

Anchovy DEPM surveys 1987-2016 in the Bay of Biscay: BIOMAN survey

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INTRODUCTION

European anchovy (*Engraulis encrasicolus*)

pelagic short-lived species (3-5 years)

Size 9-20cm

70–80% adult 1 year old (mature)



population depends on ANNUAL RECRUITMENT



FORANGE SPECIES. Major predators on eggs, juveniles and adults: macrozooplankton, pelagic and demersal fish, birds and mammals.

pre-spawning aggregation

SPAWNING



LARVAE

JUVENILES

- Fisheries data collected and managed by the EU member states:
 - Landings, discards (considered negligible), age structure, weight, length, maturity, etc.
- Research surveys:

	BIOMAN	PELGAS	JUVENA
Time-series	1987-2014 (except 1993)	1989-2014 (some GAPS)	2003-2013
Period	spring	spring	autumn
Type of survey	DEPM	acoustic	acoustic
Estimates for assessment	Adult biomass and Nage	Adult biomass and Nage	Juveniles biomass
Institute	AZTI-Tecnalia	IFREMER	AZTI-Tecnalia

- First applied in the Bay of Biscay in 1987 (Santiago and Sanz, 1992).
- Following the methodology described in Lasker (1985) and Motos *et al.* (1994, 2005).
- Since 2005 used new ageing method and GLM estimation of P0 (Ibaibarriaga *et al.* 2007; Bernal *et al.* 2011a,b; Santos *et al.* 2011).
- Since 2013 used new method for estimating S (Alday *et al.*, 2008, 2010; Uriarte *et al.*, 2011).
- Full revision of the historical series presented in 2013 to ICES WKPELA (2013).
- The anchovy biomass and numbers at age resulted from the DEPM are used in the ICES assessment working group for horse mackerel, anchovy and sardine (WGHANSA).

ESTIMATION OF DAILY EGG PRODUCTION: ASSIGN STAGED EGGS INTO COHORTS

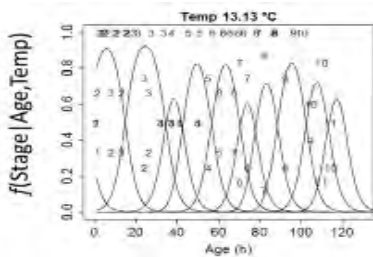
- Eggs classified into stages, classified into daily cohorts according to the Bayesian ageing method:

$$f(\text{age} \mid \text{stage}, \text{temp}) \propto f(\text{stage} \mid \text{age}, \text{temp}) f(\text{age})$$

Spawning time
distrib.

Survival probability

$$f(\text{age}) \propto f(\text{spawn} = \tau - \text{age}) \exp(-Z \text{age})$$



**DEVELOPMENT MODEL
DEPENDING ON
TEMPERATURE**

**SPAWNING
SYNCHRONICITY
N(mu=23, sd=1.25)**

MORTALITY

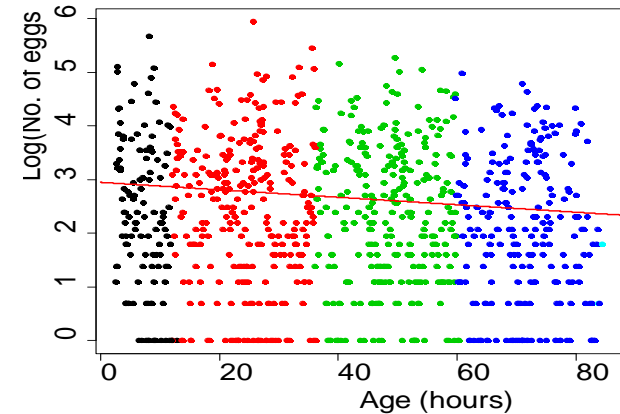
ESTIMATION OF DAILY EGG PRODUCTION: FIT EGG MORTALITY MODEL

- GLM with negative binomial distribution and log link
- Each station weighted by its corresponding relative area
- The too old or too young cohorts are removed to avoid potential biases

