch, and collapse of fish stocks, **causing serious damage to delicate marine ecosystems (like cold-water corals**, that were only recently discovered off the BC Coast). The trawling fleet is estimated to represent a total of 15,000 of the 100,000 vessels in the European fleet. In terms of destructive trawling however, the impact greatly exceeds this percentage. European trawlers do not only operate in EU waters. A significant number of European trawlers operate around the world, fishing in both third-country territorial waters and on the high seas.

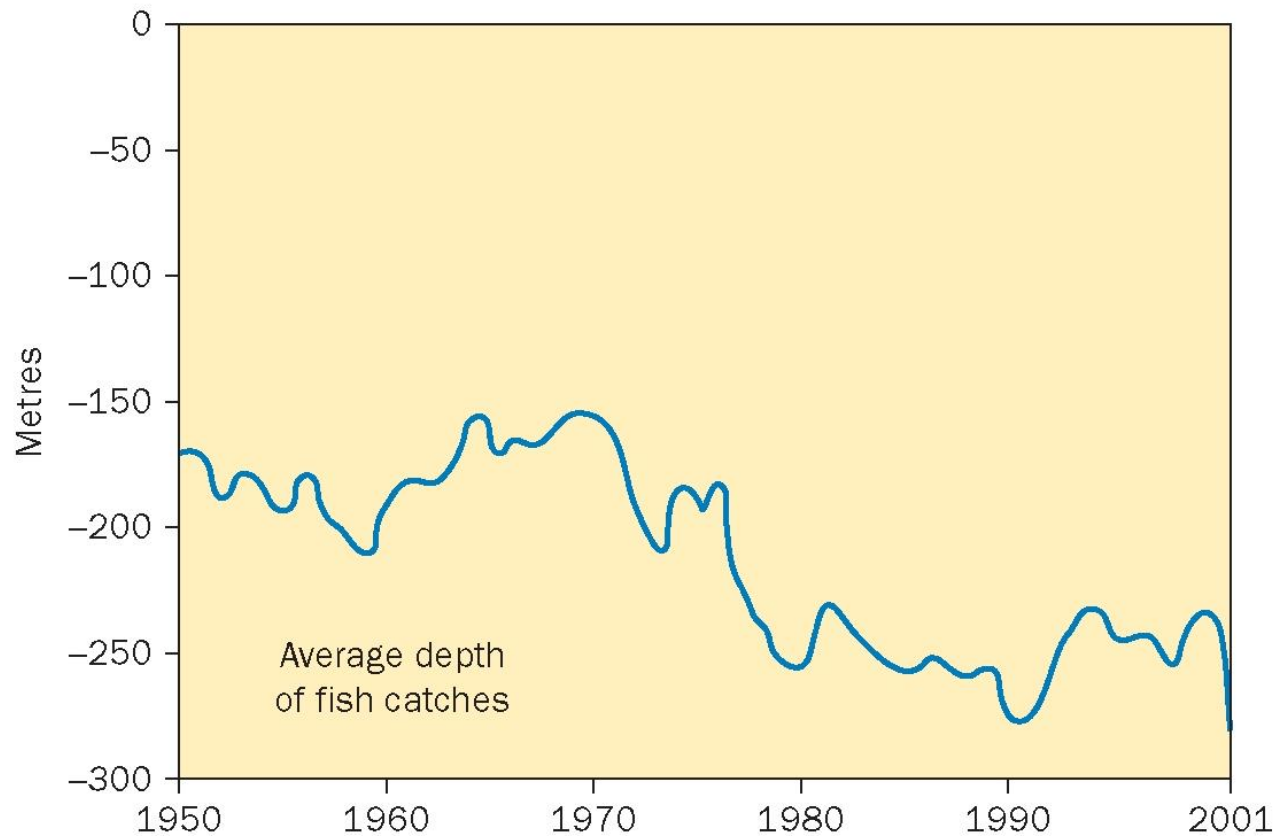


Places of note:  
Haida Gwaii  
Vancouver Island  
Continental Shelf

**Figure 1.** Relative density of coral and sponge by-catch, where orange areas account for more than one standard deviation, and yellow is approximately 0.5 standard deviations of the overall relative density after square-root transformation. Proposed Coral-sponge protection areas: (1) Learmonth Bank; (2) Bell Passage; (3) Kindakun; (4) McHarg Bank; (5) Mid-Moresby Trough; (6) Mitchell's