TECHNICAL REPORT 3271
APRIL 2022

Summary Report on the Second Collaborative Beaked Whale Cruise off Baja California, Mexico

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An expedition was conducted with the goal of visually locating, acoustically recording, and obtaining biopsy samples of the Mesoplodon beaked whales that were encountered in 2020 and produce BWB pulses, as well as locating the beaked whales that produce the BW43 echolocation pulse in order to conclusively determine what species produce each of the pulse types.

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ADMINISTRATIVE INFORMATION

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EXECUTIVE SUMMARY

In November 2021, an expedition was conducted off the coast of Baja California, Mexico to relocate the unknown species of beaked whales encountered in 2020. Daily non-systematic searches were carried out both in the area where the 2020 group was observed as well as closer to shore off San Quintín. An apparent beaked whale hotspot was discovered in the nearshore waters, with nine beaked whale individuals or groups sighted. However, weather conditions and animal behavior precluded close approaches to identify many of the sightings to species or to obtain photo-ids or biopsy samples. However, two encounters were identified as Cuvier's beaked whales (*Ziphius cavirostris*). In addition to the beaked whales, many other species were also encountered, including short-beaked common dolphins (*Delphinus delphis*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), bottlenose dolphins (*Tursiops truncatus*), blue whales (*Balaenoptera musculus*), humpback whales (*Megaptera novaeangliae*), Bryde's whales (*Balaenoptera edeni*), and gray whales (*Eschrichtius robustus*). Future efforts will include a return to the hotspot to determine how persistent it is over time, and to identify the species of beaked whales that utilize the area.

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ACRONYMS

BW	Beaked whale
DASBR	Drifting acoustic spar buoy recorder
eDNA	Environmental Deoxyribonucleic acid
GPS	Global positioning system
RHIB	Rigid hulled inflatable boat
US Navy	United States Navy

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CONTENTS

FIGURES

TABLES

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1. INTRODUCTION

Perrin's beaked whale (*Mesoplodon perrini*) has never been identified at sea and has only been described from strandings in southern California (Dalebout et al. 2002). However, acoustic research has identified a unique echolocation pulse, termed BW43 based on the peak frequency (Baumann-Pickering et al. 2013), which has been detected only in southern California (Baumann-Pickering et al. 2014; Keating et al. 2018) and northern Baja California, Mexico (Simonis et al. 2020) that is believed to be made by Perrin's beaked whale. The dense concentration of detections off northern Baja California led to an expedition in 2020 to acoustically and visually locate the BW43 species and conclusively link it to Perrin's beaked whale (Barlow et al. 2021; Henderson et al. 2021). However, rather than finding Perrin's beaked whales, the expedition found a potentially new species of beaked whale that produces a similar but unique echolocation pulse, termed the BWB pulse (Barlow et al. 2021). Although several water samples were obtained from the dive locations of this group, no environmental DNA (eDNA) turned up in the samples, and so the species of this new whale could not be confirmed.

Since both the BW43 and BWB beaked whales occur in waters on and adjacent to US Navy ranges, it is critical to confirm the species that produces these pulses in order to truly understand their distribution and habitat use, and to correctly estimate potential impacts from Navy training activity. Therefore, a second expedition was planned for October and November of 2021 to return to the area off Baja California, Mexico where both species were acoustically detected in 2020 in an attempt to locate both species and get photographs, acoustic detections, and biopsy samples to confirm the species' identifications.

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2. METHODS

A collaborative expedition was planned to take place from October 28 – November 12, 2021 on board the charter vessel the *Azteca*, based out of the Ensenada Harbor. In order to be adaptive to weather conditions, a flexible cruise plan was developed. The plan was to head directly to the start of the area of the highest density of acoustic detections from the 2018 effort (Simonis et al. 2020). The first Drifting Acoustic Spar Buoy Recorder (DASBR) would be deployed once the location of the 2020 beaked whale encounter was reached. From there, if weather conditions were good, that area would be searched extensively for beaked whales, and additional DASBRs would be deployed as needed depending on when and where additional encounters occurred. If weather conditions were poor, then the vessel would head closer to shore, working and anchoring off Bahía San Quintín. The vessel would begin the return transit back to Ensenada no later than November 10.

