9th Meeting of the
International Scientific Committee for
Tuna and Tuna-Like Species in the North Pacific Ocean

The 2008 Canadian North Pacific Albacore Troll Fishery[1]

John Holmes
Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, BC, V9T 6N7, Canada
Email: John. Holmes@dfo-mpo.gc.ca

July 2009

[1]Prepared for the Ninth Meeting of the International Scientific Committee on Tuna and Tuna-like Species in the North Pacific Ocean (ISC), 15-20 July 2009, Kaohsiung, Taiwan. Document not be cited without permission of the authors.

INTRODUCTION

Canadian fishermen have been fishing for albacore tuna (*Thunnus alalunga*) since the mid-1930s. The Canadian fishery started in the coastal waters of British Columbia and is a troll fishery using jigs to targets albacore tuna in the surface waters of four areas of the Pacific Ocean in which the fleet operates: (1) British Columbia coastal, (2) British Columbia/United States coastal, (3) high seas north Pacific ocean, and (4) high seas south Pacific ocean. Although the Canadian fleet will follow 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 and this trend continued in 2008. 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 Canadian and U.S. fishers to catch north Pacific albacore in each other's EEZ, and land albacore tuna at designated ports in Canada and the United States.

Canada is committed to providing detailed catch and effort statistics, logbook data, and fishing vessel information, as is required under the Highly Migratory Species Convention. Management regulations for Canadian vessels fishing albacore tuna in 2008 are documented in the Pacific Region Integrated Fisheries Management Plan: Tuna - April 1, 2008 to March 31, 2009, which is available at: http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/MPLANS/plans08/2008_IFMP-Tuna_complete.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 the Canadian Pacific Albacore Tuna 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 2008 to 31 March 2009, but all catch and effort in the North Pacific Ocean occurred between June and October 2008 when albacore availability to the fleet in coastal waters was 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 (catch length frequencies) data for the Canadian North Pacific albacore troll fishery in 2008. Similar summaries for the 1995 to 2007 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). 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., see Partlo 1951 and Ketchen 1980).

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 sales, 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 does not currently have a domestic program to collect these data from catch landed in Canadian ports.

Fisheries and Oceans Canada embarked on a program in March 1999 to reconcile past estimates of total Canadian catches of albacore from logbook, sales slip, phone-in and transshipment data, which culminated in the development and implementation of the Canadian Albacore Tuna Catch and Effort Relational Database (Stocker et al. 2007). During the process updates, based on new logbook and sales slip information, were made to catches and number of vessels as reported in earlier reports (Shaw and Argue 1999, Argue and Shaw 2000 and Argue et al. 1999). The catch and effort data up to 2006 in the present report are our best estimates and the 2007 data are considered preliminary.

The catch and effort data for 2008 are preliminary and subject to change, and in this report are taken from database version 09.05.07. Logbook coverage was estimated to be 95.5% of expanded catch and effort. The data in this report up to and including 2007 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 (S + X report described in Stocker et al. 2007).

CATEGORY I DATA

Catch

The preliminary estimate of north Pacific albacore tuna caught by the Canadian troll fishery in 2008 is 5,478 metric tons (t), which represents a 10% reduction in catch relative to 2007 (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 4,733 t for the 1995 to 2008 period. All of the 2008 catch occurred in FAO Statistical Area 67 (Table 2) and was distributed in the Canadian EEZ (4%), the United States EEZ (87%), and the highseas (9%) (Figure 2). There are some outliers on Figures 2 and 3 under investigation (either mis-reporting or transcriptional errors,

e.g., 50°N, 126°W), but correcting these data will not change the overall pattern of catches or effort (see below). 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 2008.

Effort

The Canadian albacore troll fleet consisted of 134 unique vessels in 2008, which is the smallest troll fleet operating in the Pacific Ocean in the 1995-2008 period (Table 1). All Canadian vessels targeted the north Pacific albacore stock exclusively. The Canadian troll fleet has ranged in size from 174 vessels in 2006 to 292 vessels in 1996 and has averaged 219 vessels since 1995.

Fishing effort in the Canadian tuna fishery is measured as the number of vessel fishing days (v-d). The 2008 estimate of fishing effort expended in the north Pacific by the Canadian fleet is 5,881 v-d and is a 17% reduction in effort relative to effort in 2007 (Table 1). Annual fishing effort has ranged between 4,324 v-d in 1997 and 10,021 v-d in 2001, averaging 7,477 v-d since 1995. However, Canadian fishing effort has declined from high levels recorded in the 2000-2002 period, which is consistent with the scientific advice in the 2004 and 2006 stock assessments (Stocker 2005, 2007b), that countries not increase their fishing effort for north Pacific albacore tuna.

