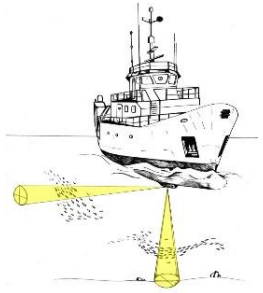
Small Pelagic Fish Symposium
9th November 2022

Habitat suitability modelling and impact of environmental factors on the distribution of *Sprattus sprattus* in the Adriatic Sea



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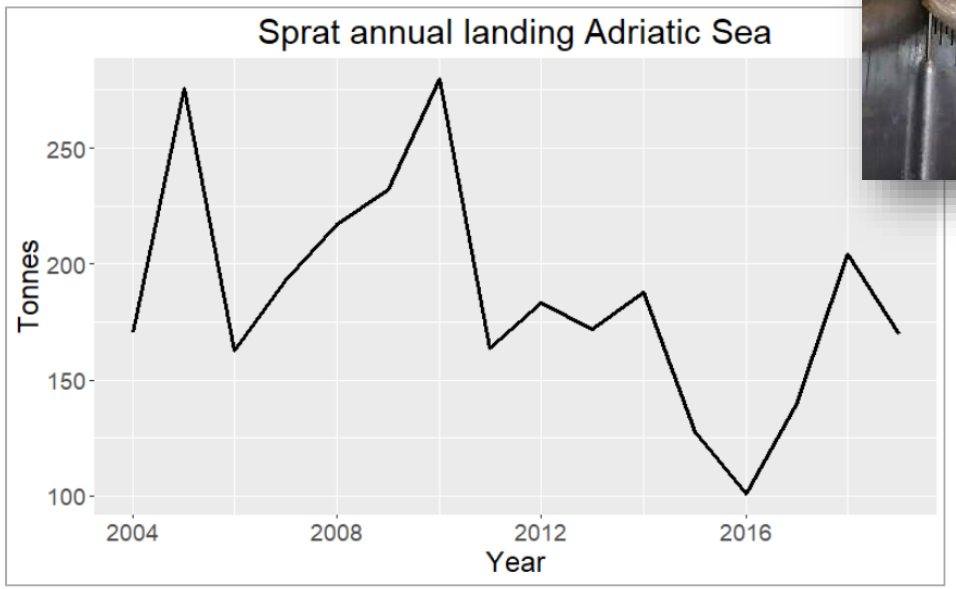
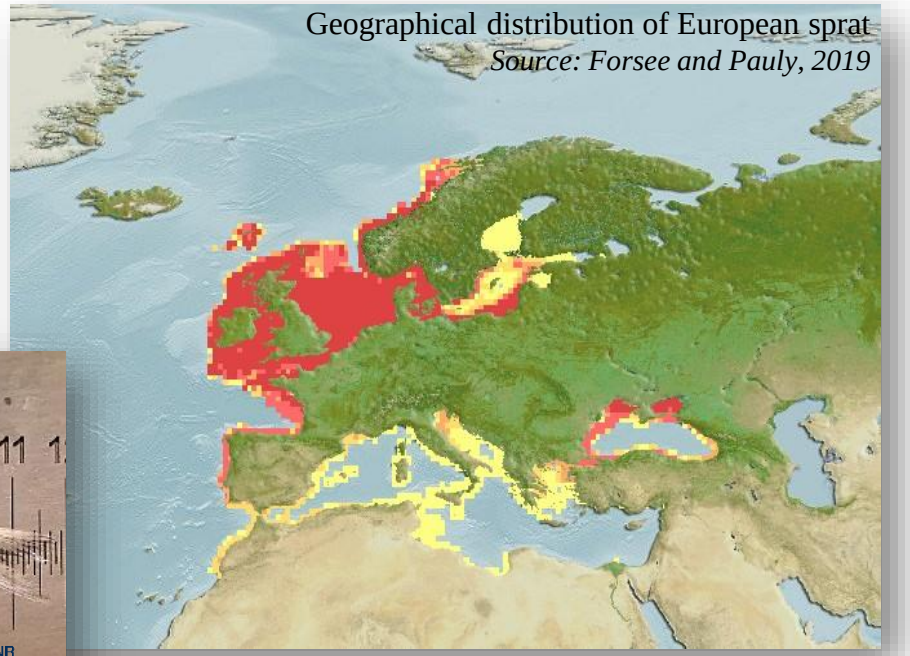
Introduction | **Target species**

Sprat is the third species in terms of landing in GFCM area (Mediterranean and Black Sea) after anchovy and sardine with an average of 57427 t landings per year from 2016 to 2018



European Sprat
(*Sprattus sprattus*)



- **Pelagic species** which inhabits mainly **shallow waters**
- **Batch spawning** species which reaches the peak in **winter** months
- **Cold favouring species**

