



**Sea Change Australia:  
Co-developing pathways to mitigate and adapt to a  
changing climate for fisheries and aquaculture in  
Australia**

SUMMARY OF TOOLS AND FRAMEWORKS

FRDC Project no.2023-011

July 2024



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## Summary

Climate change adaptation in fisheries and aquaculture has been identified as one of the key needs to improve sustainability in the world's fisheries. The extensive literature on climate adaptation has resulted in the development of numerous frameworks aimed at enhancing climate resilience of species, ecosystem, and human communities. However, only a subset of these approaches is applicable to socio-ecological systems, particularly in the fisheries and aquaculture sectors. This report provides an overview of the main frameworks and tools available for climate risk assessment and adaptation planning for fisheries and aquaculture. It provides a summary and detailed comparison of 22 resources, helping users identify relevant tools, providing direct links to sources, and discussing the key components and challenges across methodologies.

Key steps in effective climate adaptation frameworks include (1) setting objectives, (2) assessing risks and adaptive capacity, (3) identifying and evaluating adaptation options through stakeholder engagement, (4) developing implementation plans, and (5) establishing monitoring and evaluation processes. This report highlights the importance of integrating scientific information and local knowledge with management capabilities to enhance resilience and adaptation in fisheries and aquaculture. This work is part of the project Sea Change Australia, a two-way knowledge exchange between fisheries stakeholders and the climate change impacts and adaptation research sector.

# 1. Introduction

## 1.1. Background

Climate change is having a significant impact on socio-ecological systems globally, with effects varying across regions and sectors. Understanding specific vulnerabilities and risks is essential for effective adaptation planning and implementation (IPCC 2023). Over the years, many countries have developed comprehensive national risk assessments and adaptation plans. Numerous platforms, tools and frameworks for climate change risk assessment and adaptation planning are now available at national and local scales, and across various sectors. However, navigating the existing literature can be challenging, and notable gaps remain in certain sectors.

Fisheries and aquaculture, as complex socio-ecological systems, face unique challenges due to climate change, which affects both natural and human drivers (Eurich et al. 2024). Climate change adaptation in fisheries and aquaculture has been identified as one of the key needs to improve sustainability in the world's fisheries (Cooke et al. 2023, Li et al. 2023). Although data on climate impacts to marine systems is more accessible than ever (Boyce et al. 2022), and an array of tools exist for fisheries stakeholders, examples of concrete adaptation and implementation measures in fisheries and aquaculture remain limited and localised (Lindegren and Brander 2018, Mason et al. 2022). Bridging the gap between scientific knowledge and management needs and capabilities is crucial for maximizing the implementation of effective adaptation strategies (Ogier et al. 2016, Ogier et al. 2020, Mills et al. 2023, Golden et al. 2024).

**This report aims to overview the main frameworks and tools currently available to the fisheries and aquaculture sector for climate risk assessment and adaptation planning.** The following sections summarise each tool or framework, providing links to key sources and associated publications. Additionally, we provide a comparison table across tools to help users identify the most relevant resources for their needs, along with a discussion of the key components and challenges across methodologies.

Work presented here is part of the project Sea Change Australia, a two-way knowledge exchange between fisheries stakeholders and the climate change impacts and adaptation research sector to ensure that climate solutions for fisheries and aquaculture can be co-designed, usable, and adoptable.

## 1.2. Sea Change Australia Project Summary

Sea Change Australia builds a strategy that will engage fishing and aquaculture stakeholders on existing knowledge regarding risks and opportunities associated with climate change to:

- i. enable resource managers and researchers to better understand the ways in which many sectors are already adapting autonomously,
- ii. identify the barriers to further adaptation, and
- iii. co-design solutions that are relevant at local- and industry-levels to help build climate-ready communities and to stimulate economic resilience.

Further, our team will work with 12 case-study fisheries and aquaculture operations, selected from around the country, to systematically assess the agility of industries to respond and adapt constructively to climate change and to extreme events.

Sea Change Australia will develop reflexive, ongoing, and two-way knowledge exchange between industry representatives, operators, and managers, and the marine climate change impacts and adaptation research sector, to ensure that climate solutions for fisheries and aquaculture can be co-designed, usable, and adoptable.

## 2. Methodology

### 2.1. General search for main tools and frameworks

An initial list of tools and frameworks for exploring climate change risks and adaptation planning for fisheries and aquaculture was generated through expert consultations and a snowball sampling method following a general web search using the keywords: *Climate change, Risk, Adaptation, Fisheries, Aquaculture, Framework, and Tool*. The tools and frameworks identified from this initial list were investigated individually and summarised in the following sections. Table 1 presents a list of experts who were consulted as part of this research effort. While the list of resources provided may not be exhaustive, it aims to provide a representative sample of the main approaches relevant for fisheries and aquaculture adaptation to climate change.

**Table 1.** List of climate change and fisheries experts consulted to contribute to the summary of tools available for climate risk assessment and adaptation planning.

Name	Affiliation	Contribution
<b>Gretta Pecl</b>	IMAS, University of Tasmania, Australia	Engaged via meetings and preparation of this document. Sea Change team.
<b>Beth Fulton</b>	CSIRO, Australia	Engaged via meetings and preparation of this document. Sea Change team.
<b>Liam Fulbrook</b>	University of Tasmania, Australia	Engaged via meetings and preparation of this document. Sea Change team.
<b>Rachel Kelly</b>	IMAS, University of Tasmania, Australia	Engaged via meetings and preparation of this document. Sea Change team.

<b>Emily Ogier</b>	IMAS, University of Tasmania, Australia	Engaged via meetings and preparation of this document. Sea Change team.
<b>Jessica Melbourne-Thomas</b>	CSIRO, Australia	Engaged via meetings and preparation of this document. Sea Change team.
<b>Martin Exel</b>	SeaBoss, Australia	Engaged in meetings and provided industry perspective and key contacts and introductions. Sea Change advisory panel.
<b>Cora Paulina Cunningham</b>	Stockholm Resilience Centre, Stockholm University, Sweden	Engaged regarding a relevant project and potential for collaboration and provided introductions.
<b>Robert Blasiak</b>	Stockholm Resilience Centre, Stockholm University, Sweden	Engaged regarding a relevant project and contributed tools.
<b>Malin Pinsky</b>	University of California Santa Cruz, USA	Engaged regarding a relevant project and contributed tools.
<b>David Smith</b>	Australian Fisheries Management Authority and IMAS, University of Tasmania, Australia	Provided relevant reports and examples and introductions.
<b>Matt Watson</b>	Marine Stewardship Council, Australia	Consulted for tools used in certification. Showed interest in hearing more about Sea Change project and summary of tools.
<b>Kate Morris</b>	Marine Stewardship Council, UK	Contributed tools – UK-specific.
<b>Katie Longo</b>	Marine Stewardship Council, UK	Unavailable for comments.
<b>Rhys Arangio</b>	Austral Fisheries, Australia	Contributed relevant reports.
<b>Tarub Bahri</b>	FAO, Italy	Unavailable for comments.
<b>Elena Ojea</b>	Universidad de Vigo, Spain	Contributed relevant tools and introductions.
<b>Juan Bueno Pardo</b>	Universidad de Vigo, Spain	Contributed relevant tools and preparing a new toolbox for biodiversity risk assessment.

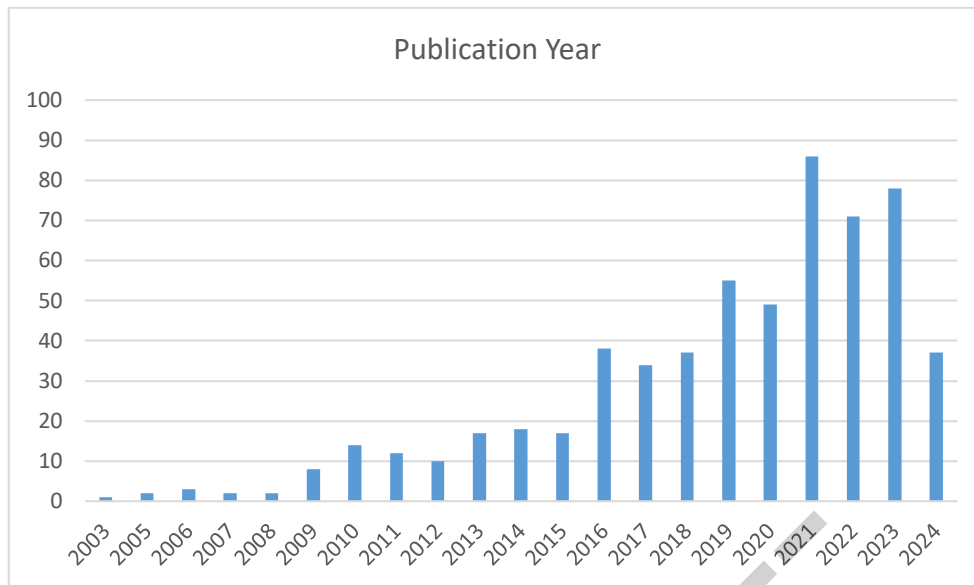
## 2.2. Systematic literature review

To further test the coverage and expand the initial list resources, we conducted a systematic scientific literature search. A literature search was performed in Web of Science using the following criteria: “*AB=(Fisher\* OR Aquaculture) AND AB=(Climate Change OR Warming OR climate-driven OR species range shift) AND AB=(Risk OR Resilien\* OR Adapt\*) AND ALL=(tool OR framework)*”. Here, AB refers to ‘abstract’ and ALL refers to ‘anywhere in the article.’ This search resulted in 591 matched articles.

Details were exported to MS Excel and scanned for relevance. Relevant articles were defined as those that described and/or utilised a tool or framework to assess climate change risks or plan for adaptation in the fisheries and aquaculture sector. Tools identified that were not already included in the summary list were added and summarised. If a tool was already on the list, the corresponding article was included as a case study or example of implementation for that approach.

The systematic search identified scientific articles spanning the last 20 years, revealing a continuous increase in the number of articles covering this topic over time (Figure 1). This trend aligns with findings by Li et al. (2023), which explored chronological trends in marine fisheries climate vulnerability assessment studies and

found a significant increase in assessments with a socio-economic and socio-ecological focus in recent years. The most common countries linked to the affiliation of the articles were United States, Australia, England and Canada, suggesting a possible bias towards English-speaking countries in these results.



**Figure 1.** Number of articles per 'year of publication' that matched the search criteria.

### 2.3. Definitions and key concepts

The search for climate risk assessment and climate adaptation planning methods in fisheries and aquaculture resulted in the identification of a variety of resources. These were classified mostly as frameworks (defined as the structure and design of a process) or tools (defined as platforms that address specific tasks or aspects of a defined process). Some resources did not fit neatly into either category but were included when they represented relevant bodies of work, such as programs or large projects that used a common theoretical framework applied to case studies.

All resources were summarised using a common template (Figure 2), which included a short summary, links to key sources and publications, and a checklist for the following components:

- **Stages included:** refers to the aspects that the tool or framework covers, from risk assessment to the implementation of new measures. The stages include:
  - **Climate Risk Assessment:** The process of evaluating the hazard, exposure and vulnerability of a system to climate change. Vulnerability encompasses sensitivity and adaptive capacity.
  - **Strategy and Adaptation Planning:** Frameworks that consider current management options and provide recommendations for adaptation. In some cases, proposed management options were evaluated for feasibility.

