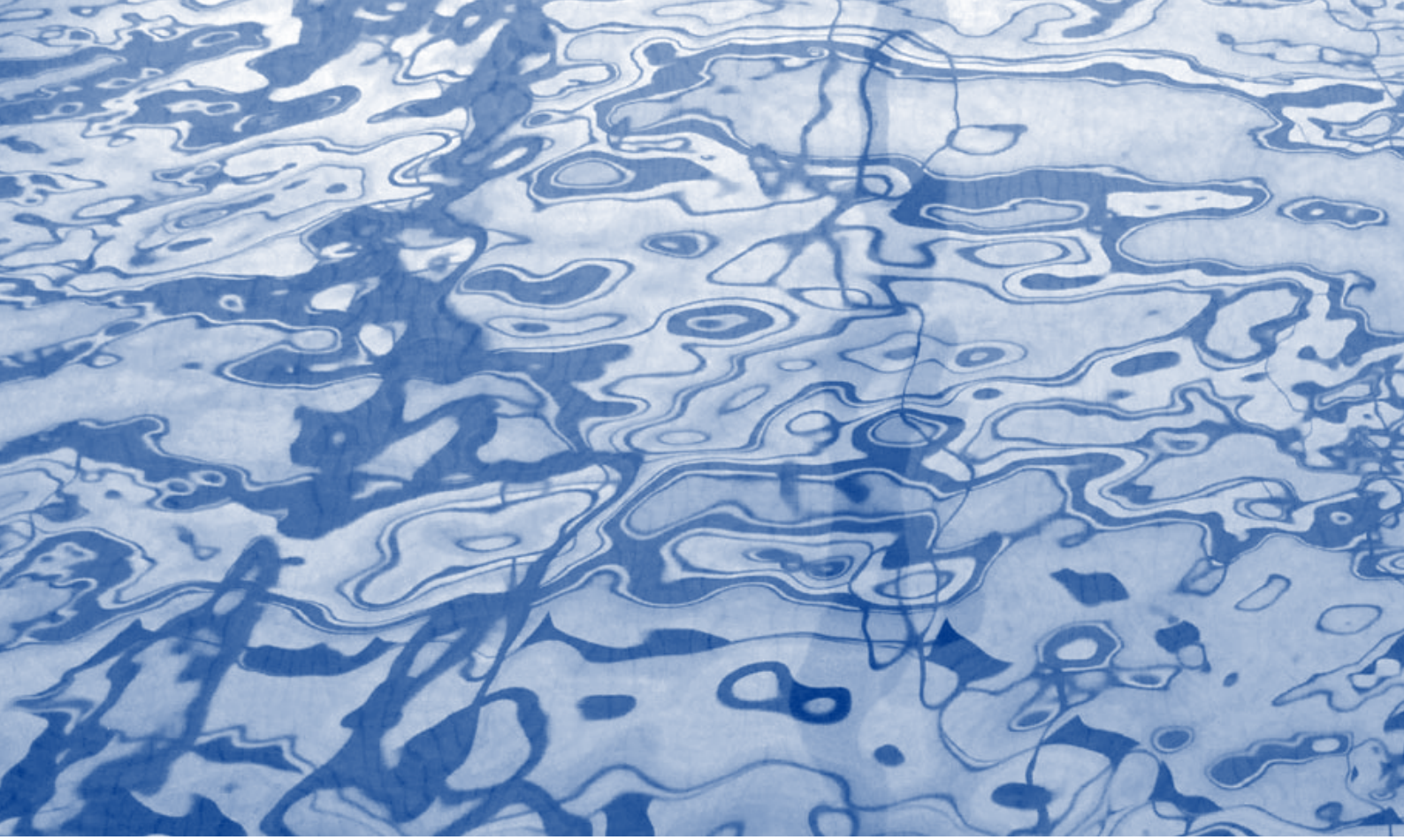
Allocation of bigeye tuna harvest rights

