An Initial Simple Model of the Revised Stock Structure Hypothesis for South African Sardine

International Stock Assessment Workshop

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Simple Model

- IA: Age-structured assessment, fitting to length data
- Key simplifications (compared to de Moor 2020):
- Not (yet) removing commercial catches or fitting to commercial LFs
- Growth is based on the von Bertalanffy growth curve for all ages, is coast- and component-independent and time-invariant

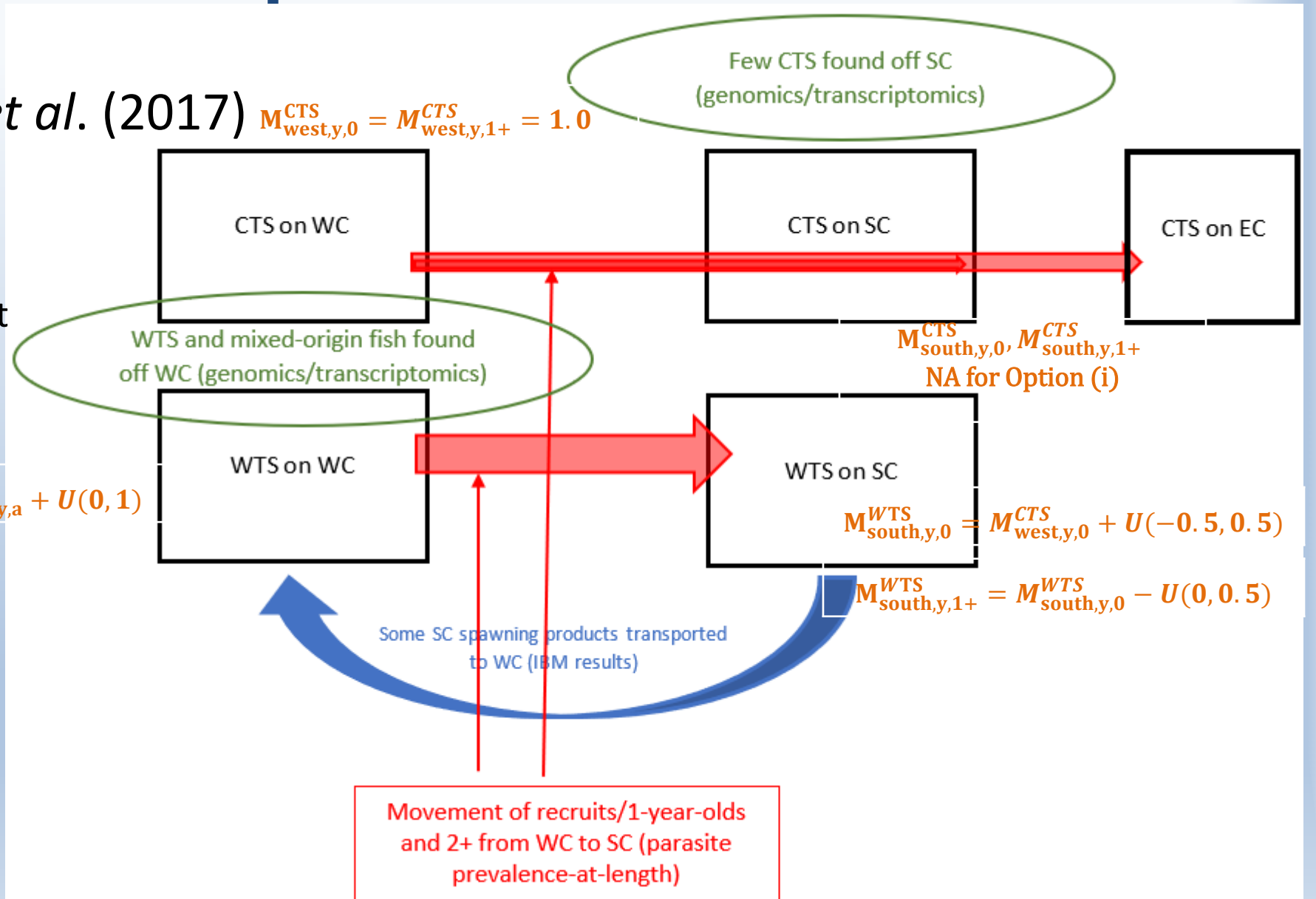
Simple Model

Table 1 of de Moor *et al*. (2017) $M^{CTS}_{west,y,0} = M^{CTS}_{west,y,1+} = 1.0$

- Option (i) only

  All CTS moving south/east

  leave the management unit

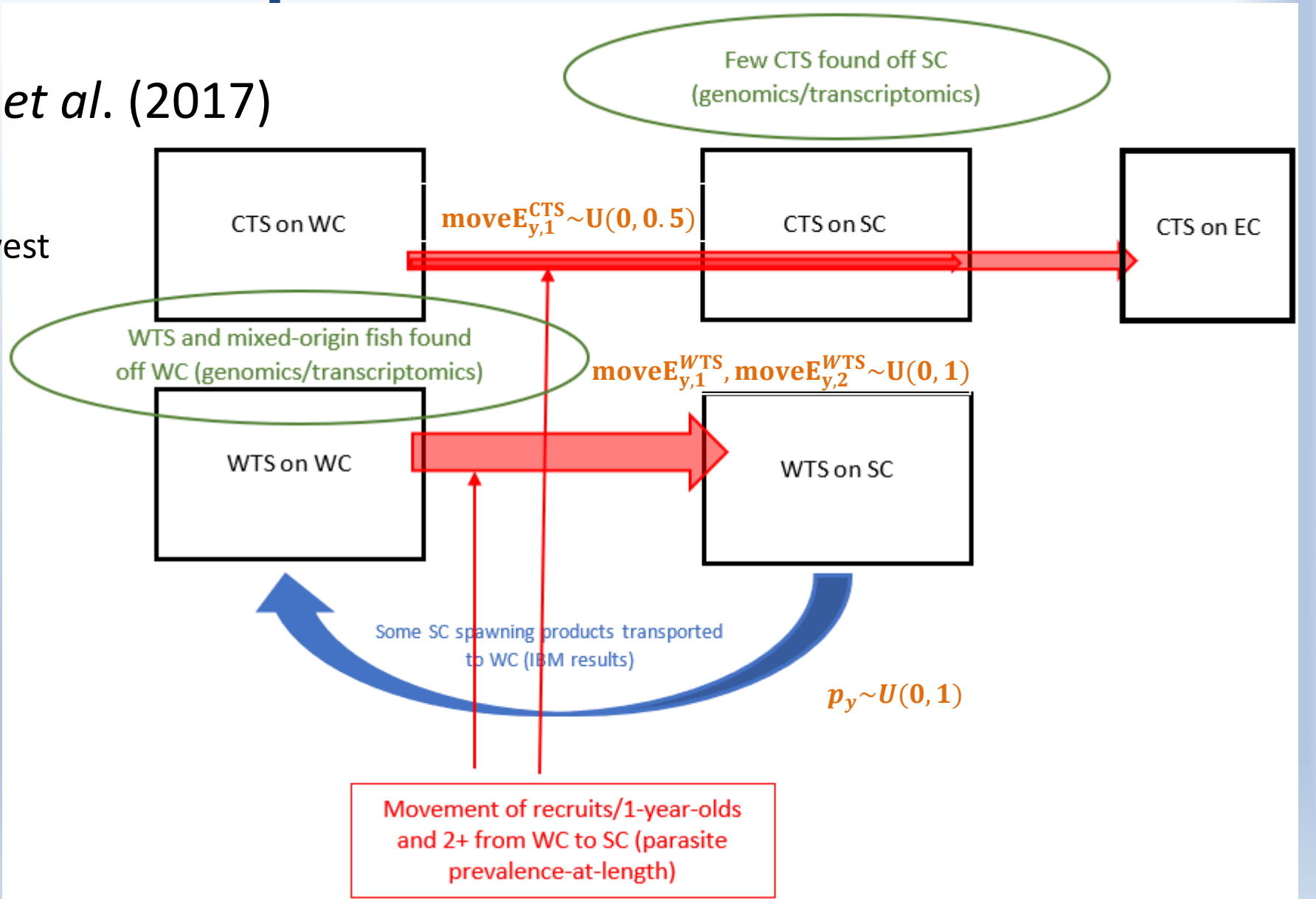


Simple Model

Table 1 of de Moor *et al*. (2017)

