

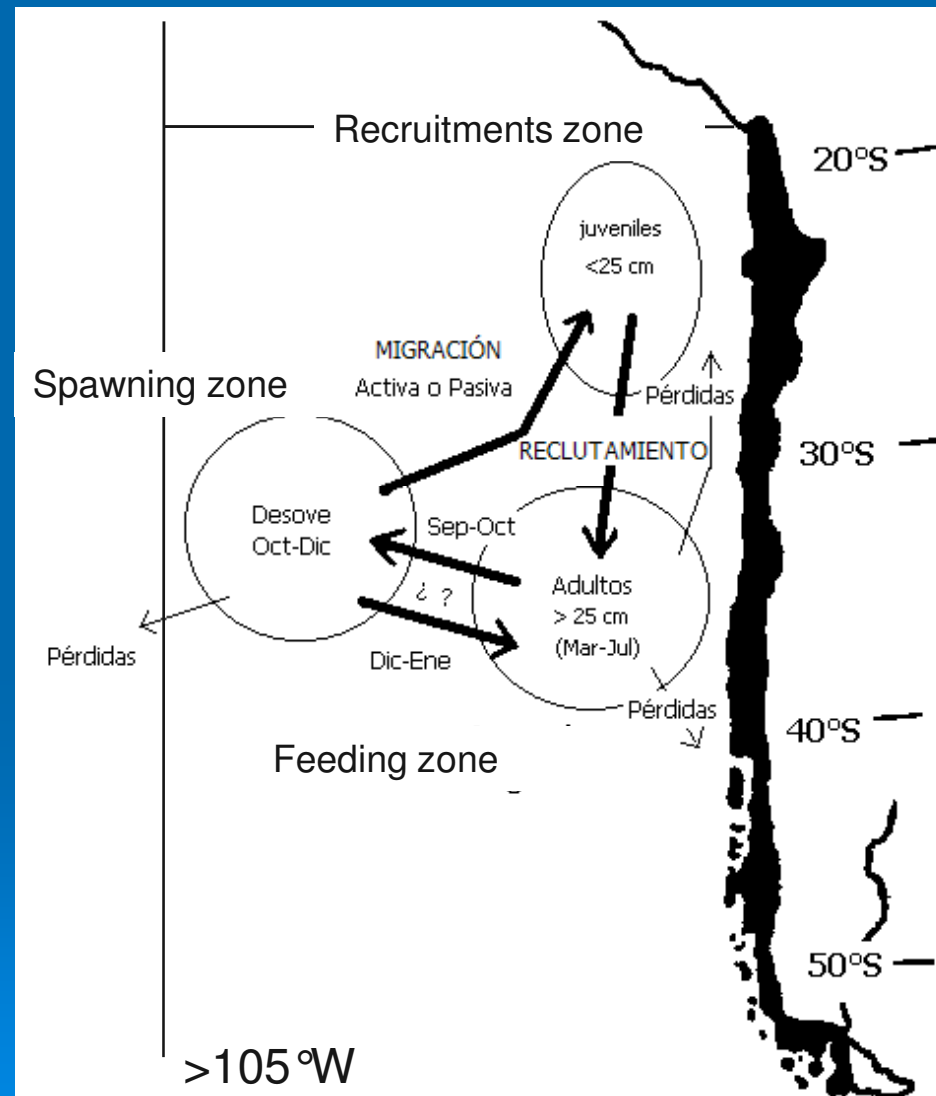
Chilean jack mackerel stock assessment model

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Chilean Jack Mackerel
Workshop

