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Decreasing flesh content of Blue mussels in the Wadden Sea – are Pacific oysters responsible?

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Pacific oysters (*Crassostrea gigas*) took over the mussel beds in the List Tidal Basin and currently are dominating this tidal basin in terms of biomass and densities. The blue mussel stock decreased strongly. Both trends seem to be induced by climate factors. In contrast, beds in the Norderhever Basin are still dominated by Blue mussels. **Blue mussel flesh content** (a-value) and maximum shell length decreased significantly in the Lister Tidal Basin (Fig. 1, 2 and 3), while mussel bed sites in the Norderhever did not show any significant trend.

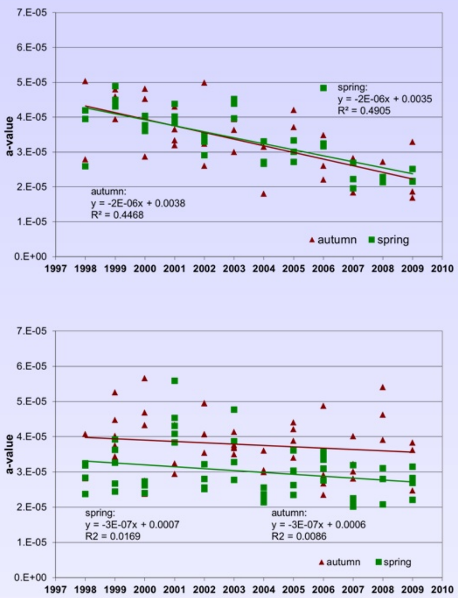

Fig. 1: Development of blue mussel condition in the List Tidal Basin (above) and Norderhever 1998-2009. Condition bases on the formula: weightF =a * length ^{b} (b = 2.8), calculations are done with the program MUSSEL (Brinkman 1993). The a –value is a dimensionless condition value which allows to compare different mussel bed sites.

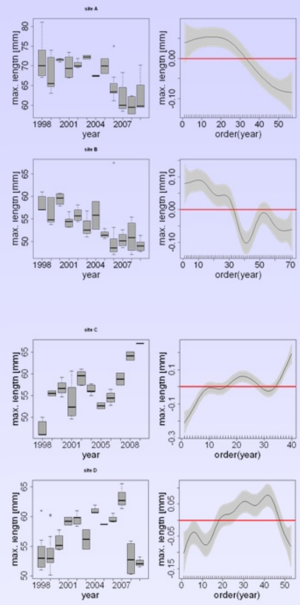

Fig. 2: Decrease of maximum shell length in the List Tidal Basin (above) and Norderhever on two monitoring sites in each basin between 1998-2009. Box plot display the variability in maximum shell length, while the negative trend is shown in a smoothed GAM (basing on length above the 97 percentile).

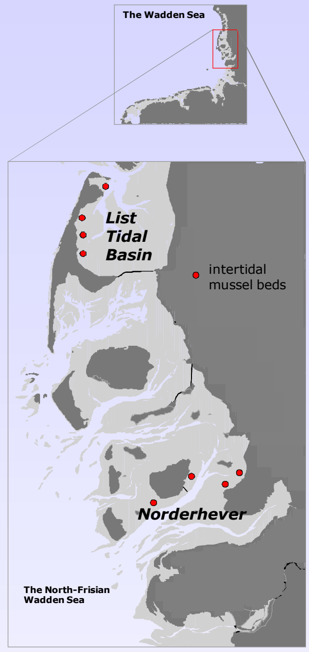

Fig. 3: Study sites in the North-Frisian Wadden Sea.

Besides a nearby effect of the increasing oyster stock in the List Tidal Basin, changes in Chlorophyll a concentrations might be responsible. **Mild winter water temperatures** in February/March affect **Chlorophyll a biomass** in the List Tidal Basin in March/April negatively (Beusekom et al. 2009). The question is whether decreasing mussel flesh content is caused by interspecific concurrence with oysters or by reduced food supply (Chl a) after mild winters?

The analysis reveal that oyster live wet weight affect mussel condition significantly negative. Higher Chl a biomass in March/April has a positive effect on mussel condition.

Analysis was done with an Linear mixed effect model in R2.10.1
- tested for spatial effects (ANCOVA)
- Fitted using Maximum Likelihood (ML)
- stepwise deletion of variables according to significance of p-values lead to the significant parameters effecting the a-values

Linear mixed effect model

	Estimate	Std.Error	DF	t-value	p-value
(Intercept)	3.1047	0.480	21	6.472	0.0000
Sqrt **(oysters LWW)**	**-0.0055**	0.001	21	-4.52	**0.0002**
Chl a (spring)	**0.0943**	0.037	10	2.577	**0.0275**

Pacific oysters have a negative effect on blue mussel condition in the List Tidal Basin in recent years. Mild winters affect blue mussel condition in spring negatively due to lower food supply (Chl a). Reduced condition leads to reduced growth and mussels are almost 1 cm smaller in the List Tidal Basin than 5 years ago.

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References:
Brinkman, A. G. (1993): Estimation of length and weight growth parameters in populations with a discrete reproduction characteristic. IBN research report 93/5, Wageningen.
Beusekom J. E. E. v., M. Loebl & P. Martens (2009): Distant riverine nutrient supply and local temperature drive the long-term phytoplankton development in a temperate costal basin. J Sea Res 61: 26-33.