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(Tuna and Tuna-like Fisheries in the
North Pacific Ocean)

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SUMMARY

Canada has one fishery for highly migratory species in the Pacific Ocean, a troll fishery targeting juvenile north Pacific Albacore Tuna (*Thunnus alalunga*). Category I, II, and III data from the 2020 fishing season are summarized in this report. The Canadian fleet consisted of 103 vessels and operated exclusively within the eastern Pacific Ocean, in 2020. The Canadian troll fishery continues to be largely coastal in its operations, occurring predominantly within the Canadian and United States exclusive economic zones (EEZ). Only a small proportion of catch and effort occurred outside the Canadian and US EEZs, in 2020. Provisional 2020 estimates of catch and effort are 2,356 metric tonnes (t) and 3,266 vessel-days, respectively, which represent a 1.9% decrease in catch and 15.9% decrease in effort relative to 2019. However, catch and effort increased in Canadian waters, and decreased substantially in US waters. Proportion of catch and effort in Canadian waters increased to 71.3% and 76.7% from 51.7% and 51.7% in 2019, respectively. Proportion of catch and effort in US waters decreased to 19.8% and 17.6% from 44.9% and 41.8% in 2019, respectively. The remaining catch and effort occurred in adjacent high seas waters. Catch rate (CPUE) was higher by 16.6% in 2020 relative to 2019. Percentage of Albacore caught in favourable water temperature band of 16-19 °C was 91% in 2020, higher than in 2019 (73%) and similar to 2018 (93%). Thirty-four (34) vessels measured 8,982 fork lengths in 2020 for a sampling rate of 2.4% of the reported catch. Fork lengths ranged from 51 to 88 cm, having a dominated mode around 67 cm. Mean length was 69.1 cm, which is considerably larger than the mean length of 66.1 cm in 2019.

1.0 INTRODUCTION

The Canadian fishery for highly migratory species uses troll gear with jigs to target juvenile north Pacific Albacore (*Thunnus alalunga*) in the surface waters of the Pacific Ocean. The majority of catch and effort by the Canadian fleet occurs within the exclusive economic zones (EEZ) of Canada and the United States. Access to the United States EEZ is permitted through a bilateral Treaty, which provides for access by Canadian-flagged and licensed vessels to fish for Albacore and to land Albacore at designated ports. Some of the larger Canadian vessels may follow Albacore into offshore waters and occasionally fish in the central and western Pacific Ocean. The most recent management regulations for Canadian vessels fishing Albacore Tuna cover one year period from 01 April 2021 to 31 March 2022 are documented in the Albacore Tuna Integrated Fisheries Management Plan (IFMP) https://waves-vagues.dfo-mpo.gc.ca/Library/40948171.pdf. Historically, most of the Canadian effort and catch for north Pacific Albacore has occurred between early July and October.

This report summarizes Category I (annual catch and effort), Category II (monthly 1° x 1° catch and effort), and Category III (bycatch, catch size composition) data for vessels active in the Canadian north Pacific Albacore Tuna troll fishery in 2020.

2.0 DATA SOURCES

Data on Albacore Tuna catch and effort from 1995 through to the present are compiled from hail records, logbooks, and sales slips and stored in the Canadian Albacore Tuna Catch and Effort Relational Database (Stocker et al. 2007). This database contains the best available estimates of annual catch and effort by geographic zone (Canadian, US, and high seas waters) for the Canadian fishery. All Canadian fishing vessels are required to hail (call) a third party service provider when they intend to start fishing and stop fishing, and when they change fishing zones. Canadian vessels must also carry logbooks in which daily position, catch and effort (latitude, longitude, number of fish, estimated weight) are recorded for Albacore Tuna and non-target species. These data have the highest temporal and spatial resolution and are obtained when logbooks are returned in November after the fishing season is completed. The third data source, sales slips, record the weight of Albacore Tuna landed and bought by domestic buyers and provide the most accurate estimates of Albacore Tuna catch in weight since these data are the basis for payment to harvesters (Stocker et al. 2007). Logbooks and sales slips from domestic buyers (plus trans-shipment slips if applicable) are forwarded for entry into the Albacore Tuna catch database (Stocker et al. 2007).

Fork length data are collected through an on-board sampling program initiated in 2009, with a sampling goal of 1% of the reported catch. Harvesters record the lengths of the first 10 Albacore landed daily to randomize measurements. Size composition data were collected by port samplers from a portion of the Canadian catch landed in United States ports between 1981 and 2008. Size data reported by Canada since 2009 are from the domestic on-board sampling program only.

The fishery data provided in this report were taken from Canadian tuna database version 20.12.31. Figures up to and including 2019 are considered definitive and are derived from a reconciliation of logbook data (best estimates of effort, catch in pieces, and geographic location)

and sales slip (best estimate of catch weight) data (Stocker et al. 2007). The 2020 data are preliminary at this time.

