



INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET



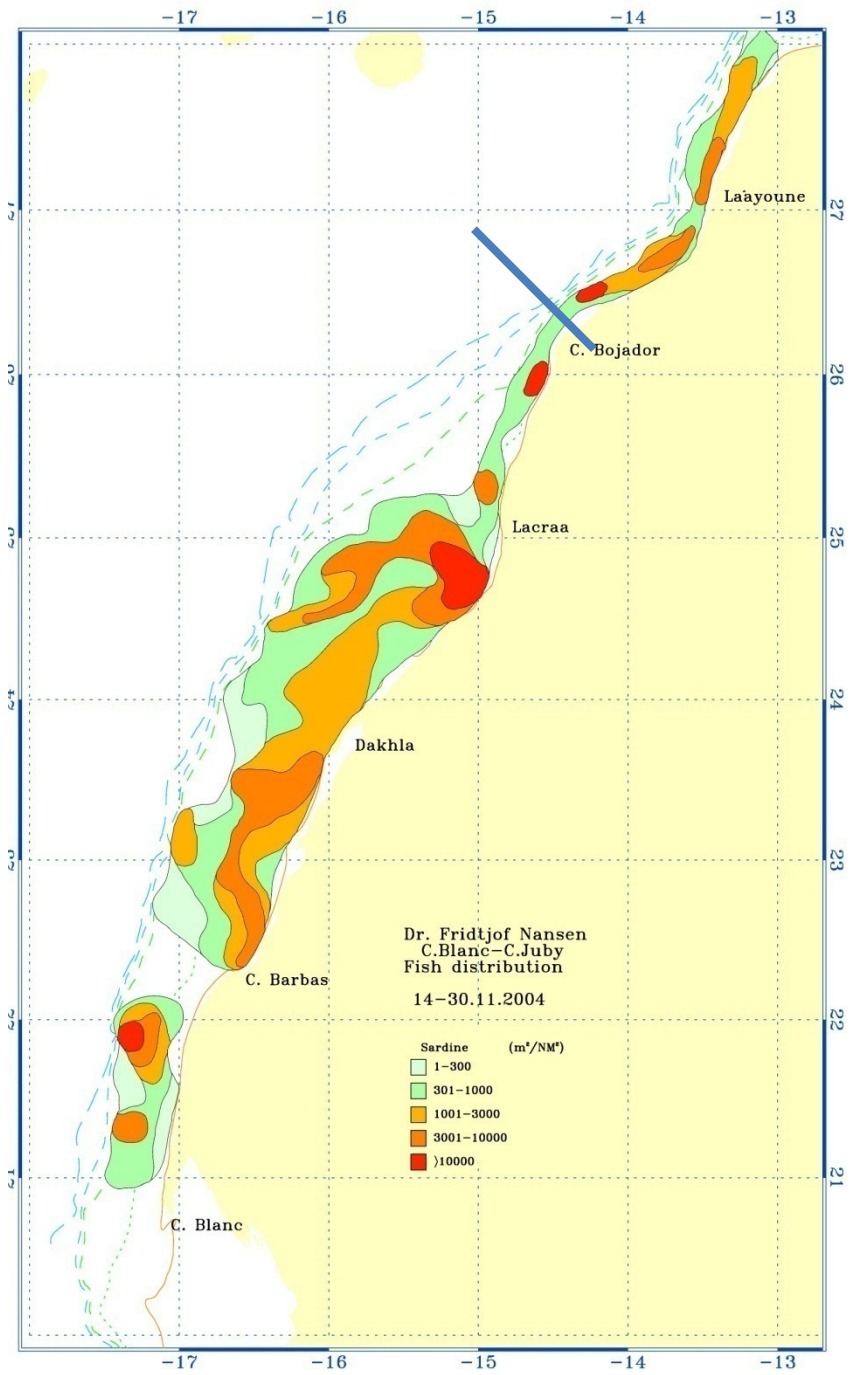
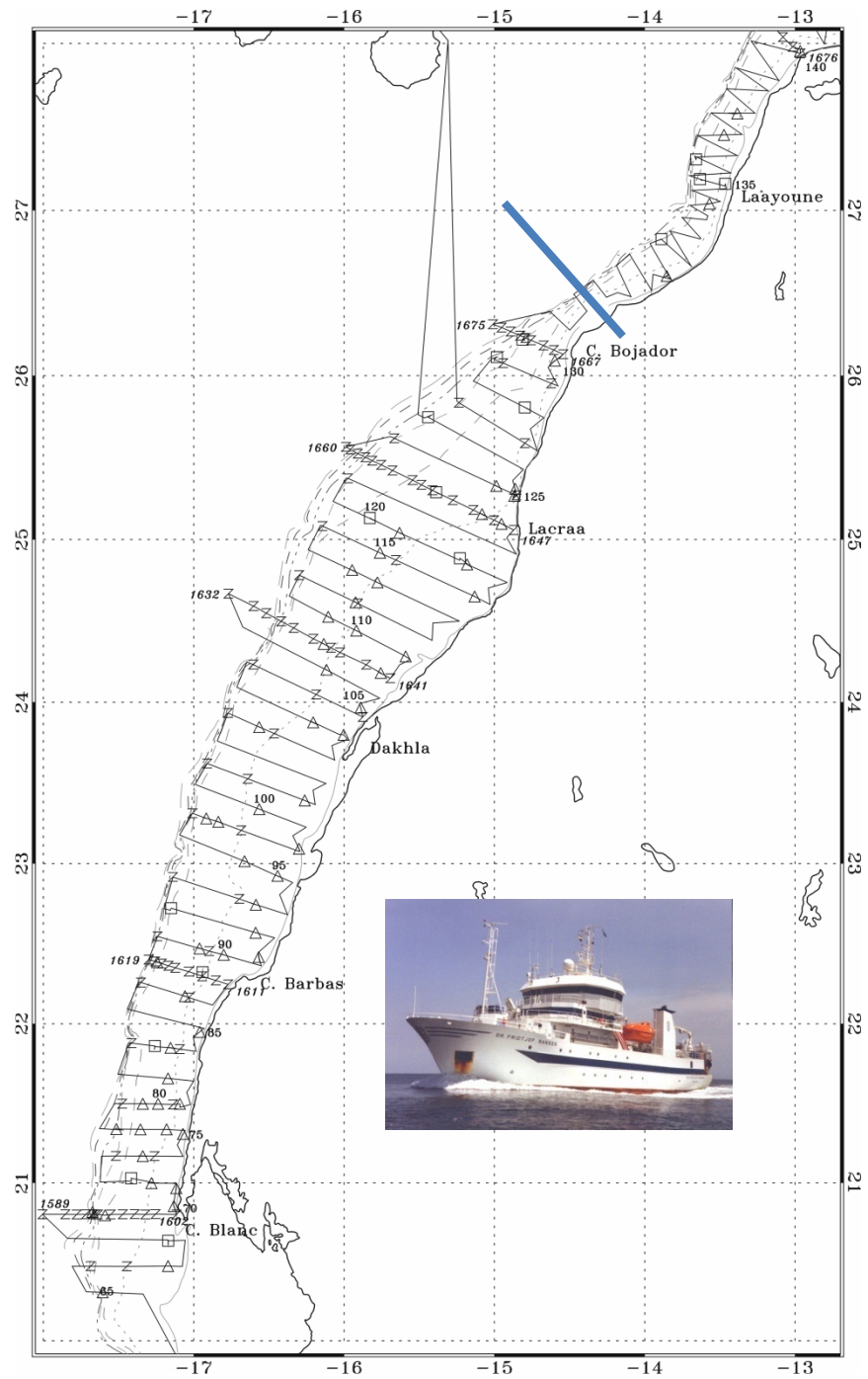
Stock collapse as natural events. Natural dynamics in the Saharan stock of sardine as observed from surveys

by

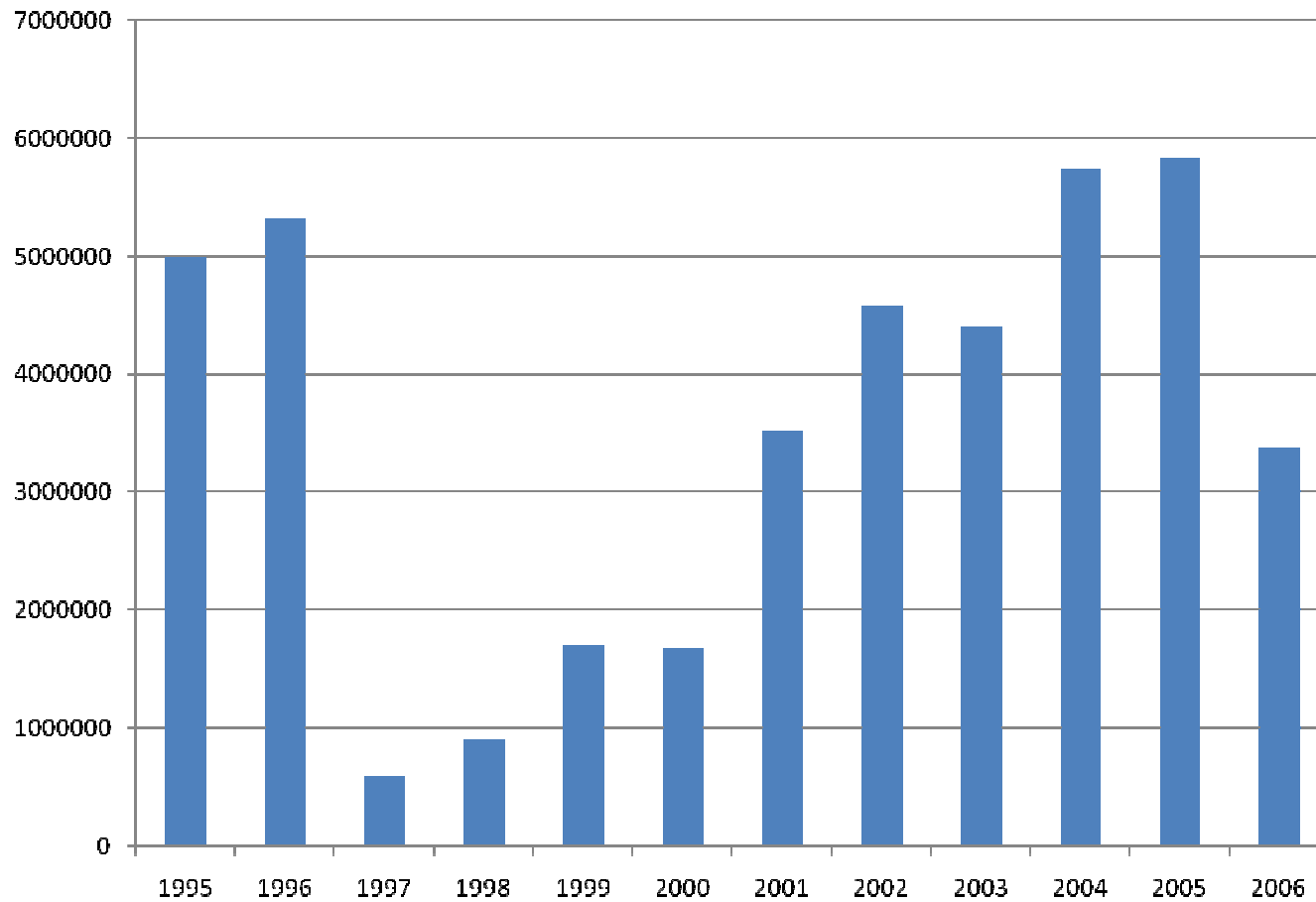
Tore Strømme¹, Najib Charouki²,
Marek Ostrowski¹ and Oddgeir
Alvheim¹

