

# BASIN-SCALE EVENTS TO COASTAL IMPACTS: AN OCEAN INTELLIGENCE SYSTEM FOR A CHANGING WORLD

*A UN Decade of Ocean Science Project by the North Pacific  
Marine Science Organisation (PICES), the North Pacific  
Anadromous Fish Commission (NPAFC) and partners*

**Presentation to IYS Synthesis Symposium— October 6, 2022**

**Robert Day**, Brian Riddell, Jacques White, Sonia Batten, Steven Bograd,  
Vladimir Radchenko, Mark Saunders, Lara Erikson, Robin Brown



# Some symposium takeaways:

- Importance and impacts of decisions not always being foreseen
- Saving the people and rebuild traditions and culture
- What does it mean to apply indigenous knowledge systems
- Fear that the future will be that "we used to have fish"
- Power of working together and the "We" - not sure how big the we is and how inclusive
- Question of resources - what can we do vs what we need to do.
- Need to keep the balance of the AND - action and analysis



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# Climate Change 2021

## The Physical Science Basis

Summary for Policymakers

# Fifth session of the Intergovernmental Conference

15 to 26 August 2022

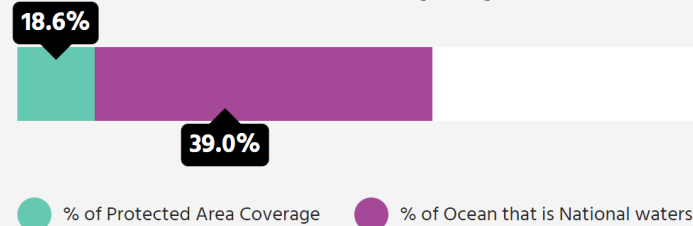
New York

# GLOBAL PROCESSES

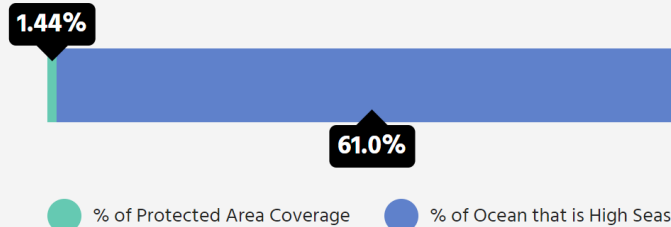
## The Science We Need for the Ocean We Want

### National Waters

### Marine protected area coverage – From UNEP-WCMC and IUCN (2022), Protected Planet



### High Seas



## CLIMATE CHANGE

is a direct driver of change in nature that is increasingly exacerbating the impact of other drivers on nature and human well-being.

### 1.0°C

Estimated warming caused by humans by 2071 compared to pre-industrial levels

### 0.2°C

The average increase in temperatures over the past 30 years per decade.



**EXTREME WEATHER EVENTS**  
have been more frequent and intense in the past 50 years



**GLOBAL AVERAGE SEA LEVEL**  
has risen by 16-21cm since 1990

These changes had impacts on many aspects of biodiversity, i.e.

- species distribution
- phenology
- population dynamics
- community structure
- ecosystem function

