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A GUIDE TO SELECTED COMMUNICATIONS PRODUCTS

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A Guide to Selected Communications Products

The Fishery-Related Ecological and Socio-Economic Assessments of the Impacts of Climate Change and Variability consultancy has been conducted with support from the Regional Track of the Pilot Programme for Climate Resilience (PPCR) in the Caribbean, which is executed by the University of the West Indies, Mona (UWI), through its Mona Office of Research and Innovation (MORI); and co-implemented by the Caribbean Regional Fisheries Mechanism (CRFM) with resources provided by the Climate Investment Fund (CIF) through the Inter-American Development Bank (IDB)".

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FISH FOR TODAY AND TOMORROW:
VIDEO DOCUMENTARY DISCUSSION GUIDE

ACKNOWLEDGEMENTS

Production of the *Fish for Today and Tomorrow* video documentary and this discussion guide would not have been possible without the leadership of Ava-Gail Gardiner, Communications Specialist of the ESSA Consulting Team. The concept and execution of the video documentary benefitted from the perspectives and time invested of dozens of representatives of the Caribbean fisheries sector, from development partners to policy professionals to fisheries officers to fisherfolk. We are so grateful for your openness to engage with us and truly hope this video documentary inspires novel action to build climate resilience in the region.

PREFACE

This is the discussion guide to be used in conjunction with the video documentary 'FISH FOR TODAY AND TOMORROW'.

This guide seeks to explore the impacts of climate change on fisheries in the Caribbean; to highlight some of the key findings of the Fishery-Related Ecological and Socio-Economic Impact Assessments and Monitoring System Project (otherwise referred to as the PPCR Regional Fisheries Project); and to promote climate action that is timely, appropriate and supported by/ anchored in science.

It is anticipated that this guide and the video documentary that it references will be used to generate lively discussions in ways that will promote heightened awareness, learning and pro-action as stakeholders across the fisheries sector confront the realities of climate change, and anticipate the future. These tools are intended to enable reflection on the contents of the video documentary in a way that enhances participants' understanding of climate change and fisheries, which in turn will influence changes in attitudes and behaviour, including support for changes in policy and management toward climate-smart fisheries.

The guide consists of two (2) sections, which corresponds to Parts 1 and 2 of the video documentary. Most issues mentioned in this guide are addressed in the video documentary. However, a few questions raise broader concerns and may prompt further discussion and research.

Facilitators are encouraged to familiarize themselves with the extensive information that has been generated under the PPCR Regional Fisheries Project, which is available on the CRFM website and Portal.

PART 1

1. INTRODUCTION

The Narrator mentions some of the factors that are putting pressure/ affecting fisheries in the Caribbean.

Q1: What are some of these influences?

Overfishing, pollution, habitat degradation, and now the impacts of climate change…

Q2: Have any of them affected you, or your livelihood/ fishing activities?

Q3: What is "climate change"?

The Facilitator can use this opportunity to open up a discussion on "climate change." Encourage participants to give their definitions/ explanations for climate change.

Use this opportunity to clarify the term and to debunk any myths/ misperceptions.

N.B. Refer to Powerpoint Presentation on Climate Change and Fisheries for points/ outline for a discussion.

Kingslyn Scott, the fisherman articulates his experience of going to sea over the past fifty years and his observation of how things have changed.

Q4: What do you think he means when he talks about "changes at the bottom of the sea"?

Encourage participants to articulate their thoughts/ elaborate on the changes that they are seeing or experiencing.

Q5: What signs of climate change are you seeing in the sea and coastal environment?

Science indicates a change in the patterns of ocean currents as a result of thermal expansion of seawater, additional energy in a warmer atmosphere and additional pressure on ocean beds as a result of sea level rise…

Mention/ reiterate these themes and encourage participants to share what they know of these phenomena.

Raphael Gabriel, the fisherman, mentions that climate change is destroying the coral reefs… is this entirely true?

With respect to reef degradation, you can note the connection between warmer waters and coral bleaching and coral disease and the importance of healthy reefs to sustain healthy fisheries. Reference can also be made to mass bleaching events (like the regional 2005 event) becoming more frequent. Ask participants for local data to evidence this occurrence.

Q6: What are some of the other factors (other than climate change) that are causing the degradation/ decline of reefs across the Caribbean?

Q7: What are some of the (emerging) issues that indicate that the climate is changing in the Caribbean?

To help participants to delve deeper into the issue, the Facilitator can highlight/ enumerate different ecosystems…e.g., shoreline/ beaches, mangroves, coral reefs, deep sea.

The influx of *Sargassum* has often been referenced as an emerging issue that some have linked to climate change, with positive and negative consequences for fisheries.

Encourage participants to share their experiences/ observations with Sargussum.

Q8: Has *Sargassum* been beneficial or detrimental to your activities/ enterprises?

2. CLIMATE CHANGE & THE FISHERIES VALUE CHAIN

This is a good place for the Facilitator to broaden the discussion, encouraging participants to start to consider the "Big Picture" impact of climate change…

Q1: How are these changes in the sea and coastal environment affecting you, or fishers in your community/ country?

It's important for participants to be able to express not just what they see and experience but also how these phenomena make them feel. By understanding and tapping into people's emotions it's possible to identify levers for self-efficacy and empowerment, as well as what might motivate people to act.

Q2: How are these issues affecting other persons along the fisheries value chain?

Depending on the audience, this might be an opportunity to explain/ outline the fisheries value chain (refer to Paper D by Khan et al. in the CRFM Research Paper Collection linked to this Project). The Facilitator can choose to delve into critical issues now, or note them for later discussion.

Q3: What economic impacts are these issues having/ anticipated to have in the short, medium and long term?

Q4: What do these changes mean for the economy of your community, country, the wider Caribbean region?

3. "WHERE ARE THE WOMEN?"

So far, we have not seen any women featured in the documentary.

Q1. Do women work in the fishing industry in your community/ country?

Q2. If so, what roles do women play in fishing? How and why are they important to the fishing industry?

Q3. Do you think climate change affects women differently from men? If so, how?

Gender is an issue that is often overlooked in fisheries. This is an opportunity for the Facilitator to encourage participants to think about the issues of gender within the fishing industry and specifically within the context of a changing climate.

N.B. It's important for people to reflect on the kinds of inequalities across the fisheries value chain and what the implications are for vulnerability to climate change impacts and capacity to adapt.

4. "WHERE ARE THE FISH GOING?"

The Narrator states that fish catches are changing…

With respect to fish migration reference can be made to regional studies that show that Caribbean waters are becoming much less favourable habitat for certain key commercial species (like dolphinfish, yellow tail tuna etc.) with just a 1 degree C rise in average temperature. Fish are migrating to environments that match their preferences, generally north and into cooler waters.

Q1: What are some of the trends/ movements that are anticipated?

Q2: Some fish may move north – why?

Q3: Which species will be affected? And why are they likely to move north? What are the push/ pull factors?

Q4: Some fish may go deeper – why?
Q5: Many fish may go extinct – why?

5. A DIFFERENT WAY OF FISHING

The Narrator indicates that young people are fishing differently. Hudson Toussaint, Fisher points out that fishers in the past "did the same kind of fishing using the same techniques", but he figures that he "can do things differently".

Q1: What do you think he means by "doing things differently"?

Q2: What are some of the things that fishers can do to make their operations more efficient, more cost-effective and/ or productive?

The video mentions Fish Aggregating Devices (FADS). A FAD is a manufactured object used to attract ocean going pelagic fish such as marlin, tuna and dolphin fish (mahi mahi). They usually consist of buoys or floats tethered to the ocean floor with concrete blocks. FADs attract fish for numerous reasons that vary by species.

Q3: Why have FADs become popular?

Depending on the audience, the Facilitator can encourage a deeper discussion about FADs…

Q4: What are the pros and cons of using a FAD?

Q5: Is it just "a fad", i.e. a trend that will soon pass or are they here to stay? Are FADs environmentally sustainable?

Q6: Can FADs be used as a measure to adapt to climate change? And if so, how are they to be managed and integrated into a sectoral strategy?

The Facilitator can open up the conversation on the theme of "developments in fishing", tying in new technologies. Ask the participants to give examples of new technologies and explain how they work/ how they add value to the practice of fishing…

In the video, the Narrator highlights the Fisheries Early Warning and Emergency Response system (FEWER).

Q7: What features make FEWER unique? How does FEWER add value to the practice of fishing in the (Eastern) Caribbean?

Q8: Have any of you used FEWER? How has your experience been with the App?

The Facilitator can open up the discussion on FEWER, encouraging the group to debate the pros vs cons of FEWER.

Q9: Is there room for improvement in the App? If so, how would you want to see it improved?

Q10: What are some of the strategies that you/ we can employ to ensure the sustainability of the fisheries industry in your country, and the wider Caribbean region?

6. SAFETY AT SEA

Towards the end of Part 1, Hudson Toussaint, the young Fisherman indicated purchase of gear. The Facilitator can use this as an opportunity deeper into the theme of "Safety at Sea".

Or before showing Part 2, the Facilitator can use this juncture to explore the theme of "Safety at Sea" in depth.

Q1: What critical safety gear should be on board every fishing vessel?

Prompt audience to enumerate these items…

Q2: What additional risks do you think climate change poses for fishers?

PART 2

As the fisheries sector confronts the realities of a changing climate, we have to be more aware of the importance of comprehensive climate-smart fisheries planning, which includes adaptation to long-term changes, disaster risk mitigation and management.

Depending on the audience, the Facilitator can use the opportunity to encourage participants to share their experiences of a hurricane or other disaster caused by natural hazards…

1. RISK MANAGEMENT

Q1: How did you fare in the storm/ hurricane?

Mention a specific storm or extreme weather event to help elicit recall of that event.

Q2: What lessons did you learn?

Q3: What would you do differently, if faced with a similar situation today?

Hudson Toussaint, the fisher raised the critical issue of the lack of access to insurance.

Q4: Is insurance widely available in your country?

Q5: Do you know of an existing solution for fishers?

If there are policy-makers in the audience, this might be an opportunity for the Facilitator to direct the discussion towards finding such a solution…See:

Caribbean Catastrophe *Risk Insurance Facility*, *https://www.ccrif.org/*

Note that in July CCRIF issued the Caribbean Oceans and Aquaculture Sustainability Facility (COAST) fisheries parametric insurance policies to two of its member governments – Grenada and Saint Lucia. The COAST insurance policies provide coverage for fisherfolk and other players in the fisheries industry to enable them to recover quickly after weather-related events.

Q6: What cue can other Caribbean countries take from the COAST insurance scheme?

Jullan Defoe, Senior Fisheries Officer enumerates the extensive loss of fishing boats and gear and of critical fisheries infrastructure in Dominica that was caused by Hurricane Maria, but he also highlights the issue of loss of livelihoods…

This is an opportunity for the Facilitator to lead participants into a deeper exploration of livelihoods and economic and social vulnerabilities of persons involved in the fisheries sector.

Where Jullan Defoe speaks to "alternatives" (finding other sources of employment/adding value to existing product(s) as a pillar for building climate resilience)… encourage participants to explore what this means in real terms…

Referencing where Jullan Defoe mentions Dominica's focus on becoming the world's first climate resilient country, the

Facilitator can use the opportunity to broaden the discussion about climate-resilience… e.g., what does this mean for the reconstruction of buildings and infrastructure?

2. THE IMPORTANCE OF DATA

Derrick Theophille, Fisheries Resource Assessment Officer mentions the different ways/ means fisheries data was stored, and which forms survived Hurricane Maria.

Q1: What key lessons were learnt about data management in the aftermath of Hurricane Maria?

Q2: What measures can be taken to reduce the loss of data?
In the Caribbean region, we still face significant challenges in the collection and storage of data in digital format.

Here the Facilitator can prompt participants to consider what practical measures can be taken for speeding up the process of digitization…

Q3: What more can be done to improve/accelerate the process of digitizing records?

Q4: What kind of support is needed and at what level(s)?

Q5: What is the role of fisherfolk in data collection either at sea or market?

Q6: How can data collection and analysis help to influence better policy-making?
Segway to the segment of the video focused on Saint Lucia…

3. POLICY AND PLANNING FOR CLIMATE CHANGE

The Facilitator can use this opportunity to discuss the importance / value of a multi-stakeholder, consultative process for planning for climate change adaptation.

Q1: What is the importance of having a National Adaptation Plan?
Q2: How does a NAP help a country to address climate change?

Q3: What is the value of sectoral adaptation plans or strategies and action plans, or SASAPs to a Caribbean country that is planning for climate change?

Q4: What are some of the key features of a SASAP for the Fisheries sector? Who should be involved in its preparation?

Q5: How can we link the fisheries sector with other key sectors – water, agriculture, tourism?
For fisheries in the Caribbean to be truly sustainable we must find a balance between protection of our marine resources, and the efficient use of these resources.

Q6: What are some of the measures you would suggest that we adopt at the community level, at the national level, and at the regional level to make our fisheries more sustainable?

The Narrator mentions integrated management of the land and sea to reduce the impact of climate change on Caribbean countries.

Q7: What do you think this means in practical terms?

Alva Lynch, Castries Fisheries Cooperative Official, highlights that his organisation is actively involved in a project to improve the quality standards at the Castries Fisheries Landing Site, and to reduce the carbon footprint of fishers.

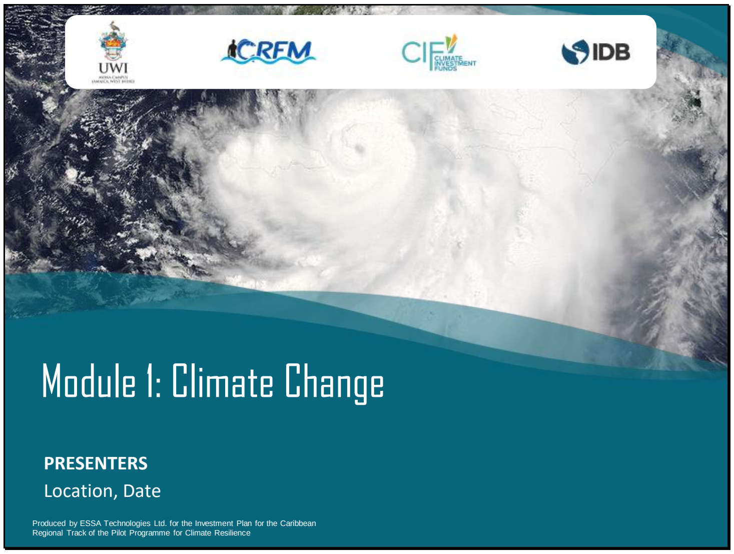
This is a good point to lead into a general discussion about taking responsibility regarding preventing further climate change (mitigation) and taking action to reduce its impact (adaptation). Much of the discussion so far will have focused on adaptation so here the Facilitator can guide discussion on mitigation as a way to wrap up the session.

Q8: What actions can you take to reduce your carbon footprint?

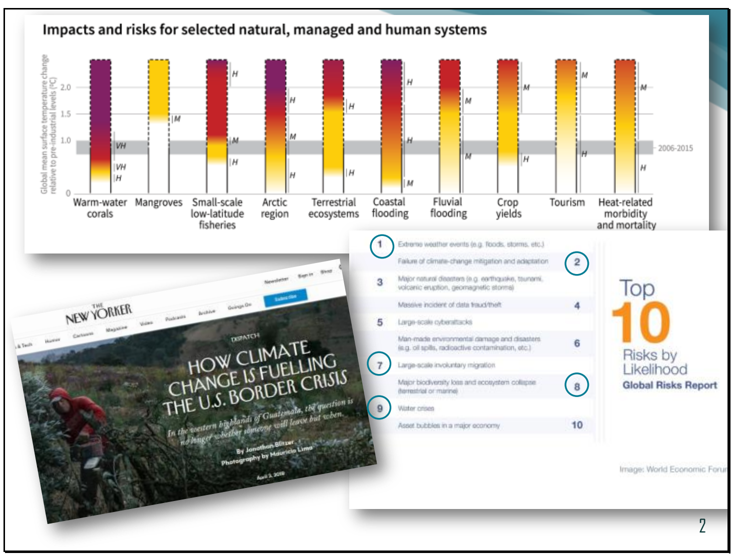
The Facilitator can lead the participants to explore this theme by considering their habits/ actions in different spheres: at home, at work, in their community, in their country…

POWERPOINT PRESENTATION
MODULE 1: CLIMATE CHANGE

Slide 1



Slide 2



Global climate change is one of the biggest challenges facing humanity. The scientific evidence that the global climate is changing and that the changes seen since the mid 1900s are caused by human activity is now unequivocal. Climate change, its impacts and responses, is no longer an issue subject to scientific advances but a top of mind issue for global economic and business affairs; it has also permeated popular discourse.

Climate change demands two responses: greenhouse gas mitigation and adaptation. This means we need cooperative action at the global level to avoid the unmanageable and action at the local level to manage the unavoidable.

This module is an introduction to the basics of global climate change.

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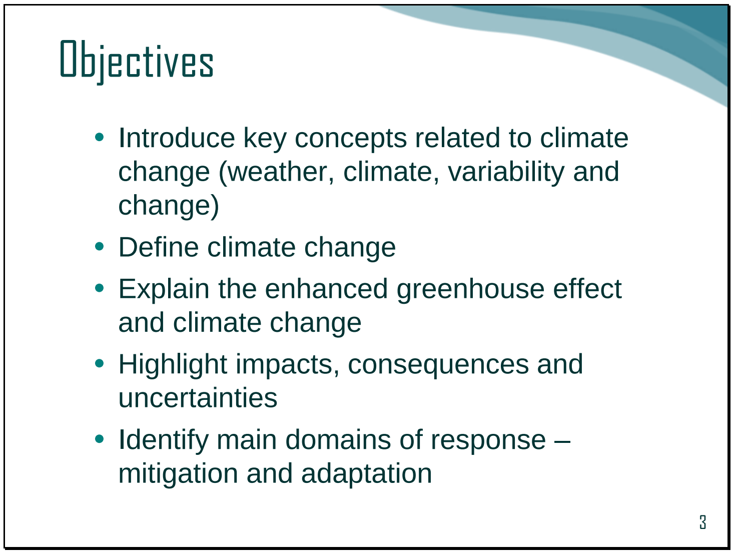
Notes:

[The top figure is from IPCC AR5 and shows a range of severe impacts of climate change and degree of confidence in their occurrence]

[The figure at the bottom right is from the World Economic Forum, showing that 5 of 10 top risks published in the WEF Global Risks Report are related to climate change.]

[The figure at the bottom left is a news story in The New Yorker, about an increasing concern – the prospect of widespread population displacement due to the impacts of climate change.]

Slide 3



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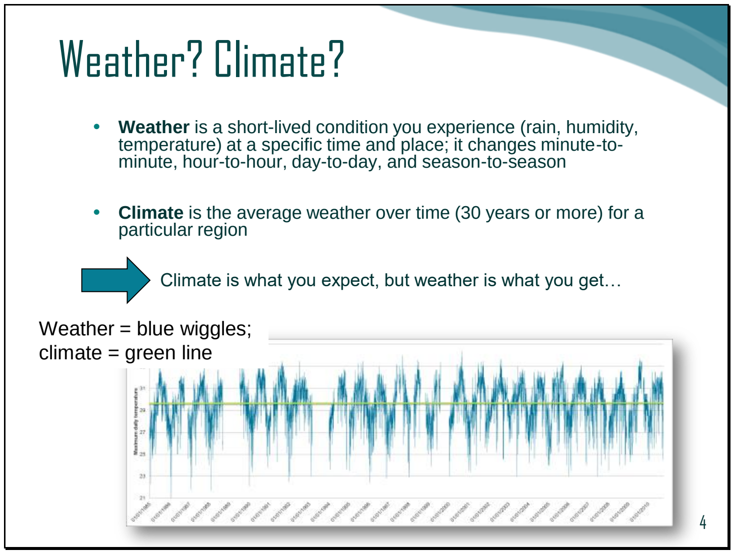
Notes:

[The slides in the module are designed to address the listed objectives. You can revisit the objectives and contents based on your own target audience, their levels of knowledge, interests and motivations.]

Slide 4



Weather differs greatly from climate. We must not confuse the two. Weather is short-term, daily type of events, whereas climate refers to longer term “averages” of weather. A short-term event or “weather” event may not at all be representative of the longer term climate.

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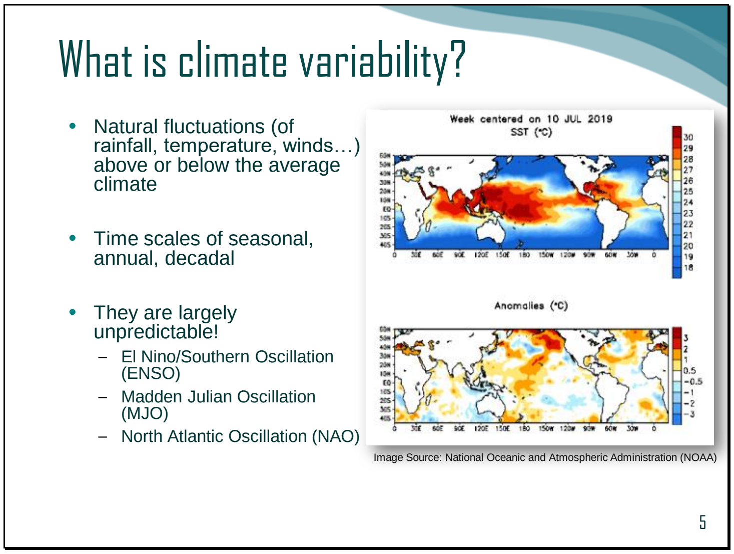
Note:

[The graphic is a plot of a time series of maximum daily temperature (degrees Celsius) between January 1, 1985 and December 31, 2013 at Worthy Park, Jamaica. There are a few gaps in the dataset.]

Slide 5

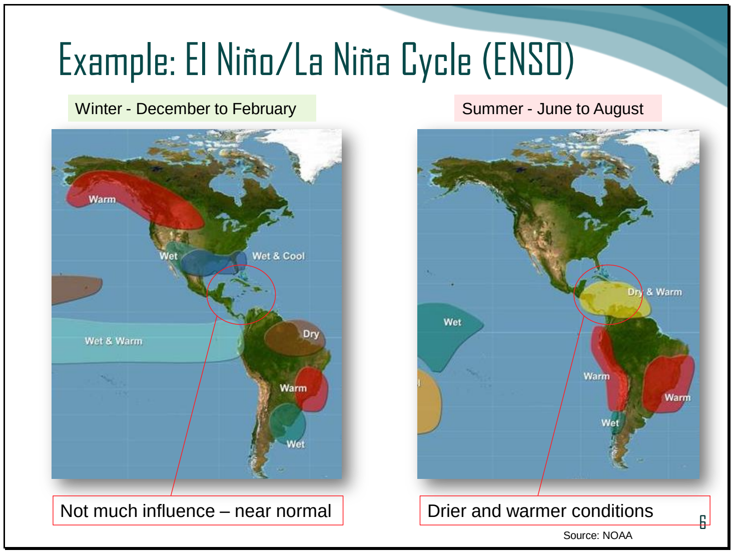


Although the general historical trend in climate conditions has been changing, there is great seasonal, year to year and decadal natural variability. These figures show the differences in sea surface temperature at a point in time around the world (top figure) and how they can be below or above long –term average conditions (so called "anomalies") (bottom figure).

There are many different climate cycles which have been identified – each with different effects globally. Perhaps the most well known is the El Nino/ENSO climate cycle. Others are shown here. These cycles vary in how long they last from months to years and as a result in some years they 'add up' to produce large changes, whereas in other years they cancel their effects out. These cycles affect our weather patterns and if they persist can affect several years consecutively.

There is still a great amount of research required to fully understand these cycles. They cannot be forecast even in the short term, let alone with any confidence under future climate change.

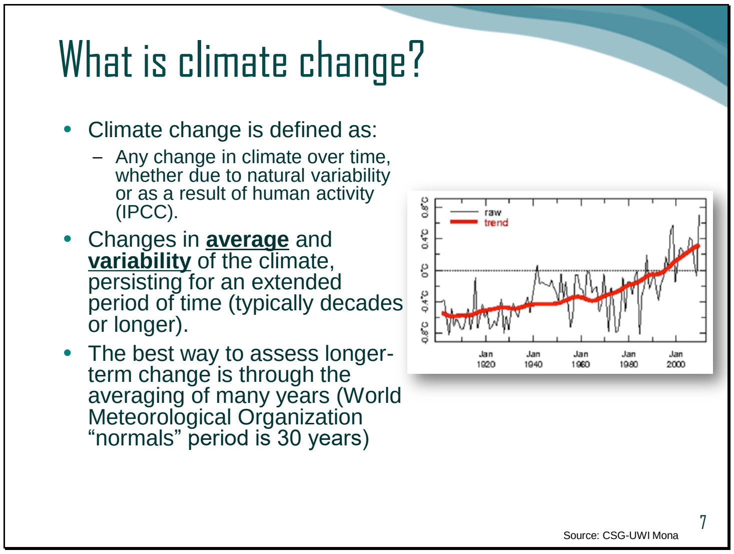
Slide 6



As a specific example, the most well-know El Nino/Nina cycle has been associated with specific climate conditions globally. This graphic shows how the El Nino cycle can affect Central America and the Caribbean. In the winter little signal is found, whereas in the summer warmer and drier than normal conditions are found.