¹IMR, Norway, ²INRH, Morocco

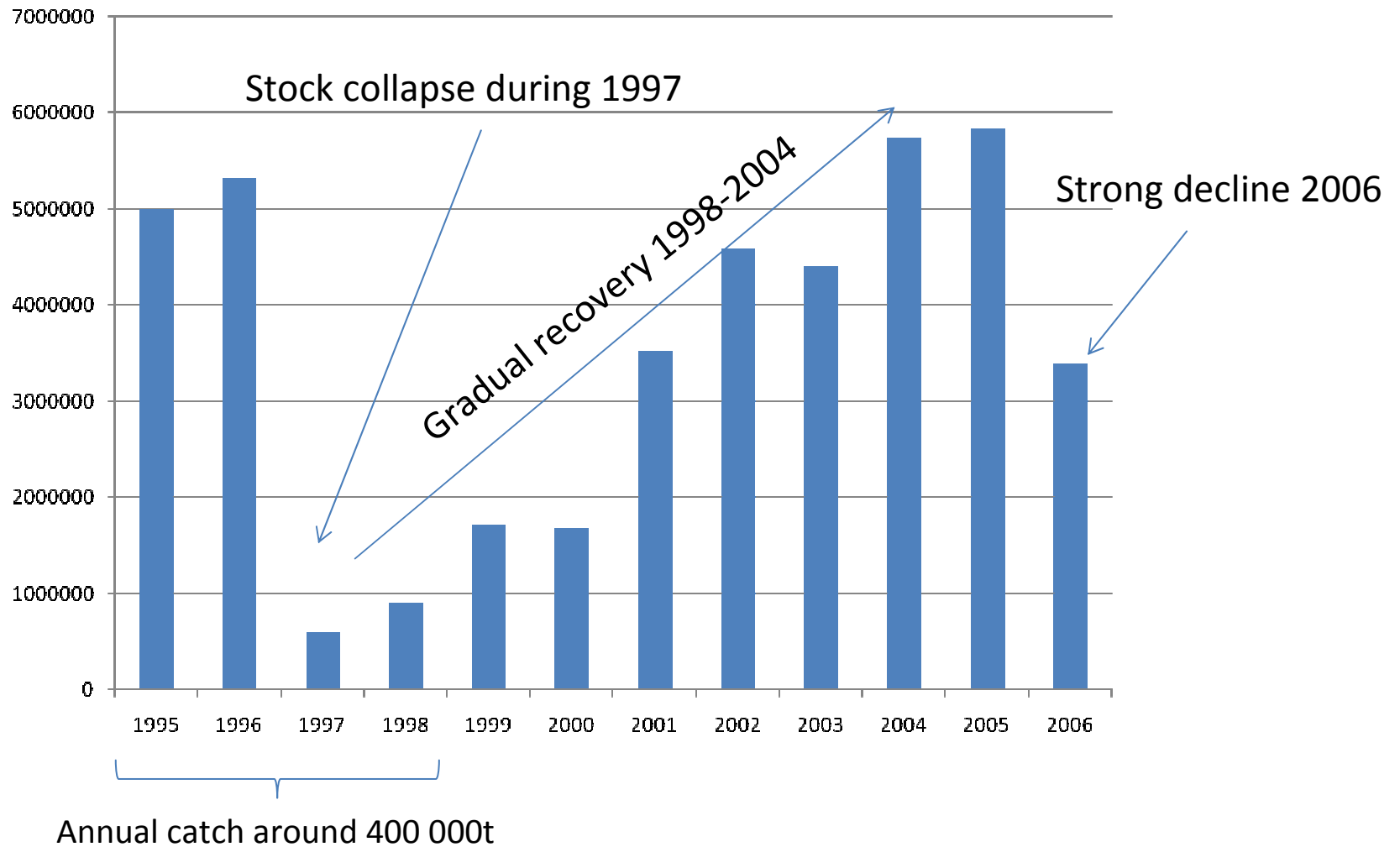




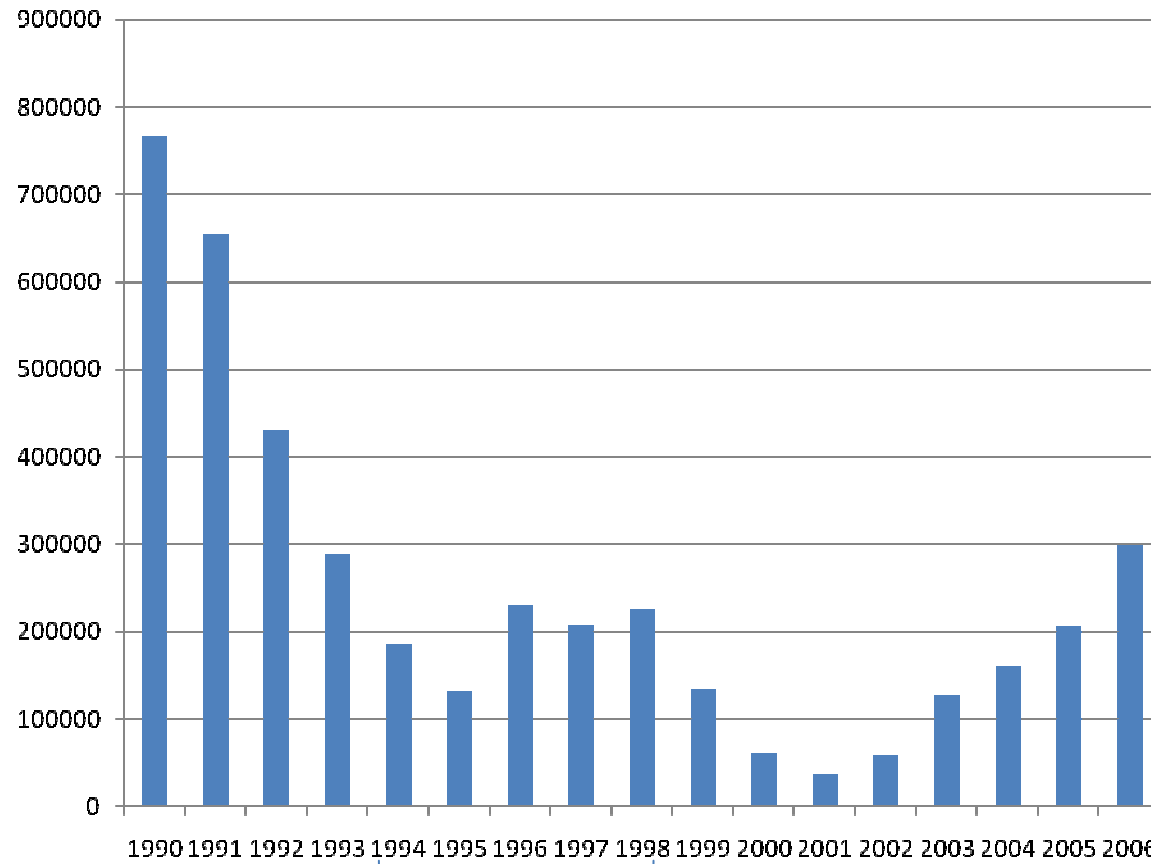
Biomass estimates sardine south of Cape Bojador 1995-2006



