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Deep-Sea Coral Research and Technology Program

Science Plan for the Alaska Deep-Sea Coral and Sponge Initiative (AKCSI): 2020-2023

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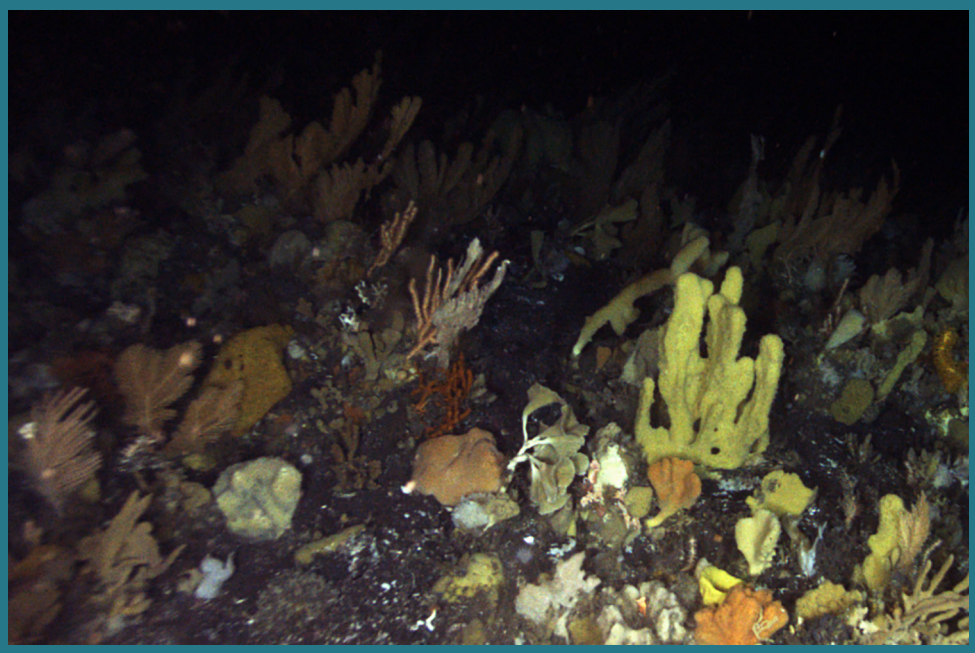

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Cover: Image taken of high density coral and sponge habitat in Samalga Pass east of Kagamil Island using an underwater stereo camera system.

Science Plan for the Alaska Deep-Sea Coral and Sponge Initiative (AKCSI): 2020-2023

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Introduction

The National Oceanic and Atmospheric Administration (NOAA) Deep Sea Coral Research and Technology Program (DSCRTP) Objectives

Deep-sea corals and sponges (DSCS) can live for hundreds or thousands of years, creating important biogenic habitats and supporting remarkably complex communities in deep waters around the globe (Hourigan et al. 2017, Roberts et al. 2009). Their habitat ranges from 6 m to more than 6,000 m below the ocean surface. In U. S. waters, deep-sea corals and sponges exist on continental shelves, slopes, canyons, and seamounts. Their full geographic extent is still unknown due to extensive seafloor areas lacking adequate exploration. The complex structures created by corals and sponges provide habitat for many fish (Husebø et al. 2002) and invertebrate species, including commercially important rockfish, shrimp, and crab (Auster 2005). In addition to their value as habitat, some deep-sea corals and sponges produce chemicals of great biomedical potential: https://www.noaa.gov/news/noaa-discovery-of-green-deep-sea-sponge-shows-promise-for-cancer-research.

The National Oceanic and Atmospheric Administration (NOAA) established the Deep Sea Coral Research and Technology Program (DSCRTP) under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as reauthorized in 2007. The goal of the DSCRTP is to provide scientific information needed to manage and protect deep-sea coral and sponge ecosystems throughout the United States (NOAA 2008, Hourigan 2009). To facilitate this mission, the DSCRTP works with partners to support multi-year regional fieldwork initiatives and targeted projects centered on conducting new research, assimilating historic data, and making results public in support of DSCS ecosystem management. Functionally, the DSCRTP supports a rotating initiative program across each U.S. National Marine Fisheries Service (NOAA Fisheries) region on an approximate 6-year cycle. The DSCRTP has funded research initiatives in the U.S. South Atlantic (2009-2011), West Coast (2010-2012, 2018-2021), Alaska (2012-2014, 2020-2023), Northeast (2013-2015), Pacific Islands (2015-2017), and greater Southeast (U.S. South Atlantic, Gulf of Mexico and U.S. Caribbean; 2016-2019) regions. The regionally-led initiatives have included mapping and surveys to understand the spatial distribution of DSCS habitats, research to understand DSCS life histories and their contributions to biodiversity, habitat suitability modeling, and assessments of impact of human activities on DSCS. A national-level data management infrastructure underlies the regional initiatives, assuring DSCRTP-supported data to be accessible to the public.

Alaska Deep-Sea Coral and Sponge Initiative (AKCSI) Overview

In 2020, the DSCRTP began a four-year Alaska Coral and Sponge Initiative (AKCSI), which will focus on research in the Gulf of Alaska (GOA), Aleutian Islands (AI), and eastern Bering Sea (EBS) regions. These regions are under the purview of the North Pacific Fishery Management Council (NPFMC), which is responsible for managing marine fishery resources, including groundfish and Essential Fish Habitat (EFH; MSA 2006), such as coral and sponge. To facilitate the initiative, a Steering Committee was created and is comprised of Principal Investigators (PIs) from the Alaska Fisheries Science Center (AFSC), as well as participants from the DSCRTP, other NOAA agencies, and Fisheries Oceans Canada (DFO). To establish research priorities, the AFSC and DSCRTP convened a 4-day workshop on 12-15 May 2020. The workshop was originally scheduled for Juneau, Alaska, but due to the coronavirus (COVID-19) pandemic,

the workshop was held virtually. A total of 59 scientists and managers, with relevant expertise from across Alaska and throughout the United States and Canada, participated in the workshop. Participants represented numerous NOAA offices, other federal agencies, non-government organizations, the commercial fishing industry, the Aleut Community of St. Paul Island, Fisheries and Oceans Canada, and academic institutions, totaling 29 entities. Working in small breakout groups, participants discussed and identified Alaska DSCS science and management priorities in six topic areas: 1) spatial distribution; 2) population dynamics, biology, and interactions; 3) diversity and genetics; 4) effects of climate change; 5) effects of other human impacts; and 6) deep-sea benthic/seafloor habitat mapping. Following the workshop and a wrap-up discussion with breakout group leads, a report was completed (Hoff et al. 2020) that identified the highest priority research topics and questions.

The AKCSI workshop and subsequent publication formed the basis for proposal solicitations that addressed the identified research priorities. Steering committee members numerically ranked all proposals, which formed the framework for this science plan. The purpose of this science plan is to outline a general strategy for the execution and completion of the most important research activities conducted under the AKCSI. This science plan is a living document. Details related to the projects will inevitably change throughout the initiative. However, the plan outlines the general approach and proposed research. Research projects supported by the 2020-2023 AKCSI will consist of the following:

- Research expeditions that survey, sample, and map DSCS ecosystems throughout the Alaska region.
- Research projects focused on DSCS data and analyses of survey samples.
- Deliverables that support the goals of AKCSI and DSCRTP.

Alaska Area Descriptions and Research Priorities

The Alaska region comprises seven major ecosystems including the Gulf of Alaska (GOA), Aleutian Islands (AI), eastern Bering Sea (EBS), northern Bering Sea (NBS), eastern Bering Sea slope (EBSS), Beaufort Sea, and Chukchi Sea (Fig. 1). Each of the seven regions includes distinct fauna, habitats, and environmental conditions due to geographic, geologic, and oceanographic features. Indigenous subsistence fishing has been occurring for at least 8,000 years in Alaska waters (Crowell and Mann 1996); early European records of cod fishing begin in the 1700s. Government regulated fisheries are documented as early as the 1930s (Fredin 1987).

The North Pacific Fishery Management Council (NPFMC) implemented a fisheries management plan (FMP) in 1978, which focused primarily on foreign fleet fisheries agreements. Beginning in 1987-1988, foreign fishing activity ceased in Alaska waters and the NPFMC directed efforts to develop fisheries management plans for many commercially important, federally regulated groundfish species. Directed fisheries included Pacific cod, walleye pollock, rockfishes, sablefish, and a variety of flatfishes. Relevant commercial fishing gear in Alaska includes bottom and pelagic trawls, longline, pots, dingle bar, dredges, and beam trawls with evidence of nearly all gear-types altering benthic habitats (Wion and McConnaughey 2000).

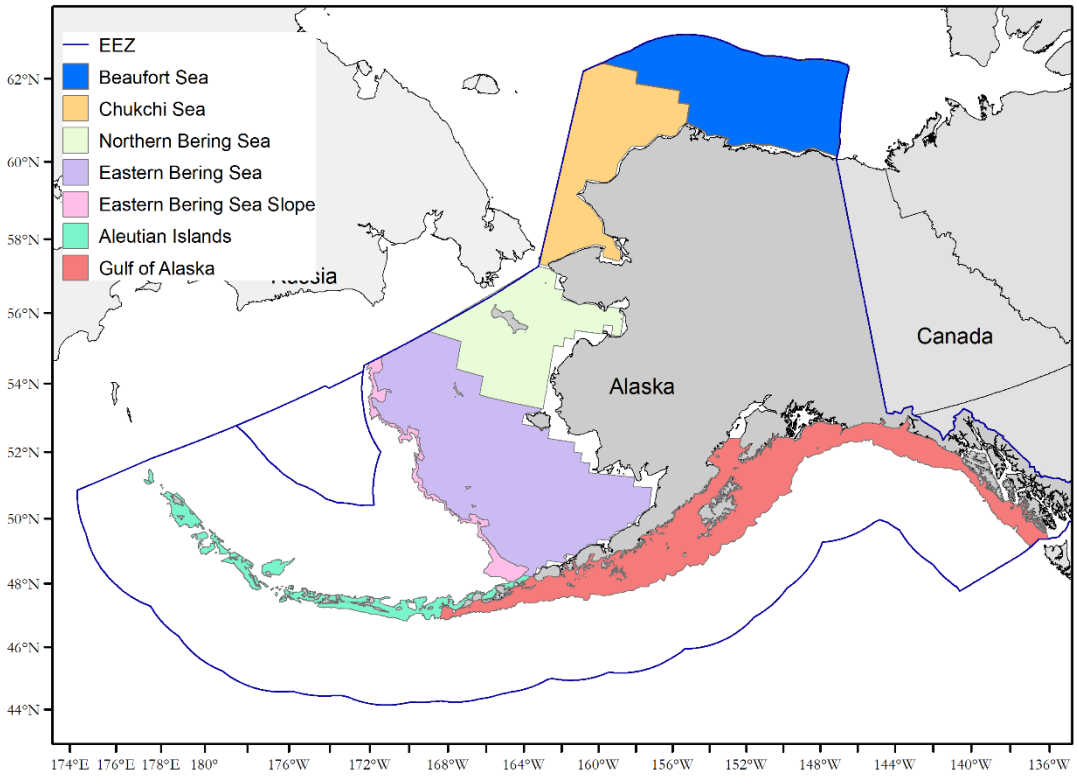

Figure 1. --The seven marine ecosystems of Alaska within the Exclusive Economic Zone (EEZ) covered by the Alaska Fisheries Science Center (NOAA-NMFS).

The NPFMC also oversees the delineation of essential fish habitat (EFH) to conserve and enhance coral and sponge ecosystems. Increased influences from climate change and human disturbance threaten many of these habitats. Corals and sponges are widely and abundantly distributed in Alaska waters with the AI having some of the densest and most diverse coral and sponge fauna in the world (Stone and Shotwell 2007). Three regions (GOA, AI, EBS) of Alaska waters support extensive coral and sponge habitat, with approximately 150 species of coral and more than 200 species of sponges identified.

