Science, Service, Stewardship

Experiences in implementing acoustic pingers in US and Canadian fisheries

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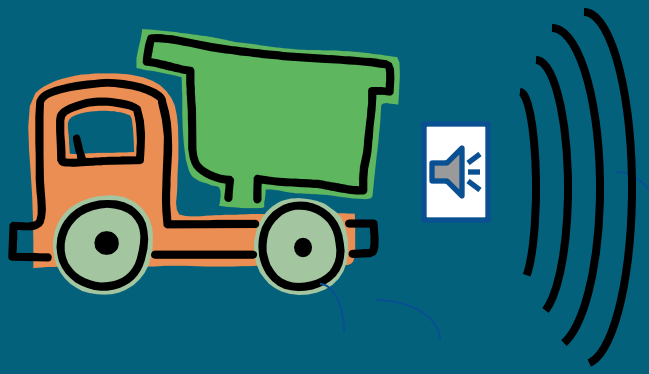
NOAA FISHERIES SERVICE

Outline

- **Brief history**
  1. Small scale investigations
  2. Scientific controlled experiments
  3. Regulations
  4. Commercial fisheries
     a. Limited
     b. Full scale

- **Issues investigated**
  - Ø Bycatch rates
  - Ø Displacement
  - Ø Habituation
  - Ø Depredation/”dinner bell effect”
  - Ø Compliance

Pinger History



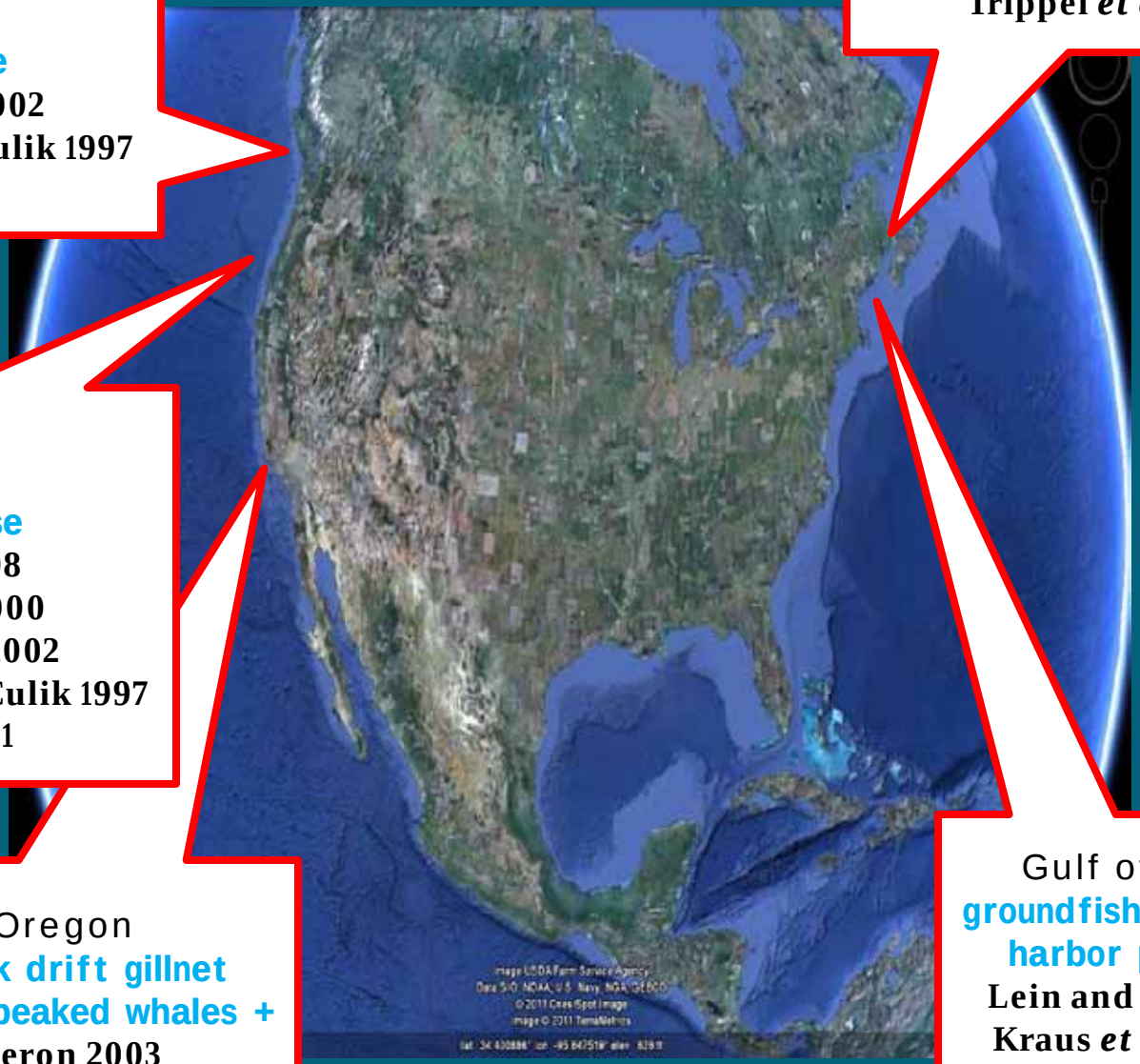
- Homemade backup beep
- Lien *et al.* 1992
- Newfoundland
- Fish traps and gillnets
- Humpback whales

- Commercially made
- Small and large scale scientific controlled experiments
- Harbor porpoises in sink gillnets (salmon, groundfish)
- Common dolphins + other spp in drift gillnets (swordfish, sharks)

Initial investigations

Vancouver Island
salmon gillnet
harbor porpoise
Olesiuk *et al.* 2002
Koschinski & Culik 1997
Culik *et al.* 2001

Bay of Fundy
groundfish sink gillnet
harbor porpoises
Trippel *et al.* 1999

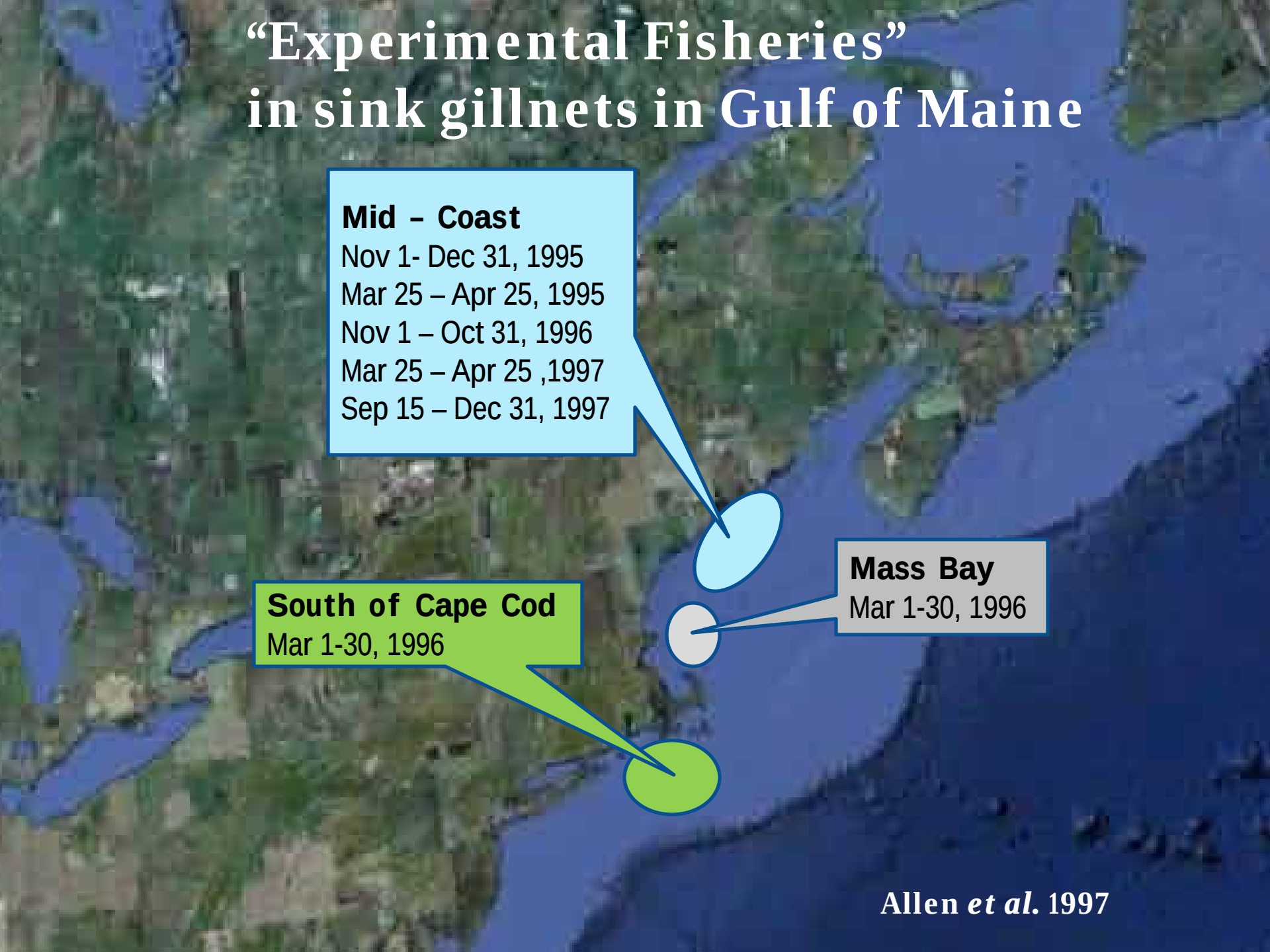


Washington
salmon gillnet
harbor porpoise
Laake *et al.* 1998
Gearin *et al.* 2000
Olesiuk *et al.* 2002
Koschinski & Culik 1997
Culik *et al.* 2001

