Evidence on the effectiveness of different combinations of mitigation methods



07 May 2024

Recap: why seabirds are caught

Seabirds are attracted to fishing operations by the availability of food and actively pursue baited hooks.

Effective seabird bycatch mitigation must prevent seabirds accessing baited hooks, otherwise they can become hooked or entangled and drown by the sinking line.

Different seabirds can dive to different depths.

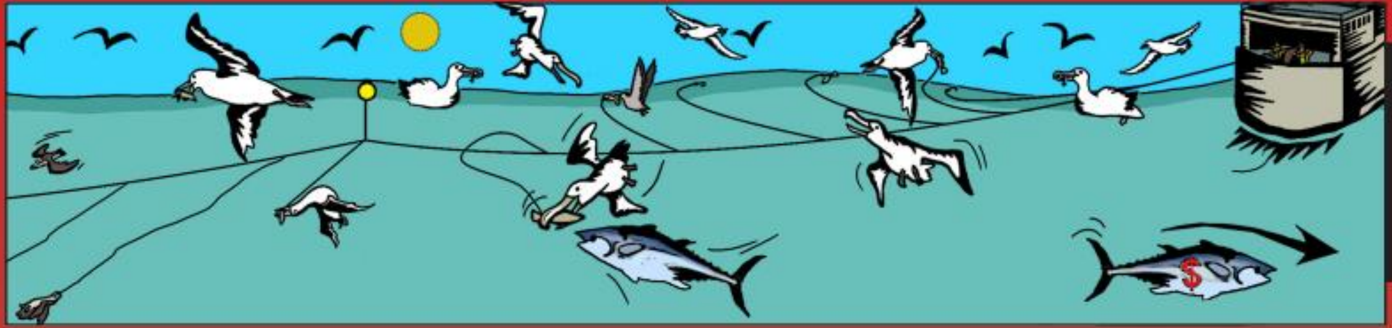
Baited hooks must be protected from seabirds until they have sunk below the dive depth of the seabird species occurring in the area.

Combinations of different bycatch mitigation methods

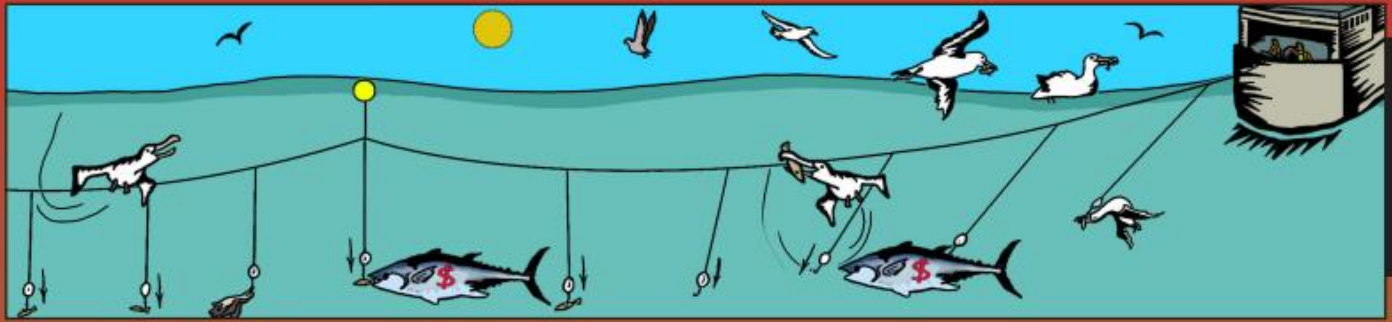
Branch line weighting, tori lines and night setting have each been demonstrated to be effective to differing degrees; however, each have limitations when used alone.

- There is a period of time when hooks are accessible to birds even when branch lines are weighted.
- Night setting used alone is less effective at reducing seabird bycatch for nocturnally active birds and during bright moon light conditions.
- Bird scaring lines used alone can rarely protect baited hooks beyond the aerial extent of the line.

