ANT Oosterschelde: ecological developments and predictions

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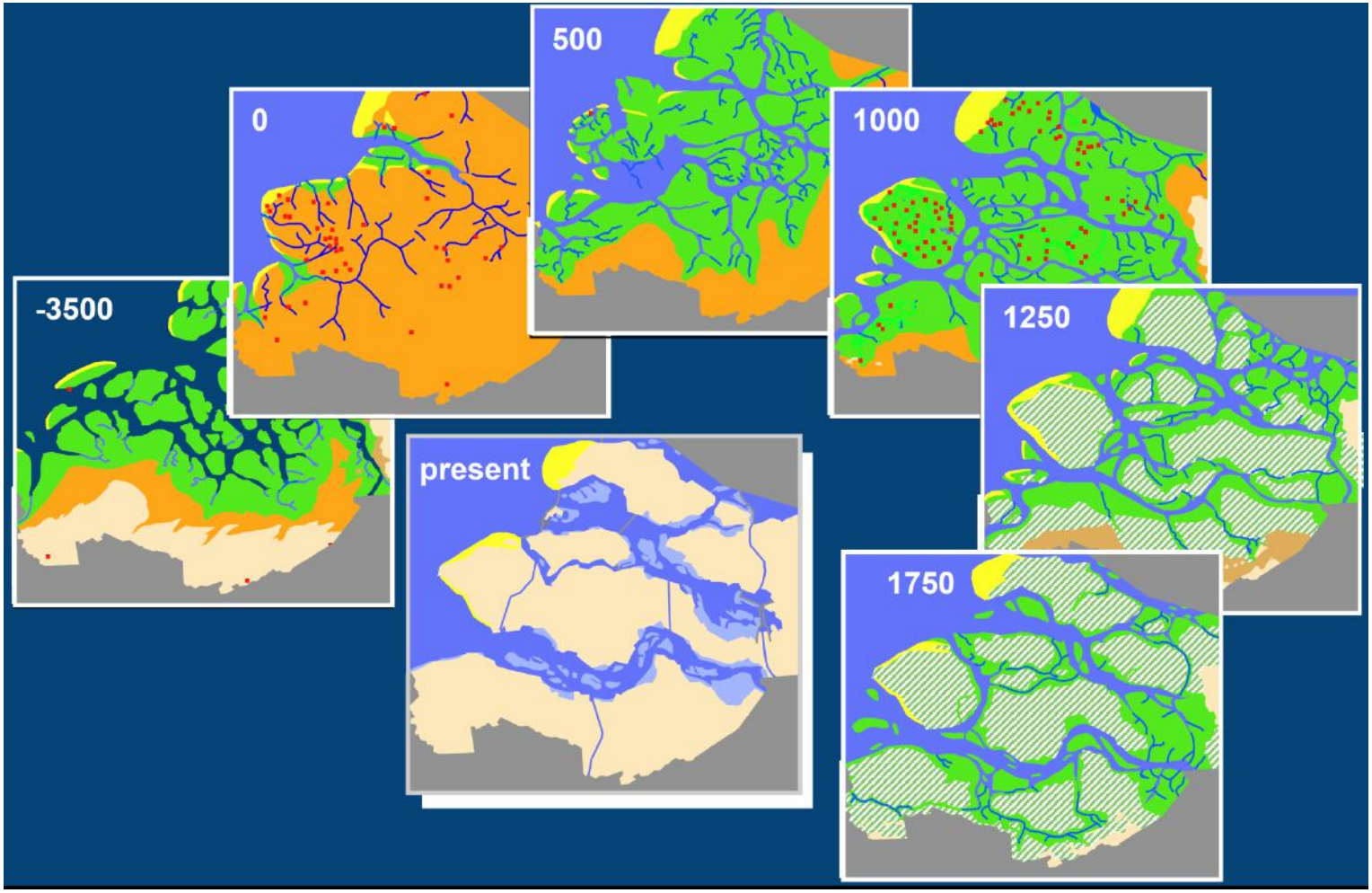
Themadag: Een veranderende Oosterschelde, 11 december 2013

SW Delta : a changing delta



Delta Plan

Primary approach:

- closing off the estuaries from the sea
- Except for the Westerschelde (= shipping route to port of Antwerp)
- = creation of freshwater lakes (agriculture)

Oosterschelde storm surge barrier

Initially a closure dam was planned.

Organised protest against closure dam started in 1970, for ecological *and* economical reasons.

1974 decision for alternative solution = open storm surge barrier that maintains tidal system (accepting high additional costs to preserve nature and shellfish culture).

Direct consequences of Oosterschelde project

	Pre-barrier	Post-barrier	% change
Total surface area (km^2)	452	351	-22
Intertidal surface area (km^2)	183	118	-36
Tidal volume (106 m^3)	1283	915	-29
Average current velocity (m/s)	1.2	0.8	-33
Residence time water (days)	50	100	+100
Fresh water input (m^3/s)	70	25	-63
Salinity	>25	>30	+15
Average tidal range (Yerseke) (m)	3.7	3.25	-12
Average suspended matter conc. (mg/l)	25	15	-40

Nienhhuis and Smaal, 1994

But: tidal landscape still present

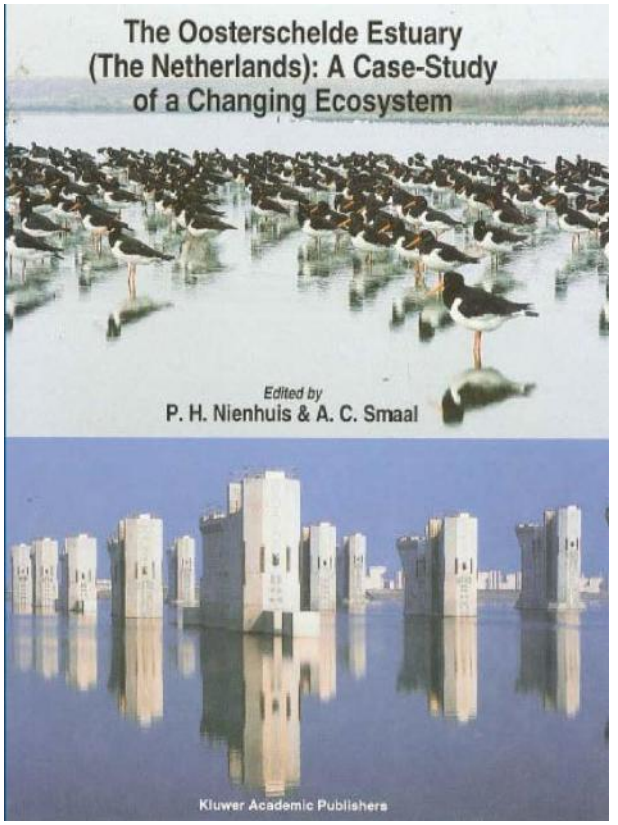
Estuarine species





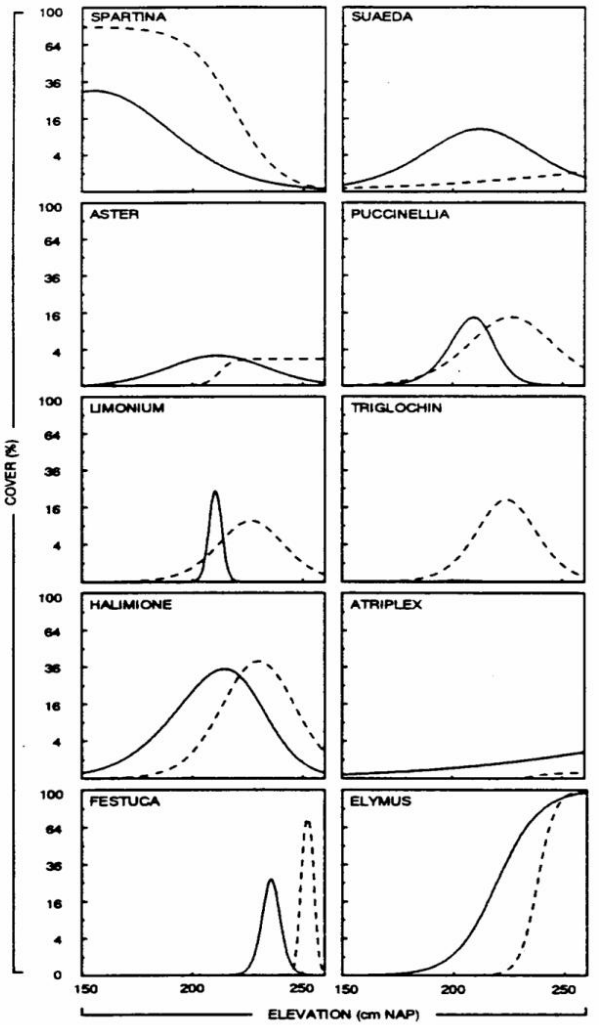

Oosterschelde project: IMPACT

- Pre-barrier (‘80-’84) – post-barrier (‘86-’90)
- Hydrodynamics, geomorphology, ecology, shellfish, modeling
- in > 40 publications (eds. Nienhuis and Smaal, Hydrobiologia, 1994).



