

**DEPARTMENT OF FISH AND GAME**

Marine Region

**CRUISE REPORT: 05-S-1**

Quantitative Monitoring of Channel Islands Marine Protected Areas using a Remotely Operated Vehicle – A cooperative study with the Department of Fish and Game, Channel Islands National Marine Sanctuary, and Marine Applied Research and Exploration

**Authors** (in alphabetical order)

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**Vessel & Dates:**

Leg 1: Department of Fish and Game PB *Swordfish* - August 14 to 27, 2005

Leg 2: NOAA RV *Shearwater* - September 22, 2005 to October 12, 2005

**Locality:** Four of the Northern Channel Islands off the Southern California Bight (San Miguel, Santa Rosa, Santa Cruz, and Anacapa Islands).

**Abstract**

Remotely Operated Vehicle (ROV) operations were conducted on the California Department of Fish and Game's (Department) Patrol Boat *Swordfish* in August, 2005 and the National Oceanic and Atmospheric Association's (NOAA) Channel Islands National Marine Sanctuary's (Sanctuary) Research Vessel *Shearwater* in September and October, 2005. Substrate and finfish abundance were quantitatively measured at ten sites in or adjacent to five marine protected areas (MPAs) on San Miguel, Santa Rosa, Santa Cruz, and Anacapa Islands. The sampling objective was to provide data to evaluate MPA effectiveness. Real-time substrate determination allowed adaptation of sampling effort at each site to acquire a fixed amount of predominantly hard substrate target strata. The target of sampling 75 one-hundred m<sup>2</sup> transects was reached at all sites.

## Introduction

In 2003, Marine Applied Research and Exploration (MARE) and the Department began developing protocols for sampling fish populations with a remotely operated vehicle (ROV). The objective was to monitor changes in finfish density over time to provide data for the evaluation of the Channel Islands Marine Protected Areas (MPAs) as described in the Channel Islands Marine Protected Areas Monitoring Plan (CDFG 2004).

In 2003 and 2004, quantitative protocols were developed and 14 of 18 potential survey sites explored. In September 2004, quantitative surveys were completed at four sites (Table 1) (Karpov et al., 2005a).

Table 1. Fourteen sites by island, name, location codes, and kilometers of track line captured during exploratory surveys from November 2003 and May 2005; and quantitative survey in September 2004 (Bergen et al., 2005).				
Island Site Name	Location Code	Kilometers of video captured		
		Nov. 2003	May 2004	Sept. 2004
Santa Rosa Island				
Carrington Point SMR*	SRI-1	2		
Carrington Point SMR	SRI-2	2		12
Rodes Reef	SRI-3	2		12
Cluster Point	SRI-4	1		
South Point SMR	SRI-5	1		
East Point	SRI-6		4	12
Santa Cruz Island				
Gull Island SMR	SCI-1	4		
Gull Island SMR	SCI-2	4		12
Bowen Point	SCI-3	2		
Blue Banks Arch	SCI-4		3	
Anacapa Island				
Anacapa SMCA**	AI-1		3	9
Anacapa SMR 1	AI-2		3	
Anacapa SMR 2	AI-3		3	
Arch Rock	AI-4		3	
	Total	18	18	56

\*State Marine Reserve

\*\*State Marine Conservation Area

The objectives of the 2005 survey were to: 1) expand quantitative sampling to ten sites, five within and five adjacent to MPAs; 2) increase sampling capability by increasing the number of vessels that could be used for ROV surveys; and 3) if time allowed, develop protocols for measuring fish size and refine methods for measuring transect length in high-relief substrate.

## Methods

Four cruises were planned for the summer of 2005:

- 1) July 17 through July 23: set up and test the Department's PB *Swordfish* for ROV operations and train additional crew
- 2) August 13 through August 28: aboard the P/B *Swordfish* to quantitatively sample four to five sites
- 3) September 25 through October 8: aboard the Channel Islands National Marine Sanctuary's R/V *Shearwater* to sample the remainder of the 10 sites
- 4) October 16 through October 22 to test the Department's R/V *Garibaldi*.

Due to delays in acquiring critical equipment and concerns for potential accidents late in the season, the first and fourth cruises were cancelled.

Detailed descriptions of ROV operations, including equipment, calibrations, deployment and retrieval are presented in Bergen et al., 2005 and Karpov et al., 2005b. A laser (used for distance measurement) calibration log was added to the field data sheets already described in Karpov et al., 2005b. This log was used by the deck officer to record the position of projected paired laser points at a distance of 0.5 and 2 m from both cameras between each of the dives (Appendix 1).

### Site and Track Line Selection

In 2003, with the aid of acoustic survey maps, potential site pairs were selected, one inside an MPA and one at an adjacent site outside the MPA, to have comparable rocky substrate and depth ranges. In general, sites were created as rectangles of at least 500 m wide spanning a depth range from 20 m - 70 m. Where possible, sites selected were offshore Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) sites being sampled by scuba divers (Karpov et al., 2005a). In 2003 and 2004, exploratory surveys were conducted at nine sites and quantitative and qualitative surveys were conducted at five sites (Table 1, Figure 1).

Analysis of substrate data from 2003 and 2004 showed that soft substrate was a major component at all sites, even though soft substrate areas identified with acoustic and side SMCAn sonar maps were excluded from sampling (Bergen et al., 2005, Karpov et al., 2005a, and Karpov et al., 2005b). In the five sites sampled in 2004, transect lines averaged from 33 to 71 percent soft substrate. In order to maximize sampling efficiency, all sites previously sampled were reviewed by superimposing the substrate data on the acoustic maps (Figure 2). This allowed more clear differentiation between hard and soft substrates. Based on this review, the area of soft substrate excluded from sampling was modified and the site design broken into smaller rectangles to target hard substrate more effectively (Figure 3).

Two sampling sites on Anacapa Island (AI-1 and AI-2), one site on Santa Cruz Island (SCI-2) and three sites on Santa Rosa Island (SRI-2, SRI-3 and SRI-6) were modified. The modification of Anacapa SMCA (AI-1) also included changing the width of the site from 800 m to 500 m. Because the existing sites (SRI-4 and SRI-5) had insufficient reef substrate and depth range, the Cluster Point and South Point sites on Santa Rosa Island were moved. Newly acquired acoustic map data (Guy Cochran, United States Geological Survey, personal communication) were used to review the sites on San Miguel Island. The Castle Rock site (SMI-2) was modified and the Harris Point site (SMI-2) moved. The resulting ten sites are named as located in Table 2 and Figure 4.

<b>Table 2.</b> Ten planned quantitative sites by island, name, and location code with number of zones and expected depth range.			
<b>Island</b> Site Name	Location Code	Number of Zones	Depth Range (m)
<b>Santa Rosa Island</b>			
Carrington Point SMR	SRI-2	2	20 - 40
Rodes Reef	SRI-3	2	20 - 40
Cluster Point	SRI-7	2	20 - 60
South Point SMR	SRI-8	2	20 - 60
East Point	SRI-6	4	20 - 50
<b>Santa Cruz Island</b>			
Gull Island SMR	SCI-2	1	30 - 65
<b>Anacapa Island</b>			
Anacapa SMCA	AI-1	2	20 - 50
Anacapa SMR	AI-2	2	20 - 65
<b>San Miguel Island</b>			
Harris Point SMR	SMI-1	2	20 - 60
Castle Rock	SMI-2	2	25 - 60

In 2004, track lines parallel to the depth zone were randomly selected for sampling. To ensure that the sampling was distributed across the entire depth zone, each site was divided into two zones with equal area. Half the lines were randomly placed in each zone. In 2005, variable size zones were structured depending on the site. Most sites had two zones, but East Point had four and Gull Island had one (Table 2). The area of each zone included only the area to be sampled; “soft substrate only” areas were excluded.

