Supplementary Information

Supplementary Text

1. Parameter assessment in the tanks

Temperature (platinum resistance thermometer PT1000, from GHL Advanced Technology, Kaiserslautern, Germany), pH (gel-electrolyte filled glass electrode, from GHL Advanced Technology, Kaiserslautern, Germany) and oxygen (dissolved oxygen optodes by LDO Hach-Lange, 4H Jena engineering GmbH, Jena, Germany) levels in the tanks and in the deep and shallow fjord waters were assessed and logged continuously. To control and correct for possible shifts of the logging sensors in the tanks, we also manually measured daily (3 h after sunrise) temperature, salinity (WTW Cond 3110 1 TetraCon 325, Wissenschaftlich Technische Werkstätten, Weilheim, Germany), oxygen (Multi WTW Oxi 3515 1FDO 925), salinity (WTW Cond 3110 1 TetraCon 325, Wissenschaftlich Technische Werkstätten, Weilheim, Germany) and pH (Mettler Toledo GmbH, Giessen, Germany) in every tank and in the inflow. In addition, in situ pCO_2, pH, temperature, salinity and O_2 were continuously logged at 1m depth beside the KOB (Hydro C CO_2, Contros, Kiel, Germany) combined to a SeapHOx unit (pH-O_2-salinity sensor package, Scripps Institution, San Diego).

Water samples for nutrient analyses (Si, NH_4, NO_2, NO_x) were taken on a weekly basis from all tanks and the inflowing fjord water by filtering 20 mL seawater through a cellulose acetate filter (Whatman) into a scintillation vial and freezing them at -20 °C until analysis in a five-channel autoanalyzer (SAN Plus by SKALAR.

2. Monitored depth profiles

As a basis for our working hypotheses, we used year-round depth profiling of the water column in the Kiel Fjord, Western Baltic Sea, done by bi-weekly cruises using a multi-sensor unit (CTD60 S/N 38, Sea & Sun, Trappenkamp, Germany). This monitoring has run continuously since 2011. The produced dataset was used to extract monthly averages of temperature, salinity, pH and oxygen at 1 m and 14 m depths (i.e. the depths from which "surface" and "upwelled" waters were pumped into the experimental tanks, see further details below) to model multi-year differences in abiotic parameters between deep and shallow water bodies in the fjord (Box 1, Fig. 1; *PANGAEA DOI to be added at a later stage*).

3. Seasonality of abiotic conditions in the surface waters in 2018

In summer (July – August) 2018, a double thermocline was found at 5–6 m and 8–10 m depth (Fig. S1a) permitting divergent evolution of environmental conditions in shallow and deepwater bodies (Fig. S1b), which became apparent during the simulated upwelling events (see below).

Between June and September 2018, surface water (1 m depth) conditions, measured in a KOB tank which received water directly from the fjord without warming or upwelling, showed variability at different temporal scales driven by changes in various physicochemical variables (Fig. S2). Temperature (Fig. S2a) increased seasonally, from 15 °C in May to 24 °C in July and dropped again to 17 °C in early September. At the scale of weeks, temperature sporadically rose or fell by 3–4 °C presumably due to water body exchange (e.g. lateral in- and outflow of the fjord water, and down- or upwelling). At the daily scale, surface water temperature fluctuated by 1–2 °C due to the variable intensity of solar radiation. Oxygen (Fig. S2b) saturation varied strongly on a daily basis (by 20 to 40%) reflecting photosynthesis-respiration cycles of the macroalga-dominated community. At a seasonal scale, daily average saturation

46   of oxygen declined from about 95% in June and July to below 80% in September. Salinity (Fig.

47   S2c) increased over the months (seasonally) from around 13 in May to about 17 in down- or

48   upwelling events. pH (Fig. S2d) showed a similar pattern as oxygen due to the same drivers.

49   Between June and September, pH levels declined from above 8.1 to almost 7.8 on average.

50   Biogenic day-night fluctuations typically span a range of 0.5 pH units.

51   It should be noted, that among these natural fluctuations, the simultaneous and conspicuous

52   decrease of temperature, oxygen and pH and the increase of salinity in the fjord surface waters

53   during late August indicated the occurrence of a natural upwelling event which coincided

54   partially with the simulated UPW3 event in our experiment.

55

56   ## 4. Macroalgae performance assessment

57   For this, algal samples were enclosed in gas tight, translucent Plexiglas cylinders of 6 L

58   volume and equipped with a magnetic stirrer and PSt3 oxygen spots (PreSens GmbH,

59   Regensburg, Germany) allowing non-invasive O_2 measurements. The incubation lasted for

60   about one hour under natural sunlight around midday to measure net primary production

61   (NPP) and in the dark conditions to measure respiration (R), by wrapping the chambers in

62   black plastic bags (details in Wahl et al., 2020). Gross primary production (GPP) was

63   calculated as NPP+R. Growth (standardized by number of days) was calculated by

64   subtracting the initial wet weight (assessed before incubation) from the final wet weight

65   (assessed after the incubation) for each algal species in a given compartment.

66   ## 5. Assessment of macroalgae – grazer interactions

67   For this, we used 5 L buckets divided into two compartments by a vertical net (1 mm mesh

68   size). Buckets were covered with a lid. Each half bucket had a 10 x 20 cm opening on the outer

69   bucket wall covered by a net (1 mm mesh) to restrict the access of grazers from the tank while

70   allowing water exchange, aeration, and full exposure to the treatment conditions during three

71 successive assays: two days before, during and two days after UPW3. The two compartments

72 of a given bucket received 40 g wet weight (WW) of algae either composed of only one species

73 or of both algal species (20 g of each). One of the two compartments of each bucket received

74 six individuals of the mesograzer *I. balthica*. Mesograzers used had lived under the various

75 experimental conditions since the start of the experiment (or since naturally recruiting to the

76 respective tank). The central mesh separation allowed full water exchange between the

77 compartments but prevented the movement of grazers between them. This set-up represented

78 a crossed arrangement of two treatments: potential differences between intra- versus

79 interspecific competition interacting with presence versus absence of grazers nested in a 6 x 2

80 combination of warming and upwelling. Three buckets with a total of six compartments (one

81 per alga-grazer combination) were immersed inside each tank.

