

# A summary of the South African sardine resource and fishery



International Stock Assessment Workshop  
Cape Town  
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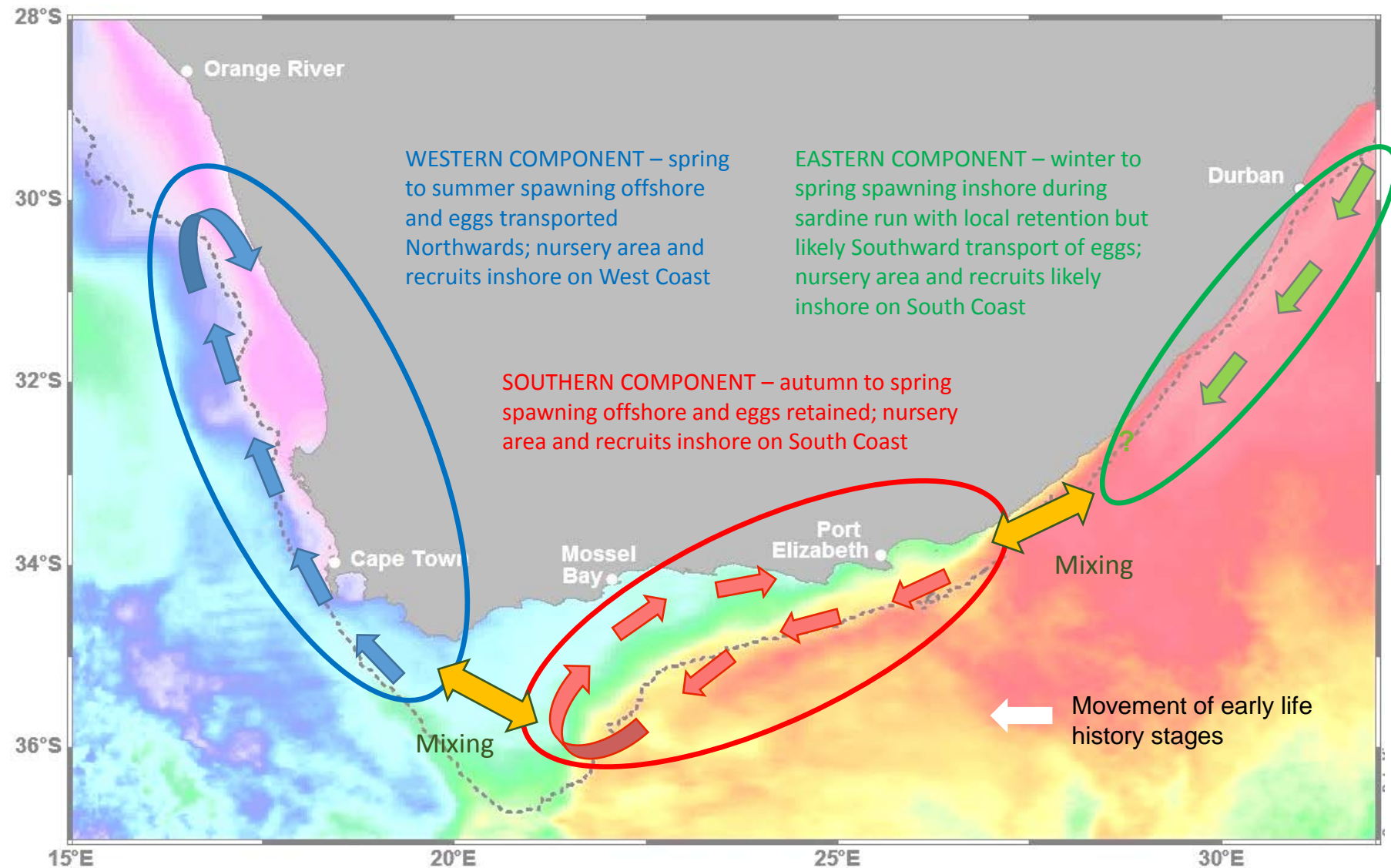


agriculture,  
forestry & fisheries

Department:  
Agriculture, Forestry and Fisheries  
REPUBLIC OF SOUTH AFRICA



The South African sardine population is hypothesized to comprise multiple components, with semi-discrete stocks off the west, south and east coast that are not isolated but show some degree of mixing



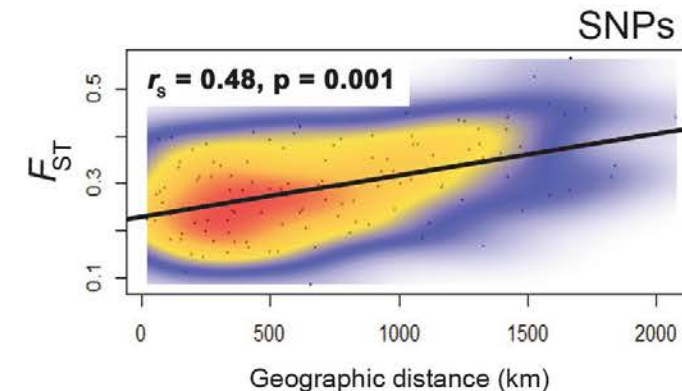
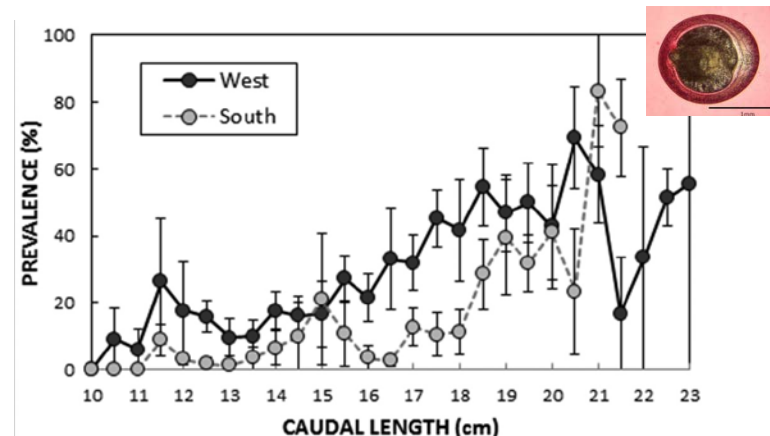
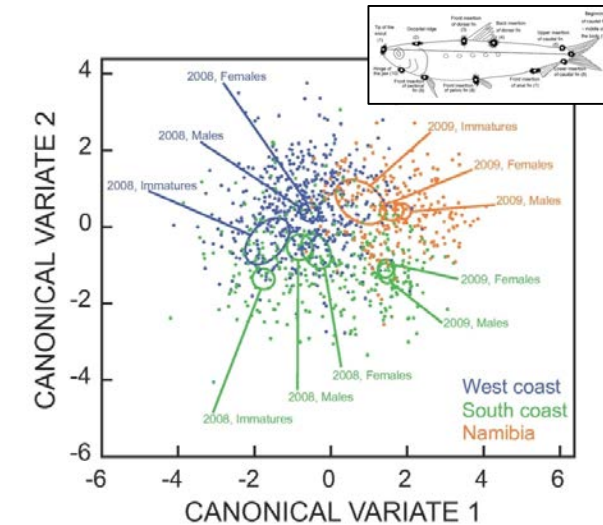
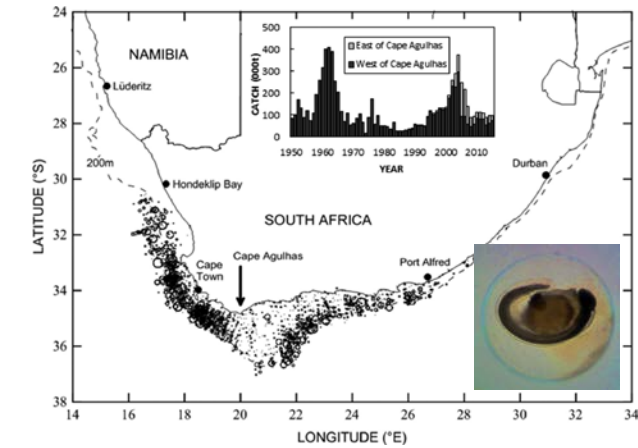
The sardine multi-stock hypothesis was developed based on observations of significant spatial differences in a variety of sardine characteristics, including:

Life history characteristics (distribution patterns, spatially-separated spawning areas, different spawning seasons (Coetzee *et al* 2008; de Moor *et al* 2017)

Phenotypic meristic (*e.g.* gill raker and vertebral number; van der Lingen *et al* 2010; Idris *et al* 2016) and morphological (*e.g.* body shape, otolith shape) characteristics (Groenewald *et al* in press)

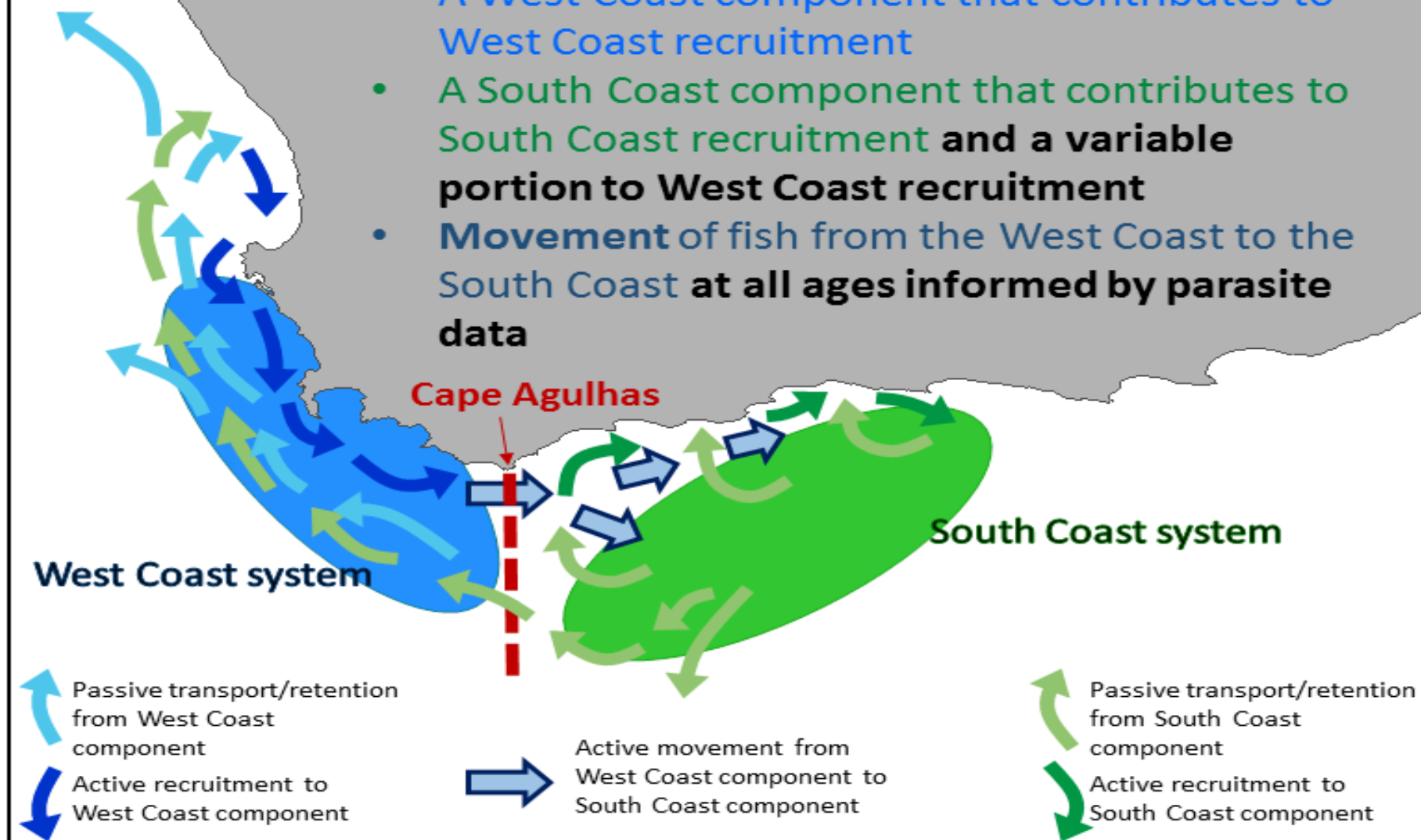
Genetics - single nucleotide polymorphisms or SNPs (Teske *et al* 2018)

Parasite biotag loads (van der Lingen *et al* 2015; Weston *et al* 2015)

