Theme session A

ICES - PICES session: Projected impacts of climate change on marine ecosystems, wild captured and cultured fisheries, and fishery dependent communities

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The Theme Session was organized by members of the ICES-PICES Strategic Initiative on Climate Change Impacts on Marine Ecosystems (SICCME). Shin-ichi Ito (Japan) represented PICES and Jon Hare (USA), John Pinnegar (UK) and Myron Peck (Germany) represented ICES.

The goal of SICCME is to coordinate northern hemisphere efforts to understand, estimate and predict the impacts of climate change on marine ecosystems. The objectives of the initiative are:

1. To advance the scientific capacity on the three main challenges identified above (understand, estimate and predict the impacts of climate change on marine ecosystems) by engaging the PICES and ICES scientific community in focused workshops, theme/topic sessions and symposia that target key uncertainties and technical barriers that impact the predictive skill of ocean models used to project the impacts of climate change.
2. To effectively communicate this capacity to clients, Member Countries, stakeholders and the broader scientific community.
3. To facilitate an international effort to design data collection networks at the spatial and temporal scales needed to monitor, assess and project climate change impacts on marine ecosystems.
4. To facilitate international collaboration to design and implement comparative analysis of marine ecosystem responses to climate change through modelling and coordinated process studies.

Climate change is expected to impact marine ecosystems throughout the world; however, the severity of these impacts will vary regionally. The theme session presented examples of the types of regional impacts that are expected in the near term (2020-2040) and longer term (2080-2100). Presentations were given representing all four objectives of SICCME.

The session opened with a talk by Ken Drinkwater. The analysis revisited a prior paper that documented temperature effects on recruitment. Updating the time series presented in the original paper, the temperature relationship was equivocal indicating some of the challenges examining long-term forcing on shorter time scales. Either the temperature relationship is weak or is masked by other factors including fishing.

Several talks then followed that projected population abundance and distribution under climate change. Examples included squid, scallop and lobsters distributions, mackerel spawning habitat, mullet habitat, oceanographic indices, and fish standing stocks in Micronesia. These talks demonstrated the diversity of techniques being used for projections and demonstrated the expanding use of these techniques topically and regional.

The next set of talks addressed climate impacts on marine resources beyond the distribution of individual species. Chang et al. described a modelling effort that examined scallop distribution from the perspective of direct temperature-limitation and temperature-limited predator distributions. Eddy et al. described global links between projected changes in coral cover and links to global fish abundance and distribution. Thorarinsdottir et al. discussed the interaction between changing environment and species invasions in Icelandic waters. These studies and others in the session represent the growing integration of climate themes with other marine ecosystem themes including predation, structural habitat, and invasive species.

A set of talks focused the effects of temperature on growth, metabolism and overwinter survival. These talks identified important links between climate change and species ecology and contribute to a process-oriented perspective on temperature effects as opposed to statistical approaches (e.g., species distribution modeling). These studies highlight the complexity of the effect of temperature on species biology and foreshadow some of the challenges when developing process-based species distribution models.

Stiasny et al. presented new research on the effects of ocean acidification on fish larvae. A commercial aquaculture facility was used outside of the season for commercial operations (this colocation of commercial and research activities is notable in and of itself). The combined effects of food limitation and acidification on larvae were studied. A number of response variables were examined including ossification and structure of the gills, which were impacted by acidification. The authors concluded that a physiological and functional understanding in required to more fully understand the effects of climate change on marine organisms.

The next set of talks described links between climate change – fisheries – and fishing communities. These talks described a number of approaches including interviews, economic data, large social science datasets, and expert opinion. Topics included the effects of storminess on fishing fleets, impact of climate change on aquaculture, climate vulnerability across European nations, understanding climate effects on human communities, changes in fish productivity and reference points, and the development of shared socioeconomic pathways for projecting the effects of climate changes.

The session closed with a discussion of the presentations. Differences in the results of climate vulnerabilities were identified and will be followed up by several of the participants. The need for coordination among human community studies was also identified so as not to overwhelm communities with researchers, particularly smaller communities.

The session evidenced that the field of science examining climate change impacts on marine ecosystems is still rapidly expanding. Some approaches are reaching maturity and can be incorporated into global and regional climate model projections (e.g. species distribution modelling). However, large parts of processes may not be fully elucidated. Other approaches are cutting edge and investigating novel impacts on marine organisms (e.g., gill ossification), marine ecosystems (e.g., lower trophic level productivity and links to fisheries in the Eastern Bering Sea), and human communities (e.g., storminess and fishing fleets). All improvements in understanding advance our skills to estimate uncertainty in future projections.