The amount of survey line needed to produce the target sample size of 75 transects depended on the amount of hard and mixed substrate within the site. For the four sites that were quantitatively sampled in 2004, it was estimated that between 3.1 and 4.3 km of hard or mixed substrate would be sampled (Bergen et al., 2005). At all other sites, 4.0 km was sampled.

To allocate sampling within the site, the length (km) of track line in each zone was prorated depending on the size of the zone (Table 3). To allow for the mix of substrate types, the length of track line was divided by the proportion of hard and mixed substrate in the zone. When available, data from exploratory and

<b>Table 3.</b> East Point (SRI-6) work table used to estimate number of track lines needed by zone to attain a target 4.3 km of hard or mixed substrate. Allocation is by zonal area and percent hard or mixed substrate encountered in 2004.							
Zone	Area (Ha*)	% of Site Area	Target Hard and Mixed Substrate by Zone (km)	% Hard and Mixed Substrate (2004)	Needed to Reach Goal		
					Km	No. of 500 m Lines	No. with 20% Buffer
1	36	30	1.3	44	3.0	6	7
2	44	37	1.6	40	3.9	8	9
3	35	29	1.3	63	2.0	4	5
4	5	4	0.2	42	0.4	1	1
<b>Total</b>	<b>119</b>	<b>100</b>	<b>4.3**</b>		<b>9.3</b>	<b>19</b>	<b>22</b>

\* Excludes rectangular areas interpreted as “soft only” from sonar map, exploratory, and quantitative track line ( $\geq 75\%$  soft only).

\*\* Bergen et al. 2005 found ~ 4 km of hard or mixed substrate was needed per site.

quantitative surveys were used to determine the proportion of hard and mixed substrate by zone. Since data were not available for the Cluster Point and South Point sites, the proportion was assumed to be the same as other sites with similar sonar imagery. For the two sites on San Miguel Island, estimates of the amount of soft substrate made in real-time during the August 2005 exploratory survey were used. The number of 500 m lines needed was determined and a 20% buffer added to allow for operational contingencies (e.g., pulling off transect). At each of the ten sites it was estimated that 12 to 26 track lines (6 to 13 km) were needed to acquire a target of 3.1 to 4.3 km of hard or mixed substrate (Table 4).

Track lines, generally parallel to the bathymetry, were distributed within each zone (Figure 3). Track lines were numbered according to the distance along an imaginary line perpendicular to the rectangular subunits. In each zone, the track lines were chosen for sampling by selecting random numbers spaced 20 meters apart equal to the distance along the perpendicular line. A 10 m minimum spacing was used at our narrowest site, Anacapa Island SMCA. In case the amount of hard and mixed substrate was underestimated, additional lines were randomly selected and sequentially labeled. Thus, if the number of transects needed to be increased, a subset of the randomly selected lines could be added to each zone.

Two approaches were adopted to assess the amount of usable substrate and track line while at sea. At the end of each sampling day, tracking data were reviewed for content and quality. If quality was compromised, lines were repeated later in the survey. The Data Manager measured substrate in “real-time” by recording the GPS time code when soft only substrate was encountered. Since the ROV velocity was relatively constant across the entire track line (Bergen et al., 2005), the ratio of the total time with soft only substrate to total

<b>Table 4.</b> Number of planned track lines to achieve site specific goals of hard or mixed substrate (Bergen et al., 2005).				
Island Site	Zone	Hard and Mixed Substrate		No. of Planned Track Lines with 20% buffer
		Percent Estimated	Kilometers Needed	
<b>San Miguel Island</b> Harris Point SMR	1	70*	2.2	8
	2		1.8 <b>4.0</b>	7 <b>17</b>
Castle Rock	1	81*	1.5	4
	2		2.5 <b>4.0</b>	7 <b>11</b>
<b>Santa Rosa Island</b> Carrington Point SMR	1	72**	1.5	5
	2	49**	1.8 <b>3.3</b>	9 <b>14</b>
Rodes Reef	1	91**	2.0	5
	2	38**	1.1 <b>3.1</b>	7 <b>12</b>
Cluster Point	1	40***	3.0	18
	2		1.0 <b>4.0</b>	6 <b>24</b>
South Point SMR	1	40***	2.0	12
	2		2.0 <b>4.0</b>	13 <b>25</b>
East Point	1	44**	1.3	7
	2	40**	1.6	9
	3	63**	1.3	5
	4	42**	0.2 <b>4.3</b>	1 <b>22</b>
<b>Santa Cruz Island</b> Gull Island SMR	1	36**	<b>3.8</b>	<b>26</b>
<b>Anacapa Island</b> Anacapa SMCA	1	40**	2.3	14
	2	36**	1.7 <b>4.0</b>	11 <b>25</b>
Anacapa SMR	1	50*	2.0	12
	2	50*	2.0 <b>4.0</b>	12 <b>24</b>
<b>Totals</b>			<b>39</b>	<b>197</b>

\* Estimated from previous exploratory survey.

\*\* Estimated from previous quantitative survey.

\*\*\* Estimated from sonar map interpretation only.

time provided an estimate of the amount of soft only substrate expected during subsequent post processing. If additional track line was needed, randomly selected alternate lines were sampled.

### Fish Sizing

The objective of the fish sizing experiment was to compare visual estimates of fish size to the actual size of fish models. Models were constructed in two body forms: rounded and elongate. The model species were blue rockfish, copper rockfish, olive rockfish, vermilion rockfish, flag rockfish, kelp greenling,

sheephead, and lingcod (Table 5). To construct models, colored photos of fish were cut out along fin margins and then sandwiched over a flat neoprene flotation core. The neoprene was either 7 or 13 mm thick. Models were attached to 13 mm rebar with 0.6 mm monofilament line. A total of 49 models were used in the experiment. Each model was marked with a number only large enough to be seen by divers.

**Table 5.** List of fish model body forms, common and scientific names, number, and range of total lengths (TL) used in field sizing experiment.

Body Form	Common Name	Scientific Name	No.	TL cm
Rounded	Blue rockfish	<i>Sebastes mystinus</i>	8	7.5 - 47.0
	Copper rockfish	<i>S. caurinus</i>	5	15.5 - 40.8
	Olive rockfish	<i>S. flavidus</i>	5	7.3 - 48.0
	Vermilion rockfish	<i>S. miniatus</i>	8	7.6 - 40.5
	Flag rockfish	<i>S. rubrivinctus</i>	6	8.3 - 35.5
Elongate	Kelp greenling (female)	<i>Hexagrammos decagrammus</i>	5	9.5 - 47.0
	Kelp greenling (male)	" "	3	25.8 - 46.8
	California Sheephead (female)	<i>Semicossyphus pulcher</i>	2	15.8 - 53.5
	California Sheephead (male)	" "	3	39.3 - 53.5
	Lingcod	<i>Ophiodon elongatus</i>	4	22.8 - 49.2
		<b>Total</b>	<b>49</b>	<b>7.3 – 53.5</b>

The sizing experiment was conducted on 7 and 9 October 2005, at Albert's Anchorage on the southwest side of Santa Cruz Island. On 7 October, an initial test with six models was run on a soft bottom in 10 m of water. Due to strong surge, the models moved back and forth too much to be effectively sampled. To try to address this problem, the monofilament line on 2/3 of the models was replaced with one or two lengths of 12 gauge hanger wire.

