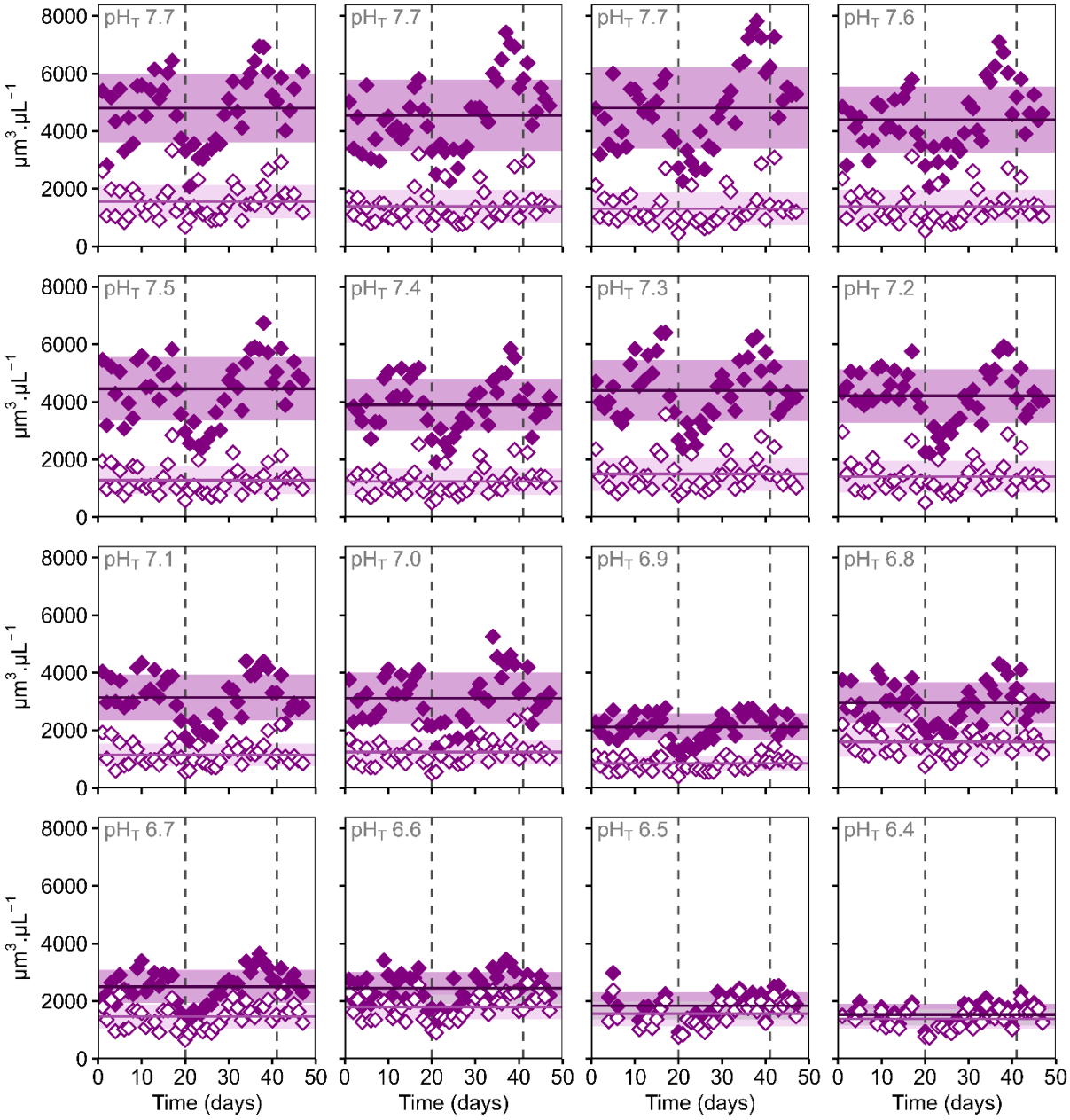

Fig. S1. Temporal evolution of the phytoplankton cell volume at the tank inlet (filled symbols) and outlet (empty symbols) during 48 days of exposure under 16 pH$_T$ conditions. This food consumption was quantified at the scale of the whole oyster batch in each tank as both *C. gigas* and *O. edulis* species were exposed in common garden. The horizontal lines correspond to the mean phytoplankton cell volume (± s.d.) over the entire experimental period. The vertical lines correspond to the sampling times of oysters, thus this decreased biomass causes a decrease in the food consumption right after. The mean phytoplankton concentration at the outlet of tanks was 1383 ± 214 µm^3.