Alternative Approach to Community Grouping of Marine Species

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Problem Statement

New bioindicators for ecosystem stability (MSF)

Species composition has major influence on ecosystem functioning and stability (Leland 2011)

Are species organized in highly structured communities in space and time

Ecosystem Resilience to anthropological and environmental stressors

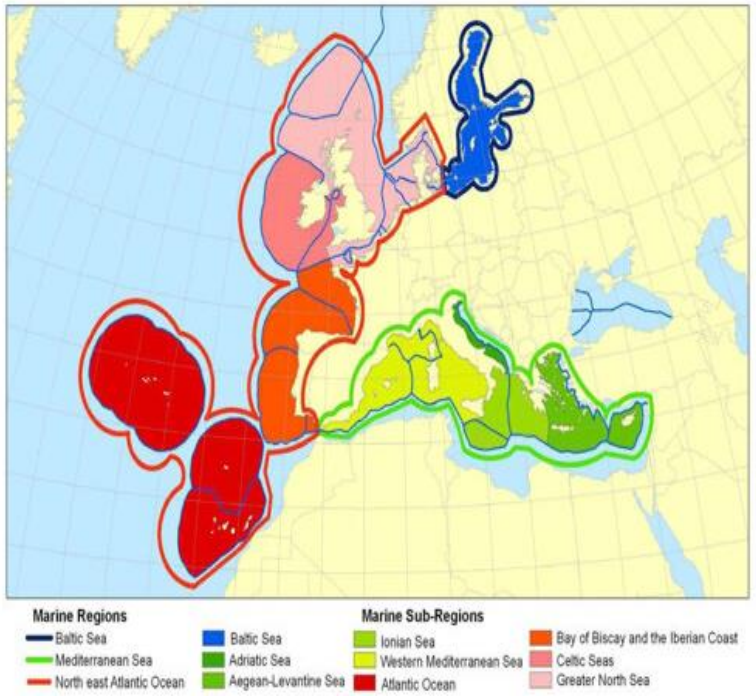
The degree to which habitat change is likely to influence ecosystem resilience will depend on community structure and connectivity

Quantifying the spatial structure of ecological communities

Have important applied implications as sampling campaigns for biomonitoring or conservation programs rely on the knowledge about the degree to which there is natural variation in communities across space

Methods : : Data

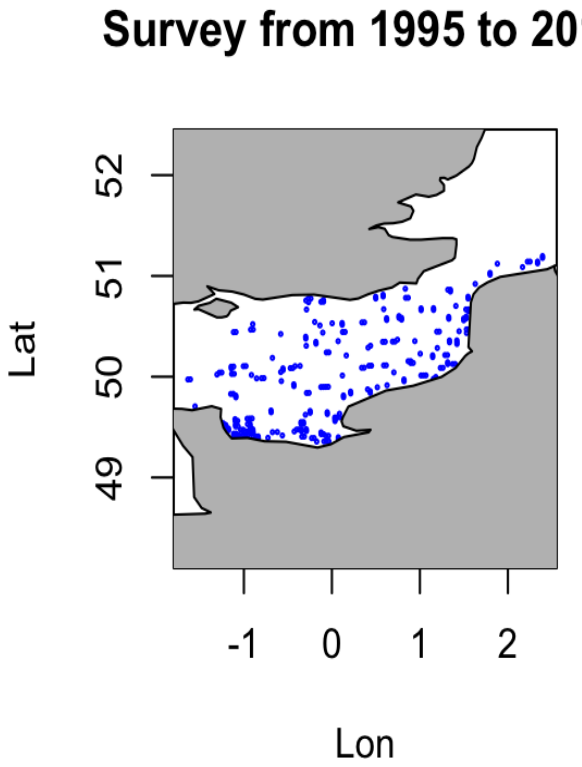
Survey	# species	# species selected	Beginning year	End year	Period
CGFS	114	41	1995	2014	15 Sept - 15 Nov
EVHOE	286	99	1997	2014	15 Oct- 01 Dec

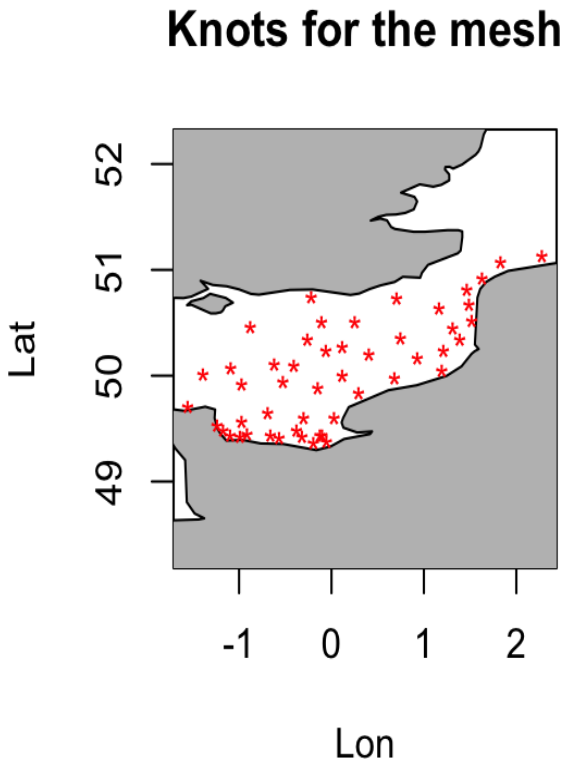


- Standardized lsurvey with a large mouth bottom trawl
- Species with too many 0% or 100% occurrence
- To limit the loss
  - Remove the first years with really abundant 0%
  - Add 1 random occurrence in 1 location on the given year

