

From theory to action: solutions for climate-ready fisheries

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Purpose and need statement

Preparing and adapting fisheries for climate change is of great importance and interest for fishery managers. Yet the question of how best to adjust management and the management system for change remains challenging, and there has yet to be widespread action toward climate-ready fisheries.

Here, we highlight tools that managers at the U.S. Regional Fishery Management Councils and NOAA Fisheries are using to respond to climate change.

I. SCENARIO PLANNING

Scenario planning is a tool that, rather than predicting a specific future, allows stakeholders and others to create and explore a set of plausible future scenarios.

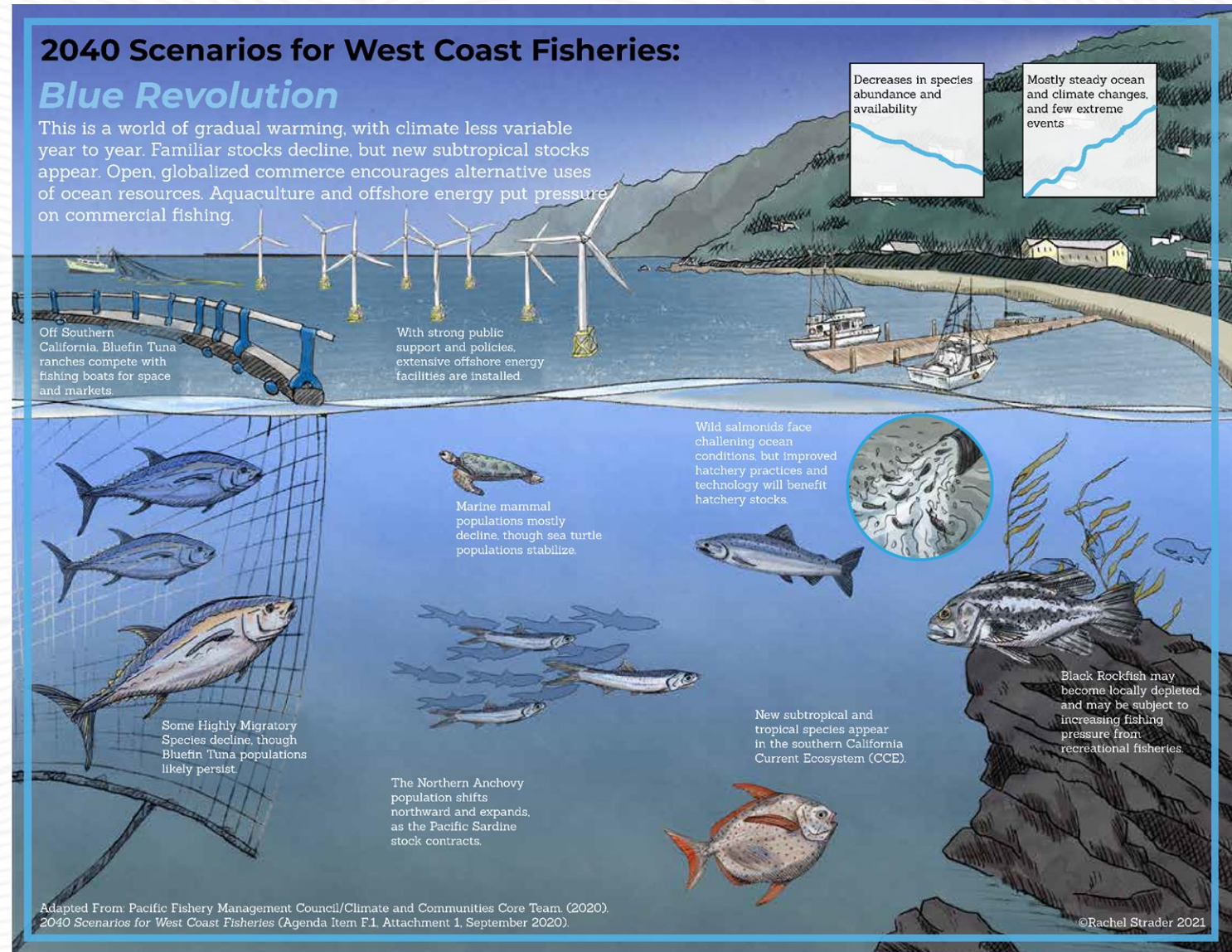
It can identify uncertainties and tradeoffs and help to find solutions and approaches that can be useful in multiple possible futures.

When done in an inclusive and effective manner, scenario planning can also increase buy-in of stakeholders and encourage broader participation from groups that tend to be less active in the management process.