CPUE

The estimated catch per unit of effort (CPUE) of the Canadian fleet targeting north Pacific albacore tuna in 2008 was 931 kg/v-d, which is the second highest CPUE in the time-series and well above the average value of 633 kg/v-d for the 1995 to 2008 period (Table 1; Figure 1). Historical variation in Canadian CPUE for north Pacific albacore tuna has ranged from a low of 297 kg/v-d in 1995 to a high of 934 kg/v-d in 2006. Both catch and CPUE follow an increasing trend over the period 1995-2004, a drop in 2005 and a resumption of the increasing trend in CPUE through 2008 (Figure 1). In contrast, fishing effort has declined since the 2002-2004 period. The inverse relationship between effort (measured either as the number of vessels or vessel-days) and CPUE in recent years may reflect increasing efficiency/experience of those fishers remaining in the fishery, i.e., less efficient fishermen have left the fishery leaving behind "highliners" who have better CPUEs. Since vessel and captain identifiers are recorded in the logbooks, this hypothesis can probably be tested through the use of GLM or other CPUE standardization methods.

CATEGORY II DATA

Distribution of Catch

Canadian vessels fishing for North Pacific albacore in 2008 operated between the west coast of North America and 141 °W and within a latitudinal range of 40 to 53 °N (Figure 2). The area encompassed by these coordinates represents an expansion of the offshore extent of fishing and a contraction of the latitudinal range relative to 2007 (134 °W and 37-54 °N, respectively). The offshore extension of the fishing area is reflected by the fact that 9% of the catch (501 t) was caught in the highseas zone in 2008; only 5 t, representing < 1% of the catch was caught in the high seas area in 2007. As in previous years, the majority of Canadian catch (87% by weight)

occurred in the United States EEZ, particularly in the coastal waters of Oregon, which accounted for 54% of the catch (by weight). Only 4% of the total catch occurred in Canadian waters in 2008, which is lower than the 16% average for the 2000-2007 period.

Distribution of Effort

Only 92% of the fishing effort by the Canadian troll fleet occurred in the coastal waters of Canada and the United States, as defined by the EEZs shown in Figure 3. This effort was primarily located off of the west coast of Washington and Oregon, and to a lesser extent the southwest coast of Vancouver Island. Minor amounts of effort and catches were reported north of Brooks Peninsula on the west coast of Vancouver Island (Figures 2 and 3). The remaining effort (8%) occurred in highseas areas adjacent to the United States EEZ.

CATEGORY III DATA

Bycatch

Retained bycatch was minimal in 2008, consisting of 107.3 kg (18 fish) of mahi mahi *Coryphaena hippurus*, 1 yellowfin tuna *Thunnus albacares*, and 3.3 kg (49 fish) of yellowtail *Seriola lalandi*. There were no reports of discarded bycatch.

Biological

Canada did not have a formal domestic sampling program to obtain biological data from albacore tuna harvested by the Canadian fleet in 2008. Fishers with measuring boards from previous programs were asked to measure and record the lengths of the first 10 fish landed daily in their logbooks during the 2008 season. A total of 736 length measurements were submitted voluntarily as a result. Canadian catches landed in designated ports in the USA may be sampled by the port sampling program implemented to collect size composition from the USA troll fleet. Size composition data for 2008 from the USA port sampling program were not available for this report. Weights are estimated from the length-weight relationship for both sexes reported by Clemens (1961):

$$\hat{W} = 4.936 \text{ x } 10^{-8} \cdot L^{2.99},$$

where $\hat{W}$ is weight in pounds (lbs x 0.4536 = kg) and L is fork length in mm.

Based on the voluntary data submitted by the Canadian fleet, albacore in the Canadian catch ranged from 54 cm (3.31 kg) to 89 cm (14.75 kg) in size (Figure 4). Three modes are present in the length frequency data at 57 cm (3.89 kg), 64 cm (5.50 kg) and 74-75 cm (8.67 kg). These modes are used to assess the age composition of the catch and ccorrespond to 2-, 3- and 4-yr old fish, respectively. As in past years, the largest proportion of the albacore tuna caught by the Canadian troll fleet are 3-year old fish.

RESEARCH ACTIVITIES

Beginning with the 2009 fishery, a domestic sampling program is being implemented to obtain size composition data from the Canadian catch of albacore. Canadian fishers were provided with

a measuring board design and have been asked to voluntarily measure and report the lengths of the first 10 fish landed daily. The database used to track albacore catch and effort data (Stocker et al. 2007) was modified to accept and record daily length measurements reported in logbooks. These measurements are linked to daily positions (latitude and longitude) and temperature recorded in logbooks so that future analysis will be able to assess the size composition of catch in the Canadian EEZ, the United States EEZ, and the highseas. We anticipate about 30% of the fleet will take on this task of making and report length measurements for size composition analysis.