Economic implications of an implicit allocation of bigeye harvest rights through an across the board reduction in effort levels in the western and central Pacific tuna fishery



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Abstract

This paper analyses the economic implications of an implicit allocation of bigeye harvest rights through an across the board reduction in effort levels in the Western and Central Pacific Tuna Fishery, a multi-species, multi-sector and multi-jurisdictional fishery. Current fishing mortality on bigeye and yellowfin tunas in the Western and Central Pacific are believed to be approaching or above that associated with maximum sustainable yield. Consequently, there have been numerous calls from various government and regional bodies for fishing mortality on these stocks to be reduced. At the same time current fishing mortality on albacore and skipjack are significantly below that associated with maximum sustainable yield. One option, among many, recently canvassed at the first meeting of the Scientific Committee of the Western and Central Pacific Fisheries Commission (WCPFC-SC1) was a cut in effort levels across all fisheries. This paper analysis the economic consequences and trade offs of such an effort reduction with regard to two areas within the competence of the WCPFC, that is, within Pacific Islands Countries (PICs) national waters and on the high seas. The paper concludes that the major beneficiaries of an across the board reduction in effort levels will be the frozen longline fleet targeting sashimi grade tuna which operate primarily on the high seas while the economic costs of such a policy will be borne primarily by the purse seine fleet and the PICs in whose waters this fleet operates.

Acknowledgements

The author wishes to thank Adam Langley and Peter Williams of the Oceanic Fisheries Programme of the Secretariat of the Pacific Community for the provision of various data and Les Clark for input into the conceptual aspects of the paper.

Introduction

Current fishing mortality rates on bigeye and yellowfin tunas in the Western and Central Pacific are believed to be approaching or above that associated with maximum sustainable yield. Consequently, there have been numerous calls from various government and regional bodies for fishing mortality on these stocks to be reduced. At the same time current fishing mortality on albacore and skipjack are significantly below that associated with maximum sustainable yield (MSY).

At the first meeting of the Scientific Committee of the Western and Central Pacific Fisheries Commission (WCPFC-SC1) an analysis was presented indicating that current (2003) effort levels in the WCPFC Convention Area are not sustainable with regard to bigeye and yellowfin, in that a continuation of effort at current levels would result in the biomass of both species in 2014 being below MSY levels (Hampton *et al.* 2005). Hampton *et al.* also undertook an analysis of possible management options with respect to the predicted biological status of the bigeye and yellowfin stocks in 2014, that is, what would the size of the stocks be relative to MSY in 10 years time. This analysis was conducted under two hypotheses with regard to future recruitment, that is repetitive, that predicted by a spawner-recruitment relationship (the BH stock-recruitment curve), and estimated recent (1994-2003) average recruitment. Two options, among many, examined were a reduction in effort across all fisheries of 15 and 30 % on that which existed in the fishery in 2003. The results of the analysis presented predicted that an effort reduction of 15 (and 30)% would result in the adult biomass of both bigeye and yellowfin being at levels greater than their MSY levels in 2014 under both recruitment hypotheses.

While the results of the Hampton *et al.* (2005) analysis predict that a 15% across the board effort reduction will result in both bigeye and yellowfin being at levels greater than their MSY levels in 2014 the economic consequences of such an effort reduction are likely to vary significantly between the three major gear types (purse seine, fresh longline and frozen longline) operating in

the WPCFC Convention Area. This is for two reasons. First, the importance of the two species of concern (yellowfin and bigeye) to these fleets varies considerably in terms of the proportion of the catch and the value of the catch that these species constitute. For example, the purse seine fishery catch usually consists of around 70-80% of skipjack while the frozen longline catch is dominated by yellowfin and bigeye. Second, the benefits of reduced costs per unit catch, through increased catch per unit effort, are also likely to vary significantly between fisheries as the biomass of the exploited stocks increases.

