Harbour porpoise and harbour seal bycatch in gillnet fisheries: effects of high frequency acoustic deterrents, gear characteristics, and environmental factors

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Background

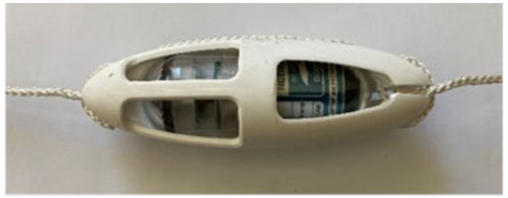
- Bycatch of marine mammals in static gillnets is known to be a major conservation concern
- The use of pingers is a mitigation method that has been shown to reduce harbour porpoise bycatch by 63 to 100 % in gillnet fisheries (WKEMBYC 2020)
- Compared to other mitigation approaches involving changing gear and/or practices, pingers are a relatively low cost (ca. 50£), unobtrusive gear modification (Dawson et al. 2013).
- Many older studies were made on pingers with lower frequencies that might not currently be found on the market.

Aims

- Evaluate the effects of currently available commercial pingers:
  - General effect on harbour porpoise and seal bycatch rate
  - ’Dinnerbell’ effect on seals
  - If/which different gear configurations show increased bycatch risk on h.p. and seals
  - Pinger functionality (battery lifetime) and handling

Methods

Fishtek's Banana pinger, (General Small Cetacean Pinger 50-120 kHz)



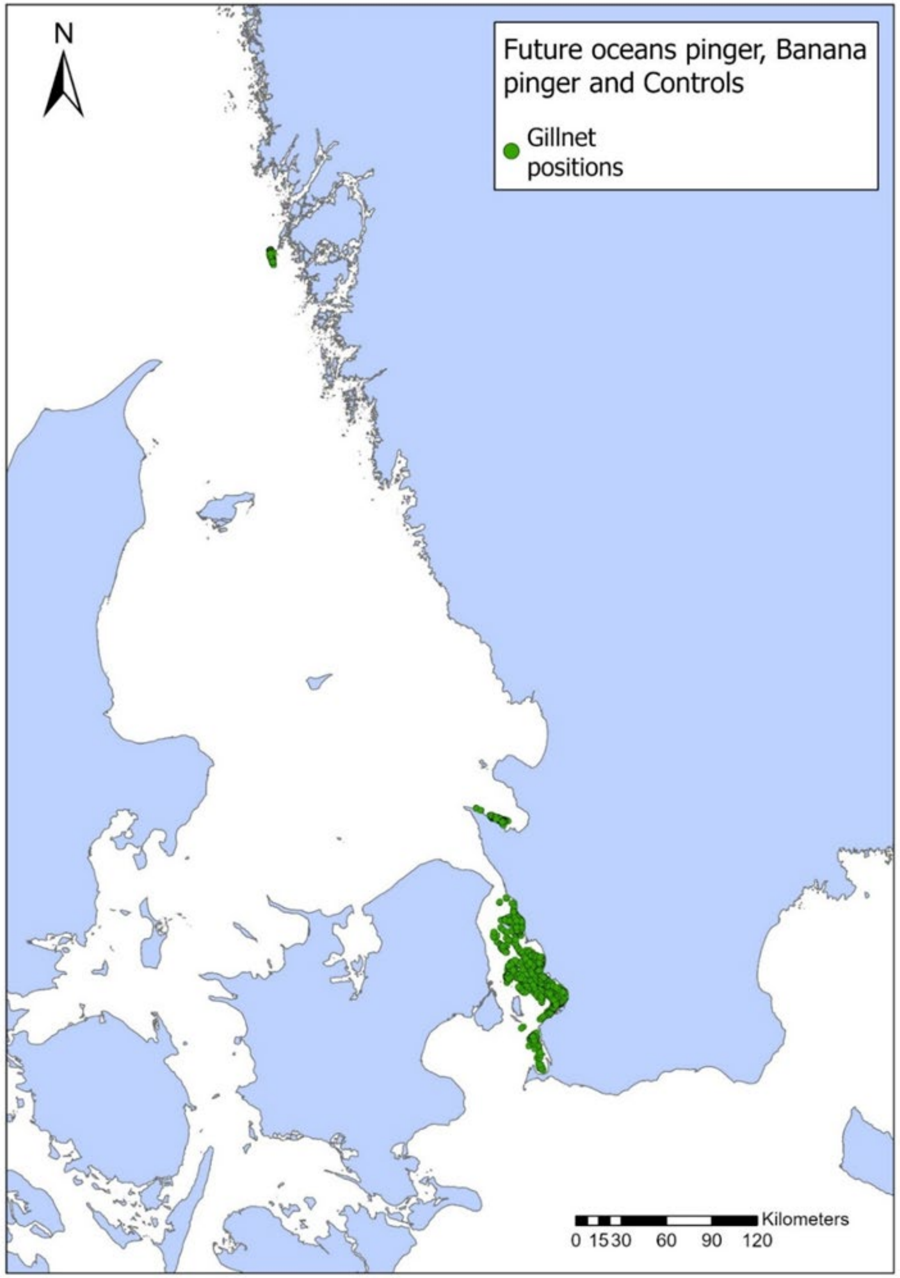
Future Oceans Netguard pinger, (Dolpin Pinger 60-120 kHz)