- **Implementation plan:** The definition of new management actions in detail and the development of a plan to execute the new measures, including timelines and prioritisation of actions.
  - **Monitoring and Evaluation:** Steps that assess the system after new measures have been implemented and evaluate their impact. This stage also refines recommendations and adjusts adaptation plans as needed.
- 
- **Approach:** Defined by whether indicators used in the tool or framework cover ecological, socio-economic, cultural or governance aspects of the evaluated system.
  - **Scale:** Defined as the range from smallest to largest spatial coverage possible. For instance, tools designed for local (or fishery) levels that can be implemented globally would be classified as Local-Global, whereas tools designed for fisheries in a specific country would be classified Local-National. When resources were associated with a specific location, that location was indicated.
  - **Data Requirements:** Refers to the type of information required; some methods require quantitative data, while others allow for qualitative inputs. Data requirements also indicate whether the source is traditional scientific data and/or local expert knowledge.
  - **Fully available online:** As part of the comparison table, resources were defined based on whether the tool or method can be fully accessed online by any user. Information available only in scientific publications is not considered fully available online, as access to scientific literature may be limited for some users.
  - **Specific to fisheries and aquaculture:** Refers to resources designed specifically for the fisheries and aquaculture sectors.
  - **End users:** Refers to potential users of the resource, including any stakeholders or the general public, industry, managers, or researchers. If a tool does not specify end users but is not highly technical and is fully available online, it was assumed to be aimed at all users.

FISHERIES/AQUACULTURE/BOTH		TOOL/Framework/APP
<i>Name:</i> <b>Full name of tool</b>		<i>Tag:</i> Short name/acronym
<i>Short Summary:</i> Add short definition and summary of the tool or framework		
<i>Developer:</i> Authors and affiliations (and funders if applicable)		Add logo if available
<i>Relevant Links and References:</i> - Add links to the resource		<i>End Users:</i> General/Managers/Research/Industry
<i>Case studies available: Yes/No</i> Refer to case studies or examples where the tool has been used (include location).		
<i>Stages Included</i>	<input type="checkbox"/> Climate Risk Assessment <input type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<i>Framework:</i>
<i>Approach</i>	<input type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<i>Scale</i>	Local      National      Global <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Location-specific:	
<i>Data Requirements</i>	<input type="checkbox"/> Traditional Scientific Data <input type="checkbox"/> Quantitative Input	
	<input type="checkbox"/> Local expert Knowledge <input type="checkbox"/> Qualitative Input	




























**Figure 2.** Summary template used to compile information for tools and frameworks assessing climate risk and adaptation in fisheries and aquaculture.

### 3. Results

#### 3.1. Comparison of tools and frameworks for climate risk assessment and adaptation




























































This section presents a comparison across the tools and frameworks reviewed to facilitate users in selecting the most appropriate approach for their interests. Tools are classified based on whether their primary focus is climate risk or vulnerability assessment (Table 2) or climate adaptation planning (Table 3). In each table, resources are sorted based on their geographic scope, from methods that have a global application to those that have been developed specifically for a region or country.

**Table 2. Comparison of tools and frameworks with a focus on climate risk assessment in fisheries and aquaculture.** Location codes refer to European Union (EU) and Philippines (PHL).




































Stage	Components	CVA	RARE CCVA	FishMIP	CRIB	CERES	VA-TURF	Fish Vool	I-C-SEA Change	
Tool overview	Fully available online	✓	✓	✗	✗	✗	✗	✗	✗	
	Specific to fisheries/aquaculture	✓	✓	✓	✗	✓	✓	✓	✗	
	Approach - Ecological  , Socio-Economic  , Cultural  , Governance 									
	End users - General  , Industry  , Managers   , Researchers 									
	Location	Global	Global	Global	Global	EU	PHL	PHL	PHL	
Climate Risk Assessment	Hazard	✓	✓	✓	✓	✓	✓	✓	✓	
	Exposure	✓	✓	✓	✓	✓	✓	✓	✓	
	Vulnerability	Sensitivity	✓	✓	✓	✓	✓	✓	✓	
		Adaptive capacity	✓	✓	✗	✓	✓	✓	✓	
Strategy and Adaptation Planning	Current management options considered	✗	✗	✗	✗	✗	✗	✗	✗	
	Recommendations for adaptation	✗	✓	✗	✗	✓	✓	✓	✗	
	Evaluation of management options (Feasibility, risk, benefits)	✗	✗	✗	✗	✗	✗	✗	✗	
Implementation	New management actions defined	✗	✗	✗	✗	✗	✗	✗	✗	
	Implementation plan (temporal/spatial scales)	✗	✗	✗	✗	✗	✗	✗	✗	
Monitoring and Evaluation	Monitoring	✗	✗	✗	✗	✗	✗	✗	✗	
	Evaluation	✗	✗	✗	✗	✗	✗	✗	✗	
	Refine and adjust plan	✗	✗	✗	✗	✗	✗	✗	✗	
References		[1, 2]	[3, 4]	[5, 6]	[7]	[8-10]	[11]	[12]	[13]	

\*See table 2 references in bibliography section

**Table 3 (Part 1 of 2). Comparison of tools and frameworks with a focus on climate adaptation in fisheries and aquaculture.** Location codes refer to Australia (AUS), Canada (CAN), European Union (EU), and United States (USA).

Stage	Components	CRF Planning Tool	FISHE	Diagnostic Approach to Adaptation	SUPREME	Quentin Grafton 2010	Climate Expert	SQA	Ogier et al. 2020	Climate ADAPT	
Tool overview	Fully available online	✓	✓	✗	✗	✗	✓	✗	✗	✓	
	Specific to fisheries/aquaculture	✓	✓	✓	✓	✓	✗	✗	✓	✗	
	Approach - Ecological  , Socio-Economic  , Cultural  , Governance 	   		  	   	   	   	   	   	   	
	End users - General  , Industry  , Managers  , Researchers 	 	 	 	 	 		 	 	 	 
	Location	Global	Global	Global	Global	Global	Global	Global	Global	Global	EU
Climate Risk Assessment	Hazard	✓	✓	✗	✓	✓	✓	✓	✗	✓	
	Exposure	✓	✓	✗	✓	✓	✓	✓	✗	✓	
	Vulnerability	Sensitivity	✓	✓	✗	✓	✓	✓	✓	✗	✓
		Adaptive capacity	✓	✓	✓	✓	✓	✓	✓	✗	✓
Strategy and Adaptation Planning	Current management options considered	✓	✓	✓	✗	✓	✓	✓	✓	✓	
	Recommendations for adaptation	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Evaluation of management options (Feasibility, risk, benefits)	✓	✗	✓	✗	✓	✓	✓	✓	✓	
Implementation	New management actions defined	✓	✗	✓	✗	✓	✗	✗	✗	✓	
	Implementation plan (temporal/spatial scales)	✓	✗	✓	✗	✓	✗	✗	✗	✓	
Monitoring and Evaluation	Monitoring	✗	✓	✓	✗	✗	✗	✓	✗	✓	
	Evaluation	✗	✓	✓	✗	✗	✗	✓	✗	✓	
	Refine and adjust plan	✗	✓	✓	✗	✗	✗	✓	✗	✓	
References		[14, 15]	[16, 17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	

**Table 3 (Continued part 2 of 2). Comparison of tools and frameworks with a focus on climate adaptation in fisheries and aquaculture.**

Stage	Components	Clime Fish	CERES	CEFI	U.S. Resilience Toolkit	VCAPS	Climate Adaptation Hub	FishAdapt Handbook	CAFF	
Tool overview	Fully available online	✓	✗	✗	✓	✓	✓	✓	✗	
	Specific to fisheries/aquaculture	✓	✓	✓	✗	✗	✓	✓	✓	
	Approach - Ecological  , Socio-Economic  , Cultural  , Governance 	   	   		   	   				
	End users - General  , Industry  , Managers  , Researchers 	 	 	 	 	 				
	Location	EU	EU	USA	USA	USA	USA	AUS	CAN	
Climate Risk Assessment	Hazard	✓	✓	✓	✓	✗	✓	✓	✓	
	Exposure	✓	✓	✓	✓	✗	✓	✓	✓	
	Vulnerability	Sensitivity	✓	✓	✓	✓	✓	✓	✓	
		Adaptive capacity	✓	✓	✓	✓	✓	✓	✓	
Strategy and Adaptation Planning	Current management options considered	✓	✗	✗	✓	✓	✓	✓	✓	
	Recommendations for adaptation	✓	✓	✓	✓	✓	✓	✓	✓	
	Evaluation of management options (Feasibility, risk, benefits)	✓	✗	✗	✓	✓	✓	✓	✗	
Implementation	New management actions defined	✓	✗	✗	✓	✗	✓	✓	✗	
	Implementation plan (temporal/spatial scales)	✓	✗	✗	✓	✗	✓	✓	✗	
Monitoring and Evaluation	Monitoring	✓	✗	✓	✓	✗	✓	✓	✗	
	Evaluation	✓	✗	✗	✓	✗	✓	✓	✗	
	Refine and adjust plan	✓	✗	✗	✓	✗	✓	✓	✗	
References		[25, 26]	[8-10]	[27]	[28]	[29, 30]	[31, 32]	[33]	[34]	



\*See table 3 references in bibliography section

## 3.2. Summary of tools and frameworks for climate change risk and adaptation



### 3.2.1. [Climate Resilient Fisheries Planning Tool; CRF](#)

FISHERIES		TOOL
<b>Name:</b> <b>Climate Resilient Fisheries Planning Tool</b>		<b>Tag:</b> CRF Planning Tool
<b>Short Summary:</b> <p>The Climate-Resilient Fisheries Planning Tool guides users through a six-step process to assess their fishery's climate resilience and identify approaches and priority actions to help build resilience in their fishery. The tool is based on rigorous scientific research, analysis of case studies exploring climate resilience in various fisheries, and expert consensus regarding key actions for climate resilience. It can be used even when detailed data on current and projected climate impacts are not available. The tool facilitates an assessment of ecological, socio-economic, and governance dimensions of a fishery that enables users to prioritize interventions across these dimensions based on the planning goals, expected climate impacts, and resilience attributes present in the fishery. Through a six-step process, it supports users in developing a set of actionable interventions and priorities to operationalize climate resilience in the fishery. The steps are presented on a series of web pages with a downloadable workbook providing a worksheet for each step. After completing Steps 1-6, tool users come away with a prioritized list of potential actions aimed at building climate resilience that can be used to build a fishery climate resilience plan.</p>		
<b>Developer:</b> <b>Science for Nature and People Partnership (SNAPP) working group on <a href="#">Climate-Resilient Fisheries</a>.</b>		
<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- <a href="https://climateresilientfisheries.net">https://climateresilientfisheries.net</a></li> <li>- <a href="https://snappartnership.net/teams/climate-resilient-fisheries/">https://snappartnership.net/teams/climate-resilient-fisheries/</a></li> <li>- <a href="#">Mason et al. 2022</a></li> </ul>		<b>End Users:</b> General, Managers, Research, Industry.
<b>Case studies available: Yes</b> There are 18 <a href="#">case studies</a> available online: Fiji Nearshore Fisheries, Mie Spiny Lobster Fishery (Japan), Hokkaido Set-Net Fishery (Japan), US Atlantic and Gulf Migratory Pelagic Fishery, Tasmania Rock Lobster Fishery, US West Coast Pacific Sardine Fishery, Madagascar Nearshore Fisheries, Northeast Atlantic Small Pelagic Fishery (Netherlands, UK, Denmark, Germany), Moorea Reef Fish Fishery (French Polynesia), Maine American Lobster Fishery (US), Madang Reef Fish Fishery (PNG), Kiribati Giant Clam Fishery, Juan Fernandez Islands Demersal Fisheries (Chile), Iceland Groundfish Fisheries, US Bering Sea Groundfish Fisheries, California Dungeness Crab Fishery, Galicia Stalked Barnacle Fishery (Spain). Also see <a href="#">FishSCORE</a> .		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input checked="" type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global  <input type="checkbox"/> Location-specific:	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