Scenario Planning – US West Coast

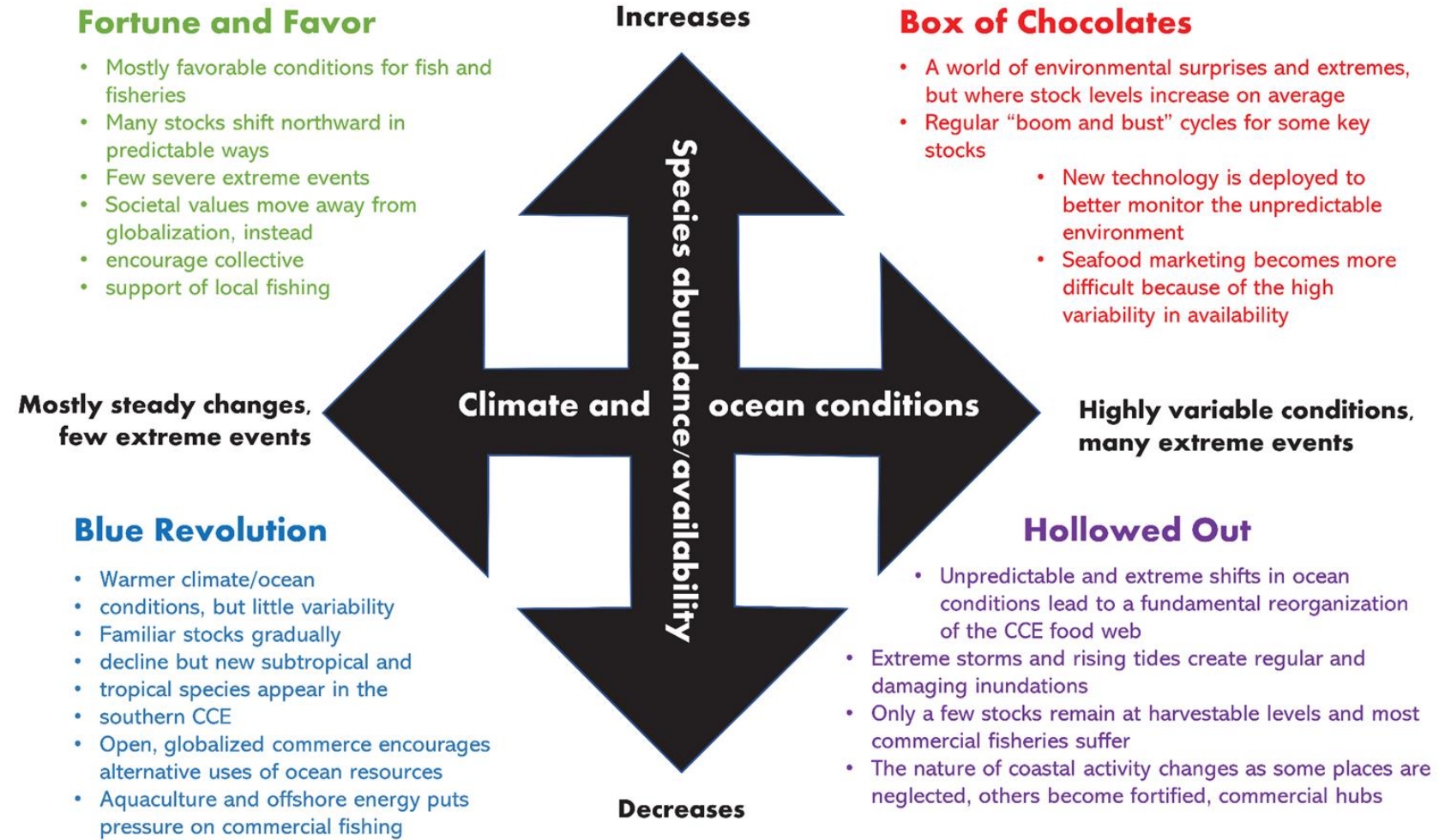
The Pacific Fishery Management Council initiated a climate change scenario planning process in early 2019 with the goal to define tools, products and processes necessary to react to potential future ecosystem states resulting from climate variability and change over the next 20 years.

An organizing team appointed by the council and stakeholders worked to create and then use four scenarios to consider the implications of possible changes described and identify actions to take in response.



View this and the other 3 scenarios produced here: <https://oceanconservancy.org/wp-content/uploads/2021/03/OC-Climate-Scenarios-Color.pdf>

Four scenarios for West Coast fisheries



II. MANAGEMENT STRATEGY EVALUATION (MSE)

Management Strategy Evaluation is a tool that uses simulation to compare different strategies under a range of possible future realities and identify performance in relation to management objectives.

