Will Climate Change Result in Seasonal Mismatches between Phytoplankton Blooms and Fish Reproduction?

*Rebecca G Asch[1,2], Charles A Stock[3], Jorge L Sarmiento[2]

1. East Carolina University, 2. Princeton University, 3. National Oceanic and Atmospheric Administration

One hypothesis explaining substantial interannual variability in fish recruitment (*i.e.*, the number of young fishes entering a fishery) is whether the timing of fish spawning matches seasonal plankton blooms that the fish's larvae depend on for nutrition. Environmental processes controlling the seasonal timing (*i.e.*, phenology) of blooms often differ from those influencing fish spawning, which could cause these events to diverge under climate change with negative consequences for fisheries. We use an earth system model to examine the impact of the RCP8.5 climate-warming scenario on the future spawning time of two classes of fishes: "geographic spawners" whose spawning grounds are defined by fixed geographic features (*e.g.*, estuaries, reefs), and "environmental spawners" whose spawning grounds move responding to variations in environmental properties, such as temperature. Our model projects that by the century's end spring and summer phytoplankton blooms will occur 16.5 days earlier on average at latitudes >40°N. The phenology of geographic spawners shifts at a rate twice as fast as phytoplankton, causing these fishes to spawn before the bloom across >85% of this region. "Extreme events" (*i.e.*, mismatches in timing >30 days that could lead to fish recruitment failure) increase 10-fold for geographic spawners in many areas. Seasonal mismatches between environmental spawners and phytoplankton were less widespread although sizable mismatches still emerged in some regions. This indicates that range shifts undertaken by environmental spawners may increase resiliency of fishes to climate change impacts associated with phenological mismatches, potentially buffering against declines in larval survival, recruitment, and fisheries.

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