### 3.2.2. Framework for Integrated Stock and Habitat Evaluation; FISHE

FISHERIES		FRAMEWORK
<b>Name:</b> <b>Framework for Integrated Stock and Habitat Evaluation</b>		<b>Tag:</b> FISHE
<b>Short Summary:</b> Scientific assessment is one of the keys to sustainable fisheries management. Yet the vast majority of the world's fisheries lack scientific assessments or management guidance, resulting in high risk of decline and collapse. Now, as climate change alters ocean conditions across the globe, scientific assessment and informed management decision-making are more critical than ever. <b>The Framework for Integrated Stock and Habitat Evaluation (FISHE) is a step-by-step process for providing scientific guidance for the sustainable, climate-resilient management of data-limited fisheries.</b> FISHE constitutes an adaptive management framework that can help to confer sustainability and climate resilience to support either precautionary or data-driven science-based management. It also helps fisheries improve their data collection and scientific assessment systems so that they can increase the effectiveness of their management regimes.		
<b>Developer:</b> Environmental Defense Fund		
<b>Relevant Links and References:</b> - <a href="https://fishe.edf.org">https://fishe.edf.org</a> - Pathways for Climate-Ready Fisheries - <a href="#">Report</a> 2019		<b>End Users:</b> General, Managers, Research, Industry.
<b>Case studies available: Yes</b> There is a hypothetical <a href="#">case study</a> presented on the FISHE website with each step mapped out.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local      National      Global <input type="checkbox"/> Location-specific:	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

### 3.2.3. [Climate Vulnerability Assessment tool; CVA](#)

FISHERIES		FRAMEWORK
<b>Name:</b> <b>Climate Vulnerability Assessment Tool</b>		<b>Tag:</b> CVA
<b>Short Summary:</b> The Environmental Defense Fund's Climate Vulnerability Assessment (CVA) tool provides a framework to assess the relative vulnerability of a suite of fisheries species to climate change, in order to support climate-ready planning and adaptive management. This Excel-based tool is modelled on the CVA framework established in Hare et al. 2016, but has been modified with language to facilitate its use in data-limited contexts. The CVA combines the exposure of a species to climate change with its sensitivity to stressors to estimate an overall climate vulnerability score. With this tool, fishery practitioners can: (1) Evaluate the exposure and sensitivity of a range of species to climate change to understand vulnerability and risk; (2) Compare the vulnerabilities of multiples species to understand the specific needs of the fishery; and (3) Estimate the potential for a change in species distribution for each species due to climate change. This CVA tool is part of FISHE (described above), a comprehensive framework for the management of data-limited fisheries.		
<b>Developer:</b> Environmental Defense Fund		
<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- <a href="https://fisherysolutionscenter.edf.org/tools/climate-vulnerability-assessment">https://fisherysolutionscenter.edf.org/tools/climate-vulnerability-assessment</a></li> <li>- <a href="#">Carroll et al 2023</a></li> <li>- CVA Tool- <a href="#">How-To-Guide</a></li> </ul>		<b>End Users:</b> General, Managers, Research, Industry.
<b>Case studies available: Yes</b> There is a <a href="#">case study</a> online looking at climate vulnerability assessment in Caribbean Recreational Fisheries and an associated paper by Carroll et al 2023.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b>
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global  <input type="checkbox"/> Location-specific:	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

FISHERIES		TOOL
<b>Name:</b> <b>RARE Climate Change Vulnerability Assessment</b>		<b>Tag:</b> RARE CCVA
<b>Short Summary:</b> Climate Change Vulnerability Assessments (CCVAs) work to identify the specific climate threats that face individual locations and how the local ecological and social systems are likely to respond to understand which threats changes are likely to have their greatest impacts and where. CCVAs are a systematic tool for evaluating climate change vulnerability at a given location. CCVAs can be applied broadly to provide a comparison of sites across areas, or narrowly to investigate the drivers of vulnerability at specific sites, referred to as regional and local CCVAs, respectively. Regional CCVAs utilize a “top-down” approach relying on datasets collected over multiple sites, often drawing from regional, national, or international datasets, or data generated systematically across all sites of interest. By contrast, Local CCVAs rely more heavily on a “bottom-up” approach whereby data are mainly gathered from stakeholders, experts, and local observation. The results of the CCVA provide a quantified ranking of vulnerability across the area with higher scores indicating higher vulnerability. The individual components, however, are equally important as they reveal the drivers of vulnerability at each location and therefore inform what actions will be most effective. By developing a comprehensive understanding of the challenges faced by communities and how well prepared each community is to face them provides an insightful perspective on how to improve that community’s resilience to climate change.		
<b>Developer:</b> RARE – Fish Forever		
<b>Relevant Links and References:</b> - <a href="https://portal.rare.org/en/tools-and-data/climate-change-vulnerability/">https://portal.rare.org/en/tools-and-data/climate-change-vulnerability/</a> - <a href="#">User guide Report</a> and <a href="#">Online Dashboard</a>		<b>End Users:</b> General, Managers, Research, Industry.
<b>Case studies available: Yes</b> Results can be explored via the online dashboard.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local                  National                  Global 	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	
	<input type="checkbox"/> Location-specific:	
		


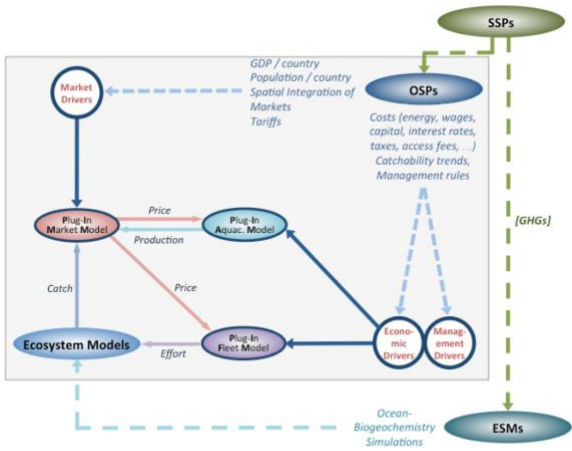
FISHERIES		FRAMEWORK
<b>Name:</b> <b>Diagnostic approach to climate adaptation for fisheries</b>		<b>Tag:</b> Diagnostic Approach to Adaptation
<b>Short Summary:</b> A diagnostic approach to climate change adaptation for fisheries is proposed to define potential climate adaptation pathways in well-managed fisheries. Traditional climate vulnerability and risk assessments tend to focus on biophysical threats and opportunities and thereby what needs to be done to adapt to climate change. Our diagnostic approach moves from such analysis to focus on how the processes of adaptation and development of adaptive capacity can be structured to achieve desired outcomes. Using a well-grounded framework, the diagnostic approach moves from system description to characterization of challenges and opportunities, through two stages of analysis and validation, to the definition and embedding of adaptation options and pathways. The framework can include all contextually relevant variables and accommodate evaluation of adaptation outcomes and comparisons across scales and contexts. Such an approach can serve as a basis for enabling stakeholders to identify challenges and opportunities, and to explore and prioritize options for development and implementation of legitimate adaptation pathways.		
<b>Developer:</b> P. Leith, E. Ogier, G. Pecl, E. Hoshino, J. Davidson, M. Haward. University of Tasmania		
<b>Relevant Links and References:</b> - <a href="#">Leith et al 2014</a>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: No</b> The paper describes the theoretical framework and provides detailed process (Supplementary materials) for implementation. Framework is developed based on the experience in Australian fisheries, but would be applicable to commercial fisheries in many developed countries.		
<b>Stages Included</b>	<input type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input checked="" type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global <input type="checkbox"/> Location-specific:	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

Fig. 1 Schematic of the diagnostic process for developing adaptation pathways for a fishery

### 3.2.6. Sustainability, Predictability and Resilience of Marine Ecosystems; SUPREME

FISHERIES		PROGRAM
<b>Name:</b> <b>Sustainability, Predictability and Resilience of Marine Ecosystems</b>		<b>Tag:</b> SUPREME
<b>Short Summary:</b> The SUPREME programme will convene global partners through knowledge networks to share information and support the production of robust ocean forecasts, predictions, and projections to guide effective marine ecosystem management and adaptation strategies in a changing climate. The overall goal of this effort is to advance the modelling tools needed to reduce risks and increase resilience of marine resources and the people who depend on them.		
<b>Primary outcomes:</b> <ul style="list-style-type: none"> <li>• Robust climate and ocean-related forecasts, predictions, and projections to inform risk assessments and resource management options</li> <li>• Adaptation strategies that reduce risks and increase resilience of marine resources and the people who depend on them.</li> </ul>		
<b>Key activities:</b> <ul style="list-style-type: none"> <li>• Enhance the utility of existing climate information</li> <li>• Develop common modelling frameworks and advance regional modelling systems</li> <li>• Establish regional teams and a community of practice</li> <li>• Fuel innovation and co-development of applications and fisheries management tools</li> <li>• Provide timely and accessible information delivery to a wide range of stakeholders, and promote international capacity development and gender, generational and geographic diversity.</li> </ul>		
<b>Developer:</b> US National Oceanic and Atmospheric Administration (NOAA) <a href="mailto:Steven.Bograd@noaa.gov">Steven.Bograd@noaa.gov</a> <a href="mailto:Edward.Gorecki@noaa.gov">Edward.Gorecki@noaa.gov</a>		
<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- <a href="https://oceandecade.org/actions/sustainability-predictability-and-resilience-of-marine-ecosystems-supreme/">https://oceandecade.org/actions/sustainability-predictability-and-resilience-of-marine-ecosystems-supreme/</a></li> <li>- <a href="#">Fact Sheet</a></li> </ul>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: Yes</b> The programme is hosting the following projects: Impacts of Heatwaves and Hypoxia on Shellfish (Canada), Canadian Ocean Climate Simulation: 1958 to Present (CanOCS), Fish biodiversity facing global change (FishGLOB; France, Canada, US), MERMAID Coral Reef Data Platform (Global), Whales and Climate (WCP; Global), Mitigation of Nat Incidence to Ocean Resilience (MoNITOR; China and Indo-Pacific).		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local      National      Global <input type="checkbox"/> Location-specific:	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input type="checkbox"/> Local expert Knowledge <input type="checkbox"/> Qualitative Input	


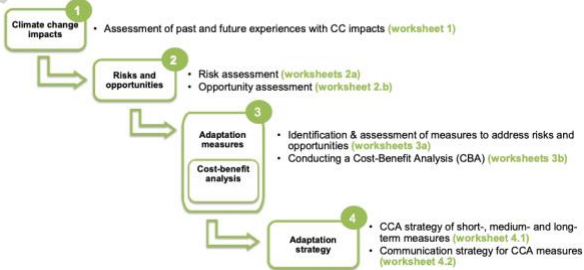
3.2.7. Fisheries and Marine Ecosystem Model Intercomparison Project; FishMIP

