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The 2010 Canadian North Pacific Albacore Troll Fishery[1]

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1.0 INTRODUCTION

Canadian fishermen have been fishing for albacore tuna (*Thunnus alalunga*) since the late-1930s in the coastal waters of Canada and the United States. The Canadian fishery is a troll fishery using jigs to target juvenile albacore tuna in the surface waters of the Pacific Ocean. Although the Canadian fleet follows albacore tuna concentrations into offshore waters, in recent years the majority of effort and catch has occurred in the coastal waters of Canada and the United States. Access by Canadian vessels to waters in the U.S. Exclusive Economic Zone (EEZ) is governed by a bilateral Canada-United States albacore tuna treaty, which enables reciprocal access to waters within each country's EEZ, and provides for the landing of albacore catches at designated ports in Canada and the United States.

Management regulations for Canadian vessels fishing albacore tuna in 2010 are documented in the Pacific Region Integrated Fisheries Management Plan: Tuna - April 1, 2010 to March 31, 2011, which is available at http://www.dfo-mpo.gc.ca/Library/340295.pdf. These regulations specify that Canadian fishers must obtain a license to fish for albacore tuna and that they must maintain accurate records of daily harvest operations in a logbook. Logbooks are purchased from the Canadian Highly Migratory Species Foundation (http://www.canadianalbacoretuna.com/) and fishers are required to submit their logbooks within 7 days of their final landing or mid-November, whichever is first. The Canadian tuna fishery in Pacific Ocean waters was open from 01 April 1 2010 to 31 March 2011, but all catch and effort occurred between 15 June and 31 October 2010 when albacore availability to the fleet in coastal waters is highest.

The present report summarizes Category I (total annual catch and effort, catch per unit of effort (CPUE)), Category II (logbook catch and effort data summarized on 1° x 1° grid), and Category III (bycatch, catch size composition) data for the Canadian north Pacific albacore troll fishery in 2010. Similar summaries for the 1995 to 2009 fisheries are presented by Shaw (1997, 1999), Shaw and Argue (1999, 2000), Argue and Shaw (2000), Shaw and Stocker (2002), Stocker and Shaw (2004a, 2004b, 2005), Stocker (2006, 2007a), and Holmes (2008, 2009, 2010). Historical catch data from 1945 to 1990 provided by Ware and Yamanaka (1991) are based on sales slip records, which capture total landings of albacore in Canadian ports but not ports in the United States. Effort associated with these catch data is not available, except when enhanced catch reporting occurred through the operation of experimental logbook programs in 1948-1950 and 1968-1974 (e.g., Partlo 1951, Ketchen 1980).

2.0 DATA SOURCES

Data on albacore tuna catch and effort are compiled from hailing records, logbooks, and sales slips from processing plants and stored in the Canadian Albacore Tuna Catch and Effort Relational Database (Stocker et al. 2007). This database contains all fishery-related scientific data from 1995 to the present and provides the best estimate of total annual catch and effort by vessel and geographic area. All fishing vessels are required to hail out when they intend to start fishing and hail in when fishing ceases. Hail data from vessels fishing in Canadian waters are obtained from Marine Communications and Traffic Services, Canadian Coast Guard, and hail data for vessels fishing in U.S. waters are obtained from Ship.com. The hail data are used to

estimate the total number of unique vessels fishing (Stocker et al. 2007). Canadian vessels must also carry logbooks while fishing for highly migratory species in any waters of the Pacific Ocean. Daily catch and effort data at the highest temporal and spatial scales are obtained from completed copies of the logbooks submitted at the end of the fishing season. Shaw and Argue (1999) and Stocker et al. (2007) provide a full description of the type of information recorded in the logbooks. Sales slips records of landings provide the most accurate estimates of albacore landings (weight), although they underestimate total annual landings because they do not fully account for international landings, domestic public sales or take-home totals (Stocker et al. 2007). Logbooks, sales slips and at-sea trans-shipment slips, completed at the time fish are landed and sold, must be returned to Fisheries and Oceans Canada (DFO) for entry into the albacore catch database (Argue et al. 1999; Stocker et al. 2007). Port samplers in American ports designated by the Canada-United States albacore tuna treaty collect length-frequency data from the Canadian albacore tuna catch landed in those ports. Canada implemented an on-board sampling program by harvesters in 2009 in which the first 10 albacore landed on a daily basis are measured and these data are recorded in the logbooks.

The preliminary catch and effort data for 2010 in this report were taken from database version 11.03.29. Logbook coverage was estimated to be 98% of expanded catch and effort. The data in this report up to and including 2009 are considered definitive and are derived from a reconciliation of trip log (best estimates of effort, catch in pieces, and geographic location) and sales slip (best estimate of catch weight) data (Stocker et al. 2007).

