

# National Marine Sanctuary Program

## NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process



NATIONAL MARINE  
SANCTUARIES <sup>TM</sup>



September 2004

NOAA  
National Ocean Service  
National Marine Sanctuaries



# **NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process**

Interim Report – September 2004

**Background:** Since 2002, with the signing of a Memorandum of Agreement, the USGS has been collaborating with the NMSP in the development of a strategy for seabed mapping in the national marine sanctuaries. Additional critical assistance and support in this effort has been provided by the UNH Center for Coastal and Ocean Mapping/Joint Hydrography Center, and the Office of Coast Survey. The goal of the strategy is to provide seabed maps of the national marine sanctuaries and Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve that will effectively support management, research, monitoring, education, outreach, and enforcement at these sites. The identification of the mapping priorities across the NMS System and at each site is necessary to guide and inform the collection, analysis, ground-truthing, and visualization of these data, as well as to effectively and efficiently coordinate with other NOAA offices and programs within the NOAA Integrated Ocean Mapping (IOM) initiative, in mapping activities across the Agency.

**UNH Workshop: Findings and Recommendations:** In order to address the first element of the USGS/NOAA MOU, a workshop was held at the University of New Hampshire in November of 2002, hosted by the Center for Coastal and Ocean Mapping/Joint Hydrography Center. This workshop brought together experts from the Center, USGS, NOAA and the academic community with NMSP managers and scientists to identify the critical elements of appropriate and useful seabed maps, and how to best acquire such data and maps.

A consensus was reached by the participants at the workshop that the Sanctuaries should be mapped completely, 100% coverage, using either acoustic or optical swath mapping technologies (multibeam, sidescan sonar, LIDAR), to a resolution of 10's of meters horizontal and 10's of centimeters vertical, which was generally consistent with the resolution of existing multibeam maps available at a few of the sites. The backscatter data, which provides some measure of bottom hardness (mud or rock, for example) must be interpreted and groundtruthed (according to a methodology to be developed...none currently exists) using regional habitat characterization schemes adopted by consensus within that region, but having elements which allow inter-comparability among the schemes selected). Areas within each sanctuary will be identified and prioritized for higher resolution mapping (around horizontal 1 m or "optical" resolution...that which can only be mapped using video data, or more advanced technology – such as laser line scan or some recent advancements in multibeam technology). National priorities will be identified for base and higher resolution mapping, established on the basis of whether sites already meet the 100% coverage goal, and sites and areas within those sites where significant management needs (zone monitoring, designated research areas, impact assessment, etc.) are driving the collection of this information.

**Identifying Priorities:** Existing seabed mapping data and metadata (where available) were collected for each NMS site (and the NWHICRER) and converted to GIS data layers, providing a comprehensive catalogue of existing seabed mapping information available for each site (except the Monitor National Marine Sanctuary.) Although most of the current survey data is from NOAA's archives, it should be noted that other sources such as USGS, and University of Southern California data collected within sanctuaries were included. The sites were then divided into cells of 1 sq. nmi. and sanctuary site personnel were asked to identify priority areas to be mapped both at "medium-resolution" and "high-resolution", or with "side scan sonar". Requests for other types of seabed mapping techniques were also considered where provided by site staff. This information was collected and summarized in the accompanying map folio. Within each prioritized polygon is a number that is connected to specific information in the spreadsheets following the maps. Definitions of some of the different types of sonar data collection techniques follow this section. An example of existing mapped areas for Channel Islands National Marine Sanctuary is included. All known recent surveys (as of Aug. 15 2004) have been included in the assessment of currently available seabed mapping data.

The results of this preliminary effort should not be considered final. The maps shown in this folio represent the first draft of sanctuary site proposed surveys. These maps and descriptive text will be provided to the site staff for review and revision. It should also be noted that this is an evolving document that will be periodically updated for new survey requirements, completions, and priority changes.

**Next Steps:** A working session is being planned at the UNH CCOM/JHC in the Fall of 2004, involving participants from NMSP, USGS, OCS, and others, to take the mapping priorities information and identify the funding, ship-time, and other asset requirements that will be required for the NMSP to implement this seabed mapping strategy. These assessments are made based on needs requirements, area covered, complexity of the survey area, depth divisions, staff availability, data processing, and equipment/platform requirements. This requirements document should be completed within two months of the completion of the working session, and be distributed to partners within NOAA and USGS involved in the Integrated Ocean Mapping collaboration.

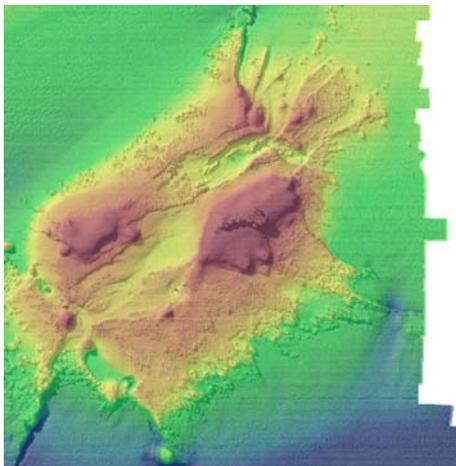
The US Geological Survey, NOAA/National Marine Sanctuary Program's Seabed Mapping Initiative: 2002-2003 Annual Report can be found at :  
<http://www.sanctuaries.nos.noaa.gov/library/national/jsbmi.pdf>

**For additional information, contact:**

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## Definition of terms:

**Multibeam sonar & backscatter** – Most modern multibeam systems are capable of measuring both sound reflectance strength (known as backscatter and is similar to side scan sonar), and the depth, which is obtained by recording the time for the acoustic signal to travel from the transmitter (transducer) to the seafloor and back to the transducer. Multibeam sonars are generally attached to a vessel, rather than being towed like a side scan sonar. Therefore, the coverage area and data resolution on the seafloor is dependent on the depth of the water, which is typically two to four times the water depth. The fact that they are attached to the vessel also allows for precise location information for each individual sounding collected by the system.

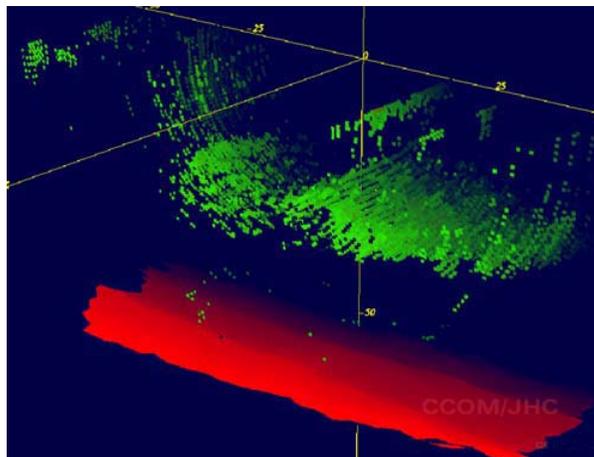


Multibeam Survey – Flower Garden Banks NMS, James Gardner, USGS

There are many types of systems available. Each system is manufactured to survey particular ranges of depths. Most shallow water systems do not survey deep water areas well, if at all (depending on depth), and vice versa. The main disadvantage of multibeam is the inability to position the transducer close to the seafloor in deeper waters as is possible with side scan sonar. Because the transducer is not being towed it can not be lowered or raised in order to obtain high resolution data across the entire seafloor being mapped. There are new AUV mounted systems that can be used and they are currently being tested by the National Underwater Research Program (NURP).

