Inputs for Fisheries Management Strategy Evaluation of Multispecies Bycatch

WCPFC Intersessional Working Group on the Review of WCPFC's Turtle CMM

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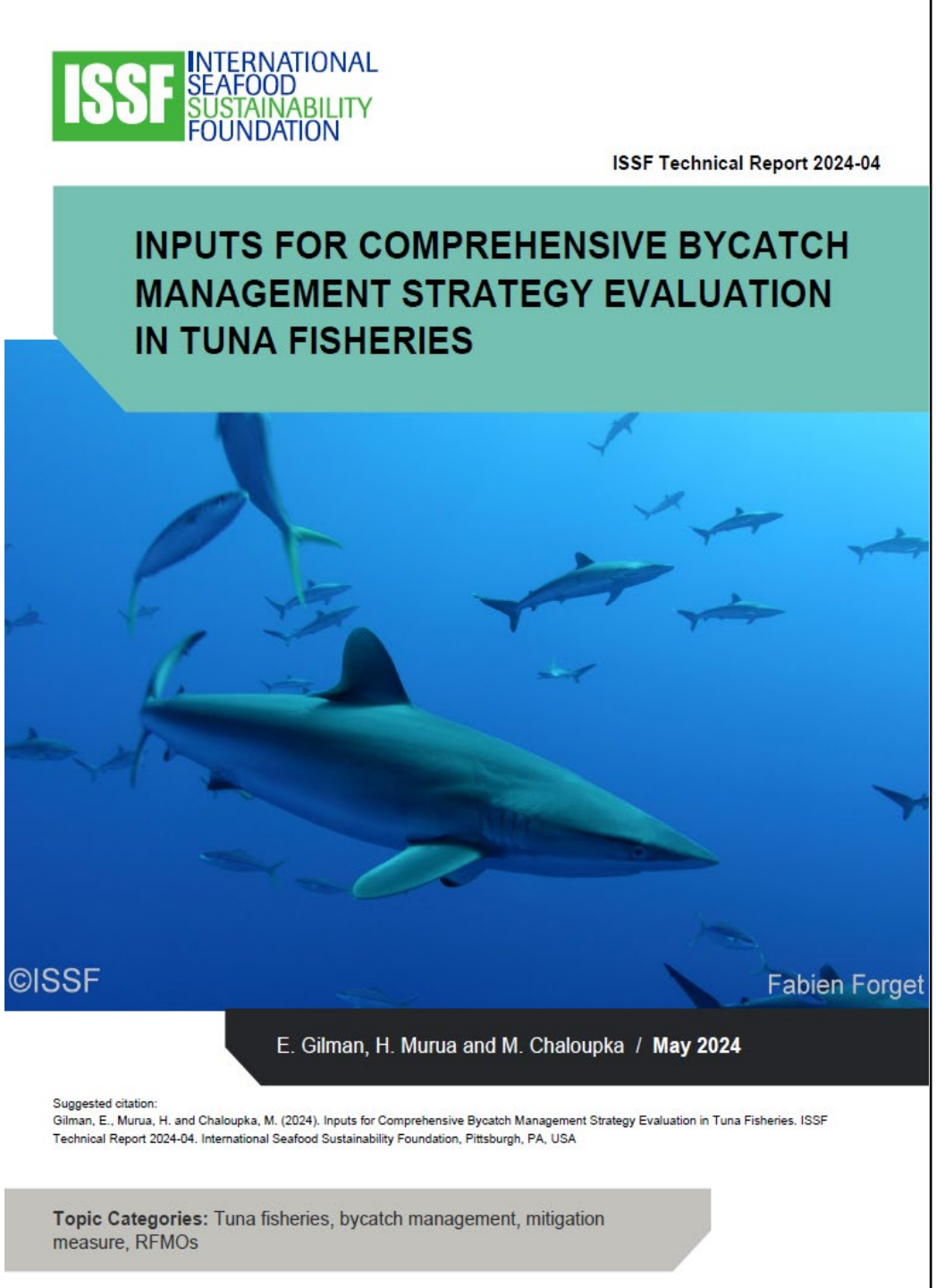


- Inputs for multispecies bycatch MSE
  - Size of catch and fishing mortality rate responses
  - Sequential mitigation hierarchy
  - Strength of evidence (from experiments and in practice)
  - Multispecies conflicts
  - Commercial viability costs
  - Compliance likelihood
  - Rates of components of fishing mortality
- Gear-specific databases of bycatch mitigation methods for tuna fisheries

Sequential bycatch mitigation hierarchy

1. Avoid the risk of capture
2. Minimize the risk of capture
3. Remediate impacts by reducing the probability of one or more of the components of fishing mortality (pre-catch, at-vessel, fate, at-release, ghost-fishing, post-release, collateral)
4. Offset residual bycatch mortalities that were not avoided, minimized and remediated – as a last resort.