There has been some research which suggests the frequency of the El Nino phase may change under climate change in the future, but this is still an active research area.

Slide 7



Climate change describes long-term changes in the climate (persisting typically decades or longer). Both natural variability and human activities can cause climate change. The World Meteorological Organization and other scientific agencies use 30-year averages of climate parameters to track climate change.

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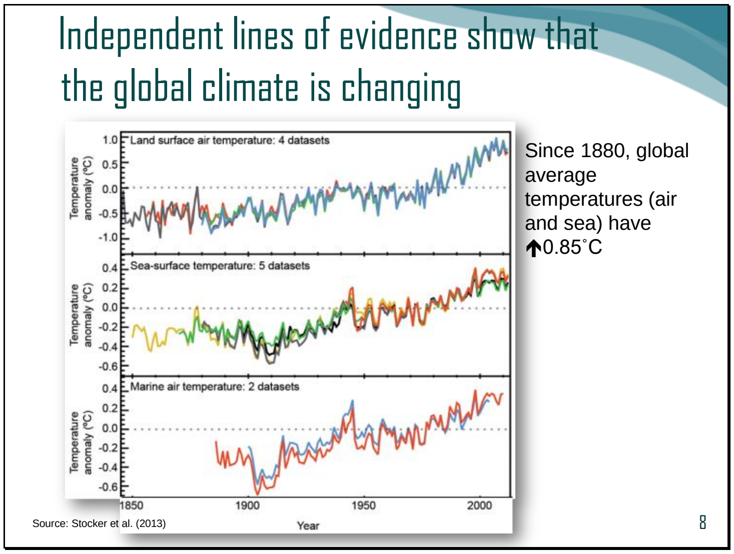
Notes:

[The figure on this slide is the average July-October temperature anomalies (degrees over or below "normal" conditions) over the Caribbean from the late 1800s with a trend line imposed. According to researchers at the Climate Studies Group at UWI Mona, the linear trend explains 54% of patterns in the data, 17% of the pattern is explained by decadal variability and 20% by year-to-year fluctuations.]

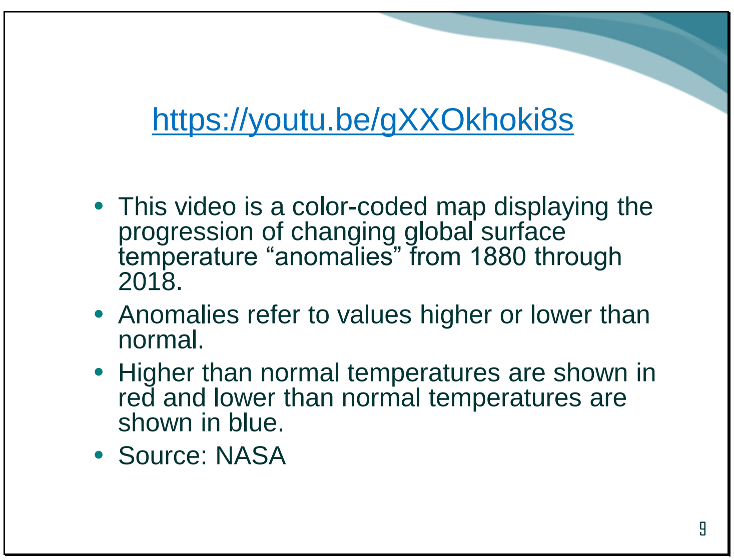
Slide 8



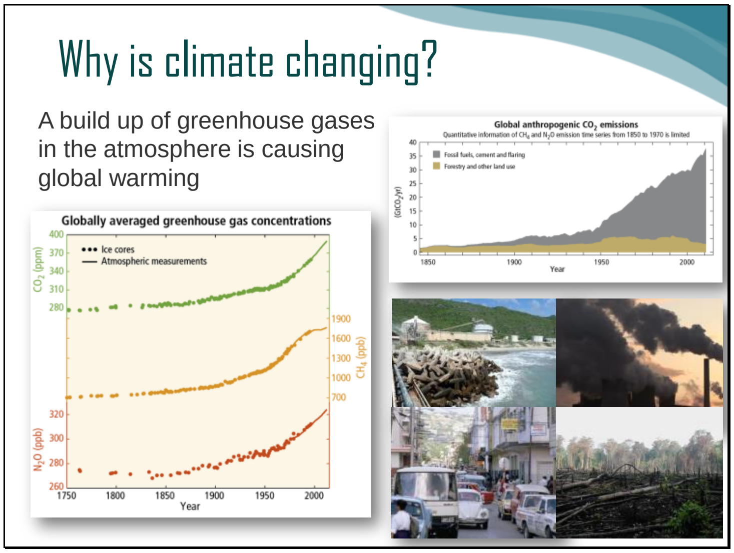
Independent lines of evidence collected by scientists and engineers from around the world tell an unambiguous story: the planet is warming.

Humans began tracking temperatures in the mid-1800s. Since 1880 global average (air and sea) temperatures have increased by 0.85 [0.65 to 1.06] °C. Since the 20th century, almost every decade that goes by is warmer than the previous one. The figures here show global trends in surface temperatures (land surface, sea surface, marine surface).

Slide 9



Slide 10



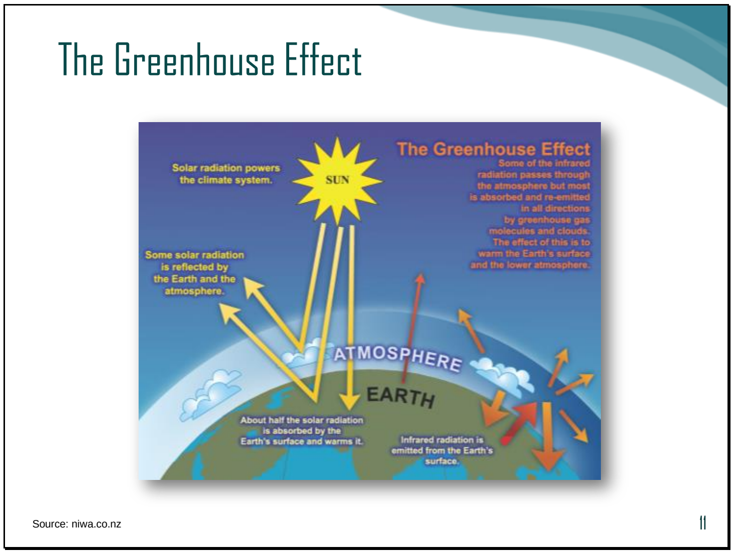
Concentrations of trace gases found in the earth's atmosphere, called greenhouse gases, have increased progressively over the past century. GHGs include carbon dioxide, methane, nitrous oxide and a range of halocarbons.

Direct measurements of carbon dioxide are available from 1958 on (for methane and nitrous oxide only since the 1970s) and atmospheric levels of GHGs from the distant past have been reconstructed through methods such as analyzing air bubbles trapped in ice sheets. Prior to the industrial revolution, the proportion of carbon dioxide in the atmosphere was about 280 parts per million by volume. Today we are just over 400ppm. GHG concentrations are the highest they have been in the last 800,000 years. [See figure on the left of the slide.]

What produces GHG? Burning of fossil fuels, cement production and deforestation release CO_2. Rice and livestock agriculture, biomass burning and landfills release methane (CH_4). Burning of fossil fuels and using agricultural fertilizers release N_2O (nitrous dioxide).

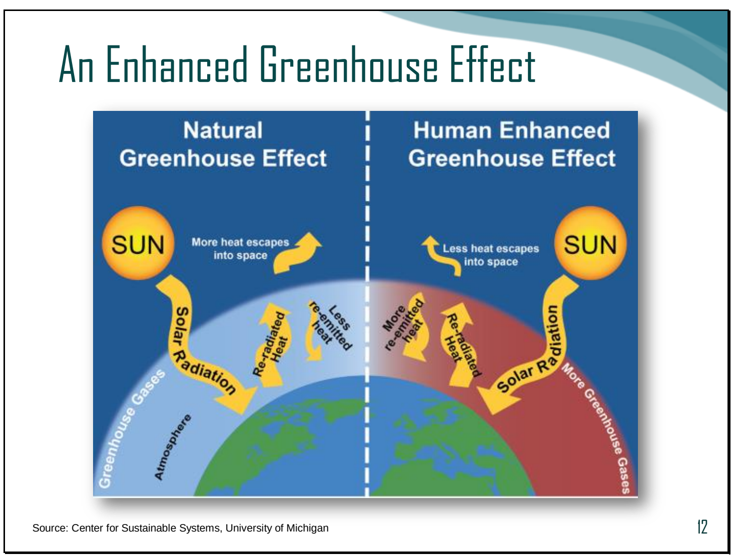
The figure to the right of the slide shows trends in global greenhouse gas emissions from human activities, singling out the contribution of fossil fuel combustion, cement and flaring.

Slide 11



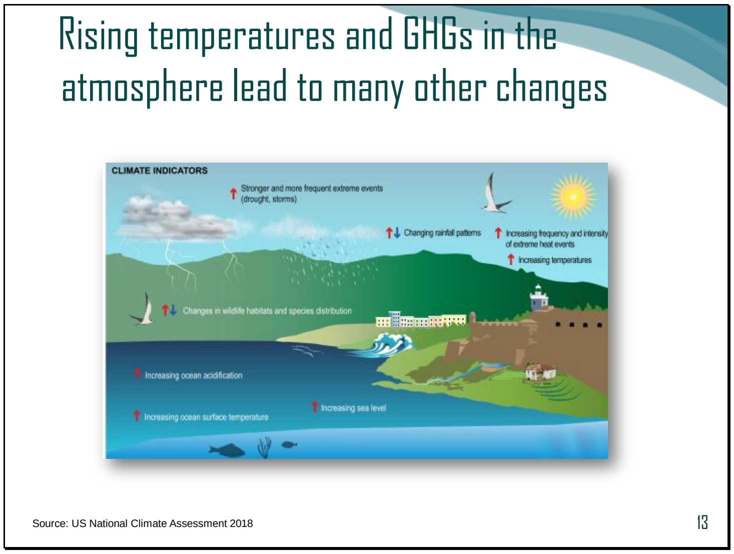
The physical mechanism that causes greenhouse gases to warm the atmosphere has been understood since the mid-1800s. About 30% of the Sun's energy is reflected back into space by clouds, dust and haze. The rest is absorbed by the Earth's surface and warms it. The warmed surface emits energy as infrared radiation, a form of light invisible to humans. Some of this infrared radiation passes through the atmosphere into space. Most if it is absorbed and re-emitted in all directions by greenhouse gases and water vapour, warming the Earth's surface and lower atmosphere to warm. Greenhouse gases and the natural greenhouse effect make the Earth livable; without them the Earth would be about -18°C on average.

Slide 12



The natural greenhouse effect is the mechanism that keeps the Earth's surface livable. However, excess concentrations of GHGs in the atmosphere means that more infrared radiation is being absorbed, more heat is being trapped than under balanced conditions, causing global warming. This is called the human-enhanced greenhouse effect.

Slide 13



Although a 0.85°C rise in global average air temperatures might seem like a small change, on a global scale this is enough to create significant impacts on global climate patterns. According to the laws of physics, a warming atmosphere would bring with it changes in other physical and biological systems. And they are indeed happening. The diagram on this slide shows changes in a range of climate indicators that are being observed, beyond a rise in air temperatures.

**Warmer ocean: The Earth is gaining heat and much of it is going into the ocean. Between 1971 and 2010, ocean surfaces (upper 75m) on a global scale have warmed by 0.11 [0.09 to 0.13] °C per decade.

**More acidic ocean: Since the onset of the industrial era, oceanic uptake of CO_2 has changed ocean chemistry. The pH of ocean surface water has decreased by 0.1 (high confidence) or 26% increase in acidity, measured as hydrogen ion concentration.

**Sea level rise: Between 1901 and 2010, global average sea levels rose by 0.19 [0.17 to 0.21] m (or 1.7mm per year on average). The expansion of water as it warms, and the melting of glaciers, ice caps and the polar ice sheets are all contributing to the rise.

**Increased humidity and changes in rainfall patterns: It is very likely that global near-surface and middle atmosphere air specific humidity has increased since the 1970s. Warming results in changes in evaporation and precipitation. Precipitation trends are harder to measure than temperature trends. Indeed, regional data analysis show the variable trends across regions, with average annual precipitation increasing in some areas and decreasing in others.

Human-caused climate change is intensifying the global water cycle. Warming of the Earth’s surface and atmosphere results in changes in evaporation and precipitation, and in atmospheric circulation patterns that influence where rain falls. In general, warmer temperatures lead to greater potential evaporation of surface water, thereby increasing the potential for surface drying and increasing the amount of moisture in the air. As warmer air can hold more moisture, more intense precipitation events are expected.

There are two sides of climate change: long-term gradual changes in average conditions, like temperature and rainfall, and the increase in frequency and / or intensity of extremes. Scientists agree that changes in the mean (say temperature), as observed over the past decades, have consequences for the intensity and frequency of extremes, such as extreme heat, drought and intense storms.

**Shifting abundance and distribution of species: Observations from around the world show that many natural systems are being affected by regional climate changes, especially by rising temperatures. Plants and animals are adapted to their habitat's climate conditions; life histories and predator-prey interactions are finely tuned to seasonal weather. Changing climate conditions is throwing these relationships out of balance.

Slide 14

Rising temperatures and GHGs in the atmosphere lead to many other changes

Physical indicator	Trend	Timeframe
Ocean temperature	+0.11°C / decade	1971-2010
Ocean chemistry	+26% in acidity due to uptake of atmospheric carbon	Since 1750
Air humidity	Increase	Since 1970s
Average annual precipitation	Regionally variable	Since 1970s
Arctic and Antarctic sea-ice extent	Net loss	Since 1978
Mountain glaciers	Widespread retreat	1900
Antarctic and Greenland ice sheets	Loss in mass	1992-2011
Sea level	+1.7mm / year	1901-2010

Source: IPCC, Stocker et al. (2013)

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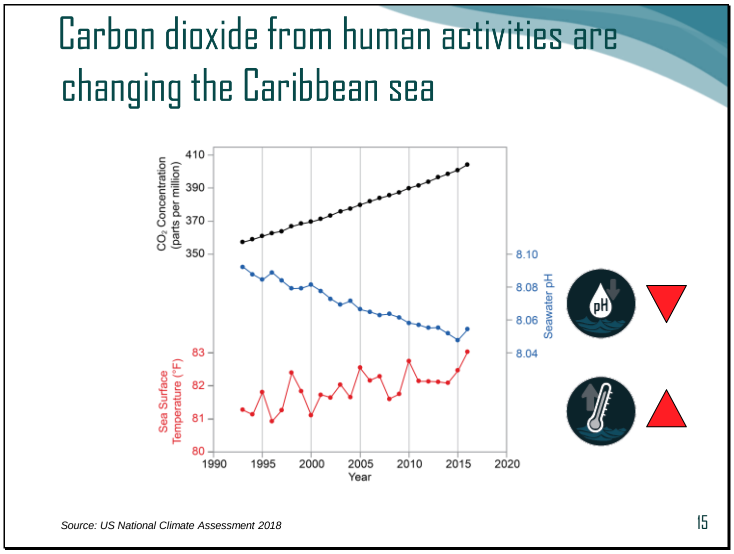
Notes:

[This slide is another way of representing some of the observed changes depicted in the previous slide.]

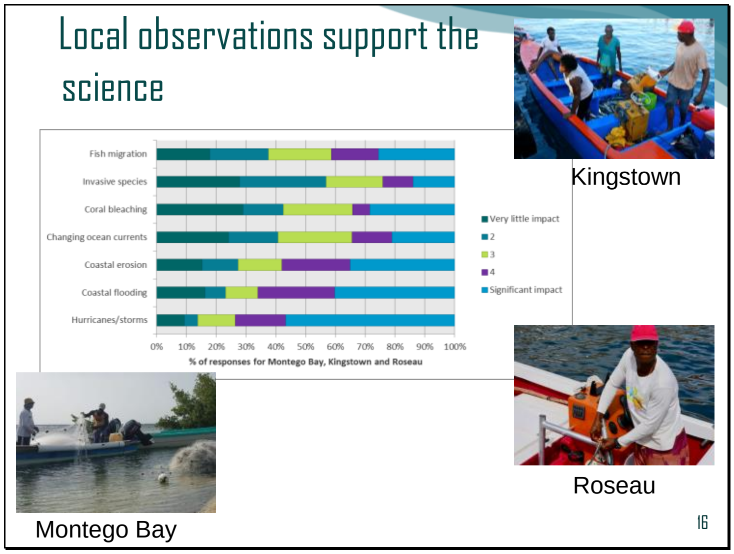
Slide 15



Noteworthy for the fisheries sector is how human-caused climate change is affecting the Caribbean Sea, making it warmer and more acidic.

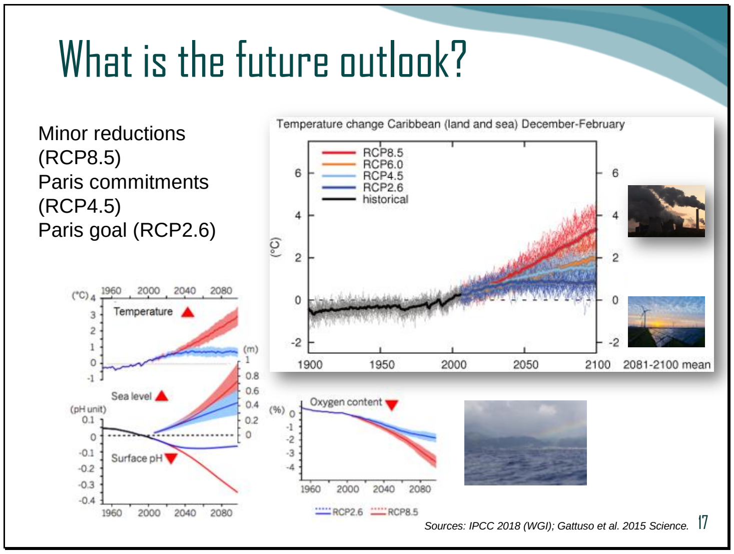
This figure represents shows annual data from 1993 to 2016 of atmospheric carbon dioxide (CO2; black line), sea surface temperature (red line), and seawater pH (blue line) for the Caribbean region. Atmospheric CO2 concentrations are changing surface pH and temperature of the Caribbean Sea. Oceans have the capacity to absorb heat from the air (leading to ocean warming). They also absorb some of the CO2 in the atmosphere through chemical reactions, leading to more acidic conditions (i.e., lower pH) in oceans. Continued ocean warming and acidification is a key concern for the fisheries sector given the negative consequences for marine life and coastal communities in the Caribbean islands that depend on these resources.

Slide 16



Communities with attachment to place and strong dependence on land, water, plants and animals for their livelihoods and well-being are also observing changes in climate indicators and their effects. This slide shows perspectives of 157 fishers in Montego Bay, Kingstown and Roseau in response to the question "on a scale of 1 to 5, how much would you say the following climate hazards have negatively affected your community / fishing area?"

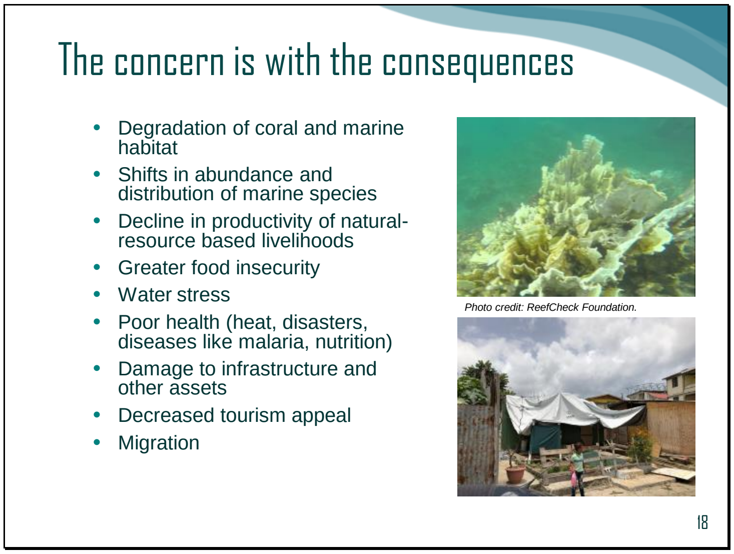
Slide 17



The climate science community uses a suite of models to inform decision makers on future climate. Among the most widely used are GCMs (Global Climate Models), which are simplified but rigorous mathematical descriptions of important physical and chemical processes governing climate, including the role of the atmosphere, land, oceans, and biological processes. To make projections of future climate, scientists need assumptions about GHG emissions trajectories from human activity, based on known drivers of GHG emissions (population size, economic activity, lifestyle, energy use, land use patterns, technology and climate policy). In its recent science assessment, the IPCC used Representative Concentration Pathways (RCPs), which describe four different 21st century pathways of GHG emissions and atmospheric concentrations, air pollutant emissions and land use. The RCPs include a scenario with deep cuts in GHG emissions (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0) and one scenario with very high GHG emissions (RCP8.5). The figure at the top right of this slide show the results of dozens of modelling runs using different GCMs operated by research institutes around the world, for the four RCPs. It shows projected temperature changes in the Caribbean to the end of the century. The other three figures show projections for sea surface temperatures, sea level, surface pH and oxygen content in the Caribbean Sea to the end of the century for low emissions and high emissions scenario. Projections indicate continued rise in ocean warming, sea level rise, decreased pH and decreased oxygen content.

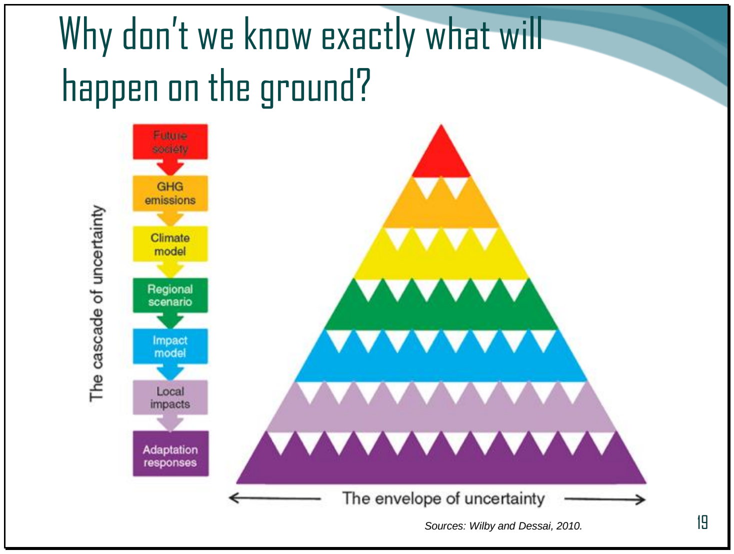
Given current GHG concentrations in the atmosphere and ongoing emissions of greenhouse gases, it is likely that by the end of this century, the increase in global temperature will exceed 1.5°C compared to 1850 to 1900 for all but one scenario (RCP2.6). Most aspects of climate change will persist for many centuries even if emissions are stopped today. The world's oceans will continue to warm, ice melt will continue and sea levels will rise.

Slide 18



Studying how climate indicators have changed and could change in the future under different emissions scenarios is essential, but policymakers, communities and businesses are most interested in understanding the ecological and socio-economic consequences of these shifts in climate. This is a list of some of the consequences of climate change that governments and communities in the Caribbean may be worried about. Can you list others?

Slide 19



There are key sources of uncertainty in projecting the local impacts of climate change.

Staring from the top of the pyramid. We know that GHG emissions and increased carbon dioxide in the atmosphere cause climate change, but how much carbon will future society pump into the atmosphere, by when?

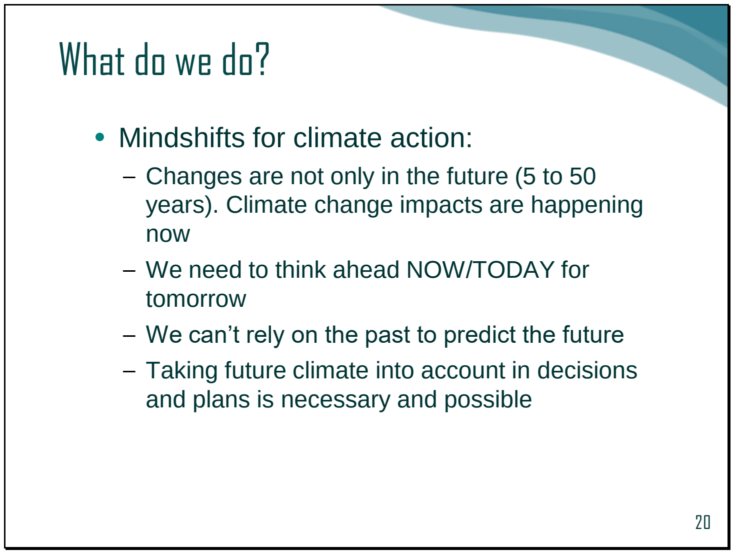
We know that more heat being trapped in the atmosphere, so the globe is warming up. But how sensitive is the global climate system? What are the tipping points and when might they occur?

