ANNEX F-1

ANNEX F-1: Background on Ocean Acidification

Scientists estimate that average surface ocean pH has fallen by about 0.1 pH units between pre-industrial times and today.[1] Although this may appear to be a relatively small change, it is nonetheless equivalent to a 26% increase in acidity. If we continue on the business as usual trajectory for fossil fuel use and rising atmospheric CO_2 (the Intergovernmental Panel on Climate Change's (IPCC) worst case scenario), pH is projected to drop by around 0.3-0.32 units by the end of the 21st century, representing an increase in acidity of 100-109% over baseline levels for the period 1986-2005.[2]

Acidification of both offshore and coastal waters is expected to have profound implications for many marine species and ecosystems. Although the nature and scale of impacts is likely to vary across different species and habitats in a complex manner,[3] some of the greatest negative impacts are expected to fall on highly calcifying organisms, including corals, mollusks, and echinoderms, by both reducing calcification rates and increasing dissolution and erosion.[4] This is because rising acidity results in both lower overall concentrations of carbonate and a reduction in the 'saturation states' for the various carbonate minerals on which calcifying organisms rely.[5] Impacts such as the observed thinning of shells of pteropod mollusks in the Southern Ocean[6] and losses of oyster larvae in hatcheries on the Pacific coast of America,[7] which have been attributed with medium to high confidence as direct consequences of ocean acidification, may act as sentinels of the potential for much more widespread changes in the future if current trends in emissions continue.[8] It is not just

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[3] Turley & Guttuso, *supra* note 1.

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the scale of projected change in pH that is significant in terms of impacts on organisms, their resilience, and their capacity to adapt, but also the projected speed of that change. While some species, particularly in naturally more variable coastal waters, appear to show greater resilience to acidification than others, the physiological adjustments necessary to survive may not be without other consequences for growth, reproduction, and survival.[9]

In its 5th Assessment report, the IPCC concluded with high confidence that the combination of acidification and warming of coastal waters "will continue with significant negative consequences for coastal ecosystems" and "will have negative impacts for many calcifying organisms", including impacts on coral bleaching, mortality, and the balance between growth and erosion.[10] There is high confidence that warm-water coral reefs, in particular, will be at increased risk of dissolution from rising acidity in a warming ocean.[11] The resulting reduction in species diversity of reef communities and, potentially, loss of structural integrity, may well be expected to have serious social and economic consequences for fisheries, coastal protection, and tourism by the middle of the century.[12] Additional socio-economic impacts are expected to arise from effects, for example, on bivalve mollusk fisheries (such as those for oysters and scallops), with perhaps the greatest impacts to fisheries reliant on wild stocks[13] or aquaculture operations in which the ability to monitor and adjust for acidification events may be limited.

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