Gulf of Alaska

The GOA is a semi-enclosed basin with the coast of Alaska to the west, north and east, and open to the greater North Pacific Ocean to the south. There are numerous bays and inlets intersecting the coast, with canyons and slope areas occurring in deeper waters. The subarctic gyre and the Alaska Coastal Current dominate the current systems, which help support the rich benthic and pelagic communities in the GOA (Stabeno et al. 2004). The GOA benthic habitat substrate is diverse and can be characterized as

areas of high relief; including bedrock, large boulders, and cobble along the slope; to flat sandy/muddy areas in bays and fjords. There are also two major seamount chains (Chaytor et al. 2007; Fig. 2):

1) The Kodiak-Bowie (Pratt-Welker) seamount chain stretches from the Aleutian Trench in the north to Bowie Seamount, west of the Queen Charlotte Islands.
2) The Cobb-Eickelberg seamount chain begins at the Aleutian Trench and extends to the southeast to Axial Seamount on the Juan de Fuca Ridge.

Since 1987, several regions of the GOA seafloor habitat have had some level of protection from fishing impacts. For example, in 1998, a Marine Protected Area was designated under GOA Groundfish FMP Amendment 41 which prohibited trawling in southeast Alaska east of longitude 140°E (Fig. 2). The 180,418-km^2 MPA not only met the objective of conserving habitat for rockfish but also had the additional benefit of protecting vulnerable coral and sponge ecosystems (Witherell and Woodby 2005). A 4.6 km^2 benthic feature, Sitka Pinnacles, was designated a Marine Reserve in 2000 as part of the GOA Groundfish FMP Amendment 59 the only no-take area in Alaska (Witherell and Woodby 2005). In addition, habitat areas of particular concern (HAPCs) designate specific EFH as critical to commercially important fish species. In 2006, 16 seamounts, labeled the Alaska Seamount Habitat Conservation Zone, became HAPCs with a total combined area of 18,278 km^2. Also in 2006, a Gulf of Alaska Coral Habitat Protection Area HAPC (230 km2) was established west of Cape Ommaney and Fairweather Grounds to protect expansive thickets of red tree coral (Primnoa pacifica) (Witherell and Woodby 2005; Fig. 2). Bottom-contact gear (longlines, trawls, pots, dinglebar gear, etc.) is prohibited in five subsets of these areas totaling 47 km2.

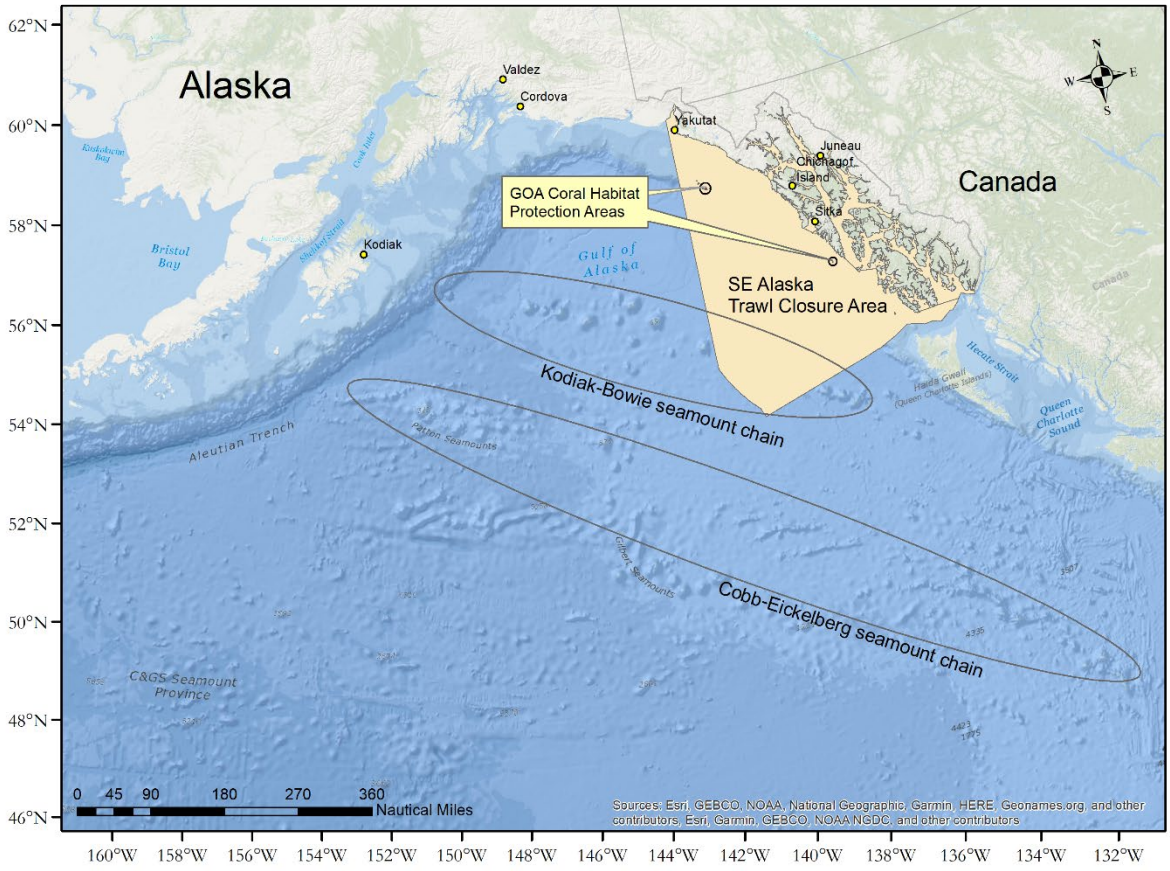

Figure 2. --Gulf of Alaska coral habitat protections areas, trawl closure zone, and seamount chains.

Researchers have identified nearly 75 species of deep-sea coral in GOA waters at depths ranging from 6 m in glacial fjords to 5,000 m on seamounts (Stone and Cairns 2020). In addition, an estimated 80+ species of sponges (50 confirmed) are suspected to occur in GOA waters (Stone and Rooper 2017, Lehnert and Stone 2016). Deep-sea coral and sponge research in GOA waters during the first DSCRTP Alaska Initiative (2012-2015) included the following:

- Mapping and studying the ecological function of areas with high abundances of *P. pacifica.*
- Estimating recovery rates and sustainable impact rates for *P. pacifica* using a landscape ecology approach.
- Determining the productivity of commercial fishes from coral and non-coral habitats.
- Developing and testing the feasibility of using a towed/drift camera system to estimate the effects of commercial long-line and pot fishing on deep-sea coral and sponge communities.
- Collecting long-term data sets of oxygen and pH from bottom trawl surveys.
- Establishing a long-term coral monitoring station at a shallow-water fjord in Southeast Alaska.

- Improving the taxonomy and conducting studies on paleo climatology, reproductive ecology, and trophic dynamics of corals and sponges.
- Compiling a geologically based substrate map.

Aleutian Islands

The Aleutian–Commander Island archipelago forms a boundary between the North Pacific Ocean and the EBS. The archipelago contains more than 300 islands and extends over 3,000 km from the Alaska Peninsula in the east to the Russian Kamchatka Peninsula in the west. The U.S. portion of the chain runs from Unimak Island in the east to Attu Island in the west, a distance of over 1,900 km. The Aleutian Ridge is a volcanic arc with more than 20 active volcanoes and frequent earthquake activity formed along zones of convergence between the North American Plate and other oceanic plates. The shelf is very narrow and drops precipitously on the North Pacific Ocean side, to depths of more than 6,000 m in the Aleutian Trench. The AI benthic habitat substrate is diverse, but is dominated by areas of high relief including pinnacles, bedrock, large boulders, and cobble interspersed with volcanic sand patches.

In 1993, National Marine Fisheries Service (NMFS) designated critical habitat for endangered Steller sea lions (SSL) based on their rookeries and foraging habitats in the AI. Critical habitat designation created no-entry buffer zones to protect SSL from disturbances such as fishing (Witherell and Woodby 2005). An unintended potential effect of identifying these critical habitats is that coral and sponge communities in these areas also escape disturbance. Submersible observations have found areas with complex coral and sponge communities within the areas encompassed by the SSL critical habitat (Witherell and Woodby 2005). In 2006, the Aleutian Islands Coral Habitat Protection Areas became a HAPC due to the prevalence of especially high densities of corals and sponges known as “coral gardens”. The protected area encompasses 377.3 km^2 of benthic habitat and is closed to all bottom contact fishing gear (Stone and Shotwell 2007, Witherell and Woodby 2005).

The Aleutian Islands support the most abundant and diverse coral assemblages in all of Alaska and possibly in the North Pacific Ocean. Almost 100 species of coral have been reported from AI waters with 57 species likely endemic to the region (Stone and Cairns 2020). Data from AFSC groundfish bottom trawl surveys indicate that a distinct shift in coral diversity may occur between the eastern and western AI, beginning at approximate latitude 169° W (Stone and Shotwell 2007). In general, many coral species may have a broader depth (and therefore habitat) distribution in AI waters than other parts of their range. Sponges are a major component of living habitat in AI waters with over 100 species identified (Stone et al. 2011) and many more yet to be recognized. Deep-sea coral and sponge research in AI waters during the first AKCSI (2012-2015) included the following:

- Determining the distribution of high abundance and diversity areas of deep-sea corals and sponges through modeling and field surveys using towed/drift cameras.
- Collecting long-term data sets of oxygen and pH from bottom trawl surveys.
- Improving the taxonomy and conducting studies on paleo climatology, reproductive ecology, and trophic dynamics of corals and sponges.
- Compiling a geologically-based substrate map.

Eastern Bering Sea

The Eastern Bering Sea (EBS) is a large water mass that covers multiple ecosystems including the southeastern EBS shelf region, the northern EBS shelf, and the EBS slope region. The EBS is bounded by the Alaska coast to the east, the AI to the south, the Russian Kamchatka peninsula (RKP) and the Bering Strait region to the north, and the RKP to the west. The EBS benthic habitat is predominantly a flat sandy to muddy bottom across the shelf region and upper slope with areas of boulder fields and rocky ledges in areas along the slope, especially in steep canyon faces.

In 1995, a large area in the south central EBS was established as the Red King Crab Savings Area totaling 13,720 km^2 to protect adult red king crab, *Paralithodes camtschaticus*, and their benthic habitat. To further conserve and protect juvenile red king crab, the adjacent Nearshore Bristol Bay Closure Area encompassing an additional 65,107 km^2 was established and closed to all trawling. These protections include an area of extremely high density of an abundant single sponge species, *Suberites montalbidus*, on the EBS shelf. In 1995, the 24,010 km^2 Pribilof Islands Habitat Conservation Area was created by BSAI Groundfish FMP Amendment 21a, and the area was permanently closed to all trawling and dredging year-round to protect habitat for juvenile blue king crab*, Paralithodes platypus*, and forage fish for marine mammals and seabirds, and to maintain a stable ecosystem in the surrounding habitats. In addition, habitat in the EBS totaling 3,087 km^2 was set aside as walrus haul-out area, protecting not only walruses but also the invertebrates that form the benthic habitat of that area.

Coral abundance is low in the EBS due to the scarcity of habitat (< 3% hard substrate) preferred by most corals other than sea pens. Directed studies (Sigler et al. 2015) and bottom trawl groundfish surveys (Hoff 2016, Conner et al. 2017) show the slope and outer shelf has significantly more coral species than the inner shelf but densities and coral biodiversity are low when compared to the adjacent AI region. A directed inventory study of sponges in the EBS during 2013-2015 demonstrated that this assemblage is much more diverse than previously believed for the EBS with > 75 species of demosponge alone and many species newly recognized to the EBS (Stone et al. 2019). This inventory study showed that the sponge taxa in the EBS (demosponges plus unidentified hexactinellid sponges) total more than twice currently known for the GOA and approximately half as many as the AI region.