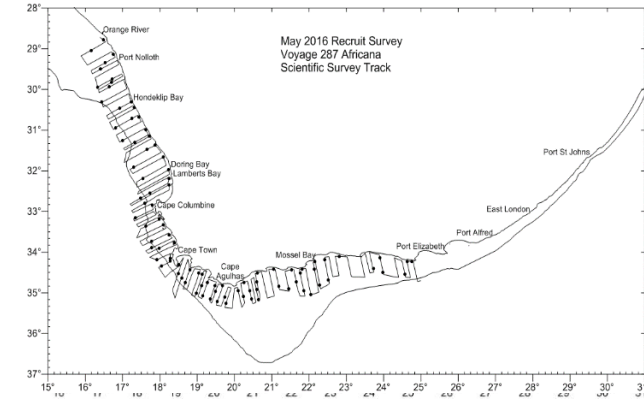
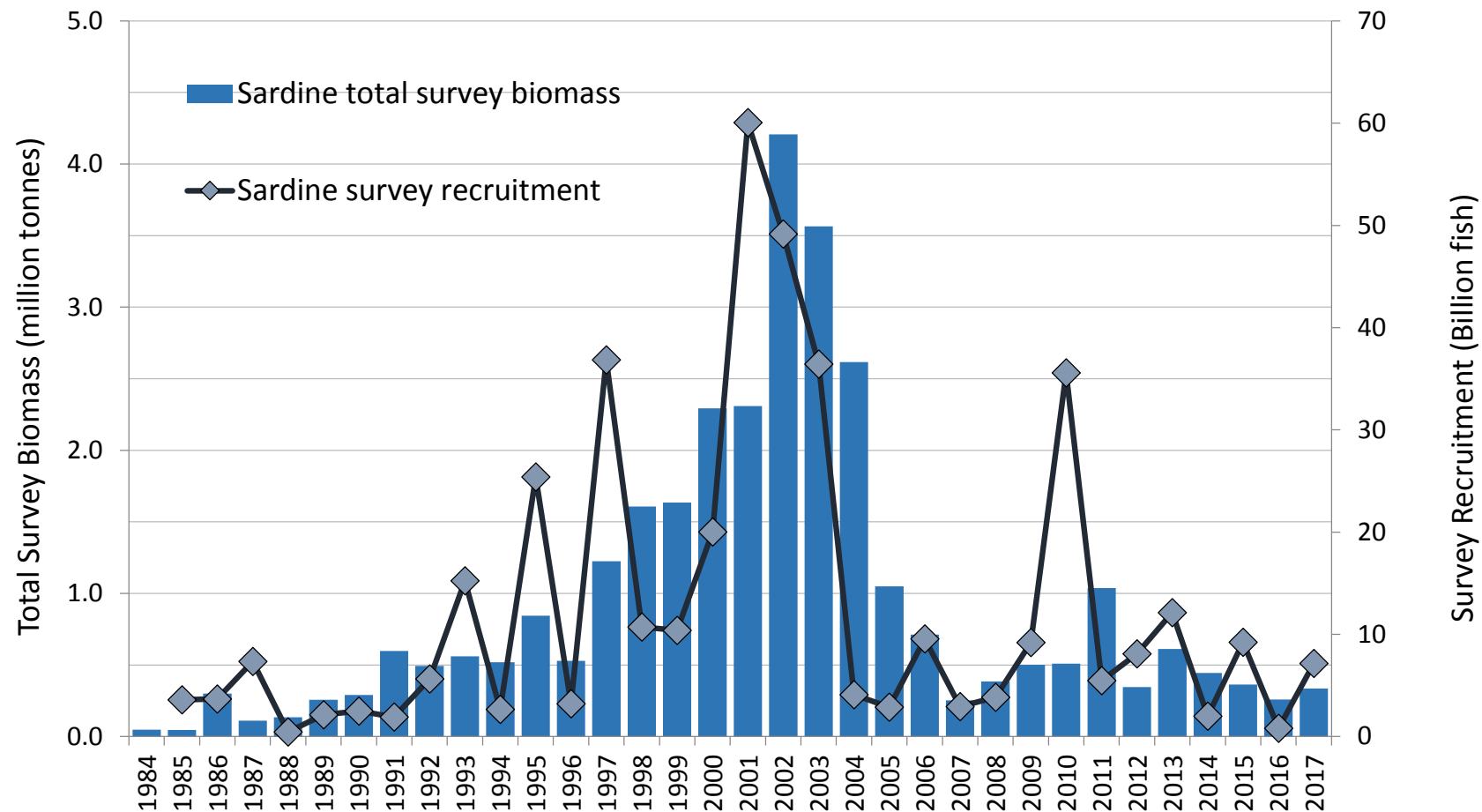


# Conceptual model

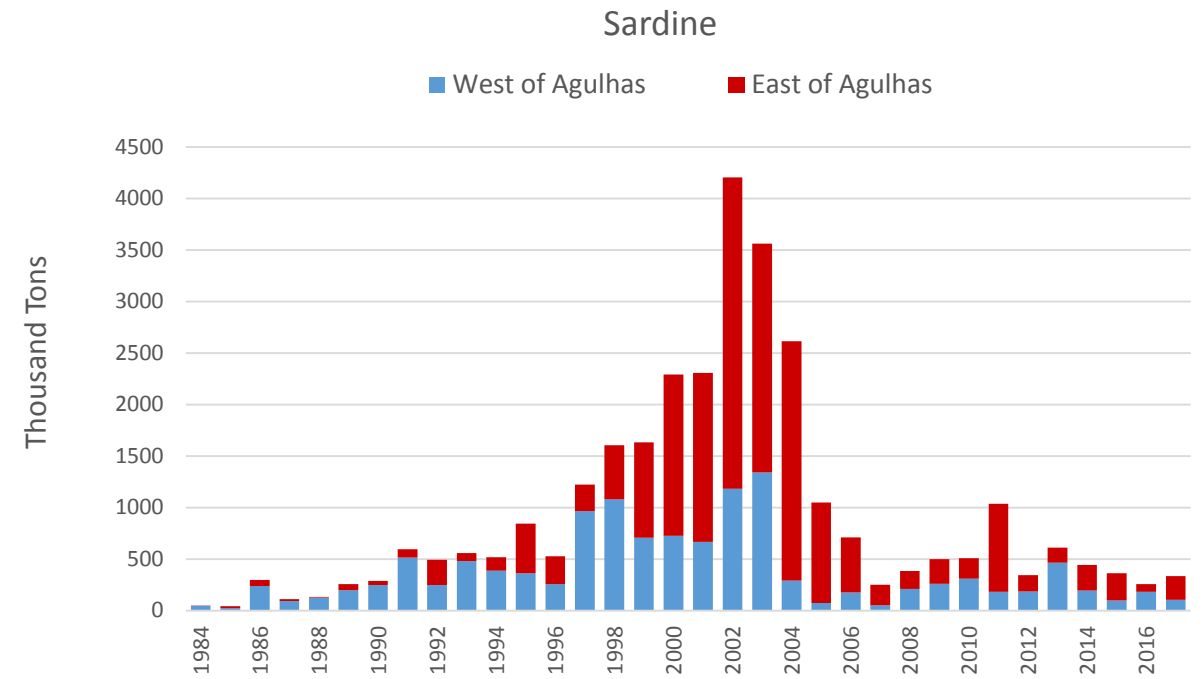
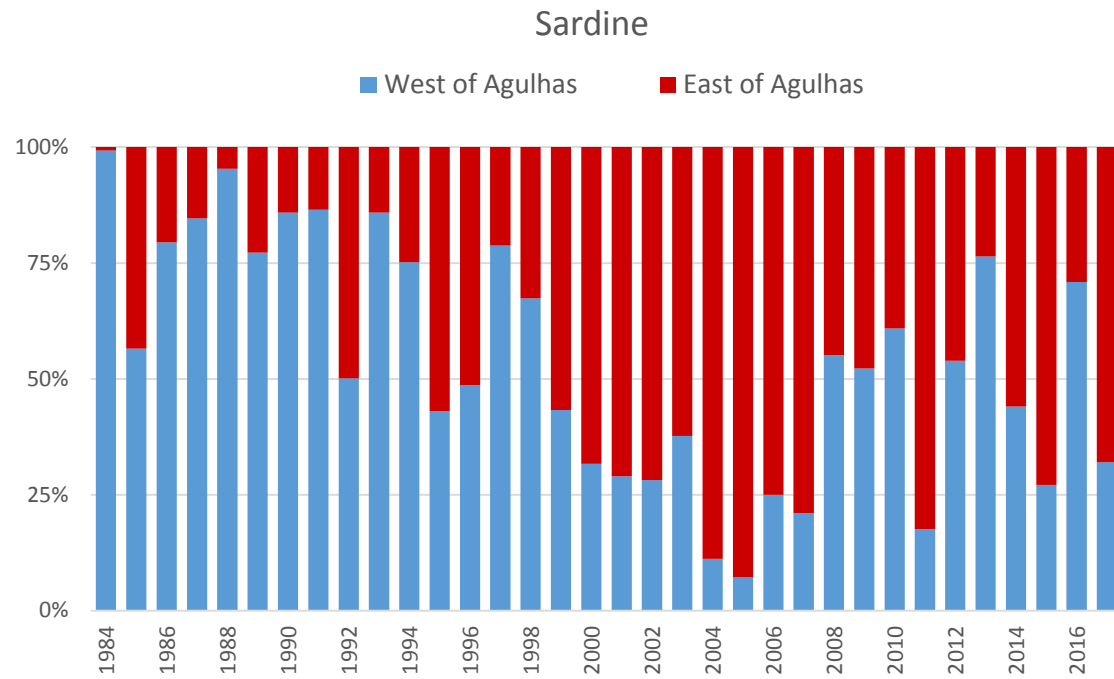
- A West Coast component that contributes to West Coast recruitment
- A South Coast component that contributes to South Coast recruitment and a **variable portion to West Coast recruitment**
- **Movement** of fish from the West Coast to the South Coast **at all ages informed by parasite data**



