

**DEPARTMENT OF FISH AND GAME**

Marine Region

**Final  
CRUISE REPORT: 04-S-2**

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

by

Konstantin Karpov, Andrew Lauermann, Mike Prall, and Christine Pattison  
California Department of Fish and Game

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Vessel: The NOAA *R/V Shearwater*

Dates: 7 Sept. 2004 to 20 Sep 2004

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

**ABSTRACT**

Quantitative habitat and biota surveys were conducted at the northern Channel Islands Marine Protected Areas (MPA's) in September 2004. Two primary site pairs were selected within and adjacent to MPA's on Santa Rosa and Santa Cruz Islands, with three secondary site pairs chosen as contingency sites. Except for one site which was 800 m wide, selected sites were 500 m wide and varied in length and depth. At each site, the ROV flew along pre-planned track targeting  $\pm 10$  m of the center line. A forward camera recorded the water column approximately 2 m in front of the ROV and a downward-facing camera recorded the substrate, sessile algae, and invertebrates. During this survey, 57 km of randomly selected ROV track line was completed, which included 12 km of ROV tracking at each of the primary site pairs for quantitative finfish analysis. The amount of ROV tracking completed per day of actual survey more than doubled from previous training and exploratory cruises; and the ability to relocate man-made debris for possible future recovery was demonstrated. Weather constraints were a major consideration in planning and executing the surveys. The most exposed sites were targeted during periodic lulls and morning and early afternoon hours and more sheltered sites were reserved for when sea and wind conditions precluded sampling elsewhere.

## INTRODUCTION

In September 2004 quantitative habitat and biota surveys were conducted at two site pairs associated with the northern Channel Islands Marine Protected Areas (MPAs). Each pair consisted of a site inside and outside an MPA, or a “reserve” and “reference” site, respectively. Sites were selected from exploratory surveys conducted in November 2003 and May 2004. Study sites were selected to have comparable habitat and depth, be close to the reserve site, and, if possible, adjacent to the inshore Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) study sites surveyed by SCUBA divers. The goal of the September survey was to complete finfish abundance surveys at each of two primary site pairs over sufficient area of hard substrate. The methods and results related to field operations during the September 2004 survey are described in this report. Once post-processing of fish counts and habitat typing is complete, the methods and results from the quantitative analysis of habitat and fish densities will be presented in a subsequent final report.

## METHODS

Exploratory ROV survey of potential reserve and reference areas sites during November 2003 and May 2004 showed a paucity of predominantly hard substrate even at locations that were pre-selected for hard substrate based on multi-beam or side-scan SONAR imagery. Sufficient ROV track line (12 km) was targeted at each site to achieve a minimum of four km of hard substrate at each planned site (Figures 1-6).

The primary site pairs were selected on Santa Rosa and Santa Cruz Islands (Figures 1, 2, and 3). Three secondary site pairs were chosen on Anacapa, Santa Rosa, San Miguel Islands (Figures 4, 5, and 6 respectively) as contingency sites if time allowed or weather conditions prohibited sampling of the primary sites. The first primary site pair, located off the northern coast of Santa Rosa Island, consisted of SRI-2, in Carrington Point State Marine Reserve (CPSMR) and SRI-3, a fished reference site adjacent to Rodes Reef located four kilometers (km) to the east of CPSMR (Figure 2). The second primary site pair included SCI-2, a site in Gull Island State Marine Reserve (GISMR), an MPA off southwest Santa Cruz Island, and SRI-6, a fished reference site off East Point Santa Rosa Island, seven km west from GISMR (Figure 3).

Selected sites varied in length, from 0.8 km to 3.5 km, and depth, ranging from 15 m to 80 m. All sites were 500 m wide with the exception of AI-1; the reference site in a State Conservation Area (SCA) off northwest Anacapa Island, which was 800 m wide (Figures 2 to 6). To ensure that sampling was distributed across the site and represented the full depth range, each site was divided into two zones of equal area (Figures 2-6). Within each zone, GIS-based track lines were randomly placed across the width of each site parallel to the prevailing depth contour. The planned tracks totaled approximately 12 linear km (6 km in each zone) in each site (Table 1). The location of track lines was chosen by selecting random numbers from zero to the total length of the site in meters from shallow to deep. Numbers that did not produce line spacing of  $\geq 20$  m were rejected. Table 1 lists an ID number corresponding to the sequence generated

randomly. Should sea conditions or time preclude completing a site, the sequence of random numbers created allowed selecting a subset of lines to sample without introducing bias (Table 1).

Table 1. Randomly selected dive lines for each of the surveyed sites. ID numbers correspond to sequence of random selection of sites. Kelp (K) and sand (S) areas were excluded from line selections. Grayed lines were planned but not executed.

| Depth  | SRI-2         | SRI-3         | SCI-2        | SRI-6         | SRI-8         | SRI-7         | SMI-1   | SMI-2   | AI-1  |
|--------|---------------|---------------|--------------|---------------|---------------|---------------|---------|---------|-------|
| Min.   | 0             | 0             | 0            | 0             | 0             | 0             | 0       | 0       | 0     |
| Zone 1 | 1 70          | 6 60          | <b>K</b> 0   | 5 160         | 8 40          | 8 130         | 10 20   | 9 160   | 9 50  |
|        | 4 110         | 7 80          | <b>K</b> 160 | 2 210         | 2 90          | 12 190        | 3 150   | 6 270   | 1 80  |
|        | 12 150        | 2 120         | <b>S</b> 190 | 10 400        | 10 110        | 11 230        | 4 350   | 1 450   | 2 130 |
|        | 6 190         | 9 150         | <b>S</b> 360 | 7 570         | 11 160        | 2 520         | 7 430   | 12 490  | 4 160 |
|        | 8 310         | 1 170         | 16 360       | 1 640         | 5 200         | 10 570        | 2 480   | 3 640   | 7 200 |
|        | 2 610         | 10 250        | 13 380       | 3 730         | 9 230         | 5 630         | 1 600   | 11 800  | 5 230 |
|        | 3 650         | 3 440         | 14 400       | 11 770        | <b>S</b> 290  | 3 700         | 9 790   | 4 920   | 6 260 |
|        | 11 680        | 11 460        | 1 420        | 4 880         | <b>S</b> 580  | 1 780         | 6 860   | 2 1080  | 8 280 |
|        | 5 880         | 4 490         | 7 450        | 6 960         | 1 640         | 6 830         | 8 1070  | 7 1110  | 3 320 |
|        | <b>S</b> 880  | 5 510         | 12 480       | 8 1160        | 12 720        | 4 860         | 12 1250 | 5 1150  |       |
|        | <b>S</b> 1100 | 12 530        | 11 510       | 9 1270        | 7 740         | 9 910         | 5 1340  | 8 1210  |       |
|        | 7 1100        | 8 600         | 4 550        | 12 1410       | 6 830         | 7 960         | 11 1500 | 10 1340 |       |
|        | 9 1140        |               | 15 570       |               | 4 850         | <b>S</b> 960  |         |         |       |
|        | 10 1160       |               | 6 590        |               | 3 870         | <b>S</b>      |         |         |       |
|        |               | 2 610         |              | <b>S</b> 870  | <b>S</b>      |               |         |         |       |
| Mid.   | 1170          | 630           | 615          | 1780          | <b>S</b> 980  | <b>S</b> 1075 | 1645    | 1510    | 350   |
| Zone 2 | 4 1190        | 4 640         | 6 670        | 4 1880        | 8 1010        | <b>S</b> 1100 | 5 1760  | 3 1520  | 2 350 |
|        | 3 1250        | 3 670         | 10 720       | 5 1900        | 5 1040        | 3 1100        | 7 2240  | 7 1560  | 1 370 |
|        | 1 1290        | 8 700         | 11 800       | <b>S</b> 1900 | 12 1060       | 8 1140        | 3 2520  | 2 1650  | 9 420 |
|        | 9 1310        | 5 720         | 4 850        | <b>S</b> 2430 | 9 1080        | 11 1270       | 11 2610 | 12 1670 | 4 470 |
|        | 2 1380        | 1 780         | 8 960        | 10 2470       | 7 1100        | 2 1300        | 1 2730  | 6 2010  | 5 520 |
|        | 7 1500        | 2 810         | 3 1030       | 2 2520        | 11 1140       | 6 1330        | 4 2830  | 1 2180  | 8 540 |
|        | 10 1570       | 12 850        | 5 1060       | 7 2550        | 10 1160       | 4 1390        | 6 2880  | 11 2310 | 6 580 |
|        | 6 1600        | 6 900         | 12 1110      | 9 2570        | <b>S</b> 1210 | 12 1410       | 10 2920 | 9 2500  | 3 600 |
|        | 8 1670        | 10 960        | 2 1140       | 3 2600        | <b>S</b> 1650 | 5 1430        | 9 2940  | 10 2790 | 7 620 |
|        | 5 1730        | 11 1050       | 9 1160       | 11 2720       | 2 1650        | <b>S</b> 1440 | 8 3020  | 4 2820  |       |
|        | 11 1970       | 7 1100        | 1 1180       | 6 2750        | 6 1690        | <b>S</b> 1630 | 12 3070 | 5 2980  |       |
|        | 12 2200       | 9 1120        | 7 1210       | 12 2910       | 1 1710        | 7 1760        | 2 3210  | 8 3020  |       |
|        |               |               |              | 1 2950        | 3 1740        | <b>S</b> 1780 |         |         |       |
|        |               |               |              | 8 2980        | 4 1840        | <b>S</b> 1830 |         |         |       |
|        |               |               |              |               | 9 1830        |               |         |         |       |
|        |               |               |              |               | 1 1920        |               |         |         |       |
|        |               |               |              |               | 10 1940       |               |         |         |       |
| Max.   | 2340          | <b>S</b> 1260 | 1230         | <b>S</b> 3560 | <b>S</b> 1960 | <b>S</b> 2150 | 3290    | 3020    | 700   |

