Assessment of the South African anchovy resource using data from 1984-2014: base case results at the posterior mode

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New Assessment

- “Simple update” presented in April
- New assessment based on data from 1984-2014, incorporating substantial changes in model formulation and fitting to new time series of data

Available Data

- Time series of Nov survey biomass and May recruitment extended 3 years
- Time series of DEPM estimates of SSB (84-93)

NEW

- Time series of prop-at-length in Nov survey
- Time series of quarterly commercial prop-at-length

Population Dynamics Model

- Age-structured at core ($0 – 4^{+}$)
- Used length-at-age distribution (i.e. variability about a growth curve) to predict numbers-at-length
  - fit directly to length-structured data
  - maturity, selectivity and weight are length-based

Population Dynamics Model

- Quarterly catches-at-age estimated within the model; removed in 4 pulses
- Commercial selectivity-at-length estimated within the model; allowed to differ by quarter

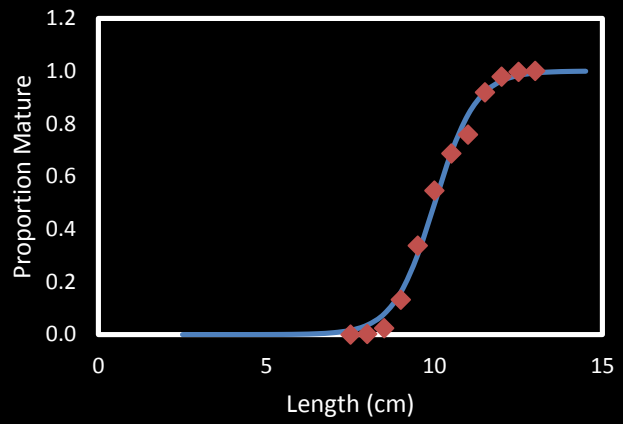
Allows for changes in length distribution in catches during the year (larger anchovy generally landed earlier in the year) and changes in the timing of peak catches over the years

Population Dynamics Model

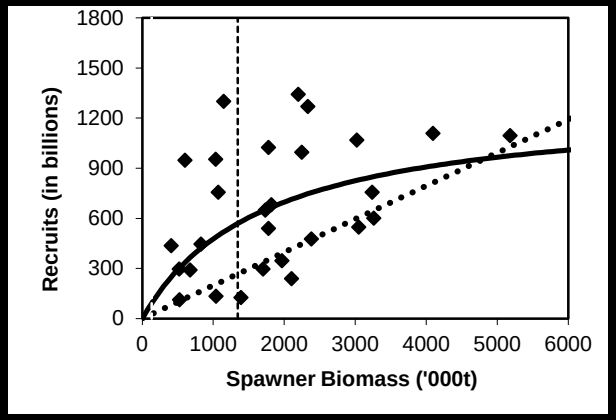
- Weight-at-length rather than weight-at-age
  - new weight-at-length relationship
  - different relationship used for November survey and monthly commercial data
  - relationships are time (annually) invariant
  - premature to make assumptions for years for which data do not exist
  - research is continuing to find environmental co-variates to explain annual differences

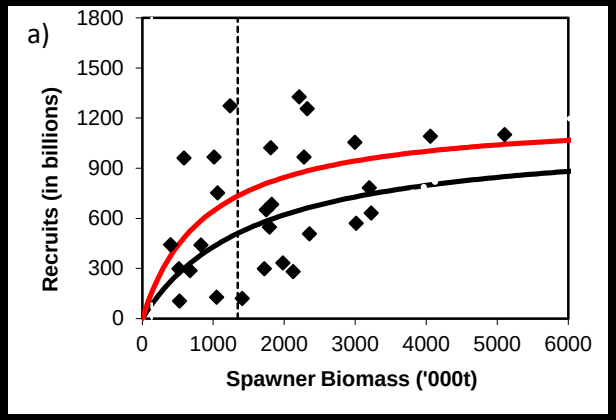
Population Dynamics Model

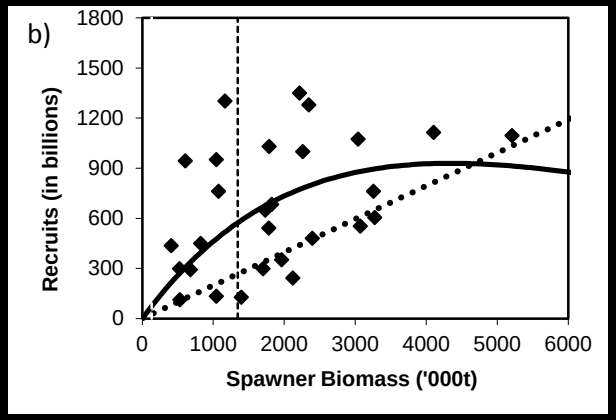
- November survey assumed to provide an estimate of total (0+) biomass
- Trawl selectivity-at-length allows a lower selectivity on anchovy <7cm in trawls used to capture prop-at-length data
- DEPM assumed to provide an estimate of SSB
- SSB now calculated from all 1+ anchovy after taking maturity-at-length into account

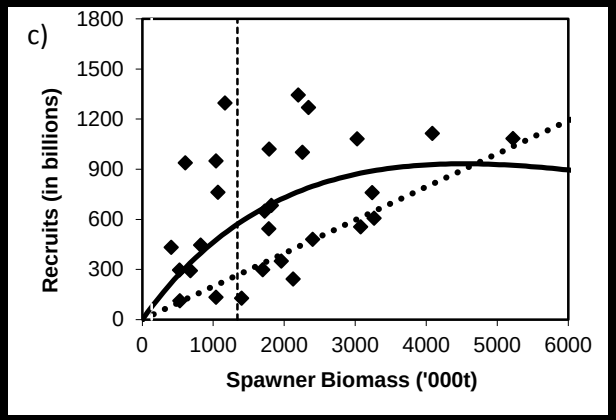


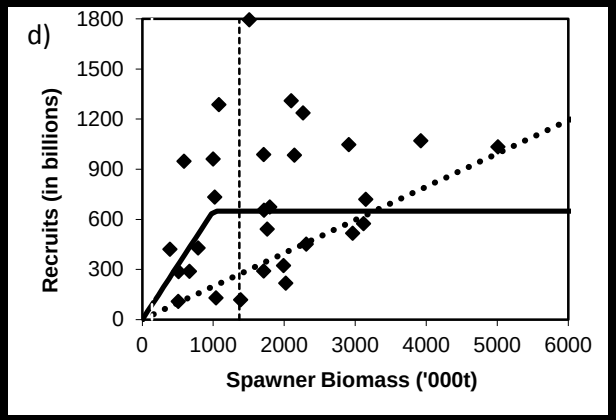
Alternative stock-recruitment relationships