source: IPBES #GlobalAssessment



# IMPLICATIONS

ANCHORAGE DAILY NEWS

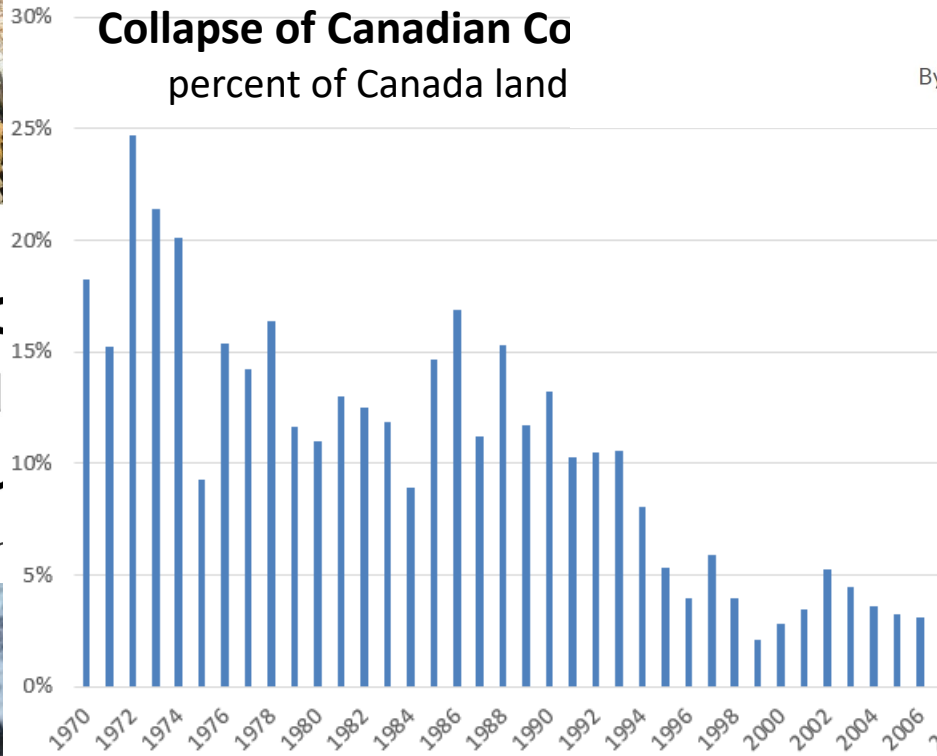
## Amid an unprecedented collapse in Alaska Yukon River salmon, no one can say for certain why there are so few fish

Last of three parts: For both summer and fall chum, around one-tenth of the normal numbers of fish were tallied. The impacts have been extreme but causes elusive.

By Zachariah Hughes Updated: September 7, 2021 Published: September 7, 2021



**Collapse of Canadian Co**  
percent of Canada land



**Pacific Saury: C  
Environmental  
of Japanese Au  
Doubt** Nippon.Com

The Cordova Times

LOCAL FISHERIES ALASKA LIFE EV

## Bristol Bay red king crab harvest halted for 2021-22

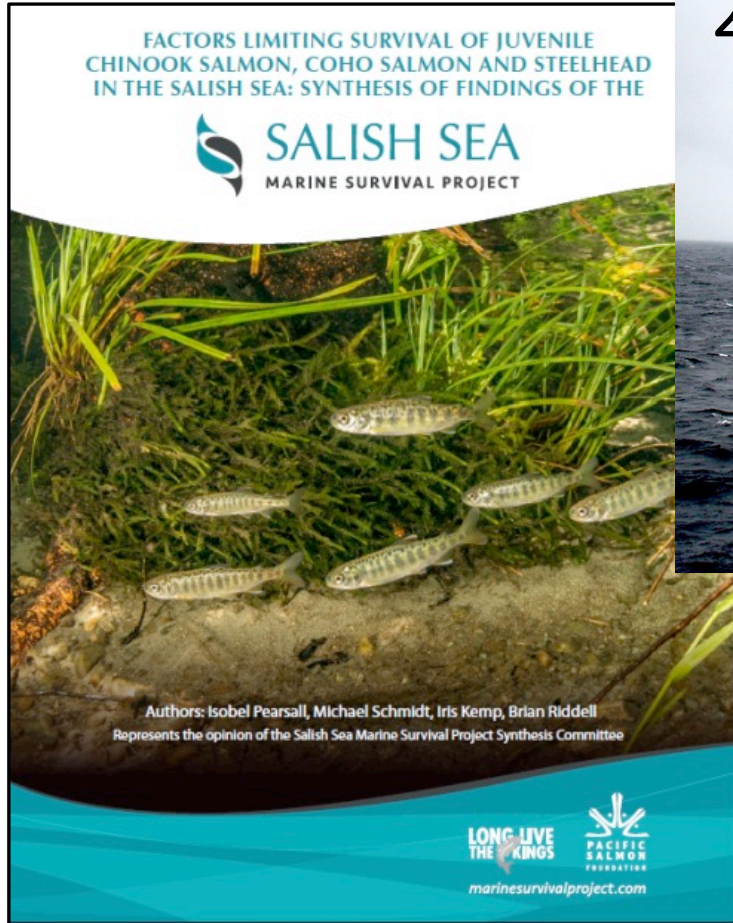
*Declining abundance of female crab prompted closure of multi-million-dollar fishery*

By Margaret Bauman - September 10, 2021



For the first time in over 25 years, the celebrated Bristol Bay red king crab fishery is closed for the season due to an inadequate abundance of mature females.

