

Fisheries Ecosystem Plan Climate and Communities Initiative  
Developing Future Scenarios for Climate Change in the  
California Current Ecosystem

# Workshop Report

Pacific Fishery Management Council  
March 2020

# Executive Summary

On January 22-23 2020, the Pacific Fishery Management Council (Council) and The Nature Conservancy hosted a scenario planning workshop to help the Council better understand and prepare for the future effects of climate change. In November 2018, the Council decided to undertake a climate change scenario planning exercise as part of the Fishery Ecosystem Plan's (FEP's) Climate and Communities Initiative. In March 2019, the Council adopted shifting stock availability (including shifting distribution) across species, fishery management plans (FMPs), and West Coast communities as the topic for exploration. The initiative is designed to help the Council define the tools, products, and processes necessary to plan for potential future ecosystem states resulting from climate variability and climate change.

The two-day workshop began with background presentations on the categories of forces expected to drive change in the California Current Ecosystem (CCE) between now and 2040: oceanographic variability and change, shifting fish stock availability and productivity, social and economic changes in fishing communities, developments in the fishing industry and market conditions, and shifting societal values. For the remainder of the first day, workshop participants discussed the suite of ecosystem-driving forces and created several 'sketch' scenarios, describing various ways in which different combinations of forces might play out over the next 20 years.

On the second day of the workshop, participants created an initial scenario matrix based on two important variables. The group first identified climate variability as an important uncertainty, meaning that future scenario planning under this initiative would imagine different future CCE conditions as affected by more or less frequent and dramatic climate variability. The group identified the second important uncertainty that would have the most obvious effects on Council decisions as fish stock abundance and availability, meaning greater or lesser amounts of our managed species available to CCE fisheries. The matrix shown in Figure 1 illustrates these major uncertainties as interacting with each other, framing combinations of future possible conditions in the CCE. For example, scenarios imagined for the upper left-hand quadrant would consider a future with relatively low climate variability and increasingly abundant fish stocks.

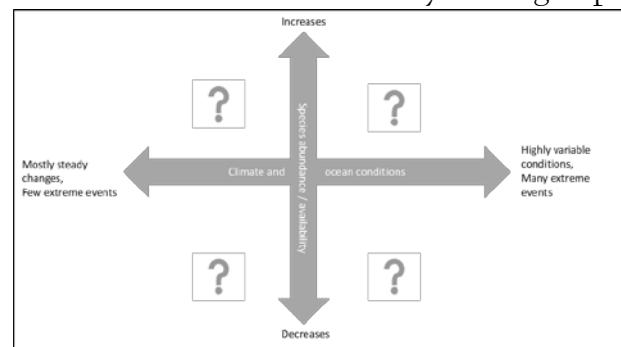


Figure 1: Major driving forces expected to frame future Council decisions

Participants broke into four groups to discuss how these scenarios might play out for species and fisheries managed under the Council's four FMPs. Participants also considered how market and other socio-economic-political developments might interact and create different future conditions. The workshop closed with discussions of how to improve and provide detail for the scenarios so that they could be more effectively used in conversations with the Council and the public.

# Developing Future Scenarios for Climate Change in the California Current Ecosystem Workshop Report

## Introduction

On January 22-23, 2020, the Pacific Fishery Management Council (Council) and The Nature Conservancy (TNC) hosted a scenario planning workshop, in support of the Council's Climate and Communities Initiative process. In November 2018, the Council decided to undertake a climate change scenario planning exercise as part of this initiative. In March 2019, the Council adopted shifting stock availability (including shifting distribution) across species, fishery management plans (FMPs), and communities across the West Coast as the topic of exploration. The overall effort is designed to help the Council define the tools, products, and processes necessary to plan for potential future ecosystem states resulting from climate variability and climate change.

## Introducing Scenarios

The Council received an overview of Scenario planning at its September 2019 [Meeting](#). Scenario planning is a technique used to think broadly - and creatively - about the risks and opportunities that we face in our markets or our operating environment. For decades, commercial organizations have used the approach when their industry is facing major change and disruption. Good scenario planners never assume that the future will be like the past - or even like the "expected future." Instead, they constantly ask, "what if?" and imagine a range of different, surprising, but plausible, situations that they might have to operate in.

Although scenarios are stories about the future, they are not predictions, nor are they descriptions of desired future states. They are created and designed to describe the range of plausible conditions that an organization or a community could face. By thinking about these ahead of time - essentially rehearsing the future - organizations can be far better prepared for the future uncertainty. Over the past decade, many organizations have begun to use scenario planning as a means to prepare for the uncertainties and surprises associated with climate change.

## January 2020 Workshop in the Context of the Overall Project

The Council's scenario planning project is divided into stages (see Figure 1). Following the establishment of the initiative in 2018, the last few months have focused on "research": gathering views and information and preparing to create a set of scenarios. These scenarios are designed to describe conditions that all stakeholders (fishermen, communities, fisheries managers, and others) might have to operate in over the next 20 years. This means anticipating changes in climate and ocean conditions, stock availability and productivity, and changes in market / political / societal conditions in the decades ahead.



Figure 1: Step-by -Step Scenario Process.

The January 2020 workshop was part of the “create” phase. The immediate next step will be to validate the scenario framework and stories. Following that, the scenario planning process uses the scenarios as a platform for a series of conversations with various stakeholders. These conversations will pose questions and raise suggestions about the decisions that need to be made to prepare for a future of climate-related uncertainty.

Therefore, the draft scenarios described in this report should be seen as a platform for further conversations recommended for March 2020 at the Council meeting (“validate”) and with individuals and communities April-June 2020 (“apply”). At this stage, they are not intended to contain answers, conclusions or recommendations for the Council. They merely set up the next set of discussions that will occur with various stakeholders in the months ahead.