3.0 CATEGORY I DATA

3.1 Catch

The preliminary estimate of north Pacific albacore tuna caught by the Canadian troll fishery in 2010 is 6,497 metric tons (t) and is a 15% increase in catch relative to 2009 (Table 1). The total catch of north Pacific albacore tuna by the Canadian troll fishery has ranged from 1,763 t in 1995 to 7,856 t in 2004 and averaged 4,898 t for the 1995 to 2010 period. All of the catch occurred in FAO Statistical Area 67 (Table 2) and was distributed in the Canadian EEZ (36%), the United States EEZ (50%), and highseas waters (14%) (Figure 2). The Canadian fishery operated exclusively within the IATTC convention area north of the equator and was inactive in the WCPFC convention area, both north and south of the equator in 2010.

The record of Canadian catches is extended back to 1952 in this document (Table 1). Increases in reported catches to values exceeding 1,000 t annually in the 1968-1974 period are due to enhanced catch reporting through a scientific logbook program used to assess the seasonal distribution and abundance of albacore in Canadian waters rather than a fishing effect (e.g., Bourque 1974, 1975; Bourque and Humphreys 1973). Catches from 1995 to the present are the best measure of the Canadian fishery and are derived from the Canadian tuna database, using logbook, sale slips and hail data to estimate annual catches. Catches reported from 1952-1994 are based on a sales slip system which captures reported landings at Canadian ports only. Thus, these earlier figures may underestimate the true catch of the Canadian fishery since they do not account for catches landed in US ports during this period and they do not account for personal use or dockside sales of albacore directly to the public.

3.2 Effort

The Canadian albacore troll fleet consisted of 157 unique vessels in 2010, representing a 16% increase in the number of vessels fishing in 2009, but below the average of 210 for the 1995-2010 period (Table 1). All Canadian troll vessels targeted the north Pacific albacore stock exclusively.

Fishing effort in the Canadian tuna fishery is measured as the number of vessel fishing days (v-d). The 2010 estimate of fishing effort is 7,532 v-d and is a 14 % increase in effort relative to effort in 2009 (Table 1). Annual fishing effort has ranged between 4,324 v-d in 1997 and 10,021 v-d in 2001, averaging 7,427 v-d since 1995.

3.3 Catch-per-Unit-Effort

The nominal catch per unit of effort (CPUE) of the Canadian fleet in 2010 was 863 kg/v-d and is well above the average value of 661 kg/v-d for the 1995 to 2010 period (Table 1; Figure 1). Nominal CPUE has increased from 297 kg/v-d in 1995 to 934 kg/v-d in 2006 and has since remained relatively stable, averaging about 874 kg/v-d (Figure 1).

4.0 CATEGORY II DATA

The Canadian troll fleet operated between 39 and 53 °N latitude and from the west coast of North America to 147° W in 2010 (Figures 2 and 3), continuing the pattern observed since the 2006 fishing season of staying within the Inter-American Tropical Tuna Commission (IATTC) convention area east of 150 °W. Roughly 51% of the catch and 53% of the effort occurred in the US EEZ, well below the average for 2000-2009 of 79% and 78%, respectively. In contrast, 36% of the catch and 39% of the effort occurred in Canadian waters and 14% of the catch and 8% of the effort occurred in adjacent highseas waters; in both areas 2010 catch and effort are at least double the long-term (2000-2009) averages. Monthly plots of catch (Figure 2) and effort (Figure 3) show a northward shift in the location of fishing as the season progressed. The increase in 2010 catch and effort relative to 2009 is attributable to an increase in the availability of albacore in Canadian waters and to an increase in the number of vessels fishing within Canadian coastal waters and secondarily in adjacent highseas waters.

Spatial catch rate anomalies for 2010 were calculated and plotted in Figure 4. 2010 anomalies (A_{2010}) were calculated for each 1° x 1° block as observed catch rate in 2010 minus the average catch rate in that block for the 2000-2009 period:

$$A_{2010} = CPUE_{I,J,2010} - \overline{CPUE_{I,J,2000-2009}}$$

where *I* is latitude and *J* is longitude. Logbook coverage exceeds 95% for the 2000-2009 period. Catch rates in the majority of 1° x 1° spatial blocks north of 48 °N and in offshore waters were above average in 2010, while catch rates further south in the US EEZ were mostly below average relative to the 2000-2009 period.

Albacore were caught in waters with sea surface temperatures ranging between 12 and 18 °C in 2010, but more than 80% of the catch occurred at temperatures between 14 and 16 °C (Figure 5). In contrast, the majority of catch has occurred in waters between 16 and 18 °C in other years.

5.0 CATEGORY III DATA

5.1 Bycatch

Reported bycatch in 2010 consisted of 3 albacore considered to small to retain (averaging 3.36 kg in size), 1 unidentified shark species (18.1 kg), 6 skipjack tuna (*Katsuwonus pelamis*) averaging 2.72 kg in size, 3 yellowfin tuna (*T. albacares*) averaging 1.6 kg each, and 45 yellowtail *Seriola lalandi* (averaging 3.77 kg in size). Total weight of all bycatch was estimated to be approximately 254 kg. All bycatch was released alive.

