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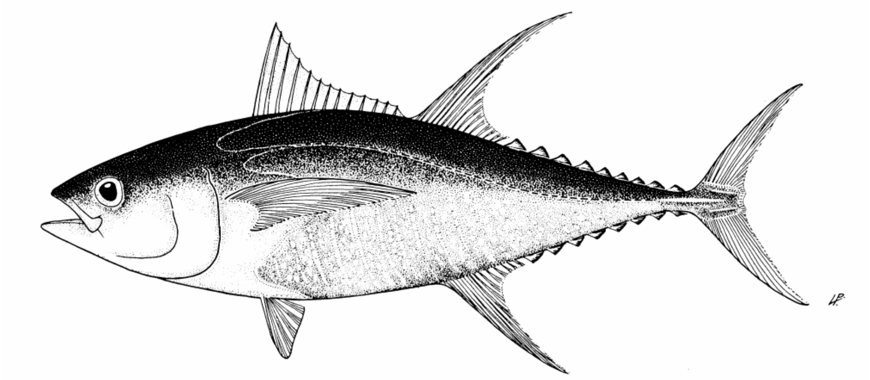
Report of the Nineteenth North Pacific Albacore Workshop



Max Stocker (Editor)

Fisheries and Oceans – Canada.

July 2005

Report of the Nineteenth North Pacific Albacore Workshop

FISHERIES AND OCEANS CANADA
PACIFIC BIOLOGICAL STATION
3190 HAMMOND BAY ROAD
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V9T 6N7

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M. Stocker, Editor

Fisheries and Oceans Canada
Science Branch
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, B.C.
Canada V9T 6N7

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Canada

HISTORY OF THE NORTH PACIFIC ALBACORE WORKSHOP

The North Pacific Albacore Workshop (NPALBW) was established in 1974 by informal agreement between the Southwest Fisheries Science Center, National Marine Fisheries Service (USA) and the National Research Institute of Far Seas Fisheries (Japan). The Workshop was conceived to promote and accelerate joint research on north Pacific albacore, particularly through exchange of data and information and collaborative research. In 1982, the Pacific Biological Station, Fisheries and Oceans Canada joined the agreement as a sponsoring member, and in 1991, the Institute of Oceanography, National Taiwan University became a sponsoring member.

Through this agreement, the parties have cooperated and coordinated their research on highly migratory albacore that inhabit the North Pacific Ocean. This cooperation includes annual exchange of fishery statistics and research plans, review of research results, and joint determination of stock condition. A formal scientific Workshop is organized to review research findings, assess the status of the population, and coordinate research planning. Participation is by invitation and limited to fishery scientists and others engaged in albacore research or in monitoring the fisheries that target north Pacific albacore. The parties organize and host the Workshop on a rotational basis. A chairman is selected by the participants of each Workshop.

The First Workshop was held in 1975 in Honolulu, HI. Meetings were held annually between 1977 and 1983. In 1983, a biannual schedule was adopted because of reduced exploitation and improved stock condition, which suggested comprehensive stock assessments could be conducted less frequently. The sponsors, however, retained the option to revert to an annual schedule as needed, particularly, if sample data indicate the condition of the stock has deteriorated.

Finally, at the 5th Meeting of the ISC held in Tokyo, Japan in March 2005, the North Pacific Albacore Workshop was formally adopted as a Working Group (Albacore Working Group) under the ISC (henceforth, referred to as the International Scientific Committee).

Date and Place of Workshops

Workshop	**Date**	**Location**
First	December 1975	Honolulu, HI, USA
Second	May 1977	Shimizu, Japan
Third	September 1978	Honolulu, HI, USA
Fourth	June 1979	Shimizu, Japan
Fifth	July 1980	La Jolla, CA, USA
Sixth	September 1981	Shimizu, Japan
Seventh	May 1982	La Jolla, CA, USA
Eighth	September 1983	Shimizu, Japan
Ninth	May 1985	La Jolla, CA, USA
Tenth	August 1987	Shimizu, Japan
Eleventh	May 1989	La Jolla, CA, USA
Twelfth	July 1991	Shimizu, Japan
Thirteenth	December 1993	La Jolla, CA, USA
Fourteenth	April 1995	Taipei, Taiwan
Fifteenth	December 1997	Nanaimo, B.C., Canada
Sixteenth	December 1999	Kesen-numa, Miyagi, Japan
Seventeenth	December 2000	Taipei, Taiwan
Eighteenth	December 2002	La Jolla, CA, USA
Nineteenth	November 2004	Nanaimo, B.C., Canada

Participants (left to right):

Ray Conser, Yukio Takeuchi, Gary Sakagawa, Jerry Wetherall, Vidar Wespestad, Chien-Chung Hsu, Marc Labelle, Paul Crone, Luis Fleischer, Simon Hoyle, Gerard DiNardo, Koji Uosaki, Miki Ogura, Adam Langley, Momoko Ichinokawa, Sandy Argue, Al Coan, Suzanne Kohin, Max Stocker

REPORT OF THE NINETEENTH

NORTH PACIFIC ALBACORE WORKSHOP

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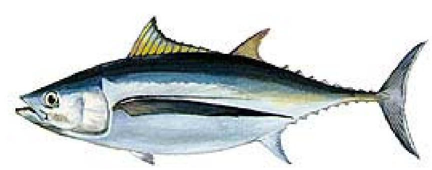

November 25 - December 2, 2004

Edited by:
M. Stocker
Fisheries and Oceans Canada
Science Branch
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, B.C.
Canada V9T 6N7

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Contents

Contents (continued)

Figures

Figures (continued)

Figures (continued)

Figures (continued)

TABLES

APPENDICES

1. INTRODUCTION

The *Nineteenth North Pacific Albacore Workshop* (NPALBW) was held at the Pacific Biological Station, Fisheries and Oceans Canada (DFO), Science Branch, in Nanaimo, British Columbia, Canada from November 25 to December 2, 2004. Dr. Laura Richards (Regional Director Science Branch, DFO) welcomed the participants. In her address to the participants, Dr. Richards reflected on the long history of the NPALBW and she observed that the Workshop has served as an effective forum for exchanging data and presenting research on albacore. She stressed that Canada recognizes the important scientific contributions the Workshop has made since 1975 to the development of an understanding of the North Pacific albacore population. These significant scientific contributions are evidenced by the high quality report and advice resulting from the Eighteenth NPALBW held in La Jolla in 2002. Dr. Richards noted that Canada is very interested in making scientific contributions that strengthen conservation and management regimes in the North Pacific and elsewhere that are consistent with UNFA, particularly regarding the Precautionary Approach. To that end, the Workshop is directly related to these goals, and she encouraged each nation to broadly support monitoring and research programs on albacore. Collectively, these efforts provide the necessary data for scientists to conduct objective analyses concerning the stock status, and for making appropriate future management recommendations. In closing, she thanked the participants, as well as past researchers, for their commitment to the Workshop.

A total of 19 participants from Canada, Japan, Mexico, Taiwan, United States (U.S.), the Inter-American Tropical Tuna Commission (IATTC), and the Secretariat of the Pacific Community (SPC) attended the Workshop (Appendix 1). Dr. Max Stocker was selected chairperson for the *Nineteenth North Pacific Albacore Workshop*. A provisional agenda that was circulated prior to the Workshop received minor revisions and was then adopted (Appendix 2). A total of eighteen working documents and one information document were received and accepted for review (Appendix 3). Jerry Wetherall, Gerard DiNardo, Paul Crone, Chien-Chung Hsu, Simon Hoyle, Ray Conser, Al Coan, Adam Langley, Gary Sakagawa, and Koji Uosaki served as section rapporteurs. Max Stocker was appointed editor for the *Report of the Nineteenth North Pacific Albacore Workshop*.

2. REVIEW OF RECENT FISHERIES

North Pacific albacore are a valuable species with a long history of exploitation in the North Pacific Ocean. During the past five years, fisheries based in Japan accounted for 70.6% of the total harvest, followed by fisheries in the United States (U.S.,15.5%), Taiwan (5.6%) and Canada (4.8%). Other countries targeting North Pacific albacore contributed 3.6% and included Korea, Mexico, Tonga, Belize, Cook Islands, Ecuador and longline catches from vessels flying flags of convenience (Table 1). The total catch of North Pacific albacore for all nations combined peaked at a record high of 125,400 metric tons (mt) in 1976, then declined to a low of 37,600 mt in 1991 (Figure 1). In the early 1990s, catches increased again, peaking in 1999 at 121,500 mt, and averaging 92,600 mt between 2000-03.

While various fishing gears have been employed over the years to harvest albacore in the North Pacific Ocean, the main gears used over the last five years were longline (38.5%), pole-and-line (37.8%), and troll (17.7%) (Figure 2). Other gears used since the mid-1990s included purse seine, gill net, unspecified and recreational fishing gears and accounted for roughly 6.0% of the total catch of albacore from the North Pacific Ocean. Historically, pole-and-line gear was the major gear employed, but since 1987, longline fishing has produced most of the albacore landings each year. The highest recorded catch from the pole-and-line fisheries occurred in 1976 (88,000 mt), and the highest catches from the longline fisheries were in 1997-98 (48,000 mt). The fishing areas associated with the major fisheries have remained virtually unchanged over the years.

As with the Japanese longline fishery, the Taiwan fishery involves two separate fleets, namely the inshore and distant-water longline fleets. While the inshore fleet primarily targets bigeye and yellowfin tunas, albacore is targeted mainly in areas west of 130°E and concentrated off Taiwan, Northern Philippines, and the South China Sea. The distant-water longline fleet largely operates in offshore waters centrally located within the North Pacific Ocean.

Since the late 1980s, the U.S. catch of North Pacific albacore has been primarily landed by the commercial troll vessels. The troll fishery targets albacore, and generally takes place along the North America coastline up to about 170°E, within a latitudinal band of 30°- 45°N. The U.S. longline fishery includes a mixture of vessels targeting species of tuna and/or swordfish. Vessels targeting tunas usually direct effort toward bigeye tuna in the central North Pacific Ocean (around Hawaii). Albacore are taken incidentally. Currently, Canada has an expanding troll fishery that takes place in similar areas as the U.S. troll fishery.

2.1. Canada

Max Stocker reported on the Canadian albacore troll fishery (NPALB/04/03). The fishery started in the mid-1930s in coastal waters off British Columbia (B.C.), Canada. The fishery targets albacore over an expanded range broadly classified into four fishing areas: (1) B.C. coastal; (2) B.C./U.S. coastal, (3) highseas North Pacific Ocean, and (4) highseas South Pacific Ocean. The coastal fleet contain the majority of the vessels, but in recent years, some of the fleet, like U.S.-based troll vessels, follow albacore concentrations into offshore waters.

Starting in 1945, sales slip records became the major source of data on albacore landings made by Canadian vessels. In 1995, Canada implemented a comprehensive database for collecting albacore fishery statistics. All Canadian vessels must carry logbooks while fishing for highly migratory species in any waters. A detailed analysis that includes a combination of sales slips, logbooks, hail-system and transshipment records is used to compile albacore landing statistics.

From 2002-03, the troll fishery started in May, with a few vessels operating north of Midway Island to the International Date Line and within the 40-45 ^{o}N latitudinal range. As the season progressed, the fleet followed migrating juvenile albacore as the stock moved to areas along the North American coast, where most of the fishing pressure was exerted (Figures 3A-B). The distribution of catches was similar in 2002 and 2003, with most catch occurring in inshore waters off the North American coast (Figure 3 C-D). The 2002 and 2003 distributions of catch-per-unit-effort (CPUE) were generally similar to the catch patterns observed over the recent time period.

The total estimated Canadian North Pacific albacore catch for 2002 and 2003 was 4,996 mt and 6,736 mt respectively, higher than in 2001 (4,985 mt). For both years, most of this catch was taken in FAO Area 67 (Figures 3 C-D). The average catch for 1995-03 was 3,973 mt. Effort and catches in Canada's Exclusive Economic Zone (EEZ) were higher in 2003 than in 2002.

The number of vessels operating in 2002-03 was 230 and 193, respectively. From 1995-03, the average number of Canadian vessels operating in the North Pacific was 238, so the current fleet size is below the average for the period. Fishing effort in the tuna fishery is reported in terms of vessel fishing days (v-d). Fishing days ranged from a low of 5,022 days in 1997 to a high of 9,826 days in 2001, with an average of 7,549 days for 1995-03. Estimates of CPUE in 2002 and 2003, were 605 and 810 kg/v-d, respectively. The average CPUE for the period 1995-03 was 521 kg/ v-d.

Length (fork cm) from the Canadian troll fisheries in 2002 (656 fish) and 2003 (1,181 fish) were obtained from fish landed in U.S. ports by their port sampling program. Albacore measured in 2002 ranged from 56 to 89 cm in length (Figure 4A). Similarly, albacore sampled in 2003 ranged from 56 cm to 88 cm in length (Figure 4B).

2.2. Japan

Koji Uosaki summarized recent trends in the Japanese fisheries (NPALB/04/09). North Pacific albacore are mainly caught by longline and pole-and-line gear, and to a lesser extent by drift net, and purse seine (Table 1). The pole-and-line fishery produced the major portion of Japan's total catch of North Pacific albacore through 1986. The landings from the longline fishery exceeded the pole-and-line fishery in every year during 1987-98. The total catch, from all gears combined, has fluctuated between 25,000 to 71,000 mt during 1950-70. In the 1970s, the catch increased rapidly and peaked at 104,000 mt in 1976; a direct result of increased effort by the pole-and-line fishery. After the peak in 1976, the catch decreased to 31,000 mt in 1988, and increased again to 92,000 mt in 1999. During 2000-03 the catch fluctuated between 55,000 mt and 78,000 mt.

Longline catches were relatively stable during 1970-92 (10,000 mt to 19,000 mt) (Table 1). In 1993, the catch increased significantly to about 30,000 mt. It remained at this high level during 1993-96, increased to a peak of 39,000 mt in 1997, and then decreased to about 26,000 mt in 2003. The increase in the 1990s is largely due to increased catches from the coastal longline fishery (vessels < 20 Gross Registered Ton, GRT). Recent catches (1993-04) of the costal longline fleet are about four times the level caught during 1983-92. The distant water/offshore longline fishery catch decreased from 11,000 mt in 2001 to 5,000 mt in 2003, mainly due to the loss of its operations in the region north of Hawaii.

In 2003, the coastal longline fleet operated principally off the eastern and southern coast of Japan, as well as in waters between the Equator to 10°N, and 140°E to 150°E (Figures 5A-B).

The fleet targeted albacore mainly during January-June, with catches distributed primarily off the south coast of Japan. In contrast, the 2002-03 Japanese offshore and distant-water longline fleet (>20 GRT vessels) broadly operated throughout the high-seas (Figures 6A-B). High concentrations of effort were in areas between the Equator and 15°N, the east coast of Japan and 175°E, and in waters N-E of Hawaii. This longline fleet targeted mainly bigeye tuna in 2002-03. Albacore were taken incidentally throughout the year and primarily from areas north of Hawaii and between 10°N to 40°N, and 160°E to 175°E (Figures 6C-D). Fishing pattern of the distant water longline fleet changed, such that fishing effort and albacore the catches N-E of Hawaii drastically decreased in the 2002-03 season.

Size (fork length, cm) measurements were taken on nearly 115,000 albacore landed by the longline fisheries of Japan in 2003. Harvested albacore ranged between 56 cm and 120 cm (Figure 7B). Size distributions showed three modes, namely at 78, 93 and 105 cm. The average size of albacore landed by the longline fisheries was roughly 88 cm.

Historically speaking, landings generated by the pole-and-line fishery increased rapidly from an average of about 24,000 mt (range = 9,000 to 41,000 mt) in the 1960s to 85,000 mt in 1976, followed by a decline to 6,000 mt in 1988 (Table 1). The pole-and-line landings reached the lowest level on record (i.e., 6,000 to 9,000 mt) between 1988 and 1991. Beginning in the mid-1990s, the landings increased again to reach 26,000 mt in 1994, and ranged from 20,000 to 50,000 mt/yr over the last decade. The pole-and-line catch in 2002 (48,000 mt) was the second highest observed from this fishery over the last twenty years.

The pole-and-line fleet of Japan targeted both albacore and skipjack tunas in 2002-03. When targeting albacore, fishing was largely off the coast of Japan and in the boundary zone where the Kuroshio and Kuroshio-extension Currents from the south intersect with the Oyashio Current from the north (Figures 8A-B). In 2002-03, catches primarily occurred from June through November, in waters between 34°N to 45°N, and 149°E to 172°E (Figures 8C-D).

Over 24,200 albacore were measured for length from pole-and-line landings in 2002-03 (Figures 9A-B). Sizes of albacore caught ranged between 46 and 96 cm. The size distributions showed two to three modes, at approximately 54, 68 and 78 cm. Average size of albacore caught in the pole-and-line fishery was roughly 66 – 70 cm.

The drift net (i.e., gill net) fishery landings rapidly increased from about 1,000 mt in the late 1970s to approximately 12,500 mt in 1982 (Table 1). This fishery terminated high-seas operations in January 1993 after the United Nation's resolution prohibiting large-scale high-seas drift net fishing. As a result, drift net operations have been limited to waters within Japan's EEZ since 1993, with annual landings ranging from 100 to 400 mt.

The Japan purse seine fishery targets skipjack and bluefin tuna seasonally off northern Honshu Island in the North Pacific Ocean. Albacore is caught incidentally. The albacore catch generated from this fishery fluctuated between zero and roughly 1,300 mt per year until 1983. Landings increased markedly from 1984 to the present, ranging from about 600 mt (in 1996) to nearly 7,000 mt (in 1999).

2.3. South Korea

No participants from South Korea were present to report on Korea-based albacore fisheries. However, participants felt that tuna fisheries of Korea that operate in the North Pacific Ocean do not typically target albacore and thus, landings are assumed to be negligible (Table 1).

2.4. Mexico

Luis Fleisher, representing the National Institute of Fisheries of Mexico (INP-Mexico), provided a Mexican Progress Report (NPALB/04/18). Dr. Fleisher commented first on the interest of Mexico to fully participate and cooperate with the Albacore Working Group as well as with other regional and multilateral fishery organizations interested in tuna. The Progress Report documented the historic albacore catches for Mexico, between 1980 and 2003 (Table 1). These data complemented the information previously provided to the North Pacific Albacore Working Group and it shows, the incidental nature and the low level of albacore catch by Mexico. The report also mentioned that new bluefin tuna farming activities developed in Mexico, have promoted some secondary effort for albacore since 2000. This important aspect will be monitored closely by the INP-Mexico in future seasons. The data indicate that the Mexican fishery is not targeting albacore but is merely catching them incidental to other fishing activities. The data presented during the Nineteenth Workshop constitutes the best estimate of the Mexican historical catches.

2.5. Taiwan

Chien-Chung Hsu reported on Taiwan's albacore fisheries (NPALB/04/inter-04) and NPALB/04/04). Two Taiwan-based tuna fisheries currently operate in the North Pacific Ocean, namely, distant-water and inshore longline fisheries (Table 1). A major distant-water drift net (i.e., gill net) fishery, once an important fishery in the North Pacific Ocean, was discontinued after 1992 due to a United Nations resolution prohibiting high-seas drift net fishing.

Total catch of albacore from the combined longline fisheries was low and varied considerably during 1967-94. Catches increased steadily from 2,500 mt in 1995 to 5,900 mt in 2000. Landings reached a historical high of in 2002 (6,500 mt), and dropped to about 6,000 mt in 2003 (Table 1). Catches since 1995 were mainly from the distant-water longline fleet.

The distant-water longline fishery generally operated in two areas of the high seas in 2001-02 (Figures10A-B). One area was north of Hawaii between 20°N and 45°N, and between 160°E and 140°W, and another area south of Hawaii between the Equator and 10°N, and between 130°W and 170°W. Most of the albacore harvested by this fishery came from areas north of Hawaii (Figures 10C-D).

Size frequency data are obtained through a systematic sampling program with fishermen aboard Taiwanese longline vessels. Fishermen measure the first 30 fish from each set (all species) and record the length and species data in the vessel logbook. Since 1995, approximately 90,000 albacore have been measured, with fish size ranging from 40 to 114 cm, with the vast majority (75%) of the albacore in the 68-94 cm range. During the NPALBW intersession meeting participants noted two problems with the resulting annual length frequency distributions: (1) for some years (e.g., 1995 and 1999), the range of lengths do not seem reasonable given the broad range of sizes generally taken in longline fisheries; and (2) for all years, more than expected small fish and fewer than expected large fish are found in the length samples.

Landings generated from the inshore longline fishery of Taiwan have generally been less than 600 mt since 1972, because bigeye and yellowfin tunas are the target species of this fishery. The highest albacore catch, reported for this fleet (1,500-3,000 mt), was in the early 1970s, when the fleet targeted this species. In 1998, the fleet fished between 110°E and 160°E, and 10°N and 35°N, in waters south and east of Taiwan, and areas northwest and northeast of the Philippines. High estimates of CPUE were observed in waters northwest and northeast of the Philippines. Relatively large albacore are harvested in this fishery (90-120 cm).

2.5.1. Discussion

As communicated in past Workshops and Intersessional Meetings (Taipei in 2000, 2004 and Nagasaki in 2002), researchers reiterated that length distributions developed in the mid and late 1990s from longline sample data collected from Taiwan fisheries should receive further scrutiny, given concerns regarding potential sampling biases that necessarily hamper developing representative length distributions from these fisheries (see Sections 3.3 and 7.1). In this regard, Workshop members suggested that critical evaluations of these data should continue, and that future size frequency sampling schemes be improved.

2.6. United States

The United States (U.S.) accounted for about 20% of the North Pacific albacore catch in 2003. In the U.S., North Pacific albacore are harvested by various types of fishing gear (Table 1). Troll gear has dominated since the early 1950s. During the last five years, troll fishing accounted for 78% of the total U.S. North Pacific albacore landings, with recreational fishing, and longline fishing generating roughly 15% and 6% respectively. Other gears included purse seine, pole-and-line, unspecified and gill net, which collectively accounted for only 1% of the total landings.

Al Coan reported on the U.S. albacore troll fishery that operates in the North Pacific Ocean (NPALB/04/02). The fleet was classified into two categories: smaller vessels that compose a 'coastal' fleet, that generally conduct many short (in duration) trips in a fishing season; and larger vessels from a distant-water fleet, that make a few long trips in a fishing season. During April-May, distant-water troll vessels begin fishing albacore in the central Pacific Ocean (around the International Date Line). As the fish become available off the North American coast in June and early July, the distant-water fleet moves closer to the coast and coastal vessels enter the fishery. The troll fishery is most successful during the mid-summer and through the fall (September-November), as migrating albacore concentrate in inshore waters off North America. The distributions of effort for the troll fishery in 2002-03 shows the broad spatial range this fishery operates in, with fishing pressure exerted from Mexico to Canada and from the west coast of North America to roughly 170°E (Figures 11A-B).

Total albacore catch for U.S. North Pacific troll fishery was 10,400 mt in 2002, and 17,200 mt in 2003. The distribution of catch from the troll fishery in 2002-03 has been consistent over the years, with the majority of the total catch concentrated along the North America coast, in the mid Pacific Ocean, and east of the International Date Line (Figures 11C-D). In 2003, fishing in the mid Pacific never occurred as large concentrations of fish along the U.S. west coast kept the fleet in coastal areas.

Data sources used to develop catch time series represent 100% coverage, and are from the Pacific Fisheries Information Network (PacFIN) data base (from landing receipt information), catch reports maintained by the fishing industry (American Fishermen's Research Foundation), catch reports from state fishery agencies (California, Oregon, and Washington), catch reports from the Honolulu Laboratory (NMFS), and landing reports from U.S. canneries in American Samoa. Logbook data are submitted voluntarily and currently represent 40% of the fleet catch. Logbook data will be collected from 100% of the fleet starting in 2005 as a requirement of the Highly Migratory Species Fishery Management Plan.

Biological sample data are collected, for the most part, through port sampling programs conducted by state (and 'territory') fishery agency personnel from California, Oregon, Washington, Hawaii, and American Samoa. Sampling coverage usually represents approximately 1% of the catch. U.S. fishermen also collect length samples to augment port sampling in underrepresented ports. In 2002-03, 12,146 and 11,933 fish, respectively, were measured via the port sampling programs (Figures 12A-B). Length distributions from the U.S. troll fishery have been very consistent over the last 10 years, with average size varying only a few centimeters over the years. In 2003, albacore ranged from 50-97 cm in length, with an average of 75 cm. Fish sampled in 2002 ranged from 52-94 cm and averaged 67 cm. The albacore harvested in the U.S. troll fishery are mainly 3-4 years of age, with occasional catches that include 2 and 5 year-old animals.

Jerry Wetherall reported on the U.S. longline fleets based in Hawaii and California (NPALB/04/08). A total of 129 U.S. longline vessels were active in 2003. Of these, 107 were Hawaii-based vessels landing catches only in Hawaii. They deployed 29.8 million hooks in 2003. Another 19 vessels were California-based, landing catches exclusively in California, while 3 vessels landed fish in both Hawaii and California. The U.S. longline fleet landed 521 mt of North Pacific albacore in 2003, including 519 mt recorded in Hawaii and 2 mt in California (Table 1).

U.S. longline vessels do not target albacore, but catch them incidentally while using shallow-set gear aimed at harvesting swordfish or gear set deeper in the water column directed at catching bigeye tuna or yellowfin tuna. Longline vessels based in Hawaii fish primarily in central Pacific waters from about latitude 40°N to the equator and between the international dateline and about 140°W (Figures 13A-D). Prior to 2001, a significant portion of the fleet fished for swordfish in the Subtropical Frontal Zone north of Hawaii, where interactions with sea turtles were more frequent than in tuna fishing grounds in lower latitudes. In late 2000, Hawaii-based longline vessels were temporarily prohibited from targeting swordfish in the North Pacific, a measure intended to protect sea turtles. The fleet's operations then focused on catching primarily bigeye tuna in waters south of 25°N. The prohibition ended on April 2, 2004, and vessels based in Hawaii were allowed to resume shallow-set operations targeting swordfish, subject to strictly enforced limits on the number of sets, use of circle hooks, use of mackerel or mackerel-like bait only, limits on the number of interactions with leatherback and loggerhead turtles, and other restrictions. California-based vessels operate primarily in waters of the North Pacific Transition Zone between about longitude 120°W and the dateline (Figures 13A-D). Longline fishing is not permitted within California's 200-mile EEZ, and since May 2004, California-based longliners have been prohibited from targeting swordfish.

NMFS monitors the catch of U.S. longline vessels through mandatory logbooks submitted by longline vessel captains. In addition, observers deployed by NMFS to monitor interactions with sea turtles and other protected species opportunistically collect biological data on albacore and other fish species. Observers measured fork lengths of 4,823 and 3,868 albacore onboard Hawaii-based longline vessels in 2002-03 (Figure 14). Observers on California-based vessels measured 77 albacore in 2002, and 171 in 2003.

2.7. IATTC

No information applicable to recent fisheries discussion was provided at this time.

3. FISHERY STATISTICS

Participants to the North Pacific Albacore Workshop have agreed to maintain a Data Base Catalog for data needs applicable to North Pacific albacore research and assessments. Data are submitted according to a protocol and a schedule developed at the *Seventeenth North Pacific Albacore Workshop* (see Appendix 4).

3.1. Data Catalog

Al Coan reported on the current status of the North Pacific Albacore Workshop Data Catalog (NPALB/04/01), including additions and updates made since the July 2004 Intersessional Meeting in Taiwan (see Appendix 6). The Data Catalog provides tables of fleet-specific data on annual catches of North Pacific albacore, the number of active vessels in each fishery, summarized logbook catch and effort, size composition and the metadata for databases used for stock assessments, and other investigations. The Southwest Fisheries Science Center (SWFSC) in La Jolla, CA, U.S.A, maintains the Data Catalog and associated database files. It provides a secure FTP server at the Alaska Fisheries Science Center, and oversees the distribution of data to Workshop members and other scientists using the FTP site. The FTP site is accessible at ftp.afsc.noaa.gov. Access requires a user account and password. In addition to data and metadata, the site archives workshop reports, working papers from previous workshops, and derived analysis data sets (e.g., estimated catch-by-age matrices) used in albacore stock assessments.

Relevant information from Workshop documents NPALB/04/02, NPALB/02/03, NPALB/04/07, NPALB/04/08, NPALB/04/09, NPALB/04/10, and NPALB/04/18 was used to update particular time series applicable to the three Category types.

Participants submit three kinds of data for inclusion in the Data Catalog:

Category I – Total landings (round weight, mt) by year, nation, and gear for each albacore-related fishery operating in the North Pacific Ocean and total nominal effort in number of active vessels by year, nation, gear, and vessel size category.

Category II – Catch and nominal effort data from logbooks, by nation, gear type, year, month, and designated area (5° latitude × 5° longitude area for longline data; 1° × 1° area for other fisheries).

Category III – Size composition (length or weight frequencies) and sex composition (if available) of the catch or landings, by nation, gear type, year, month, and the same spatial resolution as for Category II data.

The Data Catalog tables in NPALB/04/01 reflect updates based on recent data submissions. Most of the data sets have been updated through 2003. In some instances uncertainty remains about table entries for recent catches because data updates have not yet been received (e.g., Category I data for the Korean longline fishery). In other cases, new data were provided at the workshop to correct table entries in NPALB/04/01 (e.g., Category I data for the Mexican purse seine fishery, and for longline vessels landing in Taiwan but flying under other flags). These corrections are reflected in Table 1 of this report.

Al Coan presented provisional 2002 and 2003 fishery-specific distribution maps of catch and nominal effort and fishery-specific length frequency distributions based on updated Category II and Category III data (except for Taiwan 2001 and 2002). When finalized, the maps and plots will be included in the final report of this workshop.

3.2. Status of Work Assignments

Al Coan also reported on the status of several work assignments from the Eighteenth Workshop (Crone and Conser 2004). Several tasks were completed, including updating of the Data Catalog, the FTP site, the summary tables of vessels and catch, and the creation of directories on the FTP site containing vessel data, Workshop Reports, and a listing of Workshop papers. Parties interested in obtaining copies of the papers are advised to contact Al Coan, who will facilitate communication with the paper's principal author. Work on other projects has been suspended pending developments in the ISC and decisions on the relationship of the North Pacific Albacore Workshop to the ISC. These projects include development of standardized formats for all data on the North Pacific Albacore Workshop FTP site and construction of a North Pacific Albacore Workshop website.

Anticipating the development of a website, Al Coan suggested several functions that the site might serve, including links to/from the ISC website; tables and graphs of annual catch by country and gear; Workshop Reports and papers (or lists of papers); distribution maps of catch and effort statistics for longline and surface (pole-and-line and troll fisheries) for the most recent 2 years; and distribution plots of length-frequency data for the same fisheries for the most recent 2 years.

3.3. Discussion

The group agreed on the need for getting better information on Category I catch data for vessels not flying the flag of Canada, Japan, Korea, Mexico, Taiwan, or the United States, including vessels presumed to have conducted illegal, unreported, and unregulated (IUU) fishing operations. Catches of North Pacific albacore may be taken but unreported by IUU vessels using longline or drift gill net gear. Adam Langley provided information from the OFP database on catches of albacore taken by IUU longline vessels in waters north of Hawaii but landed in the South Pacific. These data represented a partial reporting of the activity by these vessels. Adam Langley and Chien-Chung Hsu used these data to update entries in Table 1 for the "other" country category. Workshop participants agreed to seek further information on activities of IUU vessels and work towards a comprehensive accounting of the North Pacific albacore catch.

Al Coan noted that the final plots of U.S. longline catch and effort would incorporate Category II data from both Hawaii-based and California-based vessels. For Japanese longline fisheries, the updated catch and effort distributions will be presented separately for coastal and distant water fleets. To facilitate this, Koji Uosaki will provide 1994-2003 Category II data for the coastal fishery.

With respect to Category III data, the Data Catalog (NPALB/04/01) includes references to length frequency data for the Taiwanese longline fishery, but these entries were removed based on Dr. Hsu's assessment that the data are still unreliable. Participants noted the sample size for Category III data in Japan's longline fishery had increased substantially since 2001. Uosaki explained that this was the result of extensive length sampling at landing sites conducted by Shizuoka Prefecture Fisheries Experimental Station (SPFES) staff under contract to NRIFSF (NPALB/04/09).

4. BIOLOGICAL STUDIES

At previous Workshops (e.g., Nagasaki, Japan in 2002 and Honolulu, U.S. in 2004), members recommended that various life history-related research studies be undertaken to generally improve understanding of albacore biology and ecology, as well as provide information to bolster assumptions relied upon when conducting stock assessments. Studies were reviewed that addressed age and growth (presentation only), sex ratio and maturity (presentation only), ongoing archival tagging projects (NPALB/04/05 and NPALB/04/13), and analysis of historical dart tag data (NPALB/04/14 and NPALB/04/15).

4.1. Age/Growth and Reproductive Biology Studies

C.-C. Hsu presented results from studies that focused on age and growth, and reproductive biology of North Pacific albacore (no paper was distributed). A total of 176 first dorsal spines and pairs of gonads were sampled from fish (67-118 cm) caught in the central and western North Pacific Ocean (2001-04). Estimates of age were made from counts of growth bands on sectioned spines. Analysis of marginal growth (by month) indicated that the annual bands are most likely formed during February and April of each year. Growth parameters were derived from back-calculated lengths and a von Bertalanffy growth equation: for males, L_∞= 131.3 cm, K = 0.184, and t_0 = -1.771; and females, L_∞= 110.1 cm, K = 0.282, and t_0 = -1.270. Also, a classical power function weight (kg)-at-length (fork length, cm) relationship was developed: a = 0.0000466 and b = 2.829.

The spawning activity of albacore was observed to peak from March to April in the northwestern Pacific Ocean. Fish collected that were greater than 100 cm were mostly males. Sex-specific, length-based maturity ogives were developed from histological examinations of gonads in the laboratory and subsequently, classical simple logistic regression models were fit to the sex-specific data, with proportion mature-at-length (fork length, cm): (1) for males, a ('intercept') = -0.2406 and b ('slope') = 0.002831; and (2) for females, a ('intercept') = -0.6932 and b ('slope') = 0.008352. Estimates of length-at-50% maturity were roughly 83 cm and 85 cm for females and males, respectively. Batch fecundity was estimated by counting hydrated or migratory nucleus oocytes in the ovaries of females (89-99 cm) and ranged from 0.17 to 1.6 million eggs.

4.1.1. Discussion

Overall, members recognized the importance of such work, particularly the need to continue research efforts that generally address this species' age/growth- and reproductive-related parameters, including longevity, first year's growth, verification/validation based on different hard parts and ageing methods, sex ratios, and maturity schedules. That is, members felt these studies should be viewed as foundations to work from in meeting the above biology-based objectives, but felt that results should be considered preliminary, given concerns regarding the limited sample frames. The overriding recommendation from the members was to build upon Hsu's study by establishing a broader (spatially and temporally), synoptic sampling design that would allow specimens to be collected from all of the different fisheries across a given year. In effect, a more expansive data collection scheme would greatly increase the likelihood of obtaining a representative sample for developing growth-related models applicable to the ocean-wide population (i.e., across its entire range in the North Pacific Ocean). Members also suggested that future studies review ageing methods for tunas used by other research institutions to ensure laboratory methods and analysis are based on current technology and estimation techniques, e.g., in establishing an accurate time series of mean estimated length-at-age, hard part analysis should include small (first year of life) fish, in addition to obtaining estimates for younger ages via traditional back-calculated methods based on larger/older fish. Finally, the general consensus of the Workshop was to critically evaluate the maturity-related schedules presented by Hsu and subsequently, work towards developing an updated maturity ogive that could be used in future population assessments—again, emphasizing the need for a broader sampling design, both spatially and temporally.

4.2. Tagging Studies

4.2.1. Archival Tagging Studies

4.2.1.1. Southwest Fisheries Science Center - USA

Suzy Kohin presented recent research activities (2001-04) that addressed a cooperative archival tagging effort between the Southwest Fisheries Science Center (La Jolla Laboratory) and the U.S. albacore fishing industry that operates in the North Pacific Ocean (American Fishermen's Research Foundation), see NPALB/04/05. To date, 234 archival tags and 43 'dummy' tags have been deployed off the U.S. Pacific coast (tags were purchased from *Lotek* and *Wildlife Computers*). During the summer of 2004, 15 tagged albacore were recaptured by sport and commercial fishers. All but 2 of the archival tags were from fish at liberty for 280 days or more. A preliminary examination of the data revealed that of 8 fish at liberty for at least 280 days, 5 utilized the waters off southern California and Baja California, Mexico; whereas, 3 fish traveled west to an area near 135ºW longitude and 26ºN latitude, where they spent several months before returning to the waters off southern California. All fish exhibited a diurnal pattern of repetitive diving to depths exceeding 200 m during the day and staying closer to the surface at night. Most recoveries to date were of fish tagged off southern California; however, tagging during 2004 was concentrated near 45ºN latitude in hopes of obtaining information from the sector of the population hypothesized to make trans-Pacific Ocean migrations. The last year of the five-year study is currently underway, with planned deployments of 120 archival tags during the spring and summer of 2005.

4.2.1.2. National Institute of Far Seas Fisheries - Japan

Koji Uosaki presented findings from a joint archival tagging study on North Pacific albacore between two Japan research organizations, the Shizuoka Prefecture Fisheries Experimental Station (SPFES) and the National Research Institute of Far Seas Fisheries (NRIFSF), see NPALB/04/13. Thus far, a total 84 archival tags were implanted in juvenile albacore off southern Japan (27˚N to 33˚N latitude and 132˚E to 138˚E longitude) during the winter and spring seasons (2000, 2002, and 2004), and off eastern Japan (34˚N to 45˚N latitude and 154˚E to 164˚E longitude) in the fall (2000 and 2004). A total of 5 fish have been recaptured to date, with days at liberty that ranged from 19 days to nearly a year. Finally, the NRIFSF and SPFES plan to deploy 40 tags (*Lotek* LTD-2310) during the summer 2005.

4.2.2. Historical Dart Tag Analysis

Momoko Ichinokawa presented research that addressed analysis of accumulated conventional dart tag data associated with the albacore population of the North Pacific Ocean (NPALB/04/14 and NPALB/04/15). The knowledge of migration patterns of young albacore has been largely based on results from conventional tagging experiments conducted by the U.S. during the 1970s and 1980s, in primarily the central and eastern North Pacific Ocean (NPALB/04/14). In the western Pacific Ocean, Japan had been conducting tagging programs, but the results have not been analyzed and published to date. This analysis was intended to increase the present knowledge regarding juvenile migration across the North Pacific Ocean by combining data from the historical tagging programs conducted by both Japan and the U.S. The release and recapture patterns summarized from these data showed that tags released in the western Pacific Ocean were rarely recaptured in 'inshore' waters off the U.S. Pacific coast; whereas, the reverse pattern of fish tagged off the U.S. Pacific coast and recaptured west of the International Date Line was frequently observed. This finding suggested a strong 'one way' migration of young albacore from east to west in the North Pacific Ocean. However, given tag releases and recoveries were unevenly distributed spatially and temporally (seasons), as well as across age classes, researchers cautioned making definitive conclusions from the available tag information. Finally, the research team suggested that future tagging experiments that were design-based would likely produce information that could be used along with the current data set to provide additional insight into this species' movement patterns in the North Pacific Ocean.

In related analysis, Momoko Ichinokawa presented findings from a critical evaluation of historical tag data (NPALB/04/14) to determine seasonal movement probabilities of North Pacific albacore. In this analysis, the researchers relied upon a spatially-structured population dynamics model based on maximum likelihood estimation and the conventional tagging data discussed above (NPALB/04/15). The goal of this analysis was to evaluate spatial/temporal migration 'probabilities' that could be used in fully-integrated stock assessment models to accurately characterize albacore migration in the North Pacific Ocean. The population dynamics model accounted for variability in albacore migration due to season, space (four broad areas), catchability by area, and fishing effort by area, season, and year. The parameterization of albacore movement considered the following two cases: first, albacore were assumed to move freely to neighboring areas in all seasons (the 'general movement' model); and second, restricted seasonal movement was assumed in efforts to reduce the number of parameters in the overall estimation (the 'restricted movement' model). Stable solutions could not be obtained from the general movement model. Unstable patterns of movement probabilities estimated from the general movement model were not simply due to small sample sizes (say numbers of released and recovered tags), but primarily because of 'unevenness' (in spatial and temporal terms) in the historical data set (see NPALB/04/14). Stable solutions were obtained from the analysis based on the restricted movement model. In summary, albacore migration could be estimated from the historical tagging data when assumptions regarding explicit seasonal migration patterns could be accommodated in the model. Finally, the researchers noted that in addition to quantitative analysis of the conventional dart tag data, qualitative examinations of results from archival tag studies would be useful for defining reasonable assumptions about albacore migration when developing a refined restricted movement model.

4.2.3. Discussion

Workshop members strongly encouraged continued tagging-related research and identified three broad areas of future study: (1) use of archival and satellite 'pop-up' tags to obtain detailed information regarding behavior and movement; (2) use of existing detailed fishery data, including conventional dart tag data, in recent fully-integrated statistical models (e.g., MULTIFAN-CL); and (3) use of genetic experiments and fish 'hard part' microchemistry methods. Members agreed that substantial progress could be realized regarding this general area of research if researchers continue to work towards formal, collaborative arrangements for conducting such work in the future, both from project cost and information dissemination standpoints.

5. STOCK ASSESSMENT STUDIES

5.1. VPA-2BOX Model Analysis

5.1.1. North Pacific Ocean Fisheries

5.1.1.1. Catch-at-age Matrices

Catch-at-age matrices derived from fishery sample information are integral sources of data used in age-structured assessment models, such as VPA-2BOX (Porch 2003). Three papers were presented that generally addressed this subject: one paper from the U.S. contingent that addressed the eastern North Pacific Ocean fisheries (NPALB/04/07); a paper from Japan researchers that focused on Japan's fisheries of the western North Pacific Ocean (NPALB/04/10); and a paper from Taiwan that focused on critical time series developed from this nation's longline fishery (NPALB/04/04).

5.1.1.1.1. Eastern North Pacific Ocean Fisheries

Paul Crone presented research (NPALB/04/07) that addressed constructing catch-at-age matrices for the albacore fisheries in the 'eastern' North Pacific Ocean, i.e., based on sample data collected from vessels associated with the nations of North America (U.S., Canada, and Mexico). The estimation methods were based generally on the assumption that all 'surface' fisheries typically target juvenile albacore. Thus, size distributions derived from the U.S. troll fishery were applied to the catches of other 'surface' fisheries, including the pole-and-line, gill net, purse seine, and recreational fisheries of the U.S., as well as the Canada troll fishery, Mexico 'unspecified' fisheries, and 'Others' troll fisheries (Table 1). Ages were assigned by using age-slicing techniques. That is, age compositions were derived from length distributions based on a length-at-age relationship and visual evaluations of annual modal progressions to determine 'limits' for size distributions within respective age classes (i.e., tails of the distributions). The upper limits for size distributions within age classes were determined by visually examining the mean estimated size distributions on an annual basis. The original size data from the sample data sets (by year) were then converted to ages based on the results from the age-slicing evaluation. Finally, the age data were subjected to a two-stage sampling estimation method to derive a mean estimated age distribution for each year; this estimation technique was similar to that used to derive time series of mean estimated size distributions.

The following methods were used to produce a final catch-at-age matrix that corresponded to the catch of the surface fisheries of the eastern North Pacific Ocean. First, only weight information of landings was typically available from the surface fisheries of the eastern Pacific Ocean and thus, landings in number of fish were estimated by dividing the landing (in kg) by the average weight of a fish (in kg) calculated from U.S. troll fishery sample data. Average-weight values for each year were calculated from the estimated mean size of fish and a weight-length relationship. Quarter-based average weights within year were generally precise for the troll fishery data and thus, an annual-based ratio was deemed appropriate. Next, for each year, the landings of all surface fisheries were summed to produce an estimate of the total landings of albacore across all surface fisheries of the eastern North Pacific Ocean. Finally, the estimated age distributions (by year and in percent) were applied to the total landings (by year and in number of fish) to generate a catch-at-age matrix that represented the surface fisheries of the eastern North Pacific Ocean. Ultimately, the constructed catch-at-age matrix reflected all surface fisheries of the U.S., Canada, and Mexico (1975-03).

For the single 'sub-surface' fishery that operated in the eastern North Pacific Ocean (i.e., the U.S. longline fishery), catch-at-age estimation was based on the following methods. Biological (length and weight) data collected from an ongoing observer sampling program (1994-03) were used to develop age-distribution time series for this fishery (i.e., an independent catch-at-age matrix). Subsequently, quarter-based length data were incorporated into the MULTIFAN-CL model for purposes of estimating age distributions on an annual basis. The model was parameterized generally and emphasized likelihood fits to this particular fishery, which incorporated the agreed to growth model for longline fisheries (Suda 1966). Average weights (1975-03) from the U.S. longline fishery were calculated from the initially-collected weight sample data and subsequently, used to convert metric tons to numbers of fish on an annual basis. The product of the age distributions (in percent) and total number of fish (in year) equaled the final catch-at-age matrix (in number of fish by year). Also, a second analysis was employed to further evaluate this estimation procedure, which involved converting the length data into age groups based on the straightforward MULTIFAN software. Ultimately, researchers chose the MULTIFAN-CL model for estimating age distributions from length data, given: (1) both methods resulted in similar estimated age distributions; (2) the MULTIFAN-CL model allowed for more objective estimation of age distributions for years prior to 1994 (the first year of available length data) than possible using more basic MULTIFAN theory, which necessarily involved subjective 'sample substitution' assumptions; and (3) this fishery is considered a minor fishery, given landings typically compose less than 5% of the total North Pacific albacore harvest and thus, this particular estimation variability is considered negligible in the context of the total uncertainty associated with modeling the overall population of the North Pacific Ocean.

Finally, the two catch-at-age matrices derived above for the surface and longline fisheries were simply summed together to produce a complete catch-at-age matrix that represented all fisheries (i.e., vessels from nations of North America) that operated in the eastern North Pacific Ocean (1975-03).

In summary, the complete catch-at-age matrix indicated that the vast majority of the albacore landed by the fisheries above were primarily juvenile fish (i.e., ages ≤ 5), which typically composed over 95% of the total (eastern North Pacific Ocean) landings in any given year (1975-03).

5.1.1.1.2. Western North Pacific Ocean Fisheries

Koji Uosaki presented methods used to develop catch-at-age matrices for Japan's surface and longline fisheries (NPALB/04/10), which ultimately, were incorporated into the VPA-2BOX model analysis. Catch-at-age matrices were developed on a calendar year basis (vs. 'fishing' year basis).

For Japan's pole-and-line fishery, catch-at-size matrices were estimated using reported catches from fisher logbooks. The catch-at-size matrices were expanded to account for pole-and-line landings not reported in logbooks. Subsequently, age compositions were constructed from length composition data using classical age-slicing methods. The same age-slicing algorithm was applied to miscellaneous surface fisheries (e.g., purse seine and 'unspecified'), given the assumption that these fisheries generally harvest juvenile albacore in a similar fashion as the pole-and-line fishery.

For the Japan drift ('gill') net fishery, catch-at-age estimation was generally conducted as described above for the pole-and-line fishery; however, size data from the pole-and-line fishery were used in conjunction with complementary data collected from the drift net fishery. That is, additional size data from the pole-and-line fishery were used to bolster length samples from the drift net fishery, given the assumption that all surface fisheries operate in a generally similar fashion.

Catch-at-age matrices for the Japan longline fisheries were estimated using simultaneous length sample analysis, based on MULTIFAN software. Longline catch-at-age estimation was partitioned into two broad fisheries: the 'large' longline fishery (offshore and distant-water longline vessels); and the coastal longline fishery. Model assumptions regarding important growth parameters required in MULTIFAN analysis followed Suda (1966).

