

# La distribution des amphihalins en mer et le rôle des Aires Marines Protégées



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Pôle OFB-INRA-Institute Agro-UPPA pour  
la gestion des migrateurs amphihalins dans  
leur environnement

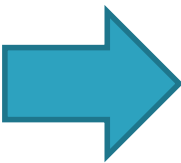


# Objectifs

1. Modéliser la distribution des amphihalins en mer.
2. Évaluer leur sensibilité aux engins de pêche.
3. Évaluer la pertinence des AMP côtières.

**Répondre aux exigences de la DCSMM et la DHFF.**

**Apporter des éléments d'aide à la décision pour la gestion des PNM et sites N2000.**

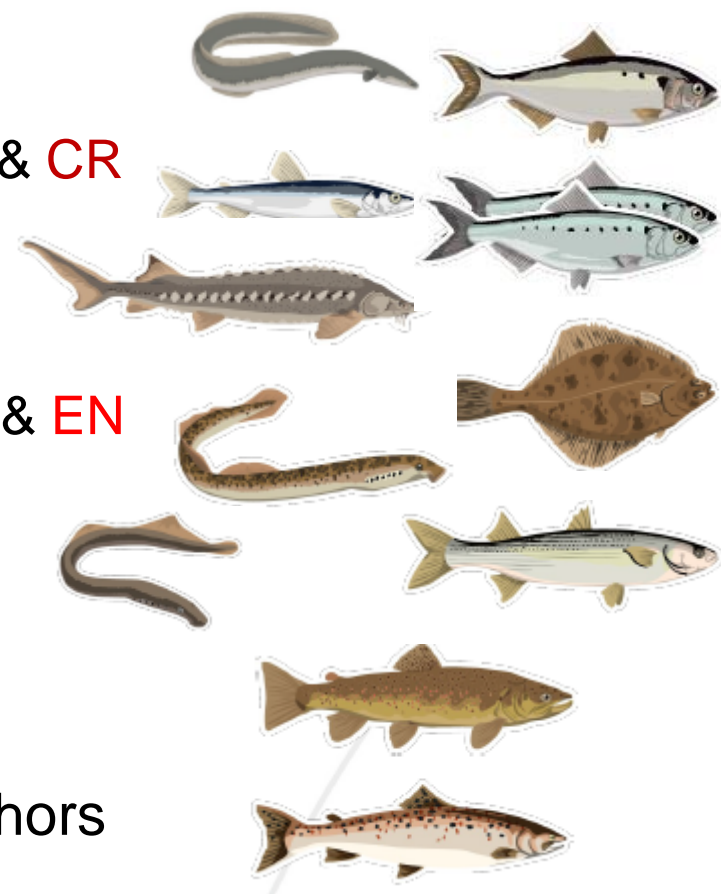


# Amphihalins considérés



Fr - 2019

- Anguille européenne\* - CR
- Aloses feintes\* et Grande alose\* - NT & CR
- Éperlan - NT
- Esturgeon européen\* - CR
- Flet - DD
- Lamproie fluviatile\* et Lamproie marine\* - VU & EN
- Mulet porc - LC
- Saumon atlantique\* - NT
- Truite de mer - LC



- **En aval des masses d'eau de transition (hors estuaires et lagunes)\***

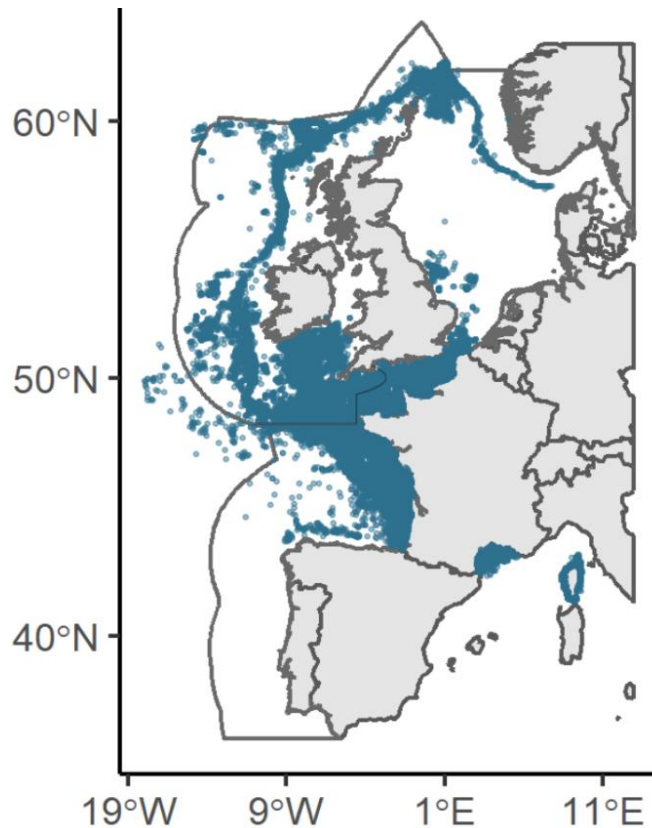
# Les campagnes

42 campagnes, 1965-2019, 168 904 traits

## Suivis des pêcheries

### OBSMER

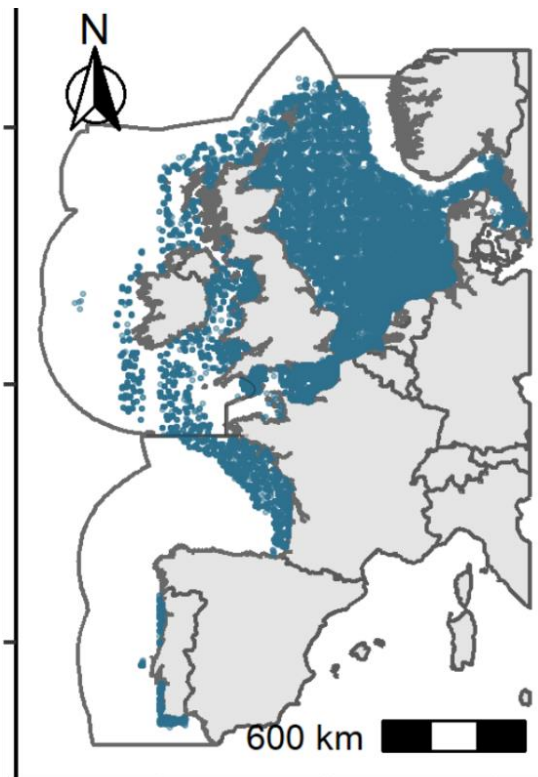
2003 – 2019, 100 617  
opération de pêche



## Campagnes scientifiques

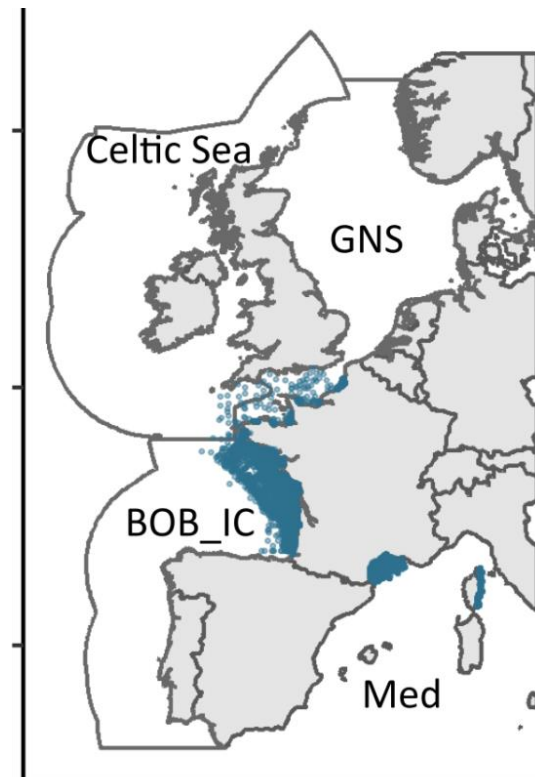
### CIEM DATRAS

1965 - 2018, 54 865 traits



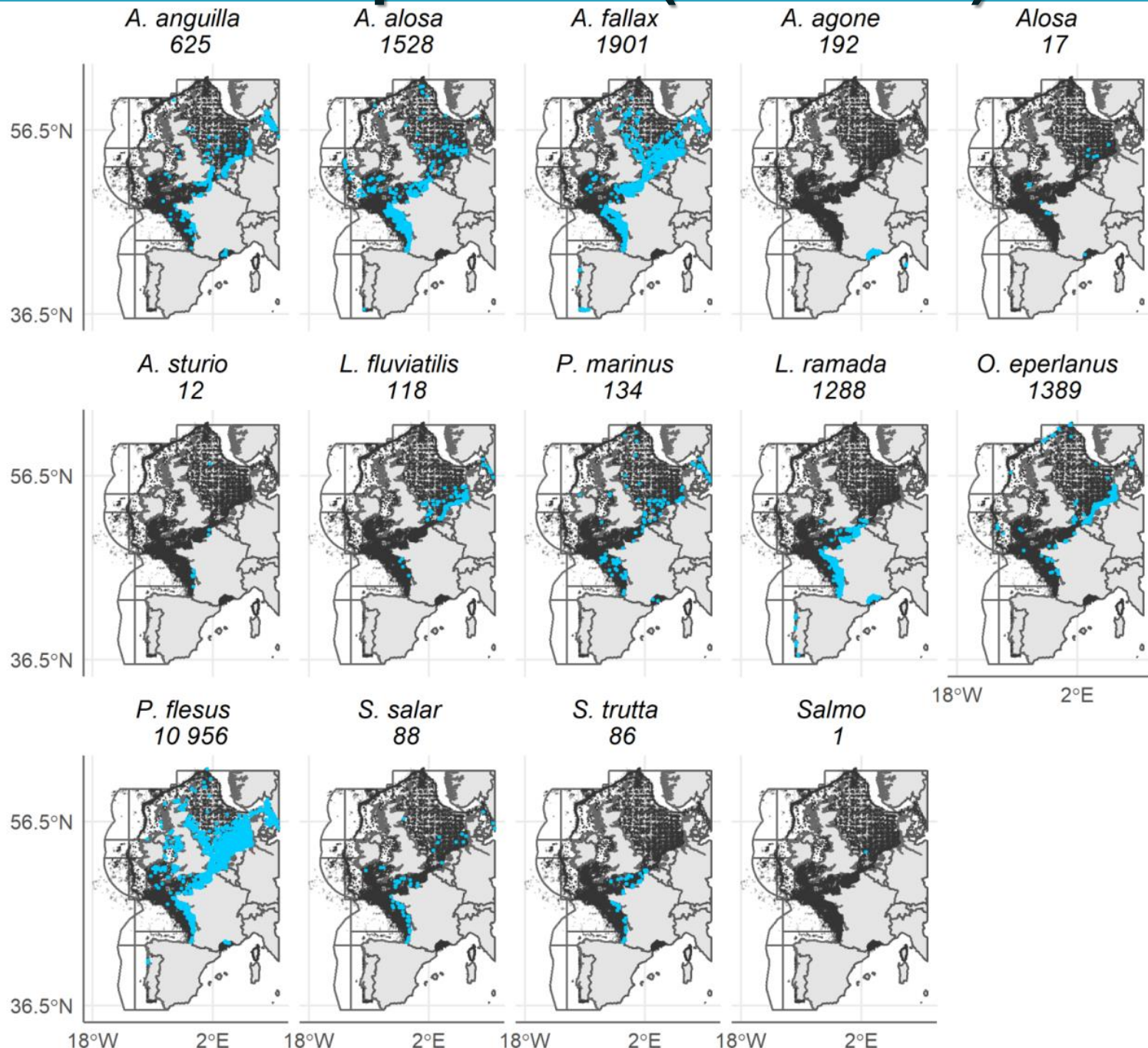
### IFREMER (hors DATRAS)

