

CWSS Workshop – The Wadden Sea Ecosystem & Climate Change

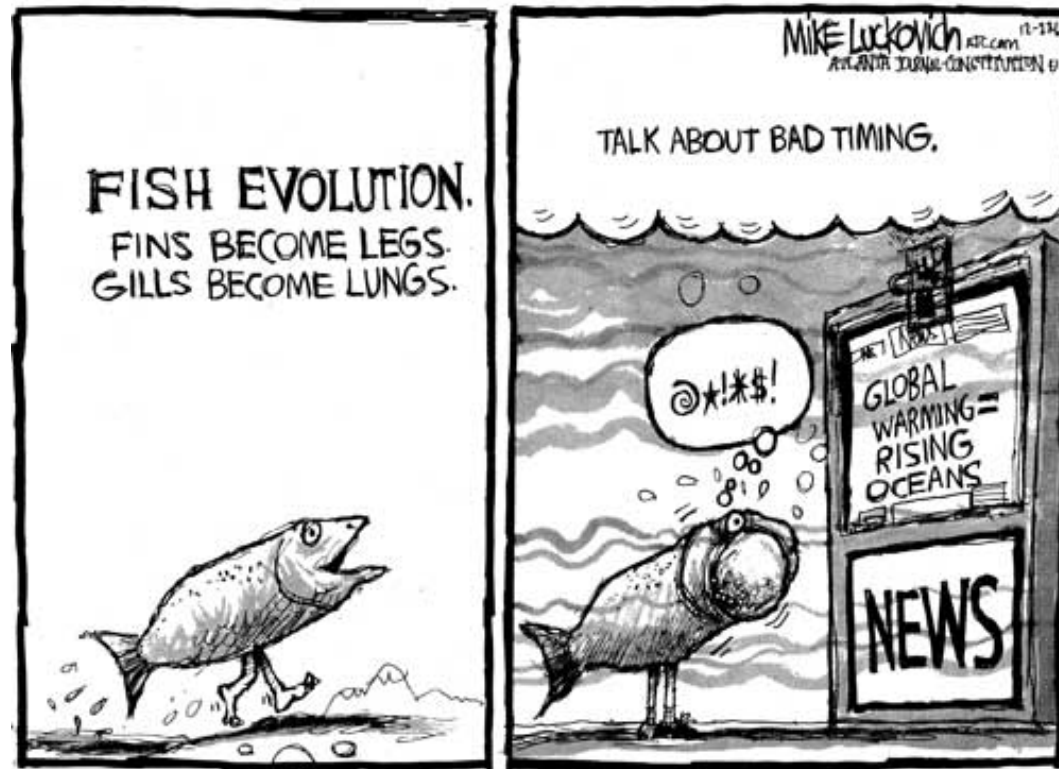
Wilhelmshaven, 30 August 2007



impacts on habitats & species

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impacts on habitats & species



CLIMATE CHANGE

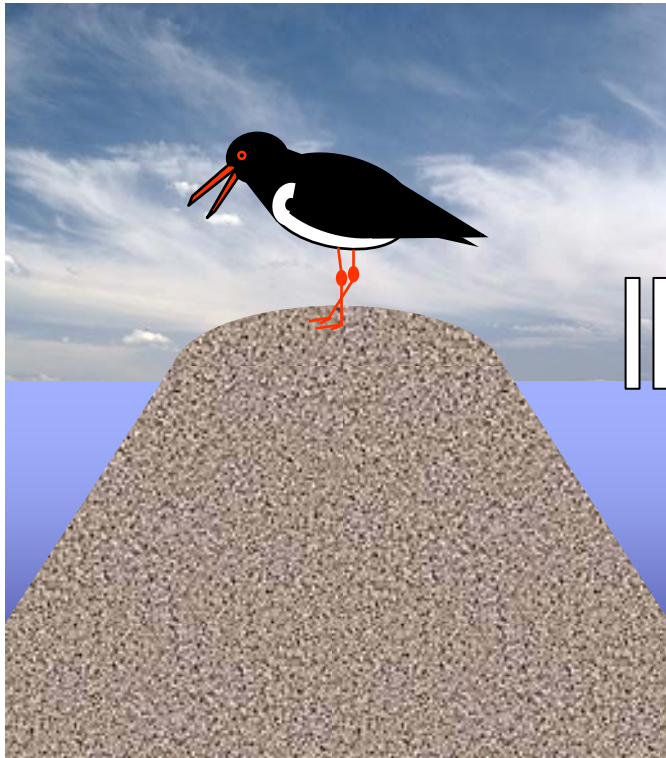
sea level – temperature – storms – waves – CO₂ concentrations – rainfall



