Updated time series associated with albacore fisheries based in the Northeast Pacific Ocean[1]

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ABSTRACT

In a previous workshop at La Jolla, USA, we presented in detail the data sources and methods used to develop these time series from albacore fisheries based in the Northeast Pacific. The albacore working group (ALBWG) considered these time series and suggested some changes. This paper presents details on updates to the time series. All time series have been updated to include data from 2009. Otherwise, all VPA time series remained the same as previously described. However, several changes were made to the SS3 time series. Most importantly, catch time series are now in metric tons rather than thousands of fish. Improvements were also made to the US troll length compositions by improving the gear filter on the database. Methods and data sources for the US longline length compositions and all CPUE time series remained the same.

INTRODUCTION

The objective of this document is to describe updates to the data sources and methods used to develop time series from albacore fisheries based in the Northeast Pacific Ocean (NEPO) that are important for the stock assessment of North Pacific albacore conducted by the albacore working group (ALBWG) of the International Scientific Committee on Tuna and Tuna-like species (ISC) in 2011. For the 2011 assessment, the ALBWG previously decided to develop both Virtual Population Analysis (VPA) and Stock Synthesis 3 (SS3) models, although most of the effort and analysis will be concentrated on the SS3 model. As such, we developed time series for both SS3 and VPA models and presented them at a previous meeting of the ALBWG in La Jolla, California (Teo, et al., 2010). The ALBWG considered these time series and suggested two main changes to the SS3 time series: 1) catch of the NEPO fisheries be in metric tons rather than number of fish, and 2) improve the gear filter on the size composition database for the nominal US troll fishery. The ALBWG accepted the VPA time series and did not suggest any changes.

For the SS3 model, we developed updated time series, including 2009 data, of: 1) catch in metric tons for the US/Canada troll, US longline, and EPO miscellaneous fisheries; 2) size compositions for the US troll, and longline fisheries; and 3) standardized abundance indices for the US/Canada troll and US longline fisheries. For the VPA, we developed updated time series, including 2009 data, of: 1) catch-at-age in numbers of fish for the EPO surface and US longline fisheries; and 2) standardized abundance indices for the US/Canada troll and US longline fisheries.

Since the data sources and methods for developing the standardized abundance indices, size compositions for US longline, and all VPA time series remained the same as Teo et al. (2010), that will not be repeated here. Instead we concentrate on describing the data sources and methods for developing time series of 1) catch in metric tons for the US/Canada troll, US longline, and EPO miscellaneous fisheries; and 2) size compositions for the US troll fishery.

MATERIALS AND METHODS

Data Sources

Three main sources of data were used to develop the time series: 1) albacore landings in metric tons from various fisheries based in the Northeast Pacific (primarily US, Canada, and Mexico), including troll, pole-and-line, gillnet, purse seine, recreational, and unspecified gears (1966-2009); 2) logbook data from the U.S. troll (1966-2009) and longline (1991-2009) fisheries; and 3) albacore size data from the U.S. troll (1966-09) and longline (1994-09) fisheries.

Estimated annual landings of North Pacific albacore in metric tons by fishery were submitted by member countries to the ISC (Anonymous, 2010) (see Table 1 for EPO-based fisheries). As some NEPO-based fisheries catch albacore west of 180°W, estimated annual landings of each fishery include all North Pacific albacore landings irrespective of capture location. Although pole-and-line and longline fleets of Japan and longline vessels of Taiwan (i.e., fisheries based in the Northwest Pacific Ocean) have fished at varying levels of intensity in the NEPO over the years, catching North Pacific albacore, data from these fisheries were not used in developing these time series.