1980 - 2018, 13 422 traits



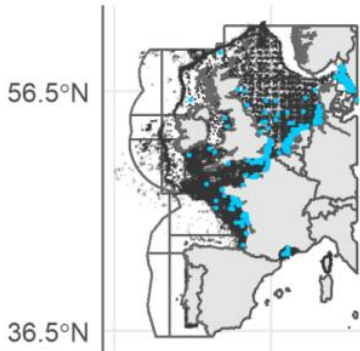
Noémie Deleys

# Présence des amphihalins (1965-2019)

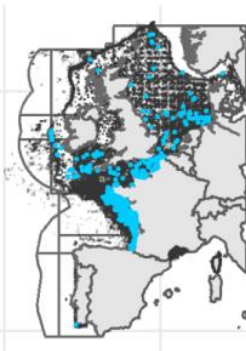


# Présence des amphihalins (1965-2019)

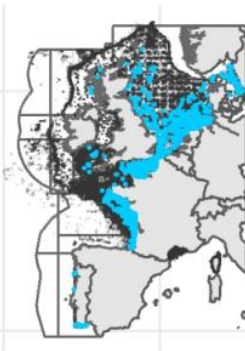
*A. anguilla*  
625



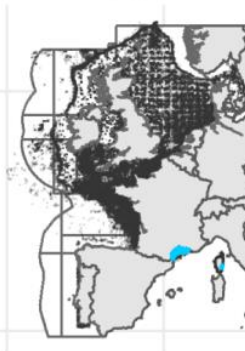
*A. alosa*  
1528



*A. fallax*  
1901



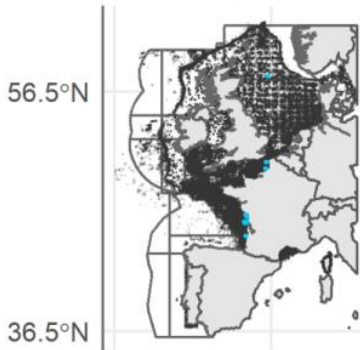
*A. agone*  
192



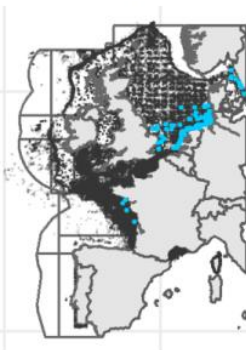
*Alosa*  
17



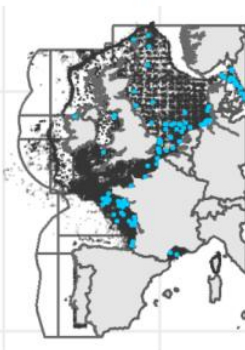
*A. sturio*  
12



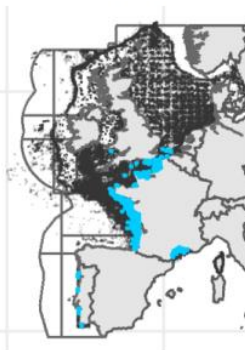
*L. fluviatilis*  
118



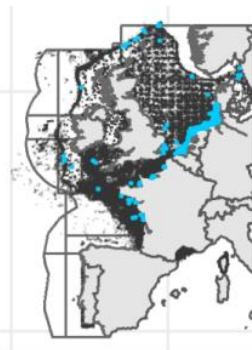
*P. marinus*  
134



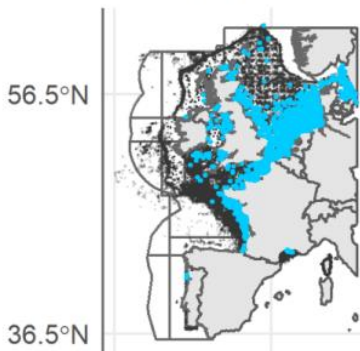
*L. ramada*  
1288



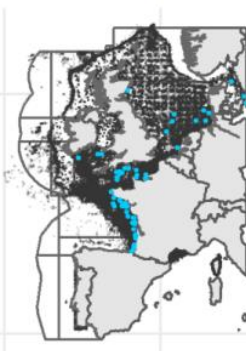
*O. eperlanus*  
1389



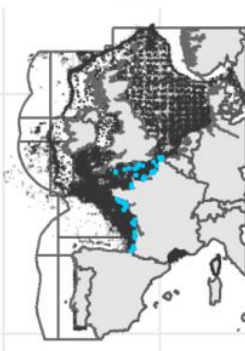
*P. flesus*  
10 956



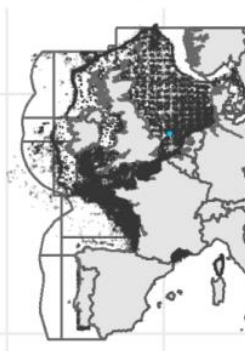
*S. salar*  
88



*S. trutta*  
86



*Salmo*  
1

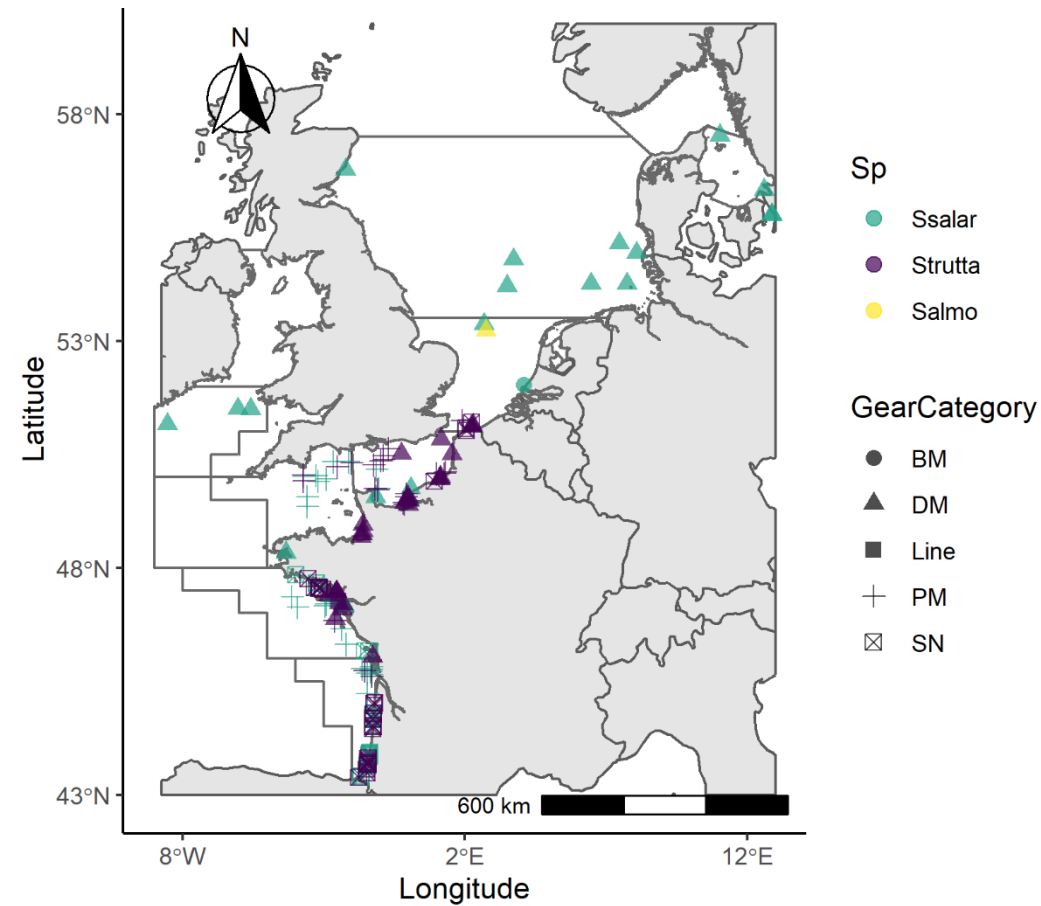


18°W 2°E

**Potentielle  
mauvaise identification**

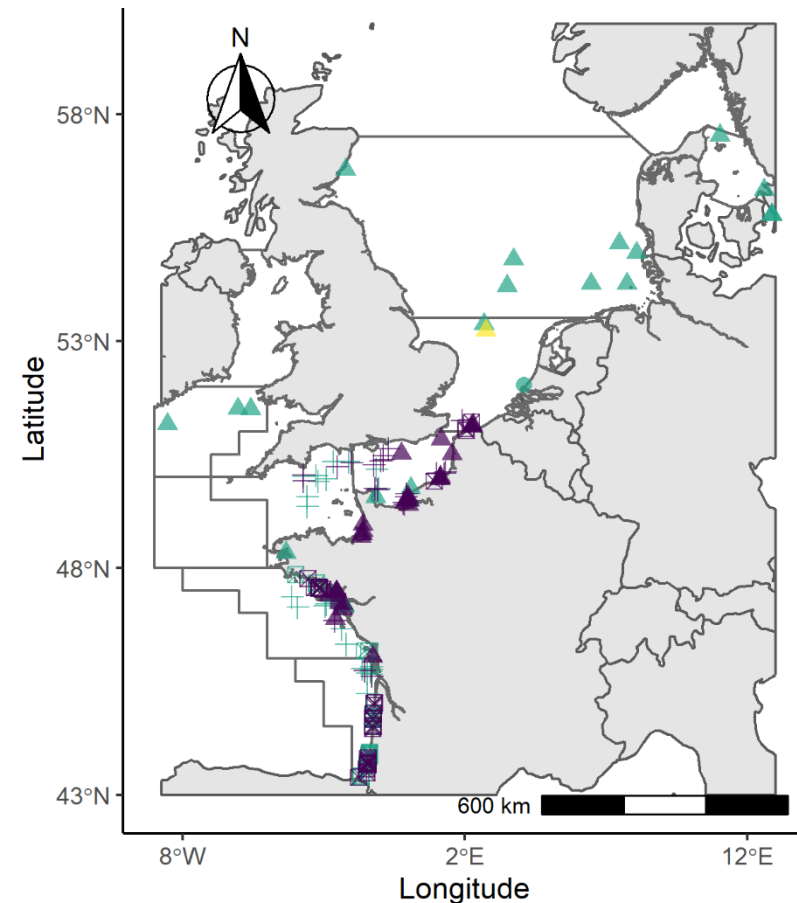


# 1) Modéliser la distribution des amphihalins en mer



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- Prendre en compte la détection imparfaite, l'effet de l'engin + autocorrélation spatiale.



