Possible Approaches for incorporating Flexibility in OMP Outputs with Comments on Possible Application to West Coast Rock Lobster

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Introduction

Risks associated with fishery management decisions (e.g. alternative TAC levels) can be meaningfully evaluated (except perhaps for very short-lived species) only for a specified series of actions carried out over a period of time, and not for a decision for a single year only. Thus in conventional assessments, risks are usually indicated in terms of the consequences of the continued application of a TAC level proposed, which is taken to be fixed over a fair number of years (typically 10-20). However, this approach considerably overestimates risk, as it takes no account of the fact that such a catch level would be decreased over time if signals from indices monitoring resource abundance suggested this to be declining appreciably, thus avoiding the undesirable depletion that would otherwise occur.

The Management Procedure approach, by taking account of such feedback, does more properly evaluate the risks associated with alternative bases for setting TACs. However the decision makers' choice of an acceptable risk level (or trade-off with anticipated catches) is made on the basis of simulation results before the procedure is implemented in practice, so that the chosen procedure conventionally provides a unique TAC recommendation for each ensuing year.

How then might flexibility in a TAC decision each year be accommodated within this approach?

A Way Forward

Fig. 1 indicates the standard simulation testing procedure used in Management Procedure development, with the procedure producing a unique TAC recommendation each cycle (typically annual).

However, what matters to the operating model ("reality") is not the TAC *per se*, but the catch actually made. These two can differ for various reasons (e.g. reporting errors), and Management Procedure evaluations frequently take these into account through modeling "implementation error" (essentially the difference between the TAC set and the eventual catch), as illustrated in Fig. 2.

Fundamentally, the situation of decision makers choosing within a range of TAC options is structurally identical to implementation error, i.e. again there may be some difference between the procedure's "central" (and unique) output and the subsequent catch (see Fig. 3).

What then becomes necessary to add to the simulation evaluation process though, is consideration of a range of options that relate the "central" output from the TAC algorithm to the catch to be made.

Modelling TAC Flexibility

For such evaluations, the Management Procedure itself must output some range about the single TAC it in any case provides. This range could depend in some complex manner on values forthcoming from monitoring data, but for the moment (for ease of understanding the concept) can be thought of simply, e.g. as $\pm$ 10%.

The next and key step is to specify where the final TAC decided might lie within this allowable range, e.g. [0.9 $TAC_{central}$; 1.1 $TAC_{central}$]. A number of example options are specified below, and it is to be hoped that discussion in the Workshop will add to these. Clearly any procedure to be implemented must be tested for robustness across the set of such options considered to span the range of possibilities considered reasonably plausible.

a) "*Greedy*"

TAC_{final} = Top end of range [e.g. 1.1 $TAC_{central}$] <u>always</u>.

i.e. the decision makers always choose the highest option. If this is considered reasonably plausible, the end result is a procedure that gives a $TAC_{central}$ of (in this example) 1/1.1 of the unique TAC that would result in the standard "no flexibility" case. Even if this "maximum" choice is not made every time in practice, having to allow for that possibility results in eventual lesser utilization than would be consistent with the level of risk considered acceptable, i.e. flexibility introduces inefficiency or "cost" (the average catch achieved is less than it could be).

b) "*Random*"

TAC_{final} chosen at random from U[Bottom of range; Top of range]

i.e. the decision makers are equally likely to choose anywhere within the range in a manner that is uncorrelated from one year to the next. Flexibility of this type will introduce only very slight inefficiency into the procedure (because of non-linear effects on abundance arising from catches set above $TAC_{central}$).

c) "*Block quota*"

For longer-lived species, "block quotas" can be set for a period of years, .e.g. a TAC applicable to a three year period, with flexibility allowed within that period. Typically some limitations are placed on such flexibility, e.g. no more than 40% of the three year amount may be caught within any one year. A negative aspect of this approach is that any limitations that might be placed on TAC changes made at one year intervals (in the interests of industrial stability) will need to be weakened if changes to a block quota can occur only every three years (say).

d) "*Adjustment for the past*"

Some adjustment might be made to the TAC recommended for the next year to allow for under- or over-runs in an earlier year – likely one year before the current year, as catches for the current year would not be known exactly at the time the TAC recommendation has to be made. The under-or over-run amount could be added to or subtracted from the "first stage" OMP output, and the result subject to any inter-annual TAC change constraints. Essentially this is an approach to adjust for implementation error. The question then becomes how to simulate the likely

distribution for such future implementation error in the simulation trials. Some guidance could be drawn from historic records (e.g. see Table 1 for west coast rock lobster), but care has to be taken to check whether the circumstances that applied in the past and led to such under- and over-runs are likely to apply also in the future.