MSE is a salient tool for managing with climate change because it can identify trade-offs and clarify the impacts of uncertainty.

MSE can also incorporate climate information and relationships. **Models that incorporate shifts in productivity or shifts in distribution to inform fisheries management are often needed to facilitate the MSE process.**

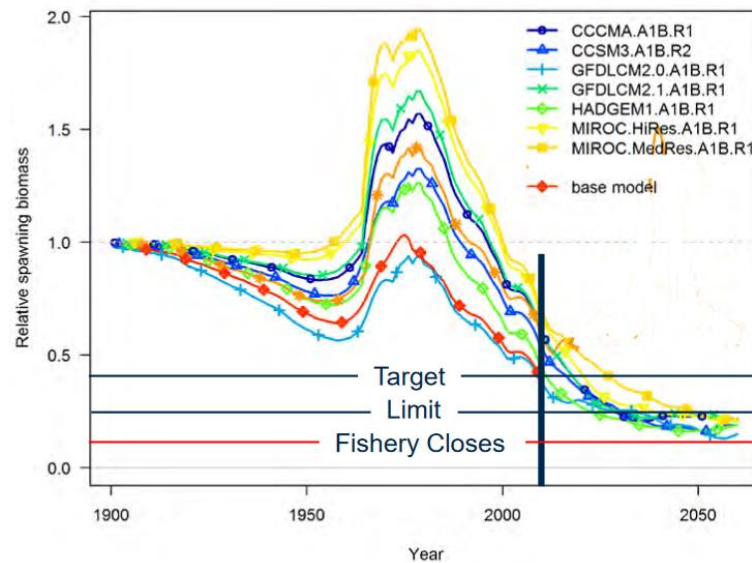
MSE - Sablefish recruitment

Issue: Are current reference points and control rules for fishery management robust to impacts of climate change?

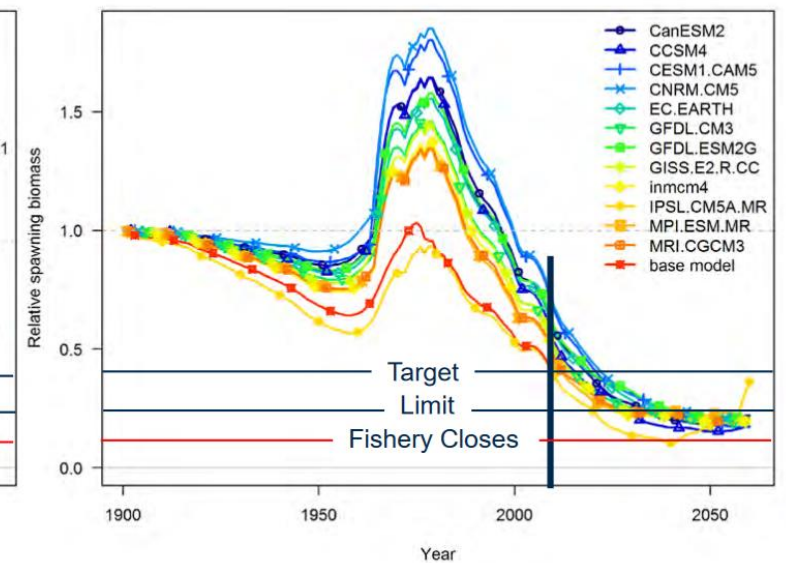
When **projected** sablefish recruitment is informed by oceanographic indicators, different future states (i.e., from IPCC scenarios) drive different stock outcomes.

MSE Results: Time Series of Stock Depletion

CMIP 3



CMIP5



- Haltuch, M. A., A'mar, Z. T., Bond, N. A., & Valero, J. L. (2019). Assessing the effects of climate change on US West Coast sablefish productivity and on the performance of alternative management strategies. *ICES Journal of Marine Science*, 76(6), 1524-1542.
- <https://www.pices.int/publications/presentations/2015-Climate-Change/S10/S10-D2/1130-Haltuch.pdf>

III. FISHERY ECOSYSTEM PLANS (FEPs)

Next-generation FEPs can serve as a tool to incorporate ecosystem considerations in fishery management. FEPs can also be a tool to operationalize climate-readiness in fishery management.

For FEPs to be effective, they must go beyond ecosystem assessment and link science and action items to management decisions **through clear processes**.

FEPs - Alaska region

The Climate Action Module under the Bering Sea FEP is designed to address strategic management needs related to climate change.

Objective 1



COLLATE

Coordinate the review of existing and emergent climate information on impacts, adaptation, and residual risk.