µl^{-1}. These are raw zootechnical data not standardized by weight.

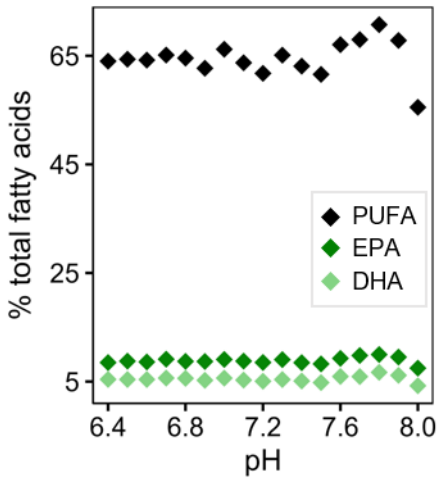

Fig. S2. Essential fatty acid proportions in phytoplankton as a function of pH (on total scale). Phytoplankton was exposed for two hours to 17 pH conditions considering a flow rate of 500 ml.min^{-1}. This experiment was performed after the main oyster experiment. Essential fatty acids were not correlated with pH decrease. Abbreviations: PUFA, total of long-chain polyunsaturated fatty acids (including EPA and DHA); EPA, eicosapentaenoic acid (20:5n-3); DHA, docosahexaenoic acid (22:6n-3).