Adaptation of nature

- Salt marsh vegetation adaptation
  - Vertical distribution of saltmarsh species adapted to relative sea level drop => species moved down the marsh elevation gradient.
    - => time scale ~ 5 year
    - => not all species adapted

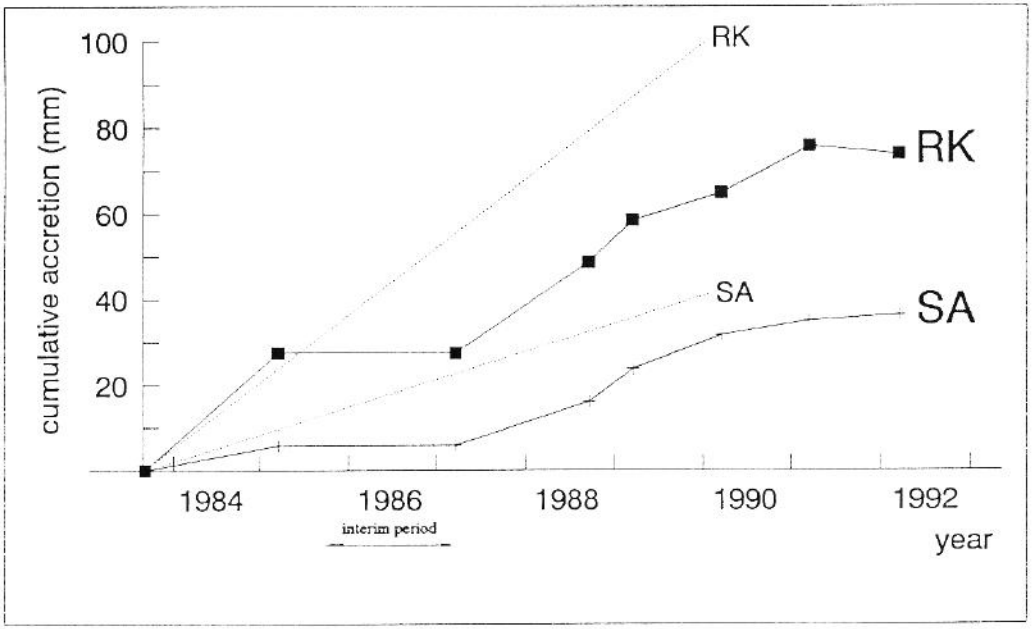


1984
1990

De Leeuw et al., 1994

Adaptation of nature

- Salt marsh vertical accretion
  - Prediction: decline due to decrease in flooding frequency and the reduction in suspended matter concentrations.
  - Observation: initially similar rates, declined after some years.
  - Future: accretion rates permanently reduced.



De Jong et al., 1994

Adaptation of nature

- Soft sediment benthic compartment:
  - Increase in microphytobenthos, due to decrease in dynamic forces;
  - Normal patterns benthic macrofauna not influenced, no overall significant trend between 1985 and 1989;
  - Large inter-annual variation; effect of severe winters.

Meire et al., 1994; de Jong et al., 2004; Seys et al. 1994; Coosen et al., 1994

Adaptation of nature

- Changes in wader populations
  - Direct decrease in wader numbers due to loss of intertidal foraging area in OS/KV (33% of 170 km^2);
  - No increase in number of intertidal foragers observed in remaining OS (~ populations close to carrying capacity);
  - Prediction: further changes, as foreseen from geomorpho-logical changes, are likely to be reflected in bird numbers.

Photo Leo Zwarts

Schekkerman et al. 2004; Meire et al., 1994

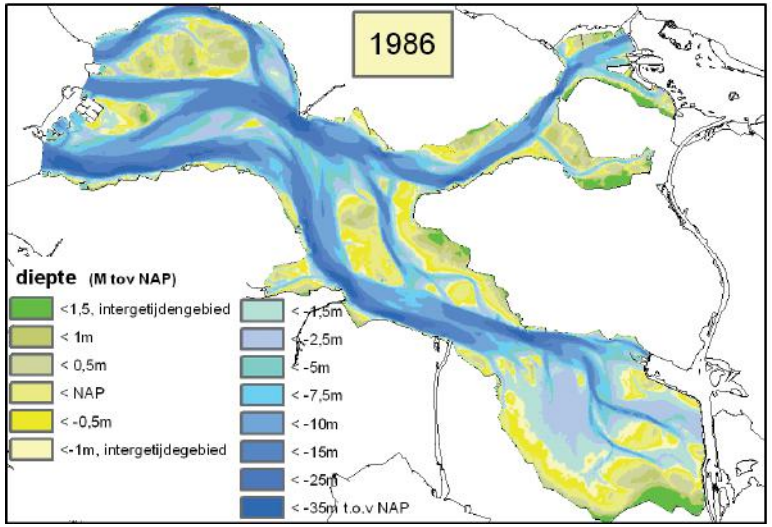
Long term consequences Delta Plan

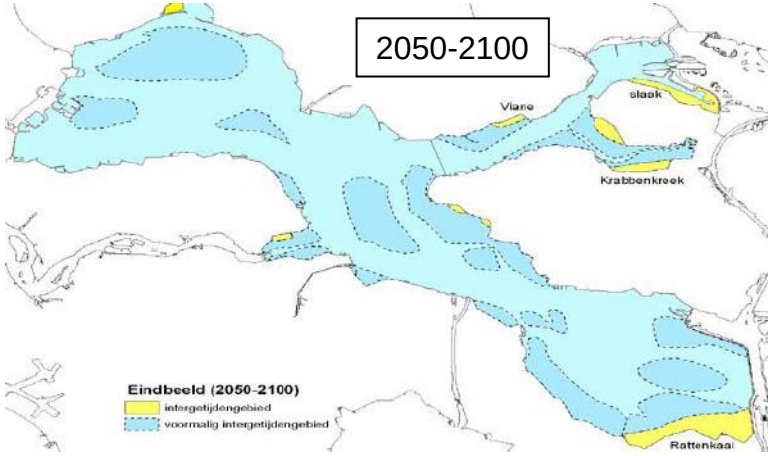
- Sand starvation (*zandhonger*)

ca. 11.000 ha in 1986
ca. 8.000 ha in 2060
ca. 5.000 ha in 2100

Long term consequences Delta Plan

- Sand starvation





Ecological consequences:

- less intertidal area
- less gradients on the shoals
- Loss of foraging grounds
- reduced feeding time birds

Safety consequences:

- Loss of protective foreland => less wave reduction in front of dikes

➔ **Processes in Oosterschelde mimic rapid sea level rise!**




Conservation status

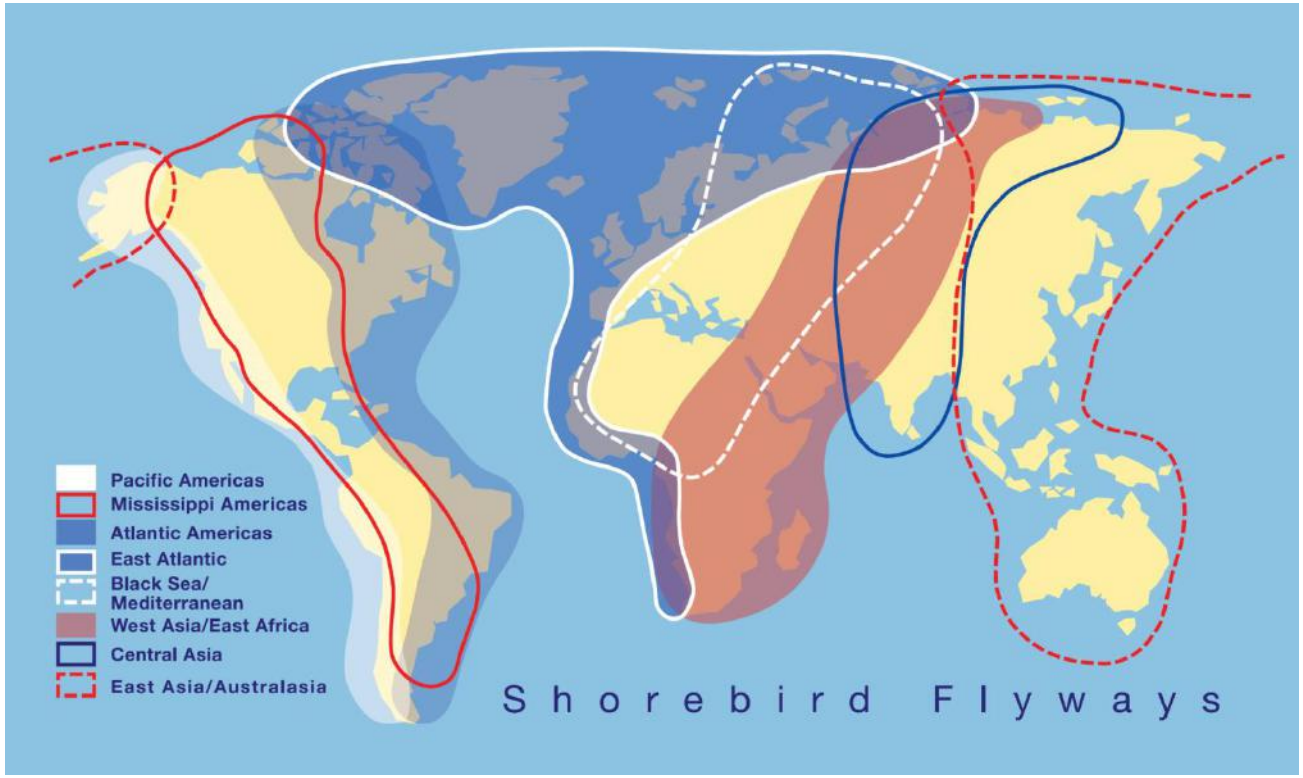
- Nationaal Park Oosterschelde (2002)
- Natura2000, Bird Directive, Habitat Directive
- Ramsar Convention
- Water Framework Directive

Ramsar
CONVENTION ON WETLANDS
(Ramsar, Iran, 1971)

NATURA 2000

Long term changes in waders

- Oosterschelde of international importance for many waterbird species, mainly waders