We have global climate models which are good at global averages but they are not that good at extremes or at regional, national or sub-national levels

What other factors are at play locally that influence our understanding of local impacts of climate change? Urban heat islands? What about adaptive capacity? How does that influence how climate change impacts are felt and distributed?

An appreciation of these is important in planning and taking action. We need to become comfortable with uncertainty – just because we can say what will happen and by when does not mean this isn't happening.

Slide 20



The science is clear. The climate is changing and is affecting people and ecosystems around the world. So what do we do about it? An overall realization is that society's relationship with the climate needs to shift, and with it our mental models about how we should behave. First, climate change is not some distant phenomenon or a future issue. Climate change impacts are happening now, including in the Caribbean. Second, although extreme events get a lot of attention because of their sometime destructive force, it's also important to start preparing now for gradual and longer-term impacts. Third, we have grown accustomed to building our houses and infrastructure, deciding what to grow, and structuring our economies recognizing that climate varied within a known range - this is called stationarity. The reality is that the climate is continuously changing and we are seeing conditions beyond historic experience. Therefore, we can't use the past to predict the future. Finally, despite the uncertainty in projecting future climate and related impacts, we need to take these future considerations into account in decision making and planning. Examples in the region and around the world are emerging to show that this is possible.

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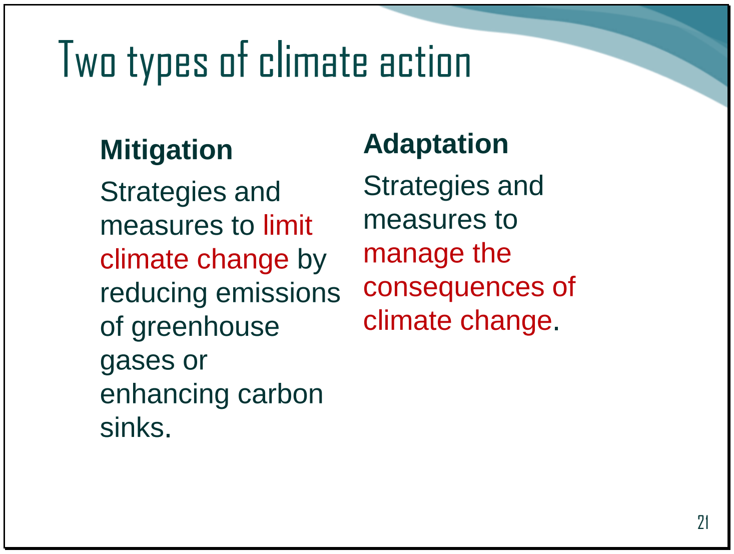
Notes:

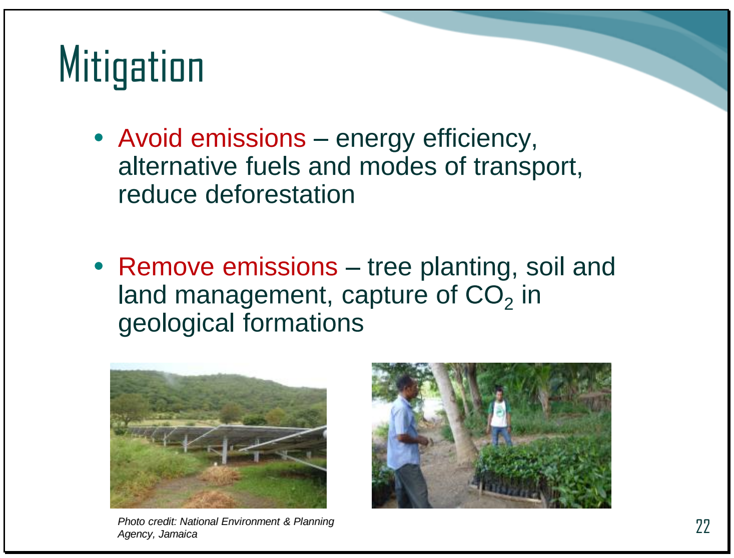
[To strengthen messaging related to the fourth point you could identify a specific example from your country or the region of a policy, plan or project that benefited from the use of climate information, e.g., climate proofed infrastructure.]

Slide 21



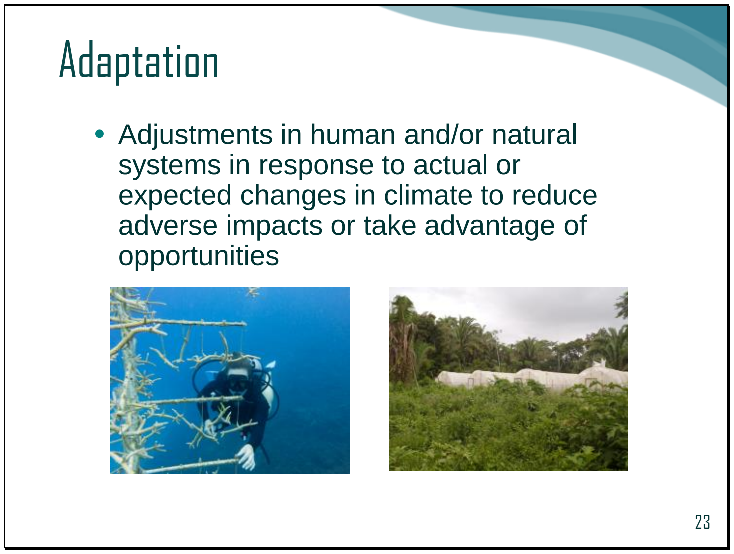
There are two responses to climate change: mitigation and adaptation. Effective climate action requires a portfolio of both types of responses.

Slide 22



Mitigation involves measures to avoid emissions of greenhouse gases or remove carbon dioxide from the atmosphere (also known as enhancing carbon sinks). This slide has a few examples of each kind of measure.

Slide 23

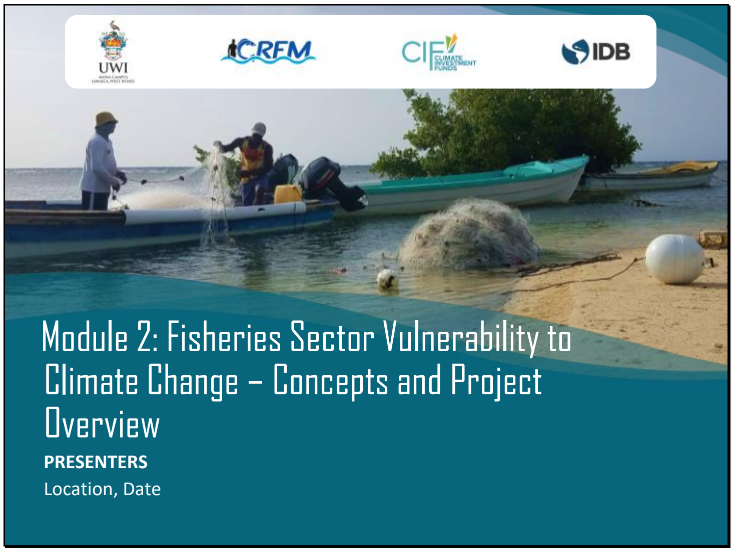


Adaptation comprises shifts in behaviour or functioning in response to or in anticipation of changes in climate conditions. Natural systems, such as forests and fish populations, are adapting to climate change but may not be able to keep pace with the speed of climate change [the photo to the left is coral gardening]. In human systems, such as communities or economic sectors, climate change adaptation is necessary in about all aspects of life as we know it. [The photo to the right shows adaptation in farming systems, introducing covered cropping to reduce crops’ exposure to extreme heat and pests.]

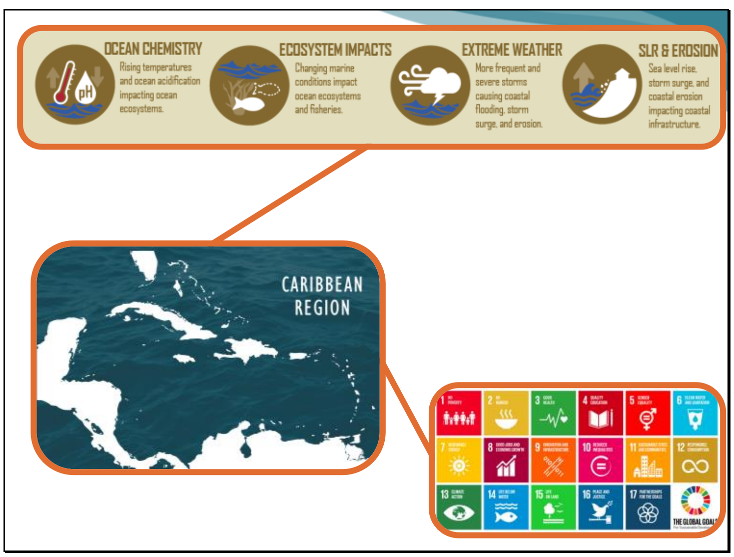
POWERPOINT PRESENTATION

MODULE 2: FISHERIES SECTOR VULNERABILITY TO CLIMATE CHANGE-CONCEPTS AND PROJECT OVERVIEW

Slide 1



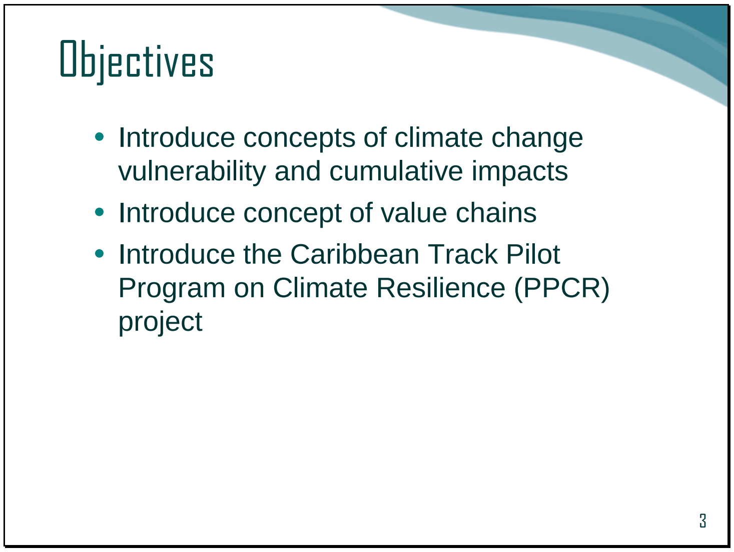
Slide 2



As small island developing states, Caribbean countries are some of the most affected by and vulnerable to climate change in the world. For some islands, climate change is a threat to achieving Sustainable Development Goals. Climate change makes disaster risk reduction even more important. With the exception of geophysical hazards climate change affects the frequency and / or intensity of all types of natural hazards.

This module provides an overview of key concepts for understanding the vulnerability of the fisheries sector to climate change and an overview of the regional PPCR project implemented from 2018-2020 in support of climate-smart fisheries.

Slide 3



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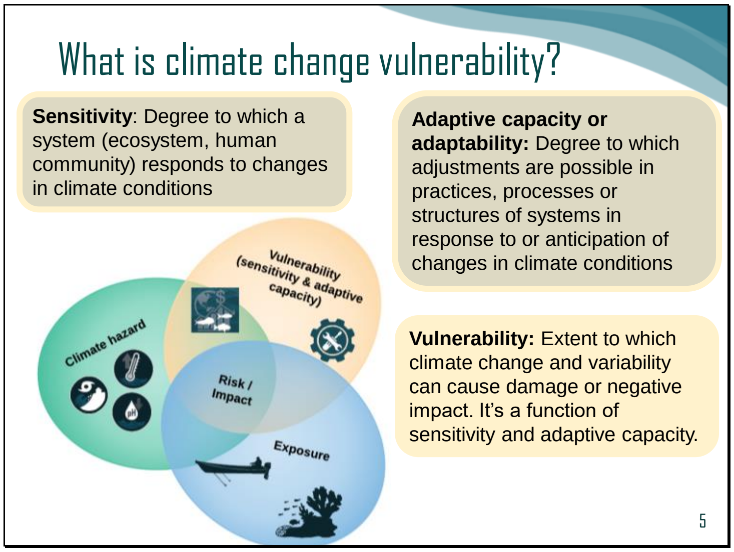
Notes:

[The slides in the module are designed to address the listed objectives. You can revisit the objectives and contents based on your own target audience, their levels of knowledge, interests and motivations.]

Slide 4

Slide 5



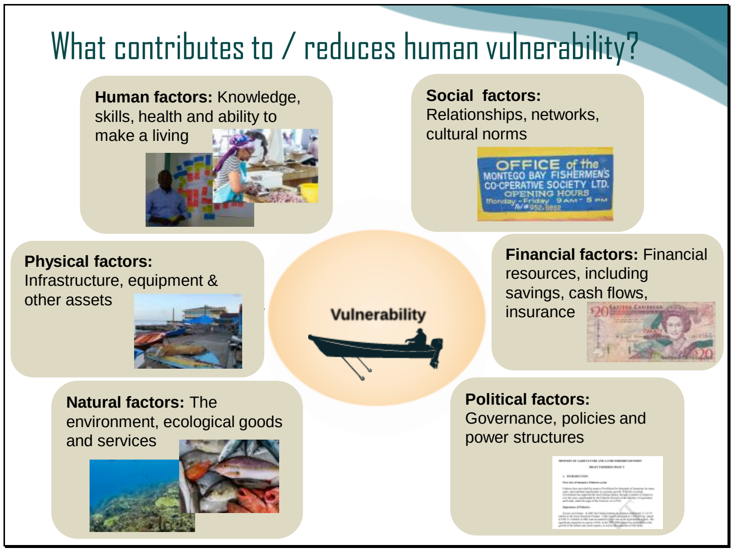
The potential impact (risk) of climate change on the environment and socio-economic systems can be understood in terms of vulnerability and exposure of the system [See definition of each component on the slide and explain each in turn.]

Vulnerability to climate change:
-depends on exposure to climate hazards
-is determined by human, social, physical, natural, political and financial factors
-varies within communities and households
-interacts with vulnerability to natural hazard
-more capacity means less vulnerability

People may be exposed to a range of different hazards. For example, a community may be exposed to drought and heavy rainfall. With climate change impacts affecting rainfall patterns, these events may become more frequent and severe.

Efforts to reduce vulnerability need to consider the different hazards people are exposed to and how the hazards might interact.

Slide 6



Many factors contribute to human vulnerability and in designing sustainable adaptation measures it's important to address root causes of vulnerability. This slide highlights some of these key factors. Households and communities that possess and can mobilize these attributes have more capacity to adapt.

**Human factors: examples of human factors influencing vulnerability include (1) lack of knowledge such as lack of knowledge of changing disaster risks or safe evacuation routes; (2) limitations in skills such as literacy, financial management, conservation agriculture; (3) poor health, including malnutrition; (4) lack of mobility to due physical disabilities or age

**Physical factors: examples include (1) inadequate housing, poorly designed or maintained infrastructure, (2) lack of storage for assets, (3) lack of communication infrastructure.

**Natural factors: examples include land degradation, deforestation, unsustainable management of water and other natural resources, geographical features, such as slopes, rivers and coastlines

**Social factors: examples include (1) a lack of social cohesion within a community, (2) poor social safety nets, (3) gender inequality, (4) cultural beliefs that prevent appropriate risk management, (5) inadequate participation of marginalized groups in community networks and organization

**Financial factors: examples include (1) a lack of savings, (2) insecure access and control over land and other resources, (3) limited access to financial services such as credit and insurance, (4) lack of opportunities to diversify livelihoods, (5) fluctuations in prices of food and other essential goods

**Political factors: examples include (1) a lack of appropriate legal and regulatory systems, (2) inadequate participation in governance, (3) inequitable policies and power structures, (4) lack of representation of marginalized groups in governance processes
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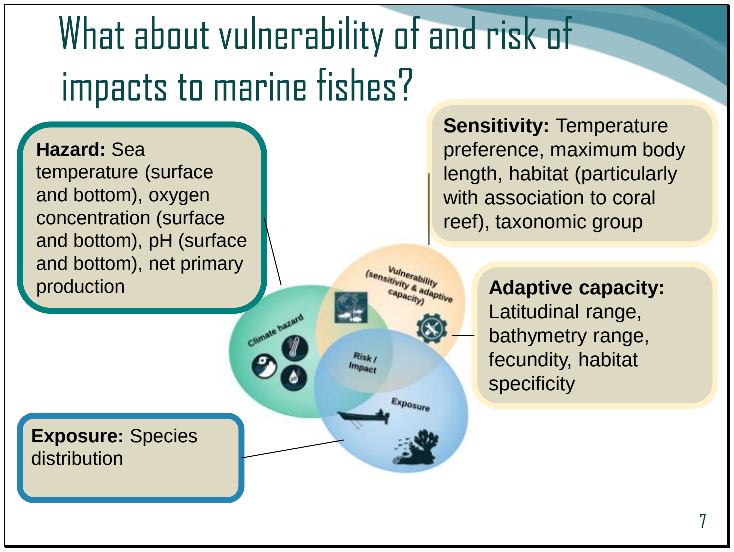
Notes:

[The content on this slide is adapted from DfiD 1999. Sustainable Livelihoods Guidance Sheets.]
[A discussion on why these factors shape vulnerability can be useful in inspiring ideas on potential adaptation measures.]

Slide 7



Human communities and sectors are not the only ones vulnerable to the impacts of climate change. Species, populations and ecosystems are also vulnerable and their vulnerability can be understood in much the same way as human systems. The risk of impact from climate change to marine fishes is a function of fishes exposure to climate hazards, such as warming sea temperatures, how sensitive different species might be to these changes and their natural capacity to adapt.

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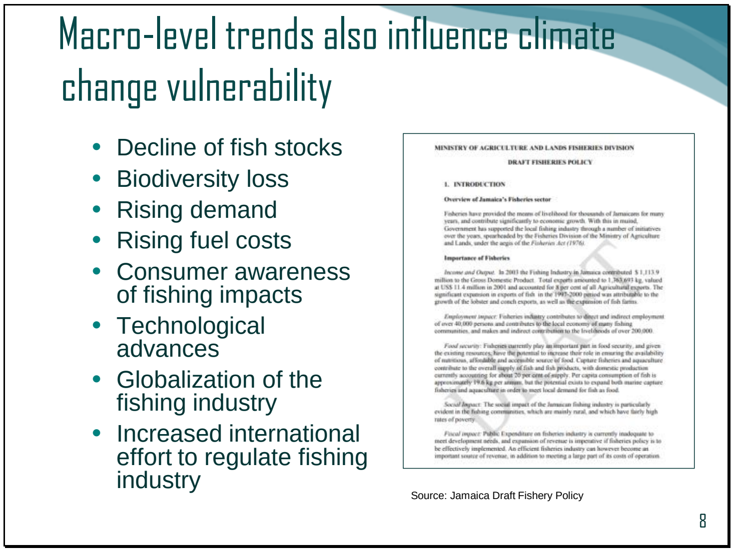
Notes:

[You can deepen this explanation by using a specific example of a fish species that will resonate with the audience.]

Slide 8



So far, we have talked about vulnerability at one scale, either at the household level or community level, for example. However, trends occurring across scales also influence vulnerability. This slide lists examples of these macro-level trends. Rising fuel costs, for instance, can reduce the adaptive capacity of fishers who have to go further out into the ocean for their catch, with shifts in the abundance and distribution of fish. Rising fuel costs can also act as an incentive to invest in more fuel efficient engines. Macro-level trends can either help mobilize or reduce adaptive capacity and understanding these interactions is important in policy and planning.

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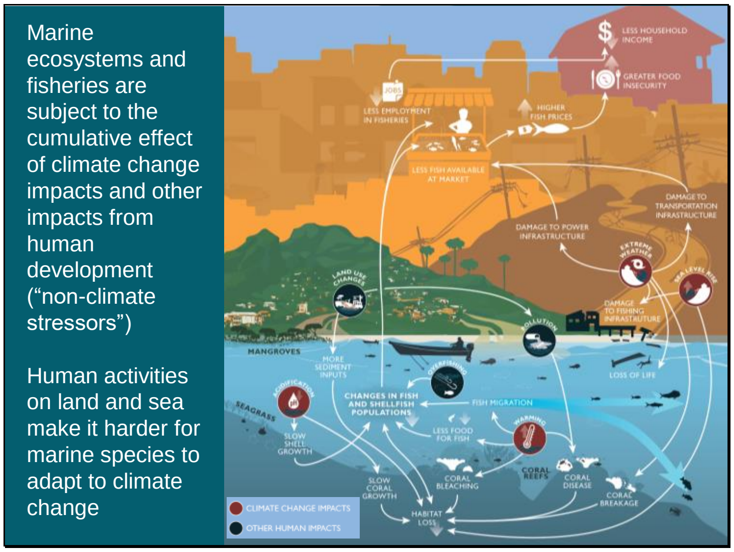
Notes:

[Most but not all of these macro drivers are included in Jamaica's Draft Fisheries Policy. You may want to substitute these bullets with macro drivers that are particularly salient in your country / operating environment.]

[You can guide a discussion with your audience to help reflect on how these (or other) macro-level trends can contribute to building adaptive capacity or undermining it, as well as how the results might differ depending on the group.]

Slide 9



Capture marine fisheries, such as are practiced in the Caribbean involve complex human-ecosystem interactions, even without considering the pathways through which climate change might affect marine resources, fisheries and fishing communities. The impact pathways in this diagram labelled in navy blue, for example, illustrate the impact of human activities on marine resources and habitats. The impacts of changing climate conditions adds to this complex network of effects. Establishing definitive causal and quantitative relationships between climate variability, climate change and its impacts on fisheries and aquaculture are difficult to establish and disentangle from natural variability and the influence of human impact.

Despite this uncertainty, we know that healthy, well-functioning ecosystems are more resilient to climate change much can be done to reduce the vulnerability of marine resources using practical, ecosystem-based approaches. There is considerable knowledge on how to build and maintain the resilience of natural ecosystems and the human communities that inhabit and depend on them, for example by lessening the impact of non-climate stressors (e.g., establishing marine protected areas to lessen the impacts of overfishing and habitat disturbance).

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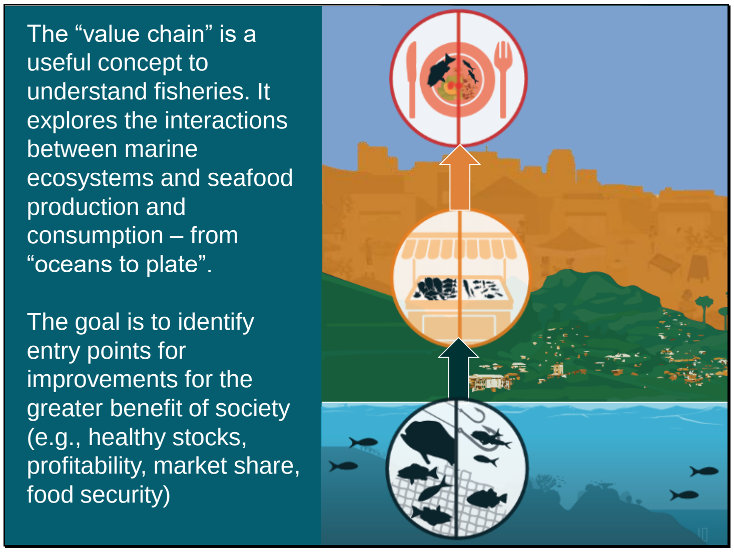
Notes:

[We recommend taking your time in reviewing this diagram with your audiences, eliciting views on components and effects that are missing as well as connections between components that are missing.]

[You can take a look at the primer on conceptual modelling in the Report of the Regional Planning Workshop for ideas on how to facilitate a group in developing such a diagram.]

Slide 10



The value chain is a useful lens to understand the level of exposure, sensitivity and adaptive capacity of marine resources and the fisheries sector to both climate and non-climatic stressors (or drivers of change) and to identify management measures that are complementary to adaptation and resilience building. The seafood or “fish value chain” focuses on understanding fishery systems. It looks at the interaction between fishery ecosystems and seafood through the production chain from “oceans to plate”, spanning from the ecological to social systems, with the goal of identifying entry points for the greater benefit of society (e.g., enhanced profitability, greater market share, enhanced food security). The **value** in value chain denotes additional benefits of increasing shelf life, product differentiation options, quality, and revenue. The value chain concept provides an analytical framework to understand seafood production starting from capture (harvest stage) to post-harvest (processing and marketing) and the interlinkages with ecosystem changes.

Slide 11

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Notes:

[The remaining slides provide an overview of the PPCR-CRFM Climate-Smart Fisheries Project.]

[This photo was taken in Kingstown, in April 2018, at the conclusion of the Regional Planning Workshop. The photo includes fisheries officers from the 6 PPCR countries, as well as fishers / representatives from fisherfolk organizations, as well as a representative from the CRFM secretariat, and several members of the ESSA consulting team.]