On 9 October, the surge had diminished and conditions were judged to be marginally workable. Divers deployed a 30 m transect line on soft bottom in 17 m of water. Six to ten models were placed on each 5 m segment of the transect line with the exception of the first 5 m, which was kept free of models to allow the ROV to maneuver onto the line. To avoid recording laser lights on the models in the video, models were not placed directly on the line. Models were either close to the line, approximately 0.2 m from the center, or offset approximately 1 m. Models were placed perpendicular to the line at haphazard distances off the substrate, depending on the length of monofilament line or depth of penetration of the wire. The distance of the models from the substrate ranged from 0 to 40 cm.

The ROV was deployed after dark to ensure that the lasers would be visible in the video record. The ROV was flown over the models six times. On four of the flights, the ROV pilot followed standard protocols, maintaining a constant heading, height above the bottom, and speed. The camera angle was set at either 25 or 30 degrees. In order to provide video for a training film, the ROV

was maneuvered so that the lasers would hit the fish on two passes through the models.

## Results

During 14 days in August, the P/B *Swordfish* was used for joint patrol and ROV research operations (Table 6). Most of this time (nine days) was spent loading, setting up the new winch, calibrating equipment, and outfitting the boat. During six days at sea, two enforcement staff were trained in ROV operations and 34 km of track line were completed. The two San Miguel Island sites (Harris Point SMR and Castle Rock) were explored using “Z-shaped” transects (Figures 5 and 6), for a total of 8 km of track line. Quantitative sampling was initiated at Anacapa Island SMR and completed at Carrington Point SMR and Rodes Reef off northern Santa Rosa Island. Between research operations, enforcement patrols were conducted by on-board enforcement staff.

During 12 days in September more than 79 km of track and the eight remaining sites were completed onboard the RV *Shearwater* (Table 6). Two days were devoted to diver deployment and taking ROV video of fish models for sizing experiments near Gull Island SMR.

<b>Table 6.</b> Locations, activities, and kilometers sampled in 2005.			
Month Date	Location	Activity	Km
<b>Period 1 – P/B <i>Swordfish</i></b>			
August 14-17	Ventura Harbor	Loading, gear set-up, calibrations and repairs	
18	Anacapa Island (SMR)	Exploratory sampling & training	Not Used
19		Quantitative sampling	4.0
20 & 21	Ventura Harbor	Planning and re-supply	
22	Anacapa Island SMR	Quantitative sampling	4.5
23	Anacapa Island SMR and Rodes Reef		5.5
24	Ventura Harbor	Repairs to <i>P/B Swordfish</i>	
25	Carrington Point SMR and Rodes Reef	Completed both sites	12.5
26	Harris Point SMR and Castle Rock	Exploratory (z-shaped tack lines)	8.0
27	Ventura Harbor	Unloaded gear	
<b>Period 2 – R/V <i>Shearwater</i></b>			
Sept. 22 & 23	Santa Barbara Harbor and Anacapa Island	Load, calibrate gear, and ROV check-out dive	
24	East Point	Quantitative sampling	4.5
25	Harris Point SMR	“ “	7.0
26	Castle Rock	Completed the site	6.5
27	East Point	Quantitative sampling	6.5

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<b>Table 6, continued</b> Locations, activities, and kilometers sampled in 2005.			
Month Date	Location	Activity	Km
28 & 29	Gull Island SMR	Quantitative sampling	12.5
30	Harris Point SMR	Completed the site	2.5
	Cluster Point	Quantitative sampling	4.5
October 1	Cluster Point	Completed the site	5.5
2	Anacapa Island SMCA	Quantitative sampling	7.5
	Anacapa Island SMR	Completed the site	4.5
3	Anacapa Island SMCA	Completed the site	5.5
4 & 5	Santa Barbara Harbor	Poor weather	
6	Santa Barbara Channel	Vessel used by NOAA.	
7	Anacapa Island SMCA	Methods demonstration	Not used
8 & 9	Santa Cruz Island	ROV film of fish models deployed by divers	
10 & 11	South Santa Rosa Island	Completed the site	12.5
12	Santa Barbara Harbor	Unloaded	

Anacapa Island SMR was the only site to require extensive re-sampling. Real-time substrate analysis showed that the central portion of the site (Lines 300 – 720) was predominantly soft substrate. In addition, some lines required re-sampling due to tracking errors during the August survey. A new set of lines planned for the October survey period were used to randomly select lines for sampling. Operations on August 19th, 22nd, 23rd, and October 2nd produced 20 usable transects from the 38 that were completed (Table 4 and 7, Appendix 2 and 3). The other seven sites did not require re-sampling.

<b>Table 7.</b> Number of track lines completed and kilometers of hard or mixed substrate estimated from data manager observations during the survey.				
Island Site	Zone	No. of Track Lines Completed	Hard and Mixed Substrate	
			Percent	Kilometers Captured
<b>San Miguel Island</b> Harris Point SMR	1	10	52	2.6
	2	9	50	2.3
		<b>19</b>		<b>4.9</b>
Castle Rock	1	6	83	2.5
	2	7	95	3.3
		<b>13</b>		<b>5.8</b>
<b>Santa Rosa Island</b> Carrington Point SMR	1	5	70	1.7
	2	9	58	2.6
		<b>14</b>		<b>4.4</b>
Rodes Reef	1	5	83	2.1
	2	6	33	1.0
		<b>11</b>		<b>3.0</b>
Cluster Point	1	14	51	3.6
	2	5	41	1.0
		<b>19</b>		<b>4.6</b>

*continued on following page*

<b>Table 7, continued.</b> Number of track lines completed and kilometers of hard or mixed substrate estimated from data manager observations during the survey.				
Island Site	Zone	No. of Track Lines Completed	Hard and Mixed Substrate	
			Percent	Kilometers Captured
South Point SMR	1	12	49	3.0
	2	13	39	2.6
		<b>25</b>		<b>5.5</b>
East Point	1	6	39	1.2
	2	10	43	2.2
	3	5	77	1.9
	4	1	37	0.2
		<b>22</b>		<b>5.4</b>
<b>Santa Cruz Island</b>				
Gull Island SMR	1	<b>25</b>	42	<b>5.3</b>
<b>Anacapa Island</b> State Conservation Area	1	13	61	4.0
	2	11	37	2.0
		<b>24</b>		<b>6.0</b>
Anacapa SMR	1	9 (15)*	52	2.3
	2	11 (22)	42	2.4
		<b>20 (37)</b>		<b>5.0</b>
<b>Totals</b>		<b>192 (209)</b>		<b>50</b>

\* ( ) Total includes replicated lines.

## Discussion

Sampling efficiency in number of kilometers of video captured each day was almost identical to the previous year. An average of 5.6 km per day was completed this year compared to 5.4 km during the September 2004 survey (Karpov et al., 2005b).

During both sampling periods 192 of 197 planned 500 m track lines were completed (Tables 4 and 7). Based on real-time substrate estimates this represented 50 km of hard or mixed substrate which exceeded the minimal 39 km target by 128%. This was expected because the protocol was designed to exceed the target by 20% (Bergen et al., 2005). The minimum goal at each site was also exceeded except at Rodes Reef, where 3.0 of the 3.1 km target was sampled. With this amount of sampling, 75 one-hundred m<sup>2</sup> transects at each site are possible (Bergen et al., 2005).

In order to minimize cost, only those lines estimated in real-time to have > 25% hard and mixed substrate will be post-processed. Since relatively few tracking errors were observed in the field, this should still provide sufficient track line to meet transect goals. Thus, only 180 (~95 km) of the 192 completed lines will be analyzed for fish density (Table 7, Appendix 3).

