

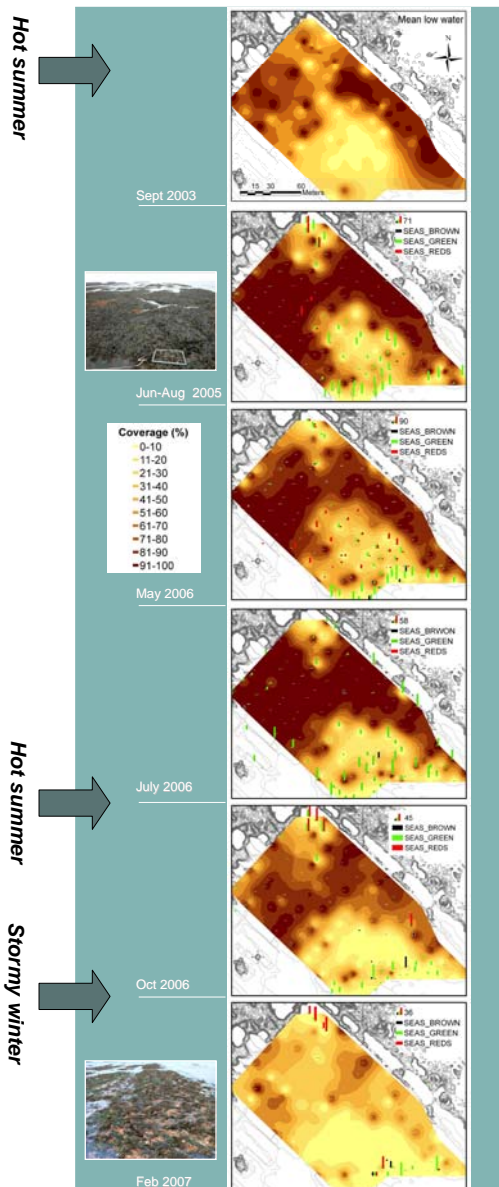
Extreme events and spatio-temporal distribution of seaweed species at Helgoland (North Sea)

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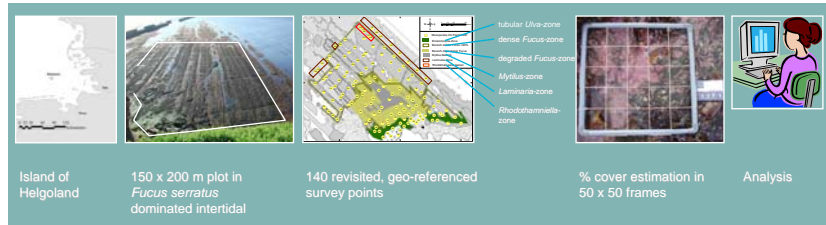
Objectives

- Quantification of spatio-temporal change of
 - species richness S
 - diversity H'
 - perennial vs. ephemeral species
 - introduced vs. indigenous species
- In order to provide quantitative background data for the interpretation
 - of environmental / biodiversity change
 - of species interactions

Change of coverage of *Fucus serratus* and ephemeral opportunistic species (Fig.1)



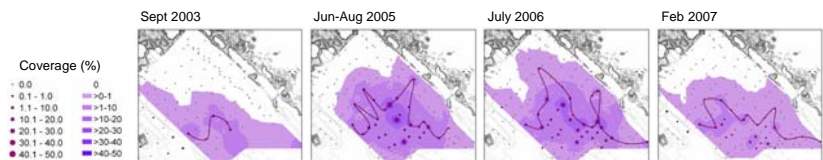
Site and Method



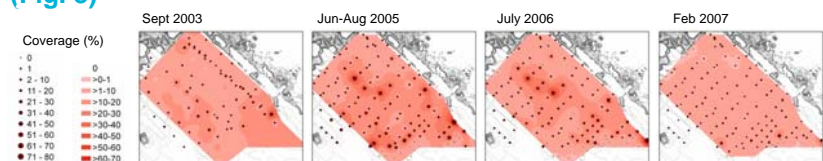
Results

- Significant change ($p = 0.05$) of *Fucus serratus* cover takes place between seasons; summer conditions are similar between years (Fig. 1)
 - Mean cover / frame (summer 2005, May, July 2006): **95 %**
 - Mean cover / frame (Feb 2007): **35 %**
- Loss of *F. serratus* cover in Feb. 2007 (Fig. 1) does not affect diversity H' (Shannon index)
- High abundance of ephemeral species (e.g. tubular *Ulva* sp., *Acrosiphona* sp., *Dumontia contorta*, *Rhizoclonium tortuosum*, *Pilayella littoralis*) only occurs in areas with no or low *Fucus* cover (< 30 %) irrespective of season or year (Fig. 1)
 - Exception: *Ulva lactuca* → may be present in all zones

Migration, increase and seasonal change of abundance of introduced *Mastocarpus stellatus* (Fig. 2)



Stable niche of indigenous species: example *Chondrus crispus* (Fig. 3)



- The red alga *Mastocarpus stellatus* still is in a state of expansion 25 years after its introduction on Helgoland and has not yet stabilized its niche (Fig. 2)
- Indigenous species investigated since 2003 show seasonal change in abundance but no obvious interannual or interseasonal range shifts (Fig. 1 and 3)

Conclusion

- Change in abundance of perennial *Fucus* cover seems to be affected by stormy winters and warm summers, but stability of diversity after disturbance (loss of *Fucus* cover) indicates high resilience of system
- Long-term data are needed to further corroborate these observations
- Monitoring the spatial extent of dense *Fucus* beds may serve as proxy for detection of change and well-being of cold-temperate rocky shores
- Abundance and spread of invasive/introduced species should be quantified on a relevant spatial scale in order to evaluate their impact