WCPFC
SECOND MANAGEMENT OBJECTIVES WORKSHOP

Cairns, Australia
28-29 November 2013

POTENTIAL TARGET REFERENCE POINTS THAT CONSIDER PROFITABILITY OF FLEETS: SOUTH PACIFIC ALBACORE LONGLINING AS AN EXAMPLE

MOW2-WP/01
14 Nov 2013

SPC-OFP

MOW WP1: ***Potential target reference points that consider profitability of fleets: south Pacific albacore longlining as an example***

Overview:

The purpose of this paper is to take one of the most commonly mentioned management objectives from MOW1 – maximizing the economic yields from the fishery (i.e., MEY) – and providing an example of how it could be made operational to help inform discussion of candidate target reference points for a fishery.

In this example we use Net Present Value (NPV) as one potential economic quantity that one could be used as an indicator, maximised as a target reference point and applied to the southern longline albacore fishery.

Using the NPV approach we can calculate potential target reference points consistent with maximizing economic returns (e.g. MEY) and can compare these to current stock status. We also examine the economic loss that is associated with harvesting at rates greater than MEY.

The paper seeks to stimulate discussion on a range of matters from the overall objective to the appropriate economic quantities to consider to the potential implications of management options for the southern longline fishery using the results presented in the example.

It is suggested that emphasis is placed on the principles and broad strategic approach outlined in the paper rather that the specifics of the costs and assumptions used in the analysis.

Funding for this work was provided by the European Union through the SciCOFish project.

Approach:

Maximizing the net present value (NPV) of a fishery is a promising approach for determining the level of fishing effort required to optimize a wide-range of economic benefits. An advantage of this approach is that it doesn't require assumptions of equilibrium conditions and can be readily estimated using the existing capabilities of MULTIFAN-CL projections. It does, however, require the collection of a range of economic data, some of which is not currently available for all fisheries.

Net present value can be defined as the sum of the current discounted future value of the fishery over a specified time horizon.

Discounted: The discount rate seeks to discount (reduce) future cash flows to their present value. This is done as the expectation of receiving a given return in the future is worth less than receiving it today. For example, a return of $100 paid today is worth more than a return of $100 paid five years from now, due to the effects of inflation and the increased risk of not receiving the payment.

Value: We define value in this paper as the economic yield gained from resource rents through the harvesting of the fish stock. Resource rents are defined as the profit earned above and beyond that required to justify undertaking fishing activity[1].

Time horizon: The time horizon is normally chosen to inform commercial (and management) decisions concerning potential investment (e.g., increase/decrease fishing effort). In this analysis we use 20 years to reflect the lifetime of a typical business loan.

[1] Alternative definition: the amount left over when all costs of a fishing activity have been deducted from revenues, taking into account a 'normal' return to capital and risk and entrepreneurship.

In effect, the analysis seeks to estimate the level of effort associated with maximum economic yield (MEY) where economic yield is defined as the net present value of the resource rent earned over the specified time horizon.

It is also possible to use other definitions of 'value' (or economic yield) in the analysis to incorporate economic benefits accruing to an economy beyond resource rents, such as crew employment or benefits arising from onshore processing of the catch. It is intended as part of future analyses to estimate the level of catch/effort associated with maximum economic yield under a range of definitions of value. In general, the level of effort that results in MEY increases when other economic benefits such as employment and onshore processing are included in addition to resource rent.

In this example we focussed on south Pacific albacore tuna as the primary species for the southern longline fishery using the 2012 stock assessment. The general steps taken in this analysis were to:

i. project catch and effort level time series (20 years) from longline fishing under different future population and economic conditions;
ii. overlay economic information to obtain a time series of revenue from the predicted catch and the opportunity cost associated with the predicted fishing effort;
iii. calculate resource rent across the time series (revenues minus opportunity costs) and other performance indicators;
iv. discount future rents;
v. sum rents across the discounted time series to get the NPV; and
vi. predict the levels of effort (across projections) that maximize i) NPV and ii) equates to the long-term 'break-even' point for the fishery.

