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2007 SURVEY OF ROCKFISHES IN THE SOUTHERN CALIFORNIA BIGHT USING THE COLLABORATIVE OPTICAL-ACOUSTIC SURVEY TECHNIQUE

Edited by
David A. Demer

NOAA-TM-NMFS-SWFSC-498

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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2007 Survey of Rockfishes in the Southern California Bight using the Collaborative Optical–Acoustic Survey Technique

COAST07

Report of the data collection, preliminary analysis, and tentative conclusions for the COAST surveys aboard NOAA FSV *David Starr Jordan* and CPFV *Outer Limits*, 26 August to 31 October 2007

Edited by
David A. Demer

January 2012

U.S. Department of Commerce
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Background

Marine sportfishing in Southern California is a huge industry that must be monitored and managed by non-lethal fish surveying techniques if it, and the associated rockfish stocks, are to be maintained. Statewide, thousands of marine sportfishing anglers purchase tickets to board Commercial Passenger Fishing Vessels (CPFV), and contribute many times this expense to the tourism businesses in the region. Of the nearly 300 operated CPFVs statewide, approximately two thirds operate from harbors in the Southern California Bight (SCB). Meanwhile, the stocks of lingcod and six rockfish species, including four that are important to California anglers and commercial fishermen (*Sebastes paucispinis*, *S. pinniger*, *S. entomelas* and *S. levis*), are estimated at or below 25% of their pristine levels, and have been declared overfished by the Pacific Fisheries Management Council (PFMC). In response, two Marine Conservation Areas (MCAs) were created in the SCB. The State and Federal MCAs in southern California cover approximately 5,600 square-n.mi., which provide critical habitat for nearly 60 rockfish species (Love et al 2002). Because numerous species of rockfish coexist in these areas, residing near or on the seabed at depths of approximately 50 to 500 m, and are low in numerical-density, there are many survey challenges. To overcome these obstacles, a combination of survey equipment is required.

Researchers at the Southwest Fisheries Science Center (SWFSC) have endeavored to exploit the advantages of both optical and acoustic sampling methods to better assess the stocks and associated seabed habitats of selected rockfish species throughout the SCB, in cooperation with the CPFV fleet. Information is obtained from multi-frequency echosounders, a multi-beam sonar, and a remotely operated vehicle with a high resolution optical imaging system. While these instruments and their associated data analysis techniques have proven utilities for estimating fish biomass, mapping bathymetry, and visually observing seabed types and fish species, respectively, the combination of methods for non-extractive surveys of rockfishes has multiple challenges.

The first challenge is to identify the essential seabed habitat for target rockfishes, thus reducing the necessary survey area. This is done with a combination of multi-beam sonar, multi-frequency echosounders, and underwater video observations. Multi-frequency echosounders and underwater cameras are used to acoustically survey the rockfishes in their habitat, visually confirm the acoustic observations, and estimate the species mixtures and their size distributions. The optically observed species mixtures are used to apportion the acoustic backscatter to species, and the optically estimated fish length distributions are used in conjunction with one or more models of acoustic target strength to convert the echo energy to biomass densities, by species. These biomass densities may be mapped. Finally, the biomass densities are multiplied by the areas of the potential habitat to estimate rockfish biomasses.

This combination of methods, known as the Collaborative Optical–Acoustic Survey Technique (COAST), has been employed and refined by researchers at SWFSC since 2003. Initial studies were conducted during November 2003 through April 2004 from CPFV *Outer Limits*. These field efforts focused on characterizing 1) the acoustical spectral signatures for the various species encountered; 2) the site fidelity of the rockfish; 3) the diel behaviors of the rockfish; and 4) the temporal variability of the mixed species assemblages.

During the subsequent survey effort, October 2004 through May 2005 from *Outer Limits* and NOAA ship *David Starr Jordan*, the focus was to estimate the distributions and abundances of rockfishes, by species, throughout the SCB. The cameras were deployed from a remotely operated vehicle (ROV). The physical oceanographic habitat was characterized using a conductivity-temperature-depth probe (CTD) with a dissolved oxygen sensor and an acoustic Doppler current profiler (ADCP), and the seabed was characterized using multi-frequency and multi-beam echosounders. Additionally, passive-acoustic measures were evaluated for their potential to monitor the health of rockfish stocks.

Objectives

This report documents a second, refined COAST survey of rockfishes throughout the SCB. The 2007 COAST survey was conducted in four legs, each approximately 15 days in duration: Leg I, 8/26-9/9; Leg II, 9/13-9/27; Leg III, 10/1-10/15; and Leg IV, 10/19-10/31. Ultimately, it will be necessary to combine the repeated estimates of rockfish distributions and abundances in the SCB with measures of the dynamics and environmental influences of rockfish recruitment processes and the dispersion or redistribution of recruits from protected to harvested areas. Such collective knowledge will provide a basis for a longer term and broader spatial-scale assessment of rockfish, and assure the effectiveness of the protected areas in the SCB.

Description of operations

After departing from San Diego circa noon on 26 August, 2007, *David Starr Jordan* dropped anchor off Shelter Island, San Diego Bay, for approximately 6 hrs to calibrate the echosounders (Simrad EK60). Immediately following the calibration, the ROV was launched to test buoyancy and system functions. Then, the multi-beam transducer was installed on the pole and the pole was mounted on the ship's port-side. The ship then proceeded to the 43 Fathom Bank. There, as at all of the survey sites (**Table 1** and **Fig. 1**), the following sequence was generally followed:

1. Deployed a passive acoustic logger (dawn);
2. Conducted an active-acoustic survey of the site (daytime only);
3. Ran one or more ROV transects at the site (daytime only);
4. Cast a CTD near the center of the site (day or night); and
5. Recovered a passive-acoustic logger (day).

The multi-frequency echosounder survey and ROV transects took priority over all other activities. The echosounder surveys were conducted between sunrise and sunset. The ROV was deployed between sunrise and approximately 1730. The CTD casts and the recoveries of the passive-acoustic loggers were also conducted during daylight hours. The multi-beam transects and the deployments of the passive-acoustic loggers were conducted exclusively at nighttime.

The 43 Fathom Bank site was surveyed twice during Leg I and once each during Legs II, III and IV, for a total of 5 replicates. At the beginning of Leg I, a long-duration passive acoustic logger (AURAL) was deployed at the 43 Fathom Bank. This logger was recovered at the end of Leg IV. Additionally, during nighttime hours of Leg I only, multi-beam surveys were conducted at 109 Seamount, and 43 Fathom, Cortes, and

Tanner Banks. At night during Legs II-IV, the ship 1) deployed the CTD, 2) deployed passive-acoustic loggers, and 3) transited to the next survey segment and was staged to begin the next echosounder survey segment or ROV transect at sunrise.

Summary of results

The rockfishes in each of 47 selected areas of the SCB (**Fig. 1.1**) were mapped using a combination of multiple-frequency echosounders (Simrad EK60); high-resolution video and still cameras deployed from an ROV; a CTD (SBE 19+); a multi-beam sonar (Simrad SM2000), for a few sites; and passive-acoustic loggers (Multi-Electronique, AURALs). These areas and waypoints were selected from the results of the COAST 2003 and 2004 surveys, and the collective records from multiple fishing masters in the commercial fleet (courtesy of Ken Franke). The total trackline, with 0.1 to 0.2 n.mi. transect spacing, totaled approximately 2654 n.mi. Surveys were conducted between sunrise and sunset (approximately 1400 to 0100 GMT, 0700 to 1800 PST, or 11 hrs per day off daylight savings time or approximately 1245 to 0245 GMT, 0545 to 1945 PST, or 13.5-14 hrs per day; PST=GMT-7 hrs. during daylight savings), at a nominal speed of 7-10 kts. The rockfishes and seabed in each area were mapped using the acoustic backscatter data. The backscatter maps were used to navigate the ROV through the fish and the optical samples were used to identify fish species and their sizes. Ultimately, these data will be used to estimate rockfish biomasses, by species, throughout the SCB.

Scientific personnel

	Personnel	Activity	Institution	Nationality
Leg I:				
	Dr. David Demer	Cruise Leader/Acoustics	SWFSC	USA
	Dr. George Cutter	Active-acoustics/Multi-beam	SWFSC	USA
	Josiah Renfree	Active-acoustics	SWFSC	USA
	Dr. John Butler	Optics/ROV	SWFSC	USA
	Scott Mau	Optics/ROV	SWFSC	USA
	David Murfin	Optics/ROV	SWFSC	USA
Leg II:				
	Dr. George Cutter	Cruise Leader/Acoustics	SWFSC	USA
	Thomas S. Sessions	Active-acoustics	SWFSC	USA
	David Griffith	Optics/ROV	SWFSC	USA
	David Murfin	Optics/ROV	SWFSC	USA
	Scott Mau	Optics/ROV	SWFSC	USA
	Noelle Bowlin	Optics/ROV	SWFSC	USA
Leg III:				
	Deanna Pinkard	Cruise Leader/Optics/ROV	SWFSC	USA
	Dr. Ana Širović	Active-/Passive-acoustics	SWFSC	Croatia
	Thomas S. Sessions	Active-Acoustics	SWFSC	USA
	Scott Mau	Optics/ROV	SWFSC	USA
	Anthony Cossio	Optics/ROV	SWFSC	USA
	Derek Needham	Active-/Passive-acoustics	STS	South Africa
Leg IV:				
	Dr. John Butler	Cruise Leader/Optics/ROV	SWFSC	USA
	Dr. Ana Širović	Active-/Passive-acoustics	SWFSC	Croatia
	Josiah Renfree	Active-acoustics	SWFSC	USA
	Scott Mau	Optics/ROV	SWFSC	USA
	Thomas Laidig	Optics/ROV	SWFSC	USA
	David Ambrose	Optics/ROV	SWFSC	USA
	Dale Sweetnam	Optics/ROV	CDFG	USA

SWFSC- Southwest Fisheries Science Center; CDFG- California Department of Fish and Game; STS- Sea Technology Services

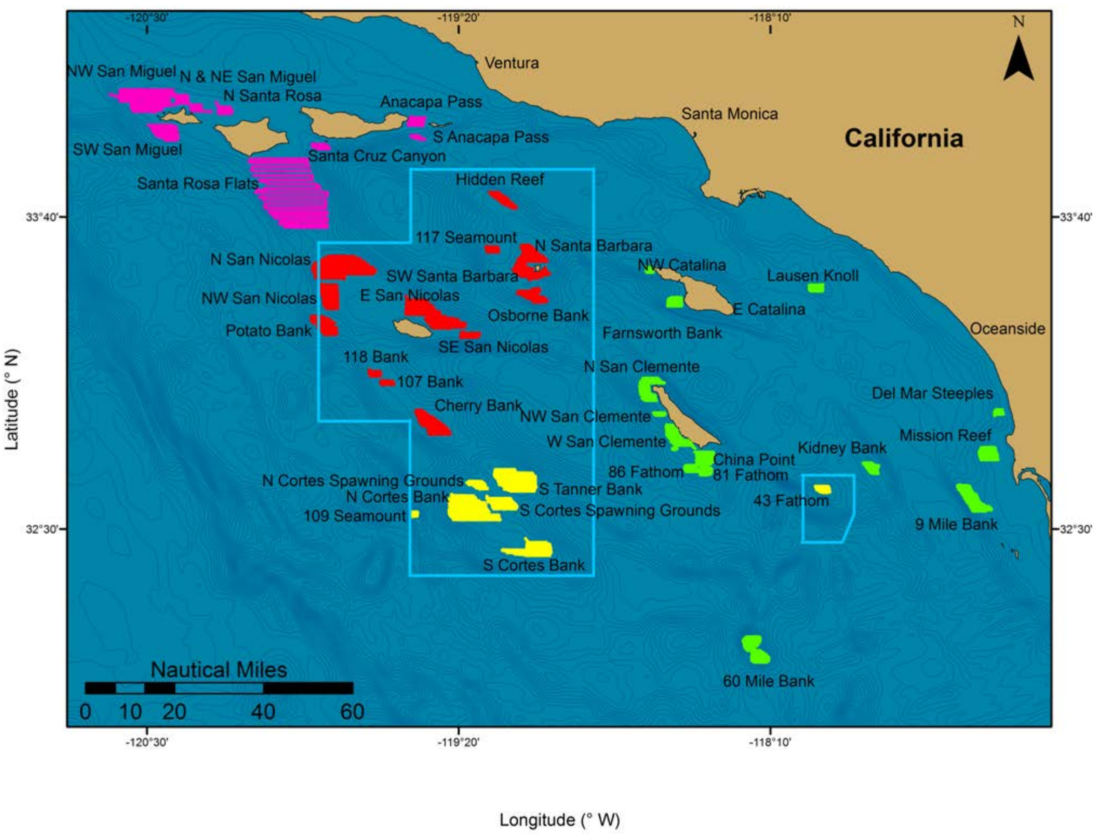
Cruise reports

1 Multi-frequency echosounder survey, submitted by David A. Demer (Leg I), George (Randy) Cutter (Legs I and II), Josiah S. Renfree (Legs I and IV), Thomas S. Sessions (Legs II and III), Ana Širović (Legs III and IV), Derek Needham (Leg III), Deanna Pinkard (Leg III), and Kyle Byers (Legs I-IV).

1.1 Objectives

The goal of the multi-frequency echosounder survey was to map the distributions of rockfishes in each of 47 selected areas of the SCB (**Fig. 1.1**) using the Collaborative Optical-Acoustic Survey Technique (COAST). Then, combining this information with the estimates of species proportions and their length distributions from the optical measurements, estimate the abundances of rockfishes in the Southern California Bight (SCB), by species.

Figure 1.1. COAST07 survey sites. Acoustic surveys were conducted at each of 47 sites (Leg I, yellow; Leg II, red; Leg III, purple; and Leg IV, green); the 43 Fathom Bank was surveyed twice during Leg I and once each during Legs II, III and IV, for a total of 5 replicates. The acoustically-estimated distributions of rockfish densities were used to direct multiple ROV transects at each site, to optically estimate species mixture and their sizes. The Cowcod Conservation Area (CCA) is outlined in light blue.



1.2 Accomplishments

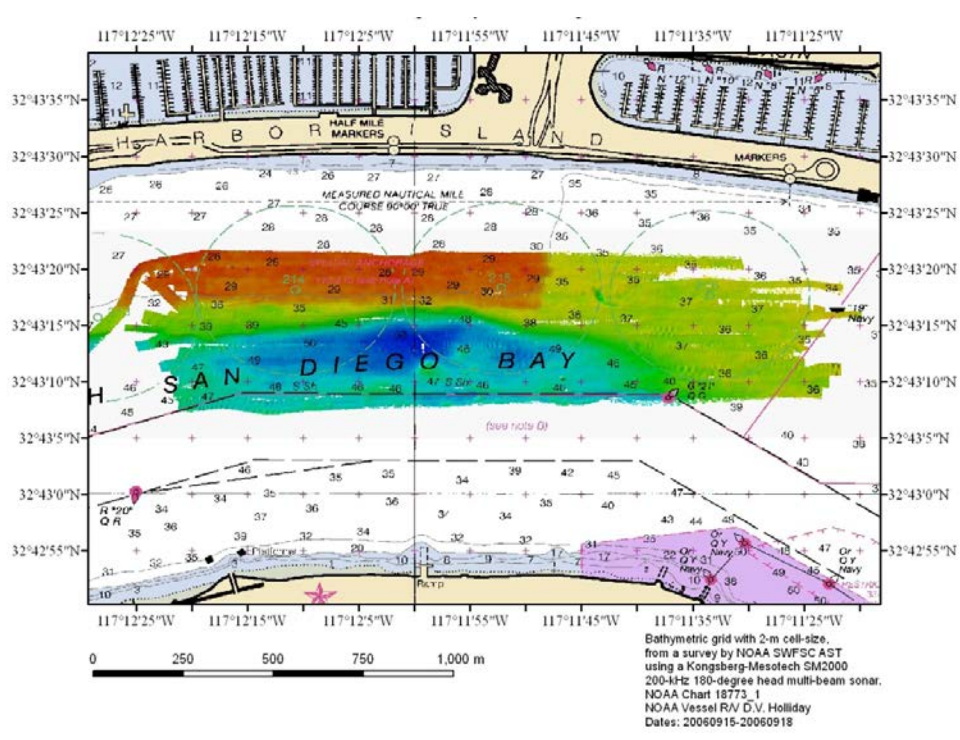
Multiple-frequency echosounders (Simrad EK60s) were used to sample grids with 0.2 n.mi. transect spacing (0.1 n.mi. for smaller sites) at 47 sites in the SCB (**Fig. 1.1**). These areas and waypoints were selected from the results of the COAST 2003 and 2004 surveys, and the collective records from multiple Fishing Masters in the commercial fleet (courtesy of Ken Franke). Surveys were conducted between sunrise and sunset (approximately 1400 to 0100 GMT, 0700 to 1800 PST, or 11 hrs per day off daylight savings time or approximately 1245 to 0245 GMT, 0545 to 1945 PST, or 13.5-14 hrs per day; PST=GMT-7 hrs. during daylight savings), at a nominal speed of 7-10 kts. The total trackline, with 0.2 n.mi. transect spacing (0.1 n.mi. for smaller sites), totaled approximately 2654 n.mi.. The rockfishes and seabed in each area were mapped using the backscatter data.

