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Report of the ISC Bluefin Tuna Working Group
Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC)

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Nagasaki, Japan

Report of the ISC Bluefin Tuna Working Group

November 30 – December 1, 2000

Shimizu, Japan

OPENING OF THE MEETING

The first meeting of the ISC Bluefin Tuna Working Group was held at the National Research Institute of Far Seas Fisheries(NRIFSF), Shimizu, Japan from November 30 to December 1, 2000. Dr. K. Wakabayashi, the Director General of the NRIFSF, welcomed all the participants.

Twenty participants, from the United States, Mexico, Korea, and Japan, attended the meeting (Appendix 1). Dr. Z. Suzuki was nominated as the Chairman of the meeting. A draft agenda was adopted as the formal agenda (Appendix 2), and rapporteurs were appointed to report on each agenda item. A total of 16 Documents, Working Papers, and Information Papers were presented for discussion (Appendix 3).

REVIEW OF PACIFIC BLUEFIN TUNA FISHERIES

Chinese Taipei (Personal Communication from Dr. C.C. Hsu, Taiwan University)

Most of the Pacific bluefin tuna (PBT) that are caught by vessels from Chinese Taipei are taken by small-scale longliners. These vessels operate in waters of the southwestern North Pacific during April to July. Most of the fish taken by these vessels are very large, mature adults, and it has been estimated that the ages of these fish range mostly from 6 to 10 years old. Since 1991, annual catches taken by small-scale longliners from Chinese Taipei have increased from about 300 metric tons (MT) to about 2,000 MT (Table 1). About half of the catch is for local consumption, and the remainder of the catch is exported to Japan. Pacific bluefin are also taken as bycatch in a Chinese Taipei purse-seine fishery (Table 1).

Japan (Document 03)

Japanese fishermen harvest PBT with purse-seine, longline, troll, pole-and-line, and set-net gears. Prior to 1993, PBT were also harvested by drift-gillnet vessels that operated on the high seas. Since 1952, total annual catches have ranged from about 8,000 to 30,000 MT, with a range of about 8,000 to 22,000 MT during the 1990s (Table 1).

More than 70 percent of the annual catch is taken by purse-seine vessels, and these vessels operate in two main areas. In the Pacific Ocean, the fishery occurs mainly from June to August. Both juvenile and adult fish are caught during this time, but the catch of juveniles is greater than that of adults. In the Sea of Japan, adult fish are caught mostly during July and August while juveniles are caught mostly from November to March. Since 1952, the annual purse-seine catch has ranged from about 2,000 to 22,000 MT. In the last decade, the catch has ranged from about 3,000 to 16,000 MT, and there has been no apparent trend in the catch (Table 1).

The longline fishery operates in both the coastal waters of Japan and on the high seas. The total longline catch has ranged from about 300 to 1,400 MT annually, and has increased during the last decade (Table 1). The catch of the longline fisheries is composed mostly of mature fish.

Two Japanese fisheries catch mostly young fish. The troll fisheries take mostly age-0 and -1 PBT during summer and winter in coastal waters. Annual troll catches have ranged from about 900 to 3,500 MT (Table 1) during the last decade. The pole-and-line fishery catches mostly age-0 and -1 PBT and operates mainly during summer and autumn.

Compared to the other Japanese fisheries, the catches of the pole-and-line, drift-net, and set-net fisheries have been relatively minor during the last decade (Table 1).

Republic of Korea (Document 02)

Pacific bluefin are caught incidentally in the Korean purse-seine fishery that targets mackerels. The fishery takes PBT around Cheju and the Tsushima Islands mostly during June through August. The PBT are 30-80 cm long (fork length), corresponding to estimated ages of 0 and 1 year old. Minimum estimates of the annual catch have ranged from about 1 to 1,000 MT during the last two decades (Table 1).

United States (Document 12)

The annual catch of PBT by US commercial fishermen has ranged from about 250 to 4,900 MT, and there has been a substantial decrease in the catch since 1996 (Table 1). More than 75 percent of the annual catch has been taken by coastal purse-seine vessels operating off the coasts of southern California and Baja California, Mexico. These vessels target PBT during summer and fall. Catches of PBT by other gears are incidental.