California/Oregon
swordfish & shark drift gillnet
common, sea lions, beaked whales +
Barlow & Cameron 2003

Gulf of Maine
groundfish sink gillnet
harbor porpoises
Lein and Hood 1994
Kraus *et al.* 1997a,b
Allen *et al.* 1999

"Experimental Fisheries" in sink gillnets in Gulf of Maine



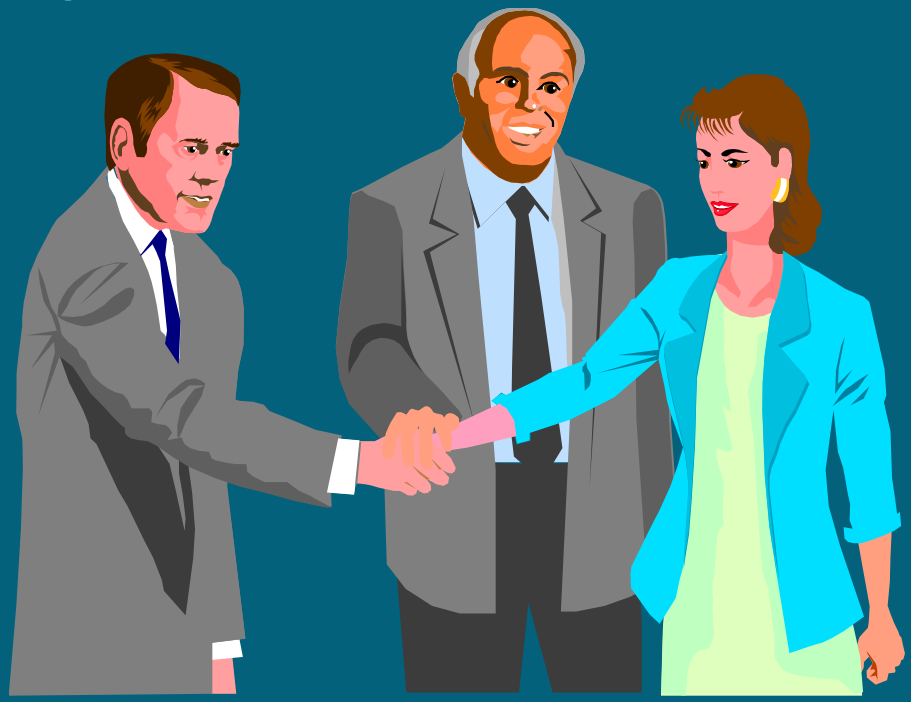
Allen *et al.* 1997

USA:

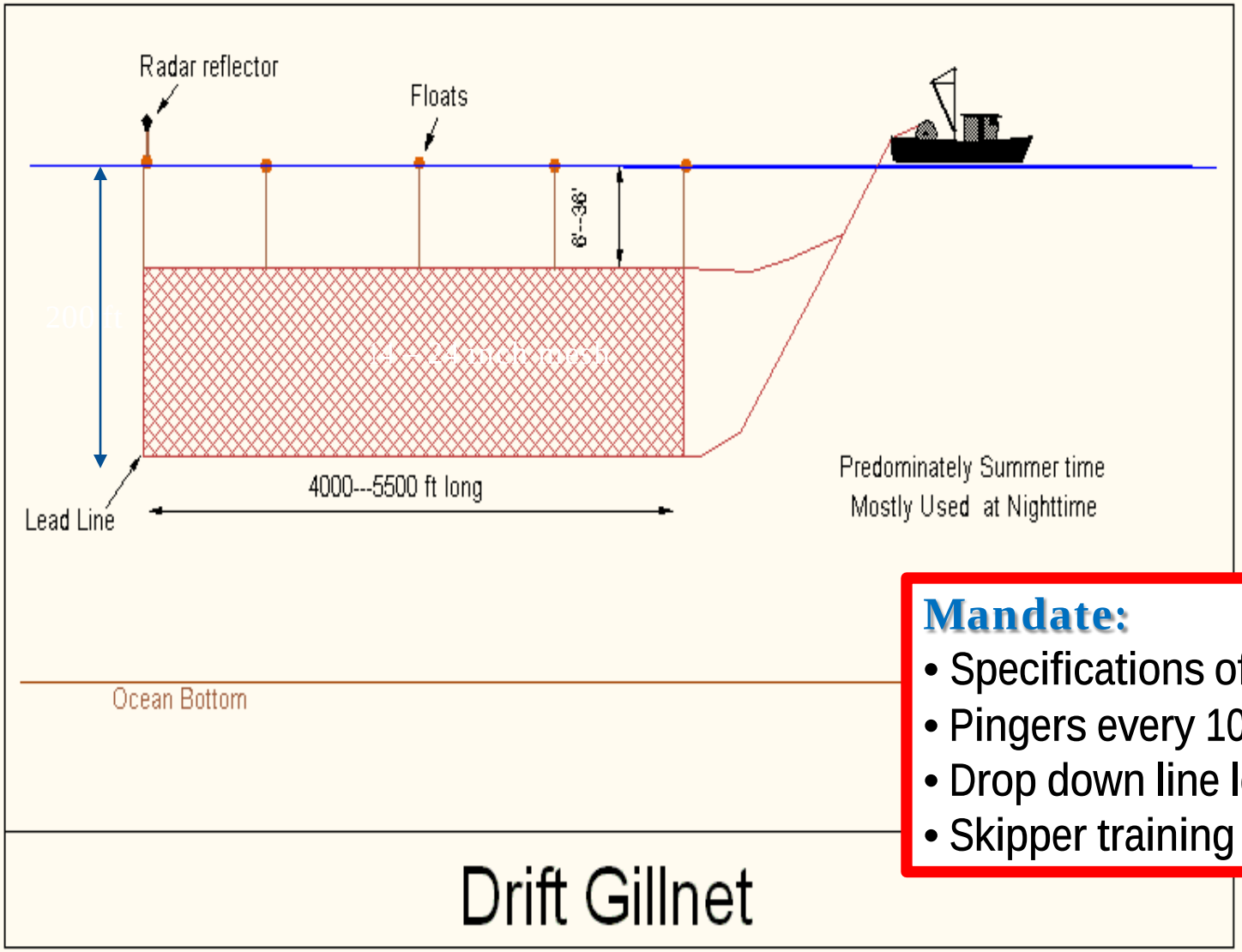
Through the Take Reduction Team process, regulations were developed by industry, scientists, NGO's and government managers

Canada:

Bay of Fundy gillnet fishery will close down if harbor porpoise bycatch is over 100 animals per season



