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Editorial: Vulnerability of Fisheries to Climate Change

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Editorial on the Research Topic

Vulnerability of Fisheries to Climate Change

Evidence that environmental and climate change (CC) cause long-term and large-scale variability in the dynamics of marine species populations is growing. This new variability, combined with the well-known impacts of fishing itself, would need to be quantified and integrated in the sustainable management of fisheries. The relative importance of fisheries and CC (e.g., warming, acidification, and sea level rise) on marine and estuarine resources remains an issue of debate within the scientific community, the fishing sector, and the general public.

A workshop hosted by the FAO (Cochrane et al., 2009) concluded that general trends of change in fish stocks could be identified and attributed to CC. On one hand, tropical and subtropical stocks may experience reduced productivity, and on the other, high latitude stocks may benefit with increased productivity. In addition, the authors concluded that fish physiological processes and the seasonal timing of life history events may be affected. Shifts in habitat productivity and physiology imply that stock assessment models would need to allow for changes in vital parameters of population dynamics. Moreover, managers would need to consider changes in the perception of the magnitude of the rates of sustainable exploitation, given the expected impact of CC on stock productivity.

This Research Topic aimed to assemble different perspectives on the role of climate change in fisheries, with research from different disciplines including fisheries oceanography, climatic modeling, time series analyses, sociology, economics, and stock assessment. Ogier et al. developed a two-step participatory approach to evaluating options for key fisheries. Species whose distribution and abundance are highly to moderately vulnerable to climatic effects were selected. A production spectrum from data collection (species biology-ecology traits, policy and management staff from fisheries management agencies, research scientists, and commercial and recreational fisher representatives) and analyses, to information gathering, knowledge production and communication was investigated. Stakeholders, whose broader function is to provide advice to decision makers on fishery management options, considered results of the study for adoption and undertook any agreed co-management actions. It was clear that planned adaptation to CC and subsequent vulnerabilities demand logistic, scientific, and societal effort and coordination.

Workshops with representatives from the regional sea food sector, science, NGOs, and local authorities identified important issues linked to CC affecting environment, society, economy (Hoerterer et al.). These authors identified policies that consequently allowed assessment of opportunities and challenges in achieving sustainable growth of the blue economy under CC. Hoerterer et al. conclude that synergies and conflicts between the sectors and subsequent political decisions threaten sustainable growth of the blue economy in highly contested regions. Thus, calling for a more flexible and adaptive approach to policy making in fisheries, considering the

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changing environmental, social and economic realities of each region.

A number of studies set background larger scale scenarios for CC, but effective vulnerability assessment and adaptation practices for fishing communities also require more local or regional approaches. Martins and Gasalla applied the Intergovernmental Panel on Climate Change (IPCC) vulnerability approach where societal vulnerability is measured as a function of sensitivity, exposure, and adaptability. Findings revealed that remoteness and the lack of climate change-related institutional support increase vulnerability among fishing communities in the region. Community organization, leadership, research partnerships, community-based co-management, and livelihood diversification reduce vulnerability and facilitate a better understanding of the nature and extent of exposure and vulnerability to CC. Moreover, these communities in examining their capacities to mitigate can cope with the adverse implications of CC on their long-term well-being. There is thus an urgent need to investigate the most effective vulnerability and adaptation practices for specific coastal communities, notably, small-scale fishers communities who play an important role in the food supply chain.

Increasingly uncertain futures of climate-induced changes generate more policy choices, leading to a "snowballing" of possible futures facing decision-makers. Thus, "The Melting Snowball Effect" that considers a chain reaction ("domino effect") increasing the number of plausible scenarios ("snowball effect") with CC (melting snow, ice, and thawing permafrost) was applied by Dankel et al. Scenarios were designed for informed decision-making in response to CC complexities based on participatory stakeholder workshops and narratives from in-depth interviews for deliberative discussions among academics, citizens, and policymakers.

Management strategy evaluation (MSE) is a powerful computer simulation methodology to evaluate courses of action in the management of fisheries. The International Commission for the Conservation of Atlantic Tunas adopted a harvest control rule (HCR) for the fishery of North Atlantic albacore stock which was evaluated using MSE. Merino et al. used the same MSE framework to evaluate the impact of changes in productivity and in recruitment variability potentially triggered by CC, finding that the adopted HCR was robust to those expected impacts. They conclude that the establishment of adequate HCR help maintain sustainable fisheries even under CC expected variability.

CC could be the epitome of a density-independent impact on the population dynamics of fish stocks. Canales et al. used per capita population growth models to quantify the influence of CC, fishing and density-dependence in the control of anchovies and sardines in northern and central-south Chile. The picture that emerged from their work was quite nuanced. They found that the northernmost anchovy stock was driven by density-dependent forces, as well as by climate, fishing, and the interaction between climate and fishing. Further south, both sardines and anchovies exhibited weaker density-dependence and stronger impact of fishing on anchovies and stronger impact of climate on sardines. Another very large pelagic stock in the South Pacific is the jack mackerel stock, exploited mostly off Central Chile, collapsed in the mid-2000s. Lima et al. attributes this collapse on the dynamics of fishing effort as the proximate cause, which was modulated by economic forces and climate variability acting on fishing effort.

Several inter-disciplinary approaches were presented in this special issue, encompassing a wide range of topics that needs to be considered to cope with the impact of CC on fisheries. These inform decision makers of the influence of CC-driven environmental variability on the biological and socioeconomic aspects of fisheries.

AUTHOR CONTRIBUTIONS

FL was responsible for the idea of this special volume, wrote, and review this editorial topic. RR-U wrote and review this editorial topic. FC review this editorial topic. All authors contributed to the article and approved the submitted version.

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