3.0 AGGREGATED CATCH AND EFFORT DATA

3.1 Catch

The preliminary estimate of the Canadian Albacore Tuna catch in 2020 is 2,356 metric tons (t), which is a 1.9% decrease relative to the catch in 2019 (Table 1; Figure 1). The total catch by the Canadian troll fishery has ranged from 1,761 t in 1995 to 7,857 t in 2004 and averaged 4,633 ± 1,792 t (± sd) since 2003, the period when annual logbook coverage has exceeded 90% of all vessels participating in this fishery. The 2020 catch was achieved primarily in Canadian coastal waters (71.3%) and US coastal waters (19.8%). Catch in the Canadian EEZ increased by 35.4% and decreased by 56.8% in the US EEZ, compared to 2019. The remaining small proportion of the catch was from adjacent high seas waters (8.9%). No Canadian Albacore-fishing vessels entered the north Pacific WCPFC convention area, in 2020. Canadian vessels which fished the US EEZ dropped from Forty-two (42) in 2019 to Thirty-four (34) in 2020.

The number of Albacore released in 2020 was 668 fish, 83.7% less then was reported in 2019 (Table 2). The estimated mean weight of released Albacore was 3.12 kg in 2020, similar to the mean weight of 3.16 kg in 2019. Albacore are released because they are below the minimum marketable size. The weight of released fish is not accounted for in Table 1, which records retained catch only.

3.2 Effort

The Canadian 2020 Albacore Tuna troll fleet consisted of 103 unique vessels, substantially below the average participation of 162 vessels since 2003 (Table 1). The 2020 estimate of fishing effort is 3,266 vessel-days (v-d) and is a 15.9% decrease relative to the fishing effort in 2019 (Table 1; Figure 1). The 2020 fishing effort is the lowest since 1995, while the highest fishing effort of 10,021 v-d occurred in 2001. Fishing effort in 2020 occurred largely in Canadian coastal waters (76.7%) and US coastal waters (17.6%). Effort increased by 48.4% in the Canadian EEZ, and decreased by 57.9% in the US EEZ relative to 2019. A small proportion of effort was used in adjacent high seas waters (5.7%) in 2020.

3.2 Catch Rate

Catch rate is expressed as catch per unit effort (CPUE), namely amount of catch in metric ton per vessel day. CPUE in 2020 was higher than in 2019 (Figure 1). CPUE has been increasing since 2017 when the CPUE dropped to the lowest level in the existing record, in the Canadian EEZ. CPUE has also been higher for the past three years relative to 2017, in the US EEZ. The CPUE in the Canadian EEZ was lower by 18% relative to the CPUE in the US EEZ, in 2020. The peak of the catch rates occurred in August of 2020 (Figure 2). One noticeable change is that CPUE increased to 1.1 t/v-d in the adjacent high seas in 2020, a 2.5 times rise relative to 2019.

4.0 SPATIAL DISTRIBUTION OF CATCH AND EFFORT DATA

The Canadian troll fleet operated primarily in the Canadian and US EEZs, where over 90% of the 2020 fishing effort and catch occurred. Catch increased in adjacent high seas waters, although fishing effort decreased there, in 2020.

In June, a small amount of effort and catch occurred in the US EEZ, while no fishing effort was spent in the Canadian EEZ during this month. Effort and catch were largely distributed in the US EEZin July which shifted to the Canadian EEZ in August. Effort and catch were predominantly concentrated in the Canadian EEZ, in September and October. High seas fishing took place in July and August, in 2020 (Figures 3 and 4).

Albacore were caught in waters with sea surface temperatures ranging from 12 to 21 °C in 2020 (Figure 5). The proportion of fish caught in waters within the favourable 16-19 °C temperature band increased from 73% in 2019 to 91% in 2020.

5.0 BIOLOGICAL DATA

5.1 By-Catch

In 2020, the reported by-catch consisted of sixteen fish and one sea bird of unidentified species (Table 3). The thirteen yellowtail amberjacks and one shark of unidentified species were retained, while the other two sharks (blue shark and salmon shark) as well as one sea bird were released.

5.2 Biological Sampling

Thirty-four (34) vessels measured 8,982 fork lengths in 2020 with a sampling rate of 2.4% of the reported catch. Fork lengths ranged from 51 to 88 cm, having a dominated mode around 67 cm (Figure 6). Mean length was 69.1 cm, which is considerably larger than the mean length of 66.1 cm reported in 2019. Proportion of large fish appeared to be higher in 2020 than in 2019. Monthly mean length of fish increased from June to September, but remained unchanged between September and October, in 2020 (Figure 7). Albacore caught from the Canadian EEZ had a larger mean length than from the US EEZ, and Albacore caught in the high seas are, on average, smaller than those harvested in the Canadian or US EEZ (Figure 8).

6.0 RESEARCH

There are, primarily, three age classes (2-4 years) of the Albacore harvested by the Canadian fleet. Harvesters collected fork length data in years of 2009-2020. Variable number of small Albacore (one year old) are also caught, but then mostly released because they are below the minimum marketable size. Harvesters started to record the number of these captured small Albacore in 2013.

Age compositions of harvested Albacore tuna were estimated, using a Bayesian mixture model on the measured length data. Age 3 and 4 were combined as one age class, Age 3-4. CPUE was calculated as the model-estimated number of Albacore of one age class captured per vessel-day. There is no statistical correlation between CPUE for Age 2 in one year and CPUE for

Age 1 in the previous year, or between CPUE for Age 3-4 in one year and CPUE for Age 2 in the previous year. However, there is a significant correlation between CPUEs for Age 2 and for Age 1 in the same year, and no such correlation exists between CPUEs for Age 3-4 and for Age 1 or Age 2 in the same year. Canadian catch was mainly (>60%) composed of Age 3-4 Albacore in 2009-2013, but primarily made up with Age 2 Albacore in 2014-2020. Proportion of Age 2 in the catch has been increasing since 2012. Such proportions were higher than 60% in 2014-2020, and more than 90% in the past four years.

