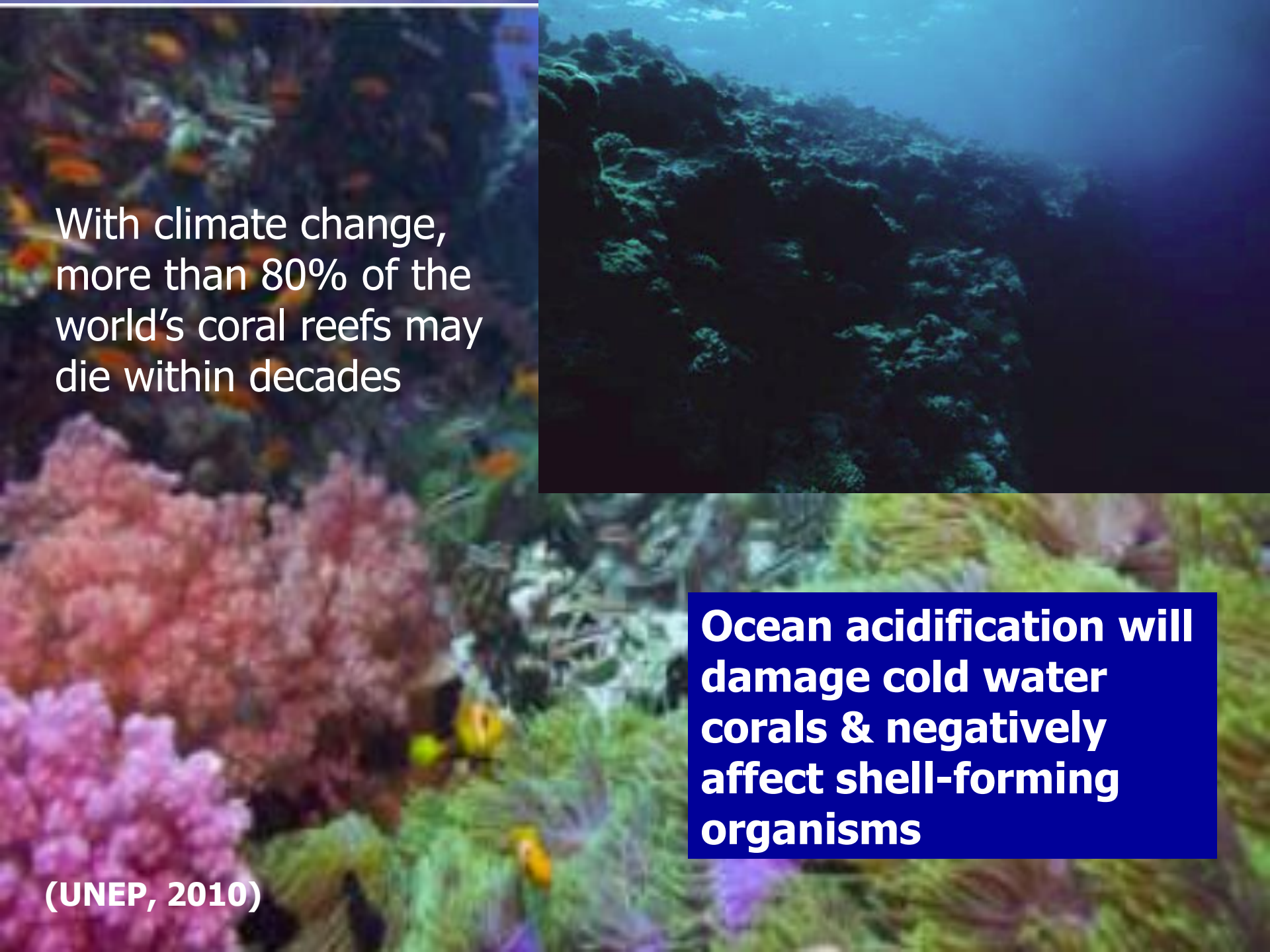


The Legacy of Overfishing



“When is an endangered species not endangered? When it’s in the sea apparently!” (Pope, 2010:1)

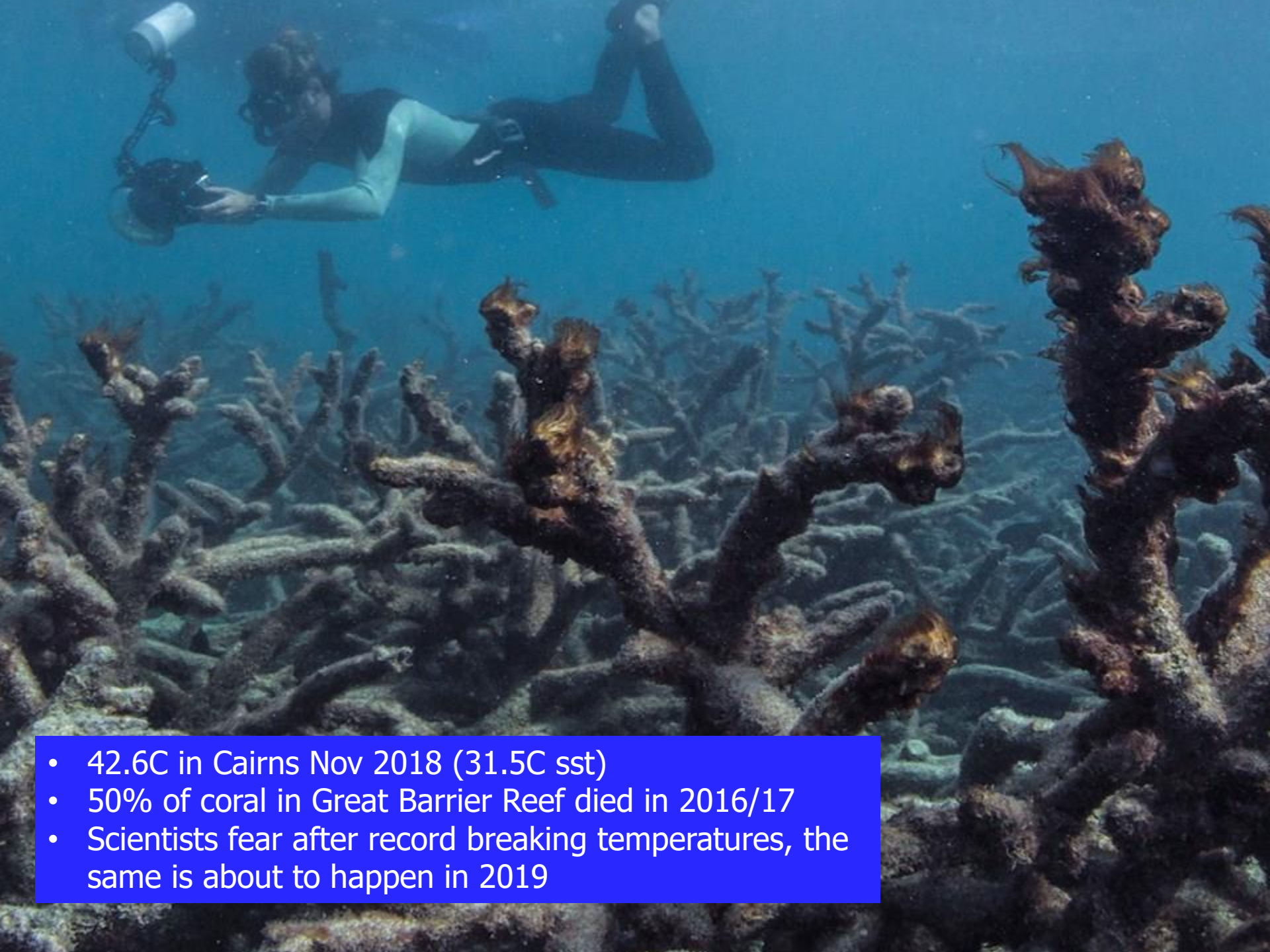




With climate change,
more than 80% of the
world's coral reefs may
die within decades

**Ocean acidification will
damage cold water
corals & negatively
affect shell-forming
organisms**

(UNEP, 2010)



- 42.6C in Cairns Nov 2018 (31.5C sst)
- 50% of coral in Great Barrier Reef died in 2016/17
- Scientists fear after record breaking temperatures, the same is about to happen in 2019



- 60km offshore of Queensland (Feb 2019)
- Weeks of flooding – agricultural run-off
- Light reduction – smothering – overgrowth algae
- Algae encourages Crown of Thorn starfish *Acanthaster planci*

A photograph of a rocky coastline. In the foreground, a metal structure, possibly a staircase or a walkway, is built into the rocks. The water is dark, but there is a prominent, bright green algal bloom or sea urchin colony in the middle ground. The sky is overcast.