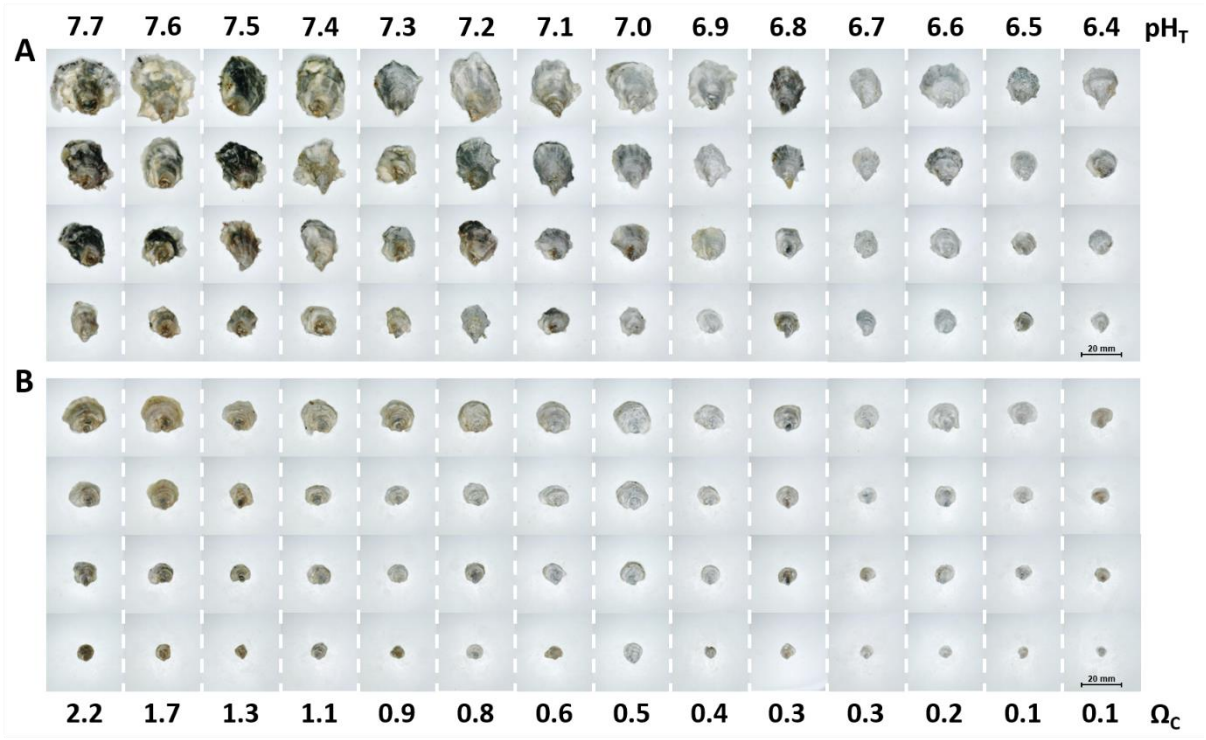

Fig. S3. The gradual shell reduction and bleaching of *Crassostrea gigas* (A) and *Ostrea edulis* (B) after 20 days of exposure to pH$_T$ levels ranging from 7.7 to 6.4. Only four oysters are shown from each condition and species, and a size variability is noted between individuals from the same condition. Corresponding seawater pH on the total scale (pH$_T$) and saturation state of calcite (Ω_C) are indicated.

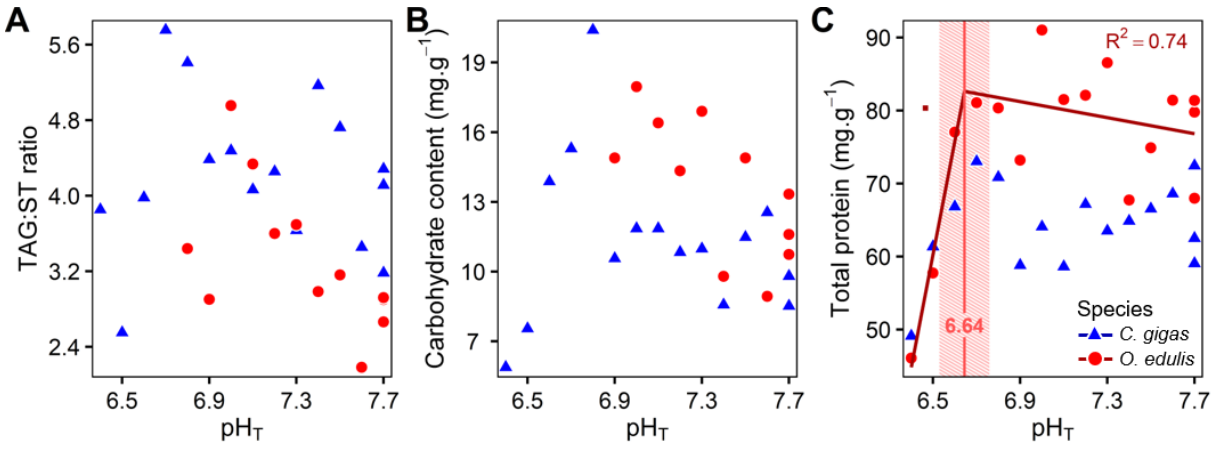

Fig. S4. Energy reserves in *C. gigas* and *O. edulis* oysters as a function of pH (on total scale). Triacylglycerol:sterol ratio (A), total carbohydrate content (B) and total protein content (C) in oysters after 41 days of exposure under 16 pH$_T$ conditions (n = 10 oysters pooled per condition and species). Tipping point and the 95% confidence interval of *O. edulis* is shown in striped red. The slopes were not significant ($p > 0.05$).

Table S1. Relative contribution of membrane fatty acids in *Crassostrea gigas*.