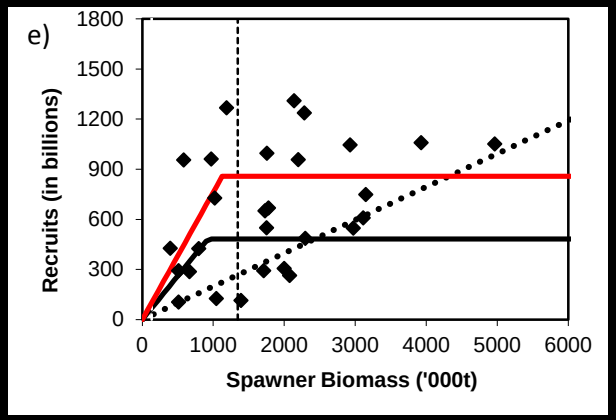








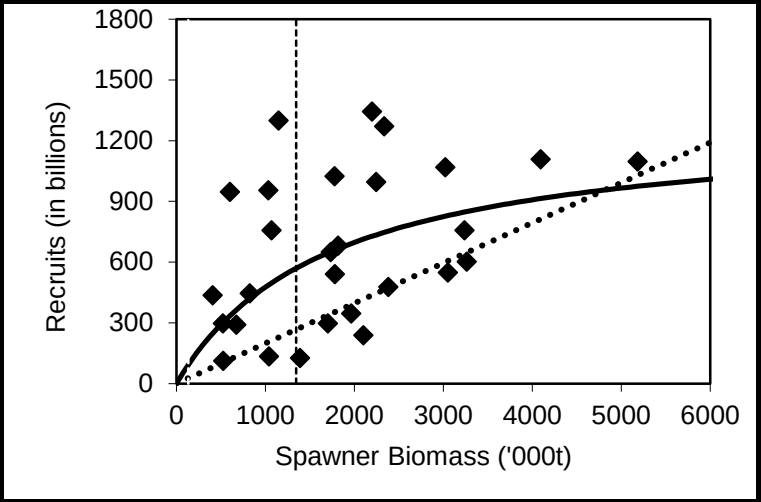


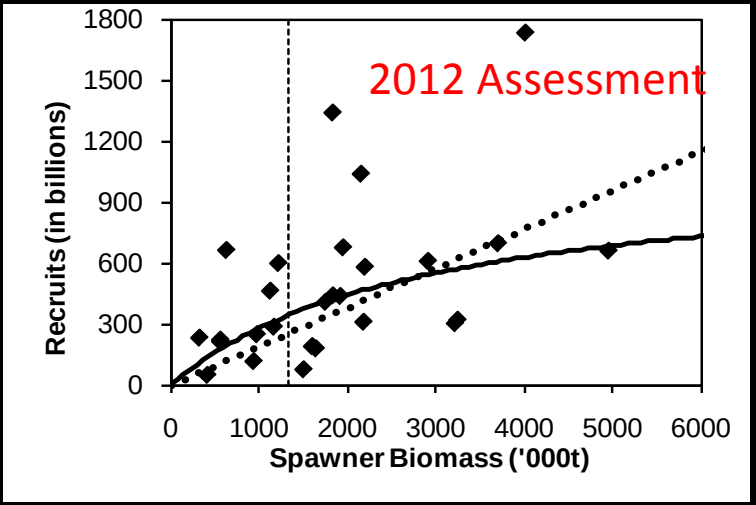


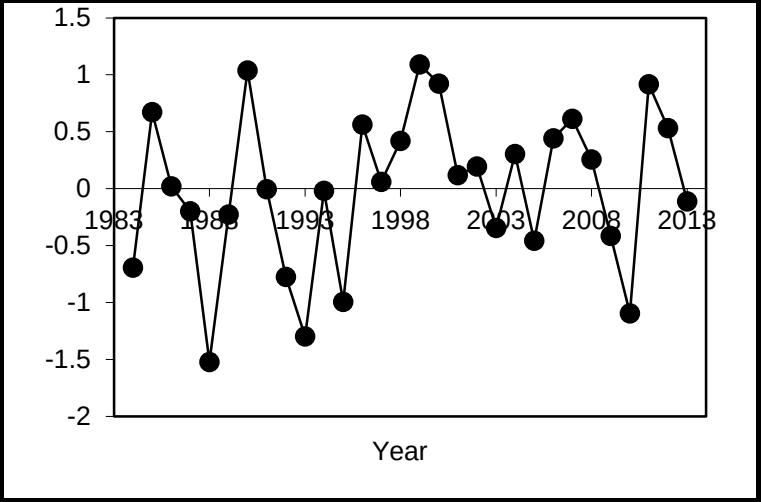
Alternative stock-recruitment relationships

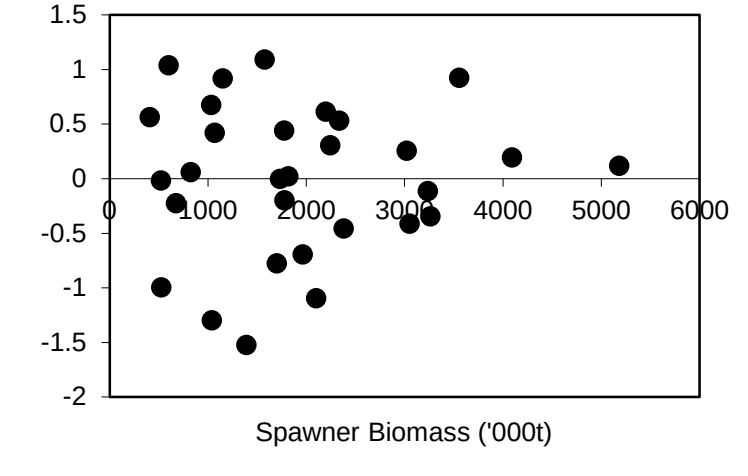
	A_{BH}	A_{2BH}	A_{R}	A_{ModR}	A_{HS}	A_{2HS}
-ln(Posterior)	-610.1	-611.9*	-609.7	-609.8*	-608.8*	-612.2*
$-\ln L^{Nov}$	-14.5	-13.2	-14.4	-14.4	-15.3	-13.4
$-\ln L^{Egg}$	6.6	6.4	6.6	6.6	6.5	6.4
$-\ln L^{rec}$	14.8	14.4	14.7	14.7	15.9	15.0
$-\ln L^{sur\ propl}$	-389.3	-389.7	-389.2	-389.1	-390.0	-390.3
$-\ln L^{com\ propl}$	-264.7	-264.6	-264.7	-264.7	-264.7	-264.7
-ln(Priors)	36.0	33.8	36.2	36.2	37.9	33.9
# parameters	53	55	53	54	53	55
Sample size (i.e. data points)	5267	5267	5267	5267	5267	5267
AIC	-1188	-1183	-1188	-1186	-1189	-1184
AIC_c	-1187	-1182	-1187	-1185	-1188	-1183
h^A	0.49	0.47	0.47	0.47		
K^A	4818	4021	4668	4695	2280	1649
a^A				0.93	650	483
b^A					1001	925
$h_2{}^A$		0.63				
$K_2{}^A$		5278				3371
$a_2{}^A$						859
$b_2{}^A$						1126

Beverton Holt



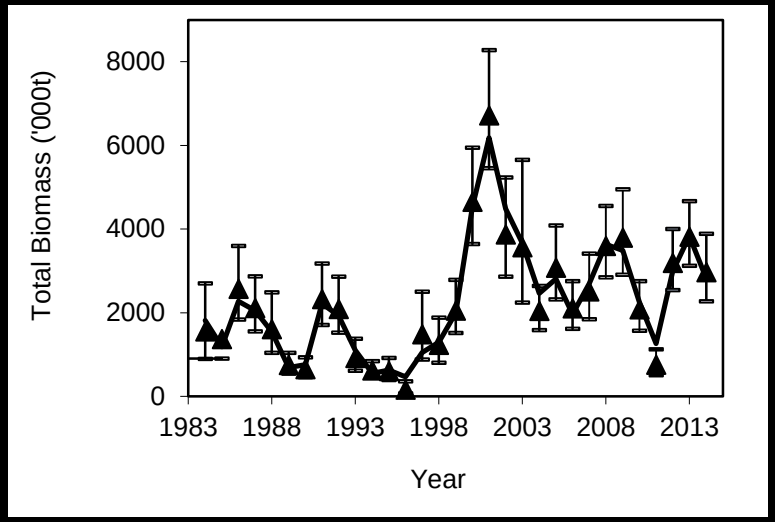


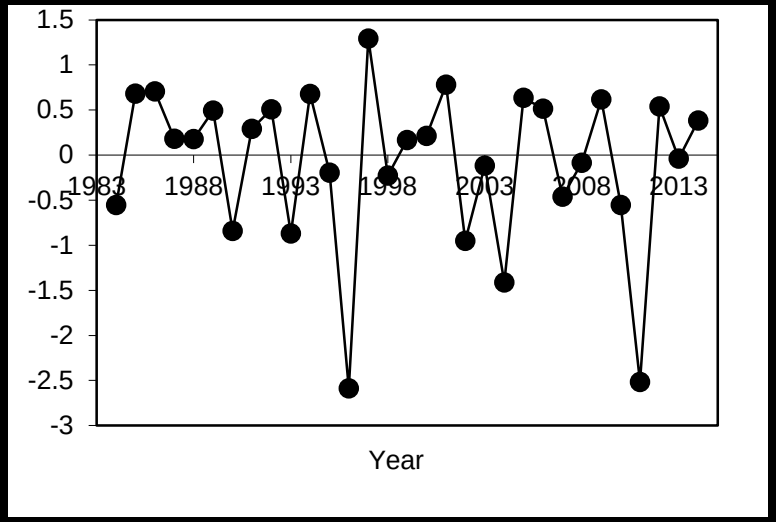




Reflects a more productive resource than was estimated in 2012

November total biomass





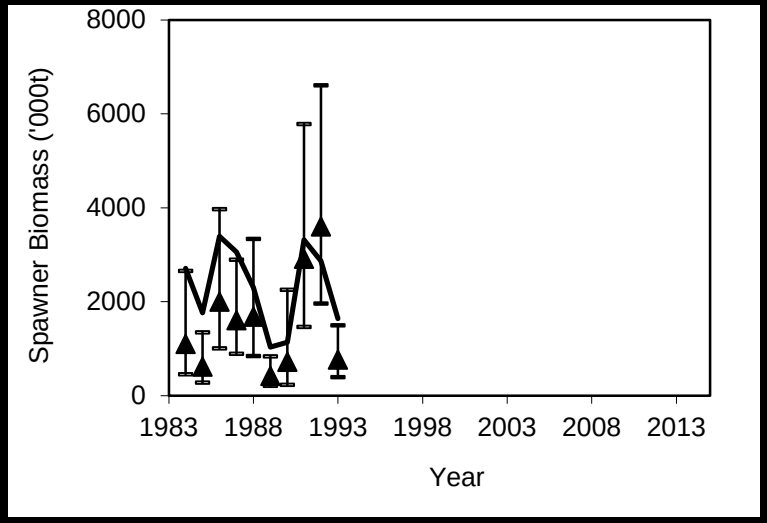
2015: k_N^A=0.67 : survey estimate an over-estimate of true total biomass
2012: k_N^A=1.16 : survey estimate an under-estimate of true 1+ biomass

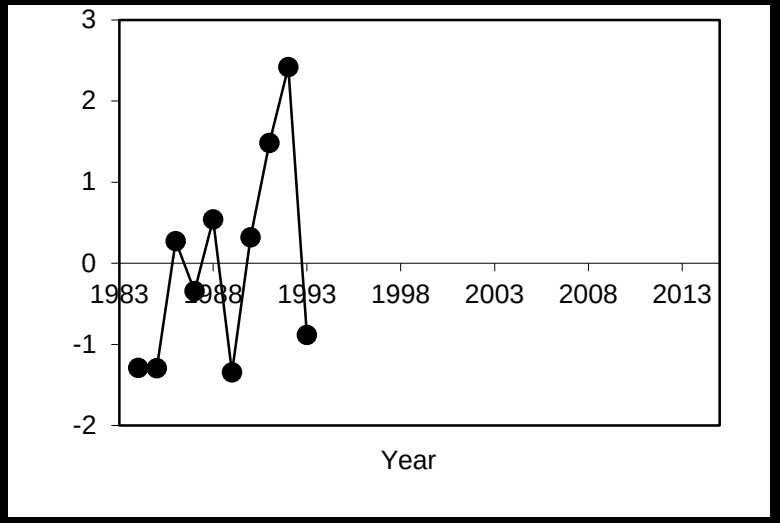
Note: Nov hydroacoustic survey and DEPM estimates of SSB no longer assumed to measure the same biomass

Note: Weight-at-length, not weight-at-age now applied

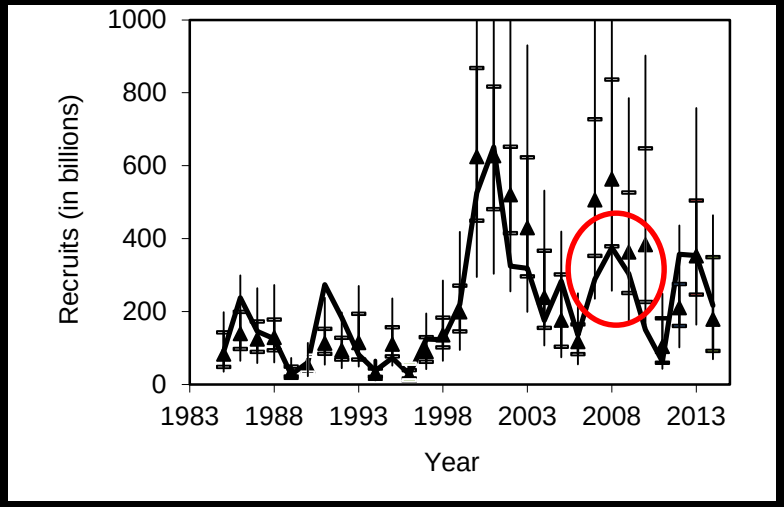
Note: maturity-at-length now used to calculate SSB

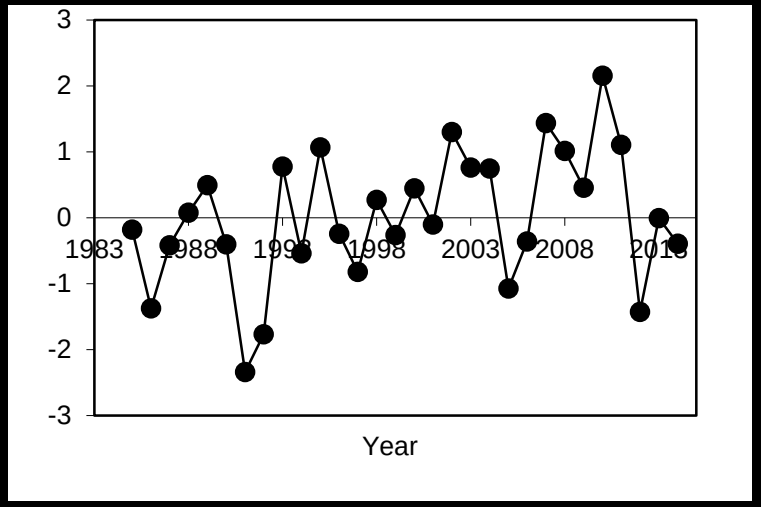
November spawner biomass



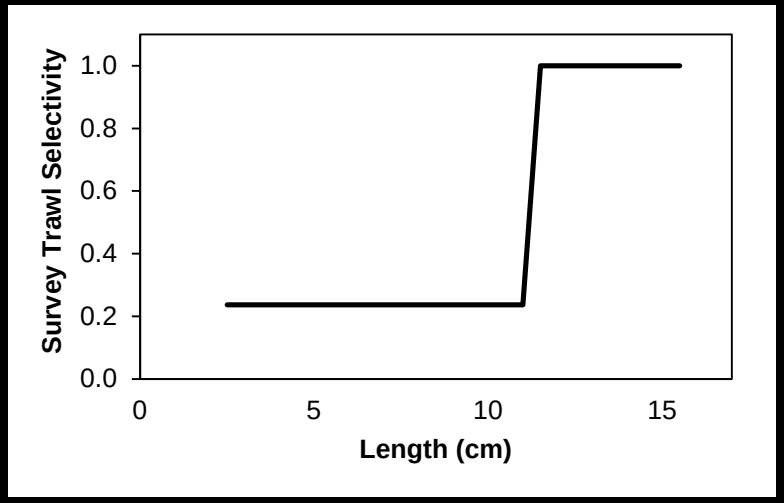


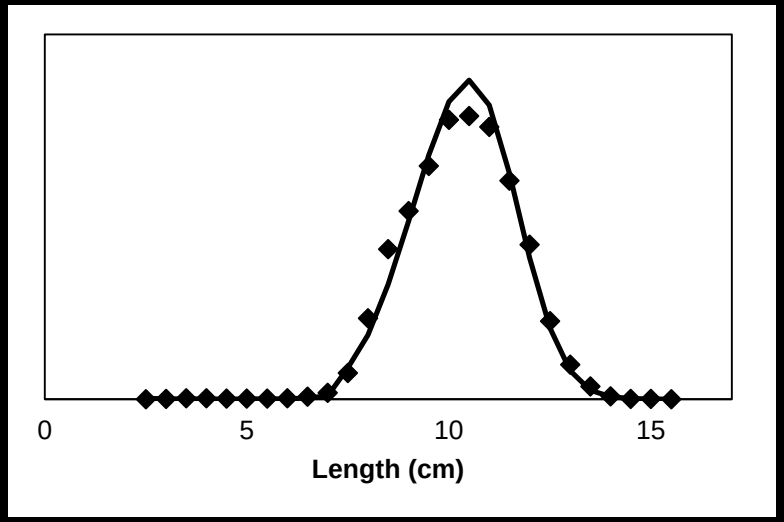
May recruitment

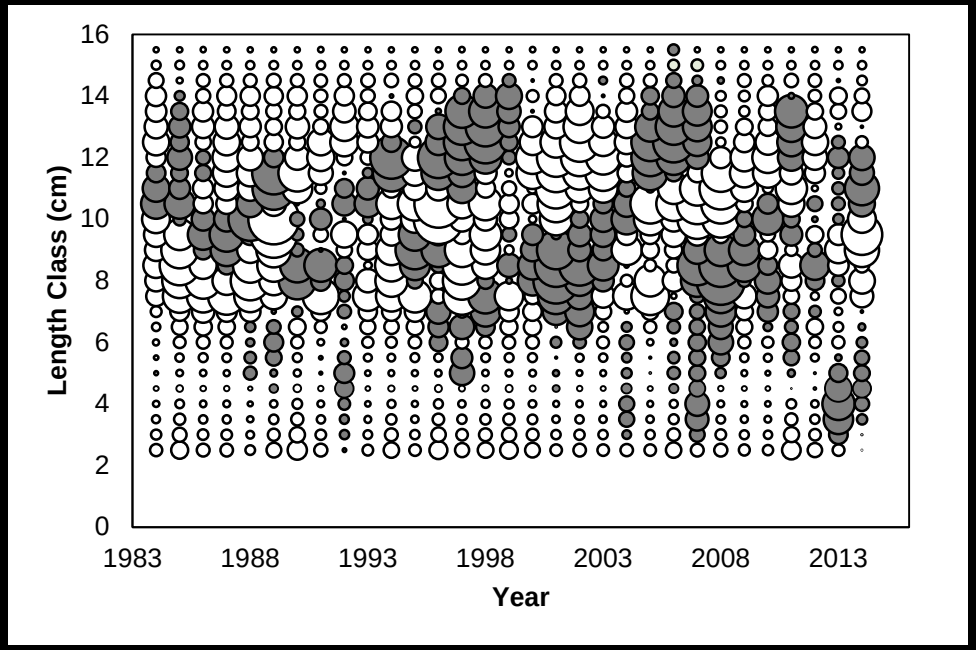




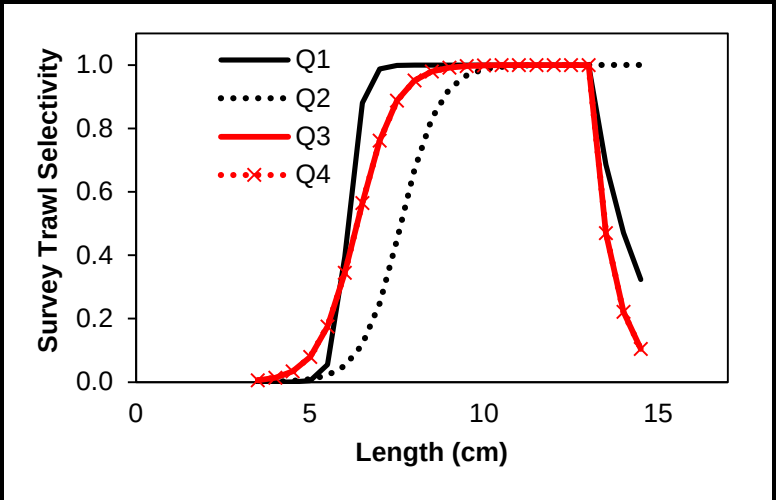
Survey proportions-at-length





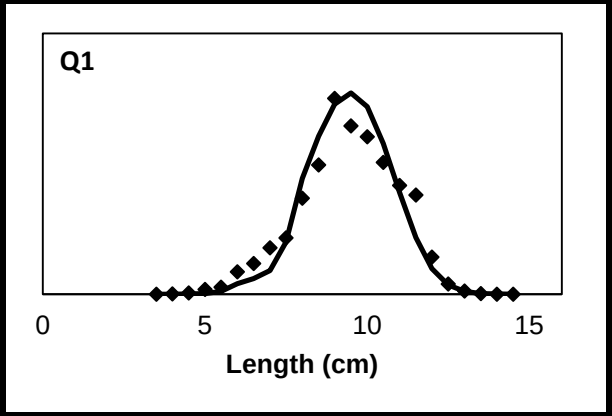


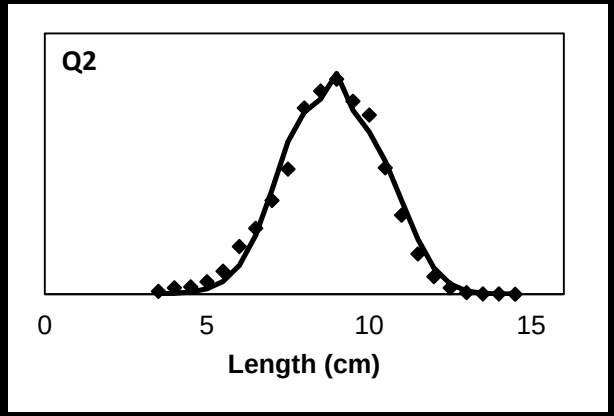
Commercial proportions-at-length

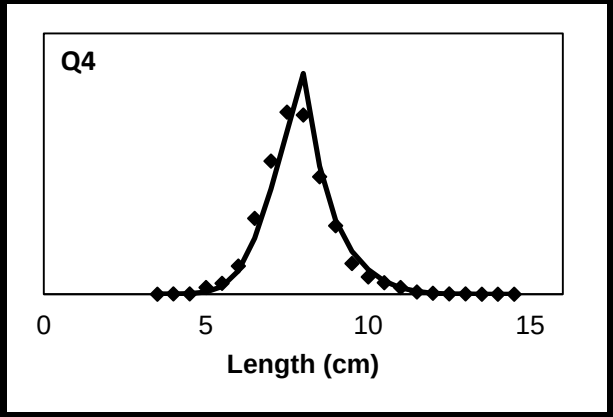


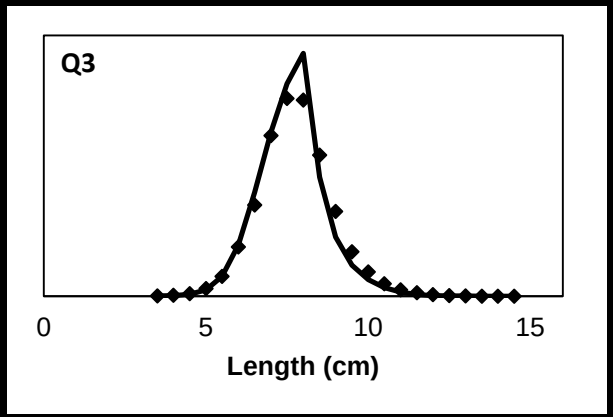
Nov-Jan: near constant selectivity 7-13cm

Feb-Apr: recruits not yet available, targeting of adults



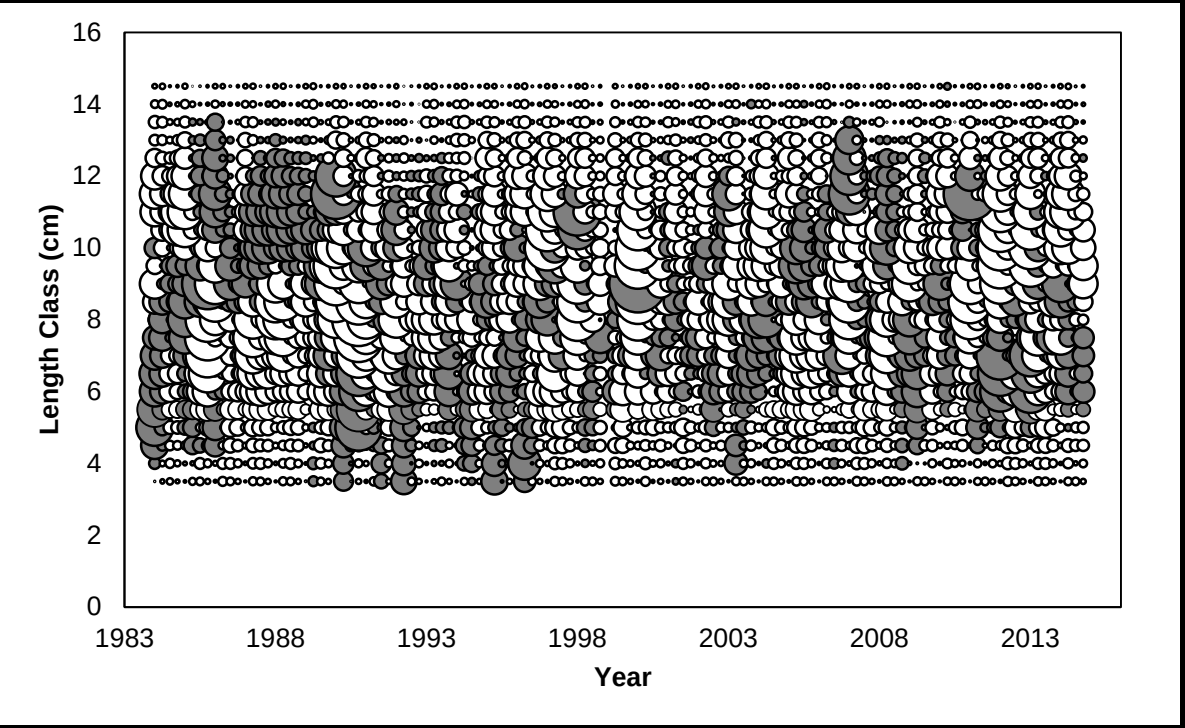




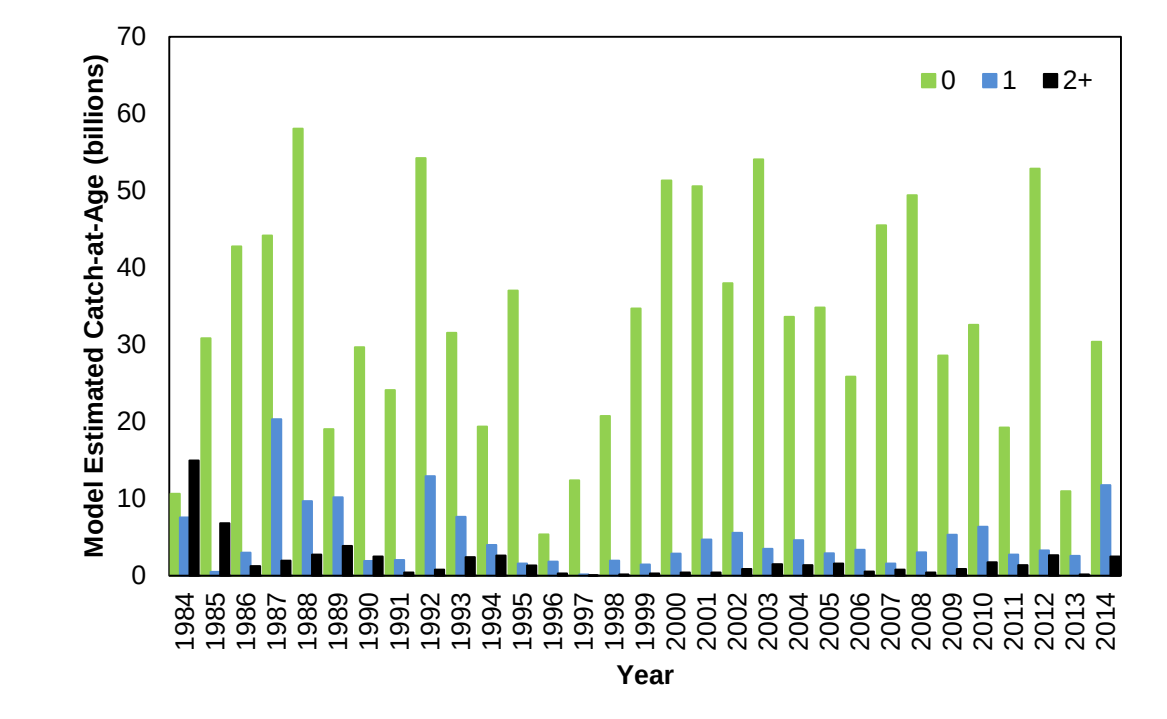


May-Oct: targeting of recruits

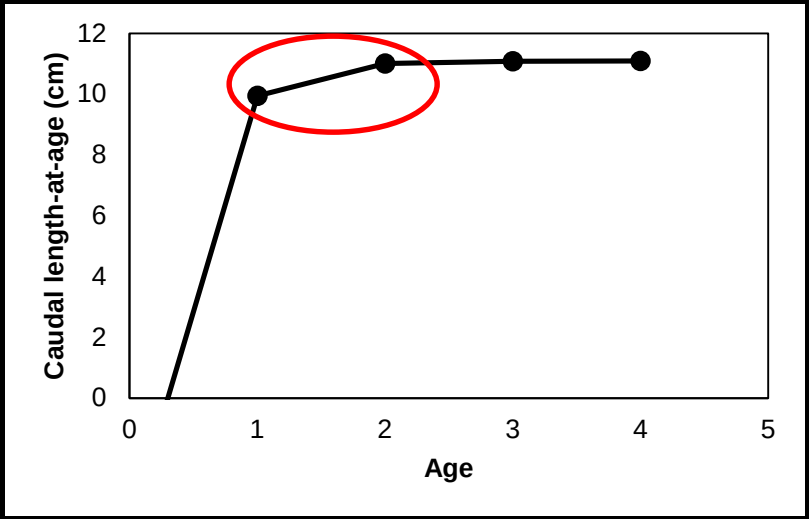
Commercial proportions-at-length



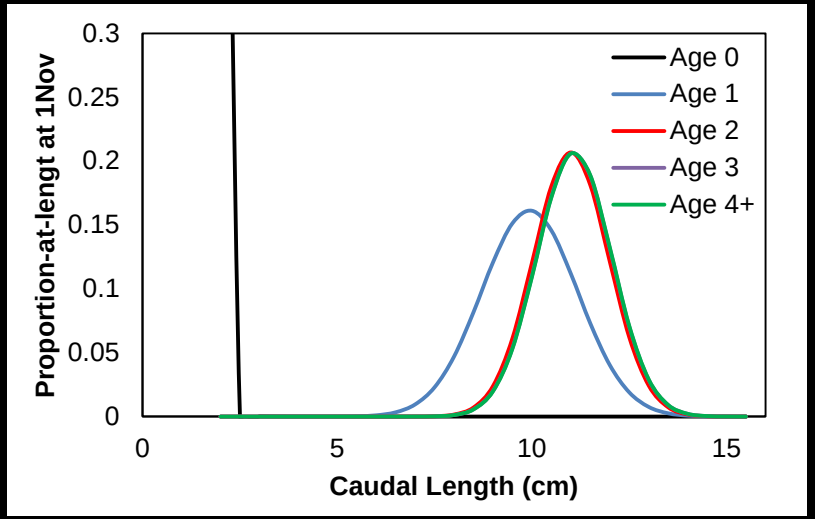
Catch-at-age


Model Estimated Catch-at-Age (billions)
70
60
50
40
30
20
10
0
0
1
2+
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year

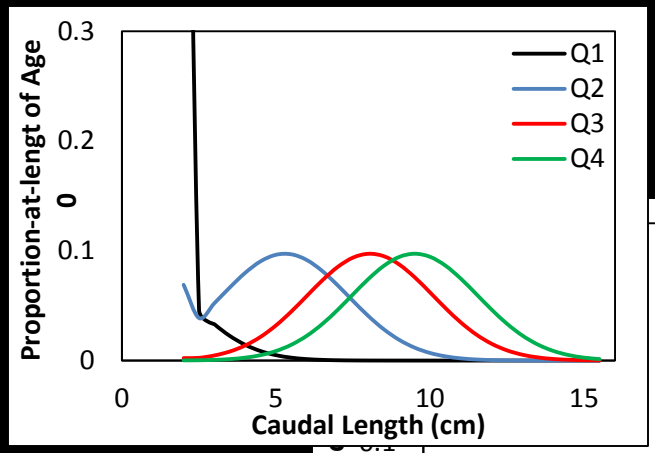
Growth curve

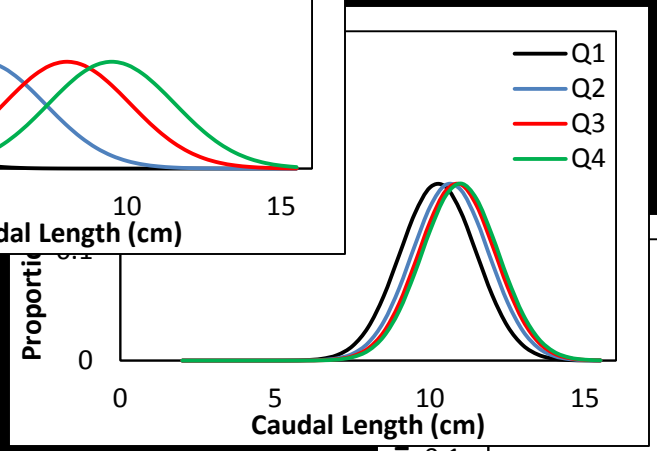


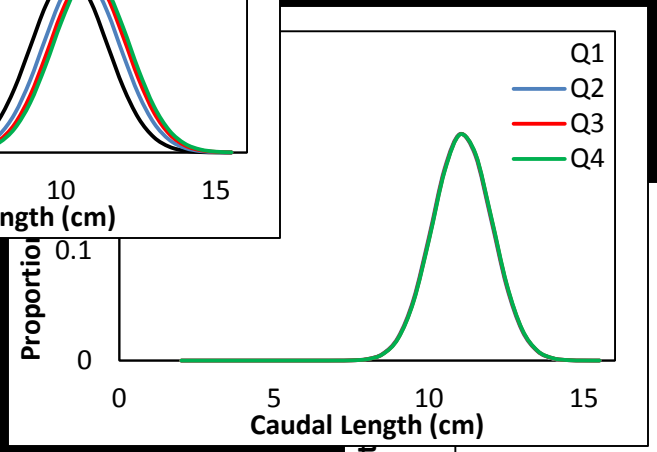
Growth curve different from that estimated from 90, 92-95 ageing data from Kerstan

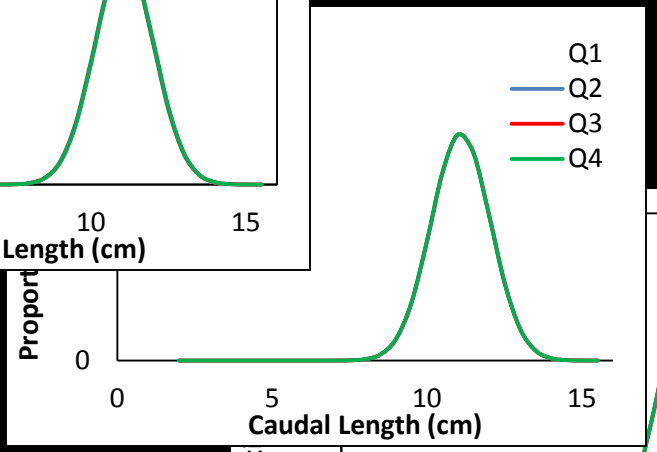


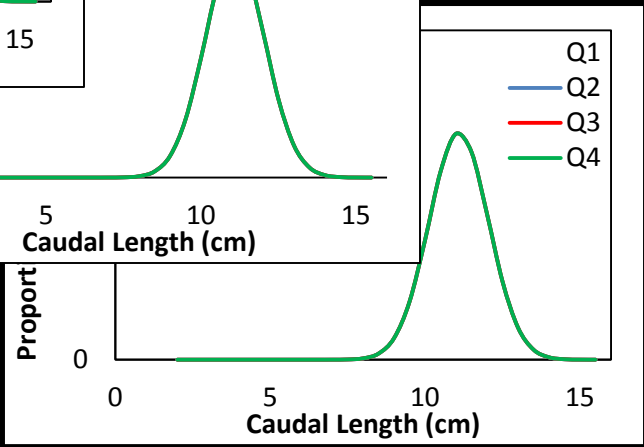
Length-at-age



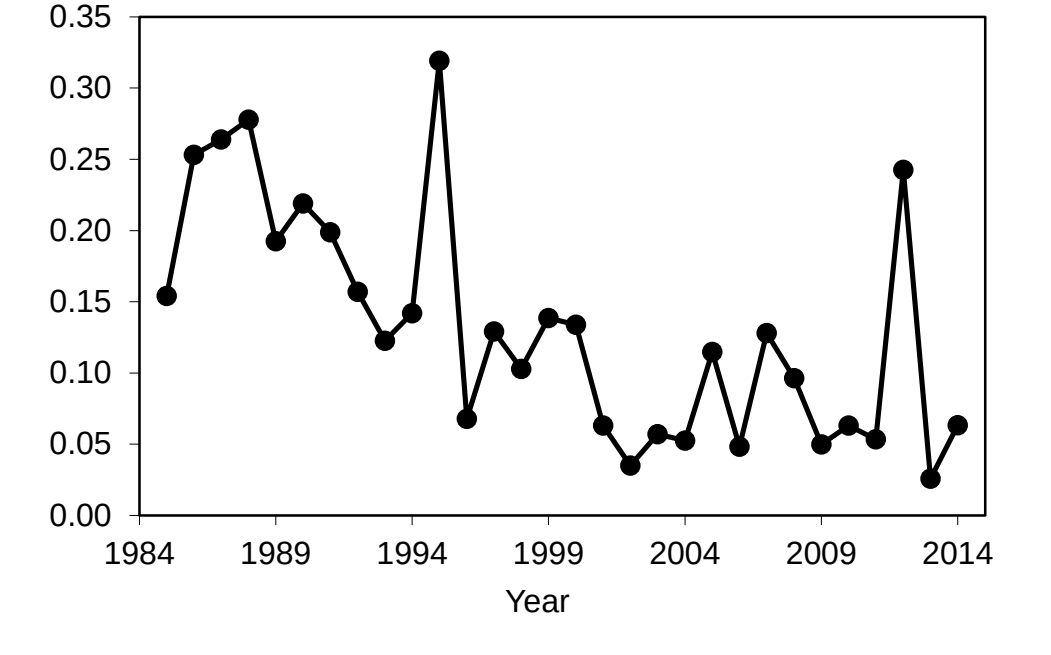






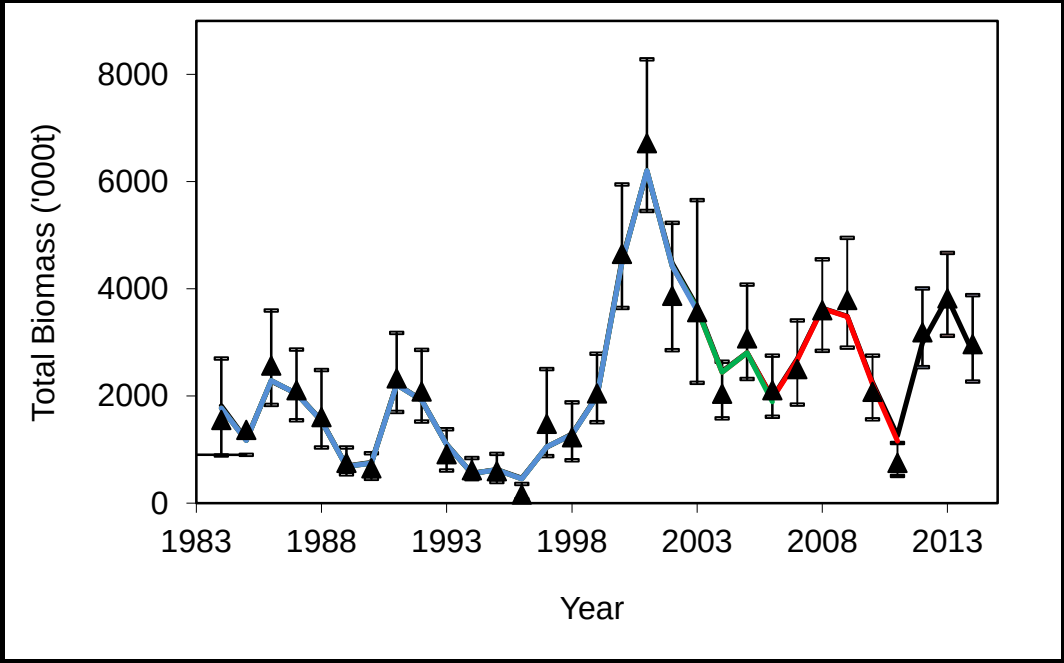


Harvest rates



Only exceeded 0.15 once in latest 19 years,
but could have been higher in recent years

Retrospective runs



Little difference in trajectories and key parameter values
More productive S-R relationship primarily due to change in methodology, assumptions and change to use length-structured data, rather than additional 3 years data

In summary

- Base case hypothesis – Beverton Holt
  - - $M_{ad} = M_j = 1.2\ year^{-1}$
- Total (0+) biomass in Nov 2014

  ~ 4.2 million t > 3.4 million t = avg(84-13)
- Three major peaks in recruitment since 2000, but low points still ~ maximum recruitment prior to 2000

Assessment of the South African anchovy resource using data from 1984-2014: base case results at the posterior mode

Thank you for your attention