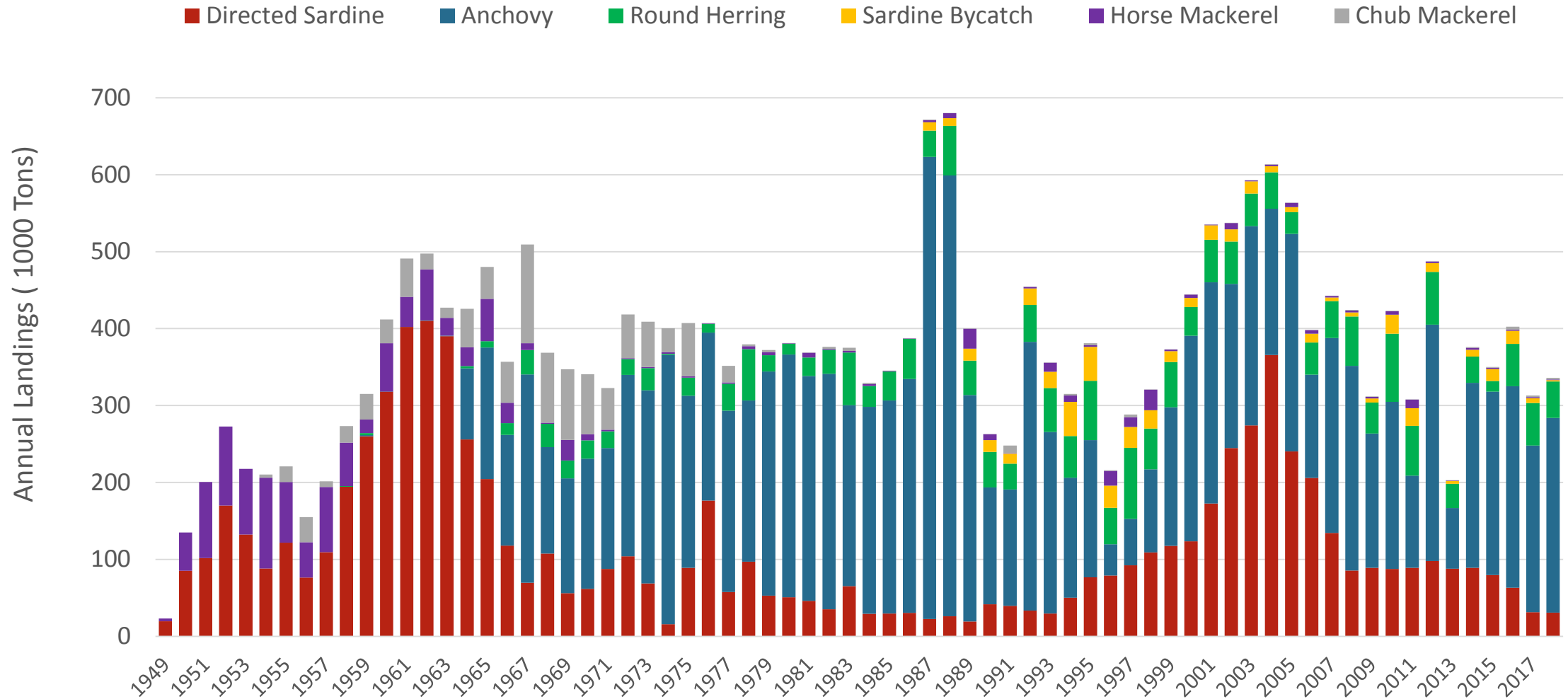
# Hydroacoustic Survey Estimates of Biomass



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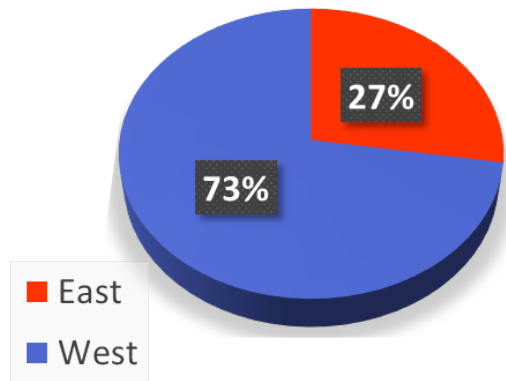


# History of the Fishery





# Sardine Fishery Background

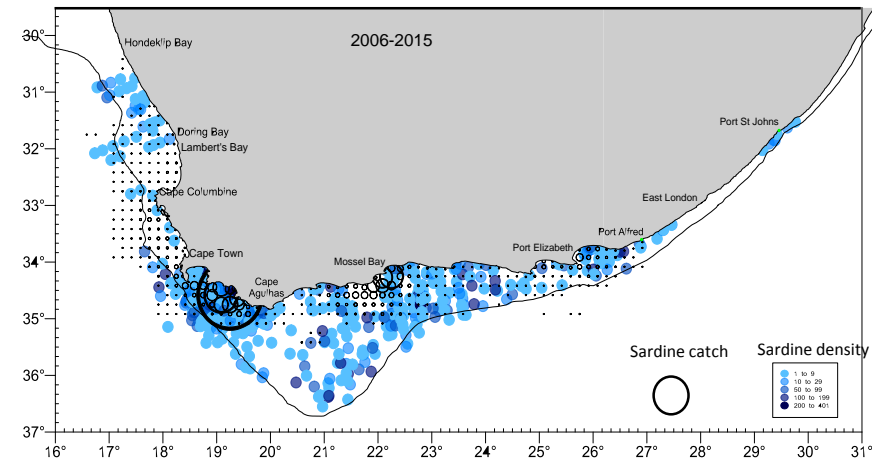
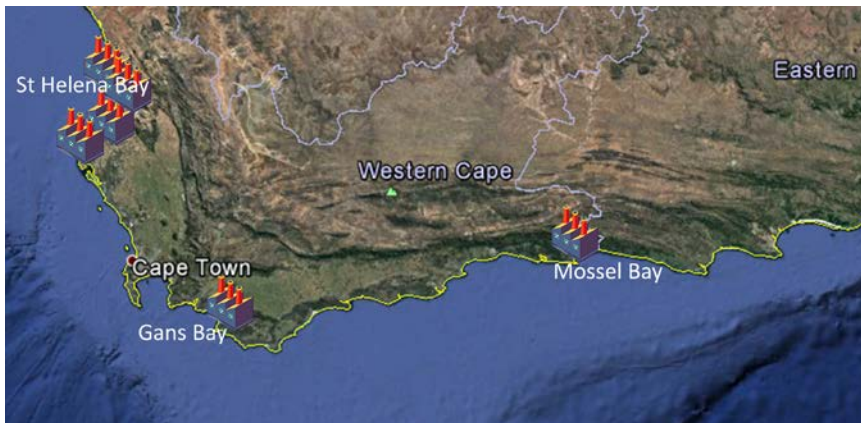