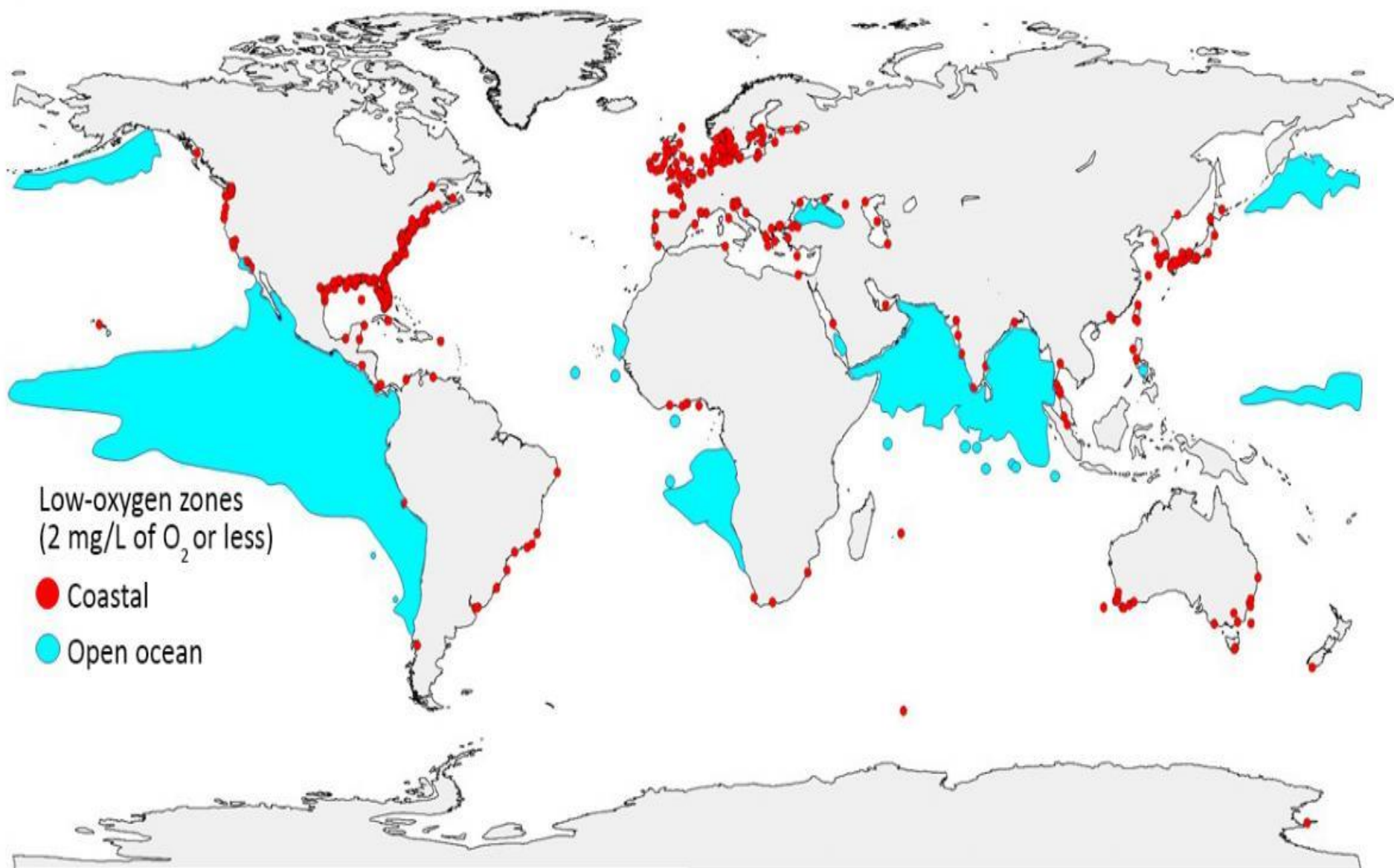
91% of inhabited coastlines will be impacted by marine pollution through increasing coastal development by 2050

A photograph of a cloudy sky. The clouds are grey and overcast, covering the entire frame.

Consequential marine dead zones – many will be in primary fishing grounds

(UNEP, 2010)



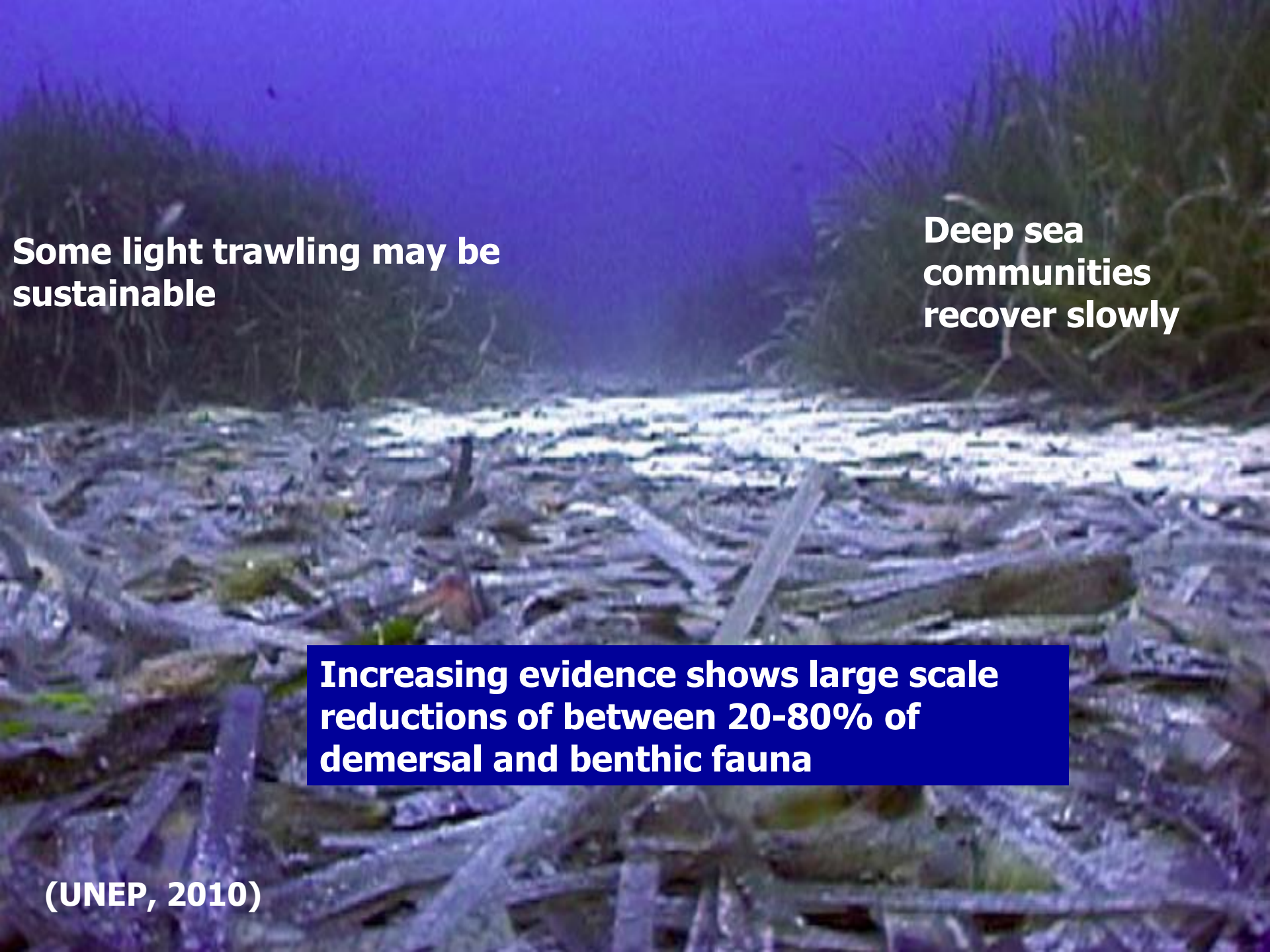


**Reduced thermohaline circulation and
natural flushing of coastal areas –
climate change & pollution**

**Ocean biodiversity hotspots degraded
through bottom trawling and
overharvesting**



(UNEP, 2010)



Some light trawling may be sustainable

Deep sea communities recover slowly

Increasing evidence shows large scale reductions of between 20-80% of demersal and benthic fauna

(UNEP, 2010)



Primary fishing grounds are increasingly invaded by alien species – ballast water (UNEP, 2010)



- 
- A sunset over the ocean with a bird in flight and a ship on the horizon.
- Assess state of global fish stocks
 - Appreciate limitations of and mismanagement involved in regulating industry
 - Provide credible evidence and statistics on
 - Habitat degradation
 - Biomass removal
 - Bycatch
 - Aquaculture

Overview: Over-harvesting

- Biggest human impact – global catch 109 million tonnes (2010) – peak of 130mt in 1996
- Overfishing – caught faster than they can reproduce
- Bycatch – 40 million tonnes
One in every four fish is wasted
- Overcapacity:
 - Subsidies
 - Price controls
 - Low interest loans and grants



(CNN, 2010)

Incorrect statistics obscures the true extent of fishing worldwide. Scientists now estimate the global catch to be 109 million metric tonnes (mt) annually (Pauly, 2016)



Wild numbers

Not knowing how much fish we take from the oceans makes sustainable management more difficult. **From 1950-2010**, landings of economically important fish such as tuna and sharks were underreported, according to the study, led by the Sea Around Us and published Jan. 19, 2016 in the journal *Nature Communications*.

95% of global annual commercial ocean catch comes from coastal waters – within 200nm of coast (UNEP, 2010)



