ISC/04/Plenary/__6___

Report of the 3rd ISC Pacific Bluefin Tuna Working Group[1]

January 2004

[1]Working document submitted to the Fourth Meeting of the Interim Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC), 26 January - 4 February 2004, Honolulu, Hawaii, USA. Document not to be cited without author's permission.

Report of the 3rd ISC Pacific Bluefin Tuna Working Group

Plumeria Room, Ala Moana Hotel
Honolulu, USA
26-28 January 2004

1. Opening of the Meeting

The third meeting of the ISC Pacific Bluefin Tuna (PBF) Working Group was held in Honolulu, HI, USA during 26-28 January 2004. Dr. Z. Suzuki (Japan) chaired the meeting. Dr. N. Miyabe (Japan) and Dr. R. Conser (USA) served as rapporteurs. Twenty-three scientists participated, representing nine ISC member nations and contributors (Appendix 1). Thirteen working documents and one reference document were contributed to the meeting (Appendix 2). A draft agenda was distributed prior to the meeting. With minor modification, this agenda was adopted by the meeting participants (Appendix 3).

2. Fisheries and Statistics for Pacific Bluefin Tuna

Chinese Taipei (No document)

A description of Chinese Taipei's longline fishery for Pacific bluefin tuna was presented by Dr. S. C. Chou. Pacific bluefin tuna are caught by a traditional and seasonal small-scale longline fleet that primarily operated in the southwestern waters of North Pacific Ocean. The annual production was not significant before 1996, and varied from about 1,500 to 3,000 mt since 1997. Nearly all of the Pacific bluefin tuna were harvested from waters off Taiwan and landed mainly at the domestic fishing ports of Tungkang and Suao. Since 2001, about 10 to 20% of the Pacific bluefin tuna are exported to Japanese sashimi markets and the rest are locally consumed. The small-scale longline fleet landed 2,780 mt of bluefin tuna in 2000, 1,839 mt in 2001, 1,523 mt in 2002, and 1,753 mt in 2003..

The engine power of these longline vessels ranged from 125 to 850 HP, in which 500 HP were the most common, followed by 300 to 350 HP vessels, and finally, 600 to 650 HP vessels. Crew sizes ranged from 5 to 9 individuals, with 7 to 8 individuals being the most common crew size for fishing trips. The duration of each trip ranged from 1 to 19 days, with the majority of the trips spanning 4 to 9 days, and the average trip taking 7 days. The fishing season for this fleet is from April to July each year, when fish are typically aggregated for spawning in the southwestern waters of North Pacific Ocean. The majority of the bluefin tuna catch is typically composed of mature fish.

Japan (ISC/04/PBF-WG/03)

Japanese catch estimates in recent years for PBF were revised by using the information of the catch and size data of PBF accumulated by a large-scale research program (RJB) conducted by NRIFSF. Catch estimates for 1952-2002 were based on official statistics (Norin-tokei), research project (RJB), and other supplementary data. According to the estimates, annual total

catch of PBF have fluctuated between about 8,000 and 30,000 mt, ranging from 8,000 to 22,000 mt during the last decade. More than 70 percent of the annual catch is taken by purse-seine vessels in Pacific and Sea of Japan, and annual total catch by purse seine is 3,000-20,000 mt level with large fluctuation. The annual catches of longline, troll and set net have been around 1,000-1,500 mt, respectively, and the catches of the pole-and-line and drift-net fisheries have been relatively minor in recent years.

Korea (ISC/04/PBF-WG/01)

Dr. Jeong-rack Koh presented a summary of the Korean national fisheries and statistics for Pacific bluefin tuna (PBF). In Korean waters, PBF are incidentally caught mainly by Korean domestic purse seine fishery targeting mackerels and mainly consists of small size less than one meter of fork length

During the years 2002 and 2003, the PBF catch from 33 purse seiners and 4 trawlers amounted to 675 mt and 1,591 mt, respectively. The increased catch by 135.7% in 2003 was mainly due to the increase in purse seine catch. Monthly catch proportion shows that the highest catch was taken in July in the year 2002 but in April and October in the year 2003. Only minor catches were reported during winter months from November to January in both years.

Fishing area for PBF were mainly scattered in the southern waters of Korea near the Cheju Island and in the Yellow Sea occasionally. Monthly distribution of PBF catch demonstrates that major catch were taken during February-October. In the case of 2002, during February-July catches were made in the southern waters of Korea and during September and October in the Yellow Sea. In contrast, in the year 2003 most of the catches were recorded in the southern waters and some catch were also reported from coastal areas near Busan.

Mexico (No Document)

Relevant information on the bluefin tuna caught in Mexican waters for farming purposes is presented in the Mexican progress report to the 4th ISC meeting. This fishery operated mainly off the west coast of the Baja California peninsula. The yield in 2002 was 1,120 mt, of which 93% was transported to the farms.

