Climate Change and South African Offshore Living Marine Resources

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Increased temperature and vertical stratification

Sea level rise and changes in circulation patterns

Changes in dissolved oxygen levels and pH

Increases in extreme weather events

Changes in species distributions

Changes in species composition

Changes in physiology and phenology

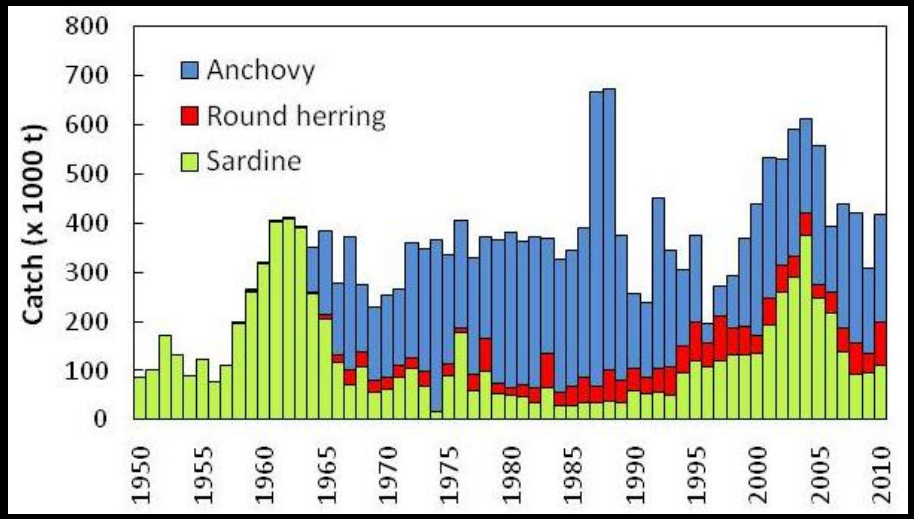
Changes in some SA offshore living marine resources - anchovy (i)

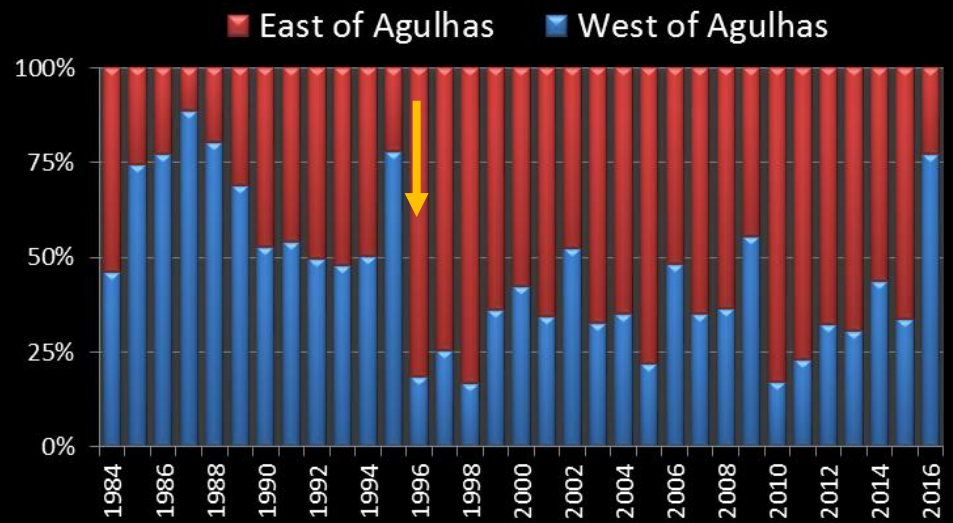
- Highly responsive to environmental forcing - “excellent bio-indicators of climate-driven changes in marine systems worldwide” (Peck *et al.* 2013)

- Primarily juveniles caught using purse-seine nets, reduced to fishmeal and oil

- Spawn on Agulhas Bank, eggs and larvae transported to west coast nursery grounds