habitats & species of the Wadden Sea

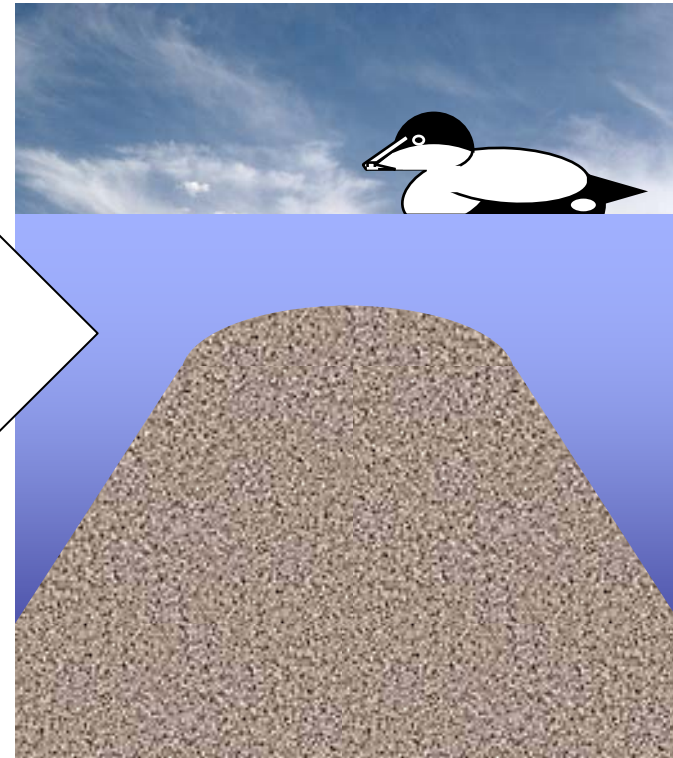
impacts on habitats & species – depth and emersion time

littoral



+ sea level

sublittoral



impacts on habitats & species – depth and emersion time



‘upward’ shift of tidal gradients in habitats



‘upward’ shift of tidal gradients in species



gain & loss of specific habitats & species
(depending on nature of borders and rate of sea level rise)

impacts on habitats & species – average and extreme temperatures

cold winters



+ temperature

hot summers



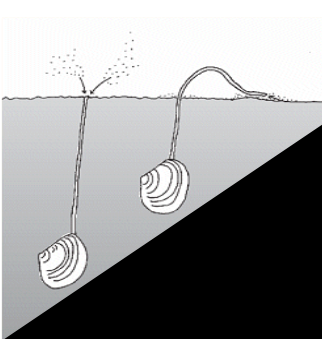
impacts on habitats & species – average and extreme temperatures



mortality rates
(e.g., freezing, anoxia, metabolic imbalance)



recruitment success
(e.g., reproductive output, food availability, predation)



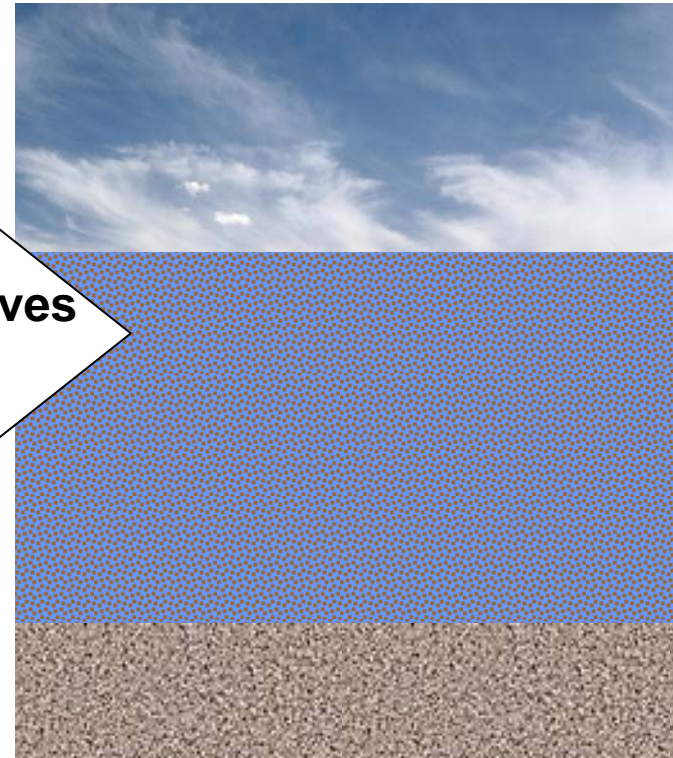
indirect effects on population dynamics
(e.g., burial depth in relation to H₂S sediment profiles)

