The pivotal role of mesograzers in modulating the impact of ocean warming on Fucus

The actors:

1. Structural, prennial macroalgae: *Fucus serratus* and *Fucus vesiculosus*
2. Shading filamentous epiphytes
3. Mesograzers: *Idotea balthica*, *Gammarus* spp.
4. Fishes: stickleback...
5. Bioc students

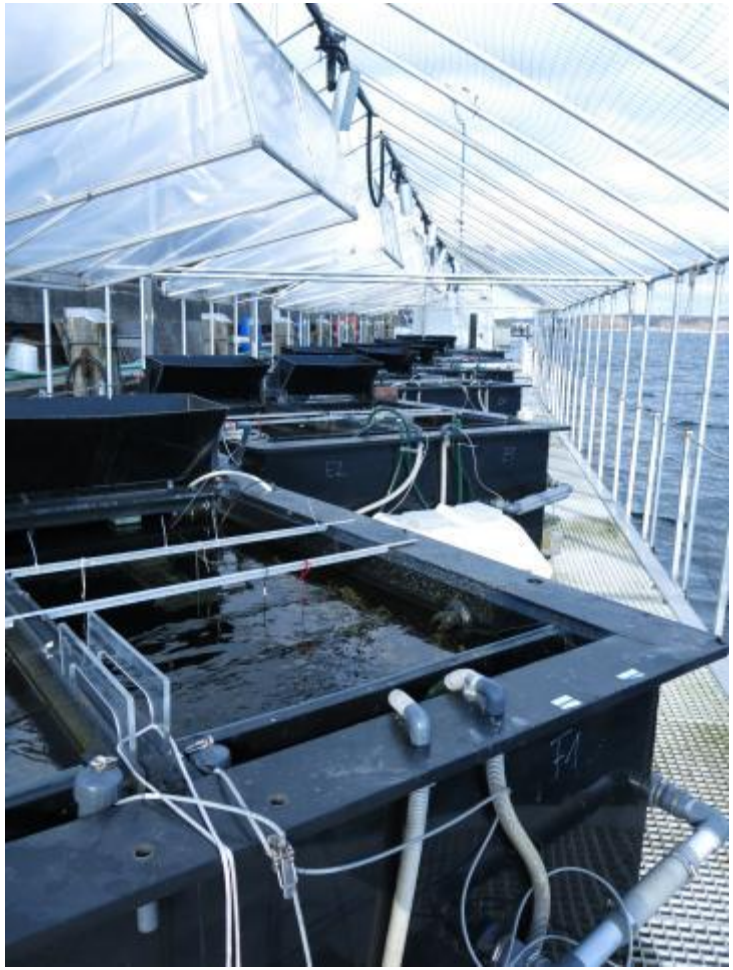
Background:

OW favors filamentous algae which may be controlled by mesograzers.
Mesograzers are favoured by moderate and inhibited by strong OW
Fish reduce the abundance (and size?) of mesograzers
Fucus are negatively impacted by epiphytes (and OW)

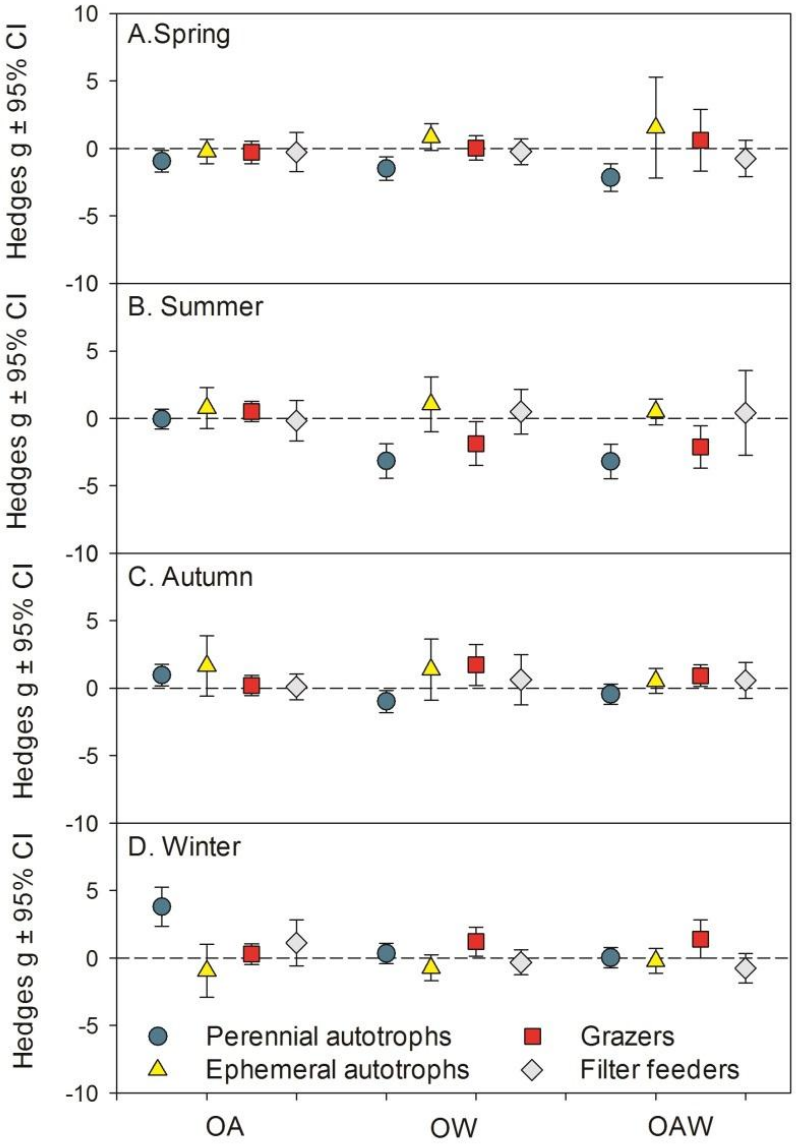
Hypotheses:

Fv and Fs are differently impacted by epiphytes
Fish impair Fucus by suppressing mesograzer control of epiphytes
OW impact on Fucus will be mitigated by mesograzers
OW impact on Fucus enhanced by fish

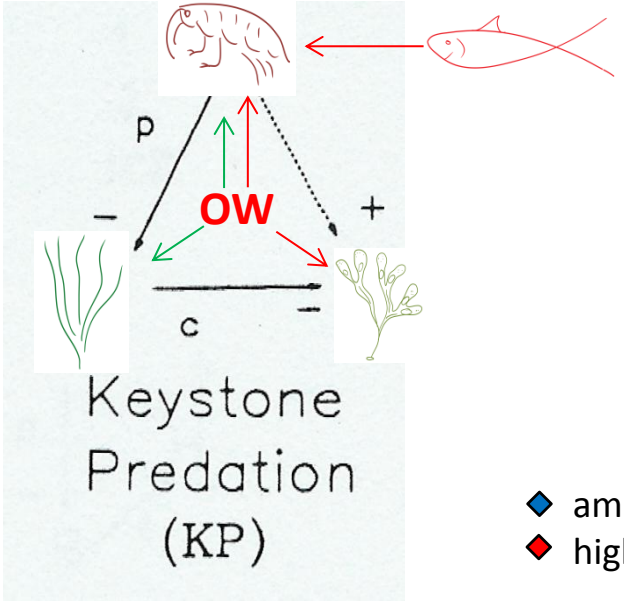
The infrastructure:
Kiel Outdoor Benthocosms