[Whenever making a presentation on the project it's always a good idea to acknowledge the project funders and implementers, using this logo band or a similar one.]

Slide 12

The detrimental impact of recent extreme weather events on the Caribbean fisheries sector has served to highlight the sector's vulnerability to climate-related hazards. For example, damage estimates for Dominica's fisheries sector in the aftermath of Hurricane Maria stood at roughly US$3 million. This figure only reflects direct damages - damages mostly to fishing boats and equipment, as well as infrastructure vital to the sector.

A growing number of global, regional, national and local studies on the impacts of climate change on fisheries are available. Global and regional studies, such as those depicted in this slide (FAO, Caribbean Marine Climate Change Report Card Scientific Reviews by Commonwealth Marine Economies (CME) Programme) provide robust high-level reviews of the ecological and socioeconomic impacts of climate change as well as current and planned adaptation. However, these same studies lack species specific information, note the lack of quantitative assessments and the challenges of downscaling climate change knowledge to small islands.

Slide 13

The Inter-American Development Bank, through grant funding for the regional track of the Pilot Program on Climate Resilience (PPCR), responded to the need to invest in scientific analysis so that countries can incorporate climate resilience into their national climate change strategies as well as in regional planning strategies, policies and financing mechanisms.
has invested in supporting the region's climate resilience.

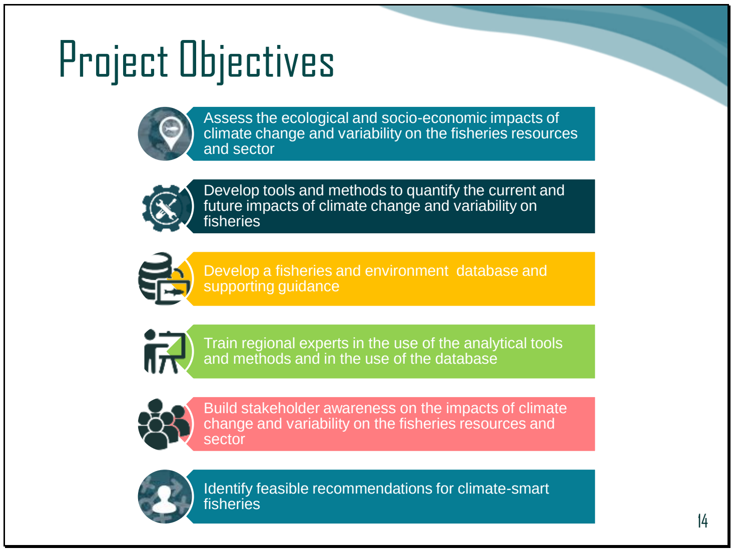
The "Fishery-Related Ecological and Socio-Economic Assessments of the Impacts of Climate Change and Variability and Development of an Associated Monitoring System" project ("the Project") is one initiative of the PPCR regional track.

Executed by the Mona Office for Research and Innovation (MORI) at the University of West Indies at Mona, Jamaica, and with the Caribbean Regional Fisheries Mechanism (CRFM) as the co-implementer and service beneficiary, the Project aims to improve availability and use of information for "climate-smart" planning and management in the fisheries and aquaculture sector in the Caribbean. The Project consists of six participating countries, which are the direct beneficiaries - Jamaica, Haiti, Dominica, Saint Lucia, Grenada and Saint Vincent and the Grenadines. Each of these also has a national PPCR program.

New knowledge generated through CRFM-PPCR project can be leveraged to reduce vulnerability and prepare for future climate change.

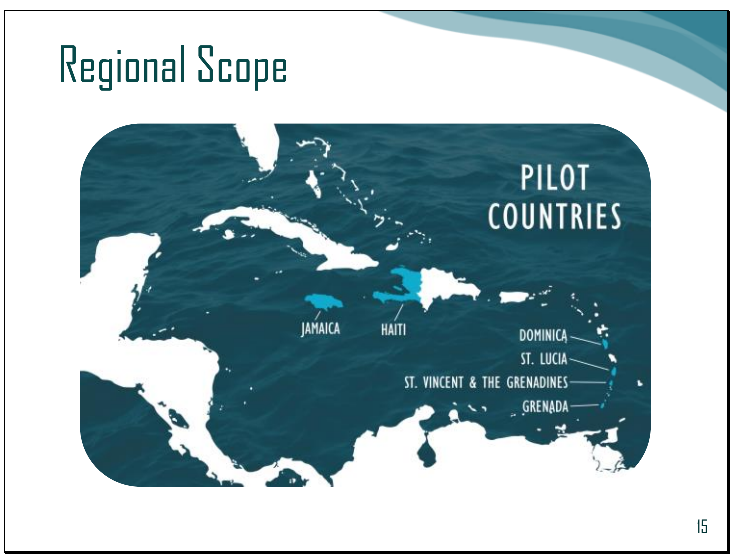
The next few slides provide an overview of the project.

Slide 14



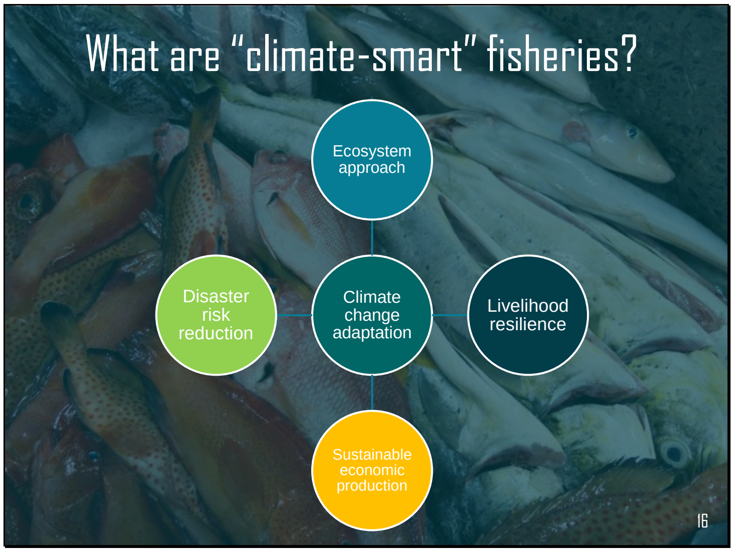
The overall goal of the project is to improve the information base and its usage for "climate-smart fisheries planning and management" decision-making, as well as, risk management in the fisheries sector. The objectives listed on the slide contribute to achieving the overall goal, delivering on 4 inter-related work packages (1.assessment, 2.database tools, 3.communications & engagement and 4 adaptation mainstreaming in regional strategy). Following the terms of reference of the assignment, much of the level of effort (and budget) was assigned to work packages 1 and 2.

Slide 15



The project's main service beneficiaries are the Caribbean Regional Fisheries Mechanism and with the six states with national PPCR initiatives shown on this slide (2 western and 4 eastern Caribbean) as focal countries for all project activities. Although project activities concentrate on these 6 countries, many of the outputs of the project have broader regional applicability.

Slide 16



There no standard definition of climate-smart approach to fisheries, but common attributes include:

**Sustainably increasing economic output, including by optimizing fishing effort and improving fisheries management
**Maintaining healthy ecosystems and stocks through ecosystem-based approaches
**Increasing the resilience of households and communities whose livelihoods depend on well-functioning fisheries the health of marine resources. Responses need to address risks of human, physical, social and financial losses associated with short-term events, as well as adjust to long-term changes
**Reducing vulnerability in the fisheries and aquaculture sector to disaster risks and climate change impacts, through disaster risk reduction and climate change adaptation at all scales. Resilience of the sector in turn supports other objectives such as food security and sustainable food systems

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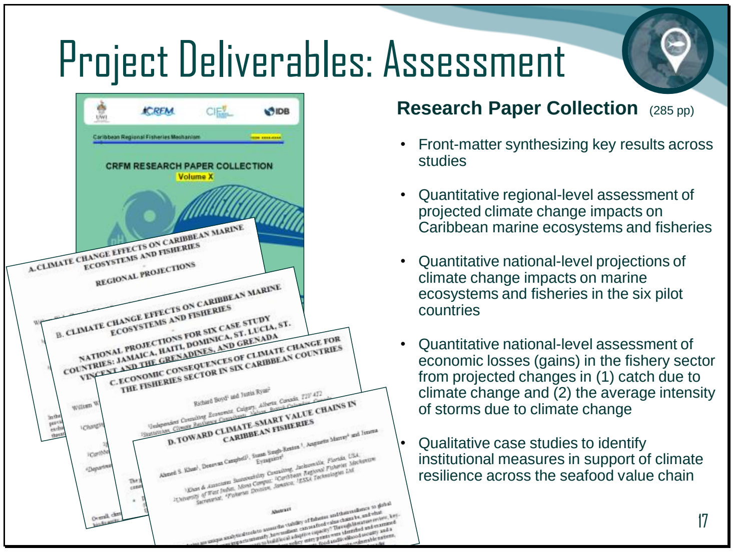
Notes:
[Reducing and removing GHGs can also be a part of climate-smart fisheries but was not a focus of this project.]

Slide 17



A major output of Work Package 1 is series of reports that assess the sector's impacts of and vulnerabilities to climate change. These technical reports conform a research paper collection that includes regional and national results from ecological modelling of climate change impacts on Caribbean marine resources, estimates of the economic impacts to the sector from climate-change induced reductions in catch and more intense tropical storms and qualitative analysis of challenges and opportunities of climate change on the sector, from value chain perspective and based on case studies from field research in Montego Bay and Kingstown.

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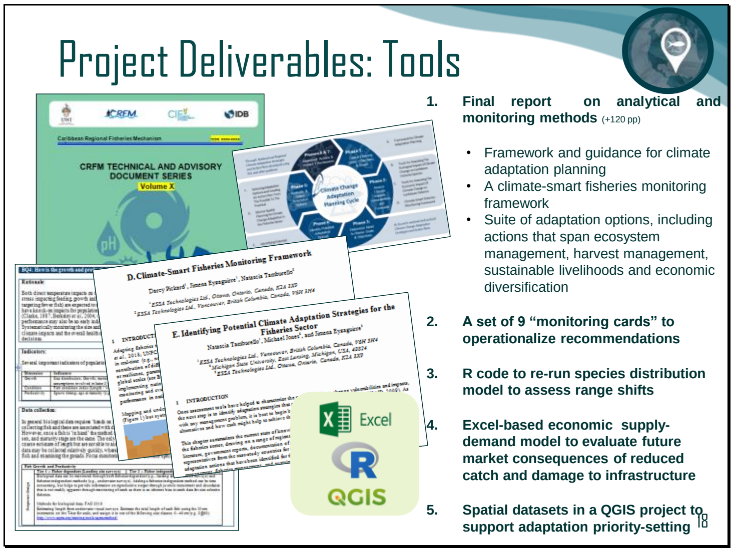
Notes:

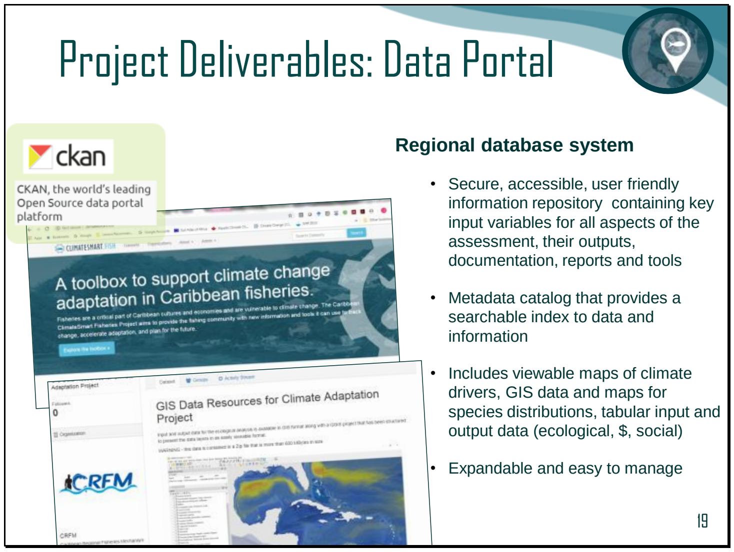
[The final version of the research paper collection benefitted from a detailed review by the CRFM Secretariat and written feedback from representatives from Saint Lucia, Jamaica and Trinidad and Tobago.]

Slide 18



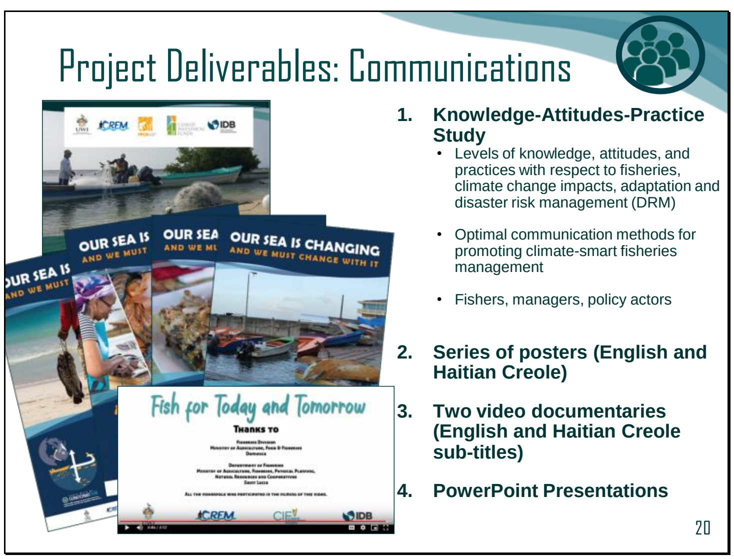
Major outputs of Work Package 2 include analytical tools and process guidance to enable assessment of climate change impacts, monitoring of biophysical and socio-economic responses to climate change and selection of adaptation options. The narrative elements of these tools are contained in a technical and advisory document series. Ancillary tools include Excel based models and R code. Training materials covering analytical tools, monitoring and adaptation guidance are available to help support uptake of the resources beyond those who were specifically trained during the project.

Slide 19



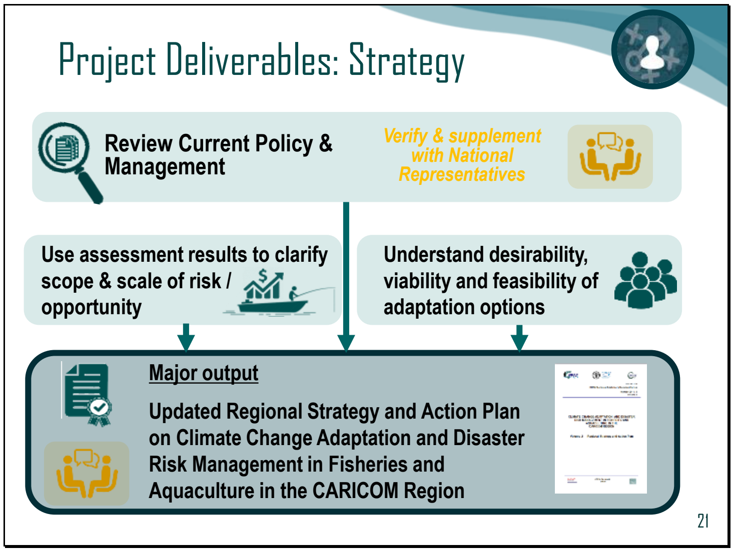
This slide also summarizes a major output of Work Package 2: a regional database system. It was built on a user friendly open source platform that can be built on over time. Resources loaded on the platform include all reports, underlying data inputs, data outputs, tools stemming from the project. Data are in various formats, spatial and tabular. A user guide is also available as well as training materials so anyone can pick up, use and contribute to long term use of the data portal. The data portal is hosted and administered by the CRFM Secretariat.

Slide 20



Work Package 3 produced a range of multi-media communications and engagement materials to support widespread dissemination of the research and analysis produced through the project. Decisions on which materials to develop, what audiences to target and what messages to highlight were based on the results of a Knowledge-Attitudes-Practice study undertaken in year 1 of the project.

Slide 21

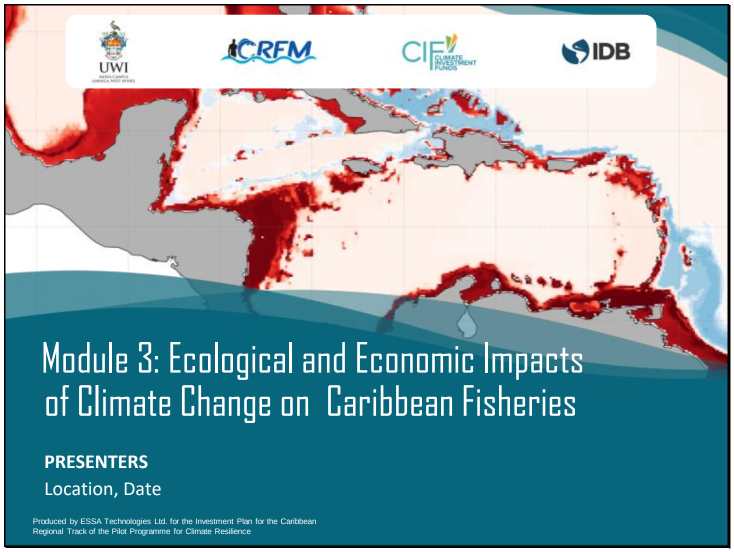


Work Package 4 is the culmination of the project. A key output is an updated Regional Strategy and Action Plan for Climate Change Adaptation and Disaster Risk Management in Fisheries and Aquaculture that builds on the current management, policy and monitoring context in the region and accounts for the new information gleaned from project research as well as the aspirations and capacities of Caribbean stakeholders across the fish value chain.

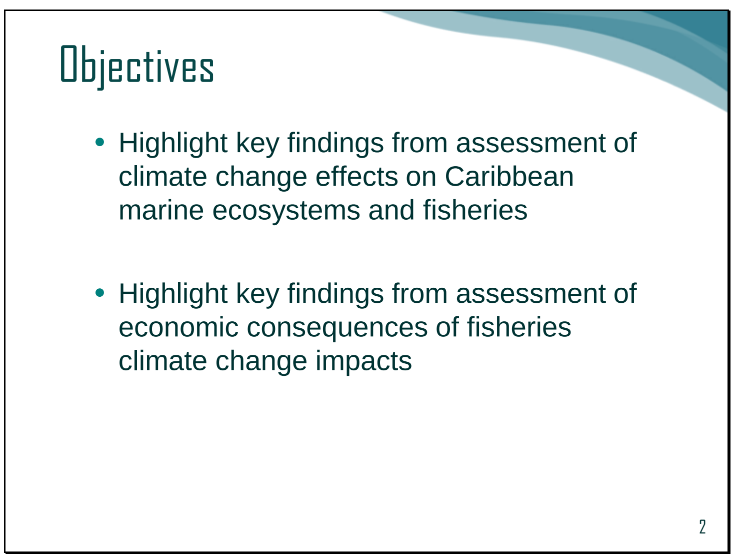
POWERPOINT PRESENTATION

MODULE 3: ECOLOGICAL AND ECONOMIC IMPACTS OF CLIMATE CHANGE IN CARIBBEAN FISHERIES

Slide 1

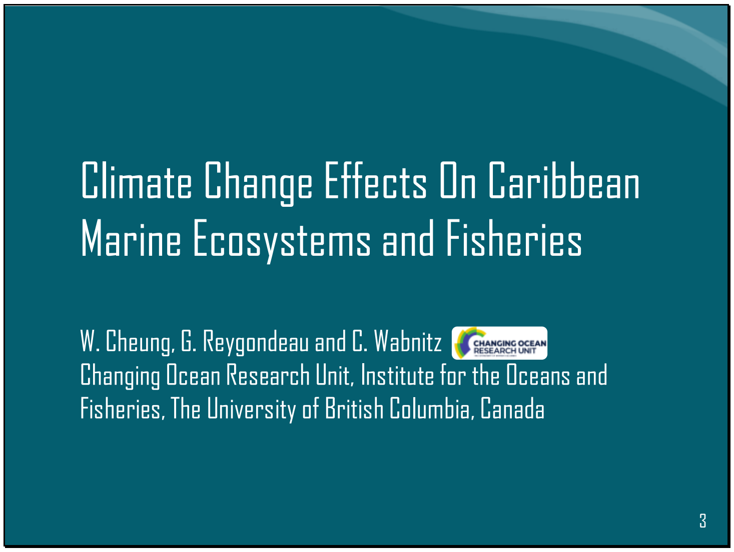


Slide 2



This presentation summarizes key results of quantitative climate change impact assessment undertaken as part of the project.

Slide 3



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Notes:

[Prior to sharing results of the ecological modelling work we recommend reading and becoming familiar with the contents of paper A: Climate Change Effects on Caribbean Marine Ecosystems and Fisheries – Regional Projections, as well as paper B: Climate Change Effects on Caribbean Marine Ecosystems and Fisheries – National Projections for Six Case Study Countries – Jamaica, Haiti, Dominica, St. Lucia, St. Vincent and the Grenadines and Grenada.]

[The slide acknowledges the Changing Oceans Research Unit at the University of British Columbia.]

[The next 24 slides present highlights from the ecological assessment work. It draws on some of the research, there is the potential to extract much more, depending on your objectives and target audience.]

Slide 4

Climate change affects marine species and fisheries in a number of ways. Changes in temperature and other ocean conditions affect the biology of species, affect population-level dynamics such as growth, abundance and distribution. This then affects species' assemblage and community structure. In turn, this affects fisheries through changes in species composition of catch or maximum catch potential, and the economics of fishing. This study explored the potential effects of the changing climate primarily through exploring the influence of climatic and oceanographic variables on species distributions, richness and potential catch.

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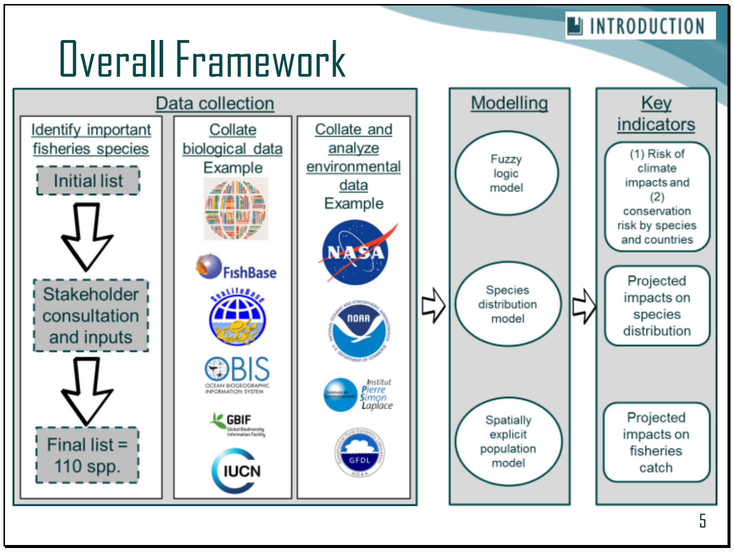
Notes:

[This was the objective of the ecological assessment work.]

Slide 5



This slide summarizes the overall research framework adopted, which included a data collection phase, modelling and derivation and presentation of key indicators.

To assess climate risks for Caribbean marine fish stocks and fisheries, a first step was to assemble three linked datasets: (1) the list of key species, agreed to together with stakeholders, this assessment should focus on; (2) occurrence data for species identified in (1), as well as life history (e.g., age at maturity) and ecological data (e.g., depth) associated with these species; and (3) variables that globally define the marine environment obtained from a number of separate model outputs.

These data are inputs into three distinct analytical approaches, which we will touch on in the next few slides, to project results to 2050s for the series of indicators shown here on the right. The use of multiple lines of evidence in projecting climate change impacts is a best practice in climate change research, given the uncertainty in understanding and capturing interactions among climatic, environmental and biological factors.

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Notes:

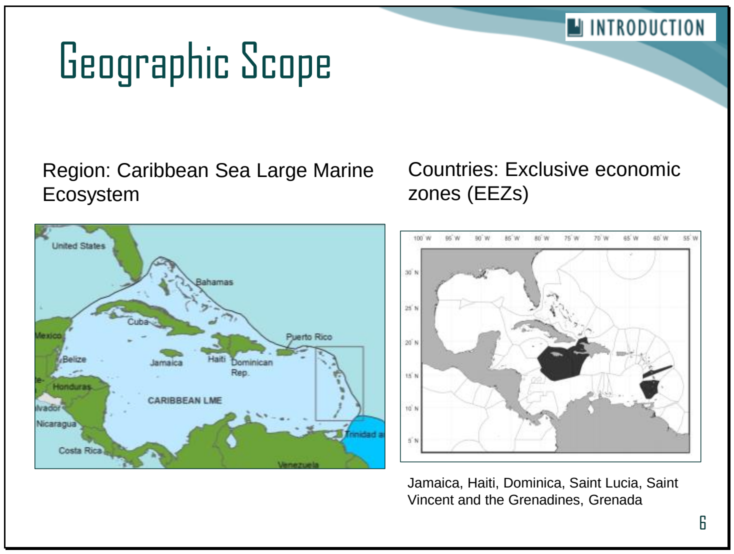
**Fisheries species: In concert with regional stakeholders, the team identified 110 priority species to model: 2 species of marine mammals (humpback whale and common bottlenose dolphin), 2 species of algae (belonging to the genus Sargassum), 7 species of invertebrates (queen conch, Caribbean spiny lobster and 5 species of sea cucumber), and 99 species of fish

**Occurrence, life history and ecological data came from published databases including FishBase, SeaLifeBase, the Sea Around Us database, Ocean Biogeographic Information System (OBIS – www.iobis.org), the Intergovernmental Oceanographic Commission of UNESCO (IOC – ioc-unesco.org), the Global Biodiversity Information Facility (GBIF – www.gbif.org), FishBase (www.fishbase.org), and the International Union for the Conservation of Nature (IUCN – http://www.iucnredlist.org/technical-documents/spatial-data).