Stock structure hypothesis

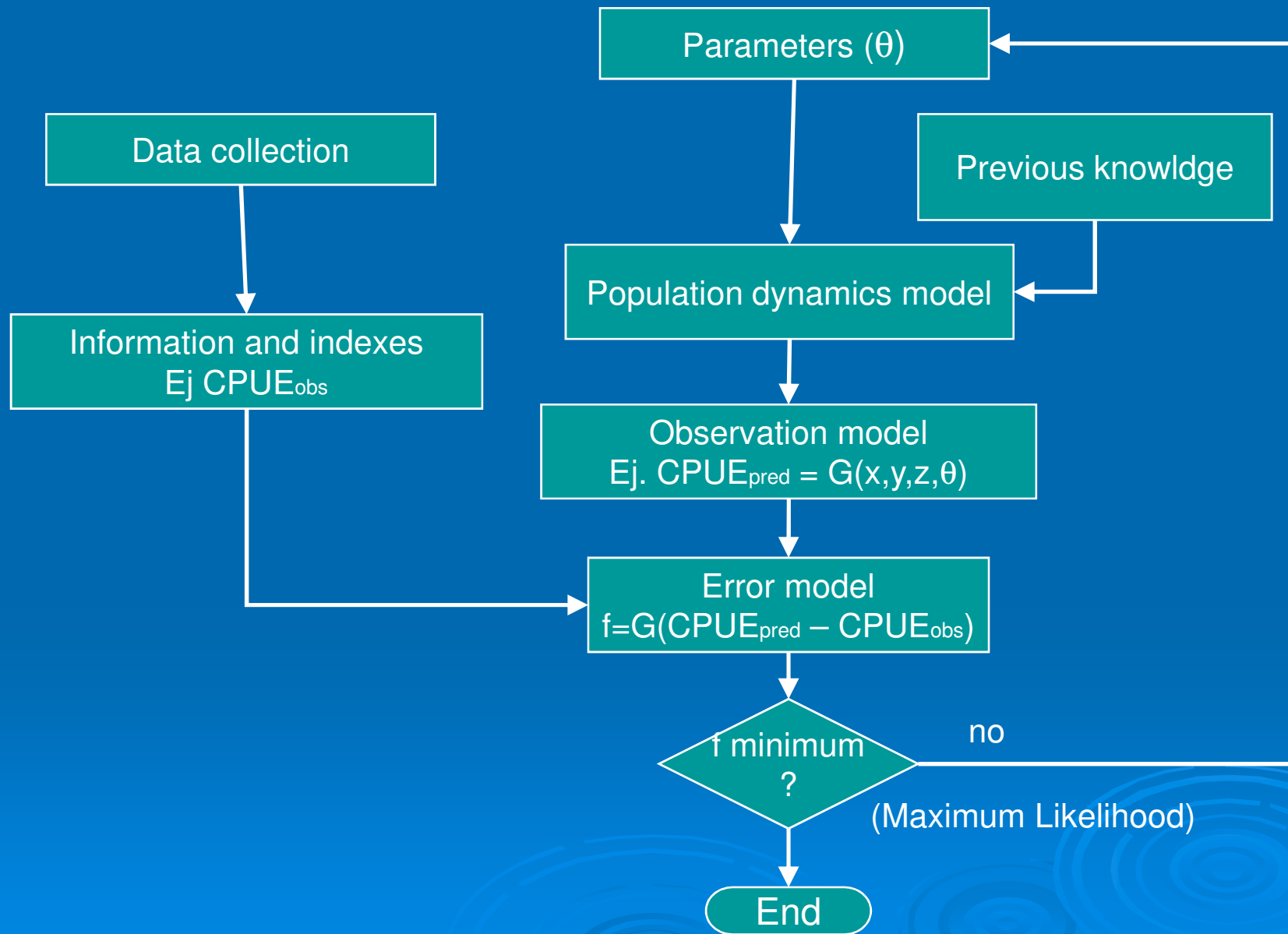


Stochastic modeling

- There are error sources in the data collection. Then, this information is an imperfect representation of the population
- This approximation implies to assume different likelihood functions for modeling, for example, the observation error
- The Chilean jack mackerel assessment is done considering this type of approximation



