POPULATION CHANGES IN SMALL PELAGIC FISH OF THE GULF OF LIONS: A BOTTOM-UP CONTROL?

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Small pelagics symposium 08/03/2016
Background:

Crash in landings

Landings

Sardine

Anchovy

Crash in landings
Background:

**Historical landings 1865-2013:**

Present level lower than before 1960 ➔ unusual situation

Van Beveren et al 2016

![Graph showing historical landings from 1865 to 2013 for anchovy, sardine, and mackerel. The present level is lower than before 1960, indicating an unusual situation.](image-url)
Background:

ECOPELGOL Project 2012-2015.

Good recruitments ?????
1. Changes in populations

- Smaller fish
- Disappearance of large old sardines

Van Beveren et al. 2014
Emigration or mortality?

Most likely migration: towards Spain

Size distribution of French vs. Spanish landings:

- No appearance of large individuals in Spain
- Very similar distribution

❖ Mortality
❖ Problem occurring at a larger scale
1. Changes in populations

**Body condition**

= quantity of nutritional reserves

.proxy of available energy

Estimated here by morphometrics, LeCren index

Decrease in condition higher in old individuals ➔ lower survival?

*Van Beveren et al. 2014*

*Brosset et al 2015*
1. Changes in populations

- More abundant
- Smaller (low growth & disappearance of older sardines)
- Leaner

Van Beveren et al. 2014
Main goals:

- Fisheries effect
- Predation by tuna or marine mammals
- Population characteristics:
  - Size
  - Age
  - Condition
  - Growth
- Trade-off with reproduction
- Climate and Plankton effect

Predators:
- Small pelagics
- Top-Down

Prey:
- Bottom-Up

Diseases:
- Virus
- Bacteria
- Parasites
2. Top-down processes?

a) Fisheries?

- Low exploitation rate
- Low size selectivity
- No temporal covariation between fishing pressure and fish biomass

*Fisheries effect probably low*
2. Top-down processes?

b) Predation by tuna?

Size distribution of the tuna pop (fisheries)

DEB $\Rightarrow$ Calories

Stomach contents

Population abundance (plane survey & fisheries)

Van Beveren et al. 2017
2. Top-down processes?

b) Predation by tuna?

- Very low proportion
- Oppurtinistic, no size-selectivity

Similar approach on dolphins predation
- Plane and boat survey -> dolphin abundance
- Stomach content
- Simple allometric energetic model

Lot of simulations

⇒ Population ingested even lower

Van Beveren et al. 2017
Queiros et al. in prep
3. Pathogens and diseases?

1 year monthly sampling (2014-2015):
1) Fresh samples from fisheries (9 * 150 sardines)
2) Large band search (bacteria, parasites & virus)
3) Tissue analyses (autopsy et histology)

Results:
- No macro-parasites
- No virus: whether on culture or by specific PCR (NODA & herpes)
- Very low prevalence of lesions on tissues
- Presence of few bacteria
- Micro-parasites (Prevalence = 77%) ➔ unidentified or coccidies in the liver

Few pathogens, no correlation with fish size or condition and very few lesions. Only micro-parasites.

Comparison with other places ➔ Anyone interested???

Van Beveren et al. 2016
4. Trade-off maintenance / reproduction

- Start reproducing earlier
- Maintain investment

Increase in reproductive effort despite low condition.
At the expense of survival?

Gonado somatic index: \( \frac{W_{gonad}}{W_{fish}} \)
5. Bottom-up processes

*Change in diet?*

\[ \delta^{13}C_{\text{Sample}} = \left( \frac{^{13}C_{\text{Sample}}}{^{12}C_{\text{Sample}}} \right) \left( \frac{^{13}C_{\text{Reference}}}{^{12}C_{\text{Reference}}} \right) - 1 \] \times 1000

**Stable Isotopes**

**Stomach contents**

*Broset et al. 2015*
*Broset et al. 2016*
5. Bottom-up processes

**Stable isotopes**

- Smaller isotopic niche, lower δC value
- Higher overlap with sprat ➔ competition?

**Stomach contents: after 2010 vs. past**

Segregated by period

- Sardines: ➔ fewer cladocerans.
- Anchovy: ➔ smaller copepodes.

Changes in diet: smaller, less energetic prey

*Brosset et al. 2016*
Summary

**Predation by tuna or marine mammals**

**Fisheries effect**

- **Population characteristics**
  - Size
  - Age
  - Condition
  - Growth

- **Diseases**
  - Virus
  - Bacteria
  - Parasites

- **Stomach contents, energetic models, population census**

**Plankton effect**

- **Diet (isotopes, stomach contents)**

**Experiments**

- In situ & modelled plankton fields

**Trade-off with reproduction**

- Harvest rate

**PREDATORS**

- Top-Down
  - SMALL PELAGICS

**PREY**

- Bottom-Up

PhD Quentin Queiros, talk in 1h Saanich room
Thanks to... 

Elisabeth Van Beveren  Pablo Brosset

You!
1. Changes in populations

**Link between condition and age**

Decrease in condition higher in old individuals ➔ lower survival?

Brosset et al 2015
3. Top-down processes?

b) Predation by tuna?

On size distribution

Opportunistic, no size selectivity

Van Beveren et al. 2017
5. Bottom-up processes

Stable isotopes
- Smaller isotopic niche, lower $\delta$C value
- Higher overlap with sprat $\Rightarrow$ competition?

Stomach contents: after 2010 vs. past

- Sardines: $\Rightarrow$ fewer cladocerans.
- Anchovy: $\Rightarrow$ smaller copepodes.

Changes in diet: smaller, less energetic prey

Anchovy
Sardine
Sprat

Brosset et al. 2016
4. Trade-off maintenance / reproduction

Size at first maturity:
- Sardine: 9/10cm now vs. 13cm in the past
- Anchovies: 9cm now vs. 11cm in the past

Start reproducing much earlier

Brosset et al. 2016
4. Trade-off maintenance / reproduction

Gonado somatic index: \( \frac{W_{gonad}}{W_{fish}} \)
- Stable in anchovy
- Stable if not increasing in sardines

Increase in reproductive effort despite low condition. At the expense of survival?
ECOPELGOL Project 2012-2015.

- Low/Intermediate biomass
- Good recruitments

- Sprat
- Anchovy
- Sardine

Biomass

Year

??????