



**NOAA**  
**FISHERIES**

# Gulf of Alaska Regional Action Plan 2.0

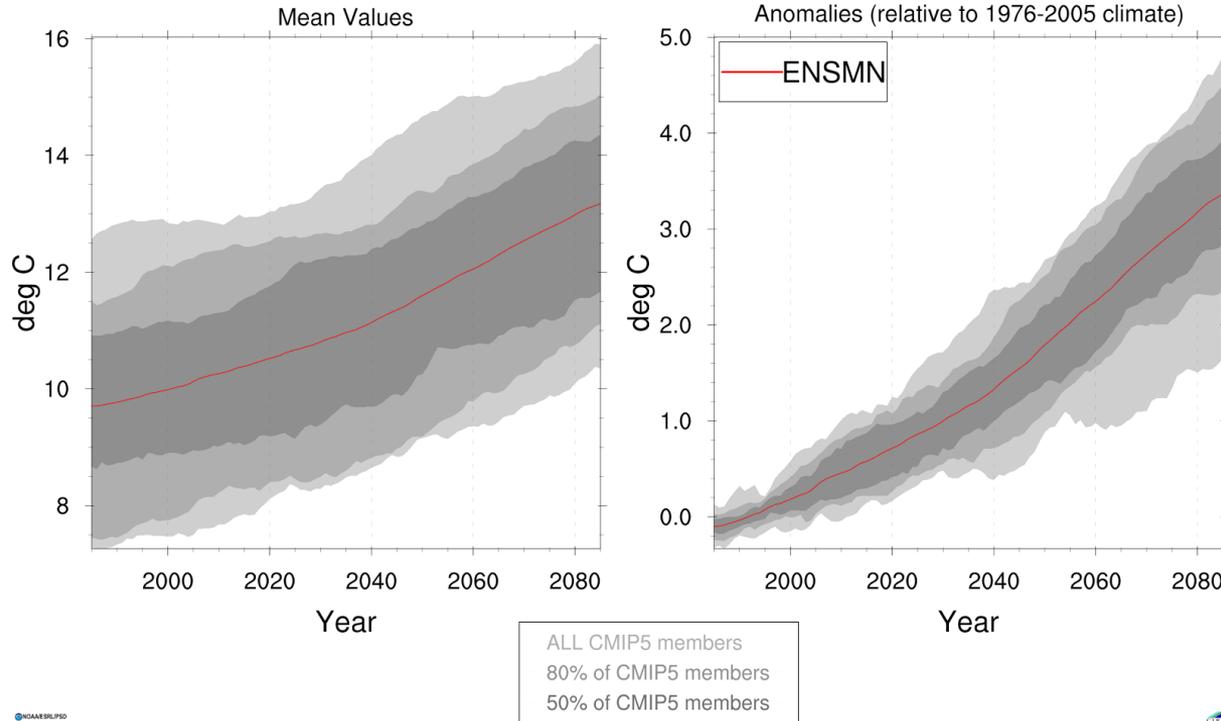


Martin Dorn  
SSC/Council presentation  
October 2021 Council meeting

ANN tos for Gulf of Alaska with 20 year running mean (20thC + rcp85)

Projected climate changes in the Gulf of Alaska:

- Ocean warming
- Ocean acidification
- Oxygen limitation
- Changes in ocean circulation and stratification



Projected increases in sea surface temperature for the Gulf of Alaska (left) and future temperatures relative to historic means (right).

# NCSS Timeline

2015. NOAA Fisheries Climate Science Strategy published. Provides for the creation of 5-year Regional Action Plans to guide climate-oriented research regionally.