USA (ISC/04/PBF-WG/02)

Pacific bluefin tuna (PBF) catch estimates from U.S. fisheries were summarized from various sources and made available to the Interim Scientific Committee for stock assessment research. Annual estimates were provided for the period 1918 to 2002 and quarterly for the period 1928 to 2002. Fishing gear identifiers were commercial and sport for 1918 to 1980. A finer division of commercial catch estimates by gear type (pole and line, purse seine, longline, gillnet, troll, and handline) was provided for 1981 to 2002. Since 1918, total PBF landings peaked at 15,920 metric tons (mt) in 1966 with the majority of the catch being made by purse seine vessels. Commercial fishing for PBF has been low in recent years, and only 63 mt were landed in 2002. Some of this catch was sold to PBF pen-rearing operations in Baja California, Mexico. Conversely, recreational fishing for PBF has increased over the past five years, and approximately 348 mt were reported caught in 2002. Port sampling for length composition has

conducted by the IATTC since 1987. Annual and quarterly length frequency summaries were provided to the PBF stock assessment authors for inclusion in the analyses.

3. Review of Research Progress

3.1 Biological Studies

3.1.1 Age and Growth

Examination and validation of age and growth (ISC/04/PBF-WG/08)

Dr. Chien-Chung Hsu reported an updated examination and validation of age and growth parameters of bluefin tuna from the North Pacific Ocean. During the fishing season from April and June each year, the spawning stock of Pacific bluefin tuna is caught by Taiwanese small-scaled longline fleets in the southeastern and eastern waters off Taiwan. None of the currently used growth curves were fitted using the extremely large fish taken the the Taiwan fishery. Hence, scales between the 2nd dorsal fin and lateral line of these large fish were collected for a new growth study. Totally, scales from 228 fish were investigated, and among those, 133 fish ranged from 204 to 255 cm were readable. Under the assumption that one ring formed in each year as reported previously, the corresponding age was from 8 to 13 year old. No significant linear relationship was found between fork length and scale radius. However, that the more rings appeared in scale the bigger was fish was confirmed. Eventually, the von Bertalanffy growth was derived from this result. This growth equation shows a discrepancy at 8 year-old and above from the curve estimated by Yukinawa and Yabuta (1967). Moreover, the relationship between fork length and eviscerated weight was estimated.

Discussion: This work is quite important since the age and growth work used for the assessment work is somewhat dated (1967). Additionally, the Taiwanese fishery has ready access to large fish that are not generally available in other fisheries. Estimation of growth rates by sex should also be carried out.

3.1.2 Reproductive Biology

Reproductive biology from the southwestern North Pacific (ISC/04/PBF-WG/07)

Dr. Hsu presented some aspects of reproductive biology of bluefin tuna in the southwestern waters of North Pacific. This investigation of reproductive biology of bluefin tuna has been pursued based on macroscopic and microscopic examination of ovaries and oocytes. Ovaries were collected from fish caught in the southeastern waters off Taiwan by longline vessels during May and June, 1999. Abundant bluefin tuna in the southeastern waters off Taiwan occurred during late April and middle June. The periods with high proportion of hydrated ovaries were consistent with the presence of spent ovaries, revealed that the spawning activity peaked at mid-May and early-June. The proportion of spent ovaries was not increased following the spawning season, suggested that spent bluefin tuna stayed on the spawning ground for a short time. Meanwhile sex ratio (172-252 cm) was not

deviated from 1:1, but all examined were male for fish greater than 252 cm. Weight of ovaries and gonadosomatic index (GSI) for all sampled fish were greater than 1.7 kg and 2.1, respectively. The largest pair of ovaries found was 19.4 kg and the GSI was 18.7. Mean diameter of the most advanced group of oocytes (MDMAGO) of the ovaries was 946 μm and the largest diameter of hydrated oocytes was 1.08 mm. Mean GSIs and MDMAGOs were about 5 and 540μm, respectively, during the sampling periods, and both peaked at mid-May, early June, and late June. MDMAGO was increased with the GSI. The size of spawning bluefin may differ depending on the spawning ground. Smaller fish may spawn at higher latitude. Fish caught in this spawning ground were mostly giant fish and few of medium fish. Lengths of 99 % fish were greater than 190 cm. The estimation of batch fecundity was based on 11 ovaries with hydrated oocytes. A linear relationship between batch fecundity and fork length. However, in the present analysis, the maturity oogive was not modeled because only large fish could be sampled from catches.

Discussion: The group strongly encouraged further development of this work with priority being given to the development of a maturity ogive. Sex ratio estimates by size should also be developed.

3.1.3 Migratory Behavior

Pop-up tag result and its evaluation of geolocation ability (ISC/04/PBF-WG/05)

Twelve adult fishes (160-230 kg in body weight) in the southern Ryukyu Islands during 2000 - 2003 and four fish (130-180 kg) in the northern Ryukyu Islands in 2002 were released after pop-up tag was attached. Four tags released in the southern area successfully popped up from the fish within 44 days at liberty. Some of them migrated southwards including one fish crossed the equator, others stayed near the release area. Two tags among those released in the northern area popped up in the south of mainland Japan showing the eastward movement while the third one moved westward and popped up in the East China Sea. This result suggests that the adult bluefin has different migration patterns depending on the fish size or spawning area.