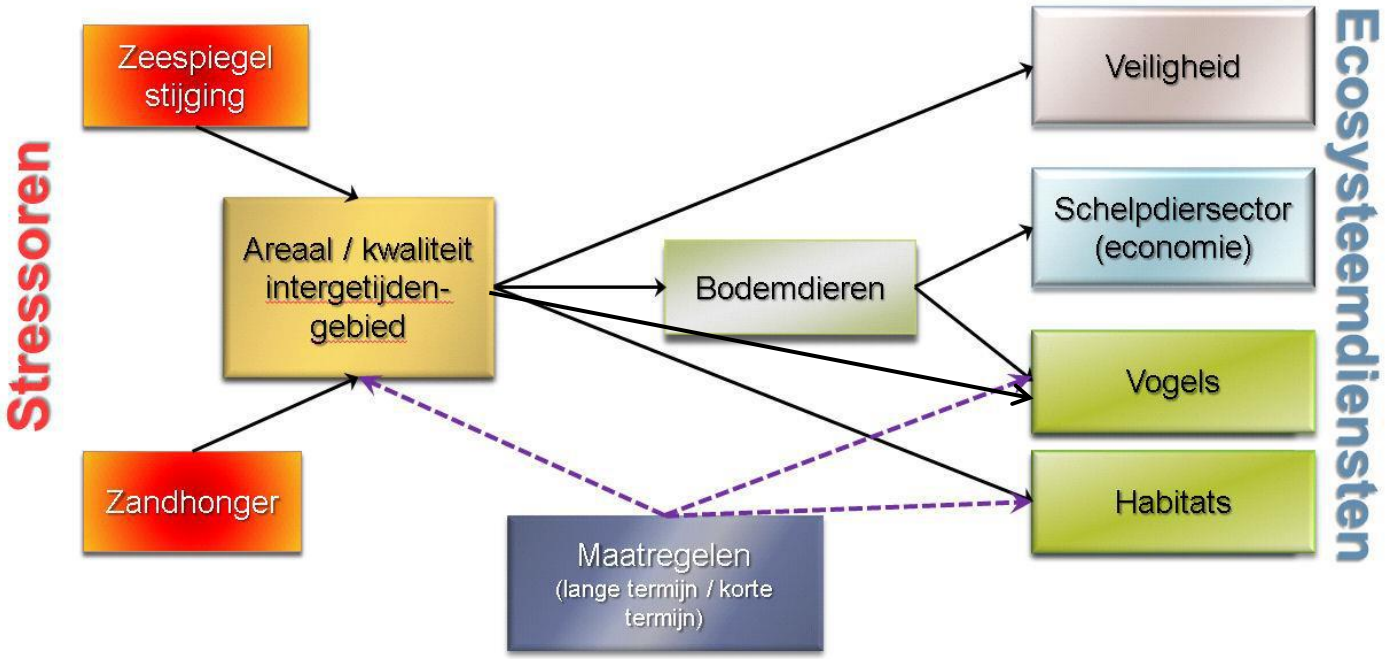
International importance

		2007/2008 - 2009/2010				
	1% norm	Najaar	Winter	Voorjaar	Zomer	Maximum
Rotgans	2000	5.3	6.2	6.0	-	6.2
Kanoetstrandloper (winter)	4500	5.4	5.3	-	-	5.4
Rosse Grutto (winter)	1200	4.2	4.3	3.1	nvt	4.3
Brandgans	4200	1.5	4.3	3.5	-	4.3
Scholekster	10200	4.2	2.9	1.3	2.2	4.2
Slobeend	400	4.0	3.1	2.1	-	4.0
Zilverplevier	2500	3.2	2.5	3.8	-	3.8
Smient	15000	1.3	2.8	-	-	2.8
Lepelaar	110	2.7	-	-	1.5	2.7
Bonte Strandloper (winter)	13300	2.6	2.6	-	-	2.6
Wulp	8500	2.5	1.9	1.4	1.7	2.5
Kluut	730	1.1	-	2.0	1.2	2.0
Pijlstaart	600	1.5	1.9	-	-	1.9
Grauwe Gans	5000	1.6	1.2	-	-	1.6
Drieteenstrandloper	1200	1.6	-	1.3	-	1.6
Bergeend	3000	-	1.4	1.2	-	1.4
Rosse Grutto (doortrek)	7200	-	-	1.3	-	1.3
Steenloper (winter)	1500	1.1	-	-	-	1.1
Goudplevier	9250	1.0	-	-	-	1.0

Strucker et al., 2011

Ecosystem effects

- ANT Oosterschelde project:

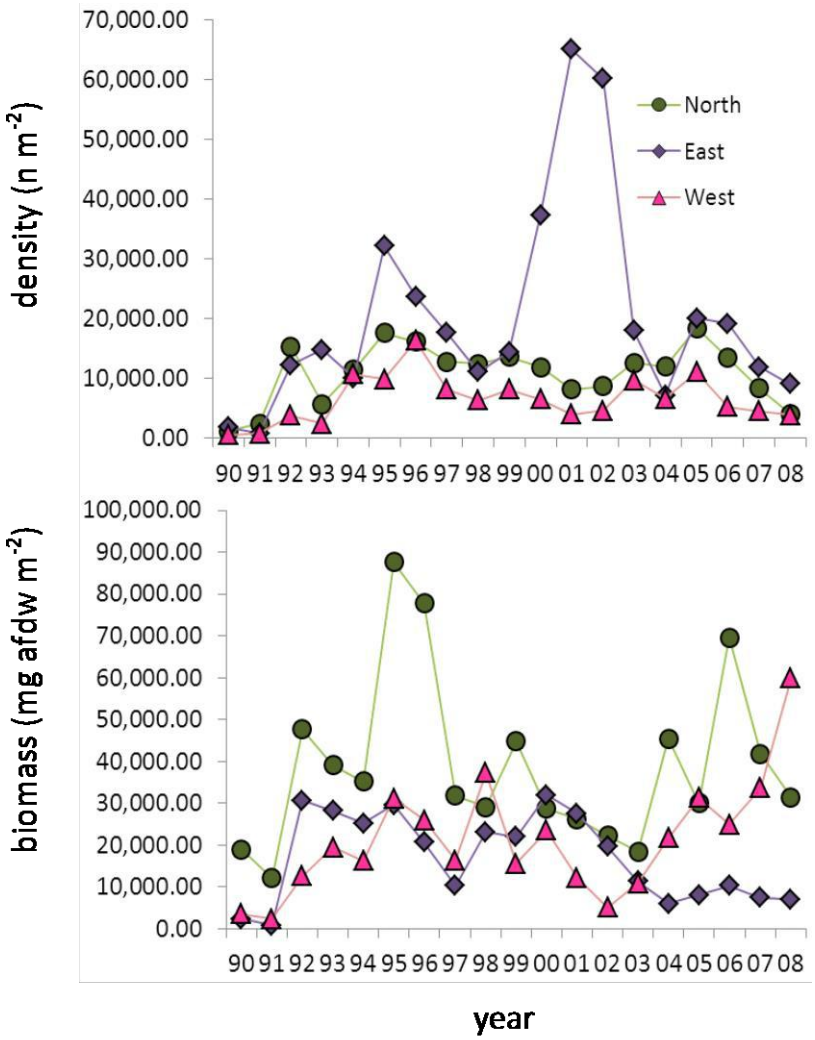


Waders

Wader numbers are influenced by:

- Surface of foraging area → Sand starvation
- Available foraging time → Sand starvation, disturbance
- Prey availability → Sand starvation, invasions, shellfisheries, prim. prod.
- (availability of suitable roosts)
- External factors

