

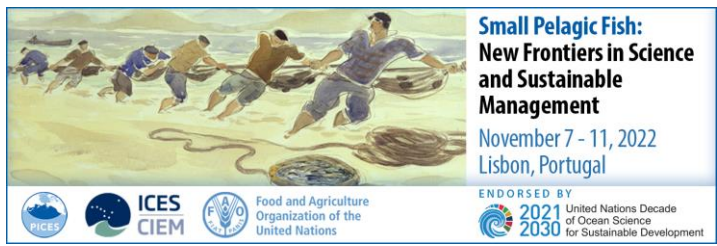
Workshop 6: Small Pelagic Fish Reproductive Resilience

Monitoring programme of the Canary small pelagic fish (Spain, NW Africa) in the Spanish Data Collection Framework

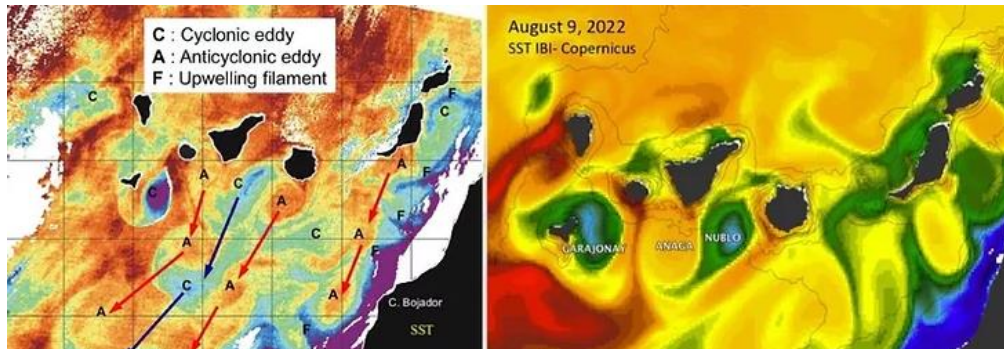
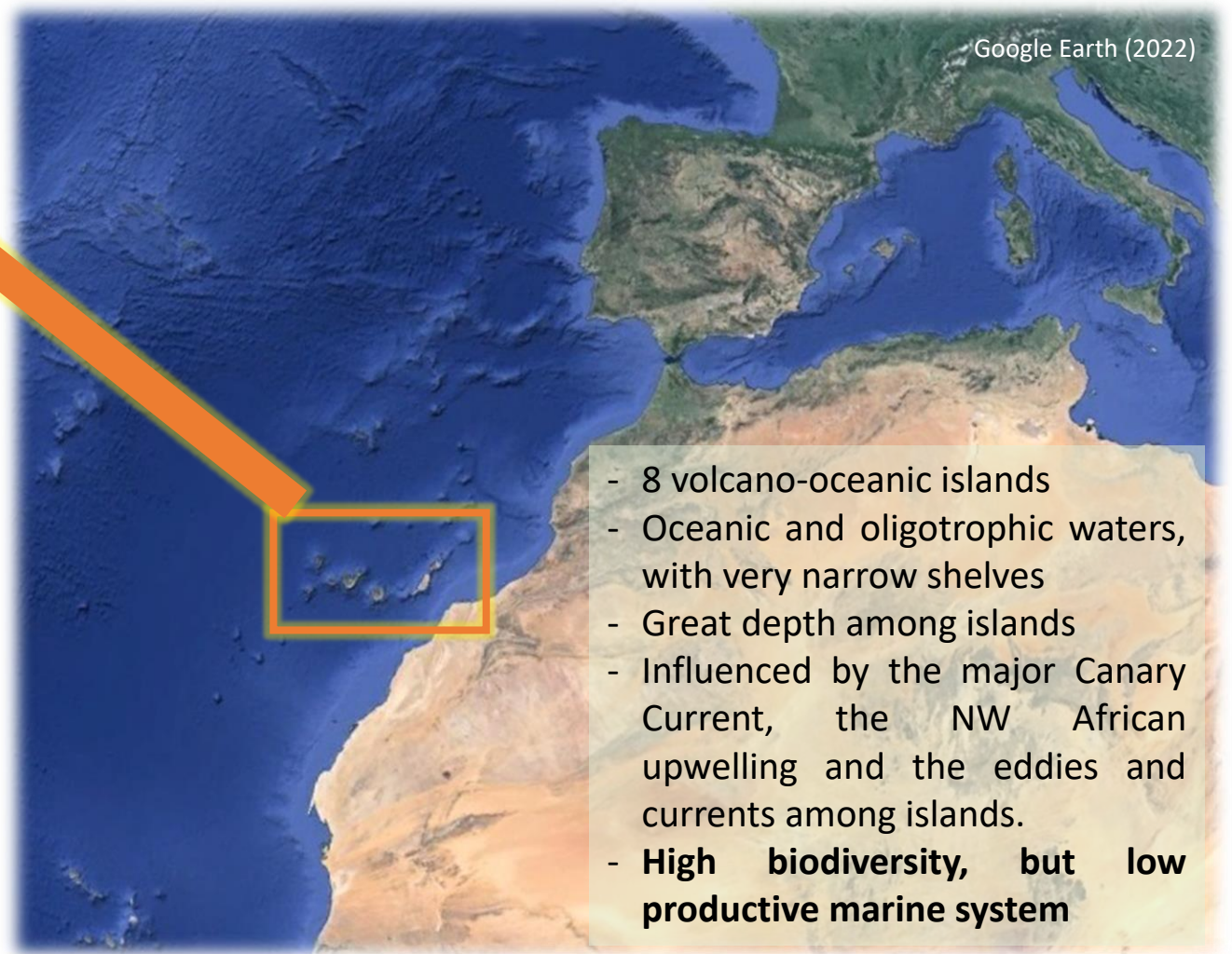
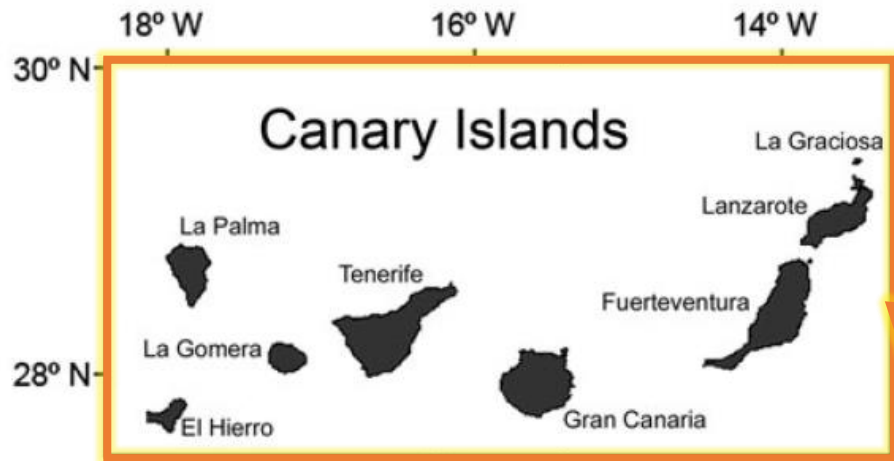
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The Canary Islands context



<https://www.gob-iocag.ulpgc.es/post/eddies-in-the-canary-islands-a-gaia-perspective>

- 8 volcano-oceanic islands
- Oceanic and oligotrophic waters, with very narrow shelves
- Great depth among islands
- Influenced by the major Canary Current, the NW African upwelling and the eddies and currents among islands.
- **High biodiversity, but low productive marine system**