For US fisheries, commercial landings of North Pacific albacore are estimated from several databases. Landings data for California, Oregon, and Washington states are maintained in the Pacific Fisheries Information Network (PacFIN) database, while landings in Hawaii and US territories in the Pacific are maintained in the Western Pacific Fishery Information Network (WPacFIN) database. Additionally, the Western Fishboat Owners' Association (WFOA), which represents the US commercial surface fleet, monitors all landings of albacore and maintains an independent database. The National Marine Fisheries Service Southwest Fisheries Science Center (SWFSC) incorporates data from these databases to estimate the annual US albacore landings by fishery, which are then submitted to the ISC. Landing statistics for US-caught albacore dates back to 1952 but only data from 1966-2009 data were used for this analysis (see below). During 1966-2009, the troll fishery has been the largest US fishery for albacore but other fishing gears have also been employed, including pole-and-line, gill net, longline, purse seine, recreational, and 'other' (e.g., hand-line, gear unknown; Table 1). Albacore landings from US longline vessels are primarily made at fish auction sites in Hawaii. Although a few vessels also operate out of California each year, Hawaii-based landings constitute over 95% of the total albacore catch from US longline vessels. It is important to note that albacore is not considered a target species of the US longline fleet, with bigeye tuna and swordfish the preferred species. Landing statistics reflect both Hawaii and California longline operations. A small amount of albacore is likely unaccounted for each year because some fishermen sell directly to the public and may not document those sales. Discard rates of albacore from the US troll fishery are not known definitively, but limited observer data from the 1990s indicated that these rates are likely low and if accounted for, would not substantially change the estimated catch. Cursory examinations of longline discard rates collected from mandatory logbook data indicate total discards of albacore from US longlines are relatively low; however, results from a longline observer sampling program do reveal that in some years, some small fish were discarded prior to landing. The catch data were not adjusted to account for discards because discards were inconsistent and infrequent, and accounting for discards would not substantially change the estimated catch.

Logbook data were used to obtain time and location-specific catch and effort of the US troll and longline fisheries. An annual logbook monitoring program for the US albacore troll fishery has been managed by the SWFSC since 1961 (Childers and Betcher, 2008). Although logbook data for the US troll fishery has been collected since 1961, only 1966-2009 data were used for this analysis (see below). The logbook format has changed over the years but time and location-specific catch-effort information have been consistently recorded throughout the program's existence. Prior to 2005, logbooks were voluntarily submitted to the SWFSC and the logbook sampling coverage varied from 7-33% (McDaniel, et al., 2006). However, in 2005, logbook submission became mandatory for this fishery and sampling coverage has increased to approximately 75% of the total number of boat trips. Importantly, the logbooks generally

include daily (sometimes partial-day) information on the location (latitude and longitude) of the vessel, the number of albacore kept and discarded, and if the vessel was actively fishing. For the US longline fishery, a mandatory logbook program has been in place since 1991 and has collected similar catch and effort data on a set-by-set basis, including the number of hooks and number of hooks between floats for each longline set. For both troll and longline fisheries, the number of albacore caught was the sum of the number of albacore kept and discarded.

Size information (fork length to the nearest cm) from the US troll and longline fisheries were collected through port-sampling and longline observer programs, respectively. A port sampling program for the US albacore surface fisheries has been conducted for approximately six decades (Childers and Betcher, 2008). Size composition time series (1966-2009) presented here were based only on troll fishery samples although small numbers of samples from other fisheries (e.g., pole-and-line, recreational, and gill net fisheries) are also present in the port-sampling database. Although information on albacore size composition was collected prior to 1961, these older data were not associated with accurate location information and were primarily from the pole-and-line fishery. For most boat trips after 1961, a sample of usually 50 to 100 fish per trip was measured to the nearest cm. If the albacore from a boat trip were sorted by size class prior to measurement, approximately 25 fish from each size class were measured. The number of measured fish used in the analysis for each year ranged from 208 in 1993 to 49425 in 1996, with >15000 fish measured for most years (Coan, 2006). For the US longline fishery, the size composition time series (1994-2009) was developed from a longline observer sampling program rather than from a port-side sampling program conducted at fish auction sites in Hawaii. This was because previous analysis showed that the mean estimated length distributions from the longline port-side census program (converted from originally-collected weight data) did not include smaller fish that were present in size compositions developed from the observer sampling program. Due to the relatively small numbers of albacore caught by the US longline fishery, most of the individuals caught during an observed longline set were measured and included in the size composition time series.

Finally, it is important to note that some data sources for the US troll and longline fisheries extend back to the early 1950s. However, the time series in this analysis begin in 1966 because current assessment models start in 1966 due to concerns regarding the accuracy associated with some of the sample data collected prior to 1966 for both eastern and western Pacific Ocean fisheries.