1997 Regulations CA/OR drift gillnet

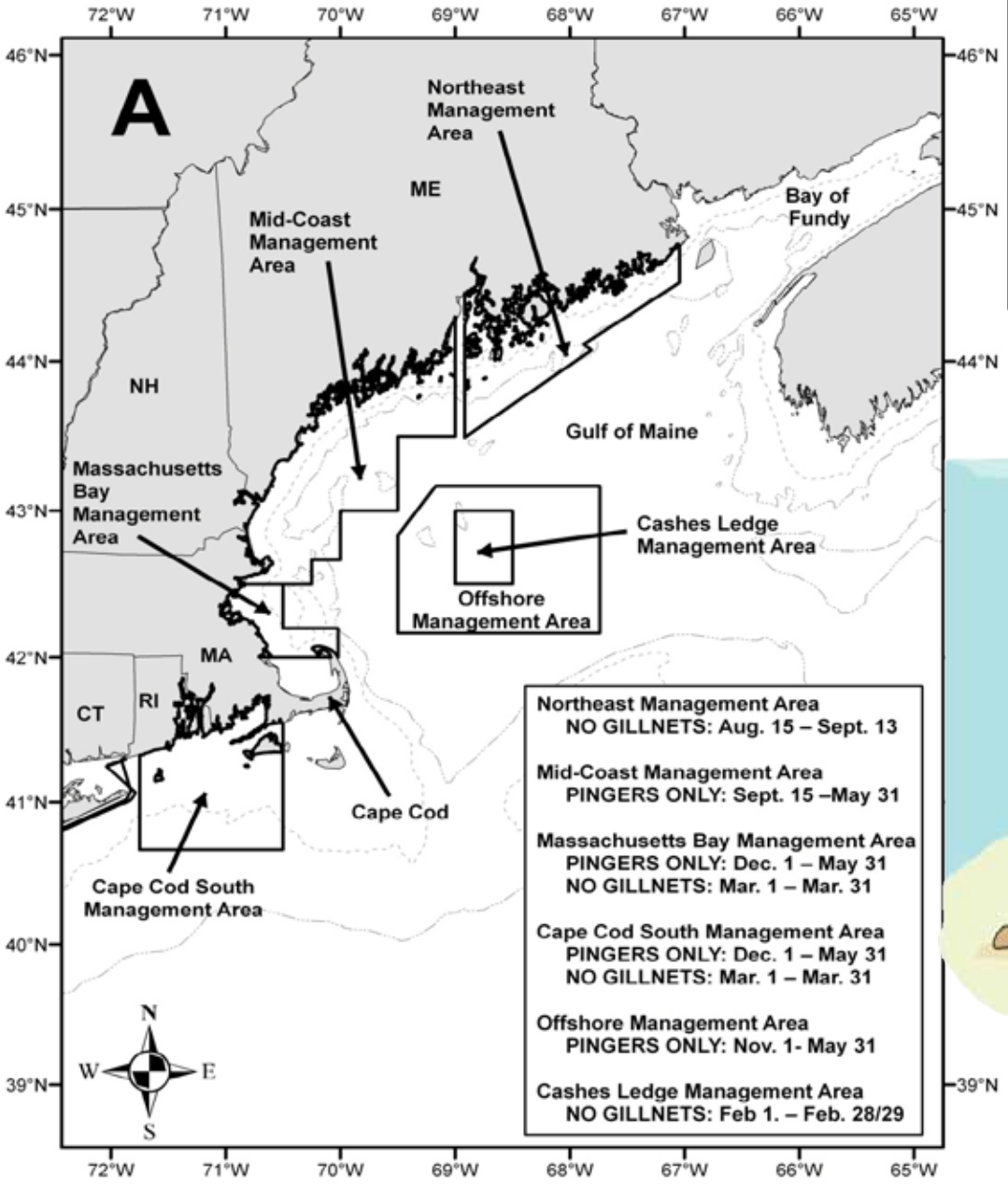


Mandate:

- Specifications of pingers
- Pingers every 100 ft
- Drop down line length > 6 fa
- Skipper training mandatory

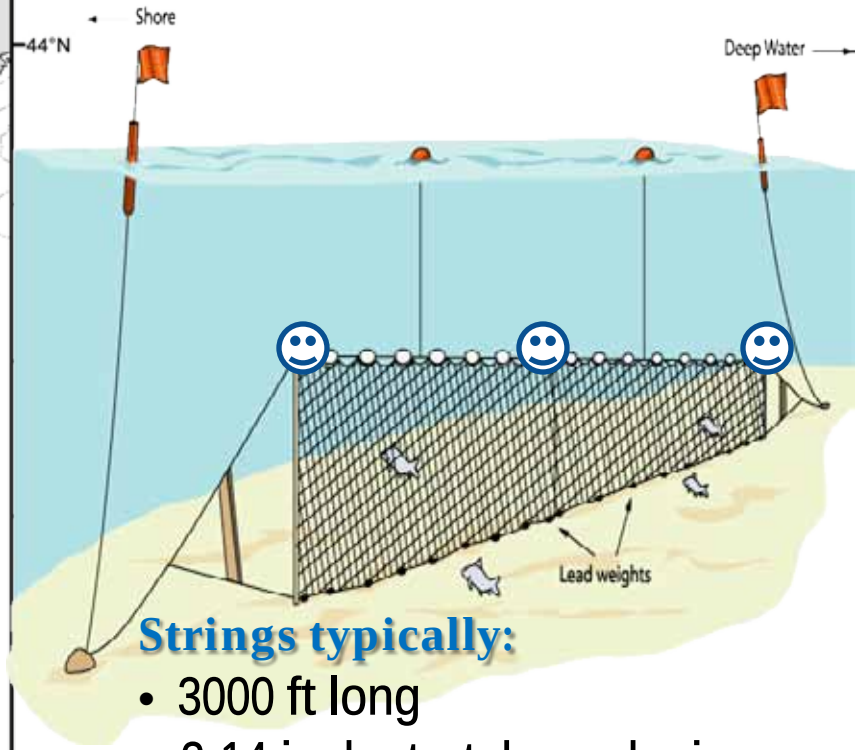
Target species: swordfish and thresher shark, fished from dusk to dawn

1999 Regulations Gulf of Maine sink gillnet



Mandates:

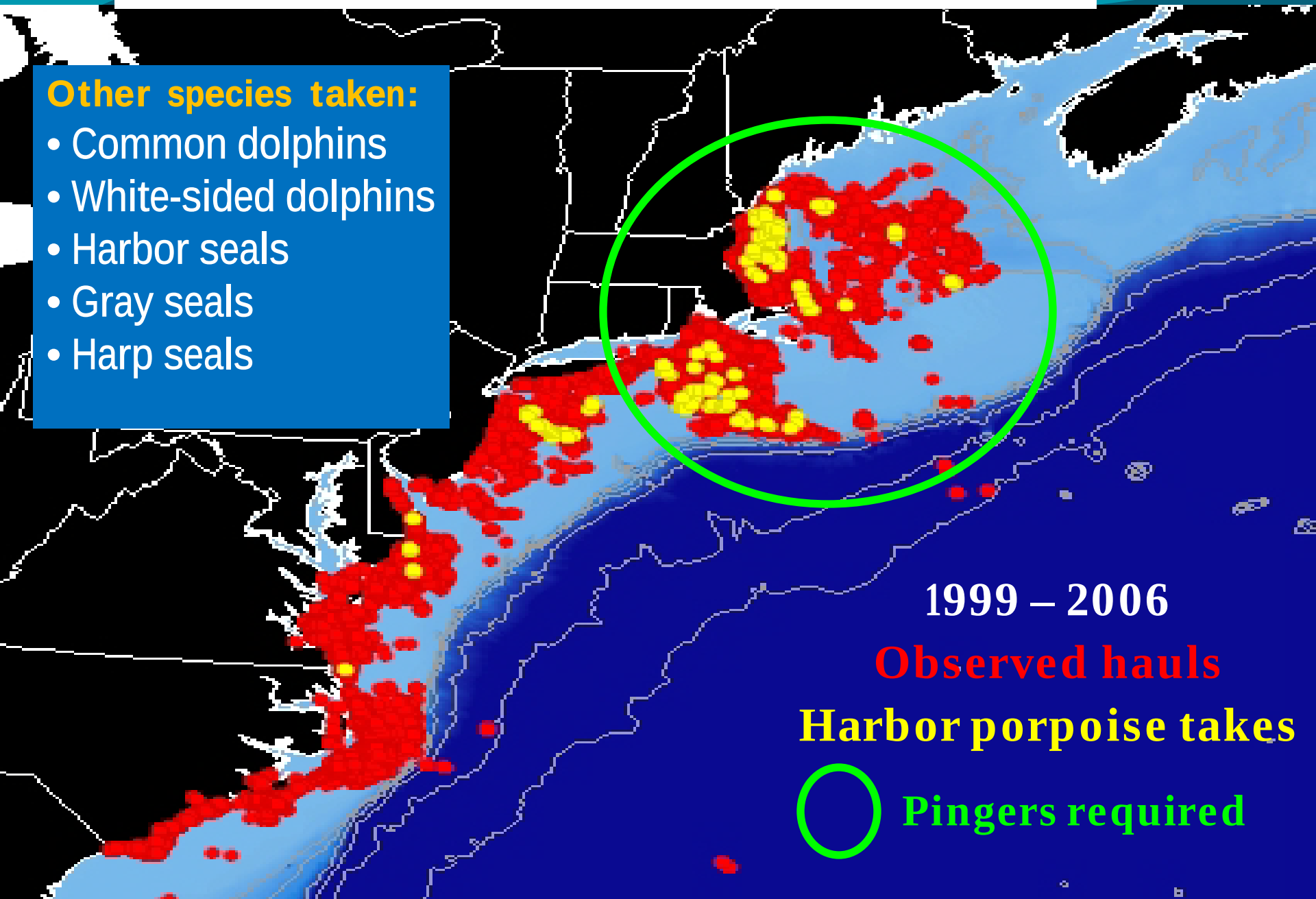
- Series of time/area closures
- Specifications of pingers
- Pingers (☺) on every net (300ft)
- Voluntary pinger training