The data from pop-up archival tag data and the ultrasonic tracking obtained from the same fish were analyzed to evaluate the pop-up tag geolocation ability. The nine geolocation data showed the biases of 1.10 ± 1.46 (mean ± SD) degree in longitude and 1.24 ± 3.85 degree in latitude from the positions determined by the GPS during the ultrasonic tracking. These geolocation biases were mainly caused by the deep descents of the fish that occurred at around sunset and sunrise (inability of finding precise times for sunset and sunrise).

Ongoing Research at NRIFSF (No Document)

Outline of the migration pattern of young PBF revealed by archival tagging experiment by NRIFSF was presented. So far about 340 fish were released around Japan with archival tags, about 90 fish were recovered, and five of them conducted the trans-Pacific migration. Though the season of the crossing migration varied, there are some similarities, such as age and duration of migration. Two distinct migration patterns, stationary pattern found in WPO and EPO, and trans-pacific movement pattern found in between them were recognized. These two behavioral patterns are well characterized by the indices of rapidness and directionality. And the migration route seemed to be influenced by the oceanographic

condition such as water temperature. In addition, preliminary biological analysis conducted by NRIFSF (Aging by otolith and vertebra, and otolith microelements analysis by PIXE (Particle Induced X-Ray Emission)) was introduced briefly.

3.1.4 Fish Behavior and Gear Performance

Relationship between longline gear depth and swimming depth of PBF (ISC/04/PBF-WG/06)

CPUE (catch/hooks) for the Japanese longline fisheries that target spawning aggregation of Pacific bluefin tuna around the Ryukyu Islands are used as a tuning index for VPA analysis. However, there are no evidence of the all hooks are available for the fishing of the bluefin tuna at the spawning ground. In the present study, they compared between setting depth data of the tuna longlines measured by the time-depth memory recorders and swimming depths collected from the ultrasonic tracking using to be attached transmitter to adult free-swimming bluefin tunas in the spawning ground of the southern Ryukyu Islands. The setting depths of hooks were covered between 0 m to 459.9 m in depth by the commercial tuna longline gear. The tuna swimming times of about 78% of the total swimming period were possible to be encountered to the hooks of the tuna longlines. All hooks of the Japanese commercial tuna longlines appear to be available for the fishing of the bluefin tuna at the spawning ground around the Ryukyu Islands.

Discussion: This type of study is critical for CPUE standardization methods that attempt to mechanistically model a fishing operation. The large variability in the depth actually fished by the deep hooks (e.g. hook 7) illustrates the need to deal with set by set data when carrying out such analyses.

3.2 Stock Assessment

3.2.1 Indices of Abundance

CPUE from the Japanese Troll fishery (ISC/04/PBF-WG/09)

In the last PBF-WG, they had presented the nominal CPUE derived from Japanese troll fishery data. There were several problems in using nominal CPUE as a tuning index in stock assessment model. This study involved some developments of standardization by using GLM, selecting the data related age 0 fish by using size category data as well as additional time series data of 2001 and 2002. Although standardized CPUE trend was not greatly different from nominal average, the age specific standardized CPUE in this study is more likely useful indictor of the recruitment.

Discussion: As the only available recruitment index for PBF, this standardized CPUE is quite important. However, its usefulness in modelling process (ADAPT or Multifan-CL) may be enhanced by fitting a continuous series (1980-2002) rather than breaking the series at 1993 for purposes of VPA tuning. In addition, since the observed CPUE reflects the weight of age 0 fish (rather than number), inclusion of a seasonal effect in the model may be warranted.

CPUE from the Japanese purse seine fishery (ISC/04/PBF-WG/10)

CPUE of Japanese purse seine fishery operating in northwestern Pacific Ocean is standardized by general linear model. Sharp increase around 1980 and steep decline thereafter may be due to a change of fishing ground from coastal waters of the main island of Japan to offshore waters that occurred at about that time.

Discussion: Standardization of purse seine CPUE is quite difficult in the absence of search time data for each set. While it is encouraging that search time data (last 10 years) may become available for this fishery within the next year or so, its interpretation may be difficult due to the fact that the fishery predominately targets skipjack rather than PBF.

CPUE from the Japanese longline fishery in the spawning ground (ISC/04/PBF-WG/11)

The CPUE series for this fishery (1952 to 2002) was standardized by GLM. Annual and quarterly indices of abundance are necessary as inputs for tuned VPA and Multifan-CL, and the analysis was done on a quarterly basis with different area stratification for each quarter. For VPA, standardized CPUE in quarter 2, which is the main fishing season, was used to index the annual abundance as was done in the previous study. The standardized values of CPUE were characterized by notable peak observed in the early 1960's. The levels of CPUEs in 1990's were higher than those in 1980's in quarter 2-4. Compare to previous study, the level of the peak is different, though the trends are similar. This difference comes from the different area definition between the two analyses. Length frequency data indicates the occurrence of the strong cohorts in the 1960's, and CPUE in this period reflected the trend of the high abundance of these cohorts.

Discussion: Standardized CPUE from the Japanese longline fishery is a critical element in the stock assessment of other Pacific tunas (e.g. yellowfin and bigeye). However, the PBF index is less influential because index trend is difficult to reconcile with the catch-at-age. Artifacts may have been introduced by splitting the index somewhat arbitrarily at 1975. In future work, it may be better to work with an unbroken series 1952-2000.