7.0 DISCUSSION

Canadian Albacore catch and catch rate were particularly low in the year of 2017. The catches and catch rates have been increasing since then, despite decreasing fishing effort over the past years. The catch rate in 2020 was the highest it has been since 2017. In particular, the catch rate has rebounded more in the Canadian EEZ than in the US EEZ since 2017. However, most of the Canadian catches since 2014 appear to be largely composed of Age 2 fish compared to the earlier years of 2009-2013, during which catches were mainly composed of Age 3-4 Albacore. It is unknown what the major factor was that caused such a shift in the age composition in the Canadian catches. Correlation between CPUEs for Age 2 and Age 1 in the same year seems to suggest that there may be some common physical or biological cues attractive to these young Albacore. On the other hand, no statistical correlation between CPUEs for Age 3-4 and Age 2 in the same year may indicate that physical or biological cues attractive to the older Albacore are different from those for the young Albacore.

8.0 LITERATURE CITED

Stocker, M., H. Stiff, W. Shaw, and A.W. Argue. 2007. The Canadian albacore tuna catch and effort relational database. Canadian Technical Report of Fisheries and Aquatic Sciences 2701: vi+76 p.

Table 1. Fishery statistics from the Canadian troll fishery for north Pacific Albacore Tuna, 1995-2020. Catch and effort data are expanded or raised to account for vessels that do not report logbook data. The level of expansion can be determined by the logbook coverage figures.

| Year	Total Catch (t)	Effort (vessel-days)	Total Vessels	Logbook Coverage (%)
1995	1,761	5,923	287	18%
1996	3,321	8,164	295	24%
1997	2,166	4,320	200	30%
1998	4,177	6,018	214	50%
1999	2,734	6,970	238	71%
2000	4,531	8,769	243	68%
2001	5,249	10,021	248	81%
2002	5,379	8,323	232	74%
2003	6,847	8,428	193	96%
2004	7,857	9,942	221	92%
2005	4,829	8,564	213	94%
2006	5,833	6,243	174	95%
2007	6,040	6,902	207	92%
2008	5,464	5,774	137	93%
2009	5,693	6,540	138	97%
2010	6,527	7,294	161	96%
2011	5,385	8,556	176	99%
2012	2,484	5,974	174	100%
2013	5,088	6,465	183	99%
2014	4,780	4,745	160	100%
2015	4,391	5,244	164	99%
2016	2,842	5,359	152	100%
2017	1,830	4,978	121	100%
2018	2,717	4,196	121	100%
2019	2,402	3,882	122	100%
2020[1]	2,356	3,266	103	100%

data **Table 2.** Releases of Albacore below marketable size (3.18 kg) reported by the Canadian Albacore fishery in 2013-2020.

Year	Number of Fish	Total Weight (kg)
2013	289	918
2014	2,214	7,153
2015	4,295	14,271
2016	562	2,134
2017	545	1,660
2018	5,508	18,291
2019	4,093	12,929
2020	668	2,082

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1. 2020 are preliminary based on 20.12.31 of *Canadian Albacore Tuna Catch Effort Relational Database*. Stocker et (2007) for a description the database.

Table 3. Reported catch of non-target species (by-catch) by the Canadian Albacore Tuna troll fishery in 2020.