Strings typically:

- 3000 ft long
- 3-14 inch stretch mesh size
- Targeting groundfish, monkfish, dogfish, skates

Northeast and Mid-Atlantic sink gillnet



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  - Ø **Displacement**
  - Ø **Habituation**
  - Ø **Depredation/”dinner bell effect”**
  - Ø **Compliance**

Changes in Bycatch Rates

CA/OR drift gillnet

species	% reduction		bycatch rate increase in operational fishery?
	scientific experiment 96-97	operational 96-09	
short beaked common	85	47	↑
N. elephant seal	69	81	
Pacific white sided	70	44	↑
beaked whales	100	100	
N. right whale dolphin	38	-142	↑
CA sea lion	71	-93	↑
All cetaceans	69	48	↑
All pinnipeds	71	12	↑

year	% reduction of harbor porpoise bycatch	
	Trippel *et al.* 1999	Gearin *et al.* 2000
	Bay of Fundy	Washington
1995		95
1996	68	97
1997	85	84

Conclusion: Pingers reduced bycatch of most species

Gulf of Maine sink gillnet

Species	% reduction			bycatch rate increase in operational fishery?
	scientific experiment 1994	experimental fishery 94-97	operational 99-07	
harbor porpoise	92	84, 50	60	↑
harbor seal	50	?	28	↑

Changes in Bycatch Rates

Conclusions:

Bycatch rates decreased more in scientific-controlled experiments then in operational fisheries. Perhaps due to:

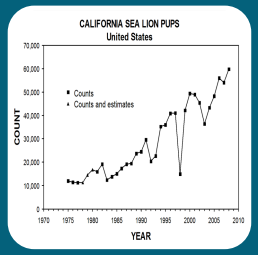
- **Scientific control (compliance)**
- **Differences in gear configurations**
- **Differences in environmental conditions**

Gulf of Maine sink gillnet

Mesh size (in)	% reduction in harbor porpoise bycatch rate	Number of hauls (no pingers/ all pingers)
≤ 6 (like exp)	100	98/431
6+ thru 7	40	1648/1187
7+ thru 10	100	733/276
10+ thru 14	59	678/512

CA/OR drift gillnet

\+ El Niño

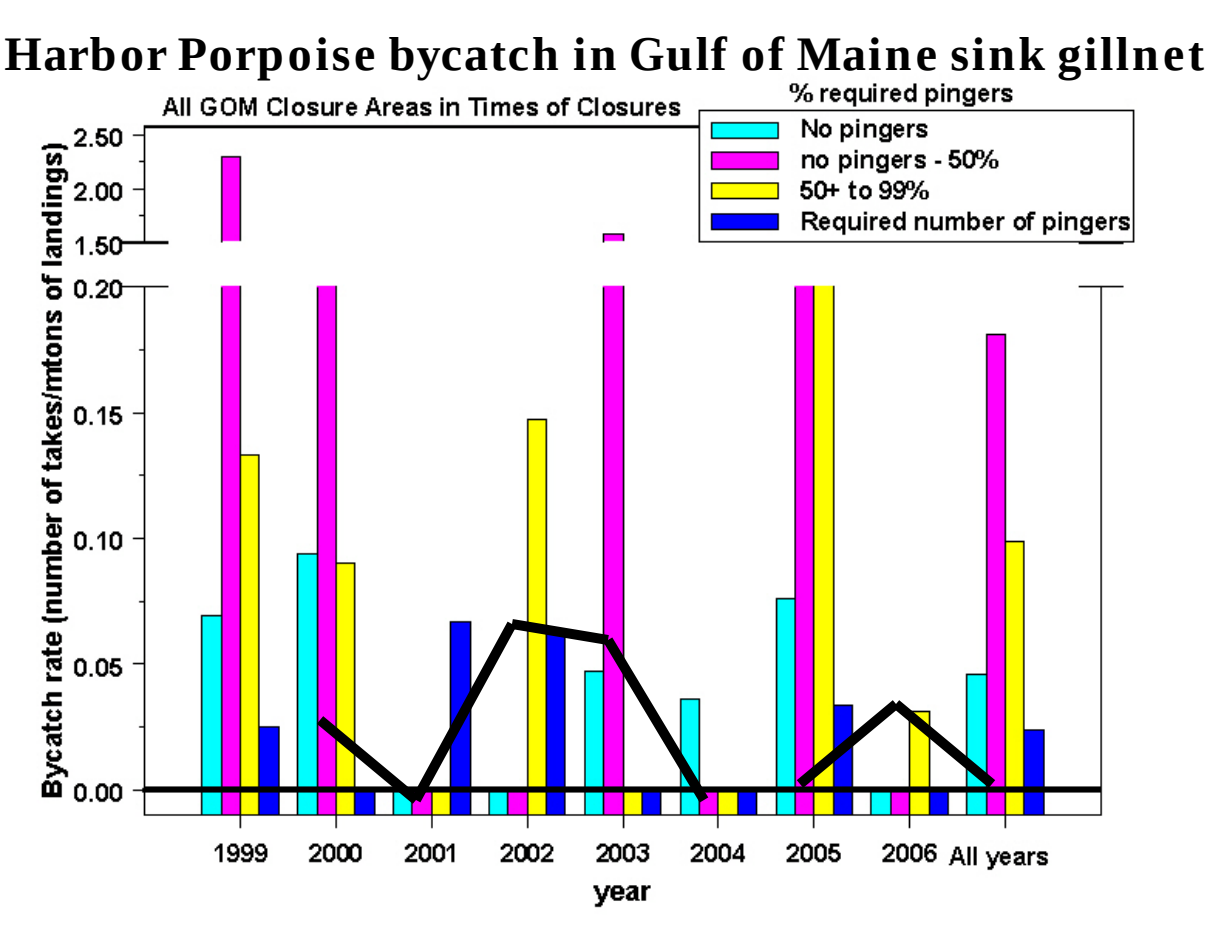


Increase numbers of sea lions

Increase in sea lion bycatch

Changes in Bycatch Rates

Conclusion: Bycatch rates vary annually, spatially, and in parts of sub-fisheries



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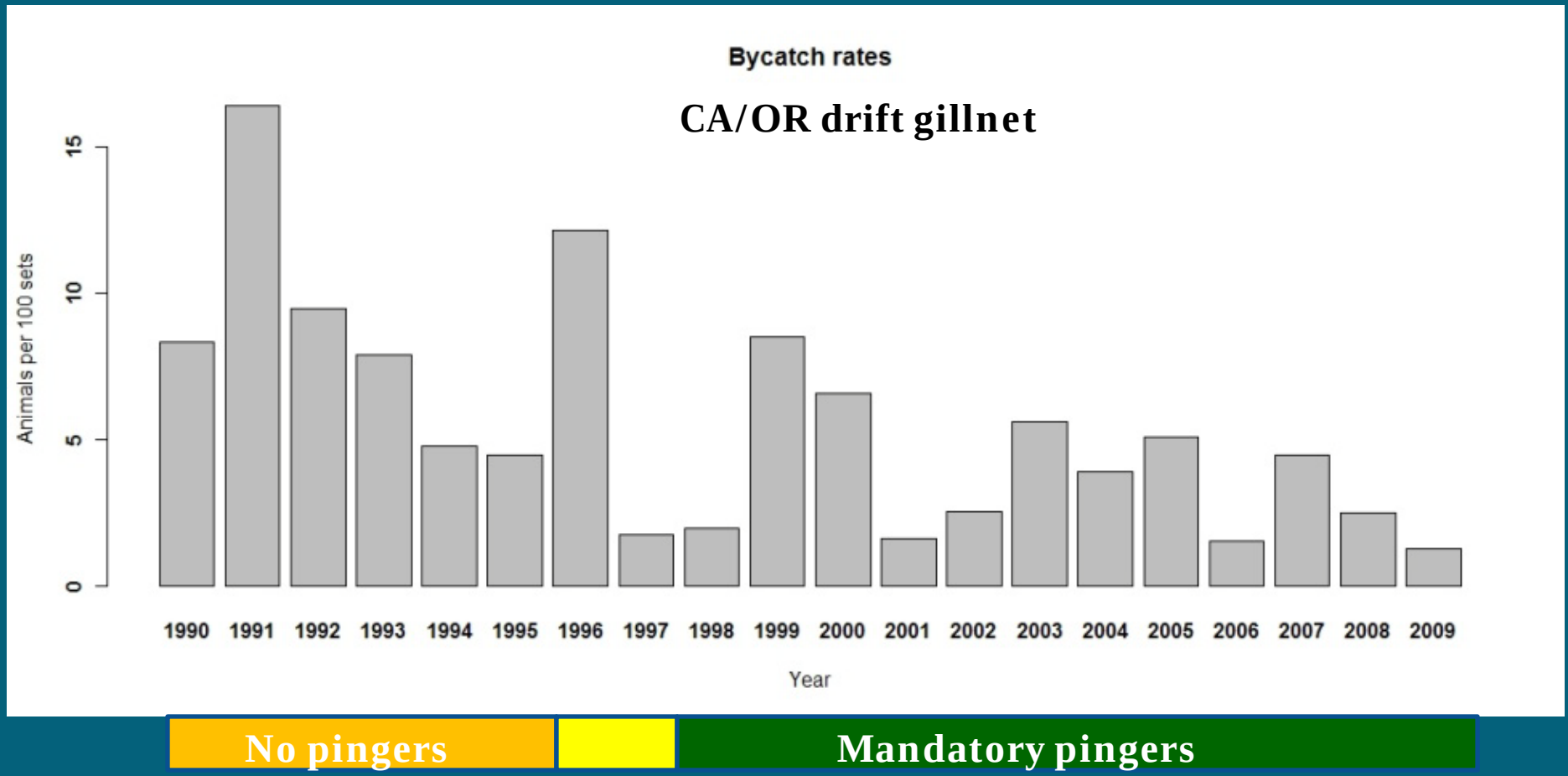