There were two larger DASBRs available with GPS trackers and back-up radio frequency location tags that could be deployed for periods of several days, each with a multi-channel SoundTrap ST4300 recorder (made by Ocean Instruments http://www.oceaninstruments.co.nz/), an HTI-92-WB hydrophone, and an HTI-96-min hydrophone (Figure 1). These DASBRs were loaned to this expedition by Pacific Islands Fisheries Science Center (PIFSC) in Hawaii. The stereo hydrophones (at ~140 and 145 m depths) allowed for horizontal localization of acoustic signals. The SoundTraps were set to record at 192 kHz continuously. There was also an additional single-channel SoundTrap ST300HF system available for shorter term recordings, also equipped with a radio frequency location tag that could be tracked up to 4 km away.

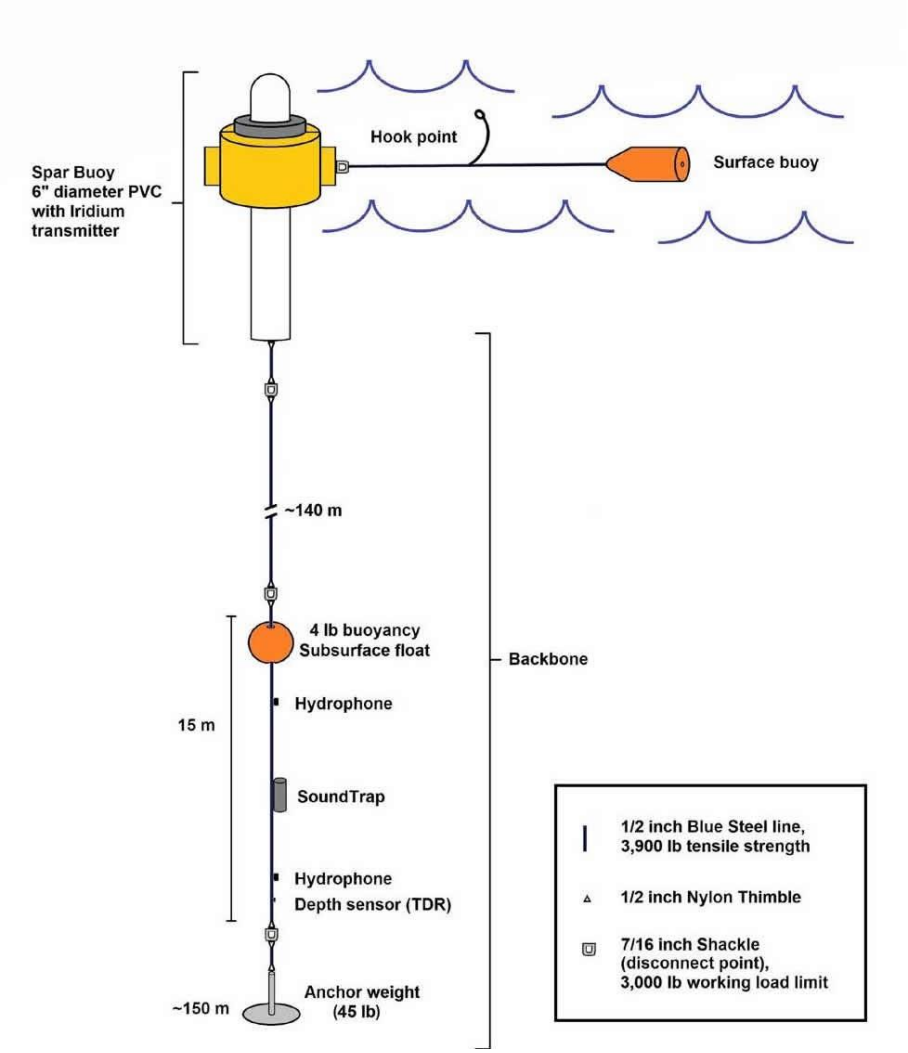

Figure 1. Configuration of DASBRs on 2021 expedition. This new configuration was designed by acousticians at the Pacific Islands Fisheries Science Center.

A total of six visual observers were available to conduct continuous visual observations from sunrise (at approximately 7:00 PST) to sunset (at approximately 17:30 PST). Observers rotated through four positions monitoring 360 degrees around the ship in half-hour shifts at each location, with the other two observers on standby. When an individual or group of marine mammals was initially observed, the start time, start latitude and longitude, species, best estimate of group size (including a minimum, maximum, and best size estimate), group behavior, and any other behavioral observations were recorded on a tablet computer using a custom-made Access database. Photographs were taken of all individuals when possible.