6. Quantification of microfouling

83 In the laboratory, biofilms were scraped from each slide using a sterile microscope cover slip

84 (Thermo Fisher Scientific, UK). Scraped biofilms were dried at 60 °C for 5 days. About 3 mg

85 (dry weight) of each biofilm was individually mixed with 10 µL of autoclaved filtered (0.2

86 µm) seawater and the suspension was vortexed for 5 s. Two µL from each biofilm suspension

87 were used to count diatoms and bacteria. Diatoms were counted in 15 randomly selected

88 fields of view using a microscope (Nikon Eclipse, USA) at 400x magnification. Then, the

89 average number of diatom cells per mm^2 was calculated. Before counting, bacteria were

90 stained with the DNA-binding fluorochrome DAPI (4,6-diamidino-2-phenylindole, Fluka,

91 Switzerland) according to Dobretsov & Thomason (2011). Stained bacteria were counted in

92 15 randomly selected fields of view using an epifluorescent microscope (Axiophot, Zeiss,

93 Germany; magnification 1000x). The average number of bacteria cells per mm^2 was

94 calculated. Because the water flowing through the containers with slides exposed to a given

4

95   treatment combination stemmed from a single large tank, the slides are considered pseudo-

96   replicates and their mean was used as a single data point. We refrained from statistically

97   analyzing apparent differences in microfouling.

7. Statistical analysis details

99   We restricted the number of basis functions (k) of each smooth term included in the GAMs to

100   three to avoid overfitting. In all cases we used Maximum Likelihood (ML) for fitting the

101   models (Wood, 2017). For count data, the *quasipoisson* distribution and a *natural logarithm*

102   link function were used to fit the GAMs, since initially fitted *poisson* models showed clear

103   signs of over-dispersion (Ver Hoef & Boveng, 2007). Upwelling was included as an ordered

104   factor to structure the model output in the form of ANOVA table, enabling the direct

105   comparison of the reference level "without upwelling" with the "with upwelling" one, and of

106   the performance trends in response to warming obtained for each of these levels (Wood 2017).

107   The mGLMs fit single Generalized Linear Models (univariate GLMs) for every species

108   included in the matrix of response variables and uses the sum of the calculated univariate

109   statistics (i.e., the likelihood ratio test statistics of the fitted GLMs) to generate a statistic at the

110   community level for each of the evaluated explanatory variables. The significance of this

111   multivariate statistic is evaluated through a resampling procedure (Warton 2011; Warton et al.

112   2012). In the present study, mGLMs were fitted using a *negative binomial* distribution and the

113   *natural logarithm* link function. A full model including warming (continuous), occurrence of

114   upwelling and sampling event (factors) as explanatory variables, and two- and three-way

115   interaction terms, were fitted initially. In addition, models derived from all the potential

116   combinations of main and interaction terms were generated. Always, when an interaction term

117   was included in a model, the respective main terms were also included. The generated models,

118   including the full and null (i.e., model without explanatory variables) models, were compared

119   using the sum of Akaike's Information Criteria (AICsum) and the delta AICsum (ΔAICsum,

i.e., difference between the AICsum of a particular model and the most parsimonious one). The AICsum of a mGLM derives from the summation of AIC values over all fitted univariate GLM (Wang et al. 2020). Models with a ΔAICsum < 10 were considered to have the same empirical support (sensu Burnham and Anderson 2002). Among models with the same empirical support, that with the lowest number of terms was selected as the best one. Once the best model was identified, uni- and multivariate statistics and p-values were obtained through the function *anova.manyglm*. The output of not-considered models with a ΔAICsum < 10 was produced and inspected in detail to ensure that no main or interaction effects with significant contributions to the observed difference were excluded. The p-values were calculated using the PIT-trap resampling method (Warton et al. 2017) and 1000 iterations. Species with likelihood ratios with a relative contribution over 10% to the multivariate statistic were considered relevant in explaining the observed effects.

Since the performance of long-lived organisms (e.g. *Fucus*, *Littorina*) or the population dynamics of short-lived species (e.g. *Gammarus* sp.) was impacted successively by all upwelling events and the intermittent non-upwelling phases we used the effect ranks attributed in the various phases to extrapolate a long-term effect. We hypothesized that if stress-release phases (e.g. upwelling during mid-summer, or non-upwelling phases between hypoxic upwelling) were long enough to permit recovery the arithmetic mean of impacts could represent the overall impact. If, however, there were carry-over effects, the sum of ranked effects might be a more realistic metric.

8. Ambient conditions during the experiment

During this mesocosm experiment, seasonally ("climatology") or sporadically ("ocean weather" *sensu* (Bates et al. 2018) one or multiple environmental factors deviated from the comfort zone of single or several components of the studied macroalgal community. The level

145 of physiological stress this deviation imposed on organisms presumably depended on their

146 specific sensitivity to a given driver, as well as the amplitude and duration of this deviation.

147 The following expectations are based on the putative stress levels suggested in Fig. S2 and two

148 relevant meta-analyses (Kroeker et al. 2013; Nagelkerken and Connell 2015) and the cited

149 studies:(i) thermal sensitivity typically decreases from macroalgae through grazers to foulers,

150 (ii) sensitivity to hypoxia is generally expected to be higher in heterotrophs than autotrophs

151 (Perry et al. 2015), (iii) sensitivity to acidification, associated with hypoxic upwelling, is

152 supposed to decline from calcifiers over soft-bodied invertebrates to non-calcifying algae (e.g.

153 Harvey et al. 2013) and (iv) sensitivity to low salinities is species-specific. Thus, summer

154 temperatures measured in this study reached moderately stressful levels (>20°C) for the

155 foundation species *F. vesiculosus* and the two other macroalgal species in mid July and mid-

156 August and severely stressful levels (>22°C) transiently in late July and early August (Fig. S2).

157 Grazers experience thermal stress at slightly higher temperatures (>23°C) than their macroalgal

158 prey and, consequently, for shorter periods in summer (i.e. end July-early August). Foulers

159 generally are more robust to ambient summer temperatures and might even benefit from

160 reduced control by thermally suppressed grazing and algal defenses during the hottest part of

161 summer (Wahl et al. 2020). Ambient oxygen saturation in surface waters became moderately

162 stressful (< 80%) to most organisms towards the end of August/beginning of September based

163 on the 24 h averages (Fig. S2), with alternations between higher biogenic hypoxia stress (<

164 60%) during the night (when respiration dominated) and recovery phases during the day when

165 photosynthesis raised oxygen concentrations (>100%). Driven by the same biotic processes,

166 pH decreased to below 8 in the end of August, with drops below 7.7 during night-time. For

167 most calcifying organism a pH below 7.9 is considered stressful (Brierley and Kingsford 2009).

168 Salinity increased over the experimental period from 12 to 19 and, thus, became more and more

169 conducive for most organisms (of marine origin) in this community.