- Option (c) only

  WTS can remain on the west coast up to the age of 3



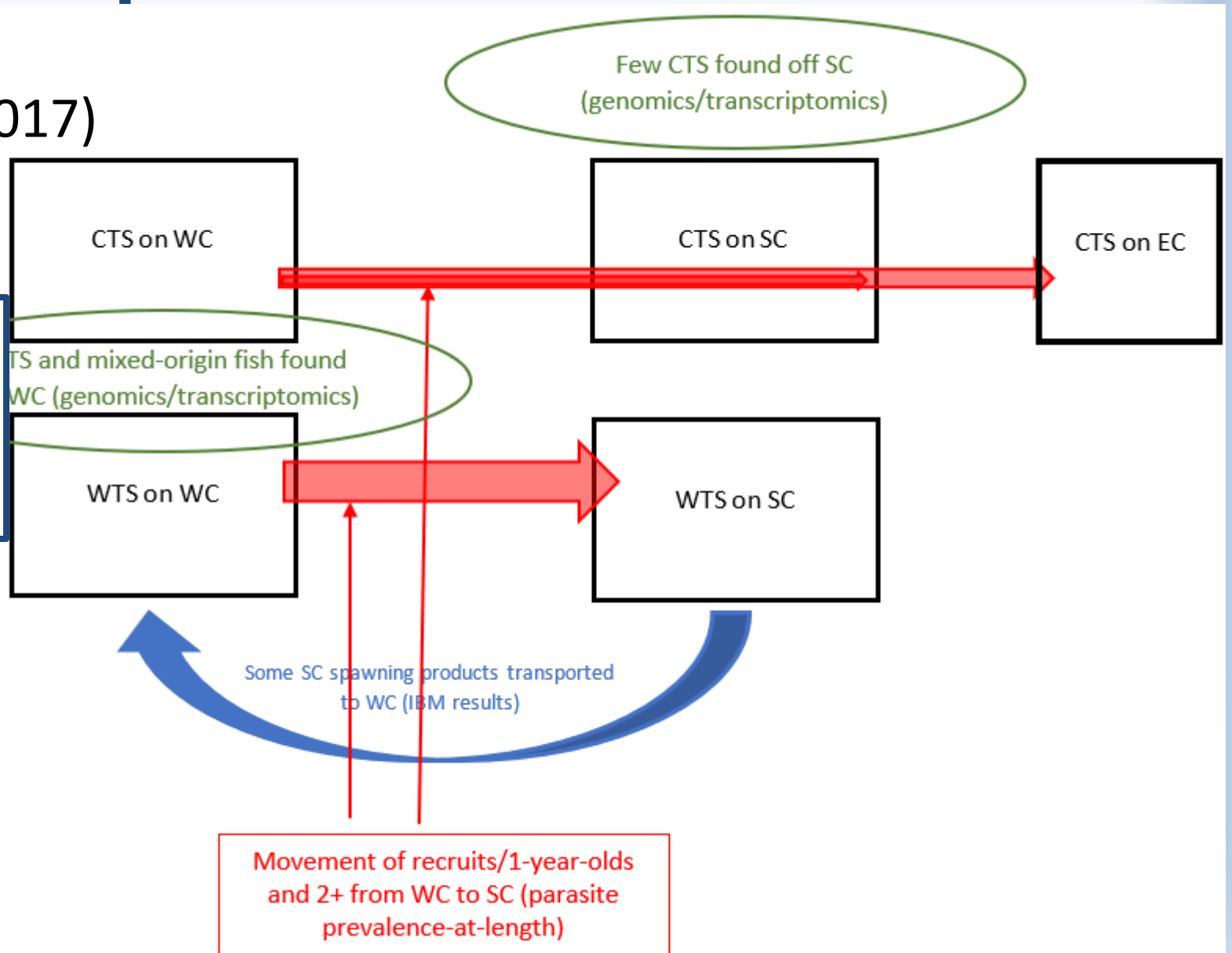
Simple Model

Table 1 of de Moor *et al*. (2017)

- Options (1)-(3)

$$N^{CTS}_{west,NI,y,0} = \frac{R \times SSB^{CTS}_{west,y}}{R \times SSB^{CTS}_{west,y} + SSB^{WTS}_{west,y}} N_{west,y,0}$$
$$N^{CTS}_{south,NI,y,0} = 0$$
$$N^{WTS}_{west,NI,y,0} = \frac{R \times SSB^{CTS}_{west,y}}{R \times SSB^{CTS}_{west,y} + SSB^{WTS}_{west,y}} N_{west,y,0} + p_y N_{south,y,0}$$
$$N^{CTS}_{south,NI,y,0} = (1 - p_y) N_{south,y,0}$$

- Recruitment estimated independently of SSB



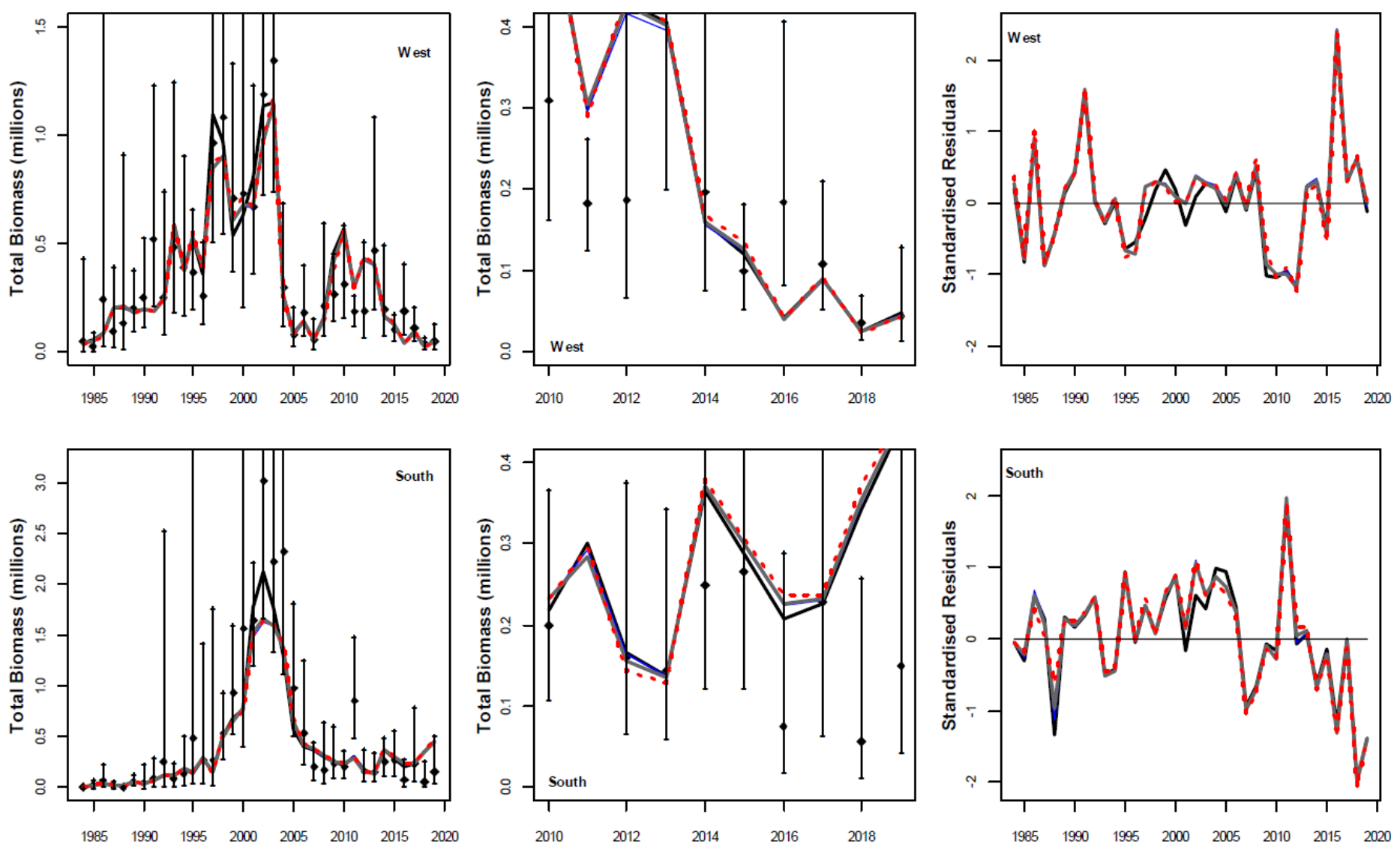
Fit to the Data

Option	Obj fn	$-lnL$	$-lnL^{Nov}$	$-lnL^{rec}$	$lnL^{com\ prop}$	$lnL^{sur\ prop}$	$-lnL^{prev}$	$ln(k_{ac}^{S})$	$move_y$	η_y^t
2020	1147.4	1076.0	61.6	40.1	-442.9	-387.5	1804.8	-1.3	-30.8	-14.5
$R = 1$	1401.1	1523.7	59.9	38.4		-388.9	1814.3	-1.4	-96.4	-24.9
$R = 2$	1401.1	1523.8	60.4	38.3		-389.6	1814.8	-1.3	-96.6	-24.9
$R = 5$	1400.4	1523.2	60.3	38.3		-390.1	1814.7	-1.3	-96.7	-24.9
$R = \infty$	1398.5	1521.7	60.1	38.8		-392.3	1815.1	-1.3	-97.0	-24.9

