Integrated Biodiversity Assessment in the Barents Sea.

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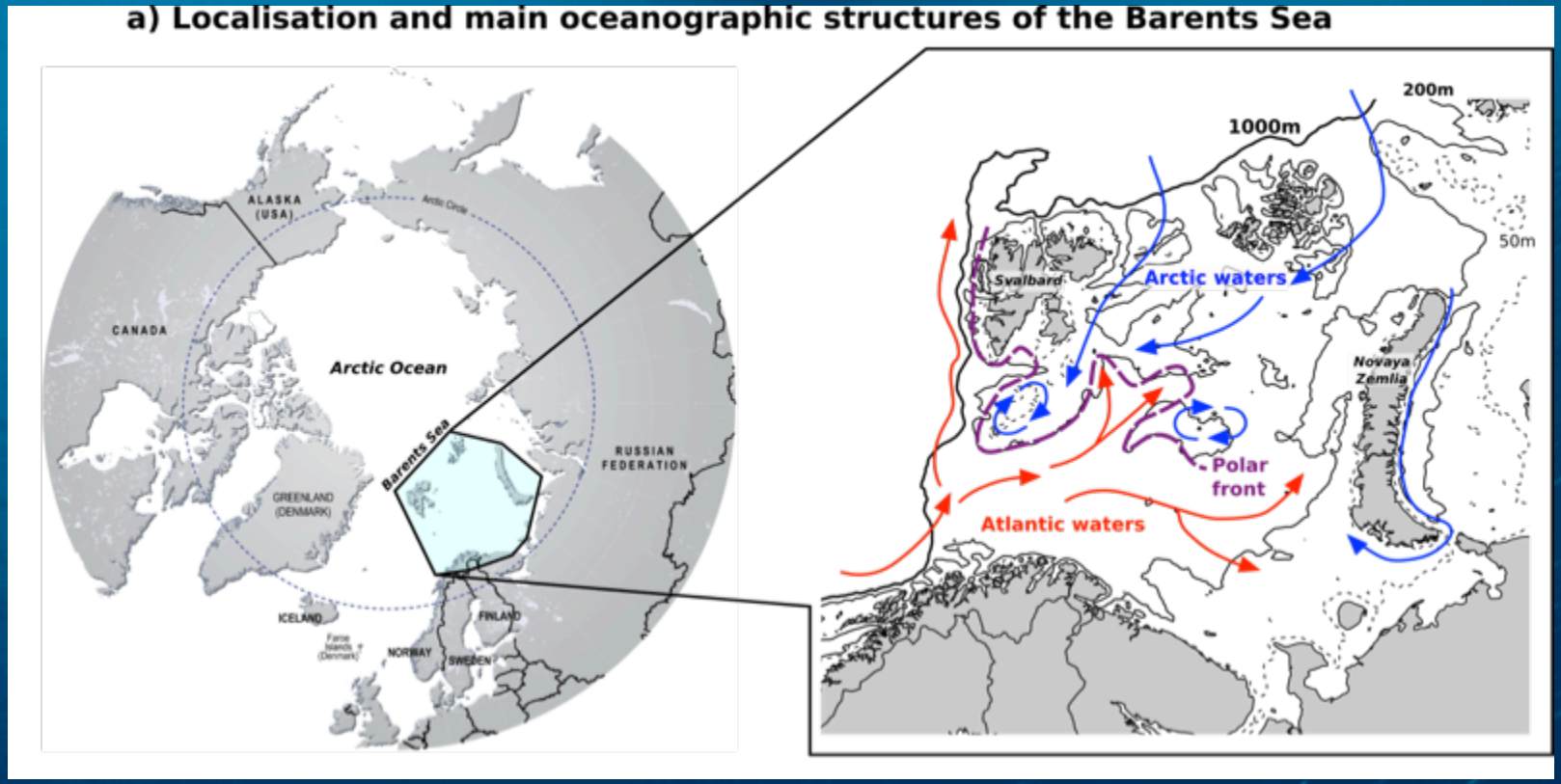
To better integrate biodiversity within management, baselines are requirred.