- Abrupt shift in relative spawner biomass from WoCA to EoCA in 1996

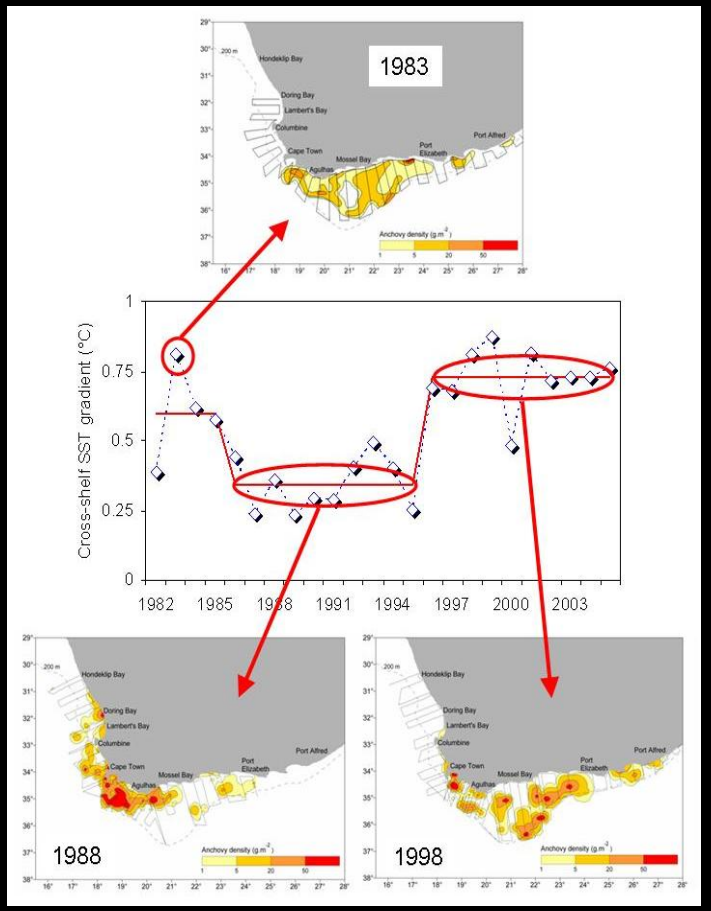


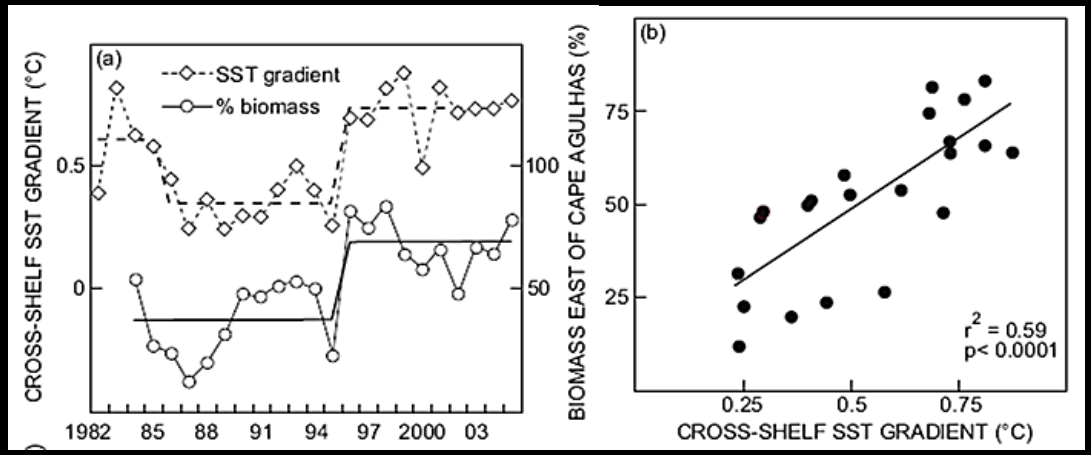


Changes in some SA offshore living marine resources - anchovy (ii)

- Pre 1996, 50% or more of anchovy adult biomass WoCA; 1996 shift coincided with lowest ever biomass estimate (162 000t) and has persisted since (except 2016)