Year	TRGPLAS	TRGPLAS
1997	0	0.00775193
1998	0.01587301	0.01587301
1999	0.03305785	0.03305785
2000	0.03252032	0.03252032
2001	0.03870967	0.03870967
2002	0.01298701	0.01298701
2003	0	0.00675675
2004	0.01438848	0.01438848
2005	0.01388888	0.01388888
2006	0.01538461	0.01538461
2007	0.02721088	0.02721088
2008	0.03973509	0.03973509
2009	0.02898550	0.02898550
2010	0.02836879	0.02836879
2011	0.03870967	0.03870967
2012	0.04477611	0.04477611
2013	0.01470588	0.01470588
2014	0.01986755	0.01986755

Methods : : Spatial Domain





- Triangulated mesh generated by the stochastic partial differential equation (SPDE)
- 50 knots equivalent to a resolution of 4.6 by 4.6 km.

Methods : : Models

VAST

Predictor zero-inflation in a zero inflation negative binomial model = approximate spatio-temporal variations using a logit link

Predictor of mean intensity function count data = approximate mean intensity function as an exponential function

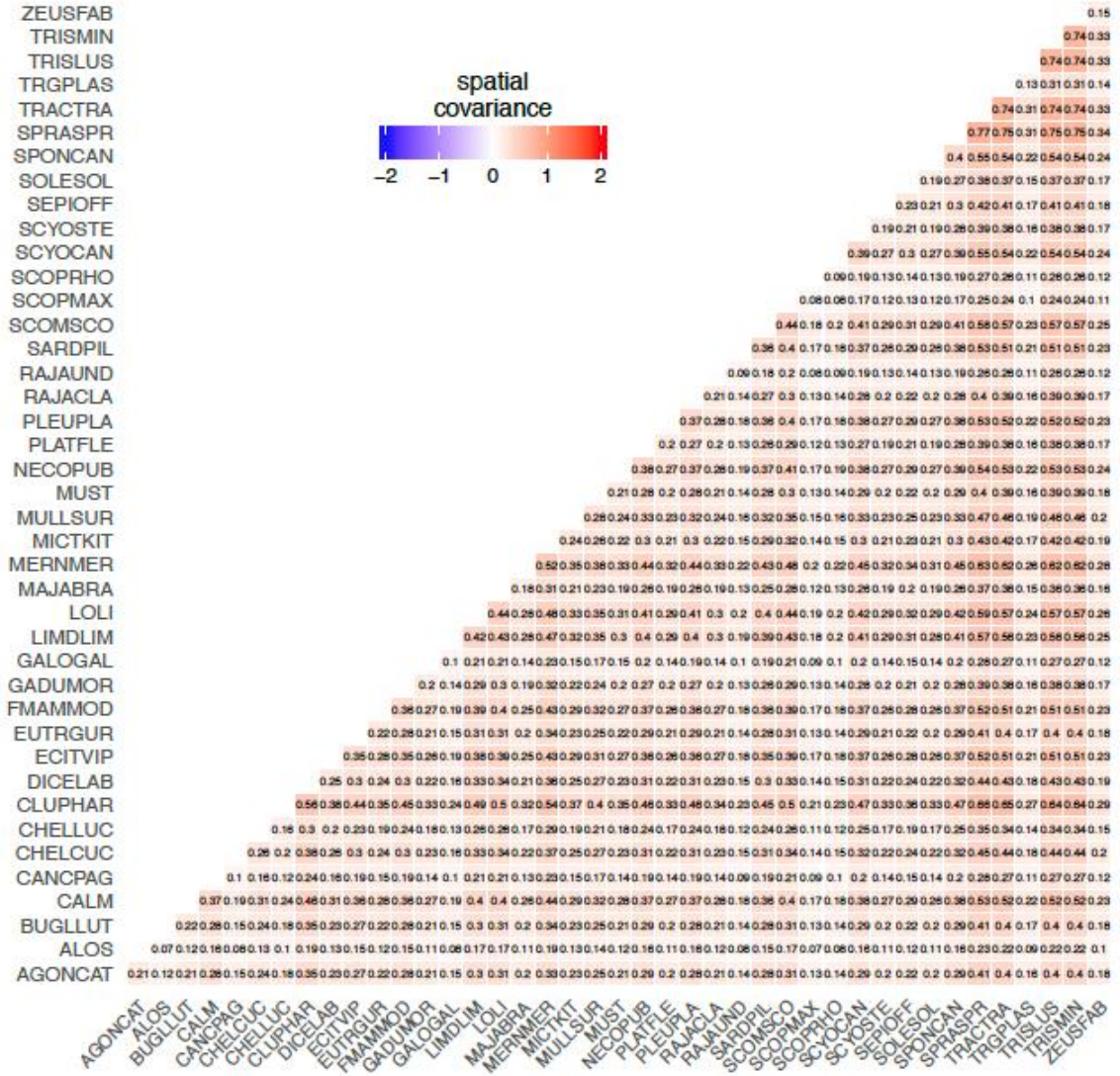
Assume intercept constant across year = correlation in abundance is explained by spatio-temporal factors