# From the Salish Sea, to the High Seas ... and now BECI



2019



2020



2022



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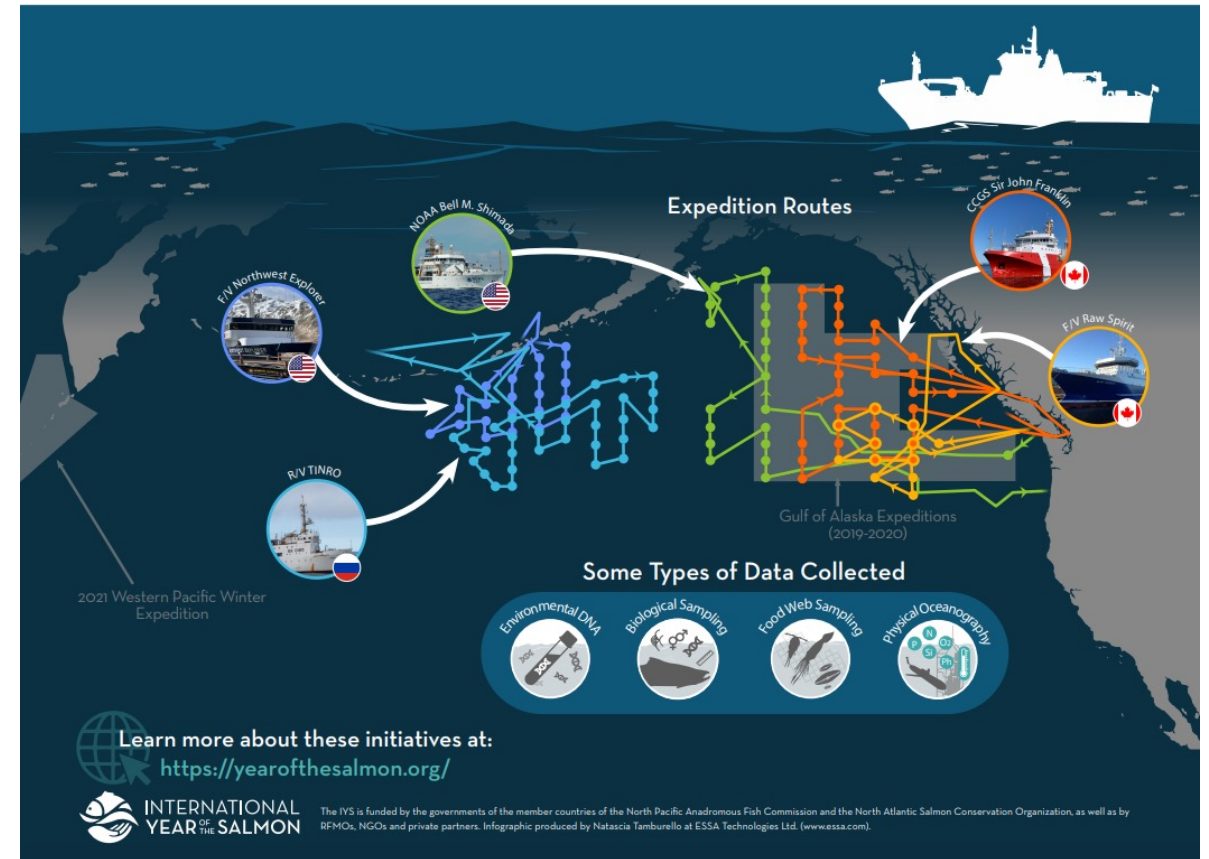
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2021-2030 United Nations Decade of Ocean Science for Sustainable Development

# PROOF OF CONCEPT – International Year of the Salmon

- **Five** vessels and a glider deployed between February and April of 2022
- 131 stations sampled catching 2,321 salmon (all species) and steelhead.
- Other catch included primarily jellyfish, squid and lanternfish (myctophids) with two salmon sharks successfully tagged and released
- 942 environmental DNA (eDNA) samples collected



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# Why build BECI - a major international research / monitoring / advisory project?