- Fishermen noted down all gear details, GPS positions and bycatch events for each haul and had an EM system onboard
- Equal numbers of strings with same gear details and soak time, equipped with each pingertype and control without pingers
- Bat detectors used (which shifts ultrasonic frequencies into the audible range) to routinely check pinger fuctionality during the trials
- Video analysis to confirm pinger model and bycatch, in BlackBox Analyzer software by Anchorlabs (www.anchorlab.net/Alanlyzer.aspx)
- Pingers were also tested under laboratory conditions to confirm battery lifetime given by the manufacturers

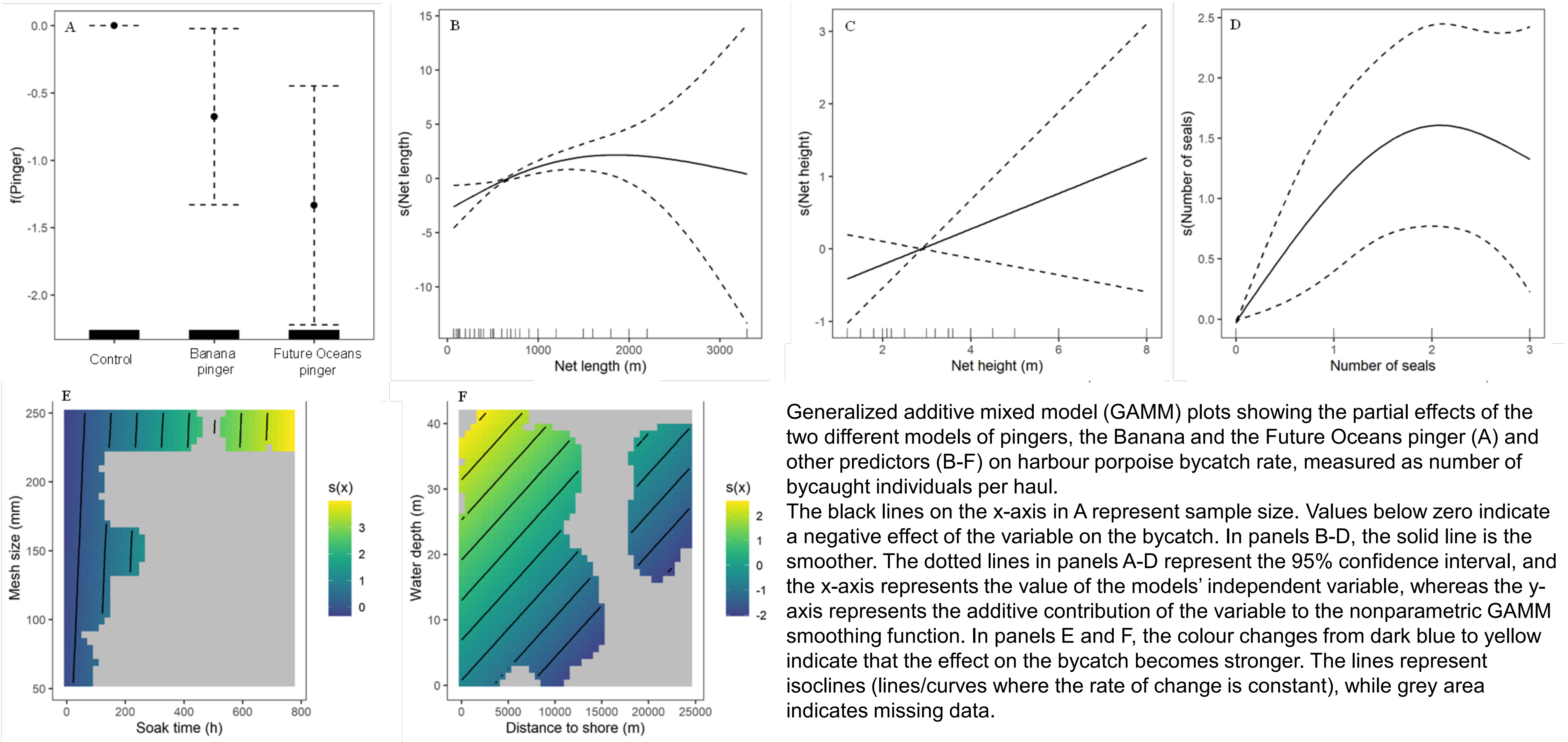
Data collection and statistics

- Between 2018-2022 in commercial gillnet fisheries
- 15 vessels, all equipped with EM systems
- 3 369 fishing hauls, mainly in SD 23

A Generalized Additive Mixed Model (GAMM) was used to analyse the porpoise and seal bycatch rates, respectively, (the observed number of bycaught animals per haul (cf. Moyes et al. 2025) in relation to potential explanatory variables.