Delphinus delphis bycatch per 100 sets

Changes in Bycatch Rates

- Bycatch rates are also associated with other factors, such as for harbor porpoises in the Gulf of Maine :
  - Season
  - SST
  - North Atlantic Oscillation
  - Twine size
  - Mesh size
  - String length
  - Soak duration

Orphanides 2009; Palka *et al.* 2008

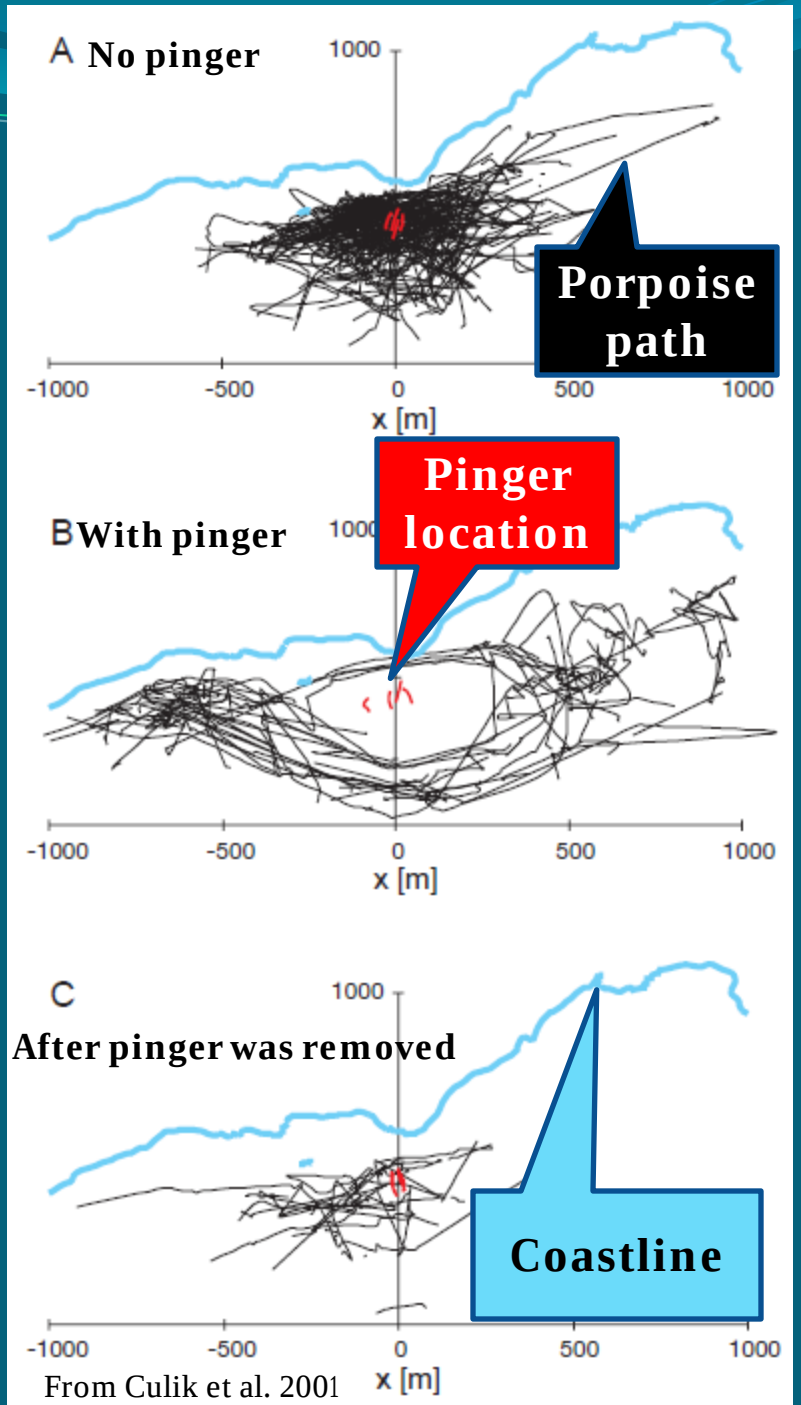
Displacement

Methods:

Monitored changes in density and distribution around pinger

Results:

Displaced Distance (m)	Location	Reference
991	Bay of Fundy	Johnston 2002
208	Bay of Fundy	Cox *et al.* 2001
200	Vancouver	Olesiuk *et al.* 2002
133	Vancouver	Koschinski & Culik 1997
130	Vancouver	Culik *et al.* 2001
125	Washington	Laake *et al.* 1998



From Culik et al. 2001

Habituation

Evidence?	Change	in	after	Area	Reference	Species
Method: Monitor change in distribution around pinger in scientific experiment						
yes	↑	animals around net	immed.	North Carolina	Cox *et al.* 2003; Read *et al.* 2006	bottlenose dolphin
yes	50% ↓	closest approach	4 days	Bay of Fundy	Cox *et al.* 2001	harbor porpoise
	NS	closest approach	5 days	Vancouver	Culik *et al.* 2001	harbor porpoise
yes	density back to control level		6 days	Vancouver	Koschinski & Culik 1997	harbor porpoise
	NS ↓	min distance	6 days	Vancouver	Koschinski & Culik 1997	harbor porpoise
Method: Monitor bycatch rates in commercial fishery						
	NS	fishery bycatch rate	9 years	Gulf of Maine	Palka *et al.* 2008	harbor porpoise
	NS ↓	fishery bycatch rate	14 years	California	Carretta & Barlow 2011	all spp except sea lion
yes	↑ 2x	fishery bycatch rate	14 years	California	Carretta & Barlow 2011	CA sea lion

