The interest of survey-based juvenile abundance for advice in stock assessment of coastal nursery-dependent species

Le Pape O.[1], Vermard Y.[2]

1. ESE, Ecology and Ecosystem Health, Agrocampus Ouest, Fr

2. EMH, Ecology and models for Fisheries Science, IFREMER, Fr

ICES WG VCHES, Copenhagen, 2018

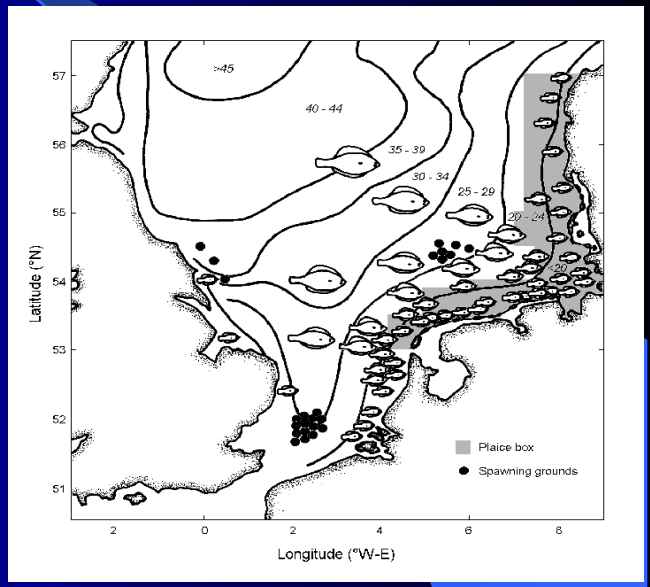
Coastal nursery- dependent fish

- Coast and estuaries = essential fish habitats
  - USA: 75 % of total landings from such dependent species
  - ICES assessed populations: 77 % of total landings
    (North Atlantic) 44% of the ICES evaluated species

Seitz *et al.*, 2014

- Among others, their nursery function

Gibson (1994); Beck *et al.* (2001)



- Spawning biomass / amount of eggs

  No clear link to future recruitment

- Juvenile abundance in nurseries

  drive fish population renewal

Coastal nursery- dependent fish

- Coast and estuaries = nursery function
  Shift from juvenile to adult habitats
  - scientific surveys at population scale do not cover shallow nurseries
  - specific coastal survey often spread on a local scale

  Partial cover + the lack of overlap with shallow nursery grounds = low reliability of recruitment estimates

- Investigate the use and usefullness of juvenile abundance index to predict recruitment of nursery-dependent species

The ICES-evaluated coastal nursery-dependent species

- 61 ICES evaluated species (2016)
- 18 ICES assessed species rely on coastal nurseries

≠ functional groups (Seitz et al, 2014)

Vertical distribution

Pelagic, demersal, benthic

Species	Vertical position
Ammodytes	Demersal
Anguilla anguilla	Demersal
Clupea harengus	Pelagic
Dicentrarchus labrax	Pelagic
Engraulis encrasicolus	Pelagic
Gadus morhua	Demersal
Limanda limanda	Benthic
Merlangius merlangus	Demersal
Mullus surmuletus	Demersal
Platichthys flesus	Benthic
Pleuronectes platessa	Benthic
Pollachius pollachius	Demersal
Pollachius virens	Demersal
Scophthalmus maximus	Benthic
Scomber scombrus	Pelagic
Scophthalmus rhombus	Benthic
Solea solea	Benthic
Sprattus sprattus	Pelagic

- They account for (Brown et al., 2018)
  - <1/3 of the ICES-evaluated species
  - 2/3 of total landings of ICES-evaluated stocks

The ICES-evaluated coastal nursery-dependent stocks

- Over the 185 ICES stocks assessed (2016),

  78 (42%) concern the 18 coastal nursery-dependent spec.

