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ANALYSIS OF THE DECEMBER 2003 PURSE-SEINE CLOSURE IN THE EASTERN PACIFIC OCEAN

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ABSTRACT

To ensure the sustainability of tuna resources in the eastern Pacific Ocean (EPO) the Inter-American Tropical Tuna Commission imposes restrictions on these fisheries. In 2003, an area in the equatorial region of the EPO was closed to all purse-seining for bigeye, skipjack, and yellowfin tuna for the month of December. Based on an analysis of recent catch and effort data, an estimate of the likely effects of this closure is obtained. It was determined that the reduction in catch attributed to the closure was negligible and that, overall, the closure was ineffective. This is because the closure was both too short and too small and the fleet were able to make good catches of yellowfin and bigeye tuna in regions outside the closed area.

INTRODUCTION

In order to ensure the sustainability of tuna resources in the eastern Pacific Ocean (EPO) the Inter-American Tropical Tuna Commission (IATTC) approves conservation measures to restrict fishing mortality. Generally, conservation measures are directed at two of the three main tuna species, yellowfin (*Thunnus albacares*) and bigeye (*Thunnus obesus*) tuna. Recent assessments for skipjack tuna are extremely uncertain, but do not indicate any conservation concerns. Recent assessments for yellowfin and bigeye tuna, however, indicate that current fishing effort is above that necessary to allow for the average maximum sustainable yield *if recruitment is strongly dependent on the amount of spawning*. Based on these concerns, the following measure was approved by the Commissioners:

"That the fishery for tunas by purse-seine vessels in the following area be closed from 0000 hours on 1 December to 2400 hours on 31 December 2003:

> From the intersection of longitude 95°W with the west coast of the Americas south to latitude 10°N, then west to longitude 120°W, then south to latitude 5°S, then east to longitude 100°W, then north to latitude 5°N, then east to longitude 85°W, and finally north to the intersection with the west coast of the Americas."

This closed area is Area 1 in Figure 1.

In this paper an estimate of the likely affect that this closure had on the catches of the three tuna species and the distribution and levels of fishing effort is obtained. This is not a simple task, as it

involves estimating what would have happened had there not been a closure, thus the analysis is based on several assumptions. It is based on historical catch and effort data, examining how effort was distributed during October through December, considering the catch per set that can be achieved for each species in different areas, and the estimates of fleet capacity at sea.

This analysis is greatly complicated by conservation measures that influenced the distributions of effort and catches in previous years. A summary of these conservation measures is provided in Appendix 1.

METHODS

Set by set data for all purse-seine sets directed at tunas were used in the analysis. Data was based on either Daily Activity Records (DARs) from the IATTC observer program, set-summary information for observers from national programs, or, in the absence of observer records, logbooks of the fishing vessels. Attention was restricted to data for 2000 to 2003. Sets were characterized as either dolphin-associated, floating-object associated, or unassociated.

For this analysis the EPO was divided into five spatial strata (Figure 1), the closed area and four surrounding areas. As described below, for analyses of dolphin-associated sets the closed area was further divided into two subregions, one north and one south of the equator. Effort (number of sets), landings, and catch per set are provided for each region and set type for each species.

Information on capacity at sea was also used. This information comes from weekly reports of the number of vessels at sea and the estimates of total capacity.

Estimated catches in the absence of a closure

To estimate what catches may have been in the absence of a closure requires estimation of (1) how much effort, overall, would have been expended had there not been a closure, (2) how much effort would have been exerted in the closed area had it not been closed, and (3) what catch per unit effort (CPUE) would have been obtained by sets in the closed area. The first part considers capacity at sea and how many vessels decided not to fish as much, or at all, when considering the management actions. The second part involves examining the distributions of effort in previous years to see how much effort might have been expected in the closed area.

Two models were considered for estimating CPUE. The first model was based on spatial extrapolation whereby CPUE in the closed area was predicted from that observed in the open areas, using historical ratios of CPUE. The second model was based on temporal extrapolation to estimate CPUE in the closed area from that observed in the closed area in previous months using historical ratios of CPUE. For each model there can be several scenarios. For example, I can estimate the CPUE in the closed area based on the observed CPUE in each of the other four areas, *i.e*. I can have four estimates of catches in the closed area from the spatial model.

RESULTS

Capacity at-sea

There is no evidence to suggest that the December 2003 closure resulted in any reduction in capacity at sea (Figure 2), and the percentage of capacity at-sea in December 2003 is higher than in previous years (Table 1). While the percentage of capacity at sea in December 2003 was slightly less than in November 2003, this is probably due to vessel maintenance and other

considerations. For these reasons, when estimating the possible effect of the closure, it is assumed that the closure has no affect on the number sets, only on their spatial distribution.

Estimated catches in the absence of a closure

Distribution of sets

To obtain estimates of the possible effects of the closure on the catches of the three tuna species it was necessary to estimate both the spatial distribution of effort in the absence of a closure, and the expected catch rates of sets in the closed area. This was done separately for the three set types.

