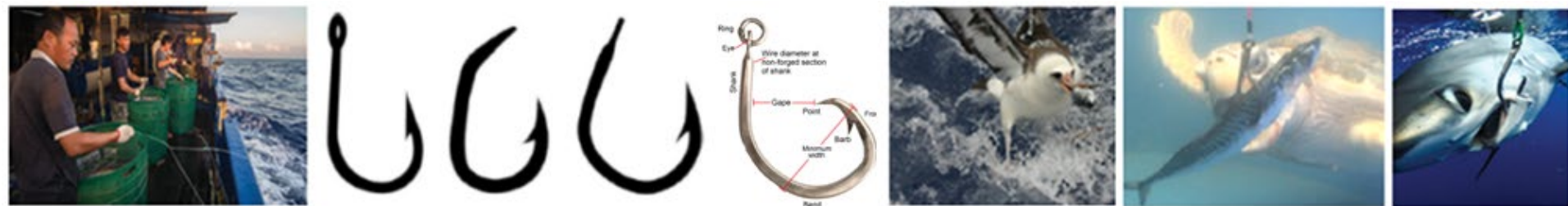# Bycatch management options for pelagic longline fisheries, including responses to hook shape and size

IATTC 2nd Sea Turtle Bycatch Mitigation and Circle Hook Workshop

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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

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
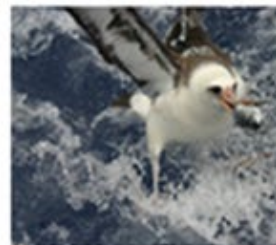
RFMO bycatch thresholds

2024. Individual and fleetwide bycatch thresholds in regional fisheries management frameworks. *Rev Fish Biol Fish* 34:253-270

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

Method	Cetaceans	Turtles-hard-shelled	Turtles-leatherback	Rays	Seabirds	Sharks-epipelagic	Sharks-mesopelagic	Teleosts	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
	▼	▲	▲	—	—	▲	▲	▲

Minimum width

Circle

J   Tuna   Teracima
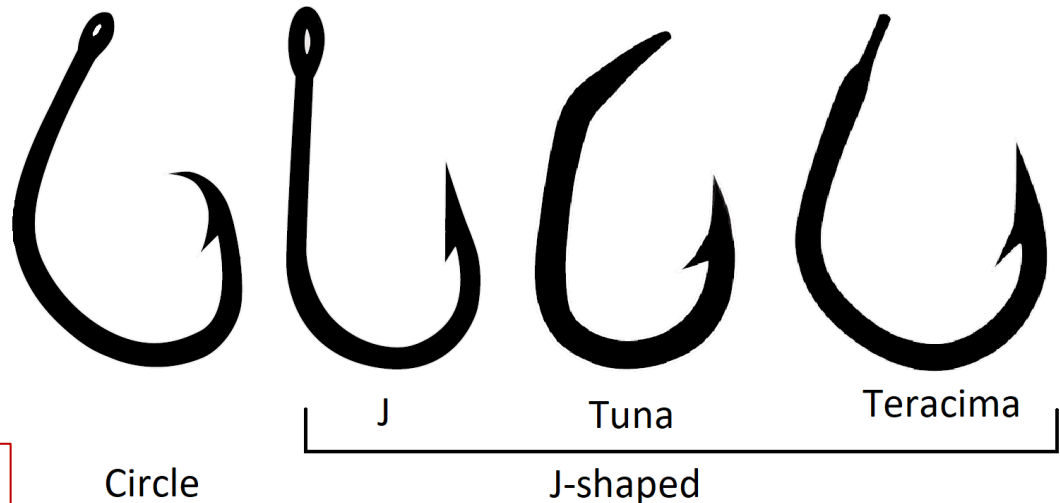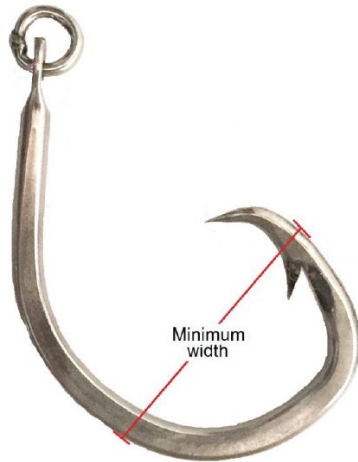
J-shaped