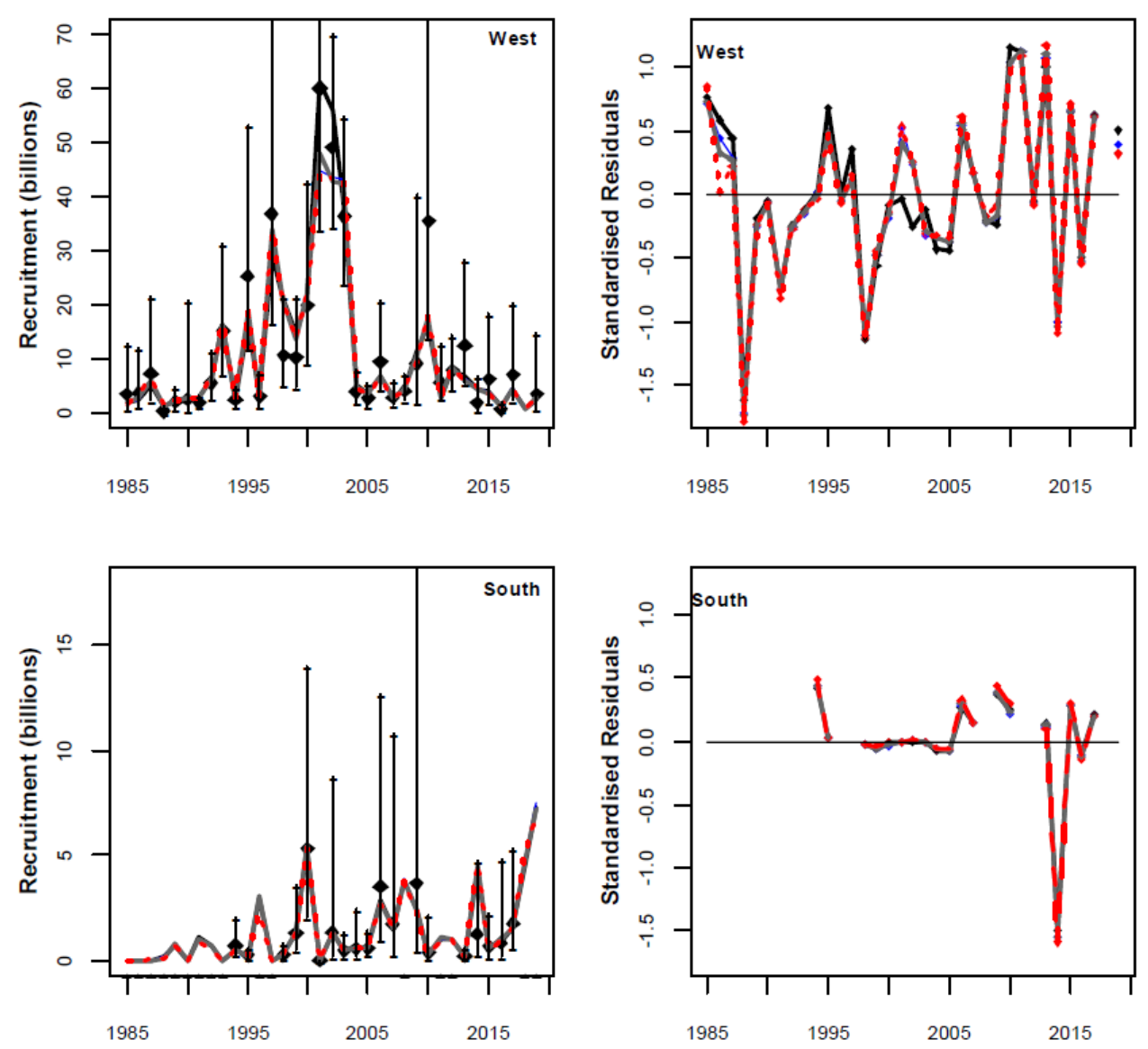
Fit to the data is better than what was obtained with the previous hypothesis

- Except for parasite prevalence-at-length, but there is only a single growth curve
- Commercial data are still to be included
- Slightly better fit as R increases