Objective 2



SYNTHESIZE

Assess key climate change impacts, adaptation actions, and residual risk.

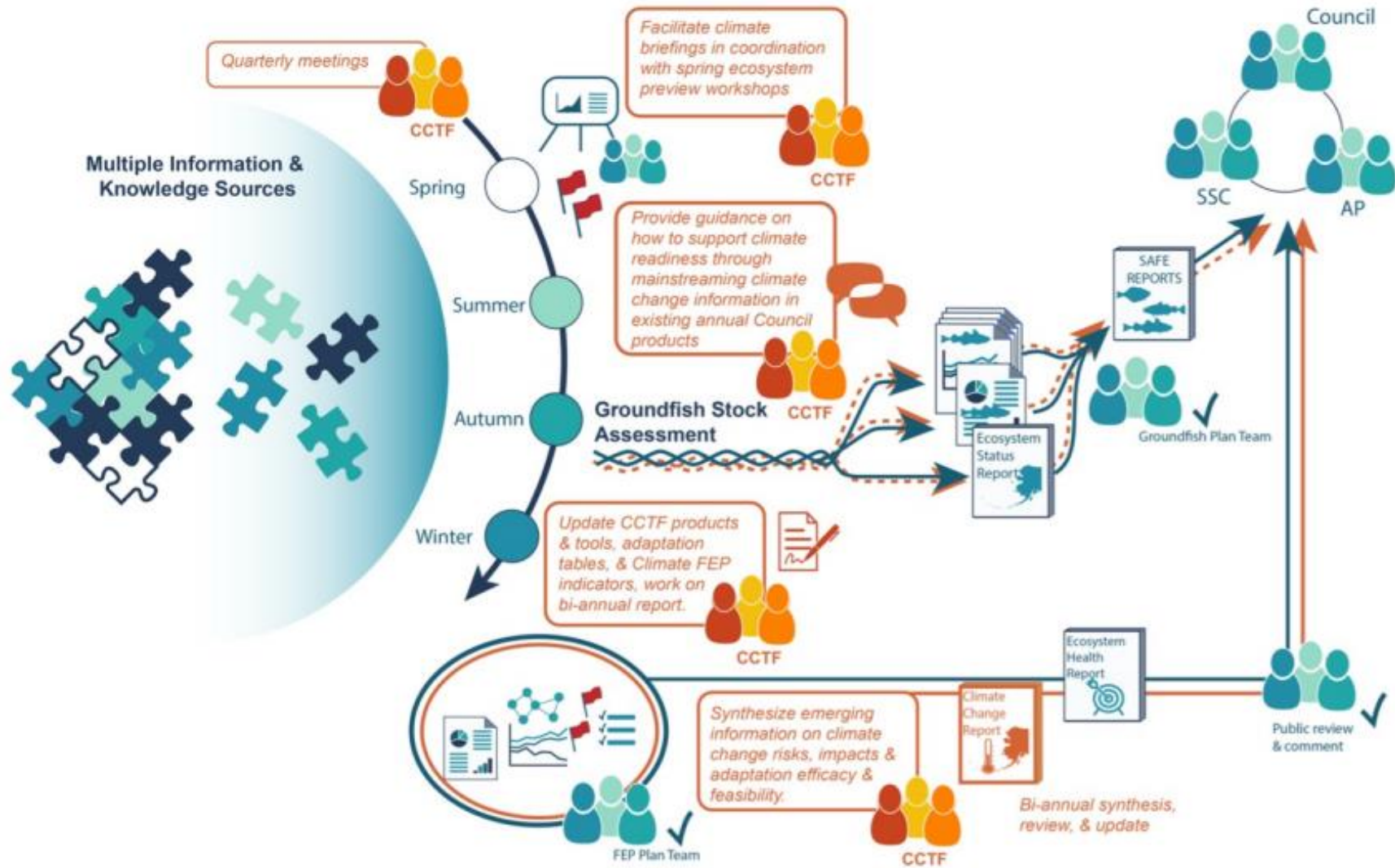
Objective 3



COMMUNICATE

Summarize and communicate potential risks and adaptation actions.

Climate-informed fisheries management: Proposed “on-ramps” and existing coordination



On-ramp 1

Tactical Near-term Advice (<2 yr)

Climate change information incorporated into stock assessment models, stock-specific indicators (ESPs), stock-specific risk tables (as appropriate).

E.g., ABC based on climate forecasts

On-ramp 2

Strategic Near-term Advice (<2 yr)

Climate change context for observed changes in social, ecological, & oceanographic conditions relevant for harvest advice and targets.