1.3 Methods

Throughout the survey, acoustical volume backscattering strength (S_v; dB re 1 m) and target strength (TS; dB 1 m^2) values were measured continuously by four echosounders (Simrad EK60) configured with 38, 70, 120, and 200 kHz hull-mounted transducers. The transducers, each with 7º beamwidths, were mounted at a depth of approximately 3.7 m. Synchronized pulses of 512 µs were transmitted downward every second, and received with bandwidths of 3.675, 6.163, 8.710, and 10.635 kHz, respectively (Simrad "raw" data format). These data were averaged every 1 m in range and stored in the "EK500" data format. Data corresponding to ranges of 500 m beneath the transducers were recorded in both formats on computer hard disk and archived on external USB V2.0 hard disk and DVD+R media. Data were processed with Echoview V3.30.58.03, and distribution maps were created with ArcGIS/Map 9.0.

The echosounders were calibrated prior to the survey, on the first day of Leg I. The ship sailed at 0800 and anchored over the deep area (32° 43.20' N, 117° 12.0' W) of the special anchorages off Shelter Island, San Diego Bay (**Fig. 1.2**), and was ready to calibrate at 1200.

Figure 1.2. Bathymetry of the special anchorages off Shelter Island, San Diego Bay. The echosounder calibrations were conducted here the first day of Leg I. The ship sailed at 1100 PST and was anchored over the deep area (32° 43.20' N, 117° 12.0' W) shown as dark blue, and ready to calibrate by 1200.



After configuring the echosounders with the calibration results (**Table 1.1**), surveys were conducted at a speed of nominally 10 kts, between sunrise and sunset (approximately 13 to 11 hrs over this 60-day period). Each night, activities ceased at a time that allowed the ship to be staged to begin the next echosounder or ROV transect at sunrise. The Acoustic transect lines replicated those surveyed during COAST 2004 (**Fig. 1.1**), except that they were all shifted north by ½-transect spacing. Waypoints were supplied to the ship in Nobeltec format.

Table 1.1. Summary of EK60 pre-survey calibration on 26 August, 2007

Standard	38.1 mm diameter tungsten-carbide sphere			
Location	32º 043.260' N / 117º 11.960' W			
Water Depth	~12 m below transducers			
Sphere Range	~8 m			
Temperature	23.9 ºC			
Salinity	34.17 PSU			
	38 kHz	**70 kHz**	**120 kHz**	**200 kHz**
Transducer Model	ES38B	ES70-7C	ES120-7C	ES200-7C
Serial Number	27281	108	27612	238
Absorption Coeff. (dB/km)	6.664	19.856	45.154	79.808
Replay results				
Transmit Power (W)	2000	1000	500	300
Pulse duration (µs)	512	512	512	512
Transducer Gain (dB)	24.34	26.52	20.21	24.96
Sa corr. (dB)	-0.68	-0.46	-0.56	-0.33
Athwartship Angle (deg.)	7.29	6.22	7.36	7.10
Alongship Angle (deg.)	6.82	6.38	7.34	7.34
Athwartship offset (deg.)	-0.04	-0.03	-0.10	-0.01
Alongship offset (deg.)	-0.03	0.02	0.08	0.01
RMS	0.54	0.58	0.37	0.47
Downrigger readings when the sphere was centered on-axis				
Port Forward		56	56	54
Starboard amidship		54	52	53
Port Aft		54	51	53

During the survey, all other echosounders and sonars operating at or near the survey frequencies were secured during all survey operations. These included the ship's 200 kHz Doppler speed log and 200 kHz bridge echosounder. The ship's 150 kHz broad bandwidth ADCP was operated during the cruise and was triggered synchronously with the EK60 transmissions. The ship's 50 kHz ES60 navigation sounder was used in passive-mode so as not to interfere with the EK60 measurements. Despite these precautions, appreciable noise degraded the echograms at all frequencies when surveying in inclement weather and swell.

For each of the survey sites, a three-dimensional (3-D) seabed was visualized by interpolating the seabed detections from the 38 kHz echosounder to render a surface. Empirical relationships between the S_v at four frequencies (38, 70, 120, and 200 kHz) were used to remotely identify and separate the scatterer taxa (i.e., large fish, small fish, and zooplankton). The integrated volume backscattering coefficients (s_A; m^2/nm^2) attributed to rockfishes were mapped in plan view (e.g., **Figs. 1.3**). The 3-D backscatter from rockfishes was overlaid on 3-D rendering of the seabed (e.g., **Fig. 1.4**).

Following the acoustic surveys of each site, maps of rockfish distribution and abundance were also generated in Geotiff format. These maps were used to direct the ROV transects at each site covering strata with low- and high-densities of rockfish (lower 30% of CDF and upper 70% of CDF, respectively), at shallow (<150 m) and deep depths (>150 m). The high resolution underwater video and still-camera images were used to estimate the fish species mixtures and their size distributions, and validate the acoustical seabed classifications.

At the conclusion of each survey segment or day, a conductivity-temperature-depth probe (Seabird Electronics 19plus CTD) was deployed in the area to within 5 m of the seabed. For each deployment, the CTD was submerged to a depth of nominally 3 m for 2 min; then beginning at the surface, the CTD was cast to within 5 m of the seabed at 60 m/min, and then retrieved at the same rate. Thus, temperature, salinity, and sound speed profiles were recorded at one or more positions within each survey location. If daytime, the ship then transited to the next cruise segment and began surveying until it was completed, or until sunset. At night, the ship either: 1) transited to the next survey segment; or 2) anchored or hove to, and was staged to begin the next echosounder survey segment at sunrise. The temperature and salinity of the surface waters (3 m depth) were continuously measured using the ship's Seabird thermosalinograph and the Scientific Computing System (SCS). These data were automatically merged with the time and position data from the ship's GPS and logged by computer each minute.

1.4 Preliminary results

COAST07 Leg I

43 Fathom Bank 1A: The survey began on 27 August 2007 at 1325 and ended at 1556 GMT the same day (**Figs. 1.3 and 1.4**).

43 Fathom Bank 1B: The survey began on 27 August 2007 at 2059 and ended at 2321 GMT the same day. (**Figs. 1.5 and 1.6**).

S Tanner Bank: The survey was conducted in two parts. Part 1 began on 28 August 2007 at 1320 and ended on 29 August 2007 at 0218 GMT. Part 2 began on 29 August 2007 and ended on 30 August 2007 at 0107 (**Figs. 1.7 and 1.8**).

N Cortes Spawning Grounds: The survey began on 31 August 2007 at 1329 and ended on 31 August 2007 at 1613 GMT (**Figs. 1.9 and 1.10**).

S Cortes Spawning Grounds: The survey began on 31 August 2007 at 1633 and ended on 31 August 2007 at 2323 GMT (**Figs. 1.11 and 1.12**).

N Cortes Bank: This survey was conducted in seven parts. Part 1 began on 1 September 2007 at 0032 and ended at 0223 GMT the same day. Part 2 began on 1 September 2007 at 2055 and ended on 2 September at 0219. Part 3 began on 3 September 2007 at 0026 and ended at 0201 the same day. Part 4 began on 3 September 2007 at 2137 and ended on 4 September 2007 at 0156. Part 4a began on 4 September 2007 at 1307 and ended at 2125 the same day. Part 4b began on 5 September 2007 at 0005 and ended at 0232 the same day. Part 5 began on 5 September 2007 at 1433 and ended on 6 September 2007 at 0237. Part 6 began on 6 September 2007 at 1349 and ended at 2221 the same day. Part 7 began on 7 September 2007 at 1540 and ended at 1636 the same day. (**Figs. 1.13, 1.14, 1.15, and 1.16**)

S Cortes Bank: This survey was conducted in two parts. Part 1 began on 6 September 2007 at 2307 and ended on 7 September 0209 GMT. Part 2 began on 8 September 2007 at 1659 and ended on 9 September 2007 at 0109. (**Figs. 1.17 and 1.18**)

109 Seamount: The survey began on 7 September 2007 at 2334 and ended on 8 September 2007 at 0104 GMT. (**Figs. 1.19 and 1.20**)

Table 1.1. COAST07 Leg I survey sites, dates, and times (GMT).

Survey Location	Start Date	Start Time	End Date	End Time
43 Fathom Bank Multi-beam 1	8/26/07	0453	8/26/07	1315
43 Fathom Bank 1A	8/27/07	1325	8/27/07	1556
43 Fathom Bank ROV 1	8/27/07	1727	8/27/07	2031
43 Fathom Bank 1B	8/27/07	2059	8/27/07	2321
43 Fathom Bank Multi-beam 2	8/28/07	0011	8/28/07	0600
S Tanner Bank	8/28/07	1320	8/29/07	0218
S Tanner Bank Multi-beam 1	8/29/07	0254	8/29/07	1230
S Tanner Bank ROV 1	8/29/07	1257	8/29/07	1805
S Tanner Bank 2	8/29/07	2026	8/30/07	0107
S Tanner Bank Multi-beam 2	8/30/07	0110	8/30/07	1230
S Tanner Bank ROV 2	8/30/07	1350	8/31/07	0108
S Tanner Bank Multi-beam 3	8/31/07	0342	8/31/07	1200
N Cortes Spawning Grounds	8/31/07	1329	8/31/07	1613
S Cortes Spawning Grounds	8/31/07	1633	8/31/07	2323
N Cortes Bank (1)	9/1/07	0032	9/1/07	0223
N Cortes Bank Multi-beam 1	9/1/07	0321	9/1/07	1303
S Cortes Spawning Grounds ROV	9/1/07	1306	9/1/07	1701
N Cortes Bank (2)	9/1/07	2055	9/2/07	0219
N Cortes Bank Multi-beam 2	9/2/07	0224	9/2/07	1350
N Cortes Bank ROV 1	9/2/07	1352	9/2/07	2003
N Cortes Bank (3)	9/3/07	0026	9/3/07	0201
N Cortes Bank Multi-beam 3	9/3/07	0208	9/3/07	1332
N Cortes Bank ROV 2	9/3/07	1354	9/3/07	2107
N Cortes Bank (4)	9/3/07	2137	9/4/07	0156
N Cortes Bank (4a)	9/4/07	1307	9/4/07	2125
N Cortes Bank (4b)	9/5/07	0005	9/5/07	0232
N Cortes Bank Multi-beam #4	9/4/07	0238	9/4/07	1151
N Cortes Bank (5)	9/5/07	1433	9/6/07	0237
N Cortes Bank Multi-beam #5	9/6/07	0238	9/6/07	1321
N Cortes Bank (6)	9/6/07	1349	9/6/07	2221
S Cortes Bank Part 1	9/6/07	2307	9/7/07	0209
N Cortes Bank Multi-beam #6	9/7/07	0219	9/7/07	1041
N Cortes Bank ROV 3	9/7/07	1347	9/7/07	1526
N Cortes Bank (7)	9/7/07	1540	9/7/07	1636
N Cortes Bank ROV 4	9/7/07	1725	9/7/07	1937
109 Seamount ROV	9/7/07	2123	9/7/07	2331
109 Seamount	9/7/07	2334	9/8/07	0104
S Cortes Bank ROV	9/8/07	1320	9/8/07	1643
S Cortes Bank Part 2	9/8/07	1659	9/9/07	0109
N Cortes Bank Multi-beam #7	9/8/07	0108	9/8/07	0300
43 Fathom Bank ROV	9/9/07	1336	9/9/07	1539

Figure 1.3. Forty-Three Fathom Bank 1A distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

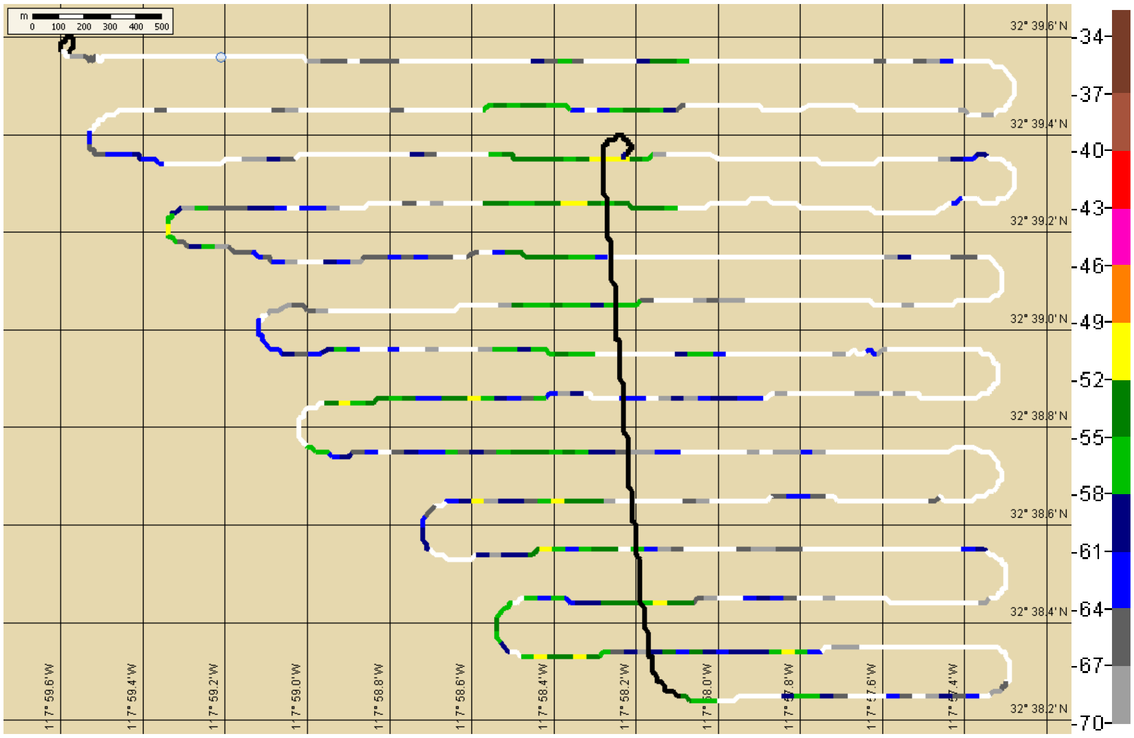


Figure 1.4. Forty-Three Fathom Bank 1A 3-D image of bathymetry (m) and S_v of rockfishes (dB).