As the proportion of unassociated sets in the closed area in December is generally low compared to that outside the closed area (2 to 4%), it was assumed that the closure had no effect on the catches of tuna from unassociated sets.

The proportion of floating-object sets by area in December 2001 (the most recent December in which restrictions would not have affected floating-object fisheries), excluding the region of the December 2003 closure, was similar to the distribution of floating-object sets in December 2003. Based on this, it was assumed that the distribution in floating-object sets across regions in December 2003 would have been the same as was observed in December 2001.

As there has not been a December is the past five years in which the distribution of dolphin-associated sets has not been modified by restrictions, it is far more difficult to predict where dolphin-associated sets would have been distributed in the absence of a closure. Furthermore, the fleets operating in the northern and southern segments of the closed area are different and the catch rates obtained in each subregion during the same month can be quite different..

Aside from the southwest side of the closed area, there is little effort around the border of the closed area (Figure 3). In recent years, there have not been any dolphin-associated sets outside the southwest corner of the area closed in December 2003 during the last three months of the year. For this reason it was assumed that all effort (89 sets) in Area 3 during the closure would have been directed within the southern region of the closed area (south of the equator) if there had there not been a closure. We also assumed that no effort in other regions would have been directed in the closed area in the absence of a closure. Allowing for some redistribution of effort from other areas made very little difference.

Bigeye tuna CPUE

As there is only one recent estimate for December of the CPUE of floating-object sets in the closed area, CPUE for October and November was also considered. In testing whether a temporal model was appropriate it was found that the ratio of CPUE in the closed area from October to November was relatively consistent from 2001 to 2003 (ranging from 0.51 to 0.68). In testing whether a spatial model was appropriate, it was found that the November ratios of CPUE from the closed area to the three most-fished open areas varied greatly within areas for 2001 to 2003. Based on this, it was decided that a temporal model was more appropriate, and the November to December ratio estimated for 2001 was used. It was assumed, based on the ratios, that the CPUE of floating-object sets in December 2003 was 71% of that in November 2003. Two spatial scenarios were used, one based on the CPUE ratios estimated for December 2001, and the other based on the average CPUE ratios that included data for November for 2001 to

2003, in addition to December 2001. For the first scenario it was assumed, based on the ratios, that the CPUE in the closed area was 152%, 51%, and 91% of that observed in Areas 2, 3, and 4, respectively, during December 2003. For the second spatial scenario it was assumed, based on the ratios, that the CPUE in the closed area was 222%, 90%, and 126% of that observed in Areas 2, 3, and 4, respectively, during December 2003.

Skipjack tuna CPUE

For skipjack tuna we considered the same approaches as for bigeye. As the skipjack catches from dolphin-associated sets are low (often less than 1% of the total skipjack catch), it was assumed that these did not change as a result of the closure. For neither the temporal or spatial models were the CPUE ratios for skipjack consistent across years.

For the temporal model it was assumed, based on the ratios, that the CPUE of floating-object sets in December 2003 was 56% of that in November 2003. For the first spatial scenario it was assumed, based on the ratios, that the CPUE in the closed area was 61%, 67%, and 98% of that observed in Areas 2, 3, and 4, respectively, during December 2003. For the second spatial scenario it was assumed, based on the ratios, that the CPUE in the closed area was 88%, 124%, and 110% of that observed in Areas 2, 3, and 4, respectively, during December 2003.

Yellowfin tuna CPUE

For yellowfin tuna CPUE for dolphin-associated and floating-object sets were considered separately. For the FO sets the approach used for bigeye and skipjack tuna was used.

As for bigeye tuna the October to November floating-object CPUE ratios were relatively consistent providing more support for the temporal model, while the spatial ratios were variable. For the temporal model it was assumed, based on the ratios, that the CPUE of floating object sets in December 2003 was 101% of that in November 2003. For the first spatial scenario it was assumed, based on the ratios, that the CPUE in the closed area was 86%, 110%, and 58% of that observed in areas 2, 3, and 4 respectively during December 2003. For the second spatial scenario it was assumed, based on the ratios, that the CPUE in the closed area was 104%, 91%, and 110% of that observed in areas 2, 3, and 4 respectively during December 2003.

As there are no December data to provide information on catch rates for dolphin-associated sets, all inferences were based on catch rates in October and November. For the temporal model we assumed that CPUE in the southern subregion was assumed to be the same as that observed during November 2003, as there was very little information to estimate a scaling factor. Only one spatial scenario was considered, and was based on data for November 2003. It was assumed that CPUE in the southern subregion was 78%, 139%, and 154% of that observed in areas 2, 3, and 5, respectively, during November 2003.

Bigeye tuna catches

Across the range of scenarios it was estimated that the December 2003 closure could have resulted in between a 1% increase to a 21% decrease in bigeye catches from floating-object sets in December 2003 (Table 2). Four of the seven scenarios estimated greater than 10% reductions. When annual bigeye catches are considered, however, the most optimistic scenario estimated that the closure resulted in only a 2% reduction 2003 catches. The remaining models predicted that 2003 catches were restricted by 1% or less.

