Supplementary Material for *Climate-driven zooplankton shifts could cause global declines in food quality for fish*

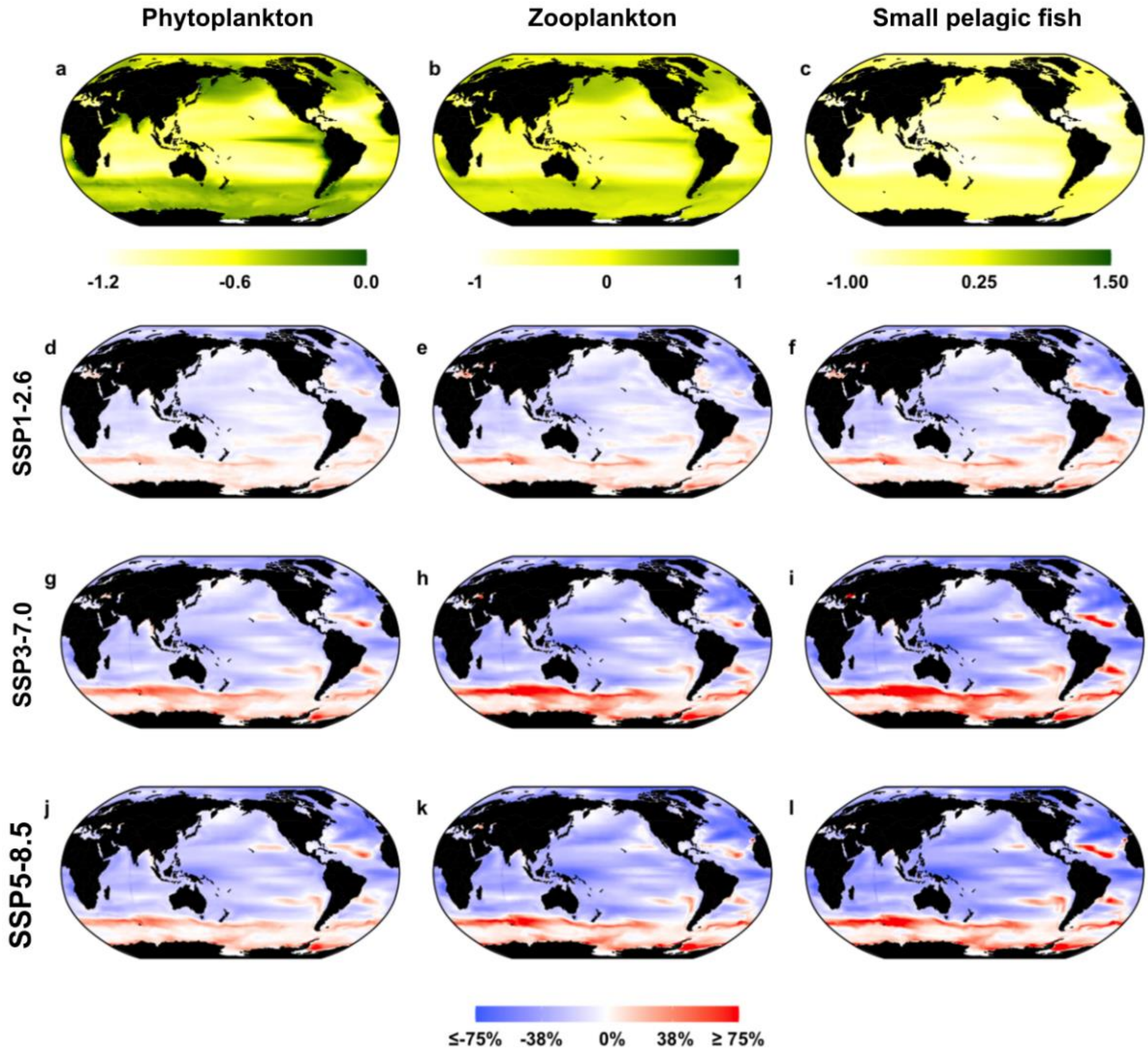

Figure S1 | Climate-induced shifts in biomass of phytoplankton, zooplankton and small pelagic fish. The mean $\log_{10}$ biomass (g m^{-2}) in 1980-2000 of: **a** Phytoplankton; **b** Zooplankton (both micro and macrozooplankton); **c** Small pelagic fish; **d–l** Maps of the mean change in the total biomass of: **d, g, j** Phytoplankton; **e, h, k** Zooplankton; and **f, i, l** Small pelagic fish in 2080–2100 compared with 1980–2000 under emission scenarios SSP1-2.6, SSP3-7.0 and SSP5-8.5 (rows).