impacts on habitats & species – sources and sinks of primary production

sedimentation



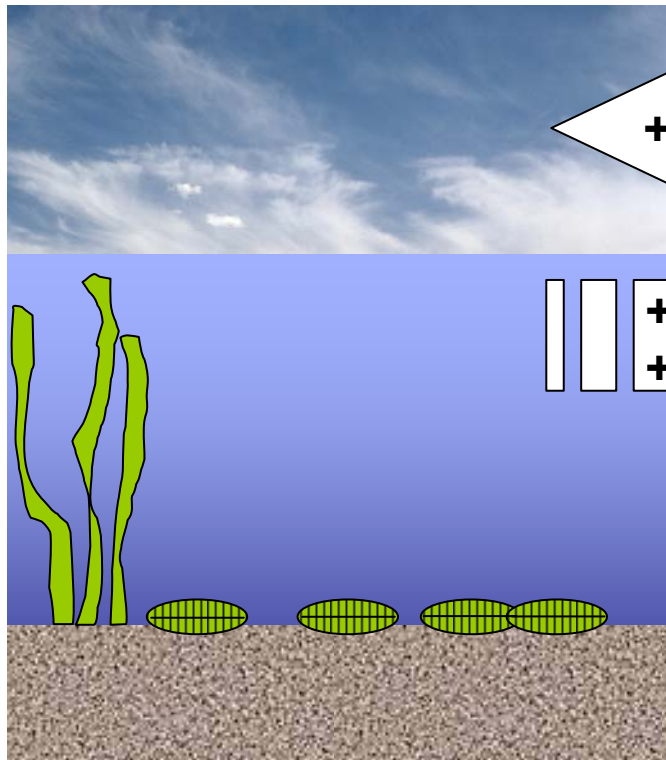
resuspension



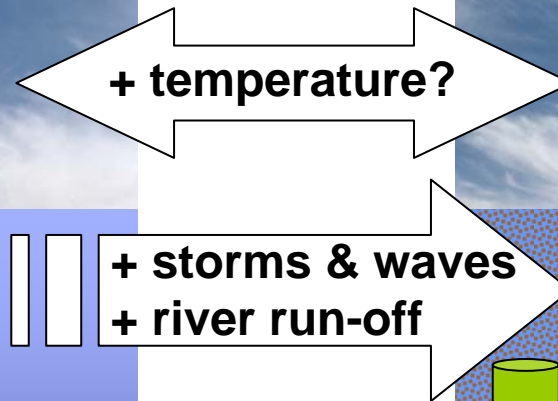
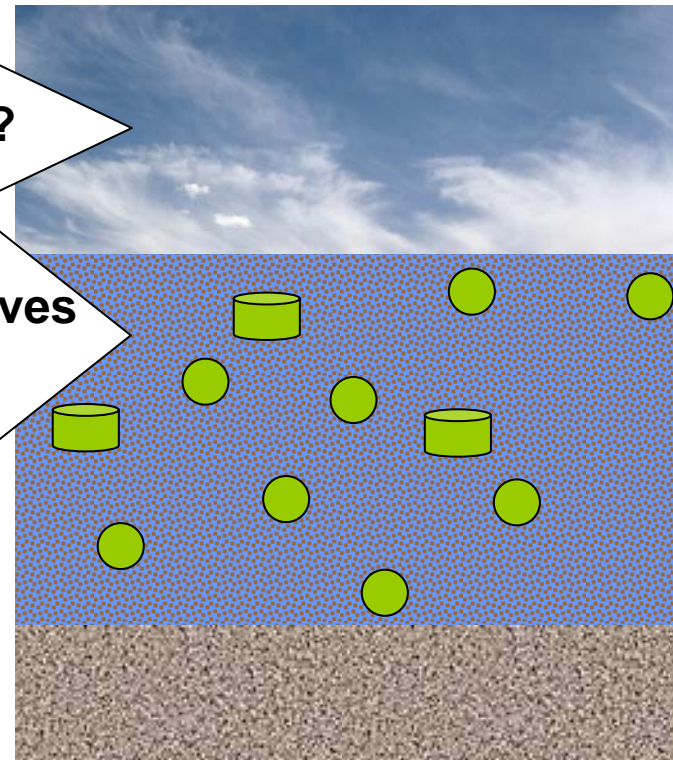
+ storms & waves
+ river run-off