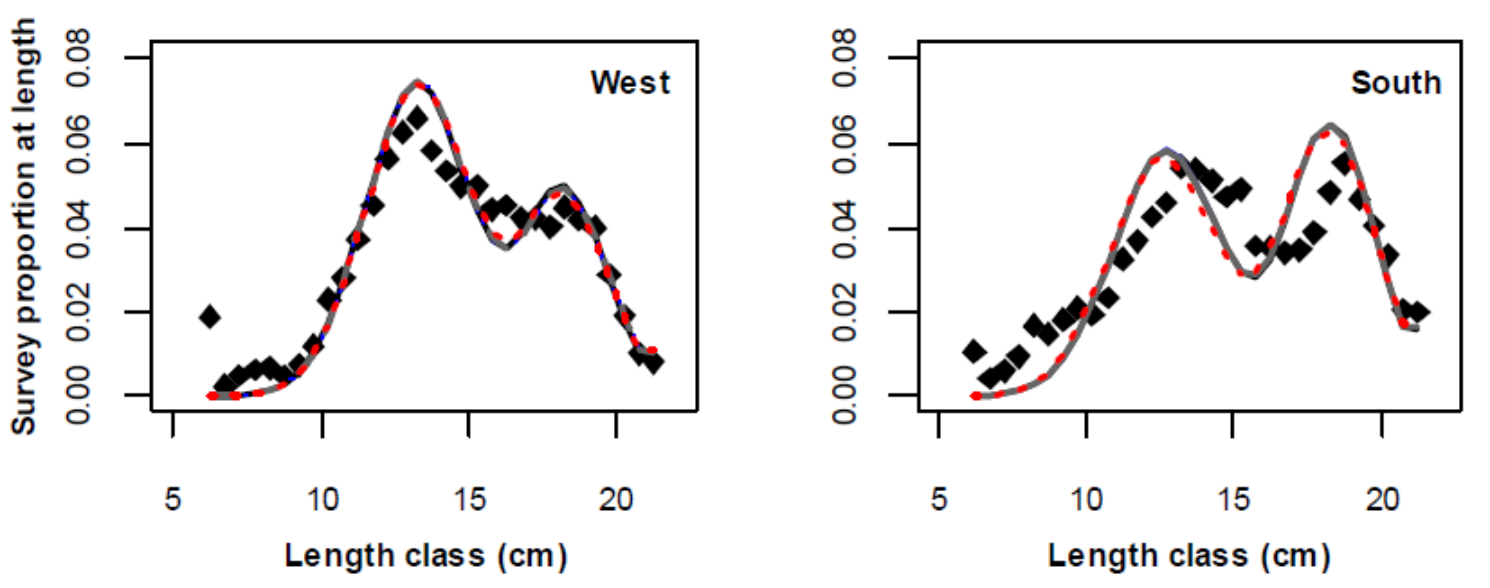
Fit to the Data

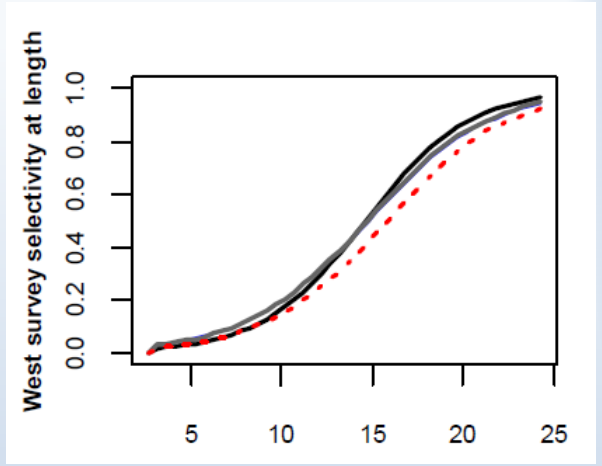


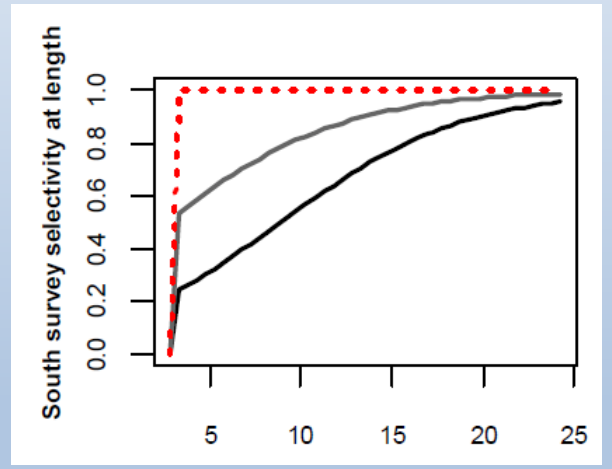
Fit to the Data

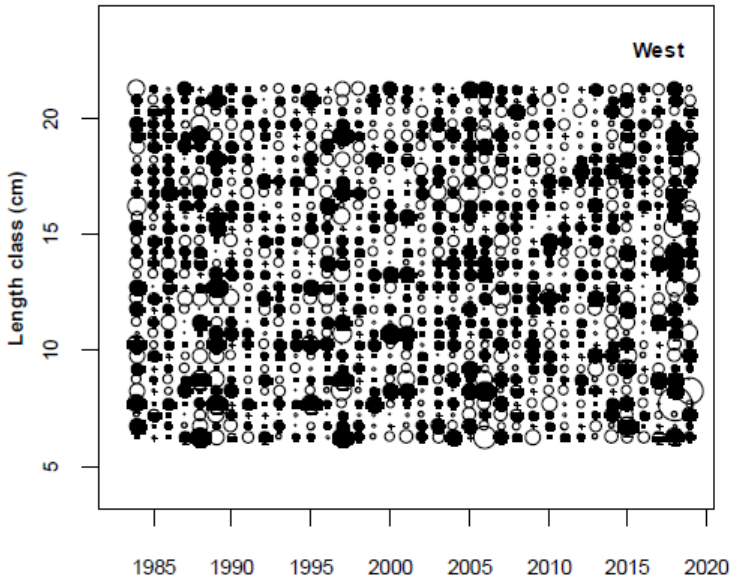


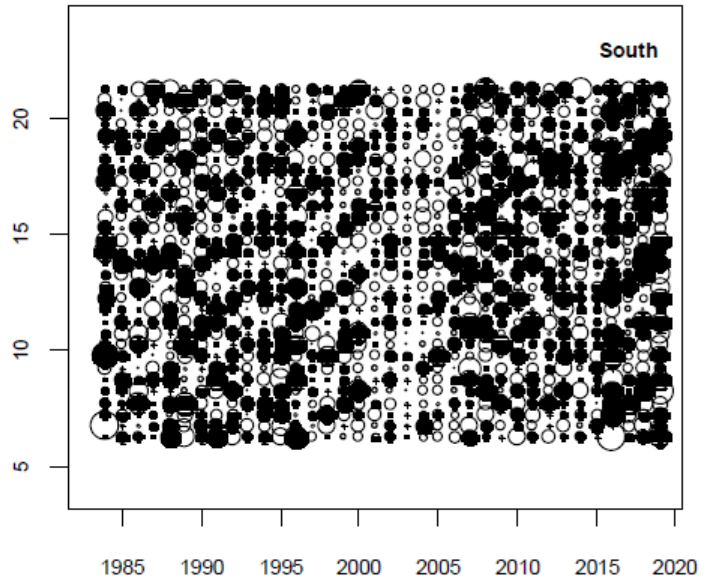
Fit to the Data





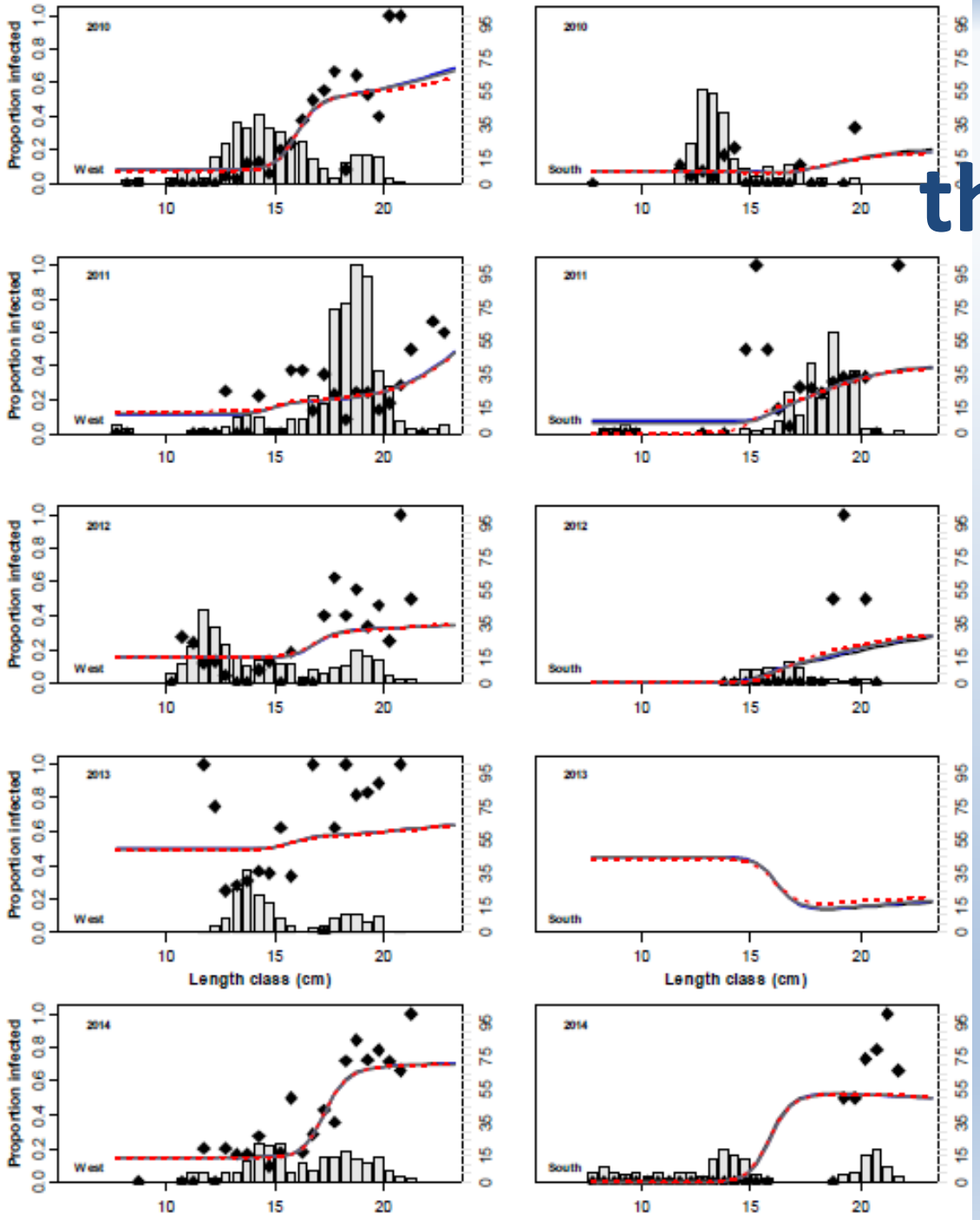


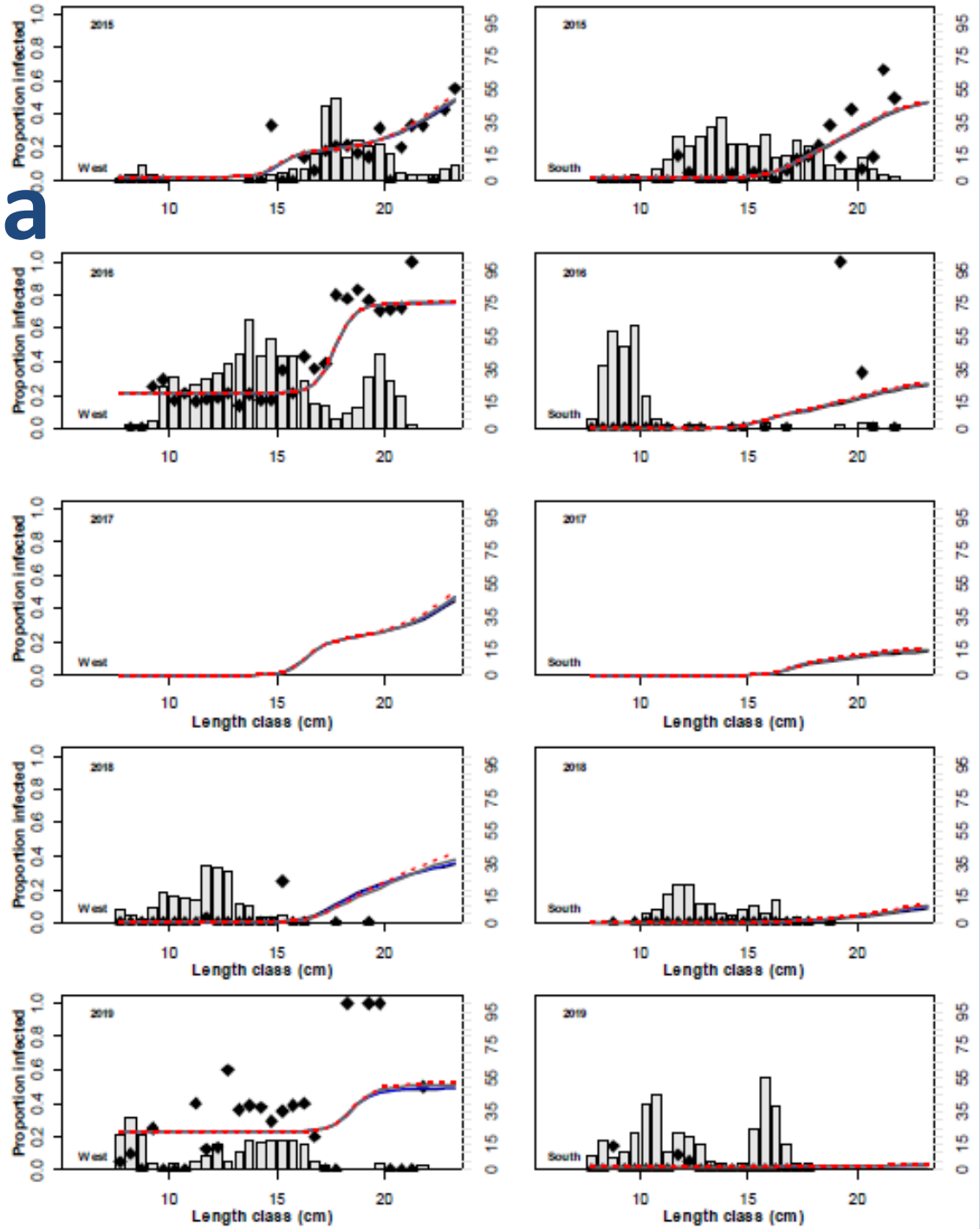




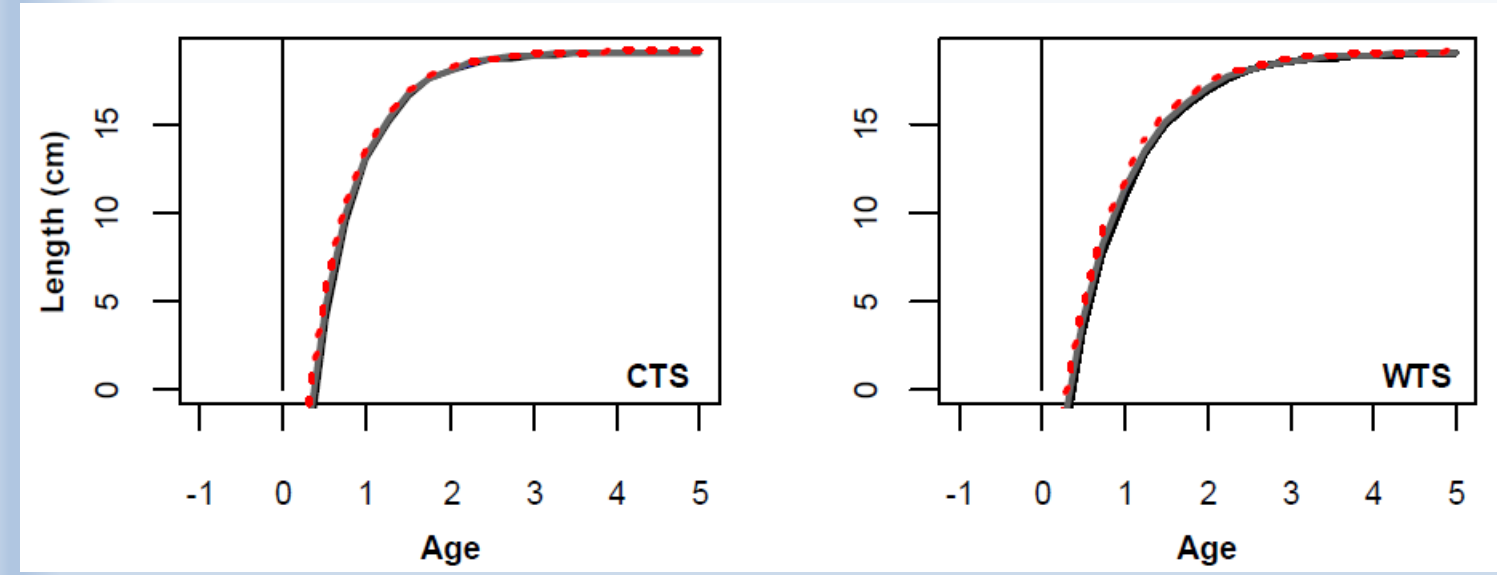
Fit to the data is relatively good, but why is survey selectivity at length not relatively flat?