Mexico (Document 04)

The Mexican fishery catches PBT with purse-seine gear. Recently, some vessels have been supplying fish to companies that ranch PBT. Pacific bluefin are mainly caught off the west coast of the Baja California Peninsula during June through October. Most of the fish in the catch range from 5 to 60 kg in weight, and 20 kg is the average weight. Annual catches were relatively stable during the 1980s, ranging from about 100 to 700 MT, but have been more variable since 1989, ranging from about 0 to 3,700 MT (Table 1).

PBT have been ranched at two sites in Baja California, Mexico, and there are permits for the development of two additional sites. The strong El Niño of 1997-1998 and Hurricane Nora in September 1997 greatly affected both the fishery and the ranching (activity has been suspended at one ranch).

REVIEW OF LANDINGS DATA

The historical landings of PBT are summarized in Table 1. The Working Group discussed the landings data provided by various parties. This discussion is outlined below.

Chinese Taipei

At the time of the meeting, catch data were available for the period 1994-1998. After the meeting, Dr. C.C. Hsu provided revised catch data for 1994-1999 to the NRIFSF.

Japan

It was noted that there is substantial variability in the annual catches made by the purse-seine fishery that operates in the Sea of Japan. Mr. H. Yamada suggested that this variability might be explained by variability in the abundance of PBT that migrate through the Sea of Japan.

The Working Group had a detailed discussion about the landings data from the Japanese longline fisheries. There are three types of longline fisheries (coastal, offshore, and distant water) whose landings data are summarized in two databases (named Norin-tokei and RJB). Since 1994, estimates of landings by coastal longliners computed from the Norin-tokei are often close to or exceed the total landings computed from the RJB. These discrepancies indicate that there is an urgent need for a serious investigation to finalize the catch statistics of the Japanese longline fisheries.

Korea

The Working Group recognized that the estimated landings presented in Document 02 are probably underestimates of the total catches from Korean fisheries. The landings estimates reported in Document 02 are less than the amounts of fresh PBT that Japan reportedly imported from Korea (Japanese import statistics for 1998 and 1999). Similar discrepancies were observed in the Korean landings statistics which were submitted to 1st ISC Plenary Meeting held in 1996 for 1983-1994 and to 6th PICES meeting for 1994-1996. The Working Group agreed to use the Japanese import statistics as minimum estimates of Korean landings and encouraged further work to provide improved statistics.

United States

Dr. G. Sakagawa reported that the landings statistics provided to the meeting were revised estimates. Catches summed under the heading of "other" gears in the previous reports (e.g. in the Report of the 6th Joint NRIFSF-IATTC Workshop on PBT) were allocated between the other types of gear (pole and line, purse seine, longline, and driftnet). Landings by the recreational fishery were not included in the catch statistics.

Mexico

The Mexican purse-seine fishery is monitored by fisheries observers, and landings estimates derived from the observer program are considered to be more reliability than those collected from log-book data. Landings by drift-net and longline vessels were reported to be negligible. All data collected from the surface fishery are included in the IATTC database.

IATTC (Document 01)

Staff members of the IATTC compiled bluefin catch data for surface fisheries that operated in the eastern Pacific. The IATTC data includes information on the catches taken both by commercial and recreational fisheries. The recreational fisheries occur off the coasts of California, and Baja California, Mexico. The IATTC data overlap with data reported by the United States and Mexico.

Other Countries

Based on Japanese import statistics, many countries export bluefin tuna to Japan. Because some of these countries, such as China and the Philippines, may, in fact, catch PBT, the submission of catch and effort data by these countries should be addressed.

BIOLOGICAL, ECOLOGICAL, AND OCEANOGRAPHIC ANALYSES

Information on Large PBT Caught by Coastal Longliners from Miyazaki (Document 09)

Data on PBT landed at Aburatsu during 1982-2000 were collected by scientists at the Miyazaki prefectural fishery station. Landings at Aburatsu have increased dramatically since 1992. These landings are made by coastal longliners that are apparently targeting spawning fish during the second quarter of the year. Most of the fish measured during 1994-2000 were about 170-210 cm long (fork length). These fish were captured off southern Kyushu (25-30°N, 126-134°E).