Main events in the Dakhla stock

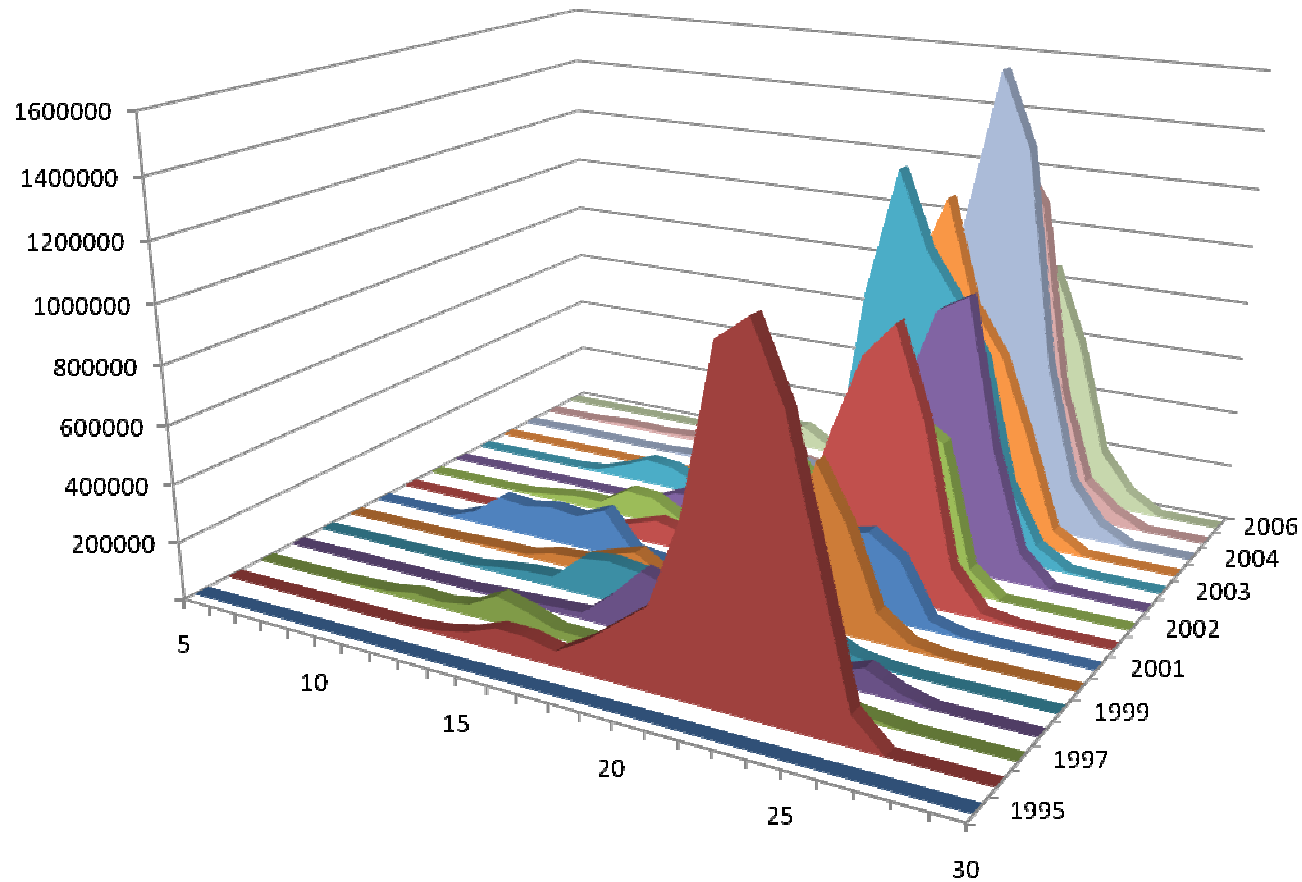


Catch in Zone C, 1990-2006

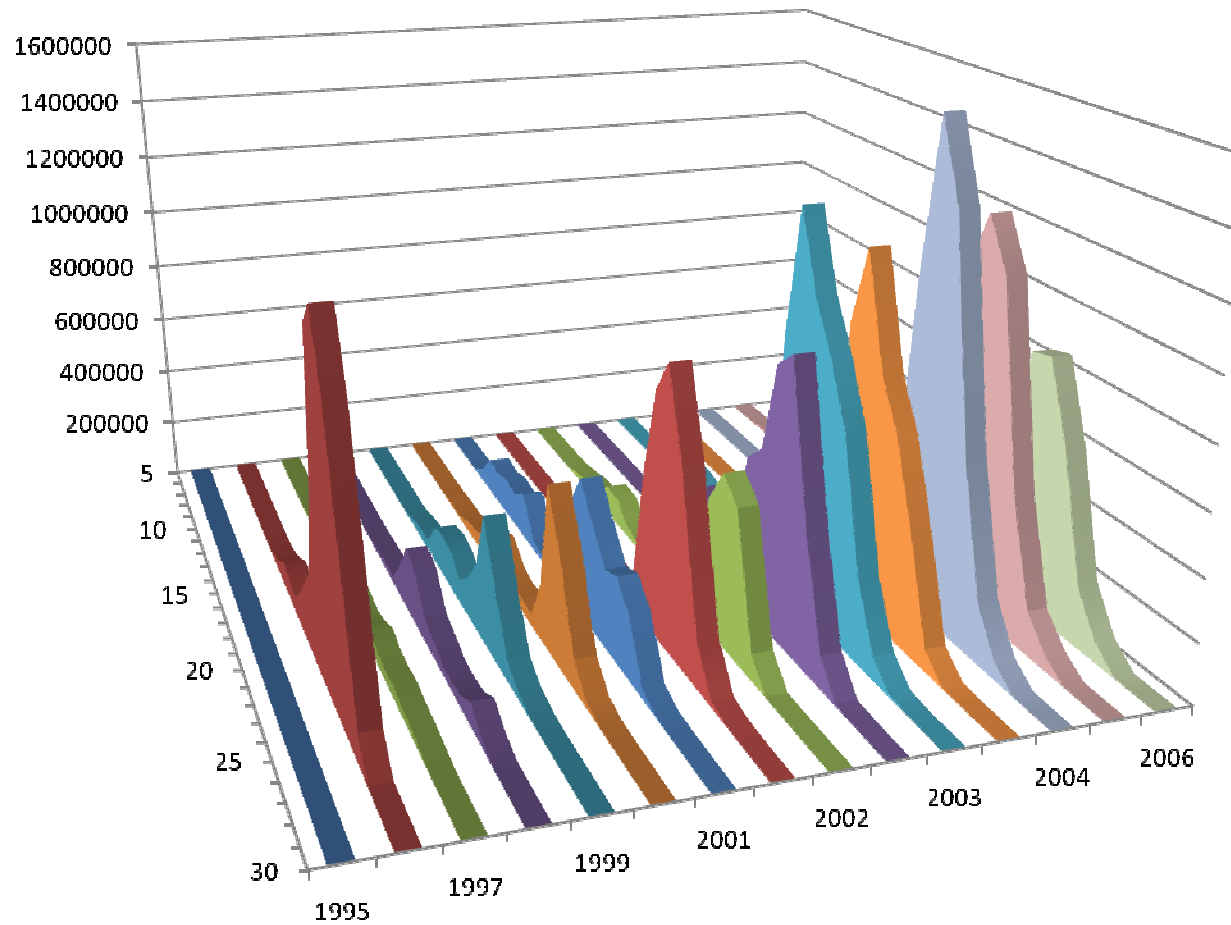


Catch level moderate and 'steady'

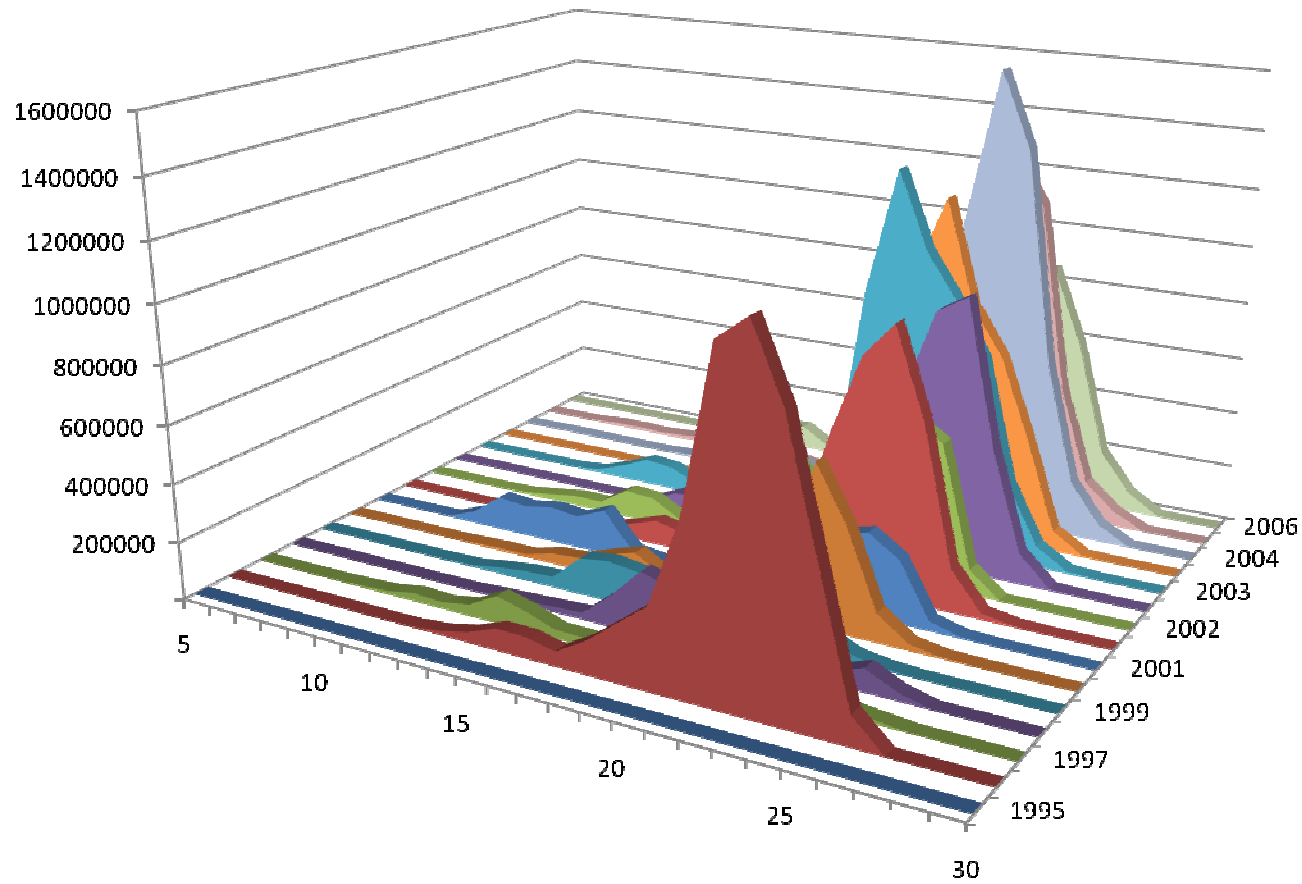
Biomass by length classes 1995-2006, Dakhla stock.

