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The Canadian Troll Fishery for North Pacific Albacore Tuna in 2010[1]

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INTRODUCTION

The Canadian fishery for albacore tuna (*Thunnus alalunga*) in the North Pacific Ocean (NPO) is a troll fishery using jigs. Canadian harvesters have been fishing albacore since 1939, targeting juvenile albacore over an expanded range broadly classified into four fishing areas: (1) British Columbia coastal, (2) United States coastal, (3) high seas north Pacific Ocean, and (4) high seas south Pacific Ocean. The majority of vessels in the Canadian fleet are between 10.67m and 18.29m in length and concentrate their fishing activities in the coastal waters of Canada and the United States from the southern Oregon coast to the northern tip of Vancouver Island. A small number of vessels exceeding 19 m in length will follow albacore concentrations into offshore waters, i.e., outside the EEZs of Canada and the United States. Historically, these offshore vessels have operated as far west as 160°E, but following the 2005 fishing season, Canadian flagged vessels have restricted their operations to the waters east of 150 °W latitude.

This report provides preliminary summaries of annual catch and effort, monthly catch and effort at a 1° x 1° spatial resolution, catch per unit of effort (CPUE), bycatch, and biological data for 2010 from the Canadian troll fishery for albacore.

DATA SOURCES

Albacore catch data are available from 1939 through 2010. Catches up to and including 1990 were compiled and reported by Ware and Yamanaka (1991). Total annual catch data prior to 1951 were estimated by converting from canned weights produced by processing companies (canneries) to landed weights using industry standard conversion factors (Argue and Shepard 2005). However, this procedure did not account for albacore sold by Canadian harvesters to buyers in United States ports and it did not consistently distinguish between albacore imported by Canadian processors (which should be excluded) and albacore landed in Canadian ports by Canadian harvesters (the target statistic). A sales slip system was implemented in 1951, which required that processers submit records of landed weight for each vessel, and data compiled from these records were used to estimate total annual catch of albacore from the Canadian fishery until 1994. This system underestimated the true catch because it did not account for albacore landed at US or other foreign ports nor did it account for direct sales of albacore to the public, i.e., dockside sales (Stocker et al. 2007). The magnitude of this bias is unknown, but it probably is not constant between years. For example, an analysis of logbook data voluntarily collected between 1972 and 1976 (Bourque and Humphreys 1973; Bourque 1974, 1975; Lockner 1977a, 1977b) concluded that sales slips underestimated total catch by 10% and as a result catches from 1970 to 1976 adjusted upward by 10% (Stocker et al. 2007). In 1995, a database was developed and implemented to capture fishery data from logbooks, sales slips and hail records for each vessel in the fishery (Stocker et al. 2007). Estimates of catch and effort since 1995 are the most reliable statistics available for the Canadian fishery and these estimates are expanded catch and effort to account for non-reporting vessels rather than nominal catch and effort.

The accuracy of nominal effort data reported prior to 1995 is unknown as there was no system in place to track these data. The vessel-days estimated for 1973 and 1974 are based on a review of logbooks as part of a voluntary program, but were not expanded to cover the entire fishery.

The catch data up to 2009 are considered our best estimates. The data for 2010 are preliminary and in this report are taken from database version 11.03.16, which uses logbook data from 97% of the vessels. Logbooks from 3% of the vessels remain outstanding..

RESULTS

Category I

The Canadian troll fleet consisted of 157 unique vessels in 2010 and preliminary annual catch and effort were 6,536 metric tons (t) and 7,579 vessel-days, respectively (Table 1). Nominal CPUE appears to have remained at the same level since 2007, averaging approximately 874 kg/v-d (Figure 1). These figures represent a 15% increase in catch and effort relative to 2009 and 16% increase in fleet size relative to 2009. The increased fleet size was due to an increase in vessels operating within the Canadian coastal waters (exclusive economic zone EEZ). The Canada/United States Albacore Tuna Treaty limits the number of Canadian vessels operating in the US EEZ to 110 annually. All catch and 99.9 % of effort occurred within FAO statistical area 67 (Table 2).

