Hybridization across the Atlantic Area

AF Belo; CS Mateus; BR Quintella; PR Almeida; D Nachón; C O'Leary; W Roche; G Lassalle; P Lambert; T Basic; O Lepais; C Antunes; F Cobo and F Daverat

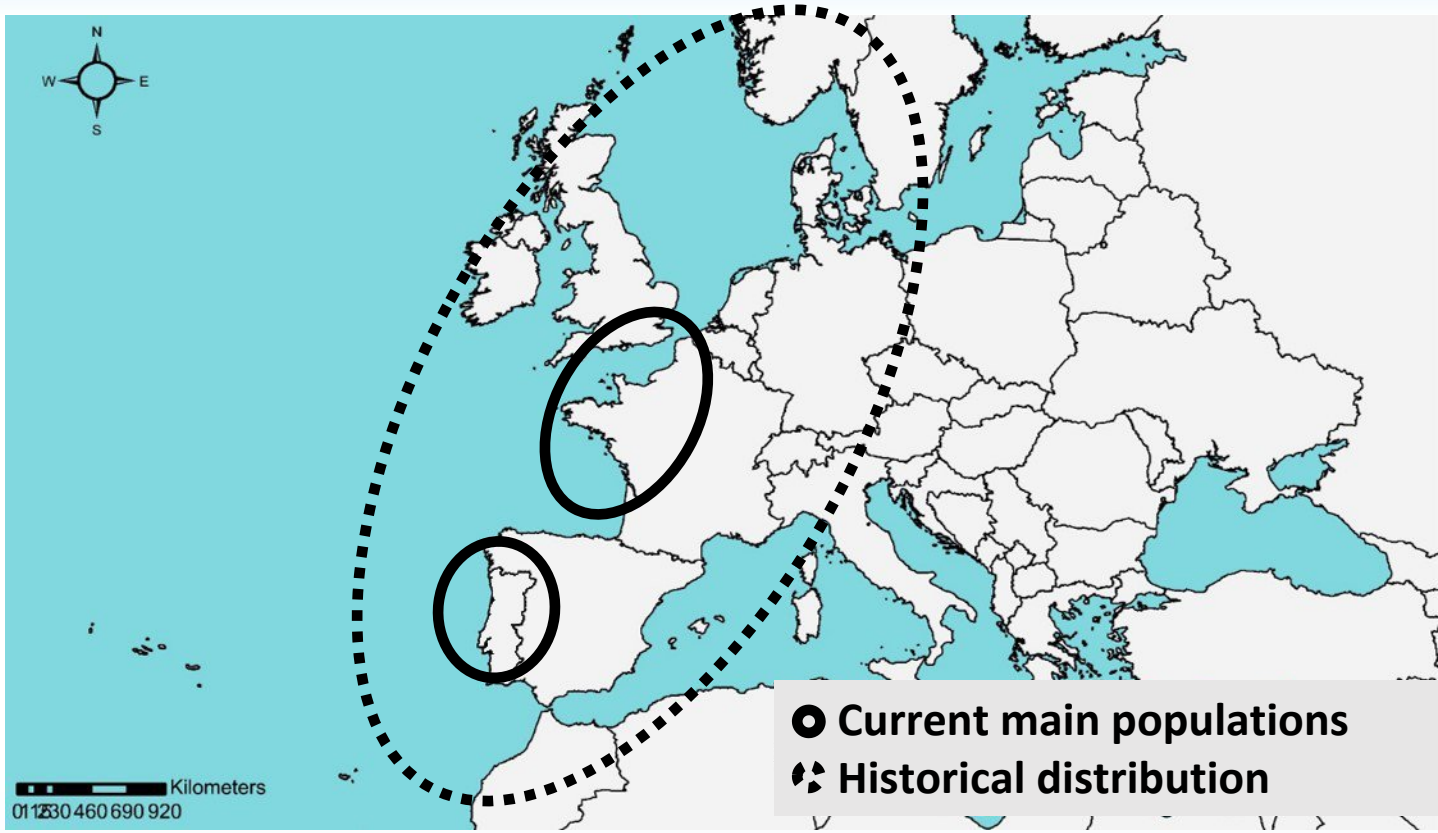
LOCAL AND GLOBAL INITIATIVES:

HOW SCIENCE SUPPORTS MANAGEMENT ACTIONS ON DIADROMOUS FISH

Allis shad

(*Alosa alosa*, Linnaeus 1758)

