Session: Introduction to NEFSC Science

Overview of NEFSC Habitat Research

Tom Noji

A habitat is a part of the ecosystem including physical, chemical and biological components. Habitat is defined by the reference organism(s). As such habitat can be specific for an individual, a life history stage, a species, a stock, a guild or other biological organizational unit. Habitat is the spatially and temporally dynamic framework that links ecosystem condition and change with species success. To predict the effects of ecosystem properties and climate change on a species, it is imperative to understand the effects on the species' habitat and the species' response.

To achieve NOAA's twin goals of resilient coastal communities and economies, an improved understanding of ecosystem processes to promote healthy habitats is required. Habitat science at the NEFSC addresses habitat suitability, characterization, vulnerability and change and thereby supports management applications such as conservation of essential fish habitats, habitat restoration, renewable energy development, protection of key species, stock assessments, integrated ecosystem assessments, and forecasting climate change effects. Due to the diverse nature of "habitat", the associated science enterprise covers a range of spatial and temporal scales, incorporating observations from the field and laboratory as well as models. Notably the habitat – species relationships are interactive, and focused not only on species' response to changing habitat but also on species' effect on habitat properties.

The needs and challenges for fisheries habitat research are broadly articulated in the NOAA Fisheries *Marine Fisheries Habitat Assessment Improvement Plan* published in May 2010. The Plan is predicated upon filling the gaps in NMFS' habitat science to improve our ability to achieve sustainable fisheries. The plan is intended to help close those gaps and be the foundation for a nationally-coordinated fisheries-focused habitat science program. Given its limited resources NEFSC habitat science effort is prioritized according to available expertise, and takes into consideration scientific benefit of any particular habitat assessment, as well as social, economic, and political factors. The Habitat Assessment Prioritization Working Group report for NE fisheries has been a valuable publication for this process.

NEFSC field operations range in scale from decades-long shelf-wide hydrographic and plankton time series, to diel variations of primary production in the upper mixed layer of the water column. Deep-sea coral surveys with resultant distribution modeling, benthic habitat characterization to inform siting of wind turbines on the shelf, and positive effects of shellfish on improving water quality in eutrophic waters have been important research foci in the last few years and designed to support ocean managers. Important also are activities to support data availability through development of a State EFH Geodatabase and authoring of EFH Source documents.

Field surveys in recent years included investigations of gear impacts to benthic habitats, invasive tunicates in the Gulf of Maine, and untrawlable habitats. Currently considerable effort is expended on exploring and modeling distribution of deep-sea coral habitats and the characterization of benthic habitats in designated wind energy areas in the Northeast and understanding associated impacts of wind-farm development. These data are valuable for multiple applications such as modeling fish assemblages in relation to habitats. Field investigations will focus increasingly on the provision of ecosystem services by habitats in coming years

Experimentation in the field in recent years has included effects of dredging on oyster habitat, effects of aquaculture Floating Upwelling Systems (FLUPSIES) on water quality, and removal of nutrients from ecosystems by cultured seaweeds and shellfish. More recently focus has been given to ecosystem services provided by shellfish through nitrogen removal leading to economic benefits estimated to range from tens to hundreds of millions of dollars annually for Long Island Sound alone. Field experiments will soon begin on impacts of caged oyster infrastructure on finfish abundance and diversity as measured with eDNA, and trophic efficiencies of integrated multitrophic aquaculture farms using nutrient extraction methods. This information is important for supporting permitting of aquaculture.

Laboratory investigations on ocean-acidification effects on finfish recruitment may last for months, while shellfish hemocyte response to ocean acidification can be measured over hours. Various species have been the focus of laboratory research in recent years. In 2016 effort will be dedicated to better understanding recruitment and metabolism of sturgeon, winter flounder, dogfish and blue mussels in relation to temperature and pH. Shellfish research will increasingly focus on interactions of multi-trophic and offshore aquaculture with habitat. Results have been used to inform fishery management decisions on status of stocks, spatially explicit influence of habitat condition on stock recruitment and natural mortality, habitat area closures, and habitat areas of particular concern.

In coming years, NEFSC habitat research will support the NEFSC Strategic Science Plan. We will support stock assessment improvements, managing climate effects on wild capture and cultured fisheries, build the science capacity to support sustainable expansion of offshore industries, and promote more sustainable food security through integrated multitrophic approaches.