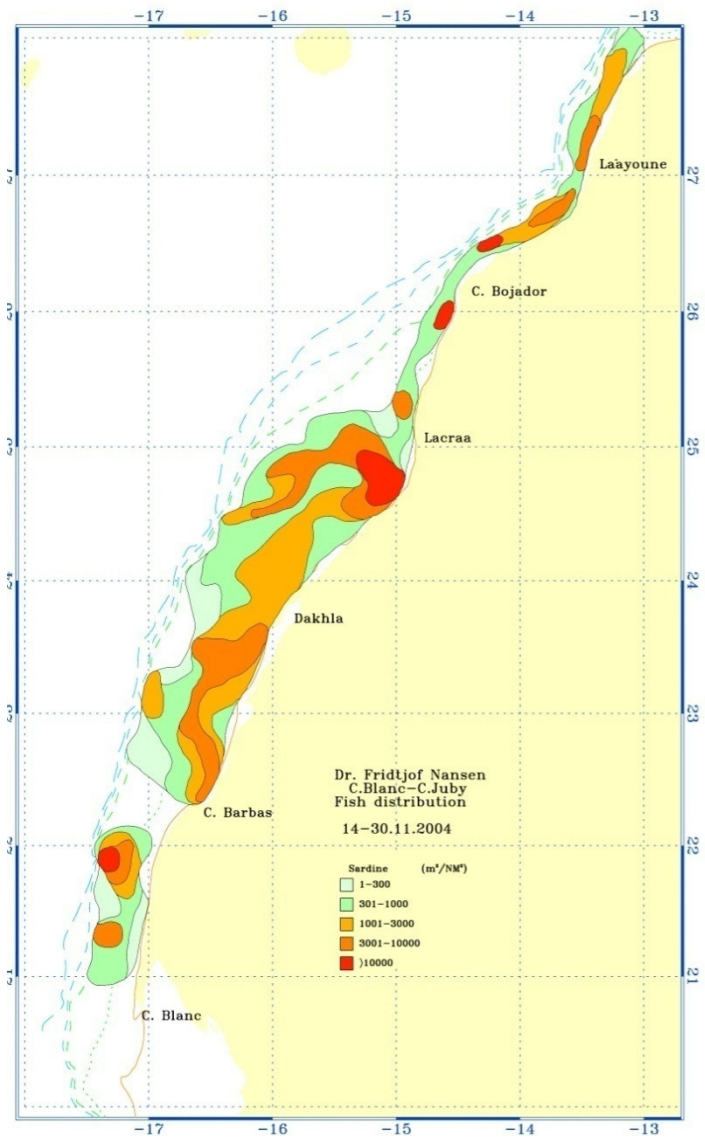


Biomass by length classes 1995-2006, Dakhla stock

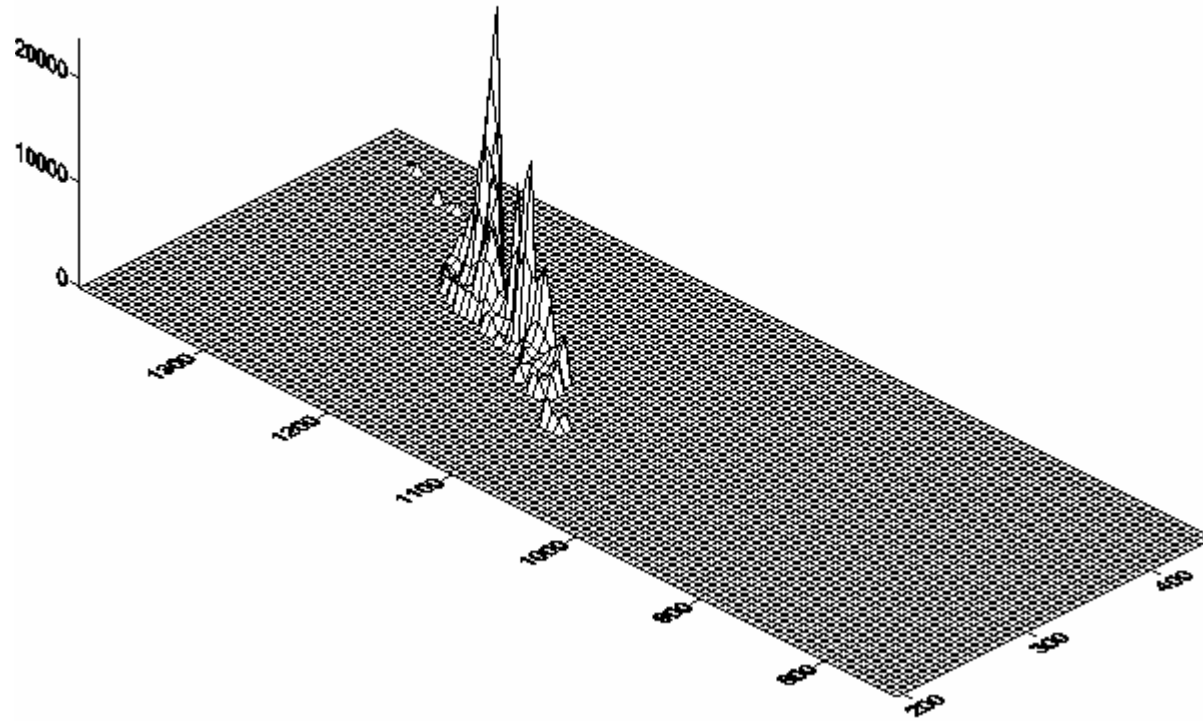


Biomass by length classes 1995-2006, Dakhla stock.

