Inputs for Multispecies Fisheries Bycatch Management Strategy Evaluation

IATTC Ecosystem & Bycatch Working Group

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INPUTS FOR COMPREHENSIVE BYCATCH MANAGEMENT STRATEGY EVALUATION IN TUNA FISHERIES

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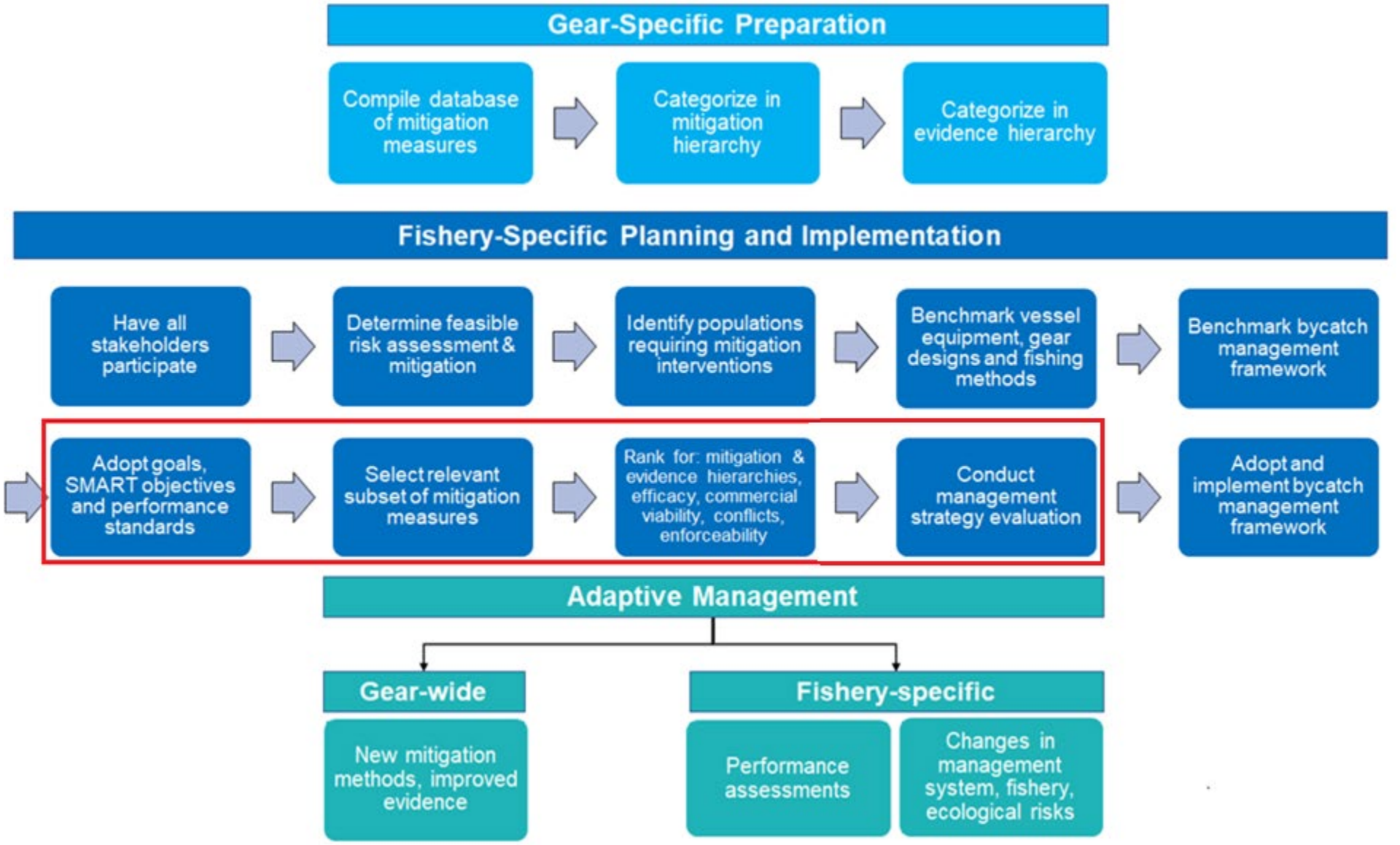
Topic Categories: Tuna fisheries, bycatch management, mitigation measure, RFMOs

- Inputs for multispecies bycatch MSE
  - Size of catch and fishing mortality rate responses
  - 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