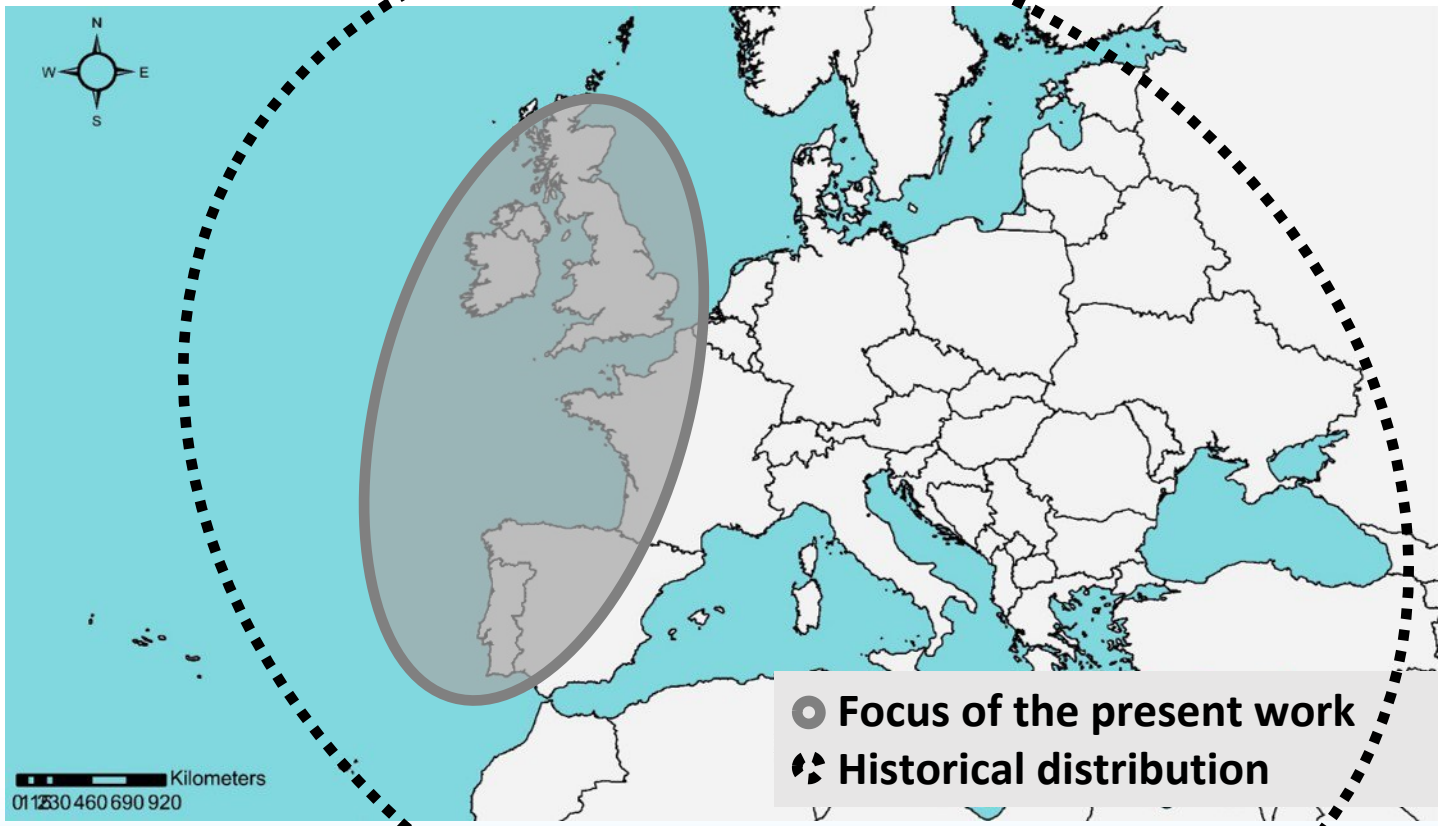
- Anadromous clupeid;
- Mostly smelparous;
- Common name: Sável; Sábalo, Grand alose or Alose vraie;
- IUCN status: LC (needs revision).



Twaite shad

(*Alosa fallax*, Linnaeus 1758)

- Anadromous clupeid;
- Iteroparous;
- Common name: Savelha; Saboga; Sábalo, Alose feinte;
- IUCN status: LC (needs revision).



Differences between the two

- Look very similar;
- Diferences:
  - Size (unreliable criteria);
  - Scale insertion (disorganized vs organized);
  - number of dots (unreliable criteria).

