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VARIABILITY IN THE MACKEREL EGG PREDATION BY CANNIBALISM IN THE NORTH OF SPAIN, DURING SPAWNING SEASON IN THE 2000' YEARS

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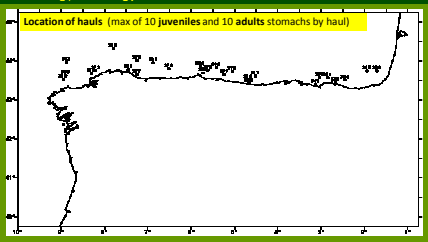
INTRODUCTION

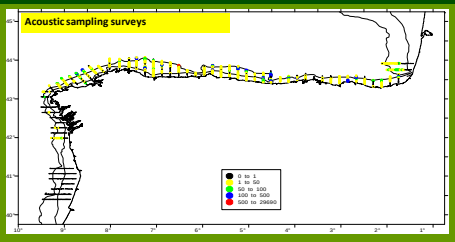
The southern component of northeast Atlantic mackerel stock spawns in the North of Spain (Division VIIIc) in spring, with a peak in Marsh / April. The fact that mackerel eat mackerel eggs is a known phenomenon. For this motive the objective of this paper is "To describe the role of mackerel as predator in ICES Division VIIIc during its spawning season", and we need to determine and quantify egg prey: 1) To estimate the abundance of mackerel and 2) To estimate the number of eggs as prey.

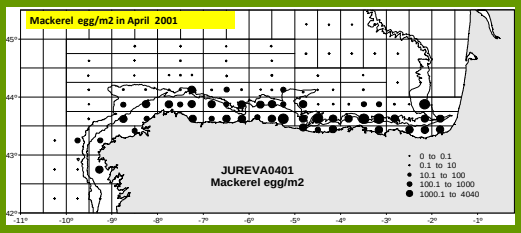


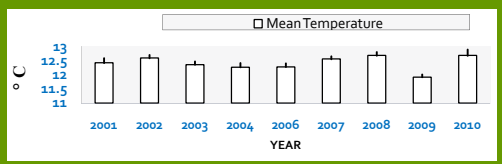
MATERIAL & METHODS

The information used in this paper are: diet composition from stomach content analyses, stage-specific production values derived from pelagic trawl hauls and ichthyoplankton surveys conducted on cruises in March and April from 2001 to 2010. **3735** stomach contents were analyzed on board volumetrically (cc). Food quantify (entire stomach contents) and food quality (food composition) were determined. Assumption= were considered that all mackerel eggs measure in average diameter of 1.2 mm (1 cc = 1350 l eggs; 1 g = 1305 eggs). To compare the feeding of the two different mackerel length distributions, we used V%BW= is the wet volume of the stomach contents expressed as a percentage of the fish body weight. Method to evaluate gastric evaluation: Eggers (1977) → $C = F_{24}$ x R (F_{24} mean of the stomach fullness index in 24 hours; R the evacuation rate: $R = 0.0406\, e^{0.1117(\text{Durbin } et\ al., 1983)}$)

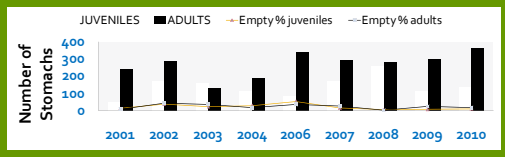






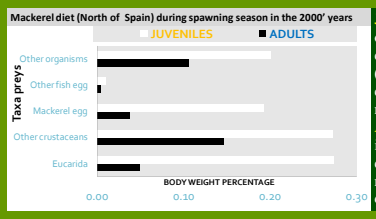


Mean temperature: obtained of the depths where the fishing were realized. We have the temperature by haul every years

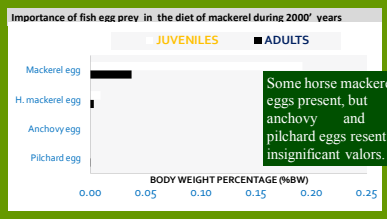


3735 mackerel stomach contents were sampled in acoustic surveys at the spawning peak between 2001 and 2010.

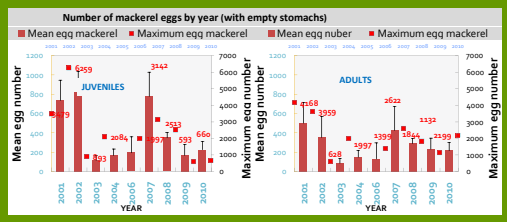
RESULTS



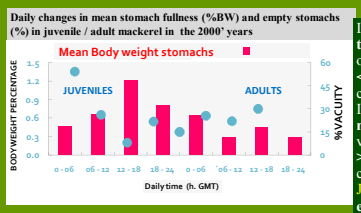
Juveniles prey overall on small crustaceans (eucarids and copepods) and mackerel eggs. Adults: importance of crustaceans and mackerel eggs decreases.



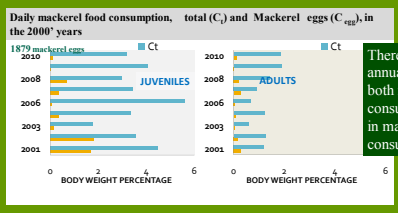
Some horse mackerel eggs present, but anchovy and pilchard eggs resent insignificant valors.