## References

- Bergen, M., M. Connell, S. Holz, K. Karpov, A. Lauermann, C. Pattison, M. Prall, D. Rosen, and C. Valle. 2005. Final September 2004 Project Report - Quantitative Finfish Abundance and Exploration of Santa Barbara Channel Islands Marine Protected Areas – A Cooperative Remote Operated Vehicle Study with the Department of Fish and Game, Channel Islands National Marine Sanctuary, and Marine Applied Research and Exploration. Department of Fish and Game. Unpublished Report. June 2005. 39p
- CDFG. 2004. Channel Islands Marine Protected Areas Monitoring Plan. [www.dfg.ca.gov/mrd/channel\\_islands/monitoring.html](http://www.dfg.ca.gov/mrd/channel_islands/monitoring.html).
- Cochran, Guy, United States Geological Survey, Menlo Park, 2004 personal communication.
- Karpov, K.A., D. Rosen, A. Lauermann, M. Prall, M. Bergen, and C. Pattison. 2005a. Exploration and Inventory of Santa Barbara Channel Islands Marine Protected Areas – A Cooperative Remote Operated Vehicle Study with the Department of Fish and Game, Channel Islands National Marine Sanctuary, and Marine Applied Research and Exploration. Department of Fish and Game. Cruise Report 04-S-1. January 2005. 71p.
- Karpov, K.A., A. Lauermann, M. Prall, and C. Pattison. 2005b. Quantitative Finfish Abundance and Exploration of Santa Barbara Channel Islands Marine Protected Areas – A Cooperative Remote Operated Vehicle Study with the Department of Fish and Game, Channel Islands National Marine Sanctuary, and Marine Applied Research and Exploration. Department of Fish and Game. Cruise Report 04-S-2. April 2005. 20p.

## Personnel

### August 15 - August 21, 2005

#### **PB *Swordfish* Personnel:**

Aaron Burger	Warden - CDFG	John Castro	Warden – CDFG
Mark Kibby	Captain - CDFG	Eric Kord	Warden - CDFG
Bob Puccinelli	Lieutenant - CDFG	John Suchil	Lieutenant - CDFG

#### **ROV Team Personnel:**

Steve Holz	Biologist - Marine Applied Research and Exploration
Konstantin Karpov	Senior Biologist – CDFG and Principal Investigator
Andy Lauermann	Biologist - Marine Applied Research and Exploration
Mike Prall	Biologist (Marine/Fisheries) – CDFG

#### **Other Participants:**

Derek Stein	Biologist (Marine/Fisheries) – CDFG
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### September 22 – October 12, 2005

#### **R/V *Shearwater* Personnel:**

Charles Lara	Captain - NOAA
Lumann Moody	Captain - NOAA
Terrence Shinn	Captain - NOAA

#### **ROV Team Personnel:**

Dr. Mary Bergen	Senior Environmental Specialist IV – CDFG; Fisheries Independent Data Mandate Coordinator
Steve Holz	Biologist - Marine Applied Research and Exploration
Konstantin Karpov	Senior Biologist – CDFG and Principal Investigator
Andy Lauermann	Biologist - Marine Applied Research and Exploration
Michael Prall	Biologist (Marine/Fisheries) – CDFG
Dirk Rosen	Director - Marine Applied Research and Exploration (MARE) Operations Supervisor, fundraising coordinator

#### **Other Participants:**

Mike Connell	Biologist (Marine/Fisheries) – CDFG
Bill Miller	Biologist, Oregon Department of Fish and Wildlife

#### **Guests:**

Pat Coulston	Research Coordinator – CDFG
Lawrence M. Rosen	
Martin J. Rosen	
Gary Stacey	Marine Region Regional Manager – CDFG

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(in alphabetical order)

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- Gary Stacey, Regional Manager, Marine Region, California Department of Fish and Game.
- Derek Stein, Biologist, California Department of Fish and Game.

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- Dan Vasey of Santa Barbara City College for providing backup equipment and technical support.
- Yuko Yokozawa, California Department of Fish and Game GIS Scientific Aid for technical support.

Appendix 1. (see Appendix\_1.PDF)

Appendix 2. Random track lines selected for each of the ten sites. I.D. numbers and letters correspond to sequence of random generation. Light grayed letters designate alternate or supplemental lines. Dark borders indicate extent of the one to four zones per site.

Harris Point SMR		Castle Rock		Carrington Point SMR		Rodes Reef		Cluster Point	
ID	Line	ID	Line	ID	Line	ID	Line	ID	Line
2	30	A	50	3	220	3	80	8	20
3	60	4	70	A	570	A	200	11	50
4	140	2	240	5	630	4	310	2	100
7	170	1	390	1	670	2	340	3	120
1	200	B	880	4	840	1	560	1	170
8	570	3	920	2	970	5	620	16	200
B	640	S*	1030	S**	890	9	670	17	220
6	730	S*	1050	S**	1090	11	750	4	260
5	990	B	1140	12	1230	8	780	6	290
A	1090	9	1350	9	1290	10	800	10	340
C	1200	8	1490	S**	1300	A	820	13	470
12	1290	10	1680	S**	1330	12	930	15	680
14	1320	C	1840	13	1380	7	960	7	740
10	1430	6	2110	A	1510	6	1000	14	760
B	1790	7	2330	6	1560	S**	1010	5	780
9	1810	A	2650	11	1610	S**	1160	9	820
13	1860			8	1670	S**	1160	12	860
A	1940			10	1700	S**	1260	18	930
11	2000			7	1860			S*	950
				14	2150			S*	1100
								21	1190
								A	1220
								19	1270
								22	1300
								23	1320
								20	1380
								24	1410

\* Excluded as sanded areas based on sonar map interpretation.

\*\* Substrate  $\geq$  75% soft only in 2004 survey.



Appendix 2. (Continued).

South Point SMR		East Point		Gull Island SMR		Anacapa Island SMCA		Anacapa Island SMR	
ID	Line	ID	Line	ID	Line	ID	Line	ID	Line
4	30	7	40	K	0	9	20	7	20
A	70	A	220	K	110	4	40	B	40
5	170	S**	240	S**	190	A	90	12	100
8	190	S**	440	S**	520	7	110	6	130
6	210	3	490	A	530	10	130	A	160
11	250	4	530	25	550	14	150	2	200
10	270	1	560	23	570	13	170	C	220
12	330	6	590	24	590	5	190	8	240
2	370	5	710	S**	600	12	200	11	260
B	390	2	740	S**	620	1	230	5	300
9	410	S**	920	22	610	8	250	4	330
7	430	S**	1220	17	630	6	270	10	400
3	470	16	1300	14	650	3	300	1	420
1	510	10	1320	16	670	2	330	9	450
A	610	14	1390	15	700	11	350	3	510
18	650	A	1400	C	710	S*	360	23	550
24	670	8	1430	6	720	S*	410	18	630
25	730	12	1490	3	750	4	430	24	650
23	810	B	1550	1	770	10	450	14	680
13	850	13	1720	11	800	A	460	21	700
22	870	9	1800	5	820	2	470	20	720
21	890	S*	1920	8	840	1	490	B	740
20	910	S*	2030	2	860	6	500	15	I 770
15	930	15	2040	21	880	12	520	F	800
19	1010	11	2110	18	910	11	540	A	820
17	1050	S**	2200	7	940	3	560	C	850
16	1130	S**	2520	20	960	5	580	22	K 880
14	1150	18	2620	D	970	S*	590	E	900
		19	2720	13	980	S*	610	13	G 920
		20	2760	4	1010	7	620	19	J 940
		17	2900	B	1030	8	640	17	H 960
		A	2950	9	1040	S**	670	D	980
		21	3050	10	1070	S**	710	14	1000
		S*	3210	19	1090				
		S*	3320	12	1120				
		A	3330	S**	1130				
		22	3390	S**	1230				
		S*	3420						
		S*	3560						

Appendix 3. Dive number, tack line, and date completed at each of ten sites sampled in 2005. Percentage of "soft only" as estimated during operations. Gray areas of  $\geq 75\%$  "soft only" will be excluded from future sampling and not post-processed. Dark borders indicate extent of the one to four zones per site. Rejected lines repeated at Anacapa Island SMR due to tracking or video errors are delineated in gray text. K denotes kelp prevented line completion.