A.fallax

A.alosa

Differences between the three

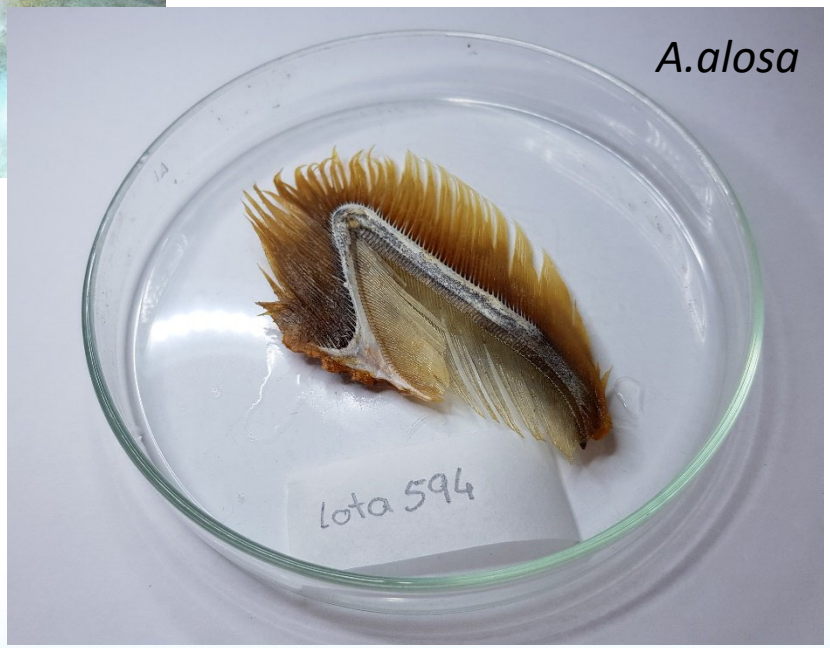
Hybrid

A.fallax

A.alosa

Differences between the three

- Number of gillrakers on the 1st branchial arch



A.alosa	**>115**
A.fallax	**<60**
Hybrids	**[60-115]**

May not detect from second generation hybrids onwards.

Hybridization between *A.alosa* and *A.fallax*

- Hybrids reported since the beginning of the 20th century;
- Reported across the whole distribution area;
- Initially thought to be a consequence of the reduction of available habitat for spawning caused by river impoundment;
- Recent studies on genetic structure and hybridization of these species (e.g. Taillebois et al. 2019; Antognazza et al. 2021; Sabatino et al. 2021; Rougemont et al. 2022).

Why study Hybridization between these species?

- Different rate of hybridization depending on the river system;
- May be a consequence of loss of spawning grounds suitable for reproduction or a survival strategy;
- Impact on population and fisheries management.

Genetic analysis: sample size and origin

Tissue samples collected among DiadES partners and other related projects were sent for genetic analysis.

Sampled individuals were either adults captured in the river (or near the river mouth) during the spawning migration, fish caught at sea or juveniles caugth near spawning grounds.

Country	Number of samples
Ireland	52
UK	83
France*	593
Spain	89
Portugal/Spain	50
Portugal	239
Total	**1106**