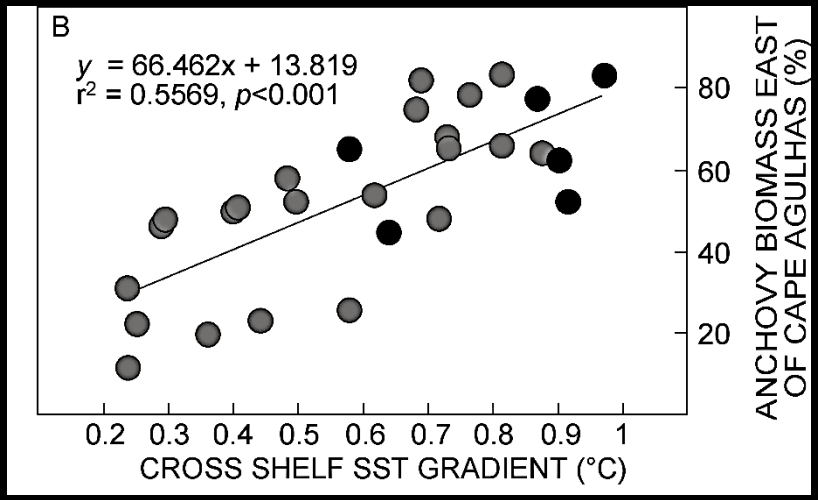
- Shift hypothesized to be temperature-related; positive correlation between % biomass EoCA and SST gradient on the CAB (1984-2005; Roy *et al.* 2007)





Changes in some SA offshore living marine resources - anchovy (iii)

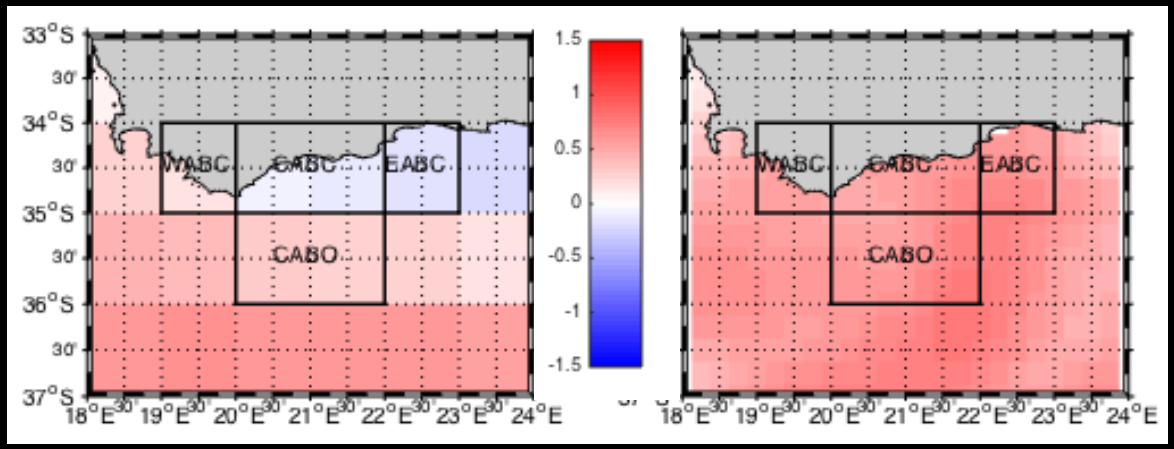
• Updated (1984-2011) relationship holds (Augustyn *et al.* in press)



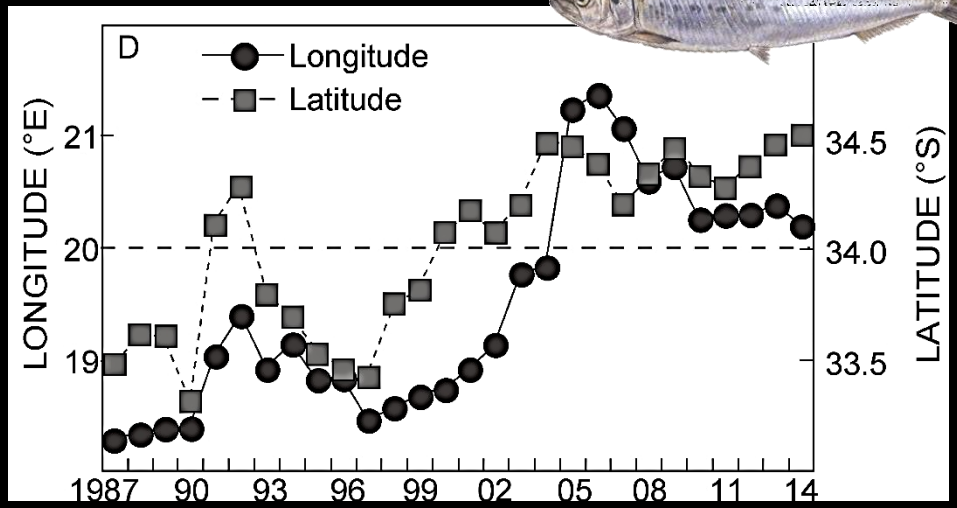
• But concerns about low (1°) resolution OISST data used; higher (0.25°) resolution OISST data indicates warming both inshore and offshore EoCA (McGrath 2015)