The data collected at Aburatsu illustrate at least three interesting points. First, there is temporal variability in body size and condition during the spawning season. Second, it appears that the average weight of PBT landed in Aburatsu has increased since 1996. Finally, the length-frequency data collected at Aburatsu shows clear modal progressions.

Discussion: Apparently, this fishery targets spawning PBT, and, therefore, the information collected at Aburatsu may be very useful for stock assessment. The available length-frequency data suggest that a relatively large cohort may have recruited to the spawning stock in recent years. This should be compared with the results of the VPA analysis.

Round-trip Migration of a PBT Traveling Across the North Pacific (Document 10)

The first archival-tag record of a PBT that made a round-trip migration across the Pacific was presented to the Working Group. The tagged fish was at liberty for 1573 days. It was released in the Tsushima Strait on 10 December 1995, and recaptured east of the Izu Islands on 31 May 2000. The archival-tag data provided valuable information about the round-trip migration pattern of bluefin tuna. The tagged fish first moved around the East China Sea, then transited through the Sea of Japan and into the western north Pacific via the Soya Strait and the Sea of Okhotsk. The fish traveled across the north Pacific and remained off the coasts of California and Baja California for about 2 years. The fish eventually returned to the western Pacific, and the duration of the return trip was about 2 months.

Additional information from archival tags recovered from other PBT was presented by Dr. D. Inagake. He showed 5 individual records (all from fish that were at liberty for more than one year) that showed a clockwise annual migration pattern in the western North Pacific. This migration pattern is apparently related to oceanographic conditions.

Discussion: The spatial distributions of physical oceanographic conditions and food organisms in the north Pacific might be related to the migration route of PBT, and mapping these distributions might be useful for understanding the migration pattern. The relationship between the vertical profiles of temperature and swimming depth of PBT may also be important and provide useful information for future studies.

Estimation of the Natural Mortality Rate of PBT using Tagging Data (Document 05)

The natural mortality rate (M) was estimated using data from three tagging experiments. Using the method of Kawano et al. (1986) (a revision of Gulland's (1955) method), M was estimated to be approximately 0.6 per year for age-0 PBT. This value is somewhat higher than previous estimates for PBT and southern bluefin tuna. Nevertheless, 0.6 may be a reasonable estimate for age-0 fish because M generally decreases as fish grow older, and the fishes considered in previous studies were older than age 0.

Discussion: Most of the Japanese catch of PBT is composed of age-0 and -1 fish, and, therefore, estimating the M of young fish is very important for assessing how fishing affects the stock. The Working Group offered three suggestions for further development of the study. First, it would be useful to assume that the tag-reporting rate varied among the three tagging experiments. Second, uncertainty in the estimate of M could be considered by Monte Carlo simulation. Finally, some members of the Working Group believed that the mortality rates of pen-reared fish might provide useful information about M.

Relationships between the Recruitment of PBT and Physical Oceanography (Document 07)

The relationships between the recruitment level of PBT and physical oceanographic conditions (sea surface temperature, sea level pressure, and the Southern Oscillation Index) were analyzed. The recruitment time series was estimated from a virtual population analysis (VPA), and the physical oceanographic indices were calculated as annual means over large regions of space. Variability in a smoothed time series of the recruitment estimates was found to be partly explained by decadal variability in oceanographic conditions.

Discussion: The Working Group noted the results of the study with interest. It was noted that a more detailed understanding of variations in the recruitment of PBT might be possible by considering additional factors, such as feeding conditions and predator abundance, in the analysis.

REVIEW OF CPUE TRENDS

Trends in four catch-per-unit-effort (CPUE) indices were used to tune a VPA of the PBT stock (see Stock Assessment). The four CPUE indices were 1) landings of the Japanese troll fishery, 2) nominal CPUEs of Japanese the purse-seine fishery, 3) standardized CPUEs of the Japanese offshore and distant-water longline fisheries, and 4) a habitat index for purse-seine fisheries in the eastern Pacific. The CPUE indices were presented to the Working Group in Documents 06 and 08, and in Working Paper 01.

The Working Group only discussed the fourth index in the context of the VPA analysis, and a short comment on this index can be found in Stock Assessment. The Group's discussion of the first three indices is outlined in the following paragraphs. As a general comment, the Working Group noted that PBT are not the only target species of most fisheries, and this fact might need to be considered when CPUE indices are developed in future work.

