Relative efficacies of branchline weighting designs at mitigating seabird bycatch in pelagic longline fisheries

IATTC Ecosystem & Bycatch Working Group

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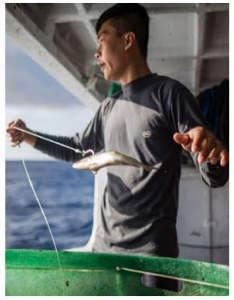
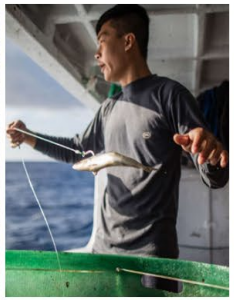
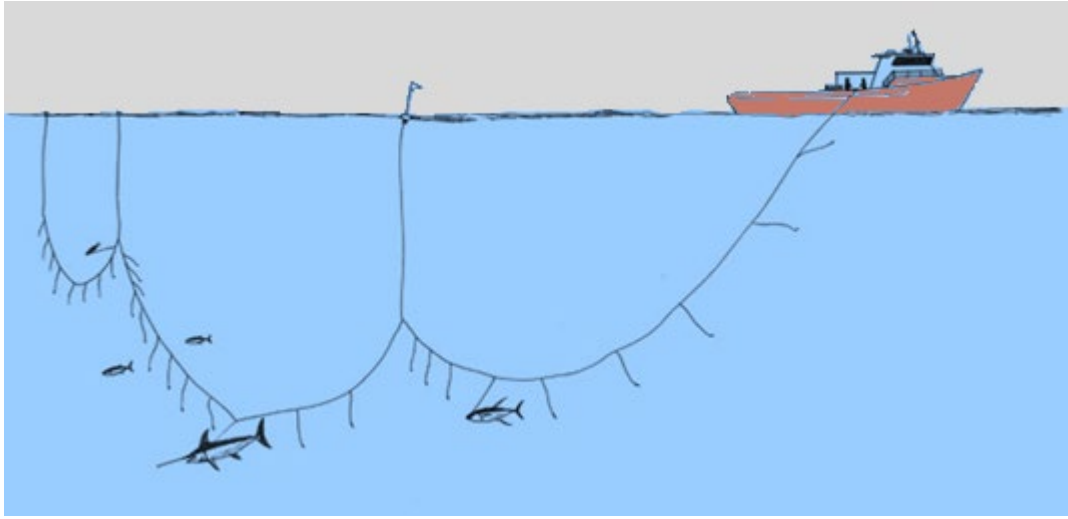
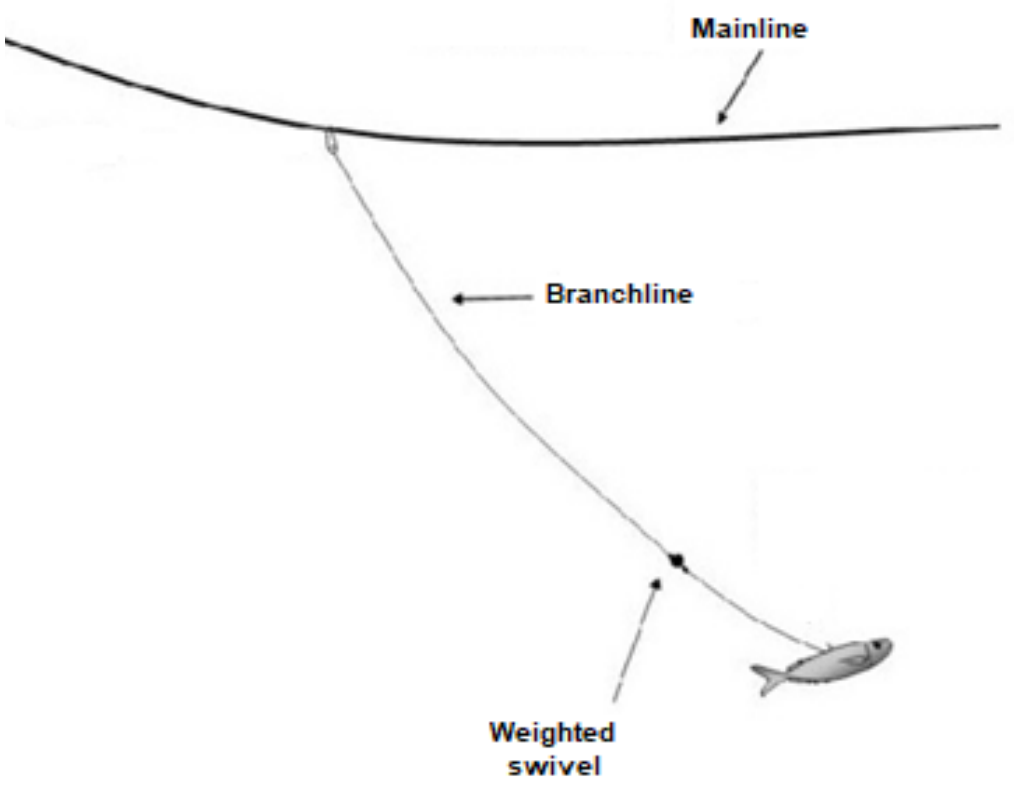



