Indirect effects of otter trawling on the condition and trophic level of *Nephrops* and flatfish in the Kattegat

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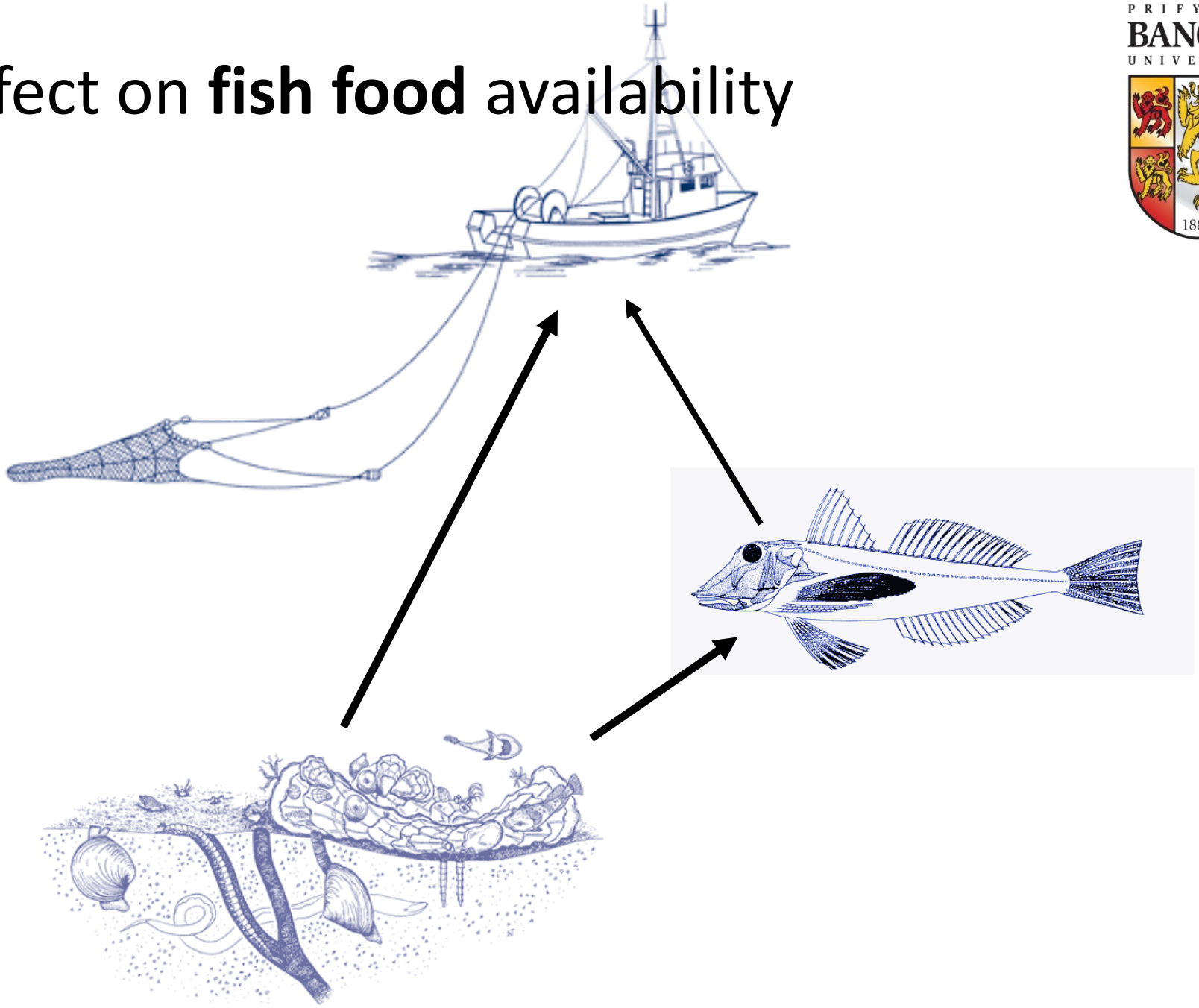
Trawls damage and kill invertebrates

