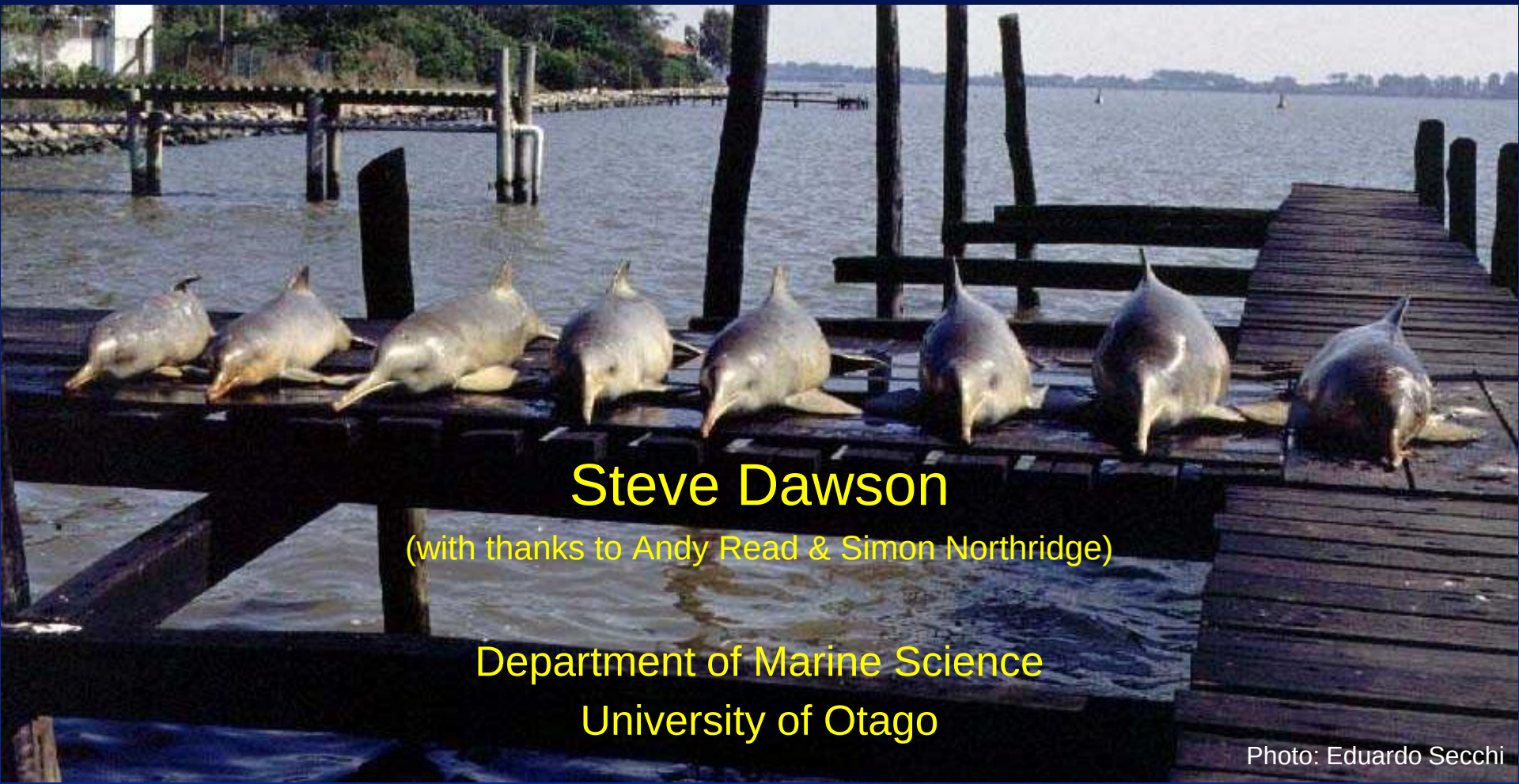
To ping or not to ping?

Use and abuse of acoustic pingers to reduce interactions between small cetaceans and gillnet fisheries



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(with thanks to Andy Read & Simon Northridge)

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Photo: Eduardo Secchi

Before the 1990s…

- Most studies of pingers effects on cetacean bycatch were poorly designed
- No clear evidence of positive effects
- The pingers themselves were hopelessly impractical for use in real fisheries