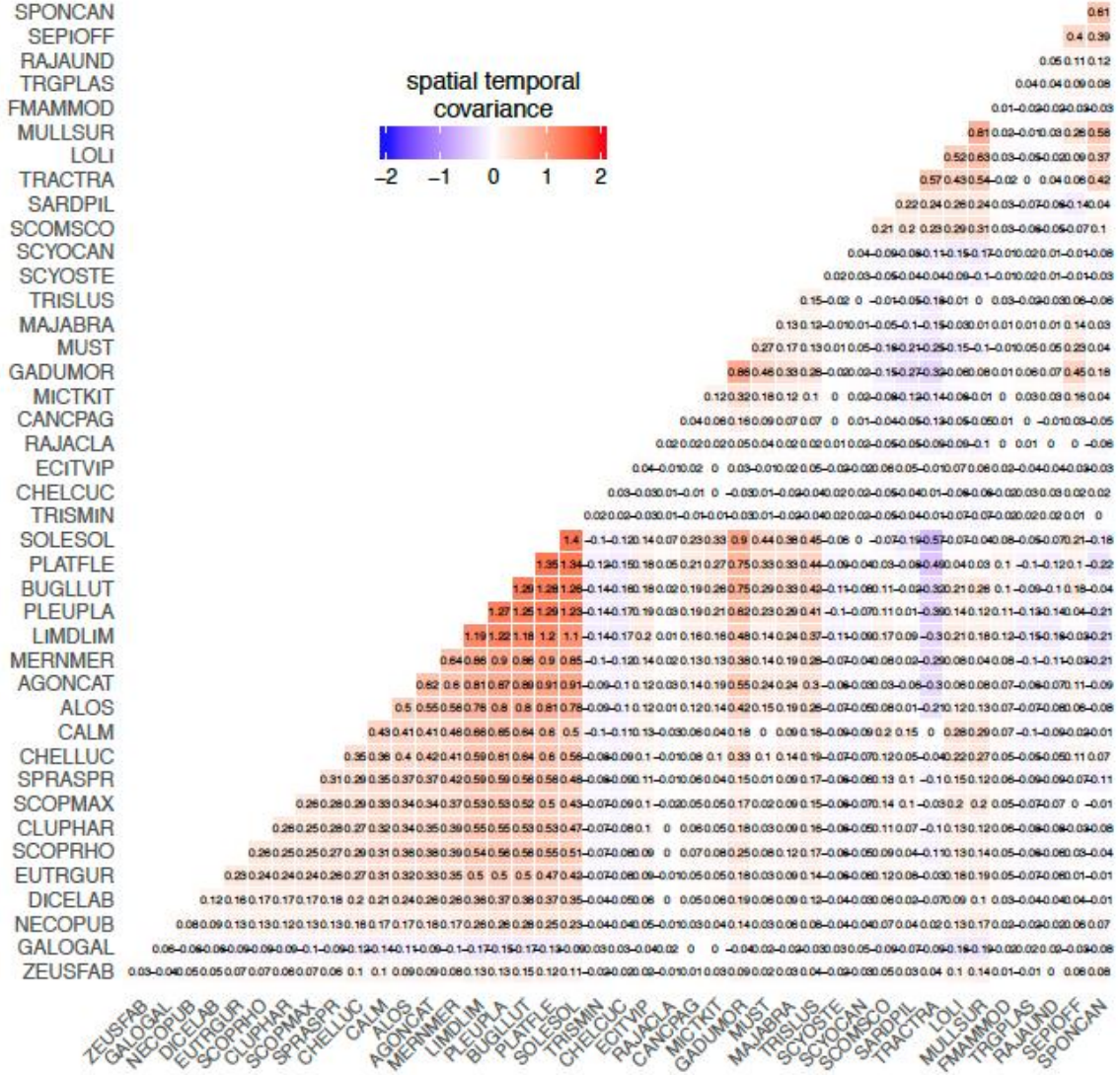
Hierarchical cluster analysis

Order the covariance or correlation matrices with dissimilarity measure

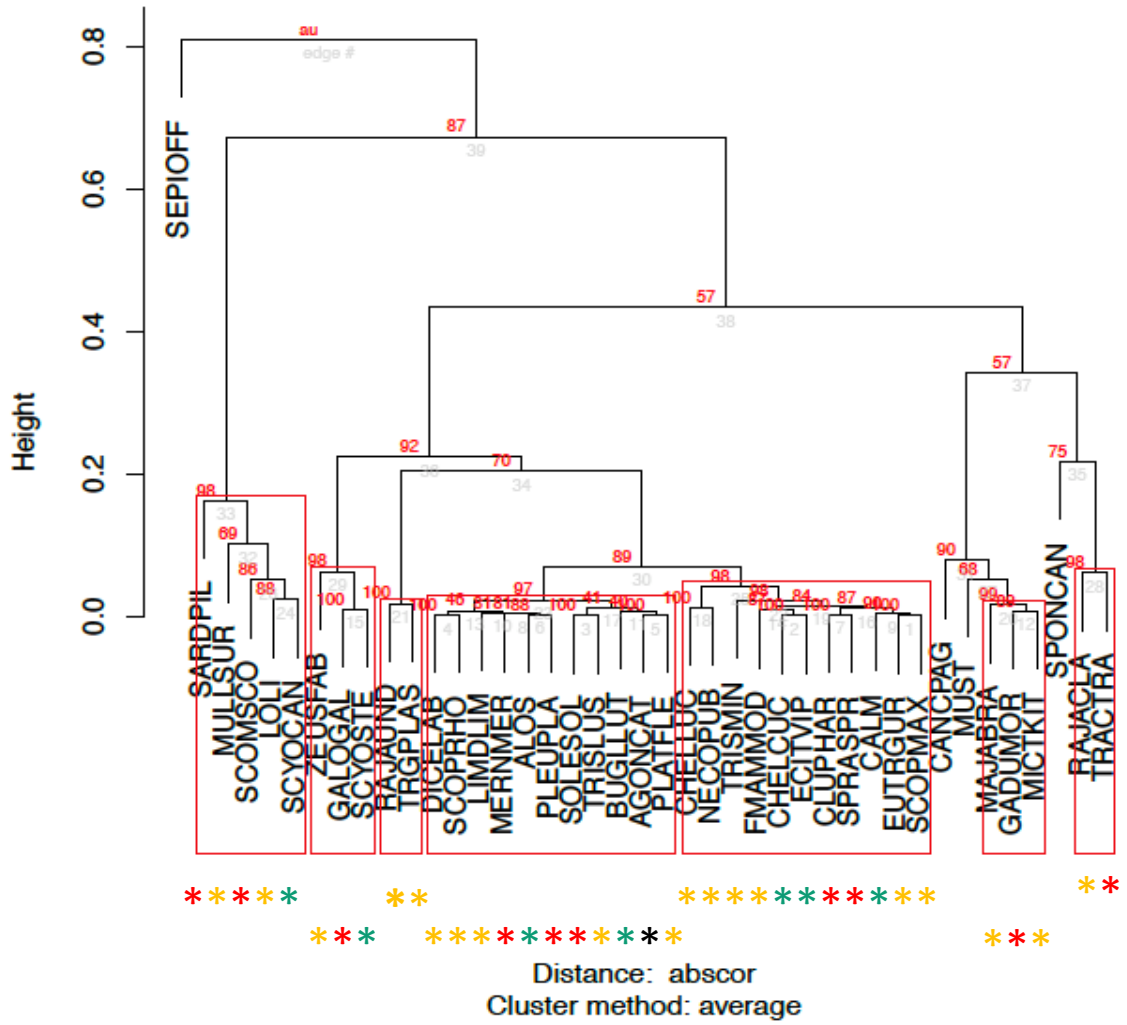
non-parametric bootstrap resampling is used to test the robustness of each cluster