Month	Common name	Scientific Name	Catch (in Number)	
			Retained	Released
July	Blue Shark	*Prionace glauca*		1
	Shark	*N/A*	1	
	Sea Bird	*N/A*		1
August	Yellowtail Amberjack	*Seriola lalandi*		1
September	Salmon Shark	*Lamna ditropis*		1
	Yellowtail Amberjack	*Seriola lalandi*		9
October	Yellowtail Amberjack	*Seriola lalandi*		3
	TOTALS		1	16
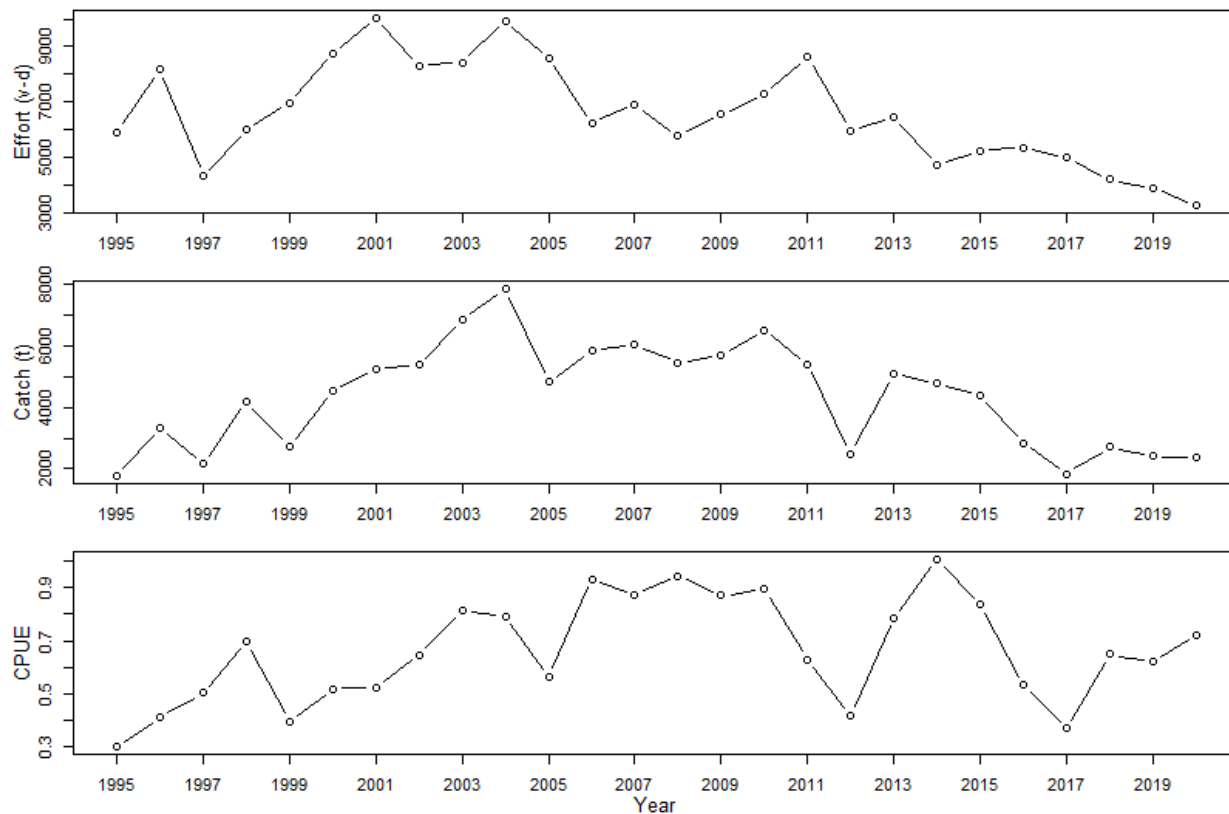
