‘Red flag’ proposals to be linked to implicit spatial management of the South African sardine resource

SWG-PEL Meeting

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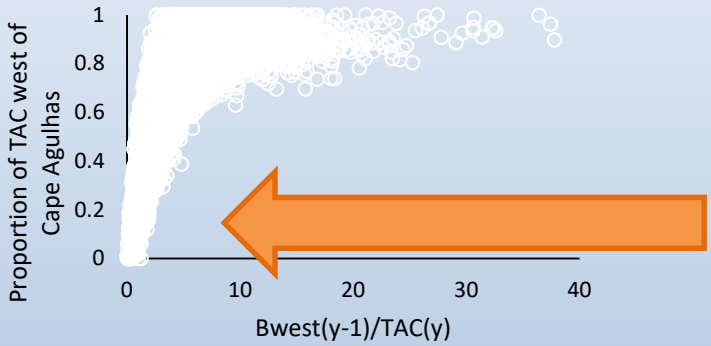
The idea behind "implicit" spatial management

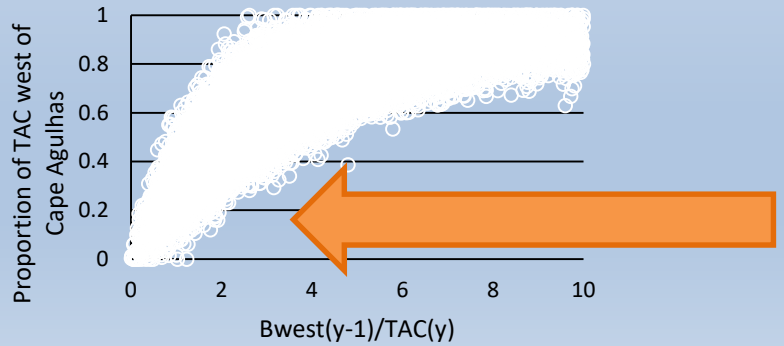
- Continue to 'fish-as-in-the-past' subject to explicit spatial management when 'red flags' are raised
- Mostly use OM1 (p=0.08, MoveR) [OM-60,OM-UL,OM-70]
- Sometimes tune to $Risk_S < 0.2$ (from CMP1, FISHERIES/2018/AUG/SWG-PEL/19); does not imply this is the risk level we should use for OMP-18

Implicit spatial management

- Relationship fit to past data/model estimates
- For CMP1 p(west) ~ 0.72 [0.31,0.94]



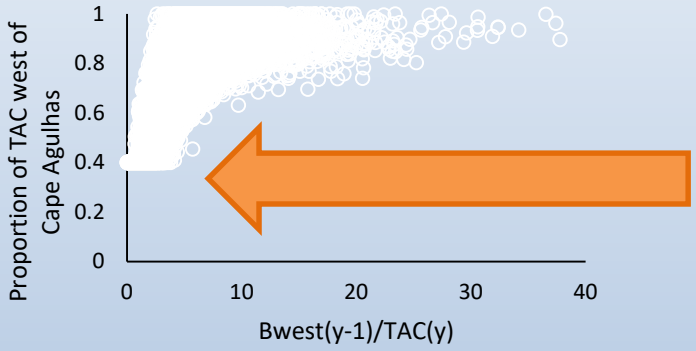
5% of cases < 30% taken west of Cape Agulhas



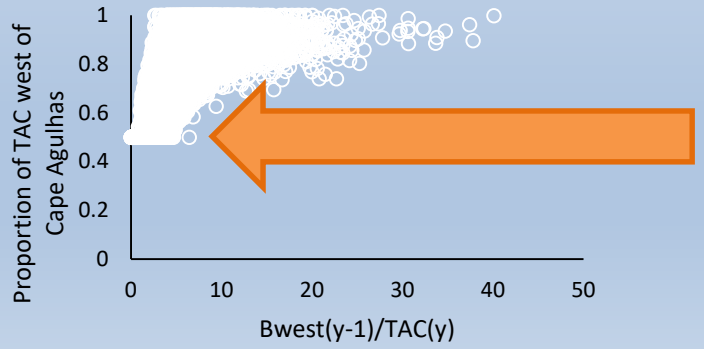
Is this a realistic assumption?!