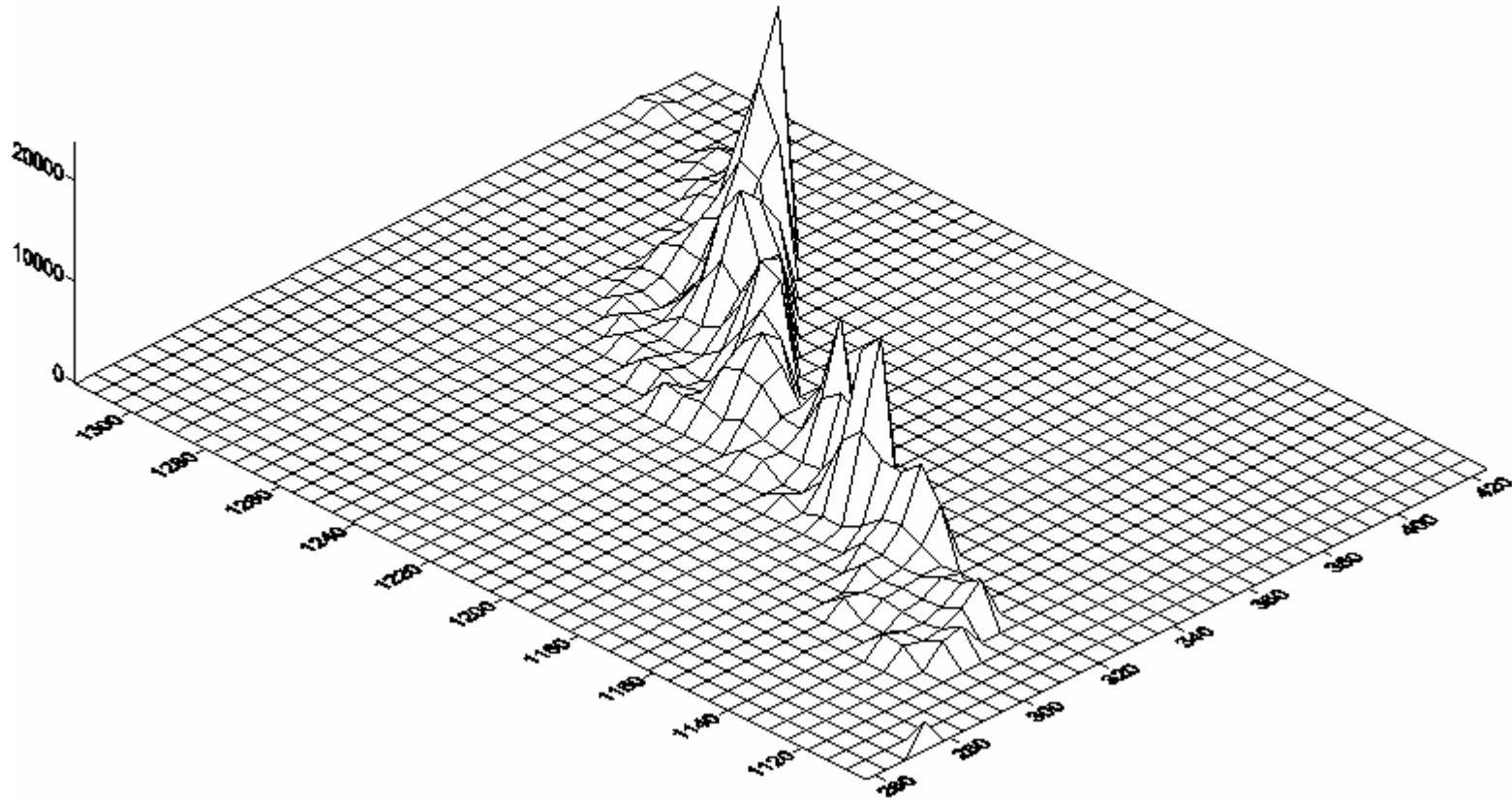




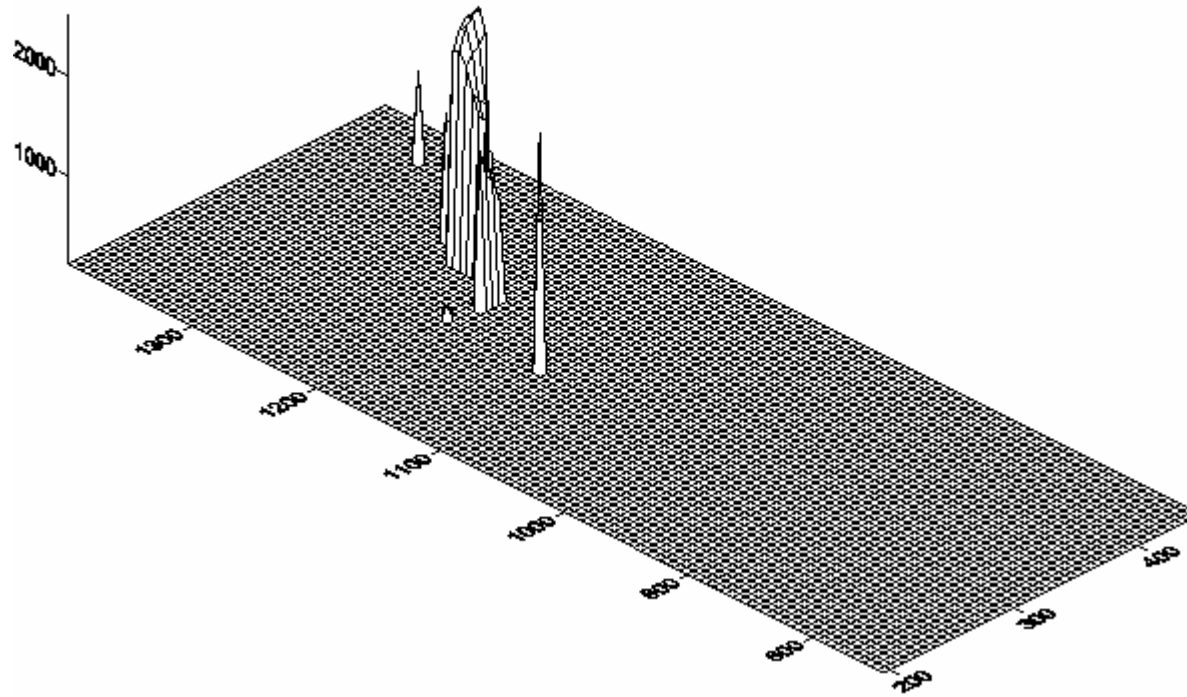
Gridded Sa distribution 1995



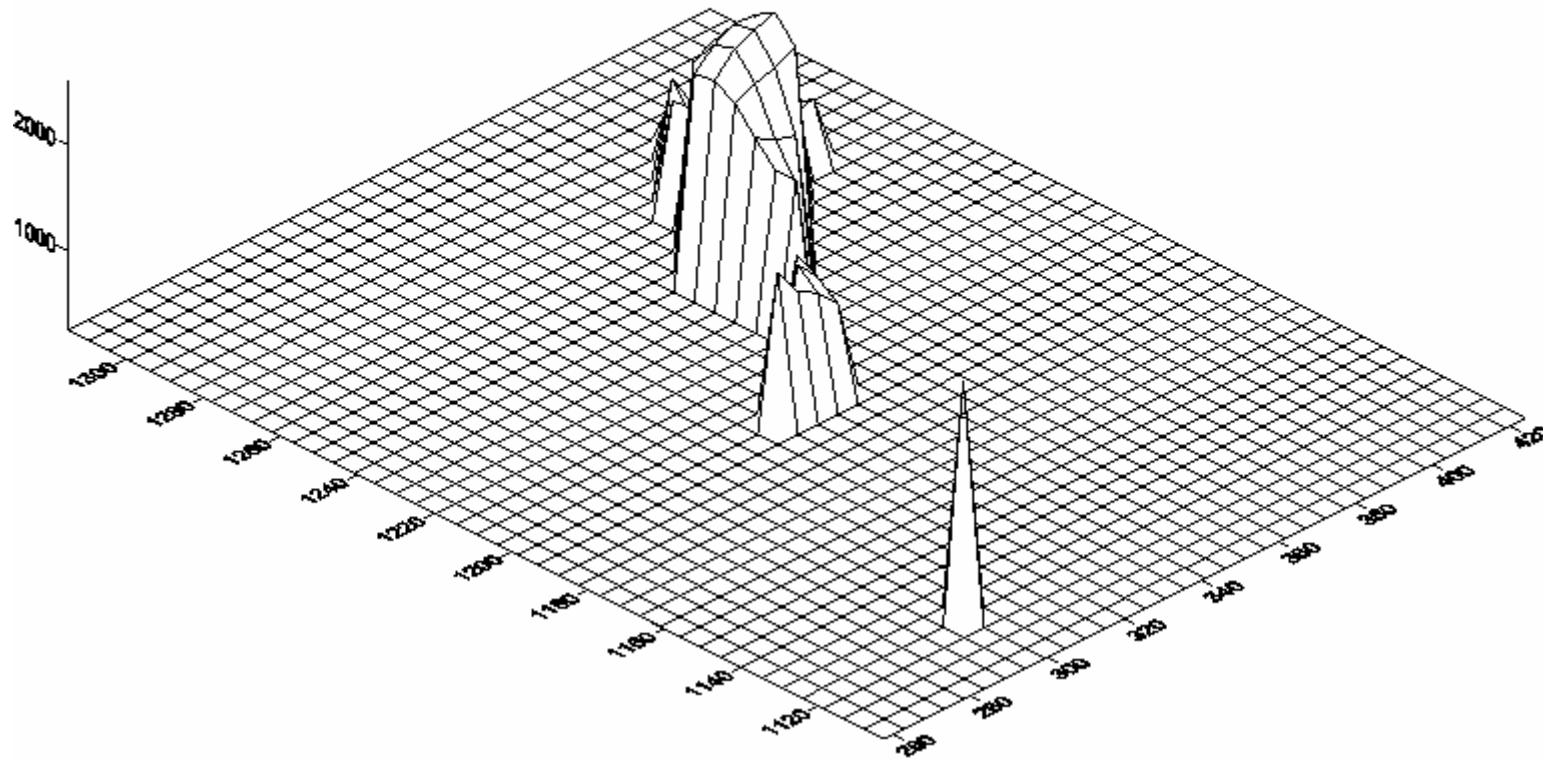
Zoomed in Sa-distribution 1995



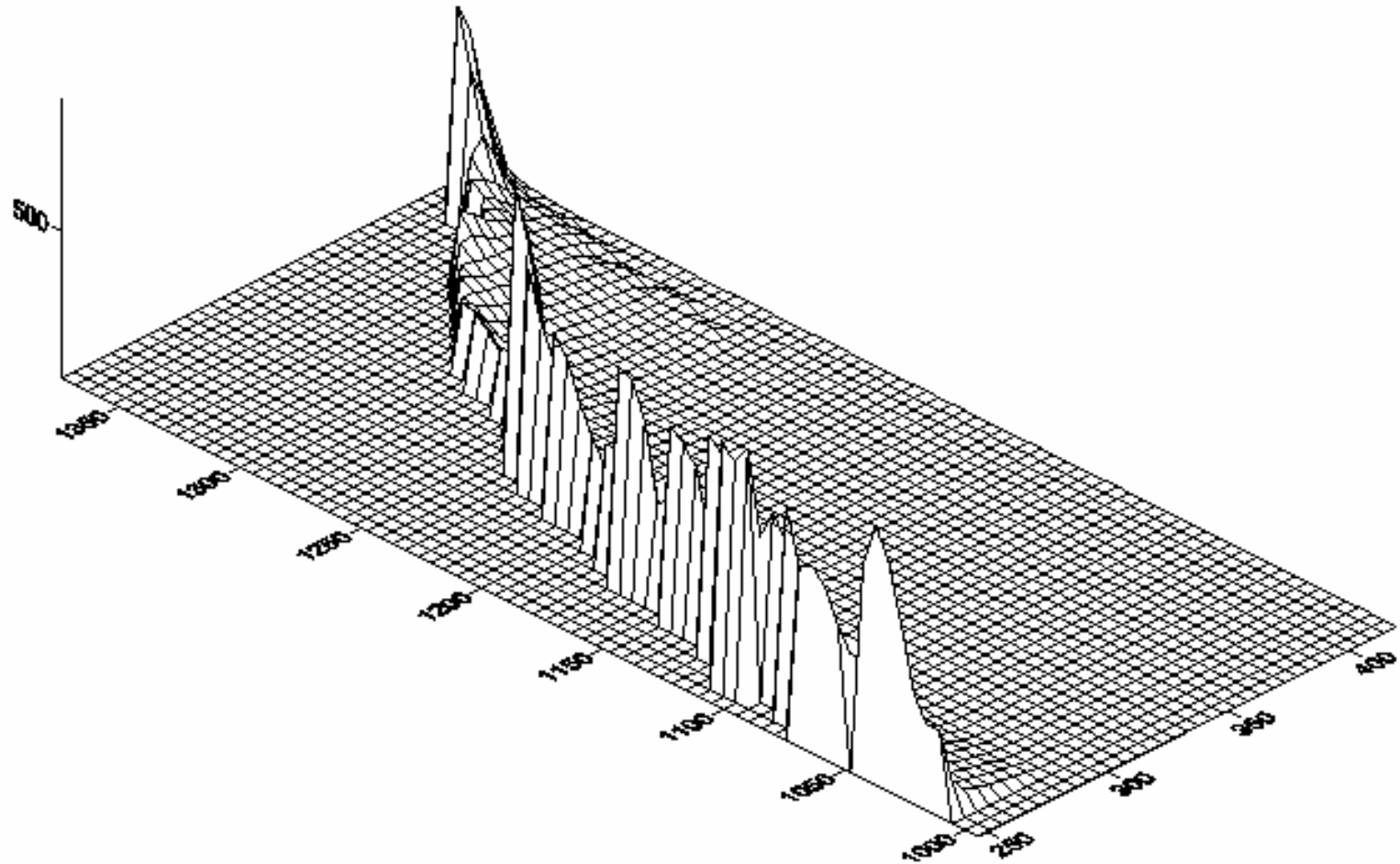
Gridded Sa distribution 1997



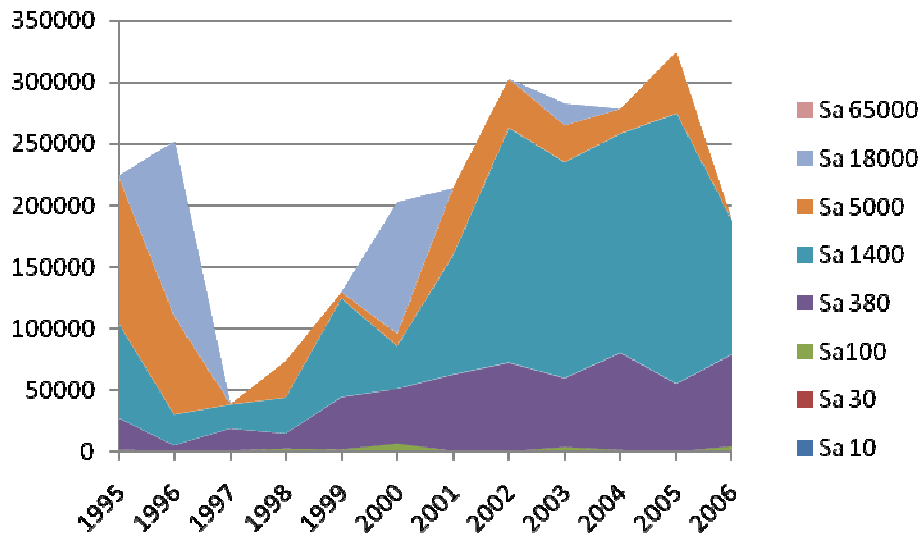
Zoomed in Sa distribution 1997



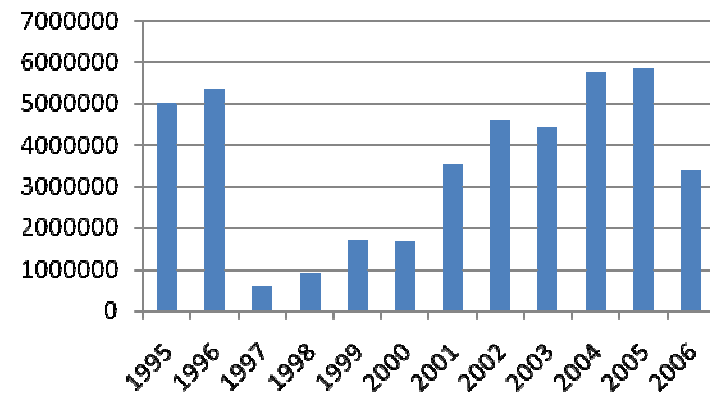
Excerpts from the bathymetric grid



Biomass indices by pure Sa values

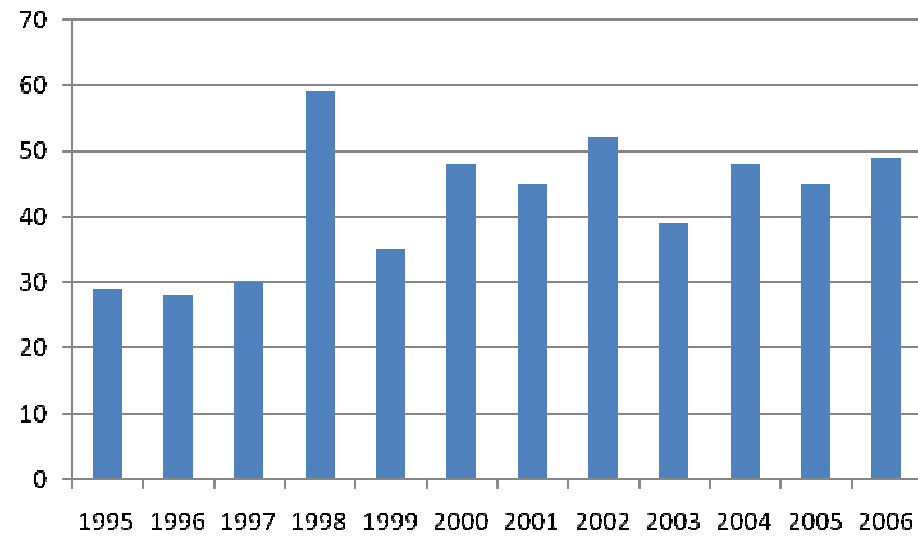


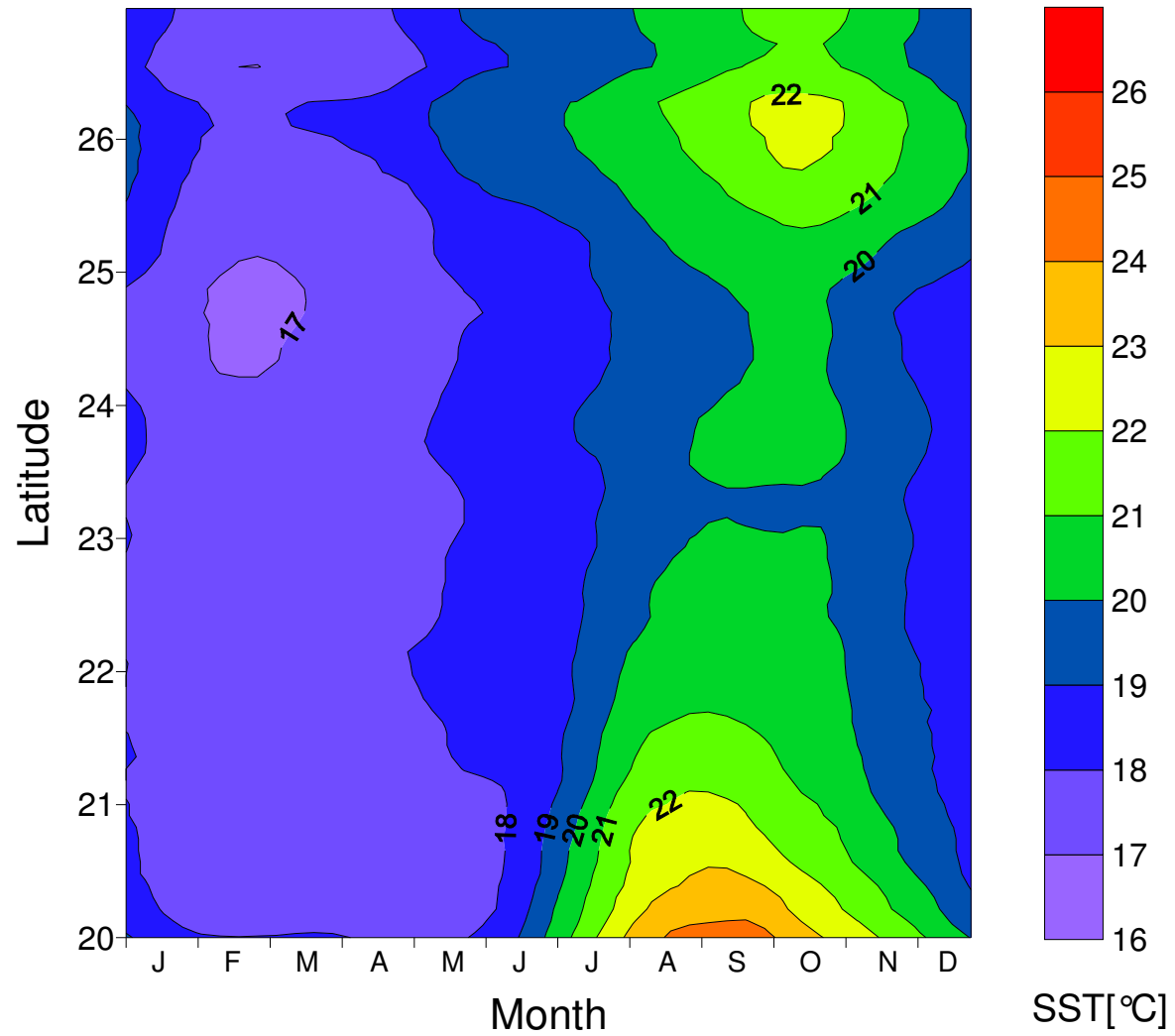
Traditional and more robust method.



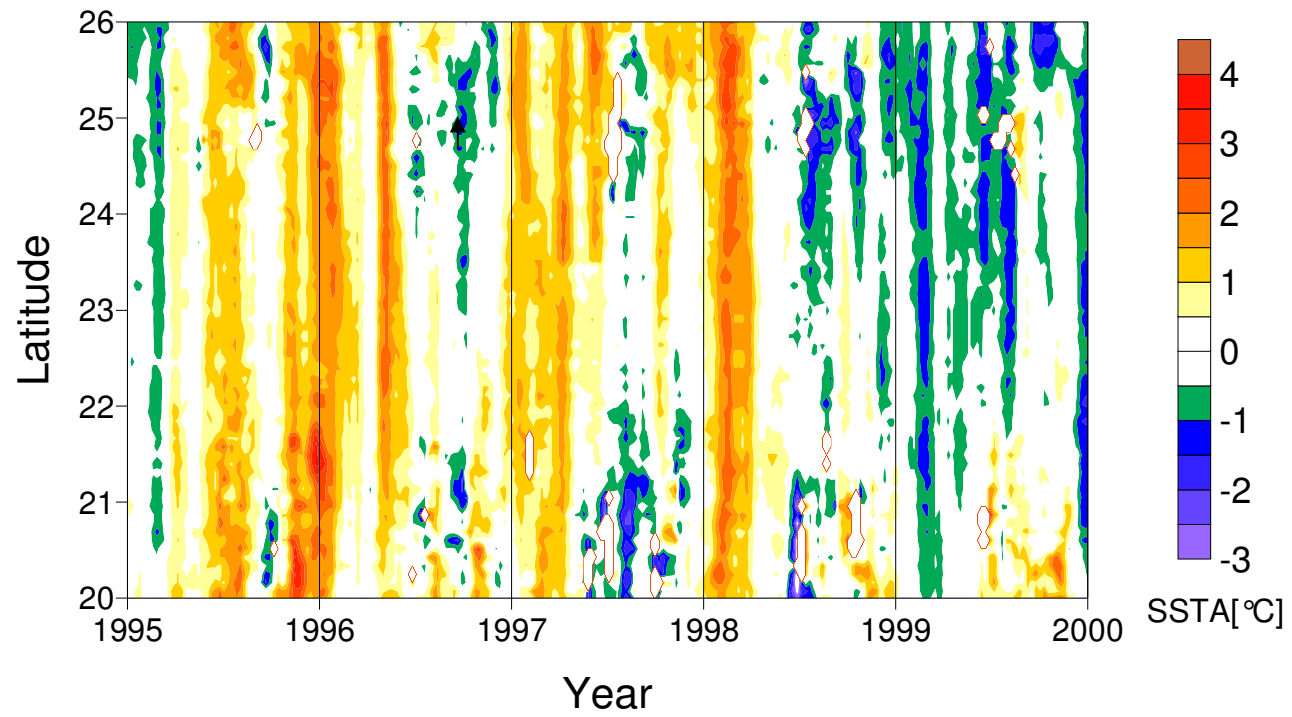
Weighted mean bottom depth by year

(Gravity point of the stock)

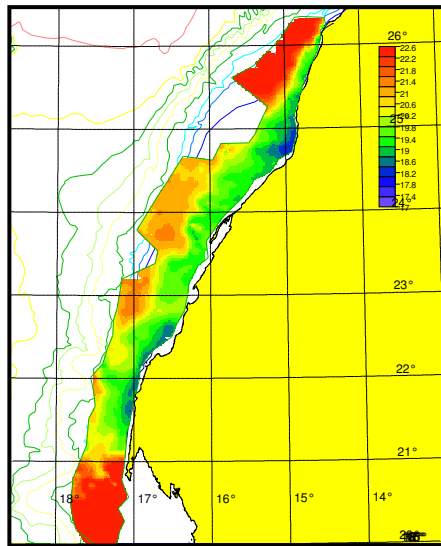




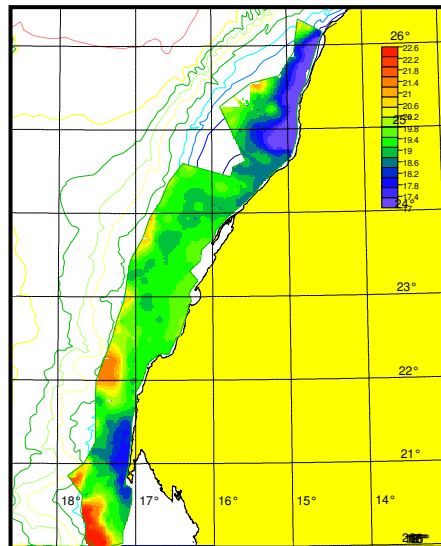
The Annual cycle of SST along the coast of Western Sahara derived from the Pathfinder dataset 1985-2006