FISHERIES AND AQUACULTURE		FRAMEWORK
<p><b>Name:</b>  <b>Fisheries and Marine Ecosystem Model Intercomparison Project</b></p>		<p><b>Tag:</b>            FishMIP</p>
<p><b>Short Summary:</b>            The Fisheries and Marine Ecosystems Model Intercomparison Project (FishMIP) is a network of more than 100 marine ecosystem modellers and researchers from around the world and has dedicated a decade to unravelling the future impacts of climate change on marine animal biomass. FishMIP projections and their associated uncertainties offer the state-of-the art in climate change impact model projections for adaptation purposes. <b>FishMIP (2.0) is now preparing a new simulation protocol to assess the combined effects of both climate and socio-economic changes on marine fisheries and ecosystems.</b></p> <p>Knowledge and model projections to estimate fish biomass gains and losses are crucial for informing climate-resilient fisheries management and adaptation planning. The Fisheries and Marine Ecosystem Model Intercomparison Project (FishMIP) presents projections to 2100 of exploitable fish biomass under different climate scenarios, for all countries and territories. The results are based on state-of-the art modelling approaches produced by a global network of marine ecosystem modelers. Investigating the medium- and long-term effects of climate change on global marine ecosystems and fisheries, modellers collaborated to compare existing models worldwide and to produce an ensemble of projections, along with their associated uncertainties, under low and high-emission future scenarios.</p>		
<p><b>Developer:</b>            Julia Blanchard and colleagues.            Institute for Marine and Antarctic Studies, University of Tasmania;            Food and Agriculture Organisation of the United Nations (FAO)</p>		
<p><b>Relevant Links and References:</b></p> <ul style="list-style-type: none"> <li>- <a href="https://fishmip.org">https://fishmip.org</a></li> <li>- <a href="#">FAO Report</a> - Climate change risks to marine ecosystems and fisheries</li> <li>- <a href="#">Blanchard et al 2024</a></li> <li>- Maury et al (<a href="#">preprint</a>)</li> </ul>		<p><b>End Users:</b>            Research.</p>
<p><b>Case studies available: Yes</b></p> <p>The associated FAO Report provides projections per region and major fishing areas. The FishMIP model ensemble includes nine global models and more than 30 regional models. Projections for regional ecosystem models have been compared with global models for a small subset of different systems around the globe, such as the coasts of the United States of America and Southern Africa, the Mediterranean Sea, and shelf regions of Australia, New Zealand and Europe.</p>		
<p><b>Stages Included</b></p>	<input checked="" type="checkbox"/> Climate Risk Assessment <input type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<p><b>Framework:</b></p>  <p><i>Figure 3: Schematic structure of the information flow from the shared socioeconomic pathways (SSPs) to the 'plug-in-models' and their coupling to marine ecosystem models (MEMs). Dashed arrows represent the drivers of the MEM-PIM complex.</i></p>
<p><b>Approach</b></p>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<p><b>Scale</b></p>	<p>Local                      National                      Global</p> <div style="background-color: #008080; width: 100%; height: 15px; margin-bottom: 5px;"></div> <input type="checkbox"/> Location-specific:	
<p><b>Data Requirements</b></p>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input type="checkbox"/> Local expert Knowledge <input type="checkbox"/> Qualitative Input	

FISHERIES		FRAMEWORK
<i>Name:</i> <b>Adaptation to climate change in marine capture fisheries</b>		<i>Tag:</i> Quentin Grafton, 2010
<i>Short Summary:</i> This paper responds to the challenge of how and when to adapt marine capture fisheries to climate change by (1) providing a set of fisheries policy options to climate change; (2) developing a risk and vulnerability assessment and management decision-making framework for adaptation; and (3) describing the possible strategies and tactics for ex ante and ex post climate adaptation in the marine environment. Its contributions include (1) a discussion of how management objectives and instruments influence resilience and adaptation; (2) a decision-making process to assess vulnerabilities to climate change and to manage adaptation responses; (3) an inter-temporal framework to assist decision-makers on when to adapt; (4) a risk and simulation approach to confront the uncertainties of the possible losses due to climate change and the net benefits of adaptation; (5) an explanation of how adaptive co-management can promote flexible adaptation responses and also strengthen adaptation capacity; and (6) a selection of possible 'win-win' management actions.		
<i>Developer:</i> R. Quentin Grafton Crawford School of Economics and Government, The Australian National University, Australia		
<i>Relevant Links and References:</i> - <a href="#">Quentin Grafton 2010</a>		<i>End Users:</i> Research
<i>Case studies available:</i> <b>No</b> The paper mostly describes the theoretical framework and steps to be applied to specific fisheries to assess vulnerability and plan for resilience and adaptation – no specific examples provided.		
<i>Stages Included</i>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<i>Framework:</i>
<i>Approach</i>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance	
<i>Scale</i>	Local                      National                      Global <input type="checkbox"/> Location-specific:	
<i>Data Requirements</i>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

Fig. 4. Vulnerability assessment and the adaptation decision-making process. Adapted from Broadleaf Capital International & Marsden Jacob Associates [43].

### 3.2.9. [Climate Expert](#)




FISHERIES AND AQUACULTURE		TOOL
<b>Name:</b> <b>Climate Expert</b>		<b>Tag:</b> Climate Expert
<b>Short Summary:</b> The Climate Expert entails a practical 5-step approach and working materials that help <b>businesses</b> analyse climate change risks and opportunities and generate strong adaptation strategies. The Climate Expert approach was developed for small and medium-sized enterprises (SMEs) and industrial zones that are or will be affected by climate change. It also addresses consultants, experts and multipliers who want to support the private sector in adapting to climate change.		
<b>Developer:</b> Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH. Developed under the GIZ global programme "Private Sector Adaptation to Climate Change (PSACC)"		
<b>Relevant Links and References:</b> - <a href="https://www.climate-expert.org/en/home">https://www.climate-expert.org/en/home</a> - <a href="#">Worksheets online</a>		<b>End Users:</b> Industry
<b>Case studies available: Yes</b> Case studies presented online but mostly not fisheries relevant. There is a case study from a fish processing company in Morocco ( <a href="#">link</a> ).		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b>  <pre> graph TD     1[Climate change impacts] --&gt; 2[Risks and opportunities]     2 --&gt; 3[Adaptation measures]     3 --&gt; 4[Adaptation strategy]           </pre>
<b>Approach</b>	<input type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global <div style="background-color: #008080; width: 100%; height: 15px; margin-top: 5px;"></div> <input type="checkbox"/> Location-specific:	
<b>Data Requirements</b>	<input type="checkbox"/> Traditional Scientific Data <input type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

FISHERIES AND AQUACULTURE		FRAMEWORK
<b>Name:</b> <b>Semi-quantitative vulnerability assessment method</b>		<b>Tag:</b> SQA
<b>Short Summary:</b> The semi-quantitative assessment (SQA) method involves a customisable 10-step process that directs the assessment focus and application of results, particularly for targeting management. The SQA method presented here includes clear steps to assess climate change vulnerability (steps 2–8) as well as applying results to inform adaptation (steps 9 and 10). All 10 steps may not be applicable in all circumstances, and selecting which steps to complete is part of customising the process to the study context. In particular, ‘review and reassess’ (step 8) may not be required depending on the results of the sensitivity analysis. Similarly, ‘prioritisation’ (step 9) may be skipped if the selection of components (in step 2) already considered values and importance. The SQA method is designed for application by decisionmakers seeking transparent support for managing natural resources, conservation areas, community-based actions and climate change impacts (includes practitioners guide in the Supplementary Material). Including participation by local experts, stakeholders and communities throughout the process ensures the results are robust and maximises uptake, delivering direct translation to management actions.		
<b>Developer:</b> Johanna Johnson*, David J. Welch, Jeffrey A. Maynarde, Johann D. Bell, Gretta Pecl, Julie Robins, Thor Saunders *C2O		
<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- Johnson, J.E., Welch, D.J., Maynard, J.A., Bell, J.D., Pecl, G., Robins, J. and Saunders, T., 2016. Assessing and reducing vulnerability to climate change: Moving from theory to practical decision-support. <i>Marine Policy</i>, 74, pp.220-229 – <a href="#">link</a>.</li> <li>- <a href="#">Online book</a> – Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change.</li> </ul>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: Yes</b> The described framework has already been applied by tailoring the 10 steps to assess the vulnerability of ecosystems and communities in tropical SES's. Two of these applications are summarised in the paper as case examples of applying the 10 steps: (1) Pacific Island food security from fisheries and (2) Gulf of Carpentaria fisheries (Australia).		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input checked="" type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global <input type="checkbox"/> Location-specific:	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

FISHERIES AND AQUACULTURE		TOOL
<b>Name:</b> <b>Participatory Evaluation of Adaptation Options for Fisheries</b>		<b>Tag:</b> Ogier et al. 2020
<b>Short Summary:</b> Planned adaptation to climate impacts and subsequent vulnerabilities will necessarily interact with autonomous responses enabled within existing fisheries management processes and initiated by the harvest and post-harvest components of fishing industries. Optimal adaptation options are those which enable negative effects to be mitigated and opportunities that arise to be maximized, both in relation to specific climate-driven changes and the broader fisheries system. We developed a two-step participatory approach to evaluating adaption options for key fisheries in the fast warming hotspot of south-eastern Australia. Involved stakeholders undertook a “first pass” screening assessment of options, by characterizing and then evaluating options. In the characterization step potential adaptation options for each fishery, contextualized by prior knowledge of each species’ climate change exposure and sensitivity, were described using a characterization matrix. This matrix included: the specific climate vulnerability/challenges, the implications of each option on the fishery system as a whole, the temporal and spatial scales of implementation processes, and realized benefits and costs. In the evaluation step, semi-quantitative evaluation of options was undertaken by stakeholders scoring the anticipated performance of an option against a pre-determined set of criteria relating to perceived feasibility, risk (inclusive of potential costs), and benefit. Our screening assessment represents a pragmatic approach to evaluate and compare support for and the effects of alternative adaptation options prior to committing to more detailed formal and resource intensive evaluation or implementation.		
<b>Developer:</b> Emily Ogier and collaborators Institute for Marine and Antarctic Studies, and Centre for Marine Socioecology; University of Tasmania, Australia		
<b>Relevant Links and References:</b> - <a href="#">Ogier et al 2020</a> - Related to this work – <a href="#">Jennings et al 2016</a> on setting objectives for evaluation adaptation options		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: Yes</b> Four fisheries (southern rock lobster, abalone, snapper, and blue grenadier) were selected as case studies on the basis of their high to moderate vulnerability to climatic effects on species distribution and abundance. Reduction of the total annual commercial catch as well as reductions in both effort and catch through spatial and temporal closures were the options scored as having the highest level of expected benefit and of feasibility and the lowest level of risk of negative outcomes overall.		
<b>Stages Included</b>	<input type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b>
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local      National      Global <input type="checkbox"/> Location-specific: Global	
<b>Data Requirements</b>	<input type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

FISHERIES		FRAMEWORK
<b>Name:</b> <b>Climate Risk Index for Biodiversity</b>		<b>Tag:</b> CRIB
<b>Short Summary:</b> Adaptation strategies will require a robust understanding of the risks to species and ecosystems and how those propagate to human societies. We develop a unified and spatially explicit index to comprehensively evaluate the climate risks to marine life. Under high emissions (SSP5-8.5), almost 90% of ~25,000 species are at high or critical risk, with species at risk across 85% of their native distributions. One tenth of the ocean contains ecosystems where the aggregated climate risk, endemism and extinction threat of their constituent species are high. Climate change poses the greatest risk for exploited species in low-income countries with a high dependence on fisheries. Mitigating emissions (SSP1-2.6) reduces the risk for virtually all species (98.2%), enhances ecosystem stability and disproportionately benefits food-insecure populations in low-income countries. Our climate risk assessment can help prioritize vulnerable species and ecosystems for climate-adapted marine conservation and fisheries management efforts.		
<b>Developer:</b> Daniel G. Boyce, Nancy Shackell, Phil Greyson, and Blair Greenan <a href="mailto:dan.boyce@dfo-mpo.gc.ca">dan.boyce@dfo-mpo.gc.ca</a> Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, Canada		
<b>Relevant Links and References:</b> - <a href="#">Boyce et al 2022</a>		<b>End Users:</b> Research.
<b>Case studies available: Yes</b> Paper by Boyce et al 2022 presents results for marine biodiversity under two climate scenarios. CRIB is also used to assess climate vulnerability in CAFF (described above).		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global  <input type="checkbox"/> Location-specific:	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input type="checkbox"/> Local expert Knowledge <input type="checkbox"/> Qualitative Input	

Fig. 2. Ecological climate vulnerability for a single species, Atlantic cod (*Gadus morhua*), calculated using the CRIB framework (Boyce et al. 2023b). Within each grid cell (here 0.25°) across the native geographic distribution of cod within its stock management units, 12 standardized climate indices are calculated and used to define the three dimensions of climate vulnerability: present-day sensitivity (blue), projected future exposure under a high emissions scenario (red), and innate adaptivity (yellow), darker shading depicts higher standardized sensitivity, exposure, and adaptivity. The indices and dimensions calculate cods' cumulative climate vulnerability (central map). The full methodology is described in Boyce et al. (2023b).