Skipjack tuna catches

Across the range of scenarios it was estimated that the December 2003 closure could have resulted in between no change and a 21% increase in skipjack catches from FO sets in December 2003 (Table 3). Four of the seven scenarios estimated greater than 10% increases. Skipjack catches from floating-object sets in December 2003 are estimated to be greater with the closure because most of the scenarios estimated that CPUE in the closed area would be much lower than in the open areas. Even with the estimated increases in December catches, overall catches were predicted to be no more than 1% higher across all models.

Yellowfin tuna catches

The estimated effects of the closure differed between FO and dolphin-associated sets. For yellowfin catches in December from FO sets, the estimated effects ranged from a 9% increase to a 19% decrease (Table 4). This variability reflects the variation in the estimates of CPUE in the closed area. All four dolphin-associated CPUE scenarios estimated that yellowfin catches in December would have been less had there not been a closure (3 to 11% increases) (Table 5). This is because all CPUE model estimated that CPUE in the closed area would be lower than surrounding areas. This estimates are uncertain because of the lack of observations of CPUE in December. Even with the estimated differences of catches in December in the absence of a closure, none of the 32 floating-object/dolphin-associated scenarios (eight floating-object and four dolphin-associated scenarios) estimated more than a 1% change in 2003 yellowfin catches as a result of the closure.

CONCLUSIONS

It is difficult to predict the effects of a time area closure as it requires estimating levels of effort, the spatial distribution of effort, and the CPUE in the closed area. This task is made more difficult as several conservations measures have modified fleet dynamics in December in the last five years. Nevertheless, considering several alternative assumptions about these important variables, a range of estimates was made of the possible effects of the December 2003 closure.

It was estimated that while the closure may have slightly restricted bigeye catches in December, the closure most likely had no measurable affect on the 2003 catches of bigeye, skipjack, or yellowfin. Therefore, it is possible that the December 2003 closure was entirely ineffective as a conservation measure. This is likely because (1) December represents only one month from the year and may even be a month where effort is lower than during other months, and (2) the closed area was relatively small, and leaving many surrounding areas where high catch rates could be attained.

The ineffectiveness of the December 2003 closure provides guidance for future management actions. First, as the necessary reductions in fishing mortality were not met by this closure, it may be necessary to adjust future conservation measures to compensate for this. Also, if closures are to be continued as a key conservation measure they must be considerably larger and/or longer, with complete area closures being preferable so effort cannot be reallocated.

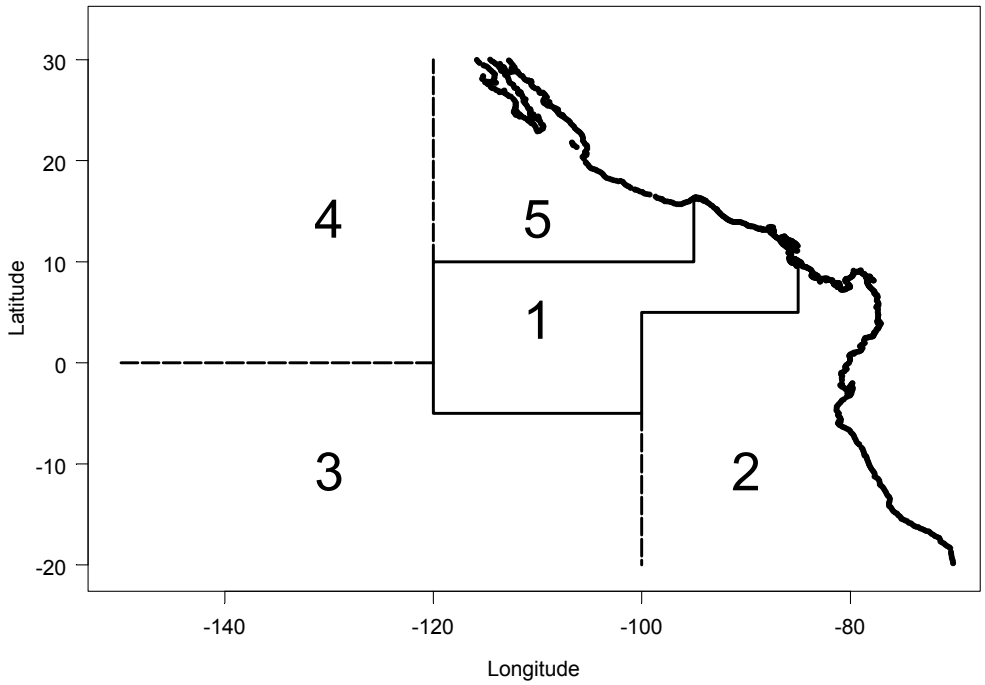

Figure 1: Plot of EPO with closed area (area 1; solid) and other regions (areas 2-5; dashed) assumed for the analysis.