Trough; (7) South Moresby Gully; (8) Goose Trough; (9) Kwakiutl Canyon; (10) Crowther Canyon; (11) Esperanza Canyon; (12) Barkley Canyon

**Source:** Ardron et al. (2007) "*Spatial identification of closures to reduce the by-catch of corals and sponges in the groundfish trawl fishery, British Columbia*"

# Increasing harder to find fish



**Figure 8.9** | Trend in mean depth of catch since 1950. Source: *Millennium Ecosystem Assessment (2005)*.

([Figure 8.9](#) from Dearden and Mitchell, 2012)

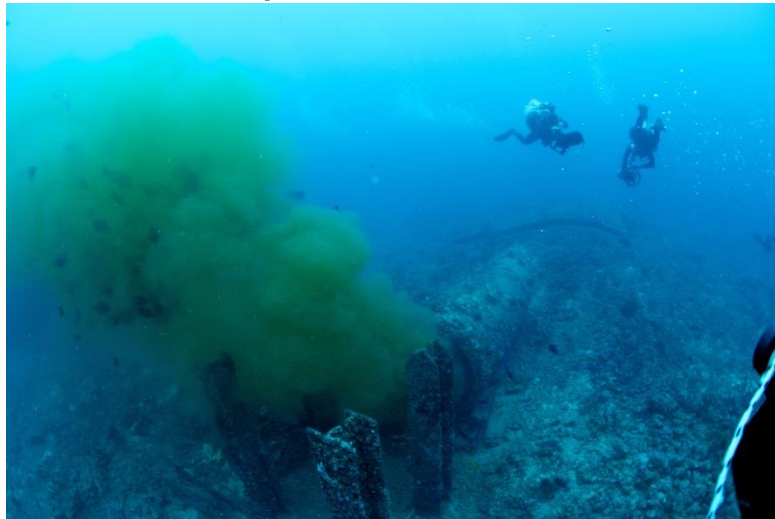
# Ocean Management Challenges

...as one skeptic put it, "dilution is the solution to pollution."

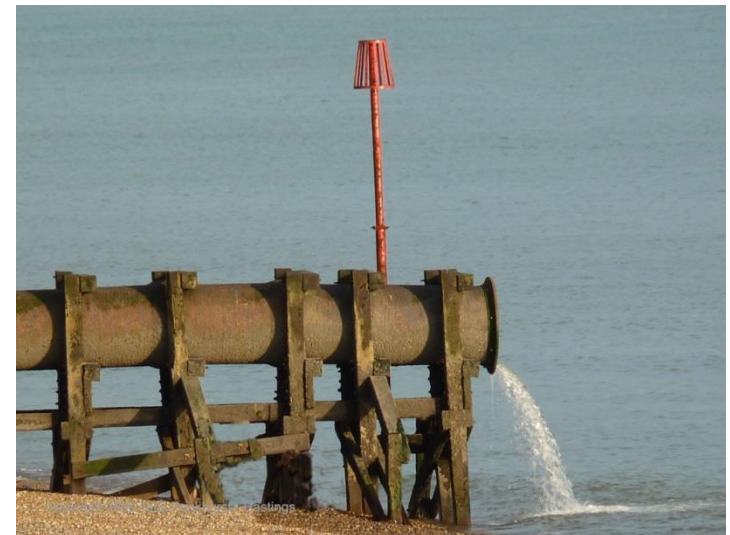


## Pollution

- All the polluted water from the land as well as airborne contaminants - oceans are the ultimate sink for many pollutants ("All drains lead to the oceans" *Finding Nemo*, 2003)
- Marine pollutants take a number of forms, originate from many different sources, and have a wide range of effects
- Chemical pollutants take two main forms: **toxic materials** and **nutrients**



