

Beyond the 2x2 Matrix: An Alternative Scenario Creation Approach

1. 2x2 Matrix

The scenarios created for the East Coast Climate Change work are based around a “2x2” matrix approach. This involves combining two variables (“critical uncertainties”) to create 4 quadrant spaces. These “spaces” are, by definition, different from each other - and they form the basis for 4 different pictures of the future.

The critical uncertainties that formed the ECSP scenarios were:

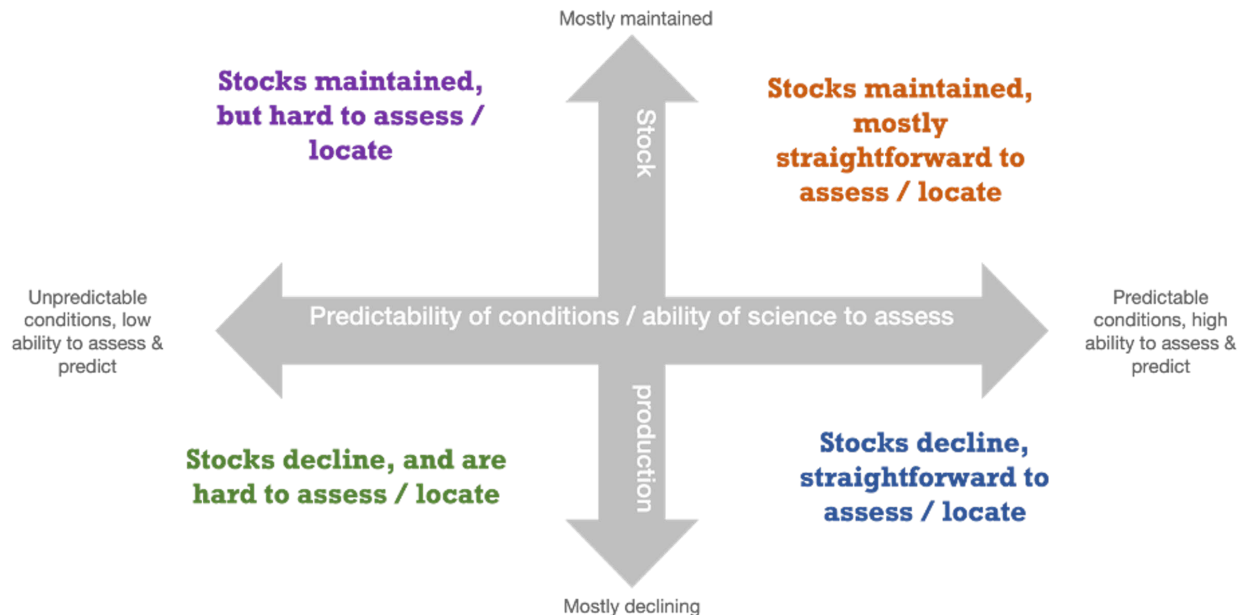
- 1. *How predictable will ocean and stock conditions be, and will science be effective in assessing and predicting such conditions as climate change continues through 2040 and beyond?* One outcome is that conditions are highly unpredictable, and science is not able to accurately assess the changes. An alternative outcome is that conditions are somewhat predictable, and that science does help accurately assess current and future ocean conditions. This uncertainty is expressed in the following way:



- 2. *How healthy, in aggregate, is stock productivity and replacement as climate change continues through 2040 and beyond?* Are stocks mostly maintained or increasing, or are stocks declining? This uncertainty can be expressed as follows:



When combined, this created the matrix used for the scenarios:



2. Multi-dimensional scenarios using cards

The 2x2 approach is sometimes criticized for being too simplistic or reductive. How can something as complex as climate change, the ocean and fisheries be summarized in two variables? It is an understandable limitation, but the solution is to use the 2x2 as a basic framework and then layer more complexity in as the stories are told.

There is also an alternative approach that involves workshop groups considering *several critical uncertainties at the same time*. It involves using two-sided cards to represent the opposite ends of the uncertainties. Then, by “playing” several cards together, groups can imagine a future scenario that is defined not by two variables, but by four or five. This approach can often be a highly effective, engaging first step to create scenarios. In fact, this was the approach adopted at the ECSP scenario creation workshop. The ideas from these ‘mini’ scenarios were ultimately developed into the 2x2 matrix described above.

So how does this card-based approach work? To prepare for it, the workshop organizers must identify several critical uncertainties, often covering different categories of variables. For the ECSP work, the uncertainties were identified and categorized as (i) physical/climate; (ii) biological; (iii) social & economic.

Physical/Climate: What might happen to each variable by 2040?

Rapid warming in the NW Atlantic	←	1. Rates of ocean warming?	→	Atlantic Meridional Overturning Circulation (AMOC) swings toward a cooler state, stalling warming trend
Major effects	←	2. Impact of saturation of calcium carbonate on shell-formation?	→	Minor effects
Minor changes	←	3. Extent of changes in the Cold Pool?	→	Significant reduction in size and duration
Become stronger but less frequent	←	4. Storm frequency and intensity?	→	Become much stronger and more frequent
Impacts limited to specific locations / times & some positive effects	←	5. Impacts of sea level rise?	→	Causes significant impacts to many facilities & habitats
Low, decreasing impact	←	6. Pollution & nutrient run-off in estuaries?	→	High, increasing impact

Biological: what might happen to each variable by 2040?

