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DEPARTMENT OF FISH AND GAME

Marine Region

Final

CRUISE REPORT: 04-S-1

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

by

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Vessel: The NOAA *R/V Shearwater*

Dates: Leg 1: November 11-14 and 19-25, 2003
Leg 2: May 13-18, 2004

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

ABSTRACT

Research cruises in November 2003 and May 2004 included cooperative training in remotely operated vehicle (ROV) and boat operations, refinements in ROV survey methods, and exploratory surveys of sites that will be used to evaluate the effects of recently-established Marine Protected Areas (MPAs) in the northern Channel Islands. With training, we developed consistency in ROV tracking and in post-processing of data as well as the ability to interchange crew members. We also increased the efficiency of ROV operations. Checklists were generated for each of the key team members. We sampled 14 sites at three of four targeted MPA's and adjacent reference sites. We completed 39.5 km of ROV track line, producing 26.4 hours of high-quality video. The video tapes have been reproduced on DVD for archival storage and ease of access for future analysis.

Introduction

Recent efforts to develop new strategies to help protect and recover California's declining ocean resources have led to considering new methods including extensive marine protected areas (MPAs) as a possible management tool (CDFG 2003 and CDFG 2004). One of the first tests of these concepts is a network of Marine Protected Areas (MPAs) in the northern Channel Islands in southern California that include eight State Marine Reserves (SMRs) where all take is prohibited (Figure 1).

Recognizing the need to develop a monitoring plan to assess the effect of these MPAs, DFG, the Channel Islands National Marine Sanctuary (CINMS) and National Oceanic Atmospheric Administration (NOAA) convened the Channel Islands MPA monitoring workshop in March 2003 (CDFG 2004). One of the priorities identified in the resulting Monitoring Plan was collection of baseline monitoring data in sites within and adjacent to the MPAs. The objective was to compare changes in abundance of species of concern in the MPA's to nearby fished "reference sites".

DFG identified a number of priority areas to be surveyed most of which have been mapped acoustically (John Ugoretz Personal Communication - Table 1). The United States Geological Survey (USGS) and California State University of Monterey Bay Seafloor Mapping Lab (CSUMB) have completed high-resolution acoustic maps in many of these areas (Guy Cochran unpublished, Rikk Kviteck unpublished). Sites off northern San Miguel Island were only recently surveyed by USGS and are in the process of being prepared for use (Guy Cochran unpublished).

The monitoring workshop proposed using visual survey methods for the monitoring, using divers in less than 20 m and ROVs and submersibles in deeper water. Recent advances in ROV technology and methods have produced monitoring protocols that are similar to SCUBA protocols with the advantage of producing archival video records with associated DGPS location that can be used for future comparisons (Veisze and Karpov 2002). SCUBA is known as an effective tool for monitoring abundance changes of finfish and invertebrates of management concern inside kelp areas where ROVs and submersibles cannot operate (Berry and Baxter 1993, Larson and DeMartini 1984, and Miller and Geibel 1973). Outside of the kelp canopy, ROVs and submersibles have the advantage of being able to survey much larger areas without the concern of time at depth that limits SCUBA surveys (Barry and Baxter 1993).

In order to conduct the ROV surveys, a partnership between the DFG, Marine Applied Research and Exploration (MARE), and CINMS was formed to combine

Table 1. Sites identified by DFG for monitoring, listed in order of priority and acoustic mapping status.

Priority	Site Name	Location	Mapping Status
1a	West Anacapa Island	Anacapa Isl.	USGS sidescan out to 100m multibeam deeper
1a	East Anacapa Island	Anacapa Isl.	USGS sidescan out to 100 m multibeam deeper
1b	Carrington Point SMR	Santa Rosa Isl.	CSUMB multibeam
1b	Rodes Reef- reference site	Santa Rosa Isl.	CSUMB multibeam
2a	South Point SMR	Santa Rosa Isl.	CSUMB multibeam
2a	W. of South Point (Cluster to Bee Rk.)*- ref site	Santa Rosa Isl.	CSUMB? multi beam
2b	Harris Point SMR	San Miguel Isl.	USGS Sidescan out to 100m, shallower than 20m not done
2b	Wilson Rock- reference site	San Miguel Isl.	USGS sidescan
3a	Gull Island SMR	Santa Cruz Isl.	CSUMB multibeam
3a	East Point- reference site	Santa Rosa Isl.	
3b	Foot print- between Anacapa Isl. & Santa Cruz Isl., pinnacles right on state waters' border (not paired)	Anacapa Isl.	USGS multibeam from 100 to 800 meters depth
3b	Scorpion SMR (little hard bottom)	Santa Cruz Isl.	USGS sidescan out to 100m, USGS or MBARI multibeam deeper
4	Richardson Rock SMR (difficult to work)	San Miguel Isl.	
5	Judith Rock & Miracle Mile	San Miguel Isl.	USGS sidescan out to 100 m
6	Santa Barbara SMR & Outside	Santa Barbara Isl.	CSUMB? multi beam

available resources. DFG provided the core ROV research team; MARE added technical assistance and the ability to garner additional fiscal support; and CINMS provided their 19 m catamaran, the *RV Shearwater*, as a research platform.

The goal of the partnership was to collect data that could be used to evaluate the effect of the newly-created State Marine Reserves (SMRs) on the abundance of finfish of management concern in hard bottom habitats in water depths between 20 to 80 m. Initially, the goal was to collect archival video that could be used as base line data and conduct exploratory surveys to locate study sites and to test final survey protocols. The ultimate goal was to conduct quantitative surveys that could be used to statistically evaluate changes in finfish abundance over time.

To meet these goals, we secured funding, planned and executed three research cruises. The first two cruises, completed in November 2003 and May 2004, included cooperative training in ROV and boat operations, refinements in ROV survey methods, and exploratory surveys. The objectives of the exploratory surveys were to: 1) visually verify habitats types as aids to using acoustic maps in selecting the best sites for quantitative surveys; 2) collect archival video with its associated DGPS position for finfish and invertebrates; and 3) count a subset of managed finfish for a preliminary evaluation of the range of abundances that might be encountered during a survey. The objective of the third cruise in September 2004 was to implement quantitative methods at two sites explored in the previous two surveys to begin testing the first priority question of MPA effectiveness in stock recovery; that is, to measure change in abundance. A report describing the field portion of the September survey has been completed by Karpov et al (2004), with a final report evaluating the results of the quantitative survey planned for the spring of 2005.

The purpose of this report is to describe the methods and results of our November 2003 and May 2004 exploratory surveys. Here we describe the results of the training, the extent of surveys we completed, the habitats we encountered, and suggest protocols for future exploratory and quantitative surveys.

Methods

Study Site and Track Line Selection

In November 2003 and May 2004, exploratory ROV surveys of reserve and reference sites were targeted at four of the northern Channel Islands: San Miguel, Santa Rosa, Santa Cruz, and Anacapa Islands (Figure 2). Based on expected topography from available acoustic maps (USGS and CUSUMB unpublished), we selected five State Marine Reserves, including Harris Point SMR, Carrington Point SMR, South Point SMR, Gull Island SMR, and Anacapa Island SMR on the four islands.

Study sites for exploratory surveys were selected by reviewing poster size enlargements of acoustic survey maps with shaded topography that appeared to contain rocky habitat. We selected potential site pairs, one in a SMR and one in nearby fished habitat to serve as a reference area. We selected sites with comparable habitat and depths, and, where possible, offshore of the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) study sites being surveyed by SCUBA divers (Figure 2). In general, sites were planned to be at least 500 m wide and to span a depth range of 20 to 80 m. In practice, the depth range was limited by the depth span of the SMR and extent of apparently hard habitat in the acoustic images.

With an ROV it is more efficient to use long transect lines relative to divers who can deploy short randomly-placed transects (Barry and Baxter 1993). For this reason, we developed a systematic random approach where we video a long track line and then randomly choose segments of the line for transects. At most sites, we used a zigzag pattern of straight lines (Figures 3 to 30). The zigzag pattern was designed to gradually move up slope, minimizing down-slope segments that are difficult to capture on forward video, while efficiently using dive time to sample a wide depth range. In steep-sloped or areas with narrow hard substrate, we used straight lines parallel to the depth contours rather than the zigzag pattern (Figure 3). Both the zigzag and parallel approach produce useable legs minimally 500 m in length. Stops for onboard sonar image capture were planned at the ends of these lines.

Operations

ROV operations were conducted off the *RV Shearwater,* a 19 m catamaran owned and operated by NOAA's Channel Islands National Marine Sanctuary (CINMS) program.

Training and system integration was planned for Nov 11 through the 14, the first week of the November survey. Our training consisted of integrating four separate teams (six ROV staff) in addition to the *RV Shearwater* captain and crew into a cohesive operational unit. The teams included a deck officer and assistant, a finfish taxonomist and data recorder, navigator and pilot, and vessel captains. The taxonomist data recorder worked next to the pilot and navigator, but independently at their own monitor and computer data station, while the other three teams were in constant communication by VHS radio. Key physical metadata needed for post-processing was communicated to the data recorder by the navigator. In addition, the navigator provided the ROV pilot with headings, VHS communication, metadata (video story board and digital records), and video recording needed to ensure quality archival video. The pilot maintained the ROV at the constant heading; target distance and width of the camera view, altitude, camera angle, and velocity needed to ensure quality virtual transect line. The deck officer directed launch and recovery of the ROV and tracking system, communicated with the bridge and navigator, while working with the assistant to adjust and record clump weight depths. The assistant ran the winch and the crane and assisted in umbilical operations and tracking system deployment.

Part of our training operation included developing printed protocols and checklists to insure critical operations were completed by our trainees without risking the operations (Appendix 1). While training was continuous, exploratory surveys were planned to begin at the end of the first week and to continue from November 19 to 29 and from May 13 to 18.

To test vessel operation, tracking and piloting skills acquired during both November and May, on the last day of field survey (May 17) we used all trained staff to replicate four track lines at the same site off Anacapa Island (AI 1). We conducted two consecutive dives, spanning five hours. To test consistency of operations, we switched among the four pilots and two vessel captains during and between each of the two dives. Post processing of habitat for both dives was also completed independently to examine consistency of spatial tracking and habitat classification by the postprocessors. Processing was completed independently by one of the co-authors and three staff trained by him to identify habitat types.

At each site, the ROV was flown along the pre-planned track targeting ± 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 (1/30th sec) and on an 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 targeted velocity of less than 1.0 m-per-second, using a 15 to 30 degree camera tilt angle. A thruster auto-trim helped the pilot maintain a constant velocity. Velocity was increased across long areas of pure sand.

At the end of each leg of the line, the ROV was landed for 10 or more seconds to capture an image with on-board Imagenex 855 ® scanning sonar that provides a clear color image of the surrounding elevated topography. These images were archived for comparison to mapped locations for future meta-analysis of spatial precision.

The ROV was flown off the vessel stern using a “live boat” technique that employed a 110 kg (220 lb) clump weight. With 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. Three herring floats were affixed to the 40 m of tether to help avoid snagging the umbilical in high relief areas.

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 red lasers spaced 110 mm apart. To achieve a transect width between 2 and 4 m, the pilot used the ranging sonar to maintain the distance from the camera to the substrate (at the screen horizontal mid point) between 1.5 to 3 m. Based on the camera field of view, transect width is computed as 1.3 times the ranging sonar distance.

In addition to the forward lasers, two pairs of downward facing lasers produce beams spaced 130 and 750 mm apart. During previous ROV research cruises, these lasers provided the only data we could use to estimate transect width. For this cruise we used the lasers to evaluate the new ranging sonar methodology.

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 and depth were checked before launch and after retrieval.

Counts of a selected subset of adult finfish including lingcod (*Ophiodon elongatus*), sheephead (*Semicossyphus pulcher*), ocean whitefish (*Caulolatilus princeps*), and rockfish (*Sebastes spp.*) were made in “real time”. The taxonomist counted the fish over the substrate when they reached a position at mid screen in the monitor, typically this would only include fish ≤ 1m over the bottom. Fish smaller then 110 mm (predominantly young of the year rockfish) were excluded from the counts. The forward paired laser was used as a reference to estimate the size of the fish. The data recorder entered the counts in the one second file (Veisze and Karpov 2002) using a keypad preprogrammed with species names.

After the survey, data was post processed. Positional information in the form of XY metric coordinates was filtered for outliers and smoothed using a 21 point running mean (Whittaker and Robinson 1967). The distance formula was used to calculate planer tracked distance per second that was then combined with width to calculate tracked area per second.

The video record was reviewed for habitat that was classified independently as rock, sand, or boulder. Substrates classification was simplified from Green et al (1999). Rock was defined as any igneous, metamorphic, or sedimentary substrate; boulders as rounded rock material that is between 0.25 and 3.0 m in diameter and clearly detached from the base substrate; and sand as any granular material with a diameter less than 6 cm (may include mud, organic debris such as shell or bone, gravel, or pebble). Cobble (6 to 25 cm was not included in our analysis. Each of the substrate types were recorded as discrete segments with a beginning and ending GPS time code. During the viewing, a substrate layer was considered continuous until a break of 2 m or greater occurred. Following processing to determine the proportion of sand only substrate, the three habitat types were combined as either purely rock, mixed (rock or boulder and sand), or sand only.

The rock only, mixed, and pure sand categories added to 100 percent. Since boulder was seldom found alone but invariably occurred either over rock, sand, or both the habitat was classified “with” boulder as a separate percentage.

Results

Training added three pilots, a navigator, a deck officer, a taxonomist and two boat captains to the list of personnel qualified to participate in ROV live boating methods. Checklists were generated for each of the key team member roles, including ROV pilot, navigator, and deck officer (Appendix 1).

During November 2003 and May 2004, 14 sites were sampled at three of four targeted State Marine Reserves (SMR) and adjacent reference sites (Figure 2, Appendix 2). We sampled three SMRs: Carrington Point, South Point, and Anacapa Island. Carrington Point SMR included two sites (SRI 1 and 2). Rodes Reef (SRI 3), four km to the west (Figure 2), is a potential reference site for SRI 1 and 2. Five sites were sampled in association with Gull Island SMR, including two sites in the reserve (SCI 1 and 2); two sites to the south-west on Santa Cruz Island (Bowen Point SCI 3 and south-central SCI 4); and a third potential reference site on south-east Santa Rosa Island (SRI 6).

During both November and May, adverse weather precluded sampling sites off Harris Point SMR on San Miguel Island and limited sampling associated with South Point SMR, Santa Rosa Island, to two small sites, one in the reserve (SRI 4) and the other off Cluster Point (SRI 5), west of South Point SMR (Figure 2). Hard bottom habitat at both these sites was limited in depth range and there was inshore kelp that risked entangling the ROV. The South Point SMR (SRI 5) line 2 was aborted due to extreme tidal currents that placed the ROV at risk. The ROV velocity at this site ranged from 0.2 m to 0.8 m per sec, the widest range encountered, as the ROV flew against and with the current (Appendix 3).

During the 17 days of cruise time in November and May, we completed 39.5 km of ROV track line, producing 26.4 hours of high quality ROV tracking video. Eight of the 17 days were required for non-sampling activities, including set up and system calibrations (3 days), training (2), adverse weather (1), and demobilization (2). During the nine remaining days of actual field sampling, we averaged 4.4 km of track line per day. The average distance sampled per field day increased from 3.7 in November to 5.2 during May (Table 2). Archival high density digital video tapes have been reproduced and stored at two CDFG sites.

On the last sampling day of the May cruise (May 17) we succeeded in repeating three of four tracked lines off the north west Anacapa Island site AI 1 (Table 2, Figures 3 and 4). Just ten minutes (20:08 GMT) into the fourth line of our second dive the ROV compass failed, forcing us to abort before completing the last line of the second dive (Appendix 3). The three replicated lines provide additional data to evaluate our piloting.

Table 2. Site codes times with ROV track length, average velocity, depth, and distance tracked per day in November 2003 and May 2004 compared to the September 2004 survey.

				ROV	Track Average			
Site	Date	Start Time (GMT)	End	Velocity (m / sec.)	Depth (m)	Width (m)	Length (km)	km / Day
SRI 1	11/14/03	16:00	17:59	0.4	36.3	2.6	2.4	
SRI 3	11/14/03	19:00	20:25	0.5	31.3	3.0	2.3	4.6
SCI 1	11/20/03	23:10	18:43	0.5	48.4	2.9	4.3	
SCI 2	11/20/03	18:01	22:02	0.4	51.2	3.9	4.3	8.7
SCI 3	11/21/03	20:28	21:17	0.8	29.9	3.7	1.7	
SRI 4	11/23/03	0:15	0:35	0.5	26.9	6.1	0.6	
SRI 5	11/23/03	22:37	23:28	0.5	25.1	4.3	0.8	1.4
SRI 2	11/24/03	15:40	16:48	0.6	29.1	3.5	2.1	
AI 2	5/14/04	19:57	21:52	0.4	29.3	2.9	2.9	
AI 3	5/14/04	22:33	18:00	0.4	41.5	3.0	2.8	5.7
AI 4	5/15/04	14:58	16:58	0.5	42.5	3.1	2.7	
SRI 6	5/15/04	20:22	22:39	0.5	28.9	3.4	3.9	6.6
SCI 4	5/16/04	18:27	19:57	0.5	37.9	2.9	2.8	
AI 1(a)	5/17/04	15:13	17:26	0.5	36.8	3.3	3.1	
AI 1(b)*	5/17/04	17:59	20:09	0.5	38.6	3.3	2.8	5.9
	Nov. 2003			0.5	34.8	3.7	18.5	3.7
	May 2004			0.5	36.5	3.2	21.0	5.2
	Combined			0.5	34.5	3.4	39.5	4.4
	Sept. 2004						57	6.3

* Does not include all four lines as in dive AI 1(a). Line four was only partially completed on dive (b) at site AI 1.

Average velocity, depth, transect width and length for the three lines was similar for the two dives (Table 3). The linearity of tracking is visually apparent over the three repeated lines in reference to the ± 10 m planned track boundary (Figure 3). On three occasions the ROV was pulled off bottom (purple lines) with two of these on line 2 during the first dive, resulting in severe deviation from the planned track.
A line by line comparison showed that track velocity was almost double on line 2 compared to both lines 1 and 3 that were run against a current.

Table 3. Comparison of tracking parameters for replicated lines off Anacapa Island Anacapa Island on May 17.

Site	Line	Dive	Date	Begin. Time (GMT)	Ending	Velocity (m/s)	Depth (m)	Width (m)	Length (m)
AI 1A	1A	241	5/17	15:13	15:55	0.3	47.8	3.2	876
	2A			16:04	16:25	0.7	41.2	3.2	863
	3A			16:29	17:01	0.4	35.3	3.3	780
	1A-3A			15:13	17:01	0.5	41.4	3.2	2,519
AI 1B	1B	242	5/17	17:59	18:38	0.3	47.2	3.1	825
	2B			18:43	19:02	0.7	43.3	3.8	816
	3B			19:17	19:51	0.4	35.4	3.1	797
	1B-3B			17:59	19:51	0.5	41.9	3.3	2,438

The relative proportion of four habitat types averaged over the three lines was almost identical, deviating less than 1 percent (Table 4). Similar habitat types were found at essentially the same locations (Figure 3a and b). Approximately the same number and species of fish species were seen on the lines, although there were more rockfish in the first than on the second pass of line 1 (52 vs. 12 fish).
The habitat types at the sites we sampled are shown in Table 5. At Anacapa Island, sites ranged from 49 to 74 percent sand only. The relative amount of rock only was greatest on the Anacapa Island SMR site AI 2 with18 percent. Only one Anacapa site (AI 4) had a large boulder field.

On south Santa Cruz Island, sand only habitat ranged from 67 percent at Bowen Point (SCI 3) to 87 percent at Gull Island SMR (SCI 1). Rock only was less than 10% and Bowen Pt did not have rock only habitat.

The six sites off Santa Rosa Island varied considerably by proportion of habitat. Sand only habitat ranged from ten percent at SRI 2 to 72 percent at SRI 6. Three sites had 36 to 47% rock only habitat, while three sites had less than 6% rock only habitat. South-east Santa Rosa Island (SRI 6) was lacking rock only habitat. At Carrington Point SMR (SRI 2) boulders were observed over rock only habitat (Figure 21, Table 5).

Table 4. Comparison of habitat and number of fish between replicated lines off Anacapa Island on May 17.

Site	Line	Rock only	Mixed	Sand only	w/ Boulder	Ling	Ocn. Whtfsh.	Sheep-head	rock-fish
AI 1A	1A	10.9%	22.2%	66.8%	0.0%	1	2	3	52
	2A	0.3%	10.7%	89.0%	4.8%				2
	3A	2.6%	32.2%	65.3%	0.0%	1		1	5
	1A-3A	4.6%	21.7%	73.7%	1.6%	2	2	4	59
AI 1B	1B	7.5%	28.2%	64.3%	0.0%	1	2	2	12
	2B	0.0%	11.4%	88.6%	4.7%	4			3
	3B	7.7%	25.4%	67.0%	0.5%	1		2	4
	1B-3B	5.1%	21.7%	73.3%	1.7%	6	2	4	19

Table 5. Percentage of rock only, mixed, sand only and with boulder at the sites sampled on Anacapa, Santa Cruz and Santa Rosa Islands

Site Description	Site Code	Percentage Rock only	Mixed	Sand only	With Boulder
Anacapa Island (AI)					
north - west AI	AI 1(a)	10	32	59	2
	AI 1(b)*	14	20	66	1
AI SMR	AI 2	18	33	49	2
AI SMR	AI 3	10	40	50	5
south east AI	AI 4	10	28	62	14
Santa Cruz Island (SCI)					
Gull Is. SMR	SCI 1	5	8	87	0
Gull Isl. SMR	SCI 2	8	28	64	0
Bowen Pt.	SCI 3	0	34	67	0
s. central SCI	SCI 4	6	19	75	0
Santa Rosa Island (SRI)					
Car. Pt. SMR	SRI 1	4	54	42	0
Car. Pt. SMR	SRI 2	36	55	10	12
Rodes Reef SRI	SRI 3	6	54	41	1
South Pt. SMR	SRI 4	42	27	31	0
Cluster Pt. SRI	SRI 5	47	41	13	2
s. east SRI	SRI 6	0	28	72	0
	All	13	32	55	3

* Does not include all four lines as in dive AI 1(a). Line four was only partially completed on dive (b) at site AI 1.

Discussion

The increase between November and May in the amount of transect sampled (Table 2) indicates that training was successful. In addition, when we repeated sampling of lines on Anacapa Island, ROV velocity and other sampling parameters as well as the amount and location of habitats were consistent, indicating that tracking and post processing were consistent. By the end of the cruise, the crew were working as a team and, with cross training, we were able to use people interchangeably.

The zigzag exploratory survey pattern was useful in sampling large areas that had been previously mapped acoustically but is, perhaps, poorly suited to determine the relative proportion of habitat types. Two factors contributed to this problem, including the patchy distribution of hard substrates among predominantly sanded areas and lack of spatial accuracy of side-scan acoustic maps. At almost all of our sites we observed either small or large islands of rocky areas surrounded by sand only habitat. When we used side-scan maps with potential errors of 20 or more meters and a widely-spaced zigzag pattern, we were likely to miss hard-bottom patches. Multi-beam maps with spatial accuracy of ± 5 m will provide better data. In addition, in future quantitative abundance surveys we will use more intensive sampling covering 12 km of transect per site where lines are distributed randomly parallel to the depth contour (Karpov et al 2004). Such survey will provide a more precise estimate of actual habitat at a sampled site.

The data from this cruise has already been useful. Preliminary results were used to select primary and secondary sites for quantitative sampling in September 2004 (Karpov et al. 2004). Acoustic mapping and the proportion of hard or mixed substrate were used to determine the location and amount of habitat needed to provide sufficient samples to statistically detect changes in finfish populations.

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May 12-18, 2004

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Sarah Fangman	Channel Islands National Marine Sanctuary, NOAA
Emma Hickerson	Flower Gardens National Marine Sanctuary, NOAA
David Jeffery	Deep Ocean Engineering
Shane Anderson	University of Santa Barbara
Eric Hessell	University of Santa Barbara
Dan Adams	Santa Barbara City College
Dan Howard	Cordell Bank National Marine Sanctuary
Michael Carver	Cordell Bank National Marine Sanctuary

Guests:

Dr. Mary Bergen	Senior Environmental Specialist IV – CDFG; Nearshore Fishes Research Mandate Coordinator
Mike Chrisman	Secretary, California Resources Agency
John Ugoretz	Senior Biologist - CDFG
Anne Canwright	Freelance writer
Chuck Cook	The Nature Conservancy
Debbie Drake	The Nature Conservancy
Lotus Veremer	The Nature Conservancy

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- Dan Howard of the Cordell Bank National Marine Sanctuary for providing equipment.
- Dan Vasey of Santa Barbara City College for providing equipment and technical support.

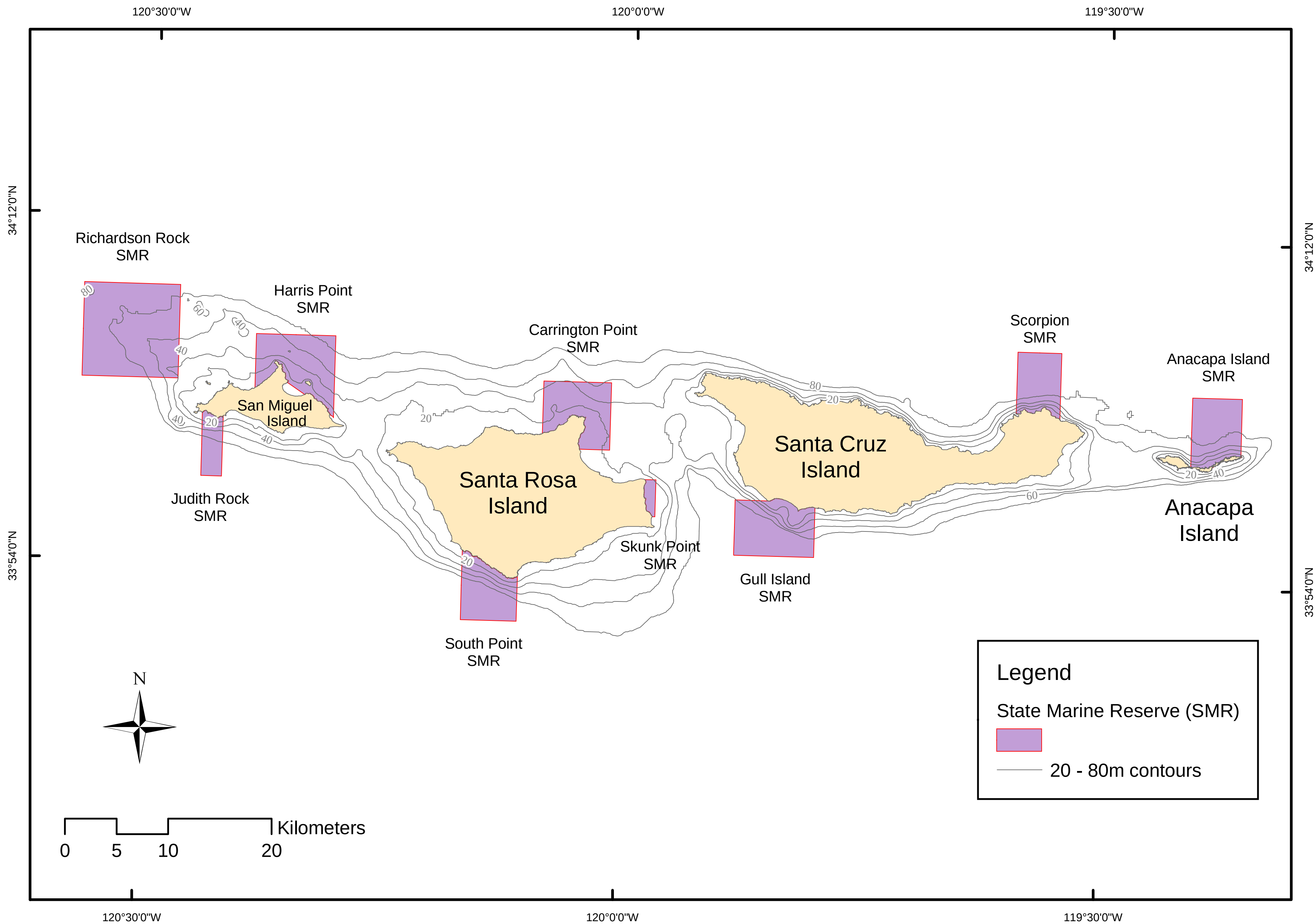

Figure 1. Northern Channel Islands with the State Marine Reserves (SMRs) and adjacent areas considered for exploratory ROV survey.

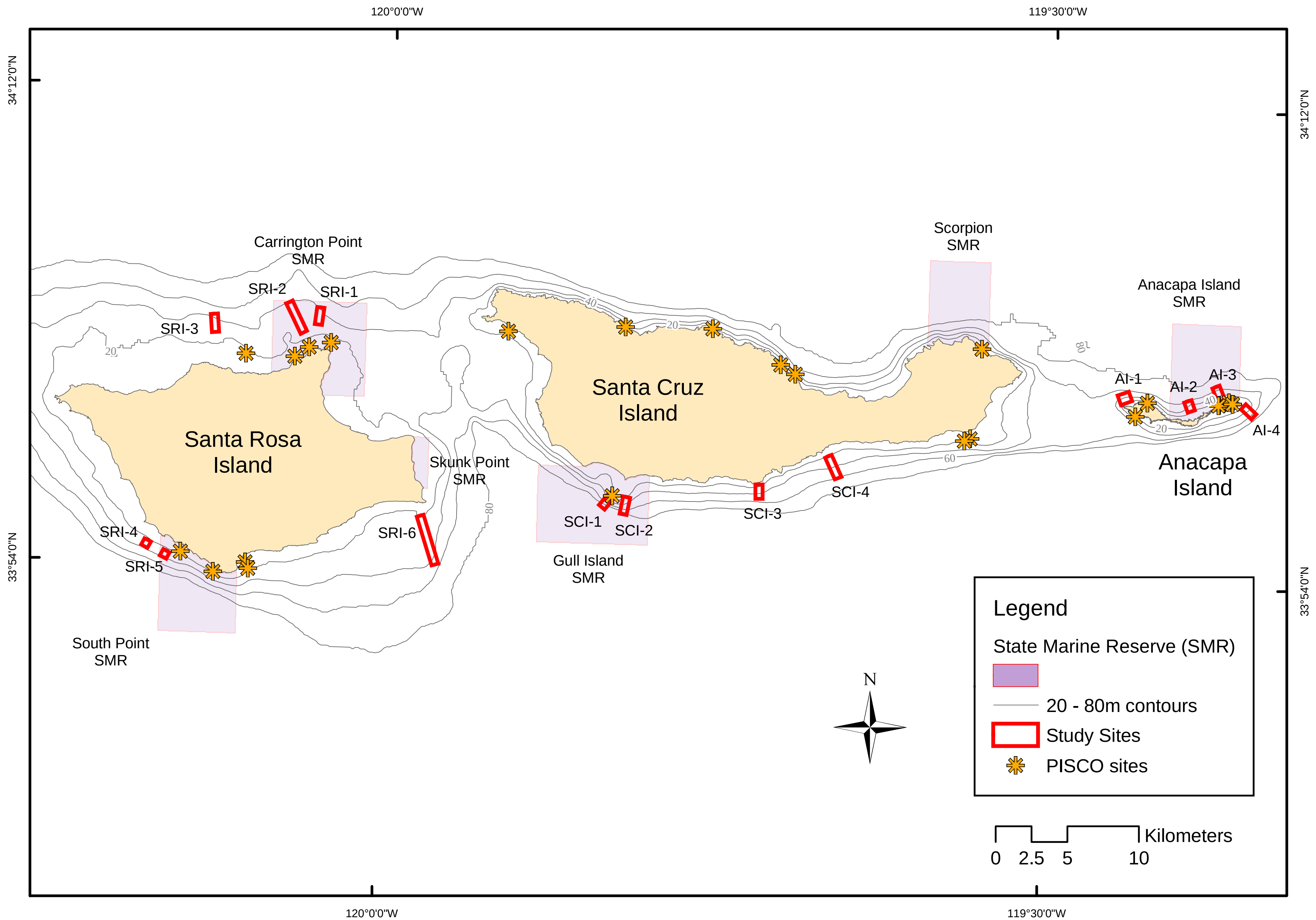

Figure 2. Location of all 14 sites surveyed during the November 2003 and May 2004 exploratory surveys relative to the five SMR off Anacapa, Santa Cruz, and Santa Rosa Islands with location of PISCO SCUBA survey sites.

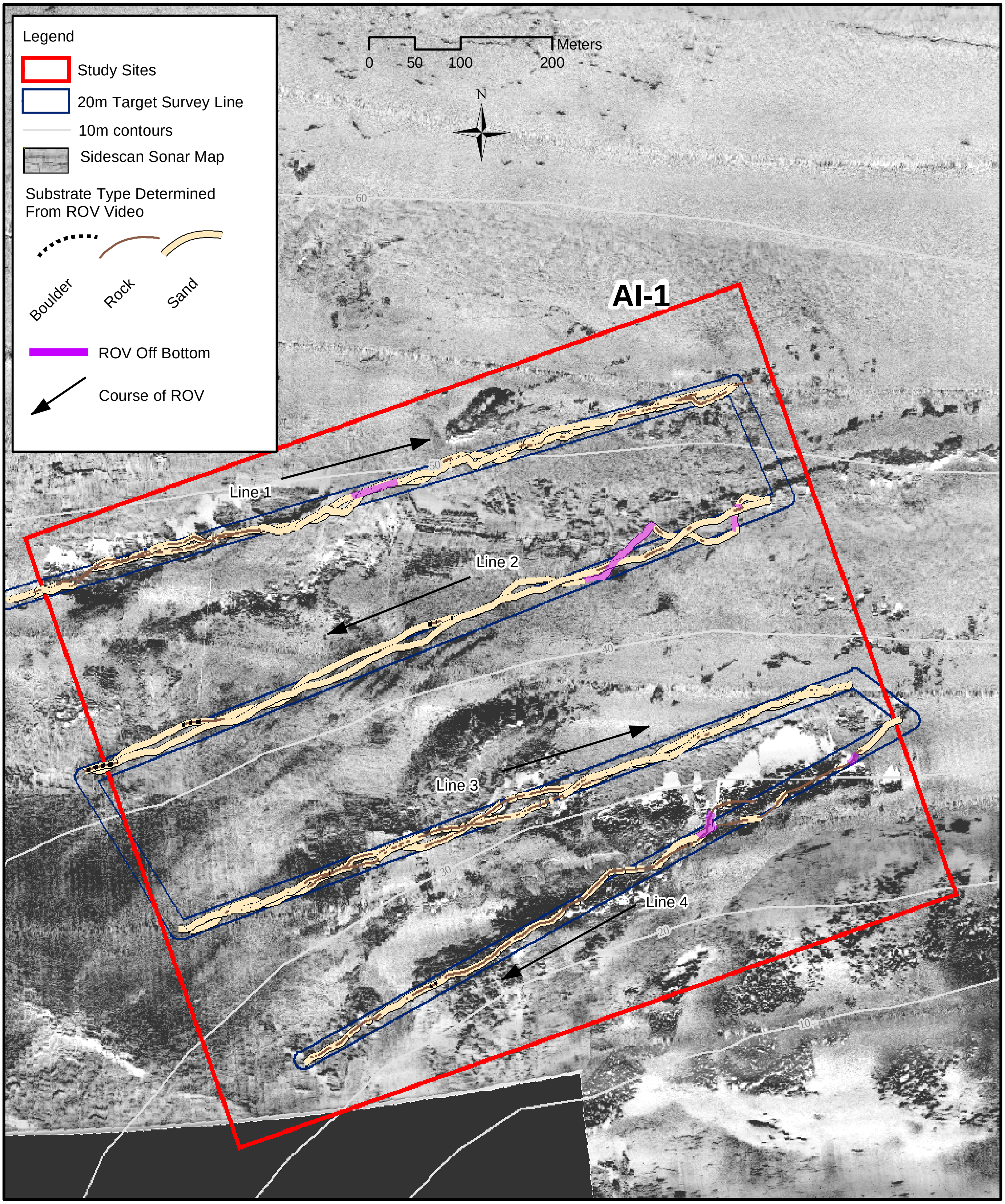

Figure 3. Habitats observed during two separate dives off north-west Anacapa Island site AI 1 (a) and (b) on May 17, 2004 over shaded relief side scan sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder. The sand layer is wider then the other two habitat layers to allow distinguishing sand only and rock only from areas of mixed habitat.

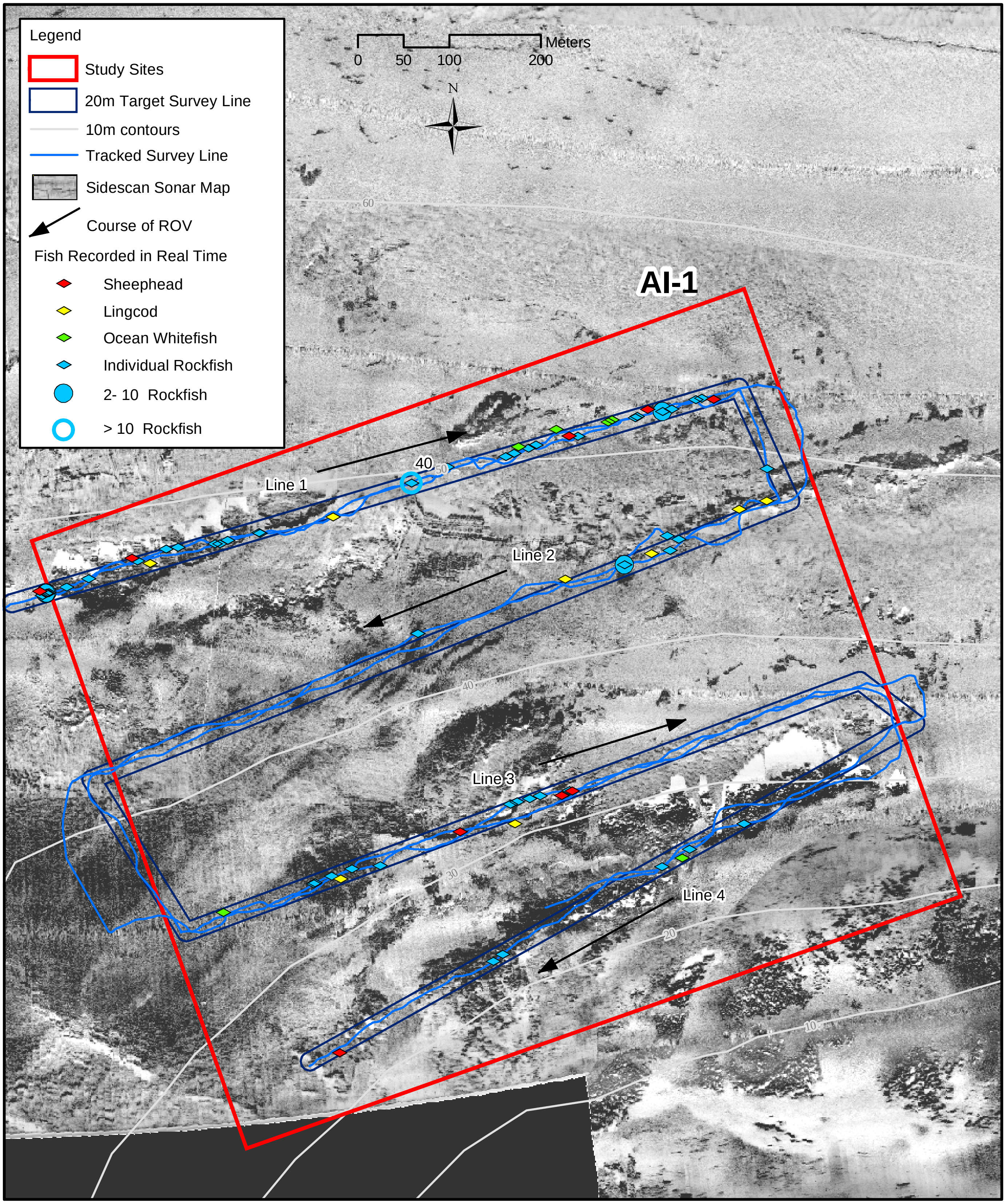

Figure 4. Location of selected fish taxa during two separate dives off north west Anacapa Island site AI 1 (a) and (b) on May 17, 2004 over shaded relief side scan sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track lines actually flown.

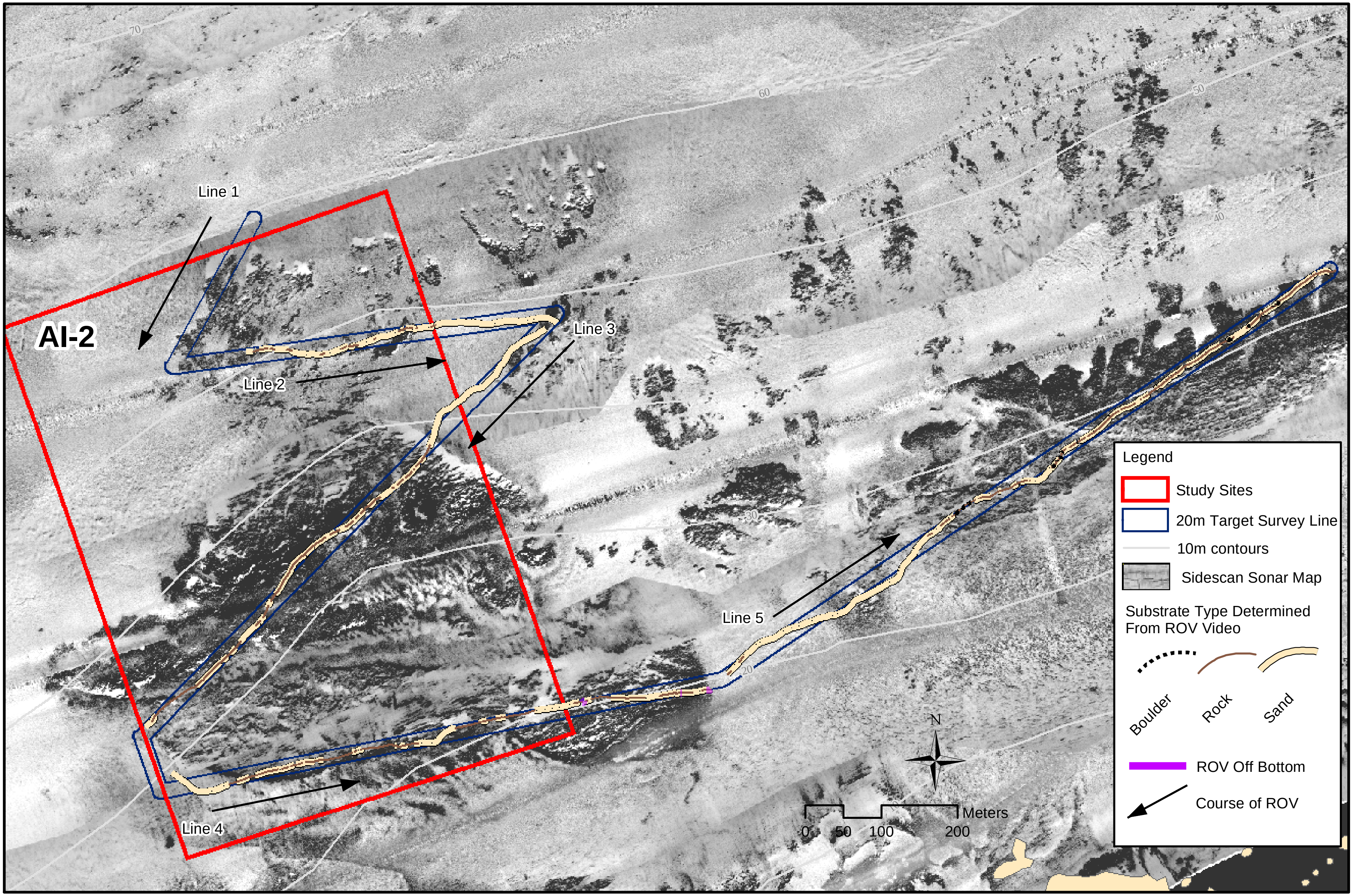

Figure 5. Habitats observed during a dive off Anacapa Island SMR site AI 2 on May 14, 2004 over shaded relief side scan sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

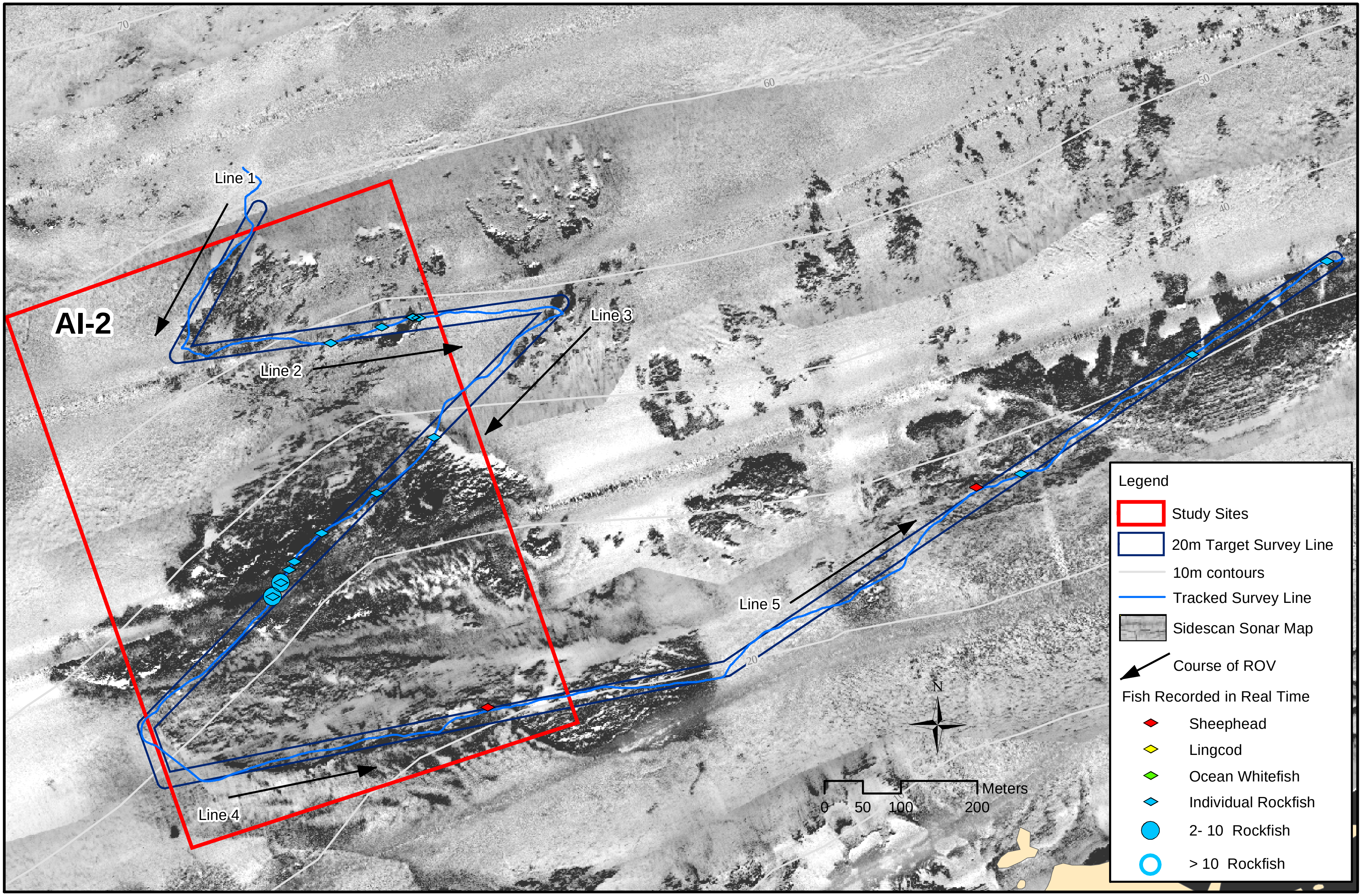

Figure 6. Location of selected fish taxa during a dive off Anacapa Island SMR site AI 2 on May 14, 2004 over shaded relief side scan sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

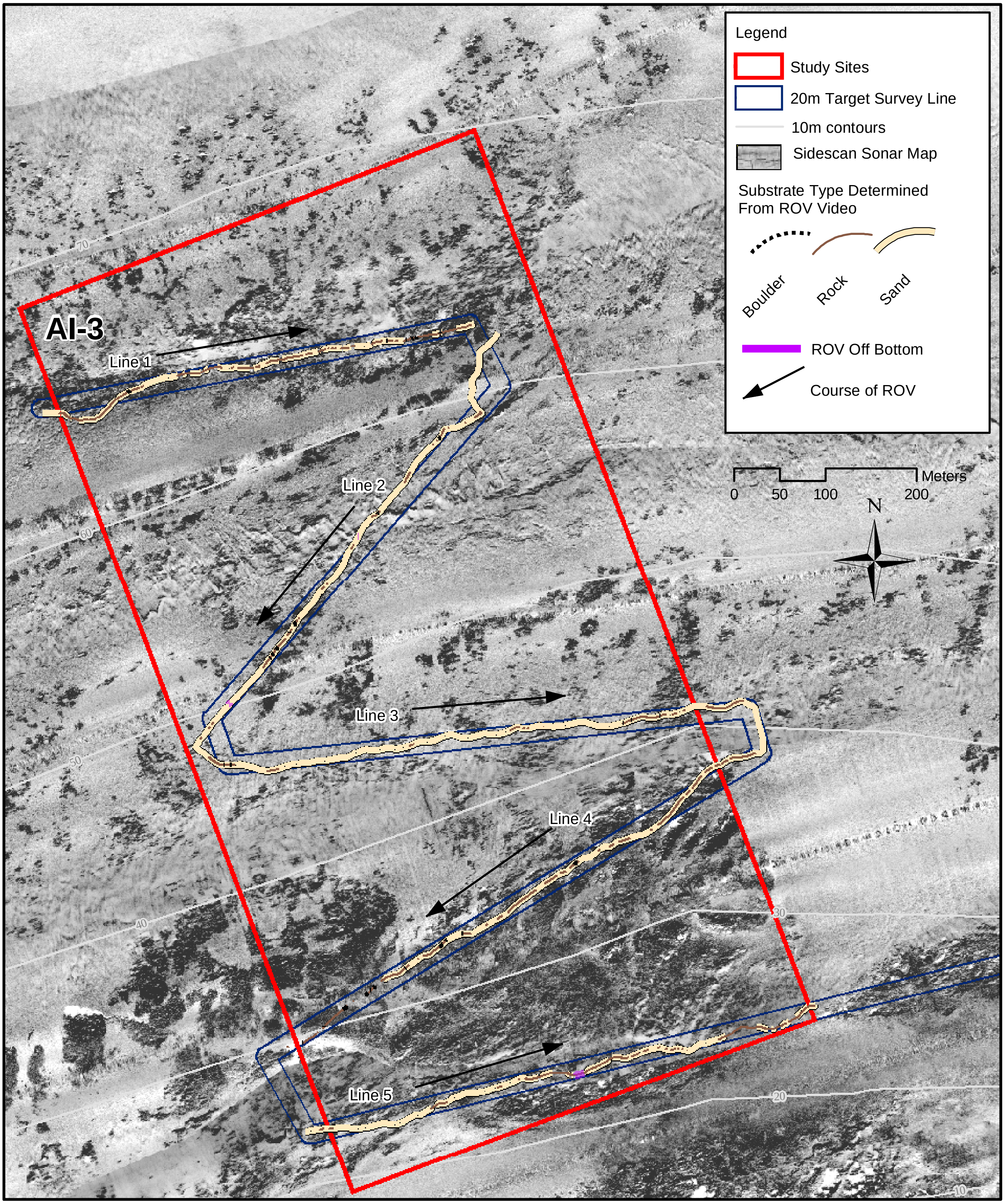

Figure 7. Habitats observed during a dive off Anacapa Island SMR site AI 3 on May 14, 2004 over shaded relief side scan sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

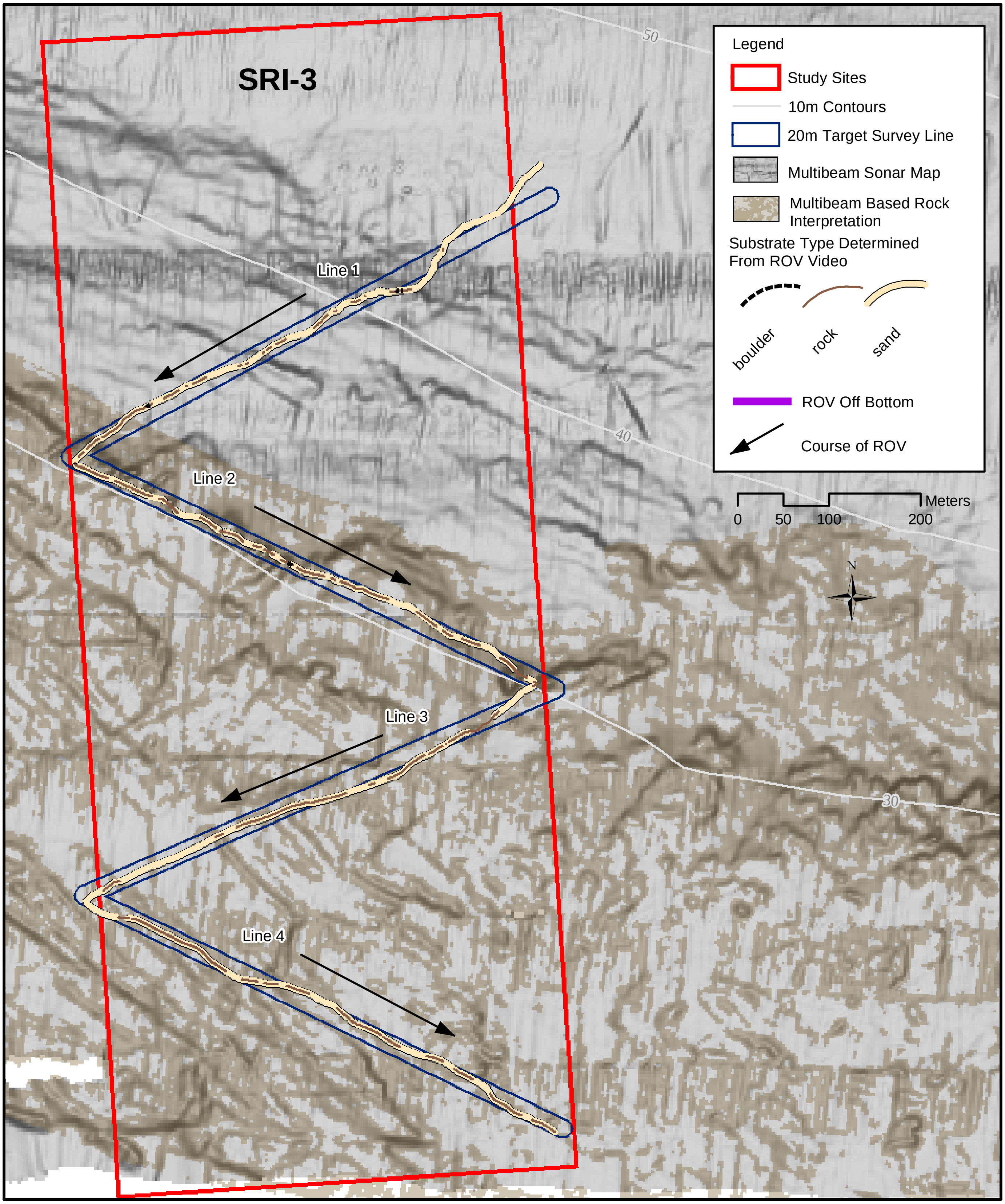

Figure 23. Habitats observed during a dive off Rodes Reef Santa Rosa Island site SRI 3 on November 14, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

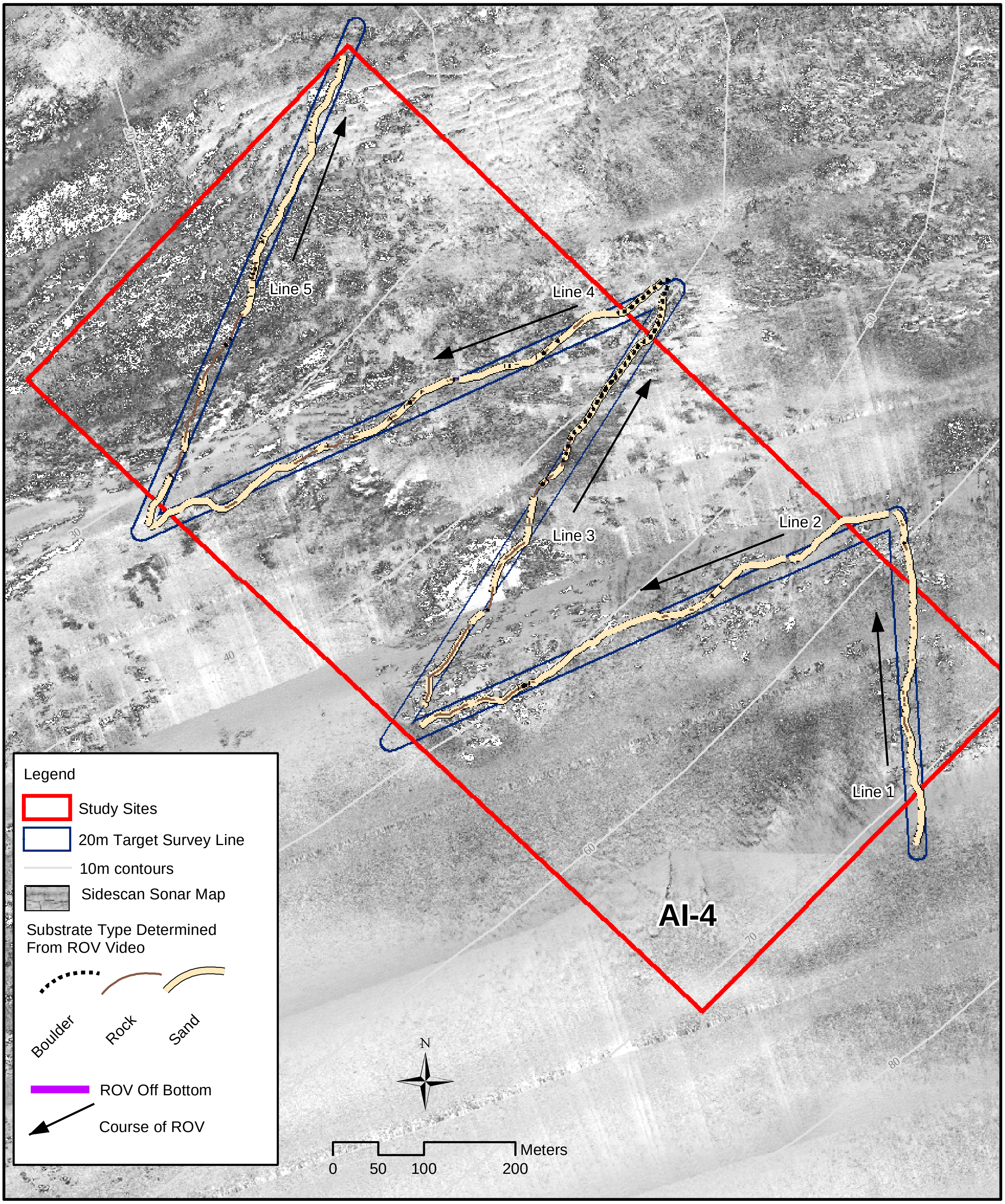

Figure 9. Habitats observed during a dive off south-east Anacapa Island site AI 4 on May 15, 2004 over shaded relief side scan sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

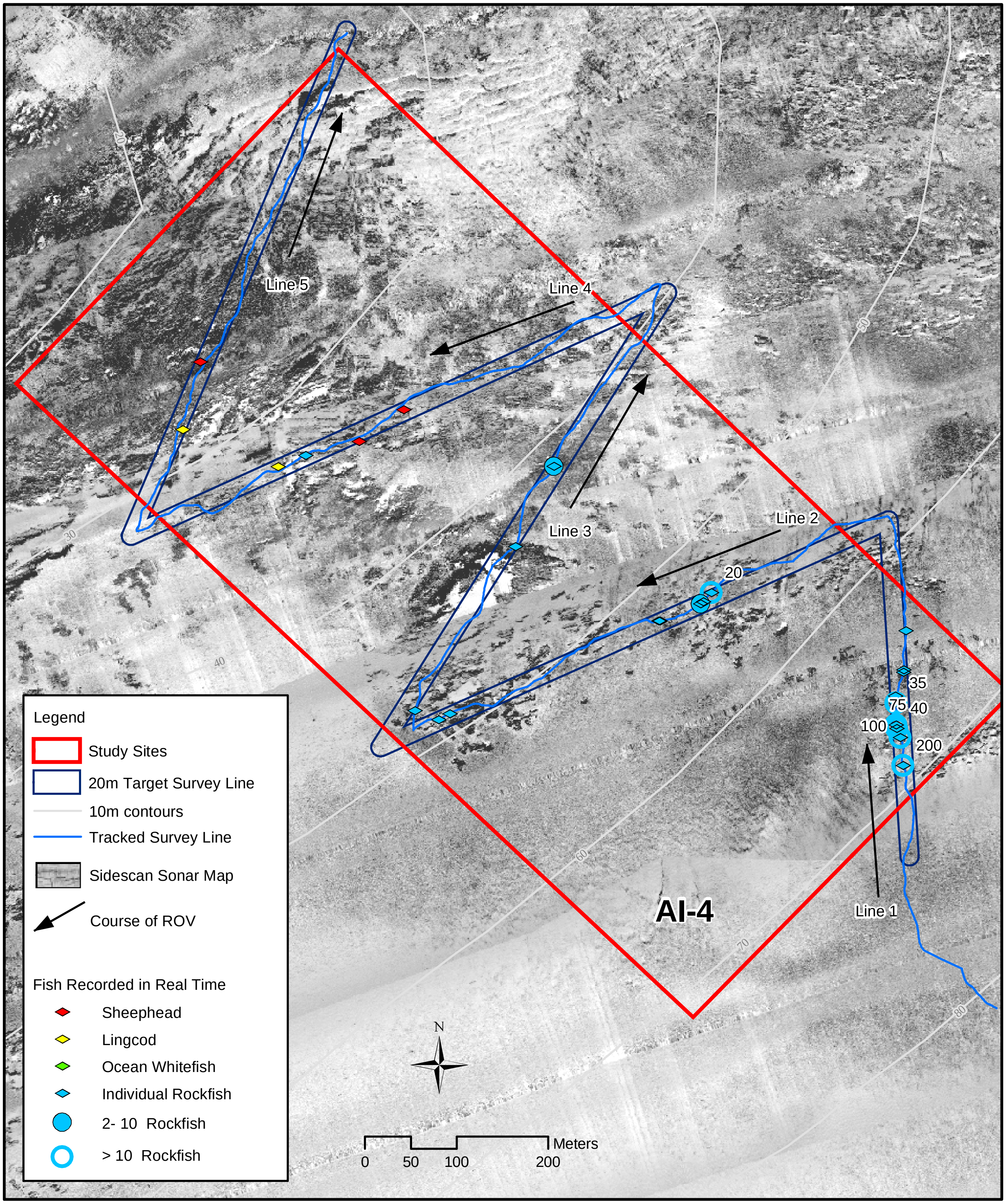

Figure 10. Location of selected fish taxa during a dive off south-east Anacapa Island site AI 4 on May 15, 2004 over shaded relief side scan sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

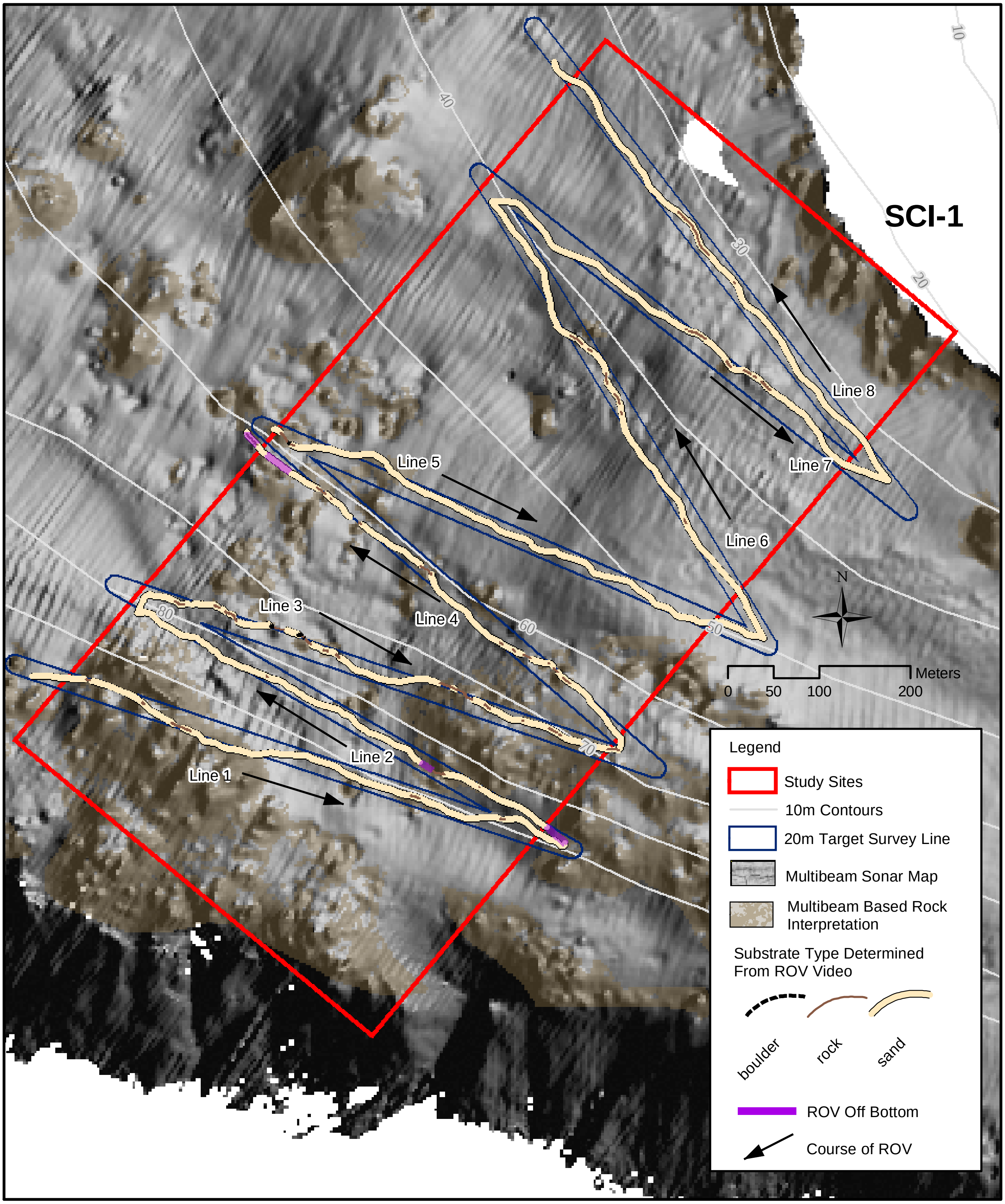

Figure 11. Habitats observed during a dive off the Gull Island SMR Santa Cruz Island site SCI 1 on November 20, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

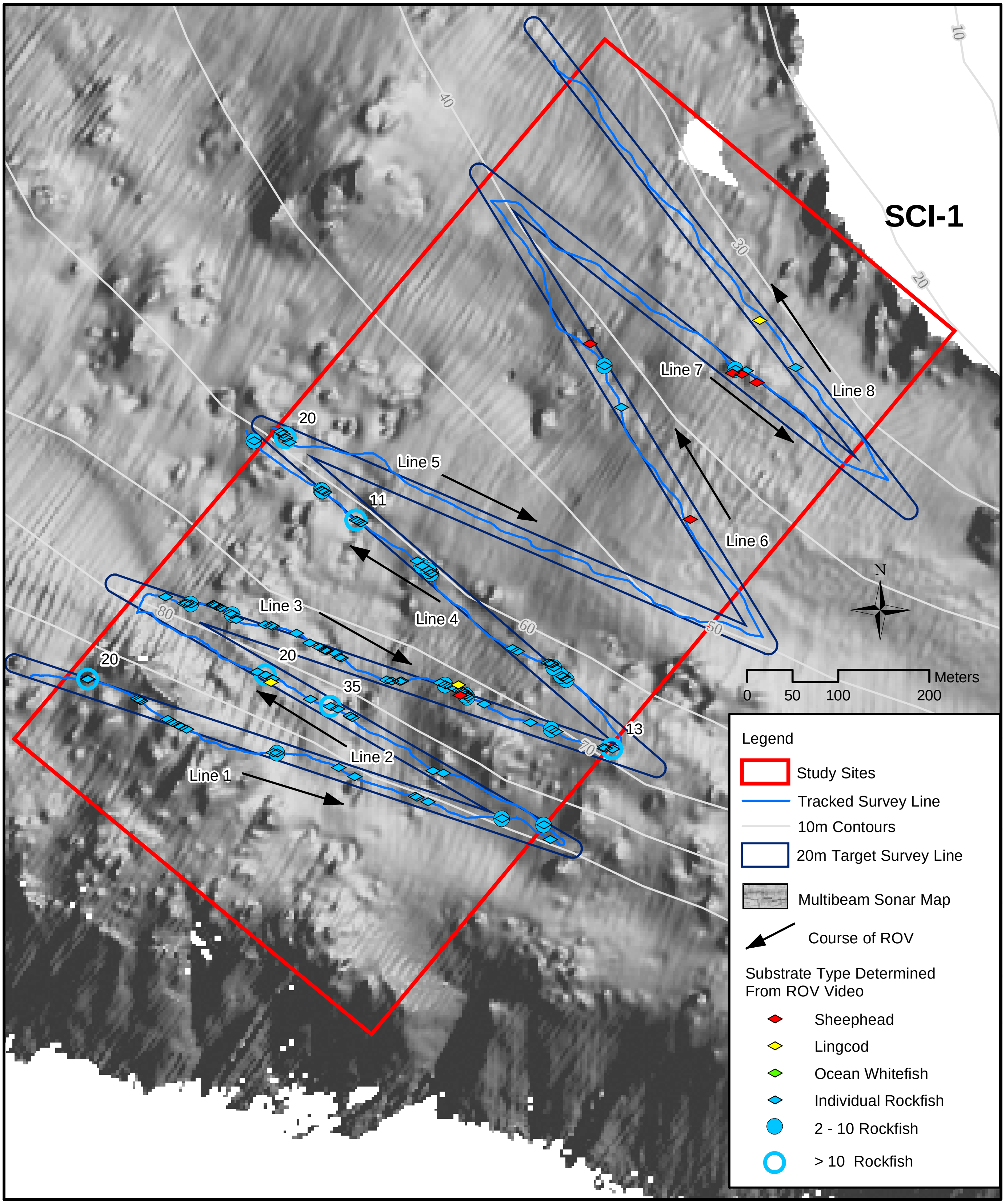

Figure 12. Location of selected fish taxa during a dive off the Gull Island SMR Santa Cruz Island site SCI 1 on November 20, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

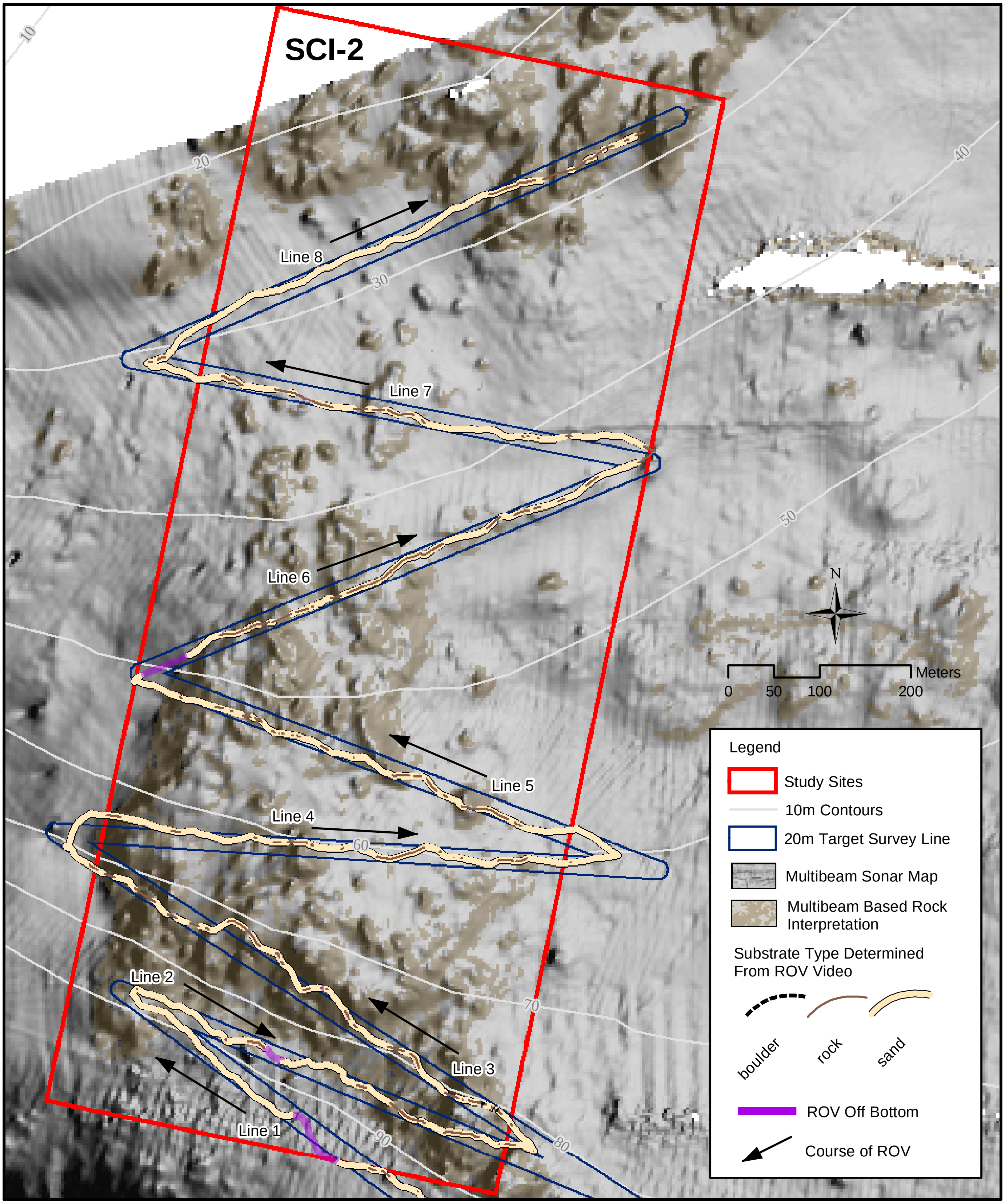

Figure 13. Habitats observed during a dive off the Gull Island SMR Santa Cruz Island site SCI 2 on November 20, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

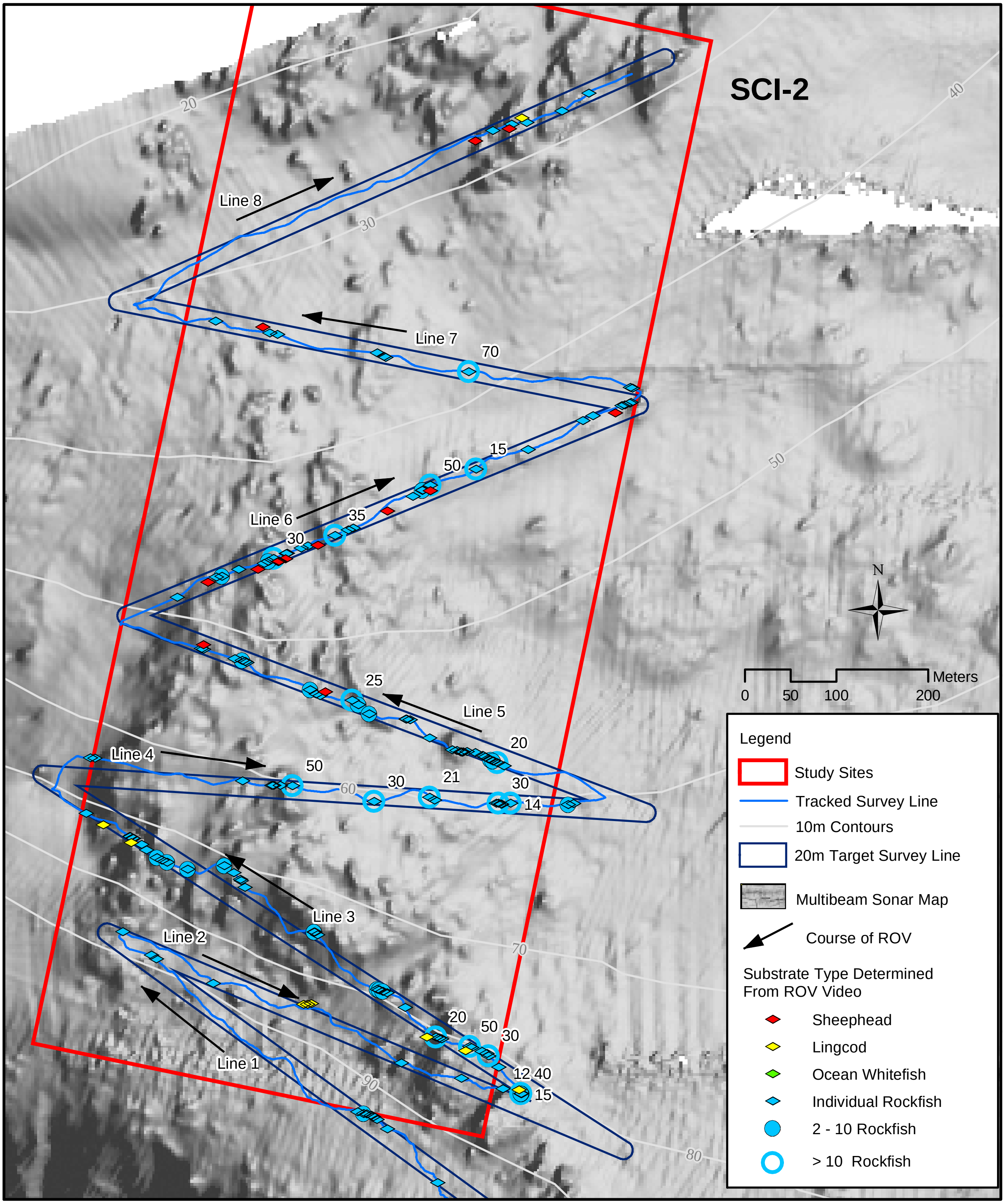

Figure 14. Location of selected fish taxa during a dive off the Gull Island SMR Santa Cruz Island site SCI 2 on November 20, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

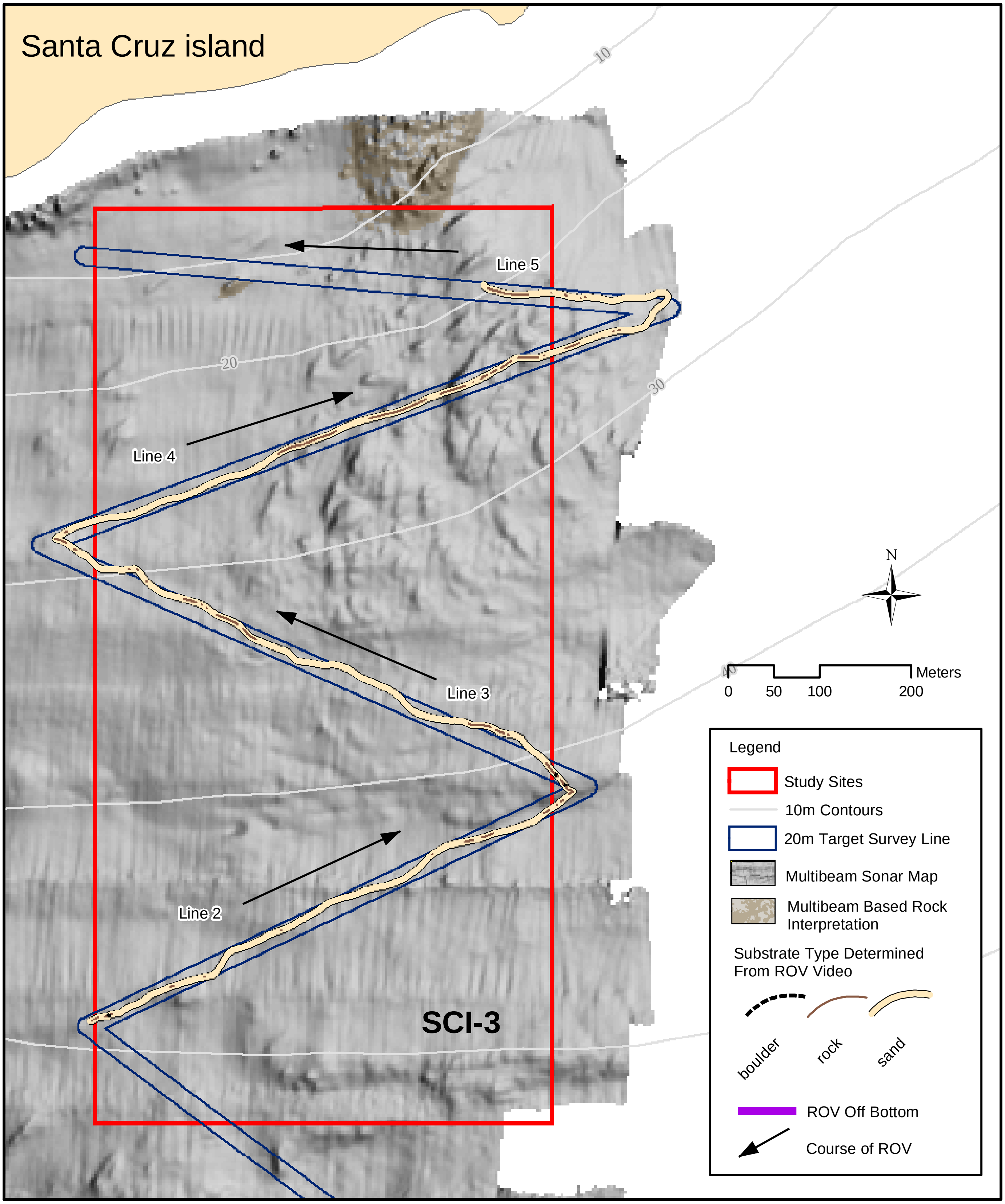

Figure 15. Habitats observed during a dive off the Bowen Point Santa Cruz Island site SCI 3 on November 21, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

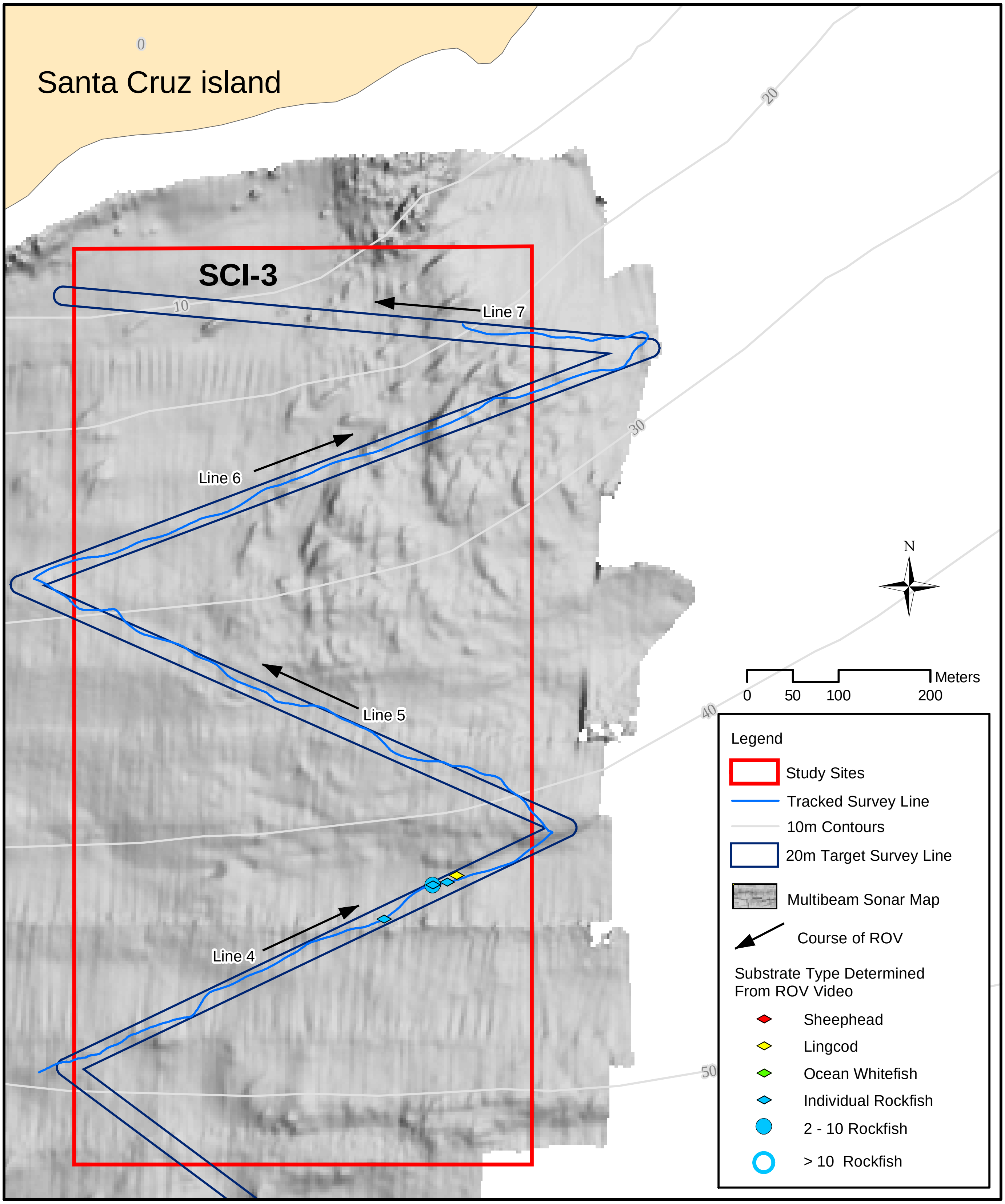

Figure 16. Location of selected fish taxa during a dive off the Bowen Point Santa Cruz Island site SCI 3 on November 21, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

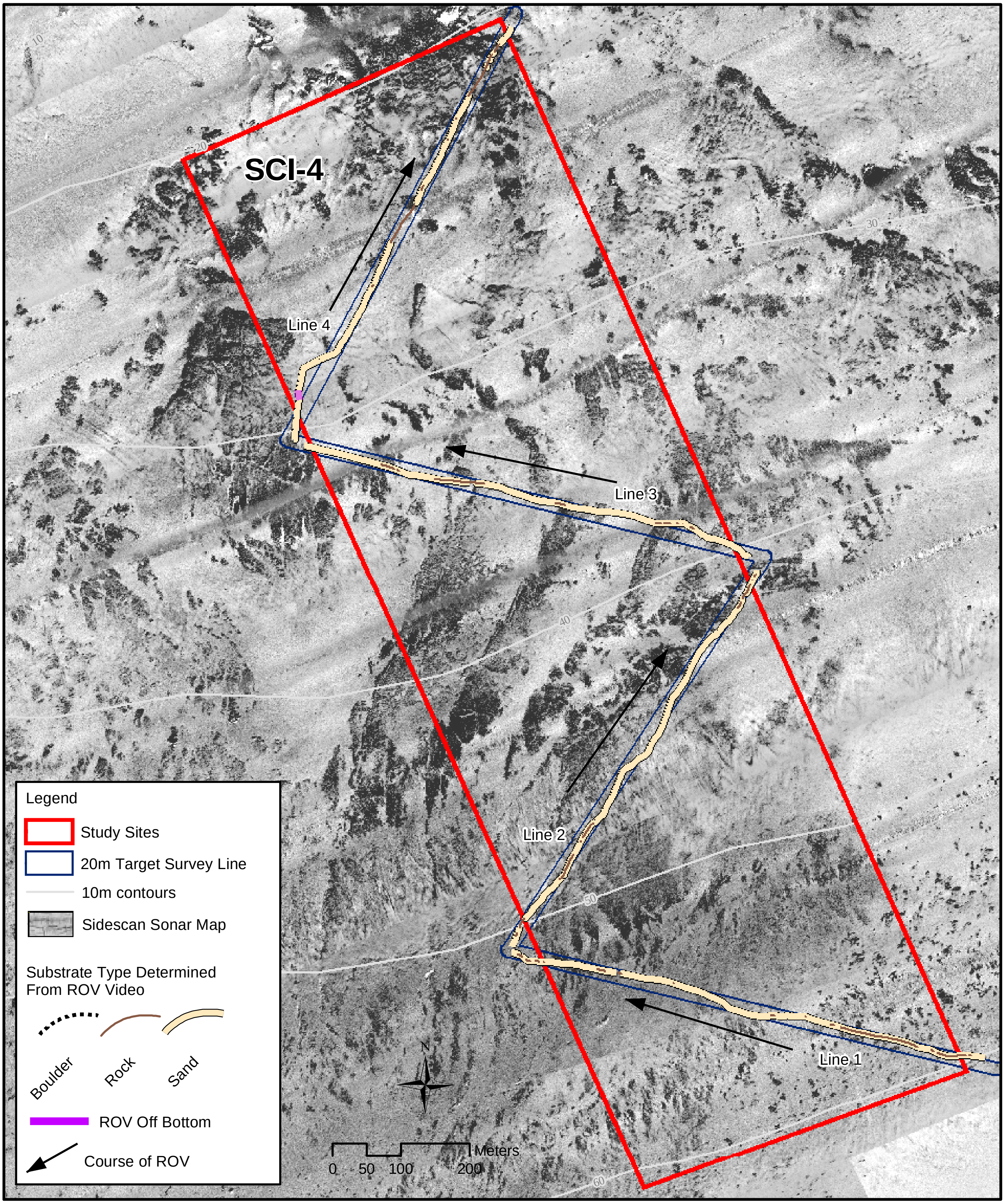

Figure 17. Habitats observed during a dive off south-central Santa Cruz Island site SCI 4 on May 16, 2004 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

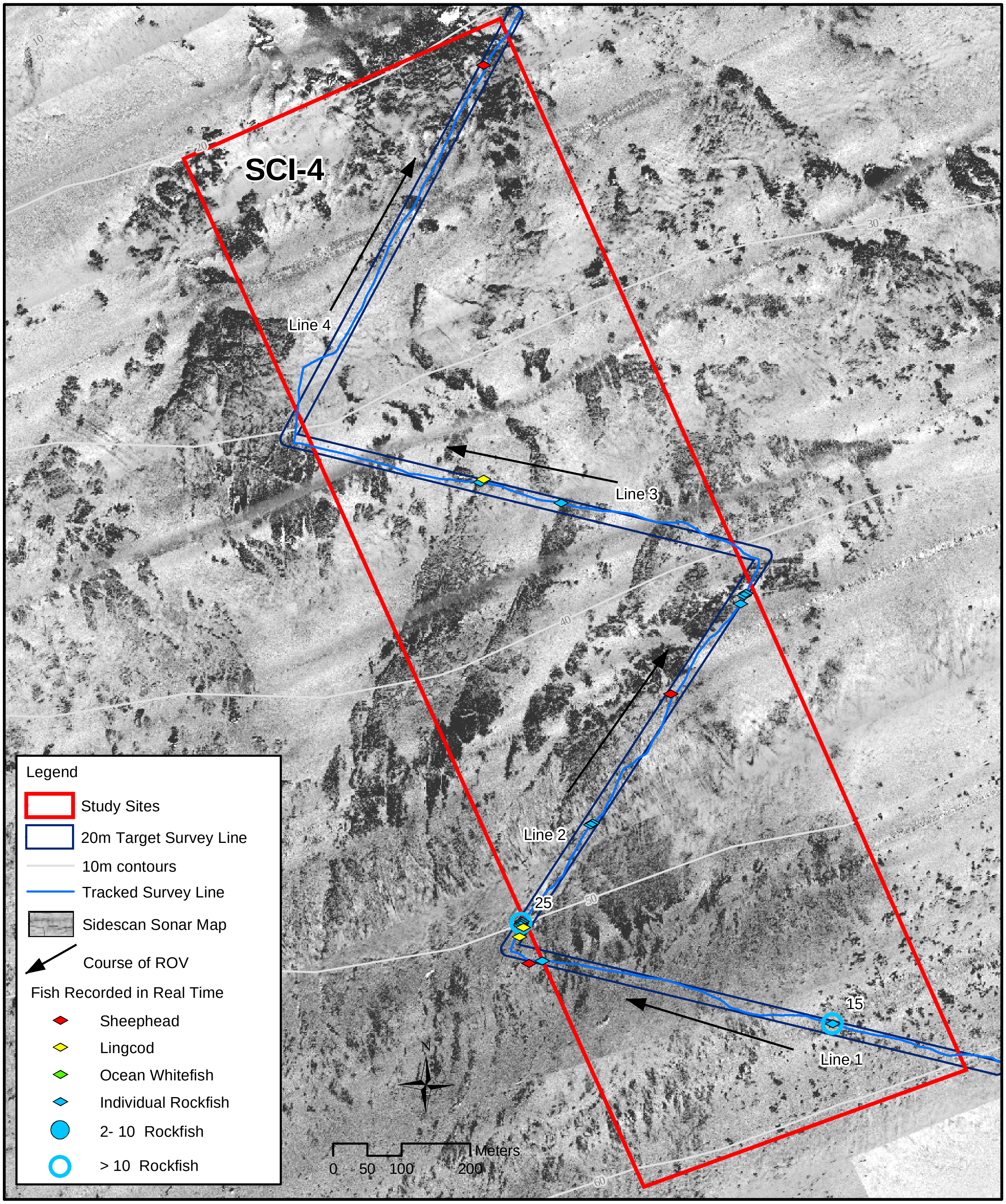

Figure 18. Location of selected fish taxa during a dive off south-central Santa Cruz Island site SCI 4 on May 16, 2004 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

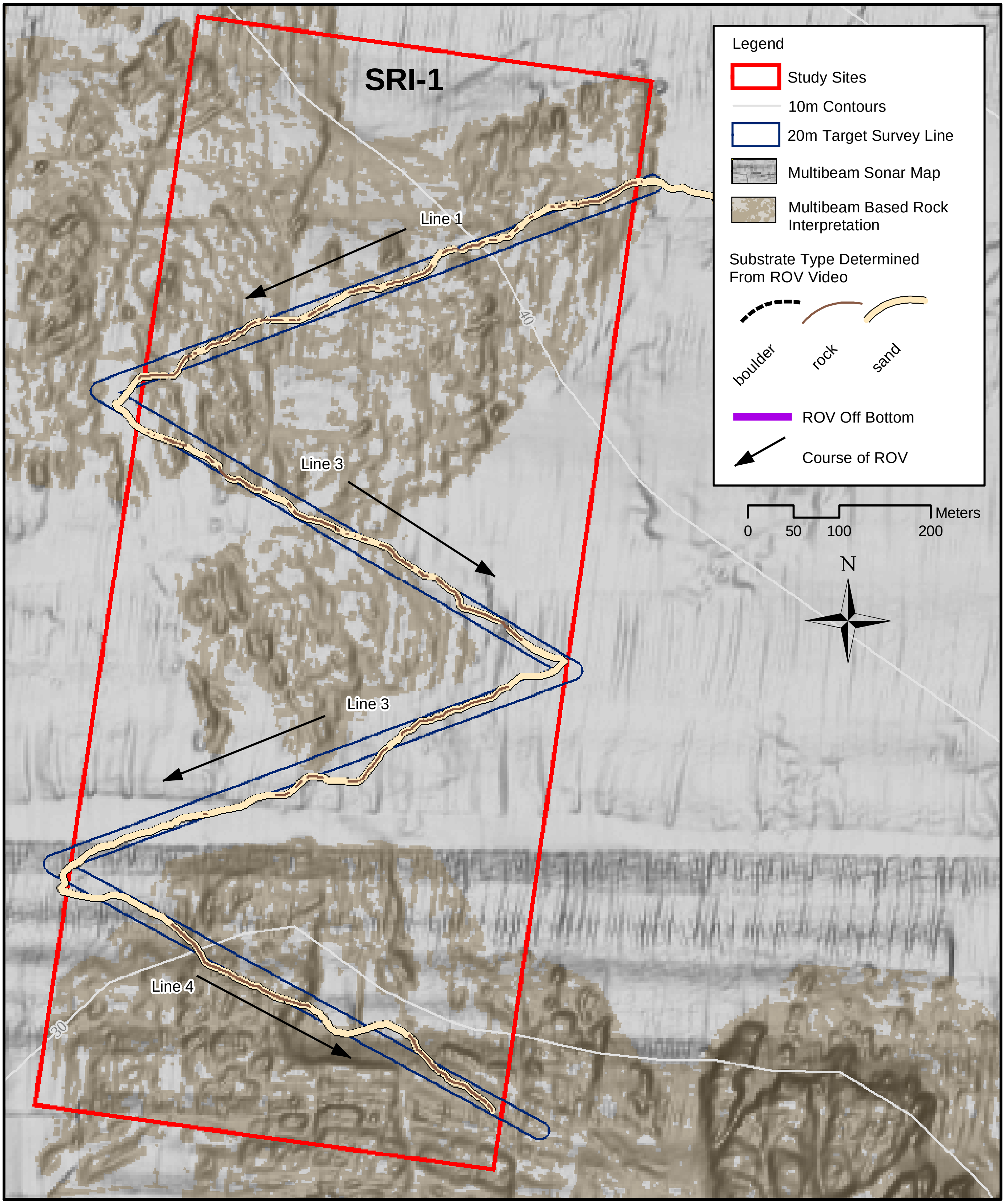

Figure 19. Habitats observed during a dive off Carrington Point SMR Santa Rosa Island site SRI 1 on November 14, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

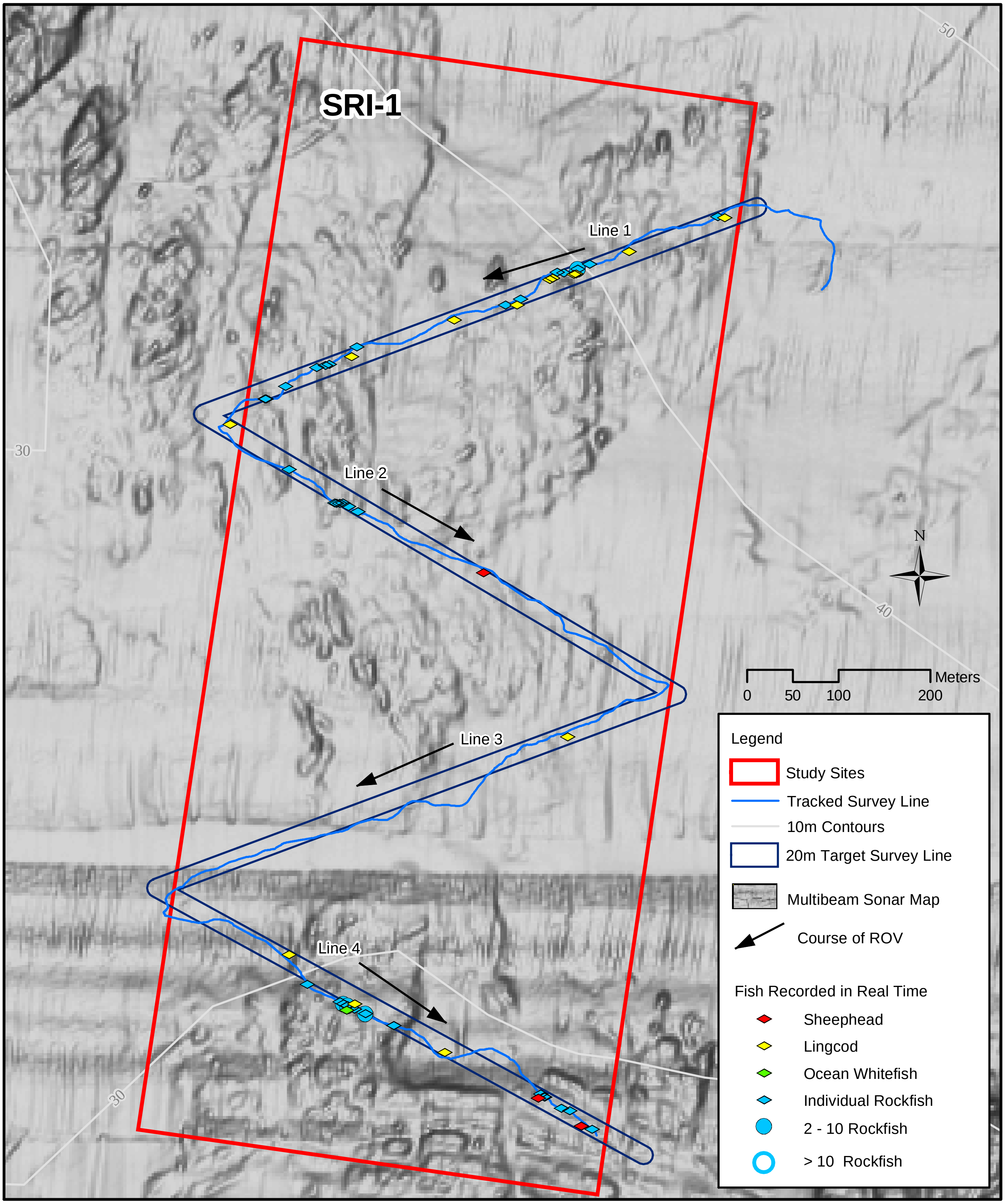

Figure 20. Location of selected fish taxa during a dive off Carrington Point SMR Santa Rosa Island site SRI 1 on November 14, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

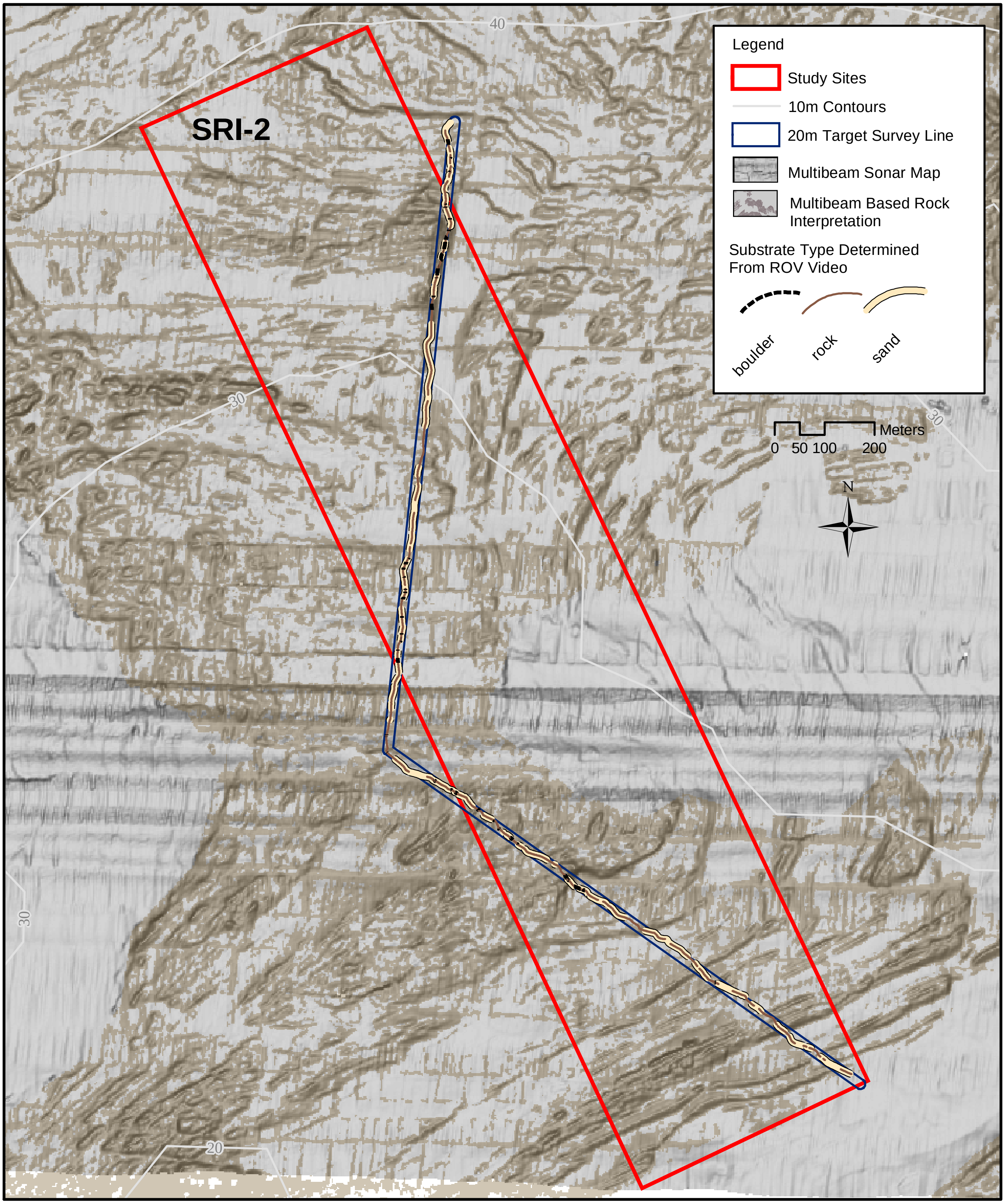

Figure 21. Habitats observed during a dive off Carrington Point SMR Santa Rosa Island site SRI 2 on November 24, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

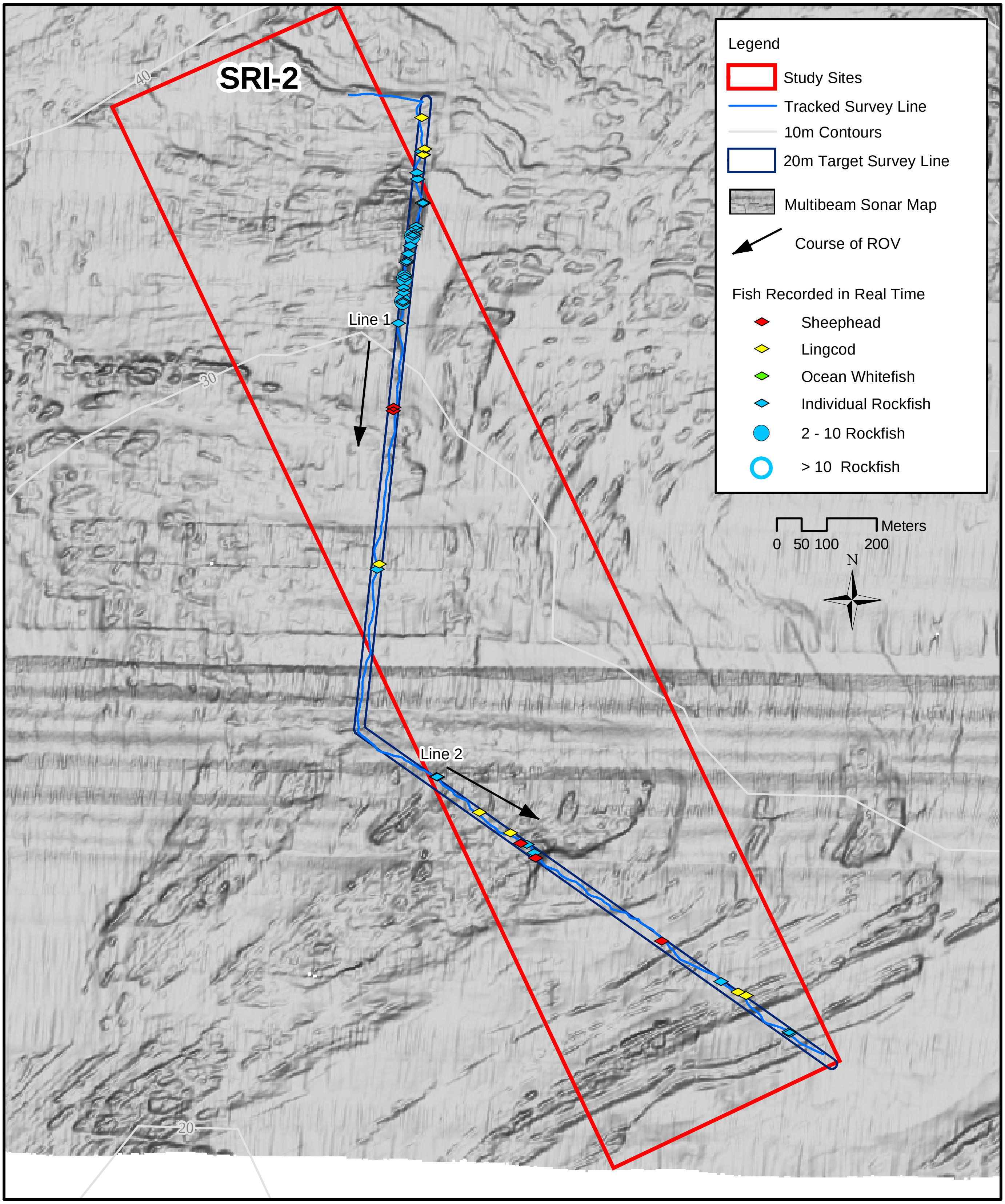

Figure 22. Location of selected fish taxa during a dive off Carrington Point SMR Santa Rosa Island site SRI 2 on November 24, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

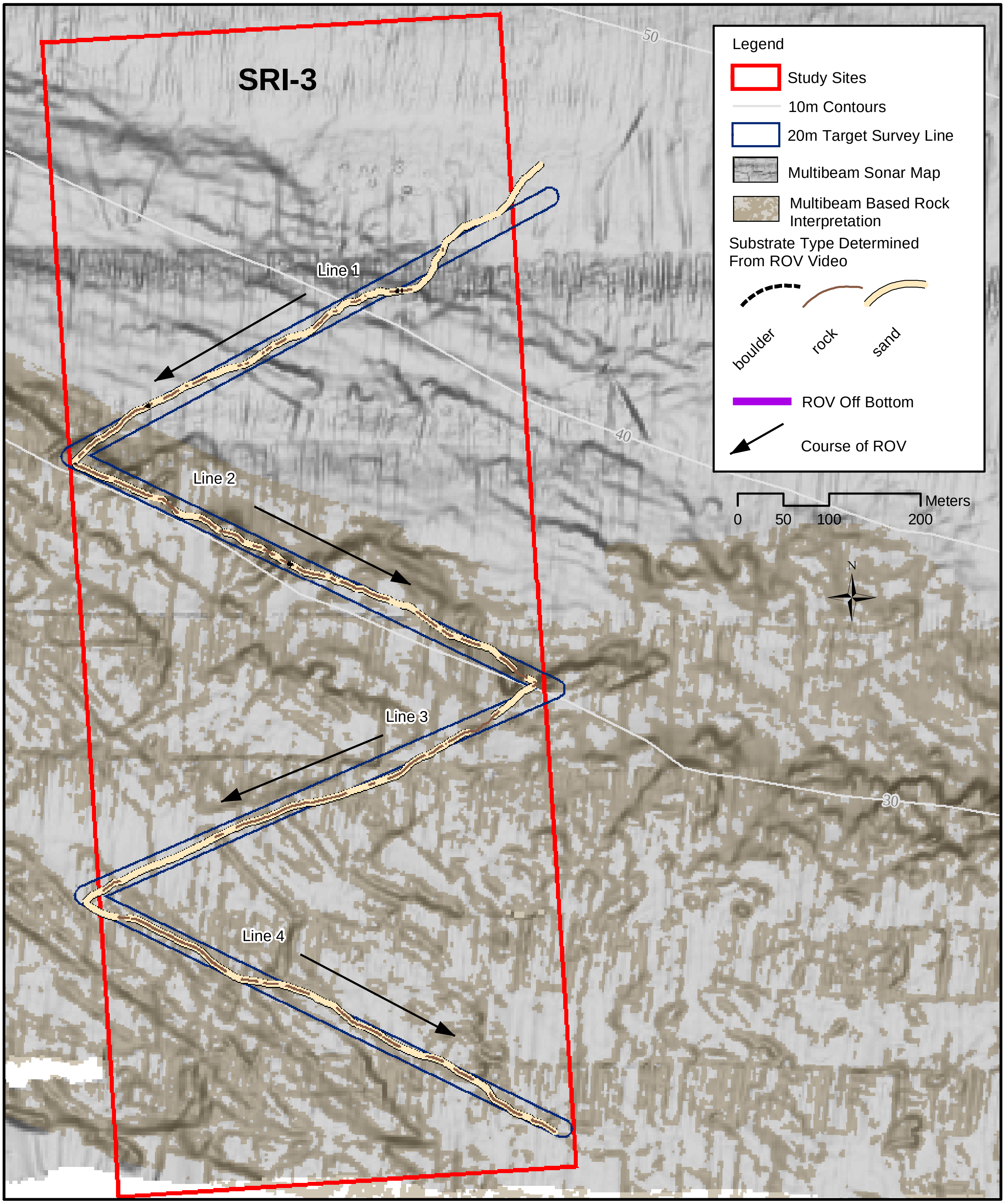

Figure 23. Habitats observed during a dive off Rodes Reef Santa Rosa Island site SRI 3 on November 14, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

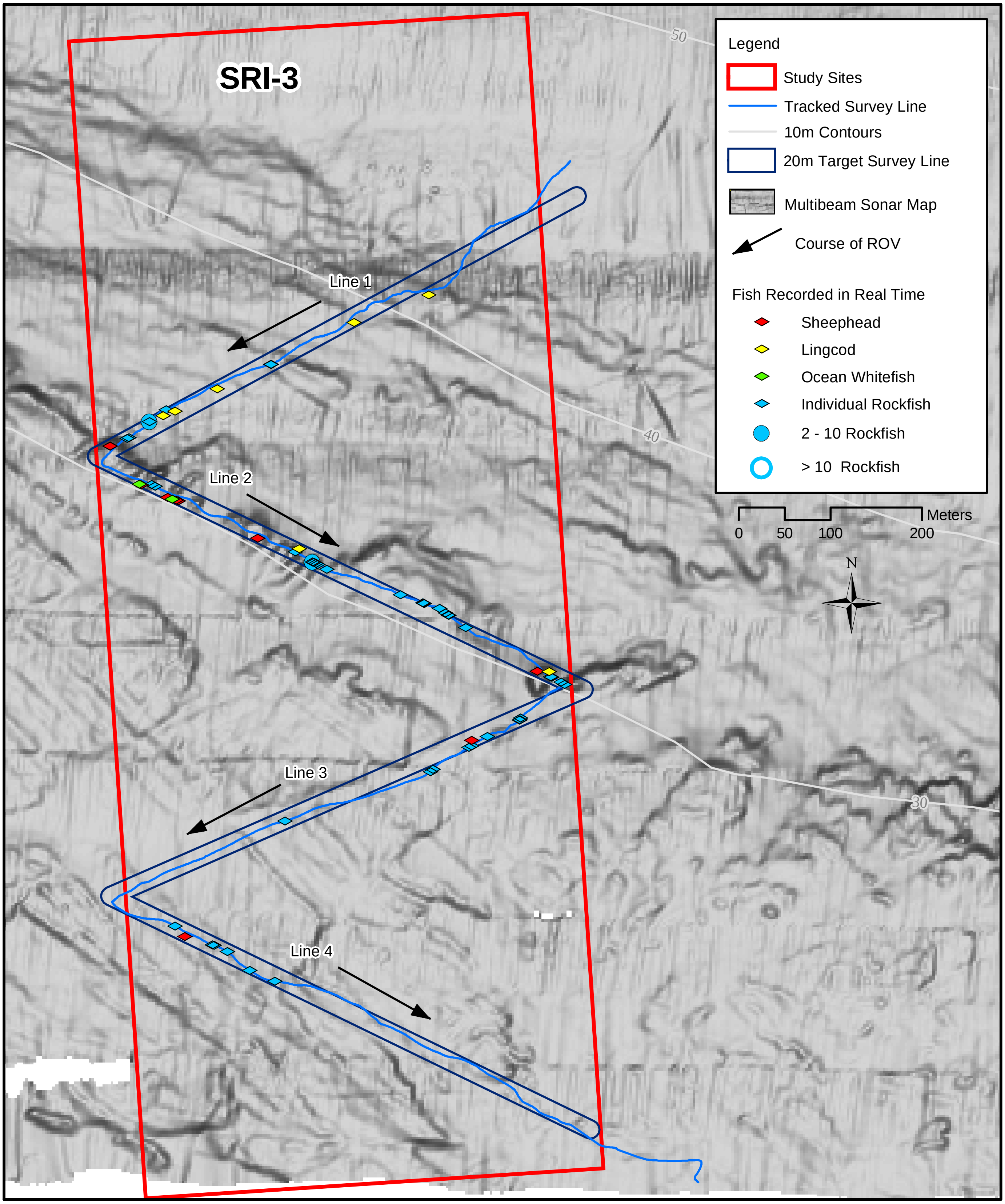

Figure 24. Location of selected fish taxa during a dive off Rodes Reef Santa Rosa Island site SRI 3 on November 14, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

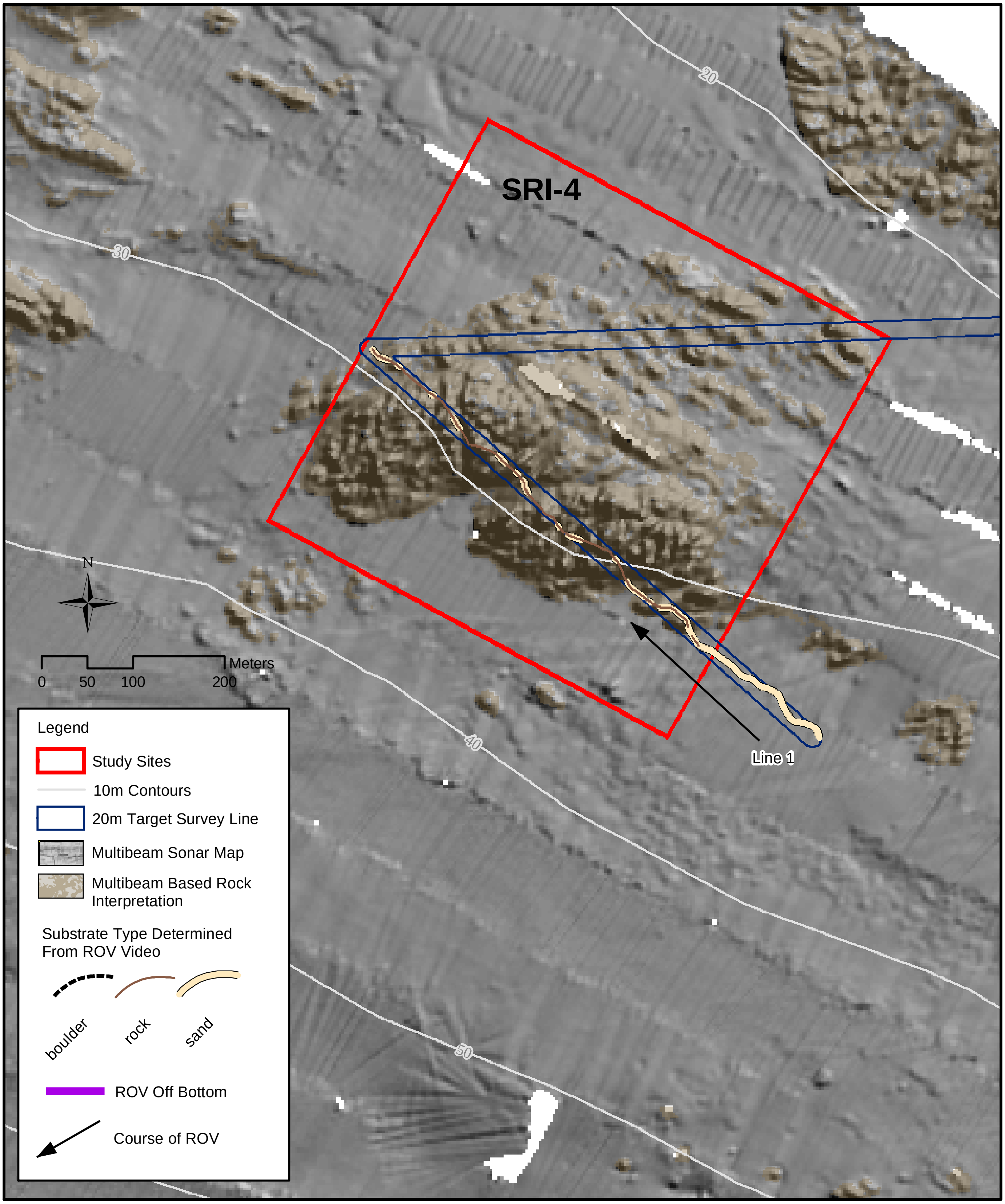

Figure 25. Habitats observed during a dive off South Point SMR Santa Rosa Island site SRI 4 on November 23, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

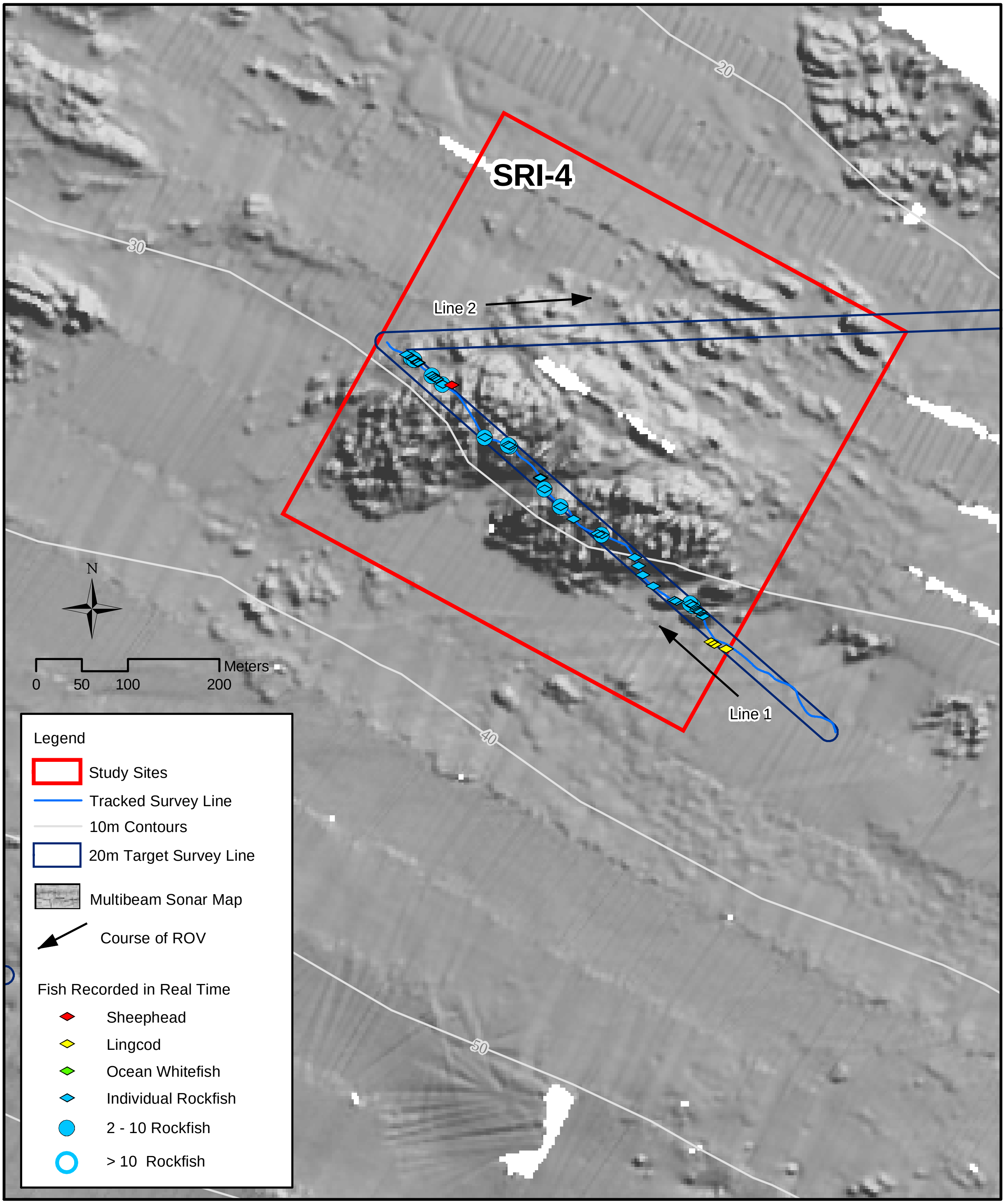

Figure 26. Location of selected fish taxa during a dive off South Point SMR Santa Rosa Island site SRI 4 on November 23, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

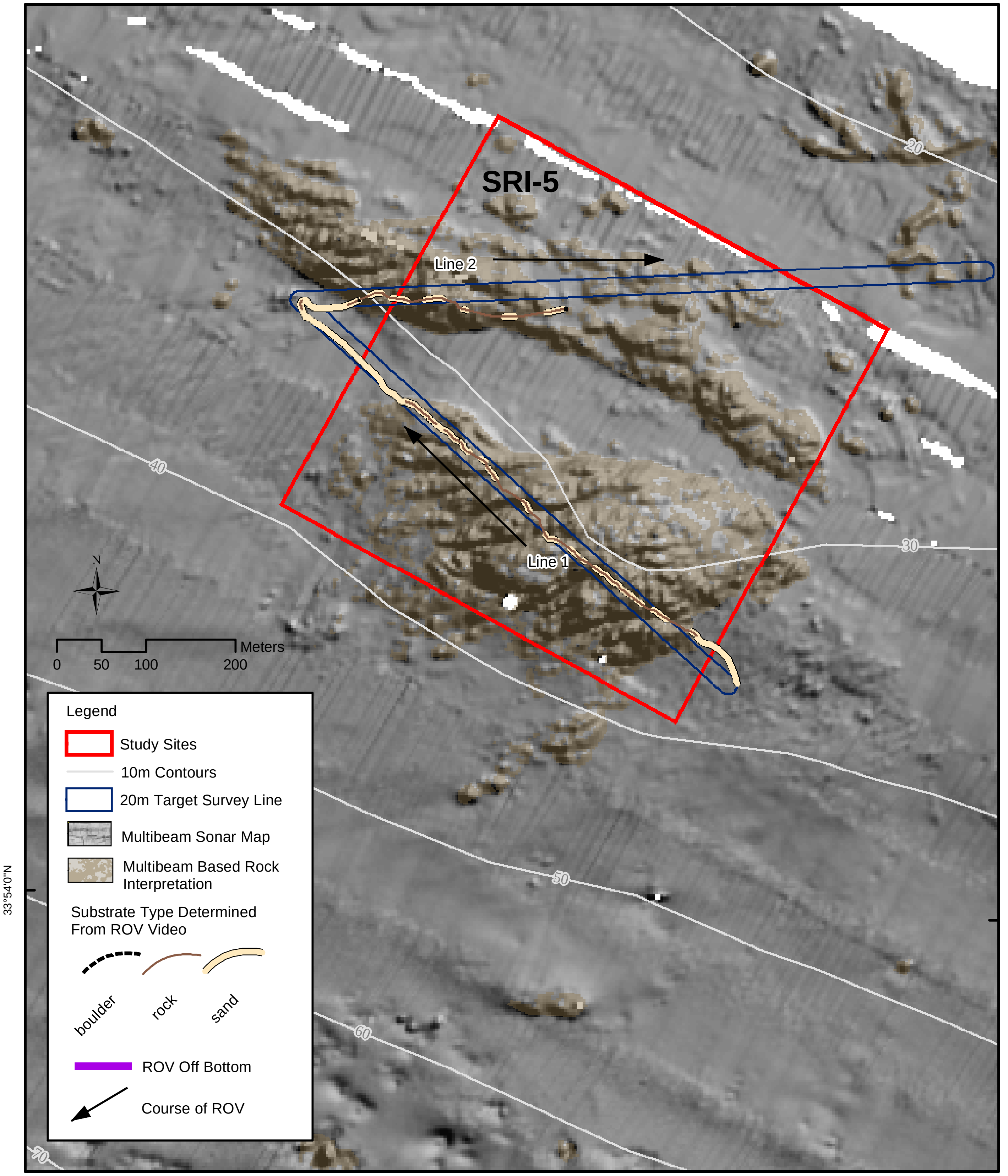

Figure 27. Habitats observed during a dive off Cluster Point Santa Rosa Island site SRI 5 on November 23, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

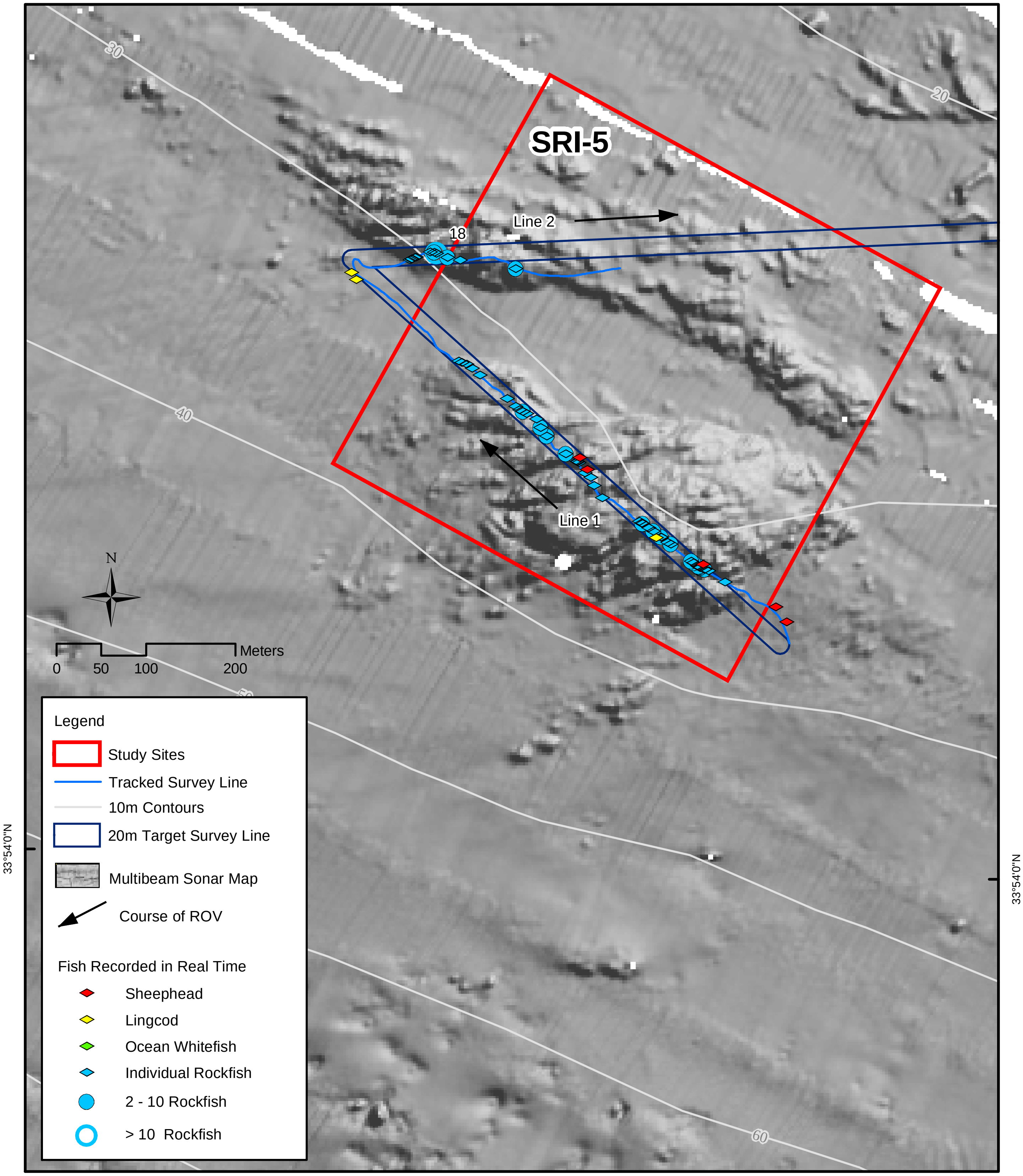

Figure 28. Location of selected fish taxa during a dive off Cluster Point Santa Rosa Island site SRI 5 on November 23, 2003 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

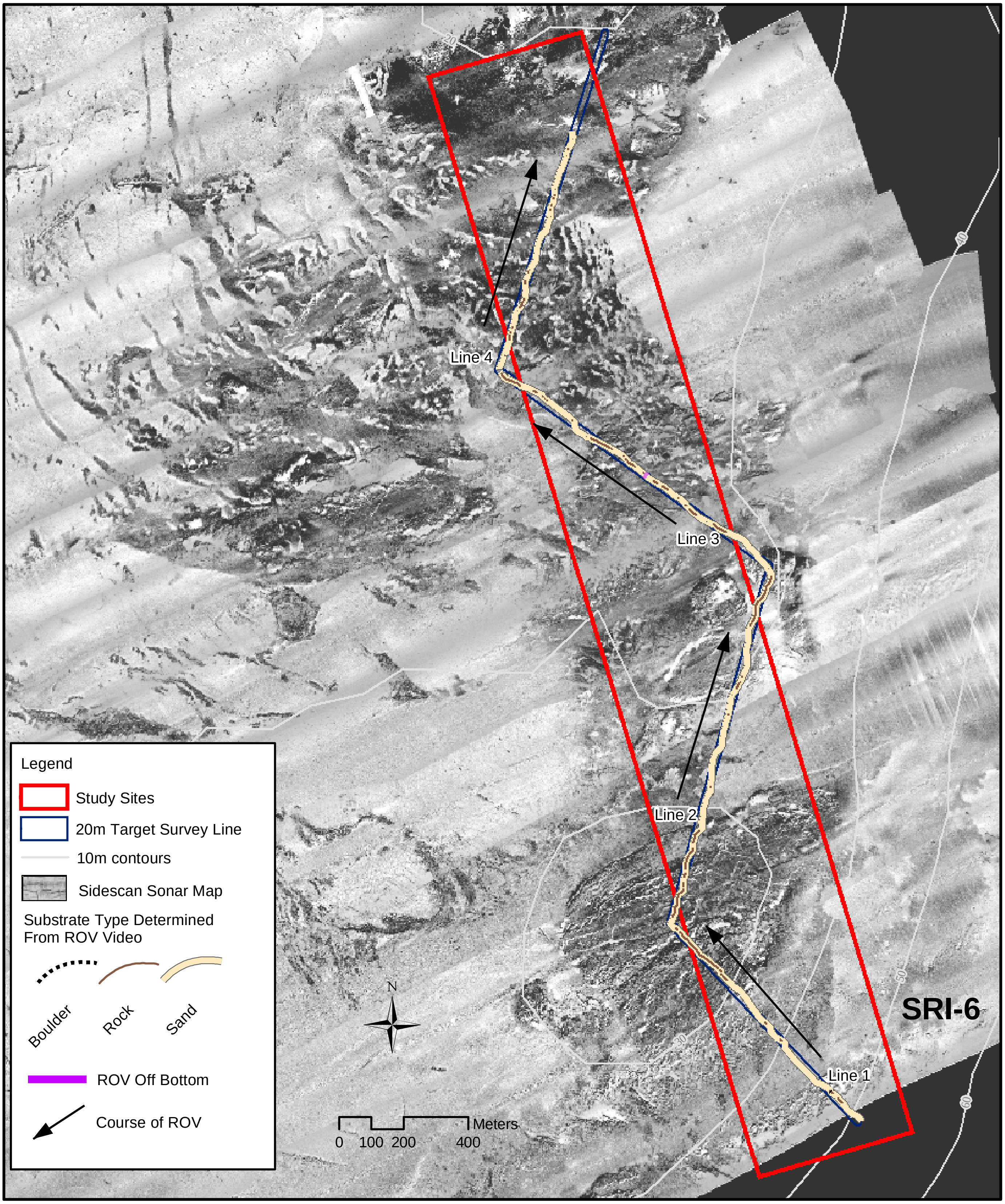

Figure 29. Habitats observed during a dive off south-east Santa Rosa Island site SRI 6 on May 15, 2004 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary in relation to smoothed ROV track line is color coded by observed habitat type of rock, sand, and boulder.

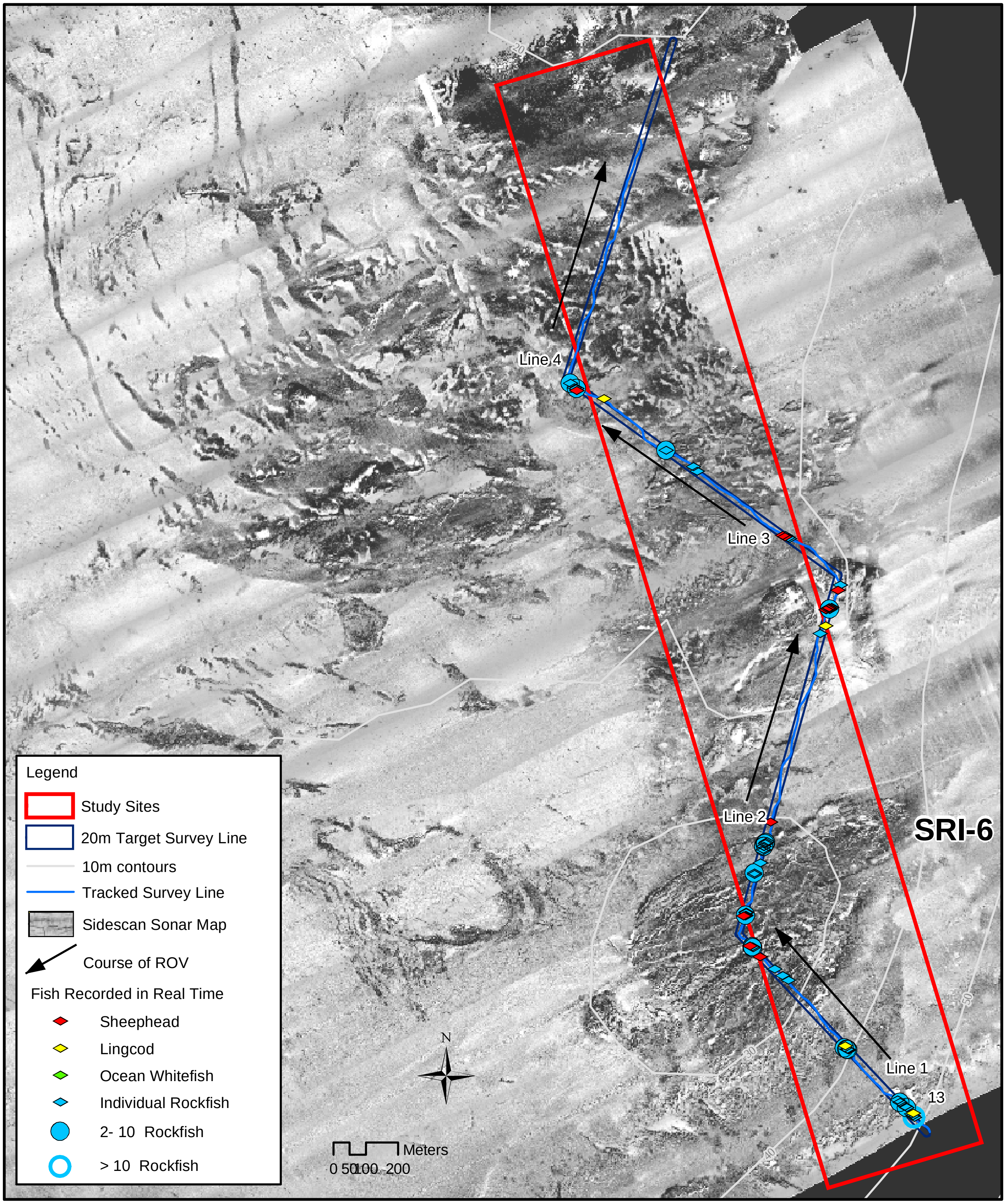

Figure 30. Location of selected fish taxa during a dive off south-east Santa Rosa Island site SRI 6 on May 15, 2004 over shaded relief multibeam sonar map. Planned ±10 m navigational boundary is shown in relation to smoothed ROV track line actually flown.

APPENDIX 1

ROV operations and data collection checklists and logs, A. – J.

A. Equipment Checklist

Equipment Checklist

Name: ________________________ Date: _________ Project: ____________________________

- ☐ *ROV (ready for use with all sensor and camera components installed)*
- ☐ *Umbilical (both new and pink).*
- ☐ *Floats for umbilical (purchase new)*
- ☐ *J-Box*
- ☐ *ROV power transformer*
- ☐ *ROV Navigational/Recording box (2 DSR-45s, nav. computer, horita)*
- ☐ *ROV Control box (ROV control, OSD, sonar, and Track II)*
- ☐ *ROV Monitor box (both forward and downward monitors)*
- ☐ *Extra DSRs (20 and 45)*
- ☐ *TC Wedge and X-Keys (two of each)*
- ☐ *Flat-plate TVs (Samsung and Sharp)*
- ☐ *Flat-plate monitors (two large, two small)*
- ☐ *DVD recording decks*
- ☐ *Story board lap-top and VGA converter*
- ☐ *GPS with antenna*
- ☐ *Hydrophone Head with stainless mount and bolts*
- ☐ *Hydrophone pole, mounting bracket, and cable*
- ☐ *Transponder and extra pingers*
- ☐ *Clump weights*
- ☐ ***Hypack Hardlock Key***
- ☐ *Box of misc. wires*
- ☐ *Tool box*
- ☐ *Spare parts for ROV (shaft seals and rods, Lasers, dummy plugs, ect.)*
- ☐ *Large format digital tapes (at least 60)*
- ☐ *Pre-made tape labels (0-25 F&D + 10 blanks)*

- ☐ *Checklists (30 each)*
- ☐ *Data Managers Notebook*
- ☐ *Site Plan maps*
- ☐ *Box of manuals*
- ☐ *Miscellaneous office supplies (paper, pens, pencils, folders, ect…)*
- ☐ *Brothers Labeler and extra tape*
- ☐ *PC supplies (CD-Rs, Floppies, cables, ect…)*
- ☐ *Field supplies (Duct tape, cable ties, rope, ect…)*
- ☐ *Color printer and extra ink cartridges*
- ☐ *Navigational computer back-up power supply*
- ☐ *Bulk coax cable and cat5 cable*
- ☐ *All chargers (transponder, radios, drill, ect…)*
- ☐ *Compass*
- ☐ *Electronics tool briefcase*
- ☐ *Scuba gear (two sets for emergency recovery)*
- ☐ *Navigator and Data Manager computer desks*
- ☐ *Folding chairs*
- ☐ *Spare altimeter (Dirk)*
- ☐ *Spare OSD E-proms*
- ☐ *Saw horses*

B. ROV Pilot Checklist

ROV Pilot Checklist

Name: ________________________________ Date: ___________ Dive #: _________

Pre-Dive:

2) ROV

- ☐ ***Check prior ROV Pilot Checklist for comments.***
- ☐ ***Check that main power is off at console.***
- ☐ *Check thruster shaft seal integrity (look for collapsing seal or other abnormality) 3/8 gap and spacer has 1/8 of play.*
- ☐ *Lifting hardware secured to ROV and free of defect.*
- ☐ ***Confirm Vent Plugs are secure (hull/camera).***
- ☐ *Make sure all end caps are seated properly. Dummy connectors in place.*
- ☐ *Check for loose cabling, connectors and bulkhead connectors.*
- ☐ *Calibrate all lasers and change batteries.*
- ☐ *Clear camera ports (Ensure dust/smudge free).*
- ☐ *Check umbilical for damage and ensure floats and clump-weight connectors are secured.*

3) Controls

- ☐ ***Trim, Auto Depth/Heading, Thruster enable, and Lights: OFF***
- ☐ *Turn main power on.*
- ☐ *Check all thruster functions (joysticks and trim).*
- ☐ ***Thruster enable: OFF***
- ☐ *Check light functions.*
- ☐ ***Lights: OFF***
- ☐ *Check laser functions.*
- ☐ ***Lasers: OFF***
- ☐ *Check all cameras (tilt and zoom).*
- ☐ *Confirm OSD reads correct depth, heading, and time.*
- ☐ *Check tracking transponder function.*

Post-Dive:

1) ROV:

- ☐ *Check light functions:* ***Turn OFF***
- ☐ ***Power down main console.***

- ☐ *Check thrusters for fouling.*
- ☐ *Check thruster seals for signs of collapse or excessive wear.*
- ☐ *Check entire ROV for signs of damage.*
- ☐ *Check Umbilical for signs of damage or wear.*
- ☐ *Check that vent plugs are secure.*
- ☐ *Check that shrouds are secure.*
- ☐ *Install shorting plug in top of tracking transponder.*
- ☐ *Complete ROV Pilot's Log.*

Comments:

C. ROV Pilot’s Log

ROV Pilot's Log

Pilot's Name:

Date: _ **Dive Number:** _

Location:

Pilot must provide a short post-dive narrative of all operational events:

Time (TC)	Depth (m)	Notes

Comments:

D. ROV Navigational Checklist

ROV Navigational Checklist

Name: ________________________________ Date: ___________ Dive: ____________

Pre-Dive:

1) ROV Planned Track Display

- ☐ *Planned track file opened and displayed on Navigational Computer and Helm monitor.*
- ☐ *ROV and Ship symbols displayed.*

2) Video Recording

- ☐ *Forward and Down camera DSR-45s loaded with tapes.*
- ☐ *Computer Video screen PowerPoint opened, with correct storyboard, site maps, and line numbers.*
- ☐ ***Storyboard recorded on both forward and down camera tapes and DVD hard drives.***
- ☐ ***Laser calibration board recorded on both forward and down camera tapes and DVD hard drives.***

3) Hypack Data Recording

- ☐ *Hypack survey file opened and ship set as main vessel.*
- ☐ *Shared Memory and OSD raw files correctly opened, with dive and file names entered.*

4) ROV Navigational Log

- ☐ *Log file opened and Pre-flight information entered into database.*
- ☐ *Paper copy of navigational map labeled with date and dive number.*
- ☐ *Paper copy of log file filled out with pre-flight information.*

Start-Dive:

1) Video Recording

- ☐ ***Forward Camera DSR-45 in recording mode.***
- ☐ ***Down Camera DSR-45 in recording mode.***
- ☐ ***Forward DVD in recording mode***
- ☐ ***Down DVD in recording mode***

2) Hypack Data Recording

- ☐ ***"Start logging" in Hypack and set ROV as main vessel.***
- ☐ ***"Start" recording of shared memory.***
- ☐ ***"Capture" OSD raw.***
- ☐ ***Video screens captured at each line start and end.***

End-Dive:

1) Communication

- ☐ *Inform deck officer dive is ending...”Prepare to surface ROV”.*

2) Video Recording

- ☐ *Stop forward camera tape recording.*
- ☐ *Stop down camera tape recording.*

3) Hypack and Text File Data Recording

- ☐ *Stop logging in Hypack survey.*
- ☐ *End logging in shared memory.*
- ☐ *Stop capture of OSD raw.*

Post-Dive:

1) Video Recording

- ☐ *Check tape labeling to verify correct Survey Name, Date, Dive Number, and Tape Number.*

2) Hypack Data Recording

- ☐ *Verify that newly created files exist (Hypack, Shared Memory, and OSD raw).*

3) Navigational Log

- ☐ *Complete paper copy of log file.*
- ☐ *Verify navigational map is complete with date and dive number.*
- ☐ *Enter all post-dive information into database.*

Comments:

E. Deck Officer's Checklist

Deck Officer's Checklist

Name: ________________________________ Date: ____________ Dive #: __________

Pre-Dive:

- ☐ *Assign deployment and retrieval responsibilities and brief all involved.*
- ☐ *Check lifting hardware on ROV for defect.*
- ☐ *Inspect umbilical hard-point to winch cable (8-10 meters from weight) for defects.*
- ☐ *Confirm clump weight hardware is secure.*
- ☐ *Discuss with helm deployment and retrieval sequence (ships position and heading).*
- ☐ *Perform a VHF radio test (Pilot/Navigator and Helm).*
- ☐ *Fill out header information on Deck Officer's Log.*

On Station:

1) **Hydrophone**

- ☐ *Deploy hydrophone once on station.*
- ☐ *Confirm hinge point is secure and lines are tightly tied off.*
- ☐ ***Inform helm Hydrophone is down.***

4) ROV

- ☐ *Have helm position ship for ROV deployment.*
- ☐ *Confirm from Pilot and Navigator ROV is ready for launch.*
- ☐ *Confirm that all involved in deployment are prepared (in position, with hardhats and lifejackets on).*
- ☐ *Inform crew, "ROV is ready for deployment".*

During Dive:

- ☐ *Secure deck, (close all gates and tie down any loose equipment).*
- ☐ *Confirm hydrophone is secure and no signs of significant movement observed.*
- ☐ ***If ROV left in water between dives**, establish who will be piloting ROV, tending umbilical, maintaining clump weight, and in radio communication with helm.*

Retrieval:

- ☐ *Have helm position ship for clump weight and ROV retrieval.*
- ☐ *Confirm from Pilot and Navigator ROV is ready for retrieval.*
- ☐ *Confirm that all involved in retrieval are prepared (in position, with hardhats and lifejackets on).*

- ☐ *Inform crew, "ROV is ready for retrieval".*

Leave Station:

- ☐ *Secure ROV and Make sure Pilot has powered down thrusters, lasers, and lights.*
- ☐ *Secure clump weight.*
- ☐ *Secure winch.*
- ☐ ***Raise Hydrophone and tie off.***
- ☐ *Secure deck, (close all gates and tie down any loose equipment).*
- ☐ *Inform ROV crew, "Ready to transit".*
- ☐ *Inform helm hydrophone is raised and deck secure.*
- ☐ *Complete Deck Officer's Log.*

Comments:

F. Deck Officer's Log

Deck Officer's Log

Deck Officer's Name: ____________________

Date: __________ Dive Number: __________

Location: ____________________

Time (TC)	Depth (m)	Notes

Time (TC)	Depth (m)	Notes

Comments:

G. ROV Data Recording Checklist

ROV Data Recording Checklist

Name: ________________________________ Date: __________ Project: ____________

Video Recording:

1) **Forward Camera**

- ☐ *ROV video recorded with no apparent loss of image quality.*
- ☐ *TC window recorded and clearly readable.*
- ☐ *ROV data sensor displays recorded and readable (Compass Heading, Date, Temperature, Camera Tilt, Range, and Depth).*
- ☐ *TC audio track recorded and tested for data extraction using the Horita TCW-50.*
- ☐ *DVD hard drive recording with TC audio track.*

2) **Down Camera**

- ☐ *ROV video recorded with no apparent loss of image quality.*
- ☐ *TC window recorded and clearly readable.*
- ☐ *TC audio track recorded and tested for data extraction using the Horita TCW-50.*
- ☐ *DVD hard drive recording with TC audio track.*

Hypack Data Recording:

1) **GPS Fix (Ships Position)**

- ☐ *Test for good GPS feed with correct X and Y coordinates*
- ☐ *Confirm correct compass heading*
- ☐ *TC and Date recorded with GPS data*

2) **ROV Positional Fix from TrackPoint II**

- ☐ *Test for "good" TrackPoint feed*
- ☐ *Test logging of X and Y coordinates*
- ☐ *Range and Bearing*
- ☐ *TC*

3) **ROV Data Sensors (all TC linked) from OSD into Hypack**

- ☐ *Depth*
- ☐ *Compass Heading*
- ☐ *Temperature*
- ☐ *Distancing Sonar*

- ☐ *Camera Tilt*

Comments:

Add to Checklist:

H. ROV Data Manager Checklist

ROV Data Manager Checklist

Data Manager's Name: ______________________________ Date: _____________ Dive #: ________

5) **Navigator's Name: ____**

- ☐ *Paper ROV Dive Log collected.*
- ☐ *Navigational Maps collected.*
- ☐ *Navigator's Post-Dive comments recorded into Data Managers Log.*

6) **Pilot's Name: ____**

- ☐ *Paper Pilot Log collected.*
- ☐ *Pilot's Post-Dive comments recorded into Data Managers Log.*

7) **Deck Officer's Name: ____**

- ☐ *Deck Officer's Log collected.*
- ☐ *Deck Officer's Post-Dive comments recorded into Data Managers Log.*

8) **Data Manager's Name:____**

- ☐ *Data Managers Log completed and site maps labeled with Date, Dive, and BTC/ETC.*
- ☐ *All collected logs and maps filed into Data Managers binder.*
- ☐ *Verify all Dates, Dive Numbers, and TC are correct on collected Logs and Maps.*

Comments:

I. Data Manager's Log

Data Manager's Log

Name:

Date: Dive Number: Site:

Location:

Line Start and End TCs

Line:	BTC:	ETC:	Comment:

Major Pulls and Stops

Type:	BTC:	ETC:	Comment:

Unique Biological Observations

Dive Number:

TC:	Observation:	(ETC):

Operational Events

Dive Number:

TC:

J. Biologist Log

Biologist Log

Dive #: ________ Vessel: _________________________ Operator: _____________________

Date: ___________ Location: _____________________________________ Station: ___________

Start Time (UTC): __________________________ End Time (UTC): ____________________

Start Time (LT): ___________________________ End Time (LT): ______________________

Biologists: _________________________________ Observers: _________________________

Pilot: ____________________________________ Navigator: ________________________________

Depth Range (meters): ________ Legs: ____

____

Forward / Down camera paired red lasers distance apart (cm):_____/_______

X-Key Pad - Check box if observed (and note minimum and maximum depth in meters)

FISH: ☐ **Copper Rockfish (______), ☐ Lingcod (______), ☐ Ocean Whitefish (______), ☐ Sheephead (______), ☐ U.I. Rockfish (______), ☐ U.I. Fish (______), ☐ Vermillion Rockfish**

INVERTEBRATES: ☐ **Red Gorgonian (______), ☐ Cancer sp. (______), ☐ Spider Crab (______), ☐ Lobster (______)**

Other species observed: ____

____

____

Notes and Comments:____

____

____

____

____

____

____

Appendix 2. ROV habitat and fish summary data for Channel Islands exploritory survey in November 2003 and May 2004.

Line Number	Line Length (m)	Percentage of Line Distance				Lingcod	Ocean Whitefish	Sheephead	Rockfish
		Rock only	Mixed	Sand Only	w/ Boulder				
SRI 1									
1	609	9%	62%	29%	0%	9			15
2	563	6%	58%	36%	0%			1	7
3	608	0%	41%	59%	0%	1			
4	565	0%	55%	45%	0%	3	1	2	19
SRI 2									
1	1028	35%	60%	5%	16%	1		2	37
2	1027	37%	49%	14%	7%	4		3	7
SRI 3									
1	601	1%	39%	60%	2%	5		1	6
2	564	11%	61%	28%	1%	2	2	6	21
3	558	8%	48%	44%	0%			1	9
4	562	2%	66%	33%	0%			1	6
SRI 4									
1	587	42%	27%	31%	0%	3			37
SRI 5									
1	575	35%	39%	26%	1%	1		6	74
2	238	58%	42%	0%	2%				35
SRI 6									
1	878.27	0.0%	30.6%	69.4%	0.2%	2		2	37
2	1190.72	0.0%	37.4%	62.6%	0.0%	1		7	31
3	1043.05	0.6%	31.7%	67.7%	0.0%	1		3	12
4	786.44	0.4%	11.4%	88.1%	0.0%				
SCI 1									
1	568	4%	6%	91%	0%				43
2	532	3%	6%	92%	0%	1			69
3	562	17%	16%	68%	2%	1		1	112

Appendix 2. ROV habitat and fish summary data for Channel Islands exploritory survey in November 2003 and May 2004.

Line Number	Line Length (m)	Percentage of Line Distance				Lingcod	Ocean Whitefish	Sheephead	Rockfish
		Rock only	Mixed	Sand Only	w/ Boulder				
SCI 1 (Continued)									
4	519	9%	8%	83%	0%				40
5	552	1%	1%	98%	1%				1
6	550	3%	8%	89%	0%				3
7	524	2%	10%	88%	0%				4
8	523	0%	12%	88%	0%	1			1
SCI 2									
1	576	1%	31%	68%	0%				11
2	484	5%	28%	67%	0%	3			45
3	538	11%	30%	59%	2%	3			195
4	522	2%	28%	71%	0%				156
5	556	7%	26%	67%	0%			2	83
6	576	13%	50%	37%	0%			8	155
7	523	16%	18%	66%	0%			1	76
8	570	11%	16%	73%	0%	1		2	5
SCI 3									
1	507	0%	10%	90%	0%	1			5
2	578	0%	26%	74%	1%				
3	540	0%	43%	57%	0%				
4	93	0%	55%	45%	0%				
SCI 4									
1	718.98	1.3%	31.7%	67.0%	0.0%			1	16
2	669.36	3.7%	16.9%	79.5%	0.0%	2		1	32
3	677.54	1.2%	20.2%	78.6%	0.0%	1			2
4	702.14	18.3%	5.3%	76.3%	0.0%			1	

Appendix 2. ROV habitat and fish summary data for Channel Islands exploritory survey in November 2003 and May 2004.

Line Number	Line Length (m)	Percentage of Line Distance				Lingcod	Ocean Whitefish	Sheephead	Rockfish
		Rock only	Mixed	Sand Only	w/ Boulder				
AI 1									
1	875.79	10.9%	22.2%	66.8%	0.0%	1	2	3	52
2	863.19	0.3%	10.7%	89.0%	4.8%				2
3	780.39	2.6%	32.2%	65.3%	0.0%	1		1	5
4	589.48	24.7%	61.8%	13.5%	2.6%		1		3
AI 1									
1	824.97	7.5%	28.2%	64.3%	0.0%	1	2	2	12
2	816.44	0.0%	11.4%	88.6%	4.7%	4			3
3	796.77	7.7%	25.4%	67.0%	0.5%	1		2	4
4	322.57	41.7%	14.2%	44.1%	0.0%				1
AI 2									
2	422.43	5.6%	17.4%	76.9%	0.0%				5
3	763.84	19.8%	37.2%	43.1%	0.0%				10
4	740.24	31.5%	35.2%	33.3%	0.0%			1	
5	985.94	14.2%	43.4%	42.4%	8.4%			1	3
AI 3									
1	484.12	22.2%	52.1%	25.7%	7.1%	1		2	33
2	494.93	0.0%	26.9%	73.1%	6.5%	3			1
3	613.98	0.0%	27.9%	72.1%	3.0%			1	7
4	630.40	12.2%	59.5%	28.3%	9.4%		1		1
5	595.40	18.0%	33.1%	48.9%	0.0%			1	
AI 4									
1	380.68	0.0%	13.3%	86.7%	0.4%				453
2	590.58	1.6%	20.1%	78.3%	3.3%				25
3	543.10	13.6%	66.4%	20.0%	43.1%				9
4	635.97	7.1%	30.0%	62.9%	17.9%	2		2	1
5	573.41	28.0%	9.9%	62.1%	7.4%				

Appendix 3. ROV dive data for all sites survey in November 2003 and May 2004.

Line	Dive	Date	Beginning Time (GMT)	Ending Time (GMT)	Begin X	Begin Y	End X	End Y	Velocity (m/s)	Depth (m)	Range (m)
SRI 1											
1	221	11/14/03	16:00:24	16:27:06	218565	3773167	218031	3772950	0.4	40.2	1.7
2	221	11/14/03	16:29:38	17:00:38	218028	3772921	218499	3772655	0.3	36.0	2.2
3	221	11/14/03	17:02:37	17:22:33	218497	3772643	217964	3772427	0.5	36.1	1.9
4	221	11/14/03	17:25:42	17:59:41	217961	3772400	218427	3772161	0.3	33.2	2.2
SRI 2											
1	232	11/24/03	15:40:22	16:02:38	216542	3773485	216441	3772488	0.8	31.1	2.9
2	232	11/24/03	16:11:25	16:48:06	216532	3772285	217341	3771710	0.5	27.0	2.5
SRI 3											
1	222	11/14/03	19:00:21	19:27:02	211192	3772710	210709	3772411	0.4	42.6	2.3
2	222	11/14/03	19:28:05	19:53:35	210708	3772397	211206	3772160	0.4	30.3	2.6
3	222	11/14/03	19:53:57	20:10:43	211207	3772159	210714	3771922	0.6	27.3	1.8
4	222	11/14/03	20:10:45	20:25:42	210714	3771922	211207	3771680	0.6	25.0	2.3
SRI 4											
1	231	11/23/03	0:15:22	0:35:56	206412	3756540	205996	3756911	0.5	26.9	4.7
SRI 5											
1	230	11/23/03	22:37:12	23:15:44	207622	3755827	207204	3756185	0.2	25.7	3.3
2	230	11/23/03	23:23:31	23:28:33	207205	3756259	207433	3756246	0.8	24.4	3.3
SRI 6											
1	239	5/15/04	20:22:19	20:55:24	225793	226383	3755482	3756095	0.4	34.8	2.7
2	239	5/15/04	20:57:02	21:37:25	225795	226106	3756100	3757200	0.5	27.9	2.6
3	239	5/15/04	21:39:46	22:13:10	225268	226088	3757206	3757804	0.5	27.9	3.0
4	239	5/15/04	22:14:42	22:39:21	225264	225492	3757812	3758547	0.5	25.1	2.3
SCI 1											
1	224	11/20/03	23:10:06	23:36:38	237827	3759605	238343	3759432	0.4	62.8	1.6
2	224	11/20/03	23:38:55	0:01:35	238349	3759439	237895	3759677	0.4	52.2	2.1
3	224	11/20/03	0:03:58	0:26:00	237911	3759698	238422	3759528	0.4	58.7	1.8
4	224	11/20/03	0:29:13	0:47:25	238423	3759530	238042	3759848	0.5	53.5	2.8
5	226	11/20/03	17:16:41	17:33:17	238059	3759867	238548	3759663	0.6	49.1	2.2

Appendix 3. ROV dive data for all sites survey in November 2003 and May 2004.

Line	Dive	Date	Beginning Time (GMT)	Ending Time (GMT)	Begin X	Begin Y	End X	End Y	Velocity (m/s)	Depth (m)	Range (m)
SCI 1 (Continued)											
6	226	11/20/03	17:37:14	18:03:19	238564	3759681	238287	3760124	0.3	41.8	2.9
7	226	11/20/03	18:07:51	18:25:14	238290	3760128	238697	3759831	0.5	35.9	2.3
8	226	11/20/03	18:28:31	18:43:44	238705	3759840	238393	3760245	0.6	33.1	1.9
SCI 2											
1	223	11/20/03	18:01:58	18:28:14	239718	3758726	239313	3759036	0.4	68.5	2.3
2	223	11/20/03	18:33:45	18:59:39	239314	3759051	239727	3758882	0.3	64.7	3.6
3	223	11/20/03	19:12:15	19:35:11	239728	3758882	239315	3759152	0.3	59.4	3.0
4	223	11/20/03	19:48:34	20:03:17	239314	3759236	239815	3759204	0.5	50.6	4.5
5	223	11/20/03	20:06:23	20:30:21	239815	3759209	239313	3759390	0.4	48.3	2.4
6	223	11/20/03	20:33:14	21:04:48	239297	3759400	239815	3759625	0.3	35.4	2.7
7	223	11/20/03	21:09:50	21:36:02	239814	3759663	239315	3759739	0.3	36.3	2.0
8	223	11/20/03	21:38:58	22:02:20	239315	3759747	239818	3759983	0.4	46.7	3.3
SCI 3											
1	227	11/21/03	20:28:16	20:39:43	248748	3760108	249195	3760321	0.7	42.8	2.2
2	227	11/21/03	20:41:49	20:55:29	249196	3760336	248694	3760571	0.7	32.8	2.2
3	227	11/21/03	20:58:53	21:09:01	248694	3760627	249196	3760812	0.9	23.8	2.0
4	227	11/21/03	21:14:58	21:17:01	249196	3760871	249107	3760883	0.8	20.2	4.8
SCI 4											
1	240	5/16/04	18:27:18	18:47:51	254013	254703	3761518	3761672	0.6	53.1	2.2
2	240	5/16/04	18:48:36	19:09:35	254013	254370	3761680	3762229	0.5	42.0	2.3
3	240	5/16/04	19:11:22	19:30:31	253711	254358	3762249	3762411	0.6	32.8	2.3
4	240	5/16/04	19:31:56	19:57:27	253696	254013	3762419	3763021	0.5	23.7	2.3
AI 1											
1	241	5/17/04	15:13:22	15:55:50	273929	274720	3767097	3767331	0.3	47.8	2.5
2	241	5/17/04	16:04:34	16:25:10	274019	274760	3766911	3767210	0.7	41.2	2.5
3	241	5/17/04	16:29:58	17:01:03	274113	274817	3766738	3767001	0.4	35.3	2.5
4	241	5/17/04	17:09:04	17:26:26	274253	274741	3766594	3766878	0.6	23.1	2.7

Appendix 3. ROV dive data for all sites survey in November 2003 and May 2004.

Line	Dive	Date	Beginning Time (GMT)	Ending Time (GMT)	Begin X	Begin Y	End X	End Y	Velocity (m/s)	Depth (m)	Range (m)
AI 1 (Continued)											
1	242	5/17/04	17:59:09	18:38:27	273957	274719	3767103	3767332	0.3	47.2	2.4
2	242	5/17/04	18:43:33	19:02:31	274013	274758	3766911	3767206	0.7	43.3	2.9
3	242	5/17/04	19:17:30	19:51:58	274122	274848	3766739	3767006	0.4	35.4	2.4
4	242	5/17/04	19:58:53	20:09:02	274634	274902	3766808	3766968	0.5	28.5	2.6
AI 2											
2	236	5/14/04	19:57:20	20:14:23	278921	279330	3766634	3766683	0.4	46.8	2.0
3	236	5/14/04	20:17:19	20:46:46	278789	279315	3766147	3766669	0.4	30.9	2.3
4	236	5/14/04	20:49:33	21:14:58	278825	279531	3766061	3766195	0.5	17.7	2.5
5	236	5/14/04	21:16:27	21:52:47	279553	280350	3766215	3766745	0.5	21.9	2.3
AI 3											
1	237	5/14/04	22:33:25	22:53:42	280612	281068	3767542	3767647	0.4	58.4	2.5
2	235	5/14/04	16:06:56	16:27:49	280764	281076	3767185	3767552	0.4	53.6	2.2
3	235	5/14/04	16:33:53	16:55:15	280773	281363	3767158	3767235	0.5	42.7	2.3
4	235	5/14/04	17:02:01	17:25:55	280856	281377	3766851	3767177	0.4	29.9	2.3
5	235	5/14/04	17:32:48	18:00:39	280884	281441	3766764	3766902	0.4	23.0	2.3
AI 4											
1	238	5/15/04	14:58:06	15:11:32	283501	283529	3765688	3766051	0.5	64.3	2.1
2	238	5/15/04	15:12:48	15:37:40	282983	283493	3765818	3766050	0.4	51.0	2.9
3	238	5/15/04	15:40:47	15:54:22	282984	283246	3765838	3766288	0.7	37.8	2.1
4	238	5/15/04	15:56:34	16:20:12	282700	283245	3766044	3766303	0.4	34.2	2.5
5	238	5/15/04	16:35:10	16:58:45	282682	282897	3766038	3766550	0.4	24.9	2.6