Landings from the Japanese Troll Fishery

The troll fishery targets young PBT, and, as described previously, landings by this fishery have varied between about 900 to 3,500 MT during the last decade (Table 1). An index derived from troll-fishery data might be a useful index of recruitment. It was noted that troll-fishery landings should not be used as index for tuning a VPA analysis unless the amount of fishing effort expended by this fishery has been stable over time. Unfortunately, estimates of effort are not currently available for the troll fishery, and the Working Group agreed that obtaining such estimates is an important topic for future work.

Nominal CPUE from the Japanese Purse-seine Fishery

Nominal CPUEs of the Japanese purse-seine fishery were calculated by dividing annual estimates of the number of positive sets into annual estimates of the total catch. The Working Group noted that this index has been increasing since about 1992 and is currently at levels obtained during the 1970s. It was further noted that additional work should be done on developing a CPUE index from the Japanese purse-seine fishery. Specifically, it would be useful to consider other CPUE indices (e.g. an index that includes unsuccessful sets and an index that considers search time), and any index should be standardized to account for possible changes in efficiency of the fishery and the effects of oceanographic conditions.

Standardized CPUEs from the Japanese Longline Fisheries

Mr. K. Yokawa presented a standardized time series of annual CPUEs for the Japanese offshore and distant-water longline fisheries (Document 08). This CPUE series was designed to index the abundance of spawning PBT. The CPUE series was standardized with a mixed effects model in which the time-area interaction was modeled as a random effect. Three periods of relatively high CPUE were identified from the time series: 1959-1964, 1974-1981, and 1990-1996. There was a large amount of uncertainty in the estimates of standardized CPUE during these times. Standardized CPUEs during the latter time period were substantially higher than those estimated by previous workers.

The Working Group found the work to be useful and made a number of suggestions to extend the analysis. First, an attempt should be made to understand why the standardized CPUEs for the 1990s are much greater those obtained by previous workers. Second, it might be useful to standardize the CPUE data using haul-by-haul data rather than aggregated data. Finally, it would also be valuable to estimate a standardized CPUE series for the coastal longline fishery. The Working Group noted, however, that this might be difficult because coastal longliners use a variety of gear configurations and detailed information on gear configuration may not be readily available. As a first step in developing a CPUE series for coastal longliners, it might be useful to use catch and effort information from the vessels that land PBT at Aburatsu.

STOCK ASSESSMENT

Virtual Population Analysis (Document 06)

Mr. H. Yamada presented the results of a VPA for PBT. The analysis was conducted using the ADAPT framework, and the four CPUE indices mentioned in the previous section were used to tune the estimates of terminal F (fishing mortality) for ages 3, 5, 8, and 9. The VPA was conducted with data from the period 1960-1998, and forward projections were performed under a variety of assumptions about the level of future recruitment and fishing mortality. The results of the VPA were also used to estimate MSY, F_{MSY}, and SSB_{MSY}. A retrospective evaluation (sequentially eliminating the most recent data and then reanalyzing the reduced data set) and sensitivity tests (eliminating individual CPUE indices and making different assumptions about M) were also performed.

The Working Group was encouraged by the progress that had been made in developing an assessment of PBT, but, after a detailed discussion of the work (see the following paragraph), it was determined that, at this time, it would not be appropriate to use the results of the VPA as a basis for managing the PBT fisheries. Despite this difficulty, the Working Group noted the following results. Spawning stock biomass was estimated to be high in the 1960s, to steadily decrease during the 1970s and 1980s, to reach an historically low level in 1990, and then to increase during the last decade. Recruitment was estimated to be highly variable, with four or five large cohorts being produced during 1960-1998. At present, the status of the PBT stock may be largely influenced by at least two large cohorts that are estimated to have recruited in 1989 and 1994.

Discussion: As mentioned previously, the Working Group had a detailed discussion about the VPA analysis. The following list of points was developed, and the Working Group agreed that these points should be addressed in future analyses.