Marine Policy 150 (2023) 105522

Bycatch-neutral fisheries through a sequential mitigation hierarchy

Eric Gilman [a,*], Milani Chaloupka [b], Hollie Booth [c], Martin Hall [d], Hilario Murua [e], Jono Wilson [f]





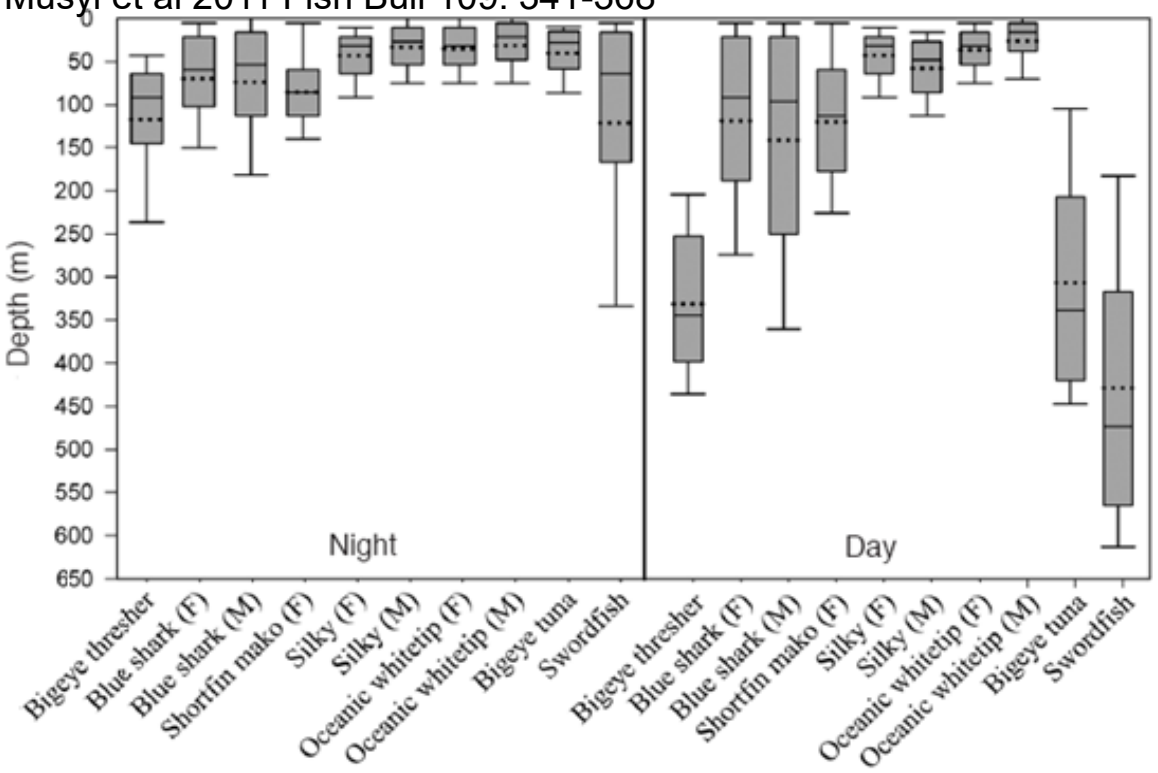
Strength of evidence, including in practice

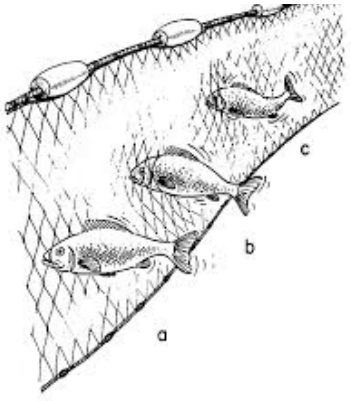
Tier	Study Method
1	Meta-analytic synthesis studies of RCTs
2	Meta-analytic syntheses of quasi-experimental, comparative or observational studies
3	Individual RCTs
4	Individual quasi-experimental and comparative experimental studies
5	Individual observational studies applying statistical modelling approaches to standardize (condition) fishing effort and applying quasi-experimental modelling approaches to infer causal impacts of an intervention
6	Individual observational studies with nominal estimates
7	Mechanistic studies
8	Qualitative systematic synthesis
9	Qualitative unstructured synthesis
10	Structured expert elicitation studies
11	Non-structured expert judgement studies
12	No records Inconclusive results Non-expert surveys/opinion Flawed studies