impacts on habitats & species – sources and sinks of primary production

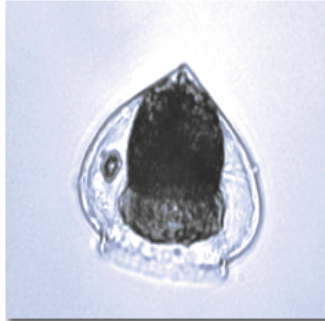
benthic primary production



pelagic primary production



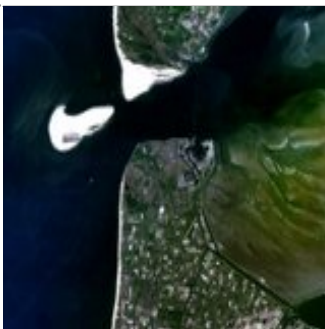
impacts on habitats & species – sources and sinks of primary production



cycling of energy and matter
(e.g., benthic macrozoobenthos vs. pelagic zooplankton)

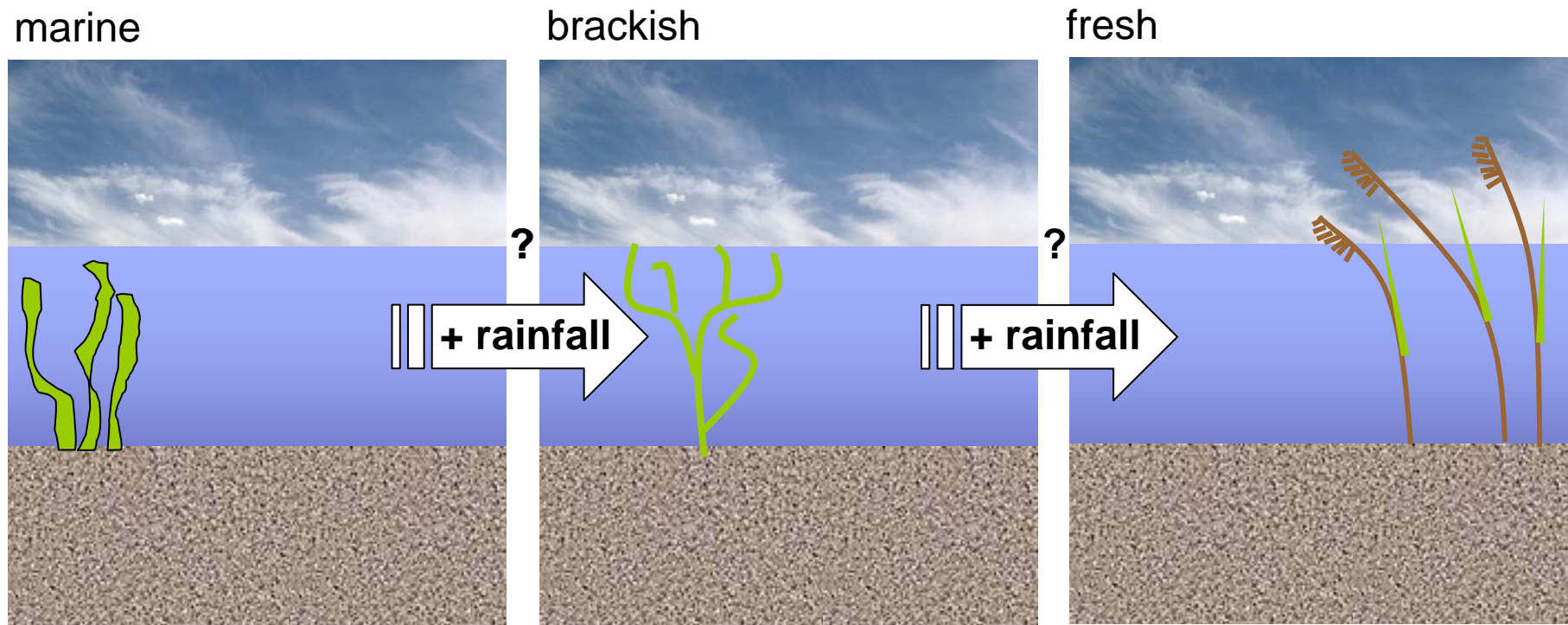


food availability macrozoobenthos
(e.g., deposit-feeding worms vs. filter-feeding bivalves)



fate of energy and matter
(e.g., local retention vs. export to open sea)

impacts on habitats & species – decrease in salinity



impacts on habitats & species – decrease in salinity



shifts from marine to brackish flora
(e.g., from Zostera to Ruppia & Phragmites)