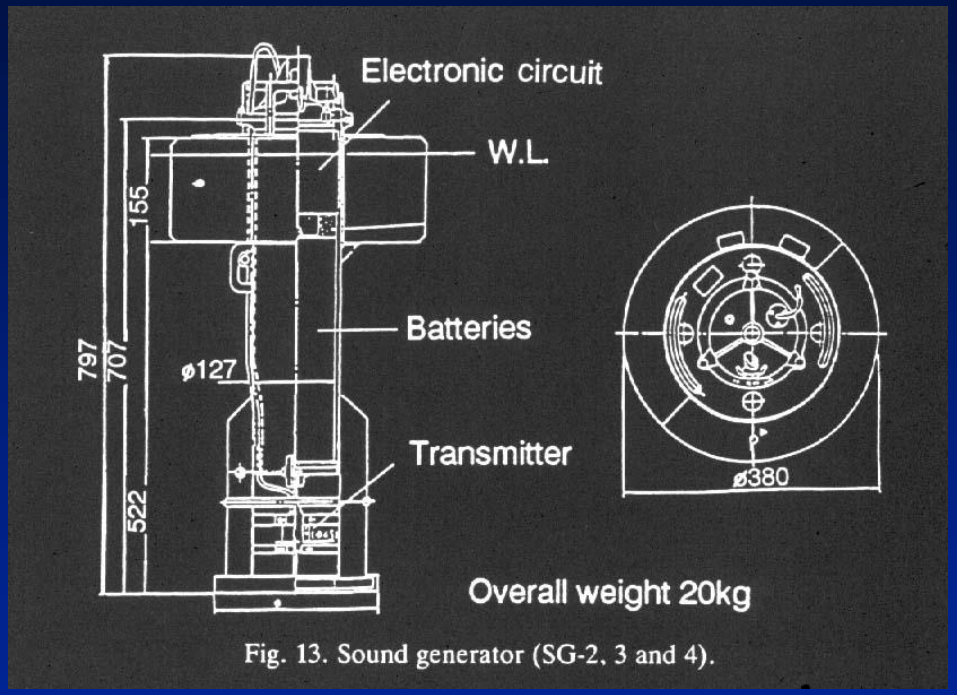


Fig. 13. Sound generator (SG-2, 3 and 4).

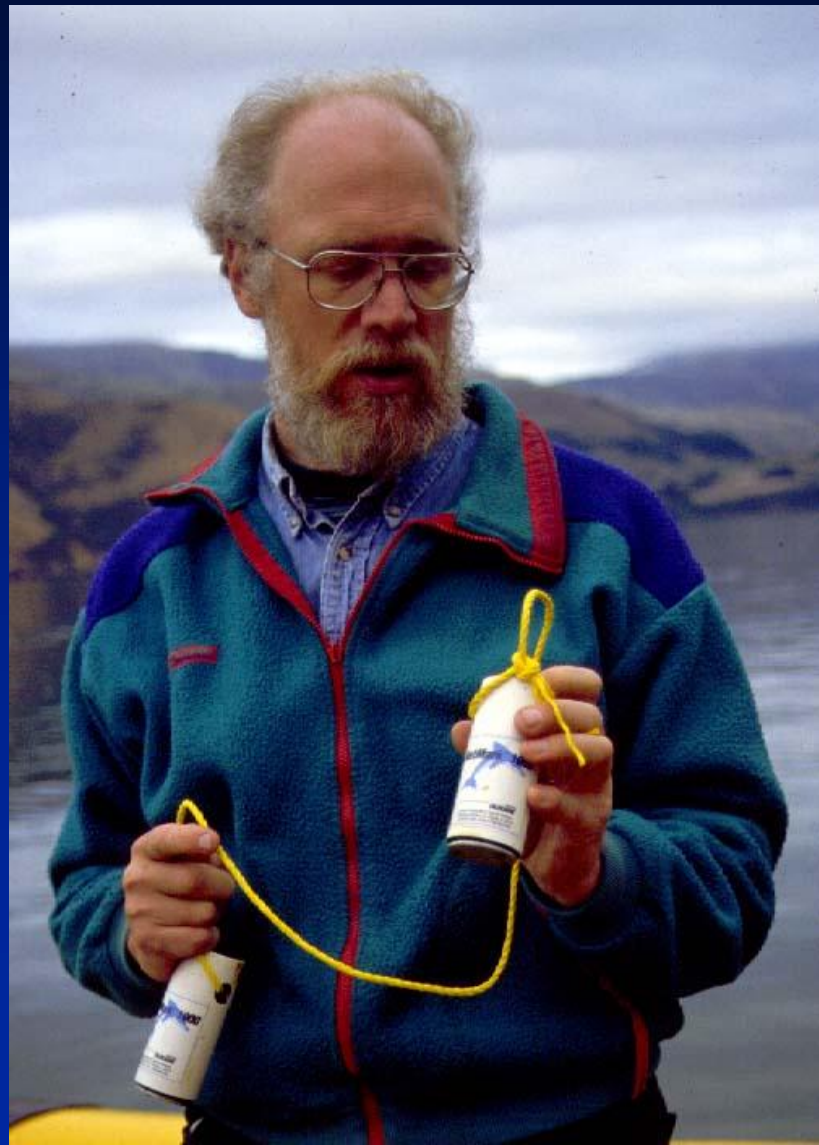
(Ogiwara, 1986; Hatakeyama, 1988; Dawson, 1991)

The 1995 New Hampshire experiment

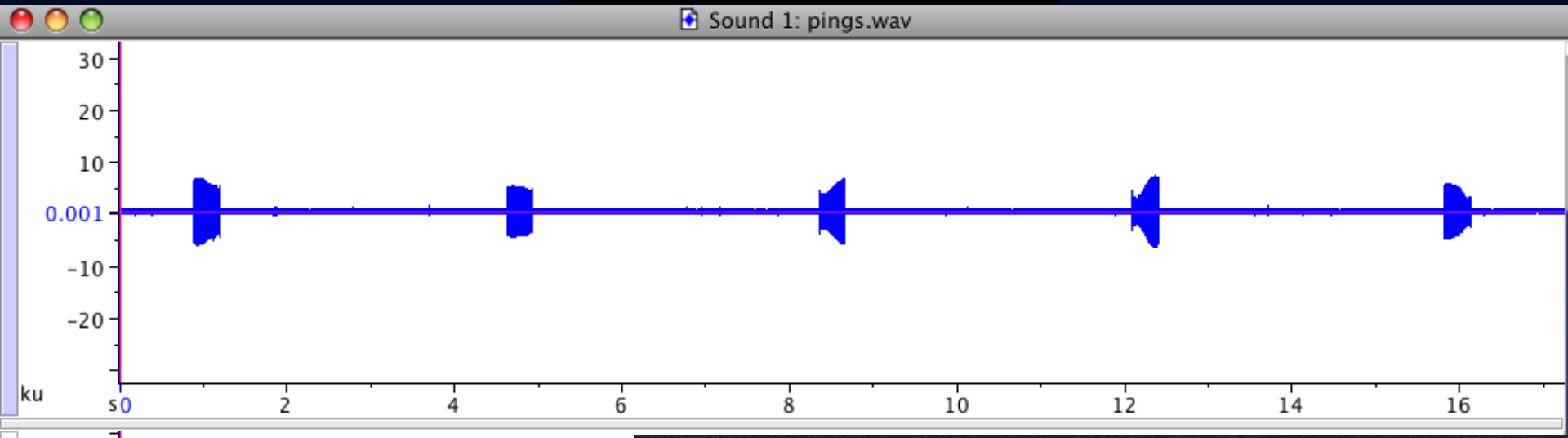
(Kraus et al., 1997)