NS = non-significant

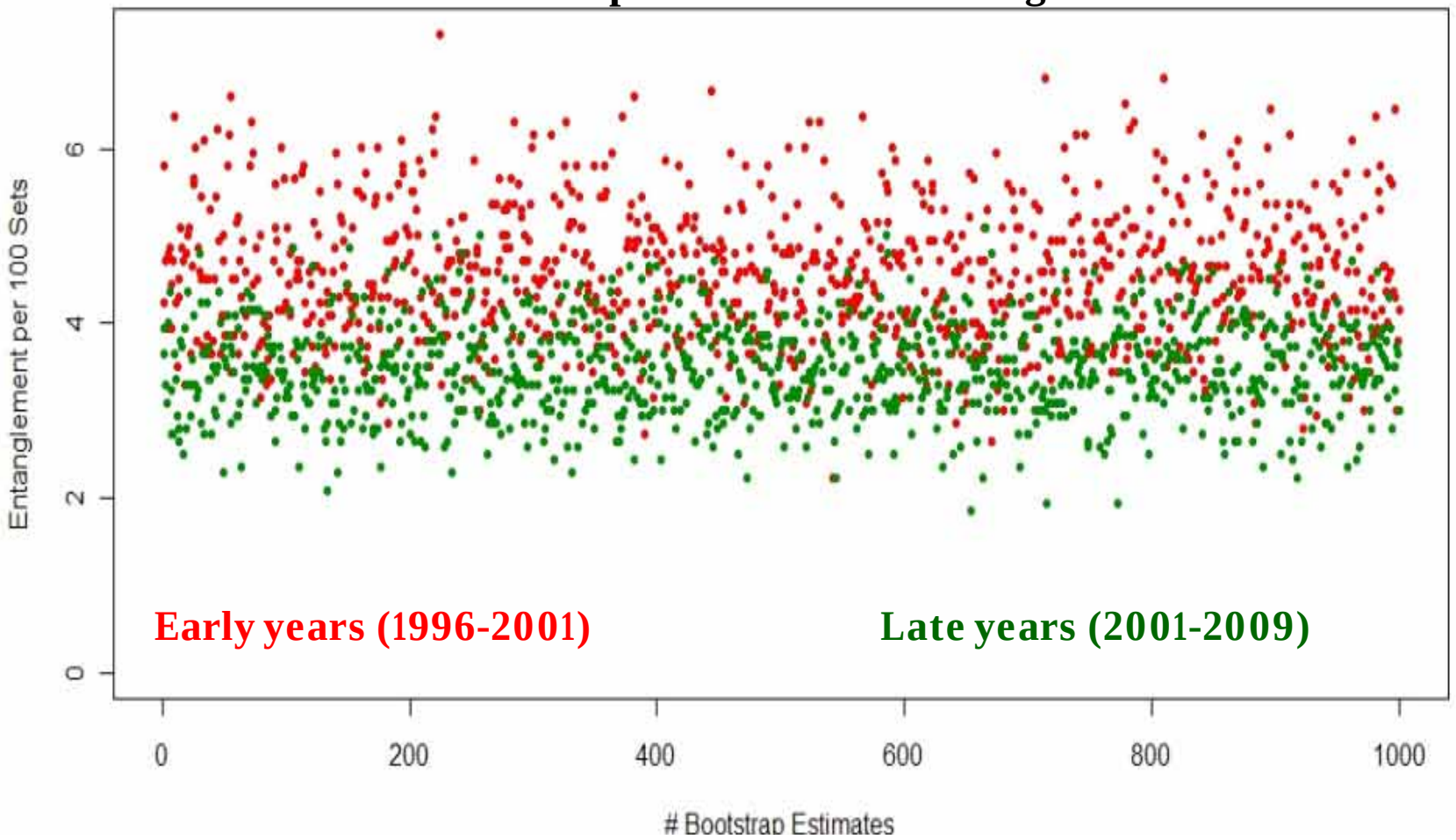
Habituation

Conclusion: In commercial fisheries bycatch rates vary annually and monthly so not possible to show habituation

Habituation

Bycatch Rates in sets with 30+ Pingers, Early vs Late Years

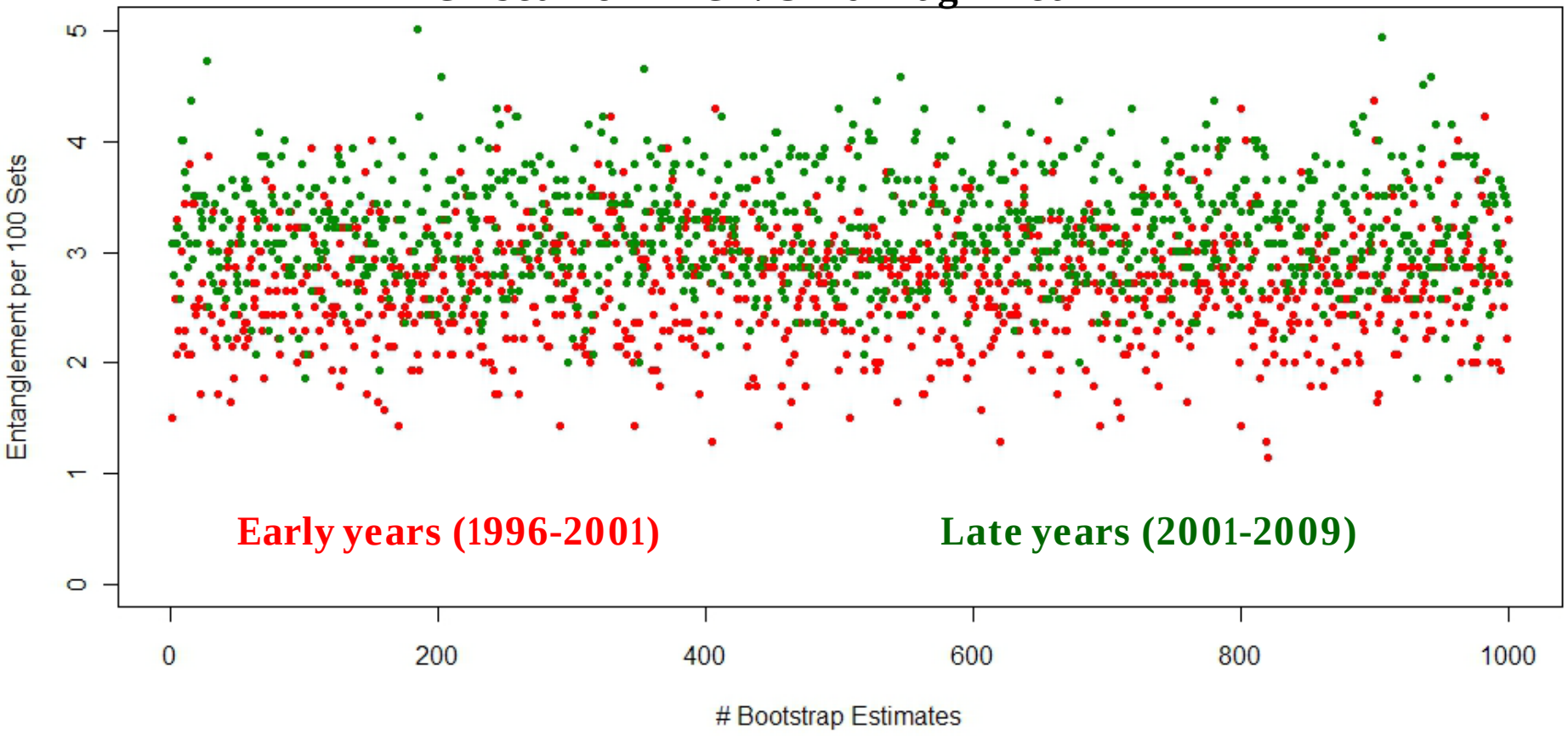
Common dolphins in CA/OR drift gillnet



Early = 49 / 1,396 sets w/bycatch **Late = 42 / 1,396 sets w/bycatch** **p=0.52**

Bycatch Rates in sets with 30+ Pingers, Early vs Late Years

CA sea lion in CA/OR drift gillnet



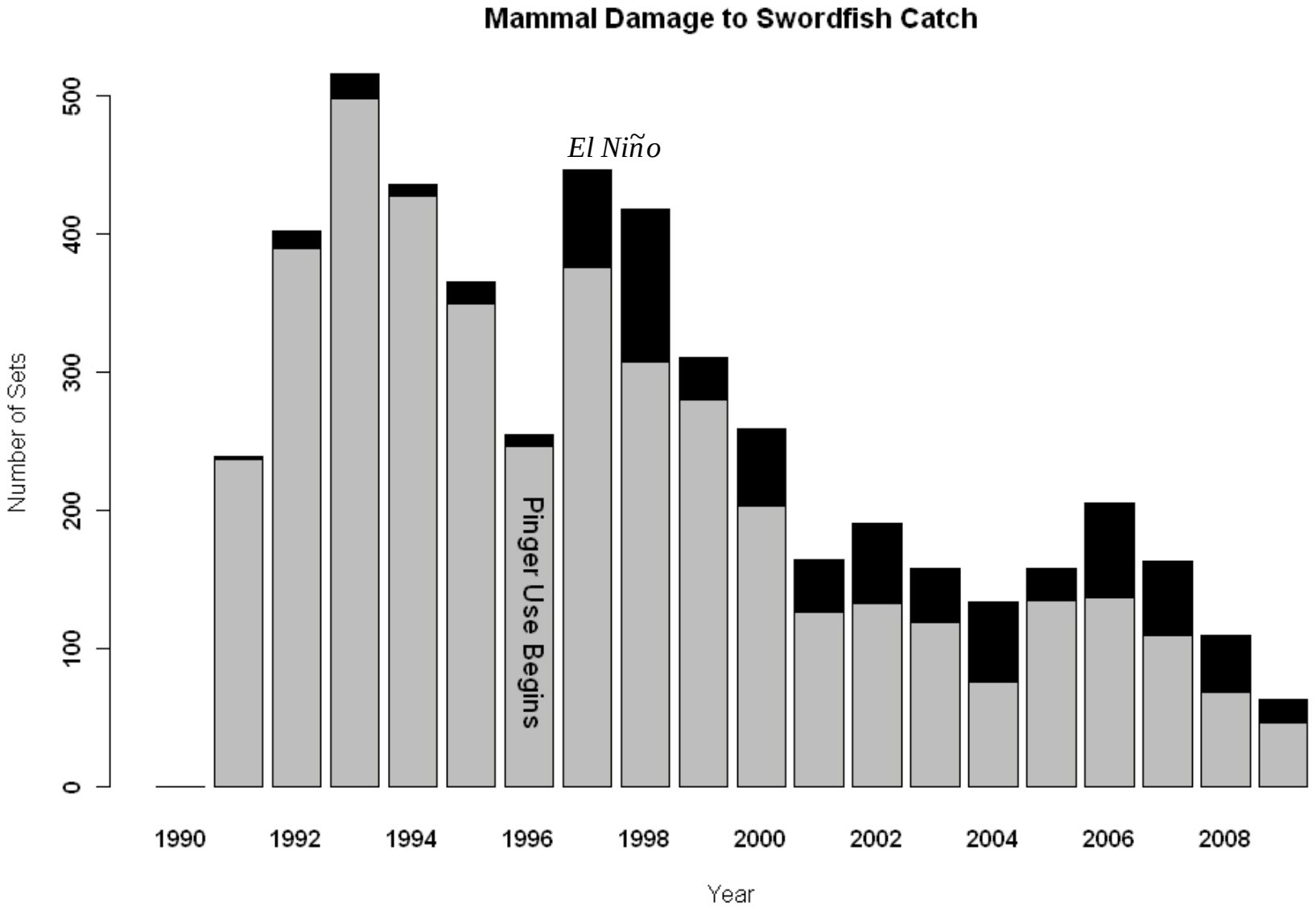
Early = 31 / 1,396 sets w/bycatch **Late = 42 / 1,396 sets w/bycatch** **p=0.24**