Results : : Covariance



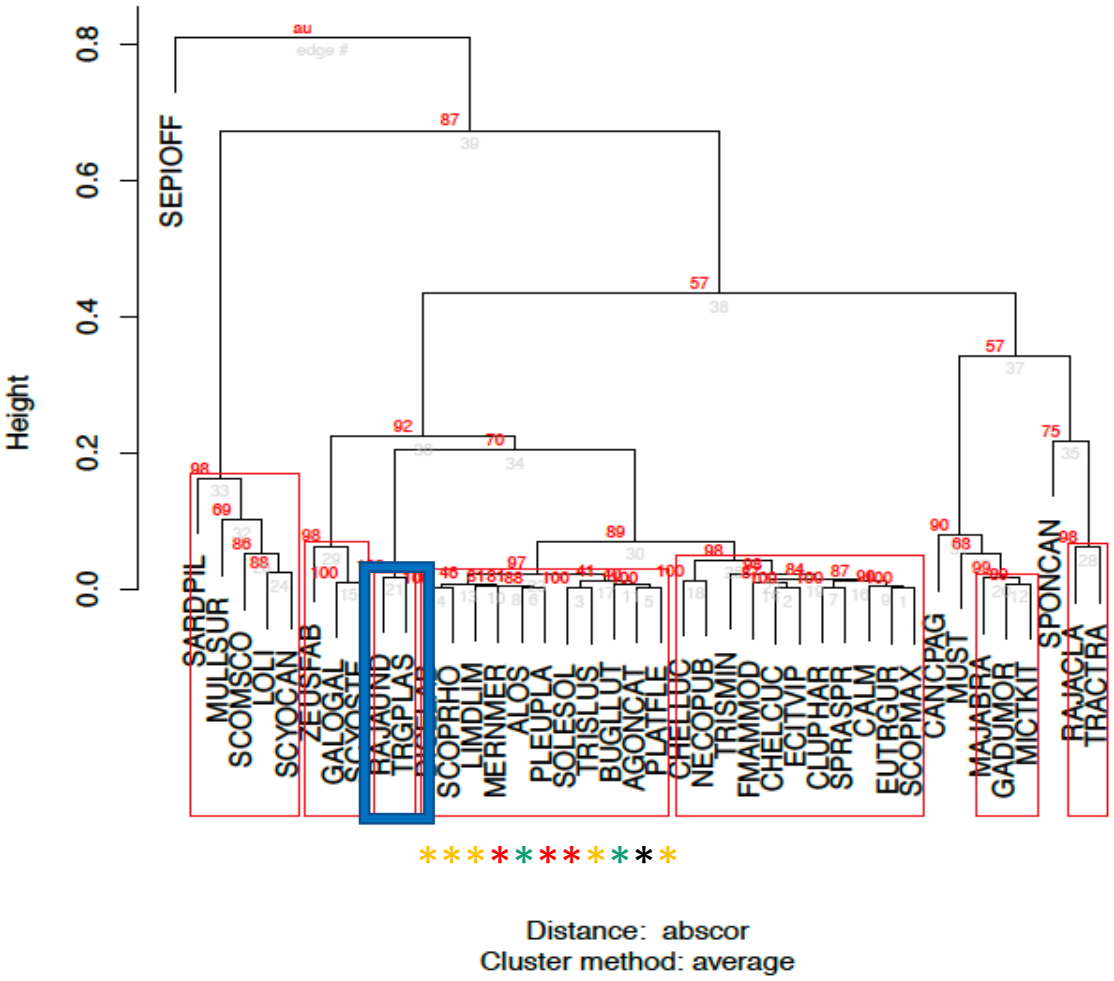


Results : : Communities



Code	Species
AGONCAT	Agonus cataphractus
ALOS	Alosa *
BUGLLUT	Buglossidium luteum
CALM	Callionymus
CANCPAG	Cancer pagurus
CHELCUC	Chelidonichthys cuculus
CHELLUC	Chelidonichthys lucernus
CLUPHAR	Clupea harengus
DICELAB	Dicentrarchus labrax *
ECITVIP	Echiichthys vipera
EUTRGUR	Eutrigla gurnardus
FMAMMOD	Ammodytidae
GADUMOR	Gadus morhua *
GALOGAL	Galeorhinus galeus *
LIMDLIM	Limanda limanda
LOLI	Loligo
MAJABRA	Maja brachydactyla *
MERNMER	Merlangius merlangus
MICTKIT	Microstomus kitt
MULLSUR	Mullus surmuletus *
MUST	Mustelus *
NECOPUB	Necora puber
PLATFLE	Platichthys flesus *
PLEUPLA	Pleuronectes platessa *
RAJACLA	Raja clavata *
RAJAUND	Raja undulata
SARDPIL	Sardina pilchardus
SCOMSCO	Scomber scombrus *
SCOPMAX	Scophthalmus maximus *
SCOPRHO	Scophthalmus rhombus *
SCYOCAN	Scyliorhinus canicula
SCYOSTE	Scyliorhinus stellaris
SEPIOFF	Sepia officinalis
SOLESOL	Solea solea *
SPONCAN	Spondyliosoma cantharus *
SPRASPR	Sprattus sprattus
TRACTRA	Trachurus trachurus *
TRGPLAS	Trigloporus lastoviza
TRISLUS	Trisopterus luscus
TRISMIN	Trisopterus minutus
ZEUSFAB	Zeus faber *

