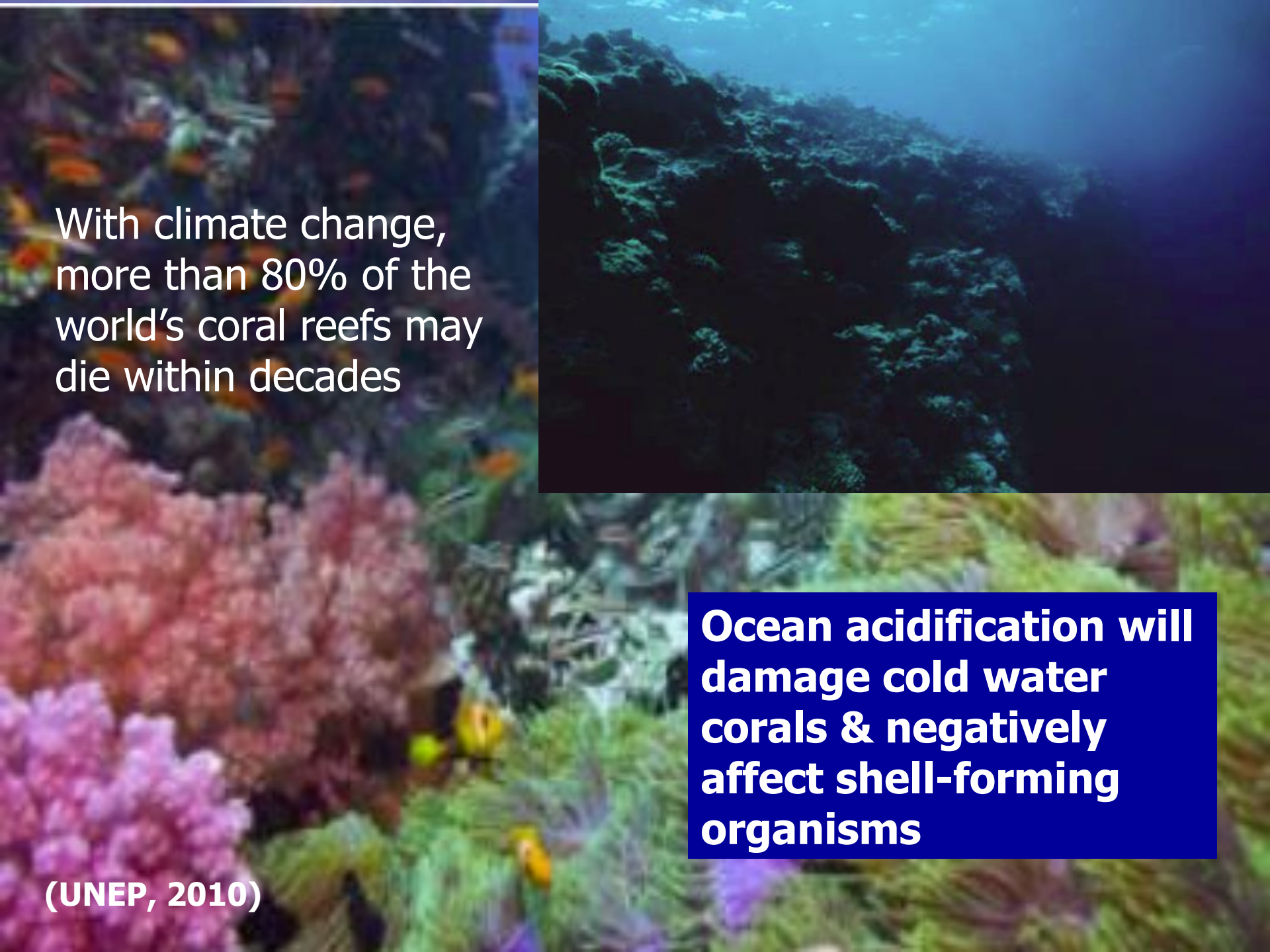


The Legacy of Overfishing



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

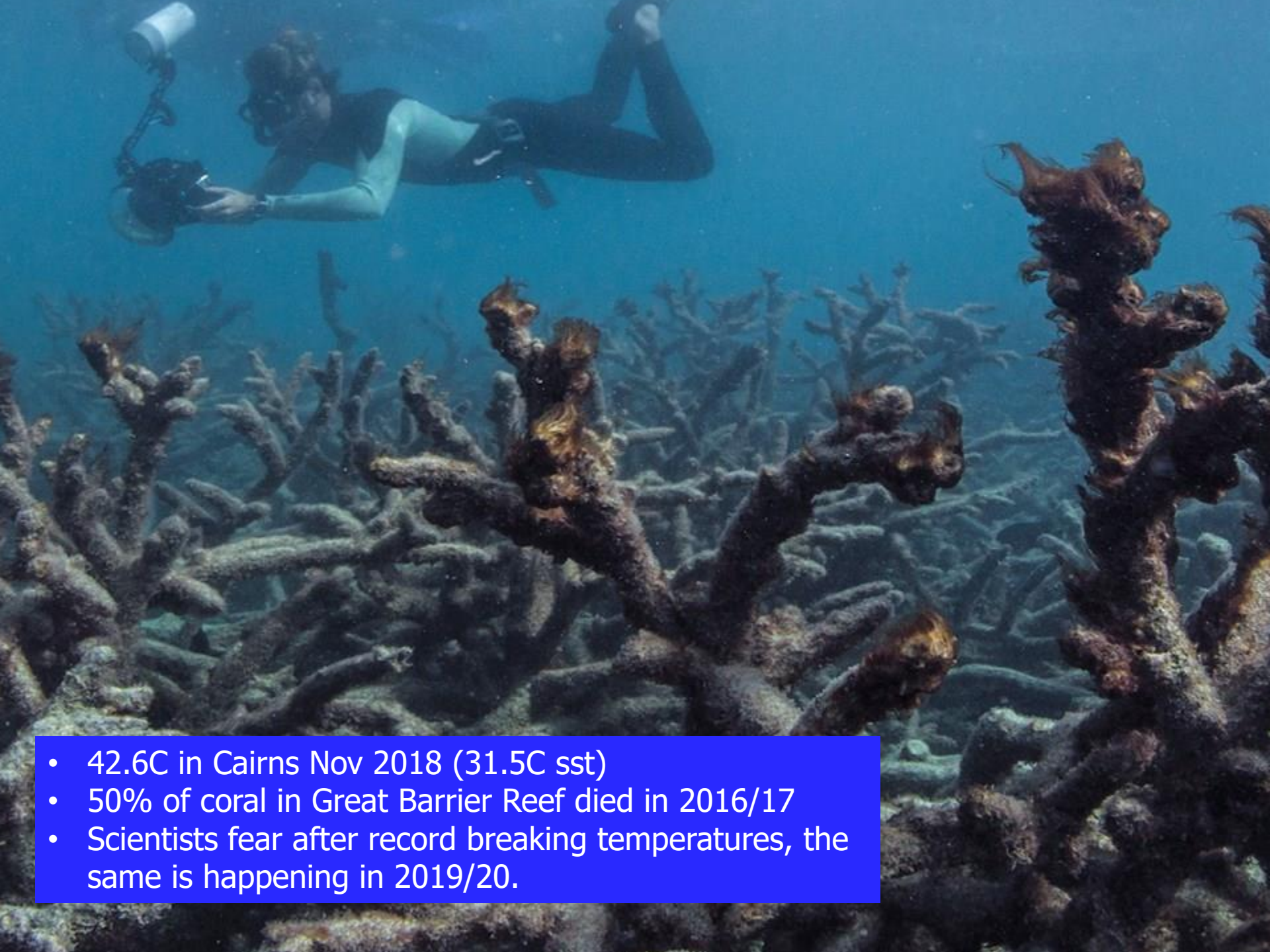




With climate change,
more than 80% of the
world's coral reefs may
die within decades

**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 happening in 2019/20.

Coral Bleaching in 2020

- Severity of bleaching second only to 2016
- “No one event will kill the Barrier Reef but successive bleaching events creates significant damage. Its resilience is not limitless” (Hughes, 2020:1)
- A recent study – corals have more than halved in the past 25 years (Visontay, 2020)





- 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*

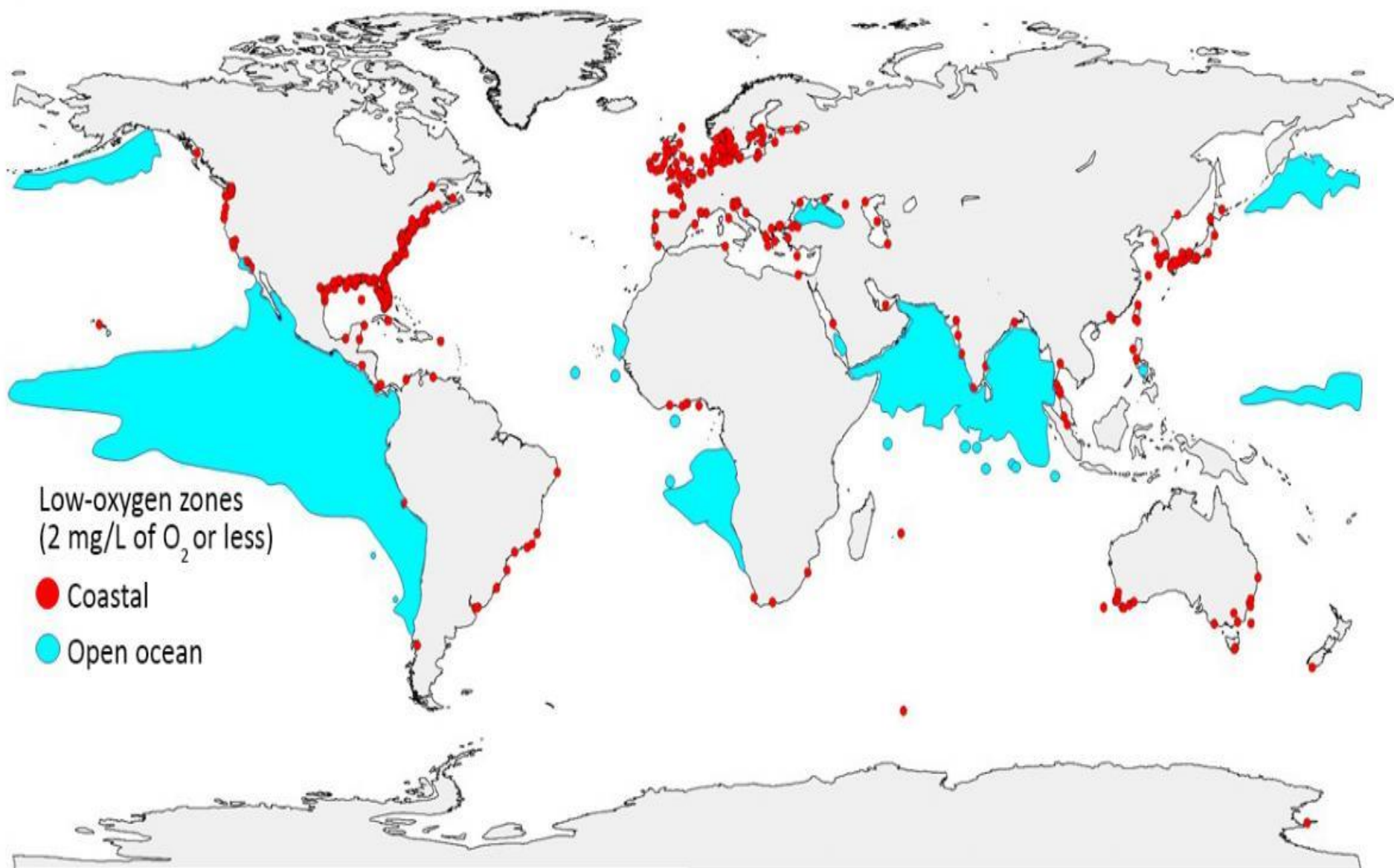
A photograph of a rocky coastline. In the foreground, a metal structure, possibly a staircase or a walkway, is built into the rocks. The water is dark, but there is a prominent, bright green algal bloom or sea urchin colony in the middle ground. The sky is overcast.