Category II

The Canadian troll fleet operated within a latitudinal range of 39 to 53 °N and from the west coast of North America to 147° W in 2010 (Figure 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.

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 latitude 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.

Category III

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.

Based on the data submitted by the Canadian fleet, albacore in the Canadian catch ranged from 51 cm to 90 cm in size (Figure 6). Two modes are present in these data 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 pattern observed in 2010 of two modes, is rarer, but has been observed several times since 1981, when port sampled data were first collected.

Reported bycatch in 2010 consisted of 3 albacore considered too 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 3.63 lbs each, and 45 yellowtail *Seriola lalandi* (averaging 3.77 kg in size). All by-catch was released. Steps have been implemented for the 2011 fishing season to ensure that species information on shark encounters/by-catch is recorded.

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 Amphitrite Point data) 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 or meander in the transition zone chlorophyll front and higher productivity and enhanced foraging opportunities for albacore in these 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	CPUE (kg/v-d)
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	-

Year	Total catch (t)	Effort (vessel-days)	Total Vessels	CPUE (kg/v-d)
1991	139	-	45	-
1992	363	-	120	-
1993	494	-	90	-
1994	1,998	-	87	-
1995	1,763	5,930	284	297
1996	3,316	8,151	292	407
1997	2,168	4,324	197	501
1998	4,177	6,018	214	694
1999	2,734	6,969	233	392
2000	4,531	8,769	238	517
2001	5,248	10,021	244	524
2002	5,379	8,323	228	646
2003	6,861	8,429	192	814
2004	7,856	9,943	220	790
2005	4,845	8,565	213	566
2006	5,832	6,243	174	934
2007	6,075	7,113	198	854
2008	5,446	5,907	134	922
2009	5,643	6,589	135	856
2010[1]	6,536	7,579	157	862

[1]Preliminary data from version 11.03.16 of the Canadian tuna database

Table 2. Canadian total catch (t) of north Pacific albacore troll fishery by FAO statistical area.

FAO Area	2003	2004	2005	2006	2007	2008	2009	2010[1]
NE Pacific (67)	6,429	7,710	4,834	5,832	6,074	5,446	5,642	6,536
NW Pacific (61)	341	44	11	0	0	0	0	0
EC Pacific (77)[2]	91	102	0	0	1	0	1	0
Total	6,861	7,856	4,845	5,832	6,075	5,446	5,643	6,536

[1] Preliminary data from version 11.03.16 of the Canadian tuna database.
[2] Excludes catch data from below the equator

