Consideration of Multiple Climate Scenarios

Evaluate climate scenarios before choosing a management or restoration technique to help ensure actions take potential future conditions into account

Scenario analysis was developed in the 1960s to help military strategists work with the many uncertainties inherent to combat. It was later taken up by businesses, and has gained traction in natural resource management as an approach to dealing with climate-related uncertainties. Scenarios can be built around many sources of uncertainty, not only climate trajectories. In climate adaptation work, it may sometimes make sense to build scenarios around something other than climate trajectories, such as human or ecosystem vulnerabilities, and/or responses to climatic changes. Scenarios can be qualitative or quantitative.

An overall goal of scenario analysis is to consider broad ranges of what is possible, and to inspire creative thinking around action options under each scenario. In some cases, building capacity for flexible, "what-if" thinking is a primary goal of scenario analysis. In other cases, the goal is to test the performance of different action options across a range of scenarios to develop risk management plans or to look for options that give an acceptable performance across all scenarios.

For wetland adaptation work, scenarios are typically built around different plausible future climatic conditions or for the responses of species, systems or people to those changes. The process for building scenarios (formal vs. informal method for generating scenarios) and the nature of the scenarios (qualitative vs. quantitative, spatial and temporal scale, complexity) can vary depending on available time, funding, capacity and the goal of the scenario exercise (exploratory vs. decision-focused).

At one end of the continuum, if time and funding are in short supply or if the stakes are low, a relatively informal process using existing scenarios for climate change or responses can be sufficient. On the other end of the continuum, if stakes are high and the decision and significant assets or resources are potentially at risk, a more formal, in-depth process led by someone with scenario planning expertise would be more appropriate. Quantitative scenarios are most useful when the decision or planning processes in question demand hard numbers and there are data and models to support a quantitative approach. However, reliable quantitative data and related models are not often readily available. Whether data and methods are qualitative, quantitative or a mix, it is important to maintain a record of data sources and methods. This way data and methods can be improved as new information and insights become available.

Once scenarios are created, they can be used to methodically test existing action alternatives, or to stimulate discussion and creative thought about goals, objectives and actions that make sense in light of the range of plausible futures.

Outputs of scenario analysis and planning processes range from:

- increased capacity for decisionmaking under uncertainty;
- an evaluation of how conservation or restoration targets and actions would fare under each scenario; or
- revised management or acquisition plans based on risks or opportunities revealed by scenario analysis.

Case Example | Prioritizing wetland restoration in San Francisco Bay

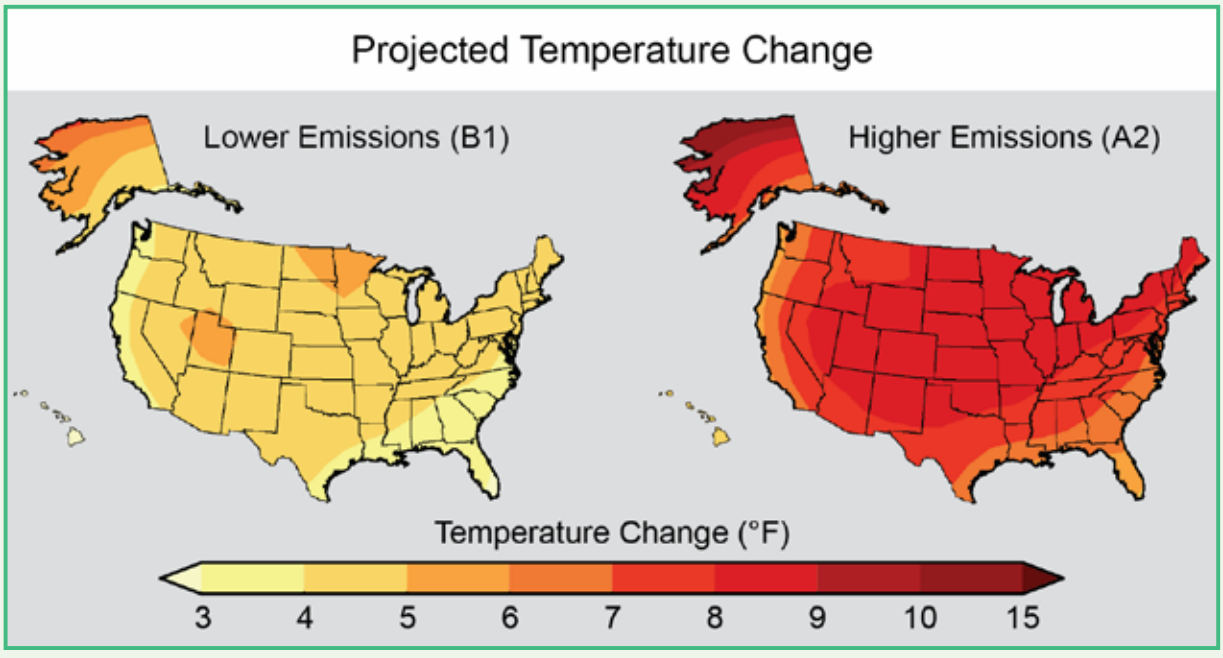
An example of using quantitative scenario analysis to assess prioritization of wetland restoration projects comes from the San Francisco Bay. Like the Great Lakes, the Bay is home to massive restoration efforts, with more than 34,000 acres either restored or planned for restoration. Also like the Great Lakes, there is uncertainty about how wetland systems will respond to climatic changes and impacts. For the Bay's coastal wetlands, two key determinants of how wetlands will respond to climate change are the rate of sea level rise and sediment availability for marsh accretion. There is significant uncertainty about both, yet wetland restoration decisions must be made.

