



Northward range expansion of Bay of Biscay anchovy to the English Channel due to increased temperature envelope and recent population increase



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**Small Pelagic Fish:
New Frontiers in Science
and Sustainable
Management**

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Introduction

- Northern limit of European anchovy in Bay of Biscay
- Increase in northern waters (North Sea, English Channel, Irish Sea) from mid 1990's: management implications?

Global Change Biology (2004) 10, 1209–1213, doi: 10.1111/j.1365-2486.2004.00790.x

An increase in the abundance of anchovies and sardines in the north-western North Sea since 1995

DOUG BEARE*, FINLAY BURNS*, EMMA JONES*, KEVIN PEACH*, ENRIQUE PORTILLA*, TONY GREIG*, EDDIE MCKENZIE† and DAVE REID*

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The anchovy returns to the Wadden Sea

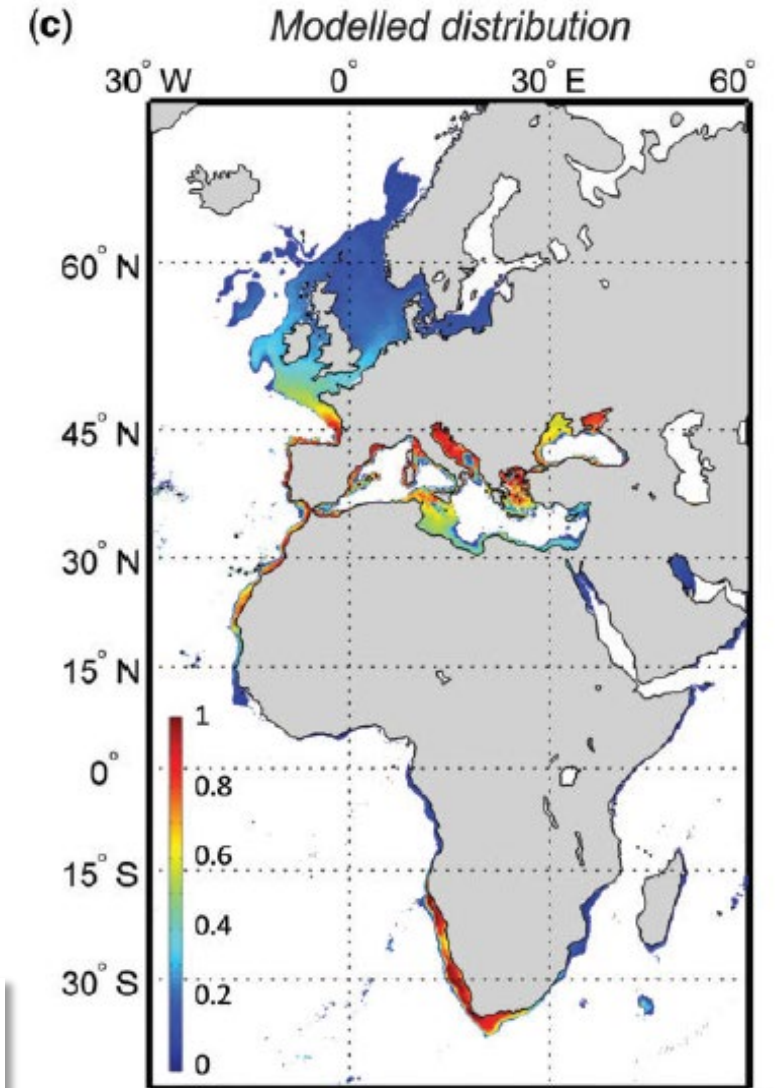
R. Boddeke and B. Vingerhoed

J. Mar. Biol. Ass. U.K. (1999), 79, 955–956
Printed in the United Kingdom

Boddeke, R., and Vingerhoed, B. 1'
ICES Journal of Marine Science, 53

The distribution of anchovy *Engraulis encrasicolus* in the northern Irish Sea from 1991 to 1999

M.J. Armstrong, M. Dickey-Collas*, M. McAliskey, W.J. McCurdy, C.A. Burns and J.A.D. Peel

