The Scientific Basis for Implementation of an Ecosystem Approach to Fisheries Management.

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The scope of what comprises an "ecosystem approach for fisheries management has evolved and become more inclusive over time. By the early 1980s the ecosystem focus was about predator-prey interactions and "multispecies assessments"; environmental drivers and dynamic ecosystem models became prominent in the late 1980s and 1990s; and biodiversity and habitat impacts of fishing were important considerations by the 2000s. In each incremental broadening scientific (and other) knowledge had three sequential roles. First was providing sufficient evidence that the ecosystem factors and processes affected productivity of stocks and sustainability of fisheries strongly enough to warrant consideration in assessment and management decisions; then taking a few typically information rich stocks/fisheries and show feasible ways to include the factors and processes in an assessment and resultant advice; and finally developing strategies to apply the lessons from the data-rich case histories more generally for cases more typical in terms of data and knowledge. Every step brought additional types of scientific expertise into the assessment and management activities - ecologists, oceanographers, climatologists, etc.

With each increment the resulting ecosystem-based advice and evidence-based decisions led to changes in management regulations about not just *how much* fish could be harvested, but also *when, how, and where* the harvesting could take place – with consequences for dependent livelihoods, cultural identity, and equity. These considerations are now part of implementing the ecosystem approach to fisheries, and social scientists are now part of the process. Thus the two major challenges the science and management in the 2020s are developing the knowledge basis to take changing climate fully into account in management, and integration of the social sciences with the environmental sciences, to take the human outcomes of options into of account such that humanity is *part of* the ecosystem, not just a user of it.