Varies by species & region - hard to generalize and identify	←	7. Evidence of range expansion/ contraction?	→	More evident, pronounced and consistent
Limited evidence of movement or unpredictable direction	←	8. Direction of species movements?	→	Mostly northwards/ deeper waters
Limited, minor	←	9. Extent of range expansion/ contraction?	→	Extensive, major
Low - species movement is not replaced by other emerging fisheries in the area	←	10. Replacement of moving species?	→	High - most species movement is replaced by other emerging fisheries in the area
Mostly maintained, worst effects on overfished populations	←	11. Stock production?	→	Declines markedly across many populations
Maintained/as now	←	12. Disease prevalence?	→	Much higher
Low	←	13. Extent of predation on key species?	→	High
Minor, occasional, generally manageable impacts	←	14. Impact of fishery interactions with protected resources or choke species?	→	Major, ongoing impacts

Social & Economic: what might happen to each variable by 2040?

Moderate tech advances, used by few	←	15. Development and use of technology to support fisheries?	→	Widely available, used extensively (e.g., gear, tracking, vessels etc.)
Declining market and lower prices as market is saturated / highly competitive (e.g., aquaculture, lab-grown fish)	←	16. Consumer preferences for wild caught and local seafood?	→	Growing market and higher prices as wild caught / local becomes a premium market
Marginal or positive effects on species distributions / research efforts etc.	←	17. Impact of offshore wind installations?	→	Mostly damaging effects on species distributions / research efforts etc.
Costs are contained creating profitable opportunities for most	←	18. Fishing & related industry viability?	→	Costs rise more quickly than revenues for most operators
Limited coastal armoring as 'living shoreline' alternatives become popular	←	19. Extent and impact of coastal armoring?	→	Significant, with widespread effect on habitats
Leads to damaging competition and less prosperous fishing communities	←	20. Impact of alternative ocean uses, other coastal developments on fishing communities?	→	Leads to more prosperous coastal and fishing communities

Groups review these uncertainties, and then choose a combination of 4-5 cards to create a future storyline. An example would look like this:

<p>CRITICAL UNCERTAINTY</p> <p>4. Storm frequency and intensity?</p> <p>b. Become much stronger and more frequent</p> <p style="text-align: right;">2042</p>	<p>CRITICAL UNCERTAINTY</p> <p>9. Extent of range expansion / contraction?</p> <p>b. Extensive, major</p> <p style="text-align: right;">2042</p>	<p>CRITICAL UNCERTAINTY</p> <p>11. Stock production?</p> <p>a. Mostly maintained, worst effects on overfished populations</p> <p style="text-align: right;">2042</p>	<p>CRITICAL UNCERTAINTY</p> <p>18. Fishing & related industry viability?</p> <p>b. Costs rise more quickly than revenues for most operators</p> <p style="text-align: right;">2042</p>	<p>PRE-DETERMINED ELEMENT</p> <p>1. Ocean temperatures continue to warm, affecting marine species biology & distribution</p> <p style="text-align: right;">2042</p>
---	---	---	---	--

HARDER TO REACH

Fish are still out there. They are just harder to reach. Fishing operators are forced to travel longer distances to access their catch. With stronger and more frequent storms, this is not only more expensive, but more dangerous. All forms of business costs are on the rise: insurance, fuel, new gear, labor, as more competition drives up costs in the industry. Recreational fishing is less popular (blame the storms). Those who stick with it are now catching very different stocks than 20 years ago.

A scenario creation workshop using cards will usually involve several groups each creating a few different scenario combinations. For the ECSP work, 8 groups each created 3 scenarios, resulting in 24 different 'mini' scenarios. The workshop organizers then looked at the patterns within the 24, and this resulted in selecting the two core critical uncertainties to be taken forward for the rest of the project.



To use this approach in future, groups could identify their own list of critical uncertainties, or use the list created for the ECSP project. The card-based scenario sketches are usually developed on a series of worksheets, as follows:

Mini-Scenario Creation (1)

Expected future

Choose five cards that, when combined, best describe the 'expected future' – the story that East Coast fishing generally assumes will happen given climate change between now and 2042

1. Briefly describe the future scenario that this combination of cards creates _____

2. What makes this scenario interesting? _____

3. What evidence exists today that makes this future seem plausible? _____

4. Give this scenario a memorable name _____

Mini-Scenario Creation (2)

Alternative future

Turn over at least 2 of the CU cards from your "Expected Future" to create an "Alternative Future". Keep the PD card. Use 1-2 new CU cards or a Wildcard.

1. Briefly describe the future scenario that this combination of cards creates _____

2. What makes this scenario interesting? _____

3. What evidence exists today that makes this future seem plausible? _____

4. Give this scenario a memorable name _____

Mini-Scenario Creation (3)

Free-Form future

What other scenario seems interesting and compelling? Use any combination of cards, with some bias towards those that you have not used yet, to create another scenario that is different from the first two

1. Briefly describe the future scenario that this combination of cards creates _____

2. What makes this scenario interesting? _____

3. What evidence exists today that makes this future seem plausible? _____

4. Give this scenario a memorable name _____

These worksheets ensure that each group creates “mini” scenarios that are different from each other.

- The first round asks the group to choose a combination of cards that reflects an “expected” future – a scenario that aligns with most peoples’ expectations of what will happen in future.
- The second round asks the group to choose a combination of cards that is an alternative (i.e., meaningfully different) to the first scenario. This should be a scenario that most people are not expecting to happen. This involves flipping over some of the cards in order to ‘play’ the other side of the uncertainty.
- The third round asks the group to create a final mini-scenario that is different from both of the first two. This ensures that each group tells at least 3 different scenario stories during their conversations.

The benefit of the card-based approach is that it creates a highly engaging experience for participants. Things move quickly, and it allows for a good amount of creativity. It can be used with large numbers of participants, who are then divided into several smaller break-out groups. This approach does not automatically create a single scenario matrix – but should provide enough information that a common matrix can be created from the patterns that emerge.