Figure 1. Historical trends in expanded catch (metric tonnes, t), effort (vessel-days, v-d) and catch per unit effort (CPUE, t/vessel-day) in the Canadian troll fishery for north Pacific Albacore Tuna from 1995 to 2020.
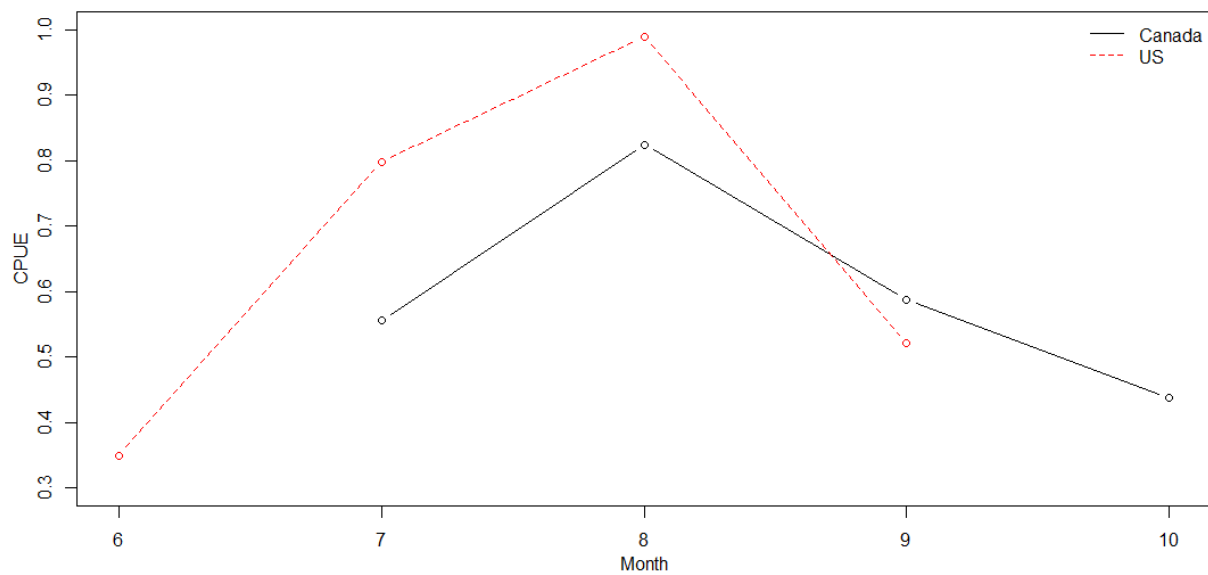
Figure 2. Monthly catch per unit effort (CPUE, t/vessel-day) in the Canadian and U.S. EEZs for Canadian Albacore Tuna troll fishery in 2020.
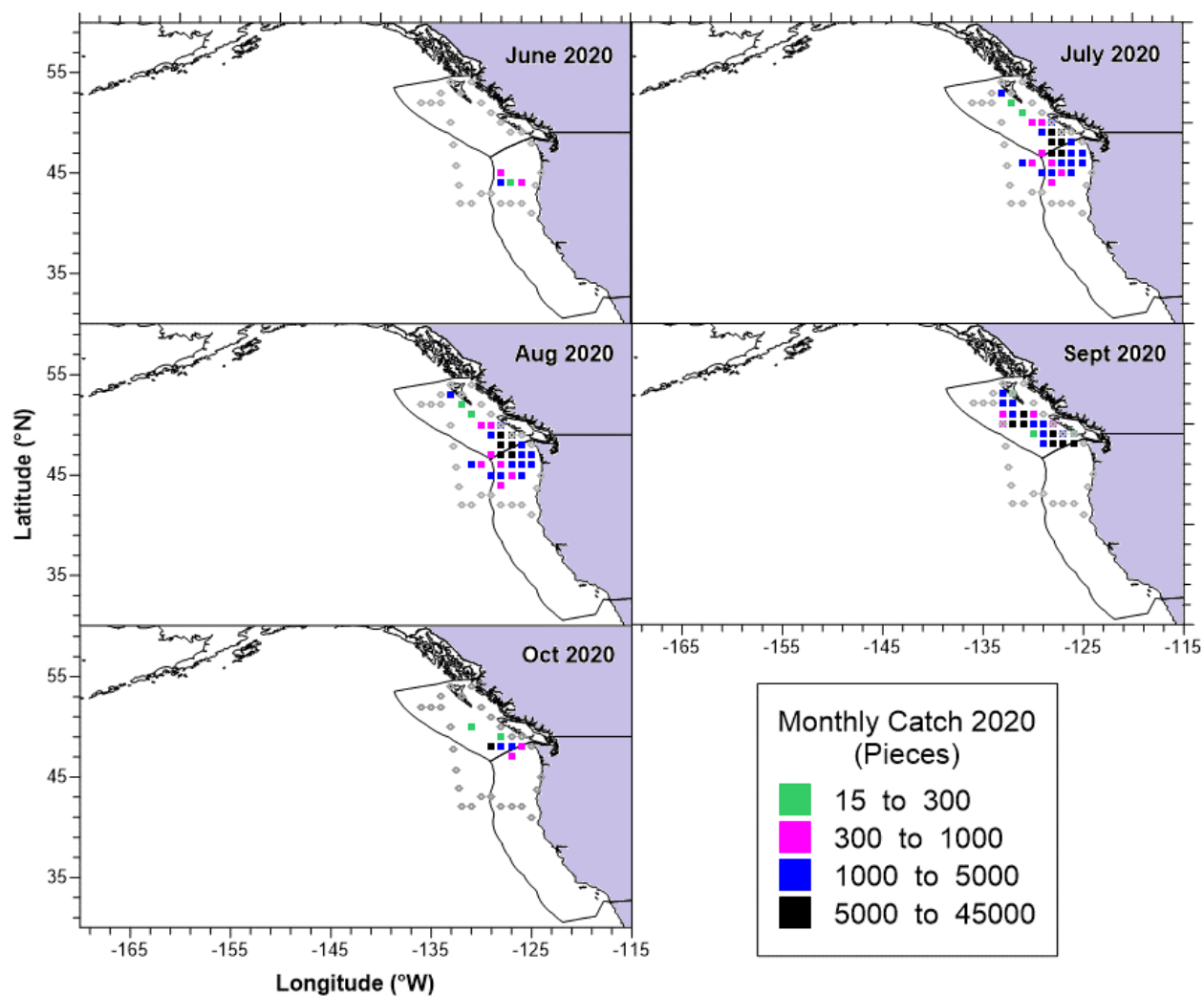