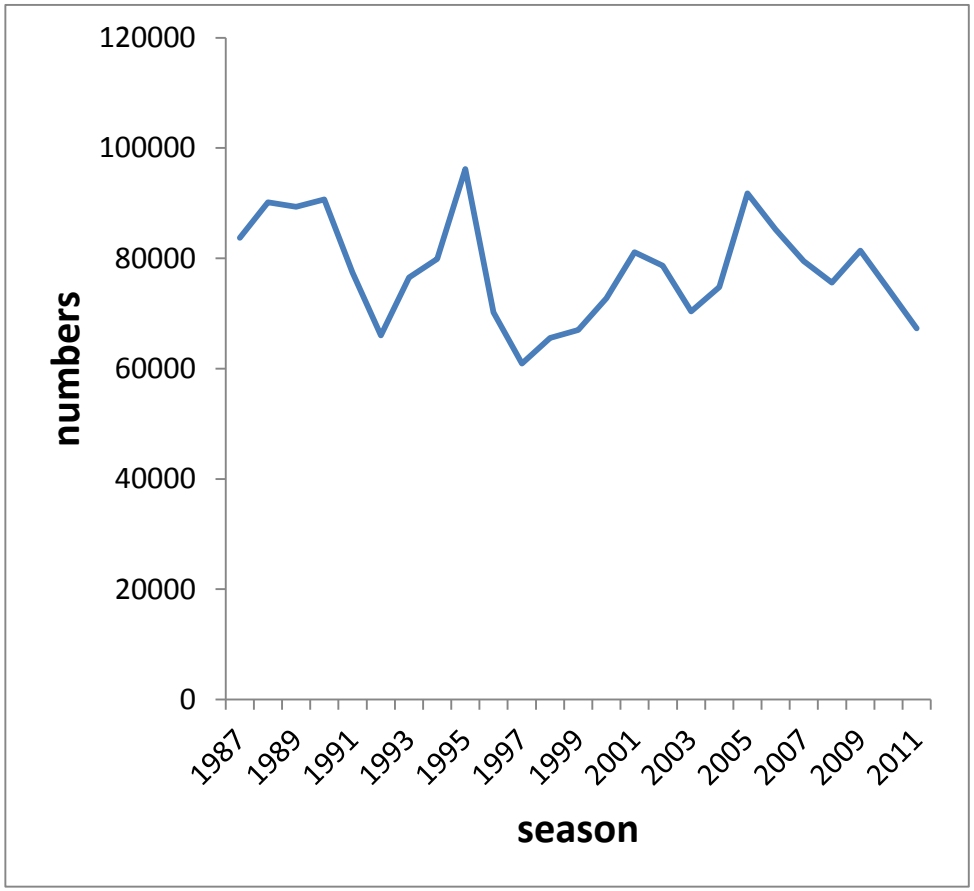
Long term changes in benthic macrofauna

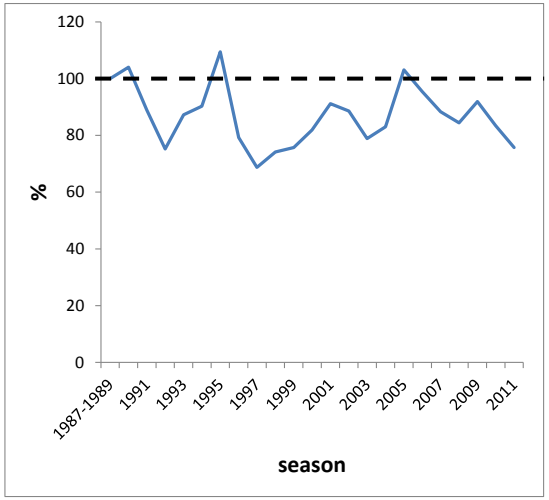


Troost & Ysebaert, 2011

Trends in wader bird numbers

- Despite the ongoing erosion, intertidal foragers do not show decline





Adapted from Troost & Ysebaert, 2011

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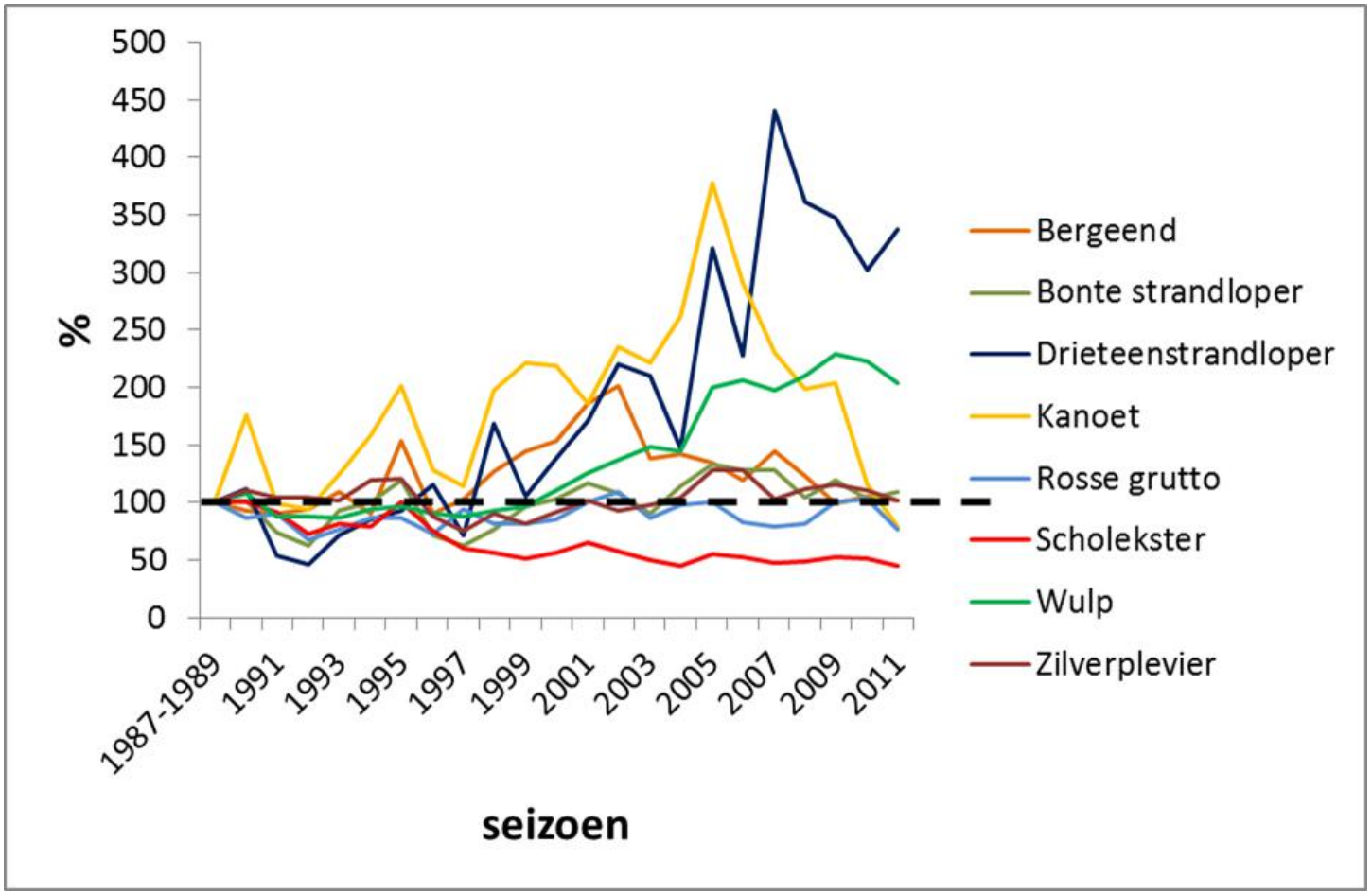
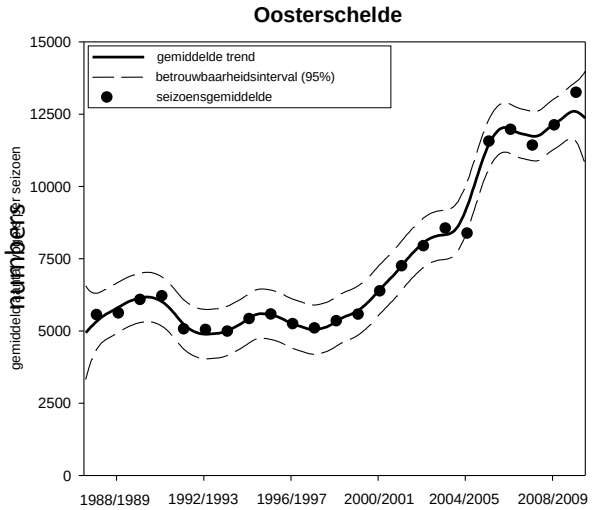
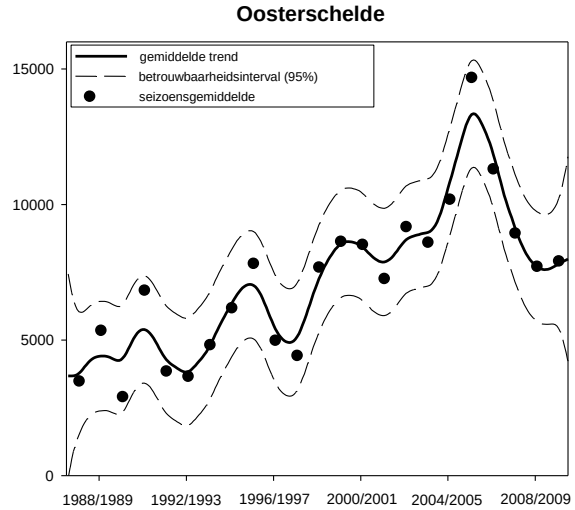
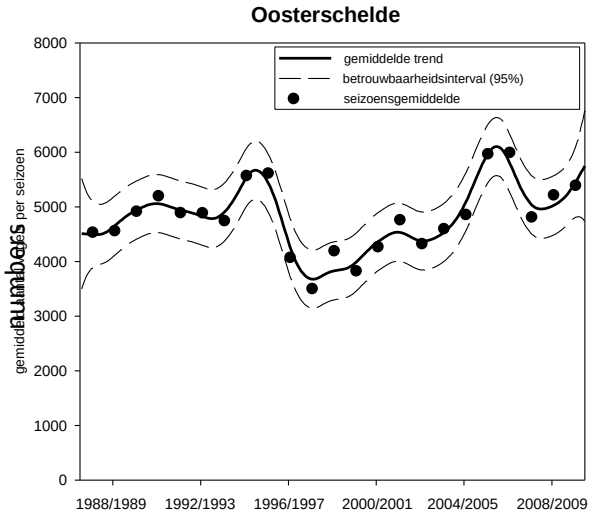
Trends in wader numbers