Leads to reduced secondary production

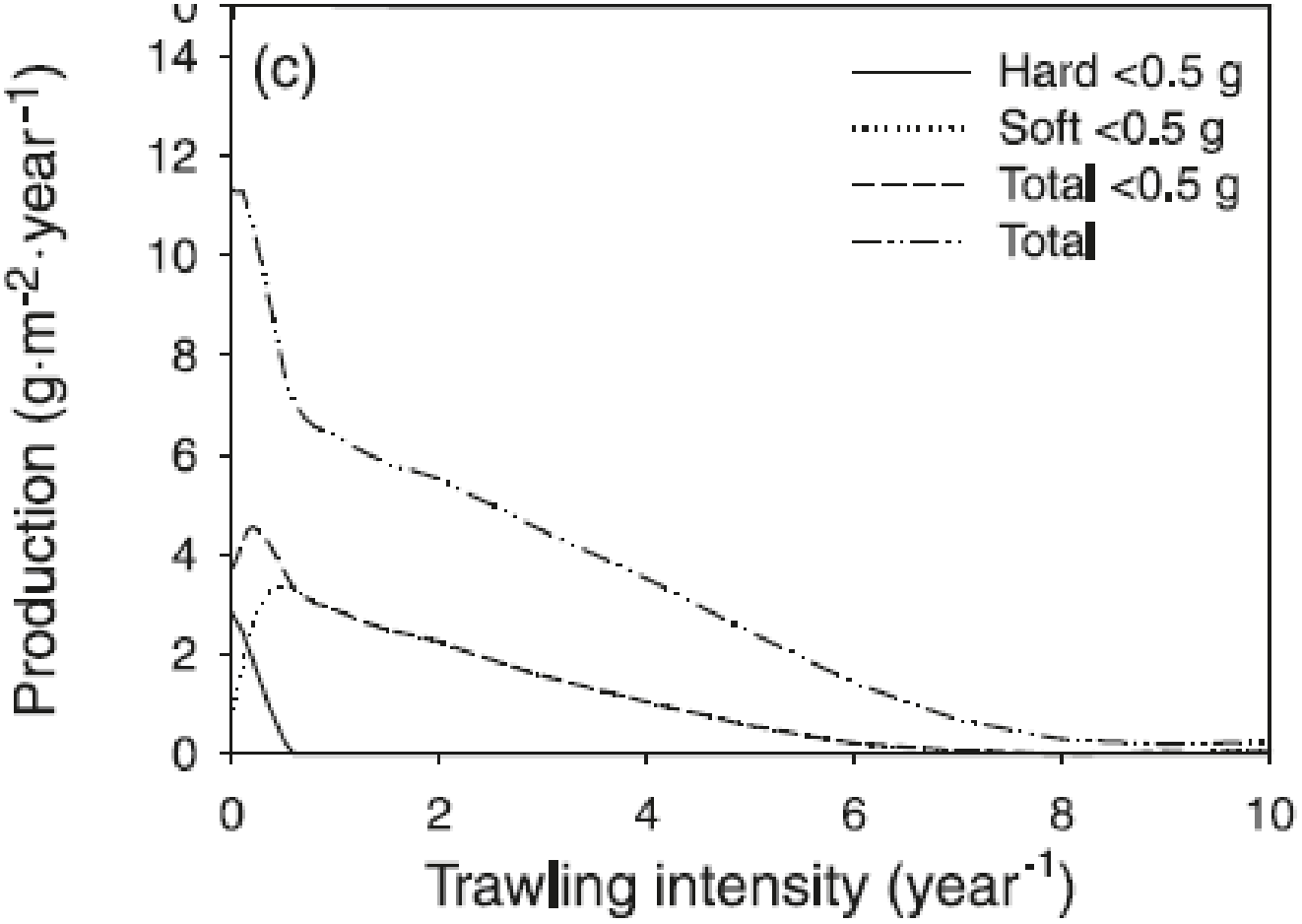
Changes in size distribution

Benthic invertebrates are important fish food

Effect on **fish food** availability



Hypotheses



Hiddink, J.G., Rijnsdorp, A.D., and Piet, G. 2008. Can bottom trawling disturbance increase food production for a commercial fish species? Canadian Journal of Fisheries and Aquatic Science, **65**: 1393-1401.

Approach

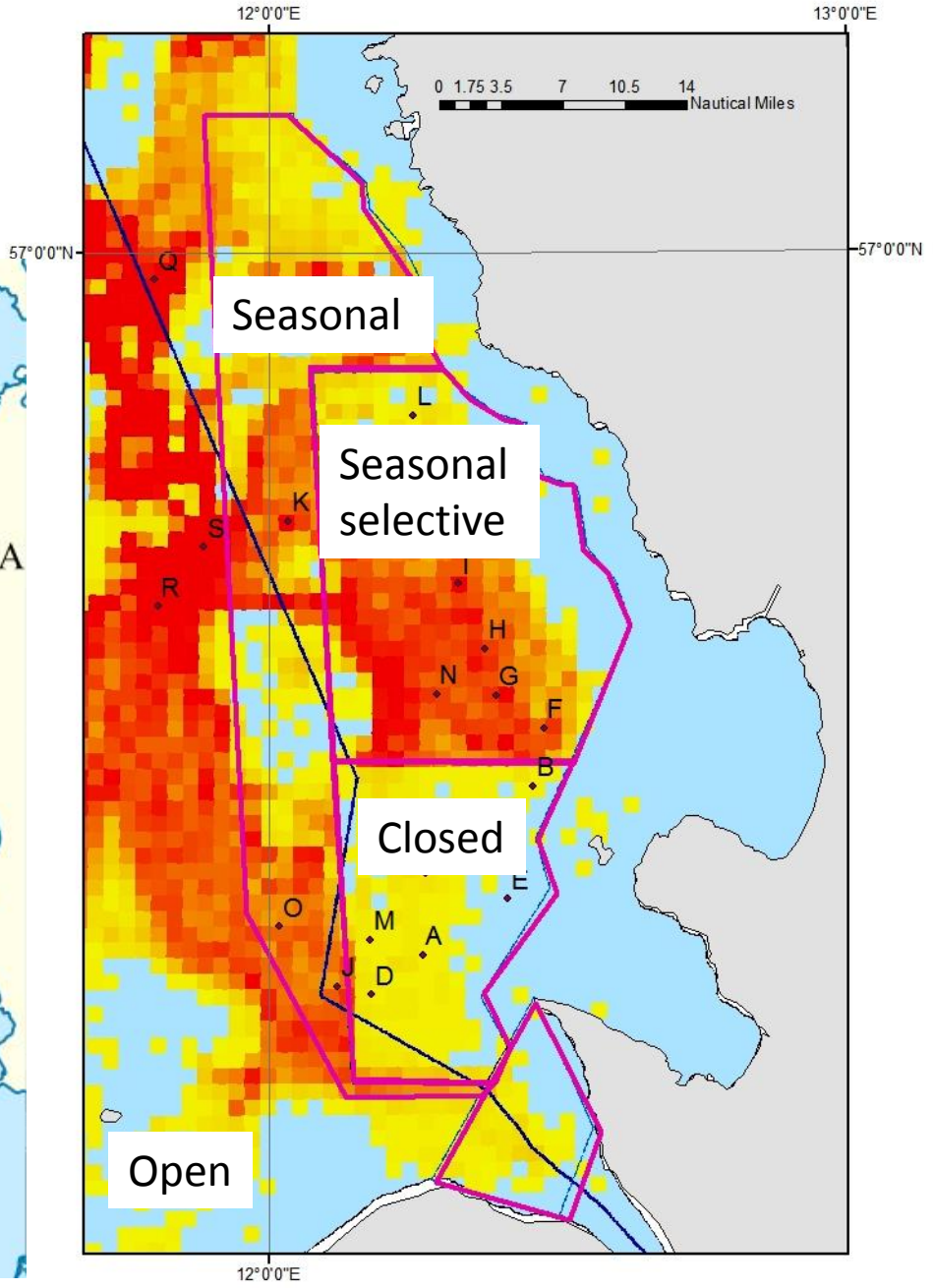
Sampling fish condition and their food across a gradient of commercial trawling effort.