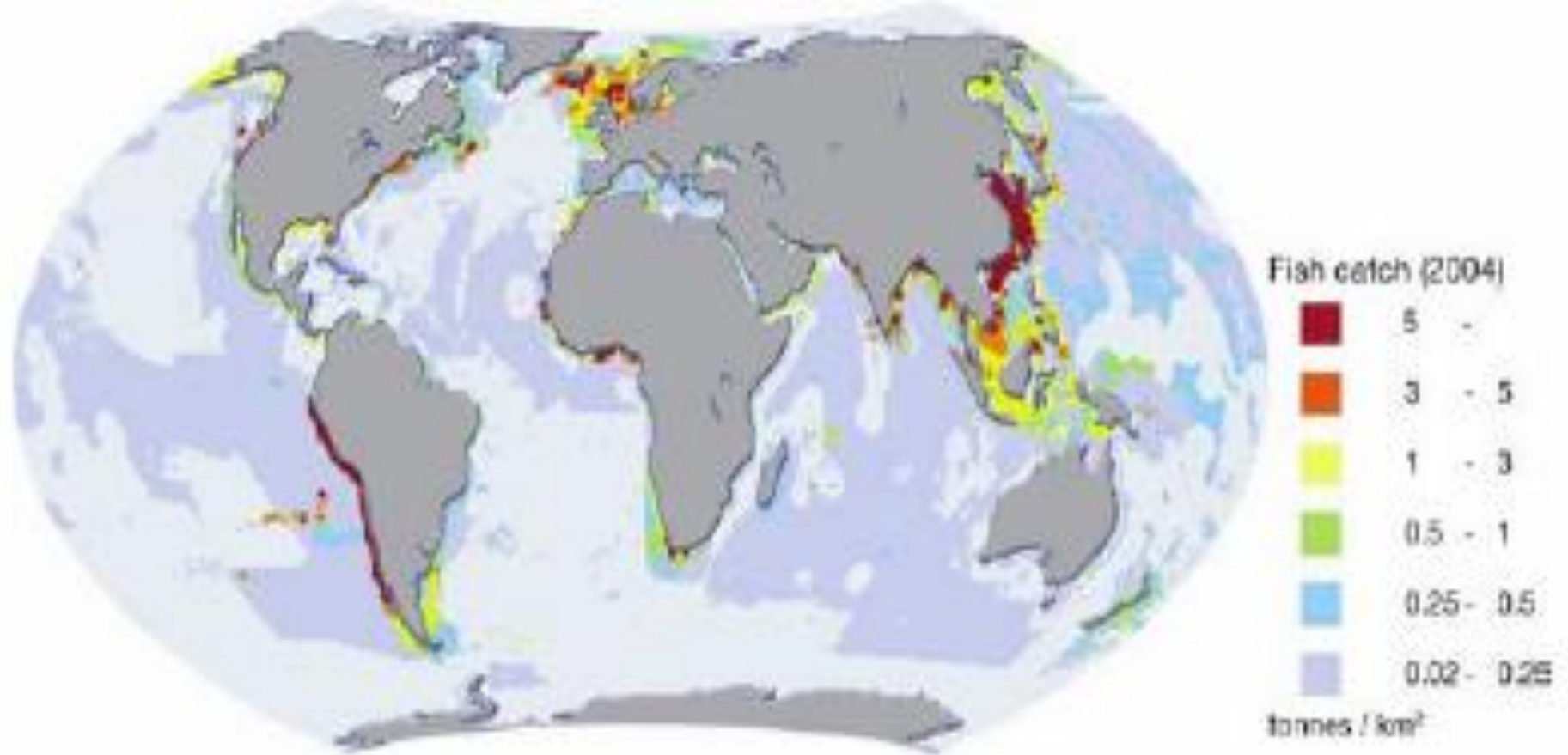
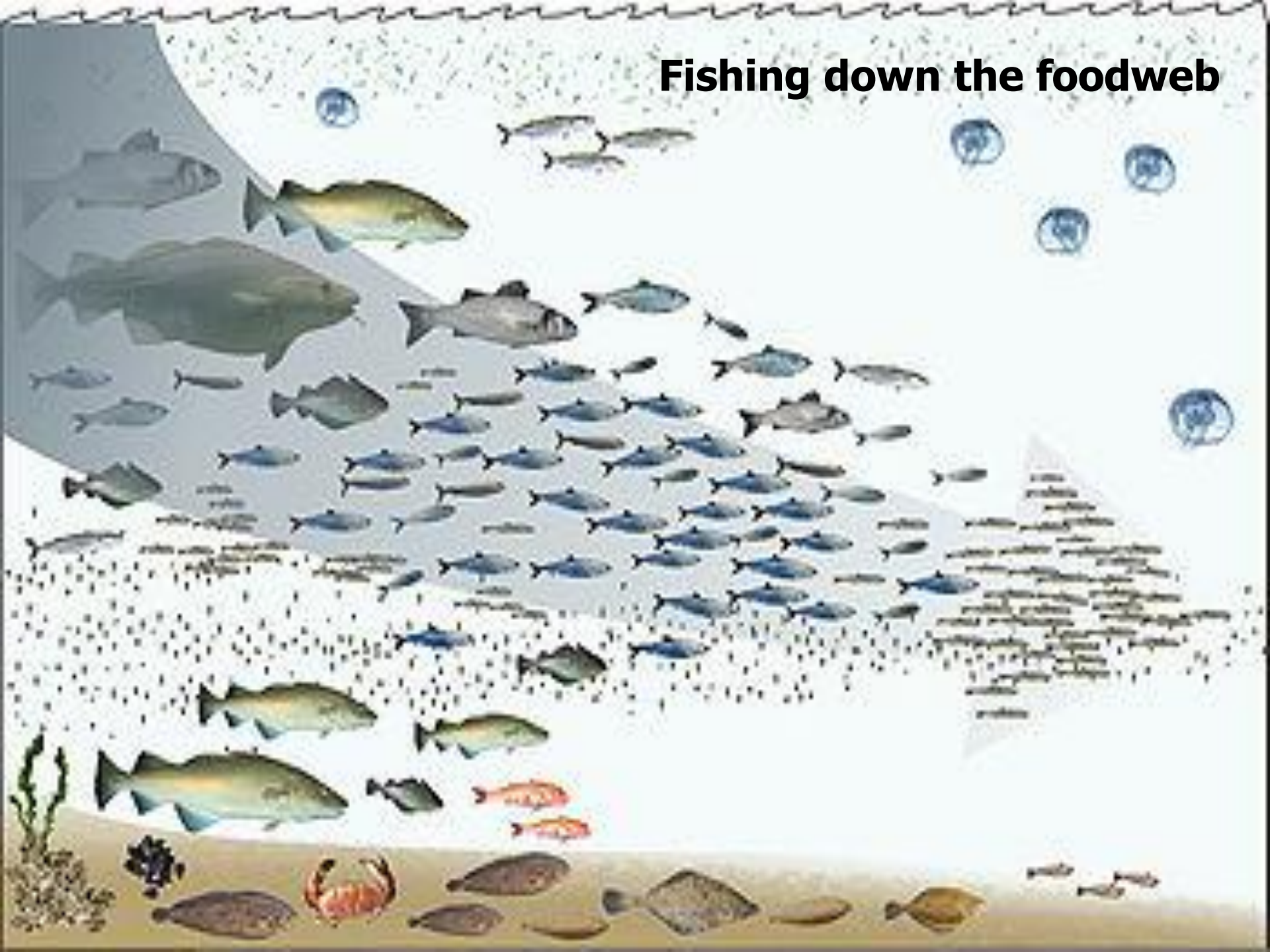


Figure 6. The World's most productive fishing grounds are confined to major hotspots, less than 10% of the World oceans.

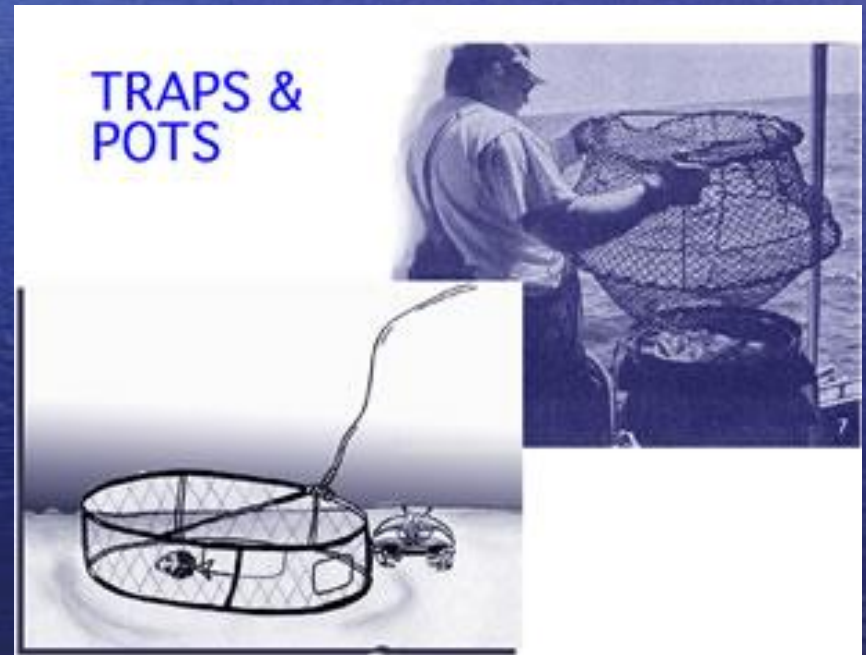
Annual catch (tonnes per km²) : a strong geographical concurrence with continental shelves, upwelling and primary productivity

Fishing down the foodweb



Fishing Techniques: Traps & Pots

- Baited cages
- Bottom-dwelling species like crab and shrimp
- Selective fishing
- Degradable line



Fishing Techniques: Trolling

- Trolling poles upright when not fishing
- 45° when fishing
- Hooks and lines attached
- Lines pulled behind boat
- Faster species which will chase a lure
- Salmon, albacore and tuna



Fishing Techniques: Fishwheel

- Used in rivers mainly
- Spawning fish
- Similar to water wheels
- Fish can be sorted and non-target species released



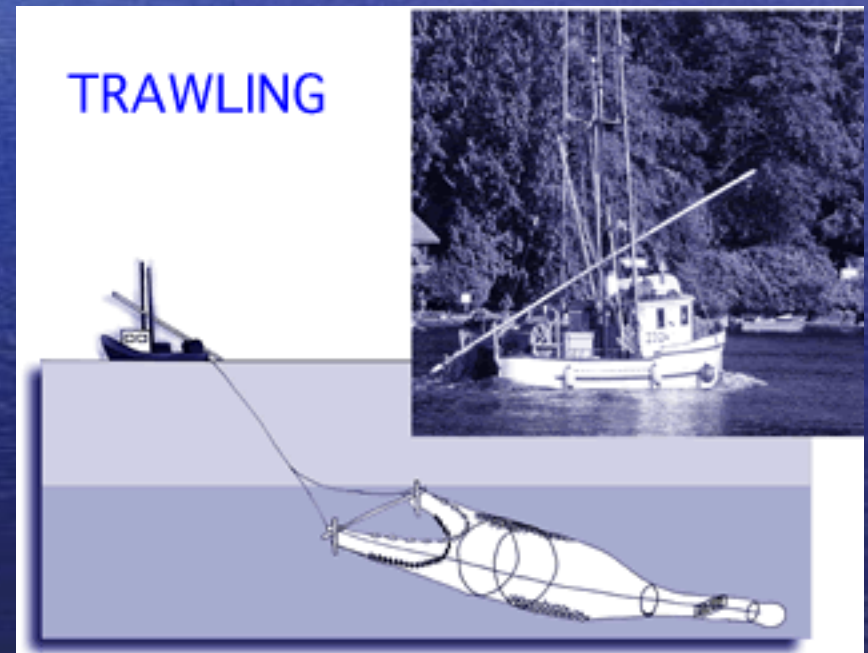
Fishing Techniques: Longlining

- In BC – used for halibut, rockfish, dogfish
- Swordfish and tuna
- Sunken long line is anchored, buoyed at surface
- Hundreds of small baited lines (100km long)
- Bycatch – over 25% catch typically thrown back (Walker, 2011)



Fishing Techniques: Trawling

- Cone-shaped net dragged behind the vessel
- Cod-end
- Differ according to depth fished
- Electronics and depth sounders
- Floats on one line; weights on bottom line
- Efficient – bycatch & habitat degradation