Results : : Species composition

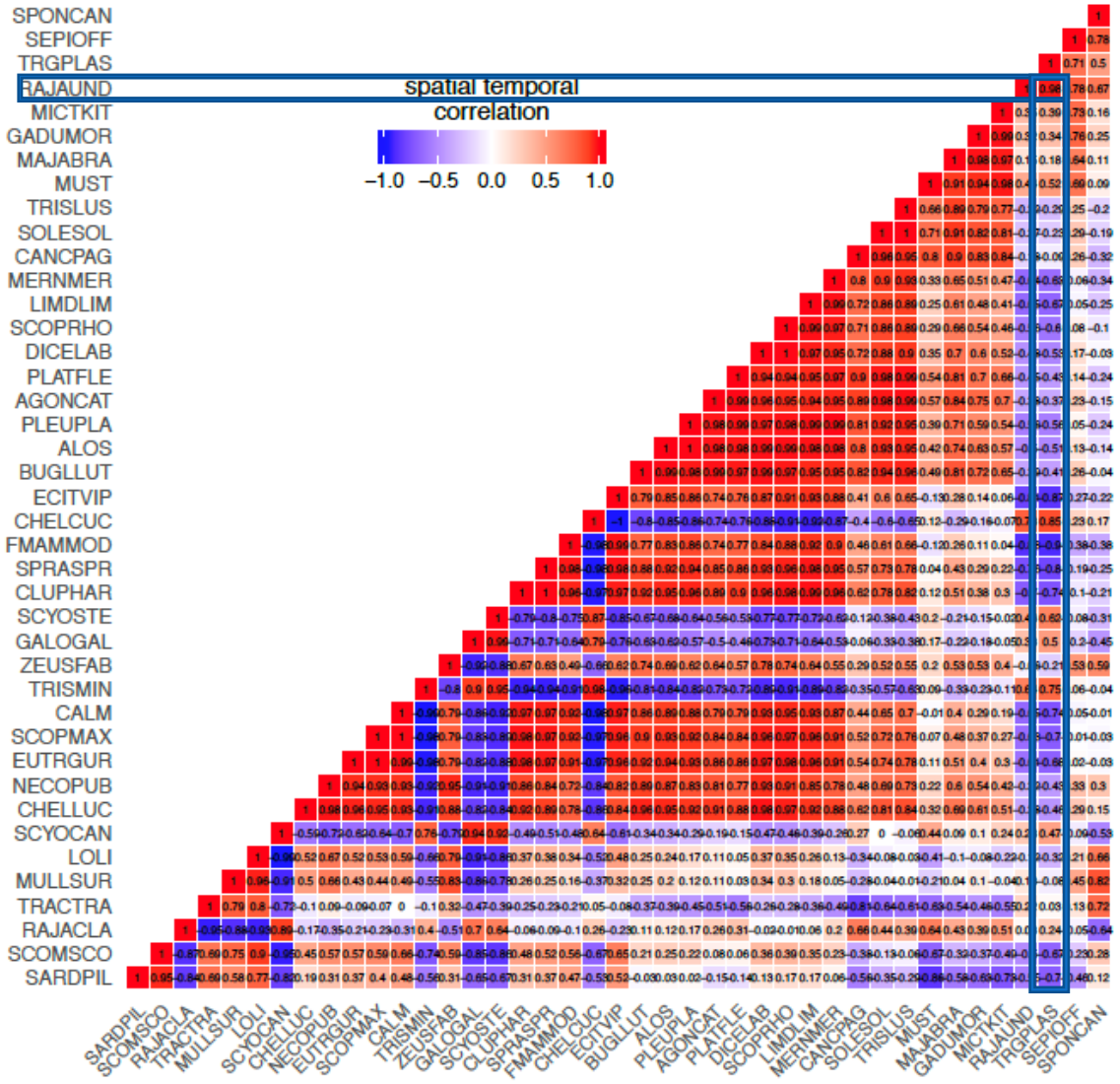


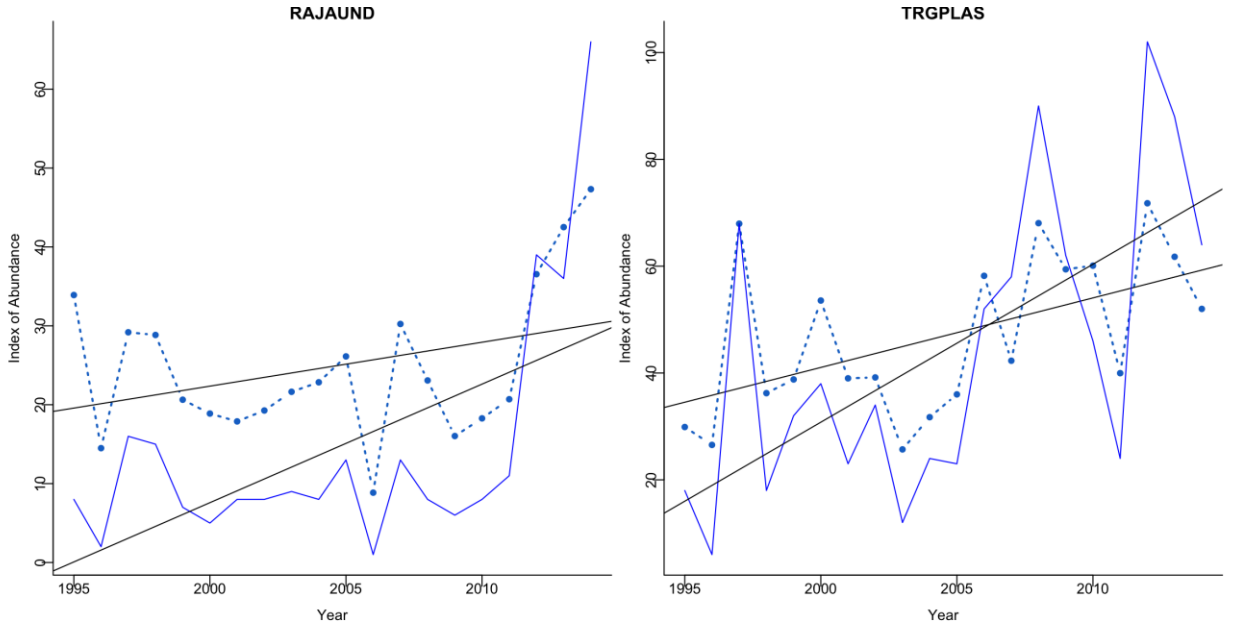
Trigloporus lastoviza (striked gunnard)

Raja undulata (undulate Ray)

- IUCN Red List : Endangered
- Bycatch by trawls trammel net and other demersal fisheries