  = a large proportion of the ICES-assessed stocks

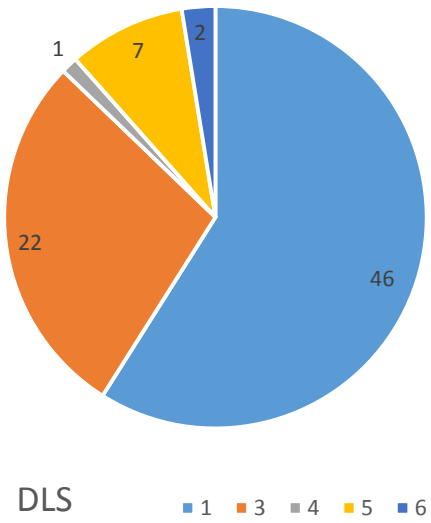
  Nursery dependent species: of interest and well studied

  ≈ 4-5 stocks / demersal & benthic species

  ≈ 3 stocks / pelagic species (wider scale)

The ICES-evaluated coastal nursery-dependent stocks

78 stocks for the 18 coastal nursery-dependent species



Category 1; quantitative assessments
Category 3; survey-based assessments
Category 4-5-6; Data poor (catch only or less)

A majority of data-rich stocks with quantitative assessment (DLS cat.1) and stocks with survey-based assessment (DLS cat. 3)

DLS Category 1+3 = 87% of 78 the stocks (well assessed stocks)

10 % of demersal data-limited stocks

The ICES-evaluated coastal nursery-dependent stocks

- Check Stock assessment WG reports & Ask info (questionnaire) to the 78 stocks leaders

Stock assessment method (DLS cat. 1, XSA, SAM, DLS cat> data poor)

Use of forecast (Y/N)

If Yes, use of recruitment indice based on survey data?

Even if no forecast, existence of survey with juvenile indice?

If there is a juvenile indice (used or not), infos on the survey

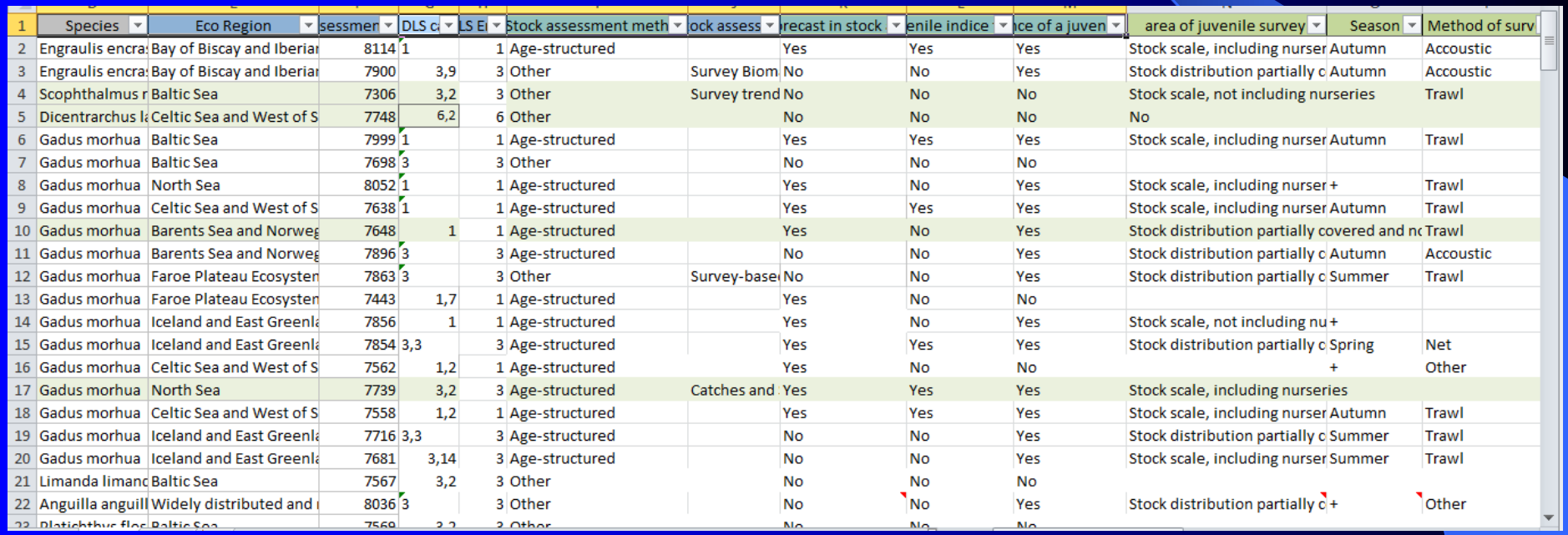
Scale
- Stock scale, including nurseries
- Stock scale, not including nurseries
- Stock distribution partially covered but including nurseries
- Stock distribution partially covered and not including nurseries