### Meeting Output

During two days of facilitated discussions, four distinct scenarios emerged that describe how climate impacts, stock productivity, and a broader set of market conditions might interact over the next 20 years. These scenarios aimed to capture a *plausible* range of uncertainty and highlight some of the particular challenges (and opportunities) that fishing communities would face if that scenario were to become reality between now and 2040.

The four draft scenario stories are as follows:

- I. A world of changing ocean conditions, moderate unpredictability, and relatively few extreme events coupled with high and/or increasing stock abundance. Alongside these biophysical effects, this is a world where west coast fishing is supported through trade policies, a shift in societal values, and increasing consumer demand for wild caught fish.

- II. A world of rapidly changing ocean conditions, high unpredictability, and frequent and intense extreme events (e.g., storms, marine heatwaves,) coupled with high and/or increasing stock abundance for some species. Alongside this surprising combination of circumstances there is greater investment in, and use of, data monitoring technologies, helping fishing communities prepare for surprises.
- III. A world of rapidly changing ocean conditions, high unpredictability, and frequent and intense extreme events coupled with low and declining stock abundance. This difficult set of circumstances is compounded by market conditions (consolidation, aging of the fleet, and demand declines) that leads to a hollowing out of the commercial fishing industry.
- IV. A world of changing ocean conditions, a moderate level of unpredictability, and relatively few extreme events coupled with low and declining stock abundance. Alongside these biophysical effects, this is a world where aquaculture and other commercial ocean uses become more popular, changing the dynamic and make-up of fishing communities.

### **Who Participated in Creating These Four Scenarios?**

The scenario creation workshop brought together more than 80 participants from different aspects of the fishing community and fisheries management, including scientists, fishery participants, marketers, conservation professionals, and others. Appendix 1 contains the full participant list.

### **How Did We Create These Four Scenarios?**

Day 1 of the workshop focused on exploring a range of driving forces that are likely to shape ocean conditions and market conditions that communities will face in the next 20 years. The morning began with a number of speakers highlighting possible future changes in biophysical and market conditions. Discussions then moved to table conversations to construct several ‘sketch’ scenarios that detailed some of the most meaningful or extreme challenges we might imagine.

On Day 2, the group reviewed the drivers and scenario sketches, winnowing down to a more manageable handful of stories. The group reflected on the initial scenarios, then focused on constructing frameworks that described variations in ocean conditions and stock availability. Participants divided into four groups, each addressing an FMP area (highly migratory species, coastal pelagic species, salmon, and groundfish). Each FMP area then took the climate/stocks framework and discussed how associated market/economic/political conditions might play out in each future. Finally, participants discussed the next steps that will be required as the process continues to unfold.

The following sections provide more detail on each of the workshop elements.

#### **Day 1 AM: Driving Forces to 2040: Speakers and Panelists**

In preparing for the workshop, it became clear that relevant scenarios for 2040 should address both climate/ocean/stock conditions and market/economic/social/political conditions. The first sessions of the workshop brought expert perspectives together that considered the future of each of these elements.

First, **Nate Mantua** (Landscape Ecology Team, Southwest Fisheries Science Center) outlined how climate change is likely to affect the California Current Ecosystem. Some of the main messages in the presentation and subsequent discussion included:

- 90% of the warming in the Earth's climate system has gone into the ocean, hence we should expect that ocean warming will continue for many decades, irrespective of what happens to future GHG emissions.
- On average, we can expect that ocean temperature highs will be warmer than in the past, and lows will be not as low. However, this does not mean that we can easily predict the timing or magnitude of near-term warm extremes (marine heatwaves) nor their impact on marine life and fisheries
- From now to 2040 in the CCS, the thermal heating of the ocean surface (due to increasing greenhouse gas concentrations and related climate feedbacks) will be overwhelmed when upwelling brings up deep cold water – and upwelling is largely dependent on winds which are largely unpredictable.
- Marine heatwaves (since 2014) have compressed the productive footprint of the CCE: one plausible scenario for the future of the CCS is that its productive area will shrink in the future, fisheries productivity will decline as we know it, and there will be an increasing overlap between many species (including protected species) and fisheries. This scenario could also include species that become more abundant. Previous marine heatwaves have included booms in rockfish recruitment and inshore anchovy numbers, and an influx of sub-tropical migratory species to nearshore waters (like the wahoo, tuna, yellowtail, dorado, and marlin increases in the Southern California Bight in 2014-2016).
- Long-term changes in ocean conditions are reasonably predictable – it will be warmer, more acidic and less oxygen. But the actual way the CCS gets to that future will include mostly unpredictable shorter-term events; we are almost certain to see more extremes and episodic events that cause major ecosystem and fishery surprises.

**Melissa Haltuch** (Research Fishery Biologist, NOAA Fisheries) and **Elliott Hazen** (Research Ecologist, Southwest Fisheries Science Center) focused more on how ocean conditions specifically impact stocks and productivity. Some of the main messages from this presentation and subsequent discussion included:

- Existing work has focused on species vulnerability assessments **that provide a triage approach towards driving additional research**, and Melissa outlined some of the main messages regarding which species are particularly vulnerable to changing conditions.

- There is uncertainty regarding how fisheries species move in response to changing ocean conditions particularly **in the California Current**. Evidence suggests that some move north, others south while others show great variability. The take home is that our conclusions are only as good as our data and current understanding of the mechanisms behind such changes. Climate driven changes may fall outside of the range of historical observations, making ongoing data collections to track such changes increasingly important.
- Fisheries science shows warmer oceans are associated with smaller body sizes. Tracking changes in size at age, particularly for fishery target species, is important as body size is directly linked to the level of sustainable catch that can be taken from a given stock.
- Overall, it is difficult to predict future productivity of species (future distributions are slightly easier to predict). One take-away is that generalists are likely to fare better in future ocean conditions compared to specialists.
- We need more effective ways of integrating, collecting, and disseminating data on climate impacts **to inform management**.