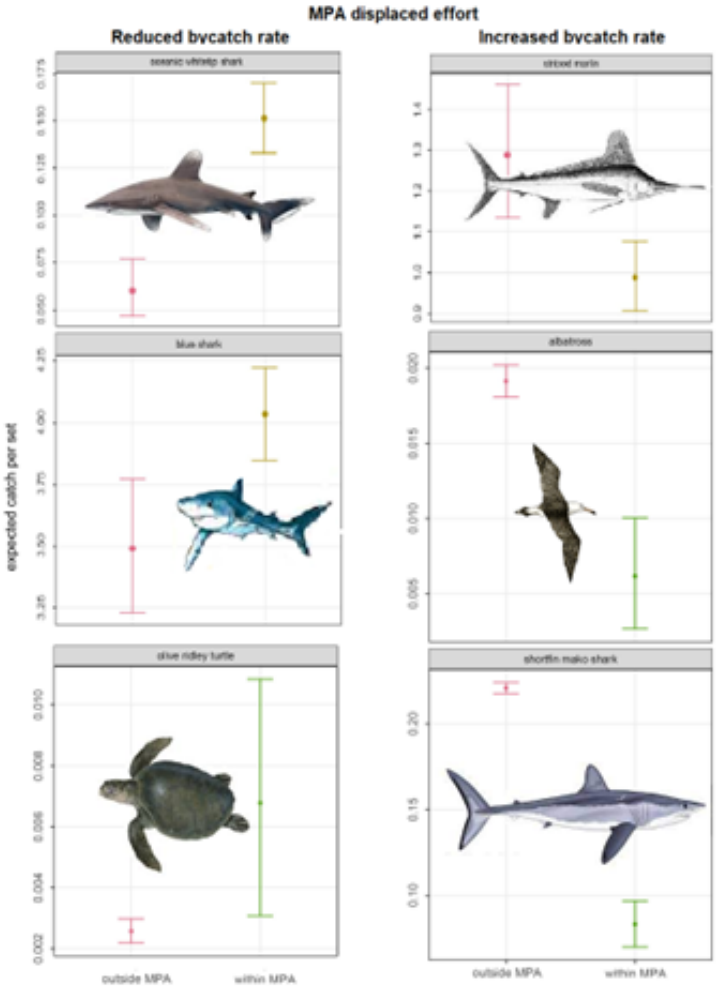
AND - evidence of real-world applicability through observational and pragmatic studies

Multispecies tradeoffs from some bycatch interventions

Musyl et al 2011 Fish Bull 109: 341-368







Ecological responses to blue-water MPAs. *PLoS ONE 15(7): e0235129*

Costs to commercial viability

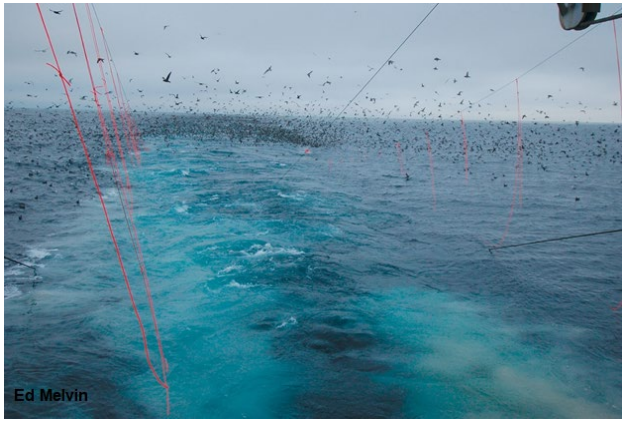
- Economic viability
- Practicality
- Crew safety
- Commercial availability