5.1.1 Erratum

Previous reports from Canada to the ISC Plenary Session and the Albacore Working Group in 2007, 2008, and 2009 (e.g., Holmes 2007, 2008, 2009) have erroneously indicated that the minimal bycatch reported by the Canadian troll fleet was retained. In fact, it is a condition of licence that non-target species reported as bycatch must be released. There is no evidence that bycatch species were landed in Canadian or treaty-designated ports of the United States.

The 2010 Canadian report to the ISC Plenary Session (Holmes 2010) included by-catch of 4,298 skipjack tuna (*Katsuwonus pelamis*) in the 2009 fishery. Subsequent investigation by Canadian officials found that these fish were small albacore that were mis-identified as skipjack tuna; furthermore, there was no evidence of any skipjack landings by Canadian vessels in Canada or treaty-designated ports in the United States in 2009. Identification sheets for common tuna, tuna-like species, and pelagic sharks were developed by Fisheries and Oceans and were distributed in all 2011 logbooks to reduce the risk of mis-identification in the future and to improve the identification of sharks species that may be encountered by fishers.

5.2 Biological

A voluntary an on-board length sampling program was initiated in 2009. Harvesters were asked to measure and record the fork lengths (rounding down to the lowest whole number) of the first 10 fish landed on a daily basis, or as often as possible.

Thirty-four vessels recorded size frequency data in 2010 and turned in 9,772 fork length measurements (Figure 6), which represents a sample of 1.04% of the total reported catch (940,341 fish). Canadian catch landed in designated ports in Washington and Oregon may be sampled by the US port sampling program collecting size composition from the USA troll fleet, but these data are not available at present.

Albacore in the Canadian catch ranged from 51 cm to 90 cm in size (Figure 6). Two modes are present in these data at 64-66 cm and 74-76 cm, corresponding to 2- and 3-yr old fish, respectively. The most common pattern of length-frequency data sampled from the Canadian

catch exhibits the first mode at 64-66 cm FL. The two-mode pattern observed in 2010 is rarer, but has been observed several times since 1981, when port sampling data were first collected.

6.0 DISCUSSION

Above average (2000-2009) catch rates of albacore in northern waters (Figure 4), changes in the contribution of different areas to total catch, and the equal dominance of 2- and 3-year old fish in the catch (Figure 6) point to a northward shift of the albacore population along the west coast of North America in 2010. Temperature does not appear to be the major driver of this shift. Coastal BC waters were 0.1-0.45 C° cooler than normal (based on data from Amphitrite Point, southwest coast of Vancouver Island) during the fishing season (July-Oct) and more than 80% of the catch was made at temperatures of 14-16 °C (Figure 5), which is cooler than temperatures at which the bulk of the catch was made in previous years (16-18 °C). Since albacore track the position of the transition zone chlorophyll front and these fronts can exhibit considerable meandering and monthly latitudinal movement in position (Laurs and Lynn 1977; Polovina et al. 2001), the increased abundance of albacore, especially 3-year old albacore, in northern waters along the North American coastline may be a response to a northerly shift in this frontal system and higher productivity and enhanced foraging opportunities for albacore in more northern waters.

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Table 1. Fishery statistics from the Canadian troll fishery for north Pacific albacore tuna, 1952-2010. A dash (-) indicates that no estimates are available.

Year	Total catch (t)	Effort (vessel-days)	Total Vessels	Nominal CPUE (kg/v-d)	Logbook Coverage (%)
1952	71	-	-	-	-
1953	5	-	-	-	-
1954	-	-	-	-	-
1955	-	-	-	-	-
1956	17	-	-	-	-
1957	8	-	-	-	-
1958	74	-	-	-	-
1959	212	-	-	-	-
1960	141	-	-	-	-
1961	4	-	-	-	-
1962	1	-	-	-	-
1963	5	-	-	-	-
1964	3	-	-	-	-
1965	15	-	-	-	-
1966	44	-	-	-	-
1967	161	-	-	-	-
1968	1,028	-	124		-
1969	1,365	-	-	-	-
1970	390	-	-	-	-
1971	1,746	-	222	-	-
1972	3,921	-	364	-	-
1973	1,400	1,862	246	752	-
1974	1,331	1,339	219	994	-
1975	111	-	22	-	-
1976	278	-	124	-	-
1977	53	-	-	-	-
1978	23	-	-	-	-
1979	521	-	104	-	-
1980	212	-	-	-	-
1981	200	-	-	-	-
1982	104	-	-	-	-
1983	225	-	-	-	-
1984	50	-	-	-	-
1985	56	-	-	-	-
1986	30	-	-	-	-
1987	104	-	-	-	-
1988	155	-	-	-	-
1989	140	-	-	-	-
1990	302	-	76	-	-
1991	139	-	45	-	-

Table 1. Fishery statistics from the Canadian troll fishery for north Pacific albacore tuna, 1952-2010. A dash (-) indicates that no estimates are available.