Areas determined to be mostly sand were excluded during the placement of random transect lines. These areas were defined from existing multibeam SONAR data (California State University Monterey Bay, Rikk Kviteck unpublished) for CPSMR, Rodes Reef, and Gull Island; and by side scan SONAR map for East Point (Guy Cochran unpublished) and also by overlaying data from exploratory ROV surveys completed in 2003 and 2004 (Karpov unpublished)(Figures 7 and 8). Using this approach, a total of 24 track lines were produced for each site, except AI-1, a wide site requiring only 18 lines to produce the same track distance (Tables 1 - Figure 9).

At each site, the ROV was flown along the pre-planned track targeting  $\pm 10$  m of the center line. The forward camera recorded the water column approximately 2 m in front of the ROV and a downward-facing camera recorded the substrate, sessile algae, and invertebrates. GPS time was recorded on each video frame (1/30<sup>th</sup> sec) and on a audio track using methods developed by Veisze and Karpov (2002). ROV sensor data for water depth, temperature, ROV heading, ranging sonar, and camera tilt angle were also recorded.

The ROV was flown to maintain an average height 0.5 m above the bottom, a velocity of 0.5 m to 1.0 m-per-second, and at a 15 to 30 degree camera tilt angle. A thruster auto-trim helped the pilot maintain a more constant velocity. Individual ROV dives were limited to approximately 2 hours (3 km) each. Surveys were conducted between the hours of 0800 and 1700 each day to avoid twilight conditions that might affect fish abundances.

The ROV was flown off the vessel stern using a "live boat" technique that employed a 136 kg (300 lb) clump weight. Using this method all but 40 m of the ROV umbilicus is secure from current induced drag by being attached to the clump weight cable which is suspended at least 5 m off the bottom. The 40 m tether allowed the ROV pilot to maintain a straight course parallel to the ship without being pulled using the location of the ship, the ROV, and the track line that are displayed on shipboard monitors.

Track line width on the forward camera was determined from a ranging sonar fixed below and parallel to the camera between the two forward facing parallel 110 mm apart red lasers. To achieve a relatively constant transect width (2 to 3 m), the pilot used the ranging sonar to target a 2 m distance from the camera to the substrate (at the screen horizontal mid point). Transect width is computed each second based on the camera field of view as 1.3 x the ranging sonar distance. In addition to the forward lasers, two pairs of downward facing lasers produce beams that are spaced 130 and 750 mm apart. Paired lasers provide redundancy for transect width determination and serves as a reference for sizing fish during post processing.

Prior to the start of the cruise and at the end of the cruise, the ranging sonar and compass on the ROV were calibrated while other calibrations such as the distance between paired laser beams, temperature, and depth were checked before launch and after retrieval. The ranging sonar was calibrated across a distance of 1 to 5 m by flying

the ROV with an attached tape measure and targeting the hull perpendicular to the stern of the RV Shearwater.

## RESULTS

The cruise was scheduled for two weeks from September 7 to 20. Data was collected from September 10 to the 18, following three days of set up and system calibration. Due to deteriorating weather and vessel mechanical failure, the cruise ended mid-day on September 18. During this survey, 57 km of ROV track line was completed, including 12 km at each of the primary site pairs off Carrington Point, Rodes Reef, Gull Island, and East Point for quantitative finfish survey and 9 km at an additional SCA site off western Anacapa Island (Table 2 – Figure 1, 2, 3, and 6).

Table 2. Line number, date, and dive of completed ROV track lines during September 2004 survey.

|               | <b>SRI-2</b> | <b>Date</b> | <b>Dive #</b> | <b>SRI-3</b> | <b>Date</b> | <b>Dive #</b> |
|---------------|--------------|-------------|---------------|--------------|-------------|---------------|
| <b>Zone 1</b> | 70           | 09/15/04    | <b>261</b>    | 60           | 09/16/04    | <b>263</b>    |
|               | 110          | 09/15/04    | <b>261</b>    | 80           | 09/16/04    | <b>263</b>    |
|               | 150          | 09/15/04    | <b>261</b>    | 120          | 09/16/04    | <b>263</b>    |
|               | 190          | 09/15/04    | <b>261</b>    | 150          | 09/16/04    | <b>263</b>    |
|               | 310          | 09/15/04    | <b>261</b>    | 170          | 09/16/04    | <b>263</b>    |
|               | 610          | 09/15/04    | <b>260</b>    | 250          | 09/16/04    | <b>263</b>    |
|               | 650          | 09/15/04    | <b>260</b>    | 440          | 09/16/04    | <b>264</b>    |
|               | 680          | 09/15/04    | <b>260</b>    | 460          | 09/16/04    | <b>264</b>    |
|               | 880          | 09/15/04    | <b>260</b>    | 490          | 09/16/04    | <b>264</b>    |
|               | 1100         | 09/15/04    | <b>260</b>    | 510          | 09/16/04    | <b>264</b>    |
|               | 1140         | 09/11/04    | <b>252</b>    | 530          | 09/16/04    | <b>264</b>    |
|               | 1160         | 09/11/04    | <b>252</b>    | 600          | 09/16/04    | <b>264</b>    |
| <b>Zone 2</b> | 1190         | 09/11/04    | <b>251</b>    | 640          | 09/16/04    | <b>265</b>    |
|               | 1250         | 09/11/04    | <b>251</b>    | 670          | 09/16/04    | <b>265</b>    |
|               | 1290         | 09/11/04    | <b>251</b>    | 700          | 09/16/04    | <b>265</b>    |
|               | 1310         | 09/11/04    | <b>251</b>    | 720          | 09/16/04    | <b>265</b>    |
|               | 1380         | 09/11/04    | <b>251</b>    | 780          | 09/16/04    | <b>265</b>    |
|               | 1500         | 09/11/04    | <b>250</b>    | 810          | 09/16/04    | <b>265</b>    |
|               | 1570         | 09/11/04    | <b>250</b>    | 850          | 09/16/04    | <b>265</b>    |
|               | 1600         | 09/11/04    | <b>250</b>    | 900          | 09/15/04    | <b>262</b>    |
|               | 1670         | 09/11/04    | <b>250</b>    | 960          | 09/15/04    | <b>262</b>    |
|               | 1730         | 09/11/04    | <b>250</b>    | 1050         | 09/15/04    | <b>262</b>    |
| 1970          | 09/10/04     | <b>248</b>  | 1100          | 09/15/04     | <b>262</b>  |               |
| 2200          | 09/10/04     | <b>248</b>  | 1120          | 09/15/04     | <b>262</b>  |               |

