North Pacific Fisheries Commission

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Synopsis of Literature Assessing the Impacts of Longline Hooks and Traps on the Seafloor – Contribution from Canada

There have been relatively few studies that directly assess the impacts of longline hooks and traps on the seafloor (Rooper et al. 2017). Most of the research to date has addressed the impacts of mobile fishing gear on the seafloor (e.g. NRC 2002, Barnes and Thomas 2005). Longlined hooks and longlined traps (pots) can interact with VME in several ways. Traps can be dropped directly on top of colonies, or dragged on the bottom during deployment and recovery (Gauthier 2017). Longlines can snag on rocks, and become entangled during recovery, or when hooked fish struggle. Published evidence of interactions between benthic organisms and longline hooks and traps can be found in museum specimens of the precious Corallium coral retrieved by longline fisheries surveys off the Azores in 2005 (Sampaio et al. 2009), and in *Paragorgia arborea* observed wrapped in longlines in the Olympic Coast National Marine Sanctuary (Brancato et al. 2007). Derelict fishing gear has also been observed caught on VME indicator taxa in other areas, such as Southern California (Rooper et al. 2017), the Gulf of Mexico (Etnoyer et al. 2015), Nova Scotia, Canada (Mortensen et al. 2005), the NPFC Convention Area (DuPreez et al. 2020) and in the northeast Atlantic Ocean (Sampaio et al. 2012).

Area contacted by gear deployments

Quantitative estimates of the area impacted by longlines and traps are rare (summarized in Table 1). Although these are fixed gears, deployment and retrieval can result in dragging the gear across the seafloor, which expands the impact (Gauthier 2017). Using expert opinion Canada has previously assumed an impacted width of 100 m for fixed gear in the absence of data (DFO 2018). A quantitative estimate was made in the CCAMLR region using the different components of longline gear by Welsford et al. (2014). They found that on average the width of the footprint for longline gear was 6.2 m, thus the estimate of the footprint could be made by multiplying the length of the longline string by the width estimate (Welsford et al. 2014). Doherty et al. (2018) estimated the mean bottom footprint of a standard sablefish trap (1.5 m^2 base) of 53 m^2 on seamounts in Canada. The typical commercial sablefish gear deployment would consist of 60 traps per longline set, which meant a total footprint of 3200 m^2 (CI = 2400-3900 m^2). Stone et al. (2006) estimated the width of furrows dug by large crab pots (5 m^2 pots) as ranging from 2 m and 9 m in width. Stone et al. (2006) also estimated that 5% of the study area in the Aleutian Islands had been impacted by longline gear. On Cobb seamount in the NPFC Convention Area, DuPreez et al. (2020) estimated that between

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0.8% and 33.8% of the seamount area to 1200 m depth had been utilized by sablefish fishing gear since 1996. The seafloor contact was not uniform across depths.

Removal of VME-type organisms

There have been a few studies that estimated the removal rates of VME by longline hooks and traps. Shester and Michelli (2011) found that VME bycatch comprised 0.49 kg/$1000 of catch in traps in Mexico. In Alaska longline surveys, on average 2-4 individual VME organisms are removed for each longline set (Rooper et al. 2017). Bycatch in the Alaska longline hook fishery during 2003 and 2005 was 20 mt of VME indicator taxa, while in the pot fisheries only 1 mt of sponge and a negligible amount of coral were removed (NMFS 2011). Edinger et al. (2007) found that the frequency of occurrence of corals in longline sets was 13% and the frequency of occurrence of corals in crab pots was 0%. Pham et al. (2014) found that removal rates were 0.011% for low complexity corals, while for higher complexity corals the rate of removal was 0.058% of the corals on the seafloor. This was about 4 orders of magnitude less than the estimates for trawl removals. From 1992 to the present, few of landings of VME indicator taxa (19 records of corals and 16 records of sponges in 3411 sets) have been recorded during sablefish trap fishing at seamounts in the eastern NPFC Convention Area.