Karma Norman (Social Scientist, Northwest Fisheries Science Center) outlined the socio-economic vulnerability of fishing communities in an era of climate change. Some of the main messages from the presentation and subsequent discussion included:

- Fishing communities are very different up and down the Pacific coast. Los Angeles, CA is a fishing community; so is Neah Bay, WA. But they could not be more different.
- Fishing communities appear to be more socially vulnerable (e.g. based on measures such as poverty, housing, sprawl, labor market conditions) compared to other communities.
- Fisheries management will have to take account of the potential for increased consolidation of fishing in a smaller number of communities, and less income diversification.
- It is possible to create social vulnerability measures for locations based on the species that is fished. Salmon fishing communities appear particularly vulnerable based on climate assessments and levels of income diversity.
- Harmful Algal Blooms are another source of vulnerability, where evidence suggests that fishing communities suffer more than other coastal communities.
- Fishing communities will come under increasing pressure (through climate impacts, consolidation, gentrification), but a strong community identity might create a resilience around fishing.

The next session was a Panel conversation that focused on possible future developments in industry and market conditions. Panelists were: Maisie Ganzler (Bon Appetit Management Company), Mike Conroy (WC Fisheries Consultants), Jana Hennig (Positively Groundfish) and Cameron Speir (NOAA Fisheries Southwest Fisheries Science Center).

Some of the main messages from the panel conversation included:

- Any consideration of the future of fishing communities must also take account of demand trends. Demand for seafood is flagging for many – the industry needs to regain the trust of consumers.
- We need to look more closely at where tastes are heading. There is a great deal of interest in sustainability. There is pushback against animal proteins and increased interest in plant-based diets. Is this a long-term trend or a fad? And what might it mean for seafood demand?
- The fishing industry faces competition for space in ports and harbors from alternative uses, such as aquaculture, offshore energy, and other commercial interests.
- In general, we can expect the next 20 years to shift towards more industry consolidation, maybe moving towards the model in much of the rest of world where consolidated large companies run fishing.
- There is hope that good fisheries management will lead to stocks that can sustain a high catch. The global landscape of seafood production will be different. Watch out for trends in Asia, specifically relating to how they deal with sustainability issues. China is scheduled to ban single use plastics next year.

Finally, Yvonne deReynier (Senior Resource Management Specialist, NOAA National Marine Fisheries Service) wrapped up the presentations with a survey of some other big picture trends that should be considered. Some of the main messages from this presentation were:

- Life in 2040 is likely to reflect the concerns of today's teenagers. What are they worrying about today? The unresponsiveness of adults to the need to prevent and prepare for climate change, potential collapses in food webs, plastic pollution in our oceans, food and housing availability to an increasing human population, the ethical concerns around genetic modification, and the need for transparency and traceability in our food sources.

### Day 1 PM: Sketch Scenarios for 2040

The next session asked participants to reflect on a wide range of driving forces and then create a number of sketch scenarios that highlighted particular climate/ocean conditions and other challenges for fishing communities. To do this, each breakout table worked with a list of 21 driving forces drawn from preparatory research (which included input from Council meetings in 2019, interviews, and the Core Team). These forces were summarized in a pre-reading document and also illustrated as a set of cards to be used during the scenario creation.

The list of driving forces– trends or developments that have the potential to shape the future for fishing communities by 2040 - were used as the ‘building blocks’ in a series of scenario creation exercises at the workshop.

1. Ocean warming
2. Ocean acidification
3. Sea level rise

4. Hypoxia / HABs
5. Ecological surprises
6. Extreme weather conditions
7. Terrestrial climate impacts
8. Marine pollution
9. Alternative ocean uses
10. Aquaculture
11. Societal values
12. Consumer demand
13. Global trade / industry policy
14. Regulation and environmental policy
15. Protected species status
16. Food technology
17. Data and monitoring technology
18. Fishing industry structure
19. Aging of fleet and expertise
20. Coastal community development
21. Range shifts and productivity

Participants were divided into nine separate breakout tables, each of which was given the same instructions. Tables were invited to add a small number of additional driving forces if they felt that there was an important element missing from the list. Each table group then used their 'building block' driving forces to construct a set of scenarios. The facilitator asked each table to create three different scenarios according to the following instructions:

1. *Expected Future*: Select four Driving Forces that, when combined, describes a 'broadly accepted' view of the future to 2040.
2. *Alternative Future*: Select four Driving Forces that, when combined, describe a very different view of the future in 2040, yet is still plausible and relevant.
3. *Divergent Future*: Select four Driving Forces that, when combined, describe a third scenario that is meaningfully different from the first two, yet is still plausible and relevant.

This exercise led to the creation of 27 different sketch scenarios (nine tables each creating three scenarios), each named with a representative title that the group selected. Within those 27, a number of patterns emerged based on clustering similar scenario themes together. The following points outline six clusters:

- A future where fishing communities are unable to cope with the **unpredictability caused by climate surprises**. These were a set of scenarios that highlighted how intense uncertainty and a series of rolling surprises would negatively affect ocean conditions and stocks, hence leading to more community vulnerability.
- A future where fishing communities suffer from changing climate conditions, but mostly from a **deteriorating set of market conditions**, including consolidation, demand trends moving away from seafood, the aging of the fleet, and greater focus on protected species.

The result is a changing structure of the industry, as only large players and maybe some boutique harvesters/processors survive.