109 long-term rights issued 2006-2020

- 86 active rights holders in 2016
- Rights range from 0.05% – 15% of the TAC
- **Rights to 73% of the TAC is held by RHs from the West Coast**

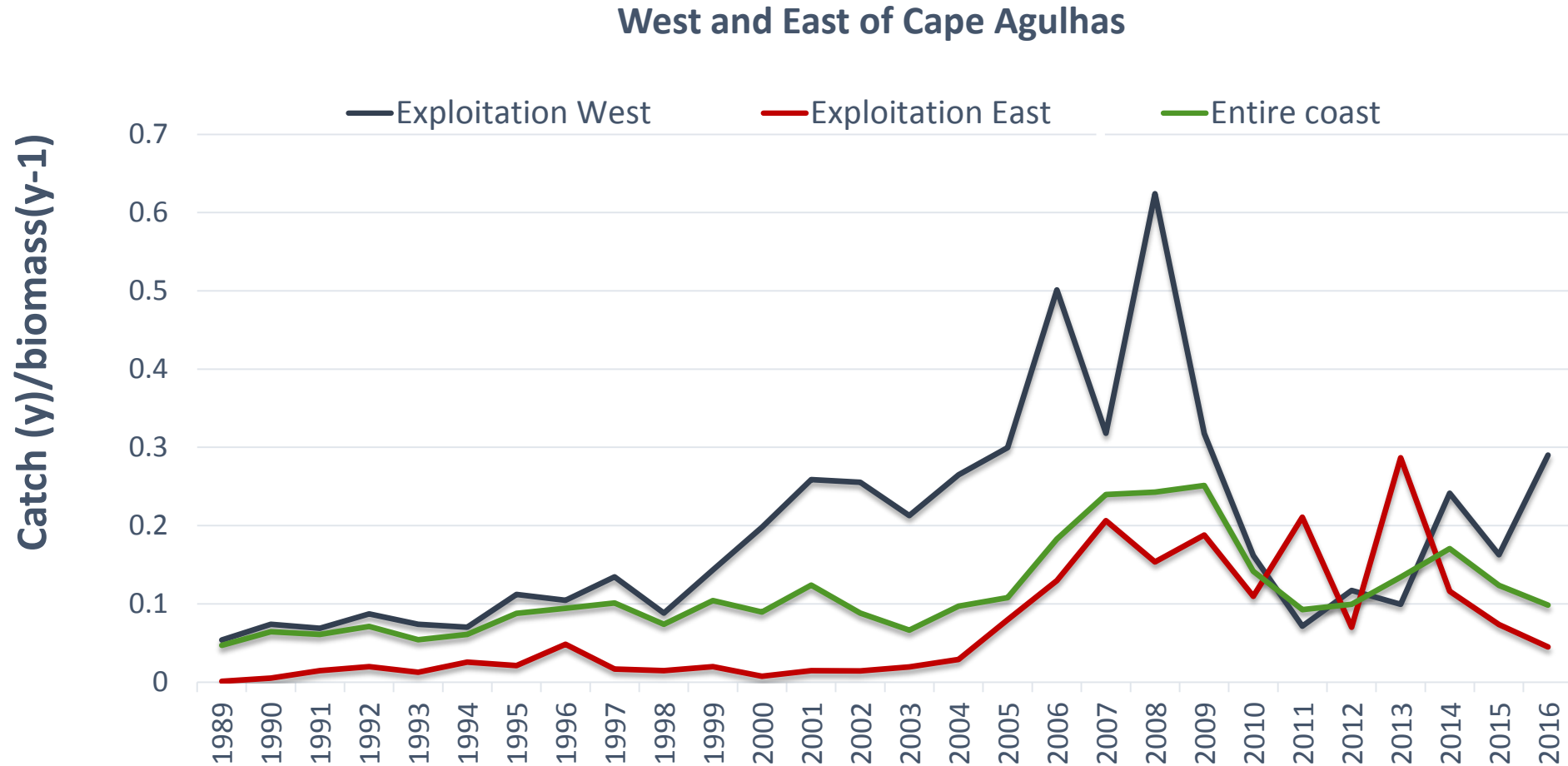
80% of the catch is canned

- 6 canning factories ( 5 on west coast)
- small pack and freeze processors (bait and human consumption)