Baseline: a well known and described area/ time period; against which future data can be compared to evaluate biodiversity & changes

Quantitative, based on extensive monitoring

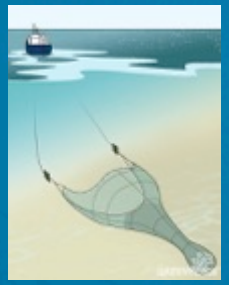
Biodiversity Assessment in the Barents Sea:

(α and β diversity of order q)



Fish diversity data in the Barents Sea: The ecosystem survey

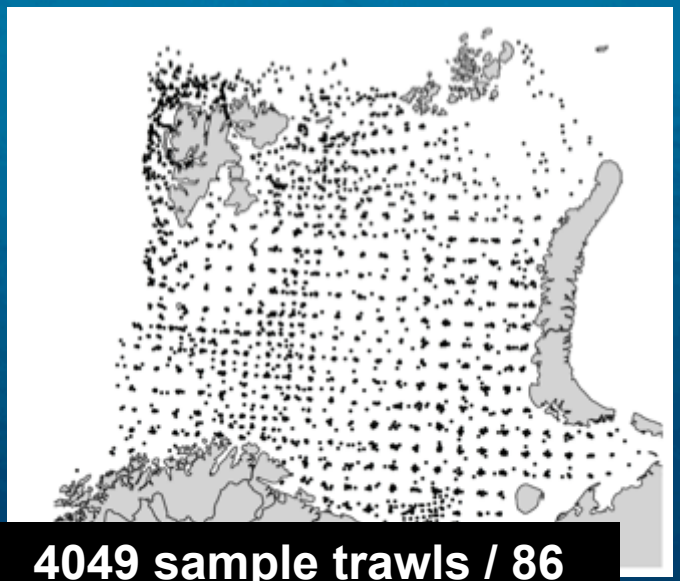
Bottom trawl



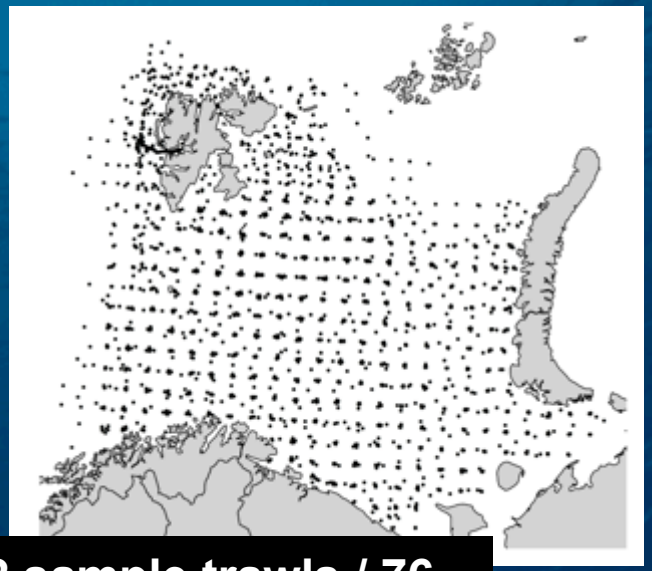
TWO GEARS

10 YEARS:
2004 - 2013

Pelagic trawl

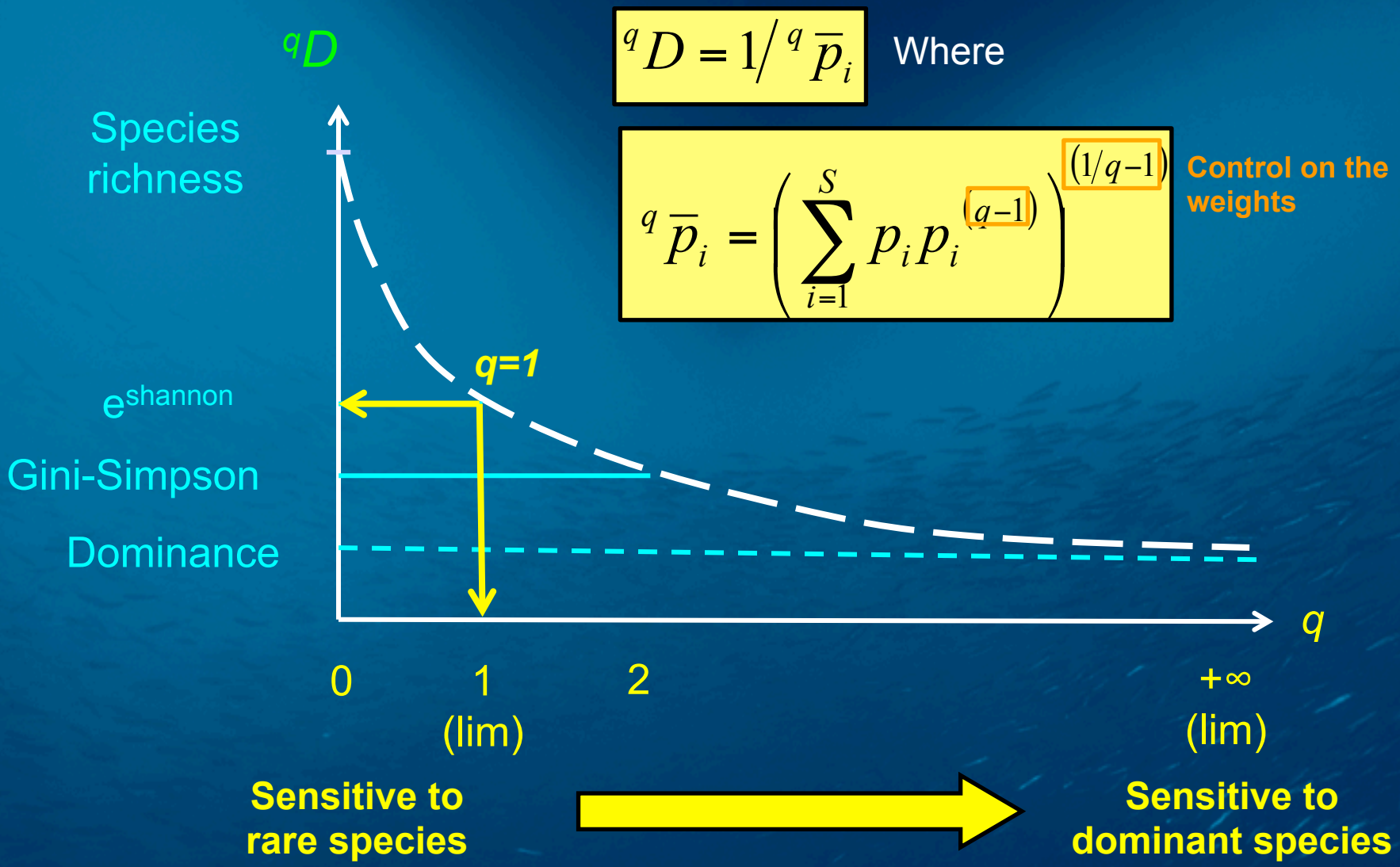


4049 sample trawls / 86 fish taxa