Depredation

- **Seal depredation similar in pingered and non-pingered hauls**
  - Gulf of Maine: 1994 experiment (Kraus *et al.* 1997)
  - Washington: 1994-97 experiments (Gearin *et al.* 2000)

- **Depredation increased in pingered hauls**
  - North Carolina: in 2003 bottlenose dolphins eat Spanish mackerel; **catch 38% less when dolphins around** (Read *et al.* 2003)
  - California: during 1996-2009 mammals eat swordfish; **probably not due to pingers** (Carretta & Barlow 2011)

CA/OR drift gillnet fishery



Observers have recorded damage to catch since 1991

CA sea lion depredation of swordfish catch

Photos courtesy Lyle Enriquez, SW Region

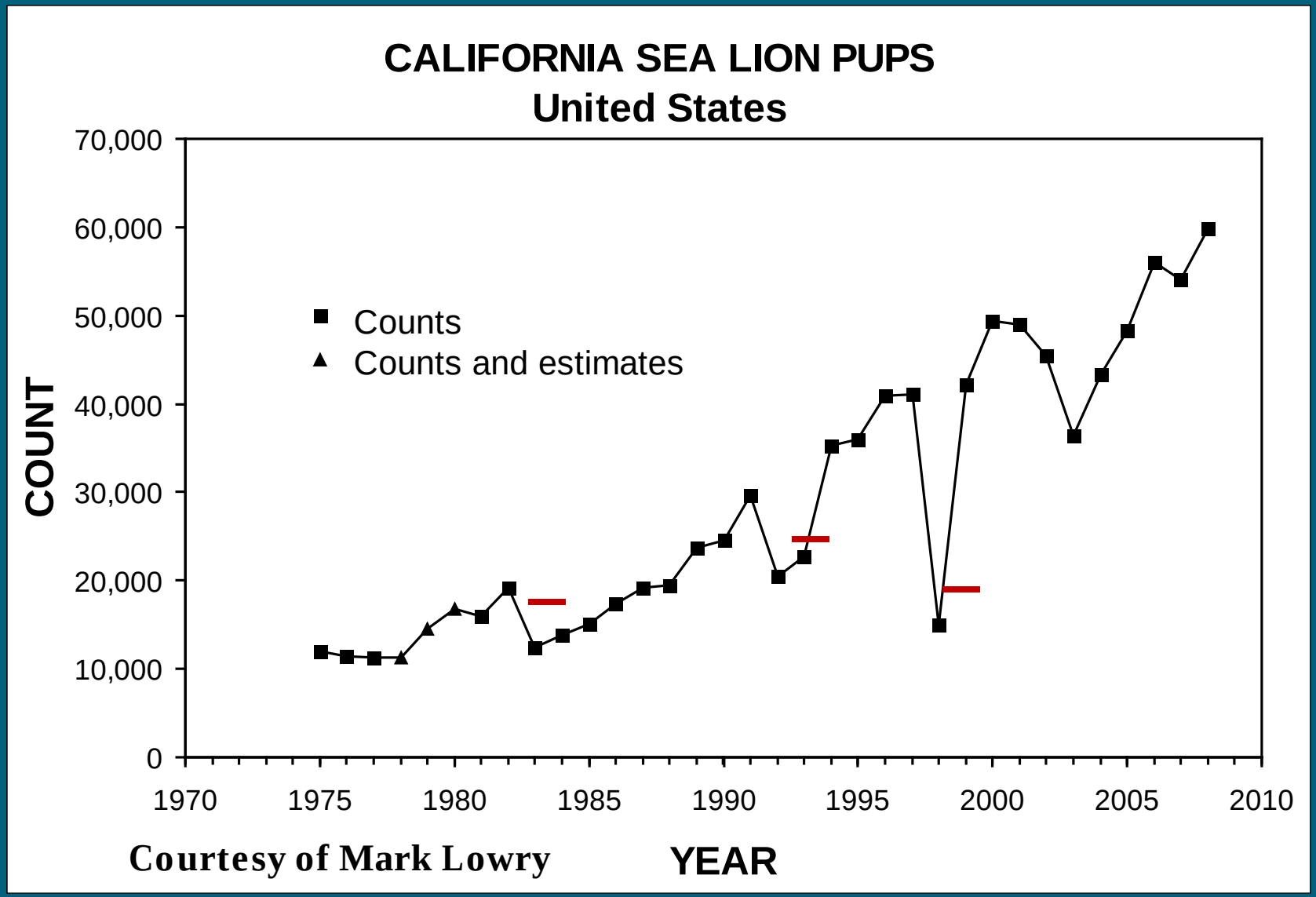
Miller, D. J., M. J. Herder, and J. P. Scholl. 1983. California marine mammal -fishery interaction study, 1979--81. NMFS Southwest Fish. Cent., Administrative Report LJ--83--13C. 233 p.

Depredation

Carretta and Barlow 2011

- Investigated effects of vessel, gear and environmental factors on depredation
- No difference in proportion of sets depredated between sets without pingers and sets with >=30 pingers
- Factors associated with depredation were: total catch, month, latitude, longitude, and presence of deck lights.
- Number of pingers was not significantly related to presence of depredation.

Increase in bycatch and depredation probably due to increase in number of sea lions