Catch-at-age matrices associated with western North Pacific Ocean fisheries of Taiwan, South Korea, and 'Others' (longline) were developed according to agreed to procedures set forth in the previous Workshop held in La Jolla, U.S. in 2002 (Crone and Conser 2004). First, an independent catch-at-age matrix for the historical Taiwan gill net fishery (1987-92) was developed by Taiwan researchers, based on similar procedures discussed above for the surface fisheries of the eastern and western North Pacific Ocean (i.e., based on age-slicing methods). Second, no biological data were available to independently derive catch-at-age matrices for the historical gill net fishery of Korea (1980-92) and thus, age distributions (in percent) from the Japan gill net catch-at-age matrix were applied to the annual catches (in number) from South Korea's gill net fisheries. Average weights (1980-92) from the Japan gill net fishery were used to convert South Korea's landings in metric tons to numbers of fish. The product of the age distributions (in percent) and total number of fish (in year) equaled the final catch-at-age matrix (in number of fish by year). Third, a catch-at-age matrix for the combined longline fisheries (i.e., Taiwan, South Korea, and Others) was developed using the following procedures: for data from 1975-86, the age distributions (in percent) from the Japan 'large' longline catch-at-age matrix were applied to the 'combined' longline fishery; for sample information from 1987-03, age distributions (in percent) from the U.S. longline catch-at-age matrix were applied to the 'combined' longline fishery; and finally, for purposes of consistency, average weights (1975-03) from the U.S. longline fishery were used to convert the 'combined' longline fishery's landings in metric tons to numbers of fish by year. The product of the age distributions (in percent) and total number of fish (in year) equaled the final catch-at-age matrix (in number of fish by year) for this 'combined' longline fishery.

5.1.1.1.3. North Pacific Ocean Fisheries

A single catch-at-age matrix (1975-03) applicable to all (inclusive) fisheries was developed by simply summing the complete catch-at-age matrices independently derived above. Ultimately, this combined catch-at-age matrix served as the foundation for stock assessments based on the VPA-2BOX model analysis (Table 2).

5.1.1.1.4. Discussion

In summary, discussion on catch-at-age matrices addressed those developed from Eastern (Section 5.1.1.1.1.) and Western (Section 5.1.1.1.2.) North Pacific Ocean fisheries. The following summary provides an overview of this discussion:

(1) Meeting participants agreed that considerable progress had been made since the last Workshop.

(2) The topic of alternative growth rates applicable to the stock was discussed generally. Both the U.S. and Japan derived weight-at-age time series by combining length-at-age and weight-length models. Ultimately, the U.S. relied on Bartoo and Foreman (1994) for both length-at-age and weight-length (i.e., Clemens 1961 presented in Bartoo and Foreman 1994) models to develop weight-at-age estimates. Japan researchers used Suda (1966) for length-at-age and Suda and Warashina (1961) 'longline-based' weight-length time series to generate weight-at-age estimates. The 'plus' age group (age 9) used in the U.S. weight-at-age time series was calculated as the average of ages 9-12 (i.e., the weight associated with the average length for ages 9-12). Ultimately, Workshop members agreed that both weight-at-age time series were similar for younger fish that are typically captured in surface fisheries (i.e., ages 1-7), but noted the two growth models diverged substantially for older fish typically captured in longline fisheries. Thus, it was recommended for future modeling efforts that require such a growth model as input to a fully-integrated population model that a single weight-at-age time series be decided upon and included in competing models (see below).

(3) It was recommended that a 'verification' of the ultimate matrices be conducted, whereby the catch-at-age matrix (in numbers of fish) be multiplied by an average weight-at-age time series and subsequently, compared back to the applicable total landings (in weight of fish), i.e., this verification is possible for particular subsets of catch-at-age (by fisheries) and should be conducted as a general diagnostic when possible.

(4) When age slicing methods are conducted, 'limits' for size distributions within respective age classes should be documented, i.e., the upper limits used for partitioning size groups into individual ages. When possible, mean (and errors when

appropriate) estimated (annual or quarter) length- and age-distribution time series should be documented.

(5) When possible, standardized methods should be used when developing the catch-at-age matrices, given the 'stages' necessarily involved in such a process. To facilitate standardization, participants discussed the possibility of a single individual, or working group, being responsible for developing all catch-at-age matrices. For example, when converting length to ages for longline-related fisheries using MULTIFAN software, a single analyst coordinating this work would likely be more efficient and produce more consistent results than if this task is carried out by multiple researchers. Although no formal decision on this topic was made, it was strongly suggested that informal collaboration regarding standardization of stock assessment-related methods be continued in the future.

5.1.1.2. Indices of Abundance

Indices of abundance (i.e., catch-per-unit-effort or CPUE) represent an important source of auxiliary data commonly used for 'tuning' purposes in VPA-based methods, such as the VPA-2BOX model. Several Workshop papers were presented that generally addressed this subject, including papers from the U.S. (NPALB/04/07), Japan (NPALB/04/11 and NPALB/04/12), and Taiwan (NPALB/04/04).

5.1.1.2.1. Eastern North Pacific Ocean Fisheries

Paul Crone presented research results regarding 'standardized' indices of abundance for both the U.S. troll and longline fisheries (NPALB/04/07). Generalized Linear Model (GLM) estimation methods were used for purposes of standardizing catch and effort data collected from ongoing logbook sampling programs for the U.S. troll (1961-03) and longline fleets (1991-03). For the U.S. troll fishery, the GLM was based on a response variable of log-transformed catch rate ($\log_e$ CPUE) as a function of three main explanatory variables (year, quarter, and area). The overall model and factors within the model were highly significant ($P < 0.001$). The CPUE index applicable to the U.S. troll fishery indicated the stock size has fluctuated markedly since the early 1960s, with generally declining catch rates from the early 1960s through the late 1980s and increasing rates, albeit variable estimates, over the last decade (Figure 15).

Crone also presented results from research investigations that focused on age-specific indices of abundance for the portion of the stock targeted by the U.S. troll fleet in the central and eastern North Pacific Ocean (NPALB/04/07). The age-specific abundance indices (ages 2-5) were essentially the age-distribution data derived from the size data sampled from the U.S. troll fleet weighted by CPUE information and a 'spatial' attribute. As indicated in other time series presented in the research, juvenile fish (primarily, ages 3-4) have generally dominated the overall age distribution each year as the stock conducts its annual migration from western to eastern North Pacific Ocean waters. The trend observed for the age-3 and age-4 indices were generally similar to the CPUE index above, with highly variable estimates that have fluctuated on a yearly basis since the early 1990s. Age-specific abundance indices for ages 2 and 5 are likely poor relative measures of abundance, given these age groups are rarely encountered (i.e., harvested) by the U.S. troll fishery in any given year.

An age-aggregated abundance index derived from logbook data collected from the U.S. longline fishery (1991-03) was also presented by Crone (Figure 15). The GLM was similar to that described above for the U.S. troll fishery; however, the response variable was in units of catch (number of fish)-per-set (i.e., each set standardized to 1,000 hooks) and explanatory variables were based on year and quarter. Since the early 1990s, catch rates for the longline fishery have been somewhat variable, ranging from roughly 0.20 to 0.54 fish/set since 2000.

Finally, the model configurations (runs) used in the VPA-2BOX model analysis were based on various age-specific abundance indices for the U.S. troll fishery and the age-aggregated abundance index calculated from U.S. longline fishery information.

5.1.1.2.2. Western North Pacific Ocean Fisheries

Koji Uosaki presented a standardized CPUE time series for the Japan offshore and distant-water longline fisheries (1975-03) based on GLM analysis (Figure 16) (NPALB/04/11). The analysis was designed to account for effects of year, quarter, area, gear configuration, as well as an interaction term between quarter and area. The estimated (standardized) CPUE was then weighted by area size, apportioned into CPUE by size class using length-frequency information and finally, converted to age groups based on MULTIFAN analysis. The CPUE indices were calculated on a ‘calendar year’ basis. The age-aggregated CPUE index was relatively stable from 1975 through the late 1980s, increased markedly from 1990-98, and has decreased since this time to historically low levels (Figure 16).

Uosaki also presented age-specific abundance indices derived from Japan longline fishery (NPALB/04/11). For the most part, age-specific abundance for the longline fishery generally mimicked the age-aggregated CPUE index above, i.e., in general, each age index remained relatively consistent from 1975 through the late 1980s, and increased moderately into the mid 1990s. For recent years, estimates of adult fish (ages 6 and older) have declined from the late 1990s to the end of the time series (2003), whereas estimates for ages 3-4 have remained relatively consistent.

A CPUE (age-aggregated) index for the Japan pole-and-line fishery (1972-03) (NPALB/04/12) was standardized using a GLM model based on the following effects: year, bi-monthly period, area, vessel size class, skipjack targeting, and various interactions among these variables. In general, the estimated CPUE remained at relatively low rates through the 1980s, gradually increased during the 1990s realizing a high point in 1999, declined markedly in 2000, and has increased substantially over the last three years (Figure 16).

Age-specific abundance indices applicable to the pole-and-line fishery were also presented (NPALB/04/12). These indices were relatively low during the 1970s and through the mid 1980s, with higher estimates observed from the late 1980s through recent years. The age-specific abundance indices by fishing year indicated that 1999 and 2002 were associated with very high estimates, which represented 1995-99 year classes. Only the 1996 year class has high abundance indices at successive ages (i.e., in the 1999 fishing year age 3, and 2000 fishing year age 4).

Age-specific abundance indices (1995-02) for the longline fishery of Taiwan were presented by Chien-Chung Hsu. In general, both GLM and MULTIFAN methods were employed to derive these statistics for ages 2-9+. Age groups 5-8 typically composed at least two-thirds of the annual age distributions for this fishery. The age-specific abundance indices were generally variable since 1995.

5.1.1.2.3. Discussion

In summary, discussion on indices of abundance addressed those developed from Eastern (Section 5.1.1.1.1.) and Western (Section 5.1.1.1.2.) North Pacific Ocean fisheries. The following summary provides an overview of this discussion:

(1) Meeting participants agreed that considerable progress had been made since the last Workshop.

(2) There was discussion surrounding the extent to which the U.S. ('Hawaii-based') longline fishery CPUE time series should be used in future population models, given this fishery does not typically target North Pacific Albacore, and its inclusion may not represent actual population trends. Ultimately, for the present time, participants agreed that the Hawaii longline CPUE time series should be included in the analysis; however, inclusion or omission of this index (as well as others) should be discussed further within a formal working group setting (see Section 5.1.1.1.4. above) regarding standardizing input data used in assessments.

(3) Participants agreed that the preliminary age-specific abundance indices from Taiwan's longline fishery should be reviewed further before including in population modeling, given ongoing concerns regarding the length data collected in some years for this fishery, as well as potential problems associated with the statistical methods employed. Relating to this issue, it was also suggested that the catch-at-age matrix regarding this fishery used in the population models continue to be developed using current methods, until alternative research can provide more accurate summarizations of the available data.

(4) Since 1990, it was observed that the 'aggregated' CPUE time series have been generally increasing. It was agreed that there exists many plausible reasons for the observed increase (e.g., changes in ocean productivity, catchability, or technology) and at this time, it is not possible to make definitive statements regarding this general increase in fishing success. Finally, participants agreed that future work is needed concerning CPUE standardization for the individual indices, as well as the suite of indices to use in population-wide assessments.

5.1.2. Results

Both Japan (National Institute of Far Seas Fisheries) and the United States (Southwest Fisheries Science Center) conducted VPA-2BOX model analysis for this year's Workshop using similar 'primary' sources of input data, i.e., the single, combined catch-at-age matrix (see Section 5.1.1.1.3. and Table 2) was used by both research teams and the suite of candidate indices of abundance (see Section 5.1.1.2) was available to both research teams. Results from the two analyses are presented separately and the Workshop-consensus analysis is presented under Stock Assessment Conclusions (Section 6).

5.1.2.1. National Institute of Far Seas Fisheries - Japan

Koji Uosaki presented the results of a preliminary VPA analysis of the 1975-2003 data using the VPA-2BOX model. VPA runs were done with two Model Scenarios (Scenarios 1 and 2). Model Scenario 1 utilized all of the abundance indices, whereas Model Scenario 2 utilized a subset of indices (analogous to models developed for the previous Workshop (Crone and Conser 2004:28)). The results showed that estimates were generally similar for both models. Total biomass estimates (January 1, 2004) were roughly 480,000 mt. It was found that predicted and observed indices of abundance for the Japanese longline fishery did not agree well for older age groups in recent years. Retrospective analysis for Model Scenario 1 suggested a tendency for past assessments to overestimate total abundance (see Section 6). Projections were also made with similar conditions and two assumptions of productivity regimes for future recruitment as in the last Workshop (Crone and Conser 2004:30). The results indicated that total biomass initially continued to be at the current level for the high productivity assumption, but converged to roughly 70% of current level within 10 years.

5.1.2.2. Southwest Fisheries Science Center - United States

Prior to the Workshop, Suzy Kohin, Paul Crone and Ray Conser conducted preliminary analyses at the Southwest Fisheries Science Center using VPA-2BOX. First, an examination of the data sets was conducted to make sure that the updated indices and total catch trends did not differ markedly from the data provided in 2002. It was concluded that the data were similar for the overlapping period. Secondly, model runs were made with VPA-2BOX based on the input data that were included in the previous assessment conducted in 2002 in efforts to corroborate that the two modeling platforms (ADAPT vs. VPA-2BOX) produce generally similar results. Efforts were made to mimic the 2002 runs as closely as possible (i.e., biological inputs were identical, same 16 abundance indices were used, and indices were weighted inversely relative to their precision). Overall, this initial modeling effort resulted in similar estimated time series between the two modeling platforms. However, there were some divergences in various runs between the ADAPT-based models in 2002 and the VPA-2BOX models conducted in 2004. The reason was likely due to the manner in which VPA-2BOX and ADAPT differ in estimating *F*s for the older ages. In 2002, using ADAPT, the age 8 *F*s for all years were calculated from back-calculated stock sizes of ages 4-8. In VPA-2BOX, the same method could not be used to estimate $F_{age\text{-}8}$. Ultimately, the two VPA platforms provided similar results overall and thus, the analysts went forward with some preliminary runs using the input data provided through 2003. Five iterations were presented: A1 – using all 16 indices, with equal weighting; B1 – using all 16 indices, with weighting of the indices inversely relative to their precision; C1 – using a subset of indices, with a single age-specific index chosen for each age and equally weighted; D1 – using age aggregated indices and inverse variance weighting; and E1 – using a single age-specific index for each age, as in C1, with inverse variance weighting.

Results indicated that biomass estimates generally overlapped for all model runs until 1996, when some divergence was observed. In general, the equally weighted runs (A1 and C1) were more 'optimistic' (higher estimates of current abundance) than the weighted runs (B1 and E1). Model runs C1 and E1 were considered overly optimistic, relative to the 2002 assessment results and to model run B1, which most closely mimicked the 2002 assessment results. The analysts examined the fits to various indices of abundance and noted the Japan pole-and-line age-2 index was highly influential to estimates of abundance in recent years. Finally, the U.S. research team recommended that model B1 (subsequently, named Model Scenario 1) be used as the baseline model to work from to develop the Workshop-consensus final model.

5.1.2.3. Discussion

First, Workshop participants noted that the catch-at-age matrix should be adjusted to account for changes in the reported catches from IUU vessels landing North Pacific albacore in the south Pacific, and some updated Mexican and Canadian landings. Second, given that CPUE indices are very influential to bottom-line results (e.g., abundance in recent years), discussion emphasized topics such as inclusion/omission and weighting of the indices used in the assessment models, e.g., contradictory trends in some of the age-specific abundance indices (age-2 indices for U.S. troll and Japan pole-and-line) and inclusion of the U.S. (Hawaii-based) longline index, given this fishery's practice of not directly targeting this species. That is, various alternative weighting methods were discussed, including prioritizing indices based on targeting (selectivity) of the gear (e.g., longline gear targets adult/older fish and troll gear targets juvenile/younger fish). Ultimately, for this assessment cycle, participants opted to include all fishery-specific indices available and to use weighting decisions for the individual indices as was done in the previous assessment (i.e., emphasis on precise indices). Further, the Workshop members noted that CPUE evaluations would be a meaningful topic to address in a future Intersessional Meeting. Third, general discussion regarding the variability associated with the estimated *F*s associated with older ages determined such uncertainty was expected, given the determination of ages for older fish is inherently problematic. Fourth, participants discussed the use of the Hawaii longline indices in the model configurations.

To evaluate the topics above, a small Working Group was appointed to update the input data, and conduct further sensitivity analysis on candidate models (see models A1, B1 and D1 above), and further examine additional configurations that are based on an agreed to suite of age-specific indices generated from the surface fisheries and age-aggregated indices for the sub-surface fisheries (subsequently, named Model F1 and ultimately, Model Scenario 2).

The Working Group recommended that models B1 (Model Scenario 1) and F1 (Model Scenario 2) be identified as the best baseline, candidate final models to further evaluate in efforts to develop a Workshop-consensus configuration. The Working Group noted the following concerning the overall uncertainty analysis regarding the two Model Scenarios: first and foremost, retrospective analysis for both Scenarios indicated a directional bias in past assessments to generate overestimates of biomass (and under estimates of *F*) in recent years; classical bias-correction techniques (e.g., biomass and *F*), such as an a priori-determined percentage decrease for each year or common bootstrap-based statistical procedures may provide useful adjustments to this potential bias. Bootstrap analysis was conducted, but resulted in only minor decreases in biomass estimates, which did not explain fully the trends illustrated in the retrospective analysis and thus, participants decided to maintain the integrity of the final deterministic runs for each Model Scenario. Following general discussion, Workshop consensus settled on Model Scenario 1 as the agreed to, final configuration for the current assessment year. Results associated with Model Scenario 1 are described below (Section 6.). Finally, participants decided to follow through with a suite of commonly used *F*-based MSY proxies (as was done in the previous assessment) for determination of biological reference points.

5.2. Alternative Stock Assessment Models

5.2.1. ASAP Analysis

Paul Crone presented a paper (NPALB/04/06) that served as an alternative population analysis of the North Pacific albacore stock based on a forward-simulation model (Age-structured Assessment Program-ASAP). The ASAP model was used to evaluate more fully the relationship between this species' population dynamics and associated fishery operations (i.e., areas of uncertainty in an overall stock assessment) than is possible using a backward-simulation approach, such as a virtual population analysis (VPA). That is, the primary goal of this initial, forward-simulation modeling effort was to develop a robust, baseline ASAP model that can serve as a sound foundation for developing more detailed models in the future, e.g., configurations that accommodate greater complexity in both model structure and estimation.

The time series used in the analysis were generally similar to those included in the VPA modeling efforts; however, the ASAP model accommodated more detailed spatial structure than possible using a VPA approach. In particular, annual estimates of catch-at-age were partitioned into four 'fisheries,' rather than the single 'fishery' assumed in the current VPA model (see Section 5.1.1.1.3.). The fisheries were stratified as follows: (1) surface fisheries (including gears such as troll, purse seine, gill net, recreational, etc.) of the eastern North Pacific Ocean (EPO-SG); subsurface (longline) fisheries of the eastern North Pacific Ocean (EPO-SSG); surface fisheries (including gears such as pole-and-line, purse seine, gill net, etc.) of western North Pacific Ocean (WPO-SG); and subsurface fisheries of the western North Pacific Ocean (WPO-SSG). The indices of abundance utilized in the ASAP model were the same as those incorporated in baseline-related VPA models. Finally, assumptions concerning biological and fishery parameters in the fully-integrated ASAP model were consistent with those utilized in the VPA (e.g., maturity, mortality, growth, etc.).

The trends associated with management-based time series (e.g., stock biomass, spawning stock biomass, and recruitment) from the ASAP analysis were generally similar as estimated in the VPA models (past 2002 analysis and recent 2004 analysis), as well as those generated from another forward-simulation population analysis (namely, the length-based, age-structured MULTIFAN-CL baseline model). In general, the analysis indicated that the stock remained at relatively low levels through the late 1980s, then began to increase in size through the 1990s, and now shows signs of a ‘leveling off,’ with biomass estimates ranging from approximately 450,000 to 500,000 mt since 2000. As expected, estimates of recruitment (age-1 fish) have been highly variable since the early 1990s, with strong and weak cohorts that have ranged in size from 20 to 60 million recruits. Finally, one of the primary advantages of utilizing a modeling structure like ASAP is its ability to account for potential heterogeneity across differently operating fisheries, e.g., differences in the age groups exploited (i.e., in catch-at-age) between surface and subsurface (longline) fisheries. In this context, surface fisheries were clearly characterized by estimated selectivity distributions that were dome-shaped, whereas estimated selectivity for longline fisheries was asymptotic (flat-topped) for older ages. Since the early 1990s, estimates of age-specific fishing mortality (*F*) have been relatively high (0.5-0.8 yr^{-1}) for older (ages 7 to $\geq$9) fish.

5.2.2. Statistical Catch-at-Age Model

Yukio Takeuchi presented results from a separate, forward projection catch-at-age model applied to the North Pacific albacore population (NPALB/04/16). The study was conducted in response to recommendations made at past Workshops (e.g., *Eighteenth North Pacific Albacore Workshop*) to further investigate the utility of age-structured models other than VPA-based methods. The model, unlike the ADAPT-based VPA model, allowed errors in catch-at-age and total catch by fleet (in weight). On the other hand, the model is more restrictive regarding selectivity. The model assumed a constant selectivity pattern for each fleet. The model shared many features with other statistical catch-at-age models, such as Coleraine and ASAP. Results were generally similar to the results from VPA methods. Two broad model configurations were evaluated based on subsets of the available indices: one, based on four age-aggregated CPUE indices; and another based on the age-specific CPUE indices (i.e., not including the U.S. longline age-aggregated index). Finally, fits to the CPUE indices suggested some temporal trends, which require further investigation.

5.2.3. Coleraine Model Analysis

Simon Hoyle presented results from collaborative work (with M. Stocker, S. Harley, and M. Maunder) using a statistical age-structured population dynamics model to assess the North Pacific albacore stock (NPALB/04/17). The assessment was conducted with the generalized age-structured model package ‘Coleraine.’ The Coleraine model can simultaneously be fitted to a multitude of data including catch-at-age, size-at-age, and multiple indices of abundance. The model estimates parameters using maximum likelihood estimation in a first phase and a Bayesian approach in a second phase. The first year of the model was 1952. Fisheries were separated into two groups: (1) the surface fishery (troll, pole-and-line, purse seine, gill net, and sport); and (2) the longline fishery. Selectivity for the two fisheries was modeled to vary by age, and recruitment followed a Beverton-Holt spawning biomass-recruitment relationship. Three commercial fishery CPUE indices were fit to mid-season vulnerable biomass using selectivity-at-age. Biological parameters (e.g., growth, natural mortality, and maturity) used in the Coleraine model analysis were the same as those used for the VPA-2BOX assessment. There were two distinct steps in model fitting: (1) obtain the best possible fit to the data by minimizing the global objective function; and (2) apply Bayesian integration to obtain estimates of the marginal posterior distribution of parameters of interest.

The model was projected into the future using constant catches of 80,000 mt, 100,000 mt, and 120,000 mt. The MCMC technique was used to generate samples from the joint posterior probability distributions. The estimated spawning biomass trajectory for North Pacific albacore showed a steady decline from the high level at the start of the time series in 1952 to the lowest level in the early 1990s. The model predicted a historical decline in biomass in the 1950s and 1960s and a recent increase in the recruitment consistent with the CPUE trend from the surface fishery. However, the recent declines observed in the longline-based CPUE indices were not consistent with this trend.

5.2.4. Discussion

This session of the Workshop considered alternative modeling approaches, principally age-structured, forward simulation techniques. A number of packages are currently available for application. Paul Crone presented modeling results using the ASAP model (included in the NOAA Fisheries Toolbox). Participants considered the ASAP model a good candidate for transitioning the assessment (from a VPA-based approach) to a forward simulation, age-structured approach.

It was noted that the input data sets were similar to those used in the VPA-2BOX model, with the exception of some more detailed spatial structure, i.e., the division of the North Pacific into four fisheries (EPO/WPO, surface/longline fisheries). The model included comparable population dynamics to a VPA model, but provided more flexibility in terms of fishery selectivity and recruitment parameterization.

Workshop participants were encouraged by the fact that the recruitment time-series and biomass trajectory from the ASAP model were comparable to the VPA-2BOX analysis, and noted that the model estimated relatively high exploitation rates for the older age classes.

Paul Crone told participants that he also conducted a model run using MULTIFAN-CL based on similar assumptions to that presented last year. The biomass trajectory differed from the ASAP results, although it was noted that the MULTIFAN-CL model was parameterized with much more detail than the ASAP configuration (e.g., numerous fisheries, age data based on a 12-yr old 'plus' group, length data partitioned into ages in a fully-integrated manner within the model, etc.), which made strict comparisons of the generated results inherently problematic.

Participants had a number of questions about the technical specifications of the ASAP model, including assumptions regarding temporal trends in selectivity and catchability. That is, in the ASAP model, these were all held constant to allow comparison with the VPA-2BOX results. The group also noted that more detailed diagnostics should be presented to allow better appraisal of the model results (e.g., fit to the age structure, etc).

The input and output files for the MULTIFAN-CL runs were circulated to the group to allow a more detailed examination of the modeling approach. It was generally agreed that further effort be applied to the application of this modeling approach to North Pacific albacore.

Yukio Takeuchi presented the results from a separate forward projection catch-at-age model. The initial age structure (1975) was estimated based on the average F for the first five years (initial exploitation rate). Selectivity was fit in the model based on a dome-shaped curve for the surface fishery and asymptotic pattern for the longline fishery. The model included two fisheries (surface and longline) in the Eastern Pacific Ocean and West-central Pacific Ocean. The estimated total biomass trend was generally similar to the VPA-2BOX estimated time series, although estimated spawning biomass was considerably lower than that generated in the VPA-based model. Diagnostic examinations of the CPUE-related fits revealed some systematic residual trends, especially for the fit to the Japan longline-based CPUE indices).

While discussing Coleraine model results, participants noted that NPALB/04/17 documents preliminary results from earlier work by Stocker and Harley that was done during the Workshop in 2002. The Coleraine model analysis differed from other model analysis in that the population was projected forward from a virgin stock size in 1952 and included two fisheries (surface and longline). The MCMC runs were undertaken to look at uncertainty of the biomass trajectory. Sensitivity analyses were also conducted to investigate various assumptions regarding steepness, natural mortality, and various weighting options for the CPUE data.

The Coleraine model generated broadly comparable results to the other models in terms of the estimated biomass time series. It was recommended that the model should include catch-at-age and CPUE data from the earlier period (prior to 1975). There was some concern that using only the catch data in the earlier period may mean that the model does not reliably represent the historical population dynamics and further, the inclusion of these data may be influential to recent estimates from the model. It was recommended that further sensitivity analysis be conducted with this model based on an abbreviated time series and subsequently, results compared with the other alternative age-structured modeling approaches. Also, participants noted that the Coleraine model based on the extended time series would benefit from the inclusion of available biological data prior to the 1970s (i.e., limited length data do exist for the 1960s and into the 1950s for the Japan longline fishery and U.S. troll fishery).

In summary, while it was recognized that results from the models differed in terms of absolute levels of estimated biomass over portions of the overall time period, ratio statistics regarding levels of current biomass to that estimated in the beginning of the time period were generally similar between the various alternative assessment approaches. Finally, on a related topic, Workshop consensus was to omit surplus production model analysis (e.g., ASPIC model) for this assessment cycle and potentially in further assessment efforts, given concerns regarding potential biases associated with this assessment method in general and the progress made with age-structured approaches already in place.

6. STOCK ASSESSMENT CONCLUSIONS

6.1. Introduction

Following review of the preliminary VPA-2BOX (Porch 2003) runs presented by Japan and the United States, Workshop participants recommended that two model configurations (henceforth, referred to as Model Scenarios 1 and 2) be further evaluated. Each of these configurations included the suite of assumptions and methods that were presented in the preliminary assessments discussed above. Given the importance of the indices of relative abundance in such assessments, the participants recommended that these two Scenarios be based on similar biological assumptions, with one utilizing all of the indices of abundance (Model Scenario 1) and the other based on a subset of the indices (Model Scenario 2). Maturity schedules (Ueyanagi 1957), weight-at-age (Suda and Warashina 1961; Suda 1966), rates of natural mortality (*M* of 0.3 for all ages and years), and general estimation methods were consistent between the two Models. Model Scenario 1 was based on the following 16 indices: age-specific indices for ages 2-5 (U.S./Canada troll fishery); age-aggregated (assumed to represent ≥ 6-yr old fish) abundance index (U.S. longline fishery); age-specific indices for ages 2-5 (Japan pole-and-line fishery); and age-specific indices for ages 3 to ≥ 9 (Japan longline fishery). Model Scenario 2 was based on the following 10 indices: age-specific indices for ages 2-5 (U.S./Canada troll fishery); age-specific indices for ages 2-5 (Japan pole-and-line fishery); and age-aggregated indices for the U.S. and Japan longline fisheries.

The estimated trends for important management-based statistics (e.g., stock biomass, spawning stock biomass, and recruitment) were generally similar between the two Model Scenarios. Thus, for the purposes of assessing current stock status and projecting future stock conditions, Model Scenario 1 was chosen as the preferred model, given: (1) statistical fits and diagnostics were deemed generally satisfactory; and (2) Model Scenario 1 utilized more of the available sample information than Model Scenario 2. The Workshop members concluded that Model Scenario 1 represented a reasonable current understanding of the population dynamics of North Pacific albacore.

6.2. Input Data and Output Results From Model Scenario 1

The catch-at-age matrix used for the Workshop-based Model Scenario 1 run is presented in Table 2. Indices of abundance data and assumptions have been described generally in Section 5 above. The Model Scenario 1 estimates of numbers-at-age, and fishing mortality-at-age are presented in Tables 3 and 4, respectively. Also, given VPA-based methods commonly produce highly uncertain (imprecise) estimates of young fish for recent years, the following calculations were conducted: (1) numbers of age-1 fish in 2003-04 reflected the mean estimate over the period 1992-99; and number of age-2 fish in 2004 reflected the exponential decline of age-1 fish in 2003 (i.e., e^{-Z} applied to the mean number of age-1 fish in 2003). Finally, extensive output associated with Model Scenario 1 can also be found in the Workshop Data Base Catalog, i.e., this output is archived in 'pdf' format and can be found at the site 'ftp.afsc.noaa.gov.' This output-related file includes all of the input data, statistical results (including diagnostics), and the complete suite of management-based results.

6.3. Results

6.3.1. Biomass and Spawning Stock Biomass Trends

Estimated stock biomass (*B*, ages ≥ 1 or 1+) decreased from about 360,000 mt in 1975 to about 270,000 mt in the late 1980s (see Figure 17). Stock biomass then increased to a peak of roughly 460,000 mt by the early-2000s and has remained at this level to date, likely, in large part, due to improved recruitment (see Figure 19). However, the estimate of stock biomass in recent years is imprecise and thus, should be interpreted accordingly. For example, the point estimate of the 2004 stock biomass is roughly 429,000 mt with 80% confidence limits (*CI* derived from a bootstrap method, based on 500 replications) ranging from roughly 329,000 to 563,000 mt (Figure 20).

Spawning stock biomass has experienced slight fluctuations since the late 1970s, but generally, it has remained relatively stable at roughly 90,000 mt over the last two decades (Figure 18). The historically high estimate observed in 2004 (approximately 165,000) was largely the outcome of a very successful year class in 1999 (i.e., age-1 fish in 2000); however, recruitment levels from 2001 to the present were considerably lower than this and thus, projected estimates of *SSB* declined to levels more typical of the historical time period. See Section 6.3.3. for further discussion regarding projected estimates of these stock parameters.

For the purpose of comparison, *B* and *SSB* time series generated from the ADAPT model (also VPA-based) in 2002 are also shown (Figures 17 and 18). For the most part, the two modeling platforms were similar; however, some discrepancies exist, given the newer modeling platform incorporated numerical estimation methods not available in the older modeling software (e.g., *F* estimation for the oldest true age, age-group 8, and variance re-weighting methods were internally different between the two VPA modeling approaches).

6.3.2. Biological Reference Points

Determination of 'biological reference points' involved uncertainty analysis based on four model configurations. That is, inherent uncertainty surrounding current levels of both stock 'productivity' (i.e., recruitment) and fishing pressure (i.e., *F*) was evaluated as follows:

'Low productivity'/'Low *F*'
'Low productivity'/'High *F*'
'High productivity'/'Low *F*'
'High productivity'/'High *F*'

'Low productivity' represented the mean recruitment for the period 1975-89 (*R* = 22.5 million recruits), whereas 'high productivity' was defined as the mean *R* for the period 1990-00 (*R* = 31 million recruits), see Figure 19. For 'low *F*', fishing mortality was assumed to be 0.43 (i.e., arithmetic mean of ages 4-9+ in 2003), whereas the 'high *F*' hypothesis was based on a *F* of 0.68 (i.e., mean estimates of ages 7-9+ in 2003). These estimates of *F* at age are not adjusted for partial recruitment at age, but partial recruitment at age is applied to *F* in the forward projections (see Section 6.3.3.).

Equilibrium yield-per-recruit (*Y/R*) and spawning stock biomass-per-recruit (*SSB/R*) calculations were conducted using the same vital rates (growth, maturity, and natural mortality) used in Model Scenario 1 (Figure 21). The partial recruitment (*PR*) schedule (i.e., selectivity ogive) was taken from Model Scenario 1 results, i.e. *PR* used in the *Y/R* and *SSB/R* analyses was calculated as an arithmetic mean (normalized to maximum value) over the period 1995-03 (Figure 21). Results from *Y/R* and *SSB/R* analyses are presented in Figure 22.

6.3.3. Stochastic Stock Projections

The initial conditions for the projections were taken from Model Scenario 1 (see Section 6.1.). More specifically, the projections used terminal year (2004) stock numbers-at-age (N_a) and fishing mortality rate (F_{2003}) as estimated in the VPA-2BOX analysis, and partial recruitment (PR_a) reflected the mean from 1995-03 (see 6.3.2. and Figure 21). Constant *F* and *PR* were used for all projection years (2005-10). The natural mortality, weight-at-age, and maturity-at-age parameters used in the projections were identical to those used in the VPA-2BOX analysis (Model Scenario 1).

The projections were carried out based on the four-hypothesis uncertainty discussed above: (1) a 'high productivity'/'low *F*' regime, characterized by randomly sampling (with replacement) from the recruitments estimated for the 1990-00 period (Figure 19), based on a $F = 0.43$; (2) a 'high productivity'/'high *F*' regime, characterized by randomly sampling (with replacement) from the recruitments estimated for the 1990-00 period, based on a $F = 0.68$; (3) a 'low productivity'/'low *F*' regime, characterized by randomly sampling (with replacement) from the recruitments estimated for the 1975-89 period (Figure 19), based on a $F = 0.43$; and (4) a 'low productivity'/'high *F*' regime, characterized by randomly sampling (with replacement) from the recruitments estimated for the 1975-89 period, based on a $F = 0.68$.

The stochastic projections were linked with the bootstrap analysis that was carried out to estimate error associated with the VPA-2BOX-based parameters using similar methods and software as in the previous assessment (see Crone and Conser 2004). Five hundred bootstrap replications were conducted using Model Scenario 1, i.e., VPA-2BOX analysis was run 500 times, with resampled indices of abundance for each run. The respective estimates of terminal year N_a, F_{2003}, and PR_a (all of which differ by bootstrap replication number) were carried forward into a 6-year projection, which was ultimately based on the deterministic estimate of biomass. Along each of these trajectories, annual recruitment (2005-10) was drawn randomly (with replacement) from the appropriate pool of VPA-2BOX-estimated recruitments (i.e., from 1975-89 or from 1990-00). Overall, the stochastic projection was designed to capture the variance in terminal year estimates (N_a, F_{2003}, and PR_a), as well as recruitment variability in all projection outputs.

Projections were made out to 2010 to illustrate the convergence of *B* and *SSB*, with the long-term mean (equilibrium) conditions expected under the assumptions of constant mortality and forecasted recruitment levels, based on the uncertainty analysis described above (*B*: Figures 23A-B for high productivity scenarios and Figures 24A-B for low productivity scenarios; *SSB*: Figures 25A-B for high productivity scenarios and Figures 26A-B for low productivity scenarios). The solid line with annual markers in the Figures is the mean of the 500 projections. The dashed lines represent the 10^{th} and 90^{th} percentiles from the 500 projections, i.e., nonparametric 80% *CI*s.

Under the 'high productivity'/'low *F*' scenario, *B* is projected to increase moderately from its current level (Table 5A and Figure 23A). Under the 'high productivity'/'high *F*' scenario, *B* is forecasted to remain at roughly its current level (Table 5B and Figure 23B). In the 'low productivity'/'low *F*' scenario, *B* is expected to decline slightly (Table 5C and Figure 24A). In the 'low productivity'/'high *F*' scenario, *B* is projected to decline substantially from its current level (Table 5D and Figure 24B).

As noted in Section 6.3.1., the magnitude of *SSB* observed in 2004 (approximately 165,000) was essentially the result of a record high recruitment (*R*, age-1 fish) estimate in 2000 (i.e., the 1999 year class), with subsequent recruitment dropping to levels more characteristic of the annual average observed during the 'high productivity' time period. For the 'high *F*' scenarios under both the 'high' and 'low productivity' assumptions, *SSB* is projected to decrease substantially (Tables 5B and 5D; Figures 25B and 26B), whereas 'low *F*' scenarios generally resulted in *SSB* remaining constant (Table 5C and Figure 26A) or increasing slightly (Table 5A and Figure 25A). Finally, it is important to note that in all scenarios, the level of uncertainty is quite high and thus, predicting trends over the long-term is necessarily problematic to some degree.

6.3.4. Stock Condition in Relation to Biological Reference Points

In addition to estimating stock sizes in the past (i.e., see Section 6.3.1.), it would be desirable to assess 'current' conditions of both fishing mortality and stock biomass in relation to biological reference points of interest. Although inclusion of such reference points is becoming a standard feature of stock status determinations, there is no agreement yet as to which reference points are appropriate for tuna stocks, including North Pacific albacore. Accordingly, participants continued to take the approach adopted at the *Eighteenth North Pacific Albacore Workshop* and simply compare current levels of fishing mortality and biomass with a familiar suite of reference points. Evaluation and selection of preferred reference points is a task for the future and should be done by consensus among scientists, fishery managers, and stakeholders.

The biological reference points considered here fall into two categories: (1) reference points that are potential candidates as *F*-based MSY proxies, namely $F_{40\%}$, $F_{30\%}$, and $F_{0.1}$; and (2) candidates to serve as *F*-based 'limit' proxies, namely $F_{20\%}$ and F_{Max}. While it is recognized that this list of reference points does not encompass all possible reference points for North Pacific albacore, it does include the most commonly used reference points for contemporary fisheries management.

Depending on the 'current' level of *F* assumed in the uncertainty analysis (see above), the population is being fished between roughly $F_{17\%}$ (i.e., $F_{2003} = 0.68$) and $F_{30\%}$ (i.e., $F_{2003} = 0.43$), see Figure 22. These results are generally similar to the previous assessment conducted in 2002 (Crone and Conser 2004). This conclusion regarding the spawning potential ratio reference point (i.e., $F_{\%}$) is essentially based on Model Scenario 1 (and assumptions regarding current *F*), coupled with the per-recruit analyses. As such, it does not depend on knowing whether the North Pacific albacore population is presently in a 'high or low productivity' regime. However, in order to compare current levels of biomass with those at equilibrium that would result from fishing at any given *F*-based reference point, it is necessary to postulate the current productivity of the stock. That is, appropriate consideration of the status of the North Pacific albacore population necessarily involves assumptions regarding current levels of recruitment. In this context, important management-based statistics presented in Table 5 are summarized below:

(1) *High productivity (Table 5A-B)*: under this hypothesis, the level of productivity observed over the past decade continues to date. For the F_{MSY} proxies considered, B_{MSY} ranges from approximately 560,000 to 660,000 mt (49% to 57% of B_0). The estimate of stock biomass in 2004 (B_{2004}) is 22% below this range. Similarly, SSB_{MSY} ranges from roughly 220,000 to 290,000 mt (30% to 40% of SSB_0), with SSB_{2004} 25% below this range. Again, note that the high level of *SSB* in 2004 is largely driven by a historically high 1999 year-class (see the age-1 data point in 2000, Figure 19), with estimates of *R* since that time declining markedly (see Table 3); also see Figures 25A-B for projected (2005-10) estimates of *SSB*. Current catch (C_{2004}) is captured within the MSY range.

(2) *Low productivity (Table 5C-D)*: under this hypothesis, the level of productivity observed over the past decade would be replaced by the lower productivity observed during the 1975-89 period. For the F_{MSY} proxies considered, B_{MSY} ranges from approximately 410,000 to 480,000 mt (49% to 57% of B_0). The estimate of stock biomass in 2004 (B_{2004}) is near the middle of the MSY range. Similarly, SSB_{MSY} ranges from roughly 160,000 to 210,000 mt (30% to 40% of SSB_0), with SSB_{2004} at the lower-end of the MSY range. Again, note that the high level of *SSB* in 2004 is largely driven by a historically high 1999 year-class (see the age-1 data point in 2000, Figure 19), with estimates of *R* since that time declining markedly (see Table 3); also see Figures 26A-B for projected (2005-10) estimates of *SSB*. Current catch (C_{2004}) is approximately 34% above the MSY range and in excess of the catch 'limits' associated with $F_{20\%}$ and F_{Max}.

In summary, as noted above, the current level of spawning stock biomass (i.e., SSB_{2004} = 165,000 mt) is largely reflective of a very strong 1999 year-class that eventually became a major contributor in 2004 as part of 'mature' (spawning) biomass. However, subsequent recruitment (*R*) declined to levels more typical of the extended historical time series, which translated to reduced levels of forecasted *SSB*, particularly, assuming 'high *F*' scenarios (Figures 25B and 26B) within the overall uncertainty analysis. This coupled with a current fishing mortality rate (F_{2003}) that is high relative to commonly used reference points, may be cause for concern regarding the current stock status of North Pacific albacore. Future conditions are less well known, but if rates of *F* continue at assumed levels, the SSB will decrease to the range from approximately 100,000 to 150,000 mt in 2010; the only potential exception to this point is the 'low productivity/'low F' scenario. Thus, participants of the North Pacific Albacore Workshop noted the critical need to closely monitor the population over the coming years, particularly, to validate SSB abundance in relation to MSY levels. In this context, it was recommended that another assessment be conducted in 2006.

Further, Workshop discussions reflected a growing concern about current and future stock condition and the uncertainties in stock assessments. It is particularly noteworthy that key biological parameters used in the overall stock status analysis, particularly growth and maturity rates, were based on studies conducted in the 1950-60s. While these remain the best available studies on which to base the analysis, it is not known to what extent vital rates of this species may have changed from those measures obtained over 40 years ago. These biological studies should be brought up-to-date as soon as possible. Concern was also expressed about the current lack of understanding of factors affecting recruitment and more generally, the processes affecting productivity (i.e., recruitment levels). Also, it is important to note that retrospective analysis revealed a noticeable trend of under-estimation of F in the ongoing Workshop-based assessments, which necessarily warrants consideration of precautionary management advice associated with the results generated from year-to-year. Finally, there is a general expectation that biological reference points will be needed to guide future fishery management discussions about North Pacific albacore. Accordingly, along with research to improve the accuracy and reliability of stock assessments, a high priority should be given to scientific studies of appropriate reference points for the stock, both with respect to fishing mortality and stock abundance. Participants agreed that provisional studies of candidate reference points should be undertaken during the intersessional period and presented at the next Workshop.

7. FUTURE RESEARCH

A suite of research recommendations were developed in 2002 by the Eighteenth Workshop (Crone and Conser 2004). The recommendations were reviewed by the participants of the Nineteenth Workshop and virtually all recommendations were determined to be still relevant for future research. However, recognizing that resources for addressing research needs are limited and fishery research is largely a long-term endeavor, the participants revised the suite with a view to identifying needs that are tractable in the medium term with on-going projects and with new projects through minimum increase in resources and additional cooperation and collaboration among participants. The recommendations are grouped into three broad categories: (1) Fishery statistics, (2) Biological studies and (3) Stock assessment studies.

7.1. Fisheries Statistics

Annual submission of fishery data by Data Correspondents to the Workshop Data Manager (Al Coan) for inclusion in the data base is a requirement of participants. Guidance for data compilation and submission is contained in the Workshop data protocol (Appendix 4). Correspondents must pay special attention to submitting up-to-date fishery data on timely basis and well in advance of planned workshops.

7.1.1. Maintain Data Base Catalog (Data Correspondents and Al Coan)

The data base catalog is to be maintained by the Workshop Data Manager as a record of available data, contributors and timeliness of submissions by Data Correspondents. The catalog also serves as a record of progress with special data requested of participants, such as detailed information on length-frequency samples: (1) sample size (i.e., number of fish measured) by year; (2) notes on measurement units, accuracy, etc. and sampling procedures used, particularly when procedures differ from the protocol; and (3) full description of steps employed and assumptions made in processing the samples to represent entire catches, particularly when different from Workshop standard procedures. The catalog is to be made available annually to participants.

7.1.2. Prepare Catch-at-Size and Catch-at-Age Matrices (Paul Crone, Koji Uosaki, Chien-Chung Hsu, Suzy Kohin)

Catch-at-size and catch-at-age matrices have been prepared for the period 1975-2003. There are some differences in key factors used to convert catches in weight to numbers by fish sizes and numbers by sizes into numbers by ages for different fisheries. The NMFS, NRIFSF and IO/NTU researchers involved in preparing these matrices need to consult and resolve the differences at the earliest opportunity. The objective would be to develop a standard set of conversion metrics and procedures for use for all catches. The group is also tasked with documenting the standard for review at the next Workshop.

For preparing catch-at-size matrices in the future, participants must use the standard set of conversion metrics and procedures. The results shall be submitted to the Data Manager for compilation. Designated participants would then be tasked with assisting the Data Manager in converting catch-at-size to catch-at-age using standard procedures. This will ensure uniformity in the preparation of catch-at-size and catch-at-age matrices as well as ensure that the Workshop data base of matrices is consistent and available for archiving and exchange among collaborating participants.

7.2. Biological Studies

Biological information is a critical building block for stock assessments. It should be reviewed and updated regularly in order to capture changes in population parameters if they occur. Unfortunately, this process has not been followed for North Pacific albacore because of limited resources for routine biological studies. The stock assessment models used by the Workshop, consequently relies on a patchwork of biological information that was developed largely in the 1950s and 1960s. There is a critical need to reassess the information and to conduct contemporary studies to update the information.

7.2.1. Conduct Age and Growth Studies (Paul Crone, Koji Uosaki, Chien-Chung Hsu)

There is a need for a wide range of related studies that the participants classified as age and growth. These include studies on weight-length relations, ageing techniques and growth curves. For all of these studies emphasis should be on developing parameter estimates that are applicable at the population level.

The research needs should be addressed at two levels. The first is a review of existing information in published documents with the objective of identifying and validating the information currently used in stock assessments. The objective would be to ensure that the best available information is being used in the assessments. This task is assigned to NMFS, NRIFSF, and IO/NTU.

The second level is to use information gained from the review to design studies to estimate biological parameters at the population level. This task is assigned to NMFS. Once the design is available and reviewed by the Workshop, the Workshop should organize a network of collaborators to implement the studies.

7.2.2. Conduct Reproductive Biology Studies (Paul Crone, Chien-Chung Hsu)

Reproductive biology information is important, for example, in separating the spawners from the non-spawners, or immature members, of the population for stock assessment analyses. Currently, a crude maturity function is being used in the Workshop's stock assessment models. The function needs to be refined. This can be done with a population-level study that investigates fecundity, sex ratio, size frequency by sex and the maturity function. A principal investigator to lead and coordinate this task on a North Pacific-wide data collection level needs to be identified.

7.2.3. Conduct Studies on Behavior and Movement with Archival Tagging (Suzy Kohin, Koji Uosaki)

Archival tags are being deployed off the U.S. West Coast by NMFS and off Japan by the NRIFSF to study albacore behavior and movement. So far, the results have not shown trans-Pacific movement, but movement solely within the respective eastern and western North Pacific where fish had been tagged. Both parties have plans for further deployment of tags and plan to report progress to the Workshop on a regular basis. Others are being encouraged to join in the cooperative tagging effort.

The Workshop also noted that information on trans-Pacific movement might be accelerated by archival tagging in the central North Pacific where albacore would cross in moving from one side of the Pacific to the other. It encouraged NMFS to take the lead in developing the design and plans for a mid-Central Pacific deployment of archival tags. It was noted, however, that deployment of tags in the mid-Pacific should not be at the expense of completing the archival tagging studies currently underway.