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

A photograph of a large industrial ship, possibly a container ship or a bulk carrier, at sea. The ship is emitting thick white smoke from its funnels. The sky is overcast, and the water is calm.

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

(UNEP, 2010)

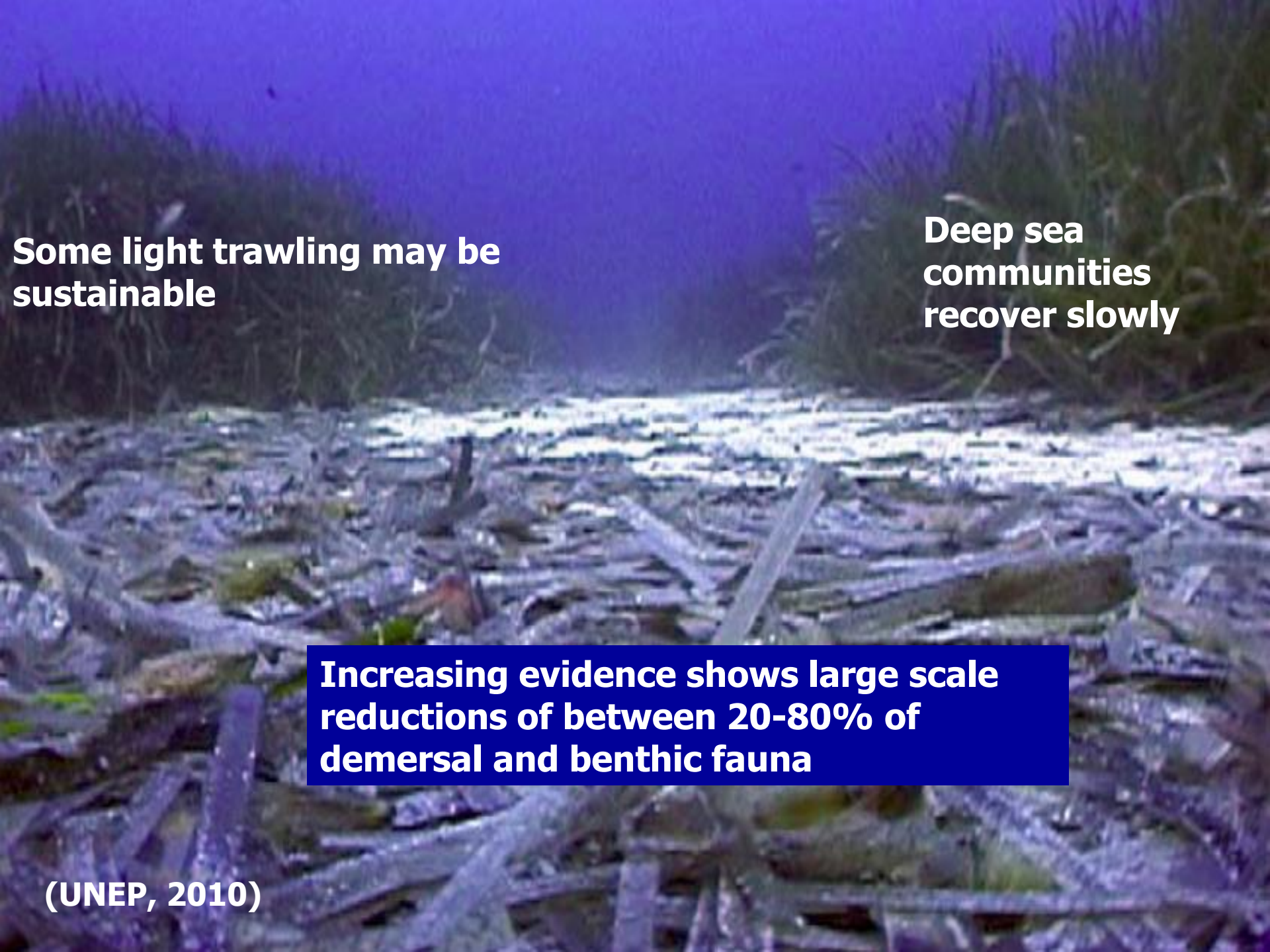


**Reduced thermohaline circulation and
natural flushing of coastal areas –
climate change & pollution**

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



(UNEP, 2010; Rahmstorf et al., 2015)



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 boat and birds in the background. The sky is filled with orange and yellow clouds, and the sun is low on the horizon. The ocean is dark blue with white-capped waves. A small boat is visible on the right side of the horizon, and two birds are flying in the foreground.
- 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
 - Sustainable Solutions

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, 2017)



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)



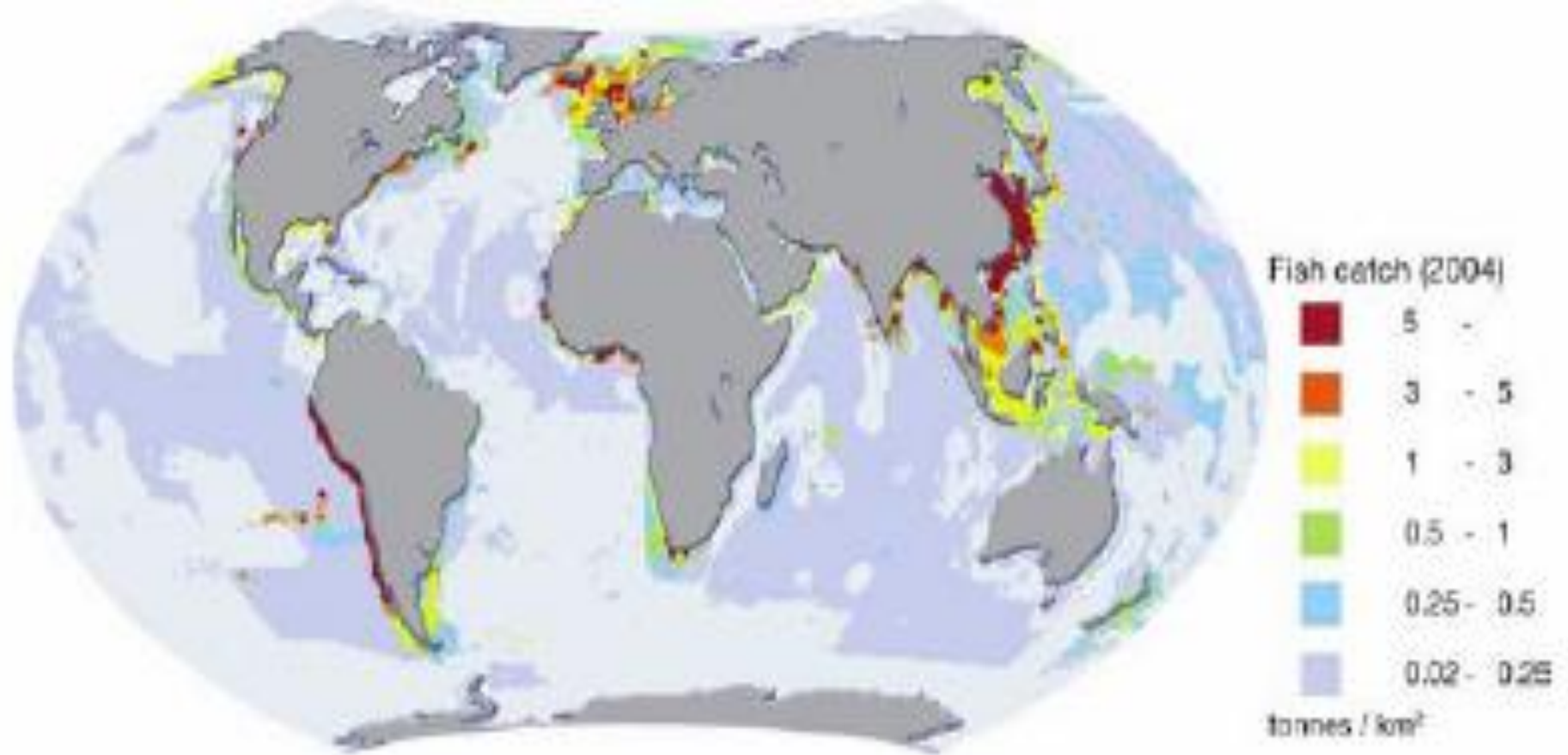
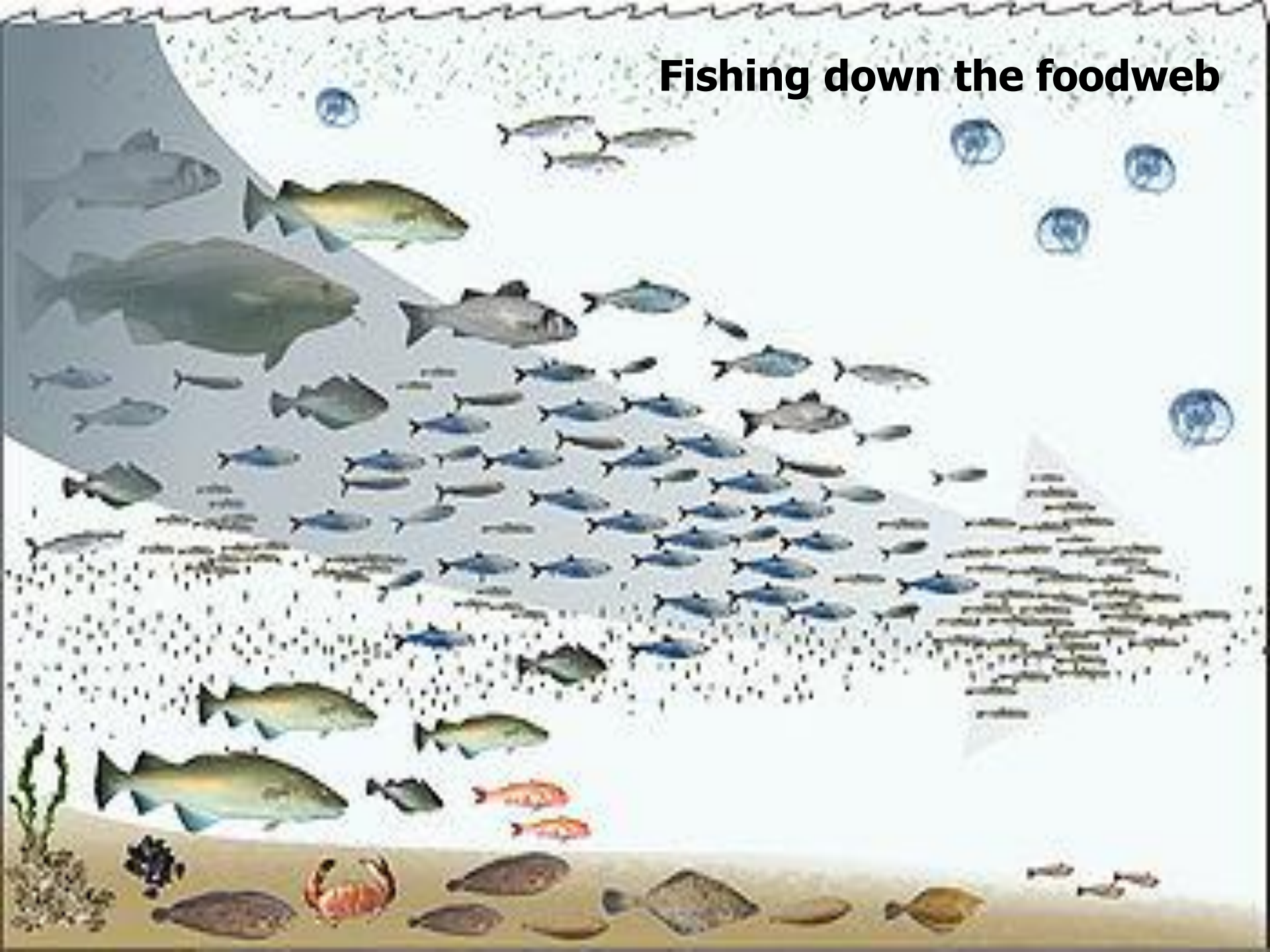


Figure 6. The World's most productive fishing grounds are confined to major hotspots, less than 10% of the World oceans.