During the Eighth Meeting of the ISC in Takamatsu, Japan, a half-day session was held to discuss biological research needs that would improve stock assessments conducted by each Working Group (Albacore, Pacific bluefin, Billfish). The two highest priority needs identified during this seminar were: (1) age and growth data (e.g., length and weight by sex, age using otoliths, fin rays, etc.), and (2) maturity data (e.g., fecundity, maturity schedules). A Biological Research Task Force (BRTF) was established and tasked with designing a multispecies and large-scale biological sampling program to obtain the data needed for both age and growth and maturity studies. The BRTF, which is led by Eric Chang (Chinese-Taipei) and assisted by John Holmes (Canada), met in Busan, Korea (28-30 May 2009) to compile sampling requirements from all ISC Working Groups. The BRTF reported its findings and presented a proposal for a multi-national, multi-species sampling program in the North Pacific Ocean to the Ninth ISC Meeting in Kaohsiung, Taiwan, 8-20 July 2009.

Canadian fishers usually record daily sea surface temperature (SST) measurements in their logbooks. Research is in the early stages of using these data and satellite imagery of ocean colour (due to phytoplankton) to investigate patterns of albacore distribution and abundance in an effort to develop tools that can be used to provide preseason forecasts of albacore availability within Canadian waters as a contribution to annual State of the Ocean reporting for the Pacific coast of Canada (e.g., see Crawford and Irvine 2009). Tuna were captured in sea surface temperatures (SST) ranging from 11 to 20 °C in 2008, with the 98% of the catch occurring at temperatures between 14 and 18 °C (Figures 5 and 6). In contrast, albacore were caught in a wider range of temperatures (9-20 °C) in 2007, and the majority of catch (98%) occurred in a slightly warmer range of 16-19 °C compared with 2008. Only 4% of the total catch occurred in Canadian waters in 2008, which is lower than the 16% average for 2000-2007, and especially lower than in 2001, which coincided with a La Niña event.

REFERENCES

Argue, A.W. and W. Shaw. 2000 MS. An update for Canadian tuna fisheries in the north and south Pacific ocean. 17pp. Document submitted by DFO to the thirteenth Meeting of the Standing Committee on Tuna and Billfish in Noumea, New Caledonia, July 5-12, 2000.

Argue, A.W., W. Shaw, and N. Williscroft. 1999 MS. An update for Canadian albacore fisheries in the north and south Pacific ocean. 8pp. Document submitted by DFO to the twelve Meeting of the Standing Committee on Tuna and Billfish in Tahiti, French Polynesia, June 16-23, 1999.

Clemens, H.B. 1961. The migration, age, and growth of Pacific albacore (*Thunnus germo*), 1951-1958. California Department of Fish and Game, Fish Bulletin 115: 128 p.

Crawford, W.R. and J. R. Irvine. 2009. State of physical, biological, and selected fishery resources of Pacific Canadian marine ecosystems. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/022. vi + 121 p. Available at: http://www.dfo-mpo.gc.ca/CSAS/Csas/Publications/ResDocs-DocRech/2009/2009_022_E.pdf)

Holmes, J.A. 2008 MS. The 2007 Canadian North Pacific albacore tuna troll fishery. Document prepared for the Eighth Meeting of the International Scientific Committee on Tuna and Tuna-like Species in the North Pacific Ocean (ISC), 22-27 July 2008, Takamatsu, Japan. ISC/08/Plenary/04: 13 p.

Ketchen, K.S. 1980. Report of the Canadian fishery for albacore in 1979. Canadian Industry Report of Fisheries and Aquatic Sciences 116, 21 p.

Partlo, J.M. 1951. A report of the 1950 albacore fishery of British Columbia. Fisheries Research Board of Canada, Pacific Biological Station Circular No. 23, 15 p.

Shaw, W. 1997 MS. The Canadian albacore fishery off the west coast of British Columbia, 1996-97. 15 pp. Document submitted by DFO to the Fifteenth Meeting of the North Pacific Albacore Workshop, Nanaimo, B.C., December 1997.

Shaw, W. 1999 MS. An update of the Canadian north Pacific albacore fishery. 6 pp. Document submitted by DFO to the Second Meeting of the Interim Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean, Honolulu, Hawaii, January 1999.

Shaw, W. and A.W. Argue. 1999 MS. The Canadian albacore fisheries in the north Pacific ocean, 1995-1998. Document submitted by DFO to the Sixteenth Meeting of the North Pacific Albacore Workshop, Kesennuma, Japan, November 4-6, 1999.

Shaw, W. and A.W. Argue. 2000 MS. The 1999 Canadian north Pacific albacore troll fishery. Document submitted by DFO to the Seventeenth Meeting of the North Pacific Albacore Workshop, Taipei, Taiwan, December 6-13, 2000.