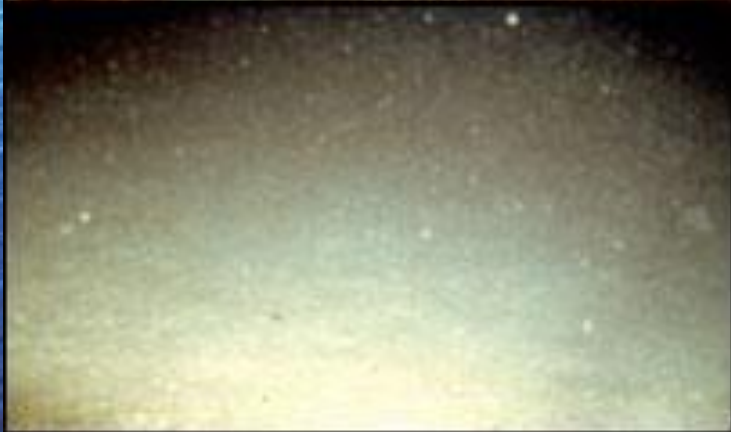
For every kilogram of sole caught in North Sea by trawlers, up to 14kg of other seabed animals are killed



Habitat Degradation: Trawling



Before



After

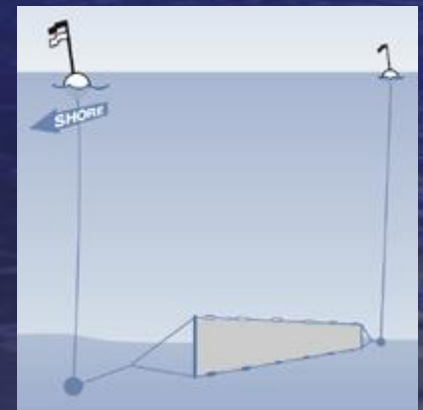
North Sea Trawling



- 90% North Sea trawled at least once a year
- Some places 6 times
- 10,000 dolphins and porpoises taken as a result
- Norway lobster: impact on firework anemone

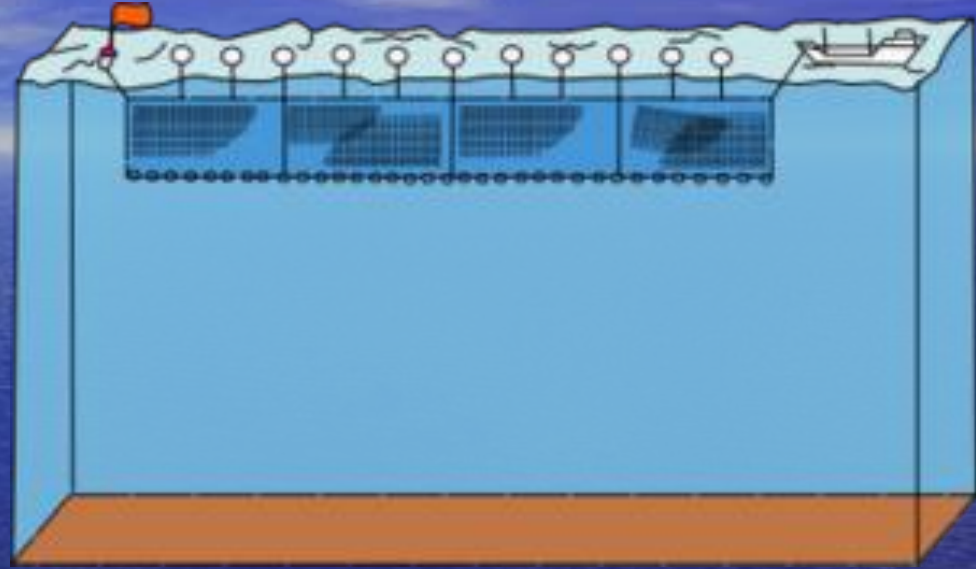
Fishing Techniques: Gillnetting

- Long, flat nets
- 'Curtains'
- Virtually invisible from underwater
- Spaces just big enough to fit fish heads
- Selective – depth & size
- Bycatch – revival tanks



Fishing Techniques - Driftnets

- Tangle nets – pelagic fish
- Free floating
- Set by boats and collected later
- Ghost fishing
- Swordfish and bluefin tuna (illegally)
- Effective, easy to use and passive – no specialisation required





- 1993 a UN moratorium on driftnets
- EU ban - >2.5km in Med
- 2003 global ban on driftnets for swordfish, marlin, sharks & cephalopods

Currently, the use of gill nets, including driftnets, longer than 2.5 kms or to catch large pelagic species is prohibited by European legislation for any EU-flagged vessel or vessels in EU waters



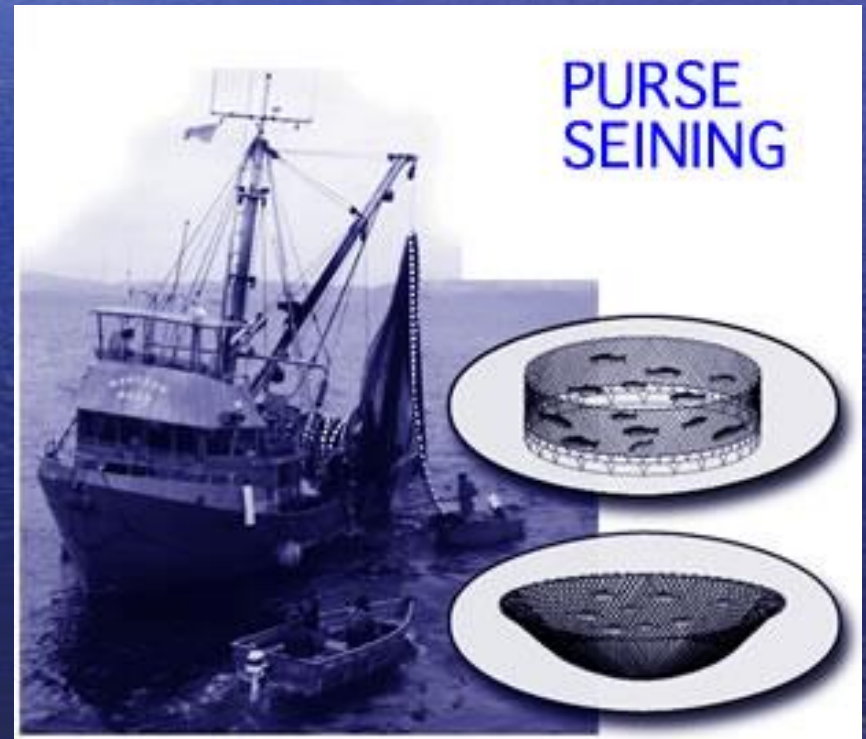
Fourteen years after being banned Italy and France alone account for a fleet of more than 151 vessels that continue using drift nets.

Driftnets

- Banned by UN & EU but many infringements (Italy, Morocco & Turkey)
- 20% swordfish catch in Med using driftnets
- Many longliners use driftnets as well
- Loopholes – conversion plan in Italy following Regulation 1239/98 = compensation
- Poor records – no idea how many driftnets
- Co-operatives beyond EU so driftnetting could continue
- New licences for 'anchored gillnets' <5km

Fishing Techniques: Purse Seining

- School fish encircled with a net – tightened like a drawstring
- Two boats needed
- Efficient
- Bycatch
- Ramping



Fishing Techniques: Recreational Fishing

- Big business – charter boats
- Released
- 'Sport'? – high powered electronics and fish finders







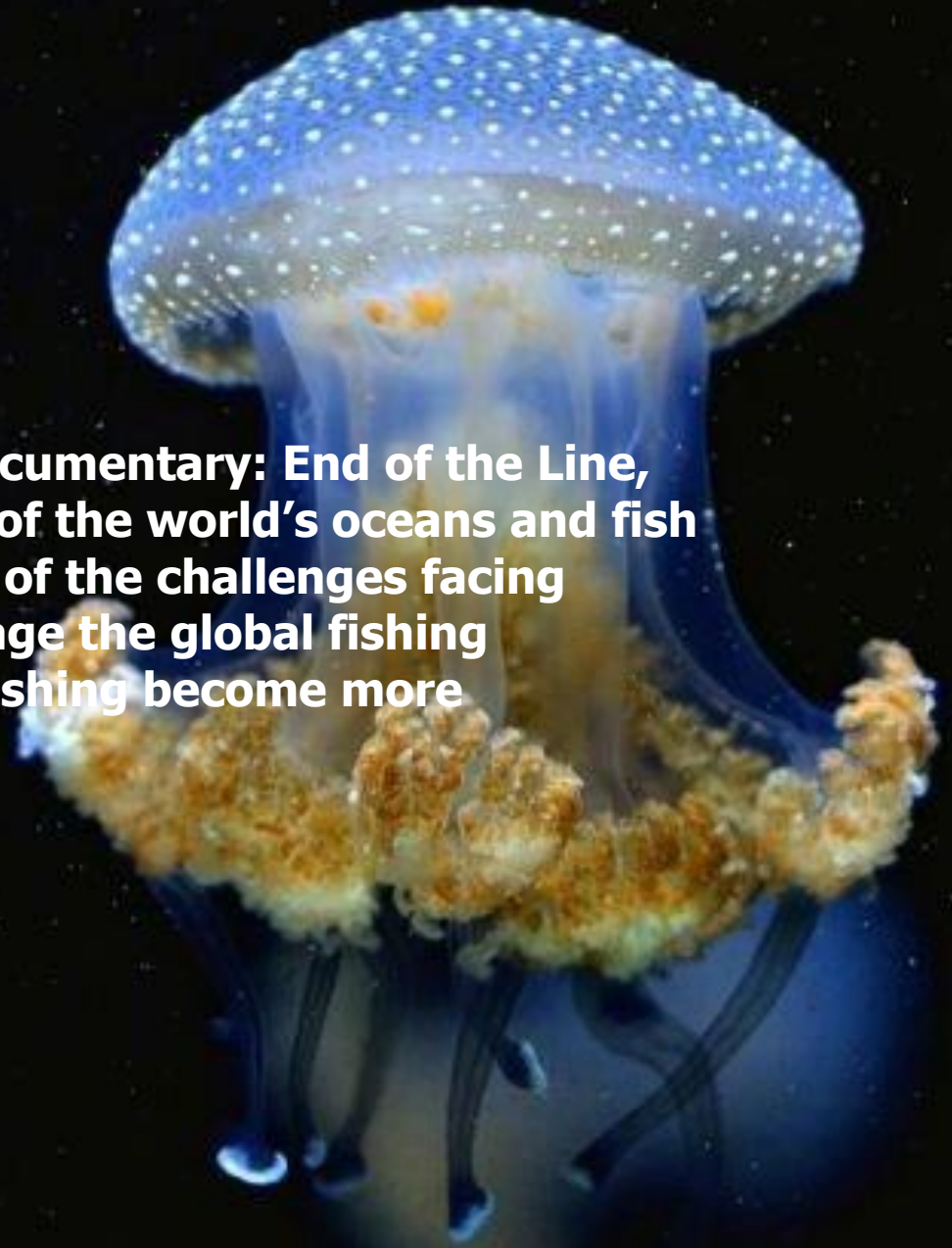
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© D.J. Struntz / Barcroft Media

**Spear fishing may
be more
sustainable but it
still has its dangers**

Use the following documentary: End of the Line, to assess the status of the world's oceans and fish stocks and the scale of the challenges facing those trying to manage the global fishing industry. How can fishing become more sustainable?



