4th Intl Zoopl. Prod. Sympos., Hiroshima, 28 May-1 June 2007

Long-term changes in the abundance and community structure of copepods in the northern Benguela upwelling system off Namibia since the 1950s

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Rudi Cloete[5]
Ferdi Kotze[3]

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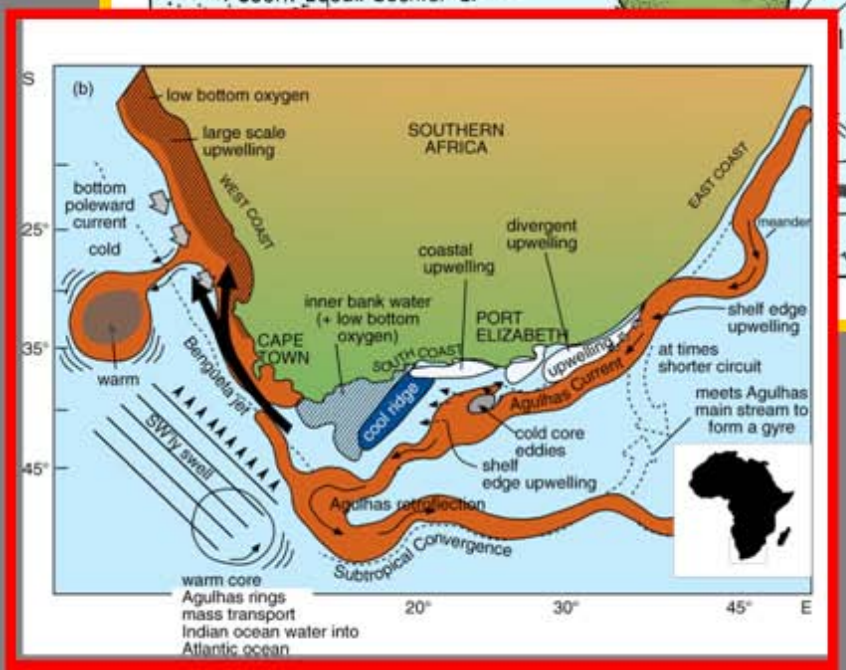
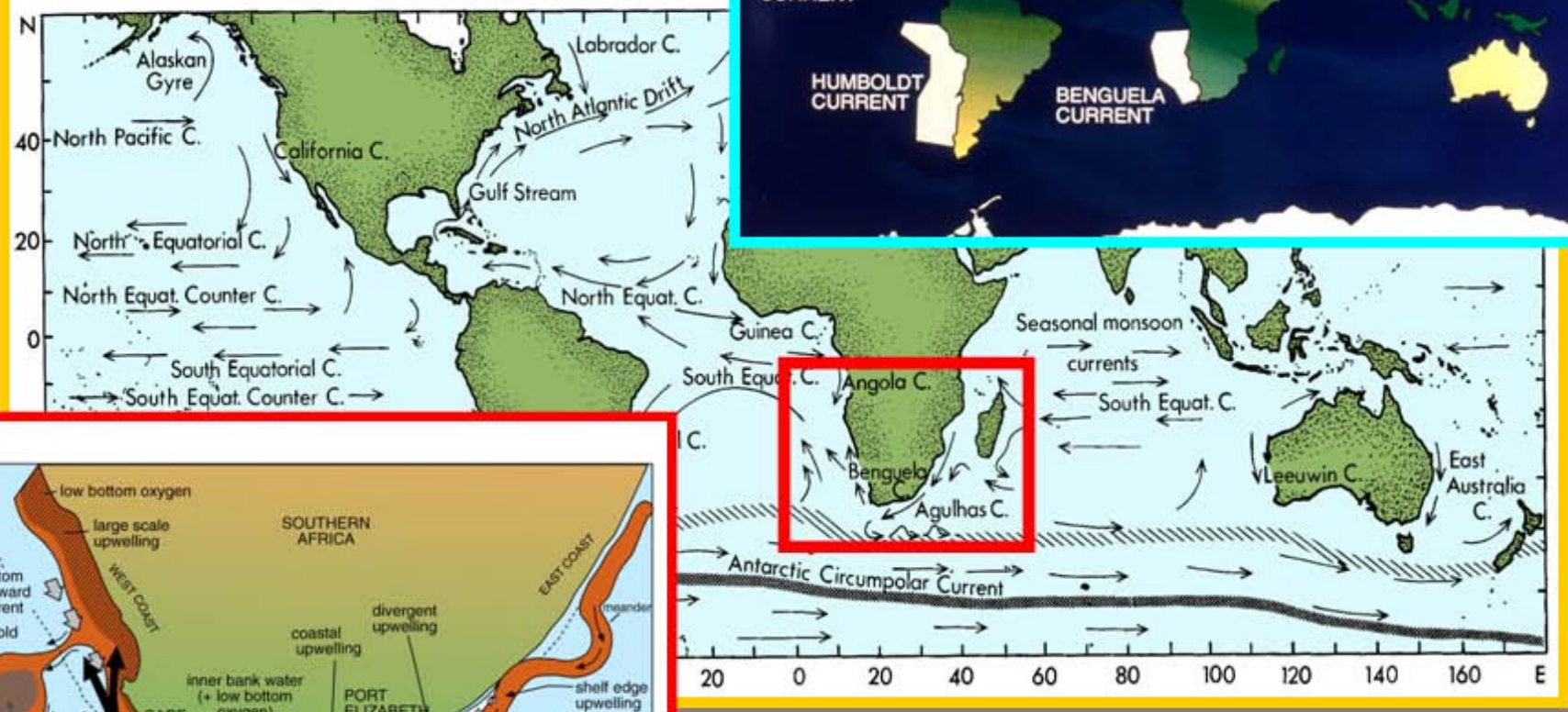
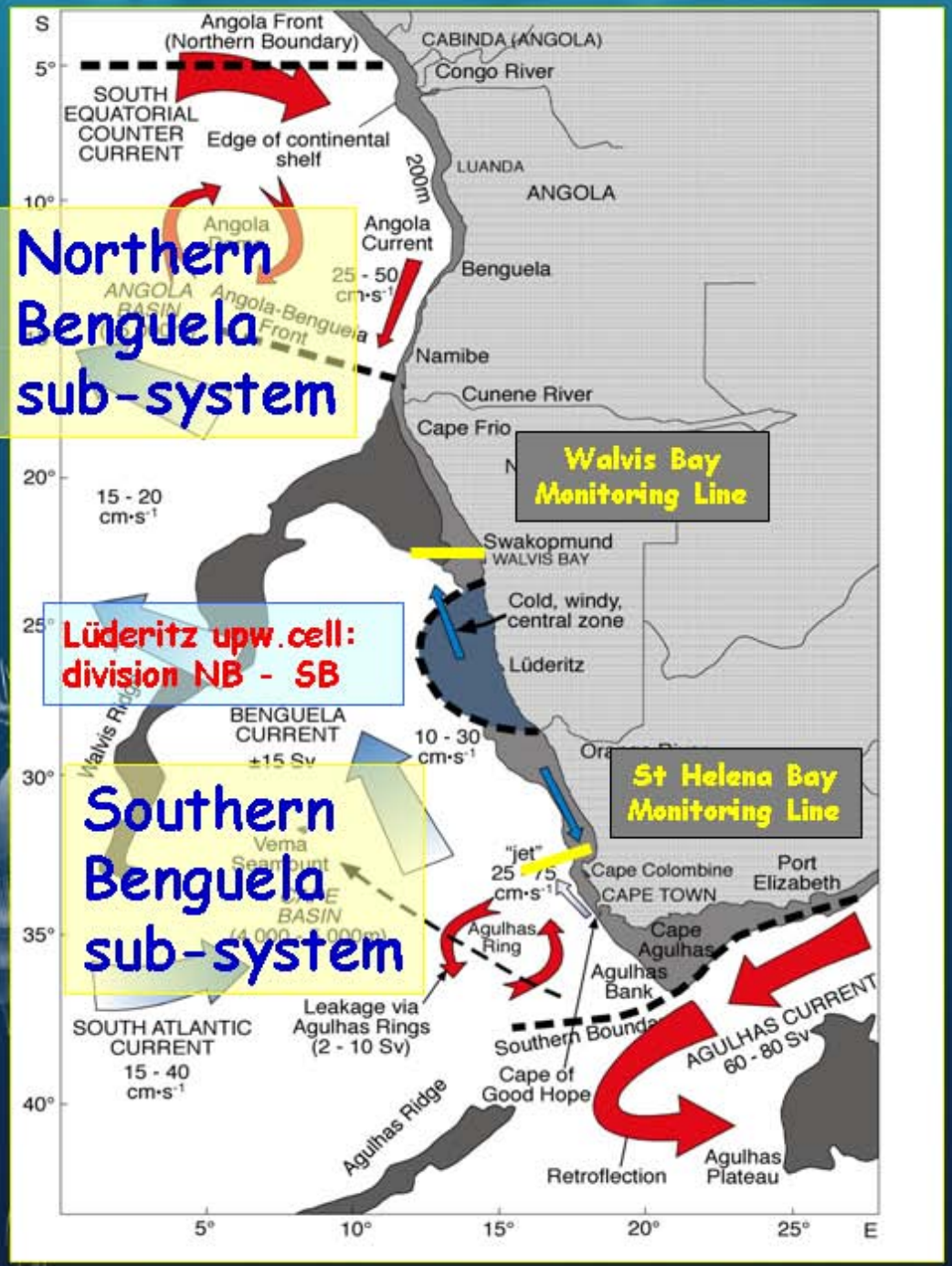
2. BENEFIT Programme
3. BCLME Programme
4. University of Cape Town, South Africa
5. MFMR, NatMIRC, Swakopmund, Namibia

Benguela Current ecosystem:
= one of 4 major Eastern Boundary Current systems





The ocean around southern Africa is one of the most complex and variable to be found anywhere



Outline

1. Northern Benguela

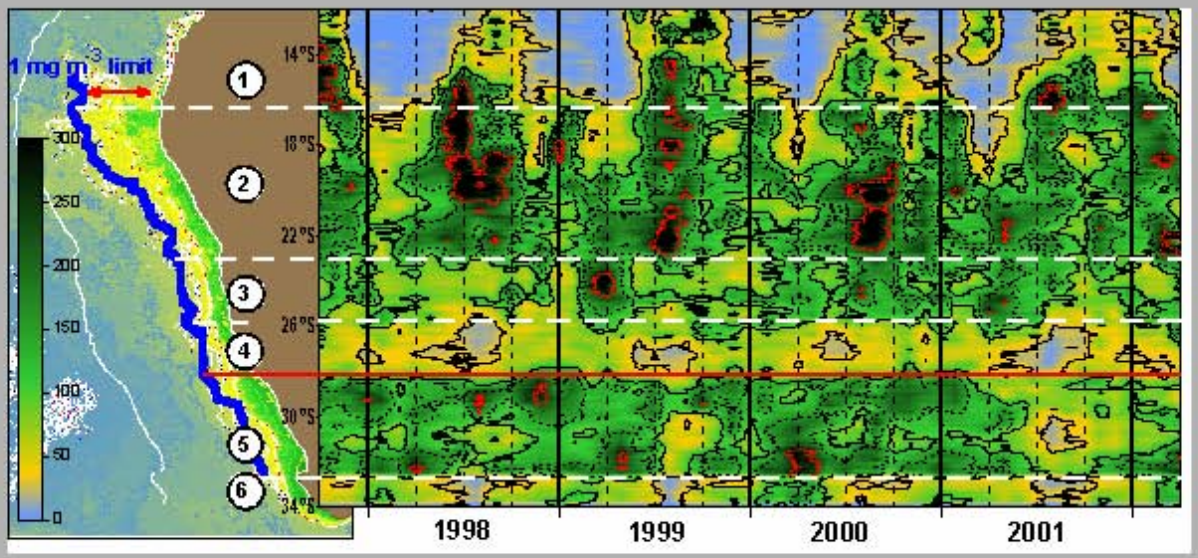
- Walvis Bay 23°S
- ± Monthly sampling
- 1959-present