The Canary artisanal fishery



- Artisanal fleet (>600 boats): multi-gear, multi-species, opportunistic and polyvalent.
- Three different *métiers* identified and monitored in the EU-DCF:
 - **LHP_LPF** Tuna pole and line fished with live-bait (68% Canary landings, monitoring launched in 2003)
 - **MIS_DES** Multigear directed to demersal species (14% Canary landings, monitoring launched in 2015)
 - **PS_SPF** Traíñas (18% Canary landings, monitoring launched in 2013)

Purse-seine fleet targeted species



Atlantic chub Mackerel - *Scomber colias*
(Gmelin, 1789)



Blue jack mackerel- *Trachurus picturatus*
(Bowdich, 1825)



Round sardinella- *Sardinella aurita*
(Valenciennes, 1847)



Sardine - *Sardina pilchardus*
(Walbaum, 1792)



FAO Working Group on the
Assessment of Small Pelagic
Fish off NW Africa
(included since 2015)



Monitoring system (EU-DCF)



Biological sampling
(IEO-COC laboratory)

Length samplings
(landing sites and on board)

Discards characterization
(on board)

Fishery statistics
(Official Sale Notes and census of boats)

Characterization of the fish populations:

- Biological data (LF, mean weight and age distribution of catches, sex-ratio, maturity) for the main SPF species targeted by the artisanal purse seiners in the Canary Islands: *Somber colias*, *Trachurus spp*, *Sardina pilchardus*, *Sardinella aurita*
- Data to assess the fisheries impact on marine ecosystems (i.e: discards, since 2017)
- Assessment of this stock status in the CECAF framework.



Characterisation of the fishery:

- Technical characteristics of the artisanal fleet targeting SPF
- Main landing and selling sites
- Landings and fishing effort analysis based on official 'sale notes' (available since 2007).



Population structure / species plasticity & Collaborative research

Atlantic chub mackerel

ADAPTIVE PLASTICITY OF OTOLITH SHAPE IN *Scomber colias* FROM THE CANARY ISLANDS

A. Jurado-Ruza^{1,2}, Z. Santana-Arocas¹, B. Sotelo¹, E. Hernández¹, J.L. Otero-Ferrer¹ and V.M. Tuset¹

Abstract: Otolith shape phenotypes. This variability reflects adaptive and non-adaptive plasticity. Environmental factors affecting otolith shape: Acidification, Temperature, Habitat, Density. Several otolith phenotypes by origin. Some phenotypes more abundant? **Materials & Methods:** 748 otoliths of *S. colias* from the Canary Islands, monthly sampled from Aug 2016 to Dec 2017. Biological sampling: total length (TL) range 17.5-39.0 cm, age range 0-4 years. Contour otolith analysis: 4° Wavelet transform of normalized distance to the centroid of the otolith contours. 812 cartesian coordinates used to discretize the shape contour (Tuset et al., 2019).

SECOND WORKSHOP ON ATLANTIC CHUB MACKEREL (*SCOMBER COLIAS*) (WKCOLIAS2)

VOLUME 3 | ISSUE 18

GROWTH VARIABILITY AND DEMOGRAPHIC STRUCTURE OF NORTHEAST ATLANTIC CHUB MACKEREL (*SCOMBER COLIAS*) IN SOUTHERN EUROPEAN ATLANTIC WATERS

Jorge Landá, Rosario Domínguez-Petit, María Rosario Navarro, Andrea V. Silva, Jorge Tornero, Carmen Hernández, Fernando Ramos, Cristina Nunes, Alba Jurado-Ruza

AIM: To identify and to describe otolith shape. **Background:** The Atlantic chub mackerel (*Scomber colias*) is a highly migratory species in the Atlantic. Otolith shape variability is a result of both genetic and environmental factors. **Material & Method:** Otolith shape variability was analyzed using wavelet transform. **Results & Discussion:** Otolith shape variability was analyzed using wavelet transform. **Conclusions:** Otolith shape variability was analyzed using wavelet transform.