This paper seeks to provide an analysis of the economic consequences and trade-offs of a 15% across the board effort reduction between areas within the competence of the WCPFC – national waters of Pacific Island Countries (PICs), other national waters and international waters – and between the three major fleets operating within the WCPFC Convention Area – purse seine, fresh longline and frozen longline.

Analysis and results

The analysis is confined to addressing the predicted outcomes of a 15% across the board reduction in effort under recent (1994-2003) average recruitment as generated by the Hampton *et al.* (2005) analysis[1]. As the Hampton *et al.* (2005) analysis was based on 2003 catch and effort levels for the sake of consistency we use data for 2003 throughout this analysis. Further, the analysis simply addresses the questions as to what would be the outcomes in terms of the value of catch under the effort reduction in 2014 following the approach taken by Hampton *et al.* (2005). It does not examine changes during the intervening ten years.

For this analysis catch changes for all major landed species are required for:

- purse seine operations in the national waters of PICs, other areas of national waters and international waters;
- fresh longline operations in the national waters of PICs, other areas of national waters and international waters, and;
- frozen longline operations in the national waters of PICs, other areas of national waters and international waters.

The Hampton *et al.* (2005) analysis provides predicted catch changes at a different spatial and gear level to that required for this analysis. To overcome this we use the aggregated results for purse seine and longline fishing operations from Hampton *et al.* (2005) and proportion these using observed 2003 spatial distribution and, in the case of the longline fleets, observed 2003 catch proportions between the fresh and frozen fleets.[2] The aggregate change in catch from the Hampton *et al.* (2005) analysis comparing 2014 with 2003 and the observed 2003 catch proportions are provided in Table 1. The resulting estimated bigeye and yellowfin catch changes by fleet and area used for this analysis are provided in Table 2.

1 Hampton *et al.* (2005) do not actually present changes in catch in their paper. These estimates were obtained from SPC-OFP (pers. com. A. Langley, Principal Fisheries Scientist, SPC-OFP, Dec 2005).

2 The frozen longline fleet is defined as the distant water longline fleet of Japan, Korea and Taiwan, all other longline fleets are classified as part of the fresh longline fleet.

Table 1. Change (2014 versus 2003) in yellowfin and bigeye catch in WPCFC Convention Area under a 15% across the board effort reduction and the proportion of 2003 catch taken by each gear by species and area.

	Bigeye	Yellowfin
WCPFC Conventiona		
Purse seine	-2,896	-36,483
Longline	3,517	-7,754
Proportion of 2003 purse seine catch caught inb		
PICs national waters	57%	65%
Other national waters	24%	19%
International waters	19%	16%
TOTAL	**100%**	**100%**
Proportion of 2003 longline catch caught by fresh longliners inb		
PICs national waters	20%	16%
Other national waters	17%	40%
International waters	10%	8%
TOTAL	**46%??**	**65%??**
Proportion of 2003 longline catch caught by frozen longliners inb		
PICs national waters	26%	18%
Other national waters	0.1%	0.2%
International waters	28%	17%
TOTAL	**54%**	**35%**

a. Hampton *et al.* 2005. b. Pers. com, P. Williams, SPC-OFP, April 2005.

Table 2. Estimated catch change by gear by species and area under a 15 per effort reduction 2014 versus 2003 (-ve indicates catch reduction, +ve indicates catch increase)

	Albacore (Mt)	Bigeye (Mt)	Skipjack (Mt)	Yellowfin (Mt)
Purse seine				
PICs national waters	Na	-1,658	-96,961	-23,573
Other national waters	Na	-684	-19,617	-7,043
International waters	Na	-554	-30,484	-5,867
TOTAL	**Na**	**-2,896**	**-147,062**	**-36,483**
Fresh longline				
PICs national waters	-2,712	697	Na	-1,276
Other national waters	-1,166	583	Na	-3,117
International waters	-1,572	339	Na	-613
TOTAL	**-5,450**	**1,619**	**Na**	**-5,007**
Frozen longline				
PICs national waters	-496	923	Na	-1,421
Other national waters	-10	5	Na	-16
International waters	-2,487	971	Na	-1,310
TOTAL	-2,993	1,898	Na	-2,748

