Response from: Dr. J. Frederick Grassle, Rutgers

What biological parameters should we be observing to enable better management of living marine resources?

- Population distribution, abundance and size of the larval, juvenile, and adult fish and shellfish species that comprise commercial and recreational fisheries. Traditional methodologies will continue to be used in the context of real-time physical data from the Integrated Ocean Observing System. These sampling techniques should be coupled with development of optical and acoustic assessment technologies.
- Population distribution and abundance of endangered and threatened species
- Recorded movements of large migratory species, (e.g. salmon, sharks, swordfish, tuna, marine mammals, turtles, etc.) using individual acoustic tags (e.g. http://www.toppcensus.org/ and http://www.vanaqua.org/POST/), acoustic arrays, and satellite data
- Abundances of bottom-dwelling and water column species. Existing monitoring programs should be supported and, wherever necessary, consolidated to assess the state of life in the ocean. These programs should be integrated with international assessments of marine biota.
- Synoptic observations of ocean color should be calibrated to provide real-time estimates of phytoplankton biomass , taxonomic composition, and productivity, including the occurrence of harmful algal blooms. Novel sensing systems, using DNA probes, for identification of harmful algal blooms and other algal species should be used as components of observing systems.

The management of living marine resources requires better understanding of "spatial and temporal components of specific ecological relationships relevant to large-scale changes in ecosystem functioning" (NAS 1999, Sustaining Marine Fisheries, p.120). Few studies of the marine environment provide information on accurately identified species in a precise spatial and temporal context. Modern navigational capabilities combined with real-time information on ocean processes at grid scales in the order of one kilometer will bring about a revolution in management of marine living resources. Examples of specific features of the ocean relevant to improving sampling designs of stock assessments used for management include:

- Fine-scale physical and chemical structure of coastal upwelling events producing plankton blooms
- Physical, chemical, and biological responses to major wind events
- Transport of particles in coastal plumes from rivers
- Formation of eddies and shifts in position of major currents
- Fine scale bottom habitat maps including fisheries areas around seamounts and in submarine canyons

Present efforts to sample living resources on continental shelves or in deep-sea areas do not adequately consider habitat or underwater environment at the time of sampling. Development of real-time feedback from an ocean observing system is a prerequisite for improving the statistical reliability of biological sampling and reducing uncertainty associated with management decisions.

A subsystem of the national ocean data system for IOOS for biological data should include data from a heterogeneous assemblage of sources and provide the technology to integrate these databases into a distributed system (see http://iobis.org). This subsystem would develop and promulgate international standards and protocols for accessing ocean biological data.