Northwest Atlantic Fisheries Organization

Serial No. N6835 **NAFO SCS Doc. 18/044**

SCIENTIFIC COUNCIL MEETING - JUNE 2018

Bycatch of Greenland Shark (*Somniosus microcephalus)* from inshore exploratory fisheries adjacent to NAFO Division 0

by
L. Wheeland[1] and B. Devine[2]

[1] Fisheries and Oceans Canada
P.O. Box 5667 St. John's, NL, Canada A1C 5X1
[2] Centre for Fisheries Ecosystems Research
Fisheries and Marine Institute of Memorial University of Newfoundland
155 Ridge Road, St. John's, NL A1C 5R3, Canada.

Abstract

Greenland shark (*Somniosus microcephalus*) bycatch was examined in exploratory fisheries occurring in coastal waters of the Canadian Arctic Archipelago, adjacent to NAFO Subarea 0. Greenland sharks were caught during longline fishing sets targeting Greenland Halibut. No entanglements were observed in gear targeting shrimp and whelk (traps and pots). Greenland shark bycatch rates from longlines varied throughout the area studied, but suggest high abundance in waters adjacent to the NAFO Convention Area, and potential for increasing bycatch with northward expansion of commercial fisheries.

Introduction

There is increasing interest in expanding commercial and subsistence fisheries in Canada's North, with the fishing industry representing a growing proportion of the economy of Nunavut. Currently, commercial fisheries operate throughout NAFO Subarea 0, targeting Greenland halibut and shrimp resources. Inshore fisheries development in waters adjacent to the NAFO Convention Area in this region is notably reduced relative to this offshore industry. Changing ocean conditions are also expected to contribute to the expansion of fishing efforts as water temperatures and salinities shift, and changing ice conditions result in increased vessel access. Bycatch of Greenland shark has been reported previously from inshore commercial Greenland halibut fisheries in Cumberland Sound, with up to 220 Greenland shark being reported from a single year (1987-2006) in this fishery (DFO 2008). Increasing fishing effort in the North leads to higher potential for bycatch conflicts with Greenland shark.

Methods

Exploratory fishing targeting Greenland halibut, whelk and shrimp took place in the late summer to early fall of 2014-2016 in coastal waters of the Qikiqtaaluk (Baffin) Region of Nunavut, Canada. These exploratory fisheries were being undertaken by the Arctic Fishery Alliance, aboard the 99-foot commercial fishing vessel *Kiviuq I.* Fishing efforts were concentrated around the communities of Grise Fiord (Aussuittuq; fishing in the waters of Jones Sound and adjacent fjords), Qikiqtarjuaq, Arctic Bay (Ikpiarjuk; waters of Admiralty Inlet), and Resolute (Qausuittuq; Barrow Strait and adjacent waters) (Figure 1). Fishing was completed with a combination of longlines, shrimp traps and whelk pots. Commercial squid bait was used in all cases.

No Greenland shark bycatch or entanglements were observed with the shrimp traps or whelk pots.

Temperature loggers were attached to fishing gear in order to record bottom temperatures. The amount of longline gear and size of hooks used varied between areas and years, and is outlined in Table 1. Soak times were targeted to be as near to 24 hours as feasible, but varied with weather conditions and other survey and/or fishery requirements, ranging from 14-42 hours (mean = 26 hours).

Greenland sharks were caught both on hooks and entangled in the groundline (mainline) and buoy lines. Sharks were not brought onboard; individuals were released from the gear at the side of the vessel. Condition upon release was assessed and generally indicated post-capture survival. Estimates of post-release survival are unavailable. Qualitative assessments indicated poorest body condition when individuals were entangled around the gills. For each shark caught on the longlines, sex was recorded based on an examination of external morphological characteristics, and a visual estimation of length was made. Length estimations were completed in intervals of 0.5m, and should be considered a qualitative estimate of size. In some cases, these characteristics could not be assessed (e.g. shark fell off the hook before observation).

Results

Catch

In total, 120 Greenland sharks were caught in longline fishing efforts during these exploratory fisheries (Tables 1, 2). In five instances, only the head or the tail of the shark was present when the gear was hauled, suggesting the occurrence of post-capture cannibalism as Greenland sharks are known to depredate entangled conspecifics (Idrobo & Berkes, 2012). Greenland shark was the most commonly caught species in longline fishing in the Admiralty Inlet area, and second only to Arctic skate (*Amblyraja hyperborea)* in Jones Sound. No sharks were caught in Qikiqtarjuaq or Resolute, however only one fishing set occurred in each of these locations, so this is not considered to indicate an absence of sharks in these areas.