Shaw, W. and M. Stocker. 2002 MS. The 2000 and 2001 Canadian North Pacific albacore troll fishery. Document submitted by DFO to the Eighteenth Meeting of the North Pacific Albacore Workshop, La Jolla, CA, December 4-11,2002. NPALB/02/16: 22p.

Stocker, M. 2005 (editor). Report of the Nineteenth North Pacific Albacore Workshop. Nineteenth North Pacific Albacore Workshop, Nanaimo, B.C., Canada, November 25-December 2, 2004. Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, B.C., Canada. 127 p.

Stocker, M. 2006 MS. The 2005 Canadian North Pacific albacore troll fishery. Document submitted by DFO to the ISC Albacore Working Group Meeting, 2006 National Research Institute of Far Seas Fisheries (NRIFSF), 5-7-1 Orido Shimizu-ku, Shizuoka-shi, 424-8633 Japan. ISC-ALBWG/06/05: 10p.

Stocker, M. 2007a MS. The 2006 Canadian North Pacific albacore troll fishery. Document submitted by DFO to the ISC Plenary Session, Busan, Korea. ISC/07/PLENARY/04: 8p.

Stocker, M. 2007b (editor). Annex V. Report of the Albacore Working Group Workshop. Shimizu, Japan, November 28 – December 5, 2006. Report of the Seventh Meeting of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean, Plenary Session, Busan, Korea, July 25-30, 2007. Annex V, 72 p.

Stocker, M. and W. Shaw. 2004a MS. The 2002 Canadian north Pacific albacore troll fishery. Document submitted by DFO to the Fourth Meeting of the Interim Scientific Committee on Tuna and Tuna-like Species in the North Pacific Ocean (ISC), Honolulu, Hawaii, 26 January-4 February, 2004. ISC/04/Plenary/1: 11p.

Stocker, M. and W. Shaw. 2004b MS. The 2002 and 2003 Canadian north Pacific albacore troll fishery. Document submitted by DFO to the Nineteenth Meeting of the North Pacific Albacore Workshop, Nanaimo, BC, November 25-December 2, 2004. NPALB/04/03: 11p.

Stocker, M. and W. Shaw. 2005 MS. The 2004 Canadian north Pacific albacore troll fishery. Document submitted by DFO to the ISC Albacore Working Group Meeting, NOAA Fisheries, Southwest Fisheries Science Center, La Jolla, CA, USA, November 28-December 2, 2005. ISC-ALBWG/05/12: 10p.

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.

Ware, D.M. and K.L. Yamanaka. 1991 MS. Catch statistics for the Canadian albacore tuna fishery: 1945-1990. 4 pp. Document submitted by DFO to the Annual Meeting of the International North Pacific Fisheries Commission, Tokyo, Japan, November 1991.

Table 1. Fishery statistics for the Canadian north Pacific albacore tuna fishery, 1995-2008.

Fishing Season	Total Catch (metric tonnes)	Effort (vessel-days)	Total Unique Vessels	CPUE (kg/v-d)	Logbook Coverage[2]
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	213	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[1]	5,478	5,881	134	931	96%
Mean	4,733	7,477	219	633	78%
Maximum	7,856	10,021	292	934	99%
Minimum	1,763	4,324	134	297	22%

[1] 2008 data are preliminary based on Ver.09.05.07 of the *Canadian Albacore Tuna Catch and Effort Relational Database* and v09.06.02 of the codebase.

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

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

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

[1] Preliminary 2008 data obtained with codebase Version 09.06.02 and Version 09.05.07 of the *Canadian Albacore Tuna Catch and Effort Relational Database*.

