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TITLE: Did a ?perfect storm? of oceanic changes and continental anthropogenic impacts cause northern hemisphere anguillid recruitment reductions?

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ABSTRACT:

Abstract The three northern hemisphere anguillid eel species experienced recruitment declines at similar times beginning in the 1970s and 1980s, but the exact causes of the declines have remained unclear. Attention focused on two categories of possible causes that included (i) anthropogenic impacts on eel growth habitats, such as dam construction, degradation and pollution of habitats, introduction of parasites, overfishing and (ii) changes in ocean-atmospheric conditions affecting their marine life-history stages. The cumulative effects of reaching peaks in dam construction, levels of pollution, and eutrophication just before the eel declines likely had reduced eel production in many areas, and contamination by metallic and organic compounds and parasites may have reduced reproductive success. Shifts in ocean-atmospheric conditions also occurred just before the eel declines that could have reduced feeding success of larvae or disrupted larval transport. If oceanic regime shifts reduced production of the marine snow food of eel larvae, it may have affected larval survival and recruitment success, especially if there is a critical time-window for successful larval first feeding when marine snow particles need to be abundant. A reduction of these particles could result in density-dependent early mortality of the larvae of each spawning event, and competition for marine snow particles with sympatrically spawning mesopelagic eel larvae would amplify this effect. Nutrient reductions causing shifts in the relative abundance of phytoplankton contributing to marine snow production and of ubiquitous cyanobacteria may mediate levels of larval survival in areas with high spawning activity. Reductions of eels reaching the spawning area from species range margins that spawn outside of peak spawning periods could have reduced recruitment further. It appears likely that a variety of impacts, oceanic and anthropogenic occurred simultaneously causing sudden declines of these eel populations.

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