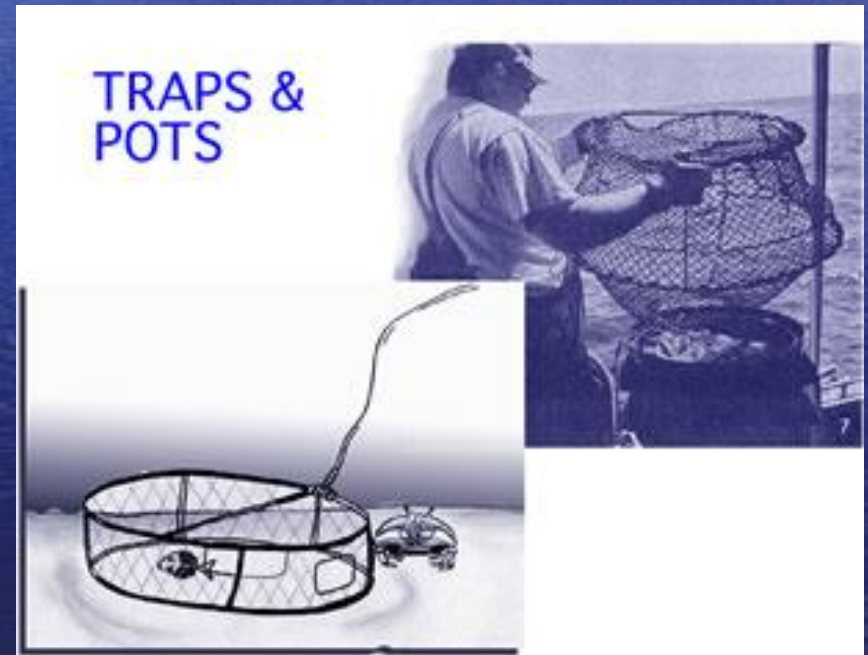
Annual catch (tonnes per km²) : a strong geographical concurrence with continental shelves, upwelling and primary productivity

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



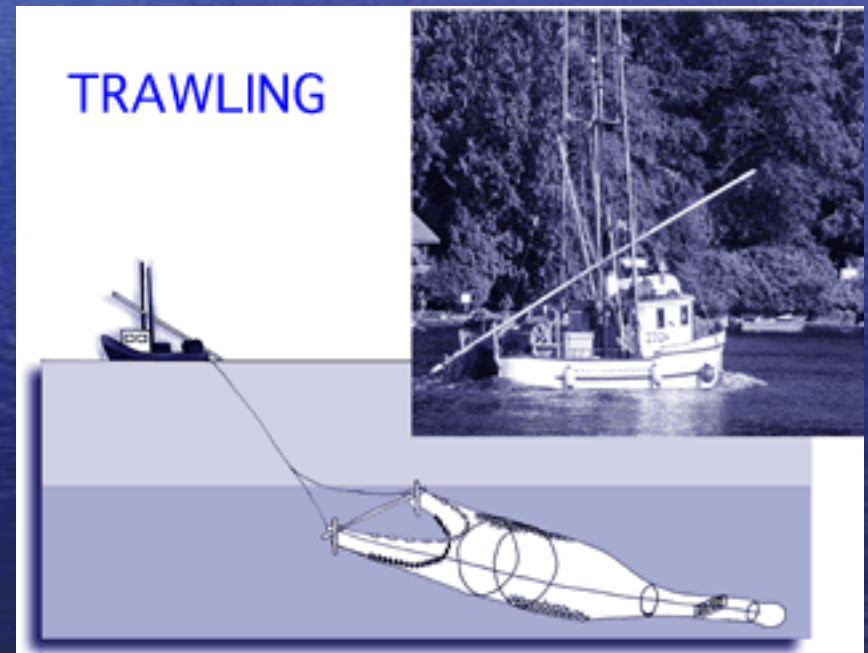
Fishing Techniques: Longlining

- 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



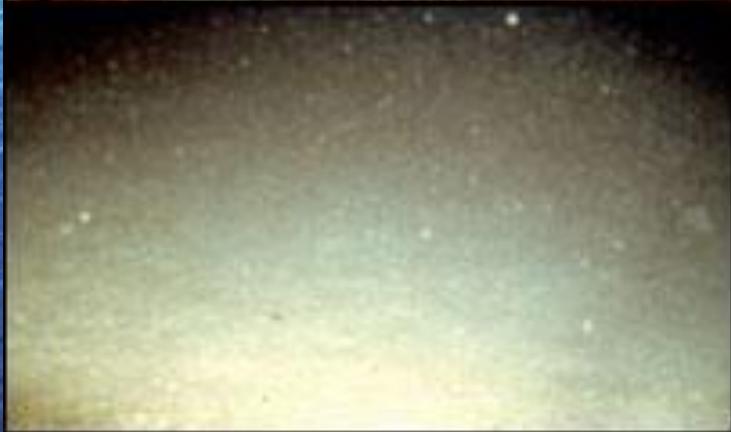
For every kilogram of sole caught in North Sea by trawlers, up to 14kg of other seabed animals are killed (McCarthy 2002)



Habitat Degradation: Trawling



Before



After

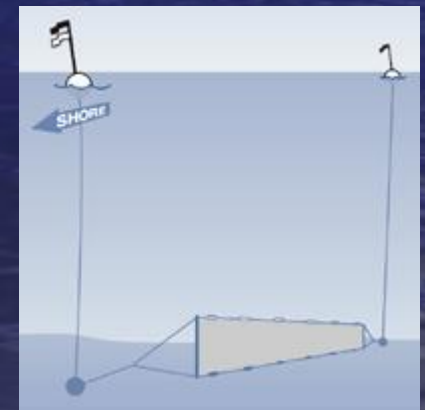
North Sea Trawling



- 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

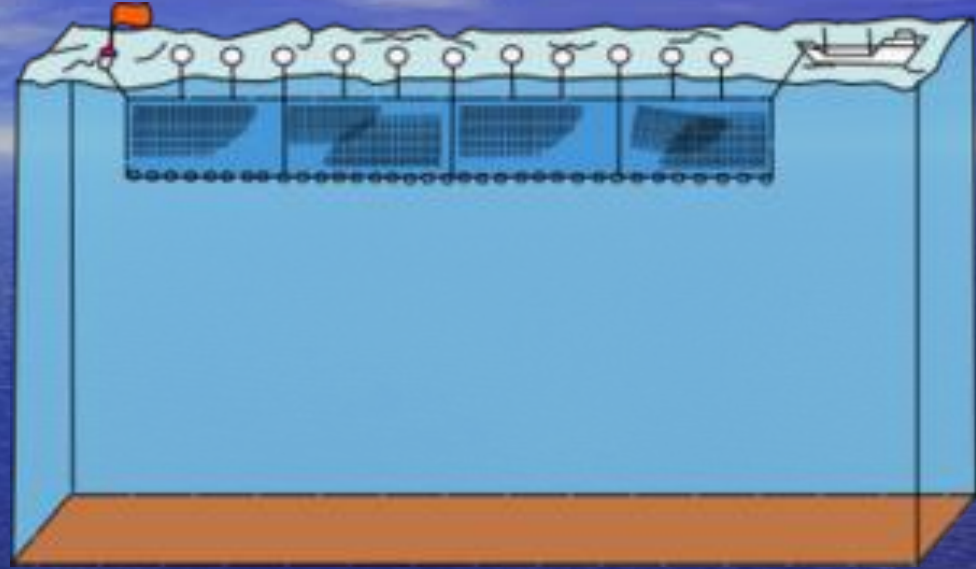
Fishing Techniques: Gillnetting

- 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

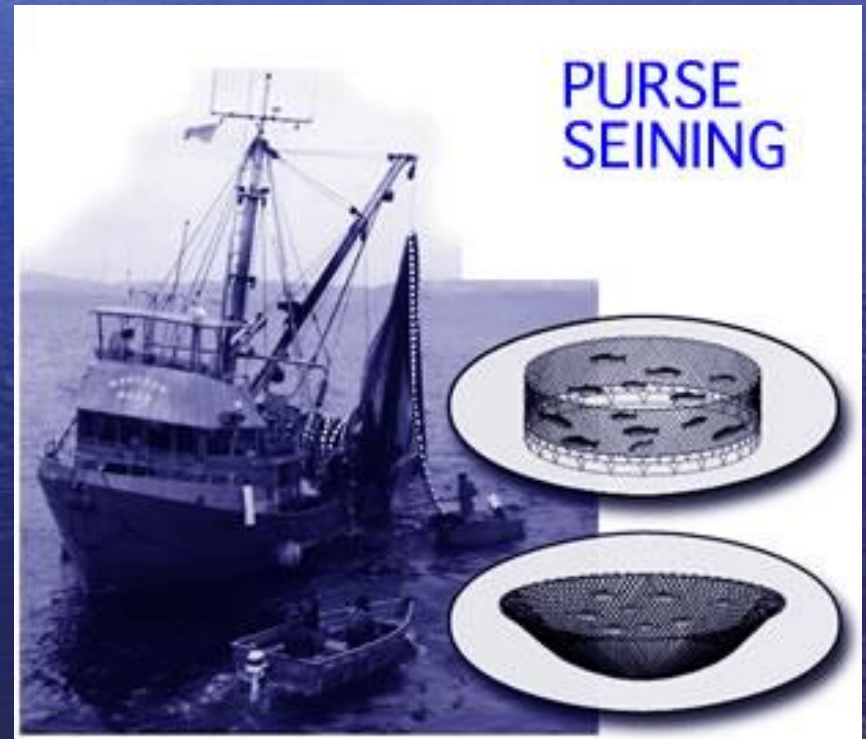
Currently, the use of gill nets, including driftnets, longer than 2.5 kms or to catch large pelagic species is prohibited by European legislation for any EU-flagged vessel or vessels in EU waters



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

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







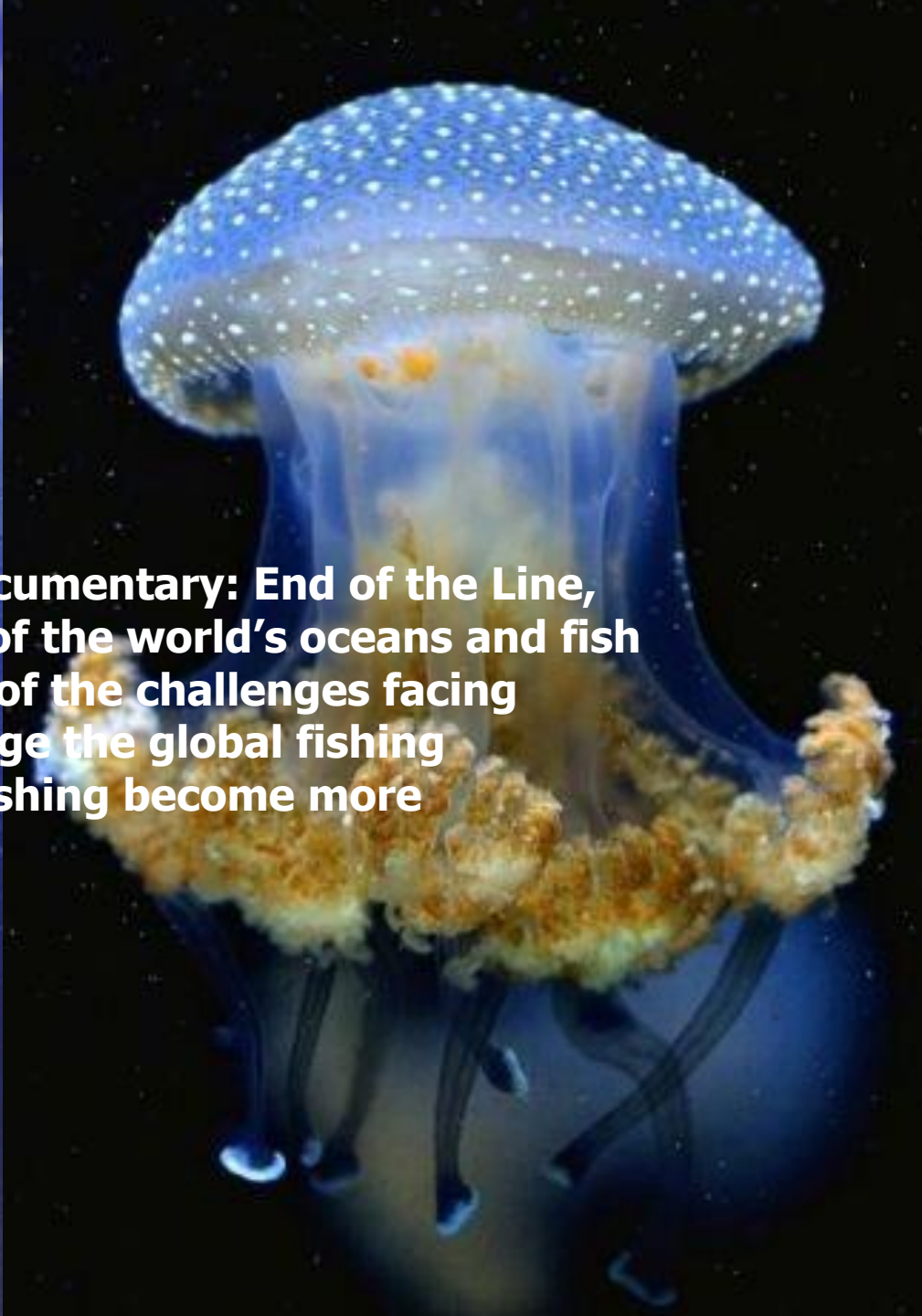
© D.J. Struntz / Barcroft Media



© 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





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)



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

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 2017
- >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
- What is the current status of these commercial stocks?