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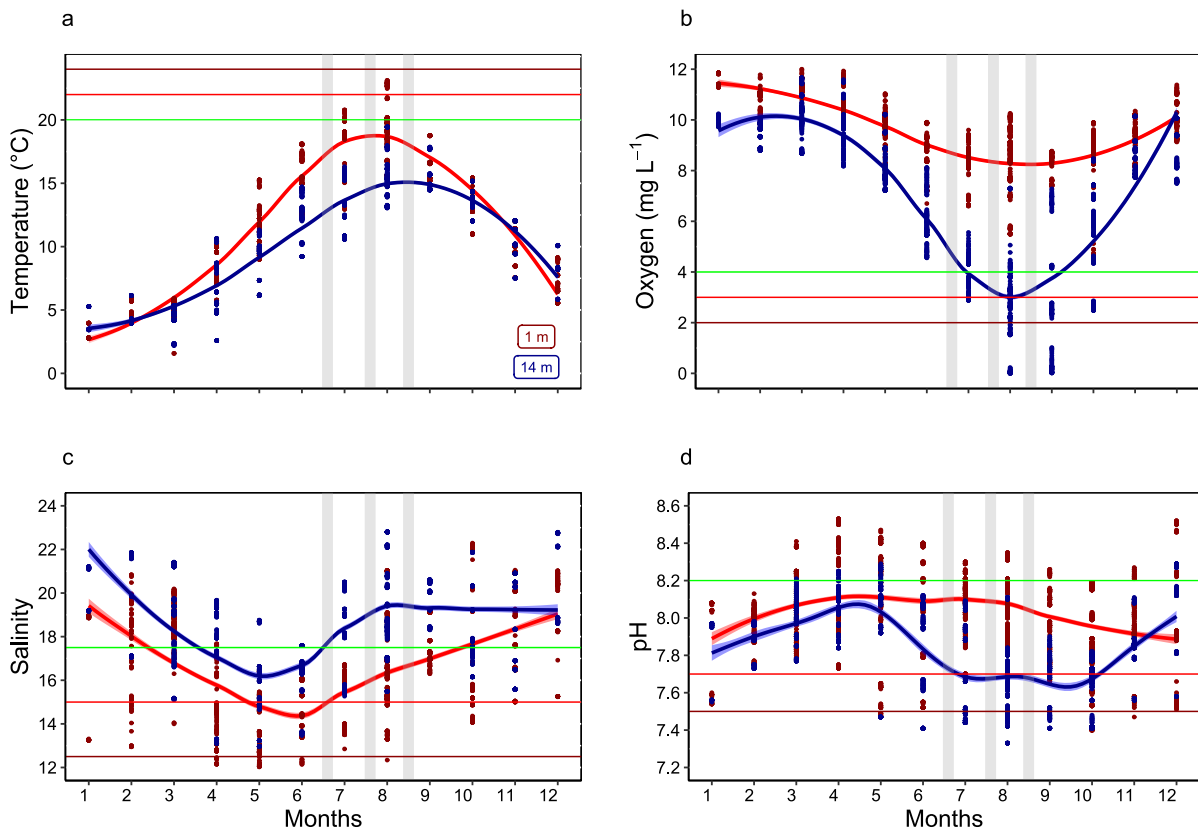
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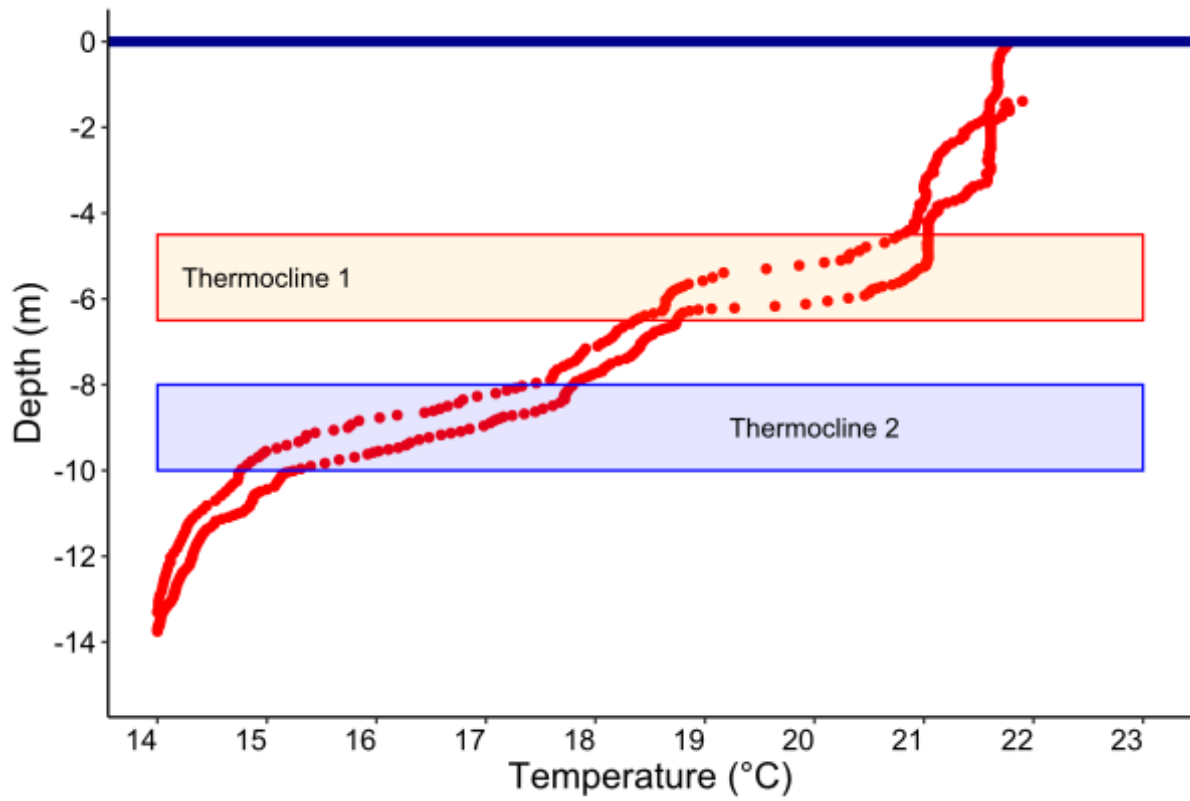
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Supplementary figures