Using Otolith Phenotypic Variability to Infer Potential Population Differences of *Scomber colias* in the Northeast Atlantic and Mediterranean Sea

Viktor M. Tuset¹, Joana Vasconcelos^{1,2}, Alba Jurado-Ruza¹, José Luis Otero-Ferrer¹, Andrea Masera¹, M. Rosario Navarro¹, Carmen Hernández¹

Abstract: Otolith shape variability was analyzed using wavelet transform. **Material & Methods:** Otolith shape variability was analyzed using wavelet transform. **Results & Discussion:** Otolith shape variability was analyzed using wavelet transform. **Conclusions:** Otolith shape variability was analyzed using wavelet transform.

Simposio Iberoamericano de Ecología Reproductiva, Recrutamiento y Pesquerías

11-15 Octubre 2021

VARIACIÓN ESPACIAL DE LOS PARÁMETROS DE HISTORIA VITAL DEL ESTORNIÑO Y SUS IMPLICACIONES EN EL POTENCIAL REPRODUCTIVO

Dominguez-Petit, R., Landá, J., Navarro, R., Nunes, C., Jurado-Ruza, A., Ramos, F., Silva, A.V., Tornero, J., Hernández, C.

European sardine

- Low coverage whole genome sequencing reveals the underlying structure of European sardine populations
- Population genomics of European sardines
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- Rute R. da Fonseca^{1,2}, Paula F. Campos^{1,2}, Alba Reygileta¹, Gustavo V. Barroso¹, Lucie A. Bergeron¹, Manuel Nanded¹, Fernando Tuya¹, Sami Abidi^{1,3}, Montse Pérez^{1,4}, Isabel Riveiro^{1,5}, Pablo Carrera¹, Alba Jurado-Ruza^{1,6}, M. Teresa G. Santamaría¹, Rui Faria^{1,7}, André M. Machado¹, Miguel M. Fonseca¹, Elsa Froufe¹, L. Filipe C. Castro^{1,8}
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- Center for Macroecology, Evolution and Climate, The Globe Institute, University of Copenhagen, Copenhagen, Denmark
- The Bioinformatics Centre, Department of Biology, University of Copenhagen, Copenhagen, Denmark
- CIMAR - Interdisciplinary Centre of Marine and Environmental Research - University of Porto, Porto, Portugal
- Centre for GeoGenetics, Natural History Museum Denmark, University of Copenhagen, Østervoldsgade 5-7, 1350 Copenhagen, Denmark
- Department of Ecology and Evolutionary Biology, University of California, Los Angeles, USA
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- Grupo en Biodiversidad y Conservación, IU-ECOQUA, Universidad de Las Palmas de Gran Canaria, Las Palmas, 35017, Canary Islands, Spain

Blue jack mackerel

Fisheries Research 216 (2019) 48–58

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journal homepage: www.elsevier.com/locate/fishres

ELSEVIER

Otolith phenotypic variability of the blue jack mackerel, *Trachurus picturatus*, from the Canary Islands (NE Atlantic): Implications in its population dynamic

Victor Manuel Tuset^{a,*}, Alba Jurado-Ruza^a, José Luis Otero-Ferrer^a, María Teresa G. Santamaría^a

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^bSpain Oceanographic Institute (IO), Canary Oceanographic Centre, Mo. Sotillo, Canary Islands, 38101, Santa Cruz de Tenerife, Spain

^cUniversidad de Huelva, Departamento de Biología Acuática, Campus Universitario de Huelva, Avda. del Atlántico, s/n 41013, Huelva, España, Spain

OTOLITH MORPHOMETRY RELATIONS OF *TRACHURUS PICTURATUS* (BOWDICH, 1825) FROM TWO DIFFERENT AREAS: THE CANARY ISLANDS AND THE LIGURIAN-NORTHERN TYRRHENIAN SEAS

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^aSpain Oceanographic Institute (IO), Canary Oceanographic Centre - 38101 Santa Cruz de Tenerife, Spain