3.2.2 Catch-at-Age

Estimation of catch-at-age by fishery in the North Pacific (ISC/04/PBF-WG/4)

The process of catch-at-age estimation was explained in detail, including a clear explanation of all the substitutions. Catch and length frequency data were aggregated by fishery and fishing year (from 3rd quarter to next 2nd quarter) in order to correspond to the year class, and decomposed to each age by a slicing method, based on the growth curve by Yukinawa and Yabuta (1967). The coverage of size frequency data in recent years is getting better by RJB and port sampling by NRIFSF and Taiwan.

Discussion: Catch-at-age estimation from the catch-at-size data may be improved by considering the seasonality of growth with the fishing year. More specifically, cohort slicing could be carried out using a monthly time step (rather than annual) and incorporating monthly mean size-at-age from the Von B growth curve. A monthly time step is commonly used for developing catch-at-age in other fora, such as the ICCAT working groups.

3.2.3 Modelling

Results of tuned VPA (ISC/04/PBF-WG/12)

The analysis was conducted using the ADAPT model, and the four CPUE indices, i.e. standardized CPUE from Japanese troll fishery for age 0, habitat index of purse seine fishery in IATTC for ages 1 and 2, standardized CPUE of Japanese purse seine for ages 2 to 7 and standardized CPUE of Japanese longline for more than age 5, were used to tune the estimates of terminal F (fishing mortality) for ages 0, 1, 2, 6 and 9. The VPA was conducted with data from the period 1952-2002. 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 results of the VPA were also used to calculate the yield-per-recruit.

The stock biomass of PBF has recovered from the lowest level of the late 1980's. Higher recruits often occurred in 1990's, which contributed to the increase. Recruits showed large yearly fluctuation, without clear relation to the SSB. Current level of F is greater than F_{max}.

Discussion: There are problems with model residuals – particularly for the Japanese longline index – indicating an inconsistency in the index and the catch-at-age. The model cannot generate a stock trajectory that matches the trend in the longline CPUE. This may have resulted in unrealistically large F's on older fish in the terminal year (2002). Additional work on both the catch-at-age and the development of more reliable indices of abundance are necessary to improve model performance.

Results of Multifan-CL application (ISC/04/PBF-WG/13)

Multifan-CL (MFCL) is applied to Pacific bluefin tuna. Although MFCL is capable to have spatial structure, current application is limited to no spatial structured model. The results are depending on the extent of weighting of size data. Biomass trends in earlier years also depend on model assumption of initial age structure. Selectivity pattern of surface fishery is very sensitive to the extent of weighting of size data. However total and spawning biomass trends in recent 20 years are fairly robust among assumptions tested. Magnitude of fishing mortality on adult is also fairly robust.

Discussion: Although the MFCL biomass trends are generally similar to those from the ADAPT model, there are some combinations of the various size weighting sensitivity runs that do show a different long term trend. This exploratory application of MFCL is encouraging and further work along these lines should be continued.

3.2.4 Summary of status of the stock

The PBF stock assessment results involve high uncertainty and many of the caveats discussed in previous sections of this report must be kept in mind when drawing conclusions on the status of the stock. As such, it is only possible to discuss general trends and broad conclusions with any reasonable degree of certainty.

The PBF fishery has been sustained for over 50 years while taking annual catches similar to those taken in recent years PBF biomass and spawning stock biomass (SSB)

have fluctuated widely over the fifty-year history examined in the stock assessment (1952-2002). These fluctuations have been driven mainly by recruitment changes (without trend) over this period. Biomass appears to have recovered from a record low level in the late 1980's to a more intermediate level in recent years, largely due to better than average recruitment during the 1990's (particularly the strong 1994 year-class). Despite good recruitment, however, the SSB has generally declined since 1995 and if the estimated recent fishing mortality rates (F) continue, SSB would likely continue to decline at least over the 2003-2005 period. Recent F is greater than F_{max}, which has economic implications (too much fishing effort for the yield returned) and is also generally taken as an indicator of biological concern. In particular, the high F on young fish (ages 0-2) and older fish (ages 6+) may be cause for concern with respect to maintaining a sustainable fishery in future years. It is recommended that there be no further increases in F for any of the fisheries taking PBF. Further, every effort should be made to reduce the uncertainty associated with the assessment results by undertaking improvements in the data collection, data analyses, and assessment models used in the PBF stock assessment process.

4. Research Recommendations

Recommendations made by the Working Group are presented under three broad headings: Fisheries Statistics, Biological Studies, and Stock Assessment.

4.1 Fisheries Statistics

As stated above, it is imperative that each nation strive to provide updated, accurate time series of annual catch estimates (Table 1) in accordance with agreed policies. However, in general, Pacific bluefin tuna fisheries' statistics are not completely satisfactory and therefore, should be improved in accordance with issues discussed during the Statistics Working Group. Readers should consult that Group's meeting Report for specific recommendations concerning bluefin tuna, as well as broader comments applicable to all monitored species that are currently harvested in the North Pacific Ocean.