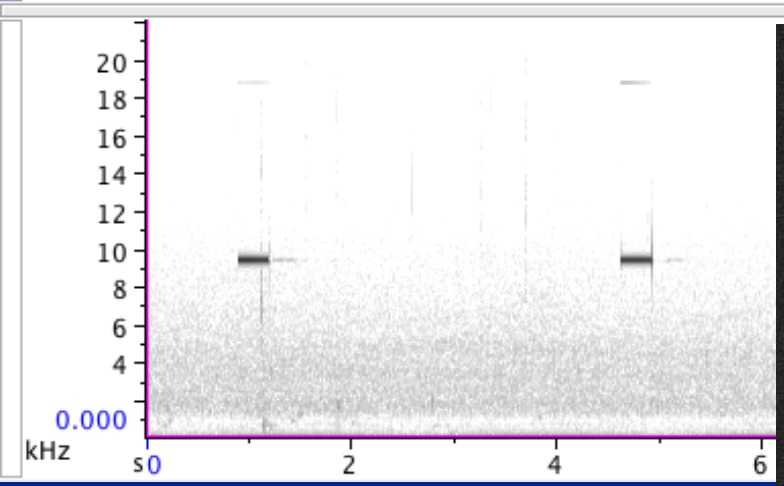
- Test of pingers in a real fishery with high bycatch
- Prior power analysis to determine scale
- Standardised fishing gear
- Pingers at Bridle (~92m apart)
- Balanced design
- Independent observers
- Double blind

Photo: Ari Friedlander

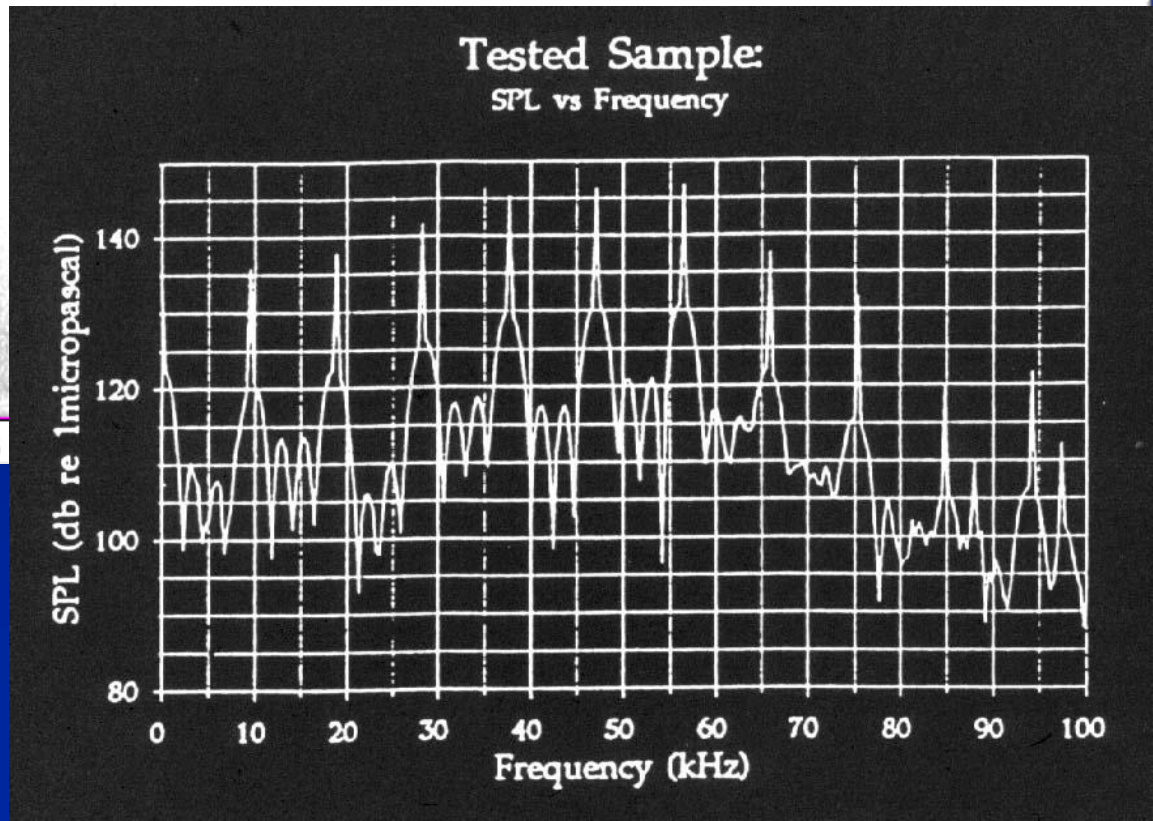


Pinger characteristics





10kHz, multiple harmonics
SPL = 132 dB re 1µPa at 1m
300 ms ping every 4s



Results

	# strings set	# porpoise kills
strings with active pingers	421	2
strings with inactive pingers	423	25

(Kraus et al., 1997)