- A future where **data and monitoring technology** is developed and used as a response to increasingly uncertain climate, ocean, and stock conditions. New technology is employed, resulting in more accurate and flexible fisheries management and fishing operations.
- A future where fishing communities learn to co-exist with **new, alternative ocean uses** as they compete for space within harbors, ports, and in the ocean. This is a world where aquaculture becomes a more significant player on the Pacific coast, driven by demand trends and changing ocean conditions.
- A future where **local/national policies** and regulations support the continued existence of fishing on the West Coast – largely driven by greater trade tensions and the public's preference to protect the industry and communities' way of life against global business and international competition.
- A future where **societal demands for local sustainability** provide an impetus to deal with unpredictable ocean conditions. There is increased awareness in youth and young adults, who use technology, and consumer power to develop sustainable and local approaches to fishing.

## Day 2 AM: Reflections on Day 1 and Plans for Day 2

Day 2 started with a plenary conversation about what we had discussed and achieved on Day 1. Was the group in a good position to achieve our objective of winnowing down 27 scenarios into a handful that explored the uncertainty inherent in climate, ocean conditions, stocks and market conditions?

Some of the main themes emerging from the Day 2 morning plenary discussion:

- Industry consolidation (often combined with the aging of the fleet) was a common theme throughout most of the sketch scenarios.
- Most of the sketch scenarios that were created seemed gloomy – most outlined a difficult set of conditions facing the industry. But there is the possibility of brighter prospects. Do we have the right balance in the scenarios at the moment?
- “It’s a messy, complicated process” (which reflects the realities of the situation). It’s hard to see how to condense down from multiple scenarios to just three to five, given that there are so many uncertainties relating to climate, politics and markets. In reference to how the oil industry uses scenarios, what is our ‘price of oil’?: Do we have a variable that we should make the central focus of our scenario descriptions?
- On reflection, virtually all of the sketch scenario stories made a simplifying assumption about climate and ocean conditions. It is legitimate to assume that we will see ocean warming, acidification and lower oxygen levels in future. However, most of our scenarios also assumed that we would see more frequent and intense extreme events. That may or may not be the case. In addition, only a few of our Day 1 scenario sketches focused on the impact of range shifts and stock productivity.

The import of this final point led to a preference to look more closely at climate and ocean conditions, and to parse out more about range shifts and productivity than we did in the Day 1 scenario creation. Essentially, this allowed us to discuss and distinguish among three different elements of the scenario process.

Subject Area 1	Subject Area 2	Subject Areas 3
Scenarios for climate / ocean conditions, range shifts, and species abundance / productivity  <i>Generated in the “CREATE” stage of a scenario process (See Fig. 1)</i>	Scenarios for market / political / economic / societal conditions that affect fishing communities  <i>Generated in the “CREATE” stage of a scenario process (See Fig. 1)</i>	Suggestions and solutions for the fishing industry, communities, and fisheries management  <i>Generated in the “APPLY” stage of a scenario process (See Fig. 1)</i>

It became clear that the Day 1 sketch scenarios focused mostly on describing Subject Area 2 – the market/political/economic/societal uncertainties that are likely to shape fishing communities. The point was also made that much of the conversation was jumping straight to Subject Area 3 – as people proposed suggestions and solutions that should be adopted to cope with an uncertain future. The workshop facilitator explained that these suggestions/solutions will be the focus of the next phase of the Initiative, which will be informed by the scenario framework.

As a result, we focused the rest of the workshop on two elements: how climate / ocean conditions and stock abundance might vary in future (Subject Area 1), and, connecting the climate/ocean/stock scenarios with some of the scenarios previously created for market / political / economic / societal conditions (i.e. combining Subject Areas 1 & 2).

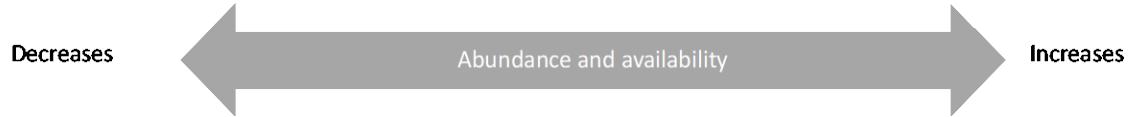
### Day 2 AM: Introducing a Scenario Framework for Climate/Ocean/Stock Conditions

The workshop considered a simple framework to address the two most basic and important uncertainties facing fishermen, communities and fisheries management. These are:

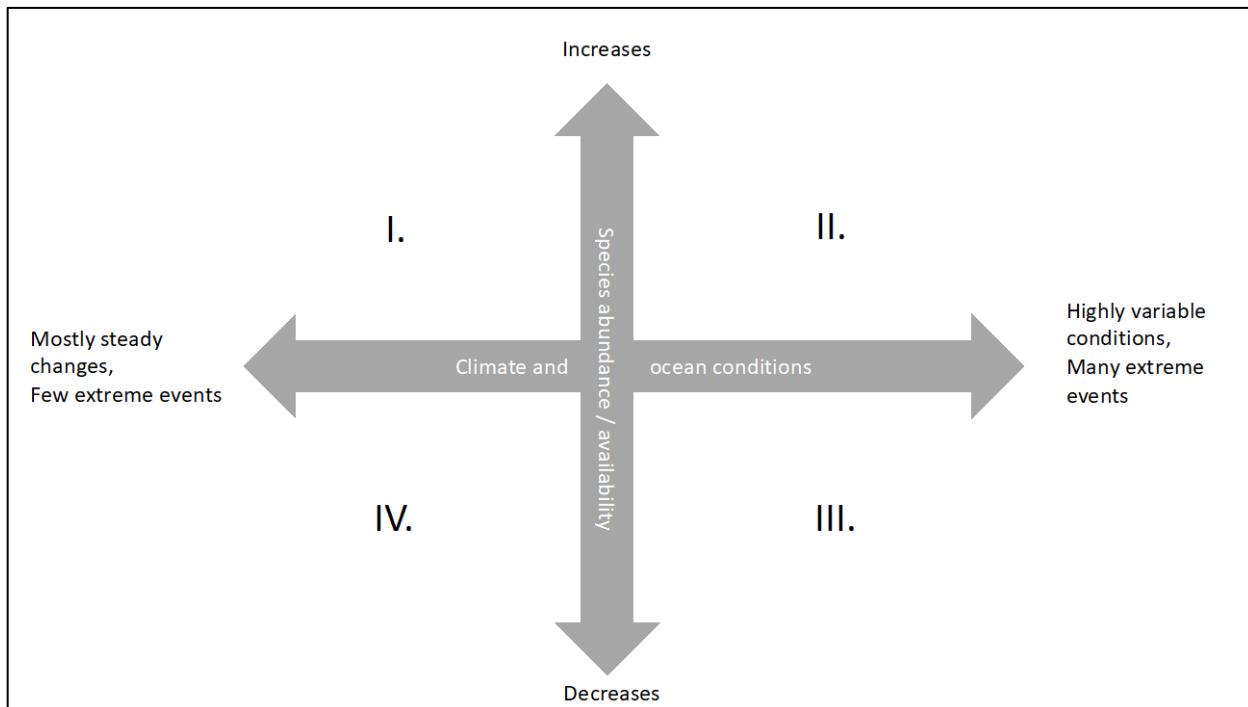
- Over the next 20 years, will we see a future where climate and ocean conditions change (e.g., warming, acidification, lower oxygen) in a relatively steady fashion, with a few extreme events OR will we see a future where climate and ocean conditions change along with more frequent and intense extreme events?



- Over the next 20 years, do our relevant fish species increase in availability and abundance or do they decrease in availability and abundance?



Combining these uncertainties together results in the following matrix.



This creates four quadrants, each of which describes a different set of conditions to be faced and managed. Given that working scenarios are not predictions or projections, but rather *plausible* future conditions, the next task for participants was to discuss whether these scenario quadrants were plausible, relevant, challenging and divergent. To gauge the potential relevance of these scenarios (and hence the usefulness of the matrix), they were discussed in 4 breakout groups, across the four different Council FMPs: highly migratory species, coastal pelagic species, salmon, and groundfish.

Before embarking on this breakout group work, there was consideration as to whether to organize conversations by geographical area. It was also suggested that species productivity might be a more useful variable than availability/abundance. Another suggestion was to use a set of climate futures that had been previously created for a California scenario project. Those scenarios were differentiated according to the degree of variability in conditions (from little variability through increases through to tipping points / threshold changes).

While all these suggestions had merit, the group eventually proceeded with the matrix framework described above. Participants chose which of the four FMP breakout groups they

wanted to join, and groups were given the task of discussing the details of each quadrant of the scenario matrix. The transcriptions of the main messages and discussion areas for each FMP group are contained in Appendix 2.

After hearing from each FMP breakout, the group discussed whether the overall scenario framework enabled us to imagine futures that were plausible, relevant, challenging, and divergent. Generally, the matrix worked, although it was difficult at this stage to imagine how the upper right (high abundance-extreme events) quadrant could be plausible - especially for salmon.

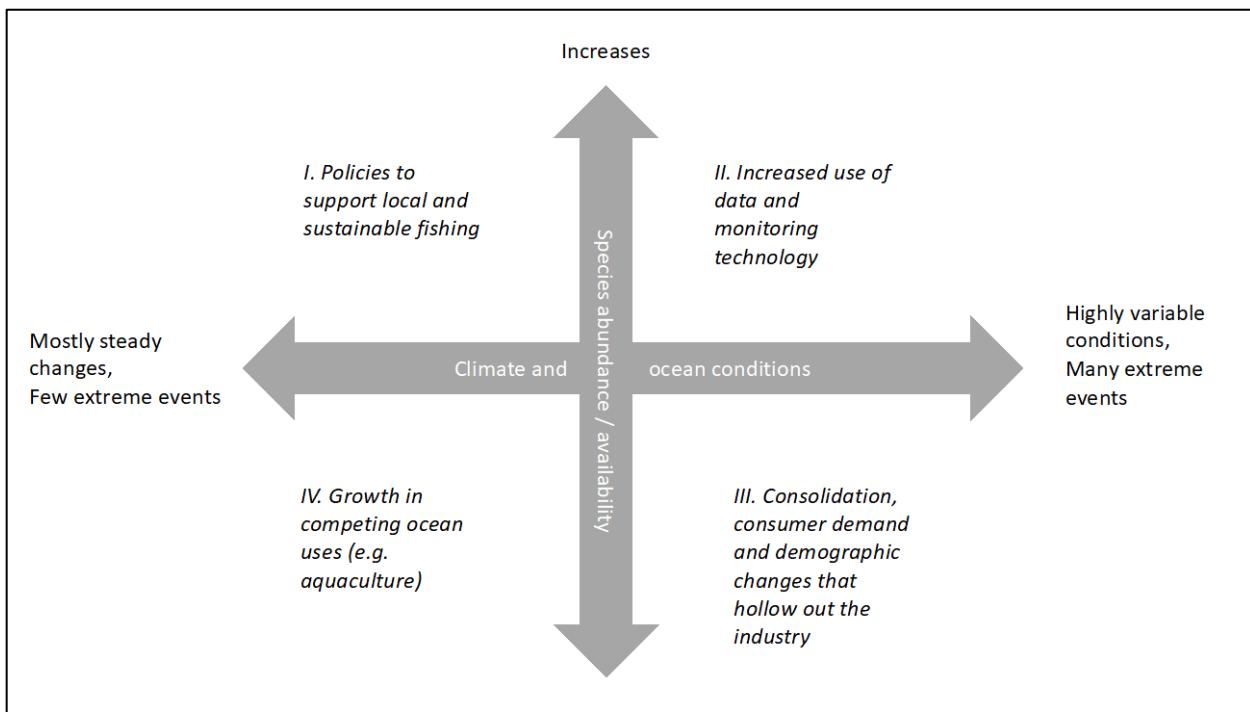
### Day 2 PM: Connecting Climate/Ocean/Stock Conditions with Market Conditions