Table 2. (Continued)

|               | SCI-2    | Date       | Dive #     | SRI-6    | Date       | Dive #     | AI-1 | Date     | Dive #     |
|---------------|----------|------------|------------|----------|------------|------------|------|----------|------------|
| <b>Zone 1</b> | 160      | 09/13/04   | <b>256</b> | 160      | 09/18/04   | <b>269</b> | 130  | 09/17/04 | <b>267</b> |
|               | 360      | 09/14/04   | <b>258</b> | 210      | 09/18/04   | <b>269</b> | 160  | 09/17/04 | <b>267</b> |
|               | 380      | 09/14/04   | <b>258</b> | 400      | 09/18/04   | <b>269</b> | 230  | 09/17/04 | <b>267</b> |
|               | 400      | 09/14/04   | <b>258</b> | 570      | 09/18/04   | <b>269</b> | 260  | 09/17/04 | <b>266</b> |
|               | 420      | 09/13/04   | <b>255</b> | 640      | 09/18/04   | <b>268</b> | 320  | 09/17/04 | <b>266</b> |
|               | 450      | 09/13/04   | <b>255</b> | 730      | 09/18/04   | <b>268</b> |      |          |            |
|               | 480      | 09/13/04   | <b>255</b> | 770      | 09/13/04   | <b>257</b> |      |          |            |
|               | 510      | 09/13/04   | <b>255</b> | 880      | 09/13/04   | <b>257</b> |      |          |            |
|               | 550      | 09/13/04   | <b>255</b> | 960      | 09/13/04   | <b>257</b> |      |          |            |
|               | 570      | 09/14/04   | <b>258</b> | 1160     | 09/13/04   | <b>257</b> |      |          |            |
|               | 590      | 09/13/04   | <b>255</b> | 1270     | 09/13/04   | <b>257</b> |      |          |            |
| <b>Zone 2</b> | 610      | 09/13/04   | <b>255</b> | 1410     | 09/13/04   | <b>257</b> |      |          |            |
|               | 670      | 09/12/04   | <b>254</b> | 1880     | 09/18/04   | <b>268</b> | 350  | 09/17/04 | <b>266</b> |
|               | 720      | 09/12/04   | <b>254</b> | 1900     | 09/18/04   | <b>268</b> | 370  | 09/17/04 | <b>266</b> |
|               | 800      | 09/12/04   | <b>254</b> | 2470     | 09/14/04   | <b>259</b> | 470  | 09/18/04 | <b>270</b> |
|               | 850      | 09/12/04   | <b>254</b> | 2520     | 09/14/04   | <b>259</b> | 520  | 09/18/04 | <b>270</b> |
|               | 960      | 09/12/04   | <b>254</b> | 2550     | 09/14/04   | <b>259</b> | 580  | 09/18/04 | <b>270</b> |
|               | 1030     | 09/12/04   | <b>254</b> | 2570     | 09/14/04   | <b>259</b> | 600  | 09/18/04 | <b>270</b> |
|               | 1060     | 09/12/04   | <b>254</b> | 2600     | 09/14/04   | <b>259</b> |      |          |            |
|               | 1110     | 09/12/04   | <b>253</b> | 2720     | 09/14/04   | <b>259</b> |      |          |            |
|               | 1140     | 09/12/04   | <b>253</b> | 2750     | 09/14/04   | <b>259</b> |      |          |            |
|               | 1160     | 09/12/04   | <b>253</b> | 2910     | 09/14/04   | <b>259</b> |      |          |            |
| 1180          | 09/12/04 | <b>253</b> | 2950       | 09/10/04 | <b>249</b> |            |      |          |            |
| 1210          | 09/12/04 | <b>253</b> | 2980       | 09/10/04 | <b>249</b> |            |      |          |            |

CPSMR, Santa Rosa Island was the first primary target sampled. This site required three separate days to complete due to periods of adverse wind and high swells (September 10, 11, and 15 - Table 2, Figure 2). Due to increasing afternoon northwesterly winds, only two lines, totaling 1 km, were completed during the first day. Six km of track was completed on September 11, with the remaining 5 km of inshore lines completed on September 15.

The CPSMR fished reference site, Rhodes Reef Santa Rosa Island, was sampled on September 15 and 16, with a project record 9.5 km of track line completed in a single day on September 16 (Table 2, Figure 2).

GISMR, Santa Cruz Island, was sampled over a three-day period (September 12, 13, and 14, Table 2). Most of the lines were completed during the first two days (9 km). On September 13, at the end of the third shoreward most line, giant kelp entangled the ROV at depths of approximately 20 m, ending the dive and causing us to abandon the four inner-most track lines. Sampling resumed at the site on September 14 with four

new randomly-selected lines in zone 1 at deeper depths (Table 1; Figure 3). Kelp was not a problem at any of the other sites at comparable shallow depths.

The East Point site off southeast, Santa Rosa Island had 12 km of track line were completed over three days (September 13, 14, and 18 – Table 2).

The single alternate site off Anacapa Island SCA was sampled at the end of the survey on 17 and 18 September. Nine km was surveyed (Table 2). On one of the lines we returned to a large fishing net that was first discovered during the May 2004 cruise draped over a high relief rocky area at about 20-24 m depth. The paired Anacapa Island reserve site (AI-3) was not surveyed as weather deteriorated.

Dockside accuracy measurements of the distancing ranging sonar used to collect transect widths completed on September 9 and 19 did not vary by more than 0.1 m across the sampled range of 1.0 to 5.0 m. A factory set up error limited the output of the ranging sonar to half of its 10 m range. Therefore, readouts recorded on the video and the database never exceeded 5.0 m.

## **DISCUSSION**

Based on earlier analysis (Karpov unpublished), the amount of habitat needed to detect changes in populations of managed fish is approximately four kilometers of mixed or hard substrate. Boot-strap for variance (Kimura and Balsiger 1985) and power analysis have already been applied to data collected in central California to determine that four km of track line over hard or mixed substrate was needed to detect that a 150% change in abundance for primary species over time was statistically significant (Karpov unpublished).

The number of kilometers of track line planned for each site was based on estimates from exploratory surveys of the proportion of hard or mixed to soft substrate encountered at CPSMR, Rodes Reef, Gull Island, and East Point. For example, at Rodes Reef, where hard substrate was estimated at 30% (November 2003 exploratory survey), the planned twenty-four 500 m lines should produce more than 4 km of hard or mixed soft and hard substrate (Figure 7).

The number of km of ROV tracking completed per day of actual survey has more than doubled from the previous training cruises on the RV Shearwater. This is attributed to both training and a shift in methods from exploratory to quantitative surveys. During the exploratory phase (November 2003 and May 2004), where training and identifying habitat were the major goals, as many sites as possible were surveyed using a zigzag pattern moving from deep to shallow for any given site (Figure 7). With this method, we covered 34 km in 12 sites during 11 days of actual survey. The current quantitative approach uses parallel lines randomly spaced while systematically working from deep to shallow and increases efficiency in use of ship time. Contiguous stations were often completed without having to retrieve the ROV, by either transiting to the next station

under water or on the surface, saving time used for clump weight retrieval, boom redeployment, and surface recalibration of the ROV system.

Weather constraints are a major consideration in planning and executing surveys off the northern Channel Islands, even during the optimal August-September sampling period. During this cruise, periods of calm were interspersed with two to three day periods of increased northwesterly seas and swells. It was discovered that the most exposed sites to the northwest (e.g. north San Miguel, northern Santa Rosa Island sites, and the two South Point sites) had to be targeted during the periodic lulls and morning hours when swells were less than 2 m with periods > 8 seconds. At these sites, except during the calmest days, the planned work period of 08:00 to 17:00 had to be terminated by 15:00 when the safety of ROV recovery operations was affected by wind-induced seas. Protracted winds of >20 knots created wind waves that placed the personnel and ROV at risk during recovery and made ROV to vessel coordination during tracking more difficult. The more sheltered sites, such as Gull Island SMR and East Point, and the northern Anacapa Islands sites were reserved for when sea and wind conditions precluded sampling elsewhere.