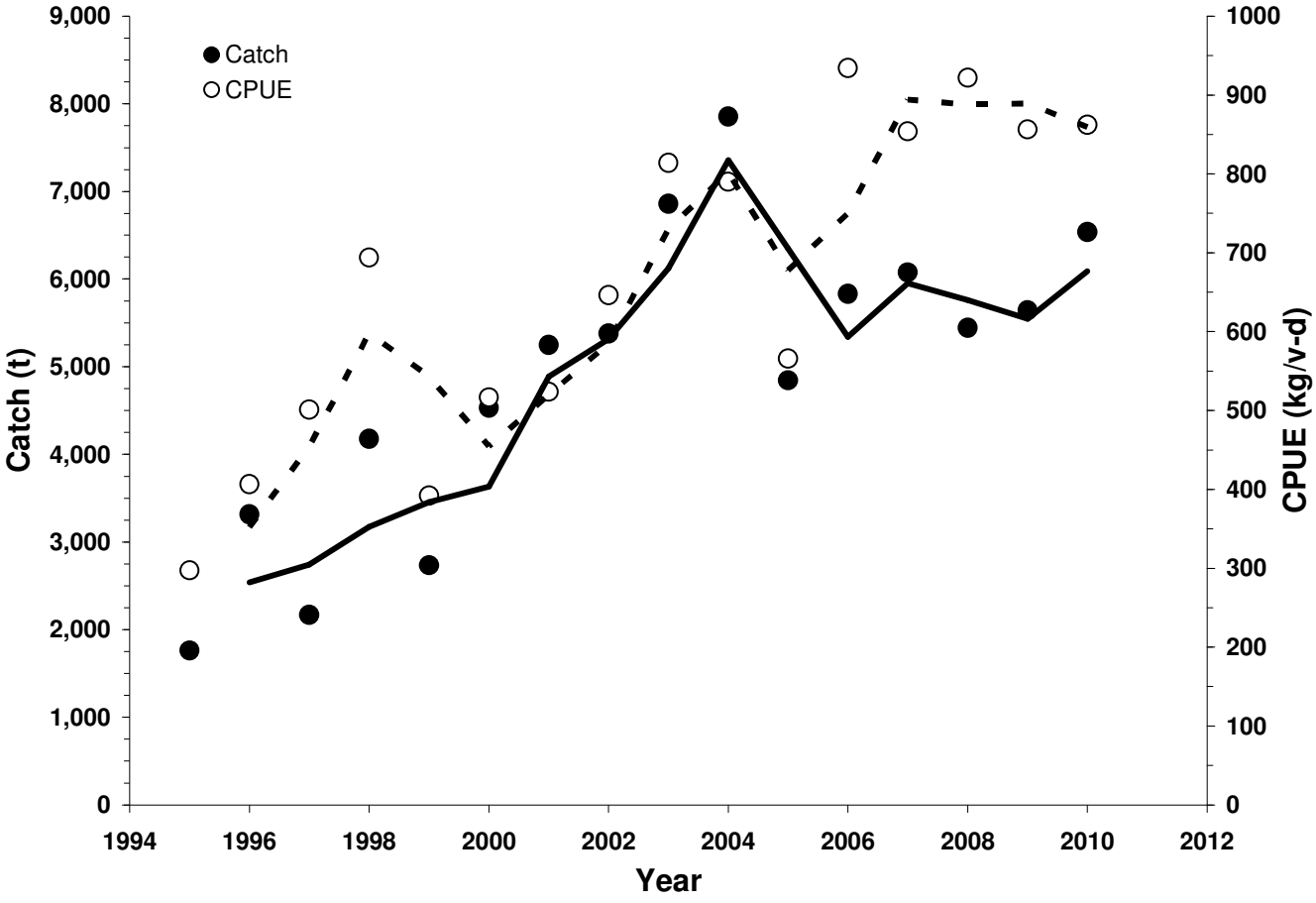

Figure 1. Expanded annual catch (t) and catch-per-unit-effort (CPUE, kg/v-d) from the Canadian troll fishery for albacore in the north Pacific Ocean, 1995-2010. Solid and dashed lines are 2-yr moving averages for catch and CPUE, respectively.