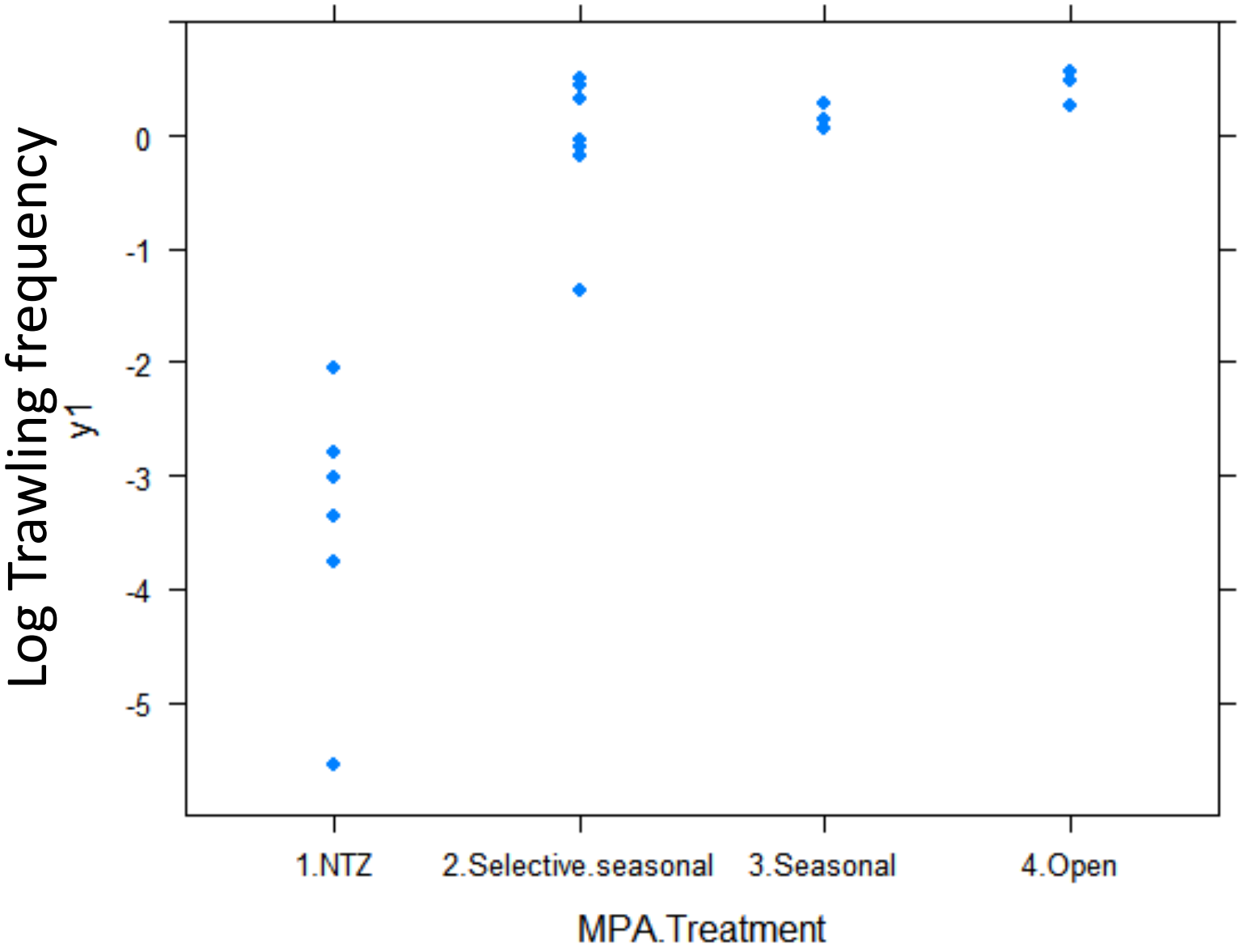
Assumptions

1. Fish build up condition over a few weeks
2. Fish do not move between stations over this period

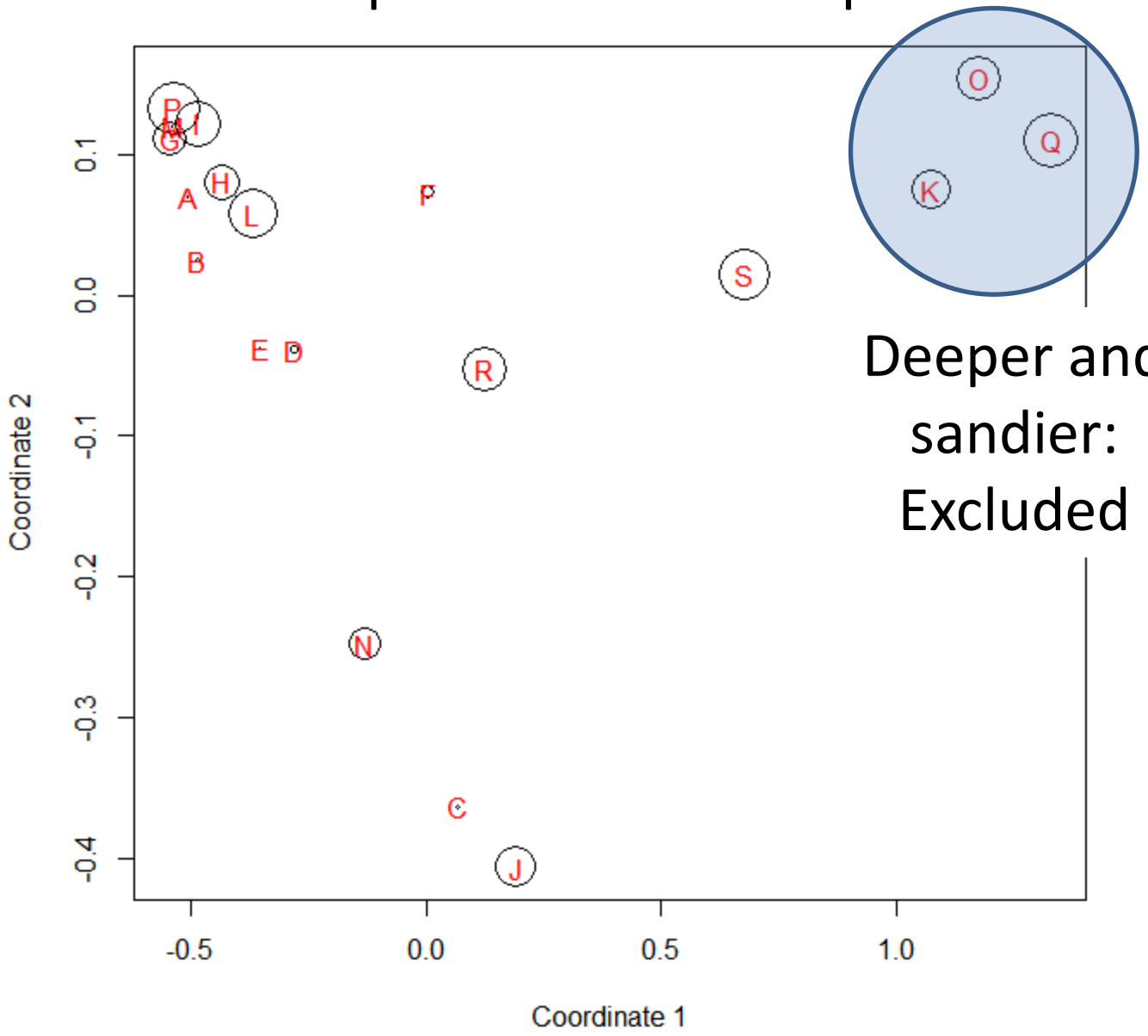
Too much movement = no pattern

Kattegat
August 2013




Log Trawling frequency
y1
0
-1
-2
-3
-4
-5
1.NTZ
2.Selective.seasonal
3.Seasonal
4.Open
MPA.Treatment