7.2.4. Monitor Developments in Stock Structure Tools (Paul Crone, Miki Ogura, Gary Sakagawa, Suzy Kohin)

The Workshop has regularly tasked participants to monitor developments of promising tools for use in determining stock structure of North Pacific albacore. So far, suitable technology and tools have not demonstrated significant promise for use with albacore. Nonetheless, the Workshop recommended that the monitoring continue.

7.2.5. Promote Studies on Environmental Effects on the Stock (Paul Crone, Mike Ogura, Max Stocker, Jerry Wetherall)

The environment has a significant influence on the albacore stock and fisheries. Yet, there has been a diminishing level of participation by scientists with biological oceanographic skills in the Workshop and a paucity of studies devoted to environmental effects on the stock. The Workshop recommended that participants invite and encourage biological oceanographers to participate in future Workshops.

7.3. Stock Assessment Studies

Recent stock assessment results as well as fishery developments suggest that the North Pacific albacore stock is at or fast approaching full exploitation by the fisheries. Demand for more frequent and more precise information on status of the stock and the sustainability of the fisheries, thus, is likely to increase. With this in mind, the Workshop identified priority research needs to be executed in the near-term to improve analyses from current stock assessment models and to better understand the models' behavior to changes in parameter estimates and assumptions. The Workshop also identified priority medium-term research to improve the overall capability of stock assessments.

7.3.1. Investigate CPUE Standardization (Paul Crone, Koji Uosaki, Yukio Takeuchi, Chen-Chung Hsu, Suzy Kohin)

Standardized CPUE series (age specific and age aggregated) have been developed to serve as abundance indices for the assessment models. Two levels of concerns have been raised about these indices. The first involves different units used for catch. That is, one series may be based on catch in weight while another is based on catch in number. This adds to uncertainty of results from the Workshop's assessment models. A common unit should be used in all series and catch in weight appears to be the better choice. NRIFSF and IO/NTU are tasked with re-estimating standardized CPUE series with catch in weight.

The second level of concern is whether all available and appropriate input data for possible explanatory variables were used in the standardization. NMFS, NRIFSF and OI/NTU are tasked with investigating this matter with data available to them.

7.3.2. Conduct Stock Production Model Analysis (Ray Conser, Miki Ogura)

Although production model analysis was explored by the Nineteenth Workshop, the results indicated that the model was unsuitable for the data used. Nonetheless, the Workshop felt that the model has advantages not available in the current models of choice and thus, its application should be explored further.

7.3.3. Continue Investigations with Virtual Population Analysis-2BOX Model (Paul Crone, Suzy Kohin, Ray Conser, Koji Uosaki, Yukio Takeuchi)

Considerable progress in assessing the stock status of North Pacific albacore was made with the use of the VPA-2BOX model during the Workshop. The exercise, however, produced some unusual results that could have been caused by the data input, assumptions or the structure of the model. Time did not permit a thorough examination of all possible causes. Further research is required and the team consisting of researchers from NMFS and NRIFSF is tasked with continuing their investigations, particularly with evaluating uncertainties identified in the exercise and to re-examine the diagnostics.

7.3.4. Conduct Research on Alternative Assessment Models (Max Stocker, Simon Hoyle, Paul Crone, Yukio Takeuchi, Ray Conser, Suzy Kohin)

Exploratory work with the Coloraine, ASAP and an operational model for albacore stock assessment were reviewed by the Workshop. All showed promise in contributing information on stock condition for evaluating results from the production model and VPA-2BOX model. Further research of these models together with the MULTIFAN-CL model as stock assessment tools for albacore are encouraged. Results of this research should be made available at the next Workshop.

7.3.5. Testing of Stock Assessment Models (Ray Conser, Yukio Takeuchi, Paul Crone)

Stock assessment models that are emerging as choices for assessing the North Pacific albacore stock are proving to be complex in their behavior to input data, assumptions, subjective parameter adjustments, etc. which affects the results. Furthermore, the complexity contributes to the level of uncertainty that complicates interpretation of the results.

Research using "operational" models to generate data of known properties on which to test assessment models should be pursued to understand the complexities of the models of choice. The work of Labelle (2005) is an example of this type of research.

7.3.6. Continue Evaluating Available Tagging Data (Momoko Ichinokawa,Yukio Takeuchi)

Extensive data from conventional tagging of North Pacific albacore are available and are being analyzed by NRIFSF for information on exploitation rates, natural mortality, movement patterns, etc. The research should be continued and broadened to determine types of data and tagging design required for producing accurate estimates of population parameters.

7.3.7. Conduct Studies on Reference Points (Ray Conser, Paul Crone, Yukio Takeuchi, Max Stocker)

The Workshop repeats its recommendation of 2002 that investigations are needed on appropriate biological reference points (MSY and limit-based) for tuna species in general and for North Pacific albacore specifically. Currently, proxies for commonly used biological reference points are computed for the albacore stock. The proxies, however, span a wide range and research to narrow the range to appropriate ones needs to be undertaken. Such research should include determining robustness of the proxies through simulation studies and with both equilibrium and dynamic states. Also, analysis of appropriate reference points of species with similar life histories to albacore could provide a basis for selecting the appropriate proxies for albacore.

7.3.8. Conduct Studies to Develop Abundance Indices (Paul Crone, Miki Ogura)

The accuracy of current stock assessments for albacore is largely constrained by the abundance indices used in the assessment models and obtained from fishery statistics. Alternative abundance indices that are largely free from the biases in fishery statistics need to be developed. Research should be supported on new methods for measuring albacore abundance, particularly indices that measure abundance of juveniles.

8. ADMINISTRATIVE MATTERS

8.1. ISC-related Matters

At the NPALBW Intersessional Meeting in February 2004 (see Appendix 5), participants were informed that the ISC had adopted a recommendation to invite the North Pacific Albacore Workshop to join the ISC as a formal Working Group. The participants discussed the consequences of joining ISC and developed a set of operating procedures to ensure the continued effectiveness of the Workshop under an ISC umbrella. The procedures are:

(1) The long-standing NPALBW format (including 8-day, hands-on meeting for conducting stock assessments) should be maintained;
(2) While the ISC NPALB WG will probably meet coincident with the ISC Plenary meetings, the stock assessments should be done at Intersessional Meetings with the same general format as the current NPALBW.
(3) The NPALBW format is critical for transparency, peer review of assessments, and sufficient time to re-do analyses during the meeting when required;
(4) Not all NPALBW Intersessional Meetings need to conduct full stock assessments – some may, for example, focus on important aspects of past assessments that require further investigation.
(5) NPALBW Intersessional Meetings should be held off-site from the ISC plenary meeting and with sufficient time lag between the two meetings to allow for preparation and agreement on a detailed NPALBW Intersessional report.
(6) Computer-related support (e.g. availability of high-speed laser printers, network router, etc.) and administrative support (e.g. high capacity copying machines, supplies, etc.) are essential for successful Intersessional Meetings.
(7) The rules and procedures adopted by the ISC Plenary were modeled after the NPALBW process. As such, it is expected that a transition from NPALBW to ISC NPALB WG will be straightforward. It is hoped that similar transitions will be smooth for the other ISC WG's as well.

Workshop participants reviewed these operating procedures and accepted them as necessary to ensure the Workshop's effectiveness as a unit of the ISC. They also unanimously agreed that the Workshop should be a part of the ISC. They tasked the Chairman to inform the ISC of this decision, probably in early 2005 when the ISC is likely to meet next and invite the Workshop to present its status of stock report.

The participants also agreed to maintain the current Workshop data submission and exchange arrangement until the responsibilities can be transferred to the ISC. The group tasked Al Coan to work with his ISC counterpart for smooth transfer of the Workshop data base and responsibilities as soon as the Workshop becomes a unit of the ISC. Data submission and exchange requirements will then follow ISC rules and be coordinated by the ISC Statistical Working Group. Workshop data requirements should not be affected by this change because ISC has adopted the Workshop data protocols.

8.2. Procedures for Clearing the Report

Max Stocker editor for the *Report of the Nineteenth North Pacific Albacore Workshop* was given the task to prepare a draft report after the Workshop. Participants agreed that the outline of the excellent report of the Eighteenth Workshop (Crone and Conser 2004) should be followed as much as possible. A handout compiling available authors' paper summaries, rapporteurs' reports, and most figures was provided at the meeting for comments. A "complete" draft document will be distributed by the Chairman for review, comment and approval by participants by mid-March 2005. The Chairman will evaluate and incorporate all appropriate comments in a final text. Completion of this process and publication of a final Workshop report is planned for no later than summer 2005.

8.3. National Coordinators and Data Correspondents

As noted in Section 8.1., the Workshop will continue to maintain its data submission, management and exchange procedures and research coordination until these responsibilities are transferred to the ISC. Designated national coordinators and data correspondents, therefore, will continue in their roles. The coordinators and correspondents are as follows:

Sector	National Coordinator	Data Correspondent
Canada	Max Stocker	Max Stocker
Japan	Miki Ogura	Koji Uosaki
Mexico	Luis Fleischer	Luis Fleisher
Taiwan	Chien-Chung Hsu	Shui-Kai Chang
United States	Gary Sakagawa	Al Coan
IATTC	Simon Hoyle	Michael Hinton
SPC	Adam Langley	Peter Williams

8.4. Time and Place

The time and place for the next Workshop meeting will be a matter addressed by the ISC when the Workshop becomes a unit of the ISC (see History of the North Pacific Albacore Workshop above). The participants, nonetheless, felt that plans for a 2005 meeting ought to be developed in the interim to ensure that the Workshop research is not interrupted by the transition to ISC governance.

8.5. Acknowledgments

Workshop participants collectively thanked the hosts (Fisheries and Oceans Canada, Pacific Biological Station chairperson and staff) for their hospitality and overall meeting arrangements that served as the foundation for meaningful scientific discussion and a successful meeting. In particular, members identified the well designed computer-related support at the Nineteenth

Workshop as a pivotal step in conducting such a scientific forum, which ultimately, allowed presentations, data exchange, and interactive modeling efforts to be conducted in a very efficient manner.

8.6. Adjournment

The Workshop was adjourned at noon on December 2, 2004. The chairperson (Max Stocker) thanked all of the participants for their attendance and contributions and finally, stressed to National Coordinators the need to maintain ongoing communication concerning scientific data exchange and research applicable to North Pacific albacore, as well as scheduling future Workshop-related forums, such as the proposed Intersessional Meetings discussed here.

9. REFERENCES

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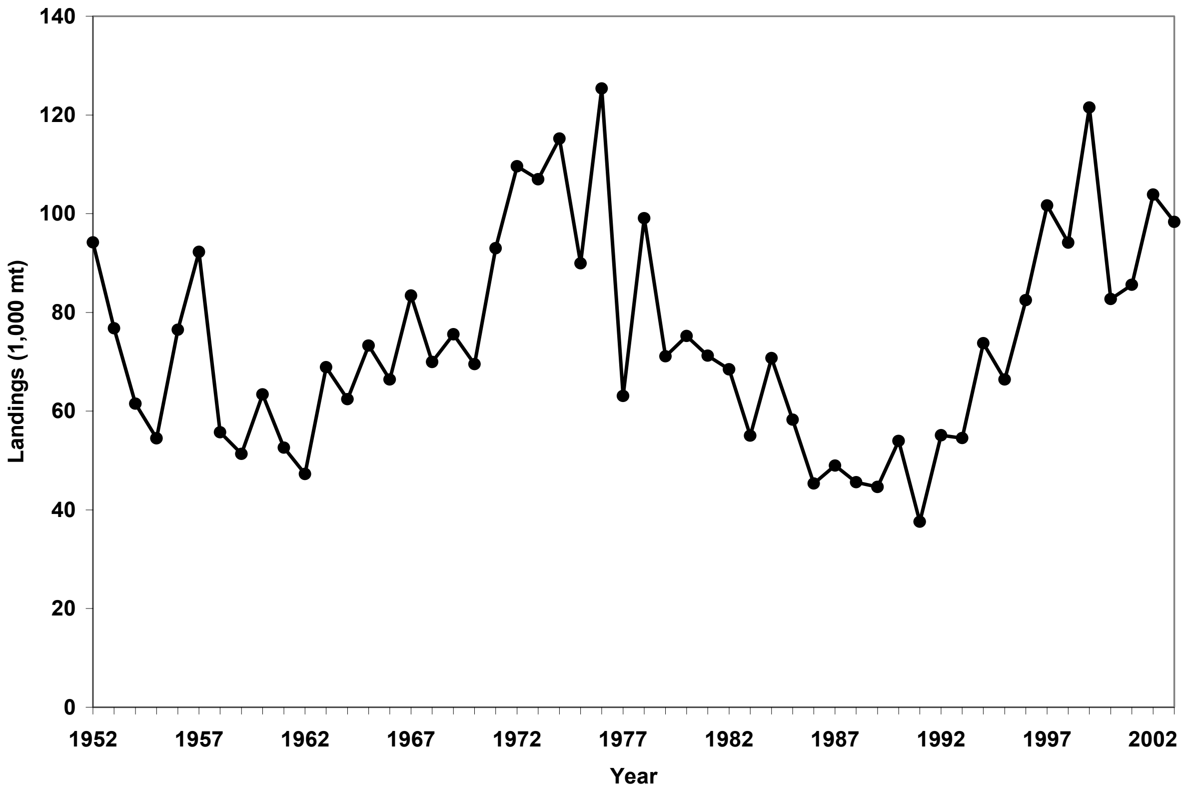


Figure 1. North Pacific Ocean albacore landings for all gears and nations combined (1952-03).

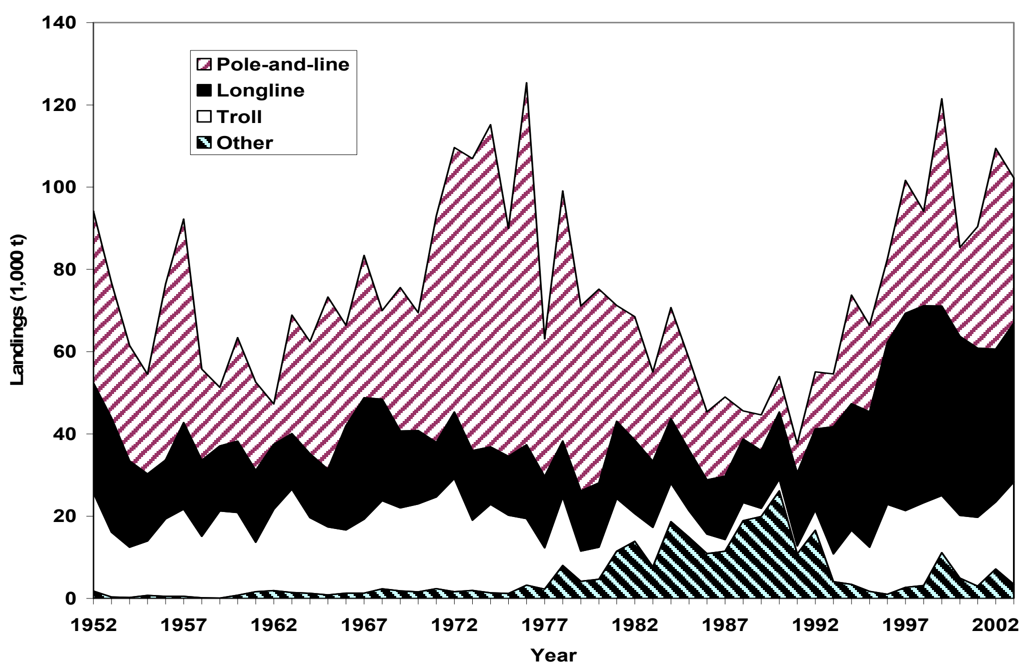


Figure 2. North Pacific Ocean albacore landings by gear (1952-03).

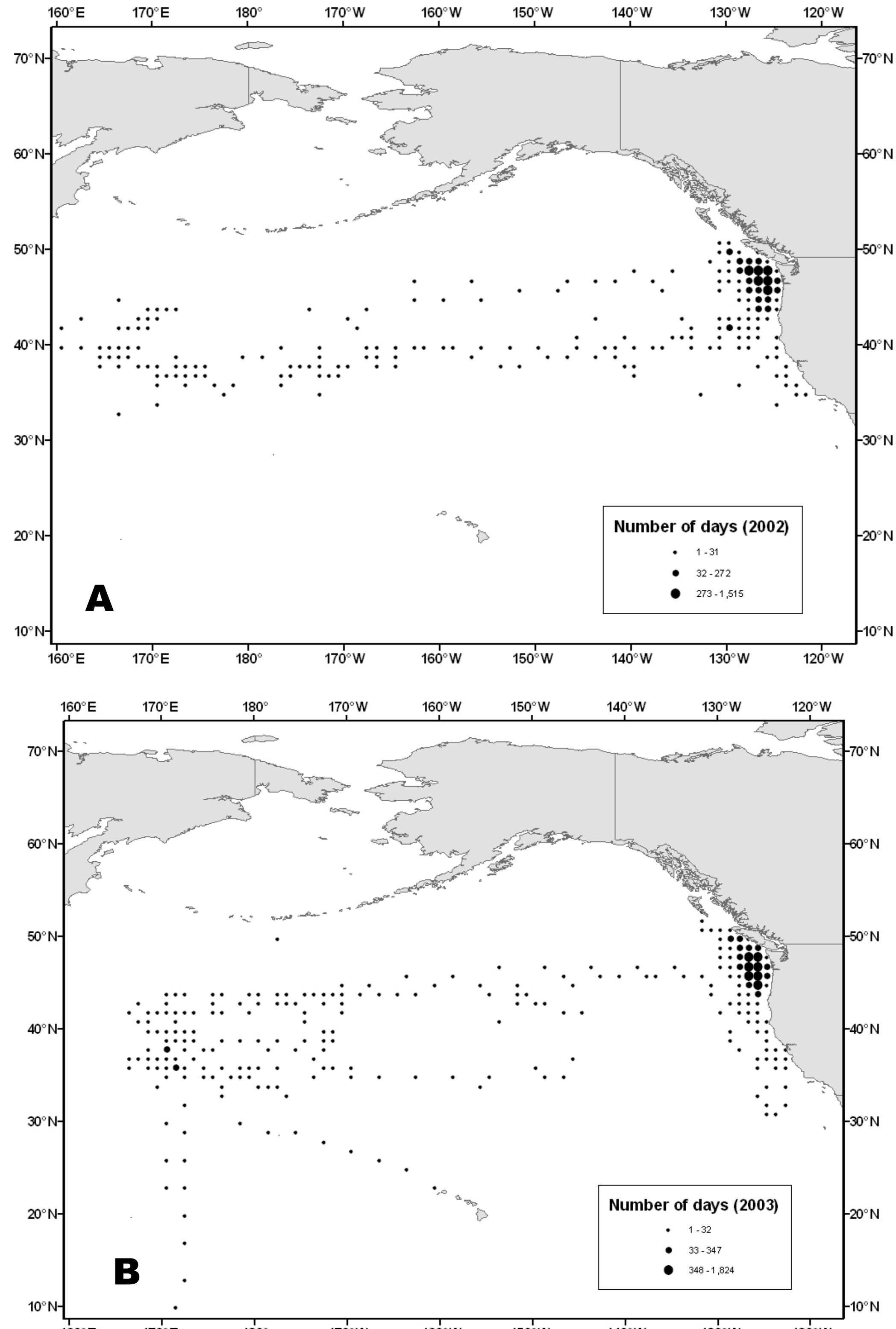
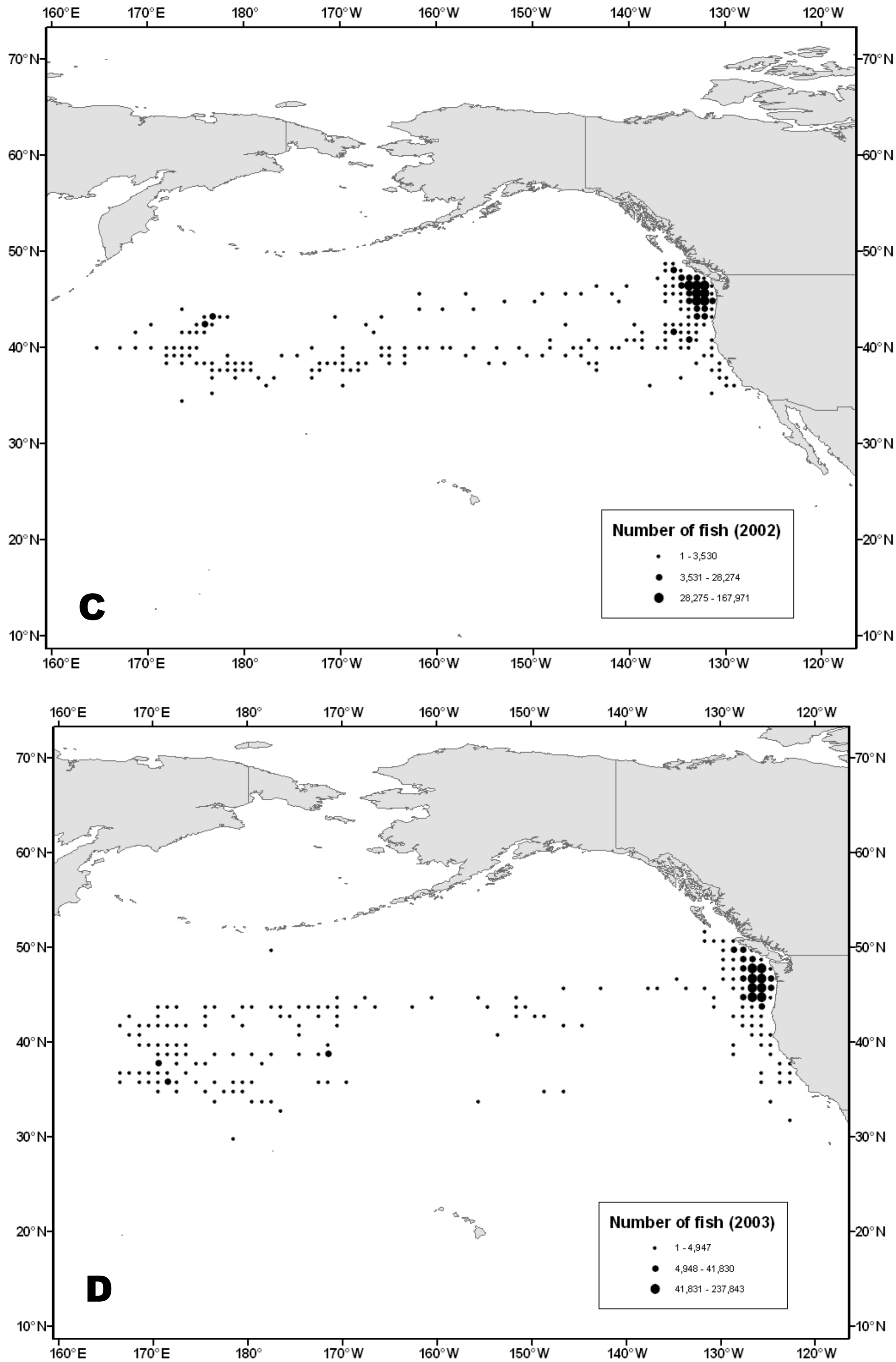


Figure 3. Distribution of fishing effort (number of days – A and B) and catch (number of fish – C and D) for the Canada troll fishery in the North Pacific Ocean (2002-03).



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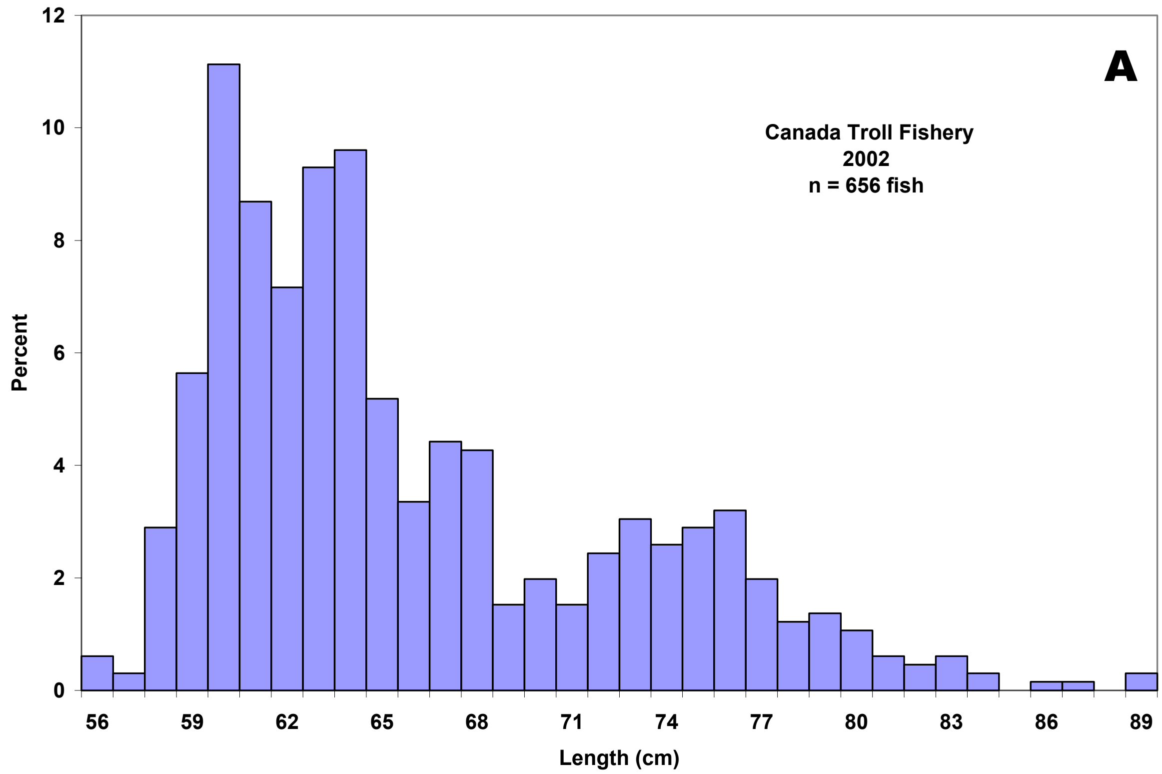


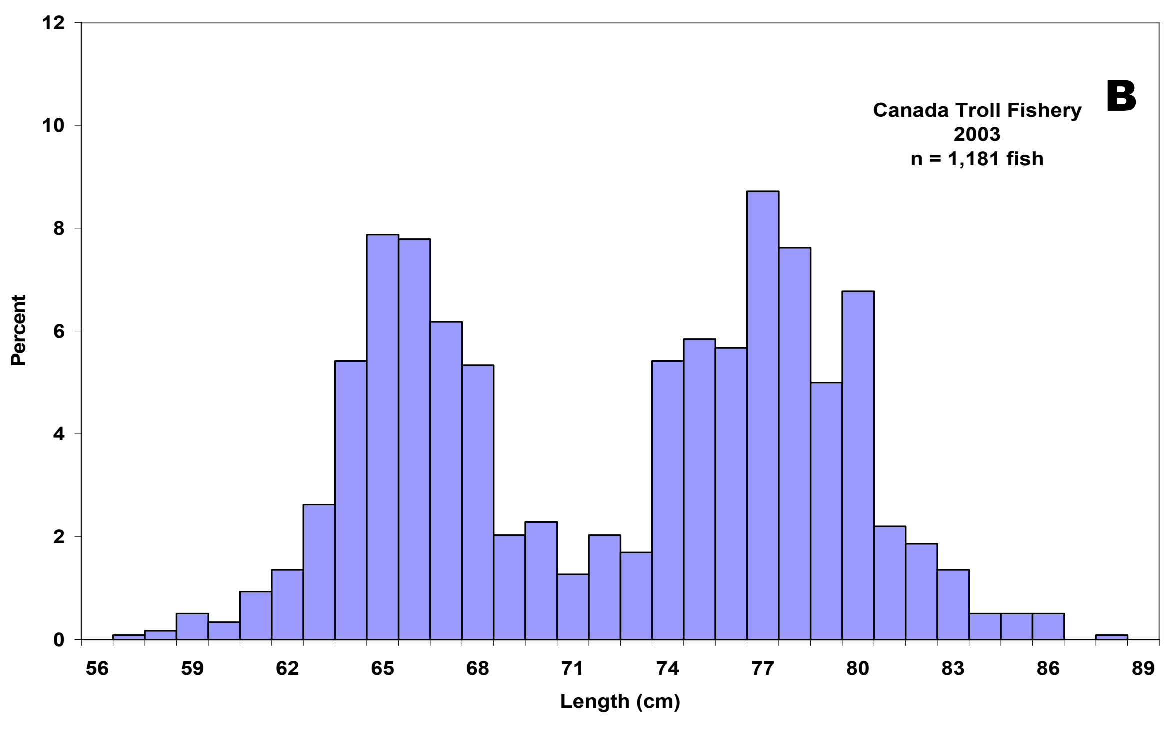
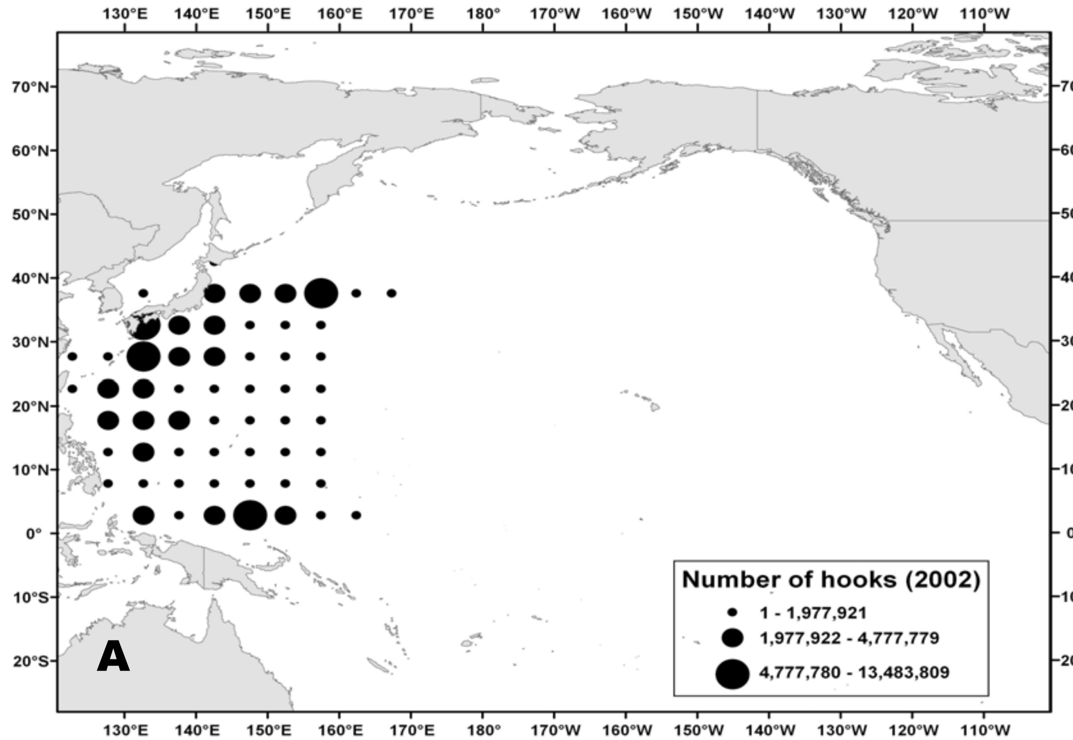


Figure 4. Length (fork in cm) distributions of albacore harvested in the North Pacific Ocean Canada troll fishery (2002-03).



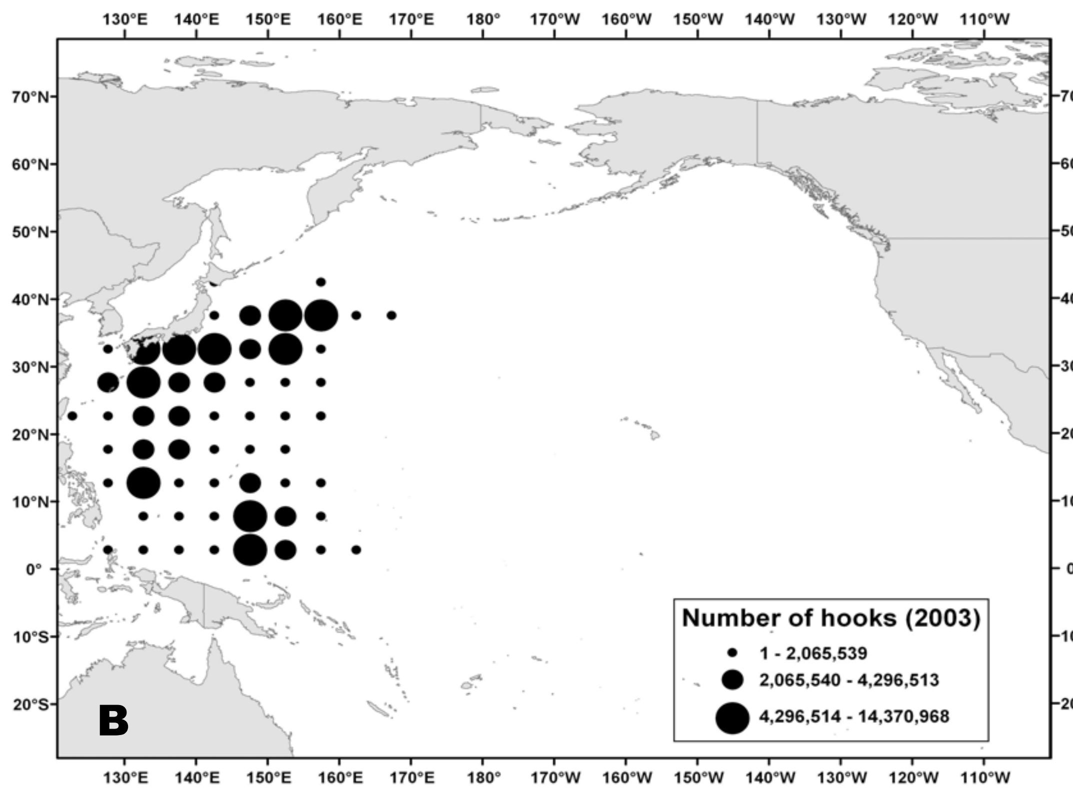
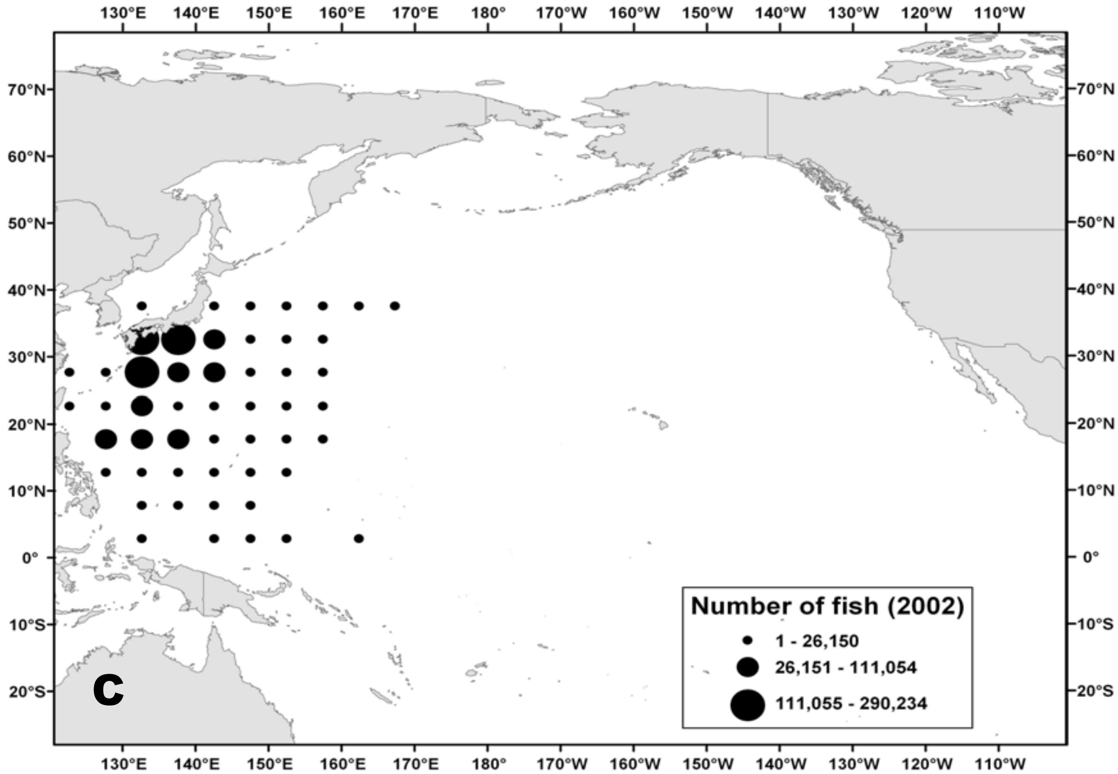
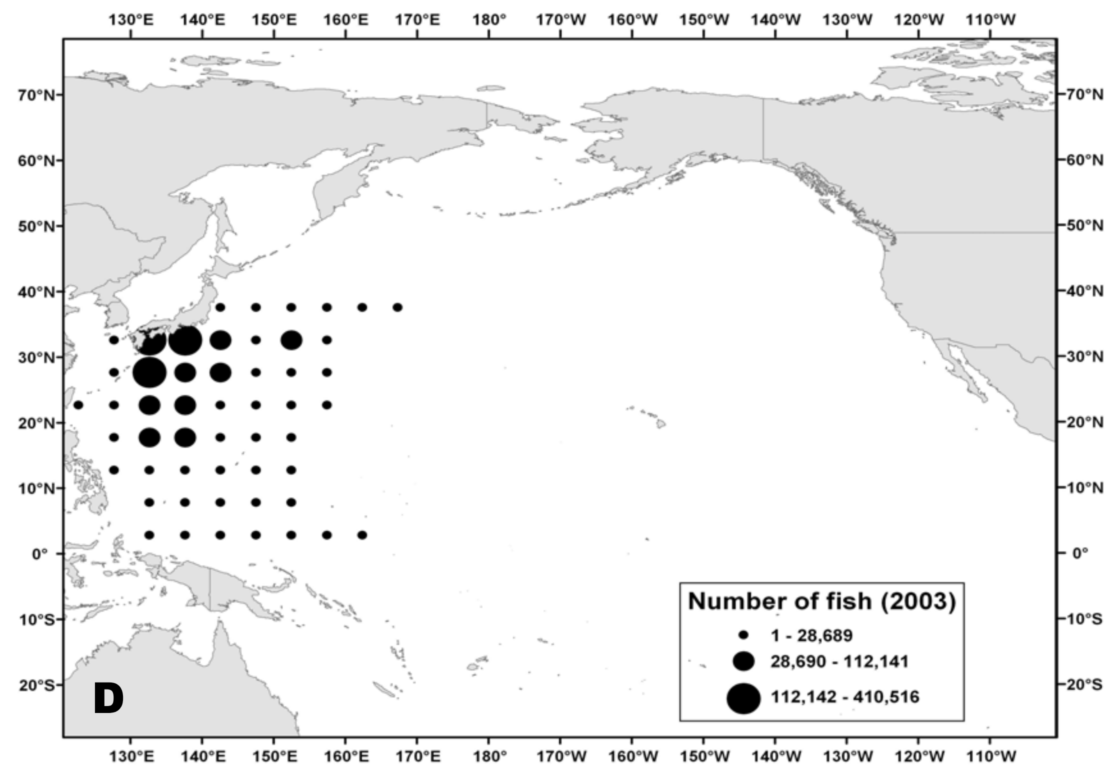


Figure 5. Distribution of fishing effort (number of hooks – A and B) and catch (number of fish – C and D) for the Japan coastal longline fishery in the North Pacific Ocean (2002-03).





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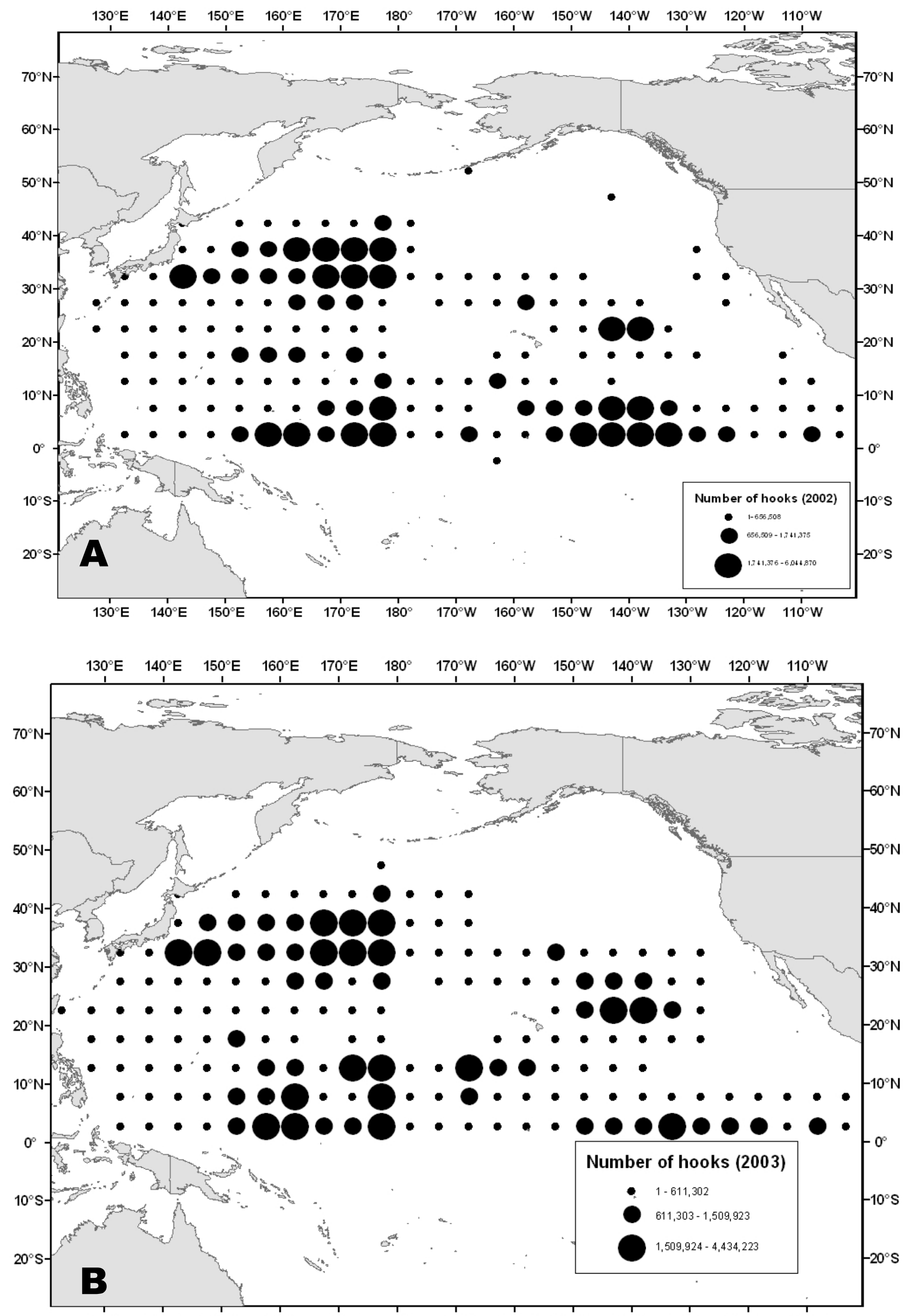
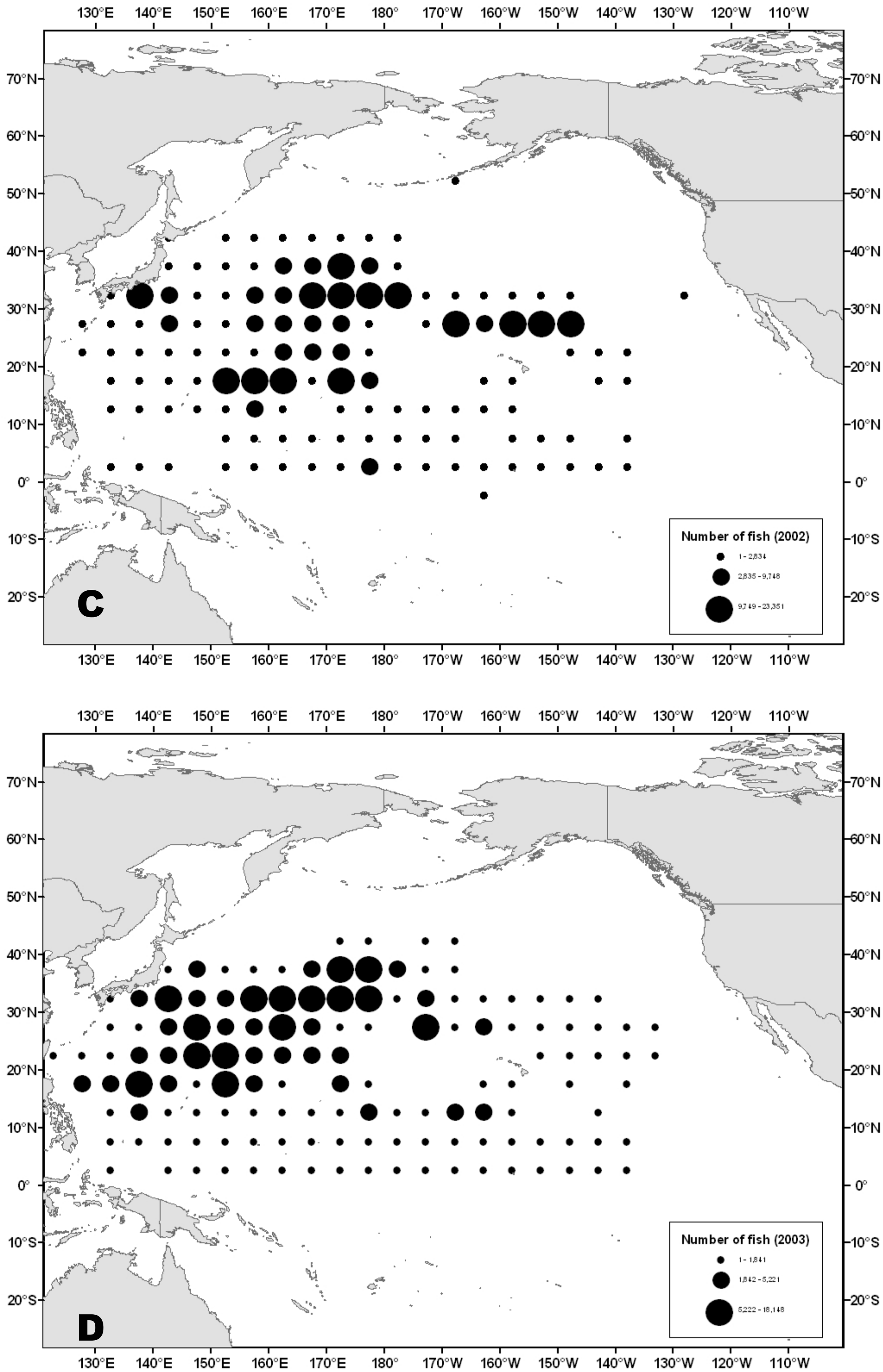


Figure 6. Distribution of fishing effort (number of hooks – A and B) and catch (number of fish – C and D) for the Japan distant-water longline fishery in the North Pacific Ocean (2002-03).