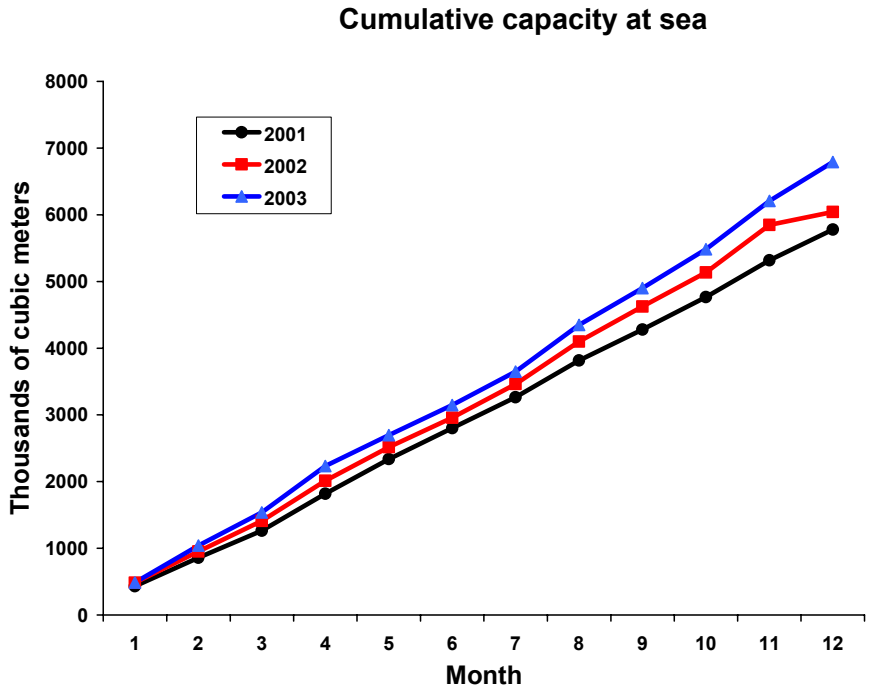

Figure 2: Cumulative capacity at sea for 2001-2003.

