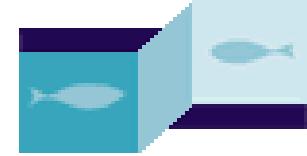


Benefits and consequences of managing the Haringvlietsluices for fish migration

Kees Storm¹, Joost Backx² en André Breukelaar²

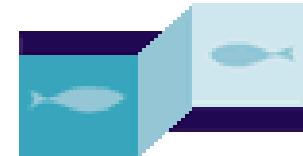
1) Rijkswaterstaat Zuid-Holland en 2) RIZA



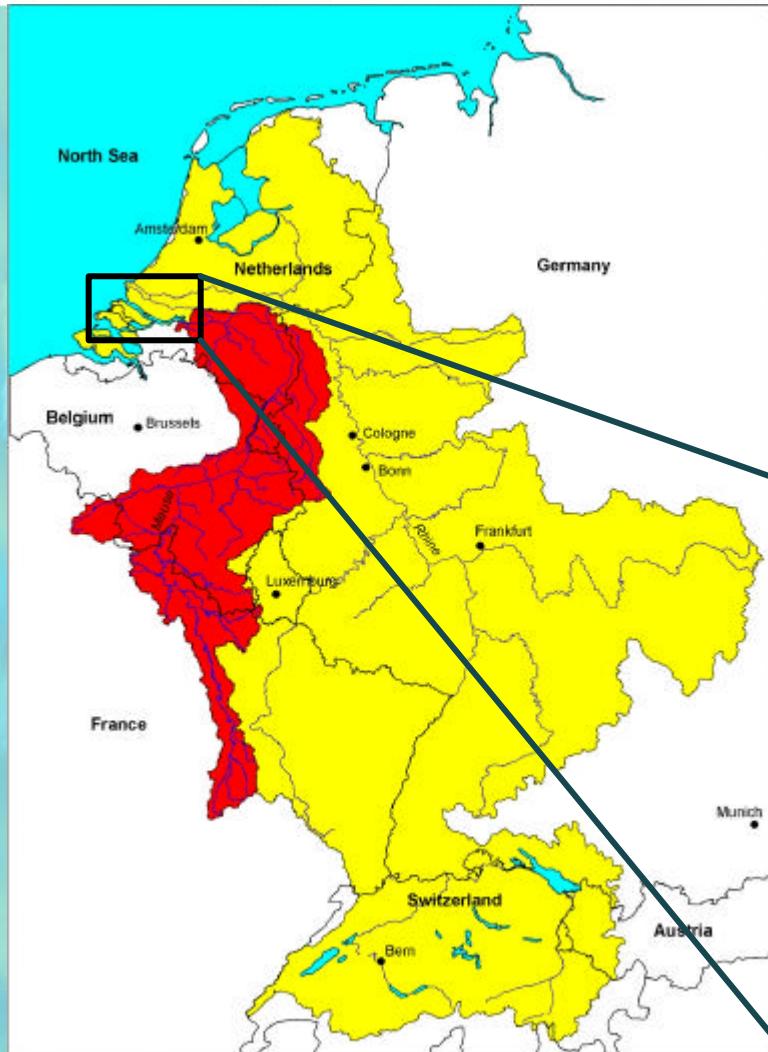


Overview of the presentation

- Intro Rhine-Meuse estuary & Haringvlietsluices
- Environmental Impact Assessment
- Alternative management of the sluices
- Conclusions



Rhine-Meuse estuary



Basin 120.000 km²

Average discharge

Rhine 2200 m³/s

Meuse 230 m³/s

Delta 40.000 km²

50% below sea level

3 water bodies:

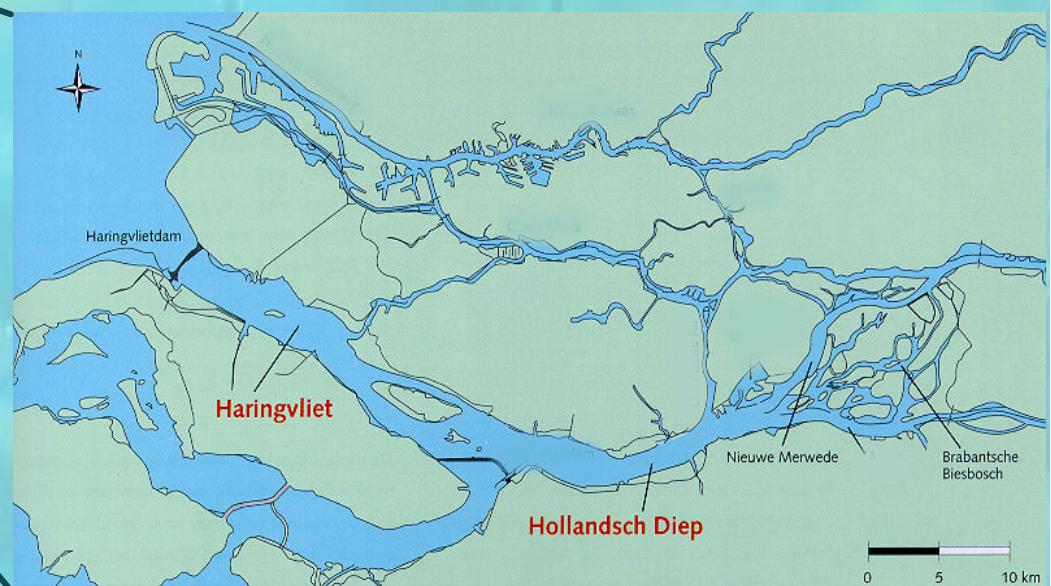
Haringvliet (80 km²)

Hollandsch diep (38 km²)

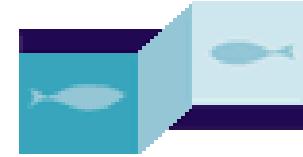
Biesbosch (10 km²)

Total length 64 km

Max. depth 5 - 12 m.