**Fisheries catch time series used in the analysis consisted of total "reconstructed" fisheries catches, as available from the Sea Around Us database for the region as a whole, and for each of the 6 focal countries.

**Environmental data (ocean, climate) derived from outputs of a subset of three Earth system models (ESM) made available as part of the fifth phase of the Ocean-Atmospheric Coupled Model Intercomparison Project (CMIP5): the Geophysical Fluid Dynamic Laboratory Earth System Model 2G (GFDL ESM 2G), the Institut Pierre-Simon Laplace Climate Model (IPSL-CM5A-MR), and the Max Planck Institute Earth System Model (MPI-ESM-MR).

Slide 6



Analysis involves spatial modelling, with the geographic scope shown on this slide. The region is defined as the Caribbean Sea Large Marine Ecosystem. In the map on the right, the dark area covers the Exclusive Economic Zones of the six case study countries.

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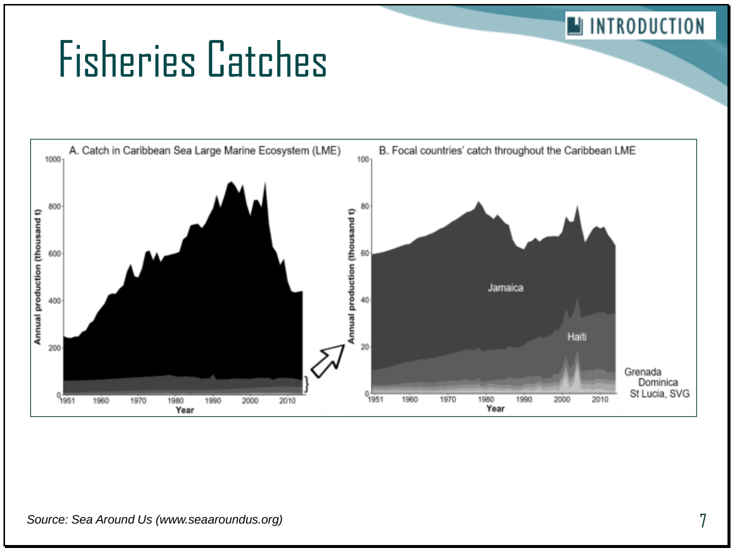
Notes:

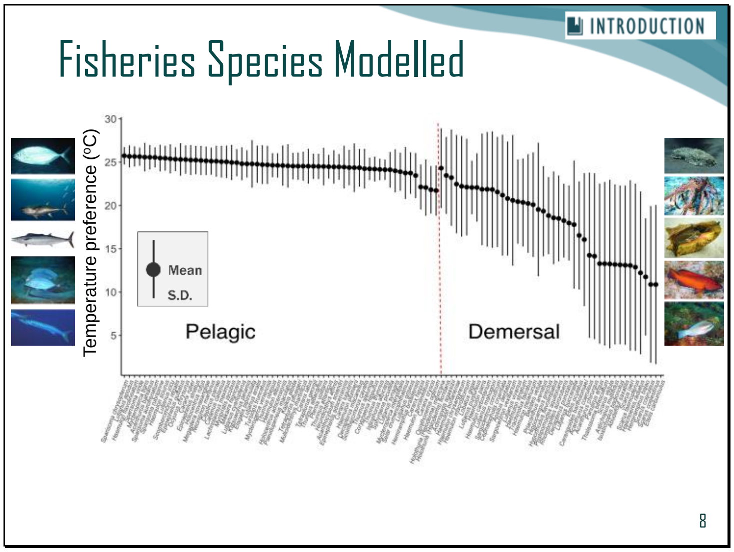
**The map of the Caribbean LME is from this source: https://clmeplus.org/clme-region/

Slide 7



Fisheries data are inputs into species distribution modelling. We used Sea Around Us data to collate datasets of reconstructed catches for the Caribbean Sea region from 1950 to 2015: figure (A) shows total regional catches and figure (B) shows catches by the six selected focal countries (Dominica, Grenada, Haiti Jamaica, St. Lucia, St. Vincent and the Grenadines) in the Caribbean Large Marine Ecosystem region. Catch from countries other than these six countries in the region is represented by the black area on the figure on the left hand side.

Slide 8

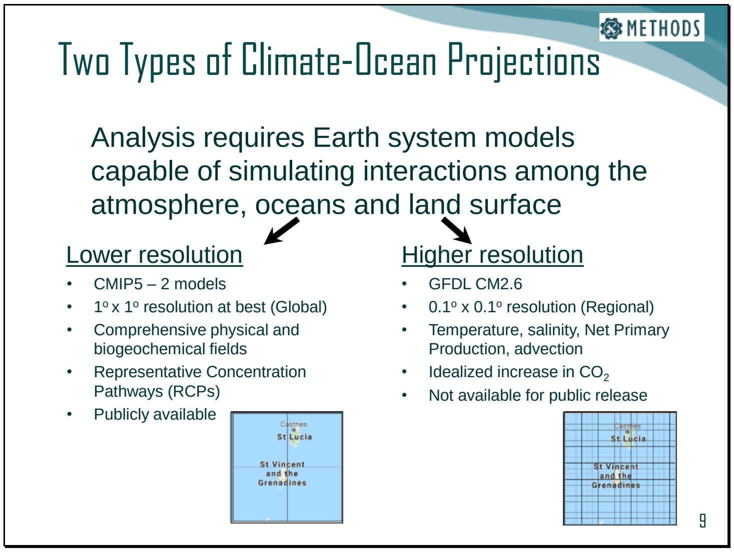


In a community of marine fishes and invertebrates, different species have different thermal preferences and tolerances. They can only live in environment where ocean temperature falls within their tolerance limits. When the ocean warms up, temperature may become too warm for some species, leading to their local extinction. At the same time, some species can invade into the area.

The estimated temperature preferences of the 106 selected marine fishes and invertebrates (i.e., excluding marine mammals and two species of algae). These variables were used to determine species' sensitivity to climate hazards. The black dots represent the preferred temperature while the vertical line represents the 95% confidence intervals of species' temperature preference profiles.

Overall, the selected 106 marine fishes and invertebrates were found to prefer temperatures ranging from 12˚C to 27˚C.

Slide 9



Projected changes in temperature and other ocean conditions derived from three different models, two of lower resolution and one of higher resolution. This slide summarizes key differences between low and high resolution models. The slides that follow include these grid figures to denote whether results use outputs from low or high resolution Earth system models.

Analysis used a single realization (or run) from each model. The Earth system models were nominally run for the period 1850 to 2005 under historical forcing (i.e., radiative forcing estimated to have occurred during that time period), and over the period 2006 to 2100 under two Representative Concentration Pathways (RCP2.6 and RCP8.5), which represent two contrasting alternative scenarios of global mitigation and resulting atmospheric concentrations from 2000 to 2100.

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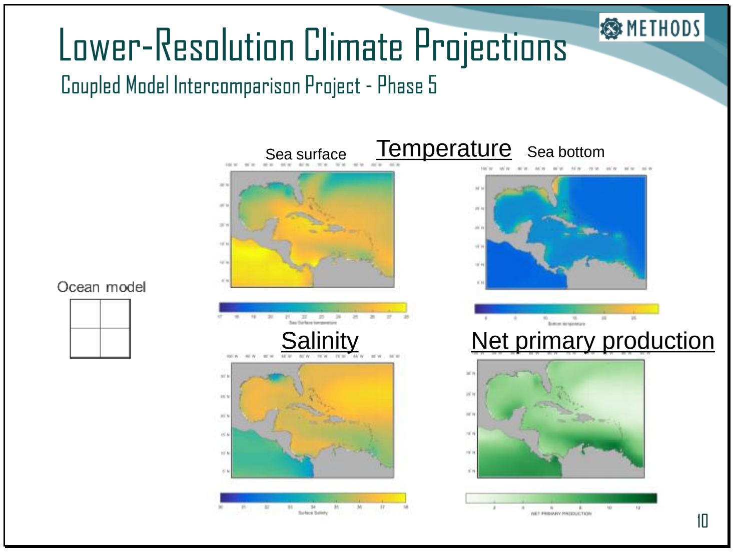
Notes:

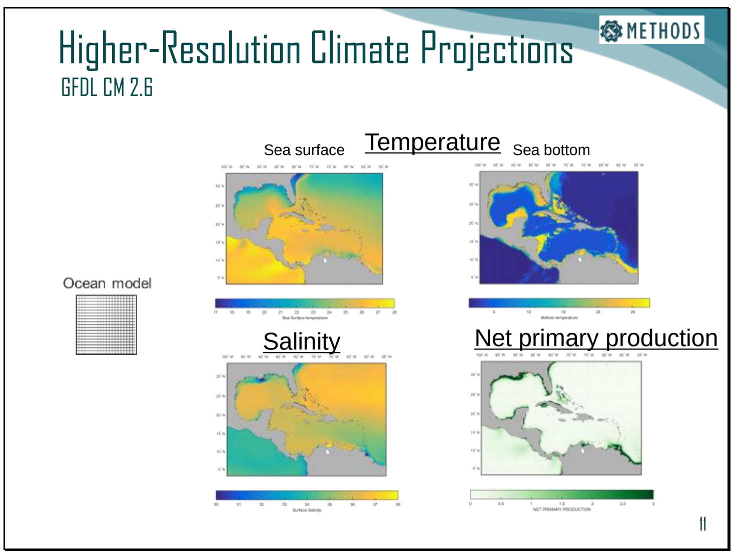
[Model outputs at 1˚ X 1˚ are interpolated to attain a 0.5˚ X 0.5˚ resolution.]

The following two slides show baseline values of sea surface temperature (surface and bottom), salinity and net primary production mapped onto the Caribbean LME. By contrasting both slides you can see the difference employing a higher resolution model can make. Unfortunately, the model outputs (fields) needed for understanding biological and ecological shifts exceeded those available from the high resolution model (GFDL CM2.6).

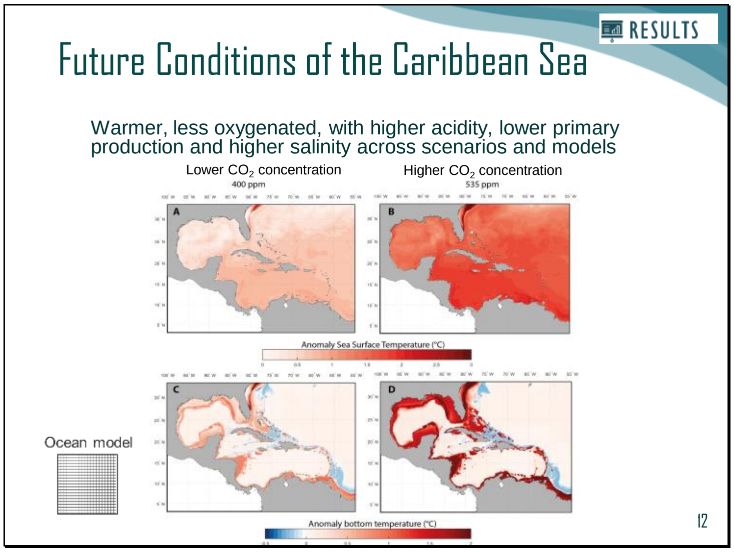
Slide 10



Slide 11



Slide 12



Regardless of global model and emissions scenario use, future climate and ocean conditions in the Caribbean Sea are expected to be warmer, more acidic, with higher salinity and less oxygen.

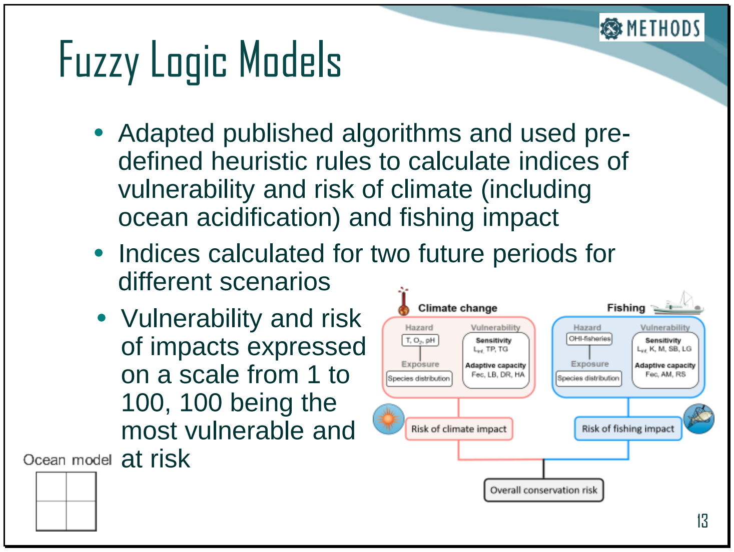
Temperature is the primary driver of biological impacts of climate change on exploited fish stocks and so we show projected changes in sea temperature. These are projected changes in sea surface temperature (A, B) and sea bottom temperature (C, D) from the high resolution Earth system model (GFDL CM2.6) under an average atmospheric CO2 concentration of 400 ppm (A, C) and 535 ppm (B, D).

Warming of surface waters is projected be more homogenous across the Caribbean Sea compared to warming of bottom water, although surface water temperature is projected to increase more in the southern and western parts of the Caribbean Sea. In contrast, warming of bottom water is generally projected to follow bathymetry, with a greater increase in temperature projected to occur along shallow shelf and coastal areas. Across the water column, warming is projected to be positively related to atmospheric CO2 concentration (scenarios of higher carbon dioxide concentration in the atmosphere correspond to more warming). Warming trend is less pronounced in the bottom environment owing to the diffusion of the heat from the surface to the bottom.

Spatial patterns of projected ocean warming in the Caribbean Sea are consistent across the high and low resolution Earth system models' outputs.

The following slides briefly describe each of the 3 analytical approaches we used and related results.

Slide 13



We assessed the climate risk, risk of fishing impact and overall conservation risk of 106 marine fish and invertebrate species of interest to key stakeholders in the Caribbean using indices generated through fuzzy logic. The risk assessment framework we used is summarized in this diagram.

In this framework, risk of climate impact (or climate risk) consists of three components: exposure to climate hazards, sensitivity to climate hazards, and species capacity to adapt to climate changes. Exposure is the nature and degree to which a species might be subjected to climate hazards (i.e., predicted changes in the physical environment). Sensitivity refers to the degree to which species are sensitive to any changes in the environment they experience as a result of climate change. Adaptive capacity is the ability of species to respond and adjust to changes from climate stresses, and to cope with, and recover from these. Each of the components is described by a specific set of variables accounting for changes in ocean conditions, biological characteristics of the selected priority species in relation to their sensitivity to environmental changes, and the likelihood a species may reduce its sensitivity to climate change through rapid adaptation (via evolutionary or phenotypic changes). Climate risk as well as sub-indices are expressed on a scale of 0 to 100, with higher values being more vulnerable or at risk.

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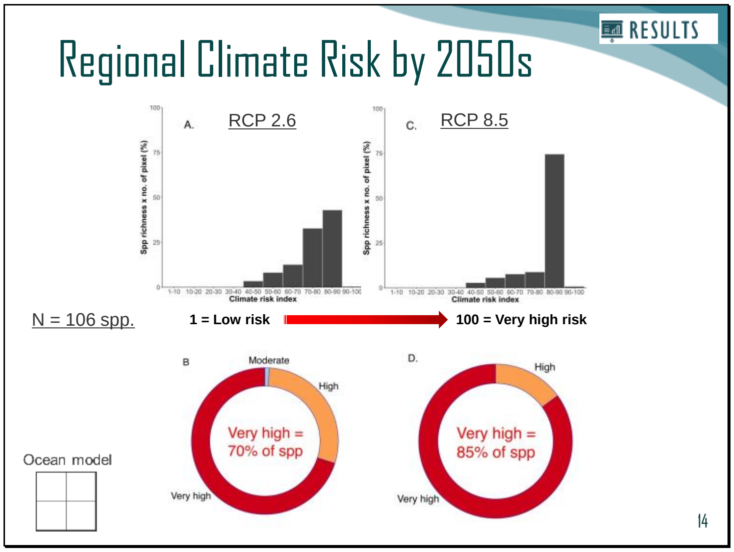
Notes:

[In each geographic cell of the 0.5˚ latitude x 0.5˚ longitude grid, we expressed the local climate hazard as changes in mean condition of each variable relative to annual variability of the historical period of the Earth system model simulations (standard deviation of annual values from 1951 – 2000) for two future periods: the mid-21st century (average of 2041 – 2060) and the end of the 21st century (average of 2081 – 2100).]

Slide 14



This slide summarizes results of the projected climate risk index for the 106 selected marine fish and invertebrate species in the Caribbean Sea using the fuzzy logic risk assessment model. Figures A and C show the frequency distribution of the percentage of pixels (in the 0.5˚ latitude x 0.5˚ longitude grid) by climate risk index for all 106 species under RCP2.6 and RCP8.5, respectively. (B, D) The proportion of species categorized according to different levels of climate risk in the region under RCP2.6 and RCP8.5, respectively.

Combining species' exposure to climate hazards with their vulnerability, we estimated a very high risk to climate change impacts for the majority of the 106 selected marine fish and invertebrates species. Projections show that most of the Caribbean Sea would register a climate risk index >75 under both RCP2.6 and RCP8.5. Under RCP8.5, more than 70% of pixels (geographical cells of the 0.5˚latitude x 0.5˚ longitude grid) were estimated to have a climate risk index >80. More than 70% of selected Caribbean marine species were projected to have a very high risk to climate impacts. Under RCP8.5, no species were categorized as at low or moderate risk. The climate risk index is significantly correlated with the risk of extinction as defined by the IUCN Red List of Endangered Species

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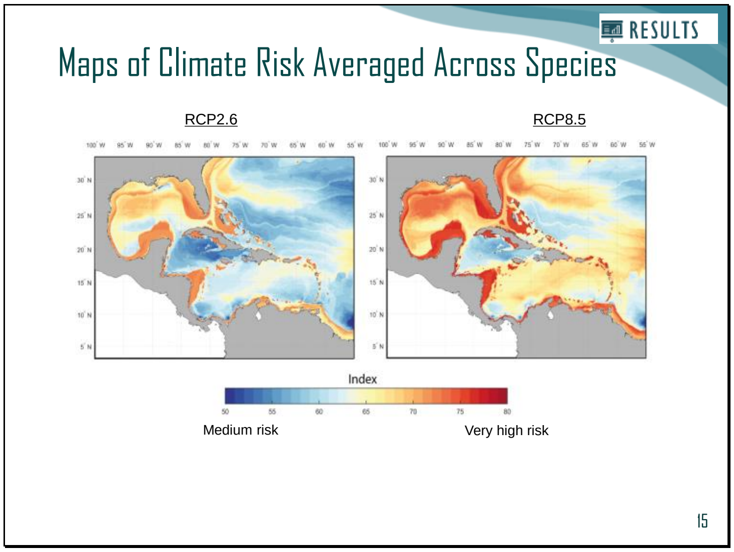
Notes:

[See Appendix A.5 in research paper A for detailed methods.]

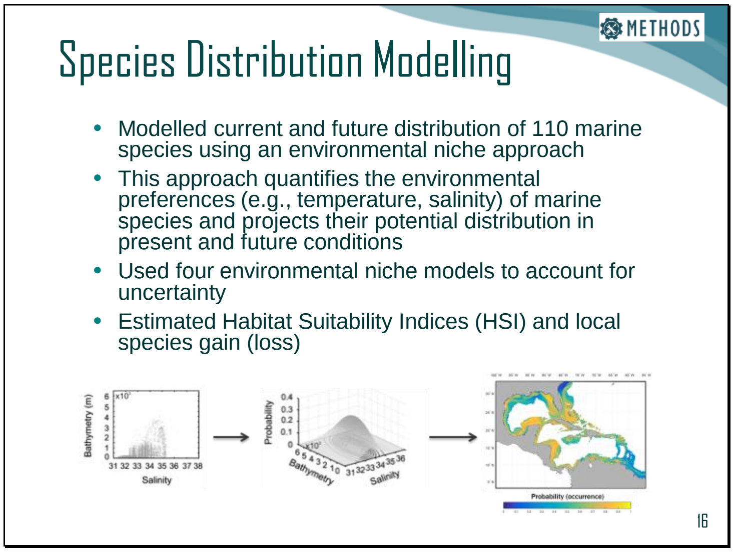
Slide 15



Here is an example of a mapped output of the work on fuzzy logic modelling. It shows the estimated average climate risk index for the 106 selected marine fish and invertebrate species projected spatially using the predicted species habitat suitability of each species under RCP2.6 (left side) and RCP8.5 (right side) by the mid-21st century.

These spatial projections show that climate risk of species assemblages are highest along the coastal and shelf seas region. Offshore, climate risk is greater in the southern part of the Caribbean Sea, while the northern region is projected to have a slightly lower (moderate level) climate risk. Across both scenarios, the area between Cuba, Mexico, Guatemala and Honduras register consistently lower climate risk indices, as do two small pockets along Costa Rica and Panama.

Slide 16

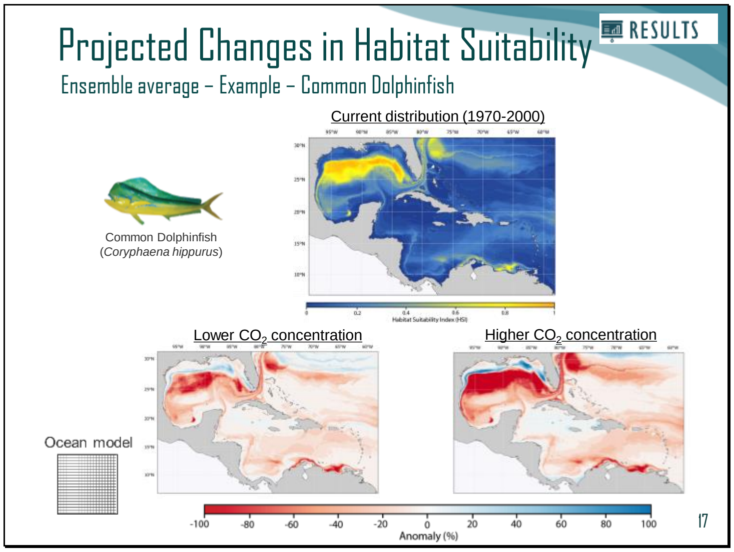


The current and future distributions of the selected 110 marine species were modelled using an environmental niche approach (sensu Hutchinson 1957). This method quantifies the environmental preferences (e.g., seawater temperature, salinity, dissolved oxygen) of marine species and projects their potential distribution according to present and future conditions.

A multi-model approach was adopted to best approximate the environmental niche of each species; four environmental niche models (ENMs) were used. For each of the 110 selected marine species, the models quantify individual species' environmental envelope by estimating the best combination of environmental conditions that describe a given species current distribution in the Caribbean Sea. The spatial distribution of each species from the four ENMs was then projected for the current period (average of the last 30 years of the historical run), as well as for mid-century and end-of-the-century conditions for the Caribbean region.

Species richness is determined as the number of species present in each cell with a predicted Habitat Suitability Index (HSI) above a specific threshold for current environmental conditions. Local species gain represents the number of species newly occurring in a geographical area relative to the number in that area during the reference period. Local species extinction (losses) represent(s) the number of species no longer found in a geographical cell relative to the reference period.

Slide 17



Results for all individual species are available in the report and as maps in the project portal. This slide presents model outputs for the common dolphinfish. Habitat suitability for common dolphinfish is projected to experience modest declines throughout much of the wider Caribbean Sea and very strong declines in areas of currently high habitat suitability in the northern Gulf of Mexico. In both of these regions, declines in more southerly areas are expected to be associated with increases in habitat suitability in more northerly areas. In the Caribbean Sea, habitat suitability is expected to decline most strongly along the northern coastlines of South America, while habitat suitability in the central Caribbean between Cuba, Mexico, and Haiti is expected to slightly increase as southerly populations move north. In the Gulf of Mexico, a similar pattern is observed where habitat suitability declines offshore, but increases closer to the northern shore of the Gulf. These projections suggest that ongoing development of pelagic fisheries may be a more successful adaptation strategy for Jamaica and Haiti than for nations in the Lesser Antilles.