**Midwater multibeam** is a multibeam system for measuring biomass in the water column.

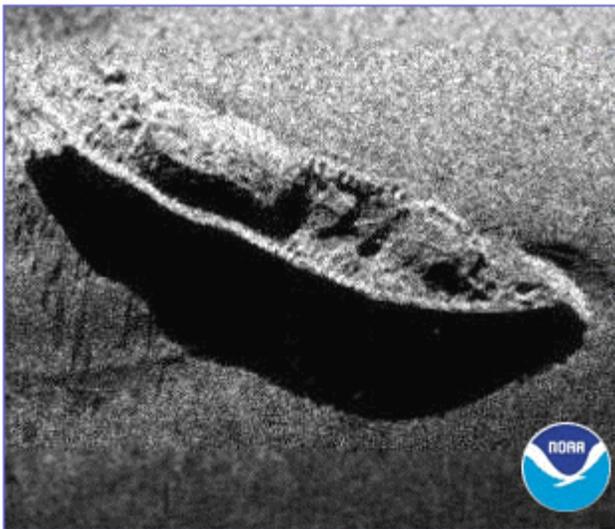
This technology is still experimental but has shown positive results for measuring fish and other biomass in the water column at the midwater trawl levels. NMFS is the most common user of midwater multibeam data. However, the NMSP may be able to utilize this type of data with the help of NMFS and the NOAA vessels outfitted primarily for fisheries research. An assessment of the types of and quantities of the animals living within and outside sanctuary waters



Midwater and Seabed Multibeam Data (Center for Coastal Ocean Mapping – Joint Hydrographic Center)

can provide the program with data that may help assess whether or not sanctuary special protection areas are working and are correctly placed. In addition to the multibeam data collection, fish trawl data must also be simultaneously collected in order to determine the types of animals that are being recorded. It is thought that this type of system may be better than traditional trawl data alone because the multibeam system will survey a wide swath to either side and below the vessel. These areas are only partially covered by the trawl nets, and are thought to be the regions where animals may typically flee from the ship noise and turbulence.

**Side scan sonar** is a specialized sonar system for searching and detecting objects on the seafloor. Like other sonars, a side scan transmits sound energy and analyzes the return signal (echo) that has bounced off the seafloor or other objects. In a side scan, side-looking transducers transmit energy that is formed into the shape of a fan that sweeps the seafloor from directly under the towfish to either side, typically to a distance of 100 meters. The strength of the return echo is continuously recorded creating a "picture" of the ocean bottom where objects that protrude from the bottom create a dark image (strong return) and shadows from these objects are light areas (little or no return). While the shape of the seafloor and objects on it can be well depicted, most side scan systems can not provide any depth information.



USS Monitor Side Scan Survey – NOAA's Hydrographic Survey Division

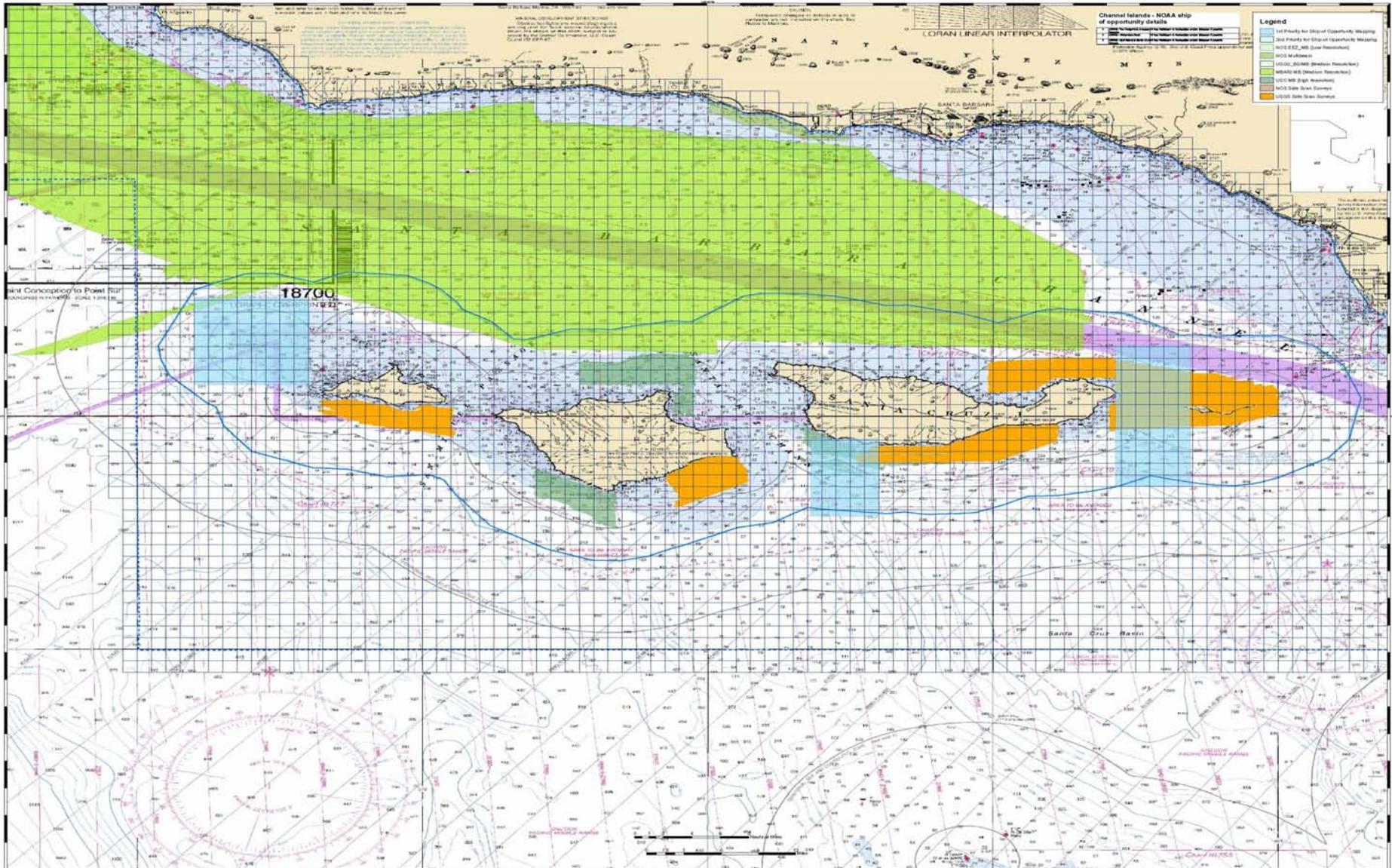
The advantage of side scan sonar over multibeam surveys is its ability to resolve small details in very deep water. While multibeam is usually hull-mounted, a side scan sonar is usually towed below and behind a ship. This allows the sonar to get as close to the target as is needed. The disadvantage of the side scan sonars is that they do not provide depth information, and are not precisely geo-rectified because the towfish cannot be tracked underwater with a GPS system so that only estimated positions can be obtained. This type of survey is particularly good

for shipwreck and hazards to navigation surveys at depth, or for getting a closer view of known depth and backscatter locations for purposes of habitat or geologic classification. Used in conjunction with multibeam surveys and ground truthed data such as video or sediment surveys, this technology can be very useful for detailed bottom classification.