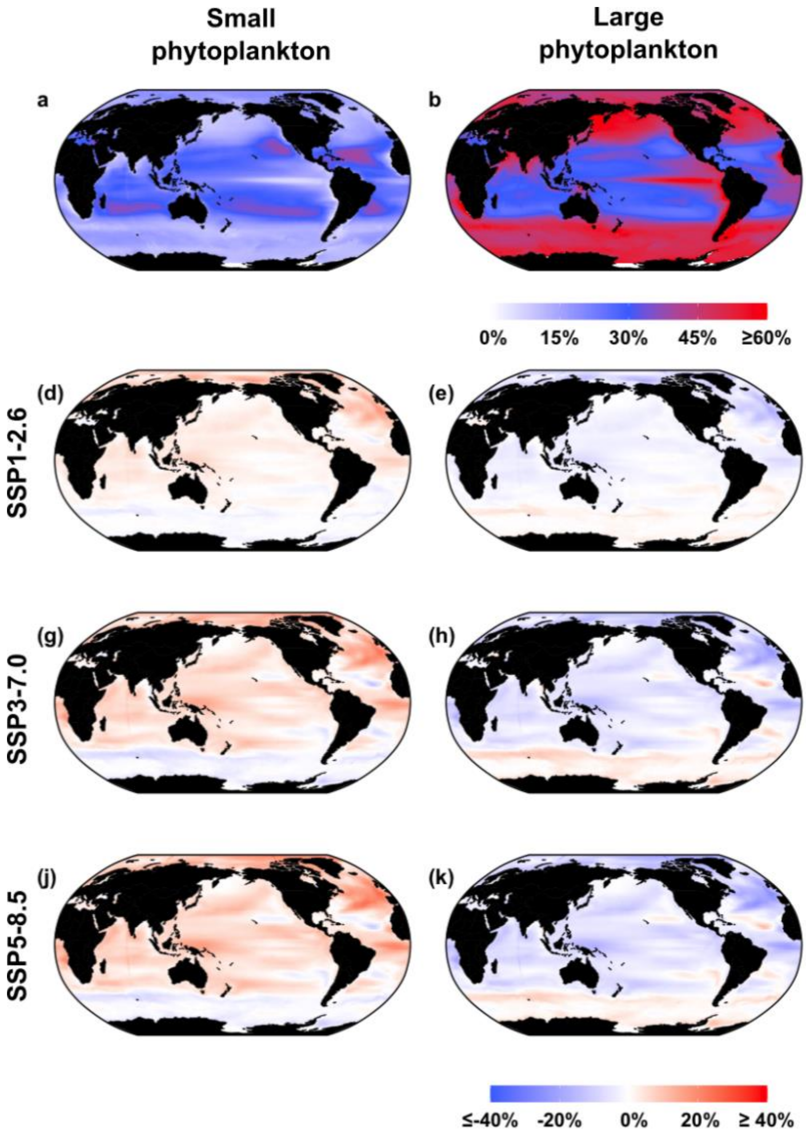

Figure S2 | Climate-induced shifts in biomass of small and large phytoplankton, and microzooplankton. The percentage of total phytoplankton and microzooplankton (heterotrophic flagellates and ciliates) biomass in 1980-2000 comprising: **a** Small phytoplankton (<5µm ESD); **b** Large phytoplankton (≧5µm ESD); **c** Microzooplankton. **d–l** Maps of the mean change in the total biomass of: **d, g, j** Small phytoplankton; **e, h, k** Large phytoplankton; and **f, i, l** Microzooplankton in 2080–2100 compared with 1980–2000 under emission scenarios SSP1-2.6, SSP3-7.0 and SSP5-8.5 (rows).