Fig. S1: Seasonal dynamics of temperature (a), oxygen (b), salinity (c) and pH (d) at 1 m
(red) and 14 m (blue) water depth in inner Kiel Fjord as assessed between 2009 and 2020.
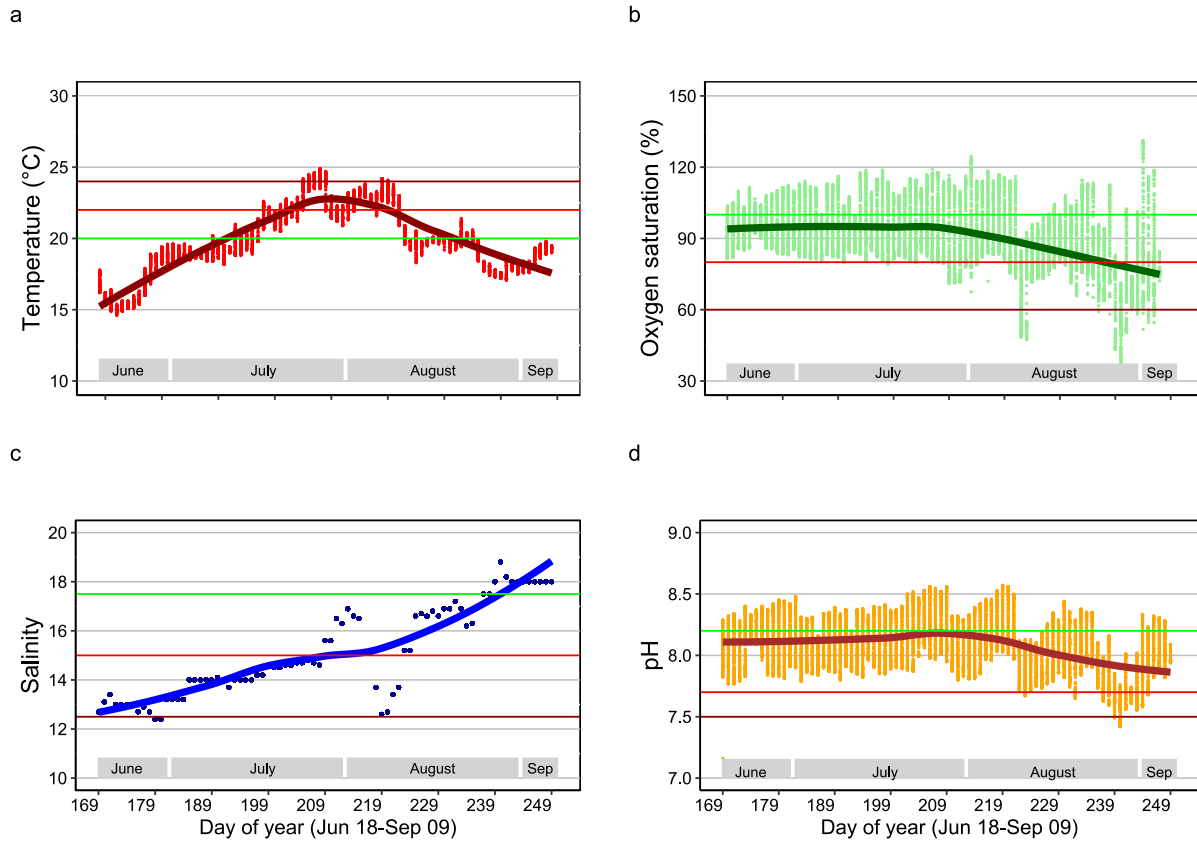The periods of imposed upwelling are indicated by grey bars.

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Fig. S2: Example for the separation of shallow and deep water by 2 thermoclines in August

2018.

Fig. S3: Ambient conditions with regard to temperature (a), oxygen (b), salinity (c) and pH (d) during the experiment as measured in tank E2 which received water directly from the fjord without warming or upwelling. Colored horizontal lines indicate the optimal conditions (green), and the onset of moderate (red) or severe (dark red) stress for most species in the system (Wahl et al. 2020).

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fig s4

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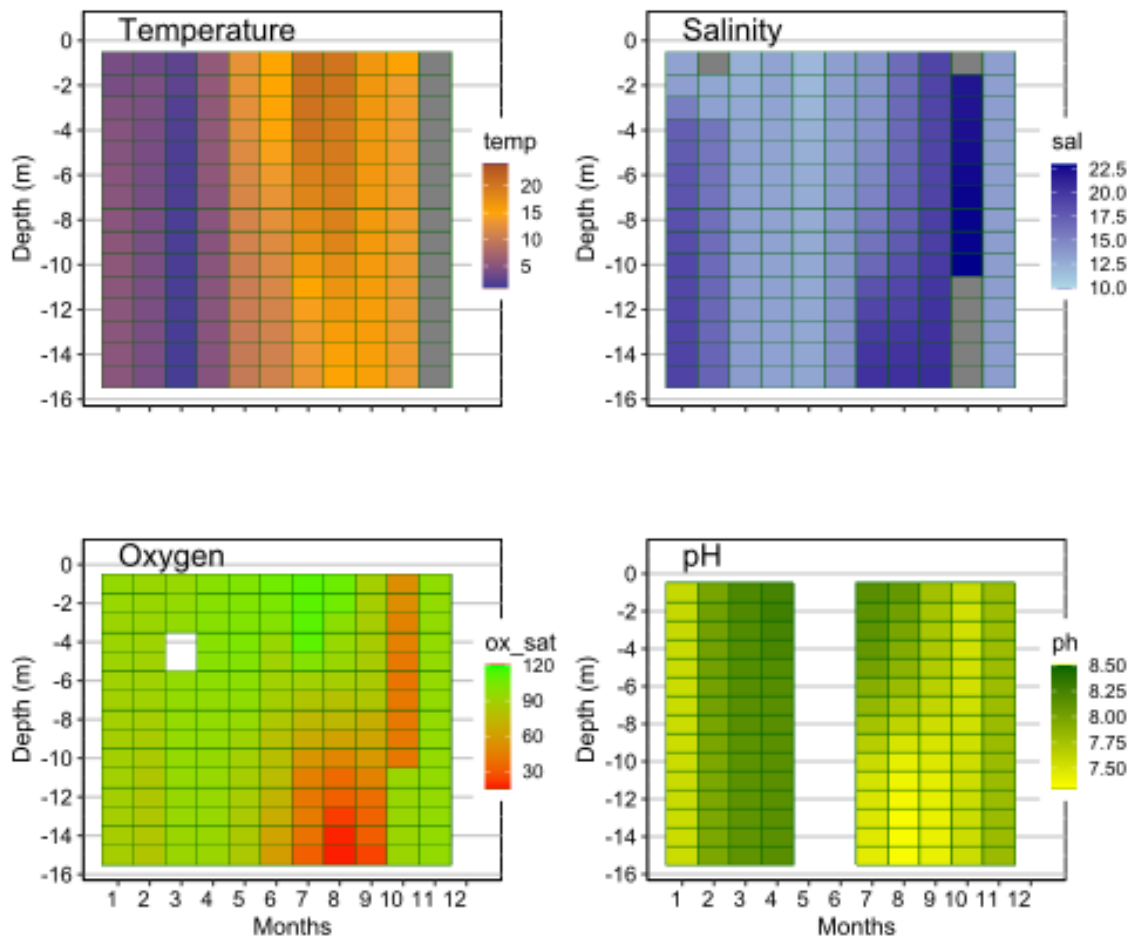
Fig. S4: Patterns of abiotic parameters temperature (upper left), salinity (upper right), oxygen

saturation (lower left) and pH (lower right) throughout the year 2018 in different water depths

of the inner Kiel fjord. White or grey cells stand for sensor failure..