Analysis:

The predicted catch and value composition by species in the final year of the projection (2030) was variable among longline fleets (Figure 1). On average, predicted catches of albacore composed approximately 50% of all longline catches by weight across fleets and nearly 40% of the total value. Similarly, catches of billfish and that for 'other' species amounted to a higher proportion of the total catch compared to their proportion of the total value of the catch. In contrast, yellowfin and bigeye composed a higher proportion of the value (29% and 18%, respectively) compared to total landed catch in weight (19% and 9%, respectively). <u>While albacore are generally the target species, the catches of other species, especially yellowfin, are critical to the economic performance of all southern longline fleets</u>.

Estimates of NPV changed considerably with the level of fishing effort applied in the WCPFC-CA for each of the nine alternative economic scenarios examined (Figure 2). Across all scenarios, the estimated MEY occurred at effort levels substantially lower than that observed in 2010 (range: 0.30 to 0.86 of 2010 effort). Three of the nine scenarios examined suggest that the fishery is below the break-even point (no long-term resource rent available) when fished at 2012 effort levels (which are higher than 2010 levels), indicating that there would be insufficient returns to justify new vessels entering the fishery if facing a cost structure of USD 1.10/hook and 2012 effort levels. <u>Currently the south Pacific albacore stock is well below the MEY level (determined using the NPV approach) and could even be below the break-even point for some fleets</u>.

Across the range of price structures and fishing costs the MEY catch ranged from 39,000 mt to 76,000 mt or 40-77% of the MSY (Table 1). The biomass which supported the MEY catch was much higher than that which supported the MSY catch (2.5 to 3.22 times higher) and this increased biomass levels was associated with increased catch rates. <u>The MEY level is considerably lower than the MSY level and much higher biomass is required to be maintained to maximise economic returns than total catches</u>.

Vessels with lower overall operational costs (such as subsidized vessels) can turn a profit at much lower catch rates. Considering the medium price structure for the catch, vessels with lower costs have a break-even point allows for a 34% decline from 2010 catch rates (Table 2), whereas those vessels with higher operational costs can only handle a further 9% decline from 2010 catch rates until they reach their breakeven point. While the stock is below the MEY level, those vessels with lower operating costs have more 'room' before they reach their break-even point.

Increased levels of resource rents and profitability can be achieved with reductions in longline fishing effort from current (2012) levels up to the level that maximizes the NPV (Figure 3). The largest amount of savings is gained with initial reductions in effort. For example, attaining 30% more of the maximum NPV from the fishery is expected to require a 20% reduction in 2012 fishing effort (see Figure 4). We can still attain greatly improved economic performance without rebuilding all the way to the MEY level.

Suggested discussion points:

- What economic indicators are most suitable for the calculation of the Maximum Economic Yield?
- Do we want to maximise economic yield – or just get 'pretty good' economic yield?
- How do you consider the differing economic performance of fleets, in particular consideration of SIDs fleet performance when considering MEY-based target reference points?
- The importance of secondary species when determining economic returns and impacts/linkages with other fisheries.
- Should bioeconomic analysis like this form part of the work of the Commission? If yes, how might it be done?

Tables and Figures:

Table 1. Population and fishery performance indicators are shown for the level of fishing effort that maximizes the net present value (NPV) according to alternative catch price structures (see Table A1 in Annex) and cost per hook (USD) estimates over the projection time horizon (20 years) using an annual discount rate of 5%. Values refer to estimates in the final year (2030) for the longline fishery in the whole of the South Pacific (SP) and when operating in the southern WCPFC convention area (SPCA) only. Forgone value is the difference between the net resource rents available when fishing at 2012 effort levels and at the level that maximizes NPV.

		PERFORMANCE INDICATOR AT MEY								
Relative Price Structure	**Cost/hook** (USD)	**Scalar at Max. NPV** (rel. 2010 Effort)	**Forgone Value** (million USD)	**Catch ALB-SP (MEY)** (mt)	**Catch MEY/MSY** %	**Biomass SBMEY/SBMSY** ratio	**Change ALB CPUE (MEY)** ratio	**Catch YFT-SP** (mt)	**Catch BET-SP** (mt)	**Catch ALL-SP** (mt)
HIGH	1.3	0.48	1,512	53,727	55	2.92	1.21	15,470	7,486	91,762
	1.1	0.64	822	64,183	65	2.70	1.11	17,620	8,348	108,527
	0.9	0.86	302	75,712	77	2.46	1.01	19,972	9,252	126,986
MEDIUM	1.3	0.38	1,965	45,998	47	3.08	1.28	13,849	6,813	79,333
	1.1	0.52	1,168	56,551	58	2.86	1.18	16,050	7,722	96,247
	0.9	0.72	526	68,704	70	2.61	1.07	18,544	8,709	115,814
LOW	1.3	0.30	2,506	39,061	40	3.22	1.34	12,336	6,163	68,002
	1.1	0.40	1,603	47,624	49	3.04	1.26	14,195	6,958	81,964
	0.9	0.56	833	59,210	60	2.81	1.16	16,601	7,944	100,560