- Mechanism underlying the effect of branchline weighting on seabird catch risk
- RFMO- and ACAP-prescribed weighting designs and model categories
- Network meta-regression modelling approach
- Efficacies relative to a reference design and rank-order
- Pairwise contrasts
- Benefits of addressing sample size limitations
- Key findings and implications



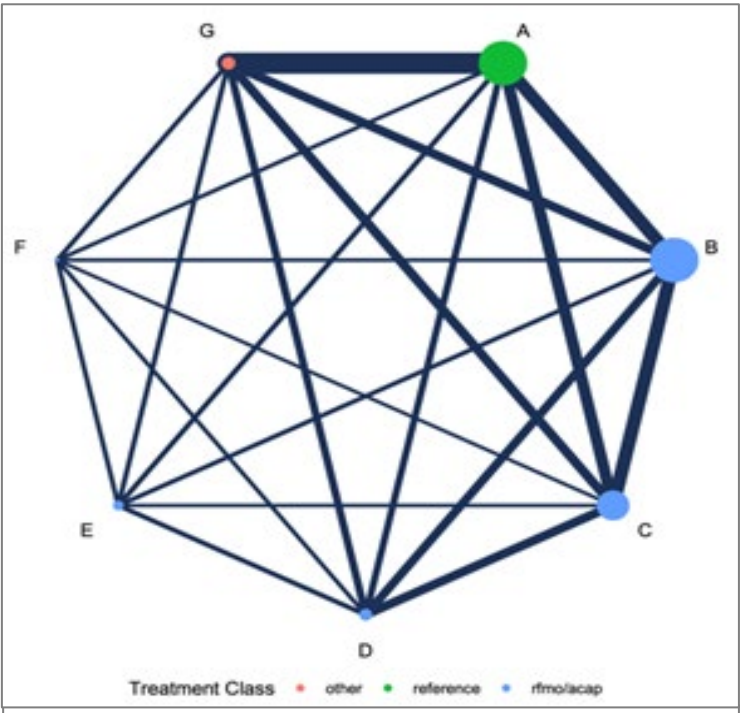



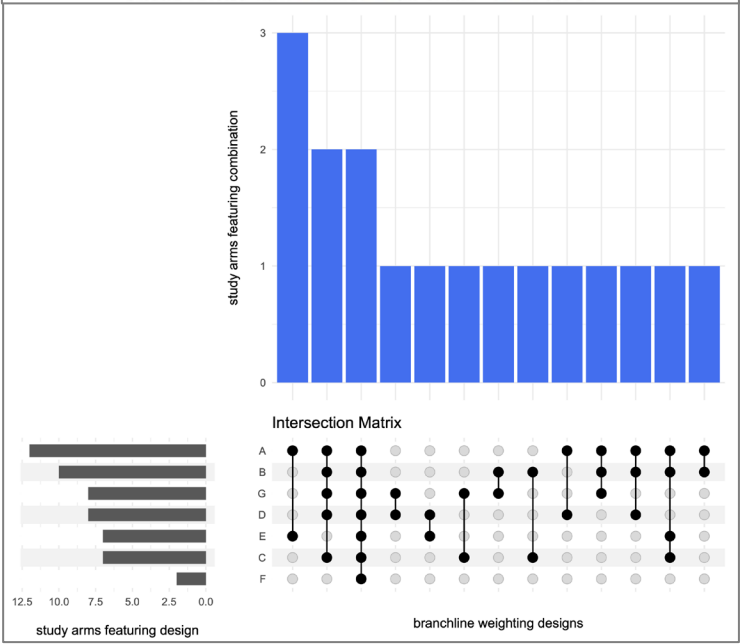

Mainline
Branchline
Weighted
swivel

Branchline weighting design	ACAP	IATTC	ICCAT	IOTC	SIOFA	WCPFC
≥40g (1 weight) within 0.5m of the hook						x
≥40g within 0.5m of the hook	x					
≥45g within 1m of the hook		x				x
>45g within 1m of the hook			x	x	x	
≥60g within 1m of the hook	x					
≥60g within 3.5m of the hook						x
>60g within 3.5m of the hook		x	x	x	x	
≥80g within 2m of the hook	x					
≥98g within 4m of the hook						x
>98g within 4m of the hook		x	x	x	x	

