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National Report of Canada (Canadian Tuna and Tuna-like Fisheries in the North Pacific Ocean)[1]

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SUMMARY

Canada has one fishery for highly migratory species in the north Pacific Ocean, an albacore (*Thunnus alalunga*) troll fishery. Category I, II, and III data from the Canadian albacore troll fishery in 2012 are summarized in this report. The Canadian fleet of 175 vessels operated primarily within eastern Pacific Ocean waters. Provisional 2012 estimates of catch and effort are 2,497 metric tonnes (t) and 6,011 vessel-days, respectively, and are a 54% decrease in catch and 30% decrease in effort relative to 2011. Approximately 81% of the catch and 93% of the effort occurred in Canadian waters during 2012 and the remaining catch and effort occurred in adjacent high seas waters. More than 90% of the catch occurred in cooler waters (15-16°C) than in previous years (15-19°C) and seasonal catch rates were much lower than average. Forty-seven vessels participated in the on-board size sampling program and measured 11,139 fish for a sampling rate of 3.0% of the reported catch. These measurements were dominated by fish between 64-69 cm fork length (FL) corresponding to 2-year old fish and a significant number of fish between 74-78 cm FL, which are 3-years old. The decline in this fishery appears to be the result of a lack of Canadian vessel access to waters in the US EEZ owing to the absence of a fishing regime for 2012 under the bilateral tuna treaty between the countries.

Catch and effort data from 2004 to 2010 were revised for the second consecutive year. These revised data are shown in this report and were reviewed by the Albacore Working Group. This revision was necessary to correct an error in the database loading procedure for the most recent data that inflated estimates of catch and effort in prior years already loaded into the database. The error was corrected, the 2004-2010 data were reloaded into the database, and the results were tested to confirm that the data were not altered by the loading procedure.

1.0 INTRODUCTION

The Canadian fishery for highly migratory species uses troll gear with jigs to target juvenile north Pacific albacore tuna (*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 reciprocal access by Canadian-flagged and US-flagged vessels licensed to fish for albacore and for the landing of albacore catches at designated ports within each country. Some of the larger Canadian vessels follow albacore tuna concentrations into offshore waters and into the central and western Pacific Ocean. Management regulations for Canadian vessels fishing albacore tuna from 01 April 2012 to 31 March 2013 are documented in the Albacore Tuna Integrated Fisheries Management Plan (IFMP) at http://www.dfo-mpo.gc.ca/Library/343252.pdf. Historically the majority of catch and effort for north Pacific albacore has occurred in a four month period from July to the end of October**.**

This report summarizes Category I (annual catch and effort), Category II (annual 1° x 1° catch and effort data), and Category III (bycatch, catch size composition) data for vessels active in the Canadian north Pacific albacore troll fishery in 2012. This report also provides information on scientific research conducted by Fisheries and Oceans Canada (DFO) in support of resource

conservation and management both domestically and internationally, including stock assessment, biological and oceanographic studies.

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 generates the best available estimates of total annual catch and effort by geographic area for the Canadian fishery. All Canadian fishing vessels are required to hail 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 and non-target species. These data have the highest temporal and spatial resolution and are obtained when logbooks are returned after the fishing season is completed. The third data source, sales slips, record the weight of albacore landed and bought by domestic Canadian buyers and provide the most accurate estimates of albacore 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 to DFO for entry into the albacore catch database (Stocker et al. 2007).

Fork length data were collected from a portion of the Canadian catch landed in United States ports by US port samplers and forwarded to Canada prior to 2009. In 2009, Canada implemented an on-board harvester program to sample fork lengths in the Canadian catch. Participation is voluntary and harvesters are asked to measure the first 10 albacore landed on a daily basis and record these data in spaces provided in their logbooks. Fork length data reported by Canada for 2009 and onward to the present are from the domestic sampling program only.

The fishery data provided in this report were taken from Canadian tuna database version 13.02.11. Figures up to and including 2011 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) The 2012 catch and effort data are considered preliminary at this time.