FISHERIES AND AQUACULTURE		FRAMEWORK
<b>Name:</b> <b>European Climate Adaptation Platform</b>		<b>Tag:</b> Climate ADAPT
<b>Short Summary:</b> Climate-ADAPT aims to support Europe in adapting to climate change helping users to access and share data and information on: <ul style="list-style-type: none"> <li>- Expected climate change in Europe</li> <li>- Current and future vulnerability of regions and sectors</li> <li>- EU, national and transnational adaptation strategies and actions</li> <li>- Adaptation case studies and potential adaptation options</li> <li>- Tools that support adaptation planning</li> </ul> <p>Within that platform, the Adaptation Support Tool (AST) is to assist policy makers and coordinators on the national level in developing, implementing, monitoring and evaluating climate change adaptation strategies and plans.</p>		
<b>Developer:</b> Partnership between the European Commission and the European Environment Agency (EEA).		
<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- Program homepage: <a href="https://climate-adapt.eea.europa.eu/en">https://climate-adapt.eea.europa.eu/en</a></li> <li>- Adaptation Support Tool (AST): <a href="https://climate-adapt.eea.europa.eu/en/knowledge/tools/adaptation-support-tool">https://climate-adapt.eea.europa.eu/en/knowledge/tools/adaptation-support-tool</a></li> </ul>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: Yes</b> Case studies provided <a href="#">online</a> , including some fishery-relevant like a control in ciguatera poisoning in the Canary Islands (Spain, <a href="#">link</a> ) or preventing lionfish invasion in Cyprus ( <a href="#">link</a> ).		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input checked="" type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global  <input checked="" type="checkbox"/> Location-specific: European Union	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

<b>FISHERIES AND AQUACULTURE</b>	<b>FRAMEWORK</b>
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<b>Name:</b> <b>Climate Adaptation Guidelines for Fisheries and Aquaculture</b>	<b>Tag:</b> Clime Fish
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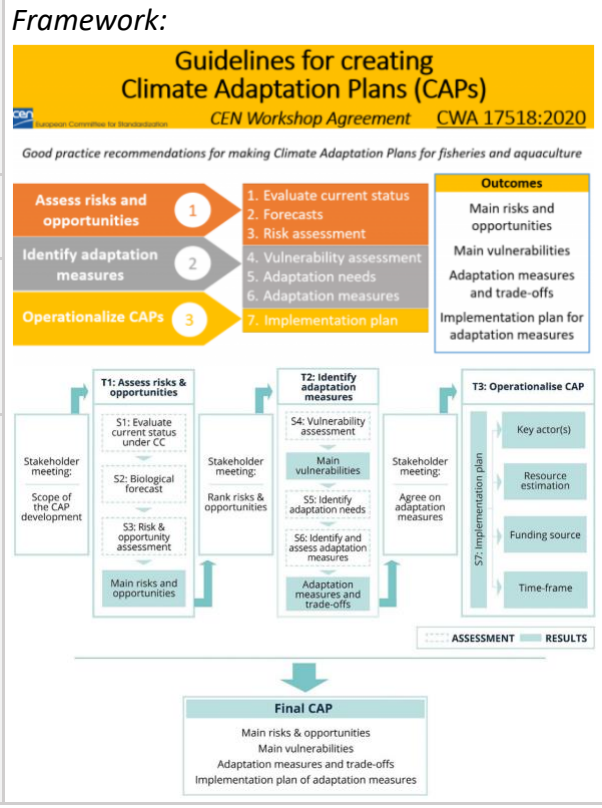
**Short Summary:**  
 Guidelines for the development of climate adaptation plans (CAPs) within fisheries and aquaculture, applying a co-creation approach that requires the participation of scientists industry representatives, policymakers, and other relevant stakeholders. The objective is to provide a stepwise approach to facilitate and enable stakeholders to plan strategies toward climate adaptation. The guidelines are based on practical experience and include a three-step process: (1) assessment of risks and opportunities; (2) identification of adaptation measures, and (3) operationalization of CAPs. The three-step process is also part of a larger cycle, including implementation, monitoring, and evaluation, again generating iterative feedback loops over time.


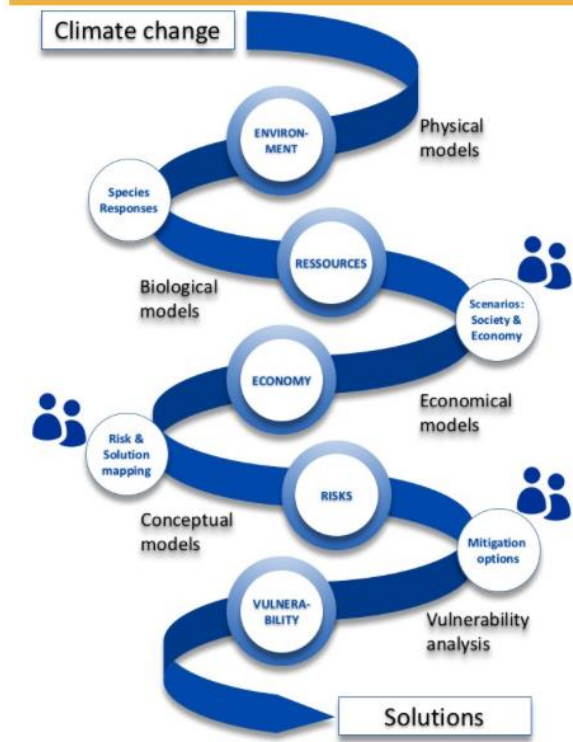

<b>Developer:</b> Partnership between the European Commission and the European Environment Agency (EEA).	 <b>ClimeFish</b>
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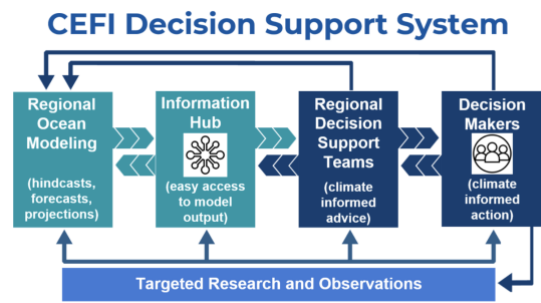

<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- Project homepage: <a href="https://climefish.eu">https://climefish.eu</a></li> <li>- <a href="#">Pham et al. 2021</a>. Guidelines for co-creating climate adaptation plans for fisheries and aquaculture</li> <li>- <a href="#">Ojea et al. 2021</a>. Assessing countries' social-ecological resilience to shifting marine commercial species</li> </ul>	<b>End Users:</b> Managers, Research, Industry.
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**Case studies available: Yes**  
 ClimeFish explores how the most important and the less resilient exploited European fish stocks and the most productive established aquaculture species respond to the different climate scenarios. Case studies provided [online](#).  
 One of the case studies, [ClimeGreAg](#), includes a Decision Support System software for the climate change adaptation of Greek aquaculture.

<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input checked="" type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance
<b>Scale</b>	Local                      National                      Global 
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input




FISHERIES AND AQUACULTURE		TOOL/Framework/APP
<b>Name:</b> <b>Climate change and European Aquatic RESources</b>		<b>Tag:</b> CERES
<b>Short Summary:</b> CERES was designed to advance a cause-and-effect understanding of how climate change will influence European fish and shellfish resources and the economic activities depending on them. More than 150 scientists from 26 partner institutions in 15 countries participated in this four-year project. Partners included national research laboratories, universities as well as industry members from the aquaculture (five partners) and fisheries (two partners) sectors and additional stakeholders. Focusing on the most commercially valuable fish and shellfish, the project increased knowledge and developed tools needed for adaptation planning for European fisheries and aquaculture sectors in marine and inland waters to anticipated climate change. The project identified not only risks but also opportunities as well as uncertainties of climate change impacts, information needed to enhance the resilience and support the development of sustainable management and governance systems in these Blue Growth sectors.		
<b>Developer:</b> A 4-year EU Horizon 2020 project, coordinated by Prof. Myron Peck (University of Hamburg) with 26 partners.		
<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- <a href="https://ceresproject.eu">https://ceresproject.eu</a> and synthesis <a href="#">report</a></li> <li>- <a href="#">Pinnegar et al 2021</a></li> <li>- <a href="#">Payne et al 2021</a></li> <li>- <a href="#">Kreiss et al 2020</a></li> </ul>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: Yes</b> The papers by Payne et al 2021 and Kreiss et al 2020 present case studies on marine fisheries and aquaculture respectively.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global  <input checked="" type="checkbox"/> Location-specific: European Union	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

FISHERIES		INITIATIVE
<b>Name:</b> <b>Climate, Ecosystems, and Fisheries Initiative</b>		<b>Tag:</b> CEFI
<b>Short Summary:</b> The Climate, Ecosystems, and Fisheries Initiative is a cross-NOAA effort to build the nationwide, operational ocean modelling and decision support system needed to reduce impacts, increase resilience, and help adapt to changing ocean conditions. The system will provide decision makers with the actionable information and capacity they need to prepare for and respond to changing conditions today, next year, and for decades to come. The system addresses four core requirements for climate-ready decision-making for marine resources: <ol style="list-style-type: none"> <li>1- Robust forecasts and projections of ocean and Great Lakes conditions for use in developing climate-informed advice;</li> <li>2- Operational capability to assess risks, evaluate options, and provide robust advice on adapting to changing conditions;</li> <li>3- Decision-maker capability to use climate-informed advice to reduce risks and increase the resilience of resources and the people that depend on them;</li> <li>4- Continuous validation and innovation through observations and research.</li> </ol> The Initiative is a timely, efficient, and effective way to address NOAA's requirements for climate-informed management of marine and Great Lakes resources. Working with many partners, the Initiative will provide decision makers the information and capacity they need to help safeguard resources and resource-dependent communities in a rapidly changing world.		
<b>Developer:</b> US National Oceanic and Atmospheric Administration (NOAA) <a href="mailto:roger.b.griffis@noaa.gov">roger.b.griffis@noaa.gov</a>		
<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- <a href="https://www.fisheries.noaa.gov/topic/climate-change/climate,-ecosystems,-and-fisheries">https://www.fisheries.noaa.gov/topic/climate-change/climate,-ecosystems,-and-fisheries</a></li> <li>- <a href="#">Fact Sheet</a></li> </ul>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: Yes</b> The SUPREME programme (described below) falls within the CEFI initiative.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local      National      Global 	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input type="checkbox"/> Local expert Knowledge <input type="checkbox"/> Qualitative Input	
<input checked="" type="checkbox"/> Location-specific: United States		

<b>FISHERIES AND AQUACULTURE</b>	<b>TOOLS and FRAMEWORK</b>
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<b>Name:</b> <b>US Climate Resilience Toolkit and Steps to Resilience</b>	<b>Tag:</b> US Climate Resilience Toolkit
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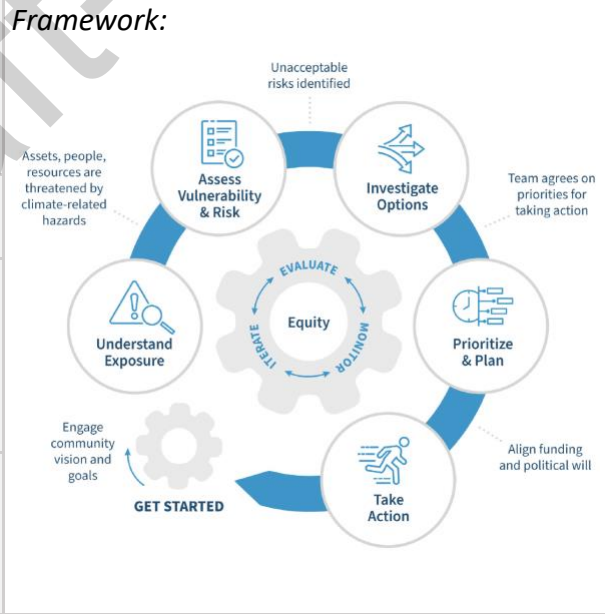
**Short Summary:**  
 Describes 'Steps to Resilience'. This framework helps you document climate hazards that could harm the things you care about, decide which situations you most want to avoid, and come up with workable solutions to reduce your climate-related risks. It works as an information hub with tools, climate risk information and case studies. Alongside the Steps to Resilience Framework, the toolkit gathers relevant tools and frameworks that can be used alongside. The toolkit includes resources and case studies that are relevant to fisheries and aquaculture. Some of which are also described here (e.g., VCAPS and the Climate Adaptation Resource Hub for Fishing Communities, etc).

