Pragmatic Approaches to Cetacean Bycatch Reduction

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Overview

- What are the objectives of mitigation?
  - How do we set targets for bycatch reduction?
- What are the possible methods of mitigation?
  - How have they worked or not worked in practice?
- What generalisations can be made?
  - How should we address mitigation in future?

What Do We Mean By: "Mitigating" Bycatch?

- Bycatch mitigation:
  - Alleviating, lessening or improving : not eliminating.
- Typically, we wish to reduce bycatch to rates that cause no serious conservation damage.
  - How do we define such rates?
  - Existing frameworks include PBR and limits of 1 – 1.7% of best estimates of abundance.
  - Not always easy to define, but such bycatch limits are biologically-based and are theoretically tractable.

Is Minimising Conservation Impact Enough?

- There are additional expectations that bycatch rates should be reduced well beyond these limits:
  - "The general aim should be to minimise (i.E. To ultimately reduce to zero) anthropogenic removals within some yet to be specified time frame." (ASCOBANS mop 2, 1997)
  - "The (US) marine mammal protection act (MMPA) was enacted in 1972 with the ideal of eliminating mortality and serious injury of marine mammals incidental to commercial fishing operations" (fed register vol. 69, no. 138 2004)

Some Level of Bycatch Is Inevitable?

- Complete closure of a fishery:
  - Will eliminate bycatch in that fishery, but will usually displace fishing effort into other fisheries, which can create other conservation problems.
- Zero bycatch is an unrealistic goal.
  - The US MMPA now defines zero pragmatically as 10% of potential biological removal.
  - To date no clear definition within Europe of what bycatch levels might prove acceptable.
- How do we successfully mitigate bycatch to defined “acceptable” levels.

Agreeing on Goals

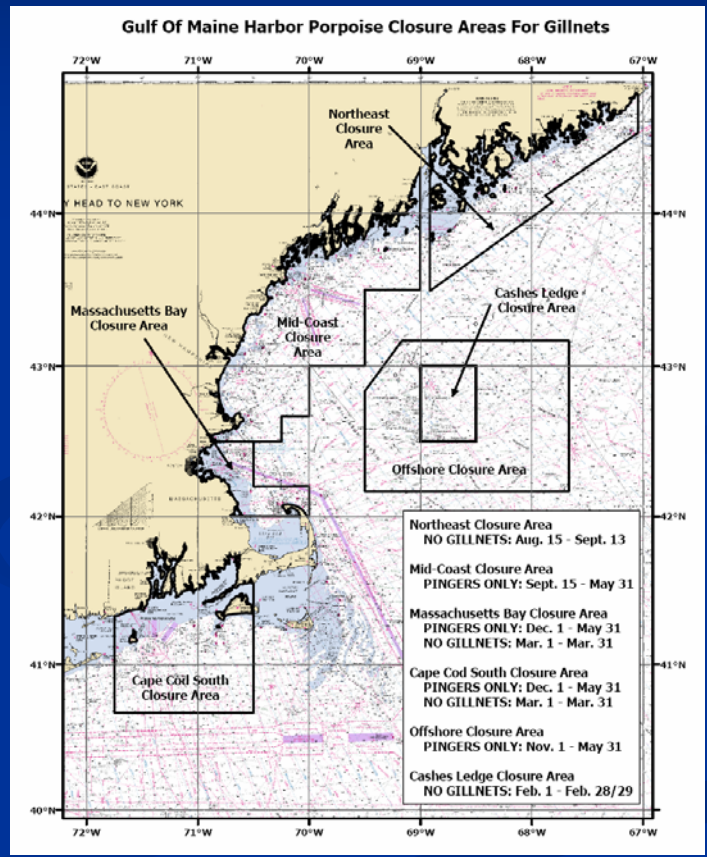
- If we accept that zero bycatch is not realistic…….
- What level of bycatch of a given species (population / management stock) can we live with?
- **Need to be clear about this from the outset:**
  - Co-operation between managers.
  - Need clear objectives for the fishing industry -not moving targets.
  - Level of reduction will dictate the mitigation methods to be tested.
- First step may be to **manage the expectations** of all the stakeholders.