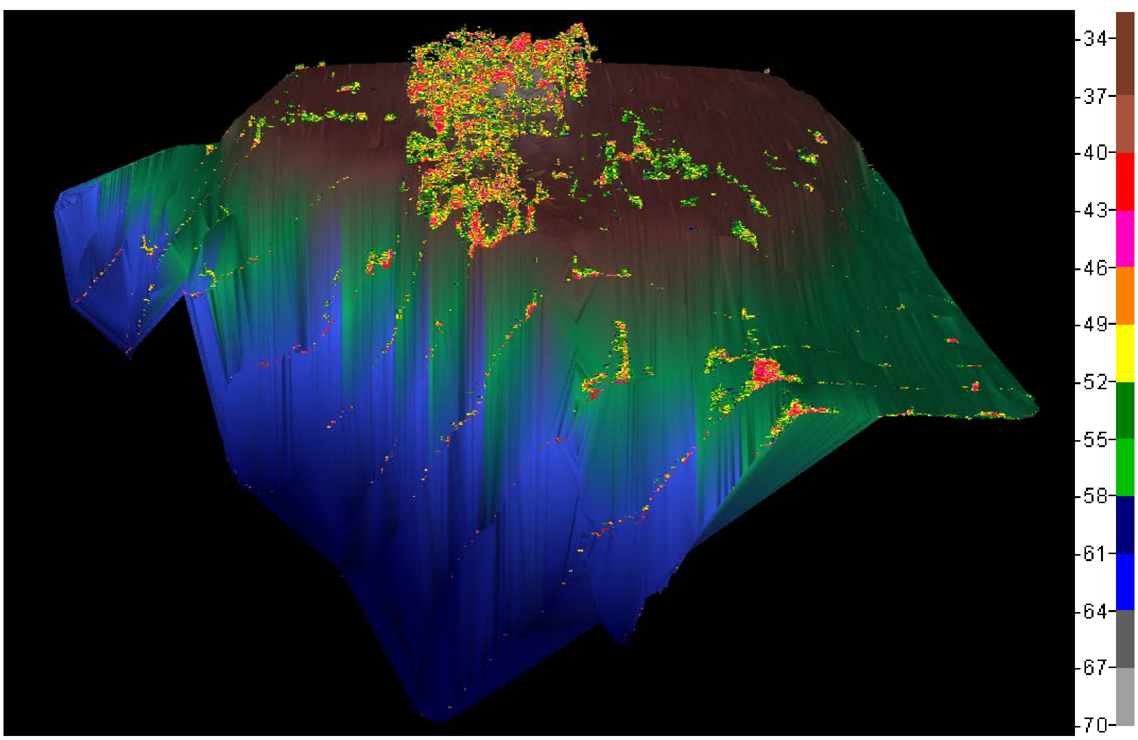


Figure 1.5. Forty-Three Fathom Bank 1B distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

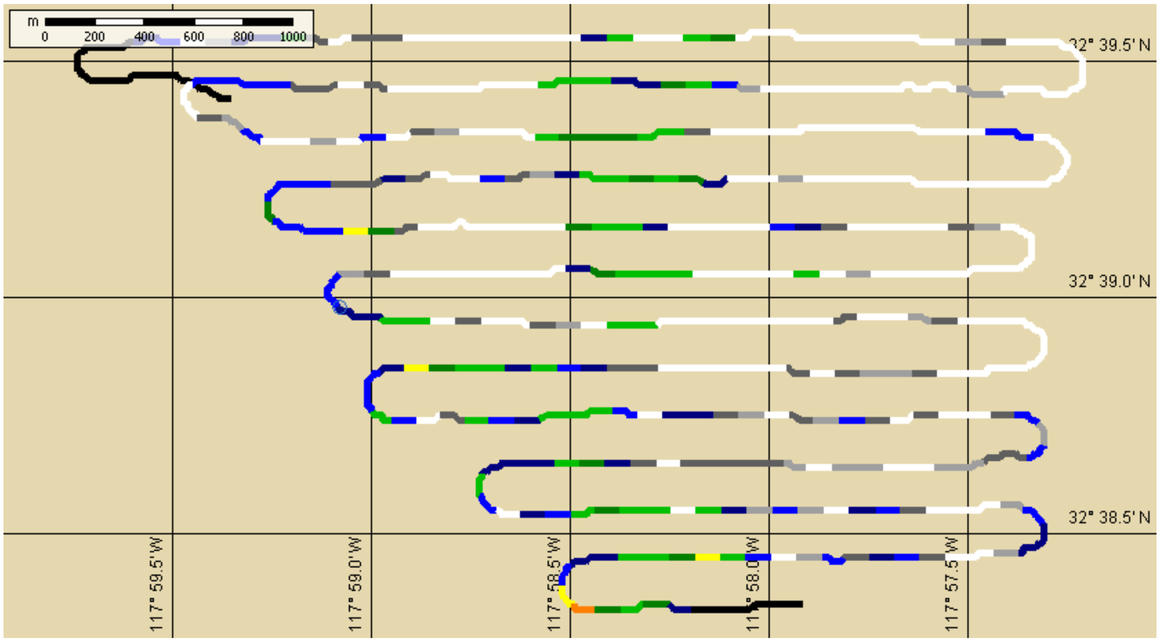


Figure 1.6. Forty-Three Fathom Bank 1B 3-D image of bathymetry (m) and S_v of rockfishes (dB).

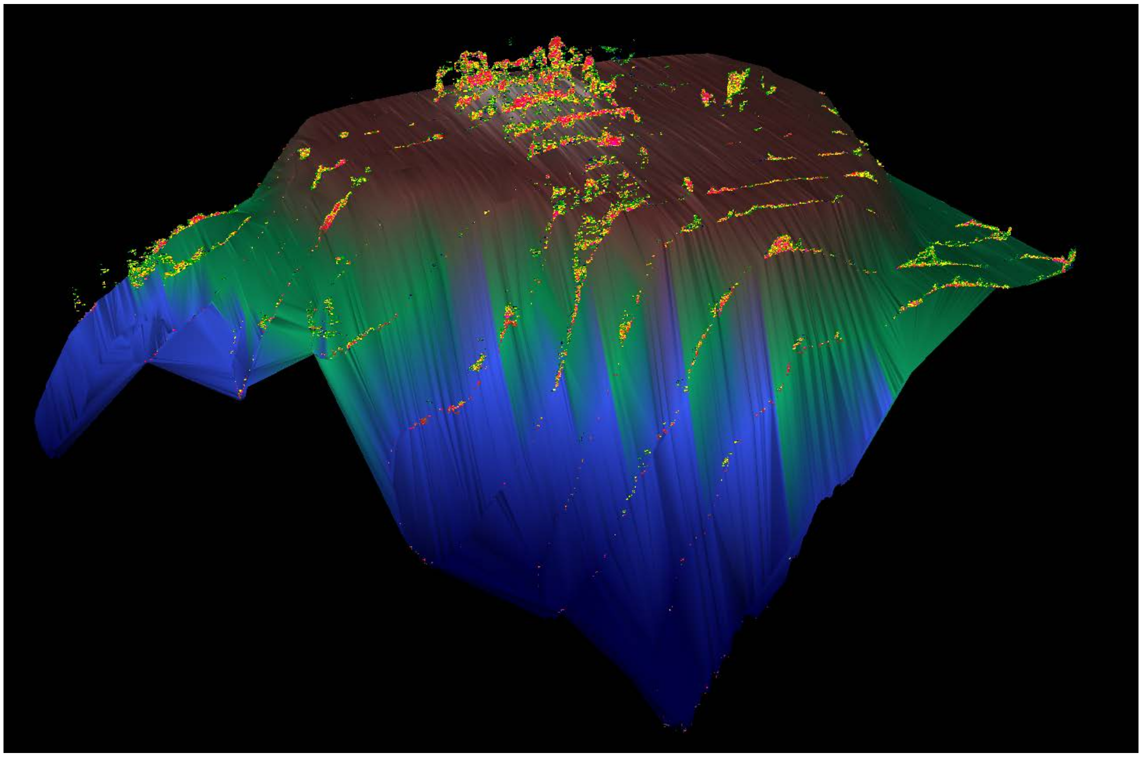


Figure 1.7. South Tanner Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

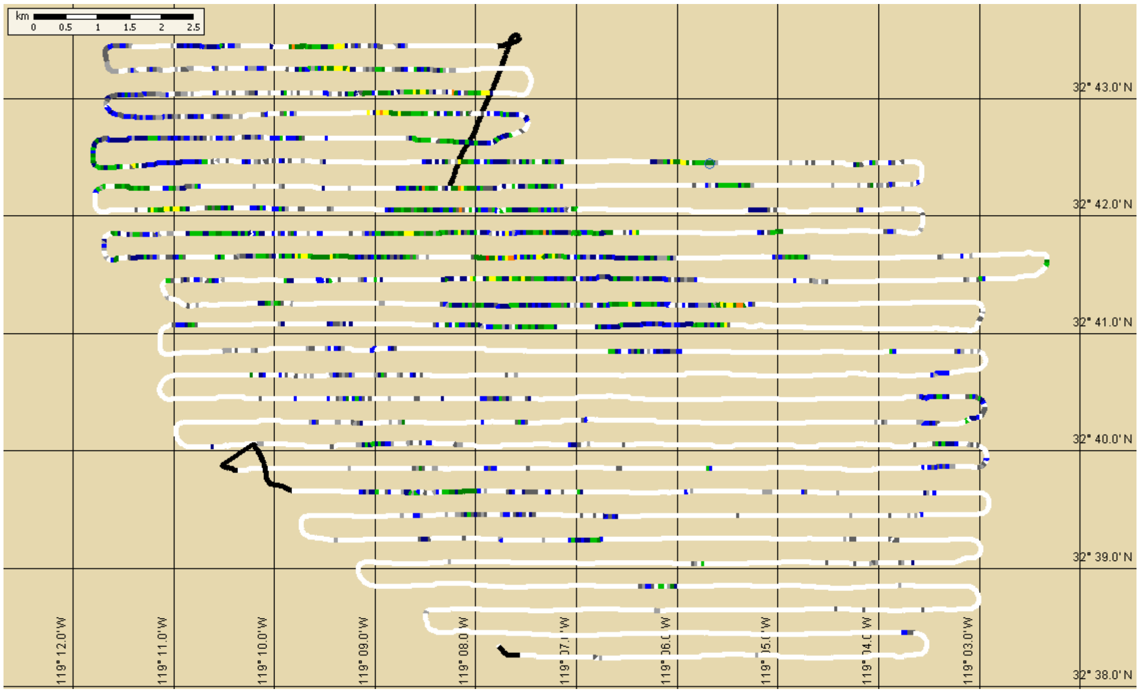


Figure 1.8. South Tanner Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

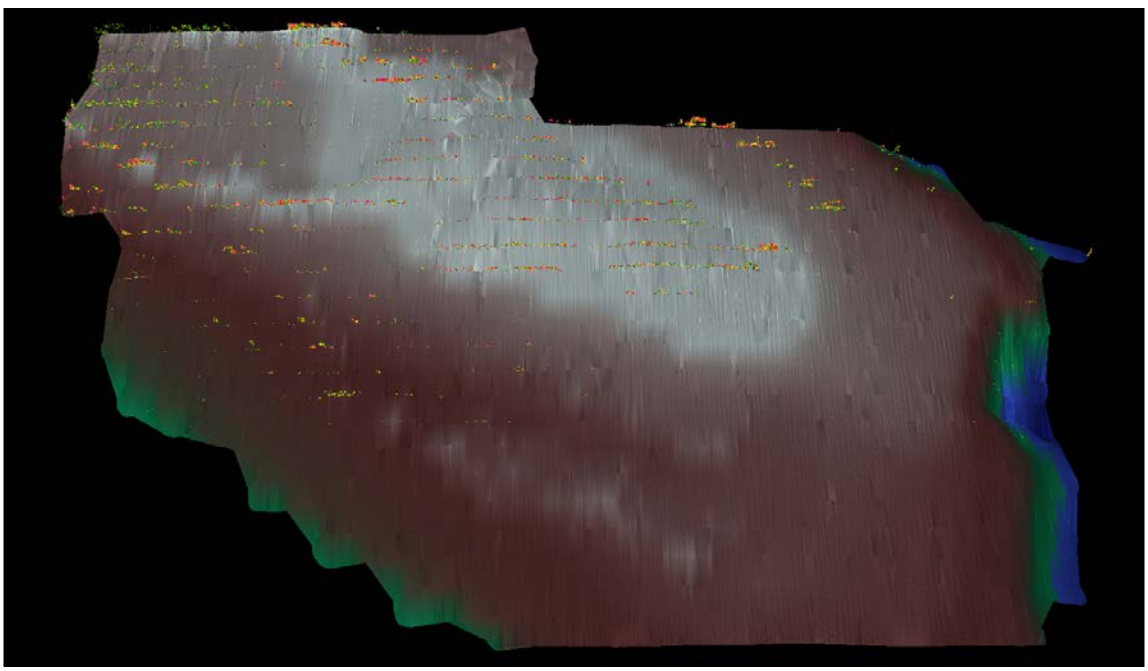


Figure 1.9. North Cortes Spawning Grounds distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

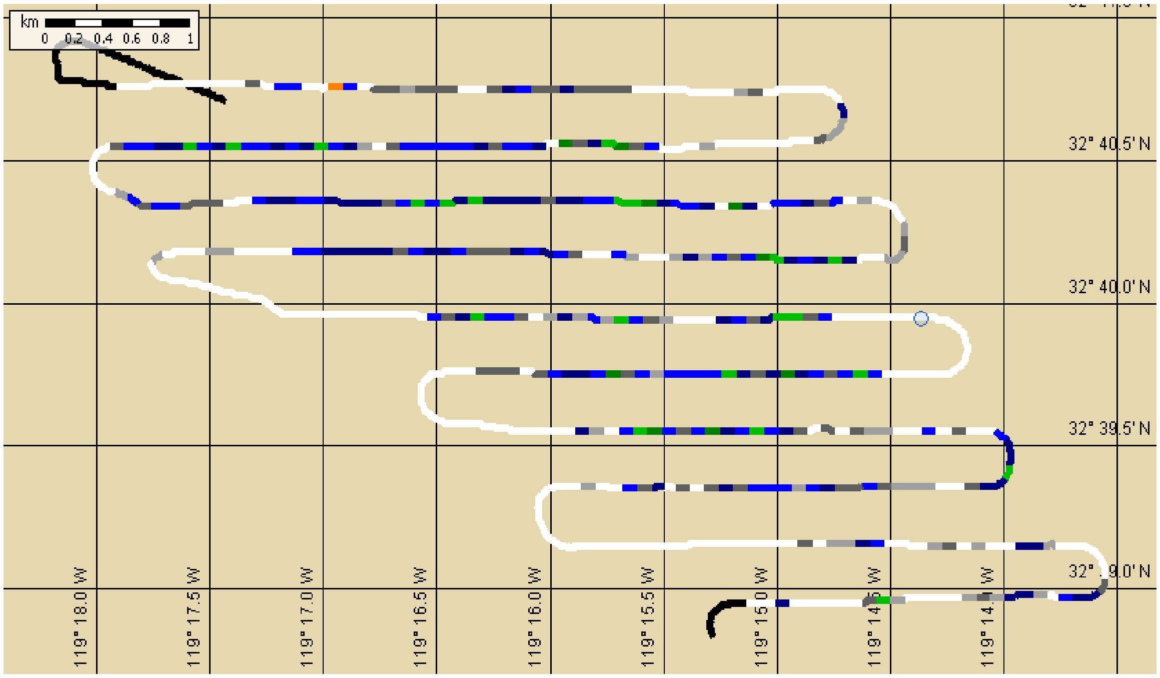


Figure 1.10. North Cortes Spawning Grounds 3-D image of bathymetry (m) and S_v of rockfishes (dB).