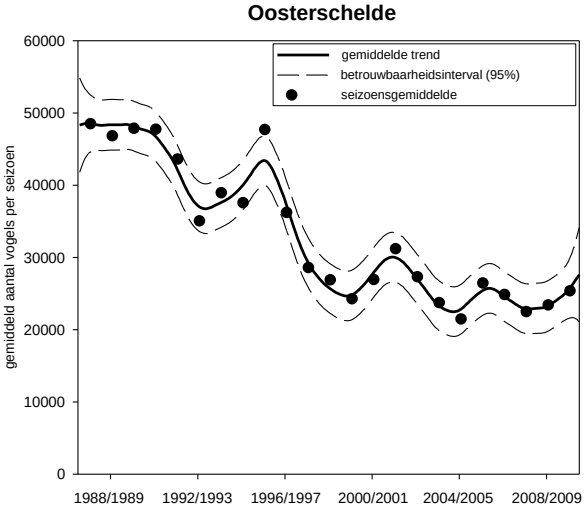


Trends in numbers of 4 wader species







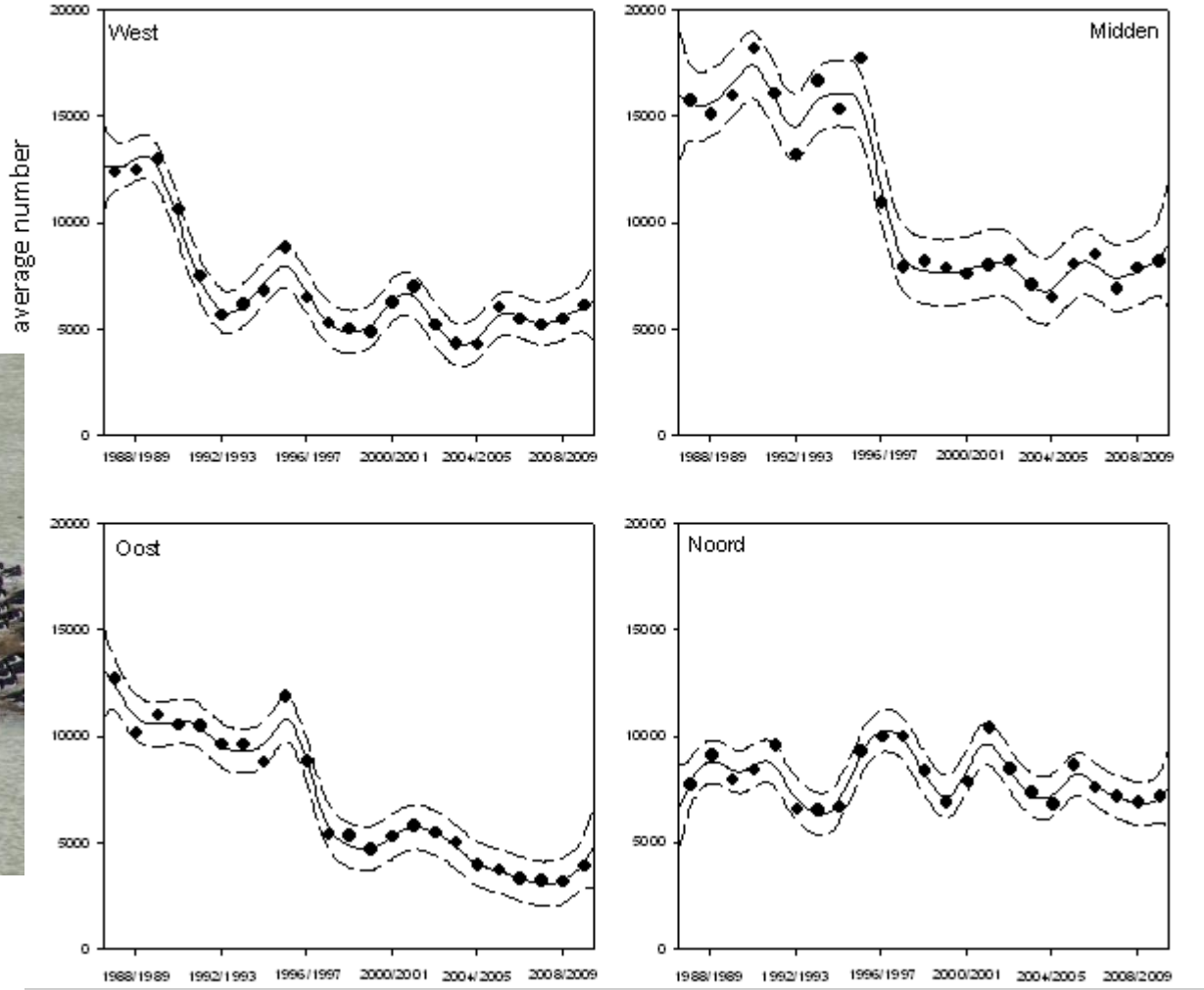


Troost & Ysebaert, 2011

IMARES WAGENINGEN UR

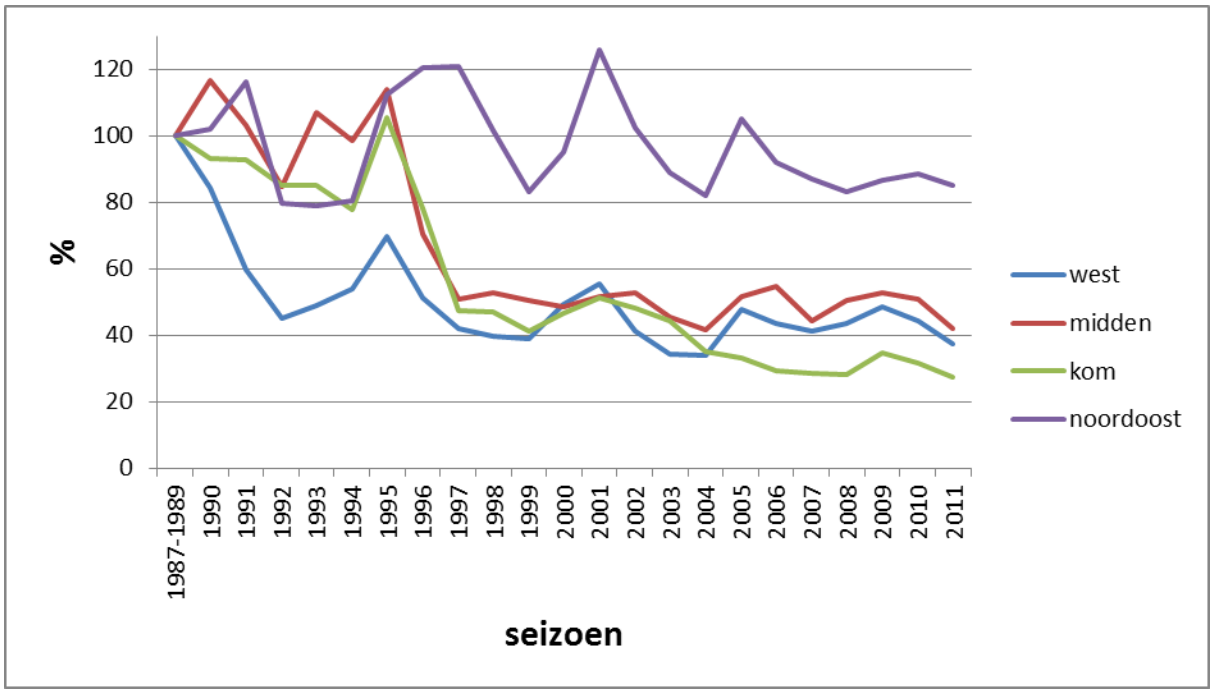
Changes in wader numbers

Oystercatcher *Haematopus ostralegus*

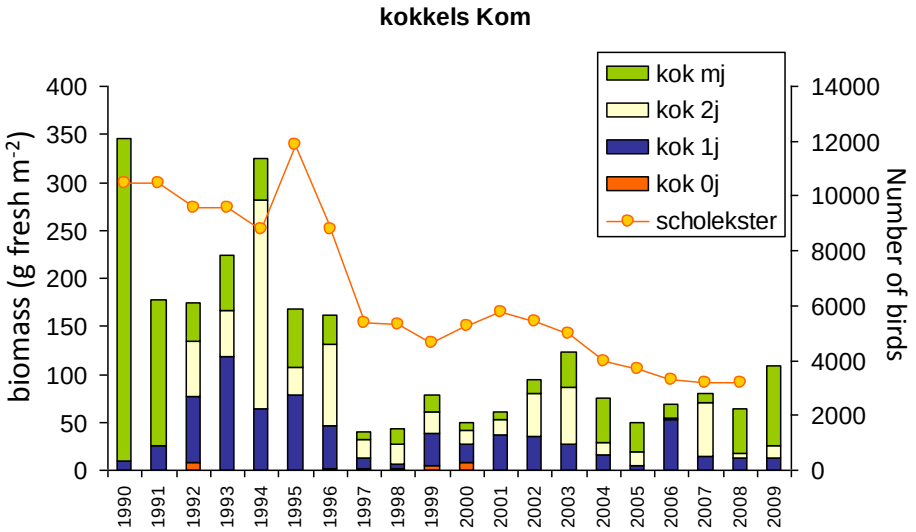


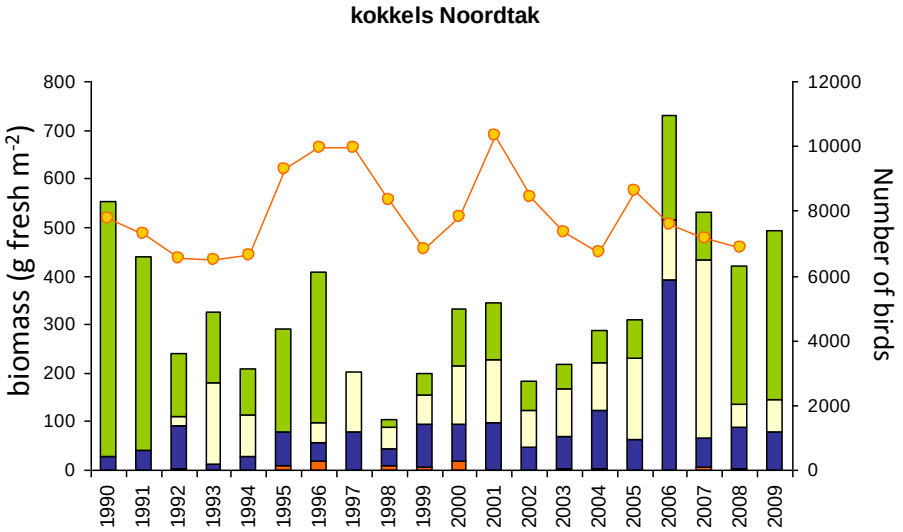
Troost & Ysebaert, 2011

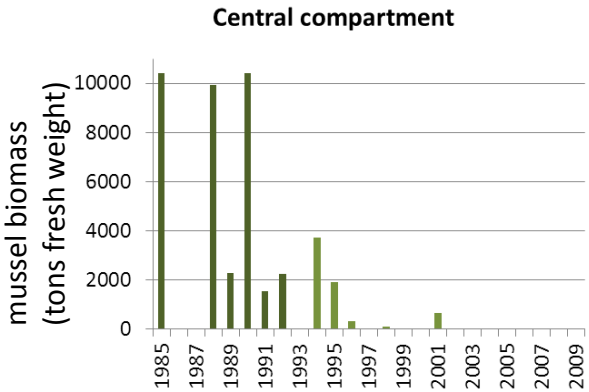
Oystercatcher

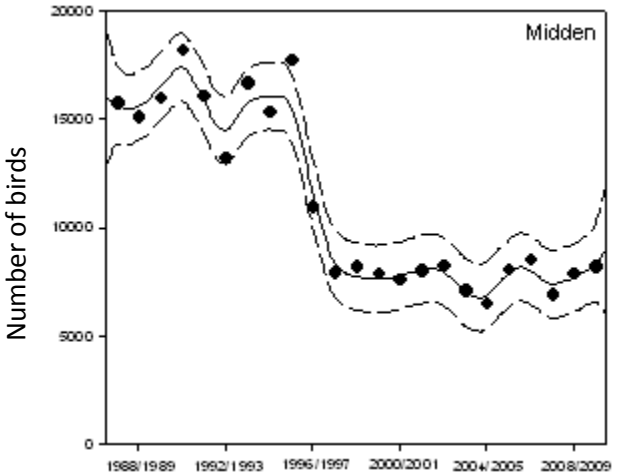


Oystercatcher and bivalves





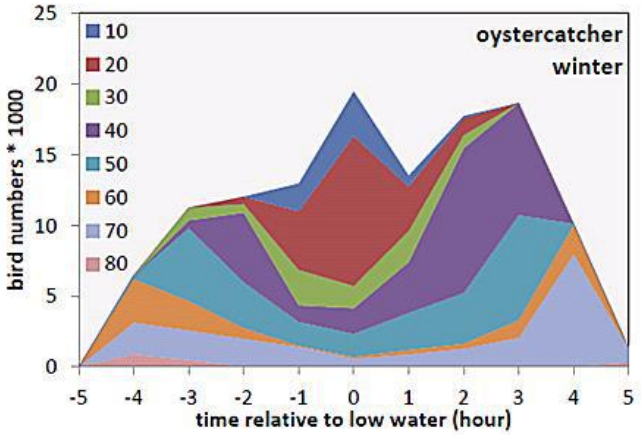


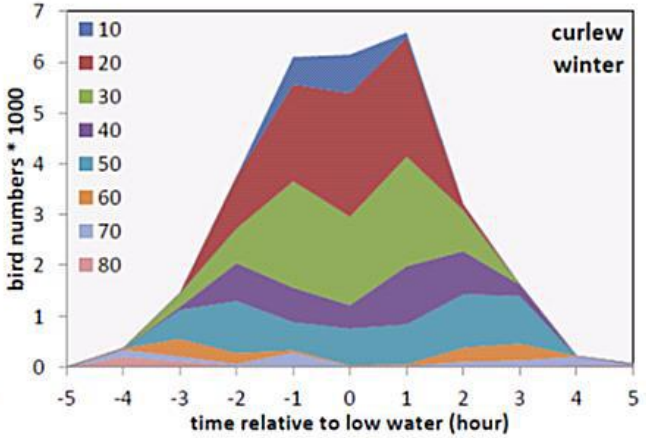


Troost & Ysebaert, 2011

Recent findings

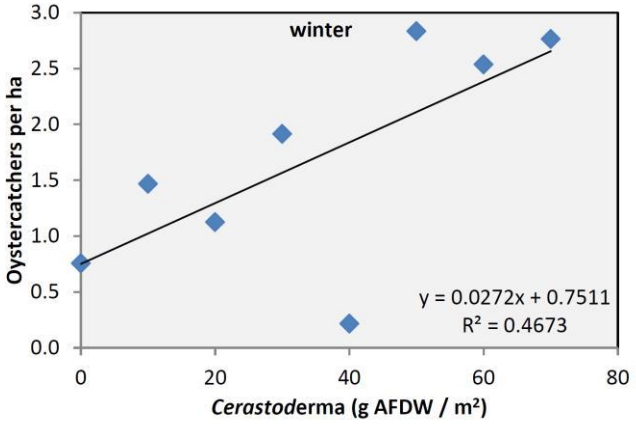
- Field studies in 2009 en 2010 (Zwarts et al. 2011):
- Some species forage high in intertidal, most species concentrate in low;