Entanglement

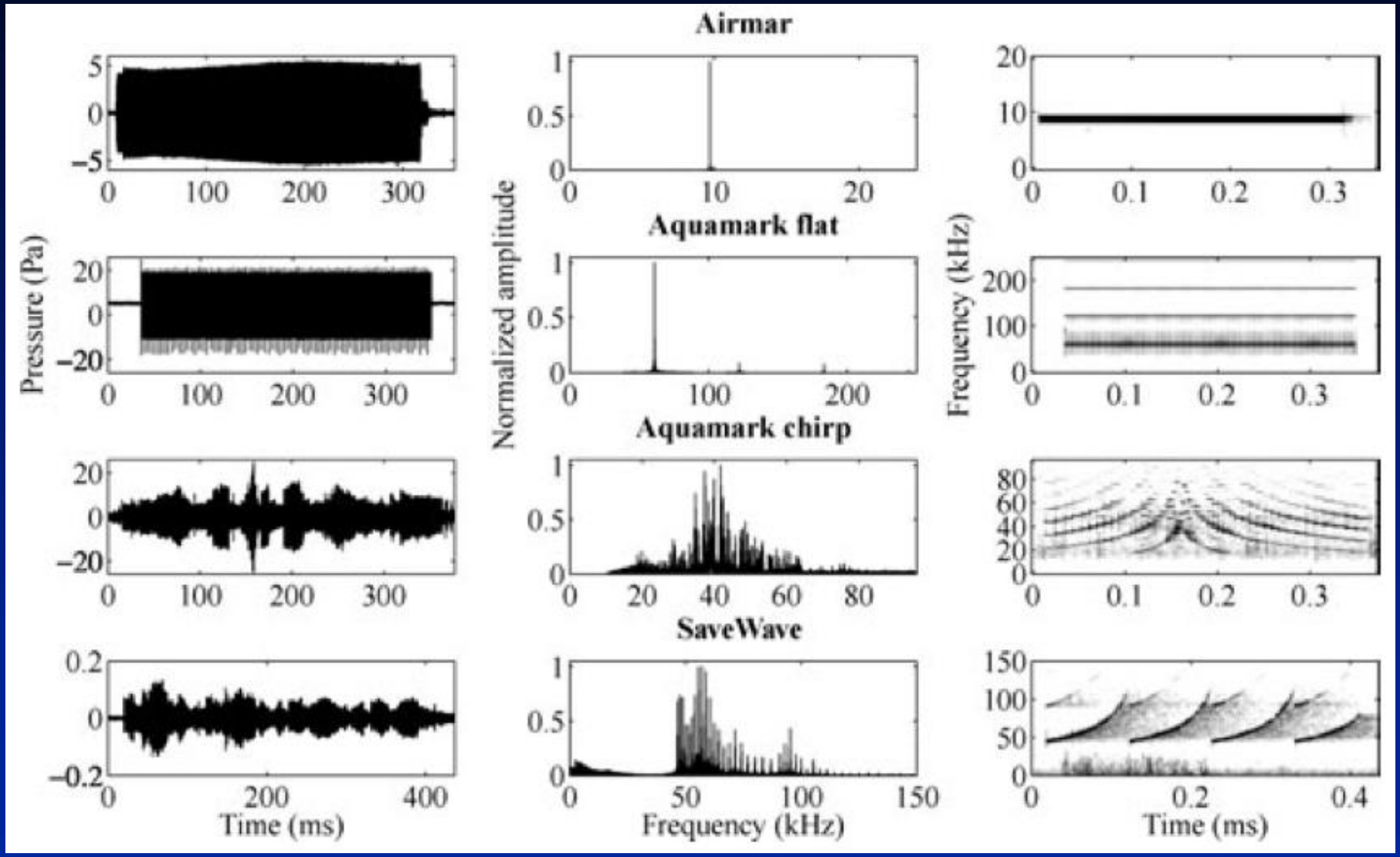
Depredation

132 dB re 1 µPa
(NMFS standard)

174 dB

Household equivalents in air

Pinger characteristics



Shapiro et al., 2009

Do they reduce entanglement?

Reducing entanglement rates in controlled experiments

harbour porpoises

9 of 11 controlled experiments in bottom-set gillnets produced large (>77%) reductions in bycatch

common dolphin

82% reduction in bycatch in California/Oregon driftnets (Cameron & Barlow 2003)

franciscana

82% reduction in bycatch in Cabo San Antonio, Argentina (Bordino et al 2002)

Reducing entanglement rates in real fisheries

harbour porpoises

New England gillnets with full compliment of pingers caught 60% fewer porpoises than nets without pingers (Palka et al. 2008)

common dolphin

50% reduction in entanglement rate in California/Oregon driftnets since pingers employed (Cameron & Barlow 2003)