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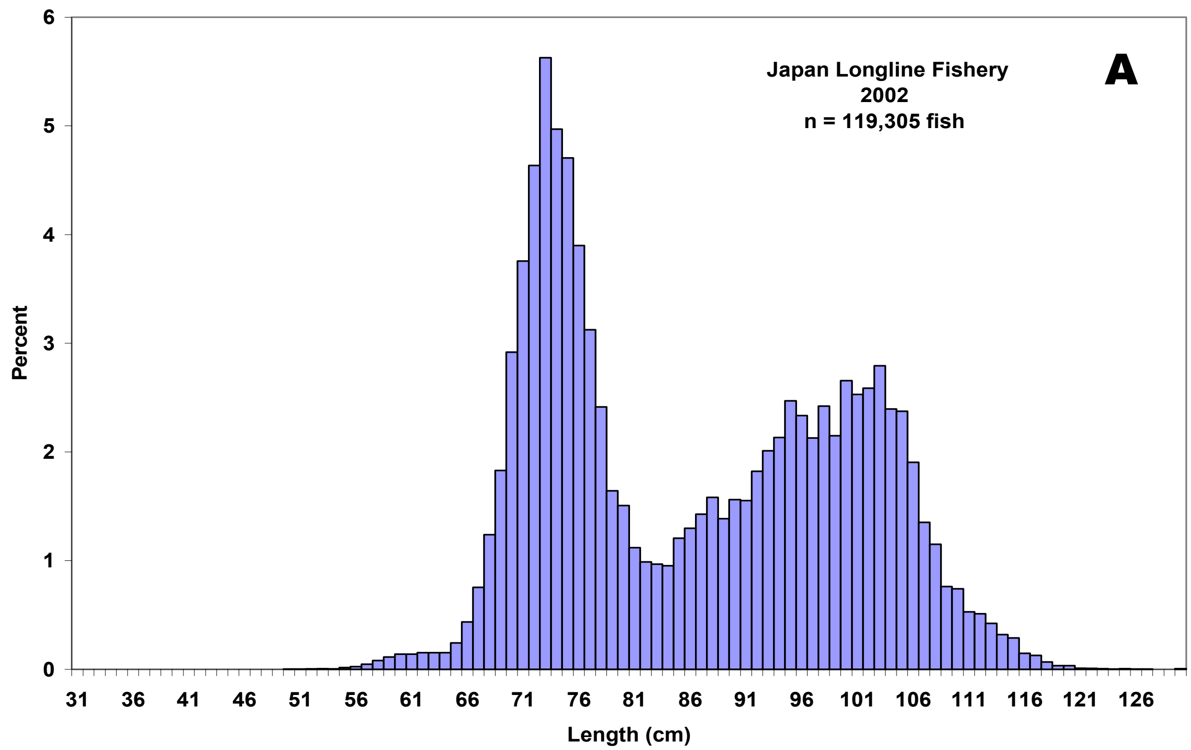


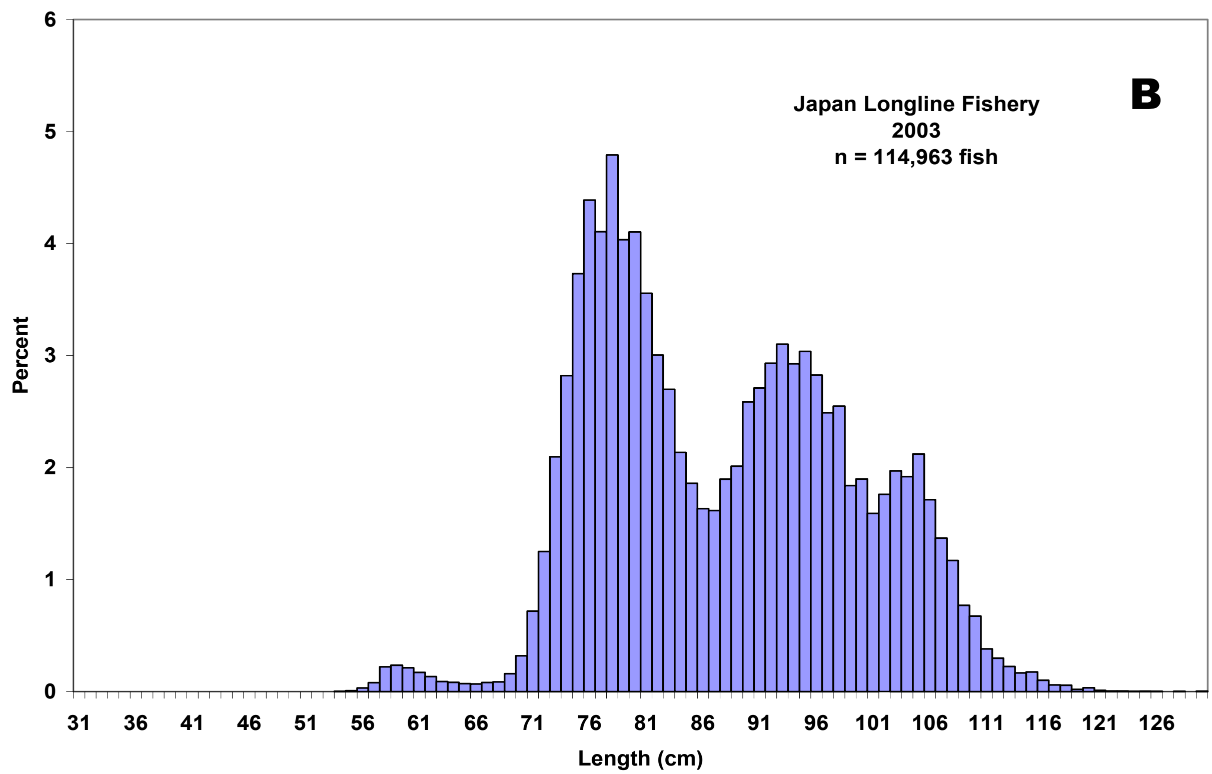


Figure 7. Length (fork in cm) distributions of albacore harvested in the North Pacific Ocean Japan distant-water and coastal longline fishery in 2002 – A and 2003 – B.

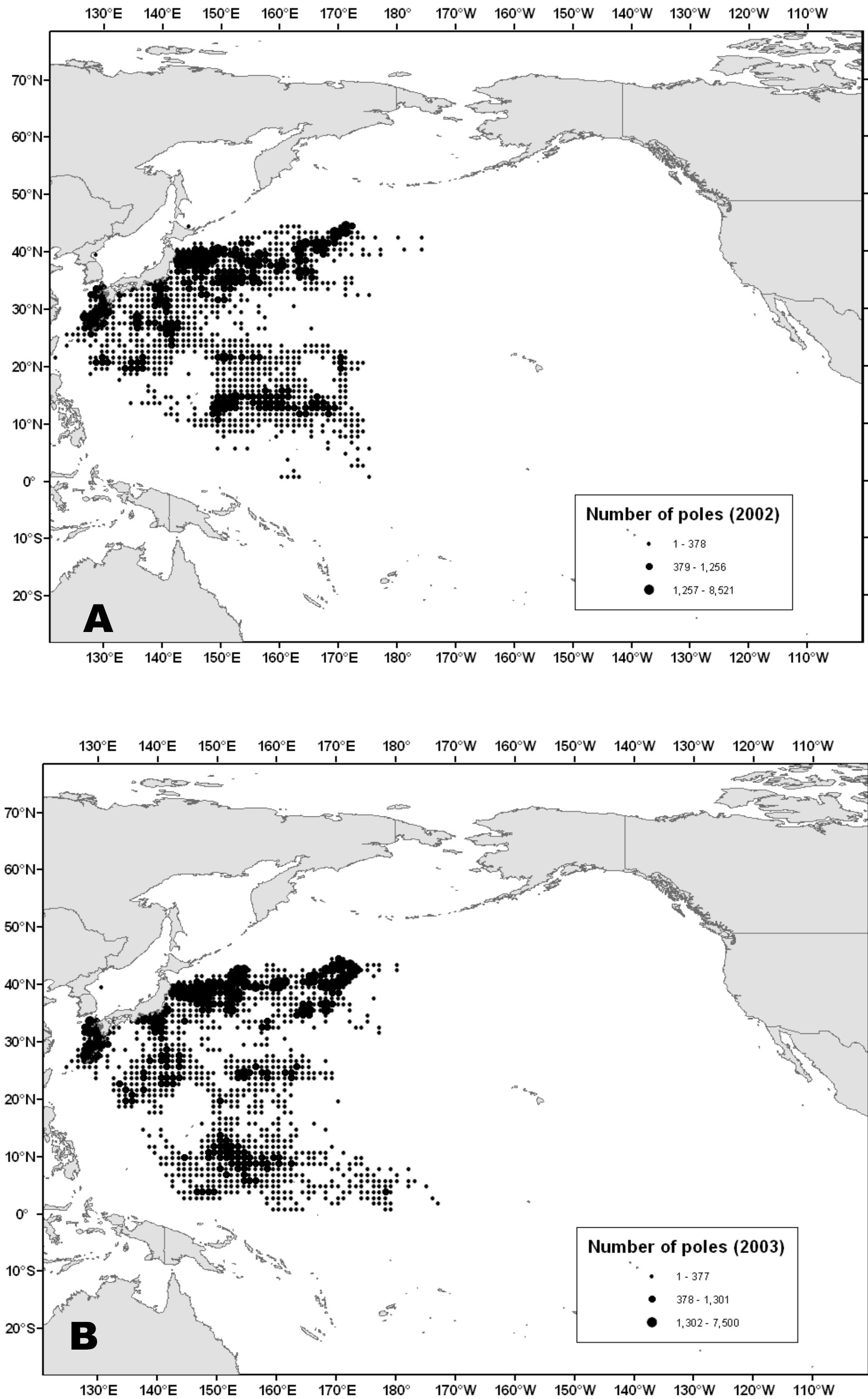
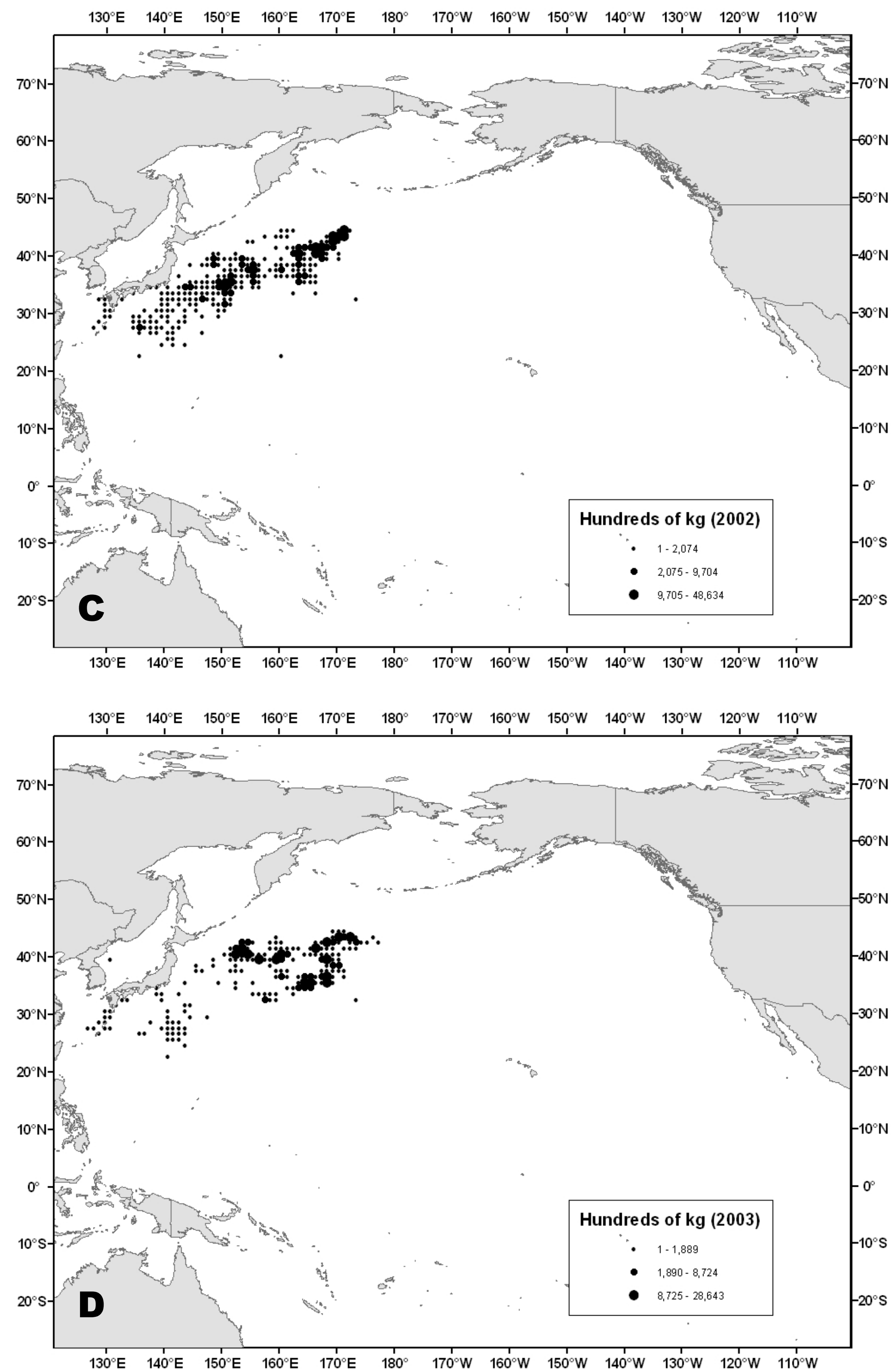


Figure 8. Distribution of fishing effort (number of poles – A and B) and catch (hundreds of kg – C and D) for the Japan pole-and-line fishery in the North Pacific Ocean (2002-03).



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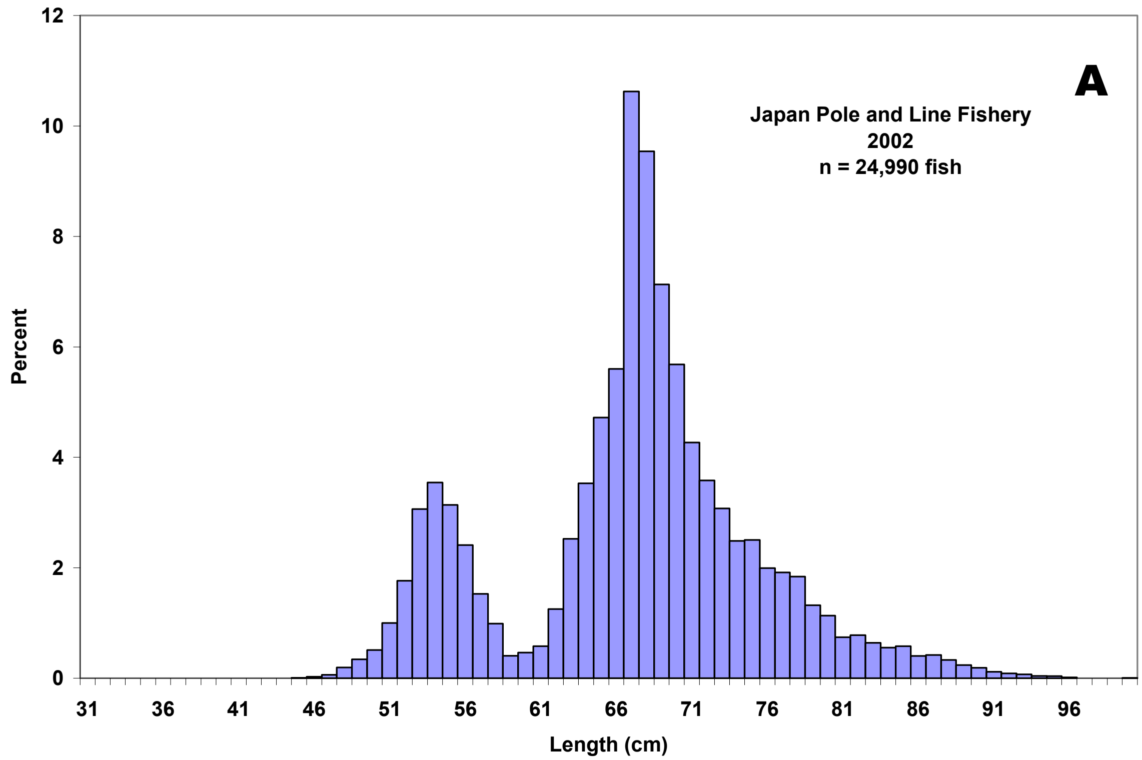


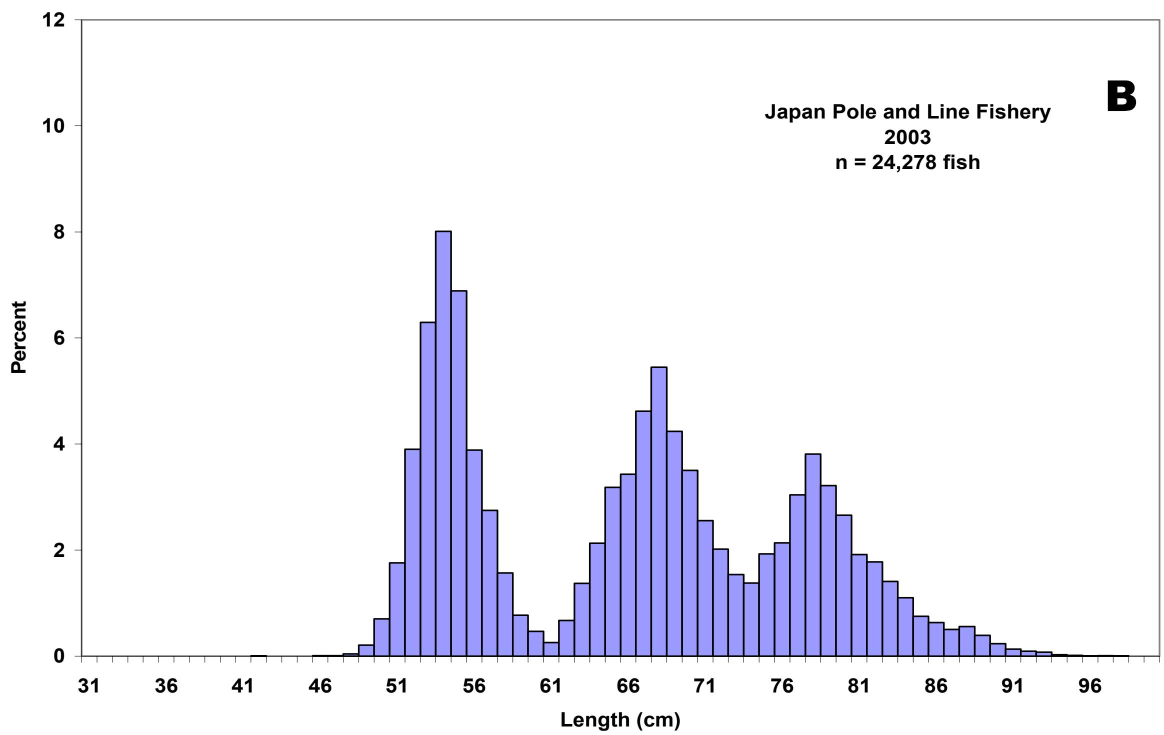


Figure 9. Length (fork in cm) distributions of albacore harvested in the North Pacific Ocean Japan pole-and-line fishery (2002-03).

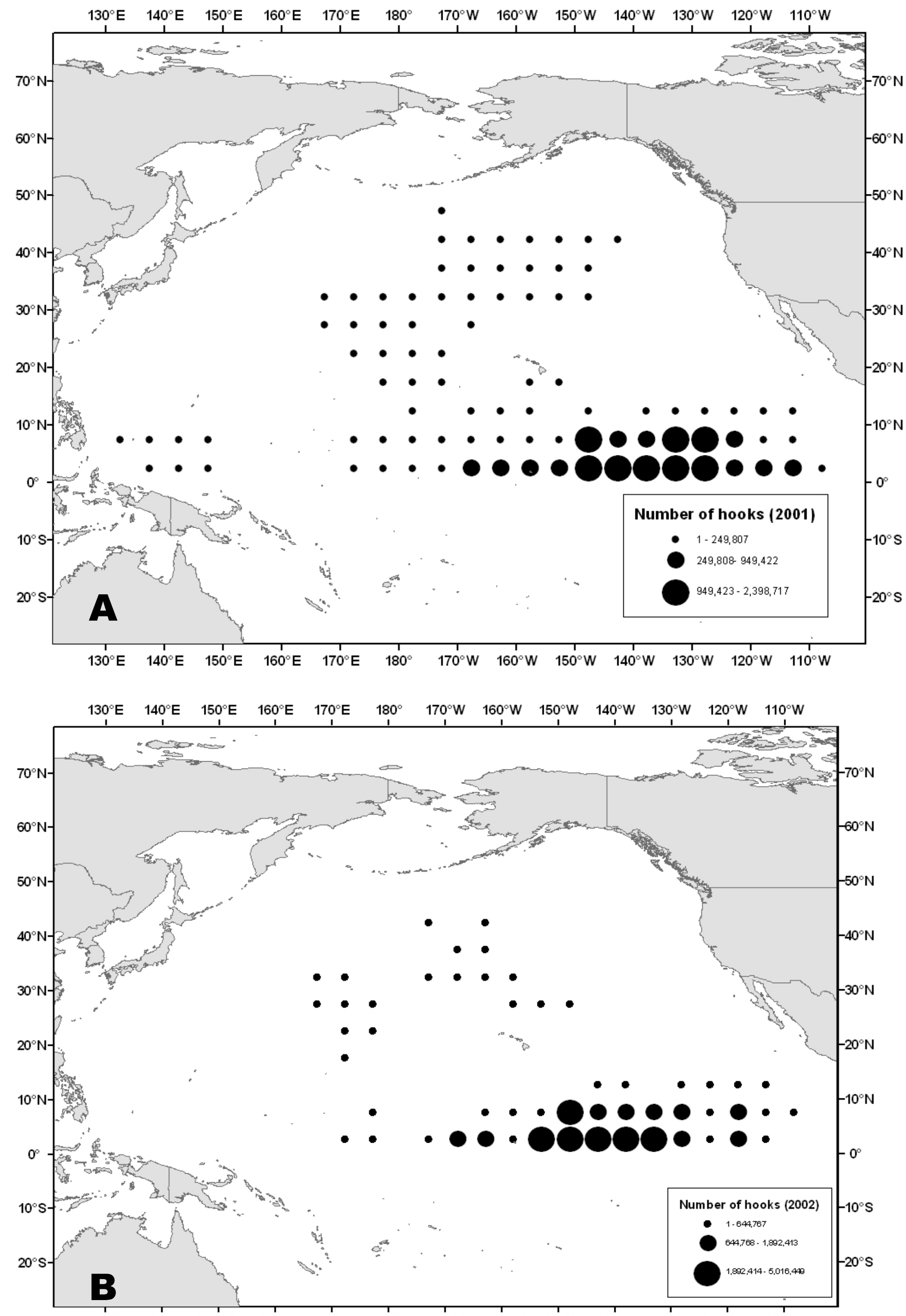


Figure 10. Distribution of fishing effort (number of hooks– A and B) and catch (number of fish– C and D) for the Taiwan longline fishery in the North Pacific Ocean (2001-02).

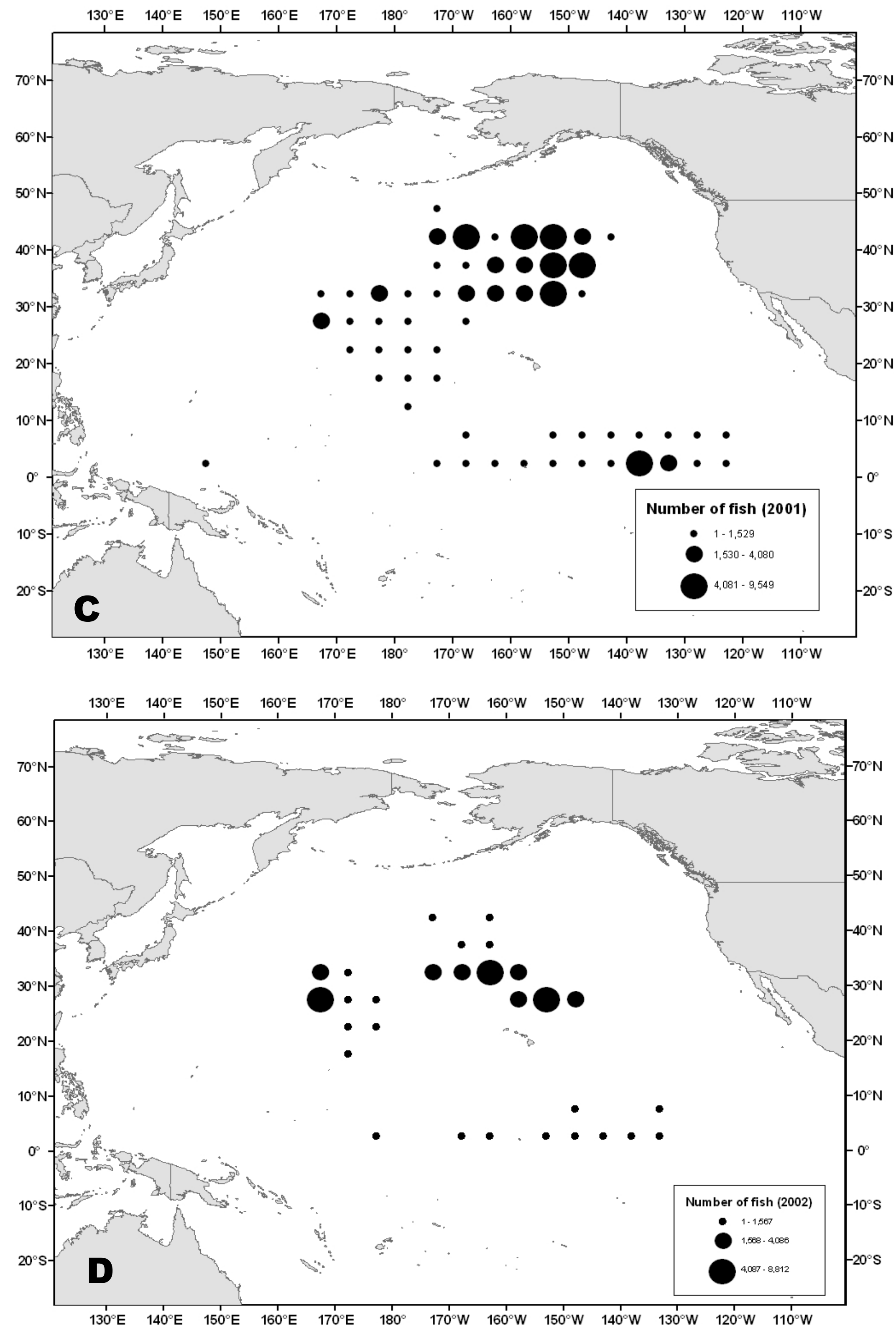
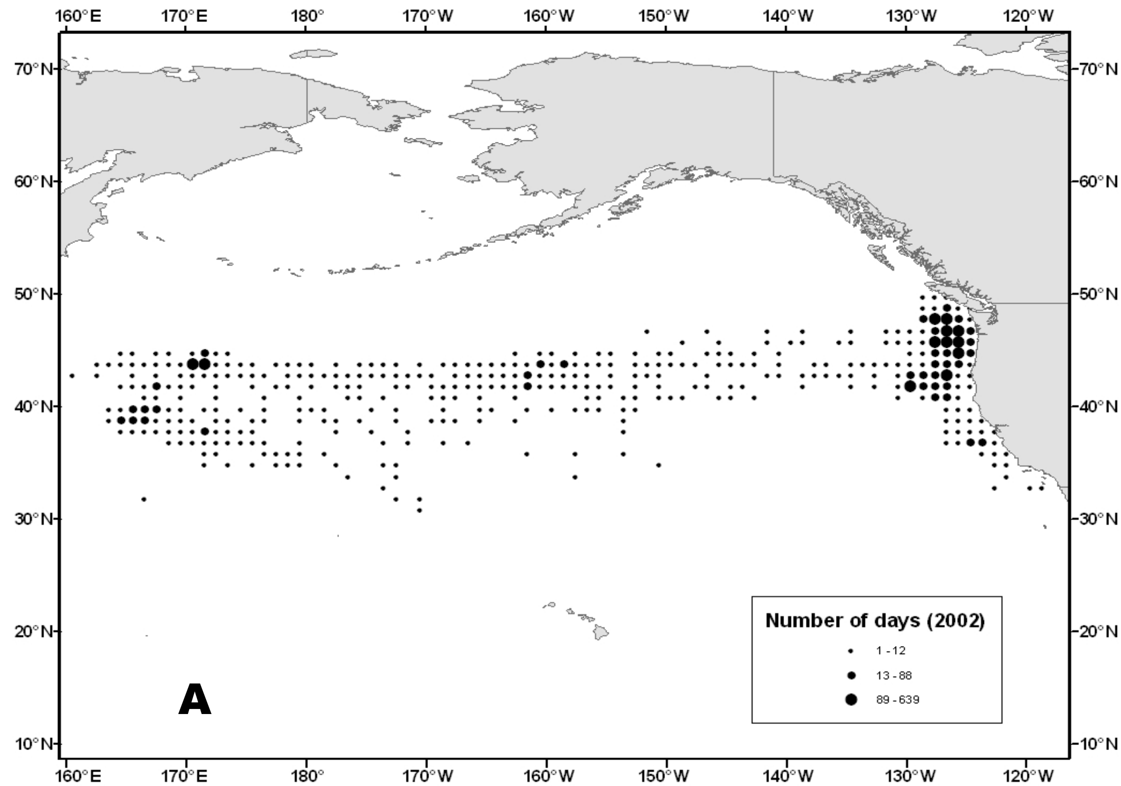


Figure 10. Continued.



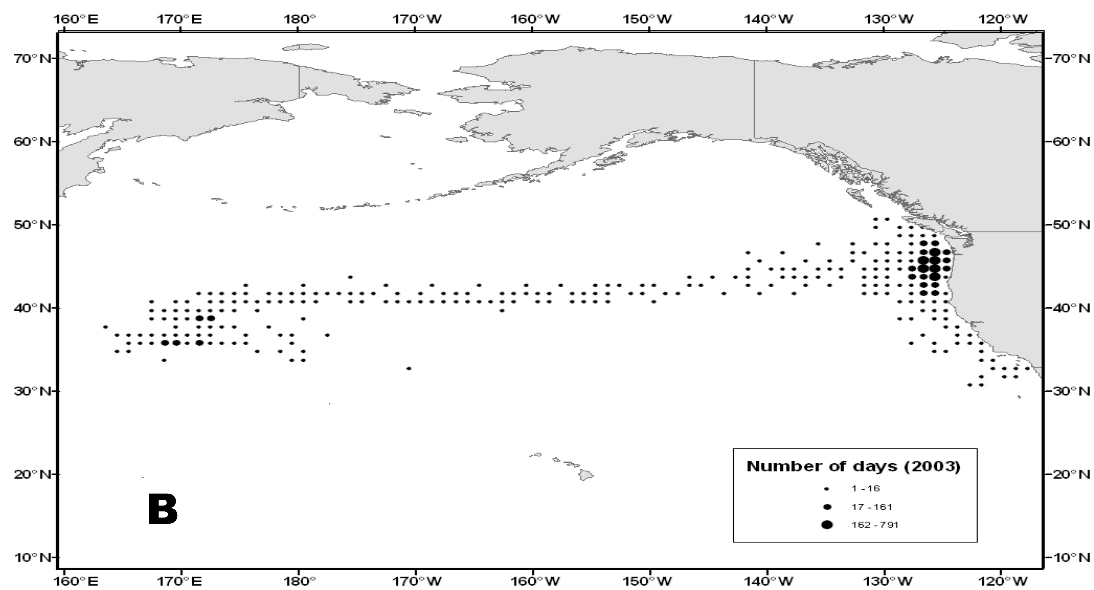


Figure 11. Distribution of fishing effort (number of days– A and B) and catch (number of fish – C and D) for the United States troll fishery in the North Pacific Ocean (2002-03).

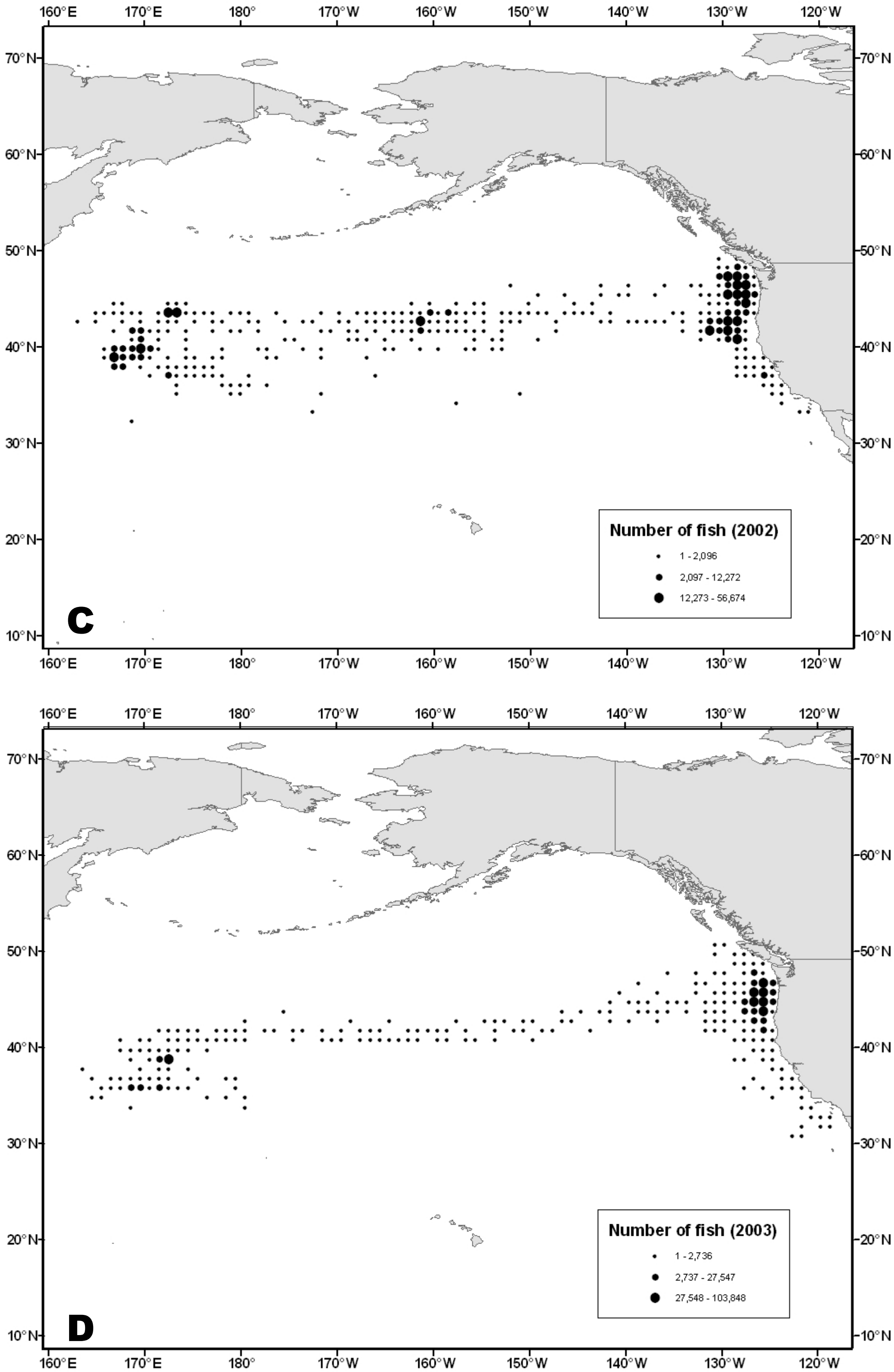


Figure 11. Continued.

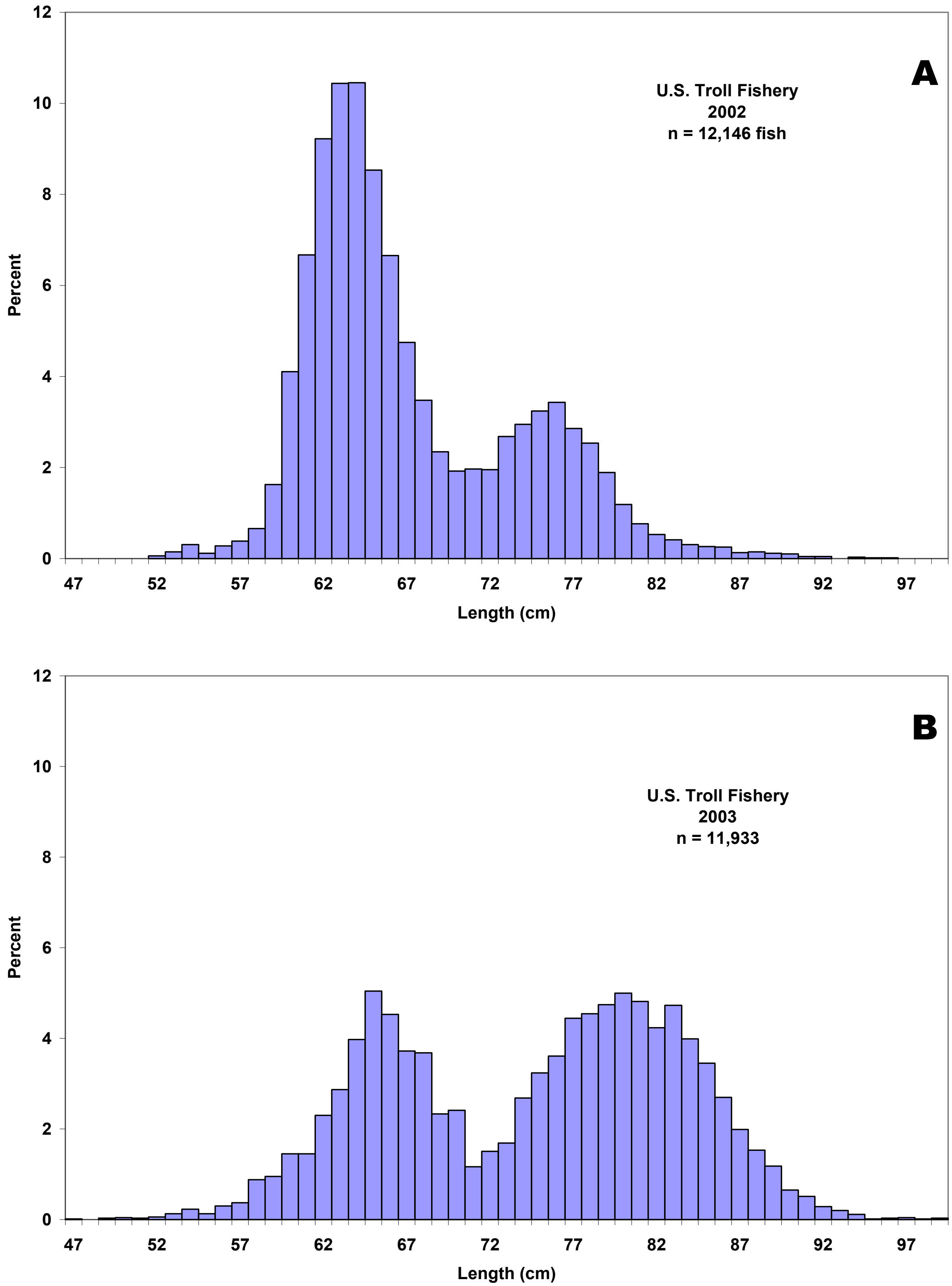


Figure 12. Length (fork in cm) distributions of albacore harvested in the North Pacific Ocean United States troll fishery (2002-03).

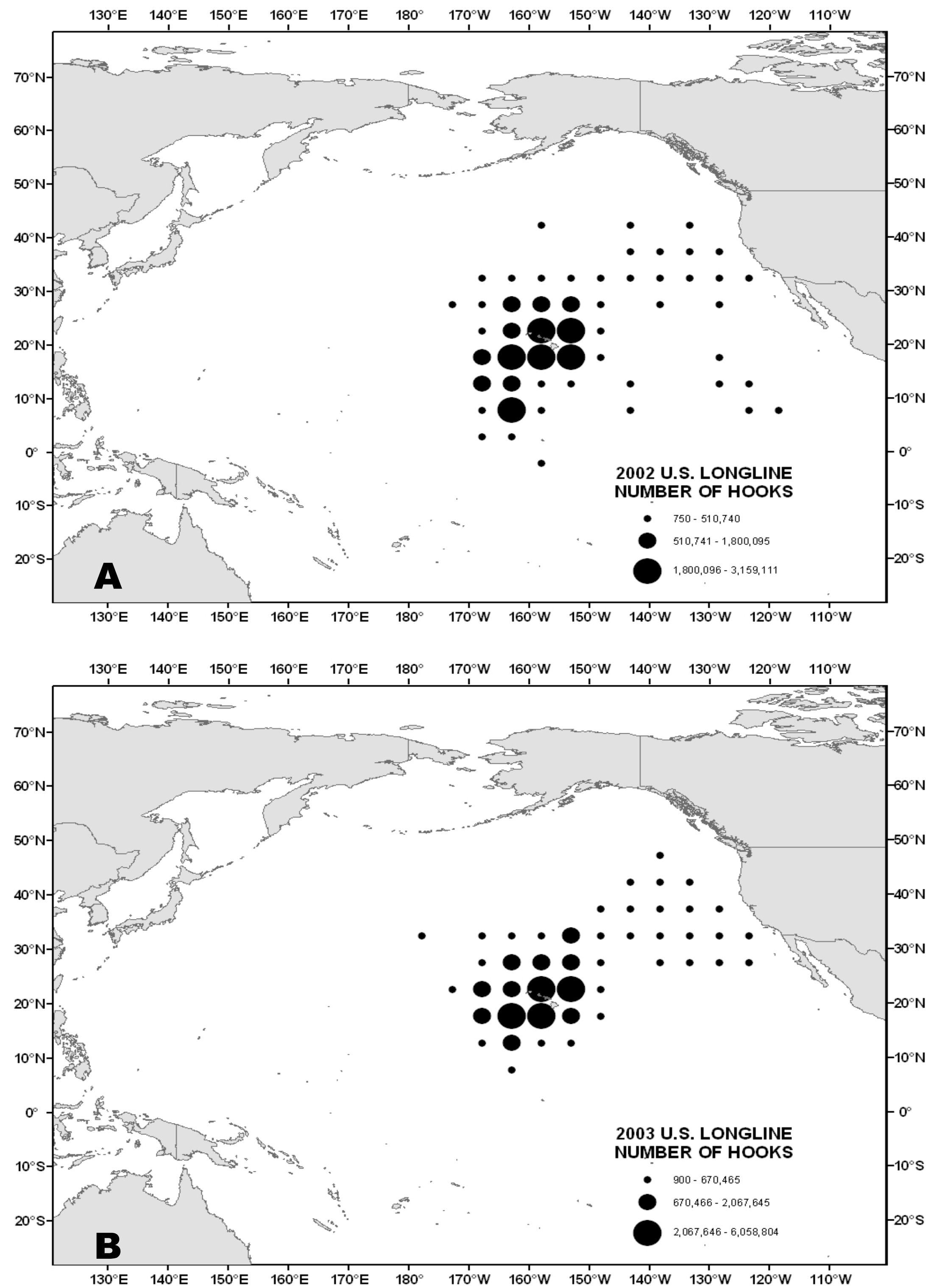
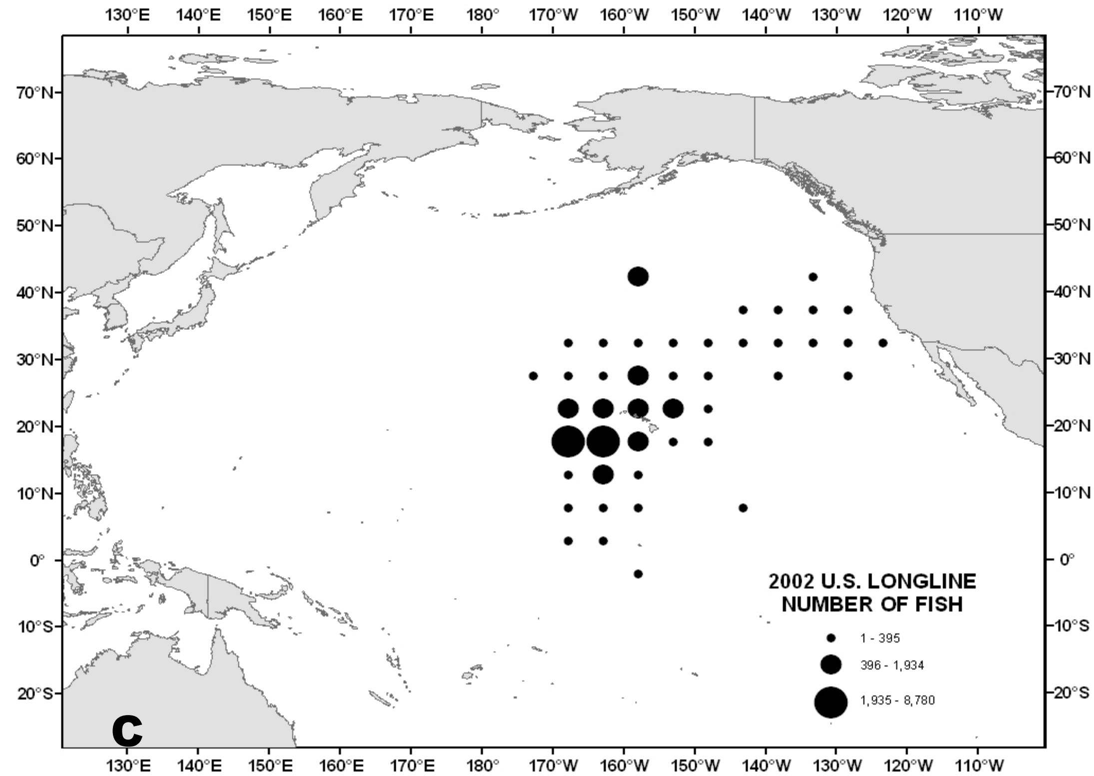


Figure 13. Distribution of fishing effort (number of hooks - A and B) and catch (number of fish – C and D) for the United States longline fishery in the North Pacific Ocean (2002-03).



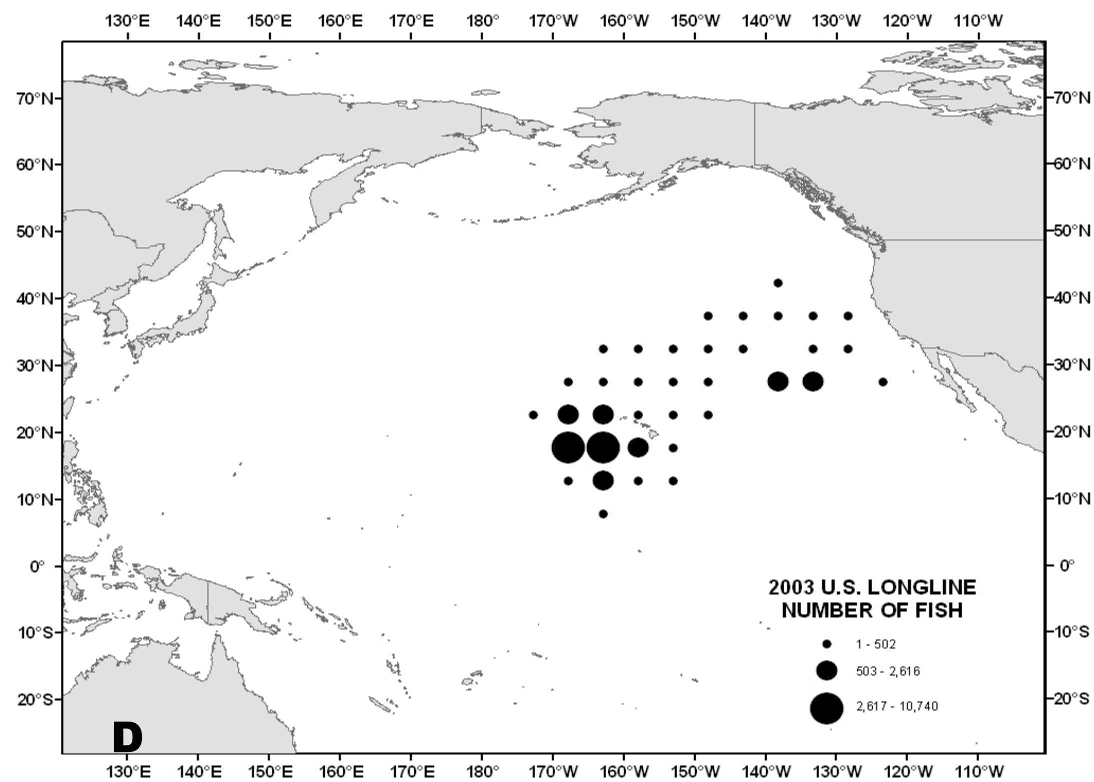
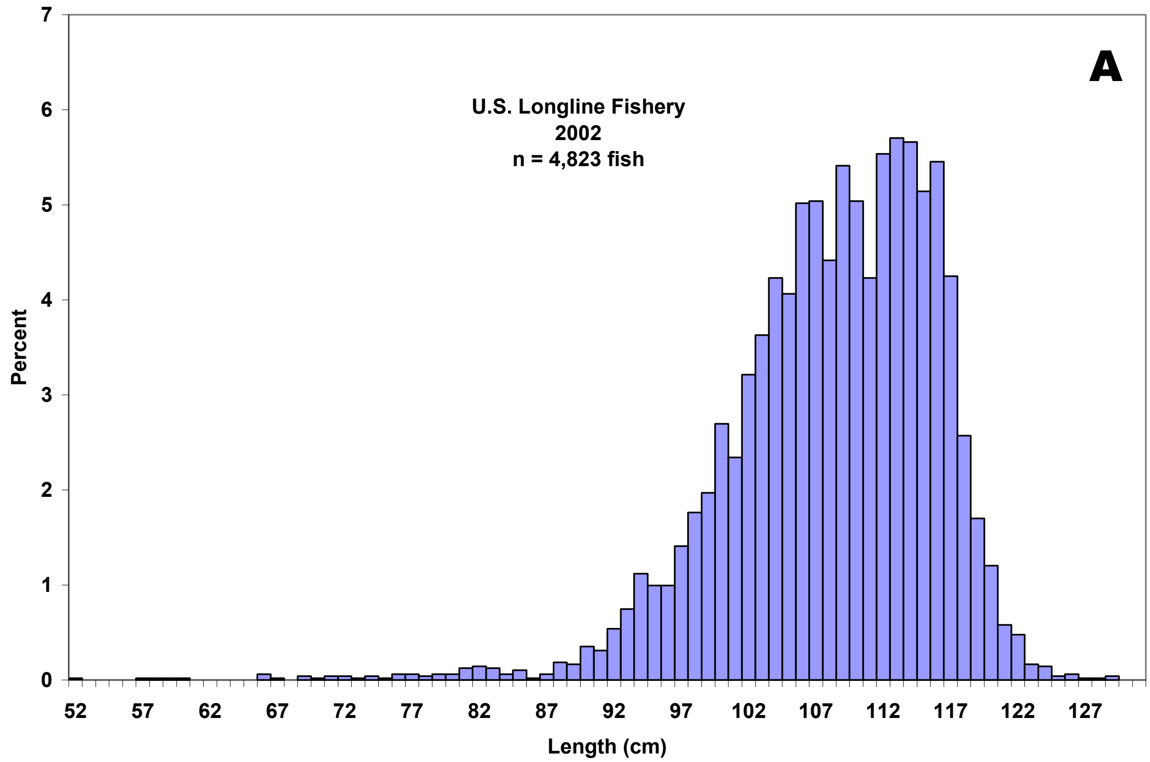


Figure 13. Continued.