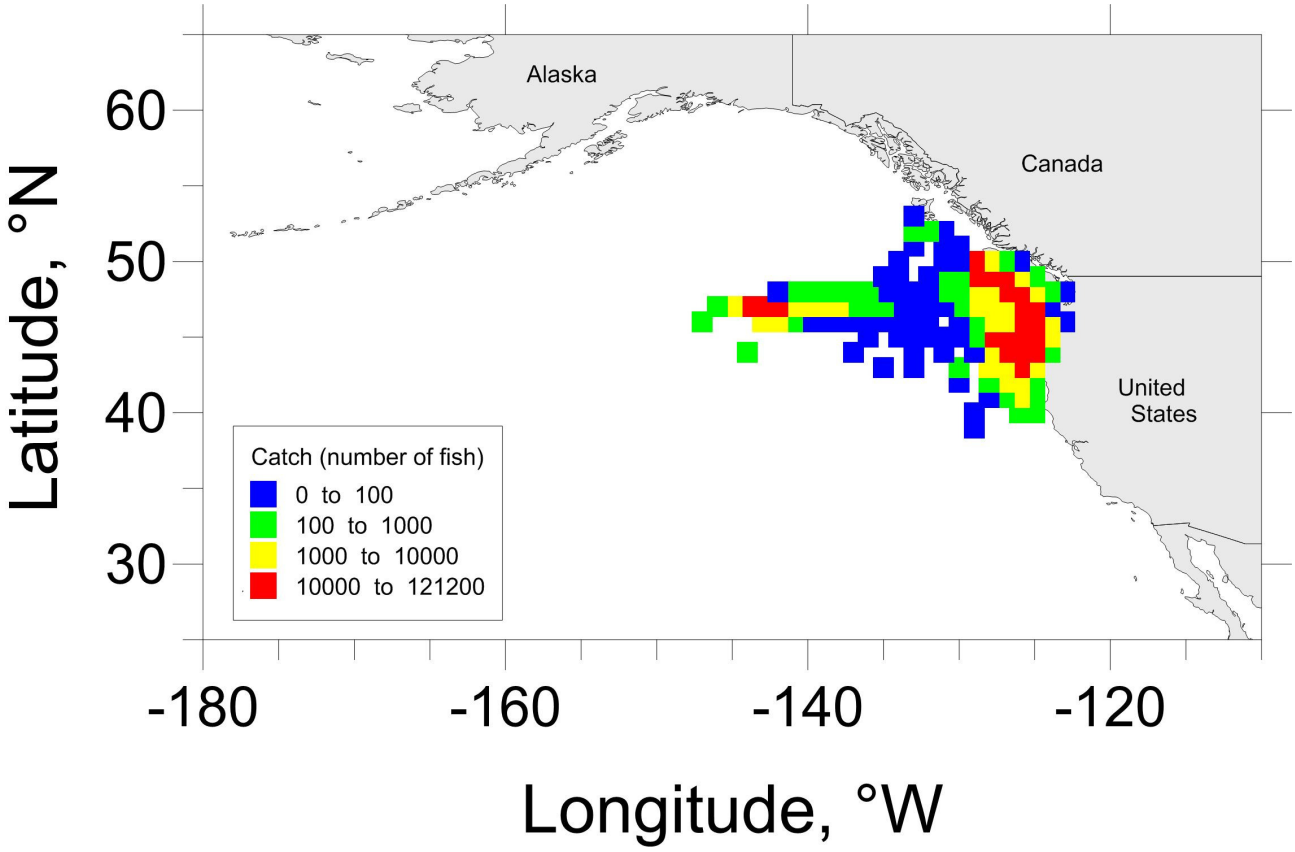

Figure 2. Distribution of the Canadian north Pacific albacore tuna troll fishery catch (number of fish) in 2010. Data are plotted on a 1° x 1° grid with symbols located on the bottom-right corner of each grid cell.