Incorporation of additional size samples and better effort standardization for the EPO fisheries is needed to better characterize the population dynamics of PBF throughout their range.

4.2 Biological Studies

The Working Group recommended that the following study areas receive further attention, in efforts to provide additional insight into bluefin tuna biology and ecology, which ultimately, will assist stock assessments conducted in the future:

1. There is a need for scientific experiments concerning tag-recovery reporting rates, tag-shedding rates by juvenile fish, and emigration rates of tagged juvenile fish to ensure estimates of mortality (both natural and fishing) are accurately determined. Work is underway on this topic and should be completed as early as possible.

2. The Working Group also strongly recommended that archival-type tagging be continued in order to obtain objective information on migratory behavior of bluefin

tuna, which will help corroborate or refute stock structure assumptions commonly employed in assessment models. Such tagging is underway in both the EPO and WPO. Progress should be monitored to ensure that the results are useful for stock assessment purposes.

3. Although age determination of this species, as well as tuna species in general, continues to be problematic, the Working Group recommended that age and growth research be continued. Possible differences in growth rates by sex needs to be explored. In this context, the Group noted the need to develop sound experimental designs for obtaining needed data (hard parts and/or size data).

4. Further work on a contemporary PBF maturity ogive is needed. It will be particularly important to include the Taiwanese sampling and reproductive work on large PBF taken on the spawning grounds. Sex ratio estimates by size should also be updated.

5. Conventional tagging in both the WPO and the EPO should be intensified, and should include experiments that will enable the estimation of reporting rates from the various fisheries. Successful completion of a well planned tagging experiment is particularly important for developing credible spatially explicit models, but will also pay dividends in current models, e.g. better estimates of stock size and fishing mortality rates.

4.3 Stock Assessment

The Working Group noted that a substantial amount of work needs to be conducted in 2004-05 in support of stock assessment of Pacific bluefin tuna, including:

1. Follow-up work regarding critical examination of catch-effort data and subsequently, standardization methods for applicable CPUE indices. If possible and when appropriate, such methods should include habitat preference of Pacific bluefin tuna, oceanographic effects, targeting strategy of fishermen, and time-space interactions, especially incorporation of accumulated data from archival tag study. Researchers should begin investigations of all fisheries that have available catch-effort statistics and consider age-specific, along with age-aggregated, abundance indices for fisheries with applicable data. This will require both biological (size- and age-composition data) and logbook (CPUE data) information in an effort to evaluate age-class trends over time.

2. Continue work using ADAPT; however, given the maturity of this approach, the greatest payoff will come from improvements in the catch-at-age (e.g. using a monthly time step) and the standardized indices of abundance (e.g. using set by set data).

3. Continue the exploration of the MFCL and/or other fully integrated model for PBF. The work to date is encouraging but should benefit from a more collaborative effort among all members and contributors to the ISC.

4. Explore the utility of using purse seine CPUE as a recruitment index and better standardization of fishing effort for the EPO fisheries.

5. To successfully carry out many of the above stock assessment recommendations, it may be necessary to hold an intersessional meeting (see below).

5. Future Arrangements

The next meeting of the Pacific Bluefin Working Group (PBF WG) should be held in conjunction with 5th ISC Plenary meeting (date to be determined, but perhaps as early as 2005). In addition and prior to the next meeting of the PBF WG, an intersessional meeting should be scheduled to address key elements of the stock assessment that required more time and resources than those that can be brought to bear during the typical 2-day meetings of the full PBF WG. More specifically, an intersession meeting of approximately one-week duration could better address issues such as (1) improvements in the Pacific-wide catch-at-age matrix; (2) development of standardization methods for PBF indices of abundance and/or fishing effort; (3) refinements of the ADAPT-based assessment; (4) further exploration of the utility of MFCL or other more fully integrated methods for PBF stock assessment, etc. As has been the standing practice with the North Pacific Albacore Workshop, intersessional meetings with substantial time for reviewing work and carrying analyses should become part of the PBF assessment process as well.

In order to facilitate planning and full participation, it is critical that the venue and timing for the PBF intersessional meeting be decided during the 4th ISC Plenary meeting (2-4 February 2004).

6. Adoption of Report

A draft report was presented and discussed on 28 January 2004. After modification, the report was cleared by all working group participants for presentation to the ISC Plenary during 2-4 February 2004.

7. Closing of the Meeting

The chair thanked all participants and the rapporteurs for their contributions in making this a successful meeting, and closed the meeting at 17:00 on 28 January 2004.