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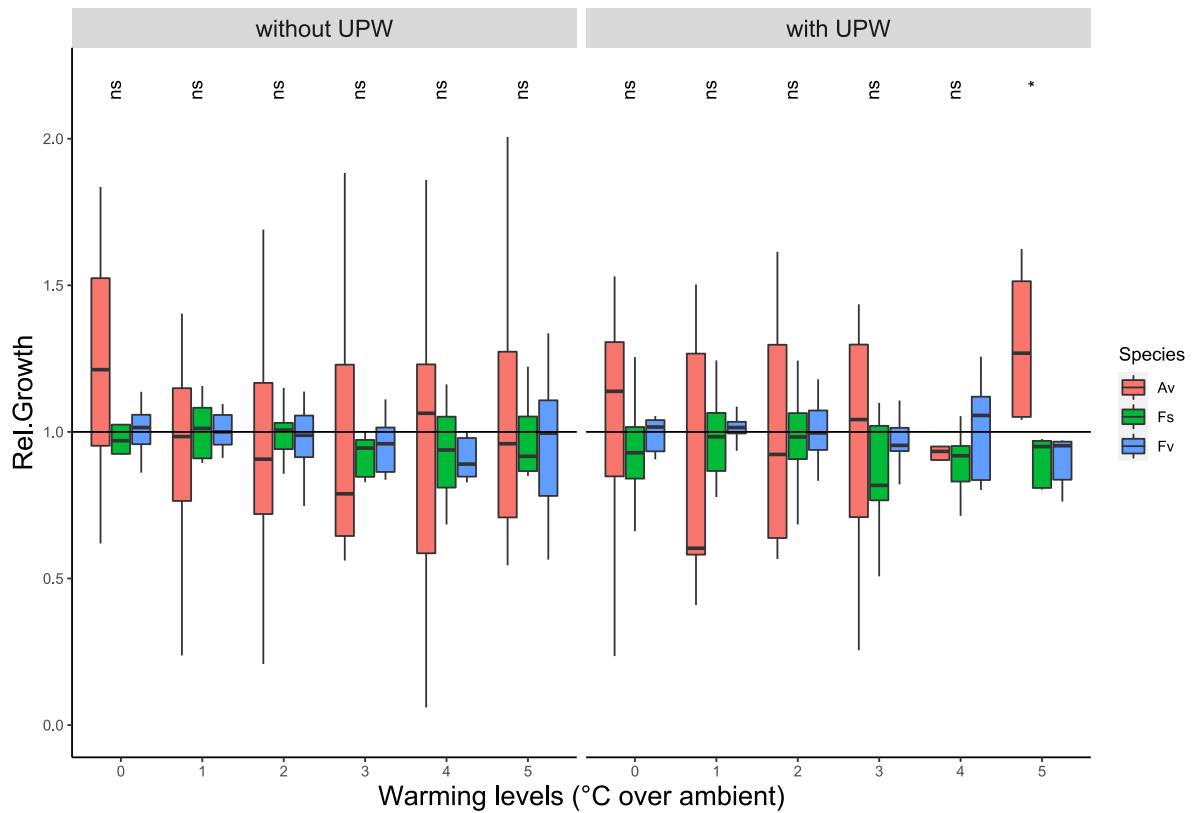
Fig. S5: Mean relative weekly growth (i.e. length change) quantified as length (Fucus vesiculosus = Fv, Fucus serratus = Fs) or wet weight (Agarophyton vermiculophylla = Av) at on a given day divided by the same parameter assessed seven days earlier for the same individual. Values >1 = net growth, values <1 = net decay.
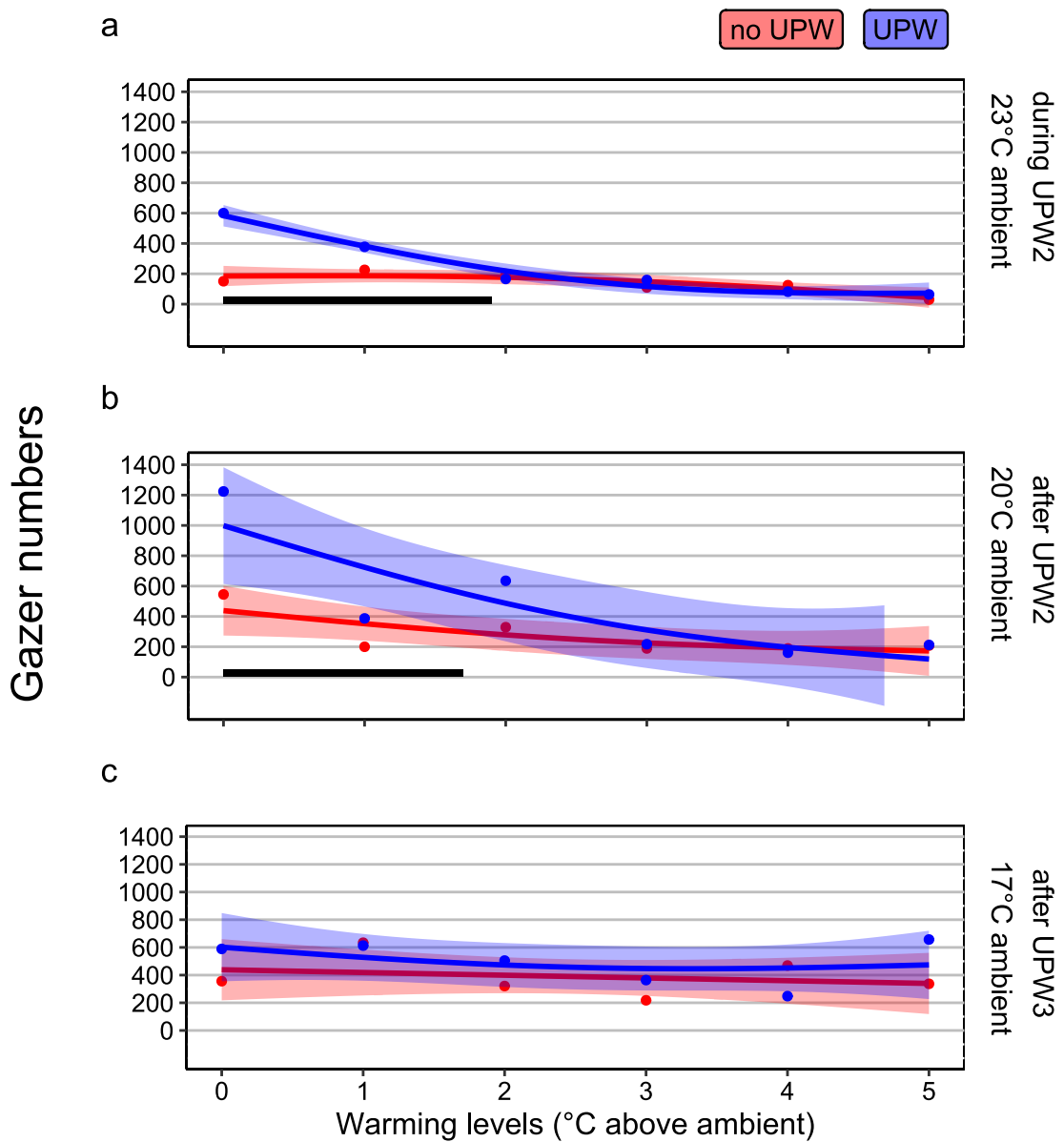
Fig. S6: Grazer abundances (subsampled) under six warming levels (0–5 °C) and in the presence (blue) versus absence (red) of occasional upwelling. a: during upwelling 2, b; between upwelling 2 and 3, c: after upwelling 3. Black horizontal bars at the bottom of the panels indicate areas of significant difference as identified by Generalized Additive Models (GAM).). Note: "upwelling" designates the imposed replacement of surface waters by sub-thermocline waters (-14m) in some of the tanks.
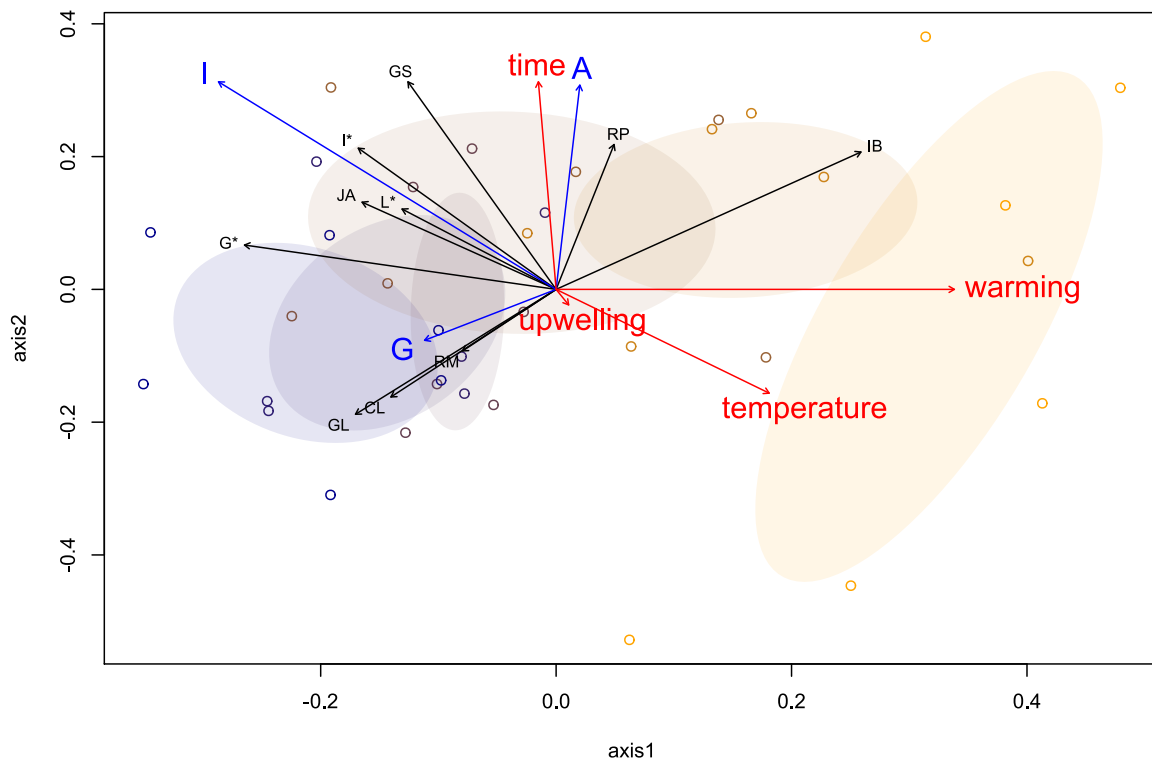
Fig. S7: Shifts in species' abundances and the community composition of mesograzers in response to warming (color shading from blue [warming level 0 °C] to orange (warming level 5 °C] x upwelling before upwelling 2 (week 32 = diamonds), between upwelling 2 and upwelling 3 (week 33 = dots) and after upwelling 3 (week 36 = triangles). Assessed by subsampling using 50 x 50 cm net exposed for 24 h. A = amphipods, CL = Calliopus laeviusculus (A), G = gastropods, G* = juvenile Gammarus (A), GL= Gammarus locusta (A), GS = Gammarus salinus (A), I=isopoda, I*= juvenile Idotea (I), JA = Jaera albifrons (I), L*= juvenile Littorina (G), RM= Rissoa membranacea (G), RP= Rissoa parva (G). upwelling = with vs without sporadic simulated upwelling, temperature = true tank temperature, warming = 6 levels of warming of ambient, time = increasing number of weeks since the start of the experiment. Note: "upwelling" designates the imposed replacement of surface waters by sub-thermocline waters (-14m) in some of the tanks.