nMDS of depth and sediment parameters



Deeper and sandier: Excluded

Dominant infauna species by biomass and abundance

Amphiura
Spatangus
Arctica
Polyphysia
Thracia

Nucula
Abra
Maldana
Diplocirrus
Iphinoe

Plaice *Pleuronectes platessa*

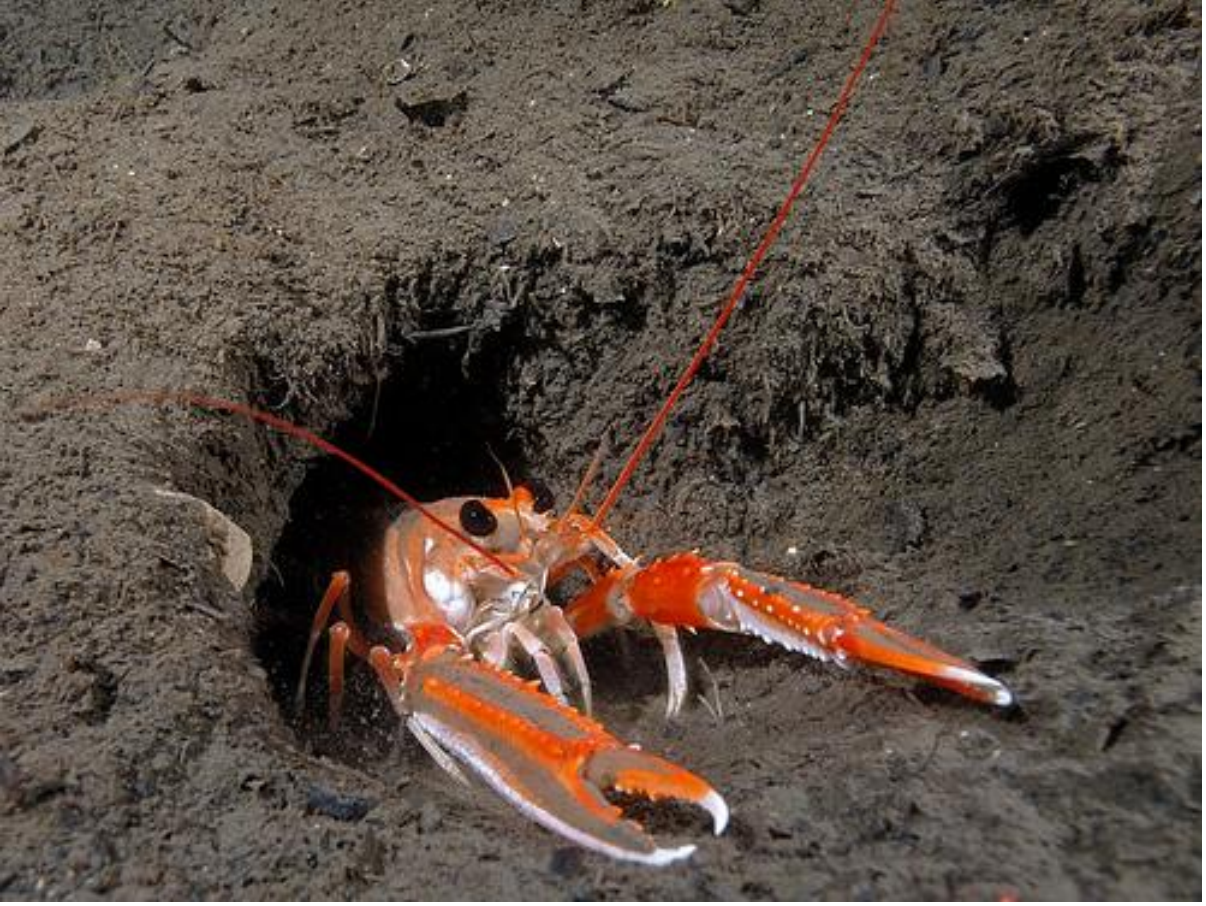
Benthivore – molluscs and polychaetes
Benefits from low levels of trawling?

