ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

Theme Session T

Death in the sea - Mortality in the zooplankton and early-life stages of marine fish (estimates, processes and outcomes)

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With the development of new laboratory and field observational techniques, and the advance of modelling methodology, it is time to review approaches for estimating, simulating, and improving our understanding of the processes that control mortality. Mortality is difficult to quantify in the field (e.g. teasing apart "true" mortality from advection/diffusion effects). In addition, little is known about the relative importance of individual processes (e.g., disease, parasitism, starvation, predation, density-dependence) and how they contribute to overall survival at the end of the larval/early juvenile period. This theme session surveyed methods for 1) estimating mortality in the field, 2) understanding underlying processes, and 3) constructing process-based forecasting tools that quantitatively link adult biomass/egg production with post-juvenile stages. We invited contributions from laboratory and mesocosm experimental research, field studies, modelling work, and synthetic approaches that elucidate, estimate, and forecast mortality of marine fish early life (including juvenile stages) and lower trophic levels (zooplankton).

The Theme Session (TS) was well attended throughout its two-days span, and most contributions generated a good response and questions from the audience. In all, there were 15 oral and 4 poster contributions, with one 1 withdrawal from the original abstract submissions in May 2009.

An interesting start to the TS was provided by two talks on methodology. Oceanographers and fishery scientists have been challenged for decades to develop methods that confidently estimate rates of death in the sea. The problem is particularly difficult when information on abundance-at-age is unavailable or difficult to obtain, as is the case for most invertebrate organisms and for the pelagic larval stages of many fishes. The scope of available methods to estimate mortality in plankton and young fishes was covered by these talks, mostly in a modelling framework and especially in increasingly common individual-based models. While model-derived estimates of mortality are perfectly acceptable in demographic studies, methods to actually estimate loss rates of plankton and young fish are needed. These two papers evaluated, reviewed, and critiqued stage-based (T:01, copepods) and size-based (T:02, fish) approaches to estimate

mortality. In both cases, the presenters concluded that available methods often gave very different estimates. Not surprisingly, violation of initial assumptions, e.g., steady state, constant recruitment rate, was responsible for errors. Errors in assigned growth rates (fishes) and stage duration (copepods) caused major variability in mortality estimates, based on length-based and stage-based methods. In the case of length-based methods, mortality was routinely underestimated. It was concluded that applying more than one method is advisable and that exploring sensitivity of estimating methods, for example in a modelling exercise, is good practice.

Contributions highlighting mortality in tropical fish species provided new insights. T:14 presented diet studies of a suite of tuna, scombrid and billfish species found in the Florida Straights. Based on the finding that the feeding incidence of most species was >80% (often >95%), the hypothesis was that starvation may not control mortality in this tropical sea. It was pointed out, however, that the balance of food intake and metabolic demands would be needed to fully address this issue. In a separate study (T:13) results were presented of an extensive field program that collected fish larvae and physical information for 30 days near a Caribbean island. Cohort analysis was used to identify depth-specific patches of larvae of similar species and age, and current velocity measurements and dynamic height calculations were used to track the transport of patches over time. Combining field observations and detailed analysis, total mortality of each larval patch was calculated for two components: 1) natural mortality, and 2) apparent mortality due to advection out of the study area. The contribution of advection-based mortality relative to total mortality differed by age and was higher than natural mortality for all but the earliest life stages. Notably, this research solidly met the goals of the theme session: to describe methods and obtain estimates of mortality in the field.

Theme Session T was a good example of the varied range of methodologies that could (and should) be applied to an ecological problem. Presentations ranged from those based exclusively on field observations, such as the case study of mortality in the early-life stages of European plaice presented in T:10, to those that favoured a purely modelling approach, through research that used a combination of methods. For example, the issue of North Sea larval herring survival was studied using a backward-running bio-physical model in T:11, while T:06 employed a combination of field survey data analysis, including stomach contents and the presence of parasites as indicators of feeding incidence, and forward-running bio-physical modelling to quantify the contribution of advective processes to estimated field mortality rates.

The Theme Session proved to be a good venue to identify and explore areas of emphasis for WKMOR, to be held 22-24 March 2010 in Aberdeen, Scotland. An invitation was extended to the TS presenters and audience to participate in the upcoming workshop.