<b>Developer:</b> NOAA and other US federal agencies	 <b>U.S. Climate Resilience Toolkit</b>
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<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- <a href="https://toolkit.climate.gov">https://toolkit.climate.gov</a></li> <li>- Steps to Resilience <a href="#">Practitioner Guide</a></li> </ul>	<b>End Users:</b> General, Managers, Research, Industry.
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**Case studies available: Yes**  
 Fisheries associated cases studies are available here - <https://toolkit.climate.gov/topics/marine/fisheries-and-coastal-communities>

<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input checked="" type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance
<b>Scale</b>	Local                      National                      Global  <input checked="" type="checkbox"/> Location-specific: United States ( <i>but mostly applicable elsewhere</i> )
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input



FISHERIES AND AQUACULTURE	TOOL/Framework/APP
<b>Name:</b> <b>Vulnerability, Consequences, and Adaptation Planning Scenarios</b>	<b>Tag:</b> VCAPS

**Short Summary:**  
 The Vulnerability, Consequences, and Adaptation Planning Scenarios (VCAPS) process supports planning by local decision makers concerned about coastal management, climate change vulnerability, and adaptation. Using the process can help communities become more resilient to weather and climate change. During the VCAPS process, community members:

- Engage in dialogue about future weather and climate threats.
- Summarize and integrate local knowledge and experience about how the community will be impacted.
- Identify gaps in data, knowledge, or understanding.
- Think strategically about how to prevent harm by taking action in both the short and long term.

VCAPS builds on concepts of hazard management and vulnerability and uses participatory modelling techniques to organize and document dialogue and learning. Local knowledge and experience is integrated with scientific knowledge. The process is flexible and can be fine-tuned to the interests of participants.

**Developer:**  
 Social and Environmental Research Institute (SERI) - Seth Tuler and Tom Webler  
 Carolinas Integrated Sciences and Assessments (CISA) - Kirstin Dow



**Relevant Links and References:**

- <http://www.vcapsforplanning.org>
- <https://toolkit.climate.gov/tool/vulnerability-consequences-and-adaptation-planning-scenarios-vcaps>
- [User Guide](#)
- [Tuller et al. 2020](#).

**End Users:**  
 General, Managers, Research, Industry.

**Case studies available: Yes**  
 Case studies for this tool are summarised in this [link](#), but fishery and aquaculture examples include:

- [Maine Lobster Fishery case study](#)
- [Climate Change Impacts on Shellfishing in Wellfleet Harbor](#)

<b>Stages Included</b>	<input type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global  <input checked="" type="checkbox"/> Location-specific: United States	
<b>Data Requirements</b>	<input type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

3.2.19. [Climate Adaptation Resource Hub for Fishing Communities](#)

FISHERIES AND AQUACULTURE	FRAMEWORK
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<b>Name:</b> <b>Climate Adaptation Resource Hub for Fishing Communities</b>	<b>Tag:</b> Climate Adaptation Resource Hub
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**Short Summary:**  
 Climate Adaptation Resource Hub for Fishing Communities is a project executed by the Gulf of Maine Research Institute to support adaptation planning in Northeast US fishing communities. The goals of the project and online platform include:

- Describe the current and future climate hazards that impact fisheries in the Northeast US.
- Provide community-specific information and projections on climate-driven shifts in distribution and availability of marine species.
- Provide helpful information and strategic steps for individuals, businesses, and communities to adapt their fisheries in the face of climate change impacts.
- Expedite access to additional guidance and resources useful for building community-scale climate resilience in Northeast US fisheries.

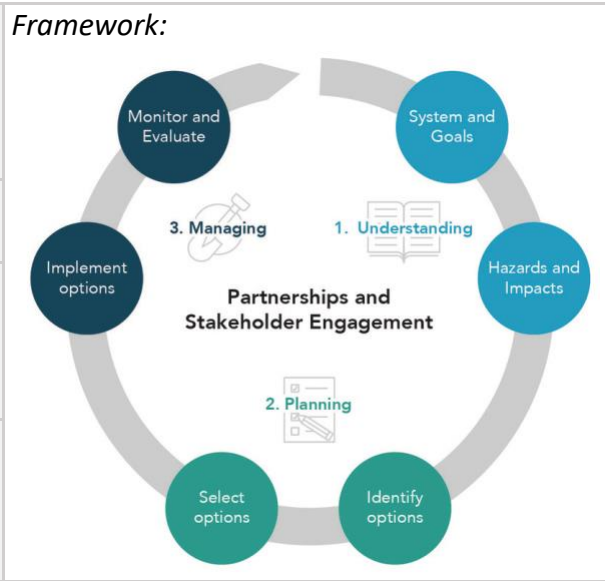
The Hub is structured as a Climate Adaptation Planning Pathway that focuses on three main stages of the adaptation process: understanding, planning, and managing. The pathway can be followed online to guide stakeholder engagement.


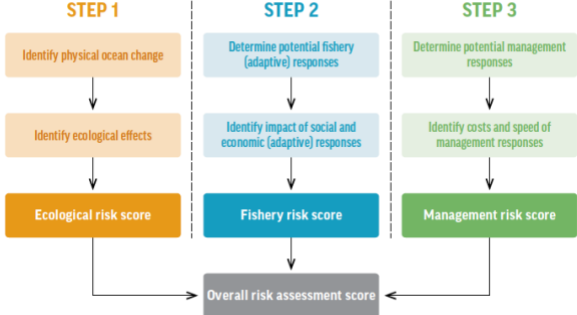
**Developer:**  
 Gulf of Mayne Research Institute  
 And NOAA  
 Katherine Mills

<b>Relevant Links and References:</b> <ul style="list-style-type: none"> <li>- <a href="https://gmri.org/projects/climate-adaptation-fisheries-resource-hub/">https://gmri.org/projects/climate-adaptation-fisheries-resource-hub/</a></li> <li>- <a href="#">Climate Adaptation Options for Fishing Communities</a></li> <li>- <a href="#">Maltby et al 2023</a> - Barriers and enablers of climate adaptation in fisheries: Insights from Northeast US fishing communities</li> </ul>	<b>End Users:</b> General, Managers, Research, Industry.
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**Case studies available: Yes**  
 Website provides examples and information on Northeast US fisheries.

<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance
<b>Scale</b>	Local                      National                      Global <div style="background-color: #008080; width: 25%; height: 10px; margin-bottom: 5px;"></div> <input checked="" type="checkbox"/> Location-specific: Northeast United States
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input



FISHERIES		FRAMEWORK
<i>Name:</i> <b>Adaptation of fisheries management to climate change Handbook</b>		<i>Tag:</i> FishAdapt Handbook
<i>Short Summary:</i> This handbook provides a step-by-step guide to help fisheries managers and other fishery stakeholders assess and help address the risks posed by climate change. Like most risk assessments it follows several phases: a pre-risk assessment (scoping phase), the actual risk assessment, and then a post risk assessment which provides actions and/or recommendations. The objective of this handbook is to help: i) develop strategies and priorities to account for effects of climate change in the management of fisheries using a risk assessment approach; ii) to assess how well the existing fisheries management framework will cope with climate change impacts; and iii) to develop an approach for fisheries managers to adapt their regulatory environment in the light of climate change impacts. The tool is fully available online through an app that guides users through the process.		
<i>Developer:</i> Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia  Fulton EA, van Putten EI, Dutra LXC, Melbourne-Thomas J, Ogier E, Thomas L, Murphy RP, Butler I, Ghebregabhier D, Hobday AJ, Rayns N.		
<i>Relevant Links and References:</i> - <a href="#">Factsheet</a> - <a href="#">Handbook</a> - <a href="#">App/Dashboard</a>		<i>End Users:</i> Managers, Research, Industry.
<i>Case studies available: Yes</i> Handbook presents a worked example in the appendix.		
<i>Stages Included</i>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input checked="" type="checkbox"/> Implementation Plan <input checked="" type="checkbox"/> Monitoring and Evaluation	<i>Framework:</i> 
<i>Approach</i>	<input checked="" type="checkbox"/> Ecological <input checked="" type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance	
<i>Scale</i>	Local                      National                      Global <input checked="" type="checkbox"/> Location-specific: Australia	
<i>Data Requirements</i>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

3.2.21. [Tool for understanding resilience of fisheries; VA-TURF](#)

FISHERIES AND AQUACULTURE		TOOL
<b>Name:</b> <b>Tool for understanding resilience of fisheries</b>		<b>Tag:</b> VA-TURF
<b>Short Summary:</b> The tool for understanding resilience of fisheries (VA-TURF) is a practical and cost-effective tool for assessing the climate change vulnerability of coastal fisheries in the tropics (Mamaug et al 2013). Developed by local marine scientists at the Marine Science Institute of the University of the Philippines Diliman, VA-TURF aims to identify vulnerable fishing communities and demonstrates how to link vulnerability assessment results to climate change adaptation. The results are inputs to drafting of action plans towards reducing vulnerability. Based on IPCC vulnerability framework. The VA-TURF upholds science-based rigor but is also simplified in a rubric approach to initiate its eventual use by local governments in coastal areas of the Philippines, as well as, potentially other areas with similar socio-economic and physical conditions.		
<b>Developer:</b> Marine Science Institute of the University of the Philippines Diliman, Philippines		
<b>Relevant Links and References:</b> - <a href="#">Mamaug et al 2013</a>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: Yes</b> Paper by Mamaug et al 2013 refers to two locations in Philippines.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b>
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	<p>The diagram illustrates the vulnerability assessment framework of VA-TURF. It shows a central flow from Exposure to Sensitivity, then to Adaptive Capacity, and finally to Vulnerability. Exposure is influenced by factors like Wave surge and Gear dependence. Sensitivity is affected by Abundance of exposure-tolerant species, Density of coral-dependent species, and Habitat quality. Adaptive Capacity is determined by Population density, Fisheries ecosystem dependency, and Socio-Economic factors. Vulnerability is the result of Exposure, Sensitivity, and Adaptive Capacity. The diagram also includes various sub-factors and their impacts on the system, such as Catch rate, Dominant catch, Abundance of exposure-tolerant species, Density of coral-dependent species, Habitat quality, Population density, Fisheries ecosystem dependency, Wave surge, Potential impact, Socio-Economic, and various socio-economic indicators like Annual fisheries income and Percentage of fishers with alternative livelihoods.</p>
<b>Scale</b>	Local      National      Global <input checked="" type="checkbox"/> Location-specific: Philippines	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input type="checkbox"/> Qualitative Input	