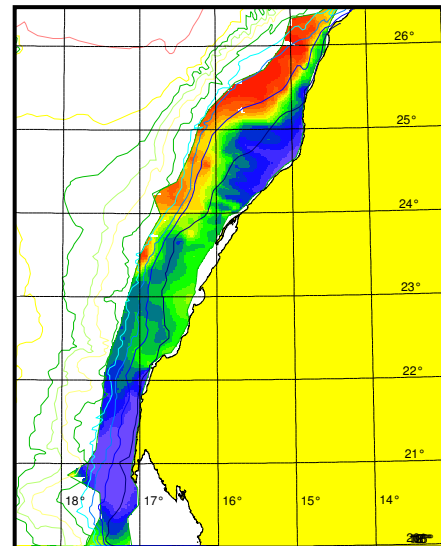
The SST anomaly 1995-2000. The anomaly is defined as the difference between the observed temperature and its long term mean from the previous slide.



1995



1996



1997

Note: survey derived surface temp. distributions: november-december

Conclusions 1997 collapse

- A concentration of the sardine population into shallow waters started in 1995 and peaked in 1996, prior to the collapse that occurred during the following year.
- The concentration was probably due to a warm water anomaly over several years leaving the sardine to occupy a small upwelling cell close to the coast for an extended period
- If this generated a mass emigration or a local mass mortality due to an environment trap or a disease trap is not known. Only the result is.

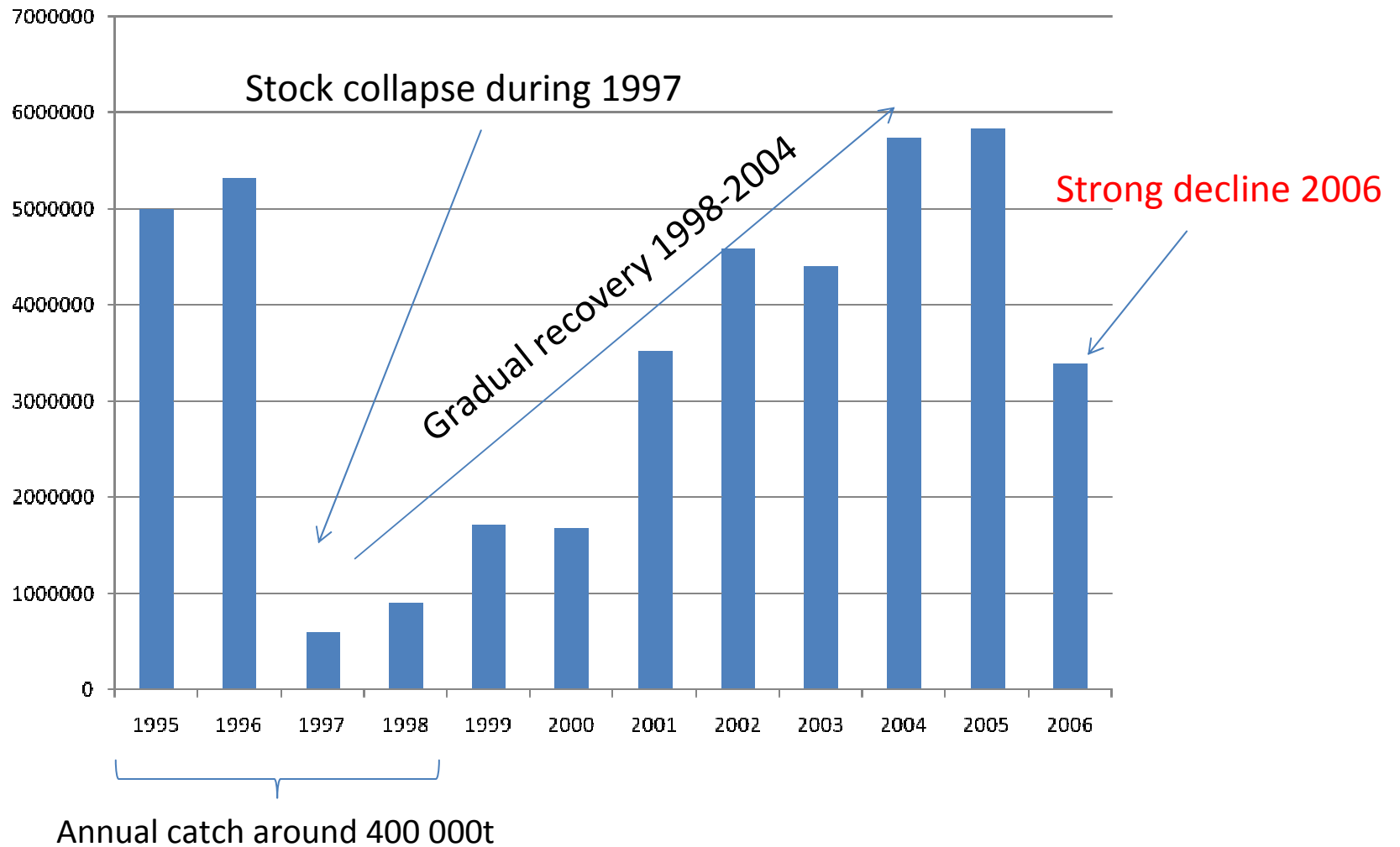


What about the 2006 reduction?