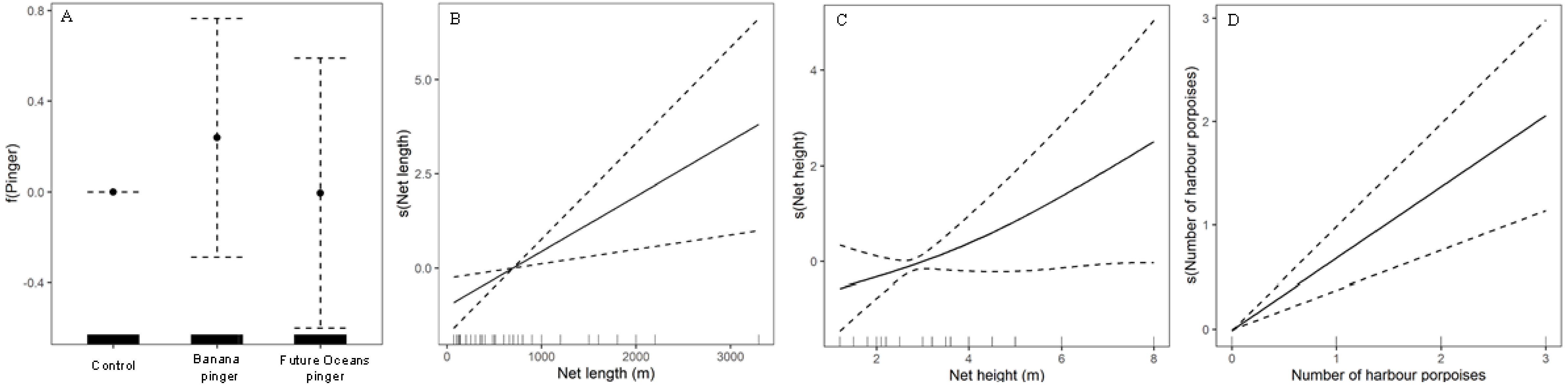
Results – harbour porpoise bycatch

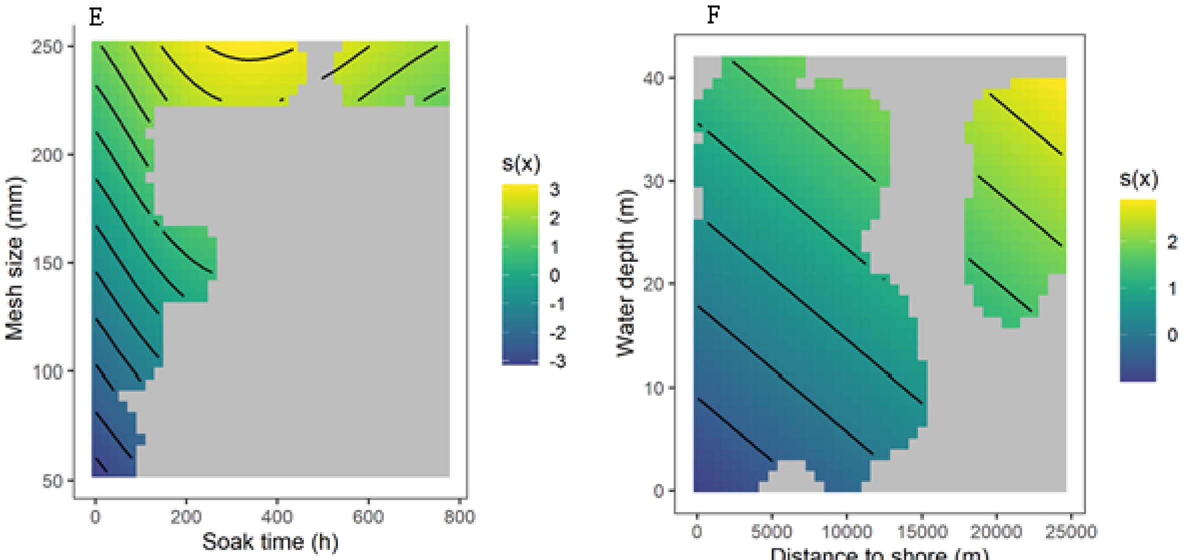


Generalized additive mixed model (GAMM) plots showing the partial effects of the two different models of pingers, the Banana and the Future Oceans pinger (A) and other predictors (B-F) on harbour porpoise bycatch rate, measured as number of bycaught individuals per haul.

The black lines on the x-axis in A represent sample size. Values below zero indicate a negative effect of the variable on the bycatch. In panels B-D, the solid line is the smoother. The dotted lines in panels A-D represent the 95% confidence interval, and the x-axis represents the value of the models' independent variable, whereas the y-axis represents the additive contribution of the variable to the nonparametric GAMM smoothing function. In panels E and F, the colour changes from dark blue to yellow indicate that the effect on the bycatch becomes stronger. The lines represent isoclines (lines/curves where the rate of change is constant), while grey area indicates missing data.

Results – seal bycatch





Generalized additive mixed model (GAMM) plots showing the partial effects of the two different models of pingers, the Banana and the Future Oceans pinger (A), and other predictors (B-F) on harbour seal bycatch rate, measured as number of bycaught individuals per haul.
The black lines on the x-axis in panel A represent sample size. Values below zero indicate a negative effect of the variable on the bycatch. In panels B-D, the solid line is the smoother. The dotted lines in panels A-D represent the 95% confidence interval, and the x-axes represent the value of the model's independent variables, whereas the y-axis represents the additive contribution of the variable to the