^bSpain Oceanographic Institute (IO), Ligurian-Northern Tyrrhenian Seas - 16129 Genoa, Italy

^cItaly Oceanographic Institute (IO), Ligurian-Northern Tyrrhenian Seas - 16129 Genoa, Italy

ABSTRACT

Otoliths have been described the presence of different population units of blue jack mackerel in the NE Atlantic region. However, the hypothesis of several populations with high similarity in the otolith shape among some regions. It suggests the possibility of genetic connectivity between populations, but the otolith shape and the age of the region with higher potential of mixing due to the oceanographic conditions. This study aims to analyze the otolith shape variability of blue jack mackerel from two different areas: the Canary Islands and the Ligurian-Northern Tyrrhenian Seas.

INTRODUCTION

Otolith shape analysis has been used to identify and track the population structure of fish. Otolith shape variability is a result of both genetic and environmental factors. This study aims to analyze the otolith shape variability of blue jack mackerel from two different areas: the Canary Islands and the Ligurian-Northern Tyrrhenian Seas.

Area	TL (cm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)
Canary Islands	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Ligurian-Northern Tyrrhenian Seas	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0

CONCLUSIONS

Otolith shape variability was analyzed using wavelet transform. **Material & Methods:** Otolith shape variability was analyzed using wavelet transform. **Results & Discussion:** Otolith shape variability was analyzed using wavelet transform. **Conclusions:** Otolith shape variability was analyzed using wavelet transform.

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Endoparasites of *Trachurus picturatus* (Pisces: Carangidae) from the Madeira and Canary Islands: Selecting parasites for use as tags

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²ICP/CIAM, Universidade da Madeira, Campus da Povoação, 9000-001 Funchal, Portugal

ABSTRACT

Otoliths have been described the presence of different population units of blue jack mackerel in the NE Atlantic region. However, the hypothesis of several populations with high similarity in the otolith shape among some regions. It suggests the possibility of genetic connectivity between populations, but the otolith shape and the age of the region with higher potential of mixing due to the oceanographic conditions. This study aims to analyze the otolith shape variability of blue jack mackerel from two different areas: the Canary Islands and the Ligurian-Northern Tyrrhenian Seas.

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Area	TL (cm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)	TL (mm)
Canary Islands	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Ligurian-Northern Tyrrhenian Seas	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0

CONCLUSIONS

Otolith shape variability was analyzed using wavelet transform. **Material & Methods:** Otolith shape variability was analyzed using wavelet transform. **Results & Discussion:** Otolith shape variability was analyzed using wavelet transform. **Conclusions:** Otolith shape variability was analyzed using wavelet transform.

Biological and fishery data from commercial fleet



Data collation

Biological samplings:

- total length (TL, 0.1 cm)
- total weight (TW, 0.1 g)
- gutted weight (0.1 g)
- sex
- sexual maturity (general 5-stages SMS)
- gonadal weight (0.1 g)
- stomach repletion (4 categories)
- visceral fat (4 categories)
- *Sagitta* otoliths extraction and preservation

RIM and on-board observations:
length frequencies

Life history traits

- Length frequencies
- LWRs
- Reproductive traits
- Growth parameters
- etc.

Mathematical assessment



Data-limited models

Length-based: LBB, LB-SPR, LCA/YR
Surplus production-based: Biodyn, SPiCT, CMSY, JABBA)

Fishery statistics (official sale-notes)

- Landings
- Fishing effort (non specific)
- LPUE (not standardized)