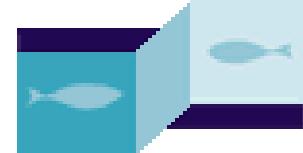


Why building sluices and barriers?



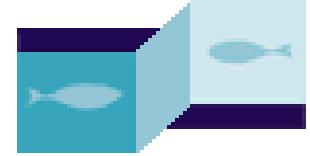
- 1953 storm flood disaster (> 1800 people killed)
- Delta project (1958)
 - dike strengthening
 - closure of coastal inlets



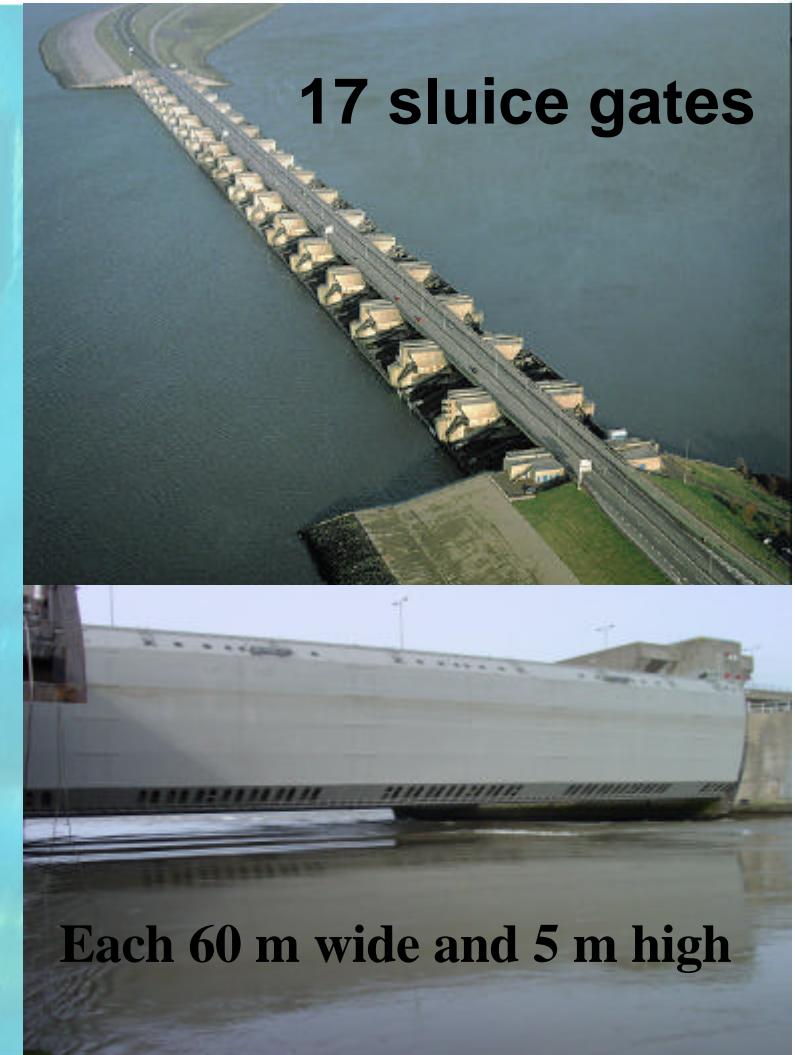
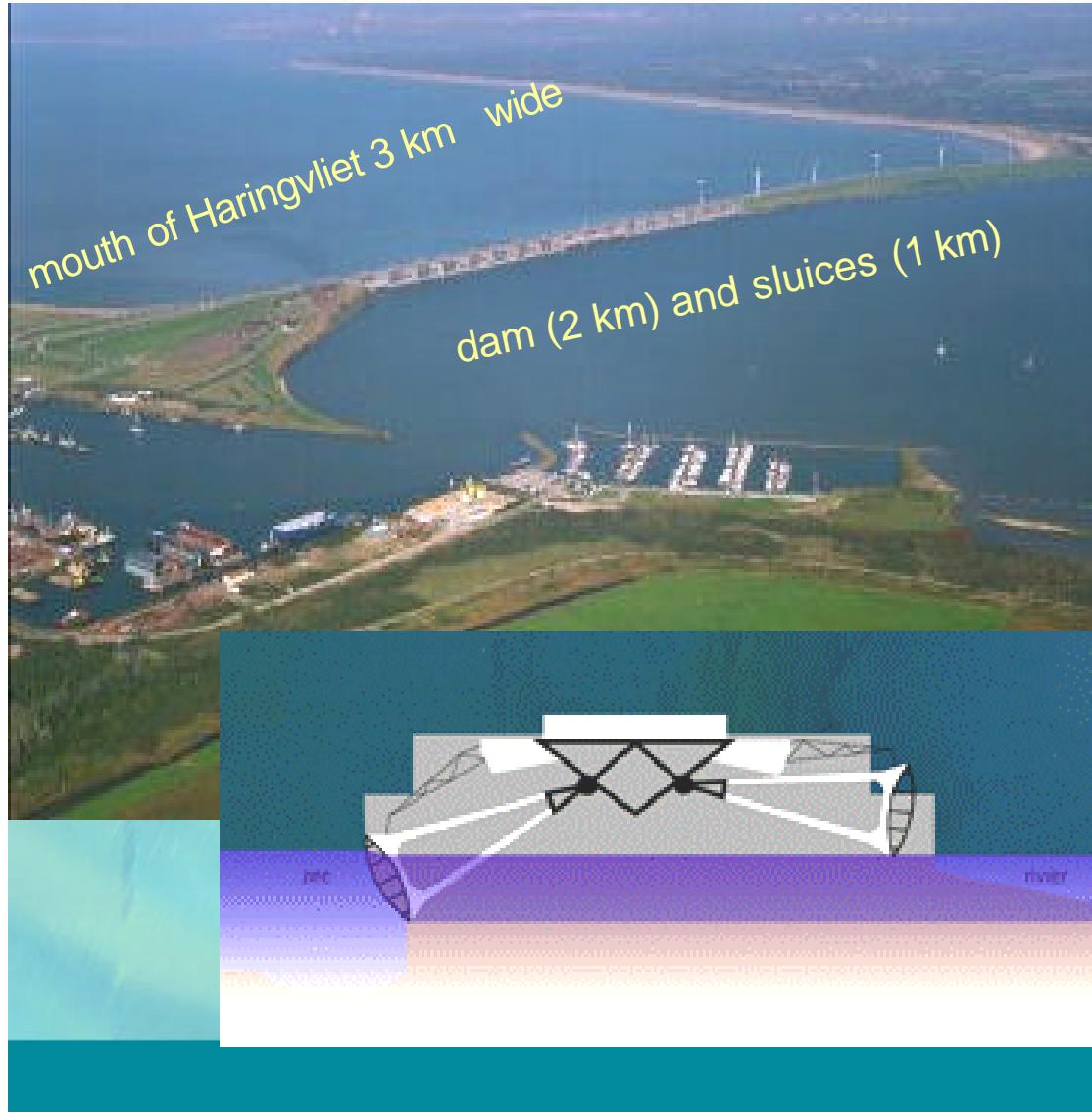