For all species other than beaked whales, once the species and group size had been confirmed and photographs had been taken, the sighting was terminated with a final time and position update. For beaked whale sightings, a DASBR or pole buoy would be deployed after the first or second sighting. Due to the long intervals between surfacings for beaked whales (5-30 minutes), the vessel would remain in the area of the initial sighting of beaked whales for at least 30 minutes, with all six

observers helping to visually search the area in order to locate the whales upon their next surfacing. A beaked whale sighting was terminated if a group was not resighted after at least 30 minutes of monitoring. A small rigid-hulled inflatable boat (RHIB) was available to approach beaked whale groups to obtain eDNA, biopsies, and additional photographs when possible.

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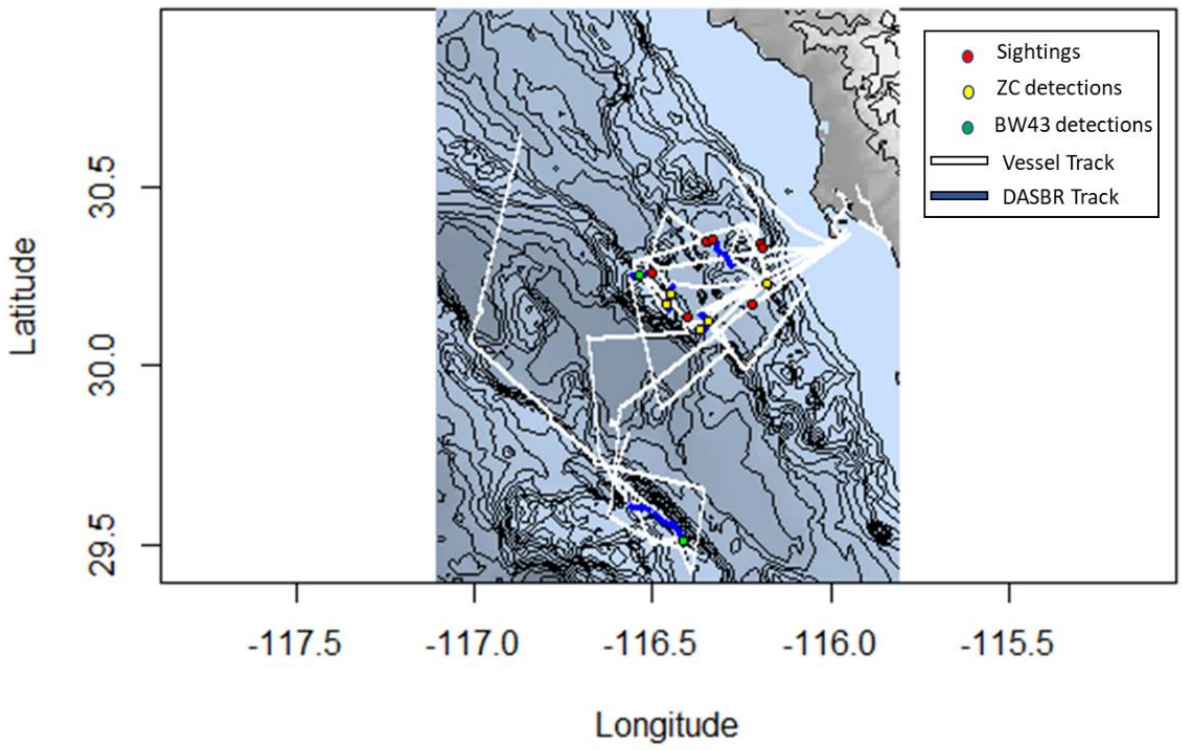
3. RESULTS