Time Series for SS3 Model

Catch

Based on previous work, the ALBWG defined three main EPO-based fisheries for the SS3 model: 1) US/Canada troll, 2) US longline, and 3) EPO miscellaneous fisheries (Anonymous, 2010). We therefore developed catch time series (catch in numbers of fish by quarter) for these fisheries (1966-2009). In general, annual landings in metric tons for each fishery were converted into quarterly catch by multiplying the annual catch with the estimated proportion of fish caught in each quarter and year.

Annual landings for the US/Canada troll fishery was calculated as the sum of US troll, Canada troll, US pole-and-line, and US sport fisheries' landings because the operations and size selectivity of these fisheries are highly similar. Annual landings for the US longline fishery consisted of only US longline landings. Annual landings for the EPO miscellaneous fishery was calculated as the sum of US purse seine, US gillnet, US tropical troll, US others, Mexico purse

seine, Mexico pole-and-line, and Others troll fisheries' landings because these are relatively minor fisheries and only landings data are available (Table 1).

For the US troll and US pole-and-line fisheries, quarterly landings in metric tons from 1981 to 2009 were obtained from PacFIN and converted into quarterly proportions. For catches from 1966 to 1980, we first extracted the quarterly numbers of fish caught for the US troll and US pole-and-line fisheries from logbooks. The logbooks for these fisheries record the number of fish caught for each day (see Data Sources above). Subsequently, we multiplied the quarterly numbers of fish caught by the estimated average weight of fish caught by the US troll fishery in those quarters (see Teo, et al., 2010 for details) and calculated the proportions of catch by weight in each quarter.

For the US sport fishery, quarterly numbers of fish caught from 1980-2009 were first extracted from Commercial Passenger Fishing Vessel (CPFV) logbooks. Subsequently, we multiplied the quarterly numbers of fish caught by the estimated average weight of fish caught by the US troll fishery in those quarters (see Teo, et al., 2010 for details) and calculated the proportions of catch by weight in each quarter. From 1966-1979, we assumed that the proportions of catch by weight in each quarter were the same as that for the US troll fishery.

For the Canada troll fishery, quarterly catches in weight from 1995 to 2009 were obtained from a logbook database maintained by the Department of Fisheries and Oceans, Canada (Holmes and Zhang, 2010) and converted into quarterly proportions. From 1966-1994, we assumed that the quarterly proportions of catch in weight were the same as that for the US troll fishery.

Annual landings in metric tons for US troll, Canada troll, US pole-and-line, and US sport fisheries were converted into quarterly catch by multiplying the annual catches in Table 1 with the estimated quarterly proportions of fish caught. The quarterly catches for these fisheries were then summed to create the time series of quarterly catches in metric tons for the nominal US/Canada troll fishery in the SS3 model.

For the US longline fishery, quarterly landings in metric tons from 1991-2009 were obtained from PacFIN and WPacFIN, summed and converted into quarterly proportions of catch in weight. From 1966 to 1990, we assumed that quarterly proportions were the same as the mean quarterly proportions during 1991-2009. The quarterly catches for the US longline fishery were subsequently derived by multiplying the annual catches in Table 1 with the estimated quarterly proportions of fish caught.

For the EPO miscellaneous fisheries, quarterly landings of the US purse seine, gillnet and harpoon fisheries during 1981-2009 were extracted from PacFIN, summed, and converted into quarterly proportions. From 1966 to 1980, we assumed that the quarterly proportions of the EPO miscellaneous fisheries followed that of the US troll fishery (see above). In addition, we assumed that the quarterly proportions of catch in the other remaining fisheries in the nominal EPO miscellaneous fishery in the SS3 model (US tropical troll, US others, Mexico purse seine, Mexico pole-and-line, and Others troll) followed the quarterly proportions of the US purse seine, gillnet and harpoon fisheries. Annual landings in metric tons for all the EPO miscellaneous fisheries were converted into quarterly catch by multiplying the annual catches in Table 1 with the estimated quarterly proportions of fish caught. The quarterly catches for these fisheries were then summed to create the time series of quarterly catches in metric tons for the nominal EPO miscellaneous fishery in the SS3 model.