*Includes samples from Taillebois et al 2020

Global Preliminary Results

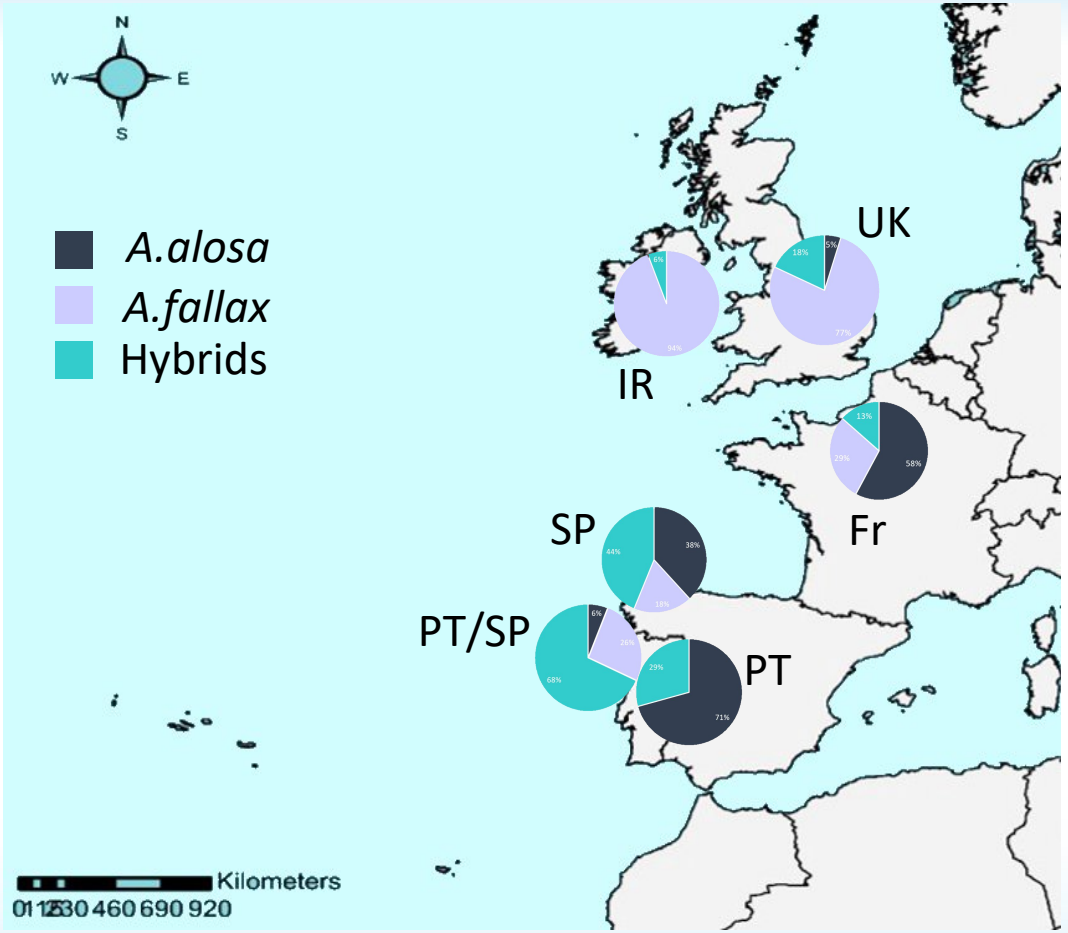
Global hybridization rate

21.79%

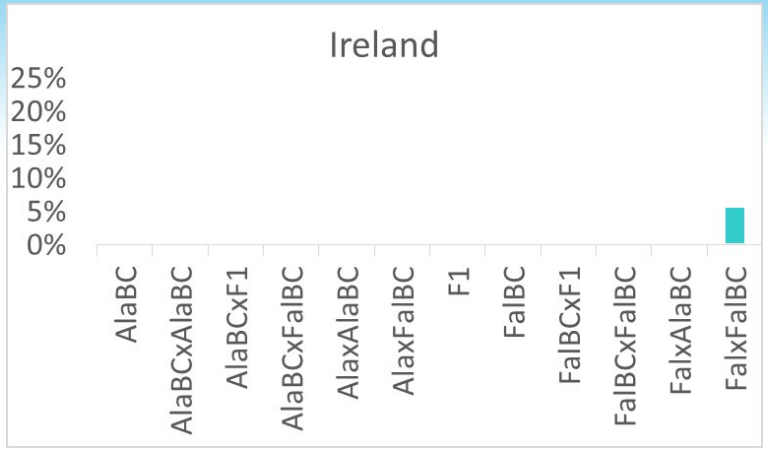
	Hybrid Cathegorial Assignment	Frequence (%)
A.alosa →	Ala	50.00%
	AlaBC	2.26%
	AlaBCxAlaBC	0.27%
	AlaBCxF1	0.18%
	AlaBCxFalBC	0.63%
	AlaxAlaBC	11.66%
	AlaxFalBC	0.81%
	F1	1.45%
A.fallax →	Fal	28.21%
	FalBC	0.54%
	FalBCxF1	0.18%
	FalBCxFalBC	0.27%
	FalxAlaBC	0.36%
	FalxFalBC	3.16%