Also shown in Table 2 are estimated changes comparing 2014 with 2003 in the purse seine catch of skipjack and the fresh and frozen longline catch of albacore by area under a 15% across the board effort reduction. Hampton *et al.* (2005) state that "…it is clear from the skipjack assessment (Langley *et al.* 2005) that current skipjack yields (average catches) would tend to have approximately a linear response to reductions in effort. Therefore, we would expect a 30% reduction in purse seine effort to result in roughly a 30% reduction in purse seine skipjack catch." (p. 13). If this holds then it follows that a reduction of 15% in purse seine effort would lead to a reduction of roughly 15% in skipjack catches. Thus, the reduction in the purse seine skipjack catch as shown in Table 2 is simply 15% of the observed purse seine skipjack catch in 2003 as given in Lawson (2005) and allocated by area based on the proportions calculated from data supplied by the Oceanic Fisheries Programme of the Secretariat of the Pacific Community (SPC-OFP) (pers. comm., Peter Williams, Fisheries Database Supervisor, April 2005). Following this, for albacore we assume that a reduction in longline effort of 15% would lead to a 15% reduction in albacore catches. This is based on the most recent albacore stock assessment undertaken by SPC-OFP (Langley and Hampton, 2005) which indicates that current effort levels are well below effort levels associated with MSY and to paraphrase Hampton *et al.* (2005) it appears current albacore yields (average catches) would tend to have approximately a linear response to reductions in effort.[3] Thus, the reduction in longline albacore catch as shown in Table 2 is simply 15% of the observed south pacific longline albacore catch in 2003 as given by Lawson (2004) and allocated by area based on the proportions calculated from data supplied by SPC-OFP (pers. comm., Peter Williams, April 2005).

To estimate the change in the value of the fishery the estimated change in catch is multiplied by the price received for the catch where price is specified by gear and species. The prices are based on those observed in 2003, for reasons previously outlined, and specified in Table 3. These prices are best treated as indicative prices only and, as such, it is important to note that there is considerable variation in prices, particularly for purse seine caught fish, both within and across years and that not all fish will be sold on the market which the prices are based on nor necessarily attract an equivalent price on other markets. Finally, no allowance is made for any impact on prices that would occur as a result of changes in catch levels. Such impacts may be significant.

3 It is important to note that the albacore stock assessment undertaken by Langley and Hampton (2005) is a regional assessment and at a national level this may not hold as the effects of an effort reduction in areas suffering from local depletion may lead to increases in catch per unit effort as effort is reduced and the stock recovers.