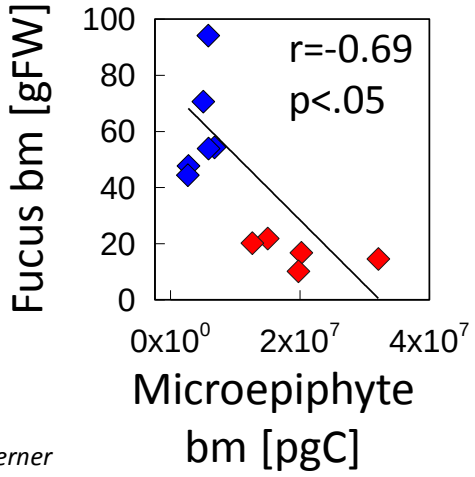
Bioacid II:
Seasonal response patterns

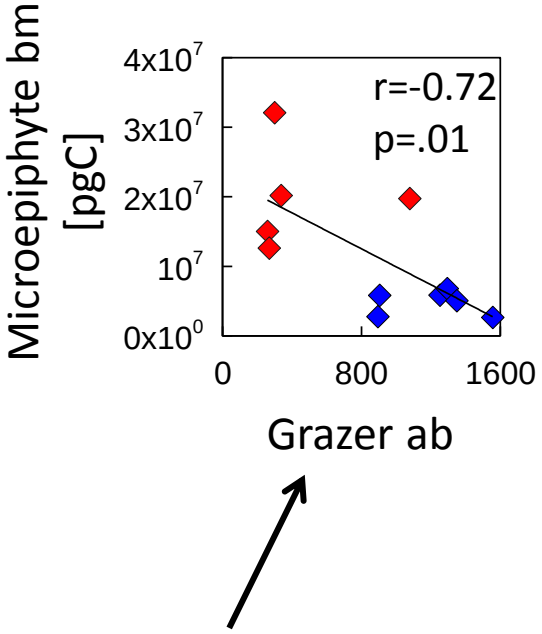


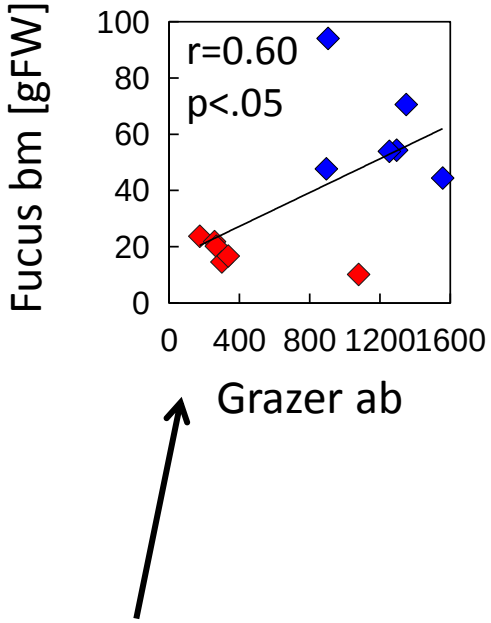
Indirect effects of warming on epiphytes and *F. vesiculosus* were mediated by grazers



ambient temperature
high temperature







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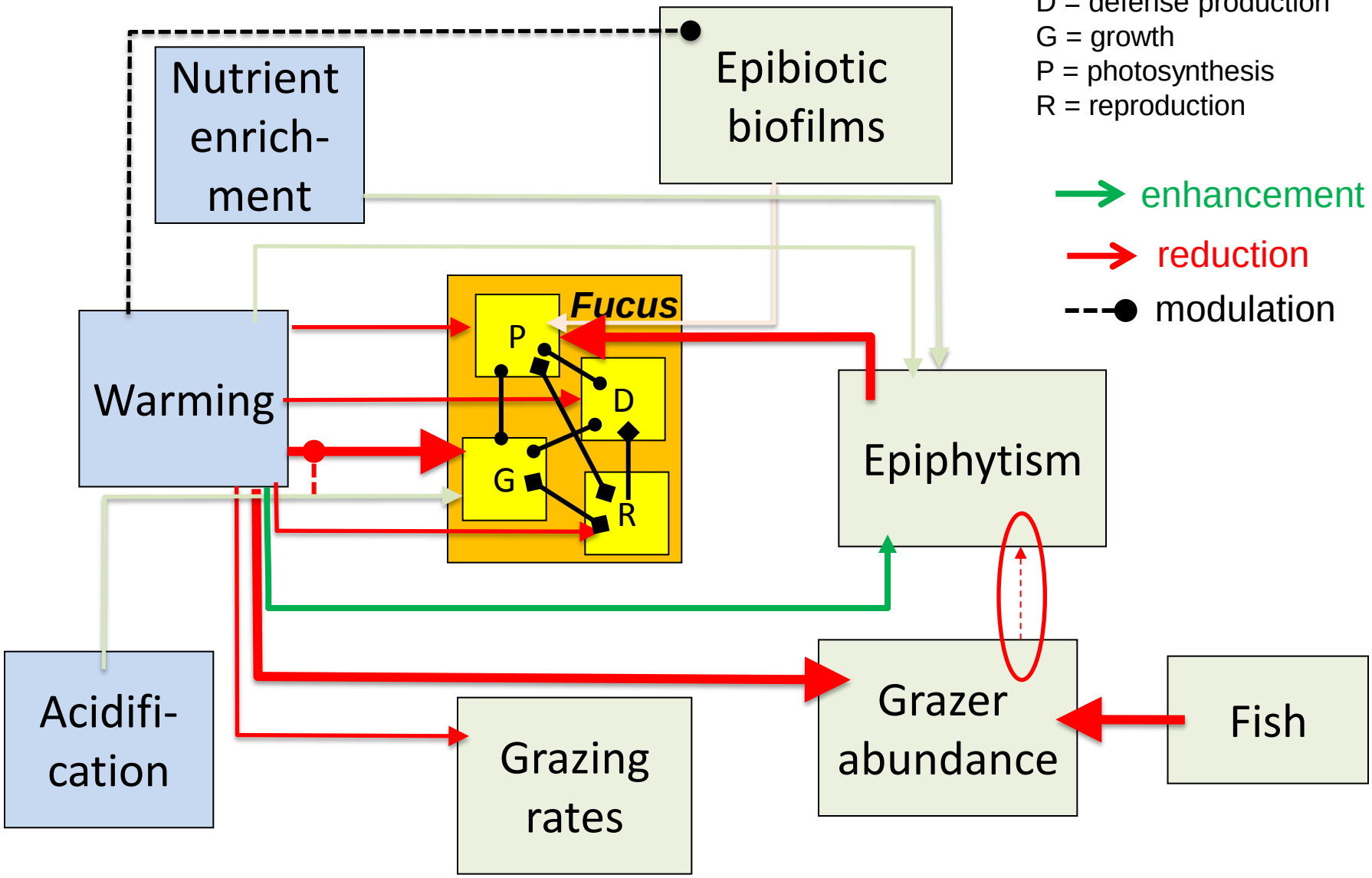
GEOMAR 2015