2. Comparison with southern Benguela

- St Helena Bay 33°S
- Austral autumn (Mar-Jun)
- 1951-present

3. Conclusions

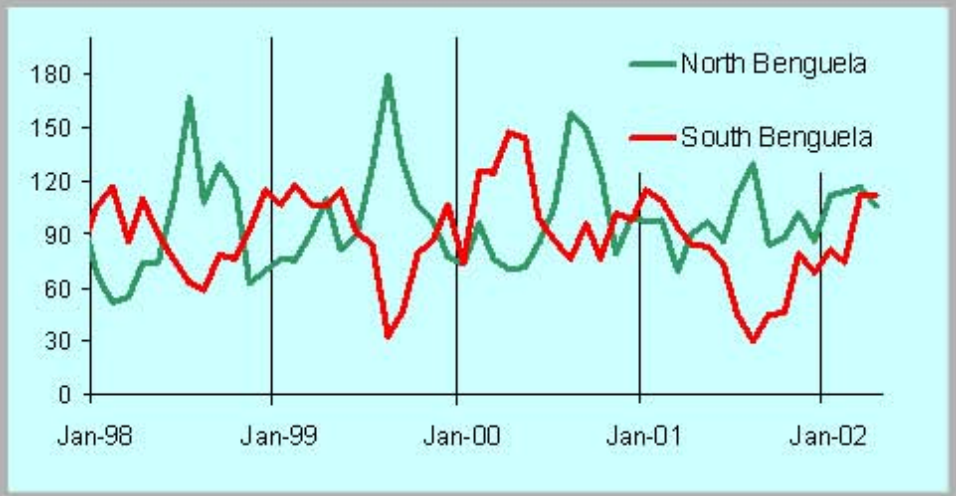
Some important differences between NB and SB sub-systems:



Monthly Chl *a* from SeaWiFS ocean colour sensor:

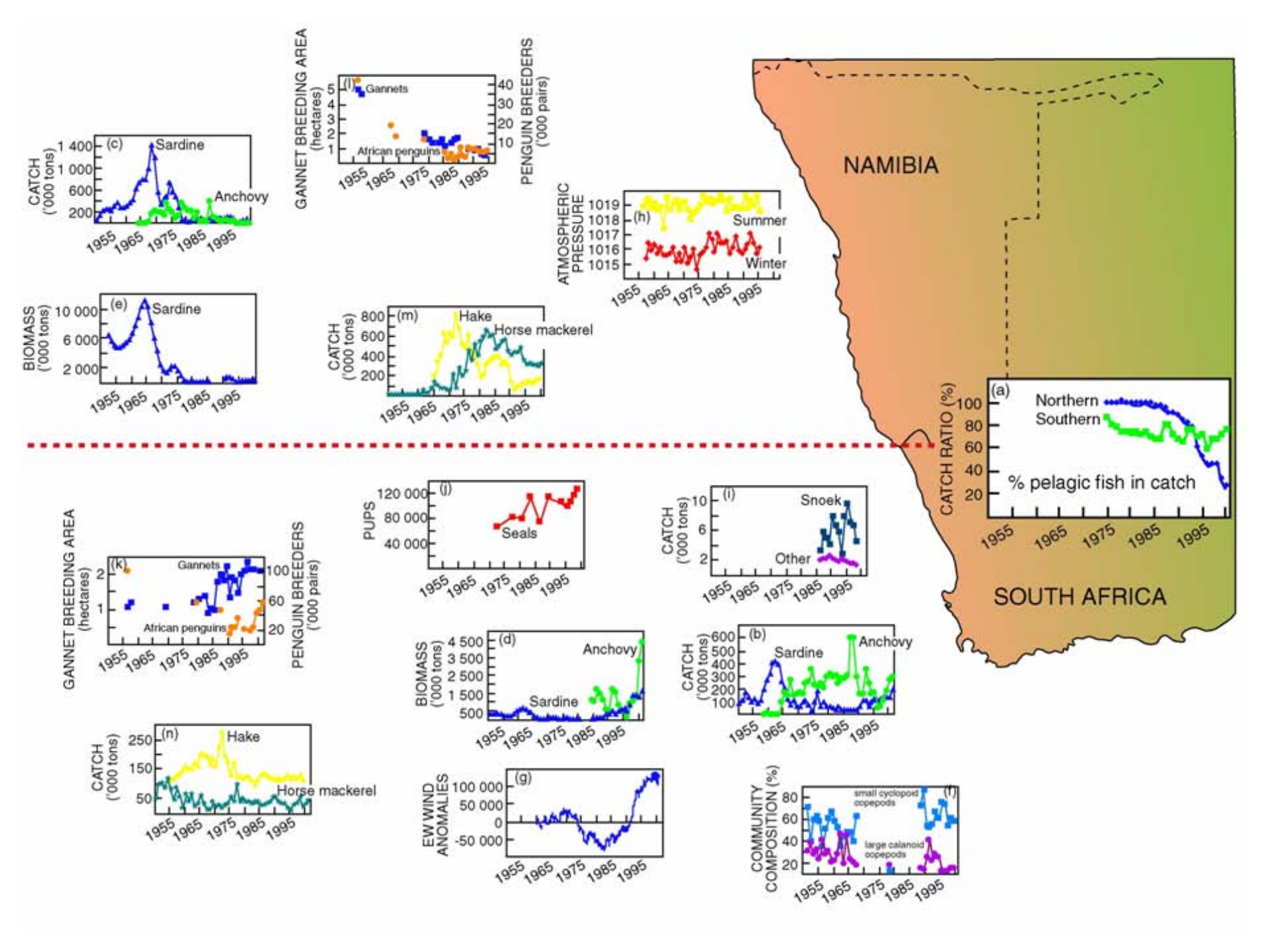
- coast – 1 mg m^{-3}
- 14–34°S
- Oct 1997–Mar 2002

(H. Demarcq, IRD)

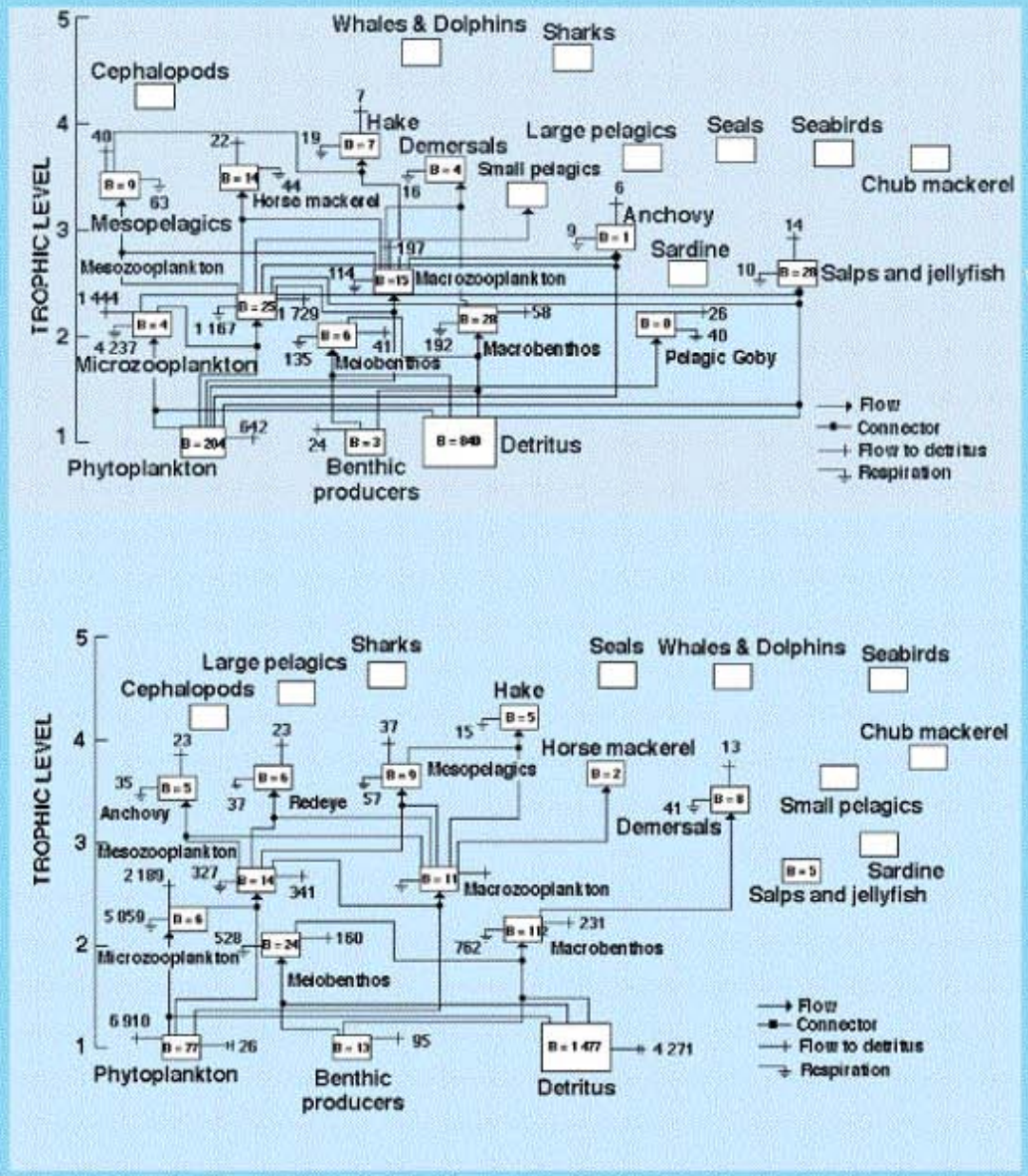


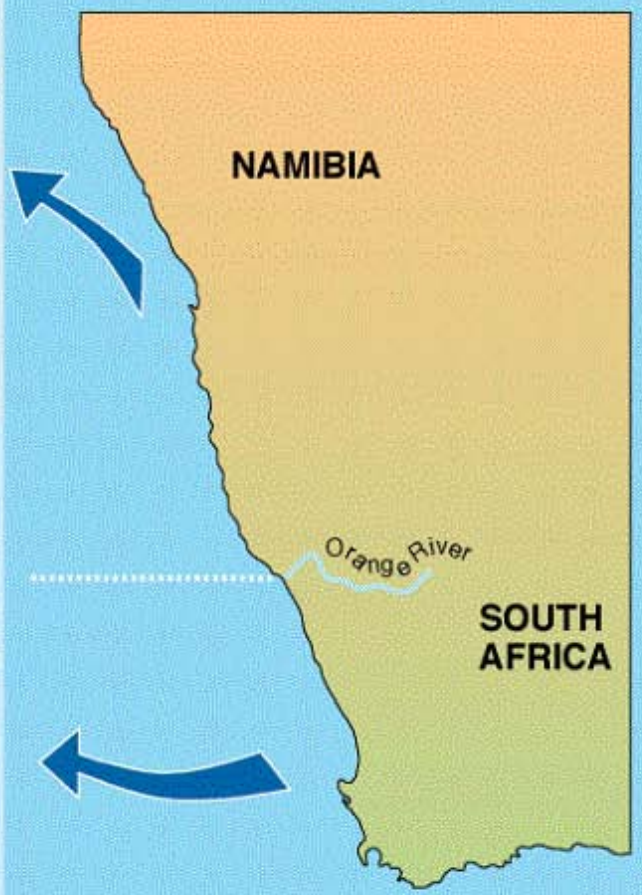
Monthly changes in the productivity index ([Chl]) in the northern and the southern Benguela