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

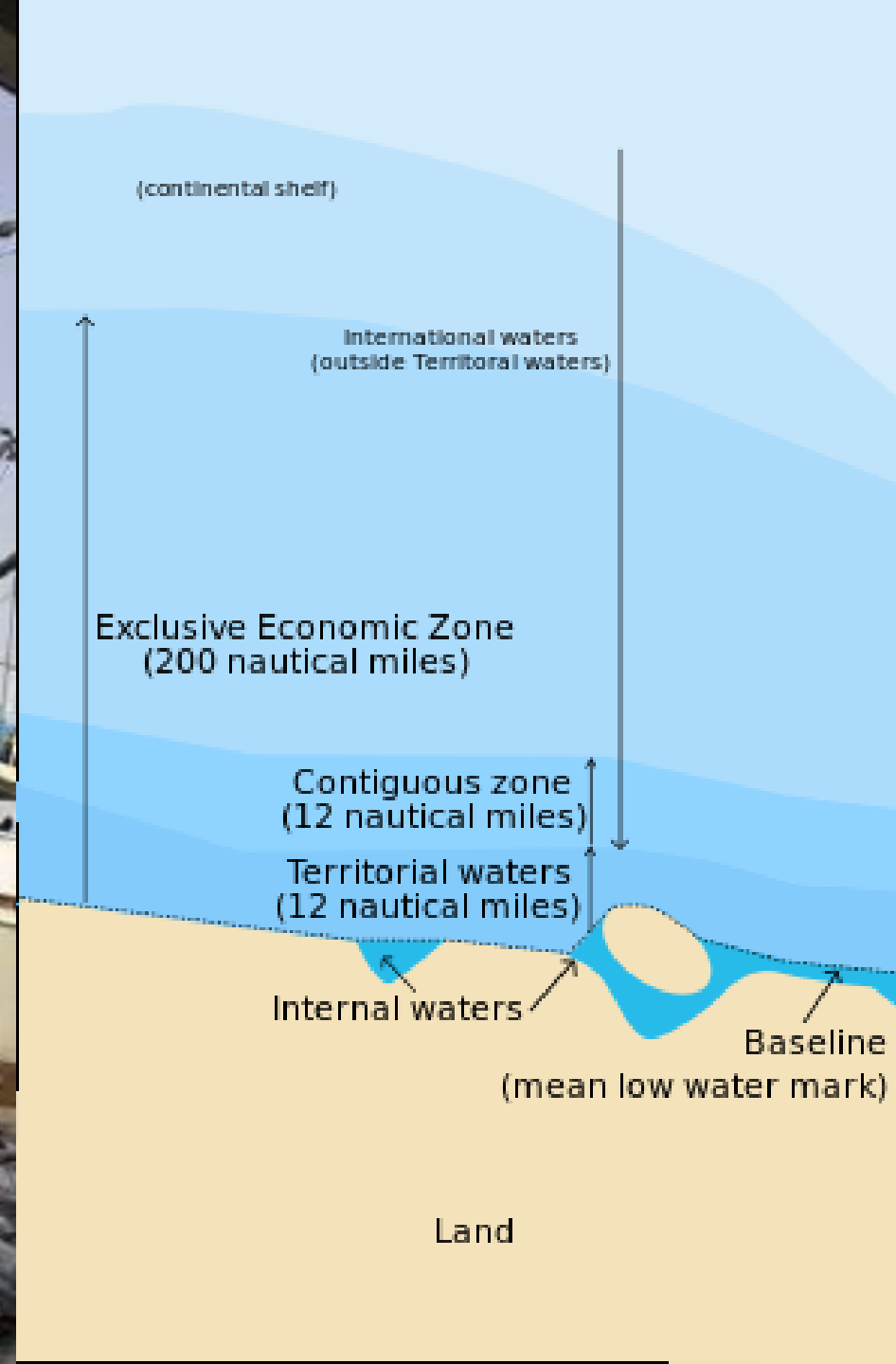
The UK is a net importer of fish, with net imports of around 730,000 tonnes in 2016, worth £3.1bn.

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

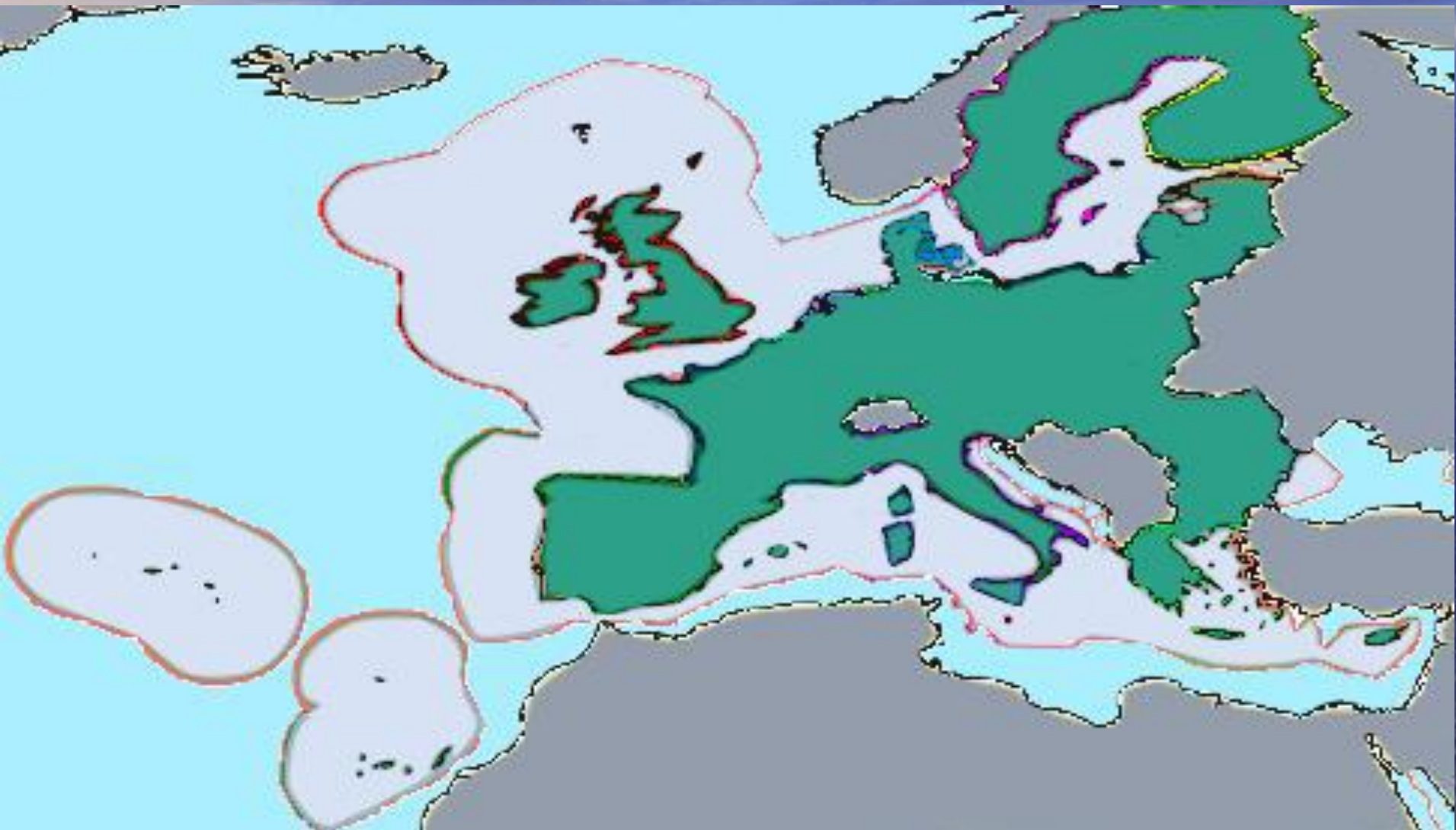
Total landings for 2016 of 700,000 tonnes, an increase of 35,000 tonnes on 2015 figures, an increase of 5%.

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)

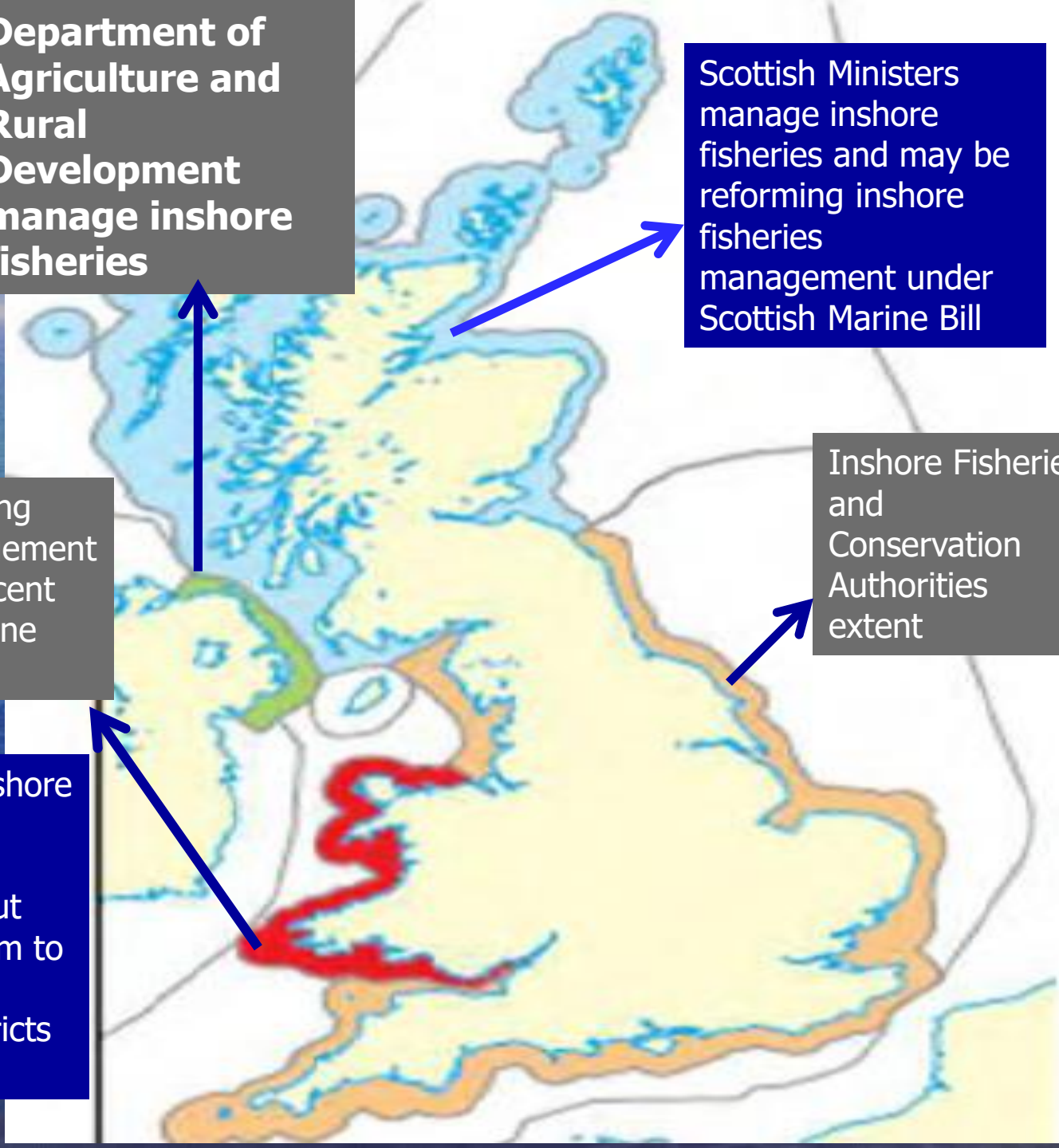
Department of Agriculture and Rural Development manage inshore fisheries

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.