Figure 3. Monthly spatial distribution of reported catch in Canadian Albacore Tuna troll fishery in 2020. Data are plotted on a 1° x 1° strata with symbols located on the bottom-right corner. Strata in which fewer than three vessels reported are not shown. Empty dots approximate the border line of the operational area of the Canadian fishery in 2020.
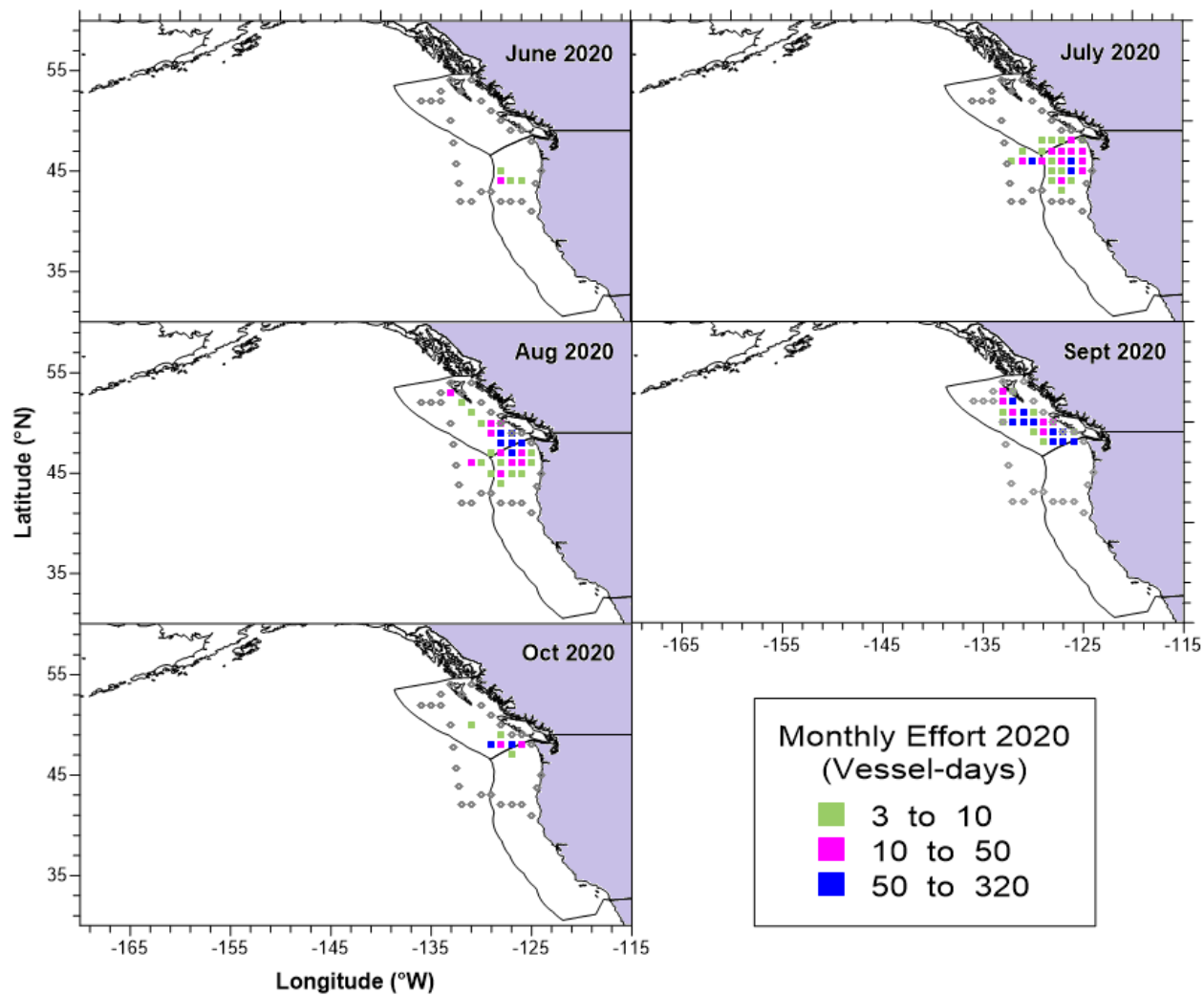
Figure 4. Monthly spatial distribution of effort by the Canadian Albacore Tuna troll fishery in 2020. Data