Thus admitting flexibility in the TAC chosen compared to the Management Procedure's "central" output will incur some cost in other respects, e.g. lower catches or less industrial stability in the longer term. Once again a trade-off issue arises, regarding which choice falls within the mandate of the decision makers, with scientists responsible to quantify the trade-off to assist the final decision.

Some Specifics of the West Coast Rock Lobster Situation

The West Coast Rock Lobster Fishery is managed as five separate management units called "super-areas". The existing OMP provides recommendations each year for a global TAC, the split of this TAC amongst the super-areas, and the allocation within each super-area amongst the different fishery sectors: offshore commercial, nearshore commercial, and recreational. The first two are managed by quota, and the last by effort (e.g. season length, bag limit) adjustment intended to achieve a catch close to the nominal quota set. While the offshore commercial allocations may change each year in a "continuous fashion", the allocations to the other two sectors are changed only if they fall outside a specified percentage range of the revised TAC, in the interests of greater stability in these sectors and their management (see MARAM IWS/DEC10/WCRLB/P1). In two of the five super-areas, allocations to nearshore commercial rights holders are such that there is no latitude for any further allocation to the offshore commercial sector.

Although the TAC is calculated using resource indices integrated over all five super-areas to dampen the variance in these indices were they to be considered for each super-area separately, nevertheless adjustments are made to the allocation of the TAC amongst the super-areas from one year to the next to react to differential trends in abundance indices in the different super-areas. Although the overall recovery objective for the resource is set in terms of male biomass over 75mm carapace length for all the super-areas combined, nevertheless simulation testing of any MP considers resource trends for each super-area separately as well as in combination to check that conservation performance is satisfactory for each.

Thus flexibility in OMP application might be sought for this resource at either or both of the overall and the super-area allocation elements of the TAC, and also differently amongst the three sectors of the fishery (to which a fourth – "interim relief" for small scale fishers – seems likely to be added in the forthcoming OMP revision).

In principle any of the approaches offered above might be applied at any or all of these disaggregation levels, as well as to the overall TAC. The key consideration remains how to model this flexibility and its impact in the OMP testing process.

This process should also take implementation error into account (see discussion above). The recreational (and now likely also the interim relief) sectors of this fishery offer further challenges in this respect because they are managed on relatively crude effort-control bases which increases the magnitude of the likely implementation error. Fig. 4 shows comparisons of past telephone survey based estimates of annual recreational catch with season length, which might provide some of the information required to model the implementation error for this component of the fishery. A key question is whether effort is indeed proportional to season length, or recreationals fish harder if their season's duration is more limited. Fig. 4 suggests that the assumption of a linear relationship through the origin is not unreasonable, though the data point for the greatest season length is rather influential in this perception.

Table 1a: Table reporting both OMP **commercial offshore** TACs and the actual **commercial offshore** catches for West Coast Rock Lobster. The final column reports the difference between the commercial offshore TAC and the commercial offshore catch. All values are in units of MT. (The arrow indicates the period prior to which OMP 2007 re-cast takes account of the actual catches taken.)

Season	Commercial offshore TAC awarded	Actual Commercial offshore catch	Awarded less actual catch
2000/01		1442	
2001/02	1738	1762	-24
2002/03	2250	2052	198
2003/04	2422	2530	-108
2004/05	2614	2511	103
2005/06	2294	1623	671
2006/07	1996	2702	-706
2007/08	1754	1428	326
2008/09	1632	1678	-46
2009/10	1632	1448	184

Table 1b: Table reporting both OMP **commercial nearshore** TACs and the actual **commercial nearshore** catches for West Coast Rock Lobster. The final column reports the difference between the commercial nearshore TAC and the commercial nearshore catch. All values are in units of MT. (The arrow indicates the period prior to which OMP 2007 re-cast takes account of the actual catches taken.)

Season	Commercial Nearshore TAC awarded	Actual Commercial nearshore catch	Awarded less actual catch
2000/01		168	
2001/02	353 (60.4*)	311	42
2002/03	453 (10.4*)	410	43
2003/04	594	387	207
2004/05	593	534	59
2005/06	560	374	186
2006/07	561	389	172
2007/08	560	435	125
2008/09	451	384	67
2009/10	451	399	52

*Kept as reserve for appeals

Table 1c: Table reporting all (commercial, interim relief and recreational) awards and the actual takes for these different sectors of the West Coast Rock Lobster fishery. The final column reports the difference between the total allocations and the total takes. All values are in units of MT. (The arrow indicates the period prior to which OMP 2007 re-cast takes account of the actual catches taken.)

