

ICES/PICES/UNCOVER Symposium on “*Rebuilding Depleted Fish Stocks – Biology, Ecology, Social Science and Management Strategies*”

by Gordon Kruse

Many fish and invertebrate stocks around the world are severely overfished and many still remain subject to overfishing. Within the PICES region, based on statistics compiled by the Food and Agriculture Organization of the United Nations (FAO), a total of 441 fish stocks have been assessed for exploitation status. Of these, 71% are “fully exploited” or “overexploited, depleted or recovering”. There has been an increasing trend in the percentage of overexploited stocks since 1974.

At the World Summit on *Sustainable Development* held in Johannesburg, South Africa, in 2002, countries from around the world pledged to restore fish stocks to levels capable of supporting maximum sustainable yield by 2015. Supportive of this pledge, the European Union (EU) funded a research project called “UNderstanding the Mechanisms of Stock ReCOVERy (UNCOVER)” to identify the strategies to recover European fish stocks. UNCOVER involves more than 120 scientists from 17 institutes from seven European countries. Research and management to rebuild depleted fish stocks have been important areas of activity in the Northwest Atlantic Ocean portion of the International Council for the Exploration of the Sea (ICES) region, as well. Likewise, in the North Pacific Ocean, rebuilding depleted fish stocks has been a topic of much interest to PICES. In fact, a special issue on “*Ecosystem Approach to Fisheries: Improvements on Traditional Management for Declining and Depleted Stocks*”, stemmed from a Topic Session held by the PICES Fishery Science Committee at our 2007 Annual Meeting (Victoria, British Columbia, Canada), was published in the journal *Fisheries Research* in September 2009 (Vol. 100, Is. 1). Effects of fishing and climate on the status of fish stocks and marine ecosystems are key components of our new science program called FUTURE, “*Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Ecosystems*”. In the past few years, multiple sessions were convened at PICES Annual Meetings on assessing and managing fishing effects on fish stocks through ecosystem approaches, including managing bycatch and ecosystem effects of fishing. PICES efforts on ecosystem approaches to fisheries involve the need to rebuild fish stocks and manage them for sustainability.

ICES, PICES, and UNCOVER forged a collaboration to co-organize a symposium on “*Rebuilding Depleted Fish Stocks – Biology, Ecology, Social Science and Management Strategies*” held from November 3–6, 2009, at Warnemünde, Germany. Dr. Gordon Kruse (U.S.A.) served as the PICES co-convenor and Dr. Toyomitsu Horii (Japan) served as a PICES member of the Scientific Steering Committee. The

host organizer institute was the Institute for Baltic Sea Fisheries, Johann Heinrich von Thünen-Institute (vTI), Federal Research Institute for Rural Areas, Forestry and Fisheries, Rostock, Germany. This institute is also the coordinator of the UNCOVER project. In addition to the EU, ICES and PICES, the symposium was co-sponsored by several research institutions or programs including vTI, Fisheries and Oceans Canada, Institute of Marine Research (Norway), North Atlantic Fisheries Organization (NAFO), and the Fish Reproduction and Fisheries (FRESH) program of the European Cooperation in Science and Technology (COST).

Research scientists, managers, policy-makers and other stakeholders were invited to present and discuss the recent status and strategies for the recovery of overexploited fish stocks. Papers on biological and ecological modeling, socio-economic and management aspects were sought. By exchanging information from ICES and PICES regions and other areas of the world, the symposium was designed to advance knowledge on how to achieve sustainable fisheries, as well as to serve as a forum to exchange ideas and views across disciplines and between scientists, the fishing industry and managers.



The small port town of Warnemünde, Germany, hosted the symposium. Located on the Baltic Sea, Warnemünde is known for shipping, shipbuilding and fishing.

The venue for the symposium was Warnemünde, Germany, an old picturesque village situated on the coastline that featured both sandy beaches and steep cliffs. The village is located at the mouth of the Warnow River, which is a major gateway to the Baltic Sea for cargo vessels, passenger ferries and fishing boats. Warnemünde is a portion of the old Hanseatic city of Rostock, which is known for its city wall, gothic brick architecture, and gabled houses.

The symposium was convened over four days, starting on Tuesday, November 3, 2009. Welcoming addresses were delivered by representatives from the three co-organizers, Dr. Cornelius Hammer (UNCOVER project coordinator and Director of the host institution), Dr. Gerd Hubold (General Secretary of ICES) and Dr. Gordon Kruse (Vice-Chairman of the PICES Fishery Science Committee). The symposium keynote lecture titled *“Rebuilding depleted fish stocks: The good, the bad and the mostly ugly”* was given by Dr. Steven Murawski, Director of Scientific Programs and Chief Science Advisor for the U.S. National Oceanic and Atmospheric Administration (NOAA). He categorized rebuilding plans as those that met their stated objectives (the “good”), those that remain “paper plans” despite assertions to the contrary (the “bad”), and those that have only been partially to completely unsuccessful despite significant management actions (the “ugly”). Attributes of successful plans were identified: consistent definition of plan objectives, support by industry, political leadership, and the public, and credible and consistent scientific monitoring of progress. Many of these successful plans also incorporate fishers into the scientific process.



The symposium keynote lecture by Dr. Steven Murawski, Director of Scientific Programs and Chief Science Advisor for the U.S. NOAA.

The symposium was structured in topical sessions. A full day Theme Session 1 dealt with the *“Impact of fisheries and environmental impacts on stock structure, reproductive potential and recruitment dynamics”*. It was co-chaired by Drs. Tara Marshall (Scotland) and Toyomitsu Horii (Japan). The session’s subtitle became *“Yes we can!”* (rebuild fish stocks). The motto was intended to be somewhat provocative and challenging to symposium participants.