Quotas



- Scientific advisers – information used by EU to establish TACs (Total Allowable Catch) of main commercial stocks
- 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



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 1986 and 2016 – 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
- What of Brexit? tbc

Discard

A photograph of a fisherman on a boat, wearing a blue jacket and green overalls, pouring a large quantity of small fish (discards) from a white bucket into a black container. Another fisherman in a yellow jacket is visible in the background. The scene is set on a boat with a red cabin and yellow railings.

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



2013 Reform!

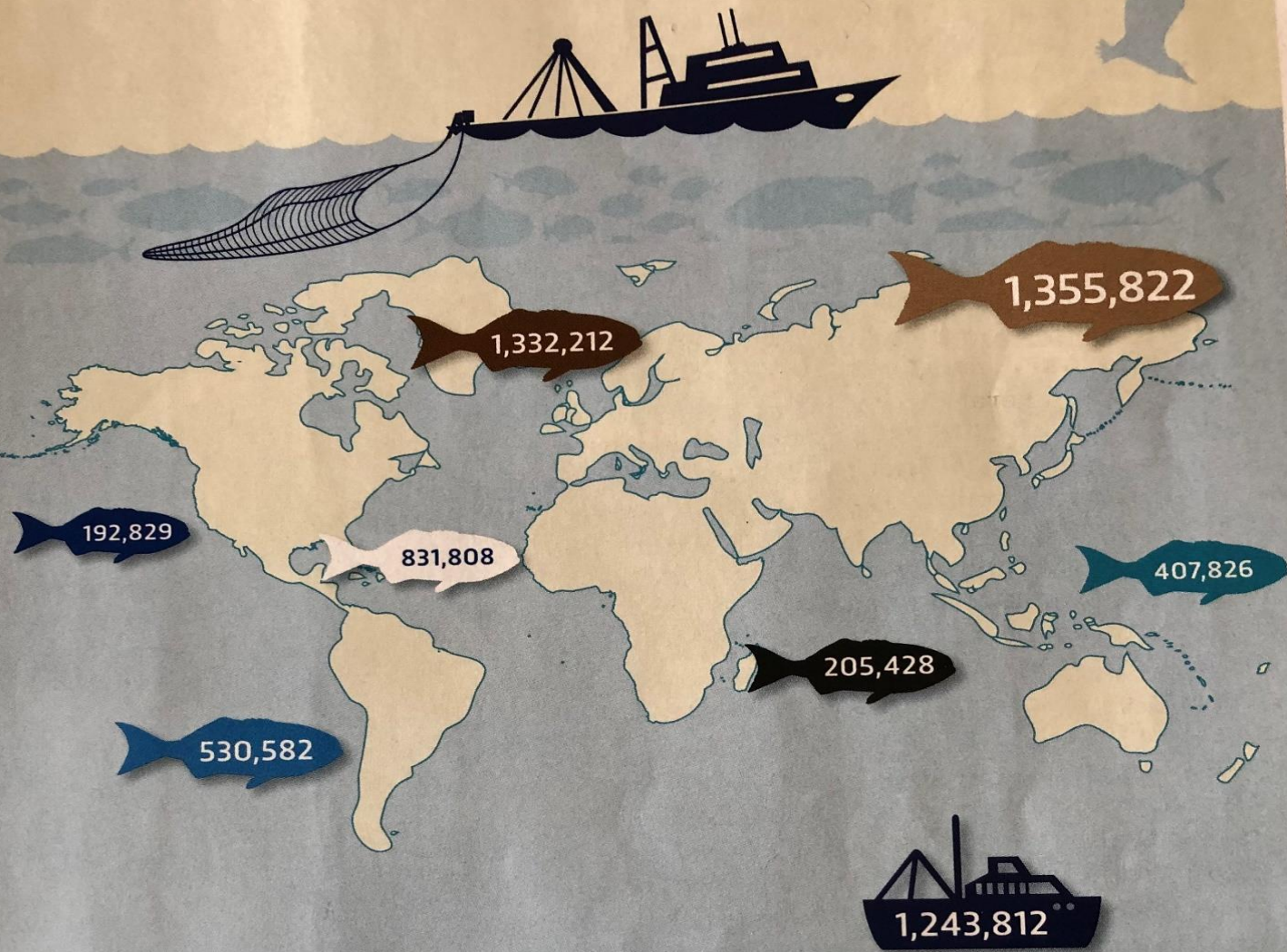
- Discards banned
- Rewarding sustainable fishing techniques
- Strict limits on number days at sea
- Integrate fisheries management into the broader marine environment
- Consider preference for coastal waters for local fisheries



2013 reform

- Passed into law 2016
- 2019 – all fish discards banned
- Spain and France opposed changes
- How will these changes work in practice?





**ANNUAL
DISCARD
RATE (IN
TONNES)
BY OCEAN
REGION**



Data Taken
from 2020
review of global
stocks

(Dr Daniel
Pauly and Prof
Callum Roberts)

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





- 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)
- The number of Scottish boats carrying cameras - which monitor the fish being caught - has halved since the scheme was introduced.
- The fall in Remote Electronic Monitoring compromises stock management

What happens when unintentional catches occur despite improved selectivity?

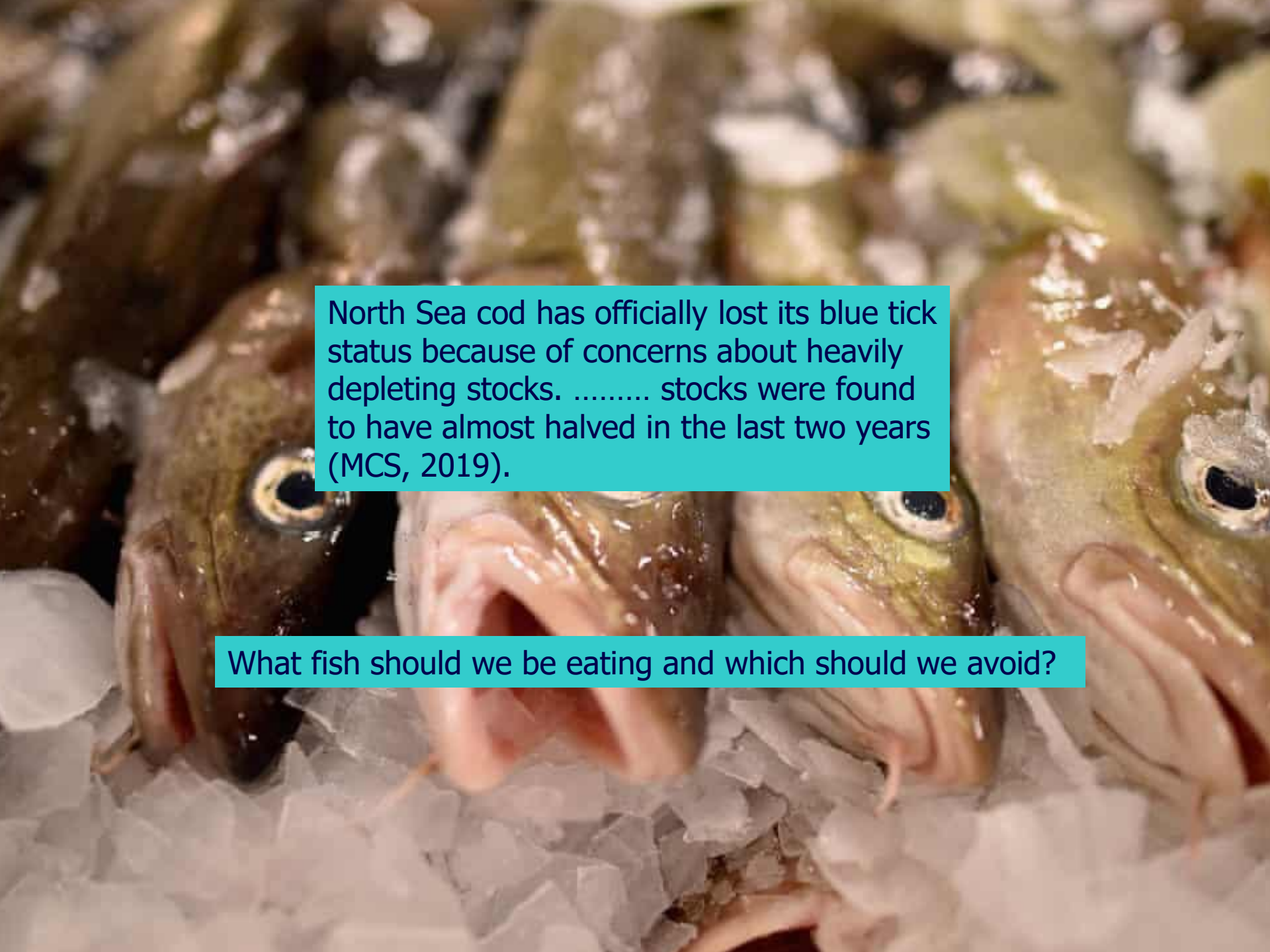
- High survival rate released
- Undersized fish – fishmeal or pet food production
- In excess of quota – marketed as normal but have to buy or lease additional quotas
- Deduct from next year's quota



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





North Sea cod has officially lost its blue tick status because of concerns about heavily depleting stocks. stocks were found to have almost halved in the last two years (MCS, 2019).

What fish should we be eating and which should we avoid?