Method, intensity, age of recruitment estimate

Reasons to not consider the indice if not used

The ICES-evaluated coastal nursery-dependent stocks

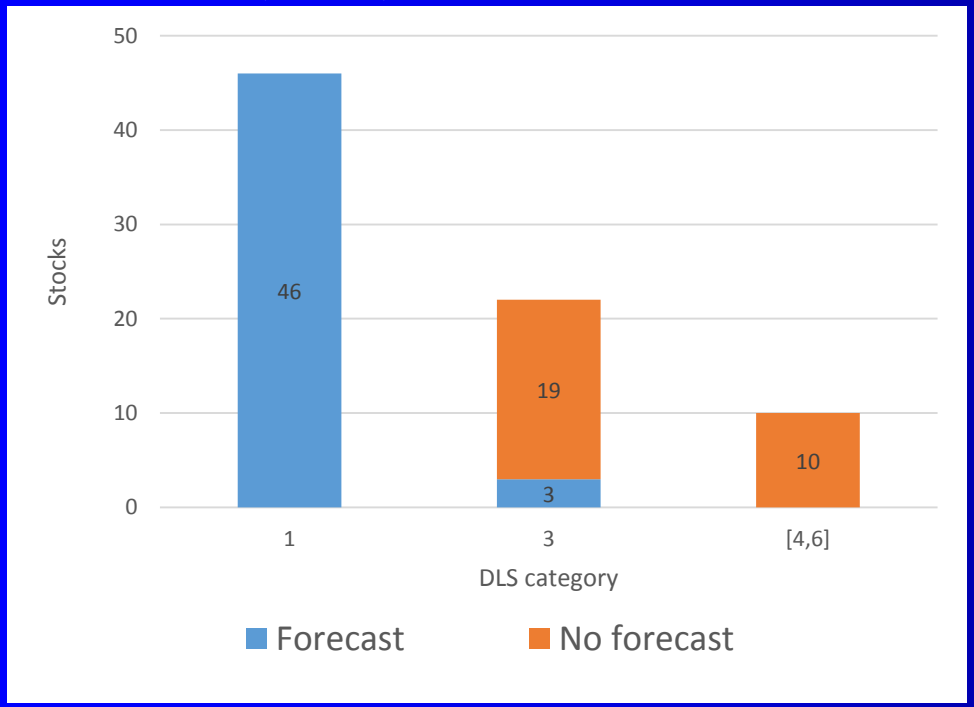
- Check WG reports & ask info (questionnaire) to the 78 stocks leaders (needed if no use of juv. ind.)



