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the proliferation of marine debris is due to a range of human and non-human activities, including tourism, fisheries, commerce, and resource extraction, and is a global phenomenon. the volume of debris in the marine environment is expected to increase in future by a factor of five by the year 2050 (unep, 2015; solaz et al., 2012). marine debris ingestion and entanglement are among the most pressing marine health hazards due to their negative impacts on aquatic ecosystems, economies, and human health (kirk, 2002). increasing quantities of plastic waste in our marine environment is of great concern due to the amount of persistent organic pollutants (pops) that this waste is expected to biodegrade, which include pcb, ddt, and pahs that have the potential to bioaccumulate in the marine food web. more than 20,000 marine species, including many commercial fish and shellfish, are currently found to be contaminated with pops through ingestion of plastic debris, and are at risk of poisoning and death through toxic accumulations in their tissues (unep, 2015). pops from debris are also known to pose a risk to human health as they bioaccumulate in human tissues and can cause major health effects in animals and human alike. research has shown that fine plastic debris are predicted to remain in the stomach of organisms for extended periods of time, increasing their bioavailability. of all the potential impacts of marine debris, this is probably the most critical, as the ingestion of marine debris could lead to a wide range of adverse impacts including: loss of habitat and biodiversity - increasing levels of debris are predicted to cause increases in coastal erosion, leading to the death of seabed and coastal ecosystems, and ultimately affect human well-being due to the loss of services such as tourism and fisheries (unep, 2015). ongoing marine debris ingestion also causes a major headache for governments, especially in regions where tourism is heavily dependent on the environment, such as the caribbean, west and central africa, and maldives. - coral bleaching - the abnormal increase of solar radiation resulting in ocean warming and ocean acidification causes coral bleaching which can weaken the coral reefs, leading to their gradual death (bruno et al., 2016). this is probably one of the biggest threats to coral reefs, high confidence. ongoing marine debris ingestion also contributes to coral bleaching by causing an extra stress on corals (fulton et al., 2013). - climate change impacts - ocean warming increases the capacity for marine species to use cooler waters, which can become too warm for essential activities such as feeding, breeding or resting. researchers predict that this will lead to ‘die-offs’ of marine species, moderate confidence. in addition, changes in oceanic circulation regimes can also lead to changes in the zonation of ocean habitats that are used by marine species. further, ocean warming will lead to changes in marine species distribution towards higher latitudes or depths, which may impact on their adaptability to climate change. moderate confidence high confidence moderate confidence low confidence high confidence

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the transverse circulation influences offshore migration by driving nutrient-rich surface waters into the deep ocean to replace nutrient-poor inflow from the

subtropics (wolf et al., 2001 306 ; lapierre et al., 2013 307 ; barthe et al., 2014 308 ; and see also hall, 1998 309). stronger upwelling during the summer months, as projected by cmip5 models, could enhance offshore circulation, resulting in less coastal upwelling and lower nutrient export to the oceans. this would decrease the regional phytoplankton resource, but more importantly, could also cause a shift in the timing of seasonal phytoplankton

blooms, which will in turn trigger a change in the migration schedules of juvenile fish stocks. in other regions, climate will cause extended periods when the temperature of the upper ocean is below the thermostable limit of larval fish (seth and stark, 2015 310). the changes in the winter circulation patterns and fish larval survival are projected to be modest and not be sufficiently large to shift the whole stock to the near

shore, however a less frequent spring upwelling could prolong a longer period of fish larval survival (seth et al., 2015 311). regional upwelling anomalies (figure 5.9a-d) will result in altered ice edge circulation patterns (figure 5.9e) and ultimately a change in the location and timing of the seasonal mixed layer (figure 5.9f) offshore (wilby et al., 2013 312 ; wilby et al., 2017 313). el niño events are projected to cool the surface and expand

surface areas of receding mixed layer, enhancing offshore currents, and can extend into the winter months increasing water residence time and allowing fertilization to occur (wigley et al., 1996 314 ; lawrence et al., 2013 315). el niño events will also increase uv at the surface of the ocean and increase stratification (pokalyuk et al., 2009 316 ; pokalyuk et al., 2017 317). these changes will influence the development of

phytoplankton, which will directly impact the zooplankton grazing community (wigley et al., 2010 318). 5ec8ef588b