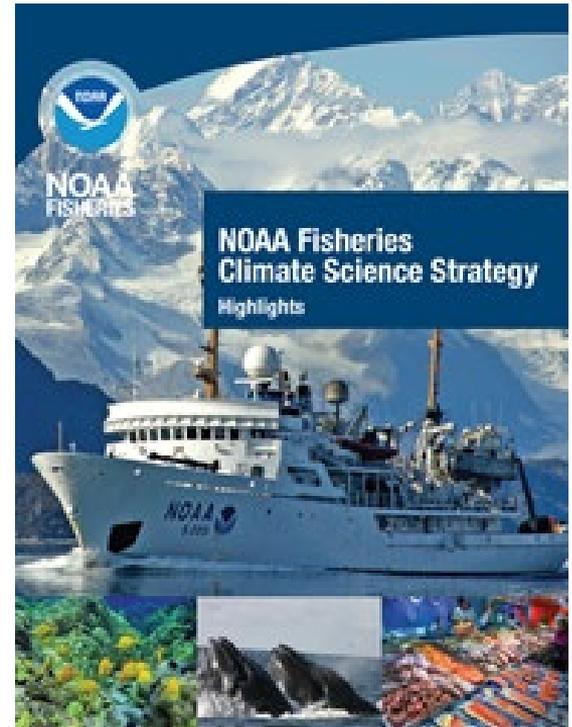
2017. Work began on GOA RAP.

2018. Gulf of Alaska RAP published

2020. Fifth anniversary of NCSS. Work began on 5 year syntheses of progress to date on the RAPs.

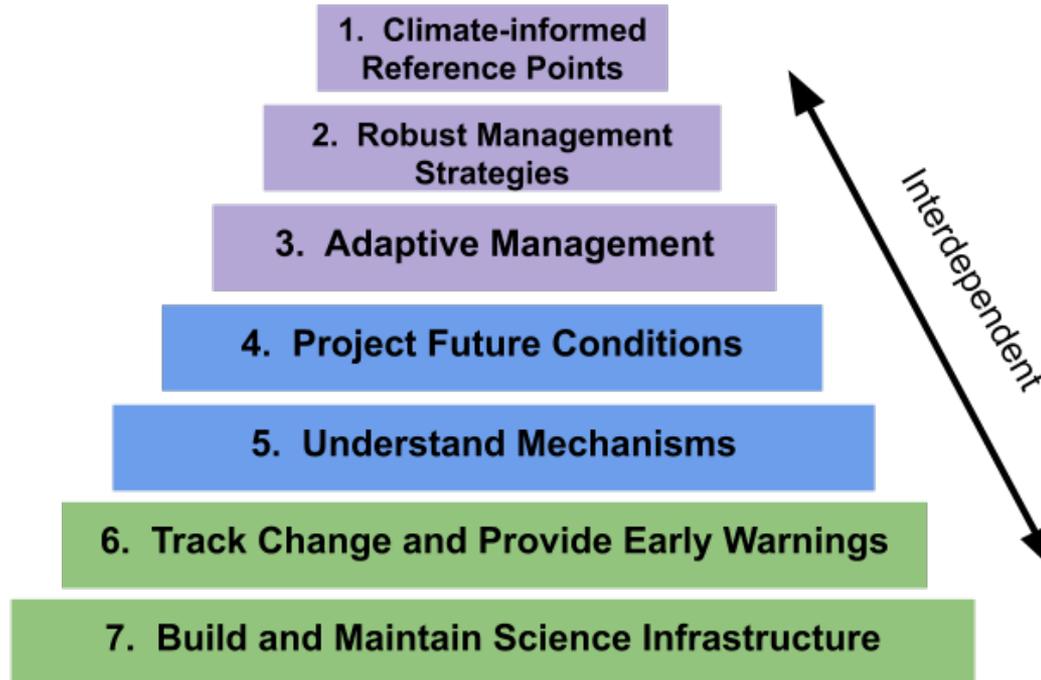
2021. Five year synthesis completed. Tech memo in press

2021. Headquarters initiative to update the RAPS for an additional 3 years, with a completion target in fall 2021.



# Conceptual Frameworks #1-NCSS Pyramid

## Climate Science Objectives



# Conceptual Frameworks #2: Three-legged stool (acknowledgements to Mike Sigler)



## 1. Monitoring

Objective 7. Build and maintain the science infrastructure need to fulfill NOAA Fisheries mandates with changing climate conditions.

Objective 6. Track trends in ecosystem, LMRs, and LMR-dependent human communities and provide early warning of change.

## 2. Process studies

Objective 5. Identify the mechanisms of climate impacts on ecosystems, LMRs, and LMR-dependent human communities.

## 3. Modeling

Objective 4. Identify future states of marine and coastal ecosystems, LMR and LMR-dependent human communities.