3.0 AGGREGATED CATCH AND EFFORT DATA

The catch and effort data for the north Pacific albacore reported in the present report (Table 1) for 2004 through 2010 were revised relative to the data reported by Holmes (2012). These revisions were necessary because quality assurance checking found that occasionally new data records were silently inserted into prior years already in the database during the loading of data for the most recent year, inflating catch and effort estimates in previous years. We have corrected the issue, reloaded the 2004-2010 data, tested the results, and are confident that these new estimates are the best available for the Canadian fishery. These revised data were reviewed earlier by the ALBWG. Logbook coverage is also documented in Table 1 and shows the level of expansion applied to logbook data (reported data) to derive the annual estimates in Table 1.

4.0 TRENDS IN CATCH AND EFFORT DATA

4.1 Catch

The preliminary estimate of the Canadian albacore catch in 2012 is 2,497 metric tons (t) and is a 54% decrease relative to 2011 (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 4,931 ± 1,660 (sd) t for the 1995 to 2011 period. The 2012 catch was distributed among the Canadian EEZ (81%) and adjacent high seas waters (19%) only. Canadian vessels were not permitted to access waters in the US EEZ during the 2012 fishing season.

4.2 Effort

The Canadian albacore troll fleet consisted of 175 unique vessels in 2012 and was unchanged in size relative to 2011, but is below the average participation of 211 vessels for the 1995-2011 period (Table 1). The 2012 estimate of fishing effort is 6,010 v-d and is a 30 % decrease in effort relative to 2011 (Table 1; Figure 1). Fishing effort in 2012 was split between the Canadian EEZ (83%) and adjacent high seas waters (17%) since access to the US EEZ was not permitted. Annual fishing effort has ranged between 4,320 v-d in 1997 and 10,021 v-d in 2001, averaging 7,459 ± 1,565 (sd) v-d since 1995.

5.0 SPATIAL DISTRIBUTION OF CATCH AND EFFORT DATA

The Canadian troll fleet operated between 32 and 54 °N latitude and from the west coast of North America to 151° W in 2012 (Figure 2), which is further south and north than in the previous five years. The Canadian fishery operated north of the equator primarily within the IATTC convention area east of 150°W, but a minor amount of catch (<1 t) was made in the WCPFC convention area, continuing a trend of concentrating catch and effort in eastern Pacific Ocean (EPO) that began in 2005. Approximately 83% of the fishing effort occurred within the Canadian EEZ and resulted in 81% of the total catch in 2012 and the remaining 19% of effort and 17% of catch occurred in high seas waters. This pattern differs from the fishing pattern in previous years and is the result of a redistribution of effort because Canadian vessels were not permitted to access waters in the US EEZ, where on average 78% of the effort and 79% catch has occurred between 1995 and 2011.

Albacore were caught in waters with sea surface temperatures ranging between 10 and 20 °C in 2012 (Figure 3). More than 90% of the fish were harvested in waters between 15 and 16 °C (Figure 3), which is a cooler temperature range than in other years when the majority of catch was made in waters between 16 and 18 °C (e.g., see Holmes 2011, 2012).

6.0 BIOLOGICAL DATA

6.1 By-catch

Reported by-catch was 45 fish and four species in 2012 (Table 2). Yellowtail amberjack (*Seriola lalandi)* was the most commonly reported by-catch species with 33 individuals. Total weight of all by-catch is estimated to be approximately 148 kg, of which yellowtail accounted for 101 kg.

6.2 Biological

Forty-seven (47) vessels measured 11,139 fork lengths in 2012 (Figure 4), representing a sample rate of 3.0% of the reported catch. This sampling rate is well above the target of 1.0% of the reported catch.

Albacore in the Canadian catch ranged from 50 cm to 90 cm in size (Figure 4), which is consistent with the size range reported in previous years (see Holmes 2011, 2012). These measurements are skewed towards a mode corresponding to 2-year old fish at 64-69 cm FL. A significant number of fish formed a less prominent second mode between 74-78 cm FL, corresponding to 3-year old fish (Figure 4). The size range and length-frequency distribution pattern in 2012 is consistent with size composition patterns observed in previous years.