- Retained and marketed for human consumption
- Patchy distribution

Results : : Correlation in indices





Results : : Spatial temporal species distribution

Trigloporus lastoviza

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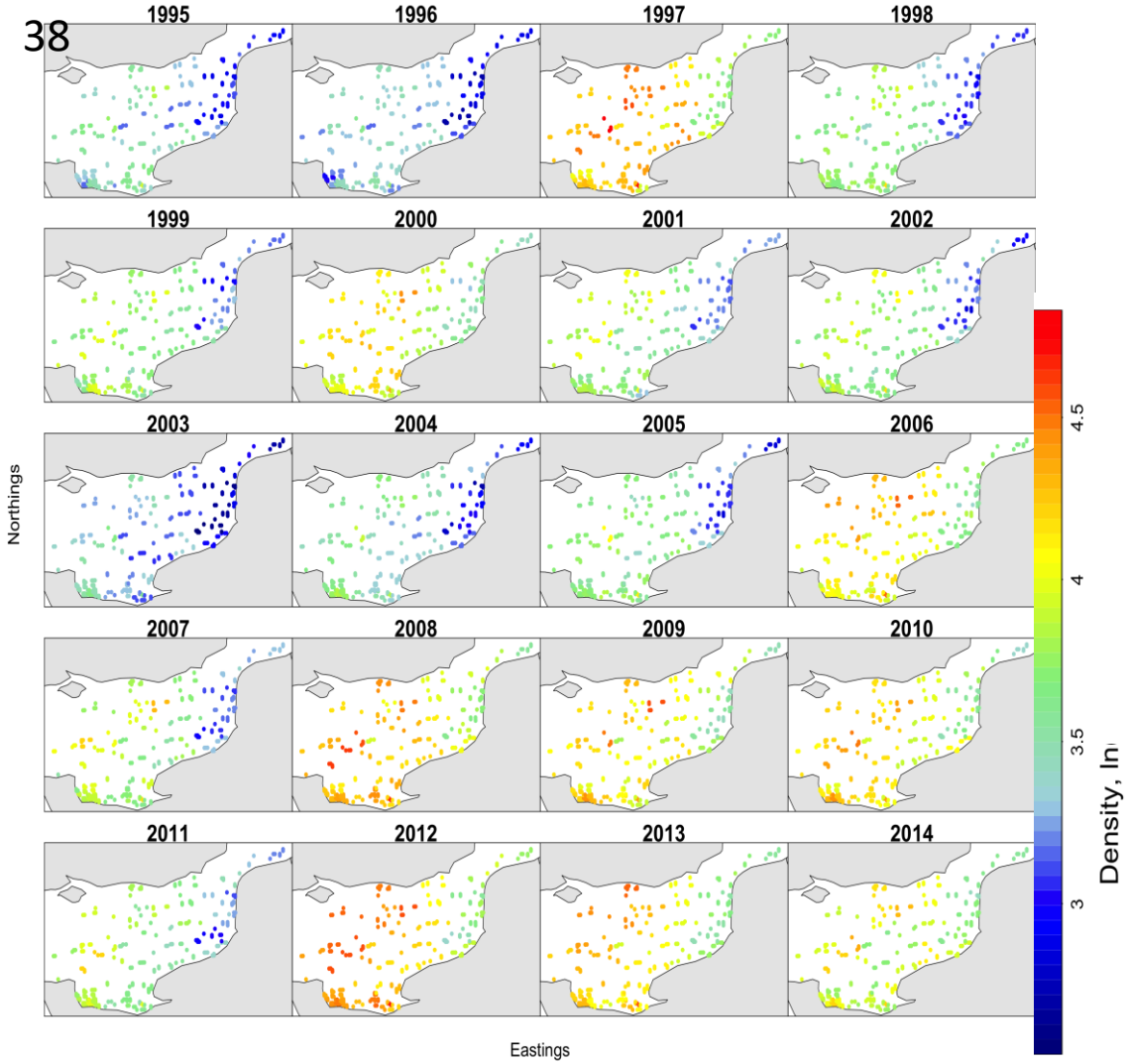