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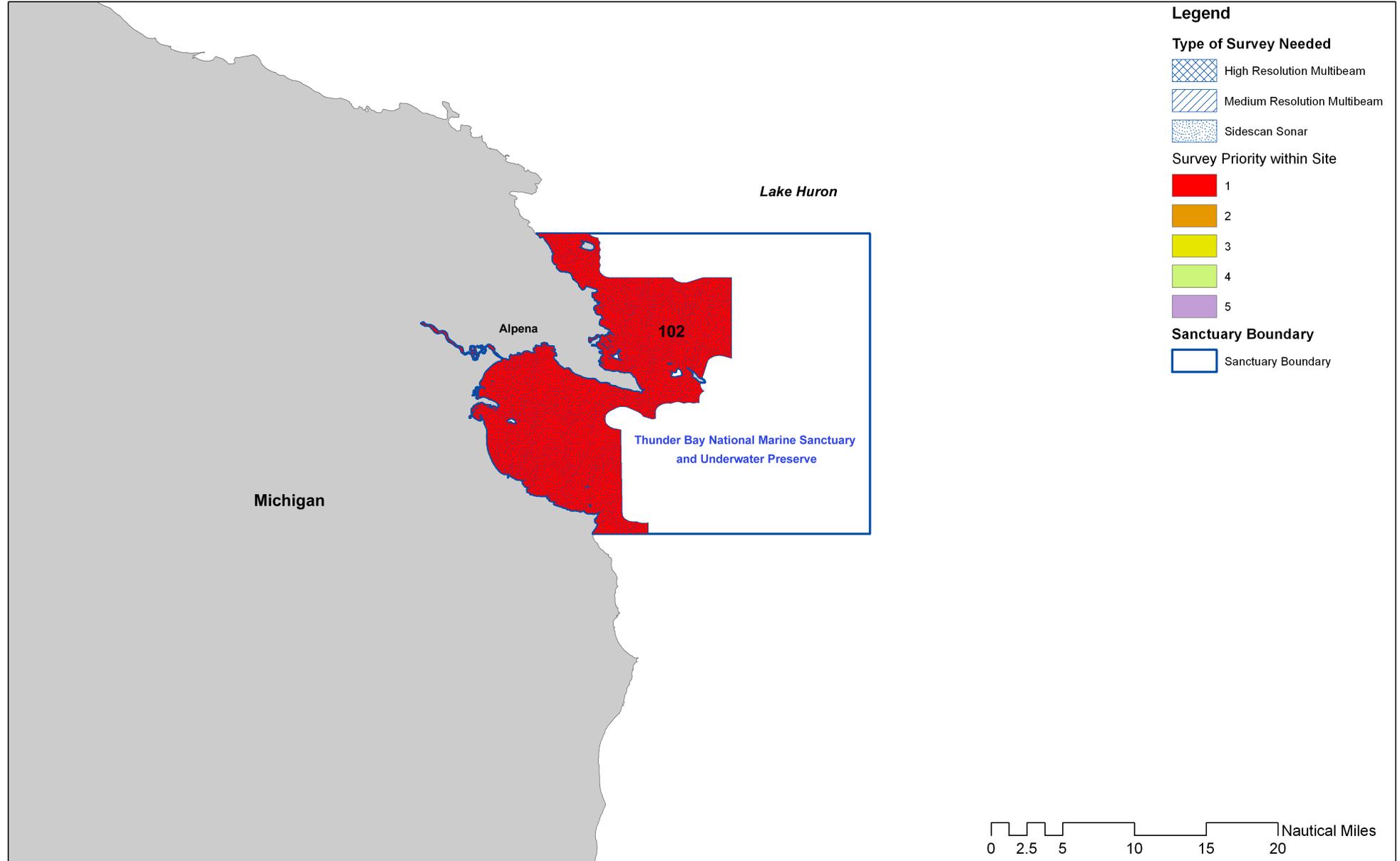
## Example of Existing Bathymetry Assessment - Channel Islands NMS

Channel Islands - Bathymetry Prioritization Grid



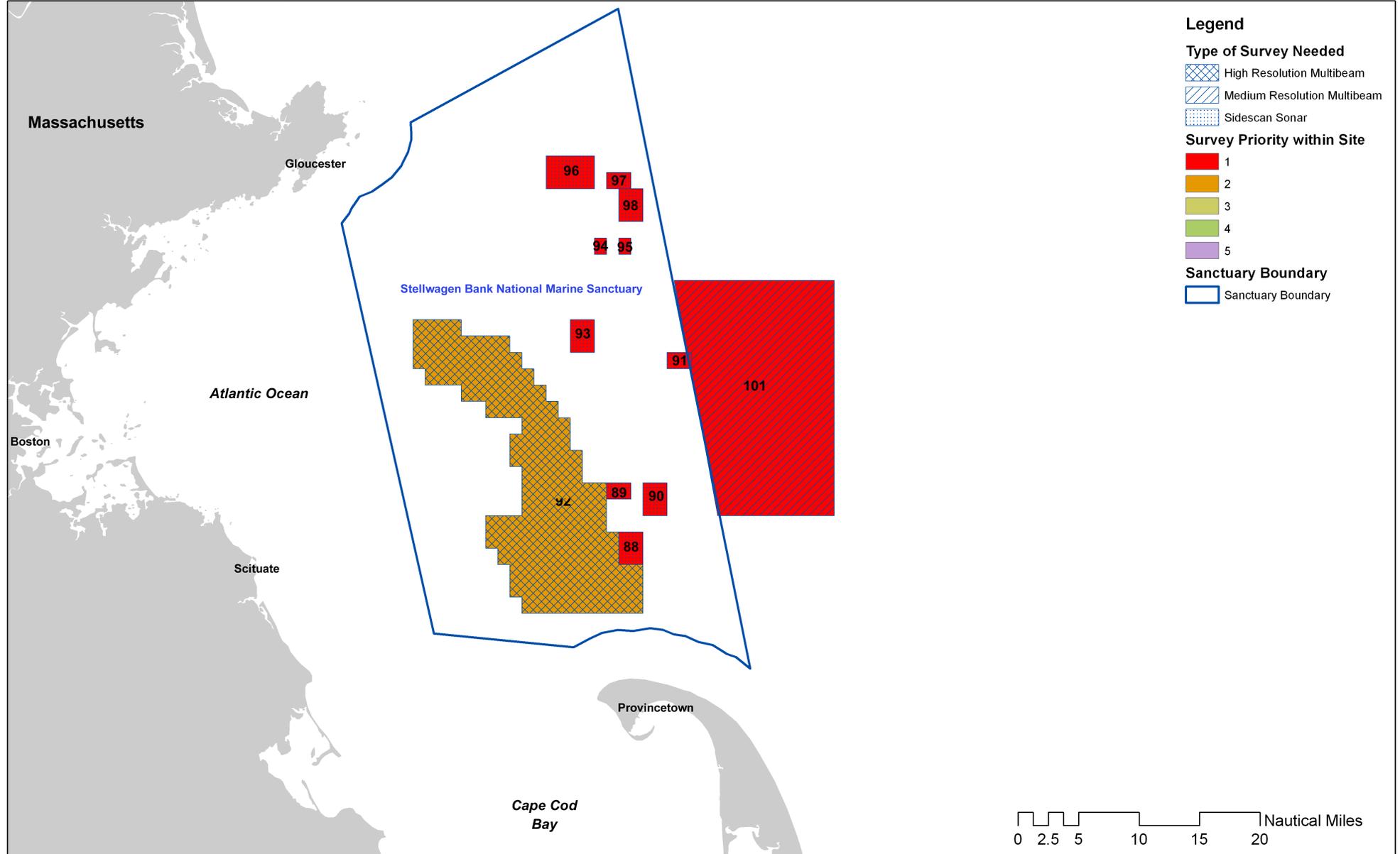
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Seabed Mapping Priorities - Thunder Bay National Marine Sanctuary



# NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process

Seabed Mapping Priorities - Stellwagen Bank National Marine Sanctuary

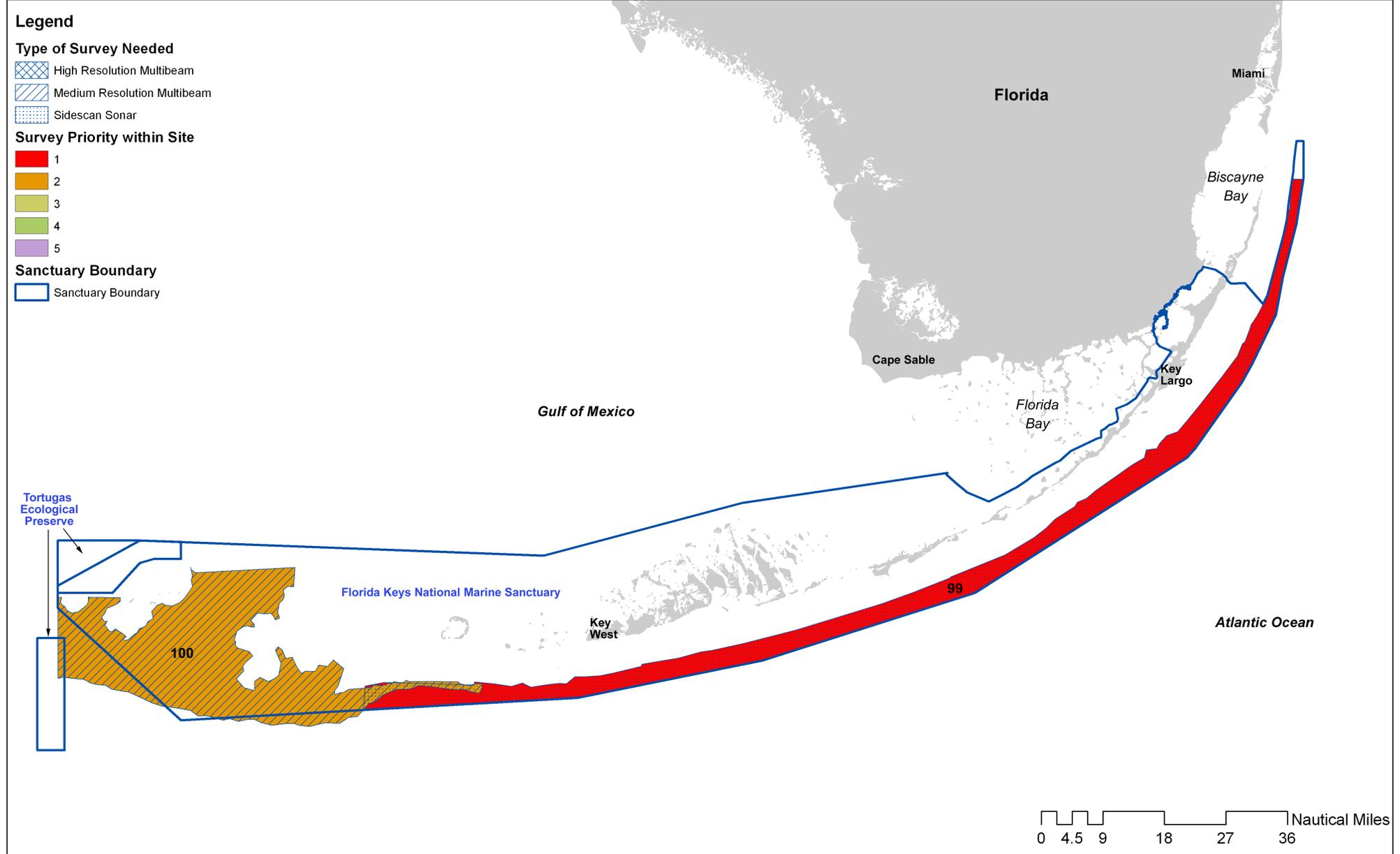


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## Seabed Mapping Priorities - Gray's Reef National Marine Sanctuary

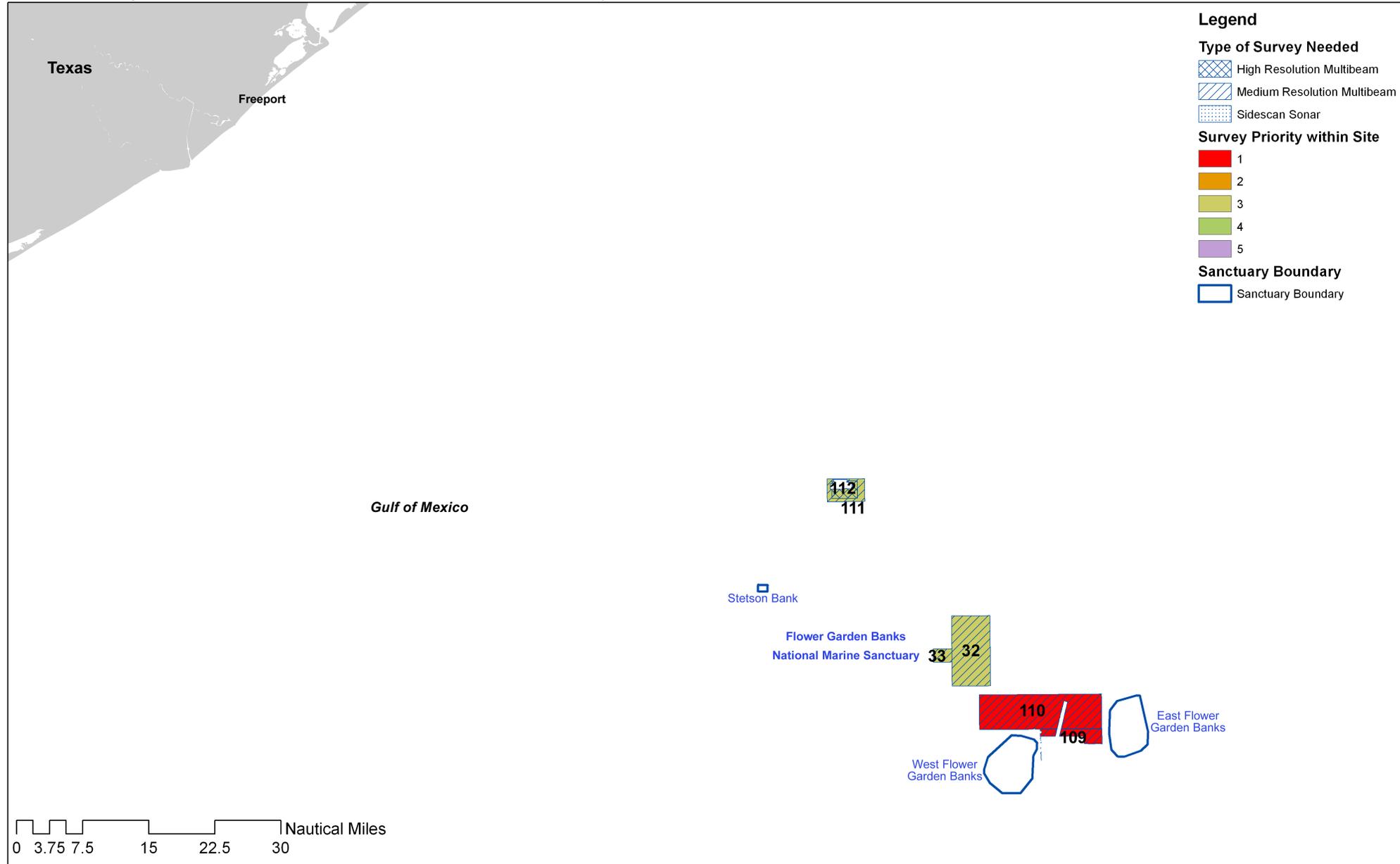


## Seabed Mapping Priorities - Florida Keys National Marine Sanctuary



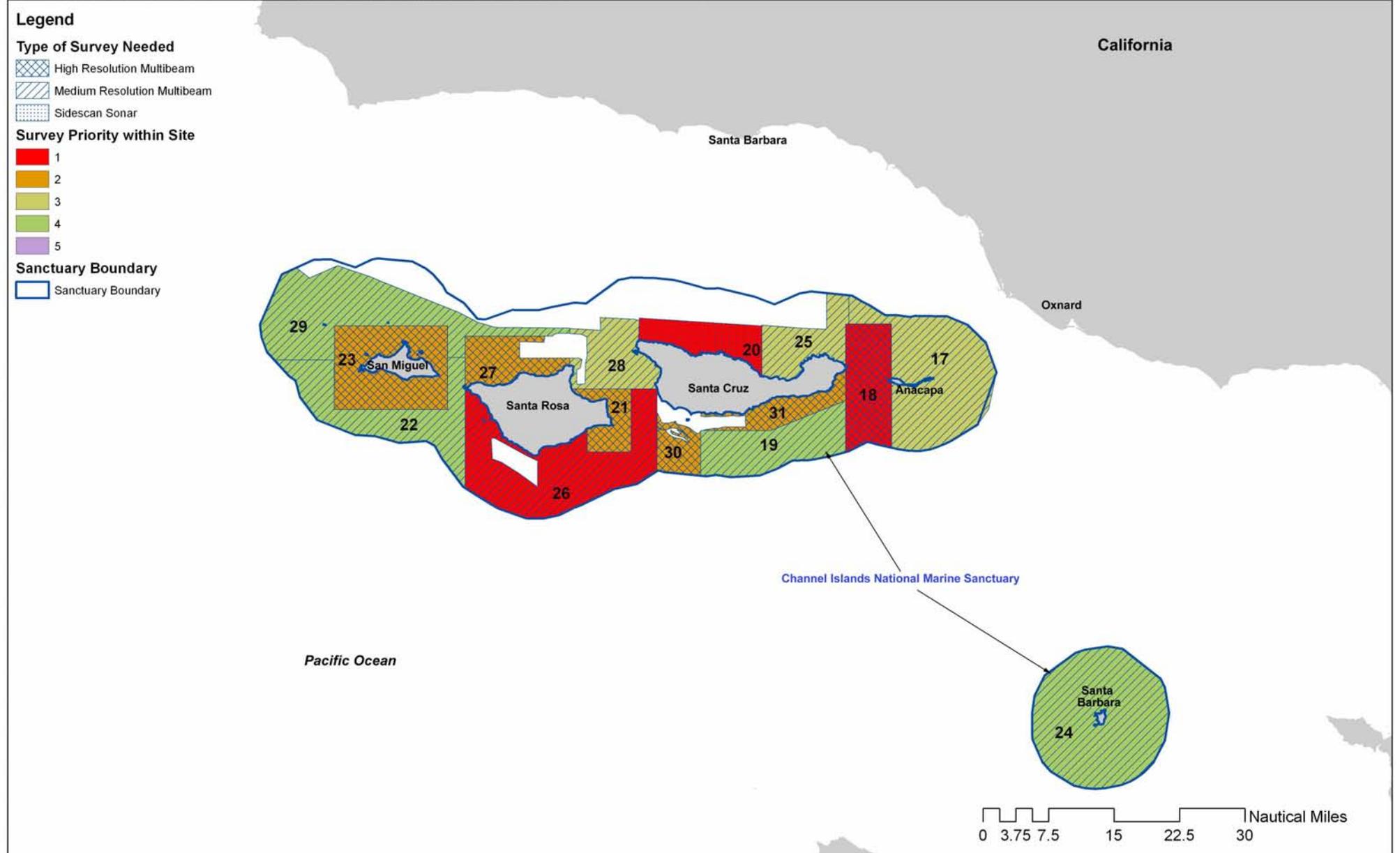
# NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process