nonparametric GAMM smoothing function. In panel E and F, the colour changes from dark blue to yellow indicate that the effect on the bycatch becomes stronger. The lines represent isoclines (lines/curves where the rate of change is constant), while grey area indicates missing data.

Results – battery liftime

Number of pingers tested and mean battery lifetime for the two pinger types.

Expected battery lifetime approx. 6 months for both types

Avg. tested battery operational time
FO: 84 days
Banana: >390 days.

Pinger type	Batch	Number of pingers tested	Mean battery lifetime (days)
Future Ocean	First Batch, stored 6 months	10	32*
	First Batch, new batteries	10	83
	Second Batch, new batteries	6	119
	Third Batch, stored 1 month	17	104*
Banana	First Batch, stored 6 months	10	>385**
	Second Batch, stored 1 month	2	>395**

* indicate that the pinger was tested with original batteries provided by the manufacturer and "stored time" (one or six months) was time from delivery date to start of testing.
** pingers were tested with original batteries and were still functioning at the end of the trial.

Conclusions

- Both pinger types sign. reduces h.p. bycatch in commercial gillnet fisheries
  - The Future Oceans pinger caused greater reduction of h.p. bycatch (74 % reduction, compared to 49 % reduction for the Banana pinger)
  - The Banana pinger has much longer battery lifetime and is easier to handle
- No pinger effect on seal bycatch – no ’dinnerbell’ effect shown
- Bycatch rates for both h.p. and seals increased with longer net lengths
- The effect of larger mesh size increased only in interaction with longer soak times
- Interactions btw distance from shore x water depth indicate a spatially varying bycatch risk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