Fit to the Data



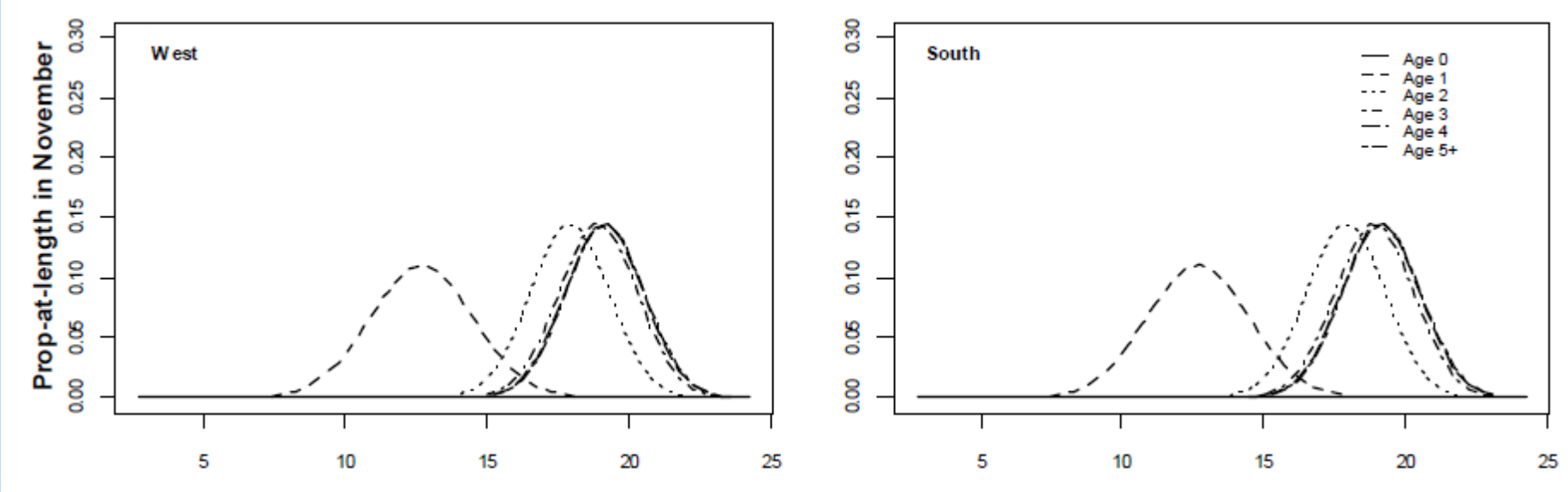


Growth



All sardine currently assumed to have same growth curves and distributions of length-at-age

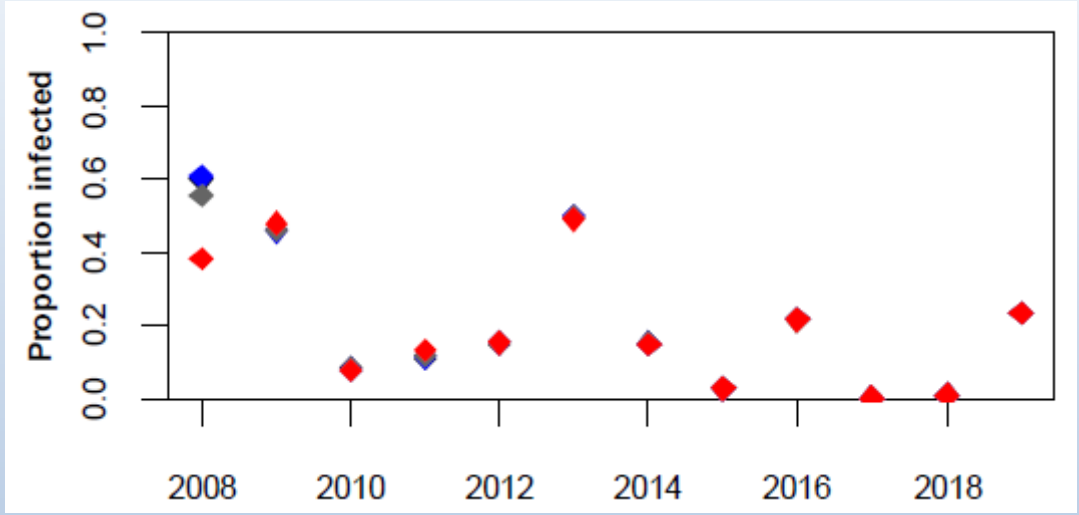
- Recruitment on south coast may be earlier (winter recruitment)
- Growth on west coast may be slower for first ~3 months



Natural Mortality

	$M^{CTS}_{west,y,0}$	$M^{WTS}_{west,y,0}$	$M^{WTS}_{south,y,0}$	$M^{CTS}_{west,y,0}$	$M^{WTS}_{west,y,0}$	$M^{WTS}_{south,y,0}$
$R = 1$	1.00	1.40	1.40	1.00	1.40	1.40
$R = 2$	1.00	1.28	1.28	1.00	1.28	1.28
$R = 5$	1.00	1.28	1.28	1.00	1.28	1.28
$R = \infty$	1.00	1.26	1.26	1.00	1.26	1.26

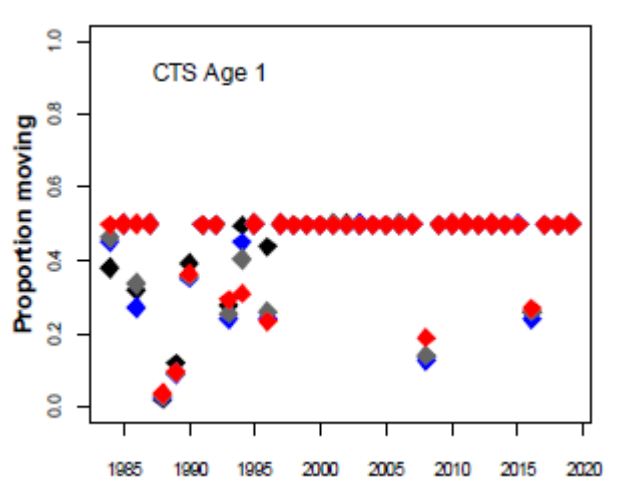
Infection

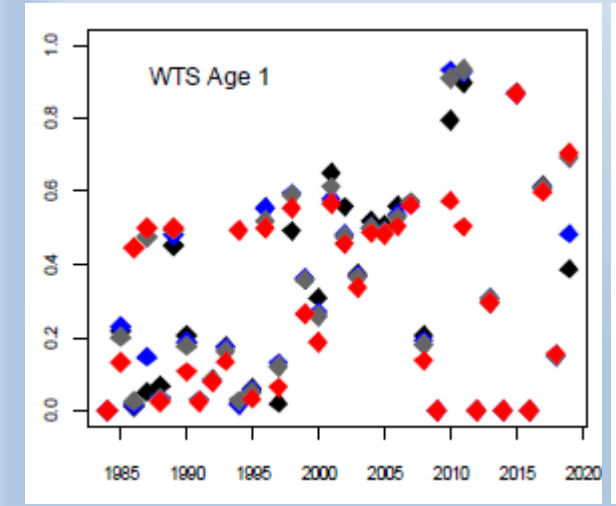


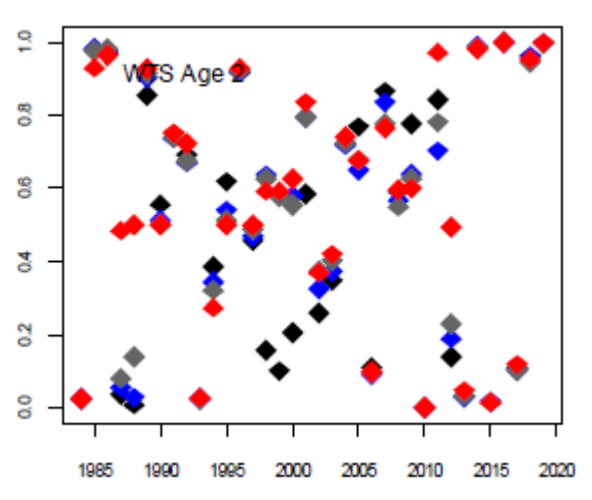
Annually on 1 November (uncertainty)