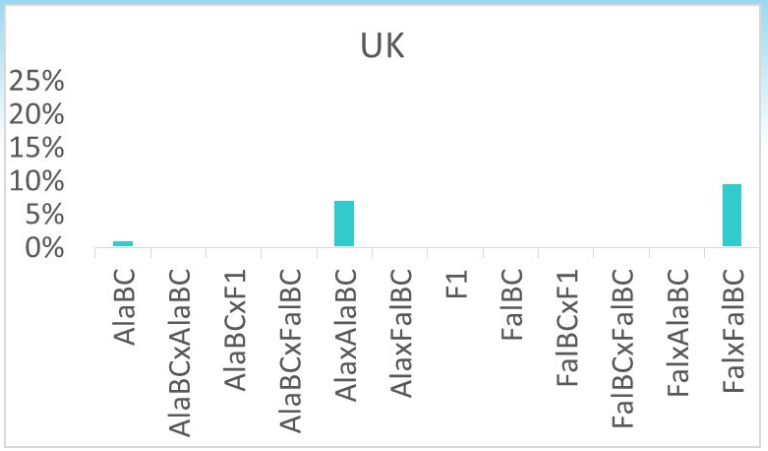
Hybridization rate per Country

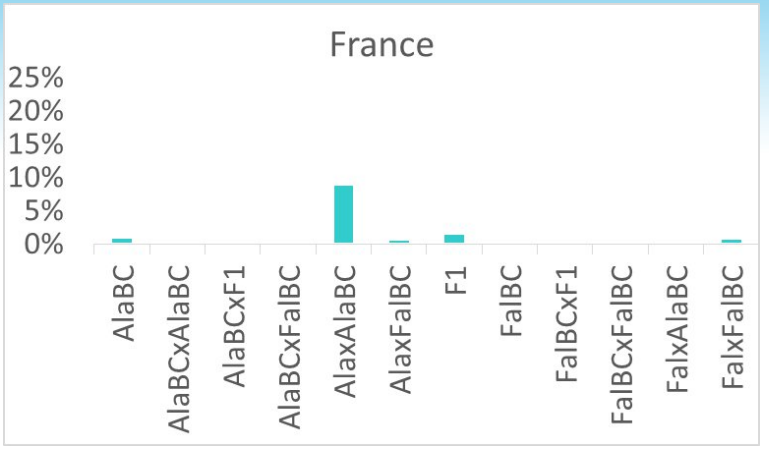
Class Assignment	Ireland	UK	France	Spain	Portugal /Spain	Portugal
Ala	0%	5%	58%	38%	6%	71%
Fal	94%	77%	29%	18%	26%	0%
Hybrids	6%	18%	13%	44%	68%	29%

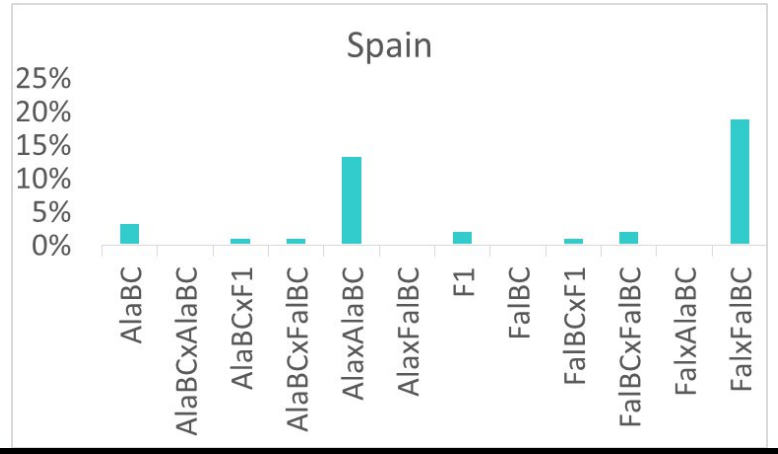


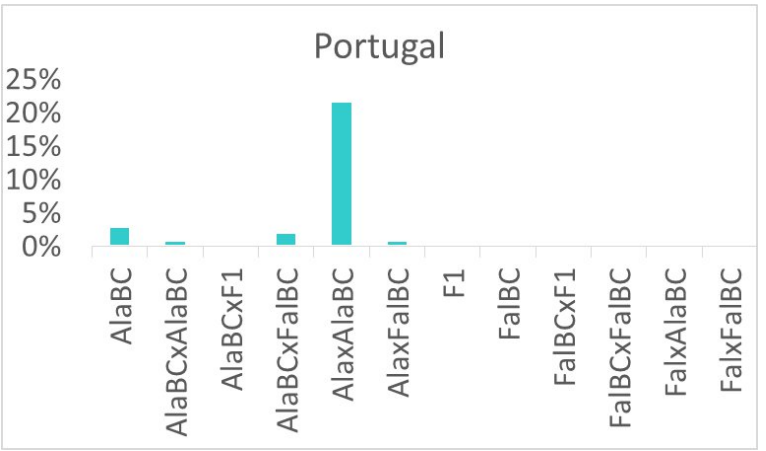
Hybridization rate per Country











Class Assignment	Ireland	UK	France	Spain	Portugal/ Spain	Portugal
Hybrids	6%	18%	13%	44%	68%	29%