1. Resource users and managers are asking for better understanding of climate impacts and the broader implications of individual management decisions or investments.
2. High seas expeditions have demonstrated the benefit, and limitations, of vessel surveys. The expedition results revealed how little we understand about the biological community in the deep ocean and implications of climate change.



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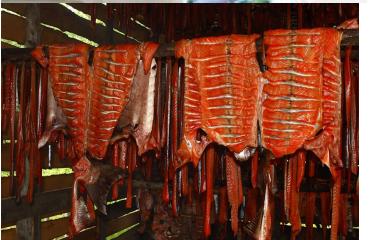
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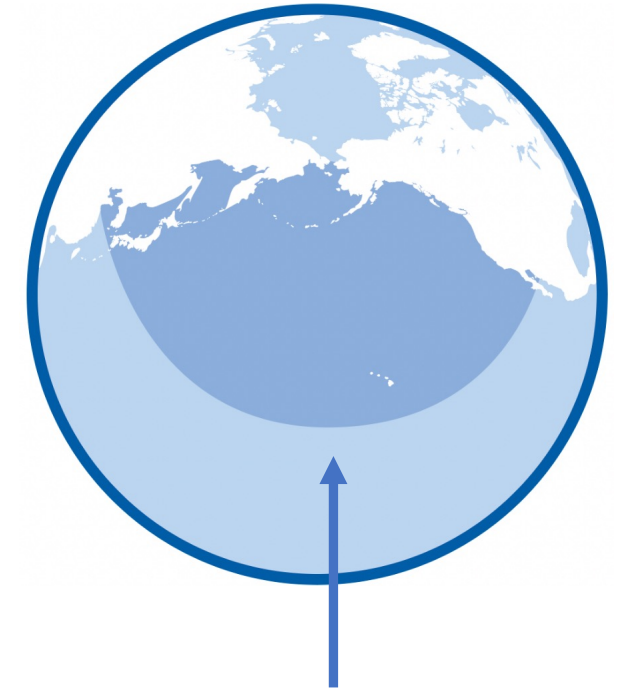


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# UNDOS: Basin Events to Coastal Impacts Program (BECI)



- **Objective:** Implement an international ocean intelligence system of monitoring, research and analytical approaches that provides timely advice to decision makers about the impact of current and future climate conditions on socio-ecological systems.
- Salmon will be an exemplar species while a modular approach will include all species of interest.



BECI area in the North Pacific



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# Why build BECI now - a major international research / monitoring / advisory project?

1. United Nations Decade of Ocean Science for Sustainable Development (2021-2030) provides a global focus on understanding ocean processes. The UNDOS BECI project will generate necessary and regionally useful knowledge.
2. Progress in global climate models and links between ocean and atmosphere processes has been significant.
3. The science community across the North Pacific voices strong agreement on the need for regional collaboration; several agencies are presently conducting climate/risk assessments in coastal zones around the Pacific Ocean, including the Bering Sea.



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# BECI: PRINCIPLES

- **Fund through partnerships**
  - arrangements across government, NGO's, foundations, academia and the private sector. No single agency can accomplish this.
- **Reflect generational, gender and geographic diversity**
  - in all elements of the program



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# BECI: PRINCIPLES

- Ensure collaborative participation and inclusion of indigenous knowledge, traditional ecological knowledge and scientific research
  - use FAIR and CARE principles



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# BECI: ENGAGEMENT

- IYS provided the basis and **proof of concept**.
- Global processes and coastal impacts emphasise the **need** – impacts on indigenous, traditional, commercial and recreational harvesters, and broader ecosystem services
- **Technical feasibility** to deliver BECI was supported in a series of workshops in 2022
- Technical Workshops informing the Science Plan – May through July 2022 – drawing on expertise from renowned scientists from six countries bordering the North Pacific Ocean – China, Korea, Japan, Russia, United States and Canada
  1. Climate and Ocean Ecosystem Modelling – Predicting the state of oceans and fisheries in the North Pacific and Bering Sea – May 9 and 10
  2. Linking Ocean Processes and Ecosystem Changes to Fish Production – May 31 and June 1
  3. Technology and Tools for Monitoring and Data Synthesis – June 13 and 14
  4. Data Mobilization and Knowledge Synthesis – July 7



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# WORKSHOP 1 – CLIMATE AND OCEAN MODELLING

- Ecological forecasting on a decadal to seasonal timeline is the most needed and most challenging.
- Development and application of down-scaled climate to biogeochemical ocean models is possible. Currently applied as a patchwork of geopolitically-based locations.
- Better integration of ocean and atmospheric modelling and monitoring needed.
- Current and emerging shelf and slope models with little connection to open basin dynamics.