Of sharks for which sex could be determined (N=86), 23% were male, 78% were female (Jones Sound: 12% male, 88% female; Arctic Bay: 45% male, 55% female). Length estimates ranged from 2 to 4m, with the mode of female sharks (3-3.49m) larger than that of males (2.5-2.99m) (Figure 2).

To account for differences in soak times between sets, catch per unit effort (CPUE) was calculated as the number of Greenland sharks caught per one thousand hook-hours. CPUE was highest in Admiralty Inlet, followed by Jones Sound in 2014 and 2016 (Figure 3). Catches were highest at greater depths, with the largest catches occurring at greater than 600m (Figure 4). None were caught shallower than 200m (2 sets; bottom temperatures were sub-zero in each). Relative differences in

CPUE between areas and across depths and temperatures are consistent with relative abundance and observation rates from baited camera footage from these areas (see Devine et al. 2018).

Occular parasites

Greenland shark are often parasitized by the ocular copepod parasite *Ommatokoita elongata.* Presence/absence of this parasite was recorded for all sharks caught in Arctic Bay, when possible. Of 26 sharks where parasite presence could be assessed, 24 (92%) contained a parasite in at least one eye. This high level of parasitism is consistent with previous reports from east Greenland waters (99%; Berland 1961).

Conclusions

Greenland shark were found to be ubiquitous throughout the studied area, suggesting an importance of inshore waters adjacent to the NAFO Subarea 0 to this species in the summer. Geographic and depth distributions of Greenland sharks, and the range of CPUEs recorded here, indicate the potential for conflict as fisheries further expand northward.

References

Berland, B., 1961. Copepod *Ommatokoita elongata* (Grant) in the eyes of the Greenland shark - a possible cause of mutual dependence. Nature, 191 (4790): 829–830

Devine, B.M., L.J. Wheeland and J.A.D. Fisher. 2018. First estimates of Greenland shark (*Somniosus mirocephalus*) local abundances in Arctic waters. Scientific Reports, 8:974

DFO 2008. Cumberland Sound Greenland Halibut (Turbot) Inshore Fishery. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/040

Idrobo, C.J., Berkes, F. 2012. Pangnirtung Inuit and the Greenland Shark: Co-producing Knowledge of a Little Discussed Species. *Human Ecol*. 40, 405–414.

Table 1 Summary of Greenland shark bycatch from longlines by location and year

Location	Year	Sets	Hook size(s)	Hooks per set	# of Greenland shark
Jones Sound	2014	21	12, 14, 16	1250	73
Qikiqtarjuaq	2014	1	12, 14, 16	2500	0
Admiralty Inlet	2015	5	12, 14, 16	250	42
Resolute	2015	1	12, 14, 16	250	0
Jones Sound	2016	3	14	375	5

Table 2 Details of exploratory longline fishing sets, 2014-2016. CPUE is measures in the number of sharks per thousand hook hours.