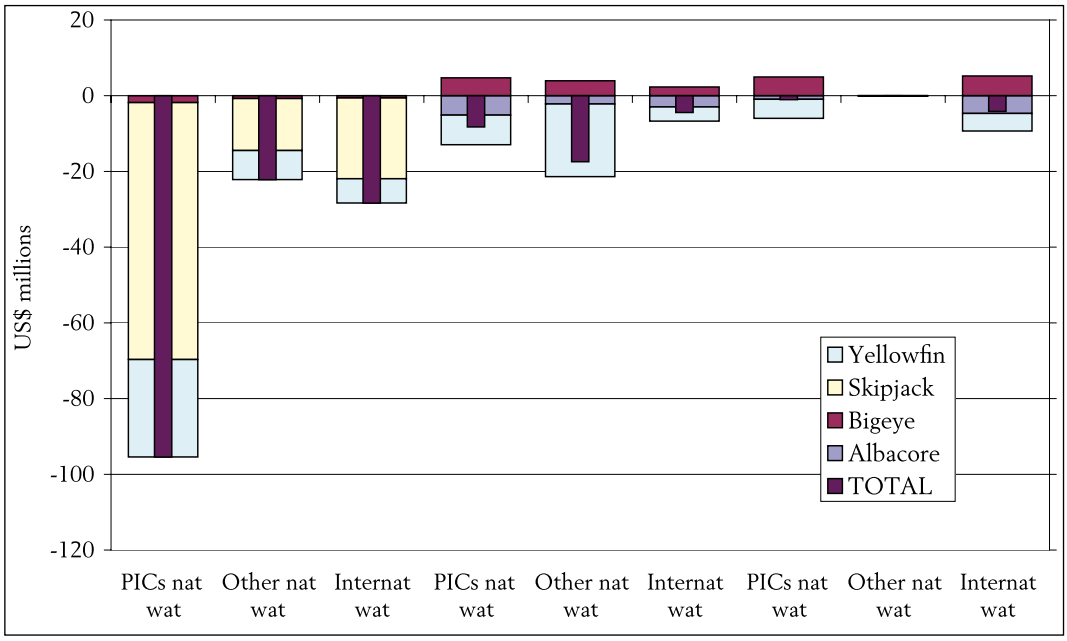
Table 3. 2003 prices by gear and species.

	Prices (US$ per metric tonne)			
	Albacore	Bigeye	Skipjack	Yellowfin
Purse seine[a]	Na	1,093	700	1,093
Longline – fresh[b]	1,884	6,782	na	6,161
Longline – frozen[c]	1,884	5,372	na	3,566

Notes: a. Skipjack and yellowfin: Thai imports of frozen skipjack and frozen yellowfin. Bigeye is usually not separated and tends to be sold in yellowfin lots and so is assumed to attract the same price as yellowfin. b. Bigeye and yellowfin: Japanese imports of fresh yellowfin and bigeye. Albacore: Thai imports of frozen albacore. c. Yellowfin: Longline caught yellowfin sold at Yaizu (Japan). Bigeye: Frozen bigeye landings at selected Japanese ports. Albacore: Thai imports of frozen albacore.

Figure 1 provides the estimated change comparing 2014 with 2003 in the gross value of the catch by gear by species and area. These results are best treated as indicative and used to obtain some understanding of potential trade offs rather than as precise measures of potential outcomes. As can be seen the impact in terms of the gross value of the catch is greatest for the purse seine fishery with most of this impact being within the national waters of PICs. It is estimated that the gross value of the purse seine fishery would in 2014 be some US$146 million less than its value in 2003 with the gross value of the purse fishery within the waters of PICs declining by around US$95 million. This result is driven by the fact that catch per unit effort and hence revenue per unit effort remained stable as effort is reduced even though the biomasses of the stocks increase. This in turn results in total catch and revenue declining at a rate similar to the reduction in effort.

Figure 1. Estimated change in the gross value of the fishery by gear by species and area under a 15 per effort reduction 2003 v 2014.



On the other hand the analysis indicates that gross value of the frozen longline fishery in 2014 will be some US$5 million less than its value in 2003 with small or negligible declines in all areas. This result is driven by the fact that catch per unit effort, and hence, revenue per unit effort increase to such an extent, as effort is reduced and the biomasses of the stocks increase, that there is only a marginal decline in the fleet's total catch.

The gross value of the fresh longline fishery is estimated to decline by some US$30 million including a US$17 million decline in other national waters and a US$8 million decline in the national waters of PICs.

In terms of areas the gross value of the catch is estimated to be US$105 million, US$40 million and US$37 million lower in 2014 than 2003 in PICs' national waters, other national and international waters respectively.

Discussion

The analysis conducted in this paper indicates that an across the board effort reduction of 15% will have widely varying impacts in terms of the gross value of the catch between areas and fleets.