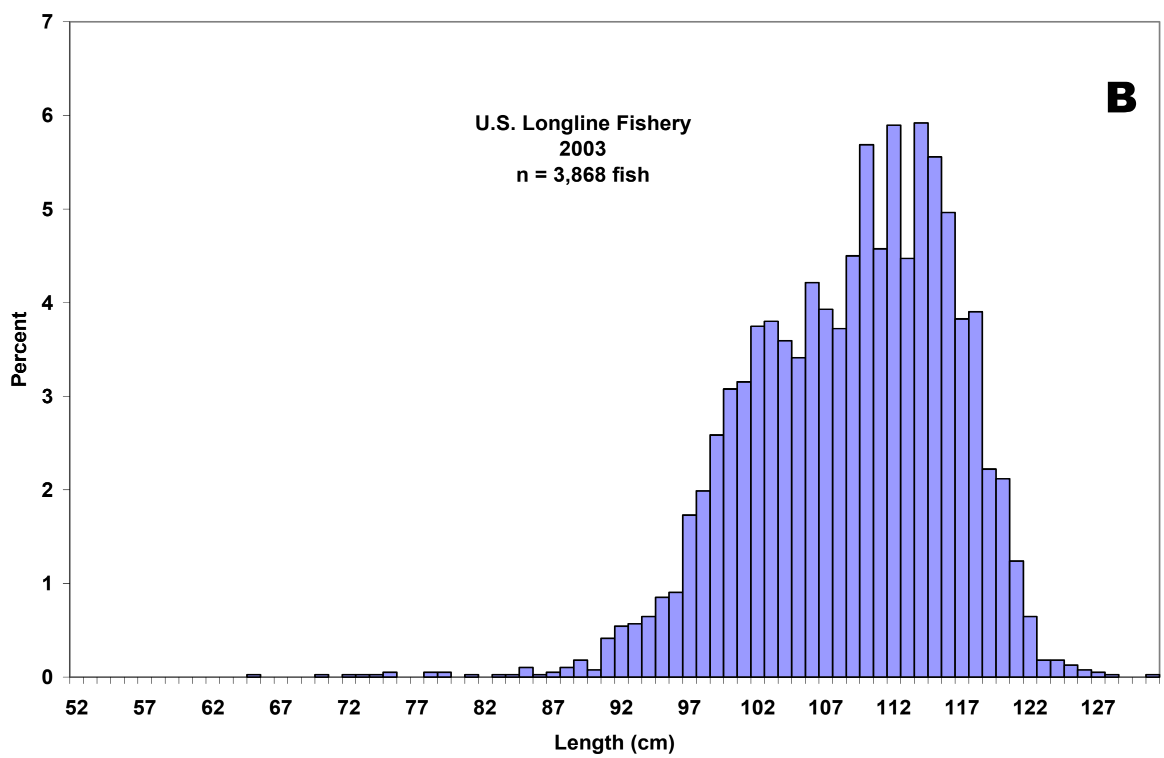


Figure 14. Length (fork in cm) distributions of albacore harvested in the North Pacific Ocean United States longline fishery in 2002 – A and 2003 - B.

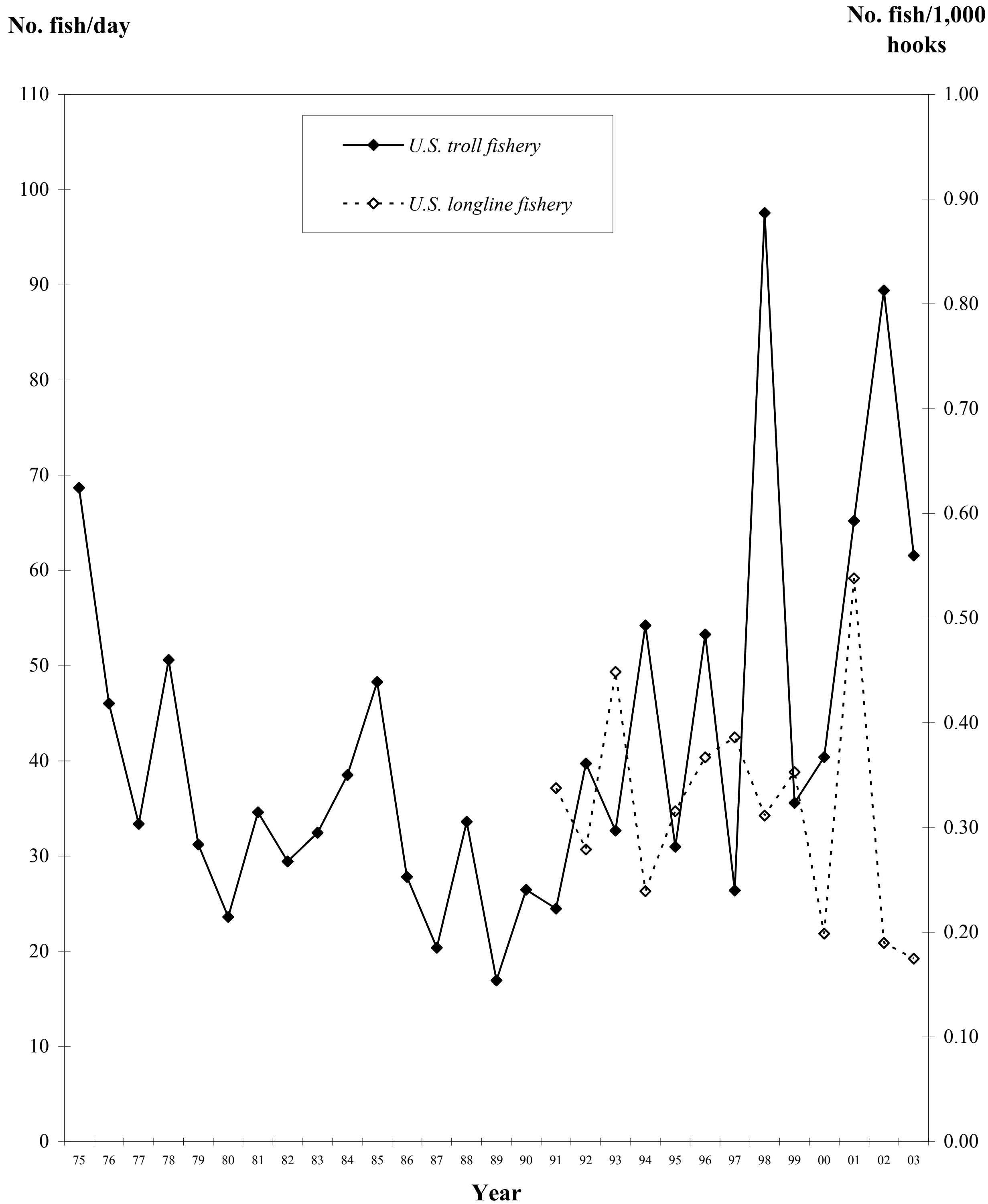


Figure 15. North Pacific albacore 'standardized' CPUE relative indices of abundance for the U.S./Canada troll (1975-03) and longline (1991-03) fisheries.

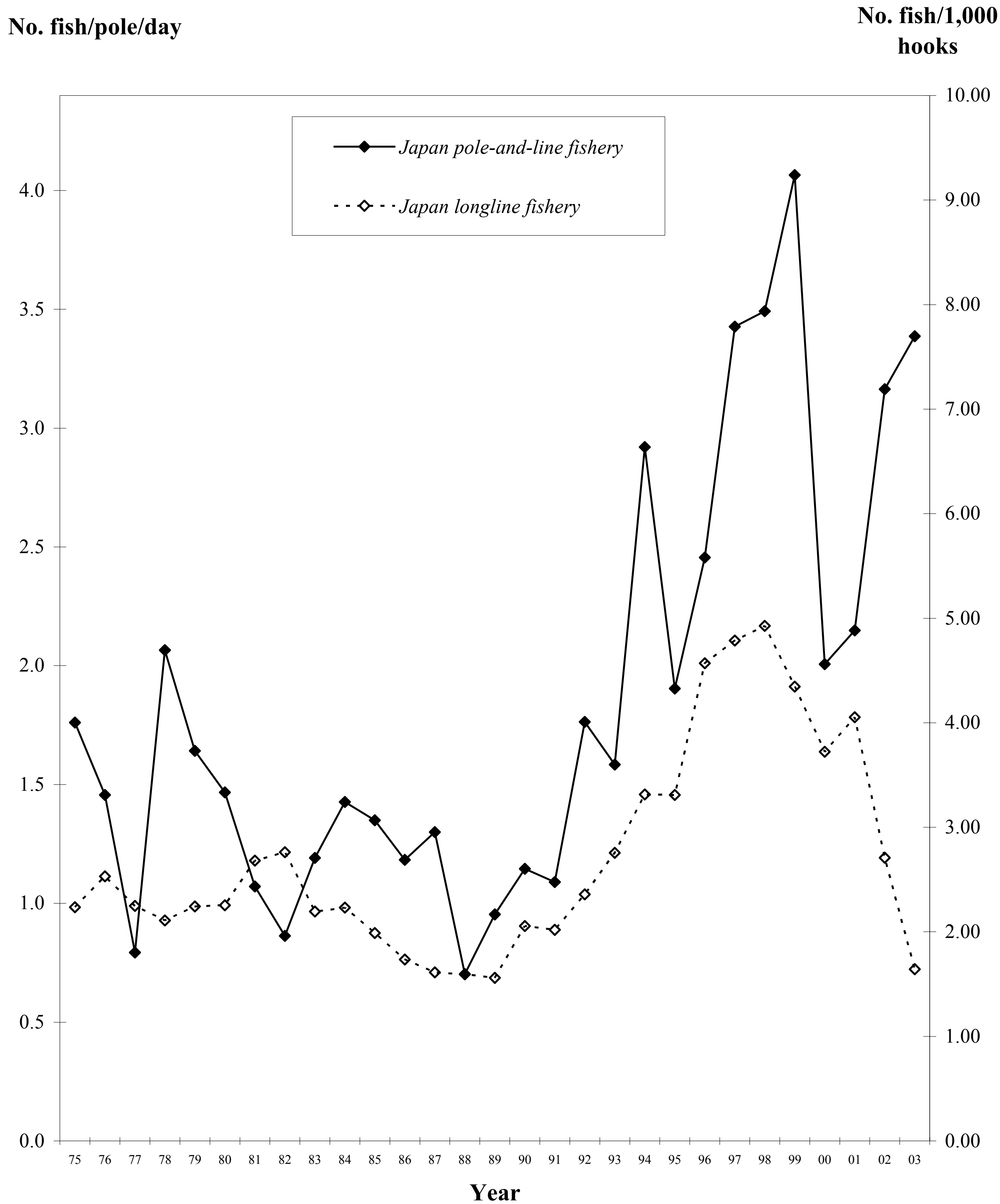


Figure 16. North Pacific albacore 'standardized' CPUE relative indices of abundance for the Japan pole-and-line (1975-03) and longline (offshore and distant-water, 1975-03) fisheries.

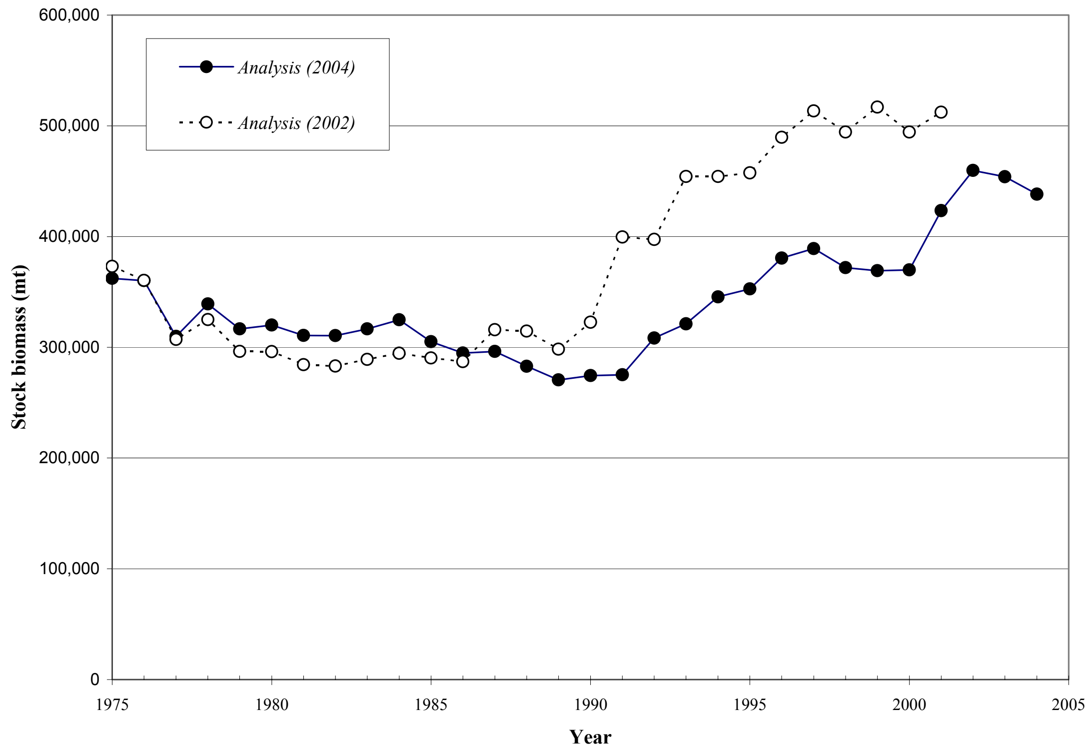


Figure 17. Total stock biomass (mt) time series (1975-04) for North Pacific albacore generated from Model Scenario 1 (Analysis 2004). Final estimated stock biomass time series from the previous North Pacific Albacore Workshop (2002) is also presented (Analysis 2002). Time series are based on January 1 estimates.

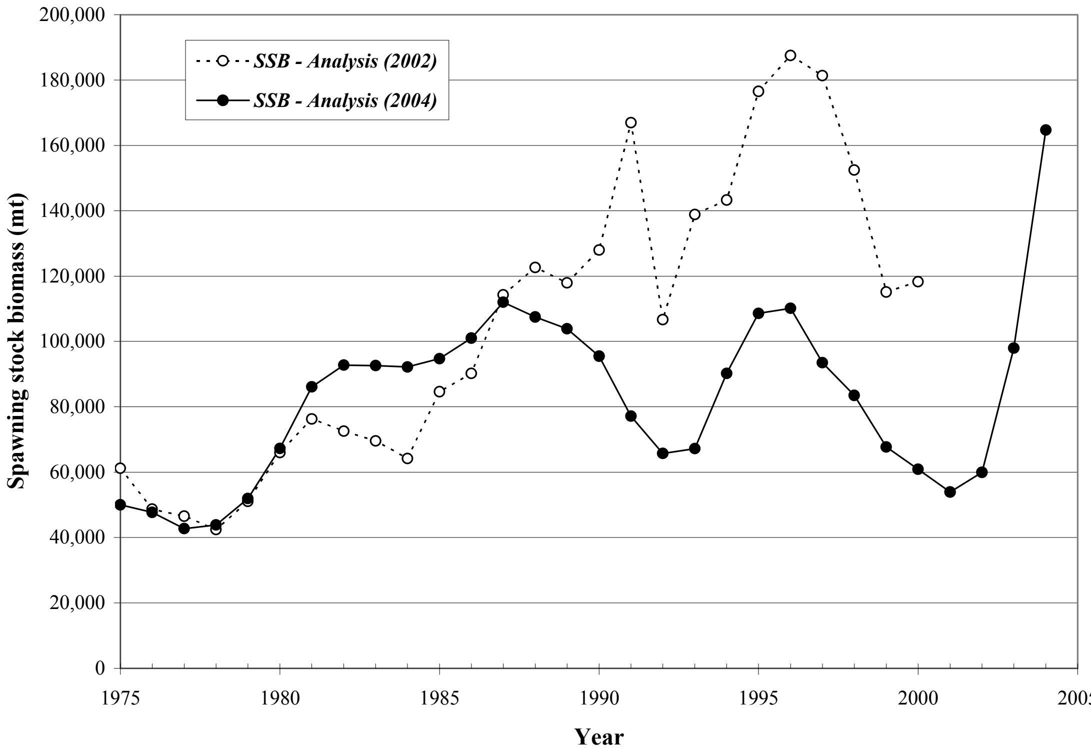


Figure 18. Total spawning stock biomass (mt) time series (1975-04) for North Pacific albacore generated from Model Scenario 1 (Analysis 2004). Final estimated spawning stock biomass time series from the previous North Pacific Albacore Workshop (2002) is also presented (Analysis 2002). Time series are based on January 1 estimates.

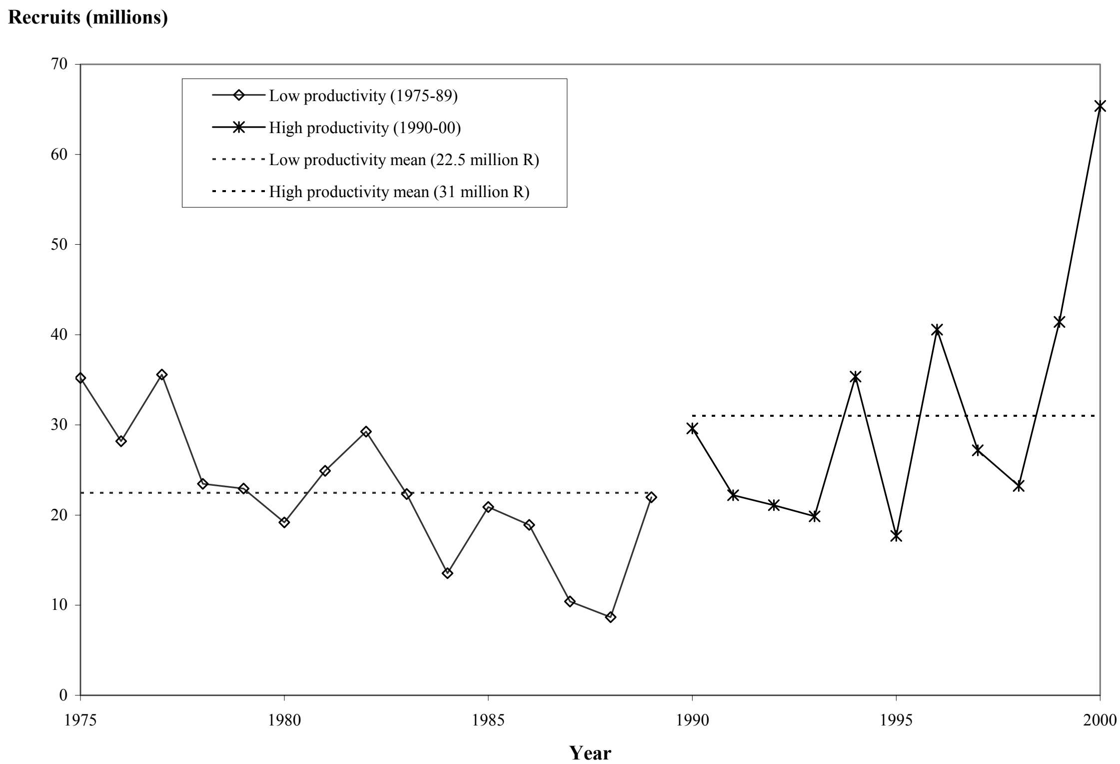


Figure 19. Recruitment (age-1 fish in millions) time series of North Pacific albacore generated from Model Scenario 1 illustrating low (1975-89) and high (1990-00) productivity scenarios. Recruitment from 2001-04 reflected the mean estimate for the low and high productivity scenario assumption, respectively (see Section 6).

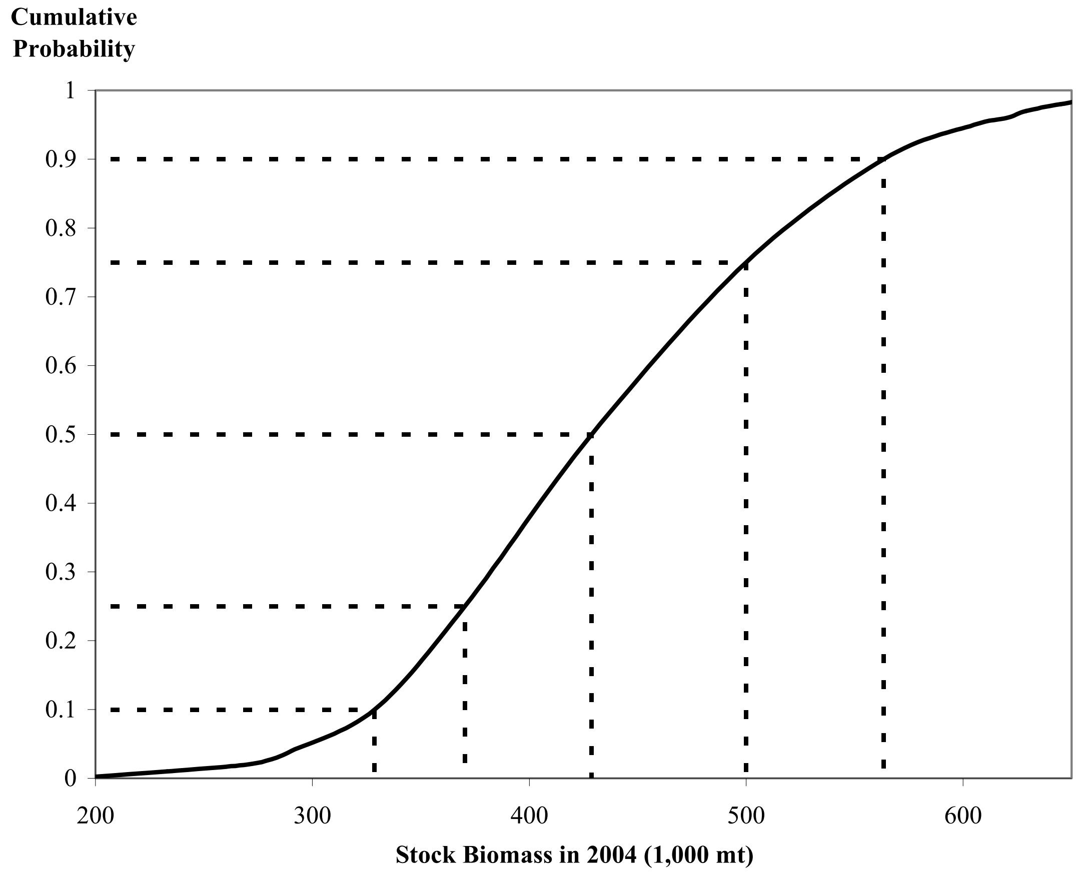


Figure 20. Probability 'profile' of total stock biomass (1,000 mt) of North Pacific albacore in 2004 generated from Model Scenario 1. The profile presents the probability that stock biomass is less than the values presented on the X-axis, e.g., there is a 90% probability that stock biomass is less than 563,400 mt. The drop lines indicate the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles.

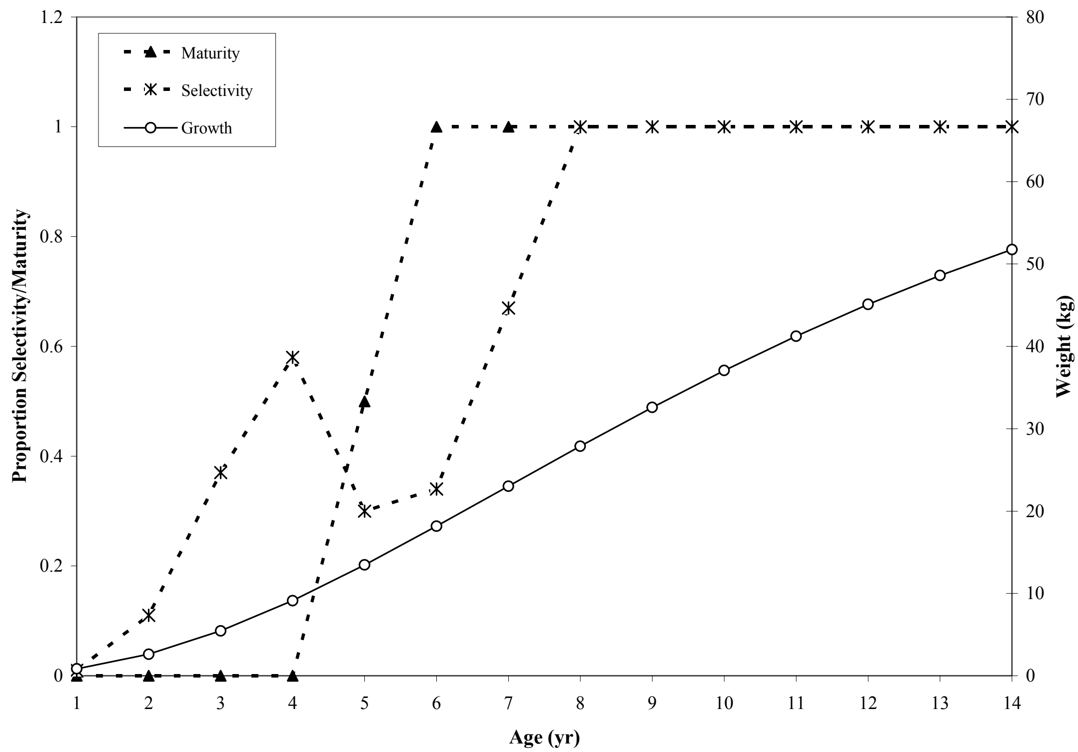


Figure 21. Partial recruitment (i.e., selectivity), maturity, and growth (in weight, kg) schedules used to determine biological reference points associated with Model Scenario 1. Maturity ogive is from Ueyanagi (1957), weight-at-age time series reflects January 1 estimates and is based on Suda (1966) and Suda and Warashina (1961), and natural mortality-at-age (M) was 0.3.

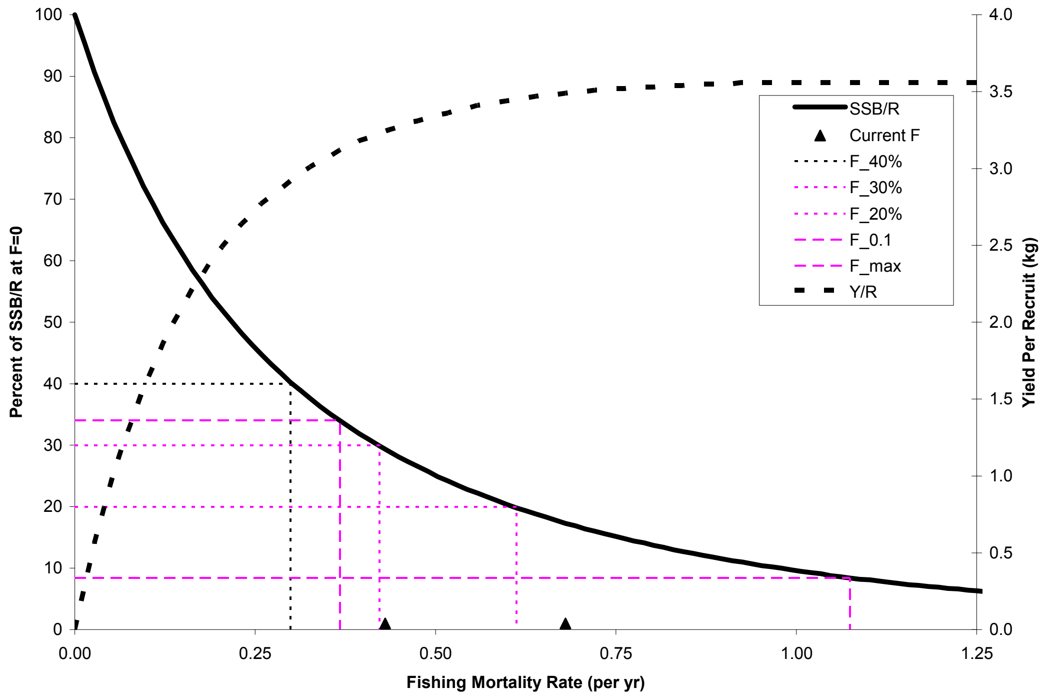
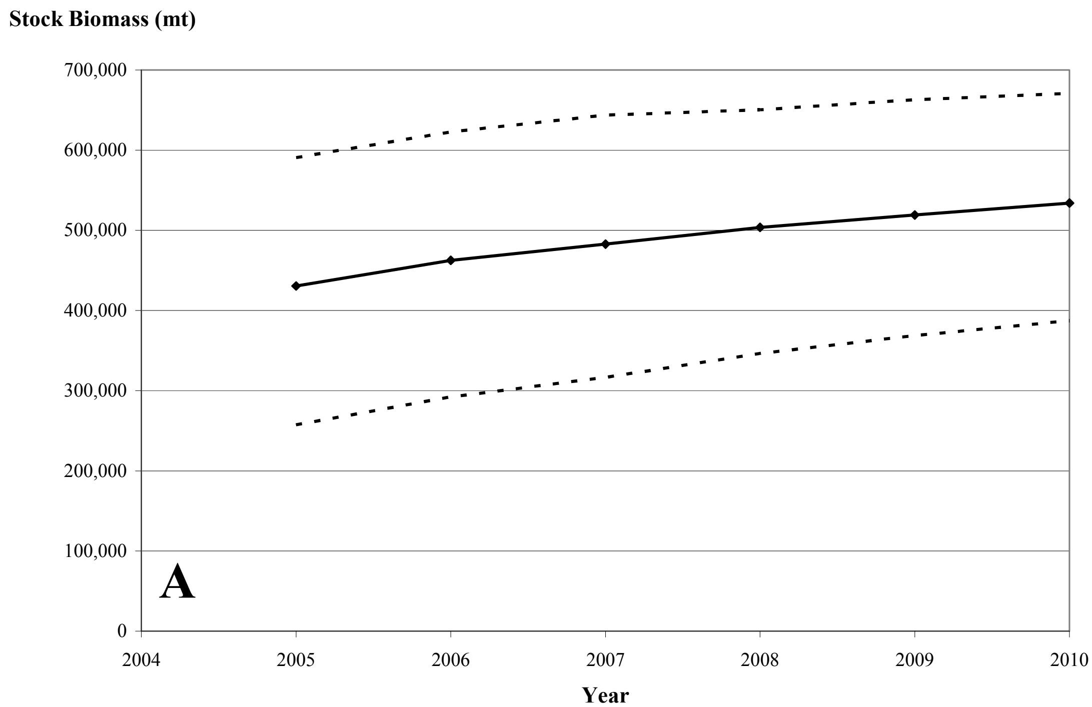


Figure 22. Equilibrium yield-per-recruit (Y/R in kg) and % of SSB/R (relative to F=0) for various F-based biological reference points as a function of fishing mortality rate (F) for North Pacific albacore associated with Model Scenario 1. The current F (2003) reflects a 'range' based on a 'low' (0.43) and 'high' (0.68) assumption involved in uncertainty analysis (see Section 6.3.2.).



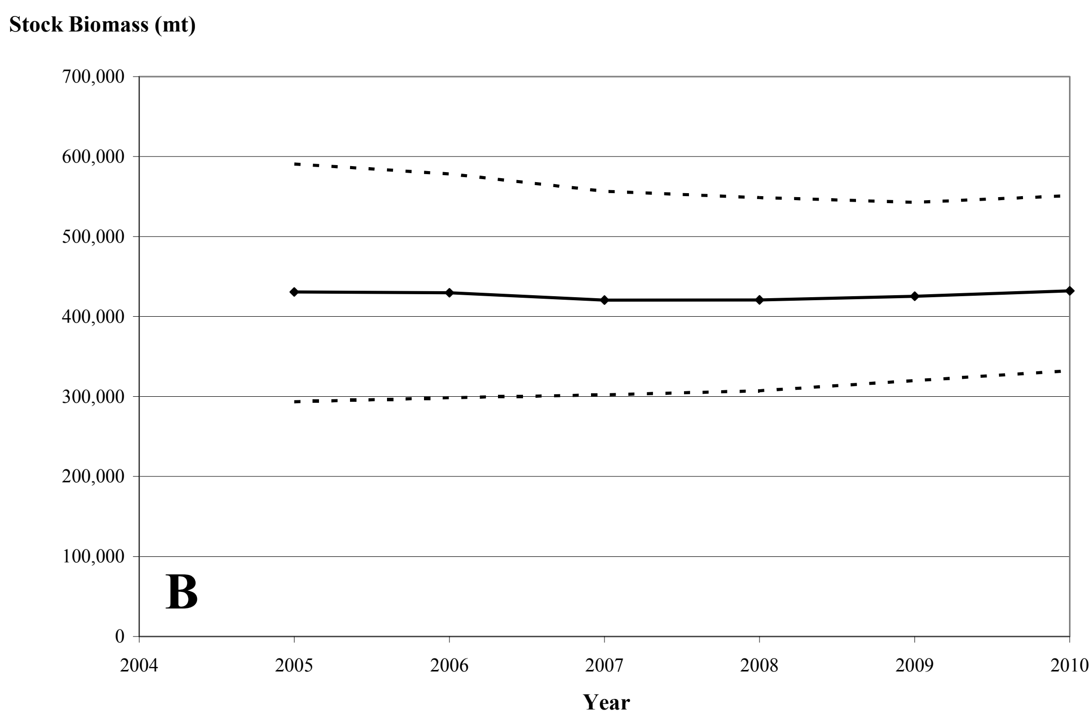
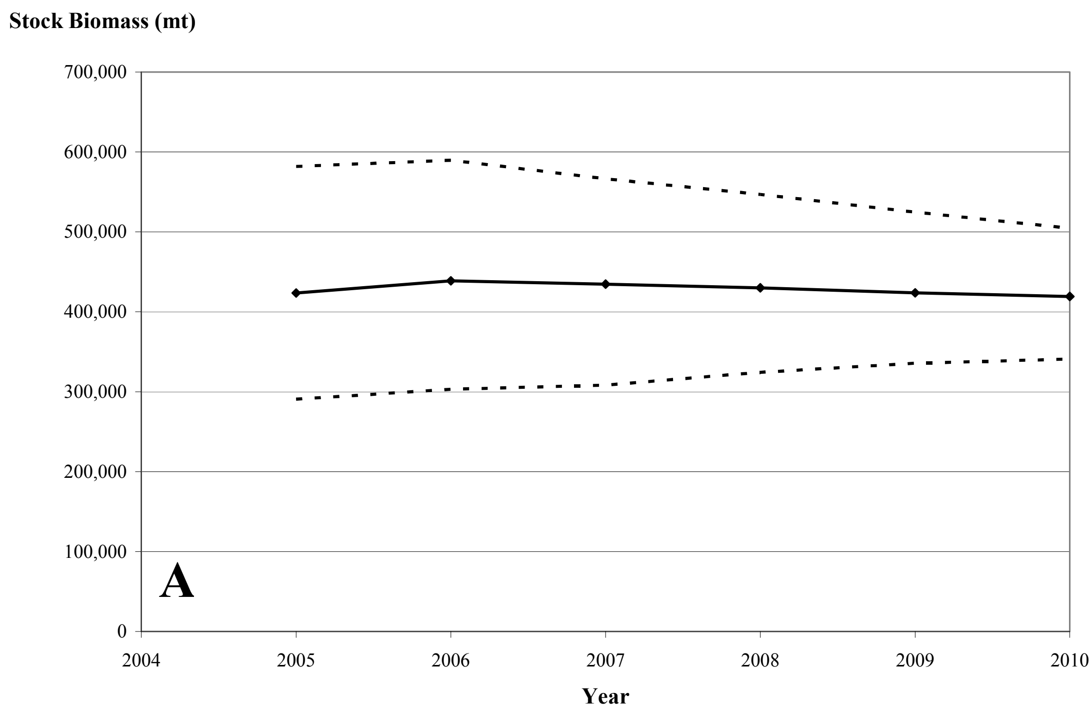


Figure 23. Stochastic projection of total stock biomass (mt) of North Pacific albacore based on the uncertainty analysis scenario 'high productivity/low F' – A, and 'high productivity/high F' – B associated with Model Scenario 1 (2005-10). Dashed lines represent 80% CI. See Section 6.3.3.



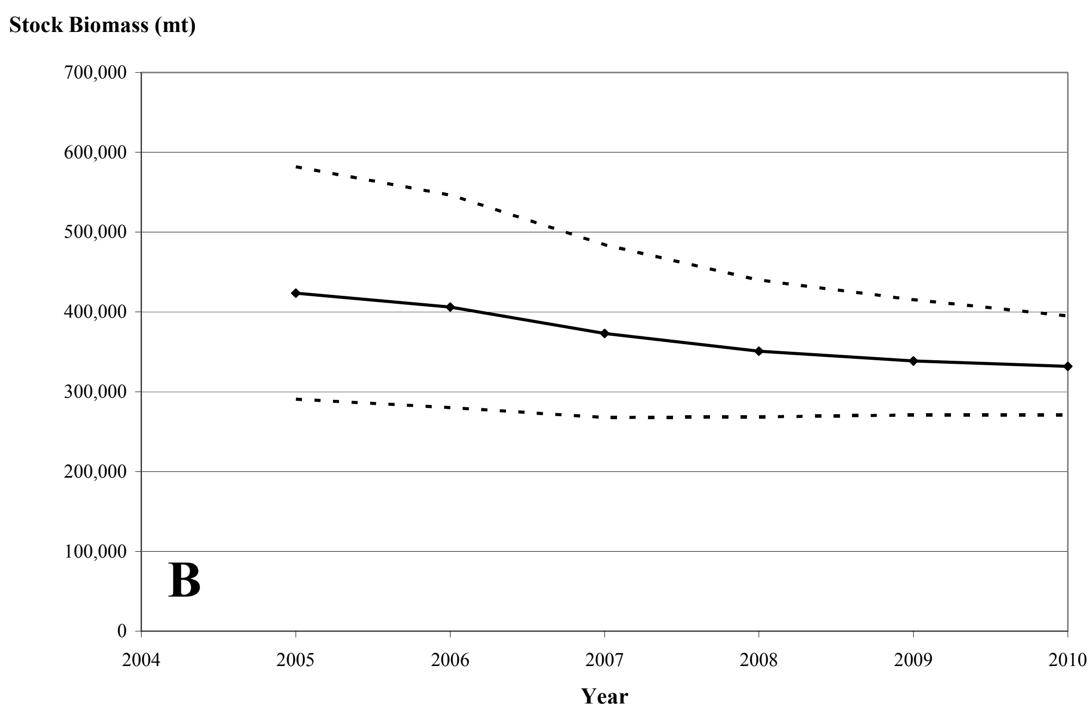
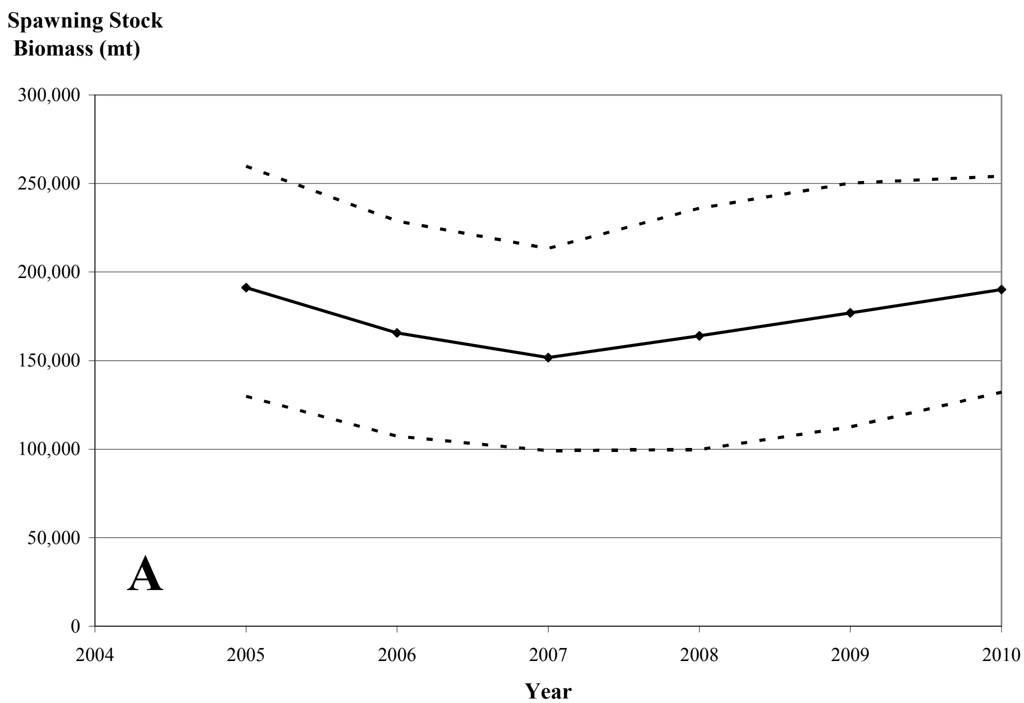


Figure 24. Stochastic projection of total stock biomass (mt) of North Pacific albacore based on the uncertainty analysis scenario 'low productivity/low F' – A, and 'low productivity/high F' – B associated with Model Scenario 1 (2005-10). Dashed lines represent 80% CI. See Section 6.3.3.



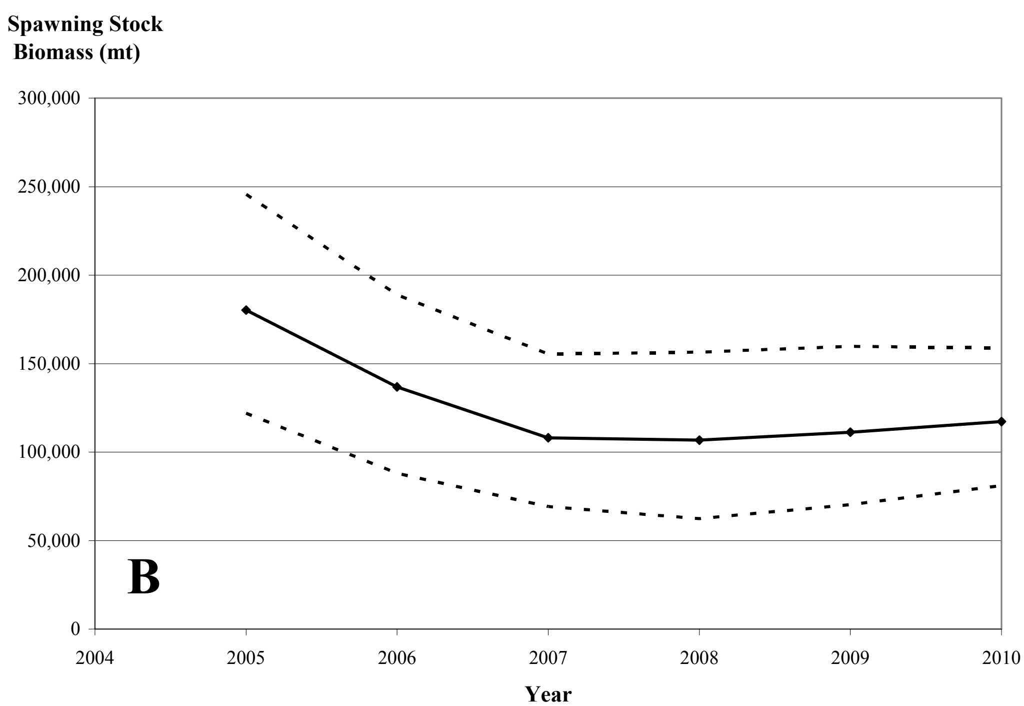
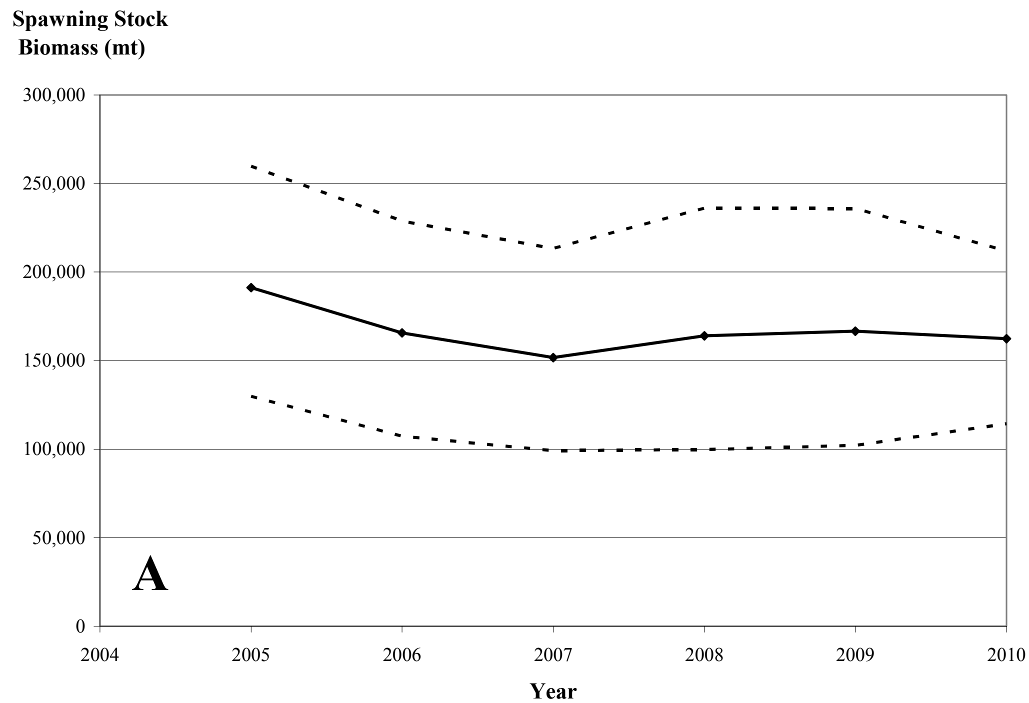


Figure 25. Stochastic projection of spawning stock biomass (mt) of North Pacific albacore based on the uncertainty analysis scenario 'high productivity/low F' – A, and 'high productivity/high F' – B associated with Model Scenario 1 (2005-10). Dashed lines represent 80% CI.