Angelini et al.,2021; Forsee and Pauly, 2019; FAO 2020; De Felice et al., 2021

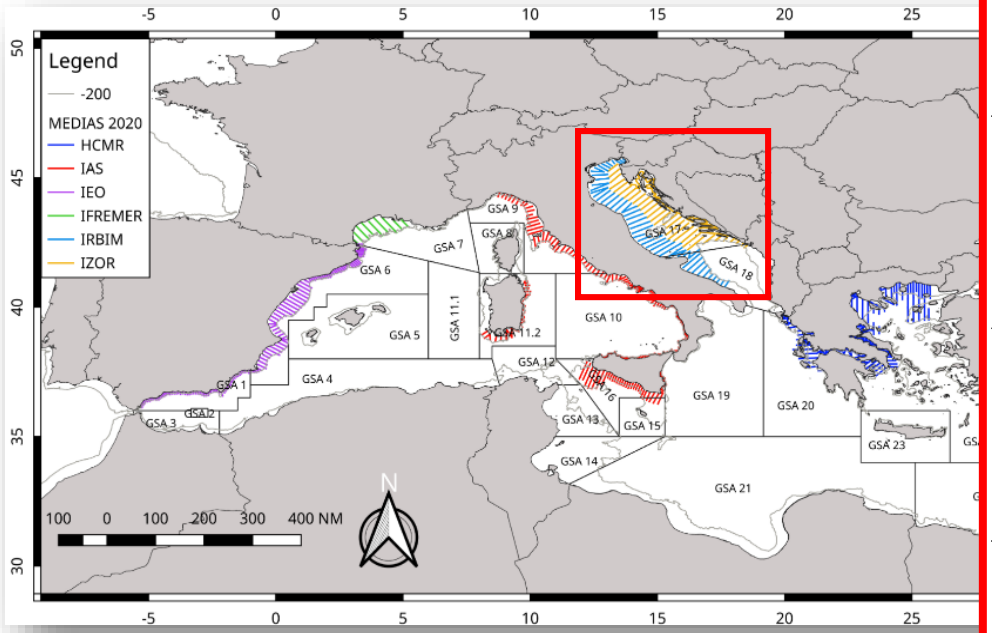
Introduction | **Data Collection**

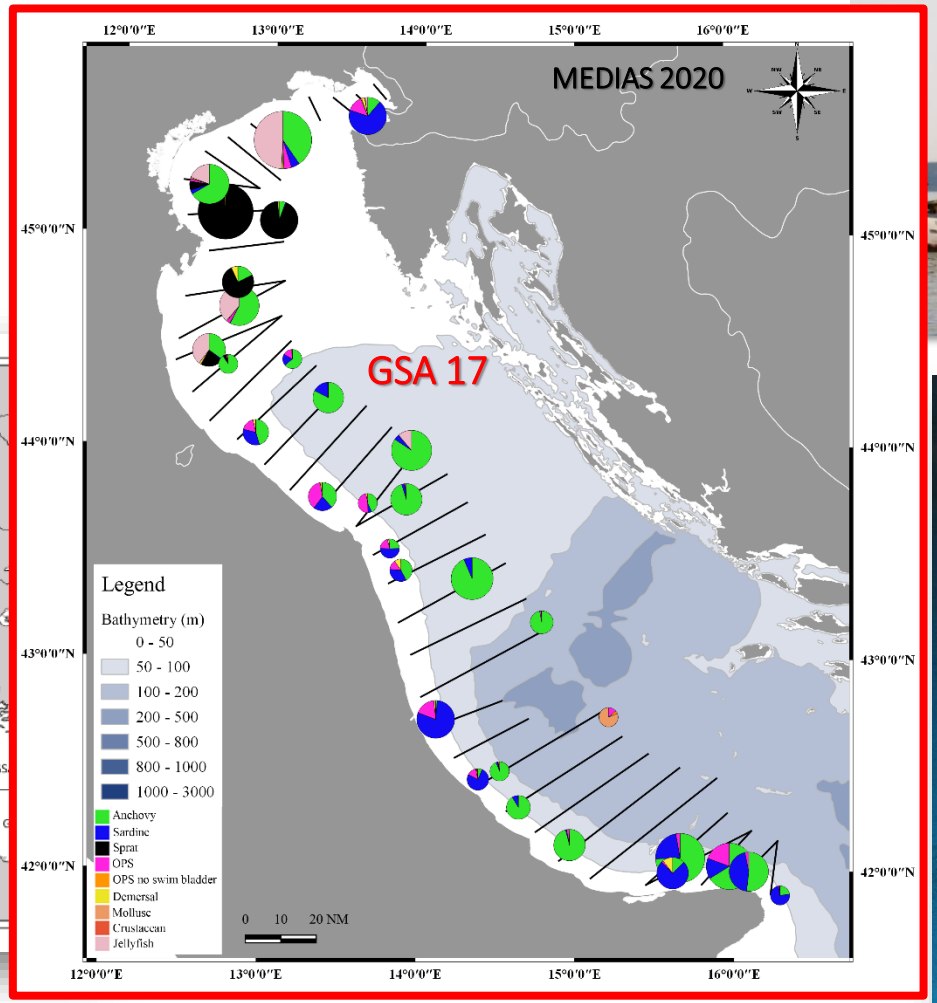
MEDIAS
MEDiterranean International Acoustic Survey

European Commission

Data Collection

Study area





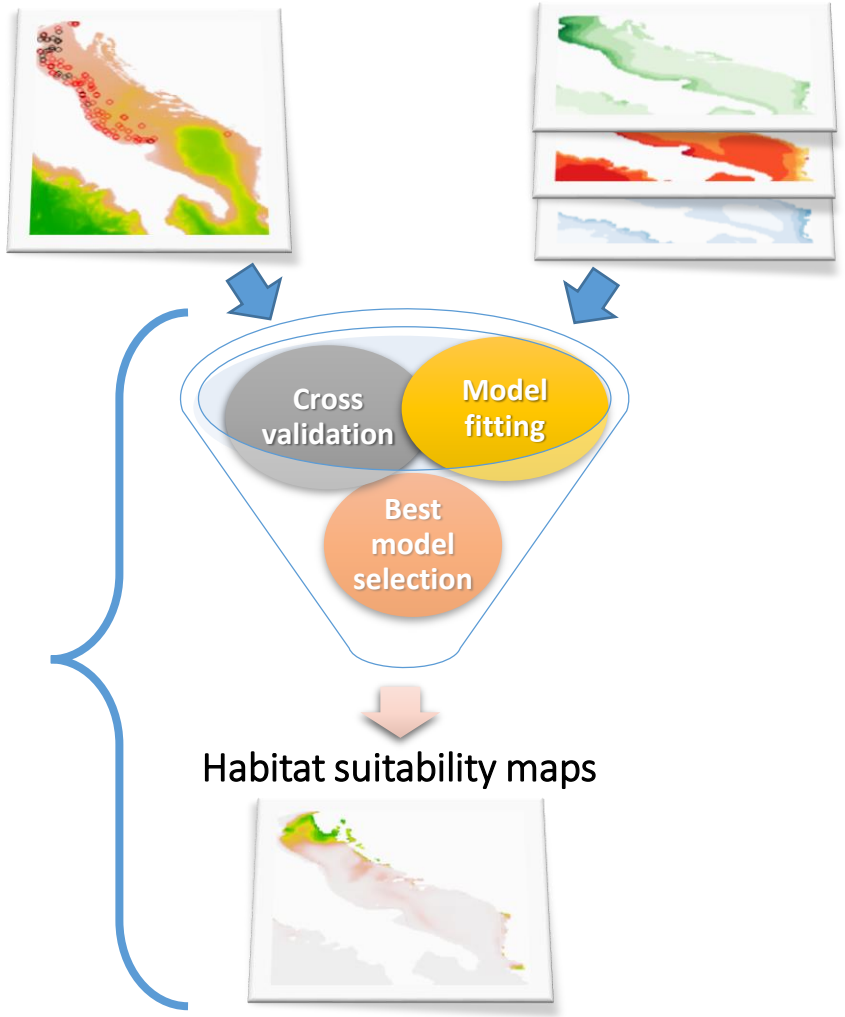
Leonori et al., 2021; MEDIAS Handbook 2021

Introduction | **Species Distribution Models**

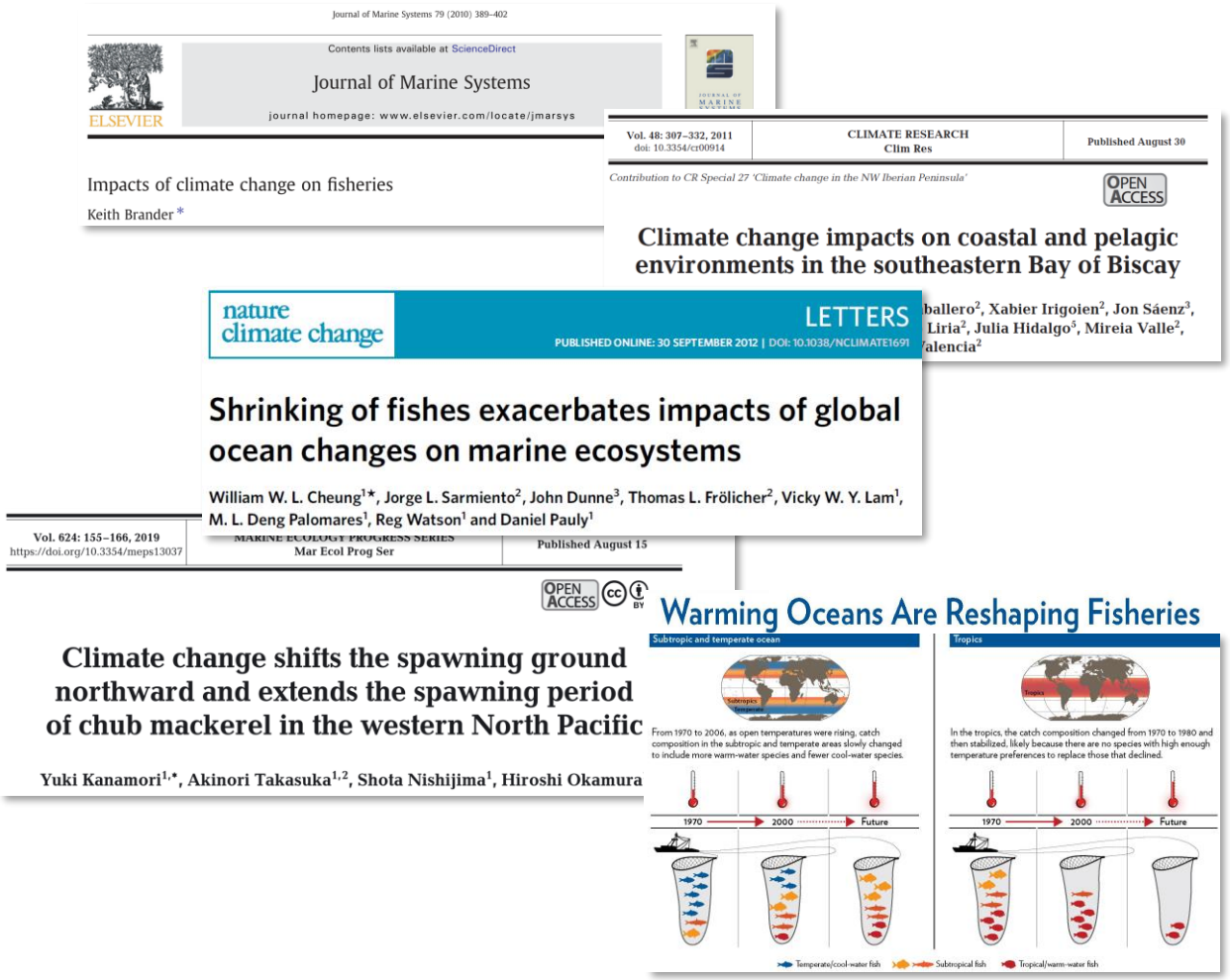
What

Observed distribution

Environmental variables



Why



Brander, 2010; Chust et al., 2011; Cheung et al., 2012;Cheung et al., 2013; Kanamori et al., 2019