Year	Total catch (t)	Effort (vessel-days)	Total Vessels	Nominal CPUE (kg/v-d)	Logbook Coverage (%)
		-		-	-
1992	363		120		
1993	494	-	90	-	-
1994	1,998	-	87	-	-
1995	1,763	5,930	284	297	22%
1996	3,316	8,151	292	407	28%
1997	2,168	4,324	197	501	38%
1998	4,177	6,018	214	694	51%
1999	2,734	6,969	233	392	74%
2000	4,531	8,769	238	517	70%
2001	5,248	10,021	244	524	81%
2002	5,379	8,323	228	646	81%
2003	6,861	8,429	192	814	98%
2004	7,856	9,943	220	790	95%
2005	4,845	8,565	213	566	94%
2006	5,832	6,243	174	934	99%
2007	6,075	7,113	198	854	96%
2008	5,446	5,907	134	922	96%
2009	5,643	6,589	135	856	99%
2010[1]	6,497	7,532	157	863	98%

1 2010 data are preliminary based on Ver.11.03.29 of the *Canadian Albacore Tuna Catch and Effort Relational Database*.

[2] (Reported Catch/Expanded Catch) x 100

Table 2. Total Canadian catch (t) of north Pacific albacore tuna in FAO Statistical Areas.

Year	FAO Statistical Area			Total
	NE Pacific (67)	NW Pacific (61)	EC Pacific (77)[2]	
2002	5,089	152	138	5,379
2003	6,429	341	91	6,861
2004	7,696	44	102	7,842
2005	4,834	11	0	4,845
2006	5,832	0	0	5,832
2007	6,074	0	1	6,075
2008	5,478	0	0	5,478
2009	5,684	0	1	5,685
2010	6,497	0	0	6,497

[1] Preliminary 2010 data obtained Version 11.03.29 of the *Canadian Albacore Tuna Catch and Effort Relational Database*.

[2] Excludes catch data from south of the equator.