Bounded implicit spatial management

- Same relationship, but assume a max of 30%, 40%, 50% or 60% of TAC taken east



CMP1-40:
p(west) = 0.4 9% of time



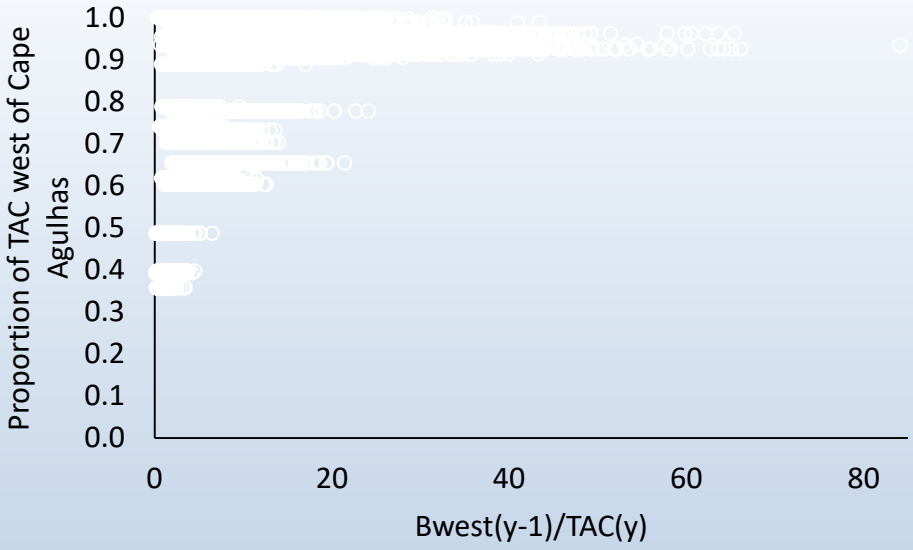
CMP1-50:
p(west) = 0.5 15% of time

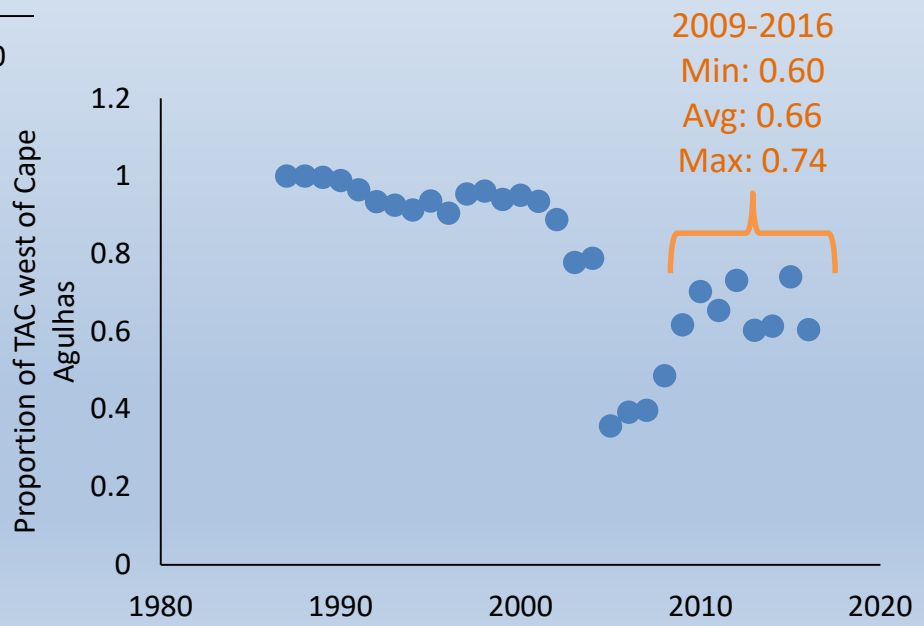
Bounded implicit spatial management

	CMP1	CMP1-40	CMP1-50	CMP1-60	CMP1-70
β	0.174	0.174	0.174	0.174	0.174
$Risk_S$	0.20	0.21	0.22	0.24	0.26
C^S_{tot}	103 92 [31,200]	103 91 [31,200]	102 90 [30,200]	101 89 [27,200]	100 87 [24,200]
C^S_{west}	68 58 [19,154]	69 59 [20,154]	70 60 [20,154]	72 62 [20,153]	75 66 [18,153]
C^S_{west}/C^S_{south}	0.72 [0.31,0.94]	0.71 [0.40,0.94]	0.71 [0.50,0.94]	0.71 [0.60,0.94]	0.70 [0.69,0.94]

	CMP1	CMP1-40	CMP1-50	CMP1-60	CMP1-70
β	0.174	0.144	0.127	0.107	0.086
$Risk_S$	0.20	0.20	0.20	0.20	0.20
C^S_{tot}	103 92 [31,200]	94 77 [31,200]	88 69 [31,200]	80 65 [31,197]	73 65 [30,161]
C^S_{west}	68 58 [19,154]	65 56 [20,148]	63 55 [20,142]	61 54 [20,130]	58 53 [23,125]
C^S_{west}/C^S_{south}	0.72 [0.31,0.94]	0.75 [0.40,0.94]	0.76 [0.50,0.95]	0.78 [0.60,0.96]	0.80 [0.70,0.97]

Bounded implicit spatial management





Explicit spatial management

- Lower proportions taken on west coast leads to