Beaked whales

Same fishery: No catches observed since pingers employed in 1995

No evidence for diminishing effectiveness via habituation

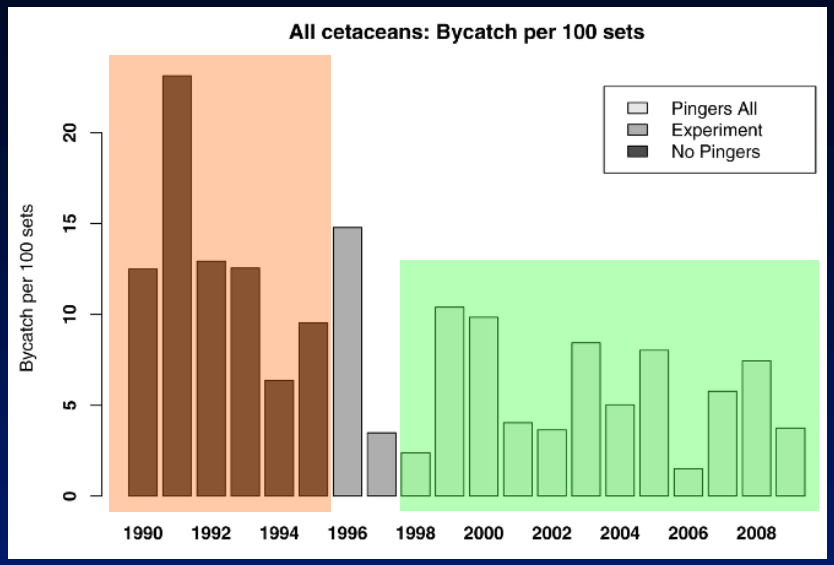
In both fisheries pingers are PART of the mitigation strategy, which includes:

- *Time/area closures (New England)*
- *Changes to net rigging (California/Oregon)*

What can we learn from these studies?

- Pingers can work in fisheries
- Catches of target species were not affected
- US Fishermen can accept this solution
- Problems:
  - Compliance
  - What is happening on unobserved vessels?
  - Pinger failure appears to result in higher catch rates

California-Oregon driftnets (Carretta & Barlow 2011)



- c. 50% before/after reduction in CD bycatch rate
- 82% in controlled experiment
- Problems with pinger failure?
- Sets with failed pingers have signif higher bycatch rates

New England gillnets (Palka et al. 2008)

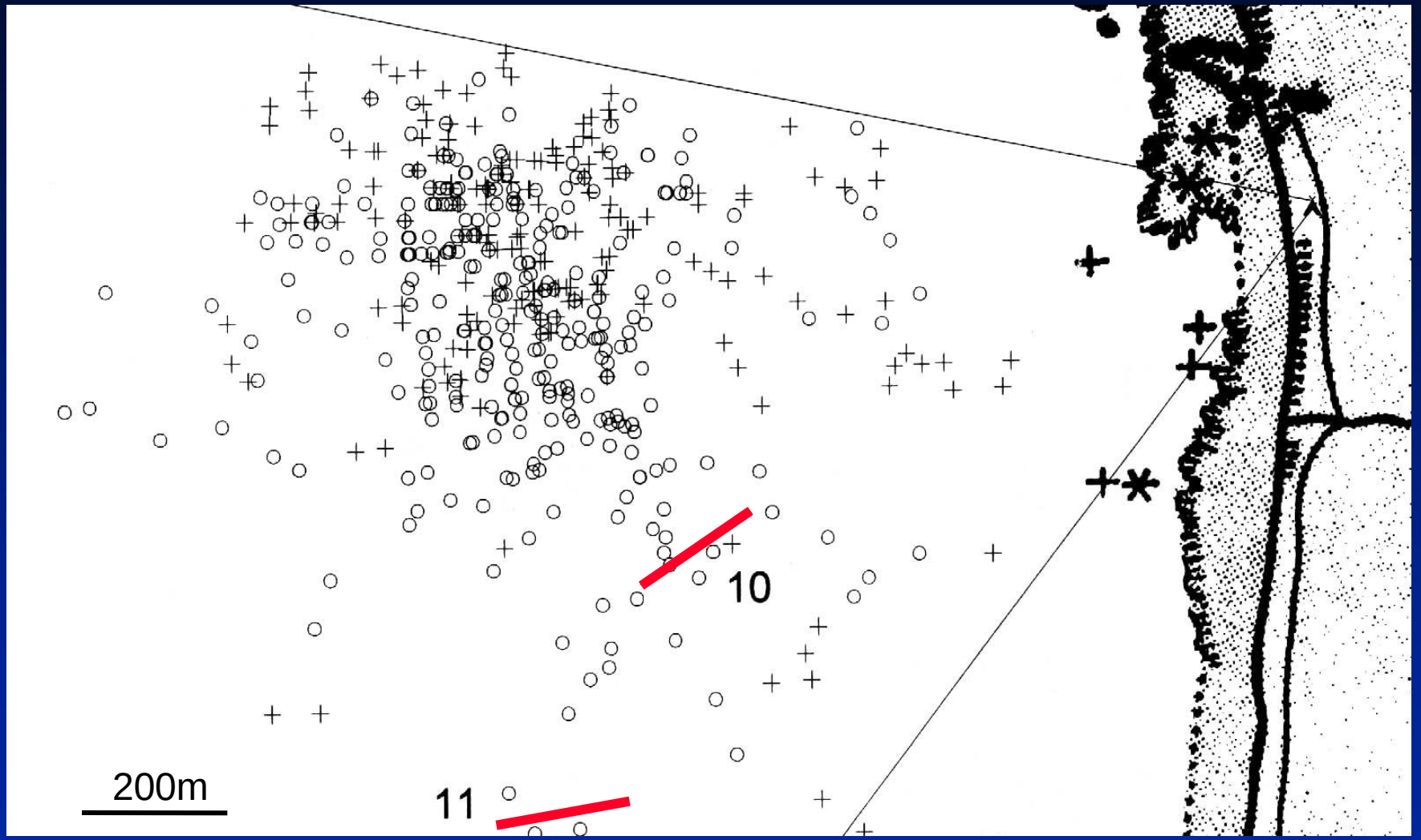
- c. 60% before/after redn in HP bycatch rate
- 92% in controlled experiment
- Sets with failed pingers have higher bycatch rates than those with no pingers