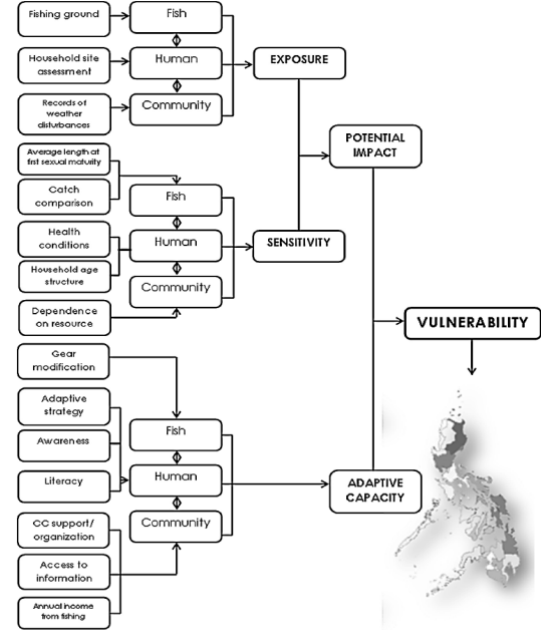

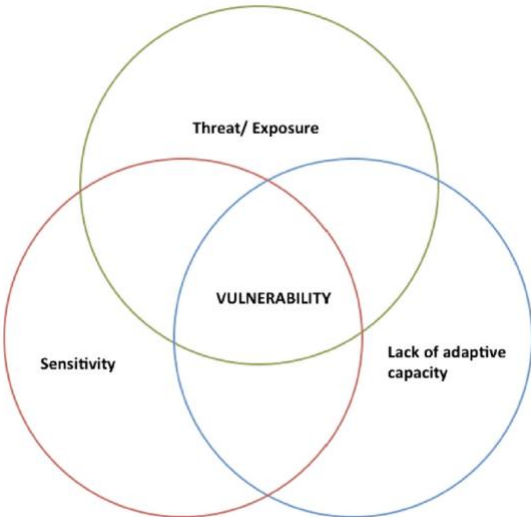

FISHERIES AND AQUACULTURE		TOOL
<b>Name:</b> <b>Fisheries Vulnerability Assessment Tool - Fish Vool</b>		<b>Tag:</b> Fish Vool
<b>Short Summary:</b> FishVool is a sector-based fisheries vulnerability assessment tool to evaluate the vulnerability of primary fishery commodities. The fisheries vulnerability assessment tool (Fish Vool) was developed following the key goal of Vulnerability Assessment to determine the vulnerabilities of fishery commodities or sectors of local municipal or commercial landing sites. The tool was refined using input and validation from fisheries and VA specialists of the University of the Philippines—Marine Science Institute, National Agricultural and Fishery Council, and Bureau of Fisheries and Aquatic Resources(BFAR) regional representatives to eliminate unnecessary parameters and incorporate relevant components. It scores different aspects (vulnerability, adaptive capacity, sensitivity) as high, medium or low. The framework for the development of Fish Vool is consistent with that used for VA-TURF, but VA-TURF targets the coastal integrity and reef ecosystem of an area, whereas Fish Vool focuses on the commercial fisheries sectors.		
<b>Developer:</b> Department of Agriculture-National Fisheries Research and Development Institute (DA-NFRDI), Philippines		
<b>Relevant Links and References:</b> - <a href="#">Jacinto et al 2016</a> - <a href="https://nfrdi.da.gov.ph/2022/12/15/fishvool-equipping-philippine-fisheries-to-manage-hazard-effects-of-climate-change/">https://nfrdi.da.gov.ph/2022/12/15/fishvool-equipping-philippine-fisheries-to-manage-hazard-effects-of-climate-change/</a>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: Yes</b> Jacinto et al 2016 paper presents an assessment of tuna and sadine fisheries in Philippines.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local      National      Global 	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input type="checkbox"/> Qualitative Input	

Fig. 2. Conceptual Framework for the development of Fish Vool.

3.2.23. [Integrated Coastal Sensitivity, Exposure, and Adaptive Capacity for Climate Change tool; ICSEA Change](#)

FISHERIES AND AQUACULTURE		TOOL
<b>Name:</b> <b>Integrated Coastal Sensitivity, Exposure, and Adaptive Capacity for Climate Change tool</b>		<b>Tag:</b> I-C-SEA Change
<b>Short Summary:</b> A synoptic, participatory vulnerability assessment tool to help identify the likely impacts of climate change and human activity in coastal areas and begin discussions among stakeholders on the coping and adaptation measures necessary to minimize these impacts. The Integrated Coastal Sensitivity, Exposure, and Adaptive Capacity for Climate Change (I-C-SEA Change) tool is built around a series of scoring rubrics to guide non-specialists in assigning scores to the sensitivity and adaptive capacity components of vulnerability, particularly for coral reef, seagrass, and mangrove habitats, along with fisheries and coastal integrity. These scores are then weighed against threat or exposure to climate-related impacts such as marine flooding and erosion. The tool provides opportunities for learning by engaging more stakeholders in participatory planning and group decision-making. It also allows for information to be collated and processed during meetings, facilitating further discussion, data validation, and even interactive scenario building. <b>The I-C-SEA Change tool is presented as a public education and communications tool that helps stakeholders achieve a better understanding of their vulnerability.</b>		
<b>Developer:</b> Licuanan et al. De La Salle University, Philippines		
<b>Relevant Links and References:</b> - <a href="#">Licuanan et al. 2015</a>		<b>End Users:</b> General
<b>Case studies available: Yes</b>  The paper presents a case study in a local “barangay” (smallest political unit) in the Philippines.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> 
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global 	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

### 3.2.24. [Climate Adaptation Framework for Fisheries; CAFF](#)

FISHERIES		FRAMEWORK
<b>Name:</b> <b>Climate Adaptation Framework for Fisheries</b>		<b>Tag:</b> CAFF
<b>Short Summary:</b> The Climate Adaptation Framework for Fisheries aims to support climate adaptation in Canadian marine fisheries. The framework seeks to quantitatively and flexibly evaluate species, fishing infrastructure, and the management and operation of fisheries to assess climate vulnerability comprehensively and provide outputs that can support climate adaptation planning across different sectors, agencies, and stakeholders. This new framework should allow future climate scenarios to be evaluated and identify actionable climate vulnerabilities related to the management of fisheries, creating a systematic approach to supporting climate adaptation in Canada's fisheries. *This framework is currently being developed for implementation.		
<b>Developer:</b> Daniel G. Boyce, Nancy Shackell, Phil Greyson, and Blair Greenan <a href="mailto:dan.boyce@dfo-mpo.gc.ca">dan.boyce@dfo-mpo.gc.ca</a> Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, Canada		
<b>Relevant Links and References:</b> - <a href="#">Boyce et al. 2023</a>		<b>End Users:</b> Managers, Research, Industry.
<b>Case studies available: No</b> CAFF was a pilot project in development at the time of publication (Boyce et al. 2023) to support adaptive decision-making in Canada's fisheries under climate change. This framework builds on previous research and uses CRIB in the ecological component.		
<b>Stages Included</b>	<input checked="" type="checkbox"/> Climate Risk Assessment <input checked="" type="checkbox"/> Strategy and Adaptation Planning <input type="checkbox"/> Implementation Plan <input type="checkbox"/> Monitoring and Evaluation	<b>Framework:</b> <p>The diagram illustrates the conceptual framework for evaluating the Climate Adaptation Framework for Fisheries (CAFF). It shows four interconnected components: Ecology, Infrastructure, Management, and Socioeconomic. Each component has a definition, methods, units, and users. Red arrows indicate the flow of information and integration between these components, leading to the central goal of 'Climate vulnerability of fisheries'. A separate box for 'Socioeconomic' is also shown at the bottom left.</p>
<b>Approach</b>	<input checked="" type="checkbox"/> Ecological <input type="checkbox"/> Cultural <input checked="" type="checkbox"/> Socio-Economic <input checked="" type="checkbox"/> Governance	
<b>Scale</b>	Local                      National                      Global <input checked="" type="checkbox"/> Location-specific: Canada	
<b>Data Requirements</b>	<input checked="" type="checkbox"/> Traditional Scientific Data <input checked="" type="checkbox"/> Quantitative Input <input checked="" type="checkbox"/> Local expert Knowledge <input checked="" type="checkbox"/> Qualitative Input	

Fig. 1. Conceptual framework for evaluating the Climate Adaptation Framework for Fisheries (CAFF). The climate vulnerability of fisheries is comprised of three axes: ecology (Green et al. 2022b, 2023a), infrastructure (Cignelli et al. 2019; Green et al. 2019, 2023), and management. Each axis can be examined independently or combined as an integrated index. Those regions, species, fisheries, and (or) communities highly vulnerable to climate-induced changes in the fisheries sector can then create individualized adaptation planning options. To be evaluated separately, the socioeconomic status provides a context to interpret the CAFF outputs.

### 3.3. Additional resources for climate change risk assessment and adaptation

There are several resources available to assess and plan adaptation to climate change that, while not specific to fisheries and aquaculture, may still be relevant. Table 4 presents a list of these resources that could be of interest to the fisheries sector.

**Table 4.** Compilation of relevant climate adaptation resources, not fishery or aquaculture specific, that are available online.