  - higher biomass
  - higher catch
- If instead of implicit spatial management (adjusting proportion in response to $B_{west,y-1}/TAC_y$), then catches need to be split 50-50 every year.
- Same trends seen if explicit spatial management only introduced during Critical Biomass metarules or if e.g. $B^{obs}_{west,y-1}$ < 200 000t (Appendix A)

The idea behind “implicit” spatial management

- Continue to ‘fish-as-in-the-past’ subject to explicit spatial management when ‘red flags’ are raised
  - Preventative red flags
  - Penalty red flags (with benefit green flags)

Preventative red flags

- Implicit spatial management until…

  Red flag raised if $B^{obs}_{west,y-1}$ < threshold

- Conserve the west component biomass

  - a primary producer of recruitment to the whole population

  - a primary source of forage for range-restricted west coast top predators

Preventative red flags

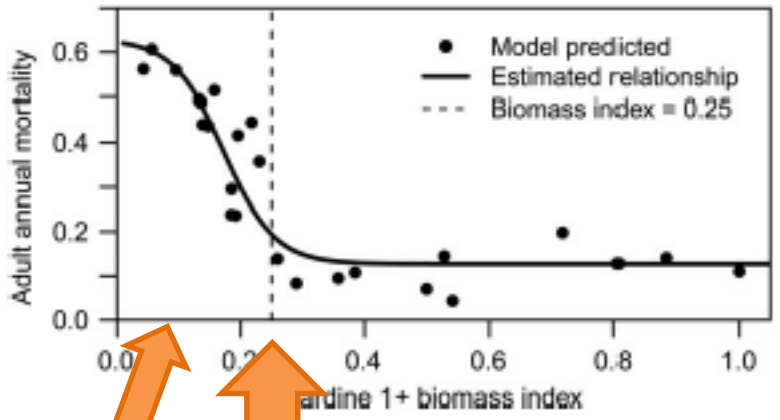


Figure 4 he estima elationship (posterior mode) between the sardine biomass i (scaled to the maximum November survey estima of 1 343 000 2003) and penguin adult mortality. The verti ashed line is 5% of the maximum observed biomass.