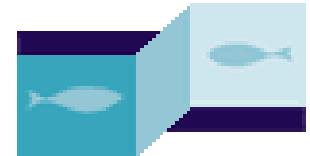
Delta project





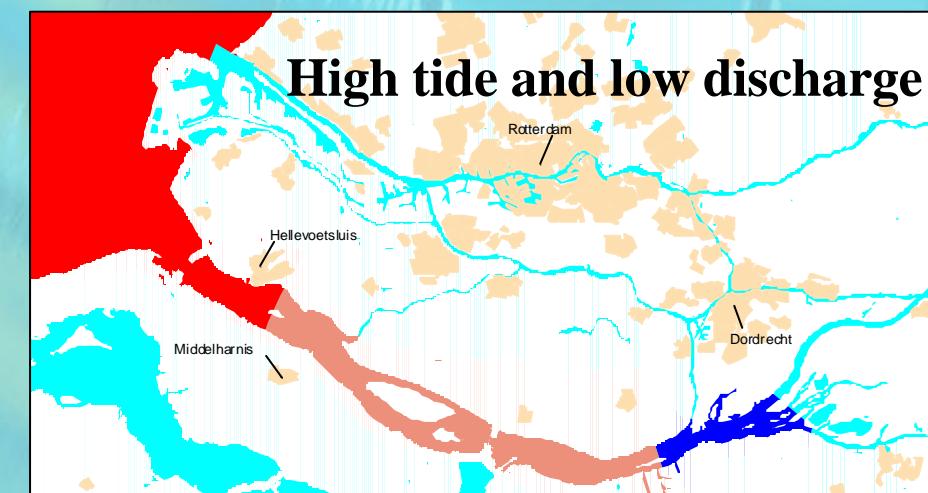
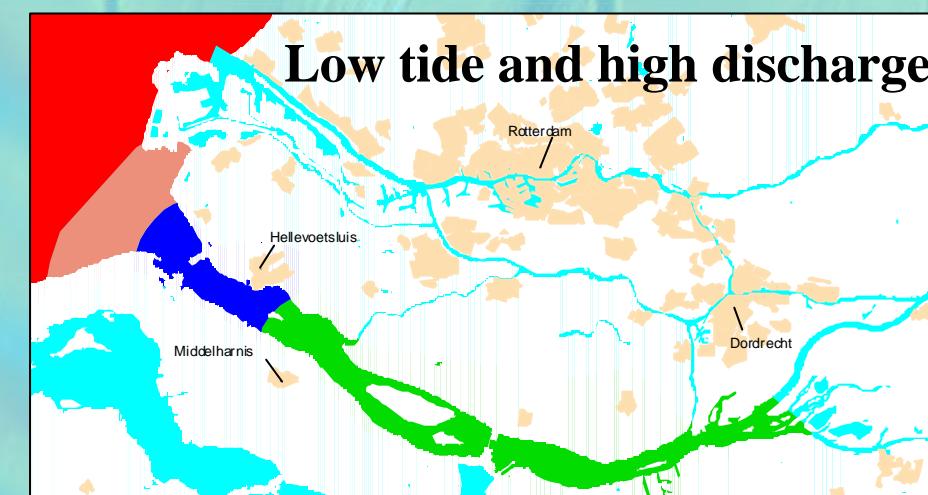
and the Haringvlietsluices (1970)