Season	Commercial TAC awarded	Recreational allocation	IR allocation awarded	**Total Global allocation awarded**	Actual Commercial catch	Actual recreational take estimate	Actual Interim relief catch estimate	**Total removals**	Awarded less actual takes
2000/01	1614	404	0	**2018**	1610	314	0	**1924**	94
2001/02	2151	468	0	**2619**	2073	336	0	**2409**	210
2002/03	2713	583	0	**3296**	2462	338.5	0	**2800.5**	495.5
2003/04	3016	320	0	**3336**	2917	341	0	**3258**	78
2004/05	3207	320	0	**3527**	3040	179	0	**3222**	305
2005/06	2854	320	0	**3174**	1998	293	0	**2291**	883#
2006/07	2557	300	0	**2857**	3091	212	0	**3303**	-446#
→ 2007/08	2314	257	0	**2571**	1863	261	174	**2298**	273
2008/09	2083	257	0	**2340**	2062	243	170	**2475**	-135
2009/10	2083	257	53	**2393**	2022*	215	278	**2515**	-122

#The TAC for 2006/07 of 2557 MT TAC from the OMP was increased by 878.3 MT as an additional amount rolled over from 2005/06 season, due to under-catches.

*note that this figure assumes that the commercial TAC for Area 8 of 1195 MT will be taken exactly (current data tables do not cover the full season for this Area)

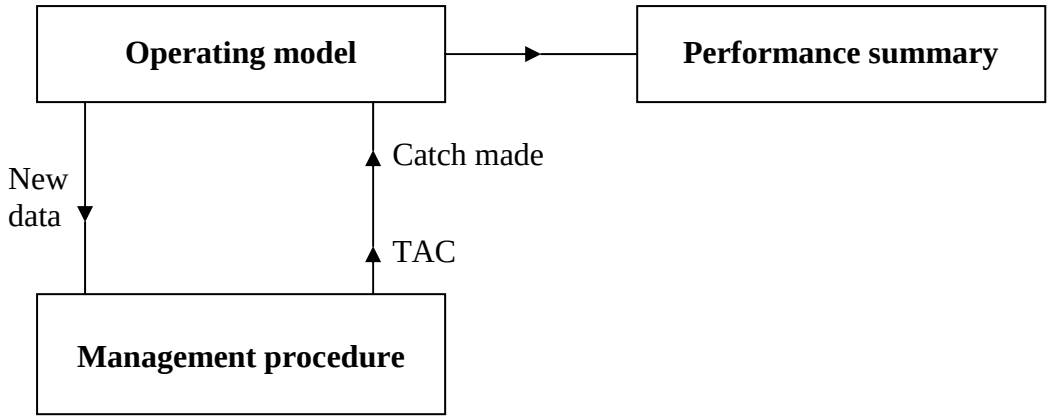

Figure 1. The standard management procedure evaluation process where annual catch made exactly equals the TAC output by the management procedure.