Criteria for bycatch MSE: Effect size on catch and fishing mortality rate responses



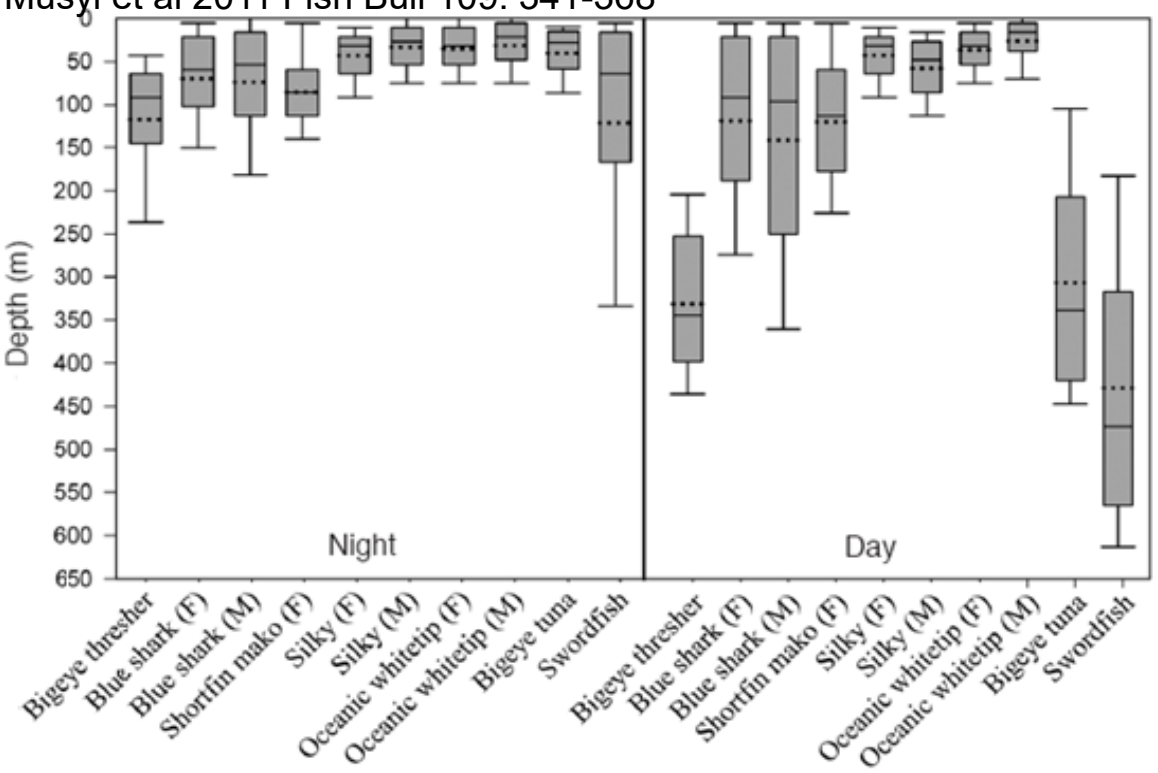
Strength of evidence, including in practice