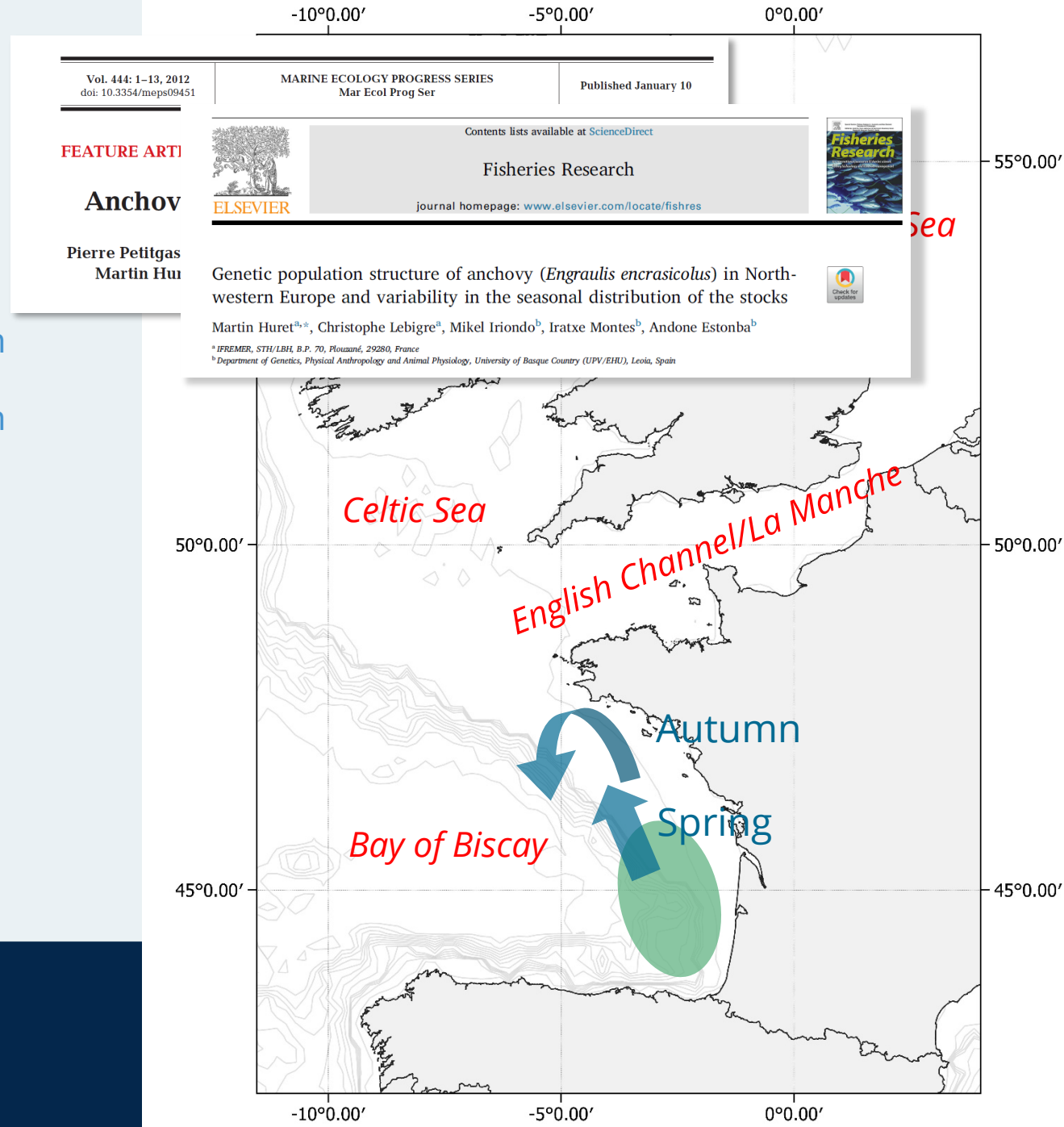


Raybaud et al. 2017 ICES J Mar Sc



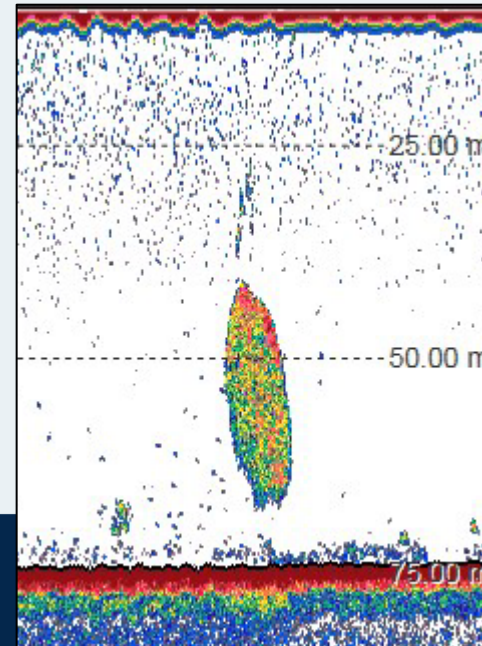
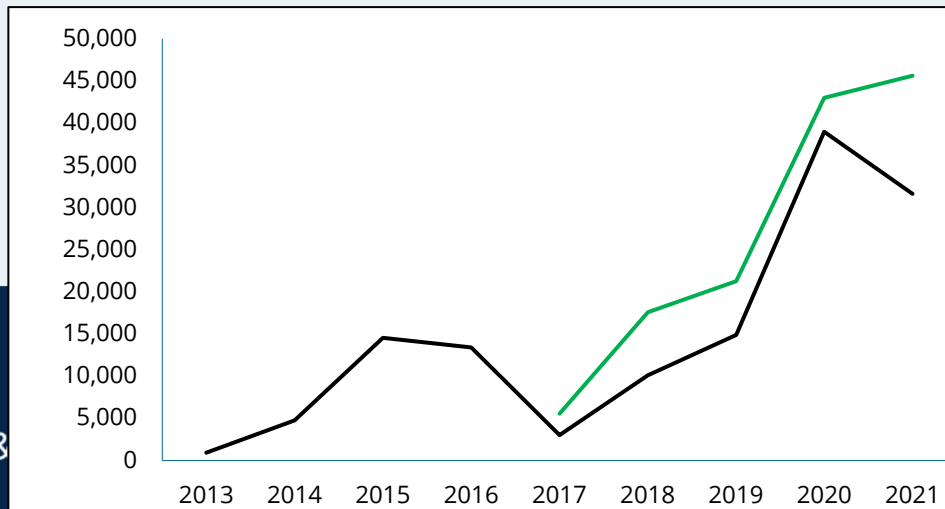
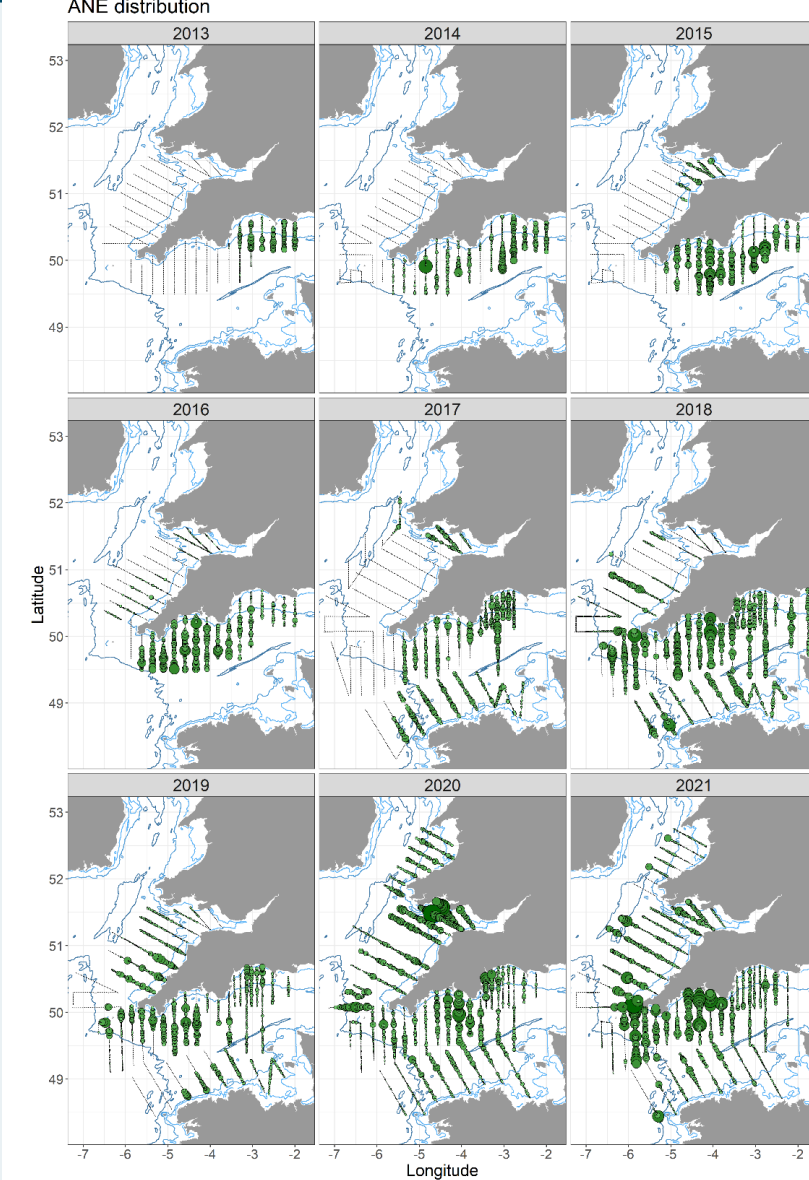
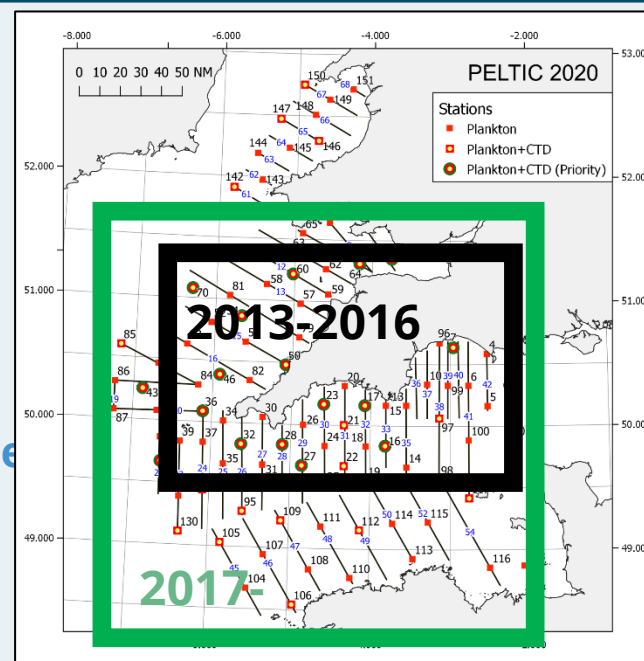
Introduction

- Northwards shift or local populations?
 - H1: A remnant population exists in the North Sea
 - H2: An allopatric population has seeded the North Sea by an introduction of early life stages
 - H3: An allopatric population has seeded the North Sea by active adult migrations
- Approach:
 - Genetics
 - Bottom Trawl Survey data
 - Larval drift modelling
- **No connectivity Biscay and Channel: Local populations**
- Seasonal distribution northern anchovy:
 - Spawn in southern North Sea
 - Overwinter in English Channel