- Foraging time differs between species and seasons.
  - Summer: relatively short, for example Curlew 5h and Oystercatcher 6h.
  - Winter and migration: foraging time increases (~ energy demand), for example Curlew 7h, Oystercatcher 7-8h, Knot, Dunlin and Grey Plover 8-9h.

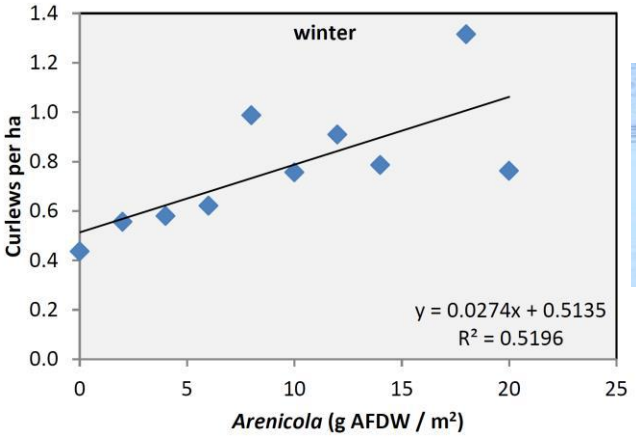




Recent findings

- Field studies in 2009 en 2010 (Zwarts et al. 2011):
- Prey choice differs among wader species: in summer crabs/shrimps relatively important, in winter worms and bivalves represent the larger fraction.





Recent findings

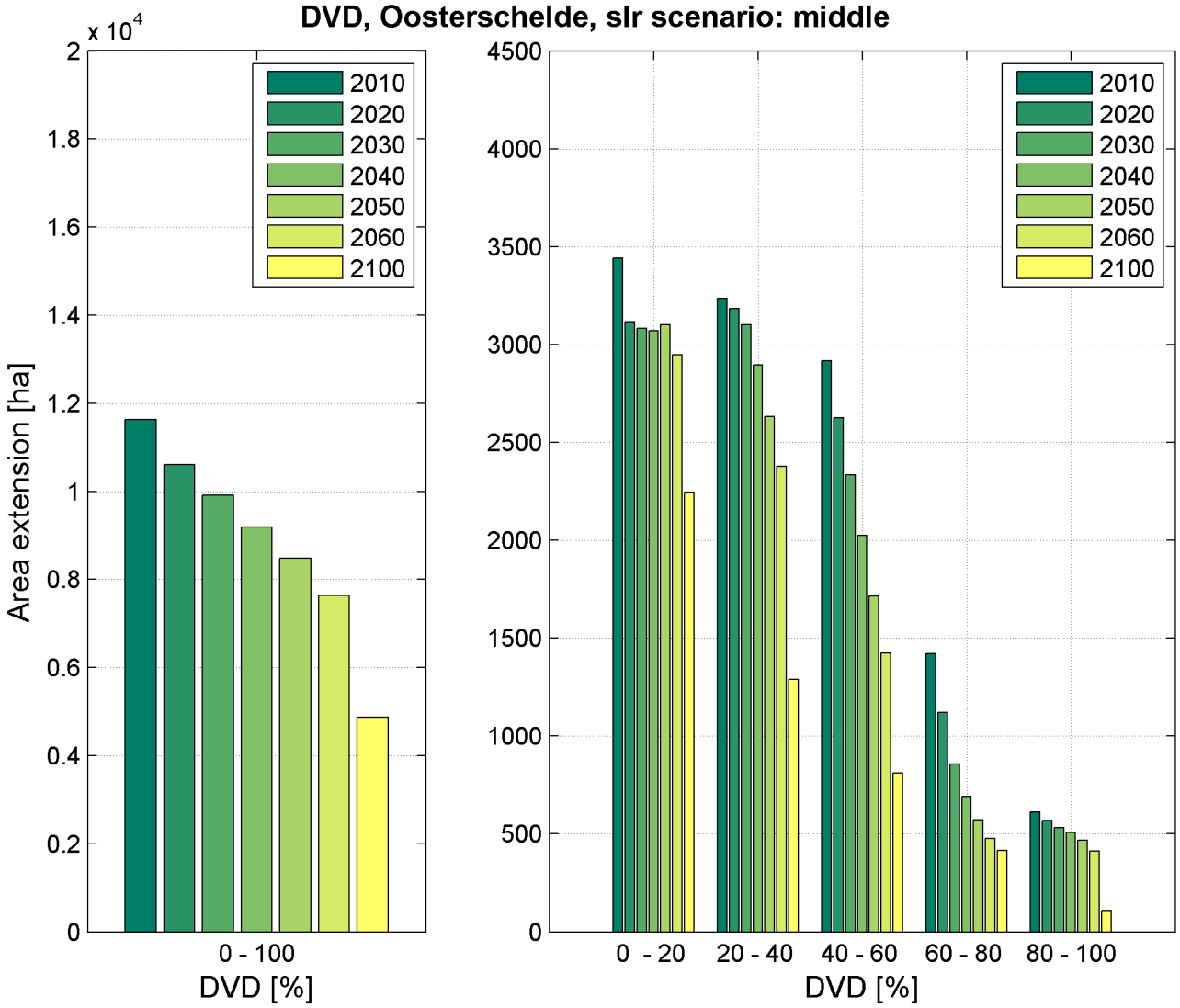
- Exposure time > 80% less important for most species;
- Lower intertidal (< 40%) have on average more macrobenthos;
- Lower intertidal only offers too little time to forage, esp. in winter;
- **Area with exposure time 40 – 80 % is important.**

Future?