Size Compositions for US Troll

Quarterly size compositions (fork length in cm) for the US troll (1966-2009) fishery were developed from data collected through a port sampling program. Only samples that were positively identified as belonging to the US troll or pole-and-line fisheries (gear codes 1, 2, or 3 in the database) were included in the time series. The size distributions were developed as follows: 1) 1 cm bins that ranged from ≤26 to 89 cm, 2) 2 cm bins whose lower edges ranged from 90 to 98 cm, 3) 4 cm bins whose lower edges ranged from 100 to 140 cm. All nominal bins reflect the lower edge of the intervals (e.g., a 4 cm bin at 100 cm consists of fish from 100 to 103 cm). If a quarter and year block had less than 500 fish measured or less than 3 trips sampled, that block was removed from the time series.

RESULTS AND DISCUSSION

Catch

Albacore catches in metric tons for the Northeast Pacific-based fisheries are shown in Figure 1. The catches of the US/Canada troll (including pole-and-line, and sport) fishery occur primarily between July and September and have increased substantially from historical lows in 1989-1991. The catches from these surface fisheries are several-fold larger than the other Northeast Pacific-based fisheries. The updated catches in metric tons show the same general pattern as when catches were estimated in numbers of fish (cf., Teo, et al., 2010)

Size Compositions

The size compositions for the US troll fishery were relatively consistent with a strong mode at ~65 cm and a secondary mode at ~75 cm (Fig. 2). The data coverage was relatively high but seasonal (Fig. 2). The updated size compositions of the US troll fishery show the same general pattern as previously, but there is a noticeable reduced prominence of large (>90 cm) fish in the winter of 1987-88 (cf., Teo, et al., 2010).

REFERENCES

Anonymous.

2010. Report of the ISC - Albacore Working Group Workshop, 12-13 July 2010, at Victoria, Canada.

Childers, J., and Betcher A.

2008. Summary of the 2006 U.S. North and South Pacific albacore troll fisheries. ISC/08/ALBWG/03. Working document submitted to the ISC Albacore Working Group Meeting, February 28-March 6, NOAA\NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores drive, La Jolla, CA 92037, USA.

Coan, A. L.

2006. International Scientific Committee Albacore Working Group database catalog. ISC/06/ALBWG/01. Report of the ISC Albacore Working Group Workshop, November 28 - December 5, 2006. Shimizu, Shizuoka, Japan.

Holmes, J., and Zhang Z.

2010. Review of the Canadian troll fishery for the north Pacific albacore for the length-based SS-3 model. ISC/10-1/ALBWG/08. Working document submitted to the ISC Albacore Working Group Meeting, 20-27 April 2010, National Research Institute of Far Seas Fisheries, Shimizu, Japan.

McDaniel, J. D., Crone P. R., and Dorval E.

2006. Critical evaluation of important time series associated with albacore fisheries (United States, Canada, and Mexico) of the Eastern North Pacific Ocean (2006). ISC/06/ALBWG/09. Working document submitted to the ISC Albacore Working Group Meeting, November 28-December 5 2006, National Research Institute of Far Seas Fisheries, Shimizu, Japan. Shimizu, Shizuoka, Japan.

Teo, S. L. H., Lee H.-H., and Kohin S.

2010. Time series associated with albacore fisheries based in the Northeast Pacific Ocean. ISC/10-3/ALBWG/02. Working document submitted to the ISC Albacore Working Group Meeting, 12-19 October 2010, Southwest Fisheries Science Center, NOAA, La Jolla, California.

Table 1. North Pacific albacore landings (mt) by country and gear for fisheries based primarily in the Northeastern Pacific Ocean (1966-2009)[a].