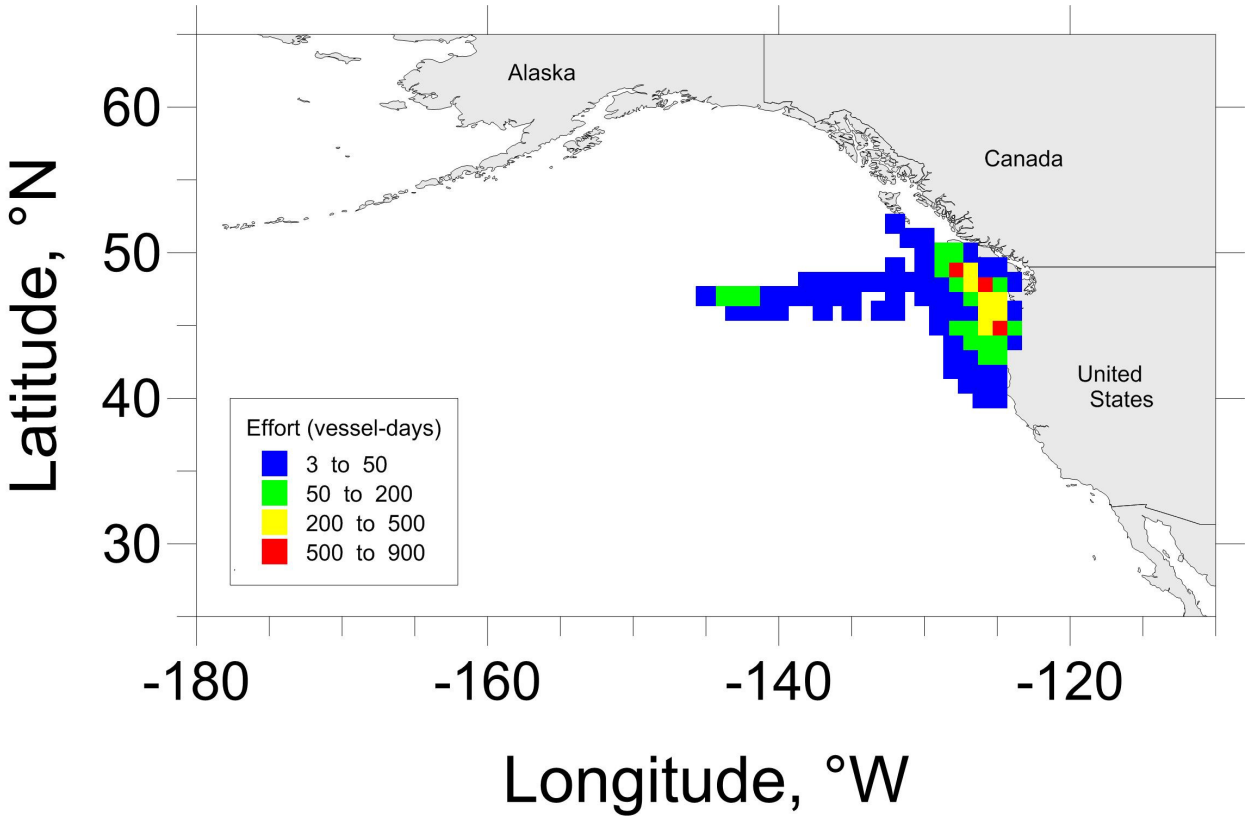

Figure 3. Distribution of the Canadian north Pacific albacore tuna troll fishery effort (vessel-days) in 2010. Data are plotted on a 1° x 1° grid with symbols located on the bottom-right corner of each grid cell.