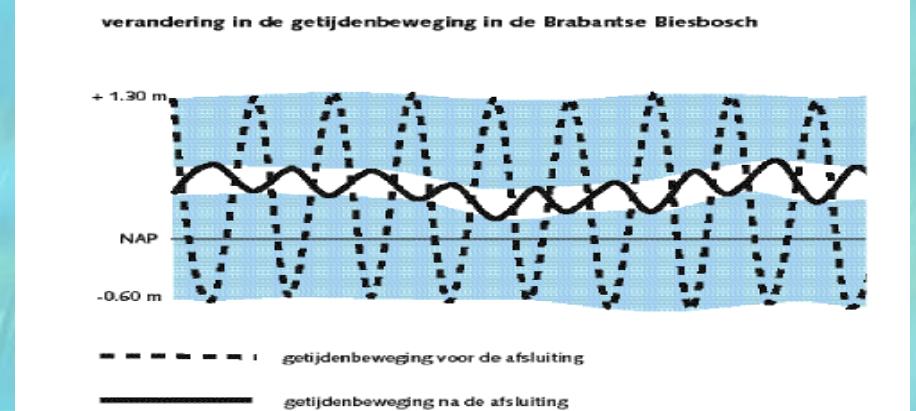
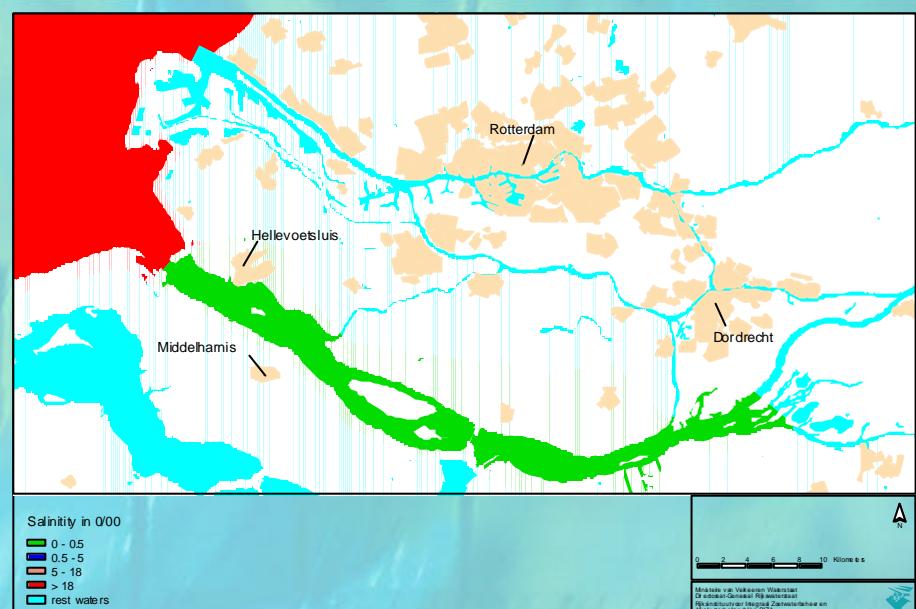


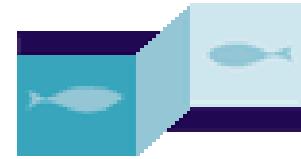
Salt gradient & Tidal range

Before 1970



Present situation





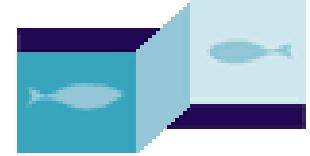
Consequences of the construction for the Haringvliet estuary

Before

- tidal range 1.8 – 2.3 m.
- salt/brackish/fresh
- free fish migration
- mudflats and creeks
- reed beds rushes and willows

After

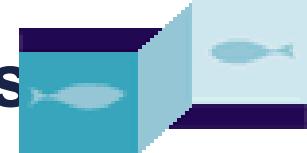
- tidal range 0.3 m.
- fresh water body
- fish migration disabled
- fresh water fish washed out
- bank erosion
- willows and nettles
- water for agriculture & drinking-water
- water recreation



Fish species (guilds)

Number of species per ecological guild	Historical	Present (1995 - 2000)
Diadromous	12	9
Estuarine resident	20	1
Freshwater	27	38
Marine (juvenile)	16	0
Marine (seasonal)	20	1
TOTAL	95	49

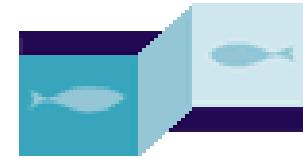
Alternative management Haringvliet sluices



In line with the national “integrated water management policy” an Environmental Impact Assessment (EIA) was carried out from 1994 to 1998 aiming:

- to restore the natural transition between river and sea
- to ensure sustainable use of waters on both sides of the sluices
- no adverse effect on flood protection

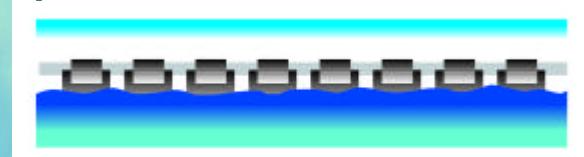




Conclusion EIA

1. For a sustainable rehabilitation of estuarine biota, the **Storm Surge Barrier** alternative would be best
2. The **negative effects** of the alternative management regimes **could all be offset by compensatory measures**
3. **Controlled tide** the preferred option (best balance between cost and ecological benefits)

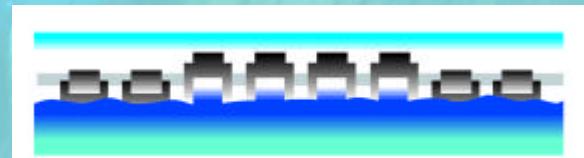
present



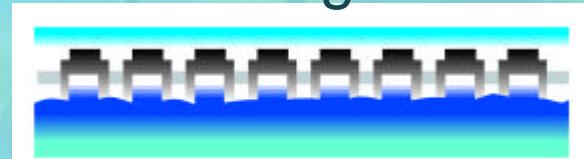
Sluices Ajar

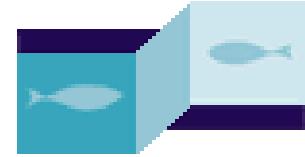


Controlled tide



Storm Surge B.