Raja undulata

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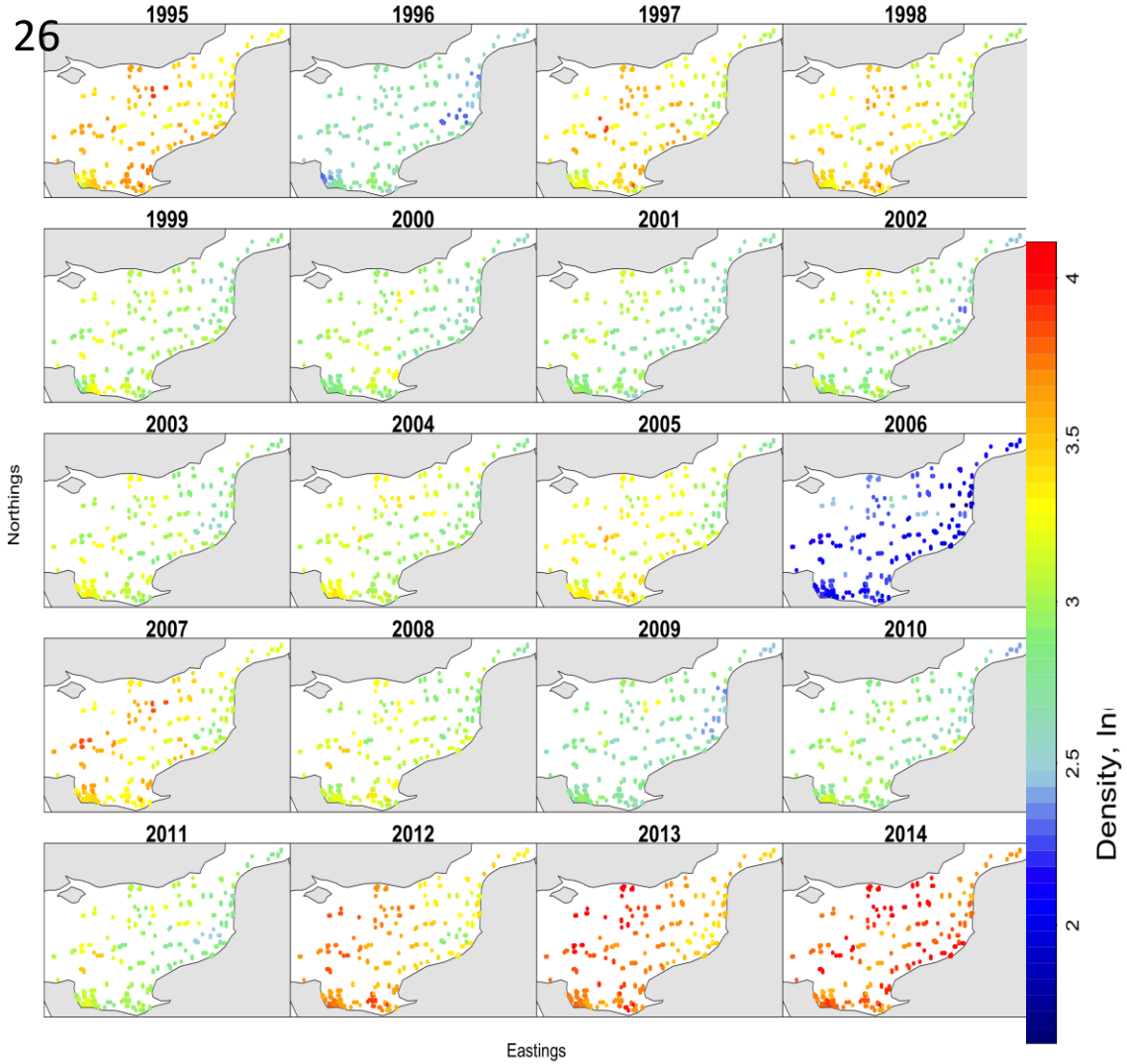
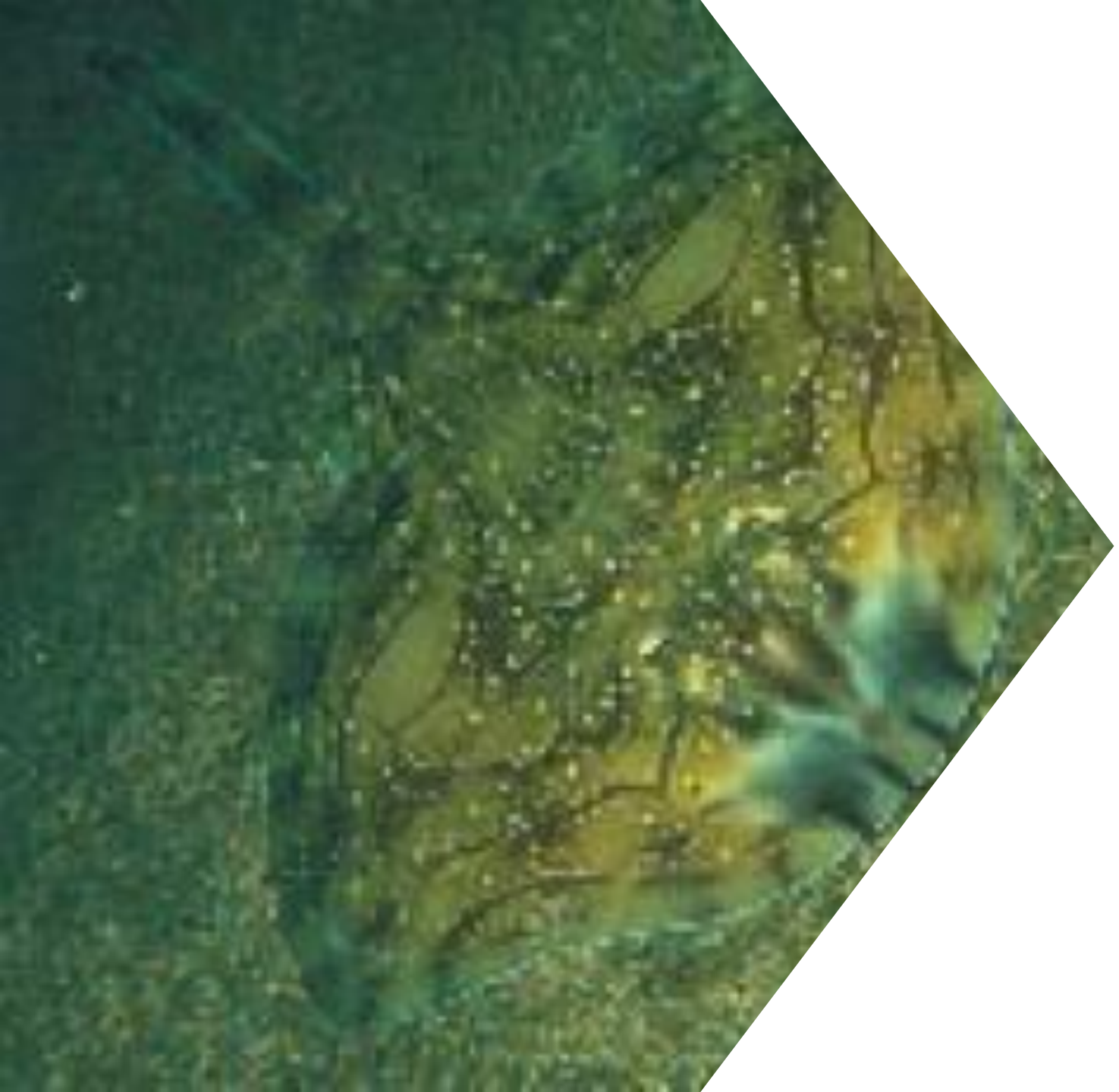