$B^{obs}_{west,y}$= 336 000t

0.1 on graph = 134 000t

75%ile of hinge point = 31 000t

$eff B^{sp}_{west}$	B^{obs}_{west}		
	$\frac{eff B^{sp}_{west}}{B^{obs}_{west}} = 0.15$	$\frac{eff B^{sp}_{west}}{B^{obs}_{west}} = 0.25$	$\frac{eff B^{sp}_{west}}{B^{obs}_{west}} = 0.35$
25 000t	167 000t	100 000t	71 000t
28 000t	187 000t	112 000t	80 000t
30 000t	200 000t	120 000t	86 000t
32 000t	213 000t	128 000t	91 000t

Preventative red flags

- Corrective measures:
  - explicit spatial management
  - implicit spatial management, lower β
  - implicit spatial management, p(<1) * TAC
- Corrective measures introduced over a smooth range, e.g. for 150 000t threshold
  - no corrective measure at 165 000t
  - half corrective measure at 150 000t
  - full corrective measure at 135 000t

Preventative red flags

- Corrective measures:

  - explicit spatial management

    √ Effective, but not practical

  - implicit spatial management, lower β

    X Doesn't work

  - implicit spatial management, p(<1) * TAC

    √ Best choice

Preventative red flags

- HCR-calculated TAC decreased by 50% when red flag raised

	CMP1-40	0.5 * TAC if red flag raised					
Red flag:		$B^{obs}_{west,y-1} < 200$		$B^{obs}_{west,y-1} < 150$		$B^{obs}_{west,y-1} < 100$	
β	0.144	0.144	0.183	0.144	0.167	0.144	0.155
$Risk_S$	0.200	0.167	0.180	0.175	0.181	0.182	0.185
$p(B_{west} < 150)$	0.141	0.122	0.128	0.126	0.129	0.129	0.131
C^S_{tot}	**94** 77 [31,200]	**83** 65 [12,200]	**93** 78 [12,200]	**86** 69 [14,200]	**92** 79 [14,200]	**89** 73 [16,200]	**93** 78 [16,200]

Preventative red flags

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$p(B_{west} < 150)$	0.141	0.122	0.128	0.126	0.129	0.129	0.131
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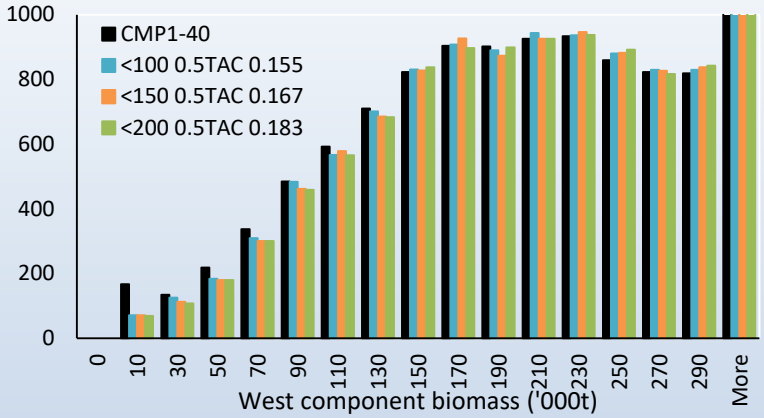
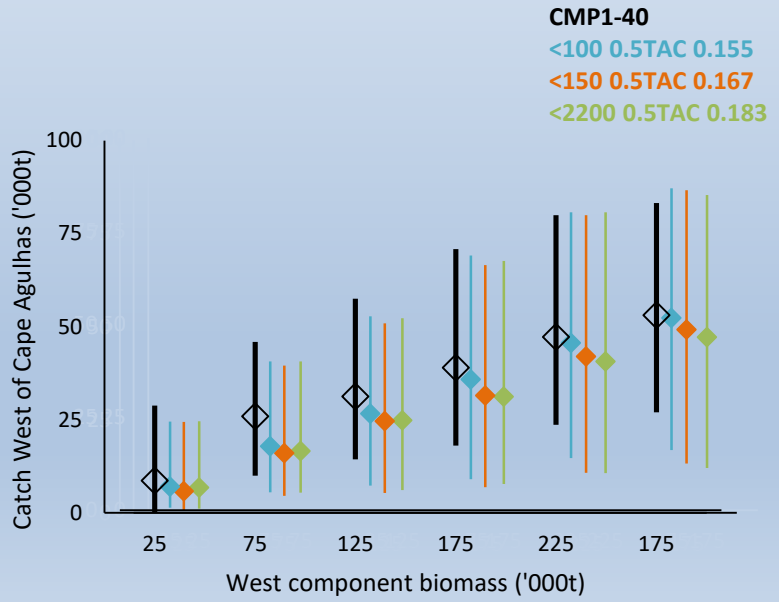
50% of TAC 37% of times