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# WORKSHOP 2 – LINKING OCEAN AND FISH PRODUCTION

- It is time to expect the unexpected. We are seeing ocean states outside of historical envelopes. This weakens our ability to predict fish populations based on historical relationships.
- Better real-time (or near real-time) monitoring, reporting and communication are required in systems with low predictability and possible with scalable technology.
- More and better fisheries-relevant indicators are required to improve forecasting and risk assessment.
- We may need to re-think our models of fish and their prey. The poorly-sampled micronekton may be competitors, not just prey.
- The limited international collaboration impedes progress.



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# WORKSHOP 3 – SCALEABLE TECHNOLOGY

- Autonomous Vehicles and their uses are increasing and now operate over, on or under the surface of the ocean.
- A clever combination of platforms and sensors can drive affordable research and monitoring required by BECI.
- Ship-based monitoring and research will remain an essential part of any ocean research and monitoring program.
- New tagging, microchemistry and monitoring techniques can place species in ecosystems spatially and temporally to help understand the impact of a changing ecosystem.
- Collaboration is essential to leverage investments and optimize application.



Photo courtesy of Andy Ziegwied – Ocean Aero Triton



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# WORKSHOP 4 – DATA MOBILIZATION AND SYNTHESIS

1. Build on existing data systems and structures allowing for evolution
2. Federated approach to reduce impact on data providers increase participation
3. Use a carefully constructed data language – making use of existing tools like GOOS to collect / contribute essential ocean variables (EOV) and [FAIR](#) and [CARE](#) principles
4. Invest in the people side - subject matter experts are needed to mobilize existing data sets and work with data engineers at the outset
5. Keep the focus on outcomes and not just outputs – ensure that the knowledge generated is useable and being used

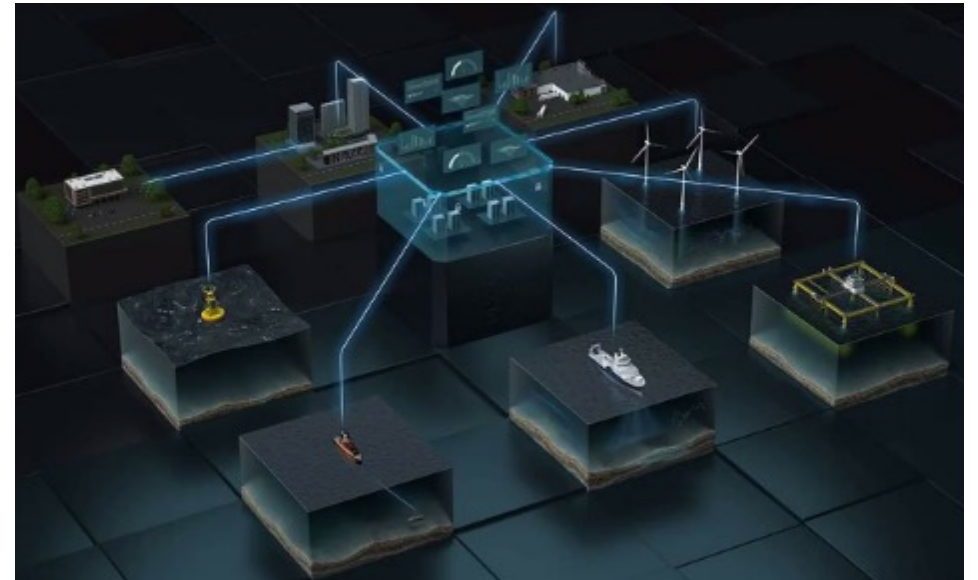


Figure courtesy of Dr. John Horne, University of Washington



# Likely components of a BECI Science and Engagement Plan:

## DATA SYNTHESIS



Data collection will be rapid and timely, drawing together observations from ocean observing systems. These data will be used to drive predictions and accessed through emerging cloud-based systems.