A common element in prioritization of coastal marsh restoration work is which marshes have the best chance of providing high quality wildlife habitat over the long term. A team of researchers decided to test different prioritization schemes against four different sea level rise/sediment supply scenarios: high sea level rise + high sediment supply, high sea level rise + low sediment supply, low sea level rise + high sediment supply, and low sea level rise + low sediment supply. For each, they modeled abundance and distribution of five tidal marsh bird species as a measure of ecological function.

Researchers then used the conservation planning software Zonation 3.0, which creates hierarchical rankings, to prioritize areas for restoration. They created six ranking strategies—one assuming no change in sea level or sediment supply (the "head in the sand" scenario), one optimized for each of the four sea level rise/sediment availability scenarios, and one combining information from all scenarios as well as current conditions—and looked at the performance of each ranking strategy under each scenario. The results? Regardless of which scenario came to pass, the "head in the sand" approach to prioritization always performed the worst. In other words, planning for any of the change scenarios, even the wrong one, was better than planning for current conditions.

Challenges and Benefits

Scenario planning can be an effective way to start difficult discussions. Rather than relying on a single prediction of what the future will be, scenario planning acknowledges what could be possible. A benefit of this approach is that it circumvents the debate about which projection will be the future or which climate model is better. Instead, it enables consideration of what the future might hold under a range of plausible futures and allows the use of various models. This can facilitate active adaptive management and helps participants identify possible tipping points.



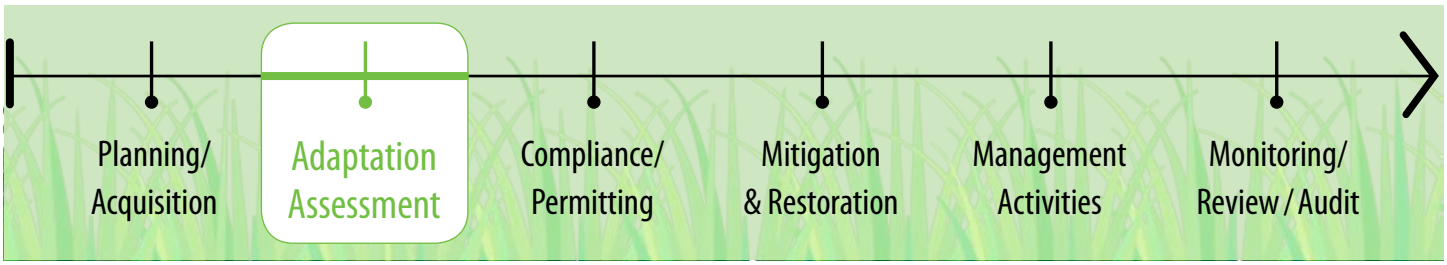
Projected change in average surface air temperature in 2071-2099 relative to 1970-1999. Source: Third National Climate Assessment

A risk of scenario planning is that participants fixate on the handful of scenarios they created or used, forgetting that many other scenarios are possible. Indeed, in most cases scenarios contain significant subjectivity and should not be seen as predictions of any sort. To minimize these risks, and to increase the effectiveness of the process, it is important to have a skilled process facilitator and, if relevant, someone with a solid understanding of climate models and their appropriate use.

Who should implement the practice?

This practice can be implemented by any group or organization, provided they have or bring in the necessary facilitation and scenario expertise.

When should this practice happen?



Tools and Resources

Using Scenarios to Explore Climate Change: A Handbook for Practitioners (2013) | Handbook that describes the five-step process for developing multivariate climate change scenarios. | **climate.calcommons.org/sites/default/files/CCScenarios-Handbook%20FINAL%20080113.pdf**

Scenario Planning for Climate Change Adaptation: A Guidance for Resource Managers (2013) | Step-by-step guide to using scenarios to plan for climate change adaptation. | **scc.ca.gov/files/2013/07/Scen-planning_17july2013_FINAL-3.pdf**

Modeling Climate Change Impacts on Tidal Marsh Birds: Restoration and Conservation Planning in the Face of Uncertainty (2013) | Peer-reviewed paper involving modeling of future distribution and abundance of five marsh bird species in light of projected climate change and other system changes. | **www.esajournals.org/doi/pdf/10.1890/ES12-00341.1**