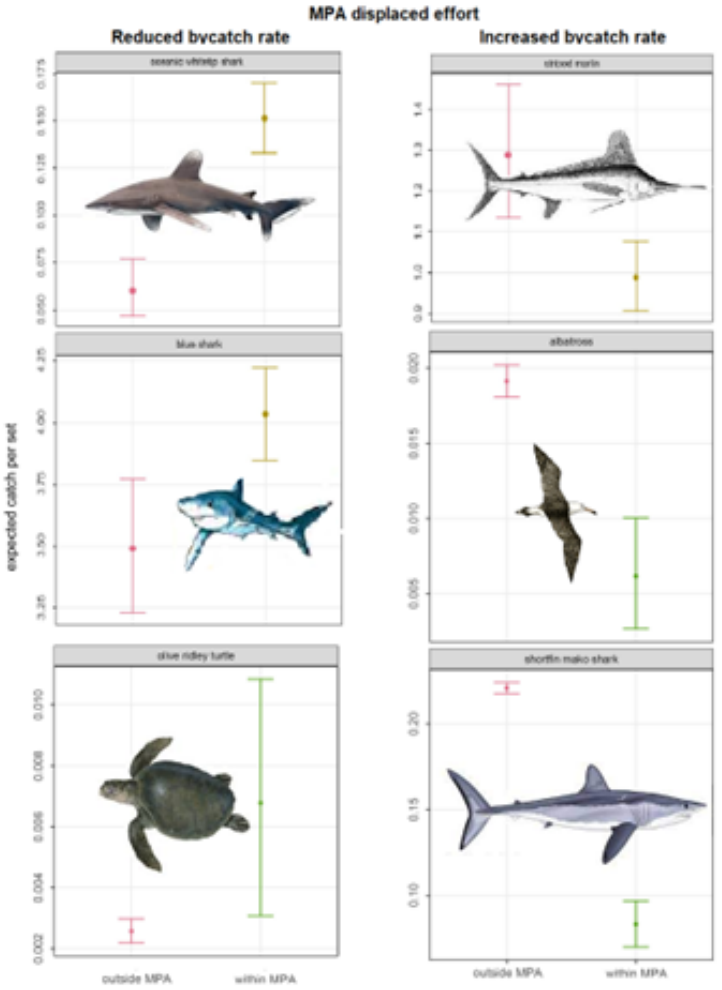
Tier	Study Method
1	Meta-analytic synthesis studies of RCTs
2	Meta-analytic syntheses of quasi-experimental, comparative or observational studies
3	Individual RCTs
4	Individual quasi-experimental and comparative experimental studies
5	Individual observational studies applying statistical modelling approaches 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

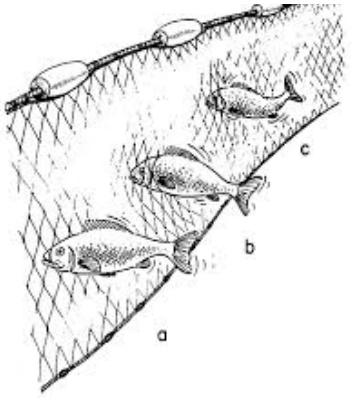
AND - evidence of real-world applicability through observational and pragmatic studies

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

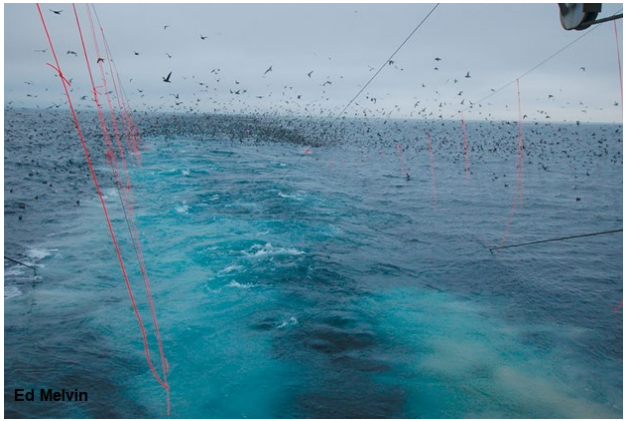
- Economic viability
- Practicality
- Crew safety
- Commercial availability



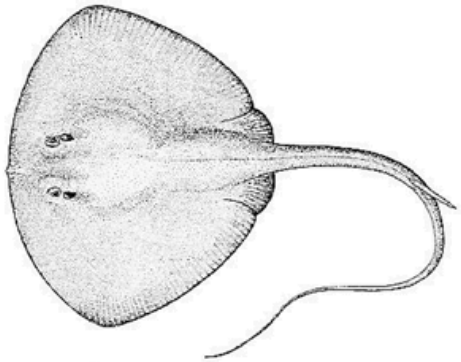



Compliance likelihood

- 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?

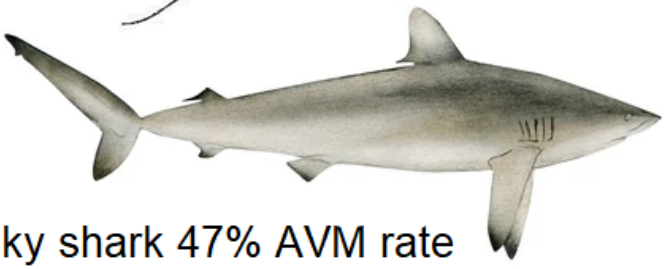


Rates of components of fishing mortality determine relevant bycatch mgmt. measures