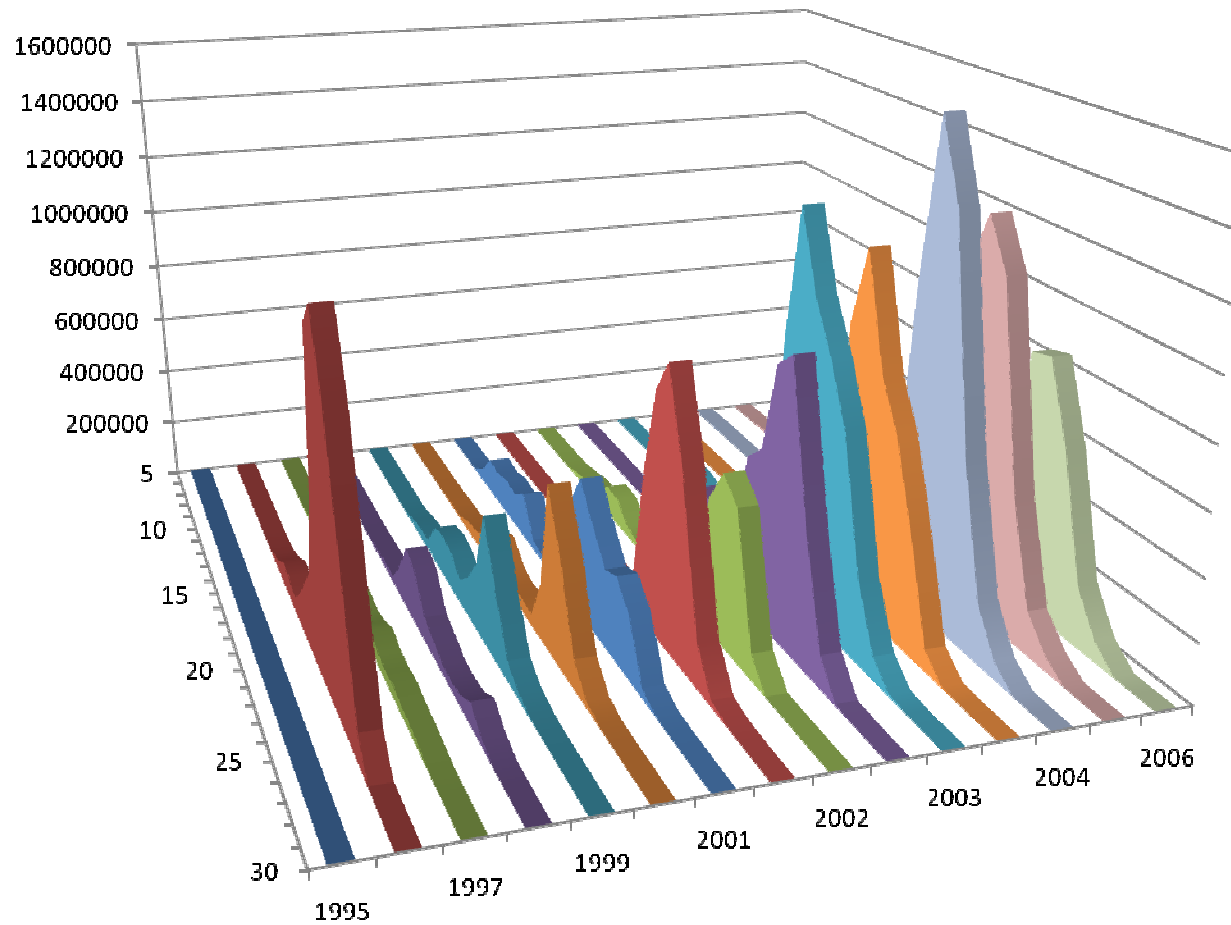
- No concentration into smaller area
- No movement towards shallow waters
- No prior sign of recruitment failure, decline is in adult stock
- No drastic increase in fishing



Main events in the Dakhla stock



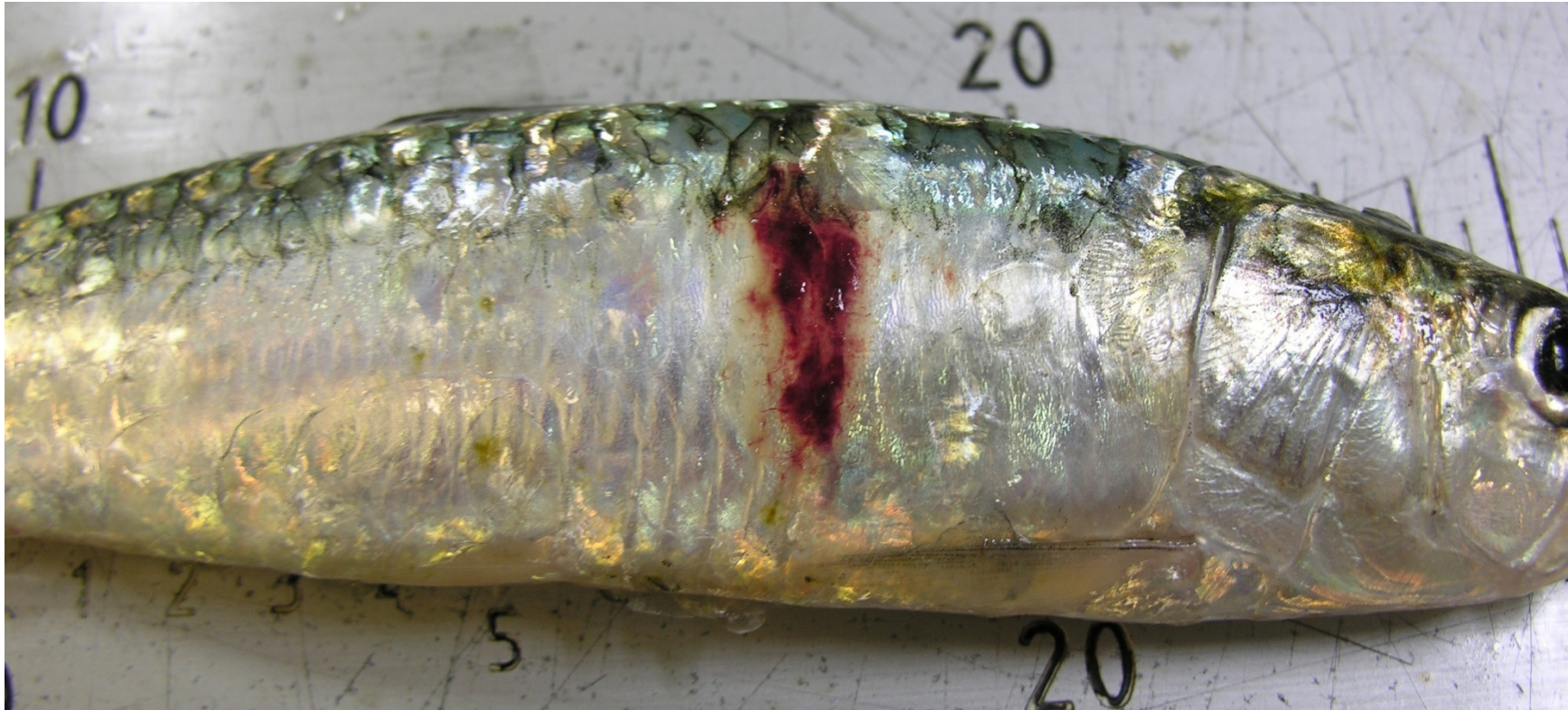
Biomass by length classes 1995-2006, Dakhla stock