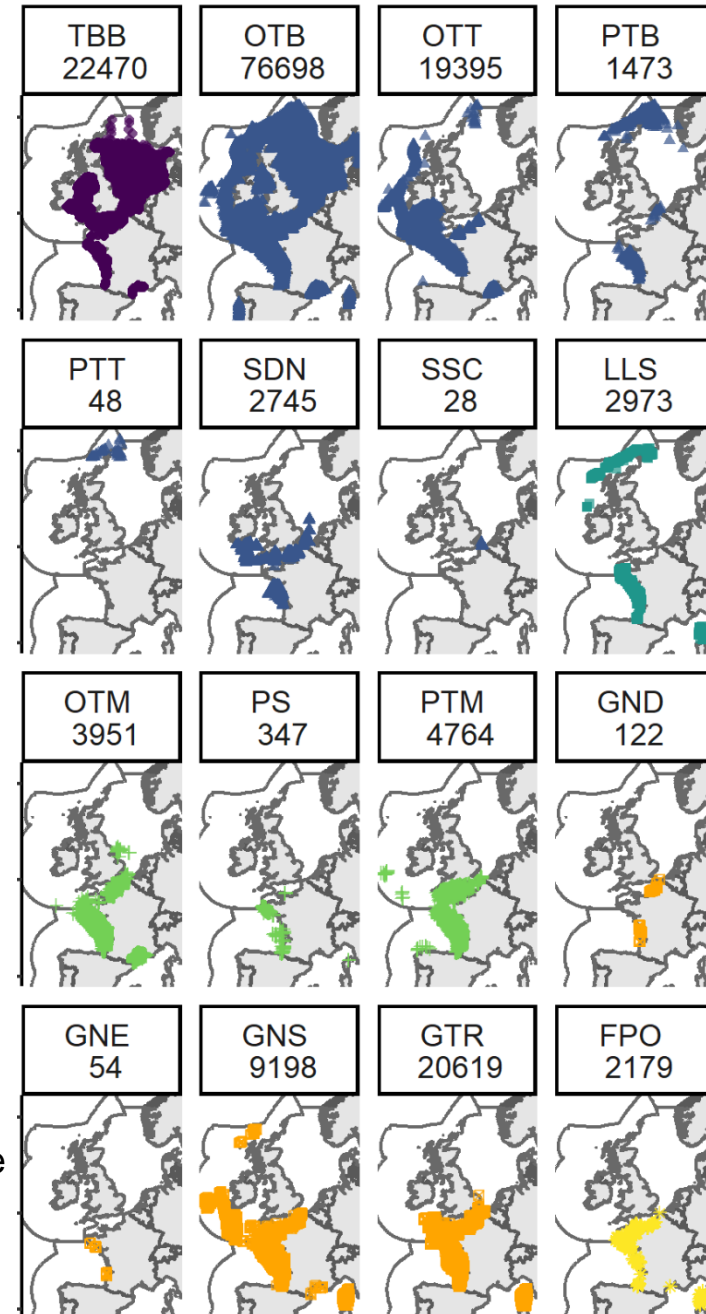
Sp

- Ssalar
- Strutta
- Salmo

GearCategory

- BM
- ▲ DM
- Line
- + PM
- ⊠ SN

- Benthic mobile
- Demersal mobile
- Line
- Pelagic mobile
- Static net



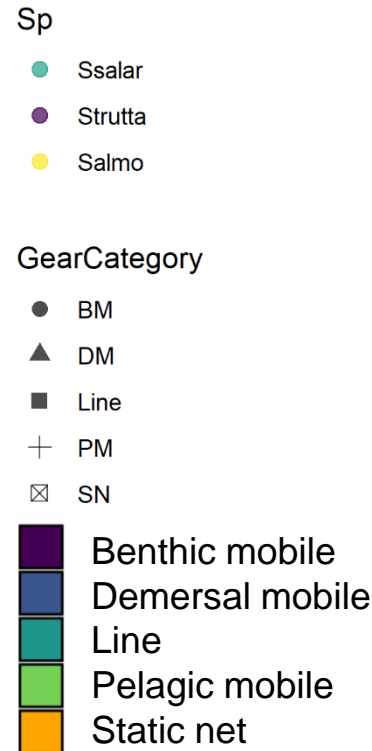
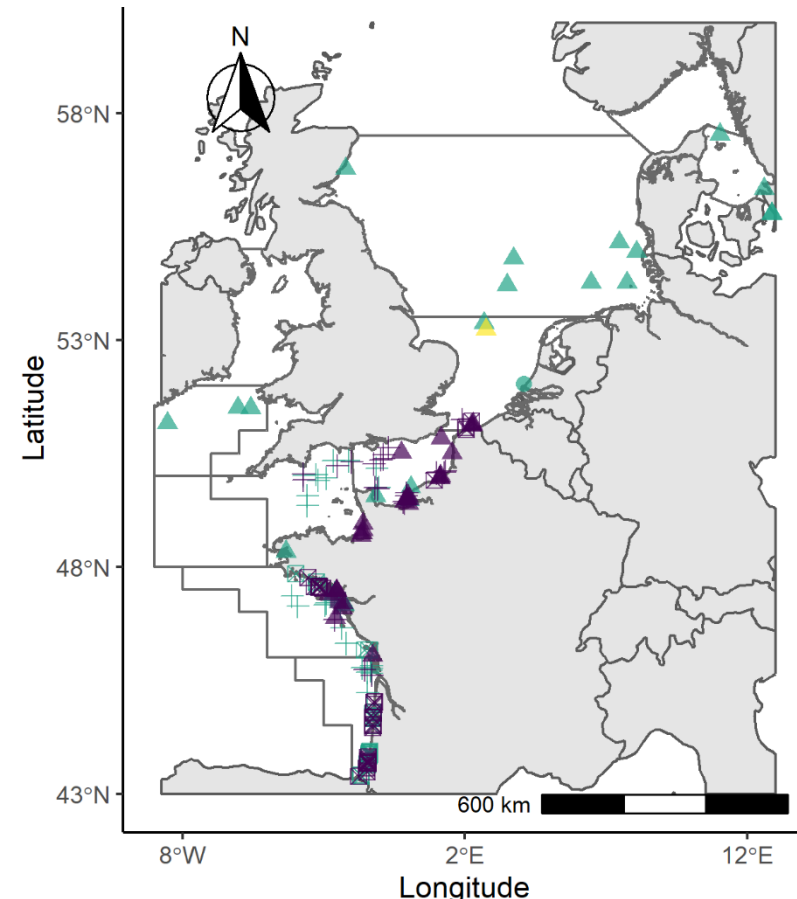
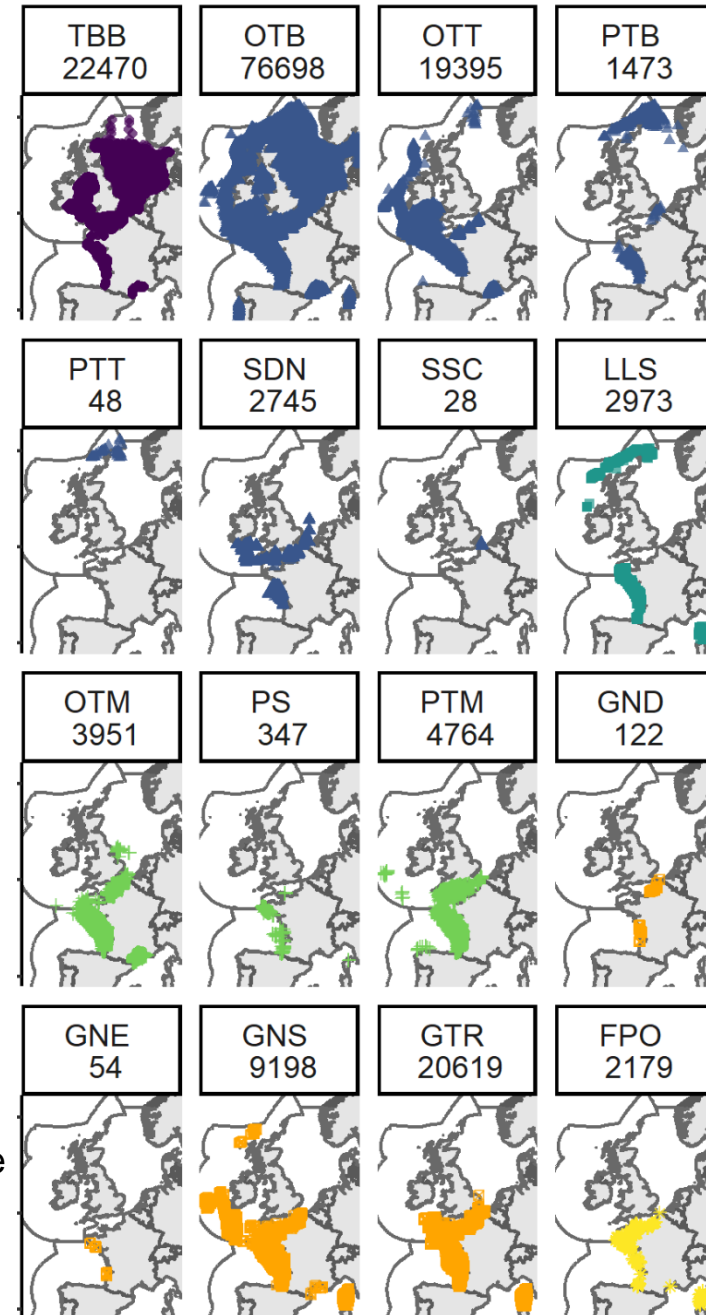


# 1) Modéliser la distribution des amphihalins en mer

- Prendre en compte la détection imparfaite, l'effet de l'engin + autocorrélation spatiale.

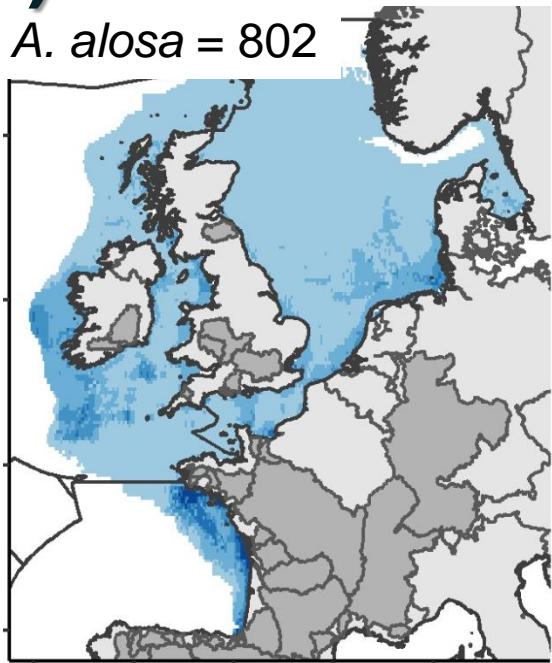


Site occupancy intrinsic conditional autoregressive model (hSDM)

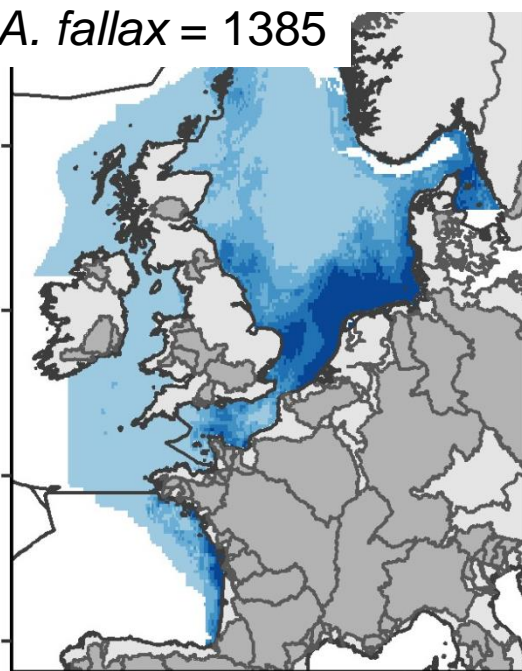


# 1) Les aloses hSDM

*A. alosa* = 802

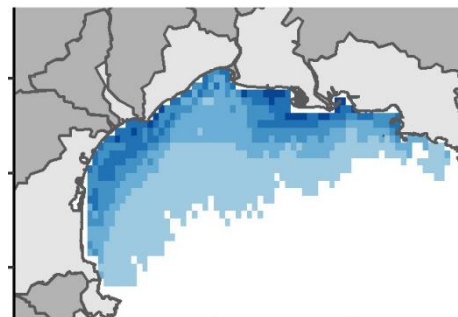


*A. fallax* = 1385

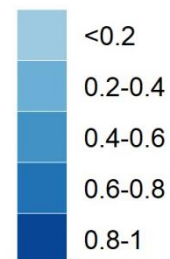


Continental presence: EuroDiad v. 4.0

*A. agone* = 176

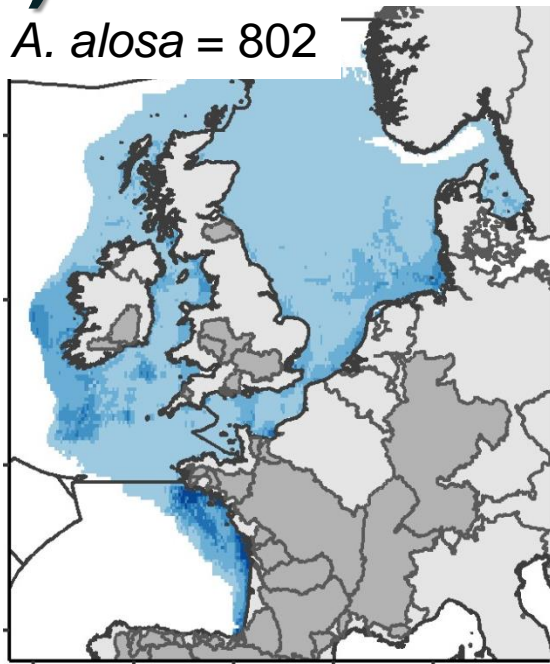


Probability of presence

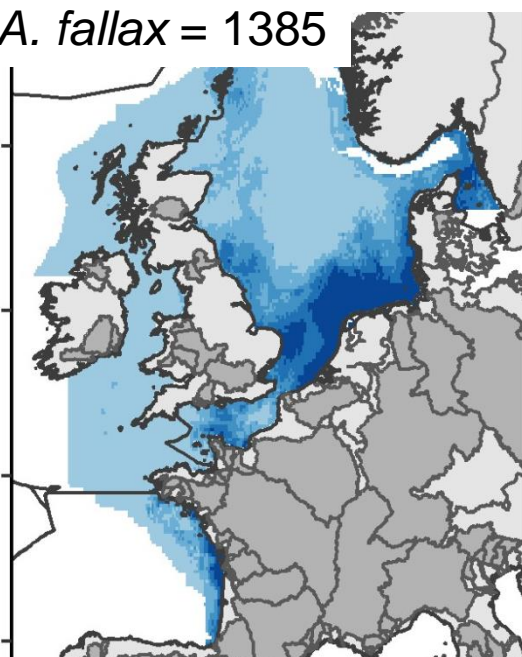


# 1) Les aloses hSDM

*A. alosa* = 802

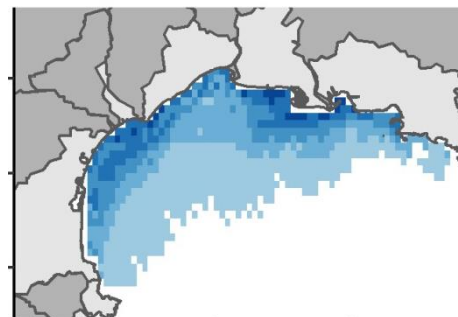


*A. fallax* = 1385

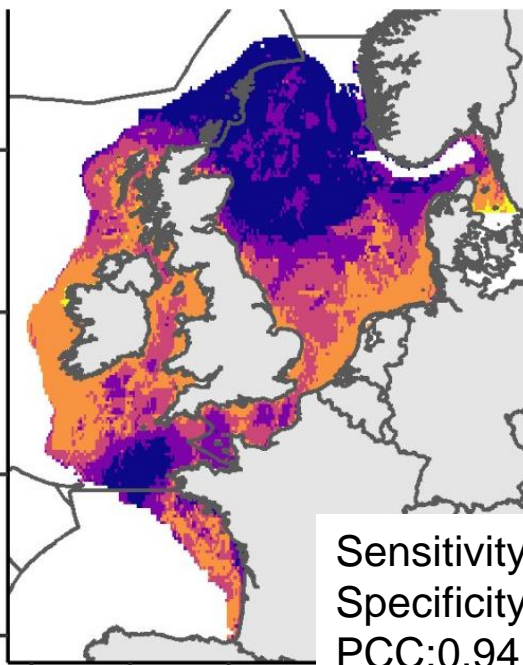
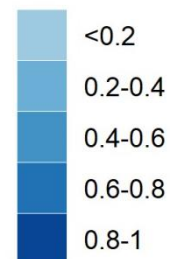


Continental presence: EuroDiad v. 4.0

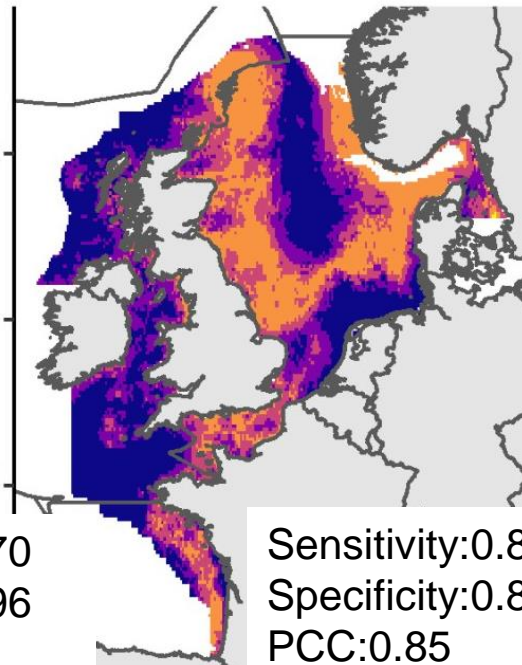
*A. agone* = 176



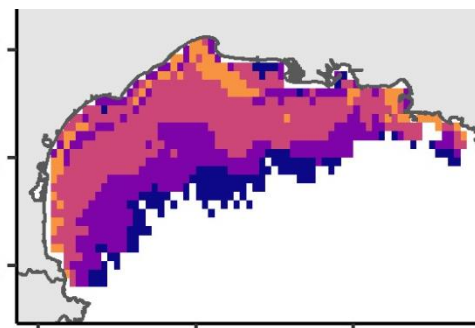
Probability of presence



Sensitivity:0.70  
Specificity:0.96  
PCC:0.94

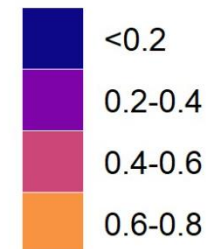


Sensitivity:0.81  
Specificity:0.85  
PCC:0.85



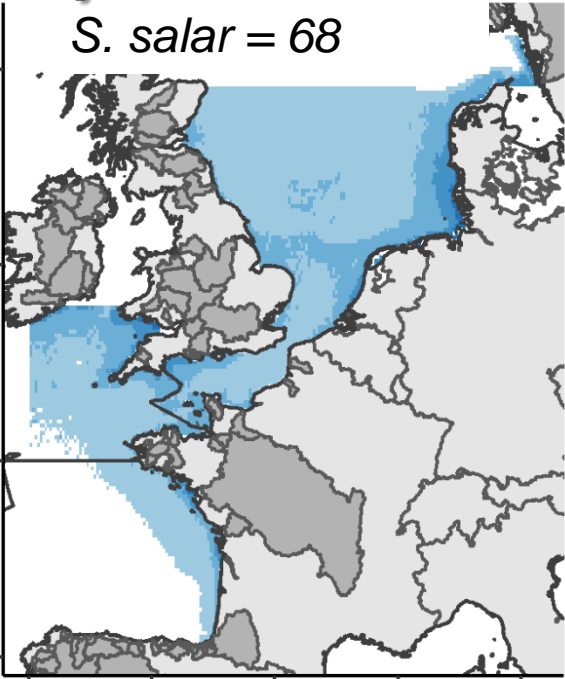
Sensitivity:0.72  
Specificity:0.82  
PCC:0.81

Uncertainty

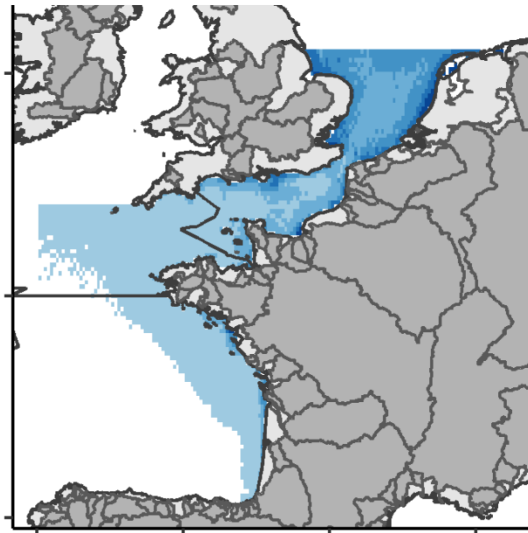


# 1) Salmonids hSDM

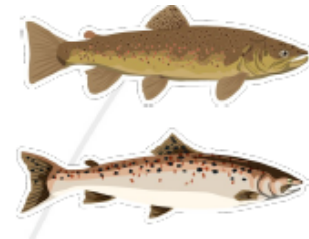
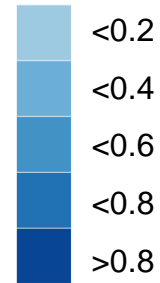
*S. salar* = 68



*S. trutta* = 63



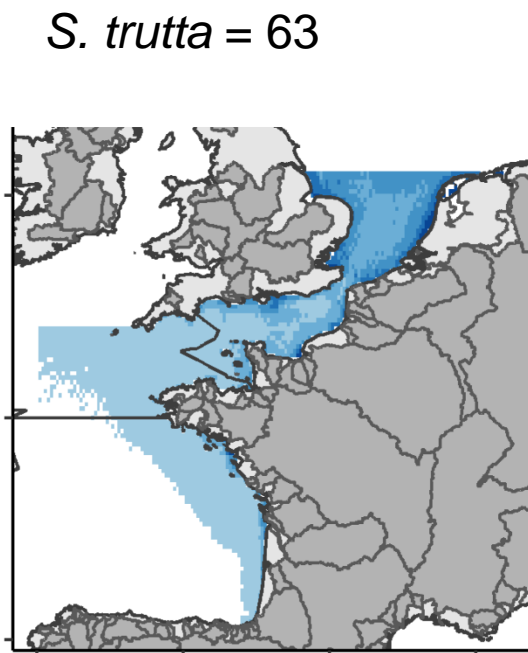
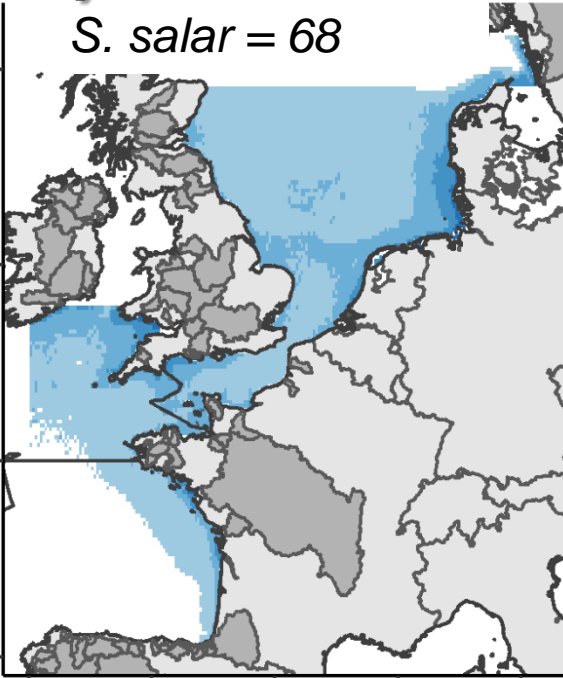
Presence  
probability



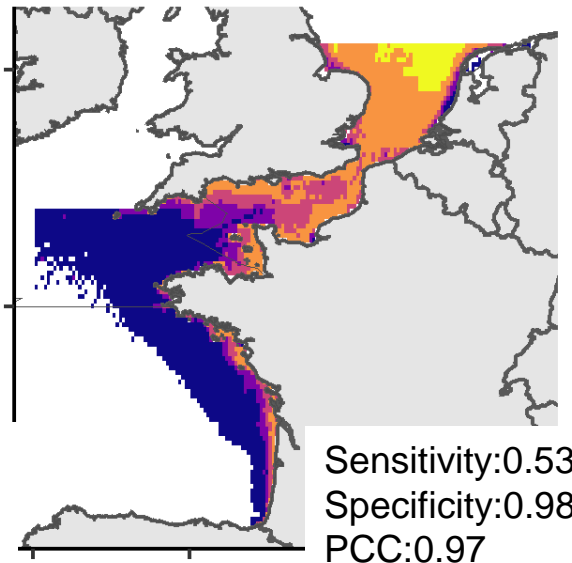
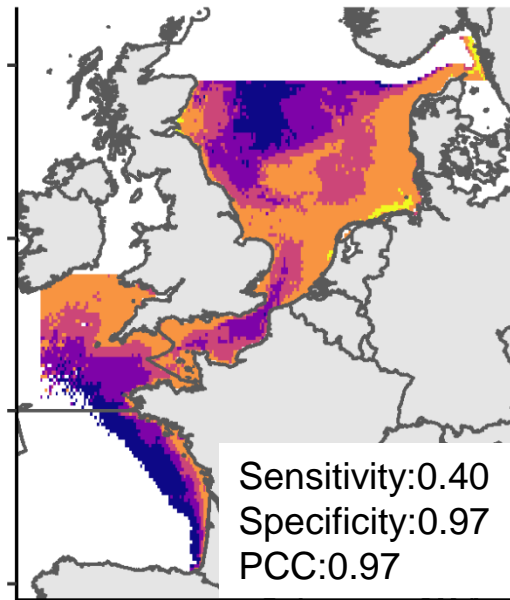
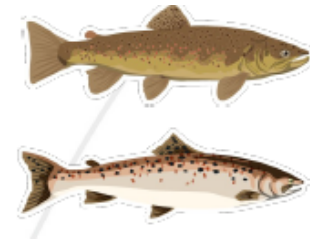
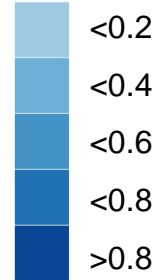
# 1) Salmonids hSDM