→ opposite trends in seasonality of PP: - winter max. in N. Benguela
- summer max. in S. Benguela

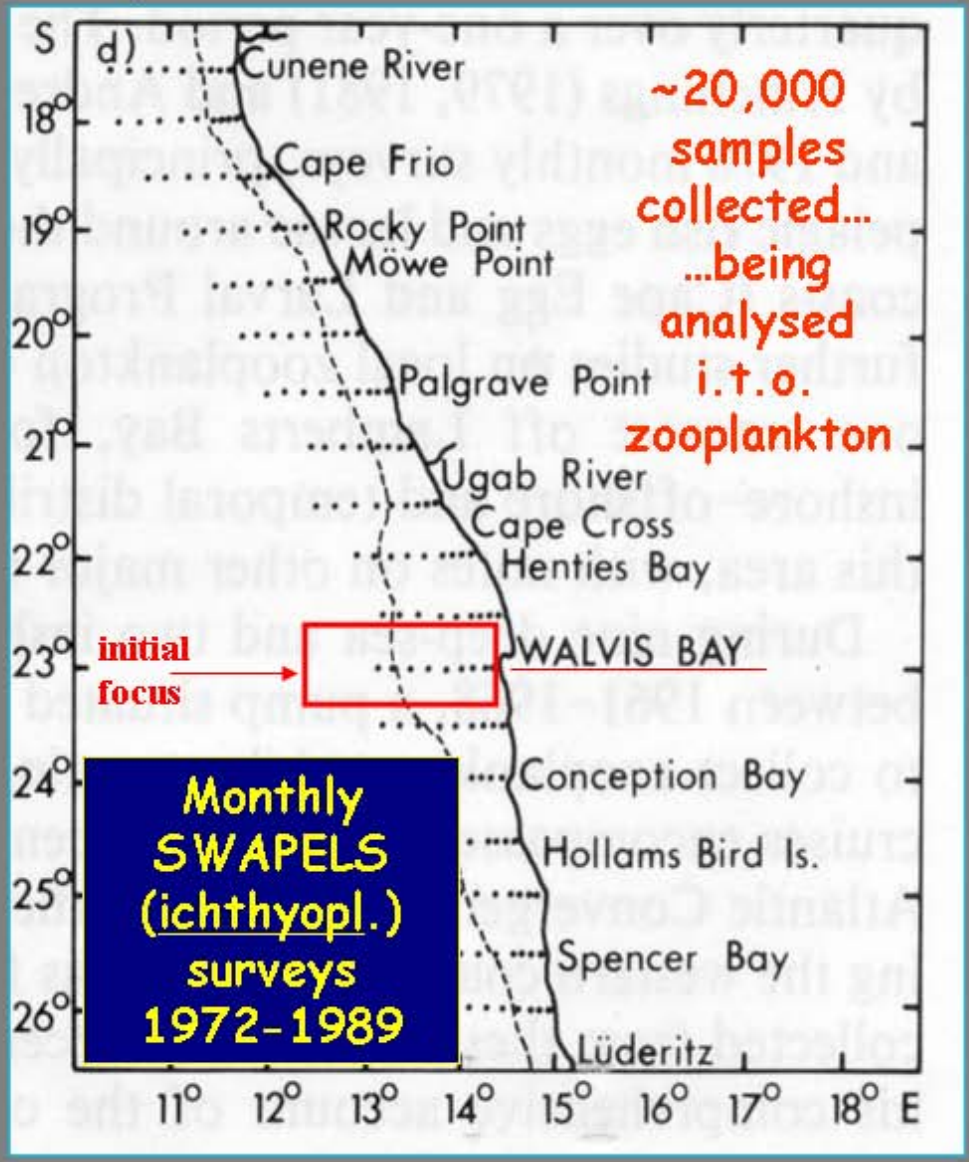

NAMIBIA
SOUTH AFRICA
(a)
Northern
Southern
% pelagic fish in catch
CATCH RATIO (%)
(b)
Sardine
Anchovy
CATCH ('000 tons)
(c)
Sardine
Anchovy
CATCH ('000 tons)
(d)
Anchovy
Sardine
BIOMASS ('000 tons)
(e)
Sardine
BIOMASS ('000 tons)
(f)
small cyclopoid copepods
large calanoid copepods
COMMUNITY COMPOSITION (%)
(g)
EW WIND ANOMALIES
(h)
Summer
Winter
ATMOSPHERIC PRESSURE
(i)
Gannets
African penguins
GANNET BREEDING AREA (hectares)
PENGUIN BREEDERS ('000 pairs)
(i)
Snoek
Other
CATCH ('000 tons)
(j)
Seals
PUPS
(k)
Gannets
African penguins
GANNET BREEDING AREA (hectares)
PENGUIN BREEDERS ('000 pairs)
(m)
Hake
Horse mackerel
CATCH ('000 tons)
(n)
Hake
Horse mackerel
CATCH ('000 tons)
1955
1965
1975
1985
1995

Implications: different ecosystem structure and functioning





1. Northern Benguela: Reconstruction of long-term zooplankton time-series



1. Pilot study: (GTZ 2001-008)

- Limited No. of years, months, samples
- 2 MSc students

2. Expanded study: (EV/PROVARE/02-05)

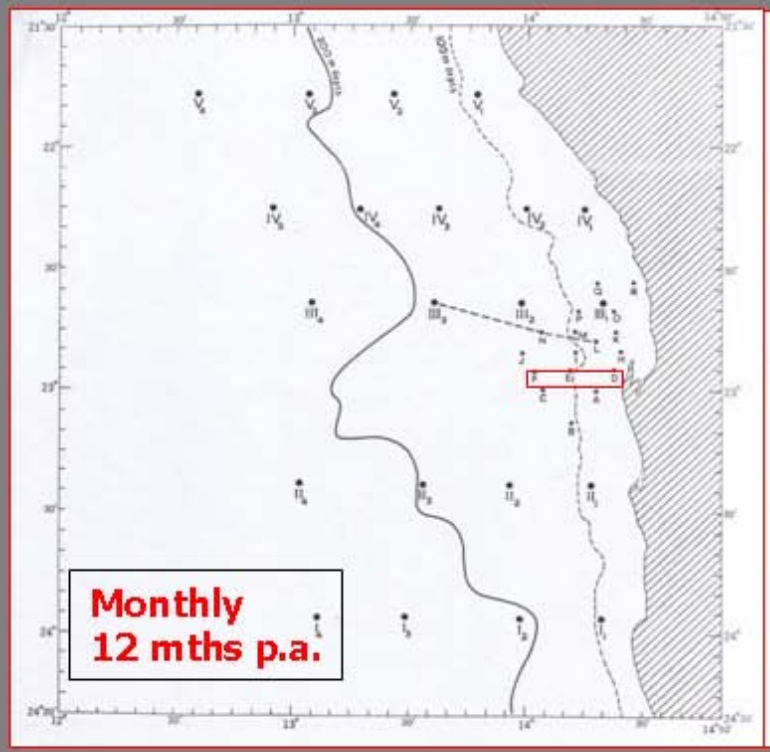
BCLME
Benguela Current Large Marine Ecosystem Programme

"Retrospective analysis of plankton community structure in the Benguela Current Large Marine Ecosystem (BCLME), to provide an index of long-term changes in the ecosystem"

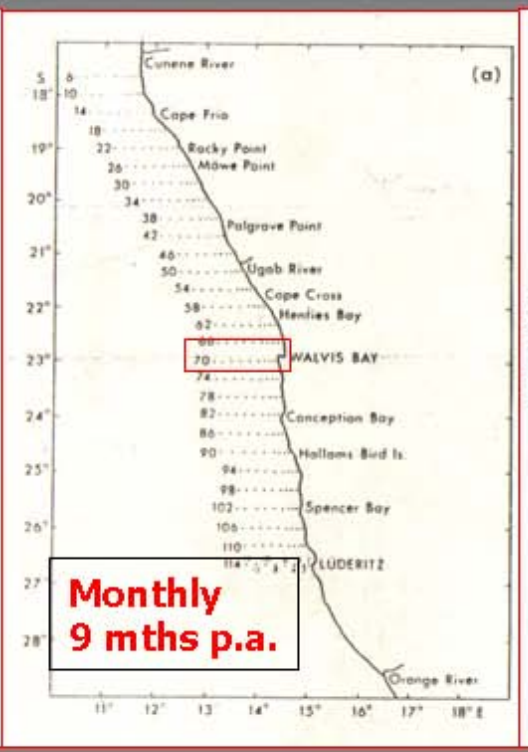
- start: 1 Aug. 2004
- 3 years (1st phase ??)
- 3 students (1 BScHons, 1 MSc, 1 PhD)
- 1 sample analyist
- 1 sample curator
- 1 data manager

Walvis Bay zooplankton time-series: data sources

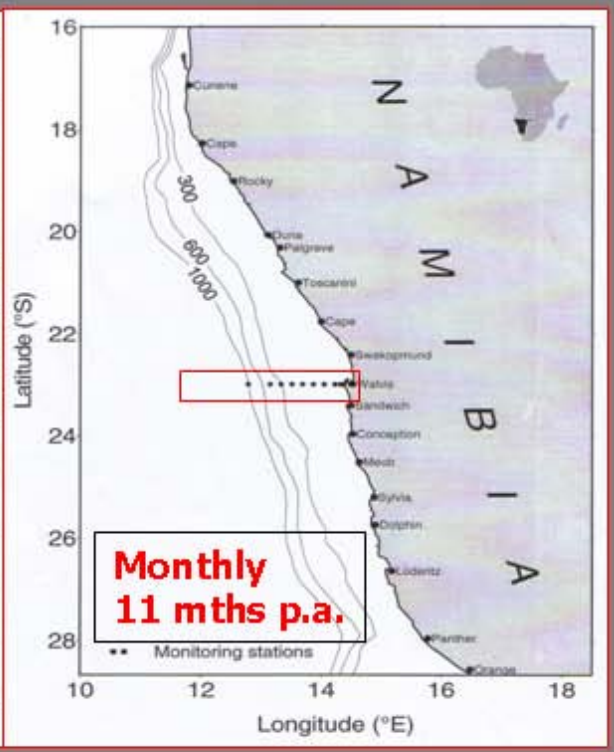
(a) 1959 (Kollmer 1963)



(b) SWAPELS (BCLME) 1970s & 1980s



(c) 2000- ... (NatMIRC)



(d) **1972** (April & August)
D.J. Coetzee
(MSc thesis 1974)