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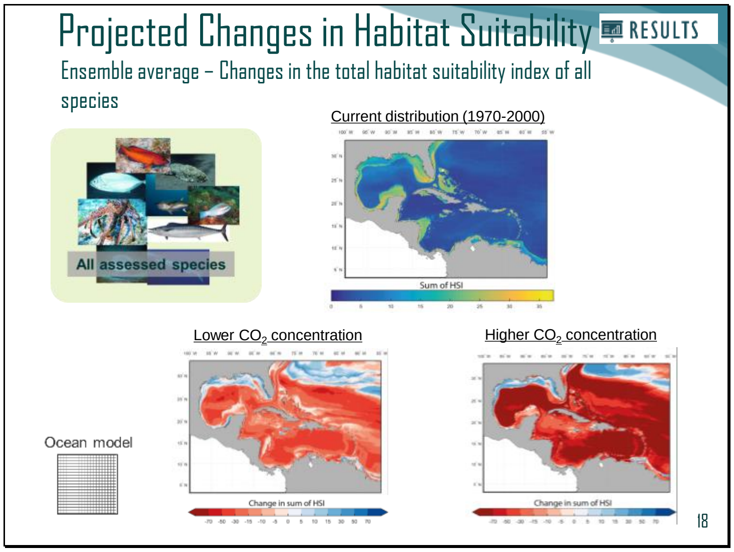
Notes:

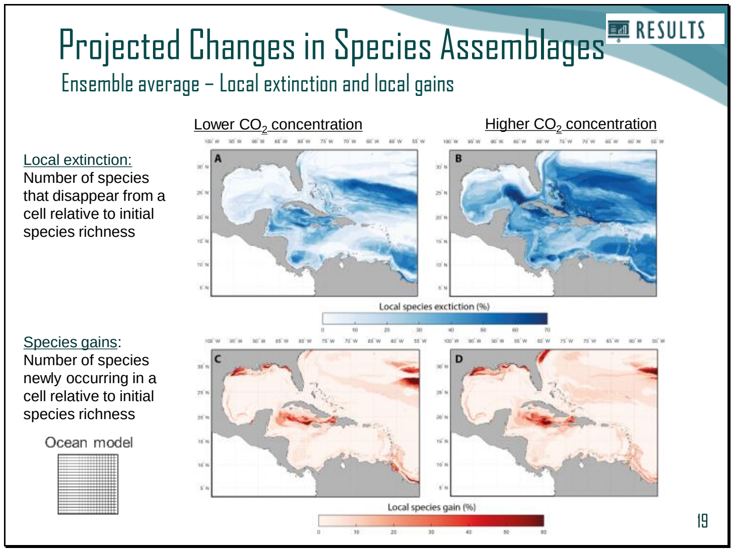
[In this context, ensemble average refers to average results of outputs from the four ecological niche models.]

Slide 18



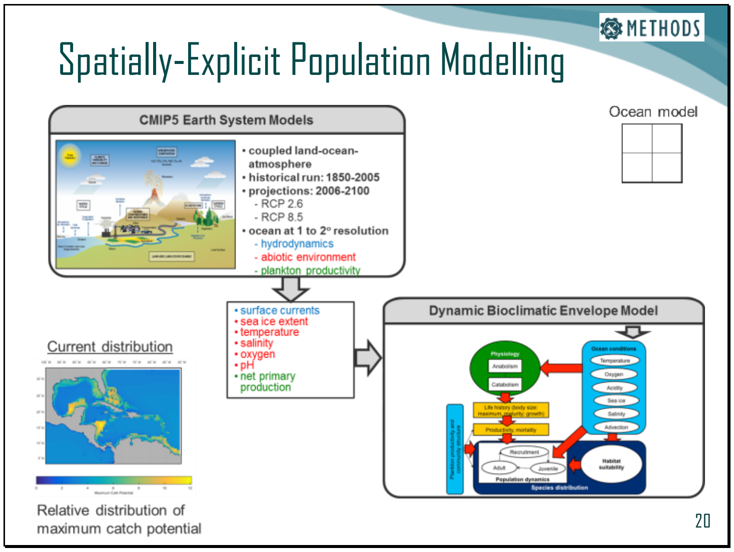
Habitat conditions in the Caribbean Sea for marine fishes and invertebrates are projected to decrease under the higher CO2 emission scenario. Across the region, the sum of individual marine species' habitat suitability index, an indicator of the environmental quality for the species, is projected to decline substantially under both ~400 ppm and ~535 ppm atmospheric CO2 concentration conditions. This pattern was particularly pronounced for the southern and eastern Caribbean Sea.

Slide 19



The projected species range shifts and large declines in habitat suitability result in large changes in species assemblages across the Caribbean Sea. The loss of suitable habitat for the majority of species under the higher CO2 emission scenario is projected to result in high rates of local extinction, particularly in the northern and southwestern part of the Caribbean Sea - including the area around Cuba and throughout the Bahamas. In contrast, species gains were projected for the northern parts of the Gulf of Mexico along the Texas and Louisiana state coasts, in an area west of the Dominican Republic and south of Cuba, as well as along the coast of Venezuela and northern Brazil. The overall percentage local extinction and species gains were projected to increase with higher atmospheric CO2 concentration. The fact that areas of greatest species gains are similar across both CO2 concentrations is attributable to oceanographic conditions that remain similar under these future climates.

Slide 20



The Dynamic Bioclimate Envelope Model (DBEM) was used to project future changes in maximum catch potential for exploited marine fishes and invertebrates in the Caribbean Sea region. DBEM is a spatially-explicit population dynamic model that simulates changes in distribution, abundance and potential catches of species on a 0.5º latitude x 0.5º longitude grid of the global ocean.

Besides temperature, DBEM takes into account ocean acidity, salinity, net primary production, sea ice extent and advection current. The last attribute is important because the movement of water mass through ocean currents determines larval dispersal patterns. Temperature, oxygen and salinity affect physiology, in turn affecting life history and population dynamics. All in all, DBEM simulates the effects of changes in ocean conditions on physiological, population and community responses.

For each simulation, changes in total annual maximum catch potential by mid-century (2050: 2041-2060) and relative to 2000 (1996-2005) under RCP2.6 and RCP8.5 were calculated for the Caribbean region.

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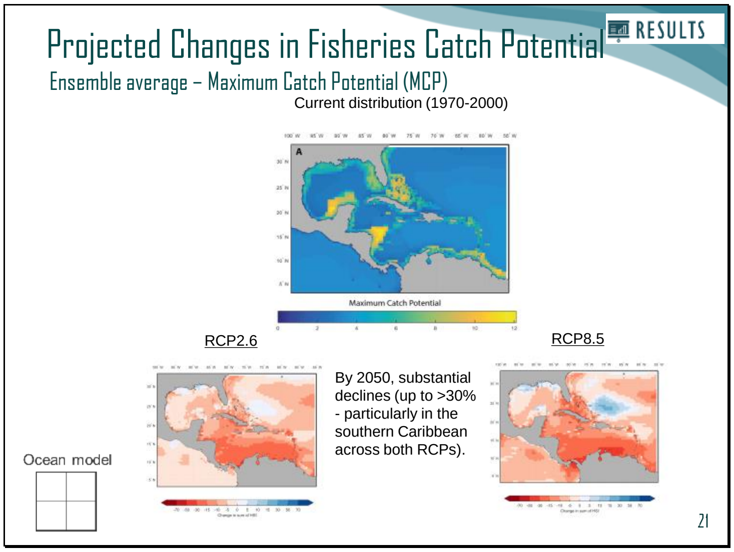
Notes:

[A summary of steps in modelling using the DBEM appears in pages 25 and 26 (section 2.2.3) of Paper A in the CRFM research paper collection.]

Slide 21



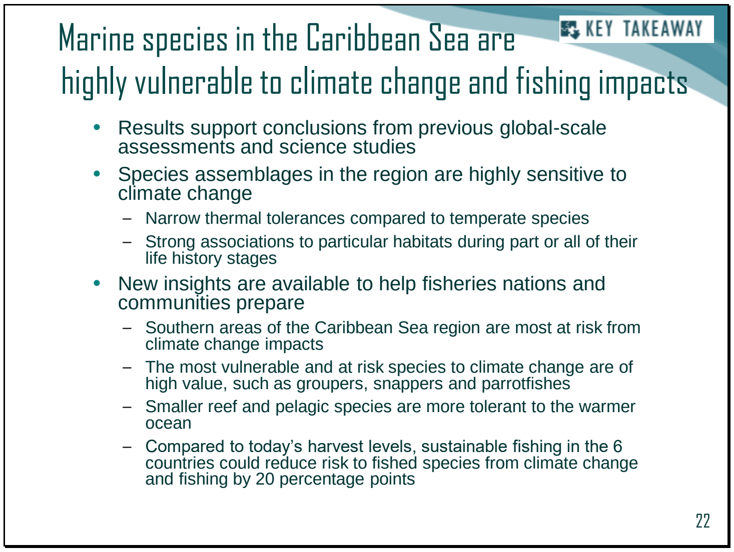
The ensemble average across maximum catch potential projections from the three earth system models (GFDL ESM 2G, IPSL-CM5A-MR, and MPI-ESM-MR) are presented here.

Climate change is projected to result in a substantial decline in maximum fisheries catch potential throughout the Caribbean region. MCP is expected to drop due to species losses and some species gains (i.e., species being caught today not the species caught 'tomorrow').

Overall, maximum fisheries catch potential across all exploited species were projected to decrease by 2050-2059 relative to 1970-2000 under RCP8.5. Although these projections were based on the coarse resolution Earth system models, the atmospheric CO2 concentration in these two time frames under RCP8.5 closely correspond to the ~400 ppm and ~535 ppm projection outputs from the high resolution Earth system model. Regionally, the decline in maximum catch potential was projected to be highest throughout the southern part of the Caribbean Sea.

Even under RCP2.6 maximum catch potential is projected to decrease. Even with significant GHG mitigation efforts (RCP 2.6), climate change will continue to have substantial impacts on the oceans for the next 60 years, due to ongoing biogeochemical processes.

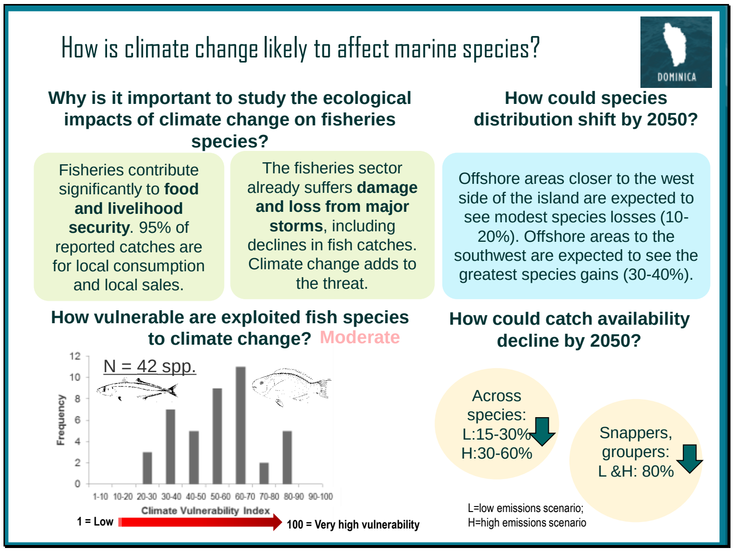
Slide 22



[These are selected high-level takeaways from the regional assessment. Results support conclusions from previous global assessments and studies.]

With regard to new insights, analysis shows that the southern part of the Caribbean Sea region emerges as amongst the most at risk and impacted under ocean conditions to be expected over the next few decades. The projected decrease in maximum catch potential and changes in species assemblages will likely pose substantial challenges to the fishing communities in the region. Many of the highly vulnerable and at risk species to climate change are commonly targeted and highly valuable species such as groupers, snappers and parrotfishes. The loss of these species may have large impacts on coastal fisheries and dependent communities from both a food security as well as livelihood perspective. Some species that are tolerant to the warmer ocean will be less affected by climate change, with our analysis suggesting that these species are likely to be smaller reef and pelagic species that are currently afforded lower market values, but still provide reasonable nutrition.

Slide 23



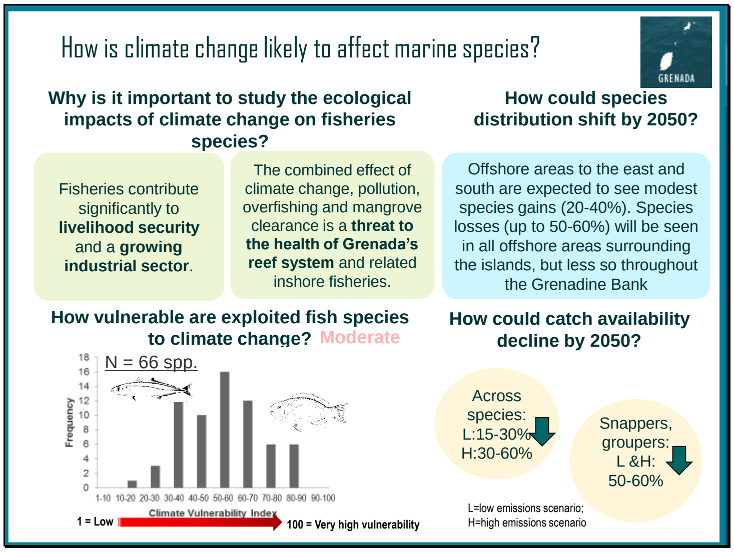
[This is a summary of national-level results for Dominica. Paper B in the CRFM research paper collection presents national discussions of results for the six focal countries. You can draw on this paper to share additional information and results, as is relevant to the target audience]

Dominica's fishery is predominantly artisanal in nature and diverse, targeting a wide range of demersal species along the island's steep and narrow shelf, and focusing on offshore large pelagic species. Amongst the 42 species assessed, the ones with the highest vulnerability index were blue parrotfish (*Scarus coeruleus*, index =90), midnight parrotfish (*Scarus coelestinus*, index = 88), and hogfish (*Lachnolaimus maximus*, index = 88). Those with the lowest vulnerability index were mackerel scad (*Decapterus macarellus*, index = 24), sergeant major (*Abudefduf saxatilis*, index = 27) and balao halfbeak (*Hemiramphus balao*, index = 27).

Overall, the sum of habitat suitability indices across selected species in the EEZ of Dominica was projected to decrease by 20.25% and 48.90%, under atmospheric CO2 concentrations similar to the 2030-2039 and 2050-2059 periods under RCP8.5. Species that were projected to have the largest decrease in HSI include sailfish (*Istiophorus albicans*), Spanish mackerel (*Scomberomorus maculatus*) and bluefin tuna (*Thunnus thynnus*)

We projected that catch potential will decline by 5% to 15% and 15% to 30% by 2030-2039 and 2050-2059 relative to the 1970-2000 period, respectively, under RCP2.6. The projected declines in MCP almost doubled for both time periods under RCP8.5.

Slide 24



[This is a summary of national-level results for Grenada. Paper B in the CRFM research paper collection presents national discussions of results for the six focal countries. You can draw on this paper to share additional information and results, as is relevant to the target audience]

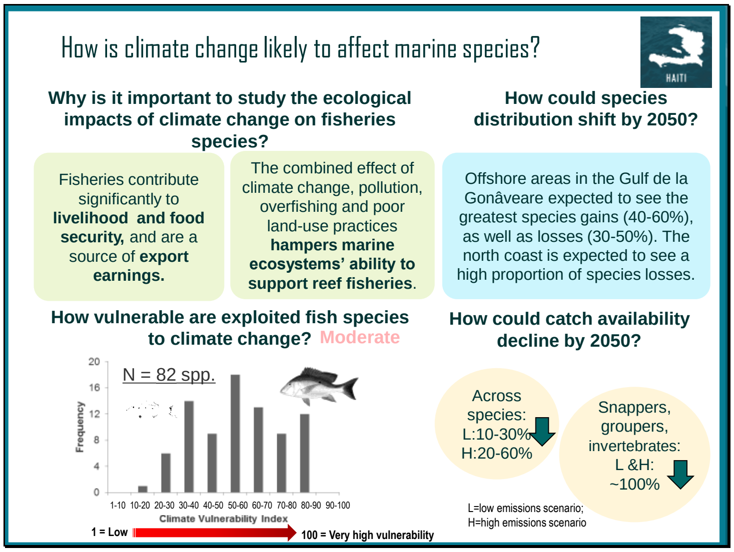
Amongst the 66 species assessed, blue parrotfish (*Scarus coeruleus*, index =90), midnight parrotfish (*Scarus coelestinus*, index = 88), and hogfish (*Lachnolaimus maximus*, index = 88) scored the highest vulnerability index. Mackerel scad (*Decapterus macarellus*, index = 24), sergeant major (*Abudefduf saxatilis*, index = 27) and blue tang (*Acanthurus coeruleus*, index = 31) on the other hand had the lowest vulnerability indices.

Amongst the 66 selected species assessed, those with the highest risk of impact index included yellowtail snapper (*Ocyurus crysurus*), red hind (*Epinephelus guttatus*) and horse eye jack (Caranx latus). Those with the lowest risk of impact index included furry sea cucumber (*Astichopus multifidus*), graysby (*Cephalopolis cruentata*) and blue tang (*Acanthurus coeruleus*).

Overall, the sum of habitat suitability index across the selected species in the EEZ of Grenada was projected to decrease by 11.3% and 28%, under atmospheric CO2 concentrations that would be similar to the 2030-2039 and 2050-2059 periods under RCP8.5. Species that were projected to have the largest decline in HSI included donkey dung sea cucumber (*Holothuria (Halodeima) mexicana*).

We projected that catch potential will decline by 5% to 15% and 15% to 30% by 2030-2039 and 2050-2059 relative to the 1970-2000 period, respectively, under RCP2.6. The projected declines in MCP almost doubled for both time frames under RCP8.5.

Slide 25



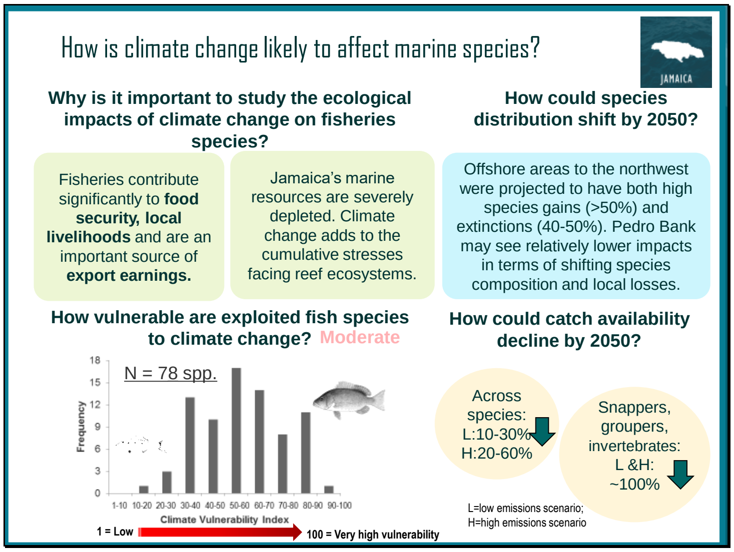
[This is a summary of national-level results for Haiti. Paper B in the CRFM research paper collection presents national discussions of results for the six focal countries. You can draw on this paper to share additional information and results, as is relevant to the target audience.]

Haiti's fisheries focus mainly on demersal (reef) fish species and a limited quantity of pelagic fish. Amongst the 82 species assessed, the ones with the highest vulnerability index were Mutton snapper (*Lutjanus analis*, index =90), jack (Caranx spp., index = 88), and gray snapper (*Lutjanus griseus*, index = 88). Those with the lowest vulnerability index were spotted goatfish (*Pseudupeneus maculatus*, index = 19), mackerel scad (*Decapterus macarellus*, index = 24) and sergeant major (*Abudefduf saxatills*, index = 27).

Amongst the 82 selected species, those with the highest risk of impact index included yellowtail snapper (*Ocyurus crysurus*), red hind *(Epinephelus guttatus*) and mutton snapper (*Lutjanus analis*) (Table 3). Those with the lowest risk of impact index included donkey dung sea cucumber (*Holothuria mexicana*), blue tang (*Acanthurus coeruleus*), and graysby (*Cephalopolis cruentata*).

Changes in ocean conditions under increased atmospheric CO2 concentrations were projected to result in a decline in the habitat suitability for selected species in the EEZ of Haiti. Overall, the sum of the habitat suitability index across the selected species in the EEZ of Haiti was projected to decrease by 25.2% and 29%, under atmospheric CO2 concentrations that would be similar to the 2030-2039 and 2050-2059 periods under RCP8.5. Species that were projected to have the largest decline in HSI include the Florida sea cucumber (*Holothuria (Halodeima) floridana*), fourwing flyingfish (*Hirundichthys affinis*) and red hind (*Epinephelus guttatus*).

Slide 26



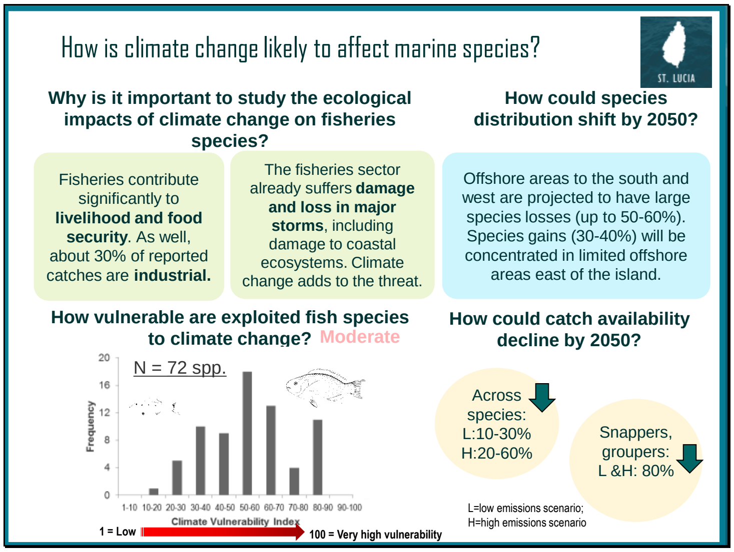
[This is a summary of national-level results for Jamaica. Paper B in the CRFM research paper collection presents national discussions of results for the six focal countries. You can draw on this paper to share additional information and results, as is relevant to the target audience.]

Vulnerability of selected species occurring in Jamaica was evaluated as moderate. A total of 78 of the selected study species were reported to occur in the EEZ of Jamaica (i.e., in the Changing Ocean Research Unit global marine biodiversity database), with a median climate vulnerability index of 57.5 (25th and 75th quartiles = 44.3 and 70.5, respectively, with 100 = maximum vulnerability). Amongst the 78 species, the ones with the highest vulnerability index were cubera snapper (*Lutjanus cyanopterus*, index =93), mutton snapper (*Lutjanus analis*, index = 90), dog snapper (*Lutjanus jocu*, index = 90) and blue parrotfish (*Scarus coeruleus*, index = 90). Those with the lowest vulnerability index were spotted goatfish (*Pseudupeneus maculatus*, index = 19), balao halfbeak (*Hemiramphus balao*, index = 27) and sergeant major (*Abudefduf saxatills*, index = 27).

Overall, the sum of the habitat suitability index across the selected species in the EEZ of Jamaica was projected to decline by 17.9% and 29.4%, under atmospheric CO2 concentrations that would be similar to the 2030-2039 and 2050-2059 periods under RCP8.5. Species that were projected to have the largest decrease in this included the Florida sea cucumber (*Holothuria (Halodeima) floridana*), the donkey dung sea cucumber (*Holothuria (Halodeima) Mexicana*) and the white margate (*Haemulon album*).

Maximum catch potential (MCP) was projected to decrease in the EEZ of Jamaica across time frames and scenarios (Figure 20). We projected that catch potential will decline by 5% to 15% and 10% to 30% by 2030-2039 and 2050-2059 relative to the 1970-2000 period, respectively, under RCP2.6. The projected decline in MCP almost doubled in both time frames under RCP8.5. Local extinction rates were very high for groupers, parrotfish, the graysby, and coney (almost 100% under the high CO2 concentration condition).

Slide 27



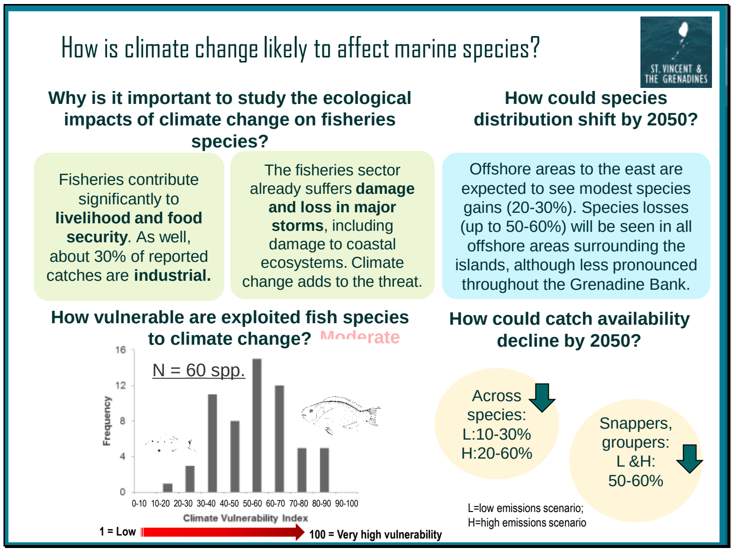
[This is a summary of national-level results for Saint Lucia. Paper B in the CRFM research paper collection presents national discussions of results for the six focal countries. You can draw on this paper to share additional information and results, as is relevant to the target audience.]

