International community's efforts to mitigate sea turtle bycatch and status of implementing relevant measures by Korean tuna longline fishery

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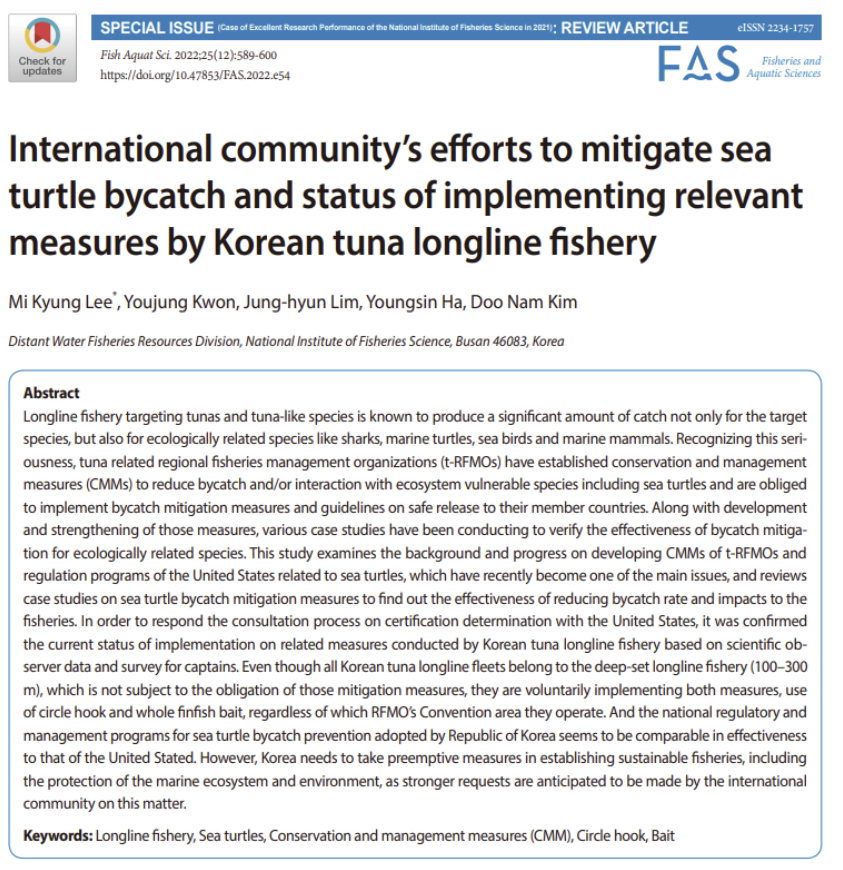

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International community's efforts to mitigate sea turtle bycatch and status of implementing relevant measures by Korean tuna longline fishery

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Abstract

Longline fishery targeting tunas and tuna-like species is known to produce a significant amount of catch not only for the target species, but also for ecologically related species like sharks, marine turtles, sea birds and marine mammals. Recognizing this seriousness, tuna related regional fisheries management organizations (t-RFMOs) have established conservation and management measures (CMMs) to reduce bycatch and/or interaction with ecosystem vulnerable species including sea turtles and are obliged to implement bycatch mitigation measures and guidelines on safe release to their member countries. Along with development and strengthening of those measures, various case studies have been conducting to verify the effectiveness of bycatch mitigation for ecologically related species. This study examines the background and progress on developing CMMs of t-RFMOs and regulation programs of the United States related to sea turtles, which have recently become one of the main issues, and reviews case studies on sea turtle bycatch mitigation measures to find out the effectiveness of reducing bycatch rate and impacts to the fisheries. In order to respond the consultation process on certification determination with the United States, it was confirmed the current status of implementation on related measures conducted by Korean tuna longline fishery based on scientific observer data and survey for captains. Even though all Korean tuna longline fleets belong to the deep-set longline fishery (100–300 m), which is not subject to the obligation of those mitigation measures, they are voluntarily implementing both measures, use of circle hook and whole finfish bait, regardless of which RFMO's Convention area they operate. And the national regulatory and management programs for sea turtle bycatch prevention adopted by Republic of Korea seems to be comparable in effectiveness to that of the United Stated. However, Korea needs to take preemptive measures in establishing sustainable fisheries, including the protection of the marine ecosystem and environment, as stronger requests are anticipated to be made by the international community on this matter.