The AKCSI conducted a significant field study in 2014 based on a request from the NPFMC to validate areas of coral concentrations for possible management measures for the conservation and management of deep-sea corals in Pribilof and Zhemchug canyons. A towed drift camera study was conducted at 250 random locations across the EBS slope and outer shelf examining coral abundance, diversity, size, and fish habitat associations. Researchers concluded that corals were predominantly located along the EBS outer continental slope edge from Pribilof Canyon to the southern part of Zhemchug Canyon. Sponge distribution was widely scattered along the EBS outer shelf and upper slope. They also concluded that canyons themselves were not the determining factor for coral distribution, but depth, latitude, and sediment type were more correlated with coral and sponge distributions (Sigler et al. 2015). Deep-sea coral and sponge research in EBS waters during the previous AKCSI (2012-2015) included the following:

- Determining the distribution of high abundance and diversity areas of deep-sea corals and sponges in the EBS outer shelf and slope region focusing on canyons through modeling and field surveys using towed/drift cameras.
- Collecting long-term data sets of oxygen and pH from bottom trawl surveys.

AKCSI Objectives

The objective of the 2020-23 AKCSI is to support research that addresses management needs and contributes to the conservation and protection of DSCS throughout the sub-Arctic waters of Alaska. This scientific research plan strives to address the information needed to understand and conserve important DSCS habitats and to leverage additional partnerships to integrate research priorities and resources. A focus is on field research and collection of new information on DSCS taxonomy, distribution, diversity, and life history, as well as natural and induced habitat changes. Specifically, research will address the priorities identified in the AKCSI priorities workshop report (Hoff et al. 2020).

Approach

To accomplish the objective, the AKCSI Steering Committee will align identified research priorities from the workshop with proposed projects. They will examine previously conducted coral and sponge research in Alaska and consult with scientists, NPFMC, industry stakeholders and local communities periodically as new or changing priorities develop. A combination of chartered commercial vessels, research cruises on NOAA ships and commercial vessels, and partnerships with federal, state, and Non-Government Organizations (NGO) partners will be used to accomplish the fieldwork goals and objectives.

The AKCSI will map, survey, and sample deep-water habitats. The information collected will be synthesized into products accessible to a broad audience and effectively communicated both internally and externally. Throughout the AKCSI, regular communication between the initiative's science team, the NPFMC, the AFSC directorate, and the DSCRTP will ensure that the initiative provides a real contribution to the management and informed protection of deep-sea coral and sponge ecosystems throughout Alaska.

Criteria for Prioritizing Projects

Research priorities for the 2021-2023 AKCSI were identified using a combination of research and management priorities. Projects addressing the priorities identified at the workshop were solicited from steering committee members and other principal investigators. Overall, six research priorities guided the development of the AKCSI science plan:

- Model validation of Gulf of Alaska coral and sponge distribution models using visual surveys that collect environmental and spatially-explicit biological data.
- Mapping of untrawlable habitats in the Gulf of Alaska and Aleutian Islands.
- Collection of life history information on corals and sponges to support population modeling.
- Use of eDNA for species distribution modelling and biodiversity studies, and other genetic techniques for taxonomy and connectivity modelling.

- Development of risk assessment models for corals and sponges in the GOA, AI, and EBS that take into account anthropogenic and climate effects.
- Investigation of recovery and susceptibility rates of corals and sponges to anthropogenic activities.

Given limited budget and ranking priorities, the AKCSI PIs will closely assess each project to provide the best use of resources to achieve the research goals. Higher priority projects a) address research priorities identified during the May 2020 workshop, b) have achievable goals and objectives in the available project time frame and c) have relevance to fisheries management and regional priorities.

Work Plan of Activities Supported by the AKCSI

Similar to previous DSCRTP initiatives in other regions, activities supported by the AKCSI will consist of the following:

- Research expeditions that survey, sample and map DSCS ecosystems.
- Research projects focused on analyzing DSCS data or samples.

Research expeditions and projects that will be supported by the AKCSI are summarized in Tables 1 and 2.

AFSC field activities were greatly reduced in 2020 with the advent of the COVID-19 pandemic. The quick rise in positive cases of the virus and the lack of knowledge about the virus, transmission, and effective treatments, made it difficult to create detailed effective travel and at sea safety plans. This resulted in cancelation of many of the surveys and research cruises scheduled to occur in Alaska (NOAA, United States Coast Guard, and National Science Foundation). Since May 2020, the NOAA Office of Marine and Aviation Operations (OMAO), AFSC, and many Alaska commercial fishing companies, have developed COVID-19 safety plans. These plans provide protocols for enhancement of safety at-sea operations including testing, quarantine, daily symptom monitoring and other operating procedures. However, there are still many remaining uncertainties that could affect fieldwork plans for 2021.

Given this uncertainty and the rapidly changing situation associated with COVID-19, the AKCSI PIs propose a reduced survey effort in 2021 to minimize the risk of lost time, effort, funding, and opportunities to fulfill the science plan. To accomplish this, research fieldwork will be minimized in 2021 to a 30-day GOA model validation cruise and a 3-4 day cruise to recover coral settlement plates. Both cruises require minimal scientists and vessel crew, limiting personnel involved. A larger effort with more sea days is planned for 2022.

Alternatively, if the AFSC remains in lockdown or travel and field research is limited in 2021, the AKCSI will focus on annotations of existing videos from previous Alaskan studies, continue sponge and coral field identification guide development, and work with in-hand specimens of coral and sponges for genetic, taxonomic, and life history studies.

Research Expeditions (Large, Vessel-Based Projects)

AKCSI research expeditions will conduct visual surveys to collect quantitative data to characterize DSCS communities and map deep-sea habitats. Specifically, visual surveys will collect data on the abundance, diversity, and distribution of DSCS communities. AKCSI research expeditions will also collect data on human impacts to coral and sponge ecosystems and gather biological data on coral and sponge reproduction, recruitment, and growth. Environmental DNA (eDNA) samples will be collected on research expeditions and be used to make presence/absence comparisons with visual observations of coral, sponge, and fish.

Subsequent to analyses, images, and other data (environmental, navigation and mapping) will be archived at the NOAA National Centers for Environmental Information (NCEI). Observations of corals and sponges will be archived and distributed through NOAA's National Database of Deep-Sea Corals and Sponges. Efforts will be made to conduct data analyses while at sea or immediately following research expeditions, and complete these no later than one year following expeditions. All expeditions are planned to be conducted in 2021-2022 (Table 1), so that efforts in the last year of the initiative (2023) can focus on summarizing results and report writing. If field expeditions need to be modified or canceled due to weather or COVID-19 pandemic, the possibility remains to shift some projects to other years or extend the AKCSI into 2024.

Validation of Coral and Sponge Distribution Modeling in the Gulf of Alaska

Investigators: Patrick Malecha NOAA, Gerald Hoff NOAA, Chris Rooper DFO Canada, Pam Goddard NOAA Affiliate, Rachel Wilborn NOAA Affiliate, Kresimir Williams NOAA, John Olson NOAA, Sean Rooney NOAA

Background and Justification

Effective management of deep-sea coral and sponge ecosystems in Alaska requires presence-absence, diversity, and abundance knowledge. The immensity of Alaska's marine waters necessitates the development of predictive models to best determine where sponges and corals are likely located, since not every site can be explored given available time and resources. Therefore, a systematic and analytical approach is needed to determine where coral and sponge ecosystems exist. This approach should accurately predict DSC presence or absence, diversity, and abundance. An important accomplishment of the previous AKCSI was the production of maps that predicted occurrence of DSCS on a 1 ha scale for each of the three major regions of Alaska -- the eastern Bering Sea, Aleutian Islands and Gulf of Alaska (Rooper et al. 2017, Rooper et al. 2014, Sigler et al. 2015). The maps and models created for the eastern Bering Sea (Rooper et al. 2016) and Aleutian Islands (Rooper et al. 2017) have been validated with visual observations in the field that confirmed that coral and sponge ecosystems occur at predictable locations where hard bottom substrate is present. The maps and models created for the Gulf of Alaska, based on trawl survey data, have not been validated with visual surveys. In 2021, a major component of analysis and fieldwork is designed to address this critical informational need. The objectives of this expedition are to collect density and size estimates for DSCS at randomly selected sites in the Gulf of Alaska and document species associations with fish and other invertebrates.

Design and Approach

Visual surveys will be conducted at 300 randomly selected stations in the Gulf of Alaska. The survey design will be stratified by depth, trawlability of the seafloor habitats (both untrawlable and trawlable sites will be surveyed), and model predictions of species presence and will occur from ~30 to ~900 m. At each station, we will deploy a stereo camera system and collect 15 minutes of on-bottom imagery from a random starting point, drifting with the prevailing current. Images will be analyzed by identifying and measuring (using stereoscopy) benthic invertebrates and fishes for determining the presence or absence of sponge and coral, species identifications, abundance, and size. Seafloor substrate type will also be recorded. Additionally, ES60 acoustic data that may be used to infer seafloor characteristics, water temperature data, and vessel trackline, depth and position data, will also be collected. In situ water samples will used for eDNA analyses that will be compared with the visual observations of corals, sponges, and fish.

Proposed Activities and Deliverables

Post-processing of seafloor images will begin as soon as the data are available and will be completed by the end of 2022. Post-cruise image analysis will be conducted to determine substrate types, DSCS species composition, density, and height. In 2023, products completed will also include the development of validated species distribution models/maps for the GOA using seafloor imagery, coral and sponge size data, and potentially eDNA presence/absence data. Species associations between benthic invertebrates and commercially important fishes will also be determined from both visual and eDNA observations. Should there be any unanticipated delays or fieldwork is not advised in 2021, the fieldwork can be postponed until 2022.

Assessing the Effectiveness of Area Closures for Maintaining Healthy Deep-Sea Coral and Sponge Communities

Investigators: Gerald Hoff NOAA, Patrick Malecha NOAA, Chris Rooper DFO, Kresimir Williams NOAA

Background and Justification

Alaska is home to some of the world's most diverse and abundant deep-sea corals and sponges (Stone and Shotwell 2007). The Aleutian Islands in particular are home to over 95 coral species representing 22 families (R. Stone, AFSC; personal communication) and over 100 species of sponges in four classes (Stone et al. 2011, Lehnert and Stone 2016), as well as some of the densest coral and sponge communities. Many commercially important fishes, including Pacific ocean perch and Atka mackerel, are associated with coral and sponge communities in the Aleutian Islands and throughout Alaska (Heifetz 2002, Malecha et al. 2005, Rooper and Boldt 2005, Rooper et al. 2007, Laman et al. 2015). In addition, coral and sponge communities are vulnerable to damage and removal by fishing gear (van Dolah et al. 1987, Auster et al. 1996, Heifetz et al. 2009, Tittensor et al. 2010). The recovery of damaged or removed communities may take decades or longer, since corals are long-lived and slow growing (Andrews et al. 2002, Andrews et al. 2009, Rooper et al. 2011).

Commercial fishing in the AI using bottom trawls, pelagic trawls, longlines, and pots target species such as Pacific cod, Atka mackerel, rockfish species, sablefish, golden king crabs, and halibut. In 2006, partly in response to concerns about vulnerability of coral communities to commercial fishing, area closures to mobile bottom contact gear were implemented throughout the Aleutian Islands. The closures effectively froze the footprint of the existing commercial fisheries. Additional areas identified as "coral gardens" (Stone et al. 2006) were also designated as closed to fishing. These fishing closures were implemented specifically to protect coral habitat (Fig. 3).