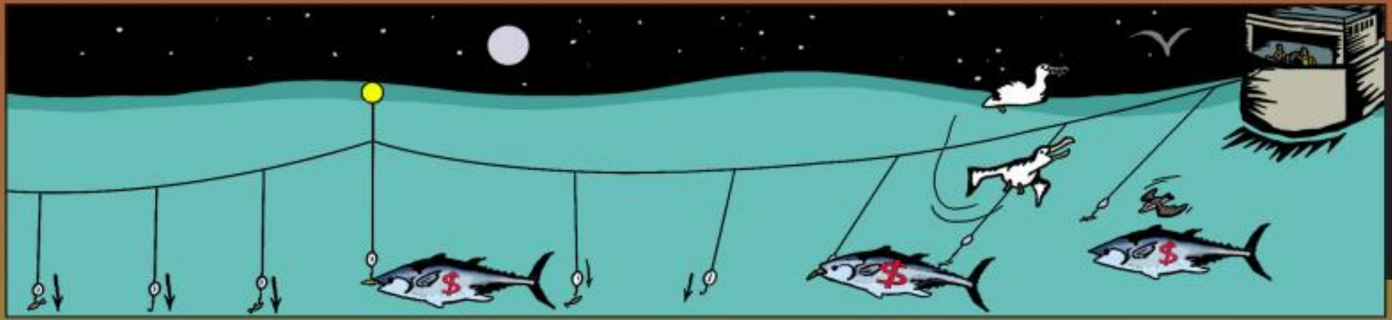
catch FISH NOT BIRDS



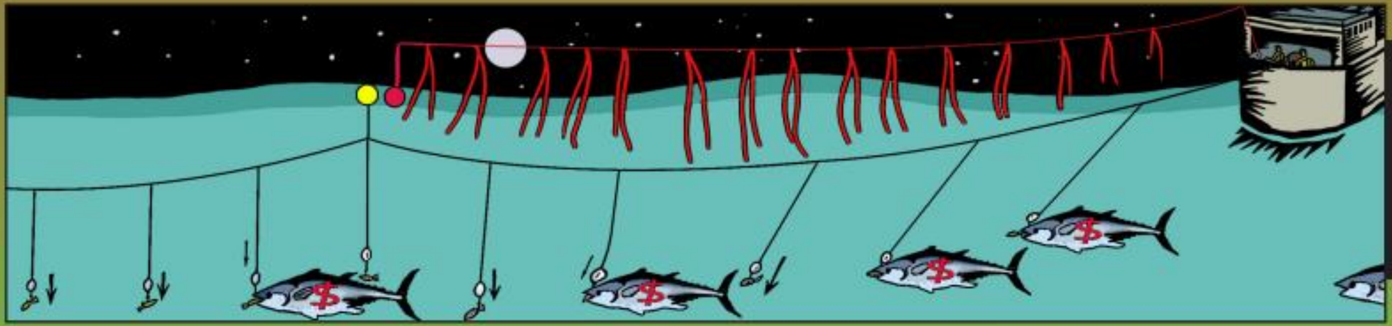
When seabirds eat baits they can get hooked and drown



Weights = fewer seabirds hooked. Diving seabirds are still in danger



Night setting + weights = few seabirds hooked. Moonlit nights are still a danger



Bird scaring lines + night setting + weights = no seabirds hooked

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Combinations of different bycatch mitigation methods

Standalone best practice mitigation options have been designed to overcome the challenges of other single mitigation methods.

- Hook-shielding devices encase the point and barb of baited hooks until a prescribed depth or immersion time has been reached.
- Underwater bait setting devices deploys encapsulated baited hooks at the stern of the vessel releasing the baited hooks at a pre-determined depth.

Evidence on effectiveness of tori lines and night setting

Studies summarised in SC-19-EB-IP-15

Location	Metric	Interaction rate per 1,000 hooks		Notes	Source
		With measures	Without measures		
Bird-scaring lines and night setting					
New Zealand	C	0.10	0.28	After fishing location, BSL quality and set time/moon phase were the factors most explanatory of seabird bycatch rates. (u) for comparison with/without both measures.	Duckworth 1995
Australia	C	0.02	(with BSLs) 0.25	BSLs were in place for all sets; bycatch rates of day and night sets were compared (and differed significantly).	Klaer and Polacheck 1998
South Africa (Japanese vessels)	C	0.44	(with BSLs) 2.0	(u) [P]**	Melvin et al. 2013
South Africa (Japanese vessels)	C	0.06	(with BSLs) 0.63	(u) [P]**	Melvin et al. 2014
South Atlantic and southwestern Indian Oceans	C	Lower	Higher	Significant bycatch reduction at night with measure; not during the day (may be due to inconsistent usage, quality of BSLs, entanglements/breakages). Authors note caveats on the dataset available for analysis.	Jiménez et al. 2020
Uruguay	C	0.28	5.49	(u)	Jiménez et al. 2019a

*Table 15. Experimental and operational research examining the effect of multiple seabird bycatch mitigation measures on seabird interactions in pelagic longline fisheries. (u)=Statistical significance not stated in the source reference, ns=not statistically significant. C=Captures, A=Attacks on baits, LAAL=Laysan albatross (*Phoebastria immutabilis*), BFAL=black-footed albatross (*Phoebastria nigripes*), BSL=bird-scaring line, [S]=Single BSL, [P]=Paired BSLs. **Double weighted branchlines used, noting that safe leads and double-weighted branchlines were deployed by Melvin et al. (2013) in different weighted gear treatments.*

Evidence on effectiveness of tori lines and branchline weighting

Studies summarised in SC-19-EB-IP-15

Location	Metric	Interaction rate per 1,000 hooks		Notes	Source
		With measures	Without measures		
Bird-scaring lines and branchline weighting					
South Africa (Japanese vessels)	C	0.06	(with BSLs) 1.07	(u) [P]**	Melvin et al. 2013
South Africa (Japanese vessels)	A C	9.8 0.12	(with BSLs) 40.6 0.63	[P]**	Melvin et al. 2014
Western and central north Pacific	C C	LAAL: [S] 0 [P] 0.10 BFAL: [S] 0 [P] 0	7.7 1.6	(u)**	Ochi et al. 2013
Brazil	A	0.17	(no BSL) 0.45	In this study, attacks/min are quantified. 'With' measures attack rates decreased further, and significantly, when only weights at 2 m from hook considered (0.08 attacks/min).	Gianuca et al. 2011
Uruguay	C	0	5.49	(u) Authors caution that a small sample size underpins this comparison.	Jiménez et al. 2019a

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Evidence on effectiveness of night setting and branch line weighting

Studies summarised in SC-19-EB-IP-15

Location	Metric	Interaction rate per 1,000 hooks		Notes	Source
		With measures	Without measures		
Night setting and branchline weighting					
Uruguay	C	0	5.49	(u)	Jiménez et al. 2019a