Name	Link
<p><b>AdaptationCommunity.net</b> – Adaptation and M&amp;E Toolbox: An overview of all tools developed by GIZ on adaptation. Including:</p> <ul style="list-style-type: none"> <li>- <b>Climate Risk Sourcebook</b></li> <li>- <b>Ecosystem-based Adaptation tools navigator</b></li> <li>- <b>Monitoring &amp; Evaluation - guidebooks, excel tools and training materials.</b></li> </ul>	<ul style="list-style-type: none"> <li>- <a href="https://www.adaptationcommunity.net/tools/">https://www.adaptationcommunity.net/tools/</a></li> <li>- <a href="https://www.adaptationcommunity.net/publications/new-eba-tools-navigator-in-english-spanish-and-french/">https://www.adaptationcommunity.net/publications/new-eba-tools-navigator-in-english-spanish-and-french/</a></li> <li>- <a href="https://www.adaptationcommunity.net/climate-risk-assessment-management/climate-risk-sourcebook/">https://www.adaptationcommunity.net/climate-risk-assessment-management/climate-risk-sourcebook/</a></li> <li>- <a href="https://www.adaptationcommunity.net/monitoring-evaluation/toolbox/">https://www.adaptationcommunity.net/monitoring-evaluation/toolbox/</a></li> <li>- <a href="#">Guidebook</a> – adaptation made to measure</li> <li>- <a href="#">Monitoring and Evaluating Adaptation at Aggregated Levels: A Comparative Analysis – Report</a></li> </ul>
<p><b>Oxfam’s PREP Value Chain Climate Resilience:</b> a guide to managing climate impacts in companies and communities.</p>	<p><a href="https://s3.amazonaws.com/oxfam-us/static/oa4/valuechainclimateresilience.pdf">https://s3.amazonaws.com/oxfam-us/static/oa4/valuechainclimateresilience.pdf</a></p>
<p><b>Community-based Risk Screening Tool – Adaptation and Livelihoods (CRISTAL)</b></p>	<p><a href="https://www.iisd.org/cristaltool/">https://www.iisd.org/cristaltool/</a></p>
<p><b>Climate Vulnerability and Capacity Analysis Handbook (CVCA)</b> by CARE</p>	<p><a href="https://careclimatechange.org/cvca/">https://careclimatechange.org/cvca/</a></p>
<p><b>Nature-based Solutions Climate Risk tool</b></p>	<p><a href="https://futureoceanslab.shinyapps.io/NBS-CRA/">https://futureoceanslab.shinyapps.io/NBS-CRA/</a></p>
<p><b>MPA-Engage Social-Ecological Vulnerability Assessment</b></p>	<p><a href="https://futureoceanslab.shinyapps.io/Engage/Guidelines%20Report">https://futureoceanslab.shinyapps.io/Engage/Guidelines Report</a> Toolbox - <a href="https://mpa-engage.interreg-med.eu/toolbox/">https://mpa-engage.interreg-med.eu/toolbox/</a></p>
<p><b>Marine Spatial Planning Addressing Climate Effects (MSPACE_UK)</b></p>	<p><a href="https://www.smmr.org.uk/funded-projects/marine-spatial-planning-addressing-climate-effects/about-the-project/">https://www.smmr.org.uk/funded-projects/marine-spatial-planning-addressing-climate-effects/about-the-project/</a></p>
<p><b>Climate Risk Planning &amp; Managing Tool for Development Programmes in Agri-Food Systems (CRISP)</b></p>	<p><a href="https://crisp.eurac.edu">https://crisp.eurac.edu</a></p>
<p><b>Centering Equity in Climate Resilience Planning and Action: Practitioner’s Guide</b></p>	<p><a href="https://library.oarcloud.noaa.gov/noaa_documents.lib/OAR/CPO/Climate_Smart_Communities/Vol_03_CS_C_CenteringEquity.pdf">https://library.oarcloud.noaa.gov/noaa_documents.lib/OAR/CPO/Climate_Smart_Communities/Vol_03_CS_C_CenteringEquity.pdf</a></p>
<p><b>UK Climate Impacts Program (UKCIP, University of Oxford) tools for business adaptation to climate change.</b> Includes:</p> <ul style="list-style-type: none"> <li>- <b>BACLIAT vulnerability assessment:</b> originally developed with/for UK businesses. It is a workshop-based process to help to quickly consider the potential impacts of future climate change on an organisation.</li> </ul>	<p><a href="https://www.ukcip.org.uk/wizard/">https://www.ukcip.org.uk/wizard/</a>  <a href="https://www.ukcip.org.uk/wizard/future-climate-vulnerability/bacليات/">https://www.ukcip.org.uk/wizard/future-climate-vulnerability/bacليات/</a></p>

<b>Good Practice Study on Principles for Indicator Development, Selection, and Use in Climate Change Adaptation Monitoring and Evaluation</b> (Earth-Eval, 2015)	<a href="https://www.eartheval.org/studies/good-practice-2015">https://www.eartheval.org/studies/good-practice-2015</a>
<b>Strengthening Monitoring and Evaluation of Climate Change Adaptation</b> (STAP, 2017)	<a href="https://stapgef.org/sites/default/files/2020-02/STAP_CCA_ME_complete_synthesis.pdf">https://stapgef.org/sites/default/files/2020-02/STAP_CCA_ME_complete_synthesis.pdf</a>
<b>The national adaptation plan process - Least Developed Countries</b>	<a href="https://unfccc.int/files/adaptation/application/pdf/nap_overview.pdf">https://unfccc.int/files/adaptation/application/pdf/nap_overview.pdf</a>
<b>AZTI Artisanal Fisheries Toolbox</b> – not specific to climate	<a href="https://www.azti.es/en/productos/artisanal-fisheries-toolbox/">https://www.azti.es/en/productos/artisanal-fisheries-toolbox/</a>
<b>FAO Climate Risk Toolbox (CRTB)</b> – not fisheries specific	<a href="https://www.fao.org/agroinformatics/projects/projects-detail/fao-climate-risk-toolbox-(crtb)/en">https://www.fao.org/agroinformatics/projects/projects-detail/fao-climate-risk-toolbox-(crtb)/en</a>
<b>IBM Climate Risk Insight</b> (using AI)	<a href="https://www.ibm.com/products/environmental-intelligence-suite/climate-risk">https://www.ibm.com/products/environmental-intelligence-suite/climate-risk</a>
Marine Sensitivity assessments:	<a href="https://www.marineandcoasts.vic.gov.au/marine-and-coastal-knowledge/feature-activity-sensitivity-tool/introduction-to-feast">https://www.marineandcoasts.vic.gov.au/marine-and-coastal-knowledge/feature-activity-sensitivity-tool/introduction-to-feast</a>
- <b>Feature Activity Sensitivity Tool (FeAST) in Marine and Coastal Knowledge Victoria (Australia)</b>	
- <b>Marine Evidence based Sensitivity Assessment (MarESA)</b>	<a href="https://www.marlin.ac.uk//sensitivity/sensitivity_rationale">https://www.marlin.ac.uk//sensitivity/sensitivity_rationale</a>
<b>Integrated Biodiversity Assessment Tool (IBAT)</b>	<a href="https://www.ibat-alliance.org">https://www.ibat-alliance.org</a>
<b>Strengthening Monitoring and Evaluation of Climate Change Adaptation</b> – STAP, Global Environment Facility	<a href="https://stapgef.org/sites/default/files/2020-02/STAP_CCA_ME_complete_synthesis.pdf">https://stapgef.org/sites/default/files/2020-02/STAP_CCA_ME_complete_synthesis.pdf</a>

While not specific to a tool or framework, the following resources are also relevant to the topic of fisheries and aquaculture mitigation and adaptation to climate change, and include initiatives working in this field:

- **Resources for the Future Report 2024** – *Adaptive Systems for Climate-Ready Fisheries Management*. [Link](#). This paper discusses how the definition of fishery can impact its adaptive capacity, and discusses the approaches available to adapt in different fishery environments.
- **Environmental Defense Fund Report 2022** – *Technologies for Climate-Resilient Fisheries*. [Link](#).
- **FAO Report 2024** – *Climate change risks to marine ecosystems and fisheries* – [Link](#).
- **FAO Report 2021** – *FAO's work on climate change. Fisheries and aquaculture 2020* – [Link](#).
- **FAO Report 2018** – *Impacts of climate change on fisheries and aquaculture. Synthesis of current knowledge, adaptation and mitigation options*. [Link](#). Includes climate change impacts and adaptations by region.
- **FAO Report 2015** – *Assessing climate change vulnerability in fisheries and aquaculture. Available methodologies and their relevance for the sector*. [Link](#). Good conceptual summary of different methods to assess vulnerability, includes case studies and suggests a “how to guide” to assist practitioners by describing steps to assess vulnerability to climate change.
- **The Aotearoa Circle Report 2021** – *New Zealand Seafood Sector Adaptation Strategy* — [Link](#) and [Report](#). Seafood Sector Adaptation Strategy 2021-2030 with over 23 seafood sector organisations and 44 sector stakeholders represented in the strategy development process.

- Climate Adaptation Knowledge Exchange (cake): <https://www.cakex.org>

## 4. Conclusions

This report provides a comprehensive overview and comparison of the primary frameworks and tools available for climate risk assessment and adaptation planning in the fisheries and aquaculture sector. The extensive literature on climate adaptation has resulted in the development of numerous frameworks aimed at enhancing the climate resilience of species, ecosystem, and human communities. However, only a subset of these approaches is directly applicable to socio-ecological systems, particularly in the fisheries and aquaculture sectors.

We summarised 22 individual resources in detail, highlighting the diverse range of tools and frameworks that support fisheries adaptation to climate change. Despite differences in objectives or specific geographic focus, these resources share several key components essential for effective adaptation. As highlighted by Leith et al. (2014), effective frameworks should (1) be clear to stakeholders, (2) include all relevant social, economic, cultural and ecological indicators, (3) allow for comparison and metanalysis across cases, and (4) be useful for defining goals and reflecting outcomes through monitoring and evaluation. Our findings also emphasise the importance of integrating scientific knowledge with local expertise, and actively engaging stakeholders in the development and assessment of adaptation measures.

The most comprehensive climate adaptation frameworks typically include the following important steps:

- 1. Defining specific objectives of the framework and gathering background information,**
- 2. Assessing climate change risks and vulnerabilities,**
- 3. Identifying and evaluating adaptation options in collaboration with stakeholders,**
- 4. Developing an implementation plan to enhance resilience, and**
- 5. Establishing monitoring and evaluation processes to adjust measures as needed.**

The comparison table presented (Table 2) allows users to directly compare resources, facilitating the selection of the most relevant option for their needs. Some resources provide a general framework and supporting documentation to guide users through all (or most) of these stages, like the Climate Adaptation Hub in the Northeast US (Maltby et al. 2023, Gulf of Maine Research Institute 2024), the Climate Resilient Fisheries Planning Tool (SNAP Partnership , Eurich et al. 2024), or the Handbook for Adaptation of fisheries management to climate change in Australia (Fulton et al. 2020). Others focus only on specific stages like climate vulnerability assessments – e.g., CVA (Environmental Defense Fund , Carroll et al. 2023), RARE CCVA (RARE Fish Forever 2019), or VA-TURF (Mamauag et al. 2013) – or the development of new adaptation

measures – e.g., Climate Adaptation Guidelines for Fisheries and Aquaculture (Clime Fish; Pham et al. 2021), or the framework by Quentin Grafton (2010) on adaptation to climate change in marine capture fisheries.

Overall, most tools reviewed include a component to quantitatively and/or qualitatively assess climate risks and recommend adaptation options. However, the ‘monitoring and evaluation’ stage has received limited attention in fisheries, despite being a crucial aspect of climate adaptation. Resources addressing this stage offer important guidance to ensure that the adaptation measures recommended are implemented and continuously assessed and refined (STAP 2017). Fisheries-specific frameworks that include monitoring and evaluation include the diagnostic approach to climate adaptation for fisheries (Leith et al. 2014), and the Climate Adaptation Resource Hub for Fishing Communities (Maltby et al. 2023, Gulf of Maine Research Institute 2024), among others. Additionally, resources from other sectors, such as the US Resilience Toolkit (NOAA) and the M&E section of the ‘AdaptationCommunity.net platform’, provide guidebooks, tools, and training materials focused on monitoring and evaluation.

This review identified more tools focused on marine fisheries (wild capture) than on the aquaculture sector specifically. However, several resources such as SQA (Johnson et al. 2016), Clime Fish (Clime Fish; Pham et al. 2021), and Climate Expert (GIZ 2024), are applicable to both sectors, including specific case studies focused on aquaculture (e.g. Decision Support System to support the adaptation of Greek aquaculture to climate change, ClimeGreAq; Stavrakidis-Zachou et al. 2021). Future research could explore the shared and differing adaptation components across fisheries and aquaculture, including relevant time frames and common management actions.

An interesting extension of this research would be to survey developers of the adaptation tools to confirm the end users, the extent of stakeholder co-development, and key lessons learnt during the development and stakeholder engagement. This information would help strengthen this review and address some of its limitations, as certain characteristics of the resources may not be clear from the descriptions alone.

In conclusion, this report has provided a comprehensive overview and comparison of the main frameworks and tools available for climate risk assessment and adaptation planning in the fisheries and aquaculture sectors. While significant progress has been made in developing diverse resources, key components such as stakeholder engagement and monitoring and evaluation remain critical for effective implementation. Our findings highlight the importance to integrate scientific information and local knowledge with management capabilities to improve resilience and facilitate climate adaptation in fisheries and aquaculture.

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