Dab *Limanda limanda*

Benthivore – infaunal and epifaunal crustaceans

Long rough dab *Hippoglossoides platessoides*

Epifauna and piscivore



Norway lobster *Nephrops norvegicus*

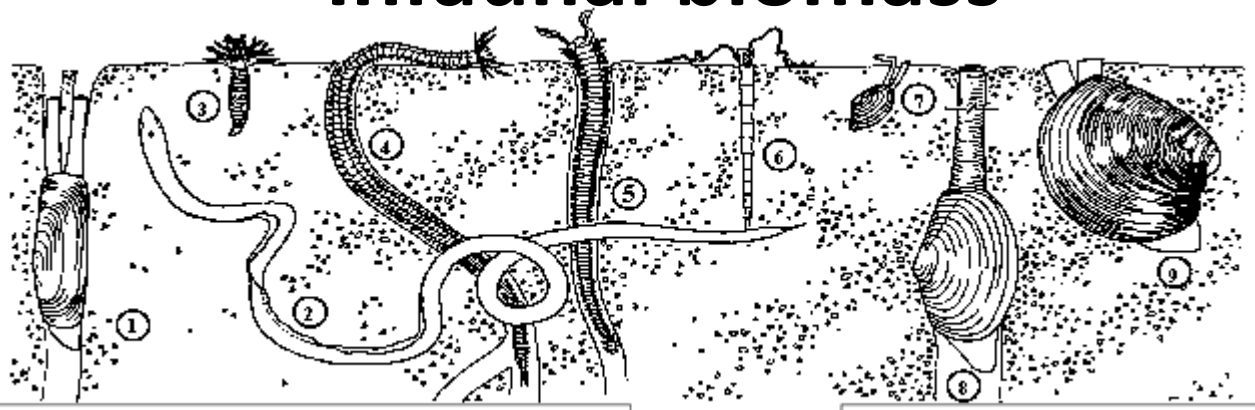
Benthivore – crustaceans
Discards

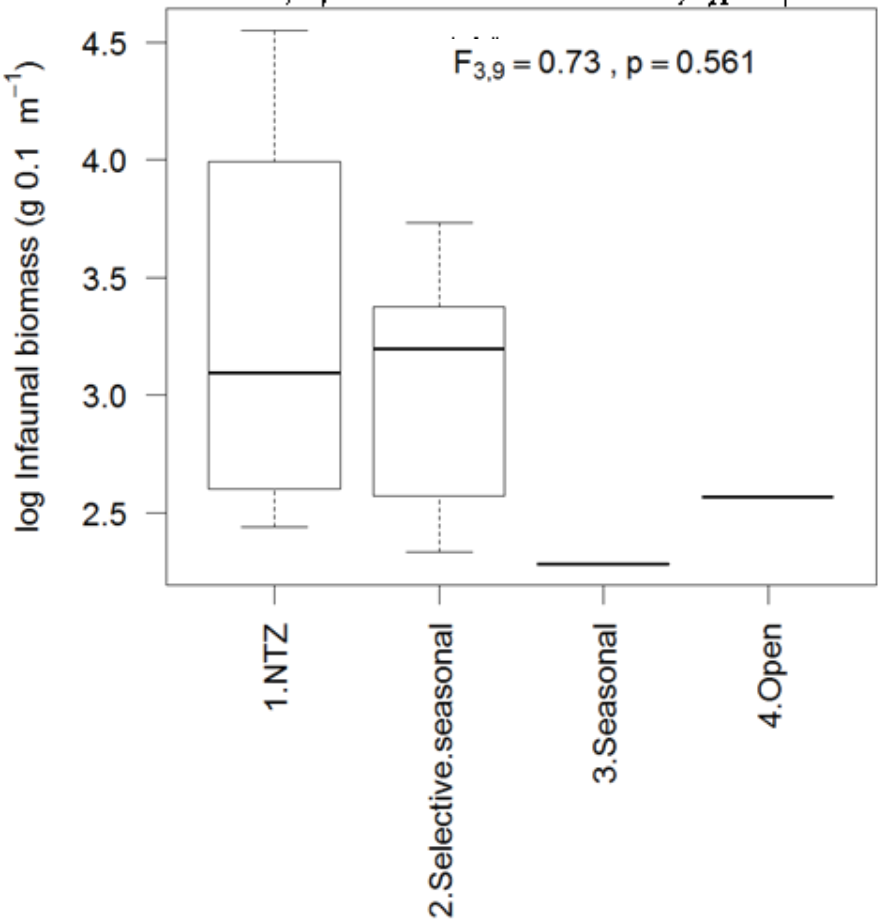
Collected

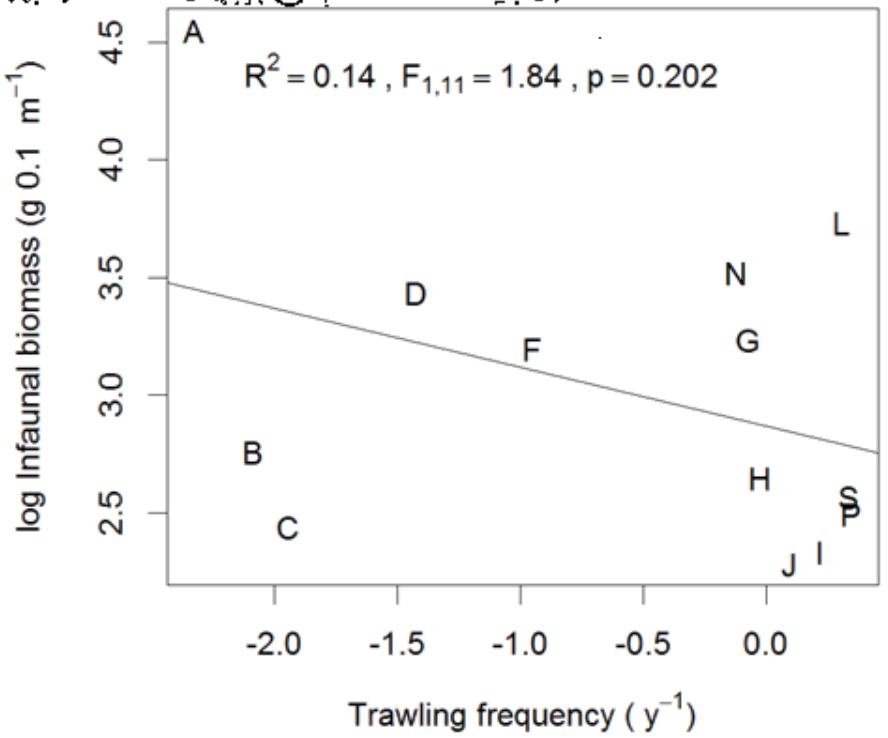
Infauna – abundance and biomass
Fish & *Nephrops* condition as relative weight
Fish & *Nephrops* isotope samples (standardized length)

Work in progress, to do:
Update fishing effort
Sort remaining benthos samples
Stomach contents
Remaining isotope samples
Analysis and conclusion preliminary
… and a bit speculative

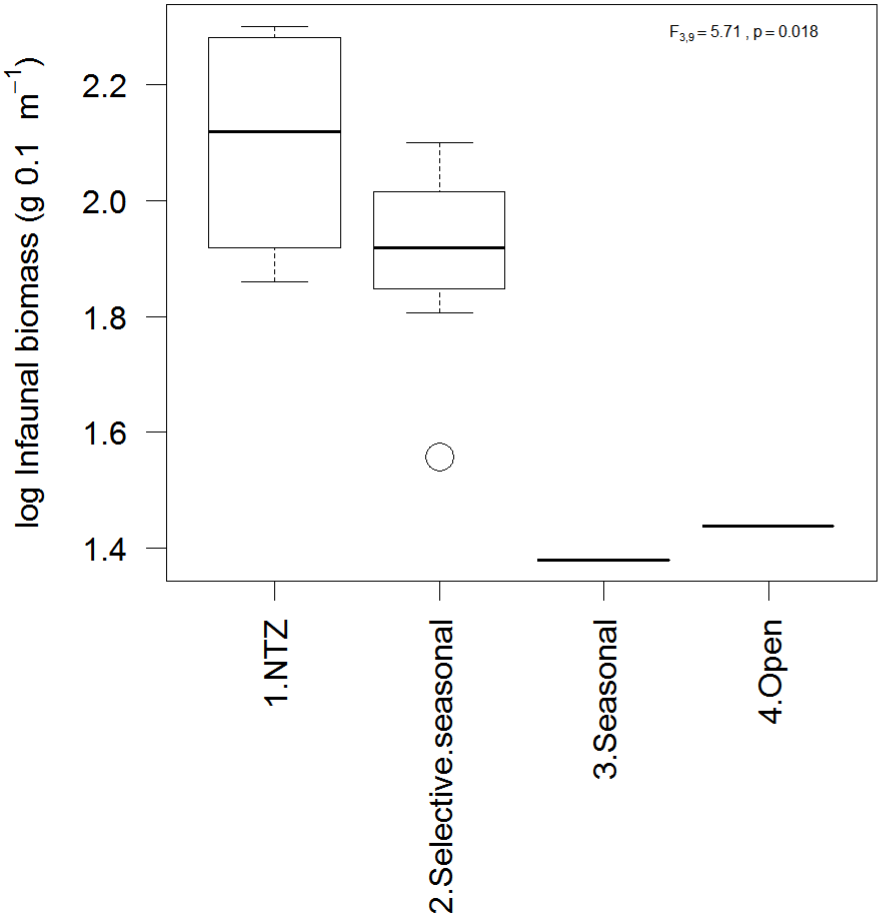
Infaunal biomass

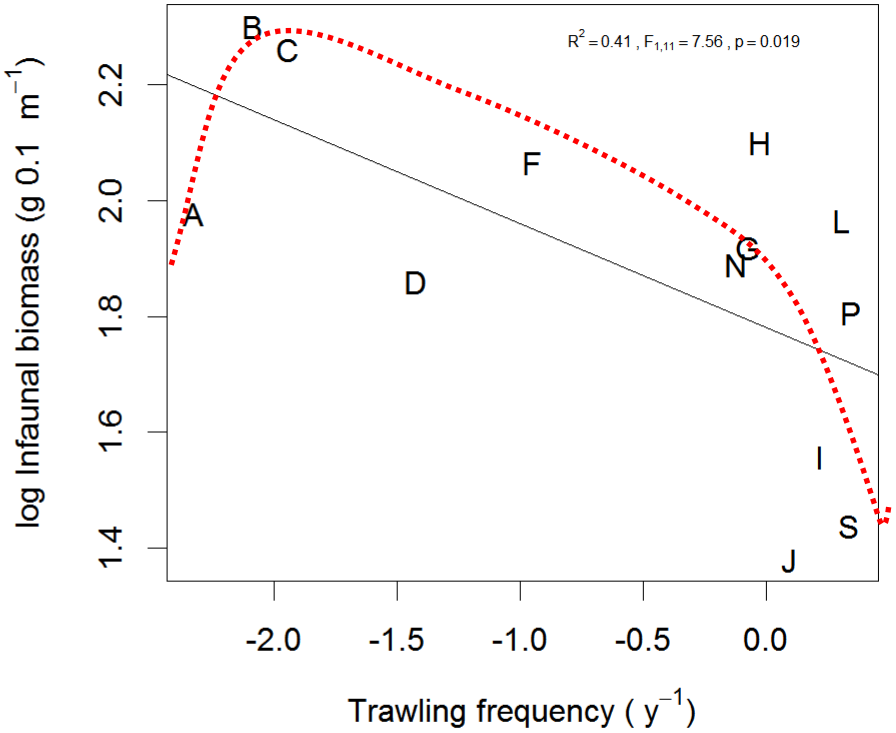






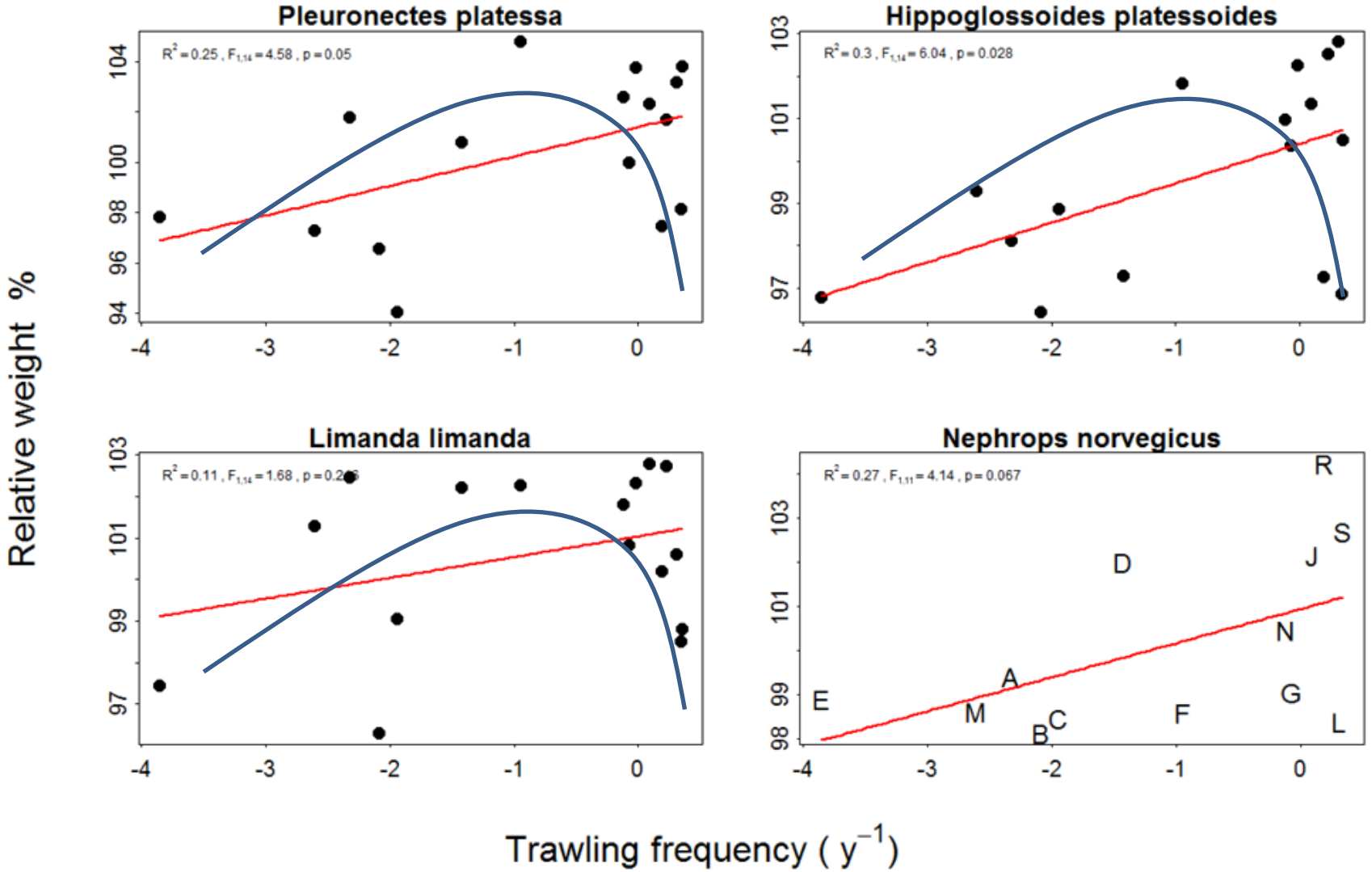
Fish food biomass
>0.01g & <0.2 g WW





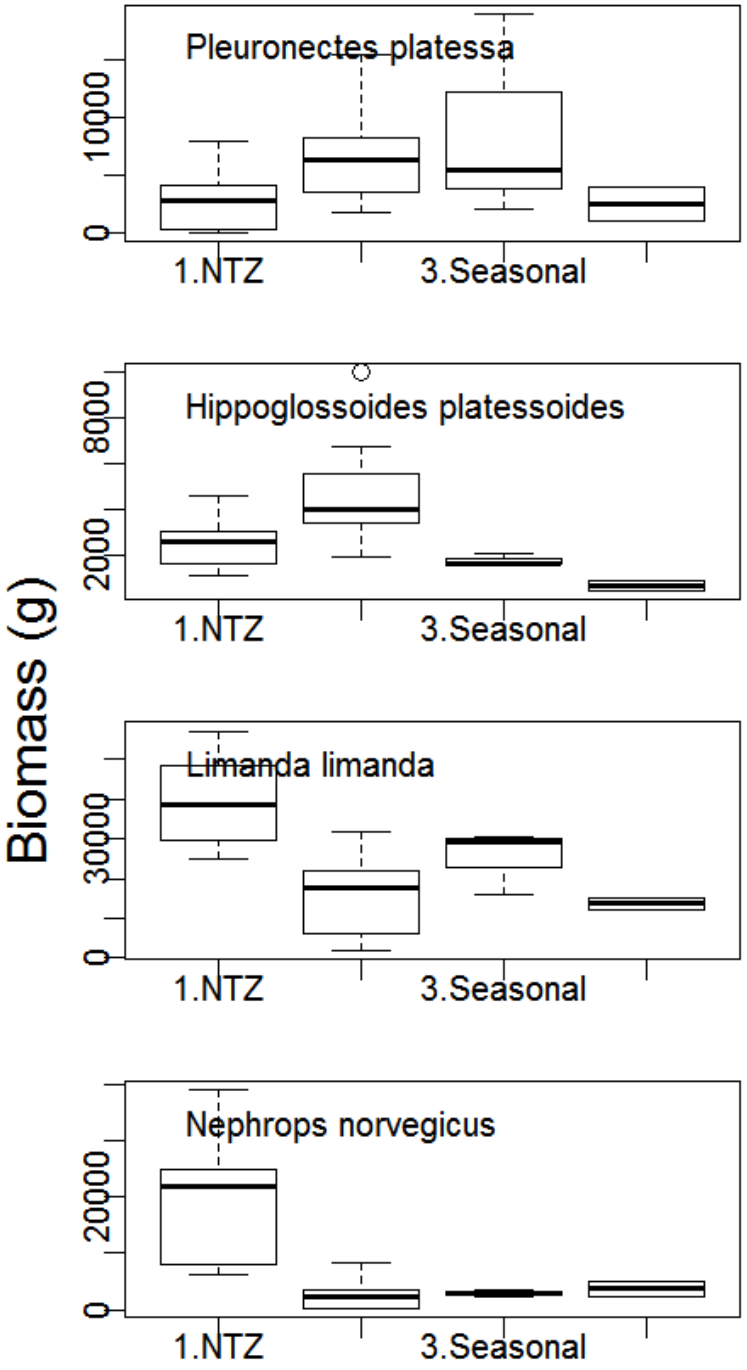
Predator condition

Need to discern between optimum curve and increasing variance

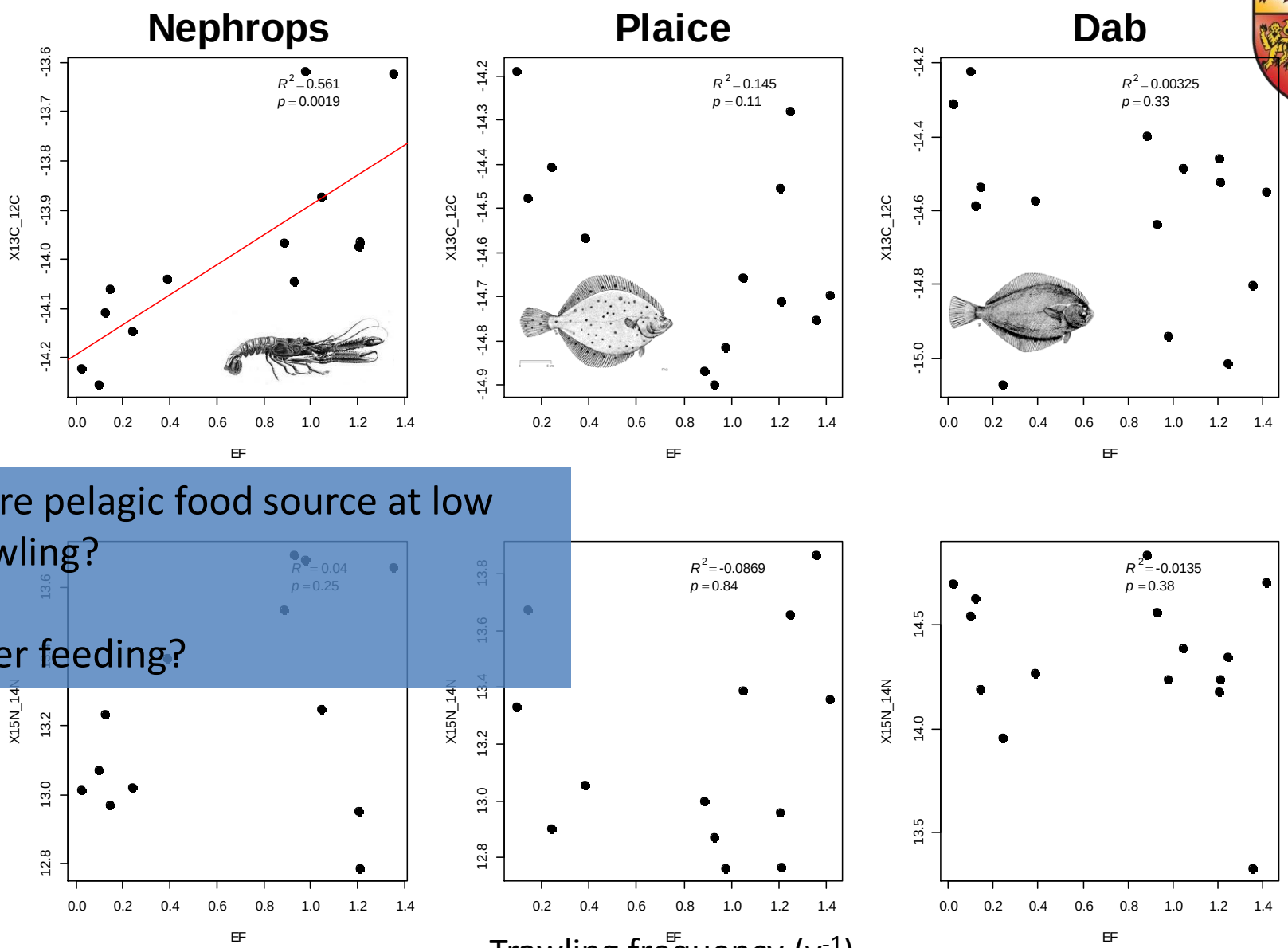


Predator population biomass

Lots of *Nephrops* in closed areas



Predator trophic level by trawling frequence

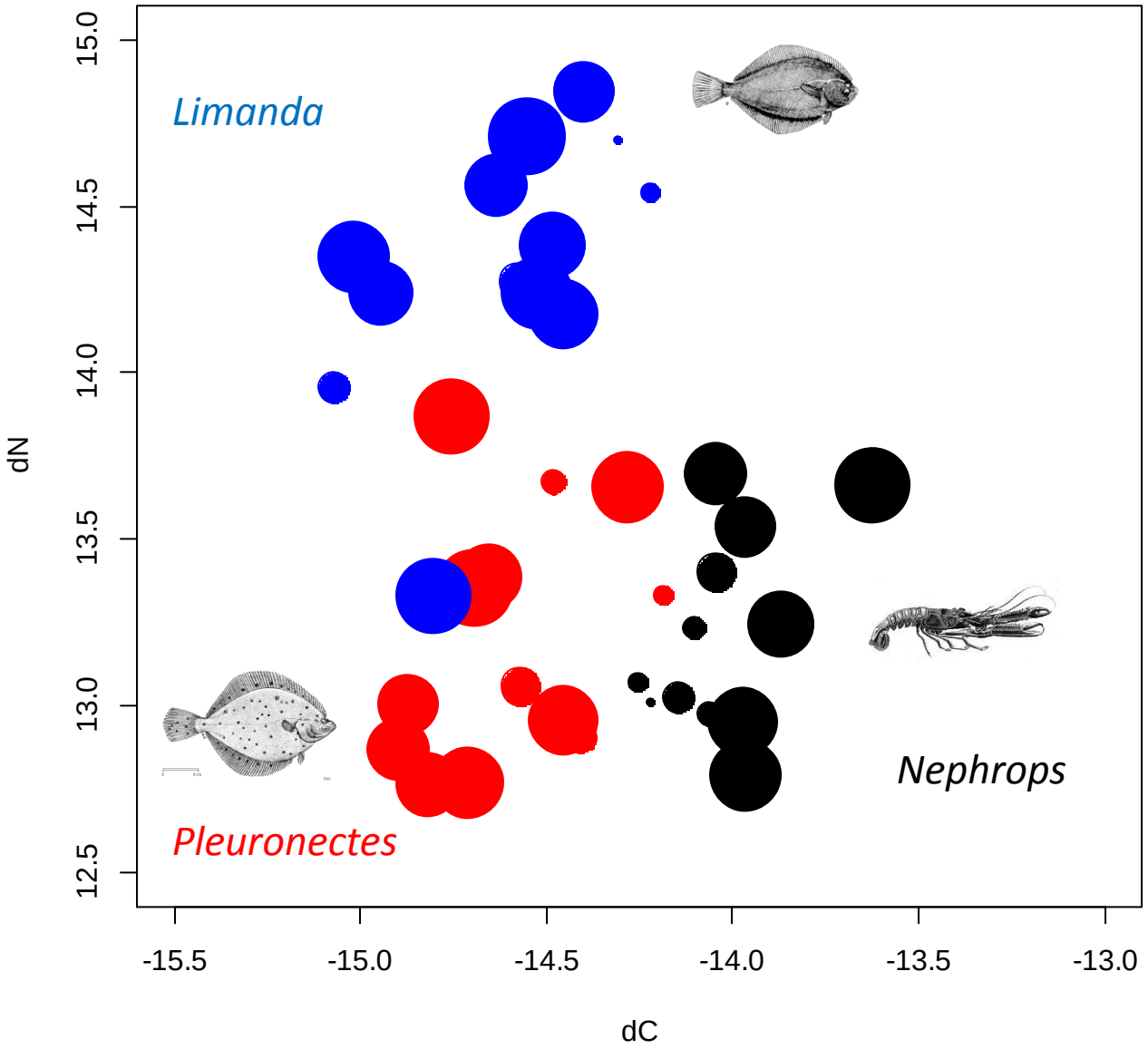


More pelagic food source at low trawling?

Filter feeding?

Trawling frequency (y^{-1})

Bubble size = sqrt(trawling frequency)



Conclusions

Trawling:

-tive effect on fish food

+tive effect on condition

Trophic level

Competition or *Nephrops*

Alternative conclusions

Low levels of trawling:

+tive effect on fish food

-tive effect on condition

Discussion

Interactions: Not all species can increase simultaneously

Need to finish sample analysis and data analysis

Trawling effort range fairly small

ASSEMBLE
ASSOCIATION OF EUROPEAN MARINE BIOLOGICAL LABORATORIES

SEVENTH FRAMEWORK PROGRAMME

BENTHIS

Hiddink, J.G., Johnson, A.F., Kingham, R., and Hinz, H. 2011. Could our fisheries be more productive? Indirect negative effects of bottom trawl fisheries on fish condition. Journal of Applied Ecology. **48**: 1441–1449

Hiddink, J.G., Rijnsdorp, A.D., and Piet, G. 2008. Can bottom trawling disturbance increase food production for a commercial fish species? Canadian Journal of Fisheries and Aquatic Science, **65**: 1393-1401.