*Table 15. Experimental and operational research examining the effect of multiple seabird bycatch mitigation measures on seabird interactions in pelagic longline fisheries. (u)=Statistical significance not stated in the source reference, ns=not statistically significant. C=Captures, A=Attacks on baits, LAAL=Laysan albatross (Phoebastria immutabilis), BFAL=black-footed albatross (Phoebastria nigripes), BSL=bird-scaring line, [S]=Single BSL, [P]=Paired BSLs. **Double weighted branchlines used, noting that safe leads and double-weighted branchlines were deployed by Melvin et al. (2013) in different weighted gear treatments.*

Evidence on effectiveness of tori line, night setting and branchline weighting

Studies summarised in SC-19-EB-IP-15

Location	Metric	Interaction rate per 1,000 hooks		Notes	Source
		With measures	Without measures		
Bird-scaring lines, night setting and branchline weighting					
South Africa (Japanese vessels)	C	0	(with BSLs) 0.63	[P]** (weighting a significant factor)	Melvin et al. 2014
Uruguay	C	0	5.49	(u)	Jiménez et al. 2019a

*Table 15. Experimental and operational research examining the effect of multiple seabird bycatch mitigation measures on seabird interactions in pelagic longline fisheries. (u)=Statistical significance not stated in the source reference, ns=not statistically significant. C=Captures, A=Attacks on baits, LAAL=Laysan albatross (*Phoebastria immutabilis*), BFAL=black-footed albatross (*Phoebastria nigripes*), BSL=bird-scaring line, [S]=Single BSL, [P]=Paired BSLs. **Double weighted branchlines used, noting that safe leads and double-weighted branchlines were deployed by Melvin et al. (2013) in different weighted gear treatments.*

Evidence on effects of combinations of mitigation methods on target catch

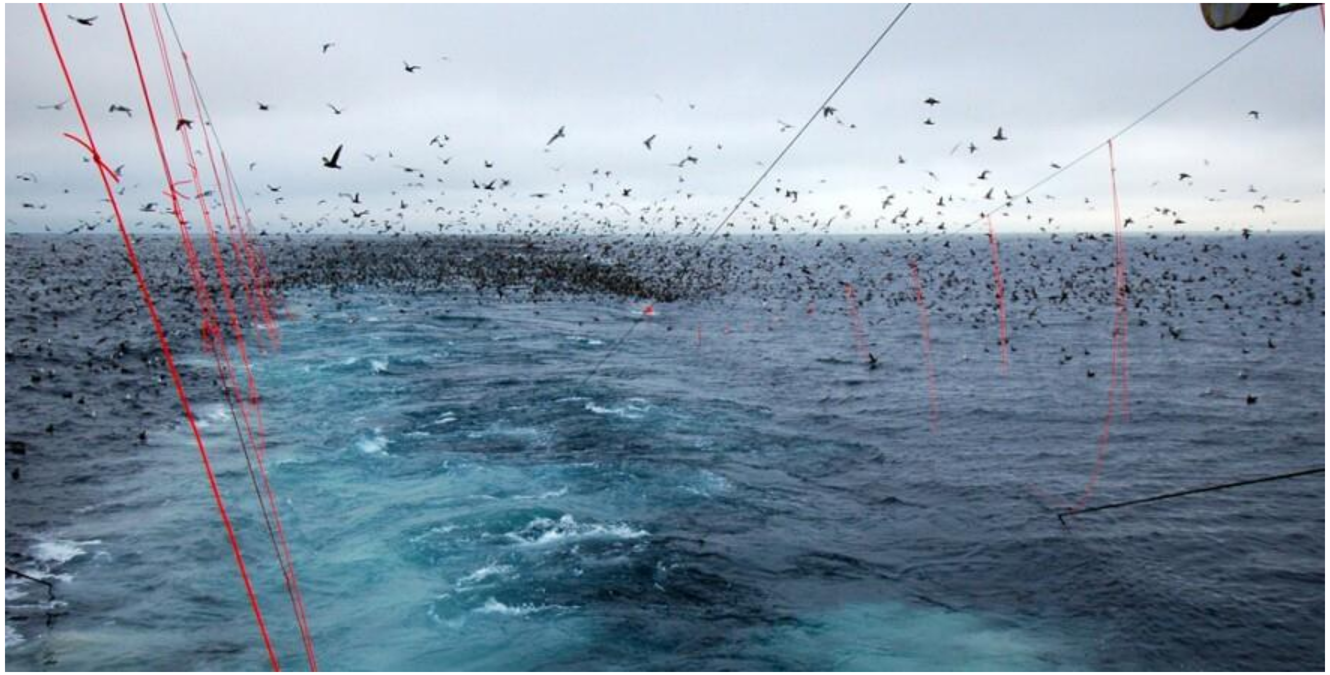
Effect on fish catch rates	Total catch	Effect size	Location	Source
Bird-scaring lines and night setting (c.f. bird-scaring lines and day setting)				
Increase	Tuna, billfish	+52% (u)	South Africa	Melvin et al. 2013
No effect	Tuna, billfish		South Africa	Melvin et al. 2014
Bird-scaring lines and branchline weighting (c.f. bird-scaring lines and unweighted branchlines)				
No effect	Tuna, billfish		South Africa	Melvin et al. 2013
	Tuna, billfish		South Africa	Melvin et al. 2014
Bird-scaring lines, night setting and branchline weighting (c.f. bird-scaring lines, day setting and unweighted branchlines)				
Increase	Tuna, billfish	+38% (u)*	South Africa	Melvin et al. 2013
	Tuna, billfish	+*	South Africa	Melvin et al. 2014

*Table 14. Research examining the effect of multiple seabird bycatch mitigation measures on fish catch rates in pelagic longline fisheries. (u)=Statistical significance not stated. *Fish catch rates were positively correlated with soak time, and daytime sets were of shorter duration. Safe leads and double-weighted branchlines were used by Melvin et al. (2013) in weighted gear treatments. Albacore was excluded from their 2013 analysis, due to inconsistent catch recording. Double-weighted branchlines were used by Melvin et al. (2014).*

Studies summarised in SC-19-EB-IP-15

Practical considerations on the use of combinations of bycatch mitigation methods

Using branch line weighting in combination with tori lines may address some of the practicality concerns regarding tori line use, in particular that fast sinking gear is less likely to tangle with the in-water parts of a tori line.



