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A candidate SLA for the common minke  
whale in East Greenland

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I use the agreed SLA for common minke whales off West Greenland (Witting 2018) as a candidate SLA for common minke whales off East Greenland (SLA description in the Appendix). The SLA operates on an inverse variance weighed average of the last three abundance estimates, where the strike limit is calculated as a growth rate fraction of a lower percentile of the abundance measure. The SLA includes a snap to need feature and a protection level, but not a trend modifier.

The SLA was agreed for West Greenland by the SC last year as having adequate need satisfaction and conservation performance for need envelope A, given the evaluation trials for North Atlantic minke whales. These trials simulate minke whales across the North Atlantic, with the focus of interest here being the conservation performance for the central and western stocks.

The evaluation trails last year assumed a fixed take of 20 minke whales off East Greenland, which is equal to the Greenland need for minke whales in East Greenland. As a SLA can never generate higher catches than the actual need, the focus of this paper is to determine whether the agreed minke whale SLA will generate acceptable need performance when applied to common minke whales off East Greenland.

Table 1 shows that the average need satisfactions of the SLA for 20 and 100 years are 1.00 for the medians of both periods, and 1.00 and 0.88 for the lower 5th quantile for the 20 and 100-year periods. We may conclude that the agreed common minke whales SLA for West Greenland is generating adequate need performance also for East Greenland.

The other statistics in Table 1 show, as expected, that the  $D1$ ,  $D10$ ,  $N12$  statistics are practically identical for the SLA and strikes equal to need. The largest influence on the conservation performance of both the central and western stock is not the presence versus absence of catches off East Greenland, but the presence versus absence of commercial catches in the central North Atlantic.

The 5th quantile and median of the  $D1$  (final depletion) and  $D10$  (depletion in year 100 relative to depletion in year 0) statistics are plotted separately for all trials in Figure 1, for the three strike levels (zero, need, SLA) given the presence versus absence of RMP catches. As noted last year, the joint conservation of  $D1$  and  $D10$  is adequate (i.e.,  $D1 \geq 0.6$  or  $D10 \geq 1$ ) for the median of all trials on both stocks, except for the most difficult trial (M04-1A) where  $D10$  is below 1 and final depletion is just below the desired 0.6 for the

Strikes	RMP	$D1_w$	$D10_w$	$D1_c$	$D10_c$	$N20$	$N100$	$N12$
Zero	–	0.886 0.831	1.063 1.022	0.980 0.973	1.041 1.030	0.000 0.000	0.000 0.000	1.000 1.000
Zero	+	0.859 0.792	1.027 0.980	0.957 0.944	1.016 1.006	0.000 0.000	0.000 0.000	1.000 1.000
Need	–	0.871 0.808	1.043 0.999	0.977 0.969	1.038 1.027	1.000 1.000	1.000 1.000	0.000 0.000
Need	+	0.844 0.769	1.006 0.954	0.954 0.939	1.012 1.003	1.000 1.000	1.000 1.000	0.000 0.000
SLA	–	0.872 0.809	1.044 0.999	0.977 0.969	1.038 1.028	1.000 1.000	1.000 0.883	0.000 0.000
SLA	+	0.844 0.769	1.006 0.954	0.954 0.939	1.012 1.003	1.000 1.000	1.000 0.878	0.000 0.000

Table 1: The averages of the 5th quantile (lower numbers) and median (upper numbers) of performance statistics across all evaluation trials (need envelope A for West Greenland). East Greenland strikes are either equal to zero, need (20), or determined by the SLA. West Greenland catches are determined by the SLA, and commercial catches are either zero or set by the RMP. [subscript  $w$  refers to the western stock; subscript  $c$  to the central stock; and the lower number for  $N12$  is the 95th quantile].

western stock when the RMP catches are taken. A couple of extra 1%-msyr-trials (M01-1A and M11-1A) are failing on  $D10$  and just failing on  $D1$  for the 5th quantile of the western stock, again only when RMP catches are taken.

For the central stock we have  $D1$  values above 0.90 for both the median and the 5th quantile across all trials, and  $D10$  values at or above 1.00 for both the median and the 5th quantile across all trials, except for trial M08-4A where  $D10$  is 0.99 for the 5th quantile. Conservation performance is thus more than adequate for this stock component.

## Appendix; SLA description

The base model of the SLA is the same as the one I used for fin whales in West Greenland (Witting 2018). However, with a lack of opportunity to detect a trend for most, if not for all the trials for minke whales in Greenland, I include no trend modifier.

With  $\tau$  being the year of a strike limit calculation, the SLA makes an interim-SLA-like calculation based on an estimate of abundance ( $N_\tau$ ) with an associated coefficient of variation ( $cv_\tau$ ). This estimate

$$N_\tau = \exp\left(\frac{\sum_{i=-2}^0 \ln N_i / cv_i^2}{\sum_{i=-2}^0 1 / cv_i^2}\right) \quad (1)$$

and its uncertainty

$$cv_\tau = \left(\frac{1}{\sum_{i=-2}^0 1 / cv_i^2}\right)^{1/2} \quad (2)$$

is an inverse variance weighted average of the last three abundance estimates (ignoring zero estimates), with  $i = 0$  denoting the most recent positive estimate, and  $cv$  being the error coefficient of variation.