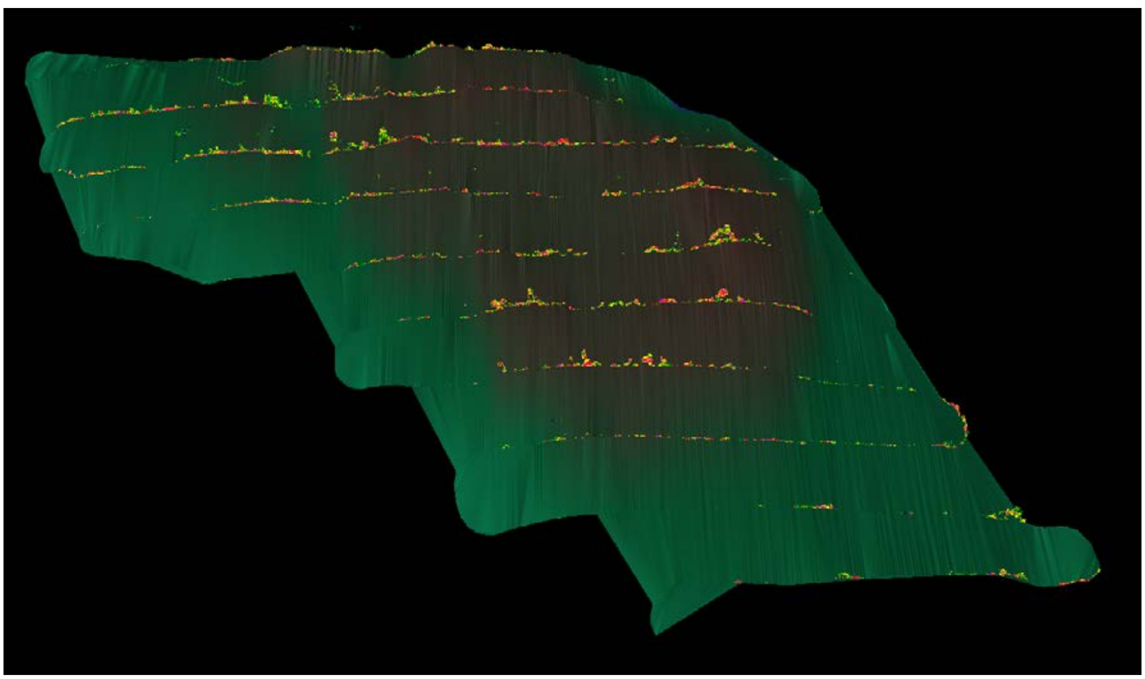


Figure 1.11. South Cortes Spawning Grounds distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

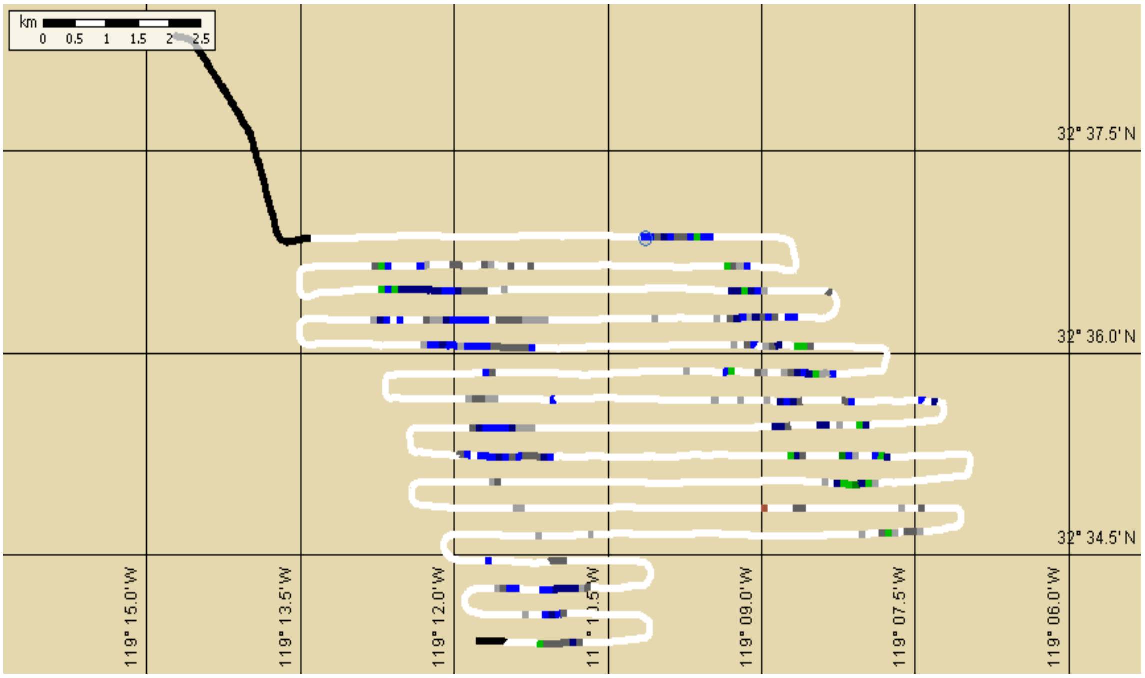


Figure 1.12. South Cortes Spawning Grounds 3-D image of bathymetry (m) and S_v of rockfishes (dB).

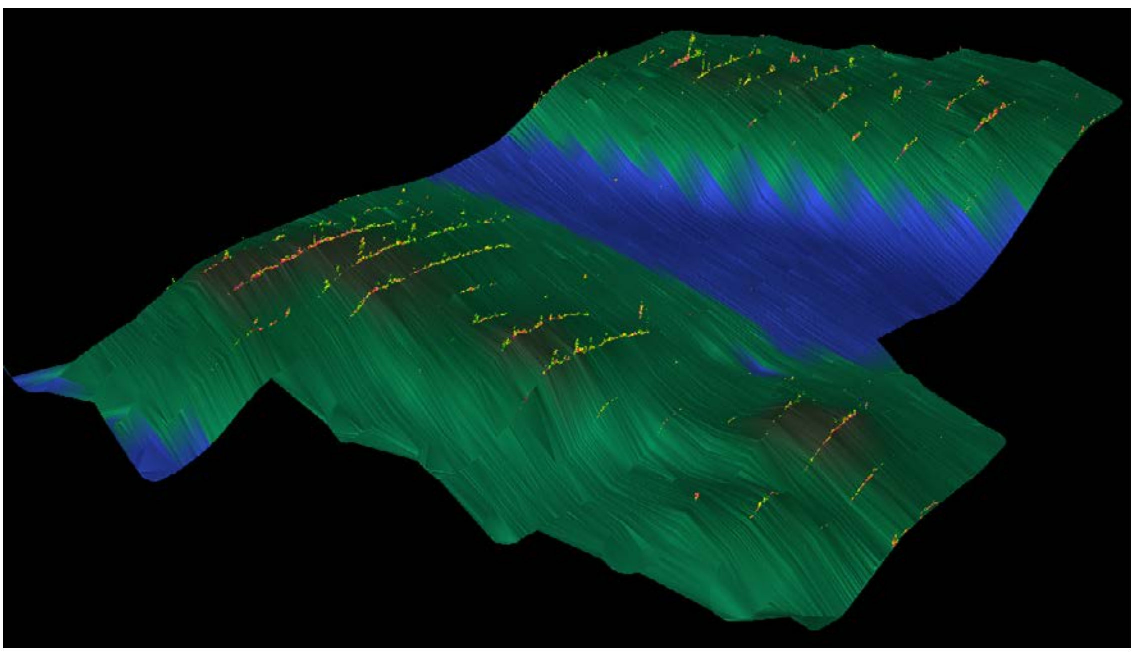


Figure 1.13. N Cortes Bank (Days 1 through 4) distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

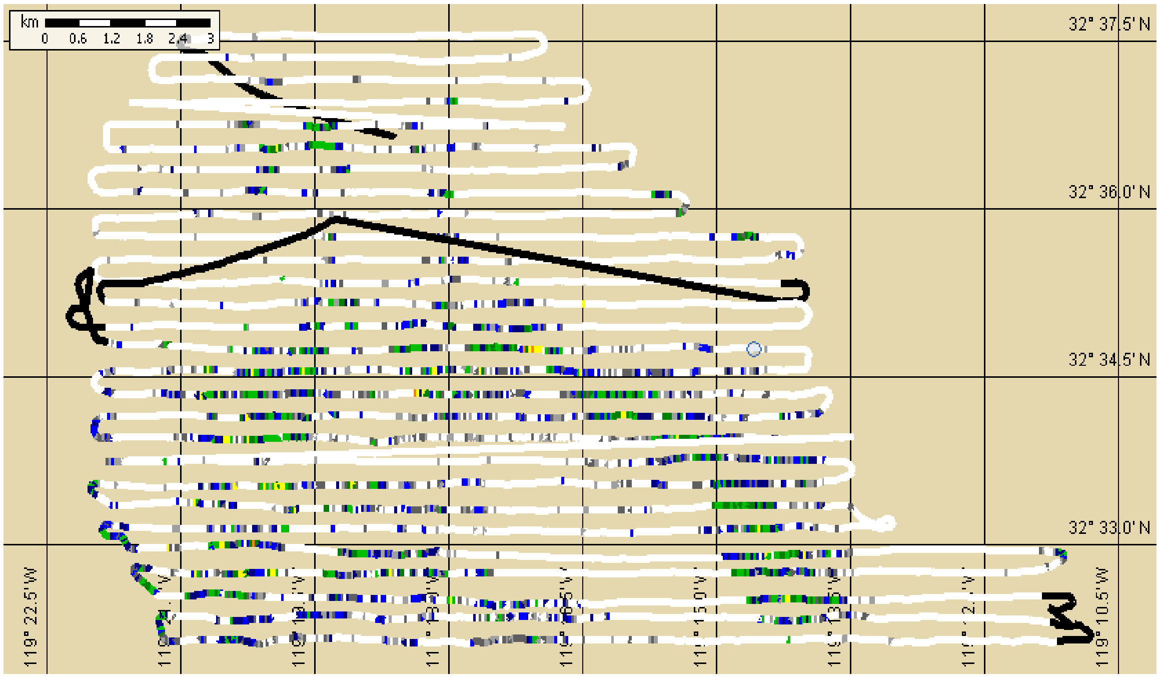


Figure 1.14. N Cortes Bank (Days 1 through 4) 3-D image of bathymetry (m) and S_v of rockfishes (dB).

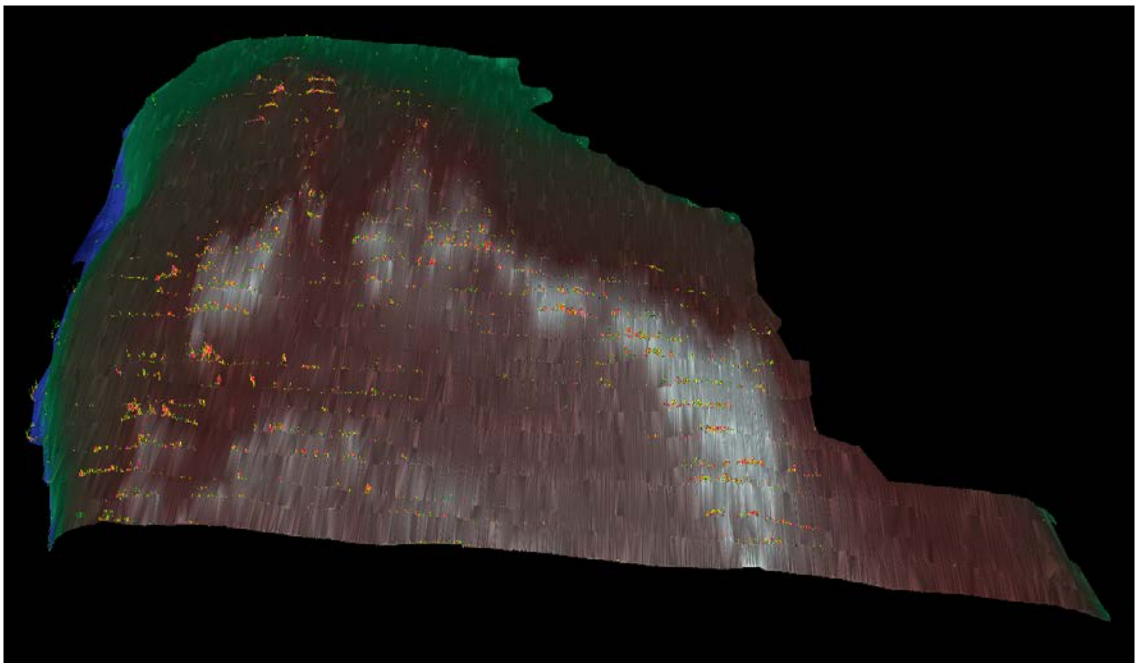


Figure 1.15. N Cortes Bank (Days 5 through 7) distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

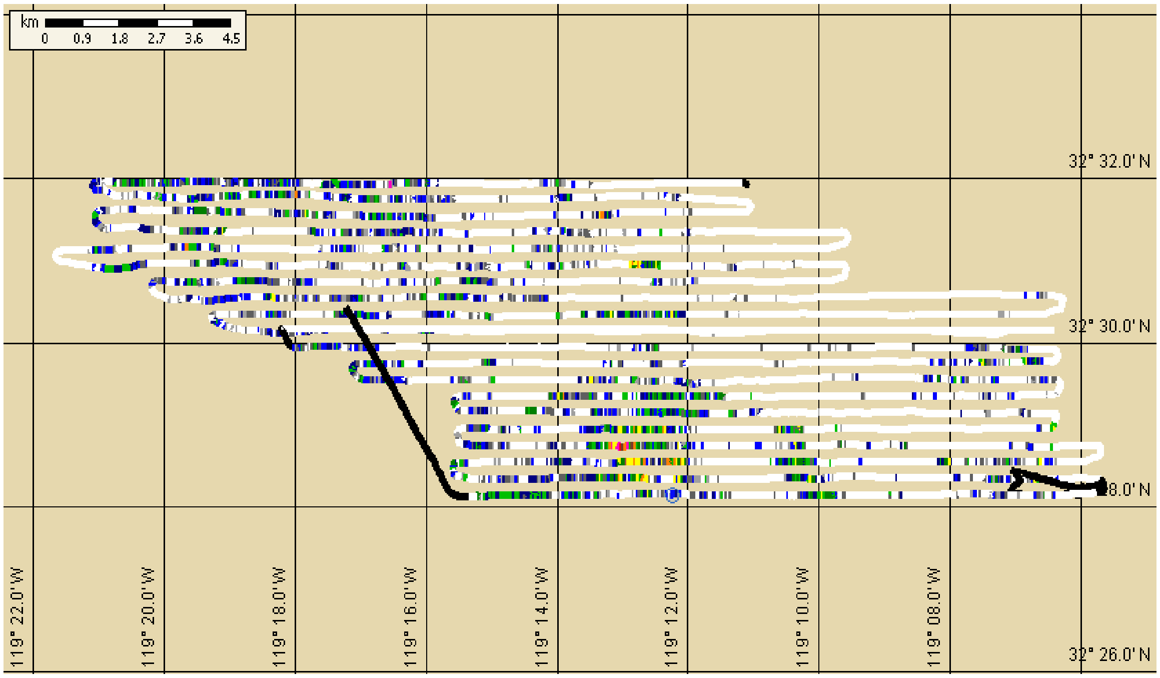


Figure 1.16. N Cortes Bank (Days 5 through 7) 3-D image of bathymetry (m) and S_v of rockfishes (dB).