Note: effort scalars of 1.13 and 1.29 correspond to observed 2011 and 2012 effort levels releative to 2010

Table 2. Population and fishery performance indicators are shown for the level of fishing effort equivalent to the estimated break-even point according to alternative catch price structures (see Table A1 in Annex) and cost per hook (USD) estimates over the projection time horizon (20 years) using an annual discount rate of 5%. Values refer to estimates in the final year (2030) for the longline fishery in the whole of the South Pacific (SP).

		PERFORMANCE INDICATOR AT Break-Even				
Relative Price Structure	**Cost/hook** (USD)	**Scalar at Break-Even** (rel. 2010 Effort)	**Catch ALB-SP** (mt)	**Vul. Biomass ALB-SP** (2030/2010)	**Catch YFT-SP** (mt)	**Catch BET-SP** (mt)
HIGH	1.3	1.44	93,048	0.81	24,288	10,795
	1.1	1.92	103,816	0.70	26,740	11,606
	0.9	> 2.50				
MEDIUM	1.3	1.12	83,071	0.91	22,177	10,257
	1.1	1.54	95,612	0.79	24,861	10,988
	0.9	2.14	107,849	0.66	27,659	11,906
LOW	1.3	0.82	70,401	1.03	19,586	9,107
	1.1	1.16	84,472	0.90	22,475	10,162
	0.9	1.66	98,448	0.76	25,510	11,202

Note: effort scalars of 1.13 and 1.29 correspond to observed 2011 and 2012 effort levels releative to 2010

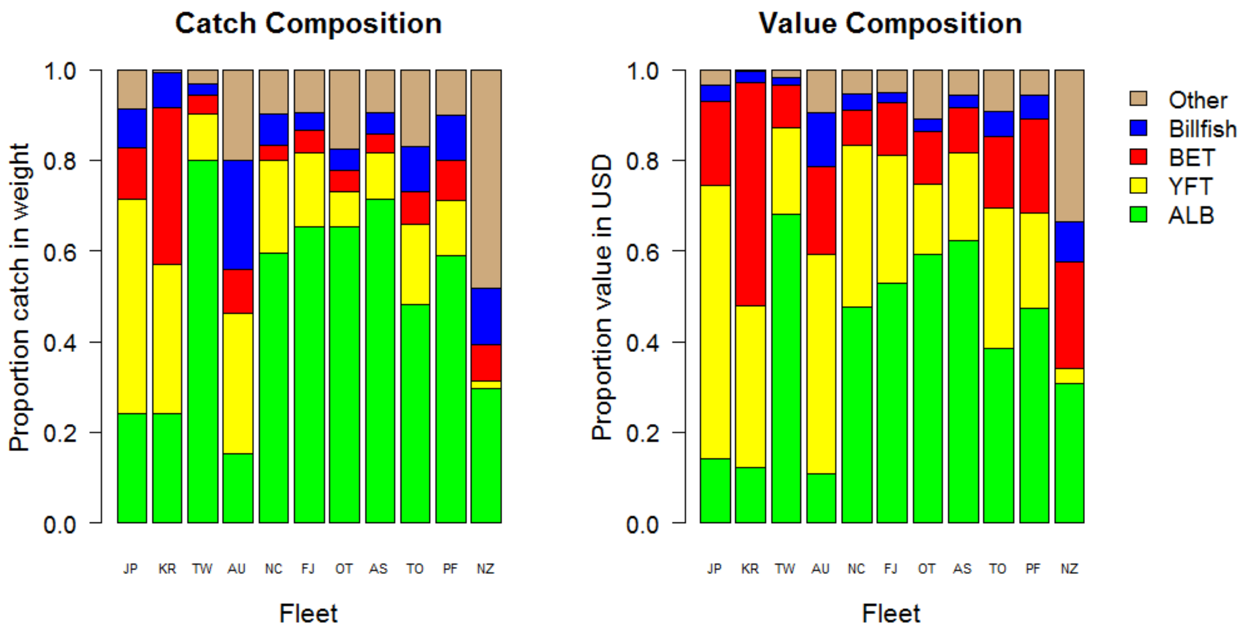

Figure 1. Predicted catch (left) and value (right; 'medium' price structure) composition by fleet and species category.