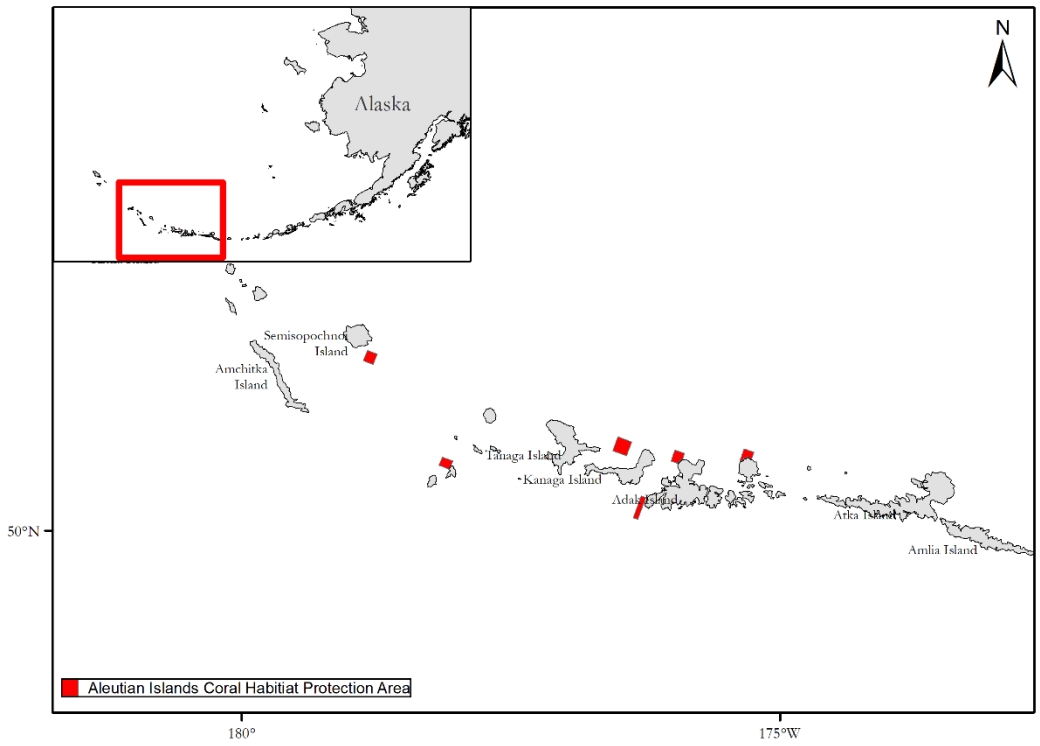

Figure 3. --Aleutian Islands coral habitat protection areas established in 2006 prohibit all types of fishing within the designated areas.

In addition to the coral habitat closures, other fishing closures to protect critical habitat for Steller sea lions have also been in place since 2003 (Fig. 4). These closures have been placed around rookery and important haul-out sites. Although they were not designed to protect coral habitat, they have effectively been refugia for benthic communities. Recent changes in regulations implemented in 2015 have resulted in changes for some boundaries of these Steller sea lion closures. These changes have allowed bottom trawling to occur within previously closed areas.

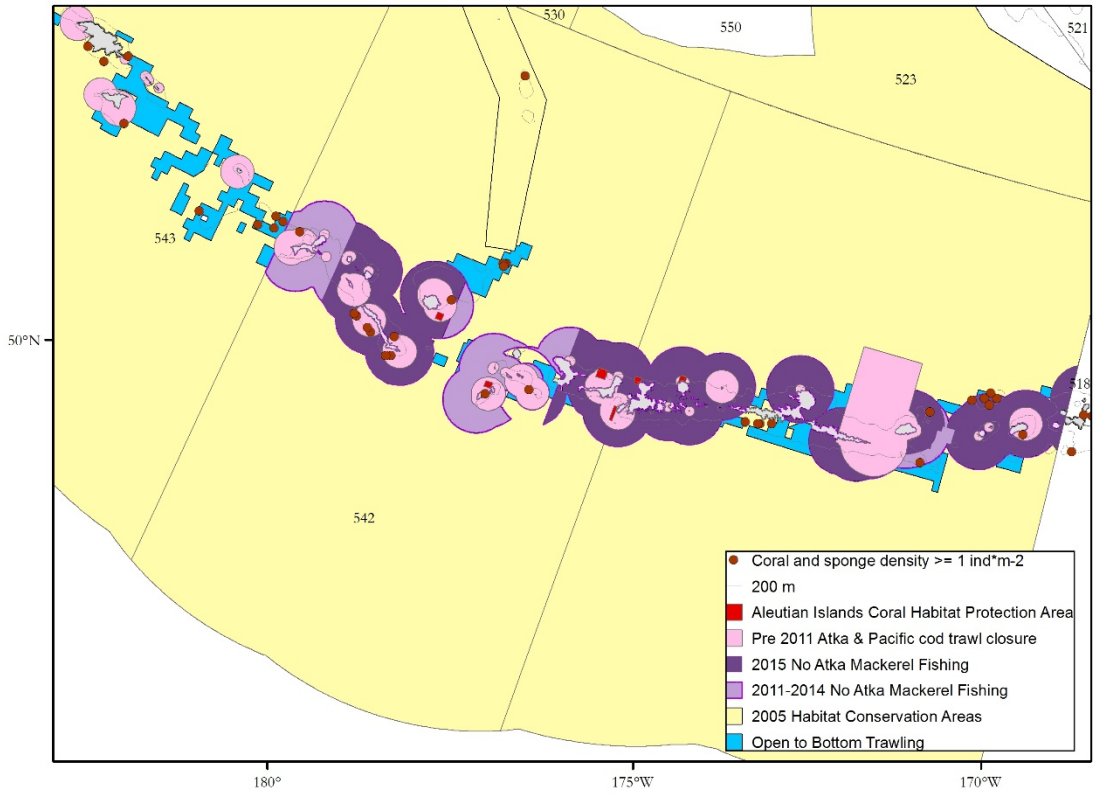

Figure 4. --Map of the Aleutian Islands showing habitat conservation area closures put in place in 2006, and the progression of fishing closures put in place in pre-2011, 2011 through 2014, and 2015 to present to protect Steller sea lions.

Since 2000, AFSC researchers have been conducting investigations of coral and sponge communities in the Aleutian Islands. These studies have used existing data from fisheries-independent bottom trawls to produce predictions of the distribution of coral and sponge communities (Rooper et al. 2014). The distribution modeling indicates that about half of the predicted coral habitat in the Aleutian Islands was protected from mobile bottom contact gear in the 2006 closure. The distribution modeling also highlighted areas of predicted high coral diversity and abundance near Seguam Pass, Kiska Island, and the area south of Amchitka Island. In 2012 and 2014, an underwater camera survey was conducted at random sites in the Aleutian Islands to verify model predictions (Rooper et al. 2017). This field study showed that areas of high-density coral were found throughout the Aleutian Islands and generally verified model predictions from bottom trawl survey data. Analysis of the underwater camera survey data further indicated that substrate type and availability of hard substrate were the primary factors determining the presence and abundance of corals (Goddard et al. 2017, Wilborn et al. 2018). These results were all consistent with previous research in the eastern Bering Sea (Sigler et al. 2015, Goddard

et al. 2016, Rooper et al. 2016). Importantly, the use of stereo-camera systems in the field study allowed collection of precise height information for corals (n > 6,000 individual colonies) observed in the Aleutian Islands, which provided estimates of the size structure of these populations by region, depth and habitat type. This data collection may be the first of its type from U.S. waters.

Two fundamental questions regarding coral habitat in the Aleutian Islands are as follows:

1) Is size, species composition, and incidence of injury of coral and sponge communities different between areas of mobile fishing gear closures versus where mobile fishing gear is allowed?
2) Is there evidence of recovery from fishing damage to coral and sponge communities within closures implemented in 2006?

The effectiveness of fishing closures implemented in 2006 has been identified as an "important (near term)" research priority for the North Pacific Fishery Management Council (Research Priority #184 - Evaluate efficacy of habitat closure areas and habitat recovery). This research project will seek to answer both of these questions using a combination of a new field study, vessel monitoring system data from the commercial fishery, and population parameters from literature studies. At the end of the study, we will synthesize these data sources to produce a stock assessment for corals in the Aleutian Islands that will provide preliminary estimates of sustainable bycatch rates for these communities. This would be the first stock assessment of coral in Alaska and perhaps the first for any northern temperate waters.

Design and Approach

The objectives of this project are to evaluate the effectiveness of fisheries closures to protect benthic habitat in the Aleutian Islands and western Gulf of Alaska. Specifically, we will address the following:

- Compare densities of corals and sponges in areas that were closed to mobile bottom contact gear to adjacent open areas where mobile bottom contact fishing has occurred since 2003 or 2005.
- Compare size structure of corals and sponges in closed and open areas.
- Compare incidence rates of damaged versus undamaged corals and sponges observed in closed and open areas and examine evidence of fishing in these areas.
- Examine patterns in fishing effort from vessel monitoring system (VMS) data and compare these to terrain metrics such as slope, depth and ruggedness to determine common habitat features among fished areas.
- Use available size data and estimates of growth rates from the literature to make the first estimate of sustainable harvest rates for corals in the Aleutian Island.

A field study to collect data will be conducted in summer 2022 at nine study locations. These study locations have been identified as having high densities of coral and sponge (> 1 colonies/ha) at multiple transects during the 2012 and 2014 underwater camera surveys (Wilborn et al. 2018). In addition to having high densities of corals and sponges, the nine selected sites are all located in areas that have adjacent bottom trawl tows targeting Pacific cod, Atka mackerel, or Pacific ocean perch. Ten or fifteen transect locations will be placed at each of the nine study sites, evenly split among areas closed to

fishing, areas with reduced fishing, and areas having continuous fishing (n = 5 per treatment) or evenly split among no fishing and reduced (n = 5 per treatment). To account for potential confounding factors, the depth ranges and substrate classifications for each treatment will be the same. For example, at a site where fishing is occurring over cobble-boulder habitats at 150-200 m depths, only the same types of habitat from non-fishing areas will be used for comparisons.

At each transect, the sampling tool will be a stereo drop-camera system (Rooper et al. 2016, Goddard et al. 2016, Wilborn et al. 2018) deployed from a chartered vessel. The stereo drop-camera system will be deployed to the seafloor and then will be towed or drifted along a transect with the prevailing current for 15 minutes of on-bottom time. Based on the sampling rate from 2012 and 2014, it is anticipated that ~10-15 transects can be sampled per day in the field using the stereo drop-camera in a concentrated area such as the study sites. Thus, approximately 12 days of survey time (including 1 day of mobilization and 1 day of demobilization) will be necessary to complete the project (~10-15 transects per day with a maximum of 125 total transects). Post-cruise image analysis will be conducted to determine substrate types, species abundance and individual target size.

Statistical analysis of the data will be completed using parametric tests such as analysis of variance and linear modeling. In addition to the tests of our main hypotheses, the data collected from transects will also be used to compute measures of diversity (the number of families or species of coral and sponge observed in each treatment). Community analyses looking at differences in community structure, such as ANOSIM, NMDS, and co-occurrence matrices will also be computed to examine any significant differences in the communities of corals and sponges among the treatments. Data collected during this study will be combined with data from previous AFSC studies and literature values to compute a simple biomass dynamic model of coral in the Aleutian Islands. Additionally, size data from stereo camera observations from this study and the 2012 and 2014 surveys will allow us to construct a population size structure for corals in the Aleutian Islands. Using size data and growth rates available for Alaska corals (Andrews et al. 2002, Andrews et al. 2009, Stone et al. 2017), we will improve our estimates of population recovery rates using coral size structures in the Aleutian Islands and literature-derived growth rates (Quinn and Deriso 1999). Sensitivity analyses will be conducted on all parameter values in the model. These sensitivity analyses will be used to place confidence intervals around important model parameters, and to determine where future research should be focused to reduce the uncertainty in population models for coral.

Since coral abundance and fishing effort are not uniformly distributed across the Aleutian Islands, we will include a spatial component in our modeling, using the biomass model to project coral population dynamics on discrete spatial scales. Using a spatially-explicit population model and including information on the seafloor characteristics that are important to fishing will allow some evaluation of the effects of future (and recent) management activities. A parallel analysis will model sponge population dynamics using the same techniques and the same types of data and modeling.