1. The process of catch-at-age estimation should be explained in detail, including a clear accounting of all the substitutions that are used and the inclusion of graphics that illustrate various features of the size/age compositions. The Working Group noted that VPAs are very sensitive to estimates of catch at age, and it is not possible to fully evaluate such an assessment without detailed information on these estimates. The Working Group did not recognized adequately how large cohorts were predicted to occur in 1989 and 1994 because, starting with the data from 1990, age compositions from the troll fishery were used to develop age compositions for the purse-seine fishery in the Sea of Japan during winter. But these large cohorts were observed in the catch by purse seine and longline fisheries in the following years detailed information on these estimates.
2. Catches from Korean fisheries should be included in the analysis.
3. The use of CPUE indices for tuning the VPA should be considered more carefully. Specifically, some thought should be given to appropriate weighting schemes. It might be more appropriate

to weigh the influence of each CPUE observation within a single index by the inverse of its variance. It might also be appropriate to give more weight to some indices than to other indices. For example, the Working Group noted that the best available catch and effort data come from the Japanese longline fisheries, and, therefore, it might be appropriate to give indices from these fisheries relatively more weight. Similarly, the Working Group noted that the habitat index for the eastern Pacific purse-seine fishery should receive relatively little weight because it is not clear whether variations in this index are related to variations in total stock size or to variations in the abundance of fish that cross the Pacific.

4. It would be useful to investigate methods for estimating additional terminal Fs or to estimate these fishing mortality rates for groups of ages rather than for individual ages.
5. The presentation of stock assessment should include a more complete presentation of the uncertainty inherent in the results. The sensitivity tests are useful and should be continued. Nevertheless, since the terminal Fs are being estimated, it would be possible to estimate confidence intervals, CVs, or other measures of uncertainty for variables such as spawning stock biomass, recruitment, and MSY.

Yield- and Spawner-per-recruit Analyses (Working Paper 02)

Dr. Y. Uozumi presented yield- and spawner-per-recruit analyses that were based on the results of the previously discussed VPA. The Working Group acknowledged that these analyses would need to be revised when the VPA is revised. Nevertheless, the work illustrated an important point. The yield per recruit can be increased by decreasing the fishing mortality rate affecting young (ages 0-4) PBT and increasing the fishing mortality rate on older PBT. Such a shift in the overall pattern of age-specific fishing mortality could cause the spawning stock biomass to decrease, and it would be important to determine what level of fishing mortality on old fish would be suitable, as well as current fishing mortality level.

Other Methods (Document 11)

Dr. G. Watters made a short presentation about “integrated” stock assessment models. These models have become popular tools for assessing tuna stocks and are different from VPAs in several important ways. One of the main differences is that length-frequency data are inputted directly into integrated models, but these data must be converted to age frequencies for use in VPAs. Using the length frequencies directly makes the assessment model more complex but removes the need to develop *ad-hoc* substitution schemes. Dr. Watters concluded the presentation by suggesting that a small group be formed with the purpose of developing an integrated assessment model for PBT. This group would work together to compile the necessary data, determine the model’s structure (the assumptions and equations), and identify alternative hypotheses that could be explored with the model.

Summary of Stock Status (Document 01, 02, 03, 06, 08, 12, W01, 02)

The Working Group reiterated its view that the VPA presented in Document 06 should not be used for management purposes at this stage. Given, the points outlined in the discussion of the VPA, there is a very large amount of uncertainty about the actual levels of spawning stock biomass, recruitment, and fishing mortality. Nevertheless, two results from the VPA appeared to be robust to the sensitivity tests and retrospective evaluations.

1. Spawning stock biomass declined from high levels in the 1960s to an historically low level in 1990, and has been increasing during the last decade.
2. Recruitment has been highly variable, but, in general, cohorts produced during the 1990s were larger than those produced during the 1980s.

RECOMMENDATIONS FOR FUTURE WORK

Fisheries Statistics

The Working Group agreed that additional work should be done to obtain and revise various statistics from the fisheries that catch PBT. The following list identifies a set of priority tasks for various data providers. If the completion of these tasks results in a new or revised set of data, these data should be presented to the Group. The Working Group further noted that all data providers should attempt to submit length-frequency data for the fisheries with which they are associated.

Chinese Taipei: Review historical time series of catch estimates for accuracy and completeness, paying particular attention to purse-seine statistics for years in which no catch is currently reported (see Table 1). Submit data on fishing effort.

