Foreword

This report summarizes the interpretations of the impacts of climate and climate change on the important marine species in the commercial fisheries of Canada, China, Japan, Korea, Russia and the United States. Leading experts in these six PICES member countries used published literature as well as their own interpretations to assess the impact of climate and climate change on the dynamics of the key commercial species and their associated marine fisheries. It has been relatively recently that climate has been recognized as a significant factor in the regulation of abundance trends of key species in world marine fisheries. Thus, the literature that is available to evaluate future climate impacts is sparse. Adding to the complexity of forecasting impacts is the uncertainty related to regional climate-induced changes in the ocean habitats and the relatively poor understanding of the natural history of many species.

The Climate Change and Carrying Capacity (CCCC) Program was the principal activity of PICES since the Second Annual Meeting of the Organization in 1993. The two major themes of the CCCC Program were the estimation of the carrying capacity of higher trophic levels and the determination of how changes in ocean conditions affect the productivity of key fish species in the subarctic Pacific. The highly relevant and challenging goal of discovering how to forecast the impacts of climate change on the productivity of key fish species and their prey was set. During the 1990s, PICES established expert teams to focus on understanding the ecosystem impacts of climate change. Symposia, workshops and meetings improved scientific understanding around the North Pacific through timely and effective communication within the ocean science community. Working Group 16 on *Climate Change, Shifts in Fish Production, and Fisheries Management* was part of the effort, accepting the challenge of reporting the impacts of climate change on the key species and their fisheries in the countries that form PICES.

There is informed speculation in this report that highlights what might happen to major fisheries in the future. There also are differences in opinion. However, this international summary should be seen as a first attempt to report what is known about the impact of climate and climate change on the major fisheries in the northern North Pacific. It is a benchmark that can be cited and used to encourage the formation of other research teams. Not all key species or major areas were addressed by all countries, but there is an accumulation of material that provides evidence of large-scale associations with climate. An effort was made to standardize the reporting among countries; however, the reader will note that structural and editorial differences occur. Also, the issues were seen differently among the scientists involved in the preparation of the report. These differences were to be expected as the approaches to fisheries management differ among the six countries. The Synopsis attempts to tie everything together by emphasizing how the major species and their fisheries may be related to large-scale climate events. This section is the interpretation of the two authors and not necessarily the view of all authors. I hope that it is the Synopsis that leads to the next report which will bring experts together to search for common mechanisms and linkages. Success in this second phase could lead to the third phase, which would connect information to global climate change models and natural physical cycles.

In the future, there needs to be better understanding of the biology, ecology and population dynamics of the key species in the major fisheries in the North Pacific. An improved understanding of the natural history of the major species will improve forecasts and may reduce the number of models used to make decisions. Readers of this report will be able to appreciate the amount of work that is involved to develop forecast models that reliably identify the impacts of future climates. It is clear from the experience of this Working Group that forecasting the impacts of a changing climate on the key fisheries in the North Pacific will require commitments by all countries to support coordinated and focused research by teams of experts.

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