Controlled by warming, grazers may reduce epiphytes and thereby favour Fucus

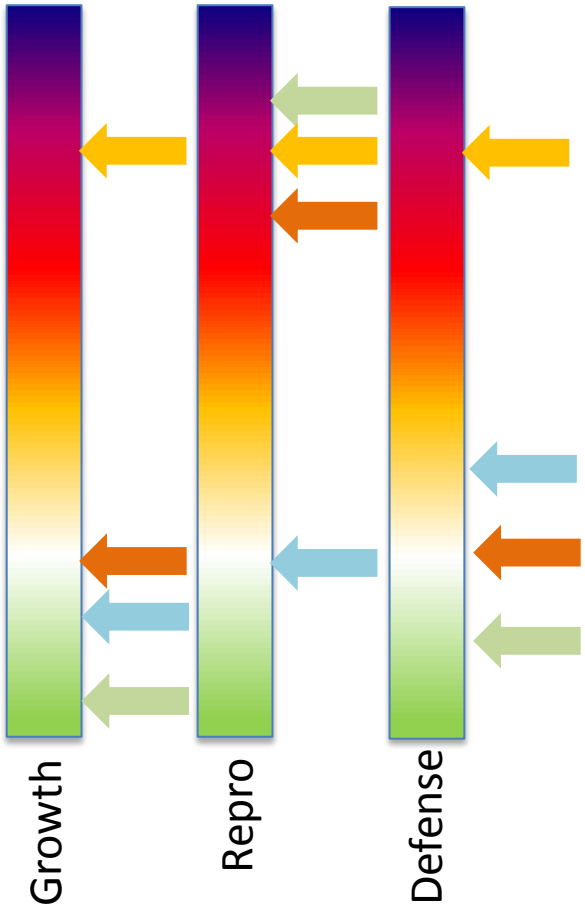
Example: Warming – Grazing – Epibiosis - Fucus

Ecosystem services (structure, C & N binding, O2…)

Summer


Performance items:
D = defense production
G = growth
P = photosynthesis
R = reproduction
enhancement
reduction
modulation
Nutrient enrich-ment
Epibiotic biofilms
Warming
Fucus
P
D
G
R
Epiphytism
Acidifi-cation
Grazing rates
Grazer abundance
Fish