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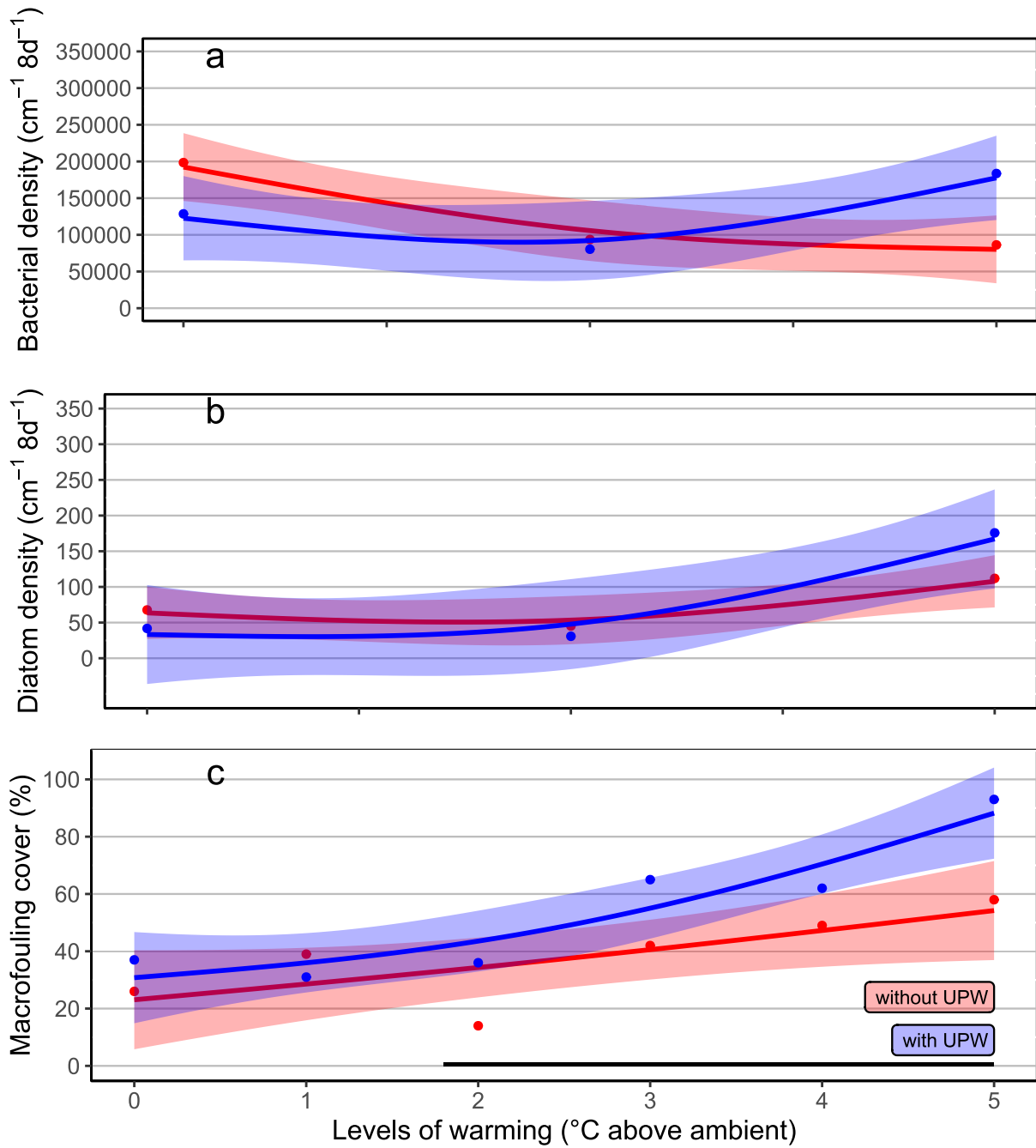
Fig. S8: Fouling on artificial substrata by bacteria (a), and diatoms (b) during the 6 days of

