ON THE RANGE OF IMPLICATIONS OF FLEXIBILITY/CONSTRAINING FUTURE INTER-ANNUAL TAC VARIATIONS ON THE RISK OF FAILING TO RECOVER THE WEST COAST ROCK LOBSTER RESOURCE

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SUMMARY

Inter alia for consistency with the Precautionary Principle, resource recovery plans have to take account not only of the target level of recovery desired, but also the risk of falling well below that target. The implications of this are illustrated by considering the example of the west coast rock lobster resource. For equivalent risk to the resource, higher levels of buffering against TAC variation necessitate lower TACs on average. The advantages of the OMP approach are evidenced by the some 33% larger TACs made possible through feedback control without increasing risk (for the example of OMP 2011 re-tuned), given pre-agreed rules for recommending TACs.

Resource recovery plans have to be considered not only in terms of the target level of recovery, but also in relation to the risk of falling well below that target. Thus for example, a plan that aimed at 20% recovery with only a 5% chance of the resource declining over the period concerned, would in all likelihood be considered preferable to one with a target of a 40% increase, but an associated 30% risk of a decline. Uncertainties in achieving a target recovery level arise primarily from three sources:

- Uncertainty about future resource dynamics – future recruitment in particular.
- Uncertainty in the current state of the resource (statistical estimation error arising from the noise in relationships such as between CPUE observations and resource abundance).
- Structural uncertainty in models of the resource dynamics.

Projections related to resource recovery will include some or all of these three sources of uncertainty (all three in the case of west coast rock lobster). Thus future projections for abundance comprise not only some single curve, but rather a temporal sequence of distributions of possible outcomes. Given the Precautionary Principle, it is generally accepted that the primary conservation focus needs to be on the lower tail of these distributions, with the lower 5%-ile envelope often providing the standard.

In essence then, choosing and maintaining a recovery target requires consideration of both the median AND a lower percentile of the projected abundance distributions. This has been routine practice when developing scientific recommendations for the management of South Africa's major fisheries over the past two decades.

An example based on the west coast rock lobster

West coast rock lobster provides a useful example to illustrate the trade-offs in performance, particularly as regards catches (TACs), that arise from different approaches to management, because of the considerations above.

Consider the situation in early 2013, when re-tuned "OMP 2011 re-tuned" was developed. The details may be found in FISHERIES/2013/JAN/SWG-WCRL/01; note in particular, though the details are somewhat complex, that this OMP essentially limited inter-annual TAC changes to 10%.. Associated with OMP 2011 re-tuned were predicted Global[1] TAC distributions for 2013-2021, as well as the projected distributions for the anticipated male biomass >75mm CL (B75m). We term this **Scenario I**. Table 1 lists known past catches and the medians of the distributions for future TACs under this OMP; these are also shown in Figure 1, which includes as well the trajectory formed by the medians of the projected B75m distributions together with their 90% probability envelope[2].

The parameters of OMP 2011 re-tuned were selected under agreement that the median of the distribution of B75m(2021/2006) be 1.35, i.e. to achieve a 35% rebuilding by 2021 relative to the 2006 level in median terms. It is important though to note also the associated "risk" implicitly accepted. The lower 5%-ile of B75m(2021/2006) was 0.72 (see the upper left panel of Figure 1). Thus though an increase was targeted in terms of the median (i.e. under the OMP-based TACs, there was equal probability of the resource increasing by more as by less than 35% by 2021 in comparison to 2006). Concomitant with acceptance of that median recovery level was also acceptance that the resource might decrease in abundance, with a 5% chance of that decrease being 28% or more.