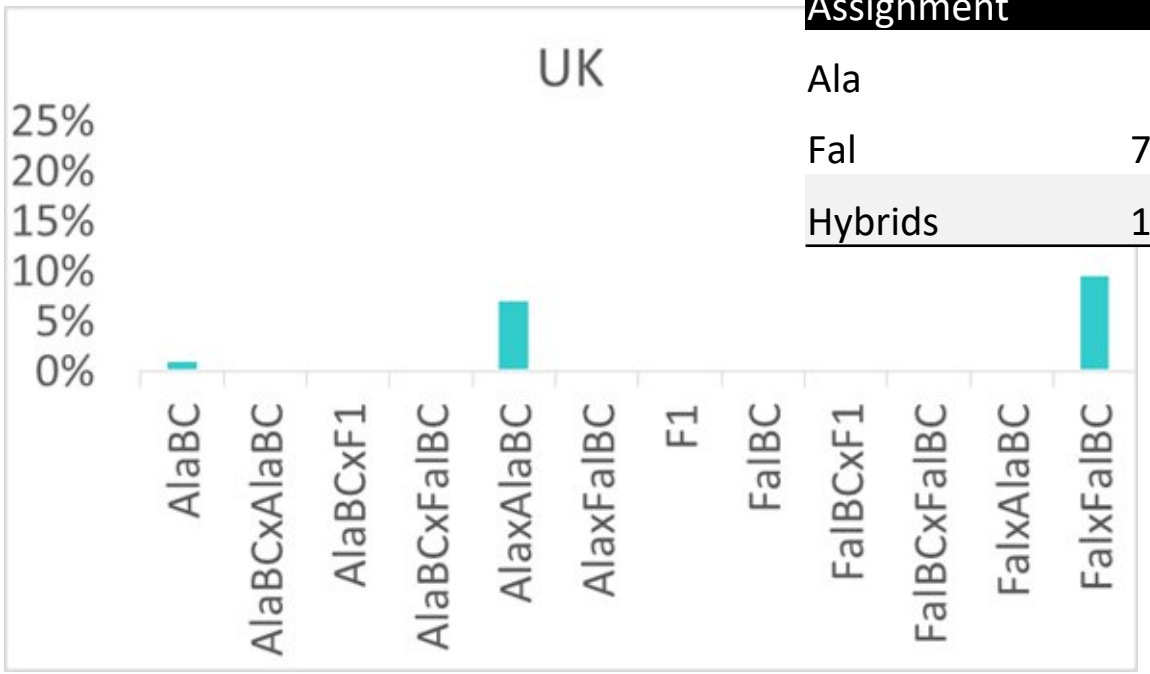
Hybridization rate Ireland

- Smallest hybridization rate (6%);
- Only FalxFalBC;
- No *A.alosa were* sampled.

Class Assignment	Ireland
Ala	0%
Fal	94%
Hybrids	6%

Hybridization rate UK

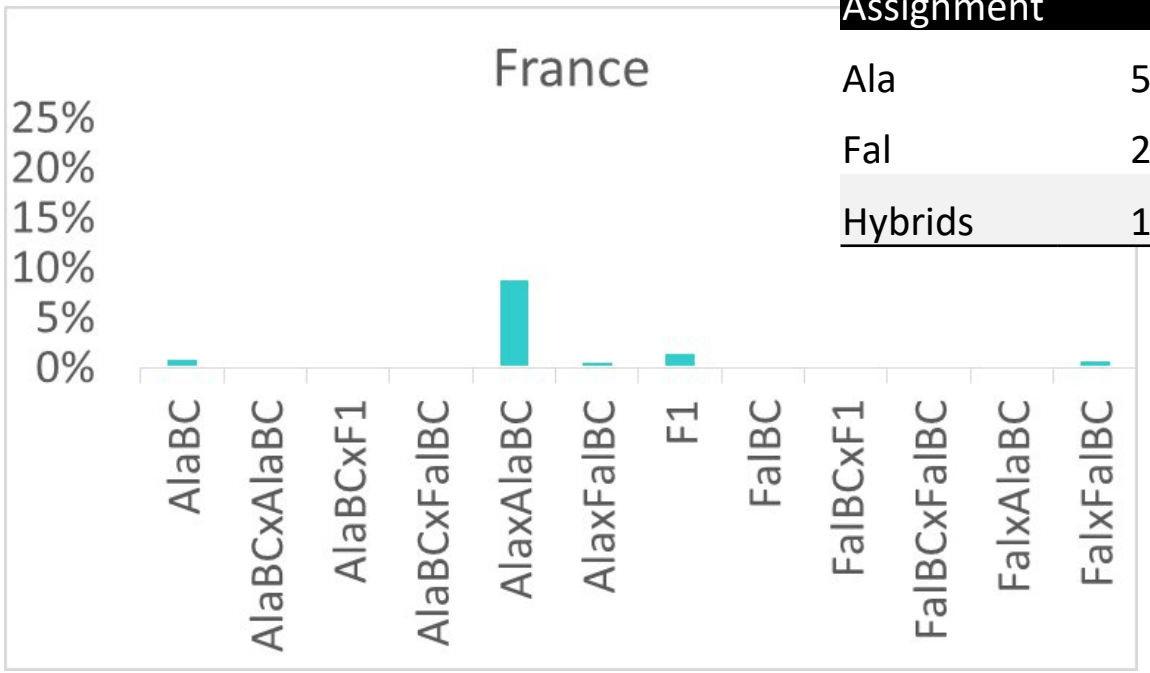
- Near average hybridization rate (18%);
- Almost absence of F1 suggests the crossing of pure breads of both species is not recent;
- Crossing of individuals resultant of back-crossing with the parent species seems to be proportionate to the abundance of each species in the sample.



Class Assignment	UK
Ala	5%
Fal	77%
Hybrids	18%

Hybridization rate France

- Small hybridization rate (13%);
- Presence of a small proportion of F1 suggests recent crossings;
- Crossing of individuals resultant of back-crossing with the parent species seems to be proportionate to the abundance of each species in the sample.