7.0 DISCUSSION

Canadian albacore fishery statistics from 1995 to 2010 were updated in 2012 (Holmes 2012) and data from 2004 to 2010 were subsequently revised in the present report (Table 1) to correct a database error. The catch and effort data shown in Table 1 for 1995 to 2011 are considered definitive and were used in subsequent tables and figures in this report.

The 2012 Canadian albacore fishery was marked by a 54% reduction in catch and 30% reduction in effort relative to 2011, although fleet size remained stable. The decline in this fishery appears to be the result of a lack of Canadian vessel access to productive albacore waters in the US EEZ owing to the absence of a fishing regime for 2012 under the bilateral Canada-United States Albacore Tuna Treaty. The lower than normal water temperatures at which the bulk of the catch was made (Figure 3) are consistent with a redistribution of fishing activity into less productive waters for albacore than normal. A one-year fishing regime was negotiated for 2013 by the Canadian and United States governments, but the outlook for future is uncertain.

8.0 RESEARCH

Canadian highly migratory species research in the Pacific Ocean has focused on improving understanding of the biology and ecology of north Pacific albacore tuna to enhance assessments of the effects of fishing and the environment on stock dynamics and status. The studies highlighted below have recently been completed or are ongoing and are conducted largely in cooperation with stakeholders and in collaboration with both Canadian and international colleagues.

A tagging program using pop-up satellite archival tags (PSATs) was designed for implementation in 2013. The goal of this program is to investigate daily and seasonal movement patterns of juvenile albacore in the eastern Pacific Ocean. Protocols for handling and tagging

fish and minimizing premature tag release have been developed and PSATs and tagging gear purchased. PSATs produced by Desert Star Systems and Wildlife Computers will be compared for performance and tags will be deployed in August or October 2013.
Five vessels were equipped with scales (spring-loaded Pesola scales) in 2012 and asked to weigh and record in logbooks weights along with lengths of the first 10 fish landed on a daily basis or as often as possible. The goal of this program is to update length-weight relationships for juvenile albacore used to by vessel captains to estimate weights in their logbooks. Approximately 3,000 data pairs were turned in by crews from two vessels for fish from Canadian and high seas waters. Two other vessels reported little success owing to rough conditions inhibiting an accurate weight reading. The same five vessels will be asked to record lengths and weight again in 2013 in order to assess differences between areas and growth and fish condition between years.

Canada has continued with modeling research evaluating the impacts of biological and oceanographic variables on the population dynamics of albacore tuna using a logistic surplus production model. The effects of oceanographic indices such as the Pacific Decadal Oscillation (PDO), North Pacific Oscillation Index (NOI), Multivariate ENSO Index (MEI), and the North Pacific Gyre Oscillation (NPGO) on K and r were modeled. The model fits primarily to abundance index derived from the Japanese longline fleet, but did not fit the other abundance indices as well. Preliminary results were reviewed at the March 2013 workshop of the ALBWG and show that the NPGO has a significant positive effect on stock productivity and the MEI has a significant negative impact on productivity at a time lag of 4 years. The other indices had no detectable effects on productivity. The mechanism by which these indices appear to affect albacore productivity is through recruitment. A manuscript describing the model and results has been submitted for publication.

Canada is collaborating with US colleagues (Y. Xu and S. Teo) on research investigating environmental influences on albacore distribution in the coastal and open ocean waters of the eastern Pacific Ocean. The project uses logbook data from the US and Canadian troll and pole-and-line fisheries to develop a predictive model of albacore distribution and abundance based on remotely sensed satellite data predictors including sea surface temperature, sea surface height (SSH) anomaly, meridional and zonal geostrophic currents and chlorophyll-a (chl-a) concentration. Preliminary results were reviewed at the March 2013 workshop of the ALBWG and showed that albacore dynamics in open ocean and coastal waters respond to different sets of environmental covariates. This project is ongoing and if the early results are found to be robust, then these types of analyses may be integrated into stock assessment models to capture effects of environmental changes on population dynamics.

Manuscripts

Zhang, Z., Holmes, J., and Teo, S.L.H. Effect of climatic variables on the productivity of the north Pacific Albacore Tuna population. Fisheries Oceanography (submitted for review 7 May 2013).