Keywords: Longline fishery, Sea turtles, Conservation and management measures (CMM), Circle hook, Bait

Review article published in Fish Aquatic Sciences (2022).

Sea Turtle Conservation in Tuna Fisheries: International Overview

1. Resource status and threat

- Sea turtles are threatened species with low productivity and high vulnerability to longline bycatch.
- This made sea turtle conservation a major issue in tuna fisheries.

2. International concern

- UNCLOS, UNFSA, and the 1995 FAO Code of Conduct established the need to minimize bycatch and protect biodiversity.

3. FAO process

- FAO expert consultations in 2004 led to the 2005 Guidelines to Reduce Sea Turtle Mortality in Fishing Operations.
- These guidelines became the basis for later RFMO measures.

4. RFMO regulation

- t-RFMOs progressively adopted measures on circle hooks, finfish bait, safe handling and release, and reporting.
- The U.S. comparability process added further implementation pressure.

Why this matters for Korea

As one of the main longline fleets, Korea should be prepared and responded to those actions based on the positive and/or negative impacts of implementing these measures to the fisheries considering the fishing characteristics of Korean tuna longline fleets.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

How the paper generated evidence

The study combines policy review, case-study synthesis, observer data, and a captain survey.

Policy review

Reviewed FAO guidelines, **t-RFMO resolutions/CMMs**, and the **2021 U.S. Biennial Report**

Effectiveness review

Summarized domestic and international *case studies* focused on **circle hooks** and **whole finfish bait**.

Observer data

Analyzed **scientific observer data** from Korean tuna longline fleets in the *Pacific, Atlantic, and Indian Oceans*

Time coverage

Hook type: 2018-2020
Bait type: 2016-2020

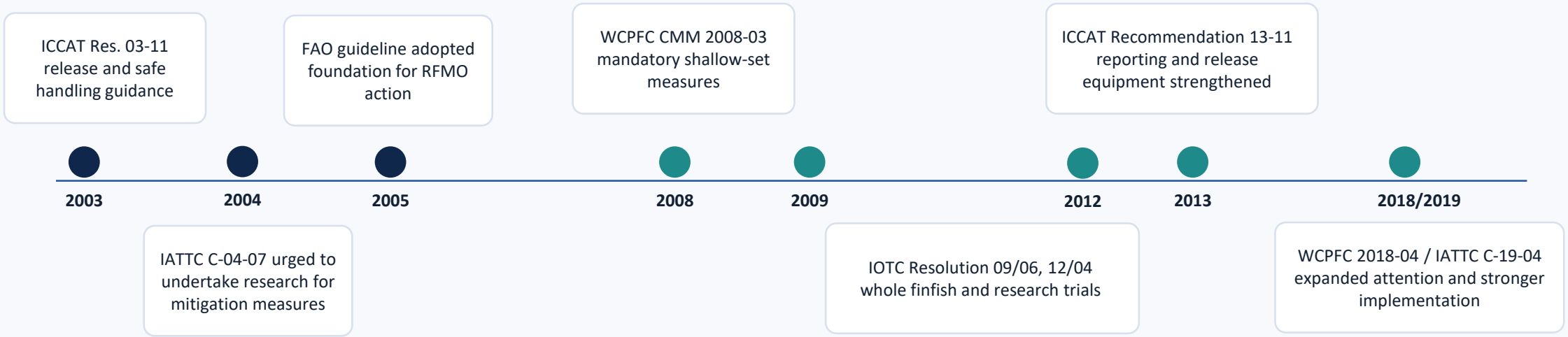
Survey

Questionnaire of **41 captains** (about **40%** of all Korean distant-water tuna longline captains) *participating in the training program*

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

t-RFMO status on sea turtle mitigation measures & U.S domestic law

The overall pattern is a shift from voluntary guidance to progressively stronger and more specific obligations.



Common direction

- Across t-RFMOs, handling/release guidelines are common. Large circle hooks and whole finfish bait are emphasized particularly for shallow-set longline fisheries.

Key message for Korea

- Even where Korean fleets were not yet under mandatory deep-set requirements, policy momentum clearly pointed toward broader implementation.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

t-RFMO status on sea turtle mitigation measures & U.S domestic law

Table 1. Summary of methods used to reduce sea turtle interactions introduced by Food and Agriculture Organization of the United Nations (FAO) Guidelines to Reduce Sea Turtle Mortality in Fishing Operation

1. Fishing gear designs and fishing method	
Gill net	- Lower-profile (narrower), stiffer nets - Deeper setting for surface gillnet fisheries - Use longer tie-downs of avoid their use in demersal gillnets - Avoid exceeding a maximum threshold for mesh size
Pelagic longline	- Replacement of J and tuna hooks with large (wider) circle hooks[1)] - Use of whole fish instead of squid for bait[1)] - Setting hooks deeper than turtle abundant depths (40–100 m) - Use of dyed bait/camouflaged gear - Reduced gear soak time - Avoidance of fishing in certain sea surface temperature - Use of intermittent flashing light sticks in place of traditional continuous flashing light sticks and not using luminous gear
Coastal Trawl	- Turtle excluder devices (TEDs) for shrimp fisheries
Purse seine	- Avoidance of encircling sea turtles - Modified designs for fish aggregating devices (FAD)
Demersal longline	None
2. Sea turtle bycatch hotspot avoidance	
	- Time-area closures/marine protected areas (MPAs) - Fleet communication for real-time bycatch hotspot avoidance
3. Adjust input and/or output controls	
	- (Input) Fishing effort and capacity limits - (Output) Sea turtle caps and/or target specie caps per fishery or per vessel
4. Other measures	
	- Bycatch fees and other methods of compensation - Avoidance and reduction of derelict fishing gear and other marine debris - Retrieval of derelict fishing gear and other debris - Consideration of effects on other sensitive species groups - Changing gear type to one with a lower turtle bycatch to target catch ratio
5. Best practices for sea turtle handling and release	
a) Retrieving a sea turtle: Assess the turtle's size, then release it or bring in on board. (Large turtle) Bring it as close to the boat as possible without putting too much strain on the line, then cut the line as close to the turtles as practical. (Small turtle) Use a dip net to lift it on board. DO NOT use a gaff and DO NOT pull on the line or grasp the eye sockets to bring the animal on board.	
b) De-hooking a sea turtle: Place a piece of wood in the turtle's mouth so it cannot bite, then cut the hook or line. If the hook's barb is visible, use bolt cutters to cut the hook in half, and remove the two parts separately. If the hook is not visible, remove as much line as possible without pulling too hard on the line, and cut it as close to the turtle as practical.	

[1)]Among the measures in the pelagic longline, the marked measures are being voluntarily taken by Korean tuna longline fishery.

Table 2. Comparison of sea turtle mitigation measures and safe release equipment for longline fishery among tuna related regional fisheries management organizations and U.S. CFR

		Mitigation measures	Safe release equipment
WCPFC	Shallow-set	Employ or implement at least one of the three measures a. Use only large circle hooks (offset not exceed 10 degrees) b. Use only finfish for bait c. Use any other mitigation or activity approved by the Commission	Line cutters, de-hookers
	Other (deep-set)	Undertake research trials of circle hooks and other mitigations	
IATTC	Shallow-set	Employ or implement at least one of the three measures a. Use only large circle hooks (offset not exceed 10 degrees) b. Use only finfish for bait c. Use any other mitigation or activity approved by the Commission	
	Other (deep-set)	Undertake research trials of circle hooks and other mitigations	
IOTC		Use of whole finfish for bait	
ICCAT		None	
U.S. CFR		Required to implement all measures; • Use only 16 or larger (non-offset) or 18 or larger (offset not exceed 10 degrees) circle hooks • Use only whole Atlantic mackerel and/or squid bait	Line cutters, de-hookers, extended reach handle, long-handled device to pull an 'inverted V', dip-net, tire, bolt cutters, long-nose or needle-nose pliers, mouth openers etc.

WCPFC, Western and Central Pacific Fisheries Commission; IATTC, Inter-American Tropical Tuna Commission; IOTC, Indian Ocean Tuna Commission; ICCAT, International Commission for the Conservation of Atlantic Tunas; CFR, Code of Federal Regulations.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

Effectiveness of mitigation measures: circle hooks

Across reviewed studies, circle hooks were repeatedly linked to lower sea turtle interactions and easier de-hooking, with limited or positive effects on target catch.