## Seabed Mapping Priorities - Flower Garden Banks National Marine Sanctuary



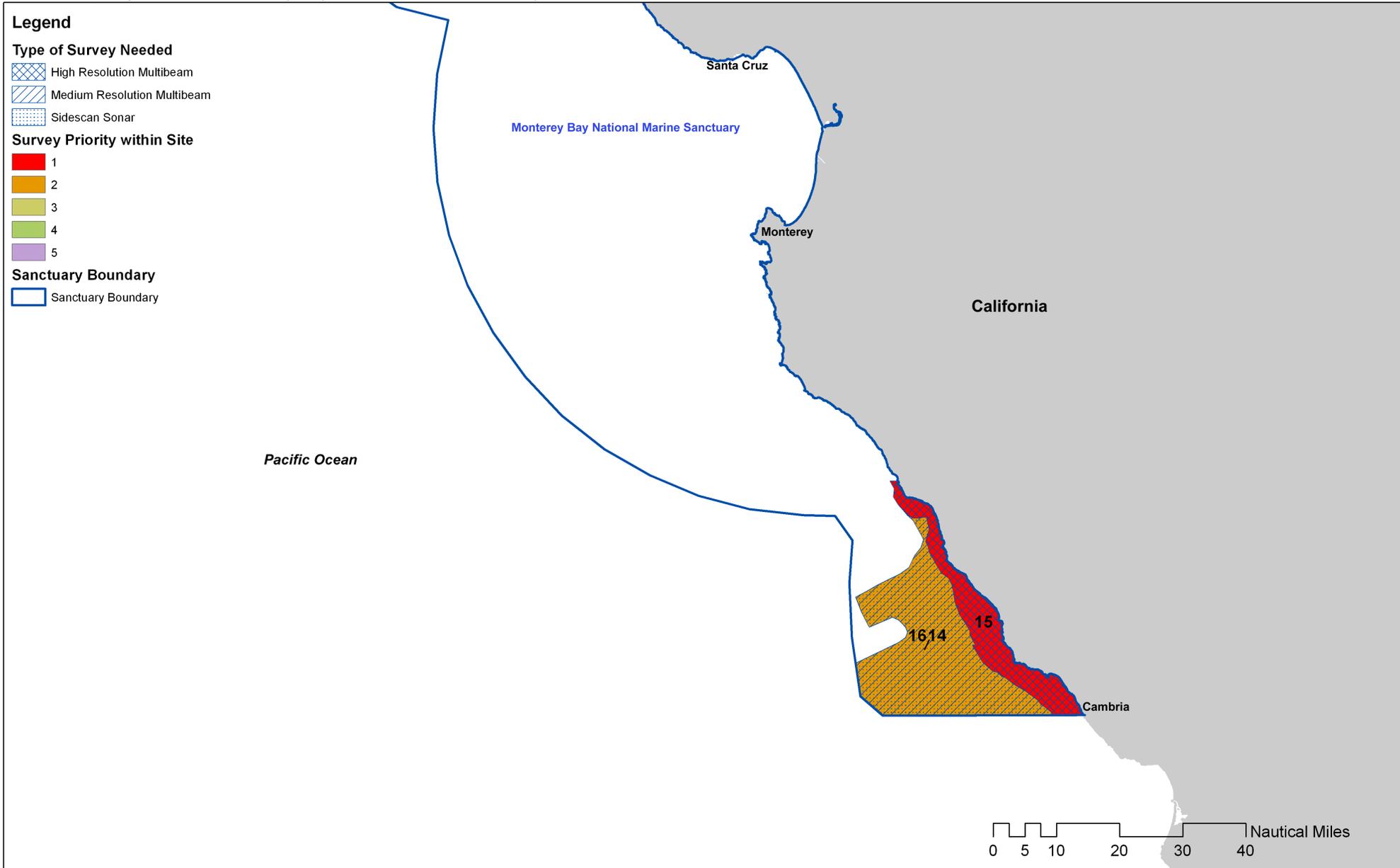
# NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process

## Seabed Mapping Priorities - Channel Islands National Marine Sanctuary



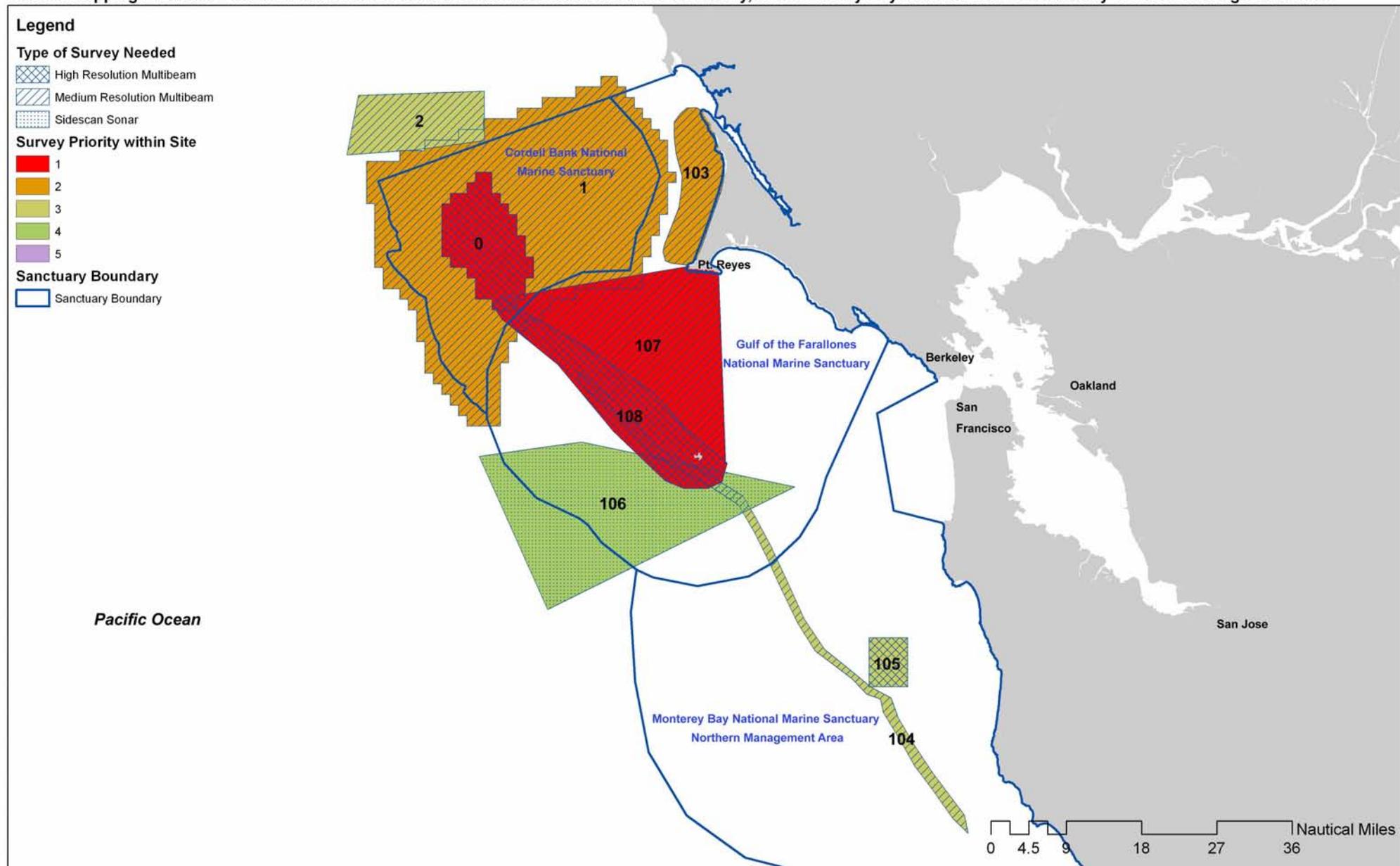
# NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process