9.0 LITERATURE CITED

Holmes, J.A. 2012 MS. The 2011 Canadian North Pacific albacore troll fishery. Document prepared for the Twelfth Meeting of the International Scientific Committee on Tuna and Tuna-like Species in the North Pacific Ocean (ISC), 18-23 July 2012, Sapporo, Hokkaido, Japan. ISC/12/Plenary/06: 16 p.

Holmes, J.A. 2011 MS. The 2010 Canadian North Pacific albacore troll fishery. Document prepared for the Eleventh Meeting of the International Scientific Committee on Tuna and Tuna-like Species in the North Pacific Ocean (ISC), 20-25 July 2011, San Francisco, USA. ISC/11/Plenary/08: 18 p.

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, 1995-2012. 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[2] (%)
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	6,041	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	5,415	8,605	177	98%
2012[1]	2,497	6,010	175	99%

1. 2012 data are preliminary based on Ver.13.02.11 of the *Canadian Albacore Tuna Catch and Effort Relational Database*.
2. Logbook coverage = Number of vessels reporting logbooks/Total number of vessels x 100 from database Ver. 13.02.11 for all years.

Table 2. Reported catch of non-target species (by-catch) by the Canadian albacore troll fishery in 2012.

Month	Common name	Scientific Name	No. of fish
August	Pacific bluefin tuna	*Thunnus orientalis*	2
	Yellowtail amberjack	*Seriola lalandi*	33
September	Yellowtail amberjack	*Seriola lalandi*	1
October	Mahi mahi	*Coryphaena hippurus*	3
	Skipjack tuna	*Katsuwonus pelamis*	3
	Yellowtail amberjack	*Seriola lalandi*	3