Objective 3. Design adaptive decision processes that can incorporate and respond to changing climate conditions

Objective 2. Identify robust strategies for managing LMRs under climate conditions

Objective 1. Identify appropriate, climate-informed reference points

# RAP 1.0 highlights

## **Informing Management (NCSS Obj. 1-3)**

- Starting development of a multi-model framework to evaluate OY range and biological reference points under projected climate scenarios.

## **Understanding Mechanisms and Projecting Future Conditions (NCSS Obj. 4&5)**

- Improved understanding of marine heatwaves on northeast Pacific groundfish and Pacific cod
- Development of the initial phase of place-based IEA for Sitka, AK, including conceptual models and ecosystem indicators.

## **Infrastructure and Tracking Change (NCSS Obj. 6&7)**

- Annual ecosystem status reports
- Early warnings of ecosystem and economic conditions through the 'Spring PEEC' workshops.
- Development of the Ecosystem and Socioeconomic Profiles (ESPs) framework
- Ecosystem monitoring surveys and expansion of sampling capabilities on moorings

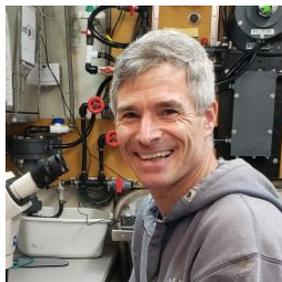
# GOA RAP working group



Overall lead:  
Martin Dorn

M. W. Dorn, B. S. Fadely, O. A. Ormseth, L. A. Rogers, R. M. Suryan, M. Szymkowiak, R.P. Angliss, M. T. Dalton, B. E. Ferriss, K. K. Holsman, J. Jansen, E. A. Laman, B. J. Laurel, E. P. Lemagie, M. A. Litzow, J. M. London, D. W. McGowan, J.R. Moran, J. H. Moss, W. A. Palsson, J. L. Pirtle, P. H. Ressler, C. Seung, K. E. W. Shelden, and B. C. Williams

Sub-lead:  
Monitoring



Rob Suryan

Sub-lead:  
Process studies



Lauren Rogers

Sub-lead:  
Modeling and  
Management



Olav Ormseth

Sub-lead:  
Marine mammals



Brian Fadely

Sub-lead:  
Socio-economics



Marysia Szymkowiak

# RAP Updates 2.0



## Goals:

- Update the RAPs to identify the key needs, goals, and proposed actions over the next 3 years to address regional priorities for climate-related information and tools.
- Identify specific goals, targets and metrics to better track and communicate progress.
- Reinforce and expand engagement and collaboration.
- Increase efforts to implement the NCSS.

# GOA RAP 2.0 timeline



Phase 1: Engagement (April-May, completed)

Phase 2: Development (June-July, completed)

Phase 3: Finalize (August-September, present to PT in Sept, SSC and Council in October, other opportunities for stakeholder input )

# RAP development process



Kickoff meeting: May 14, then sub-leads organized multiple meetings

Scope included climate-relevant work being done at AFSC (taken broadly), including ongoing research and monitoring, planned new research in the next few years (including funded OA and IEA projects), and projects that AFSC would like to do if we had additional funding

# GOA RAP Highlights



A list of 2 or 3 projects to highlight in each section.

These are supported projects for which there is good expectation that there will be progress in the next three years of the RAP.

# Long-Term Monitoring and Assessments:



**Expanding the scope of monitoring.** AFSC will heavily leverage external collaborators to expand scope of surveys, for example tracking harmful algae blooms and food web impacts.

**Rapid assessment methodologies.** AFSC is developing new methodologies for efficient and rapid assessment of key metrics such as fish condition and relative abundance to reduce lags in use for fishery management.

**Additional survey-derived indicators.** AFSC will continue to add key survey-derived indicators to ESRs, ESPs, and risk tables.

# Process-oriented research projects:



**Thermal effects on age-0 Pacific cod.** A suite of projects is examining thermal effects on Pacific cod samples (e.g. for age, growth, food habits, trophic biomarkers), with the aim of understanding how early life history processes influence subsequent recruitment in a warmer GOA.

**Experimental studies on temperature and ocean acidification.** Process studies on OA will involve a series of laboratory experiments to examine the effect of OA on the growth and development of Pacific cod, walleye pollock, and northern rock sole and efforts will be expanded to examine effects on yellowfin sole.