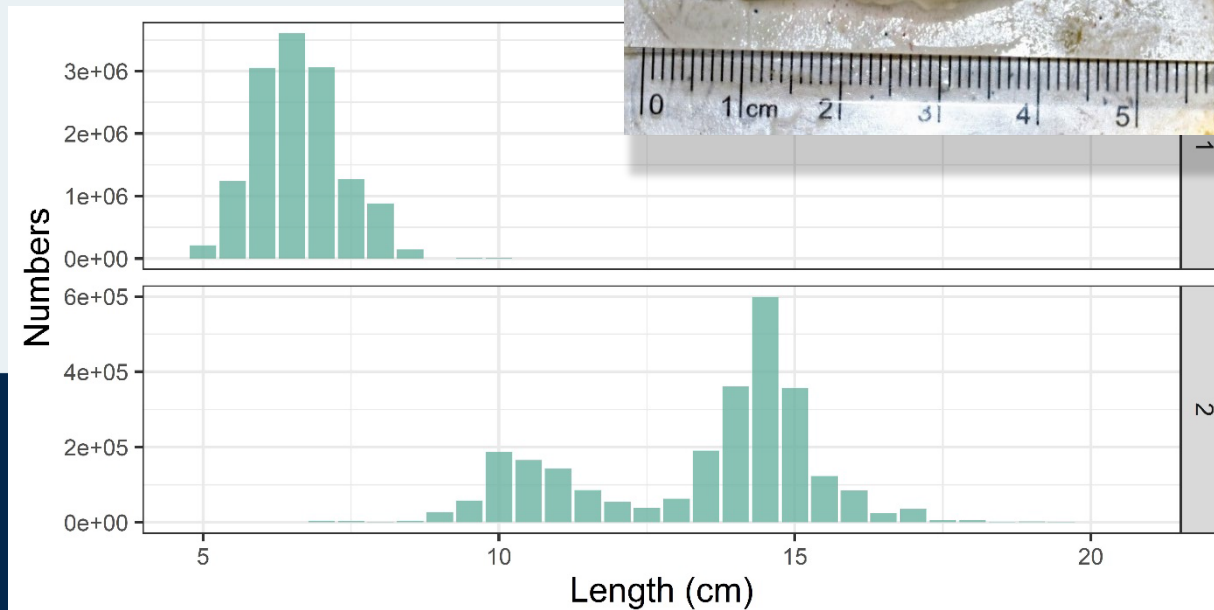
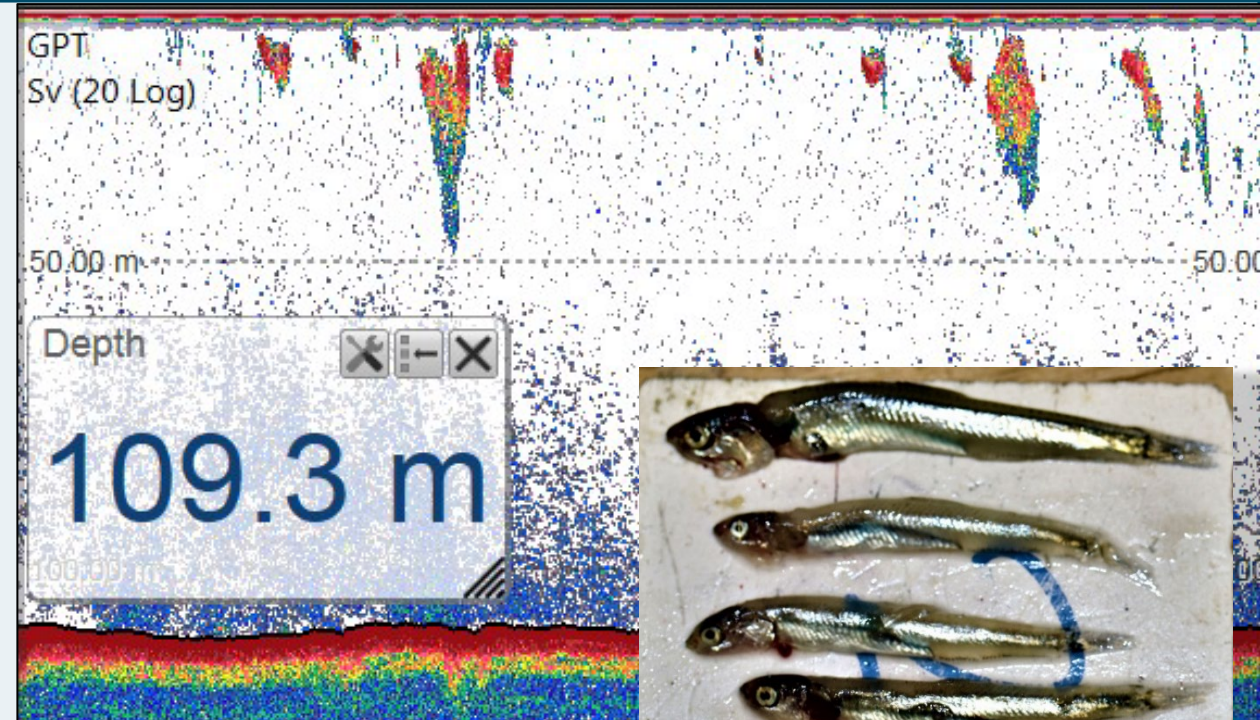
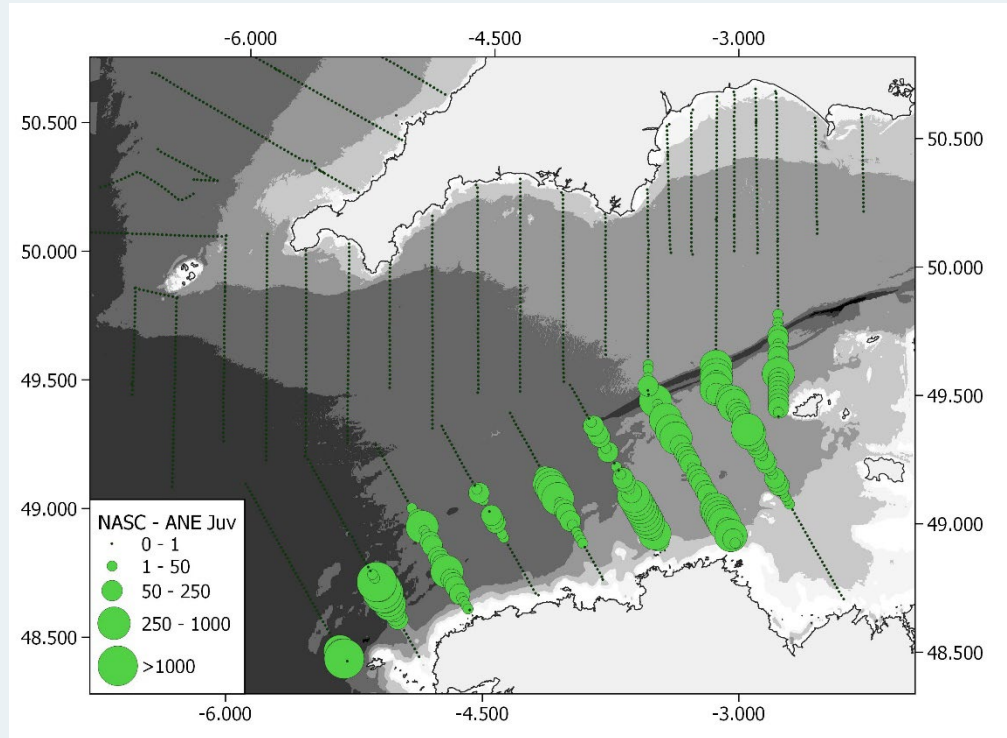
Introduction