Sewage Outfall, Hollywood, CA



# Ocean Management Challenges

- One rapidly emerging impact related to pollution is **endocrine disruption**
  - is the interference of normal bodily processes such as sex, metabolism, and growth by chemicals in such products as soaps and detergents that are released into an ecosystem, as happens among aquatic species, often causing feminization (or hermaphroditic changes) ... e.g., these thought to be partially the cause of fall in human male sperm counts in the past 50 years.
- **Nutrient Enrichment** → **Oxygen Depletion** ...
  - Creating large dead areas within the oceans;
  - These areas (**hypoxic** or oxygen-deficient areas) increased from 149 in 2003 to more than 200 in 2006
  - Their growth could also promote the development of far more male fish than female, threatening some species with extinction



# Dead Zones or Hypoxic areas Worldwide

## Marine dead zones

*"Dead zones", poorly oxygenated areas in the world's seas and oceans, are on the rise.*



# Dead Zones or Hypoxic areas Worldwide

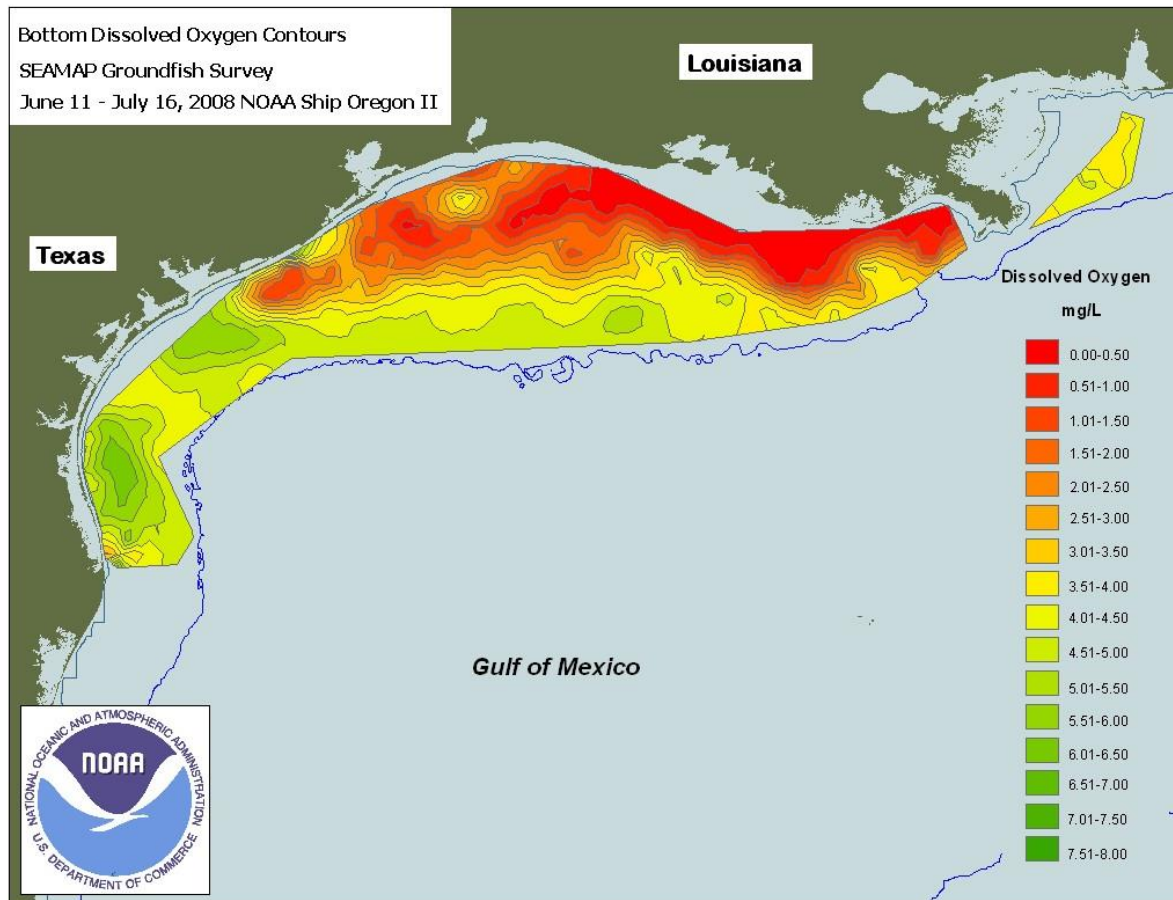


“Dead zones” are areas where the **bottom water** (at the sea floor) is anoxic (has **very low** (or completely zero) concentrations of **dissolved oxygen**). These are occurring in many areas along the coasts of major continents, and they are spreading over larger areas of the sea floor. Because very few organisms can tolerate the lack of oxygen in these areas, they can destroy habitats of these organisms. Source: <http://coastalcare.org/2010/>



# CSCOR-supported Research Provides Foundation for Effective Management of the "Dead Zone" in the Northern Gulf of Mexico

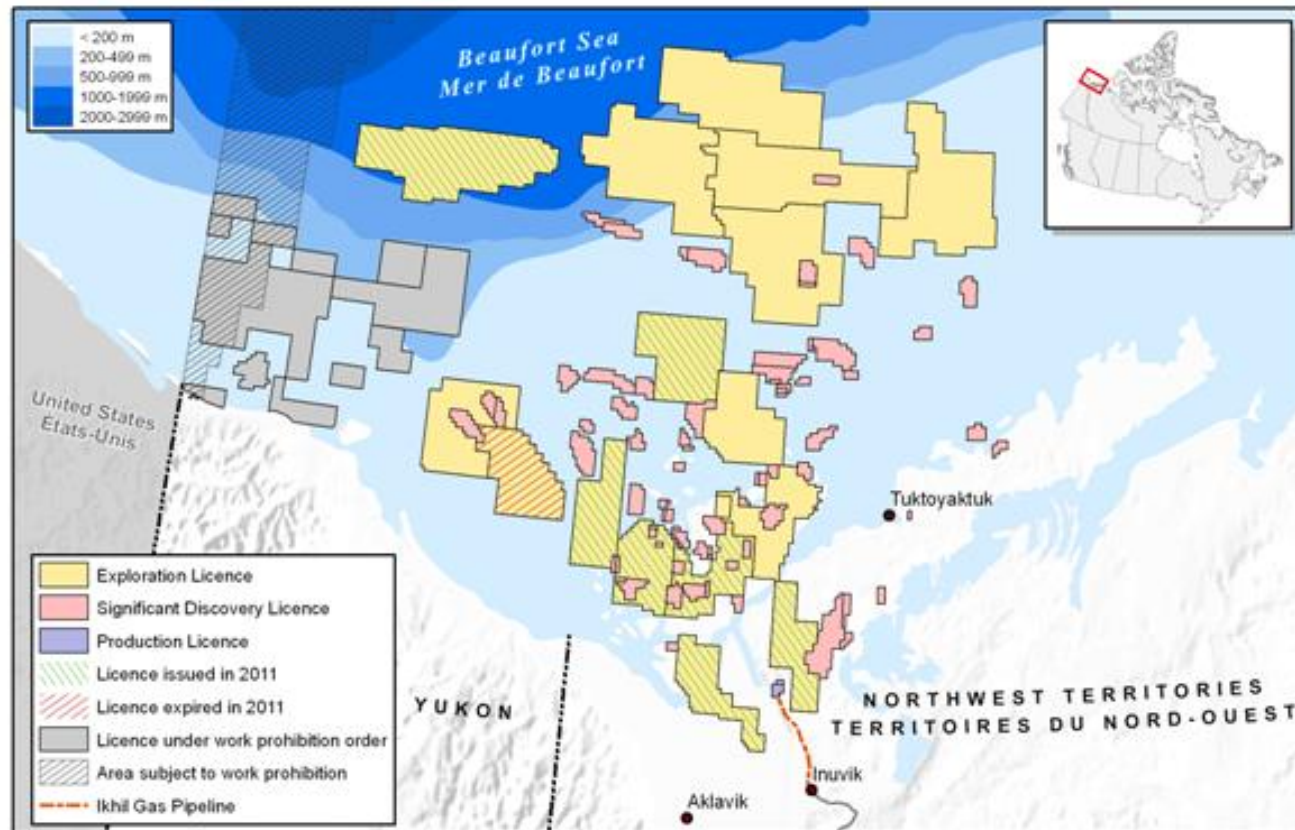
[http://www.cop.noaa.gov/stressors/extremeevents/hab/features/hypoxiafs\\_report1206.aspx](http://www.cop.noaa.gov/stressors/extremeevents/hab/features/hypoxiafs_report1206.aspx)