50% of TAC 28% of times

50% of TAC 17% of times

Preventative red flags





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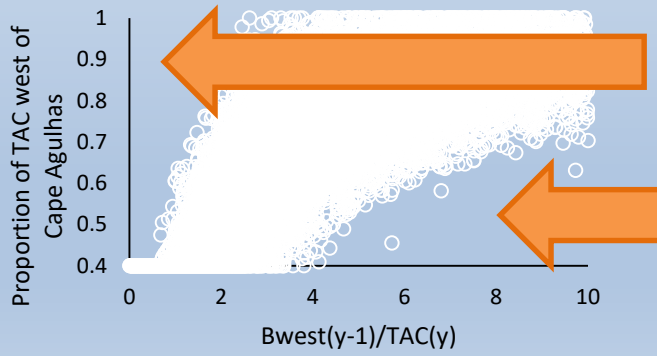
- Continue to ‘fish-as-in-the-past’ subject to explicit spatial management when ‘red flags’ are raised
  - Preventative red flags
  - Penalty red flags (with benefit green flags)

Penalty red flags

- Implicit spatial management assumes future catches spread according to past behaviour, but if not…

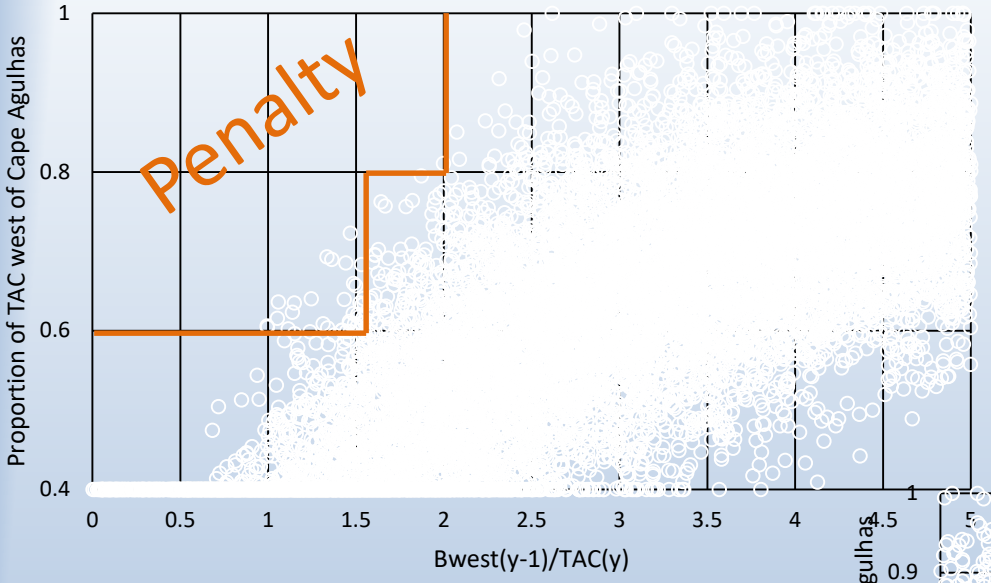
  - Red flag (penalty) raised if p(west) too high