A. Harbor Porpoises

	no pingers			some pingers			required number of pingers		
Area	byc rate	%CV	n hauls	byc rate	%CV	n hauls	byc rate	%CV	n hauls
all MA's	0.053*	19.9	3157	0.120+	20.9	1065	0.024	35.1	2407
Mid-Coast MA	0.084	25.6	1287	0.130+	23.1	670	0.041	40.1	1057
Mass Bay MA	0.009	101.4	927	0.524+	63.7	39	0	0	353
CC South MA	0.075*	29.4	660	0.139	53.4	262	0.023	71.9	743
Offshore MA	0	0	269	0	0	92	0	0	249
Cashes Ledge MA	0	0	14	0	0	2	0	0	5
Stellwagen Banks Area	0.074	26.7	1371	0.238+	72	68	0	0	118
WGOM CA	0.099	49.9	212	0.131	42	149	0.034	1.0	122

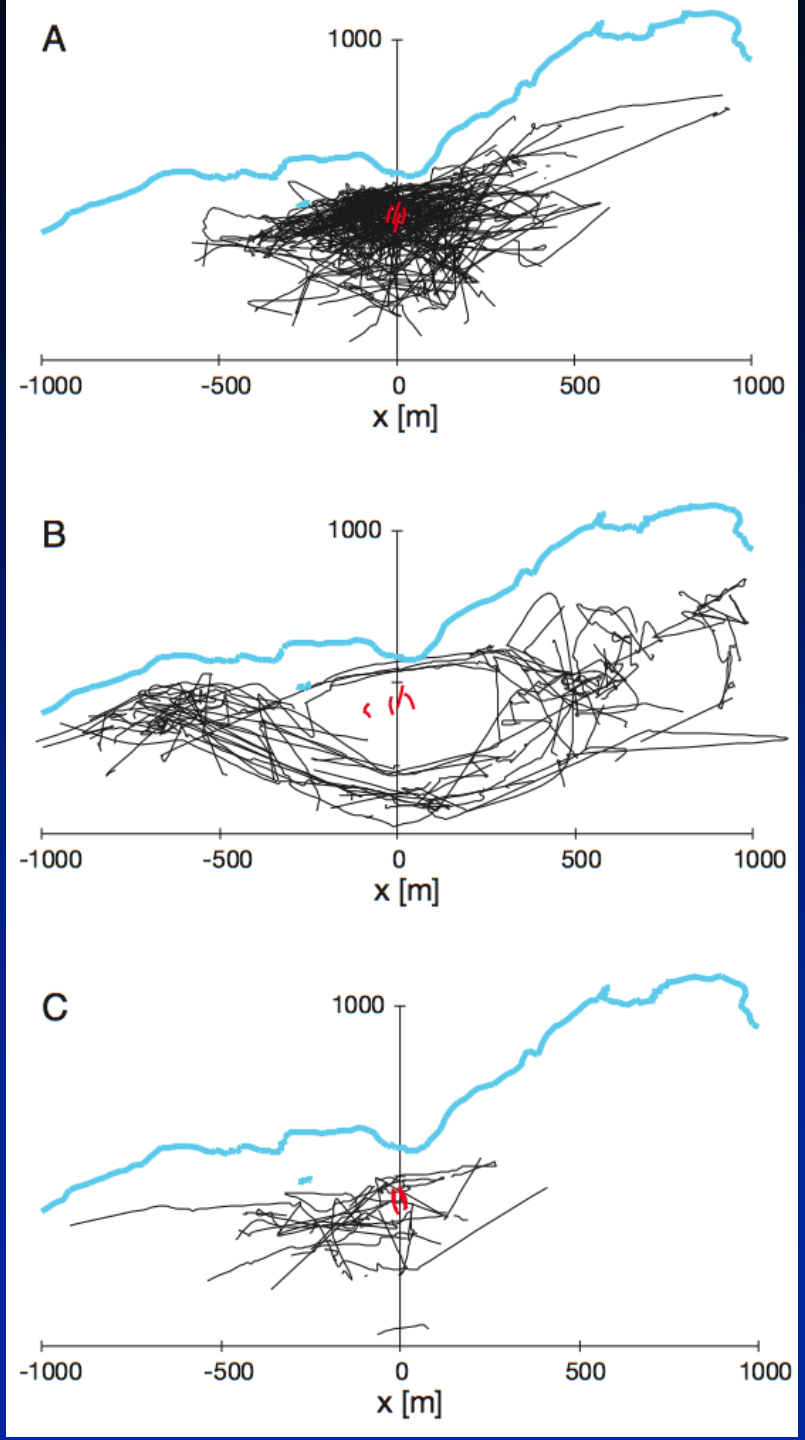
How do pingers work?