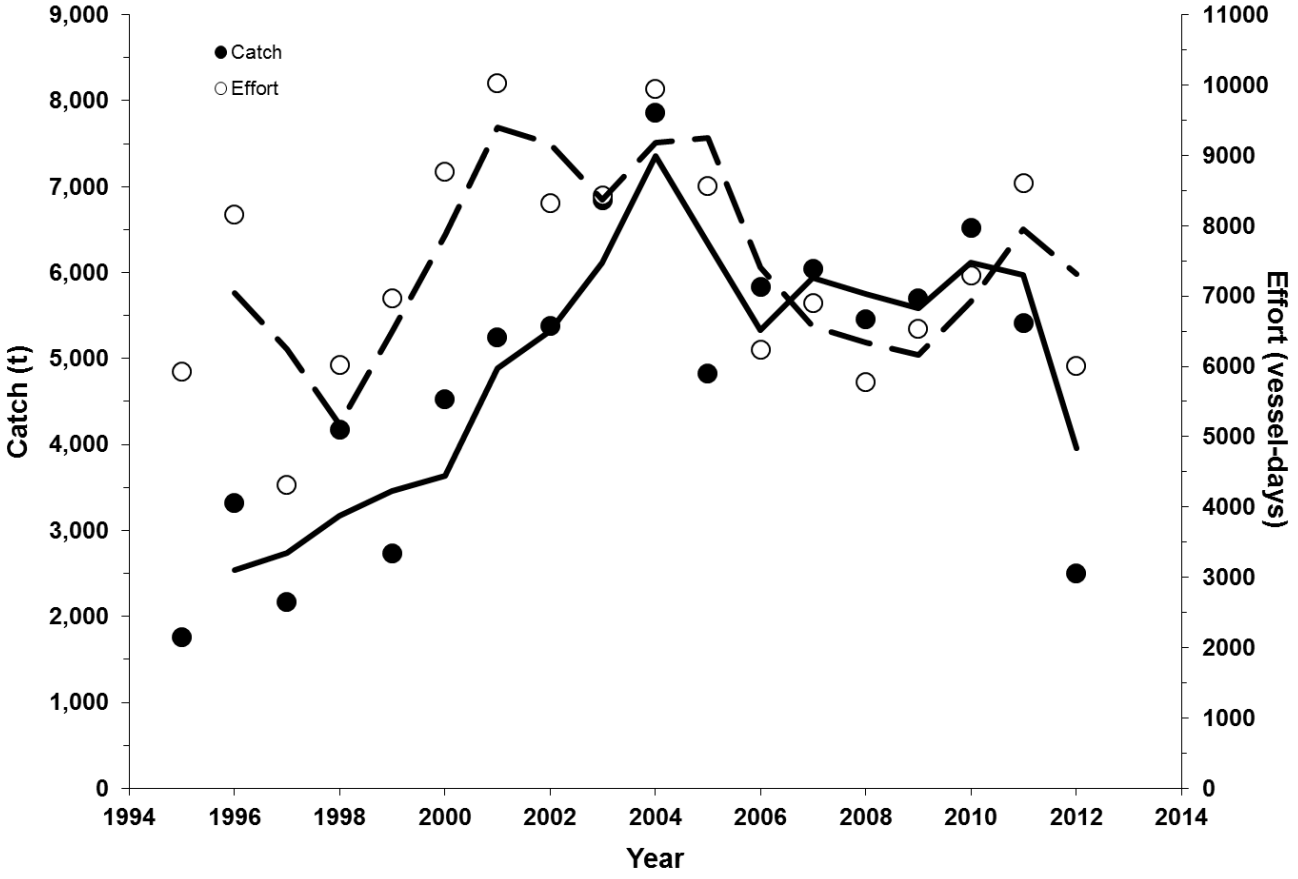

Figure 1. Historical trends in expanded catch and effort in the Canadian troll fishery for north Pacific albacore tuna from 1995 to 2012. Lines are 2-yr moving averages of catch in t (**—**) and effort in vessel-days (– –).