Effect of C vs. J-shaped hooks of same minimum width

- **Sharks and rays**: higher catch rate, lower proportion deeply hooked & AVM rate
- **Hard-shelled turtles**: no effect on catch rate, lower proportion deeply hooked & AVM rate
- **Leatherback turtles**: lower catch rate

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

Responses to circle hook width

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?
Wider hook minimum width of same shape	—	▲	▲	▲	V[3]	V	V	V	Minimize		
	▼	▲	▲	—	—	—	—	—	Remediate	Y	N

Rev Fish Biol Fisheries (2018) 28:417–433

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Effects of pelagic longline hook size on species- and size- selectivity and survival
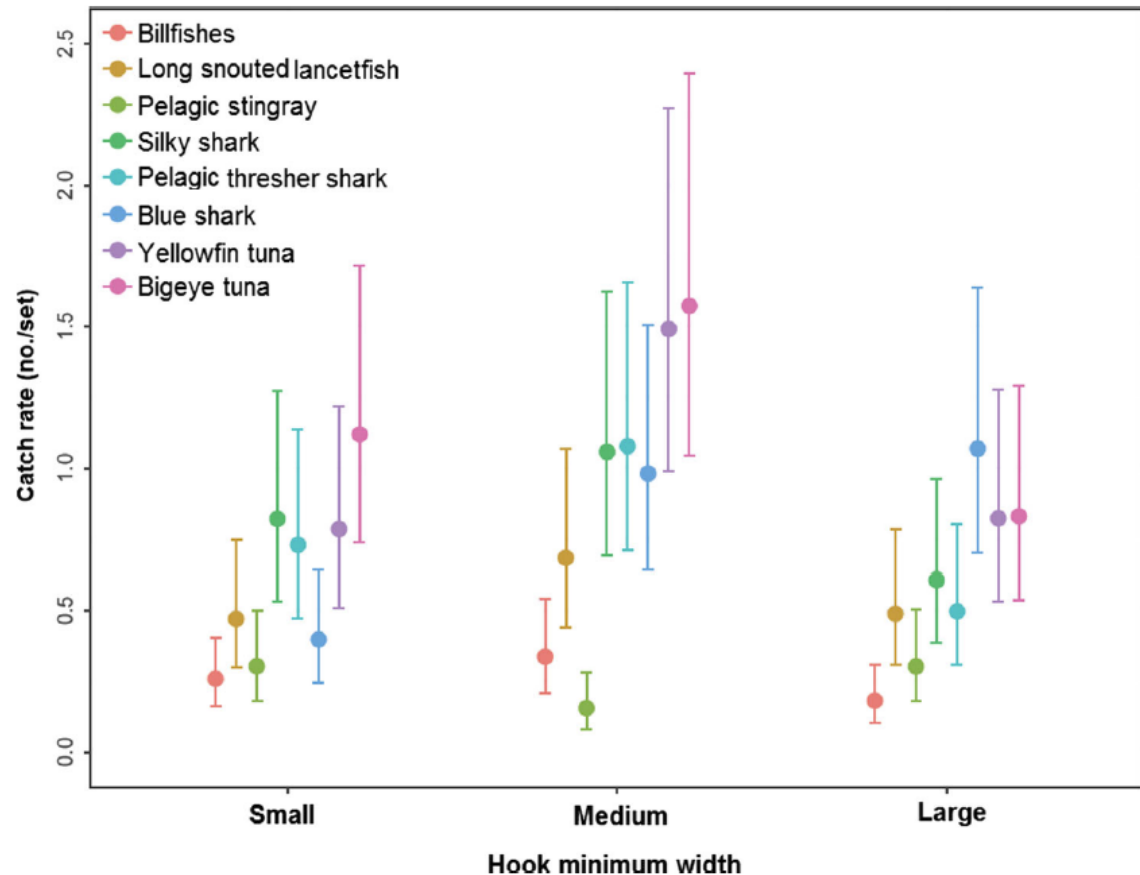
Underlying mechanisms for responses to circle hook width