The strike limit  $S_\tau$  is calculated as

$$\tilde{S}_\tau = r N_\tau e^{-q cv_\tau} \quad (3)$$

$$\dot{S}_\tau = \begin{cases} \tilde{S}_\tau & \text{if } \tilde{S}_\tau < s \text{ need}_\tau \\ \text{need}_\tau & \text{if } \tilde{S}_\tau \geq s \text{ need}_\tau \end{cases}$$

$$S_\tau = \begin{cases} \dot{S}_\tau & \text{if } N_\tau > 2n \\ \frac{N_\tau - n}{n} \dot{S}_\tau & \text{if } n < N_\tau \leq 2n \\ 0 & \text{if } N_\tau \leq n \end{cases}$$

with the total number of strikes for a six year block period being  $6S_\tau$ . The parameters of the SLA are  $r = 0.0353$ ,  $q = 1.65$ ,  $s = 0.8$  and  $n = 500$ .

#### REFERENCES

- Witting, L. 2018a. A candidate SLA for fin whales in West Greenland. *IWC/SC/67b/AWMP13* .
- Witting, L. 2018b. A candidate SLA for the common minke whale in West Greenland. *IWC/SC/67b/AWMP/14* .

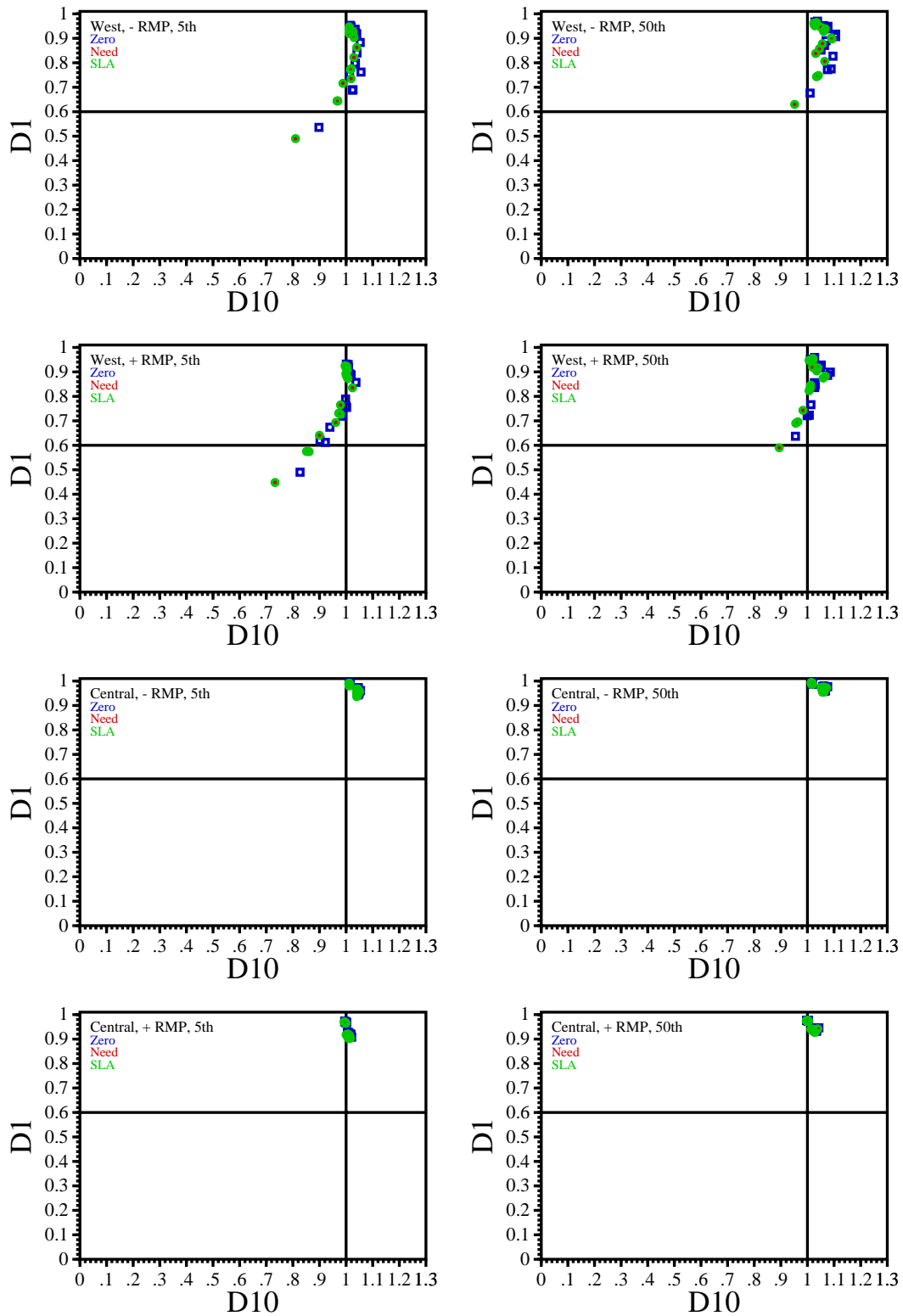


Figure 1: D10 - D1 plots for the western (top 4 plots) and central (bottom 4) stocks of common minke whales in the North Atlantic. East Greenland strikes are either equal to zero, need (20), or determined by the SLA. West Greenland catches are determined by the SLA, and commercial catches are either zero or set by the RMP.