Date Set	Site	Latitude (N)	Longitude (W)	Mean Depth (m)	Soak time (hrs)	Bottom Temp (°C)	Number of Greenland shark	'000 hook hours	CPUE
09-Sep-14	Jones Sound	76.06	86.76	630	34.8	NA	8	43.4	0.18
09-Sep-14	Jones Sound	76.01	86.45	429	28.0	NA	8	35.0	0.23
10-Sep-14	Jones Sound	76.00	87.01	503	39.0	0.18	1	48.8	0.02
10-Sep-14	Jones Sound	75.92	87.13	347	22.1	0.14	5	27.6	0.18
11-Sep-14	Jones Sound	75.95	86.72	601	13.8	0.18	2	17.3	0.12
12-Sep-14	Jones Sound	75.94	86.25	676	25.3	0.18	2	31.6	0.06
12-Sep-14	Jones Sound	76.06	86.23	579	39.9	0.14	2	49.9	0.04
13-Sep-14	Jones Sound	76.22	86.38	568	19.6	0.18	10	24.5	0.41
14-Sep-14	Jones Sound	76.21	85.62	86	17.8	-0.93	0	22.3	0.00
14-Sep-14	Jones Sound	76.13	85.49	764	41.2	0.22	6	51.5	0.12
15-Sep-14	Jones Sound	76.05	85.43	678	31.7	0.20	6	39.6	0.15
16-Sep-14	Jones Sound	75.85	85.04	617	19.5	0.18	1	24.4	0.04
16-Sep-14	Jones Sound	76.00	85.04	671	20.3	0.16	1	25.4	0.04
17-Sep-14	Jones Sound	75.94	84.53	629	23.9	0.18	0	29.9	0.00
18-Sep-14	Jones Sound	76.06	84.29	722	22.2	0.18	3	27.7	0.11
18-Sep-14	Jones Sound	76.05	83.89	689	39.9	0.25	4	49.9	0.08
19-Sep-14	Jones Sound	76.12	83.10	835	24.2	0.31	2	30.2	0.07
20-Sep-14	Jones Sound	76.26	83.30	623	22.9	0.22	2	28.7	0.07
20-Sep-14	Jones Sound	76.33	83.01	630	23.0	0.22	5	28.8	0.17
21-Sep-14	Jones Sound	76.42	83.04	314	16.0	0.07	3	20.0	0.15
21-Sep-14	Jones Sound	76.46	83.20	359	20.4	0.06	2	25.5	0.08
15-Oct-14	Qikiqtarjuaq	67.67	63.50	582	24.5	0.75	0	61.3	0.00
13-Aug-15	Admiralty Inlet	73.00	85.39	354	21.3	0.02	1	15.9	0.06
14-Aug-15	Admiralty Inlet	73.00	85.89	673	14.2	0.33	2	10.6	0.19
15-Aug-15	Admiralty Inlet	73.11	85.93	797	26.9	0.35	9	20.2	0.45
16-Aug-15	Admiralty Inlet	73.06	86.12	607	41.5	0.26	12	31.1	0.39
17-Aug-15	Admiralty Inlet	73.05	85.92	696	38.7	0.31	18	29.0	0.62
06-Aug-16	Jones Sound	76.11	83.16	787	25.3	NA	0	9.5	0.00
03-Aug-16	Jones Sound	76.13	82.00	731	29.3	0.28	1	11.0	0.09
04-Aug-16	Jones Sound	76.07	81.57	818	21.3	0.18	4	8.0	0.50
05-Sep-15	Resolute	74.43	95.36	178	15.8	-1.11	0	11.9	0.00