- Management Unit/population:
 1. Anchovy in Bay of Biscay (ICES)
 2. Anchovy in North Sea/Western Channel (no assessment)
- PELTIC (acoustic, trawl, ichthyoplankton, oceanography)
- **Autumn** anchovy distribution and biomass in western Channel
- **No anchovy eggs/larvae** in Channel



Introduction

- In 2019, **2020**, (2021): juvenile surface anchovy



Approaches (methods)

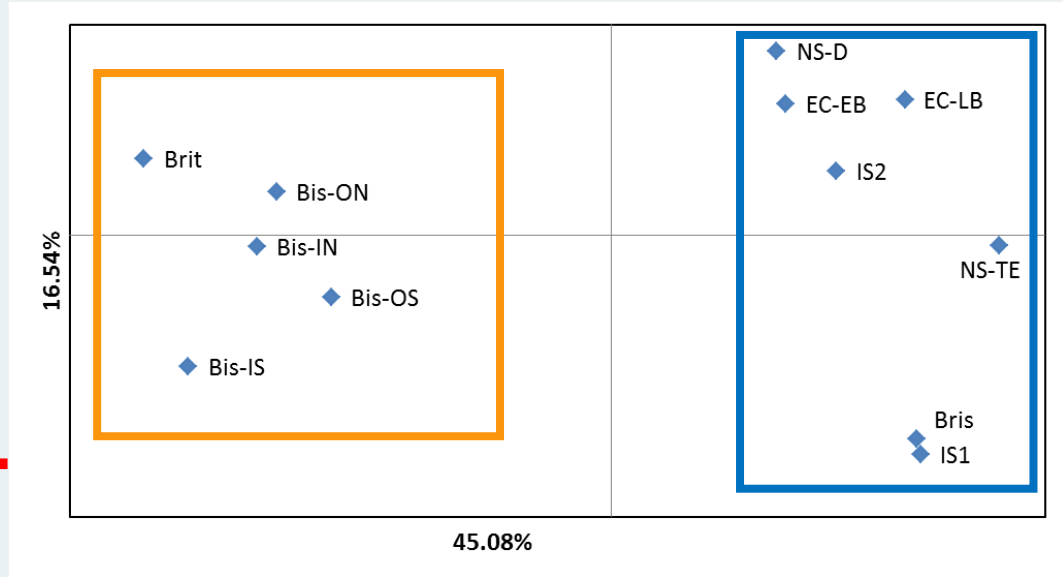
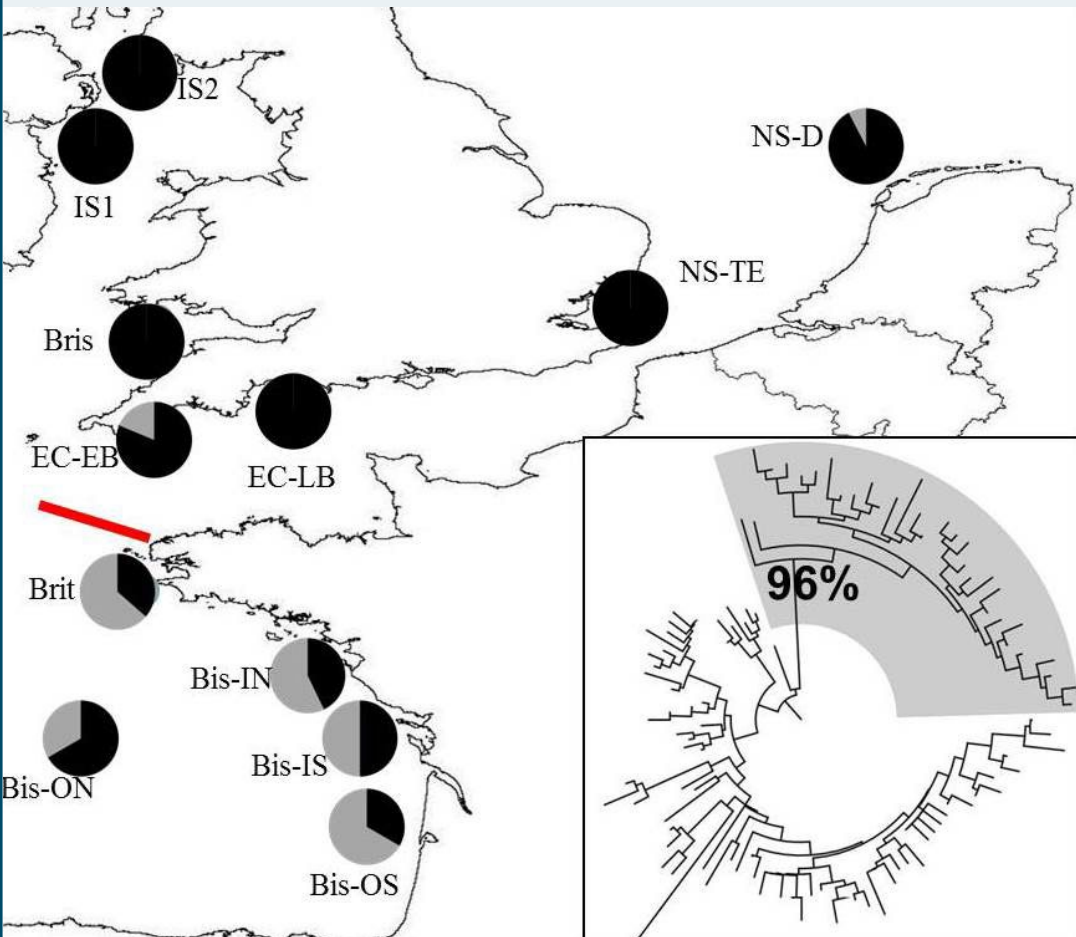
- Juveniles in English Channel
- SW of channel
- Different size than “northern anchovy”
- No local spawning
- Petitgas et al. 2012: no drift from Biscay?
- Management implications

1. Identity/origin juvenile anchovy: Genetics
2. Changes in anchovy distribution in Biscay: juveniles, eggs: Survey data
3. Changes in timing/location of spawning: particle tracking modelling



Methods 1:

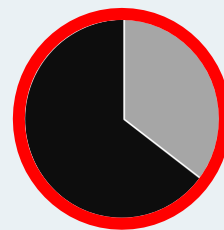
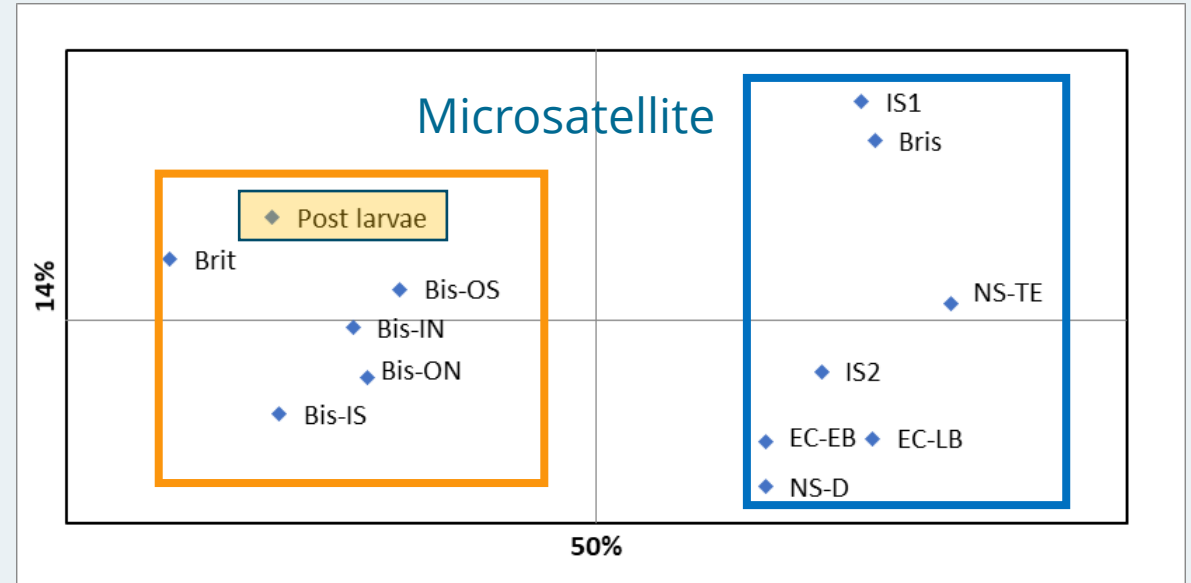
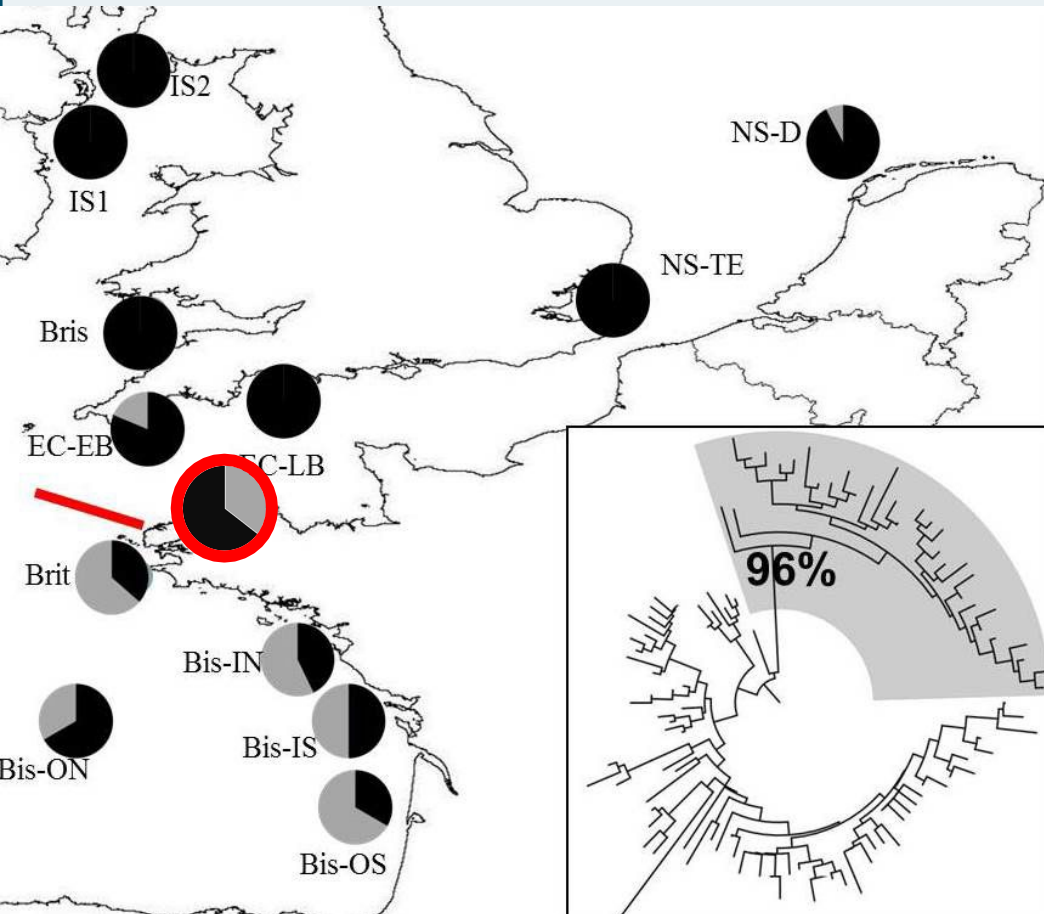
Genetics adult anchovy: mitochondrial DNA and Microsatellites



- Genetics of adult anchovy confirm a North -South break
- Individuals can be assigned to these groups

Methods 1:

Ascribing juvenile anchovy to group

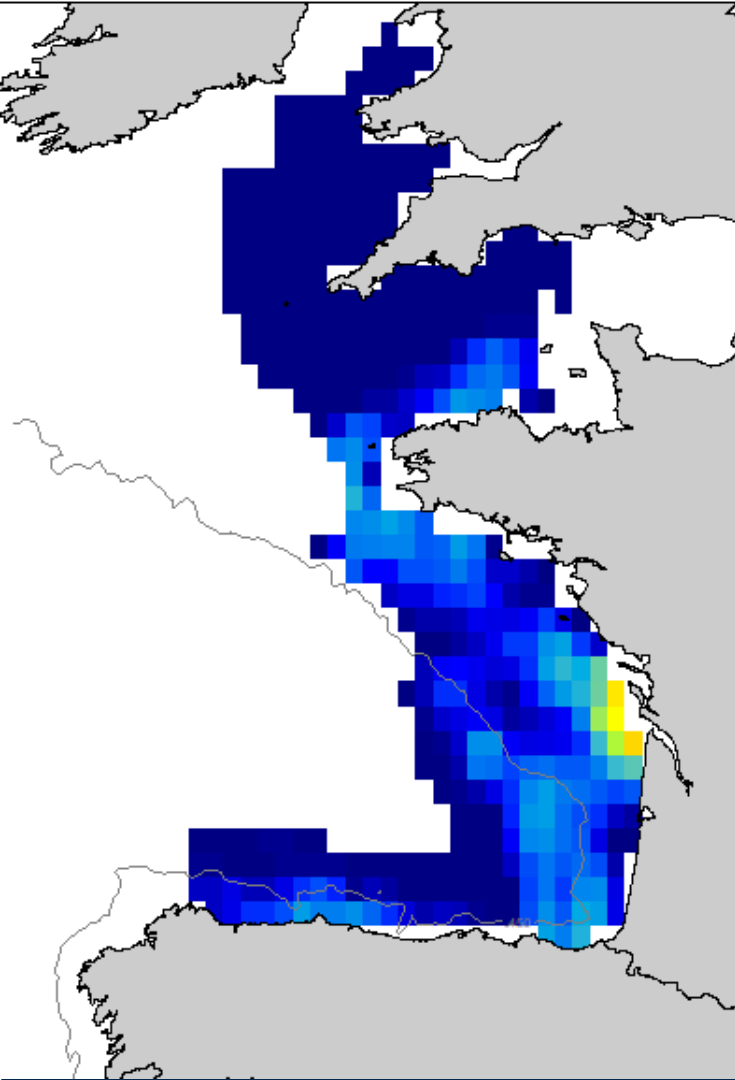


Large proportion of 'grey' suggests Southern group Affinity

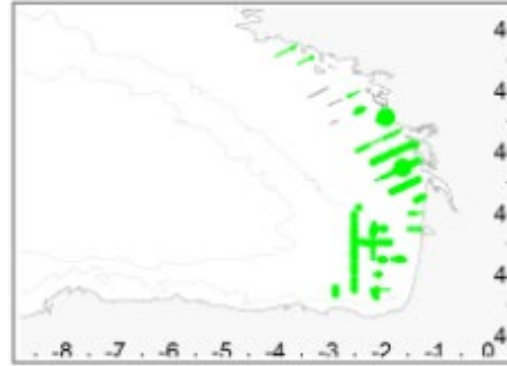
Methods 2:

Survey data: autumn juvenile anchovy (JUVENA)