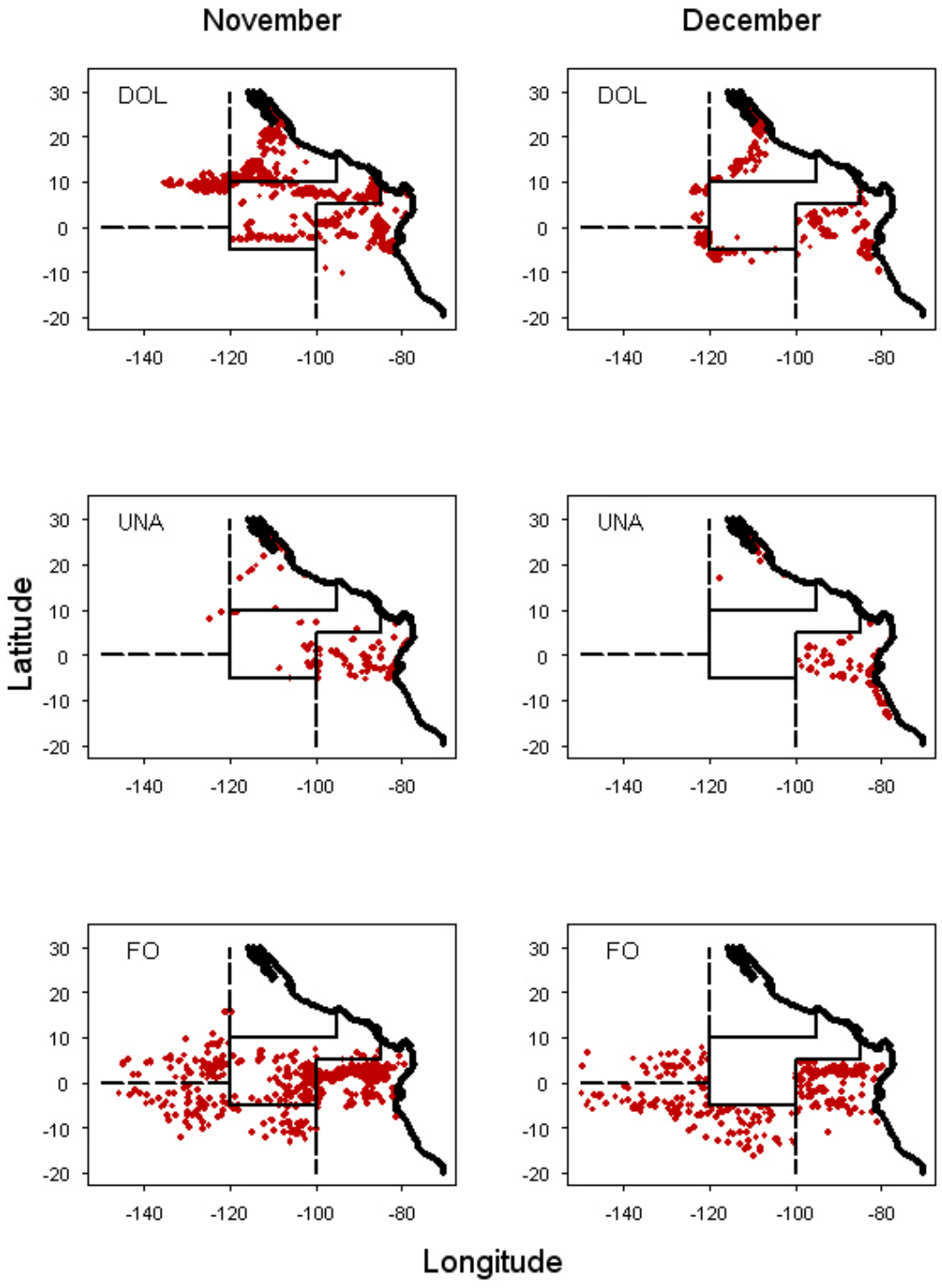

Figure 3: Distribution of sets by set type in November and December of 2003. The closed area and other regions assumed in the analysis are overlaid.

Table 1. Percentage of total capacity at sea by week and year for the weeks 39 to 52 of 2000 to 2003.

Week of year	2000	2001	2002	2003
39	51	57	63	63
40	54	60	66	72
41	55	64	63	73
42	48	70	60	72
43	45	65	63	73
44	46	60	67	71
45	41	59	74	68
46	43	50	74	69
47	44	49	66	65
48	45	50	29	62
49	40	48	14	58
50	37	47	13	56
51	34	42	16	53
52	37	46	23	46

Table 2. Estimated percentage difference in bigeye catches for December 2003 from floating object sets and for all of 2003, based on different assumptions about how the fishery would have operated in the absence of a closure. Positive values indicate that catches would have been greater in the absence of a closure.

		Spatial: December 2001			Spatial: All data		
	Temporal	Area 2	Area 3	Area 4	Area 2	Area 3	Area 4
Dec. 2003 FO	3	0	-1	11	10	14	21
Total 2003	0	0	0	1	1	1	2

Table 3. Estimated percentage difference in skipjack catches for December 2003 from floating object sets and for all of 2003, based on different assumptions about how the fishery would have operated in the absence of a closure. Positive values indicate that catches would have been greater in the absence of a closure.

		Spatial: December 2001			Spatial: All data		
	Temporal	Area 2	Area 3	Area 4	Area 2	Area 3	Area 4
Dec. 2003 FO	-12	-12	-17	-21	-2	0	-18
Total 2003	0	0	-1	-1	0	0	-1

Table 4. Estimated percentage difference in yellowfin catches for December 2003 from floating object sets, based on different assumptions about how the fishery would have operated in the absence of a closure. Positive values indicate that catches would have been greater in the absence of a closure.

		Spatial: December 2001			Spatial: All data		
	Temporal	Area 2	Area 3	Area 4	Area 2	Area 3	Area 4
Dec. 2003 FO	10	-9	10	3	-5	5	19

Table 5. Estimated percentage difference in yellowfin catches for December 2003 from dolphin-associated sets, based on different assumptions about how the fishery would have operated in the absence of a closure. Positive values indicate that catches would have been greater in the absence of a closure.

		Spatial: November 2003		
	Temporal	Area 2	Area 4	Area 5
Dec. 2003 DOL	-15	-10	-8	-15

APPENDIX 1

The following is a brief description of conservation measures directed at yellowfin and bigeye tuna in the EPO. Measures that affect bigeye tuna also affect skipjack tuna. These measures may also affect yellowfin tuna catches, but as the catches of yellowfin tuna in the floating-object fishery are small, we have ignored this. Table A.1 summarizes this information to indicate during which months and years that the fisheries for each species were modified by management actions.

1999 – Yellowfin tuna
Resolution: Catch limit of 225,000 t for the CYRA, with three additional 15,000 t increments at the discretion of the Director. An allowance for 15% YFT bycatch within the CYRA during the restricted period was also provided.
Outcome: One increment was added, at October 14, 1999, two small areas were closed. At November 23, 1999, fishing for YFT in the CYRA was restricted.

1999 – Bigeye tuna
Resolution: Catch limit for 45,000 t. After this limit is reached, sets on floating-objects are prohibited.
Outcome: Estimated catches reached the limit. Floating object sets prohibited after November 9, 1999.

2000 – Yellowfin tuna
Resolution: Catch limit of 240,000 t for the CYRA. Included provisions for alternative management such as a closure of the CYRA from December 1, 2000.
Outcome: Catches did not reach the limit, but most nations stopped fishing in December.

2000 – Bigeye tuna
Resolution: Closure of the fishery on floating objects from September 15 through December 15.
Outcome: Fishery was closed for the closure period.