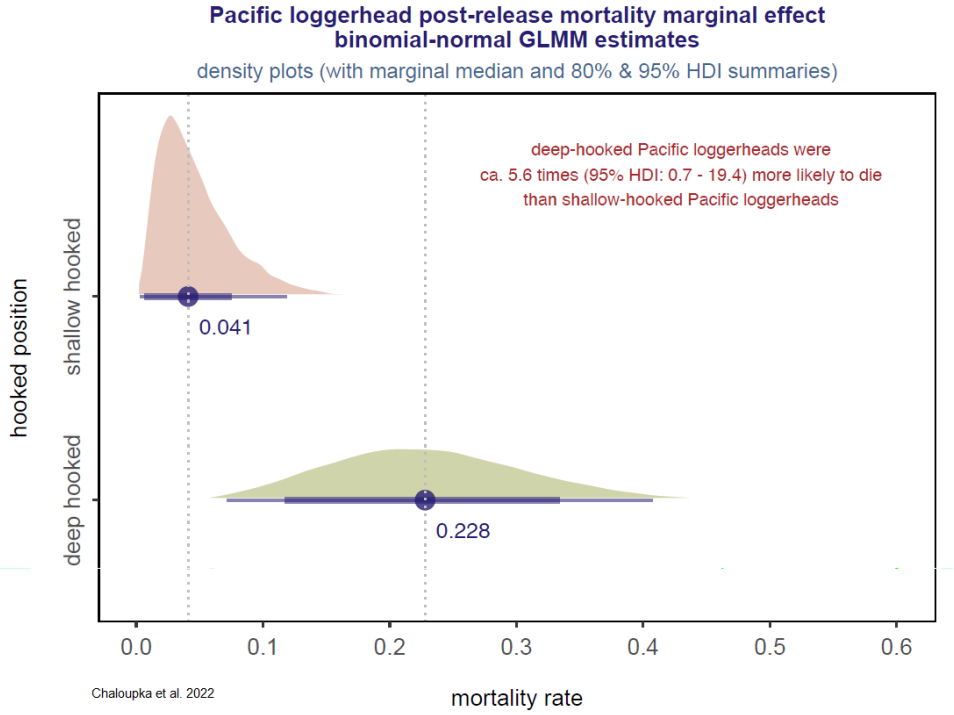



Compliance likelihood

- Is voluntary compliance expected?
  - Commercial viability costs
  - Degree of change from conventional practices
- Does crew behavior affect the performance of the bycatch mitigation method?
- Capacity of the fisheries mgmt. framework
  - What monitoring and surveillance methods enable determining compliance – dockside inspection, at-sea observers/EM, VMS/AIS…?
  - How robust are monitoring, control, surveillance and enforcement frameworks? Are outcomes of enforcement actions adequate deterrents of non-compliance?



Rates of components of fishing mortality determine relevant bycatch mgmt. measures



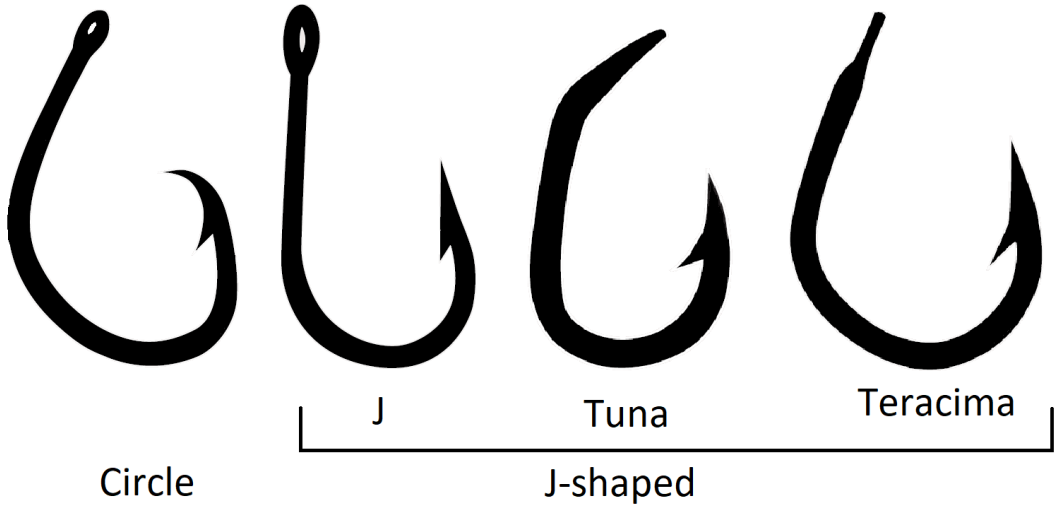
- **Variable AVM within a gear type**: Methods that decrease AVM rates (e.g., hook and bait type, soak duration, fishing depth, and branchline length).
- **Low AVM and PRM rates**: Handling and release methods hold promise.
- **High and low AVM rates**: Methods that reduce catch rates hold promise.