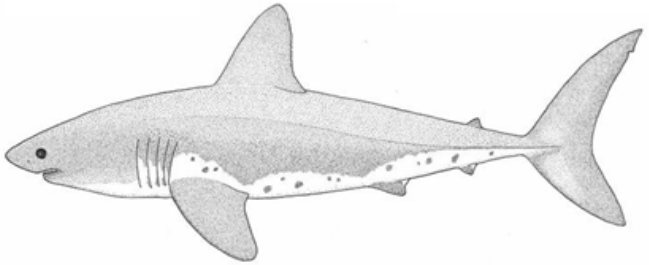


Pelagic stingray
5% AVM rate

Blue shark 11% AVM rate



Silky shark 47% AVM rate



Salmon shark 76% AVM rate

- **High retention**: Methods that decrease AVM rates (e.g., hook and bait type, soak duration, fishing depth, and branchline length) likely ineffective.
- **High AVM rates**: Retention bans, bans on shark finning, bans on international trade ineffective – but could catalyze reduction in shark targeting practices.
- **Low AVM, retention and PRM rates**: Handling and release methods hold promise.
- **High and low AVM rates**: Methods that reduce catch rates hold promise.

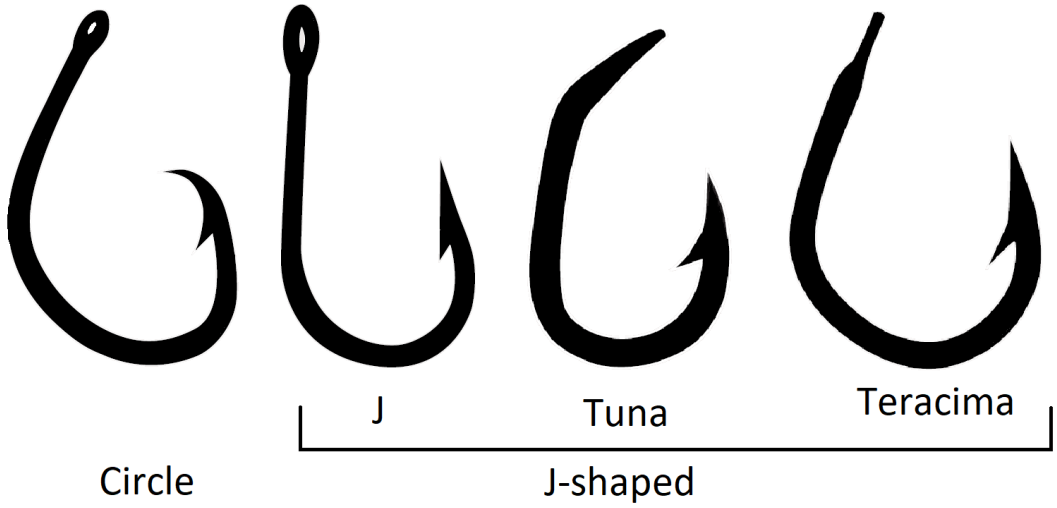
2022 *Sci Reports* doi: 10.1038/s41598-022-21976-w

Longline database – shark 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?
Leader material: Monofilament leaders only	?	?	?	?	?	▲	▲	V	Minimize	Y	N
	?	–	–	–	–	?	?	V	Remediate		
Ban shark lines	–	▲	▲	▲	–	▲	–	V	Minimize	Y	Y
	–	–	–	–	–	–	–	–	NA		
Ban lazy lines	–	–	–	–	▲	–	–	–	Minimize	Y	Y
	–	–	–	–	–	▲	▲	–	Remediate		
Long branchlines	–	–	–	–	–	–	–	–	NA	Y	N
	–	▲	▲	–	–	–	▲	V	Remediate		
Ban shark finning	–	–	–	–	–	–	–	–	NA	Y	N
	–	–	–	–	–	V	V	–	Remediate		
Artificial bait[10]	?	?	?	?	?	▲	▲	▲	Minimize	N	N
	–	–	–	–	–	V	V	–	NA		
Corrodible hooks and rings	–	–	–	–	–	–	–	–	NA	N	N
	?	?	?	?	?	?	?	?	Remediate		
Repellants	?	?	?	?	?	?[11]	?[11]	?	Minimize	Y	Y
	–	–	–	–	–	–	–	–	NA		
Remote release of hook	–	–	–	–	–	–	–	–	NA	N	Y
	?	?	?	?	?	?	?	?	Remediate		

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 –excerpt

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

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