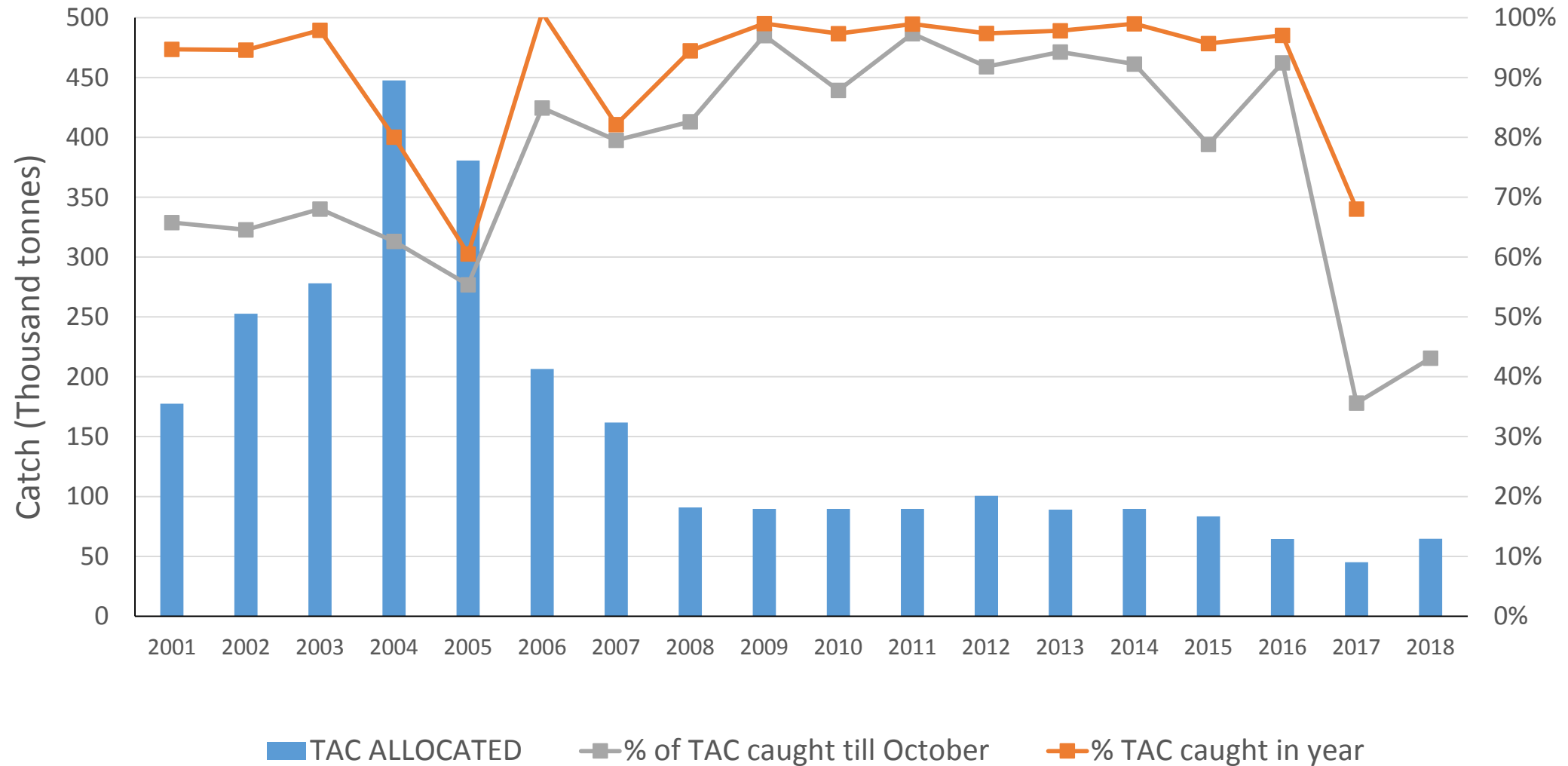




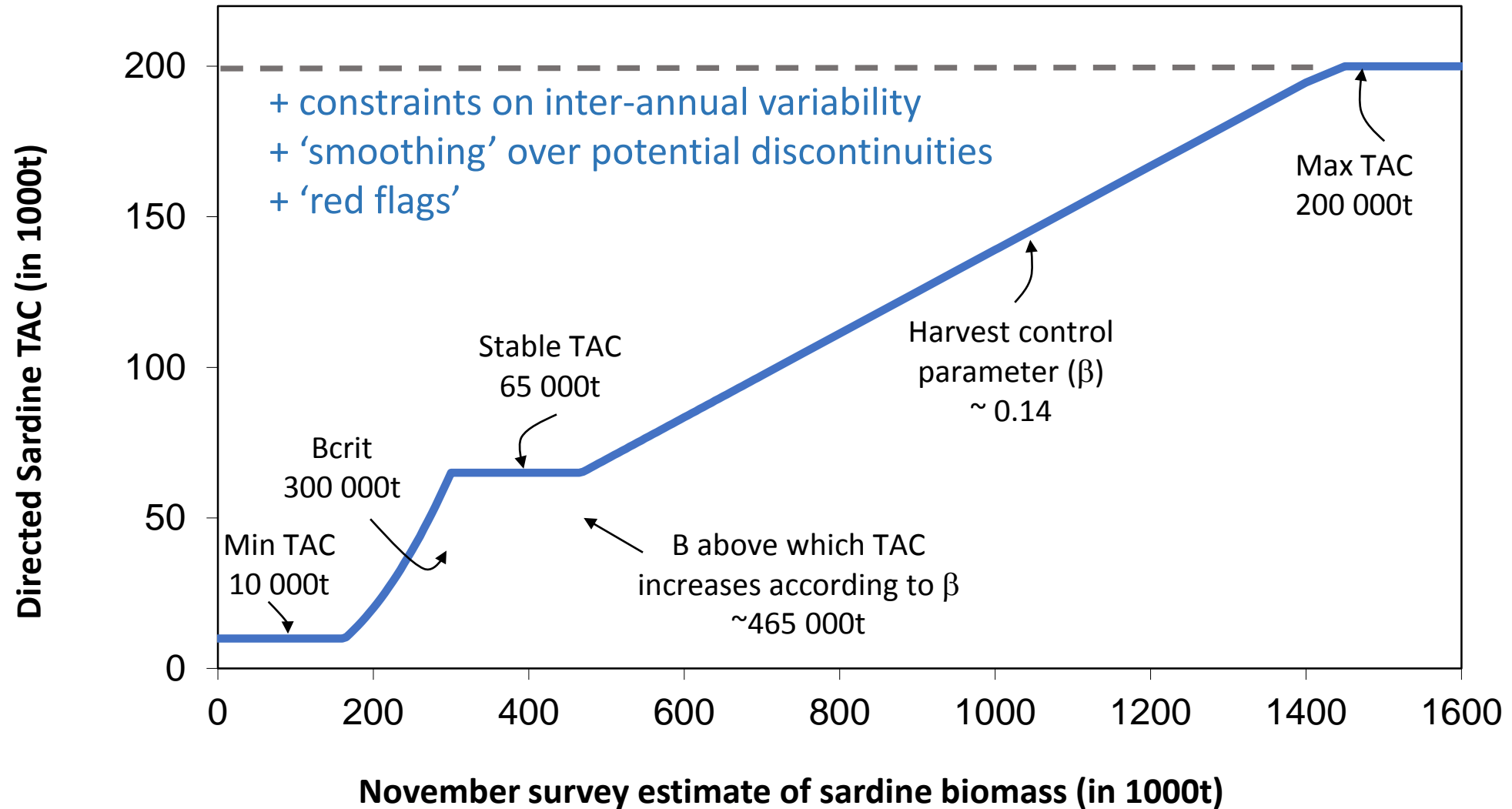
# Spatial Distribution of Directed Sardine Catches