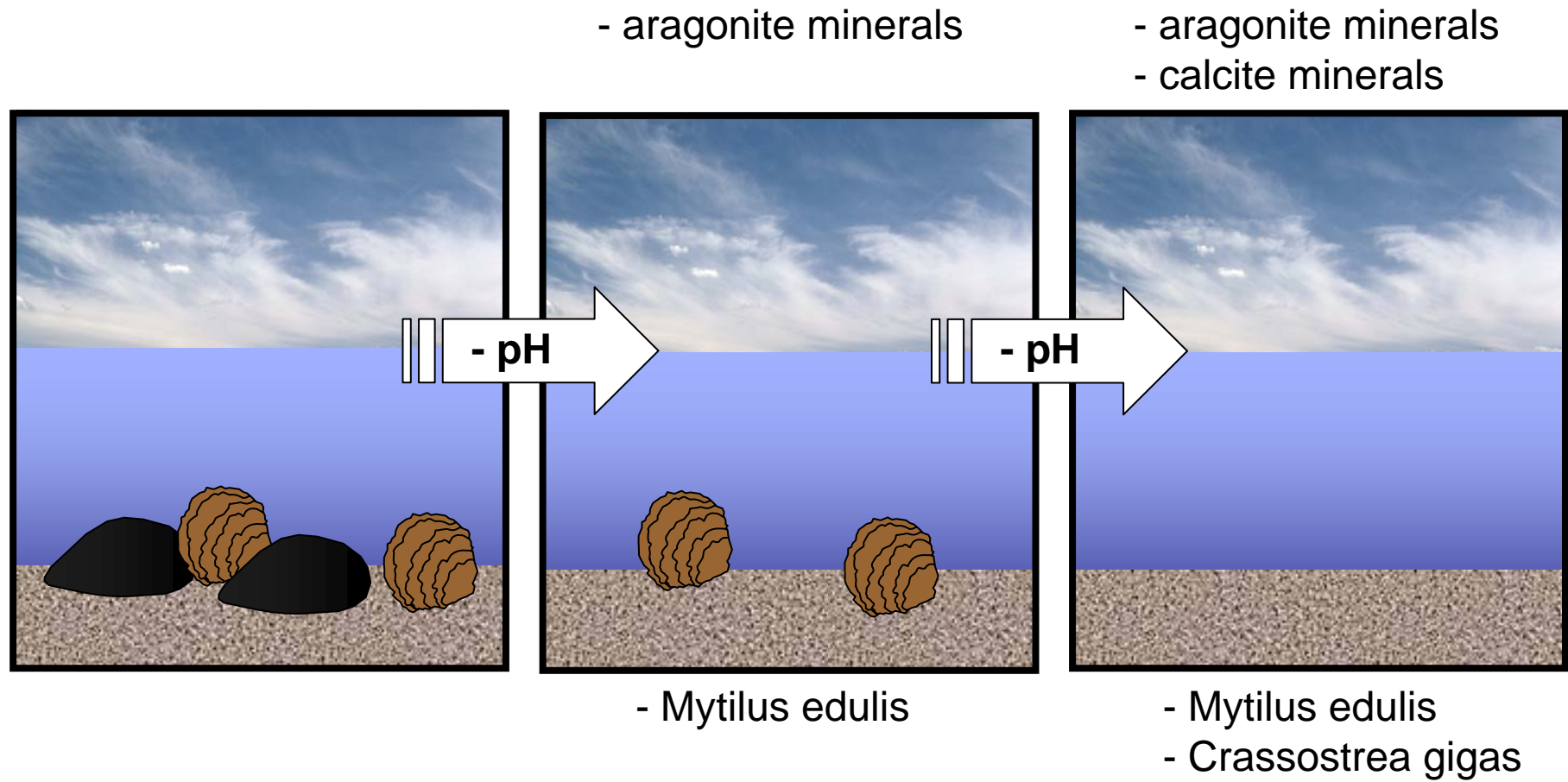


shifts from marine to brackish fauna
(e.g., from Arenicola & Lanice to Nereis)



consequences for (other) species & habitats
(e.g., decline in Lanice results in loss of biodiversity)

impacts on habitats & species – acidification



impacts on habitats & species – acidification