Marine Fisheries

- 1% global economy - livelihood of 200 million people
- Poor management and regulation
- 30-50% overcapacity
- Biological stock estimates – quotas set
- $\frac{2}{3}$ fish stocks around UK over-exploited
- Size of catch altered
- 60% probability spawning Southern bluefin tuna reduced to zero by 2020





Atlantic Dawn



The Atlantic Dawn catches in one month what 7,000 artisan fishermen would catch in a good year.

(Hargreaves, 2006)

A large shark is being processed on a ship's deck. A person wearing a red life vest and yellow gloves is holding the shark's head. The shark's mouth is open, showing its sharp teeth. The shark's skin is being peeled back, revealing the underlying flesh.

50% decline in north-west
Atlantic in last 40 yrs

£140/kg in Asia

From 600,000 – 800,000
tonnes in last 20 yrs

**Removal of the 'old men
of the sea'**

(Humphrey, 2009)



Not easy watching but Gordon Ramsey's series called Shark Bait (45mins long on You Tube) is a real eye-opener



On 6 June 2013, the Council of the European Union completed the final step to close loopholes in EU shark finning ban. By adopting a "fins naturally attached" policy without exception, the EU has now effectively ended the practice of shark finning by EU vessels.



The International Union for Conservation of Nature (IUCN) has recommended that sharks be landed with their fins attached, and ten countries have adopted "fins-attached" regulations. Chile, Costa Rica, Colombia, Ecuador, El Salvador, Germany, Oman, Panama, the United Kingdom and the United States require that sharks must be landed with their fins still attached to the carcass.

Lion's Mane Jellyfish

Reduction sharks in N. Atlantic –
explosion in cownose rays *Rhinoptera*
bonasus. Scallop industry in North
Carolina collapsed as a result

(Jha, 2008)



Krill



- Omega-3 fatty acids
- Enzymes – medical purposes
- Cleansers for contact lenses
- Basis of marine food chain
- Future ? Harvesting from 100,000 tonnes to several million tonnes

(Fogarty, 2008)

EU Fishing Fleet

- 88,520 fishing vessels in 2007
- >50% - Greece, Italy and Spain
- UK = 7%
- UK boats n = 6,191 (2016)
- 77% <10m in length
- 25,000 people employed (11,757 in UK in 2016)
- Top 5 commercial catch – herring, mackerel, blue whiting, Norway lobster and haddock





The total number of fishermen is around 11757, down from around 20,000 in the mid-1990s.

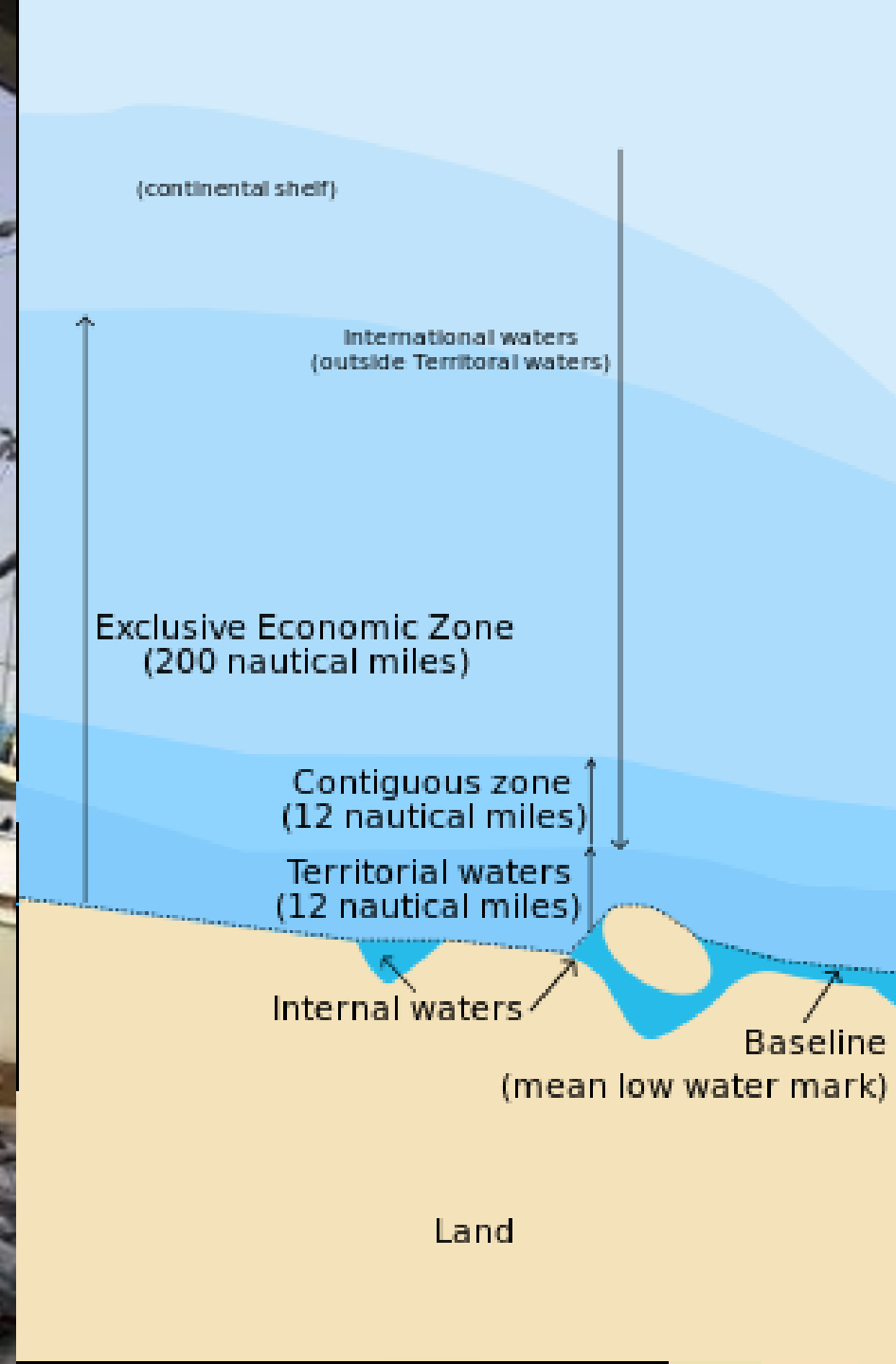
The UK is a net importer of fish, with net imports of around 730,000 tonnes in 2016, worth £3.1bn.

The UK fleet has the second largest total catch (in terms of landed weight) and has the third-largest fleet size (in gross tonnage terms) in the EU

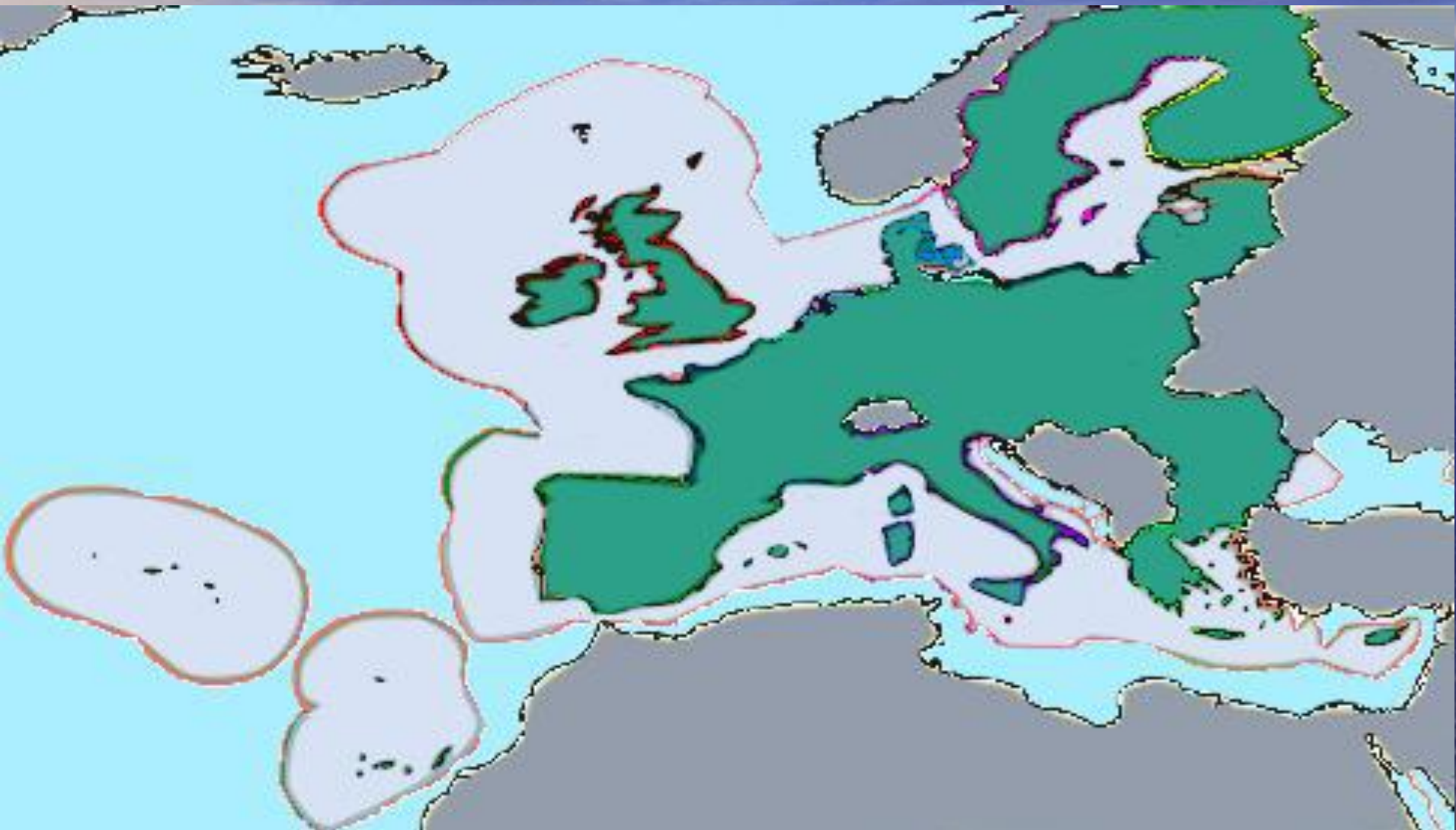
Total landings for 2016 of 700,000 tonnes, an increase of 35,000 tonnes on 2015 figures, an increase of 5%.

