THIRD REGULAR SESSION
Apia, Samoa
11-15 December 2006

PROPOSAL IN RESPECT OF PARAGRAPH 11 OF CONSERVATION AND MANAGEMENT MEASURE 2005-01

WCPFC3-2006/16 Rev. 1
15th November 2006

Paper prepared by the Secretariat

Reissued to correct the information presented in paragraph 39.

Summary: This paper has been prepared in response to paragraph 11 of Conservation and Management Measure 2005-01 adopted at the last Session of the Commission. It is designed to support discussion on temporary purse seine closures in the Convention Area at the Third Regular Session of the Western and Central Pacific Commission. The scientific advice on which the paper is based is drawn principally from the Commission's Scientific Committee and its Scientific Services Provider but experience in other regional fisheries management organisations is also drawn upon.

Options for reducing mortality on bigeye and yellowfin tuna in the WCPO include closure of the most significant purse seine fishing grounds in the Convention Area to purse seine fishing (as applies in the EPO) including limited spatial (such as the high seas and/or areas under national jurisdiction) or temporal closures (quarterly), closure on purse seine set types (FAD and floating object sets) to effort and catch reductions in other fisheries responsible for significant bigeye and yellowfin mortality (the longline fishery). They may be implemented immediately or they may be phased in over time.

Four scenarios for contributing to a reduction in fishing mortality for bigeye tuna and yellowfin tuna are considered[1].

Scenario 1: A 12-month closure of high seas enclaves to all purse seine fishing (and no effort transfer to waters under national jurisdiction).

Scenario 2: Closure on FAD and floating objects sets on the high seas and in waters under national jurisdiction (except archipelagic waters) in the last two quarters of the year.

Scenario 3: Closure on FAD and floating objects sets in the third quarter of the year and total purse seine effort closure on high seas in the last quarter of the year.

[1] These scenarios are indicative only and other permutations and combinations of options for adjusting fishing mortality can be modeled at relatively short notice.

Scenario 4: High seas purse seine closure, closure on FAD and floating objects sets in waters under national jurisdiction (except archipelagic waters) in the last quarter of the year, and a quota on bigeye longline catch on the high seas**.**

The paper presents an assessment, on the basis of the best available scientific information, of the implications for the implementation of each of these scenarios.

In isolation, only a large scale purse seine closure is capable of meeting the recommended level of effort reduction required to achieve the target level of fishing mortality for bigeye tuna recommended by the Scientific Committee. While many of the scenarios meet the F_{MSY} management objective for yellowfin tuna, the only scenario that meets the same objective for bigeye requires an additional measure to reduce bigeye longline catch. The scope of potential management options increases considerably if reductions in bigeye longline effort and catch are also considered.

A draft proposal, in the form of a template for a Conservation and Management Measure supporting closures, is appended to the paper for the consideration of the Commission.

Introduction

1. The Second Regular Session of the Commission (WCPFC2), at Pohnpei, Federated States of Micronesia, 12-16 December 2005 adopted Conservation and Management Measure 2005-01, Conservation and Management Measures for Bigeye and Yellowfin Tuna in the Western and Central Pacific Ocean (CMM 2005-01). Paragraph 11 of CMM 2005-01 states:

> "In order to achieve the overall reduction in catch and effort required for bigeye and yellowfin tuna, in accordance with advice and recommendations received from the Scientific Committee, the Executive Director shall work with CCMs during 2006 to develop a proposal for consideration at the Third Session of the Commission that is consistent with the IATTC arrangements that allow for a system of temporary purse seine closures".

2. This paper has been prepared in response to the directive that the Executive Director work with CCMs during 2006 to develop a proposal that allows for a system of temporary purse seine closures.

3. The paper commences with a review of advice from the Scientific Committee in respect of the reduction in catch and effort required for yellowfin and bigeye tuna. It then reviews each element of paragraph 11 of CMM 2005-01. On the basis of discussion during the Second Regular Session of the Scientific Committee, 7-18 August 2006 at Manila, Philippines (SC2), and contributions and suggestions received in respect of temporary purse seine closures since the Manila meeting, a summary of supplementary analysis undertaken by the Commission's Scientific Services Provider in relation to closures is presented[2]. The paper concludes with a presentation of several scenarios for temporary purse seine closures,

[2] The original analysis on which these summaries are based are appended to this paper.

including a draft proposal, for consideration by the third session of the Commission (WCPFC3)[3].

First Regular Session of the Scientific Committee

4. In responding to the Resolution on Conservation and Management Measures adopted at the Inaugural Session of the Commission in 2004, which requested advice on sustainable catch and effort levels, the First Regular Session of the Scientific Committee (SC1), in August 2005, SC1 did not specify the level of reduction in fishing mortality required to meet the MSY-based reference point for bigeye and yellowfin tuna. However, relative to the average level of fishing effort for 2001-2003, a reduction of 19% would have been required to achieve the F_{MSY} fishing mortality-based reference point for both species. If recent levels of recruitment were to continue for bigeye, a smaller reduction in effort, approximately 5% of the 2001-2003 level, would be required to meet the MSY-based reference point for this stock.

5. The SC1 considered model scenarios to investigate the effects of time/area closures by fishing method for bigeye and yellowfin including controls on sets on floating objects in the purse seine fishery (Scenarios 9 and 10, Table 1 of the SC1 Report). The main conclusions of the projections were:

> *For bigeye tuna (paragraph 5.9 of the SC1 Report):* Of the scenarios simulating some form of quarterly closure of purse seining in the western equatorial Pacific, scenario 9 (quarterly closure of log/FAD purse seine fishing in the Western Tropical Pacific (WTP) – effort transfer to school sets in WTP) and was more effective that scenario 9A (quarterly closure of purse seine fishing in the WTP and effort transfer to ETP in each set type). In fact, scenario 9A resulted in 2014 biomass levels both less than the MSY levels and less than those obtained under the status quo (scenario 2). For the same set of measures in the eastern equatorial Pacific regions (scenarios 10 and 10A), there was little difference between set types versus regional redistribution of effort;
>
> and
>
> *For yellowfin tuna:* Management measures simulating quarterly closures with various transfers of fishing effort (scenarios 9, 9A, 10, 10A, 11 and 12) were not found to improve biomass over the *status quo* outcome (scenario 2).

Conservation and Management Measure 2005-01

5. The introductory sentence to paragraph 11 of CMM 2005-01 implies that CMM 2005-01 was formulated with the intent reducing catch and effort for bigeye and yellowfin tuna. However, the measures introduced under CMM 2005-01 are unlikely to result in any reduction in fishing mortality rates for bigeye and yellowfin tuna, particularly to below the 2001-03 baseline level. Rather, the measures have effectively limited nominal fishing effort and catch (for bigeye) to the highest levels recorded.

6. Effort levels in the purse seine fishery in 2004 were greater than the average for the period 2001-2003. By adopting 2004 as the base year for effort in the purse seine fishery, or

[3] The scenarios presented are by no means definitive. There are a large number of possibilities for reducing effort in the purse seine fishery through a system of temporary purse seine closures that could include set types, temporal and spatial closures.

the average for the period 2001 to 2004, CMM 2005-01 provides for approximately a 15% increase in purse seine effort relative to the 2001-2003 average.

7. By adopting the annual average longline catch of bigeye for the years 2001-2004 (or 2004 in the case of China and the USA), CMM 2005-01 provides for a 15% increase in longline bigeye catch over the average for 2001-2003. If those CCMs covered by the 2,000mt limit (as provided for in CMM 2005-01, para. 18), increased their catches to this limit, it could result in up to a 46% increase in longline bigeye catch.

8. Paragraph 6 of CMM 2005-01 effectively provides a waiver for small island State members and participating territories seeking to develop their own domestic fisheries. The eight Members, Cooperating Non-members and Participating Territories (CCMs) that are parties to the Palau Arrangement, have committed to manage purse seine effort within waters under national jurisdiction by a Vessel Day Scheme that will be fully implemented by December 1, 2007. Apart from a total catch limit for bigeye in the Convention Area (CMM 2005-01 para. 17 and 18) there is currently no mechanism to control catch or effort for purse seine fishing or longlining on the high seas.

9. However, paragraph 11 proposes that the Executive Director and CCMs work together during 2006 to develop a proposal for temporary purse seine closures with the purpose of achieving a reduction in bigeye and yellowfin mortality. In addition to working together through the subsidiary bodies of the Commission, particularly the Scientific Committee, the Executive Director formally wrote to CCMs in August 2006 inviting contributions and suggestions for developing the proposal.

10. Based on the direction under this paragraph 11 of CMM 2005-01 the Commission may consider proposals for a system of temporary purse seine closures to assist it in achieving the necessary reductions in catch and effort.

Second Regular Session of the Scientific Committee

11. The Second Regular Session of the Scientific Committee (SC2), which met at Manila, Philippines, 7-18 August 2006 recommended:

> In order to maintain the bigeye stock at a level capable of producing MSY the Scientific Committee recommends a 25% reduction in fishing mortality from the average levels of 2001-2004.
>
> and
>
> In order to maintain the yellowfin stock at a level capable of producing MSY the Scientific Committee recommends a 10% reduction in fishing mortality from the average levels of 2001-2004[4].

12. Effort reductions of 10% across all fisheries would be necessary to reduce fishing mortality to a level that would sustain stocks at B_{MSY} for yellowfin tuna whereas a 25%

[4] The 2006 assessment included corrections to input data – particularly data concerning the length/weight and dressed/whole weight conversion factors for yellowfin tuna. The resulted in a smaller reduction in the size of fish over the entire model period which meant recent fishing mortality rates were lower than previously estimated.

reduction across all fisheries would be required to achieve the same for bigeye tuna[5]. If the purse seine fishery alone was to be targeted to achieve the recommended levels of fishing mortality a significant reduction of effort (by 75%) would be required to achieve F_{MSY} for bigeye tuna[6]. However, because almost all of the purse seine bigeye catch occurs in sets on floating objects (referred to generally as "FAD sets"), such a reduction need only be applied to FAD fishing to achieve the necessary reduction in bigeye fishing mortality. However, if the Commission chose a more precautionary target, to maintain stocks above B_{MSY}, greater effort reductions would be necessary[7].

13. High seas account for approximately 15% of the total purse seine fishing effort in the western tropical Pacific. As a result, a total closure of high seas will only result in a 15% reduction in total purse seine effort. Whilst the reduction in fishing mortality resulting from a high seas closure would contribute substantially to the recommended level of reduction of total fishing mortality for yellowfin (estimated $F/F_{MSY}=1.03$) such a closure would yield only a small reduction in total bigeye fishing mortality relative to the level of reduction recommended by the Scientific Committee.

Reducing BET and YFT catch while limiting impacts on the SJT catch in the purse seine fishery

14. Although SC2 did not consider specific management options for achieving the necessary reductions in yellowfin and bigeye mortality, the Scientific Committee's Stock Assessment Specialist Working Group did consider a methodological framework for evaluating seasonal purse seine closures[5]. As an example, the approach was applied to purse seine data for 1996-2005 to determine, on an empirical basis, whether closures in certain months would be more effective than others in respect of two objectives: (1) to maximize the percentage reduction in yellowfin and bigeye catch; and (2) to minimize the reduction in skipjack catch. These two objectives were considered as the SC recognised the importance of determining the potential impacts on skipjack catches of measures directed at bigeye and yellowfin tuna.

15. A summary of the results, provided at Table 1, suggest that a three month closure towards the end of the year (September—November) would minimise the effect of a closure on catches of skipjack (24.9% reduction) while maximising the reduction of bigeye and yellowfin tuna catch (29.8% reduction), relative to any other 3-month period in the year. However, the resulting reduction in bigeye mortality is insufficient to achieve the objectives for fishing mortality reduction recommended by SC 2.

---

[5] Refer to: Hampton, J, A. Langley and P. Kleiber. (2006). *Stock assessment of bigeye tuna in the western and central Pacific Ocean, including an analysis of management options*. WCPFC–SC2 SA WP–2. Paper prepared for the Second Regular Session of the Scientific Committee, 7-18 August 2006, Manila, Philippines. Western and Central Pacific Fisheries Commission. 97 pages. Hampton, J, A. Langley and P. Kleiber. (2006). *Stock assessment of yellowfin tuna in the western and central Pacific Ocean, including an analysis of management options*. WCPFC–SC2 SA WP–1. Paper prepared for the Second Regular Session of the Scientific Committee, 7-18 August 2006, Manila, Philippines. Western and Central Pacific Fisheries Commission. 99 pages.

[6] Langley A. and Hampton, J. (unpublished manuscript). *Potential impact on catches of skipjack by the WCPO purse seine fishery of various WCPFC conservation and management measures considered for bigeye and yellowfin. Secretariat of the Pacific Community, Oceanic Fisheries Programme. July 2006. 4 pages.*

[7] The Commission is yet to consider reference points for the management of WCPO highly migratory fish stocks. In the absence of management objectives adopted by the Commission F_{MSY} has been used as a benchmark because of the provisions of the Convention requiring CCMs, *inter alia*, to maintain or restore stocks at levels capable of producing maximum sustainable yield and to ensure that levels of fishing effort do not exceed those commensurate with the sustainable use of fishery resources.

16. SC2 considered a more detailed analysis could examine the inter-annual variation in catch composition and potentially consider the effect of set type, if appropriate to any particular management proposal including stratifying the analysis spatially to assess closures in particular sub-areas of the fishery to take into account apparent temporal and spatial differences in the catch composition – particularly in relation to juvenile and adult yellowfin. For example, a proposal directed specifically at associated sets could result in a considerably lower impact on the level of skipjack catch relative to a total closure, while still reducing the fishing mortality rate on bigeye tuna.

Table 1. Percentage catch reductions assuming that various monthly closures had been applied over the period 1996-2005. The rankings for skipjack (SKJ) are numbered 1 through 12 from the lowest to highest percentage reductions. The rankings for yellowfin plus bigeye (YFT+BET) are numbered 1 through 12 from the highest to lowest percentage reductions. Composite catch reduction indices, *CRI*, are derived by subtracting SKJ from YFT+BET weighted catch reductions: $CRI = \left(C_{y+b} w_{y+b} - C_s w_s\right) / \left(w_{y+b} + w_s\right)$, and ordering from highest to lowest. The highest ranks (1 being the highest), which are highlighted in yellow for each set of weightings, are months with low SKJ catch reduction and high YFT+BET catch reduction.

