

Southern California Seafloor Mapping Initiative: Identifying the Gaps and Prioritizing Future Efforts



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Photo of the Channel Islands National Marine Sanctuary and National Park during the 2015 Mapping cruise aboard the NOAA ship *Bell M. Shimada*. Photo Credit: Sarah Raskin NOAA Teacher at Sea





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Table of Contents

Abstract..... iv

Key Words iv

Introduction.....1

Identification of Data Gaps.....3

Prioritization of New Acquisition Areas6

Next Steps 18

Acknowledgements..... 20

Glossary of Acronyms 21

Literature Cited 22

Appendix..... 23



Abstract

Bathymetric and seafloor information is a critical data layer for decision-making for a number of marine management fields including navigational safety, fisheries, renewable energy, oil and gas extraction, and ecological conservation. Prior to this effort only 13% of the seafloor off of Southern California out to the Exclusive Economic Zone Line had available mapping data. To address this information gap, the Channel Islands National Marine Sanctuary (CINMS) and the National Centers for Coastal and Ocean Science (NCCOS) launched the Southern California Seafloor Mapping Initiative in 2014.

CINMS and NCCOS staff gathered all the available seafloor information from state and federal program, created a geodatabase, and shared this information via an ArcGIS Online Story Map with stakeholder groups. The team then hosted a one-day workshop with 17 stakeholder groups to identify needs and priority areas for new seafloor data. Participants were asked to present how their group is involved in working with seafloor data, their information and data needs, and any plans for data acquisition. After presentations, stakeholders discussed known data gaps. Seafloor mapping priorities were captured as georeferenced shapefiles in ArcGIS.

Following the workshop, the priority shapefiles were organized and ranked by examining spatial overlap. While this methodology did not perfectly account for each stakeholder's prioritization ranking, priority areas largely coalesced across stakeholders. Areas that ranked highly across stakeholders included waters of the Channel Islands National Marine Sanctuary, the nearshore "white zone," Marine Protected Areas, and potential locations for offshore energy. Spatial overlap of stakeholder priority was highest for CINMS' waters as a number of agency stakeholders have jurisdictions and management measures in place around the northern Channel Islands. Priority area polygons were shared with the Interagency Working Group on Ocean and Coastal Mapping's Sea Sketch project (A larger national scale coordination project of which this project is in conjunction with) to help plan future seafloor data acquisitions. The workshop outcomes have already guided NCCOS and CINMS' mapping efforts.

Key Words

Mapping, Habitat, Seafloor, Spatial Management, Bathymetry

Chapter 1

INTRODUCTION

Coastal and marine areas provide vital services to support the economic, cultural, recreational, and ecological needs of human communities. Sustaining these benefits requires a balance between growing, and often competing, uses and activities. Minimizing coastal zone conflict and reducing human-induced impacts to ecological resources requires access to reliable information on the spatial distribution and condition of marine resources. Seafloor mapping provides a detailed spatial depiction of ocean bottom structure and rugosity – core data that underpins many resource management strategies. The lack of detailed maps of the seafloor hinders the effectiveness of prioritizing marine policy, regulatory review processes, and marine stewardship.

In southern California, seafloor maps have proven critical to inform an array of management decisions including disaster response, navigational safety, endangered species and fisheries management, conservation, research, energy development, and other marine planning actions. At the time of writing, seafloor maps are being used to make determinations about the Refugio oil spill in May 2015, the placement of fiber optic cables between offshore islands, the efficacy of marine protected areas (MPAs), and the designation of Essential Fish Habitat (EFH). Despite the critical nature of seafloor data uses, large offshore areas and areas around the northern Channel Islands remain unmapped. Our analysis found only 13% of the ocean bottom from Cambria, CA to the Mexican

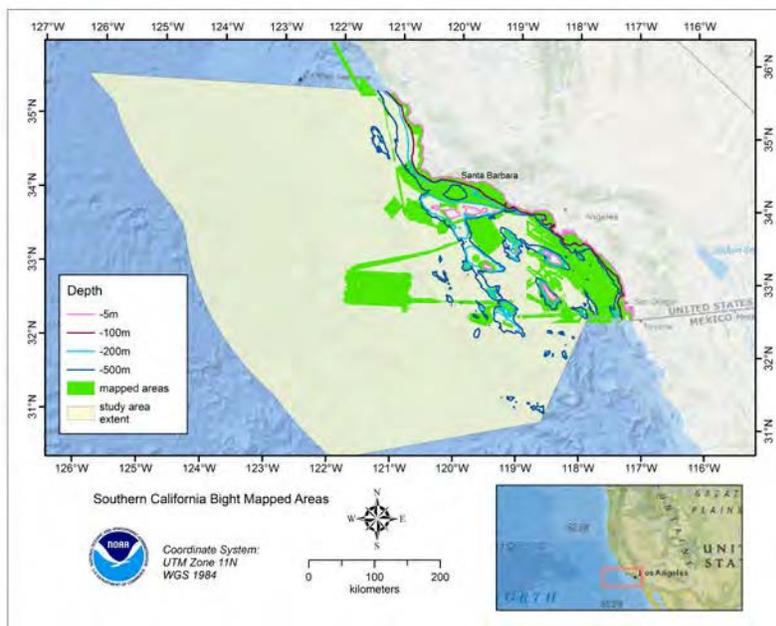


Figure 1. Recently mapped areas within the Southern California Bight study area.



Border, and from the shoreline out to the Exclusive Economic Zone (EEZ) Line have been mapped at a resolution sufficient for most management decisions (e.g., under a 50 m cell size, Fig. 1). Further, there is no central data repository for California's existing seafloor data for a stakeholder to inquiry. These data gaps present a significant challenge for managers to effectively make decisions.

To address this problem in the Southern California Bight (SCB), the Channel Islands National Marine Sanctuary (CINMS) and the National Centers for Coastal and Ocean Science (NCCOS) formed the Southern California Seafloor Mapping Initiative. This report describes the process the Initiative has undergone to: 1) identify seafloor data gaps, and 2) prioritize the acquisition of new seafloor data that will support local management organizations.

1.1 Related Ongoing Mapping Efforts

The Southern California Seafloor Mapping Initiative's prioritization process is being conducted in partnership with two other concurrent efforts: the Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM) and the California Seafloor and Coastal Mapping Program (CSCMP).

1.1.1 Interagency Working Group on Ocean and Coastal Mapping

The IWG-OCM was established in 2006 to "facilitate the coordination of ocean and coastal mapping activities and avoid duplicating mapping activities across the Federal sector as well as with State, industry, academic and non-governmental (NGO) mapping interests" (<https://iocm.noaa.gov/iwg/>). Recently, IWG-OCM has partnered with [SeaSketch](http://www.seasketch.org) (www.seasketch.org) to facilitate mapping data acquisition nationwide. The result of this collaboration is an ongoing, comprehensive online spatial project focused on nationwide coordination between federal agencies. Specifically, the online platform communicates where mapping exists and aims to reduce redundancy. The US Mapping Federal Coordination Project on the SeaSketch portal can be viewed online: <http://fedmap.seasketch.org>.

1.1.2 California Seafloor and Coastal Mapping Program (CSCMP)

The CSCMP is a "collaborative, multi-institutional campaign creating the first comprehensive, high-resolution basemap of California's state waters (shoreline out to 3 nautical miles)" (<http://seafloor.otterlabs.org/csmp/csmp.html>). The project is spearheaded by the California Ocean Protection Council, which has partnered with a number of federal, state and academic groups to create seafloor data products along California waters. A number of areas in state waters still require data acquisition and at the time of this writing CSCMP has no plans for further acquisitions in southern California, but is planning on drafting a vision document for when new funds become available.



Chapter 2

IDENTIFICATION OF DATA GAPS

2.1 Spatial Data Collection and Synthesis

Since there is no central data repository for California's existing seafloor data, CINMS and NCCOS staff assembled data from various sources to create a complete data footprint of the SCB. Compiling efforts were focused on data types that are or can produce high resolution bathymetry and habitat maps. Bathymetric data were originally collected via multibeam and interferometric sidescan. Backscatter and analogous data types were collected via multibeam backscatter, sidescan, and interferometric sidescan. For the purposes of this synthesis, hazards data, sub-bottom profiling, sediment cores and other seafloor data sets were not included. While these other data types are important, they were not the primary foci of the sanctuary. Metadata included data collector, project name, year of collection, type of data collected (e.g., backscatter, sidescan), whether ground-truthing ROV dives were conducted, and resolution/cell size. The data compilation was cross-referenced with local experts to ensure no relevant data products were missing from the geodatabase. Primary data sources included the National Centers for Environmental Information (NCEI), California State University Monterey Bay (CSUMB), US Geological Survey (USGS), Oregon State University (OSU), Monterey Bay Aquarium Research Institute (MBARI) and California Seafloor Mapping Program (CSMP).

2.2 Gap Analysis

With the data set described in 2.1, CINMS conducted a gap analysis of existing mapping efforts in our area of interest (from Cambria, CA to the US-Mexico border out to the EEZ) and found that 87% of the region remains unmapped (Fig 1). In our area of interest, we evaluated gaps at various depth strata and across different management areas (Table 1). Depth ranges were established based on the types of technologies suited to map each depth strata. The seafloor between 5-100 m has the best data coverage, with approximately 70% of the seafloor having bathymetry data. In the area of interest, the very shallow (0-5m) and very deep habitats (> 500) have proportionately less data coverage with only 10.8% and 9.0% respectively.



Table 1: Summary of spatial data gap analysis for bathymetry, backscatter/sidescan data, within ten boundary layers.

<i>Boundary Layer</i>	<i>Area of Boundary (km²)</i>	<i>Total Area Bathymetry Mapped (km²)</i>	<i>Total Area Backscatter/Sidescan Mapped (km²)</i>	<i>Percentage Bathymetry Mapped</i>	<i>Percentage Backscatter/Sidescan Mapped</i>
0-5 m Depth	502	54	51	10	10
5-100 m Depth	10524	7367	6751	70	64
100-200 m Depth	5648	2365	2293	41	40
200-500 m Depth	16215	7947	7501	49	46
500 m Depth – EEZ	360555	32642	27836	9	7
CA & CINMS MPAs	2142	1370	1402	63	65
CINMS	5541	2609	2948	47	53
CHIS	694	129	286	18	41
Groundfish EFH	156168	45836	39909	29	25
Area of Interest	392984	50370	44441	12	11

Notably, the shallowest area (0-5m) has the least amount of total area surveyed, but is likely subjected to the most anthropogenic impact and alteration. This analysis does not include topographic or bathymetric LiDAR collections, meaning the nearshore (0-5m) data collection may be under represented. However, collections along the coast appeared limited and a disproportionate lack of data in the “white zone,” (e.g., habitat space from the intertidal to depth where it is safe to operate vessel based mapping technologies) the very shallow area near and in the surf zone, was noted.

Across management areas, the State and Federal Marine Reserves in the study region had the best high-resolution bathymetry coverage with 64%. NOAA’s essential fish habitats (EFH) have far less coverage with less than 30%. The existing seafloor data in EFH was primarily collected by NMFS in partnership with Oregon State University in 2011. There are significant data gaps around the northern Channel Islands, which encompass a number of conservation designations including NOAA and California Department of Fish and Wildlife (CDFW) Marine Reserves, State Water Resources Board’s Areas of Special Biological Significance, CINMS, and the Channel Islands National Park (CHIS). Less than 50% of the sanctuary was mapped and only 18.5% of the CHIS’s waters had associated bathymetry data.



2.3 Planned Acquisitions

In addition to compiling existing data sets, we reached out to regional stakeholders that have already collected seafloor data such as the Navy, CDFW, MBARI, CSUMB, USGS, Fugaro-Pelagos and the IWG-OCM to delineate footprints of proposed future acquisitions. Four such proposals were identified. The first traces the route of a proposed new fiber optic cable that the Navy intends to lay from San Nicolas Island around Anacapa Island to the north side of Santa Cruz Island. This fiber optic cable will improve communications between Navy facilities on the islands. The US Navy is undergoing a NEPA process (2016-2017) to plan for the project. The seafloor data acquisition will be used to guide the placement of the cable away from sensitive deep sea habitats. The second project is led by the NMFS west coast regional office and involves mapping eel grass beds in the SCB. Eelgrass beds are known to be important EFH for a number of species. A contract was awarded to Merkel and Associates to map eelgrass beds in Southern California, who previously mapped the eastern half of Santa Cruz Island and a large segment of Santa Monica Bay from Leo Carrillo State Park to Marina Del Rey. The third proposed area for data acquisition is by Fugaro Pelagos Inc. and USGS located just north and offshore of Point Conception. This area was identified as important to map for hazards and potential energy exploration; however, there are no immediate data collection plans. Lastly, the Army Corps of Engineers (ACOE) had acquired topobathy LiDAR data along the mainland Santa Barbara Coast in the summer of 2015. As of this writing the data are not available and therefore, is considered a future acquisition.



Chapter 3

Prioritization of New Acquisition Areas

In an effort to obtain a robust understanding of available seafloor data, intended uses and requirements, and to set data collection priorities for the SCB, a one-day stakeholder workshop was held in Santa Barbara, CA on Aug. 28, 2015 (see Appendix for agenda). Workshop attendees were encouraged to come in person, however we allowed for digital participation through WebEx to ensure inclusivity. In-person participants represented 17 government agencies, academia, and non-governmental organizations (NGOs), as follows:

- Ocean Protection Council (OPC): Amy Vierra
- Bureau of Ocean Energy Management (BOEM): Donna Schroeder
- U.S. Geological Survey: Guy Cochrane and Ken Hudnut
- NOAA's Office of Coast Survey: Jeff Ferguson
- Southern California Coastal Ocean Observing System: Libe Washburn
- NOAA's National Marine Fisheries Service: Mary Yoklavich
- NOAA's Office of Ocean Exploration and Research: Mashkoor Malik
- The Nature Conservancy: Mary Gleason
- Monterey Bay Aquarium Research Institute: Charlie Paull
- Channel Islands National Park: Rocky Rudolph
- University of California Santa Barbara: Robert Miller
- U.S. Navy: John Ugoretz
- California State University Monterey Bay Seafloor Mapping Lab: Carrie Bretz
- California Department of Fish and Wildlife: Paulo Serpa
- National Geodetic Survey: Dana Caccamise
- Ocean Exploration Trust: Nicole Raineault
- U.S. Army Corp of Engineers: Ron Spencer

3.1 Displaying Existing Information

In preparation for the prioritization workshop, NCCOS staff developed an ESRI Story Map of the existing seafloor mapping database's spatial footprints (see section 2.1 and Fig. 2). The goal of the Story Map was to give stakeholders a clear understanding of our study area, including relevant management zones, proposed mapping efforts and existing data. Key data layers in the Story Map included:

- study area of interest
- footprint of existing bathymetry and backscatter with associated metadata from the database
- CINMS priority areas developed for the 2015 mapping cruise on the NOAA ship *Bell M. Shimada*

- state and federal protected areas around CINMS including Marine Reserves and EFH designations
- CSCMP Mapping blocks
- US Navy Testing Range
- CINMS and CHIS boundaries

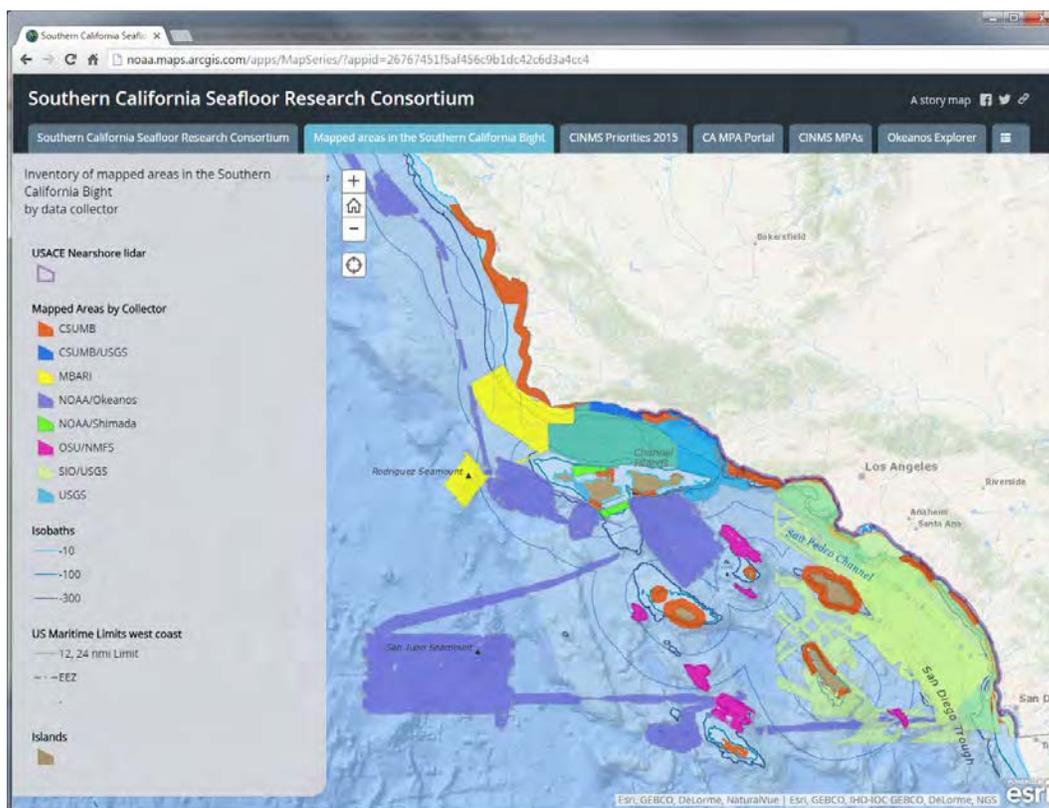


Figure 2. Story map developed to aid workshop preparation and discussion.

The Story Map was a useful tool for data organization and gap analysis. Prior to the workshop, meeting participants were provided the Story Map as a visual primer to assist them in preparing their mapping needs. The map interface was interactive, enabling users to click on shapefiles and obtain more information on each data set prior to and during the workshop. This visual display provided an accessible format for stakeholders to see what data were available, where the gaps were and what resource management areas are in place in the SCB. While the Story Map did not hold the original data for download, users were able to access metadata including the source of the desired data. Many of the relevant data layers from the Story Map have since been migrated over to IWG-OCM's SeaSketch project

(<http://www.seasketch.org/#projecthomepage/5272840f6ec5f42d210016e4>, see 4.0 Next Steps for more information).

3.2 Assessing Priorities

After synthesizing existing data workshop participants prioritized areas for future data acquisition. Participants were asked to review the existing data compilation and ensure no data sets were missing and that all had been correctly attributed. Once complete, the revised shapefile of areas with existing data was included in a GIS project as a spatial data layer (Fig. 3).

Participants were also asked to respond to the three questions listed below and prepare a brief three-slide presentation on their agency's or group's involvement with mapping. See Table 2 for an overview of each stakeholder's response.

- What are your agencies'/institutions' mapping data requirements?
- What are your plans for data collection or data use?
- What are your agencies'/institutions' mapping priorities?

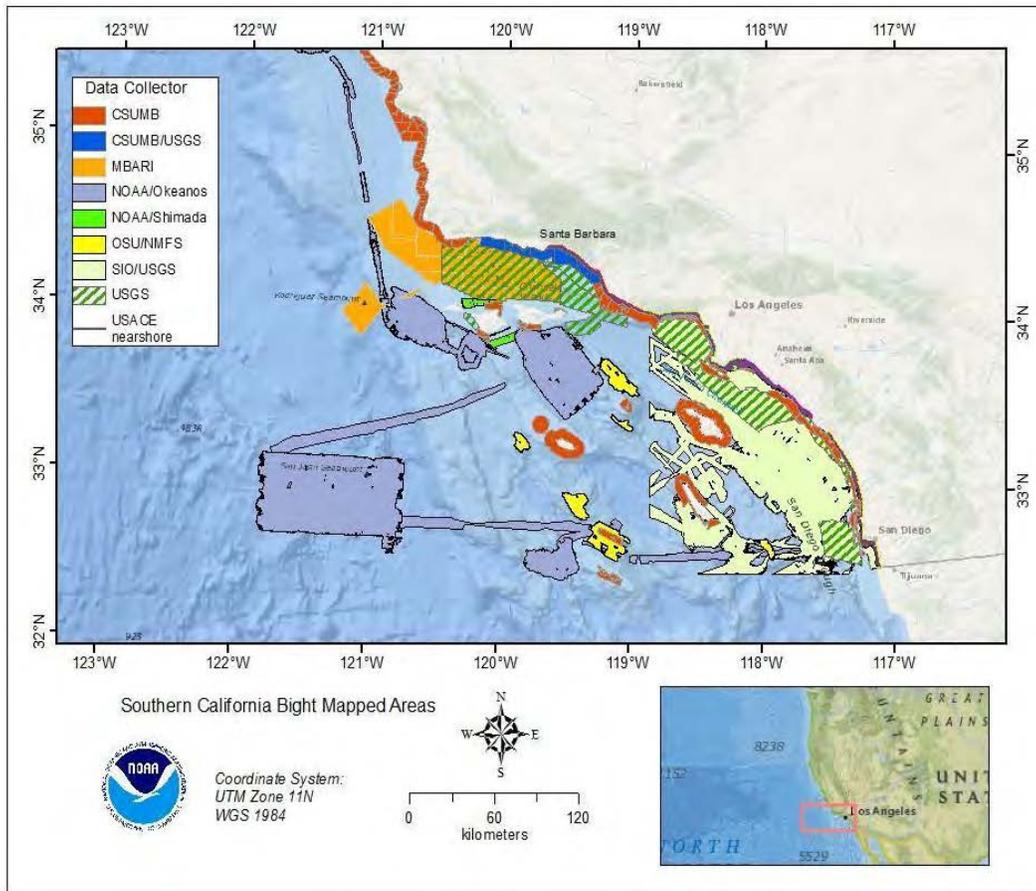


Figure 3. Existing spatial data by data collector at the time of the prioritization workshop.



Table 2. Spatial data requirements, use, and priorities by agency.

<i>Agency</i>	<i>What are your agencies'/institutions' mapping data requirements?</i>	<i>What are you plans for data collection or data use?</i>	<i>What are your agencies'/institutions' mapping priorities</i>
ACOE	Primarily focused on harbors, breakwaters and embayments for dredging. LA office has one survey vessel in operation and the other is being repaired	There are 15 harbors that are regularly surveyed	Priority is given to federal navigation channels and breakwaters. ACOE can survey other areas depending on client needs
BOEM	Authority in Federal waters outside of sanctuaries for energy leases	No immediate plans	Areas with (1) offshore renewable energy potential, and (2) high value for marine research
CDFW	CDFW is responsible for marine resource management in state waters. Bathymetry and habitat maps are essential for spatial management, population assessments and resource characterization	CDFW collects limited seafloor data itself, uses the CSCMP to identify priorities and funding	Complete bathymetric mapping within state waters, fill in the “white zone” and complete derivative habitat maps within the USGS folios
CHIS	CHIS manages the 5 Northern Channel Islands out to 1 mile offshore	No immediate acquisition plans, recently conducted very fine resolution multibeam of Kelp Forest Monitoring Sites	Complete coverage of KFM sites, inside and adjacent to MPAs, and generally shallow water and nearshore to the islands
CINMS	The seafloor within the Sanctuary boundary	CINMS is using NOAA vessel time to fill in some data gaps around the islands	Filling in the gaps around the islands to support local research and management decisions
CSUMB SFML	The SFML has vessels and mapping equipment available for contracting; they specialize in shallow water mapping	Working on SF Bay mapping shallow water habitats	The SFML works with CSCMP to determine areas that need to be mapped
MBARI	MBARI primarily focuses on new technology development	Their goal is to find appropriate places to utilize their new technology	Focus on the San Clemente fault line and gas seeps
NAVY	The Navy manages the Point Mugu Sea Range, San Clemente and San Nicolas Islands. Seafloor mapping would be useful for a number of the Navy’s at sea operations.	There is a planned acquisition for a proposed fiberoptic cable between San Nicolas and Santa Cruz Island	The Navy has high quality bathymetry for portions of San Clemente Island and the entire area surrounding San Nicolas Island to 3 nm from shore. Beyond the cable, the Navy has interest in the deep water between San Nicolas and Santa Barbara Islands as well as the waters



			around San Miguel.
NGS	The National Geodetic Survey is the geodetic foundation for all geospatial products	NGS is doing research and development of bathy-topo LiDAR	Focus on coastal resource management, storm surge and coastal flood monitoring
NMFS	Seafloor mapping is used to support EFH designation, stock assessments, survey design and conservation	Upcoming cruise of the R/V Ruben Lasker to make EFH areas around the northern Channel Islands	High priorities include unmapped areas within Rockfish Conservation Areas, EFH, and MPAS being considered in the PFMC Pacific Coast Groundfish Area
OCS	OCS conducts hydrographic surveys to update navigation charts to aide in safe navigation	Most current data collection is focused in Alaska, no current plans for SCB but will assist CINMS team.	Along the coast out to 40m depth; focused in Alaska/Arctic currently
OER	OER focuses on data gaps; and exploration (not monitoring or continuous projects)	In 2016-2017, the R/V Okeanos Explorer will be in the National Monument in the Pacific	Unexplored deep habitats as identified by partner groups and agencies
OET	OET uses the E/V Nautilus to work with other group's suggested exploration areas	Next year, the Nautilus will spend 1-2 months off California; the specific sites are still TBD at the time of writing	OET has workshops and planning exercises with local groups to identify target areas; they themselves do not have priority areas
OPC	Full seafloor map of CA state waters	Provide data and map folio products to stakeholders	To be decided by a Steering Committee in early 2016
SCCOOS	SCCOOS acts as a data stream for the West Coast Governor's Alliance and is interested in the SCB and part of Central CA	There are no immediate acquisition plans	SCCOOS is interested in data from high tide line out to the EEZ
TNC	Interested in high resolution seafloor data for biodiversity assessments, spatial fisheries management, and designing research	No acquisition plans	State waters around Santa Cruz Island (especially in the deep canyons), areas proposed as EFH, and offshore of drainages to assess erosion impacts
UCSB	A number of academic projects depend on bathymetric and seafloor maps	No immediate plans for collection	Nearshore (0-30 m) around the northern Channel Islands; there are also deepwater researchers interested in areas > 200 m
USGS	USGS must address Coastal Change, Geo-Hazards, Ocean Resources and Ecosystem Science issues	Groundtruth some previously mapped areas from a project aboard the R/V Shearwater	Areas that pose Geohazards are becoming a primary focus



3.2.1 Workshop Follow Up

During the weeks following the prioritization workshop, a combination of in-person meetings and phone calls were held with several stakeholders that did not attend in-person, including NOAA's Office for Coastal Management (OCM) and the California Coastal Commission (CCC). These meetings were meant to gather additional information regarding their organization's mapping requirements, existing mapping efforts, and acquisition priorities (Table 3). In these meetings, there were two on-going mapping efforts discussed: the mapping of San Francisco Bay (SFB) and eelgrass mapping by NMFS. The SFB project is funded by CSCMP and carried out by CSUMB, Fugaro-Pelago Inc (a private sector seafloor mapping group), and USGS with the goal of mapping the bay's subtidal habitat. These efforts are included in sections 2.1 and 2.3 of this report.

A number of groups identified priorities, but indicated that they are not currently engaged in any mapping efforts (Table 3). Along the nearshore, NGS' interest is focused on coastal erosion impacts from El Niño. NMFS Protected Resources is focused on subtidal eelgrass and NMFS Restoration Center's priority is the areas with the potential for outplanting White Abalone. In the offshore habitat, the CCC has mapping interests in areas where alternative energy projects are being proposed. Because these participants engaged in discussion after the workshop, they did not have an opportunity to discuss acquisition priorities, and so their input was not included in the gap analysis (section 2.2) or priority setting (sections 3.0-3.2). Instead, they are presented here (Table 3) to provide a more inclusive list of information and aid in further discussion. The high degree of overlap of these two sets of priority mapping needs, along with those identified through the workshop, adds further justification for increasing seafloor data coverage in the area of interest.

Table 3. Spatial data requirements as gathered by post-workshop follow up, use and priorities by agency.

<i>Stakeholder that did not attend workshop</i>	<i>What are your agencies'/institutions' mapping data requirements?</i>	<i>What are you plans for data collection or data use?</i>	<i>What are your agencies'/institutions' mapping priorities</i>
CCC	Mapping products are used in the review of development permits	No immediate plans for collection	Mapping is needed in areas around Point Conception and the Central Coast where there is high interest in alternative energy development
NMFS Protected Resources	Interested in mapping areas for EFH designation	There is recent acquisition of mapping data around eelgrass beds both at CINMS and in Santa Monica Bay	Eel grass bed extent around Santa Rosa Island, Anacapa Island, and parts of the mainland coast
NMFS Restoration Center	Interested in mapping areas for Abalone restoration and understanding habitat suitability for eventual out planting of White Abalone	No immediate plans for collection	A number of sites have been identified around the southern California Bight as potential habitat for White Abalone. A number of these sites fall within CINMS

3.3 Refining Priorities

Seafloor mapping is costly and resources are limited, therefore data acquisition across the large area of the SCB requires careful spatial prioritization. To further refine stakeholder priorities and spatially delineate locations of interest, we used a consensus based approach aided by participatory geographic information systems (GIS). This was accomplished by having each stakeholder representative describe priority areas while geospatially referencing the base layers within the region. Under the direction of the representative, a recorder captured the priority as a new polygon in ArcGIS (Figure 4). For each area identified, the management focus or requirement for each proposed priority area was also recorded.

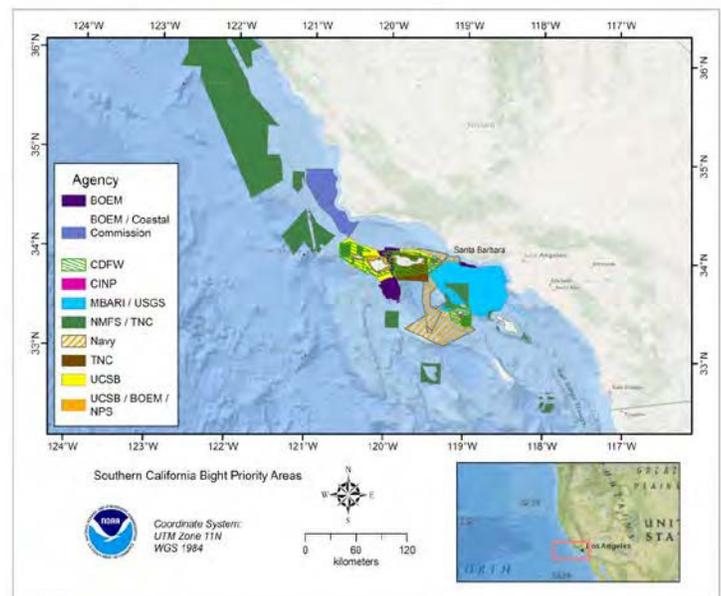


Figure 4. Priority Areas identified by workshop participants.

Two additional steps were taken to complete the evaluation of spatial priority areas. First, previously mapped areas were subtracted from the priority areas noted by the workshop participants to focus on locations where maps of the seafloor currently do not exist. Panel A in Figure 5 depicts all of the previously mapped areas. Panel B in Figure 5 shows the mapping priority areas identified during the workshop. We overlaid these two layers (panel C of Fig. 5), and subtracted previously mapped areas from the identified priority areas to identify unmapped areas of priority (panel D of Fig. 5). In addition, factors such as age of data sets, resolution, variability by sensor, and adherence to International Hydrographic Organization standards should be considered prior to merging older data sets with new survey data. This is because existing data may or may not meet future needs, and areas that have been excluded from future priorities may (i.e., panel D of Fig. 5) in fact require new data collection efforts, depending on the data's use. In light of this, indicators of data quality were assigned to previous data collections and reviewed with workshop participants.

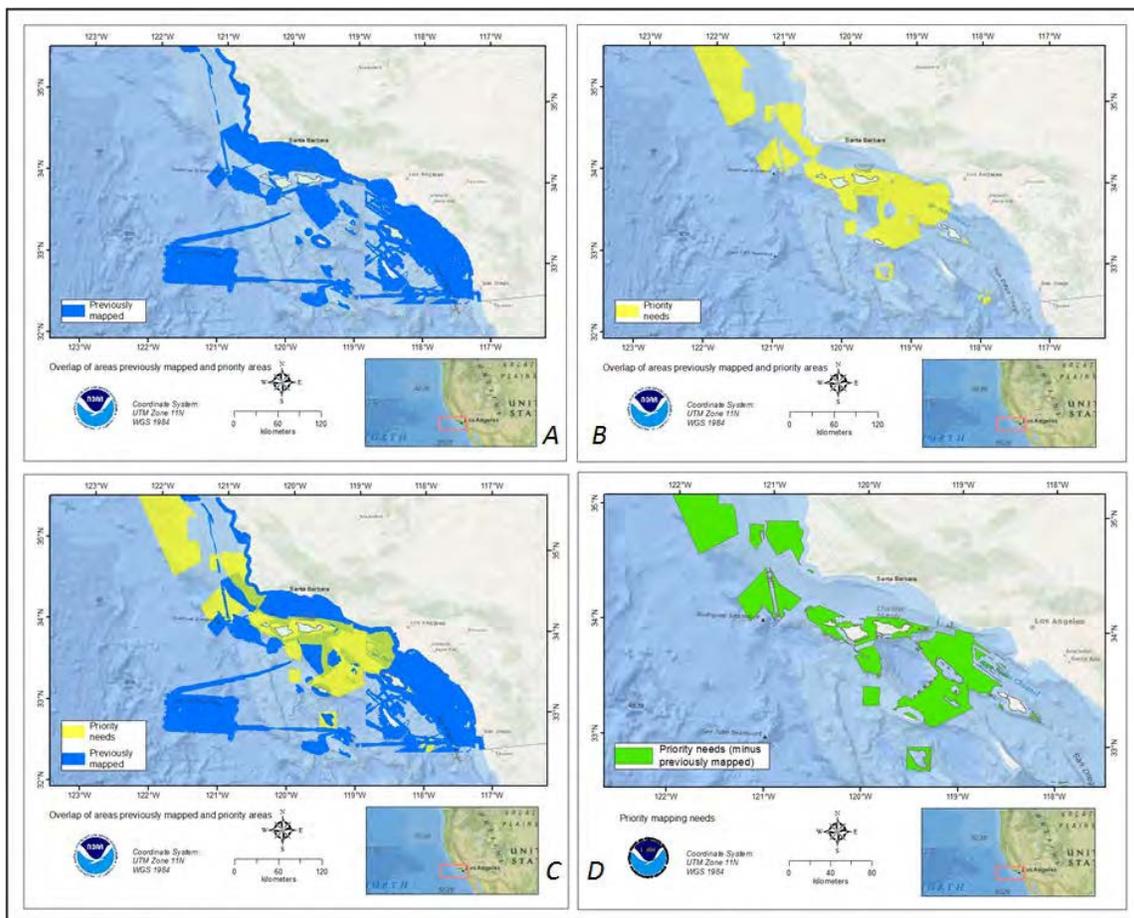


Figure 5. (A) Previously mapped areas, (B) priority mapping areas, (C) overlay of previously mapped and priority areas, (D) priority areas minus previously mapped areas.

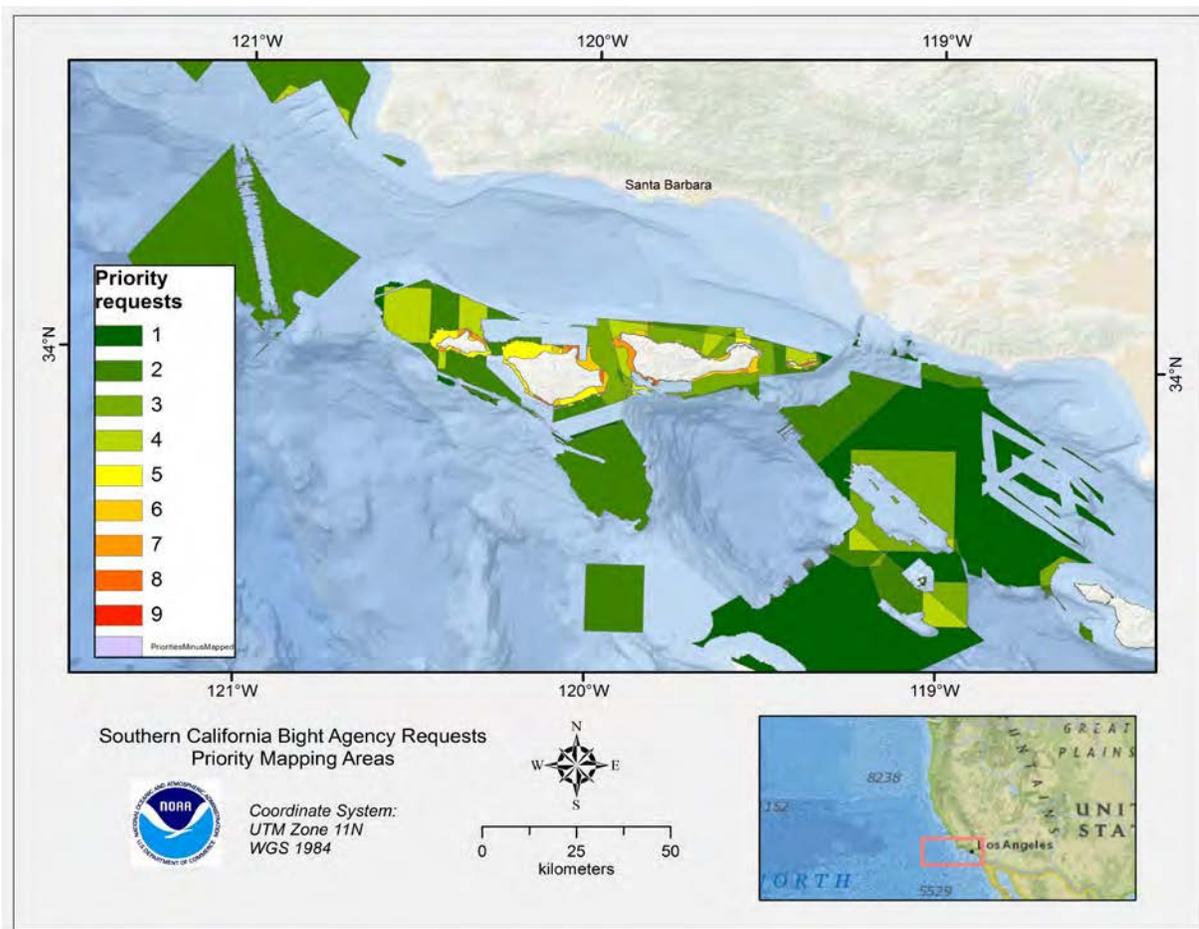


Figure 6. Overlapping agency priority areas indicating number of agency requests to rank priority areas. The number in the legend corresponds to the number of polygons that overlap in that space.

Second, the priority polygons were overlaid as a mechanism to determine where multiple stakeholders have co-occurring interests (Fig. 6). The number of acquisition requests in any given area was summed to rank priority areas across stakeholders and guide future acquisition efforts. While more complex quantitative approaches have been utilized elsewhere to prioritize mapping efforts (e.g., Menza et al. 2014), it was decided that the number of stakeholders, size of the geographic area, and time available to conduct the prioritization was conducive to a simplistic approach. A more complex methodology would have enabled us to rank the entire list of regional priorities and pare down to a few select locations, allowing some flexibility in matching needs with capabilities or piggyback opportunities. However, since stakeholder priorities were so wide ranging,



there may have been little ‘common ground’ other than where there is spatial overlap. With our approach, the full array of requirements is preserved for partners that share resources and data. Also, the final map identifies areas that need future mapping efforts.

3.4 Synthesis of Results

Stakeholder mapping priorities identified at the workshop centered around the northern Channel Islands, areas from 0m to 300m, unmapped EFH Conservation Areas, the Santa Monica basin, deep canyons, and kelp forest monitoring sites surveyed by the CHIS (Table 4, Fig. 7). Additional priorities identified in follow-up discussions highlighted needs for bathymetry data collections around the northern Channel Islands and off Point Conception, as well as new LiDAR efforts to address coastal change (Table 3).

The interest in seafloor data around the northern Channel Islands stems in part from multiple overlapping jurisdictions. CDFW, TNC, CINMS, CHIS, and the Navy each have a role in managing the marine environment or neighboring land. In many cases, these entities were set up with missions related to conserving pristine marine ecosystems that surround the islands. CDFW and CINMS, for example, collectively manage a network of marine reserves around the islands. The Navy, along with resource management entities, also has an interest in understanding potential environmental impacts associated with any action they might take. Additionally, awareness of and careful planning around historic cultural sites are needed if efforts for offshore energy development are pursued by energy groups. Further, the CHIS is interested in additional mapping around their Kelp Forest Monitoring sites, where they have been conducting subtidal monitoring for over 30 years. This data set is vital to informing park and sanctuary management and is one of the longest running data sets of this kind worldwide. Linking bathymetry data to the rich benthic habitat and fish abundance data set would allow park researchers to better understand the relationship between benthic habitat structure and the park’s natural resources. TNC and USGS are also interested in the bathymetry data around the islands, specifically in relation to how land management affects nearshore ecosystems. Finally, USGS is particularly interested in a sandbar that is forming off south San Miguel due to increased erosion on the island. The sandbar is drastically and rapidly altering the seafloor, yet there is little data to confirm the spatial extent and other details of the disturbance.

BOEM and the CCC are interested in characterizing the environment around Point Conception and northward because a number of groups have expressed interest in leasing areas for alternative energy. One potential project by Trident Winds would involve the placement of 100 floating wind turbines 15 miles offshore of Morro Bay.

A better understanding of offshore faults and hazard zones, like the Santa Monica Basin, are also a concern for managers. The basin is a sink for sand and erosion from Santa Monica Bay and could be a major sink for pollution, but it remains uncharacterized. Likewise, the “white zone” and nearshore habitats need high quality, high resolution bathymetry and habitat maps to support research objectives, and manage coastal erosion

and land-based impacts. Such maps would also better inform new EFH designation across the SCB.

Table 4. Priority areas identified by workshop participants.

<i>Stakeholder</i>	<i>Priority Description</i>	<i>Management Focus</i>	<i>Meeting Representative</i>
UCSB, BOEM, CHIS, CINMS	0-10m around northern Channels Islands	Research, resource management	Bob Miller Donna Schroeder Rocky Rudolph Chris Caldow
UCSB, BOEM, CHIS, CINMS	10-30m around northern Channel Islands	Research, resource management	Bob Miller Donna Schroeder Rocky Rudolph Chris Caldow
CDFW (3)	MPAs and MPA Reference Sites around northern Channel Islands	Fisheries management	Paulo Serpa
Navy	Bathymetry to help operations	Naval training	John Ugoretz
UCSB	Data gaps out 300m	Research and habitat suitability modeling	Bob Miller
BOEM	From 10-130m. High resolution data within the Santa Cruz Channel	Research	Donna Schroeder
BOEM	From CINMS boundary to 300m; Priorities in this area are spatially variable as guided by ongoing projects. It should be noted that BOEM is not equally interested in all areas within this bounding polygon.	Low Priority Areas for Various Research Projects	Donna Schroeder
BOEM	From state to 500m; Priorities in this area are spatially variable as guided by ongoing projects. It should be noted that BOEM is not equally interested in all areas within this bounding polygon.	Low Priority Areas for Various Research	Donna Schroeder
BOEM, CCC	From state coastline to 500m (both federal and state waters). CCC is concerned with these areas in State Waters while BOEM is concerned with federal waters. Lower priority/ higher resolution where low resolution data already exists.	Low Priority Areas for Research and Potential Alternative Energy projects	Donna Schroeder Cassidy Teufel
MBARI, USGS	Santa Monica Basin	Sediment Contaminants, Submarine Landslide and Tsunami Hazard	Charlie Paull
CDFW	MPA Reference Site With PISCO Data	Fisheries Management	Paulo Serpa
CDFW	MPAs	Fisheries Management	Paulo Serpa
Navy	NEPA for Fiber-optic Cable Laying	Navy Seafloor Disturbance	John Ugoretz
TNC	SCI Management, offshore drainages and erosion impacts. Desired a focus on deep canyons.	EFH and TNC Management	Mary Gleason
NMFS/TNC	Unmapped EFH Conservation Areas	EFH Conservation Designation	Mary Yoklavich Mary Gleason
CHIS	KFM sites	KFM and Park Management	Rocky Rudolf

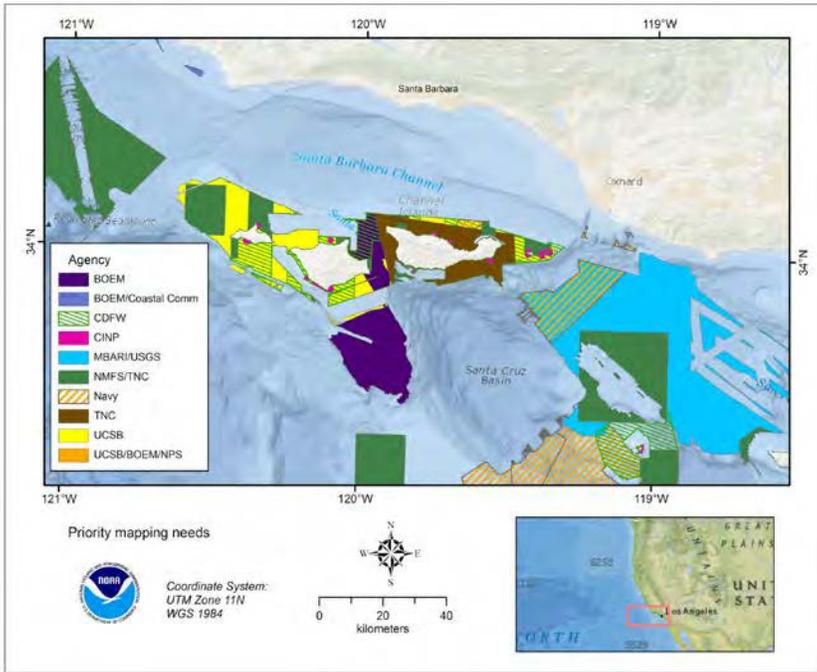
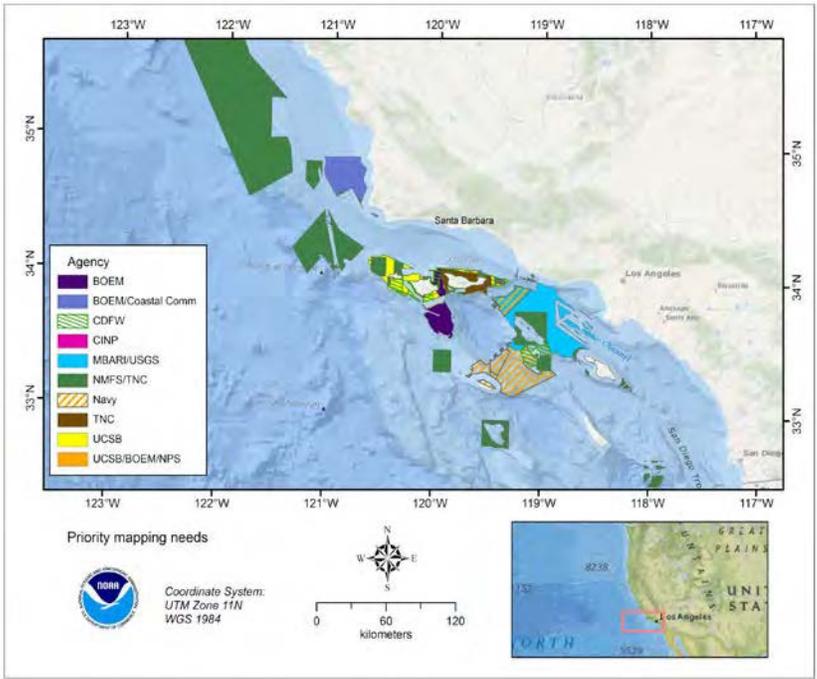


Figure 7. Overlapping agency priorities in the SCB (upper) and around the northern Channel Islands (lower).



Chapter 4

NEXT STEPS

4.1 NOAA Seafloor Data Acquisition

As discussed in section 3.4 and shown in Fig. 7, one high priority seafloor data acquisition target identified from this effort is the area around the northern Channel Islands. In 2015, a NOAA partnership composed of CINMS, NCCOS, Office of Coastal Survey (OCS), OMAO, Office of Ocean Exploration and Research (OER) and NOAA's Deep Sea Coral Research and Technology Program (DSCRTP) successfully mapped 81 km² of previously unmapped habitat within CINMS boundary using the NOAA ship *Bell M. Shimada*. A science team collected multibeam data and discovered a previously unmapped pinnacle (Caldow et al. 2015). This is important for the nautical charts and understanding the distribution of habitat for living marine resources. In addition, 13 remotely operated underwater vehicle (ROV) surveys were performed. To follow on the success of the mapping effort on the *Shimada*, CINMS, NCCOS, and other programs within NOAA are looking to leverage resources to continue mapping around the northern Channel Islands. In 2016, survey missions are planned aboard the NOAA ship *Reuben Lasker* in partnership with Southwest Fisheries Science Center (SWFSC) and the *Shimada*. NOAA staff are working on securing additional opportunities for mapping in the SCB by taking advantage of OER's partnership with Ocean Exploration Trust's (OET) Exploration Vessel (E/V) *Nautilus*. In addition to using larger vessels for mapping, CINMS is scoping a plan to outfit the sanctuary vessel, the Research Vessel (R/V) *Shearwater* using a pole-mounted multibeam mapping system.

4.2 Partner Seafloor Data Acquisition

Outside of NOAA, other stakeholders are working to map the priority areas identified by this Southern California Seafloor Mapping Initiative collaborative process. The Ocean Protection Council (OPC) is set to conclude the California Seafloor and Coastal Mapping Program Steering Committee process as part of the CSCMP by mid-2016. Due to limited remaining funds, they sought input from various state and federal agencies to prioritize which of the original CSCMP mission goals to complete. Five proposals, each with a different mix of new seafloor data acquisitions and creation of additional USGS map portfolios (data products derived from seafloor data), were considered in a vote by the Steering Committee in 2016. Unfortunately, the mapping proposals that included acquisition in Southern California were not funded. The OPC has coordinated with CINMS to develop cost estimates for mapping around the northern Channel Islands, which were included in the cost estimates for the proposals.



4.3 Data Accessibility and Dissemination

A key need identified during the prioritization workshop is a central location to display available seafloor data and associated metadata. This need was underscored by how challenging it was for us during the workshop planning phase to discover and access relevant data sets across several groups involved in mapping efforts. In partnership with IWG-OCM, the authors decided to use the SeaSketch platform to aid data discovery across the SCB. The SeaSketch project displays georeferenced existing seafloor data as well as the priority areas identified through this process, and while it does not serve as a data repository, it can point users to a Uniform Resource Locator (URL) where the data can be accessed. In SeaSketch, seafloor data collections are shown as footprints complete with metadata on year of collection, organization responsible for acquiring the data, and data format and resolution. Priority areas are shown with information on the requesting stakeholder(s) and management focus. The [SeaSketch](http://fedmap.seasketch.org) project (<http://fedmap.seasketch.org>) is updatable as new acquisitions become publicly available.

4.4 Seafloor Data Product Development

While bathymetry and backscatter are both critical data layers in and of themselves, they also form the basis for a wide range of other valuable product types. Information on physical features such as slope and curvature help identify large scale features (e.g., canyons, seamounts, etc.) and fine scale features (e.g., patch reefs). From these data layers, we can develop comprehensive habitat maps that aid delineation of both suitable and critical habitats for living marine resources. Such habitat maps also enable forecasting of how habitat use will change across scenarios of varying environmental and anthropogenic forces. Altogether, these information streams will lead to better management of human uses of the SCB.



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GLOSSARY OF ACRONYMS

ACOE: Army Corps of Engineers
BOEM: Bureau of Ocean Energy Management
CCC: California Coastal Commission
CDFW: California Department of Fish and Wildlife
CINMS: Channel Islands National Marine Sanctuary
CHIS: Channel Islands National Park
CSCMP: California Seafloor Mapping Program
CSUMB: California State University Monterey Bay
DSCRTP: NOAA’s Deep Sea Coral Research and Technology Program
EEZ: Exclusive Economic Zone
EFH: Essential Fish Habitat
IHO: International Hydrographic Organization
IWG-OCM: Interagency Working Group for Ocean and Coastal Mapping
MBARI: Monterey Bay Aquarium Research Institute
MPA: Marine Protected Area
NCCOS: National Centers for Coastal and Ocean Science
NCEI: National Centers for Environmental Information
NEPA: National Environmental Policy Act
NGS: National Geodetic Survey
NMFS: National Marine Fisheries Service
NOAA: National Oceanic and Atmospheric Administration
OMAO: NOAA’s Office of Marine and Aviation Operations
OCM: NOAA’s Office of Coastal Management
OCS: NOAA’s Office of Coastal Survey
OER: NOAA’s Office of Ocean Exploration and Research
OET: Ocean Exploration Trust
OPC: Ocean Protection Council
USGS: United States Geological Survey
ROV: Remotely Operated Vehicle
SCB: Southern California Bight
SCCOOS: Southern California Ocean Observing System
SFML: California State Monterey Bay Seafloor Mapping Lab
TNC: The Nature Conservancy
UCSB: University of California Santa Barbara



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APPENDIX

SRC Seafloor Mapping Meeting Agenda Friday August 28, 2015 CINMS Offices

8:30: Coffee, snacks

9:00: Welcome and Introductions

9:15: Overview of Meeting Goals

9:30: Attendee PowerPoints

These will be a series of 3 slide PowerPoints overviewing each agency/institution's mapping needs. The slides will cover the following areas:

1. An overview of your agency/institution's mapping data requirements (i.e. Bathymetry and Seafloor Habitat)
2. An overview of plans for data collection (including mapping techniques/instrumentation) or data use
3. An overview of their agency/institution's mapping priorities (ex: depth range)

10:45: Overview of Existing Data in the Southern California Bight

CINMS/NCCOS will explain the story map and the database of the existing mapping data products. This time will be used to talk about data gaps, other spatial management data relevant to coastal management, other potential missing data from the database, and data quality issues. We will also discuss what areas are planned for collection and discuss ability to piggyback on upcoming collection efforts.

12:00: Lunch

1:00: Area Priority Setting

NCCOS' priority setting exercise will use input from meeting attendees to locate what areas are most important to map first. Input will be binned by depth range (0-10m, 10-100m, 100-300m, 300+ m). Input will be captured digitally in an ESRI program (feel free to send shape files of agency priorities prior to the meeting if you have them available).

3:00: Time and Cost Estimation

Discussions will focus on cost of data acquisition, data processing, data hosting, data archiving, groundtruthing, and accuracy assessment.

3:30: Meeting Wrap up

Follow-ups and to-dos from the meeting will be recapped



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