Table 1. Catch table by country and fishery. Unit: Metric tons

Year	Western Pacific states											Eastern Pacific states									Total
	Japan							Korea *1		Taiwan		Sub Total	United States *2							Mexico	Sub Total	
	Purse Seine	Longline	Troll	Pole and Line	Set Net	Drift Net	Others	Purse seine	Trawl	Longline	Purse Seine		Pole and Line	Purse Seine	Longline	Troll	Gillnet	Other	Sport	Purse Seine		
1952	3,690	2,581	659	4,852	2,467	286	249					14,784		2,076					2		2,078	16,862
1953	4,189	1,998	2,175	3,049	2,205	9	49					13,674		4,433					48		4,481	18,155
1954	4,043	1,588	1,994	3,041	5,790	48	37					16,541		9,537					11		9,548	26,089
1955	10,561	2,099	2,026	2,839	3,484	15	62					21,086		6,173					93		6,266	27,352
1956	15,810	1,242	2,313	4,058	5,109	24	116					28,672		5,727					388		6,115	34,787
1957	15,971	1,490	1,720	1,795	4,246	14	21					25,258		9,215					73		9,288	34,546
1958	7,860	1,429	774	2,337	1,281	7	71					13,759		13,934					10		13,944	27,703
1959	9,108	3,667	589	586	1,645	1	19					15,615		6,914					15	171	7,100	22,715
1960	9,268	5,784	1,537	600	2,676	67	66					19,997		5,422					1		5,423	25,420
1961	8,120	6,175	2,485	662	3,631	19	60					21,152		8,136					26	130	8,292	29,444
1962	9,501	2,238	1,731	747	2,729	6	50					17,002		11,268					28	294	11,590	28,592
1963	8,677	2,104	3,067	1,256	4,240	18	112					19,473		12,271					8	412	12,691	32,164
1964	7,950	2,379	3,076	1,037	2,442	9	89					16,982		9,218					8	131	9,357	26,339
1965	10,173	2,062	1,803	831	2,477	52	160					17,558		6,887					1	289	7,177	24,735
1966	8,790	3,388	1,208	613	1,387	42	40					15,469		15,897					23	435	16,355	31,824
1967	5,750	2,099	2,796	1,210	2,993	39	195					15,082		5,889					36	371	6,296	21,378
1968	8,341	2,278	1,572	983	3,229	6	40					16,450		5,976					1	195	6,172	22,622
1969	2,876	1,366	1,978	721	2,253	32	23					9,248		6,926					17	260	7,203	16,451
1970	2,644	1,123	1,583	723	2,472	62	21					8,629		3,966					21	92	4,079	12,707
1971	3,559	757	2,600	938	1,534	35	7					9,428		8,360					8	555	8,923	18,352
1972	3,827	724	1,792	944	1,341	39	8					8,674		13,348					17	1,646	15,011	23,685
1973	2,001	1,158	3,089	526	2,823	309	50					9,956		10,746					61	1,084	11,891	21,847
1974	3,679	3,533	2,889	1,192	6,523	335	145					18,295		5,617					65	344	6,026	24,321
1975	4,308	1,558	1,908	1,401	2,408	676	69					12,328		9,583					38	2,145	11,766	24,094
1976	1,964	520	1,833	1,082	3,207	1,085	15					9,705		10,646					23	1,968	12,637	22,342
1977	3,960	712	3,070	2,256	2,419	884	28					13,330		5,473					21	2,186	7,680	21,010
1978	8,878	1,049	6,328	1,154	2,827	2,030	68					22,334		5,396					5	545	5,946	28,280
1979	12,266	1,223	5,158	1,250	5,021	1,541	75					26,534		6,118					12	213	6,343	32,877
1980	10,414	1,170	2,323	1,392	2,701	1,479	63					19,542		2,938					8	582	3,528	23,069
1981	23,219	796	2,456	754	2,130	2,130	15			179		31,679	0	868	0	10	4	1	6	218	1,107	32,786
1982	17,584	880	1,479	1,777	1,644	1,577	3	31		176		25,151	0	2,566	0	0	1	1	7	502	3,077	28,228
1983	13,272	707	2,606	356	962	807	30	13		157		18,911	6	754	0	0	3	0	21	218	1,002	19,913
1984	4,217	360	2,722	587	2,475	532	25	4		471		11,395	4	674	0	0	5	1	31	166	881	12,276
1985	3,820	496	2,904	1,817	2,678	728	37	1		210		12,691	3	3,320	0	0	6	1	55	676	4,061	16,752
1986	7,138	249	2,714	1,086	2,885	316	13	344		70		14,815	1	4,851	0	0	15	0	7	189	5,063	19,878
1987	7,962	346	1,352	1,565	2,085	258	3	89		365		14,026	0	861	0	0	2	0	21	119	1,003	15,028
1988	3,243	241	1,714	907	864	371	3	32		108	197	7,680	5	923	0	0	4	0	4	447	1,383	9,063
1989	5,423	440	1,593	754	823	173	4	71		205	259	9,745	8	1,046	0	0	3	0	70	57	1,184	10,929
1990	2,678	396	1,756	536	768	256	19	132		189	149	6,879	62	1,380	0	0	9	94	40	50	1,635	8,514
1991	8,410	285	3,015	286	1,734	236	26	265		342		14,599	0	410	2	0	3	5	57	9	486	15,085
1992	6,313	573	1,331	166	1,227	888	2	288		464	73	11,325	1	1,928	38	0	8	81	93		2,149	13,474
1993	5,678	857	895	231	978	159	3	40		471	1	9,313	4	580	42	0	32	25	114		797	10,110
1994	6,917	1,138	2,883	314	1,149	126	3	50		559		13,139	1	906	30	0	28	101	24	65	1,155	14,294
1995	15,975	769	3,417	396	1,835	110	12	821		335		23,670	0	689	29	0	19	0	166	11	914	24,584
1996	6,675	978	2,331	437	1,106	67	8	102		956		12,661	0	4,639	25	2	43	0	30	3,700	8,439	21,099
1997	11,122	1,383	1,476	243	756	109	9	1,054		1,814		17,965	1	2,240	26	1	57	0	90	367	2,782	20,747
1998	4,375	1,260	1,640	269	821	91	8	188		1,910		10,562	3	1,771	54	172	40	1	213	1	2,255	12,817
1999	13,439	1,155	1,548	256	1,082	59	355	256		3,089		21,239	2	184	54	20	19	2	397	2,369	3,047	24,286
2000	14,020	1,005	1,944	398	1,229	51	314	794	0	2,780		22,536	12	692	19	1	30	0	220	3,026	4,000	26,536
2001	6,728	1,004	1,551	666	1,371	100	37	995	10	1,839		14,301	1	149	6	7	34	0	226	863	1,286	15,587
2002	8,007	615	982 *3	517	887 *3	212	83	674	1	1,523		11,602	2	50	2	2	7	0	348	1,120 *3	1,531	13,133
2003								1591 *3	0 *3													