Examples of Mitigation Measures:

- Technical measures, such as:
  - Acoustic deterrent devices – (“pingers”).
  - Increasing acoustic reflectivity of nets.
  - Exclusion devices - grids.
  - Tori lines.
  - Circle hooks.
  - ***None of the technical means so far tested has proven 100% effective.***

Examples of Mitigation Measures:

- Management measures:
  - Restrict fishing by time and area.
  - Fishery closure.
- Changes in fishing practice.
- ***Such measures often have unintended and unpredicted deleterious effects.***



Mitigating bycatch in gillnets

- Nylon nets can be detected by echolocating cetaceans.
  - Theoretical studies – e.g. Au and Jones 1991.
  - Observations eg Hatakeyama et al 1988.
- Therefore entanglement may occur if :
  - An animal fails to detect the net because it is not echolocating
  - An animal detects the net but does not perceive it as a threat.
  - An individual both detects the net and perceives it as a threat but makes a mistake – may be distracted

Pingers

- Principle – alert cetaceans to the presence of fishing gear / deter from interacting with the gear.
- Jon lien developed acoustic warning devices in Newfoundland in the 1980s.
- Initial porpoise bycatch reduction trial was conducted in gulf of Maine by local fishermen in 1992 and 1993.
  - Results of this trial were regarded as equivocal.

Pingers.

- US government sponsored trial in 1994 involving double blind testing of dummy and active pingers randomly assigned on identical strings of gillnets showed a >90% bycatch reduction (Kraus et al 1997)

How Pingers are Used:

- Wall of netting which hangs vertically in the water column
- Mainly nylon since the 1960's
- Vary in mesh size , height and length depending on target catch

Beep Beep Beep

Pinger Trials and Progress

- Numerous trials have shown that pingers reduce porpoise and other cetacean bycatch in gillnet fisheries by around 90%:
  - Kraus et al (1997) Sink gillnet fishery, Gulf of Maine, US.
  - Trippel et al (1999) Sink gillnet fishery, Bay of Fundy, US.
  - Gearin et al (2000) Salmon gillnet fishery, Washington, US.
  - Larsen et al (2002) Cod wreck-net fishery, Denmark.
  - Bordino et al (2002) Artisinal gillnet fishery, Argentina.
  - Barlow & Cameron (2003) California Drift Net fishery.
- Yet in the 13 years that this has been known, close to 100,000 porpoises have probably drowned in gillnets in the North Atlantic basin alone.
- A Proven mitigation method – not working; why?

Problems With Pingers

- Habituation?
  - Was cited as most likely reason they would not work. Has not proved to be the case.
  - Although Cox et al 2001 found a waning of response to a moored pinger over a three month period but this is **not** the same as decline in effectiveness
- Expensive and mechanically unreliable.
- Rely of fishermen to implement them properly.
- Very difficult to enforce.
- Conservation NGOs ambivalent (increased noise effects)
- In some areas fishermen resent using them

>Consensus on mitigation measure is vital<

Altering the Acoustic Detectability of Nets

- Passive mitigation measure; Produces no noise there for there is no stimulus to habituate to, no costly mechanical device requiring maintenance.
- Increasing acoustic target strength of nets ($baso_4$ impregnated nylon) has been associated with much lower bycatch rates (Trippel et al 2000, 6:2; Trippel et al 2003 12:0).
- No reduction in target catch.

Altering the Acoustic Detectability of Nets

- Larsen et al (2007) also showed reduced bycatch in Iron Oxide impregnated nets, though results were attributed to *stiffness* not acoustic properties (8:0).
- Mooney et al (2007) tested acoustic properties of chemically altered nets and found them more acoustically reflective than standard nylon nets but **only** close to perpendicular orientation of an animal to the net

Testing Reflective or Dense Nets Trials by SMRU in England:

Reference:

Northridge, S.P., Sanderson, J.D., Mackay, A.I. And Hammond, P.S., 2003. Analysis and mitigation of cetacean bycatch in UK fisheries. Final Report to the Department for Environment Food and Rural Affairs. Project MF0726.

- Three fleets of 10 nets of each type of netting.

  $BaSO_4$ nets: 241mm mesh (nominal), 0.67mm twine

  Standard nets: 267mm mesh (nominal), 0.60mm twine

- Same hanging ratio (0.3), same rigging.

- Fleets of nets shot randomly around fishing ground.

Barium Sulphate Net Test Results

Net type	Hauls	Porpoises	Seals	P/H	S/H
$BaSO_4$	171	8	10	0.047	0.058
Normal	173	3	5	0.017	0.029

$BaSO_4$ nets did not reduce bycatch here.
Acoustic factors not important.
> Need to understand underlying reasons for any observed bycatch reduction <