- ## Species and size selectivity
  - Larger mouths needed to ingest larger hooks (particularly species w/ small mouth dimensions and that tend to ingest hooks)
  - Weak effect for species tending to be foul-hooked/entangled
  - Smaller gapes of narrower hooks prevent larger length classes to fit jaws into the gape, preventing point penetration
  - Smaller C hooks have higher probability of being swallowed, enabling severing mono leaders prior to hook sliding back to mouth

- ## Anatomical hooking position
  - Larger hooks have lower probabilities of ingestion and of deep hooking (likely a smaller effect than other gear components)

- ## At-vessel mortality rate
  - Correlated w/ effects on size selectivity (smaller organisms are generally weaker/more sensitive) and on hooking position

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 in place of J-shaped hooks of same minimum width and ≤10 degree offset	▲	—	▲	▲	—	▼	▼	V	Minimize	Y	N
	—	▲	▲	—	—	▲	▲	▲	Remediate		
Wider hook: larger hook minimum width of same shape	—	▲	▲	▲	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 or pieces of large incidental catch	?	▲	▲	?	▲[3]	▲	▲	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 characteristics (peak wavelengths, wavelength range, flicker rate, directionality, and light level) that reduce turtle catch risk	—	▲	▲	?	—	?	?	?	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		

Supporting integrated bycatch MSE

- Expand fields to cover all key inputs for integrated bycatch MSE

- Expand records to include RFMO-prescribed combinations of bycatch mgmt. measures

- Living webtool for integrated bycatch MSE
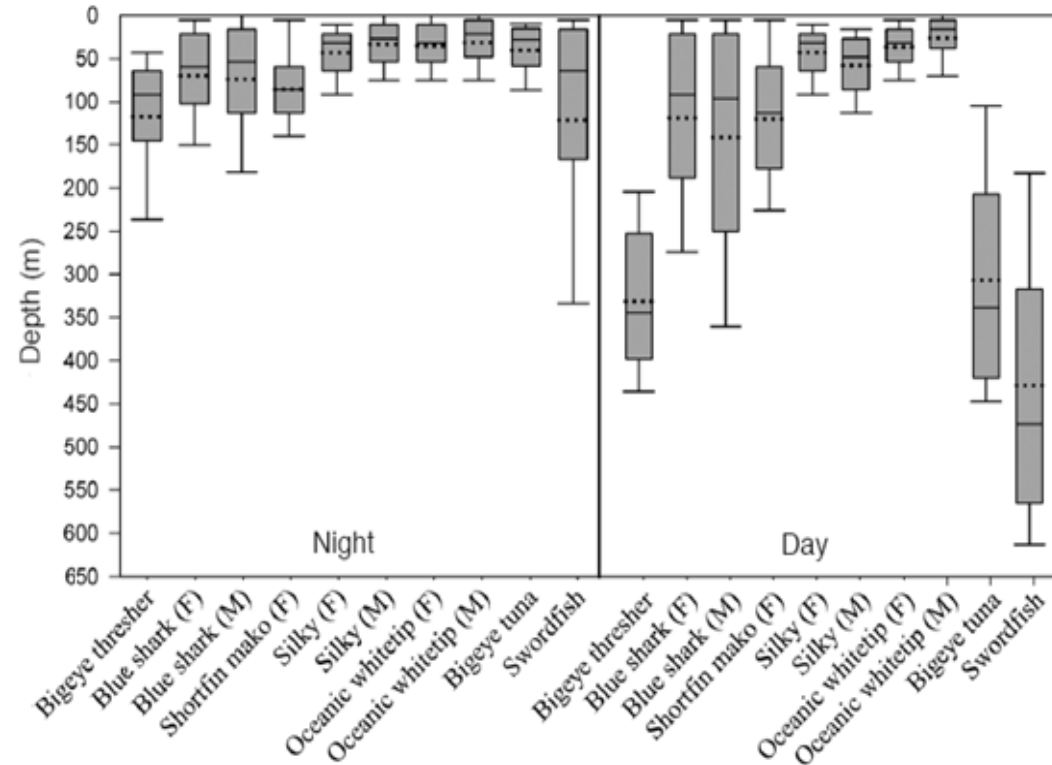
Musyl et al 2011 Fish Bull 109: 341-368

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/