*1: Catch statistics of Korea were derived from Japanese Import Statistics from 1982-1999 (minimum estimates).

*2: Catch statistics of United States were categorized into commercial fishing and sports fishing for 1952-1980.

*3: Preliminary estimates.

Appendix 1

ISC4 PACIFIC BLUEFIN TUNA WORKING GROUP PARTICIPANT LIST

January 26-28, 2004

Tony Beeching
WPRFMC
1164 Bishop St., #1400
Honolulu, HI
808-522-8224
808-522-8226 (fax)
Tony.Beeching@noaa.gov

Keith Bigelow
NOAA/NMFS PIFSC
2570 Dole Street
Honolulu, HI 96822
808-983-5388
808-983-2902 (fax)
Keith.Bigelow@noaa.gov

Shih-Chin Chou
Overseas Fisheries Development Council of the Republic of China
19, Lane 113, Roosevelt Rd., Sec. 4
Taipei, Taiwan, ROC
886-2-33436139
886-2-33436268 (fax)
cshihchin@msl.ta.gov.tw

Atilio Coan
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
858-546-7177
858-546-7003 (fax)
Al.Coan@noaa.gov

Ray Conser
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
858-546-5688
858-546-7003 (fax)
Ray.Conser@noaa.gov

Luis Fleischer
CRIP-LA PAZ
Instituto Nacional de la Pesca Mexico
Km 1. Carretera A. Pichnilingue
La Paz, B.C.S. CP. 23000
Mexico
52-612-12-21367 (ext. 107)
52-612-12-51623 (fax)
lfleischer21@yahoo.com

Kevin Hill
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
858-546-7052
858-546-7003 (fax)
Kevin.Hill@noaa.gov

Michael G. Hinton
Inter-American Tropical Tuna Commission
8604 La Jolla Shores Drive
La Jolla, CA 92307-1508
858-546-7033
858-546-7133 (fax)
mhinton@iattc.org

Chien-Chung Hsu
Institute of Oceanography
National Taiwan University
1, Sect. 4, Roosevelt Rd.
Taipei, Taiwan, 106
886-2-23622987
886-2-23661198
hsucc@ccms.ntu.edu.tw

Jeong-rack Koh
National Fisheries Research & Development Institute
Sirang-ri, Gijang-Gun, Busan, Korea
82-51-720-2325
82-51-720-2337 (fax)
jrkoh@nfrdi.re.kr

Suzy Kohin
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
858-546-7104
858-546-7003 (fax)
Suzanne.Kohin@noaa.gov

Naozumi Miyabe
National Research Institute of Far Seas Fisheries
5-7-1 Shimizu-orido
Shizuoka, Japan, 424-8633
81-543-36-6000
81-543-35-9642 (fax)
miyabe@fra.affrc.go.jp

M.P. Miyake
Japan Tuna
3-3-4, Shimorenjaku
Mitaka-Shi, Tokyo, Japan
81-422-46-3917
81-422-43-7089
miyake@sistelcom.com

Kevin Piner
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
Kevin.Piner@noaa.gov

Hirokazu Saito
National Research Institute of Far Seas Fisheries
5-7-1 Shimizu-orido
Shizuoka, Japan, 424-8633
81-543-36-6035
81-543-35-9642 (fax)
hisaito@fra.affrc.go.jp

Gary Sakagawa
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
858-546-7177
858-546-7003 (fax)
Gary.Sakagawa@noaa.gov

Max Stocker
Department of Fisheries and Oceans
Science Branch
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, B.C.
Canada V9T6N7
250-756-7200
250-756-7053
stockerm@pac.dfo-mpo.gc.ca

Ziro Suzuki
National Research Institute of Far Seas Fisheries
5-7-1 Shimizu-orido
Shizuoka, Japan, 424-8633
81-543-36-6000
81-543-35-9642 (fax)
zsuzuki@fra.affrc.go.jp