2852 sample trawls / 76 fish taxa

Hill diversity "profile", (as its exponent *q* varies over [0, +∞[ )



$$ {}^{q}D = 1 / {}^{q}\overline{p}_i $$

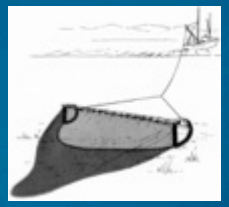
Where

$$ {}^{q}\overline{p}_i = \left(\sum_{i=1}^{S} p_i p_i^{(q-1)} \right)^{(1/q-1)} $$

Control on the weights

Many trawls: partitioning diversity in ”intra” (α) and ”inter” (β) component.

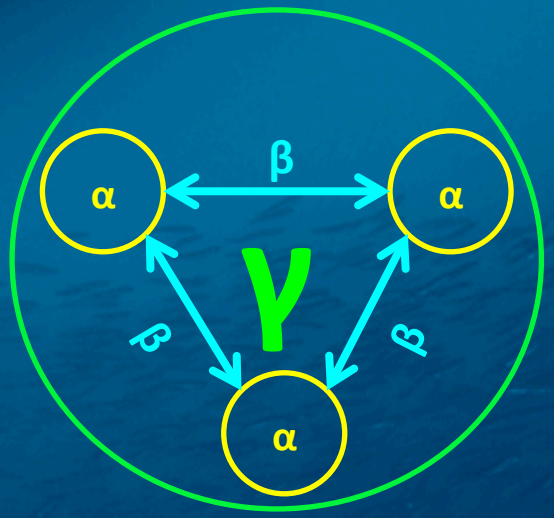
Any dataset can be composed of *j*=1…N ”compositional units”.



N=3 Trawled locations

α - Diversity per compositional unit,
β – Diversity between compositional units
γ – Total diversity