Longline database – turtle group excerpt

Method	Cet-aceans	Turtles, hard-shelled	Turtles, leather-back	Rays	Sea-birds	Sharks, epi-pelagic	Sharks, meso-pelagic	Tel-eosts	Mitigation hierarchy tier[1]	Commercial use?	Compliance monitoring requires observers or EM?
Hook shape: Circle hooks in place of J-shaped hooks of the same size (minimum width) and with ≤10 degree offset	▲	—	▲	▲	—	▼	▼	V	Minimize	Y	N
	—	▲	▲	—	—	▲	▲	▲	Remediate		
Hook minimum width: Use wider hooks.	—	▲	▲	▲	V[3]	V	V	V	Minimize	Y	N
	▼	▲	▲	—	—	—	—	—	Remediate		
Hook shape and width: Wider circle v. narrower J-shaped hook	▲	▲	▲	▲	V[3]	▼	▼	V	Minimize	Y	N
	▼	▲	▲	—	—	▲	▲	▲	Remediate		
Bait type: Forage fish bait instead of squid bait	?	▲	▲	?	▲[3]	▲	▲	V	Minimize	Y	N
	?	?	?	—	—	▼	▼	?	Remediate		
Bait type: Forage fish bait instead of pieces of large incidental catch	?	?	V	?	?	V	V	V	Minimize	Y	N
	?	?	?	?	?	?	?	?	Remediate		
Deeper fishing: Deeper (all hooks soak >100m) daytime fishing as compared to shallower nighttime fishing (some or all hooks soak < 100m)	▲	▲	▲	▲	▼[4]	▲	▼	V	Minimize	Y	N
	?	▼	▼	?	▼	▼	▲	V	NA		
Deeper fishing: Depth of shallowest hook >100 m [5]	▲	▲	▲	▲	—	▲	—	V	Minimize	Y	Y
	—	—	—	—	—	—	—	—	NA		
Ban lightsticks	▲	▲	▲	—	?	?	▲	V[6]	Minimize	Y	N
	—	—	—	—	—	—	—	—	NA		
Light emitting device characteristics: Light emitting devices that have light characteristics that reduce detection by marine turtles	—	▲	▲	?	?	?	?	?	Minimize	Y	N
	—	—	—	—	—	—	—	—	NA		
Branchline and floatline relative lengths: Branchline longer than floatline	—	—	—	—	—	—	—	—	Minimize	Y	N
	—	▲	▲	—	—	—	—	—	NA		
Floatline material: Monofilament nylon (polyamide) instead of polypropylene float lines	—	—	—	—	—	—	—	—	NA	Y	N
	—	▲	▲	—	?	—	—	—	Remediate		
Bait threading: Single baited instead of threaded bait on hook (and see entry under Seabirds on anatomical location of hooking bait)	?	▲	?	?	?	?	?	▲	Minimize	Y	Y
	—	—	—	—	—	—	—	—	NA		

Hook shape and size

Method	Cetaceans	Turtles-hard-shelled	Turtles-leatherback	Rays	Seabirds	Sharks-epi-pelagic	Sharks-meso-pelagic	Teleosts
Hook shape: Circle hooks in place of J-shaped hooks of the same size (minimum width) and with ≤10 degree offset	▲	—	▲	▲	—	▼	▼	V
	—	▲	▲	—	—	▲	▲	▲
Hook shape and width: Wider circle v. narrower J-shaped hook	▲	▲	▲	▲	V[3]	▼	▼	V
	▼	▲	▲	—	—	▲	▲	▲



3 meta-analyses on longline hook type:
Gilman et al (2016) Fish Fish 17:748-784
Reinhardt et al (2017) Fish Fish 19:413–430
Santos et al (2023) Aquat Conserv doi: 10.1002/aqc.4027