# Directed Sardine Catch v TAC

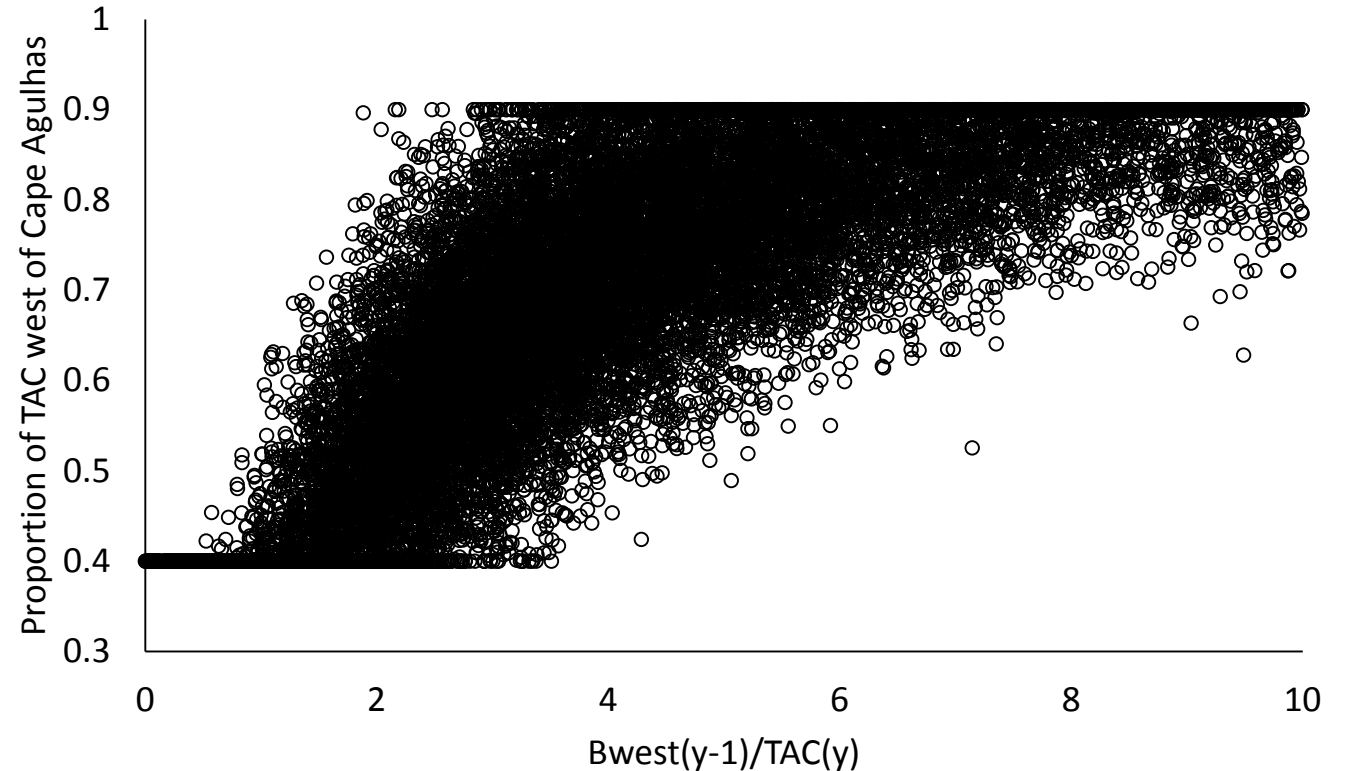
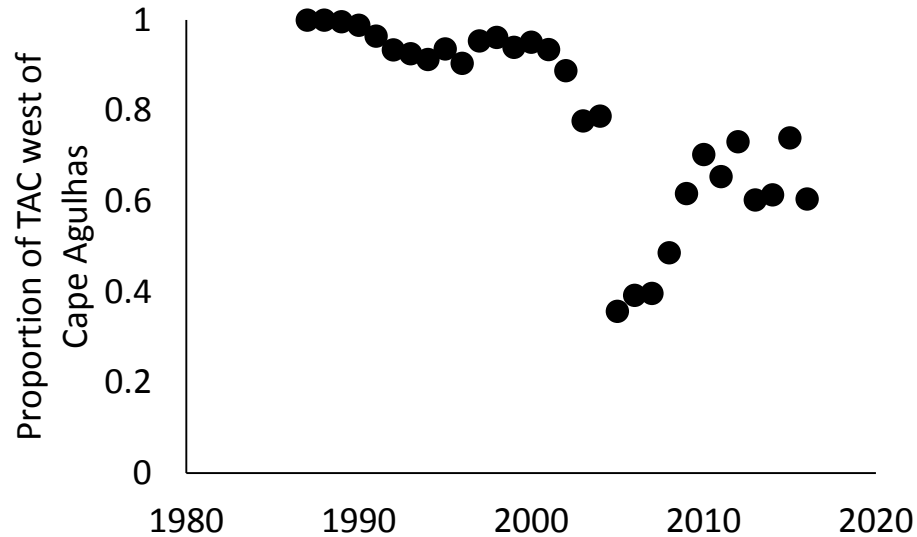


# Example Directed Sardine HCR

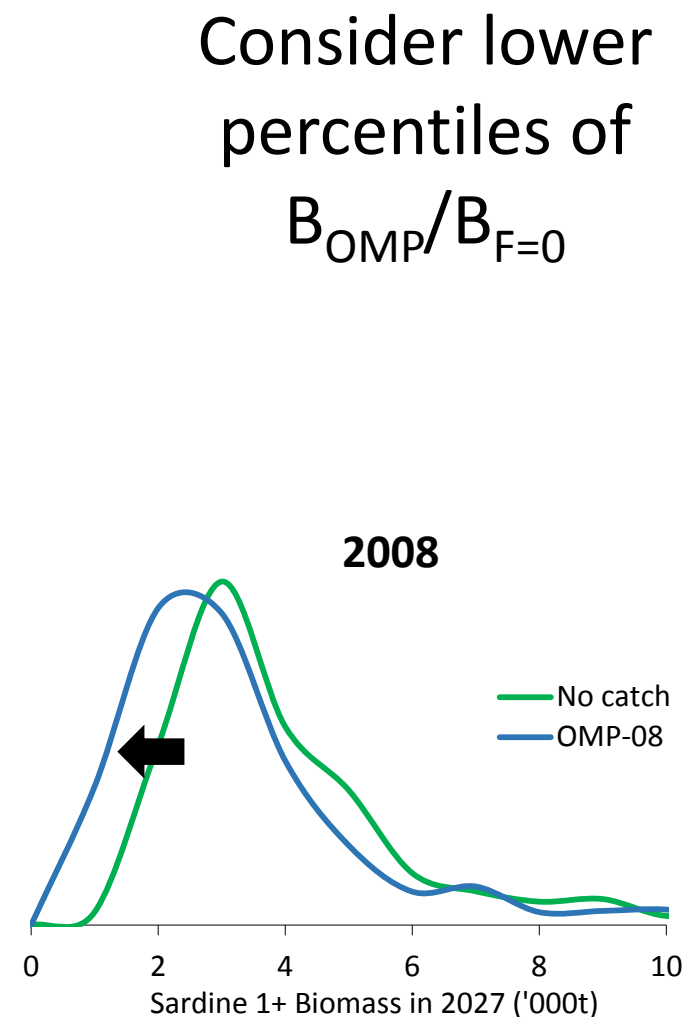
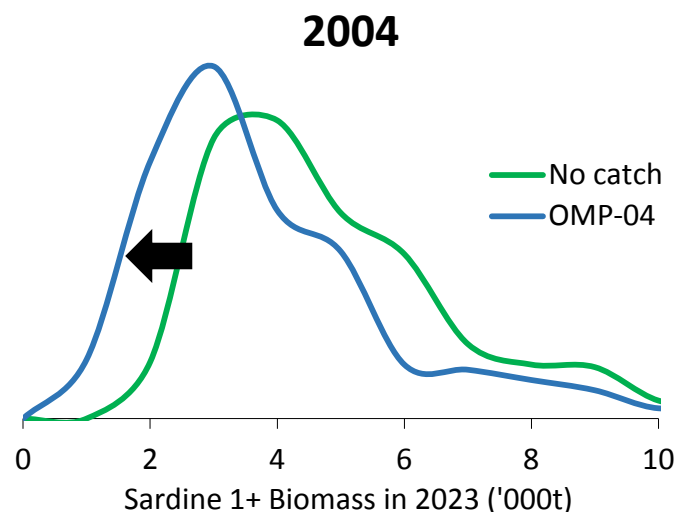
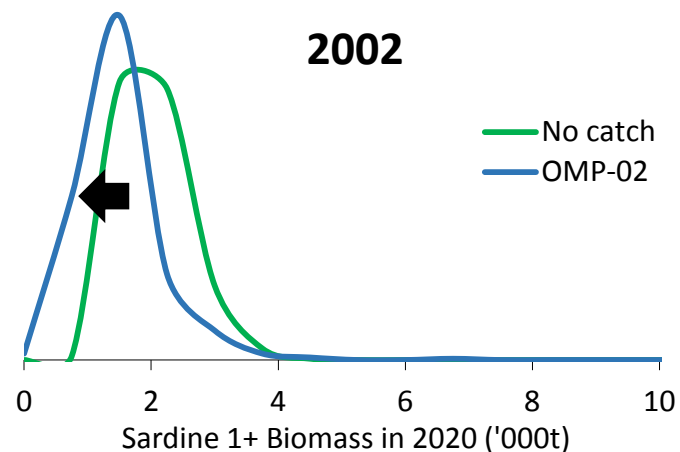