Stochastic modeling



Information employed

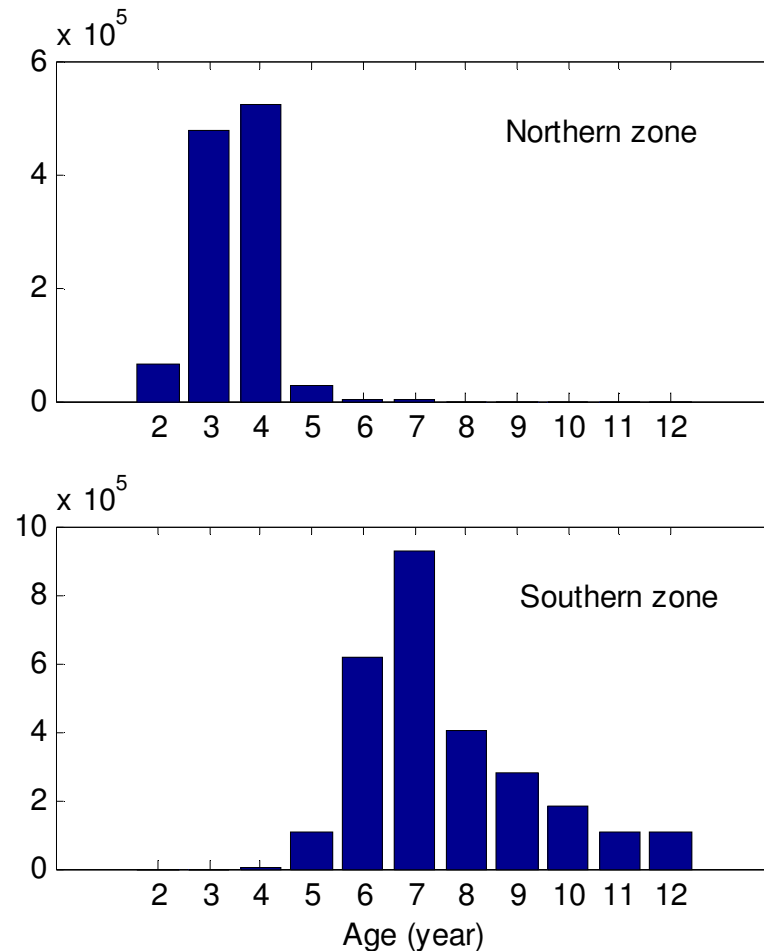
- Estimates of growth, maturity, and natural mortality ($M=0.23$) parameters.
- Landings for the northern and central-southern fleets (1975-2007).
- Age at catch (2 - 12+ years) matrices per fleet/zone. The length compositions data from ex-URSS fleet, were assumed to be similar to the data collected in the central southern zone of Chile.
- Average weight at age matrices.
- Age compositions from the acoustic cruises (1997-2006) in the central-southern zone.
- Acoustic biomass (1997-2007).
- Spawning biomass indices estimated by the Daily Egg Production Method (DEPM) (1999- 2001; 2003-2006).
- CPUE for the central-southern purse seine fleet (1996-2003).

Space considerations

- There is an age-specific migration process, from northern Chile towards central-south area. This is a gradual process that occurs when the fish have 4-5 years old

- This means that, in the northern area, the older fish are less available for exploitation. Complementary, in the central-south area the fish are fully exploited since 7 years old

Catch-at-age



Main modelling considerations

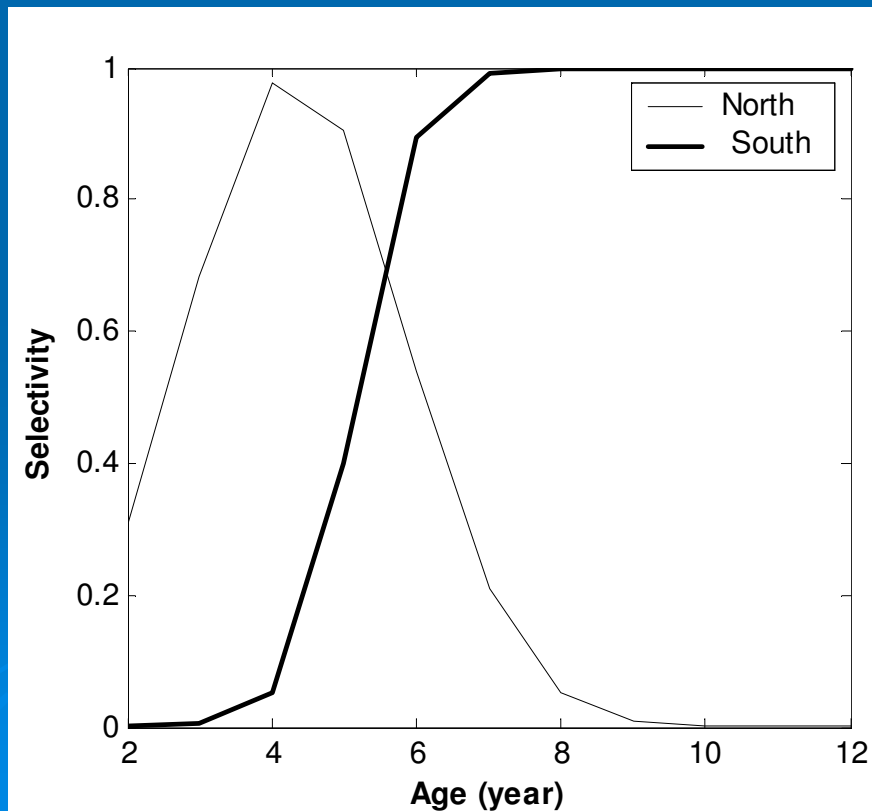
Selectivity

Northern area

$$S_{a,t}^f = e^{-\frac{1}{2s_t^2}(a-\mu_t)^2}$$

Southern area

$$S_{a,t}^f = \left[1 + e^{-\ln(19) \frac{a-a_{50\%,t}^f}{\Delta f_t}} \right]^{-1}$$



Main modelling considerations

Acoustic catchability hypothesis $B_c = q_c * B$

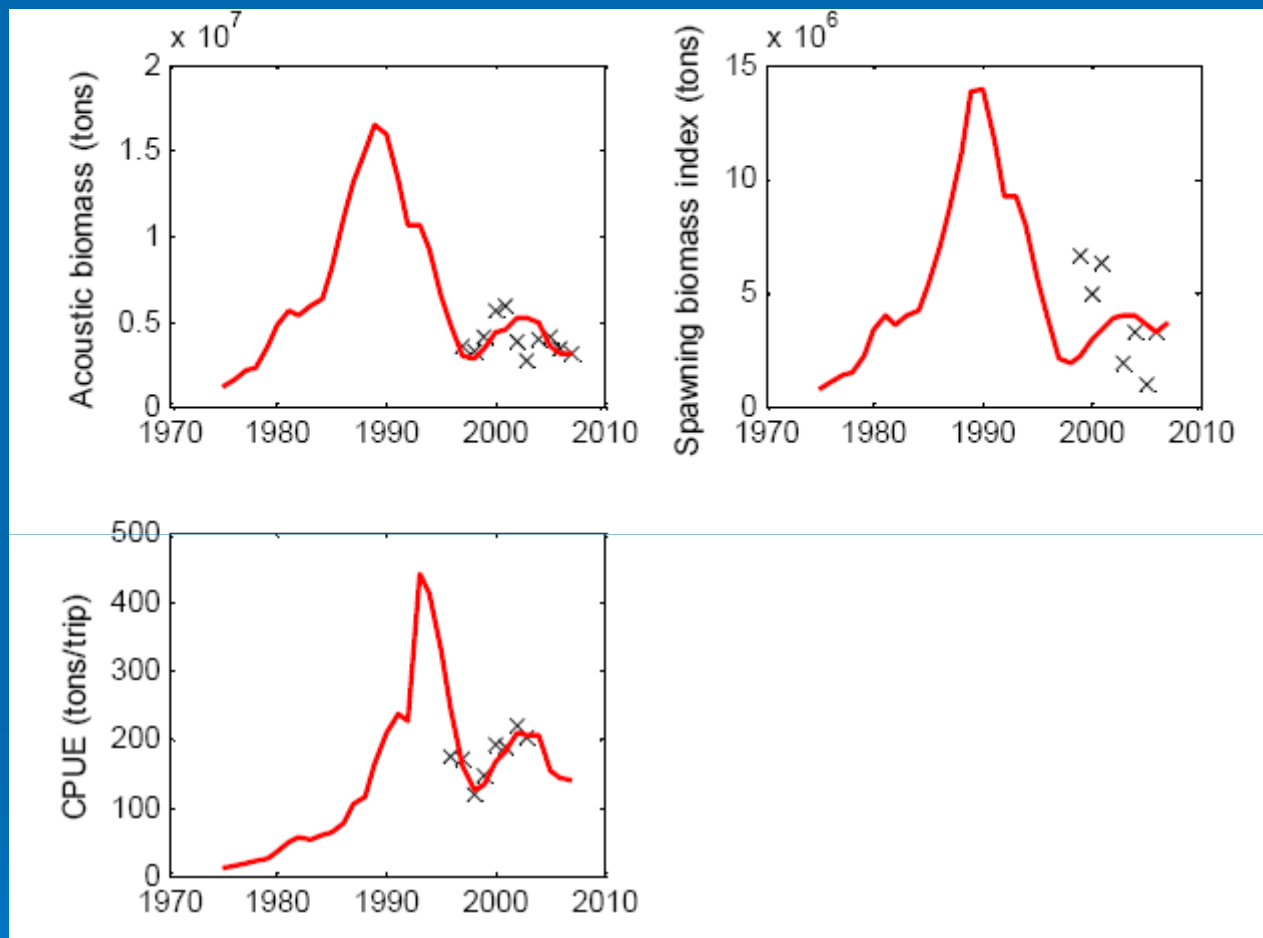
1) Change in distribution: $q_y^c = \exp \left[\frac{1}{n} \sum_i \log \left(\frac{B_y}{\hat{B}_y} \right) \right]$

2) Contraction of biomass:

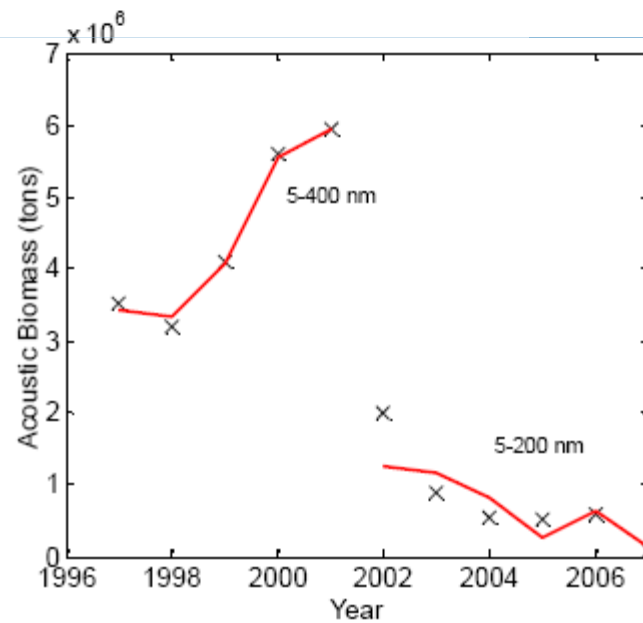
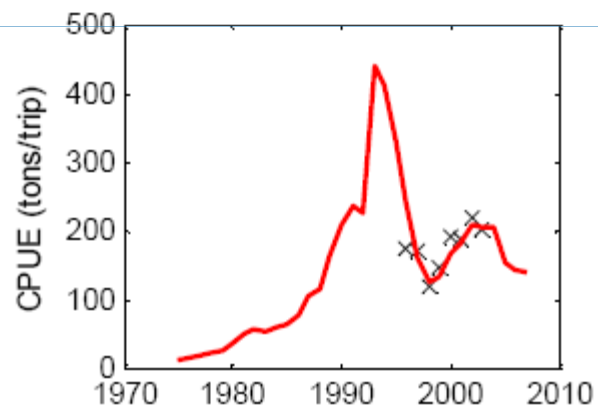
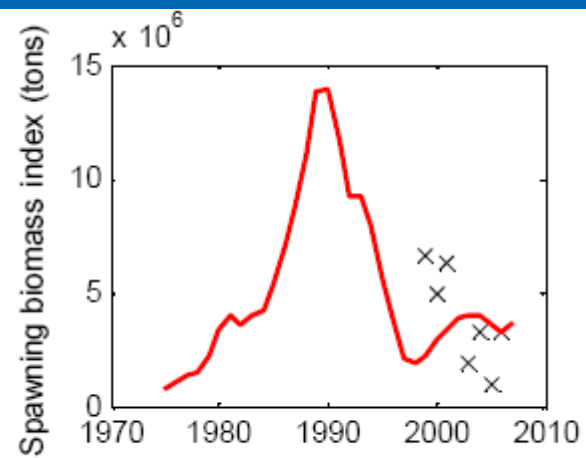
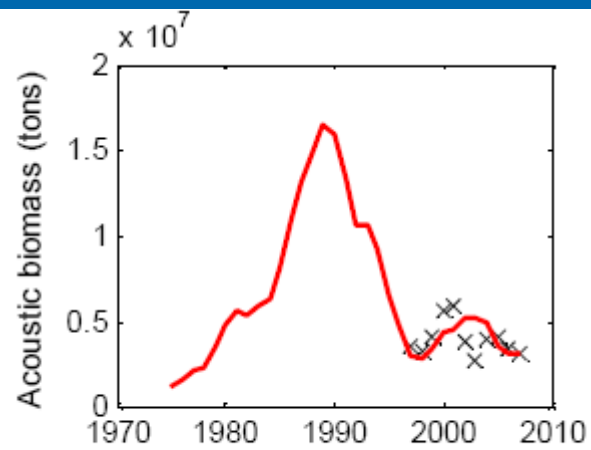
$$q_y^c = \begin{cases} \exp \left[\frac{1}{n} \sum_i \log \left(\frac{B_y}{\hat{B}_y} \right) \right] & y < 2002 \\ & B_y \in [5 - 400]mn \\ \eta \hat{B}_y^\lambda & y \geq 2002 \\ & B_y \in [5 - 200]mn \end{cases}$$