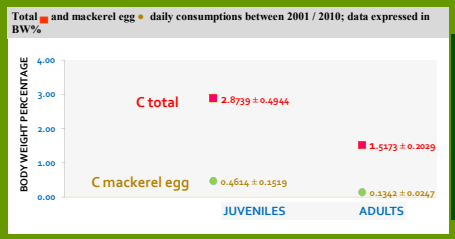
Every year stomachs appeared which contained more than 1000 mackerel eggs, and the largest recorded number of mackerel eggs in one stomach was 6259 in a juvenile and 5526 in an adult.



In juveniles **during the night** (66%) occurs > vacuity and < mean stomach content in weight. In adults **during the night** occurs < vacuity and > mean stomach content in weight. Juveniles eat more **at evening** and adults **at night**.



There are great annual variations both in total consumption and in mackerel egg consumption



Daily consumption in number of mackerel eggs:

457 mackerel eggs per 100 g of juvenile mackerel predator

148 mackerel eggs per 100 g of adult mackerel predator

DISCUSSION

We have **mackerel data from 2001- 2010** from **daily ration, biomass** and **egg production**. As example we consider the number of cannibalized mackerel eggs at spawning peak in the year 2001: **First** we present the proportion of mackerel stomachs with mackerel eggs as an estimate of the number of active egg-predators in the area, B_{2001}. B_{2001} was then **multiplied by the daily consumption** of mackerel eggs in 2001, $C_{\text{mackerel egg}}$, and this was in turn **multiplied** by the number of mackerel eggs in one gram, $N_{\text{mackerel egg}}$ / g.

Thus, the number of mackerel eggs cannibalized by the Southern Component of the Northeast Atlantic mackerel Stock per day, $N_{\text{egg cannibalized}}$, is:

$N_{\text{egg cannibalized}} = (B_{2001} \text{ x } C_{\text{mackerel egg}} \text{ x } (N_{\text{mackerel egg}} / \text{ g}))$

JUVENILES: $44.45 * 10^9$ mackerel eggs

ADULTS: $92.80 * 10^{10}$ mackerel eggs

Using the data of mackerel egg production 2001 estimated for ICES Division VIIIc in April 2001), **the number of eggs available for consumption by mackerel:**

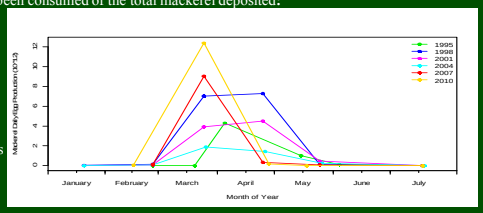
$N_{\text{egg I}} = 4.53 * 10^{12}$ Mackerel eggs / day **If we compare the number of eggs depredated by day in 2001**, $N_{\text{egg canibalized}}$, with the estimate of the total number of eggs determined in the ichthyoplankton survey 2001, N_{eggI} We can calculate the mackerel that would have been consumed of the total mackerel deposited:

Juveniles: 1.00 % of mackerel egg production by day.

Adults: 20.4% of mackerel egg production by day

By **multiplying by 30 days,** we have estimated the number of cannibalized mackerel eggs **at the spawning peak (April 2001)**

But we know that there have been changes in the spawning peaks in the two last decades. There are great annual variations in mackerel biomass (mackerel biomass – acoustic), and there are also variations in the estimates of the annual mackerel egg production in the southern spawning area in 2001, 2004, 2007 and 2010 (ICES, 2011a; 2011b).



There are studies showing temporal changes in egg production estimated at the end of the decade of 2000 in the Southern Area. Egg surveys recording show that highest densities of eggs were gradually appeared earlier, from April (1995) to March-April (1998-2004) and finally they have been recorded in March (2007-2010) (Villamor et al., 2011).

MAJOR CONCLUSIONS

- **The gastric evacuation model used offers estimates of Atlantic mackerel consumption comparable to those of other pelagic fish species.**
- **Our results suggest cannibalism to be an important source of mackerel egg mortality in the Cantabrian Sea.**
- **The high cannibalism in mackerel eggs varies over the years, and changes in these predation rates may lead to large fluctuations in recruitment.**
- **The estimations realized on mackerel eggs cannibalized, can only give a rough indication of the real predation rate, since the parameters used are so highly variable.**

Future developments:

- To adjust sampling periods in the next cruises with spawning peaks.
- Hydrological models.
- Design of the egg surveys.

References: Durbin EG, Durbin AG, Langton RVV, Bowman RE (1983) Stomach contents of silver hake, *Merluccius bilinearis*, and Atlantic cod, *Gadus morhua*, and estimation of their daily rations. Fish Bull US 81(3):437-454; Eggers DM (1977) Factors in interpreting data obtained by diet sampling of fish stomachs. J Fish Res Bd Can 34:290-294; ICES, 2011a. Report of the Working Group on Mackerel and Horse Mackerel Egg Surveys (WGMEGS). ICES CM 2011/SSGESST:07 ; ICES, 2011b. Report of the Working Group on Widely Distributed Stocks (WGWIDE). ICES CM 2011/ACOM:15; Villamor, B., G. Costas, C. Gonzalez-Pola, A. Lago de Lanzós, J.R. Pérez, C. Franco and D. Garabana. 2011. Temporal variability of the spawning season for the southern component of the Northeast Atlantic Mackerel (*Scomber scombrus*) (1990-2010). ICES/NAFO Decadal Symposium 2011, Santander 10-12 May 2011.

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