UPW3, as well as by macrofoulers (c) over the entire experiment, in six temperature

treatment levels (0–5 °C) and in the presence (1, blue) and absence (0, red) of upwelling.

Curves are based on means of three pseudo-replicates per treatment combination. Note:

"upwelling" designates the imposed replacement of surface waters by sub-thermocline waters

(-14m) in some of the tanks.

Supplementary tables

Table S1: Optimal temperatures (T_{opt}) and minimal salinity (S_{min}) threshold for the most important components of the Western Baltic macroalgal community. Empty cells: no information available.

Species	T_{opt}	Reference	S_{min}	Reference
Fucus vesiculosus	9-18	(Wahl et al. 2020)	4	(Bonsdorff 2006)
Fucus serratus			7	(Bonsdorff 2006)
Agarophyton vermiculophyllum	20	(Nejrup et al. 2013)	8-10	(Jensen et al. 2007; Wahl et al. 2020)
Littorina littorea	17	(Wahl et al. 2020)	8	(Bonsdorff 2006)
Rissoa membranacea			8	(Hayward and Ryland 2017)
Calliopius laeviusculus			6	(Hayward and Ryland 2017)
Gammarus locusta	21	(Wahl et al. 2020)	6	(Hayward and Ryland 2017)
Gammarus salinus	21	(Wahl et al. 2020)	6	(Hayward and Ryland 2017)
Jaera albifrons			4	(Sjöberg 1967; Jones 1972)
Idotea baltica	14	(Wahl et al. 2020)	4	(Bonsdorff 2006; Hayward and Ryland 2017)
Hydrobia ulvae			3	(Hayward and Ryland 2017)
Rissoa parva				
Microdeutopus gryllotalpa				
Filamentous foulers	18.5	(Wahl et al. 2020)		

287 Table S2: Biomasses added or removed during the experiment

Date	Species	Provenance	Individuals-per-tank	WW_added-per-tank (g)	WW_removed-per-tank (g)
2018-05-18	*F. vesiculosus*	Bülk	3	604	
2018-05-18	*F.serratus*	Kiekut	3	474	
2018-05-18	*L. littorea*	Bülk	20		
2018-05-18	*Grazers*	Bülk & Kiekut	as found in the algae		
2018-05-18	*M.edulis*	Pier	10		
2018-06-11	*Fs,Fv,epiphytes*				75
2018-06-20	*A.vermiculophyllum*	Heiligenhafen		7.8	
2018-06-28	*A.vermiculophyllum*	Tirpitzhafen		100	
2018-07-09	*F. vesiculosus*				95
2018-07-09	*F.serratus*				81
2018-07-09					56
2018-08-13	*F. vesiculosus*	Bülk	1 or 2	200	
2018-08-13	*F.serratus*	Kiekut	1 or 2	160	
2018-08-28	*A.vermiculophyllum*	Tirpitzhafen		200	
2018-09-05	*F. vesiculosus*				50
2018-09-05	*F.serratus*				43
2018-09-05	*A.vermiculophyllum*				33

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291 Table S3: ANOVA table on z-growth of the three macroalgal species exposed to warming ("ow", smoothing function) and/or upwelling ("upw",

292 fixed factor). Note: "upwelling" designates the imposed replacement of surface waters by sub-thermocline waters (-14m) in some of the tanks.

Phase	Predictors	*F. vesiculosus (z.growth)* Estimates	SE	CI	Stat	df	Predictors	*F. serratus (z.growth)* Estimates	SE	CI	Stat	df	Predictors	*A. vermiculophylla (z.growth)* Estimates	SE	CI	Stat	df
Upwelling 1	(Intercept)	0.22	0.23	-0.32 – 0.76	0.95	7.1	(Intercept)	0.1	0.32	-0.63 – 0.83	0.32	7.79	(Intercept)	0.21	0.17	-0.21 – 0.62	1.52	7.4
	upw	-0.44	0.33	-1.21 – 0.33	-1.35	7.1	upw	-0.2	0.45	-1.24 – 0.84	-0.45	7.79	upw	-0.82 **	0.24	-1.24 – 0.01	-3.44	7.4
	ow	1.0 **			17.8		ow	1.24 *			6.08		ow	1.0 *			13.18	
	ow * upw	2.2 *			5.24		ow * upw	1.0 *			7.11		ow * upw	1.58 ***			21.87	
	Observations	12					Observations	12					Observations	11				
	R²	0.679					R²	0.399					R²	0.819				
Upwelling 2	(Intercept)	-0.38 *	0.14	-0.71 – -	-2.66	8	(Intercept)	0.05	0.11	-0.53 – 0.63	0.46	6.08	(Intercept)	0.3	0.19	-0.16 – 0.76	1.57	6.1
	upw	0.76 **	0.2	0.29 – 1.23	3.76	8	upw	-0.1	0.16	-0.92 – 0.71	-0.65	6.08	upw	-0.6	0.27	-1.25 – 0.06	-2.22	6.1
	ow	1.0 ***			44.7		ow	2.92 ***			20.18	2.99	ow	1.92 **			12.76	
	ow * upw	1			1.82		ow * upw	1.0 *			6.26	1	ow * upw	1.93 *			7.49	
	Observations	12					Observations	12					Observations	12				
	R²	0.877					R²	0.923					R²	0.783				
Upwelling 3	(Intercept)	-0.11	0.2	-0.57 – 0.36	-0.53	7	(Intercept)	-0.24	0.4	-1.15 – 0.67	-0.61	8	(Intercept)	-0.11	0.2	-0.58 – 0.37	-0.53	6.8
	upw	-0.25	0.28	-0.91 – 0.41	-0.89	7	upw	0.64	0.56	-0.64 – 1.93	1.15	8	upw	-0.25	0.28	-0.92 – 0.43	-0.88	6.8
	ow	1.36 *			8.9		ow	1			0.7		ow	1.36 *			7.63	1.6
	ow * upw	1.87			1.39		ow * upw	1			0.38		ow * upw	1.87			1.03	2.2
	Observations	12					Observations	12					Observations	12				
	R²	0.741					R²	-0.097					R²	0.731				