Mean pHT	Fatty acid (% polar fatty acids)									
	14:0	16:0	16:1n-7	18:0DMA	18:0	18:1n-9	18:1n-7	18:2n-6	18:3n-3	18:4n-3
7.7	2.3	12.2	2.1	9.1	3.1	1.7	5.6	1.3	1.1	1.6
7.7	2.2	12.2	1.9	9.3	3.9	1.7	5.2	1.3	1.2	1.6
7.7	2.2	11.9	1.9	9.1	3.6	1.8	5.3	1.4	1.3	1.6
7.6	2.3	11.9	2.0	9.1	3.1	1.7	5.9	1.3	1.1	1.6
7.4	2.4	11.2	2.1	8.9	3.1	1.8	5.8	1.4	1.2	1.7
7.3	2.3	12.0	2.0	7.0	3.1	1.9	6.0	1.5	1.3	2.0
7.2	2.1	11.1	1.9	8.9	3.4	1.8	5.9	1.4	1.2	1.9
7.1	1.9	10.1	1.8	9.7	3.7	1.8	5.6	1.5	1.3	1.9
7.0	1.9	10.5	1.6	9.5	3.9	1.8	5.5	1.3	1.3	1.7
6.9	2.0	11.1	1.9	9.0	3.5	1.8	5.9	1.4	1.1	1.7
6.8	2.0	11.4	2.1	7.9	4.5	1.9	6.3	1.3	1.2	1.6
6.7	2.0	10.5	2.2	8.3	3.5	1.9	6.8	1.4	1.1	1.7
6.6	1.4	8.8	2.0	8.7	4.0	1.7	6.2	1.0	0.9	1.1
6.5	1.4	9.4	2.1	7.7	4.1	2.0	6.2	0.9	0.7	1.0
6.4	1.0	9.6	1.8	9.0	4.9	2.4	5.6	0.6	0.3	0.5
Contribution to PC1 (%)	4.5	28.9	0.0	1.5	4.7	0.4	1.1	1.3	1.4	3.0
Correlation to PC1	0.9	0.9	-0.2	0.3	-0.7	-0.7	-0.4	0.8	0.8	0.8

Mean pHT	Fatty acid (% polar fatty acids)								
	20:1DMA	20:0	20:1n-11	20:1n-7	20:4n-6	20:5n-3	$22:2_{i,j}$NMI	22:5n-6	22:6n-3
7.7	2.3	1.3	1.4	4.0	3.9	11.8	5.1	3.0	17.1
7.7	1.8	1.2	1.8	4.0	4.0	10.6	5.2	3.3	17.8
7.7	1.9	1.3	1.9	4.2	3.8	10.7	5.5	3.1	17.7
7.6	2.0	1.3	1.5	4.0	3.9	12.2	4.9	3.1	17.6
7.4	2.1	1.1	1.6	4.1	3.8	12.2	5.1	3.1	17.0
7.3	1.6	1.1	1.6	4.3	3.9	12.8	5.2	3.1	17.6
7.2	1.9	1.1	1.6	4.1	4.0	12.0	5.3	3.1	17.9
7.1	1.9	1.1	1.8	4.2	4.0	11.3	5.5	3.2	17.9
7.0	2.0	1.2	1.9	4.5	4.0	11.2	6.0	3.0	17.7
6.9	2.1	1.5	1.6	4.3	4.0	11.8	5.4	2.9	17.4
6.8	1.8	1.1	1.7	4.6	4.2	12.3	5.5	2.4	15.5
6.7	2.0	1.2	1.6	4.5	4.0	12.3	5.9	2.5	16.2
6.6	2.7	1.1	2.1	5.2	4.9	12.4	7.3	2.2	16.0
6.5	2.7	1.1	1.7	5.3	4.9	12.7	7.0	2.1	16.1
6.4	3.3	1.7	1.6	5.3	3.9	12.8	6.5	2.1	15.7
Contribution to PC1 (%)	3.9	0.0	0.1	6.7	2.0	5.7	13.3	5.0	16.5
Correlation to PC1	-0.8	-0.1	-0.3	-1.0	-0.7	-0.6	-0.9	1.0	0.8

The relative contribution (%) of each fatty acid is indicated for the 16 pH_T conditions. Only fatty acid contributing to >1% were considered. Their contribution and correlation to the first principal component (PC1) of the PCA (Fig. 5A) are indicated at the bottom of the table.