Main results



Main results



Testing hypotesis

Hypotesis	SSB (ton)	SSB/SSBo	-log Like	p	AIC
S1=Distribution change	4,807,400	0.2697	4,360	61	8842
S2= Contraction of biomass distribution	4,083,400	0.2418	4,372	63	8871

SSB: Spawning biomass, SSBo: Virginal Spawning biomass, -log Like: - log likelihood, p: parameters number, AIC: Akaike information criterion

Even in the most optimistic of cases (S1), the population is reduced to a level lower than is recommendable (SSB/SSBo=0.4)

Challenges

Explicit spatial modelling

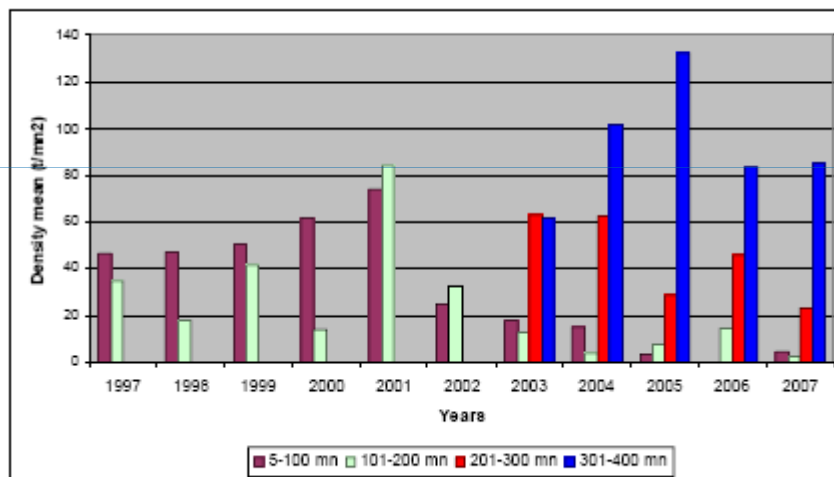


Figure 7.- Main acoustic density weighted by year and distance from the coast.

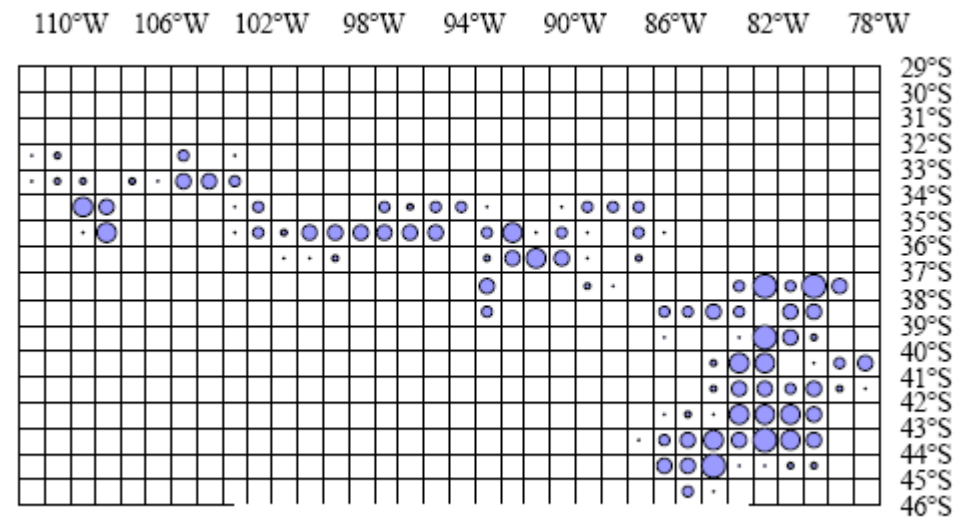


Fig. 8 fishing map of 2007

Table 1 CPUE (ton/hour) of 8 fishing vessels during 2000-2007

	2000	2001	2002	2003	2004	2005	2006	2007	mean CPUE
CPUE	7.86	7.20	6.39	5.26	5.07	5.95	7.52	6.81	6.21