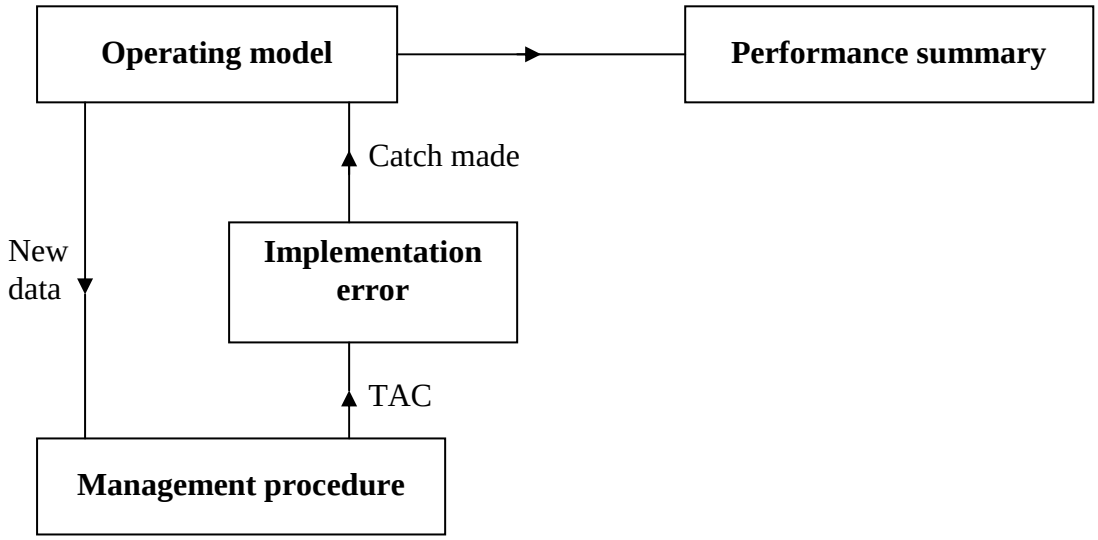

Figure 2. The standard management procedure evaluation process modified to include implementation error: the catch made may differ from the TAC output by the management procedure, but in a specified manner (which may include stochastic components).

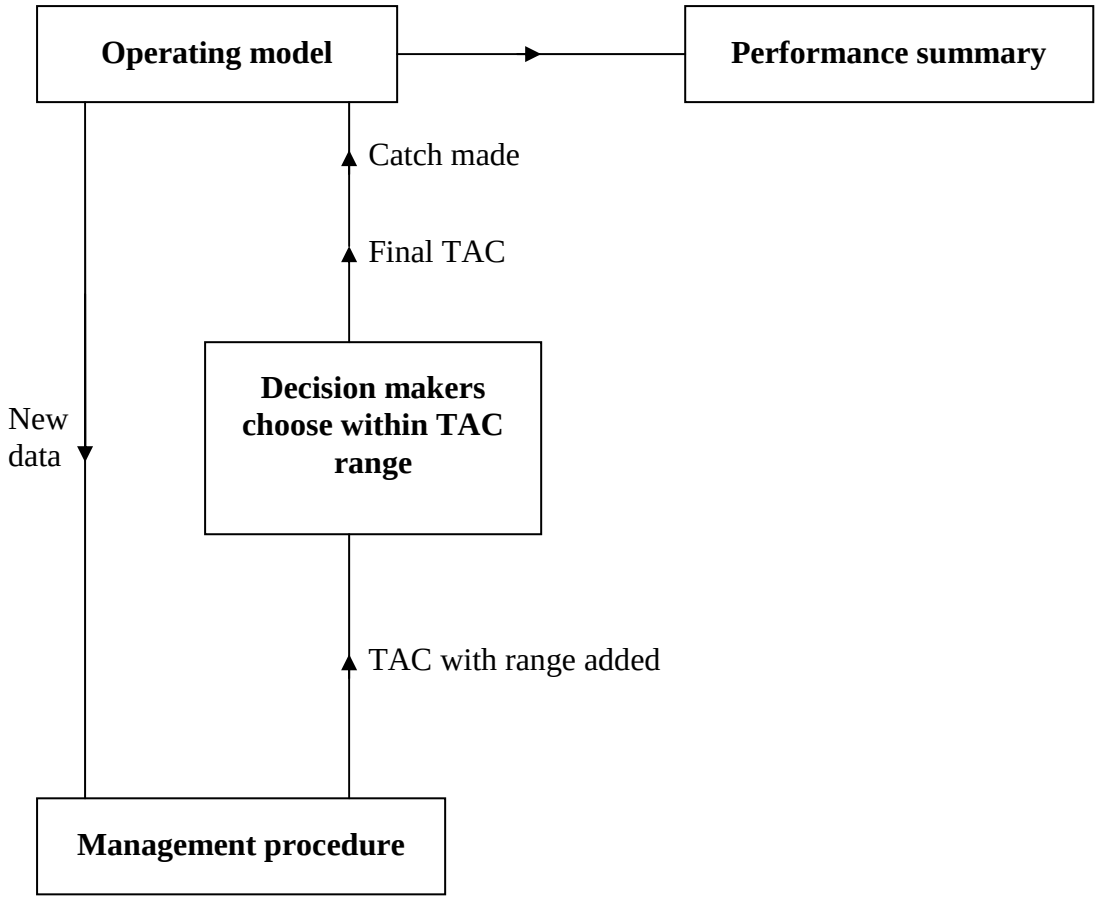

Figure 3. The management procedure evaluation process when the decision makers choose a TAC from within a range of output. The manner in which the final TAC relates to the range output by the procedure must be specified (but may include stochastic components). Note that this process is structurally identical to that of Fig. 2.

Figure 4. Recreational catch in relation to season length for the West Coast rock lobster resource.