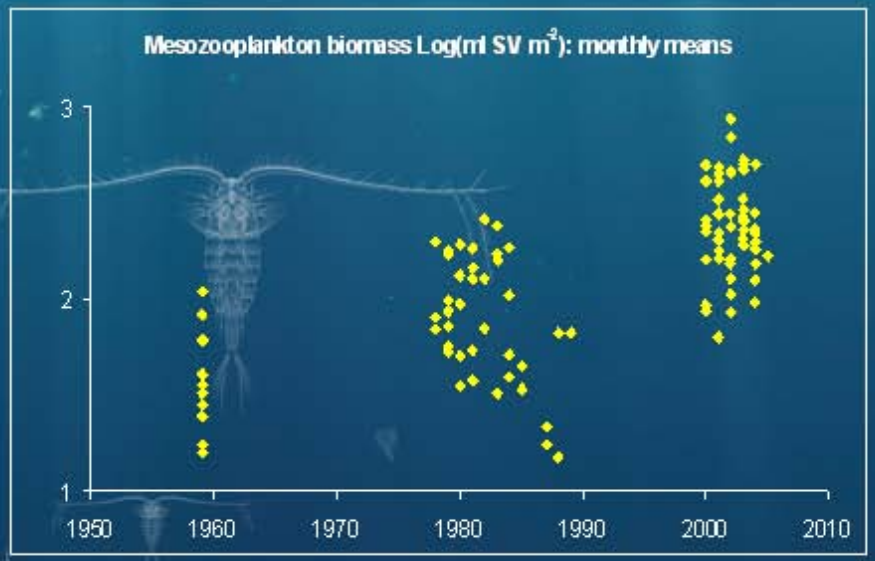
(e) **1997** (June)
Rippe & Téjédor
(unpubl. MS)

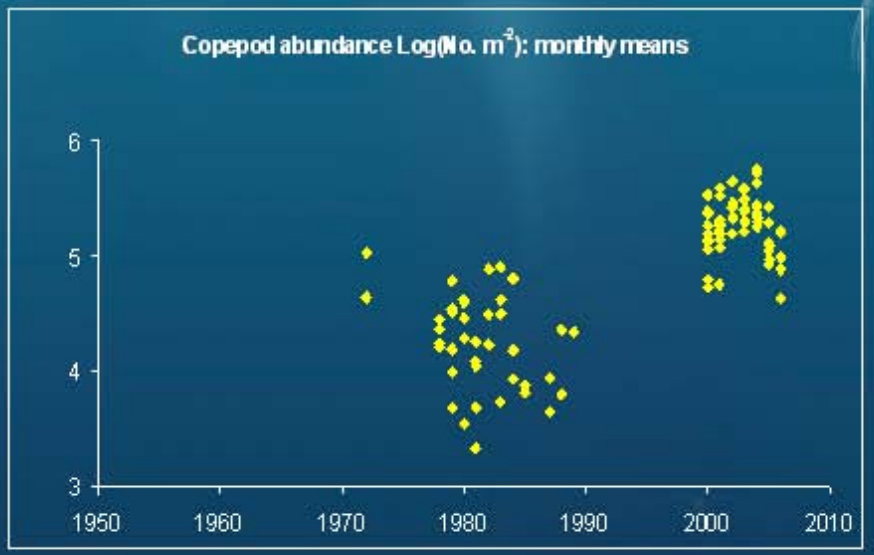
Walvis Bay zooplankton time-series:

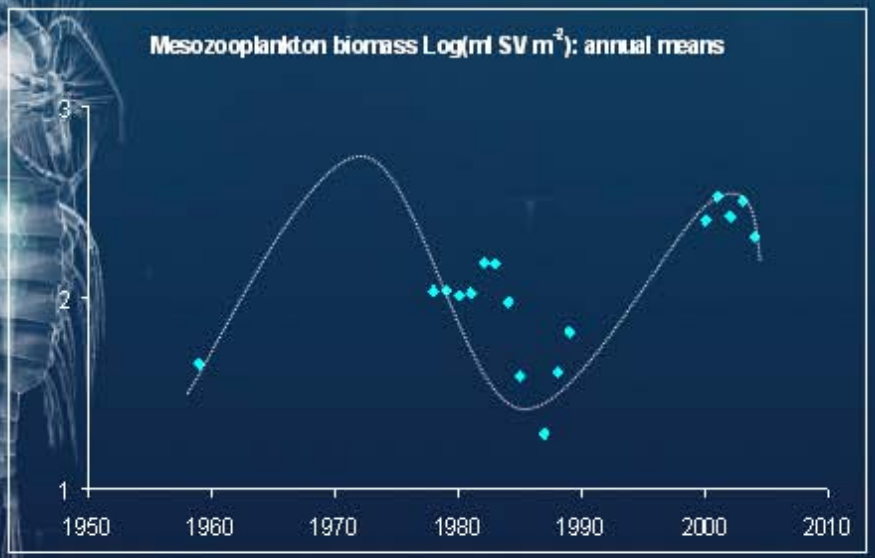
methodological differences between ≠ sampling programmes

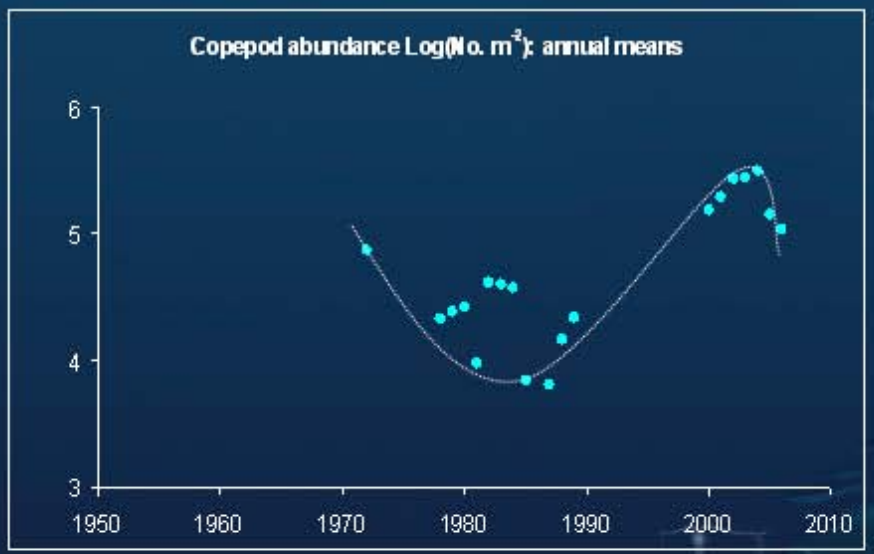
Parameter	1959	1974-1989	2000-ongoing
Time	Jan.-Dec.	Jan.-Dec. (excl. winter)	Feb.-Dec.
Sampling depth(m)	100	50	200
Gear type	N70V	Bongo (N50V – winter)	WP-2
Towing mode	Vertical	Oblique (N50V – vertical)	Vertical
Mouth area (m^2)	0.385	0.255 (N50V: 0.196)	0.255
Mesh size (µm)	200	300 (N50V – 80)	200
Flowmeter	None	Calibrated digital	Calibrated digital
Information Source	Kollmer 1963	BENEFIT + BCLME projects: Kauvee 2005, Tsotsobe 2005 Mainoane 2006, Cazassus 2008?	Hansen *et al.* 2005; NatMIRC (MFMR) (R Cloete, A Kreiner)

Monthly, interannual and interdecadal variability of mesozooplankton biomass {$Log_{10}[(ml\ SV.m^{-2})+1]$} and copepod abundance {$Log_{10}[(No.m^{-2})+1]$} along a transect at 23°S off Walvis Bay, Namibia, 1959-2006





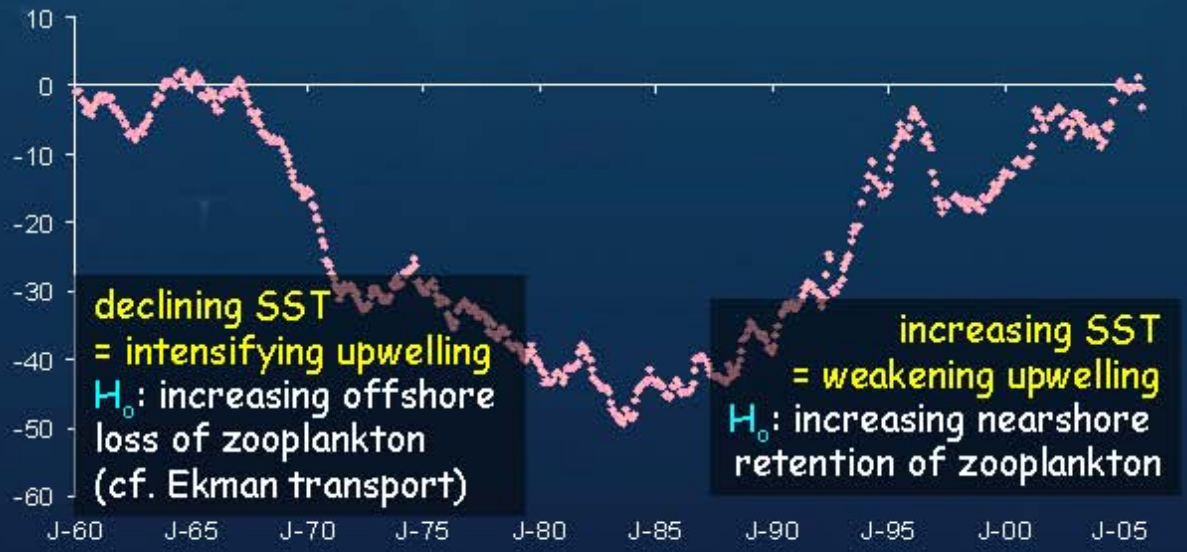




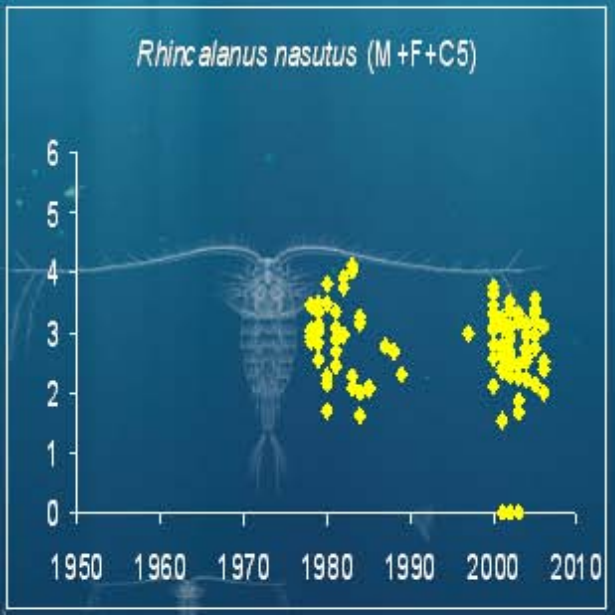
Copepod abundance Log(No. m^{-2}): annual means

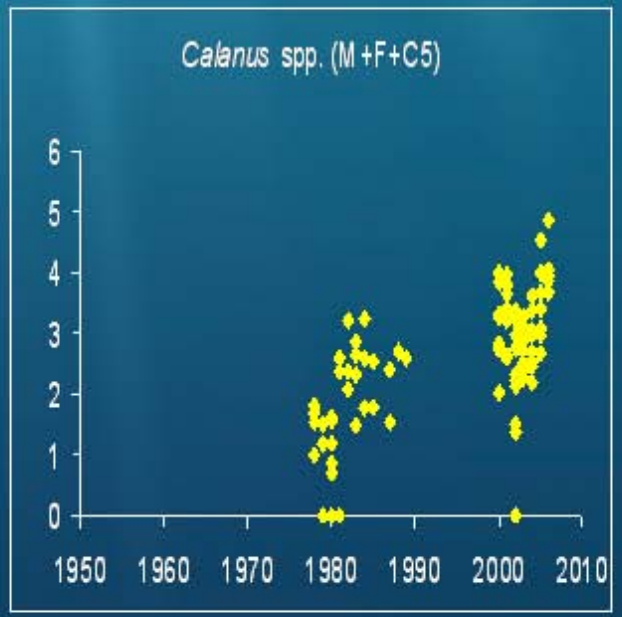
Monthly cumulative SST standardised anomalies
23-24°S and 13-14°E (COADS data)

