

Supplementary Information

Follow-up study after four years shows reduced deterrence effect of pingers on harbour porpoises in Norwegian gillnet fishery

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MODELING DECISION FLOW

The modelling decision workflow is illustrated in Figure S11. See the methods section of the manuscript for a detailed description of the modelling.

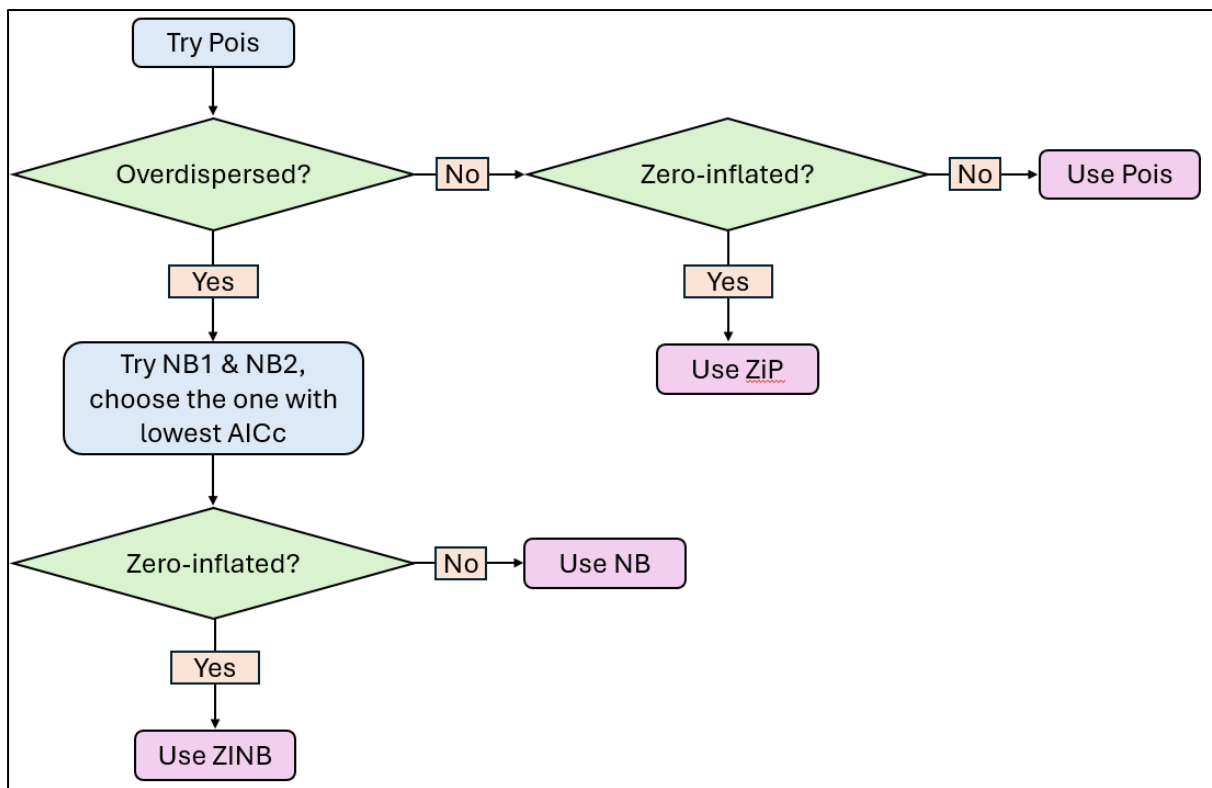


Figure S11: Modelling decision workflow

SIMULATION STUDY

To investigate the effect of sample size on the estimation of the pinger effect size, we created 1000 random permutations of the data collected in Moan and Bjørge (2022), each with the same number of observations as the data in the present study, i.e. $n = 308$. These down-sampled datasets were created by sampling with replacement. We then fitted each of the down-sampled datasets to the GLMM described in equation 1 and inspected the resulting distribution of exponentiated estimates of the pinger term.

The average relative rate RR of harbour porpoise bycatch in pingered nets vs control nets was 0.07, with the 0.025 and 0.975th quantiles 0.00 and 0.40. Figure S11 shows the distribution of

pinger RRs. 17 of 1000 replicates were as great as or greater than the RR of 0.0464 estimated in Moan and Bjørge (2023). This suggests that the difference between estimated pinger RRs between the present study and Moan and Bjørge (2023) cannot be explained by the difference in sample size.