Avg pre-1996 (1985-1995)
minus
Avg post-1996 (1996-2007)

• Offshore warming responsible for cross-shelf gradient EoCA rather than coastal cooling as hypothesized



Changes in some SA offshore living marine resources - sardine and round herring

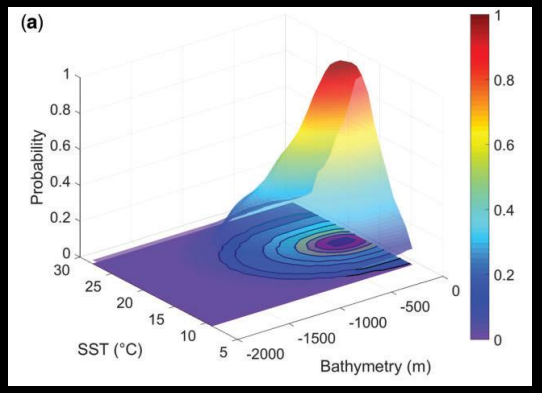


- Trend in the annual location of the Centre of Gravity (CoG) of sardine catches (Augustyn *et al.* in press) – most fish caught WoCA (20°E) and north of CT (34°S) before the turn of the 21st century but EoCA and south of CT thereafter (population structure effects)

- Similar but smaller-scale pattern of a south-eastward shift in the CoG of redeye round herring catches (Geja *et al*. in prep)

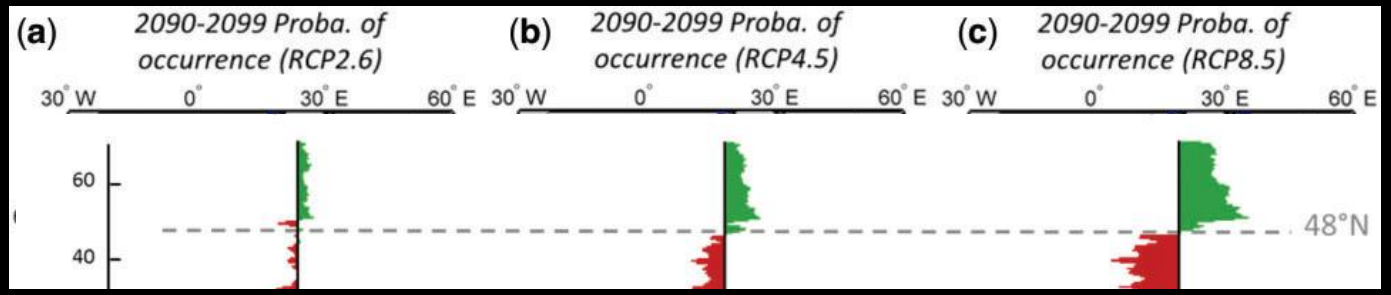
- Poleward shifts?

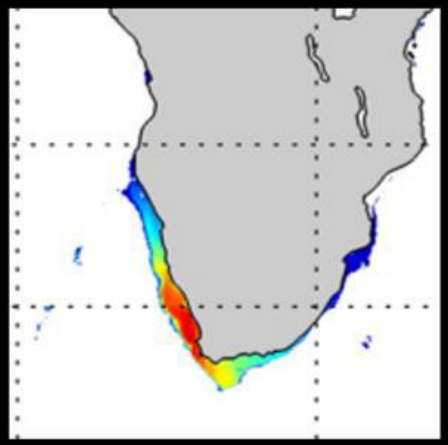
Changes in some SA offshore living marine resources - anchovy (iv)