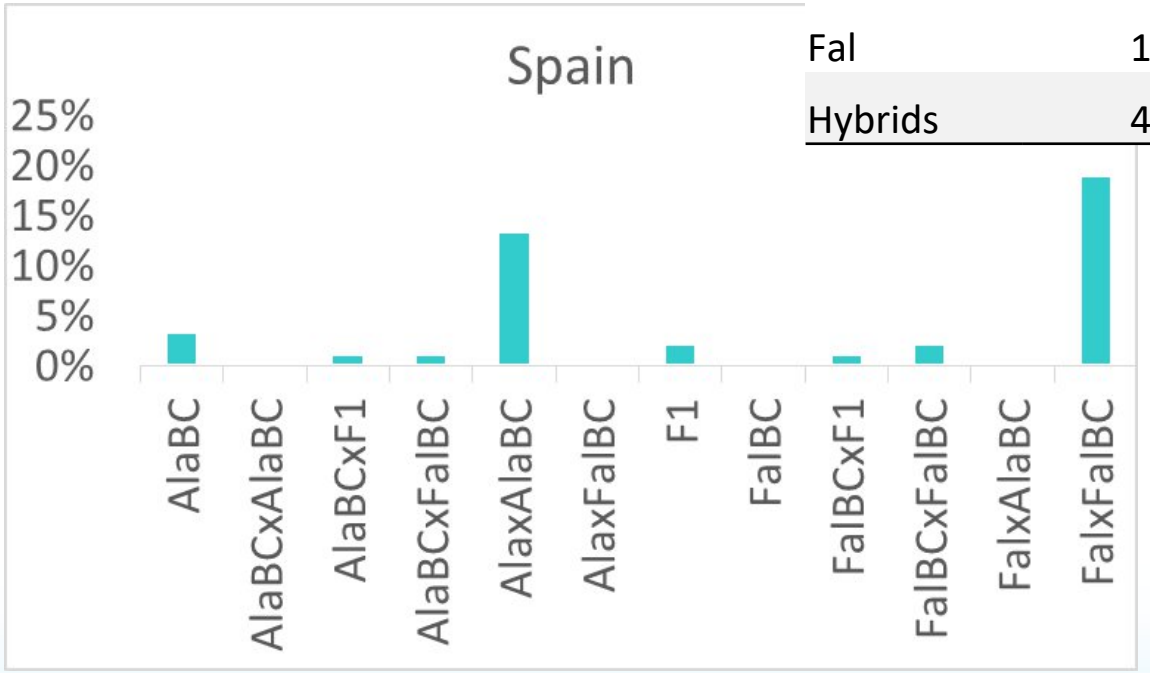


Class Assignment	France
Ala	58%
Fal	29%
Hybrids	13%

Hybridization rate Spain

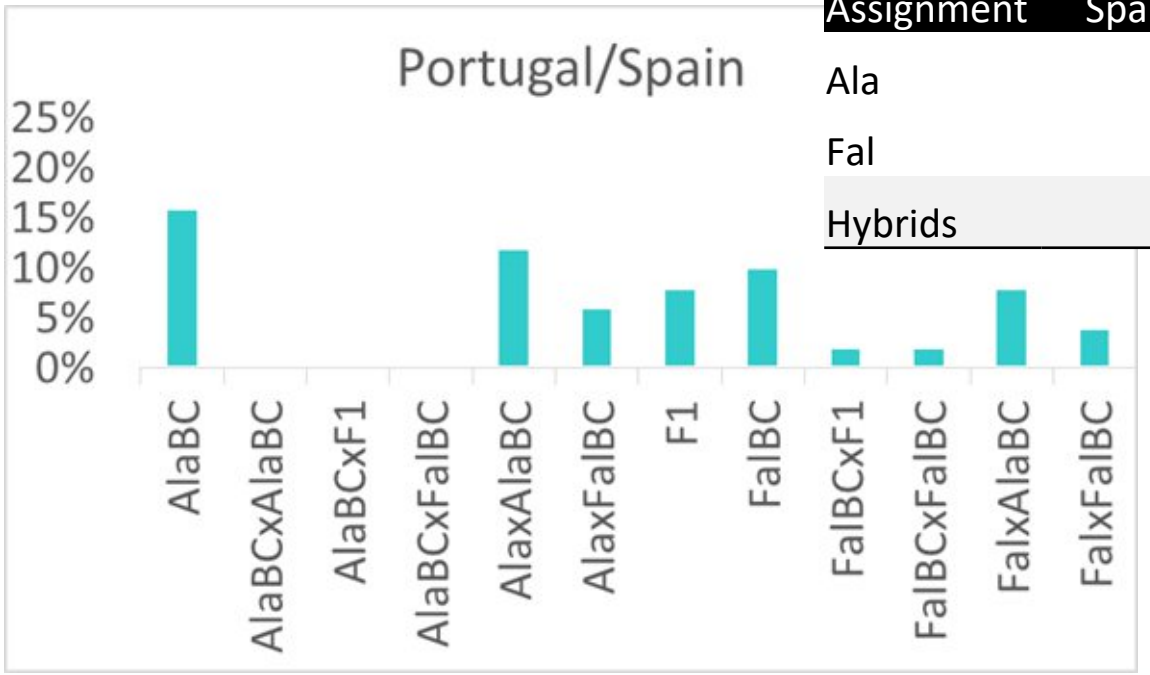
- High hybridization rate (44%);
- Presence of a small proportion of F1 suggests recent crossings;
- Crossing of individuals resultant of back-crossing with the parent species does not seem to be proportionate to the abundance of each species in the sample.