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

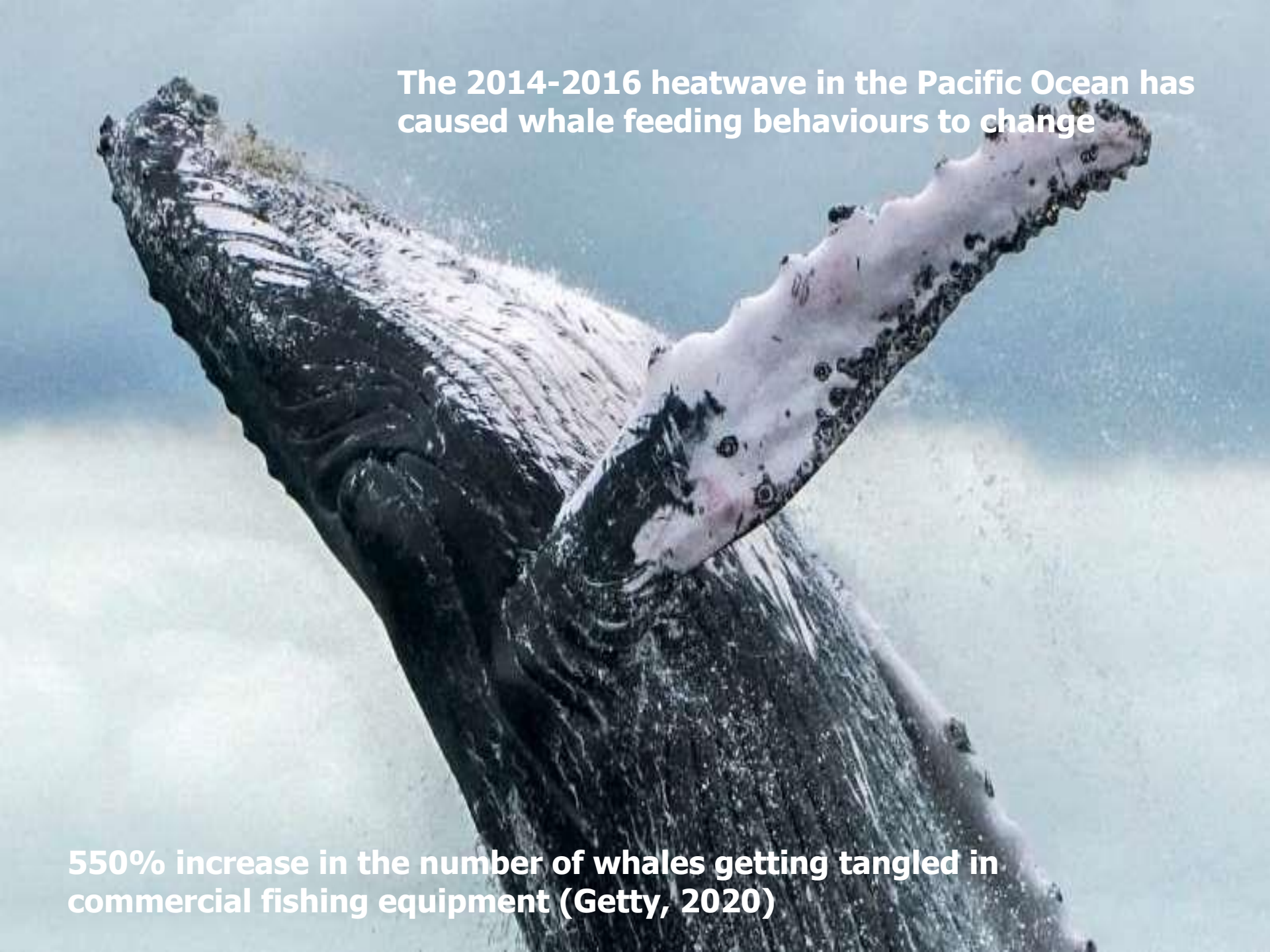
European Fisheries Fund (EFF)

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



A humpback whale is captured in the middle of a breach, its massive head and upper body emerging from the water. The whale's skin is dark and textured, with a lighter, mottled pattern on its throat and underside. A large, white, foamy splash of water is visible around the whale's head. The background is a clear, light blue sky.

The 2014-2016 heatwave in the Pacific Ocean has caused whale feeding behaviours to change

550% increase in the number of whales getting tangled in commercial fishing equipment (Getty, 2020)

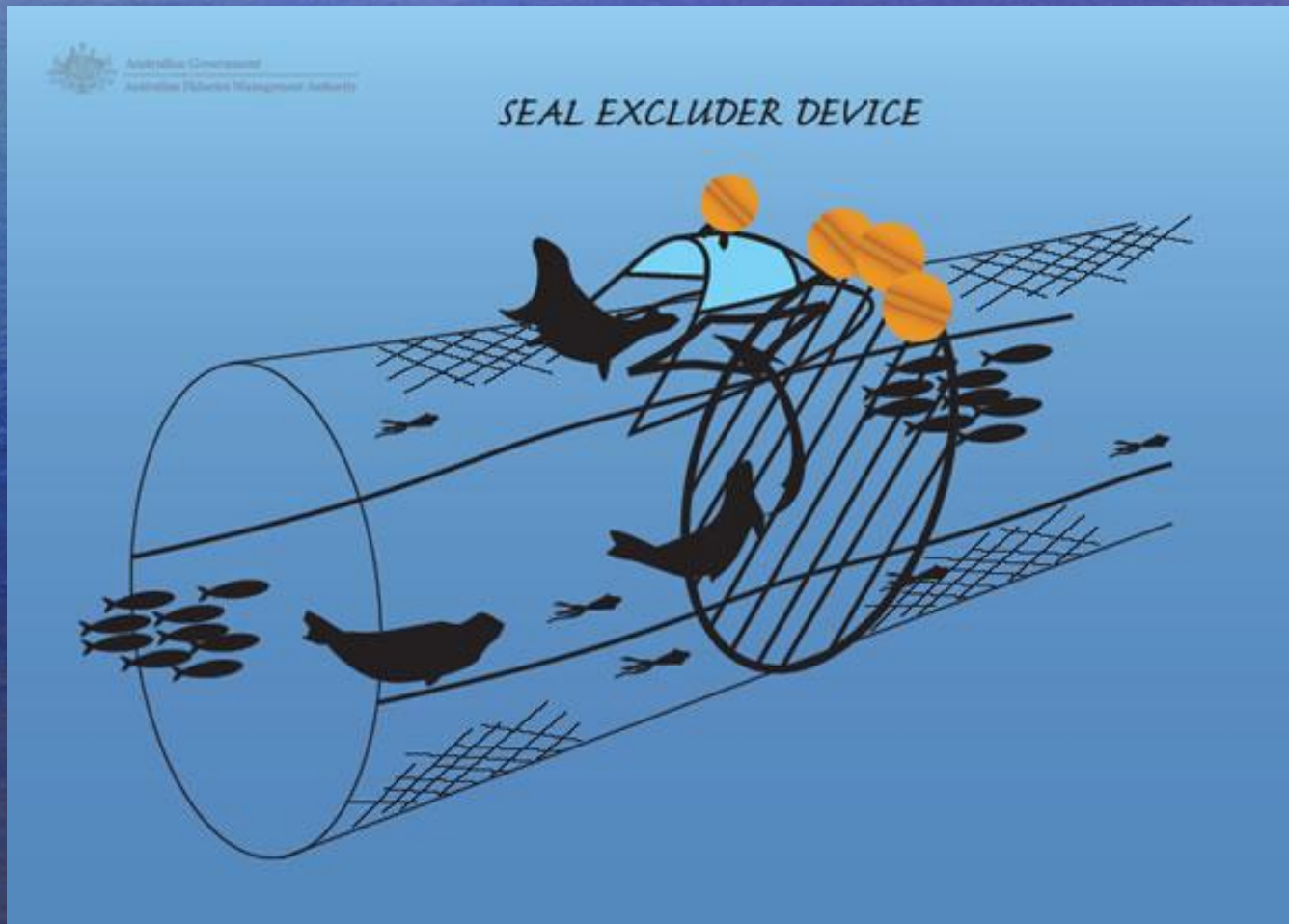
Why Cetaceans Get Caught?

Mitigation

- Nets have limited acoustic detectability (Kaschner, 2003)
- Pelagic trawls are very noisy underwater – unlikely animals cannot detect the nets (Gosselin, 2001)
- Most mitigation looks at exclusion techniques – physical or acoustic
- Also net modifications and management of fisheries involved

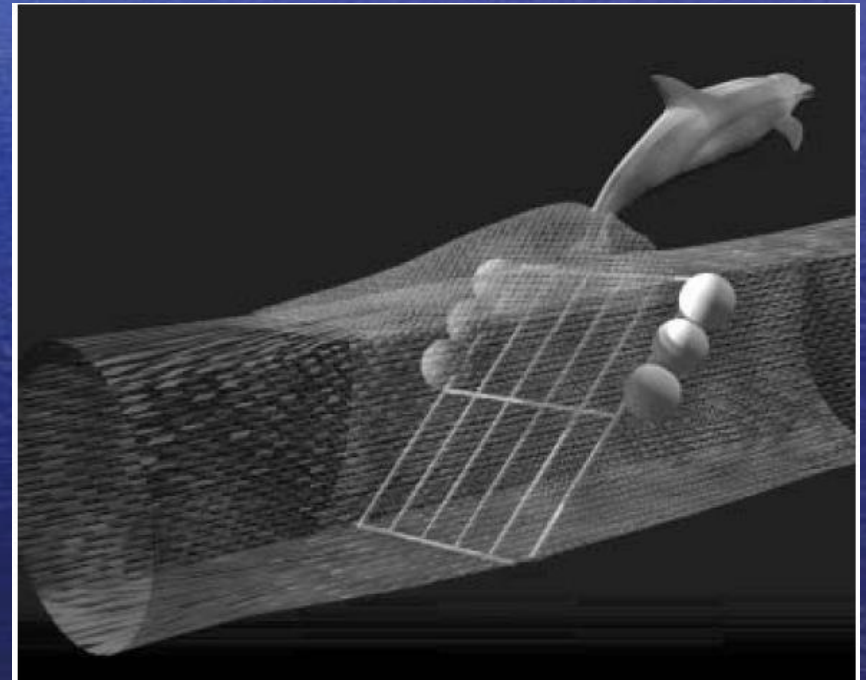


Bycatch Exclusion Devices



Mitigation Measures: Exclusion devices

- Selection grids also used in shrimp fisheries where turtle bycatch is a problem
- Widely spaced metal grid allows fish through, but angle deflects larger species upwards to an escape hatch
- Successful trials in 2003 – more ongoing
- Concerns have been raised about possible injuries sustained by passage through the grid



Mitigation Measures: Acoustic devices

- 'Pingers'
- Initially a success story during trials
- Unpopular— expensive, prone to failure and interfere with setting and hauling.
- Habituation (*Cox et al., 2001*)
- Exclusion from critical habitats with widespread use



Mitigation Measures: Net Modifications

- Increasing acoustic detectability—impregnating barium sulphate
- Trials in Bay of Fundy were positive
- Danish observers — reduced fish catches — stiffness of net
- Unpopular — bulkier, heavier nets with reduced fish catches



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."





- Biobank – a Noah’s Ark for coral
- Project to house 800 hard corals in a purpose-built facility in Port Douglas (Vistonay, 2020)
- Conserve and bolster degraded reefs
- Public and home aquarium collectors to hold and maintain backup fragments all over the world, creating the largest collaborative preservation network of corals.

Research, teaching & open to the public



Constance Moorfushi, Maldives

- No waste water discharges
- Coral Planting
- Weekly water and beach litter cleans



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
- 4 tonnes wild caught fish required for 1 tonne of fishmeal
- Scavengers
- Predators
- Vectors of disease
- Waste – sea grass impacts



Seaweed Farming



- 3 mill rely on seafood - <50% comes from wild caught fish
- 25mill tonnes seaweed is farmed pa
- Predominately in Asia but also US
- 'superfood'
- Carbon neutral
- Can be used as a biofuel
- Cattle rearing – used in feeds – produces less CH₄

Seabird mitigation

- Longline fisheries – during baiting and sinking of hooks
- Trawls – cable-related and net entanglement
- Mitigation involves:
 - Setting times and seasonality
 - Limit access to hooks
 - Deterrents
 - Reduce attractiveness or visibility of bait

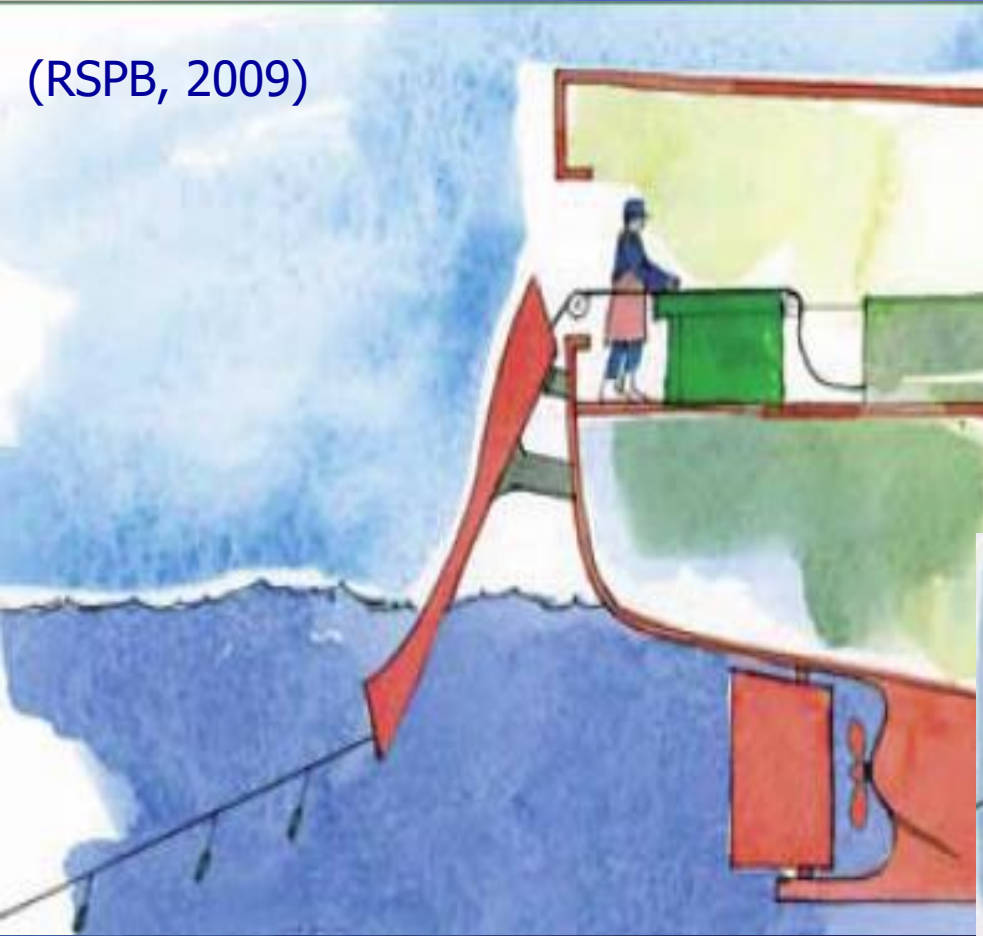
Demersal and Pelagic Longline: Night - setting