	Species	Eco Region	sessmer	DLS c	LS E	Stock assessment meth	ock assess	recast in stock	enile indice	ce of a juven	area of juvenile survey	Season	Method of surv
2	Engraulis encra	Bay of Biscay and Iberia	8114	1	1	Age-structured		Yes	Yes	Yes	Stock scale, including nurser	Autumn	Accoustic
3	Engraulis encra	Bay of Biscay and Iberia	7900	3,9	3	Other	Survey Biom	No	No	Yes	Stock distribution partially c	Autumn	Accoustic
4	Scophthalmus r	Baltic Sea	7306	3,2	3	Other	Survey trend	No	No	No	Stock scale, not including nurseries		Trawl
5	Dicentrarchus la	Celtic Sea and West of S	7748	6,2	6	Other		No	No	No	No		
6	Gadus morhua	Baltic Sea	7999	1	1	Age-structured		Yes	Yes	Yes	Stock scale, including nurser	Autumn	Trawl
7	Gadus morhua	Baltic Sea	7698	3	3	Other		No	No	No			
8	Gadus morhua	North Sea	8052	1	1	Age-structured		Yes	No	Yes	Stock scale, including nurser	+	Trawl
9	Gadus morhua	Celtic Sea and West of S	7638	1	1	Age-structured		Yes	Yes	Yes	Stock scale, including nurser	Autumn	Trawl
10	Gadus morhua	Barents Sea and Norweg	7648	1	1	Age-structured		Yes	No	Yes	Stock distribution partially covered and nc		Trawl
11	Gadus morhua	Barents Sea and Norweg	7896	3	3	Age-structured		No	No	Yes	Stock distribution partially c	Autumn	Accoustic
12	Gadus morhua	Faroe Plateau Ecosysten	7863	3	3	Other	Survey-base	No	No	Yes	Stock distribution partially c	Summer	Trawl
13	Gadus morhua	Faroe Plateau Ecosysten	7443	1,7	1	Age-structured		Yes	No	No			
14	Gadus morhua	Iceland and East Greenla	7856	1	1	Age-structured		Yes	No	Yes	Stock scale, not including nu	+	
15	Gadus morhua	Iceland and East Greenla	7854	3,3	3	Age-structured		Yes	Yes	Yes	Stock distribution partially c	Spring	Net
16	Gadus morhua	Celtic Sea and West of S	7562	1,2	1	Age-structured		Yes	No	No		+	Other
17	Gadus morhua	North Sea	7739	3,2	3	Age-structured	Catches and	Yes	Yes	Yes	Stock scale, including nurseries		
18	Gadus morhua	Celtic Sea and West of S	7558	1,2	1	Age-structured		Yes	Yes	Yes	Stock scale, including nurser	Autumn	Trawl
19	Gadus morhua	Iceland and East Greenla	7716	3,3	3	Age-structured		No	No	Yes	Stock distribution partially c	Summer	Trawl
20	Gadus morhua	Iceland and East Greenla	7681	3,14	3	Age-structured		No	No	Yes	Stock scale, including nurser	Summer	Trawl
21	Limanda liman	Baltic Sea	7567	3,2	3	Other		No	No	No			
22	Anguilla anguill	Widely distributed and	8036	3	3	Other		No	No	Yes	Stock distribution partially c	+	Other
23	Platichthys flos	Baltic Sea	7569	3,2	3	Other		No	No	No			