Class Assignment	Spain
Ala	38%
Fal	18%
Hybrids	44%



Hybridization rate River Minho (Portugal/Spain)

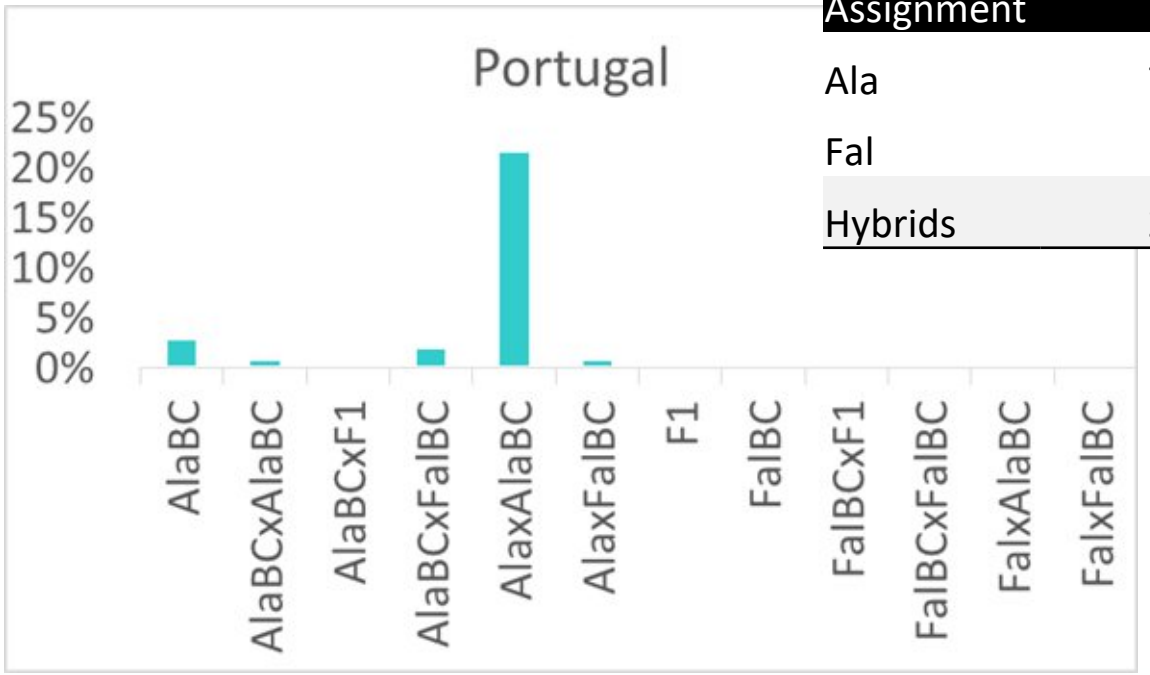
- Highest hybridization rate (68%);
- Few *A.alosa* pure breads;
- Almost all types of crossings are represented;
- Highest proportion of F1's;
- Crossing of individuals resultant of back-crossing with the parent species seems to be proportionate to the abundance of each species in the sample.



Class Assignment	Portugal/ Spain
Ala	6%
Fal	26%
Hybrids	68%

Hybridization rate Portugal

- High hybridization rate (29%);
- Almost absence of F1 suggests either the crossing of pure breads of both species is not recent or F1 were not sampled;
- No *A.fallax* were sampled (but occurrence confirmed).



Class Assignment	Portugal
Ala	71%
Fal	0%
Hybrids	29%

Summing up...

- Different scenarios seem to be present within the study scope;
- Hybridization rate can be very high;
- A larger hybridization rate seems to be associated with the Iberian Peninsula population, possibly associated with the presence of important populations of both species.

Next Steps

- The differences found are associated with the sample chosen or are there environmental factors at play?
- Which environmental factors are influencing the hybridization rate?
- How should we consider hybrids in species management?

Acknowledgements

Special thank you to all the DiadES partners involved on sample collection, processing and analysis.

Thank you for your attention!

affadb@uevora.pt

LOCAL AND GLOBAL INITIATIVES:

HOW SCIENCE SUPPORTS MANAGEMENT ACTIONS ON DIADROMOUS FISH