## OCEAN MONITORING & MODELING



A sustainable international ocean monitoring program will deliver near real-time data using new and emerging ocean monitoring technologies. These data will drive ocean models used to understand and predict impacts on ecosystems and coastal communities.



## BASIN-WIDE PARTNERSHIPS

A basin-scale project of this magnitude is beyond the capability of any one country or entity. BECI will be delivered through a partnership of government, private sector, NGO, and Indigenous groups.



## SUPPORTING DECISIONS

Ocean monitoring and data synthesis will help inform decision makers working with coastal and marine communities and organizations who will ultimately benefit from the BECI ocean intelligence system.



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# BECI TIMELINE

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- Update to PICES and NPAFC – September 2022
- Ongoing development of BECI Science and Implementation Plans and engaging partners and donors – through October 2023
- Decade project to run through 2030 (and become self-sustaining)



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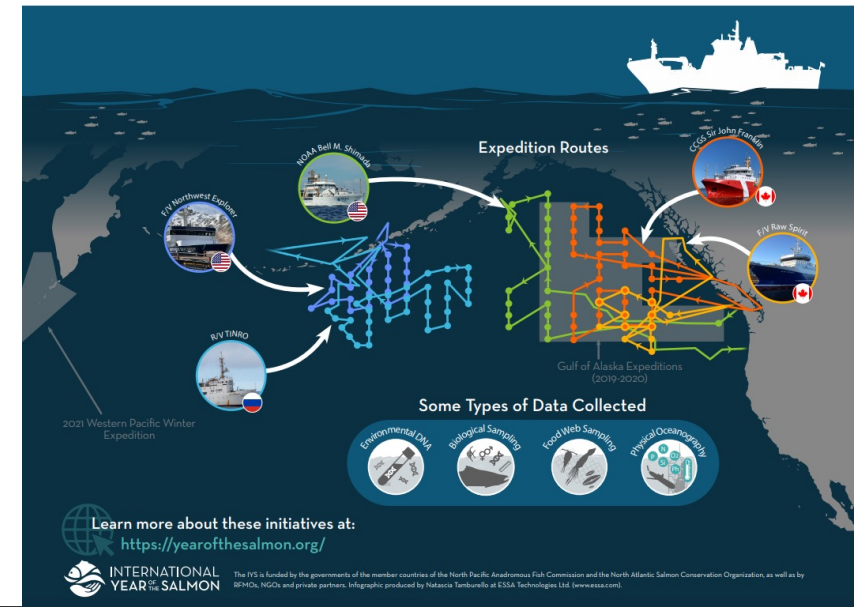
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# BECI: STRATEGIC CONSIDERATIONS

- IYS proof of concept – BECI **will work technically** but needs enhanced capacity in order to predict and adapt to changing climate conditions for national and international fisheries and impacted communities
- The desire to make use of the BECI outputs has been heard and the interest of researchers is high – **commitment exists**
- Multiply capacity through **coordination** of financial, platform (e.g., ship time), computing, personnel resources and partnerships at the basin-scale
- BECI is **complementary** to national and international projects and processes
- Goal is to have BECI **persist** beyond 2030



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# BECI: What do we need from you?

- Seeking additional participants and support for the concept, planning and delivery of BECI.
- Continuing to identify complementary projects and potential partners.
- Align BECI outputs with science-based decision making processes.
- Identification of additional species of interest (e.g., as modules and areas of focus).
- How can BECI more directly support the IYS “Roadmap to 2030”



