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A Review on Climate Change and the Shifting Routes of Migratory Fish

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ABSTRACT: Climate change is profoundly altering fish migration patterns, affecting species distribution, seasonal movements, and survival. Rising ocean temperatures, shifting currents, and changes in salinity disrupt traditional migration routes and spawning grounds, leading to ecological and economic consequences. This review synthesizes current research on the impacts of climate change on fish migration, highlighting physiological stress, altered habitat suitability, and shifts in food availability. Additionally, it explores potential adaptation strategies for fisheries management and conservation efforts. Understanding these changes is crucial for mitigating risks to marine biodiversity and ensuring sustainable fisheries in a rapidly evolving climate.

I. INTRODUCTION

Climate change is significantly altering fish migration patterns by affecting environmental cues like temperature, salinity, and ocean currents (Cheung et al.,2013). Rising ocean temperatures drive species to move poleward or deeper, while ocean acidification impairs navigation (Pauly et al.,2013). Changes in currents and salinity further disrupt migration routes, impacting biodiversity, fisheries, and food security. These shifts lead to ecological imbalances and economic challenges. This review examines the causes, consequences, and potential adaptation strategies to mitigate the effects of climate change on fish migration(Munday et al.,2014)

II. CLIMATE CHANGE AND CHANGING OCEAN CONDITIONS

Climate change is altering ocean conditions, impacting fish migration through rising temperatures, ocean acidification, and changes in currents and salinity. Warming waters force fish to migrate poleward or deeper, affecting ecosystems (Cheung et al., 2015). Ocean acidification impairs sensory functions, leading to disorientation and lower survival rates (Munday et al., 2009). Shifts in ocean currents and salinity, disrupt migration routes and spawning grounds, threatening marine biodiversity (Peck et al., 2010). Understanding these effects is essential for effective conservation and fisheries management.

III. SHIFTS IN MIGRATION PATTERNS DUE TO CLIMATE CHANGE

Climate change is altering fish migration patterns, affecting distribution, breeding cycles, and habitat access. Poleward and depthward migration occurs as species seek cooler waters, impacting ecosystems and fisheries (Pinsky et al., 2013). Early or delayed migration timing disrupts breeding cycles, leading to mismatches with food availability (Juanes et al., 2004). Habitat fragmentation and human-made barriers, further obstruct migratory routes, threatening biodiversity (Lennox et al., 2019). Effective management, habitat restoration, and sustainable policies are crucial to support fish populations.

IV. ECOLOGICAL AND BIODIVERSITY IMPACTS ON FISH

Climate change is disrupting ecosystems by altering predator-prey relationships, enabling species invasions, and causing the decline of cold-water species. Migration mismatches lead to food shortages and ecosystem imbalances (Freer et al., 2021). Warmer waters facilitate species expansion, increasing competition and displacing native fish (Perry et al., 2005). Cold-adapted species like salmon face population declines due to habitat loss and reduced



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reproductive success (Jonsson et al., 2009). Conservation efforts and adaptive management are crucial to maintaining ecosystem stability.

V. SOCIO-ECONOMIC CONSEQUENCES

Climate change poses socio-economic challenges by affecting fisheries, coastal communities, and resource management. Fish availability declines, threatening livelihoods and food security (Brander et al.,2007).Shifts in commercially important fish stocks force fisheries to adapt, disrupting traditional fishing grounds and causing resource conflicts (Drinkwater et al.,2005).Fisheries management faces challenges as unpredictable migration patterns demand adaptive policies for sustainability (Hollowed et al., 2013). Global cooperation and sustainable practices are essential to mitigate these impacts.

VI. ADAPTATION AND MITIGATION STRATEGIES

Adaptation and mitigation strategies are crucial for addressing climate change impacts on fish migration and ensuring marine sustainability. Marine Protected Areas (MPAs) help conserve habitats and biodiversity, reducing stressors like overfishing (Roberts et al., 2017). Fisheries adaptation strategies—such as diversifying target species and improving gear—support economic stability amid shifting fish distributions (Sumaila et al., 2011). Climate-resilient policies that integrate science into fisheries management and promote international cooperation are essential for long-term sustainability (Gattuso et al., 2015). Combining conservation, adaptation, and policy efforts is key to securing global fisheries.

VII. CONCLUSION

Climate change is disrupting fish migration by altering species distribution, breeding cycles, and ecosystem stability. Rising temperatures, ocean acidification, and shifting currents drive fish to new regions, impacting biodiversity and fisheries-dependent communities. Mitigation strategies like Marine Protected Areas (MPAs), adaptive fisheries management, and climate-resilient policies are essential for safeguarding fish populations. Integrating scientific research into policies and fostering global cooperation will help ensure sustainable marine resources. Proactive measures are needed to minimize climate change's impact on migratory fish and the ecosystems and communities that depend on them.

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