Due to poor weather conditions for much of the planned period, a shortened expedition took place from October 28 – November 9, 2021. The Azteca initially transited directly to Waypoint 1, the onset location of the BW43 detections from the 2018 effort (Figure 2; Simonis et al. 2020). From there, the Azteca transited along a seafloor ridge to the location of the 2020 BWB encounter (near Waypoint 2, Figure 2). However, due to poor weather conditions that inhibited beaked whale visual sightings, the Azteca spent only half a day in this location before moving closer to shore, near Bahía San Quintín. Two days were spent surveying this nearshore area, where deep basins and complex bathymetry occur only 22 km from shore (Figure 3). The next two days were spent onshore, during which time the beaches around Bahía San Quintín were combed for skeletons of stranded cetaceans. The skeleton of a Kogia spp. and a common dolphin were discovered, along with partial remains of multiple pinnipeds. Additional mounted skeletons of gray whales were located in the town of San Quintín, along with some probable Cuvier's beaked whale vertebrae, but no beaked whale skulls were discovered. The next two days were spent back on the water searching the basins off Bahía San Quintín and deploying DASBRs in the area. The vessel then moved offshore again, but was only able to stay offshore for a day before coming back to the basin area. This area was surveyed for another two days until the weather prohibited additional survey effort in the area and the expedition was terminated. The full survey effort, including vessel tracks, DASBR tracks, and all beaked whale sightings and acoustic detections, is depicted in Figure 3.

Figure 2. Map of waypoints 1, 2, and 3 from the 2020 beaked whale expedition, plus locations of Isla San Martin and Bahía San Quintín where the vessel *Azteca* moored during poor weather conditions.



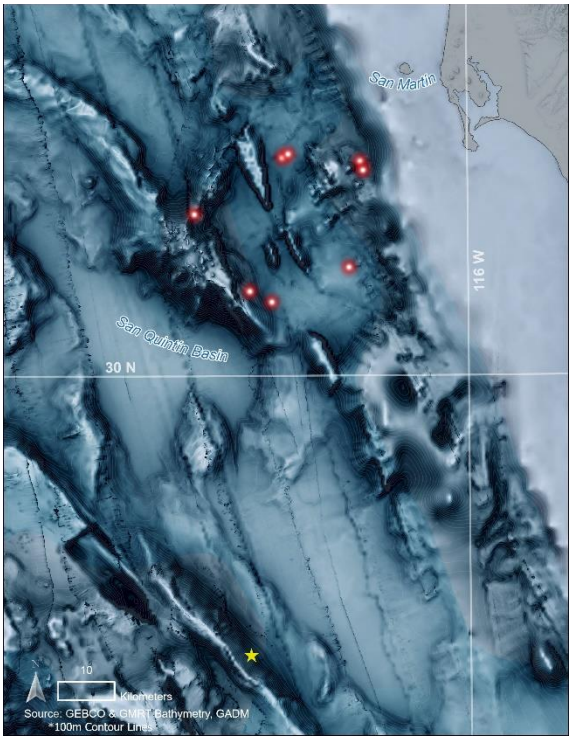
- The sightings are shown in red, while Cuvier's beaked whale (*Ziphius cavirostris*) acoustic detections are shown in yellow and BW43 detections are shown in green. No BWB detections occurred.

Figure 3. Vessel tracks (in white), DASBR tracks (in blue), and sighting and acoustic detection locations of all beaked whales.

3.1 SIGHTING DATA

There was a total of 53 cetacean sightings over the course of the expedition (Table 1); nine of these were of beaked whales (Figures 3 and 4). Two of the beaked whale sightings were confirmed to be Cuvier's beaked whale (*Ziphius cavirostris,* Zc), while the other six were not identified to the species level and could have been Cuvier's or Mesoplodon beaked whales (UnBw or UnIDMsp). No beaked whales were observed in the offshore area where the beaked whale encounter occurred in 2020; however, due to poor weather conditions only one and a half days were spent searching that area. Instead, all of the beaked whale sightings occurred in the basins off Bahía San Quintín, and largely occurred over bathymetric features like ridges, seamounts, and basin edges (Figure 4).

Of the nine beaked whale sightings, only two were observed for more than one surfacing, and only one of these encounters lasted long enough to deploy the RHIB to approach the group of two Cuvier's beaked whales. However, the RHIB was not able to approach closely enough to get an eDNA sample or biopsy, although these were low priority goals for Cuvier's beaked whales.



- Figure provided by Michael Mcdermott and used with permission.

Figure 4. Beaked whale sighting locations. The sightings from this 2021 expedition are shown in red, while the 2020 sighting location is given with a yellow star.

Other species observed included common dolphins (*Delphinus delphis,* Dd or Dsp), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*, Lo), bottlenose dolphins (*Tursiops truncatus*, Tt), blue whales (*Balaenoptera musculus*, Bm), humpback whales (*Megaptera novaeangliae*, Mn), Bryde's whales (*Balaenoptera edeni,* Be), gray whales (*Eschrichtius robustus,* Er), and several unidentified large whales (UnMyst, UnLgCet) and unidentified dolphins (UnDelph) (Table 1).