Vulnerability of selected species occurring in the Saint Lucia EEZ was evaluated as moderate. A total of 72 of the selected study species were reported to occur in the EEZ of Saint Lucia (i.e., in the Changing Ocean Research Unit global marine biodiversity database), with a median climate vulnerability index of 57.0 (25th and 75th quartiles = 43.5 and 66.0, respectively, with 100 = maximum vulnerability). Amongst the 72 species, dog snapper (*Lutjanus jocu*, index =90), mutton snapper (*Lutjanus analis*, index = 90), and blue parrotfish (*Scarus coeruleus*, index = 90) registered the highest vulnerabilities. Spotted goatfish (*Pseudupeneus maculatus*, index = 19), sergeant major (*Abudefduf saxatills*, index = 27) and mackerel scad (*Decapterus macarellus*, index = 24) on the other hand had the lowest vulnerabilities.

Overall, the sum of the habitat suitability indices across the selected species in the EEZ of Saint Lucia was projected to decrease by 25.6% and 39.2%, under atmospheric CO2 concentrations that would be similar to the 2030-2039 and 2050-2059 periods under RCP8.5. Species that were projected to have the largest declines in HSI include donkey dung sea cucumber (*Holothuria (Halodeima) Mexicana*), the Florida sea cucumber (*Holothuria (Halodeima) floridana*) and the vermilion snapper (*Rhomboplites aurorubens*) (see online data portal associated with this project for maps of HSI for all individual species).

Maximum catch potential (MCP) was projected to decline in the EEZ of St. Lucia across time frames and scenarios (Figure 25). We projected that catch potential will decline by 5% to 15% and 10% to 30% by 2030-2039 and 2050-2059 relative to the 1970-2000 period, respectively, under RCP2.6. The projected declines in MCP almost doubled in both time frames under RCP8.5.

Slide 28



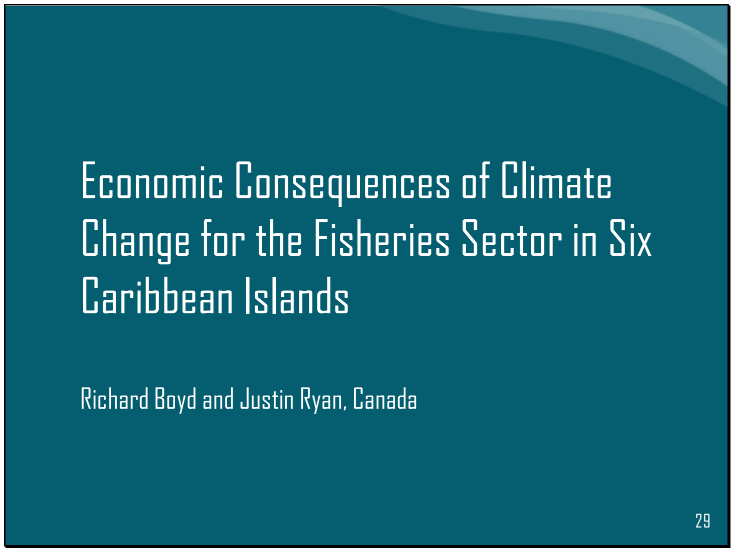
[This is a summary of national-level results for Saint Vincent and the Grenadines. Paper B in the CRFM research paper collection presents national discussions of results for the six focal countries. You can draw on this paper to share additional information and results, as is relevant to the target audience.]

A total of 60 species of the selected study species were reported to occur in the EEZ of SVG (i.e., in the Changing Ocean Research Unit global marine biodiversity database), with a median climate vulnerability index of 55.5 (25th and 75th quartiles = 41.3 and 64.0, respectively, with 100 = maximum vulnerability). Amongst the 60 species, the ones with the highest vulnerability index were blue parrotfish (Scarus coeruleus, index =90), midnight parrotfish (*Scarus coeruleus*, index = 88), and hogfish (*Lachnolaimus maximus*, index = 88). Those with the lowest vulnerability index were spotted goatfish (*Pseudupeneus maculatus*, index = 19), sergeant major (*Abudefduf saxatills*, index = 27) and blue tang (*Acanthurus coeruleus*, index = 31).

Overall, the sum of habitat suitability index across the selected species in the EEZ of SVG was projected to decline by 31.4% and 46.6%, under atmospheric CO2 concentrations that would be similar to the 2030-2039 and 2050-2059 periods under RCP8.5. Species that were projected to have the largest decrease in HSI include donkey dung sea cucumber (*Holothuria (Halodeima) mexicana*), Atlantic bluefin tuna (*Thunnus thynnus*) and Atlantic sailfish (*Istiophorus albicans*).

Maximum catch potential (MCP) was projected to decline in the EEZ of SVG across time periods and scenarios (Figure 30). We projected that catch potential will decline by 5% to 15% and 10% to 30% by 2030-2039 and 2050-2059 relative to the 1970-2000 period, respectively, under RCP2.6. The projected declines in MCP almost doubled in both time periods under RCP8.5.

Slide 29



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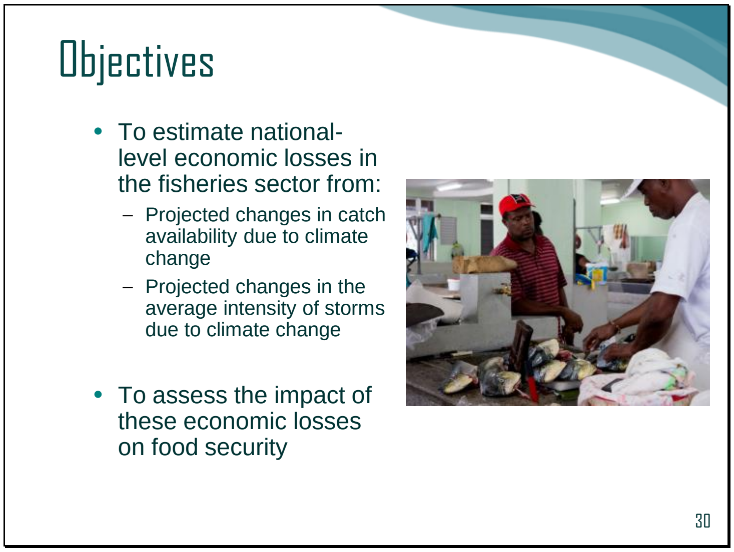
Notes:

[Prior to sharing results of the ecological modelling work we recommend reading and becoming familiar with the contents of paper C: Economic Consequences of Climate Change for the Fisheries Sector in Six Caribbean Countries. This paper is part of the CRFM research paper collection, containing reported outputs from Work Package 1.]

[The slide acknowledges the two Canadian economists who led the economic study.]

[The next 24 slides present highlights from the ecological assessment work. It draws on some of the research, there is the potential to extract much more, depending on your objectives and target audience.]

Slide 30



Fisheries and marine resources in the Caribbean region are vulnerable to a range of climate change impacts. Among them, further rising sea surface temperatures (SST), increased ocean acidification, further sea-level rise (SLR), and increases in the (average) intensity of tropical cyclones are likely to exacerbate ongoing challenges facing the sector in the near- and long-term. These climate change impacts will result in direct and secondary economic consequences for both harvesting and post-harvesting activities in the fisheries sector.

Data availability and interests of project stakeholders shaped the scope of the research on the economic consequences of climate change, which focused on analyzing and presenting the economic impacts of changes in fishery production (landings) due to:

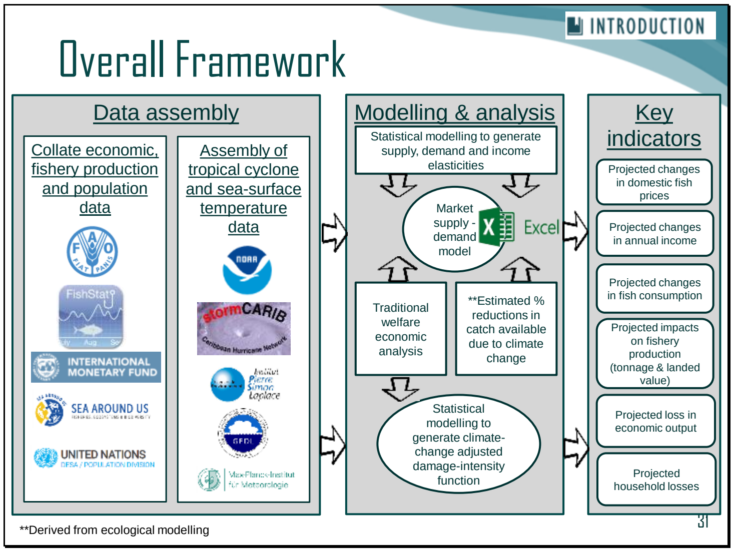
**Changing ocean conditions (reflecting rising SSTs and ocean acidification), building on the results of the complementary ecological impact assessment, which generated estimates of changes in fishery production (catch) for each country under different climate scenarios (specifically, RCP (Representative Concentration Pathway) 2.6 and RCP 8.5); and

**Changes to the (average) intensity of tropical cyclones

**The impact of these economic losses on food security are also explored.

Economic estimates are presented at the national level for each of the countries with Pilot Program on Climate Resilience (PPCR) activities: Dominica, Grenada, Haiti, Jamaica, Saint Lucia and Saint Vincent and the Grenadines (SVG).

Slide 31

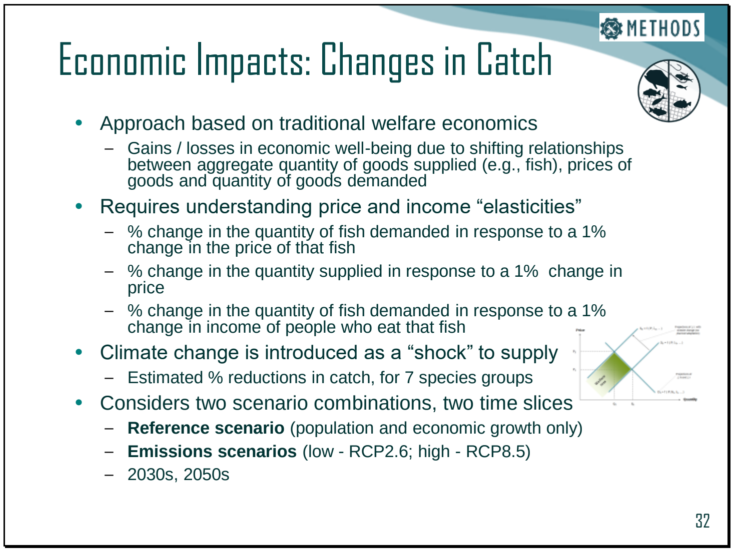


This slide summarizes the overall research framework adopted, which included a data collection phase, modelling & analysis and derivation and presentation of key indicators.

To estimate the economic consequences to fisheries sectors of climate change impacts on landings, a first step was to assemble two sets of data for each of the six countries: (1) economic (e.g., gross domestic product, seafood consumption / production), trade (imports / exports of seafood), landings (weight and value of seafood) and population data for the 2009-2013 baseline period. Fisheries data were compiled for 7 species groupings: Aquaculture, Demersal fish, Pelagic - tuna & billfishes, Pelagic – other than tuna & billfishes, Marine fish – other, Crustaceans and Cephalopods & molluscs. (2) historical tropical cyclone data from 1950 to 2014 (location, category, closes point of approach, whether it made landfall) and sea surface temperature data.

These data are inputs into two distinct analytical approaches, which we will touch on in the next few slides, to generate results to 2030s, 2050s and 2080s for the series of indicators shown here on the right.

Slide 32



The economic impacts of climate-induced changes in fishery production (landings) are assessed using a market supply-demand model developed for each of the six case study countries. It is based on theoretical concepts of traditional welfare economics, which seeks to explore how the allocation of resources affects well-being of producers and consumers in an economic system.

A key component of the market supply-demand model is the derivation of price and income elasticities for each aggregate species grouping and country. Elasticity is a quantitative understanding of how changes in price of a good or service or changes in consumer income influence production and consumption patterns. Basic goods, such as food staples, are largely "inelastic"; they have few substitutes and people will continue to buy them even when there are price spikes, for example. We employed regression analysis to estimate three types of elasticities for each of the 7 species groupings for each of the 6 countries. When regression analysis did not yield statistically significant coefficients, we extrapolated values from the literature.

The impacts of climate change are integrated into the modelling framework as a supply shock. Maximum catch potential for 2035 and 2055 derived from the ecological modelling work were converted into % reductions in landings by main species groups by emissions scenario and time period.

With the market supply demand model, we first project future demand, prices and quantities supplied without the effect of climate change (the reference scenario) and then overlay climate change as a supply shock (for two emissions scenarios). The results of comparing these two cases measure the incremental impact of climate change or the economic losses (or gains) caused by climate change.
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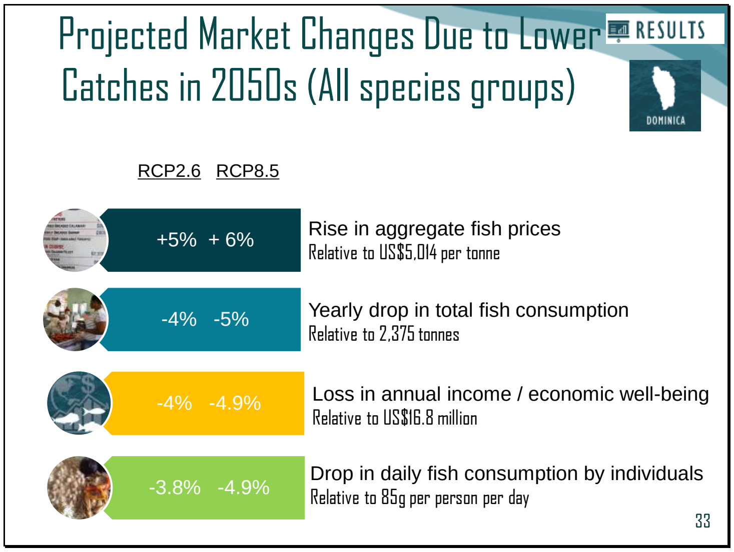
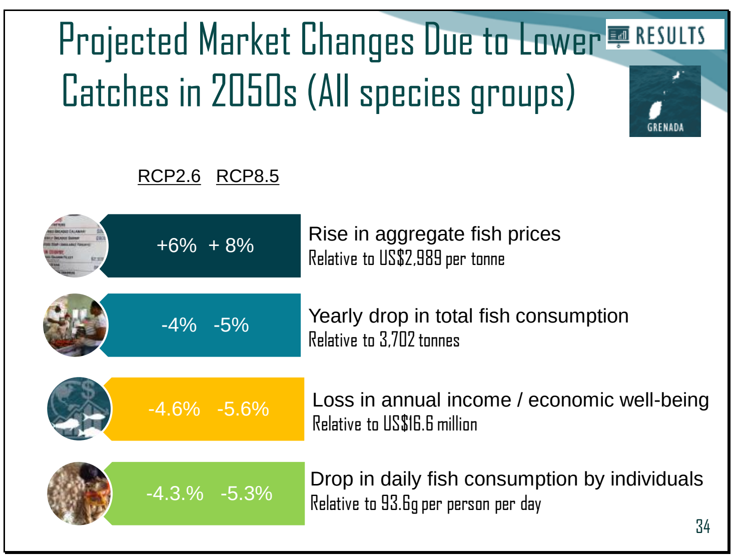
Notes:
[The market supply-demand model is based on the analytical framework developed by Dey et al (2016), who evaluated the economic impacts of climate change and climate adaptation strategies for the fisheries sectors of Fiji, Solomon Islands, Timor-Leste and Vanuatu. The full mathematical specification of the model is contained in Dey et al. 2016.]

[The following six slides summarizes key results for each of the six PPCR countries. The results shown are relative to projected future values for 2050s. See the full study for additional results and explanations. The Excel-based market supply and demand models for each country are available for download on the project data portal.]

Slide 33



Slide 34

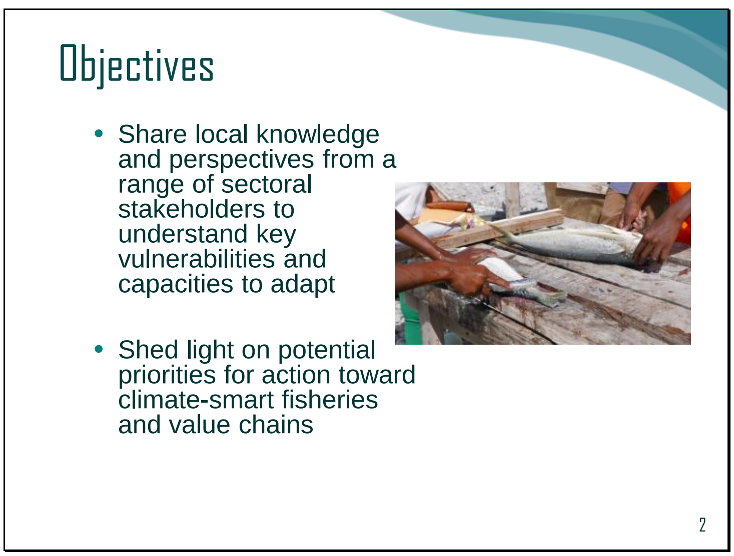


POWERPOINT PRESENTATION

MODULE 4: ADAPTIVE CAPACITY OF CARIBBEAN FISHERIES SECTORS

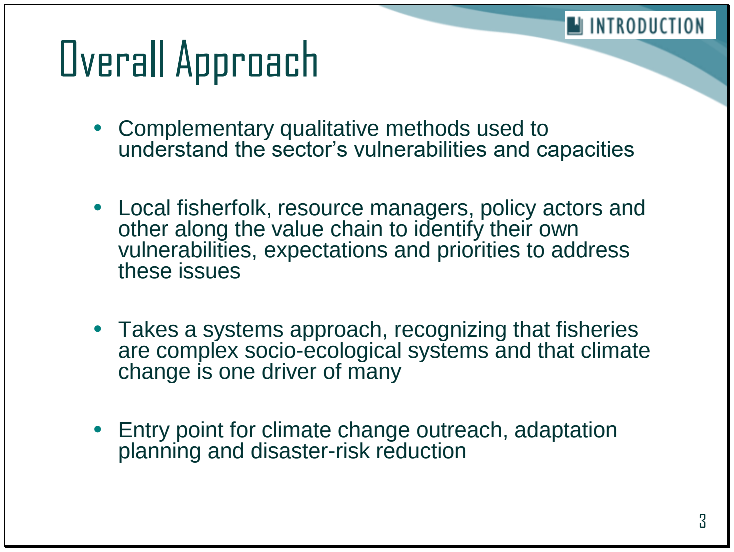
Slide 1

Slide 2



The project included opportunities for qualitative research with local stakeholders to learn about baseline factors that increase or reduce vulnerability to climate change as well as perspectives on adaptation priorities.

Slide 3



The quantitative climate change impact assessment work completed under Work Package 1 provided important information on the sector's exposure and sensitivity to climate change, producing results at a species level, national and regional scales. This type of work focuses less on understanding key aspects of human adaptive capacity, which is best addressed through qualitative, social science research. Two different project activities involved field-based data collection at selected fishing sites and served to (1) characterize knowledge attitudes and current action on climate change and (2) characterize assets and vulnerabilities across seafood value chains.

Although the focus of both streams of work (the KAP study and value chain analysis) was on hearing from fisherfolk, views from resource managers, policy actors and other stakeholders in the sector were also sought. Both research activities adopted a systems lens, recognizing the intimate connections between ecosystem health, environmental change and human activities at different scales and recognizing the importance of not looking at climate change in isolation of ongoing stresses and threats.

The aim was for this work to inform climate change outreach, sectoral adaptation planning and disaster risk reduction.

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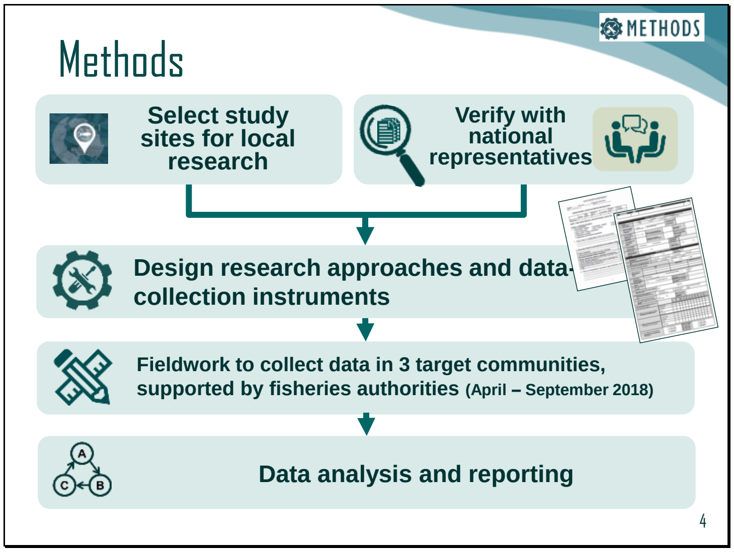
Notes:

[This Module picks up concepts introduced in Module 2. You may want to include some slides from Module 2 as part of the introduction to the Knowledge-Attitudes-Practice and value chain research.]

Slide 4



This slide summarizes the broad approach taken for the two research activities. Because of budget and logistical limitations it was important to select sites for local research and this was the very first step, followed by design of data collection instruments (questionnaire, online survey, interview guides), field work in 3 target fishing sites, which took place in 2018, qualitative and semi-quantitative data analysis and preparation of reports.

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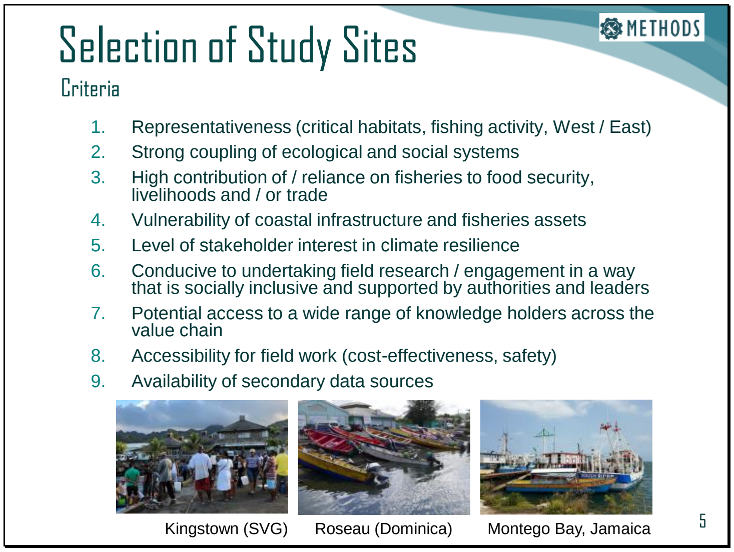
Notes:

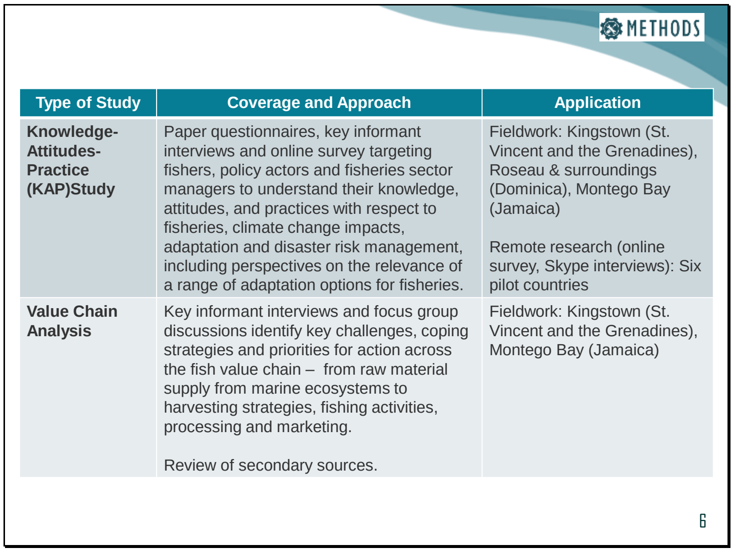
[Contents of this presentation draw from two sources: (1) paper D in the CRFM Research Paper Collection – Toward Climate-Smart Value Chains in Caribbean Fisheries and (2) the Knowledge-Attitudes-Practice Study, which was a main output of Work Package 3. Both sources are available on the project data portal.]