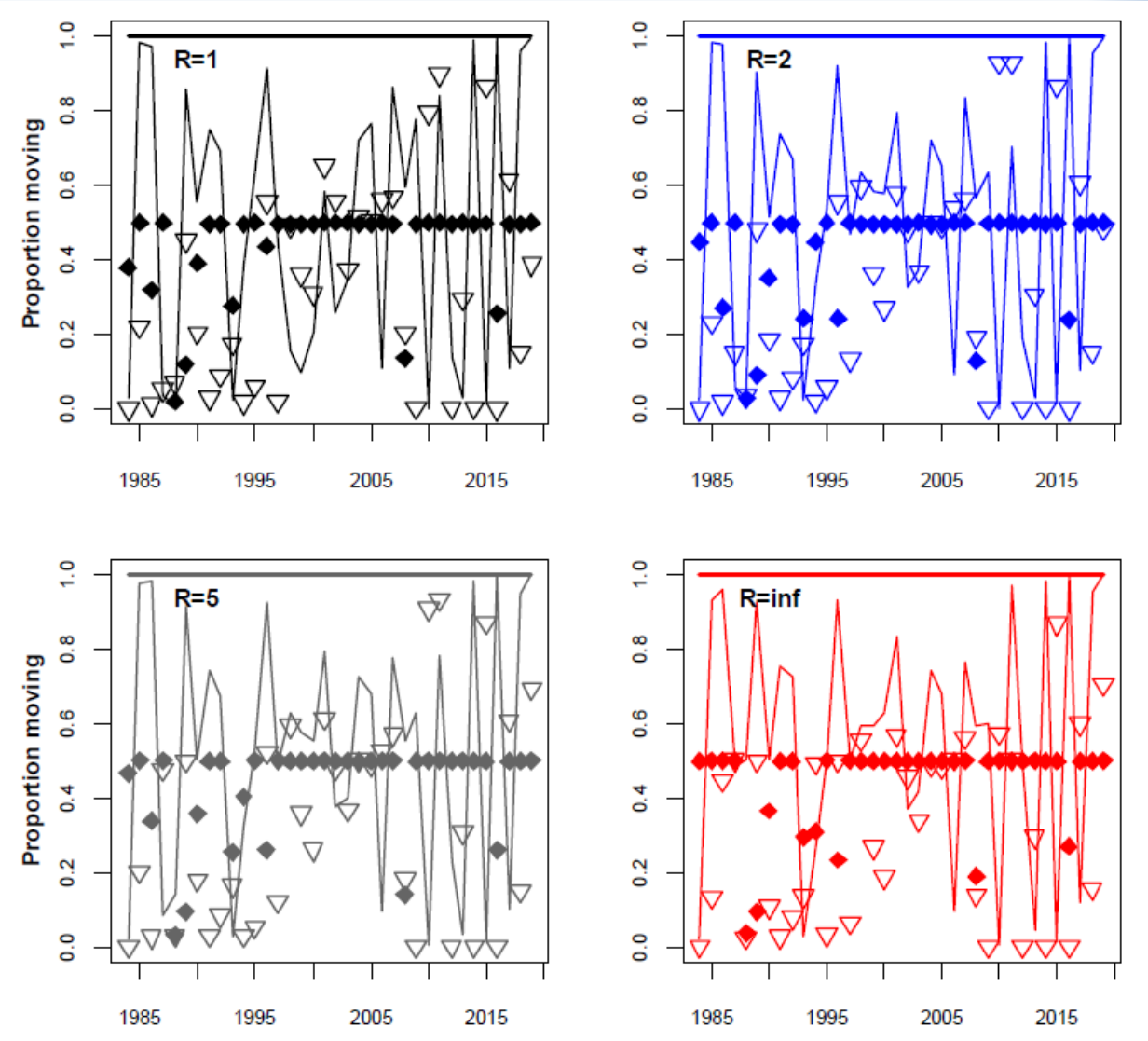
Infection doesn’t affect sardine (e.g. M, movement etc.)

Active West to South/East Movement

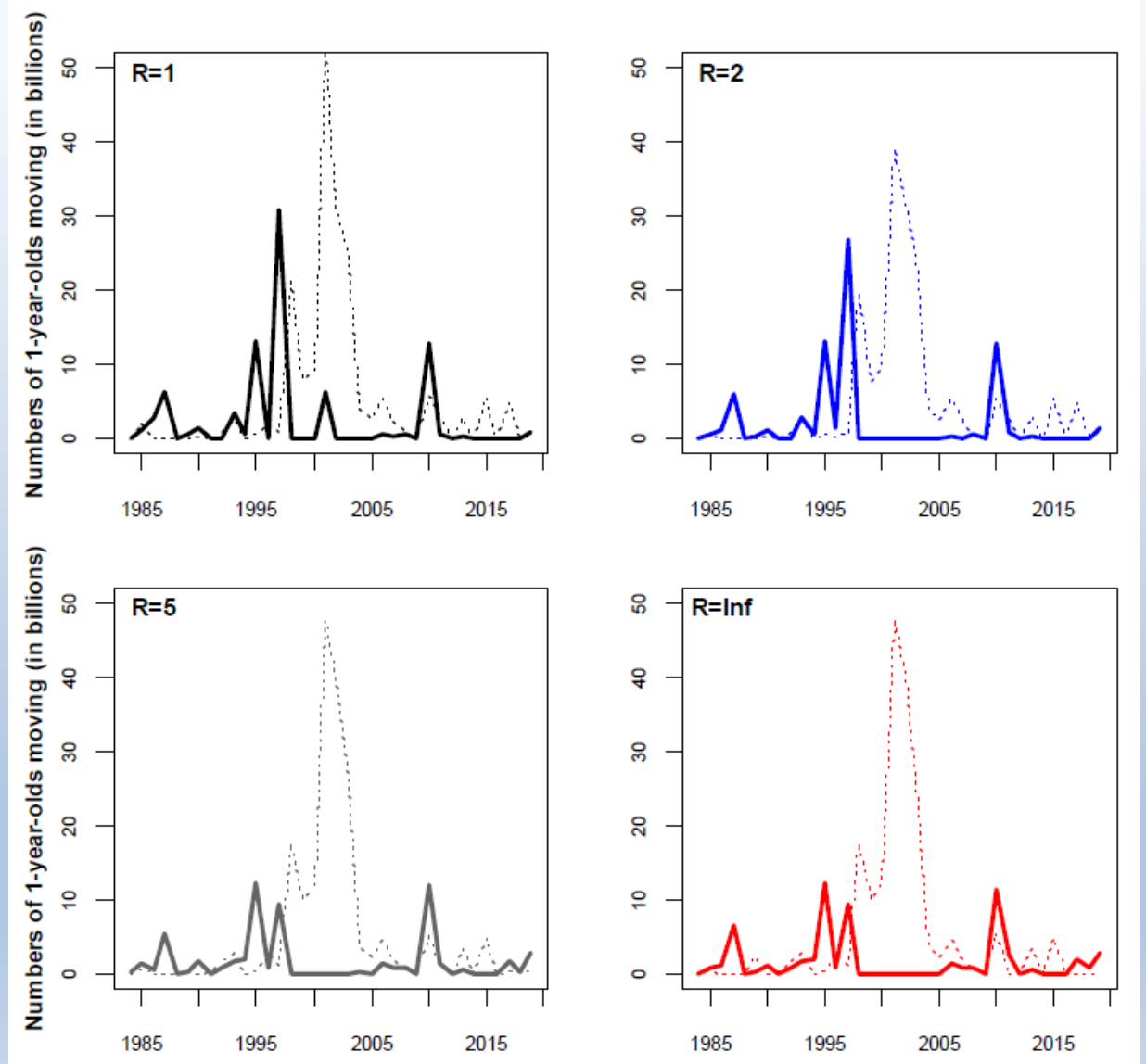








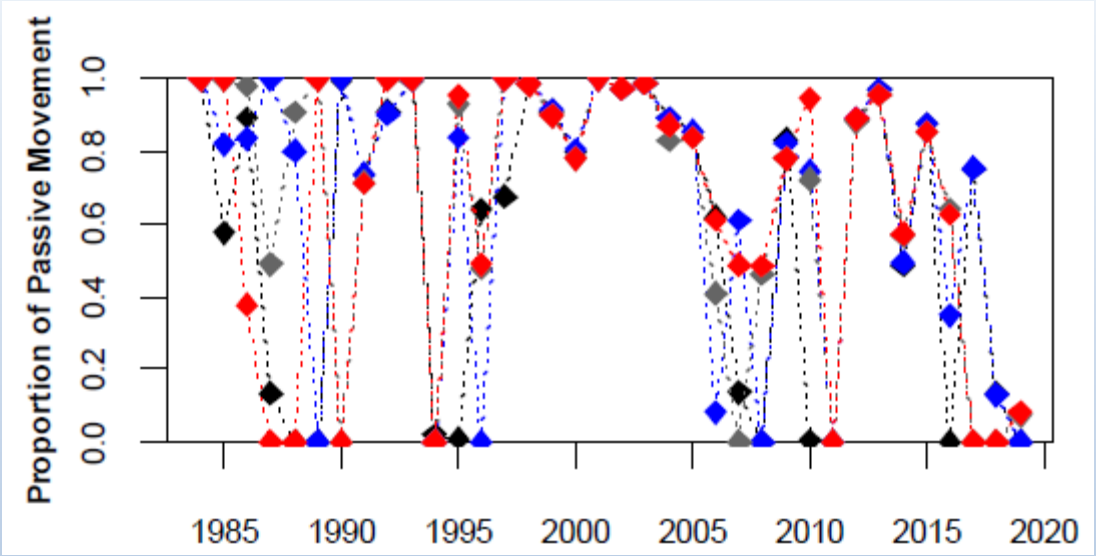
Active West to South/East Movement



This has been a "red face test"

- Absence of CTS on south coast (Teske *et al*. 2021)
- Relatively small sardine biomass on east coast