Closure month	% Catch reductions		Rank		Composite rank					
					$w_{y+b} = 50$ $w_s = 50$		$w_{y+b} = 25$ $w_s = 75$		$w_{y+b} = 75$ $w_s = 25$	
	SKJ	YFT + BET	SKJ	YFT + BET	*CRI*	Rank	*CRI*	Rank	CRI	Rank
1	7.7	8.5	1	7	0.83	5	-3.64	3	4.46	6
2	8.0	7.7	6	8	-0.30	8	-4.06	8	3.76	8
3	9.4	6.4	11	12	-2.95	12	-5.43	11	2.48	12
4	9.1	6.7	10	11	-2.39	10	-5.16	10	2.76	11
5	9.6	7.0	12	10	-2.62	11	-5.44	12	2.82	10
6	7.9	7.3	4	9	-0.62	9	-4.10	9	3.48	9
7	7.9	8.7	5	5	0.82	6	-3.74	4	4.56	5
8	7.9	8.6	3	6	0.70	7	-3.76	5	4.46	6
9	8.0	10.4	7	1	2.34	1	-3.44	1	5.77	1
10	8.5	9.5	9	3	0.99	4	-3.99	7	4.98	4
11	8.4	9.9	8	2	1.51	3	-3.80	6	5.31	2
12	7.8	9.4	2	4	1.69	2	-3.46	2	5.14	3

Supplementary analysis

17. Subsequent to SC2, and on the basis of contributions and suggestions from CCMs and others, the Commission's Scientific Services Provider has undertaken supplementary analysis of the spatial distribution of the catch of juvenile bigeye and yellowfin tuna with respect to quarter and set type – presented in Attachment A.

18. The geographical distributions of purse-seine fishing effort by set type and quarter for 2001-05 are presented in Figure 1-4 of Attachment A. While there is considerable inter-annual variation in the distribution of fishing effort, fishing effort by unassociated sets is generally concentrated in the western equatorial region during the first and fourth quarters of the year and extends further eastward during the second and third quarters (Figure 1).

Localized areas of intense fishing effort are largely driven by short-term concentrations of fishing effort (Figure 1).

19. Drifting FAD sets are more concentrated in the eastern equatorial areas of the WCPO and are distributed over a broader latitudinal range than unassociated sets, particularly south of the equator (Figure 2). By contrast, anchored FAD sets (Figure 3) and sets associated with logs tend to be concentrated in western equatorial WCPO, particularly in the waters of Papua New Guinea (PNG) (Figure 4).

20. Catches of skipjack tuna by associated sets (anchored FAD, drifting FAD and log sets) are concentrated in the western equatorial waters, particularly around PNG, during the first and fourth quarter (Figure 5). Catches of skipjack tuna by associated sets tend to be lower and more broadly distributed during the second and third quarter. The spatial distribution of skipjack catches from unassociated sets is more variable than for associated sets, although there is an increase in the catch from the eastern equatorial region during the second and third quarters (Figure 6). As with the distribution of unassociated fishing effort, there is considerable variation in the distribution of catch with localized areas yielding high catches during relatively short periods.

21. Yellowfin catches from associated purse-seine sets are concentrated around the archipelagic waters of PNG (anchored FADs) and extend eastward, concentrated along the equator (Figure 7). The spatial distribution of yellowfin from unassociated sets is highly variable both within and among quarters (Figure 8).

22. The distribution of bigeye tuna purse-seine catches, almost exclusively taken by associated sets (Figure 8), is comparable to the distribution of yellowfin catch by associated sets. Catches are concentrated in archipelagic waters of PNG and extend eastward along the equator. In the first and fourth quarters, relatively high catches of bigeye tuna were taken in the area of international waters surrounded by the exclusive economic zones of the Federated States of Micronesia (FSM), PNG, Solomon Islands, Nauru, Tuvalu, and Kiribati.

23. It is important to note that, in the absence of reliable catch reporting for bigeye tuna from most purse-seine fleets, bigeye catches are derived from model estimates of the proportion of bigeye in the combined yellowfin and bigeye catch sampled by scientific observers. The model estimates the bigeye proportion by year and set type and these estimates are then applied to apportion the bigeye and yellowfin catch. The resulting estimates of bigeye catch represent the best available information regarding the spatial and temporal distribution of bigeye catch from the purse-seine fishery.

IATTC Arrangements

24. A summary of experience with closures in other oceans is presented at Attachment B. Consistency with the IATTC arrangement (Resolution C-04-09 and presumably C-06-02), as called for in CMM 2005-01, may include consideration of i) fishing methods, ii) area of application, iii) timing, and iv) duration.

25. The IATTC measure is a multi-annual program first established for the period 2004, 2005, 2006 in Resolution C-04-09 and renewed for 2007 in Resolution C-06-02. Both measures apply to purse seine and longline vessels.

26. In relation to purse seining, each IATTC Party can elect one of two 42-day periods (August/September or November/December) during which its purse seine vessels will remain in port, i.e. not fish in the Eastern Pacific Ocean (EPO) between 40° North and 40° South and from the west coast of the Americas to 150° West (i.e. including waters under national jurisdiction and high seas) – approximately 90% of the IATTC convention area.

27. In relation to longline fishing, the Resolution allocates a quota to China, Japan, Korea and Chinese-Taipei while other Parties are obligated to take measures to ensure their catch of bigeye tuna in the EPO in does not exceed their 2001 catch levels (for 2004, 2005 and 2006: C-04-09) or 500 tonnes for 2007 (C-06-02).

28. Each Party is committed to reporting catches to the Commission on a monthly basis. In addition, each Party is required to prohibit landings, transhipment and commercial transactions in tuna and tuna products that are positively identified as originating from fishing activities that contravene the Resolution.

29. Both Resolutions require the IATTC Scientific Working Group to analyze the effect of the measure and propose, if necessary, refinement for subsequent years for the consideration of the Commission.

30. The IATTC also maintains a closed registry of purse seine fishing vessels which, in effect, is a closure on carrying capacity of the purse seine fleet in the EPO[8].

31. A summary of an evaluation of the effect of C-04-09 is included at Attachment B[9].

Proposals by CCMs (and the WTPO)

32. In August 2006, the Executive Director wrote to CCMs inviting them to contribute to the proposal called for in CMM 2005-01 for consideration at WCPFC3 (Circular 2006-09). Responses were received from four CCMs: Japan, Korea, PNG and FSM. In addition, the World Tuna Purse Seine Organisation (WTPO) requested an opportunity to express a view on the matter.

33. The suggestions received (appended at Attachment C) range from closures to apply throughout the Convention Area, to be confined to the high seas, to apply to purse seine, longline, and Indonesian/Philippine fisheries, minimise impact on skipjack fisheries and the development aspirations of small island developing States, be based on the best available scientific evidence and ensure measures adopted are compatible for the high seas and within areas under national jurisdiction.

Considerations in examining options for a system of temporary purse seine closures

34. Some of the key considerations associated with a purse seine closure for the Commission include:

- Obligations in the Convention;

[8] IATTC Resolution-2002-02. Resolution on the capacity of the tuna fleet operating in the Eastern Pacific Ocean (revised).

[9] Maunder, M.N. and Hoyle, S.D. (2006). *Evaluation of the effect of Resolution C-04-09.* Document SAR-7-12. 7th Meeting of the Working Group to Review Stock Assessments, Inter-American Tropical Tuna Commission, 15-19 May 2006, La Jolla, California.

- Fairness and burden sharing;
- Uncertainty associated with the absence of a clear description of management objectives for the WCPO tuna fisheries;
- The influence of a reduction in effort and catch in the longline fishery on the scope of a purse seine closure;
- The relative importance of sets on FAD/floating object sets to some CCM purse seine fleets;
- The benefits of a measure to reduce the catch of juvenile bigeye will mostly accrue to fisheries targeting the adult bigeye stock;
- The value of the bigeye resource to the longline fishery relative to its value taken as juveniles in the purse seine fishery;
- Relocation of effort from FAD/floating object sets to freely associated schools may be strongly positive for bigeye but less so for yellowfin;
- Challenges in achieving an effort and catch reduction in surface fisheries responsible for a relatively high proportion of the juvenile catch of yellowfin and bigeye tuna (Indonesia and Philippines);
- Current limited capacity for monitoring compliance by both purse seine and longline fleets (such as through the regional observer programme/VMS);
- Costs, and responsibilities for costs, associated with monitoring compliance;
- Limited understanding of the individual and collective costs and benefits associated with a closure for fleets and/or zones;
- Impacts of a closure on the financial viability of purse seine and longline vessels;
- Limited evaluation of long term benefits that would accrue as a result of a reduction in the current effort and catch;
- Issues associated with relocation or transfer of effort out of a closed area to elsewhere in the Convention Area and subsequent implications for an effort reduction objective;
- Potential re-aggregation of fishing effort into the closed area after the fishery closure; and
- Uncertainty about the actual level of effort reduction realised: fleets may utilise the closure period to undertake routine servicing of vessels thereby reducing the effective level of effort reduction anticipated by such a measure.

The Convention

35. The objective of the Convention is to ensure, through effective management, the long term conservation and sustainable use of highly migratory fish stocks in the WCPO. Article 5, in relation to principles and measures for conservation and management, expands on this by providing for CCMs to adopt measures that ensure long-term sustainability, promote the objective of optimum utilisation and, on the basis of the best scientific advice available, maintain or restore stocks at levels capable of producing MSY, as qualified by relevant, yet to be specified, economic and environmental factors, including the special requirements of developing States. Significantly, Article 5 (g) also provides that, in order to manage and conserve highly migratory fish stocks in the Convention Area in their entirety, CCMs will take measures to prevent or eliminate over-fishing and excess fishing capacity and ensure that levels of fishing effort do not exceed those commensurate with the sustainable use of fishery resources. In addition, Article 6, in respect of the application of the precautionary approach, requires CCMs to take measures to ensure that, when reference points are approached, they

will not be exceeded. In the event that they are exceeded, CCMs, without delay, will take action to restore those stocks – including within waters under national jurisdiction (Article 7).

Indonesia and Philippines

36. The Indonesia and the Philippines region accounts for 27% of the recent WCPO tuna catch. As a result full participation of Indonesia and Philippines in an effort and catch reduction scheme is crucial. Without a reduction in these fisheries, SPC-OFP estimates that the non-Philippine/Indonesian longline fleets would need to reduce effort by 50% (relative to 2001-2004 average levels) to achieve F_{MSY} for bigeye tuna, if the reduction was applied solely to this fishery. Similarly, a greater reduction in fishing effort would be necessary if the reduction was solely applied to the purse-seine fishery. A reduction of 25% in effort in the Indonesian and Philippine fisheries would still require considerable reductions (>30%) elsewhere in either the WCPO purse seine or the longline fisheries. Clearly, the Philippines and Indonesia fisheries are major considerations in the Commission's deliberations on effort and catch reduction possibilities.

Purse seine closure

37. A 75% reduction in effort is required if the purse seine fishery alone is to be responsible for the necessary reduction in fishing mortality for bigeye. Given the social and economic considerations of any reductions in fishing effort, the Commission will likely need to consider a variety of measures that equitably share, across the various WCPO tuna fisheries, the costs and benefits associated with achieving an objective of maintaining stocks of bigeye and yellowfin at or above B_{MSY}.

Relationship between bigeye and yellowfin

38. Bigeye are not taken in unassociated purse seine sets. Almost the entire purse seine bigeye catch is taken in FAD or floating object associated sets. While effort reduction on associated sets can achieve positive outcomes for reducing the mortality of bigeye tuna there is also potential to increase the mortality of yellowfin if purse seine effort is simply transferred from associated sets to un-associated sets. In addition, some CCMs are utilise FAD sets, both drifting and anchored, to support their purse seine fisheries. An effort reduction scheme aimed at reducing mortality from FAD-associated sets would result in those CCMs assuming a significant share of the responsibility for reducing bigeye and yellowfin mortality.

39. Both bigeye and yellowfin, together with albacore, are the target species for fresh and frozen longline fishing. Based on 2001-2004 data, 28% of the total bigeye longline catch was taken by frozen longliners in the waters of Pacific Island CCMs, 37% of the total bigeye longline catch was taken by frozen longliners in international waters with a relative small proportion (0.1%) of the total bigeye longline catch taken by frozen longliners in the waters of other CCMs. In respect of the total longline catch of yellowfin 21% was taken by frozen longliners in Pacific Island CCM waters, 19% of the total longline yellowfin catch was taken by frozen longliners in international waters and 0.04% was taken by frozen longliners within the waters of other CCMs. Relatively small proportions of the total longline catch of yellowfin (7%) and bigeye (6%) were taken by fresh longliners in international waters during that period. 15% of the total bigeye longline catch was taken with the national waters of

Pacific Island CCMs by fresh longliners and 14% of the total bigeye longline catch was taken by fresh longliners in the waters of other CCMs. Fresh longliners operating in the national waters of Pacific Island CCMs accounted for 20% of the total longline catch of yellowfin and fresh longliners operating in the national waters of other CCMs accounted for 32% of the total longline yellowfin catch[10].

40. SPC-OFP predict that if current levels of effort in the Indonesian and Philippine fishery and the purse seine associated effort is maintained the bigeye longline catch will decrease. They also advise current levels of bigeye longline catch could be maintained at lower levels of longline effort (80% of 2001-2004 base-line effort) if corresponding reductions in effort are applied to the purse seine associated fishery. Greater reductions in the purse seine associated fishery would result in increased CPUE in for the longline fishery.

National waters and the high seas

41. Sixty percent of the 2001-2004 purse seine catch was taken within waters under the national jurisdiction of Pacific Island CCMs, 20% was taken in international waters with the remainder taken within waters under the national jurisdiction of other CCMs.

42. Pacific Island CCMs have an opportunity to have a significant influence over effort and catch reduction schemes simply as a result of the large proportion of the purse seine catch taken in waters under their jurisdiction. On the other hand, at least in the short term (until reduced supply can theoretically exert a positive influence on prices for raw material), reduced catches within national waters, and associated reduced revenue, also means these coastal States would shoulder the majority of the economic costs resulting from reduced production (reduced access fees, potential threatened economic viability of processing plants, implications for linked industries, reduced employment opportunities, reduced foreign exchange, etc.).

43. A closure of the high seas enclaves to purse seine fishing could result approximately a 15% reduction in purse seine effort (based on 2001-2004 data) – and so make a major contribution to an objective of reducing effort to F_{MSY} for yellowfin tuna. However, the resulting reduction in fishing mortality for bigeye would be small relative to the scale of reduction recommended by the Scientific Committee.

44. Several CCMs rely on access to high seas tuna resources to sustain their purse seine operations – and so they may argue a measure involving high seas closures requires them to shoulder a disproportionate burden. In addition, although effort limits are being introduced for eight CCMs under the VDS, conservation benefit would be reduced if effort that was previously deployed on the high seas was transferred to waters under national jurisdiction in the event of a high seas closure. For coastal States reliant on licensing other fleets to harvest tuna within waters under national jurisdiction a high seas closure does have the potential to positively impact the value of access – particularly if reduced supply positively impacts prices for raw material.