Over the next 20 years, fishermen, communities and fisheries management will need to prepare for changing climatic / ocean conditions while also considering what might be happening concurrently in markets, society and politics. Therefore, the final step in our process was to make some connections between the climate/ocean/stock matrix and the market conditions sketch scenarios that we had created on Day 1.

To do this, the workshop facilitator reintroduced a number of the Day 1 scenario themes and asked each FMP group to imagine the interaction between the biophysical conditions and the market conditions. The four market scenario themes were:

1. More intensive and effective use of data monitoring and technology by various stakeholders across the industry
2. Political and societal developments (and policies) that increased the viability of local and sustainable West Coast fishing operations
3. A major increase in competing ocean uses (especially aquaculture)
4. A combination of market conditions (consolidation, demand declines, aging) that leads to a hollowing out of the core of the industry

Each FMP group was asked to make connections and associations between their biophysical matrix and the market conditions. With no communication or coordination between the groups, each group crafted stories that made similar connections, as follows.



This brought us to the set of four scenarios described at the start of this meeting report document.

### Day 2 PM: What Comes Next?

The final set of conversations began with an explanation that the scenario planning process is far from over. We made great progress in identifying a framework for future use, but there is much to do to ensure (i) that the framework and the scenarios are validated, deepened and made as useful as possible, and (ii) then applied to the real work of identifying the kinds of actions and solutions fishermen, communities and fisheries management will need to adopt to cope with future uncertainty. For the last discussion on Day 2, participants shared their views on what needs to happen in the coming weeks and months. Their ideas are summarized here.

### Suggested Ways of Validating, Deepening and Improving the Scenarios (February/March 2020)

- Determine if the four scenarios are the best way to move forward, or whether there is an alternative framework that could be more useful
- Draw on the expertise of subject / species / topic experts to ensure the scenarios are realistic and include sufficient detail
- Find current evidence for the plausibility of each of these scenarios
- Address local versus Pacific-wide abundance
- Ensure scenarios identify opportunities to increase influence and shape the future

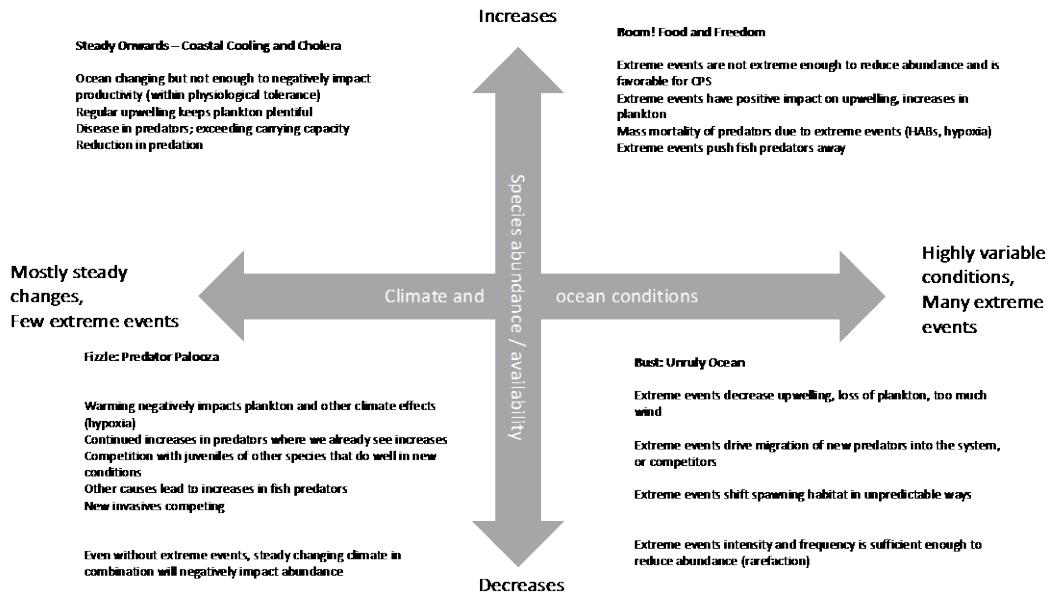
- Identify ways to track changes in the world and thus identify tipping points of change
- Sketch out more specific examples or instances that could be emblematic of each scenario (i.e. what ecological surprises might we see?)
- Review past stories and surprises as guides to some of what might happen in future
- Integrate across FMPs for each scenario quadrant
- Investigate the impact of other likely drivers (e.g., international trade)
- Explore interactions in more detail (e.g., bycatch, predators)
- Consider whether our current framework allows us to identify worst case scenarios.