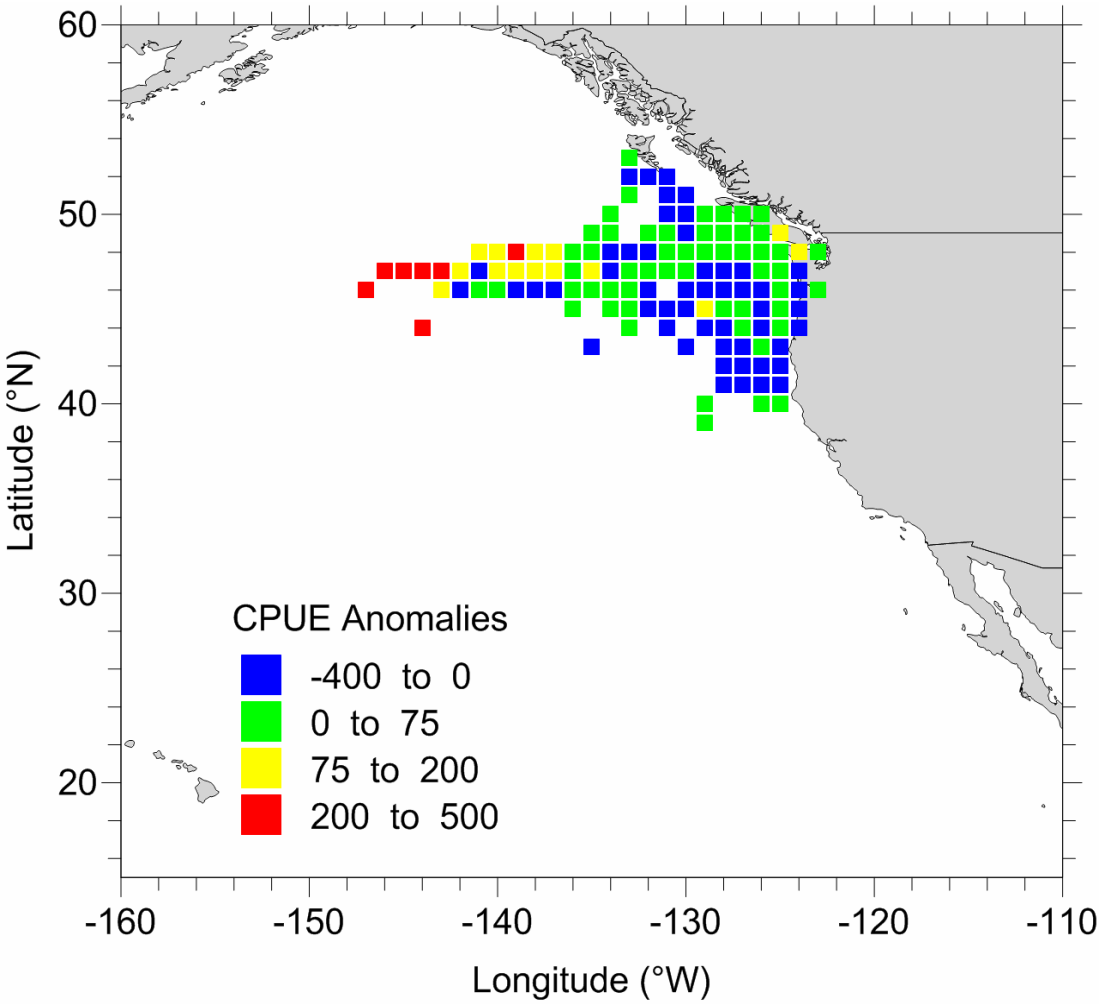

Figure 4. Catch-rate anomalies (fish/vessel-day) based on logbook data in areas fished by the Canadian fleet in 2010. Anomalies are calculated for 1° x 1° spatial blocks.
$Anomaly_{I,J} = Observed_{I,J,2010} - Average_{I,J,2000\text{-}2009}$
where I and J refer to latitude and longitude in whole degrees, respectively. Blocks in blue are below average; all other colours above average catch rates.

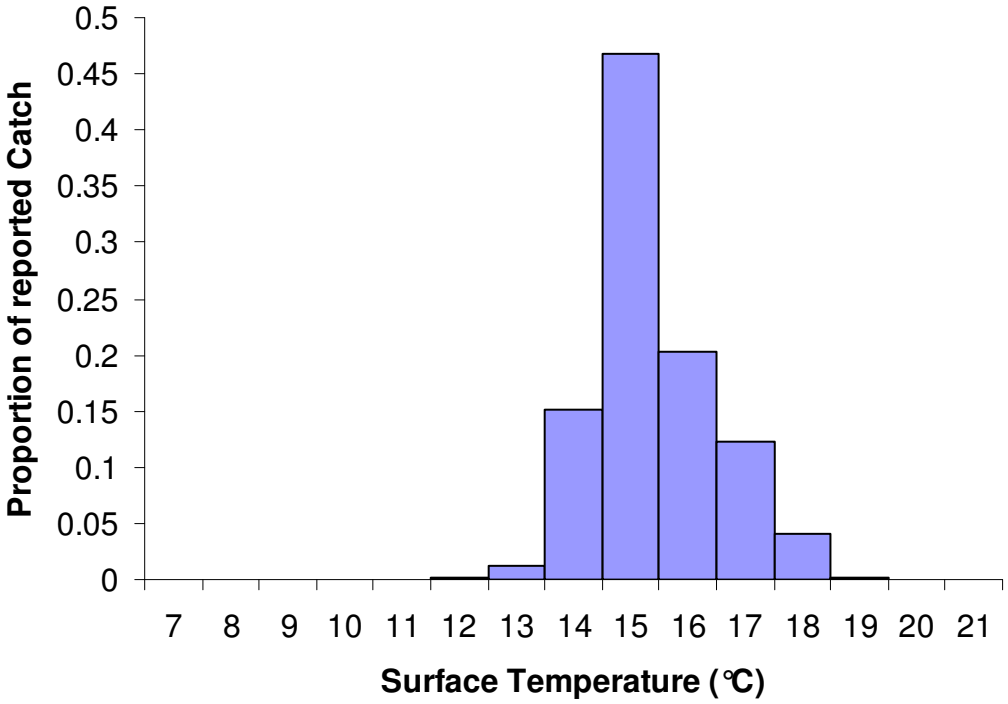

Figure 5. Sea surface temperatures at which albacore tuna were caught by the Canadian troll fishery in 2010 (N = 940,341 fish).