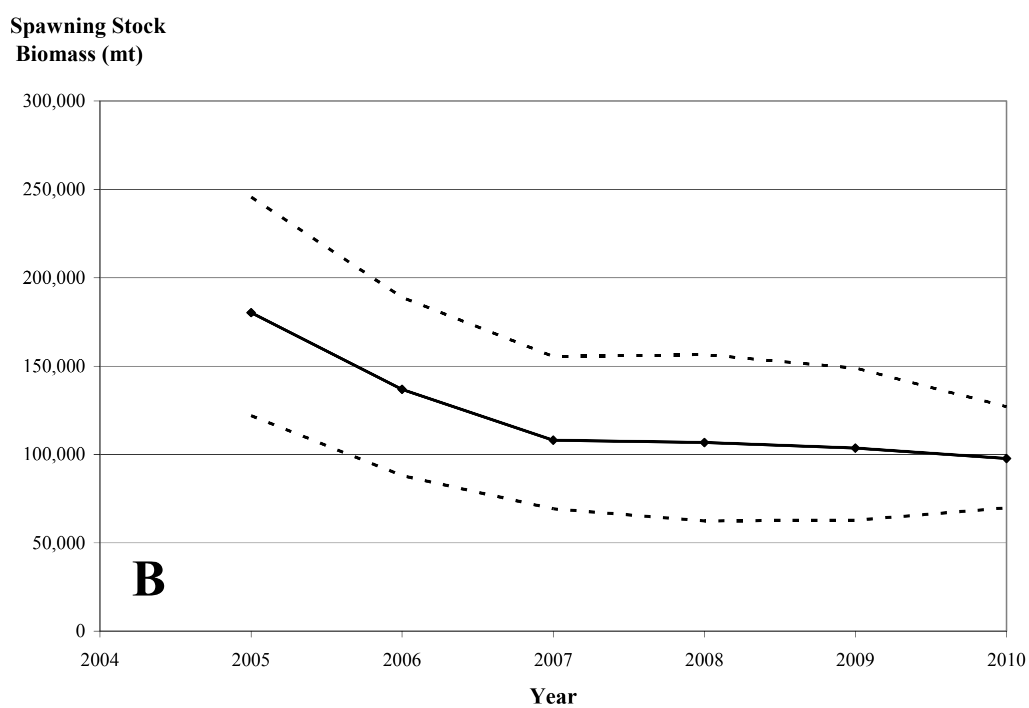


Figure 26. Stochastic projection of spawning stock biomass (mt) of North Pacific albacore based on the uncertainty analysis scenario 'low productivity/low F' – A, and 'low productivity/high F' – B associated with Model Scenario 1 (2005-10). Dashed lines represent 80% CI.

Table 1. North Pacific albacore catches (in metric tons) by fisheries, 1952-2003[1]. Blank indicates no effort. -- indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ().

YEAR	CANADA[2] TROLL	CANADA[2] PURSE SEINE	JAPAN[3] GILL NET	JAPAN[3] LONG LINE	JAPAN[3] POLE & LINE	JAPAN[3] PURSE SEINE	JAPAN[3] TROLL	JAPAN[3] UNSP. GEAR	KOREA[4] GILL NET	KOREA[4] LONG LINE	MEXICO[5] UNSP. GEAR
1952	71			26,687	41,787	154		237			
1953	5			27,777	32,921	38		132			
1954				20,958	28,069	23		38			
1955				16,277	24,236	8		136			
1956	17			14,341	42,810			57			
1957	8			21,053	49,500	83		151			
1958	74			18,432	22,175	8		124			
1959	212			15,802	14,252			67			
1960	5	136		17,369	25,156			76			
1961	4			17,437	18,639	7		268			0
1962	1			15,764	8,729	53		191			0
1963	5			13,464	26,420	59		218			0
1964	3			15,458	23,858	128		319			0
1965	15			13,701	41,491	11		121			0
1966	44			25,050	22,830	111		585			0
1967	161			28,869	30,481	89		520			
1968	1,028			23,961	16,597	267		1,109			
1969	1,365			18,006	31,912	521		935			0
1970	390			16,283	24,263	317		456			0
1971	1,746			11,524	52,957	902		308			0
1972	3,921		1	13,043	60,569	277		623			100
1973	1,400		39	16,795	68,767	1,353		495			0
1974	1,331		224	13,409	73,564	161		879			1
1975	111		166	10,318	52,152	159		228		2,463	1
1976	278		1,070	15,825	85,336	1,109		272		859	36
1977	53		688	15,696	31,934	669		355		792	0
1978	23		4,029	13,023	59,877	1,115		2,078		228	1
1979	521		2,856	14,215	44,662	125		1,126	0	259	1
1980	212		2,986	14,689	46,742	329		1,179	6	597	31
1981	200		10,348	17,922	27,426	252		663	16	459	8
1982	104		12,511	16,767	29,614	561		440	113	387	7
1983	225		6,852	15,097	21,098	350		118	233	454	33
1984	50		8,988	15,060	26,013	3,380		511	516	136	113
1985	56		11,204	14,351	20,714	1,533		305	576	291	49
1986	30		7,813	12,928	16,096	1,542		626	726	241	3
1987	104		6,698	14,702	19,082	1,205		155	817	549	7
1988	155		9,074	14,731	6,216	1,208		134	1,016	409	15
1989	140		7,437	13,104	8,629	2,521		393	1,023	150	2
1990	302		6,064	15,789	8,532	1,995		249	1,016	6	2
1991	139		3,401	17,046	7,103	2,652		392	852	3	2
1992	363		2,721	19,049	13,888	4,104		1,527	271	(15)	10
1993	494		287	29,966	12,797	2,889		867		(32)	11
1994	1,998		263	29,612	26,389	2,026		799		(45)	6
1995	1,720		282	29,080	20,981	1,177	856	81		440	5
1996	3,591		116	32,492	20,272	581	815	117		333	21
1997	2,433		359	38,988	32,238	1,068	1,585	123		319	53
1998	4,188		206	35,813	22,926	1,554	1,190	88		(288)	8
1999	2,641		289	33,365	50,369	6,872	891	127		107	23
2000	4,465		67	30,032	21,549	2,408	645	171		414	428
2001	4,985		117	28,809	29,430	974	416	96		82	18
2002	4,996		332	23,642	48,454	4,303	787	135		(146)	0
2003	(6,736)	(0)	(332)	(25,684)	(35,222)	(683)	(787)	(135)	(0)	(146)	(29)

[1] Data are from North Pacific Albacore Workshop meetings except as noted.

[2] 1960 Canadian purse seine catch from Shaver (1962). 1994 troll catch from Shaw, 2001.

[3] Japanese pole & line catches include fish caught by research vessels. Longline catches for 1952-1960 exclude minor amounts taken by vessels under 20 metric tons.

[4] Korean longline catches for 1975 to 1986 calculated from Y. Gong (pers. comm.) using the ratio of catches in numbers, from the North Pacific. Gillnet catches for 1979-1990 are calulated by multiplying the 1991 CPUE (# fish per pok) by effort (# poks) then multiplying by average weight (1991, 1992: 4.13 kg/fish). 1987 - 1991 catches provided by Inter-American Tropical Tuna Commission (M. Hinton, pers.com.). 1992 - 2002 catches provided by D. Moon (pers. com.)

[5] 1998-2002 Mexico catch from purse seine and bait boats. Catches provided by Inter-American Tropical Tuna Commission (M. Hinton, pers.com.)

Table 1. Continued

YEAR	TAIWAN		U.S.							OTHERS		GRAND TOTAL
	GILL NET	LONG LINE	POLE & LINE	GILL NET	LONG[6] LINE	PURSE SEINE	SPORT	TROLL[7]	UNSP. GEAR	LONG[8] LINE	TROLL[9]	
1952					46		1,373	23,843				94,198
1953					23		171	15,740				76,807
1954					13		147	12,246				61,494
1955					9		577	13,264				54,507
1956					6		482	18,751				76,464
1957					4		304	21,165				92,268
1958					7		48	14,855				55,723
1959					5		0	20,990	0			51,328
1960					4		557	20,100	0			63,403
1961			2,837		5		1,355	12,055	1			52,608
1962			1,085		7		1,681	19,752	1			47,264
1963			2,432		7		1,161	25,140	0			68,906
1964		26	3,411		4		824	18,388	0			62,419
1965		261	417		3		731	16,542	0			73,293
1966		271	1,600		8		588	15,333	1			66,421
1967		635	4,113		12		707	17,814	0			83,401
1968		698	4,906		11		951	20,434	0			69,962
1969		634	2,996		14		358	18,827	0			75,568
1970		1,516	4,416		9		822	21,032	0			69,504
1971		1,759	2,071		11		1,175	20,526	0			92,979
1972		3,091	3,750		8		637	23,600	0			109,621
1973		128	2,236		14		84	15,653	0			106,964
1974		570	4,777		9		94	20,178	0			115,197
1975		1,494	3,243		33		640	18,932	10			89,950
1976		1,251	2,700		23		713	15,905	4			125,381
1977		873	1,497		37		537	9,969	0			63,100
1978		284	950		54		810	16,613	15			99,100
1979		187	303		--		74	6,781	0			71,110
1980	--	318	382		--		168	7,556	0			75,195
1981	--	339	748		25		195	12,637	0			71,238
1982	--	559	425		105		257	6,609	21			68,481
1983	--	520	607		6		87	9,359	0			55,039
1984	--	471	1,030		2	3,728	1,427	9,304	0			70,729
1985	--	109	1,498	2	0		1,176	6,415	0			58,279
1986	--	--	432	3			196	4,708	0			45,344
1987	2,514	--	158	5	150		74	2,766	0			48,986
1988	7,389	38	598	15	308		64	4,212	10			45,592
1989	8,350	544	54	4	249		160	1,860	23			44,644
1990	16,701	287	115	29	177	71	24	2,603	4			53,966
1991	3,398	353	0	17	313	0	6	1,845	71			37,594
1992	7,866	300	0	0	337	0	2	4,572	72			(55,096)
1993		494		0	440		25	6,254	0			(54,556)
1994		586	0	38	546		106	10,978	213		158	(73,763)
1995		2,504	80	52	883		102	8,045	1		137	66,426
1996		3,594	24	83	1,187	11	88	16,938	0	1,735	505	82,503
1997		4,199	73	60	1,652	2	1,018	14,252	1	2,824	404	101,651
1998		4,797	79	80	1,120	33	1,208	14,410	2	5,871	286	(94,147)
1999		4,768	60	149	1,540	48	3,621	10,060	1	6,307	261	121,499
2000		5,866	69	55	940	4	1,798	9,645	3	3,654	490	82,702
2001		4,641	139	94	1,295	51	1,635	11,210	0	1,471	127	85,591
2002		6,545	378	30	525	3	(2,357)	10,387		(700)	(127)	(103,848)
2003		(5,973)	(59)	(15)	(521)	(44)	(2,212)	(17,237)	(2)	(2,400)	(127)	(98,345)

[6] Hawaii catches for 1987 through 1999 are from Ito and Machado, 2001. Hawaii catches for 2000 through 2003 are from Ito (pers. Comm.).

[7] U.S. troll catches for 1952-1960 include fish caught by pole & line vessels. U.S. troll catches for 1984-1988 include gillnet catches.

[8] Other longline catches from vessels flying flags of convenience being called back to Taiwan.

2002 and 2003 values based on SPC logbook landings (from the north Pacific landed in southern ports) assuming 50

[9] Other troll catches from vessels registered in Belize, Cook Islands, Tonga, and Ecuador

Table 2. North Pacific albacore catch-at-age (number of fish in 1,000s) matrix used for all VPA-2BOX model analysis conducted during the Workshop (1975-03).

YEAR	AGE (yr)									TOTAL
	1	2	3	4	5	6	7	8	≥9	
1975	0.0	792.1	4,931.1	2,958.5	1,680.5	261.8	99.3	74.0	207.6	11,004.8
1976	0.4	2,285.8	4,952.3	5,758.9	2,607.4	342.2	133.0	138.3	93.6	16,311.9
1977	0.2	765.4	3,042.5	1,991.1	1,026.5	452.2	101.8	99.8	87.6	7,567.1
1978	2.5	5,932.8	2,308.5	4,764.8	1,088.2	360.2	114.2	59.3	47.9	14,678.3
1979	0.1	582.6	1,289.0	3,707.2	1,121.7	329.3	131.7	67.1	46.1	7,274.7
1980	0.1	2,480.0	2,950.9	3,174.2	733.7	307.9	111.7	86.4	55.2	9,900.0
1981	3.8	927.4	1,653.6	2,764.7	1,182.1	340.8	264.2	85.7	76.5	7,298.6
1982	75.0	606.0	2,135.8	3,260.2	459.7	265.2	220.3	179.3	69.3	7,270.8
1983	2.0	1,185.8	2,657.9	2,305.9	271.3	161.2	142.0	186.1	87.4	6,999.5
1984	4.8	1,106.1	4,756.6	2,914.3	263.7	171.3	152.1	145.8	79.2	9,594.1
1985	1.7	318.5	1,332.6	2,782.4	627.6	140.5	183.5	144.6	216.2	5,747.7
1986	0.1	801.4	1,099.4	2,341.7	194.6	123.2	146.4	56.6	113.9	4,877.3
1987	0.6	275.6	2,203.4	1,282.1	465.9	251.0	173.6	98.4	151.4	4,902.0
1988	3.5	142.7	1,704.1	1,126.5	293.9	586.3	200.9	154.7	152.4	4,365.0
1989	106.3	441.0	390.0	1,242.8	1,039.1	322.8	217.5	120.0	129.7	4,009.1
1990	107.0	315.1	285.4	1,106.1	1,685.9	568.8	202.1	133.3	209.9	4,613.5
1991	77.7	695.2	1,740.8	409.0	319.2	270.8	172.8	92.7	220.8	3,999.0
1992	0.9	392.9	2,493.7	1,546.8	594.6	407.0	153.0	109.6	150.8	5,849.4
1993	0.0	494.0	1,263.2	1,970.3	622.6	176.0	185.4	135.7	252.4	5,099.5
1994	27.5	697.1	2,001.2	2,050.0	1,090.0	553.2	188.6	77.0	129.6	6,814.3
1995	1.5	531.3	1,964.3	2,451.9	320.7	393.5	404.2	76.8	83.0	6,227.2
1996	7.6	498.4	4,394.6	1,815.6	566.6	576.2	496.5	216.3	64.9	8,636.8
1997	0.1	2,342.4	1,888.9	4,433.8	397.6	188.3	457.3	536.7	212.4	10,457.6
1998	0.0	1,125.1	4,353.7	1,676.6	1,259.6	384.2	327.8	424.6	233.0	9,784.6
1999	76.6	826.7	3,982.2	5,885.3	475.4	436.3	416.3	326.1	174.1	12,599.1
2000	0.0	1,269.2	2,041.0	2,882.0	973.5	397.7	440.9	276.9	84.8	8,366.0
2001	4.1	1,511.9	4,510.5	1,585.7	1,078.1	467.8	370.2	234.0	51.6	9,813.9
2002	0.1	1,485.5	8,099.8	2,629.2	565.6	313.6	315.6	92.1	31.1	13,532.8
2003	0.0	3,049.9	4,204.2	3,326.6	706.1	346.9	282.1	133.8	42.0	12,091.7
TOTAL	504.0	33,878.0	80,631.3	76,144.3	23,711.3	9,896.2	6,804.9	4,561.7	3,554.4	239,686.2

Table 3. North Pacific albacore numbers-at-age (millions of fish on January 1) as estimated in Model Scenario 1 (1975-04). Recruitment (age-1 fish) from 2003-04 reflects mean estimate from 1992-99; and (2) age-2 fish in 2004 reflects exponential decline (e^{-Z}) of age-1 fish in 2003, see Section 6.2.

YEAR	AGE (yr)								
	1	2	3	4	5	6	7	8	≥9
1975	35.215	19.034	19.325	9.338	3.082	0.903	0.534	0.159	0.446
1976	28.199	26.088	13.422	10.124	4.409	0.876	0.447	0.311	0.211
1977	35.588	20.890	17.371	5.754	2.684	1.089	0.359	0.218	0.191
1978	23.461	26.364	14.820	10.275	2.577	1.120	0.425	0.180	0.145
1979	22.938	17.378	14.481	9.009	3.600	0.991	0.525	0.218	0.150
1980	19.184	16.993	12.375	9.626	3.545	1.716	0.455	0.277	0.177
1981	24.912	14.212	10.472	6.657	4.441	2.001	1.009	0.242	0.216
1982	29.254	18.452	9.734	6.347	2.598	2.285	1.192	0.523	0.202
1983	22.343	21.608	13.150	5.393	1.965	1.533	1.466	0.695	0.326
1984	13.546	16.550	14.992	7.478	2.050	1.224	0.998	0.965	0.524
1985	20.889	10.031	11.314	7.073	3.077	1.294	0.761	0.609	0.911
1986	18.913	15.474	7.158	7.243	2.889	1.745	0.838	0.407	0.820
1987	10.413	14.011	10.777	4.365	3.381	1.974	1.187	0.496	0.764
1988	8.670	7.714	10.143	6.107	2.145	2.107	1.248	0.731	0.720
1989	21.967	6.420	5.592	6.061	3.564	1.338	1.063	0.753	0.814
1990	29.623	16.183	4.378	3.809	3.431	1.758	0.717	0.602	0.948
1991	22.189	21.853	11.718	2.999	1.883	1.125	0.820	0.359	0.856
1992	21.085	16.372	15.594	7.195	1.873	1.123	0.603	0.461	0.634
1993	19.851	15.619	11.792	9.425	4.013	0.883	0.487	0.317	0.589
1994	35.350	14.706	11.148	7.656	5.304	2.442	0.504	0.204	0.344
1995	17.664	26.164	10.298	6.552	3.930	3.001	1.338	0.214	0.231
1996	40.471	13.084	18.928	5.955	2.780	2.637	1.887	0.648	0.195
1997	26.971	29.975	9.266	10.283	2.871	1.577	1.463	0.976	0.386
1998	23.071	19.980	20.202	5.256	3.878	1.787	1.007	0.696	0.382
1999	40.511	17.091	13.839	11.259	2.472	1.805	0.997	0.469	0.250
2000	63.867	29.946	11.954	6.871	3.404	1.426	0.966	0.387	0.119
2001	28.223	47.314	21.097	7.115	2.658	1.695	0.719	0.345	0.076
2002	14.963	20.905	33.756	11.789	3.921	1.059	0.858	0.222	0.075
2003	28.122	11.085	14.215	18.117	6.495	2.422	0.518	0.369	0.116
2004	28.122	20.791	5.621	6.963	10.586	4.208	1.498	0.148	0.210

Table 4. Instantaneous rates of fishing mortality-at-age (yr^{-1}) as estimated in Model Scenario 1 (1975-03).

YEAR	AGE (yr)								
	1	2	3	4	5	6	7	8	≥9
1975	0	0.049	0.346	0.45	0.959	0.404	0.241	0.753	0.753
1976	0	0.107	0.547	1.028	1.098	0.59	0.417	0.704	0.704
1977	0	0.043	0.225	0.503	0.574	0.64	0.393	0.735	0.735
1978	0	0.299	0.198	0.749	0.656	0.459	0.368	0.473	0.473
1979	0	0.04	0.108	0.633	0.441	0.478	0.34	0.434	0.434
1980	0	0.184	0.32	0.474	0.272	0.231	0.331	0.442	0.442
1981	0	0.078	0.201	0.641	0.364	0.218	0.357	0.519	0.519
1982	0.003	0.039	0.291	0.872	0.228	0.144	0.239	0.498	0.498
1983	0	0.066	0.265	0.667	0.173	0.129	0.118	0.367	0.367
1984	0	0.08	0.451	0.588	0.16	0.176	0.193	0.191	0.191
1985	0	0.037	0.146	0.595	0.267	0.134	0.324	0.318	0.318
1986	0	0.062	0.195	0.462	0.081	0.085	0.224	0.175	0.175
1987	0	0.023	0.268	0.41	0.173	0.159	0.185	0.259	0.259
1988	0	0.022	0.215	0.239	0.172	0.384	0.205	0.279	0.279
1989	0.006	0.083	0.084	0.269	0.407	0.324	0.268	0.203	0.203
1990	0.004	0.023	0.078	0.405	0.815	0.462	0.39	0.294	0.294
1991	0.004	0.037	0.188	0.171	0.217	0.324	0.277	0.351	0.351
1992	0	0.028	0.204	0.284	0.452	0.535	0.344	0.319	0.319
1993	0	0.037	0.132	0.275	0.197	0.26	0.57	0.669	0.669
1994	0.001	0.056	0.231	0.367	0.27	0.301	0.557	0.563	0.563
1995	0	0.024	0.248	0.557	0.099	0.164	0.425	0.528	0.528
1996	0	0.045	0.31	0.43	0.267	0.289	0.359	0.481	0.481
1997	0	0.095	0.267	0.675	0.174	0.148	0.443	0.972	0.972
1998	0	0.067	0.285	0.454	0.465	0.284	0.466	1.16	1.16
1999	0.002	0.058	0.4	0.896	0.25	0.325	0.646	1.502	1.502
2000	0	0.05	0.219	0.65	0.397	0.385	0.731	1.595	1.595
2001	0	0.038	0.282	0.296	0.62	0.38	0.876	1.426	1.426
2002	0	0.086	0.322	0.296	0.182	0.415	0.545	0.641	0.641
2003	0.002	0.379	0.414	0.237	0.134	0.18	0.956	0.535	0.535

Table 5. Rates of fishing mortality (F), annual catch (C), stock biomass (ages >1, B), and spawning stock biomass (SSB) for a range of FMSY and FLimit proxy biological reference points from uncertainty analysis associated with Model Scenario 1 (see Section 6.3.2.). Generated statistics are based on assumptions regarding current levels of productivity (recruitment) and *F*: (a) high productivity/low *F*; (b) high productivity/high *F*; (c) low productivity/low *F*; (d) low productivity/high *F*. Recent estimates of fishing mortality (F_{2003}), catch (C_{2004}), stock biomass on January 1 (B_{2004}), and spawning stock biomass at the beginning of the spawning season (SSB_{2004}) are highlighted in bold. Similarly, the corresponding projected estimates in 2010 are also shown in bold. See Section 6.3.2.

A HiPro/LoF

		F **(per yr)**		***C*** **(1,000 mt per yr)**		***B*** **(1,000 mt)**	**Percent of unfished**		***SSB*** **at mid-yr (1,000 mt)**	**Percent of unfished**
No Fishing		0.00	C_0 =	0	B_0 =	1,153	100	SSB_0 =	724	100
	F_{2003} =	**0.43**	**C_{2004} =**	**98**	**B_{2004} =**	**438**	38%	**SSB_{2004} =**	**165**	23%
Potential F_{MSY} Proxy Reference Points	$F_{40\%}$ =	0.30	C_{MSY} =	91	B_{MSY} =	656	57%	SSB_{MSY} =	291	40%
	$F_{30\%}$ =	0.42	C_{MSY} =	100	B_{MSY} =	562	49%	SSB_{MSY} =	216	30%
	$F_{0.1}$ =	0.37	C_{MSY} =	97	B_{MSY} =	600	52%	SSB_{MSY} =	246	34%
Potential F_{Limit} Reference Points	$F_{20\%}$ =	0.61	C_{Limit} =	107	B_{Limit} =	464	40%	SSB_{Limit} =	144	20%
	F_{Max} =	1.07	C_{Limit} =	110	B_{Limit} =	334	29%	SSB_{Limit} =	61	8%
			C_{2010} =	**92**	**B_{2010} =**	**534**		**SSB_{2010} =**	**190**	

B HiPro/HiF

		F **(per yr)**		***C*** **(1,000 mt per yr)**		***B*** **(1,000 mt)**	**Percent of unfished**		***SSB*** **at mid-yr (1,000 mt)**	**Percent of unfished**
No Fishing		0.00	C_0 =	0	B_0 =	1,153	100	SSB_0 =	724	100
	F_{2003} =	**0.68**	**C_{2004} =**	**98**	**B_{2004} =**	**438**	38%	**SSB_{2004} =**	**165**	23%
Potential F_{MSY} Proxy Reference Points	$F_{40\%}$ =	0.30	C_{MSY} =	91	B_{MSY} =	656	57%	SSB_{MSY} =	291	40%
	$F_{30\%}$ =	0.42	C_{MSY} =	100	B_{MSY} =	562	49%	SSB_{MSY} =	216	30%
	$F_{0.1}$ =	0.37	C_{MSY} =	97	B_{MSY} =	600	52%	SSB_{MSY} =	246	34%
Potential F_{Limit} Reference Points	$F_{20\%}$ =	0.61	C_{Limit} =	107	B_{Limit} =	464	40%	SSB_{Limit} =	144	20%
	F_{Max} =	1.07	C_{Limit} =	110	B_{Limit} =	334	29%	SSB_{Limit} =	61	8%
			C_{2010} =	**104**	**B_{2010} =**	**432**		**SSB_{2010} =**	**117**	

Table 5. Continued.

C LoPro/LoF

		F (per yr)		*C* (1,000 mt per yr)		*B* (1,000 mt)	Percent of unfished		*SSB* at mid-yr (1,000 mt)	Percent of unfished
	No Fishing	0.00	C_0 =	0	B_0 =	837	100	SSB_0 =	525	100
	F_{2003} =	**0.43**	**C_{2004} =**	**98**	**B_{2004} =**	**438**	52%	**SSB_{2004} =**	**165**	31%
Potential F_{MSY} Proxy Reference Points	$F_{40\%}$ =	0.30	C_{MSY} =	66	B_{MSY} =	476	57%	SSB_{MSY} =	211	40%
	$F_{30\%}$ =	0.42	C_{MSY} =	73	B_{MSY} =	408	49%	SSB_{MSY} =	157	30%
	$F_{0.1}$ =	0.37	C_{MSY} =	70	B_{MSY} =	435	52%	SSB_{MSY} =	178	34%
Potential F_{Limit} Reference Points	$F_{20\%}$ =	0.61	C_{Limit} =	78	B_{Limit} =	337	40%	SSB_{Limit} =	104	20%
	F_{Max} =	1.07	C_{Limit} =	80	B_{Limit} =	243	29%	SSB_{Limit} =	44	8%
			C_{2010} =	**76**	**B_{2010} =**	**419**		**SSB_{2010} =**	**162**	

D LoPro/HiF

		F (per yr)		*C* (1,000 mt per yr)		*B* (1,000 mt)	Percent of unfished		*SSB* at mid-yr (1,000 mt)	Percent of unfished
	No Fishing	0.00	C_0 =	0	B_0 =	837	100	SSB_0 =	525	100
	F_{2003} =	**0.68**	**C_{2004} =**	**98**	**B_{2004} =**	**438**	52%	**SSB_{2004} =**	**165**	31%
Potential F_{MSY} Proxy Reference Points	$F_{40\%}$ =	0.30	C_{MSY} =	66	B_{MSY} =	476	57%	SSB_{MSY} =	211	40%
	$F_{30\%}$ =	0.42	C_{MSY} =	73	B_{MSY} =	408	49%	SSB_{MSY} =	157	30%
	$F_{0.1}$ =	0.37	C_{MSY} =	70	B_{MSY} =	435	52%	SSB_{MSY} =	178	34%
Potential F_{Limit} Reference Points	$F_{20\%}$ =	0.61	C_{Limit} =	78	B_{Limit} =	337	40%	SSB_{Limit} =	104	20%
	F_{Max} =	1.07	C_{Limit} =	80	B_{Limit} =	243	29%	SSB_{Limit} =	44	8%
			C_{2010} =	**83**	**B_{2010} =**	**332**		**SSB_{2010} =**	**98**	

APPENDIX 1

List of Participants

CANADA

Alexander (Sandy) Argue
BC Ministry of Agriculture, Food and Fisheries
780 Blanshard Street
PO Box 9359 Stn Prov Govt
Victoria, BC
Canada V8W 9M2
Phone: 250-356-7015
Fax: 250-721-0442
Email: Sandy.Argue@gems2.gov.bc.ca

Marc Labelle
LGL
9768 Second Street
Sidney, BC
Canada V8L 3Y8
Phone: 250-656-0127 Ext. 220
Fax: 250-655-4761
Email: mlabelle@lgl.com

Max Stocker
Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, B.C.
Canada V9T 6N7
Phone: 250-756-7200
Fax: 250-756-7053
Email: StockerM@pac.dfo-mpo.gc.ca

JAPAN

Miki Ogura
National Research Institute of Far Seas Fisheries
5-7-1, Shimizu-Orido, Shizuoka
424-8633 Japan
Phone: 81-543-36-6032
Fax: 81-543-35-9642
Email: ogura@fra.affrc.go.jp

List of Participants (continued)

Momoko Ichinokawa
National Research Institute of Far Seas Fisheries
5-7-1, Shimizu-Orido, Shizuoka
424-8633 Japan
Phone: 81-543-36-6014
Fax: 81-543-35-9642
Email: ichimomo@fra.affrc.go.jp

Yukio Takeuchi
National Research Institute of Far Seas Fisheries
5-7-1, Shimizu-Orido, Shizuoka
424-8633 Japan
Phone: 81-543-36-6039
Fax: 81-543-35-9642
Email: yukiot@fra.affrc.go.jp

Koji Uosaki
National Research Institute of Far Seas Fisheries
5-7-1, Shimizu-Orido, Shizuoka
424-8633 Japan
Phone: 81-543-36-6033
Fax: 81-543-35-9642
Email: uosaki@fra.affrc.go.jp

MEXICO

Luis Fleischer
CRIP-LA PAZ
Instituto Nacional de la Pesca, Mexico
Km 1. Carretera a Pichnilingue
La Paz, B.C.S. CP. 23000
Mexico
Phone: 52-612-12-21367 Ext. 107
Fax: 52-612-12-21367 Ext. 124
Email: lfleischer21@yahoo.com

List of Participants (continued)

TAIWAN

Chien-Chung Hsu
Institute of Oceanography
National Taiwan University
P.O. Box 23-13
Taipei
Taiwan 106
Phone: 886-2-2362-2987
Fax: 886-2-2366-1198
Email: hsucc@ntu.edu.tw

UNITED STATES

Atilio L. Coan Jr.
National Marine Fisheries Service
Southwest Fisheries Science Center
8604 La Jolla Shores Drive
La Jolla, CA 92037
Phone: 858-546-7079
Fax: 858-546-5653
Email: Al.Coan@noaa.gov

Ray Conser
National Marine Fisheries Service
Southwest Fisheries Science Center
8604 La Jolla Shores Drive
La Jolla, CA 92037
Phone: 858-546-5688
Fax: 858-546-5656
Email: Ray.Conser@noaa.gov

Paul R. Crone
National Marine Fisheries Service
Southwest Fisheries Science Center
8604 La Jolla Shores Drive
La Jolla, CA 92037
Phone: 858-546-7069
Fax: 858-546-5653
Email: Paul.Crone@noaa.gov

List of Participants (continued)

Gerard DiNardo
National Marine Fisheries Service
Pacific Islands Fisheries Science Center
2570 Dole Street
Honolulu, HI 96822
Phone: 808-983-5397
Fax: 808-983-2902
Email: Gerard.Dinardo@noaa.gov

Suzanne Kohin
National Marine Fisheries Service
Southwest Fisheries Science Center
8604 La Jolla Shores Drive
La Jolla, CA 92037
Phone: 858-546-7104
Fax: 858-546-5653
Email: Suzanne.Kohin@noaa.gov

Gary Sakagawa
National Marine Fisheries Service
Southwest Fisheries Science Center
8604 La Jolla Shores Drive
La Jolla, CA 92037
Phone: 858-546-7175
Fax: 858-546-5653
Email: Gary.Sakagawa@noaa.gov

Vidar Wespestad
American Fisherman's Research Foundation
21231 8th Pl. W.
Lynnwood, WA 98036
Phone: 425-672-7603
Fax: 425-672-1357
Email: vidar@worldnet.att.net

Jerry Wetherall
National Marine Fisheries Service
Pacific Islands Fisheries Science Center
2570 Dole Street
Honolulu, HI 96822
Phone: 808-983-5386
Fax: 808-983-2902
Email: Jerry.Wetherall@noaa.gov

List of Participants (continued)

IATTC

Simon Hoyle
Inter-American Tropical Tuna Commission
8604 La Jolla Shores Drive
La Jolla, CA 92037-1508
USA
Phone: 858-546-7022
Fax: 858-546-7133
Email: shoyle@iattc.org

SPC

Adam Langley
Secretariat of the Pacific Community
PB D5 98848 Noumea
New Caledonia
Phone: 687 262000
Fax: 687 263818
Email: AdamL@spc.int

APPENDIX 2

Agenda

November 25 *(Thursday)*, 0900-1630

1. Registration and distribution of documents, **0900-0930**
2. Opening of Workshop, **0930-1000**
   - Welcome remarks by DFO Science Branch Director
   - Work program and logistics

3. Agenda
   - Adoption of agenda
   - Appointment of rapporteurs

4. Review of fishery data used in stock assessments
   - Status of NPALBW Data Catalog
   - Review and update of catch data (Category I)
   - Review and update of catch/effort data (Category II)
   - Review and update of length-frequency data (Category III)
   - Conclusions and work assignments

5. Workgroup session on input data used in VPA-2BOX model
   - Catch-at-age matrices
   - CPUE: age-aggregated and age-specific indices of abundance
   - Conclusions and work assignments

   Reception: 1700-1900 (*Pacific Biological Station*) - Welcome reception with guests and friends sponsored by CHMSF

November 26 *(Friday)*, 0900-1700

5. Workgroup session on input data used in ADAPT model (*Continued*)

6. Review of biological studies
   - Age and growth
   - Reproductive studies
   - Archival tagging
   - Conventional tagging studies

7. Review of fisheries and highlights of research progress
   - Canada
   - Japan
   - Korea
   - Mexico
   - Taiwan

Agenda (continued)

- United States
- IATTC

8. Review of VPA-2BOX requirements
- Inputs – time series, estimates, assumptions
- Exploratory model runs
- Conclusions and work assignments

November 27 *(Saturday)*, 0900-1200

9. Review of ASPIC requirements
- Inputs – time series, estimates, assumptions
- Exploratory model runs
- Conclusions and work assignments

10. Review of biological reference points

1300-1700: Small Workgroup Sessions

November 28 *(Sunday)*, No meeting

November 29 *(Monday)*, 0900-1200

11. Review of results from work assignments

12. Review of alternative stock assessments models
- MULTIFAN-CL results
- ASAP model results
- Coloraine model results
- Conclusions and work assignments

November 30 *(Tuesday)*, 0900-1400

13. Review of results from work assignments (continued)

14. Future research

15. Administrative matters
- ISC related matters
- Procedures for clearing the report
- National coordinators and data correspondents
- Time and place for next meeting

Agenda (continued)

1400-1700: Report preparation – rapporteurs and others

Dinner: 1900 ***(Wesley Street Cafe)***

December 1 ***(Wednesday)***, **0900-1200**

16. Stock status conclusions

1300-1700 – Report preparation -- rapporteurs and others

December 2 ***(Thursday)***, **0900-1500**

17. Clearing of Workshop Report

18. Adjournment

APPENDIX 3

List of Documents

NPALB/04/INF01: Summary Report of the North Pacific Albacore Workshop Intersessional Meeting Ala Moana Hotel, Honolulu, HI, USA 5-6 February 2004 – P. R. Crone and R. J. Conser (Editors)

NPALB/04/01: North Pacific Albacore Workshop Data Base Catalog – A.L. Coan

NPALB/04/02: Summary of the 2003 U.S. North and South Pacific Albacore Troll Fisheries – J. Childers

NPALB/04/03: The 2002 and 2003 Canadian North Pacific Albacore Troll Fishery – M. Stocker and W. Shaw

NPALB/04/04: Age Specific Abundance Indices for North Pacific Albacore Caught by the Taiwanese Longline Fishery, 1995-2002 – H. H. Lee and C. C. Hsu

NPALB/04/05: Summary of the 2004 U.S. Albacore Archival Tagging Program – J. Childers and S. Kohin

NPALB/04/06: Population Analysis of North Pacific Albacore Based on the ASAP Model – P. R. Crone and R. J. Conser

NPALB/04/07: Critical Evaluation of Important Time Series Associated With Albacore Surface Fisheries (United States, Canada and Mexico) of the Eastern Pacific Ocean – P. R. Crone and J. McDaniel

NPALB/04/08: North Pacific Albacore Catch in the U.S. Longline Fishery – J.Wetherall and A. Coan

NPALB/04/09: A review of Japanese albacore fisheries in the North Pacific – K. Uosaki and Y. Nishikawa

NPALB/04/10: Update of catch-at-age matrix of albacore caught by the Japanese fisheries in the North Pacific, 1975-2003 – K. Uosaki

NPALB/04/11: Age specific abundance index for North Pacific albacore caught by the Japanese longline fishery, 1975-2003 – K. Uosaki

NPALB/04/12: Updated age specific albacore abundance index for Japanese pole and line fishery, 1972-2003 – M. Ogura

NPALB/04/13: Outline of the archival tagging experiment for the North Pacific albacore conducted in Japan – K. Uosaki

NPALB/04/14: Review of the conventional tagging data for North Pacific albacore, *Thunnus alalunga*, during 1970's and 1980's by U.S. and Japan – M. Ichinokawa and Y. Takeuchi

NPALB/04/15: Maximum likelihood estimation of seasonal and spatial albacore movement in the North Pacific, from historical tagging data – M. Ichinokawa and Y. Takeuchi

NPALB/04/16: An application of a statistical catch at age model to north Pacific albacore – Y. Takeuchi

NPALB/04/17: Preliminary work on a generalized age-structured statistical stock assessment model (Coleraine) applied to North Pacific albacore – M. Stocker and S. Harley

NPALB/04/18: Mexican progress report on the albacore tuna fishery – L. A. Fleischer

APPENDIX 4

Protocols for Data Exchange and Access

Data exchange has been a significant activity of the North Pacific Albacore Workshop since its inception in 1974. At first, the types of data, format, frequency, schedule, etc. for exchange were handled on an informal and ad hoc basis, largely because the nucleus of researchers involved was small and only a few fisheries produced significant catches. As the Workshop participation expanded and the fisheries increased, it became evident that a more formalized exchange procedure was needed. Thus, formal procedures were developed based generally on those adopted by the International Commission for the Conservation of Atlantic Tunas (ICCAT), but modified to suit the special conditions of the North Pacific albacore fisheries and the customary practices of the Workshop organizers. Recently, significant revisions were made to the procedures to accommodate the increasing use of the internet as a communication channel and requests for albacore-related data by researchers. It is intended that further revisions will be accommodated in the future as needs arise.

See Section 3 (Fishery Statistics) for detailed discussion concerning the Data Base Catalog maintained by the Workshop. Protocols for data exchange and access adopted by the Workshop as of December 2000 are as follows:

Category I Data

Landings: Total landings in mt (round weight) shall be reported by year, nation, and gear for each albacore-related fishery that operates in the North Pacific Ocean (i.e., north of the Equator). If round weight is estimated from processed weight, the conversion algorithm and procedure for estimation is to be provided.

Effort: Total effort (nominal estimates) in number of active vessels fishing should be reported by year, nation, gear, and vessel size category for each albacore-related fishery in the North Pacific Ocean. If effort cannot be reported for the North Pacific region only, effort should be reported for a larger area, the area boundaries provided in the data submission. Vessel size categories to be used in reporting effort are as follows:

Gear type	Nation	Vessel size category
Longline	Taiwan	(1) Distant-water; and (2) Offshore
	Japan	(1) Distant-water; (2) Offshore; (3) Coastal
	Other	(1) Distant-water; and (2) Coastal
Purse seine	Japan	(1) Distant-water; and (2) Offshore
	Other	(1) Large (>300 mt capacity vessels); and (2) Small (<300 mt capacity vessels)
Harpoon, handline, troll, gill net, pole-and-line, etc.	All	Aggregated by gear type

Category II Data

Catch and effort data (from logbooks) should be reported by nation, gear type, area, and year/month. The format is as follows:

Gear Type	Area	Catch by species	Effort	Region
Longline	5°[a]	Number or weight	Hooks	North Pacific
Purse seine	1°	Weight	Days fishing (including searching)	North Pacific
Troll	1°	Number	Days fishing (include searching)	North Pacific
Gill net	1°	Number	Tans or net-days	North Pacific
Harpoon	1°	Number	Days fishing	North Pacific
Handline	1°	Number	Number of lines/days fished	North Pacific
Pole-and-line	1°	Number or weight	Number of poles/successful days	North Pacific
Other	1°	Number or weight	As needed	North Pacific

[a] Preference is 1 x1 degree data, but 5 x5 data are acceptable, if this is necessary for confidentiality purposes.

Category III Data

Size composition (length or weight of fish frequencies) and sex data (if available) should be reported by nation, gear type, year, and the same area resolution information as required for Category II data. However, broader area resolutions may be substituted, if recommended resolutions are not appropriate. Reporting of length frequencies should be in intervals of 1 or 2 cm.

All size composition data should include notes on collection method, including: (1) port sampled, observer sampled, fisherman sampled; (2) type of measurement (fork or total length), whole or gill-and-gutted weight, sample size, etc.; and (3) accuracy of measurement (nearest cm, next larger 2-cm interval, nearest kg, etc.).

Access and Availability

Category I statistics are largely free from proprietary information and therefore, shall be made available to anyone that requests the statistics. Category II (catch and effort) and Category III (biological) statistics may contain proprietary information and thus, shall be made available only to Workshop members, as well as authorized scientists designated by Workshop participants. A File Transfer Protocol (FTP) electronic file system will be used to exchange these statistics among the interested parties. The Southwest Fisheries Science Center (SWFSC) in La Jolla, CA has been assigned the task of serving as the depository for these data, maintaining the FTP system, and overseeing the exchange of data among the Workshop members and authorized scientists.

Submission Deadlines

Data for the previous year shall be submitted to as follows, e.g., 2000 data submitted in 2001 and (year '-1' = 1999):

Submission date	Statistics
April 1	(1) Preliminary Category I
3 months (or sooner)	(1) Final/updated Category I
before Workshop Meeting	(2) Final longline Category II (year '-2'; preliminary longline Category II (year '-1'; and final surface Category II[a]
	(3) Final longline Category III (year '-2'); preliminary longline Category III (year '-1'); and final surface Category III[a]
	(4) Estimated current year (e.g., 2001) Category I

[a] Surface gears are all gears other than longline gear.

APPENDIX 5

Summary Report of the
North Pacific Albacore Workshop Intersessional Meeting
Ala Moana Hotel, Honolulu, HI, USA
5-6 Febuary 2004

1.0 Introduction

During the Eighteenth North Pacific Albacore Workshop (NPALBW18) in December 2002, it was recommended that an Intersessional Meeting of the NPALBW be held in conjunction with the fourth meeting of the Interim Scientific Committee (ISC4) for Tuna and Tuna-like Species (February 2004). The NPALBW Intersessional Meeting was convened in Honolulu, HI, USA on 5 February 2004. G. Sakagawa was appointed chairman and R. Conser was appointed rapporteur. Scientists from Canada, IATTC, Japan, Taiwan, and USA participated (Attachment 1). Six working documents and one reference document were tabled (Attachment 2). The draft agenda was reviewed and adopted with minor modification (Attachment 3).

The primary purpose of this meeting was to update data and other information needed for the stock assessment analyses that will be conducted prior to and revised at the Nineteenth North Pacific Albacore Workshop (NPALBW19) (December 2004). More specifically, the agreed terms of reference were:

1. to review task reports describing available fisheries data;
2. to review task reports describing CPUE standardization for the major fleets;
3. to review progress on biological research efforts; and
4. to revise (as necessary) data files and CPUE analyses to reflect group consensus on the best starting points for the stock assessment analyses that will be conducted prior to NPALBW19.

2.0 Total Catch, Catch-and-Effort, and Size-Frequency Data

Participants reviewed the availability of total catch data (Category I), catch-and-effort data (Category II), and size-frequency data (Category III) for use in stock assessment analyses.

NPALBint/04/01 described the NPALBW database catalog which lists Category I, II, and III data from Canada, Japan, Korea, Taiwan, and USA. These data reside on a secure FTP server maintained by the USA. Workshop participants can access the server through use of an account number and password. Participants updated the Category I data that had appeared as Table 1 in the NPALBW18 Report. Although Korea was not represented at this meeting, updates of Korea landings were provided by IATTC as preliminary estimates. (Korean scientists will be asked to verify.) The updated Table 1 is attached to this report (Attachment 4).

Participants agreed to submit all Category I, II, and III updates to the NPALBW database by the end of May 2004, so that they can be used in the stock assessment analyses. The general expectation is that all 2002 data from NPALB fisheries, and most of the 2003 data will be submitted on this schedule. Any questions regarding the mechanics of submitting data to the NPALBW database should be directed to A. Coan (Al.Coan@noaa.gov).

3.0 Estimation of Catch-at-Size and Catch-at-Age

NPALBint/04/03 provided the procedures used to estimate annual catch-at-age (CAA) for the USA, Canadian, and Mexican fisheries (1975-2002). 2003 CAA will be available as well. Estimates are currently available for all gears. Age composition for the surface fisheries has been developed using straightforward cohort slicing techniques, i.e., derived using a length-at-age relationship coupled with visual evaluation of modal progression. For the USA longline fishery, age composition will be estimated using either cohort slicing or MULTIFAN program. In either case, the growth parameters of Suda (1966) will be used. By the end of May 2004, CAA estimates by year (1975-2003) and by gear will be available for stock assessment analyses.

Taiwan reported that CAA estimation is underway. CAA estimates by year (1981-2003) and by gear will be available by the end of May 2004. Additionally, every attempt will be made to extend the time series back to 1975, i.e. to provide CAA estimates for 1975-1981. Progress in this task will be much enhanced if a planned Intersessional Meeting occurs in July 2004 (see details below).

Japan has previously provided the procedures used to estimate annual CAA for Japanese fisheries. These procedures differ somewhat by type of fishery (e.g. longline, pole-and-line, driftnet, etc.) and for some small-scale surface fisheries, it was necessary to assume the age composition was the same as that in the pole-and-line fishery. No procedural change is expected. By the end of May 2004, CAA estimates by calendar year (1975-2002) and by gear will be available for stock assessment analyses. For distant water longline and pole-and-line fisheries, it may be possible to have the 2003 CAA data available in September 2004. However, 2003 CAA for the coastal longline fisheries will not be available in time for analyses.

CAA estimates for the Korean gillnet fishery (1975-1990) and for the Korean longline fishery (1975-86) were developed for NPALBW18 by the USA using size composition samples from similar Japanese fisheries. CAA estimates for the Korean longline fishery (1987-2000) were similarly developed using size composition samples from USA longline fishery. The USA will update the CAAs through 2002 by May 2004. The U.S. effort will be much enhanced if a planned Intersessional Meeting occurs in July 2004 (see details below).

For all fisheries, CAA data through 2002 will be made available, and attempts will be made to provide preliminary 2003 data as well. These data should be distributed directly to all participants for use in this year's stock assessment analyses. Further details that were agreed regarding CAA are:

1. All CAA estimates should represent a calendar year;
2. The units of CAA should be number of fish.
3. Suda (1966) should be used, as appropriate, for age determination in developing CAA estimates for longline fisheries.
4. Other growth models can be used for surface fisheries but their use should be justified and properly cited by the analyst.

5. In some cases, it will be necessary to substitute size composition data from other fisheries (sometimes for other nations) in order to extend all national CAA estimates back to 1975.

Further, participants agreed to develop quarterly catch (in number) and catch-at-size estimates by fishery for the Multifan-CL (MFCL) modelling work. The development of these files should be done in parallel with the development of the CAA files. The NPALB fisheries are defined in Attachment 5.

4.0 Age-Specific Abundance Indices and Effort Standardization

NPALBint/04/03 described the development of age-specific indices of abundance from the USA-Canada troll fishery. Indices through 2003 will be provided for ages 2, 3, 4, and 5 by the end of May 2004. Some difficulties have been encountered in developing indices from the USA longline fishery, but the difficulties are expected to be solved and indices should be available in May. Standardized quarterly effort by fishery for the MFCL analysis will also be available in May 2004.