Damage to VME-type organisms

The estimates of the structural damage to VME indicator taxa not retained in the catch is variable for longline hooks and traps. Published quantitative estimates include damage to 17% of the VME indicator taxa within 1 m of traps (Shester and Michelli 2011) and 20% of the VME indicator taxa near longlines (Pham et al. 2014). A study looking at damage rates in areas of the central Aleutian Islands that were only fished with fixed gear (pots and longlines) found damage rates to be higher (15%), but not significantly higher than damage rates in unfished areas (4%) due to the large variability in observed damage rates at transects (Heifetz et al. 2009). There are no estimates of the percentage of VME indicator taxa damaged by longline hook or trap gear in the eastern NPFC Convention Area.

Calculation of area contacted by gear in the eastern NPFC Convention Area

Calculation of the seafloor contacted by longline hooks and traps at eastern NPFC Convention Area seamounts can be estimated using the literature described above and the best available data on fishing locations (based on fishing set start and end positions) from sablefish fishing activity since 1992. Seamounts were considered in the area of interest for the eastern NPFC Convention Area shown in Figure 1. Bathymetry from GEBCO was downloaded for the region and used to identify

the total seamount area less than 1500 m depth (in 100 m intervals). The beginning and ending positions of fishing sets were transformed into lines. Each line was buffered by the estimated width of the contact. For longline hooks this width was 6.2 m based on Welsford (2014). For longline traps, the number of traps was multiplied by 53 m^2 based on Doherty et al. (2018). The pots were assumed to be placed equidistance along the set length to estimate the area contacted. Where the number of traps was not known, an average value (59.8) was used.

To estimate the area contacted, the buffered lines were intersected with a 20 by 20 m raster grid. The number of intersected grid cells was then divided by the total number of grid cells to estimate the percentage of seamount area contacted by gear. Overall, 4.5% of the total seamount area in the eastern portion of the NPFC Convention Area has been contacted by fishing gear. The proportion of area contacted is greater at mid-depths (400-800 m) reflecting the depth distribution of sablefish fishing and the more limited seamount area at these depths. Considering only Cobb Seamount (the most heavily fished seamount in recent times), 12.4% of the total seamount area above 1500 m has been contacted by fishing gear (Figure 2).

Conclusions relative to the eastern NPFC Convention Area

An estimated 4.5% of the seamount area in the eastern NPFC Convention Area has likely been contacted by longline hook and longline trap gear. This contact has been more concentrated at depths of 400-800 m.

This estimate only accounts for impacts since 1990 and historical fishing effort is mostly unknown, but likely higher on some seamounts. There are historical records of 4 bottom trawl hauls at Warwick and Eickelberg Seamounts in 1988 (2) and 1992 (2) and 12 bottom trawl hauls at Cobb Seamount in 1980 (8), 1988 (1), 1991 (2) and 1993 (1), so historical fishing also included mobile fishing gears, such as bottom trawls (Curtis et al. 2015).

Based on data collected in other areas, it is likely that 17-45% of the VME indicator taxa inside the footprint have been structurally damaged or killed after a single interaction with longline and trap gear depending on their complexity. It may be likely that 100% of the VME indicator taxa are structurally damaged or killed after just a couple of interactions with longline and trap gear (Welsford et al. 2014).

Based on bycatch data from the sablefish fishery, it is unlikely that longline hooks or traps remove large amounts of VME indicator taxa.

Table 1. List of studies that quantified the impacts of longline hook and longline trap gear on the seafloor.

Gear	Study area	Description of impacts	Area impacted	Bycatch rate	Damage rates	Reference
Traps and gillnets	Gulf of Mexico (< 25 m)	Removal of VME by gillnets, damage of VME near gears.	Within 1 m of the gillnets, area of the trap for traps.	0.5 kg of VME/$1000 of revenue, 0% of total catch was VME for traps (~20% for gillnets)	17% within 1 m of longline	Shester and Micheli 2011
Longlines	Global	Removal of VME		0.011-.0058%	20% of nearby VME	Pham et al. 2014
Longlines and pots	Aleutian Islands	Broken or damaged branches, tearing, etc.			15% (background level = 4%)	Heifetz et al. 2009
Longlines and pots	NW Atlantic	Occurrence of VME as bycatch		13% (longlines) and 0% (pots) frequency of occurrence in sets		Edinger et al. 2007
Longlines and crab pots	Aleutian Islands		5% of total area (longlines), furrows of 2-9 m (pots)			Stone 2006
Longlines	Antarctic		10 m wide footprint		9-45% (combined damaged and killed depending	Welsford et al. 2014

					on the taxa)	
Sablefish traps	Canadian seamounts		Seafloor footprint = 3200 m^2 per set			Doherty et al. 2018
Sablefish longlines and traps	Cobb Seamount		Seafloor footprint = 3994 – 291,500 m^2			DuPreez et al. 2020