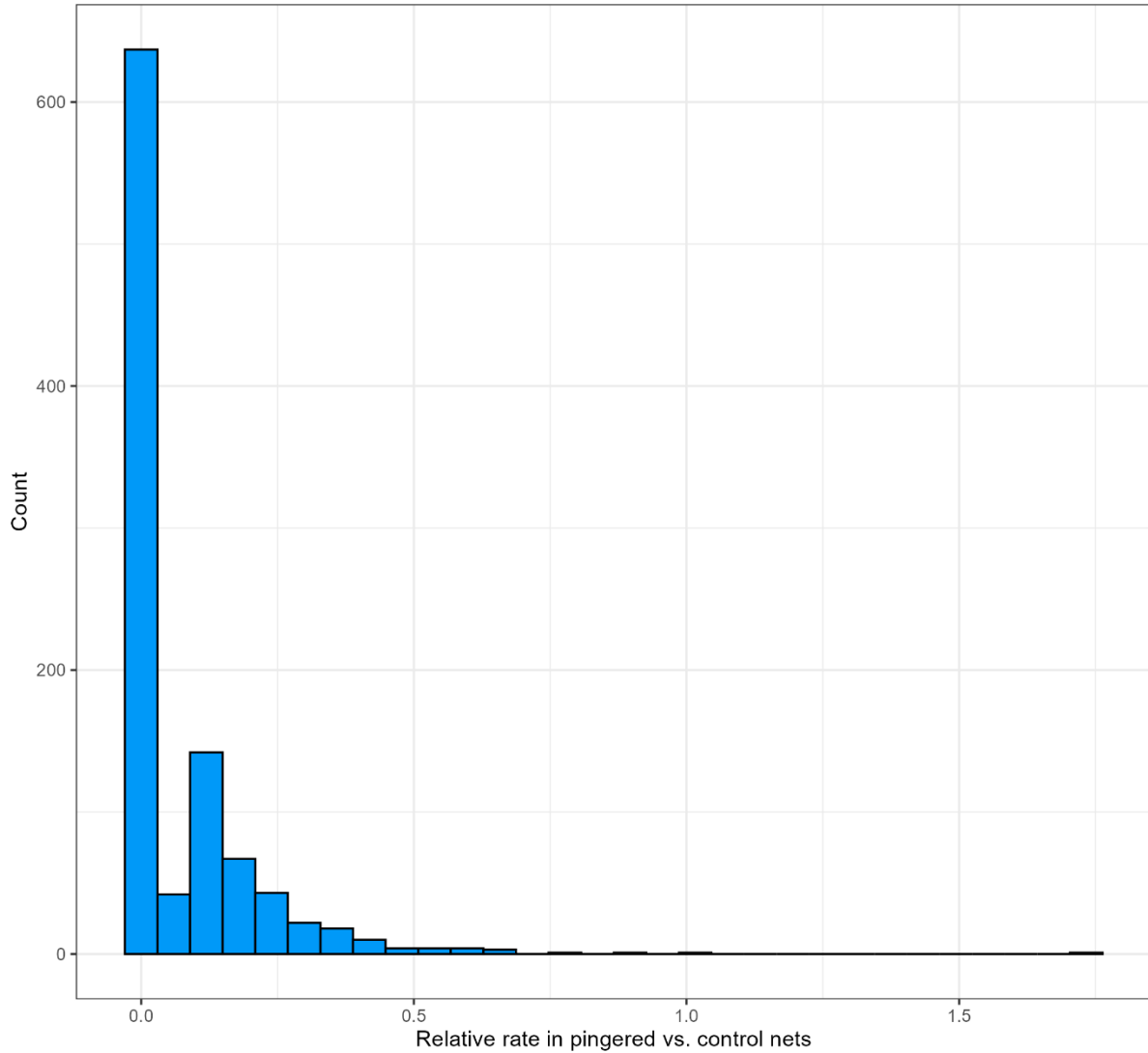


Figure SI2: Distribution of pinger relative rate estimates calculated from bootstrap resamples

Table S11: Overview of model candidates and ranking of models. Family is the error distribution. RR is the estimated relative rate in pingered vs control nets. Sign denotes the significance of the pinger covariate, using R notation (i.e. significance at the 0.05 level is denoted by one or more stars). The best models for each measure of fishing effort, in terms of AICc, are highlighted in bold.