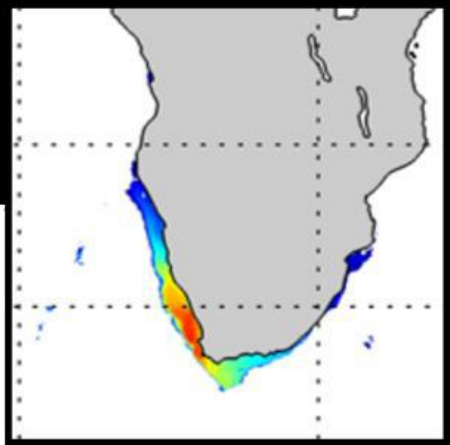


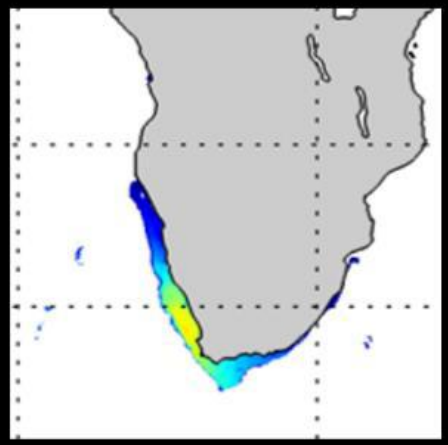
• Ecological niche model (2d; SST and bathymetry) and ocean-atmosphere global circulation model used to evaluate potential effects of global CC on European anchovy (*E. encrasicolus*) future distributions (Raybaud *et al.* 2017)

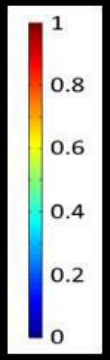
• Poleward shifts very likely







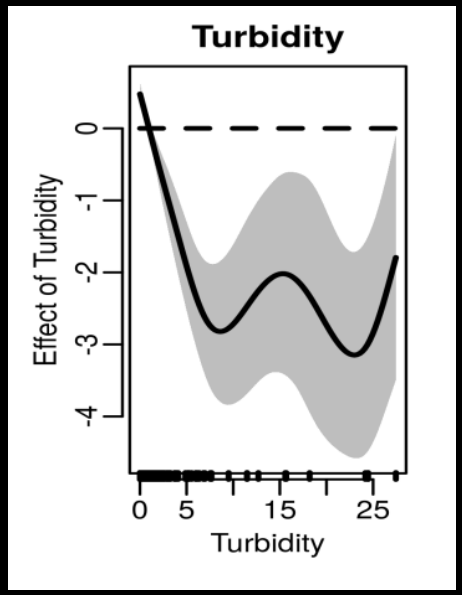




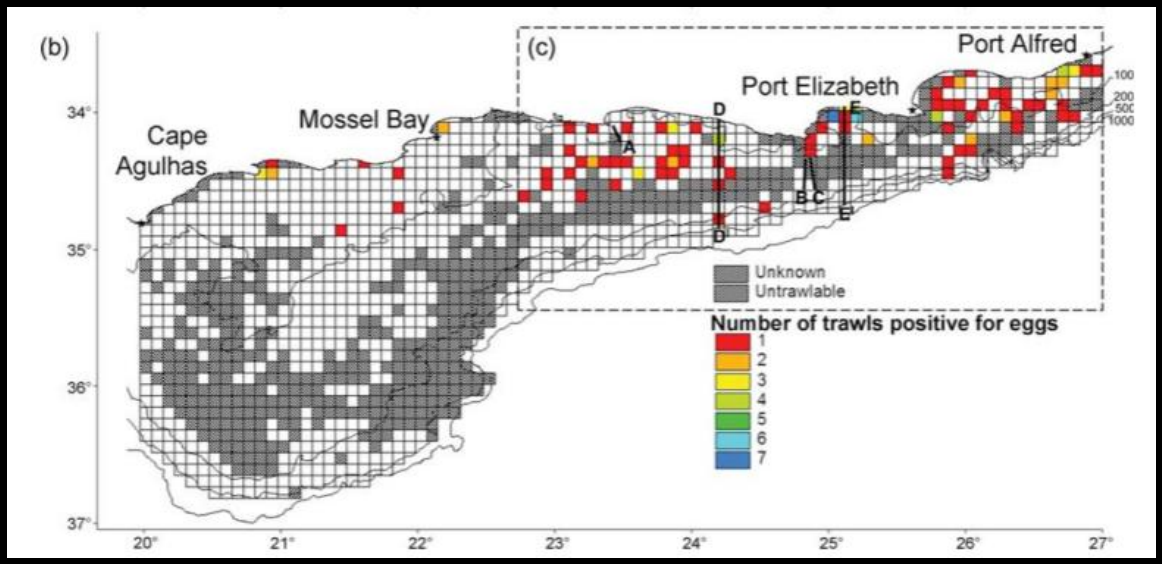
Changes in some SA offshore living marine resources - squid