# Ocean Management Challenges - Energy

- World demand for energy, particularly oil and gas, continues to rise
- Most accessible ocean oil basins have already been developed, so exploration and development are pushing into increasingly challenging and fragile environments like the Arctic Ocean and North Pacific (e.g., Beaufort Sea, Prudhoe Bay)
- Recent research has highlighted the potential for seabed-based methane hydrates to meet some energy demands
- Risk of oil spills both during production and transport (e.g., Exxon Valdez, Alaska 1989) (British Petroleum, Gulf Coast 2010)

# Oil Exploration – Beaufort Sea



**Source: Northern Oil and Gas Annual Report 2011**

<http://www.aadnc-aandc.gc.ca/eng/1335971994893/1335972853094>

# Ocean Management Challenges – Coastal Development

## Ten Cities with the Largest Populations Threatened by Coastal Flooding

City	Country	Population at Risk
Mumbai	India	2,787,000
Guangzhou	China	2,718,000
Shanghai	China	2,353,000
Miami	USA	2,003,000
Ho Chi Minh City	Vietnam	1,931,000
Kolkata	India	1,929,000
New York-Newark	USA	1,540,000
Alexandria	Egypt	1,330,000
Bangkok	Thailand	907,000
Dhaka	Bangladesh	844,000

*From: Ranking of the World's Cities Most Exposed to Coastal Flooding Today and in the Future – OECD 2007. Available at: [http://www.rms.com/publications/OECD\\_Cities\\_Coastal\\_Flooding.pdf](http://www.rms.com/publications/OECD_Cities_Coastal_Flooding.pdf)*



(photo from Dearden and Mitchell 2012 text) **Mumbai**, a coastal mega-city, place marine ecosystems under increasing pressures. Issues include: coastal erosion, saltwater intrusion on coastal freshwater aquifers, habitat losses (birds, fish, other marine life), marine pollution and depletion of fishery resources.

# Mega-cities

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<b>Shanghai</b>	China	2,353,000
<b>Miami</b>	USA	2,003,000
<b>Ho Chi Minh City</b>	Vietnam	1,931,000
<b>Kolkata</b>	India	1,929,000
<b>New York-Newark</b>	USA	1,540,000
<b>Alexandria</b>	Egypt	1,330,000
<b>Bangkok</b>	Thailand	907,000
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# Case Study

## □ East Coast Fisheries

### Major fishing areas in Atlantic Canada

(Figure 8.11 from Dearden and Mitchell, 2012)