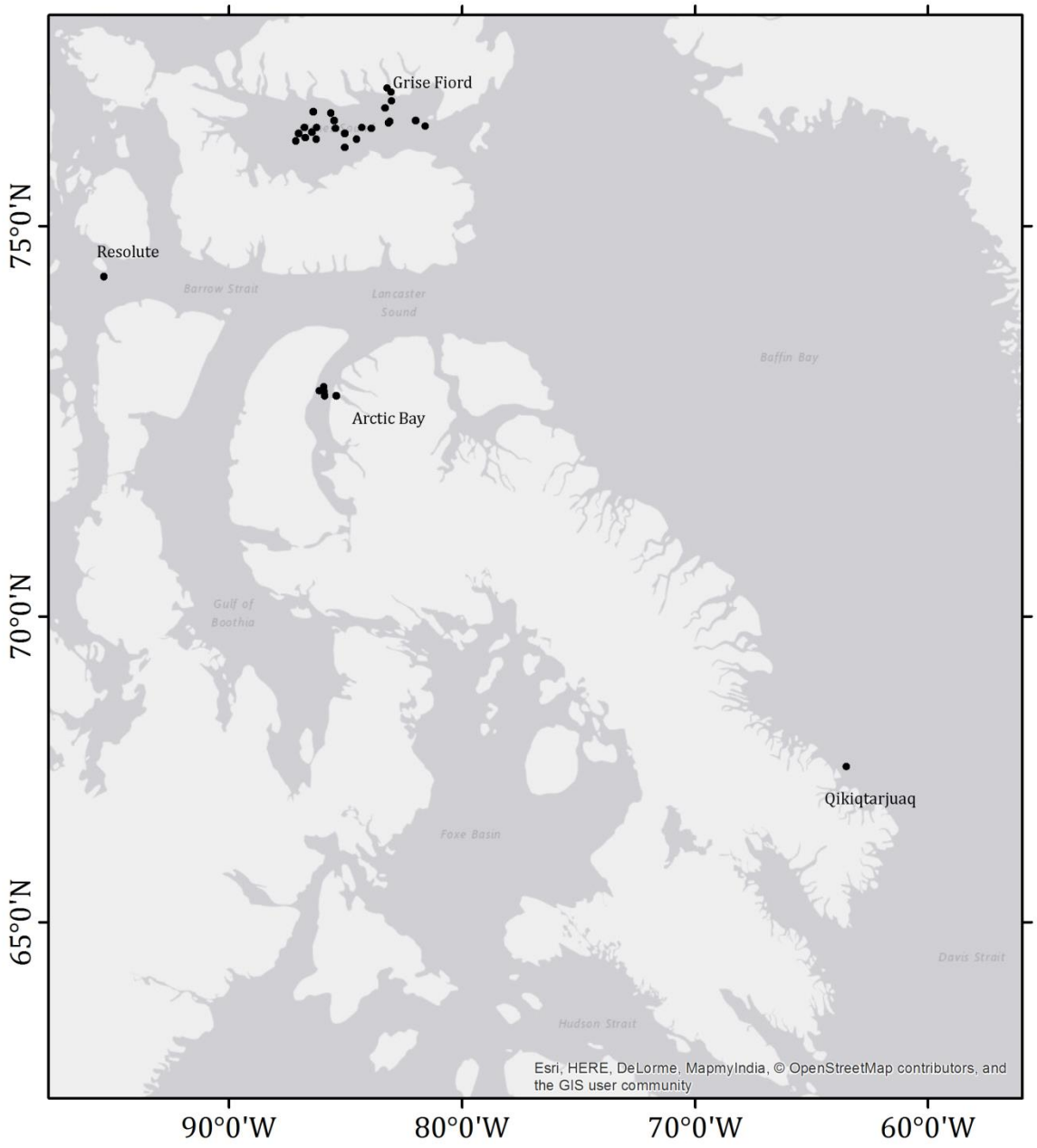

Fig. 1. Locations of fishing sets in the waters adjacent to the communities of Grise Fiord (Jones Sound), Resolute (Barrow Strait), Arctic Bay (Admiralty Inlet), and Qikiqtarjuaq