Harbour porpoise surfacing positions: + = pinger on, o = pinger off



Lien pingers (2.7kHz, 123 dB, 16.6m apart)

(Laake et al., 1998)



Harbour porpoise tracks

before

Single PICE pinger (randomised 20-160kHz, 145 dB)

During (ON)

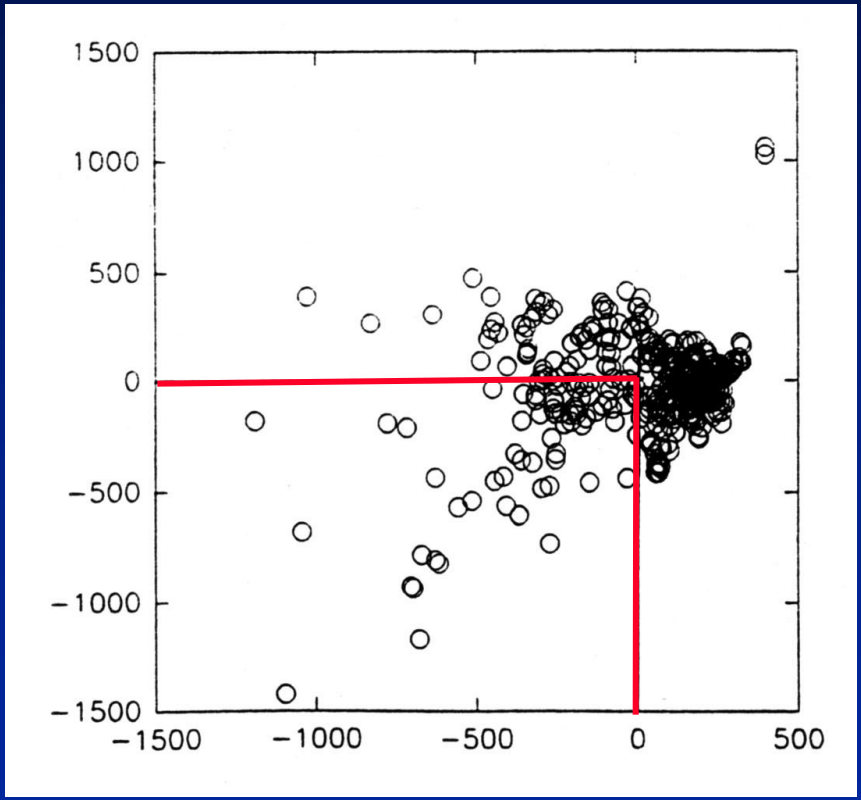
after

(Culik et al 2001)

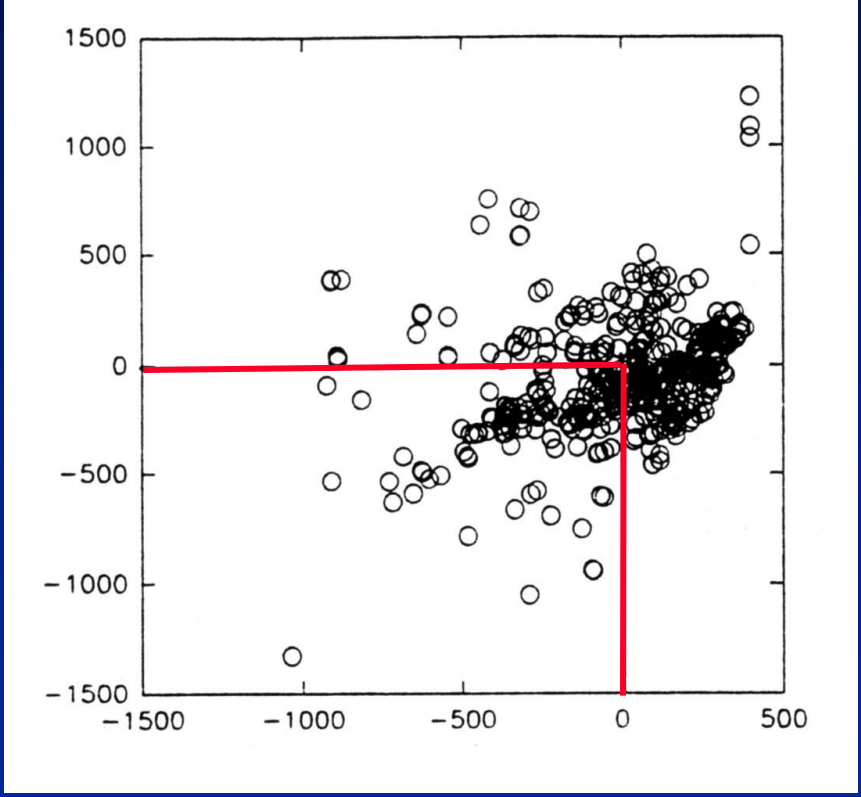
Hector's dolphin positions

Single Dukane pinger (10kHz, 132 dB)

Pinger off



Pinger on



(Stone et al., 1998)

Tucuxi positions

Dukane pingers (10 kHz, 132dB, at 25m intervals

(Montiero-Neto et al., 2004)

What is the *mechanism*?

1. Are pinger sounds are intrinsically aversive, causing displacement?

Yes: Harbour porpoise (Laake et al 1998; Culik et al 2001)

No: Hector's, tucuxi, bottlenose (Stone et al 1999, Monterio Neto et al 2004, Cox et al 2003)

2. Do pingers encourage echolocation, and therefore make detection of the net more likely?

No: (Harbour porp, Bottlenoses, Hector's) (Cox et al 2001, Carlstrom et al 2009, Leeney et al 2007, Stone et al 1999)

3. Do pinger sounds interfere with the animals' sonar, causing them to leave the area?

Untested, but unlikely with NMFS-spec pingers

4. Do pingers work by changing distributions of prey?

No: (Harbour porpoise) (Kraus & Brault 1999, Culik et al 2001)

NMFS-spec pingers do not alter herring behaviour (Wison & Dill, 2002)

What about depredation?