Monitoring and compliance

[10] Reid, C. (*unpubl. manuscript*). An analysis of economic implications and tradeoffs in achieving maximum sustainable yield for bigeye and yellowfin tuna in the western and central Pacific Ocean. Paper prepared for an FFA *Management Options Workshop,* 16-20 October 2006, Nadi, Fiji.

45. An operational VMS and regional observer programme are critical components of the Commission's evolving regulatory framework that will support the monitoring of non-compliance with conservation and management measures involving closures. Other elements such as full catch reporting, port State monitoring, high seas boarding and inspection procedures, a transhipment and unloading verification scheme, catch documentation and additional mechanisms to address IUU fishing will further strengthen the capability of the Commission to monitor and appropriately respond to infringements or violations of the conservation and management measures of the Commission. While these programmes are being designed and implemented monitoring compliance with the decision of the Commission in relation to any agreed closure essentially rests with the flag State.

Scenarios

46. There are a wide range of purse seine closure options for reducing mortality on bigeye and yellowfin tuna in the WCPO (see Attachment D)[11]. Proposals received from CCMs in response to Circular 2006-09 and during discussion at the Scientific Committee meeting at Manila range from a closure of the most significant purse seine fishing grounds in the Convention Area to purse seine fishing (as applies in the EPO), to limited spatial or temporal closures (such as the high seas and/or areas under national jurisdiction), closure on purse seine set types (FAD and floating object sets) to effort and catch reductions in other fisheries responsible for significant bigeye and yellowfin mortality (the longline fishery). They may be implemented immediately or they may be phased in over time. However, it is clear that, in isolation, only a large scale purse seine closure is capable of meeting the recommended level of effort reduction required to achieve the target level of fishing mortality for bigeye tuna recommended by the Scientific Committee.

47. Four scenarios for contributing to the objective of a 25% reduction in fishing mortality for bigeye tuna and a 10% reduction in fishing mortality for yellowfin tuna are presented below. **These are indicative only and other permutations and combinations of options for adjusting fishing mortality can be modelled at relatively short notice**. Tables 2, 3 and 4 present, on the basis of the best information available, the implications for the implementation of each of these scenarios. It is important to note that while many of the scenarios meet the F_{MSY} management objective for yellowfin tuna, the only scenario that meets the same objective for bigeye requires an additional measure to reduce bigeye longline catch. The extent of the reduction required reflects the fact that 2001-2004 levels of effort and catch are significantly above that required to achieve the target level of fishing mortality recommended by the Scientific Committee.

48. For the various scenarios, a baseline distribution of fishing effort is defined as per the SC 2 stock assessment papers. The reduction in fishing effort associated with each scenario represents the proportion of the total effort in the relevant combination of quarter(s), set type(s), and area (high seas and national waters) averaged over the 2001-2005 period. Purse-seine reductions are applied only to the equatorial region. Some scenarios allow for a transfer of effort from associated to unassociated sets, although the magnitude of transfer can not be estimated. In this case, a range of values are assumed for the purpose of considering the impact on yellowfin tuna.

[11] Langley, A. and J. Hampton. (*unpubl. manuscript*). A consideration of management options for yellowfin and bigeye tuna in the WCPO tuna fishery. Paper prepared for an FFA *Management Options Workshop,* 16-20 October 2006, Nadi, Fiji.

Scenario 1: A 12-month closure of high seas enclaves to all purse seine fishing (and no effort transfer to waters under national jurisdiction).

Scenario 2: Closure on FAD and floating objects sets on the high seas and in waters under national jurisdiction (except archipelagic waters) in the last two quarters of the year.

Scenario 3: Closure on FAD and floating objects sets in the third quarter of the year and total purse seine effort closure on high seas in the last quarter of the year.

Scenario 4: High seas purse seine closure, closure on FAD and floating objects sets in waters under national jurisdiction (except archipelagic waters) in the last quarter of the year, and a quota on bigeye longline catch on the high seas**.**

Predicted outcomes

49. The broad implications of the implementation of these measures are summarised in Tables 2, 3 and 4 below.

Table 2. The predicted outcome of the various scenarios considered relative to the F_{MSY} reference point for bigeye and yellowfin tuna. A range of values are given for yellowfin based on different assumptions regarding the level of transfer from associated to un-associated purse-seine sets.

Option	F/F_{MSY} BET	F/F_{MSY} YFT	Comment/assumptions
2001-2004 average	1.32	1.11	Base-line of 2001-2004 average effort
Scenario 1	1.23	1.03	Represents a 16% reduction in total PS effort.
Scenario 2	1.12	-	43% reduction in PS associated sets.
	1.12	0.99	0% increase in PS unassociated sets from assoc.
	1.12	1.01	10% increase
	1.12	1.02	20% increase
	1.12	1.03	30% increase
	1.12	1.05	40% increase
	1.12	1.06	50% increase
	1.12	1.08	60% increase
Scenario 3	1.12	-	44% reduction in PS associated sets. 4% reduction in PS unassociated.
	1.12	0.98	0% increase in PS unassociated sets from assoc.
	1.12	0.99	10% increase
	1.12	1.01	20% increase
	1.12	1.02	30% increase
	1.12	1.03	40% increase
	1.12	1.05	50% increase
Scenario 4	1.00	-	23% reduction in PS associated sets. 4% reduction in PS unassociated. 35% reduction in total longline effort (equates to a 58% reduction in bigeye catch in IW).
	1.00	0.97	0% increase in PS unassociated sets from assoc.
	1.00	0.99	10% increase
	1.00	1.00	20% increase

	1.00	1.01	30% increase

50. The scope of potential management options increases considerably if reductions in bigeye longline effort and catch are also considered. Scenario 4 considers a reduction in bigeye longline catch in the high seas in conjunction with a fourth quarter prohibition on high seas purse seine fishing and purse seine fishing associated with fishing on FADs and floating objects in waters under national jurisdiction (archipelagic waters excluded).

51. It is estimated that 43% of the total WCPO bigeye longline catch is taken in international waters[12]. If Indonesia and the Philippines did not contribute to a reduction in effort, a 35% reduction in total longline effort, from the 2001-2005 average, would be required to achieve the F_{MSY} reference point for bigeye in conjunction with the other measures specified in Scenario 4. This equates to a 58% reduction in bigeye longline effort if the reduction is applied solely to high seas. Based on recent (high levels) of bigeye recruitment, this would represent a reduction in bigeye high seas longline catch from 46,100 mt to 19,200 mt. A return to longer term levels of recruitment for bigeye would necessitate a further reduction in the catch level.

52. As noted above, other permutations and combinations are possible – and can be modelled at short notice to assist CCMs in understanding additional options available to respond to the advice of the Scientific Committee in relation to reducing the fishing mortality of bigeye and yellowfin tuna in the Convention Area.

Proposal

53. A draft proposal, broadly drawing on the scenarios presented above, is presented at Attachment E, for the consideration of the Commission.

[12] Reid, C. (*unpubl. manuscript*). An analysis of economic implications and tradeoffs in achieving maximum sustainable yield for bigeye and yellowfin tuna in the western and central Pacific Ocean. Paper prepared for an FFA *Management Options Workshop,* 16-20 October 2006, Nadi, Fiji.

Table 3. The estimated percentage reductions in total purse-seine fishing days by flag resulting from each of the scenarios detailed above. The reductions include no allowance for transfer of purse-seine effort from associated to unassociated sets or from high seas areas to national waters. This is likely to occur, to some extent, under scenarios 2-4, although the magnitude of such a transfer can not be estimated. Consequently, the effort reductions represent the maximum reduction in purse-seine fishing days.

	Flag												
Scenario	**FSM**	**China**	**Japan**	**Korea**	**NZ**	**PNG**	**Phil**	**RMI**	**SI**	**C-T**	**USA**	**Van**	**Total**
1	21.4%	25.3%	28.2%	18.1%	26.9%	10.3%	5.8%	22.9%	4.0%	21.0%	21.5%	32.1%	18.7%
2	31.1%	29.5%	31.1%	12.4%	37.0%	18.6%	20.1%	42.8%	3.6%	23.0%	28.7%	25.1%	23.1%
3	32.6%	30.1%	36.6%	15.8%	32.1%	17.8%	22.1%	40.7%	5.0%	25.5%	32.6%	26.9%	25.4%
4	17.7%	21.9%	19.7%	9.0%	17.4%	10.9%	9.7%	21.3%	1.3%	14.0%	16.4%	18.3%	13.9%

Table 4. Percent reductions in total bigeye longline catch by flag (from 2001-2005 average levels) resulting from the catch reduction applied to the high seas (Scenario 4).

	Flag					
	China	**Japan**	**Korea**	**C-T**	**USA**	**Van**
Reduction	11.94%	37.06%	46.96%	27.71%	31.36%	38.19%

Spatial summary of effort by purse seine set type for the period 2001-2005

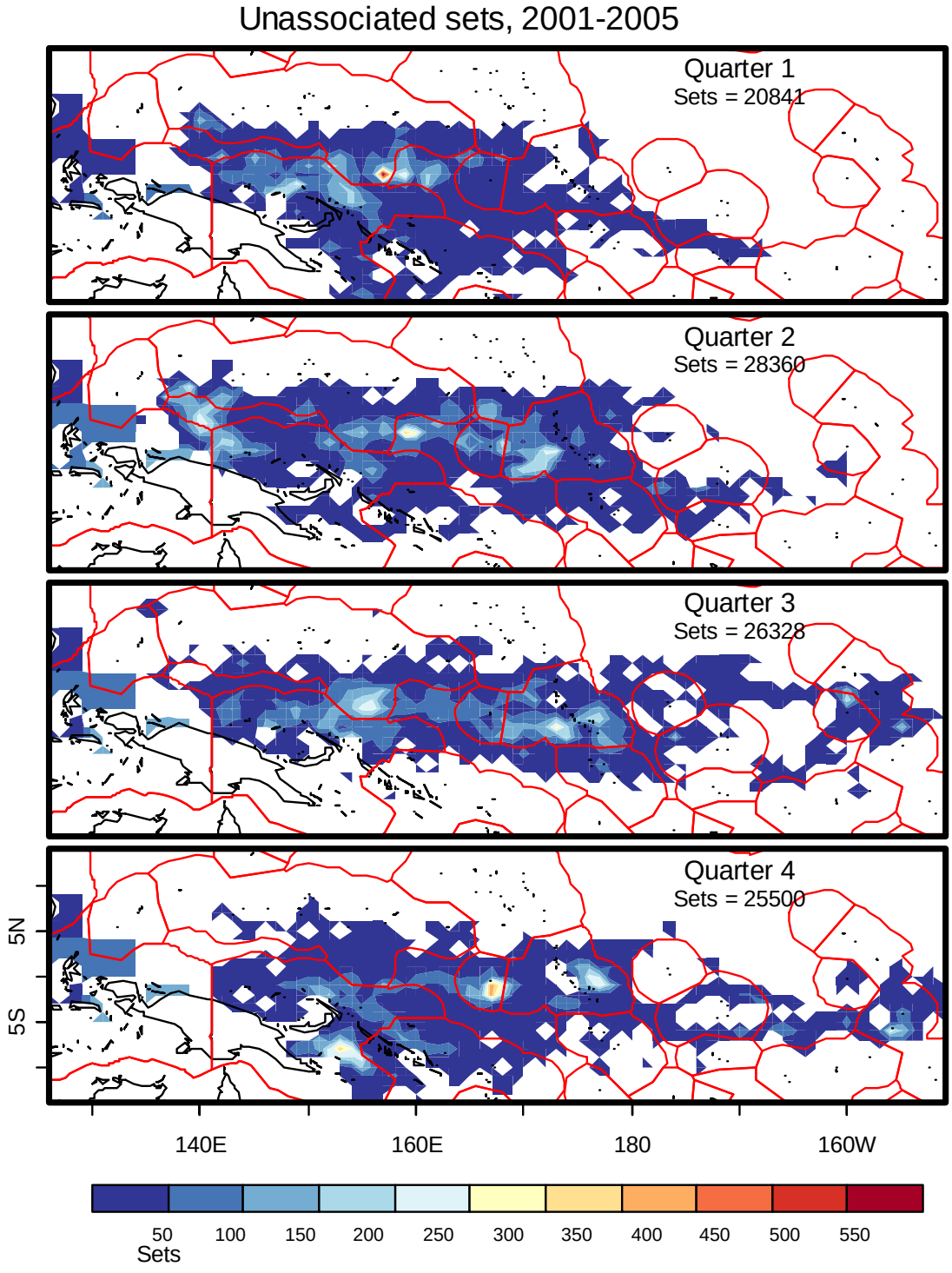


Figure 1. Distribution of quarterly purse-seine fishing effort by unassociated sets from 2001–05, all years combined. The number of sets is the total number of sets in the quarter.