Gaps

- **Absence data** are often **not available** or artificially made from fishery-dependent data
- **Few studies on ancillary species** in the Mediterranean Sea
- **No available studies on sprat suitability map**

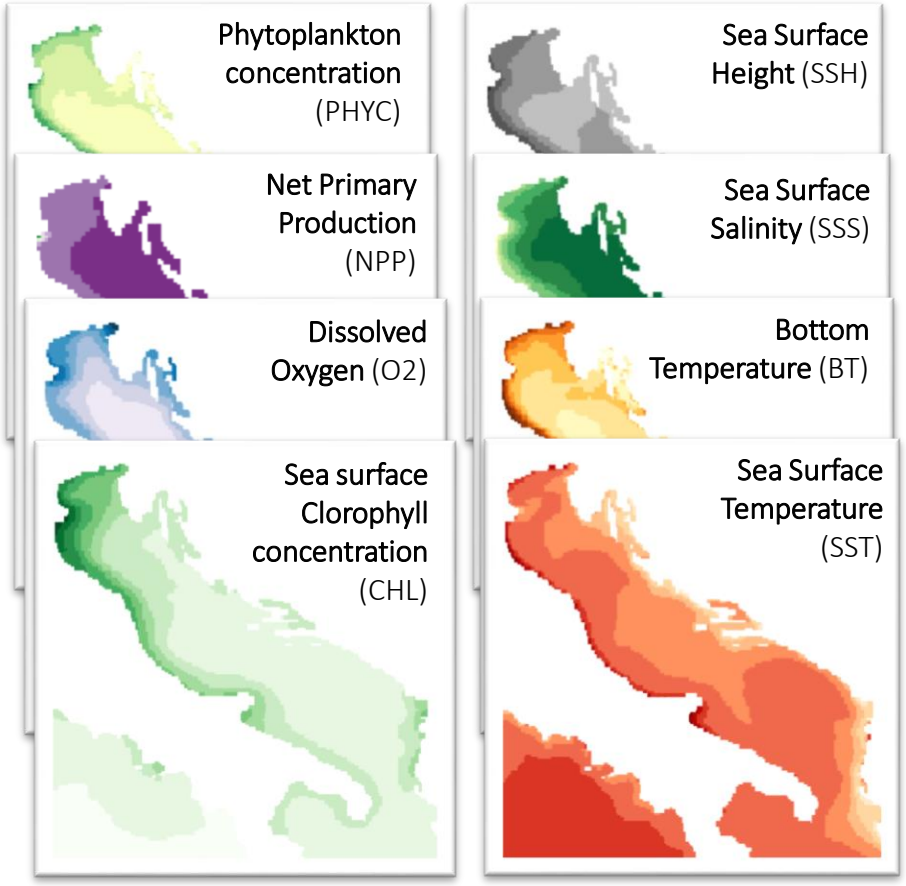
Targets

- Apply Species Distribution Model to provide the first **high-resolution habitat suitability map of sprat** in the Adriatic Sea
- Developing **past and future predictions** on sprat population spreading

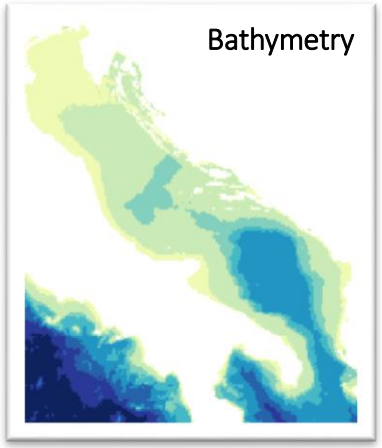
Effrosynidis et al., 2020; Quinci et al., 2022

Materials and methods | **Dataset**

Environmental data



Copernicus Marine service
resolution = 0.042° × 0.042°
https://doi.org/10.25423/CMCC/MEDSEA_MULTIYEAR_BGC_006_008_MEDBFM3I
https://doi.org/10.25423/CMCC/MEDSEA_MULTIYEAR_PHY_006_004_E3R1



MARSPEC
resolution = 1km × 1km
https://doi.org/10.1890/12-1358.1

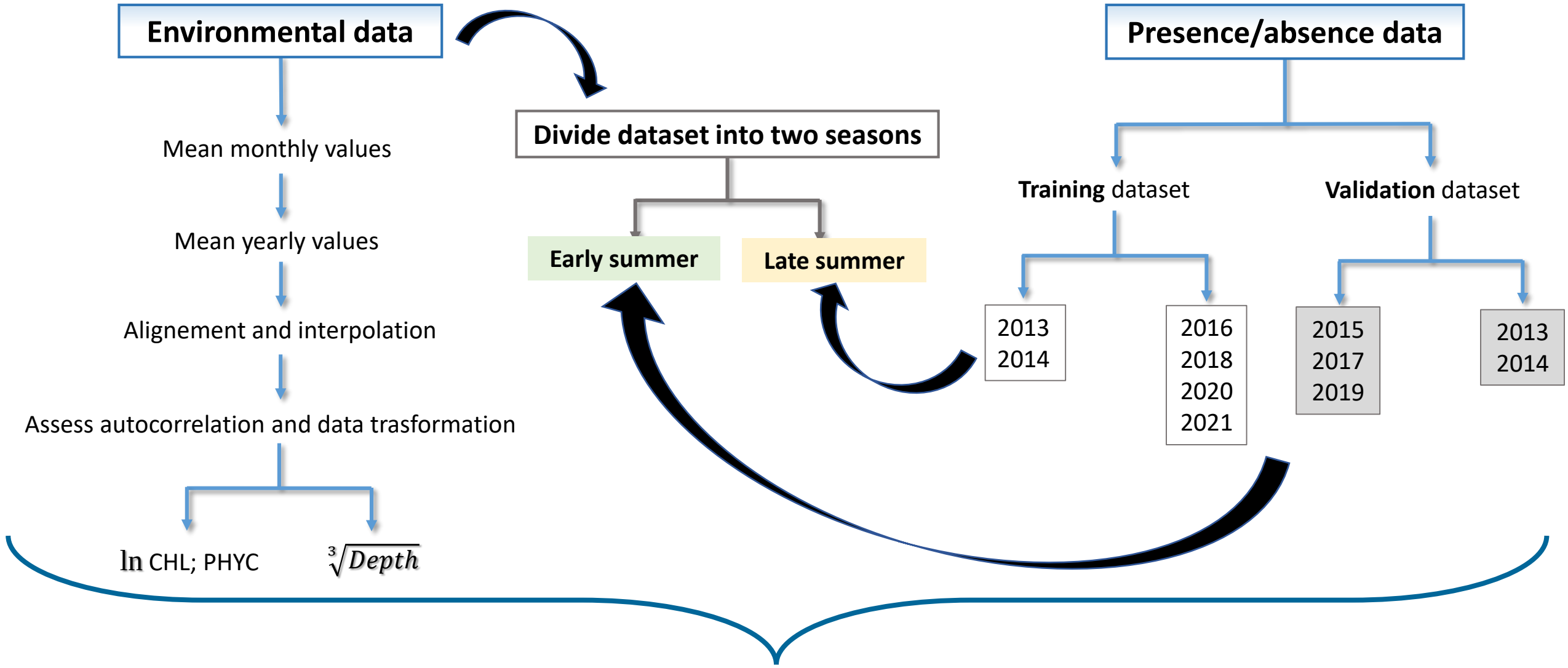
Presence/Absence data

(presence if ≥ 50 ind. on total fish number)

Year	Period	Sampling effort GSA 17 (survey hauls)
2013	04 September – 27 September	43
2014	26 August – 17 September	37
2015	12 June – 30 June	33
2016	07 June – 26 June	35
2017	12 June – 28 June	36
2018	16 June – 11 July	35
2019	12 June – 07 July	32
2020	01 July – 28 July	31
2021	04 June – 23 June	32