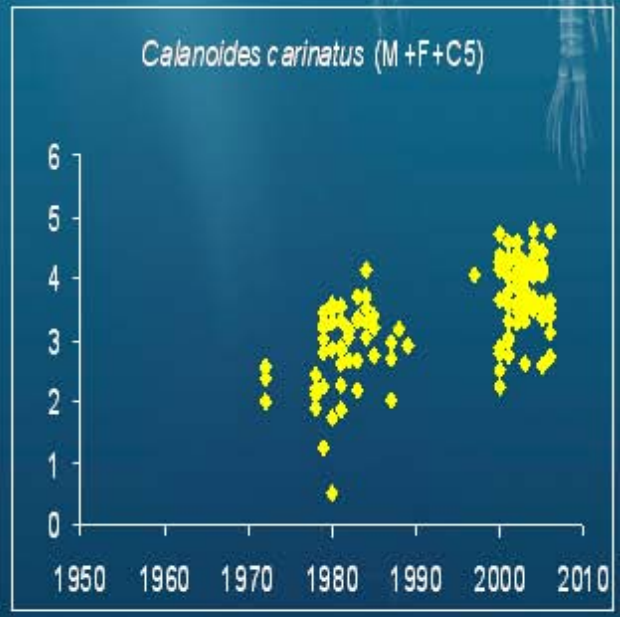
(SST: proxy for upwelling)

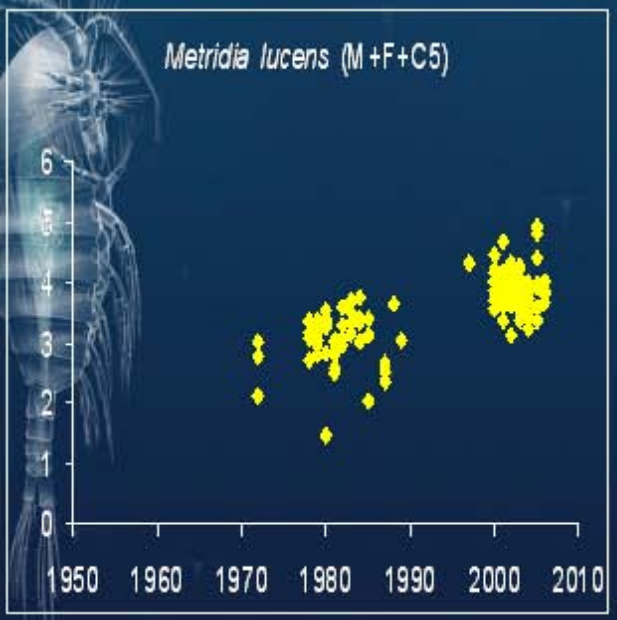


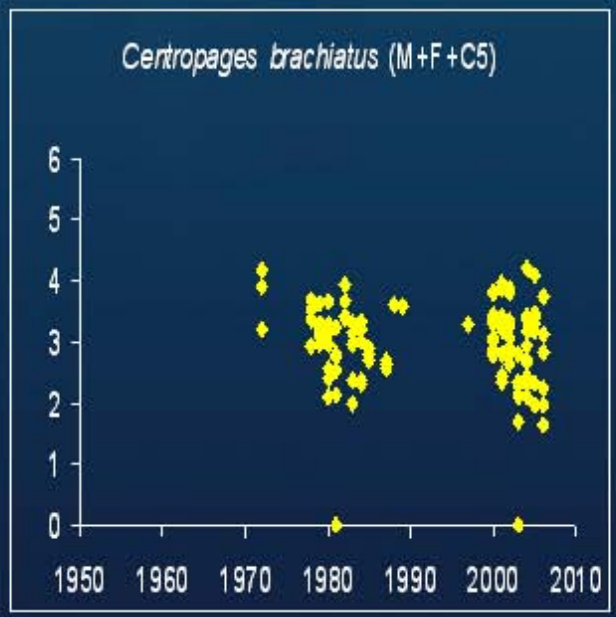
6 dominant copepod species: monthly mean abundance [$Log_{10}(No.m^{-2})$]

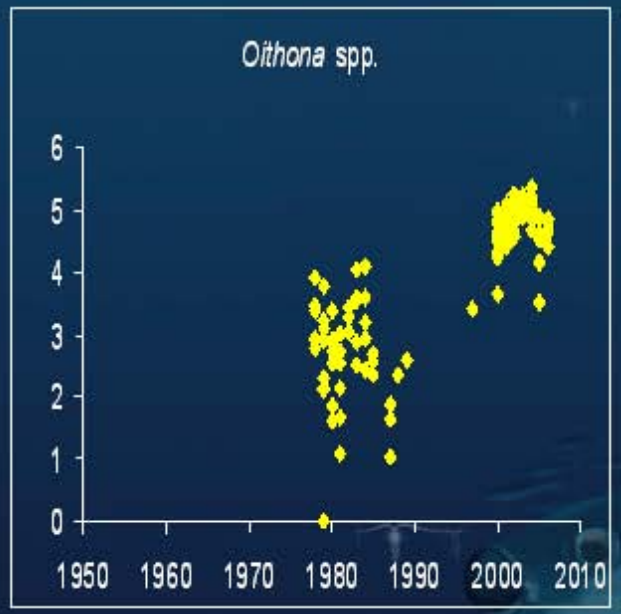




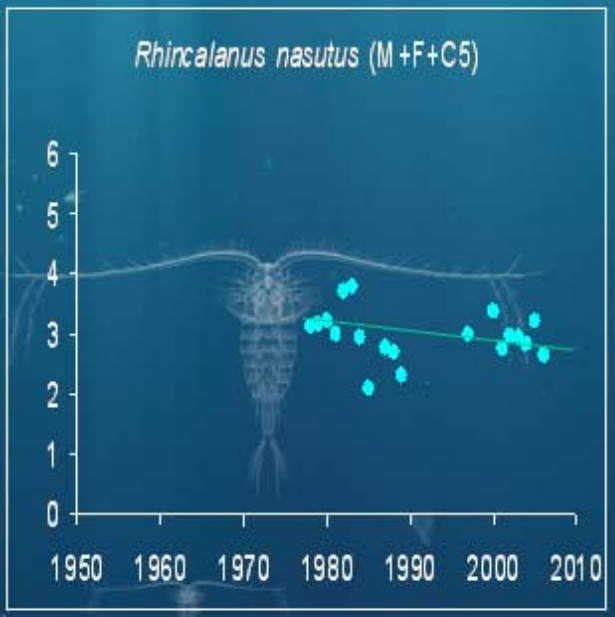


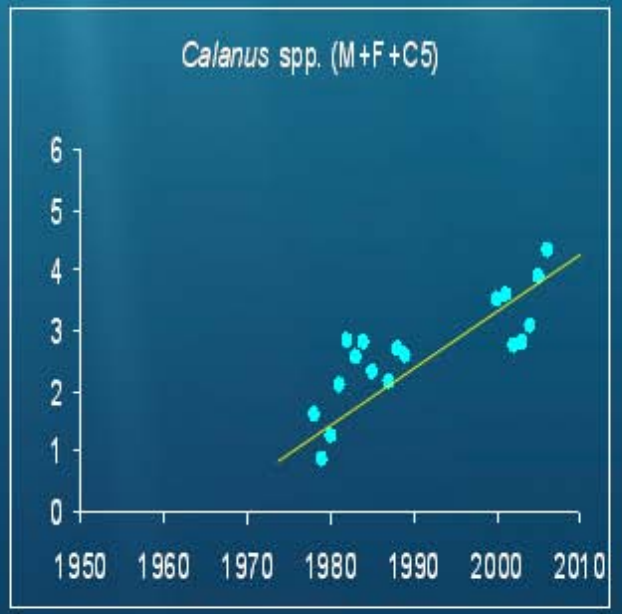


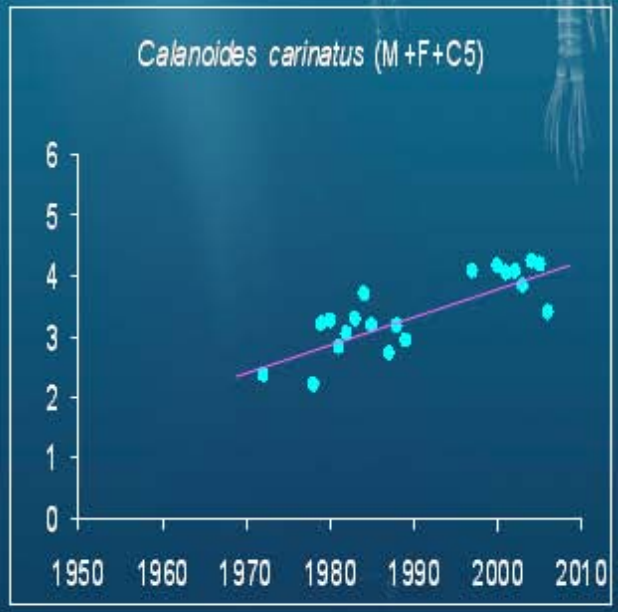


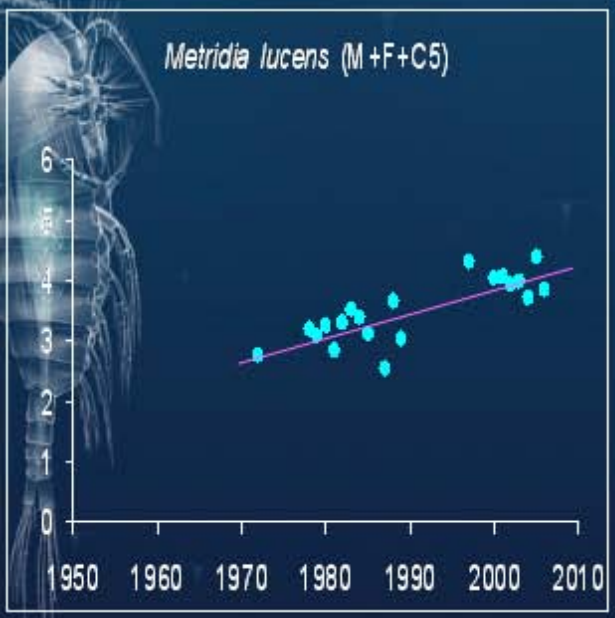


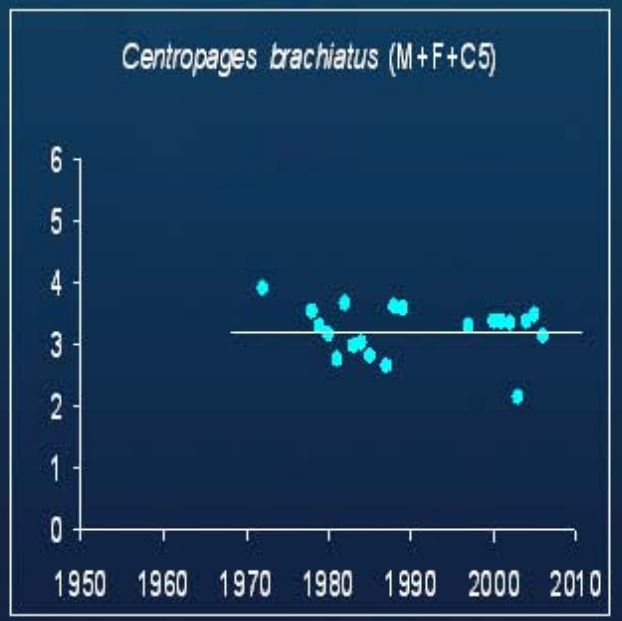
6 dominant copepod species: annual mean abundance [$Log_{10}(No.m^{-2})$]