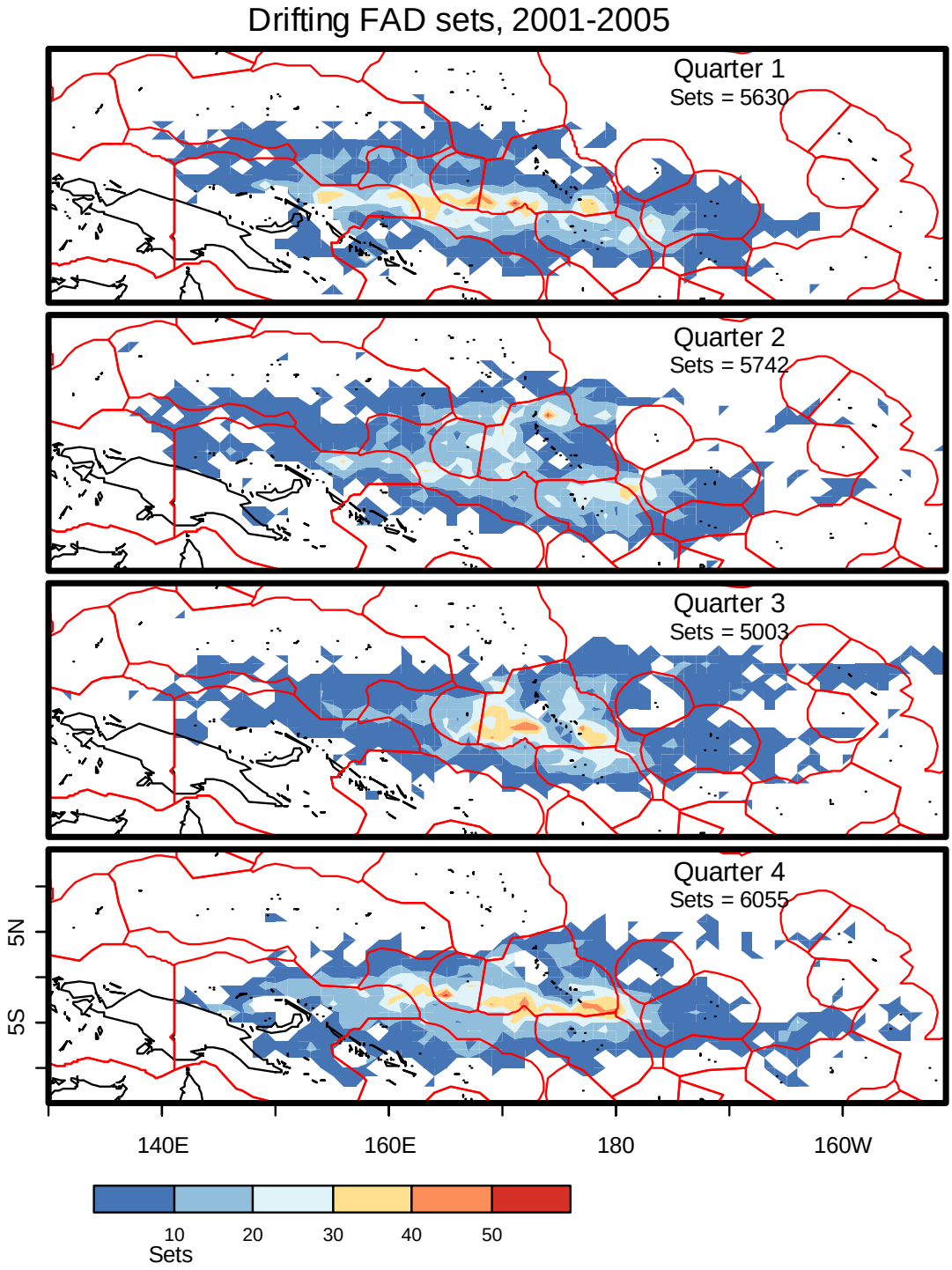


Figure 2. Distribution of quarterly purse-seine fishing effort by drifting FAD sets from 2001–05, all years combined. The number of sets is the total number of sets in the quarter.

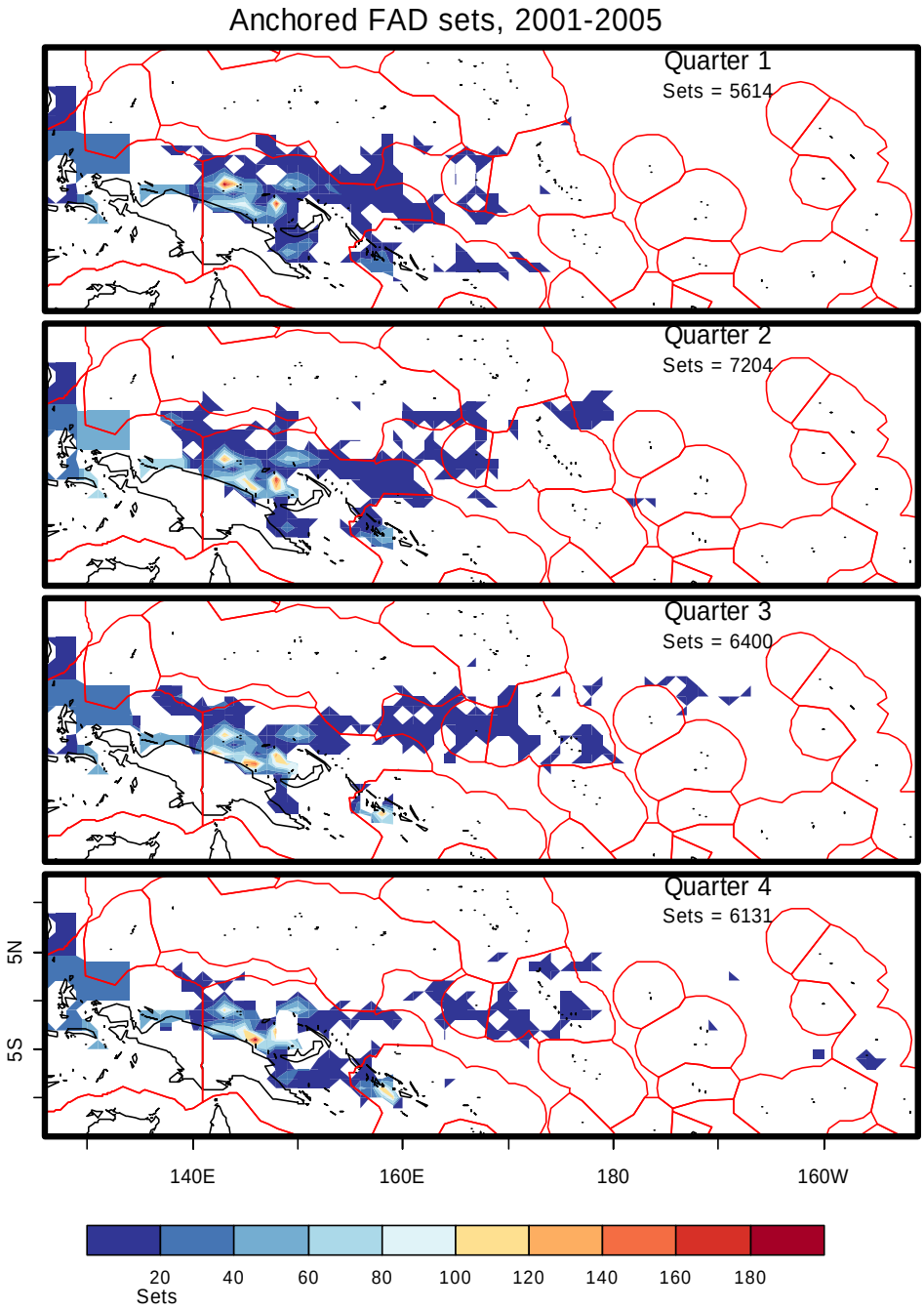


Figure 3. Distribution of quarterly purse-seine fishing effort by anchored FAD sets from 2001–05, all years combined. The number of sets is the total number of sets in the quarter.

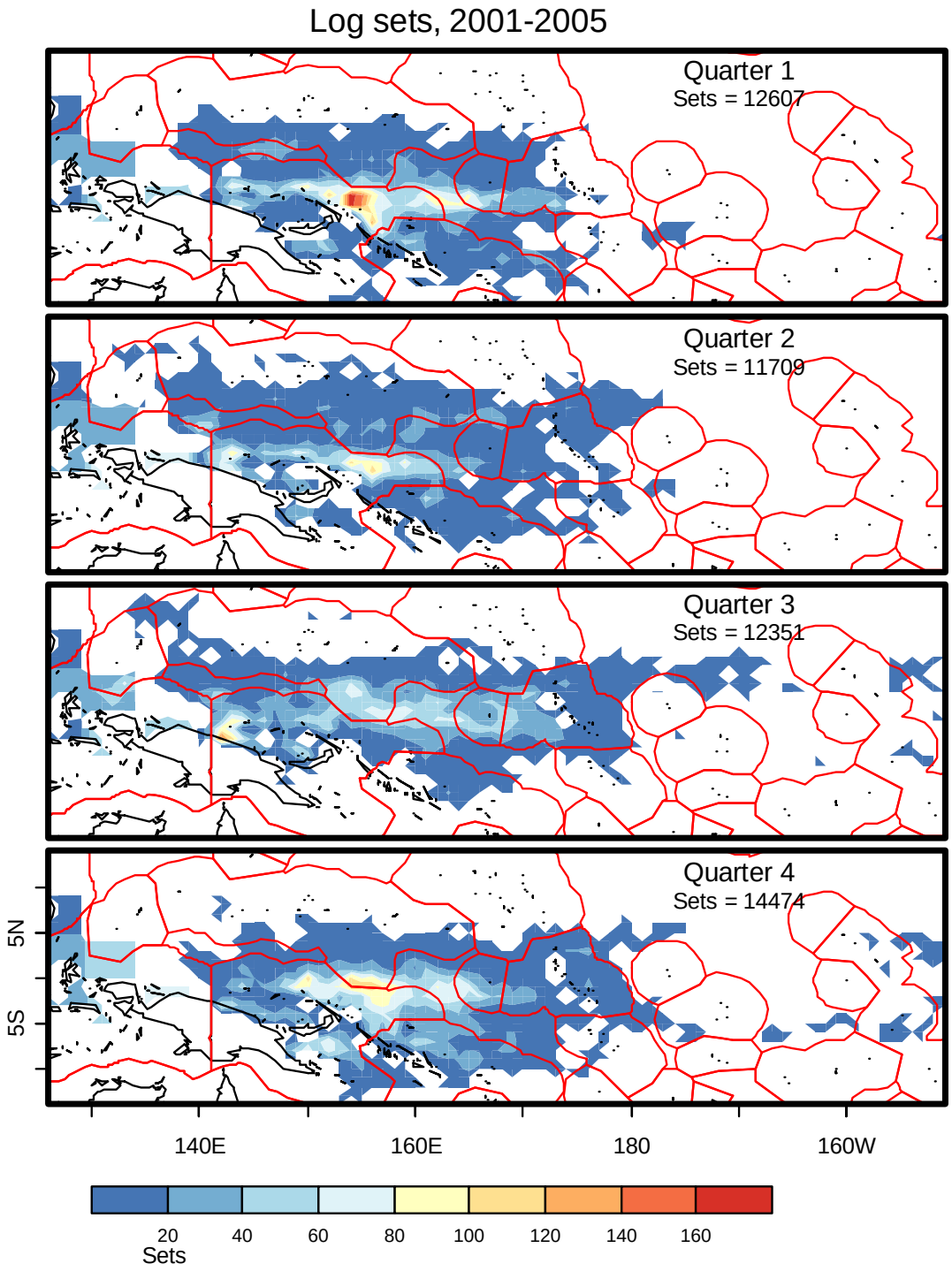


Figure 4. Distribution of quarterly purse-seine fishing effort by log sets from 2001–05, all years combined. The number of sets is the total number of sets in the quarter.

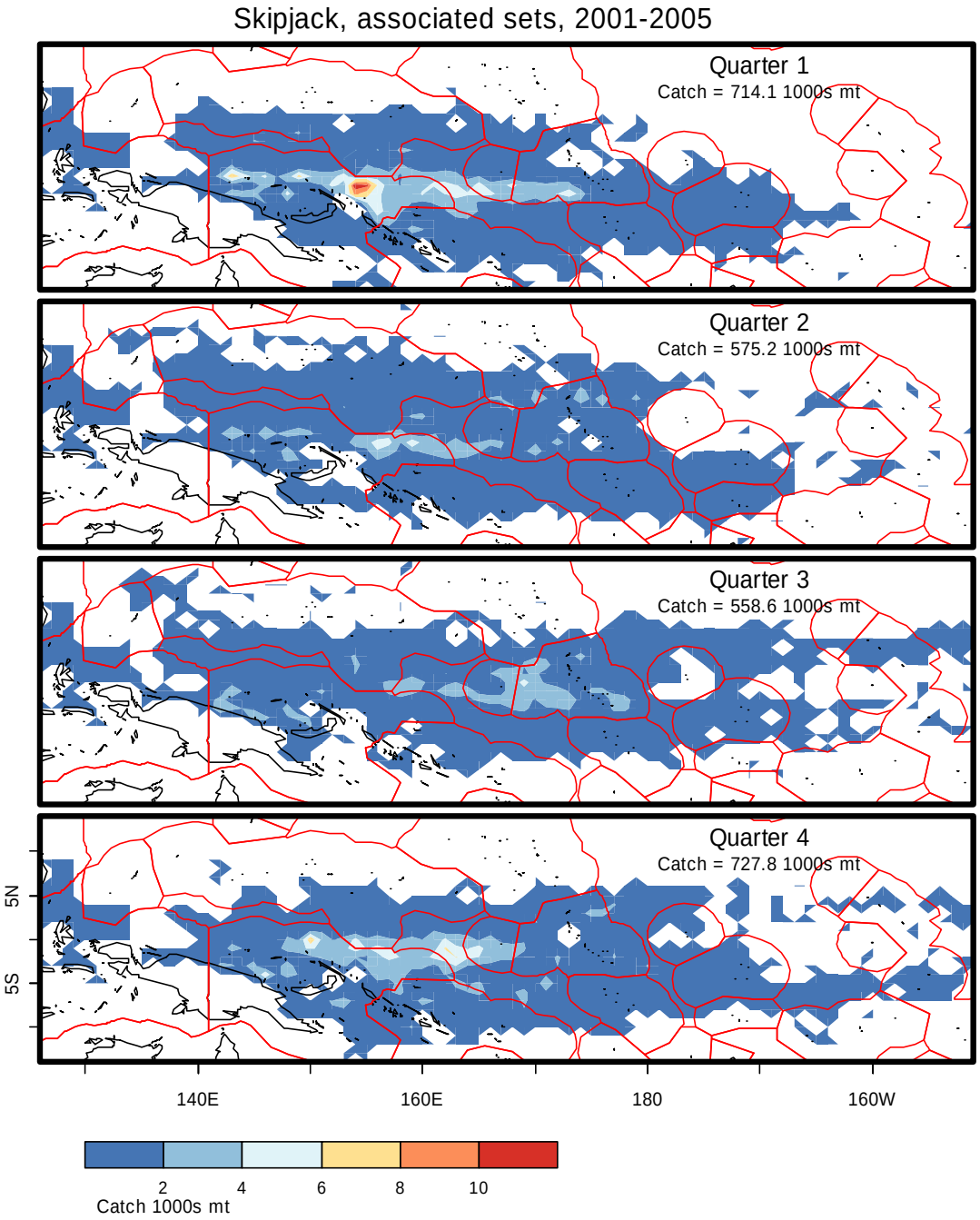


Figure 5. Distribution of quarterly purse-seine skipjack catch (1000s mt) by associated sets from 2001–05, all years combined.