Proposed Activities and Deliverables

In 2022, a 14-day research expedition will occur in the Aleutian Islands area. This project will advance our knowledge of the effectiveness of existing mobile fishing gear closures by comparing coral and sponge populations within open and closed areas. The coral and sponge population modeling will provide information that could inform management decisions regarding the sustainability of current area closures. The population modeling will also be a tool to evaluate future changes in management and commercial fishing activity. In 2022-23, we anticipate delivering 1) two peer-reviewed manuscripts (one describing the effectiveness of open and closed areas at maintaining coral and sponge density, size, and community structure and one describing the coral and sponge population modeling and spatial modeling component), and 2) reporting of the findings to the NPFMC for potential incorporation into fisheries management policy (Plan Teams, Ecosystem Committee, and Scientific and Statistical Committee).

Joint Canada – USA Seamount Exploration in the Eastern North Pacific Ocean (SEENPO)

Investigators: DFO Canada: Chris Rooper, Janelle Curtis, Tammy Norgard, Cherisse Dupreez; NOAA USA: Gerald Hoff, Patrick Malecha

Background and Justification

Deep-sea coral and sponge distributions in United States, Canada, and international waters are relatively under-explored, with the exception of a number of studies conducted at the Cobb Seamount complex off Washington and southern British Columbia, and exploratory dives at two seamounts (Murray and Pratt) in the Gulf of Alaska. The fauna of deep-sea coral and sponge ecosystems changes with latitude, so that many of the species of coral and sponge in Alaska are different (and more diverse) than those found on the continental shelf of British Columbia and the U.S. west coast. The SGaan-Kinghlas (Bowie) and Cobb hot spot trails form a potential geological connection between the British Columbia continental shelf and the Alaska continental shelf that may exhibit latitudinal changes in deep-sea coral and sponge distribution and diversity. Partnering with Canada to understand the biogeography of seamount coral and sponge communities both within and outside the EEZ and from Washington to Alaska will contribute to better comprehension of inter-connectivity along the west coast of North America.

Historically (1970s-1990s) many of these offshore seamounts were fished by both domestic (Canadian and USA) and foreign (Russia, Korea, and Japan) fishing fleets. Currently, there is limited fishing at these seamounts in international waters only by the Canadian Sablefish longline trap fleet. The intersection between deep-sea coral and sponge distribution and fisheries is an ongoing concern of the North Pacific Fisheries Commission (NPFC), the Regional Fisheries Management Organization for international waters of the North Pacific Ocean (www.npfc.int). Both Canada and the United States are parties to the NPFC, which manages fisheries and is tasked with protecting vulnerable marine ecosystems, including deep-sea corals and sponges from significant and adverse impacts from fishing.

Thus, there is interest in the SGaan-Kinghlas Bowie and Cobb seamount chains, both in terms of their biological characteristics and for management issues related to international fisheries. In addition, the

recently held AKCSI workshop for prioritizing Alaska's new field initiative identified 1) the distribution of deep-sea corals and sponges on Gulf of Alaska and wider North Pacific Ocean seamounts and 2) deep-sea coral and sponge hotspots as a priority for conducting visual surveys. This project could also potentially address issues of climate change, genetic connectivity among coral populations, historical fisheries impacts and recovery rates and linkages between fished species and deep-sea corals and sponges, all of which were identified as priority areas of research for the 2020-2023 AKCSI. This project will also support the Canadian objective to collect baseline comparative data from seamounts outside Canada's marine protected areas that are still potentially experiencing fishing pressures.

Design and Approach

The fieldwork proposed here is designed to provide an assessment of the distribution of corals and sponges on a region-wide scale for seamounts of the North Pacific Ocean using visual survey tools in areas that have been previously unexplored. This fieldwork is proposed as a collaboration between Canada and the USA, with each providing support for the research.

The primary objective of this work will be to conduct a visual survey of eight seamounts (Fig. 5) in the SGaan-Kinghlas Bowie (4) and Cobb (4) seamount chains to determine the density, size, species composition, and diversity of deep-sea corals and sponges on the seamounts. In addition, visual survey will allow the collection of data on associated fish and invertebrate species and observe any damage to coral and sponge communities by historical fishing. The visual survey will be designed in a robust statistically sound method so that inferences about the deep-sea coral and sponge communities on seamounts can be made. This will be aided by the development of a distribution model for these seamounts using existing data sources derived from both Alaska and Canada.

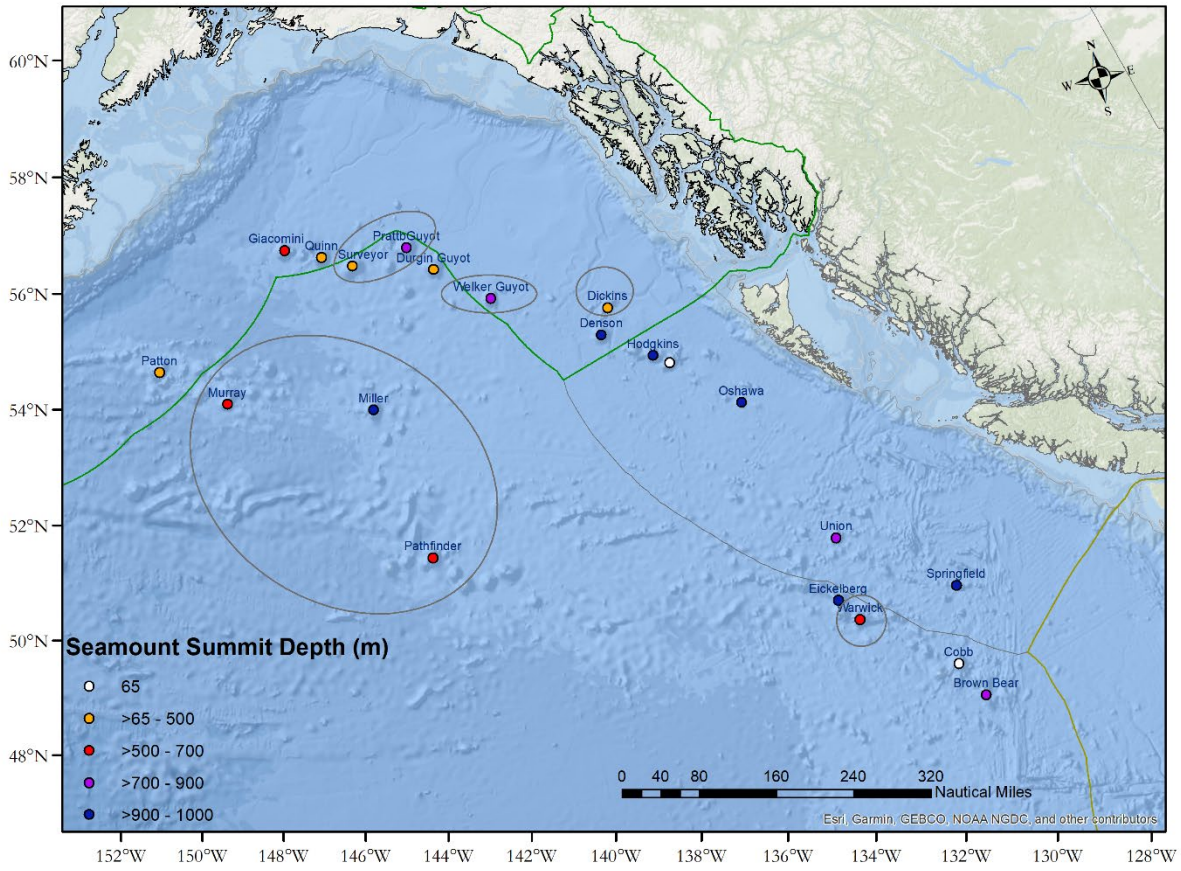

Figure 5. --Proposed study locations are on Murray, Miller, Pathfinder, Warwick, Surveyor, Pratt, Welker, and Dickens seamounts.

The secondary objectives will be to collect data for ancillary projects. We anticipate collecting data to compare physical conditions experienced by deep-sea coral and sponge communities at the seamounts. We also anticipate collecting water samples with adjoining images that can contribute to ongoing eDNA studies and taxonomic studies and ongoing studies of ocean acidification impacts. Acoustic data from scientific echosounders will be also be collected for benthic mapping.

Proposed Activities and Deliverable

In 2020-2021, distribution models of corals and sponges will be developed from existing data sources for the proposed study areas. The fieldwork will be conducted over 21 days during a research cruise in 2022. We will coordinate this work with the scheduled activities of a Canadian Coast Guard research vessel. The visual surveys will be conducted with a combination of towed and drop cameras and potentially with an autonomous underwater vehicle (AUV). We are proposing to conduct 24-hour operations during the cruise to maximize the number of visual transects obtained. Analyses of the visual and biological observations will commence at the conclusion of the research expedition. Report writing

will be completed in 2023 and deliverables will include documentation of the biological communities present, species distributions and associations, impacts from human activities, and an evaluation of preliminary species distribution models.

Recruitment, Reproduction, and Larval Supply of Alaska Deep-Water Corals

Investigators: Rhian G. Waller-Darling Marine Center, University of Maine and Hollings Marine Laboratory, SC; Peter Etnoyer and Bryan Costa, NOAA-NCCOS

Background and Justification

Basic biological and life history information are lacking for most coral and sponge species in Alaska waters. Information about reproduction, growth, and recruitment are all needed to more fully understand their population dynamics and responses to human and natural disturbances. The work described under this heading involves three interrelated projects that directly support the AKCSI. The projects address data gaps regarding rates of recruitment, growth, development, ocean acidification, and reproduction of corals and sponge.

In 2013 during the previous AKCSI, natural stone settlement plates were placed on the seafloor in close proximity to aggregations of *Primnoa pacifica* colonies. Portions of the plates were collected to look for recruits during the previous initiative after only a short duration on the seafloor. The initial observations of the retrieved plates did not yield any *P. pacifica* recruits but recruits of the holaxonian coral *Calcigorgia spiculifera* were observed. The plates were cleaned and returned to the seafloor near plates that were not retrieved. It has now been 7 years since the plates were originally placed on the seafloor. Since coral and sponge reproduction is believed to sporadic and episodic, recruitment to the plates is likely to be temporally variable, thus observations on a longer term are advised.

The effect of ocean acidification on the skeletal composition of stylasterid corals is poorly understood. In addition to potential skeletal changes, secondary effects on reproduction and growth may also occur. To understand acidification effects, live corals are necessary for laboratory experiments. Conveniently, near the settle plates, and perhaps upon them, are an array of stylasterid corals. Their availability will allow collection of live specimens that can be transported overnight to lab facilities for analytical observations under controlled environments.

There are currently over 600 Alaska coral and sponge specimens available at the Smithsonian Institution, California Academy of Sciences, and the AFSC with little literature published on reproductive processes of any of these species. A master's level graduate student will use these sources of specimens for reproductive analyses. The analyzed and published research will provide novel information about coral and sponge reproductive physiology and will be of great value for informing future studies, including investigations of human and natural disturbances and population dynamics (e.g., Feehan and Waller 2015, Fountain et al. in prep.).

Design and Approach

In 2021, we will return and retrieve the settlement plates with a small ROV equipped with a manipulator arm. The plates will be examined for coral and sponge to determine recruitment processes. Recruitment plates will also be analyzed for community composition (differences and similarities between plates and areas) and growth of corals present. As recruitment plates are collected, small sprigs of *P. pacifica* colonies will be collected in the vicinity and transported live to the Darling Marine Center where they will be induced to spawn so that fertilization and larval dynamics can be investigated.

In 2021, in association with the collection of the settlement plates described above, live stylasterid corals will be collected for husbandry and laboratory experiments. Collections may also occur as part of other AKCSI expeditions in the GOA or Aleutian Islands. Live stylasterids will ship overnight to the Hollings Marine Laboratory, SC, and be placed into long-term incubators at differing OA environments. Potential analyses will include skeletal density, growth and reproductive effects.

In 2021 and 2022, a graduate student at the University of Maine will conduct reproductive analyses of Alaska corals and sponges from either new AKCSI field collections or preserved specimens held at the Smithsonian, California Academy, and the AFSC. This project will happen in addition to either of the above projects, or as a standalone in the absence of any research cruises. If fieldwork is reduced or none is accomplished, the number of preserved specimens analyzed will be increased. Additional sources of samples from fisheries surveys will also be investigated to broaden the range of specimens.