## Seabed Mapping Priorities -Monterey Bay National Marine Sanctuary

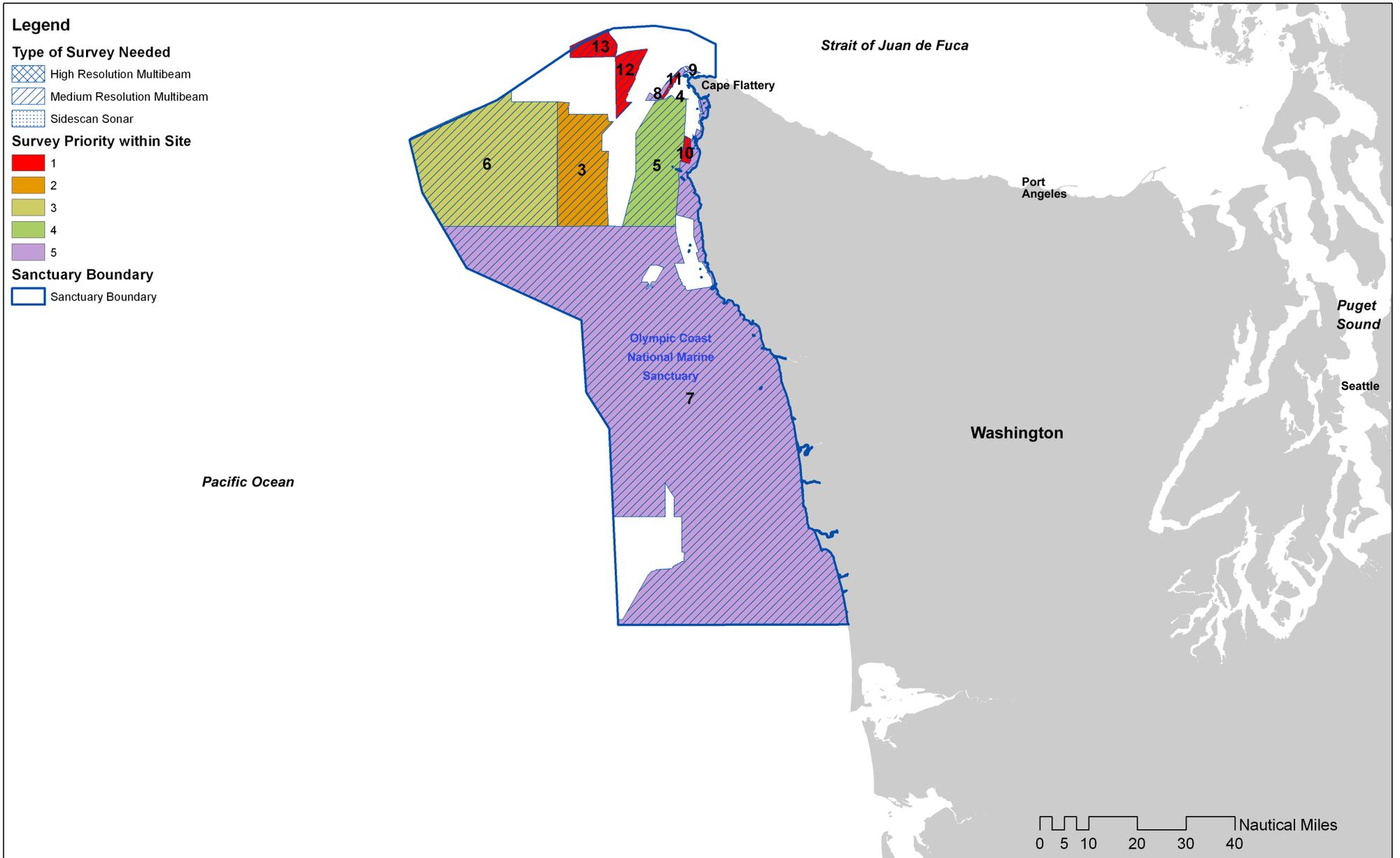


# NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process

Seabed Mapping Priorities - Cordell Bank and Gulf of the Farallones National Marine Sanctuary, and Monterey Bay National Marine Sanctuary Northern Management Area