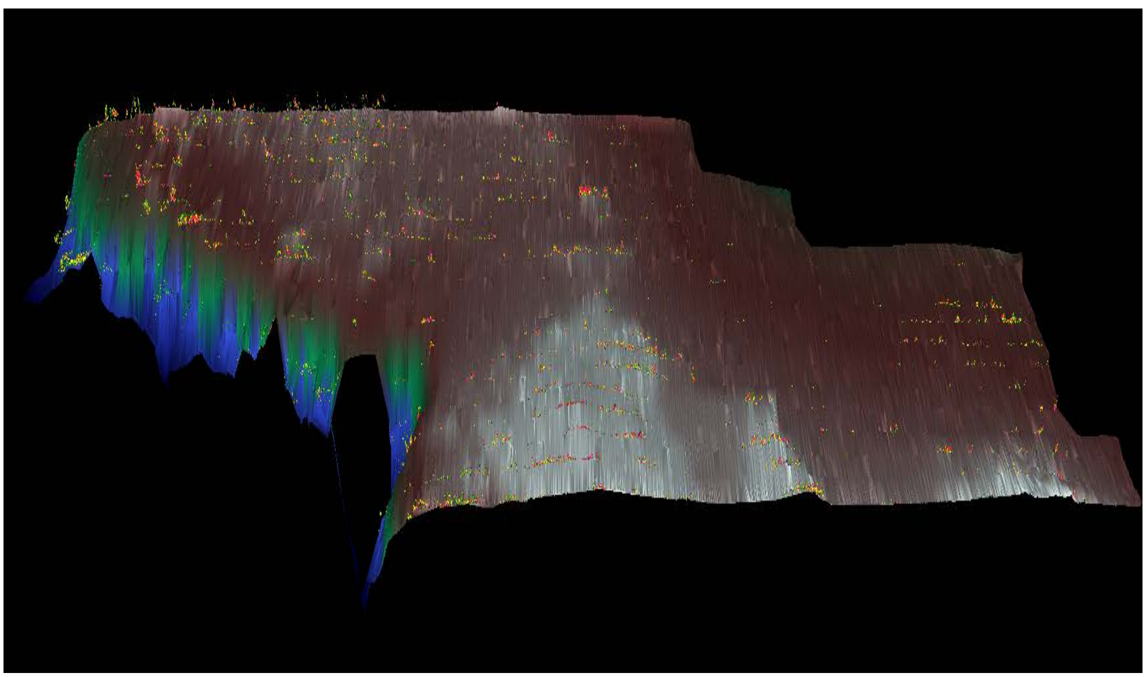


Figure 1.17. S Cortes Bank distribution of s_A ($m^2/n.mi.^2$) attributed to rockfishes

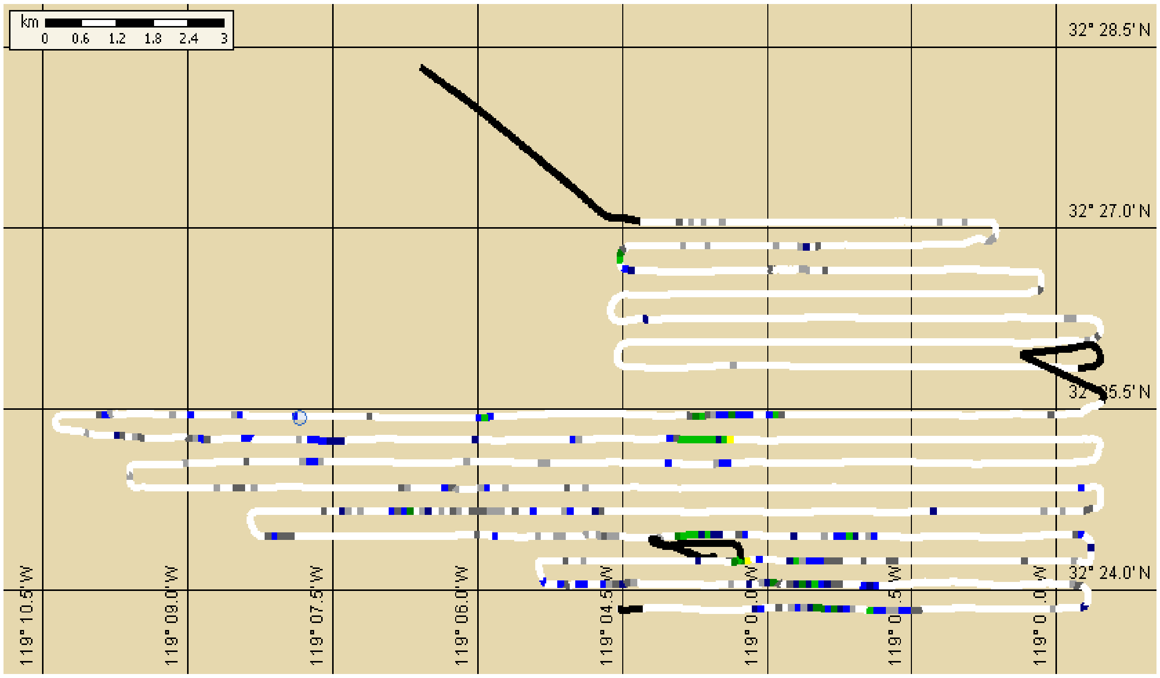


Figure 1.18. S Cortes Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

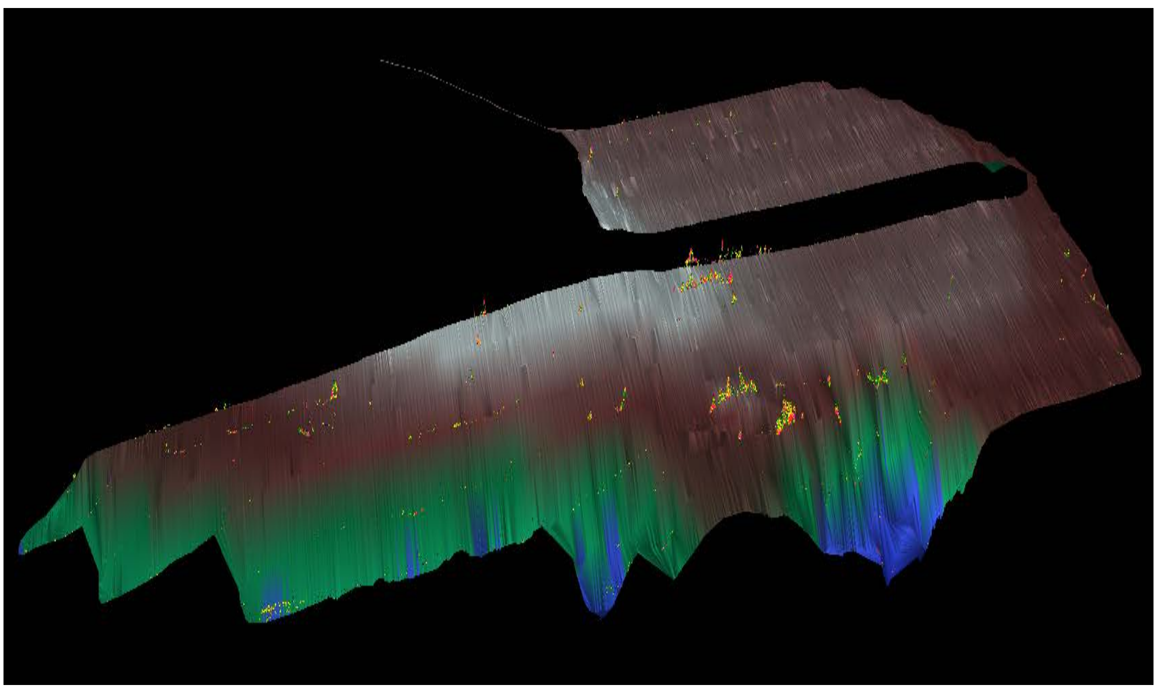


Figure 1.19. 109 Seamount distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes

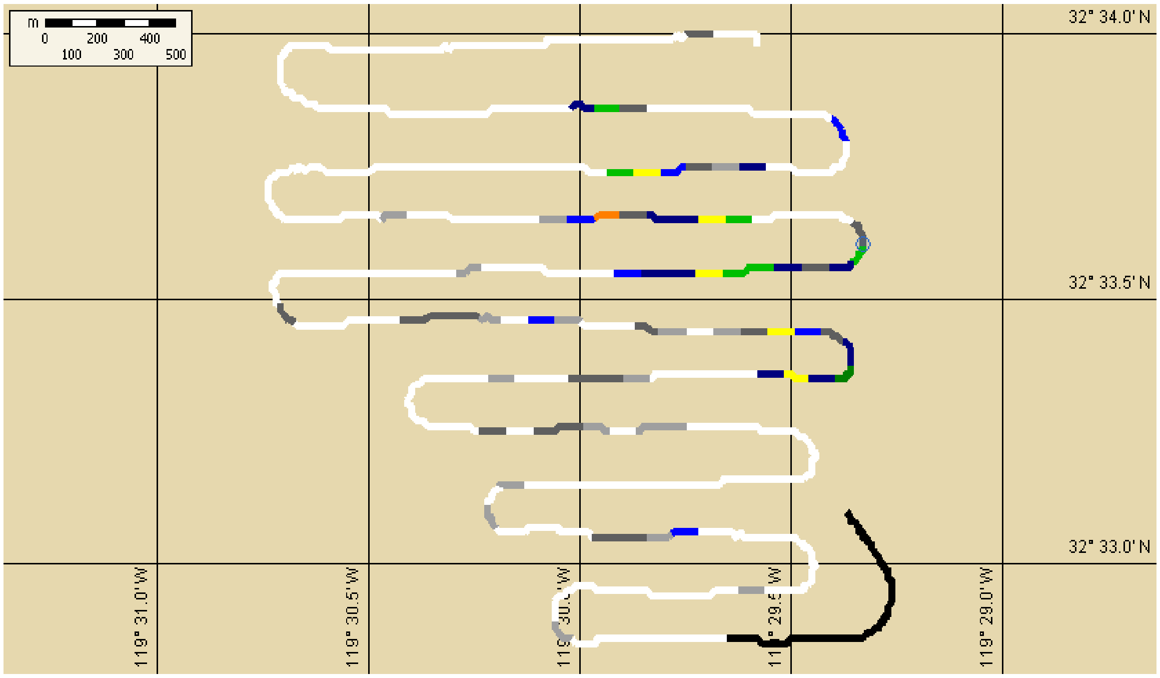
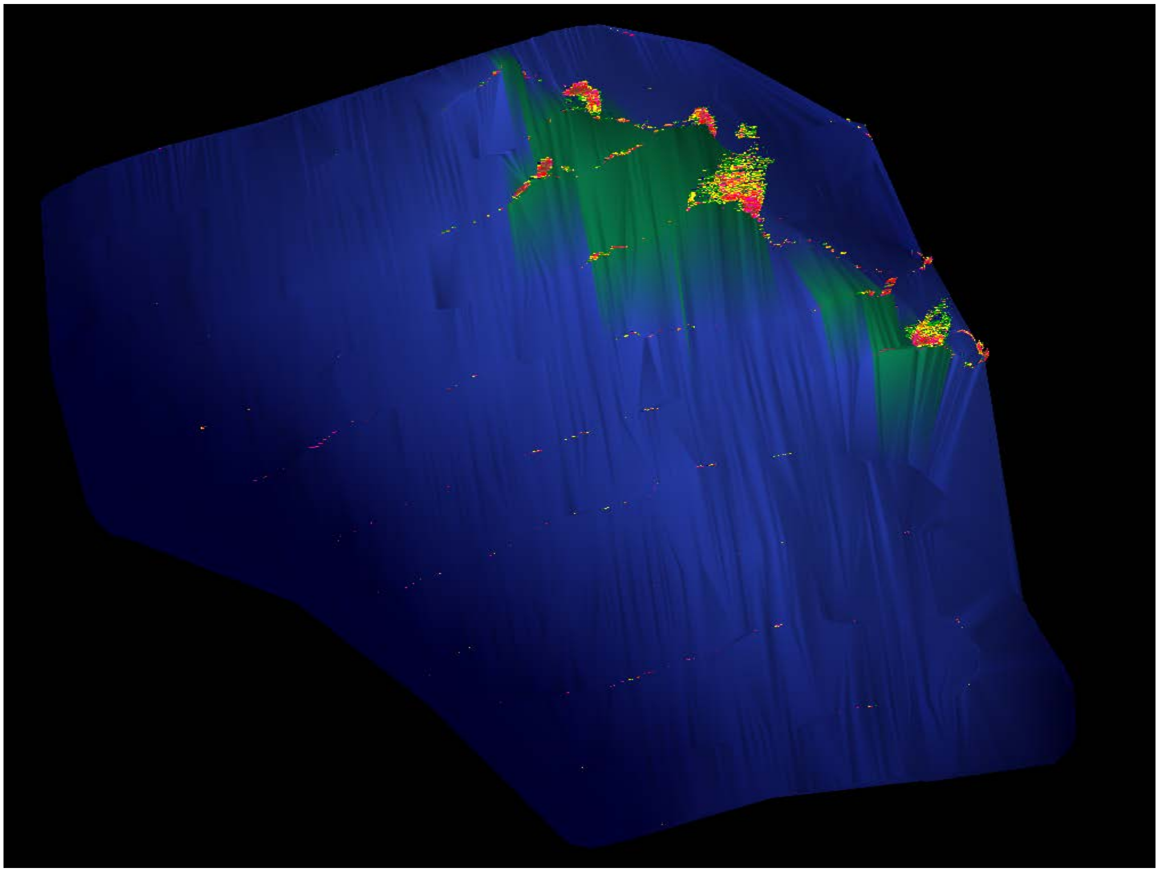


Figure 1.20. 109 Seamount 3-D image of bathymetry (m) and S_v of rockfishes (dB).



COAST07 Leg II

The ship sailed from the Scripps Institution of Oceanography's marine facility pier at 0025 on 14 September 2007, tied up to fuel dock, and took on fuel. The ship left the fuel dock at 1915. At 1957, data were being logged from the EK60s.

15 September 2007: At 0000 on 15 September 2007, the ship arrived at 43 Fathom Bank. The acoustic survey there began at 0007 and ended at 0201 (**Figs. 1.21 and 1.22**). A CTD (overall #12, Leg2 #1) was then cast there. At 1230, a PAL was deployed at N Santa Barbara Island (33 31.486 N, 119 04.04 W). The ship then proceeded to 117 Seamount. The acoustic survey of the 117 Seamount began at 1339 and ended at 1516 (**Figs. 1.23 and 1.24)**. A CTD (#13) was cast there at 1532. An ROV transect was conducted there between 1700 and 2129. The ship then proceeded to N Santa Barbara Island. An acoustic survey began there at 2135.

16 September 2007: A CTD (#14) was cast at N Santa Barbara Island at 0222 on 16 September 2007. The acoustic survey of N Santa Barbara Island resumed at 1352 and ended at 1700 (**Figs. 1.25 and 1.26**). A CTD (#15) was cast there at 1712. An ROV transect (dive #1) was conducted there between 1900 and 2145. Another ROV transect (dive #2) was conducted there beginning at 2205.

17 September 2007: The second ROV transect at N Santa Barbara Island ended at 0020 on 17 September 2007. The ship then proceeded to SW Santa Barbara Island. The acoustic survey began there at 0103, halted at sunset, 0203, resumed at 1346, and ended at 1950 (**Figs. 1.27 and 1.28**). The ship then proceeded to North Santa Barbara Island and recovered a PAL at 2030. The ship then proceeded to SW Santa Barbara Island to begin an ROV transect at 2225.