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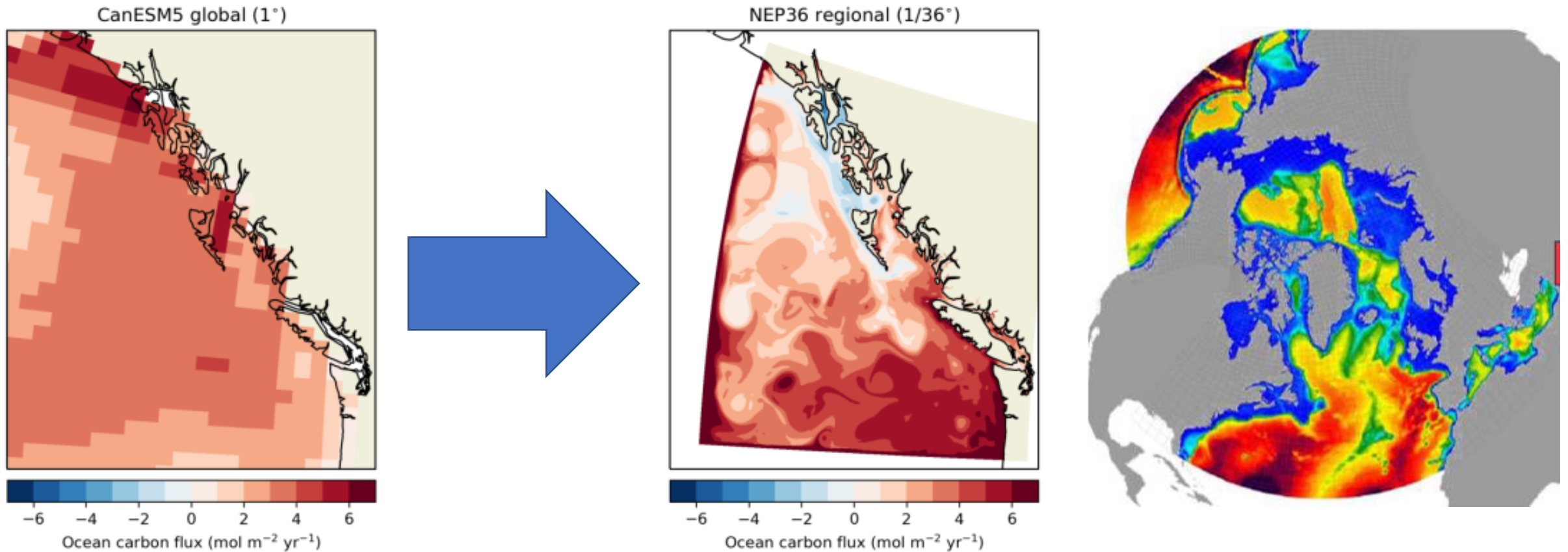
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# USING OCEAN MODELS TO UNDERSTAND MECHANISMS AND DRIVE PREDICTIONS AND PROJECTIONS



Figures from Dr. Neil Swart: Canadian Centre for Climate Modelling and Analysis, Environment and Climate Change Canada.



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# BECI: TRANSFORMATIVE ELEMENTS

## *Living with Climate Change*

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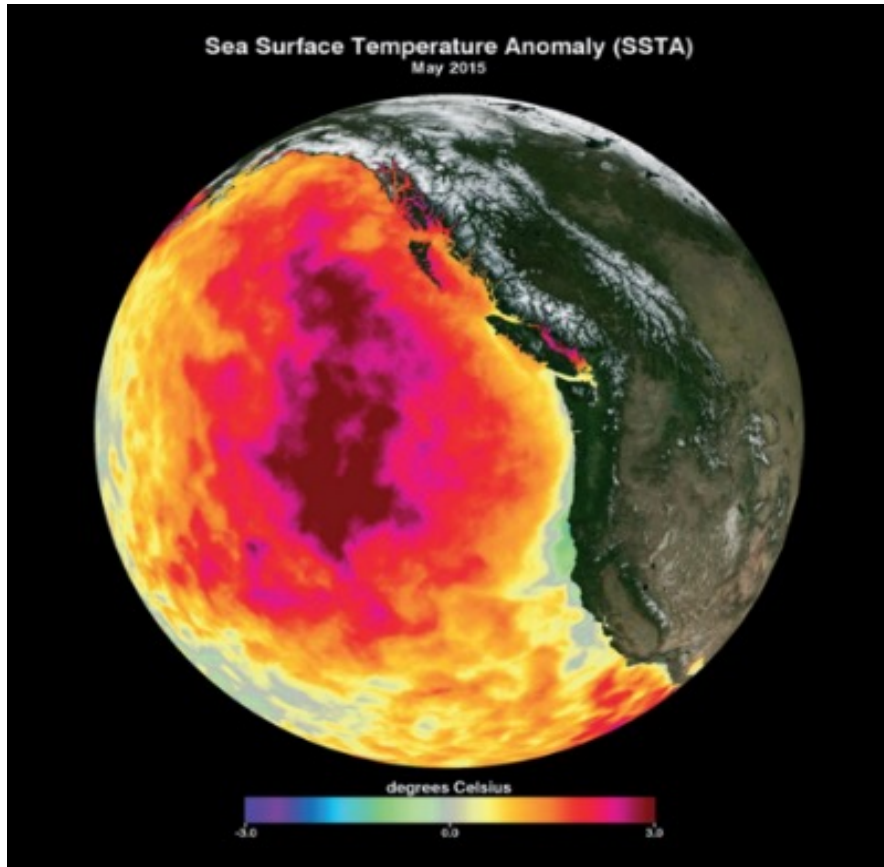
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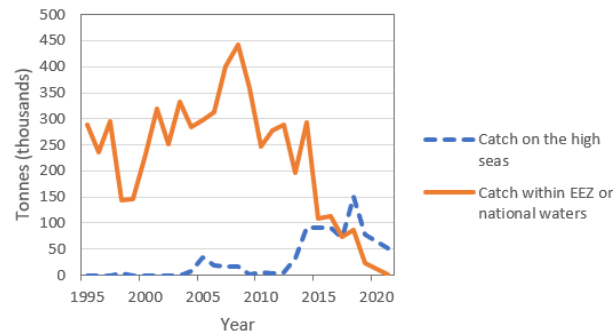
# NEED AND OPPORTUNITY FOR CHANGE