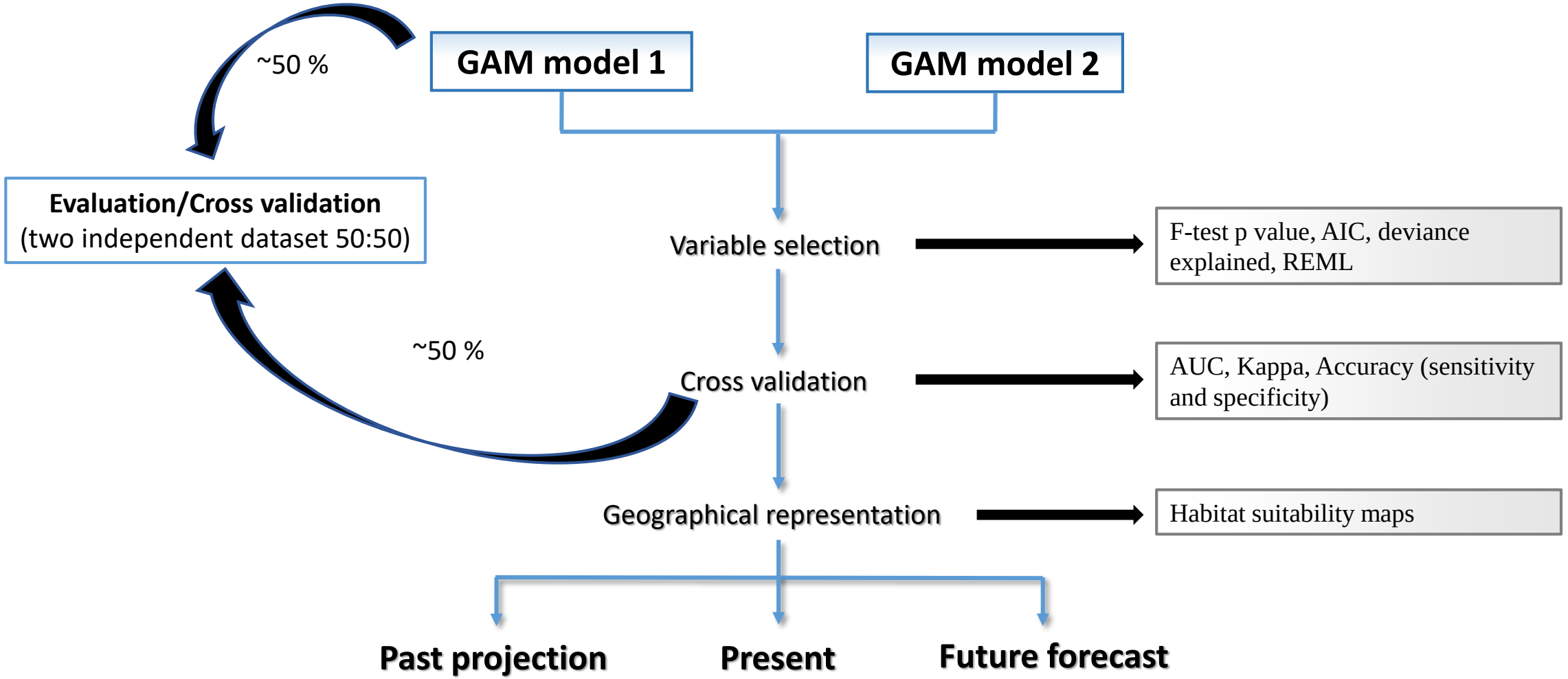
Escudier et al., 2020; Teruzzi et al., 2021; Clementi et al., 2021; Feudale et al., 2021

Materials and methods | **Dataset**



Giannoulaki et al., 2013; Giannoulaki et al., 2017; Fernandez-Corredor et al., 2021

Materials and methods | **GAM model**

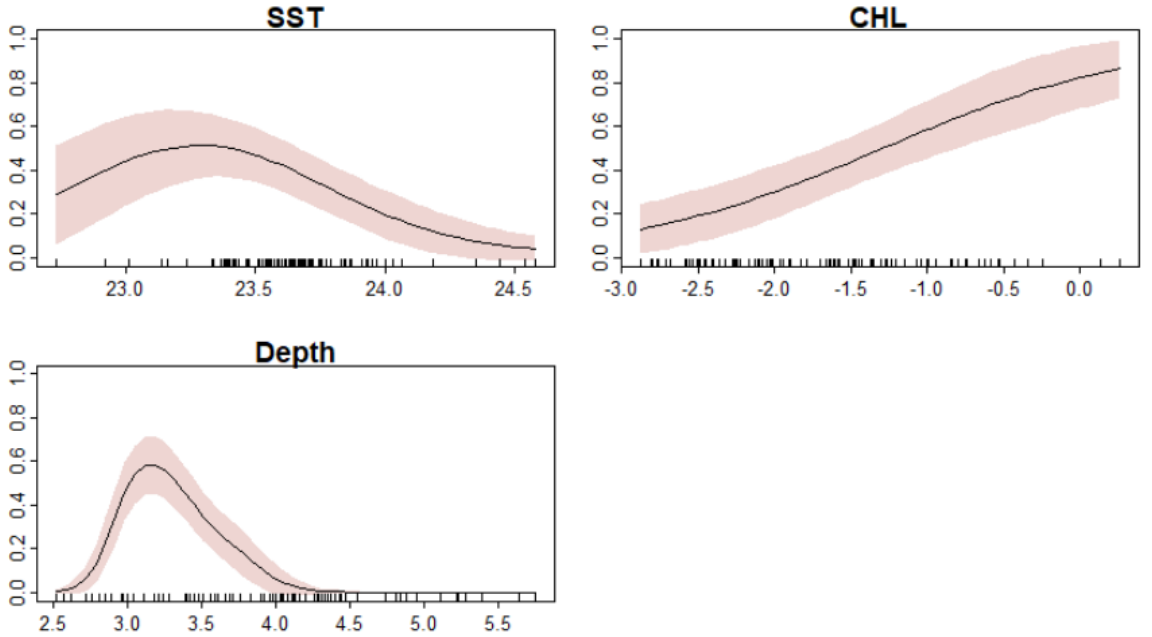


Marra et al., 2011; Giannoulaki et al., 2013; Giannoulaki et al., 2017; Fernandez-Corredor et al., 2021

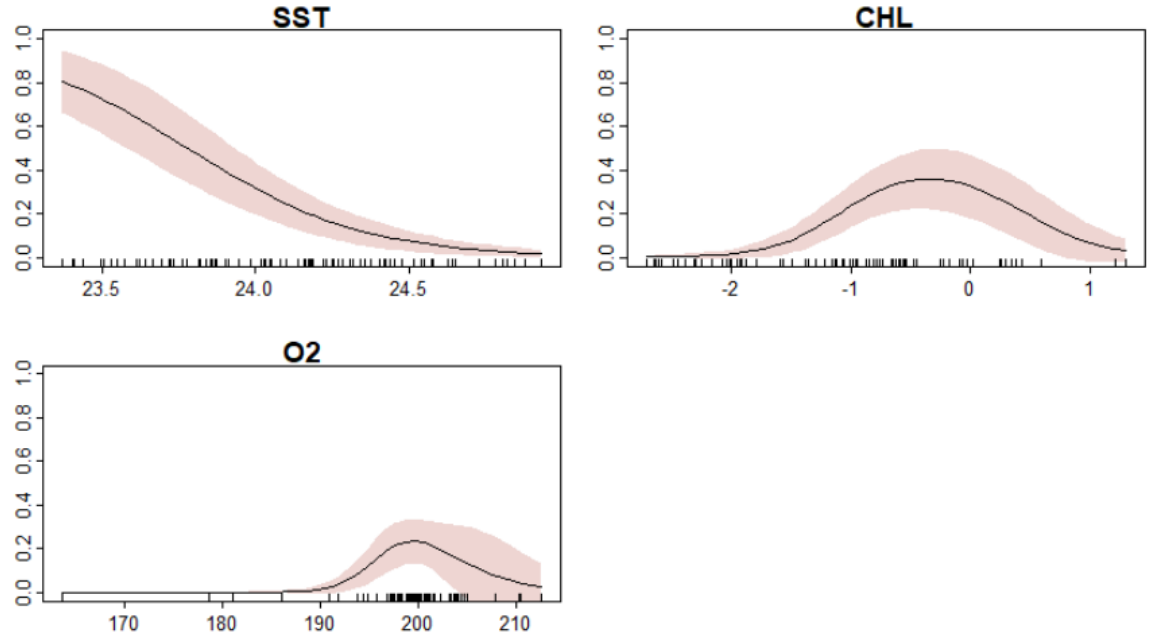
Results | **GAM model**

Period	Model	Akaike Information Criterion (AIC)	Restricted maximum likelihood (REML)	Deviance explained (DEV)
Early summer	Species occurrence ~ s(SST)+s(CHL)+s(Depth)	94	48.9	47.6
Late summer	Species occurrence ~ s(SST)+s(CHL)+s(O_2)	55	28.4	45.8