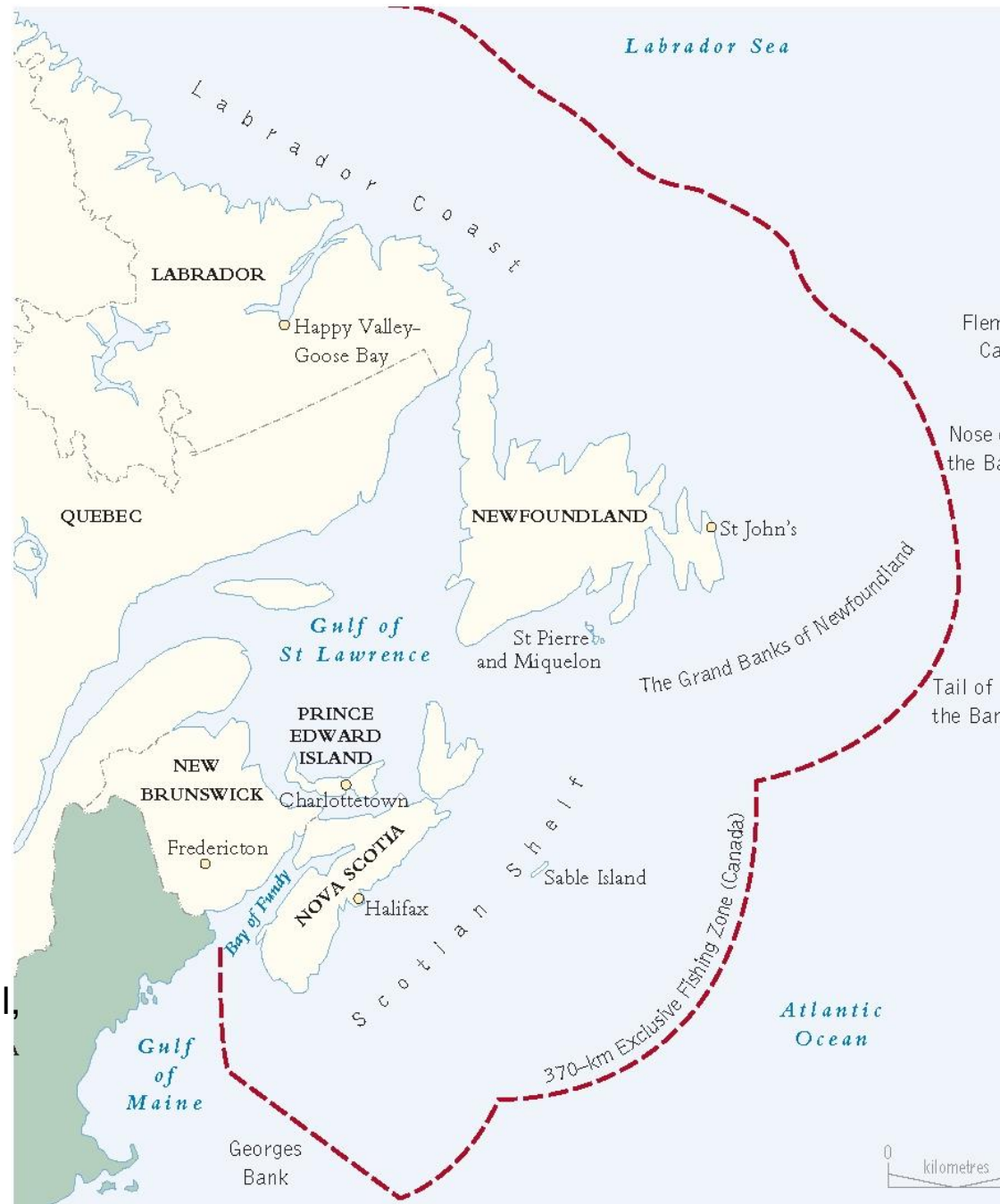
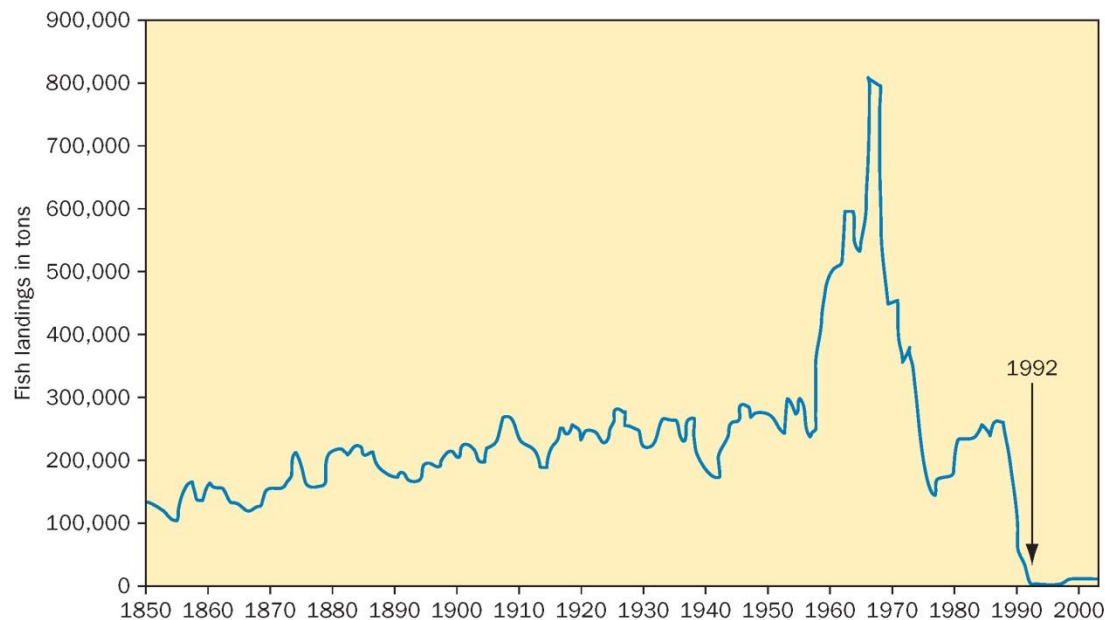