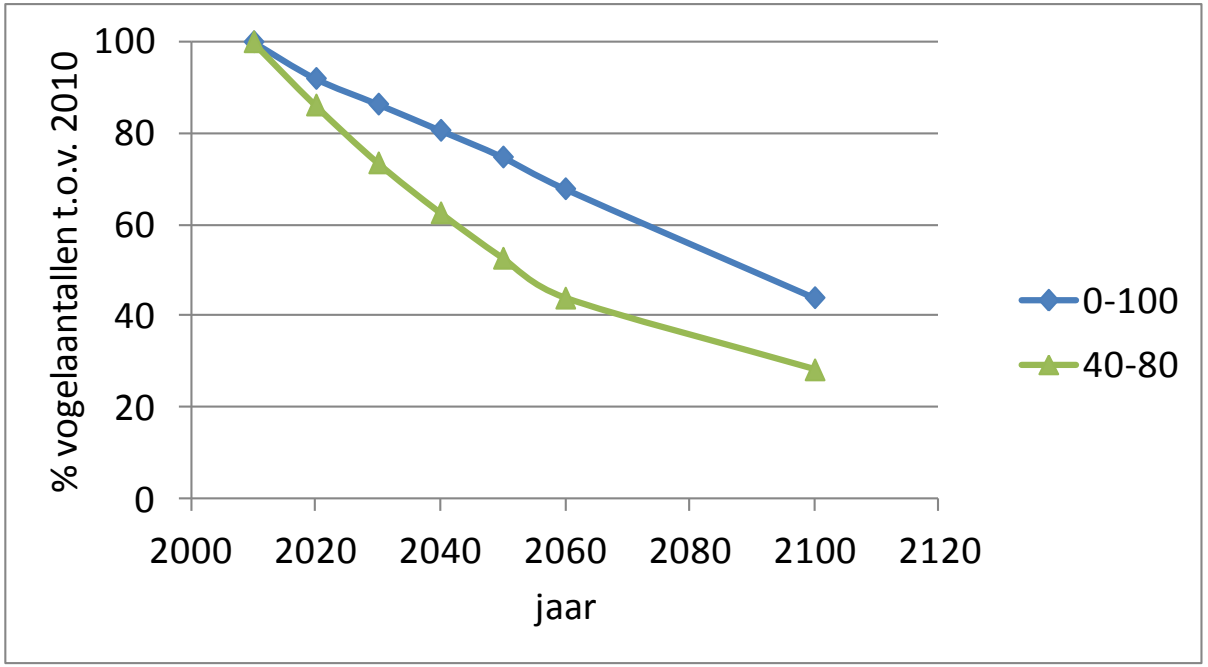
- Until present: (target)numbers still largely reached, but what in the future?
- Precautionary principle: carrying capacity is reached (Oosterschelde is full!!).

