Published on *OpenChannels* (https://www.openchannels.org)

Using Biological Survey Data When Selecting MPAs: A Framework

Editor's note: The following perspective piece by Mat Vanderklift and Trevor Ward offers one view of how MPA practitioners can organize their planning processes. It provides a bridge between two topics that MPA News has addressed in recent issues: the science of MPAs (MPA News 2:10) and MPA effectiveness (MPA News 2:11). This piece was adapted from an article that Vanderklift and Ward published last year in the journal *Pacific Conservation Biology* (Vol. 6: 152-61. Surrey Beatty & Sons, Sydney. 2000).

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Ecological information is an important basis for the selection of marine protected areas. However, when evaluating areas, planners are often faced with limited and uncertain ecological information on which to base their decisions. They usually do not have good information about the distribution patterns of species, habitats, and ecosystems over extensive areas. Even less is known about the processes that maintain biological diversity (such as those that maintain fish or invertebrate recruitment to an area) and the extent of ecological interconnectedness of different areas.

Arbitrary declaration of areas for MPAs on the basis of poor ecological knowledge leads to a high risk that objectives will not be met. If MPAs are to be more than just paper exercises to appease lobby groups with politically acceptable solutions, appropriate ecological data from a carefully designed process of sampling and analysis are required. MPAs identified and selected using only superficial ecological knowledge will provide a false sense of security, and may disguise continuing decay of marine biological diversity both within and around designated MPAs.

One solution to this knowledge deficiency is to conduct biological surveys. Obtaining data that may be synthesized into a comprehensive information base can be difficult and expensive. As a result, planners will often need to prioritize resources so that data collected meet specific information requirements. This can only be achieved using a framework that defines the respective roles of existing and required data in the MPA selection process.

We propose a seven-step operational framework to help managers decide how to prioritize information requirements, and how to manage the subsequent collection of biological data that meet those requirements. This framework is nested in an information-gathering phase that falls between the initial expression of interest and the final selection and declaration of an MPA. Below is a synopsis of the framework.

Step 1 -- Define the objectives for the MPA

Establishing well-defined and explicitly stated objectives is probably the most critical step when planning an MPA. When objectives are weakly defined or are specified in only generic terms (such as "protection of biodiversity"), the information requirements cannot be clearly established. As a result, survey designs become open-ended, and potentially very expensive to design and implement. Carefully defined objectives should ensure that MPA performance can be measured effectively.

Step 2 -- Classify spatial units to sample within

Next, define the spatial and/or ecological classes for which data are required. The classes may be set at any resolution (e.g., bioregions, habitats), with the appropriate resolution determined by the objectives of Step 1. Because ecological data on classifications are usually not comprehensive, surrogates may be needed. Surrogates, or indicators, for each classification should be simple and readily identified. Once surrogates are selected, classes may be mapped across the whole area.

Step 3 -- Select what attributes to measure

No project is likely to conduct a comprehensive survey and evaluation of all aspects of marine biodiversity, even in a small area. Therefore, usually only a small subset of the biota will be surveyed. Choice of the biological variables to measure can have a major effect on the location and boundaries of the intended MPA. Again, the use of surrogates becomes important. Such surrogates should be adopted in survey design with extreme care, and preferably only after field study validation of their effectiveness as a surrogate (Step 4).

Step 4 -- Assess surrogates

Assessment of the surrogates is best done in a purpose-designed set of studies. Such studies may include, for example, comparisons of how distributions and abundances of a surrogate reflect the distributions and abundances of the biodiversity targets included in the MPA objectives. Such a study may be used to evaluate distributions of dominant fishes as a surrogate for fish assemblages, and to select species that best discriminate among assemblage types.

Step 5 -- Design and conduct survey

The allocation of samples in space should follow systematic principles, and most likely will form some sort of regular grid, random point, or stratified random sampling design. This is because the most common purpose of a survey will be to establish the spatial distribution of the chosen surrogates across the region of interest, or within a class, with appropriate estimates of uncertainty.

Step 6 -- Model and interpolate data

Much of the data collected during the survey will be point data -- measurements of, say, species abundances or habitat occurrences taken from a small area. The analysis of point data may be used to assess and predict the distributions of individual attributes (e.g., species) in space. Such assessment and prediction may be done using a range of procedures, including inferential statistics, spatial statistics, or predictive modeling from correlated variables.

Step 7 -- Validate the MPA

The final step is to test whether an area identified as a candidate is a valid choice. The specific objective of these tests is to compare the actual values for biodiversity targets in the selected area(s) with the predicted values derived from the models and/or surrogates.

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