Early summer



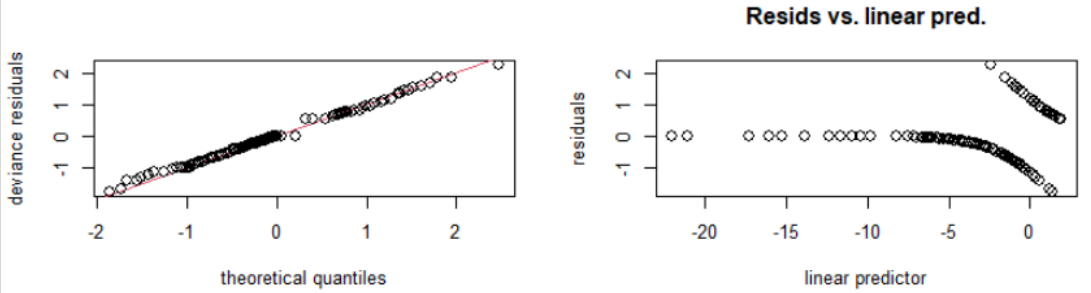
Late summer



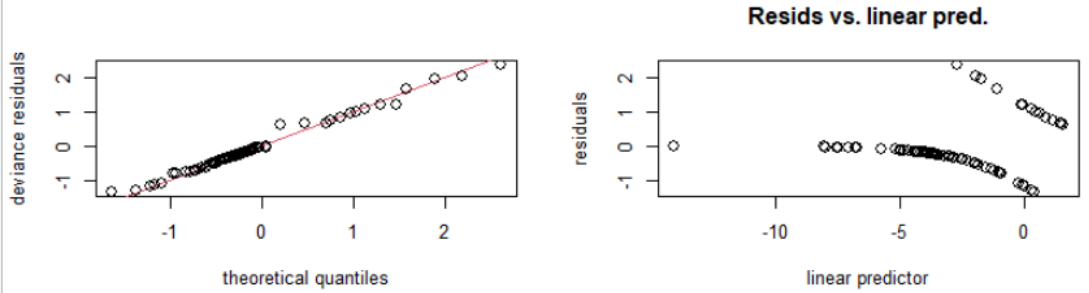
Results | **Model evaluation**

Period	Model	Area Under the Curve (AUC)	Kappa	Sensitivity	Specificity
Early summer	Species occurrence ~ s(SST)+s(CHL)+s(Depth)	0.82	0.44	0.77	0.79
Late summer	Species occurrence ~ s(SST)+s(CHL)+s(O_2)	0.79	0.45	0.78	0.80