Burning ember for the fate of a Fucus community



Fucus vesiculosus

Spring
Summer
Winter
Autumn

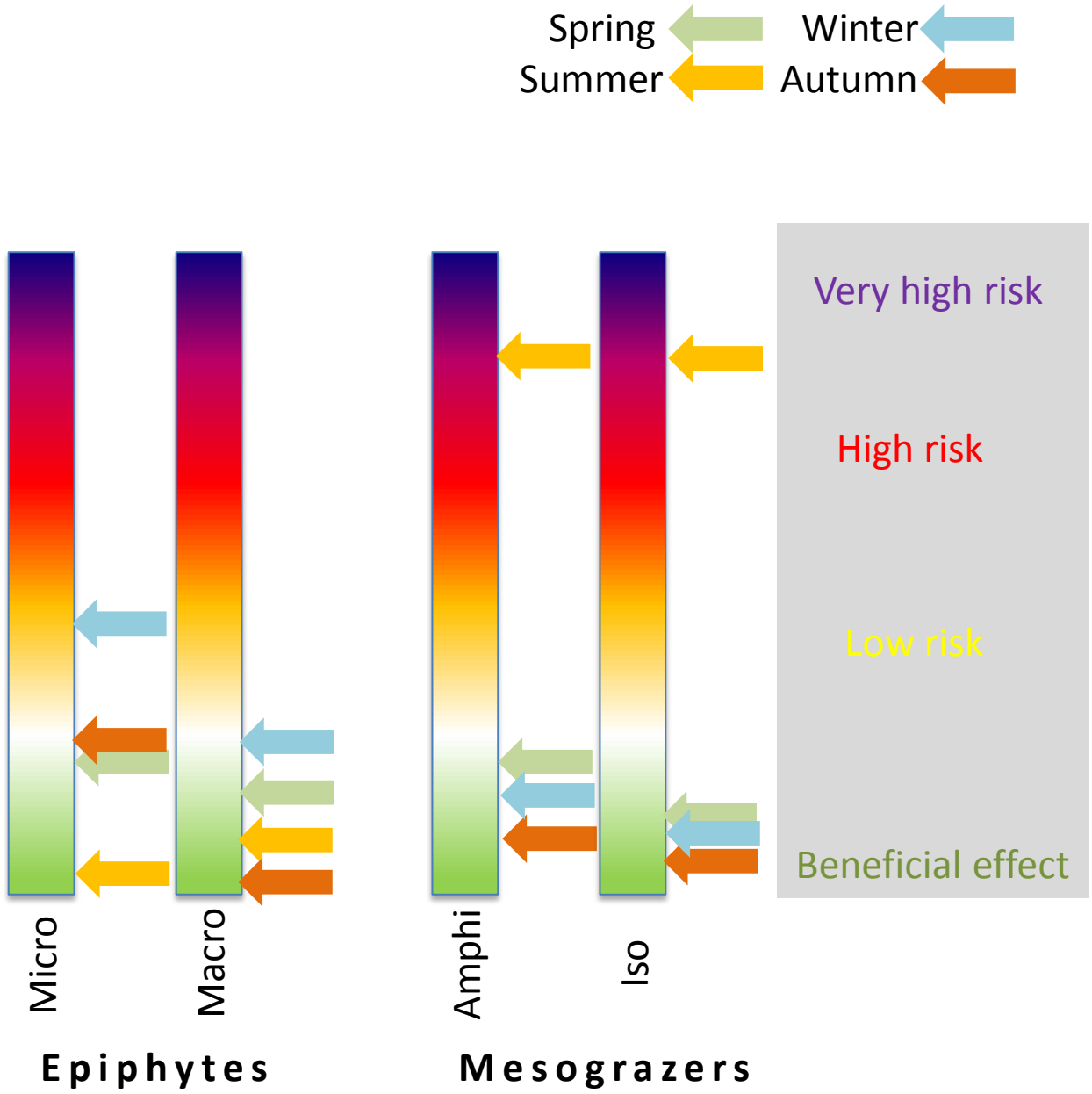
Very high risk

High risk

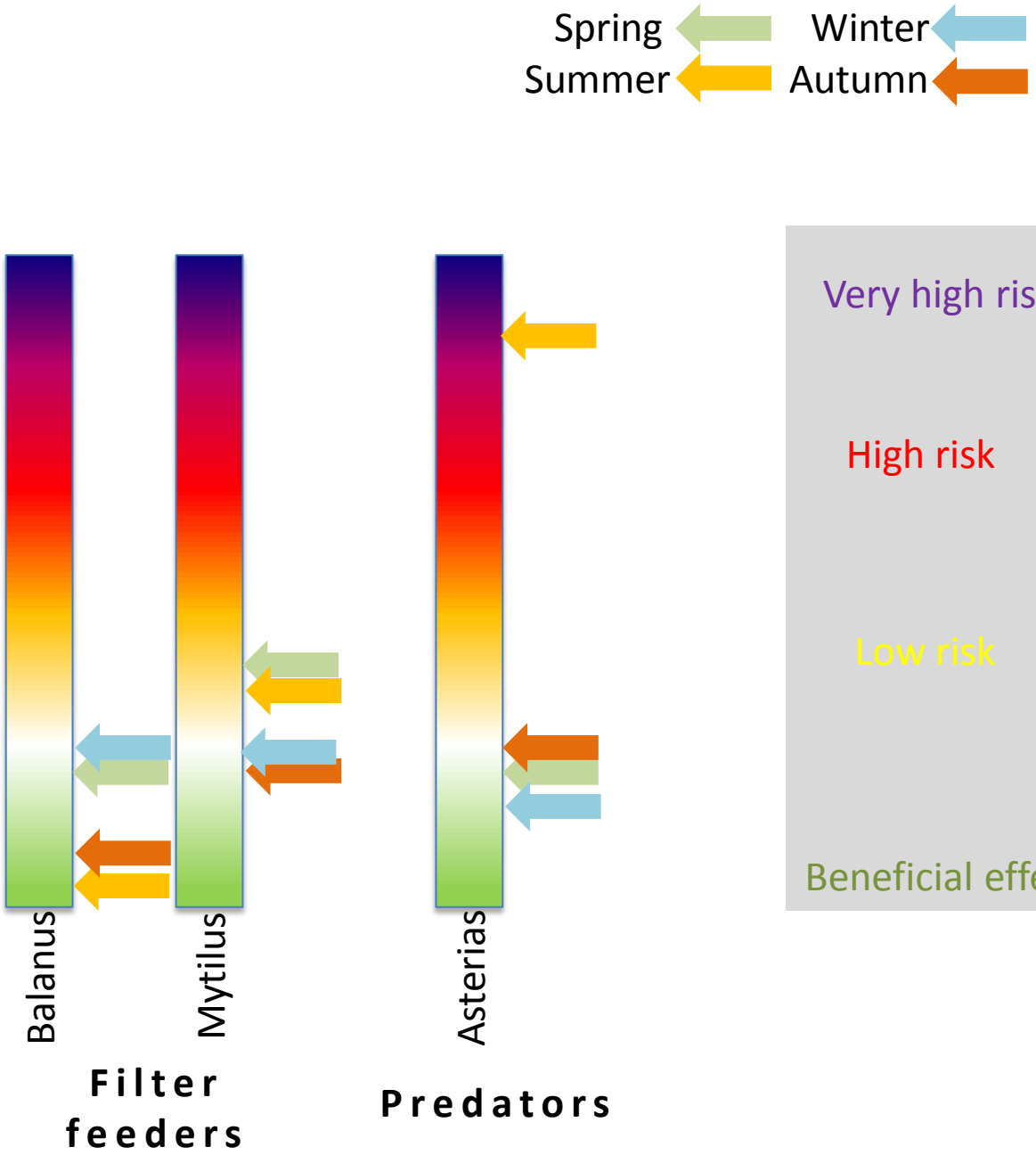
Low risk

Beneficial effect

Burning ember for the fate of a Fucus community