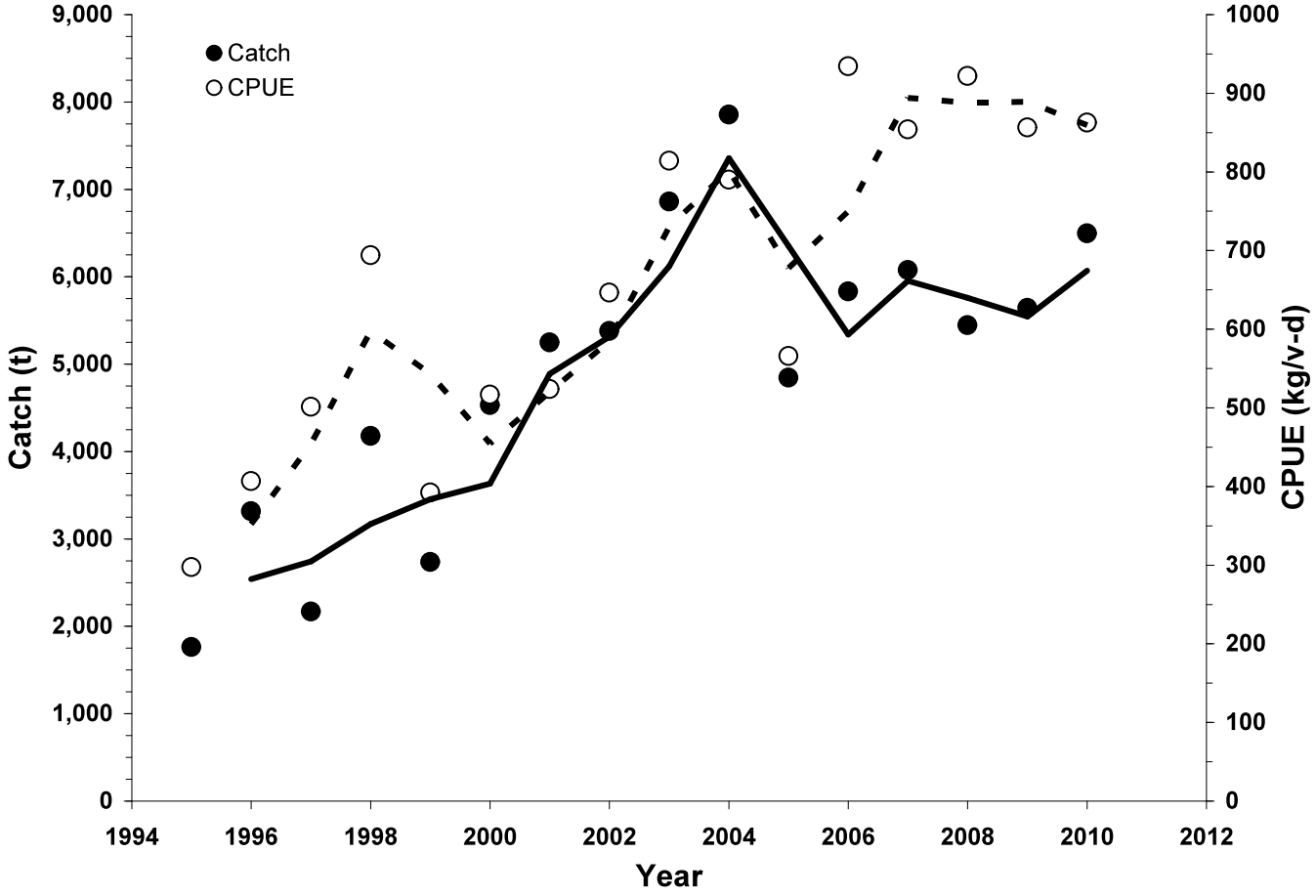

Figure 1. Canadian north Pacific albacore troll catch (●) and catch-rates (CPUE) (○) from 1995 to 2010. Lines are 2-yr moving averages of catch in t (▬) and CPUE in kg/v-d (– –).

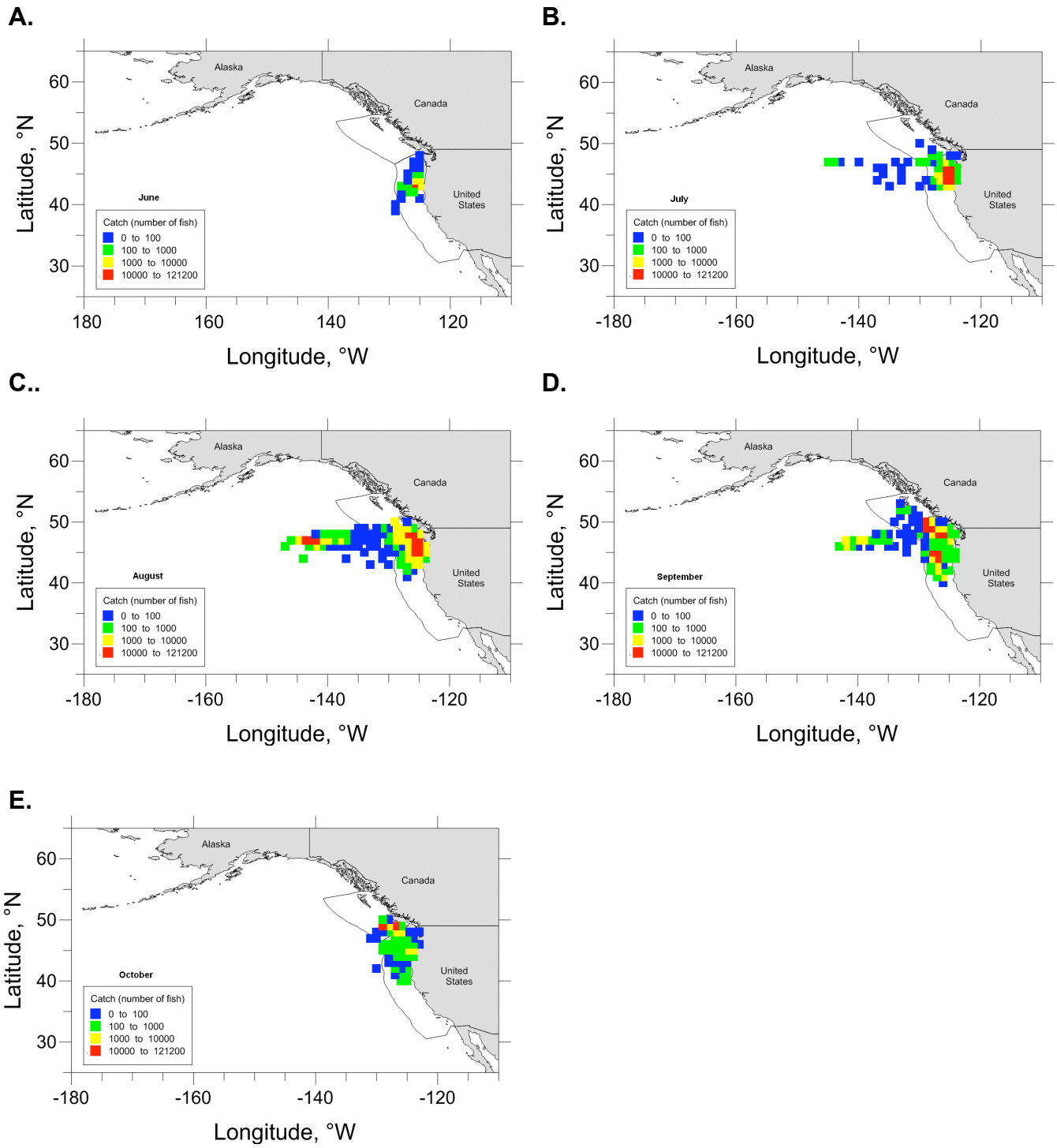

Figure 2. Monthly distribution of the Canadian north Pacific albacore tuna troll fishery catch (number of fish) in 2010. A – June, B – July, C – August, D – September, E – October. Data are plotted on a 1° x 1° grid, where grid location is specified by the bottom-right corner of each grid cell. Colour of the cell is proportional to the catch. The black line marks the boundaries of the Canadian and United States exclusive economic zones (EEZ - 200-mile limits).