Proposed Activities and Deliverables

In 2021, a vessel and ROV will be chartered to collect the settlement plates in the eastern Gulf of Alaska. Plates will be examined, and species compositions will be determined. If feasible, the plates will be cleaned and returned to the original locations on the seafloor. Sprigs of *P. pacifica* recovered from the plates or from nearby colonies will be collected and transported to the University of Maine for analyses of reproduction dynamics.

In association with the settlement plate work, live stylasterid corals will be collected and transported to the Hollings Marine Laboratory. Once there, they will be cultured under variable ocean acidification environments to determine developmental, growth, and reproductive effects.

Graduate work at the University of Maine will occur in 2021 and 2022. The graduate student will examine new and preserved coral specimens and will deliver published descriptions of Alaska coral and sponge anatomy, reproductive mechanisms, and characteristics. Specimens will be serially sectioned to identify males and females and internal anatomy described. Oocytes will be measured (allows assessment of oocyte stages, predictions of larval type, and potentially seasonality of gametogenesis) and fecundity of each species determined. Males will have spermatogenesis described and staged, to determine sexual maturity and male gamete development.

Mapping the Extent of Previously Identified Coral and Sponge Gardens and Exploration of Deep-Water Coral and Sponge Habitats on the NOAA ship *Okeanos Explorer*

Investigators: Gerald Hoff, Patrick Malecha

Background and Justification

Though it is beyond the timeline of other field projects, NOAA ship *Okeanos Explorer* is scheduled to be in Alaska waters in 2023 and is committed to providing support to the AKCSI. However, a detailed field schedule is not yet available and thus it is not known how much vessel time will be available to the AKCSI. For this reason, the AKCSI is planning to be flexible to accommodate the vessel's schedule yet fully utilize the time that is available. Two potential research expeditions are described in this section that could be executed if sufficient time is available on the *Okeanos Explorer*. Requests will be submitted in 2022 for ship time in 2023 using the NOAA VPASS system.

Previously collected data from stereo camera surveys and remotely operated vehicle (ROV) deployments between the years 2002-2014 identified 59 sites with high densities (>1 individual/m^2) of coral and/or sponge (gardens) in the central Aleutian Islands. At least 14 of these sites extend below 250 m depth. The extent of these diverse habitats and the zone of transition from high density to low density have not been quantified and only limited video data are available. When considering habitat protections such as habitat areas of particular concern, a thorough understanding of the size of these unique habitats is critical for informed management decisions. To delineate the extent of these known areas of high coral and sponge density and characterize the benthic communities within and near these areas, we propose surveying the 14 sites that extend below 250 m using the *Okeanos Explorer*, as time allows.

Additionally, we plan to utilize the *Okeanos Explorer* to extend the depth range of the seamount exploratory work described above and sample in habitats below the limits (approximately 900 m) of the drop camera systems. As the vessel is available, we will utilize its capabilities to produce detailed bathymetric maps of the seamounts, observe the deepwater communities, and collect imagery and samples with the vessel's ROV.

Design and Approach

NOAA's Office of Ocean Exploration and Research operates the *Okeanos Explorer*. The ship is equipped with advanced technologies to explore and characterize unknown or poorly understood deep ocean areas, features, and phenomena at depths ranging from 250 to 6,000 m. The ship utilizes four different types of sonars that collect high-resolution data about the seafloor and the water column, a dual-body remotely operated vehicle (ROV) capable of diving to depths of 6,000 m, and a suite of other instruments to help characterize the deep ocean. Expeditions typically consist of either 24-hour mapping operations or a combination of daytime ROV dives and overnight mapping operations. Once the field schedule for the *Okeanos Explorer* is more clearly defined, the AKCSI will formalize research plans that take advantage of the vessel's capabilities.

Proposed Activities and Deliverables

The fieldwork involving the *Okeanos Explorer* will occur in 2023. Detailed bathymetric maps will be created. Oceanographic data and water samples will allow observations of conductivity, temperature, and dissolved oxygen at depth, as well as eDNA analyses. Coral and sponge species composition, densities, size, extent, habitat associations, fish and other invertebrate associations, and evidence of human impacts will all be determined from ROV video observations.

Table 1. --Proposed research expeditions by NOAA Deep-Sea Coral Research and Technology Program's Alaska's Deep-Sea Coral and Sponge Initiative 2020-2023.

Expedition Title	Lead and Affiliation	Region	Expedition Dates	Vessel	DSCRTP Support
Validation of coral and sponge distribution in the Gulf of Alaska (sec. 4.1.1)	Patrick Malecha-AFSC/ABL	GOA	2021	Charter vessel-TBD	vessel support, camera system, travel, science personnel, video analysis
Recruitment, reproduction and larval supply of Alaska deep-water corals (sec. 4.1.4)	Rhian Waller-UMaine, Peter Etnoyer-NCCOS, Bryan Costa-NCCOS	GOA	2021-2023	Alaska Dept. Fish and Game (ADFG)-*Pandalus*	vessel support, ROV, travel, science personnel
Assessing the effectiveness of area closures to maintaining healthy deep-sea coral and sponge communities (sec. 4.1.2)	Gerald Hoff-AFSC/Seattle, Chris Rooper-DFO	AI	2022	Charter Vessel-TBD	vessel support, camera system, travel, science personnel, video analysis, support for AUV (SeaBed)
Joint Canada-USA seamount exploration in the Eastern North Pacific Ocean (sec. 4.1.3)	Gerald Hoff-AFSC/Seattle, Chris Rooper-DFO	GOA	2022	Canadian Coast Guard *Tully* or *Franklin*	vessel support, camera system, travel, science personnel, video analysis
Mapping the extent of previously identified coral and sponge gardens and exploration of deep-water coral and sponge habitats on the NOAA ship *Okeanos Explorer* (sec. 4.1.5)	Gerald Hoff-AFSC, Patrick Malecha-AFSC/ABL	GOA, AI	2023	NOAA Office of Ocean Exploration and Research OER)-*Okeanos Explorer*	research support, video analysis

Research Projects (or Small Projects in the Parlance of DSCRTP).

Small projects funded with DSCRTP research support will occur on vessels of opportunity such as the above-planned expeditions and the annual AFSC bottom trawl and longline surveys.

Genetic and eDNA Work to Support Studies in Taxonomy, Species Identification and Distribution, and Connectivity in Deep-Sea Corals and Sponges.

Investigator: Meredith Everett NOAA-NWFSC

This genetic work is in support of the overall research goals of the AKCSI. Specifically, this project will continue species identifications and development of sequence voucher libraries for corals and sponges in the Alaska region. Clear species identifications will be determined for specimens obtained from new field expeditions, as well as from AFSC surveys. Specimen identifications will be contributed to the deep-sea coral database and can be used for species distribution modeling and will support the development of a multi-agency, multi-region species identification guide. The ongoing improvement of voucher sequence libraries is also a key component of eDNA surveys, providing a clear reference database for identifying species to informative taxonomic levels. This work will also support AKCSI population connectivity studies of deep-sea corals and sponges.

The Influence of DSCS Ecosystems on the Life History of FMP Species in Alaska

Investigator: Christina Conrath NOAA-AFSC-Kodiak

It is often assumed structure-forming invertebrates provide valuable habitat that results in higher productivity of commercially important fish species. This is supported by observed associations (e.g., Stone 2014) and modeling (Rooper et al. 2018). The objective of this study is to test this assumption by examining growth and reproduction of commercially important fish species observed within and outside habitats containing coral and sponge. The proposed approach is to collect samples over broad spatial scales during AFSC bottom trawl surveys in the Gulf of Alaska in 2021 and the Aleutian Islands in 2022. Appropriate habitat areas in the Aleutian Islands will be identified using known coral areas identified during the 2012-2014 sampling period (Rooper et al. 2017). Identifying appropriate areas in the Gulf of Alaska will be more difficult but there are a few known areas (49 Fathom Pinnacle and Snakehead Bank), and additional ones can likely be identified using data collected in 2012-2014. Species examined will include, northern rockfish (*Sebastes polyspinis*), dusky rockfish (*S. variabilis*), Pacific ocean perch (*S. alutus*), and other species that occur regularly within these habitat areas. Parameters examined will include maturity, fecundity (when possible), reproductive failure, age structure, and condition.

Environmental DNA (eDNA) Collections for Identifying Fish Associations with Coral and Sponge

Investigators: Wes Larson, Patrick Malecha NOAA-AFSC-ABL

Environmental DNA (eDNA) is a relatively new but rapidly growing field of research. eDNA can be used as a surveillance tool to monitor for the genetic presence of aquatic species and determine biodiversity. The advantage of eDNA is that the presence or absence of an organism can be determined at various locations even if the organisms are not visible or able to be sampled. For cryptic and rare species, this makes eDNA highly advantageous and for deep-sea environments that are difficult and expensive to

observe, eDNA provides a relatively inexpensive and simple sampling mechanism. In addition to presence/absence information and measures of diversity, eDNA may provide insight into species associations between fish and structure-forming invertebrates, such as coral and sponge, which are poorly understood in deep-sea Alaska habitats. Furthermore, this technique may eventually be used to roughly quantify fish and structure-forming invertebrate population densities based on the strength of the eDNA signal. eDNA presence, absence, and signal strength will be compared with visual survey (e.g., GOA model validation expedition) analyses to reconcile species composition, diversity, and density of fish, coral, and sponge between the two types of observations. eDNA data will also be available for incorporation into or validation of species distribution models for fish, coral and sponge. These results will aid in identifying EFH and determining areas for protection such as habitat areas of particular concern. Water samples collected for the above-mentioned coral and sponge eDNA project will be shared with this project and collaboration between the two (NWFSC and AFSC) labs will facilitate sharing of these samples.

Refine Estimates of Longline and Pot Gear Footprints and Interactions with Corals and Sponges

Investigators: Patrick Malecha NOAA-AFSC-ABL, John Olson NOAA-AKRO

The objectives of this project are to obtain more accurate estimates of bottom footprints of longline and pot gears, as well as to examine the susceptibility of corals and sponges to these gears. Once determined, these values can be used to refine and improve the outputs from an already published fishing effects model. In the previous AKCSI, a project was funded to look at the impacts of longline gear on corals and sponges; however, success was limited due to the available camera technology. A benthic impacts camera system has been developed in Australia and is a proven system that can be attached to non-rigid fishing gears such as longlines, allowing direct observations of the gear as it interacts with benthic habitats. The footage can be used to determine the footprint of the gear, as well as susceptibility of benthic habitats, such as corals and sponges. This project will attach a benthic impacts camera system onto longline sets made on the AFSC longline survey in the Gulf of Alaska. Utilizing the survey provides a low-cost opportunity to deploy this technology for enhancing our understanding of fishery impacts on corals and sponges. This project may also be expanded to include in-kind support from Alaska Department of Fish and Game (ADFG), who operate pot and longline surveys across Alaska. Video review will be conducted using the Sebastes software package (Williams et al. 2016).

Risk Assessment of the Impacts of Commercial Fishing on Corals and Sponges in Alaska

Investigators: John Olson NOAA-AKRO, Scott Smeltz APU, Brad Harris APU, Chris Rooper DFO

There are very few Alaska-specific studies on the effects of fishing and the susceptibility of epibenthic organisms to fishing gears and their subsequent recovery. Grabowski et al. (2014) analyzed a number of existing studies relevant to the northeast U.S., but specifically excluded impacts on, and recovery of, corals in their review. The results from Grabowski et al. (2014) were parameterized for Alaska in the Alaska Fishing Effects model (Smeltz et al. 2019). Utilizing VMS data from the Catch-in-Areas database and outputs from the Fishing Effects model, the objective of this study is to develop a risk assessment for corals and sponges in Alaska utilizing the Ecological Risk Assessment for the Effects of Fishing

methodology (ERAEF, Hobday et al. 2007, 2011), likely at Level 2. The ERAEF is a framework developed in Australia and adopted by the Marine Stewardship Council. This method has a scoping phase and a three-stage analysis that rates fishing activities for their effects on five ecological components of the ecosystem: target species, byproduct and bycatch (non-target) species, threatened, endangered, and protected species, habitats, and ecological communities. The scoping phase describes the activities and management of the fishery and its ecological components and compiles all available data and information. The subsequent process becomes more complex with each of the three stages. Each level, however, screens out issues of low or lesser concern, so that the focus is on high-risk issues.