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

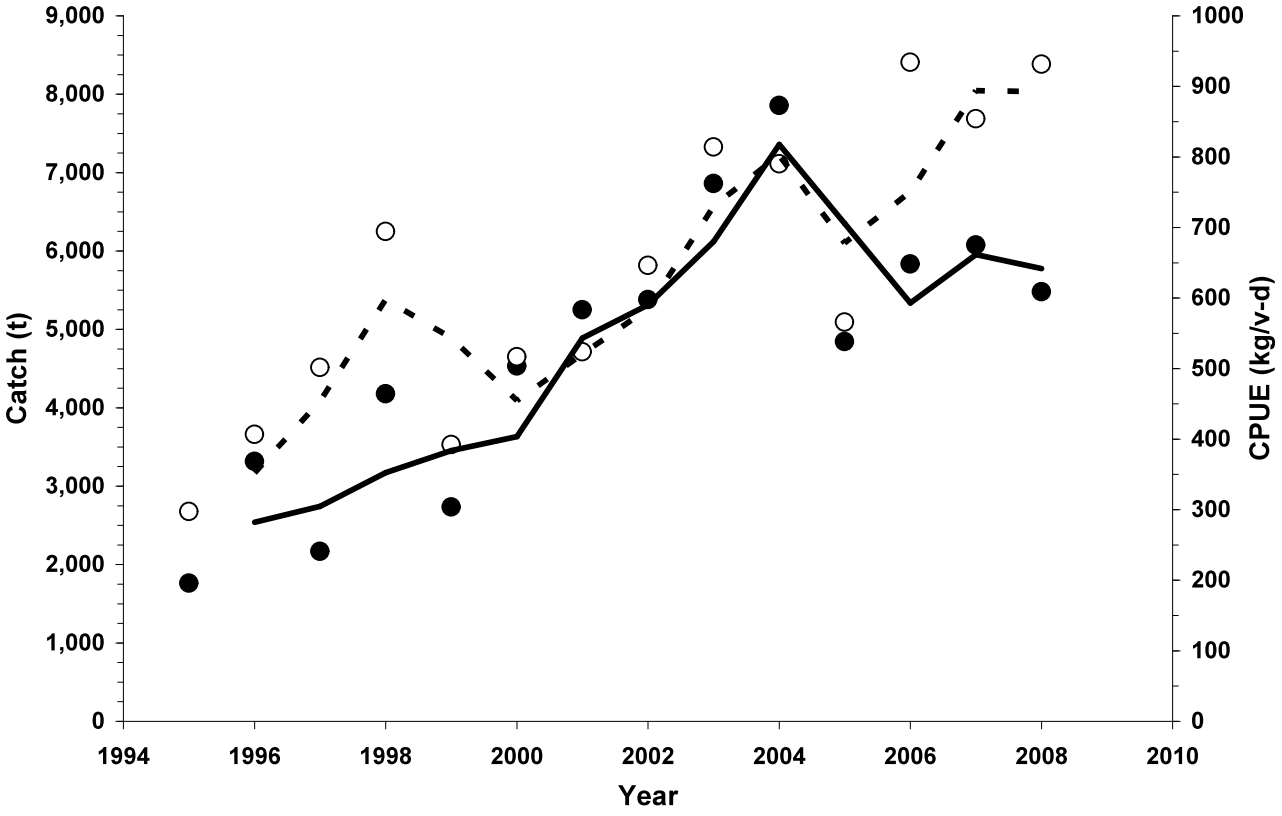

Figure 1. Canadian north Pacific albacore troll catch (●) and CPUE (○) from 1995 to 2008. Lines are 2-yr moving averages of catch (▬) and CPUE (– –).