Mexico: Submit catch and effort data from longline fisheries that catch PBT.

Japan: Review the accuracy of catches by the coastal and high seas longline fleets. Clarify the estimation method used to summarize the Norin-tokei statistics. Estimate the percentage of the catch that is sold directly to central markets and adjust the sampling coverage in the RJB program accordingly. Develop a times series of estimates of fishing effort for the troll and set net fisheries.

Korea: Provide a time series of gear-specific catch estimates that are consistent with Japanese import statistics. Submit data on fishing effort.

United States: Investigate the catch of PBT in the US longline fishery. Submit data on the amount of fishing effort expended by the US longline fleet.

IATTC: Provide gear- and country-specific estimates of catch, taking into account the data submitted by the U.S. and Mexico.

Other Countries: At a minimum, provide a time series of annual catch estimates.

Directed Studies

The Working Group agreed that the following three studies would be useful for improving future stock assessments of PBT.

1. An age and growth study of large PBT (this would require collection of appropriate sample material as a first step).
2. A study to incorporate uncertainty into the tag-based estimate of the natural mortality rate of young PBT (*e.g.* by using Monte Carlo techniques).

3. A study to estimate tag induced mortality (this estimate would be incorporated into the tag-based estimate of M).

Stock Assessment

The Working Group noted that a substantial amount of work should be done to improve the stock assessment of PBT. The following list of work items was identified.

1. All CPUE time series that will be used for assessment purposes (i.e. to tune VPAs) should be standardized. Such standardization should include consideration of oceanographic effects and changes in targeting behavior. It would also be useful to develop new CPUE time series for the Japanese coastal and Chinese Taipei longline fisheries. In developing new CPUE series for the longline fisheries, it might be useful to develop indices that are age-specific.
2. Each of the items listed in the discussion of the VPA should be addressed.
3. A group should be formed to begin the development of an integrated assessment model for PBT. This group should meet during the intersessional period, perhaps immediately before (or after) another international meeting in which many of the interested parties normally participate (e.g. various meetings held by the IATTC).

MANAGEMENT IMPLICATIONS

There is some evidence, from the VPA and from the standardized CPUEs of the Japanese longline fisheries, that the spawning stock biomass of PBT has increased during the last decade. However, given the large amount of uncertainty in both the VPA and the standardized CPUEs, careful monitoring of the stock should be continued. It is especially important to continue the collection of catch, effort, and length-frequency data. The yield per recruit could be increased by decreasing the fishing mortality on young (ages 0-4) fish. Regardless of yield-per-recruit considerations, it appears that the recent pattern of fishing has been sustainable.

OTHER BUSINESS

The Working Group agreed that a first draft of this report would be prepared by the end of January, 2001. The final version of the report would then be prepared by 15 February 2001.

CLOSE OF THE MEETING

The meeting was adjourned on December 1, 2000, and the Chairman expressed his thanks to all of the participants for their collaboration. The Working Group also expressed their thanks to the NRIFSF for hosting the meeting.

Appendix 1: List of participants

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Appendix 2: Agenda

Opening of the Meeting
- Welcome
- Selection of chairperson and rapporteurs
- Adoption of agenda
- Tabling of documents

Review of Pacific Bluefin Tuna Fisheries
- Chinese Taipei
- Japan
- Republic of Korea
- United States
- IATTC
- Other countries

Review of Landings Data

Stock Structure and Biological Parameters
- Distribution and migration from statistics and tagging studies
- Oceanographic conditions affecting tuna distribution
- Natural mortality from tagging studies

Review of CPUE Trends
- Recruitment
- Spawning stock biomass

Stock Assessment
- VPA
- Yield-per-recruits analyses
- Other methods
- Summary of stock status

Recommendations
- Fishery statistics
- Directed studies
- Stock assessment

Other Business

Close of the Meeting

Appendix 3: Document List

ISC BFT-WG/00/DOCUMENT #

01, *Catch at Age of Pacific Bluefin Tuna in the EPO by Surface Gear*
(by Pat Tomlinson and Jenny Suter)

02, *Incidental Catch of Juvenile Northern Bluefin Tuna in Waters off Korea*
(by Jong-Bin Kim, Dae-Yeon Moon, and Kang-Suk Hwang)

03, *Japanese Bluefin Tuna Fisheries in the North Pacific*
(by Harumi Yamada and Mio Takahashi)

04, *Mexican eastern Pacific purse-seine fishery: bluefin tuna catch statistics*
(by Juan G. Vaca R. and Guillermo Compean J.)