2001 – Yellowfin tuna
Resolution: Catch limit of 250,000 t for the CYRA, with three additional 20,000 t increments at the discretion of the Director. An allowance for 15% YFT bycatch within the CYRA during the restricted period was also provided.
Outcome: All three increments were included. As of October 27, 2001, vessels were restricted to 15% YFT bycatch.

2001 – Bigeye tuna
Resolution: Catches of small BET were to be limited to 1999 levels. If these levels were reached the floating object fishery would be closed two weeks later, but not prior to November 1, 2001.
Outcome: Catches did not reach the limit so no closure occurred.

2002 – Yellowfin tuna
Resolution: EPO to be closed as of December 1, 2002.
Outcome: EPO was closed.

2002 – Bigeye tuna
Resolution: EPO to be closed as of December 1, 2002.
Outcome: EPO was closed.

2003 – Yellowfin tuna
Resolution: A section of the EPO to be closed December 1, 2002.
Outcome: Section of EPO was closed.

2003 – Bigeye tuna
Resolution: A section of the EPO to be closed December 1, 2002.
Outcome: Section of EPO was closed.

Table A.1. Summary of restrictions affecting the fisheries for bigeye, yellowfin, and skipjack tuna in the EPO by month and year for 1999-2003. Note that for December 2000, while, technically, the fishery for yellowfin tuna was not restricted, many nations interpreted the Resolution in such a way that they restricted the fishing activities of their vessels. Thus, while the fishery was not officially restricted, the fishery did not operate consistent with an unrestricted fishery.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999												
2000												
2001												
2002												
2003												

All three tuna species
Yellowfin only
Bigeye and skipjack only
No restrictions

APPENDIX 2. Table of catches, effort, and catch per set.

Table A.2.1 Effort, set-type, and area for October to November and years 1999 to 2003. A. 1, A. 2, etc., represent areas the areas assumed in the analysis (see Figure 1).

	Dolphin sets (DOL)														
	October					November					December				
Year	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5
1999	267	91	0	140	279	232	38	0	85	360	11	12	0	4	1
2000	893	31	0	0	68	446	68	0	66	186	67	135	1	4	120
2001	528	58	0	16	490	312	7	3	160	27	211	48	3	21	1
2002	767	72	0	13	421	648	92	0	5	627	133	26	0	0	0
2003	448	38	0	172	412	249	158	0	123	266	3	195	89	21	181
	Unassociated school sets (UNA)														
1999	11	364	1	2	73	13	533	1	2	76	14	293	0	3	21
2000	79	240	0	1	74	19	150	0	8	249	9	135	1	0	79
2001	19	89	0	0	82	6	96	0	1	96	12	131	0	0	13
2002	30	72	52	26	153	13	235	39	3	83	0	0	0	0	0
2003	69	114	2	13	101	18	210	1	2	131	0	249	0	0	129
	Floating-object sets (FO)														
1999	140	115	22	96	1	40	12	22	28	0	3	19	0	0	0
2000	15	25	0	0	1	5	29	0	11	2	124	95	53	10	0
2001	262	94	127	78	2	134	132	112	28	7	127	145	130	45	4
2002	168	336	78	59	15	71	272	61	69	12	0	4	0	0	0
2003	148	272	106	66	8	139	238	110	85	1	0	185	120	41	0

Table A.2.2 Bigeye tuna catches by set-type, and area for October to November and years 1999 to 2003. Dashes indicate strata where no sets were made (see Table A2.1).

	Dolphin sets (DOL)														
	October					November					December				
Year	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5
1999	267	3	-	0	0	0	0	-	0	0	0	0	-	0	0
2000	893	0	-	-	0	0	0	-	0	0	0	0	0	0	0
2001	528	0	-	0	0	0	0	0	0	0	0	0	0	0	0
2002	767	0	-	0	0	0	0	-	0	0	0	0	-	-	-
2003	448	0	-	0	0	0	0	-	0	0	0	0	0	0	0
	Unassociated school sets (UNA)														
1999	11	234	12	44	0	8	82	0	0	0	0	93	-	0	0
2000	79	459	-	0	0	81	102	-	0	0	0	54	0	-	0
2001	19	16	-	-	0	0	4	-	0	0	0	10	-	-	0
2002	30	52	2	0	0	0	119	6	0	0	-	-	-	-	-
2003	69	114	0	0	0	0	170	0	0	0	-	25	-	-	0
	Floating-object sets (FO)														
1999	140	425	687	1317	0	491	119	473	406	-	0	120	-	-	-
2000	15	0	-	-	0	77	0	-	208	0	3112	428	1560	172	-
2001	262	252	1825	1162	0	1043	563	2369	146	0	705	529	1405	274	0
2002	168	918	868	840	0	1123	1252	556	794	0	-	436	-	-	-
2003	148	1455	3142	812	0	2281	1864	1851	1122	0	-	1242	2312	715	-

Table A.2.3 Yellowfin tuna catches by set-type, and area for October to November and years 1999 to 2003. Dashes indicate strata where no sets were made (see Table A2.1).