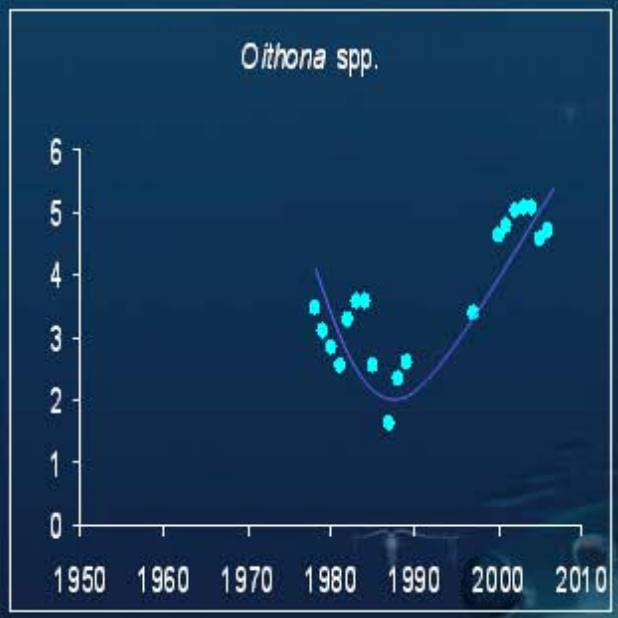




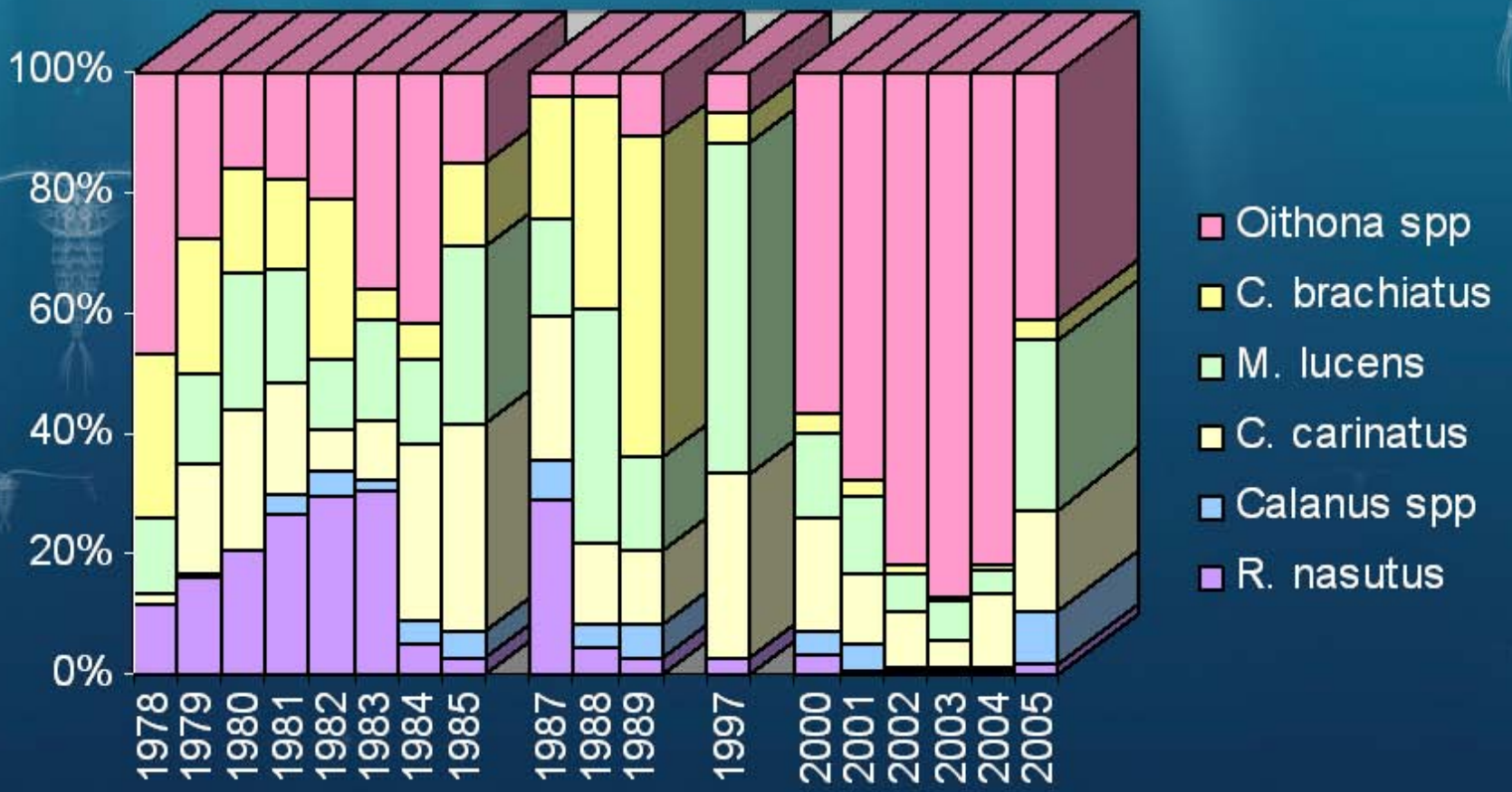








Long-term/decade-scale changes in copepod community structure



→ **Shift in community structure**

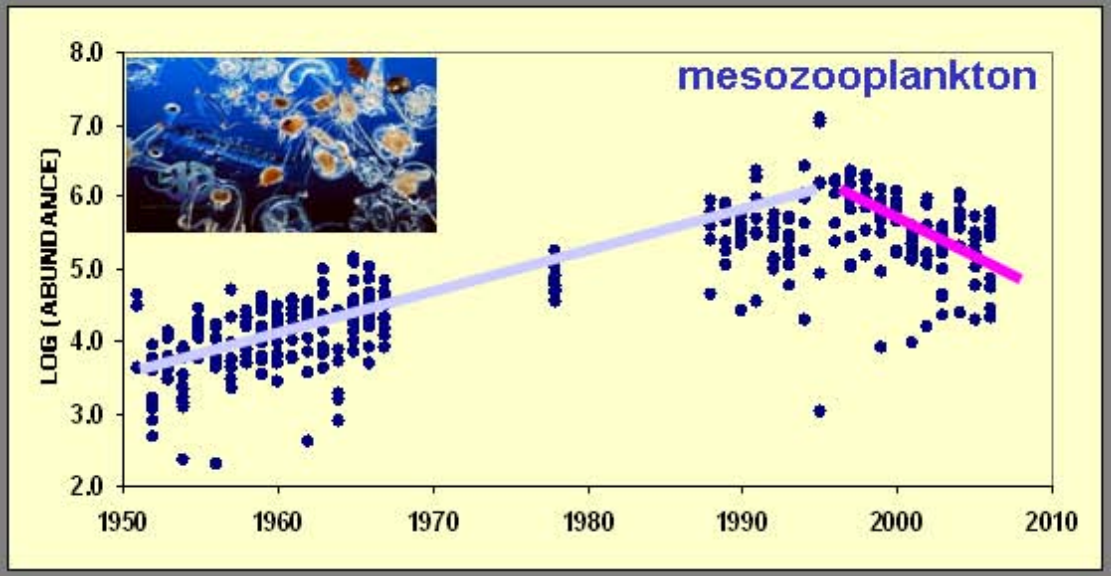
More details:
Poster No.:
(Session S1)