$$P_{i,j} = P_0 \exp(-Za_{i,j})$$

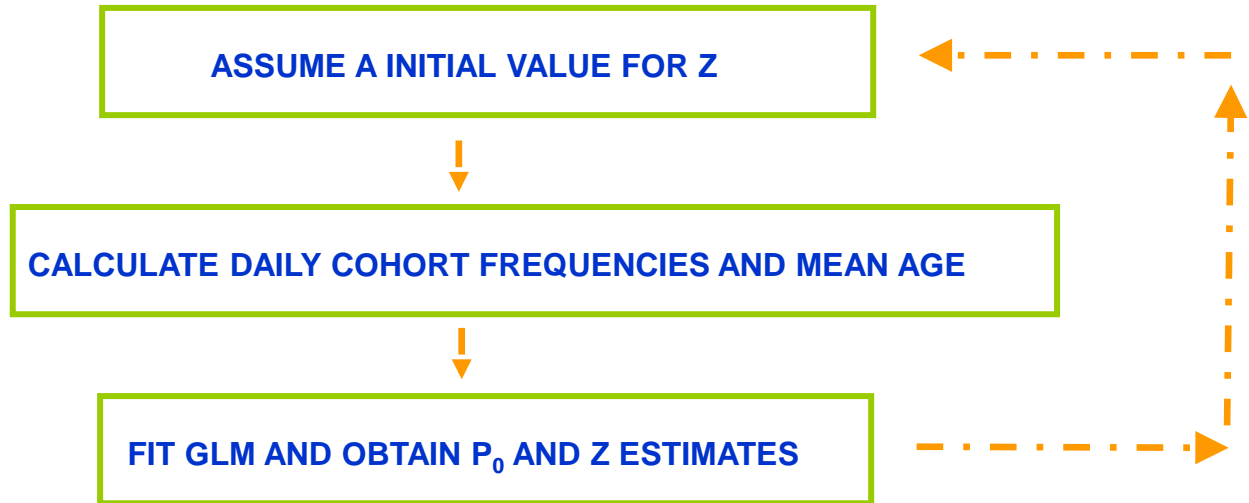


$$\log(E[N_{i,j}]) = \log(R_i) + \log(P_0) - Za_{i,j}$$



BUT, P_0 and Z estimates depend on the ageing and the ageing depends on Z

ESTIMATION OF DAILY EGG PRODUCTION: ITERATIVE ESTIMATION PROCESS



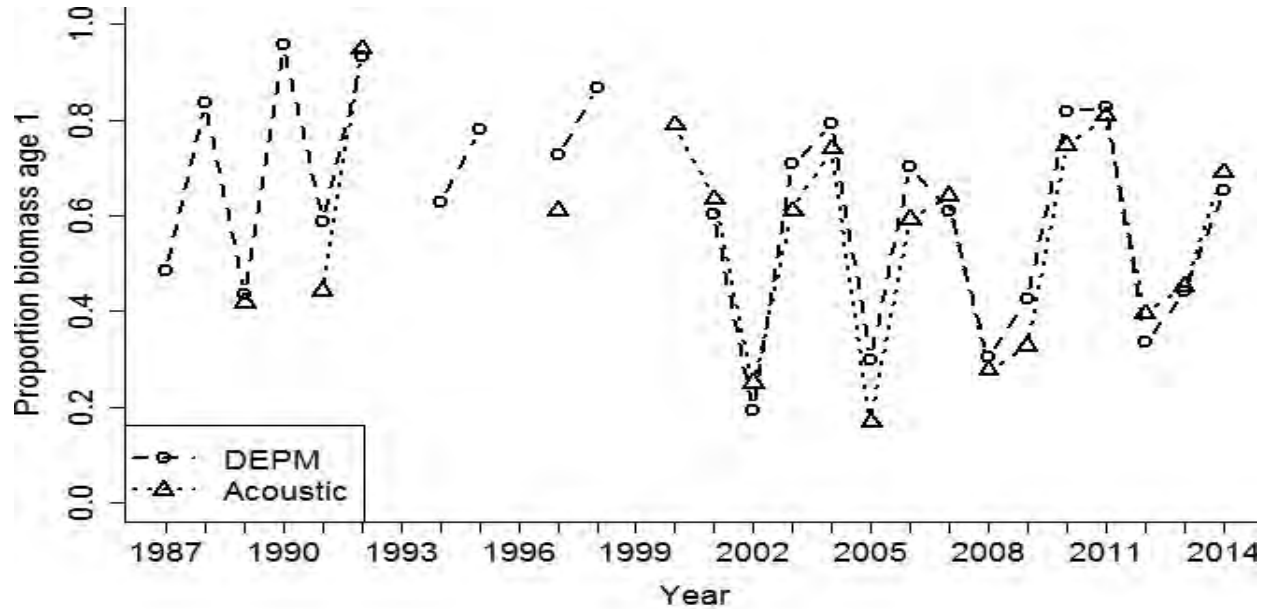
Repeat until the difference between the old and new Z estimates is small

SPAWNING FREQUENCY (S) PER SAMPLE

- Since 2013 the new procedure is accepted and applied.
- **Staging** and **ageing** (POFs and oocytes) are **separated**.
- Staging of oocytes and POF is separated. Key is described in *Alday et al.* (2008).
- Ageing according to matrices depending on the time of the day based on historical samples from 1990-2007 and two experiments (one on board and one at the San Sebastian aquarium).
- New estimator for S described in *Uriarte et al.* (2011). $(\text{Day } 0 + \text{Day } 1) / 2$
- Before this study the S was considered 4 days, now is considered 2.5 days.

% BIOMASS AT AGE 1

consistent with the trends pointed out by a parallel acoustic survey



- 29 years of consolidated series
- Total egg production is the parameter of major relevance determining biomass
- Provided biomasses by age, consistent with the ones estimated by the parallel acoustic survey.
- Great contribution to the study of reproductive biology and spawning dynamics of European anchovy
- Several Ph.D. thesis studies have provided ecosystem information of the Bay of Biscay (Albaina, 2007; Zarauz, 2007; Díaz, 2008; Aldanondo, 2010; Bachiller, 2012).

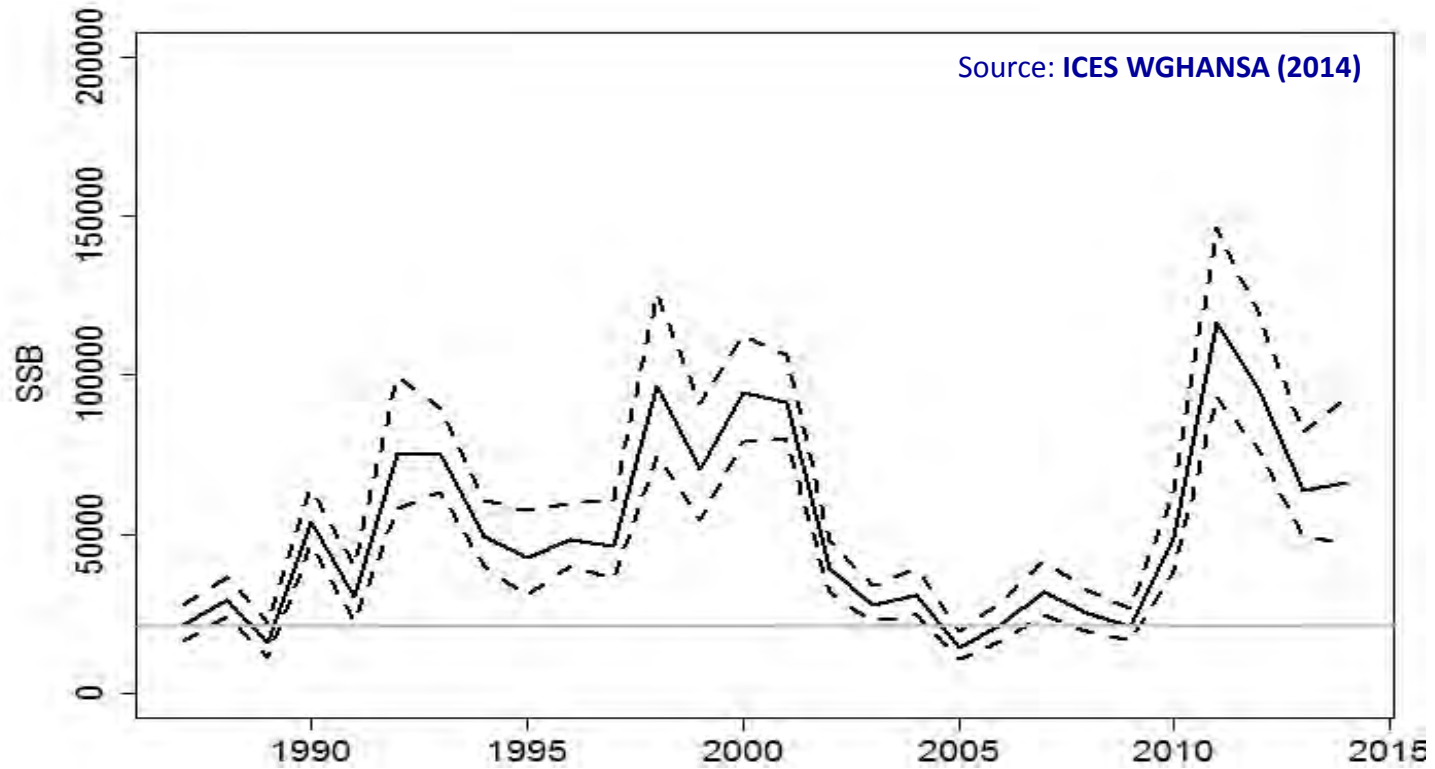
ASESSMENT: POPULATION DYNAMICS MODEL

- Assessment conducted in the ICES WGHANSA (working group on southern horse mackerel, anchovy and sardine) at the end of the year.

Bayesian state-space model: Ibaibarriaga *et al.* (2008, 2011)

- Process model:
 - Two-stage (recruits and age 2+) in terms of biomass
 - $M1=0.8$ and $M2+=1.2$
 - Separability assumption by semester
- Observation model:
 - SSB and P1 from DEPM and acoustics
 - R from autumn acoustic survey
 - C and CP1 by semester
- Inference using Markov Chain Monte Carlo implemented in JAGS

ASSESSMENT: SPAWNING STOCK BIOMASS



Thank you for your attention!