However, changes in gross values are not necessarily a good indicator of changes in the economic value of fishery with costs and other factors, including impacts on the economic value generated in countries which have on-shore processing industries, being vital components in the determination of the level of net economic benefit that a country or fleet obtains from the exploitation of fish stocks. In addition the estimated gross values do not take into consideration the forgone value that may be generated from increases catch levels of skipjack and albacore for which current catches are believed to be significantly below MSY levels (Langley *et al*. 2005; Langley and Hampton 2005).

Within the context of the issue of fishing costs and the level of net economic benefit that arise directly from fishing activity the following can be drawn from the results of the analysis. For the frozen longline fishery gross revenue only declines marginally under the 15% across the board effort reduction. This is driven by a substantial increase in catch per unit effort which in turn will lead to a substantial increase in revenue per unit effort. This increase in catch per unit effort is driven by an increase in bigeye catch per unit effort with bigeye constituting *around nearly* half the total catch of this fleet. Assuming that costs per unit effort remain constant, total costs in the fishery would decline by a similar magnitude as the effort reduction. Thus the change in net economic value generated by the longline fleet resulting from an effort reduction of 15% would be substantial as revenues in 2014 remain at 2003 levels and costs in 2014 fall in the order of 15% compared with 2003 levels. For the purse seine fishery, however, catch and revenue per unit effort in 2014 remain at similar levels to that in 2003. Thus, a 15% effort reduction leads to a similar proportionate fall in the gross value of the fishery and, assuming constant cost per unit effort, the total cost of landing the catch.

Thus, net economic benefits (or losses) generated in the fishery will decline by an amount similar to the level of the effort reduction. It needs to be noted that this assumes that there is no increase in prices as a result of lower catches. The results for the fresh longline fleet fall in between these results with bigeye making up a significantly smaller portion of the catch than for the frozen longline fleet and hence the benefits gained from increased bigeye catch rates being less than that seen for the frozen longline fleet.

In many PICs there are large pools of underutilized resources for which there are no or very little opportunity costs in their utilisation. Thus, processing of tuna in PICs, such as Papua New Guinea, may generate substantial economic benefits through the employment of otherwise unemployed resources, particularly labour, aside from the benefits associated with value adding and profit generation. As such, any comprehensive economic assessment of the trade offs of reducing effort levels in the Western and Pacific Ocean (WCPO) tuna fishery needs to take into consideration the impact of any resulting reduction in supplies to the processing industries in such countries.

Conclusion

This paper seeks to provide some preliminary analysis of potential economic consequences and trade offs of one possible management option to address concerns relating to the sustainability of bigeye and yellowfin catches in the WCPO, that is an across the board reduction in effort levels. The results of the analysis indicate that such an approach is likely to lead to very different economic outcomes for different fishing fleets and countries, be they distant water fishing nations or coastal states. This in turns leads to the question of whether it is reasonable to expect one party or one group of parties to agree to measures that may have significant adverse economic consequences while other parties gain significant economic benefits without any form of compensation for the loss borne for the benefit of the other.

The report of the Norway-FAO Expert Consultation on the Management of Shared Fish Stocks (FAO 2002) noted that the consultation emphasized among other things "that that the sharing of the benefits from the fisheries should not be restricted to allocations of TACs, or the equivalent, to national fleets, and; that consideration should also be given to the use of what the consultation referred to as "negotiation facilitators", or "side payments", such as quota trades, or mutual access arrangements. These would allow broadening the scope for bargaining over allocations, assist in achieving compromises when there are differences in the management goals of cooperating States/entities, and enhance the flexibility and resilience of the cooperative arrangements over time. The results of this paper provide evidence that the adoption of management measures by the WCPFC is likely to have substantially different economic outcomes for different fleets and commission members. To overcome the difficulties inherent in obtaining agreement on implementing management measures members of the WCPFC will need to give serious consideration to the possibility of the use of "negotiation facilitators" or "side-payments" in order to ensure that the costs and benefits of any such management measures are borne equitably between members.

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