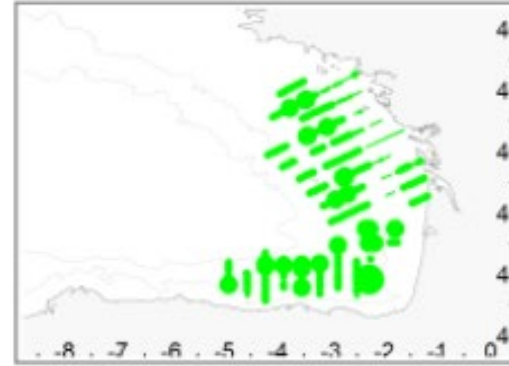
2020 mean NASC ENGR-JUV



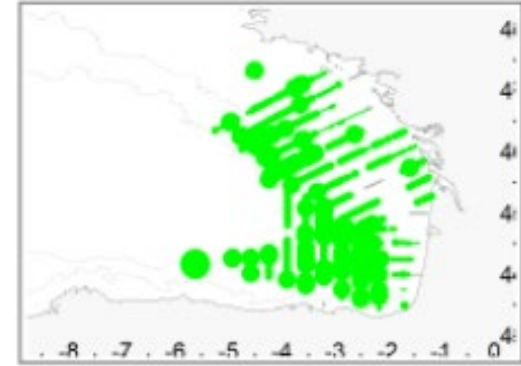
2008



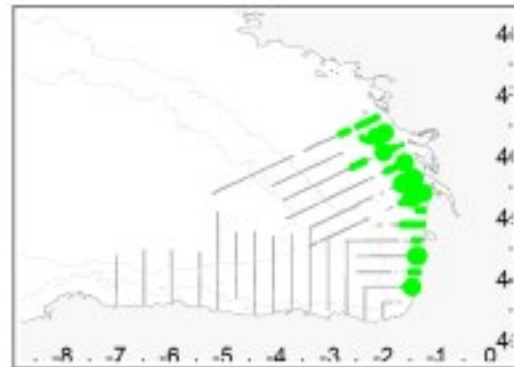
2009



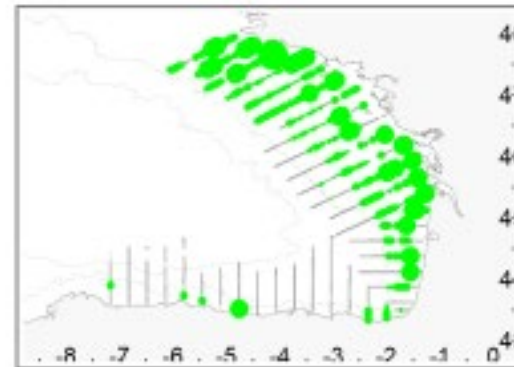
2010



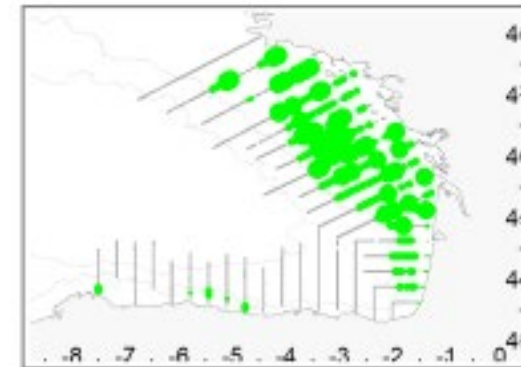
2019



2020



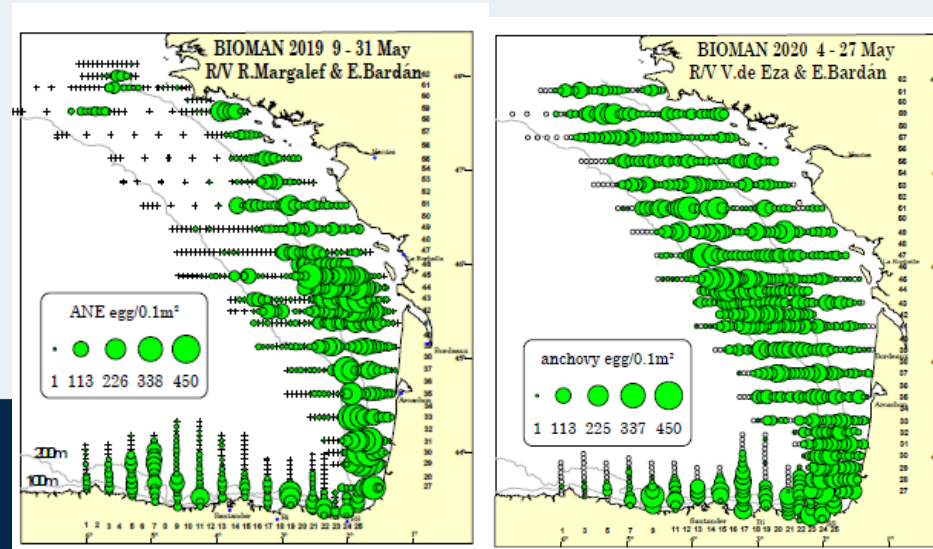
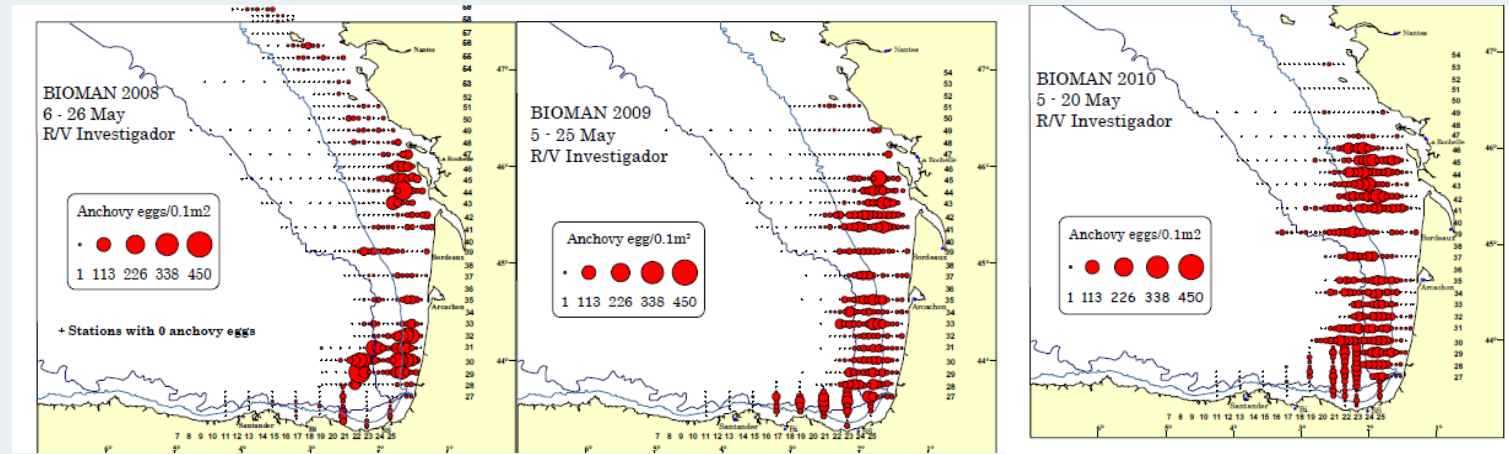
2021



Methods 2:

Survey data: spring anchovy eggs (Bioman & Pelgas)