- Inshore (≤70m) EAB is squid spawning epicentre, but deeper spawning on the mid-shelf makes meaningful contribution to recruitment

- Could increased nearshore turbidity (from increased precipitation) and avoidance of turbid waters by squid change relative importance of spawning areas ?



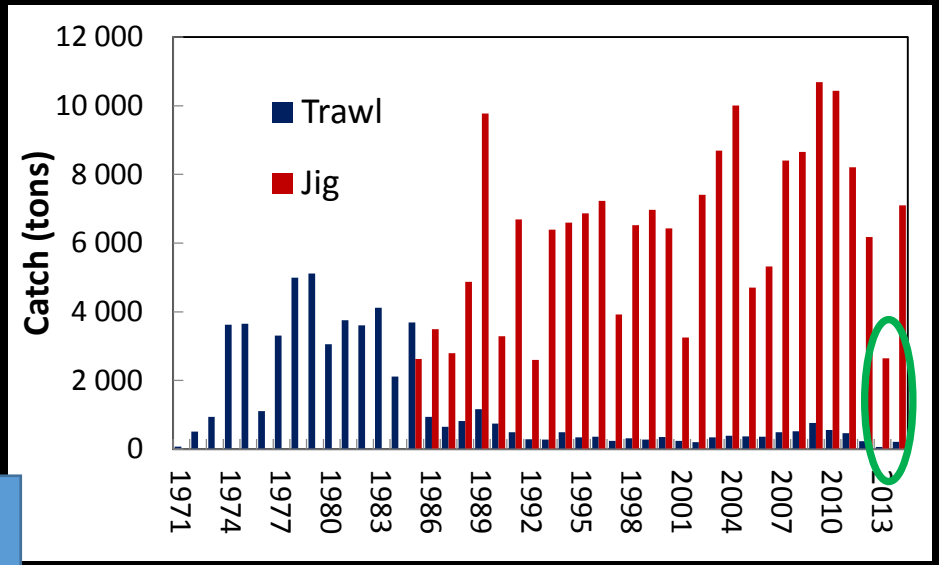
GAM effects of turbidity on squid catch rates (Augustyn et al. in press)