The differences between side scan and multi-beam data used to filter out sand areas are illustrated in figures 7 and 8, where a subset of transect lines were almost entirely sand. What is not shown in this illustration is that spatial accuracy of features is more reliable for multi-beam which is therefore more useful for predicting precise areas of hard substrate. This was a problem primarily at two sites, East Point and Anacapa Island SCA, where side scan sonar and not multi-beam sonar was used. Areas estimated to be sand will be excluded from future surveys, thus assuming that major sand shift does not occur, increasing the probability of obtaining the targeted 4 km of reef with fewer transect lines. In addition, once habitat post-processing is complete, estimates of the required area that needs to be sampled will be more precise and may reduce the total number of kilometers sampled accordingly.

Debris such as nets, abandoned crab pot gear, cables, and lines were located and spatially recorded based on tracking. The spatial accuracy is estimated at approximately 6 to 12 m (Karpov unpublished). The ability to relocate such objects for possible future recovery was demonstrated during this cruise when a large net, possibly lampara, was observed at the Anacapa SCA site in the same location as it was seen on two previous dives conducted during the May 2004 exploratory survey.

## REFERENCES

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## Personnel

### R/V Shearwater Personnel:

|                |                |
|----------------|----------------|
| Lumann Moody   | Captain - NOAA |
| Terrence Shinn | Captain - NOAA |
| Steve Dyer     | Captain - NOAA |

### ROV Team Personnel:

|                    |   |
|--------------------|---|
| Konstantin Karpov  | Principle Investigator / Research Director - Senior Biologist, CDFG   |
| Dirk Rosen         | Operations Director / Funding Coordinator - President, Marine Applied Research and Exploration (MARE) and Vice President, Special Projects - Deep Ocean Engineering |
| Dr. Mary Bergen    | Co-Principle Investigator - Senior Environmental Specialist IV – CDFG; Nearshore Fishes Research Mandate Coordinator  |
| Michael Prall      | Biologist (Marine/Fisheries) - CDFG   |
| Andy Lauermann     | Biologist / ROV Specialist - MARE / CDFG  |
| Christine Pattison | Associate Biologist (Marine/Fisheries) - CDFG   |
| Steve Holz         | Biologist - MARE / CDFG   |

### Other Participants:

|             |   |
|-------------|---|
| Jackie Buhl | Channel Islands National Marine Sanctuary, NOAA |
|-------------|---|

### Guests:

|                    |  |
|--------------------|--|
| Sam Schuchat       | California Coastal Conservancy- Executive Director; Commissioner - California Fish and Game Commission |
| Burr Heneman       | Commonweal   |
| David T. Kingsbury | Moore Foundation (MF) - Marine Program Director  |
| Meaghan Calcan     | MF - Marine Program  |
| Rachel Strader     | MF - Marine Program  |
| Kara Kemmler       | California Coastal Conservancy- Project Manager  |
| Phil Stevens       | The Nature Conservancy (TNC)- Foundation Development   |
| Mary Gleason       | TNC - Sr. Conservation Planner   |
| Mike Sweeny        | TNC Acting CA Director   |
| John Ugoretz       | Senior Biologist - CDFG  |
| Marc Lopata        | MARE Board Member  |

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- Rikk Kviteck of California State University Monterey Bay for multi-beam maps.
- Guy Cochran of the USGS for side scan maps.
- Dan Vasey of Santa Barbara City College for providing equipment and technical support.
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- Marc Lopata MARE board member for assisting in editing the text of this report.
- Jessica Hobba for assistance in editing the text of this report.

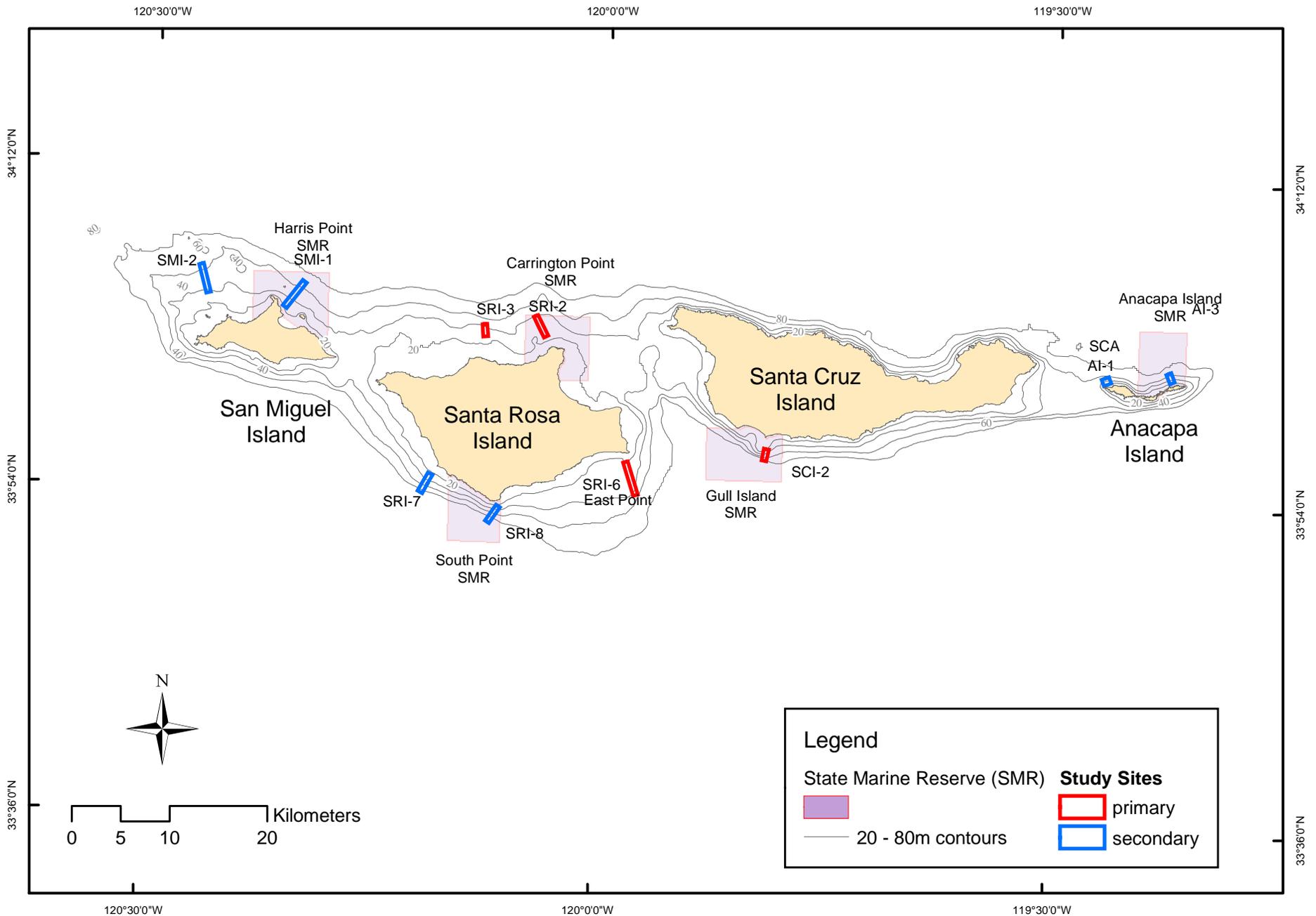


Figure 1. Location of primary and secondary survey sites targeted inside and outside of selected State Marine Reserves at the northern Channel Islands during the September 2004 survey.