Almost always involves bottlenose dolphins

Generalisation impeded by…

- wide range of devices used (130dB to >170dB)
- Many studies poorly designed (low power to detect effects)
- Difficult to conclusively identify net damage as caused by dolphins

However…

- Generally small and inconsistent improvements in fish catches
- Somewhat reduced net damage (Brotons et al. 2008; Busciano et al. 2009; Gazo et al. 2008)
- Do not eliminate risk of entanglement (McPherson et al., 2004; Read & Waples, in review; Northridge et al., unpub data)
- Should we expect effectiveness when food rewards are present for ignoring pinger sounds?

Looking ahead - Under what circumstances will pingers be effective?

Clear displacement and/or reduced entanglement rate of

- harbour porpoise
- beaked whales
- common dolphins
- striped dolphins
- franciscana

Neophobic (easily spooked)?
Behaviourally inflexible?
Shelf edge/Oceanic
Low site fidelity

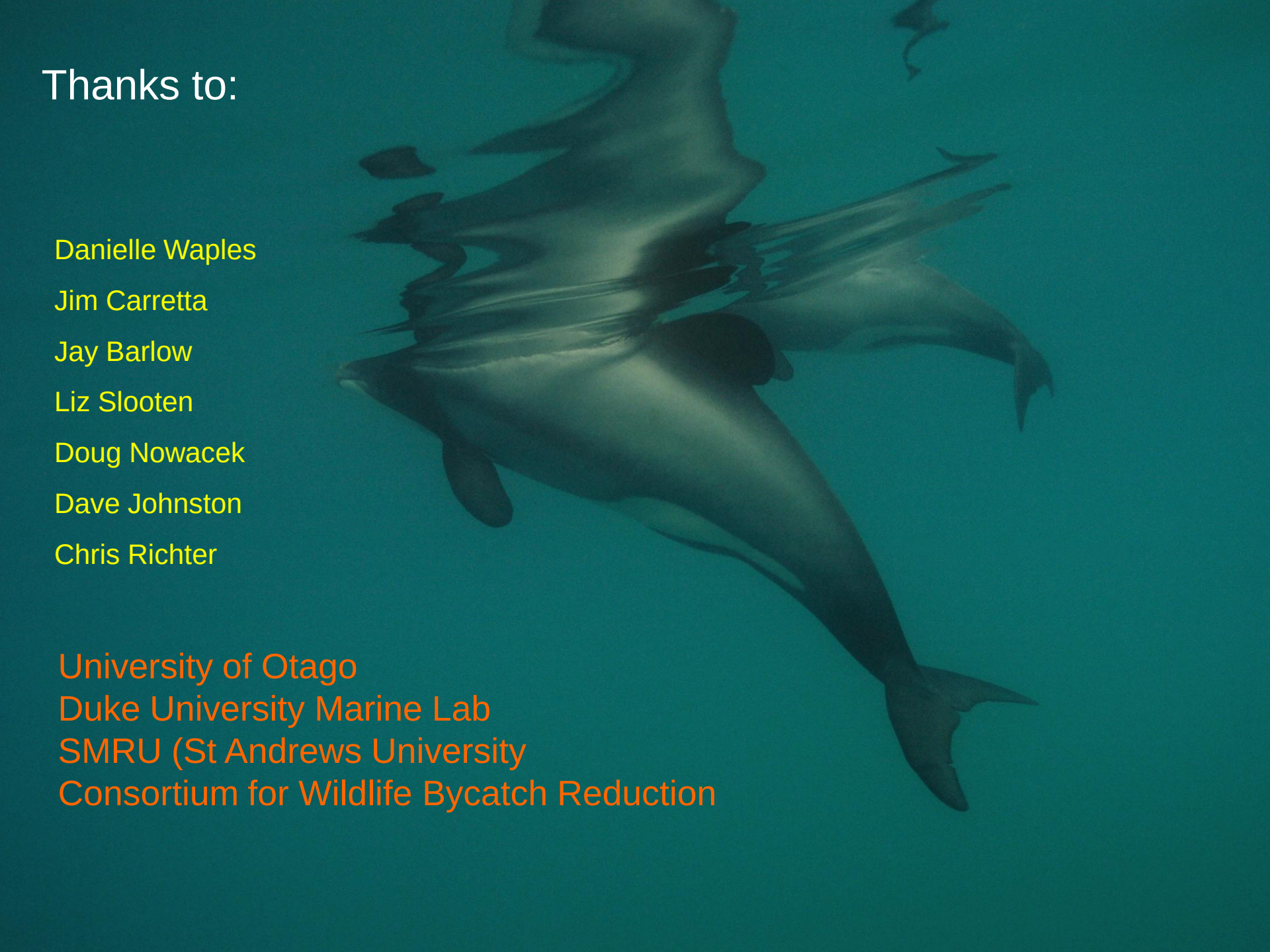
No clear displacement of

- bottlenose dolphin
- Hector's dolphin
- tucuxi

Not

Lessons from the last decade

- *In real fisheries pingers produce long-lasting reductions in entanglement rates of porpoises and common dolphins. May or may not work with other species.*
- *Implementation is difficult and costly, and likely possible only in developed nations*
- *Monitoring to ensure compliance and ongoing effectiveness will be expensive – in some cases it may exceed the value of the fishery*
- *Consistency of use and pinger reliability are crucial issues, especially if failures spectacularly raise bycatch rates*
- *Pingers are unlikely to be used appropriately unless mandated*
- *We do not know if, or under what circumstances, pingers with randomised output are more or less effective*
- *Quality control needs to improve. Same brand pingers can vary by >15dB*



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