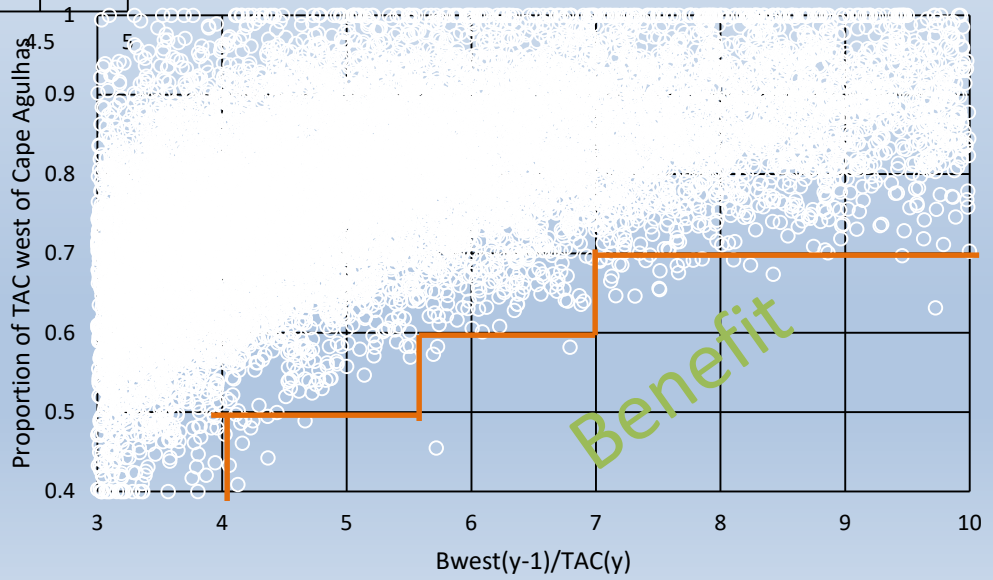
  - Green flag (benefit) raised if p(west) too low



If OM1 is most realistic model, then future p(west) should NOT be here

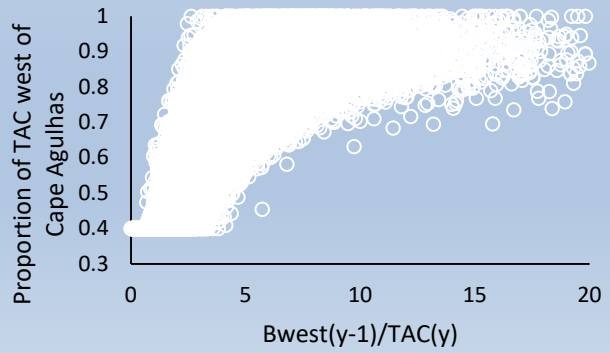
Penalty red flags





Penalty red flags

- Testing alternative catch patterns:
- OM1: baseline
- OM-60: catches at least 60% west of Cape Agulhas
- OM-UL: relationship moves ‘up and left’
- OM-70: catches 70% west of Cape Agulhas



Penalty red flags

- p(y) = proportion of HCR-calculated TAC(y), subject to preventative red flag
- Corrective (benefit) measures:

  - initially p=1

  red flag: p(y) = p(y-1) – PENALTY

  green flag: p(y) = p(y-1) + BENEFIT

  no flag: p(y) = p(y-1)

  - if (p(y-1)=p(y-2)) and (p(y)=p(y-1)) p(y)->1

  - if (p(y-1)=p(y-2)) and (green flag) p->max(1,p(y))

Penalty red flags

Type equation here.	OM1	OM-60	OM-UL	OM-70
$Risk_S$	0.200	0.212	0.220	0.219
$p(B_{west} < 150)$	0.141	0.150	0.155	0.154
C_{tot}^{S}	94	93	93	93