Harris Point SMR (SMI-1)				Castle Rock (SMI-2)			
Dive	Lines	% Soft Only	Date	Dive	Lines	% Soft Only	Date
295	30	52	9/25	297	50	4	9/26
	60	46			70	7	
	140	65			240	5	
	170	37			390	19	
	200	22			880	65	
	570	71			920	2	
304	640	43	9/30	296	1140	1	9/26
295	730	65	9/25		1350	0	
294	990	34	9/30		1490	9	
304	1090	44			1680	0	
304	1200	42	9/30		2110	16	
294	1290	63	9/25		2330	4	
	1320	79		2650	2		
	1430	25					
304	1790	82	9/30				
294	1810	60	9/25				
	1860	42					
304	1940	32	9/30				
294	2000	28	9/25				

Appendix 3. (Continued)

Carrington Point SMR (SRI-2)				Rodes Reef (SRI-3)			
Dive	Lines	% Soft Only	Date	Dive	Lines	% Soft Only	Date
289	220	32	8/25	286	80	27	8/23
	630	9			310	26	
	670	41			340	3	
	840	35			560	12	
	970	33			620	19	
289	1230	59	8/25	287	670	67	8/25
	1290	42			750	69	
288	1380	48			780	67	
	1560	37			800	56	
	1610	24			930	72	
	1670	49			960	74	
	1700	24					
	1860	48					
	2150	43					

Appendix 3. (Continued).

Cluster Point (SRI-7)				South Point SMR (SRI-8)				East Point (SRI-6)			
Dive	Lines	% Soft Only	Date	Dive	Lines	% Soft Only	Date	Dive	Lines	% Soft Only	Date
308	50	24	10/1	319	70	13	10/11	299	220	K	9/27
	100	37		319	170	22			490	48	
	120	27		319	190	27			530	72	
	170	14		319	210	41			560	41	
	200	--		319	250	73			590	38	
307	290	60	9/30	319	270	70	10/11		710	80	9/27
	340	85		319	330	87			740	87	
	470	93		318	370	78		298	1300	63	
306	680	53		318	410	41			1320	71	
	740	66		318	430	42			1390	75	
	760	50		318	470	54			1400	71	
	780	50		318	510	62			1430	81	
305	820	43	9/30	318	650	47	10/11		1490	48	9/24
	860	39			670	54	10/10		1720	41	
305	1190	30	9/30	317	730	62		293	1800	37	
	1270	46			810	66			2040	27	
	1300	57			850	60			2110	56	
	1380	85			870	55		293	2620	9	
	1410	78			890	81			2720	13	
				316	910	74			2760	20	9/24
					930	70		292	2900	25	
					1010	51			3050	50	
					1050	33		292	3390	63	9/24
					1130	73					
					1150	64					

Appendix 3. (Continued).

Gull Island SMR (SCI-2)				Anacapa Island SMCA (AI-1)				Anacapa Island SMR (AI-2)			
Dive	Lines	% Soft Only	Date	Dive	Lines	% Soft Only	Date	Dive	Lines	% Soft Only	Date
303	550	63	9/29	314	20	44	10/3	283	20	55	8/22
	570	63			40	55		310	40	48	10/2
	590	67			90	53		283	100	39	8/22
302	630	53	9/28	313	110	45			130	48	
	650	42			130	53		310	160	18	10/2
	670	35			150	18		283	200	51	8/22
	700	53			170	13		310	220	43	10/2
	720	66			190	8		282	240	42	8/19
301	750	63		312	200	30	10/2		260	57	
	770	69			250	38			300	86	
	800	66			270	48			330	79	
	820	65			330	40			400	95	
	840	52			350	73			420	82	
300	860	70		311	430	87		281	450	68	
	880	61			460	65			510	86	
	910	47			470	76		285	550	82	8/23
	940	65			490	88			630	87	
	960	54			500	75			650	94	
	980	55			520	66			680	76	
	1010	64			540	36			700	--	
	1030	59			560	17			720	85	
	1040	49			580	56		309	740	61	10/2
	1070	57			620	72		284	770	--	8/22
	1090	49			640	52		315	770	78	10/7
	1120	57						309	800	57	10/2
									820	78	
									850	59	
								284	880	--	8/22
								315	880	55	10/7
								309	900	31	10/2
								284	920	39	8/22
								315	920	42	10/7
								284	940	--	8/22
								315	940	--	10/7
								284	960	--	8/22
								315	960	76	10/7
								309	980	61	10/2
								284	1000	92	8/22