Photo Leo Zwarts

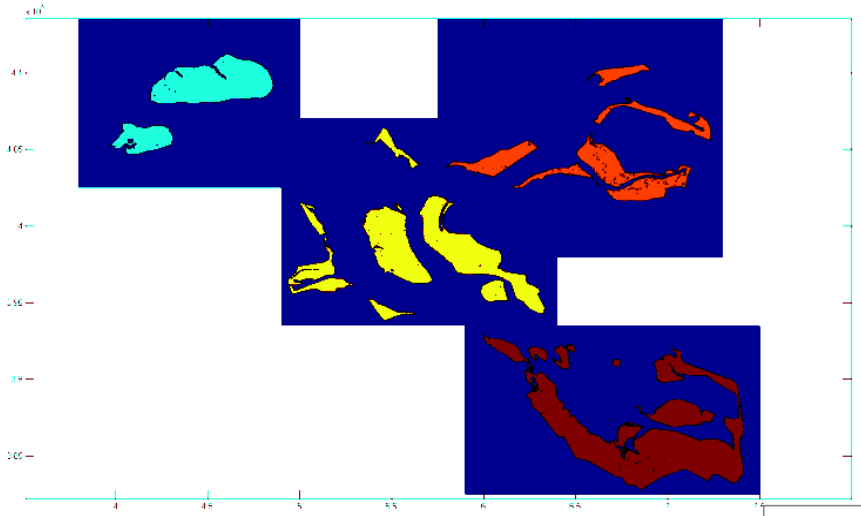
Development in (exposure time) area

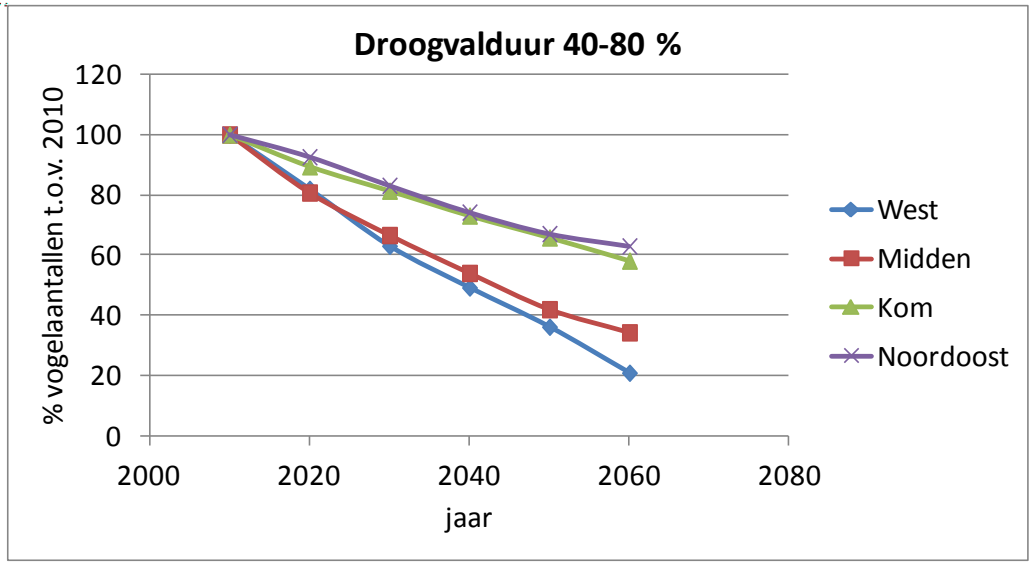


Prediction bird numbers



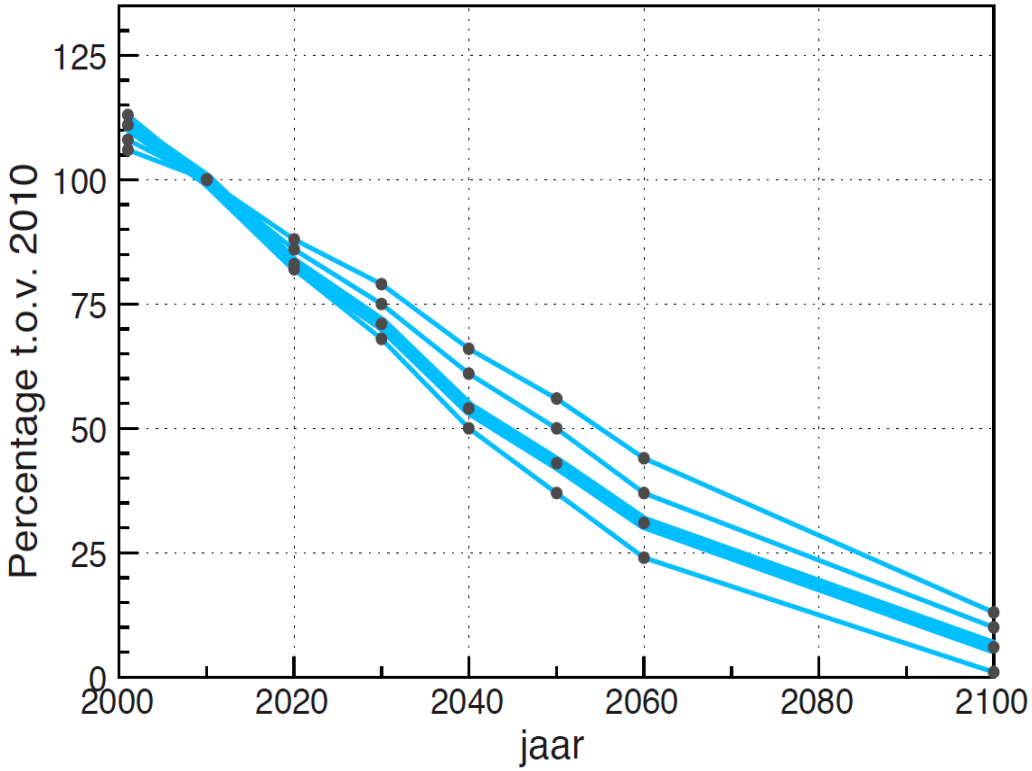
Prediction bird numbers per subarea





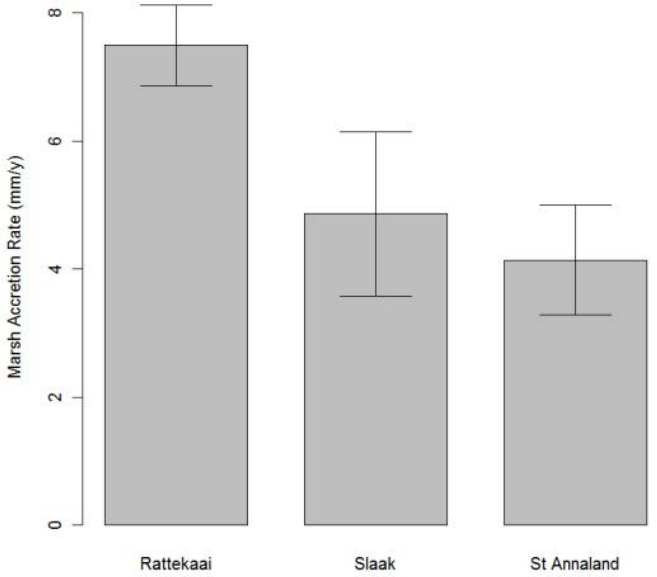
Prediction Oystercatcher

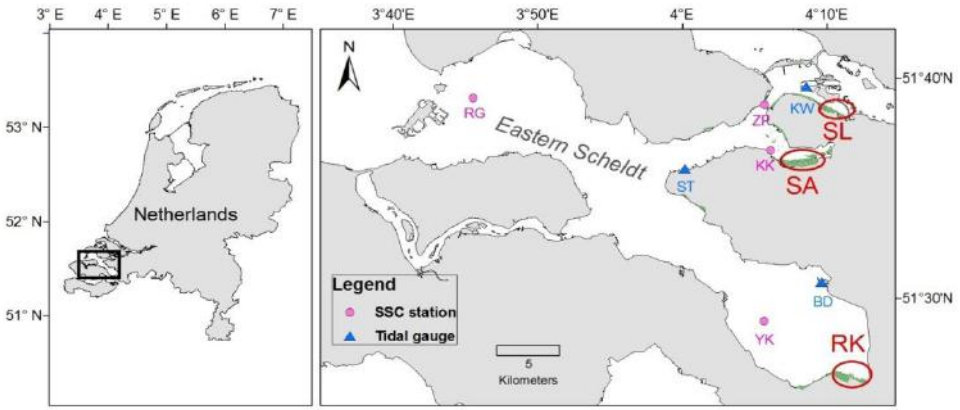
- More detailed prediction model Webtics (Rappoldt en Ens, 2013)



Long term changes in saltmarshes

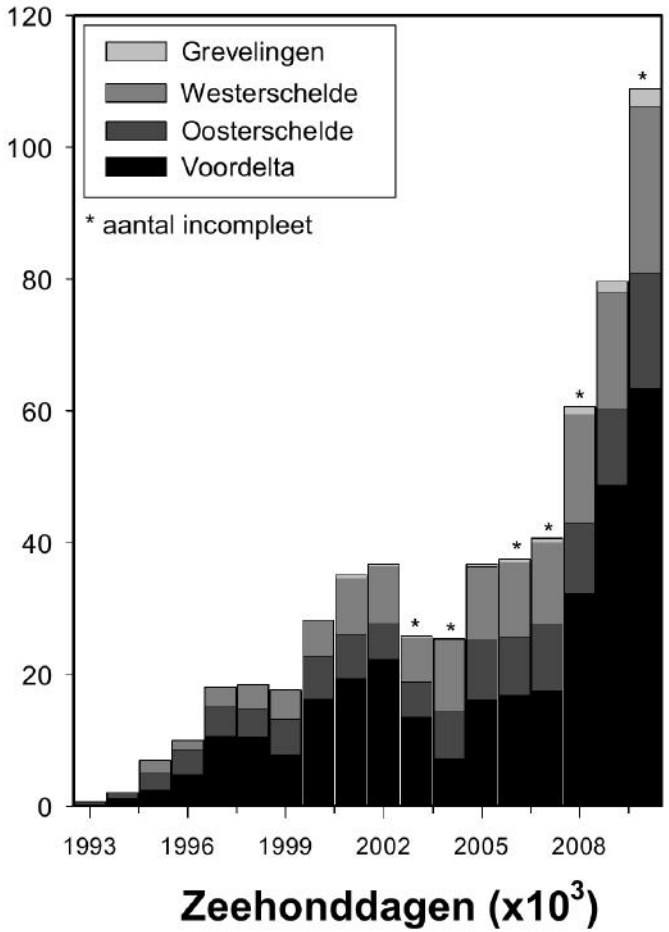
- Net accretion
- Cliff erosion





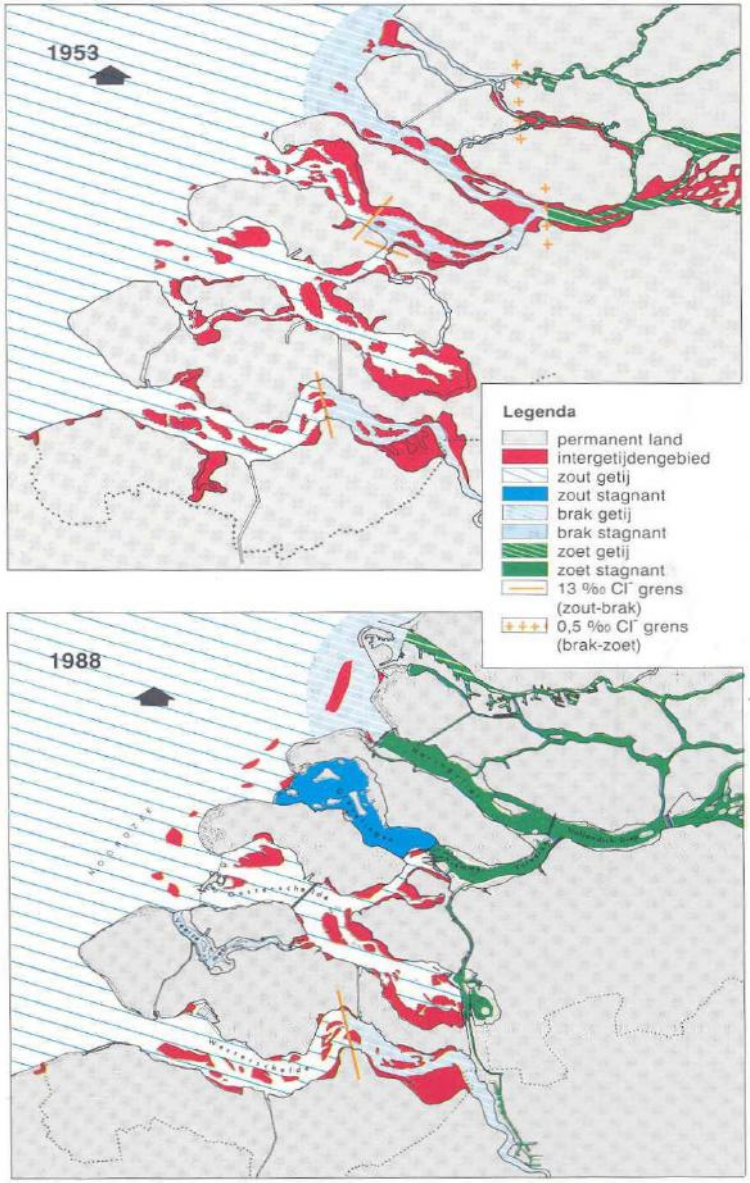
Zhigang Ma et al. in prep.

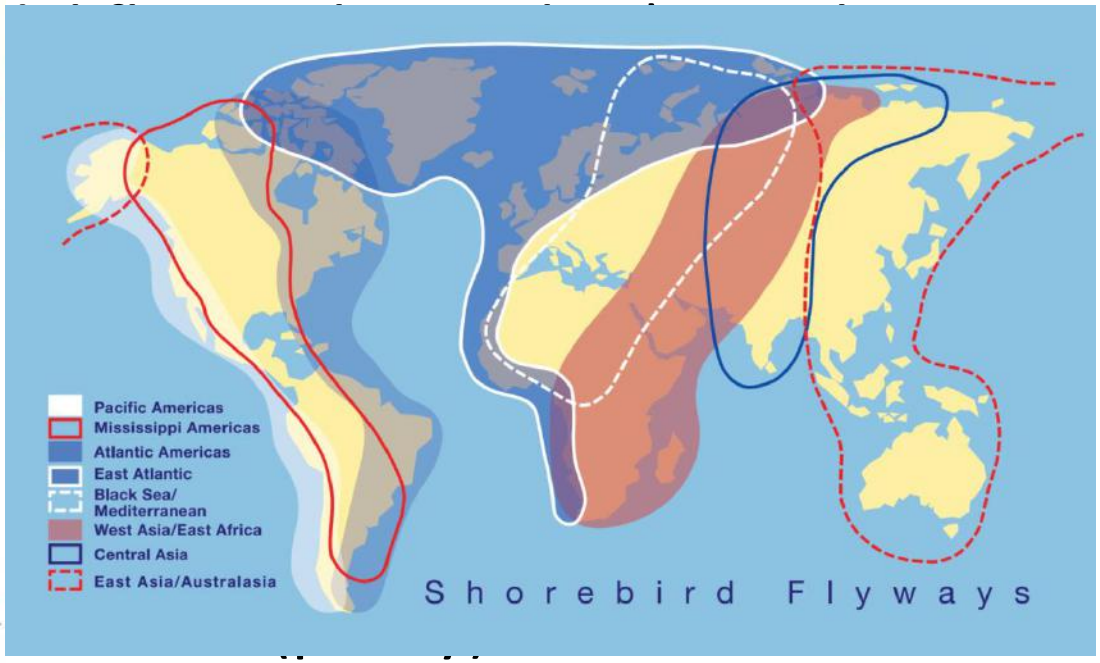
Seals



Strucker et al. 2012

Future Oosterschelde





Conclusions

- Oosterschelde storm surge barrier was one of first big infrastructural projects in NL where ecology played an important role.
- Tidal landscape preserved, but ecological/economical adverse effects in the future
  - Due to sand starvation
  - Loss of connection with rivers
- Measures to prevent further loss of intertidal habitat are being investigated
- More information:
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  - tom.ysebaert@nioz.nl