Time Area Closures

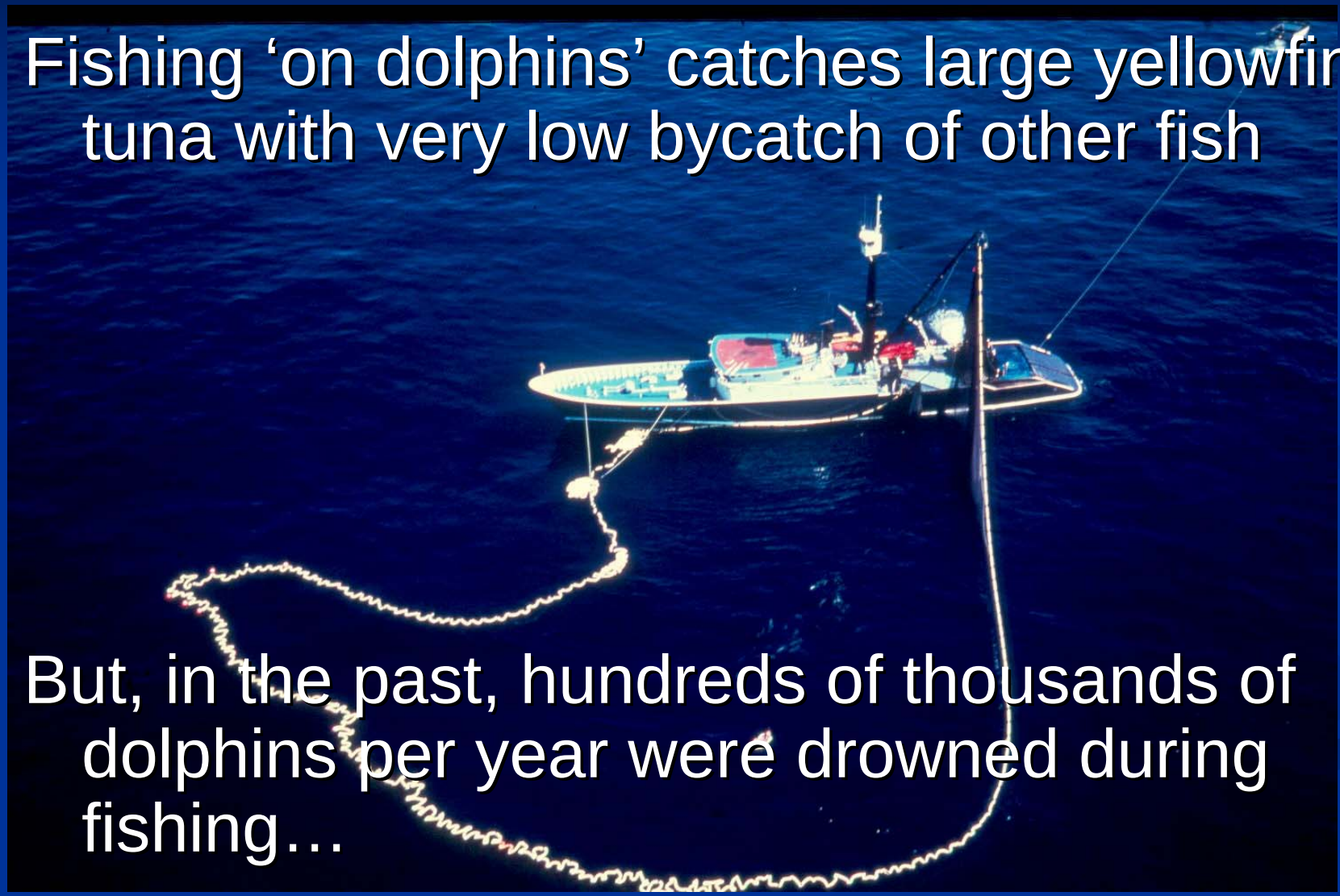
- Gulf of Maine season and area closure of gillnet fisheries 1994 – Murray et al 2000.
- Using 1992-1993 data, areas and seasons of highest bycatch rate were closed.
- Subsequently, bycatch rates were higher in the period two months *before* closure and also in *other* geographical areas.
- Fishing effort was also displaced to other areas

Time / Area Restrictions

- Time Area Closures can only work when:
  - Bycatch occurs mainly in a relatively small frame.
  - Spatial and temporal occurrence of bycatch is predictable.
  - Effort not displaced to other high bycatch areas.
  - Industry supports the plan.
  - Adequate pre-closure data are available.
- **>Time area closures are rarely going to be effective for cetacean bycatch reduction <**

Changes in Fishing Practice

Eastern Tropical Pacific Tuna Fishery



Fishing ‘on dolphins’ catches large yellowfin tuna with very low bycatch of other fish

But, in the past, hundreds of thousands of dolphins per year were drowned during fishing…