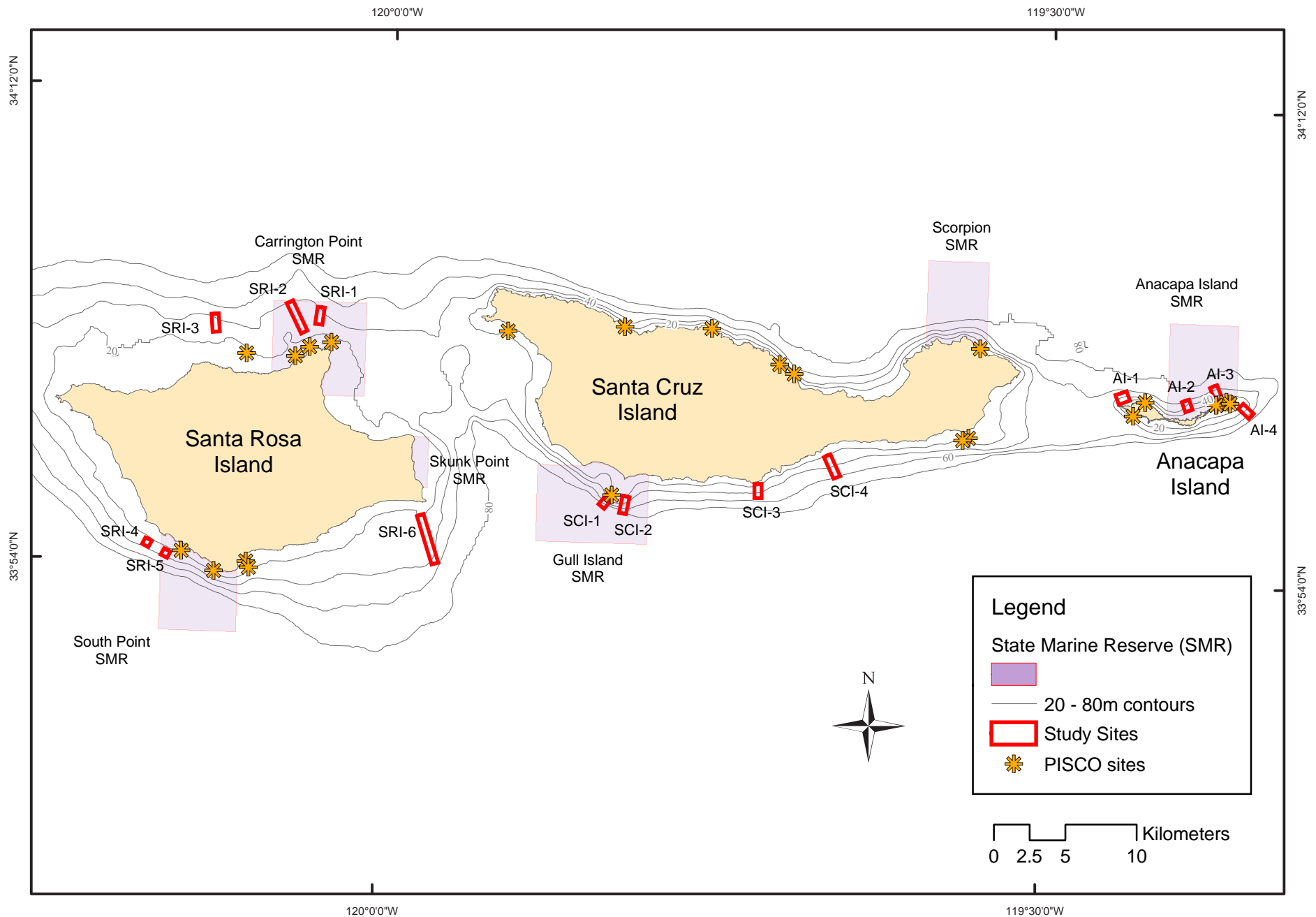


Figure 1. Location codes for sites surveyed during November 2003, May 2004, and September 2004 relative to the five State Marine Reserves and locations of PISCO SCUBA survey sites.

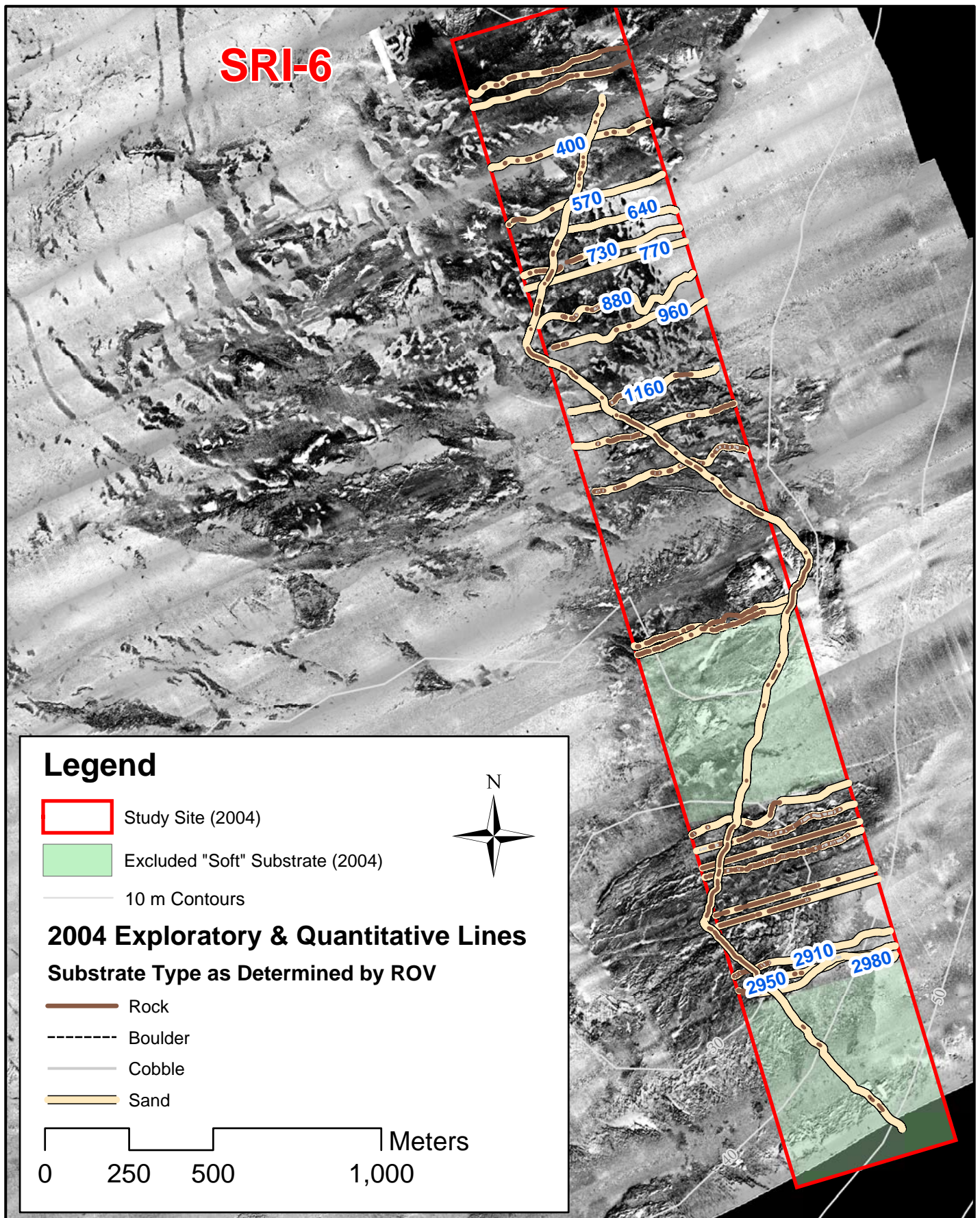


Figure 2. East Point (SRI-6) study site substrate types from ROV exploratory and quantitative surveys in May and September 2004. Track lines from September 2004 with >74% the "soft only" substrate are numbered (Bergen et al. 2005; Appendix 3).