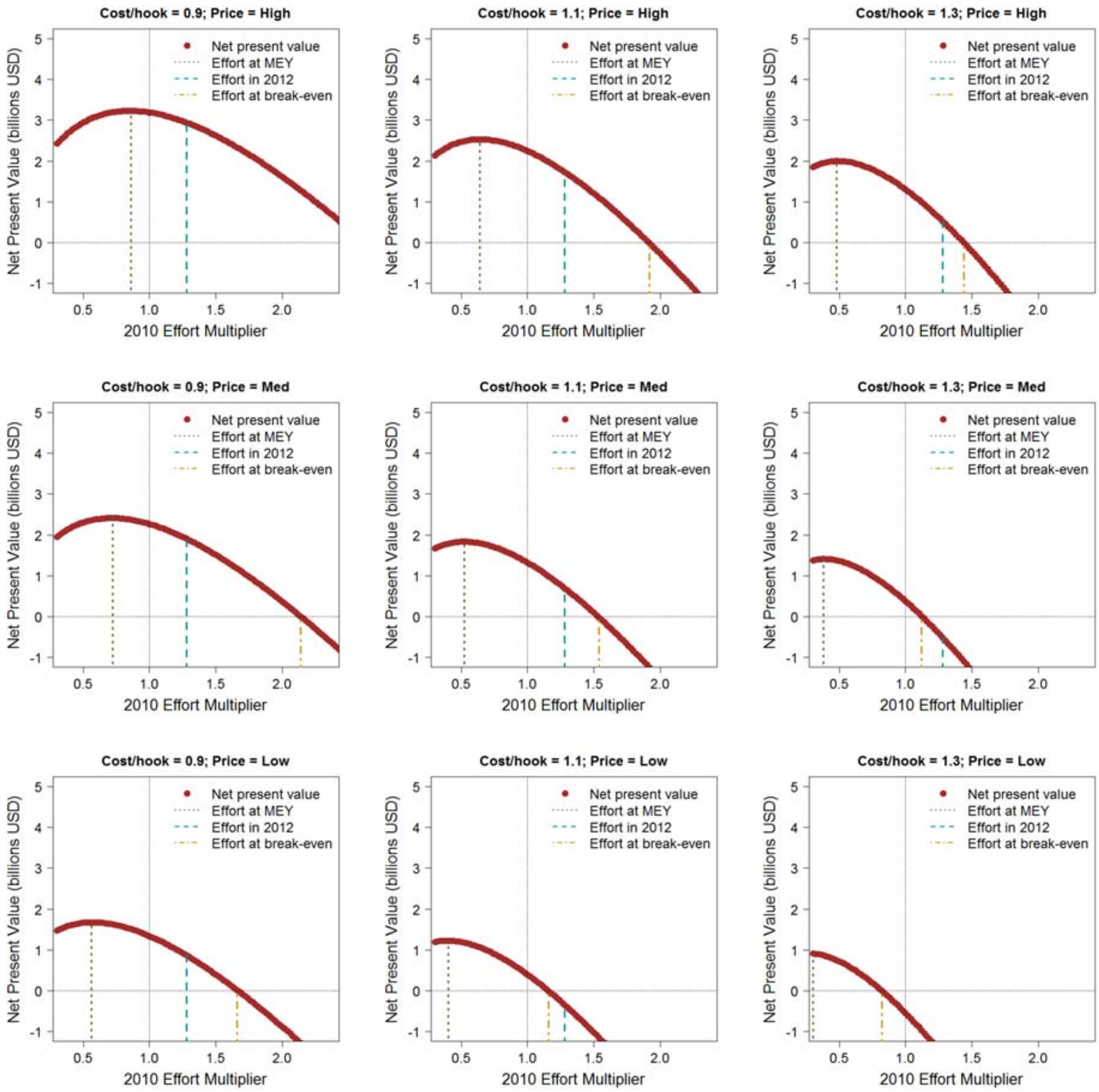

Figure 2. Estimates of net present value (NPV) are shown for the South Pacific longline fishery operating in the WCPFC convention area for different cost per hook (USD) and price structure (see Table 1) assumptions using a discount rate of 5%. Effort multipliers are relative to 2010 levels. Effort in 2012 was observed at 1.29 times 2010 levels (according to logsheet information).