Mio Takahashi
National Research Institute of Far Seas Fisheries
5-7-1 Shimizu-orido
Shizuoka, Japan, 424-8633
81-543-36-6000
81-543-35-9642 (fax)
m.takahashi@fra.affrc.go.jp

Yukio Takeuchi
National Research Institute of Far Seas Fisheries
5-7-1 Shimizu-orido
Shizuoka, Japan, 424-8633
81-543-36-6000
81-543-35-9642 (fax)
yukiot@fra.affrc.go.jp

Pedro Ulloa
Instituto Nacional de la Pesca Mexico
Calle Tortuga #1, La Cruz Huanacaxtle
Nayarit, C.P. 63732
Mexico
52-322-29-72140
52-329-29-55630 (fax)
ulloapedro@hotmail.com;
cripbadeba@prodigy.net.mx

Yuji Uozumi
National Research Institute of Far Seas Fisheries
5-7-1 Shimizu-orido
Shizuoka, Japan, 424-8633
81-543-36-6000
81-543-35-9642 (fax)
uozumi@fra.affrc.go.jp

Harumi Yamada
National Research Institute of Far Seas Fisheries
5-7-1 Shimizu-orido
Shizuoka, Japan, 424-8633

81-543-36-6000 hyamada@fra.affrc.go.jp
81-543-35-9642 (fax)

Appendix 2

Document List: *PACIFIC BLUEFIN TUNA*

ISC BFT-WG/04/DOCUMENT #

1. *Fisheries of Bluefin Tuna in the Waters off Korea*
   J. Koh and D. Moon
2. *Documentation of Procedures Used to Develop United States Catch Time Series for Pacific Bluefin Tuna in the North Pacific Ocean*
   K. Hill and A. Coan, Jr.
3. *Reviews of Japanese Fisheries and Catch Estimation on the Pacific Bluefin Tuna*
   M. Takahashi and H. Yamada
4. *Estimation of Pacific Bluefin Tuna Catch-At-Age by Fishery in the North Pacific*
   M. Takahashi and H. Yamada
5. *Pop-Up Tagging Experiment in the Spawning Ground with Evaluation of Estimated Geolocation by Tag*
   H. Yamada, K. Yano, M. Takahashi and T. Kosuge
6. *Preliminary Results of Relationship Between Setting Depth of Tuna Longline and Swimming Depth of Pacific Bluefin Tuna at the Spawning Grounds*
   K. Yano, H. Yamada and T. Kosuge
7. *Some Aspects of Reproductive Biology of Bluefin Tuna, Thunnus thynnus, from the Southwestern North Pacific*
   K. Chen and C. Hsu
8. *Newly Updated Examination and Validation of Age and Growth Parameters Estimation of Bluefin Tuna (Thunnus thynnus) from the North Pacific Ocean*
   C. Wu, K. Chen and C. Hsu
9. *Standardization of CPUE of Age-0 Pacific Bluefin Tuna by Japanese Troll Fishery*
   H. Yamada and N. Takagi
10. *A Standardization of a Bluefin CPUE by Japanese Purse Seine Fishery in Pacific Side of Japanese Coastal Water*
    Y. Takeuchi and H. Yamada
11. *Standardization of Pacific Bluefin Tuna CPUE Caught by Japanese Distant-Water and Offshore Longliners in the Spawning Ground from 1952 to 2002*
    M. Takahashi and Y. Takeuchi
12. *Updated Stock Assessment of Pacific Bluefin Tuna, Using a Tuned VPA*
    H. Yamada, Y. Takeuchi and M. Takahashi
13. *An Application of Multifan-CL to Pacific Bluefin Tuna*
    Y. Takeuchi and M. Takahashi

ISC BFT-WG/04/INFORMATION PAPER #

1. *Report of the Second Meeting of the Pacific Bluefin Working Group Interim Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean*

Appendix 3
Fourth Meeting of the Interim Scientific Committee
For Tuna and Tuna-like Species in the North Pacific Ocean (ISC)

Third Meeting of the Pacific Bluefin Tuna Working Group

26–28 January 2004

Plumeria Room (8:30 am), Ala Moana Hotel, Honolulu, Hawaii

Agenda – Chair Harumi Yamada

1. Opening
   Welcoming Remarks
   Selection of Chairperson and Rapporteurs
   Adoption of Agenda
   Tabling of Documents

2. Fisheries and Statistics for Pacific Bluefin Tuna
   Fisheries Report by Countries
   Compilation of Statistics

3. Review of Research Progress
   3.1 Biological Studies
      3.1.1 Age and growth
      3.1.2 Reproductive Biology
      3.1.3 Migratory behavior

   3.2 Stock Assessment
      3.2.1 CPUE indices
      3.2.2 Catch-at-age
      3.2.3 Modelling
      3.2.4 Summary of Status of the Stock

4. Research Recommendations
   4.1 Fishery Statistics
   4.2 Biological Studies
   4.3 Stock Assessment

5. Future Arrangements

6. Adoption of Report

7. Closing of the Meeting