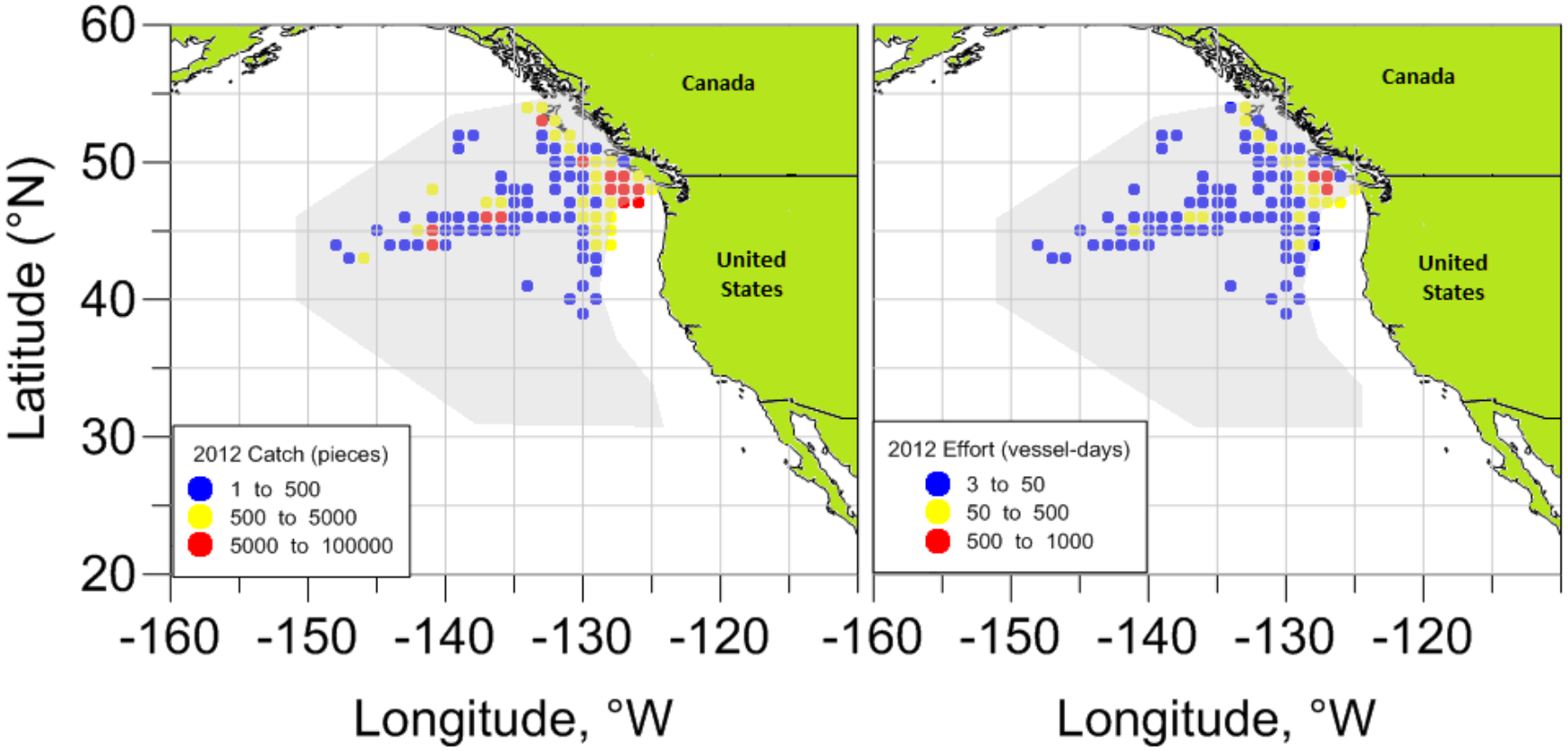

Figure 2. Spatial distribution of reported (logbook) Canadian albacore troll fishery catch (number of fish) and effort (vessel-days) in 2012. Catch data are shown in the left panel and effort data in the right panel. Data are plotted on a 1° x 1° grid with symbols located on the bottom-right corner of each cell. Cells in which fewer than three vessels reported are not shown. Grey area is the approximate operational area of the Canadian fishery in 2012.