Table 1. Sighting information for all cetacean encounters. Beaked whale sightings are in bold.

Date	Start Time	Sighting	Species	Start Latitude	Start Longitude	Est Size Best	Group Behavior
10/28/2021	13:50	1	Dd	30.1526	-116.972	100	Travel-Fast
10/28/2021	16:37	2	Dd	29.873	-116.79	1000	Travel-Fast
10/29/2021	12:28	1	Bm	29.844	-116.611	1	Travel-Slow
10/29/2021	12:50	2	UnMyst	30.387	-117.008	1	
10/29/2021	13:04	3	UnMyst	30.4021	-116.986	1	
10/29/2021	16:48	4	Dd	29.8473	-116.59	18	Bowride
10/30/2021	7:19	1	Lo	30.3212	-116.156	5	Travel-Fast
10/30/2021	**16:09**	**2**	**UnBw**	**30.1171**	**-116.362**	**2**	**Travel-Slow**
10/31/2021	**8:34**	**1**	**UnBw**	**30.3479**	**-116.342**	**1**	
10/31/2021	10:22	2	Tt	30.3743	-116.378	8	Travel-Slow
10/31/2021	11:50	3	Dd	30.335	-116.491	120	Travel-Fast
10/31/2021	**12:40**	**4**	**UnBw**	**30.2575**	**-116.504**	**1**	**Travel-Slow**
10/31/2021	**15:12**	**5**	**ZiCa**	**30.1344**	**-116.403**	**1**	**Travel-Fast**
10/31/2021	18:21	6	Dsp	30.2395	-116.178	25	
11/1/2021	**8:09**	**1**	**UnID Msp**	**30.3419**	**-116.198**	**1**	
11/1/2021	8:14	2	Lo	30.3399	-116.202	6	
11/1/2021	9:21	3	Mn	30.4206	-116.199	1	Travel-Slow
11/1/2021	9:32	4	Mn	30.4324	-116.2	1	Travel-Slow
11/1/2021	10:07	5	Mn	30.4871	-116.239	2	
11/1/2021	10:13	6	Mn	30.4995	-116.246		
11/1/2021	12:47	7	UnDelph	30.3631	-116.048	30	Travel-Fast
11/1/2021	14:02	8	Er	30.3928	-115.989	1	Milling
11/1/2021	14:27	9	Tt	30.4193	-115.968	3	Milling
11/4/2021	11:52	1	UnMyst	30.3236	-116.014	1	
11/5/2021	6:48	1	UnDelph	30.2149	-116.063	10	
11/5/2021	6:51	2	Dd	30.2096	-116.067	100	Travel-Fast
11/5/2021	7:13	3	Dd	30.1717	-116.095	60	Travel-Mod
11/5/2021	7:28	4	Dsp	30.1459	-116.114	20	Travel-Slow
11/5/2021	10:58	5	Be	30.112	-116.411	2	Feeding
11/5/2021	13:31	6	Dd	30.0755	-116.677	20	Travel-Mod

Date	Start Time	Sighting	Species	Start Latitude	Start Longitude	Est Size Best	Group Behavior
11/5/2021	17:11	7	Dd	29.6456	-116.585	25	Surface Active
11/6/2021	9:15	1	UnLgCet	29.6491	-116.348	1	
11/6/2021	9:18	2	Dd	29.6442	-116.349	40	
11/6/2021	17:01	3	Dd	29.6784	-116.59	65	Surface Active
11/6/2021	17:10	4	Bm	29.6889	-116.605	1	Travel-Slow
11/7/2021	**9:03**	**1**	**UnBw**	**30.3487**	**-116.352**	**1**	**Surface Active**
11/7/2021	**9:16**	**2**	**UnBw**	**30.3536**	**-116.331**	**3**	Milling
11/7/2021	11:24	3	Dd	30.373	-116.304	35	Travel-Mod
11/7/2021	11:53	4	Mn	30.3911	-116.239	2	
11/7/2021	11:54	5	Dd	30.3919	-116.236	30	Travel-Slow
11/7/2021	12:14	6	Mn	30.3594	-116.21	1	
11/7/2021	12:21	7	Dsp	30.3471	-116.202	25	Surface Active
11/7/2021	12:34	8	Bm	30.3226	-116.195	1	Travel-Slow
11/7/2021	12:45	9	Dsp	30.2985	-116.19	45	Surface Active
11/7/2021	**14:01**	**10**	**UnBw**	**30.1723**	**-116.22**	**1**	**Travel-Mod**
11/7/2021	15:21	11	Dd	30.1696	-116.222	12	Travel-Mod
11/8/2021	6:09	1	Dd	30.3636	-116.255	15	
11/8/2021	8:10	2	Bp	30.3426	-116.365	1	Travel-Slow
11/8/2021	12:50	3	Mn	30.2824	-116.183	2	Travel-Slow
11/8/2021	12:53	4	Bm	30.2868	-116.184	1	Travel-Mod
11/8/2021	**13:17**	**5**	**ZiCa**	**30.3274**	**-116.193**	**2**	Surface Active
11/8/2021	14:52	6	Dd	30.3342	-116.189		
11/8/2021	15:21	7	UnLgCet	30.381	-116.22		
11/8/2021	16:09	8	Dsp	30.3403	-116.22	20	
11/8/2021	16:12	9	Dsp	30.3346	-116.217	40	