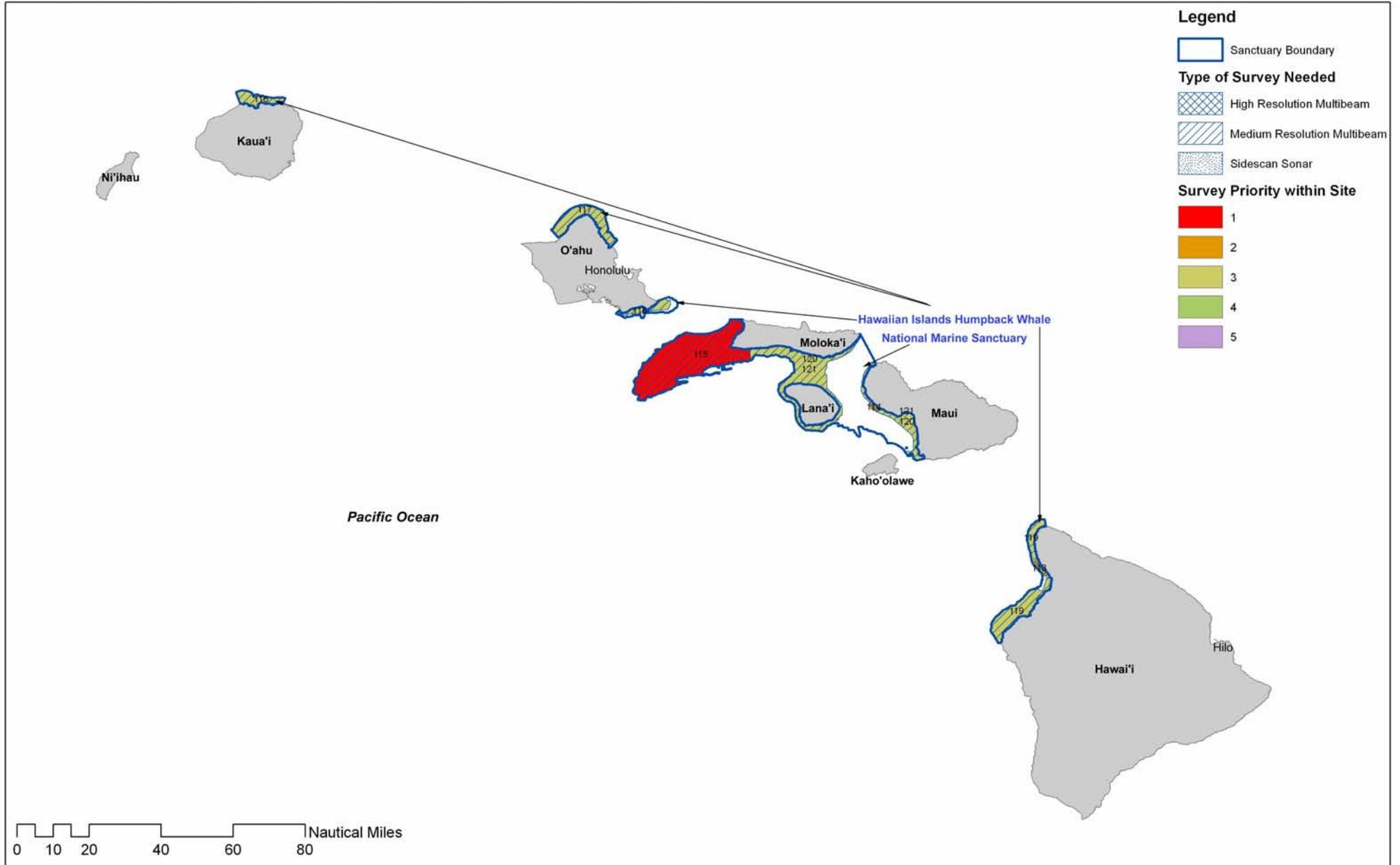


## Seabed Mapping Priorities - Olympic Coast National Marine Sanctuary



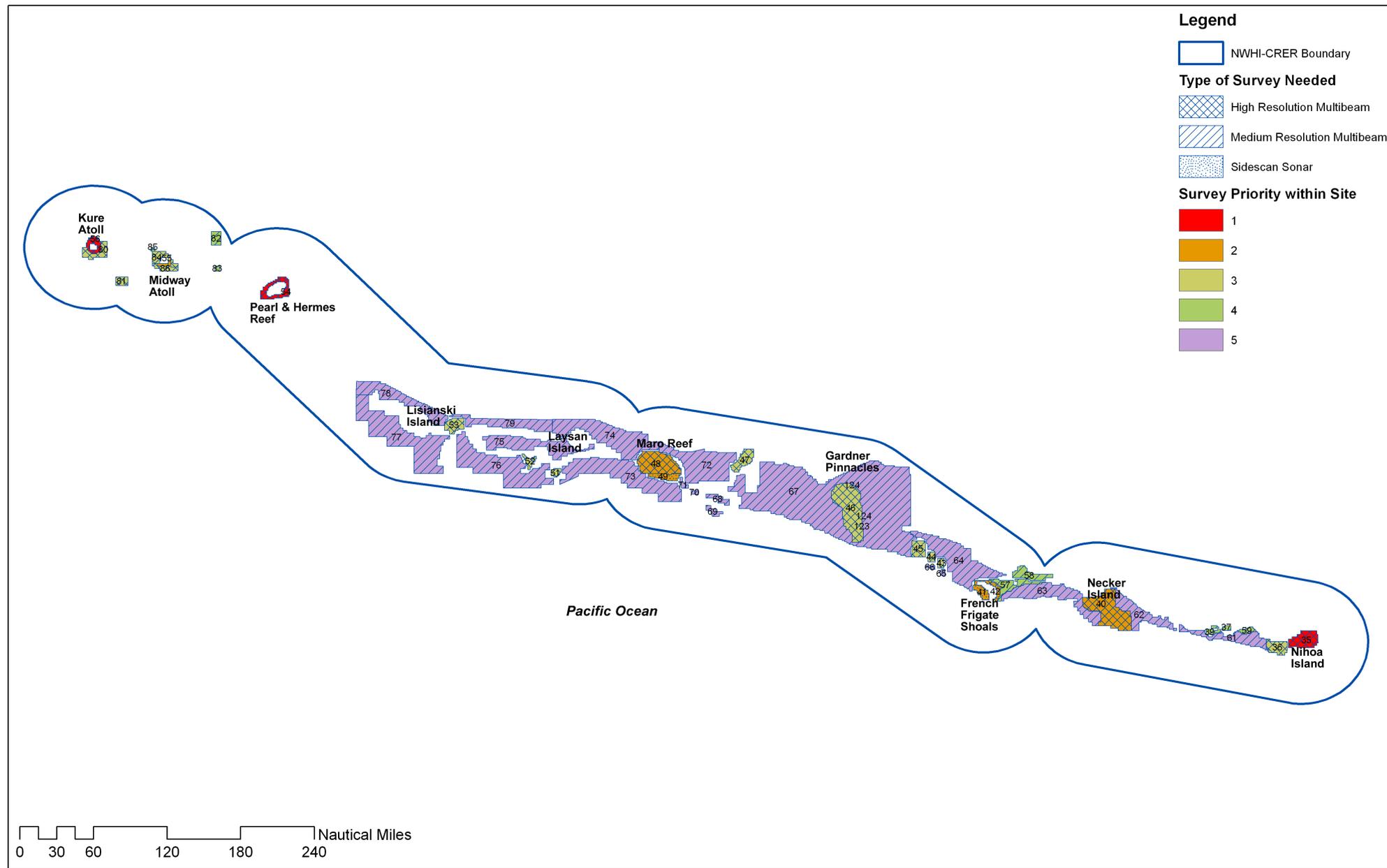
# NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process

Seabed Mapping Priorities - Hawaiian Islands Humpback Whale National Marine Sanctuary



# NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process

Seabed Mapping Priorities - Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve



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The following table links to the numbered polygons on the maps.



# NMSP/USGS Joint Seabed Mapping Initiative: Sanctuary Mapping Priorities Identification Process



Survey Area No.	Sanctuary Code	Type of Survey Needed	Survey Priority within Site	Notes	Secondary Survey Type Request	Polygon Perimeter in NM	Polygon Area in NM	Total Area in NM
<b>Thunder Bay National Marine Sanctuary</b>								
102	1	Sidescan Sonar	1	Area not currently mapped	Sidescan Sonar	141.31	120.60	120.60
<b>Stellwagen Bank</b>								
88	2	Sidescan Sonar	1	Seafloor Hab. Outside Closed Fishery (2)	Digital Photo/Video Mosaics	7.05	2.97	
89	2	Sidescan Sonar	1	Seafloor Hab. Inside Closed Fishery (2)	Digital Photo/Video Mosaics	4.92	1.48	
90	2	Sidescan Sonar	1	Seafloor Hab. Inside Closed Fishery (2)	Digital Photo/Video Mosaics	7.05	2.97	
91	2	Sidescan Sonar	1	Piled Boulder Reef (1)	Digital Photo/Video Mosaics	4.91	1.48	
92	2	Hi Res MB	2	Sand Lance Habitat Investigation (3)	Backscatter	70.37	103.87	
93	2	Sidescan Sonar	1	Seafloor Hab. Outside Closed Fishery (2)	Digital Photo/Video Mosaics	7.04	2.96	
94	2	Sidescan Sonar	1	Seafloor Hab. Inside Closed Fishery (2)	Digital Photo/Video Mosaics	3.52	0.74	
95	2	Sidescan Sonar	1	Piled Boulder Reef (1)	Digital Photo/Video Mosaics	3.52	0.74	
96	2	Sidescan Sonar	1	Seafloor Hab. Outside Closed Fishery (2)	Digital Photo/Video Mosaics	9.81	5.91	
97	2	Sidescan Sonar	1	Seafloor Hab. Inside Closed Fishery (2)& PBR(3)	Digital Photo/Video Mosaics	4.90	1.48	
98	2	Sidescan Sonar	1	Piled Boulder Reef (1)	Digital Photo/Video Mosaics	7.03	2.95	
101	2	MB	1	Wildcat Knoll	Sidescan Sonar	46.71	121.61	249.17
<b>Gray's Reef National Marine Sanctuary</b>								
87	3	Midwater MB Survey	2	Anywhere in the sanctuary	n/a	16.45	16.69	16.69
<b>Florida Keys National Marine Sanctuary</b>								
99	4	Sidescan Sonar	1	Id fish spawn/agg topo features & shipwrecks		315.83	387.86	
100	4	MB	2	Id fish spawn/agg topo features	Backscatter	195.60	479.45	867.31
<b>Flower Garden Banks National Marine Sanctuary</b>								
32	5	MB	3	Coffee Lump Bank	Backscatter	21.98	27.07	
33	5	MB	3	Coffee Lump Bank - interesting extension	Backscatter	6.35	2.48	
34	5	Hi Res MB	2	McGrail Bank	Backscatter	0.81	0.04	
109	5	MB	1	FGB - EW connecting Areas 1	Backscatter	19.92	5.69	
110	5	MB	1	FGB - EW connecting Areas 4	Backscatter	37.01	41.91	
111	5	MB	3	Claypile Bank	Backscatter	18.89	6.78	
112	5	Hi Res MB	3	Claypile (Hi Res - if possible Area)	Backscatter	10.85	2.96	86.94
<b>Channel Islands National Marine Sanctuary</b>								
17	6	MB	3		Backscatter	59.31	113.08	
18	6	Hi Res MB	1		Backscatter	34.72	50.88	
19	6	MB	4		Backscatter	37.05	58.83	
20	6	Sidescan Sonar	1		MB	33.84	34.30	
21	6	Hi Res MB	2		Backscatter	27.16	20.91	
22	6	MB	4		Backscatter	64.39	70.77	
23	6	Hi Res MB	2		Backscatter	62.40	74.66	
24	6	MB	4		Backscatter	48.33	139.29	
25	6	MB	3		Backscatter	36.27	37.14	
26	6	MB	1		Backscatter	84.64	113.53	
27	6	Hi Res MB	2		Backscatter	33.63	31.45	
28	6	MB	3		Backscatter	40.49	40.63	
29	6	MB	4		Backscatter	74.24	109.72	
30	6	Hi Res MB	2		Backscatter	31.59	18.12	
31	6	Hi Res MB	2		Backscatter	43.20	24.66	937.96