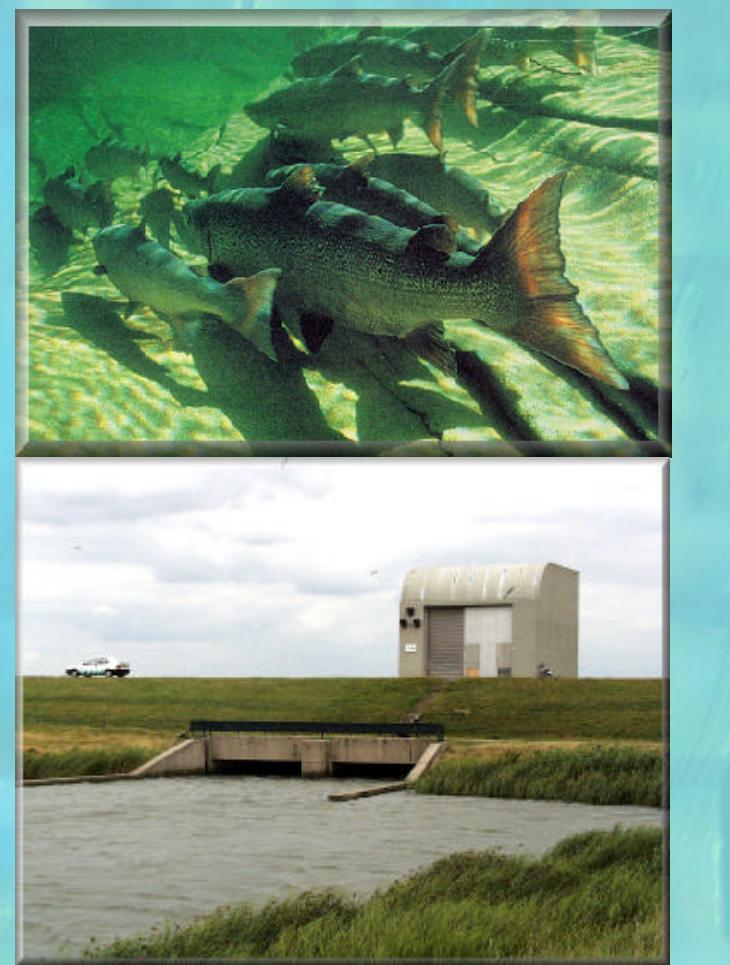


'Sluices Ajar' a balancing act

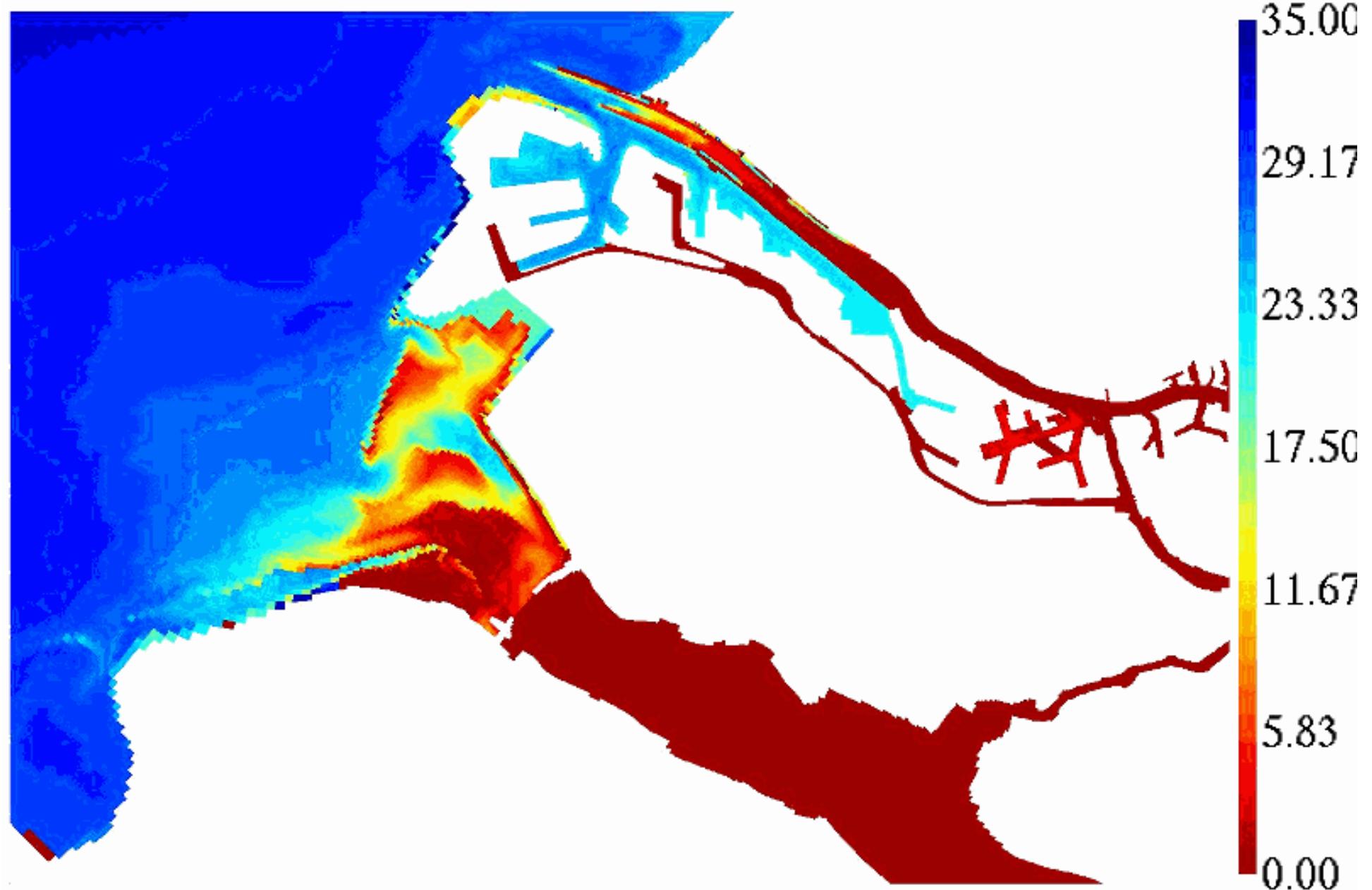
**Optimizing effect on ecology
with maximum opening during
flood and ebb periods**