18 September 2007: The ROV transect at SW Santa Barbara Island ended at 0045 on 18 September 2007. The ship then proceeded to Osborne Bank where the acoustic survey was conducted between 0131 to 0201 and 1421 to 1844 (**Figs. 1.29 and 1.30**). An ROV transect was conducted there between 1903 and 2150, when a CTD (#16) was cast in the area. The ship then sailed to SE San Nicolas Island and began the acoustic survey at 2340.

19 September 2007: The acoustic survey of SE San Nicolas Island was halted at 0156 on 19 September 2007. A CTD (#18) was cast there at 0215. At 0700, DATA_02 storage disk crashed. At 1210, a PAL was deployed at E San Nicolas Island (33 18.019, 119 25.512; 76 m). The acoustic survey of SE San Nicolas Island resumed at 1346 and was completed at 1509 (**Figs. 1.31 and 1.32**). The acoustic survey of E San Nicolas Island began at 1535.

20 September 2007: The acoustic survey of E San Nicolas Island was halted at 0150 on 20 September 2007. A CTD (#19) was cast at E San Nicolas Island at 0256. An ROV transect was conducted there between 1350 and 1540, during which a PAL was seen. Another ROV transect was conducted there between 1708 and 1815. The acoustic survey of E San Nicolas Island resumed at 1841. At 2022, a PAL was recovered at E San Nicolas Island. The acoustic survey resumed at 2030.

21 September 2007: The acoustic survey of E San Nicolas Island halted at 0154 on 21 September 2007. A CTD (#20) was cast there at 0230. A PAL was deployed at N San Nicolas Island at 1300. The acoustic survey of E San Nicolas Island resumed at 1355 and ended at 1711 (**Figs. 1.33 and 1.34**). The ship then proceeded to N San Nicolas Island and began the acoustic survey at 1822.

22 September 2007: A CTD (#21) was cast at N San Nicolas Island at 0004 on 22 September 2007. The acoustic survey of N San Nicolas Island was halted at 0204, resumed at 1345, and ended at 2217. An ROV transect was conducted there, beginning at 2315.

23 September 2007: The ROV transect at N San Nicolas Island ended at 0202 on 23 September 2007 **(Figs. 1.35 and 1.36)**. A CTD (#22) was cast at N San Nicolas Island at 0231. The acoustic survey of NW San Nicolas Island began at 1347 and halted at 2258 (**Figs. 1.37 and 1.38**).

24 September 2007: An ROV transect was conducted at NW San Nicolas beginning at 0110 and ending at 0218. A CTD (#23) as cast at 0233 in the area of NW San Nicolas. A PAL was deployed in the Potato Bank area at 1300. The acoustic survey of Potato Bank began at 1348 and ended at 1844 (**Figs. 1.39 and 1.40**), as Navy Fleet Control required the ship to exit the working grounds due to hazardous operations. The PAL was recovered at 1900 and the ship proceeded to Cherry Bank. At 2157, the acoustic survey of Cherry Bank began.

25 September 2007: At 0159, the acoustic survey of Cherry Bank was halted and a CTD (#24) was cast in the area. The PAL was deployed in the Cherry Bank area at 1250. An ROV transect was conducted from 1350 to 1540. The acoustic survey of Cherry Bank was resumed at 1604 and completed at 2145 (**Figs. 1.41 and 1.42**). An ROV transect was conducted from 2225 to 0005 on 26 September, the ship then proceeded to 107 Bank.

26 September 2007: The acoustic survey of 107 Bank began at 0137 and halted at 0157 (**Figs. 1.43 and 1.44**) for a CTD cast (#25). The ship proceeded to Potato Bank. The acoustic survey of Potato Bank was resumed at 1351 and was completed at 1633 (**Figs. 1.39 and 1.40**). The ship proceeded to 118 Bank. The acoustic survey of 118 Bank began at 1751 and ended at 2001 (**Figs. 1.45 and 1.46**). The acoustic survey of 107 Bank was resumed at 2011 and completed at 2220 (**Figs. 1.43 and 1.44**). A CTD (#26) was cast in the area at 2232. The ship proceeded to Cherry Bank.

27 September 2007: The PAL was recovered from Cherry Bank at 0045. The ship then proceeded to Mission Bay Reef. The acoustic survey of Mission Bay Reef began at 1337 and was completed at 1917 (**Figs. 1.47 and 1.48**). A CTD (#27) was cast in the area at 1931. The ship then returned to San Diego, completing Leg II.

Table 1.3. COAST07 Leg II survey sites, dates, and times (GMT).

Survey Location	Start Date	Start Time	End Date	End Time
43 Fathom Bank 2	9/15/07	0007	9/15/07	0201
117 Seamount	9/15/07	1339	9/15/07	1516
117 Seamount ROV (transit to SB)	9/15/07	1700	9/15/07	2129
N Santa Barbara Island	9/15/07	2135	9/16/07	0202
N Santa Barbara Island Day 2	9/16/07	1352	9/16/07	1700
N Santa Barbara Island ROV	9/16/07	1729	9/16/07	2145
N Santa Barbara Island ROV 2	9/16/07	2305	9/17/07	0020
SW Santa Barbara Island Part 1	9/17/07	0103	9/17/07	0207
SW Santa Barbara Overnight	9/17/07	0211	9/17/07	1333
SW Santa Barbara Island Part 2	9/17/07	1346	9/17/07	1947
SW Santa Barbara Island ROV	9/17/07	2225	9/18/07	0045
Osborne Bank Part 1	9/18/07	0131	9/18/07	0201
Osborne Bank Overnight	9/18/07	0204	9/18/07	1413
Osborne Bank Part 2	9/18/07	1421	9/18/07	1844
Osborne Bank ROV	9/18/07	1903	9/18/07	2150
SE San Nicolas Island Part 1	9/18/07	2340	9/19/07	0156
SE San Nicolas Island Overnight	9/19/07	0226	9/19/07	1339
SE San Nicolas Island Part 2	9/19/07	1346	9/19/07	1509
E San Nicolas Island 1	9/19/07	1535	9/20/07	0150
E San Nicolas Island Overnight	9/20/07	0243	9/20/07	1331
E San Nicolas Island ROV	9/20/07	1333	9/20/07	1815
E San Nicolas Island 2	9/20/07	1842	9/21/07	0154
East San Nicolas Overnight	9/21/07	0156	9/21/07	1356
East San Nicolas Island 3	9/21/07	1400	9/21/07	1711
N San Nicolas Island - 1	9/21/07	1822	9/22/07	0204
N San Nicolas Island Overnight	9/22/07	0321	9/22/07	1338
N San Nicolas Island - 2	9/22/07	1347	9/22/07	2217
N San Nicolas Island ROV	9/22/07	2315	9/23/07	0202
NW San Nicolas Island	9/23/07	1346	9/23/07	2258
NW San Nicolas Island ROV	9/24/07	0110	9/24/07	0218
NW San Nicolas Island Overnight	9/24/07	0220	9/24/07	1342
Potato Bank - 1	9/24/07	1348	9/24/07	1844
Cherry Bank - 1	9/24/07	2157	9/25/07	0159
Cherry Bank ROV 1	9/25/07	0140	9/25/07	0340
Cherry Bank - 2	9/25/07	1604	9/25/07	2145
Cherry Bank ROV 2	9/25/07	2225	9/26/07	0005
107 Bank - 1	9/26/07	0137	9/26/07	0148
107 to Potato- overnight	9/26/07	0242	9/26/07	1348
Potato Bank – 2	9/26/07	1351	9/26/07	1633
118 Bank	9/26/07	1751	9/26/07	2001
107 Bank	9/26/07	2011	9/26/07	2220
Mission Bay Reef	9/27/07	1337	9/27/07	1917

Figure 1.21. Forty-Three Fathom Bank 2 distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

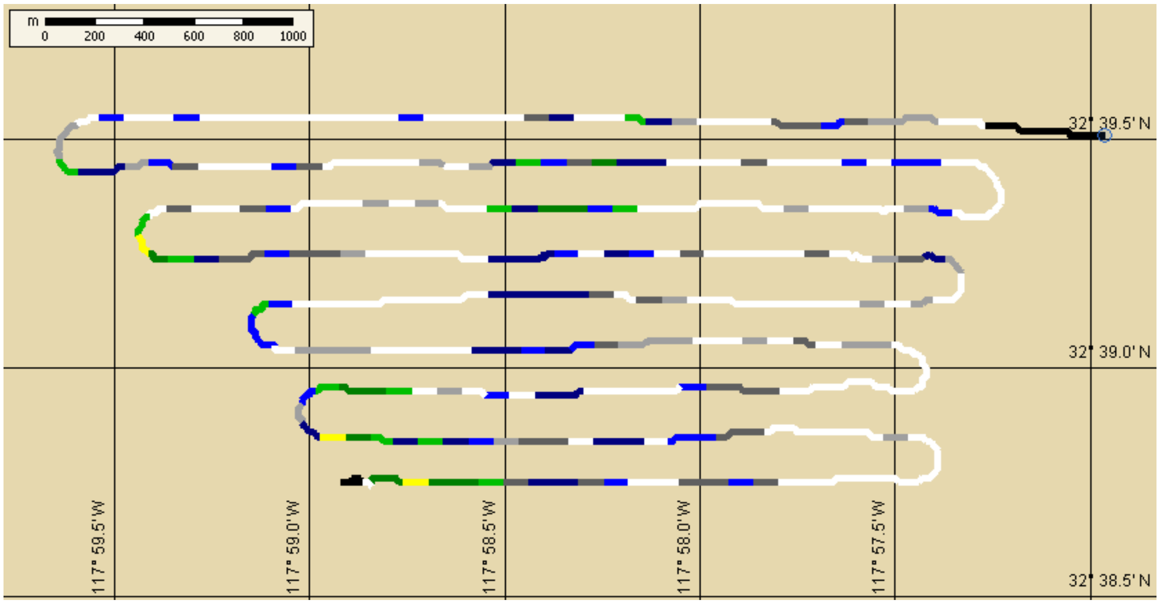


Figure 1.22. Forty-Three Fathom Bank 2 3-D image of bathymetry (m) and S_v of rockfishes (dB).

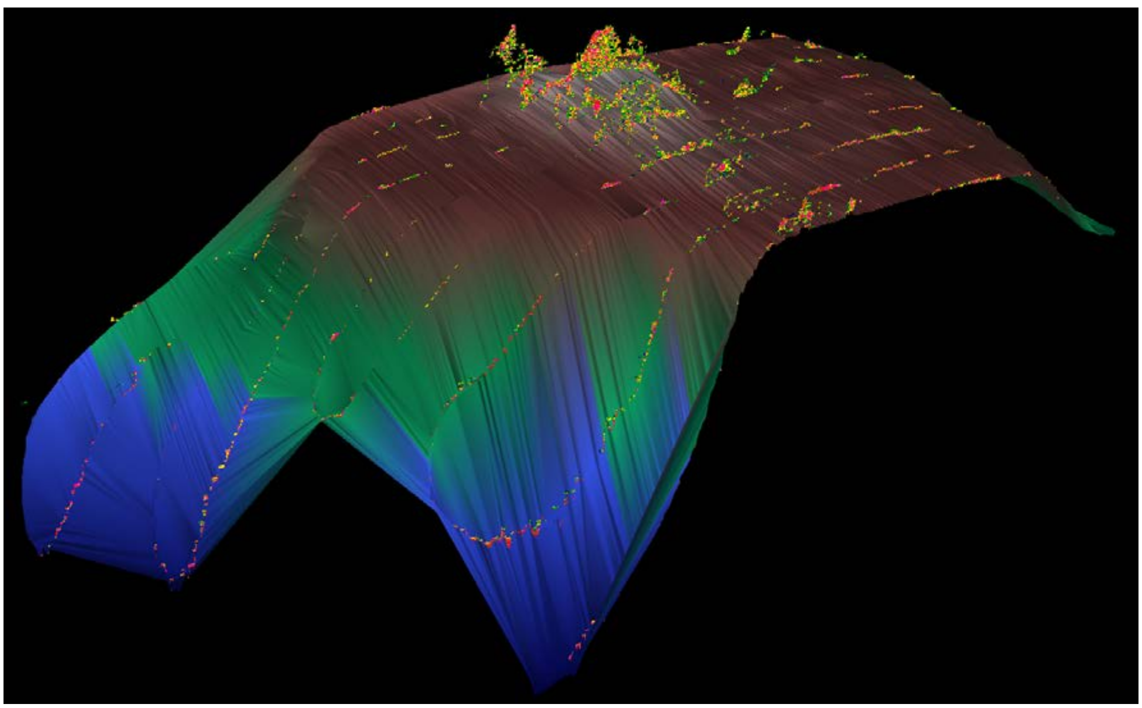


Figure 1.23. 117 Seamount distribution of s_A ($m^2/n.mi.^2$) attributed to rockfishes.

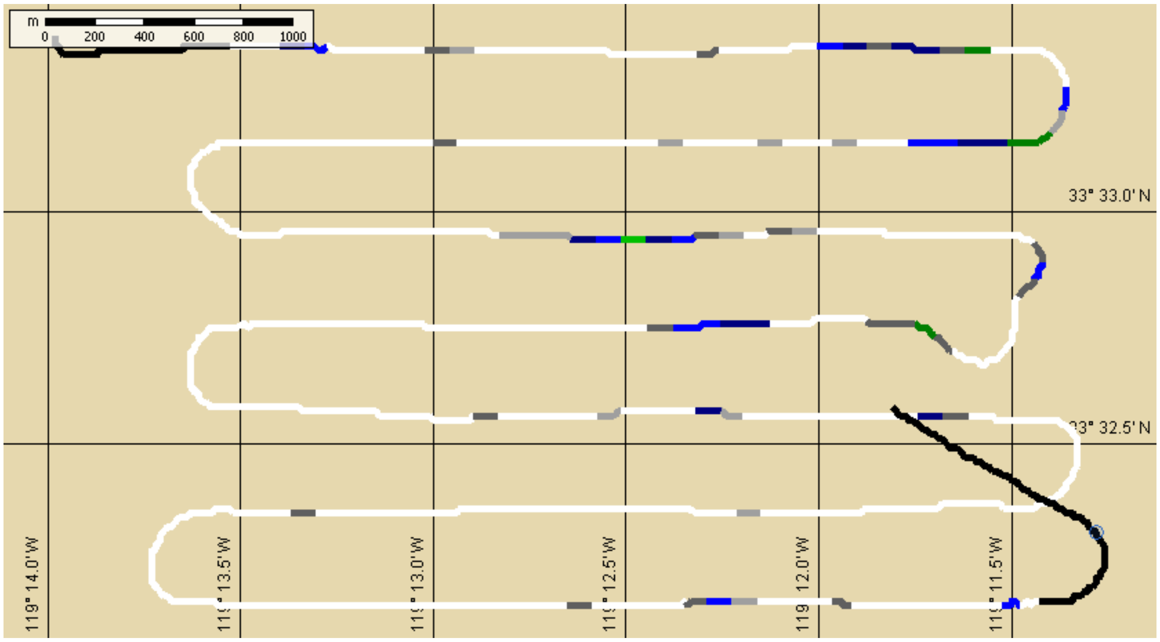


Figure 1.24. 117 Seamount 3-D image, looking southward, of bathymetry (m) and S_v of rockfishes (dB).

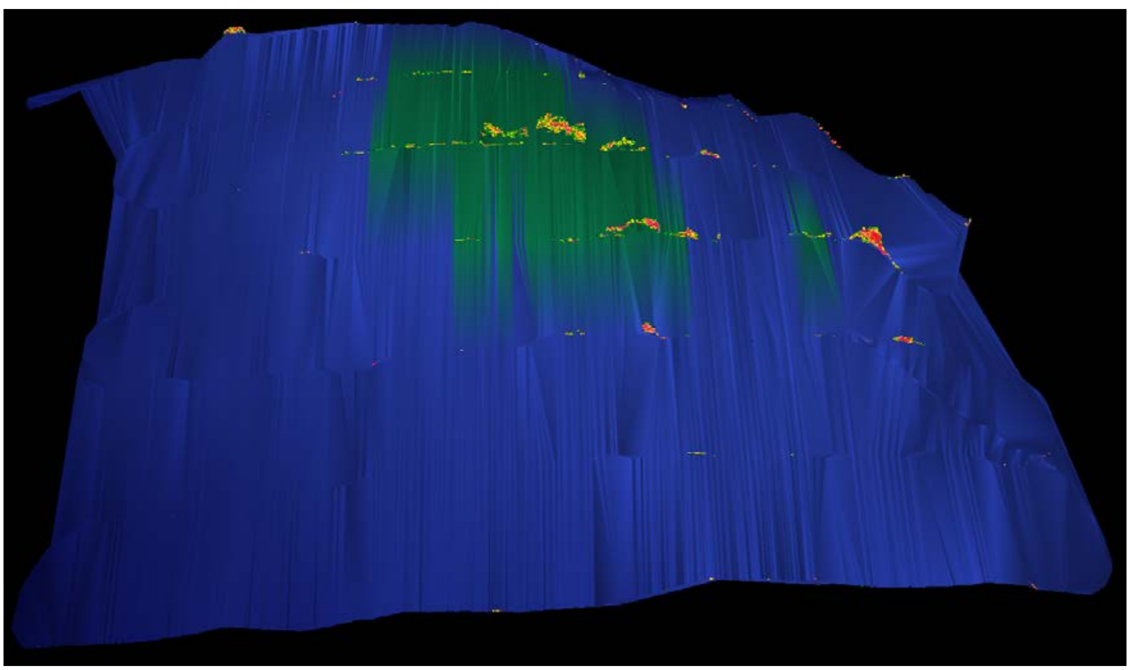


Figure 1. 25. North Santa Barbara Island distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

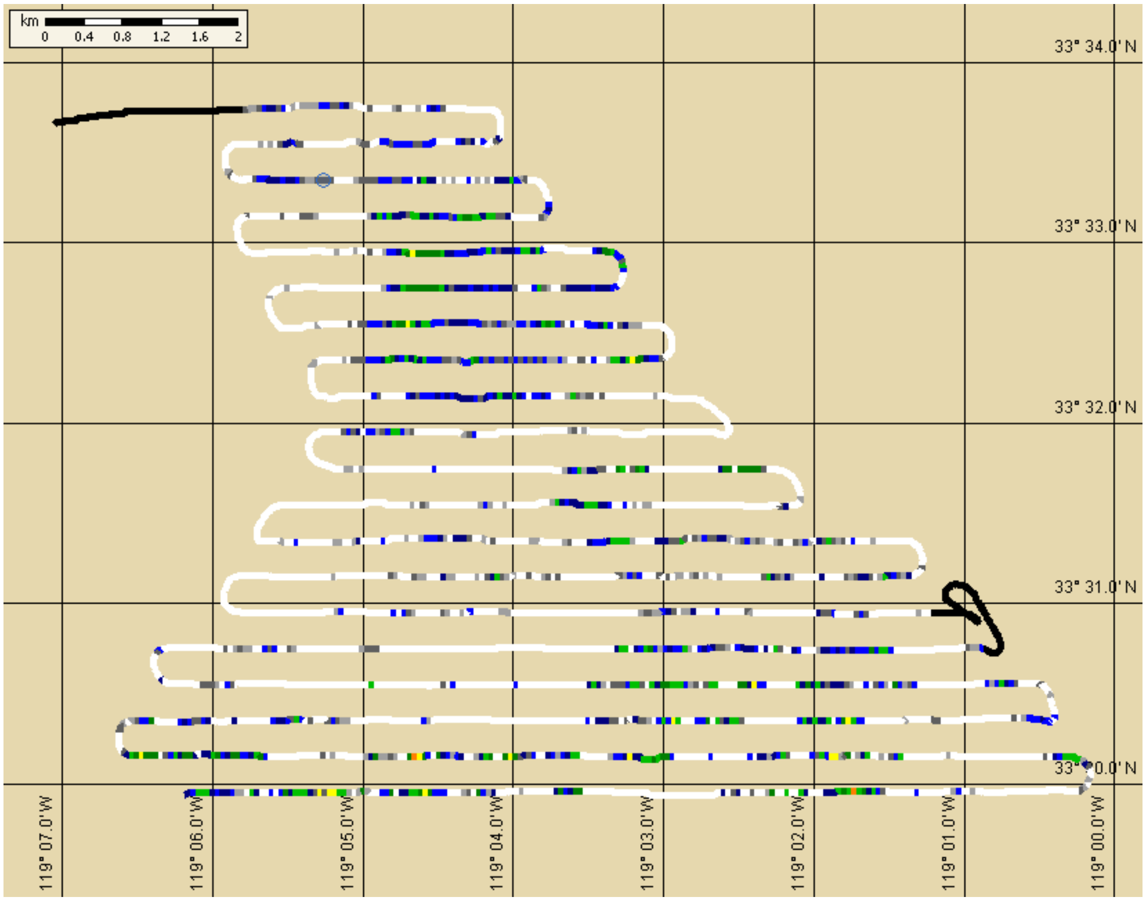


Figure 1.26. North Santa Barbara Island 3-D image of bathymetry (m) and S_v of rockfishes (dB).

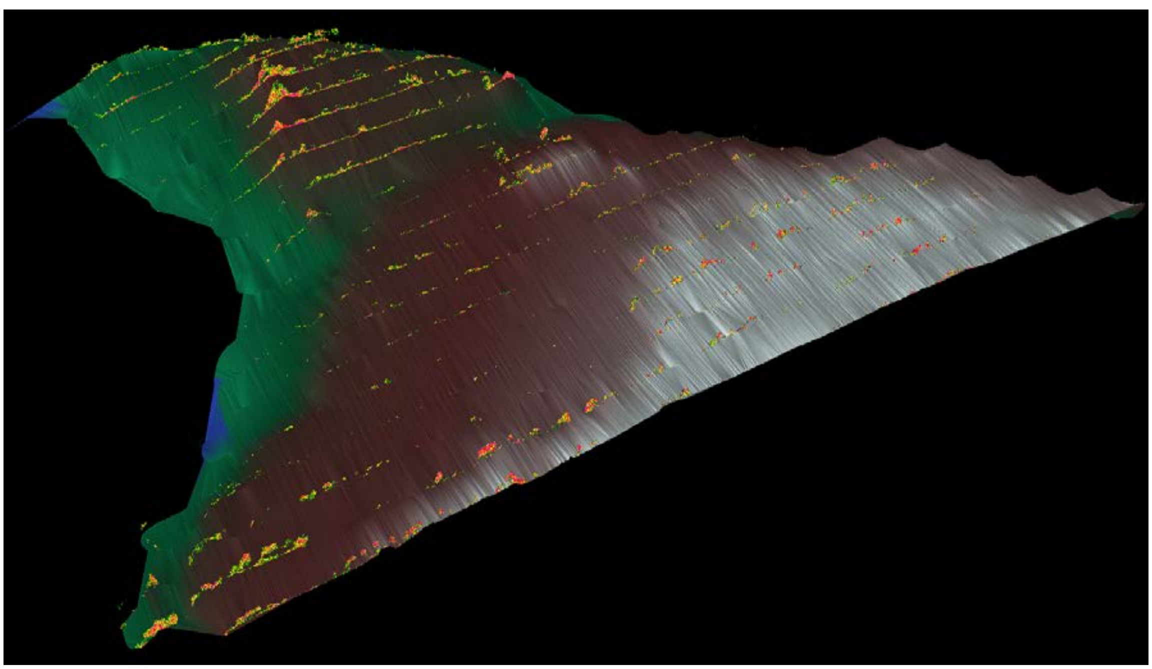


Figure 1.27. Southwest Santa Barbara Island distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

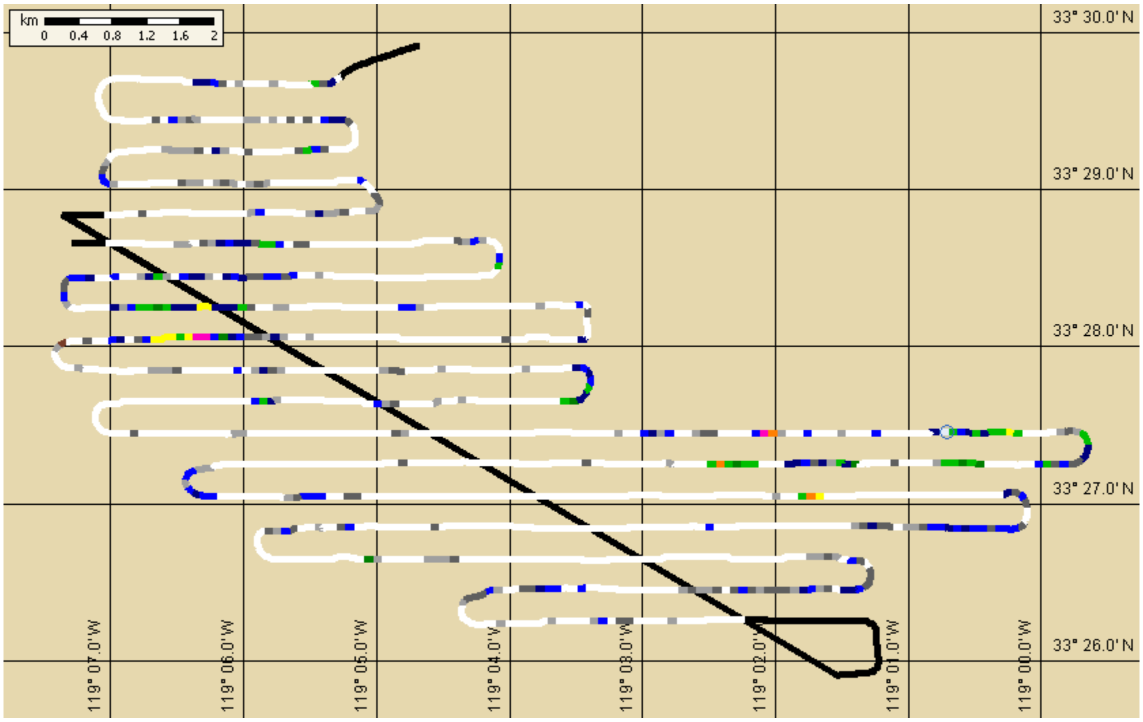


Figure 1.28. Southwest Santa Barbara Island 3-D image of bathymetry (m) and S_v of rockfishes (dB).

