

Supplemental Table 1. Interactive environmental change factors affecting coastal upwelling systems. The distinction between drivers and impacts is not necessarily straightforward.

Perturbation	Drivers	Potential Impacts	Reference number	References for impacts
Upper Ocean warming	Greenhouse gases production (CO ₂ , CH ₄ , N ₂ O)	Upper ocean stratification Surface current modification Upwelling dampening Upwelling intensification Increased N ₂ fixation	82 40 82 40 80, 58	Behrenfeld et al. 2006, Bakun et al. 2010 Behrenfeld et al. 2006 Bakun et al. 2010 Breitbarth et al. 2007, Hutchins et al. 2009
Ocean Acidification	Anthropogenic CO ₂ invasion of upper ocean	Physiological effects Calcification inhibition and CaCO ₃ dissolution Reduced iron availability Increased phytoplankton C:N ratios Inhibition of nitrification	58 5, 28 66 83 72	Hutchins et al 2009 Hofmann et al 2011, Feely et al 2008 Shi et al 2010 Riebesell et al. 2011 Beman et al 2011
Surface nutrient increase (coastal)	Upwelling intensification Nutrient increase in upwelling source waters Amplified runoff and point source discharge from land Atmospheric deposition	Stimulation of primary productivity Stimulation of respiration OMZ expansion	37 60 30	Rykaczewski & Dunne 2010 Oschlies et al. 2008 Stramma et al. 2008
Surface nutrient decrease (open ocean)	Increased stratification with upper ocean warming Expansion of OMZ with warming and organic flux Denitrification/ anammox increase	Constraint of primary productivity	82	Behrenfeld et al. 2006
Changes in iron availability	Altered ratios of Fe:NO ₃ - in upwelled water Upwelling intensification Atmospheric deposition Changing iron speciation due to acidification OMZ expansion	Intensification or alleviation of phytoplankton iron limitation Increases in toxic algal blooms	17, 19 84-86	Bruland et al. 2001, 2005 Silver et al. 2010, Sun et al. 2011, Tatters et al. 2012

References (continued)

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