Current stock status assessment

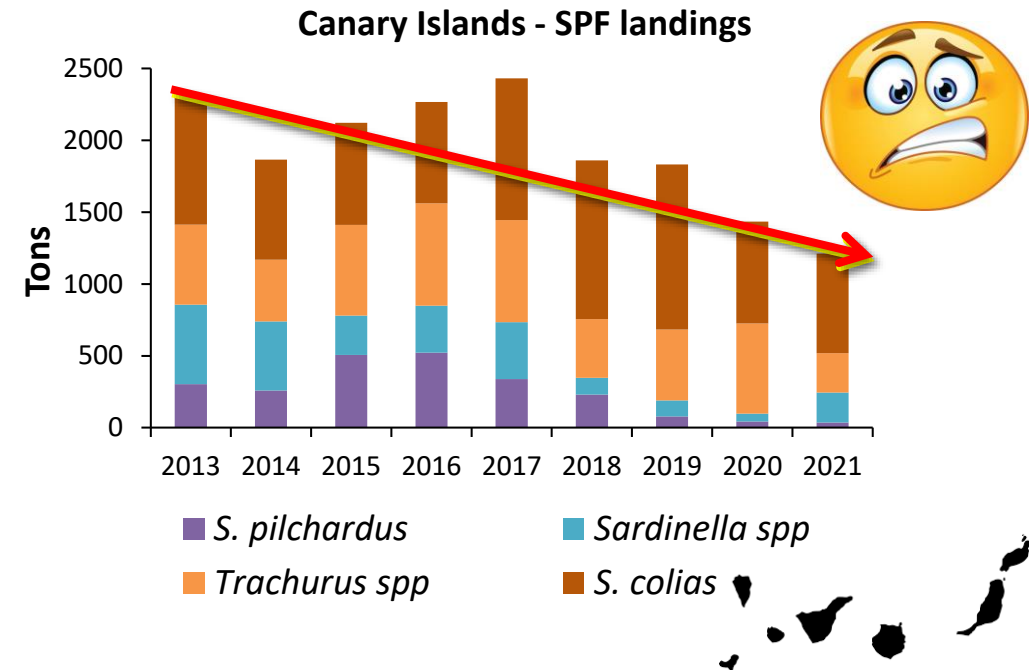
Presented in  (2021)

Presented in  and  assessment WG (2022)

RESULTS & CONCLUSIONS						
Assessment model	Length-based models			Surplus production-based models		
	LBI	LB-SPR	(LCA+)YPR	CMSY	JABBA	BioDyn
<i>Scomber colias</i>						
<i>Trachurus spp</i> (Mixed landings)						
<i>Sardinella spp</i> (Mixed landings)						
<i>Sardina pilchardus</i>						

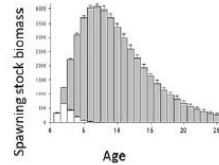
Species	Allowed catch size	LFM reference	Updated LFM
<i>Scomber colias</i>	20	20 (Lorenzo and Pajuelo, 1996)	18.90
<i>Trachurus picturatus</i>	15	22 (Jurado-Ruzafa and Santamaría, 2013)	19.00
<i>Sardina pilchardus</i>	11	15 (Méndez-Villamil et al., 1997)	15.02
<i>Sardinella aurita</i>	na	na	18.34

- ✗ The exploratory multi-model approach to assess the small pelagic fish in the Canary Islands by using seven different data-limited methods proves that a quantitative assessment is not feasible yet .
- ✗ It is not possible to provide scientific advice in terms of catch or effort limits.