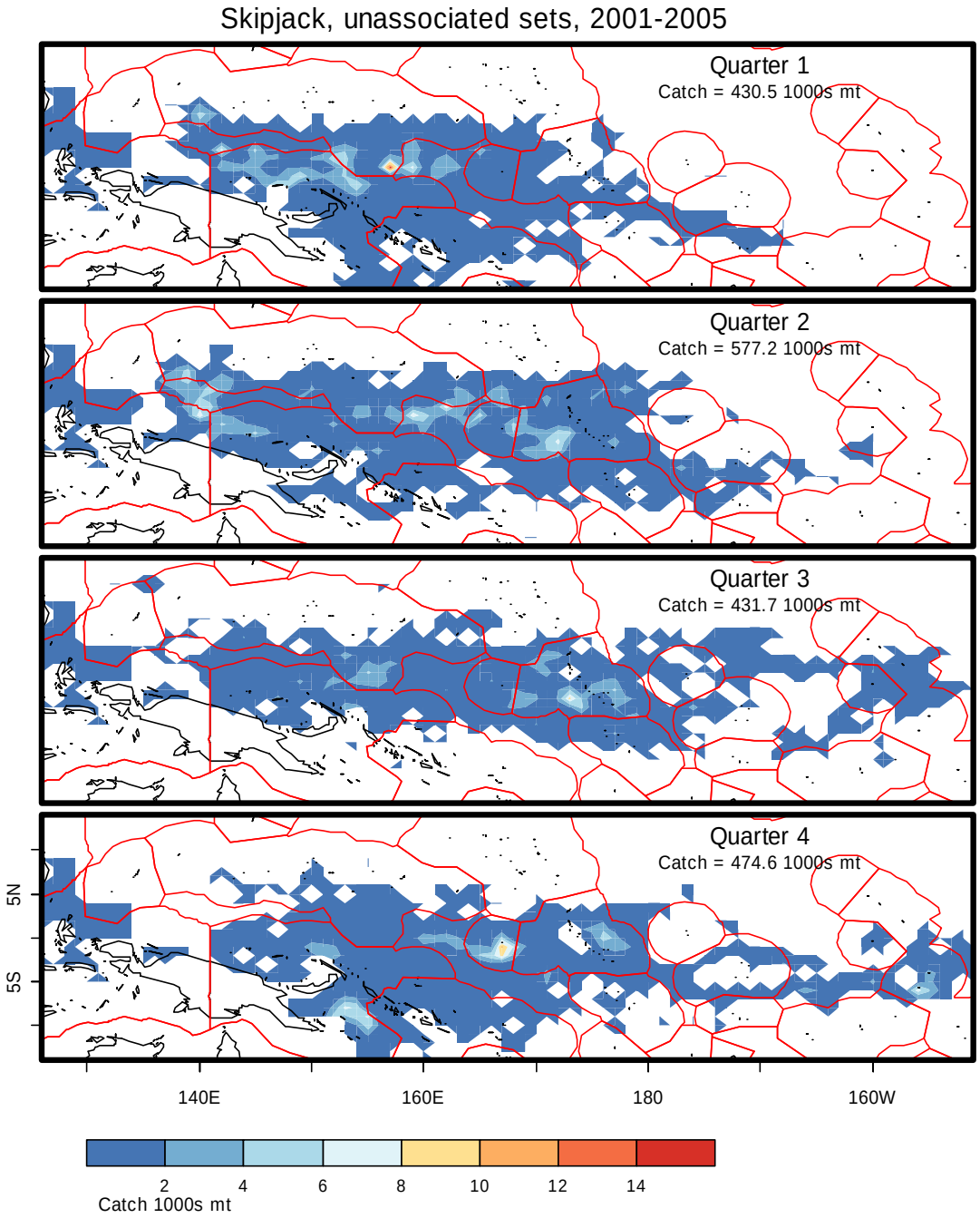


Figure 6. Distribution of quarterly purse-seine skipjack catch (1000s mt) by unassociated sets from 2001–05, all years combined.

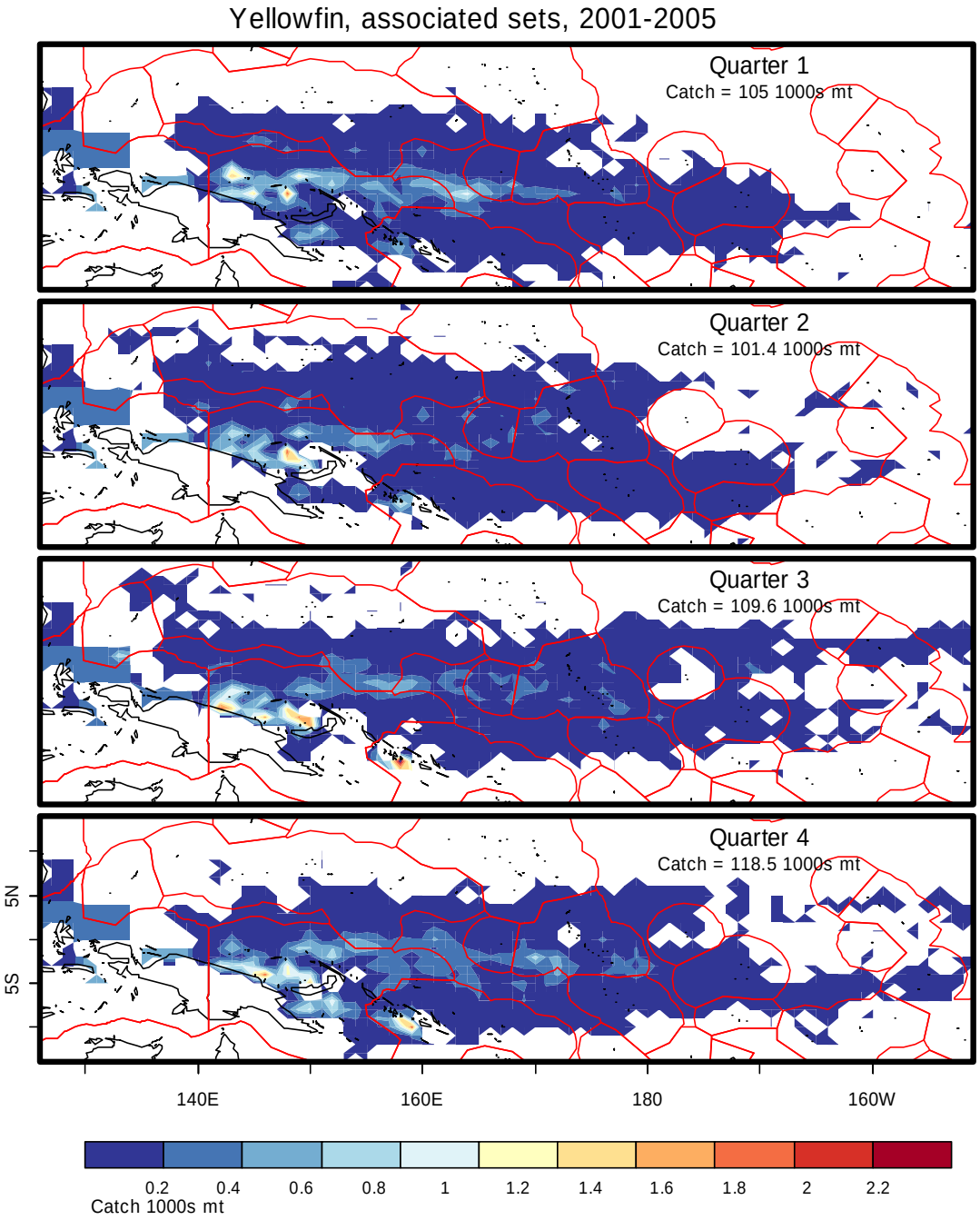


Figure 7. Distribution of quarterly purse-seine yellowfin catch (1000s mt) by associated sets from 2001–05, all years combined.

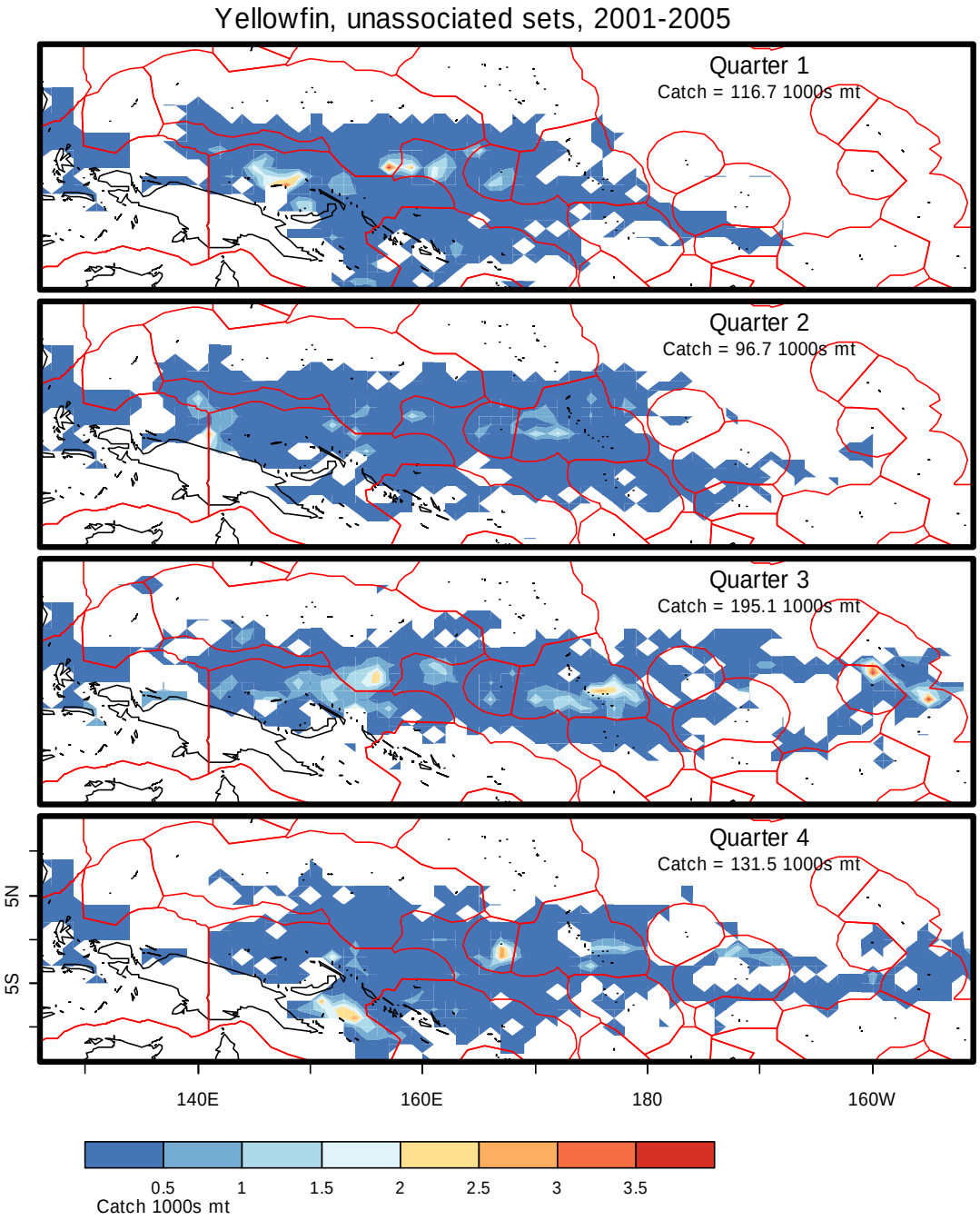


Figure 8. Distribution of quarterly purse-seine yellowfin catch (1000s mt) by unassociated sets from 2001–05, all years combined.

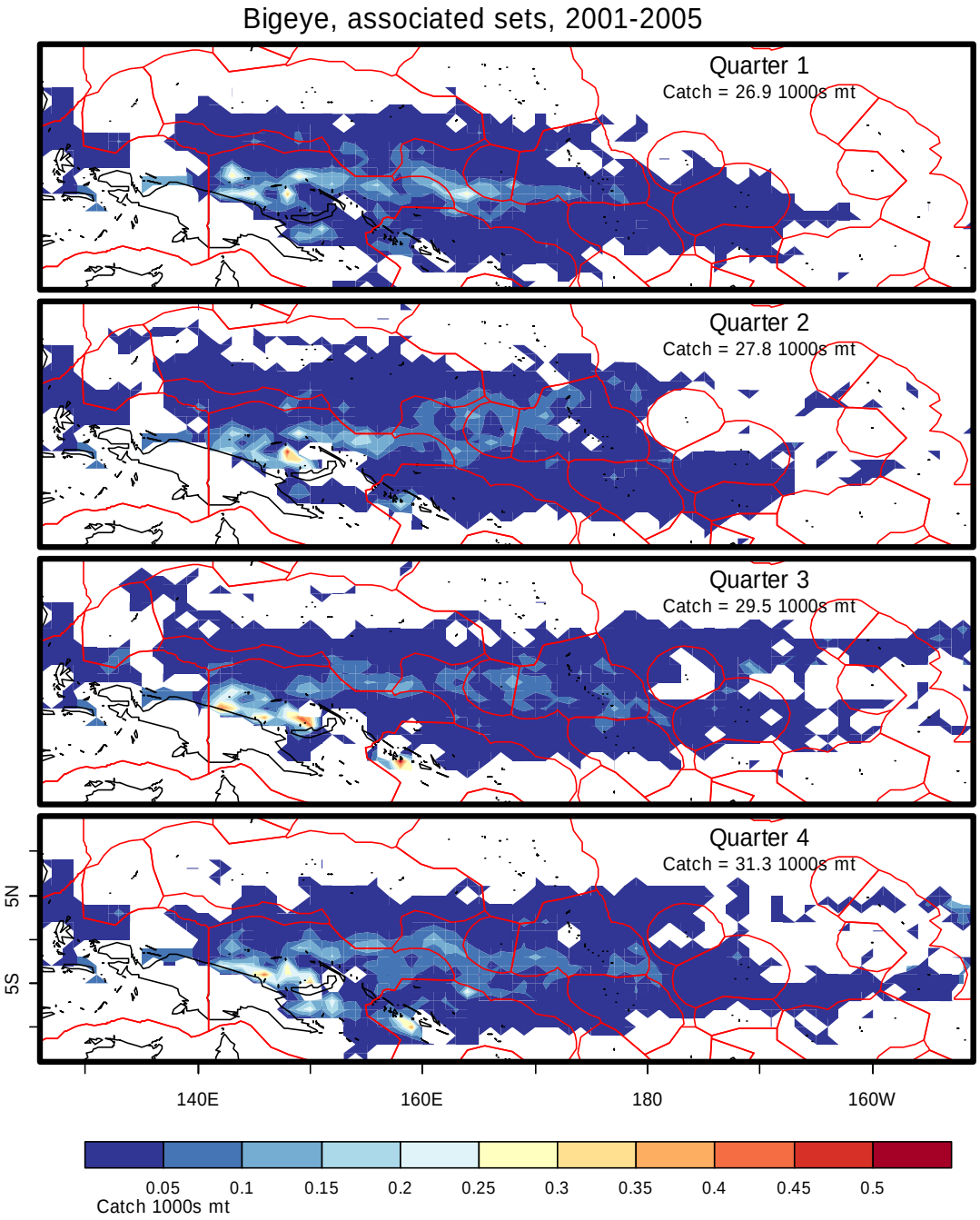


Figure 9. Distribution of quarterly purse-seine bigeye catch (1000s mt) by associated sets from 2001–05, all years combined.