	US								Canada	Mexico		Others
Year	Purse Seine	Gill Net	Pole & Line	Troll	Tropical Troll & handline	Sport	Longline	Other gears	Troll	Purse Seine	Pole & Line	Troll
1966	0	0	1600	15333	0	588	8	0	44	0	0	0
1967	0	0	4113	17814	0	707	12	0	161	0	0	0
1968	0	0	4906	20434	0	951	11	0	1028	0	0	0
1969	0	0	2996	18827	0	358	14	0	1365	0	0	0
1970	0	0	4416	21032	0	822	9	0	390	0	0	0
1971	0	0	2071	20526	0	1175	11	0	1746	0	0	0
1972	0	0	3750	23600	0	637	8	0	3921	100	0	0
1973	0	0	2236	15653	0	84	14	0	1400	0	0	0
1974	0	0	4777	20178	0	94	9	0	1331	1	0	0
1975	0	0	3243	18932	0	640	33	10	111	1	0	0
1976	0	0	2700	15905	0	713	23	4	278	36	5	0
1977	0	0	1497	9969	0	537	37	0	53	3	0	0
1978	0	0	950	16613	0	810	54	15	23	1	0	0
1979	0	0	303	6781	0	74	0	0	521	1	0	0
1980	0	0	382	7556	0	168	0	0	212	31	0	0
1981	0	0	748	12637	0	195	25	0	200	8	0	0
1982	0	0	425	6609	0	257	105	21	104	0	0	0
1983	0	0	607	9359	0	87	6	0	225	0	0	0
1984	3728	0	1030	9304	0	1427	2	0	50	107	6	0
1985	26	2	1498	6415	7	1176	0	0	56	14	35	0
1986	47	3	432	4708	5	196	0	0	30	3	0	0
1987	1	5	158	2766	6	74	150	0	104	7	0	0
1988	17	15	598	4212	9	64	307	10	155	15	0	0
1989	1	4	54	1860	36	160	248	23	140	2	0	0
1990	71	29	115	2603	15	24	177	4	302	2	0	0
1991	0	17	0	1845	72	6	312	71	139	2	0	0
1992	0	0	0	4572	54	2	334	72	363	10	0	0
1993	0	0	0	6254	71	25	438	0	494	11	0	0
1994	0	38	0	10978	90	106	544	213	1998	6	0	158
1995	0	52	80	8045	177	102	882	1	1763	5	0	94
1996	11	83	24	16938	188	88	1185	0	3316	21	0	469
1997	2	60	73	14252	133	1018	1653	1	2168	53	0	336
1998	33	80	79	14410	88	1208	1120	2	4177	8	0	341
1999	48	149	60	10060	331	3621	1542	1	2734	0	57	228
2000	4	55	69	9645	120	1798	940	3	4531	70	33	386
2001	51	94	139	11210	194	1635	1295	0	5248	5	18	230
2002	4	30	381	10387	235	2357	525	0	5379	28	0	466
2003	44	16	59	14102	85	2214	524	0	6861	28	0	378
2004	1	12	127	13346	157	1506	361	0	7856	104	0	0
2005	0	20	66	8413	175	1719	296	0	4845	0	0	0
2006	0	3	23	12524	95	385	270	0	5832	109	0	0
2007	0	4	21	11887	98	1225	250	0	6075	40	0	0
2008	0	1	1059	10732	29	257	353	0	5478	10	0	0
2009	39	3	2088	10700	99	541	203	0	5685	17	0	0

[a] The Northeastern Pacific Ocean-based fisheries are represented here by the countries U.S., Canada, Mexico, and 'Others'(Belize, Cook Islands, Tonga, and Ecuador). Asian countries (e.g., Japan, Taiwan, and Korea) that have also harvested albacore from these waters are not accounted for in this tabulation.