**Suggested Ways of Applying the Scenarios in Conversations with Fishermen, Communities and Fisheries Management (April – July 2020)**

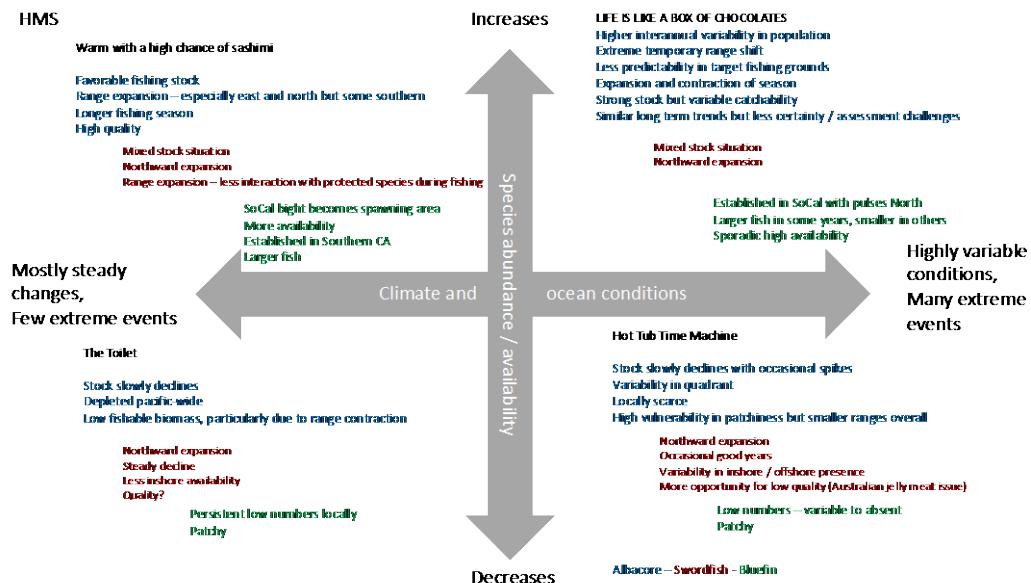
- Use the scenarios to facilitate conversations for specific species (including many that are currently not included in FMPs)
- Use the scenarios for conversations at a variety of different geographic locations and constituent groups
- Use the scenarios to help construct a series of specific ‘what ifs?’ that could be discussed by stakeholder groups
- Identify what an ideal fishing industry structure might look like under each different scenario
- Identify the characteristics of a successful fishing community under each different scenario
- Craft the scenarios so that they fit within the confines of the FMPs (or ask questions about what the FMPs could be under statutory regulations)
- Use the scenarios to identify the different levers and actions that are available to stakeholders to react to and shape change
- Consider the consequences of doing / not doing management actions (this is often known as ‘wind tunneling’ or ‘stress testing’ a current set of actions against a range of different future conditions)