Figures

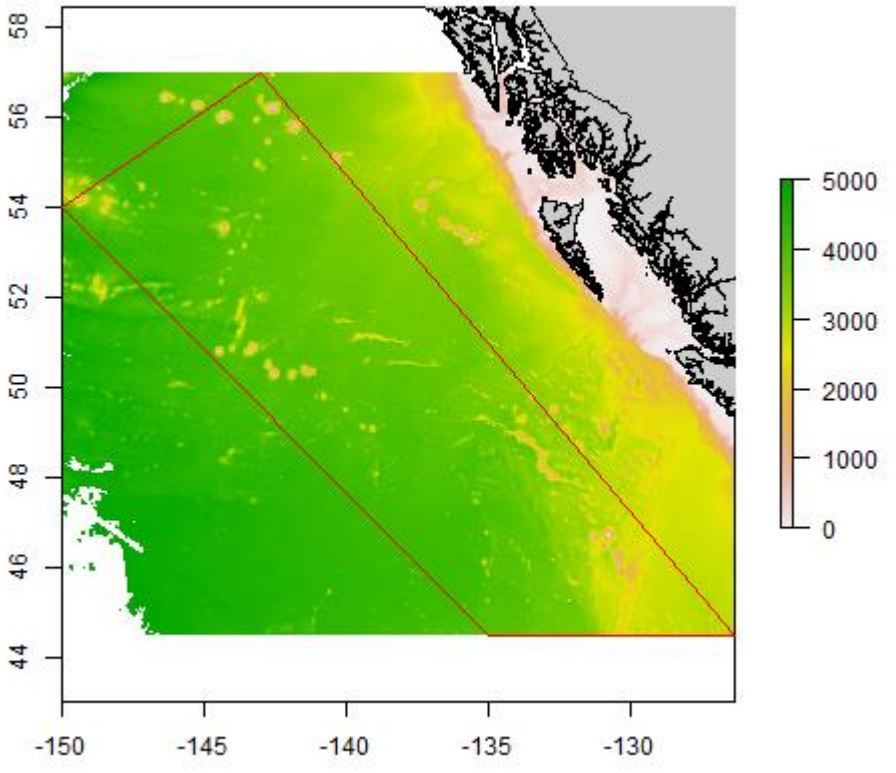

Figure 1. Map of North Pacific Fisheries Commission eastern Convention Area showing seamount area (in red) and the seamounts (black dots) considered in the calculation of the area contacted by fishing gear.