05, *Preliminary estimation of natural mortality of juvenile Pacific Bluefin tuna Thunnus orientalis using tag-recapture data.*
(by Mio Takahashi)

06, *Preliminary stock assessment of Pacific bluefin tuna, using a tuning VPA*
(by Harumi Yamada, Yukio Takeuchi, Mio Takahashi and Hiroshi Shono)

07, *Relationships Between Recruit of Pacific Bluefin Tuna and Some Preliminary Physical Properties*
(by Kazuyuki Uehara, Mio Takahashi, Makoto Okazaki, Takahiko Kameda and Denzo Inagake)

08, *Standardization of Pacific Bluefin Tuna CPUE Caught by Japanese Distant-water and Offshore Longliners in the Spawning Ground*
(by Kotaro Yokawa)

09, *The Fishing of Bluefin-Tuna on landing at Aburatsu*
(by Tsugihiko Mizuno)

10, *The round trip migration of bluefin tuna cross the Pacific Ocean recorded by an archival tag*
(by Harumi Yamada, Mio Takahashi and Denzo Inagake)

11, *Decision Making for "Integrated" Assessment*
(by George Watters)

12, *U.S. commercial catches (metric tons) of bluefin tuna caught in the North Pacific Ocean*
(by Gary Sakagawa)

ISC BFT-WG/00/WORKING PAPER

01, *Comparison of abundance index of bluefin tuna ～for the input of VPA～*

(by Kotaro Yokawa)

02, *Yield per Recruitment and Spawner per Recruitment analysis for Pacific Bluefin*

(by Yuji Uozumi)

ISC BFT-WG/00/INFORMATION PAPER

01, *Incidental Catch of Juvenile Northern Bluefin Tuna in Waters off Korea*

Dae Yeon MOON, Chul in BAIK, Jong Hwa PARK, Seon Jae HWANG, Jong Bin KIM, and Hyun Su JO, PICES Sixth Annual Meeting abstract, p.56 (1997)

02, *New information on age composition and length-weight relationship of bluefin tuna,* Thunnus thynnus*, in the southwestern North Pacific*

Chien-Chung HSU, Hsi-Chiang LIU, Chi-Lun WU, Shih-Tsung HUANG and Hsueh-Keng LIAO, Fisheries Science vol.66(3), p485-493 (2000)