**Changes in zooplankton size due to warming.** An NPRB-funded project will examine the relationship between zooplankton size and climate variability in the western Gulf of Alaska through reconstruction of a historical time-series of zooplankton size.

# Modeling and management-oriented synthesis:



**Climate vulnerability analysis for the Gulf of Alaska.** This project will qualitatively assess species vulnerabilities to climate change and provide guidance on research prioritization.

**Ecosystem and socio-economic Profiles (ESPs).** We will continue to create new and update current ESPs over the next three years and plan to implement an indicator submission system for ESPs that is linked to the stock assessment cycle for both groundfish and crab stocks.

**GOA-CLIM.** This integrated program includes oceanographic modeling driven by climate projections of earth system models (ESM), an ensemble of biological models including single species, multi-species, and ecosystem models, e.g. Atlantis, Ecopath, Mizer.

# Marine Mammals:



**Harbor seal abundance estimates.** Updated estimates of abundance harbor seal stocks in the Gulf of Alaska region and evaluation of trends within glacial fjord habitats (Survey data of glacial fjords are from 2020, SE stocks are being surveyed in 2021, and PWS stocks are planned to be surveyed in 2022).

**Heatwave impacts on Steller sea lions.** Evaluate impacts of major environmental anomalies to Steller sea lion populations using the 2013-2016 marine heatwave as a natural experiment.

**Impact of environmental variation on Cook Inlet beluga whales.** Evaluate impacts of major environmental anomalies to Cook Inlet beluga whales using Population Consequences of Disturbance (PCOD) and Population Viability Analysis (PVA).

# Socio-economic impacts on fishing communities:



**Coupled fleet-community-adaptation model.** Develop a coupled fleet-community-adaptation model to examine how climate change impacts may reverberate across Gulf of Alaska communities.

**Bio-economic model of Pacific cod in the Gulf of Alaska.** Develop a bio-economic model of Pacific cod in the Gulf of Alaska to evaluate the effect of ocean acidification on abundance, yields, and fishery income.

**Decision support tools for ocean acidification.** Develop decision support tools that incorporate the risks of OA into localized, coupled socioecological systems to support coastal communities.

# Communications and engagement strategy:



Communications and engagement strategy to support co-producing science with Gulf of Alaska communities. Through regular communications, outreach and engagement efforts, we plan to facilitate bi-directional knowledge exchange to increase trust and enable collaborative research that informs NOAA Fisheries mission to manage living marine resources.

# Key gaps and unfunded needs (these are actually opportunities to expand the RAP initiative):



A list of 2 or 3 projects that are unfunded needs/gaps for each section.

These should be projects that should be able to be spun up relatively quickly if funding became available.

# Key gaps and unfunded needs



Improve the efficiency of the AFSC survey enterprise (monitoring).

Increase survey focus on nearshore juvenile fish-rearing habitat (monitoring).

Increase spatial coverage of new autonomous sampling platforms and moorings (monitoring).

Euphausiid dynamics. Additional funding is needed for work focused on refining at-sea acoustic measurements of the zooplankton community to resolve euphausiids, field studies to characterize climate-mediated changes in euphausiid phenology and life-history, and a suite of laboratory studies that examine climate-forced shifts in euphausiid lipid availability (process studies).

# Key gaps and unfunded needs:



Climate-driven changes in maturation and reproductive potential (process studies).

Incorporating recruitment processes into life-cycle models for walleye pollock and Pacific cod (modeling).

Dynamic species distribution models (SDM) for identifying changes to Essential Fish Habitat (modeling).

Annual harbor seal survey in Gulf of Alaska glacial fjord habitats. Additional funding and NOAA aircraft availability would allow annual survey effort of harbor seals in GOA glacial fjord habitats in 2022-2024 (marine mammals).

Cetacean abundance, distribution, and density surveys in the GOA (marine mammals).

# Key gaps and unfunded needs:



Expand socio-economic research on adaptive strategies (socioeconomics).

Resilience and transformative capacity of fishing communities. Conduct research across Gulf of Alaska communities on how absorptive, adaptive, and transformative capacity manifests itself and contributes to resilience (socioeconomics).

Social data collection in fishing communities. Collect social data about fishermen and fishing communities including demographics and cultural information about well-being ties to fisheries (socioeconomics).

Improving community decision support tools (communication strategy).