Conclusions from the literature review

The review presented in SC-19-EB-IP-15 concluded:

- The effects of various combinations of measures on seabird bycatch have been documented, though statistical significance is not available for most studies, given the extent of threatened seabird mortality that this would require.
- Reductions in bycatch are consistently evident with two and three mitigation measures in place.
- Even in assemblages dominated by white-chinned petrels, a species that presents particular challenges for bycatch reduction, bycatch was reduced to zero with tori lines, branchline weighting, and night setting in place.
- No evidence on target catch rate reductions following the use of multiple mitigation measures exists.

Which combination is the effective?

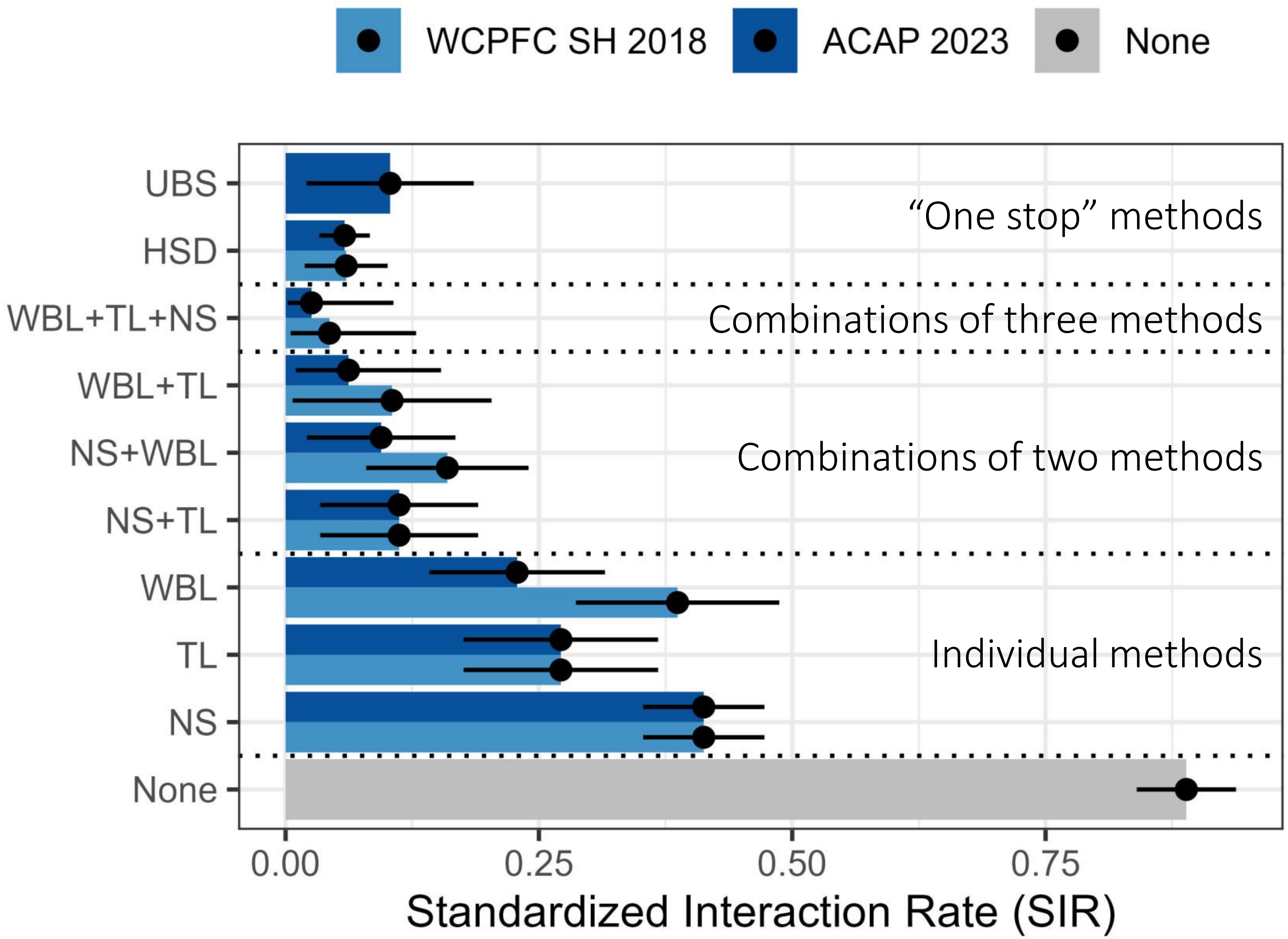
- Different combinations of mitigation methods are intended to provide flexibility to allow for the best approach "on the water"
- Comparing overall effectiveness is challenging due to context-specific trials
- Few studies evaluate different combinations and specifications experimentally
- Bell *et al.* in prep developed a method to evaluate *relative* performance across mitigation methods of different specs by calculating Standardized Interaction Rates (SIR_i) per method and combination:

$$SIR_i = \prod_{n=1}^{j} \frac{\sum_{n=1}^{j} \left(\frac{IPUE_{ij}}{\max_i (IPUE_j)} \right)}{n_j}$$

in which $IPUE_{ij}$ = interaction per unit effort (bycatch rate/contact rate/attack rate, usually per 1,000 hooks) per mitigation method $_i$ per trial/study $_j$.