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3.2 ACOUSTIC DATA

Drifting acoustic recorders were deployed 11 times, with the larger two DASBRs deployed eight times and the smaller pole buoy deployed three times in the vicinity of beaked whale sightings (Table 2). Beaked whales were acoustically detected on six of the eight DASBR drifts (Figure 5) but on none of the pole buoy drifts. Cuvier's beaked whale echolocation pulses were detected five times and BW43 pulses were detected twice; BWB were not detected at all. In addition, no detections occurred during or just after a beaked whale sighting, so no sightings and detections could be directly linked as being the same animal(s).

Table 2. Drifting acoustic recorder deployment and recovery times and durations.

DASBR Drift #	DASBR/Buoy	Deployment Time	End Recording Time	Recording Duration (days)
1	13	10/28/2021 20:05	10/29/2021 7:16	0.47
2	13	10/30/2021 10:26	10/31/2021 12:30	1.09
3	Pole	10/30/2021 16:19	10/30/2021 17:36	0.05
4	7	10/30/2021 16:55	10/31/2021 16:15	0.97
5	Pole	10/31/2021 8:39	10/31/2021 9:52	0.05
6	Pole	10/31/2021 13:09	10/31/2021 14:02	0.04
7	7	10/31/2021 18:34	11/1/2021 7:00	0.52
8	7	11/4/2021 15:05	11/5/2021 10:25	0.81
9	13	11/5/2021 17:40	11/6/2021 12:20	0.78
10	7	11/7/2021 18:00	11/8/2021 10:27	0.69
11	13	11/7/2021 10:00	11/8/2021 7:00	0.88

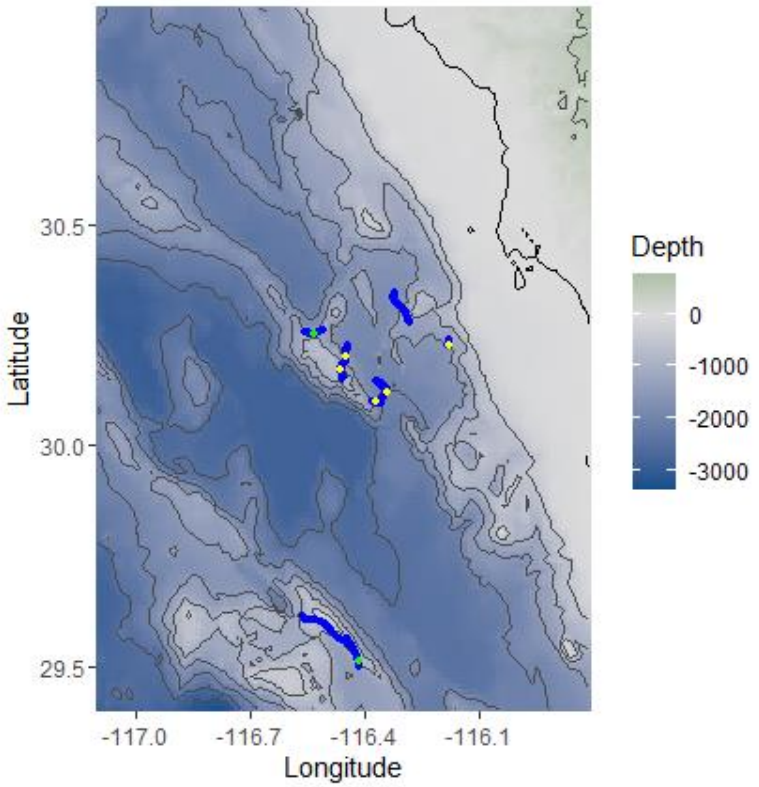

Figure 5. Tracks of the eight DASBR deployments and locations of Cuvier's beaked whale detections (in yellow) and BW43 detections (in green).