loss of ecosystem engineers
(e.g., shift from sedimentation to erosion)



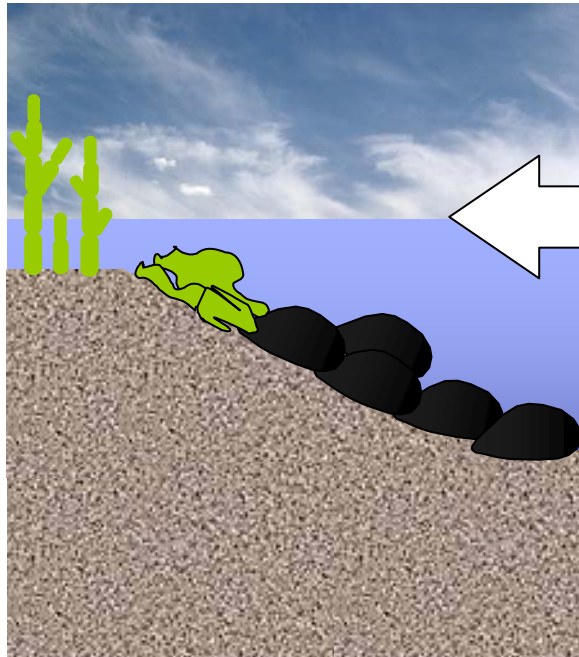
loss of strong filter-feeders
(e.g., less grazing on phytoplankton & larvae)



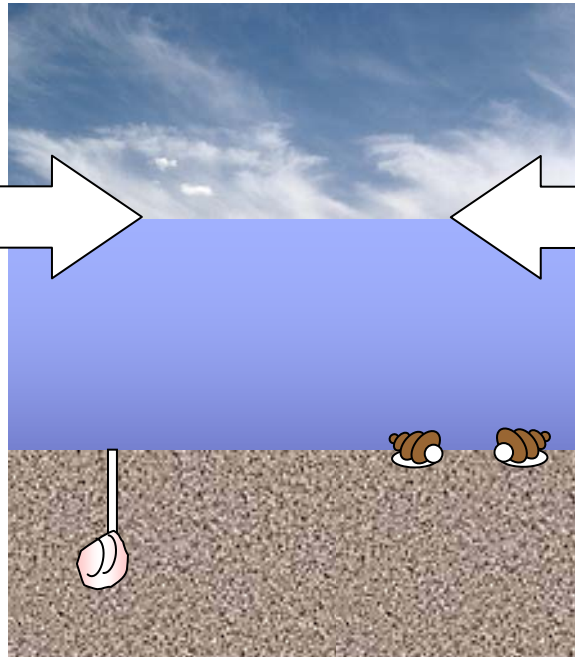
loss of the “third dimension”
(e.g., loss of biodiversity)