*S. salar* = 68

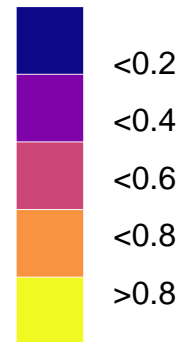
*S. trutta* = 63



Presence probability

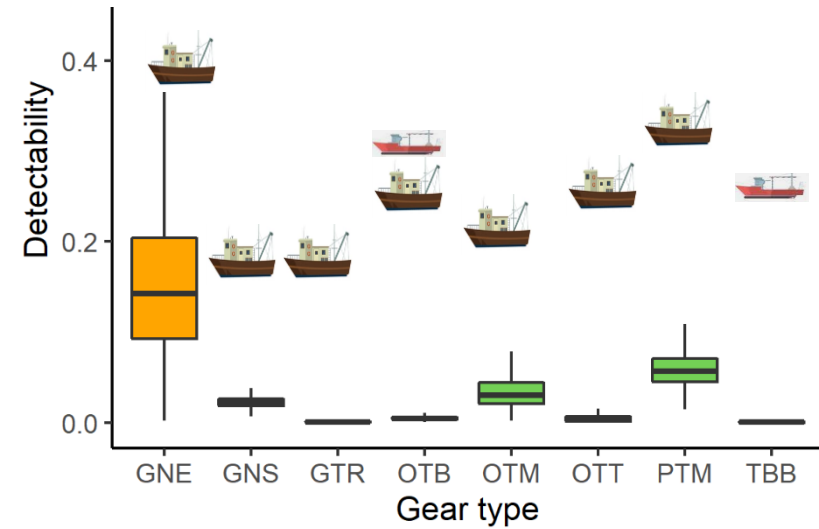


Uncertainty

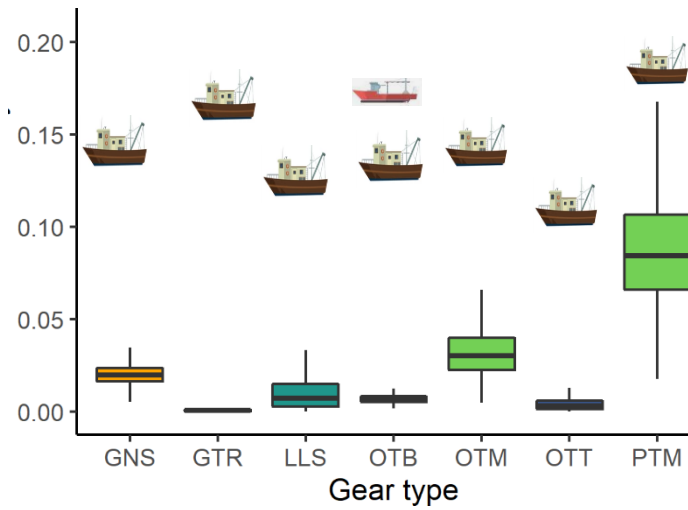


# Salmonidés – capture pars type d'engins

## *S. salar*



## *S. trutta*

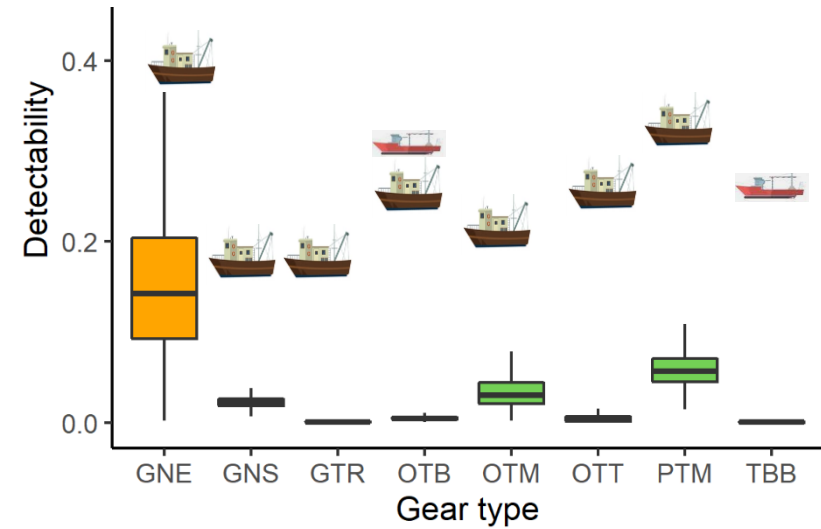


### Gear type

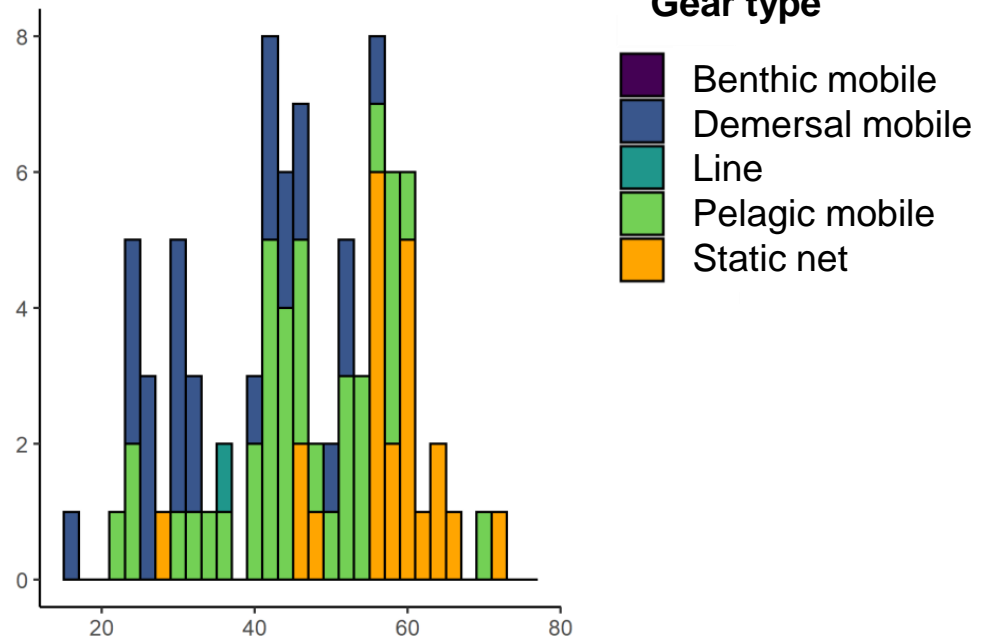
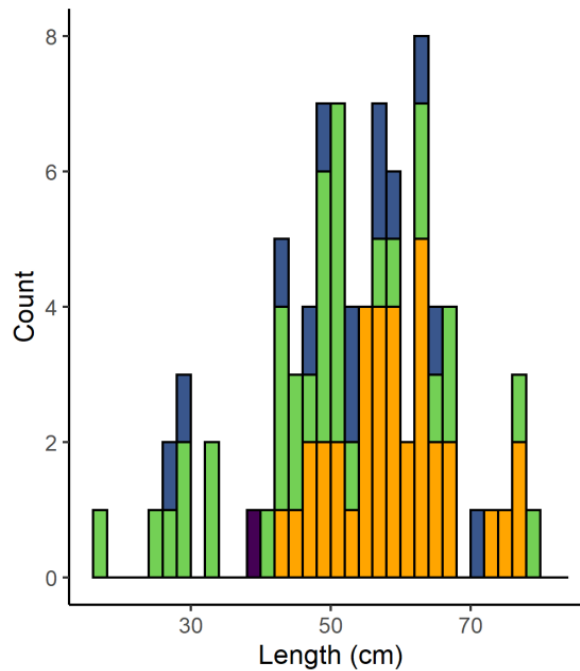
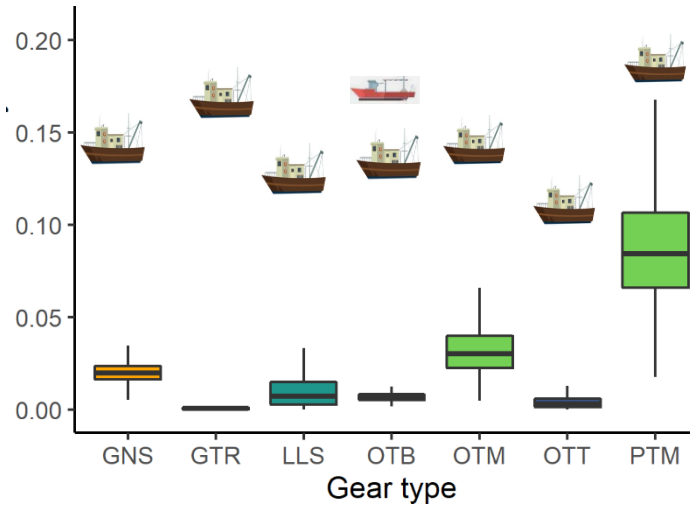
- Benthic mobile
- Demersal mobile
- Line
- Pelagic mobile
- Static net

# Salmonidés – capture pars type d'engins

## *S. salar*



## *S. trutta*



### Gear type

- Benthic mobile
- Demersal mobile
- Line
- Pelagic mobile
- Static net

## 2) Analyse Risque Pêche espèce

Données ObsMer + littérature



Gear category	Fishing gear abbreviations	Lamprey		Shad		Salmonids		<i>A. anguilla</i>	
Surrounding nets	<u>PS</u>	1		1		1		1	
Seines net	<u>SSC</u> , <u>SDN</u>	1		1	3#	1		1	
Trawls	<u>OTB</u> , <u>OTT</u> , <u>OTM</u> , <u>PTB</u> , <u>PTM</u> , <u>TBB</u>	2		2	3#	2	3#	2	3*#
Dredge	<u>DRB</u>	1		1		1		1	
Gillnets	<u>GND</u> , <u>GNC</u> , <u>GNE</u> , <u>GNS</u> , <u>GTR</u>	3*	2#	3#		3#		1	2

Acou et al., 2021

3
2
1



Risque

\* ciblé

# débarqué



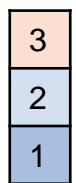
# 2) Analyse Risque Pêche espèce

Données ObsMer + littérature



Gear category	Fishing gear abbreviations	Lamprey		Shad		Salmonids		<i>A. anguilla</i>	
Surrounding nets	<u>PS</u>	1		1		1		1	
Seines net	<u>SSC</u> , <u>SDN</u>	1		1	3#	1		1	
Trawls	<u>OTB</u> , <u>OTT</u> , <u>OTM</u> , <u>PTB</u> , <u>PTM</u> , <u>TBB</u>	2		2	3#	2	3#	2	3*#
Dredge	<u>DRB</u>	1		1		1		1	
Gillnets	<u>GND</u> , <u>GNC</u> , <u>GNE</u> , <u>GNS</u> , <u>GTR</u>	3*	2#	3#		3#		1	2

