

Challenges of Evaluating Marine Reserves Against Stated Objectives: Meeting Social Expectations with Scientific Understanding

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Hal Weeks, Oregon Department of Fish and Wildlife, Newport, OR 97365
541.867.0300 ext 279
Hal.Weeks@state.or.us

Studies of existing marine reserves (i.e. no-take areas) consistently have shown increases in the number, size and biomass of focal species, along with the diversity of organisms, within a reserve when compared to the same area before reserve establishment or similar nearby areas outside the reserve. Given these positive changes, why are marine reserves such a controversial topic on the U.S. West Coast? Generally speaking, this is because no-take reserves represent a fundamentally different way of managing human uses of fishery resources. Fishers fear loss of freedom and economic opportunity. At the same time, there is substantial uncertainty in our understanding of ocean resources and habitats, and the depth of the human footprint, at several scales of resolution. Therefore, the magnitude of benefits that will be provided by marine reserves in meeting conservation and management goals, relative to other more familiar management tools, are highly uncertain in a context of recent sharp declines in harvest levels of West Coast groundfish.

In the United States, marine fishery resources are managed through public processes and, until recently, U.S. fishery law and policy encouraged the development of marine fisheries. With the recent marked shift toward a greater conservation emphasis in U.S. law, marine reserves will succeed as conservation and management tools only if they receive ongoing public support, including that of fishery user groups. To receive this support, the objectives for marine reserves must be clearly stated, and reserves must be rigorously evaluated against those objectives.

As an example for discussion, the Pacific Fishery Management Council has established six general objectives for its consideration of marine reserves in managing West Coast fisheries under federal jurisdiction. These are stock rebuilding, biological productivity, economic productivity, insurance against uncertainty and management error, habitat protection, and opportunities for research and education.

In considering whether to adopt marine reserves as conservation and management tools, there will be an interplay between the expectations that people have for reserves, the objectives that are established for reserves, and the possible siting and design of the reserves. These expectations and objectives, combined with our observations of nature and the ocean, will frame scientific hypotheses that can be tested. These discussions will rapidly bring up the question of how much information is adequate (or compelling) to state whether reserves are or are not meeting their objectives. Further, these considerations will highlight issues of ecological scale. Reserves will be small in comparison to the total ocean area being managed, and it is important to consider the issue of scale in formulating the questions that are being asked relative to the answers that evaluation can provide.

Comparing the six PFMC objectives against just the pattern of increases in biomass, density, reproductive potential and diversity observed in reserve evaluations, would we say the objectives are being met? In most cases, we'd probably have to conclude that the jury is still out. However, it is well known that reserves can and do benefit fisheries. Closed areas in New England waters have led to rapid rebuilding of sea scallop populations that are now available to the fishery on a carefully controlled basis. The Merritt Island Reserve in Florida adjacent to Cape Canaveral has led to increased production and encounters of trophy size fish in waters adjacent to the reserve. So, the question of what level of information (or scientific proof?) is adequate to make conclusions about reserve performance is an important one. Recognizing the differences between the scale of our objectives and the scale of likely evaluative research is imperative.

Three potential scenarios are discussed: state variables in a reserve, spillover effects, and larval transport. Hypotheses and data collection schemes are set forward for illustration and discussion. The three evaluation scenarios represent a continuum of increasing complexity, necessary collaboration among researchers and user groups, expense and longevity of needed monitoring, and increasing difficulty of establishing causation. As a general pattern, reserve networks that are small, close to shore, few in number, and that are focused on state variables and sessile or sedentary organisms will be easier and less expensive to evaluate compared to those that are large, distant, numerous and that involve dynamic process variables and highly mobile organisms.

In conclusion, a note of irony is presented. Reserves are suggested as a hedge against uncertainty in our knowledge of marine systems, and management error. Yet, it is this same uncertainty that makes marine reserves controversial, and their evaluation scientifically challenging. Marine reserves represent an experimental opportunity to improve the precision of our understanding of human and natural causes of variation; and thereby to improve management decisions through basic ecological knowledge and understanding. This scientific challenge is framed by a very difficult social and political context, and it is important that marine scientists help decision-makers to understand the resolution of our scientific understanding – and potential pathways to improve this understanding – throughout the public decision-making process.