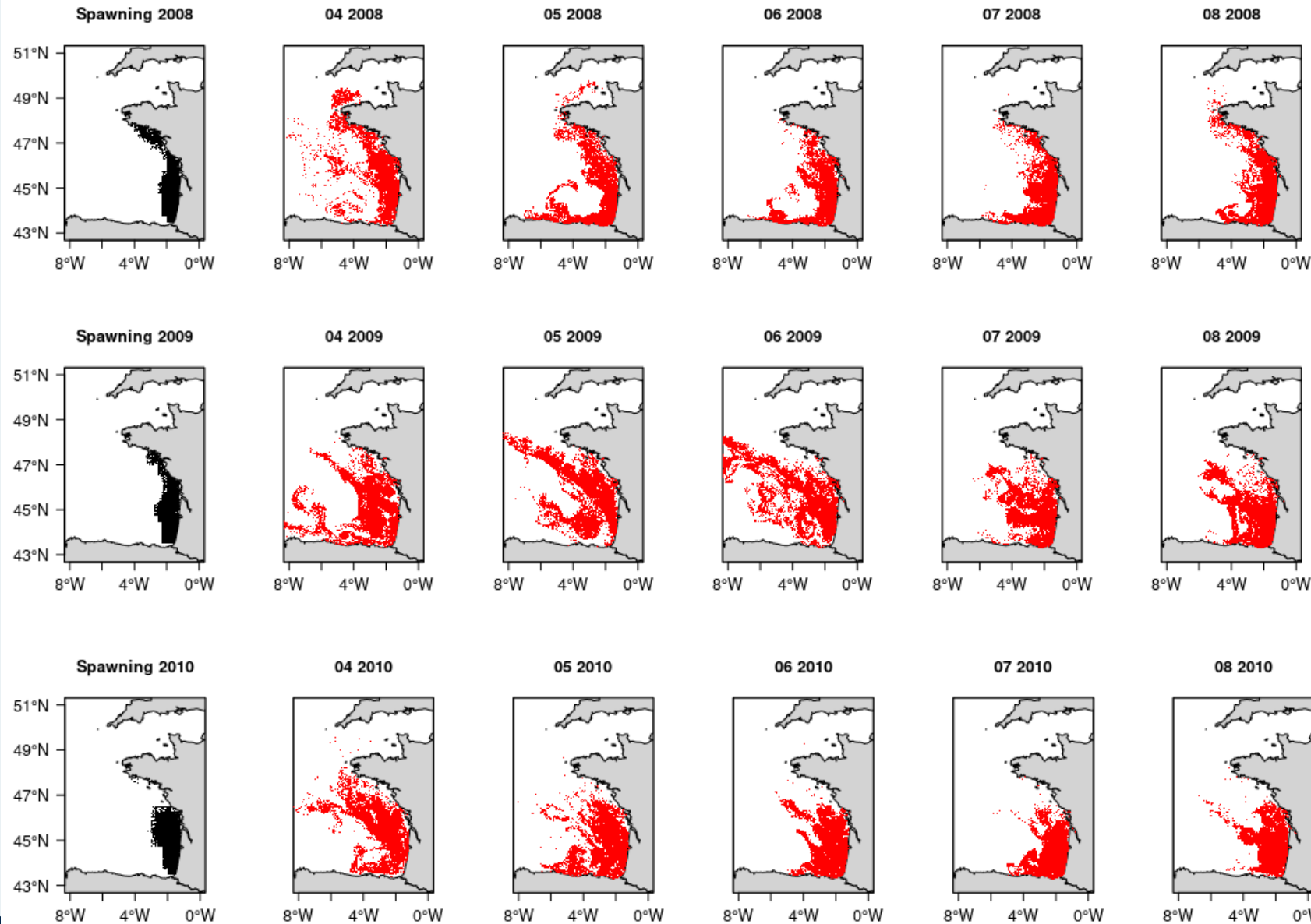
- Spring Egg distribution “historically”: southern and central Bay of Biscay
- Recent distribution (2019-2020) more widespread and further north
- BUT: incomplete coverage (April/May)



Methods 3:

Particle tracking model

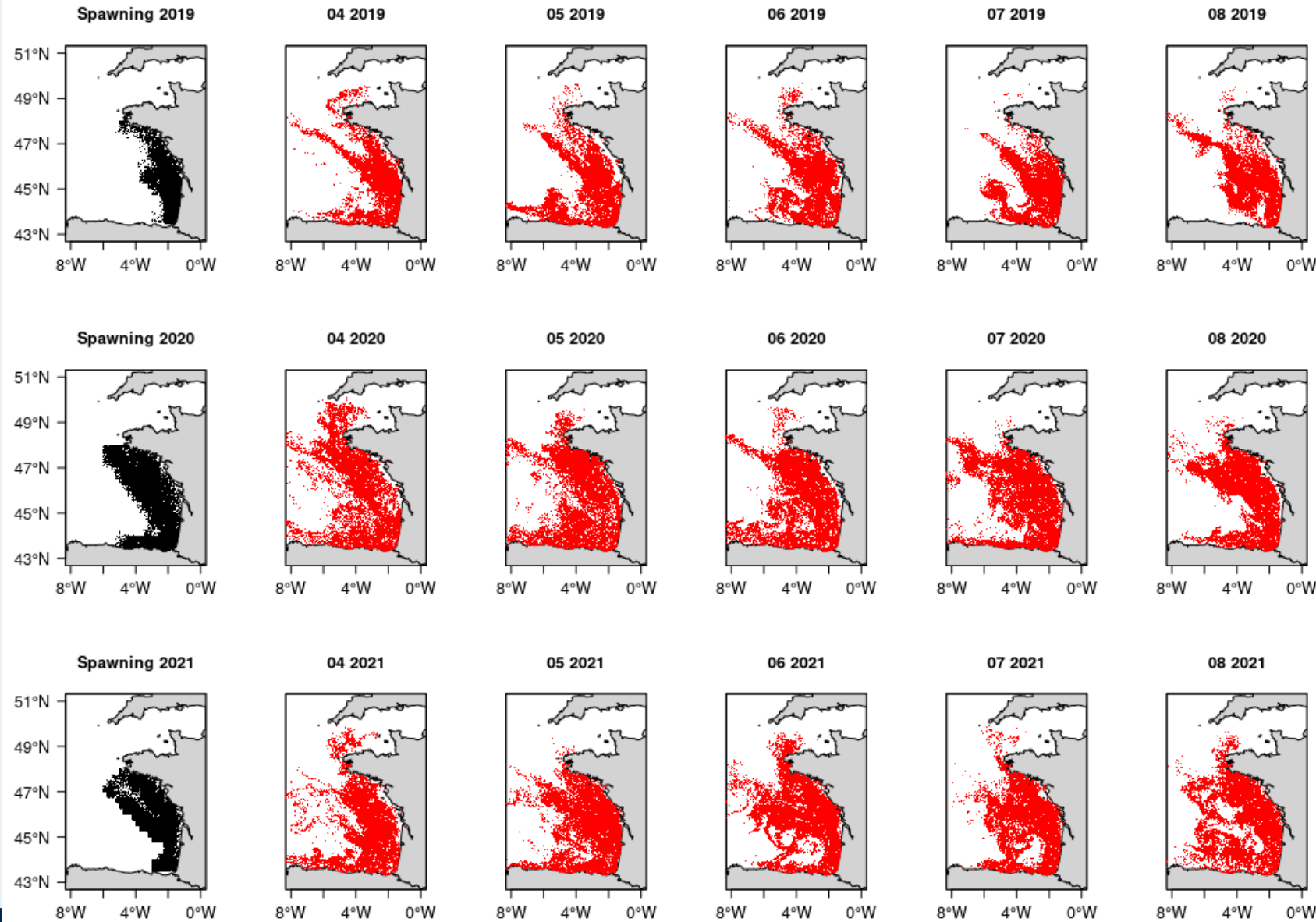
- Larval drift + DEB
- ~25000 particles released on 15th of each month from April to August
- Position after 60 days drift (metamorphosis)



Methods 3:

Particle tracking model

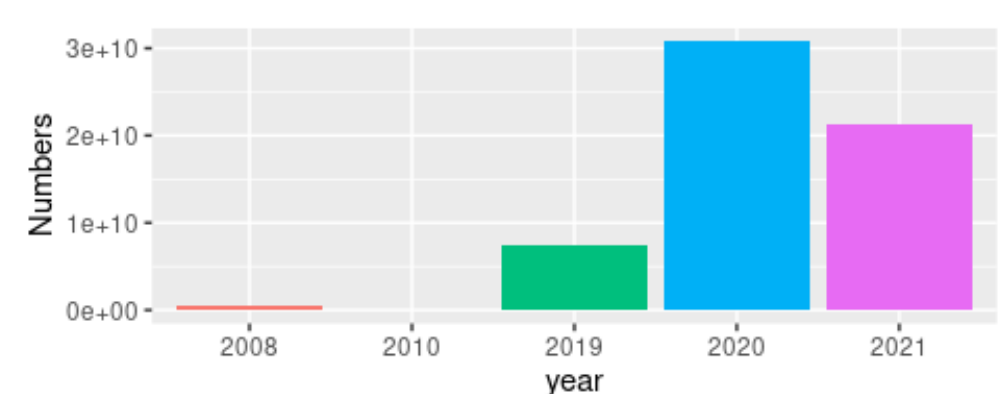
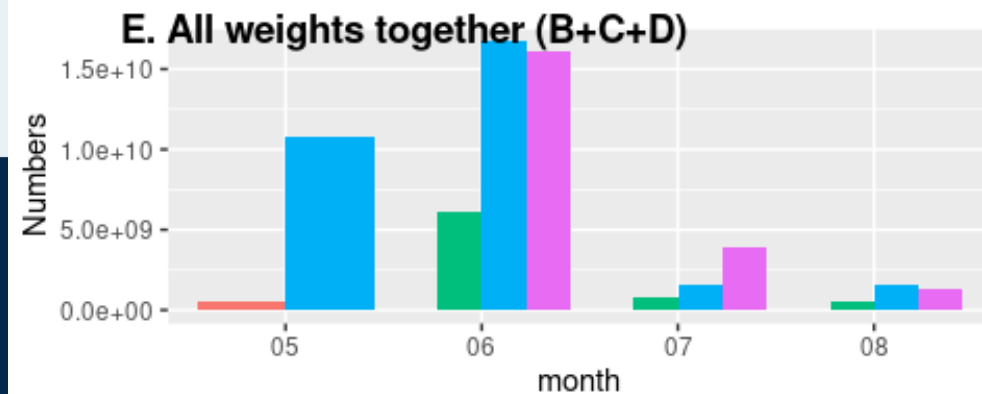
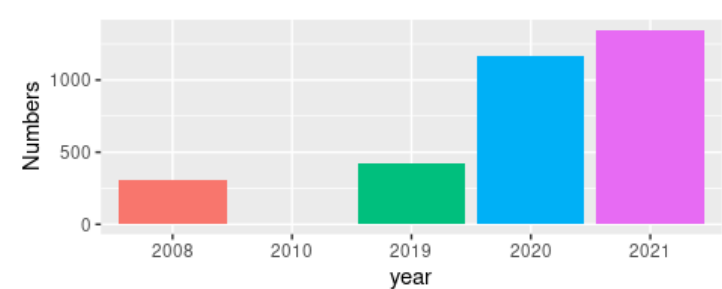
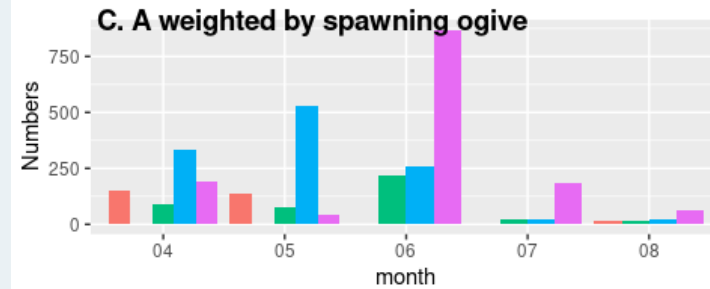
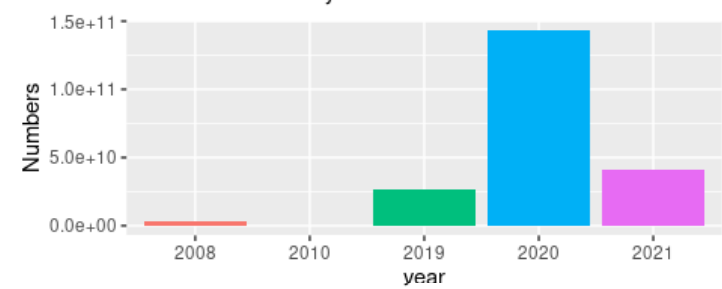
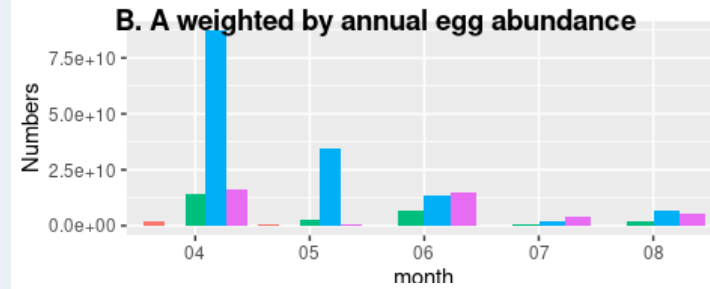
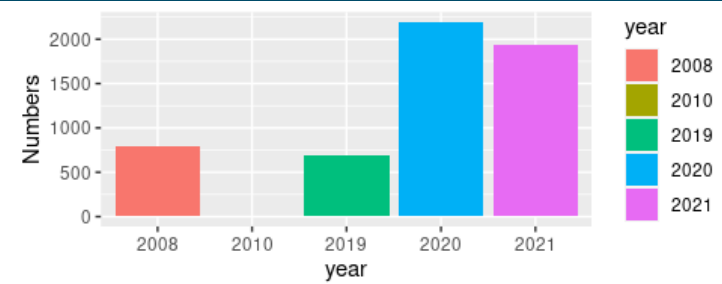
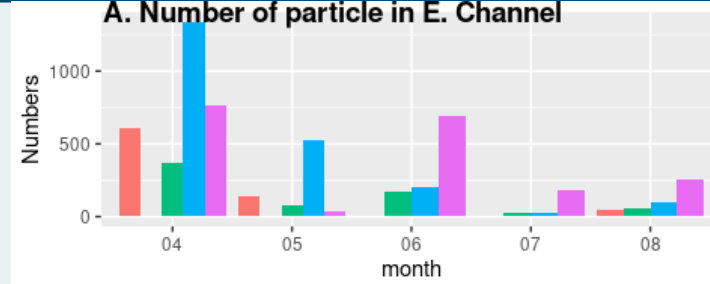
- Historically: limited (2008)/no transport into channel
- Recent period (2019-2021): eggs/larvae enter English Channel
- However: assumes same (monthly) distribution and numbers



Methods 3:

Particle tracking

- Historically: limited (2008)/no transport into channel
- Recent period (2019-2021): eggs/larvae enter English Channel
- Weighted by annual egg abundance
- Weighted by spawning ogive
- Combine all weights:**
 - 2008 is almost null (early spawners)
 - 2019-'21: enter Channel



(Preliminary) Conclusions

- Mid-1990's: Northern expansion of anchovy by local populations
- Two separate management units/populations:
 1. Anchovy in Bay of Biscay (ICES area 8)
 2. Anchovy in North Sea/western Channel (ICES area 4, 7)
- New scenario 2020's: Biscay juveniles entering Channel
 - More widespread (north) spawning Biscay
- Drivers:
 - **High(est) Biscay Anchovy SSB**
 - Milder/warmer conditions?
- Geographic overlap two populations
- What happens to the juvenile anchovy (return or settle)?
- Mixing of two stocks?



What next?

- Refine selection of years (particle drift):
 - Average periods/regimes of egg distribution/numbers
 - include 2017 and 2018
- Growth at northern latitudes and temperatures
- Drivers
 - SSB
 - Temperature conditions