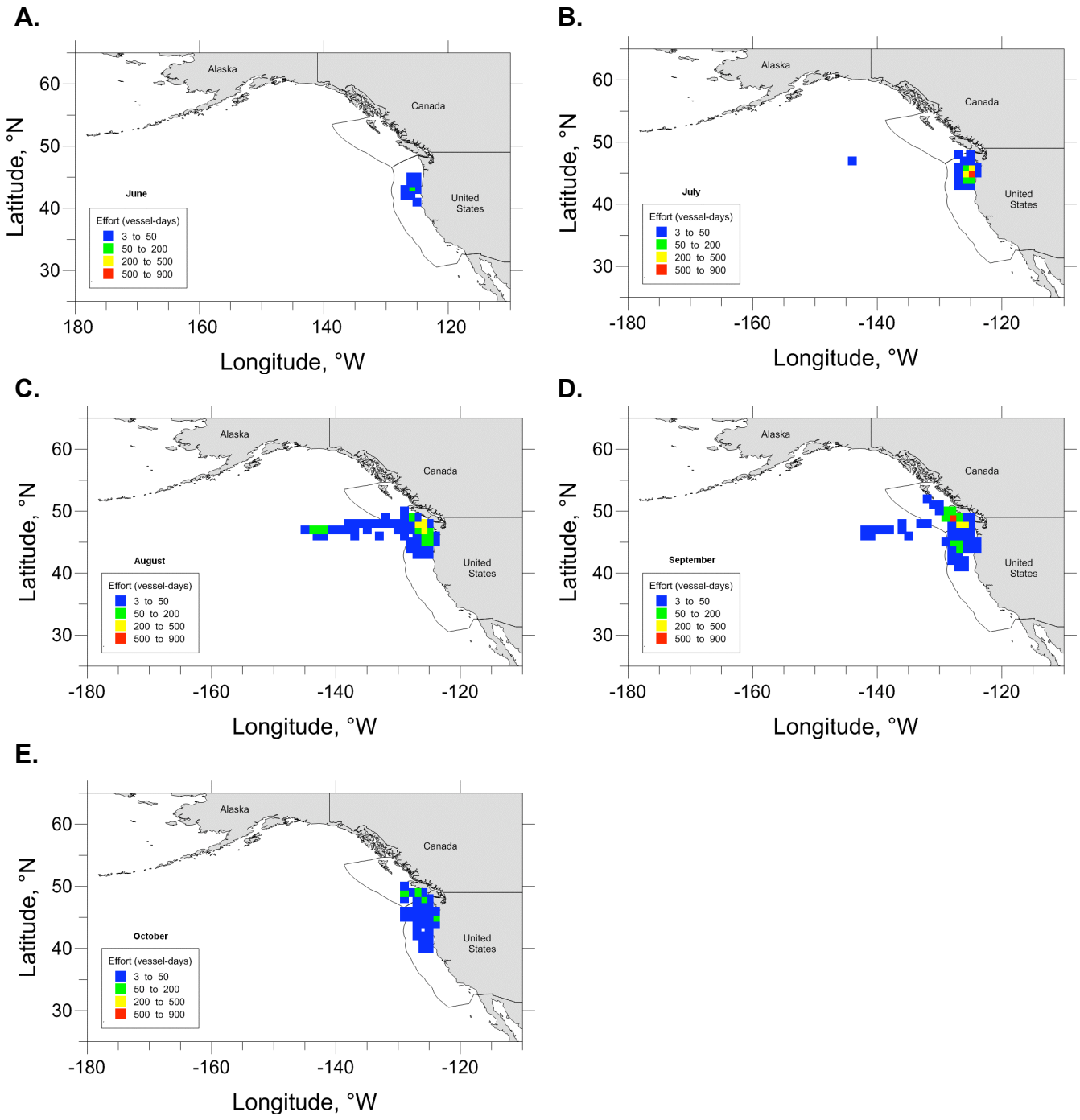

Figure 3. Monthly distribution of the Canadian north Pacific albacore tuna troll fishery effort (vessel-days) in 2010. A – June, B – July, C – August, D – September, E – October. Data are plotted on a 1° x 1° grid with symbols located on the bottom-right corner of each grid cell. Size of the symbol is proportional to effort. The plot also shows the boundaries of the Canadian and United States exclusive economic zones (200-mile limit).