Design ID	Design definition	RFMO	ACAP
A	0g within 5m (reference)	n	n
B	≥40g within 0.5m	y	y
C	≥45g to <60g from 0.5-1m	y	n
D	≥60g from 0.5-1m	y	y
E	≥60g to <80g from 1-3.5m or ≥80g from 2-3.5m	y	n
F	≥80g from 1-2m	y	y
G	≥8g to ≤39g within 1m or ≥45g to ≤80g from 1.3-4m	n	n

Bayesian network meta-regression modelling approach …





What is Network Meta-Analysis ?

— statistical modelling approach used for comparing relative efficacies of ≥ 3 interventions by synthesising aggregate and/or individual evidence sourced from multiple studies (combines **direct** and **indirect** (inferred) sources of evidence)

Bayesian inference framework

— fitted within a **Bayesian multilevel meta-regression framework** to the 21 design comparisons for 7 branchline weighting designs shown opposite in **Network Geometry** using Stan as computation backend

— not all 7 possible designs need to be in found in each study so long as each study comprises a subset of at least 2 or more of the designs (**Upset Plot** opposite)

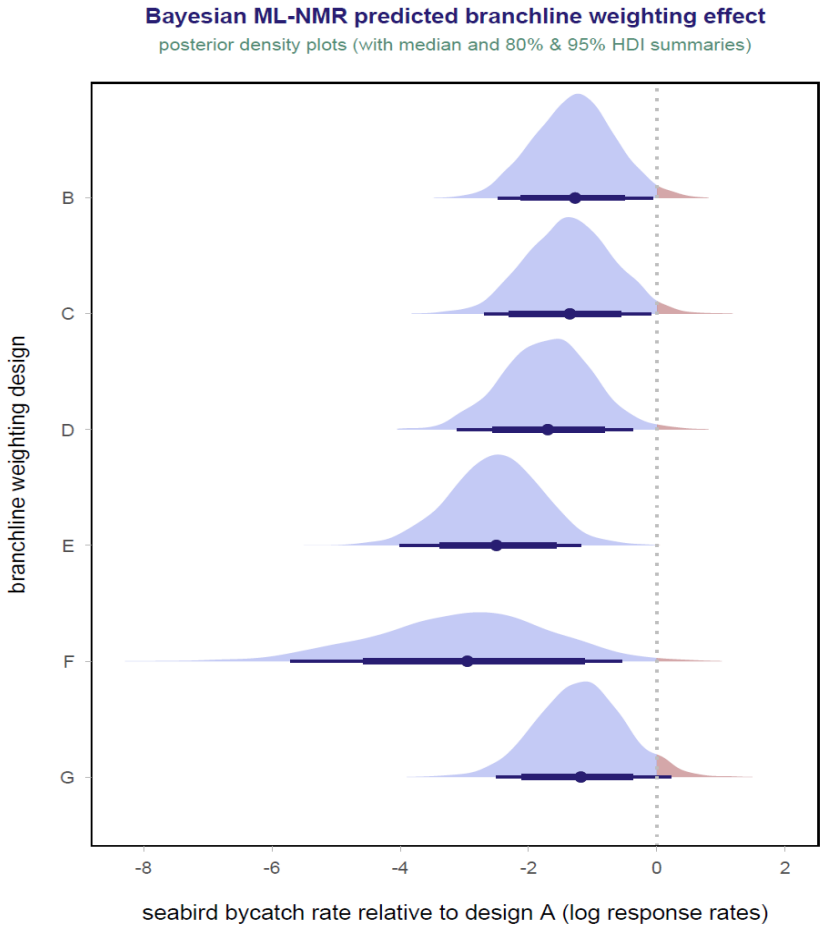
Model specific detail

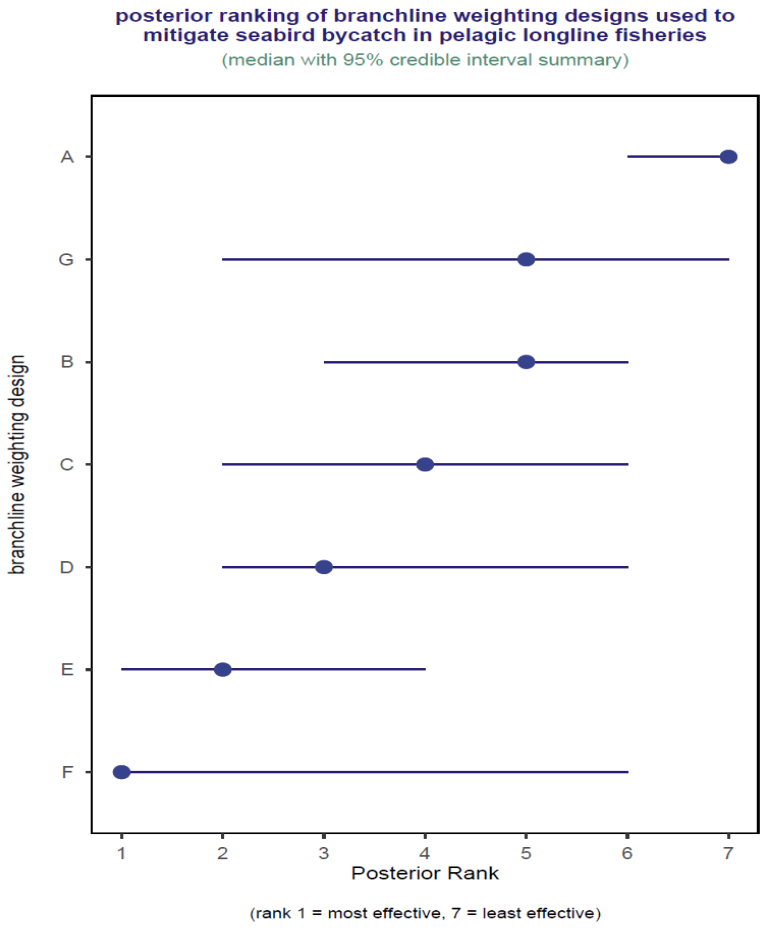
— Stan invoked here via the `multinma` R interface with Poisson likelihood (log link) for **study-specific aggregate seabird catch** with the **study-specific aggregate hooks (fishing effort) as exposure metric**

— response (**effect size**) being the study-specific **log rate ratio,** potentially informative covariates also included

— **model selection** via `loo` CV and Bayesian stacking, **model evaluation** via global (**unrelated means**) and local (**node-splitting**) **consistency assumption** assessments