Acou et al., 2021

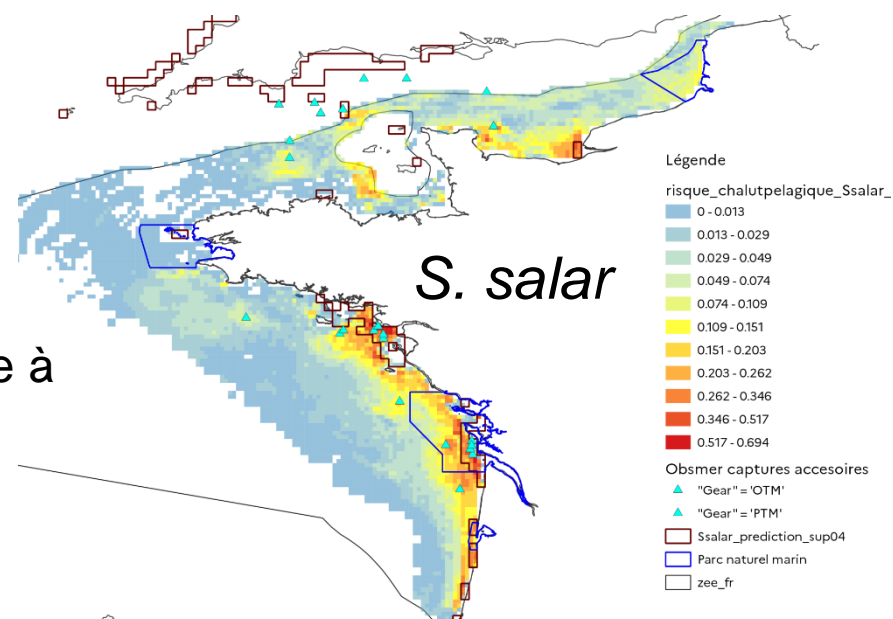


Risque

\* ciblé  
# débarqué

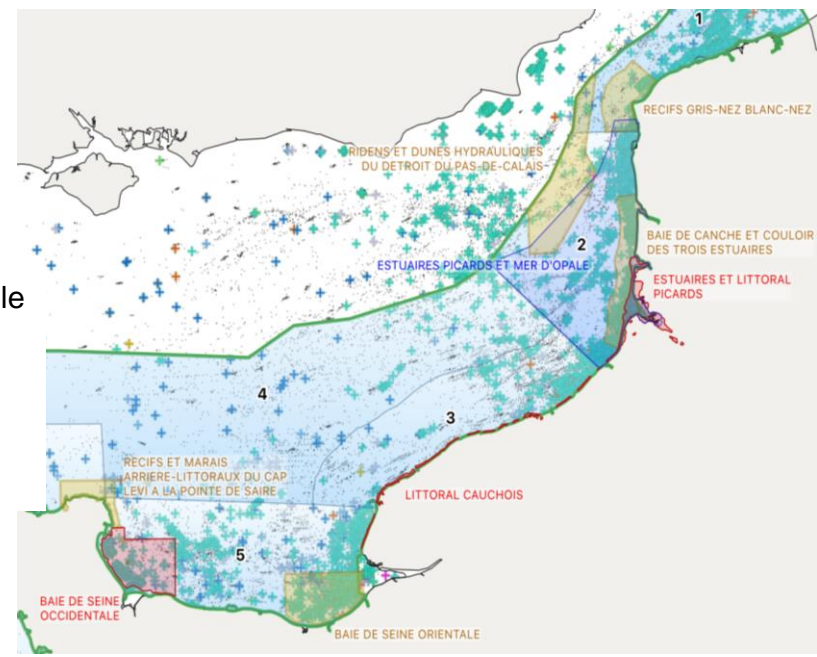
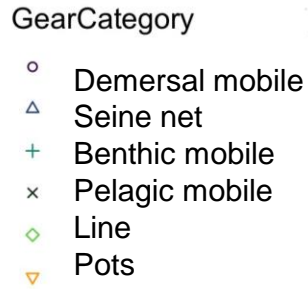
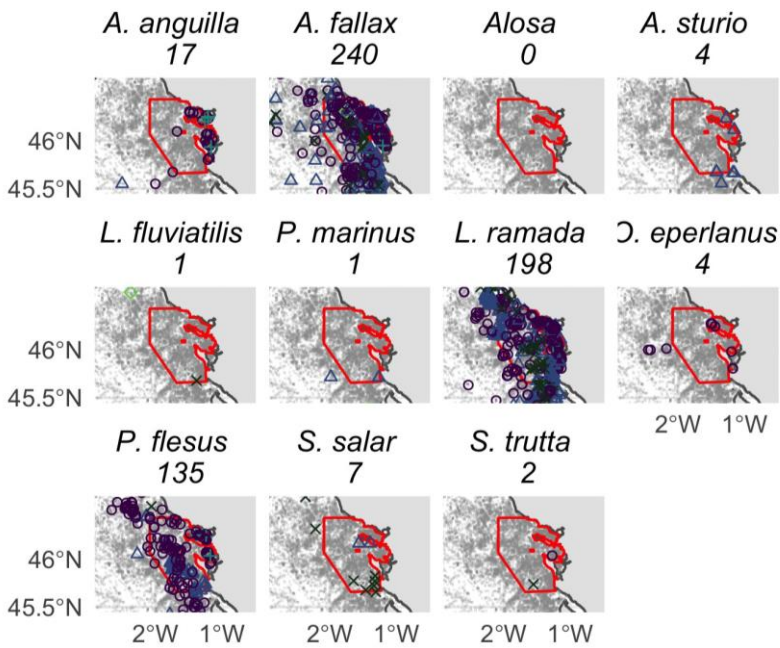
Prochain étape:

- V. Toison et al., Evaluer la pression de pêche à partir des modèles hSDM + effort de pêche.



# 3) Modéliser la distribution des amphihalins à une plus fine résolution

- Maximiser la précision des SDM pour évaluer la pertinence des AMP.
- Apporter des éléments d'aide à la décision pour la gestion des AMP.

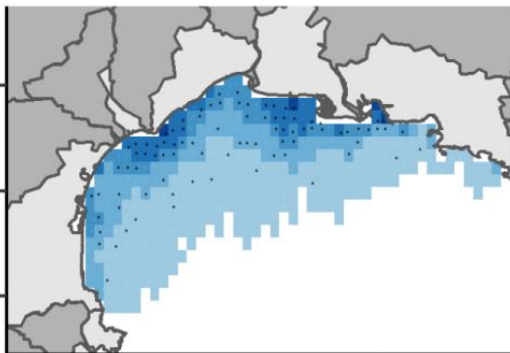


# 3) Précision des SDM

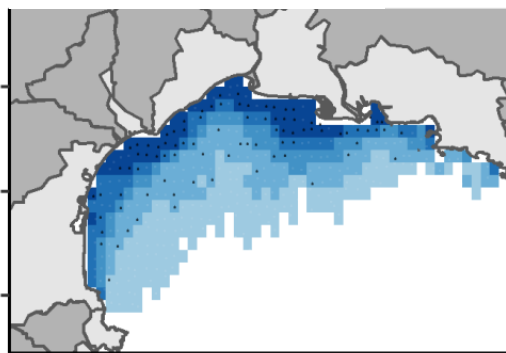
Analyse comparative de la précision des prédictions de différents modèles:

1. Gridded binomial (BN) iCAR
2. Zero inflated binomial (ZIB) iCAR
3. Site occupancy (SO) iCAR
4. Integrated Nested Laplace Approximation ZIB

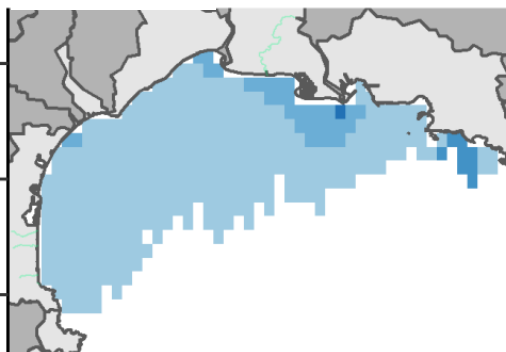
**Gridded BN iCAR**



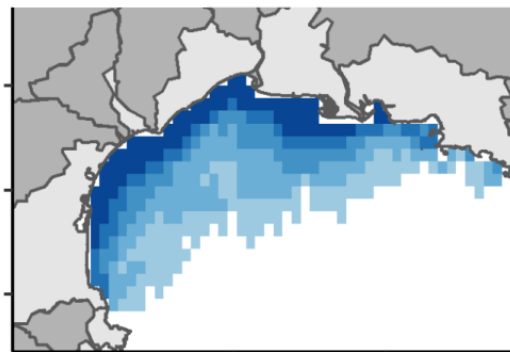
**Gridded ZIB iCAR**



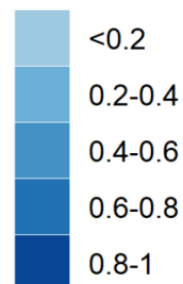
**INLA ZIB**



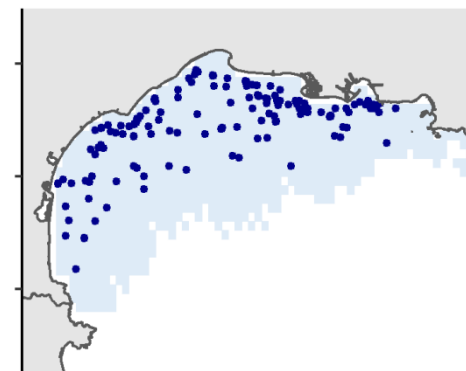
**SO iCAR**



PredCat

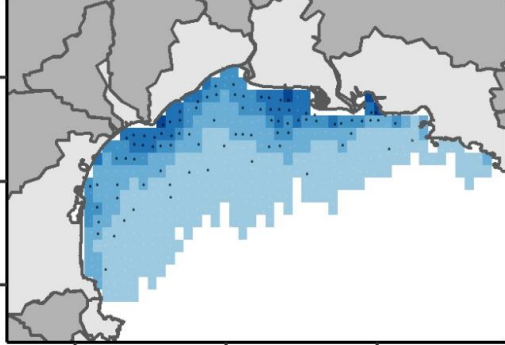


*Alosa agone*

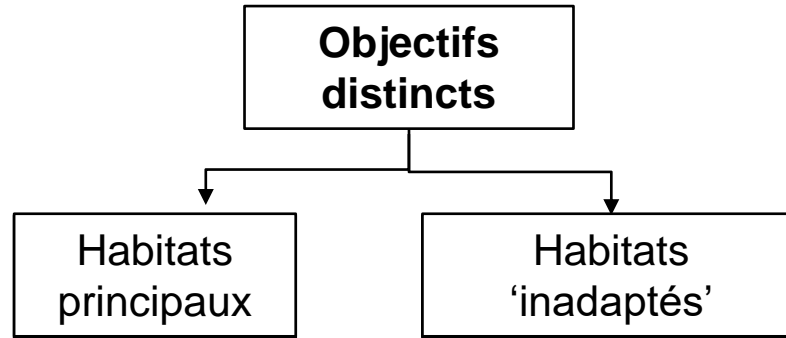
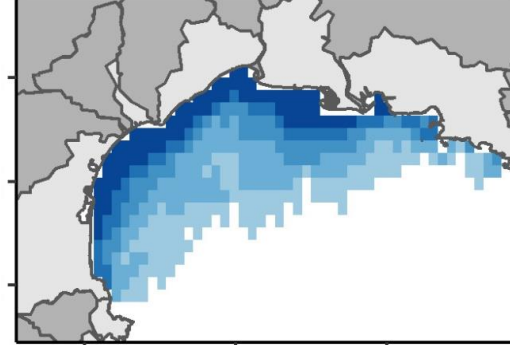