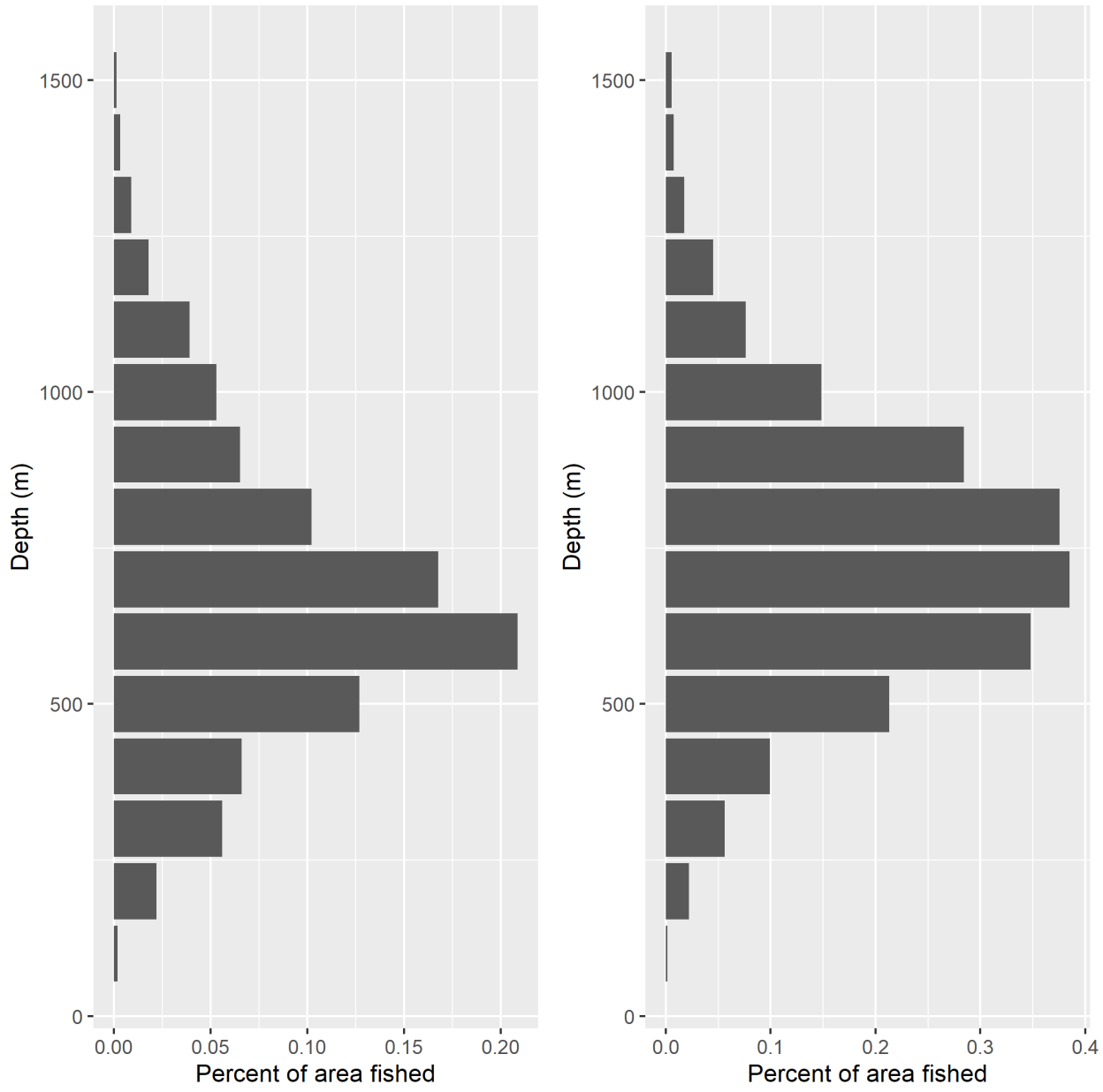

Figure 2. Estimated percentage of seamount area by depth contacted by fishing gear in the North Pacific Fisheries Commission eastern Convention Area (left panel) and on Cobb Seamount (right panel)

References

Barnes PW, Thomas JP. 2005. Benthic Habitats and the Effects of Fishing. American Fisheries Society Symposium 41. 890 pages.

Brancato MS, Bowlby E, Hyland J, Intelmann SS, Brenkman K (2007) Observations of Deep Coral and Sponge Assemblages in Olympic Coast National Marine Sanctuary, Washington. Cruise Report: NOAA Ship McArthur II Cruise AR06-06/07. Mar Sanctuaries Conserv Ser. U.S.

Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD

Curtis JMR, Du Preez C, Davies SC, Pegg J, Clarke ME, Fruh EL, Morgan K, Gauthier S, Gatien G, Carolsfeld W. 2015. 2012 Expedition to Cobb Seamount: Survey methods, data collection, and species observations. Can Tech Rep Fish Aquat Sci 3124. xiii:145.

DFO, (2018). Framework to Support Decisions on Authorizing Scientific Surveys with Bottom Contacting Gears in Protected Areas with Defined Benthic Conservation Objectives. Can. Sci. Adv. Sec. Sci. Res. 043. Available at: https:// waves-vagues.dfo-mpo.gc.ca/Library/40726277.pdf.