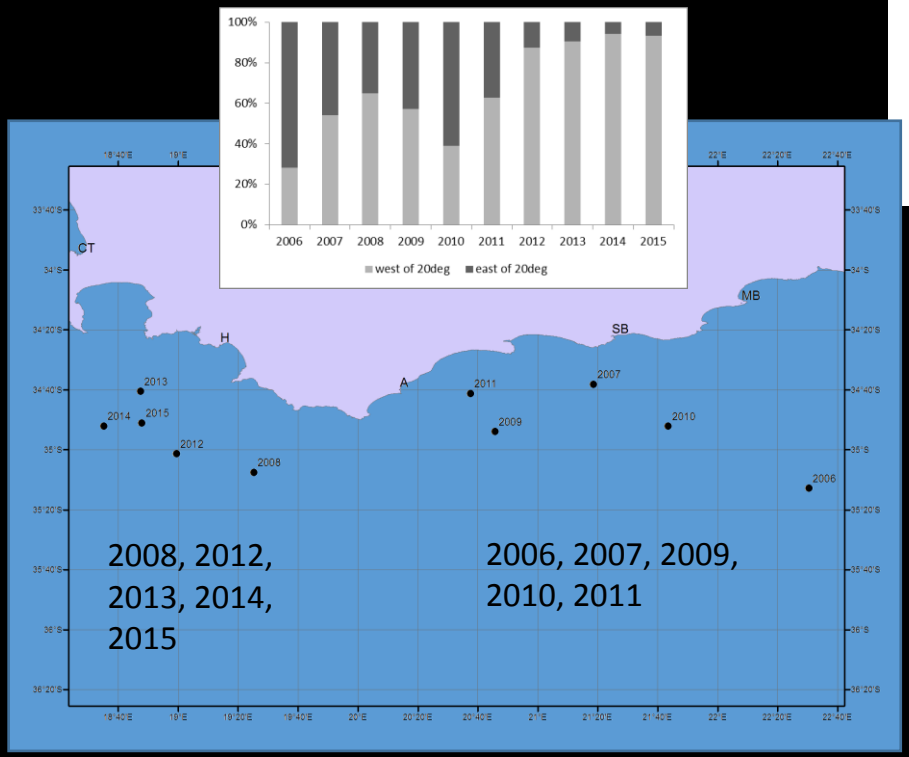


Distribution of squid eggs in demersal trawls, 1985-2008 (Roberts et al. 2012)

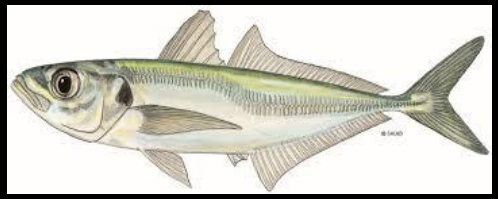
Changes in some SA offshore living marine resources - squid and horse mackerel

• Annual squid landings dominated by jig fishery since 1986; effort-controlled fishery with variable catches; low catches in 2013



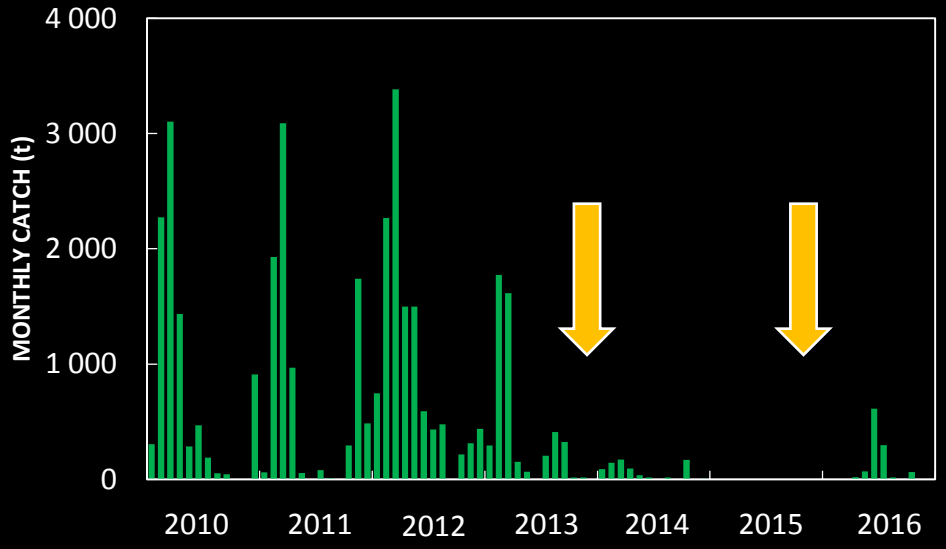


• Westward shift in effort from EoCA to WoCA in the midwater trawl fishery for horse mackerel from 2012 onwards (Fairweather 2016)



Changes in some SA offshore living marine resources - sardine and HABs on the Agulhas Bank

- Predicted increase in HABs arising from climate change
- Spatially and temporally extensive HABs off south cost in recent years
- Two such HABs off PE in 2013/14 and 2015 – sardine catches by PE fishery negligible; poor condition of sardine in HAB area



Changes in some SA offshore living marine resources - synthesis and questions

- Changing distributions of some species: eastward for small pelagics; westward for horse mackerel (?), eastward for some inshore species (eg kelp, lobster)

- Where do you go in a poleward direction from the west coast?

- The Agulhas Bank?

- And sub-tropical and tropical species will be moving down from the east coast

- But what is happening on the Agulhas Bank? Anomalous HABs, changed fishery behaviour and catches, others?