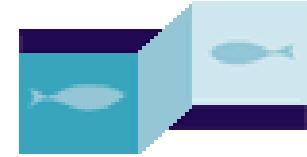
&

**controlling salt intrusion and
preventing significant effect on
fresh water supply**

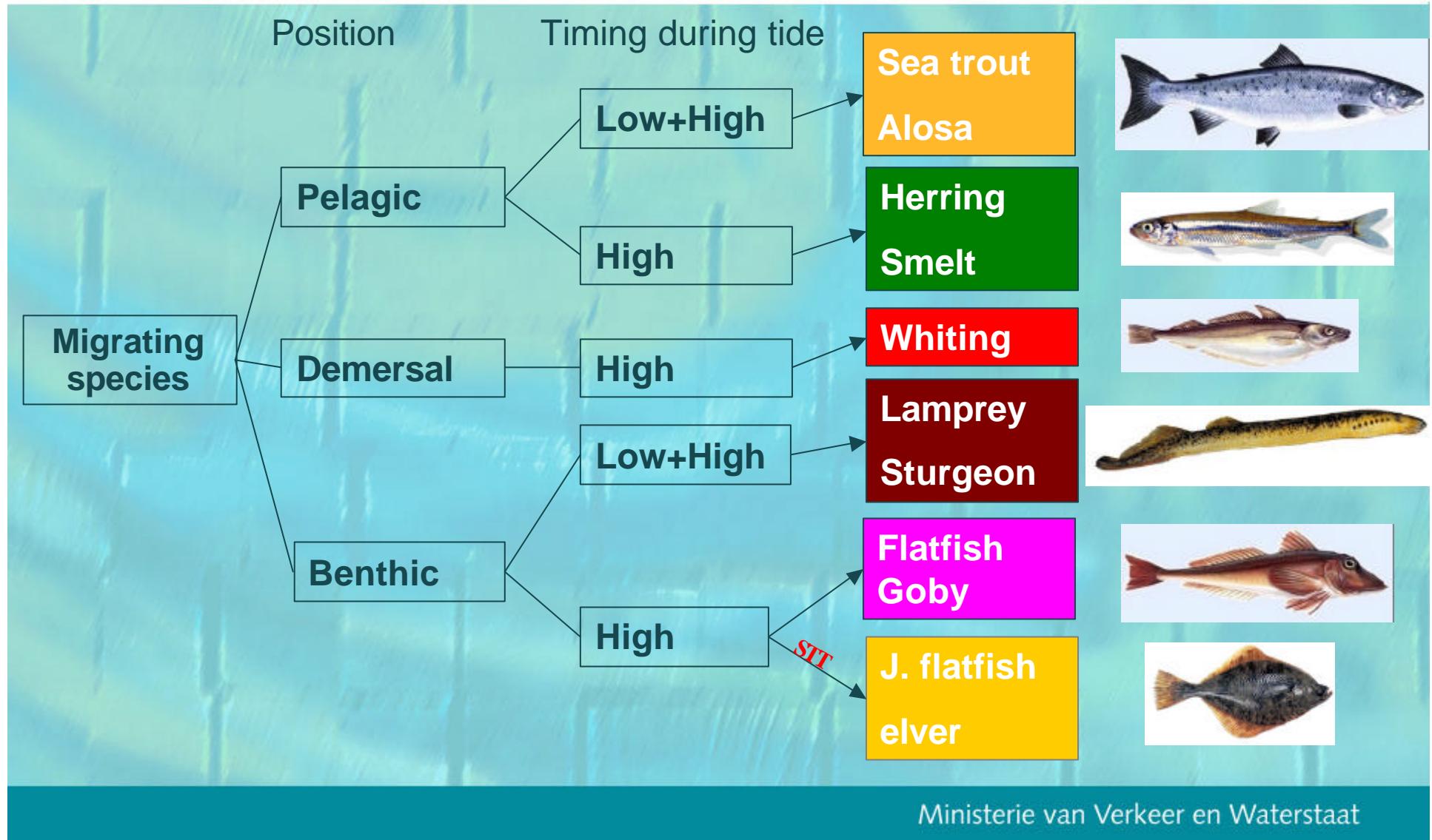


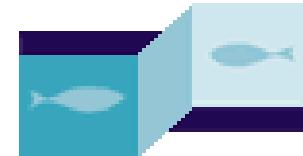
salinity at bottom [ppt]
10-Mar-1997 00:00:00