GAM check early summer

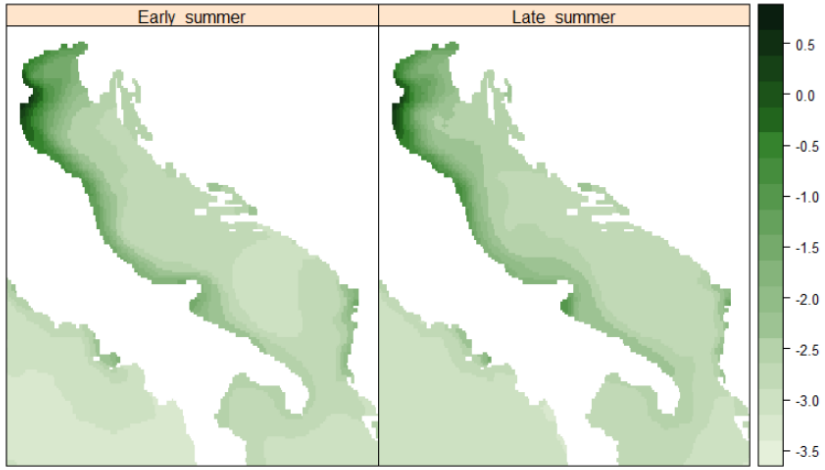


GAM check late summer

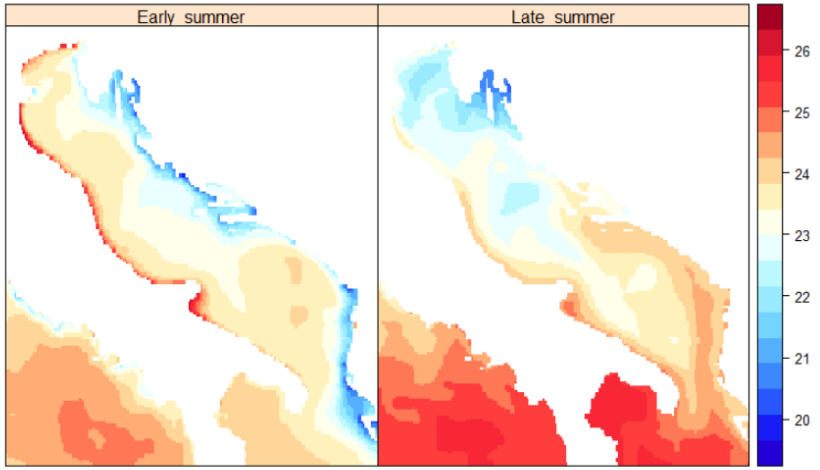


Results | **Significant variables**

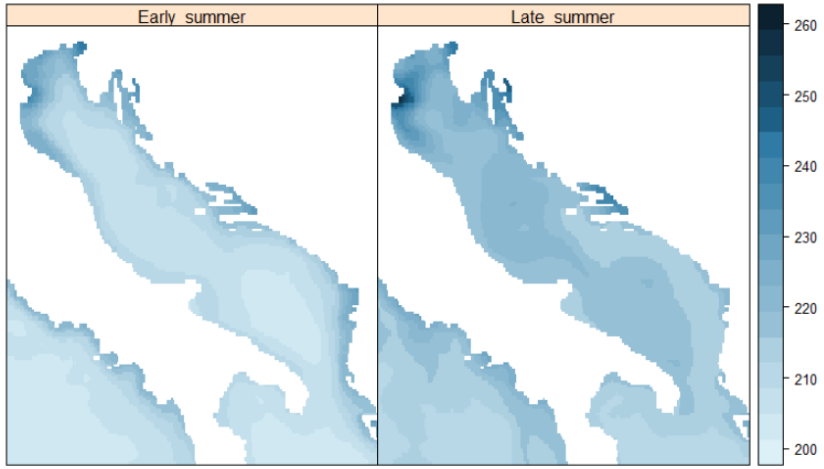
CHL (mg/m^3) *ln scale*



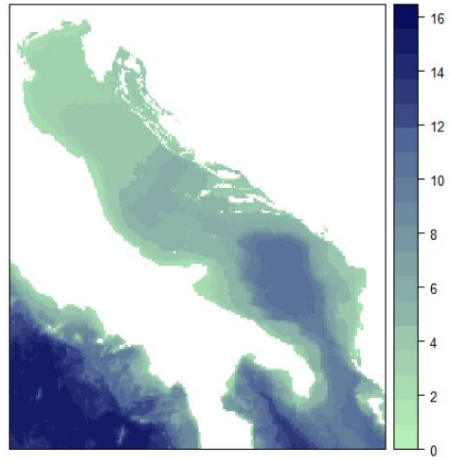
SST at 5 meter depth $(C°)$



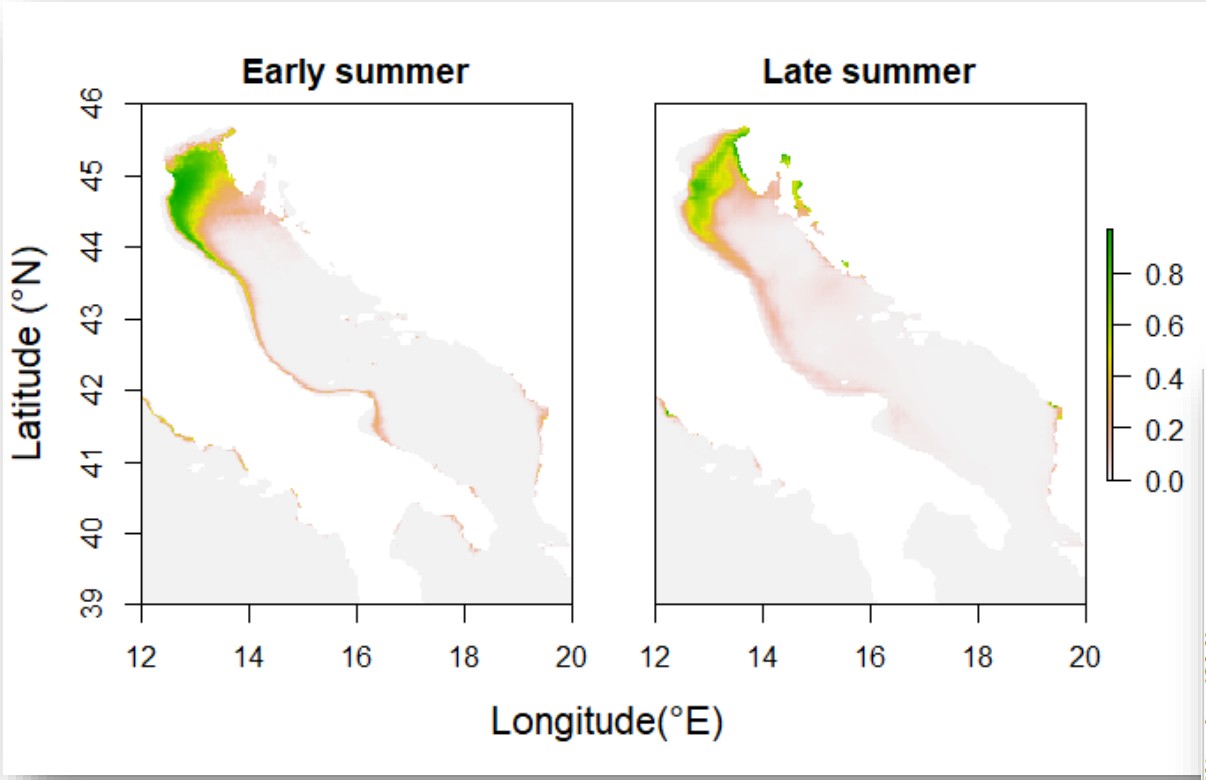
O_2 at 5 meter depth $(mmol/m^3)$



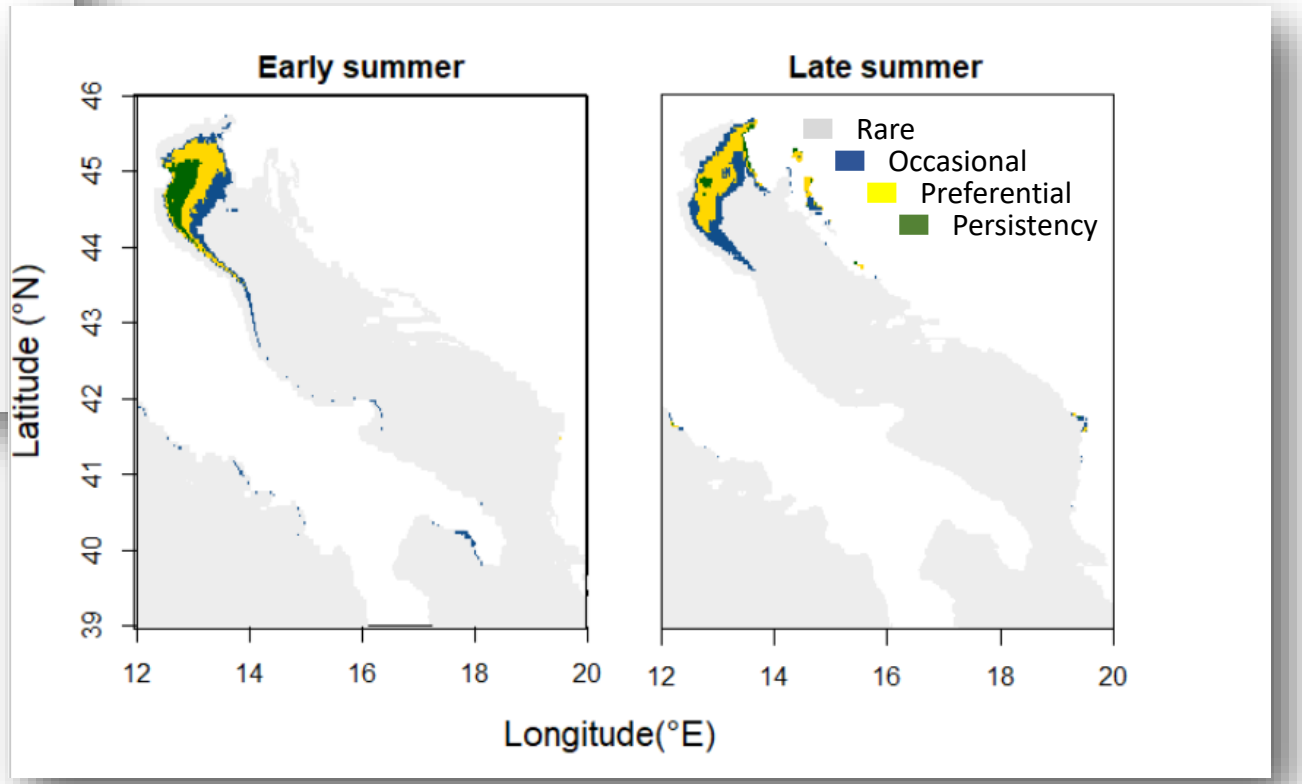
Depth (m) $\sqrt[3]{scale}$



Results | **Habitat suitability map**



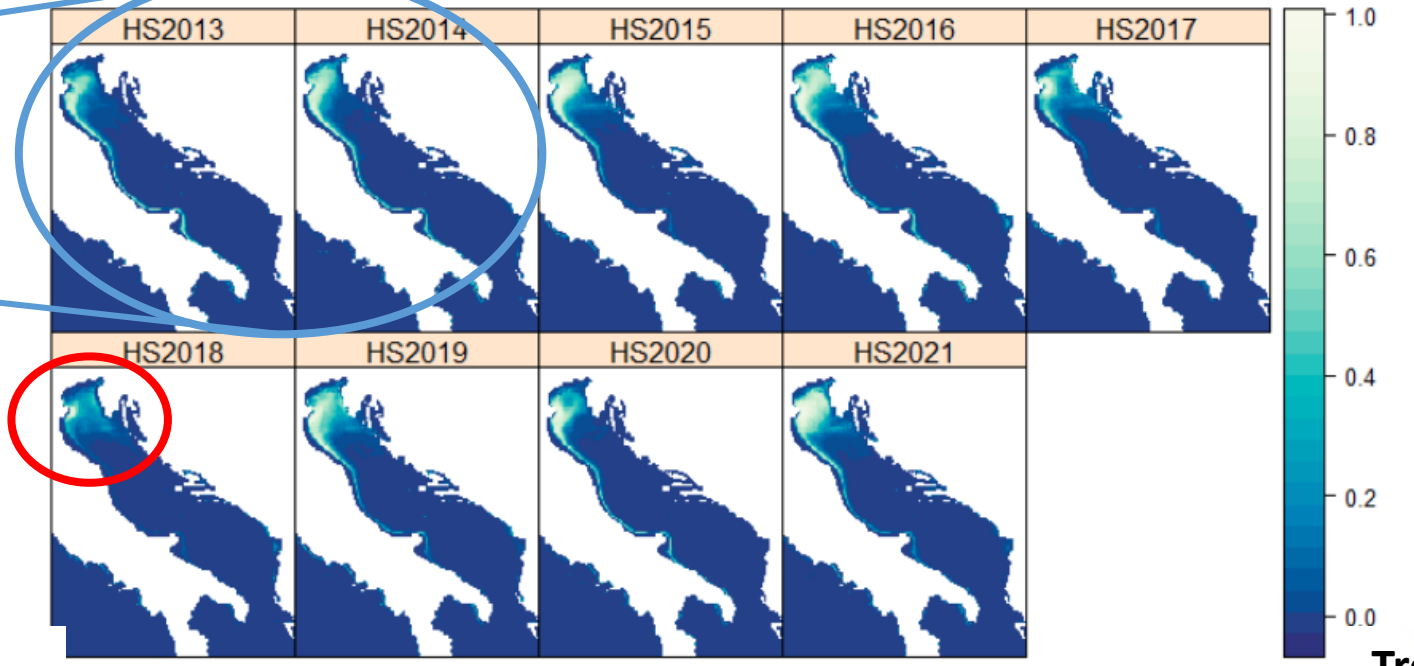
- Results shows a **west-east migration** from **feeding area to spawning grounds**
- The Sprat **preferred habitat** is located in the **North-Adriatic Sea**
- Sprat could be occasionally found in the Mid-West Adriatic Sea **up to Gulf of Manfredonia**