Pacific saury (*Cololabis saira*) 

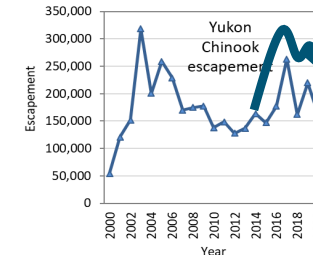


Pacific Saury - changes in catch with time



BECI – derived from NPFC data

Chinook salmon (*Oncorhynchus tshawytscha*) 



Columbia (Dam counts)

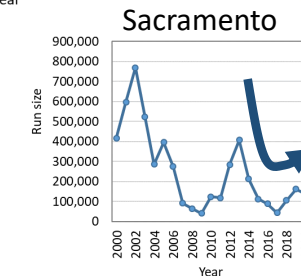
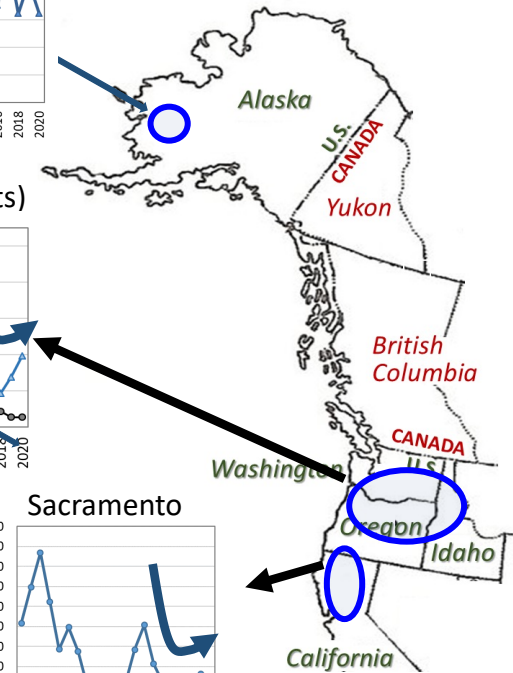
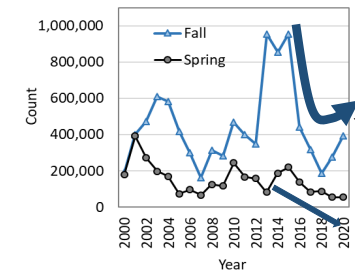


Figure courtesy of Dr. Laurie Weitkamp, NOAA



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# BECI CONTEXT

- Range of global ocean-related processes
- Regional challenges for fisheries – food and economic
- Expertise exists that can be coupled and made more effective to better support decision-making and adaptation.
- BECI provides a basin scale integrated intelligence system that is based on an established proof of concept through the International Year of the Salmon



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1. Modeling and Prediction
2. Real-Time Monitoring and Reporting
3. Data Mobilization and Synthesis
4. Targeted At-Sea Research
5. Engagement / applied knowledge / education



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