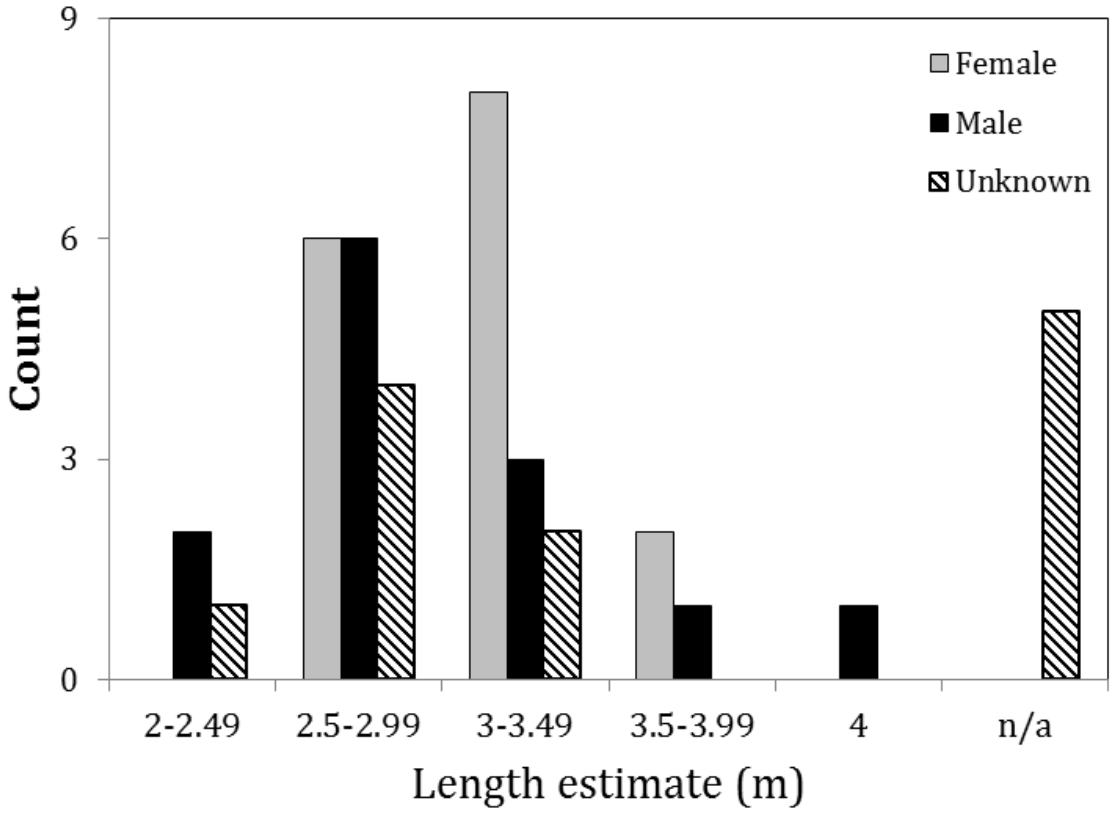

Fig. 2. Length estimates, by sex, of Greenland Sharks caught. Lengths were recorded based on visual estimation, by half-meter intervals, and should therefore be considered as a qualitative record of shark size.

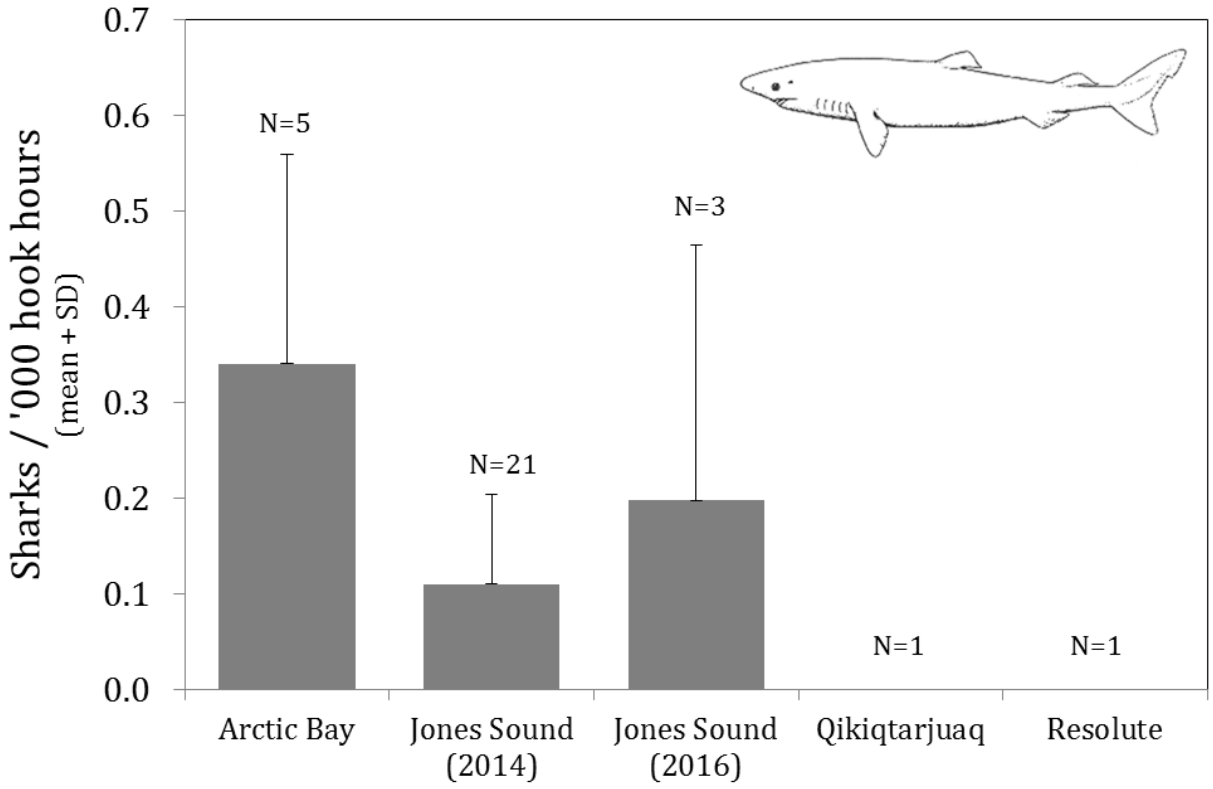

Fig. 3. Catch per unit effort (CPUE; mean + SD) by thousand hook-hour from longline fishing sets by location and year. N values indicate the number of fishing sets that occurred.