The ICES-evaluated coastal nursery-dependent stocks

- ≈ 49 (2/3) use forecast in stock assessment

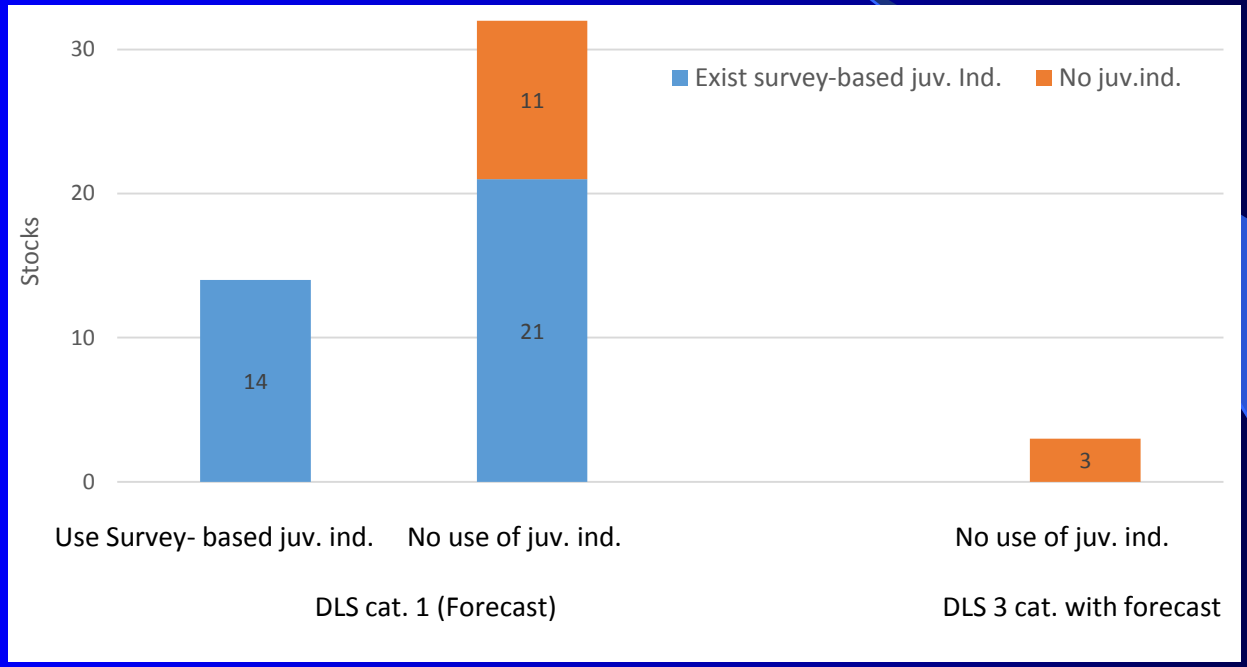


Systematic in DLS cat. 1
Sometimes (14%) in DLS cat. 3
None for « *qualitative* » assess.

- Now focus on DLS categories 1 & 3 with forecast

The ICES-evaluated coastal nursery-dependent stocks

- For stocks with forecast (49): survey-based juvenile ind. ?



  - frequent survey-based juvenile abundance index (71%)

    (also 10 other survey-based juvenile indice for stock without forecast)

  - but frequently not used (60%!), especially for demersal species

Stocks with R forecast

- On the 78 ICES-evaluated stocks of the 18 coastal nursery-dependent species
- Recruitment forecast for 49 stocks (the 46 DLS cat. 1+ 3 DLS cat. 3)
- Only 14 stocks (DLS cat. 1) use survey-based recruit.
- Available survey-based recruitment (>70%), presently used (40%) or not, to forecast

Stocks with R forecast
Survey-based indice, but not used

Reasons to neglect 21/35 survey-based indice?

Reason to reject	Number	Type of surveys
Uncomplete series	2	
Produced too late to be used	4	(Sandeel)
Not investigated, nor tested	11	Partial stock coverage and/or no nursery cover
Investigated and rejected	4	Only partial stock coverage with/without nursery coverage

A problem of scale and nursery coverage

No perfect survey, 90% cover only a fraction of the stock, and the half do not sample coastal nurseries

Stocks with R forecast
With survey-based juvenile indice

49 stocks, 14 use survey-based recruitment indice

in specific post-assessment prediction procedure (*e.g.*, RCT3)

or integrated in assessment (e.g., SAM Model)

Area of juvenile survey	Number
Stock scale, including nurseries	7
Stock distribution partially covered but including nurseries	4
Stock scale, not including nurseries	3

50% of "perfect surveys"

0 partial stock cover without nursery

14 Stocks with forecast from survey-based juvenile indice

- Testing for accuracy of recruitment forecast

Level of correlation r

Stock assessed recruitment / recruitment indice

Compared with the geometric mean of the assessement-based recruitment / previous 5 years