	Dolphin sets (DOL)														
	October					November					December				
Year	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5
1999	5027	1408	-	3229	4134	3627	785	-	1490	4477	171	253	-	61	3
2000	17459	342	-	-	798	8131	1182	-	1659	1800	1255	2827	25	68	1599
2001	13733	1081	-	317	8835	8257	89	36	4008	538	5516	1646	275	850	15
2002	19946	2289	-	180	8257	14409	1837	-	127	12955	3521	751	-	-	-
2003	7099	706	-	3958	6972	3851	4435	-	1947	3798	72	6793	3303	480	3395
	Unassociated school sets (UNA)														
1999	152	4226	11	63	775	49	10272	0	0	1365	18	2413	-	0	66
2000	3078	3259	-	0	843	432	1685	-	0	3496	122	568	3	-	1611
2001	733	1664	-	-	1699	66	1078	-	0	2185	369	1457	-	-	199
2002	595	1652	3050	1321	3377	269	6211	1915	1	974	-	-	-	-	-
2003	637	2601	0	216	586	96	2554	0	0	1794	-	6268	-	-	1871
	Floating-object sets (FO)														
1999	1578	1060	261	1653	15	603	93	151	301	-	10	240	-	-	-
2000	351	133	-	-	5	250	149	-	41	54	1198	709	684	304	-
2001	1257	1103	974	353	4	696	1059	901	87	126	649	859	603	397	63
2002	1078	2544	334	181	74	467	1459	336	441	72	-	64	-	-	-
2003	714	1415	628	491	5	563	671	629	478	1	-	422	456	226	-

Table A.2.4 Skipjack tuna catches by set-type, and area for October to November and years 1999 to 2003. Dashes indicate strata where no sets were made (see Table A2.1).

	Dolphin sets (DOL)														
	October					November					December				
Year	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5
1999	69	6	-	23	10	59	2	-	19	10	0	0	-	0	0
2000	7	0	-	-	2	52	0	-	1	39	0	0	0	0	8
2001	62	0	-	1	64	19	0	0	21	0	79	0	0	7	0
2002	238	0	-	23	28	51	2	-	1	365	0	1	-	-	-
2003	642	0	-	236	91	66	13	-	624	165	0	82	16	93	303
	Unassociated school sets (UNA)														
1999	414	2407	0	144	1161	477	3940	36	90	39	420	3348	-	418	60
2000	622	2809	-	6	133	698	2129	-	409	91	284	2373	17	-	0
2001	409	309	-	-	384	3	645	-	15	95	59	1178	-	-	54
2002	174	365	1	4	25	0	892	99	60	568	-	-	-	-	-
2003	2354	1833	20	305	1346	624	2420	26	35	341	-	2745	-	-	351
	Floating-object sets (FO)														
1999	6612	3495	830	6018	0	1223	234	455	1650	-	170	983	-	-	-
2000	303	112	-	-	1	179	593	-	537	9	2822	2334	1671	515	-
2001	6147	1471	2641	1634	3	2774	3168	1772	414	155	1487	2778	2288	538	45
2002	1848	6433	1126	843	393	1266	5353	1449	3091	382	-	106	-	-	-
2003	6441	9293	2562	1992	158	5878	8968	2084	2205	1	-	7055	3459	683	-

Table A.2.5 Catch per set of bigeye tuna by set-type, and area for October to November and years 1999 to 2003. Dashes indicate strata where no sets were made (see Table A2.1).

	Dolphin sets (DOL)														
	October					November					December				
Year	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5
1999	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0
2000	0.0	0.0	-	-	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	-	-
2003	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Unassociated school sets (UNA)														
1999	0.1	0.6	11.8	22.2	0.0	0.6	0.2	0.0	0.0	0.0	0.0	0.3	-	0.0	0.0
2000	0.1	1.9	-	0.0	0.0	4.3	0.7	-	0.0	0.0	0.0	0.4	0.0	-	0.0
2001	2.5	0.2	-	-	0.0	0.0	0.0	-	0.0	0.0	0.0	0.1	-	-	0.0
2002	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	-	-	-	-	-
2003	4.2	1.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	-	0.1	-	-	0.0
	Floating-object sets (FO)														
1999	9.1	3.7	31.2	13.7	0.0	12.3	9.9	21.5	14.5	-	0.0	6.3	-	-	-
2000	1.7	0.0	-	-	0.0	15.4	0.0	-	18.9	0.0	25.1	4.5	29.4	17.2	-
2001	5.3	2.7	14.4	14.9	0.0	7.8	4.3	21.2	5.2	0.0	5.6	3.6	10.8	6.1	0.0
2002	8.1	2.7	11.1	14.2	0.0	15.8	4.6	9.1	11.5	0.0	-	109.0	-	-	-
2003	10.9	5.3	29.6	12.3	0.0	16.4	7.8	16.8	13.2	0.0	-	6.7	19.3	17.4	-

Table A.2.6 Catch per set of yellowfin tuna by set-type, and area for October to November and years 1999 to 2003. Dashes indicate strata where no sets were made (see Table A2.1).