Table S2. Relative contribution of membrane fatty acids in *Ostrea edulis*.

Mean pHT	Fatty acid (% polar fatty acids)									
	14:0	16:0	16:1n-7	18:0DMA	18:0	18:1n-9	18:1n-7	18:2n-6	18:3n-3	18:4n-3
7.7	1.8	9.1	2.1	11.3	4.1	1.9	2.9	1.5	1.2	1.0
7.7	2.0	9.3	2.1	11.4	4.6	2.0	3.0	1.6	1.4	1.2
7.7	2.1	9.9	2.2	10.8	4.0	2.1	3.0	1.6	1.5	1.1
7.6	1.9	9.4	2.2	10.5	4.1	2.0	3.1	1.5	1.1	1.1
7.5	2.0	9.7	2.3	10.3	4.2	2.1	3.3	1.7	1.3	1.2
7.4	1.7	8.6	2.1	10.3	4.0	1.9	3.9	1.5	1.2	1.3
7.3	1.9	9.6	2.2	11.5	4.3	2.0	3.1	1.5	1.1	1.1
7.2	1.7	9.5	2.1	11.8	4.3	1.7	2.9	1.4	1.0	1.0
7.1	1.6	9.1	2.0	11.2	4.6	1.8	3.0	1.4	1.3	1.0
7.0	1.6	9.5	2.1	12.0	4.7	1.8	2.9	1.3	1.2	1.0
6.9	1.5	9.2	2.0	11.6	4.3	1.7	2.9	1.3	1.1	1.0
6.8	1.4	9.4	1.8	11.3	5.1	1.9	2.7	1.4	1.1	1.1
Contribution to PC1 (%)	3.7	0.0	0.9	29.7	6.8	1.3	6.6	1.3	0.8	1.4
Correlation to PC1	0.7	-0.0	0.7	-0.8	-0.7	0.7	0.7	0.8	0.5	0.8

Mean pHT	Fatty acid (% polar fatty acids)								
	20:1DMA	20:0	20:1n-11	20:1n-7	20:4n-6	20:5n-3	22:2$_{i,j}$NMI	22:5n-6	22:6n-3
7.7	1.2	0.7	1.5	5.1	5.1	13.9	7.2	3.2	15.2
7.7	1.1	0.6	1.4	4.8	4.6	13.1	6.8	3.4	16.0
7.7	1.1	0.8	1.3	4.8	4.8	13.2	6.8	3.3	15.2
7.6	1.2	0.8	1.4	5.0	5.0	14.2	7.1	3.1	14.9
7.5	1.0	0.7	1.3	4.7	4.9	13.3	6.5	3.2	16.1
7.4	1.4	0.6	1.3	5.0	5.0	14.4	6.6	2.9	16.1
7.3	1.2	0.7	1.2	5.0	4.8	13.3	6.9	3.1	15.5
7.2	1.2	0.8	1.3	5.2	4.9	14.2	6.8	2.9	15.3
7.1	1.1	0.7	1.4	5.1	5.0	14.0	7.1	2.8	15.2
7.0	1.1	0.8	1.4	4.8	4.8	14.1	6.7	2.6	14.8
6.9	1.2	0.8	1.3	5.3	5.3	14.4	7.1	2.6	14.9
6.8	1.0	0.7	1.4	5.0	4.9	13.2	7.2	2.4	14.2
Contribution to PC1 (%)	0.2	n.a.	0.2	1.2	0.5	1.6	3.1	7.8	33.0
Correlation to PC1	0.4	n.a.	-0.4	-0.5	-0.3	-0.2	-0.6	0.8	0.9

The relative contribution (%) of each fatty acid is indicated for the 16 pH_T conditions. Only fatty acid contributing to >1% were considered (then not 20:0). Their contribution and correlation to the first principal component (PC1) of the PCA (Fig. 5B) are indicated at the bottom of the table.