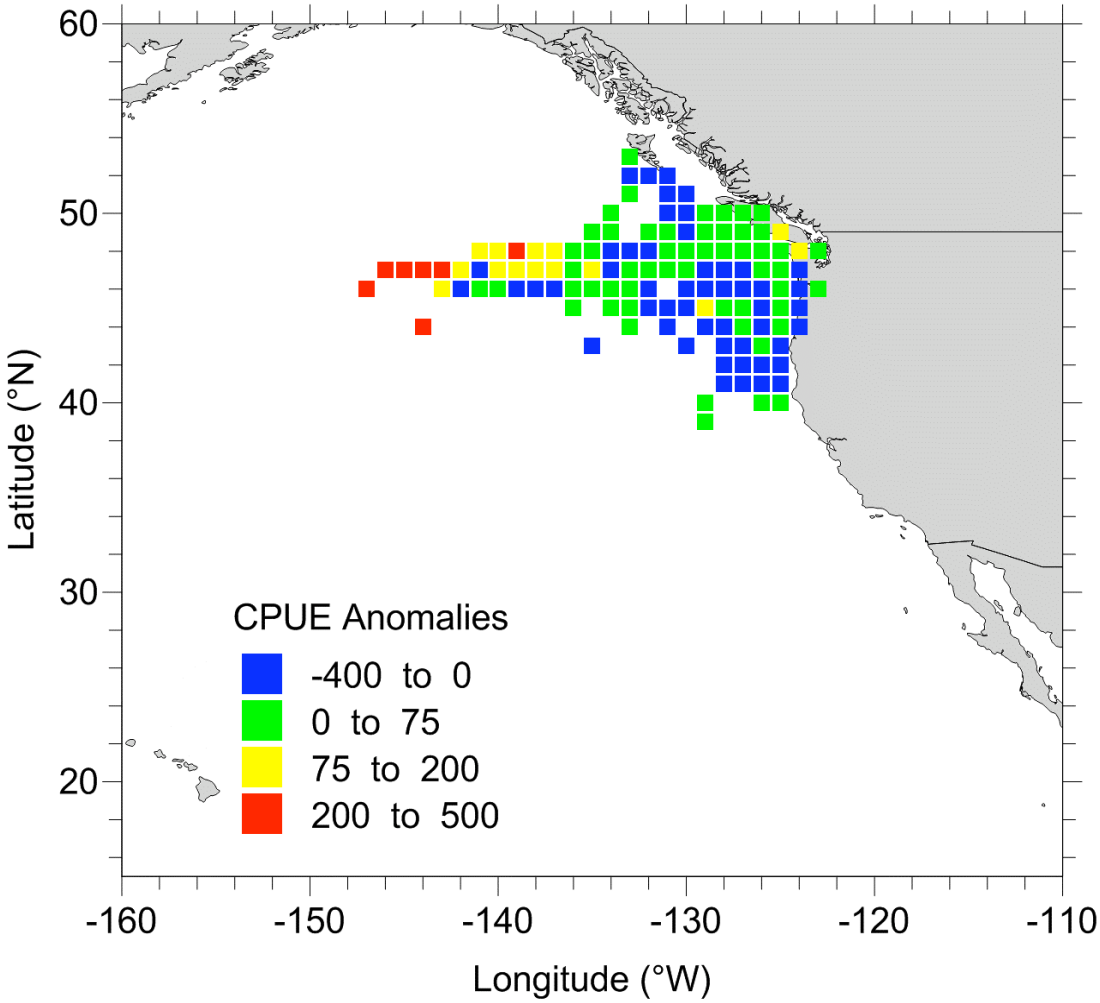

Figure 4. Catch-rate anomalies (fish/vessel-day) based on logbook data in areas fished by the Canadian fleet in 2010. Anomalies are calculated for each 1° x 1° spatial block as:

$$\text{CPUE Anomaly}_{I,J} = \text{Observed}_{I,J,2010} - \text{Average}_{I,J,2000\text{-}2009,}$$

where I and J refer to latitude and longitude in whole degrees, respectively. Blocks in blue are below average CPUE; all other colours above average.