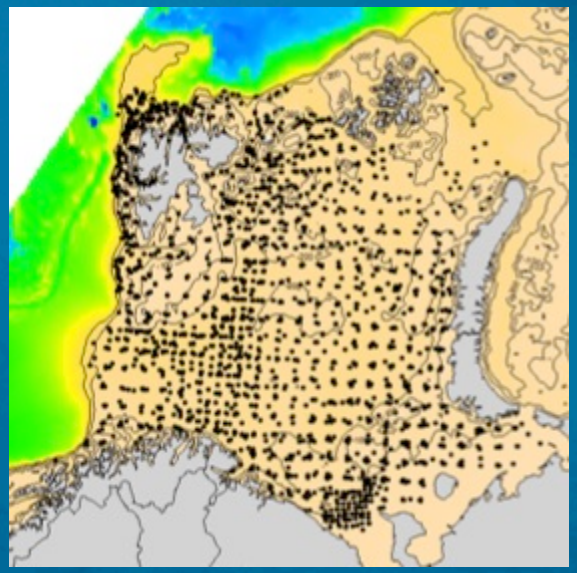
$$\alpha * \beta = \gamma$$



Partitioning can be hierarchical: We can have any number of nested levels…

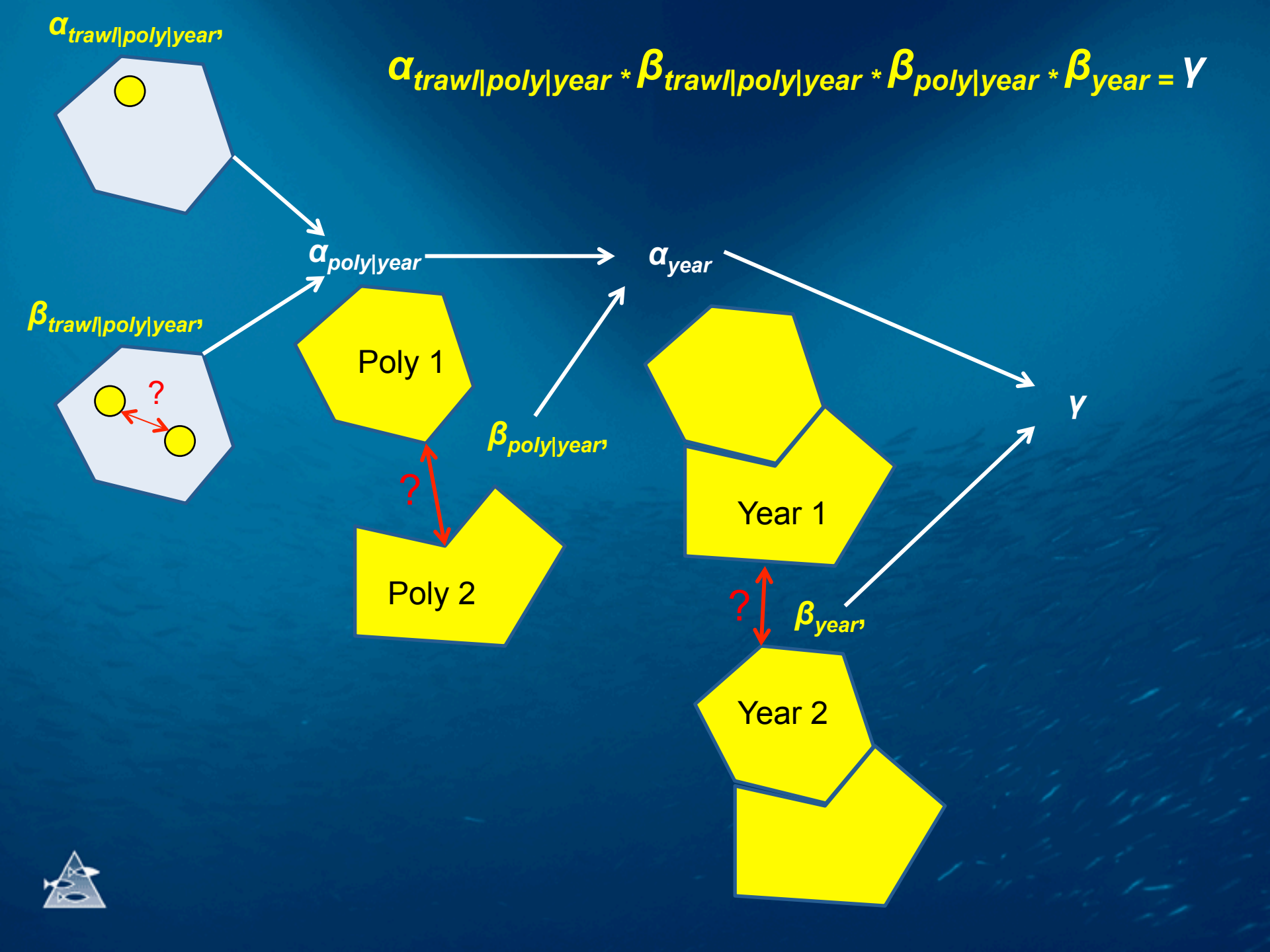
Partitioning Diversity in the Barents Sea: 3 sub-levels