Fisheries Legislation

- Coastal states have sovereign jurisdiction – 12 nautical miles (nm) from baseline.
- A state can further extend its limit to 200nm – Exclusive Economic Zone (EEZ)
- Exploitation Rights
- Beyond EEZ – High Seas – freedom of movement and resource access (Rose, 1996).



Exclusive Economic Zone in Europe



Fisheries Legislation - International

- **EU Habitats Directive**
- **ASCOBANS** (Agreement on Conservation of Small Cetaceans of the Baltic and North Seas)
- **UN Convention on the Law of the Sea (CLOS)(1995)**
 - Requires Member States to take responsibility for marine ecosystem and biota preservation within their national boundaries
 - Extends to EEZ
 - Legally binding for states who have ratified agreement

Fisheries Legislation - Regional

- **Common Fisheries Policy** (2002) – fisheries required to minimise adverse ecosystem impacts.
- Sea Fisheries Committees – statutory bodies which regulate territorial waters
- Enforce byelaws and undertake gear and catch inspections
- Jurisdiction out to 6 mile limit (CCW, 2003)



Inshore Fisheries Management (Defra, 2009)

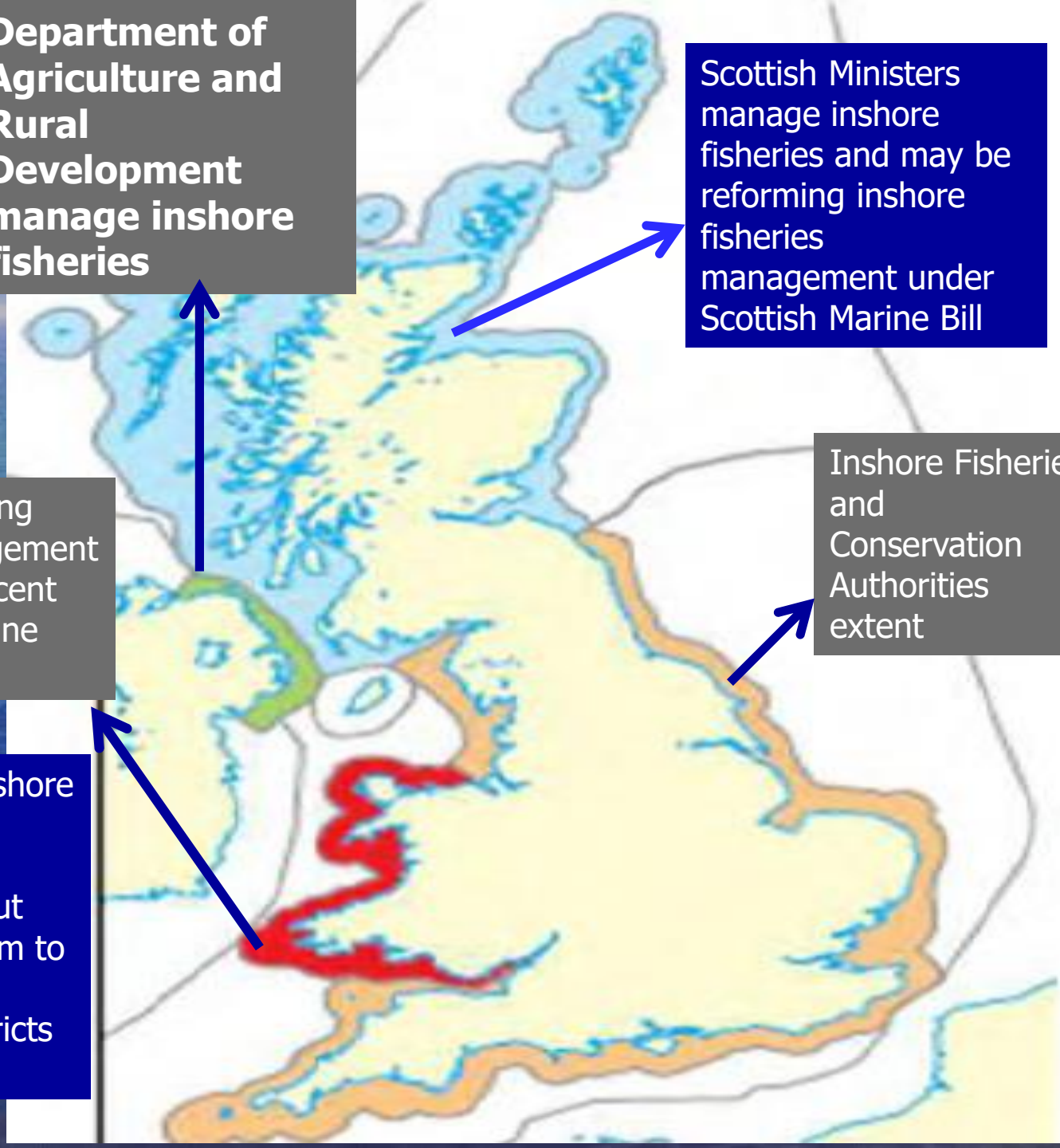
Department of Agriculture and Rural Development manage inshore fisheries

Scottish Ministers manage inshore fisheries and may be reforming inshore fisheries management under Scottish Marine Bill

Welsh Government taking inshore fisheries management powers for waters adjacent to Wales under UK Marine and Coastal Access Act

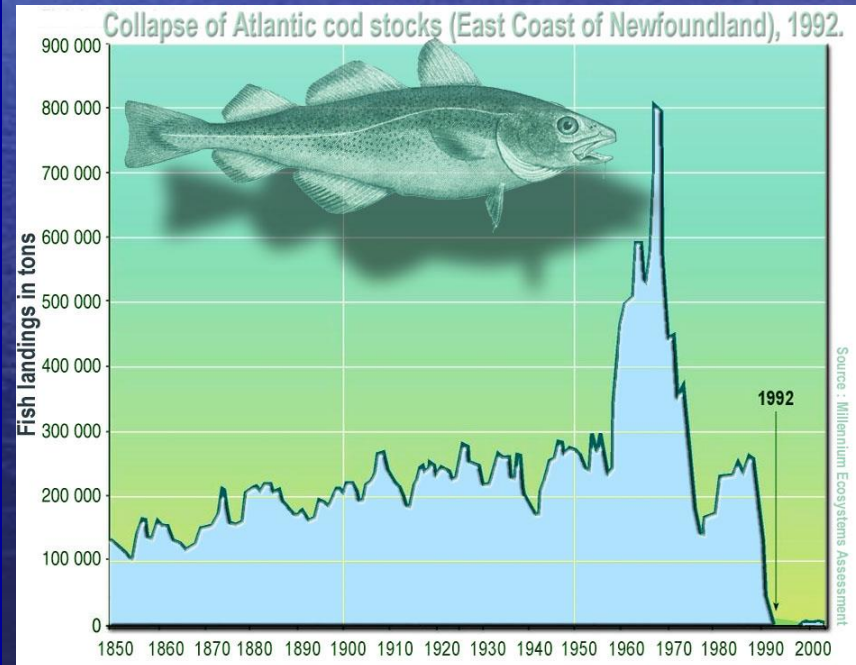
Inshore Fisheries and Conservation Authorities extent

NOTE: The Act allows Inshore Fisheries & Conservation districts to extend up to 12nm (as shown here) but policy intention is for them to extend to 6nm, as Sea Fisheries Committee districts do now.



Problems with the CFP

- Overfishing & environmental degradation
- –90% cod caught before mature
- –European Commission claims 88% EU stocks are overfished
- –Closure North Sea cod fishing grounds repeatedly ignored by the Council of Ministers
- –Oceans are being cleared at twice the rate of forests





Problems with CFP

Over-capacity and Enforcement

- Too many boat chasing too few fish
- EU funding schemes to reduce capacity – in essence taxpayer subsidies awarded so that fishermen don't go to sea!
- EU Court of Auditors (2007) – all aspects of enforcement were failing (incl the UK)
- Poor data
- Inadequate monitoring
- Inadequate powers for the Commission to pursue Member States flouting the rules.

Problems with CFP



•Politics & Previous Reforms

- Political clout
- Member States failing to stand up to fishing industry leaders
- While attempts have been made to decommission and introduce quotas – they all failed to reduce over-fishing

Fisheries Conservation Methods

- Basis for management: Common Fisheries Policy 1983; 2002; 2012
- Complicated, bureaucratic and expensive
- Protection of stocks:
 - Quotas
 - Technical conservation methods
 - Fleet reduction programme

Quotas



- Scientific advisers – information used by EU to establish TACs (Total Allowable Catch) of main commercial stocks
- Distribution of TACs based on historic patterns of fishing
- Reinforcement – trawlers limited to no. days at sea and particular species
- Common for trawler owners to purchase licences off one another

Quotas

- Failed in their conservation objectives
- Landing of 'black fish' common practice
- 40% landings illegal in some ports
- Underestimation of landing statistics
- **Quota hopping** - in 1991 the European Court of Justice overruled a court decision in the UK and legalised the practice of quota hopping. This set a precedent allowing national fleets (Spanish, in this instance) to register their boats and buy quotas in other member states to avoid fishing restrictions





“75% of EU fish stocks are overfished, compared to 25% on average world wide. This overfishing in the EU damages fish stocks, leads to uncertain catches and makes our fishing industry financially vulnerable. Fragile fish stocks lead to suboptimal catches and this in turn leads to more fishing. Today, overfished stocks are mostly made up of smaller and less valuable fish. These are discarded back into the sea either because of their low commercial value or because they are below the minimum size” (Europa, 2011:1)

Discard

A photograph of a fisherman on a boat, wearing a blue jacket and green overalls, pouring a large white bucket of discarded fish into the sea. Another fisherman in a yellow raincoat stands in the background. The scene is set on a boat with a red cabin and yellow masts.