Japan will provide (by September 2004) age-specific indices of abundance through 2003 from the Japanese longline fishery (ages 3 through 8 and age 9+), and from the pole-and-line fishery (ages 2, 3, 4, and 5). Standardized quarterly effort by fishery for the MFCL analysis will also be provided.

Taiwan will provide (by the end of May 2004) age-specific indices of abundance from its longline fishery (ages 3 through 8 and age 9+) 1995-2002 (and perhaps 2003 as well). Standardized quarterly effort by fishery for the MFCL analysis will also be provided.

5.0 Historical Data (prior to 1975)

Although some fisheries data exist back to the 1950's, 1975 has been used as the starting year for CAA-based stock assessments to date. Attempts are underway by Japan and USA to recover data prior to 1975. Attachment 6 provides an inventory of such data. 1954 and 1960 may be practical limits for the extension of CAA for the Japanese and USA fisheries, respectively, due to the lack of size information in earlier years.

6.0 Biological Research Efforts

NPALBint/04/04 described recent archival tagging of albacore in the eastern Pacific Ocean (off southern California). 159 tags have been placed successfully in 5 trips since November 2001 using pole-and-line gear to capture the animals. A $500 award is being offered for recaptured archival tags. Reward posters have been printed in English and Japanese. One fish -- at liberty for 12 weeks -- has been recaptured. Additional detail and a streaming video showing the tagging operation can be found at:

http://swfsc.nmfs.noaa.gov/frd/HMS/Large%20Pelagics/Albacore/archival%20tagging/tagging1.htm

NPALBint/04/06 described the Japanese archival tagging project. Forty archival tags (Lotek) were placed in April 2002 off Shikoku and Kyushu islands. Fish were taken by longline gear and priority was given to placing tags in small fish, i.e. ages 2-5. One fish was recaptured by the longline fishery – 313 days at liberty. The albacore covered long distances east and west but was recaptured in the same general area as tagged. Another 40 tags are planned for release in the next month or so.

As pointed out in the NPALBW18 Report, there is a need to revisit the NPALB maturity schedule. Taiwan has collected samples from their distant-water longline fishery over a 2-year period (2000-2001). A preliminary maturity ogive should be available for NPALBW19, but sampling over a broader geographic area will be needed to complete the work. The USA will develop a sampling design for a population-based study and present it at NPALBW19.

Taiwan also reported that new age and growth work is underway and that a progress report will be presented at NPALBW19.

7.0 Assessment Modelling

It is expected that both the USA and Japan will present assessments using the ADAPT model at NPALBW19. A joint paper using the MFCL model is also expected. Canada and IATTC may collaborate on application of the Coleraine model. Japan and/or the USA may provide production model analyses as well.

8.0 Biological Reference Points

NPALBint/04/ref01 discussed the need for simulation work to better determine appropriate reference point(s) for NPALB. Working paper(s) on the subject are being planned for NPALBW19. It was also noted that some NPALBW participants contributed to a recent IATTC workshop on biological reference points for tunas and the IATTC report would be available at NPALBW19.

9.0 Intersessional Meeting in Taipei

The NPALBW18 recommended that a 3-day Intersessional Meeting be held in Taipei to resolve issues concerning data from the longline fleets (e.g. the most appropriate match of size samples and total catch statistics). The Taipei venue would help considerably in resolving some longstanding issues with both Taiwan and Korean fisheries data. Attempts in 2003 at resolving the issues through e-mail and other correspondence were not fully successful. The need for the Taipei Intersessional Meeting was re-affirmed during this meeting. After reviewing the schedule of other tuna meetings over the next year, it appeared that mid-July 2004 was the best timing for the Intersessional Meeting in Taipei.

10.0 Plan for the Nineteenth North Pacific Albacore Workshop

The Nineteenth North Pacific Albacore Workshop will be held in Nanaimo, British Columbia, Canada during 1-8 December 2004. A draft agenda for NPALBW19 was reviewed (Attachment 7). It was agreed that M. Stocker would serve as chairman for NPALBW19 and begin the process of issuing invitations and making arrangements for hosting the meeting. Agenda updates and other arrangements will be finalized through correspondence.

11.0 Member Coordinators and Data Correspondents

The table of coordinators and data correspondents that appeared in the NPALBW18 report was updated as follows:

Member	Coordinator	Data Correspondent
Canada	Max Stocker	Max Stocker
Japan	Miki Ogura	Koji Uosaki
Taiwan	Chien-Chung Hsu	Shui-Kai Chang
USA	Gary Sakagawa	Al Coan
IATTC	Shelton Harley	Michael Hinton

12.0 Implications of ISC Membership

During the ISC4 meeting (2-4 February 2004), the ISC agreed to invite the NPALBW to become a fully-fledged working group of the ISC (NPALB WG). It is expected that this invitation will be made formally prior to NPALBW19. Discussion during this meeting reaffirmed the generally positive comments about NPALBW joining ISC found in the NPALBW18 Report with the following additional points.

(1) The long-standing NPALBW format (including 8-day, hands-on meeting for conducting stock assessments) should be maintained;
(2) While the ISC NPALB WG will probably meet coincident with the ISC Plenary meetings, the stock assessments should be done at Intersessional Meetings with the same general format as the current NPALBW.
(3) The NPALBW format is critical for transparency, peer review of assessments, and sufficient time to re-do analyses during the meeting when required;
(4) Not all NPALBW Intersessional Meetings need to conduct full stock assessments – some may, for example, focus on important aspects of past assessments that require further investigation.
(5) NPALBW Intersessional Meetings should be held off-site from the ISC plenary meeting and with sufficient time lag between the two meetings to allow for preparation and agreement on a detailed NPALBW Intersessional report.
(6) Computer-related support (e.g. availability of high-speed laser printers, network router, etc.) and administrative support (e.g. high capacity copying machines, supplies, etc.) are essential for successful Intersessional Meetings.
(7) The rules and procedures adopted by the ISC Plenary were modeled after the NPALBW process. As such, it is expected that a transition from NPALBW to ISC NPALB WG will be straightforward. It is hoped that similar transitions will be smooth for the other ISC WG's as well;
(8) The ISC invitation will be taken up at NPALBW19.

13.0 NPALBW Website

The NPALBW website has been updated to include all of the summary data that falls into the public domain. However, further website development has been postponed until such time that standard procedures for the ISC website have been established.

14.0 Closing of the Meeting

The meeting was adjourned at 15:00 on 6 February 2004. The chairman expressed his appreciation to all participants for their cooperation in making this a successful meeting. In closing, it was agreed that a draft report of the meeting would be prepared and distributed to all participants via email. After comments on the draft are incorporated, the chairman will clear the final report.

ATTACHMENT 1. List of Participants

CANADA

Max Stocker
Department of Fisheries and Oceans -- Science Branch
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, B.C.
Canada V9T6N7
stockerm@pac.dfo-mpo.gc.ca

JAPAN

Katsumasa Miyauchi
Resources and Environment Division, Fisheries Agency, Government of Japan
1-2-1, Kasumigaseki, Chiyada-Ku, Tokyo, 100-8907 Japan
katsumasa_miyauchi@nm.maff.go.jp

Miki Ogura
National Research Institute of Far Seas Fisheries
Orido 5-7-1, Shimizu 424-8633 Japan
ogura@fra.affrc.go.jp

Yukio Takeuchi
National Research Institute of Far Seas Fisheries
Orido 5-7-1, Shimizu 424-8633 Japan
takeuchi@affrc.go.jp

Koji Uosaki
National Research Institute of Far Seas Fisheries
Orido 5-7-1, Shimizu 424-8633 Japan
uosaki@affrc.go.jp

TAIWAN
Shih-Chin Chou
Overseas Fisheries Development Council of the Republic of China (Taiwan)
19, Lane 113, Roosevelt Rd., Sec. 4
Taipei, Taiwan, ROC

Chien-Chung Hsu
Institute of Oceanography, National Taiwan University
Taipei, Taiwan
hsucc@ccms.ntu.edu.tw

USA
Ray Conser
NOAA/NMFS, Southwest Fisheries Science Center
8604 La Jolla Shores Drive, La Jolla, CA 92038, U.S.A.
rconser@ucsd.edu

Paul Crone
NOAA/NMFS, Southwest Fisheries Science Center
8604 La Jolla Shores Drive, La Jolla, CA 92038, U.S.A.
pcrone@ucsd.edu

Gary Sakagawa
NOAA/NMFS, Southwest Fisheries Science Center
8604 La Jolla Shores Drive, La Jolla, CA 92038, U.S.A.
Gary.Sakagawa@noaa.gov

IATTC
Michael G. Hinton
Inter-American Tropical Tuna Commission
Scripps Institution of Oceanography, 8604 La Jolla Shores Drive
La Jolla, CA 92037-1508, U.S.A.
mhinton@iattc.org

ATTACHMENT 2. List of Documents

NPALBint/04/01
North Pacific Albacore Workshop Data Base Catalog
A. L. Coan Jr.

NPALBint/04/02
Summary of the 2002 U.S. North and South Pacific Albacore Fisheries
J. Childers

NPALBint/04/03
Critical Evaluation of Important Time Series Associated with Albacore Fisheries (United States, Canada, and Mexico) of the Eastern North Pacific Ocean
P. R. Crone and R.J. Conser

NPALBint/04/04
North Pacific Albacore Archival Tagging Project (2001-05)
S. Kohin, P. R. Crone, and J. Childers

NPALBint/04/05
The 2002 Canadian North Pacific Albacore Troll Fishery
M. Stocker and W. Shaw

NPALBint/04/06
Vertical and Horizontal Movements of North Pacific Albacore Revealed With Archival Tag
K. Uosaki

NPALBint/04/ref01
Summary Report on Japan-USA Cooperative Research on North Pacific Albacore Stock Assessment
R.J. Conser, M. Ogura, P. Crone, K. Uosaki, and Y. Takeuchi

ATTACHMENT 3. Meeting Agenda

INTERSESSIONAL MEETING (2004) OF THE
NORTH PACIFIC ALBACORE WORKSHOP

Ala Moana Hotel, Honolulu, HI, USA

5-6 February 2004

Agenda

1. Opening of Workshop
   - Appointment of chairperson and rapporteurs
   - Adoption of Agenda and meeting procedures
   - Review the Report of the Eighteenth North Pacific Albacore Workshop (including Recommendations Section)

2. Review status of NPALBW Data Base Catalog
   - Review and update of catch data (Category I)
   - Review and update of catch/effort data (Category II)
   - Review and update of length-frequency data (Category III)
   - Conclusions and work assignments

3. Review summarized fishery data used in stock assessments
   A. VPA-based assessments
      - Review and update catch-at-size and catch-age matrices
      - Review and update age-aggregated and age-specific abundance indices
   B. MULTIFAN-CL assessments
      - Review and update catch/effort and size distribution time series

4. Review progress of stock assessment modeling efforts–past and future
   - VPA-based analysis
   - MULTIFAN-CL analysis
   - Coleraine analysis

5. Review progress of biological research efforts
   - Archival tagging projects of United States and Japan
   - Maturity schedule project
   - Other projects

6. Administrative matters
   - Review of plans for the Nineteenth North Pacific Albacore Workshop, Nanaimo, B.C., Canada in late 2004
   - Intersessional Meeting in Taiwan that focuses on input data and time series in mid-2004
   - Update list of national coordinators and data correspondents
   - Progress on website development
   - Other items (e.g., inclusion in ISC)
   - Clearing of the Report of the Intersessional Meeting (2004) of the North Pacific Albacore Workshop

7. Adjournment

The following attachments have been omitted from this report:

ATTACHMENT 4. North Pacific Albacore Landings (Update of Table 1)

ATTACHMENT 5. North Pacific Albacore Fisheries

ATTACHMENT 6. Inventory for North Pacific Albacore Fisheries Data Prior to 1975

ATTACHMENT 7. Draft Agenda for NPALBW19

APPENDIX 6

Summary Report of the
North Pacific Albacore Workshop Intersessional Meeting
National Taiwan University
Taipei, Taiwan
20-22 July 2004

1.0 Introduction

During the Eighteenth North Pacific Albacore Workshop (NPALB 18) in December 2002, it was recommended that an Intersessional Meeting of the NPALB be held in Taipei, Taiwan to resolve issues concerning data from the longline fleets (e.g. the most appropriate match of size samples and total catch statistics). The Taipei venue was considered essential for resolving longstanding issues concerning Taiwan longline data, in particular, but also for updating the fisheries data from Japan, the USA and others as well. Resolution of these issues is critically important, but it has not been possible to do so through the use of email and other correspondence.

The NPALB Intersessional Meeting was convened at the National Taiwan University (NTU) in Taipei on 20 July 2004. Mr. Tzu Yaw Tsay (Director, Deep Sea Fisheries Division, Fishery Agency, Council of Agriculture, Taiwan) welcomed the group and noted the important work that needed to be undertaken during the course of the 3-day meeting.

G. Sakagawa was appointed chairman and C.C. Hsu and R. Conser were appointed rapporteurs. Scientists from Taiwan, Japan, and USA participated (Attachment 1). Five working documents were presented (Attachment 2). The draft agenda was reviewed and adopted with minor modification (Attachment 3). Although the primary focus of the Intersessional Meeting was to examine longline data issues, the group also used the opportunity to update other data and information needed for the stock assessment analyses that will be conducted for NPALB 19 (November 2004).

2.0 Report on Assignments from NPALB 18

The NPALB 18 Chairman (G. Sakagawa) reported progress on several tasks assigned to him at the last Intersessional Meeting in December 2002. These included fishery information on Vanuatu longline vessels, missing Category 1 data for the Korean longline fishery and dates for the 19th Workshop of NPALB. Sakagawa reported that he contacted two sources for information on the Vanuatu fleet and received information that the fleet was not fishing in the North Pacific. Updated Korean catch data were received and made available to correspondents. The 19th Workshop is being planned for November 25 to December 2 and hosted by the Pacific Biological Station in Nanaimo, B.C., Canada. M. Stocker is the organizer.

3.0 Review of Longline Fisheries Data

The primary purpose of this Intersessional Meeting was to review the available data from the longline fisheries taking albacore in the North Pacific (Table 1). The USA and Japanese data were considered only briefly under this agenda item – as much work has been done on these fisheries in previous NPALB meetings. Consequently, the group focused primarily on the Taiwanese longline data.

3.1 USA Longline Data

R. Conser introduced a working paper (NPALBinter2/04/01) that provided an overview of available fishery data for the U.S. longline fleet fishing from ports in Hawaii and California. The vessels target swordfish and/or tunas. Category I-III data through 2003 are available for the fleet.

The best Category III data on sizes of fish caught has been from a U.S. observer program which began in 1994. For this reason, the catch-at-size matrix for the U.S. longline fishery is based on this source for length measurements. The matrix include 1994 through 2003 catches and is currently available on the Workshop Data Base.

3.2 Japanese longline data

K. Uosaki introduced a working paper (NPALBinter2/04/02) that reported on progress with assembling Japanese fishery data for the 19th Workshop. Complete Category I-III data up to 2003 have been prepared for all fisheries using procedures agreed to at earlier Workshops. Work is progressing on assembling longline (coastal and distant-water) and pole-and-line fisheries data for 2003. Good progress is being made and virtually complete data should be available in time for the Workshop.

3.3 Taiwanese Longline Data

H.-H. Lee and C.C. Hsu reported on Taiwan longline data (NPALBinter2/04/04 and 05).

Category I (landings data) are being estimated using data from a variety of sources, including logbooks, off-loading records, industry records, etc. This is similar to the procedure used by other nations for estimating tuna landings.

Category II (catch and effort data) are obtained from logbooks and a sub-sample of Taiwanese longline vessels fishing in the North Pacific. These sample catch and effort data are "raised" to total catch and effort (by time-area strata) using a combination of Category I and Category II data to estimate year specific raising factors. The method has been modified for recent years (2001-2003) to reflect the change in targeting by the longliners (from albacore to bigeye). More specifically, the year-specific raising factors (R_y) are computed as follows:

$$R_y = \frac{C_y^{Category\_I}}{\sum_s C_{sy}^{Logbook}}$$

where

y is the year, and
s is the time-area stratum (e.g., month-5^o square; strata covering the entire Pacific Ocean).

For years 2000 and all earlier years:
$C_{sy}^{Logbook}$ is the logbook catch of albacore (in weight) for time-area stratum s in year y

$C_{y}^{Category\_I}$ is the total Pacific Ocean Category I catch of albacore in year y

For 2001, 2002, and 2003:

$C_{sy}^{Logbook}$ is the logbook catch of albacore+bigeye (in weight) for time-area stratum s in year y

$C_{y}^{Category\_I}$ is the total Pacific Ocean Category I catch of albacore+bigeye in year y

The participants noted that although the procedure used for raising the Taiwanese Category II data is generally similar to that used for other longline fisheries, it is preferable to estimate raising factors for the North Pacific and the South Pacific separately. This can be accomplished using the same basic data sources. Participants, therefore, recommended that the raised Category II data should be re-estimated using separate North and South Pacific raising factors.

The procedure for the North Pacific would be the same as outlined, above. However, because species targeting changes, species composition in recent years should be checked (albacore vs. bigeye) to determine the proper dividing year for using only albacore catches vs. albacore+bigeye catches in the raising formula

Additionally, for South Pacific data from recent years, the raising should be done using albacore+bigeye+yellowfin catches (since significant catches of yellowfin are more common for the South Pacific area).

It was also noted that further stratification to estimate raising factors by vessel size categories would also be desirable, but the group recognized that the necessary data needed to do so may not be available.

Finally, because significant longline effort in the equatorial region is being directed at bigeye rather than albacore, the group suggests that for standardization of fishing effort and/or catch-per-unit-effort, the area between 0° and 10° N should be excluded for North Pacific albacore analyses (Figure 1, lower).

<u>Category III (size frequency data)</u> are obtained through a systematic program in which fishermen aboard Taiwanese longline vessels measure the first 30-fish caught from each set (all species) and record the length and species data in the vessel logbook. This program has resulted in a large number of albacore size samples; particularly since 1995 (approximately 90,000 albacore

have been measured). However, the participants noted two features with the resulting annual length frequency distributions (Figure 2):

(1) for some years (e.g. 1995 and 1999), the range of lengths do not seem reasonable given the range of sizes generally taken in longline fisheries; and
(2) for all years, more than expected small fish and fewer than expected large fish are found in the length samples. In contrast, limited sampling by Taiwan scientists in 2001 do not show this feature (Figure 3).

Participants explored possible sources for these apparent discrepancies by comparing the Taiwanese data with length composition data from Japanese, USA, and SPC sources by year-quarter-area strata (using areas defined in Figure 1). Figures 4 through 7 illustrate the comparisons made using data from Japan, Taiwan, USA, and SPC, respectively.

Examination at this finer time-area resolution did not resolve the discrepancies in the data collected by Taiwanese fishermen. It was suggested that a quick examination of the original logbooks might help to determine whether the problem originates at the sampling level (i.e. onboard the vessels) or with the processing of data that occurs after logbooks are submitted. The original logbooks for 1999 were examined, and it was determined that the data (as it appears in Figure 2) do indeed correspond to the original logbook entries.

Based on these analyses conducted during the meeting, participants recommended that the Taiwanese onboard length frequency samples not be used for stock assessment purposes. Instead, the following process should be undertaken:

(1) length samples from the port sampling in American Samoa (SPC data) (Figure 7) should be used for the year-quarter-area strata that have adequate sample size;
(2) for the remaining strata, Japanese longline onboard length samples should be applied for strata in which the Japanese sample size is adequate;
(3) for the remaining strata, USA longline observer samples should be applied for strata in which the USA sample size is adequate; and
(4) for any remaining strata, the substitution rules delineated in NPALBintTaipei/04/04 should be applied.

4.0 Expected Participation at NPALB 19

For planning and logistical purposes, the Chairman requested early confirmation on the level of participation at the upcoming NPALB 19 to be held in Nanaimo, British Columbia, Canada in November 2004. Although plans are still tentative for many potential participants, Japan indicated the expectation that 4 scientists would participate; Taiwan indicated 2 scientists; the USA indicated 4 or 5 scientists. Further, the Chairman has contacted Korea and learned that they expect to send one scientist. Also based on previous workshops, the IATTC will likely send one scientist, and the SPC may send one as well.

5.0 Analyses to be carried out during NPALB 19

In order to make the best use of time during the upcoming NPALB 19, the group discussed ways of improving the logistics and process for the Workshop. Several recommendations were adopted.

(1) All analyses that support the eventual stock assessment (e.g. GLM analysis used for CPUE standardization, development of catch-at-size and catch-at-age by nation, new biological studies that have bearing on the assessment, description of new stock assessment models, application of exploratory stock assessment methods, etc.) should be fully described in scientific papers prepared prior to NPALB 19. These papers will become the formal "working documents" for the meeting; will be referenced in the NPALB 19 Report; and will be archived on the Workshop website.
(2) Participants are encouraged to carry out preliminary stock assessment runs using the models that have been adopted for use at previous NPALB's (i.e. ADAPT age-structured assessment and surplus production model assessment). For preliminary analyses that the author(s) wish to share with the other NPALB participants, the results should be documented either in brief papers and/or detailed PowerPoint presentations. In cases where only PowerPoint presentations are provided, hard copy of all slides should be made available to workshop participants. These papers and presentations will not be considered formal "working documents" of the NPALB and will not be referenced in the report.
(3) A consensus stock assessment using the standard models will be conducted during the course of the workshop and detailed results of this agreed stock assessment will be presented in the NPALB 19 report. All output from the agreed runs will also be archived on the NPALB website for future reference.
(4) For standard models, participants should strive to use the same software for both preliminary runs and for runs conducted during the workshop. For ADAPT runs, the VPA 2-Box software will be the software of choice. For surplus production model runs, the ASPIC software is suggested. Participants will not be prevented from using other software but the use of other software should be justified (e.g. better performance, more flexibility, etc.) and in all cases, the results should be compared with the results given by the standard software.

6.0 2003 Catch-at-age data

Participants were briefed on the up-dating of data residing on the Workshop Data Base (NPALBinter2/04/03). It was noted that as of July 13, 2004, data from some key fisheries are missing. Participants were reminded that data (Category I-III) for all fisheries including for 2003 need to be submitted to Al Coan by September 2004. This is priority task for all Data Correspondents because the stock assessment planned for the 19th Workshop hinges on availability of complete data through 2003.

Participants were also reminded that assignments for age-specific indices of abundance through 2003 for the USA-Canada troll fishery, Japanese longline fishery and Japanese pole-and-line fishery are due by September 2004. As soon as the indices are received, they will be made available to persons assigned to stock assessment tasks.

For participants assigned to prepare catch-at-size and catch-at-age matrices by fishery through 2003, the assignment is due by September 2004.

7.0 Data for MULTIFAN-CL model

The MULTIFAN-CL stock assessment model has many features, including a spatial component, that are desirable for a species such as albacore with long distance movement. As the seasonal movement of albacore in the North Pacific become better known, the merits of implementing the MULTIFAN-CL model for North Pacific albacore becomes stronger. In the meantime, preparation of the fishery data for implementation in the MULTIFAN-CL model should continue. The priority task in this regard is to segment the annual fishery data and catch-at-size matrices into a quarterly time scale. The participants agreed to continue to make progress at this task.

8.0 Logistical support for NPALB 19

Participants reviewed preliminary plans for logistical support for the 19th Workshop in Nanaimo. Max Stocker had earlier advised that a local network and server would be available for the Workshop. Stocker also advised that participants should plan on submitting their papers to him in advance of the meeting especially if copies are to be prepared by him. If not, participants should plan on bringing copies with them to the Workshop. Only limited photocopying capacity will be available for the Workshop.

9.0 Closing of the Meeting

The meeting was adjourned at 15:00 on 21 July 2004. The Chairman thanked all participants for their cooperation in making this a successful meeting, and expressed his appreciation to the National Taiwan University and the Taiwan Fisheries Agency for their support and gracious hospitality. In closing, it was agreed that a draft report of the meeting would be prepared and distributed to all participants via email. After comments on the draft are incorporated, the chairman will clear the final report.

List of Figures and Attachments

Figure 1. North Pacific albacore area definitions used for (upper) compiling category I, category II, and category III data; and (lower) for the standardization of fishing effort and catch-per-unit-effort.

Figure 2. Length distribution of albacore caught in distance water (DW) Taiwan longline fishery operated in the north Pacific region during (A) 1981-1994 period, and in (B) 1995, (C) 1996 (D) 1997, (E) 1998, (F) 1999, (G) 2000, (H) 2001, and (I) 2002.

Figure 3. Length frequency distribution (2001) for North Pacific albacore caught by the Taiwanese longline fishery based on limited samples obtained by National Taiwan University scientists, who purchased the fish directly from the fishing vessels. The hatched areas in the upper map shows where the specimens were collected.

Figure 4. Length frequency distribution (by year-quarter-area strata) for North Pacific albacore caught by the Japanese longline fishery with sampling done onboard training vessels and at landing sites in Japan. See Figure 1 for definition of the areas employed.

Figure 5. Length frequency distribution (by year-quarter-area strata) for North Pacific albacore caught by the Taiwanese longline fishery with sampling done onboard by the fishermen. See Figure 1 for definition of the areas employed.

Figure 6. Length frequency distribution (by year-quarter-area strata) for North Pacific albacore caught by the USA longline fishery with sampling done onboard by observers. See Figure 1 for definition of the areas employed.

Figure 7. Length frequency distribution (by year-quarter-area strata) for North Pacific albacore caught by the Taiwanese longline fishery with sampling done by trained port samplers in American Samoa. Fishing area information is recorded by the port samples, but the accuracy of the location data is unknown. See Figure 1 for definition of the areas employed.

Attachment 1. List of Participants

Attachment 2. List of Documents (NPALBintTaipei/04/01 through NPALBintTaipei/04/05)

Attachment 3. Meeting Agenda

Table 1. North Pacific albacore catches (in metric tons) by fisheries, 1952-2003[1]. Blank indicates no effort. -- indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in (). Table updated on 7/7/04.

YEAR	CANADA[2]		JAPAN[3]						KOREA[4]		MEXICO[5]
	TROLL	PURSE SEINE	GILL NET	LONG LINE	POLE & LINE	PURSE SEINE	TROLL	UNSP. GEAR	GILL NET	LONG LINE	UNSP. GEAR
1952	71			26,687	41,787	154		237			
1953	5			27,777	32,921	38		132			
1954				20,958	28,069	23		38			
1955				16,277	24,236	8		136			
1956	17			14,341	42,810			57			
1957	8			21,053	49,500	83		151			
1958	74			18,432	22,175	8		124			
1959	212			15,802	14,252			67			
1960	5	136		17,369	25,156			76			
1961	4			17,437	18,639	7		268			0
1962	1			15,764	8,729	53		191			0
1963	5			13,464	26,420	59		218			0
1964	3			15,458	23,858	128		319			0
1965	15			13,701	41,491	11		121			0
1966	44			25,050	22,830	111		585			0
1967	161			28,869	30,481	89		520			
1968	1,028			23,961	16,597	267		1,109			
1969	1,365			18,006	31,912	521		935			0
1970	390			16,283	24,263	317		456			0
1971	1,746			11,524	52,957	902		308			0
1972	3,921		1	13,043	60,569	277		623			100
1973	1,400		39	16,795	68,767	1,353		495			0
1974	1,331		224	13,409	73,564	161		879			1
1975	111		166	10,318	52,152	159		228		2,463	1
1976	278		1,070	15,825	85,336	1,109		272		859	36
1977	53		688	15,696	31,934	669		355		792	0
1978	23		4,029	13,023	59,877	1,115		2,078		228	1
1979	521		2,856	14,215	44,662	125		1,126	0	259	1
1980	212		2,986	14,689	46,742	329		1,179	6	597	31
1981	200		10,348	17,922	27,426	252		663	16	459	8
1982	104		12,511	16,767	29,614	561		440	113	387	7
1983	225		6,852	15,097	21,098	350		118	233	454	33
1984	50		8,988	15,060	26,013	3,380		511	516	136	113
1985	56		11,204	14,351	20,714	1,533		305	576	291	49
1986	30		7,813	12,928	16,096	1,542		626	726	241	3
1987	104		6,698	14,702	19,082	1,205		155	817	549	7
1988	155		9,074	14,731	6,216	1,208		134	1,016	409	15
1989	140		7,437	13,104	8,629	2,521		393	1,023	150	2
1990	302		6,064	15,789	8,532	1,995		249	1,016	6	2
1991	139		3,401	17,046	7,103	2,652		392	852	3	2
1992	363		2,721	19,049	13,888	4,104		1,527	271	(15)	10
1993	494		287	29,966	12,797	2,889		867		(32)	11
1994	1,998		263	29,612	26,389	2,026		799		(45)	6
1995	1,720		282	29,080	20,981	1,177	856	81		440	5
1996	3,591		116	32,492	20,272	581	815	117		333	21
1997	2,433		359	38,988	32,238	1,068	1,585	123		319	53
1998	4,188		206	35,813	22,926	1,554	1,190	88		(288)	8
1999	2,641		289	33,365	50,369	6,872	891	127		107	23
2000	4,465		67	30,032	21,549	2,408	645	171		414	428
2001	4,985		117	28,809	29,430	974	416	96		82	18
2002	4,996		(332)	(23,917)	(48,454)	(4,303)	(787)	(135)		(146)	(0)
2003	(6,754)	(0)	(332)	(23,917)	(35,222)	(683)	(787)	(135)	(0)	(146)	(0)

[1] Data are from North Pacific Albacore Workshop meetings except as noted.

[2] 1960 Canadian purse seine catch from Shaver (1962). 1994 troll catch from Shaw, 2001.

[3] Japanese pole & line catches include fish caught by research vessels. Longline catches for 1952-1960 exclude minor amounts taken by vessels under 20 metric tons.

[4] Korean longline catches for 1975 to 1986 calculated from Y. Gong (pers. comm.) using the ratio of catches in numbers, from the North Pacific. Gillnet catches for 1979-1990 are calulated by multiplying the 1991 CPUE (# fish per pok) by effort (# poks) then multiplying by average weight (1991, 1992: 4.13 kg/fish). 1987 - 1991 catches provided by Inter-American Tropical Tuna Commission (M. Hinton, pers.com.). 1992 - 2002 catches provided by D. Moon (pers. com.)

[5] 1998-2002 Mexico catch from purse seine and bait boats. Catches provided by Inter-American Tropical Tuna Commission (M. Hinton, pers.com.)

Table 1. Continued

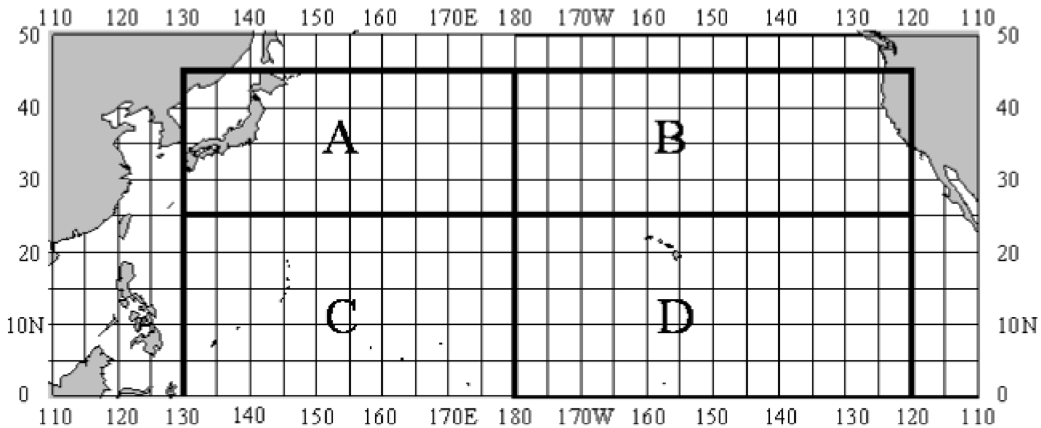
YEAR	TAIWAN		U.S.							OTHERS		GRAND TOTAL
	GILL NET	LONG LINE	POLE & LINE	GILL NET	LONG[6] LINE	PURSE SEINE	SPORT	TROLL[7]	UNSP. GEAR	LONG[8] LINE	TROLL[9]	
1952					46		1,373	23,843				94,198
1953					23		171	15,740				76,807
1954					13		147	12,246				61,494
1955					9		577	13,264				54,507
1956					6		482	18,751				76,464
1957					4		304	21,165				92,268
1958					7		48	14,855				55,723
1959					5		0	20,990	0			51,328
1960					4		557	20,100	0			63,403
1961			2,837		5		1,355	12,055	1			52,608
1962			1,085		7		1,681	19,752	1			47,264
1963			2,432		7		1,161	25,140	0			68,906
1964		26	3,411		4		824	18,388	0			62,419
1965		261	417		3		731	16,542	0			73,293
1966		271	1,600		8		588	15,333	1			66,421
1967		635	4,113		12		707	17,814	0			83,401
1968		698	4,906		11		951	20,434	0			69,962
1969		634	2,996		14		358	18,827	0			75,568
1970		1,516	4,416		9		822	21,032	0			69,504
1971		1,759	2,071		11		1,175	20,526	0			92,979
1972		3,091	3,750		8		637	23,600	0			109,621
1973		128	2,236		14		84	15,653	0			106,964
1974		570	4,777		9		94	20,178	0			115,197
1975		1,494	3,243		33		640	18,932	10			89,950
1976		1,251	2,700		23		713	15,905	4			125,381
1977		873	1,497		37		537	9,969	0			63,100
1978		284	950		54		810	16,613	15			99,100
1979		187	303		--		74	6,781	0			71,110
1980	--	318	382		--		168	7,556	0			75,195
1981	--	339	748		25		195	12,637	0			71,238
1982	--	559	425		105		257	6,609	21			68,481
1983	--	520	607		6		87	9,359	0			55,039
1984	--	471	1,030		2	3,728	1,427	9,304	0			70,729
1985	--	109	1,498	2	0		1,176	6,415	0			58,279
1986	--	--	432	3			196	4,708	0			45,344
1987	2,514	--	158	5	150		74	2,766	0			48,986
1988	7,389	38	598	15	308		64	4,212	10			45,592
1989	8,350	544	54	4	249		160	1,860	23			44,644
1990	16,701	287	115	29	177	71	24	2,603	4			53,966
1991	3,398	353	0	17	313	0	6	1,845	71			37,594
1992	7,866	300	0	0	337	0	2	4,572	72			(55,096)
1993		494		0	440		25	6,254	0			(54,556)
1994		586	0	38	546		106	10,978	213		158	(73,763)
1995		2,504	80	52	883		102	8,045	1		137	66,426
1996		3,594	24	83	1,187	11	88	16,938	0	1,735	505	82,503
1997		4,199	73	60	1,652	2	1,018	14,252	1	2,824	404	101,651
1998		4,797	79	80	1,120	33	1,208	14,410	2	5,871	286	(94,147)
1999		4,768	60	149	1,540	48	3,621	10,060	1	6,307	261	121,499
2000		5,866	69	55	940	4	1,798	9,645	3	3,654	490	82,702
2001		4,641	139	94	1,295	51	1,635	11,210	0	1,471	127	85,591
2002		6,545	378	30	525	3	(2,357)	10,387		(1,471)	(127)	(104,894)
2003		5,973	(59)	(15)	(521)	(44)	(2,212)	(17,237)	(2)	(1,471)	(127)	(95,637)

[6] Hawaii catches for 1987 through 1999 are from Ito and Machado, 2001. Hawaii catches for 2000 through 2003 are from Ito (pers. Comm.).

[7] U.S. troll catches for 1952-1960 include fish caught by pole & line vessels. U.S. troll catches for 1984-1988 include gillnet catches.

[8] Other longline catches from vessels flying flags of convenience being called back to Taiwan.

[9] Other troll catches from vessels registered in Belize, Cook Islands, Tonga, and Ecuador



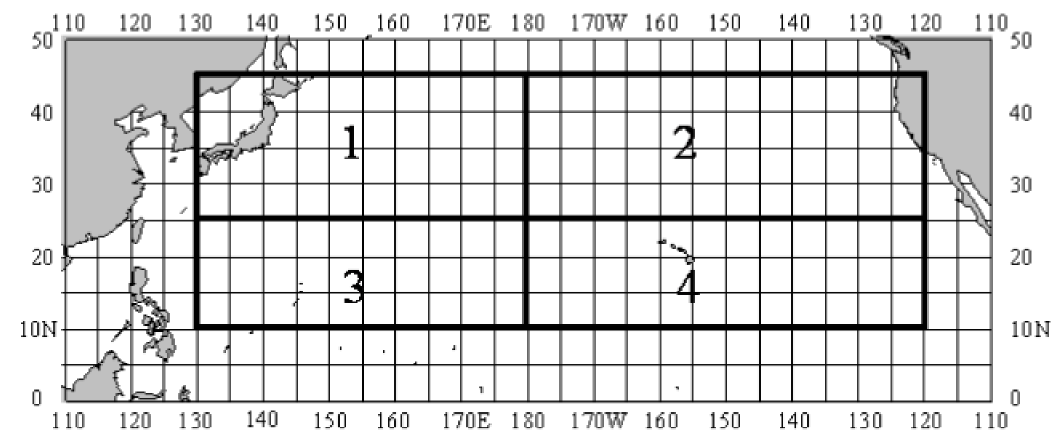


Figure 1. North Pacific albacore area definitions used for (upper) compiling category I, category II and category III data; and (lower) for the standardization of fishing effort and catch-per-unit-effort.

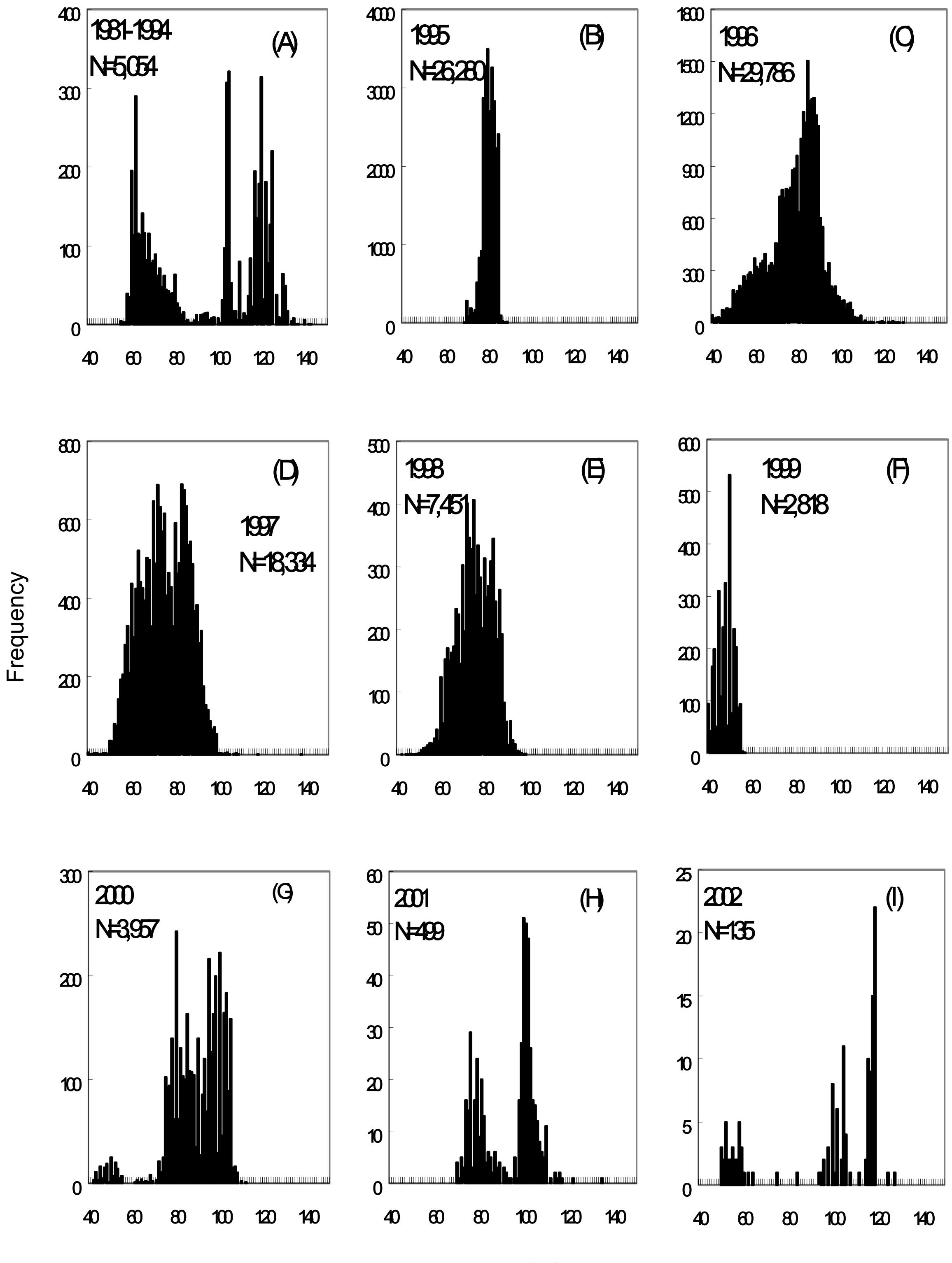
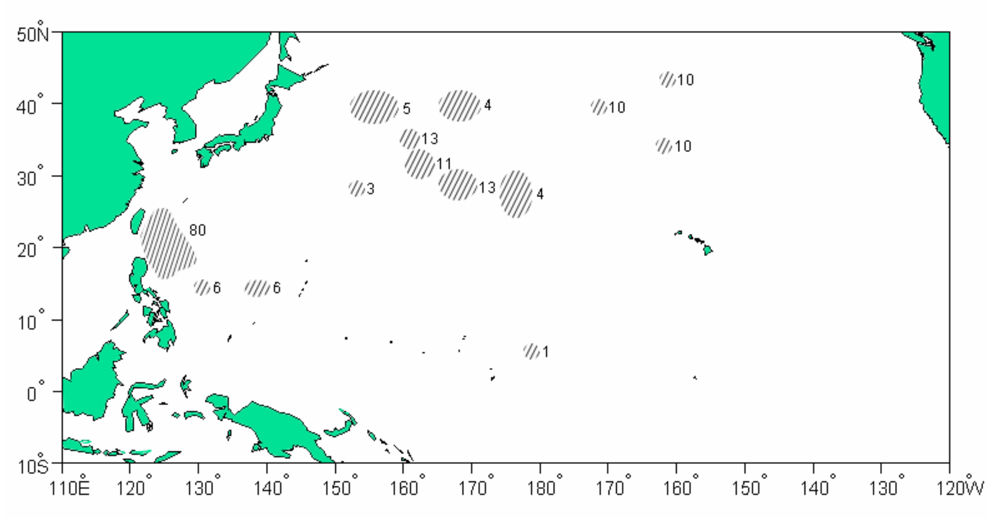


Figure 2. Length distribution of albacore caught in distant water (DW) Taiwan longline fishery operated in the north Pacific region during (A) 1981-1994 period, and in (B) 1995, (C) 1996, (D) 1997, (E) 1998, (F), 1999, (G) 2000, (H) 2001, and (I) 2002.



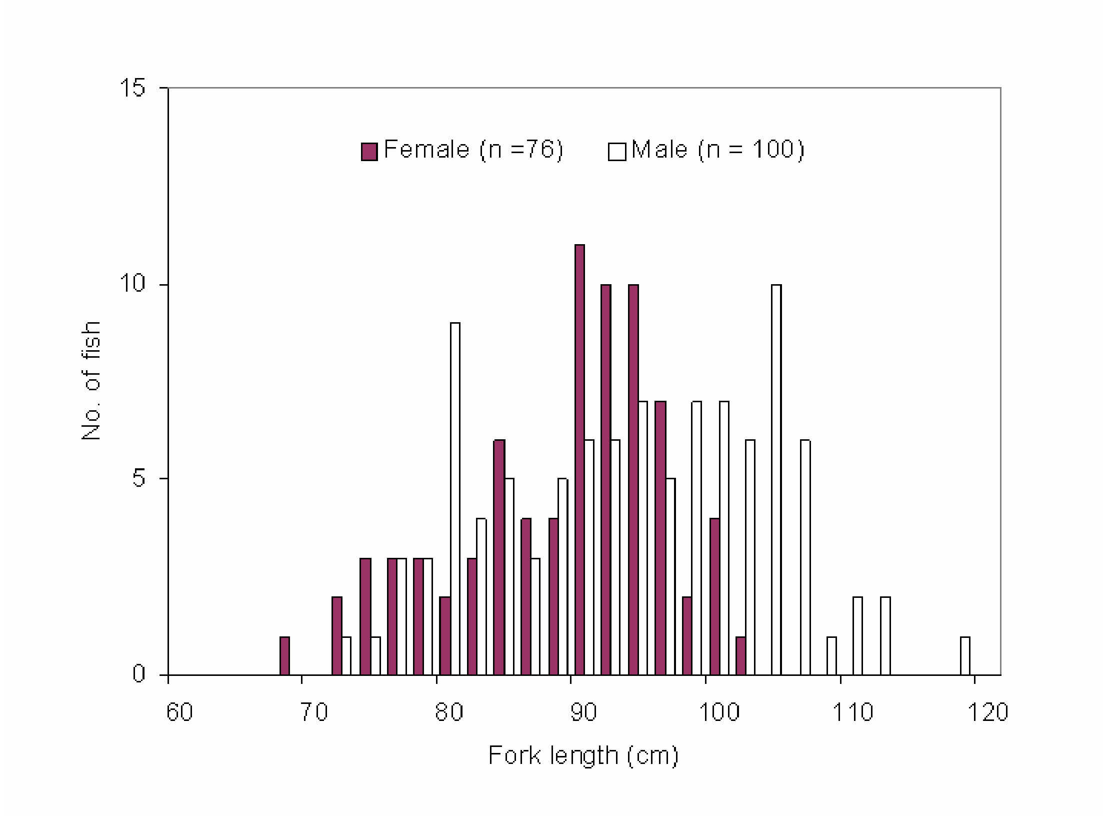


Figure 3. Length frequency distribution (2001) for North Pacific albacore caught by the Taiwanese longline fishery based on limited samples obtained by National Taiwan University scientists, who purchased the fish directly from the fishing vessels. The hatched areas in the upper map shows where the specimens were collected.