impacts on habitats & species – bioturbation

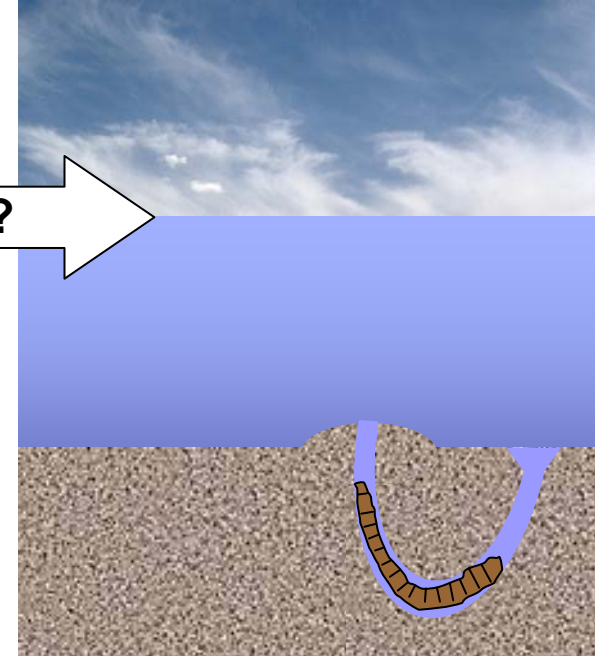
bio-stabilisers



bio-destabilisers



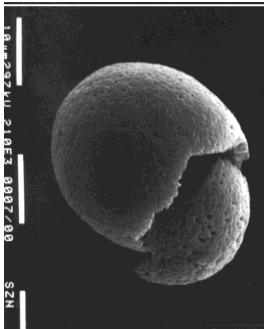
bio-turbators



impacts on habitats & species – bioturbation



bio-irrigation
(e.g., oxygen, nutrients)

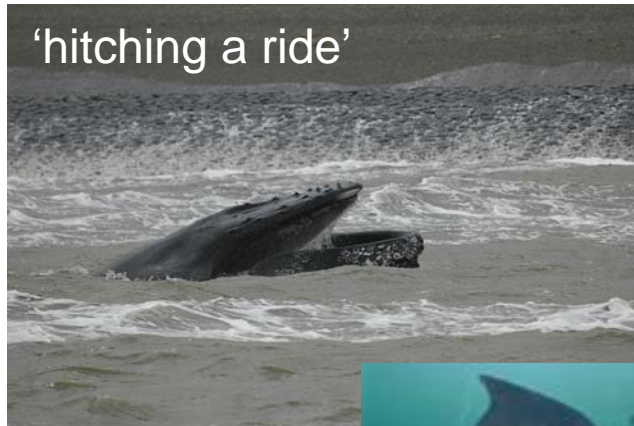


resting stages of planktonic organisms
(e.g., copepods, diatoms & dinoflagellates)



burial of 'solid particles'
(e.g., clay, organic matter, eggs, shells)

impacts on habitats & species – room for new species



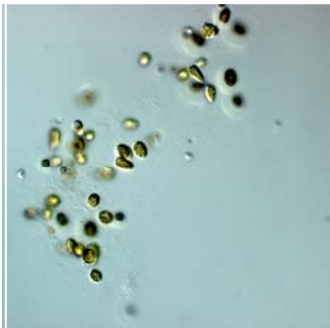
active travel



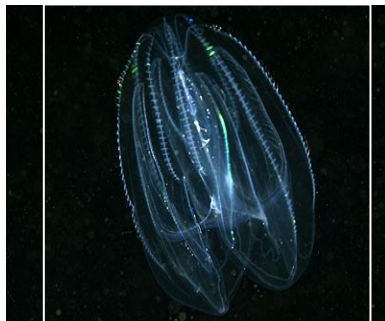
impacts on habitats & species – room for new species



competitive abilities
(e.g., edible mussels vs. inedible oysters)



toxicity
(e.g., bloom of *Verrucophora verruculosa*)



predation pressure
(e.g., occurrence of *Mnemiopsis leidyi*)

impacts on habitats & species – future research



adaptive capabilities vs. rate of change
(e.g., reproduction Pacific oyster)

external forcing vs. internal dynamics
(e.g., height of mussel beds)

impacts on habitats & species – future research



appropriate temporal scale
(e.g., events or long-term means)

appropriate spatial scale
(e.g., m²-scale or tidal basin, source-sink,
inside or outside Wadden Sea)