# What's “Implicit” Spatial Management?

- Directed sardine TAC for “full area”
- Spatial spread of catches impact the components differently

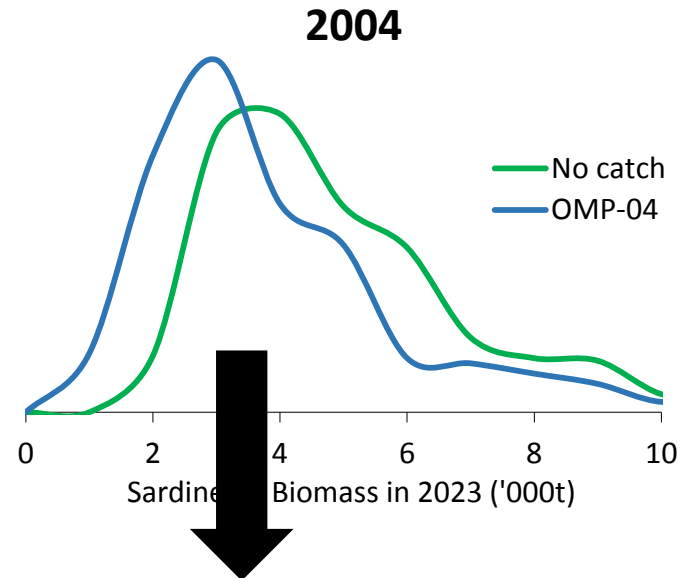


# What's the “Leftward Shift”



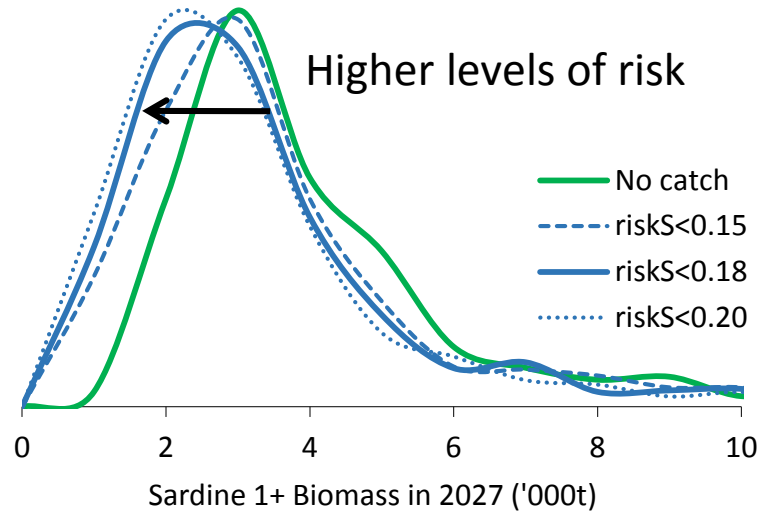
Maintain a similar level  
of downward shift  
under proposed new  
MP

# What's the “Leftward Shift”



	$B_{OMP-04}/B_{F=0}$	Options for $B_{OMP-08}/B_{F=0}$		
		$risk_S < 0.15$	$risk_S < 0.18$	$risk_S < 0.20$
10%ile	0.59			
20%ile	0.68			
30%ile	0.69			
40%ile	0.71			
median	0.72			

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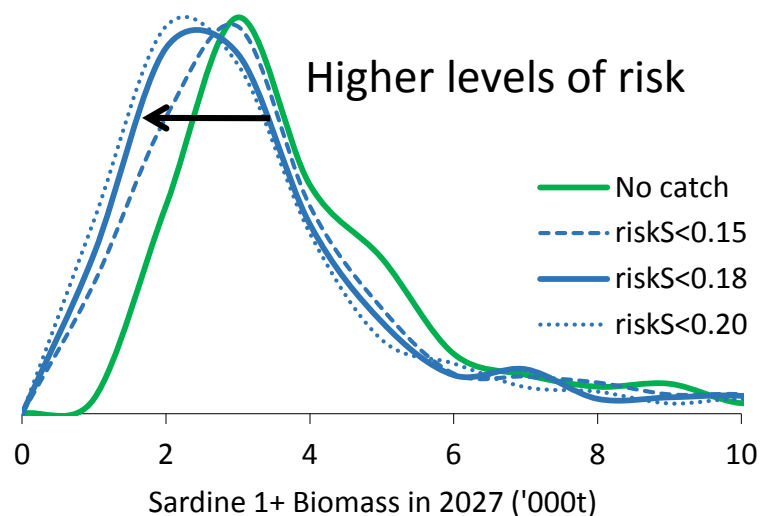


$risk_S$  – the probability that adult sardine biomass falls below the average adult sardine biomass over Nov 91-94 at least once during the projection period of 20 years

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		$risk_S < 0.15$	$risk_S < 0.18$	$risk_S < 0.20$
10%ile	0.59	0.60	0.49	0.45
20%ile	0.68	0.76	0.68	0.62
30%ile	0.69	0.80	0.72	0.68
40%ile	0.71	0.80	0.73	0.68
median	0.72	0.80	0.72	0.68

Green – less  
 Black – same  
 Red – more

Aim:  
 Match ratios at 20%ile  
 Similar ratios at other lower %iles

# What's the current “problem” with Leftward Shift

- Substantial change in OM from OMP-14 to OMP-18
  - 2 mixing components, not single homogeneous stock
  - includes maturity-at-length (previously  $B^{sp} = B^{2+}$ )
- Change in risk threshold and risk definition
  - the probability that **sardine 1+ biomass** falls below the average 1+ sardine biomass over Nov 91-94 *at least once* during the projection period of 20 years
  - the probability that **sardine west component effective spawner biomass** falls below the 2007 level *during* the projection period of 20 years
- Leftward shift in terms of total biomass

# What's Happened in the Past Year?

- Risk thresholds and definitions set according to panel recommendations (thank you😊)
- Difficulty agreeing on appropriate level of risk
  - 'leftward shift' in terms of  $B_{tot}$ .
  - risk in terms of  $effB_{west}^{sp}$
- One baseline OM ( $p=0.08$  and MoveD)
- Implicit spatial management for OMP-18 except when 'red flags' are raised

MARAM/IWS/2018/Sardine/BG2

# Key Questions

1) Is the method followed to estimate a fixed  $\sigma_R^S$  to apply in sardine projections for OMP testing appropriate?

MARAM/IWS/2018/Sardine/P2

MARAM/IWS/2018/Sardine/P3

# Key Questions

2) How might one best check whether use of the variance-covariance matrix from the Hessian to reflect stock assessment uncertainty is an acceptable alternative to the Bayesian sampling approach to develop joint-distributions for parameters in question for OMP testing.

MARAM/IWS/2018/Sardine/P4

# Key Questions

3) Is the general approach used in P4 appropriate for attempting to determine the reasons underlying different sardine OMs indicating different levels of harvest intensity to correspond to the same level of risk (as expressed by leftward shift)? How would one best apply the approach further to uncover the underlying mechanism(s) causing such differences?

MARAM/IWS/2018/Sardine/P4

+ hopefully one more 😊

# Key Questions

4) When risk is to be related to wishing to avoid dropping below a certain level of abundance, how is that risk best measured in a way that is readily interpreted, and also shows appreciable differences when the management controls are changed substantially?

MARAM/IWS/2018/Sardine/P5

+ hopefully one more 😊