Model formula	AICc	Family	RR	sign
<i>Models fitted with data from 2024 (n = 308)</i>				
porps ~ (1 fvessel) + fpinger + offset(log_netkmhrs)	221.57	NB2	0.460	.
porps ~ (1 fvessel) + fpinger + day_of_year + day_of_month + offset(log_netkmhrs)	213.30	NB2	0.505	
porps ~ (1 fvessel) + fpinger + poly(depthmin, 2) + offset(log_netkmhrs)	223.95	NB2	0.476	.
porps ~ (1 fvessel) + fpinger + half_mesh + offset(log_netkmhrs)	223.53	NB2	0.464	.
porps ~ (1 fvessel) + fpinger + offset(log_catch)	238.06	NB2	0.427	.
porps ~ (1 fvessel) + fpinger + day_of_year + day_of_month + offset(log_catch)	225.88	NB2	0.587	
porps ~ (1 fvessel) + fpinger + poly(depthmin, 2) + offset(log_catch)	240.38	NB2	0.460	
porps ~ (1 fvessel) + fpinger + half_mesh + offset(log_catch)	239.70	NB2	0.427	.
porps ~ (1 fvessel) + fpinger + offset(log_hauls)	221.67	Pois	0.452	*
porps ~ (1 fvessel) + fpinger + day_of_year + day_of_month + offset(log_hauls)	211.25	Pois	0.514	.
porps ~ (1 fvessel) + fpinger + poly(depthmin, 2) + offset(log_hauls)	224.70	Pois	0.461	.
porps ~ (1 fvessel) + fpinger + half_mesh + offset(log_hauls)	223.56	Pois	0.449	*
<i>Models fitted with pooled data, i.e. data from 2018-2020 and 2024 (n = 1,043)</i>				
porps ~ (1 fvessel) + fpinger + (1 fstudy) + offset(log_netkmhrs)	388.02	Pois	0.262	***
porps ~ (1 fvessel) + fpinger + day_of_year + day_of_month + (1 fstudy) + offset(log_netkmhrs)	382.11	NB1	0.283	***
porps ~ (1 fvessel) + fpinger + poly(depthmin, 2) + (1 fstudy) + offset(log_netkmhrs)	391.41	Pois	0.264	***
porps ~ (1 fvessel) + fpinger + half_mesh + (1 fstudy) + offset(log_netkmhrs)	386.94	Pois	0.252	***
porps ~ (1 fvessel) + fpinger + (1 fstudy) + offset(log_catch)	431.18	NB2	0.166	***
porps ~ (1 fvessel) + fpinger + day_of_year + day_of_month + (1 fstudy) + offset(log_catch)	427.22	NB2	0.177	***
porps ~ (1 fvessel) + fpinger + poly(depthmin, 2) + (1 fstudy) + offset(log_catch)	450.74	NB1	0.260	***
porps ~ (1 fvessel) + fpinger + half_mesh + (1 fstudy) + offset(log_catch)	423.08	NB2	0.193	***
porps ~ (1 fvessel) + fpinger + (1 fstudy) + offset(log_hauls)	390.44	Pois	0.254	***

$\text{porps} \sim (1 \mid \text{fvessel}) + \text{fpinger} + \text{day_of_year} + \text{day_of_month} + (1 \mid \text{fstudy}) + \text{offset}(\log_hauls)$	392.13	Pois	0.268	***
$\text{porps} \sim (1 \mid \text{fvessel}) + \text{fpinger} + \text{poly}(\text{depthmin}, 2) + (1 \mid \text{fstudy}) + \text{offset}(\log_hauls)$	394.24	Pois	0.254	***
$\text{porps} \sim (1 \mid \text{fvessel}) + \text{fpinger} + \text{half_mesh} + (1 \mid \text{fstudy}) + \text{offset}(\log_hauls)$	392.10	Pois	0.257	***