# 3) Combined Model for Accurate Predictions (CMAP)

BN iCAR

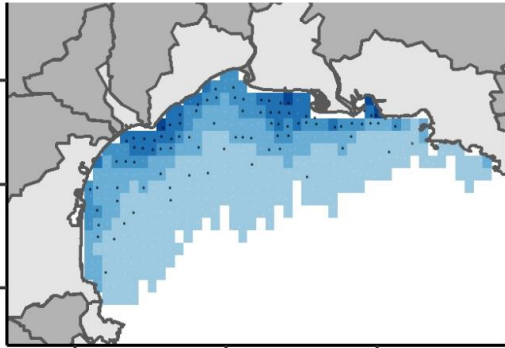


SO iCAR

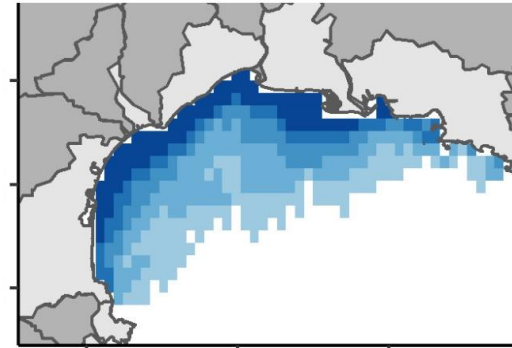


# 3) Combined Model for Accurate Predictions (CMAP)

BN iCAR



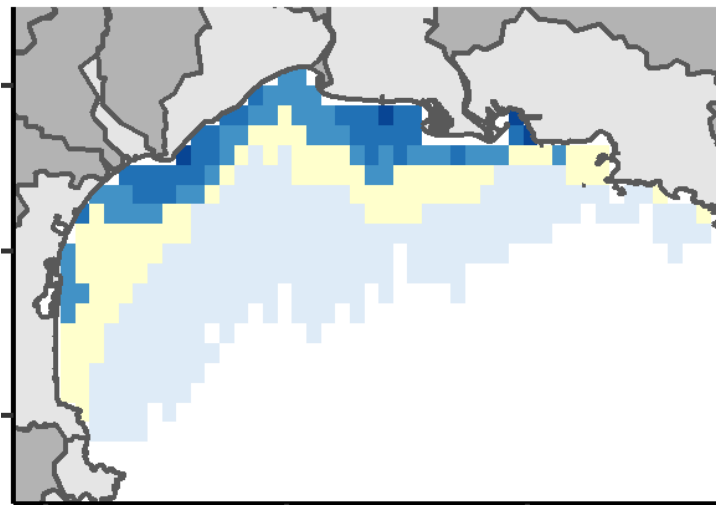
SO iCAR



Objectifs  
distincts

Habitats  
principaux

Habitats  
'inadaptés'



<0.2

0.2-0.4

0.4-0.6

0.6-0.8

0.8-1

Uncertain

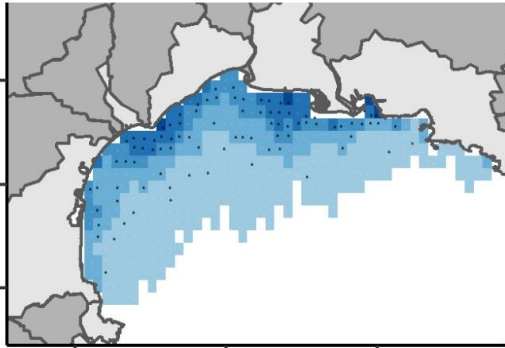
SO iCAR

BN iCAR

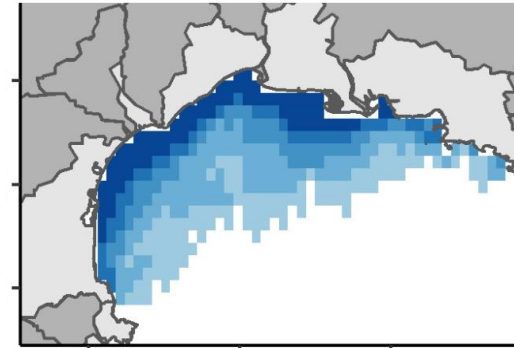
SO iCAR > 0.4 +  
BN iCAR < 0.4

# 3) Combined Model for Accurate Predictions (CMAP)

BN iCAR



SO iCAR

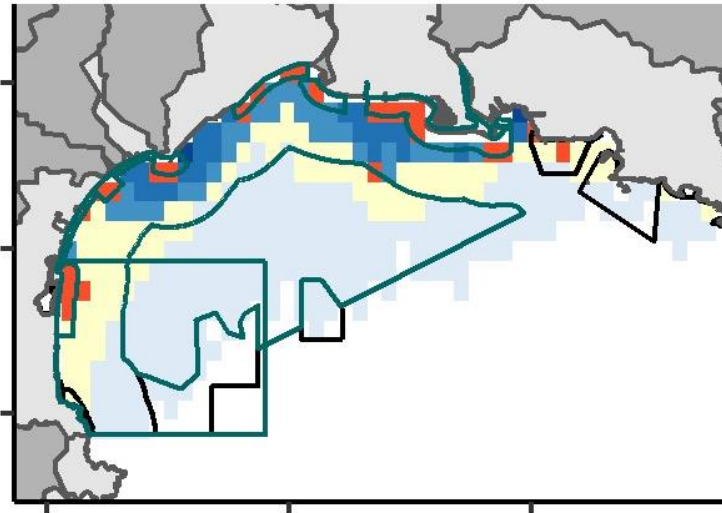


Objectifs  
distincts

Habitats  
principaux

Habitats  
'inadantés'

Sans mesures  
Avec des mesures



<0.2

0.2-0.4

0.4-0.6

0.6-0.8

0.8-1

Uncertain

SO iCAR

BN iCAR

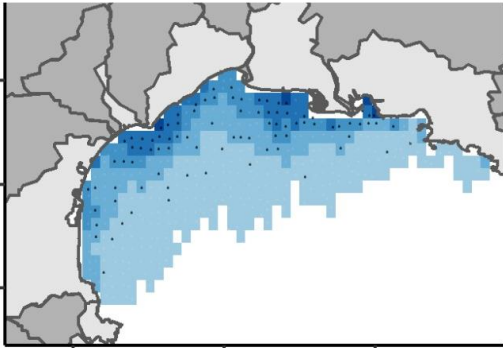
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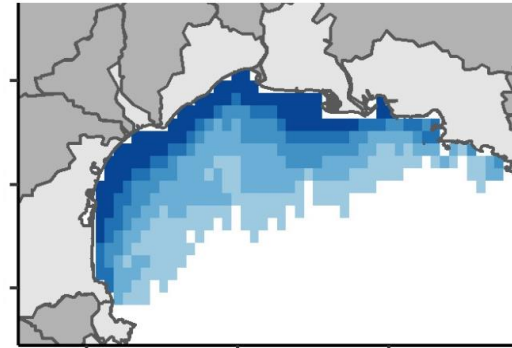
Habitats principaux dans  
des AMP

# 3) Combined Model for Accurate Predictions (CMAP)

BN iCAR



SO iCAR

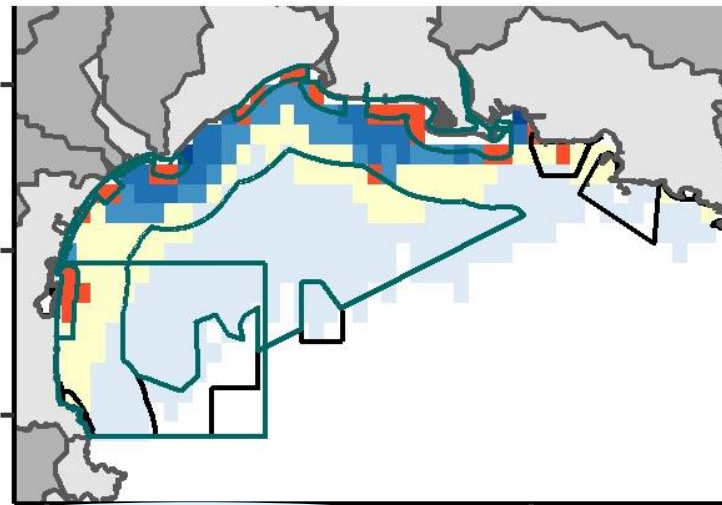


Objectifs  
distincts

Habitats  
principaux

Habitats  
'inadaptés'

— Sans mesures  
— Avec des mesures



<0.2

0.2-0.4

0.4-0.6

0.6-0.8

0.8-1

Uncertain

SO iCAR

BN iCAR

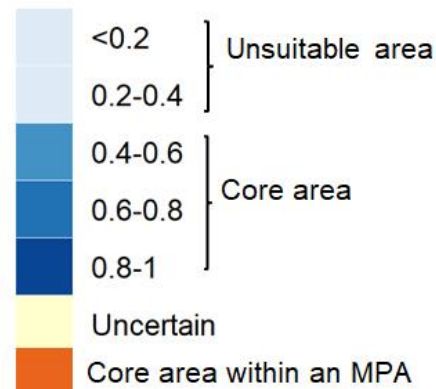
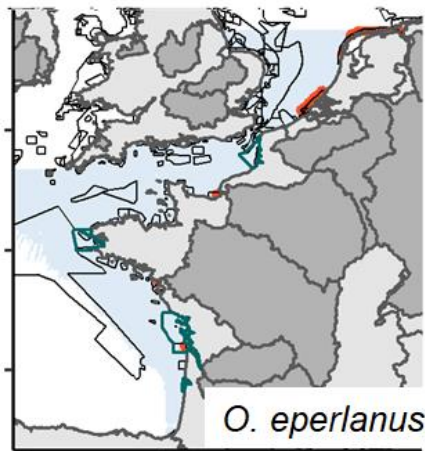
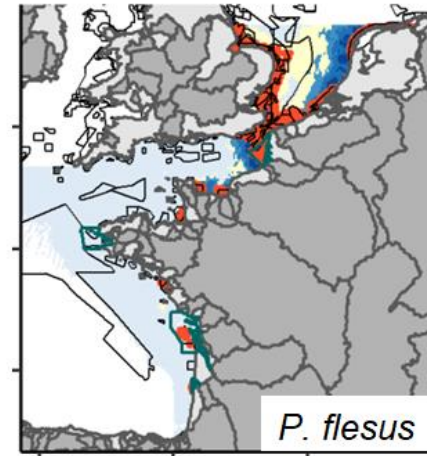
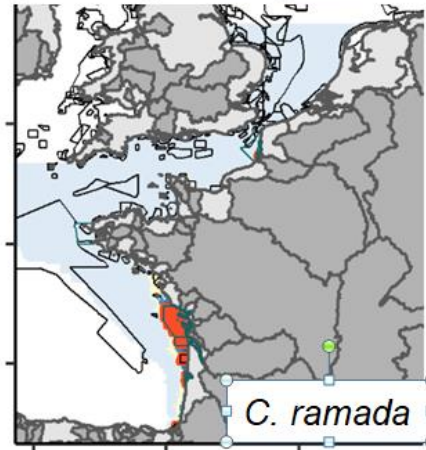
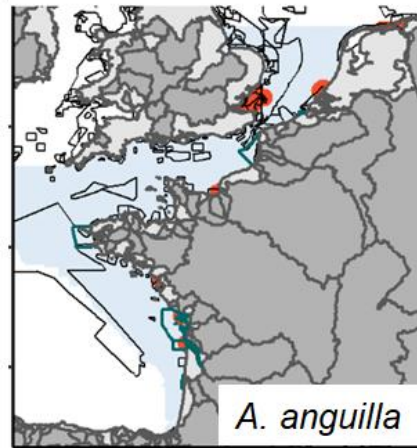
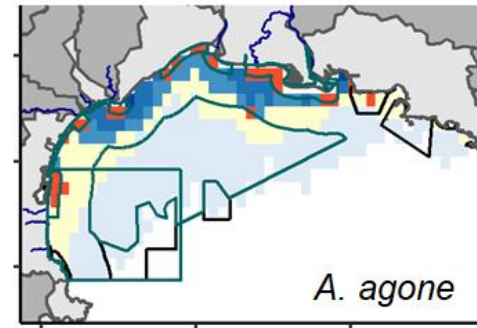
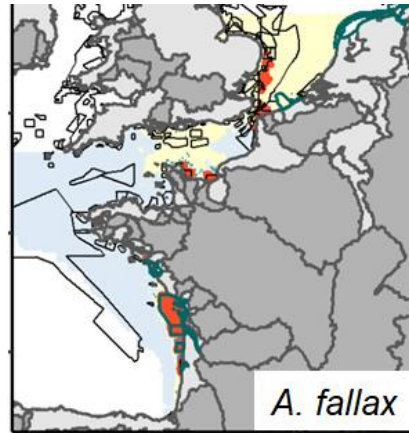
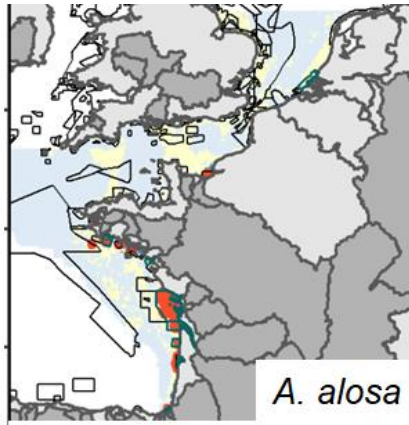
SO iCAR > 0.4 +  
BN iCAR < 0.4