## Appendix I: Climate/Ocean Conditions/Stock Frameworks.

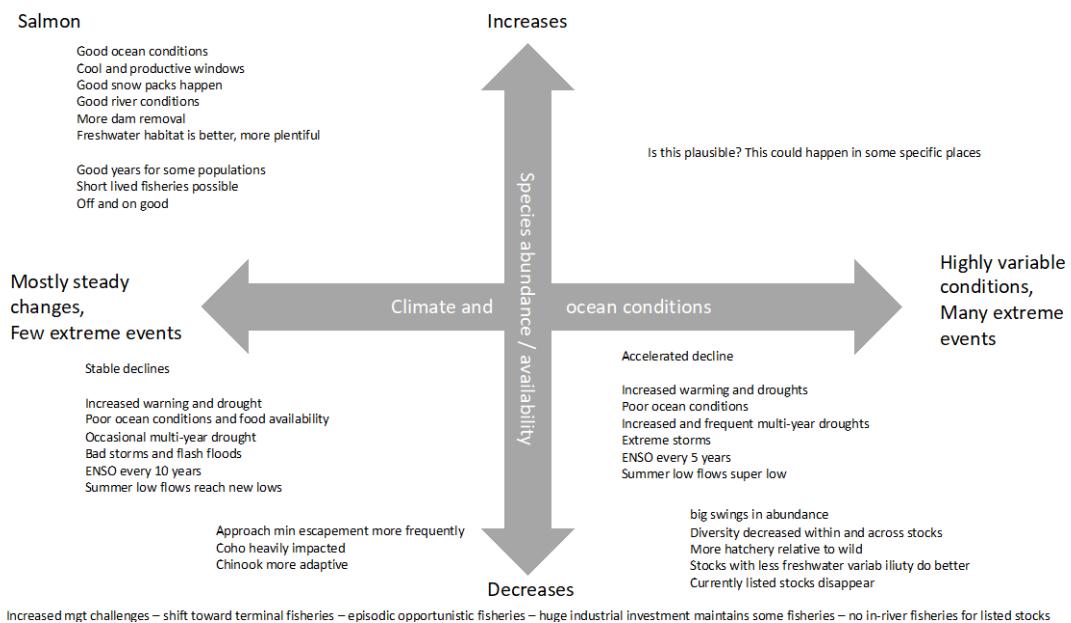
### Coastal Pelagic Matrix



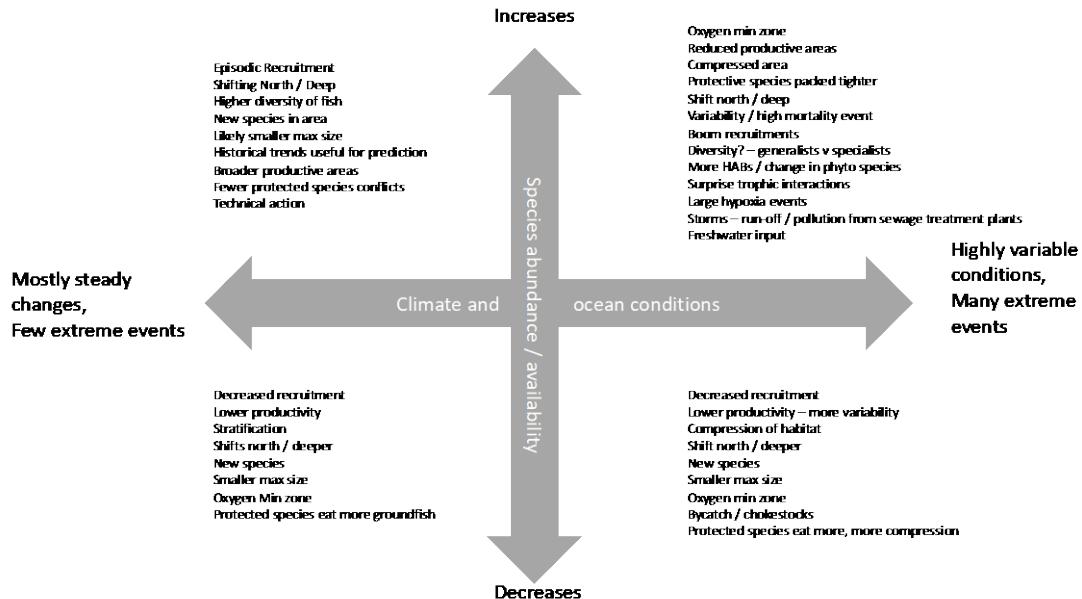
### Highly Migratory Species Matrix



## Salmon Matrix



## Groundfish Matrix



## Appendix 2: List of Participants

### Workshop facilitator

**Jonathan Star**

Scenario Insight

### Climate and Communities Core Team

**Caren Braby**

Oregon Department of Fish and Wildlife  
(Council member)

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**Richard Lincoln**

Council Member

**Tommy Moore**

Northwest Indian Fish Commission  
(Ecosystem Workgroup)

**Corey Niles**

Washington Department of Fish and Wildlife (Ecosystem Workgroup)

**Corey Ridings**

The Ocean Conservancy (Ecosystem Advisory Subpanel)

**Gway Rogers-Kirchner**

The Nature Conservancy (Ecosystem Advisory Subpanel)

**Jameal Samhouri**

NOAA Fisheries, Northwest Fisheries Science Center

**Stephen Stohs**

NOAA Fisheries, Southwest Fisheries Science Center (HMS Management Team)

**John Ugoretz**

California Department of Fish and Wildlife  
(Council member)

### Presenters and panelists

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West Coast Fisheries Consultants (HMS Advisory Subpanel)

**Masie Ganzier**

Bon Apetit Management Company

**Melissa Haltuch**

NOAA Fisheries, Northwest Fisheries Science Center

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California Department of Fish and Wildlife  
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Oregon Sea Grant

**Aaron Dufault**

Washington Department of Fish and Wildlife

**Sherry Flumerfelt**

Monterey Bay Fisheries Trust

**Natalya Gallo**

University of California San Diego

**Marisol Garcia Reyes**

Farallon Institute (SSC)

**Richard Goche**

Oregon Albacore Commission

**Marc Gorelik**

Council Member

**Jennifer Hagen**

Quileute Indian Tribe

<b>Chris Harvey</b>	Noah Oppenheim
NOAA Fisheries, Northwest Fisheries Science Center	Pacific Coast Federation of Fishermen's Associations (Habitat Committee)
<b>Elliott Hazen</b>	Diane Pleschner-Steele
NOAA Fisheries, Southwest Fisheries Science Center	California Wetfish Producers Association (CPS Advisory Subpanel)
<b>Richard Heap</b>	Carrie Pomeroy
Council Salmon Advisory Subpanel	California Sea Grant & University of California Santa Cruz
<b>Elizabeth Hellmers</b>	Fran Recht
California Department of Fish and Wildlife	Pacific States Marine Fisheries Commission (Habitat Committee)
<b>Gregory Helms</b>	Anthony Rogers
The Ocean Conservancy	California Ocean Science Trust
<b>Jaime Jahncke</b>	Jan Roletto
Point Blue Conservation Science	Greater Farallones National Marine Sanctuary
<b>Shems Jud</b>	Julia Sanders
Environmental Defence Fund	Global Ocean Health
<b>Kristen Koch</b>	Richard Scully
NOAA Fisheries, Southwest Fisheries Science Center	Council Salmon Advisory Subpanel
<b>Laura Koehn</b>	Sarah Shoffler
University of Washington / The Nature Conservancy	NOAA Fisheries, Southwest Fisheries Science Center
<b>Theresa Labriola</b>	James Smith
Wild Oceans	NOAA Fisheries, Southwest Fisheries Science Center
<b>Gwendal Le Fol</b>	David Sones
Independent Consultant	Makah Indian Tribe
<b>Lewison, Rebecca</b>	Ana K. Spalding
San Diego State University	Oregon State University
<b>Ludemann, Heather</b>	Bruce Steele
The David and Lucile Packard Foundation	Commercial Fisherman
<b>Scott McMullen</b>	Christa Svensson
Oregon Fishermen's Cable Committee (Ecosystem Advisory Subpanel)	Council Member
<b>Christine Moffitt</b>	Andrew Thompson
University of Idaho (ret.)	NOAA Fisheries, Southwest Fisheries Science Center (Groundfish Management Team)
<b>Barbara Muhling</b>	Daniel Waldeck
University of California San Diego	Pacific Whiting Conservation Cooperative (Groundfish Advisory Subpanel)
<b>Laura Nelson</b>	
The Nature Conservancy	
<b>Trung Nguyen</b>	
California Department of Fish and Wildlife	
<b>Richard Ogg</b>	
Commercial Fisherman	

**Lorna Wargo**

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### Appendix 3: Instant Poll Results

At various points in the workshop, participants were asked to respond to a number of instant online poll questions. This proved an effective way to capture ideas from a large number of participants. The poll results are illustrated here:

