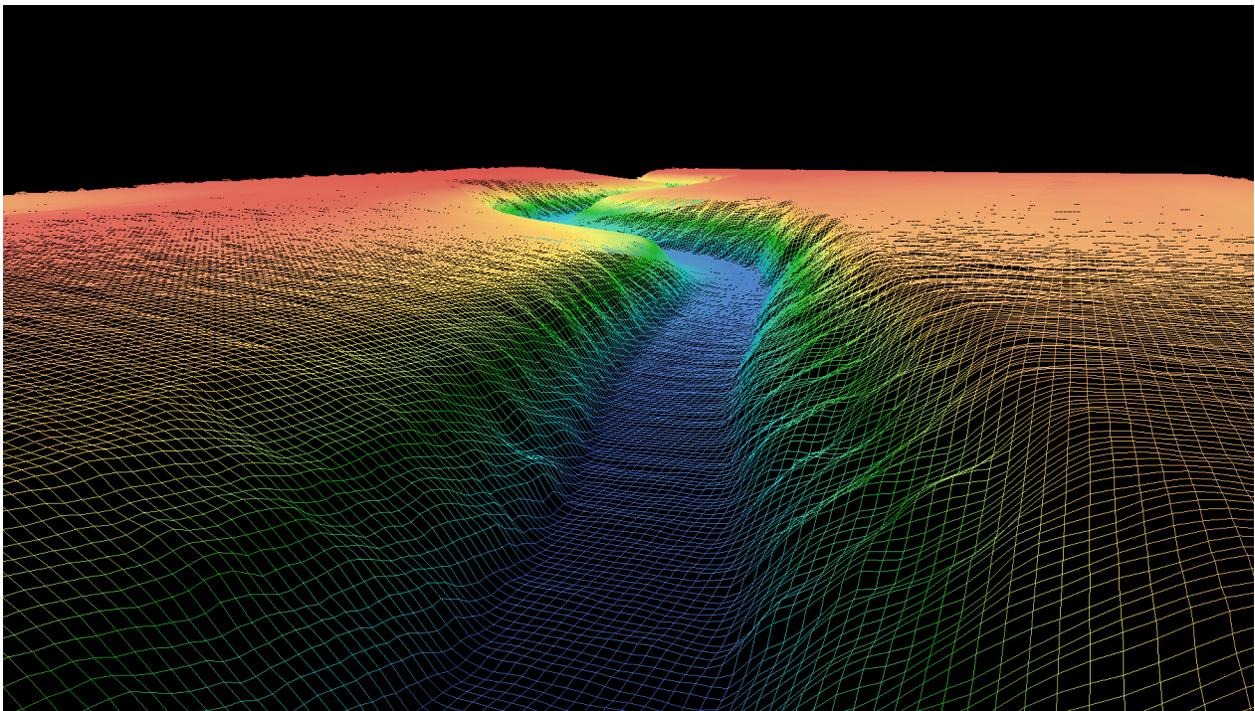


Expedition Report: EX2307, Seascope Alaska 6: Gulf of Alaska Transit Mapping



Authors: Abby Letts,^{1,2} Shannon Hoy,¹ Marcel Peliks,³ Bryce Dewees,² Trish Albano,¹ Evan Schneider,² Adrianna Ebrahim,³ Ingrid Martinson,³ and Jonathan Griffiths³

Affiliations:

¹ NOAA Ocean Exploration

² NOAA Office of Marine and Aviation Operations

³ University Corporation for Atmospheric Research

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Abstract

From September 23 – October 14, 2023 (Seward, Alaska to San Francisco, California), NOAA Ocean Exploration completed Seascope Alaska 6: Gulf of Alaska Transit Mapping (EX2307). Operations during this 22-day expedition included collection of 47,899 square kilometers of seafloor bathymetry (40,108 in the U.S. Exclusive Economic Zone). During mapping operations, NOAA Ocean Exploration simultaneously collected EM 304 multibeam sonar bathymetry observations and Simrad EK60/EK80 split-beam fisheries sonar observations of biologic material in the water column, as well as Knudsen 3260 sub-bottom profiler observations of sub-seafloor geologic structure and sediment. Focused survey regions included closing bathymetric gaps in the Gulf of Alaska, California, and off the coast of British Columbia, Canada. An additional focused survey in the Cascadia margin off the coast of Washington improved data quality in a region of interest for geological hazards. The exploratory mapping operations conducted during this expedition provide initial characterization of the region, as well as data to support further exploration. All data associated with this expedition have been archived and are publicly available through the NOAA archives.

Region of Operation: Gulf of Alaska; west coast of Canada, Washington, Oregon, and California

Ports: Seward, Alaska to San Francisco, California

Bounding Coordinates: 121.16°W, 35.92°N, 149.80°W, 60.69°N

Expedition Dates: September 23 - October 14, 2023

Expedition Type: Mapping

Theme Keywords: deep water mapping, Seascope Alaska, EXPRESS

Place Keywords: Alaska, Canada, Washington, Oregon, California, west coast

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For further information, direct inquiries to:

NOAA Ocean Exploration

1315 East-West Hwy, SSMC3 RM 2313

Silver Spring, MD 20910

Email: ex.expeditioncoordinator@noaa.gov



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1. Introduction

NOAA Ocean Exploration is dedicated to exploring the unknown ocean and unlocking its potential through scientific discovery, technological advancements, and data delivery. By working closely with partners across public, private, and academic sectors, we are filling gaps in our basic understanding of the marine environment. This allows us, collectively, to protect ocean health, sustainably manage our marine resources, accelerate our national economy, better understand our changing environment, and enhance appreciation of the importance of the ocean in our everyday lives.

With priority placed on exploration of deep waters and the waters of the U.S. Exclusive Economic Zone (EEZ), NOAA Ocean Exploration applies the latest tools and technologies to explore previously unknown areas of the ocean, making discoveries of scientific, economic, and cultural value. By making collected data publicly available in increasingly innovative and accessible ways, we provide a unique and centralized national resource of critical ocean information. And, through live exploration video, online resources, training and educational opportunities, and public events, we share the excitement of ocean exploration with people around the world and inspire and engage the next generation of ocean scientists, engineers, and leaders.

NOAA Ocean Exploration uses NOAA Ship *Okeanos Explorer* to conduct much of this work. Data collected by NOAA Ocean Exploration on NOAA Ship *Okeanos Explorer* in the Gulf of Alaska and U.S. West Coast will contribute to [Expanding Pacific Research and Exploration of Submerged Systems \(EXPRESS\)](#) and [Seascape Alaska](#). EXPRESS is a multiyear, multi-institution cooperative research campaign in deep-sea areas off California, Oregon, and Washington, including the continental shelf and slope. EXPRESS data and information are intended to guide wise use of living marine resources and habitats, inform ocean energy and mineral resource decisions, and improve offshore hazard assessments. Seascape Alaska is a multiyear, multipartner cooperative research campaign with an aim to create accessible, high-quality modern seabed data for Alaskan waters to support U.S. research, resource management, sustainable economic growth, and the health and security of Americans. The goal of Seascape Alaska is working to fully map the U.S. waters off Alaska through collaborative efforts among federal, tribal, state, and nongovernmental partners with a wide range of interests and dependencies on mapping data across coastal and ocean waters throughout the U.S. EEZ.

NOAA Ocean Exploration's expeditions on *Okeanos Explorer* contribute to the [National Strategy for Mapping, Exploring, and Characterizing the United States Exclusive Economic Zone](#) and [Seabed 2030](#).

2. Expedition Overview

From September 23 to October 14, 2023, NOAA Ocean Exploration and partners conducted a telepresence-enabled ocean exploration expedition on *Okeanos Explorer* to collect critical baseline information and improve knowledge about unexplored and poorly understood deepwater areas of the Gulf of Alaska, Canada, and U.S. west coast (EX2307). This expedition is part of a series of expeditions to support the Seascapes Alaska Campaign, building upon the following expeditions in the region: Seascapes Alaska 1: Aleutians Deepwater Mapping (EX2302), Seascapes Alaska 2: Aleutians Deepwater Mapping (EX2303), Seascapes Alaska 3: Aleutians Remotely Operated Vehicle Exploration and Mapping (EX2304), Seascapes Alaska 4: Gulf of Alaska Deepwater Mapping (EX2305), and Seascapes Alaska 5: Gulf of Alaska Remotely Operated Vehicle Exploration and Mapping (EX2306). This expedition also contributed to the EXPRESS campaign, building upon the following expeditions in the region: EXPRESS: West Coast Mapping 2022 (EX2208) and 2023 Shakedown + EXPRESS West Coast Exploration (EX2301).

During the 22 days at sea, 47,899 sq. km of bathymetric data were collected (see **Figure 1**). Section 5, of this document, provides details about the expedition schedule. A station log detailing the location of each operation conducted is provided as a supplemental file to this expedition report. Names, roles, and affiliations of science team members are in **Appendix A**.

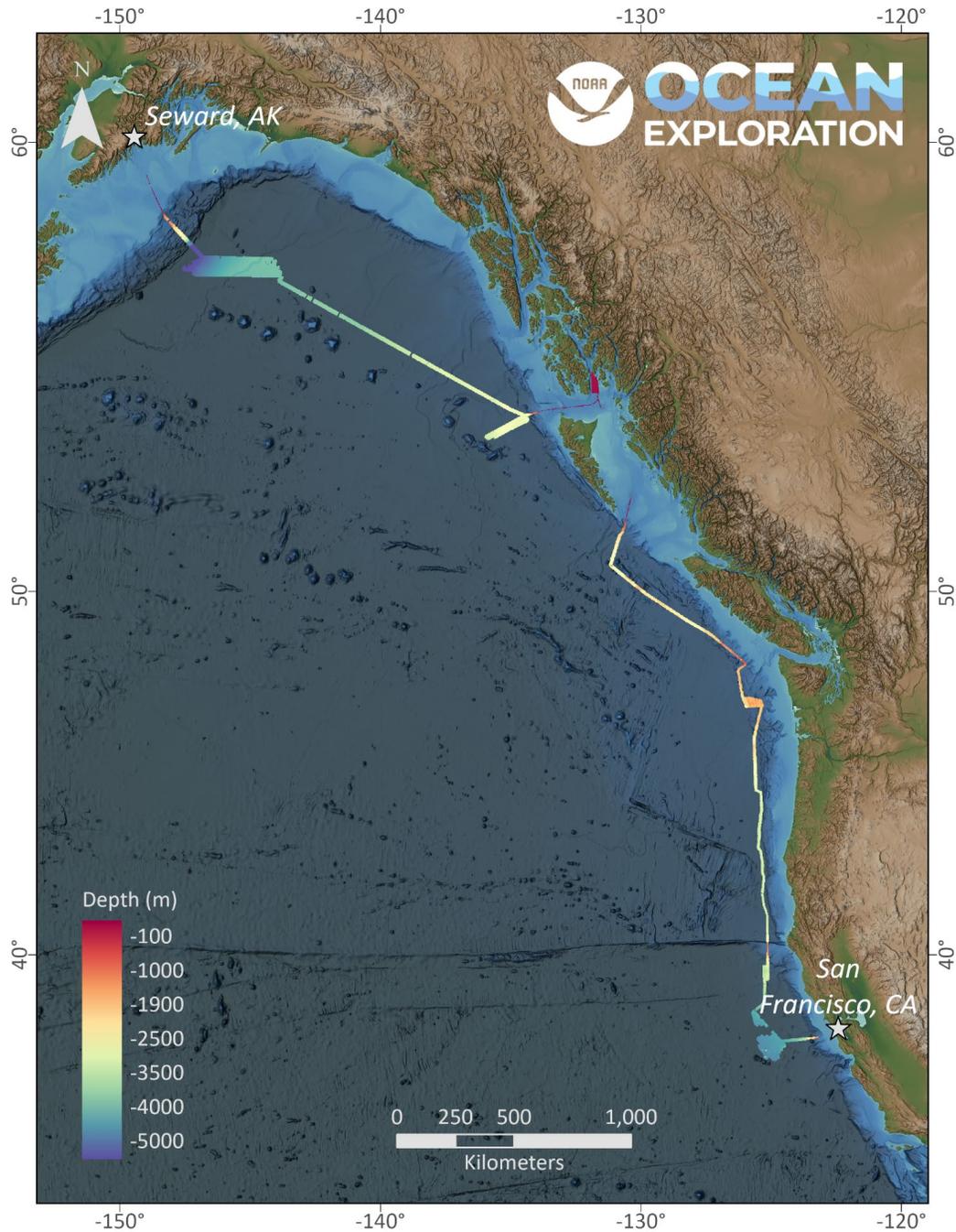


Figure 1. Bathymetric data collected during EX2307. Background image Digital Elevation Model from Esri, HERE, Garmin, FAO, NOAA, USGS, EPA.

2.1 Rationale for Exploration

As part of the planning for the EXPRESS and Seascope Alaska expeditions, NOAA Ocean Exploration collaborated with the ocean science and management communities to assess exploration needs and data gaps in unknown and poorly known areas of the U.S. west coast. To

define the operating area for this expedition, we considered the 2023 call for input, results from EXPRESS campaign meetings, the Seascape Alaska working group, and known priorities from resource managers.

The continental shelf, slope, and deepwater regions offshore California, Oregon, and Washington are rich environments, home to deep-sea corals, chemosynthetic communities, and other sensitive habitats, as well as marine geohazards that threaten coastal communities with earthquakes, landslides, and tsunamis. Among these environments are vast energy resources in the form of seafloor minerals, wind, and waves.

Mapping and exploring these deep waters results in critical baseline information that can be integrated into EXPRESS campaign core datasets to help guide wise use of living marine resources and habitats, inform ocean energy and mineral resource decisions, and improve offshore natural hazard assessments.

Alaska's coastline is longer than that of any other U.S. state or territory and is approximately one-third of the entire U.S. coastline. Despite representing the largest distinct region of the U.S. Exclusive Economic Zone (EEZ), Alaska's waters remain one of the least explored areas in the United States. According to the "Progress Report on Unmapped U.S. Waters" (IOCM 2023), only 34% of Alaskan waters had been mapped to modern standards (100-meter resolution) as of January 2023. Additionally, many of the deepwater habitats of the Gulf of Alaska, Aleutian Islands, and the Aleutian trench remain largely unexplored.

Mapping and exploring Alaska's deep waters will provide baseline information needed to sustainably manage these areas. Filling data gaps and increasing the understanding of this region has far-reaching benefits, including, hazard mitigation, preservation of marine habitats and heritage, a deeper comprehension of natural resources, and fisheries management.

Data and information from this expedition will support local scientists and managers seeking to understand and manage deep-sea resources, and stimulate subsequent exploration, research, and management activities.

This expedition contributed to ongoing collaborations with the U.S. Geological Survey (USGS) and the Bureau of Ocean Energy Management (BOEM).

2.2 Objectives

EX2307 addressed scientific themes and priority areas put forward by NOAA scientists and partners, including USGS and BOEM, and the broad ocean science and management communities. The primary objective of the expedition was to explore deepwater areas of the

U.S. west coast to provide baseline information to support science and management needs. Briefly, this expedition sought to:

- Collect high-resolution bathymetry in areas with no or low-quality mapping data.
- Map and survey geological features in the Gulf of Alaska, Canadian EEZ, and coasts of Washington, Oregon, and California to better understand the geological context of the region.
- Acquire a foundation of sonar and oceanographic data to better understand the characteristics of the water column and fauna that live there.
- Identify, map, and explore the diversity and distribution of benthic habitats.
- Engage a broad spectrum of the scientific community and the public in telepresence-based exploration.
- Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.

A full list of expedition objectives is in “Project Instructions: EX2307, Seascapes Alaska 6: Gulf of Alaska Transit Mapping” (Letts 2023).

3. Methodology

The primary systems used throughout EX2307 to accomplish objectives were:

- Sonar systems (Kongsberg EM 304 multibeam sonar, Knudsen 3260 sub-bottom profiler, Simrad EK60 and EK80 split-beam sonars, and Teledyne acoustic Doppler current profilers) to conduct seabed and water column mapping operations.
- A high-bandwidth satellite connection to provide real-time ship-to-shore communications (telepresence).

The following sections further detail the equipment and procedures used by NOAA Ocean Exploration during expeditions on *Okeanos Explorer*.

3.1 Acoustic Operations

Acoustic operations included Kongsberg EM 304 multibeam sonar, Simrad EK60 and EK80 split-beam sonar, Knudsen 3260 sub-bottom profiler, and acoustic Doppler current profiler (ADCP) data collection to map the seafloor, sub-seafloor, and water column. Standard survey operations included concurrent collection of multibeam, split-beam, and sub-bottom sonar data synchronized using a Kongsberg Synchronization Unit (K-Sync) with the EM 304 set as the master. The ADCPs were secured during standard surveying operations due to interference with other sonars. When mapping operations were secured (e.g. in water depths <200 m), the ADCPs were used to collect data.

Mapping operations were planned to maximize edge matching of existing data or to fill data gaps in areas with incomplete bathymetric coverage. In regions with no existing data, lines were optimized for potential discoveries and to complete relatively large continuous areas to support interpretation of features from bathymetry and backscatter. Targeted mapping operations were conducted in the Gulf of Alaska, Canada, and off the coast of Washington. Mapping operations occurred 24 hours/per day.

More information about general equipment calibration procedures, data collection, processing, reporting, and archiving is in the “NOAA Ocean Exploration Deepwater Exploration Mapping Procedures Manual” (Hoy et al. 2020).

3.1.1 Equipment and Data Collection Methods

Detailed descriptions of mapping equipment, annual calibrations, and capabilities on *Okeanos Explorer* are in the “NOAA Ship *Okeanos Explorer* Mapping Systems Readiness Report 2023” (Candio 2023). Any deviations from the readiness report are noted in the following sections.

Supplemental files may be added to the readiness report throughout the year if changes to the equipment are made, such as mid-season calibrations. Therefore, users of mapping data from EX2307 should refer to the 2023 readiness report to see if any supplemental files report changes that may affect their analysis.

3.1.1.1 Multibeam Sonar

Okeanos Explorer is equipped with a 26 kHz Kongsberg EM 304 MKII multibeam sonar. The multibeam sonar was used to collect seafloor bathymetry, seafloor backscatter, and water column backscatter. Bathymetric and seafloor backscatter data are stored in .kml files as beam-averaged backscatter values and as full time-series values (snippets) within each beam. Water column backscatter data are stored separately in .kmwcd files.

Throughout the expedition, mapping watchstanders monitored multibeam data quality in real time. Ship speed was adjusted to maintain data quality and sounding density as necessary, and line spacing was planned to ensure one-quarter to one-third swath-width overlap between lines, depending on the environmental conditions and impact on the quality of the outer swath regions. Angles in the Seafloor Information System (SIS) were generally left open to 65°/65° during transit to maximize data collection and were adjusted on the port and starboard sides to ensure the best data quality and coverage. If outer beams were returning obviously spurious soundings (e.g., due to attenuation or low grazing angle), beam angles were gradually reduced and monitored closely until a high-quality swath was obtained.

Real-time surface sound speed values were provided by a Reson SV70 sound velocity probe mounted in close proximity to the EM 304 transducer and were monitored in SIS for deviations

from the values determined by sound speed casts. Sound speed profiles were collected every four hours or more frequently as dictated by local oceanographic conditions (typically every three hours when operating in more dynamic areas).

Vessel positioning and attitude were measured by Applanix POS MV V5 and Kongsberg Seapath 380 positioning systems during data collection. This redundancy allowed for either system to be the primary source of positioning/attitude for the multibeam data in the event that one of them failed. Positioning/attitude data were applied to the multibeam data in real time and were stored in .kml files. The primary system used is noted in the processing logs.

Background data used to guide multibeam mapping operations included the Global Multi-Resolution Topography (GMRT) synthesis data set, the National Centers for Environmental Information (NCEI) [multibeam mosaic dataset](#), and bathymetry collected during Nautilus expeditions NA122 and NA130, and Revelle expedition RR2210.

3.1.1.2 Sub-Bottom Profiler

Okeanos Explorer is equipped with a Knudsen 3260 sub-bottom profiler with a central frequency of 3.5 kHz. This sonar was used to collect echogram images of shallow geological layers underneath the seafloor to a maximum depth of approximately 80 m below the seafloor. Phase, range, and gain were monitored and optimized for data collection. New files were created when changes were made to pulse lengths and/or power settings.

3.1.1.3 Split-Beam Sonars

Okeanos Explorer is equipped with a suite of five Simrad EK60 and EK80 split-beam sonars: three general purpose transceivers (GBTs), the 18, 120, and 200 kHz sonars, and two wide-band transceivers (WBTs), the 38 and 70 kHz sonars. These quantitative scientific echosounders were calibrated to identify the target strength of water column acoustic reflectors (e.g., deep scattering layers, fish, gas bubbles from seeps), providing additional information about water column characteristics and anomalies.

Calibrations were performed during EX2305, and these calibration values are most appropriate for the EX2307 dataset. The calibration files are archived with the sonar data, and the calibration report is available as a supplemental file to the 2023 mapping readiness report (Candio 2023).

The split-beam sonars were used continuously throughout EX2307 during 24/7 mapping operations.

3.1.1.4 Acoustic Doppler Current Profiler

Okeanos Explorer is equipped with two acoustic Doppler current profilers (ADCPs), a Teledyne Workhorse Mariner (300 kHz) and a Teledyne Ocean Surveyor (38 kHz). Depending on environmental conditions, the 300 kHz system provides ocean current data to a depth of approximately 70 m, and the 38 kHz system provides data to a depth of approximately 1,200 m.

3.1.2 Data Processing and Quality Assessment Methods

3.1.2.1 Multibeam Sonar Bathymetry and Seabed Backscatter

Full-resolution multibeam files (.kmall) were imported into QPS Qimera and then processed and cleaned of noise and artifacts. Outlier soundings were removed using multiple methods, including automatic filtering and/or manual cleaning with the swath and subset editing tools. The default sound speed scheduling method used was “Nearest-in-Time.” If another method was used, it was noted in the multibeam processing log that is archived with the dataset. Gridded digital terrain models were created using the weighted moving average algorithm and were exported in multiple formats using QPS Fledermaus. Daily bathymetric surfaces were created and sent to shore.

A final quality check of the data was performed on shore prior to submission to the archive. This involved additional fine cleaning of soundings and minimization of residual artifacts from sound speed biases and field-cleaning errors. Depth values from mainscheme line files (**Table 1**) were compared against crossline file “0371_20231004_010545_EX2307_MB.kmall” to evaluate the consistency of the multibeam sonar data collected during the expedition (**Figure 2**). A crossline analysis was completed using the Crosscheck Tool in QPS Qimera (**Table 2**) to evaluate the data against the Order 1 S-44 standards set by the International Hydrographic Organization (IHO 2008).

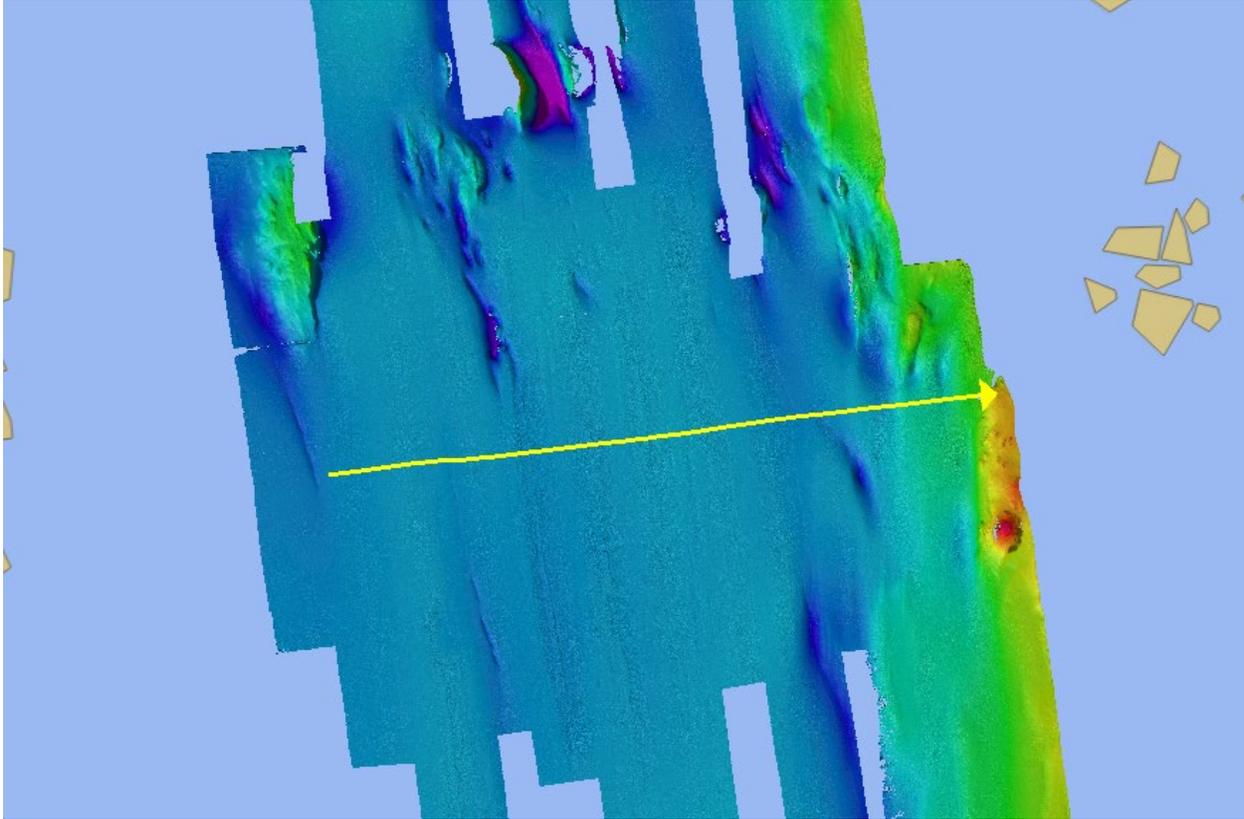


Figure 2. EX2307 crossline (shown in yellow) used for comparison against the bathymetric grid generated via orthogonal multibeam survey lines. In the bathymetric grid, red-yellow indicates shallow water depths and blue-violet indicates deep water depths.

Table 1. Mainscheme line files.

0295_20231002_102429_EX2 307_MB.kmall	0324_20231003_032516_EX2 307_MB.kmall	0350_20231003_145100_EX2 307_MB.kmall
0299_20231002_121855_EX2 307_MB.kmall	0325_20231003_033022_EX2 307_MB.kmall	0354_20231003_171910_EX2 307_MB.kmall
0300_20231002_131855_EX2 307_MB.kmall	0326_20231003_033711_EX2 307_MB.kmall	0360_20231003_211504_EX2 307_MB.kmall
0304_20231002_154935_EX2 307_MB.kmall	0327_20231003_034157_EX2 307_MB.kmall	0369_20231004_005312_EX2 307_MB.kmall
0309_20231002_183516_EX2 307_MB.kmall	0336_20231003_070300_EX2 307_MB.kmall	0370_20231004_010142_EX2 307_MB.kmall

0313_20231002_212534_EX2 307_MB.kmall	0343_20231003_100756_EX2 307_MB.kmall	0372_20231004_015855_EX2 307_MB.kmall
0318_20231003_000928_EX2 307_MB.kmall	0348_20231003_132820_EX2 307_MB.kmall	0373_20231004_020130_EX2 307_MB.kmall
0323_20231003_023932_EX2 307_MB.kmall	0349_20231003_142820_EX2 307_MB.kmall	

Table 2. Crosscheck results.

Statistic	Value
Number of Points of Comparison	2898741
Grid Cell Size (m)	10.000
Difference Mean (m)	-0.113767
Difference Median (m)	-0.083782
Difference Standard Deviation (m)	1.279375
Difference Range (m)	[-12.00, 8.02]
Mean + 2* Standard Deviation (m)	2.672517
Median + 2* Standard Deviation (m)	2.642532
Data Mean (m)	-397.468884
Reference Mean (m)	-397.355118
Data Z-Range (m)	[-445.58, -236.38]
Reference Z-Range (m)	[-443.07 -236.23]
Order 1 Error Limit (m)	5.189759
Order 1 # Rejected	2704
Order 1 P-Statistic	0.000933
Order 1 Survey	ACCEPTED

The results in **Table 2** confirm that the data collected meet International Hydrographic Organization Order 1 specifications for data quality.

Each line of cleaned full-resolution data was exported to a .gsf file (Level-01 data). The processed and cleaned files were used to create a static surface in QPS Qimera. This final surface was re-projected to the field geographic WGS84 reference frame in QPS Fledermaus and saved as an .sd file for archiving. Using QPS Fledermaus, this .sd bathymetric grid file was then exported as ASCII .xyz, color .tif, floating point .tif, and Google Earth .kmz files. The .gsf files were used to create daily backscatter mosaics using QPS Fledermaus FMGT.

All products maintain horizontal referencing to WGS84 (G1762) and vertical referencing to the assumed mean waterline (based on the waterline measured during the annual shakedown expedition). The draft values for *Okeanos Explorer* used during the expedition are in **Table 3** for the purpose of further post-processing, if desired by the user. Positioning data files for post-processing can be requested by sending an email to ex.expeditioncoordinator@noaa.gov.

Table 3. *Okeanos Explorer*'s draft at the beginning and end of EX2307.

Location	Start of Expedition (09/23/2023)	End of Expedition (10/14/2023)
Forward	15' 2.5"	14' 10.5"
Aft Starboard	16' 4"	15' 1"
Aft Port	16' 1"	15' 2"

3.1.2.2 Multibeam Sonar — Water Column

EM 304 water column files (.kmwcd) were reviewed in QPS FM Midwater or Qimera for anomalies (e.g., gas seeps and hydrothermal plumes). EM 304 files (.kmwcd) that include observed water column anomalies are flagged in the dataset's relevant processing logs. Locations of observed anomalies are provided in the data package (.shp and .csv files). All products maintain horizontal referencing to WGS84 (G1762) and vertical referencing to the assumed mean waterline.

3.1.2.3 Split-Beam Sonars

The EK data was not reviewed for anomalies. During acquisition, no anomalies were observed during this expedition.

Calibration reports and files are archived with the split-beam data.

3.1.2.4 Sub-Bottom Profiler

Using Natural Resources Canada's SEGYP2 software, the raw files (.sgy) from the sub-bottom profiler were processed for gain to produce the clearest image of sub-bottom layers. The gain processed files were converted to jpeg images (.jpg) and shapefile tracklines (.shp).

3.1.2.5 Sound Speed

Raw sound speed profiles collected from expendable bathythermographs (XBTs) were processed using HydrOffice Sound Speed Manager and archived as .asvp files.

3.1.3 Data Collection and Processing Software

Table 4 provides a list of the data collection and processing software versions used during EX2307.

Table 4. Versions of data collection and processing software used during EX2307.

Software	Purpose	Version
SIS	EM 304	5.11.1
EK80	EK suite	21.15.2
EchoControl	Knudsen	4.09
UHDAS	ADCPs	14.04
AMVERSEAS	Autolaunch XBT	9.3.6
WinMK21	XBT	3.0.2
K-Sync	Synchronization	1.9.0
Qimera	Bathymetry	2.5.3
FMGT	Backscatter	7.10.3
FM Midwater	Water Column	7.9.4
Sound Speed Manager	Sound Speed Profiles	2023.0.7
NRCan (SegJp2)	Sub-Bottom	1.0
Fledermaus 7	Visualization/Data Analysis	7.8.12

3.2 Sun Photometer Measurements

NOAA Ocean Exploration gathers limited at-sea measurements aboard *Okeanos Explorer* to support a NASA-led, long-term research effort that assesses marine aerosols. As time allowed on cloud-free days, onboard personnel collected georeferenced sun photometer measurements for the Maritime Aerosol Network (MAN) component of the Aerosol Robotic Network (AERONET). AERONET is a network of sun photometers that measure atmospheric aerosol properties around the world. MAN complements AERONET by conducting sun photometer measurements on ships of opportunity to monitor aerosol properties over the global ocean.

4. Environmental Compliance

General records of multi-expedition environmental compliance are in the “NOAA Ship *Okeanos Explorer* FY23 Field Season Instructions” as appendices (Cuellar 2023). Overviews of expedition-specific compliance activities are provided below. Copies of associated records of compliance are in **Appendix B**.

Pursuant to the National Environmental Policy Act (NEPA), NOAA Ocean Exploration is required to include in its planning and decision-making processes appropriate and careful consideration of the potential environmental consequences of actions it proposes to fund, authorize, and/or conduct. The companion manual (NOAA 2017) for [NOAA Administrative Order 216-6A: Compliance with the National Environmental Policy Act, et al.](#) describes the agency’s specific procedures for NEPA compliance.

An environmental review memorandum was completed for all *Okeanos Explorer* expeditions in 2023 in accordance with Section 4 of the companion manual in the form of a categorical exclusion worksheet. Based on this review, a categorical exclusion was determined to be the appropriate level of NEPA analysis necessary, as no extraordinary circumstances existed that required the preparation of an environmental assessment or environmental impact statement. NOAA Ocean Exploration is preparing a programmatic environmental assessment to cover future expeditions.

5. Schedule

Table 5 provides a day by day breakdown of EX2307.

Table 5. EX2307 schedule.

Date (UTC)	Activity
9/21-9/22	Mobilization in Seward, Alaska
9/23	Departure; transit mapping
9/24	Priority area mapping in the Gulf of Alaska
9/25	Priority area mapping in the Gulf of Alaska
9/26	Priority area mapping in the Gulf of Alaska
9/27	Priority area mapping in the Gulf of Alaska
9/28	Transit mapping across the Gulf of Alaska; live interaction webinar
9/29	Transit mapping across the Gulf of Alaska
9/30	Priority area mapping off the coast of British Columbia, Canada
10/1	Priority area mapping off the coast of British Columbia, Canada; transit mapping towards weather avoidance area in the Clarence Strait south of Ketchikan, Alaska
10/2	Mapping polygon in weather avoidance area
10/3	Mapping polygon in weather avoidance area; transit through Queen Charlotte Sound, no mapping as depths <200 m
10/4	Transit mapping towards priority polygon off the coast of Washington

Date (UTC)	Activity
10/5	Transit mapping towards priority polygon off the coast of Washington
10/6	Mapping priority polygon off the coast of Washington
10/7	Mapping priority polygon off the coast of Washington; transit mapping towards priority polygon off the coast of Oregon
10/8	Transit mapping through priority polygon off the coast of Oregon
10/9	Transit mapping off the coast of California
10/10	Mapping priority polygon off the coast of California
10/11	Mapping priority polygon off the coast of California
10/12	Mapping priority polygon off the coast of California
10/13	Mapping priority polygon off the coast of California; transit mapping.
10/14	Transit mapping; arrival in San Francisco, California.
10/15 - 10/16	Demobilization. Mission team departure.

6. Results

This section details the results of EX2307. Metrics for the expedition’s major scientific work are in **Table 6**. A station log detailing the location of each operation conducted is provided as a supplemental file to this expedition report.

Table 6. Summary of scientific metrics for EX2307.

Metrics	Totals
Days at Sea	22
Linear km Mapped by EM 304	3216
Sq. km Mapped by EM 304	47,899
Sq. km Mapped by EM 304 in U.S. Waters	40,108
XBT Casts	120

6.1 Acoustic Operations Results

NOAA Ocean Exploration mapped 47,899 sq. km of seafloor during the 22 days at sea for EX2307. Of the 47,899 sq. km mapped, 40,108 sq. km was deeper than 200 m and within the U.S. Exclusive Economic Zone and Territorial Sea.

Acoustic mapping data is sent to the NOAA archives within 120 days of the end of an expedition. The 2023 mapping readiness report describes the data archived for each dataset, including file formats (Candio 2023). Information about proprietary software and freeware that can handle the varying data types is in the “NOAA OER Deepwater Exploration Mapping Procedures Manual” (Hoy et al. 2020). **Appendix C** provides excerpts about mapping operations from daily situation reports to provide situational awareness for future users of the data collected during EX2307.

6.2 Engagement

EX2307 engaged with audiences around the world, opening a window of understanding into the deep sea. Highlights included:

- Live video feeds received nearly 13,200 views during EX2307.
- Held a live interaction through the NOAA Live! Alaska webinar series that engaged 698 people, 615 of whom were students.

7. Data Access

All data collected during NOAA Ocean Exploration expeditions and associated products are made publicly available via the NOAA archives and NOAA’s National Centers for Environmental Information (NCEI). Data collected by NOAA must be covered by a data management plan to ensure they are archived and publicly accessible. The data management plan for EX2307 is in the “Project Instructions: EX2307, Seascape Alaska 6: Gulf of Alaska Transit Mapping” (Letts 2023).

The primary tools for accessing data collected during this expedition and archived at NCEI are the [NCEI data access landing pages](#) and the [NOAA Ocean Exploration Data Atlas](#). Refer to the [NOAA Ocean Exploration Data Access web pages](#) for help navigating expedition data. Other resources include the [NOAA Ocean Exploration Data \(NCEI\) ArcGIS online group](#), which provides access to all NOAA Ocean Exploration geospatial data services managed by NCEI, including the geospatial data layers found in the data atlas, and the [NOAA Ocean Exploration Data Management website](#).

NCEI makes data publicly available over time as quality-control measures are completed, data are released, and publications and related materials are published. Thus, not all data and products will be made available at the same time. To access data and products from EX2307 that aren’t yet public, request assistance by submitting a [data request form](#) or sending an email to oer.info.mgmt@noaa.gov.

7.1 Digital Data/Product Locations

The locations for directly accessing specific types of digital data collected during EX2307 and products documenting expedition results are provided in **Table 7**.

Table 7. Online locations for direct access to digital data collected during EX2307 and products documenting expedition results (at the time of writing this report).

Data/Product Type	Description
EM 304 Bathymetry and Backscatter Data	EM 304 bathymetric and backscatter data, supporting informational logs, and ancillary files are available through NCEI's Bathymetric Data Viewer POSPac and BS correction files can be requested from oar.oer.exmappingteam@noaa.gov
Water Column Data (EM 304 and EK60/EK80)	EM 304 and EK60/EK80 water column data, supporting data, and informational logs are available through NCEI's Water Column Sonar Data Viewer
Knudsen 3260 Sub-Bottom Profiler Data	Sub-bottom data, supporting data, and informational logs are available in NCEI's Trackline Geophysical Data Viewer
Sound Speed Profiles	Ancillary sound speed profiles are available with the mapping data through NCEI's Bathymetric Data Viewer .
Oceanographic Dataset	Oceanographic Data and Products are available from NCEI. These data include data from shipboard sensors, including navigational data, meteorological data (wind), and oceanographic data (bathythermograph, sound velocity probe, thermosalinograph); additional data and products include profile data (CTD and XBT), event logs, images, ROV ancillary data, and sample data.
Sun Photometer Measurements	Sun photometer measurements are available through NASA's Marine Aerosol Network
Reports and Papers	Reports and peer-reviewed papers are available through the NOAA Ocean Exploration Library Guide and the NOAA Institutional Repository

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Appendix A: EX2307 Science Team Members

Onboard mission personnel during EX2307 are listed in **Table A1**.

Table A1. EX2307 onboard mission team personnel.

Name	Role	Affiliation
LTJG Abby Letts	Expedition Coordinator	NOAA Ocean Exploration
Hoy, Shannon	Mapping Watch Lead	NOAA Ocean Exploration
Albano, Trish	Mapping Watch Lead (in training)	NOAA Ocean Exploration
Peliks, Marcel	Mapping Watch Lead	University Corporation for Atmospheric Research
Aragon, Fernando	Global Foundation for Ocean Exploration Team Lead	Global Foundation for Ocean Exploration
Durbin, Mark	Data Engineer	Global Foundation for Ocean Exploration
Ebrahim, Adrianna	Explorer in Training	University Corporation for Atmospheric Research
Martinson, Ingrid	Explorer in Training	University Corporation for Atmospheric Research
Griffiths, Jonthan	Explorer in Training	University Corporation for Atmospheric Research

Appendix B: EX2307 Environmental Compliance Documentation

NEPA Categorical Exclusion Evaluation

Categorical Exclusion (CE) Evaluation Worksheet

Project Identifier: EX2307

Date Review Completed: 7/20/2023

OAR NEPA Project Lead: Amanda Maxon, Environmental Compliance Specialist, Contractor, NOAA Office of Ocean Exploration and Research

OAR Functional Area: OER

Worksheet File Name: 2023-07-OER-G3-EX2307

Step 1. CE applicability

- 1. Is this federal financial assistance, including via grants, cooperative agreements, loans, loan guarantees, interest subsidies, insurance, food commodities, direct appropriations, and transfers of property in place of money?**

no

- 2. What is the proposed federal action?**

The proposed action is the NOAA's Office of Exploration and Research (OER) to complete a transit mapping expedition using the NOAA Ship Okeanos Explorer scientific deepwater sonar systems (Kongsberg EM 304 multibeam, Simrad EK60 and EK80 split-beam sonars, Knudsen 3260 Chirp sub-bottom profiler, and Teledyne acoustic Doppler current profilers) and expendable bathythermograph (XBTs). EX2307 Seascape Alaska: Gulf of AK (Transit Mapping) will depart from Seward, Alaska on September 23, 2023 and will conclude in San Francisco, California on October 14, 2023 for around 22 days at sea. The exact start and end dates may vary by a few days to a few months depending on weather and other logistical considerations.

During EX2307, the proposed actions of the expedition include acoustic exploration mapping operations for areas generally deeper than 200 m in Canada and U.S. waters offshore of Alaska, Washington, Oregon, and California and adjacent waters of the high seas as the EX transits to San Francisco, California. Mapping operations will be conducted at depths between 200 m and 6,000 m. In case of poor weather, the transit to San Francisco, California will go through the Inside Passage located within Canadian

waters. No scientific operations would take place during the contingency plan through the Inside Passage located in Canadian waters. This action has independent utility and has not been inappropriately segmented from a larger action for review.

3. Which class of CE in Appendix E of the NAO 216-6A Companion Manual is applicable to this action and why?

- a. G3: Topographic, bathymetric, land use and land cover, geological, hydrologic mapping, charting, and surveying services that do not involve major surface or subsurface land disturbance and involve no permanent physical, chemical, or biological change to the environment.
- b. The topical scope for this action is consistent with the CE number G3 in Appendix E of the Companion Manual to NOAA Administrative Order (NAO) 216-6A: Topographic, bathymetric, land use and land cover, geological, hydrologic mapping, charting, and surveying services that do not involve major surface or subsurface land disturbance and involve no permanent physical, chemical, or biological change to the environment. EX2307 will conduct mapping operations using the active acoustic sonars which would involve no permanent physical, chemical, or biological changes to the environment in areas deeper than 200 meters in depth throughout the expedition. XBT are dropped over the side of the ship collecting data to accurately plot depth measurements used by the multibeam sonars to create a profile of the water column within the area of interest. EX2307 will focus on performing mapping survey operations between Seward, Alaska and San Francisco, California which would not involve surface or land disturbance causing permanent changes to the environment

Step 2. Extraordinary Circumstances Consideration

4. Would the action result in adverse effects on human health or safety that are not negligible?

The acoustic exploration mapping operations of the NOAA Ship Okeanos Explorer will take place in remote deep-sea (>200m) areas located offshore the U.S. waters of Alaska, Oregon, Washington, and California, offshore Canada, and in adjacent waters of the high seas. All acoustic exploration mapping operations by the EX are underwater and will have no human presence in the area besides those on onboard the EX2307. The vessel will transit through different depths as it moves from the ports of call to the areas of operations in deeper waters. These actions do not involve any procedures or outcomes known to result in impacts on human health and safety.

5. Would the action result in adverse effects on an area with unique environmental characteristics that are not negligible?

While the Okeanos Explorer is operating within the U.S. EEZ where majority of operations would take place, the effects will be negligible as acoustic mapping operations are considered transient and would not cause any permanent or direct impacts on the seabed or within the water column. The procedures that are employed when operating acoustic and ROV systems impacts are well-documented and would follow the accepted industry standards and best management practices for all operations onboard the vessel that have been tested to ensure that the level of impact is below minor to the point of being barely detectable. Expedition operations are planned and reviewed before any actions are taken in order to determine whether there would be the potential for adverse effects on the area.

6. Would the action result in adverse effects on species or habitats protected by the ESA, MMPA, MSA, NMSA, or MBTA that are not negligible?

The activities are not likely to have a negative effect on species or habitats protected by the ESA, MMPA, MSA, NMSA, or MBTA. According to NOAA Fisheries, there are 7 ESA endangered and threatened species found along Alaska, Canada, and the United States. The Okeanos Explorer operations will abide by the Best Management Practices and Mitigation Measures developed in collaboration with the various regulatory and federal agencies to ensure that operations in these sectors would not result in any activities having adverse effects on the species or habitats protected under ESA, MMPA, MSA, NMSA, or MBTA. Mitigation measures and Best Management Practices are provided to the expedition coordinators and the ship before operations are taken to ensure that they are following the actions developed to minimize or limit any potential adverse effects on species or habitats in the proposed action area.

7. Would the action result in the potential to generate, use, store, transport, or dispose of hazardous or toxic substances, in a manner that may have a significant effect on the environment?

All expedition operations will be in compliance with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the OMAO procedure that supersedes it) to ensure generation, use, storage, transport, and disposal of such substances will not result in significant impacts.

8. Would the action result in adverse effects on properties listed or eligible for listing on the National Register of Historic Places authorized by the National Historic Preservation Act of 1966, National Historic Landmarks designated by the Secretary

of the Interior, or National Monuments designated through the Antiquities Act of 1906; Federally recognized Tribal and Native Alaskan lands, cultural or natural resources, or religious or cultural sites that cannot be resolved through applicable regulatory processes?

The proposed action will not result in adverse or indirect effects that cannot be resolved through applicable regulatory processes since we will not be operating within listed or eligible properties, lands, resources or sites coming under the umbrella of protection referenced above.

9. Would the action result in a disproportionately high and adverse effect on the health or the environment of minority or low-income communities, compared to the impacts on other communities (EO 12898)?

The NOAA Ship Okeanos Explorer will be operating in the remote and offshore areas of Canada and along Alaska, Oregon, Washington, and California as the EX transits between Seward, Alaska and San Francisco, California during EX2307. There are no communities within or near the geographic scope of the expedition due to activities operating in areas greater than 200 meters in depth. The expedition does not involve actions known or likely to result in adverse impacts on health or the environment of minority or low income communities.

10. Would the action contribute to the introduction, continued existence, or spread of noxious weeds or nonnative invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of the species?

During EX2307, NOAA Ship Okeanos Explorer will not make landfall in areas other than commercial ports in Seward, Alaska and San Francisco, California. The ship and OER mission team will comply with all applicable local and federal regulations regarding the prevention or spread of invasive species. At the completion of every conductivity, temperature, and depth (CTDO) cast, the equipment will be thoroughly rinsed with fresh water and completely dried to prevent spreading organisms from one site to another. Also the Engineering Department aboard the NOAA Ship Okeanos Explorer attends yearly Ballast Management Training in accordance with NOAA Form 57-07-13 NPDES VGP Annual Inspection and Report to prevent the introduction of invasive species.

11. Would the action result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment?

OER has taken measures to ensure that any effects on species or habitats protected by the ESA, MMPA, MSA or NMSA meet the definition of negligible. The proposed actions will not result in any Federal, State, or local law violations or requirements imposed for protection of the environment. OER received a ESA Programmatic Letter of Concurrence and Project Design Criteria letter dated March 14, 2022 from the NMFS ESA Interagency Cooperation Division for ESA Section 7 that concurs with OER's determination that the proposed action may affect, but is not likely to adversely affect ESA-listed species and their designated or proposed critical habitat in the action areas. The ESA Programmatic Letter of Concurrence and its Project Design Criteria will be provided in the EX2307 expedition report.

Given the offshore focus of most of our proposed work, it was determined that it is not likely that we will encounter marine mammals protected under the MMPA, or sea birds protected under the MBTA as they are often found in territorial and state waters. If we did encounter any such protected animals, our impacts would be negligible because of the best management practices that were developed with relevant agencies that we adhere to avoid or minimize environmental impacts. These best management practices and project designed criteria are outlined in the FY23 Field Season Instructions.

OER requested an Essential Fish Habitat (EFH) consultation under section 304 of the Magnuson-Stevens Fishery Conservation and Management Act for expeditions conducted by the NOAA Ship Okeanos Explorer during its 2023 field season in the North Pacific Ocean, Eastern Pacific Ocean, Central Pacific Ocean, and Alaska. The EFH Letter of Acknowledgement was received on August 3, 2022 from the Assistant Regional Administrator for the NOAA Office of Habitat Conservation stating that the FY23 expeditions will not adversely impact EFH. This letter will additionally be included in the EX2307 expedition report.

OER determined that MBTA authorizations are not required for EX's operations due to EX's operations occurring in waters 200 m and greater located outside MBTA protected areas. Evaluation of the potential impact of EX's operations on marine mammals protected under MMPA was conducted for 2018-2019 field season and in 2022 and beyond on a Programmatic level. OER leveraged the biological evaluation conducted as part of our informal and Programmatic ESA Section 7 consultation, which assessed the potential impacts of our operation on low and mid-frequency cetaceans, Phociid pinnipeds and otariid pinnipeds. Additional analysis evaluated the potential impacts of our operations on high-frequency marine mammals protected under MMPA in our operating area. OER evaluation has determined that, with continued implementation of our best management practices, operations would not result in a Level A or B take.

12. Would the action result in highly controversial environmental effects?

5

The exploration activities are considered small and minimal following the best available information about effects of the equipment to support determination that activities would be localized and be short in duration in any particular area at any given time with no notable or lasting changes to the environment. Given the project's scope and breath, no notable or lasting changes or highly controversial effects to the environment by mapping operations conducted onboard the Okeanos Explorer. Any effects would be small and considered minimal as the vessel transits through the area of interest continuously using acoustic sound sources which have been analyzed under NEPA, ESA, MMPA, and EFH to determine the effects that may occur during operations.

13. Does the action have the potential to establish a precedent for future action or an action that represents a decision in principle about future actions with potentially significant environmental effects?

The decision to take this action will not result in growth-inducing changes, compel future actions with potential impacts, or foreclose options for future actions. Each expedition is independently useful and is not connected to subsequent federal actions.

14. Would the action result in environmental effects that are uncertain, unique, or unknown?

The techniques and equipment used are standard for this type of field study, and the effects are well known and assessed to determine whether the actions may result in environmental effects that are uncertain, unique, or unknown.

15. Does the action have the potential for significant cumulative impacts when the proposed action is combined with other past, present and reasonably foreseeable future actions, even though the impacts of the proposed action may not be significant by themselves?

The techniques and equipment used are standard for this type of field study, and the effects are well known and assessed to determine whether the actions may result in environmental effects that are uncertain, unique, or unknown.

CE Determination

I have determined that a Categorical Exclusion is the appropriate level of NEPA analysis for this action and that no extraordinary circumstances exist that would require preparation of an environmental assessment or environmental impact statement.

I have determined that an environmental assessment or environmental impact statement is required for this action.

OAR Decision Maker's Name: Jennifer Lukens

OAR Decision Maker's Position/Title: Deputy Director, NOAA Office of Ocean Exploration and Research (OER)

Date Signed:

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LEIGH.1365832583

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Canadian Letter of Acknowledgement



UNCLASSIFIED
IGR-1340/42 [UPDATE]

August 1, 2023

Ms. Jennifer Becker
Deputy Director
Ocean Science Policy and Authorizations
Office of Ocean and Polar Affairs
United States Department of State
2201 C Street NW
Washington, D.C. 20520

Dear Ms. Becker,

Revised authorization for the Research Ship OKEANOS EXPLORER (May 1 – October 31, 2023).

I am pleased to advise that the Government of Canada grants its consent to the request for the research ship **OKEANOS EXPLORER** to undertake marine scientific research in areas under Canadian jurisdiction or sovereignty during the above mentioned dates.

Enclosed is the Canadian Hydrographic Service (CHS) request for the submission of bathymetric data for this mission. Canada requires copies of all bathymetric data derived from these marine scientific research projects. This includes single and multi-beam data collected in passage to and from the research site, as well as the bathymetric data collected at or in the investigation area. The attached document provides necessary information and directions.

Additionally, the proponent is asked to ensure their Best Management Practices reflect that any injured or dead marine mammals must be reported to DFO when in Canadian Pacific waters (see: <https://www.dfo-mpo.gc.ca/species-especes/mammals-mammiferes/report-rapport/page01-eng.html>).

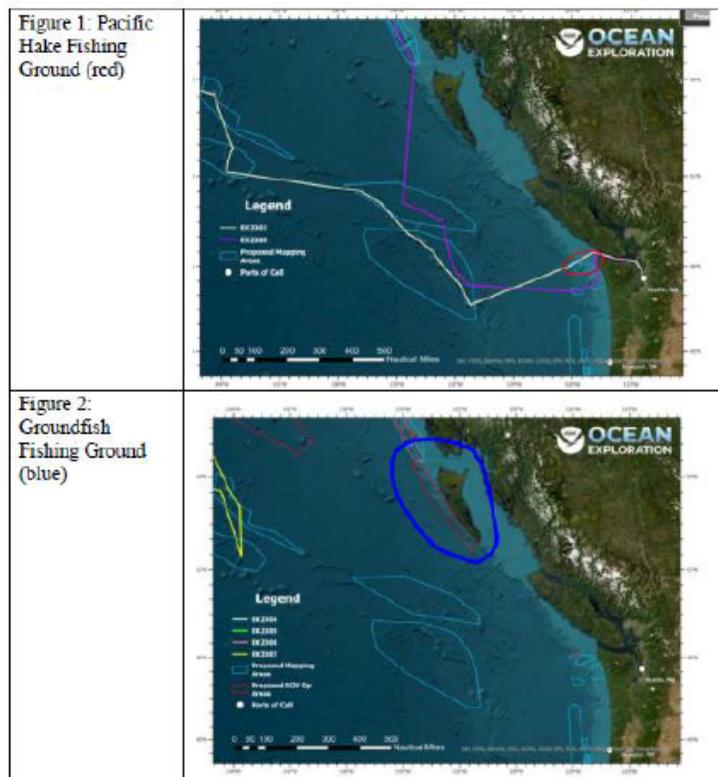
Please inform the applicant that the portion of the cruise within the southern area of EX2303 (circled in red on Figure 1) contains active Pacific Hake fishing grounds, outside of Juan de Fuca Strait. If this research mission requires specific clearances from other vessels to conduct their mapping activities, please advise Canada's Department of Fisheries and Oceans immediately at DFO.NCRForeignVesselClearance-DegagementnavireetrangerRCN.MPO@dfo-mpo.gc.ca.

Canada

Please inform the applicant that the portion of the cruise pertaining to the contingency plan for ROV mapping (circled in blue on Figure 2) overlaps active groundfish fishing areas. As a courtesy, the applicant is asked to notify the following key fishing representatives should their plans shift to Canadian waters:

- Bruce Turris, Canadian Groundfish Research and Conservation Society bruceturris@shaw.ca
- Brian Mose Deepsea Trawlers Association bmose@uniserve.com
- Rob Kronlund Canadian Sablefish Association arkronlund@canadiansablefish.com
- Chris Atcheson Canadian Sablefish Association cacheson@canadiansablefish.com
- Chris Sporer Pacific Halibut Management Association phma@citytel.net
- Jordan Belveal Outside ZN rep jordan@jordanbelveal.com

Please also cc DFO on any notifications (DFO.NCRForeignVesselClearance-DegagementnavireetrangerRCN.MPO@dfo-mpo.gc.ca)



Should the vessel's research activity take place inside Canadian waters (territorial sea or internal waters), please be aware of the Canada Border Services Agency (CBSA) marine reporting requirements.

Canada Border Services Agency (CBSA) - marine reporting requirements:

Foreign expeditions arriving in Canada by research vessel and entering Canadian waters (territorial sea or internal waters) are required to report to the nearest Canada Border Services Agency (CBSA) Marine Reporting office.

CBSA Marine Reporting Office Pacific:
Phone: (604) 713-9840 and email: NP12REXC01G@cbsa-asfc.gc.ca

Vessels are required to transmit the following completed forms: **Form A6** General Declaration and **Form A6A** Freight/Cargo Manifest. The forms can be obtained electronically via the links below:

Form A6: <http://www.cbsa-asfc.gc.ca/publications/forms-formulaires/a6.pdf>

Form A6A: <http://www.cbsa-asfc.gc.ca/publications/forms-formulaires/a6a.pdf>

There are no reporting requirements to the CBSA if no research activity is taking place inside Canadian waters (territorial sea or internal waters).

We are pleased that Canadian participants would be welcome to join the project, and that the scientific results and all the data from this cruise will be freely and generously shared. We request copies of the preliminary and final cruise reports.

Yours sincerely,



Kevin Tunney,
Deputy Director
Security and Defence Relations Division

Encl.



Special Requirements for Bathymetric Data MARINE SCIENTIFIC RESEARCH REQUESTS

The Government of Canada wishes to inform all parties requesting authorization to conduct marine scientific research in areas under Canada's jurisdiction (meaning Canada's inland waters, territorial sea (0-12NM), exclusive economic zone (12-200NM), and extended continental shelves) that Canada requires copies of all bathymetric data derived from these marine scientific research projects. This includes single and multi-beam data collected in passage to and from the research site as well as the bathymetric data collected at or in the investigation area.

Bathymetric data collected in areas under Canada's jurisdiction must be provided to Fisheries and Oceans Canada's Canadian Hydrographic Service (CHS). In order to ensure that this data can be properly utilized, the Government of Canada requests the following:

1. A metadata profile containing, to the fullest extent possible, the elements in Table 1 be provided when the data is submitted;
2. Copies of all the files associated with the bathymetric data set(s) are submitted;
3. Where possible, the bathymetric data be gridded to the best possible resolution and that this grid is submitted with the data; and,
4. All of the above are concurrently submitted to the IHO Data Centre for Digital Bathymetry (DCDB).

Table 1. Metadata Profile for Bathymetric Data

General Information	
Location(s)	<i>(e.g. city, river)</i>
Survey purpose	<i>(e.g. site monitoring, after dredging)</i>
Start and end date of survey	Start <i>yyyy-mm-dd</i> End <i>yyyy-mm-dd</i>
Organization name	
Organization contact information	
Responsible researcher for survey - Name	
Responsible researcher for survey - Contact information	
Analyzed for Navigational Warnings (NAVWARN)	Yes <input type="checkbox"/> No <input type="checkbox"/>
Restricted data	Yes <input type="checkbox"/> No <input type="checkbox"/>
Backscatter available	Yes <input type="checkbox"/> No <input type="checkbox"/>
Data Acquisition	
Vessel(s)	
Sounding hardware	<i>(e.g. Hydrobox, Kongsberg EM2040)</i>
Technique of Sounding	<i>(e.g. multi-beam sonar, LiDAR)</i>
Resolution	<i>(e.g. 0.5m, 5m x 5m matrix)</i>
Data acquisition software	<i>(e.g. HYPACK, QINSy, SIS, ISAH)</i>
Data processing software	<i>(e.g. HYPACK, FLEDERMAUS, AutoCAD, HIPS, JRSondeW7)</i>
Horizontal Reference	
Horizontal coordinates system	<i>(e.g. Northing, Easting, DD, D-M-S)</i>
Horizontal datum	<i>(e.g. NAD 27, NAD 83, WGS84)</i>
Projection	<i>(e.g. UTM zone 3)</i>
Positioning method	<i>(e.g. DGPS, RTK, PPK)</i>
Positioning hardware	<i>(e.g. Trimble R7, Trisponder, POSMV)</i>
Benchmark reference	<i>(e.g. 80k0559)</i>
Benchmark coordinates	<i>Northing, Easting or D-M-S</i>



Vertical Reference	
Vertical reference system	(e.g. CD, CGVD28, IGLD)
Benchmark reference height	
Water level reduction method	(e.g. HyVsep, Tidal observation)
Tidal station reference	(e.g. : Toronto #13320)

Survey Accuracy	
Horizontal accuracy	(e.g. $\pm 1m$, $\pm 5m$)
Vertical accuracy	(e.g. $\pm 0.15m$, $\pm 0.50m$, $\pm 1m$)
Sounding corrected for vessel draft	Yes <input type="checkbox"/> No <input type="checkbox"/>
Calibration data	Yes <input type="checkbox"/> No <input type="checkbox"/>
IHO CATZOC	(e.g. CATZOC = A2)
IHO Order of Survey	(e.g. Special, 1A)

All correspondence with the CHS shall be coordinated by email to:

DFO.NCRCHSInfo-InfoSHCNCR.MPO@dfo-mpo.gc.ca

Subject: MSR Bathymetric Data

Hydrographer General of Canada

Appendix C: Excerpts from Daily Situation Reports

The following entries are excerpts from the daily expedition situation reports provided by the shipboard team to the onshore support team and therefore are somewhat informal in language. They are included here to provide situational awareness for future users of the data mapping collected during this expedition. All times are in local ship time (-8 hours from UTC).

Sep 21-23

- Data collection began near the 200 m contour. Weather was favorable and data quality was high. Synthetic sound speed profiles were used while transiting through the shallower shelf.

Sep 24

- SIS stopped recording data suddenly and lost connection with the EM304. An error occurred stating unable to ping. Logging and pinging were stopped and restarted several times, but this did not fix the issue. SIS was restarted and the issue was resolved. A small data gap occurred as a result of the pinging error. This event took place in a span of time less than 5 minutes. This issue occurred a second time in the polygon causing another ~ 5 minute gap.
- Seapath signaled degraded positioning and attitude velocity and showed an “unsafe warning.” The Seapath software and hardware were restarted though the error remained. After some time the Seapath returned to normal functioning - though it is unclear why. More investigation is needed to determine if this may be caused by a failing antenna. The primary positioning feed for the Multibeam was set to the POS MV as it seemed more reliable.

Sep 25

- Seapath issues appeared to be resolved after a system reboot.
- EK80 ping rate was controlling K-Sync ping cycle when EM304 should be the controlling master pinger. Several EK sounder frequencies were uninstalled until the 18kHz was discovered to be causing the issue. After it was reinstalled, the problem was resolved and the EM304 controlled the ping cycle for K-Sync again.
- Knudsen performance issue: data quality is very poor and strong double bottom returns when phase mode is set to Auto, issue resolved when phase mode is set to Manual.
- HDDS gridding engine failed in SIS. Functionality returned after a restart.

Sep 26

- Operations continued as normal, mapping in the first priority polygon.
- Data quality was affected by rough sea conditions when heading west.

Sep 27

- Mapping operations continued as normal.
- Poor weather degraded data quality.

Sep 28

- Loss of connection to the sounders caused logging to stop automatically. To resolve the issue, a new SIS project was created after completing polygon 1.
- Unable to accomplish cross line in polygon due to weather.
- Transit mapping toward the Canadian mapping area. Following seas improved data quality. The EM 304 was manually set to “Deeper” mode to collect better resolution data in the improved conditions.

Sep 29

- Continued transit mapping towards Canadian mapping area.
- Occasional “no depths received” error in SIS

Sep 30

- Commenced mapping polygon 2 off the coast of British Columbia, Canada. Weather deteriorated at night and data quality became exceedingly poor on westbound line.
- SIS lost connection to sonars. SIS restarts temporarily fixed the issue.
- XBT frequency increased to every 3 hrs due to variable sound speed.
- Occasional no depths errors in SIS.

Oct 1

- Rough sea conditions deteriorated data in SW direction and lines were re-surveyed in the reciprocal direction. Bad data was logged but not processed in Qimera, and was subsequently removed from the project.
- Wobbles were observed in Multibeam, EK, and Knudsen data. These wobbles were seen with the POS MV and Seapath unit set to primary. Troubleshooting of the issue did not result in a solution for acquisition, but artifacts were removed from the bathymetry in post-processing by using RTK heights instead of instantaneous water height vertical referencing.
- Continued to have the “no depths received when pinging” error in SIS intermittently causing a dropped ping in the bathymetry.

Oct 2

- Began survey in weather avoidance area. Wobble artifacts were no longer apparent in data.
- SIS sonar connection issues and surface gridding drop outs continued, temporarily resolved by SIS restart.
- Continued to vertically reference the data using RTK heights which was helpful for removing vertical offsets in the shallow polygon.

Oct 3

- Continued survey in weather avoidance area.
- Increased XBT frequency to 2-3 hrs depending on environmental conditions and associated data quality.

Oct 4

- Secured sonars when depths reached <200m.
- ADCPs collected data

Oct 5

- UHDAS reported suspicious activity with the WH300 that could be indicative of a failing unit.
- SIS gridding issue continued, restart of the computer and PU was needed to resolve.
- SIS and SSM connection issues continued, full restart of the EX-CTD-1 computer was needed in the correct sequential order after the SIS computer to reestablish connections.

Oct 6

- Transit mapping with one survey line on the US-Canada EEZ border
- Exited Canadian EEZ and continued transit towards priority polygon offshore WA.
- Continued intermittent ping drop outs with the “No Depths Received during Pinging” error.

Oct 7

- Mapped in polygon off the coast of Washington.
- Attempted to obtain high density soundings by reducing vessel speed to 6 kt.

Oct 8

- Interference in the 38kHz range appeared in multibeam and EK data. Source of interference is unknown. Attempted to use an interference filter in SIS, but it was not effective.
- Gridding issues with SIS necessitated restart

Oct 9

- Poor data quality due to rough seas.

Oct 10

- Several gridding issues occurred in SIS and restarts were needed to resolve. New SIS project was created.
- SSM connection issues to SIS persisted as SIS needed to be restarted several times.

Oct 11

- Mapped polygon off the coast of CA
- SIS gridding issues persisted.
- A few AXBTs were faulty and did not provide good cast data.

Oct 12

- Continued mapping polygon off the coast of CA
- There was an outage on the network and KVMs that caused all screens to go black and a loss of a few minutes of mapping. It is unclear what caused the issue.

Oct 13

- Continued mapping polygon off the coast of CA
- Data quality was low on northbound lines due to weather.

Oct 14

- Secured mapping at 0600 and ran ADCPs. Confirmed with UHDAS that the ADCPs functioned as normal.
- Ship pulled into port ~1530 in San Francisco, CA.