Purse seine database –excerpts

Method	Marine mammals	Turtles-hard-shelled	Turtles-leather-back	Rays	Sharks	Billfishes	Commercial use?	Compliance monitoring requires observers or EM?
MULTISPECIES								
Free school sets compared to drifting FAD sets, in terms of catch per set[2]	–	▲	▼	▼	▲	▲	Y	N[3]
	–	–	–	–	–	–		
Non-entangling drifting FADs compared to entangling and less-entangling designs[4]	–	▲	–	–	▲	–	Y	Y
	–	–	–	–	–	–		
Hopper, release ramps, release doors	–	–	–	–	–	–	Y	Y
	?	▲	▲	▲	▲	–		

Method	Marine mammals	Turtles-hard-shelled	Turtles-leather-back	Rays	Sharks	Billfishes	Commercial use?	Compliance monitoring requires observers or EM?
Ban intentional sets on live cetaceans	▲	–	–	–	–	–	Y	Y
	–	–	–	–	–	–		
Backdown maneuver, ban on night sets (Optimal if used in combination with a Medina panel and a speed boat to herd dolphins)	▲	–	–	–	–	–	Y	Y
	?[5]	–	–	–	–	–		
Medina dolphin safety panel	–	–	–	–	–	–	Y	N
	▲	–	–	–	–	–		
Rescue divers to release large at-risk bycatch from the net (increase pre-catch survival)	–	–	–	–	–	–	Y	Y
	▲	▲	▲	▲	▲	–		

Driftnet database – excerpt

Method	Marine mammals	Turtles-hard-shelled	Turtles-leather-back	Rays	Sea-birds	Sharks-epi-pelagic	Sharks-meso-pelagic	Tel-eosts	Commercial use?	Compliance monitoring requires observers or EM?
MARINE MAMMALS										
Stiffer netting and floatlines	? ▲	▲ ▲	▲ ▲	▲ ▲	— —	▲ ▲	▲ ▲	V ▲	Y	Y
Active acoustic alert and deterrent devices	V[2] —	? —	? —	—[3] —	— —	—[3] —	—[3] —	—[3] —	Y	Y
Active acoustic harassment device	V —	? —	? —	— —	— —	— —	— —	— —	Y	Y
Passive acoustic devices	? —	— —	— —	— —	▲ —	— —	— —	— —	N	Y
Less durable gear	▲ —	? —	? —	? —	— —	? —	? —	? V	?	N
Reduced amount of vertical lines	? —	— —	— —	— —	— —	— —	— —	— —	N	Y
TURTLES										
Deeper subsurface fishing	▲ ▼	▲ ▼	▲ ▼	? —	▲ ▼	▲ ?	▼ ?	V ?	Y	Y
Illumination	▲ —	▲ —	▲ —	▲ —	▲ —	▲ —	▲ —	V —	N	Y
Visual deterrent within gear	? —	▲ —	? —	? —	? —	? —	? —	▲ —	N	Y
Mesh size	▲ —	▲ —	▲ —	V —	▲ —	V —	V —	V —	Y	N
No buoys or buoy lines	V —	▲ —	▲ —	V —	▲ —	▲ —	▼ —	▼ —	N	N

Bycatch mitigation methods relevant across gear types

- Output controls
  - Bycatch thresholds
  - Retention bans and limits
  - International trade bans
  - Shark finning ban
- Input controls
  - Limits on vessels, vessel size, gear, fishing aids, effort
  - Limits on duration of fishing
- Handling & release practices
- Spatiotemporal mgmt.
  - Static and dynamic spatial and/or temporal restrictions
  - Move-on rules
  - Real-time fleet communication
- ALDFG mitigation
- Offsets

Variable	Category	% of IGOs	% of measures
Threshold approach	Individual vessel non-transferable limit	79	37
	Fleetwide TAC	79	63
Threshold definition	Catch or mortality magnitude	50	21
	Catch or mortality rate	79	36
	Retention magnitude	64	40
	Retention rate	14	7
Management response	Retention ban	50	30
	Retention restriction	43	22
	Move-on with or without area closure	50	24
	Reward - reduced bycatch mitigation requirements	14	4.5
	Penalty - increased bycatch mitigation requirements	21	7.5
	Fishery closure	14	6
	Closure of purse seine sets on dolphins	7	3
	Required retention if dead at haulback	14	3

2023 *Rev Fish Biol Fish* doi: 10.1007/s11160-023-09811-5

Inputs for Comprehensive Multispecies Bycatch Management Strategy Evaluation

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https://www.iss-foundation.org/about-issf/what-we-publish/issf-documents/issf-2024-04-inputs-for-comprehensive-bycatch-management-strategy-evaluation-in-tuna-fisheries/