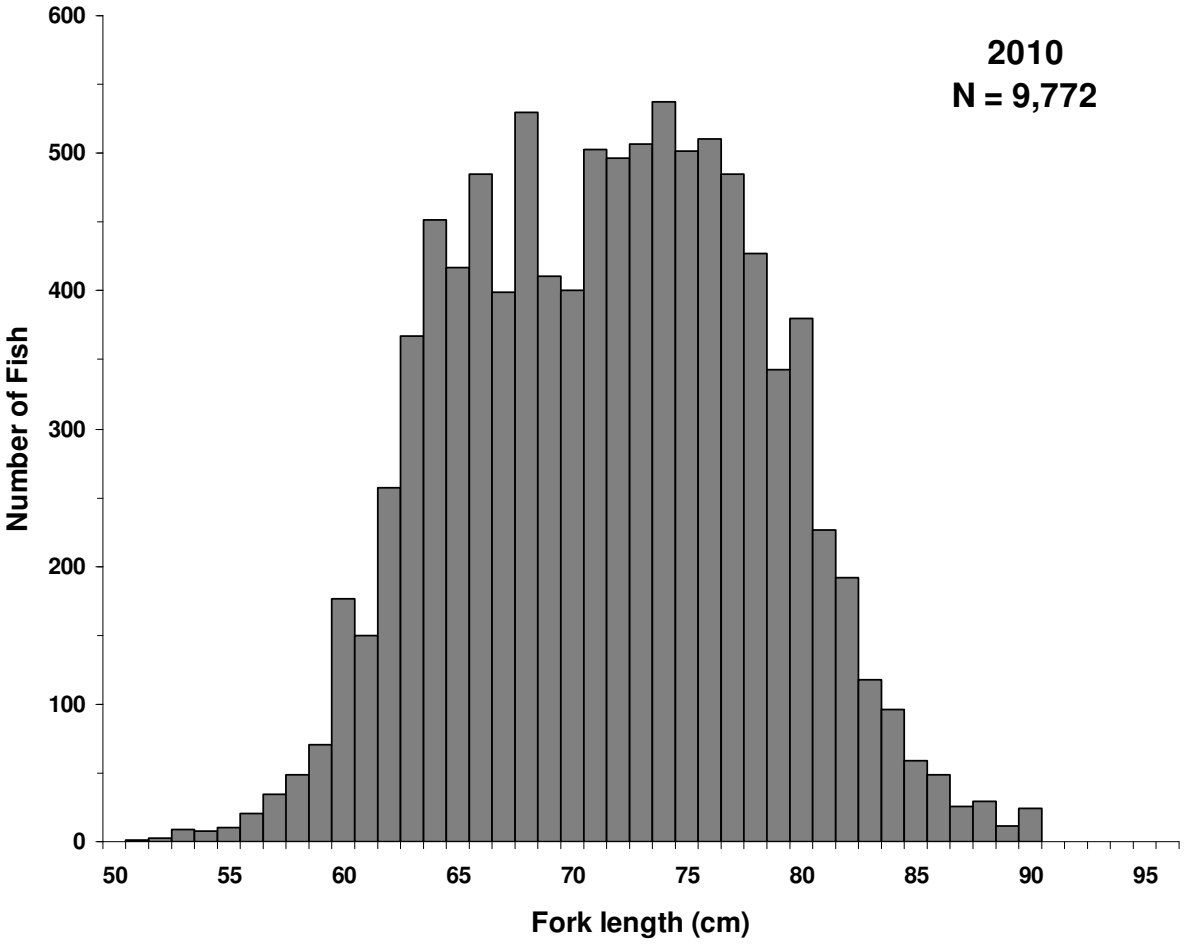

Figure 6. Fork lengths of 9,772 north Pacific albacore harvested by the Canadian fishery in 2010. Data consist of samples from the on-board voluntary program in the Canadian fleet. Additional fork length data may have been collected by the U.S. port sampling program, but these data are not available at present.