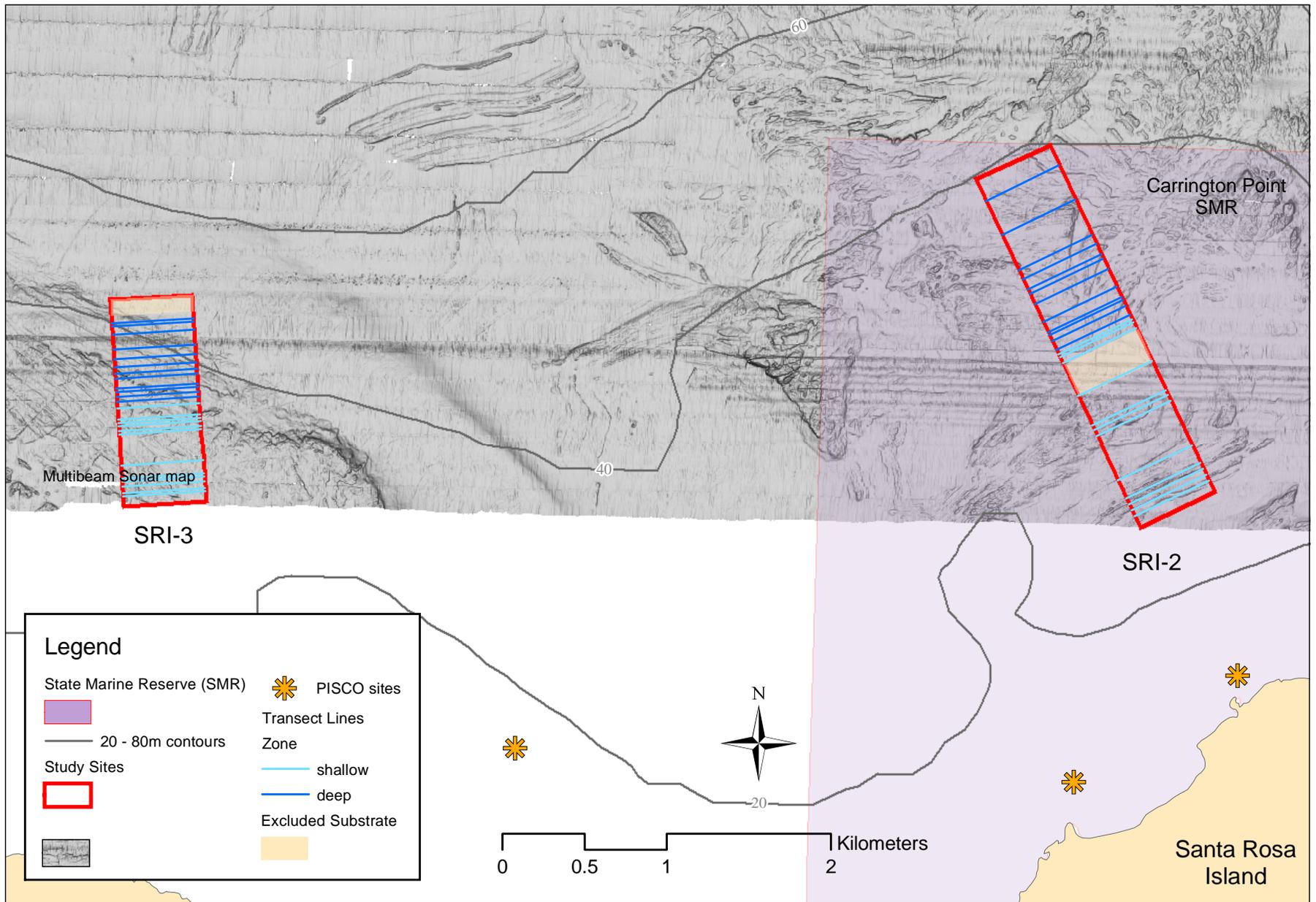


Figure 2. Location of Carrington Point State Marine Reserve (SRI-2), paired fished reference (SRI-3), and PISCO survey sites off northern Santa Rosa Island. Completed deep and shallow survey lines are displayed with excluded sanded areas over shaded relief multibeam sonar bathymetry map.

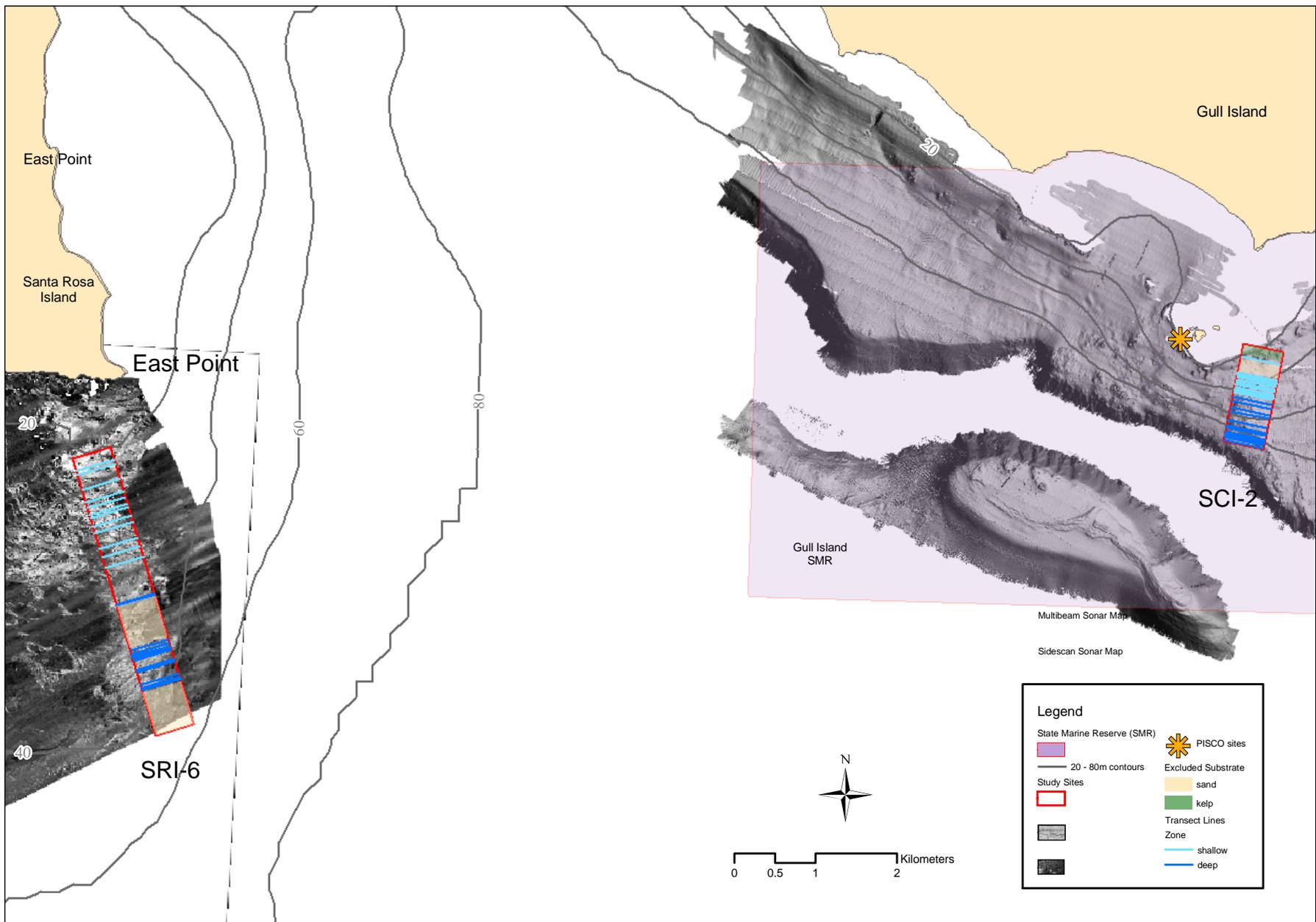


Figure 3. Location of Gull Island State Marine Reserve (SCI-2) and PISCO survey sites off southwest Santa Cruz Island; and paired fished reference site (SRI-6) off East Point Santa Rosa Island. Completed deep and shallow survey lines are displayed with excluded sanded areas over shaded relief multibeam sonar bathymetry map at SCI-2 and shaded relief sidescan sonar substrate map at SRI-6.