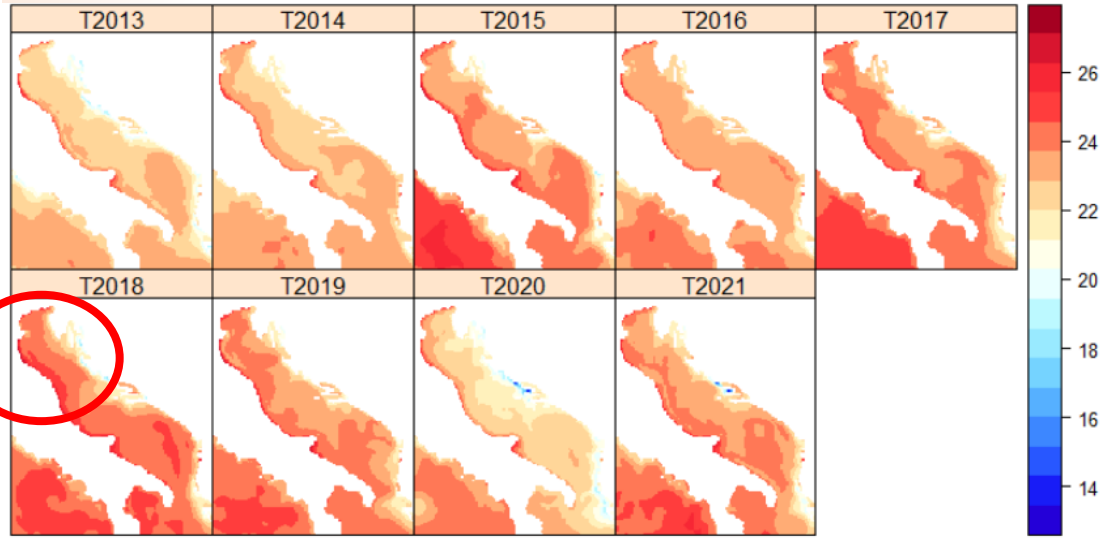
Escudier et al., 2020; Teruzzi et al., 2021; Clementi et al., 2021; Feudale et al., 2021

Results | **Past projection - early summer**

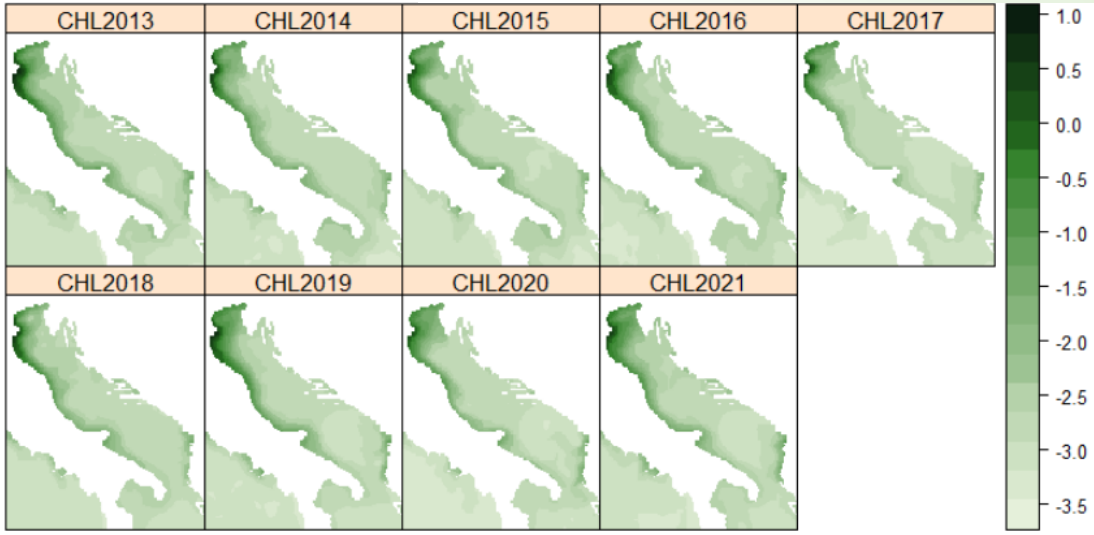
Past projection allows to **backdetermine sprat distribution**