impacts on habitats & species – trilateral approach



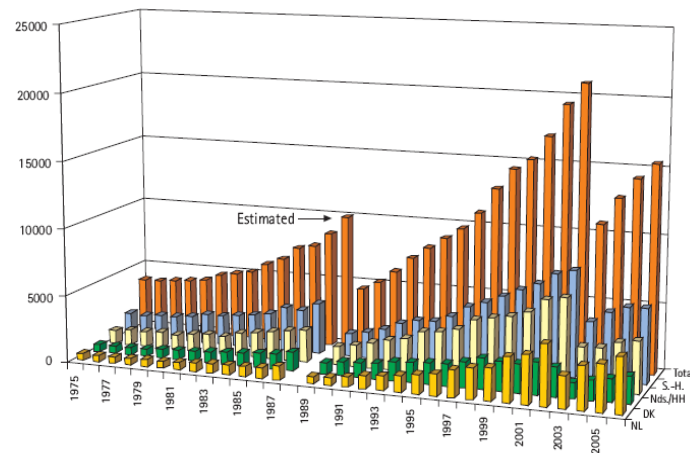
continuation of long-term field observations

- temperature & salinity
- currents & wave heights
- nutrients
- phytoplankton
- macrozoobenthos
- fish, birds & sea mammals

extension of (automatic) field measurements

- model parameters
- missing state variables
(e.g., microphytobenthos & zooplankton)
- appropriate spatial & temporal resolution

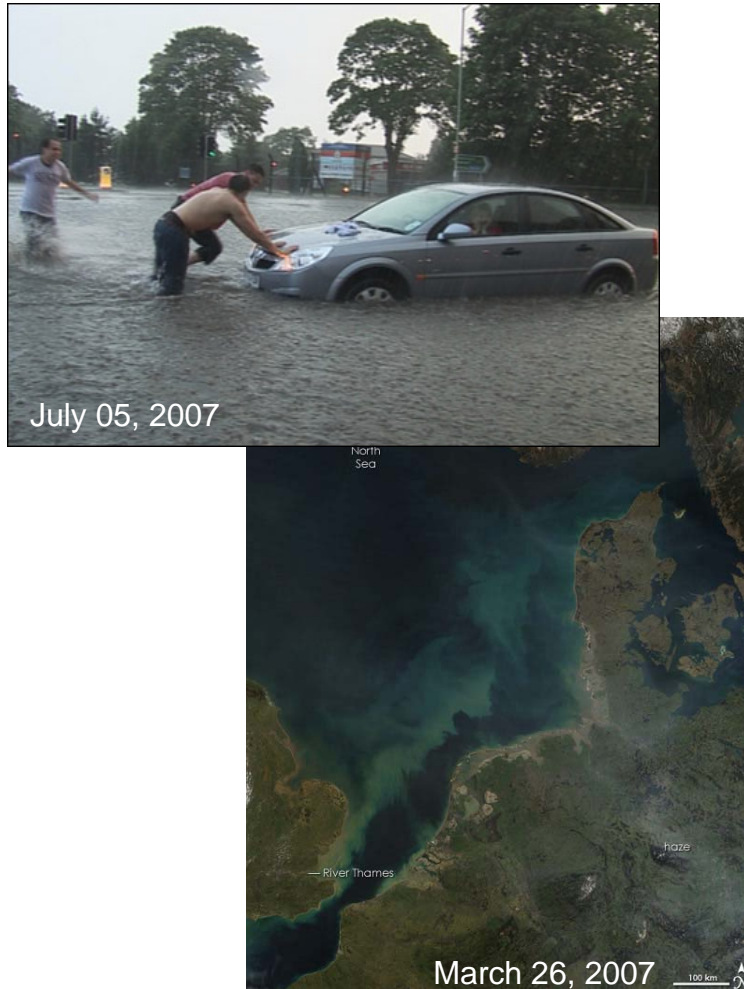
impacts on habitats & species – trilateral approach



- combination & exploration of information
- reports (e.g., Quality Status Reports)
 - long-term field observations (e.g., TMAP)
 - satellite images
 - 'dynamic' habitat maps

impacts on habitats & species – trilateral approach

flooding & plume of the Thames



predictions & scenario's
(e.g., can management make a difference?)

fast feedback of (new) developments
(e.g., prerequisite for adaptive management)

CWSS Workshop – The Wadden Sea Ecosystem & Climate Change

impacts on habitats & species



conclusions

- climate change has a potentially high impact on species & habitats
- present knowledge of Wadden Sea ecosystem is insufficient to predict the future
- management must, therefore, mainly rely on keeping a close watch