- **No fishing gear modification**
- **Between nautical dusk and dawn**
- **Fewer birds actively foraging**
- **Species specific : Albatross vs shearwaters**
- **Moonlit nights and deck floodlights**

Demersal Longline – Underwater setting chute

(RSPB, 2009)



- Greatest threat when baited hooks are @ or near surface

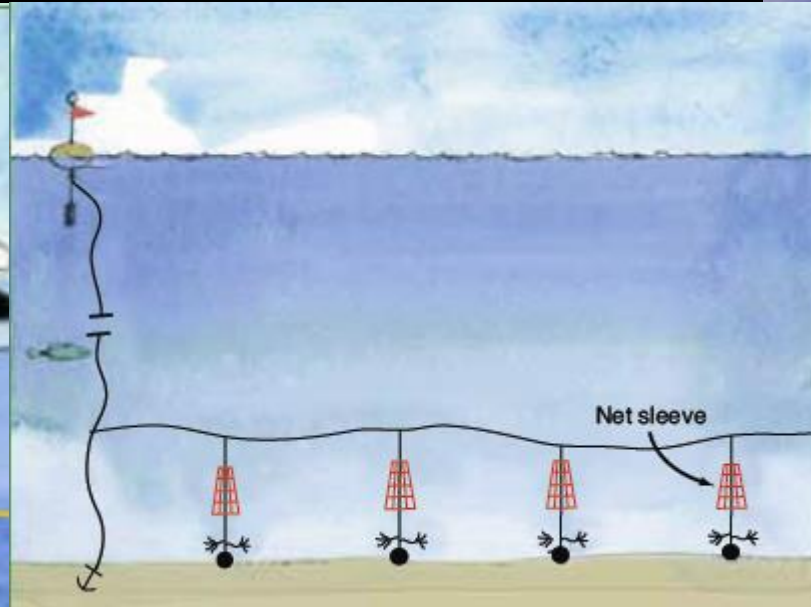
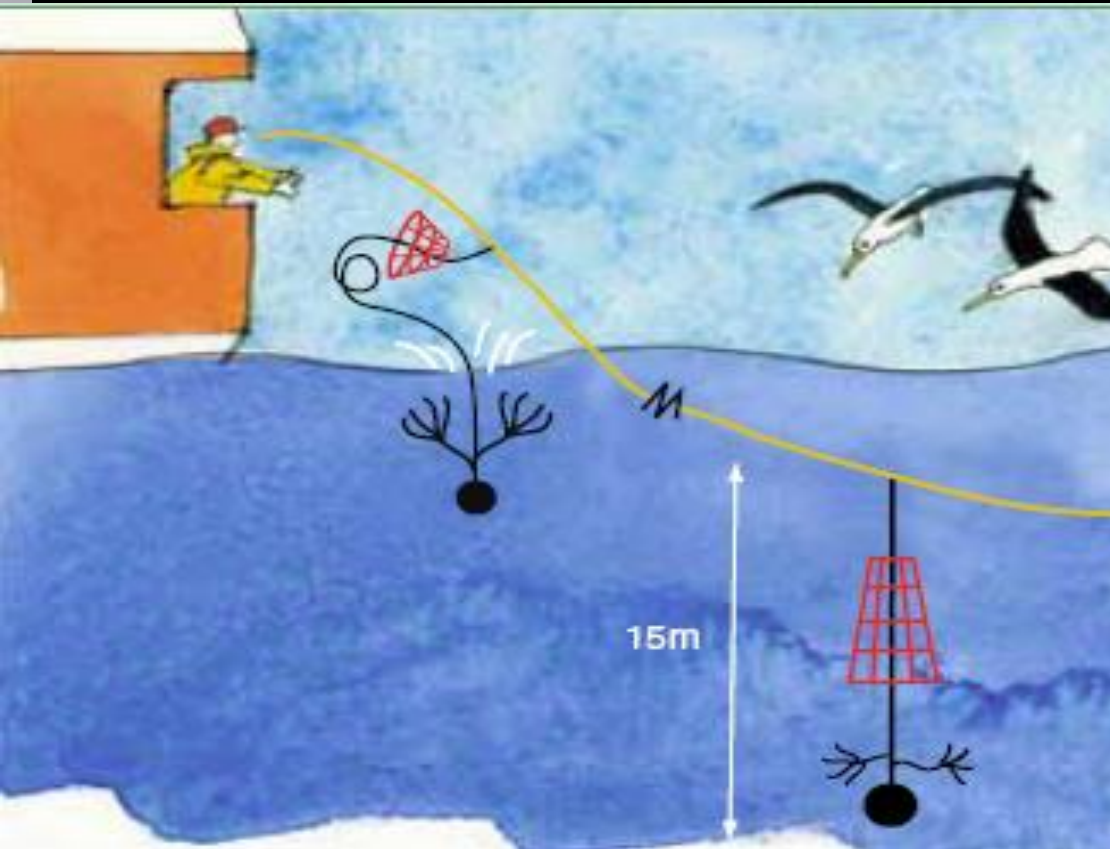
- Bycatch of Northern Fulmars in Norway from 1.75 to 0.49 birds per 1,000 hooks (Løkkeborg, 1998)

In rough weather, setting is less effective

(RSPB, 2009)



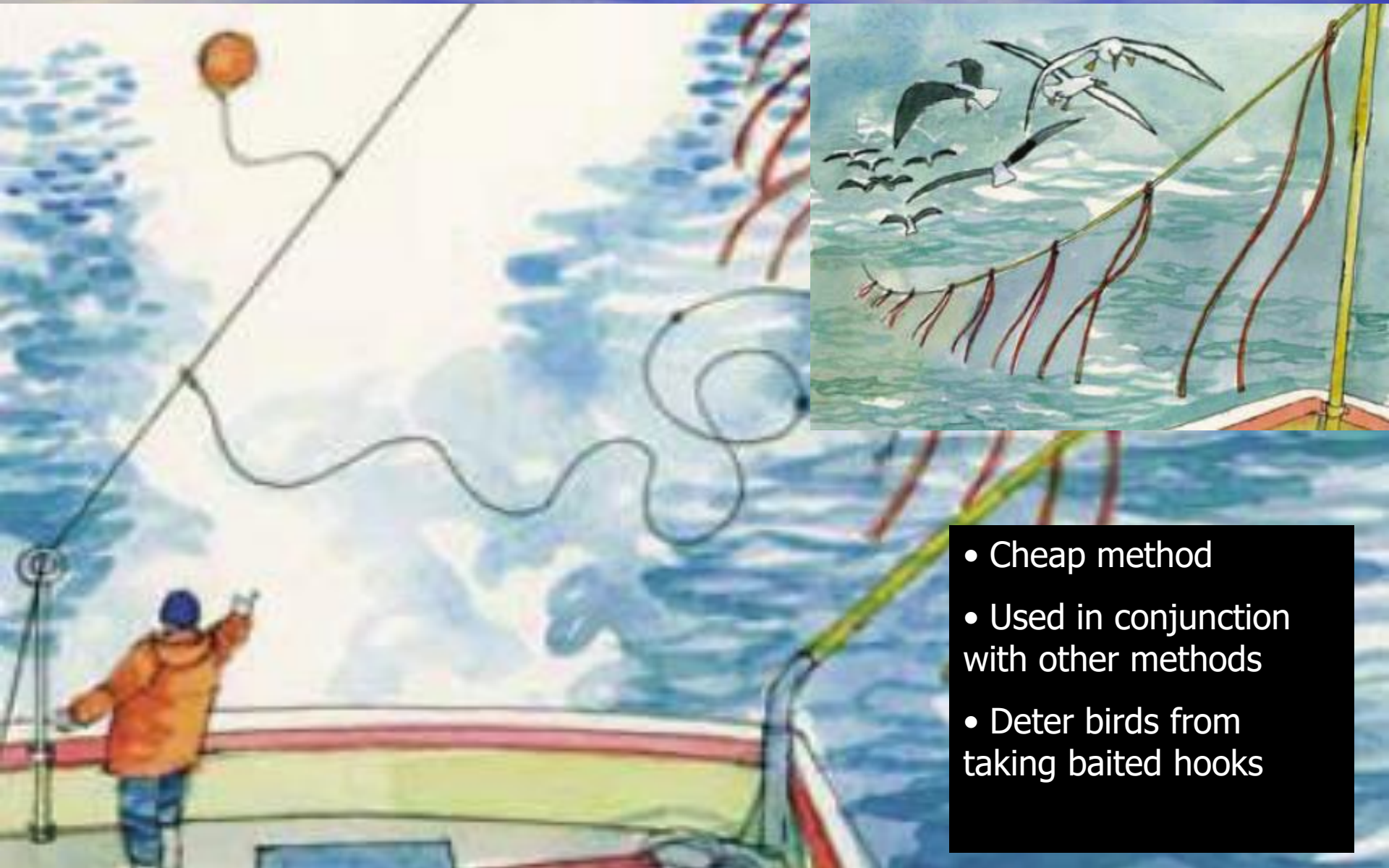
Demersal and pelagic longline – line weighting



- Tension and drag an issue
- Pushing weights from setting table and using metal-lines boxes ↓ tension
- 0.3m/s sink rate and 6kg weights @ 20m intervals (Robertson *et al.*, 2007)

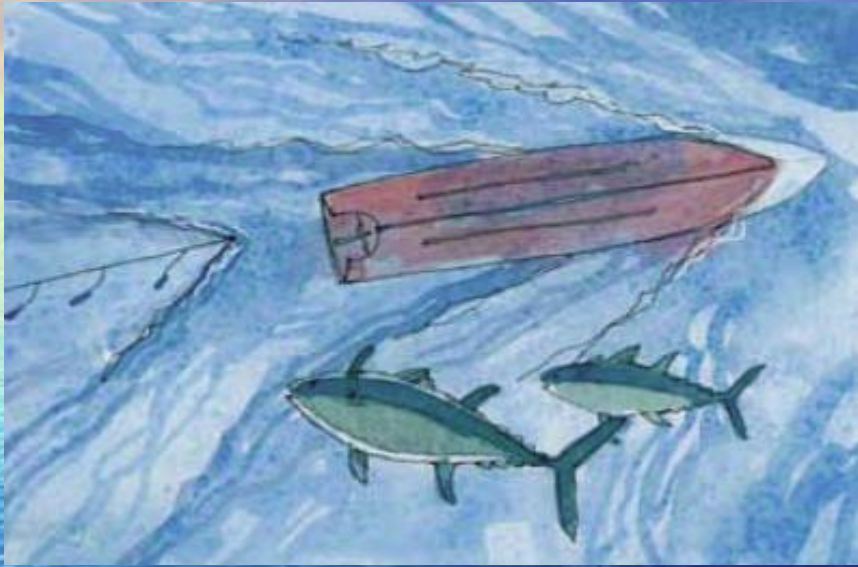


Fisheries bycatch mitigation – streamer lines



- Cheap method
- Used in conjunction with other methods
- Deter birds from taking baited hooks