Now what is predicted to happen if instead of using OMP 2011 re-tuned with its feedback mechanisms taking account of future data, the Global TACs for 2013-2021 were fixed in 2013 to the median expected TAC levels predicted by the OMP projections? We term this is **Scenario 2**, with results shown in the central panels of Table 1 and Figure 1. Note that while, by construction, the total catch over 2013 to 2021 is unchanged from that expected in median terms under **Scenario I**, and the median resource recovery is nearly the same (up 37% compared to 35%), there is an important difference as without the benefits of feedback, the distribution of the 2021 B75m projected value widens. Crucially, the resource could decrease to an appreciably greater extent, with the lower 5%-ile for B75m(2021/2006) dropping from 0.72 to 0.57. Thus the management approach associated with **Scenario 2**, though delivering the same expected total catch, is appreciably more risky.

Scenario 3 considers by how much TACs would have to be reduced compared to the **Scenario 2** situation for "equivalent risk" to **Scenario I**, i.e. a lower 5%-ile for B75m(2021/2006) increased from 0.57 to 0.72 (see the right side panels of Table 1 and Figure 1). Note that catches have to be reduced by 25% to achieve this, though there is a compensatory increase in the median recovery to be expected (37% increases to 55%).

Implications

Comparison of the results for **Scenarios I** and **III** shows that the feedback aspects of the OMP allow a considerably greater catch (by some 33%) to be achieved compared to a fixed catch approach, for the same level of risk to the resource.

[1] Global refers to offshore and nearshore commercial, interim relied and recreational catches (i.e. excludes poaching)

[2] Note the convention in this document that, for example, the 2014/15 season is referenced as 2014.

What are the implications of this in moving forward towards a basis for recommending future WCRL TACs?

- Recovery targets must specify BOTH a median and a lower percentile, and the management approach planned must address both. Thus, for example, for "equivalency" to the 2013 target decision, the median B75m(2021/2006) value must be at least 1.35 and the lower 5%-ile at least 0.72 under any management approach to be considered.
- Attempts should be made to improve the TAC recommending algorithm to reduce the spread of the abundance trajectory projections evident in Figure 1, as this could allow, for example, for larger TACs without an increase in risk to the resource.
- Admittedly over-simplifying somewhat, **Scenario I** corresponds to a 10% maximum constraint on inter-annual TAC changes, whereas **Scenario III** corresponds to a 0% maximum constraint. Clearly the more flexibility in terms of inter-annual TAC changes that resource users can accept (i.e. the less buffering), the greater the TACs can be (on average), and *vice versa*.
- These risk computations rely on prior agreement on the basis to set future TACs, so that the benefits of feedback can be calculated directly, as is inherent in the OMP approach. In the absence of that approach, the only way to take account of the Precautionary Approach within the "traditional assessment paradigm" is fixed catch projections, similarly to **Scenario III**, which would necessitate TACs being set appreciably lower.

Table 1: Global WCRL TAC values for three different management scenarios. Values in *italics* are the actual catches that eventuated. For **Scenario 1** values after 2012 are distribution medians.

	Scenario 1	**Scenario 2**	**Scenario 3**
	TAC = OMP 2011 re-tuned	TAC=constant catches fixed at median OMP 2011 re-tuned values	TAC=constant catches fixed at 75% of median OMP 2011 re-tuned values
2006	*2857*	*2857*	*2857*
2007	*2571*	*2571*	*2571*
2008	*2340*	*2340*	*2340*
2009	*2393*	*2393*	*2393*
2010	*2286*	*2286*	*2286*
2011	*2426*	*2426*	*2426*
2012	*2426*	*2426*	*2426*
2013	2272	2272	1704
2014	2133	2133	1600
2015	2035	2035	1526
2016	2107	2107	1581
2017	1997	1997	1498
2018	2029	2029	1522
2019	1943	1943	1457
2020	1944	1944	1458
sum 13-20	16462	16462	12347

Figure 1: The B75m(year/2006) trajectories for the WCRL resource as a whole showing medians and 5th and 95th percentiles for the three scenarios. The bottom plots show the median or fixed catch Global TAC trajectories for each scenario, with the total over the 2013-2020 period indicated within the plot.

SCENARIO 1 **SCENARIO2** **SCENARIO3**