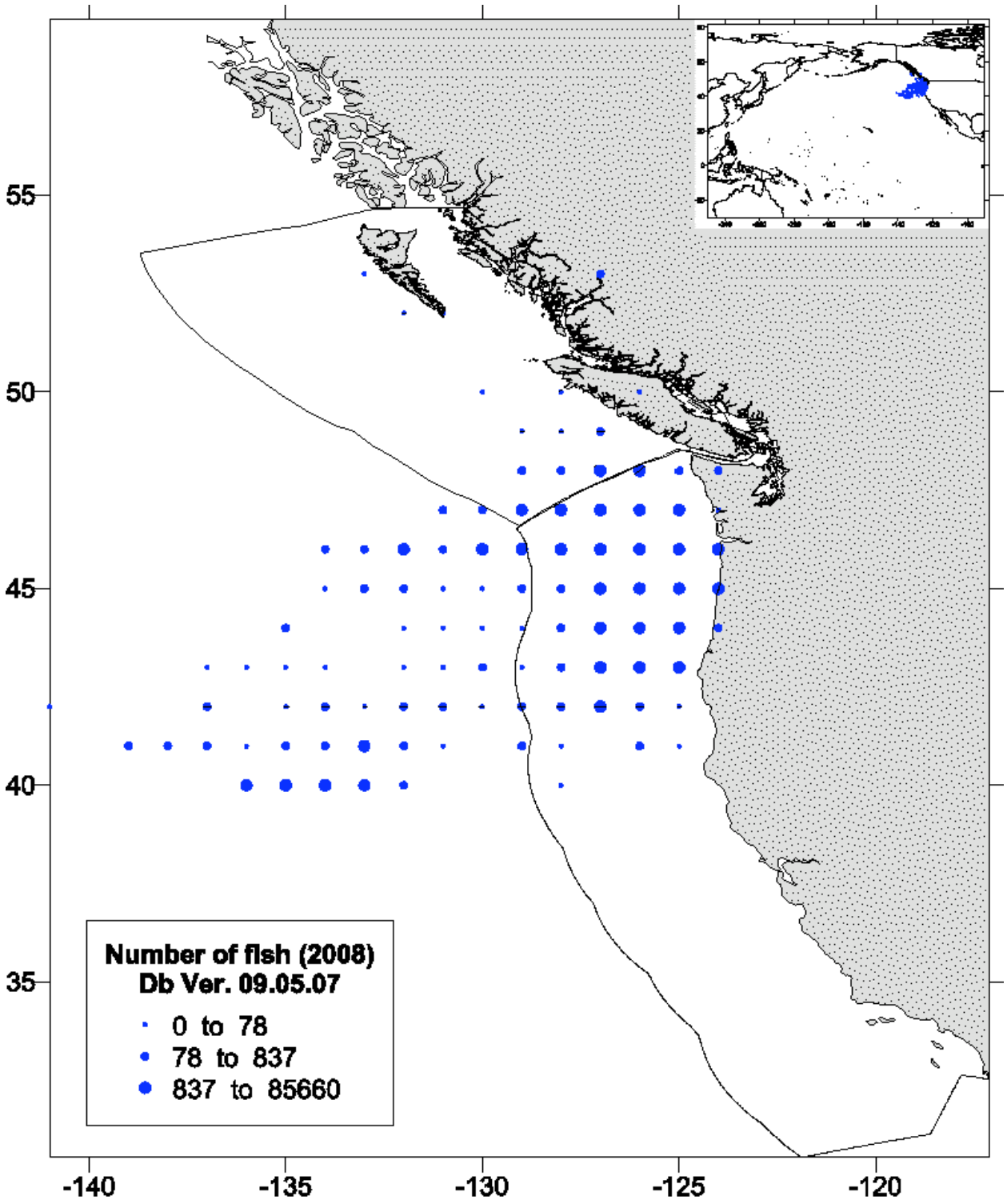

Figure 2. Distribution of the Canadian north Pacific albacore tuna troll fishery catch (Number of fish) in 2008. Data are plotted on a 1° x 1° grid with symbols located on the bottom-right corner of each grid cell. Size of the symbol is proportional to the catch. The plot also shows the boundaries of the Canadian and United States exclusive economic zones (200-mile limit).