Conclusion

- Community spatial structure seem consistent temporally despite high fishing effort and change in the environment.
- Inference could be made about the fishing behavior
  - fishing effort
  - market prices
- Predict catch composition ratios for multispecies fisheries
- Predict likelihoods of bycatch species by knowing dynamics between bycatch and target species
- These results give insights into the magnitude of spatial variation in nature and should be highly beneficial for conservation and bioassessment programs that are built on the information about how communities vary in space.

It’s a work in progress

- Linking Habitat to these results (Sophie)
- Test the spatial temporal grouping to spatial resolution
- Add fishing behavior and effort of targeted species and try to predict bycatch.
- Compare with the results from the fishery dependent data
- No model diagnostics for zero-inflated negative binomial count data



Abundance proxies for Endangered IUCN red list of european marine Communities

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Methods : : Data

IUCN status	ACRONYM	Definition	# species
Extinct	EX	No known individuals remaining	0
Extinct in the wild	EW	Known only to survive in captivity, or as a naturalized population outside its historic range	0
Critically endangered	CR	Extremely high risk of extinction in the wild	1
Endangered	EN	High risk of extinction in the wild	2
Vulnerable	VU	High risk of endangerment in the wild	8
Near threatened	NT	Likely to become endangered in the near future	5
Least concern	LC	Lowest risk; does not qualify for a higher risk category. Widespread and abundant taxa are included in this category.	76
Data deficient	DD	Not enough data to make an assessment of its risk of extinction	10
Not evaluated	NE	Has not yet been evaluated against the criteria.	20

Methods : : Indices

Spatially aggregated abundance Indices

$$d(x,c,t) = r_1^*(x,c,t) \times r_2^*(x,c,t)$$

$$I(c,t,l) = \sum_{x=1}^{n_x} \left(a(x,l) \times d(x,c,t) \right)$$

Assume intercept constant across year = correlation in abundance is explained by spatio-temporal factors