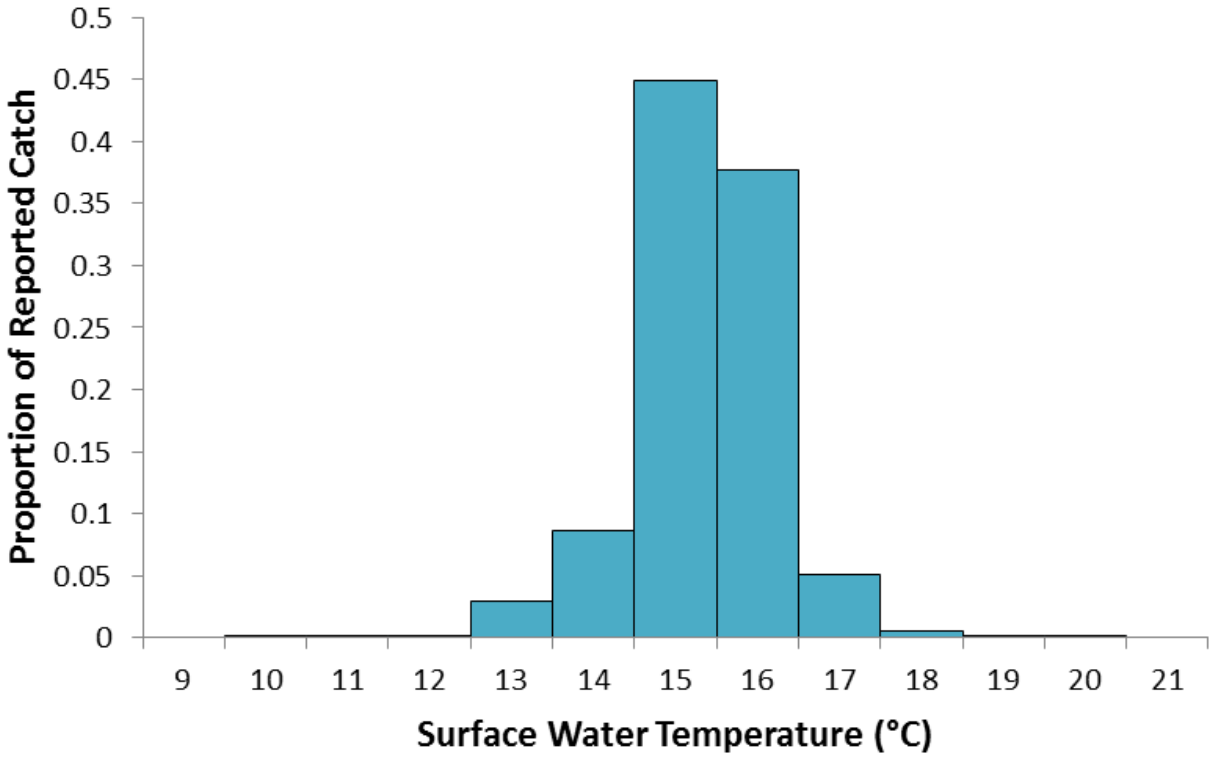

Figure 3. Sea surface temperatures at which albacore tuna were caught by the Canadian troll fishery in 2012. N = 332,038 fish with associated water temperature data reported in logbooks.

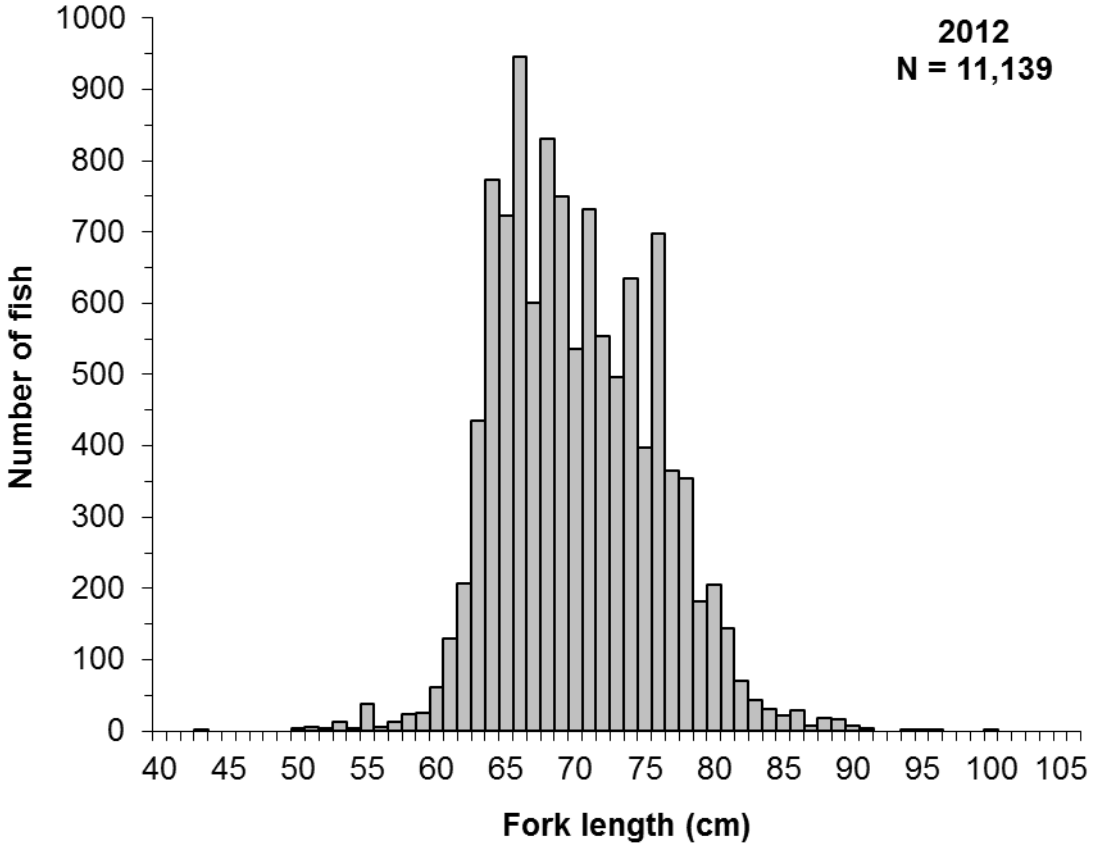

Figure 4. Fork lengths of North Pacific albacore harvested by the Canadian troll fishery in 2012. The 11,139 measurements represent a sampling rate of 3.0% of the reported 2012 catch.