Attachment B

Closure experience in other oceans

Atlantic

1. In April 1997 French and Spanish frozen tuna producers (ORTHONGEL, ANABAC and OPAGAC) committed to voluntary 3-month spatial closure (November 1997 to January 1998) in the Atlantic for purse seine fishing on floating objects. The objective of this Voluntary Protection Plan was the protection of the main spawning ground for tropical tunas, and the reduction of juvenile bigeye catch, in the Gulf of Guinea. In 1998, the Agreement was renewed for 1998/99 and extended to include a 3-month spatial closure in the Indian Ocean covering a similar period (November to January) off the coast of Somalia[13].

2. In November 1998, and after considering the deliberations of ICCAT's Scientific Committee for Research and Statistics (SCRS) and the positive reports of the voluntary measures promoted by European Community vessel owners, ICCAT adopted a recommendation (98-01 TROP) for all purse seiners operating in the Atlantic to comply with the Gulf of Guinea closure during a 3-month period from November 1999 to January 2000[14]. This was renewed in 1999 on a multi-year basis (99-01 YFT & BET)[15].

3. At its 2004 session, ICCAT adopted a substitute time-area closure (04-01 BET) which entered into force in mid-2005. The measure closes fishing by purse seiners and bait boats in the "Piccolo" area – an area within the original moratorium area – but approximately 21% of the size of the original closure area. As the period of closure was reduced to one month (November) the effective time-area closure is approximately 7% of that agreed in 99-01 YFT & BET).

4. An increase in the catch of tropical tunas, consisting predominantly of juvenile fish, is predicted as a result of this change (Brooks and Mosqueira, 2006; Cass-Calay *et. al*., 2006). The October 2006 meeting of the Standing Committee on Research and Statistics (SCRS) noted that it was too early to assess the affects of this measure.

Mediterranean

5. The October 2006 session of the SCRS also considered eight closure scenarios for eastern Atlantic Bluefin (BFTE) in the Mediterranean and East Atlantic as a measure that could be considered by ICCAT for rebuilding the spawning stock biomass (SSB). Only scenarios involving the closure of the entire Mediterranean during the spawning season - together with increasing size limits for both the East Atlantic and the Mediterranean (minimum sizes of 10, 25 and 30 kg overall) were considered capable of significantly reducing fishing mortalities to rebuild the SSB to levels to avoid fishery and stock collapse.

6. A Special Meeting of the Commission in mid-November 2006 will consider possible management responses that may take into account the analysis undertaken by the SCRS.

---

[13] Second Agreement of Community frozen tuna producers for the protection of tunas in the Atlantic and Indian Oceans In: Moron, J. 2001. *Report on Management Measures for the European Tuna Purse Seine Fleet…..*

[14] *ICCAT 98-01 TROP. Recommendation Concerning the Establishment of a Closed Area/Season for the Use of Fish Aggregating Devices (FADs), entered into force June 21,1999*

[15] *ICCAT 99-01 YFT & BET. Recommendation Concerning the Establishment of a Closed Area/Season for the Use of Fish Aggregating Devices (FADs), entered into force June 15, 2000.*

East Pacific Ocean

7. As a supplement to paragraphs 15-19 (above), in response to an increase in purse seine capacity in the EPO since the adoption of the 2004 Resolution, IATTC Staff advised the 74th Meeting of IATTC at Busan in June 2006 that, in order to maintain the yellowfin stock at a level capable of providing AMSY, the closure should be increased to 69 days. Staff advised that such an extension was not sufficient to achieve a similar management objective for bigeye tuna. To supplement the proposed 69 day closure, Staff proposed four options:

- Close the purse seine fishery to sets on floating objects for an additional 95 days in the second half of the year, or
- Close the purse seine fishery on floating objects when the estimated purse seine catch of bigeye tuna reaches 46,000 t; or
- Establish an annual bigeye quota for each purse seine vessel (within a total quota of 46,000 t) – and prohibit sets on floating objects after that limit is reached (certified by observer or unloading inspection); or
- Time/area closure for sets on floating objects (with the objective of achieving a 38% reduction in fishing mortality on bigeye tuna), and
- a 6% reduction in longline catch for the period 2007-2009.

8. The Commission agreed to extend the existing measure un-amended.

9. IATTC Staff presented an evaluation of the of the effectiveness of C-04-09 to the 7th Meeting of the IATTC Working Group on Stock Assessments, 15-19 May 2006[16]. The results indicated that sets associated with dolphins (which target yellowfin), actually increased in 2004, and decreased in 2005 relative to 2003. Effort in unassociated fisheries increased in both 2004 and 2005. On average, for 2004 and 2005, there was a 5% reduction in effort in the FAD fishery than in 2003 (compared to a 12% reduction anticipated by the Measure). Although complete data for 2005 was not available for the evaluation it was reported that the longline catch of bigeye tuna had decreased in 2004 to 60% of that taken in 2001.

10. Staff simulated the affect of the Measure for the period 2004 (the first year of the Measure) to 2010. For bigeye, Staff concluded that, by the end of 2005, the spawning stock biomass of bigeye would be 23% higher (17% higher for yellowfin) than would be the case in the absence of the Measure. The 2004 and 2005 bigeye catch would have been 13% and 7% higher respectively for purse seine (9% and 3% higher for yellowfin) and 31% and 18% higher respectively for longline (30% and 17% higher for yellowfin) – in the absence of the Measure. It was predicted that by 2008, purse seine catches based on the lower effort due to restrictions would be higher than if no restrictions had been implemented. Similarly, bigeye catches based on lower effort in the purse seine and longline fisheries due to restrictions are predicted to be higher in 2007 than in an unrestricted situation.

11. Staff noted that the intended affect of the Measure was constrained as a result of several large purse seine vessels that fished through the closure, a growth in capacity during the 2003-2005 period by 10,000m^3, plus other adaptations among the fleets.

[16] Maunder, M.N. and Hoyle, S.D. (2006). *Evaluation of the effect of Resolution C-04-09.* Document SAR-7-12. 7th Meeting of the Working Group to Review Stock Assessments, Inter-American Tropical Tuna Commission, 15-19 May 2006, La Jolla, California.

Indian Ocean

12. In 1999, the Indian Ocean Tuna Commission (IOTC) adopted Resolution 99/01 O*n the management of fishing capacity and on the reduction of the catch of juvenile bigeye tuna by vessels, including flag of convenience vessels, fishing for tropical tunas in the IOTC Area of Competence*. The Resolution forecast the adoption, at the 2000 Session of the Commission, a season and area closure of the use of floating objects in the IOTC Area of Competence. The Commission requested scientific advice relating to precise area, periods and conditions for a moratorium on the use of floating objects that would bring about a reduction in fishing mortality of juvenile bigeye. No decision was taken to implement a moratorium on purse seine fishing on floating objects or a reduction of longline capacity at the 5th Session of the Commission in 2000.

13. At its 2002 Session, the IOTC again resolved to seek technical advice from its Scientific Committee, for consideration at the 2003 Session of the Commission, relating to management measures designed to reduce fishing mortality on juvenile bigeye and yellowfin tuna (Resolution 02/08). The measures to be investigated were to include time and/or area closures on purse seine fishing on floating objects, and other forms or effort reduction or alternative fishing strategies.

14. At its 2003 Session, the IOTC considered measures to limit the impact of purse seine fishing on floating objects on juvenile bigeye and yellowfin tuna and to reduce the impact of longline fishing on the bigeye stock. The Commission noted that some Members were reducing fishing capacity of their longline fleets and that, until conservation and management measures were applied to all fleets operating in the Area of Competence of the Commission, including measures taken to address IUU fishing, the benefits of moratoria applied to the purse seine fishery were uncertain.

Attachment C

Proposals received from CCMs (and the WTPO) in response the Circular 2005-09

i). Federated States of Micronesia

09/20/2006 16:28 FAX 3202383 NORMA 001

National Oceanic Resource Management Authority
FSM National Government
P.O. Box PS122
Palikir, Pohnpei, Federated States of Micronesia 96941
Tel: (691) 320-5181/2700 Fax: (691) 320-2383 Email: norma@mail.fm

September 20, 2006

Mr. Drew Wright
Executive Director
Western and Central Pacific Fisheries Commission
Kolonia, Pohnpei FM 96941

Dear Drew,

Re: Paragraph 11. Conservation and management Measure 2005-01

In response to your Circular 2006/09 on the above subject, I would like to propose that you present some drafts on how this should be accommodated. I am sure after the Manila meeting you should have a general idea of how people want to go about this. The other option is to invite proposals by CCMs.

In trying to achieve the overall reduction in catch and effort required for bigeye and yellowfin consideration should be given to the following:

- Catch of skipjack tuna is not unduly restricted;
- Closure of all the high seas areas in the Convention Area to all purse seining;
- Prohibit the use of all forms of fish aggregating devices (natural or man-made, drifting or anchored);
- Control the domestic fisheries in Indonesia and the Philippines;
- Reduce longline effort of some of the larger fleets; and
- Not unduly prohibit legitimate development aspirations by small island developing states.

These are my comments for. I hope they are useful.

Sincerely yours,

Bernard Thoulag
Executive Director

ii). Republic of Korea

From: Chiguk Ahn [mailto:chiguka62@yahoo.com]
Sent: Friday, September 15, 2006 19:41
To: Andrew Wright
Cc:
Subject: Korea's Comments on Time Closures

Dear Mr. Andrew Wright,

I am responding to your letter dated 16 August 2006, regarding Paragraph 11 of the Conservation and Management for Bigeye and Yellowfin Tuna 2005-03.

General Considerations

- - The primary concept for the conservation and management measure for bigeye and yellowfin is not to increase the total level of fishing efforts across the Convention area to ensure the long-term conservation and sustainable use.
- Conservation and management measures for bigeye and yellowfin tuna should be based on the best scientific evidence available and precautionary approach in accordance with the Article 5 of the Convention. Primary consideration should be given to protection of the juvenile bigeye and yellowfin.
- Compatible measures between EEZs and High Seas should be established in accordance with the Article 8 of the Convention. And also consistent measure with IATTC arrangements that the Commission agreed in the second session should be developed.
- Any conservation measure for time closure should be taken into consideration the easiness, fairness, efficiency and cost effectiveness of the implementation.

Substantive Elements

- - Applicable vessels should be all purse seine vessels across the Convention area for a certain period.
- Review process by the Commission (including SC and TCC) to evaluate the effectiveness of the measure should be established.

The Process for Developing the Proposal

- Could we have a chance to see your draft in the coming TCC meeting and exchange views?
- would appreciate your efforts to promote conservation and sustainable use of the tuna resources in the Convention area.

Sincerely yours,

Mr. Chiguk Ahn
Deputy Director
International Cooperation Division
International Cooperation Bureau
Ministry of Maritime Affairs and Fisheries
Tel : 82-2-3674-6994~5
Fax : 82-2-3674-6996
E-mail : chiguka62@yahoo.com

iii). Papua New Guinea

NATIONAL FISHERIES AUTHORITY
PO Box 2016, Port Moresby, National Capital District, Papua New Guinea
Telephone 309 0444, Facsimile: 320 3024, Email: nfa@fisheries.gov.pg

OFFICE OF THE MANAGING DIRECTOR

19 September 2006

Mr. Andrew Wright
Executive Director
Western Central Pacific Fisheries Commission (WCPFC)
PO Box 2356
Kaselehlieh Street
Kilomia, Pohnpei State of Micronesia
FSM

Dear Mr. Wright,

SUBJECT: PROPOSAL FOR PURSE SEINE CLOSURE

Thank you for your letter of 16 August 2006.

Please be advised as follows:

Papua New Guinea proposes the following closure measure:

1. There shall be no fishing by large scale tuna longline vessels or by tuna purse seine vessels in the WCPF Convention Area, in the high seas bounded by the 20°N parallel and the 20°S parallel between 0000 hours on 1 July and 2400 hours on 31 December of each year.

2. In addition, there shall be no fishing at any time by large scale tuna longline vessels and by tuna purse seine vessels in the following high seas pockets:

   i) the area of high seas bounded by the national waters of the Federated States of Micronesia, Indonesia, Palau and Papua New Guinea; and
   ii) the area of high seas bounded by the national waters of the Federated States of Micronesia, Fiji, Kiribati, Nauru, Papua New Guinea, Solomon Islands and Tuvalu.

The rationale for this proposal is as follows:

There are now limits in place on purse seining in national zones, but not in the high seas. This is not consistent with the requirement in the Convention (Article 8) that measures adopted for the highs seas and national waters shall be compatible; it undermines the purse seine limits being applied in national waters under Commission Measure 2005-01 because vessels can simply transfer effort to the high seas; it transfers a disproportionate burden of management and conservation action onto the Pacific Island countries in whose waters the majority of purse seining takes place; it is not consistent with the advice of the Scientific Committee; and it is not consistent with measures adopted by the IATTC because it leaves the high seas of the WCPO as the only area in the whole tropical Pacific Ocean where there are no limits on purse seining.

The proposal above is consistent with the IATTC arrangements because it covers the two closure periods applied by the IATTC. Papua New Guinea also considers that compatible measures should be applied to longlining on the high seas, and propose that all high seas areas in the tropical Convention area between 20 N and 20 S should also be closed for six months annually to large scale longlining.

Papua New Guinea is also deeply concerned about status of fishing in the high seas pockets adjacent to Papua New Guinea's waters. These pockets are a base for vessels involved in IUU fishing. Closing the pockets is necessary to deter IUU fishing and provides the kinds of benefits that are known to arise from the establishment of Marine Protected Areas. Papua New Guinea therefore proposes a permanent closure of these high seas pockets to all large scale tuna fishing.

Yours sincerely,

SYLVESTER B. POKAJAM
Acting Managing Director

iv). Japan

FISHERIES AGENCY
MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES, GOVERNMENT OF JAPAN
2-1, 1-Chome, Kasumigaseki, Chiyoda-ku, Tokyo 100-0013, JapanTEL: +81-3-3502-8111 EXT:

Mr. Andrew Wright
Executive Director of WCPFC
Kolonia, Pohonpei FM 96941
Federated States of Micronesia

16 September 2006

Dear Executive Director,

Re: Paragraph 11. Conservation and Management Measure 2005-01

I wish to refer to your Circular letter (2006/09) requesting the Member's view on above noted subject until 16th September 2006. I wish to inform you that unfortunately Japan is unable to submit its comments at this time. This is because, in addition to the complexity and importance of this issue, most of our human capacity had been dedicated to the work of the second session of the Northern Committee this week, which prevented us from conducting thorough consideration on this item.