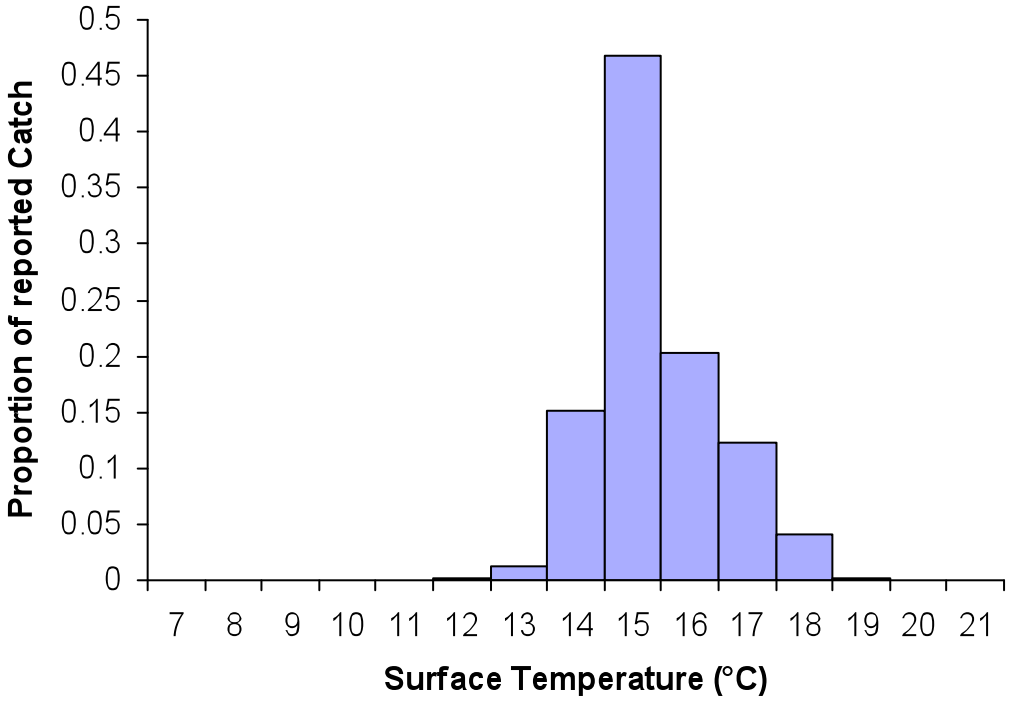

Figure 5. Sea surface temperatures at which albacore tuna were caught by the Canadian troll fishery in 2010 (N = 940,341 fish).

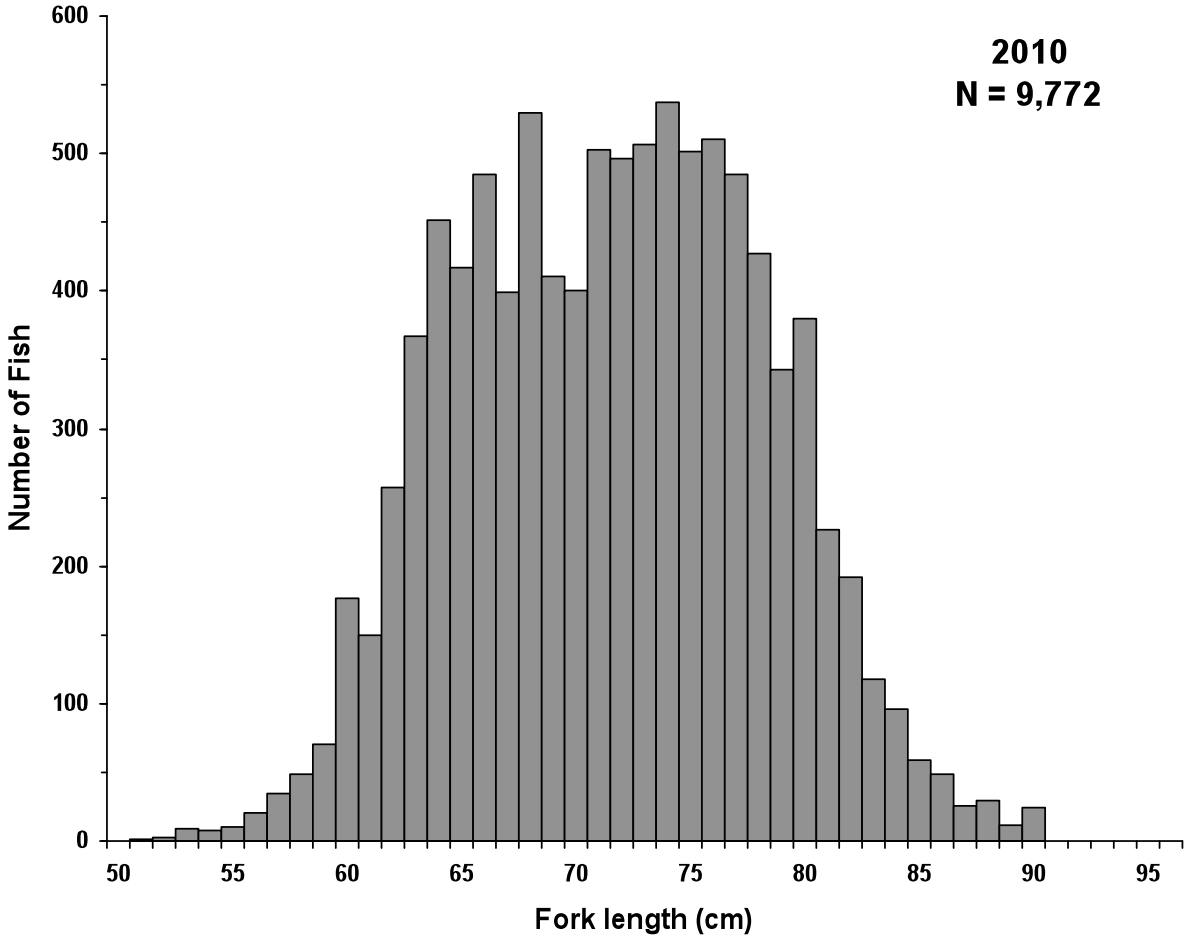

Figure 6. Fork lengths of North Pacific albacore harvested by the Canadian fishery in 2010 and recorded on board by harvesters. Additional fork length data may have been collected by the U.S. port sampling program, but these data are not available at present.