4. DISCUSSION

This expedition was conducted with the goal of visually locating, acoustically recording, and obtaining biopsy samples of the Mesoplodon beaked whales that were encountered in 2020 and produce BWB pulses, as well as locating the beaked whales that produce the BW43 echolocation pulse in order to conclusively determine what species produce each of the pulse types. November was chosen in both years as the optimal time frame for this effort, as historically it was the best offshore weather period in the area off Baja California, Mexico. Unfortunately, in both 2020 and 2021 there were a limited number of excellent weather days with calm flat seas, which are critical when visually locating beaked whales. In 2021, the number of days spent searching the offshore area over the undersea ridge where the beaked whales were located in 2020 was limited to only one and a half, and beaked whales were never sighted during those days, although one BW43 acoustic detection did occur.

However, a potential beaked whale hotspot was located from about 25 to 50 km offshore of Bahía San Quintín. While the two confirmed species sightings were of Cuvier's beaked whales, as were most of the acoustic detections, at least some of the sightings appeared to be Mesoplodon species and one BW43 detection did occur. Therefore, while it may be predominantly an area used by Cuvier's beaked whales, there is good potential to find other species in the region as well. This area could be easily explored using pangas or other vessels departing from Bahía San Quintín during periods of excellent weather, and therefore is an important discovery for future beaked whale research. Potential periods of good weather could be explored to determine when a better time frame might be for a full follow-on investigation.

The sightings and detections that occurred in this new beaked whale habitat were all located over areas of high bathymetric relief, including the steep sloped edge of the basin and small undersea ridges and seamounts. The depths of these features ranged from 1117 to 1996 m (Michael Mcdermott pers. comm.). Although it is unknown to what depth the animals themselves were diving, it is likely they were close to the seafloor and were taking advantage of these underwater features to forage on squid or other organisms in the deep scattering layer (e.g. Southall et al. 2019; MacLeod and D'Amico 2006; Barlow et al. 2020). Future efforts could examine the specific feature types and associated water depths for different beaked whale species occupying this habitat to determine if there are elements that could be used to locate additional beaked whale habitats in the US Navy SoCal Range Complex.

Although this effort has proven to be challenging, there were still beneficial findings that contributed towards the longer-term goal of identifying the BWB and BW43 species. Locating a hotspot of beaked whale occurrence relatively close to shore will be valuable for future efforts, especially for shorter efforts with the goal of finding an optimal weather window. In addition, finding a habitat used by multiple species may provide insights into niche partitioning that may benefit subsequent analyses.

A future expedition to identify the unidentified *Mesoplodon* off Baja California would benefit from having a towed hydrophone for continuous, real-time detection capability, and two pairs of mounted, bigeye binoculars (25 x 150 mm) for making visual observations. This was amply demonstrated during a cruise off Oregon last September, when several from the scientific party from this effort (Barlow, Pusser, Pitman) towed a hydrophone behind the 84' Oregon State University research vessel *Pacific Storm* (https://mmi.oregonstate.edu/research-vessels). They detected the vocalizations of BW37V, a *Mesoplodon* that had previously been recorded dozens of times in the northeast Pacific but never identified to species. They waited in the area where the whales quit calling, and a pair of individuals eventually surfaced close enough to the vessel that they were able to take a biopsy sample

with a crossbow. The whales were subsequently genetically identified as *M. carlhubbsi*, Hubbs' beaked whale (https://agsci-labs.oregonstate.edu/gyrex). Visual observers using bigeye binoculars are about as good as the acousticians at initially detecting mesoplodonts, which doubles the chances of detecting beaked whales. These binoculars are often key to locating surfacing whales that have quit vocalizing and for allowing the vessel or a secondary small boat to stay with the whales to obtain photographs and DNA samples necessary to confirm identification. The bigeyes can also be used identify to genus or species animals that surface far away from the vessel (one half mile or more), even if the vessel is not able to approach them.

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