Throughout this session in particular, and the symposium in general, it became apparent that many stocks can be and have been recovered by implementation of rebuilding plans. However, it also became apparent that others failed to recover, despite implementation of rebuilding plans, including extended periods of low fishing mortality. In some cases, climate regime shifts and associated ecosystem reorganizations have delayed the restoration of overfished stocks under rebuilding plans. Presentations in the session addressed the role of spatial processes in reproduction and recruitment, fishery-induced impacts on stock structure and reproductive potential in sexually dimorphic species, and influence of life history traits, age structure, migration dynamics and fishery-induced evolution on stock rebuilding.

A half-day Theme Session 2 on *“Trophic controls on stock recovery”* was co-chaired by Drs. Axel Temming (Germany) and Bjarte Bogstad (Norway). This session focused on multispecies interactions, such as the role of predator–prey relationships, cannibalism and competition. Cannibalism was proved to be a significant factor affecting population dynamics of two gadid species, southern hake and Atlantic cod. It was shown that, when the capelin (prey) stock is large, the cod (predator) stock can withstand higher fishing pressure in the Barents Sea. One presentation revisited the role of cod–seal interactions on the lack of recovery of cod from the Northwest Atlantic. It concluded that seals accounted for an increasing proportion of total mortality on cod since the fishery closure in 1993, likely contributing to the lack of cod stock recovery. Mechanisms reported in this session provided explanations for the failure of some plans to rebuild depleted fish stocks.

A half-day Theme Session 3, co-chaired by Drs. Ana Parma (Argentina) and Dr. Laurence Kell (Spain), addressed *“Methods for analysing and modelling stock recovery”*. A common thread through talks in this session was the level of uncertainty and how to address it. One case study recounted the sad history of severe depletion of the southern bluefin tuna, a depletion that was widely recognized but where no agreement could be reached on quotas for many years. A major breakthrough on the political impasse was the institution of a Scientific Committee charged with developing a management evaluation procedure to objectively assess management alternatives under uncertainties about various processes and parameters. Although a consensus recommendation was made in 2005, the agreed-upon management procedure was not implemented because substantial underreporting of catches became apparent, thus throwing into question the modelling analyses. A fuzzy logic approach was proposed as one means to effectively identify and communicate the environmental and fisheries indicators responsible for periods of fishery productivity, as well as periods of lack of recovery. Management strategy evaluation approaches were presented in which an operational (population) model was coupled to a management model, providing a means to evaluate uncertainty in various parameters and processes

under alternative rebuilding strategies. There was considerable discussion about exactly how much uncertainty should be presented so as not to erode the underlying motivation to take management actions necessary for stock rebuilding.

A half-day Theme Session 4, co-chaired by Drs. Denis Bailly (France) and Douglas Wilson (Denmark), focused on “*Social and economic aspects of fisheries management and governance*”. A case was made for conducting social impact assessments and community profiles to better understand the social and economic consequences of fishery collapses, as well as the implications of recovery plans on communities.

A half-day Theme Session 5, co-chaired by Drs. Joseph Powers (U.S.A.) and Fritz Köster (Denmark), covered “*Management and recovery strategies*”. Case studies for fish and crabs provided examples of rebuilding of previously heavily exploited stocks after reduction of total fishing mortality. A meta-analysis conducted by the UNCOVER project showed that the following four criteria are most important for stock rebuilding: (1) rapid reduction of the fishing mortality, (2) incorporating environmental variability into assessment and management, (3) developing approaches specific to the life history characteristics of the stocks under consideration, and (4) implementation of rights-based management criteria.

The final day of the symposium was dedicated to a four-hour panel discussion. Dr. Gordon Kruse was one of the panellists in this session. In general, it was concluded that there was clear evidence that collapsed and severely depleted fish stocks can be recovered, although climate regime shifts and ecosystem reorganization may cause recovery to be much slower than expected for some species. It was agreed that it is extremely important to avoid stock depletion in the first place by constraining fishing mortality to sustainable levels. However, in cases of stock depletion, an immediate, sharp reduction in fishing mortality is a common feature of many successful

rebuilding plans. Stock rebuilding and sustainable fishery management efforts in the U.S., and in particular in Alaska, were recognized by several participants as useful models for future stock rebuilding efforts in the North Atlantic. Another important point was the distinction between ‘recovery’ and ‘rebuilding’. Recovery considers only the increase in stock biomass to some specified level, whereas rebuilding goes further to also consider restoration of age structure, and evolutionary (*e.g.*, size at maturity) and behavioural traits (*e.g.*, migration routes). Typically, rebuilding of the stock with respect to these attributes takes a much longer time than recovery to biomass thresholds.

This well-attended symposium was highly successful. Because of the sponsorship, venue, and close timing of the symposium relative to the 2009 PICES Annual Meeting, the majority of participants and presentations represented fisheries in the Atlantic Ocean, particularly the Northeast Atlantic. However, talks and posters about fisheries in the North Pacific provided excellent contributions to and enriched the symposium. Accepted papers will be published in a special issue of the *ICES Journal of Marine Science*. Once published, this volume will be of much interest to scientists working towards recovery of depleted fish stocks in the PICES region. This compendium of case studies, modelling methods, management approaches, and social and economic considerations, in combination with those found in the PICES special issue of the journal *Fisheries Research* (September 2009, Vol. 100, Is. 1), will be very useful published resources to fishery scientists and managers in PICES member countries.

In conclusion, this symposium was another outstanding successful collaboration of PICES with other international organizations. It was a great pleasure and privilege for me to work with ICES and UNCOVER colleagues on this topic of great mutual interest. The symposium was very well organized, well run, and many participants extended their appreciation to the co-convenors and local meeting organizers, alike.



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(Photo shows Gordon during a hike in Juneau, Alaska.)