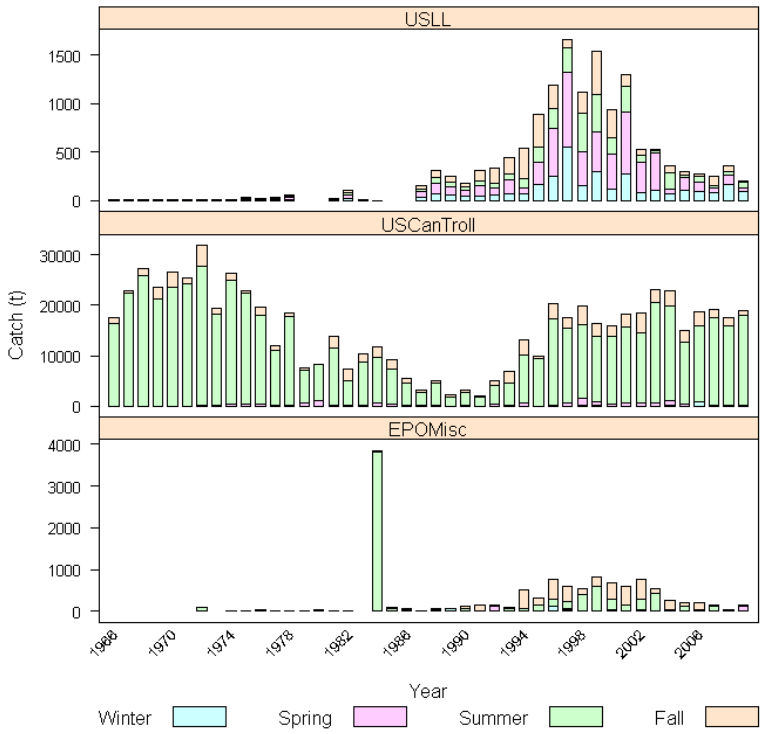

Figure 1. Albacore catch in metric tons of US longline (USLL), US/Canada Troll (USCanTroll), and EPO miscellaneous (EPOMisc) fisheries (see fisheries definitions in text) by year and season.

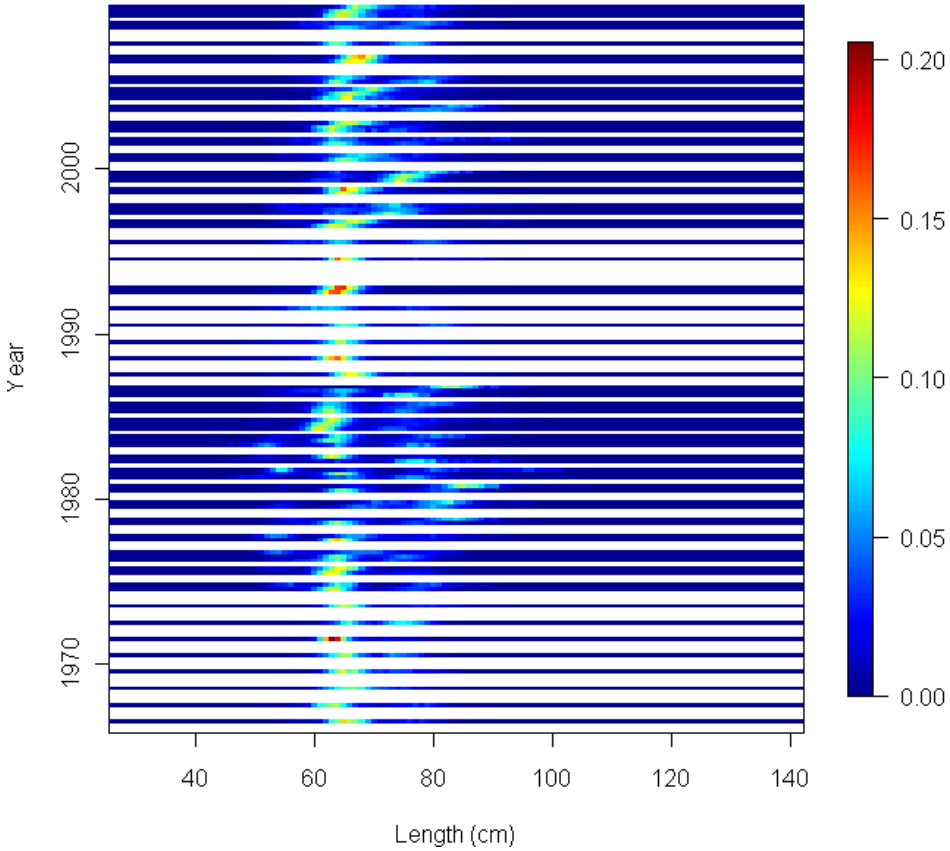

Figure 2. Quarterly size compositions (fork length, cm) of albacore for US troll (1966-2009) fishery. White bars indicate missing data.