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*p<0.05 **p<0.01 ***p<0.001

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Table S4a: ANOVA table on macroalgal relative growth in response to species, warming ("OW"), upwelling ("UPW"). * p < 0.05, ** p < 0.01, *** p < 0.001. Note: "upwelling" designates the imposed replacement of surface waters by sub-thermocline waters (-14m) in some of the tanks.

Relative growth of macroalgae during UPW3

	Df	Sum Sq	Mean Sq	F	value	Pr(>F)	
OW	1	695	695.1	1	2.207	0.000755	***
UPW	1	146	145.8		2.56	0.113237	
species	1	2	1.9		0.034	0.854378	
OW:UPW	1	0	0.4		0.008	0.930105	
OW:species	1	568	567.8		9.97	0.002195	**
UPW:species	1	108	107.9		1.894	0.172283	
OW:UPW:species	1	21	20.7		0.363	0.54861	
Residuals	86	4897	56.9				

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302   Table S4b: ANOVA table on the effects of grazing ("grazers") during upwelling 3 in

303   response to warming ("OW") and upwelling.

Grazing in the absence of upwelling

Predictors	Relative_area_change (% WW day^{-1})				
Predictors	Estimates	std. Error	CI	Statistic	df
(Intercept)	10.49	10.01	-12.60 – 33.58	1.05	8
grazers	-34.31 *	14.16	-66.96 – -1.65	-2.42	8
Smooth term (OW)	1.0			0	8
Smooth term (OW) * grazers	1.0			5.19	8
Observations	12				
R^2	0.544				

Grazing in the presence of upwelling

Predictors	Relative_area_change (% WW day^{-1})				
Predictors	Estimates	std. Error	CI	Statistic	df
(Intercept)	9.87	9.47	-11.98 – 31.71	1.04	8
grazers	-58.86 **	13.4	-89.76 – -27.97	-4.39	8
Smooth term (OW)	1.0			0.5	8
Smooth term (OW) * grazers	1.0			2.28	8
Observations	12				
R^2	0.631				

*p<0.05   ** p<0.01   *** p<0.001*

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305

306   Table S5a: Multivariate output for the full and most parsimonious multivariate generalized

307   linear models (mGLMs) fitted for the analysis of structural changes in grazers' assemblages.

308   The residual degrees of freedom (RDF), degrees of freedom (DF), multivariate and associated

309   p-values are presented for each model component. Significant p-values are highlighted in

310   bold. Interaction terms are represented by the use of colon mark following R syntax. OW:

311   warming, UPW: upwelling, week: sampling event. Note: "upwelling" designates the imposed

312   replacement of surface waters by sub-thermocline waters (-14m) in some of the tanks.

Model	Model component	RDF	DF	Deviance	p-value
Full	OW	34	1	162.47	**<0.001**
	UPW	33	1	19.49	0.190
	week	31	2	218.06	**<0.001**
	OW:week	29	2	40.58	0.090
	OW:UPW	28	1	22.27	0.164
	UPW:week	26	2	26.59	0.650
	OW:UPW:week	24	2	19.61	0.833
Most parsimonious	OW	34	1	162.5	**<0.001**
	week	32	2	211.3	**<0.001**

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314

315   Table S5b. Univariate output for the most parsimonious multivariate generalized linear model

316   (mGLM) fitted for the analysis of structural changes in grazers' assemblages. The univariate

317   statistics, the associated p-values and the contribution to the multivariate statics are presented

318   for every species and term included in the model (i.e., OW: warming, week: sampling event).

319   Significant p-values and contributions over 10% are highlighted in bold. Asterisks after the

320   species name indicate juvenile forms.

Species	Warming (OW)			Time (weeks)		
	Deviance	Contribution (%)	p-value	Deviance	Contribution (%)	p-value
Calliopius laeviusculus	26.09	**16.06**	**<0.001**	13.11	6.23	**0.018**
Gammarus sp.*	37.47	**23.06**	**<0.001**	5.07	2.41	0.129
Gammarus locusta	30.46	**18.75**	**<0.001**	6.18	2.94	0.129
Gammarus salinus	0.19	0.12	0.872	22.83	**10.85**	**<0.001**
Hydrobia sp.*	0.92	0.57	0.773	5.62	2.67	0.129
Idotea balthica	3.94	2.43	0.208	23.97	**11.39**	**<0.001**
Idotea chelipes	0.01	0.01	0.899	10.05	4.75	**0.040**
Idotea sp.*	6.03	3.71	0.118	33.37	**15.85**	**<0.001**
Jaera albifrons	19.3	**11.88**	**<0.001**	14.09	6.69	**0.012**
Littorina sp.*	4.78	2.94	0.186	15.63	7.43	**0.011**
Microdeutopus gryllotalpa	12.41	7.64	**0.004**	21.00	9.98	**<0.001**
Rissoa membranacea	20.49	**12.61**	**<0.001**	10.86	5.16	**0.040**
Rissoa parva	0.37	0.23	0.872	28.73	**13.65**	**<0.001**

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322

323   Table S6: ANOVA table about the impacts of warming ("warming") and ("upwelling") on

324   macrofouling. Note: "upwelling" designates the imposed replacement of surface waters by

325   sub-thermocline waters (-14m) in some of the tanks.

Macrofouling

A. parametric coefficients	Estimate	SE	t-value	p-value
(Intercept)	38	4.1107	9.2442	< 0.0001
upwelling	16	5.8134	2.7523	0.0275
B. smooth terms	edf	Ref.df	F-value	p-value
warming	1.7519	1.9385	5.7119	0.05
warming * upwelling	1.0001	1.0001	2.385	0.1664

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