Passive South to West Movement

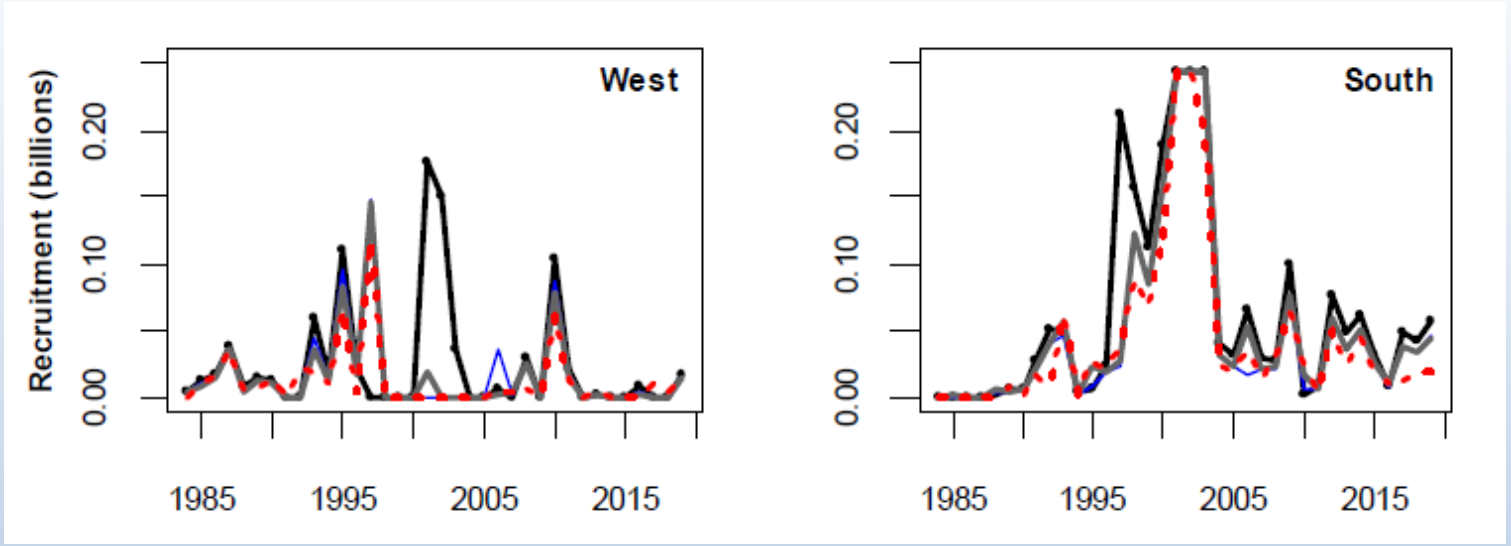


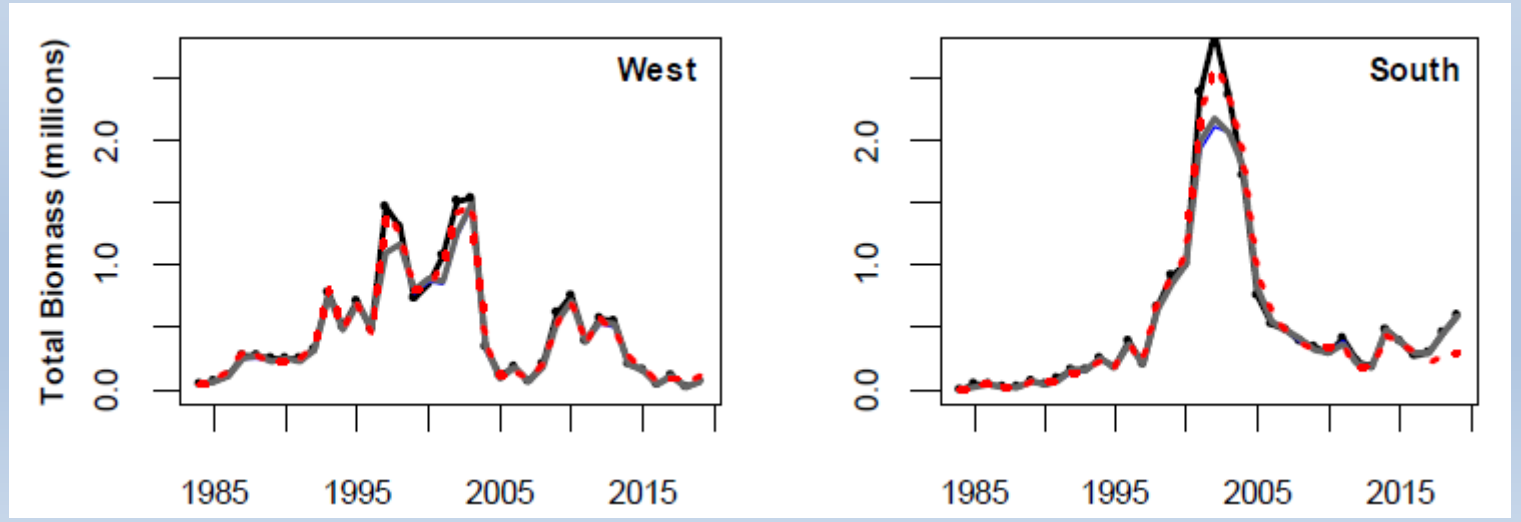
p_y~U(0,1)
See WP2

High proportions pre-2000
likely inconsequential

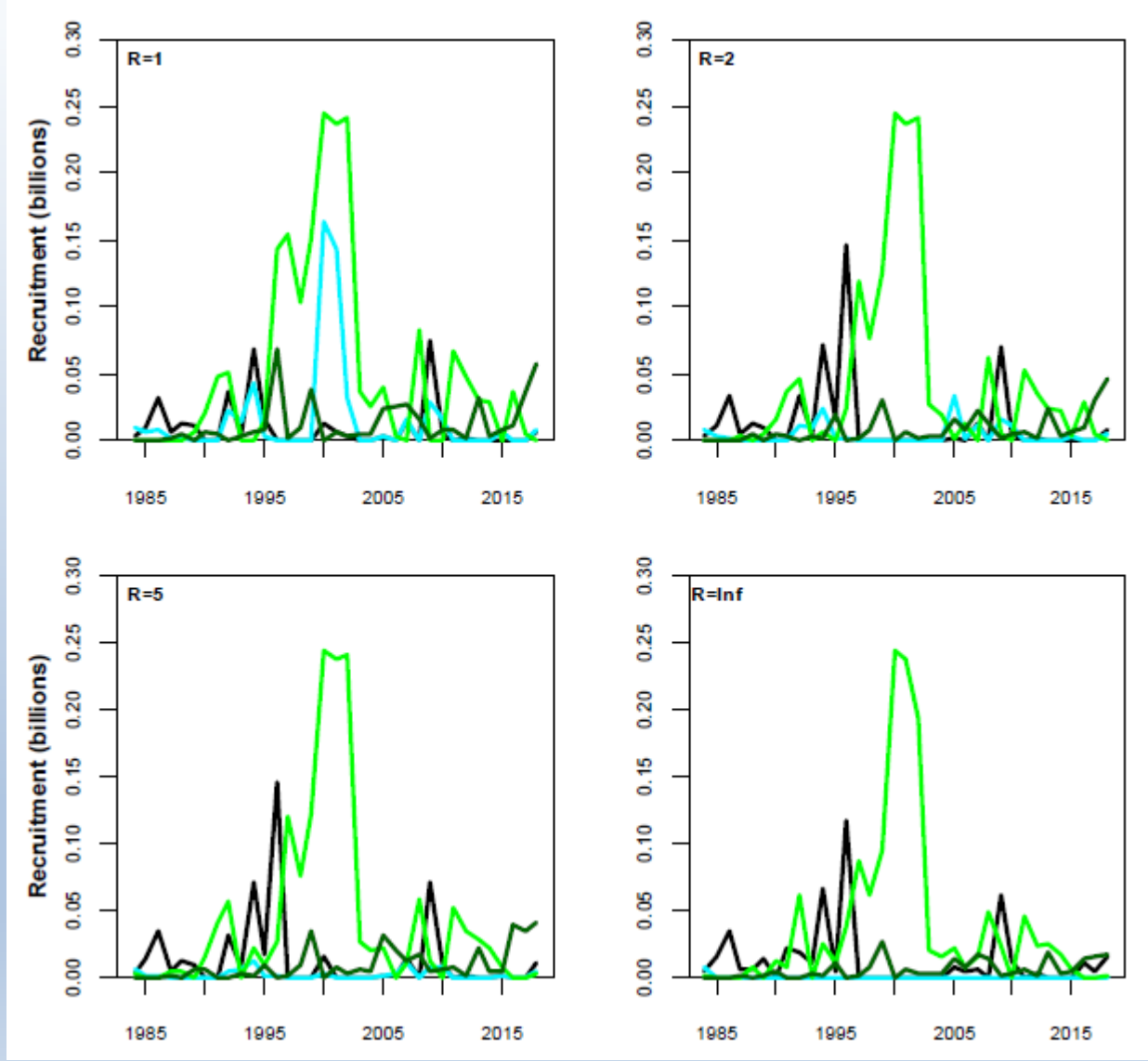
p_y~ 17.4% or 18% !