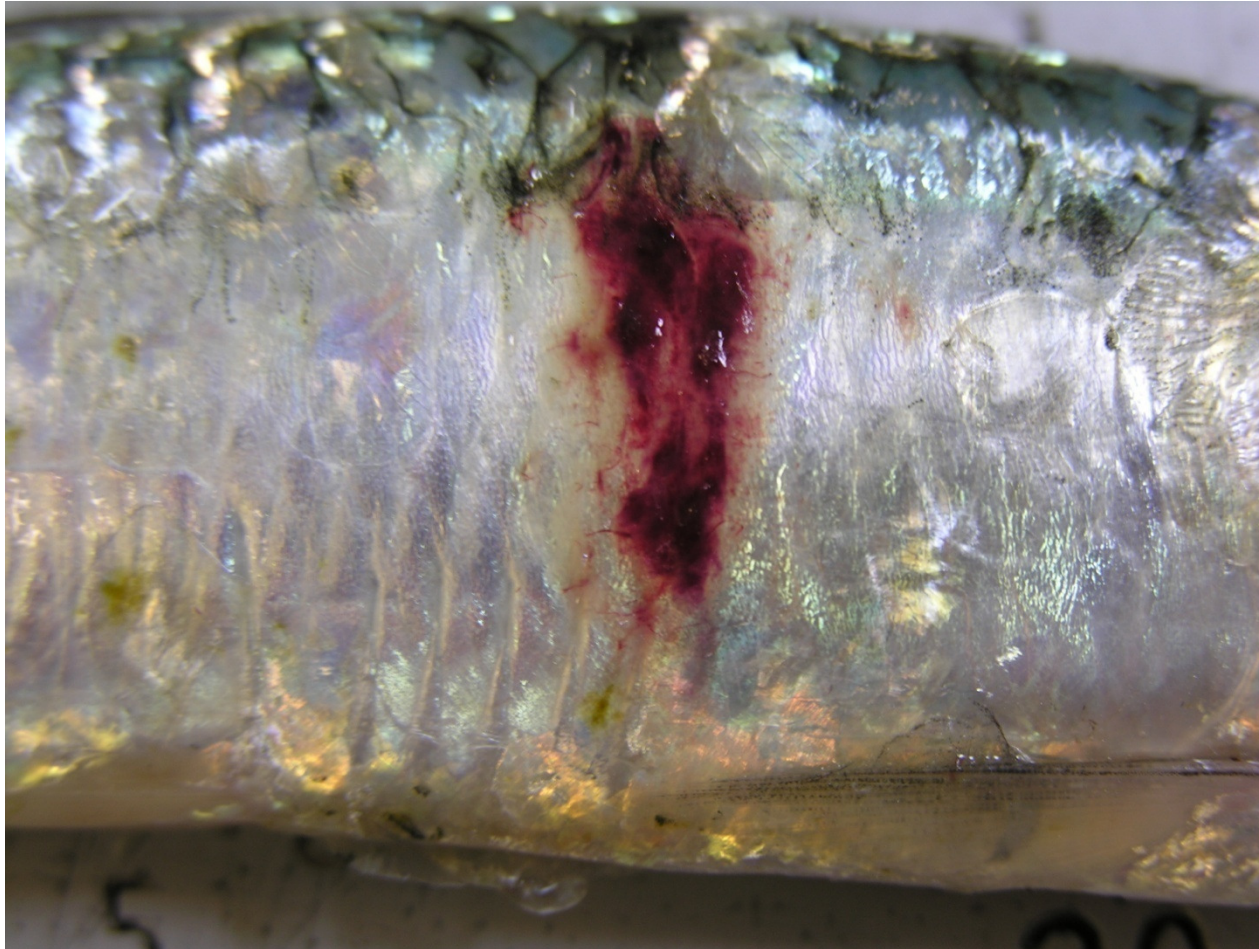
Fish with lesions common in 2005



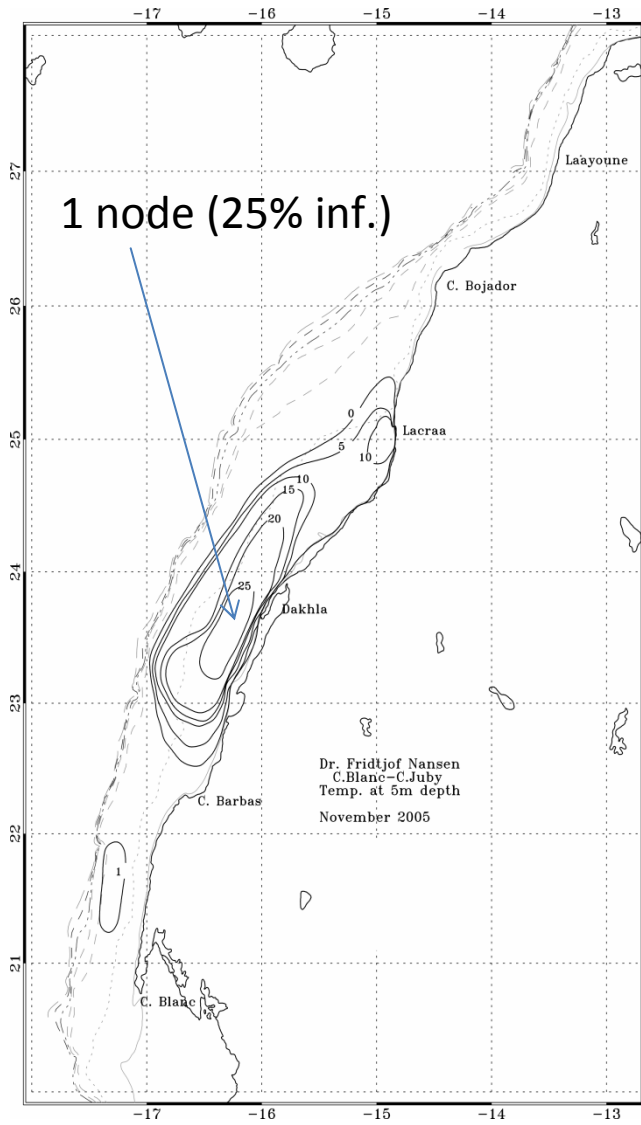
Forensic tests show neither bacteria or virus in the lesions



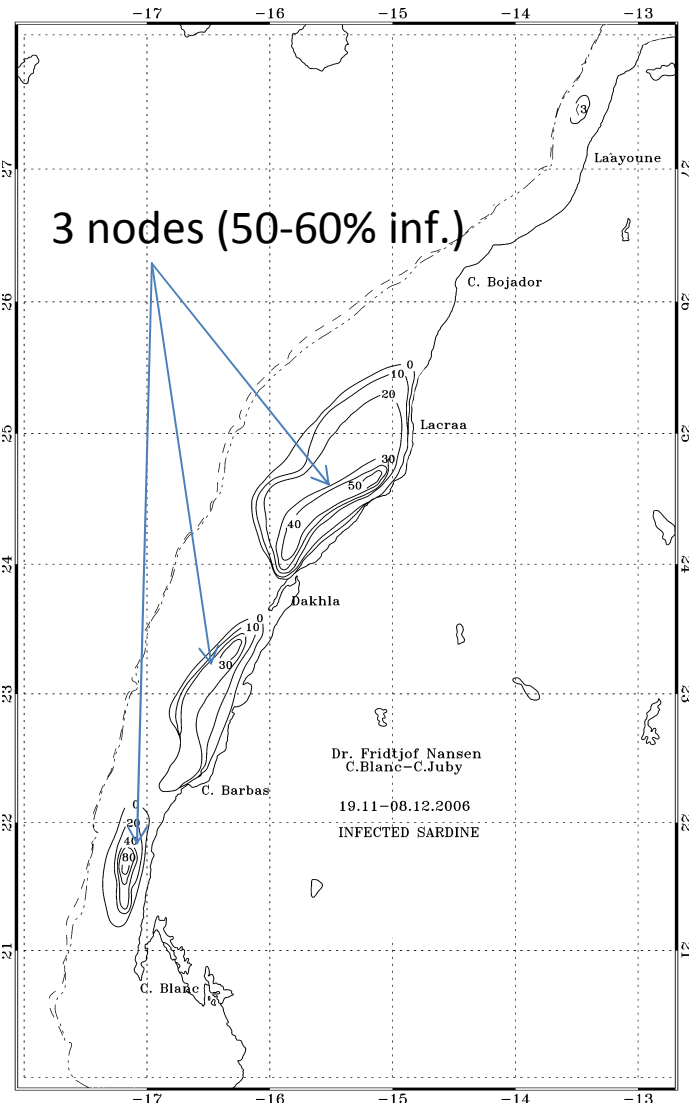
It is still not solved what disease this is



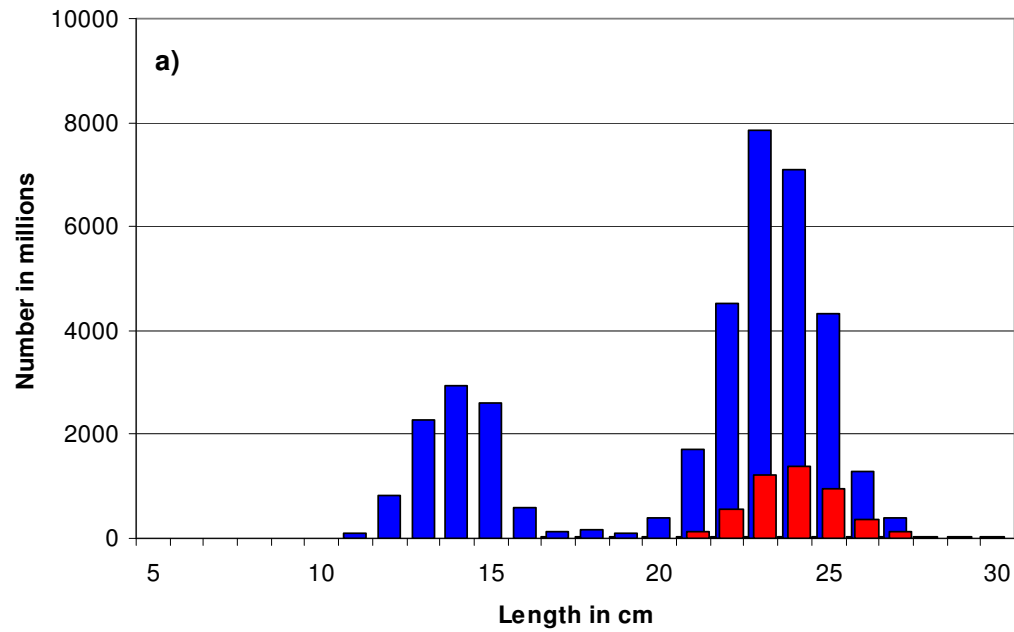
2005



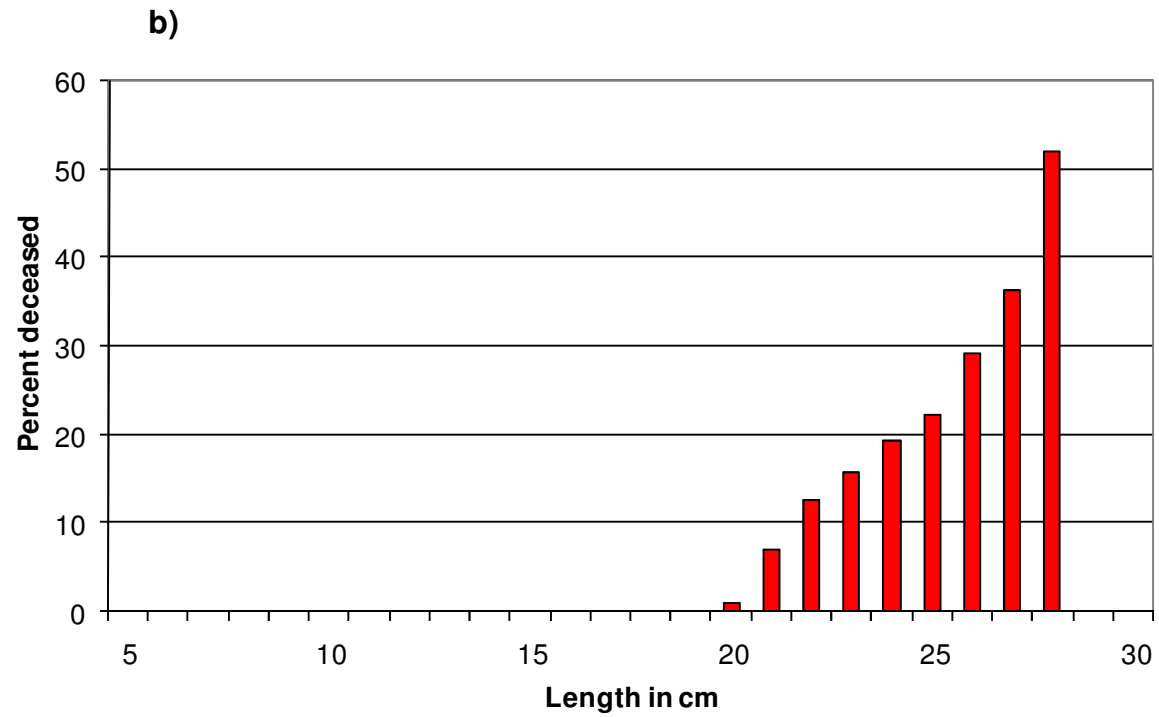
2006



Infected fish as part of the total population (in numbers) and by length classes



% infected fish as function of length



Conclusions 2006 decline

- This seems to be a density dependent mortality generated from an infectious disease
- Only the adult part of the population was affected.
- The rate of infection is increasing with the age of the fish, perhaps indicating less immunity with age.



General conclusions

- Mass mortalities in fish is a natural event, and probably more frequent in stocks close to the carrying capacity of the ecosystem.
- In a locked-in ecosystem such as an upwelling system stock collapse can occur naturally if a major environment anomaly occurs.
- This is a well known natural phenomenon in other parts of the world (El Nino in Peru), but less known in NW-African waters.



Thank you.