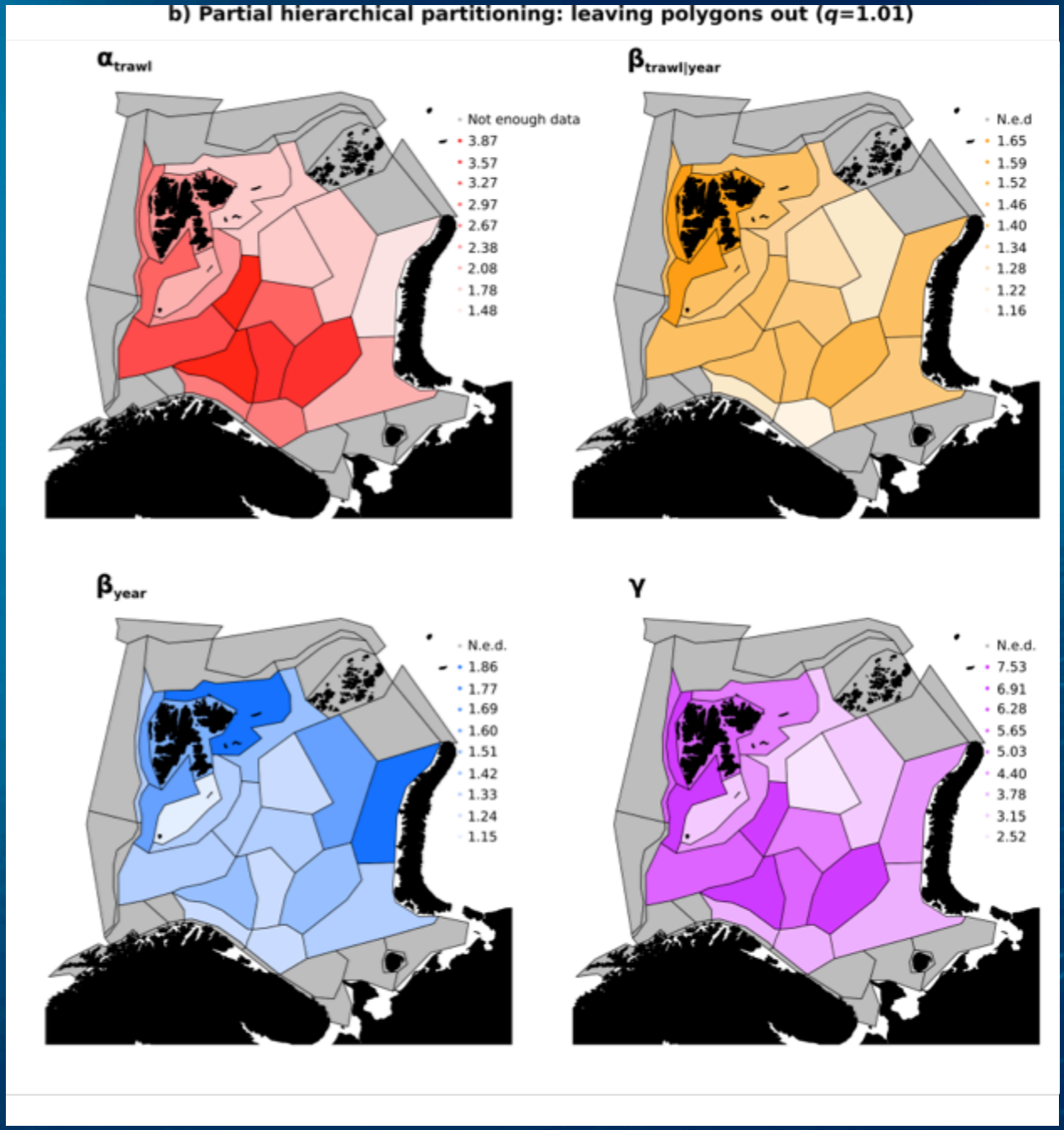
SAMPLE (local)



POLYGON (regional)

YEAR


$\alpha_{trawl|poly|year}$
$\alpha_{trawl|poly|year} * \beta_{trawl|poly|year} * \beta_{poly|year} * \beta_{year} = \gamma$
$\alpha_{poly|year}$
α_{year}
$\beta_{trawl|poly|year}$
?
Poly 1
$\beta_{poly|year}$
?
Poly 2
Year 1
γ
?
β_{year}
Year 2

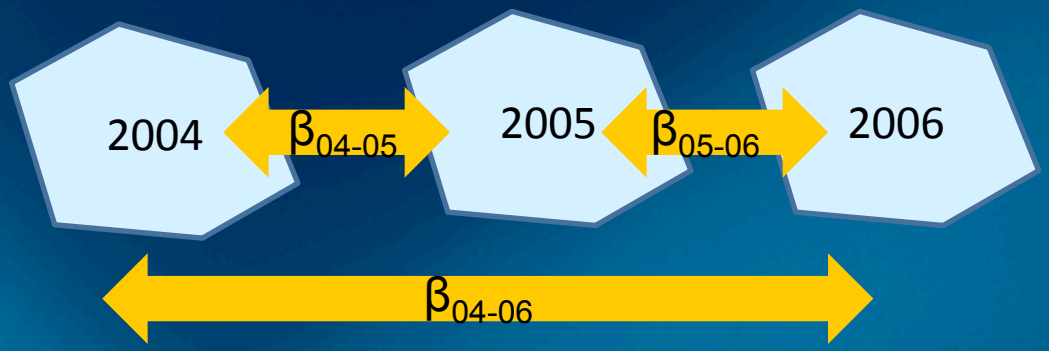

b) Partial hierarchical partitioning: leaving polygons out (q=1.01)
α trawl
Not enough data
3.87
3.57
3.27
2.97
2.67
2.38
2.08
1.78
1.48
β trawl|year
N.e.d
1.65
1.59
1.52
1.46
1.40
1.34
1.28
1.22
1.16
β year
N.e.d.
1.86
1.77
1.69
1.60
1.51
1.42
1.33
1.24
1.15
γ
N.e.d.
7.53
6.91
6.28
5.65
5.03
4.40
3.78
3.15
2.52