Table 1. Catch table by country and fishery

unit: metric tones

Year	Western Pacific states											Eastern Pacific states						Total
	Japan							Korea	Chinese Taipei			United States				Mexico		
	Purse Seine	Longline ※1	Troll	Pole and Line	Set Net	Drift Net	Others	※2	Longline	Purse Seine	Sub Total	Pole and Line	Purse Seine	Longline	Driftnet	Purse Seine	Sub Total	
1952	3,690	2,581	659	4,852	2,467	286	249				14,784						2,077	16,861
1953	4,189	1,998	2,175	3,049	2,205	9	49				13,674						4,468	18,142
1954	4,043	1,588	1,994	3,041	5,790	48	37				16,541						9,545	26,086
1955	10,561	2,099	2,026	2,839	3,484	15	62				21,086						6,240	27,326
1956	15,810	1,242	2,313	4,058	5,109	24	116				28,672						6,006	34,678
1957	15,971	1,490	1,720	1,795	4,246	14	21				25,258						9,267	34,525
1958	7,860	1,429	774	2,337	1,281	7	71				13,759						13,941	27,700
1959	9,108	3,667	589	586	1,645	1	19				15,615						6,925	22,540
1960	9,268	5,784	1,537	600	2,676	67	66				19,997						5,423	25,420
1961	8,120	6,175	2,485	662	3,631	19	60				21,152						8,135	29,287
1962	9,501	2,238	1,731	747	2,729	6	50				17,002						11,145	28,147
1963	8,677	2,104	3,067	1,256	4,240	18	112				19,473						12,272	31,745
1964	7,950	2,379	3,076	1,037	2,442	9	89				16,982						9,217	26,199
1965	10,173	2,062	1,803	831	2,477	52	160				17,558						6,888	24,446
1966	8,790	3,388	1,208	613	1,387	42	40				15,469						15,897	31,366
1967	5,750	2,099	2,796	1,210	2,993	39	195				15,082						5,888	20,970
1968	8,341	2,278	1,572	983	3,229	6	40				16,450						5,976	22,426
1969	2,876	1,366	1,978	721	2,253	32	23				9,248						6,926	16,174
1970	2,644	1,123	1,583	723	2,472	62	21				8,629						3,966	12,595
1971	3,559	757	2,600	938	1,534	35	7				9,428						8,360	17,788
1972	3,827	724	1,792	944	1,341	39	8				8,674						13,347	22,021
1973	2,001	1,158	3,089	526	2,823	309	50				9,956						10,744	20,700
1974	3,679	3,533	2,889	1,192	6,523	335	145				18,295						5,617	23,912
1975	4,308	1,558	1,908	1,401	2,408	676	69				12,328						9,583	21,911
1976	1,964	520	1,833	1,082	3,207	1,085	15				9,705						10,645	20,350
1977	3,960	712	3,070	2,256	2,419	884	28				13,330						5,473	18,803
1978	8,878	1,049	6,328	1,154	2,827	2,030	68				22,334						5,397	27,731
1979	12,266	1,223	5,158	1,250	5,021	1,541	75				26,534						6,117	32,651
1980	10,414	1,170	2,323	1,392	2,701	1,479	63				19,542					582	2,939	22,481
1981	22,091	796	2,456	754	2,130	2,130	15		179		30,551					238	1,089	31,640
1982	17,584	880	1,479	1,777	1,644	1,577	3	31	176		25,151					520	3,150	28,301
1983	13,272	707	2,606	356	962	807	30	13	157		18,911					214	853	19,764
1984	4,217	360	2,722	587	2,475	532	25	4	471		11,395					166	881	12,276
1985	3,820	496	2,904	1,817	2,678	728	37	1	210		12,691	3	3,320	0	6	676	4,005	16,696
1986	7,138	249	2,714	1,086	2,885	316	13	344	70		14,815	1	4,851	0	15	189	5,056	19,871
1987	7,962	346	1,352	1,565	2,085	258	3	89	365		14,026	0	862	0	2	119	983	15,009
1988	3,243	241	1,714	907	864	371	3	32	108	197	7,680	4	923	0	4	447	1,378	9,058
1989	5,422	440	1,593	754	823	173	4	71	205	259	9,744	8	1,046	0	3	57	1,114	10,858
1990	2,678	396	1,756	536	768	256	19	132	189	149	6,879	62	1,380	0	10	50	1,502	8,381
1991	8,522	285	3,015	286	1,734	236	26	265	342	-	14,711	0	410	0	4	9	423	15,134
1992	6,246	573	1,331	166	1,227	888	2	288	464	73	11,258	1	1,828	9	21	0	1,859	13,117
1993	5,753	857	895	68	899	159	3	40	471	1	9,146	5	580	45	56	0	686	9,832
1994	7,150	962	2,988	302	434	126	3	50	559	-	12,573	1	906	24	27	65	1,023	13,596
1995	16,668	585	3,506	427	1,281	110	12	821	335	-	23,745	1	619	27	19	11	677	24,422
1996	6,713	917	2,561	217	480	67	8	102	956	-	12,021	2	4,523	53	42	3,700	8,320	20,341
1997	11,585	1,009	1,611	77	311	109	10	1,054	1,814	-	17,580	2	2,240	52	57	327	2,678	20,258
1998	4,860	1,224	1,749	108	381	91	12	188	1,910	-	10,523	48	1,771	56	40	1	1,916	12,439
1999	14,238	1,401	1,601	124	377	59	213	256	2,089		20,358	3	186	39	21	2,327	2,576	22,934

※1: There are some inconsistencies among the different statistics.
※2: Minimum estimates based on Japanese Import statistics.
※3: Subtotal of Eastern Pacific states from 1952 to 1984 were cited from IATTC statistics.