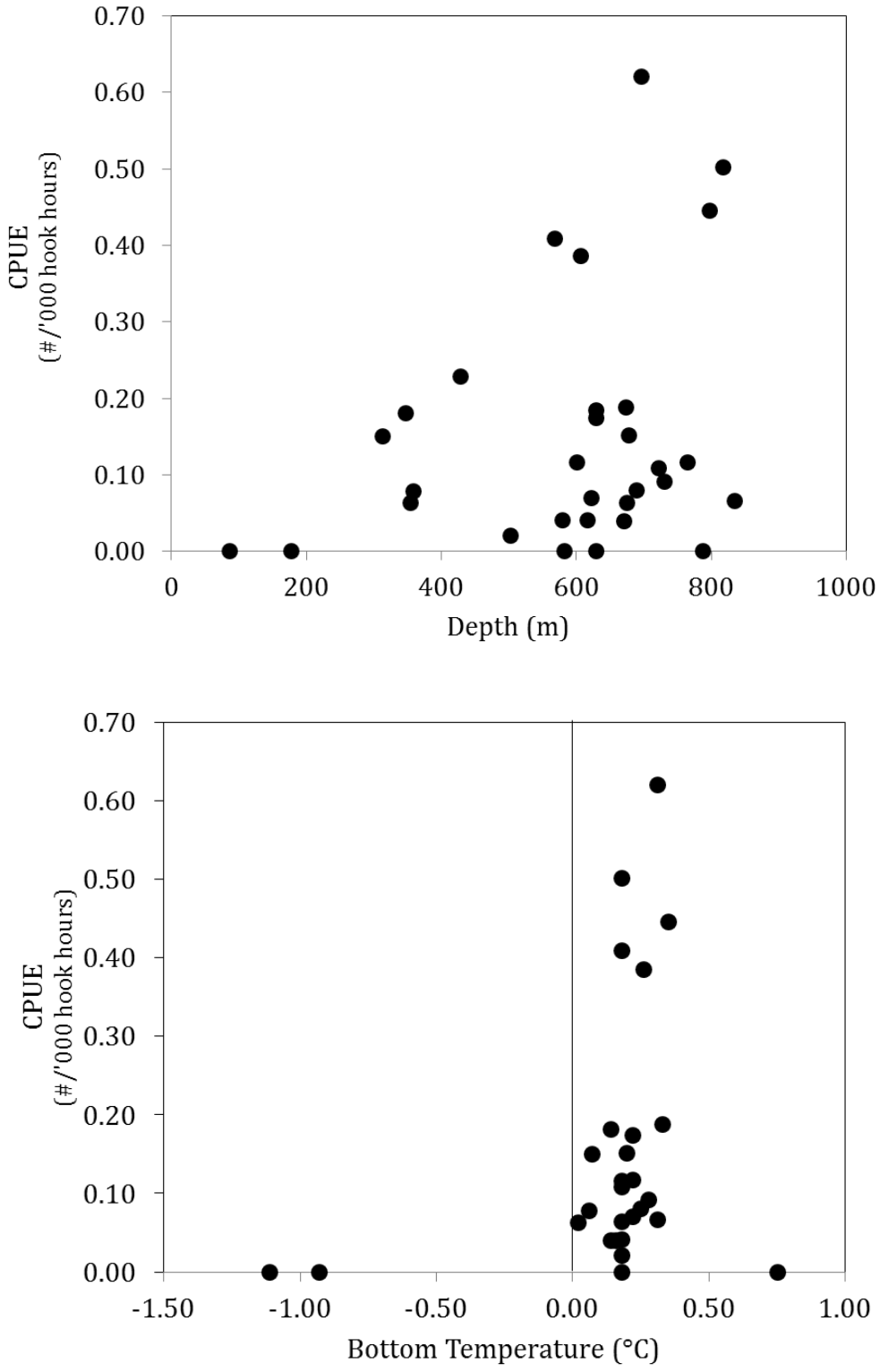

Fig. 4. Greenland shark bycatch CPUE by fished depth (top) and bottom temperature (bottom)