It is our understanding that the deadline was set for the sake of your work instructed by the Commission to develop Secretariat's paper. Japan will continue to work on this point with particular care and reserves its right to develop its own paper or make comments on any of idea in this regard before or at the coming session of the Commission.

With respect to the process of developing the proposal, I would suggest that you would simply compile all the suggestions you received for the Commission's discussion instead of developing single proposal.

Thank you for your continued cooperation.

With best regards,

Akira Nakamae
Japanese Commissioner to WCPFC

v). World Tuna Purse Seine Organisation

From: bgmin [mailto:bgmin@dw.co.kr]
Sent: Monday, September 18, 2006 19:11
To: dreww@mail.fm
Cc: ( ); ( ); K.S.Lee
Subject: WTPO position for temporary closure in WCPFC

Dear Mr. Wright

We appreciate your e-mail message dated September 16, 2006, kindly advising us of the possible way for WTPO to present its position on development of Temporary closures for the purse seine fishery according to the paragraph 11. of Conservation and Management Measures for Bigeye and Yellowfin tuna in the Western and Central Pacific Ocean(WCPFC 2005-03) adopted in 2005.

With reference to the development of Temporary closures for the purse seine fishery, World Tuna Purse Seine Organization(WTPO) whose observer status was acquired last year acknowledges that it is an issue for CCMs.

However, WTPO, as a representative of a large portion of the purse seine fleet in the Western and Central Pacific Ocean(WCPO), whose members control more than 300 tuna purse seiners which is approximately 60% of the World's tuna purse seine fleet and 80% of the purse seine fleet fishing within the WCPO, would like to put forward our basic position on the conservation and management measures for Bigeye and yellowfin tuna for consideration during discussions with CCMs to develop a proposal of Temporary closures for the purse seine fishery, as belows.

1. Under the WCPF Convention, compatible and feasible measures should be established in EEZs and high seas of the Convention Area, and also consistent measures with IATTC arrangements should be developed.

2. Also, it needs to be ensured that the total fishing effort(namely fishing capacity) level for Bigeye and Yellowfin tuna in the Convention Area shall not be increased beyond existing level, in a manner consistent with the Conservation and Management Measures for Bigeye and Yellowfin tuna in the Western and Central Pacific Ocean(WCPFC 2005-03).

I am looking forward to discussing this issue with you and CCMs in a due course.

Sincerely yours,

Byung Goo, Min,
Acting Chairman, WTPO

Attachment D

Focus

TUNA RESOURCE MANAGEMENT

Management options for yellowfin and bigeye tuna in the WCPO fishery

Adam Langley and John Hampton

Secretariat of the Pacific Community

At the second meeting of the Scientific Committee (SC2) of the Western and Central Pacific Fisheries Commission (WCPFC), the stock assessments for yellowfin tuna and bigeye tuna in the Western and Central Pacific Ocean (WCPO) were presented (see Hampton et al. 2006a, 2006b). On the basis of these assessments, SC2 provided the following management advice to the Commission.

- In order to maintain the bigeye stock at a level capable of producing the maximum sustainable yield the Scientific Committee recommends a 25 per cent reduction in fishing mortality from the average levels for 2001–2004.
- In order to maintain the yellowfin stock at a level capable of producing the maximum sustainable yield the Scientific Committee recommends a 10 per cent reduction in fishing mortality from the average levels for 2001–2004.

The SC2 did not provide any direction as to how these reductions in fishing mortality should or could be implemented. The simplest interpretation would be to implement the advice by a direct reduction of fishing effort in all fisheries to 75 per cent of the average level of effort in 2001–2004. However, this approach is overly simplistic as it unduly impacts those fisheries that are not causing a significant impact on either the bigeye or yellowfin stocks, particularly the fisheries outside of the equatorial regions where fishing mortality rates are low.

There are a wide range of potential management measures that could be introduced to achieve the recommended reductions in fishing mortality in these two stocks. The simplest approach is to identify the main fisheries responsible for these impacts and explore the range of effort reductions required to achieve the fisheries management target. For the purpose of this analysis, the target reference point was considered to be an overall fishing mortality rate equivalent to F_{MSY} (that is, the level of fishing mortality that will produce the maximum sustainable yield). However, the SC2 also recognises that the Commission may decide to maintain stocks at a level

higher than B_{MSY} (that is, the equilibriumlevel of total biomass for a stock fished at the F_{MSY} level) and this would require fishing mortality to be at a corresponding level below F_{MSY}. Under that management objective, a larger reduction in overall fishing mortality would be required.

Methods

A wide range of potential management options for yellowfin and bigeye were investigated within the framework of the stock assessments presented at SC2. The analysis involved varying the fishing effort for four main fishery groups (longline, purse-seine associated sets, purse-seine unassociated sets, and Indonesian and Philippines fisheries) relative to a base-line level of effort ('base-line scenario'). The baseline effort was comparable to the effort series formulated for the projections undertaken in the two stock assessments (see Hampton et al. 2006a, 2006b). The projections also assumed equilibrium conditions, that is, long-term average recruitment, mediated by the stock recruitment relationship (SRR).

The outcomes of each management scenario were summarised by determining $F/F_{MSY,}$ the change in fishery specific catch (and catch per unit effort, or CPUE) relative to the base-line scenario, the change in maximum sustainable yield (MSY), and the corresponding (equilibrium) biomass level relative to the B_{MSY} level.

For the analysis, the base-line levels of fishing effort are defined as follows.

- Total purse-seine effort levels (days) equivalent to the 2004 level. The distribution of effort (days) among regions, quarters and set types was specified according to the average distributions for the period 2001–2004.
- Longline effort levels equivalent to the average of 2001–2004.
- Relative effort levels for the Philippines and Indonesian domestic fisheries at 2004 levels (due to increases in estimated effective effort for those fisheries during 2001–2004).
- For fisheries with estimated time-series variation in catchability, the estimated catchability for the last data year (2005) was assumed.

Projections were undertaken using multiples of the levels of effort for the four fishery groups: longline (LL), purse-seine associated sets (PS ASSOC), purse-seine unassociated sets (PS UNASSOC), and the Philippines/Indonesian fisheries (ID/PH).

Table 1 **Multiples of base-line effort**

Fishery group	Multiples of base-line effort
LL	0.50, 0.55, 0.60,0.65,0.70,0.75, 0.80, 0.85, 0.90, 0.95, 1.0, 1.1*, 1.2*
PS ASSOC	0.50, 0.55, 0.60,0.65,0.70,0.75, 0.80, 0.85, 0.90, 0.95, 1.0, 1.1*, 1.2*
PS UNASSOC	0.50, 0.55, 0.60,0.65,0.70,0.75, 0.80, 0.85, 0.90, 0.95, 1.0, 1.1*, 1.2*
ID/PH	0.75, 1.0

* only undertaken for runs with ID/PH effort at 0.75.
This resulted in a total of 3,528 (11*11*11*1 + 13*13*13*1) different scenarios of effort in the projection period. Each scenario was undertaken for both bigeye and yellowfin.

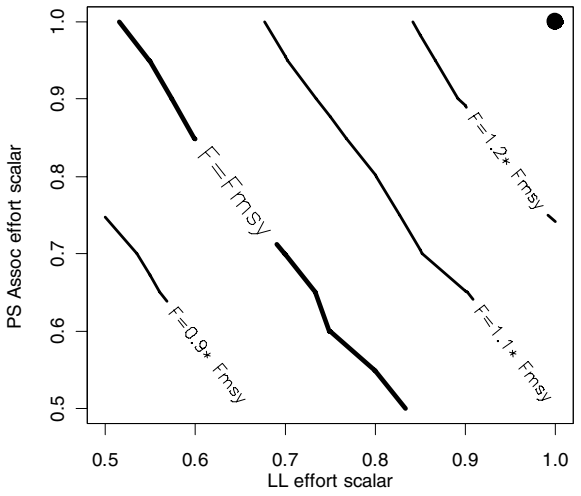
Summary and conclusions

The analysis generates a large amount of output and the results of individual runs can be examined in detail. However, this report focuses on the key outcomes of the analysis, in particular the performance of the various model scenarios were assessed relative to the main (assumed) fisheries management objective; that is, achieving a level of overall fishing mortality equivalent or below the F_{MSY} level.

Bigeye

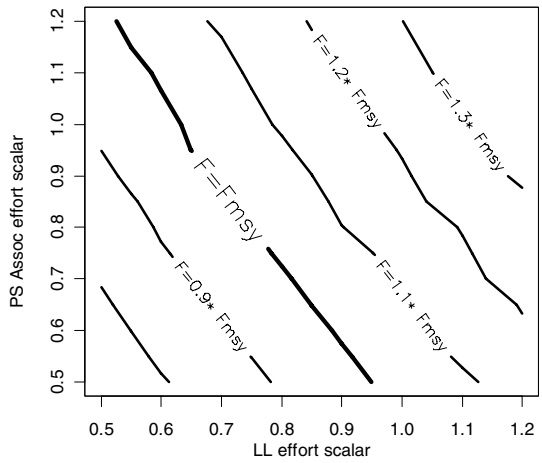
- Bigeye tuna are not caught in purse-seine unassociated sets and, consequently, the level of purse-seine unassociated effort does not affect the overall level of fishing mortality for bigeye.
- For scenarios without a reduction in Indonesian/Philippines effort (effort scalar 1.0), a large (50+ per cent) reduction in effort of either longline or purse-seine associated effort is required to reduce exploitation rates to the F_{MSY} level (Figure 1).
- Considerably smaller reductions (30+ per cent) in effort for these two fishery groups are required to achieve F_{MSY} if effort in the Indonesian/Philippines fisheries is reduced by 25 per cent (effort scalar 0.75) (Figure 2).
- A wide range of effort scenarios applied to both the longline and purse-seine associated fisheries will achieve the F_{MSY} level. For example, at current levels of effort for the Indonesian and Philippines fishery, F_{MSY} can be achieved by effort

Figure 1 **Total WCPO bigeye tuna fishing mortality rates relative to F_{MSY} for differing levels of longline and purse-seine (associated sets) fishing effort and recent Philippines and Indonesian effort levels.**



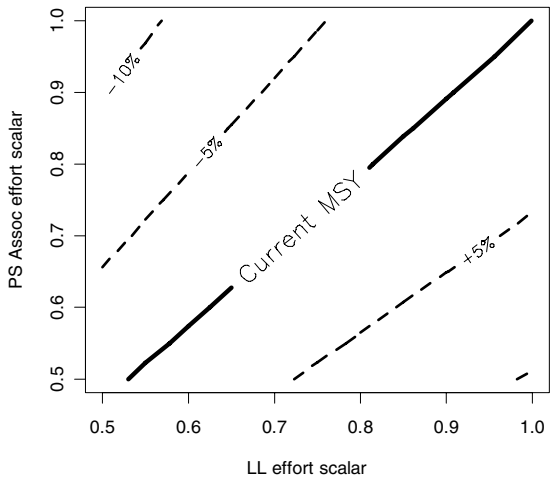
Note: Effort is expressed as multiples of the baseline effort. Effort levels for the Philippines and Indonesian fisheries are held at the baseline level (1.0). The lines represent contours of fishing mortality relative to the F_{MSY} level of effort. The point represents the current effort level.

Figure 2 **Total WCPO bigeye tuna fishing mortality rates relative to F_{MSY} for differing levels of longline and purse-seine (associated sets) fishing effort and 75 per cent of recent Philippines and Indonesian effort levels**



Note: Effort is expressed as multiples of the baseline effort. Effort levels for the Philippines and Indonesian fisheries are at 75 per cent of the recent level. The lines represent contours of fishing mortality relative to the F_{MSY} level of effort.

Figure 3 **Changes in maximum sustainable yield (MSY) for the WCPO bigeye tuna fishery for differing levels of longline and purse-seine (associated sets) fishing effort and recent Philippines and Indonesian effort levels**

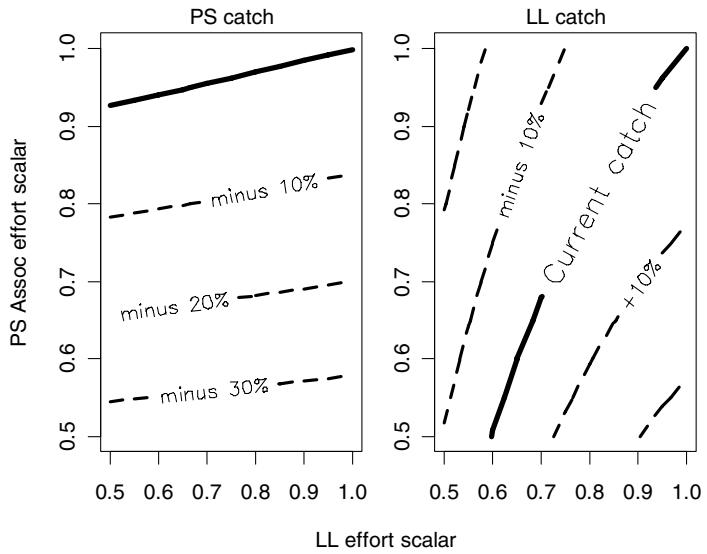


Note: Expressed as the percentage difference from the MSY from the base-case assessment ('current MSY'). Effort is expressed as multiples of the baseline effort. Effort levels for the Philippines and Indonesian fisheries are held at the baseline level (1.0).

reductions of 45 per cent and 20 per cent in the purse-seine associated and longline fisheries, respectively. Alternatively, the same target can be achieved by effort reductions of 15 per cent and 40 per cent, respectively.