Developing a Coral and Sponge Field Guide for the Northeastern Pacific

Investigators: Gerald Hoff NOAA-AFSC, Rachel Wilborn NOAA Affiliate-AFSC, Meredith Everett NOAA-NWFSC, Sean Rooney NOAA-Kodiak, Chris Rooper DFO

This project will produce a single, comprehensive deep-sea coral and sponge guide that is applicable to British Columbia, Canada, and into Alaska, including the high arctic of the Chukchi and Beaufort seas. The Department of Fisheries and Oceans Canada and NOAA's Alaska Fisheries Science Center will collaborate to create the field guide. This project will integrate Alaska and British Columbia coral guides with guides created for Washington, Oregon, and California with the goal of producing a user-friendly field guide that is consistent across the entire Northeast Pacific Ocean. The completed field guide will provide needed taxonomic and genetic reference material that will aid in understanding species compositions in commercial fishery and survey catches in Alaska, which addresses an urgent priority of the North Pacific Fishery Management Council. The approach is to use existing work from regional efforts and assemble them into one comprehensive guide that meets current international standards for an image identification database (Howell et al. 2019). The finished field guide will use similar taxonomic descriptions, key characteristics, and levels of identification to provide a more transferable dataset across the entire region.

Sponge Identification and Genetics in the Gulf of Alaska (GOA) and Aleutian Islands (AI)

Investigators: Sean Rooney NOAA-AFSC-RACE, Meredith Everett NOAA-NWFSC

This project will catalog and identify voucher specimens collected during AFSC's Resource Assessment and Conservation Engineering Division's Groundfish Assessment Program's (RACE) biennial bottom trawl surveys in the Gulf of Alaska (summer 2021) and Aleutian Islands (summer 2022). Voucher specimens will be retained as bycatch during research bottom trawls. The specimens will be preserved for later identification and a small section will be collected for genetic sequencing. In addition to new field collections, the proposed research will also utilize historical specimens (approximately 200), collected during the 2017 and 2019 RACE surveys currently housed at AFSC's Kodiak Laboratory (Sean Rooney, AFSC-RACE). Specimen processing will take place from 2021 to 2023. Voucher specimens will be identified using morphological methods including a combination of light microscopy and scanning electron microscopy methods in consultation with morphological taxonomists (Helmut Lehnert, GeoBio-Center LMU München and Dorte Janussen Senckenberg Research Institute and Natural History Museum, Frankfort). Sequencing of vouchers for genetic markers will be conducted by Meredith Everett (NOAA-NWFSC). Creating a voucher collection for sponges with accompanying molecular barcodes to aid in

sponge identification is the intent. The resulting sequences and identifications will be made available through national databases including the DSCRTP National Database and Genbank. The molecular barcode collections will also be crucial to environmental DNA (eDNA) research activities and for providing reference datasets for identification. The outputs of this study will also contribute to existing efforts for developing a sponge and coral field guide for the Northeastern Pacific deep-sea.

Investigating the Influence of Edge Effects on Deep-Sea Coral Communities

Investigator: Ben Stablow George Mason University

This research would determine if species richness of invertebrates and fish, and average fish biomass, increases or decreases with distance from the edge of deep-sea coral ecosystems. This work would determine how relative abundances of different species or taxonomic groups of marine organisms vary along an edge-distance gradient. To answer these questions, a drop camera will be used to collect transect data on epibenthic invertebrates and fish. An autonomous plankton pump may also be used to collect data on larval assemblages. In the instance that there is a gradual transition between adjoining habitats rather than a well-defined edge, density of coral per m^2 of seabed will be determined using image analysis software, as an alternative metric to distance from the edge. A model will be developed to analyze spatial trends in the data, which will be mapped using GIS software. The model will then be used to predict how overall community composition changes with total area of a coral habitat. This work may provide critical insight into how bottom-trawling, and other stressors that diminish seafloor habitat, impacts the composition of deep-sea coral communities.

Collecting and Analyzing Alaska Deep-Sea Green Sponge Samples for the Discovery of Potentially New Pancreatic Medicines

Investigator: Kaya Mondry University of Wisconsin

The green sponge (*Latrunculia austini*) was discovered by NOAA scientists in deep waters of the North Pacific Ocean. Biomedical research at the Hollings Cancer Center at the Medical University of South Carolina and at the Henry Ford Cancer Institute in Detroit Laboratory demonstrated that molecules of the green sponge selectively target and kill pancreatic tumor cells. The green sponge covers an unprecedented chemical space; the structures of the molecules are not related to anything you would find on land or even in a tropical shallow-water marine environment. This project supports an internship that will allow scholar(s) to work with NOAA scientists, experience a deep-sea expedition to collect sponge samples, and to collaborate with a research medical facility to examine samples and potentially identify useful pharmaceutical and medical treatments. Scholar(s) will experience a research expedition cruise while collecting green sea sponge samples from deep-sea environments off the coast of Alaska during the summer of 2021. Samples would then be put on agar plates and sent to a lab located in the Medical University of South Carolina for examination.

Table 2. --Research projects and anticipated support by the NOAA Deep-Sea Coral Research and Technology Program's Alaska Deep-Sea Coral and Sponge Initiative in 2020-2023.

Project Title	Lead and Affiliation	Region	Project Dates	DSCRTP Support
Genetic and eDNA work to support studies in taxonomy, species identification and distribution, and connectivity in deep-sea corals and sponges (sec. 4.2.1)	Meredith Everett-NWFSC	All	2020-2023	support of genetic analysis, supplies, shipping, sampling equipment
The influence of DSCSE on the life history parameter of FMP species in Alaska (sec. 4.2.2)	Christina Conrath-AFSC/Kodiak	GOA/AI	2021-2022	vessel support, shipping, supplies, analysis
Environmental DNA (eDNA) collections for identifying fish associations with coral and sponge. (sec. 4.2.3)	Wes Larson-AFSC/ABL	GOA/AI	2021-2022	support of genetic analysis, supplies, shipping, sampling equipment
Refine estimates of longline and pot gear footprints and interactions with corals and sponges (sec. 4.2.4)	Patrick Malecha-AFSC/ABL, John Olson-AKRO	GOA/AI	2021-2022	vessel support, camera system, travel, science personnel, video analysis
Risk assessment of the impacts of commercial fishing on corals and sponges in Alaska (sec. 4.2.5)	John Olson-AKRO, Scott Smeltz-APU, Brad Harris-APU, Chris Rooper-DFO	GOA	2021-2023	in-kind support
Developing a sponge and coral field guide for the Northeastern Pacific deep-sea (sec. 4.2.6)	Gerald Hoff-AFSC/Seattle, Rachel Wilborn-AFSC/Seattle, Chris Rooper-DFO	GOA/AI/EBS	2020-2023	taxonomic identification, contractor support and publishing
Sponge identification and genetics in the GOA and AI (sec. 4.2.7)	Sean Rooney-AFSC/Kodiak, Meredith Everett-NWFSC	GOA/AI	2021-2023	taxonomic ID, shipping, genetic analysis
Investigating the influence of edge effects on deep-sea coral communities (sec. 4.2.8)	Ben Stablow-George Mason University	GOA/AI	2021	in-kind support, mentorships, provide video files
Collecting and analyzing Alaska deep-sea green sponge samples for the discovery of potentially new pancreatic medicines (sec. 4.2.9)	Kaya Mondry-UWisconsin	GOA/AI	2021	in-kind support, mentorships, provide samples

Deliverables and Products

Table 3. --Data products generated by expeditions and small projects of the Alaska Deep-Sea Coral and Sponge Initiative in 2020-2023.

Data Product Type	Ultimate Repository	Point of Contact	Submission Process
Final AKCSI report*	NOAA DSCRTP website	Gerald Hoff	Email PDF to robert.mcguinn@noaa.gov
Still images and video annotations of coral, sponge, and fish observations *	NOAA Deep-Sea Coral Data Portal	Project PI	Email or Google Drive XLS submission template: LINK; cc robert.mcguinn@noaa.gov, arvind.shantharam@noaa.gov
Image or videos associated with cruise/projects, include metadata within each folder*	NCEI	Project PI	Denise Gordon NOAA National Centers for Environmental Information 1021 Balch Blvd., Room 1003 Stennis Space Center, MS 39529 (228) 688-3984 (direct) (601) 337-1706 (cell)
All other cruise data	NCEI	Project PI	Denise Gordon (at the address above)
Genetic coral and sponge samples	Smithsonian National Museum of Natural History OR California Academy of Sciences	Meredith Everett, Sean Rooney	Samples initially processed at AFSC, Seattle as part of voucher specimen program. Give coral and sponge genetic samples to Meredith (in person). Mail sponge voucher specimens to: Sean Rooney 301 Research Court Kodiak, AK 99616
Biological samples collected during expeditions	California Academy of Sciences	Project PI	Specimens and metadata mailed to: Christina Piotrowski Collections Manager of Invertebrate Zoology California Academy of Sciences 55 Music Concourse Drive Golden Gate Park San Francisco, CA 94118

Data Product Type	Ultimate Repository	Point of Contact	Submission Process
Coral ID guide	NMFS, DFO	Rachel Wilborn, Meredith Everett, Chris Rooper	AFSC publications, DFO publications
Peer-reviewed publications	Scientific journals	ALL	Depends on journal. PDF copies will be mailed to robert.mcguinn@noaa.gov
Coral growth plates	NOAA Fisheries Juneau	Rhian Waller	Plates collected at sea will be transported to the Juneau lab.
Live coral colonies	NOAA Fisheries Juneau	Rhian Waller	Collect colonies at sea and ship to NOAA Fisheries Juneau, or Maine

*Notify Robert McGuinn and Arvind Shantharam when submitting data to NCEI or NOAA DSC Data Portal. Data submitted to Denise DiGiovanni-Gordon will be processed and sent to Robert and Arvind. Portable hard drives available.

Contributions to the Broader Community

List of Desired Samples and Data to Support External Research

Collected samples will be deposited at the National Museum of Natural History, Smithsonian Institution or California Academy of Sciences, so that they are available for further study to qualified researchers from around the world.

Opportunities for Undergraduate and Graduate Students

The NOAA Hollings Scholarship Program provides undergraduate students in science, technology, engineering, and mathematics fields an opportunity to complete paid nine-week internships in the summer months at a NOAA facility. The NOAA Office of Education provides funding for these internships, and any NOAA staff is eligible to host student interns if they can dedicate time to mentor students throughout the internship. We are anticipating accepting two Hollings Scholars and a graduate student to conduct research during the AKCSI. We are currently developing research plans with each of them providing guidance and mentorship to ensure success.

Outreach to Science and Public Communities

Fishing Communities and Management Organizations

We will periodically provide updates and presentations to the North Pacific Fishery Management Council and Ecosystem Committee as well as the AFSC Board of Directors when significant progress has been achieved.

We anticipate participating in local community seminar series and briefings throughout Alaska to provide updates and presentations on the AKCSI.

Scientific Community

Updating and adding pertinent information to the Deep-sea Coral Data Portal.

Attend scientific meetings such as the 8th International Symposium on Deep-Sea Corals in Edinburgh, Scotland, 2022.

Deep-sea coral and sponge presentation for the Alaska Fisheries Science Center Seminar Series, 2021-2022.

General Public

Works with AFSC Communications on live-blogging and newsletter articles.

Roles and Responsibilities

The AKCSI science team will consist of NOAA staff and NOAA-affiliated staff of multiple line offices. The NOAA science team will conduct a large portion of the work required to complete the research expeditions and projects outlined above, and will seek advice and support from experts outside of NOAA as necessary. The roles and responsibilities of each member of the NOAA science team and primary outside partners are outlined in Table 4.