Slide 5



As mentioned, primary data collection in fishing communities across the 6 PPCR countries was not possible due to budget and logistical constraints. Instead we focused these efforts on 3 pilot study sites identified and approved by the project Working Group in June 2018. These sites are: Montego Bay, Kingstown and Roseau. These 3 sites scored most favourably in our assessment of an initial list of 8 sites scored against the criteria shown on this slide (high, medium and low). Information to score each option came from the Food and Agriculture Organization (FAO) country profiles (http://www.fao.org/fishery/countryprofiles/search/en) and a preliminary review of the literature.

Slide 6



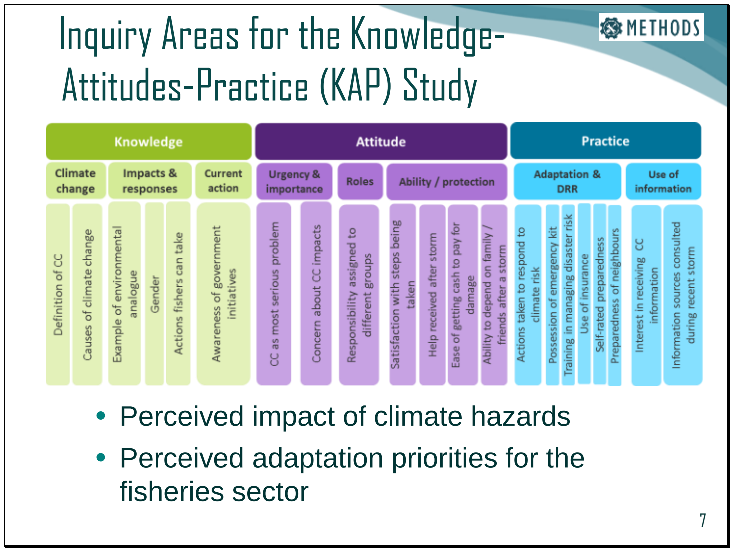
METHODS

Type of Study	Coverage and Approach	Application
Knowledge-Attitudes-Practice (KAP)Study	Paper questionnaires, key informant interviews and online survey targeting fishers, policy actors and fisheries sector managers to understand their knowledge, attitudes, and practices with respect to fisheries, climate change impacts, adaptation and disaster risk management, including perspectives on the relevance of a range of adaptation options for fisheries.	Fieldwork: Kingstown (St. Vincent and the Grenadines), Roseau & surroundings (Dominica), Montego Bay (Jamaica) Remote research (online survey, Skype interviews): Six pilot countries
Value Chain Analysis	Key informant interviews and focus group discussions identify key challenges, coping strategies and priorities for action across the fish value chain – from raw material supply from marine ecosystems to harvesting strategies, fishing activities, processing and marketing. Review of secondary sources.	Fieldwork: Kingstown (St. Vincent and the Grenadines), Montego Bay (Jamaica)

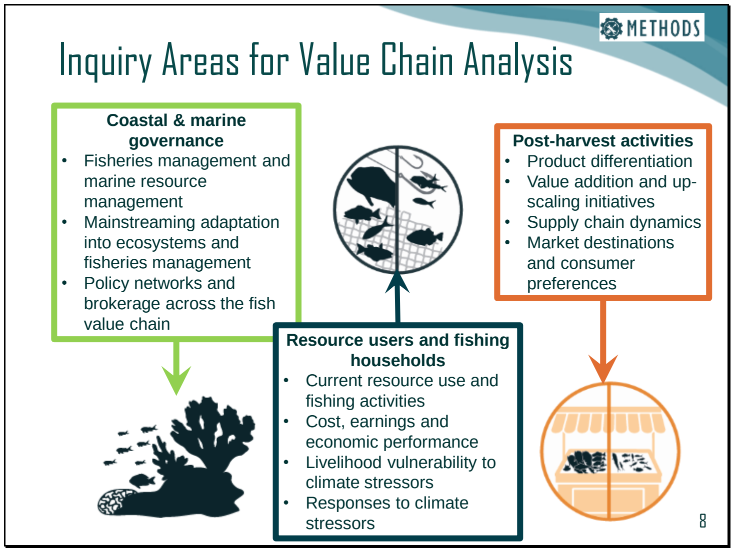
6

This slide summarizes what we did, how we did it and where. The next two slides provide additional information on the inquiry areas covered through each of the studies. Inquiry areas were translated into specific questions in data collection instruments.

Slide 7



Slide 8



Slide 9

METHODS

Who participated?

Sex	KAP Study - Fishers: Montego Bay (JAM)	Kingstown (SVG)	Roseau (DOM)	KAP Study - Managers* and Policy Actors**
Female	0	1	2	15
Male	37	59	58	15
No answer	3	0	1	
Total				191

	Value Chain Analysis - Jamaica			Value Chain Analysis - SVG		
Sex	Fishers	Processors, marketers, retailers	Public officials	Fishers	Processors, marketers, retailers	Public officials
Female	0	0	2	0	0	5
Male	16	4	2	6	4	8
Total						47

* For example, from Montego Bay Marine Park Trust, National Environment and Planning Agency (Jamaica), National Emergency Management Organization (St. Vincent and the Grenadines), 4BluC's (Saint Lucia), Fisheries Divisions & Departments and the CRFM Secretariat.
**Chief Fisheries Officers and a Director of Fisheries

9

Through both research activities we were able to gather knowledge and perspectives from over 230 individuals in the sector, 2/3 of them fishers. Female representation is very low among fisherfolk but balanced among managerial and policy actors.

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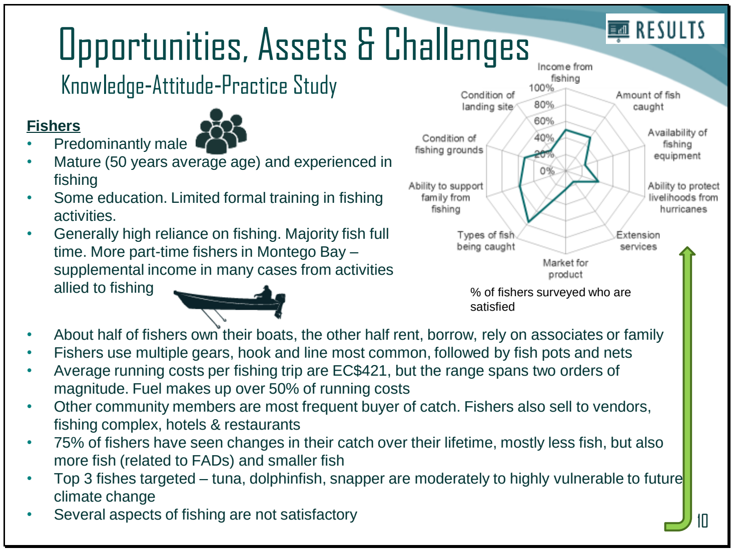
Notes:

[You may wish to engage in a short discussion about your own past experiences in undertaking research and stakeholder engagement, and any issues you have had in being inclusive. You can also discuss potential implications of not incorporating female perspectives in this particular research.]

Slide 10



This series of slides reports on results of KAP study expressed as opportunities and assets or factors that could contribute to climate resilience, as well as vulnerability challenges, by stakeholder group (fishers, managers, policy actors). Fishers surveyed in the KAP study present a range of socio-economic attributes – like age, education and reliance on fishing that in some cases could confer vulnerability. For example, low levels of education can mean fishers are less able to diversify income-generating activities and may have low financial literacy. The bottom half of the slide summarizes key characteristics of the sample's fishing activities. Of note, a majority of fishers are satisfied with the types of fish being caught; however, the top 3 fish species targeted are vulnerable to future climate change.

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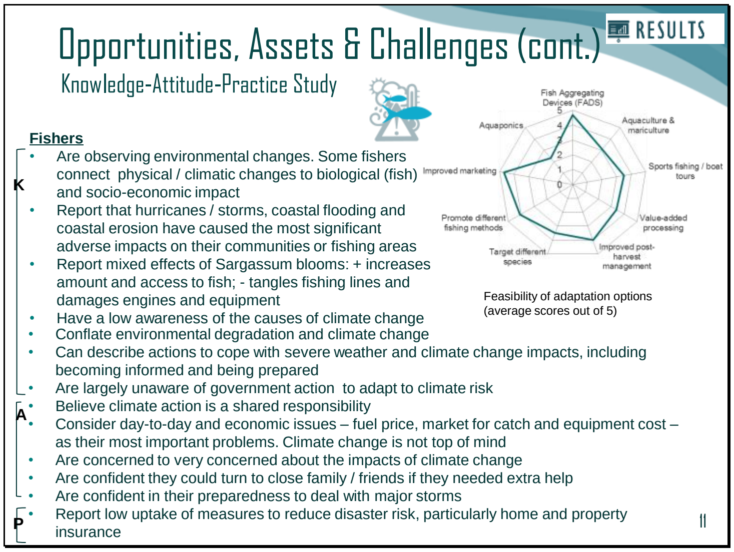
Notes:

[You may wish to remind or provide your audience a brief background on factors that enhance / reduce vulnerability to climate change and other stressors, as reviewed in Module 2.]

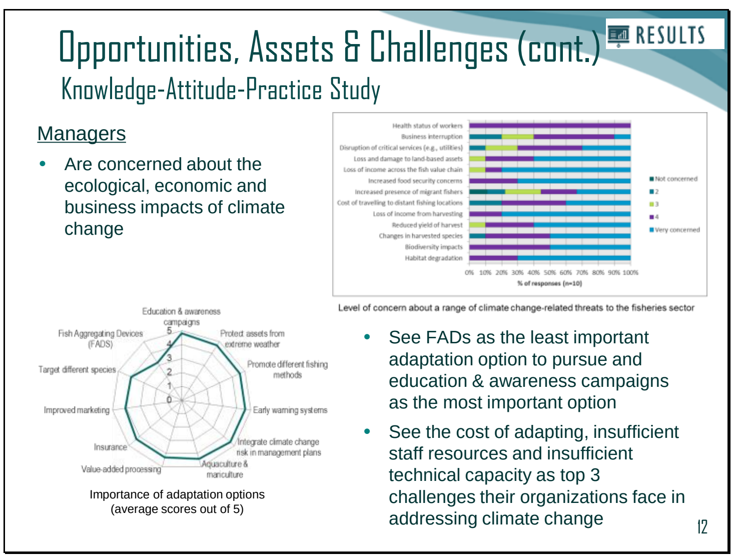
[Because these results are based on case study research, we recommend using these points to elicit discussion with your target audiences. A first step might be to engage your audience in a discussion on which of the points sounds familiar (or are commonly exhibited in their community / constituency). Next, engage your audience in a discussion focused on exploring whether the identified attributes make the community vulnerable or confer resilience.]

Slide 11



This slide shows key results related to climate change knowledge, attitudes and practice of fishers. Each of these points can inform climate change outreach as well as government action to manage climate risk in the sector.

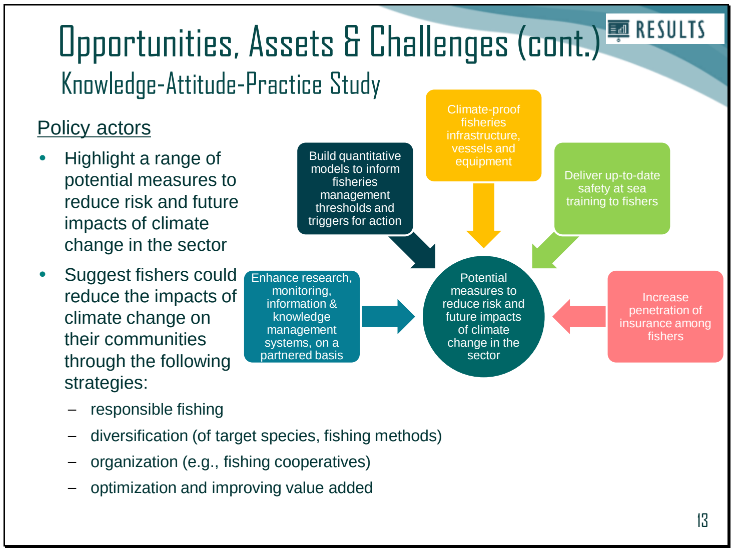
Slide 12



The response rate to the online survey targeting managers was low so the results shown here are highly indicative and meant to spur additional exploration and conversation. Results on this slide show managers' stated levels of concern about a range of climate change impacts and their assessment of the importance of adaptation option. Of note, managers see FADs as the least important option to pursue whereas fishers regarded this option as most feasible.

With regard to challenges in adapting to climate change, managers highlighted capacity and resource constraints: the cost of adapting (the implication being it's too expensive for them to adapt), insufficient staff resources and technical capacity. Managers did not register opposition from stakeholders or the public or lack of organizational leadership as challenges to action, indicating good potential to move forward if other structural (e.g., legal mandate, political will) and capacity-related assets are in place.

Slide 13



This slide summarizes highlights of key informant interviews with policy actors in the region (4 chief fisheries officers or fisheries directors) with regard to adaptation action and climate risk management. The diagram contains fiver categories of measures mentioned, ranging from research, monitoring and knowledge management to enhancing penetration of risk transfer mechanisms. Policy actors also had views on strategies fishers could take to protect themselves and their communities from climate change. These four strategies are "no regrets" in that their implementation could yield good results regardless of exposure to climate change.

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Notes:

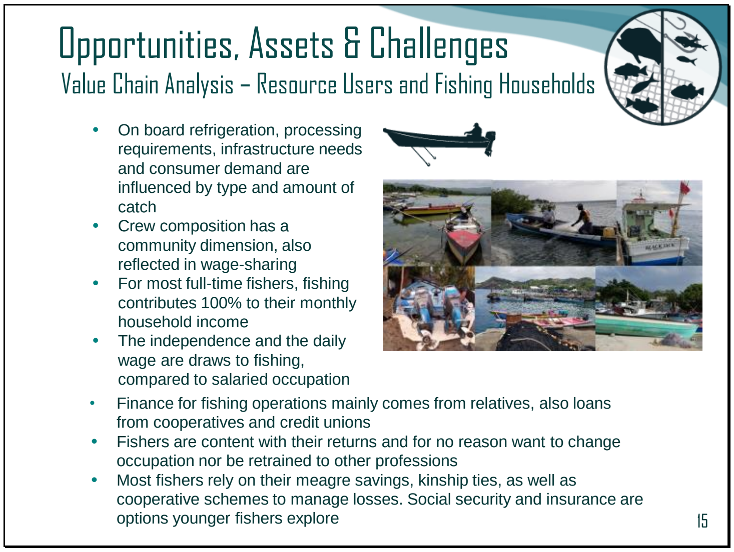
[You can lead a discussion that compares and contrasts preferred or suggested adaptation options by fishers, managers and policy actors. Where is there common ground?]

Slide 14

The next seven slides summarize results from the value chain analysis work. Key points are provided by link in the value chain (coastal & marine governance, harvest and post-harvest activities, culminating with takeaways on future policy directions.

With regard to coastal and marine governance, severe important building blocks are in place to support climate-resilient marine resources. However, enforcement of management rules, control measures and restrictions, is an issue, and stressors due to human activities continue to erode ecosystems' adaptive capacity.

Slide 15



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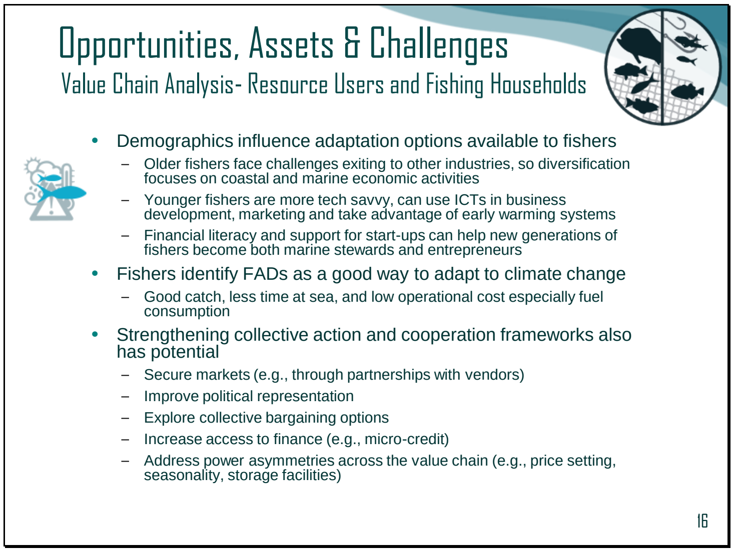
Notes:

[Because these results are based on case study research, we recommend using these points to elicit discussion with your target audiences. A first step might be to engage your audience in a discussion on which of the points sounds familiar (or are commonly exhibited in their community / constituency). Next, engage your audience in a discussion focused on exploring whether the identified attributes make the community vulnerable or confer resilience.]

Slide 16



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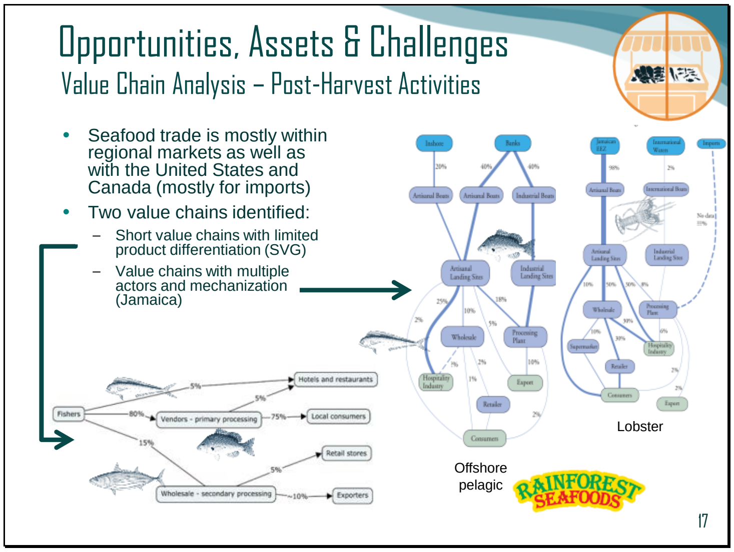
Notes:

[Because these results are based on case study research, we recommend using these points to elicit discussion with your target audiences. A first step might be to engage your audience in a discussion on which of the points sounds familiar (or are commonly exhibited in their community / constituency). Next, engage in discussion about the potential applicability of adaptation actions and measures highlighted by resource users in value chain research.]

Slide 17



Value chain research revealed 2 different types of value chains: (1) short value chains with limited product differentiation, such as the one reflected in the bottom left of the slide and (2) semi-industrial value chains with multiple actors and some mechanization, such as the ones show on the right of the slide.

With about 36 landing sites and about half of that on Saint Vincent, most of the catch is taken to Kingstown due to limited storage and processing infrastructure at other landing sites. The Kingstown Fish Market is a hub for landing fish, reporting catch statistics, as well as processing and having weekly seafood displays and vendors. About 80 to 90% of the local catch harvested goes through vendors with limited value addition and high level of post-harvest spoilage. The 10 to 20% that goes through the Fish Market is sold frozen, often filleted according to retail needs and in the form of weekly supplies to supermarket chains focusing on larger pelagics such as swordfish, barracuda, skipjack tuna and snapper.

In Jamaica, the fish chain is multi-faceted depending on the fish species, ecosystems in which fishing takes place, targeted markets and enabling policy environment for local consumption or export markets. Currently, fishers are interested in a wide variety of commercial species of importance including snappers, parrotfish, conch, kingfish, dolphinfish, lobster and, to some extent, sea cucumbers. The value chain can be very short involving direct sales to households, such as for snappers or lobsters to the hospitality industry. For other commercial species destined for export markets such as conch, the value chain can be longer including brokers, processors, retailers, traders and/or exporters and with mechanized infrastructure. A key feature in Jamaica's fish chain is the location and operations of one of the largest seafood processor and retailer in the Caribbean: Rainforest Seafoods. Rainforest Foods also has major processing infrastructure and operations in Saint Lucia, Belize and Barbados, with planned operations in Saint Vincent and the Grenadines.

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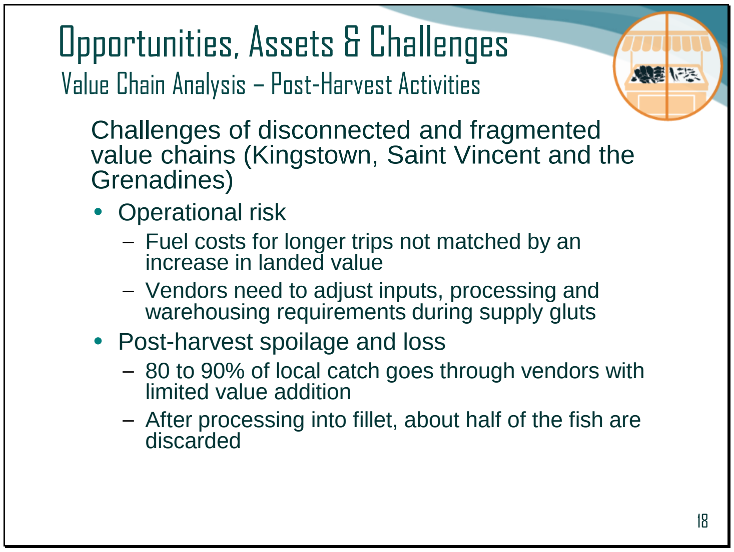
Notes:

[The fish species shown on this slide are as follows: Dolphinfish, blackfin snapper, skipjack tuna (SVG value chain) and dolphinfish, blackfin snapper, lobster (Jamaican value chain)

Slide 18



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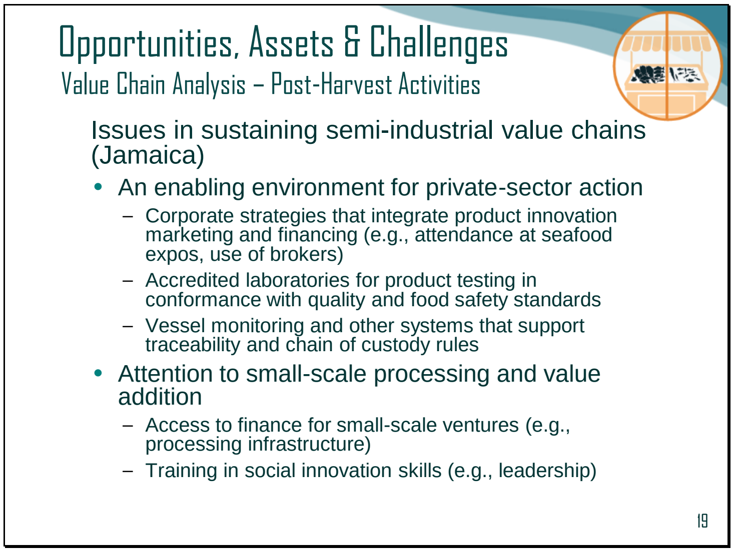
Notes:

[Because these results are based on case study research, we recommend using these points to elicit discussion with your target audiences. A first step might be to engage your audience in a discussion on the challenges noted on the slide and what their implications might be for vulnerability to climate change. What opportunities might there be to increase adaptive capacity and resilience?]

Slide 19



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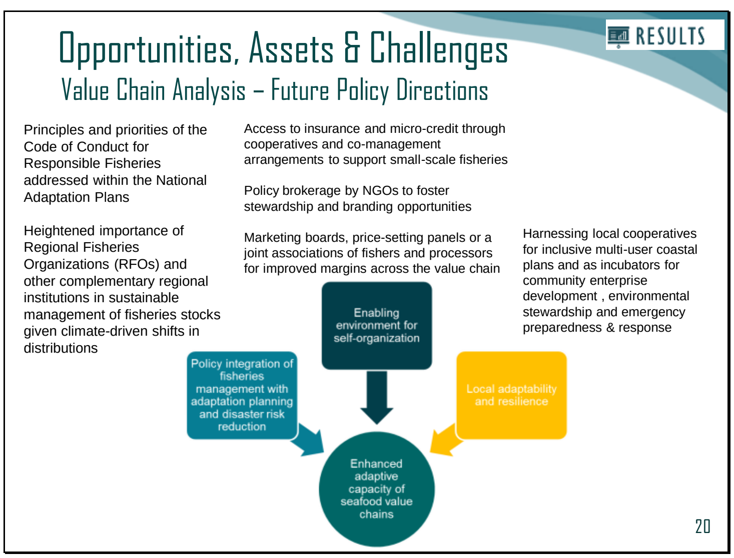
Notes:

[Because these results are based on case study research, we recommend using these points to elicit discussion with your target audiences. A first step might be to engage your audience in a discussion on the issues noted on the slide and what their implications might be for vulnerability to climate change. What opportunities might there be to increase adaptive capacity and resilience?]

Slide 20



Having identified value chain dynamics in the two study sites, this slide offers future policy directions in support of climate smart seafood value chains in the region. Policy directions stem from three inter-related pillars: adaptation mainstreaming, an enabling environment and empowering local action.

The CRFM is an inter-governmental organization whose mission is to "Promote and facilitate the responsible utilization of the region's fisheries and other aquatic resources for the economic and social benefits of the current and future population of the region". The CRFM consists of three bodies – the Ministerial Council, the Caribbean Fisheries Forum and the CRFM Secretariat.

CRFM members are Anguilla, Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago and the Turks and Caicos Islands.

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