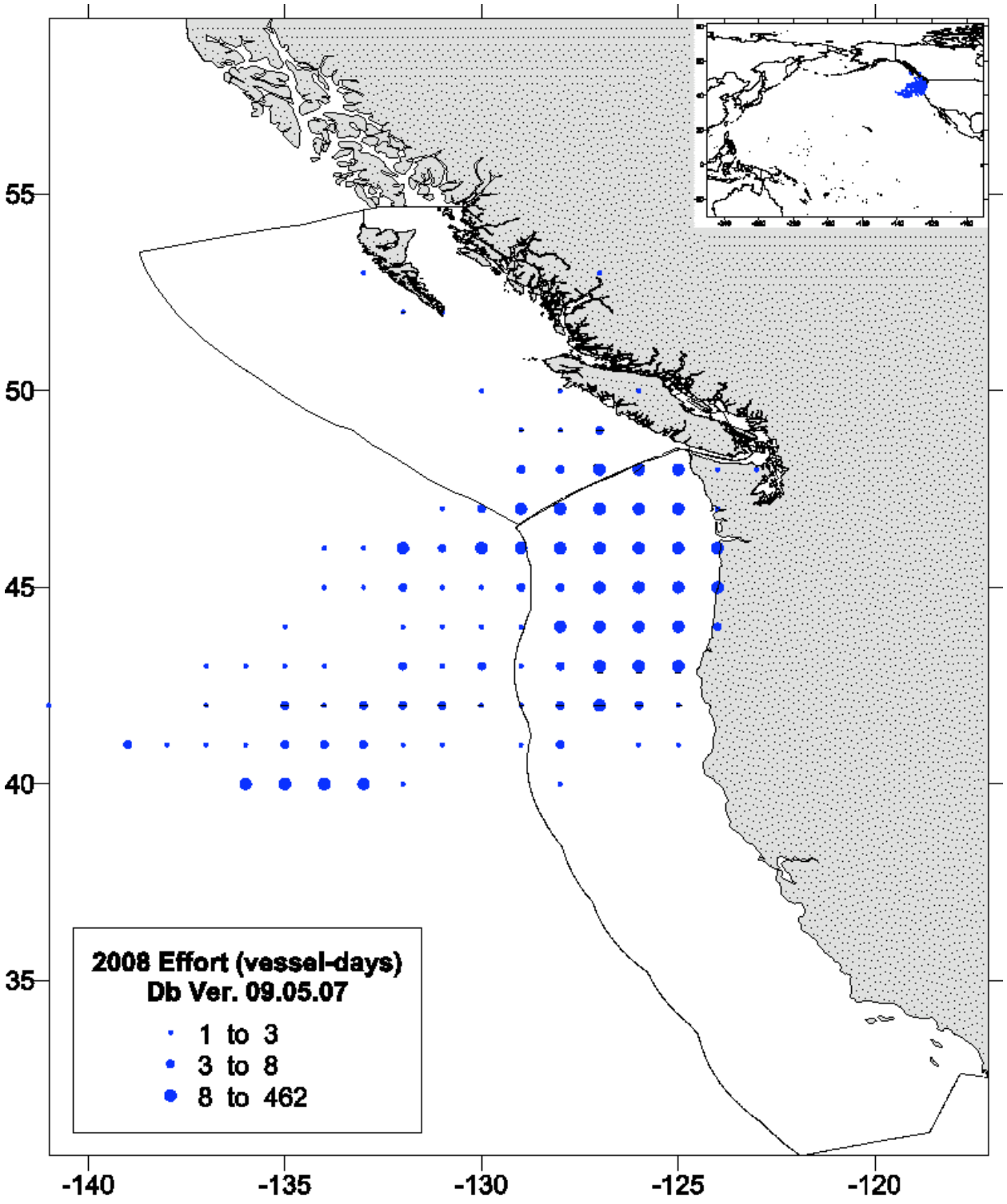

Figure 3. Distribution of the Canadian north Pacific albacore tuna troll fishery effort (vessel-days) in 2008. Data are plotted on a 1° x 1° grid with symbols located on the bottom-right corner of each grid cell. Size of the symbol is proportional to effort. The plot also shows the boundaries of the Canadian and United States exclusive economic zones (200-mile limit).

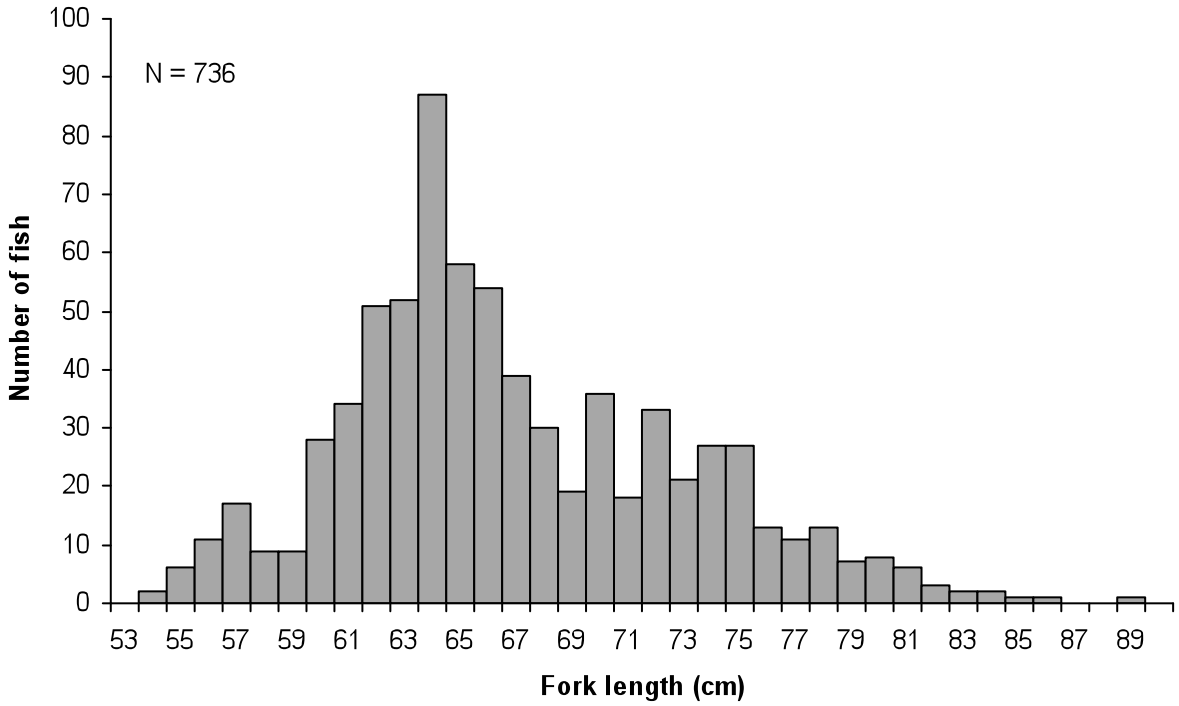

Figure 4. Fork lengths of North Pacific albacore harvested by the Canadian fishery in 2008 and reported voluntarily by fishers.

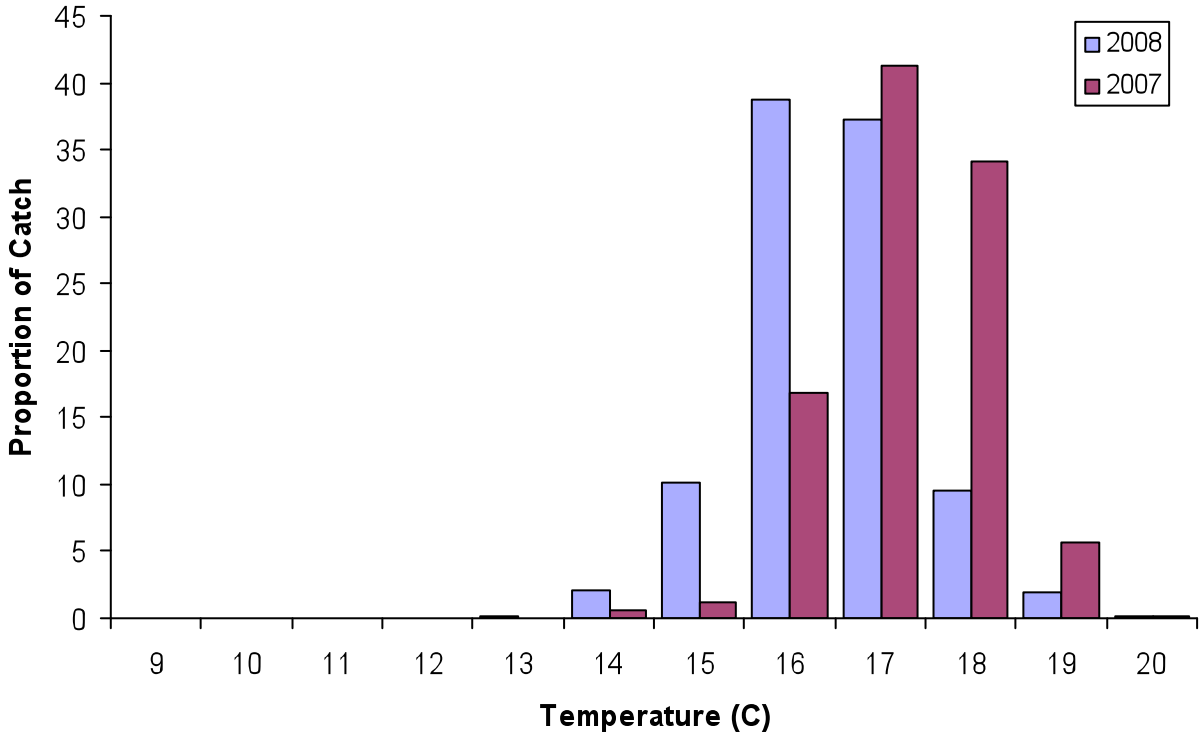

Figure 5. Sea surface temperatures at which albacore tuna were caught by the Canadian troll fishery in 2007 (N = 874,263) and 2008 (N = 731,657).

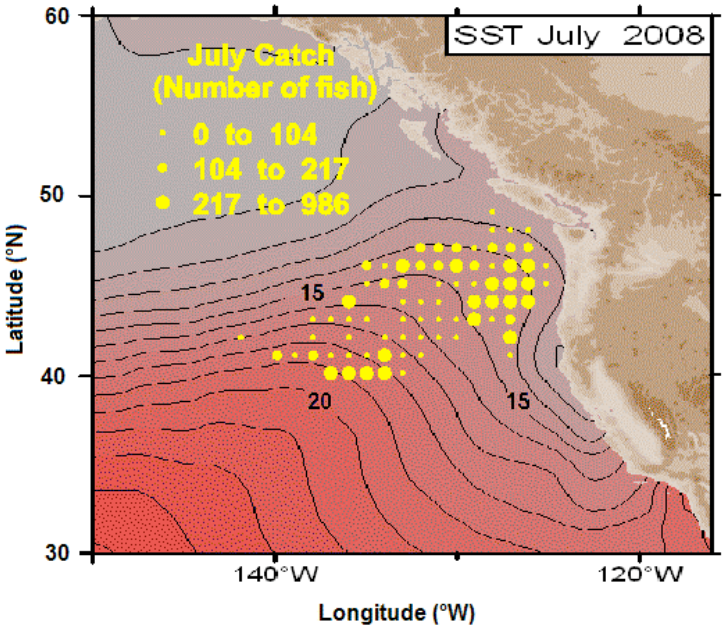

Figure 6. Distribution of Canadian albacore catch reported by the Canadian fleet in July 2008 relative to sea surface temperature isotherms. Catch data are reported on a 1° x 1° grid and each dot is located on the lower right corner of each grid cell. Temperature isotherm interval is 1 C°. SST graphic obtained from: http://www-sci.pac.dfo-mpo.gc.ca/osap/data/sstarchive_e.htm