Recruitment and Total Biomass

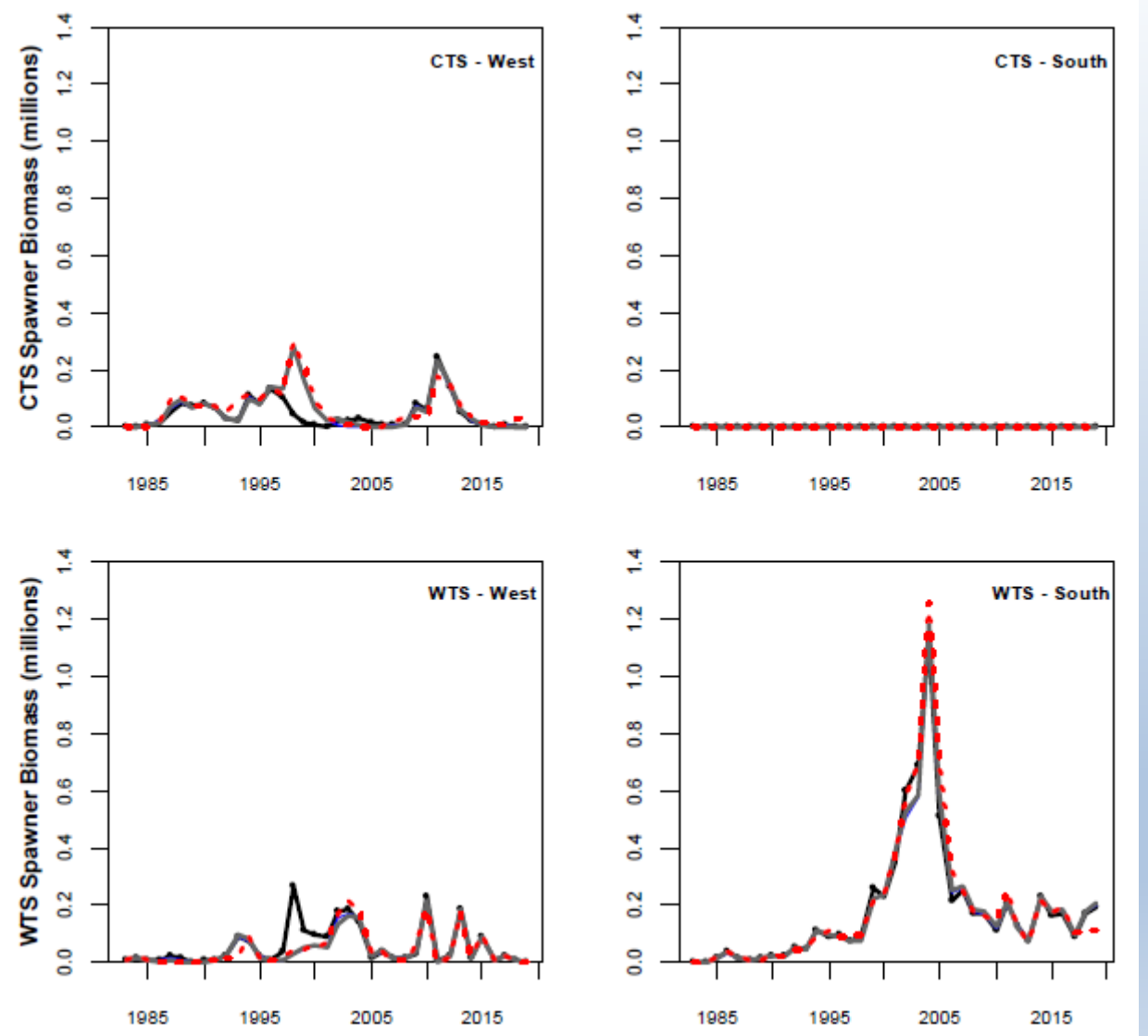




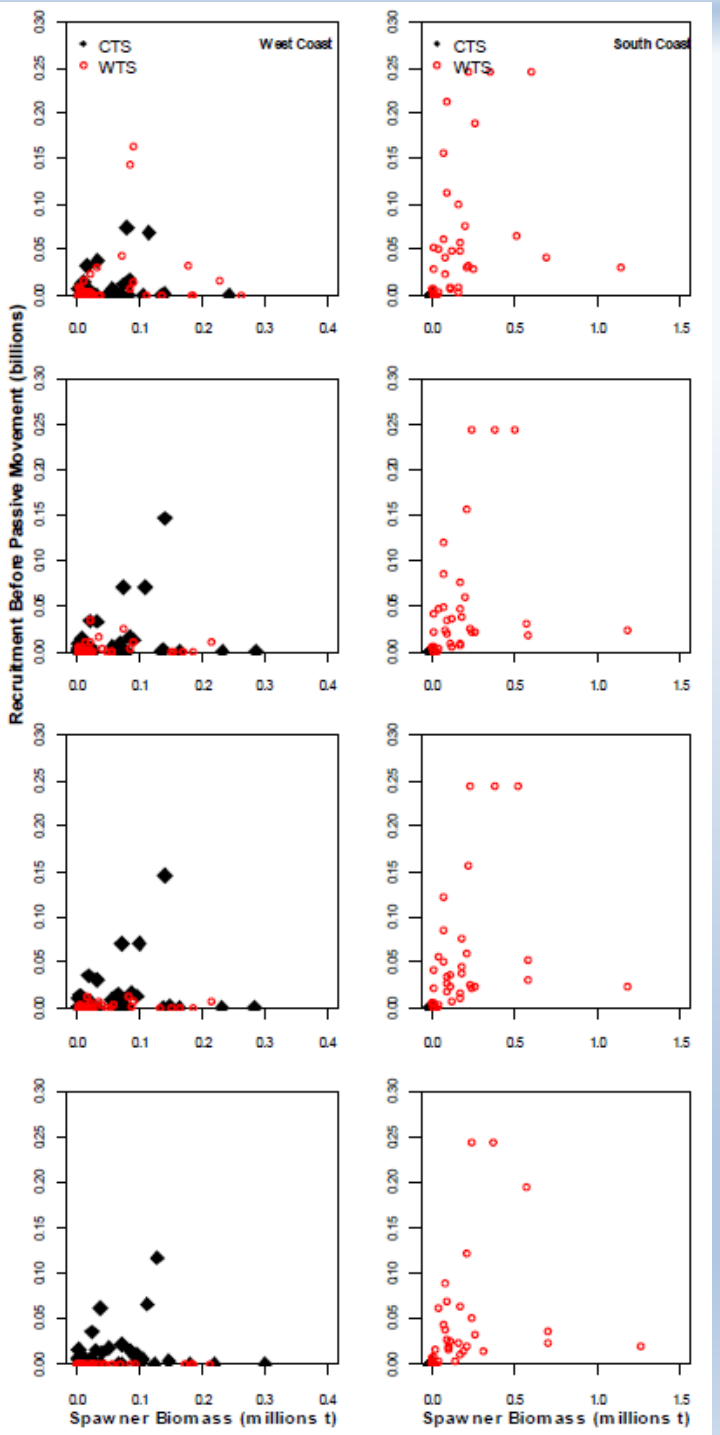
Recruitment

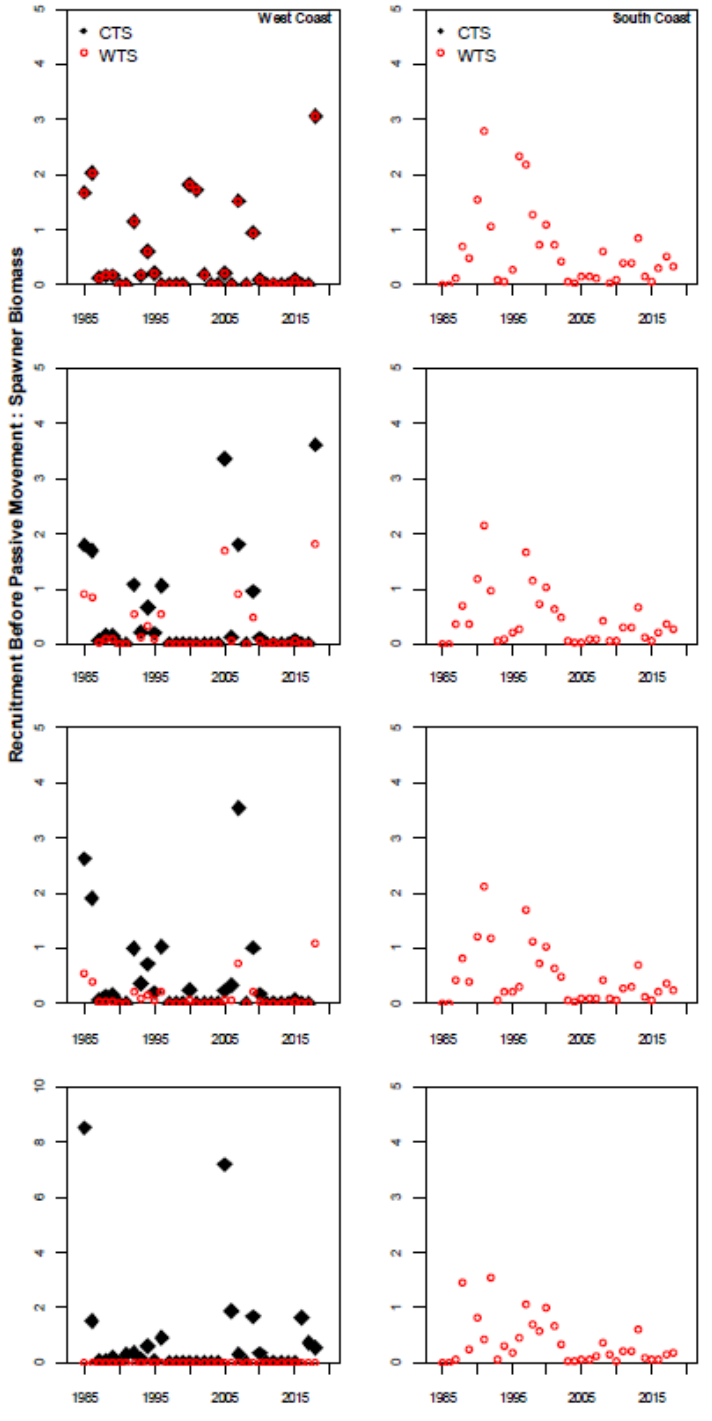


Spawner Biomass



Spawner Biomass and Recruitment





Another
“red face test”

Next Steps

- Informative priors on p_y
- Survey selectivity
- Time varying M
- Growth curves
- Commercial data
- Options (ii)-(v)
- Allow 4 or 5+ WTS to remain on west coast