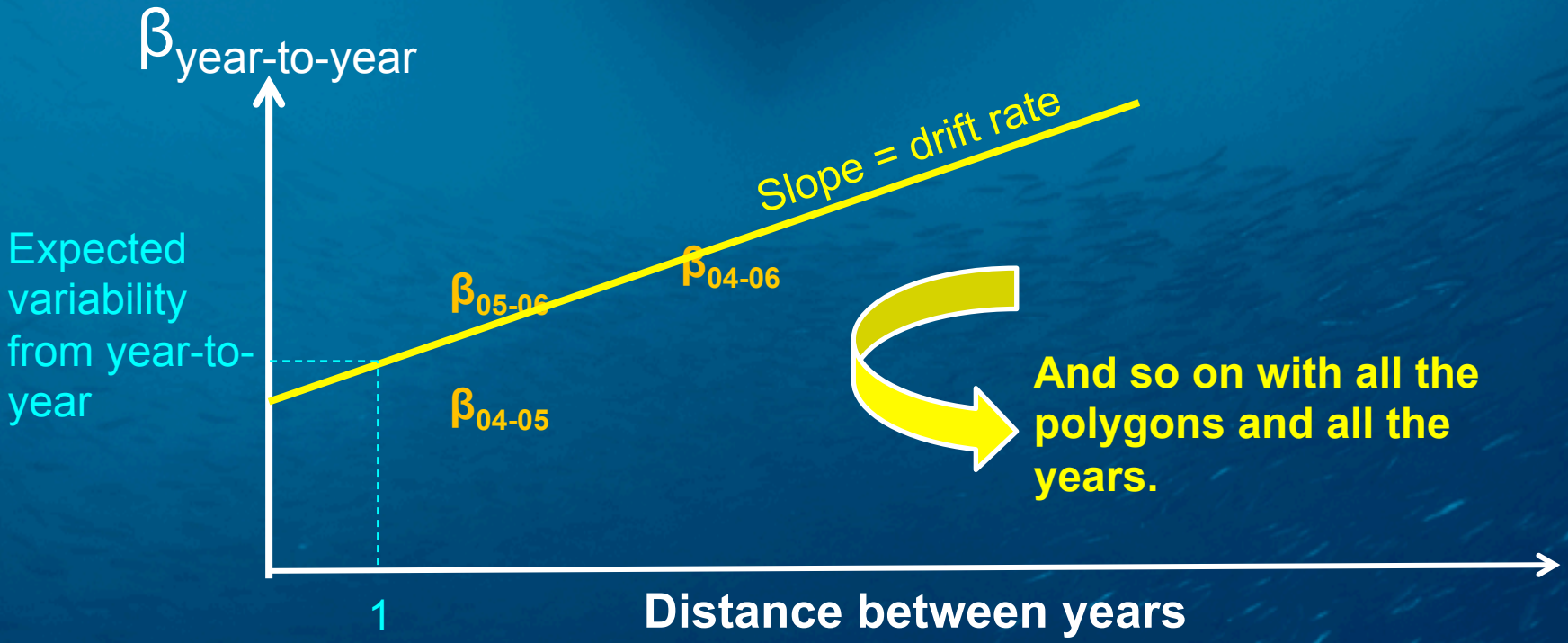
Assessment = Numbers with confidence Intervals for unambiguous comparison

	Polygon number	α_trawl	$\beta\_trawl\|year$	β_year	γ
demersal	19	2.67 [1.73-3.06]	1.43 [1.25-1.67]	1.33 [1.21-1.47]	5.11 [2.9-6.63]
	21	2.56 [2.13-3.11]	1.63 [1.45-1.79]	1.56 [1.34-1.89]	6.5 [5.46-7.99]
	22	2.34 [2.05-2.68]	1.6 [1.46-1.75]	1.44 [1.28-1.76]	5.51 [4.8-6.3]
	23	2.87 [2.5-3.35]	1.66 [1.5-1.84]	1.55 [1.37-1.75]	7.54 [6.18-8.7]
	24	1.78 [1.56-2.09]	1.45 [1.29-1.67]	1.15 [1.07-1.3]	3.01 [2.58-3.66]
	25	3.02 [2.65-3.44]	1.43 [1.34-1.52]	1.26 [1.18-1.37]	5.43 [4.65-6.45]
	26	2.31 [2.05-2.67]	1.37 [1.28-1.47]	1.26 [1.13-1.39]	4.02 [3.25-4.99]
	30	2.51 [2.11-3.14]	1.2 [1.15-1.27]	1.19 [1.12-1.29]	3.65 [2.89-4.67]
	33	2.63 [2.48-2.82]	1.15 [1.12-1.18]	1.17 [1.13-1.21]	3.52 [3.27-3.83]
	38	1.86 [1.38-2.24]	1.34 [1.19-1.52]	1.31 [1.18-1.48]	3.34 [2.18-4.21]
	39	3.32 [2.91-3.67]	1.47 [1.38-1.57]	1.33 [1.24-1.57]	6.58 [5.56-7.74]
	40	3.28 [2.9-3.76]	1.41 [1.32-1.5]	1.21 [1.16-1.27]	5.6 [4.71-6.65]
	41	3.87 [3.44-4.27]	1.44 [1.35-1.53]	1.35 [1.27-1.45]	7.52 [6.69-8.4]
	42	3.76 [3.44-4.14]	1.42 [1.32-1.53]	1.27 [1.19-1.46]	6.91 [5.93-7.99]
	43	2.85 [2.66-3.05]	1.39 [1.31-1.48]	1.25 [1.17-1.36]	4.97 [4.44-5.6]
	44	1.59 [1.32-2.07]	1.21 [1.11-1.41]	1.59 [1.34-1.87]	3.07 [2.31-4.46]
	45	1.48 [1.29-1.78]	1.45 [1.25-1.68]	1.85 [1.52-2.26]	4.03 [3.15-4.95]
	47	1.72 [1.52-1.96]	1.23 [1.16-1.32]	1.18 [1.11-1.47]	2.51 [2.04-3.43]
	48	1.7 [1.38-2.3]	1.31 [1.18-1.52]	1.35 [1.2-1.7]	3.14 [2.07-4.97]
	49	1.68 [1.42-2.28]	1.39 [1.24-1.63]	1.82 [1.47-2.32]	4.41 [2.96-6.78]

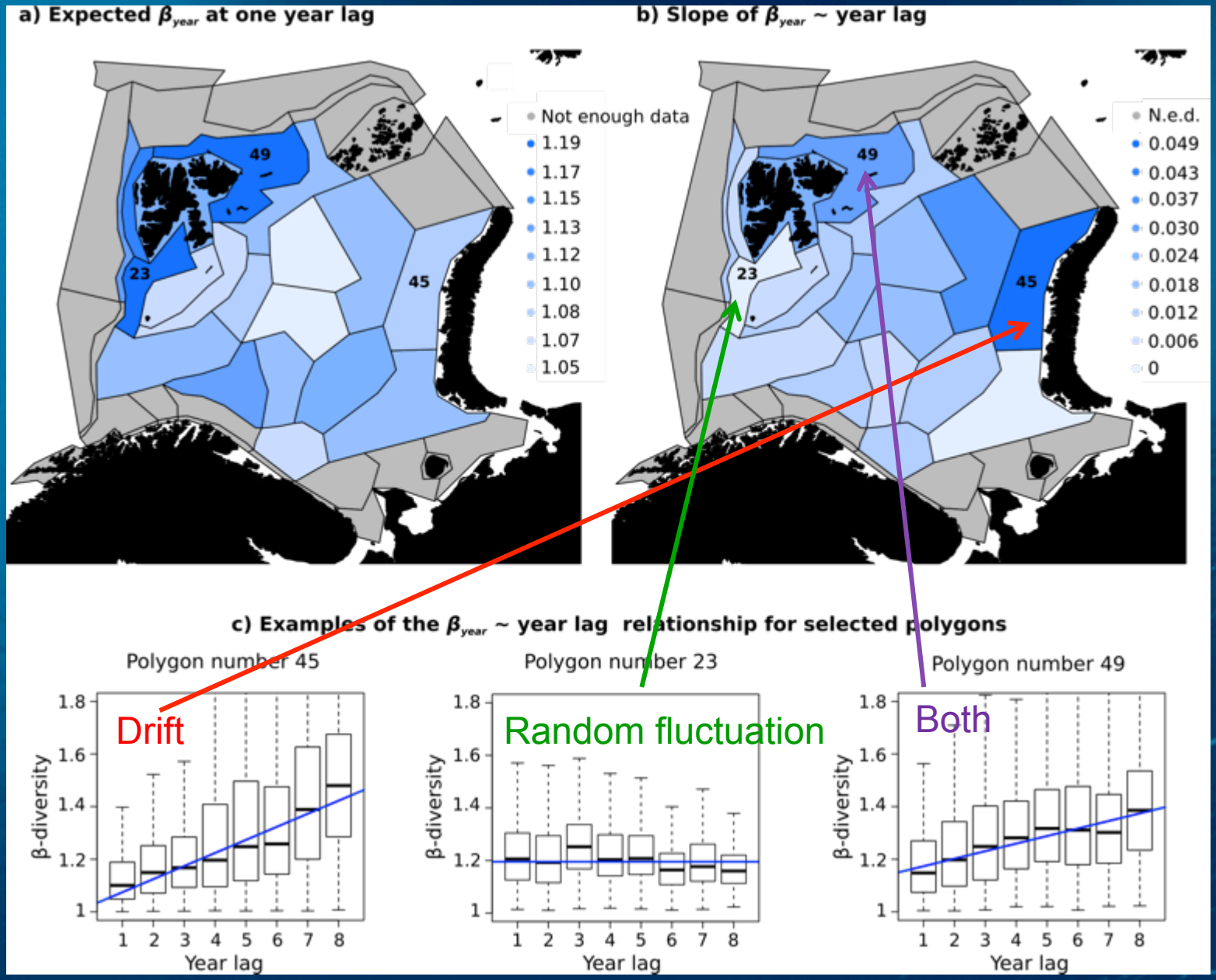
Spatial drift rate: ”year-to-year” β diversity:

Data at the polygon scale:





And so on with all the polygons and all the years.


a) Expected β_{year} at one year lag
b) Slope of β_{year} ~ year lag
Not enough data
1.19
1.17
1.15
1.13
1.12
1.10
1.08
1.07
1.05
N.e.d.
0.049
0.043
0.037
0.030
0.024
0.018
0.012
0.006
0
49
23
45
c) Examples of the β_{year} ~ year lag relationship for selected polygons
Polygon number 45
Polygon number 23
Polygon number 49
Drift
Random fluctuation
Both
β-diversity
Year lag

Conclusion:

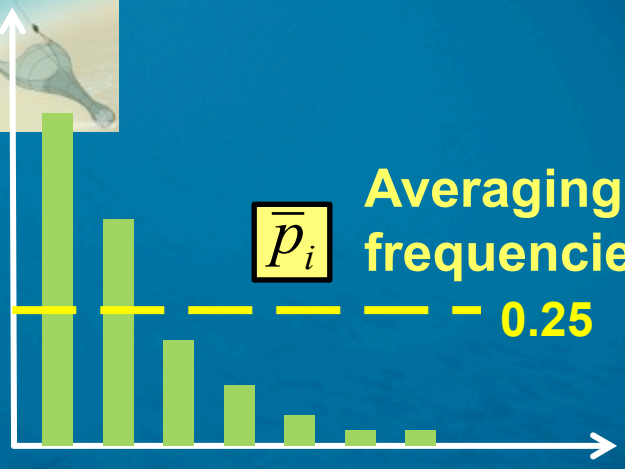
We have a quantified biodiversity & biodiversity changes in the fish community in the Barents Sea for a 10year time period – This can be used as a baseline for evaluating future changes.

Thanks for your attention !

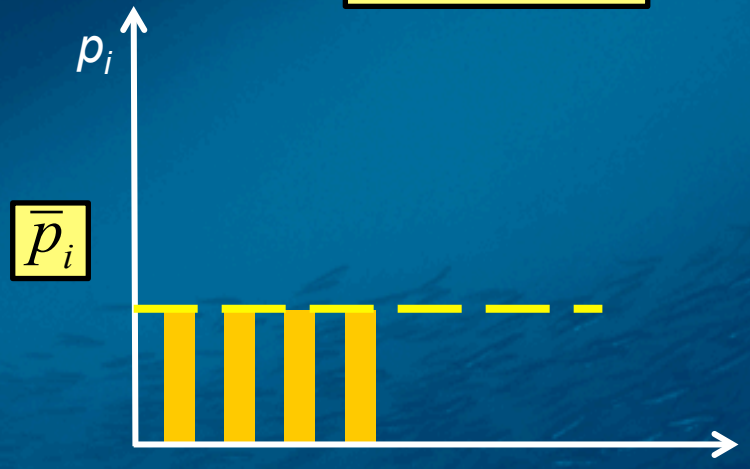
Measuring Diversity for one trawl

A trawl = **a biodiversity sample**

frequencies p_i



Writing: $D = 1/\overline{p}_i$ **= 4**



For Generalisation, Hill (1973) introduces **weights**, and an **exponent, *q*,** to control the [illegible] ties.

$${}^{q}D = 1/{}^{q}\overline{p}_i$$

Where

$${}^{q}\overline{p}_i = \left(\sum_{i=1}^{S} p \, p^{(q-1)} \right)^{(1/q-1)}$$

Control on the weights

frequencies **Weights**