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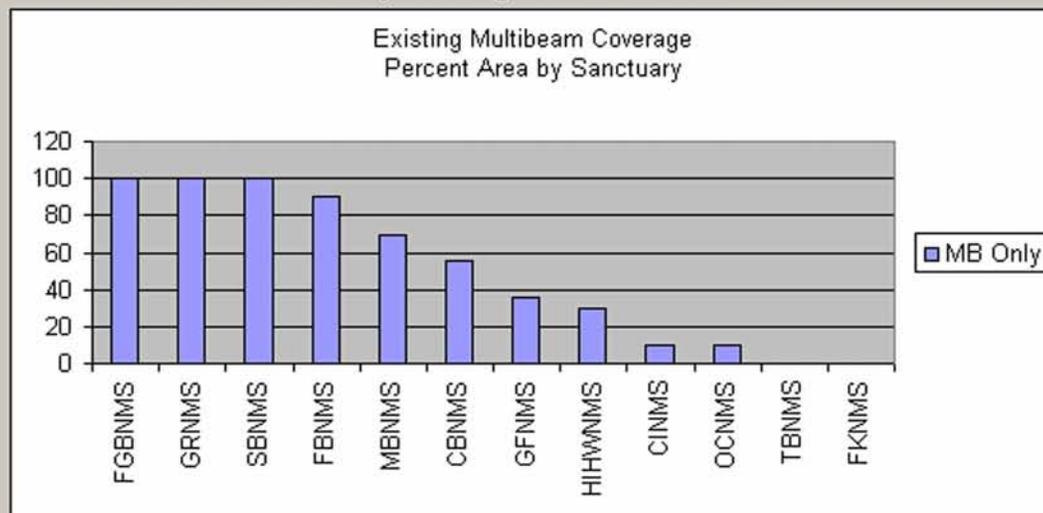
Survey Area No.	Sanctuary Code	Type of Survey Needed	Survey Priority within Site	Notes	Secondary Survey Type Request	Polygon Perimeter in NM	Polygon Area in NM	Total Area in NM
<b>Monterey Bay National Marine Sanctuary</b>								
14	7	MB	1		Backscatter	98.81	275.15	
15	7	Hi Res MB	1	Big Sur Coast	Backscatter	91.24	107.35	
16	7	Sidescan Sonar	2		n/a	98.81	275.15	657.66
<b>Gulf of the Farallones National Marine Sanctuary</b>								
103	8	MB	2	Bottom substrate typing, groundtruthing, bathy	Backscatter	36.13	52.55	
104	8	Hi Res MB	3	Hi-res habitat classification	Backscatter	16.82	17.14	
105	8	MB	3	Cont. Shelf Substrate Typing & Bathy	Substrate Typing	119.65	47.92	
106	8	Sidescan Sonar	4	Radio Active Waste Very Deep	AUV MB/BS	70.73	241.96	
107	8	MB	1	Pt. Reyes Convergence Zone Sent. Site	Backscatter	64.95	177.29	
108	8	Hi Res MB	1	Farallone Archipelago Sent Site	Substrate Typing (Backscatter or Sidescan)	58.12	100.08	636.93
<b>Cordell Bank National Marine Sanctuary</b>								
0	9	Hi Res MB	1	Old BSSS data is 100m distance between tracks	Backscatter	43.93	71.02	
1	9	MB	2	Needs decent MB to determine habitat types	Backscatter	168.93	468.56	
2	9	MB	3	Adjacent productive Canyon - need more detail	Backscatter	34.37	64.20	603.78
<b>Olympic Coast National Marine Sanctuary</b>								
3	10	MB	2		Backscatter	51.40	106.75	
4	10	MB	5		Backscatter	2.99	0.16	
5	10	MB	4		Backscatter	49.15	108.42	
6	10	MB	3		Backscatter	69.15	298.91	
7	10	MB	5		Backscatter	329.88	1466.28	
8	10	MB	5		Backscatter	14.12	3.16	
9	10	MB	5		Backscatter	9.42	1.43	
10	10	MB	1	Planned for Oct. 2004 - Rainier	Backscatter	9.40	3.77	
11	10	MB	1	Planned for Oct. 2004 - Rainier	Backscatter	10.97	1.90	
12	10	MB	1	Planned for Oct. 2004 - Rainier	Backscatter	25.78	21.21	
13	10	MB	1	Planned for Oct. 2004 - Rainier	Backscatter	17.39	17.20	2029.17
<b>Hawaiian Islands Humpback Whale National Marine Sanctuary</b>								
113	11	Hi Res MB	2	Existing Behavior Sighting Stations	Backscatter	16.01	7.12	
114	11	Hi Res MB	2	Existing Behavior Sighting Stations	Backscatter	9.46	3.84	
115	11	MB	1	2nd Highest Whale Concentration Area	Backscatter	124.45	311.08	
116	11	MB	3	Remaining Unmapped Portion of Sanctuary	Backscatter	36.12	30.49	
117	11	MB	3	Remaining Unmapped Portion of Sanctuary	Backscatter	61.16	67.25	
118	11	MB	3	Remaining Unmapped Portion of Sanctuary	Backscatter	42.09	20.38	
119	11	MB	3	Remaining Unmapped Portion of Sanctuary	Backscatter	100.13	101.26	
120	11	MB	3	Remaining Unmapped Portion of Sanctuary	Backscatter	282.00	206.28	
121	11	MB	3	Remaining Unmapped Portion of Sanctuary	Backscatter	282.00	206.28	953.97



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Sanctuary Name in order of Total Area	Total Area in Nautical Miles
Fagatele Bay	0
Monitor	1
Gray's Reef	17
Flower Garden Banks	42
Tortugas Ecological Reserve - FK	137
Thunder Bay	337
Cordell Bank	399
Stellwagen Bank	639
Gulf of the Farallones	966
Hawaiian Islands Humpback Whale	1031
Channel Islands	1092
Olympic Coast	2405
Florida Keys	2960
Monterey Bay	4018
Northwestern Hawaiian Islands CRER	102428
<b>Total Area</b>	<b>116472</b>

Multibeam Survey Coverage as of November 2002



Current Priorities and Survey Type Requests for New Surveys