- At current levels of effort for the Indonesian and Philippines fishery, the level of Maximum Sustainable Yield (MSY) from the bigeye stock would be marginally increased by an increase in the total effort that is apportioned to the longline fishery, at the expense of the purse-seine associated fishery. This is evident from scenarios that include an effort reduction in the purse-seine associated fishery (Figure 3). Conversely, a proportional shift to purse-seine associated effort will result in a marginal reduction in MSY from the stock.
- At current levels of effort for the Indonesian and Philippines fishery, the level of bigeye catch from the purse-seine fishery is predicted to decline with reduced levels of purse-seine unassociated effort (Figure 4). Declines in longline effort do not result in a significant increase in bigeye purse-seine catch.
- At current levels of effort for the Indonesian and Philippines fishery, decreases in longline effort result in declines in bigeye longline catch at current levels of purse-seine associated effort (Figure 4). However, current levels of bigeye longline catch are predicted to be achieved at lower levels of longline

Figure 4 **Estimated change in purse-seine (left) and longline (right) catch for the WCPO bigeye tuna fishery at differing levels of longline and purse-seine (associated sets) fishing effort and recent Philippines and Indonesian effort levels**



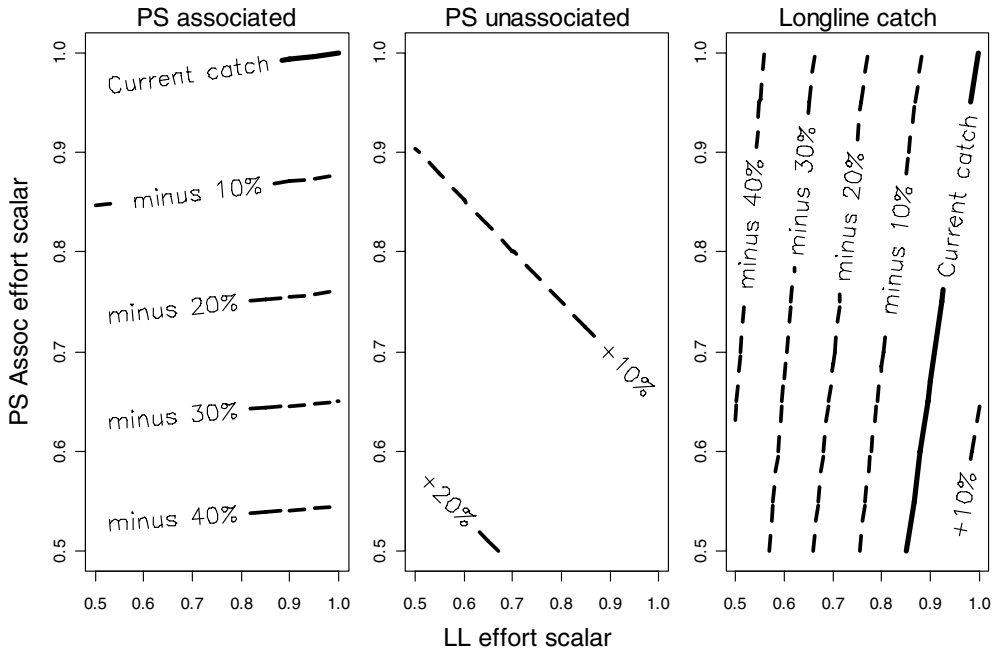
Note: Expressed as the percentage difference from the catches at obtained at the baseline level of fishing effort ('current catch'). Effort is expressed as multiples of the baseline effort. Effort levels for the Philippines and Indonesian fisheries are held at the baseline level (1.0).

effort (for example, 80 per cent of baseline effort) if corresponding reductions in effort are applied to the purse-seine associated fishery. This would result in a corresponding increase in bigeye longline CPUE. Significant (greater than 10 per cent) increases in longline catch (and CPUE) are achieved at current levels of longline effort if higher (greater than 40 per cent) reductions were applied to the purse-seine associated fishery.

Yellowfin

- Unlike bigeye, significant catches of (large) yellowfin are taken by purse-seine unassociated sets. Accordingly, this element of the fishery also needs to be considered in the range of effort scenarios considered for yellowfin tuna.
- A range of effort reductions were considered for the three fishery groups—longline, purse-seine associated, and

Figure 5 **Change in yellowfin catch by purse-seine associated (left), purse-seine unassociated, and longline (right) from the WCPO yellowfin tuna fishery at differing levels of longline and purse-seine (associated sets) fishing effort and recent levels of purse-seine unassociated, Philippines, and Indonesian effort**



Note: Expressed as the percentage difference from the catches obtained at the baseline level of fishing effort ('current catch'). Effort is expressed as multiples of the baseline effort. Effort levels for the purse-seine unassociated, Philippines and Indonesian fisheries are held at the baseline level (1.0).

purse-seine unassociated sets—at two levels of effort for the Indonesian and Philippines fisheries (0 per cent and 25 per cent reduction). For the scenarios with no effort reduction in Indonesia and Philippines, the target level of fishing mortality (F_{MSY}) is estimated to be achieved from a wide range of different effort scenarios. Compared to the two purse-seine fisheries, the reduction of longline fishing effort makes a smaller contribution to the overall fishing mortality for the WCPO stock.

- For scenarios that reduce Indonesian and Philippines effort by 25 per cent (0.75 of recent effort), the F_{MSY} for yellowfin is achieved at current levels of effort for the other three fisheries.
- An example of the change in yellowfin catch by fishery group for a range of effort scenarios is presented in Figure 5. The scenarios include the range of longline and purse-seine associated sets, while maintaining recent (base-line) effort levels for purse-seine unassociated sets and Indonesian and Philippines fisheries. Catches from both the purse-seine associated sets fishery and the longline fishery decline in proportion to the level of effort reduction. Declines in effort for both these fisheries result in an increase in predicted catch from the purse-seine unassociated set fishery.

Summary

The various scenarios included in the analysis enable a wide range of potential management options to be considered. The details of individual scenarios can be examined in further detail to assess the impact on individual fisheries as well as on the four fishery groupings. The various scenarios can also be applied to consider the impact of effort reductions achieved via a range of mechanisms such as time and area closures. More complex scenarios can also be explored through this approach, although, as with all these analyses, it is assumed that there is no compensatory behaviour by the individual fisheries that may result in an increase in the effectiveness of the fishing effort.

Overall, all the management measures investigated that achieved the F_{MSY} for bigeye also resulted in levels of fishing mortality for yellowfin that were below the F_{MSY} level. Nevertheless, more sophisticated effort scenarios, such as those that divert purse-seine effort from associated to unassociated sets, may achieve the F_{MSY} target for bigeye, but may not result in a significant reduction in the overall level of fishing mortality for yellowfin.

References

Hampton, J., Langley, A., Kleiber, P., 2006a. *Stock assessment of yellowfin tuna in the western and central Pacific Ocean, including an analysis of management options*, WCPFC SC2 SA WP-1, Manila, 7–18 August.

——, 2006b. *Stock assessment of bigeye tuna in the western and central Pacific Ocean, including an analysis of management options*, WCPFC SC2 SA WP-2, Manila, 7–18 August.

Acknowledgments

This paper was originally presented at the Fisheries Economics Management and Tuna Management Workshop for the Pacific Islands, The Australian National University, 25 and 26 September 2006. The workshop was hosted by the Crawford School of Economics and Government with the support of the Australian Agency for International Development (AusAID).

Attachment E

DRAFT PROPOSAL

**[CONSERVATION AND MANAGEMENT MEASURES [CLOSURES]
FOR BIGEYE AND YELLOWFIN TUNA
IN THE WESTERN AND CENTRAL PACIFIC OCEAN**

[Draft] Conservation and Management Measure-2006-xx

Recalling the objective of the *Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean* is to ensure through effective management, the long-term conservation and sustainable use of the highly migratory fish stocks of the Western and Central Pacific Ocean in accordance with the 1982 Convention and the Agreement.

Recognizing that the Scientific Committee expressed concern on current stock status of bigeye and yellowfin tunas and recommended reduction in the current fishing mortality for bigeye and yellowfin.

Aware that reductions of effort in purse seine fisheries and longline fisheries for bigeye and yellowfin tuna provides the best potential for reducing fishing mortality to F_{MSY}.

Noting that the Commission shall give full recognition to the special requirements of developing States and participating territories parties to this Convention, in particular small island developing states and territories and possessions, in relation to the conservation and management of highly migratory fish stocks in the Convention Area and development of fisheries on such stocks (Article 30).

Recalling that the Commission, at its Second Regular Session in December 2005 adopted *Conservation and Management Measure for Bigeye and Yellowfin Tuna in the Western and Central Pacific Ocean (Conservation and Management Measure 2005-01)* that described measures for limiting fishing effort for the purse seine fishery within waters under national jurisdiction and for limiting the catch of bigeye tuna in the Convention Area.

Seeking to take further measures to reduce the current fishing mortality for bigeye and yellowfin tuna in accordance with the advice of the Scientific Committee.

Encouraging all Members, Cooperating Non-members and Participating Territories (CCMs), and the WCPO purse seine industry, to research and develop fishing strategies to reduce the catch of juvenile bigeye and yellowfin tuna in the purse seine fishery.

Decides to adopt, in accordance with Article 10 of the Convention, the following measures with respect to bigeye tuna and yellowfin tuna, in particular.

Capacity limitation

1. A capacity limitation……

2. For purse seine vessels……

3. For longline vessels…….

Longline fishery and bigeye catch limits in the Convention Area

4. Based on the average catch for the period 2001-2004, or 2004 in the case of China and the USA, the catch limits for the following CCMs in the Convention Area shall be applied for the X year period.

CCM	2007	2008	2009	2010
x	2,000 – agreed reduction?			

5. All underages and overages of this catch limit of bigeye may be added or shall be deducted from the catch limit as follows (*example only)*:

Year of catch	Adjustment year
2007	2008 and/or 2009
2008	2009 and/or 2010
2009	2010 and/or 2011

6. The maximum underage that a CCM may transfer in any given year shall not exceed XX% of its annual catch limit.

7. The total catch and catch limits for [year] shall be reviewed and, if necessary, revised, based on the results of stock assessments in [year] by the Scientific Committee. Should adjustment to the total catch for [year] be required following this assessment, the relative shares of the CCMs for [year] shall remain unchanged from those in paragraph 4 (above) of the current Conservation and Management Measure.

Other commercial fisheries in the Convention Area

8. The catch of bigeye and yellowfin tuna by other commercial fisheries …….

Area closure

9. In order to reduce fishing mortality on yellowfin and bigeye tuna fishing by purse seiners CCMs shall, in respect of their flag vessels, ……

10. For the high seas…….

11. Within areas under national jurisdiction……

OR

12. In order to reduce fishing mortality on juvenile yellowfin and juvenile bigeye tuna by purse seine vessels CCMs shall, in respect of vessels flying their flag, prohibit fishing on anchored or drifting fish aggregating devices or floating objects for the period X month to X month in each of the following XX years…….

Catch retention

13. 100% of the catch of skipjack, yellowfin and bigeye by purse seine vessels will be retained by the vessel and delivered for transhipment to a carrier or unloading to a shore facility. The regular session of the Technical and Compliance Committee will monitor and report on compliance with this provision.

Contraventions

14. Each CCM will prohibit landings, transhipment and commercial transactions in tuna and tuna products that are positively identified as originating from fishing activities that contravene any element of this Conservation and Management Measure. The regular session of the Technical and Compliance Committee will monitor and report on the implementation of this provision.

Research and development

15. CCMs will encourage research and development of technologies that will assist purse seine fishing vessel operators identify the species composition of schools of highly migratory fish prior to sets. Research and development efforts to characterise the composition of schools of highly migratory fish species, particularly juveniles, beneath fish aggregating devices and floating objects, is considered highest priority. The regular session of the Technical and Compliance Committee and the Science Committee will monitor and report on the developments in respect of this research and implementation efforts.

Indonesia and Philippines

16. ……fisheries in Indonesia…….

17. …… and Philippines……

Data collection

18. All CCMs will ensure that purse seine and longline vessels flying their flag and actively fishing in the Convention Area fully comply with the provision of operational level catch and effort data as required by the Commission.

19. CCMs whose vessels operate in other commercial fisheries in the Convention Area will take necessary measures to ensure that the Commission is provided with complete and accurate data relating to the catch of all highly migratory fish stocks.

Review

20. Commencing in 2007, the Scientific Committee will review fishery dynamics, including the catch and effort by gear (and set type for the purse seine fishery) and fishery and provide advice to the Commission so that measures supporting the objective of reducing fishing mortality for bigeye and yellowfin tuna may be reviewed and refined as considered necessary by the Commission. In particular, the scientific committee shall assess the use of alternative management measures to achieve the necessary reductions in fishing mortality for bigeye and yellowfin tuna. Measures considered shall include *inter alia*:

- Effort limits (days fished, sets, hooks)
- Catch limits
- Compulsory retention
- Capacity limits (number of vessels, purse seine well capacity)
- Seasonal and spatial closures
- Gear restrictions (set types, FAD configurations)

21. The Commission will review this Conservation and Management Measure at its regular annual session until decided otherwise.**]**

Literature

Cass-Calay, S.I., Brooks, E.N., Brown, C.A. and Scott, G.P. (2006). *A possible framework for estimating the effect of the replacement of the FAD moratorium with a time-area closure on catches of Atlantic tropical tuna.* Col. Vol. Sci Pap. ICCAT, (59) 2: 518-524.

Brooks, E.N. and Mosquueira, I. (2006). *Further analysis of time-area closures and their potential to reduce juvenile mortality of Atlantic tropical tunas.* Col. Vol. Sci Pap. ICCAT, (59) 2: 536-545.

Fonteneau, A. 2001. Potential Use of Marine Protected Areas Applied to Tuna Fisheries and Offshore Pelagic Ecosystems. Vilm Symposium on MPAs.

Hampton, J., Langley, A., Harley, S., Kleiber, P., Takeuchi, Y, and Ichinokawa, M. 2005. Estimates of sustainable catch and effort levels for target species and the impacts on stocks of potential management measures. WCPFC-SC1 SA WP-10. 34pp.

Harley, S.J. and Suter, J.M. (in press) Potential of time-area closures to reduce the catches of bigeye tuna (Thunnus obesus) in the purse-seine fishery of the eastern Pacific Ocean. Fishery Bulletin.

Langley, A. and J. Hampton. (*unpubl. manuscript*). A consideration of management options for yellowfin and bigeye tuna in the WCPO tuna fishery. Paper prepared for an FFA *Management Options Workshop,* 16-20 October 2006, Nadi, Fiji.

Lawson, T. (2003). Analysis of the proportion of bigeye in "yellowfin plus bigeye" caught by purse seiners in the Western and Central Pacific Ocean, based on observer data. Working Paper SWG-6, 16th Meeting of the Standing Committee on Tuna and Billfish, 9-15 July, 2003, Mooloolaba, Australia. Secretariat of the Pacific Community, Oceanic Fisheries Programme, Noumea, New Caledonia. 23 pages.

Maunder, M.N. and Hoyle, S.D. (2006). *Evaluation of the effect of Resolution C-04-09.* Document SAR-7-12. 7th Meeting of the Working Group to Review Stock Assessments, Inter-American Tropical Tuna Commission, 15-19 May 2006, La Jolla, California.

Moron, J. (*unpubl. manuscript*). Report on management measures for the European tuna purse seine fleet. 10 pages.

Reid, C. (*unpubl. manuscript*). An analysis of economic implications and tradeoffs in achieving maximum sustainable yield for bigeye and yellowfin tuna in the western and central Pacific Ocean. Paper prepared for an FFA *Management Options Workshop,* 16-20 October 2006, Nadi, Fiji.