Table 4. --Roles and responsibilities of the science team and primary outside partners of the NOAA Deep-Sea Coral Research and Technology Program's Alaska Deep-Sea Coral and Sponge Initiative in 2020-2023.

Name	Affiliation	Role and Responsibility
DSCRTP Leadership		
Tom Hourigan	NOAA NMFS/ OHC DSCRTP	Review science plan and data products; identify collaborative opportunities; ensure that science plan deliverables are met; communicate need for ship time to NOAA leadership.
Heather Coleman	NOAA NMFS/ OHC DSCRTP	Communicate with fishery management councils; transfer funds from DSCRTP to offices that will use them; maintain DSCRTP website updates; obtain budget and cruise information
AKCSI Leadership		
Gerald Hoff	NOAA NMFS/ AFSC	Prepare and execute science plan; budget science plan activities; lead 2022 Aleutian expedition.in open and closed areas (planning, execution, data analysis and reporting) , coordinate explorations on NOAA ship *Okeanos Explorer*; contribute and participate on other expeditions
Patrick Malecha	NOAA NMFS/ AFSC	Prepare and execute science plan; budget science plan activities; lead 2021 GOA model validation expedition (planning, execution, data analysis and reporting); lead longline and pot gear footprint research; contribute to and participate on other expeditions
Pamela Goddard	Lynker Technologies/ NOAA NMFS/ AFSC	Co-Coordinate: execution of budget and logistics with DSCRTP, workshop; initiative reporting requirements; annotation of video, and contribute to report writing

Name	Affiliation	Role and Responsibility
Rachel Wilborn	Lynker Technologies/ NOAA NMFS/ AFSC	Co-Coordinate: execution of budget and logistics with DSCRTP, workshop; initiative reporting requirements; annotation of video, and contribute to report writing
Vanessa Lowe	Lynker Technologies/ NOAA NMFS/ AFSC	Co-Coordinate: execution of budget and logistics with DSCRTP, workshop; initiative reporting requirements; annotation of video, and contribute to report writing
AKCSI Science Team		
John Olson	NOAA NMFS/ AKRO	Lead risk assessment of fishing impacts; lead incorporation of coral and sponge covariates into fishing effects model ; collaborate on longline and pot footprint research; lead data mining of archived imagery; participate on GOA validation cruise
Chris Rooper	DFO	Lead 2022 GOA seamount expedition (planning, execution, data analysis and reporting), coordinate CG ship time requests, lead data analyses of GOA model validation
Caitlin Adams	NOAA OER	Communicate needs of initiative to OER leadership; coordinate OER ship time requests; engage OER media team.
Jennifer Le	NOAA OER	Communicate needs of initiative to OER leadership; coordinate OER ship time requests; engage OER media team.
Christina Conrath	NOAA NMFS/ AFSC	Lead investigation of influence of deep-sea coral and sponge on life history parameters of FMP species
Bryan Costa	NOAA NOS/ NCCOS	Contribute to investigations of coral and sponge recruitment, reproduction, and growth
Rhian Waller	Univ. Of Maine	Lead investigations of coral and sponge recruitment, reproduction, and growth

Other Small Project Leads		
Sean Rooney	NOAA NMFS/ AFSC	Lead sponge identification project; participate on GOA validation cruise
Meredith Everett	NOAA NMFS/ NWFSC	Lead genetic taxonomy and identification of coral and sponge; lead eDNA coral and sponge investigations
Wes Larson	NOAA NMFS/ AFSC	Lead eDNA investigation of coral and fish association
Data Management		
Robert McGuinn	NOAA NCEI	Support data archival in national database in collaboration with NCEI; prior to cruises contact cruise leads and send out metadata cruise forms; after cruises collect reports and data.
Arvind Shantharam	NOAA NCEI	Support data archival in national database in collaboration with NCEI; prior to cruises contact cruise leads and send out metadata cruise forms; after cruises collect reports and data.

Budget

The total funds available to the AKCSI will be $200K in 2020, $1 million in each of 2021 and 2022, and $100K in 2023.

Acknowledgments

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Appendices

Appendix A. --Cruise Data Deliverables Guide

Cruise Data Deliverables Guide

Deep Sea Coral Research and Technology Program (DSCRTP)

Contact: Robert McGuinn, robert.mcguinn@noaa.gov, 301-713-4848

Introduction

The following is a checklist of the data and documents expected from all funded cruises of the DSCRTP. A short description of each deliverable follows the checklist. Examples and templates are also included where appropriate. The principal investigators (PIs) have primary responsibility for all deliverables. PI's should communicate directly with regional coordinators on the status of each deliverable. This document outlines the typical requirements and schedule of a cruise fully funded by DSCRTP. Modifications to the required products and delivery schedule should be agreed upon in advance between the PI and DSCRTP leadership and communicated to the DSCRTP data management team and regional coordinators. It is critical that products are delivered in a form suitable for public release on the deepseacoraldata.noaa.gov web portal. Issues regarding the timing of public release of data should also be discussed in advance of field activities.

Guides

- Guide 1: Regional Initiative
- Guide 2: Targeted Project
- Guide 3: Cruise Data
- Guide 4: Database Submission

Where to send?

Please send notifications about submission of data and reports to this email address: deepseacoraldata@noaa.gov.

If you have questions about the data submission process or reporting requirements please contact: Robert McGuinn - robert.mcguinn@noaa.gov, 843-762-8640

Any information that is too big to email (or share via Google Drive) should be sent via external hard drive, sd card, or thumb drive to the following address:

Denise Gordon
NOAA National Centers for Environmental Information
1021 Balch Blvd., Suite 1003
Stennis Space Center, MS 39529
denise.gordon@noaa.gov
(228)-688-3984

Checklist

Pre-cruise

- Fill out DSCRTP Pre-Cruise Survey: https://docs.google.com/forms/d/e/1FAIpQLSe2pW10koTqF3fT7ZPMJdTDTBSW0sbrFipjHZjJUiyCZetHxg/viewform (1 per cruise)
- Sign data management agreement (plus data embargo rules)
- Arrange to receive a DSCRTP hard drive to load cruise data

On disembarkation at the end of the research cruise

- Load Cruise File Structure to DSCRTP hard drive and the following cruise data:
  - Imagery: videos and photos (highlight, in-situ, and on deck)
  - Vessel (ship) and vehicle navigation (ROV, AUV, submersible, etc).
  - Raw multibeam bathymetry and backscatter data
  - Conductivity, temperature, depth profiler (CTD) and other sensor data
- Return hard drive to DSCRTP

Within 30 to 60 days from the end of the cruise

- Cruise report
  - Brief summary of cruise results in the form of a news release
  - Sample and dive logs as appendix
  - Highlight images

Within 1 year from conclusion of a cruise

- Processed multibeam maps
- Coral and sponge records from completed surveys (in the national database format)
- Fish annotations

Further Guidance on Deliverables

Pre-cruise

Data Input Form and Data Management Agreement

Description: Each cruise lead (PI or designated staff) is required to fill out a Data Input Form which includes a Data Management Agreement section. The Data Input Form is meant to capture a full detailed description of each data collection effort and will be used to populate formal metadata for archive and retrieval. The Data Management Agreement will establish a clear understanding between the data provider and the DSCRTP. The cruise lead has to option to complete the form themselves or work the DSCRTP data manager to complete the form.

Survey: Pre-Cruise Survey

On disembarkation at the end of the cruise

Cruise file structure
Description: Please load the cruise file structure zip onto the hard drive and unzip the file. The unzipped file structure needs to be used for the cruise files being loaded onto the hard drive.

Imagery: videos and photos
Description: All in situ video and still imagery from cruise and dives. Images should include an overlay showing horizontal and vertical geographic position and date/time (x,y,z, t), or alternatively an associated file that includes this information, referenced by run time and video file name.

Vessel navigation
Description: Horizontal geographic position and time stamp (x,y,z,t) from the vessel-based navigation system.

Vehicle navigation (ROV, AUV, submersible, etc)
Description: Horizontal and vertical geographic position (x,y,z) from the vehicle-based navigation system. This information must include a timestamp to enable linkage with other data products.

CTD and other sensor data
Description: Conductivity, temperature, depth (CTD) and other oceanographic sensor data from either downcasts made from ship, or instruments mounted on vehicles.

Raw Multibeam bathymetry
Description: The “raw” files from the sonar unit for archive and backup purposes.

Within 30 to 60 days from the end of the cruise/survey

Cruise Report (s)
Description: Brief report summarizing cruise accomplishments, highlighting relevant information for management applications, such as species observed, number of events (dives or tows), time on bottom, the number and types of samples collected. Includes sample and dive logs and highlight images with captions.

Sample log
Description: List of all physical specimens collected during the funded activity. Each individual sample log entry should include longitude and latitude in decimal degrees, depth in meters, dive number (EventID), time and date (UTC if possible), with unique labels of still images of the specimen in situ and on-deck (preferably with scale bar and SampleID within the photo). If providing sample images with the sample log, please provide a description of the file naming convention given to the image.

Dive log
Description: List of all observations from dives. Each individual dive log entry should include longitude and latitude in decimal degrees, depth in meters, dive number (EventID), time and date (UTC if possible), with links to still images if available.

Dive/tow summaries
Description: Bottom start and stop coordinates and times and dates for each dive, tow, or transect. These should each be assigned some unique identification information by the field team, typically alphanumeric, referred to as an "EventID".

Within 1 year from conclusion of a survey event

Processed Multibeam
Description: Grid-based bathymetric surfaces suitable for display and analysis in a GIS.

At the end of the 3-year project period(s)

Observations of fish
Description: Presence-only observations fish in the prescribed DSCRTP format, derived from the still photo and video analysis.

Coral and sponge observations for the DSCRTP National Database
Description: Presence only observations for corals and sponges in the prescribed DSCRTP format, derived from the still photo and video analysis.

Appendix B.--Data Submissions

Database Submissions

How to submit coral and sponge occurrence records to the National Database for Deep Sea Corals and Sponges

Contact: Robert McGuinn, robert.mcguinn@noaa.gov, 843-460-9696

Step 1

Before starting any DSCRTP-funded activity which will create new occurrence records for the National Database, please schedule a meeting with the DSCRTP data systems manager, Robert McGuinn, for both database. Robert will go over the data and reporting requirements in detail and answer any questions you may have. It will also be important to discuss the proposed survey methodology in detail with Tom Hourigan before beginning the cruises or annotating video or still images.

Step 2

Please review the NOAA Technical Memorandum describing the database here: https://deepseacoraldata.noaa.gov/internal-documents/program-guidance/science-team-guidance-for-data-management/database_intro.

Step 3

Download most recently updated data dictionary, published here: https://deepseacoraldata.noaa.gov/internal-documents/program-guidance/science-team-guidance-for-data-management/20170707.xlsx/view.

IMPORTANT NOTE: This data dictionary should be used as a reference ***instead of*** the one published in the appendices of the 2015 technical memo (linked above in Step 2). The data dictionary has changed since the publication of the memo.

Step 4

Note the taxa of interest to the program are outlined here: https://docs.google.com/document/d/1r8QVVw2VMmM1kZeGEGo6QVWSMCZFnWp-W54K6X3be4U/edit?pli=1. If you are annotating different organisms as part of your process, please alert us.

Step 5

Please download the Excel-based data submission template at the following location: https://deepseacoraldata.noaa.gov/internal-documents/program-guidance/science-team-guidance-for-data-management/dscrtp-database-records-submission-template.xlsx/view. Please carefully follow the instructions on 1st tab in the spreadsheet to properly fill out the template.

IMPORTANT NOTE: Please submit a ***small example dataset*** for program review prior to completing all of the data preparation work. This early review will save everyone a lot of time and rework.

U.S. Secretary of Commerce
Acting Agency Head
Wynn Coggins

Performing the duties of
Under Secretary of Commerce for
Oceans and Atmosphere
Benjamin Friedman

Acting Assistant Administrator for
Fisheries
Paul Doremus

February 2021

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