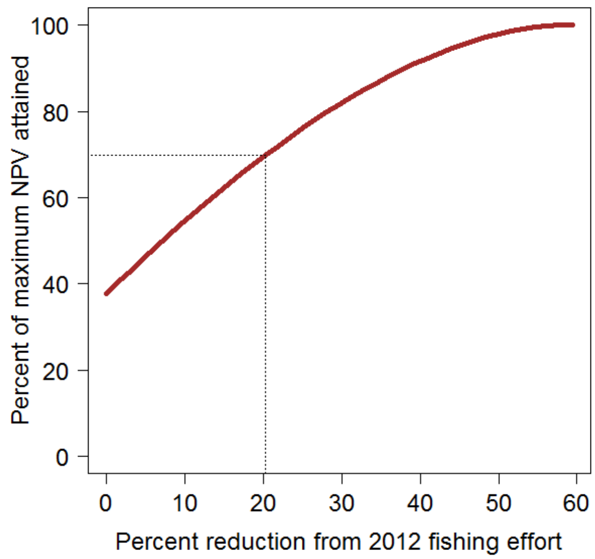

Figure 3. The expected level of the maximum net present value (NPV) attained as a function of the amount of reduction in 2012 fishing effort in the South Pacific WCPFC-CA (solid line) for the 'medium' price structure and USD 1.10 cost/hook scenario. Note that the function is concave so gains in maximum NPV occur at a faster rate than reductions in fishing effort. For example, attaining 30% more of the maximum NPV from the fishery (moving from 40% to 70% of the maximum NPV) is expected to require a 20% reduction in 2012 fishing effort (moving from 0% to 20%; dotted line).

Annex: Methods (please contact Shelton Harley sheltonh@spc.int for further details)

Stochastic projections to the year 2030 (time horizon of 20 years from 2010 conditions) were used to estimate alternative future South Pacific albacore catch levels under a range of longline effort scalars using the 2012 South Pacific albacore assessment model (model 'run 93'). The catch of yellowfin, bigeye, billfish, and a combined 'other species' category was then calculated according to the estimated albacore catch and a fleet- and species-specific scaling factor. Longline effort scalars were applied to fleets operating in the South Pacific WCPFC-CA only; longline fleets in the eastern South Pacific and troll fleets effort levels remained at 2010 levels. Projection results for each scenario were averaged over two-hundred alternative future recruitment levels to acknowledge uncertainty in future SP albacore recruitment.

Cost per hook estimates were based on an 'average' cost of putting a hook in the South Pacific waters of the WCPFC-CA for a 'typical' longline vessel (USD 1.10 per hook). Sensitivity analyses were conducted with a cost structure of ±USD 0.20 per hook. The lower range is generally consistent with other cost estimates of a heavily fuel subsidized fleet. The cost of putting a hook in the water is assumed to be constant throughout the projection period.

Three price structures were used (low, medium, and high prices) to capture recent market fluctuations. Revenues were based on an average price received for an average metric ton of fish caught by species category. Market prices are assumed to be constant throughout the projection period, invariant to the landing location, and do not take into account any size-based market differences.

Table A1. List of price, cost, and discount rate scenario options used in the projections to calculate net present value. Twenty-seven total scenarios were examined, covering each combination of the three scenarios for price, cost/hook and discount rate.

Parameter	**Species**	**High**	**Med.**	**Low**
Price/mt (USD)	ALB	3,500	3,116	2,731
	YFT	8,200	6,716	5,231
	BET	10,100	8,747	7,394
	Billfish	2,194	2,144	2,094
	Other[a]	2,094	2,094	2,094
Cost/hook (USD)		1.30	1.10	0.90
Discount rate		0.07	0.05	0.03

[a] Includes sharks and other finfish