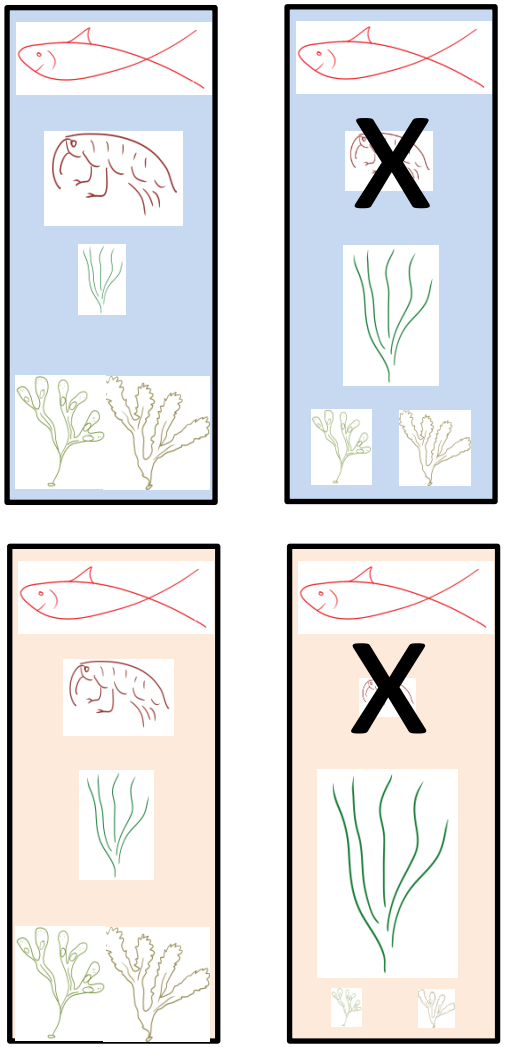


Burning ember for the fate of a Fucus community



Set-up

The beneficial (cleaning) or detrimental (consumption) role of gammarid mesograzers under present and future temperature conditions on two important Fucus species