- We applied this method to results presented in >40 different papers (incl. those in SC-19-EB-IP-15) containing sufficient data and specifications to estimate SIR_i and provide standardised insights into which method and combination of which specs are most effective for each Hemisphere

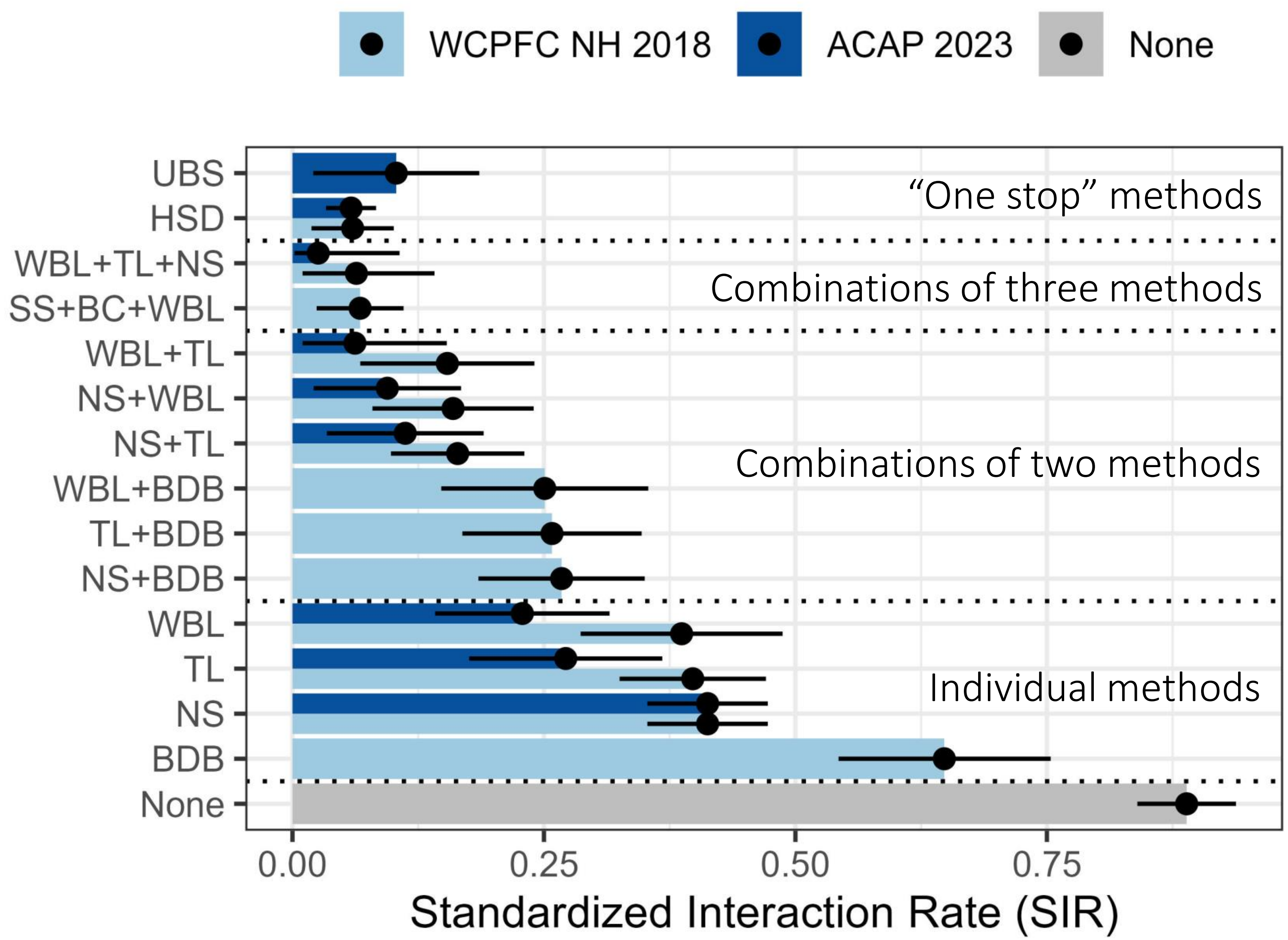
Which SH combination is most effective?



***SIR_i* analyses for the SH show:**

- Order of effectiveness among single methods is reflected in the order of effectiveness of combinations
- WBL + Tori lines + NS is most effective
- WBL + Tori lines is most effective 2/3 option
- Adopting ACAP 2023 specs would result in overall relative effectiveness gains of **24%**
- This gain would be driven by improved BLW specs (relative improvement of 41%)

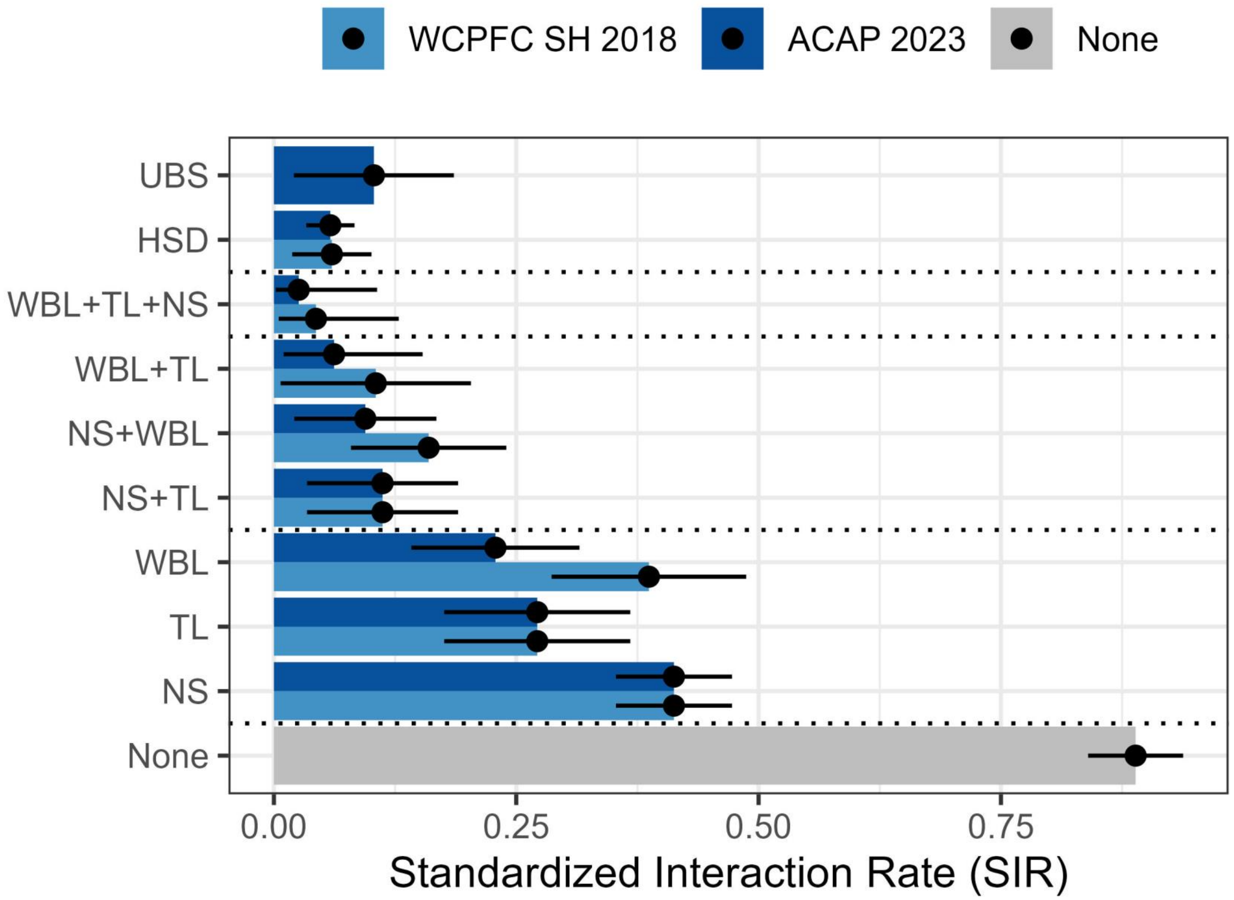
Which NH combination is most effective?

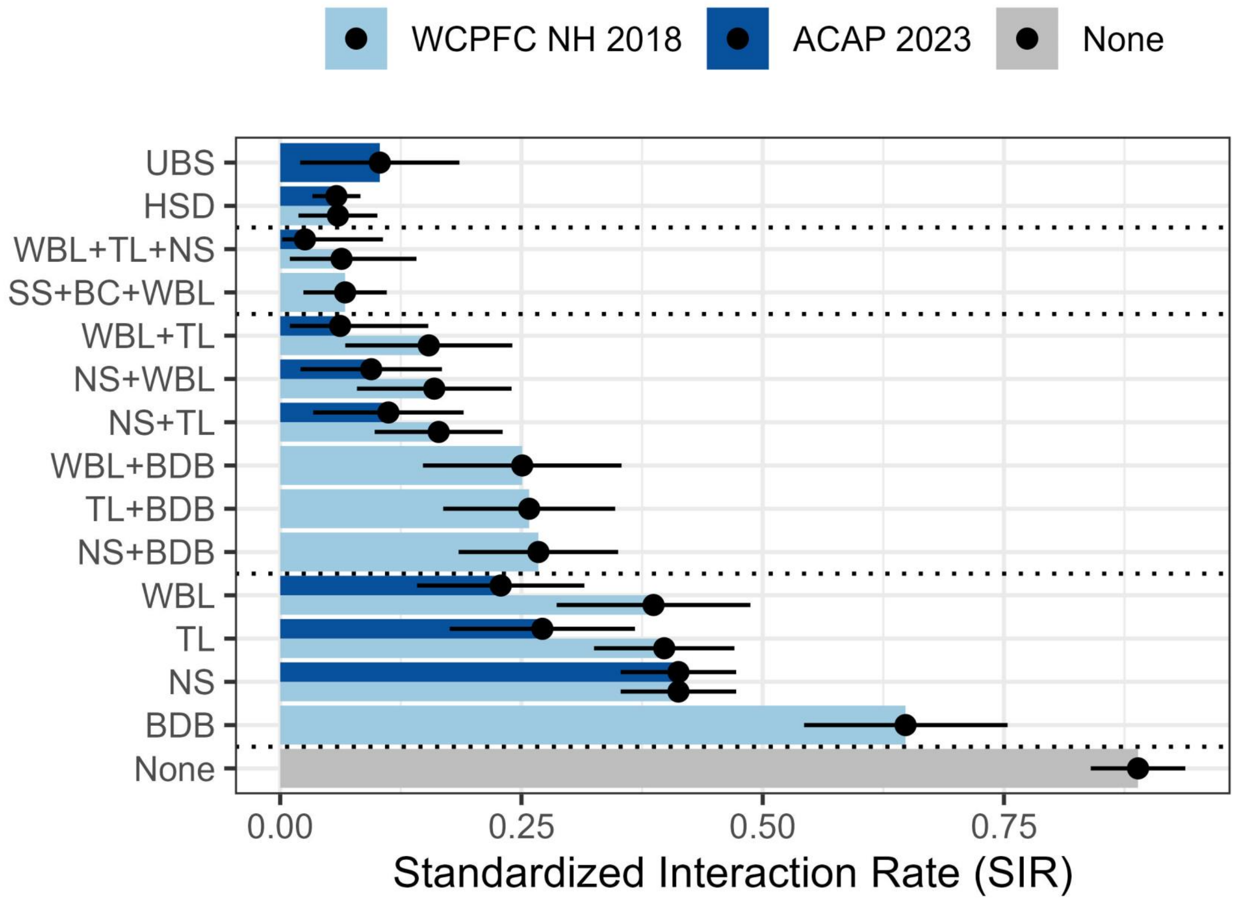


***SIR*$_i$ analyses for the NH show:**

- Similar order as in SH
- BDB performs poorly
- Line shooter trial did not contain sufficient data to include
- WBL + Tori lines + NS is most effective
- WBL + Tori lines is most effective 2/3 option
- Adopting ACAP 2023 specs would result in overall relative effectiveness gains of **44%**
- This would be driven by improvements in TLs (relative improvement of 32%) and WBLs (41%) and removal of BDB
- Adopting WCPFC SH specs in the NH would result in overall relative effectiveness gains of **26%**

Which combinations are the best in which hemisphere?





Discussion prompt: Do you have any evidence to share on the effectiveness of combinations of mitigation methods, either in the NH or SH?

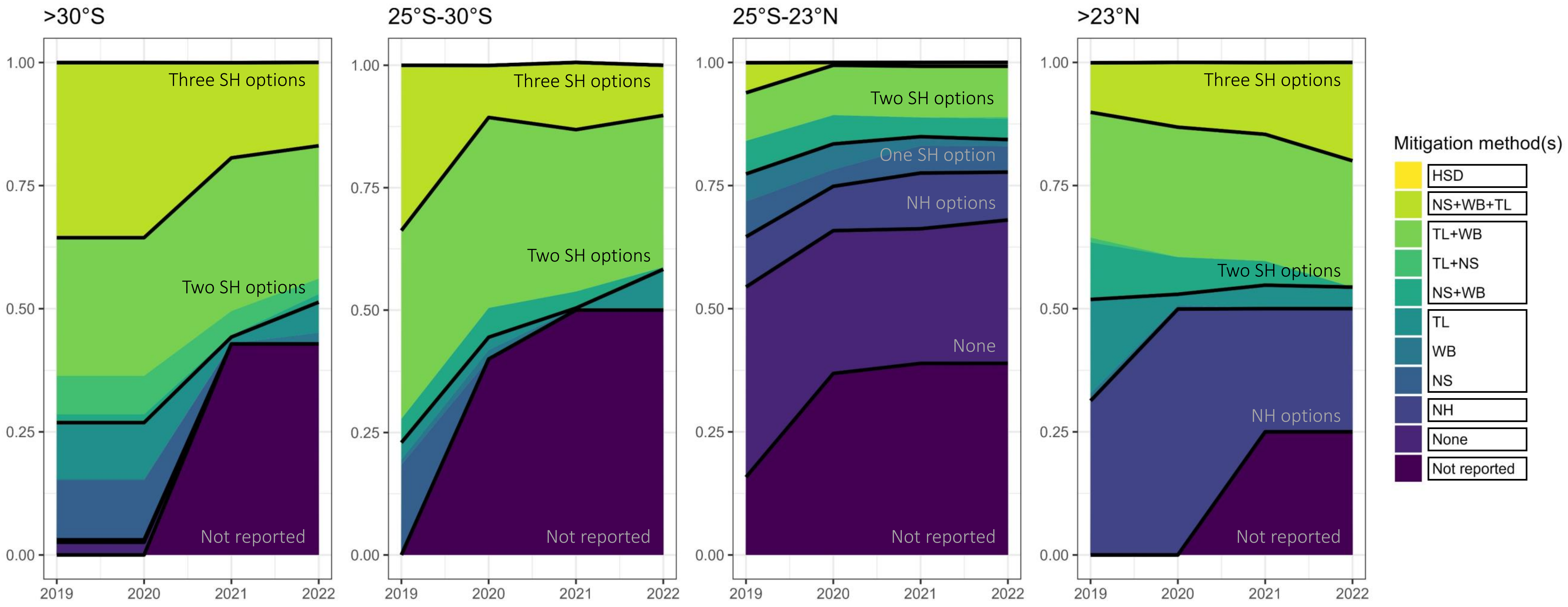
Which method(s) are reported most often?

- Four years (2019-22) of Annual Reports - Part. 1 for 29 CCMs were analysed to identify preferences and trends in mitigation use across the WCPO per latitudinal band
- Limited reporting of fishing effort (per relevant latitudinal band) limits weighted analyses

Mean proportions reported as used by CCMs during 2019-22 in the WCPO

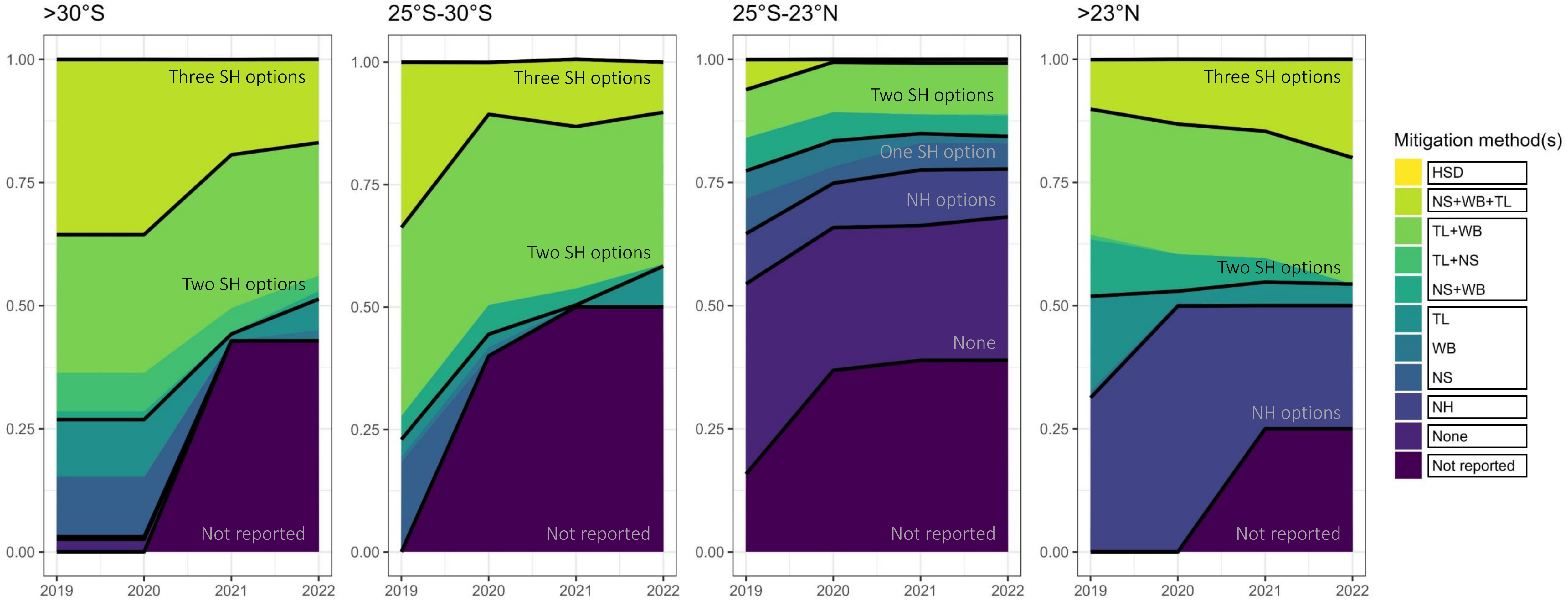
Mitigation method	>30ºS	25ºS - 30ºS	25ºS - 23ºN	>23ºN
Night setting	32%	16%	13%	21%
Tori line	62%	34%	12%	48%
Weighted branch lines	53%	34%	21%	47%
Hook Shielding Devices	0%	0%	0%	0%
NH options	0%	0%	10%	33%

Which method(s) are reported most often?



Data based on Annual Reports - Part 1 as submitted to SC16-19 and show proportions among CCMs, i.e., not weighted by fishing effort

Which method(s) are reported most often?



Discussion prompt: Do you have any scientific evidence to share on the preference for, or trends over time, in regard to the use of mitigation method combinations?

References

Bell et al. in prep. Effectiveness of conservation and management measures for reducing seabird bycatch on pelagic longlines in the South Atlantic.

Duckworth 1995. Analyses of factors which influence seabird bycatch rates in the Japanese southern bluefin tuna longline fishery in New Zealand waters, 1989-93. New Zealand Fisheries Assessment Research Document 95/26. Ministry of Agriculture and Fisheries, Wellington.

Gianuca et al. 2011. The effect of leaded swivel position and light toriline on bird attack rates in Brazilian pelagic longline. SBWG-4 Doc 40 Rev1. Fourth Meeting of the Seabird Bycatch Working Group, Guayaquil, Ecuador, 22–24 August 2011. Agreement on the Conservation of Albatrosses and Petrels, Hobart.

Jiménez et al. 2019. Mitigating bycatch of threatened seabirds: the effectiveness of branch line weighting in pelagic longline fisheries. Animal Conservation 22: 376-385.

Jiménez et al. 2020. Towards mitigation of seabird bycatch: Large-scale effectiveness of night setting and Tori lines across multiple pelagic longline fleets. Biological Conservation 247: 108642.

Klaer & Polacheck 1998. The influence of environmental factors and mitigation measures on by-catch rates of seabirds by Japanese longline fishing vessels in the Australian region. Emu 98: 305-316.

Melvin et al. 2013. Reducing seabird bycatch in the South African joint venture tuna fishery using bird-scaring lines, branch line weighting and nighttime setting of hooks. Fisheries Research 147: 72-82.

Melvin et al. 2014. Best practice seabird bycatch mitigation for pelagic longline fisheries targeting tuna and related species. Fisheries Research 149: 5-18.

Ochi et al. 2013. At-sea experiment to evaluate the effectiveness of multiple mitigation measures on pelagic longline operations in western north Pacific. WCPFC-SC9-2013/ EB-WP-11 Rev 1.

Pierre. 2023. Mitigation of seabird bycatch in pelagic longline fisheries: Best practice measures, evidence, and operational considerations. WCPFC SC19-EB-IP-15.