

Theme session D

Ecosystem changes and impacts on diadromous and marine species productivity

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The ICES theme session D was proposed by the ICES Working Group on the Science Requirements to Support Conservation, Restoration and Management of Diadromous Species (WGRECORDS). The motivation for the session stemmed from recent publications that identified the impacts that climate-related changes in the ocean are having on Atlantic salmon stocks across the North Atlantic. In addition, climate and ecosystem influences on some marine fish species have been widely documented at local, regional, and Atlantic basin scales. The goal of the session was to bring together scientists working on both diadromous and marine species from across the North Atlantic to compare results and, in the process, develop a better understanding of how ecosystem changes are affecting broadly distributed fish populations.

Contributions covering a variety of topics were invited as part of the session, including:

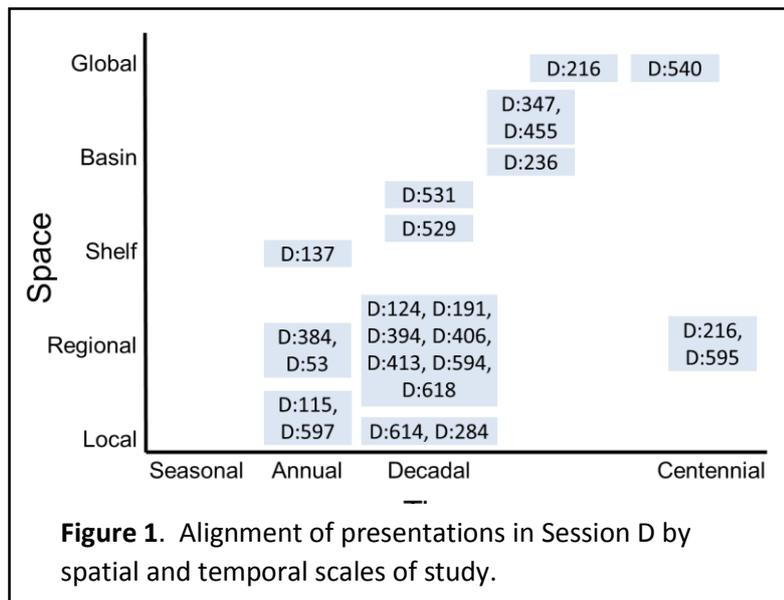
- Linkages between important biological processes across one or more trophic levels
- Key climate and physical drivers that structure these processes
- Ecosystem impacts and resulting species responses to climate and physical changes
- Evaluation of potential mechanisms driving the observed species responses
- Projections of population dynamics and ecosystem processes under future climate scenarios
- Examples of species management that accounts for climate and ecosystem conditions

All of these topics were represented to some extent within the 24 oral presentations and 5 posters that were part of the session. However, most of the contributions focused on topics in the first four bullets; fewer contributions covered future projections and management approaches.

Oral presentations documented a range of biological mechanisms through which climate and ecosystem changes can affect fish species. Several talks addressed productivity in general, while others focused on recruitment, growth or condition, spatial and temporal distribution, and predator-prey interactions as mechanisms through which ecosystem changes may affect productivity. Four talks at the end of the session discussed stock assessment approaches that may incorporate the influences of climate conditions on fish populations and discussed the relative value to management systems of more explicitly considering these influences in scientific advice.

Across the program of presentations, many contributions focused on changes in mean ocean temperature as both a direct and indirect driver of changes in fish population characteristics. Several talks highlighted other factors such as river flow, predator or prey changes, and fishing pressure as important drivers of population levels or traits. Further, a number of talks linked a 1990s shift in large-scale climate forcing mechanisms which ultimately resulted in changes in zooplankton community characteristics and fish populations through shifting energy availability and pathways, thereby connecting physical conditions to lower trophic levels and then to higher trophic levels. Most talks in the session focused on mean physical conditions and biological responses, but the need to also consider variability in both physical factors and biological outcomes was raised in discussions.

We introduced a framework based on spatial and temporal scales as a way of organizing information presented in the session. Although an interest when developing the session was in cross-basin comparisons, we expected information to be derived from a



range of scales. When organizing talks in the session along these scale axes, we noted a strong emphasis on studies that focused on annual to decadal time scales and local to regional spatial scales (Figure 1). How this prominence of local to regional and annual to decadal perspectives aligns with needed management advice should be considered further.

Integrating information from across scales can be valuable, and one talk (D:455) provided an example of a meta-analysis that drew information from multiple populations to inform one assumption in a large-scale basinwide life cycle model of Atlantic salmon. Discussions throughout the session focused on the value of this approach for scaling up based on multiple pieces of more “local” information. Such an approach may be necessary for developing basinwide insights from more locally-focused scientific studies. Empirical data will be important for assessing whether this upscaling approach provides realistic results at larger scales.

Data needs also represented an important topic in discussions throughout the session. Several speakers raised the issue of mismatches between the scale of data and the scale of scientific interests and management needs. The spatial and temporal extent of many analyses was constrained by the limits of individual monitoring programs and by challenges of using data from multiple monitoring programs that differ in history and protocols. Long-term monitoring programs that collect data on biological characteristics and higher temporal

and spatial resolution in surveys were recognized as critical needs to support large-scale studies investigating the impacts of climate and ecosystem change.

The session was well attended both in numbers and diversity of participants. Attendance averaged around 90 people during the session, and the attendees represented a range of countries, diverse types of scientists (from biologists to modelers), and a mix of scientists working on diadromous and marine species. It was noted that a number of presentations within other sessions at the ASC were applicable to our session, and in fact, a session on inshore fisheries was concurrently scheduled. Unfortunately, this left many attendees moving between sessions, but it also clearly highlighted the need and interest for future exploration in this area. Contributions and discussions in this session provided information to improve the understanding of common drivers and trends that affect ecosystem processes, lower trophic levels, and diadromous and marine fish stocks on both sides of the Atlantic, and it raised interest in larger-scale studies and cross-basin comparisons.