Doherty B, Johnson SDN, Cox SP (2018) Using autonomous video to estimate the bottom-contact area of longline trap gear and presence–absence of sensitive benthic habitat. Can. J. Fish. Aquat. Sci. 75: 797–812 dx.doi.org/10.1139/cjfas-2016-0483

Du Preez C, Swan KD, Curtis JMR (2020) Cold-Water Corals and Other Vulnerable Biological Structures on a North Pacific Seamount After Half a Century of Fishing. Front. Mar. Sci. 7:17. doi: 10.3389/fmars.2020.00017

Edinger E., Baker K., Devillers R., Wareham V. Canada: World Wildlife Fund; 2007a. Deepwater Corals Off Newfoundland and Labrador: Distribution and Fisheries Impacts; p. 49.

Etnoyer PJ, Wickes LN, Silva M, Dubick JD, Balthis L, Salgado EJ, MacDonald IR (2015) Decline in condition of gorgonian octocorals on mesophotic reefs in the northern Gulf of Mexico: before and after the Deepwater Horizon oil spill. Coral Reefs:1-14

Gauthier M. 2017. Trap camera videos from SGaan Kinghlas – Bowie Seamount: Overview of data obtained during sablefish bottom longline trap fishing in 2016. Canadian Data Report of Fisheries and Aquatic Sciences 1279. iii + 18 p.

Heifetz J, Stone RP, Shotwell SK (2009) Damage and disturbance to coral and sponge habitat of the Aleutian Archipelago. Mar Ecol Prog Ser 397:295-303

Mortensen PB, Buhl-Mortensen L, Gordon DCJ, Fader GBJ, MacKeown DM, Fenton DG (2005) Effects of fisheries on deepwater gorgonian corals in the Northeast Channel, Nova Scotia. Am Fish Soc Symp, Book 41

National Marine Fisheries Service (NMFS) (2011) U.S. National Bycatch Report. In: Karp WA, Desfosse LL, Brooke SG (eds) NOAA Tech Memo. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-F/SPO-117C,
508pp,www.nmfs.noaa.gov/by_catch/National_Bycatch_Report/2011/2011_National_Bycatch_Report.pdf

National Research Council (NRC) (2002) Effects of Trawling and Dredging on Seafloor Habitat. National Academy Press, Washington D.C.

Rooper CN, Boldt JL, Zimmermann M (2007) An assessment of juvenile Pacific Ocean perch (Sebastes alutus) habitat use in a deepwater nursery. Estuarine, Coastal and Shelf Science 75:371-380

Rooper CN, Etnoyer PJ, Stierhoff KL, Olson JV (2017) Effects of Fishing Gear on Deep-Sea Corals and Sponges in U.S. Waters. In: Hourigan TF, Etnoyer, PJ, Cairns, SD (eds.). The State of Deep-Sea Coral and Sponge Ecosystems of the United States. NOAA Technical Memorandum NMFS-OHC-4, Silver Spring, MD. 36 p. Available online: http://deepseacoraldata.noaa.gov/library.

Sampaio Í, Braga-Henriques A, Pham C, Ocaña O, de Matos V, Morato T, Porteiro FM (2012) Cold-water corals landed by bottom longline fisheries in the Azores (north-eastern Atlantic). J Mar Biol Assoc Uk 92:1547-1555

Shester GG, Micheli F (2011) Conservation challenges for small-scale fisheries: Bycatch and habitat impacts of traps and gillnets. Biol Cons 144:1673-1681

Bradley G Stevens, The ups and downs of traps: environmental impacts, entanglement, mitigation, and the future of trap fishing for crustaceans and fish, ICES Journal of Marine Science, Volume 78, Issue 2, March 2021, Pages 584–596, https://doi.org/10.1093/icesjms/fsaa135

Stone, R. (2006). Coral habitat in the Aleutian Islands of Alaska: depth distribution, fine-scale species associations, and fisheries interactions. Coral Reefs 25, 229–238. doi: 10.1007/s00338-006-0091-z

Welsford DC, Ewing GP, Constable AJ, Hibberd T, Kilpatrick R. 2014. Demersal fishing interactions with marine benthos in the Australian EEZ of the Southern Ocean: An assessment of the vulnerability of benthic habitats to impact by demersal gears. The Department of the Environment, Australian Antarctic Division and the Fisheries Research and Development Corporation.