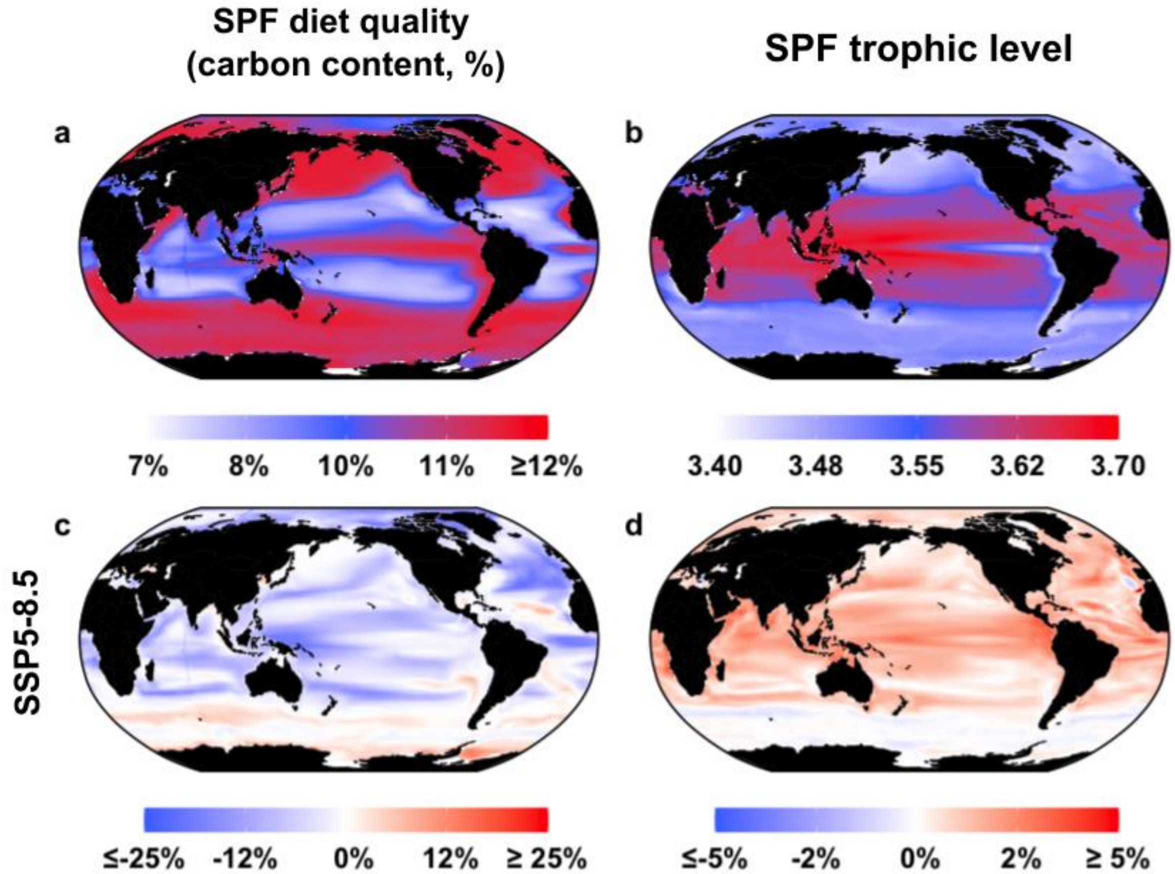

Figure S3 | Climate-induced changes in small pelagic fish diet quality and trophic level. Maps of mean small pelagic fish (SPF) **a** Diet quality (% carbon content) and **b** Trophic level in 1980-2000, and maps of the mean percentage change in SPF **c** Diet quality and **d** Trophic level in 2080–2100 compared with 1980–2000 under emission scenario SSP5-8.5.

Table S1 | Trait values for the nine zooplankton and three fish groups (reproduced from Heneghan et al. 2020).

Group	Min. Size, $\log_{10}(g)$*	Max Size, $\log_{10}(g)$*	$\log_{10}$PPMR range	Carbon (% of wet weight)
Heterotrophic flagellates	–10.7[a]	–6.8[a]	0.2–0.7[2]	15[4]
Heterotrophic ciliates	–9.3[b]	–6.3[a]	2.5–2.9[2]	15[4]
Larvaceans	–6.4[c]	–3.2[c]	6.8–10.8[7]	2[9]
Omnivorous copepods	–7.5[d]	–3.5[e]	3.6–4.6[2]	12[1]
Carnivorous copepods	–7.5[d]	–2.5[e]	0.8–1.9[2]	12[1]
Euphausiids	–4.2[f]	0.2[g]	6.6–7.8[3,15]	12[1]
Chaetognaths	–5.9[h]	–0.9[h]	1.9–3.4[16]	4[1]
Salps	–4.7[i]	1.4[i]	6.8–11.7[19]	2[9]
Jellyfish	–3[j]	2[j]	2.7–4.7[1]	0.5[1]
Small pelagic fish	–3[k]	2	2[22]	10[23]
Medium pelagic fish	–3[k]	4	2[22]	10[23]
Large pelagic fish	–3[k]	6	2[22]	10[23]

* g wet weight calculated from ESD, assuming 1 gram = 1 cm^3.

[a] From Table 3 in (1), [b] From figure 1 in (5), [c] Minimum and maximum larvacean trunk lengths taken from (6) and (8) respectively, and converted to ESD and wet weight using equation derived in (7), [d] Carbon mass obtained from supplementary material in (10), converted to wet weight and ESD using carbon: wet weight ratio from (1) [e] Maximum omnivorous and carnivorous copepod lengths taken from (11) and converted to ESD and then wet weight using equation derived in (12), [f] Euphausiid embryo ESD from figure 2 in (13), [g] Maximum length taken from supplementary material in (3) and converted to ESD and wet weight using equation from (14), [h] Minimum and maximum ESD from supplementary material in (3), lengths derived using head width: body length ratio from (16) [i] Minimum and maximum salp length taken from (17) and converted to ESD and wet weight using equation derived in (18), maximum salp body size taken as geometric mean of Salpida and Pyrosomatida from (17), after using equation in (18) [j] From supplementary material in (20), [k] From (21).

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