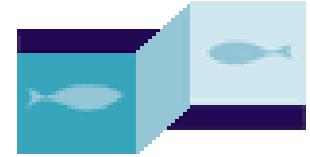
Fish migration guilds



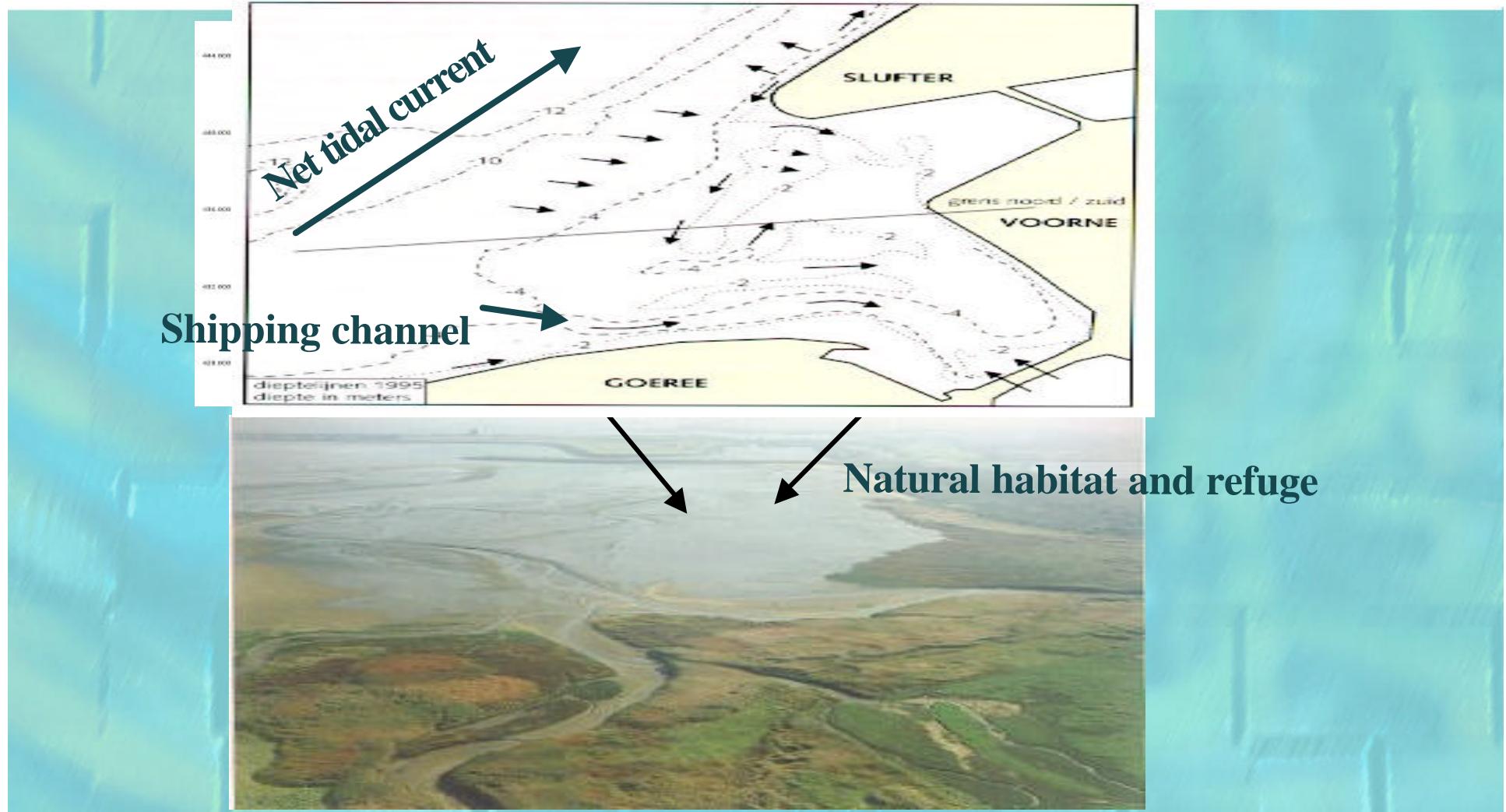


Moment of fish migration

Vissoort	Migratie Wijze	Periode											
		jan	feb	mrt	apr	mei	jun	jul	aug	sep	okt	nov	dec
Schol (juv)	6									®	®	®	®
Spiering	2									®	®	®	®
Haring (juv)	2									®	®	®	®
Sprot (juv)	2												
3-D. Stekelbaars	2												
Puitaal	5												
Aal	4								®	®	®	®	®
Schar (juv)	6												
Tong (juv)	6	®	®										®
Dikkopje (adult)	5												
Zeebaars	3									®	®	®	®
Zeeprikk	4												
Fint	1									®	®	®	®
Elft	1			®	®								
Steur	4												
Bot (juv)	6									®	®	®	®
Ansjovis	2										®	®	®
Steenbolk	3												
Diklippharder	3												
zandspiering	5												
Smelt	5												
Tong	5												®
Dikkopje (juv)	5	®	®										
Kleine zeenaald	5												
Schar (adult)	5		®	®									
Schol (adult)	5			®	®						®	®	®
Slakdolf	5												
Vijfdradige meun	5												
Wijting (juv)	3												
Zeeforel	1		®	®									
Zalm	1												
Houting	1												
Harnasmannetje	5												
Sprot (adult)	2												
Rivierprikk	4												
Zeedonderpad	5			?									
Kabeljauw (juv)	3												



South side preferred to open first

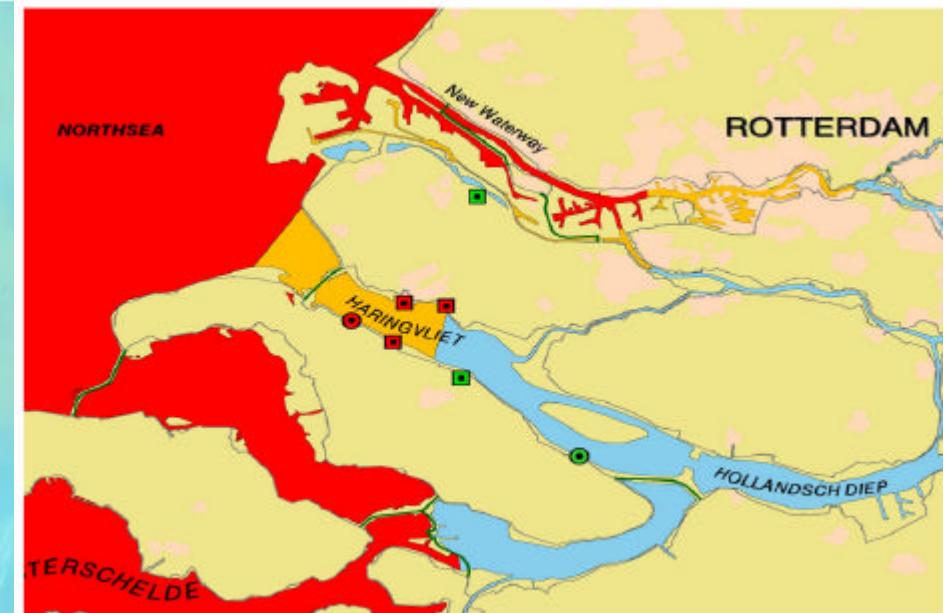




'Sluices Ajar' in 2008 ?!

Controlling factors:

- marginal lowering of water levels
- restricted salt intrusion & network to monitor salt
- set up network to monitor changes in ecosystem
- draw up protocols with water boards and water supply companies



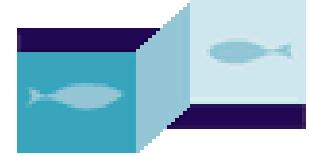
Compensation:

- relocating intakes for drinking and agricultural water



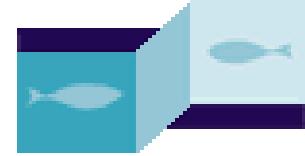
Next step: towards ‘Controlled tide’?

- evaluation of ‘Sluices Ajar’ after 5 years in operation (2013)
- new political decision for a possible further step towards ‘Controlled Tide’ for restoration of tidal habitats for estuarine fish



Conclusions

- Closing off the Haringvliet has had a major impact on estuarine ecology
- Partial restoration is possible with alternative sluice management (sluices Ajar)
- In 2008 Haringvlietsluices will open also during flood period; diadromous fish should benefit the most
- restoring the ecological continuum, it is an important measure in the implementation of the Water Framework directive



Thank you for your attention!