Habitats principaux dans  
des AMP

- **Evaluer la pertinence du réseau d'AMP**
- **Maximiser la protection en minimisant les impacts sur les usagers**

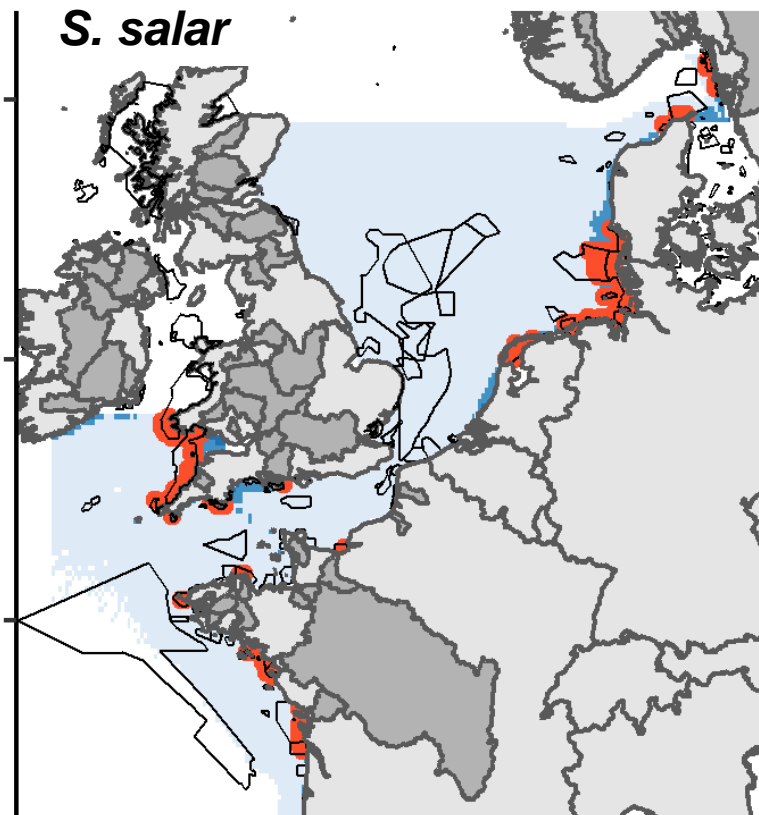
# 3) Combined Model for Accurate Predictions (CMAP)



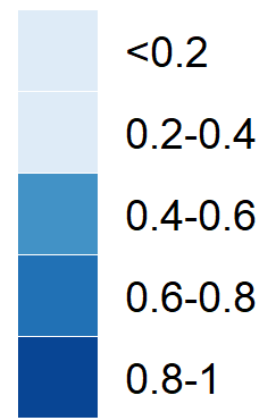
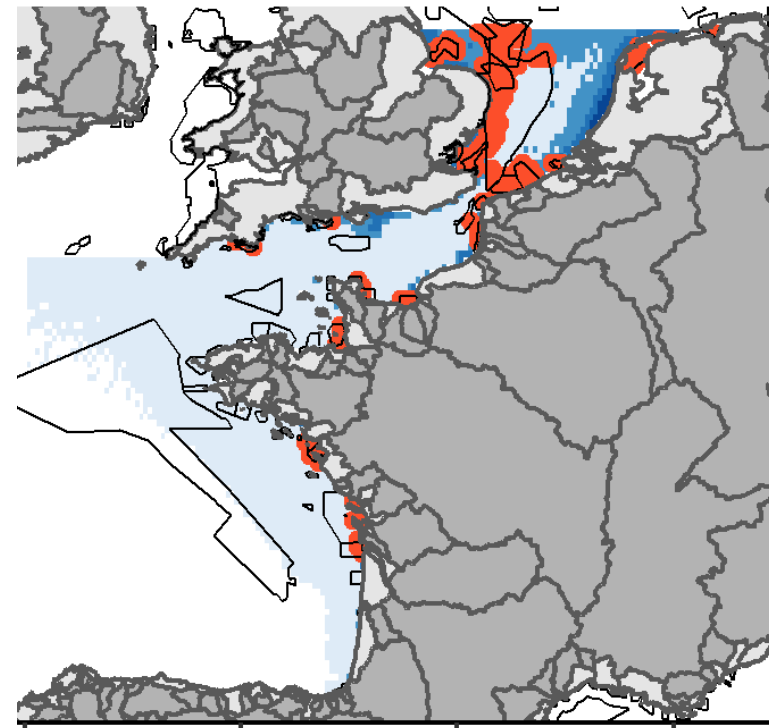


# Pertinence des Sites d'Importance Communautaire - hSDM

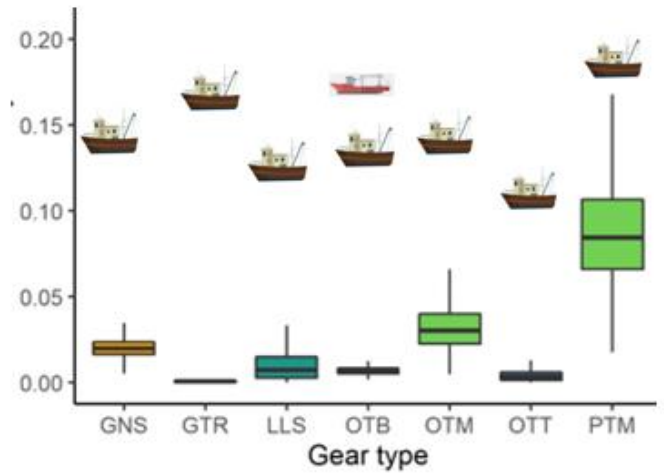
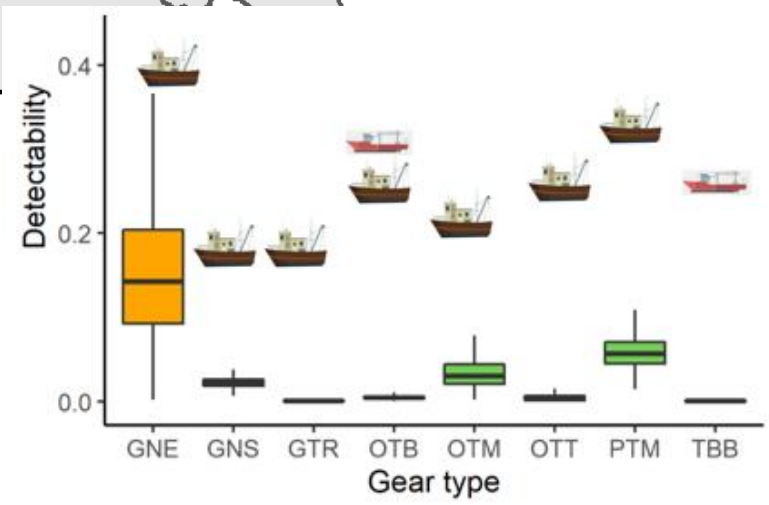
*S. salar*



*S. trutta*

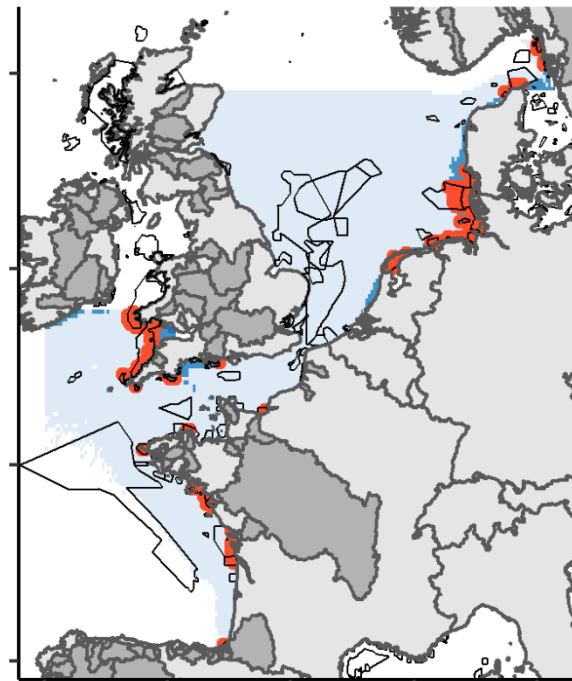
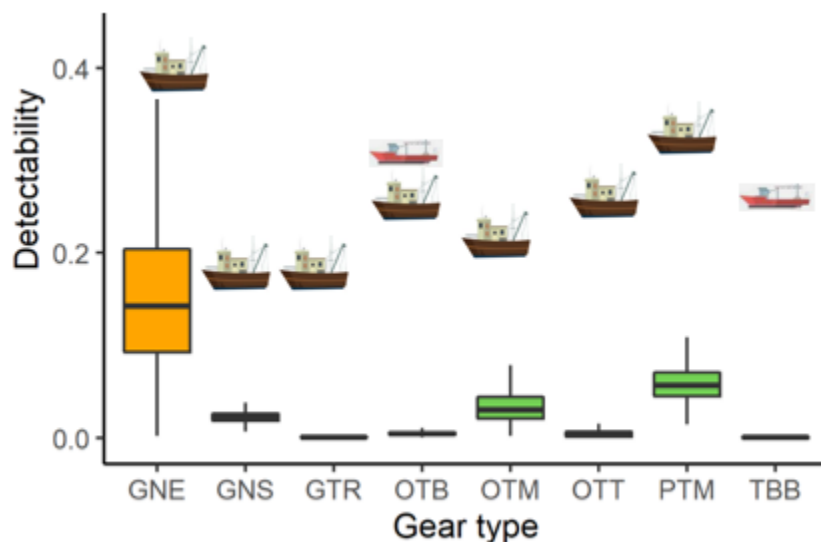
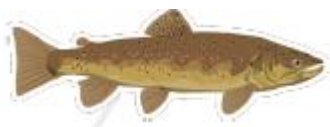


Habitats principaux dans des SIC



# Conclusion

- Modèle hSDM (détection imparfaite) - plus adapté pour des données avec un excès de zéros.
- CMAP est plus précis pour des gestions spatiale.
- Capturé principalement par des chaluts et des engins statiques.
- Les AMP avec des mesures de gestion de pêche pourrait apporter de la protection aux amphihalins.
- Les AMP connectées aux habitats d'eau douce plus efficaces pour leur protection.
- Les salmonidés en mer restent dans les zones côtières.
- Nécessité de quantifier la mortalité spécifique des engins !



# Outputs

1. Elliott et al, 2021. Shedding light on the river and sea lamprey within western European waters. Endangered species research. DOI:10.3354/esr01113.
2. Elliott et al, In review. Modelling the distribution of rare diadromous fish at sea for protected area management. Biological Conservation.
3. Elliott et al, In review. Data paper: Fisheries dependent and independent data used to model the distribution of diadromous fish. Biological Conservation.
4. Elliott et al, In prep. Accurately predicting data-limited species distribution for spatial protection.
5. Acou et al, 2021. Matrice d'interaction entre espèces amphihalines et activité de pêche dans le milieu marin. OFB.
6. Dambrine et al, In prep. Connecting diadromous fish freshwater and marine habitats to assess climate change vulnerability.



# Merci! Question?

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Pôle AFB-INRA-Institut Agro-UPPA pour la  
gestion des migrateurs amphihalins dans  
leur environnement