	Dolphin sets (DOL)														
	October					November					December				
Year	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5
1999	18.8	15.5	-	23.1	14.8	15.6	20.7	-	17.5	12.4	15.5	21.1	-	15.2	3.0
2000	19.6	11.0	-	-	11.7	18.2	17.4	-	25.1	9.7	18.7	20.9	25.0	17.0	13.3
2001	26.0	18.6	-	19.8	18.0	26.5	12.7	12.0	25.1	19.9	26.1	34.3	91.7	40.5	15.0
2002	26.0	31.8	-	13.8	19.6	22.2	20.0	-	25.4	20.7	26.5	28.9	-	-	-
2003	15.8	18.6	-	23.0	16.9	15.5	28.1	-	15.8	14.3	24.0	34.8	37.1	22.9	18.8
	Unassociated school sets (UNA)														
1999	13.9	11.6	10.9	31.3	10.6	3.8	19.3	0.0	0.0	18.0	1.3	8.2	-	0.0	3.1
2000	39.0	13.6	-	0.0	11.4	22.7	11.2	-	0.0	14.0	13.6	4.2	3.0	-	20.4
2001	38.6	18.7	-	-	20.7	11.0	11.2	-	0.0	22.8	30.8	11.1	-	-	15.3
2002	19.8	22.9	58.7	50.8	22.1	20.7	26.4	49.1	0.3	11.7	-	-	-	-	-
2003	9.2	22.8	0.0	16.6	5.8	5.3	12.2	0.0	0.0	13.7	-	25.2	-	-	14.5
	Floating-object sets (FO)														
1999	11.3	9.2	11.9	17.2	15.4	15.1	7.8	6.9	10.7	-	3.3	12.7	-	-	-
2000	23.4	5.3	-	-	5.0	50.0	5.1	-	3.7	27.1	9.7	7.5	12.9	30.4	-
2001	4.8	11.7	7.7	4.5	2.0	5.2	8.0	8.0	3.1	18.0	5.1	5.9	4.6	8.8	15.8
2002	6.4	7.6	4.3	3.1	4.9	6.6	5.4	5.5	6.4	6.0	-	16.0	-	-	-
2003	4.8	5.2	5.9	7.4	0.6	4.1	2.8	5.7	5.6	1.0	-	2.3	3.8	5.5	-

Table A.2.7 Catch per set of skipjack tuna by set-type, and area for October to November and years 1999 to 2003. Dashes indicate strata where no sets were made (see Table A2.1).

	Dolphin sets (DOL)														
	October					November					December				
Year	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5	A. 1	A. 2	A. 3	A. 4	A. 5
1999	0.3	0.1	-	0.2	0.0	0.3	0.0	-	0.2	0.0	0.0	0.0	-	0.0	0.0
2000	0.0	0.0	-	-	0.0	0.1	0.0	-	0.0	0.2	0.0	0.0	0.0	0.0	0.1
2001	0.1	0.0	-	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.4	0.0	0.0	0.3	0.0
2002	0.3	0.0	-	1.8	0.1	0.1	0.0	-	0.2	0.6	0.0	0.0	-	-	-
2003	1.4	0.0	-	1.4	0.2	0.3	0.1	-	5.1	0.6	0.0	0.4	0.2	4.4	1.7
	Unassociated school sets (UNA)														
1999	37.6	6.6	0.0	72.1	15.9	36.7	7.4	36.3	44.9	0.5	30.0	11.4	-	139.4	2.9
2000	7.9	11.7	-	6.0	1.8	36.7	14.2	-	51.1	0.4	31.6	17.6	17.0	-	0.0
2001	21.5	3.5	-	-	4.7	0.5	6.7	-	15.0	1.0	4.9	9.0	-	-	4.2
2002	5.8	5.1	0.0	0.2	0.2	0.0	3.8	2.5	20.0	6.8	-	-	-	-	-
2003	34.1	16.1	10.0	23.5	13.3	34.7	11.5	26.0	17.5	2.6	-	11.0	-	-	2.7
	Floating-object sets (FO)														
1999	47.2	30.4	37.7	62.7	0.0	30.6	19.5	20.7	58.9	-	56.5	51.8	-	-	-
2000	20.2	4.5	-	-	1.0	35.8	20.5	-	48.8	4.4	22.8	24.6	31.5	51.5	-
2001	23.5	15.6	20.8	20.9	1.5	20.7	24.0	15.8	14.8	22.1	11.7	19.2	17.6	12.0	11.3
2002	11.0	19.1	14.4	14.3	26.2	17.8	19.7	23.8	44.8	31.8	-	26.5	-	-	-
2003	43.5	34.2	24.2	30.2	19.8	42.3	37.7	18.9	25.9	1.0	-	38.1	28.8	16.7	-