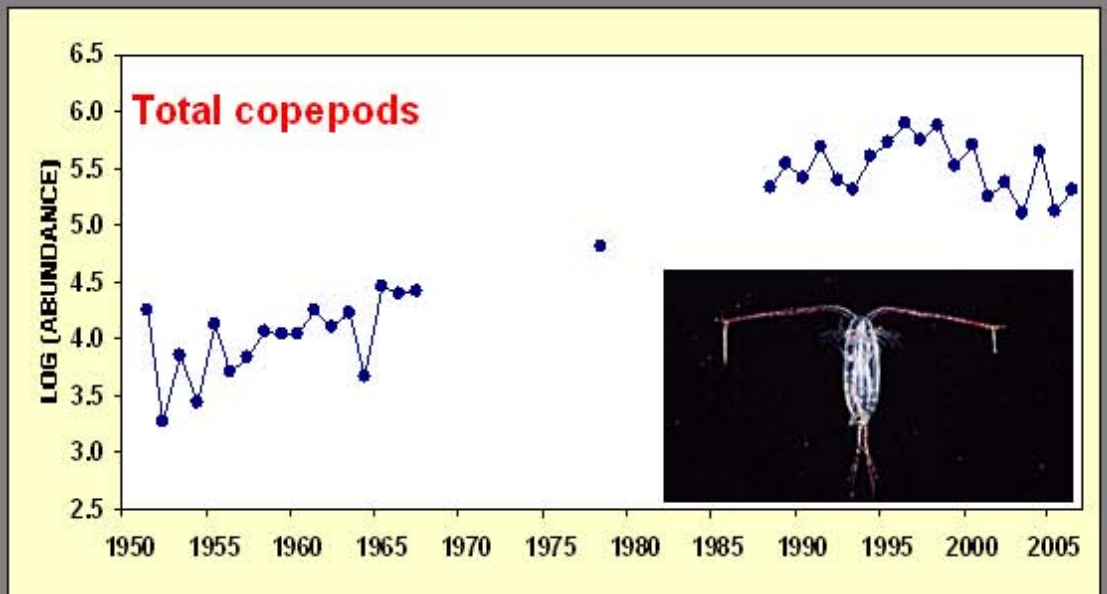
Cazassus *et al.*
3623

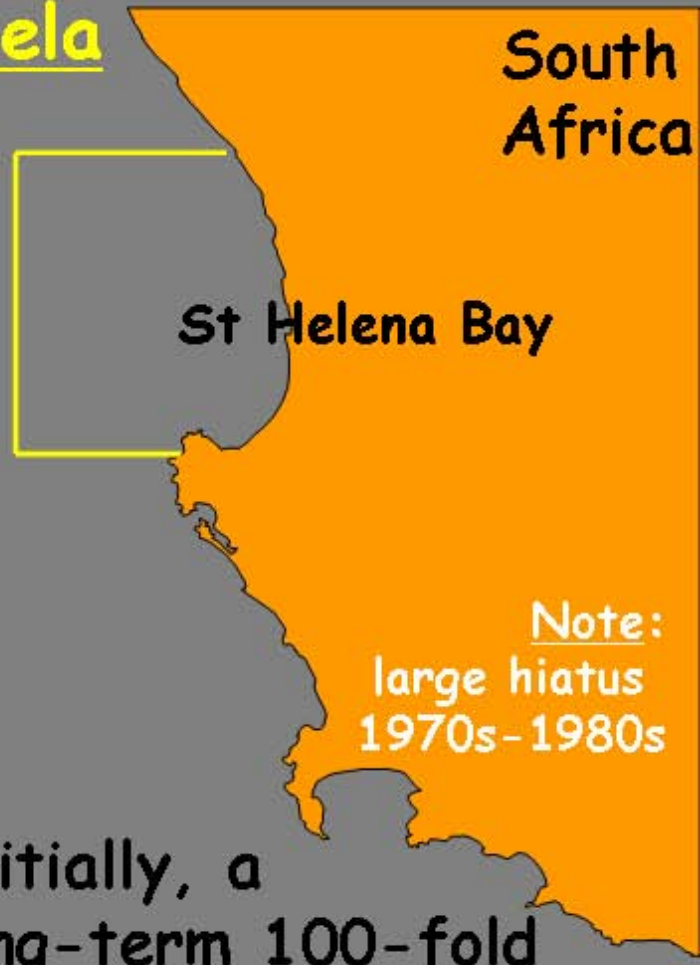
Kreiner *et al.*
3444

Comparison with southern Benguela

Time-series of autumn mesozooplankton & copepods in St Helena Bay, 1951-2006

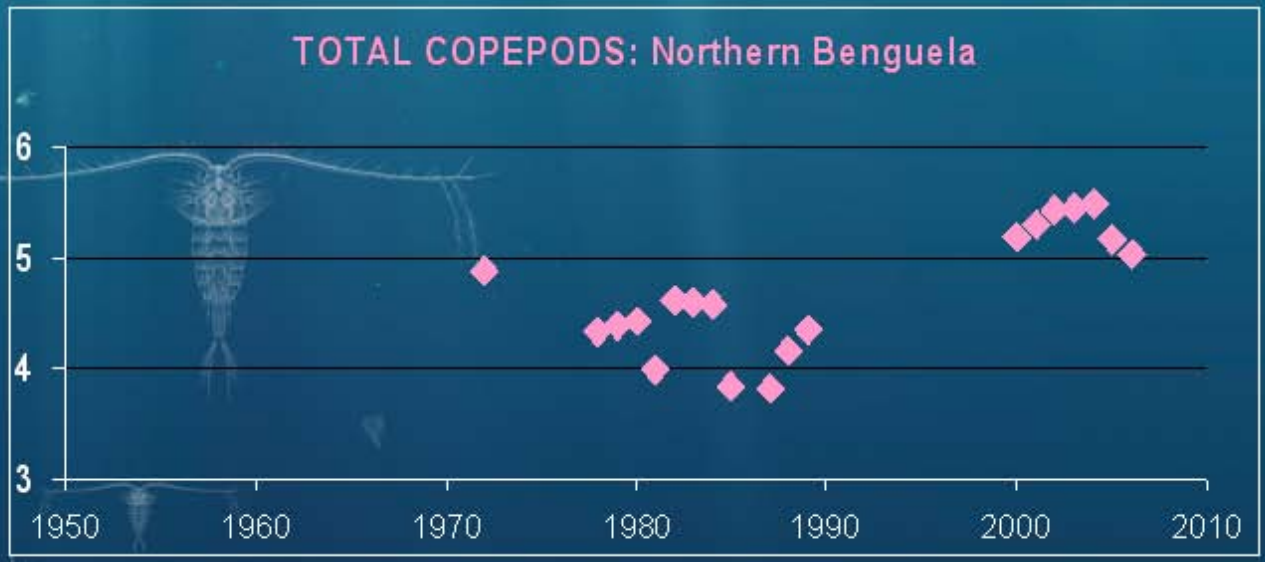


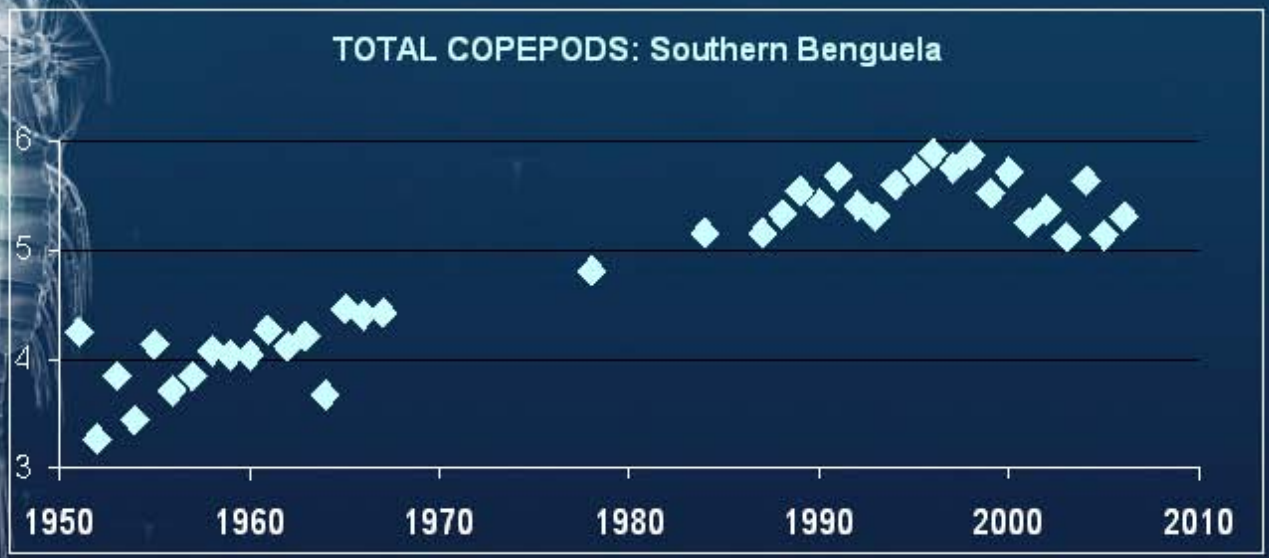


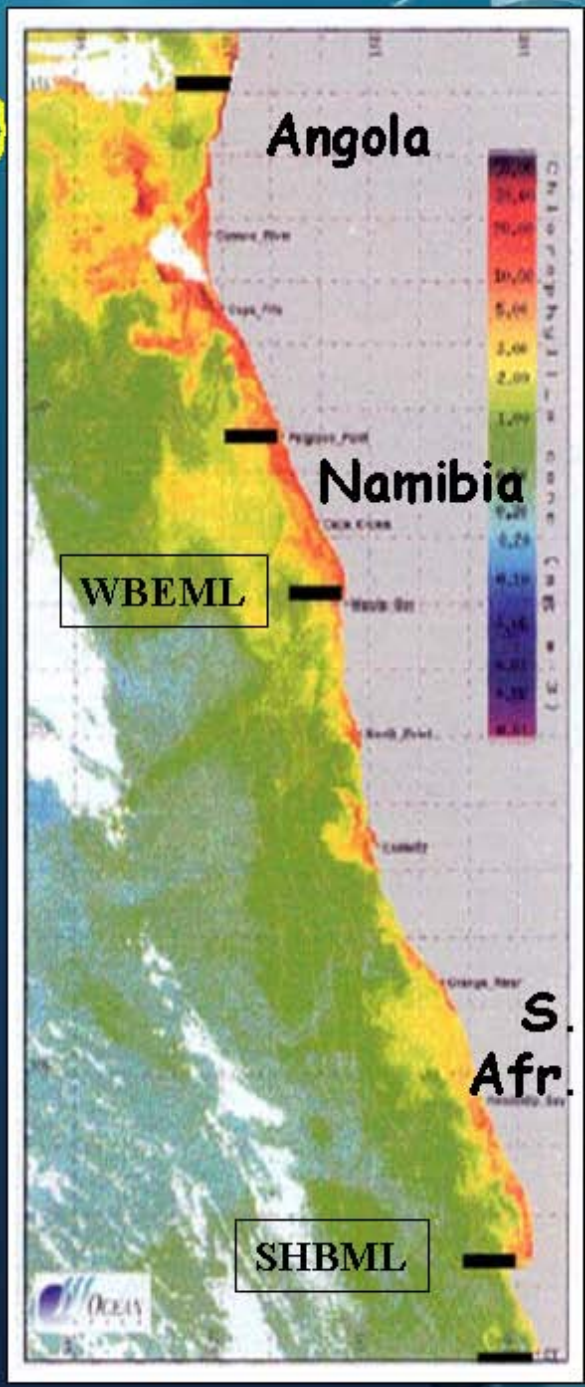


Initially, a long-term 100-fold increase in abundance from 1950s until mid-1990s; thereafter, reversal to downward trend.

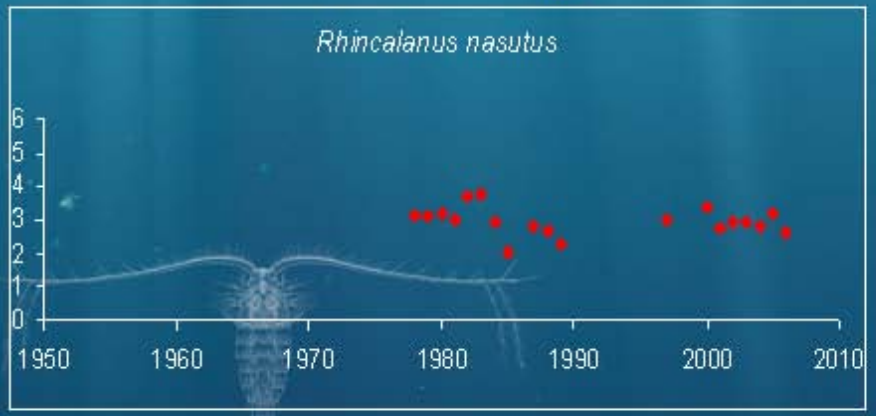
northern – southern Benguela comparison: total copepod abundance {$Log_{10}[(No.m^{-2})+1]$}