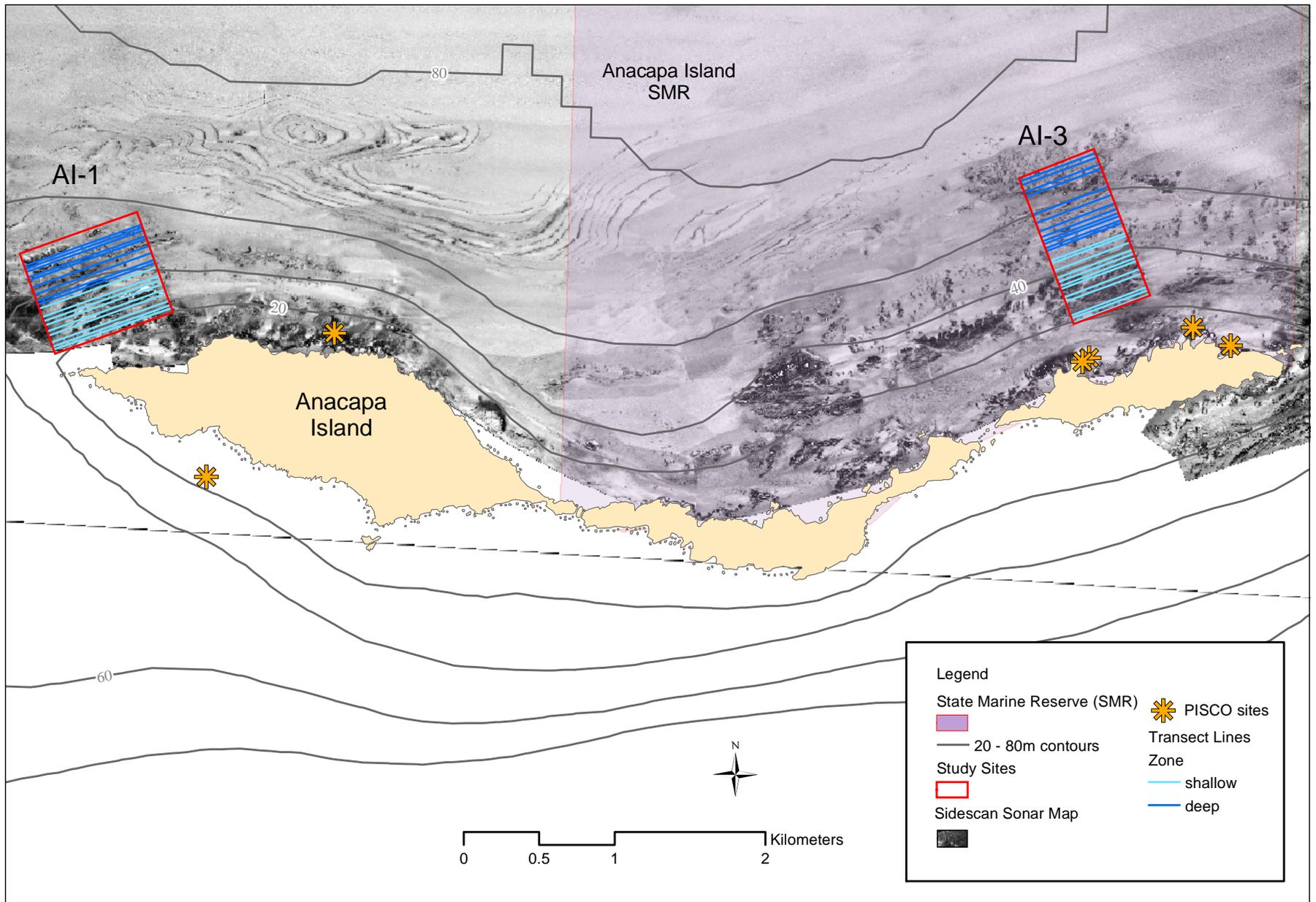


Figure 4. Location of Anacapa Island State Marine Reserve (AI-3), paired fished reference (AI-1), and PISCO survey sites off Anacapa Island. Targeted deep and shallow survey lines are displayed with excluded sanded areas over shaded relief sidescan sonar substrate map.

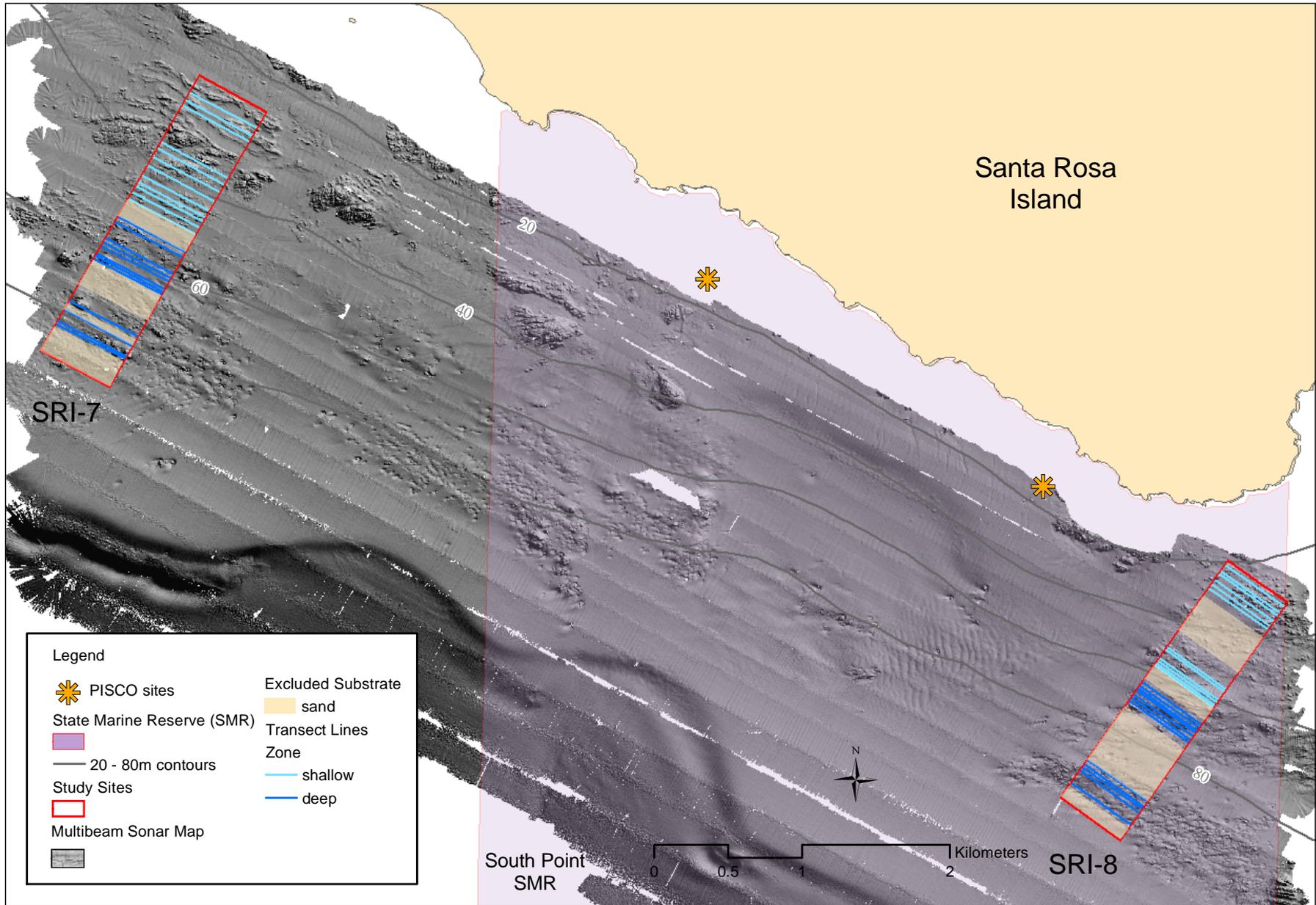


Figure 5. Location of South Point State Marine Reserve (SRI-7), paired fished reference (SRI-8), and PISCO survey sites off southern Santa Rosa Island. Planned deep and shallow survey lines are displayed with excluded sanded areas over shaded relief multibeam sonar bathymetry map.

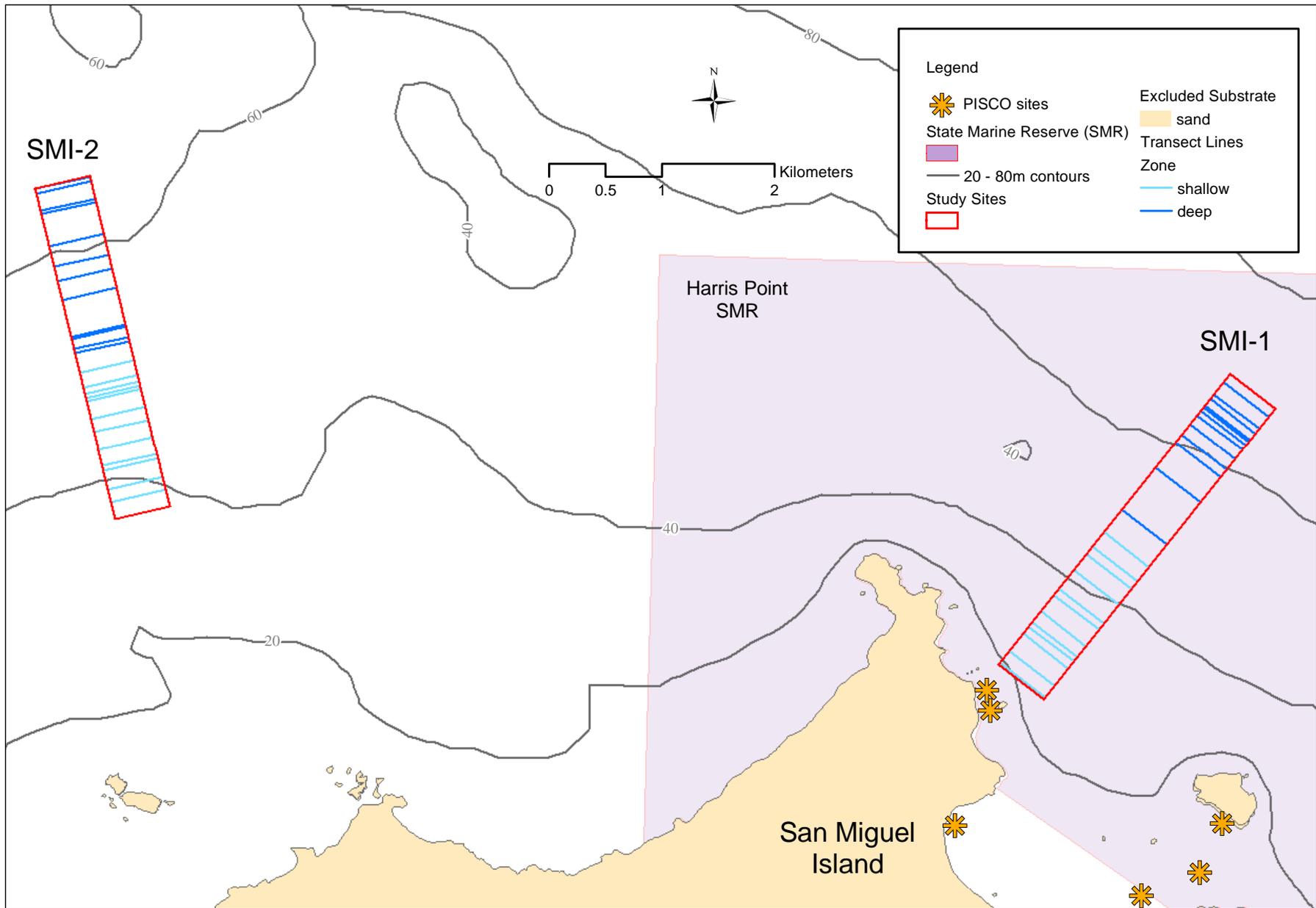


Figure 6. Location of Harris Point State Marine Reserve (SMI-1), paired fished reference (SMI-2), and PISCO survey sites off northern San Miguel Island. Planned deep and shallow survey lines are displayed.

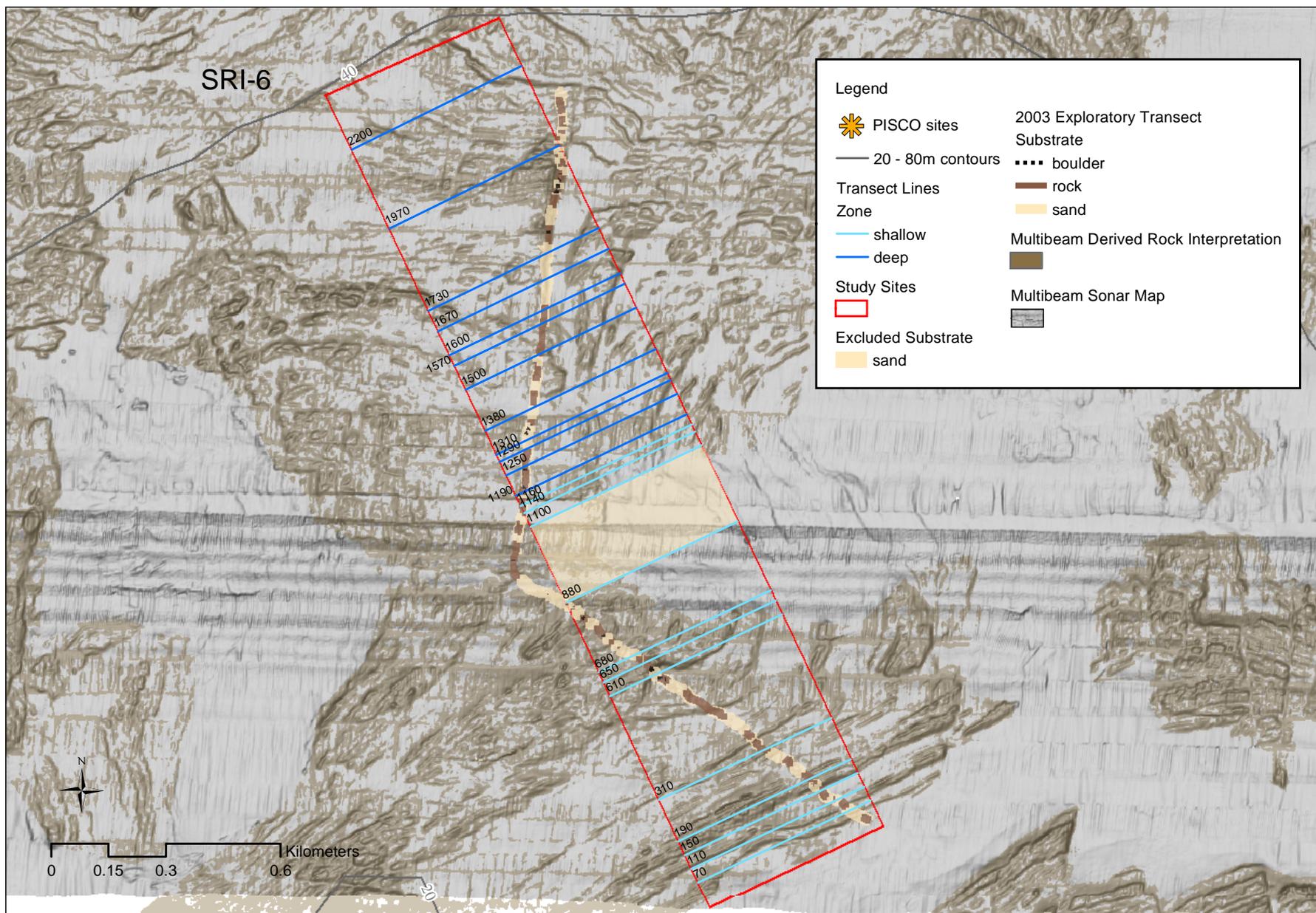


Figure 7. Randomly selected planned survey lines in deep and shallow zones at Carrington Point State Marine Reserve (SRI-6). Sand substrate excluded using ROV video based substrate classification from November 2003 exploratory survey and multi-beam sonar rock interpretation (CSUMB unpublished) are displayed over shaded relief multibeam bathymetry maps.

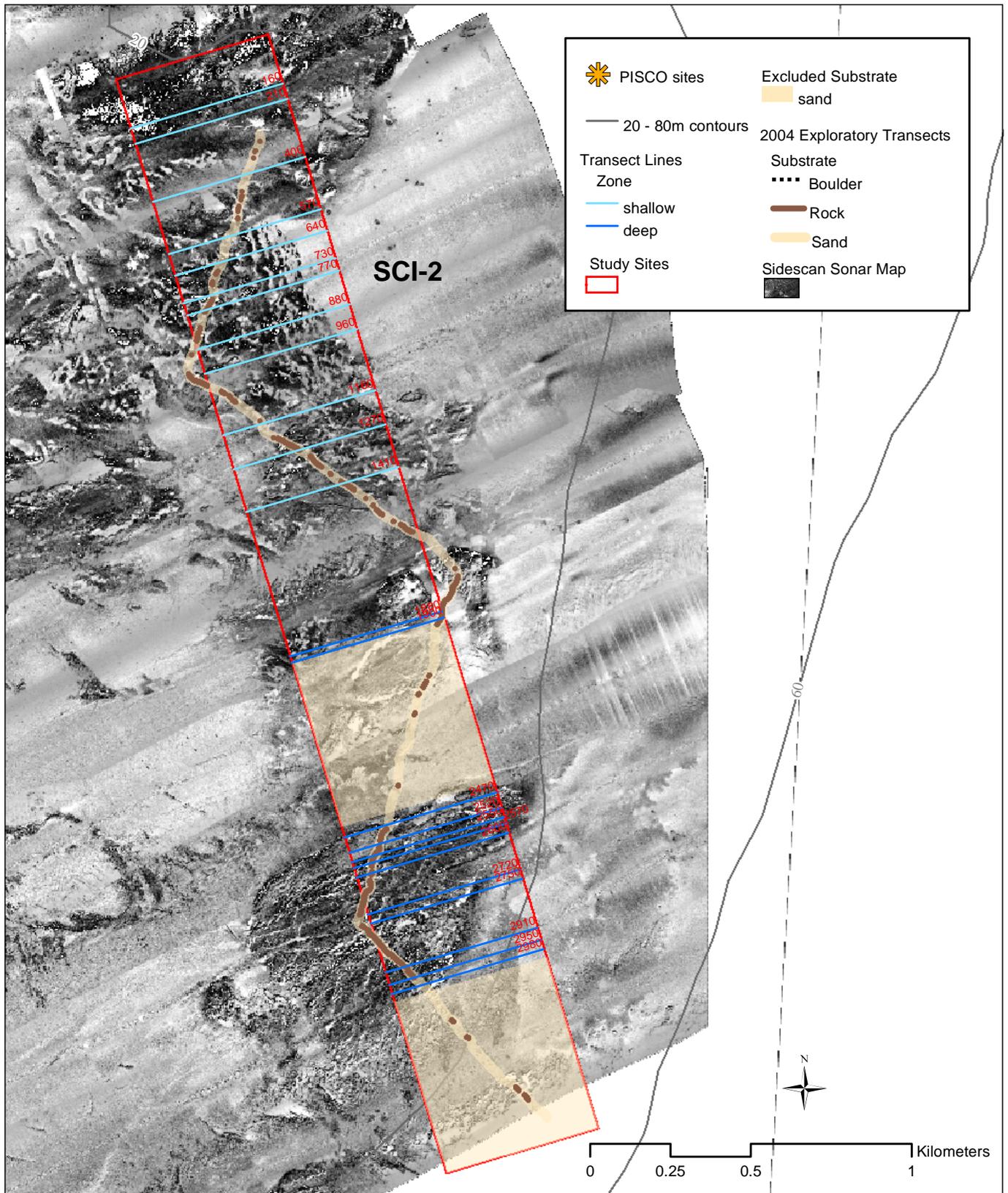


Figure 8. Completed survey lines in deep and shallow zones at Gull Island reference site (SCI-2). Sand substrate excluded as determined from ROV video based substrate classification from May 2004 exploratory survey and sidescan sonar is displayed over shaded relief sidescan sonar substrate map.

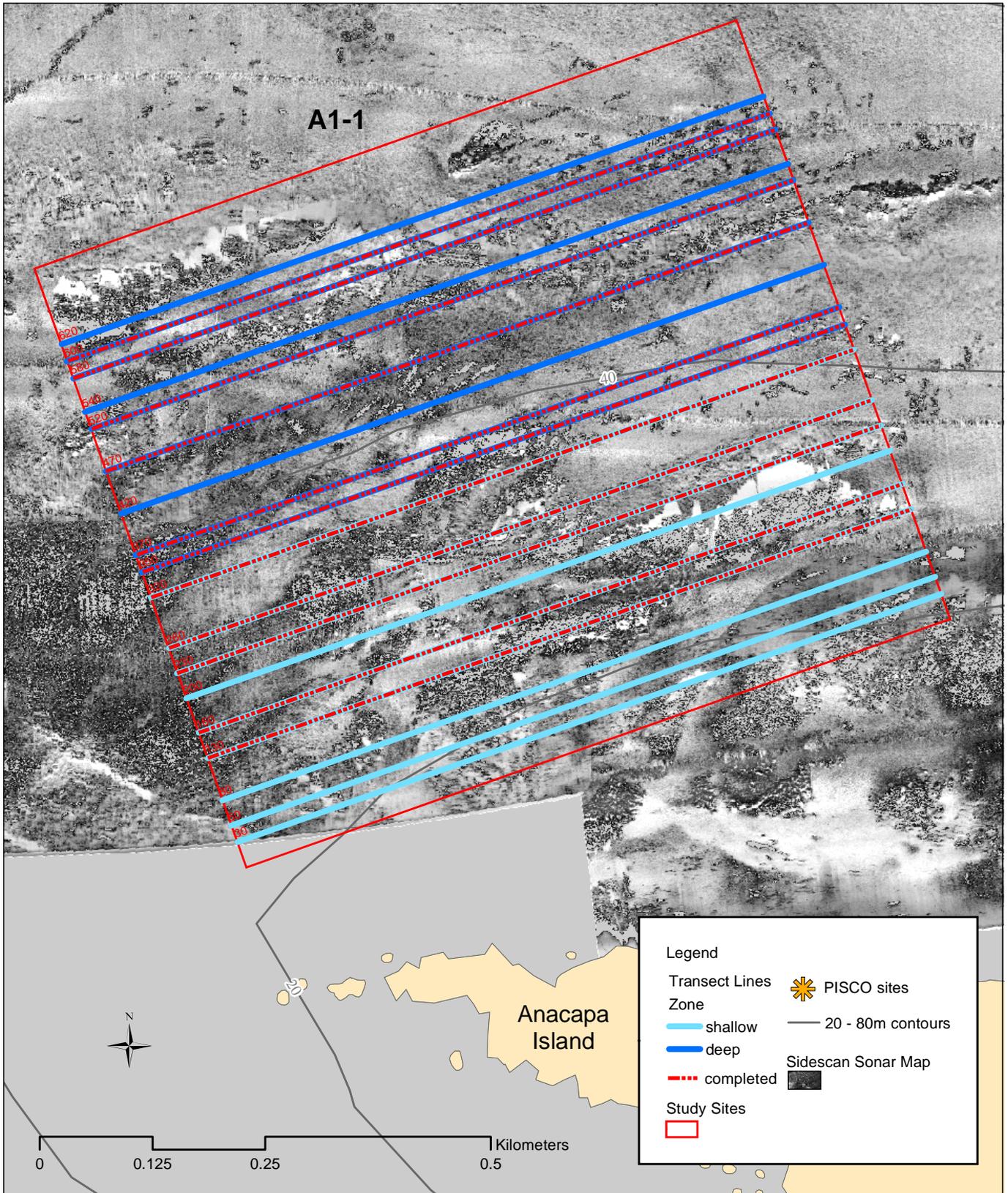


Figure 9. Eleven completed transects out of 18 planned at Anacapa Island reference site (AI-1) deep and shallow zones (Table 1 and 2) displayed over sidescan sonar substrate map.