Figure 8.11 | Major fishing areas in Atlantic Canada. Source: Adapted from Cameron (1999)

# East Coast Fisheries (2)

- The marine fishery has been an important part of the economy and culture of Atlantic Canada for centuries
- The cod industry collapsed in 1992 and 1993, leading to employment losses for 40,000 to 50,000 people in Newfoundland, the Maritime provinces, and Quebec



**Figure 8.12** | Collapse of Atlantic cod stocks off the east coast of Newfoundland, 1992. Source: *Millennium Ecosystem Assessment (2005)*.



# East Coast Fisheries (3)

- In 1989, overfishing led the minister to **reduce the total allowable catch (TAC)** for northern cod, followed by a **moratorium in July 1992**
- In 2003, the cod fishery in Newfoundland, the Maritime provinces, and Quebec was officially **closed**;

# East Coast Fisheries (4)

- Factors contributing to the collapse of the cod industry:
  - Foreign overfishing
  - Domestic overfishing
  - Imperfect science and management
  - Inappropriate incentives for processing plants and fish workers
  - Changing environmental conditions
  - Predators (thought related to closure of seal hunt in the 1980s)
- Fishing down the web has led to increased fishing pressure on shrimp (which cod need in order to recover)

# East Coast Fisheries (4)

## Lessons

- The collapse of the Atlantic groundfish fishery highlights how some contemporary resource management practices may encourage resource liquidation
- The case study illustrates that fisheries management requires scientific understanding of the biophysical resource system, a greater appreciation of traditional or local ecological knowledge, and parallel understandings of the history, culture, economy, and politics of the region, as well as federal and provincial fisheries and regional development policies

# References

- Ardron, JA, Jamieson, GS, and Hangaard, D. 2007. Spatial identification of closures to reduce the by-catch of corals and sponges in the groundfish trawl fishery, British Columbia, Canada. pp 157-167 *In*: George, R. Y. and S. D. Cairns (eds.) Conservation and adaptive management of seamount and deep-sea coral ecosystems. Rosenstiel School of Marine and Atmospheric Science, University of Miami.
- Dearden, P and Mitchell, B. 2012. Environmental Change and Challenge, Fourth Edition, Don Mills, Ontario: Oxford University Press {chapter 8}