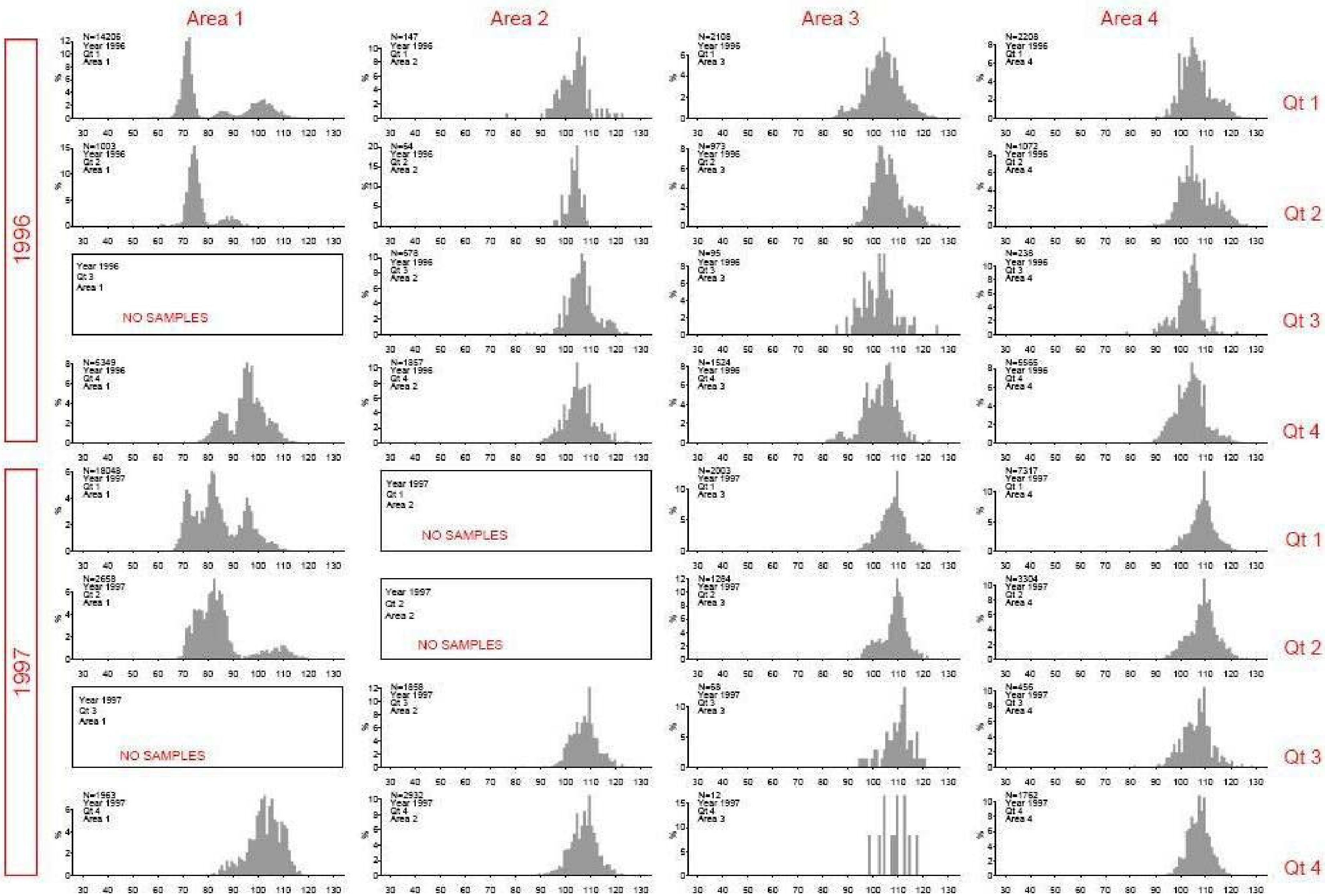
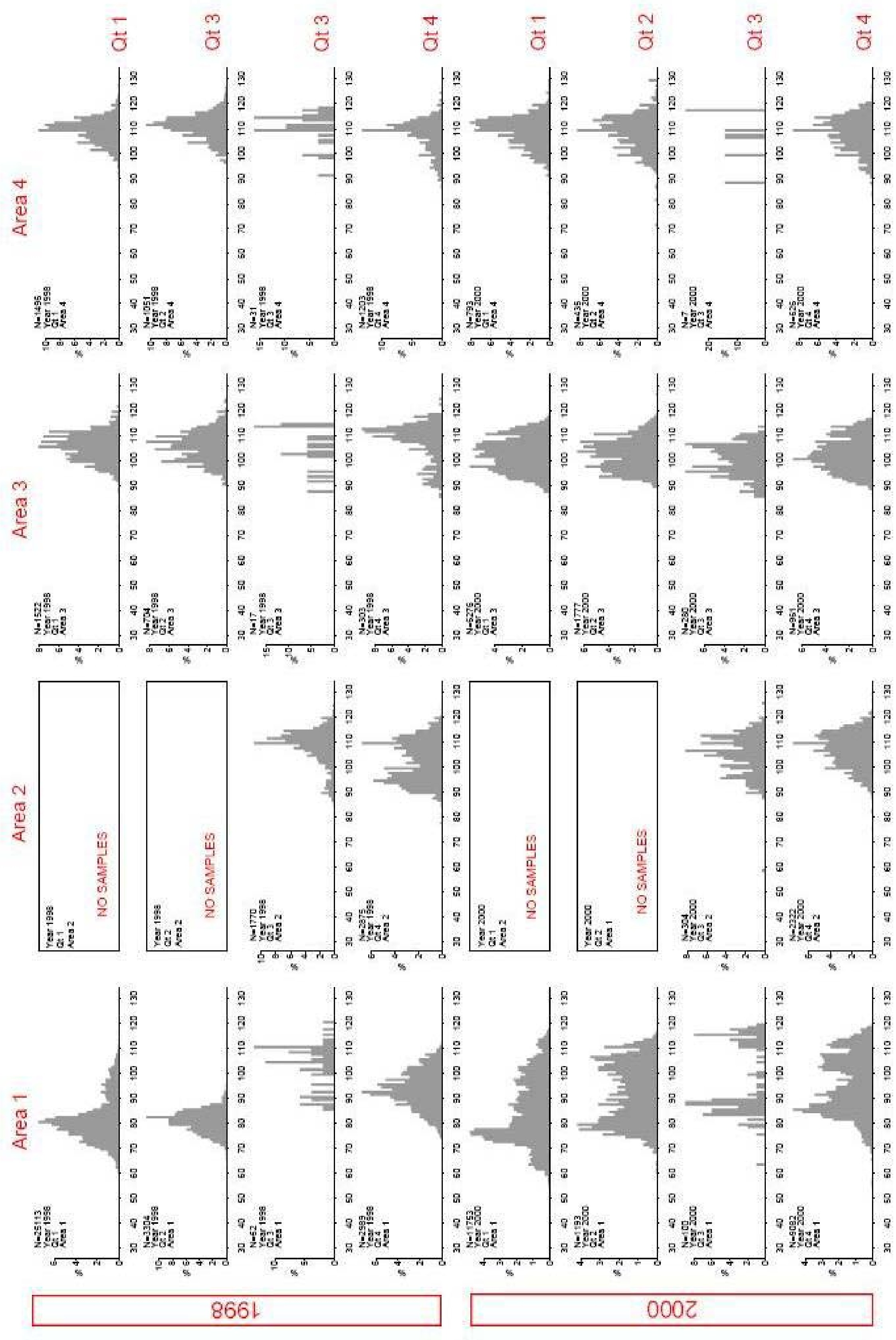


Figure 4. Length frequency distribution (by year-quarter-area strata) for North Pacific albacore caught by the Japanese longline fishery with sampling done onboard training vessels and landing sites in Japan. See Figure 1 for definition of the areas employed.



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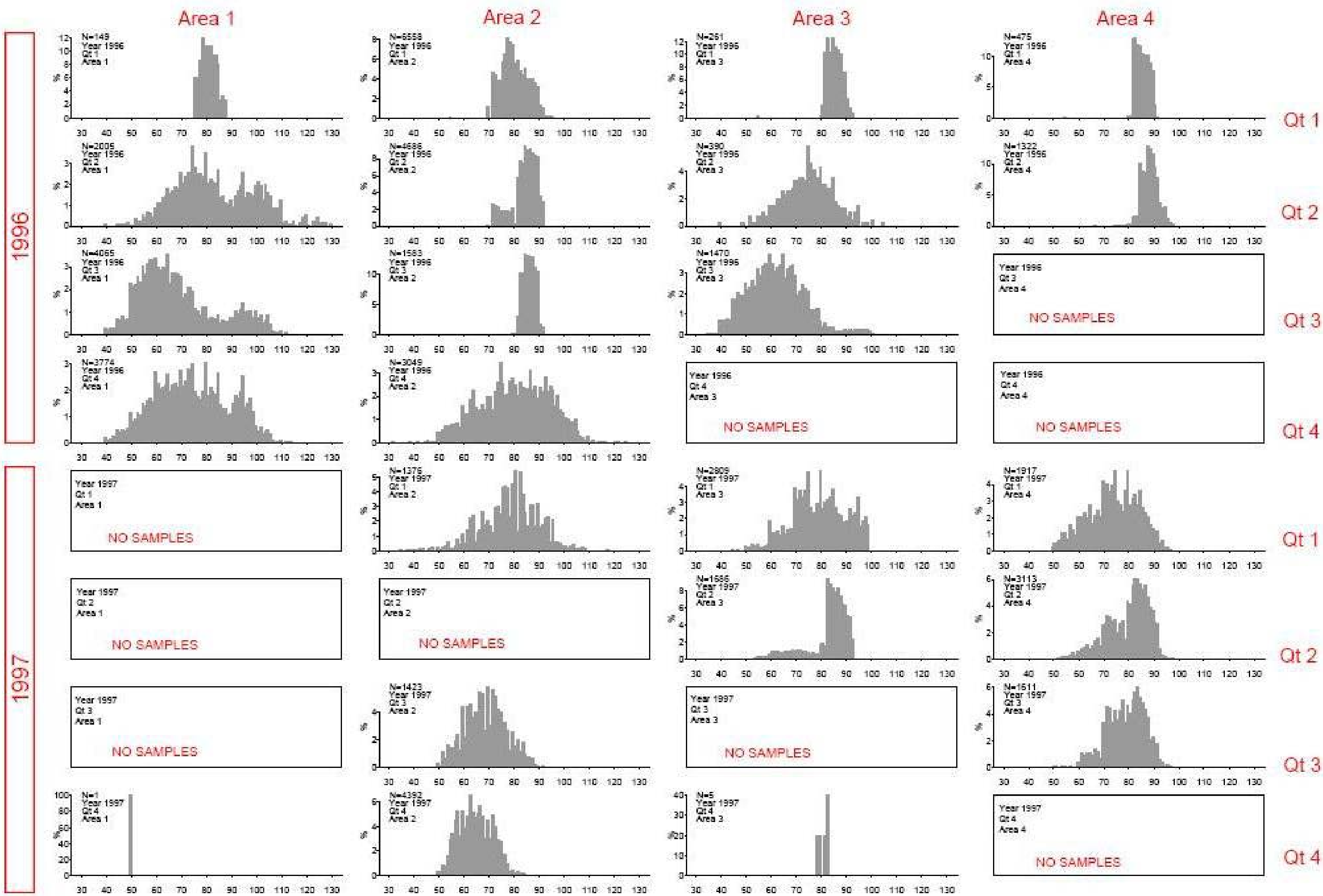

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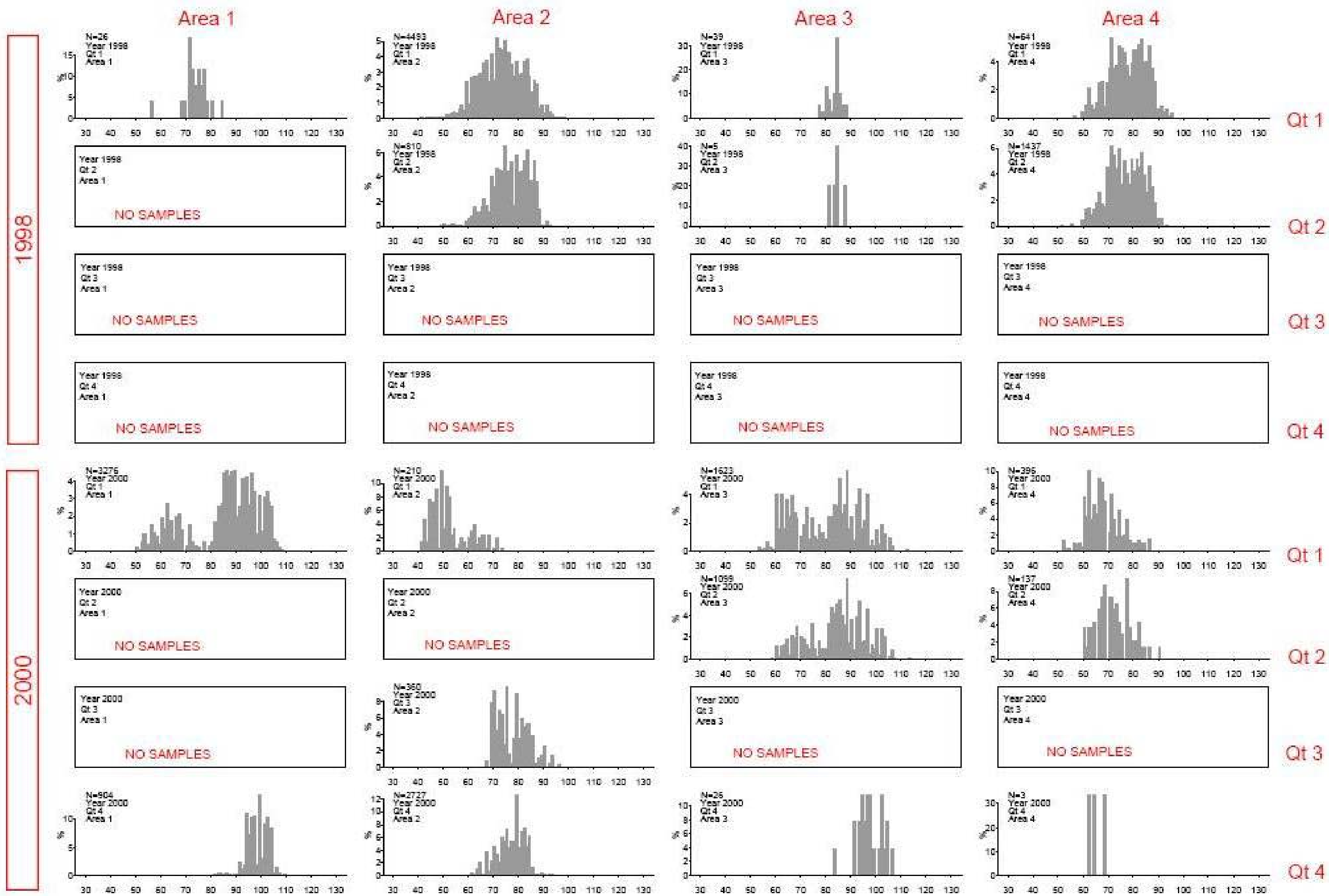

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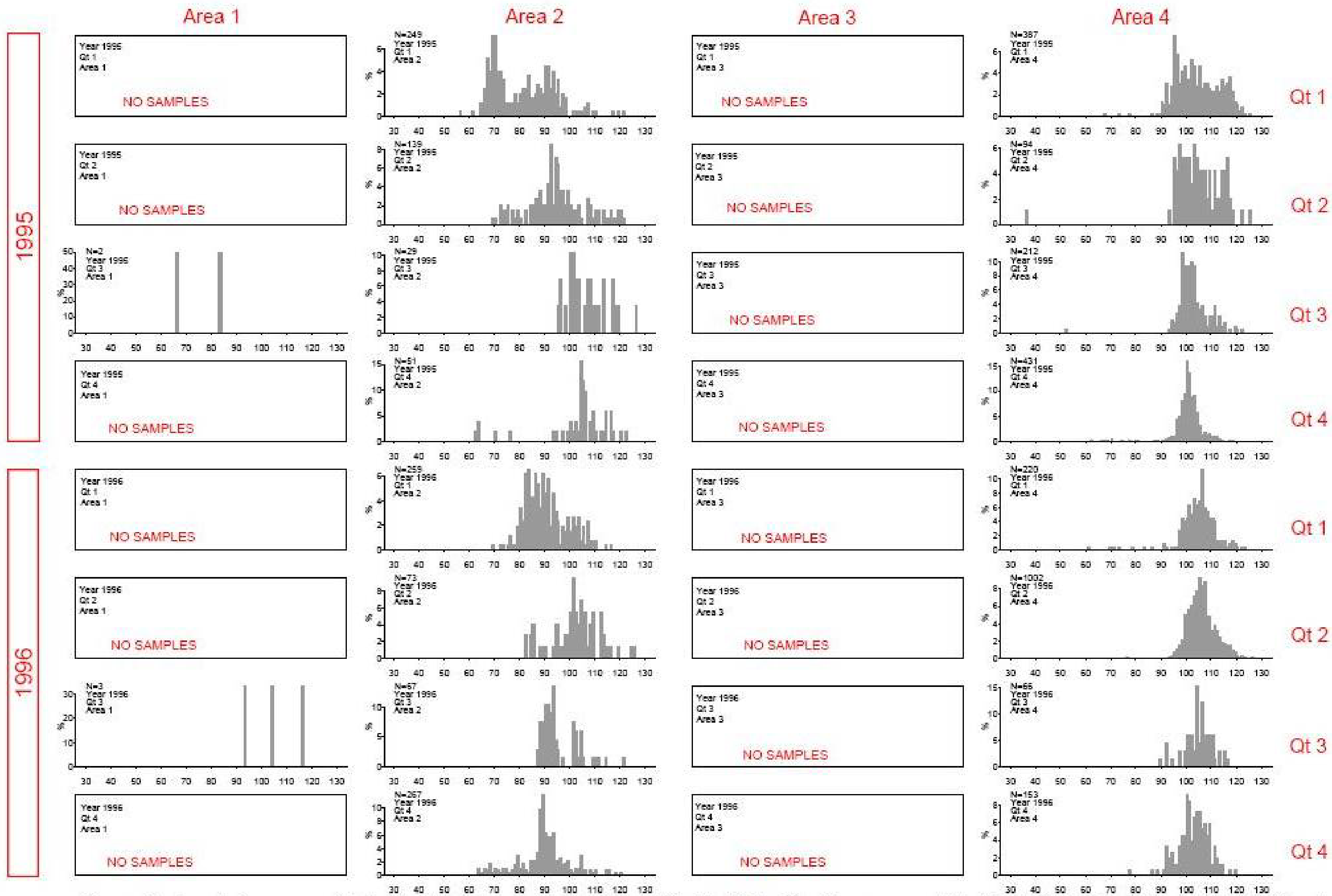
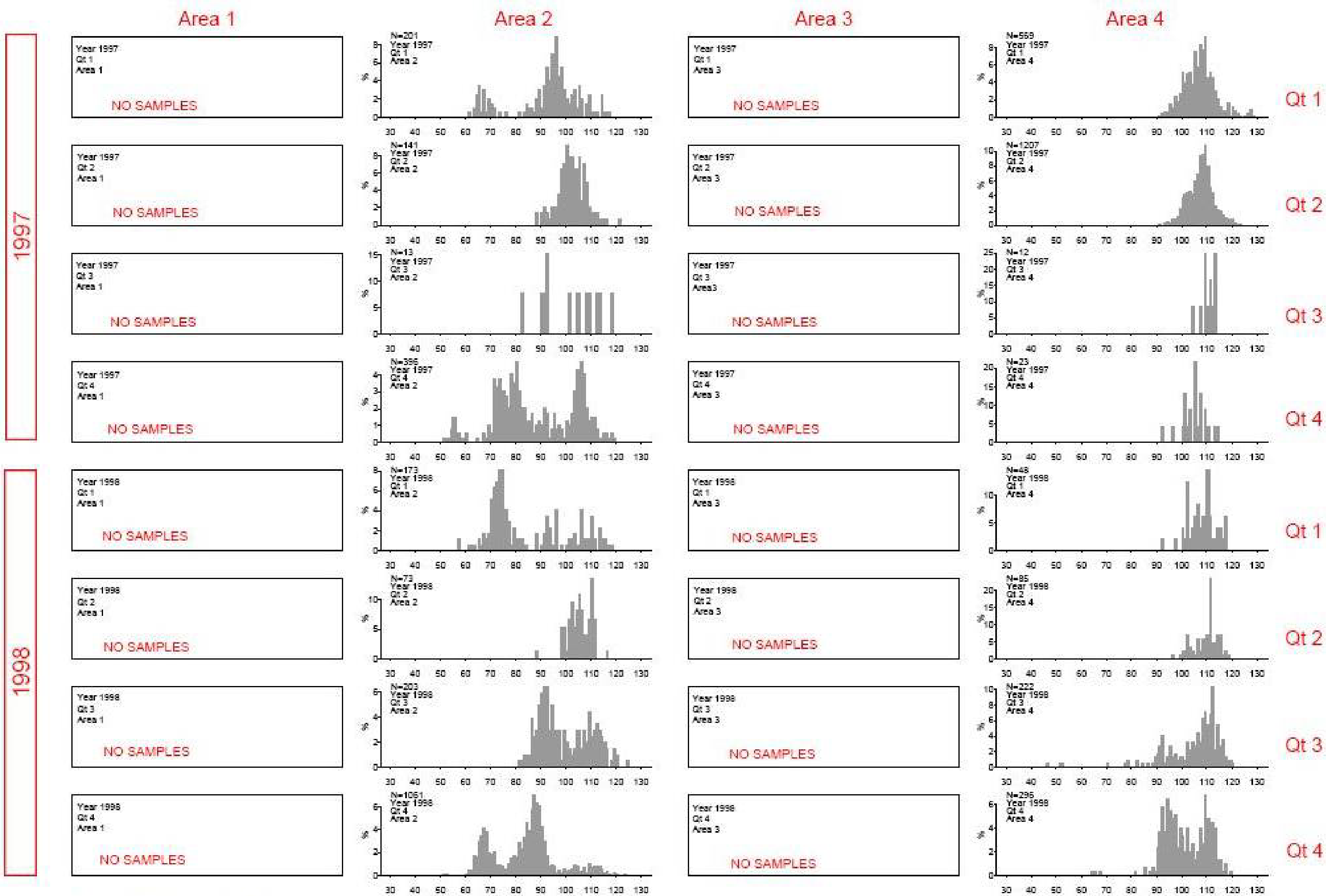


Figure 6. Length frequency distribution (by year-quarter-area strata) for North Pacific albacore caught by the USA longline fishery with sampling done onboard by observers. See Figure 1 for definition of the areas employed.



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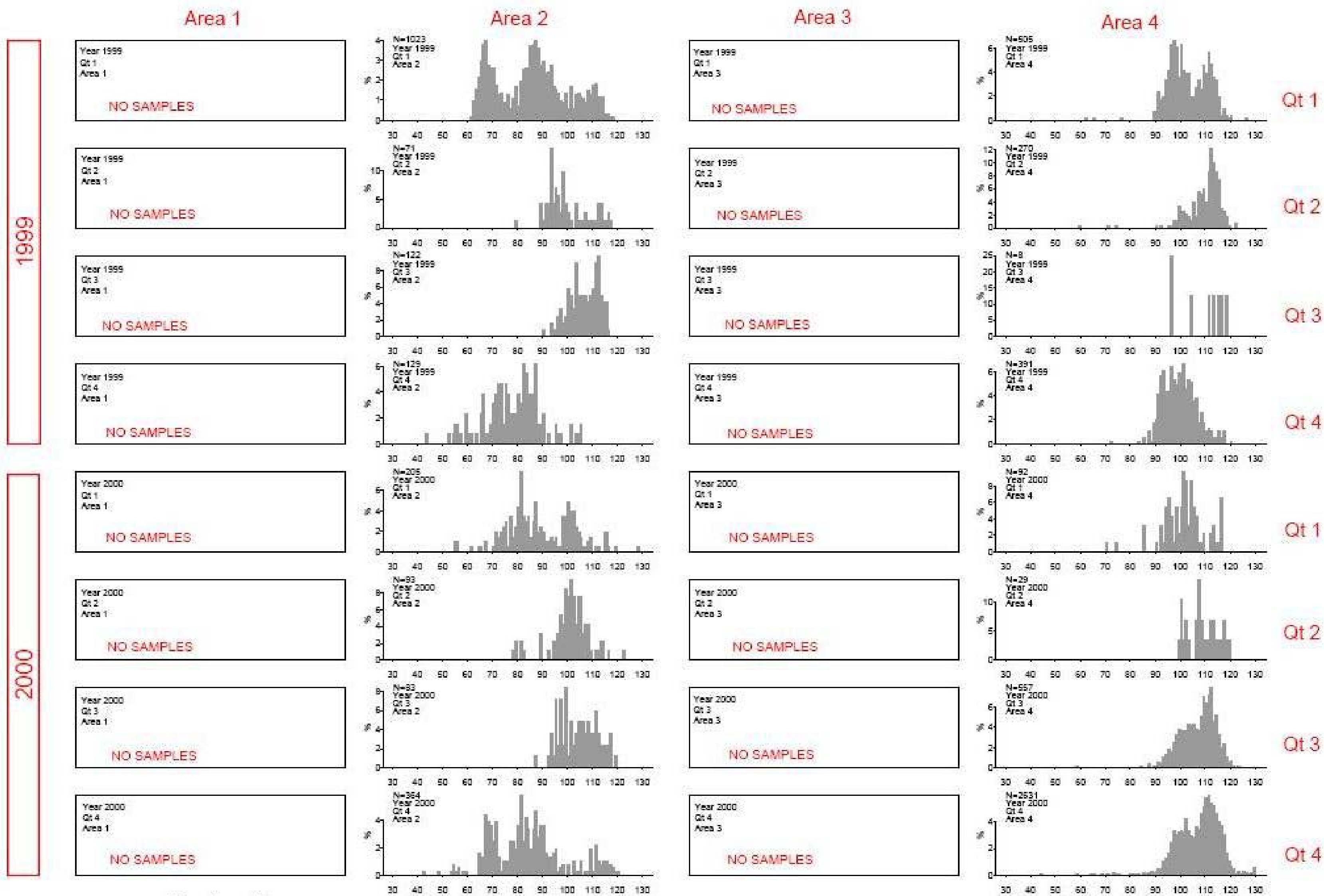

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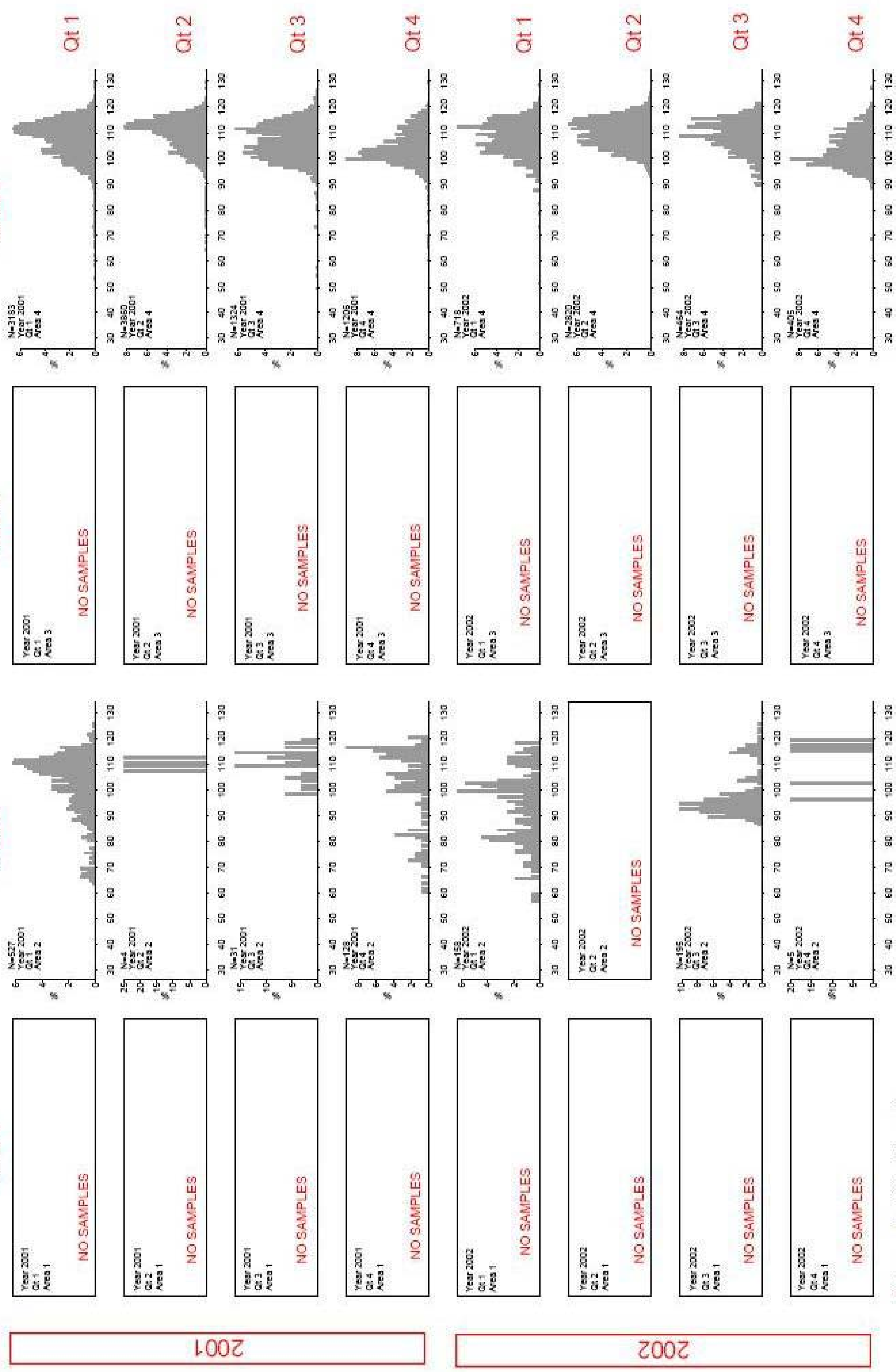

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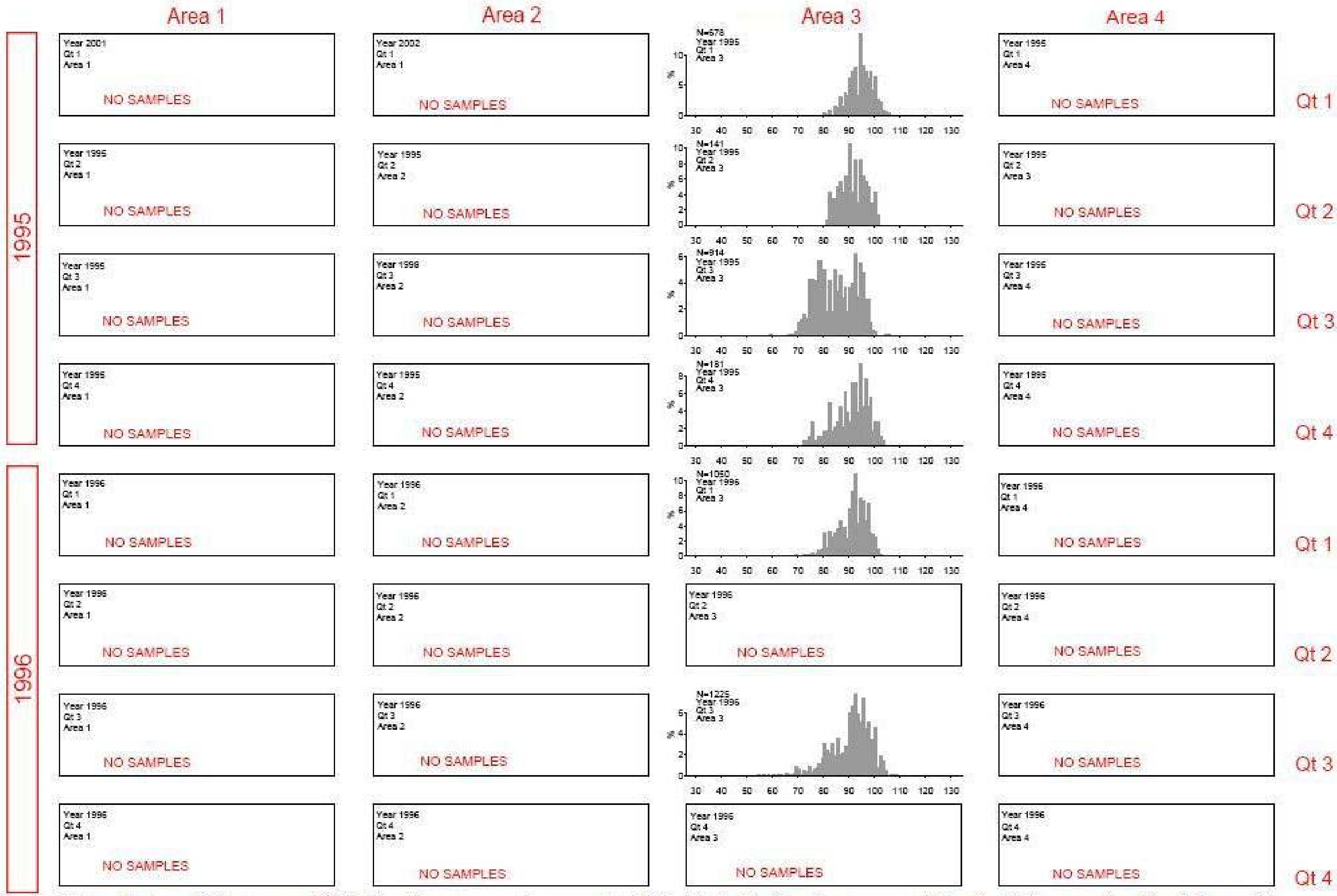

Figure 7. Length frequency distribution (by year-quarter-area strata) for North Pacific albacore caught by the Taiwanese longline fishery with sampling done by trained port samplers in American Samoa. Fishing area information is recorded by the port samples, but the accuracy of the location data is unknown. See Figure 1 for definition of the areas employed.

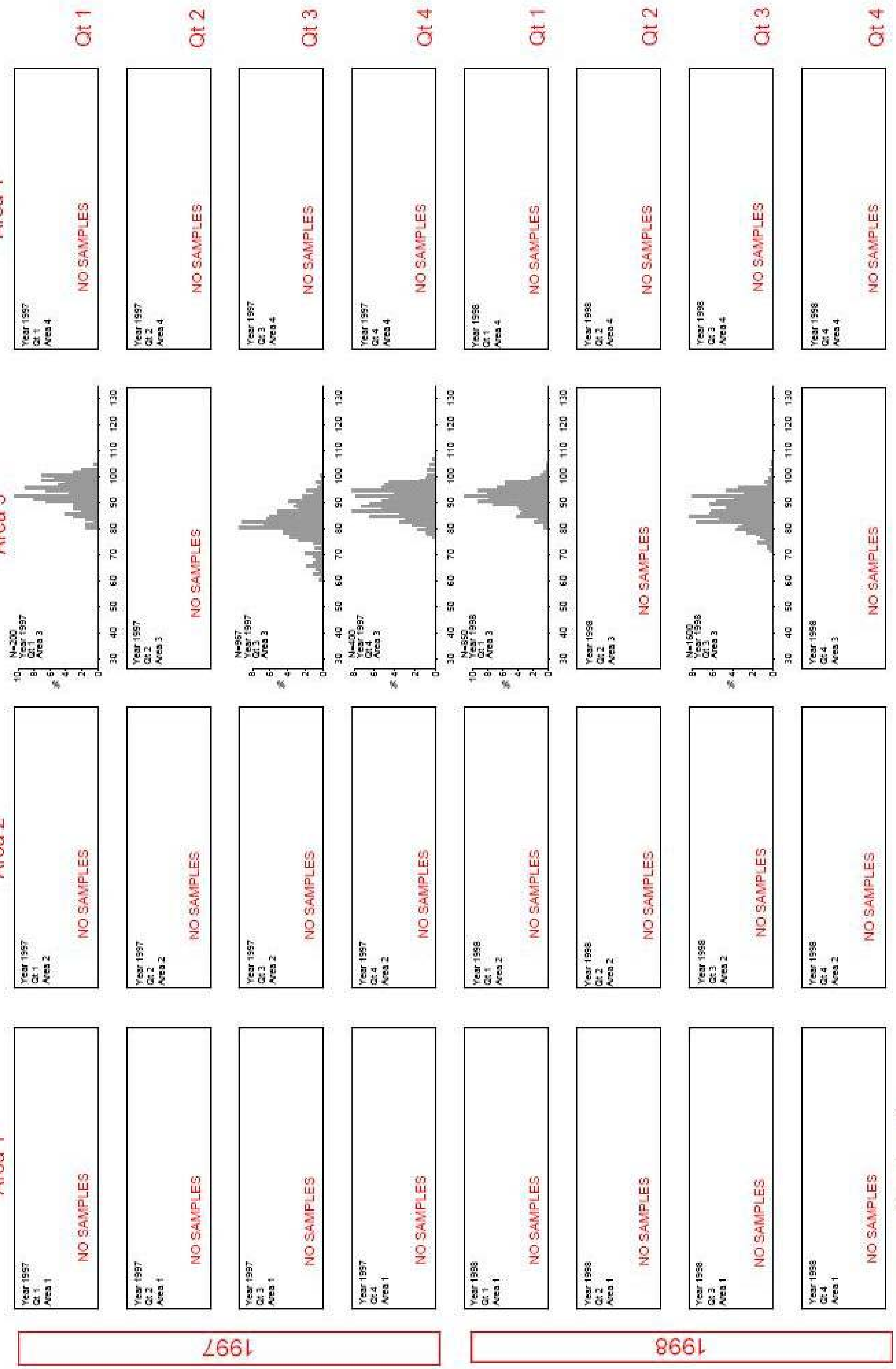

Figure 7. (Continued)

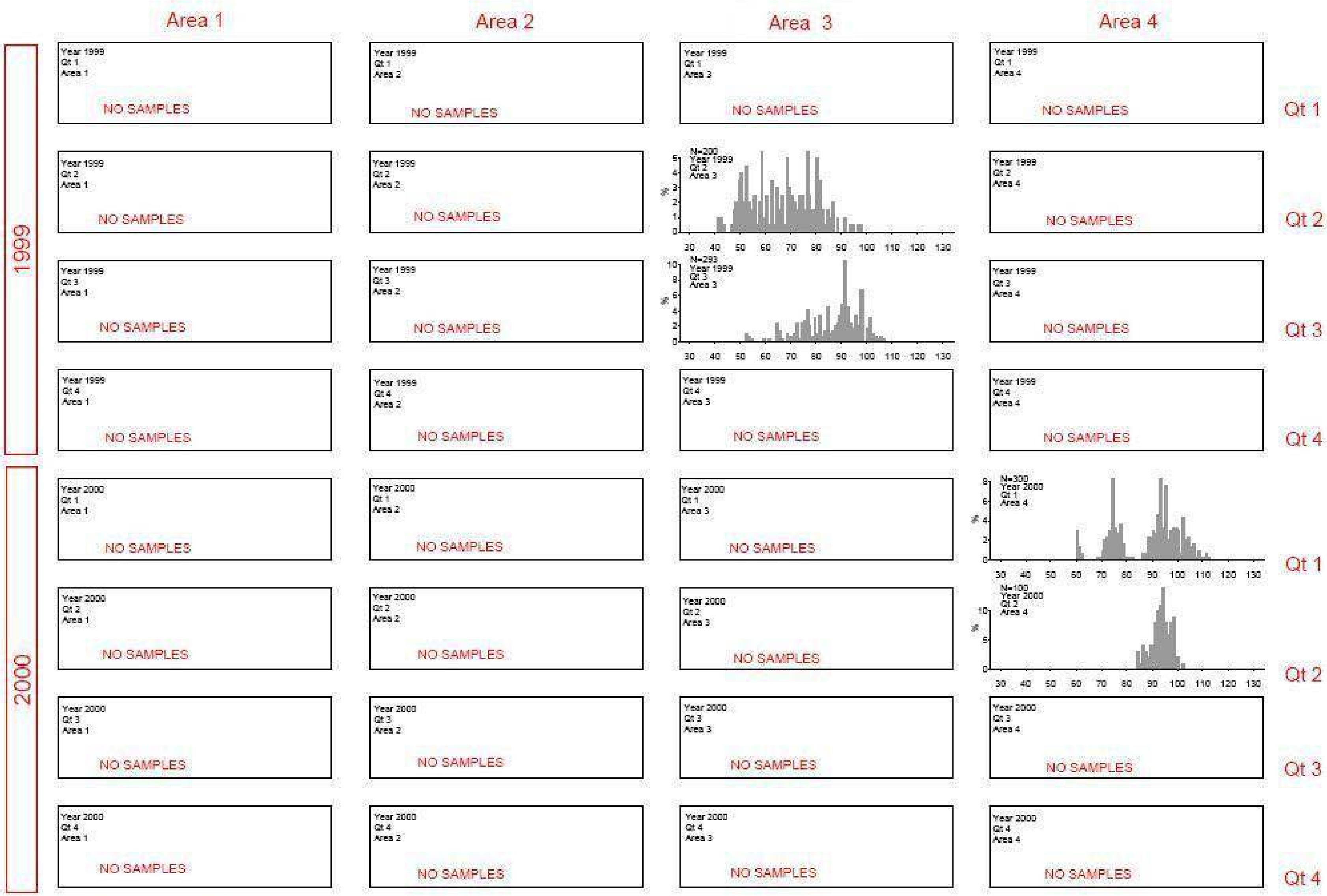

Figure 7. (Continued)

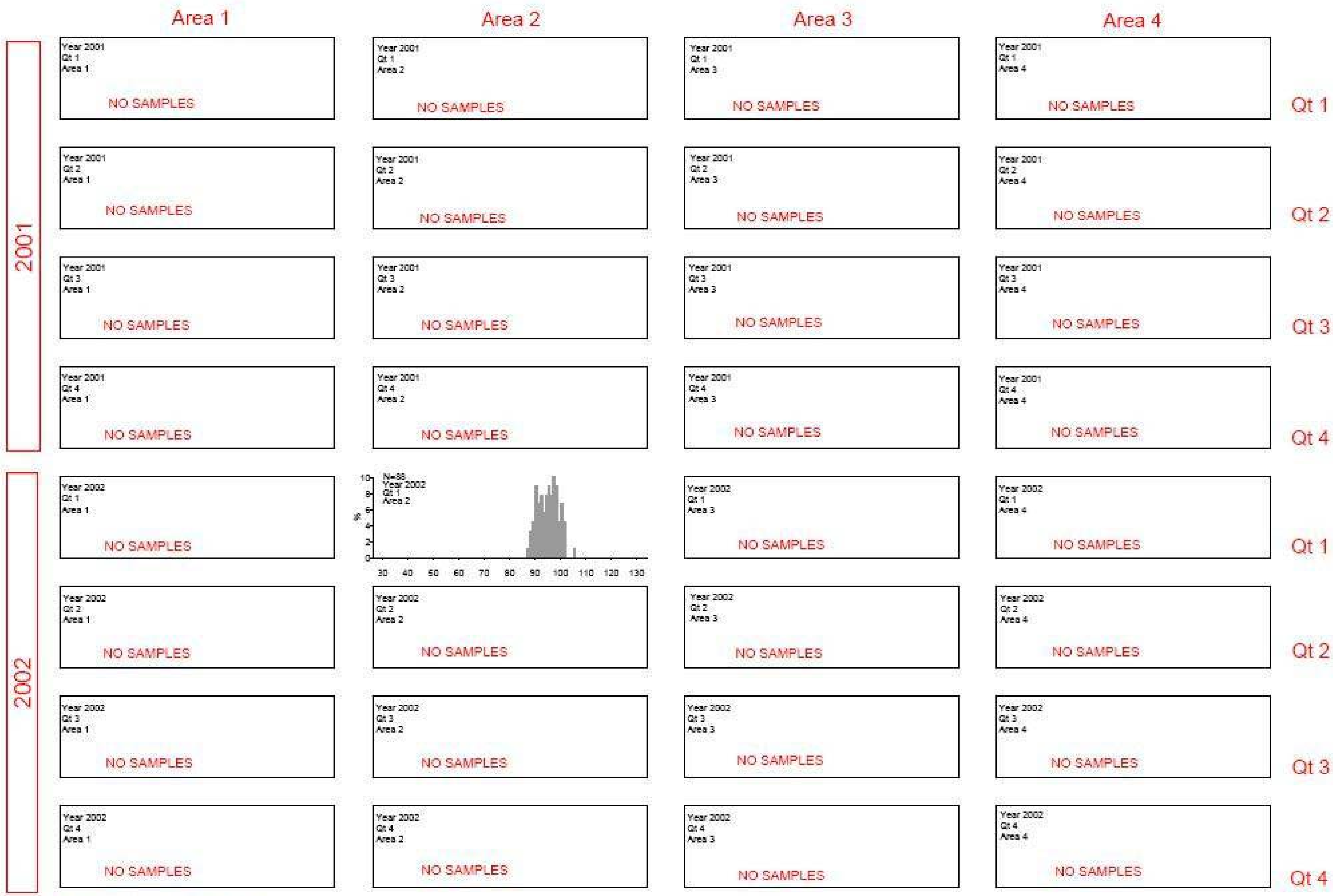

Figure 7. (Continued)

ATTACHMENT 1. List of Participants

Japan
Miyake, Peter M.
Japan Tuna, 3-3-4 Shimorenjaku, Mitaka-Shi, Tokyo, 181-0013 Japan
Tel: +81 422 46 3917, Fax: +81 422 43 7089, E-mail: p.m.miyake@gamma.ocn.ne.jp

Ogura, Miki
National Research Institute of Far Seas Fisheries, 5-7-1, Shimizu Orido, Shizuoka, 424-8633 Japan
Tel: +81 543 36 6032, Fax: +81 543 35 9642, E-mail: ogura@fra.affrc.go.jp

Uosaki, Koji
National Research Institute of Far Seas Fisheries, 5-7-1, Shimizu Orido, Shizuoka, 414-8633 Japan
Tel: +81 543 36 6033, Fax: +81 543 35 9642, E-mail: uosaki@fra.affrc.go.jp

Taiwan
Chang, Feng-Chen
Overseas Fisheries Development Council of the Republic of China, 19, Lane 113, Section 4, Roosevelt Road, Taipei, 106 Taiwan
Tel: + 886 2 2738 1522 ext. 126 , Fax: +886 2 2738 4329, E-mail: fengchen@ofdc.org.tw

Chen, Kuo-Shu
Institute of Oceanography, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 106 Taiwan
Tel: +886 2 2362 2987; Fax: +886 2 2366 1198; E-mail: chenks@ntu.edu.tw

Chou, Shih-Chin
Fisheries Agency, No. 2, Chao-Chow Street, Taipei, 106 Taiwan
Tel: +886 2 3343 6138, Fax: +886 2 3343 6268, E-mail: cshihchin@ms1.fa.gov.tw

Hsu, Chien-Chung
Institute of Oceanography, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 106 Taiwan
Tel: +886 2 2362 2987; Fax: +886 2 2366 1198; E-mail: hsucc@ntu.edu.tw

Ko, Ching-Hsiu
Institute of Oceanography, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, Taiwan
Tel: +886 2 2362 2987; Fax: +886 2 2366 1198; E-mail: R92241206@ntu.edu.tw

Lee, Hui-Hua
Institute of Oceanography, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 106 Taiwan
Tel: +886 2 2362 2987; Fax: +886 2 2366 1198; E-mail: D91241003@ntu.edu.tw

Liu, Heng-Hsin
Institute of Oceanography, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 106 Taiwan
Tel: +886 2 2362 2987; Fax: +886 2 2366 1198; E-mail: R92241207@ntu.edu.tw

Yeh, Shean-Ya
Institute of Oceanography, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, Taiwan
Tel: +886 2 2363 7753; E-mail: sheanya@ntu.edu.tw

Yeh, Yu-Min
Fisheries Agency, No. 2, Chao-Chow Street, Taipei, 106 Taiwan
Tel: +886 2 3343 6267, Fax: +886 2 3343 6268, E-mail: yumin@ms1.fa.gov.tw

USA

Conser, Ray
National Marine Fisheries Service, Southwest Fisheries Science Center, 8604 La Jolla Shores Dr., La Jolla, CA 92037 USA
Tel: +1 858 546 5688, E-mail: rconser@ucsd.edu

Sakagawa, Gary
National Marine Fisheries Service, Southwest Fisheries Science Center, 8604 La Jolla Shores Dr., La Jolla, CA 92037 USA
Tel: +1-858 546-7177, E-mail: Gary.Sakagawa@noaa.gov

ATTACHMENT 2. List of Documents

NPALBinter2/04/01 USA albacore longline fishery – Overview of sampled data. P. R. Crone, R.J. Conser and G. Sakagawa.

NPALBinter2/04/02 Brief report of the current situation of the Japanese data needed for the stock assessment of North Pacific albacore – Koji Uosaki

NPALBinter2/04/03 North Pacific Albacore Workshop Data Base Catalog - A. L. Coan

NPALBinter2/04/04 An updated information on tuna fisheries of Taiwan operated in the North Pacific region – Overseas Fisheries Development Council of the Republic of China and Deep Sea Fisheries Department, Fisheries Agency, Council of Agriculture

NPALBinter2/04/05 Age specific abundance indices for North Pacific albacore caught by the Taiwanese longline fishery, 1995-2002 - Hui-Hua Lee and Chien-Chung Hsu

ATTACHMENT 3. Meeting Agenda

1. Opening of Intersessional Meeting

    1.1. Introduction
    1.2. Appointment of chairperson and rapporteur
    1.3. Adoption of Agenda
    1.4. Review of objectives

2. Review of U.S. longline data through 2003

3. Review of Japanese longline data through 2003

4. Review of Taiwan longline data

    4.1. Description of the fisheries and sources of data
    4.2. Procedures used to compile Category I data
    4.3. Procedures used to compile Category II data
    4.4. Procedures used to compile Category III data
    4.5. Conclusions and recommendations

5. Other matters

    5.1. New dates for 19th Workshop, Nov. 25-Dec. 2, 2004
    5.2. Computations to be performed at 19th Workshop?
    5.3. Due date of Sep. 1 for CAA series including 2003
    5.4. Clearing of Intersessional Meeting report

6. Closing remarks