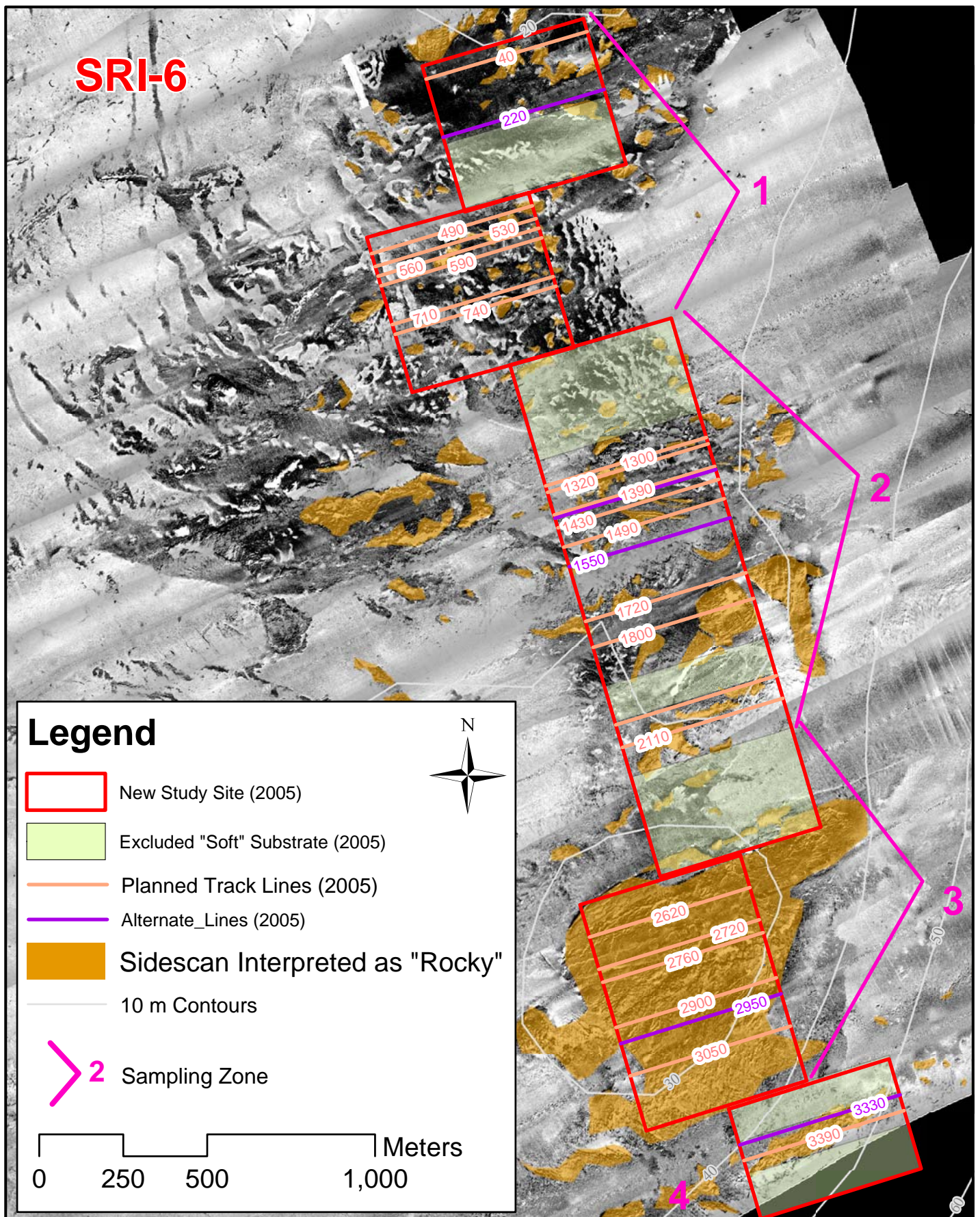


Figure 3. Modified East Point (SRI-6) study site, sampling zones, planned, and alternate track lines as planned for the 2005 survey. Sidescan sonar areas interpreted as more "rocky" from previous sampling experience. Site boundaries were modified to avoid predominantly "soft only" areas.



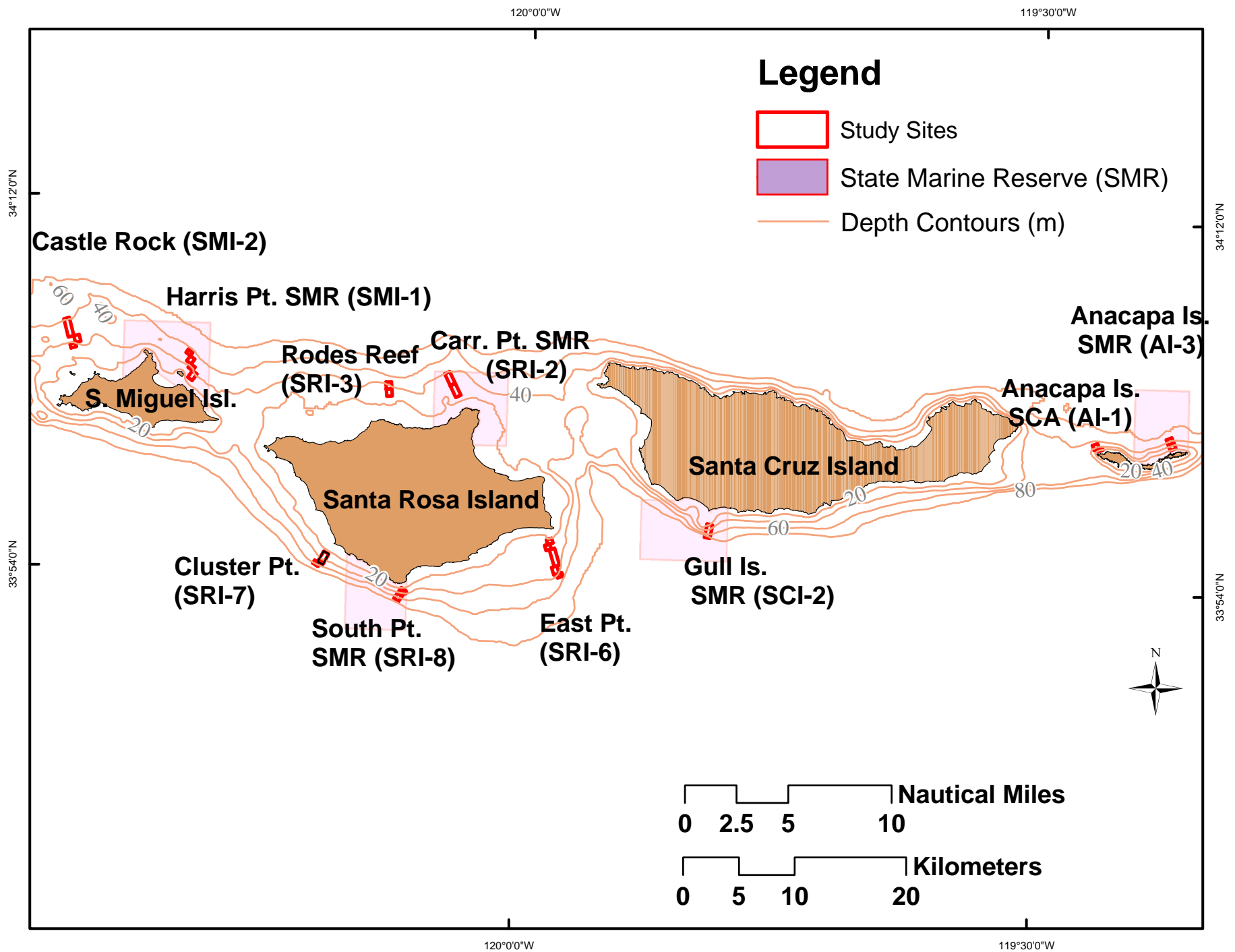


Figure 4. Location and codes for ten sites surveyed from August through October 2005.