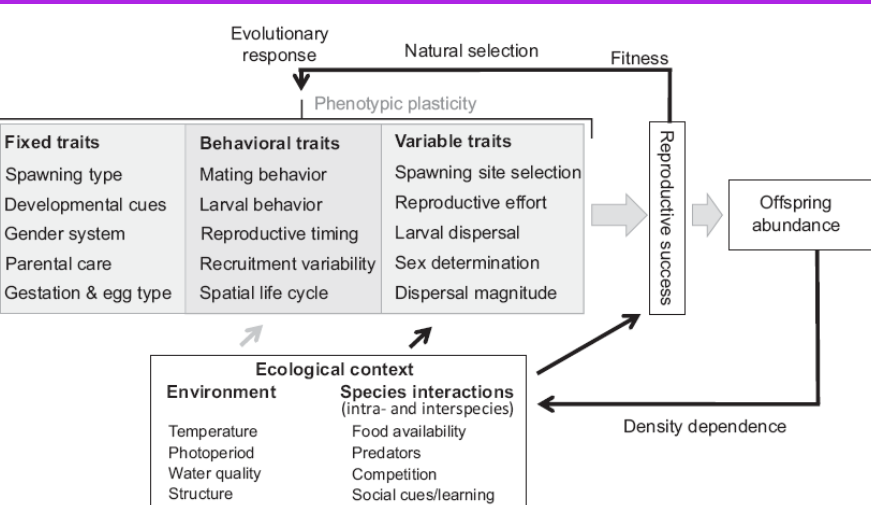
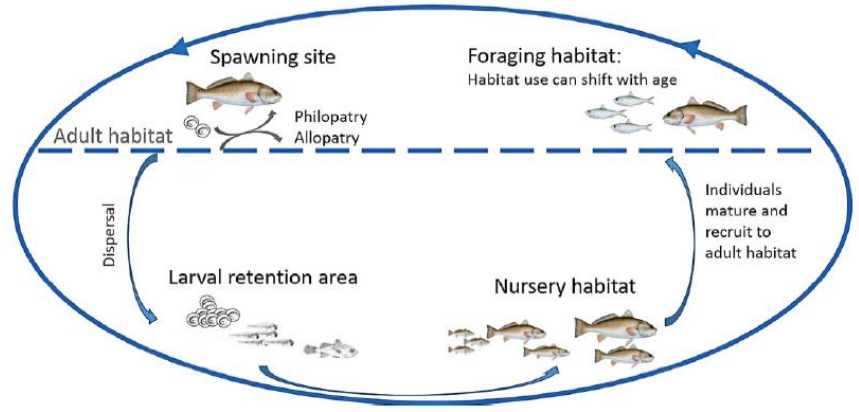
Management context:

Harvest control rules=conserve some portion of mature females (reproductive potential based on spawning stock biomass as a proxy)



Ecological context:

Reproductive success=an individual's offspring survive to reproductive age (affected by genetics, habitat, environmental factors, predation, and food availability)



From Lowerre-Barbieri et al. (2017)

Reproductive potential is commonly based on spawning stock biomass (SSB) but, in many marine species, spatial components of the life cycle may be more important to reproductive success.

W6 final aim: To operationalize the use of the *reproductive resilience paradigm* to inform management.

W6 departure hypotheses:

1. The *reproductive resilience paradigm* takes an eco-evolutionary perspective to identify species-specific traits in spawner-recruit systems that drive reproductive success and consequently resilience to fishing pressure.
2. Reproductive success is tightly coupled with **adult abundance** and **fecundity** in many terrestrial animals and, in exploited marine fish, **where and when fish spawn**, and consequent **dispersal dynamics**, may have a greater impact.

W6-detected needs for the scientific side:

To move beyond the intrinsic population growth equation to understand drivers of transgenerational productivity requires scientific dialogue across fields including **fisheries ecologists, geneticists, early life biologists** and **stock assessment scientists**.

Our aim

To achieve the knowledge to be able to know the actual state of these stocks, in order to provide the best scientific advice **to protect our environment and the marine resources.**



The **reproductive resilience** of these species should be further understood

Pending work in reproductive characterization:

- Microscopic validation of the maturity stages assignments
- Estimation of fecundity and reproductive potential
- Egg and larval development
- Spawning locations
- Larval dispersal and connectivity
- Spatio-temporal analyses
- etc.



Needs:

- To obtain fishery independent abundance/biomass estimations
- To keep the monitoring system
- Improvements in the First sale-notes reporting
- Fishing effort standardization to estimate reliable specific CPUEs
- To better understand the environmental drivers impacting these species
- **Collaborative approaches including broader interdisciplinary and geographic perspectives**

But also:

- Trained staff
- Funds and materials
- Time to analyse data



Comments and suggestions
are more than welcome