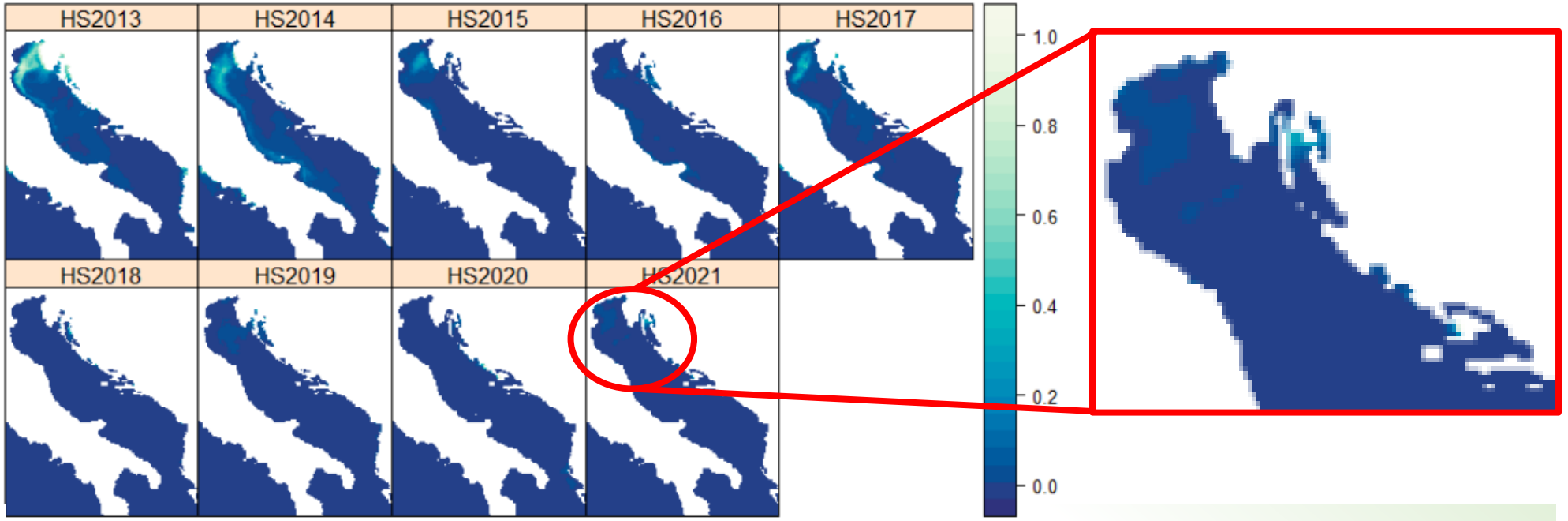
Trend temperature



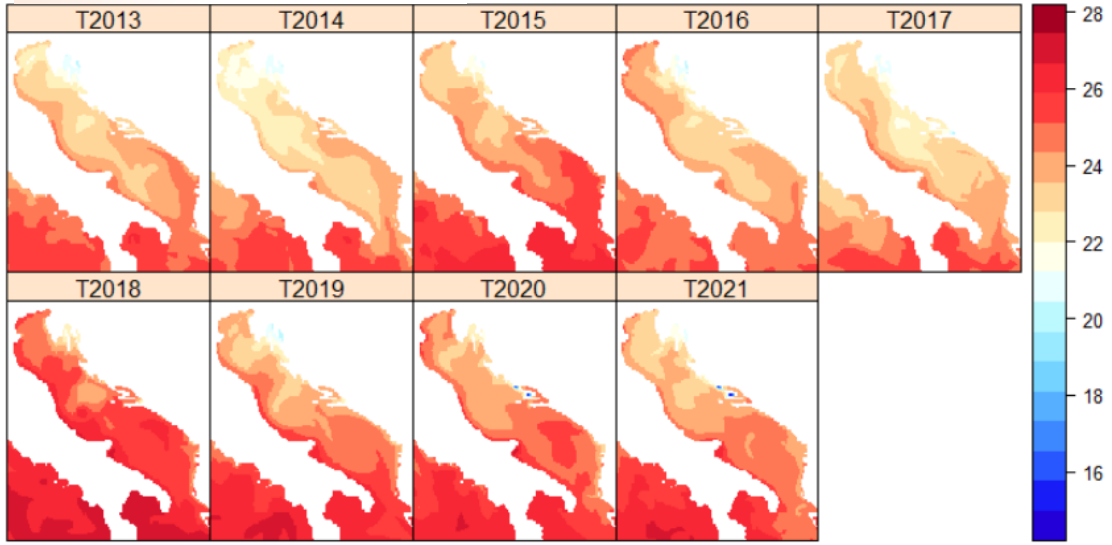
Trend chlorophyll concentration



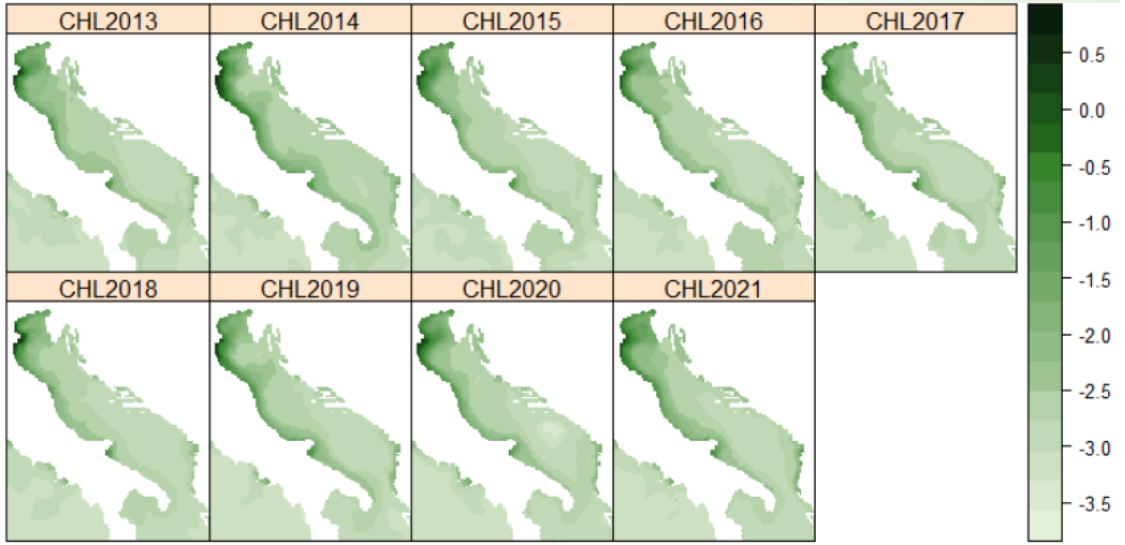
Results | **Past projection - late summer**



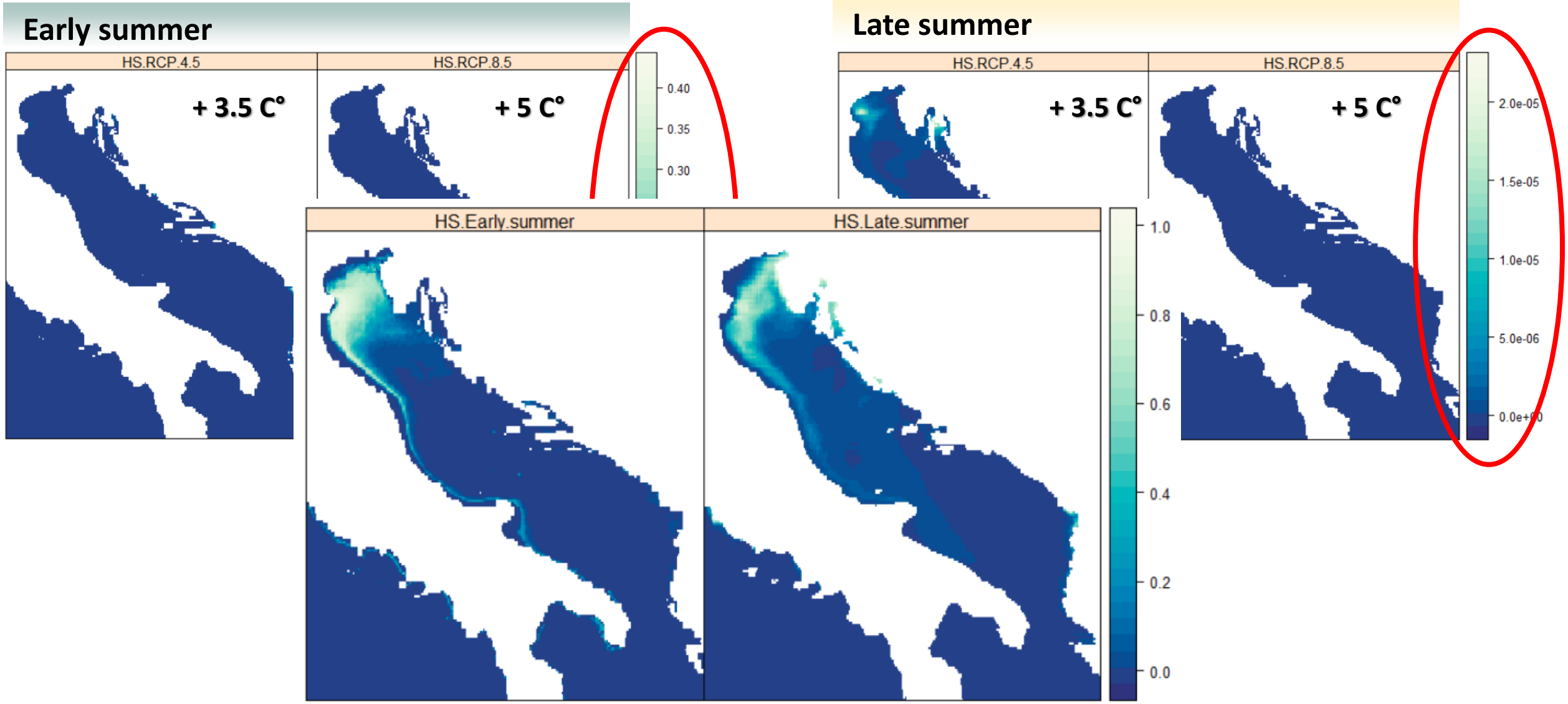
Trend temperature



Trend chlorophyll concentration



Results | **Future forecast**



Denamiel et al 2020

| Discussion and conclusions |

- ✓ **Sea surface temperature** and **chlorophyll concentration** resulted as the **main explanatory variables** followed by bottom depth and dissolved oxygen in both periods.
- ✓ We confirmed that **sprat is mostly located in the North-Adriatic Sea**
- ✓ The model revealed a **west-east shift in the preferential area** between the two periods
- ✓ This work underline the **suitability of GAM model to predict pelagic species distributions**

- ➢ Our results foresee a strong shrinkage and a possible future local extintion of sprat due to the increase of temperature in the next decades

Thank You for your attention

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References

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