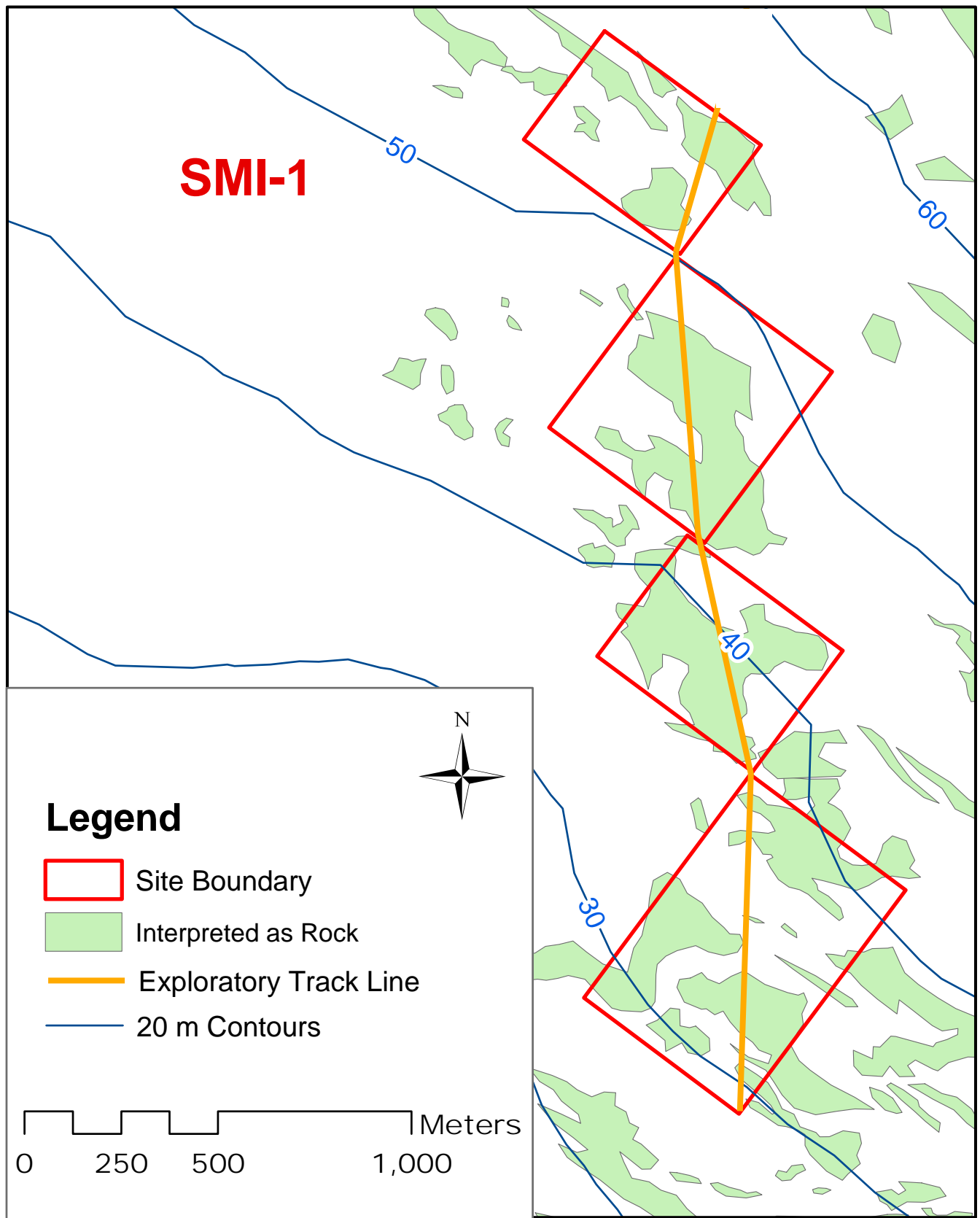


Figure 5. Harris Point SMR site boundary with exploratory track line sampled in 2005. Rocky habitat as interpreted by us from sidescan sonar maps provided by USGS.

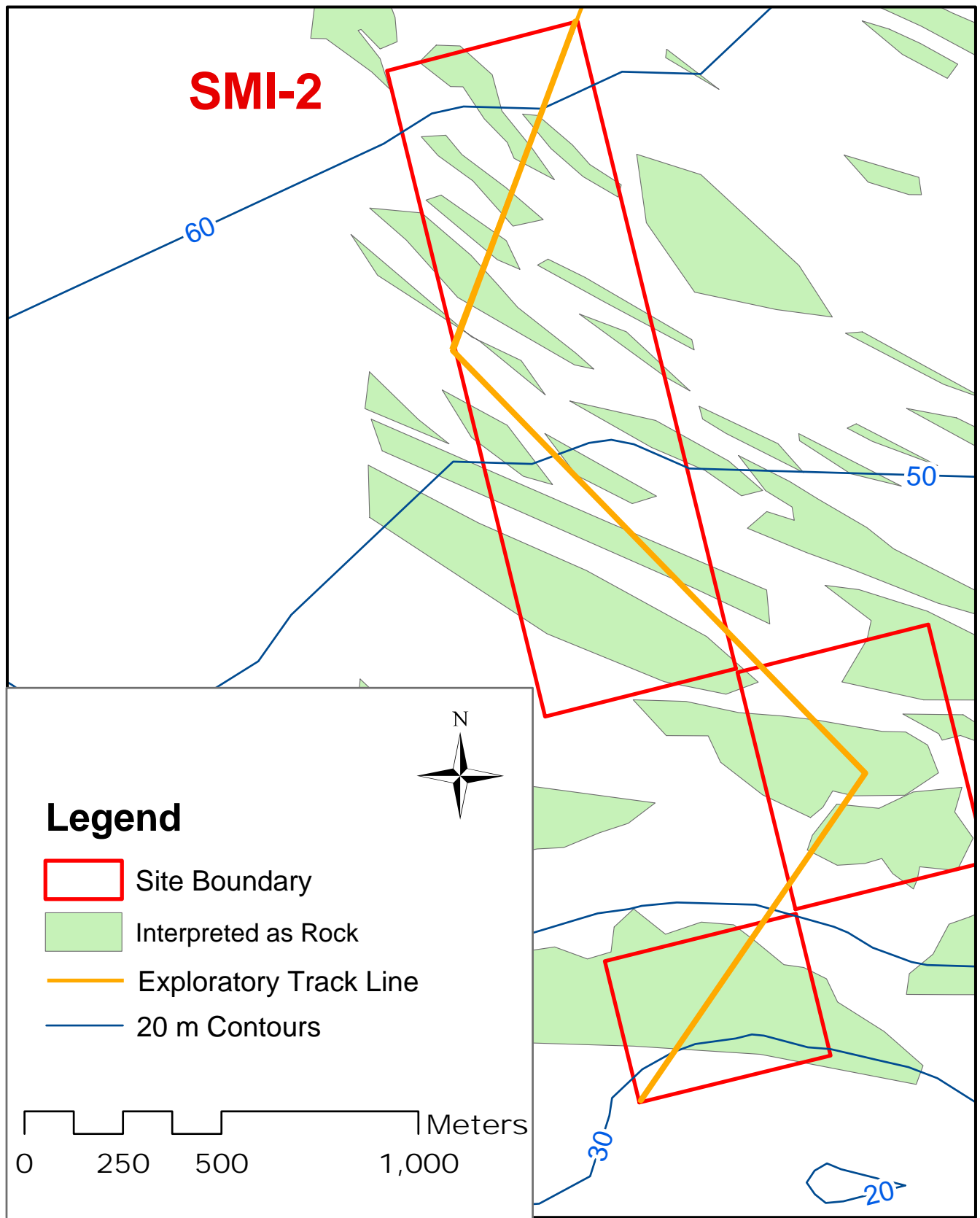


Figure 6. Castle Rock site boundary with exploratory track line sampled in 2005. Rocky habitat as interpreted by us from sidescan sonar maps provided by USGS.

## Deck Officer's Log

Date:

Dive Number:

Name:

Location:

Site:

Clump Weight (lbs):

\* Please provide a short post-dive narrative:

**Launch and Recovery:**

**Live-boating Operations:**

**Equipment Problems:**

**Post-Dive Comments:**

Time (TC)	Depth (m)	Notes

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# Laser Calibration Log

*Pre-Dive*

Dive Number:

## Forward Camera

1/2 meter:

2 meter:

## Down Camera

1/2 meter:

2 meter:

*Post-Dive*

## Forward Camera

1/2 meter:

2 meter:

## Down Camera

1/2 meter:

2 meter:

Comment:

*\* Please make a mark for each laser within the appropriate distance box before and after each dive.*