

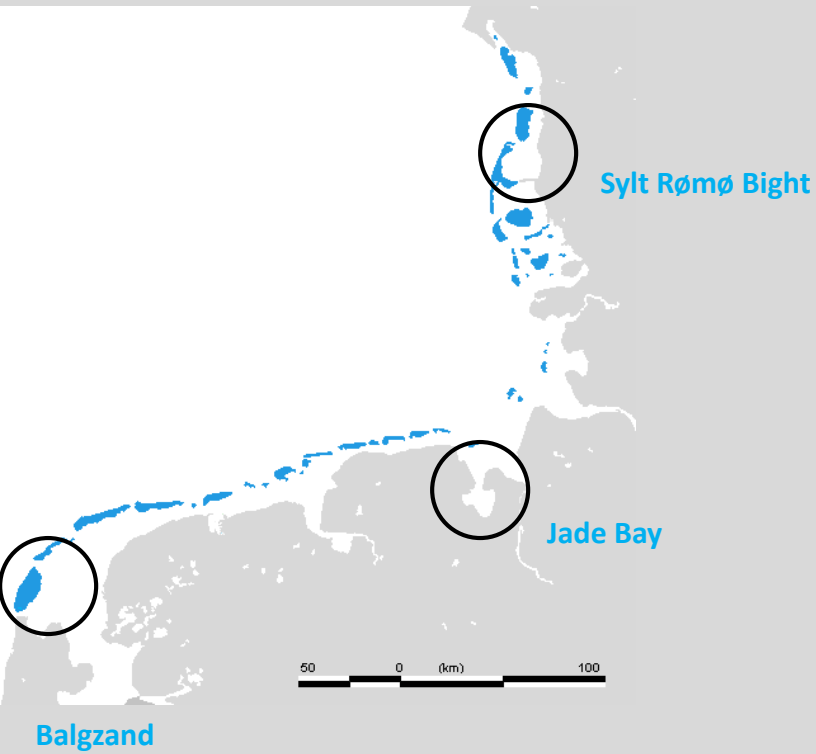
# Impact of top predators on the Wadden Sea food web A modelling approach

Harald Asmus

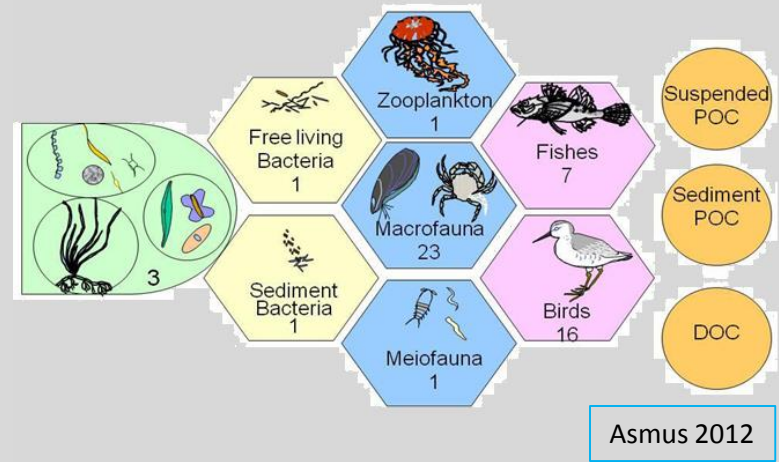
Benoit Lebreton, Ursula Siebert, Ragnhild Asmus



# Wadden Sea



# Ecological Network Analysis



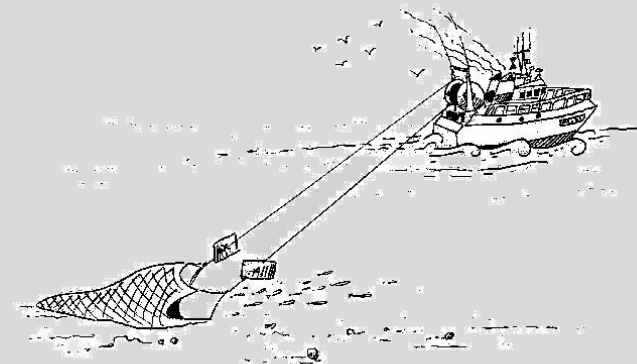
# Impact of changes on Wadden Sea food webs



**Replacement of one compartment**



**Addition of one compartment**



**Loss of one compartment**

## Marine mammals in the Wadden Sea / North Sea

### Native species

- Harbor seal
- Grey seal
- Harbor porpoise



Habitat loss

Overexploitation

Pollution

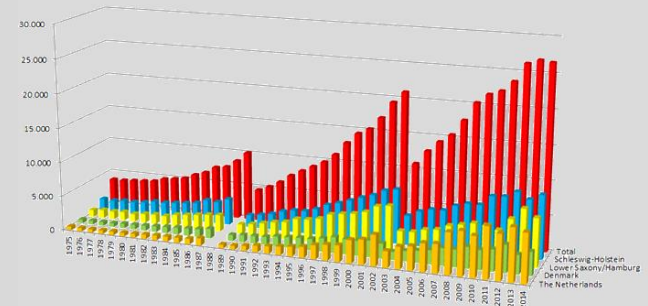


Early 20<sup>th</sup> century

Severe depletion of most of the top predators



Galatius et al. 2014 – Trilateral Expert Group



Harbour seals - 1975 - 2014

Recovery of several species



1970s

Prohibition of hunting

Regulation of fisheries

Protection area

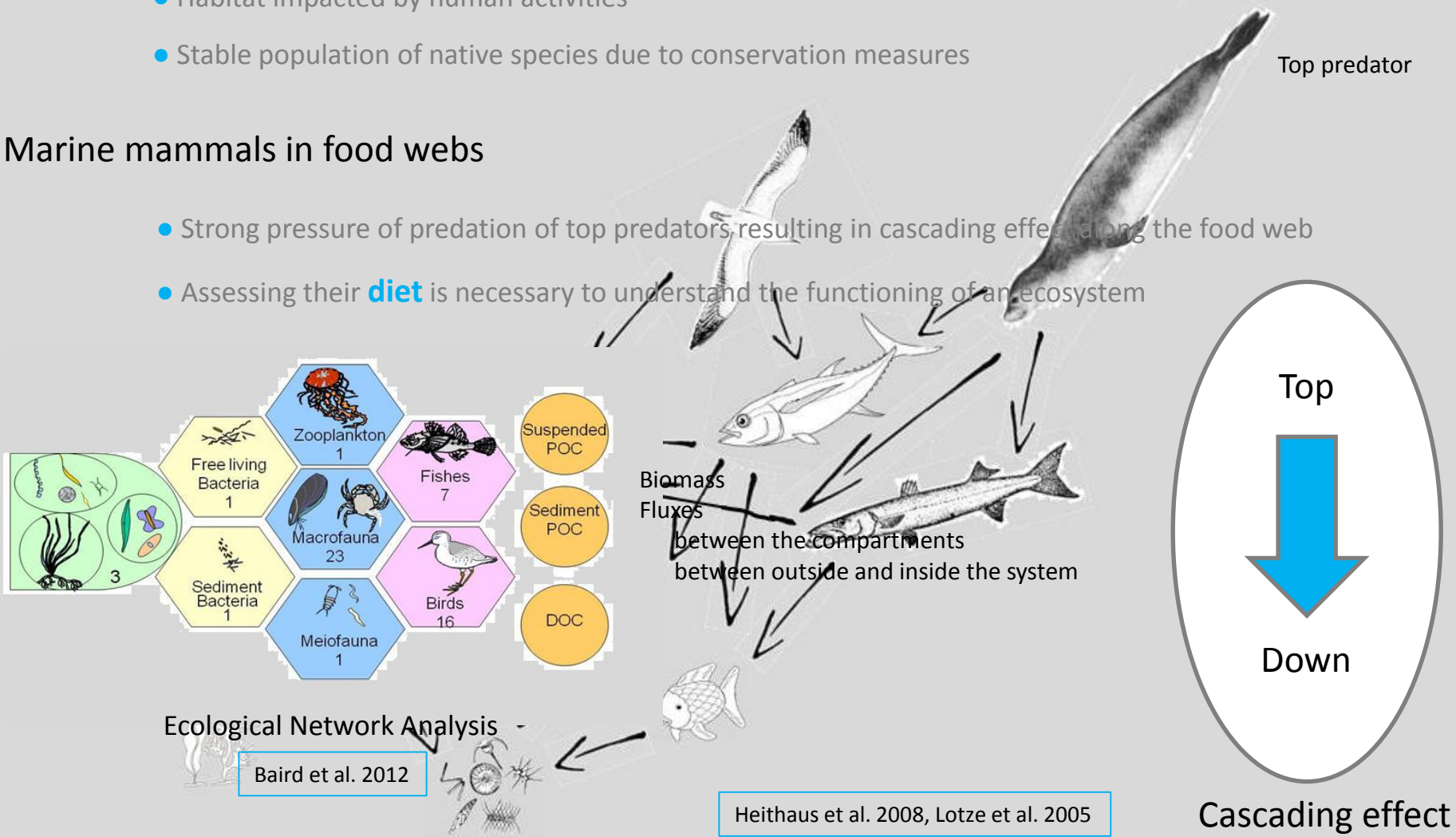
Lotze et al. 2006, Lotze et al. 2005, Reijnders et al. 1995

## Marine mammals in the Wadden Sea / North Sea

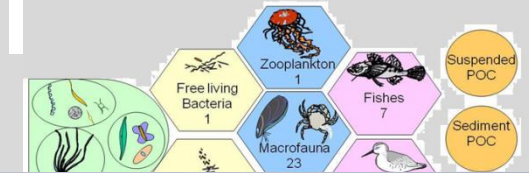
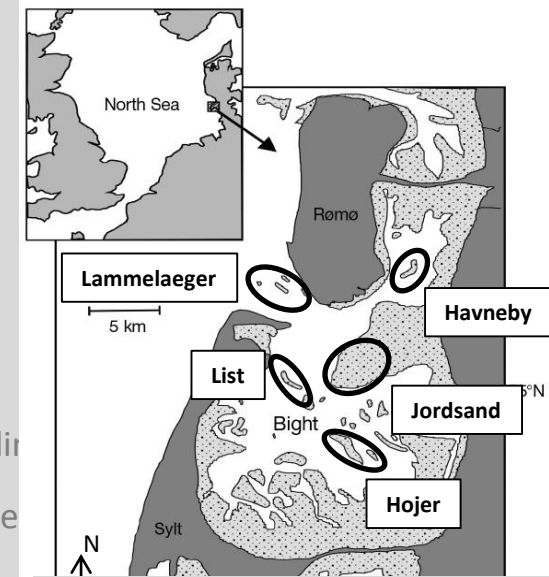
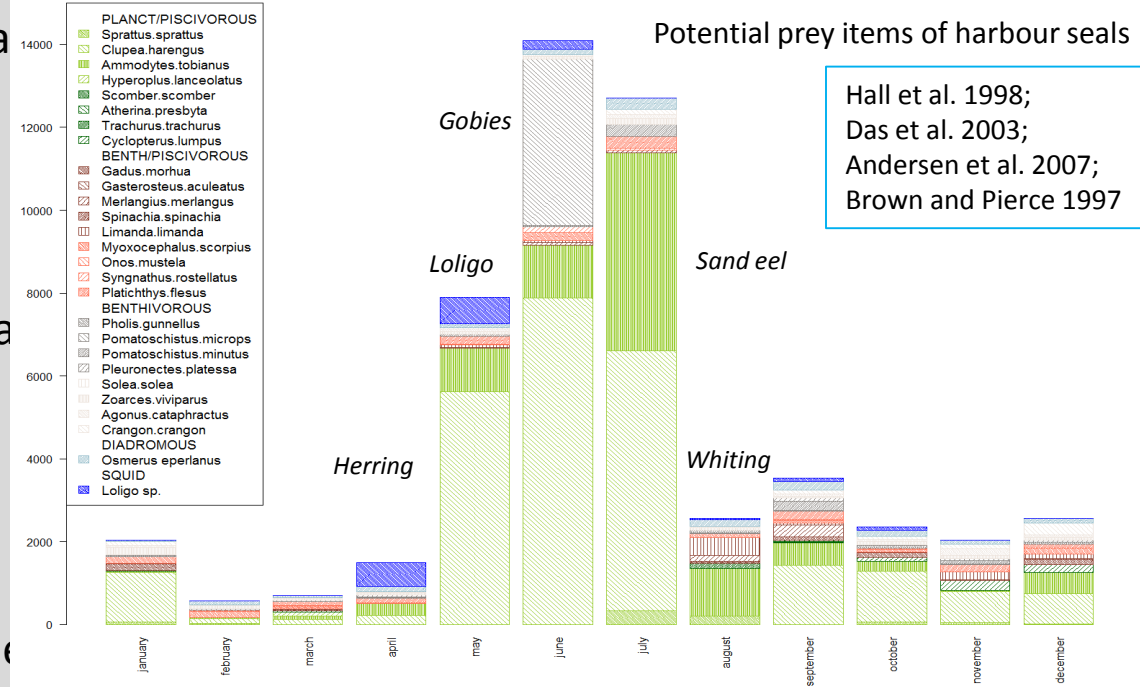
- Habitat impacted by human activities
- Stable population of native species due to conservation measures

## Marine mammals in food webs

- Strong pressure of predation of top predators resulting in cascading effects along the food web
- Assessing their **diet** is necessary to understand the functioning of an ecosystem



Kg in the SRB



- Big colony in the bight (  $\approx 450$  seals )
- Potential prey species are present in the SRB

Fish production = **99.6** kg of C per day

Consumption of harbour seals per day  $\approx 4$ kg

Consumption of harbour seals  $\approx 99.1$  kg of C per day

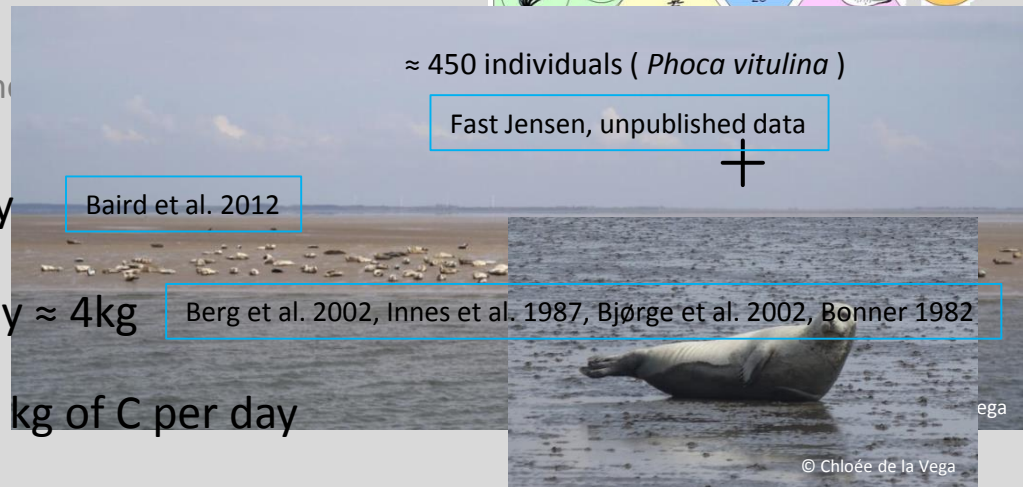
$\approx 450$  individuals ( *Phoca vitulina* )

Fast Jensen, unpublished data



Baird et al. 2012

Berg et al. 2002, Innes et al. 1987, Bjørge et al. 2002, Bonner 1982



## Marine mammals in the Wadden Sea / North Sea

- Habitat impacted by human activities
- Population of endemic species stable due to conservation measure

## Marine mammals in food webs

- Strong pressure of predation of top predators which results in cascade effect along the food web
- Assessing their diet is necessary to understand the functioning of an ecosystem

## Harbor seals in the Wadden Sea / Sylt-Rømø bight

- Big colony in the bight (  $\approx$  450 seals )
- Feed on clupeids, gadoids, squid, crustaceans
- Potential prey species are present in the bight at every season



Do harbour seals use the Sylt-Rømø bight food resources ?  
On which prey items and in which proportions do they feed ?  
Does their diet vary seasonally ?

2 trophic markers:

Stable Isotopes (C and N)

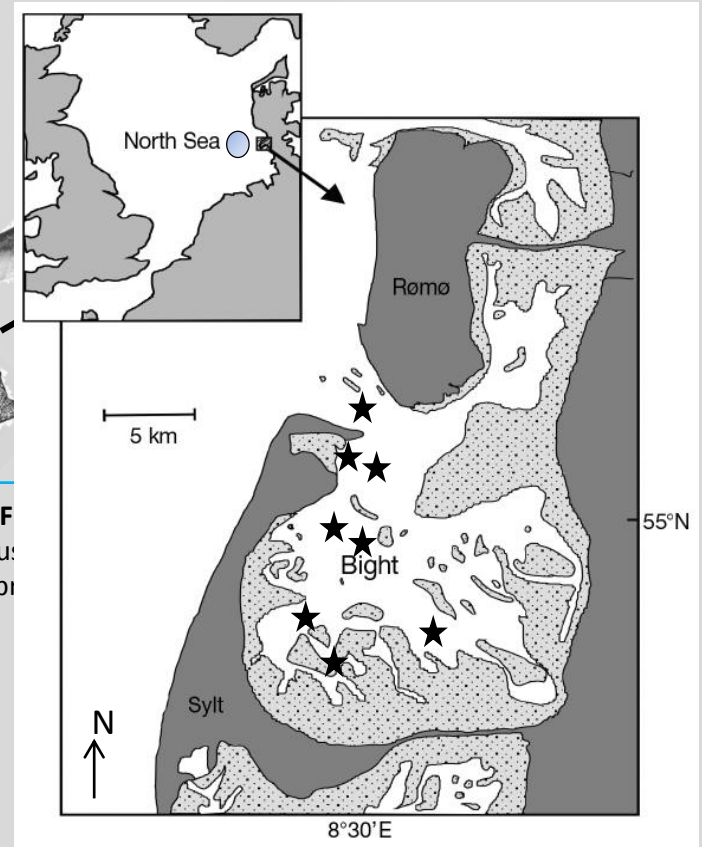
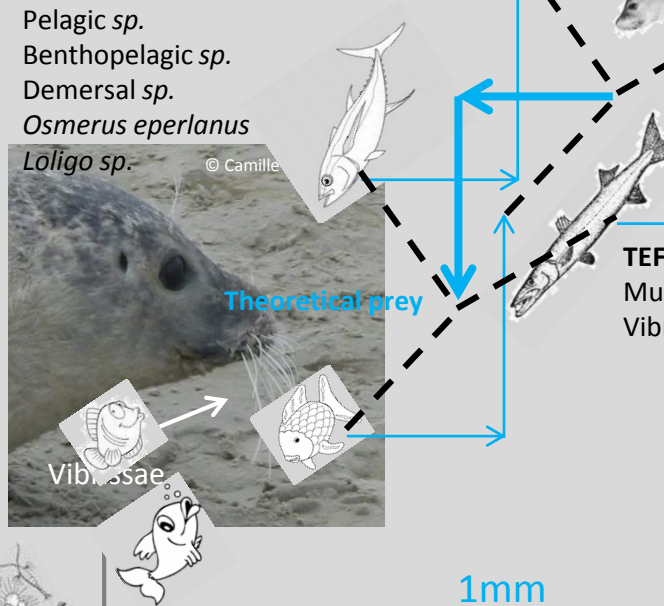
Fatty Acids  $\delta^{15}\text{N}$

Prey items

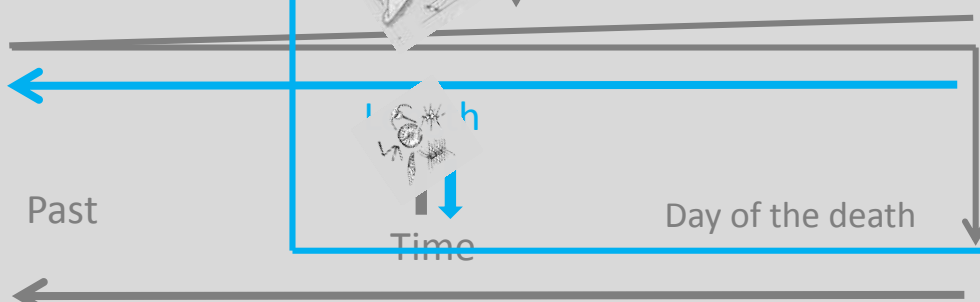
- the Sylt-Rømø bight
- the North Sea

Seal

- vibrissae



Institute for Terrestrial and Aquatic Wildlife Research (ITAW)  
 of University of Veterinary Medicine Hannover, Foundation

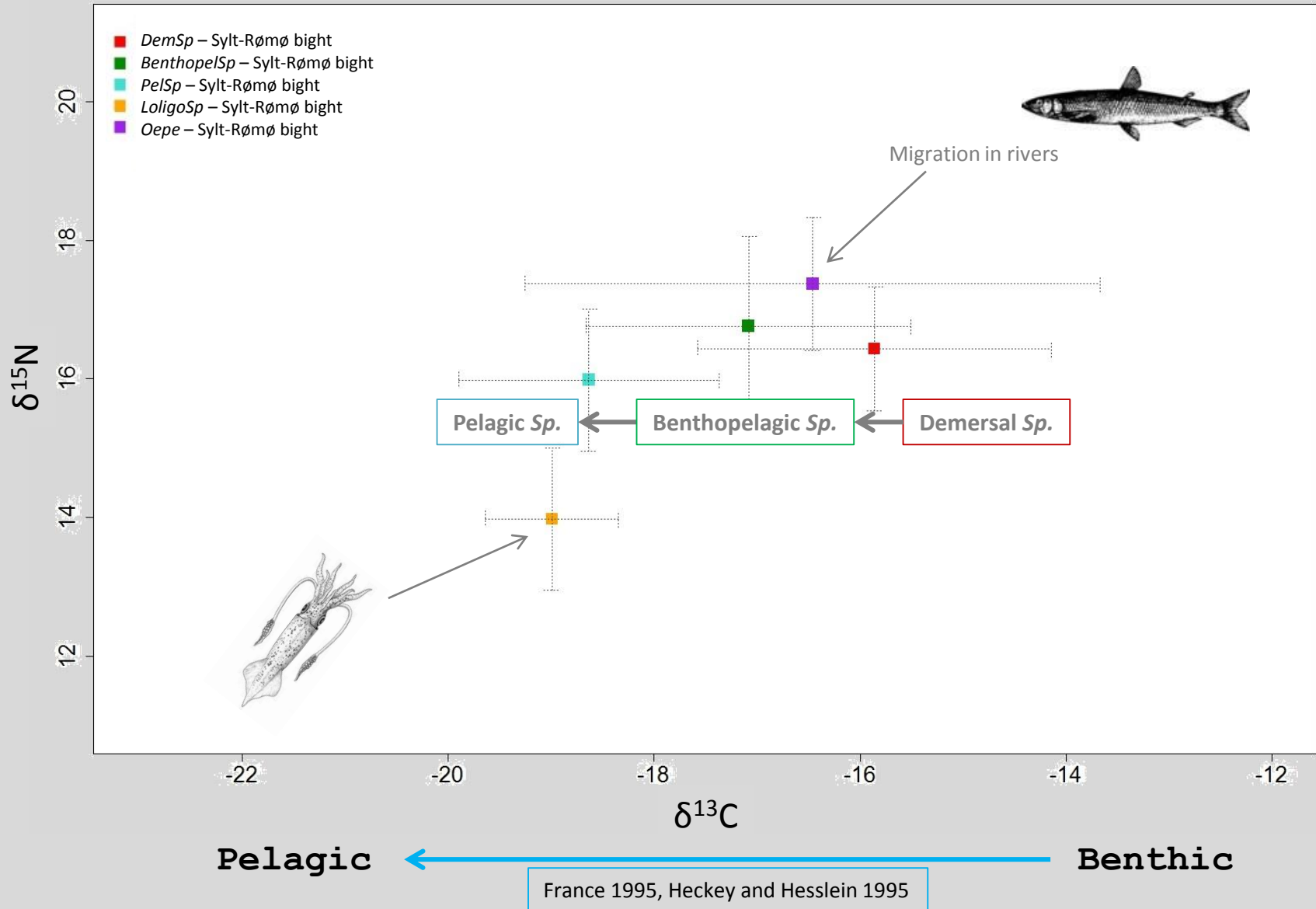


Vibrissae growth rate : Zhao and Schell, 2004

May → Sept = 0.78mm/day

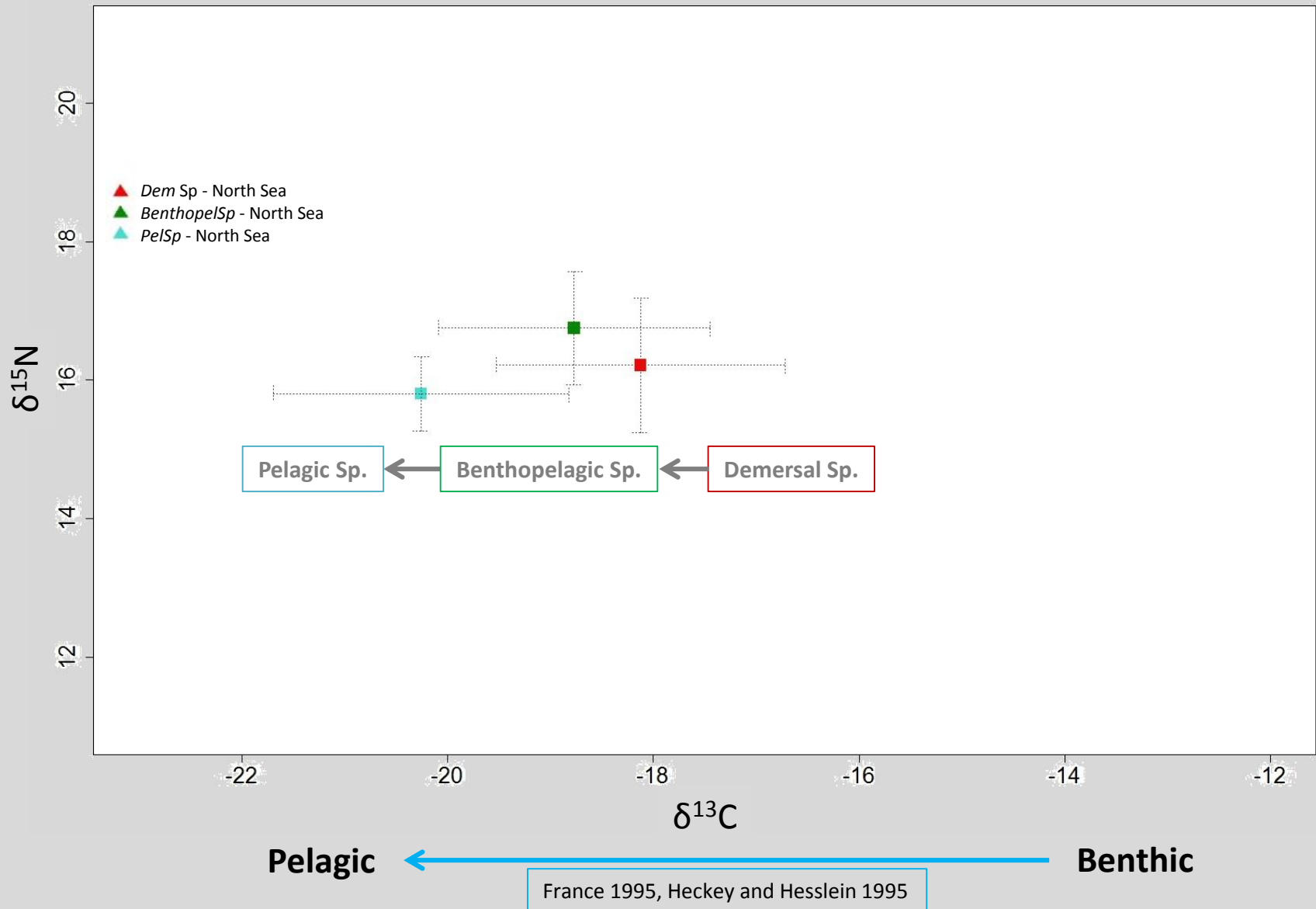
Oct → April = 0.075mm/day

## Sylt Rømø bight

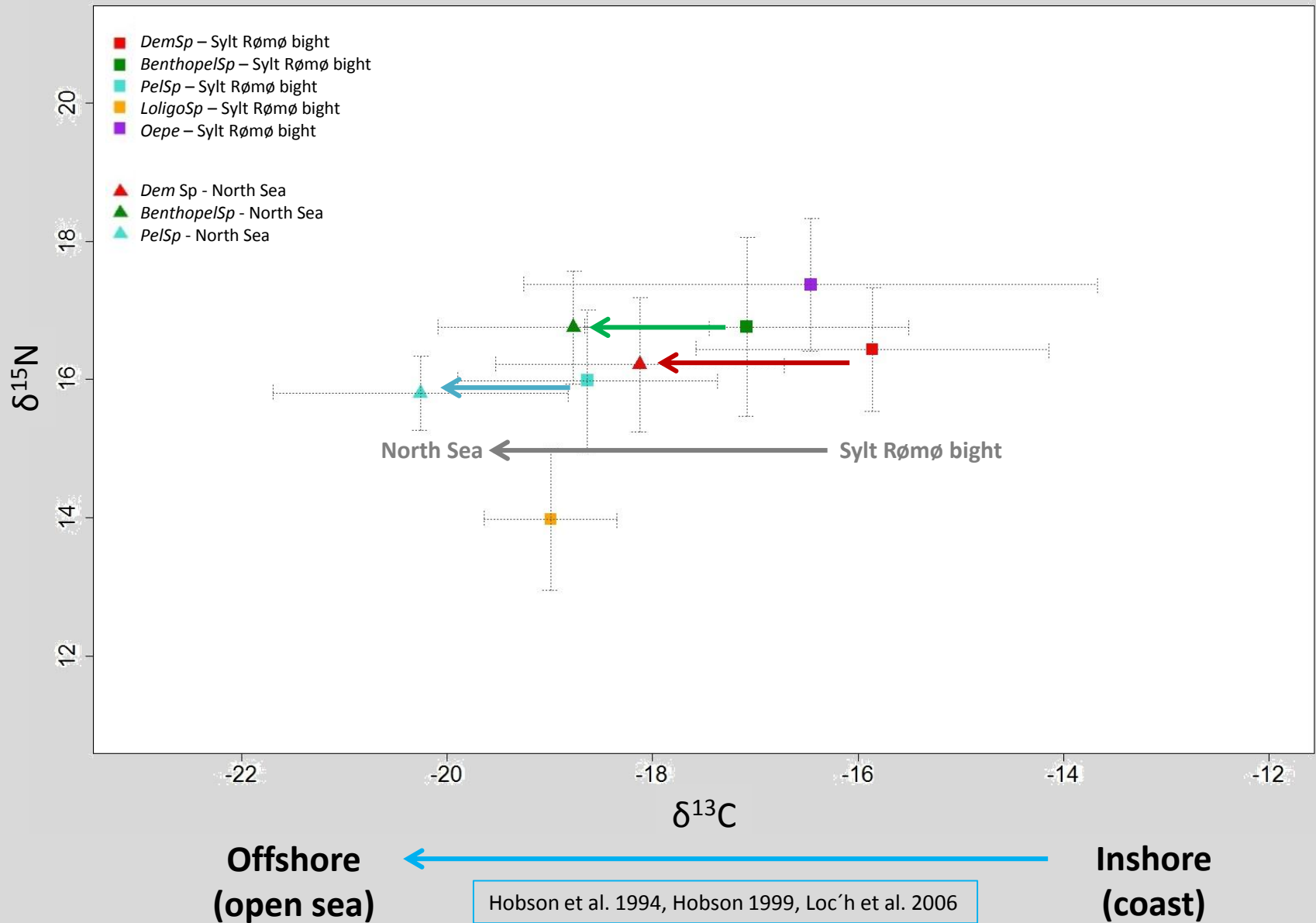




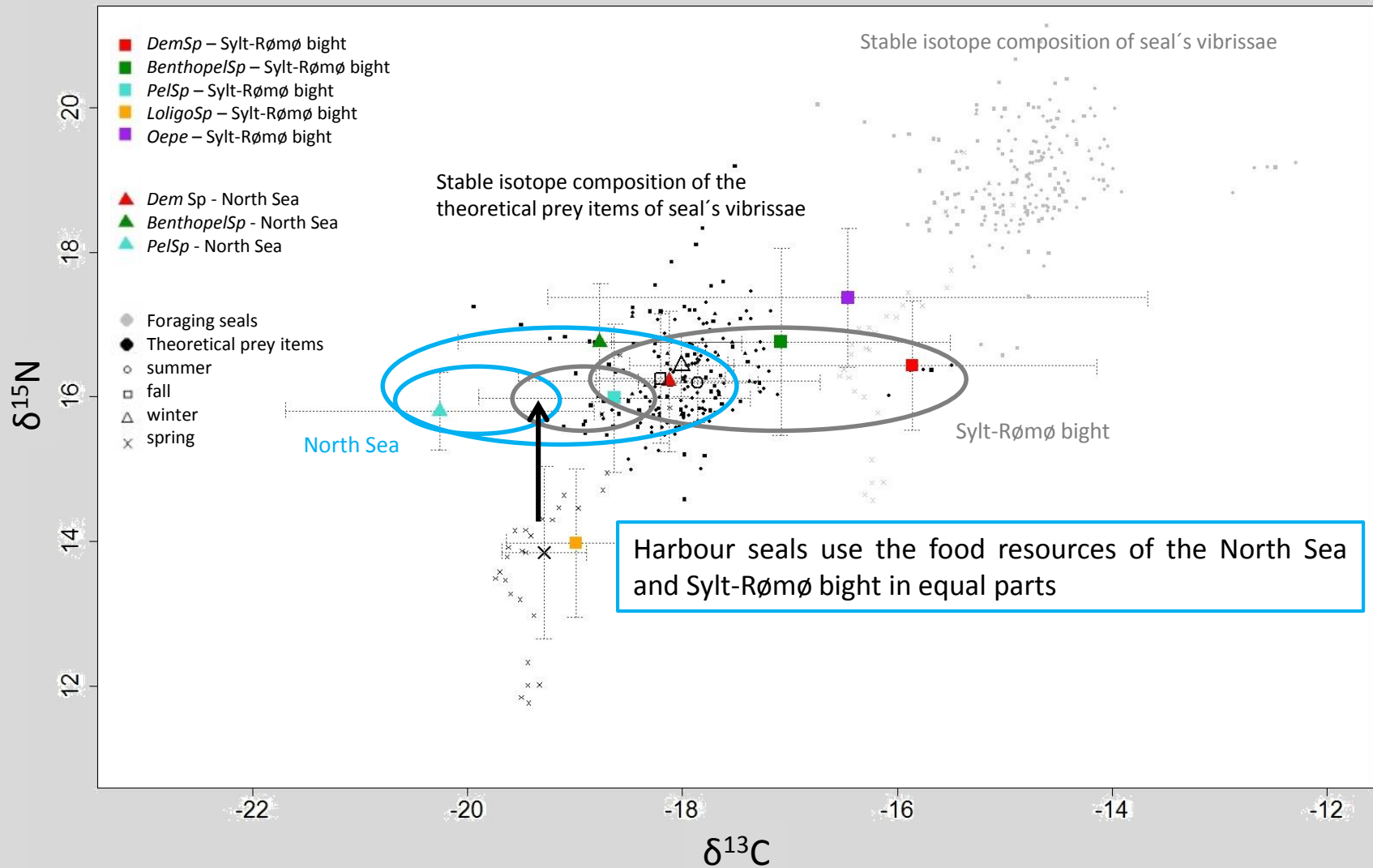
North Sea



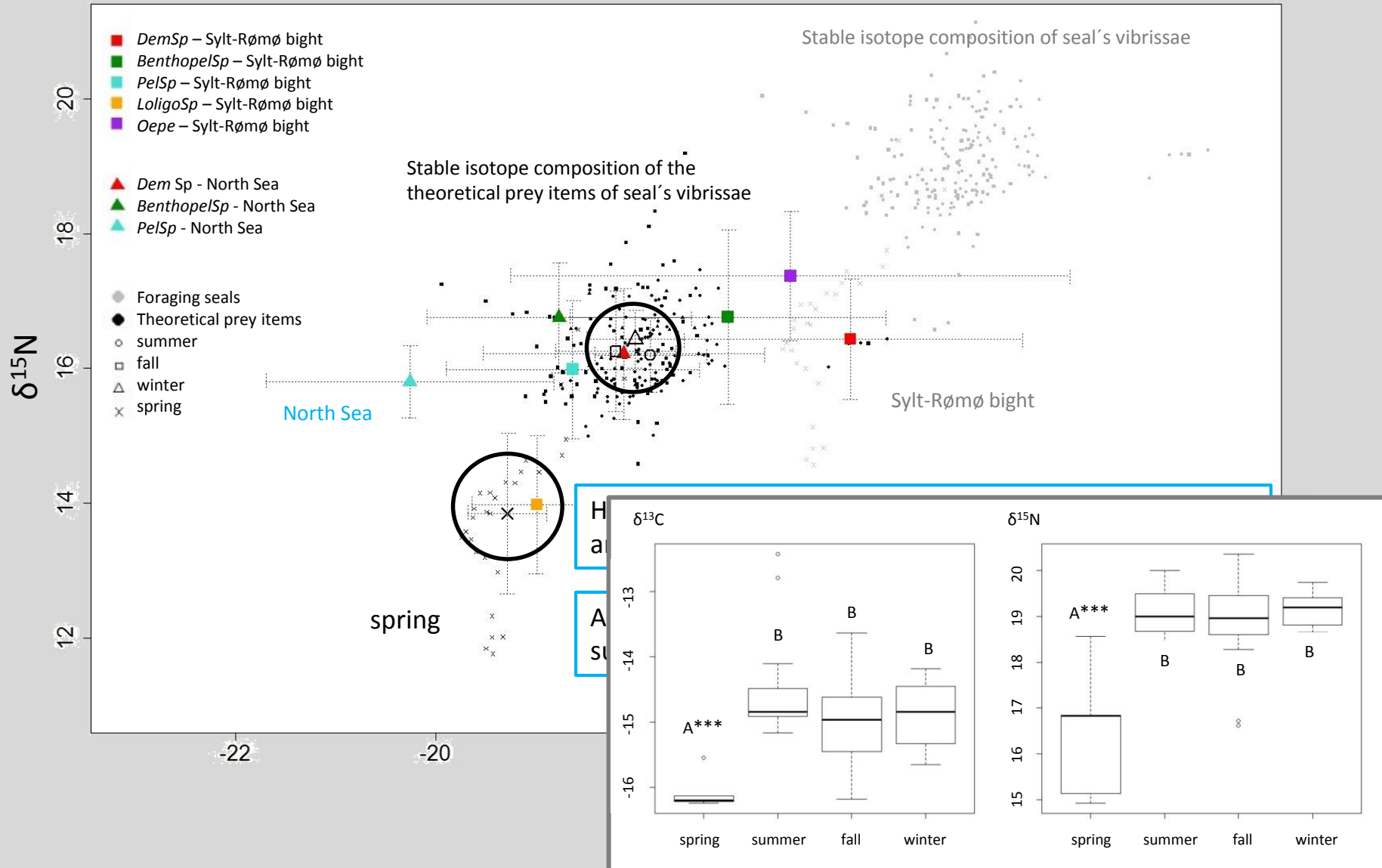
## North Sea + Sylt-Rømø bight



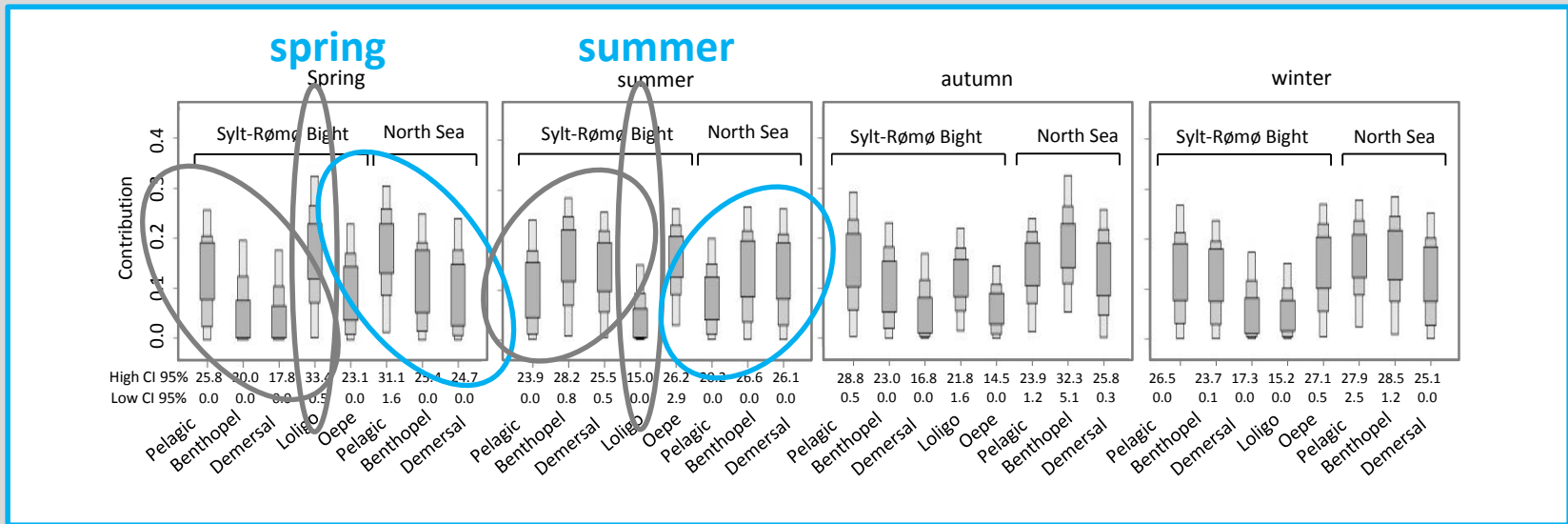
## Vibrissae



## Vibrissae



## SIAR mixing models

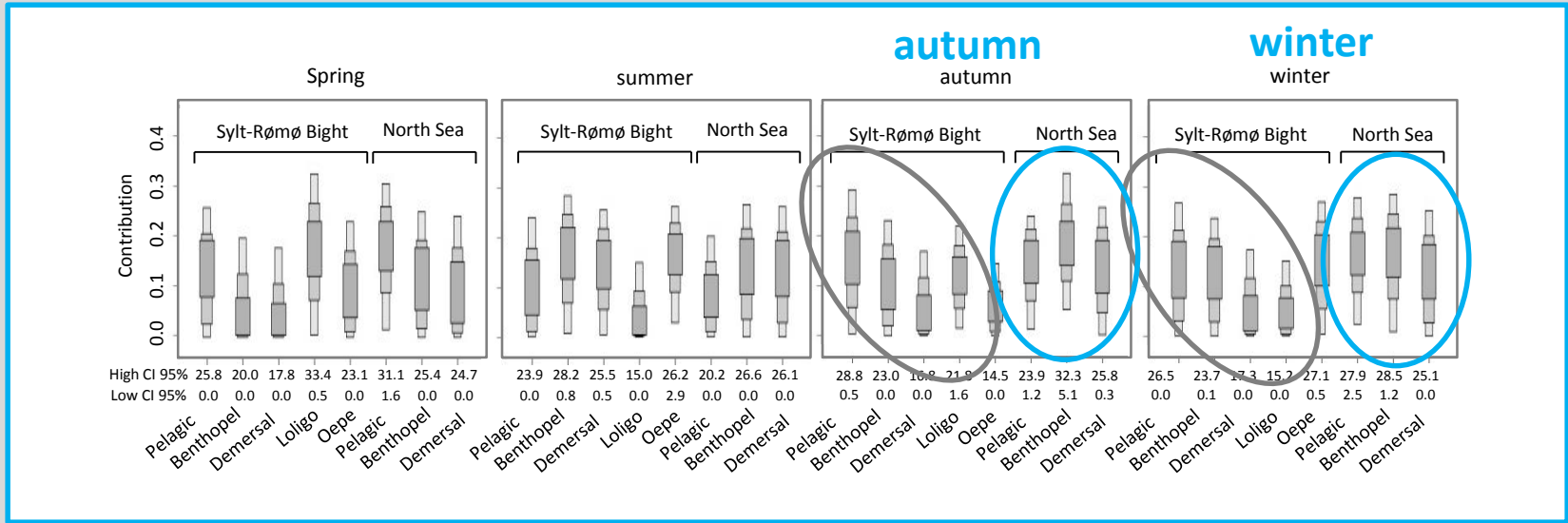


**Spring and summer** The Sylt-Rømø bight and the North Sea have the same contribution to the diet



Switch from a **pelagic** based diet in **spring**  
to a **benthic** based diet in **summer**

## SIAR models



**Spring and summer** The Sylt-Rømø bight and the North Sea have the same contribution to the diet



Switch from a **pelagic** based diet in **spring** to a **benthic** based diet in **summer**

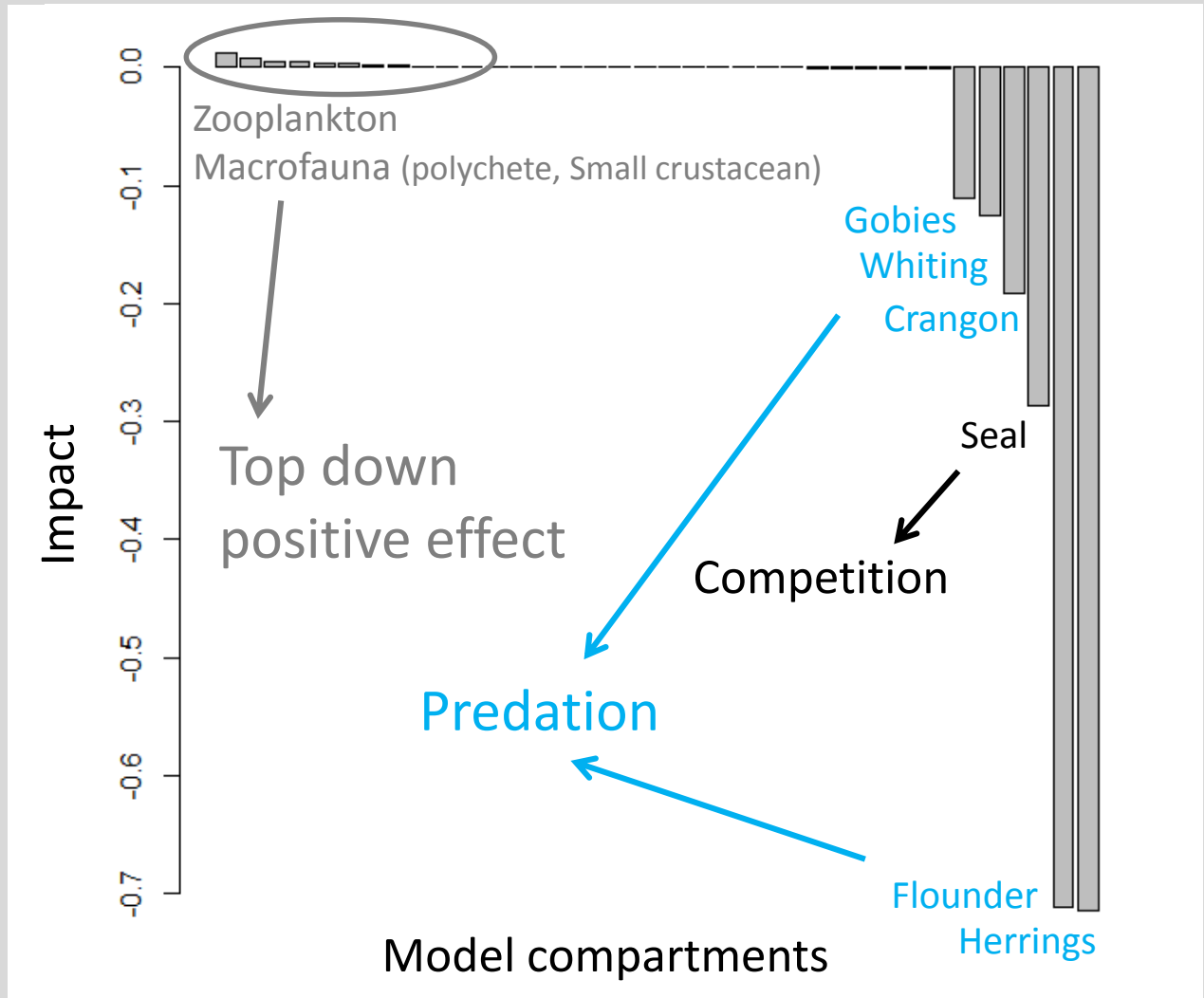
**Autumn and winter** The Sylt-Rømø bight and the North Sea have different contribution to the diet







Harbour seals probably use more the **North Sea** than the Sylt-Rømø bight

ENA model : preliminary results

Impact of „seal compartment“ on the other compartments of the food web



-  In spring and summer, the Sylt-Rømø bight supports approximately half of the harbour seal's diet
-  Harbour seals use the North Sea more in autumn and winter, when the food resources in the Sylt-Rømø bight are not sufficient
-  The seals have a pelagic based diet in spring, and a benthic based diet in summer, fall and winter
-  Top down cascading effects are visible along the food chain although the impact of seals on their prey items is not very high



# Thank you for your attention

Questions and comments are welcome !