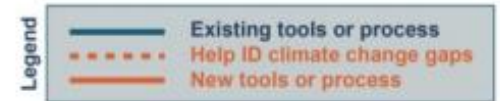
E.g., Forecasts of climate-driven distributions, tipping points, & thresholds

On-ramp 3 (new)

Strategic & Long-term Advice (>2 yr)

Climate - informed long-term strategic decision making & planning informed by IK, LK, and climate & management scenario evaluations, risk assessments, & adaptation efficacy & feasibility evaluations.

E.g., Targets based on climate projections



IV. RISK TABLES & RISK ASSESSMENTS

Risk and uncertainty are increased in stock and ecosystem assessments due to climate change. New tools to assess risk and uncertainty (not captured in traditional stock assessments) are needed to manage effectively under climate change.

A related key need is for decision support tools that can inform managers and others about how to respond to risks and changes in risk based on environmental, ecological, and socio-economic conditions.

Risk Tables – Alaska

Alaska Fishery Science Center (AFSC) staff developed a classification matrix for assessing 4 primary considerations: assessment, population dynamics, ecosystem, and fishery performance. Such considerations are intended to capture risk or uncertainty not accounted for in the stock assessment itself and are used to inform Allowable Biological Catch determinations. Risk tables can support precautionary management under climate change.

Example Risk Table from Gulf of Alaska Pacific Cod Stock Assessment

Assessment-related considerations	Population dynamics considerations	Environmental/ecosystem considerations	Fishery Performance	Overall score (highest of the individual scores)
Level 2: Substantially increased	Level 2: Substantially increased	Level 2: Substantially increased	Level 1: Normal	Level 2: Substantially increased

Risk Assessments - Mid-Atlantic

NOAA's Integrated Ecosystem Assessment Team worked with the Mid-Atlantic Fishery Management Council to use risk assessment as a tool in implementing its ecosystem approach to fisheries management.

Indicators from an annual ecosystem status report are tied to specific risk elements for management, including climate risks.

Updated understanding of the status of risk elements for different species, sectors and the ecosystem has helped the council prioritize management and has informed modeling efforts

2021 EAFM Risk Tables

Table 3: Species level risk analysis results; l=low risk (green), lm= low-moderate risk (yellow), mh=moderate to high risk (orange), h=high risk (red)

Species	Assess	Fstatus	Bstatus	FW1Pred	FW1Prey	FW2Prey	Climate	DistShift	EstHabitat
Ocean Quahog	l	l	l	l	l	l	h	mh	l
Surflam	l	l	l	l	l	l	mh	mh	l
Summer flounder	l	l	lm	l	l	l	lm	mh	h
Scup	l	l	l	l	l	l	lm	mh	h
Black sea bass	l	l	l	l	l	l	mh	mh	h
Atl. mackerel	l	h	h	l	l	l	lm	mh	l
Butterfish	l	l	lm	l	l	l	l	h	l
Longfin squid	lm	lm	lm	l	l	lm	l	mh	l
Shortfin squid	lm	lm	lm	l	l	lm	l	h	l
Golden tilefish	l	l	lm	l	l	l	mh	l	l
Blueline tilefish	h	h	mh	l	l	l	mh	l	l
Bluefish	l	l	h	l	l	l	l	mh	h
Spiny dogfish	lm	l	lm	l	l	l	l	h	l
Monkfish	h	lm	lm	l	l	l	l	mh	l
Unmanaged forage	na	na	na	l	lm	lm	na	na	na
Deepsea corals	na	na	na	l	l	l	na	na	na

Table 4: Ecosystem level risk analysis results; l=low risk (green), lm= low-moderate risk (yellow), mh=moderate to high risk (orange), h=high risk (red)

System	EcoProd	CommRev	RecVal	FishRes1	FishRes4	FleetDiv	Social	ComFood	RecFood
Mid-Atlantic	lm	mh	h	l	mh	l	lm	h	mh

Mid-Atlantic Fishery Management Council. Mid-Atlantic EAFM Risk Assessment: 2021 Update, available at: <https://www.mafmc.org/eafm>

Conclusions

Climate-ready fishery management will require implementation of many tools, and those tools should be tailored to the specific region and fisheries. Each of the tools highlighted here benefits from collaboration and robust involvement of stakeholders in the process.

Scenario planning, MSE, risk tables and the use of FEPs all serve to bring climate and ecosystem information into the management process and clarify trade-offs, better capture uncertainty, and identify options for decision-making.

These tools are already being used by some Councils, which suggests they could be adopted by managers in other regions.

Overall, there is a need to use information at hand to take management action in the near term while planning for the longer term.