Across all EU fleets, stocks of cod worth £2.7bn were discarded in the North Sea, the Channel and Skagerrak, the strait adjoining Norway, Sweden and the north of Denmark between 1963 and 2008 (Walker, 2011)

Why Discard?

- Regulations of CFP are to blame:
- Non-quota species
- Quotas exceeded
- Immature stock – under legal minimum landing size
- Low commercial value
- Unwanted benthos or capture protected species
- Unselective gear



Technical Conservation

- Minimum mesh size
- Size of fish to be landed
- Restrict access to juvenile aggregation areas
- Real time closures



**EU cod fishing
quotas increased in
North Sea while
reduced effort
employed in Irish
Sea**

**Also separator
trawls used which
allow haddock to
be caught but cod
to escape.**

(Jenkins, 2000)



Fleet Reduction

- Decommissioning
- Technological efficiency outweighing any decommissioning
- 'Rule beaters' – vessels below 10m escape certain forms of legislation
- "one out one in"



UK Position



- Between 1886 and 2006 – reduced its fleet by 21%
- Cuts in white fishing fleet affected 60-70% of fleet
- Sale of licences to other EU countries has obviously caused much discontent

2013 Reform!

- Discards banned
- Rewarding sustainable fishing techniques
- Strict limits on number days at sea
- Integrate fisheries management into the broader marine environment
- Consider preference for coastal waters for local fisheries



2013 reform

- Not quite final –passed into law 2016
- Spain and France oppose changes
- How will these changes work in practice?



Common Fisheries Policy 2014 (Reform)

- Commitment to eliminate discards
- Decentralise decision making away from Brussels.
- Legally binding requirements to set fishing rates at sustainable levels.
- Brexit..... Who knows?
- With decentralised decision making, member states can work together to agree which detailed measures are appropriate for their shared fisheries.

Incentives to accompany discard ban

- Support from the European Maritime and Fisheries Fund (EMFF):
 - Extra storage capacity
 - Fund marketing campaigns
 - On-board observers
- Enforcement – Electronic tracking, reporting





- The number of Scottish boats carrying cameras - which monitor the fish being caught - has halved since the scheme was introduced. New species were added to the ban at the start of January- cod & whiting
- The fall in Remote Electronic Monitoring compromises stock management
- Until this year, skippers were allowed an additional quota for North Sea cod if they agreed to install the camera equipment, but that incentive has ended. (Keane,2017)

What happens when unintentional catches occur despite improved selectivity?

- High survival rate released
- Undersized fish – fishmeal or pet food production
- In excess of quota – marketed as normal but have to buy or lease additional quotas
- Deduct from next year's quota



The Norwegian Model

- Land whole catch.
- That above the quota is paid @25% - discourage repeat offenders.
- Money raised goes to fisheries charity
- Min size cod is 44cm cf. 37cm European standard
- Barents Sea – only Norway & Russia – easier to form agreement & enforce regs



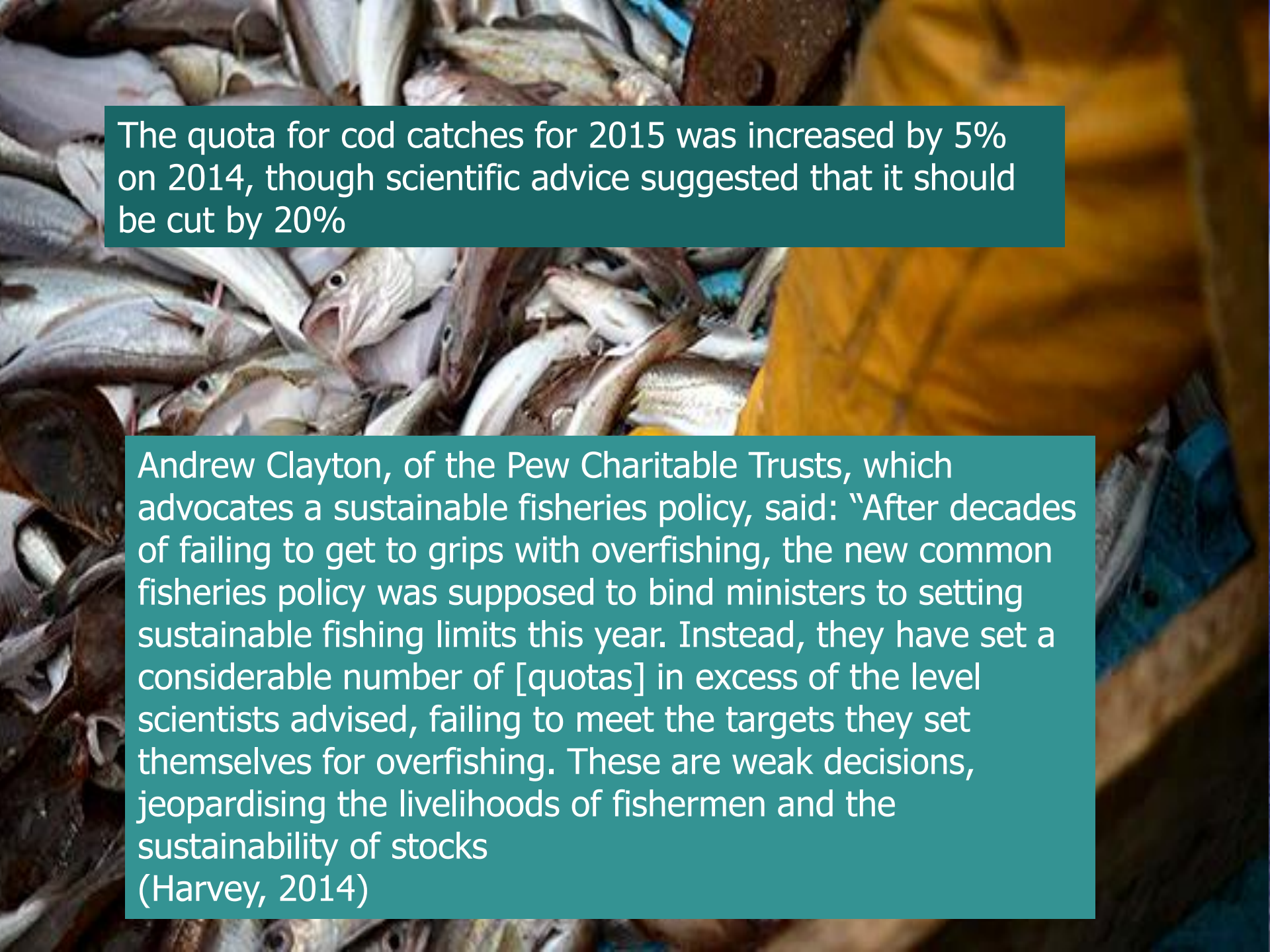
Maximum Sustainable Yield

- Largest catch that can be taken over an indefinite time without harming the population
- Achieved by 2015
- 11 stocks already – North Sea haddock, Rockall haddock, North Sea herring, megrim off Spain
- Fished sustainably with increased landings & income



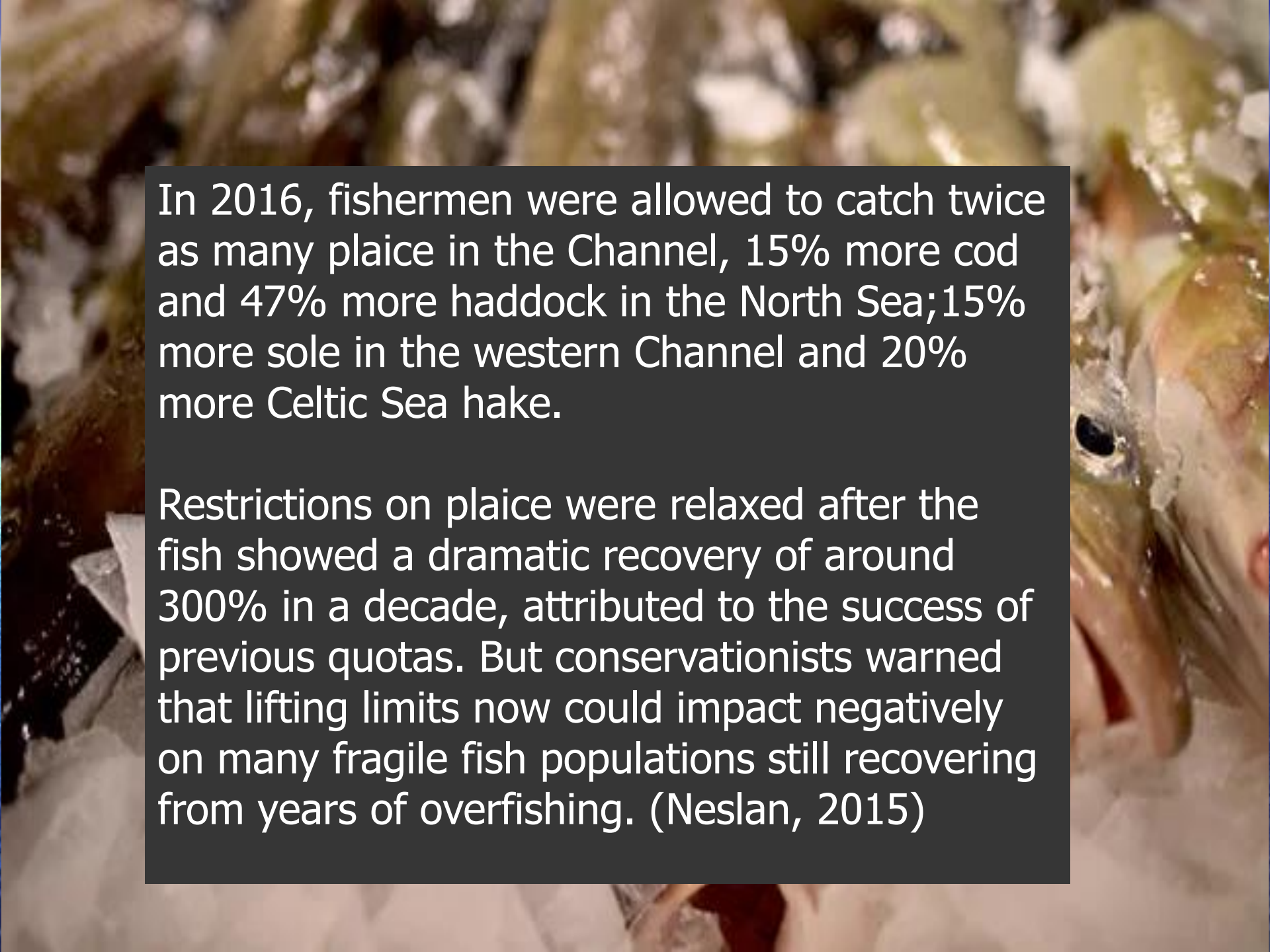
MSY for data deficient stocks

- Obligation to land all catches
- New partnerships – scientists and fishermen
- Mixed fisheries – more selective gear
- Mixed fisheries – quotas for all species
- Marketing initiatives – brand MSY fish



The quota for cod catches for 2015 was increased by 5% on 2014, though scientific advice suggested that it should be cut by 20%

Andrew Clayton, of the Pew Charitable Trusts, which advocates a sustainable fisheries policy, said: "After decades of failing to get to grips with overfishing, the new common fisheries policy was supposed to bind ministers to setting sustainable fishing limits this year. Instead, they have set a considerable number of [quotas] in excess of the level scientists advised, failing to meet the targets they set themselves for overfishing. These are weak decisions, jeopardising the livelihoods of fishermen and the sustainability of stocks
(Harvey, 2014)

The background of the slide is a close-up photograph of fishing gear, specifically a mesh net, filled with various types of fish. The fish are mostly silvery and yellowish, likely plaice or similar flatfish, and are packed closely together. The lighting is somewhat dim, giving the scene a natural, documentary feel.

In 2016, fishermen were allowed to catch twice as many plaice in the Channel, 15% more cod and 47% more haddock in the North Sea; 15% more sole in the western Channel and 20% more Celtic Sea hake.

Restrictions on plaice were relaxed after the fish showed a dramatic recovery of around 300% in a decade, attributed to the success of previous quotas. But conservationists warned that lifting limits now could impact negatively on many fragile fish populations still recovering from years of overfishing. (Neslan, 2015)

CURRENT ADVICE ON WHICH FISH TO EAT

Cod: Only eat if the stock comes from the north-east Arctic or Iceland. Other areas are classed as overfished and unsustainable.

Dab: Often discarded by fishermen because of its relatively low value, this flatfish is considered relatively abundant.

Herring: A resilient species. But don't buy stock from west of Scotland and west of Ireland caught in large nets that ensnare a lot of bycatch (pelagic trawl).

Mackerel: Returned to the fish-to-eat list in 2013 after signs stocks were recovering. Best when caught with traditional methods including handlines, ringnets and drift nets.

Rainbow trout: Largely sourced from fish farms in the UK. For wild-caught rainbow trout, ask if the fishery is certified.

A recovery from near total collapse has led North Sea cod stocks to be labelled as sustainable by the Marine Stewardship Council for the first time in 20 years (July 2017)



CURRENT ADVICE ON WHICH FISH TO AVOID

Sea bass: A tasty white fish, the exact status of stocks is unknown and slow growth and late maturity make the species particularly vulnerable to overexploitation.

Whitebait: A catch-all term for small fish. Harvesting fish when they are small and young affects the overall growth of the population. These fish are also important prey for other marine species.

Atlantic halibut: This delicacy has been heavily overfished and is listed as an endangered species.

Plaice: North Sea stocks are considered sustainable but this flatfish suffers from high discard rates elsewhere.

Whiting: Mainly a bycatch species that suffers from high discard rates. Ask for and eat fish from trawlers using approved methods to improve selectivity.

(Marine Conservation Society, 2016)

European Fisheries Fund (EFF)

- Fund to make industry more sustainable but remain profitable
- Fixed pot of money – applications were open until 31st Dec 2013
- Different allocations according to location, nature of project etc
- Cornwall is ring-fenced as it is in a convergence area – weak economy

European Fisheries Fund (EFF)

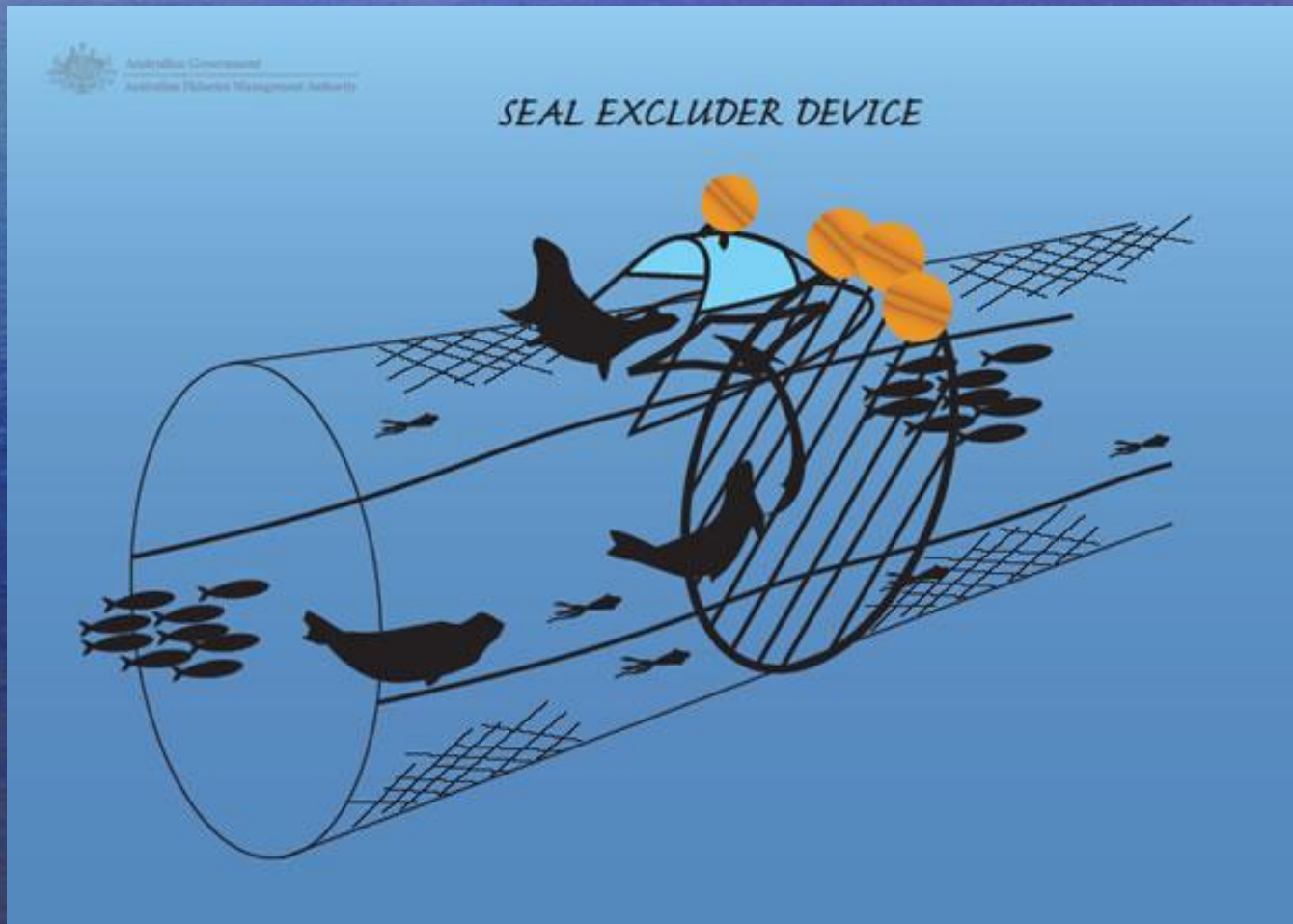
Measure	England	Cornwall
Axis 1: Measures for the adaptation of the community fishing fleet, such as improvements on board fishing vessels.	£11.5 million	£3 million
Axis 2: Measures for investments in aquaculture and processing, and for marketing of fishery and aquaculture products	£4.3 million	£1.2 million
Axis 3: Measures of common interest, such as harbour and port developments which will benefit fishermen.	£12 million	£3.5 million

European Fisheries Fund (EFF)

- Innovation Fund - £1 million to support new ideas that could improve the way the under 10 metre sector operates.
- Devolved nations:
 - Scotland nearly £44 million (€55 million)
 - Northern Ireland just over £14 million (€18 million)
 - Wales just under £14 million (€17 million).
- Managed by Defra and the Marine Management Organisation



Bycatch Exclusion Devices



Sustainable Fishing Techniques

- Escape rings that light up
- Harvest own energy from water motion
- Keep net rigid
- Average net would need 20 costing £500



Sustainable Fishing Techniques

- The rings fit into the 'cod-end' of the net - the part where all the fish are kept - and they basically exploit fish behaviour and their physical size to guide some to safety while keeping the other ones in. They act as kind of emergency escape sign."



What About Pirate Fishing?

- Unregulated
- Flags of Convenience
- Cheap registration fees
- Low or no taxes
- Freedom to employ cheap labour
- Safety issues with language barrier
- Environmental Justice Foundation – look up reports



Pirate Fishing

- £8.3 billion p.a
- Chiefly in prawns
- Fleets from Japan, Korea, Taiwan and Europe
- >700 illegal vessels operating off Somalia
- £500 million loss p.a.



Some suggest that the money spent on debt relief or aid may be better spent on helping African nations enforce international law

Aquaculture/Mariculture

Demand fish products increases

Global population increases

Over harvesting persists

Farmed fish can plug the void

2.5 million tonnes caged fish



- 
- Job creation
 - Product - fish, molluscs and crustaceans
 - Wastes – uneaten food, faeces, chemicals, disease organisms
 - So is aquaculture the answer to the overfishing?

Aquaculture

- 2.5 million tonnes salmon p.a.
- Pollution - Eutrophication
- Dilution of genetic integrity
- Habitat loss
- 50% reduction wild populations (Ford and Myers, 2008)



Aquaculture

- Sited sensitively
- Intensification of production
- Boat disturbance
- Feed consumption – 23% fishmeal production; 28% fish oil use
- Scavengers
- Predators
- Vectors of disease
- Waste – sea grass impacts



Self Study / Revision

- Assess the state of our oceans. How big an issue is overfishing and how can the problem be tackled
- How does pirate fishing affect the global fishing industry and how extensive is the problem?
- Evaluate technical solutions designed to minimise bycatch and discard?
- Is aquaculture the answer to overfishing?