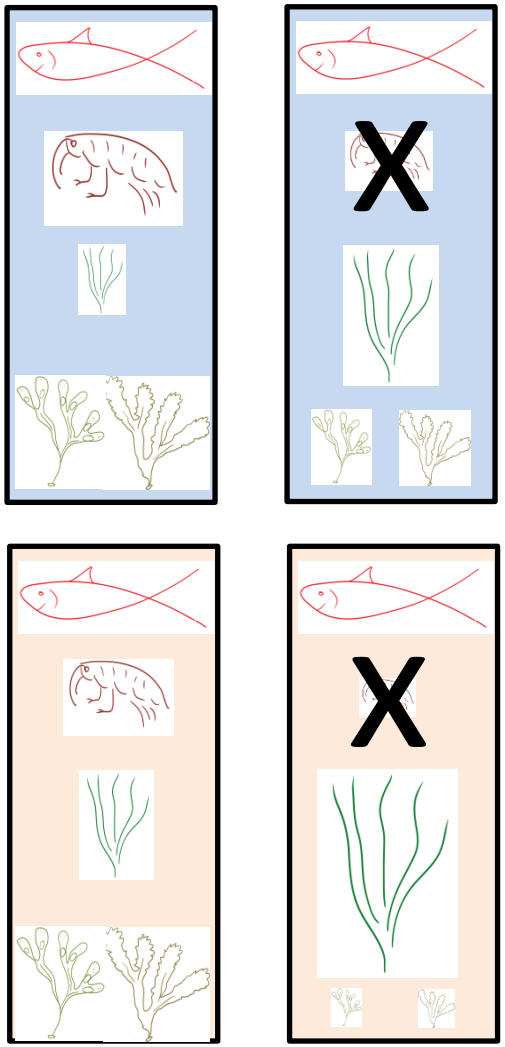


$T_{ambient}$

$T_{\Delta 5°C}$

Set-up in mid-March

	Tasks	Continuous logging of pH, salinity, O2
April	Set-up	Fish (y/n), mesograzers (y/n), F. vesiculosus & serratus
	Fucus assessment	Fucus WW, C/N, epibiosis, performance (O2 prod)
	Ecosystem assessment	24h monitoring (O2, pH, DIC, TA, plankt. CHl a)
May		
	Structural assessment	Fucus WW and length growth, C/N, epibiosis, performance (O2 prod), abundance & size mesograzers
	Functional assessment	24h monitoring (O2, pH, DIC, TA, nutrients, plankt. CHl a), Fucus performance (O2 prod), feeding rates of mesograzers
June		
	Structural assessment	Fucus WW and length growth, C/N, epibiosis, performance (O2 prod), abundance & size mesograzers
	Functional assessment	24h monitoring (O2, pH, DIC, TA, nutrients, plankt. CHl a), Fucus performance (O2 prod), feeding rates of mesograzers ...
July		
	Structural assessment	Fucus WW and length growth, C/N, epibiosis, performance (O2 prod), abundance & size mesograzers
	Functional assessment	24h monitoring (O2, pH, DIC, TA, nutrients, plankt. CHl a), Fucus performance (O2 prod), feeding rates of mesograzers ...
	Trophic structure	stable isotopes of all components