Compliance - CA drift gillnet

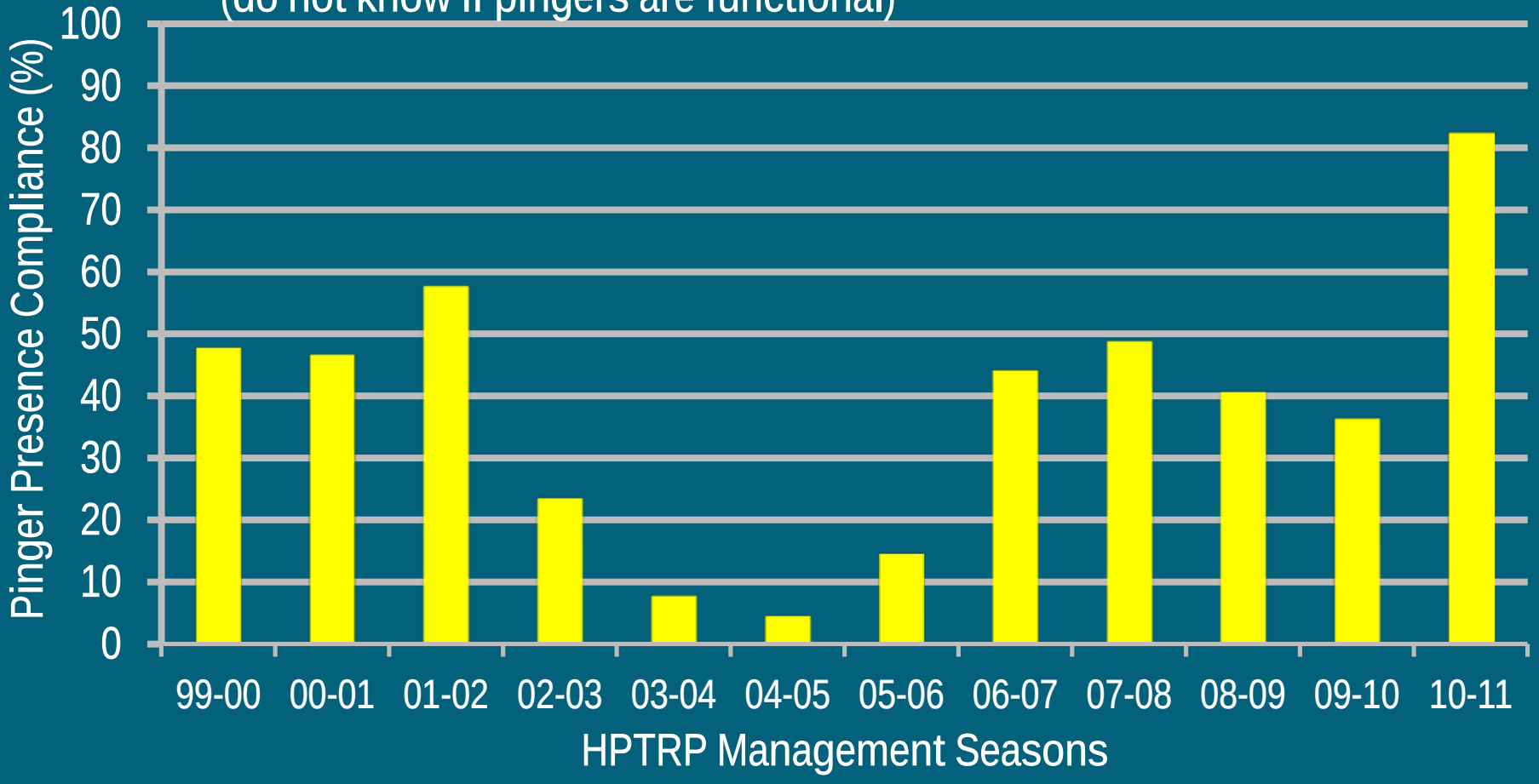
- Limited pinger failure documented (**3.7% of 502 sets**) during 2001-2009
- **Cetacean bycatch 10x higher in sets with non-functioning pingers compared to sets with functioning pingers**

	No Bycatch	Bycatch >=1	Individuals/100sets
Pingers ok	**471**	**15**	**4.7**
Pinger failure	**12**	**4**	**50.0**

Proportion of sets with cetacean bycatch is significantly higher when pingers fail. *p = 0.0000113 (Fisher Exact Test)* Cattetta & Barlow 2011

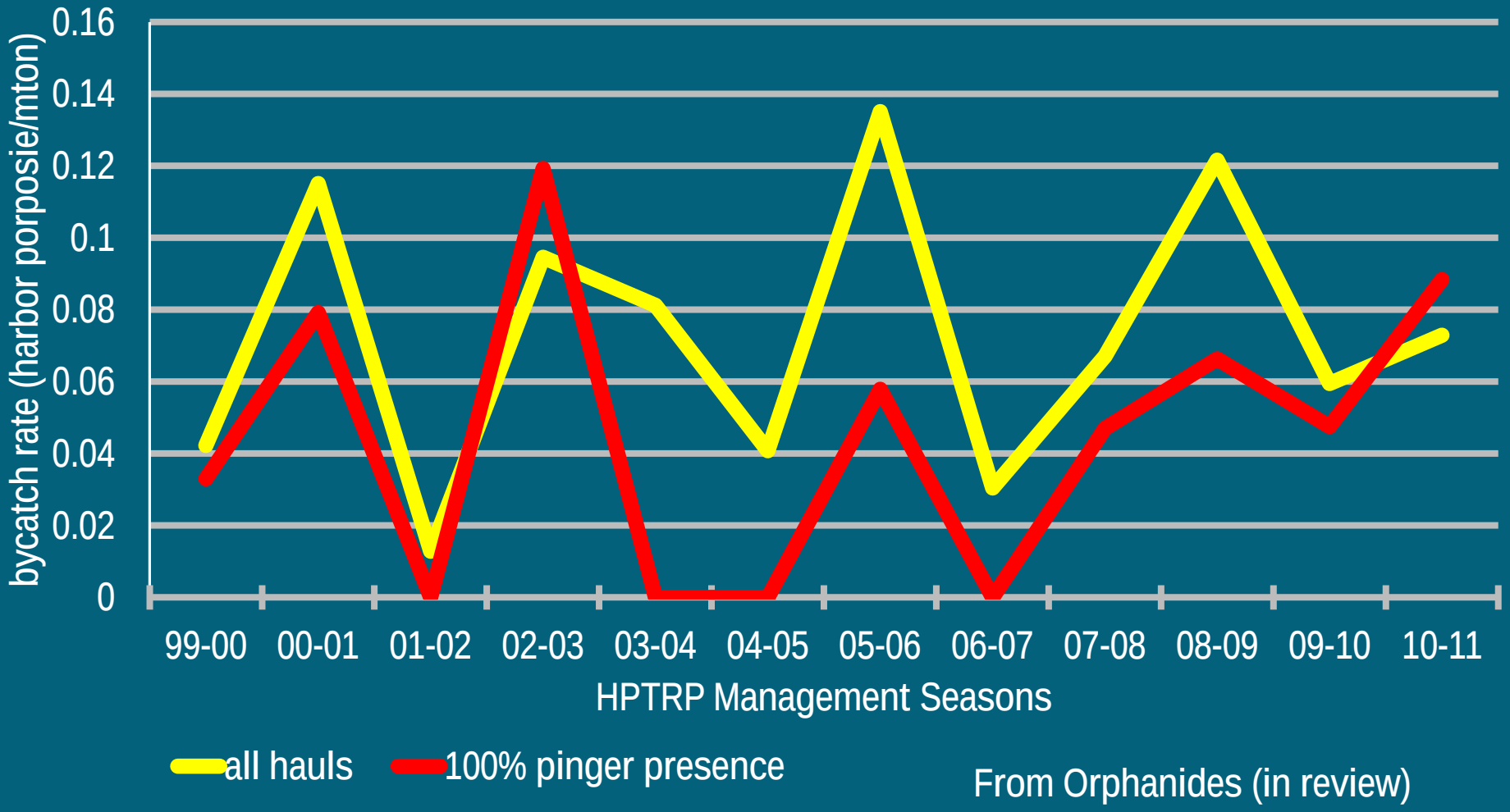
Compliance – Gulf of Maine

% of time all pingers are present in observed Gulf of Maine strings
(do not know if pingers are functional)



From Orphanides (in review)

Bycatch rates in Gulf of Maine lower when use all of the pingers (though do not know if all pingers are functional)



From Orphanides (in review)

Why not complying? (Bisack & Das 2011)

- Social-economic analysis modeled observer data from 61 vessels that carried observers during the 2009-2010 fishing year in the Gulf of Maine sink gillnet fishery.
- Vessels were more likely to violate the pinger requirements if:
  - They only fished with gillnet gear
  - They violated the pinger requirements in previous years
  - They belonged to a groundfish “sector”
  - They were not observed often (less than the median observer rate)
  - They were on smaller vessels
  - They had gross revenues greater than $232K

Conclusions – bycatch rates

1. Pingers reduce bycatch of most species in the CA swordfish and shark drift gillnet and in the Gulf of Maine/Bay of Fundy sink groundfish gillnet fisheries
2. However, bycatch has increased in pingered nets for a few species
3. Pingers are not 100% effective, there is inter-annual and inter-seasonal differences
4. Other factors also are associated with bycatch rates, such as environmental factors (SST, El Niño/NAO) , number of animals in the fishery area, mesh size, twine size, soak duration, and string length.
5. Bycatch rates in scientific controlled experiments appear to be less than that results during the operational fishery

Conclusions – displacement & habituation

1. Pingers seem to displace most animals a short distance from the pinger, as documented when following individual animals.
2. Habituation has been documented when pinger is in water for 4-6 days.
3. However the displacement does not appear to be displacement out of the habitat and the animals do not appear to habituate to operational fisheries since bycatch continues to occur in the operational fisheries.

Conclusions – depredation

1. Depredation occurs, with and without pingers. Other factors, such as the increased presence of CA sea lions could also be attributed to increased depredation.

2. Pingers have been attributed to attracting more bottlenose dolphins to the fishing nets, thus, resulting in increased depredation.

Conclusions – compliance

1. Reducing compliance to pinger regulations has resulted in increased bycatch rates
2. Non-compliance will probably always occur when humans are involved.

Food for thought …

- Do we need to know how and why animals get entangled to fully develop very effective mitigation measures
- (or else can we be lucky and get the right combination of measures to be as effective as possible)

- Any questions?