Relative efficacies & rank-order

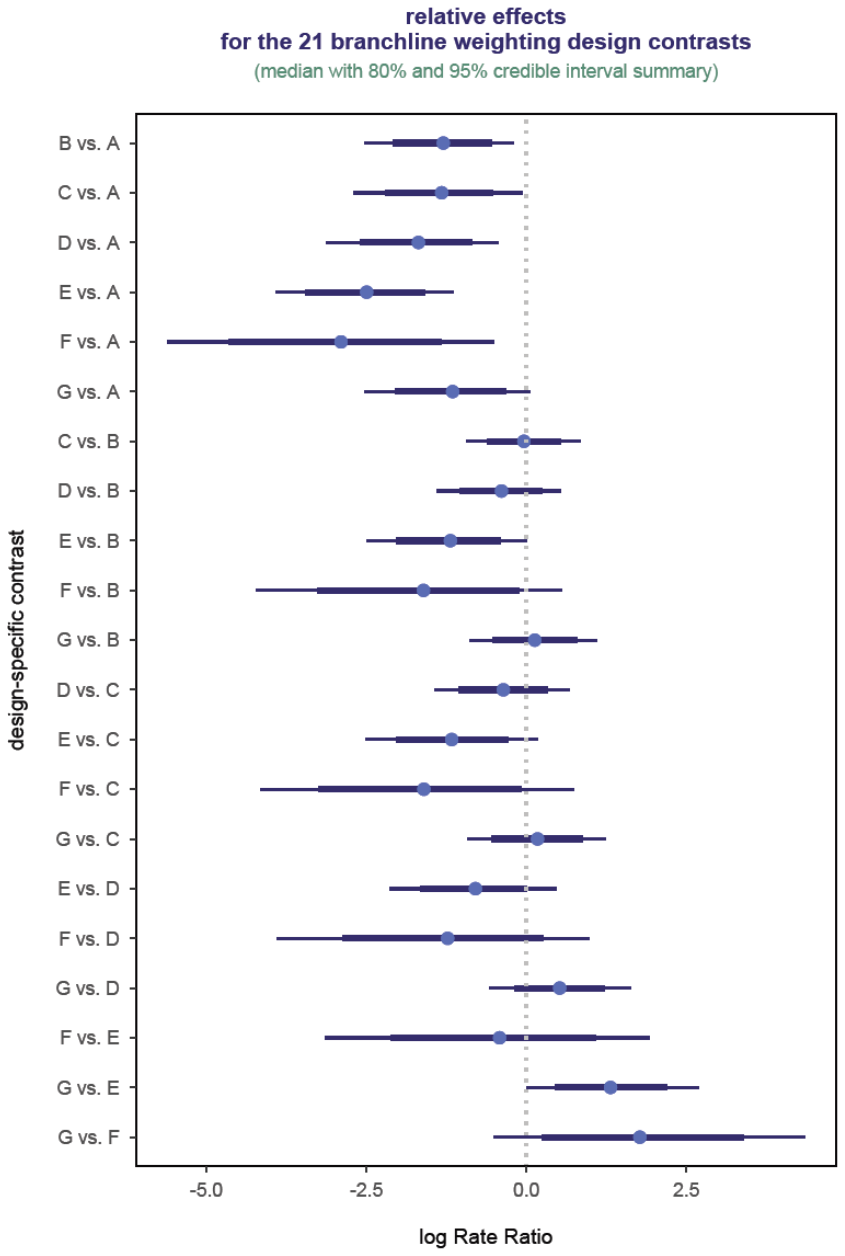




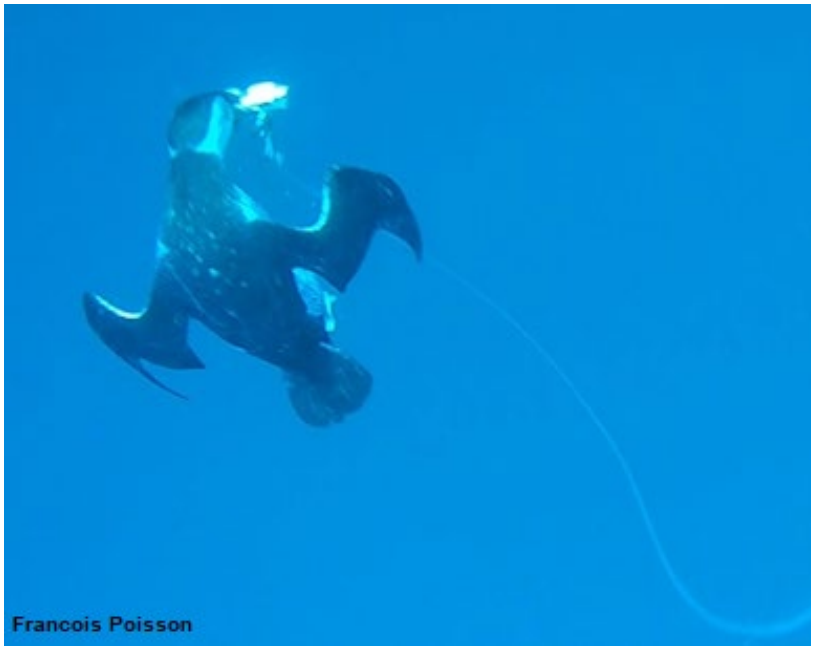
- ≥ 98% probability that the 5 prescribed treatments (B through F) had lower median seabird catch rates relative to reference (A); between 67% to 89% lower seabird catch rates
- 97% probability that non-prescribed design G had lower seabird catch than reference; 62% lower catch rate
- Some RFMO and ACAP prescribed designs had significant probabilities of having different seabird catch rates.

Pairwise contrasts

- 21 pairwise contrasts between the 7 weighting designs
- All designs perform significantly better than reference treatment (first 6 contrasts)
- Some prescribed designs not equal – eg:
  - Of 10 contrasts for the 5 prescribed designs, 4 w/ very high probabilities of different catch rates (FvC >92%, FvB >93%, EvC >95%, EvB >97%)
  - E&F w/ >60g attached more than 1m from the hook performed the best, with >93% probability performed significantly better than B&C with less weight but close to hooks



Sample size limitations



- Operational variables
- Environmental conditions
- Spatiotemporal distribution of effort
- Seabird local abundance
- Seabird species complex

Key points

- First meta-synthesis of relative efficacies of alt weighting designs at mitigating seabird bycatch
- Prescribed designs had 67% to 89% significantly lower seabird catch risk relative to no weight within 5m
- Not all RFMO/ACAP design options perform equally – with larger sample sizes and more robust estimates, designs with relatively low efficacies could be eliminated, or w/ IATTC and WCPFC seabird measures with 2 lists, split weight designs based on their relative efficacies
- These robust estimates of relative efficacies of weighting designs, in combination with info on costs to economic viability and crew safety, enable comprehensive evaluation of alternative bycatch management strategies

The Safina Center

NOAA Fisheries
BREP

National Fish and Wildlife Foundation NFWF

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