Analysis of the drivers of accuracy of r

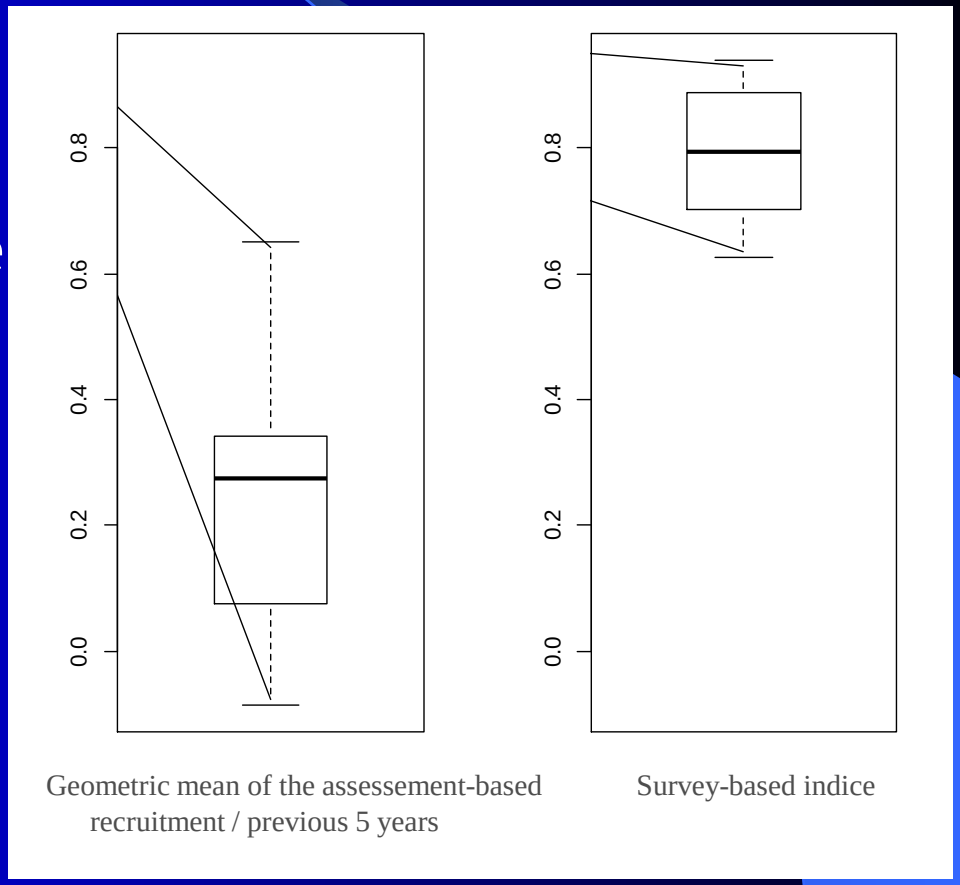
14 Stocks with forecast from survey-based juvenile indice