are plotted on 1° x 1° strata with symbols located on the bottom-right corner. Empty dots approximate the border line of the operational area of the Canadian fishery in 2020.
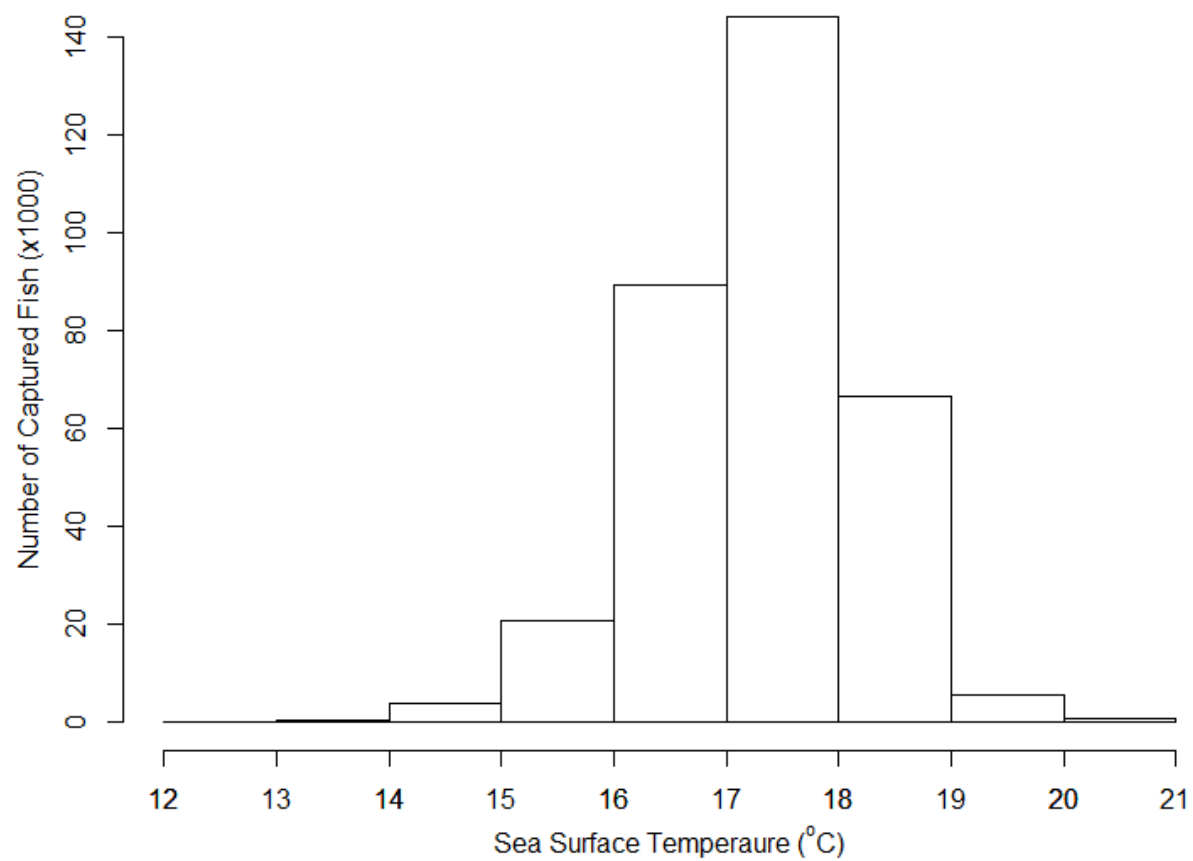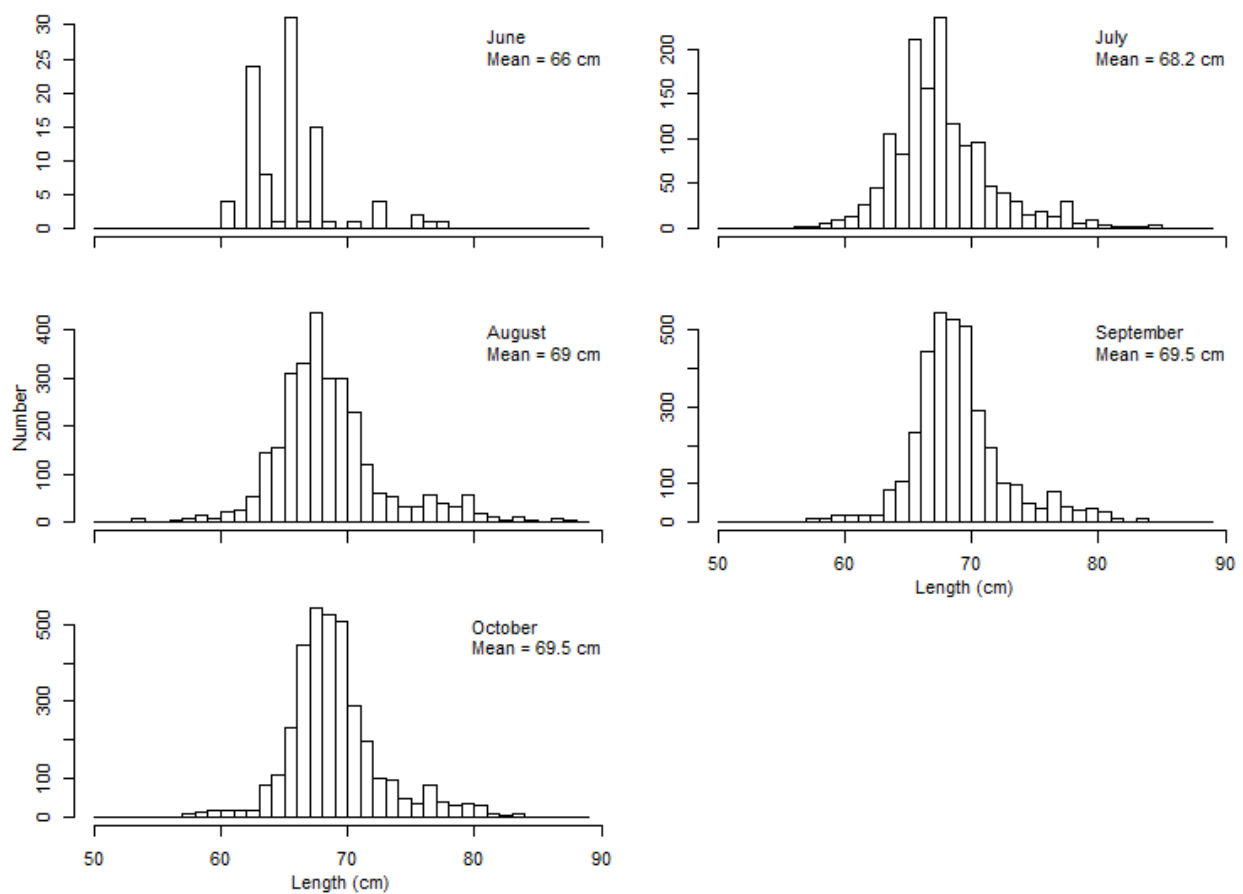
Figure 5. Number of north Pacific Albacore Tuna caught by the Canadian troll fishery in 2020 at various sea surface temperatures.
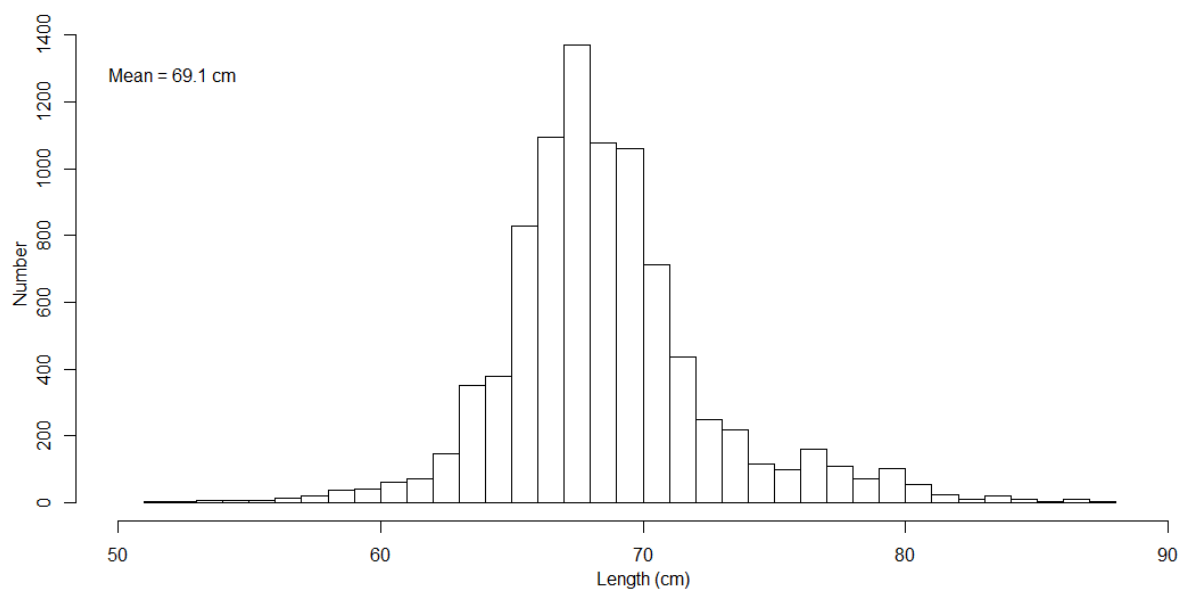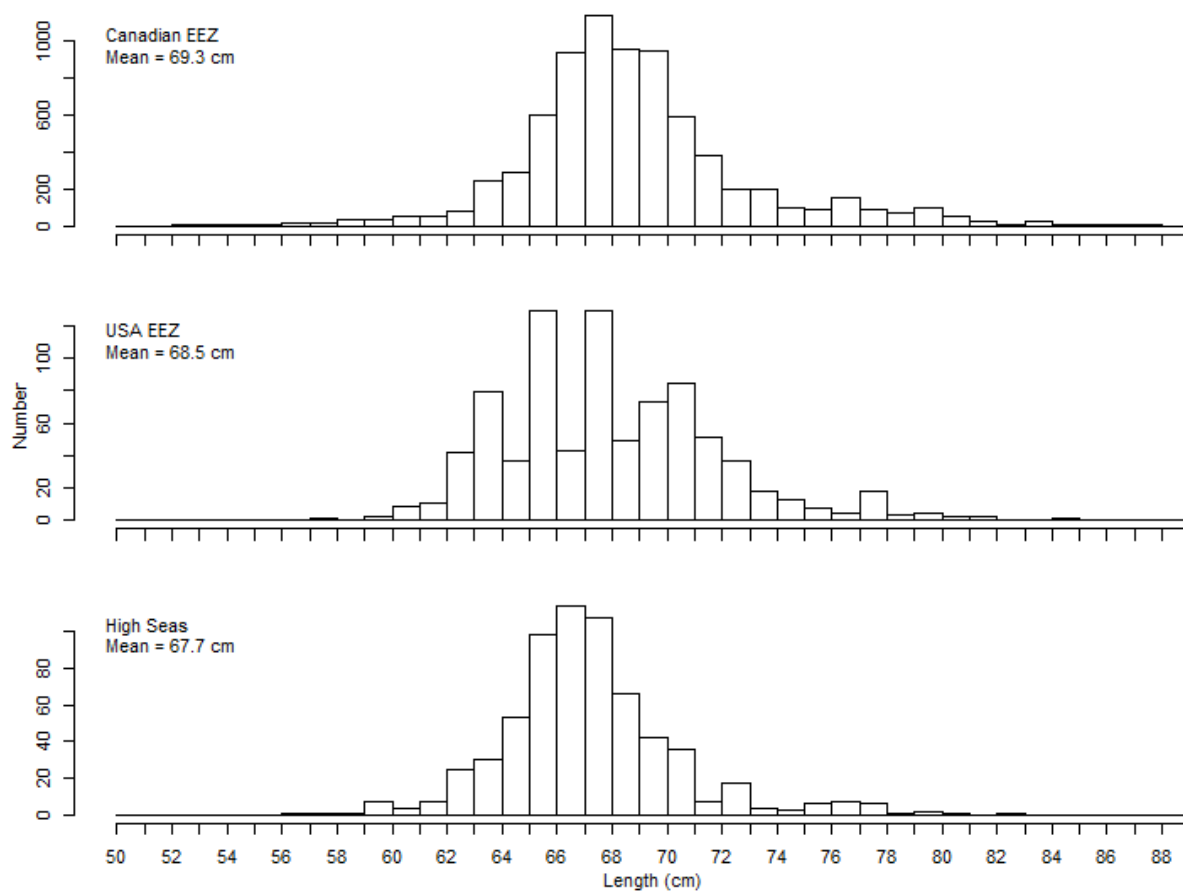
Figure 6. Distributions of fork lengths (cm) of north Pacific Albacore Tuna harvested by the Canadian troll fishery in 2020.

Figure 7. Monthly fork length (cm) distributions of north Pacific Albacore Tuna harvested by
the Canadian troll fishery in 2020.

Figure 8. Distributions of fork lengths (cm) of north Pacific Albacore Tuna harvested by the Canadian troll fishery in 2020 in Canadian EEZ, USA EEZ and High Seas.