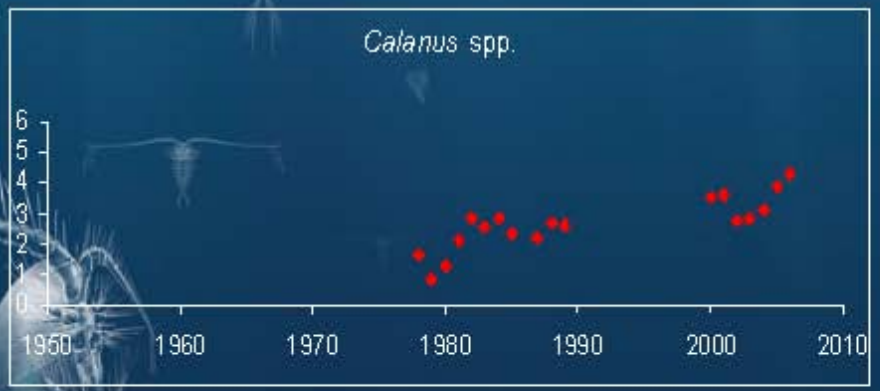


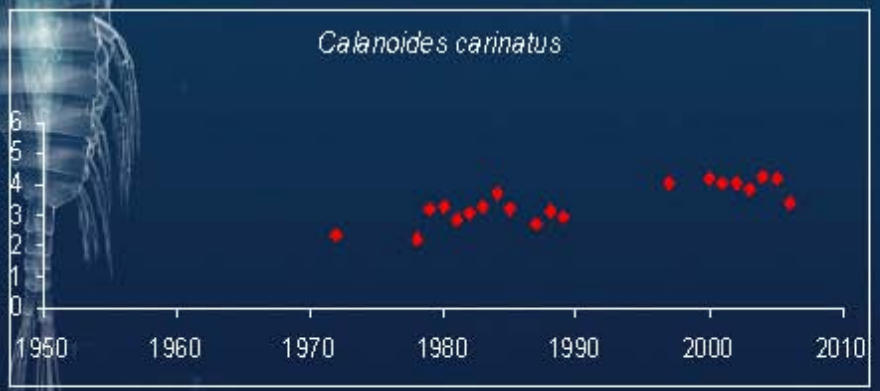




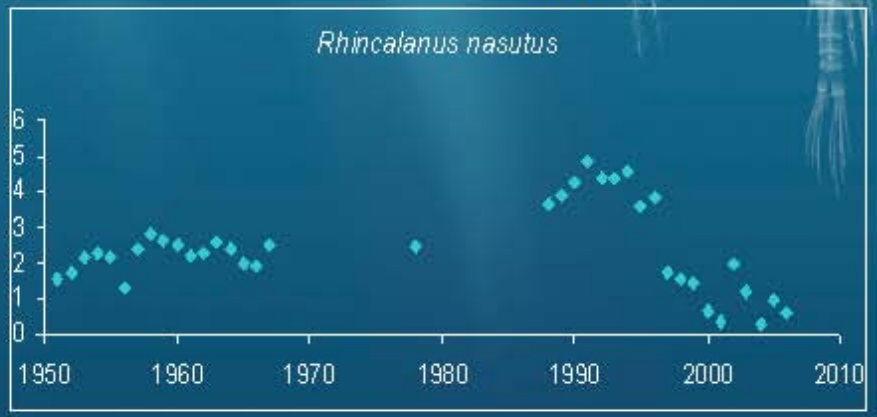
northern Benguela

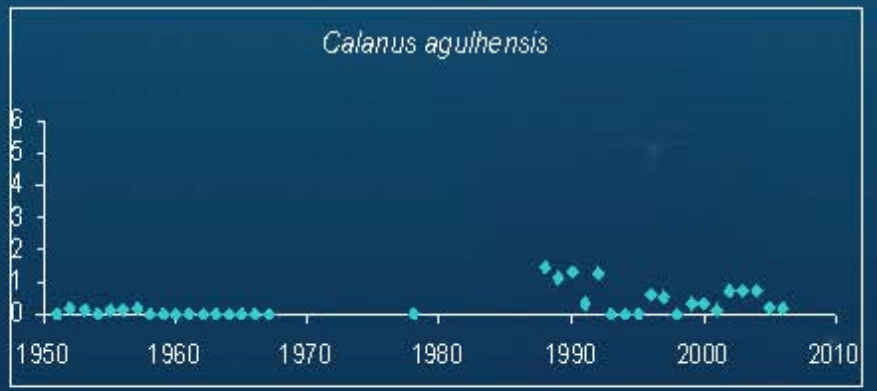


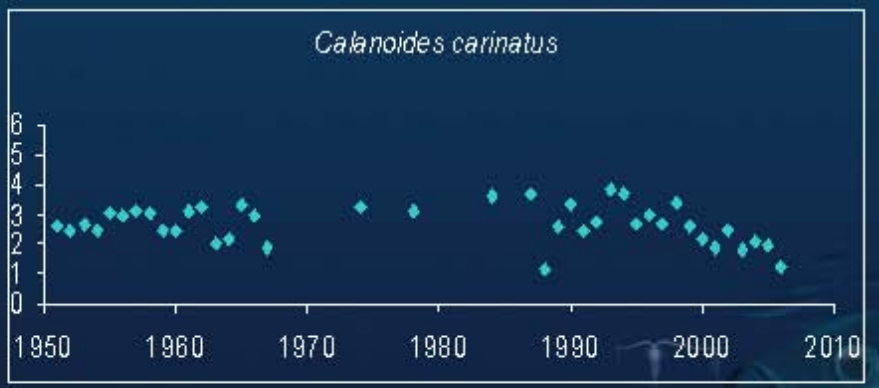




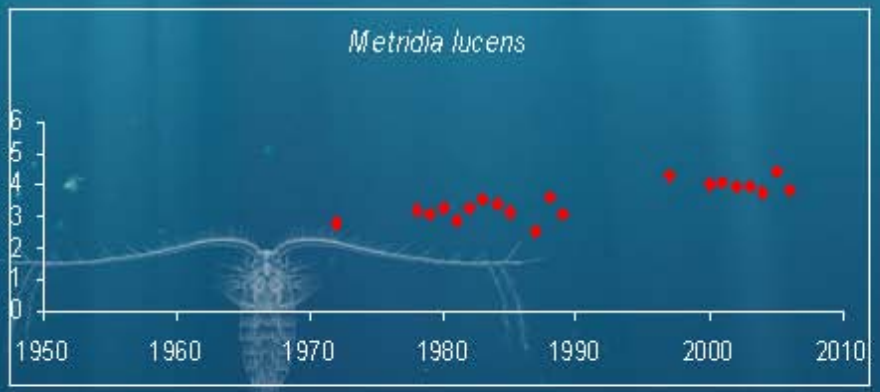
southern Benguela

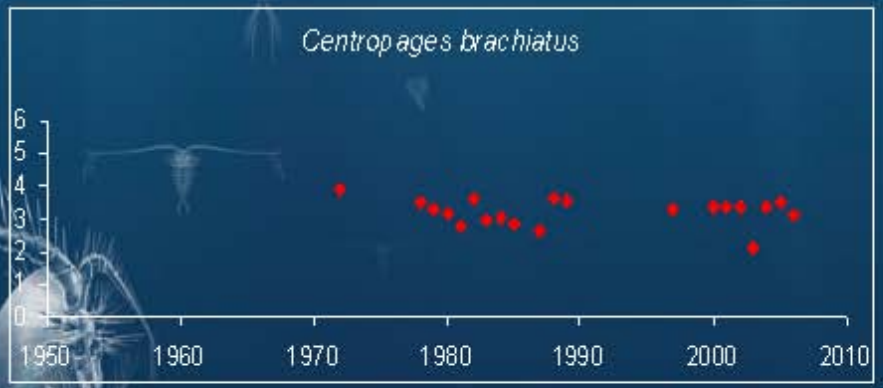


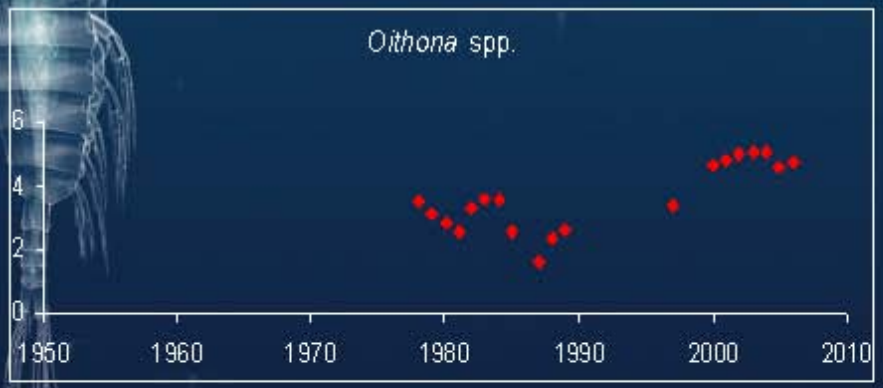




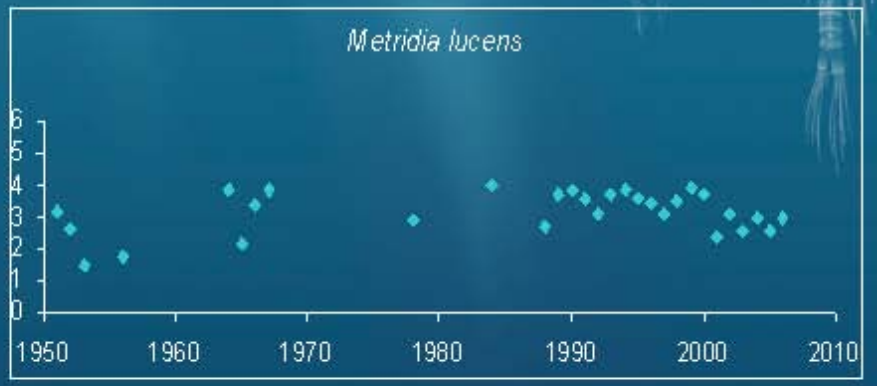
northern Benguela

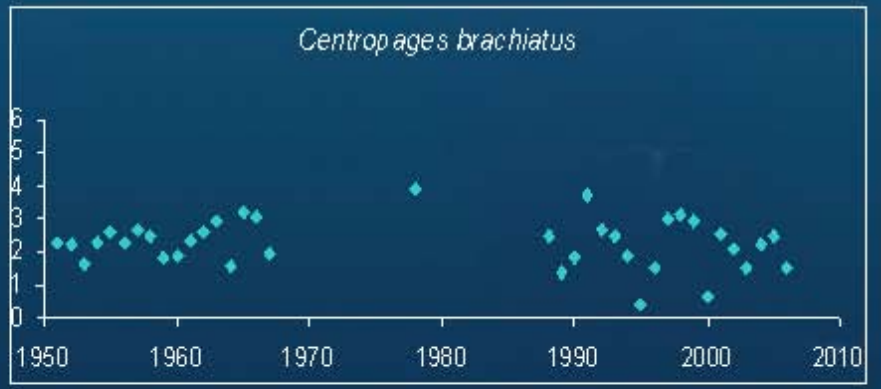


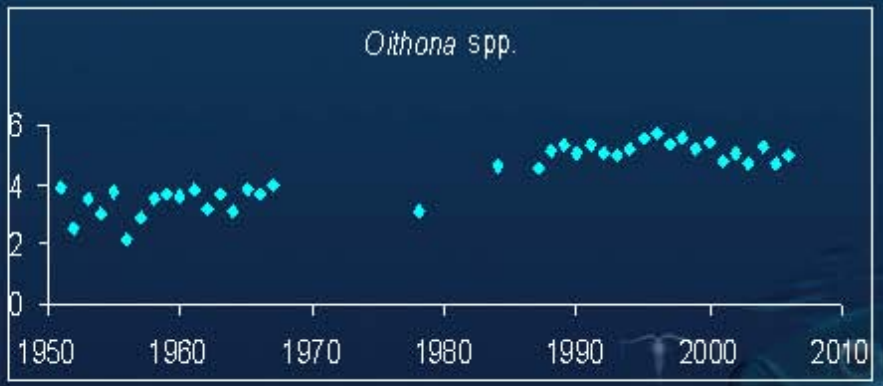




southern Benguela







Tentative conclusions

1. Caution! - both time-series too 'gappy' to allow firm conclusions about LT changes in zooplankton biomass, abundance, community structure!

2. Northern Benguela (off Namibia):
   - initial decline in zooplankton during period of intensified upwelling (early 1960s - early 1980s), followed by increase until early 2000s, then (possibly) declining again;
   - mid-1980s "turning point' follows the 1982/83 Benguela Niño, after which upwelling intensity weakened, enhancing retention of coastal zooplankton populations through time.

3. Southern Benguela (off South Africa):
   initially, 100-fold increase in abundance from 1950s to mid-1990s 'turning point' with 10- to 100-fold species-specific declines.

4. Northern and southern Benguela do not appear to be in synchrony w.r.t. decadal changes in zooplankton abundance/community structure.


Thank
you…!
BENEFIT
environment & tourism
Department:
Environmental Affairs and Tourism
REPUBLIC OF SOUTH AFRICA
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