- Accuracy of recruitment forecast

Level of correlation

Stock assessed recruitment / survey-based recruitment indice

A dramatic improvement statistically sig. ***

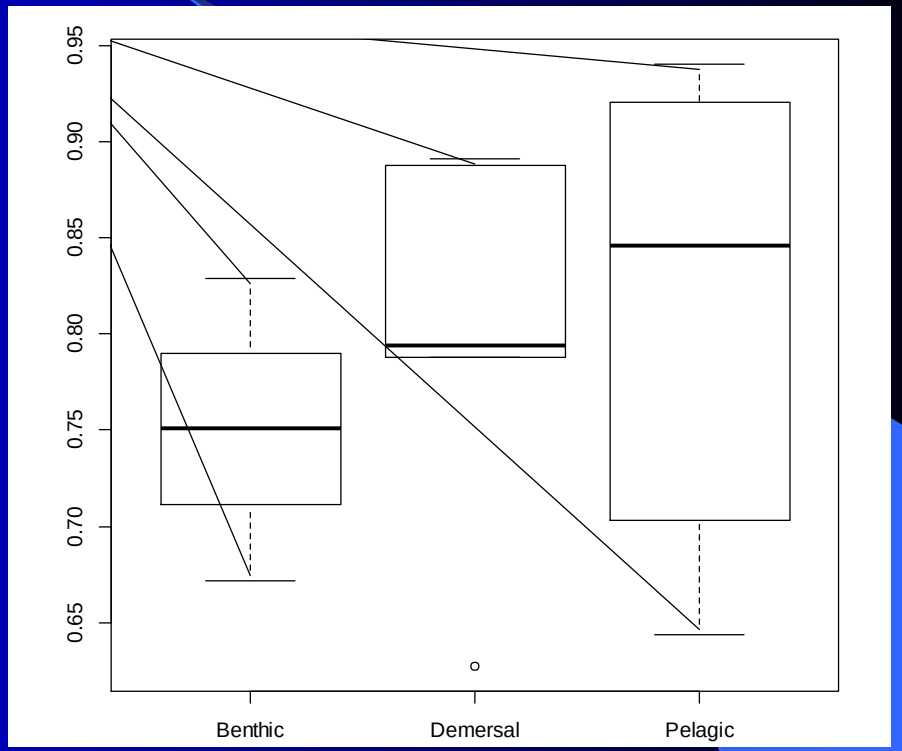


14 Stocks with forecast from survey-based juvenile indice

Drivers of accuracy: species habitat?

Level of correlation

Stock assessed recruitment / survey-based recruitment indice



Not statistically significant

But seems lower for benthic species more restricted to shallow areas

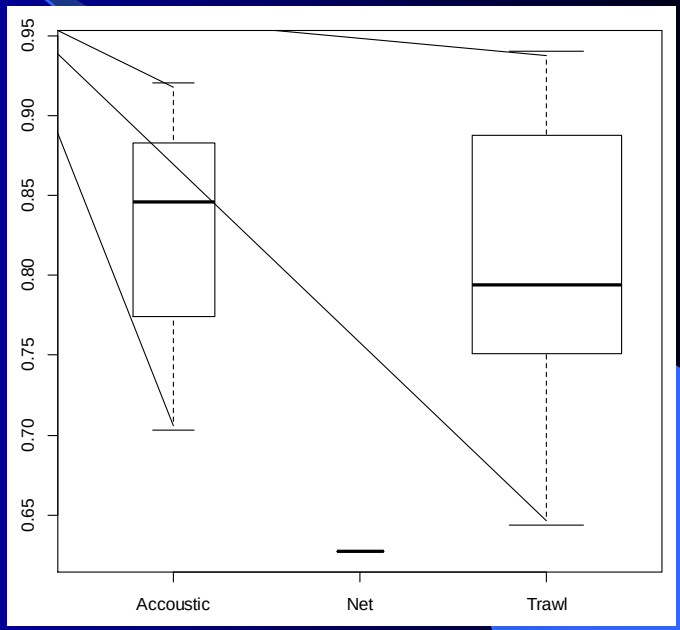
14 Stocks with forecast from survey-based juvenile indice