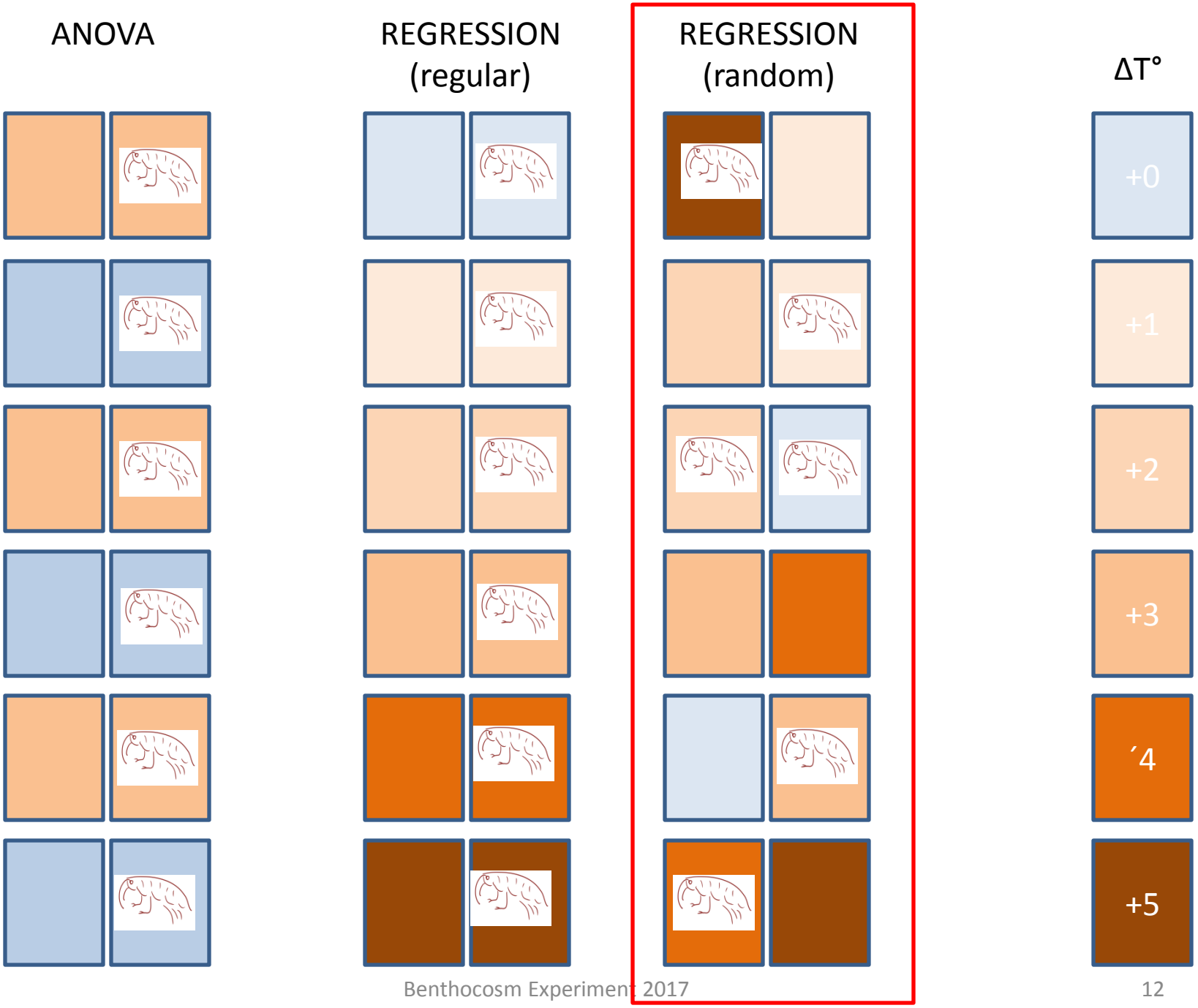
$T_{ambient}$

$T_{\Delta 5°C}$

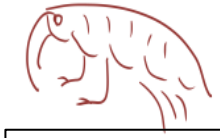
Possible project topics

(to be done alone, in student pairs, or in collaboration with a scientist)

- Effect of OW on population growth of gamarids
- Effect of temperature on consumption rates of gammarids
- Effect of OW on palatability of *Fucus vesiculosus* and *Fucus serratus*
- Do the two Fucus species differ in their responses to OW (reg. photosynthesis, growth, palatability)?
- Effect of OW on filamentous epiphytes on Fucus
- Control of epiphytism by mesograzers und ambient and warmed conditions
- Changes of ecosystem functions in repsonse to OW and/or grazing
- ....


ANOVA
REGRESSION (regular)
REGRESSION (random)
ΔT°
+0
+1
+2
+3
´4
+5

Small swimming crustaceans: amphipods, isopods



The tiny engineers of Global Change

Warming -> Grazer response -> Macroalgal response -> Ecosystem response

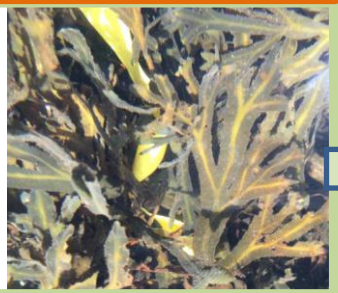
Warming

+5°
+4°
+3°
+2°
+1°
today

No grazing -> explosion of epiphytes
Fucus

Intense grazing -> *Fucus*

Moderate grazing -> epiphytes
Fucus



X

X

All year round *Fucus* contributes to a healthy environment

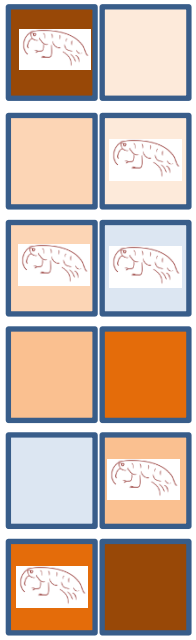
provides shelter for juvenile fish habitat for numerous species

supplies oxygen binds CO2

mitigates ocean acidification

What you see: tanks with and without grazers and with warming between 0 and 5°C (from light to dark shades)

N (left)



S (right)

Expectation: with increasing warming the ecologically important macroalga *Fucus* will first suffer from excessive grazing, then from excessive overgrowth and may finally disappear

Responsible: Prof. Dr. Martin Wahl (GEOMAR), more infos: