Preliminary trials to assess bycatch reduction potential for deep-set pelagic longline gear in the U.S. Atlantic fishery

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Introduction

The U.S. Atlantic pelagic longline fishery uses a shallow-set gear configuration to target swordfish and yellowfin tuna at depths of around 75-100 m. However, the fishery has been the subject of several bycatch reduction regulations due to incidental catch and mortality of sea turtles, istiophorid billfishes, and marine mammals. Used in the U.S. pelagic longline fishery based in Hawaii, the deep-set deployment method differs from the shallow-set by deploying a greater length of mainline per unit distance through the use of a line shooter, resulting in a deeper catenary curve and gear that fishes much deeper in the water column at depths around 250 m. Catch composition differs greatly between the two gear types, as each gear type is fishing in different vertical water strata.

From June 2020 to February 2021, deep-set gear was formally trialed in the U.S. South Atlantic Bight pelagic longline fishery to assess catch rates and assess its potential for bycatch reduction compared to shallow set gear. Over 50 sets of each gear deployment technique, effective fishing depths were recorded with micro-TDRs and catches were monitored with at-sea fisheries observers. Since the early 2000's, regulatory changes have been implemented to the fishery to reduce bycatch and bycatch mortality, such as mandatory circle hook use. Based on known habitat distributions, the deep-set style appears to occupy depths below the frequented depths of bycatch species in the Atlantic. This project was designed to assess the utility of deep-set gear in NW Atlantic for further bycatch reduction.

Methods

- 50 paired shallow- and deep-set longline trips with 7-12 sets per trip conducted in open areas of the South Atlantic Bight NOAA pelagic statistical areas; exact location based on oceanographic/weather conditions and local availability of marketable tuna and swordfish (see Figure 1).
- NOAA-standard data collection protocols (including effective fishing depths using micro-TDRs) collected by PI and graduate student fisheries observers. Involves recording all interactions on hooks, including fish condition characteristics (hooking location, disposition, survival at haulback, size, species, sex).
- Geographic position, SST, water depth, other oceanographic conditions, and gear parameters were recorded (vessel speed, line setter speed, distance between branchlines, length of floatlines and branchlines, bait type, hook type).
- ~30 micro-TDRs (model LAT 1100, ~2 g each; Lotek Wireless, St Johns, Newfoundland) were deployed along the gear per each set at the points of the shallowest hook and the deepest hook.
- Catch rates were converted to catch-per-unit-effort (CPUE) reflecting individuals/1,000 hooks.
- Generalized linear model (GLM) was used to statistically assess difference in the CPUE of target and bycatch species between the two gear types.
- Non-parametric wilcoxon rank sum test used to assess differences in size frequencies between albacore and yellowfin tuna.

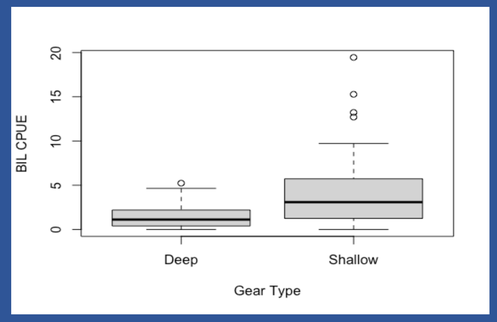

Figure 1. Catch per unit effort (CPUE) of the prohibited billfish for the shallow-set and deep-set pelagic longline gear in the US Atlantic Fishery. The billfish include blue marlin, white marlin, longbill spearfish, roundscale spearfish, sailfish, and juvenile swordfish. CPUE is calculated as total catch per 1000 hooks.

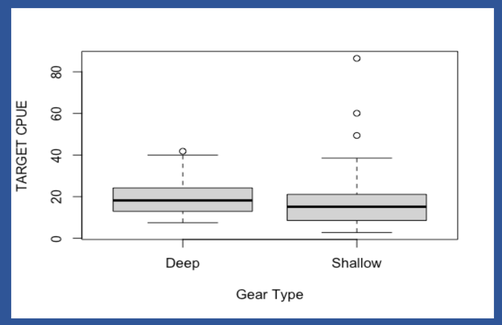

Figure 2. Catch per unit effort (CPUE) of the target species for the shallow-set and deep-set pelagic longline gear in the US Atlantic Fishery. The target species include legal sized albacore tuna, bigeye tuna, yellowfin tuna, and swordfish. CPUE is calculated as total catch per 1000 hooks.

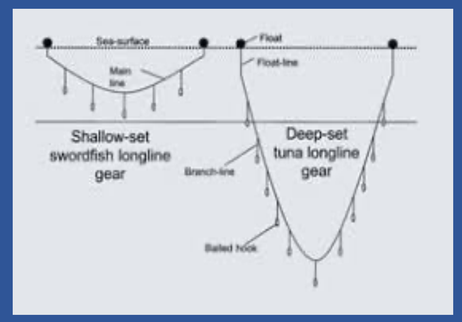

Figure 1. Comparative diagram of shallow-set gear configuration (left) and deep-set gear configuration (right). Use of longer float lines, branch lines, more hooks between floats, and use of a line shooter to deploy more mainline per basket allows deep set gear to achieve significantly deeper depths in a catenary curve shape.

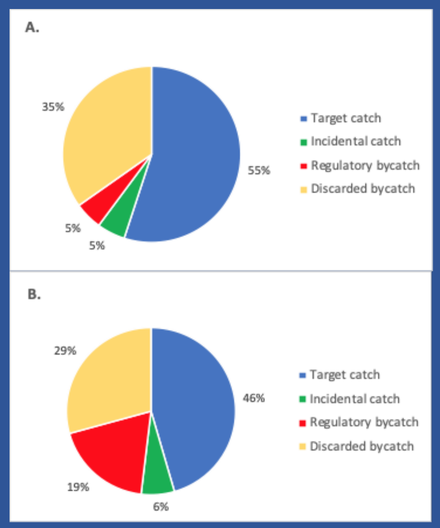

Figure 4. Type of catch for deep-set (A.) and shallow-set (B.) pelagic longline gear categorized by target catch (deep: 2893, shallow: 653), incidental catch (deep: 269, shallow: 91), regulatory bycatch (deep: 267, shallow: 270), and discarded bycatch (deep: 1833, shallow: 420) in the US Atlantic Fishery. Target catch includes legal sized albacore tuna, bigeye tuna, yellowfin tuna, and swordfish. Incidental catch includes wahoo, dolphinfish, bluefin tuna, (large) escolar, opah, and pomfret. Regulatory bycatch includes all prohibited elasmobranch species, billfishes, sea turtles, pilot whales, and undersized swordfish, yellowfin, and bigeye tuna. Discarded bycatch includes all other fish species.

Results

- Months fished: Shallow: 2020- Jun, Jul, Aug, Sep, Oct, Nov; 2021- Jan vs Deep: 2020- Jun, Jul, Sep, Oct, Nov; 2021- Feb
- Total fish caught: Shallow: 1449 vs Deep: 5033
- Total protected species caught: Shallow: 2 sea turtles, 1 pilot whale vs Deep: 1 sea turtle
- The average depth range for deep-set gear is 60.2 ± 8.6 m to 242.2 ± 26.8 m.
- The average depth for shallow-set gear is 45.0 ± 9.2 m.
- There is a significant difference between gear type and combined billfish CPUE ($p = 1.785e-08$).
- There is no significant difference between gear type and total sea turtle CPUE ($p = 0.1955$), marine mammal CPUE ($p = 0.86$), and target CPUE ($p = 0.9469$).
- Size distribution of albacore tuna is significantly different between gear types (p-value = 0.001748). Size distribution of yellowfin tuna is not significantly different between gear types (p-value = 0.3291).

Discussion

- Micro-TDR data demonstrated that deep-set gear covers a wide range of depths considerably deeper and entering the mesopelagic zone, compared to shallow gear which remains in epipelagic waters.
- Deep-set gear was associated with more hooks, causing higher total bycatch, but lower bycatch CPUE. Additionally, deep-set is associated with higher total target catch, but similar target CPUE compared to shallow-set.
- High variability in CPUE values for commercial longline fishing methods between the two longline boats can be attributed to factors such as weather and individual vessel captain decision making. These factors affected the location fished, time of gear soak, and gear drift, the latter of which strongly affected hook depth.
- Deep-set longline gear significantly reduced total billfish bycatch CPUE compared to shallow-set gear without changing target species CPUE.
- Differences in the size distribution of target species, such as albacore tuna, could be related to varying depth utilization of the species, with stratification by size with depth. Similar size distributions in target species, such as with yellowfin tuna, could be associated with a more stable size variance across the fishable depths.

To further gauge bycatch reduction potential and economic feasibility, further trials of this gear type are recommended for additional seasons and geographic regions of the U.S. Atlantic pelagic longline fishery.

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Charles Cichra is inviting you to a scheduled Zoom meeting.

Topic: Bycatch reduction in deep-set pelagic longline

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