Changes in ETP Fishing Practice

- Techniques developed to allow dolphins to be released.
  - A number of fishermen killed by sharks while releasing dolphins
- Many vessels have switched to other practices such as setting nets around drifting debris or FADS – results in higher catches of other non-target species caught – worse ecological impact ? (Hall 1998)
- > **Changes in technique to deter bycatch of one species may result in other unintended impacts** <

By-catches in numbers of individuals per 1000 metric tons of tuna loaded for the different types of sets.[a]

	Dolphin sets ($n = 33927$)	School sets ($n = 19210$)	Log sets ($n = 21567$)
Dolphins	19.47	0.15	0.40
Billfishes			
Sailfish	4.02	6.86	0.42
Black marlin	0.40	1.28	4.60
Striped marlin	0.53	1.39	1.12
Blue marlin	0.41	1.55	6.01
Unidentified marlin	0.22	0.36	0.83
Swordfish	0.07	0.19	0.10
Shortbill spearfish	0.06	0.02	0.08
Unidentified billfish	0.67	0.15	0.43
Large bony fishes			
Mahi-Mahi	2.13	182.12	4288.51
Wahoo	3.67	23.54	2307.38
Rainbow runner	0.05	36.82	383.77
Yellowtail	14.12	448.22	330.24
Other large bony fish	0.27	367.69	206.09
Sharks			
Blacktip shark	22.08	98.78	163.07
Whitetip shark	2.06	3.25	31.52
Silky shark	3.57	16.48	73.97
Hammerhead shark	0.99	8.41	6.72
Other sharks	3.02	9.57	29.78
Unidentified sharks	5.70	11.83	43.53
Rays			
Mantaray	3.77	29.84	0.93
Stingray	2.19	8.72	1.02
Sea turtles			
Olive ridley	0.18	0.41	0.42
Green-black	0.01	0.08	0.07
Loggerhead	0.01	0.03	0.01
Unidentified turtles	0.07	0.14	0.14

[a] Combined data for 1993–1998.

Hall et al (2000) By-catch problems and solutions. Marine pollution bulletin

Fishery Closures

- Closing a fishery or minimising it to increase another can result in other bycatch problems:
- Driftnet use expanded rapidly in Italy in the 1980s as a result of government encouragement, as driftnets were considered to have more desirable conservation properties than longlines.
  - **Resulted in very high levels of cetacean bycatch.**
- French Irish and UK driftnet fishery for tuna phased out and replaced by pelagic pair trawling in France and Ireland.
  - **May have led to an overall increase in cetacean mortality.**
  - **Did lead to industry refusal to cooperate further.**
- > Closing fisheries can exacerbate problems <

Bass Fishing in the Channel

- Strong local environmental NGO support for ‘ecological’ small boat fishing using handlines.
- Three or four pair trawl teams kill ~100 dolphins per year and take 14 tonnes of bass in 74 days fishing. (Approx 200kg / day)
- Small boats using hand lines take 21 tonnes of bass in 684 days fishing. (Approx 30kg /day)
- Replacing trawlers by hand-liners would be equivalent to increasing small boat days at sea by 466 days (60%)

Human Fatalities in Fishing

- Hand line fishing, like pair trawling, has little fish bycatch, but:
- Within the UK under-12 metre sector from 1995 to 1999, 8 fishermen died per year and more than 15 vessels were lost.
- In terms of fatal injuries per 10,000 employees/yr, sea fishing (12.2) is a considerably more dangerous industry than agriculture (0.89) or construction (0.48).
- Last year one hand-line fisherman died in this area…
- **How does one balance human / dolphin deaths**?

Generalisations about Mitigation (1):

- Expectations must be realistic
- Fundamental causes of cetacean bycatch are unknown: bycatch is generally a “rare” event, devising new mitigation measures is hard.
- Currently no simple and effective solutions.
- Existing methods do not eliminate bycatch
- Mitigation measures can have unforeseen consequences:

Generalisations about Mitigation (2):

- Fishermen will undermine mitigation measures if those measures are detrimental to their interests.
  - It is vital to have a consensus on best approach and 'buy-in' from industry **and** environmental groups.
- Need to understand how or why proposed mitigation measures might work to ensure they continue to work
- Time/Area closures require a specific set of rarely-found circumstances to be even partially effective
- Fishery closures and changes in fishery practice can displace bycatch problems and may have other unforeseen consequences.

Ways Forward?

- The variety of possible mitigation measures need to be assessed for each situation.
- An assessment of the potential benefits and costs of each measure needs to be addressed.
- The industry needs to be involved in developing solutions that provide additional benefit to the people implementing the mitigation measures.
- An holistic approach needs to be taken, assessing the health and safety, social and economic impacts of any proposed measures in addition to the environmental benefits and impacts.