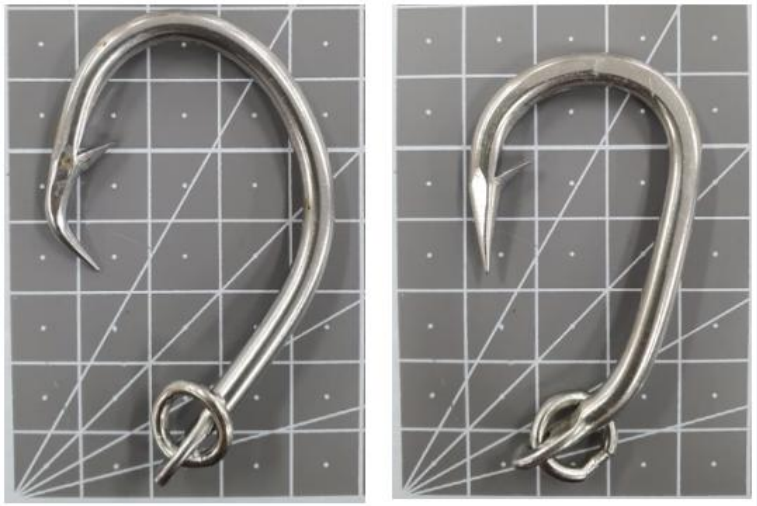


Fig. 1. Hook type used in the Korean tuna LL fishery; (left) Circle hook(C14), (right) Japanese tuna hook(3.4 sun)

Why circle hooks matter

- The inward-curved point makes hook swallowing harder for sea turtles and reduces deep hooking.
- Lower deep hooking improves safe-release potential.

For target species

- Several studies reported no adverse effect on catch rates of target tunas.
- For bigeye tuna, some studies found relatively higher catch rates and larger mean size with circle hooks.

Operational caveat

- Much of the global evidence comes from shallow-set longline fisheries.
- Applicability to deep-set longline requires careful interpretation, although Korean experiments were favorable.

Circle hooks form the core mitigation option because they reduce turtle hooking severity without clearly sacrificing target-species performance.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

Effectiveness of mitigation measures: whole finfish bait

The mechanism is species-selective feeding: larger and softer whole finfish baits tend to reduce hook ingestion by sea turtles relative to squid bait.

Mechanism

- Larger bait lowers the relative catchability of smaller species with smaller mouth dimensions.
- Sea turtles can tear pieces from finfish more easily, reducing the chance of ingesting hook and bait together.

Evidence synthesis

- Multiple studies supported finfish bait as an important turtle-bycatch mitigation option.
- The strongest evidence is again from shallow-set longline settings, where turtle interactions are more common.

Operational reading for Korea

- Korean fleets voluntarily used whole finfish and, in some areas, whole finfish/squid combinations.
- This supports the practical mitigation package highlighted by t-RFMOs.

Circle hook + whole finfish is the practical mitigation package most consistently emphasized by the paper and by RFMO rules.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

Korean implementation status: hook type and size

Observer data show that Korean tuna longline fleets were already using circle hooks at high rates, especially in the Pacific Ocean.

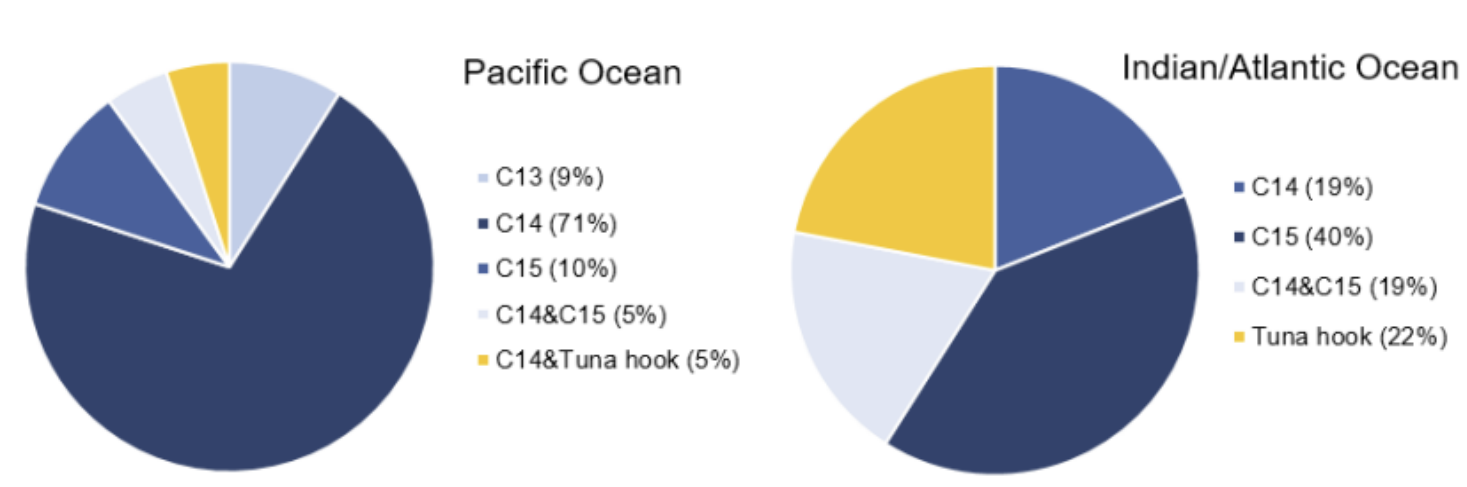


Fig. 2. The proportion of hook type and size used in the Korean tuna longline fishery based on the scientific observer data collected during 2018-2020. Tuna hook indicates Japanese tuna hook.

Observer data (2018-2020)

- **Pacific Ocean**: circle hooks accounted for ***95%*** of hooks; C14 dominated (71%).
- **Indian/Atlantic Oceans**: circle hooks accounted for ***78%***; C15 was most common (40%).

Key interpretation

- No J hook was used in Korean tuna longline fisheries during 2018-2020.
- Japanese tuna hooks remained important mainly in Atlantic bluefin tuna operations.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

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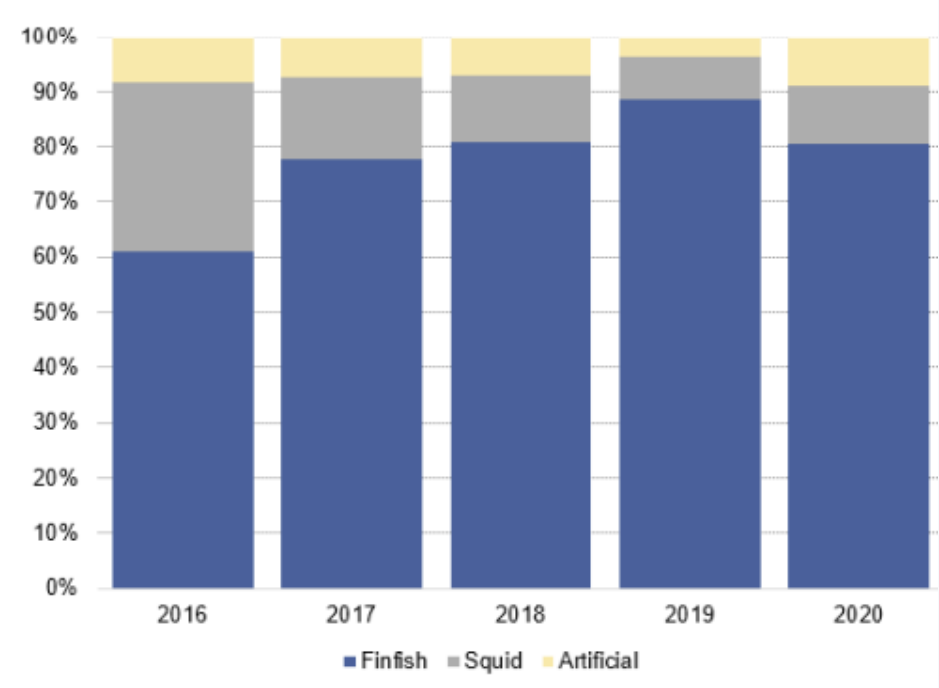
Korean implementation status: bait-type trend

In the Pacific Ocean, observer data indicate a rising use of finfish bait and a declining share of squid bait from 2016 to 2020.



Reading of the trend

- Whole finfish increased from roughly 60% in 2016 to around 80% by 2019-2020 in Pacific observer records.
- Squid showed the opposite trend, while artificial bait remained marginal.

Why it matters

- This trend supports the paper's claim that Korean fleets were voluntarily implementing measures aligned with the direction of RFMO guidance.

Fig. 3. The proportion by bait type used in the Korean tuna longline fishery operating in the Pacific Ocean based on the information collected by scientific observers, 2016-2020.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

Captain survey: implementation and satisfaction

The survey reinforces the observer-data picture: adoption was already high, and captains generally did not report operational harm from using circle hooks.

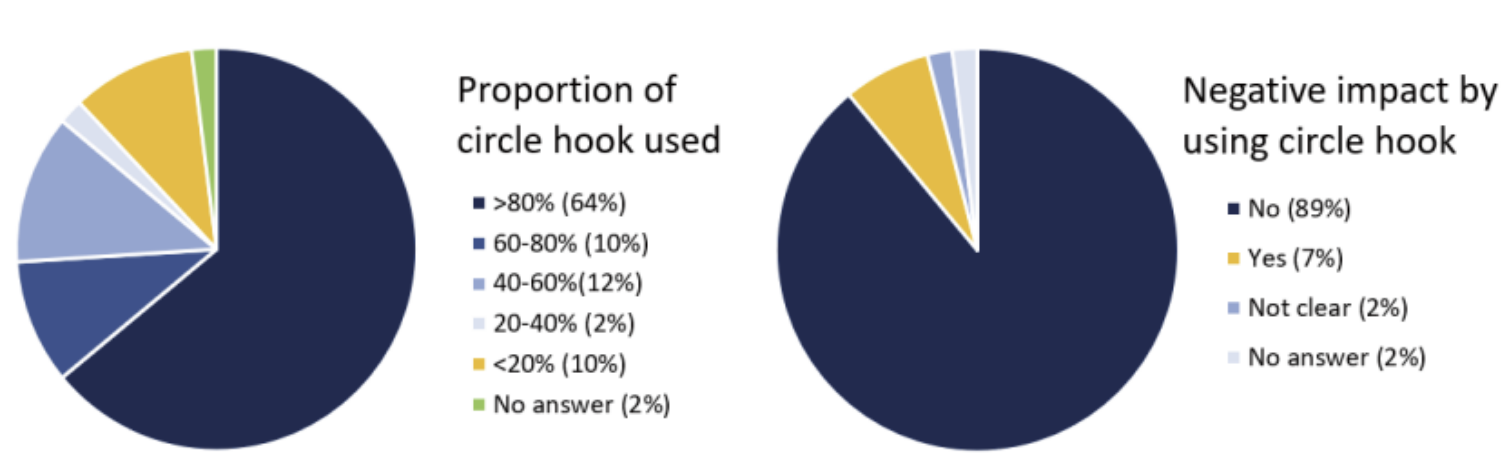


Fig. 4. The result of survey on proportion of circle hook used and the fishermen's opinion related to negative impact by using circle hook.

Survey highlights

- 64% of responding captains reported using circle hooks for more than 80% of hooks in a set.
- All captains planning to fish in the Pacific Ocean reported all or most hooks as circle hooks.

Perceived impact

- 89% said circle hooks had no negative impact on target-species catch rate.
- When negative impacts were mentioned, they related more to cost than to reduced catch performance.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

Korea’ s national programs and voluntary efforts

Korea already had a layered framework - legal, administrative, data, education, and industry action - that was broadly comparable in effectiveness.

Act to Conserve and Manage Marine Ecosystem	Protects listed sea turtle species and prohibits capture, sale, or other unauthorized handling; requires efforts to avoid interactions with protected species.
Distant Water Fisheries Development Act	Allows license conditions for resource management, imposes strict penalties for non-reporting or false reporting of bycatch, catch, landing, and transshipment data.
Data collection and reporting	Electronic monitoring and scientific observers collect species-specific interaction data; relevant data are reported to respective RFMOs.
Education and training	National Institute of Fisheries Science provides pre-trip education, safe-handling and release posters, and species-related guidance to vessel masters.
Voluntary industry action	Korean deep-set longline fleets used circle hooks and whole finfish/whole finfish-squid baits even where not mandatory in the all Oceans.

Source: Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600

Thank you for your attention!

Based on Lee et al. (2022), Fish Aquat. Sci. 25(12):589-600