Drivers of accuracy: the sampling gear? No

Level of correlation

Stock assessed recruitment

/ survey-based recruitment indice



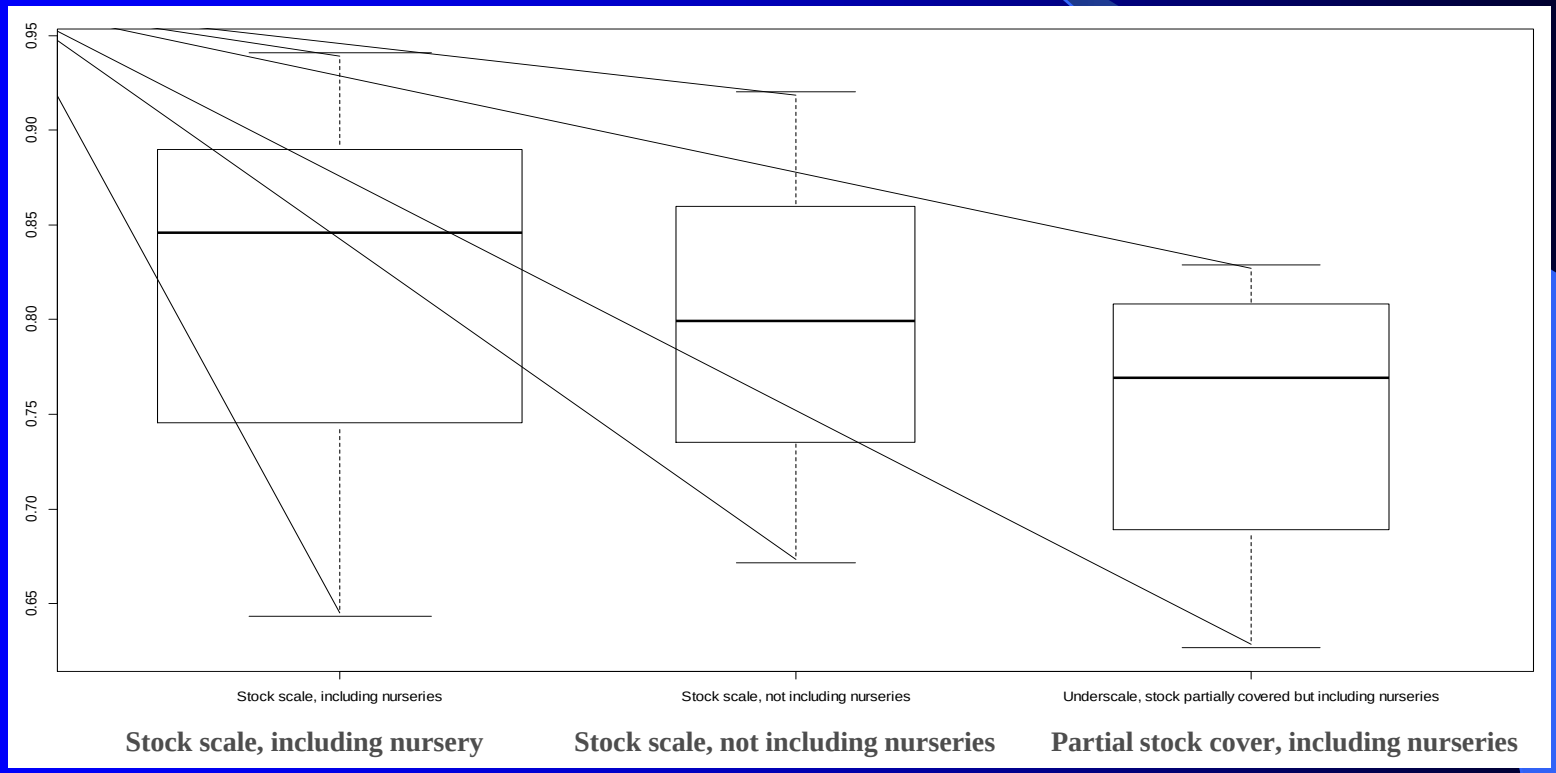
No more effect of the number of trawl samples

Nor of the duration of the time-series

14 Stocks with forecast from survey-based juvenile indice

- Drivers of accuracy? The spatial sampling design

Level of correlation (stock-assessed recruitment/ survey-based recruitment indice)



Small sample and no significant effect (but the better the higher?)

Conclusions

- Survey-based recruitment indice are reliable

  Provide accurate forecast

  are useful but under-used

- Could be helpful for decision making

  Included or not in the assessment

  (Fishermen trust data, more than model outputs)

Test the interest of other existing data (60% not used)

Develop (or reshape) recruitment oriented surveys

large (stock) scale, including nurseries

Thanks

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to scientists in charge of the 78 stock assessments

The WG VCHES for fruitful discussions