Pelagic longline – Blue-dyed bait



- Reduced contrast between bait & surrounding sea
- Variable results
- Blue-dyed squid effective; blue-dyed fish bait is not (Cocking *et al.*, 2008)

Shark Bycatch by Fishing Gear

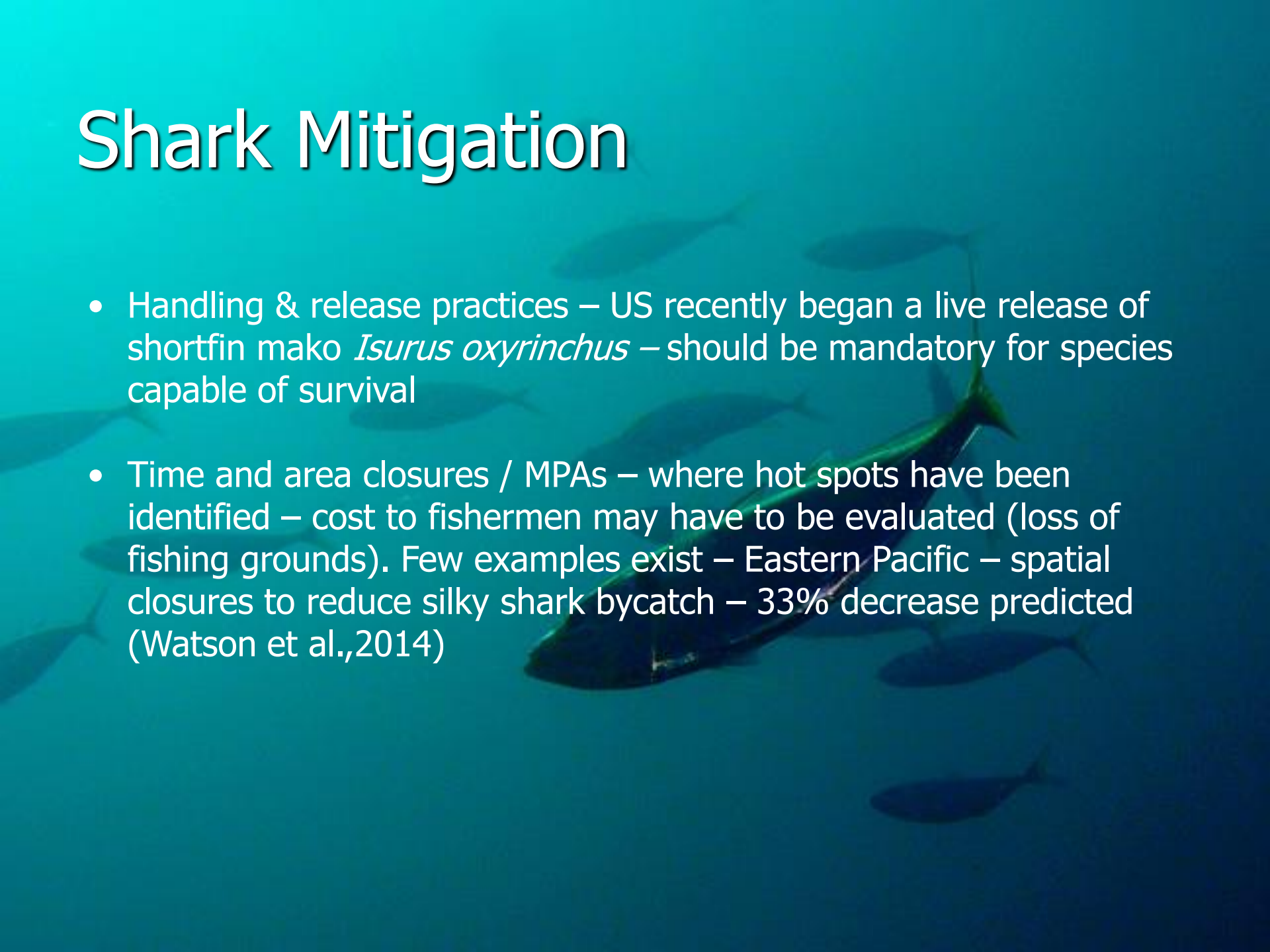
Gear type	Capture mortality (percent)	References
Pelagic longline gear	< 30	Diaz and Serafy 2005, Campana et al. 2006, Francis et al. 2001, Megalofonou et al. 2005
Bottom longline gear	15–90	Morgan and Carlson 2010, Rulifson 2007
Gillnet gear	>70	Manire et al. 2001, Rogan and Mackey 2007, Thorpe and Frierson 2009
Trawl gear	0–60	Rulifson 2007, Rodríguez-Cabello et al. 2005, Mandelman and Farrington 2007, Enever et al. 2009,
Purse Seine gear	Estimated to be very high – may be close to 100%	Molony, 2005

Shark Mitigation

A background image showing a shark breaching the water surface, creating a large splash. The shark is white and is captured in mid-air, with its body arched and its head pointing upwards. The water is dark blue, and the sky is a lighter blue.

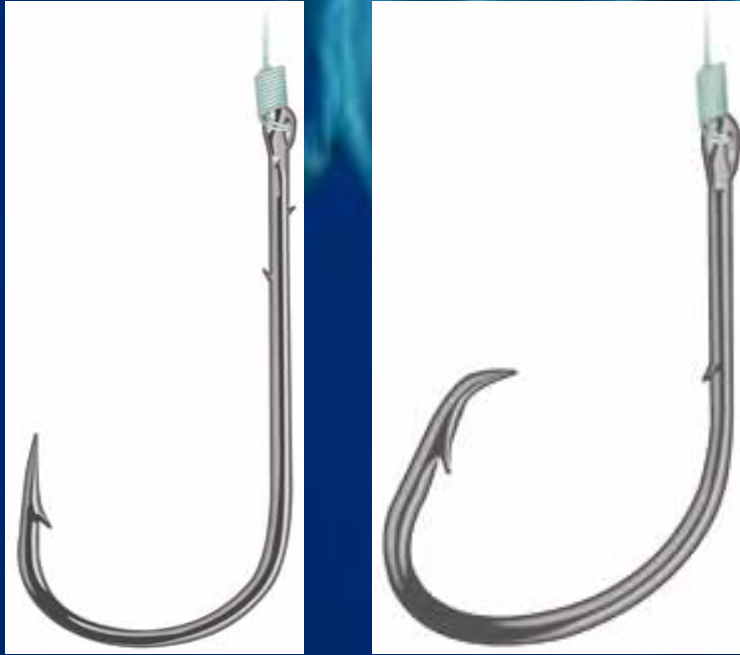
- Effort limitation - reduced capacity of fishing fleet
- Ban catch, landing or sale of shark species
- South African longline tuna & swordfish limits shark landings to 10%
- High seas more difficult to enforce
- Ban shark finning – fine in areas where there is no demand for shark meat

Shark Mitigation

A large shark, likely a shortfin mako, is swimming towards the left in the foreground. Several smaller fish are visible in the background, swimming in the same direction. The water is a deep blue-green color.

- Handling & release practices – US recently began a live release of shortfin mako *Isurus oxyrinchus* – should be mandatory for species capable of survival
- Time and area closures / MPAs – where hot spots have been identified – cost to fishermen may have to be evaluated (loss of fishing grounds). Few examples exist – Eastern Pacific – spatial closures to reduce silky shark bycatch – 33% decrease predicted (Watson et al., 2014)

Shark Bycatch Mitigation



From J hooks → Circle hooks

- Use of circle hooks has significantly reduced turtle bycatch
- Some uncertainty on results for sharks – Kim *et al.*, 2007 – circle hooks led to an increase in capture rate; Gilman *et al.*, 2007b – the opposite!
- Use of circle hooks does appear to reduce injury and lead to a higher survival rate if caught.

Shark Bycatch Mitigation

- **Bait Restrictions** – replacing squid bait with fish bait reduced blue shark catch rate (pelagic longline) (Watson *et al.*, 2005)
- **Temperature avoidance** – setting gear in colder temperatures (colder side of fronts) reduces shark bycatch levels (Gilman *et al.*, 2007) More work on thermocline dynamics necessary
- **Repellents** – certain chemicals trigger a flee response (Ammonium acetate – component of decaying shark flesh). Also magnets – interfere electro-sensory system

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- A white bird, possibly a booby, is perched on a dark, textured branch. The bird is facing away from the camera, looking towards the top right. The background is a clear, bright blue sky. The bird's feathers are white and appear slightly ruffled. The branch is dark and has some small, light-colored spots.
- Despite all the monitoring and mitigation measures that have been put in place in recent years, we still have an insurmountable problem.

So what would happen if we banned commercial fishing?



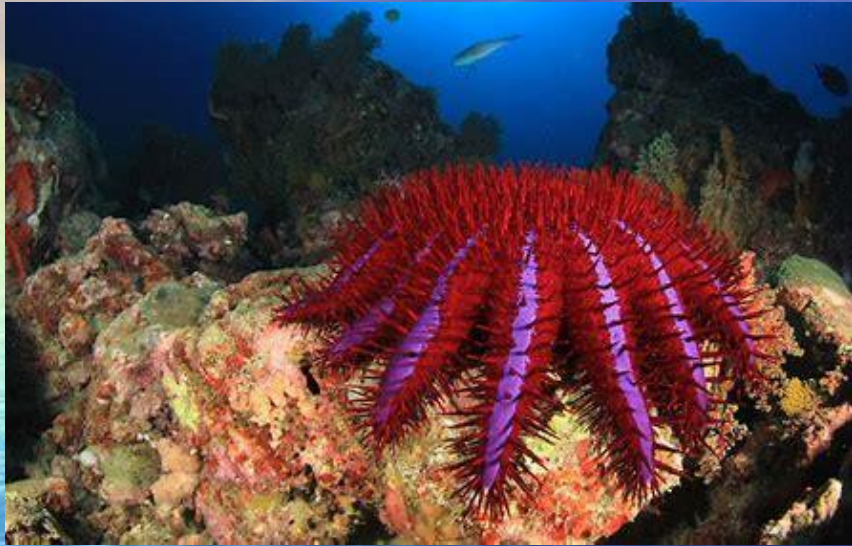
- Millions would potentially starve
- Wealthier economies would switch to a meat or soya based diet
- Black market for fish?

Seafood Farms would increase?



- Choice would be limited initially (Atlantic salmon)
- Land-based systems would develop potentially reducing water pollution
- Give respite to much of the ocean – 1% ocean surface could provide equivalent of global catch
- Any large scale food production can fundamentally alter the environment

Stocks and corals would recover



- For some species it is already too late (sea cucumbers in Papua New Guinea)
- Increasing fish stocks would help rebalance the ecosystem
- Predator – prey balance: Emperor fish and crown-of-thorns starfish. Lobster: urchins: kelp
- A more resilient ocean can help reduce algae smothering coral beds due to climate change and pollution

Cleaner Oceans



- Lost gear accounts for 10% marine litter
- 86% of litter in Pacific Garbage Patch (Bennett, 2020)
- Fishing vessels are also polluting and fuel intensive
- Reduce the prevalence of INNS distribution

Self Study / Revision

- Assess the state of our oceans. How big an issue is overfishing and how can the problem be tackled?
- Investigate the sustainable potential of seaweed farming?
- Evaluate what would happen if commercial fishing were banned?

Reports to look up:

1. Longline fishing: a global catastrophe for seabirds
http://www.abcbirds.org/policy/seabird_report.pdf
2. The Net Effect: A review of cetacean bycatch... <http://www.wdcs.org>
3. Cocking, L.J., Double, M.C., Milburn, P.J. and Brando, V.E. (2008) Seabird bycatch mitigation and blue-dyed bait: A spectral and experimental assessment. *Biological Conservation*. 141: 1354-1364
4. Waugh, S.M., Baker, G.B., Gales, R. and Croxall, J.P. (2008). CCAMLR process of risk assessment to minimise the effects of longline fishing mortality on seabirds. *Marine Policy*, 32:442-454
5. Cosandey-Godin, A. and Morgan, A. (2011). Fisheries *Bycatch of Sharks: Options for Mitigation*. Ocean Science Division, Pew Environmental Group, Washington. 19pp