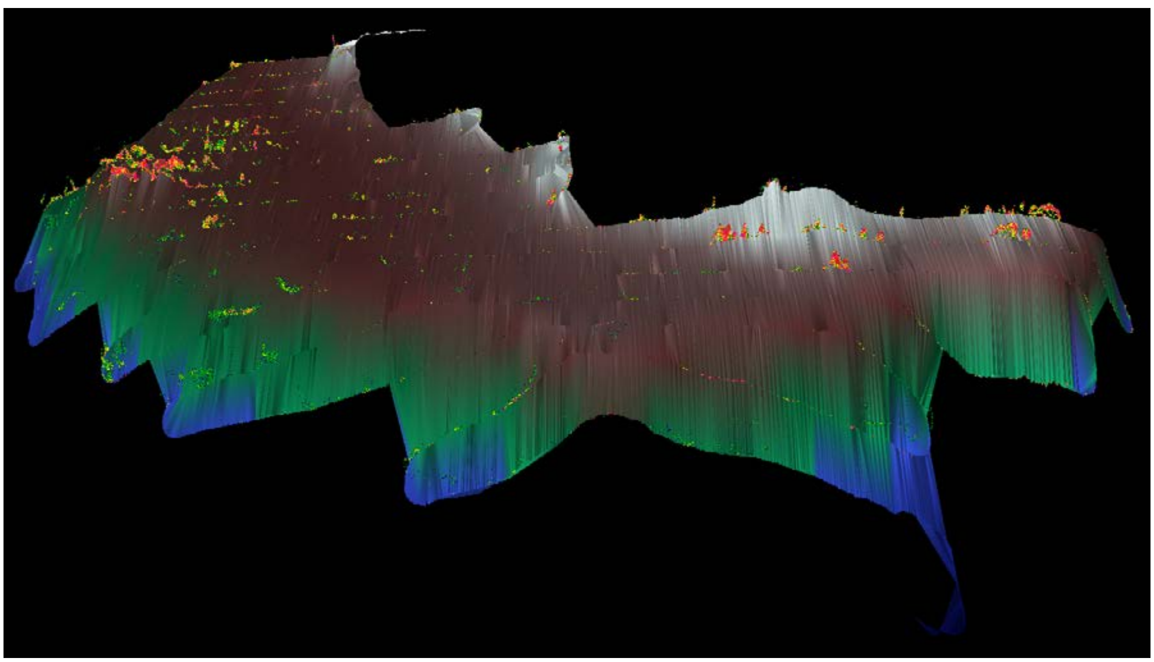


Figure 1.29. Osborn Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

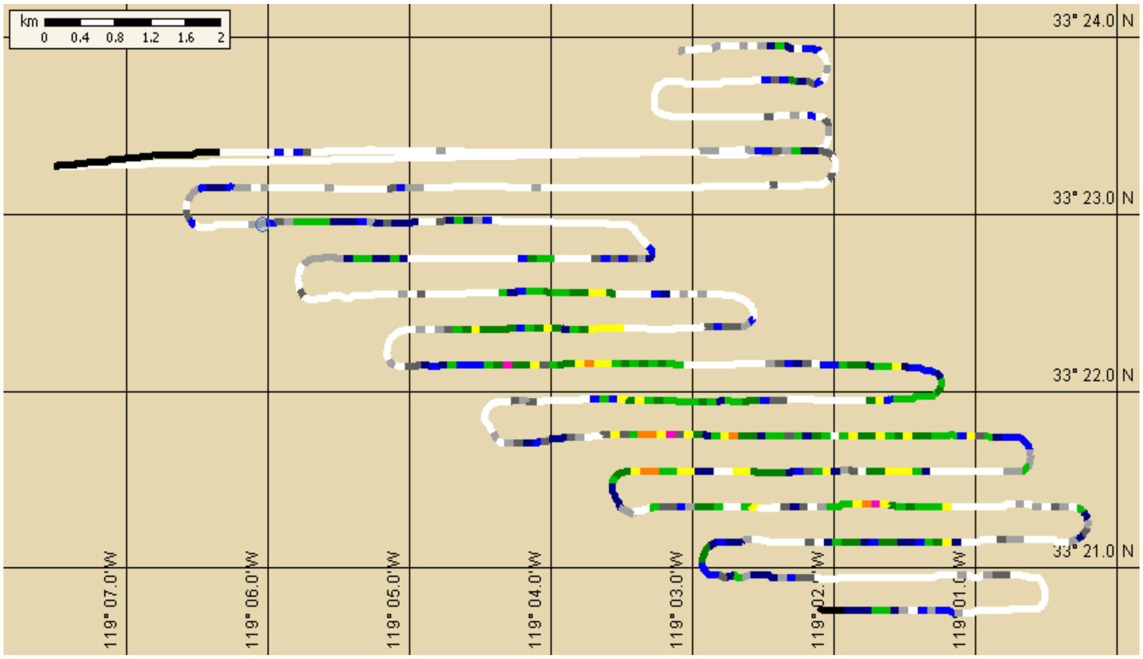


Figure 1.30. Osborn Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

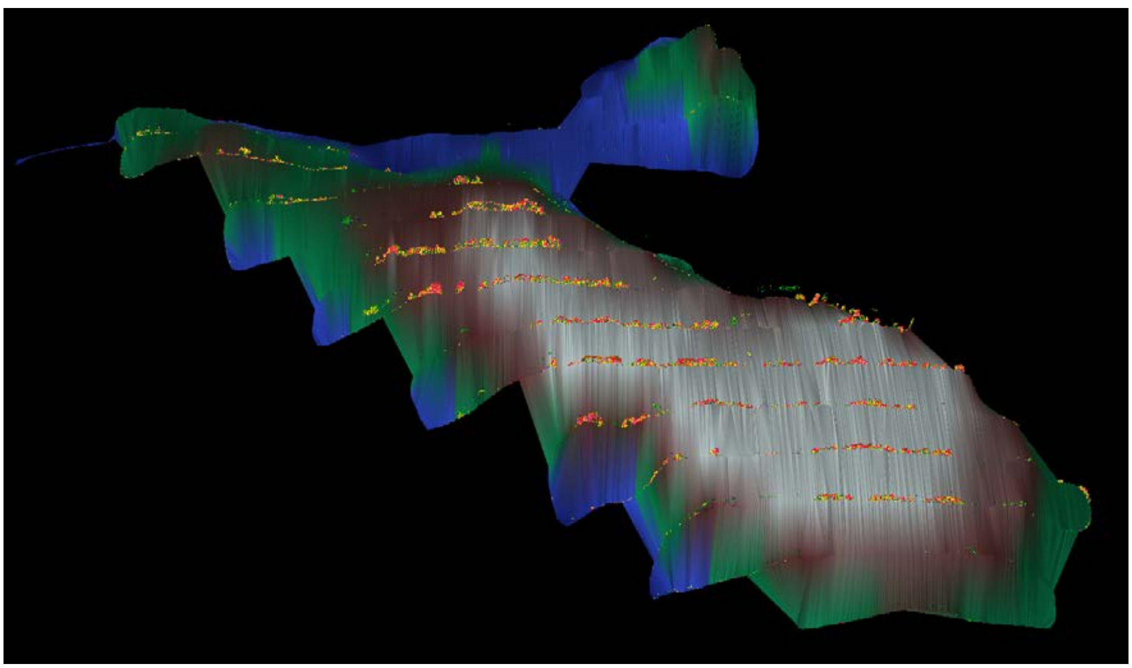


Figure 1.31. Southeast San Nicolas Island distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

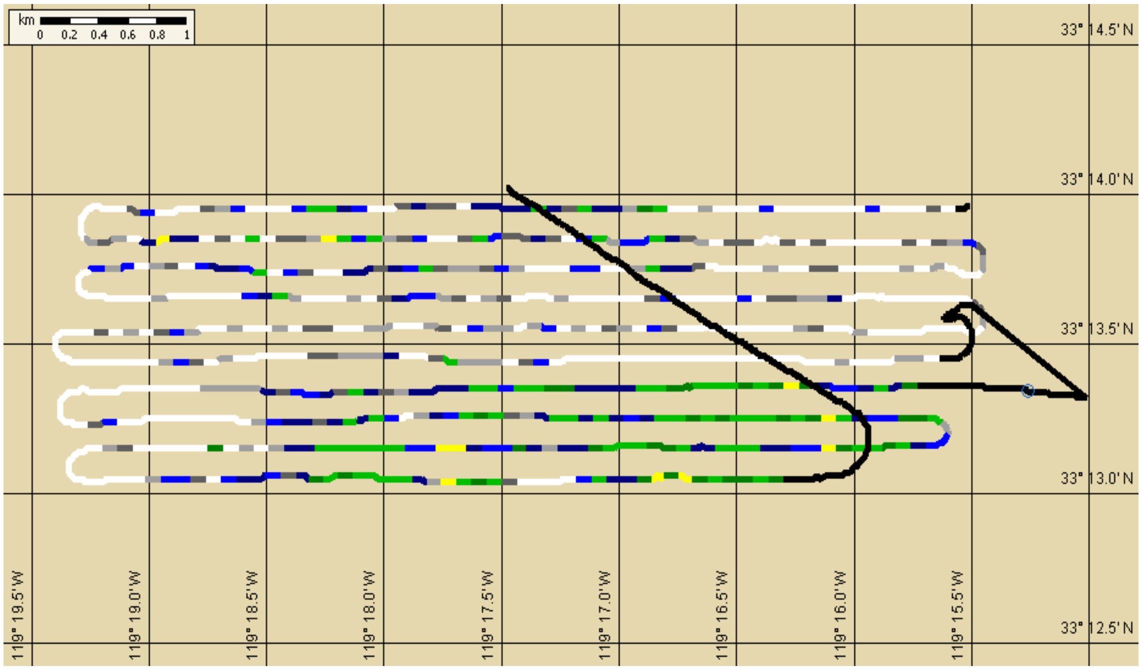


Figure 1.32. Southeast San Nicolas Island 3-D image of bathymetry (m) and S_v of rockfishes (dB).

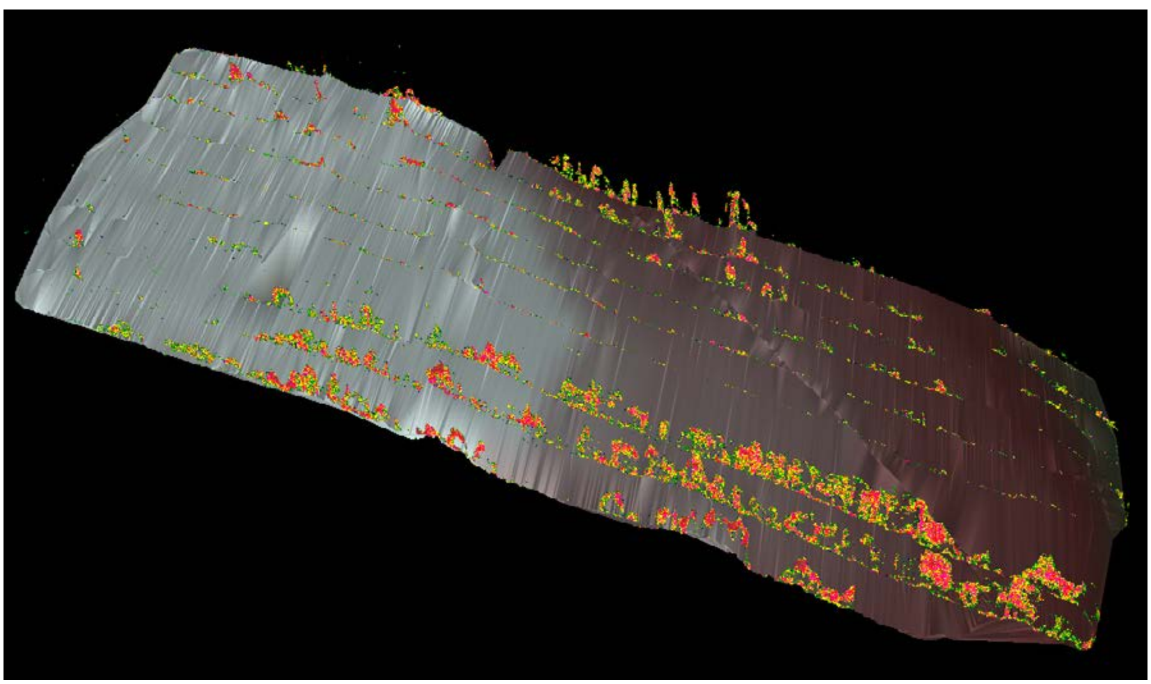


Figure 1.33. East San Nicolas distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

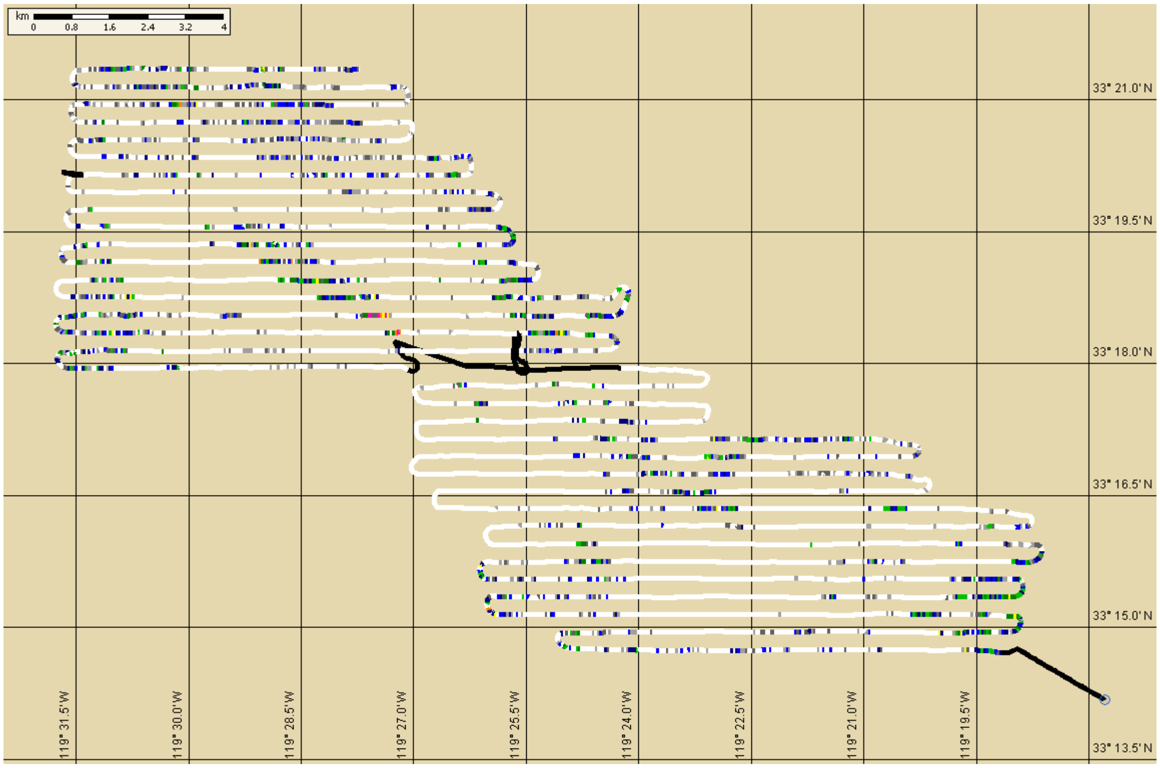


Figure 1.34. East San Nicolas 3-D image of bathymetry (m) and S_v of rockfishes (dB).

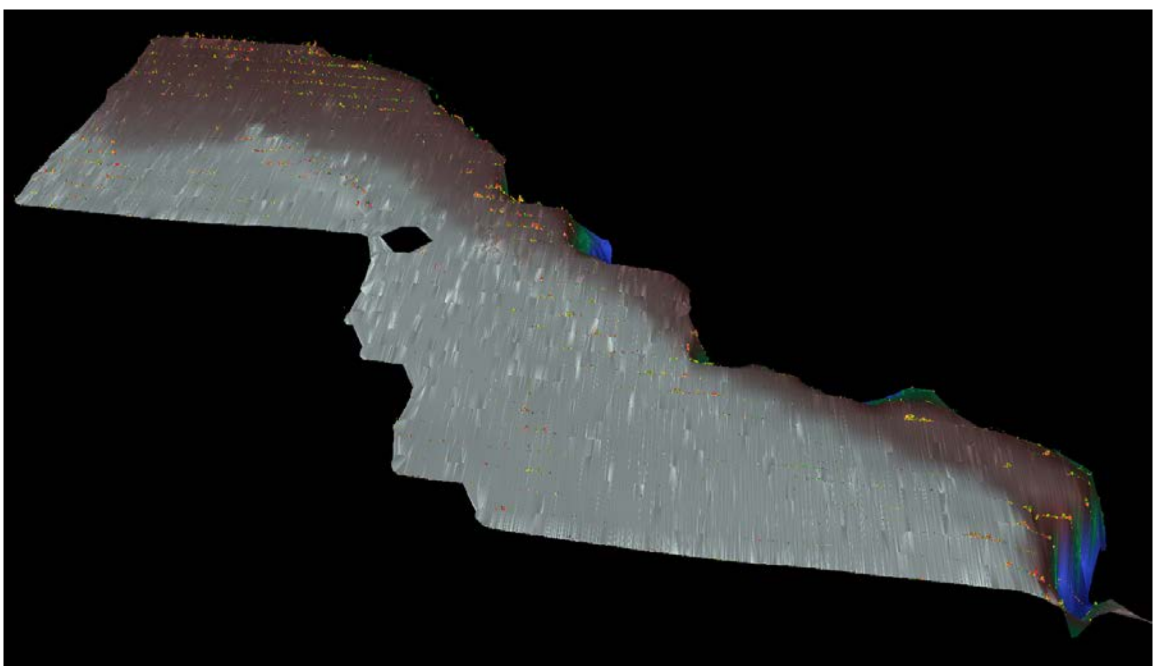


Figure 1.35. North San Nicolas distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

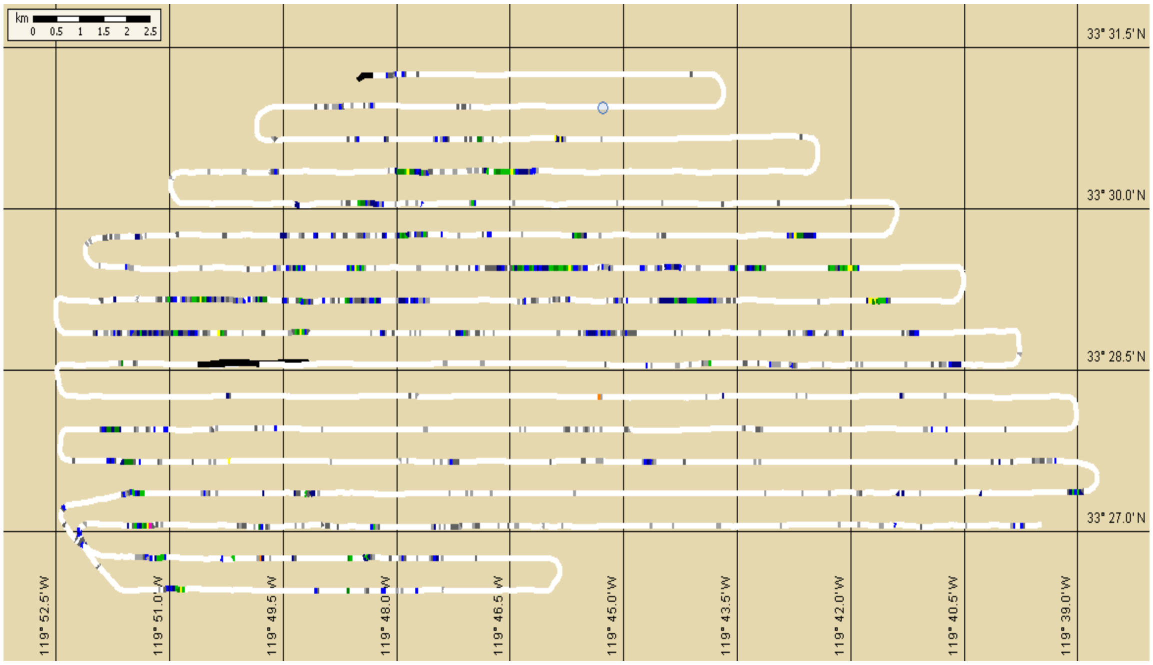


Figure 1.36. North San Nicolas 3-D image of bathymetry (m) and S_v of rockfishes (dB).

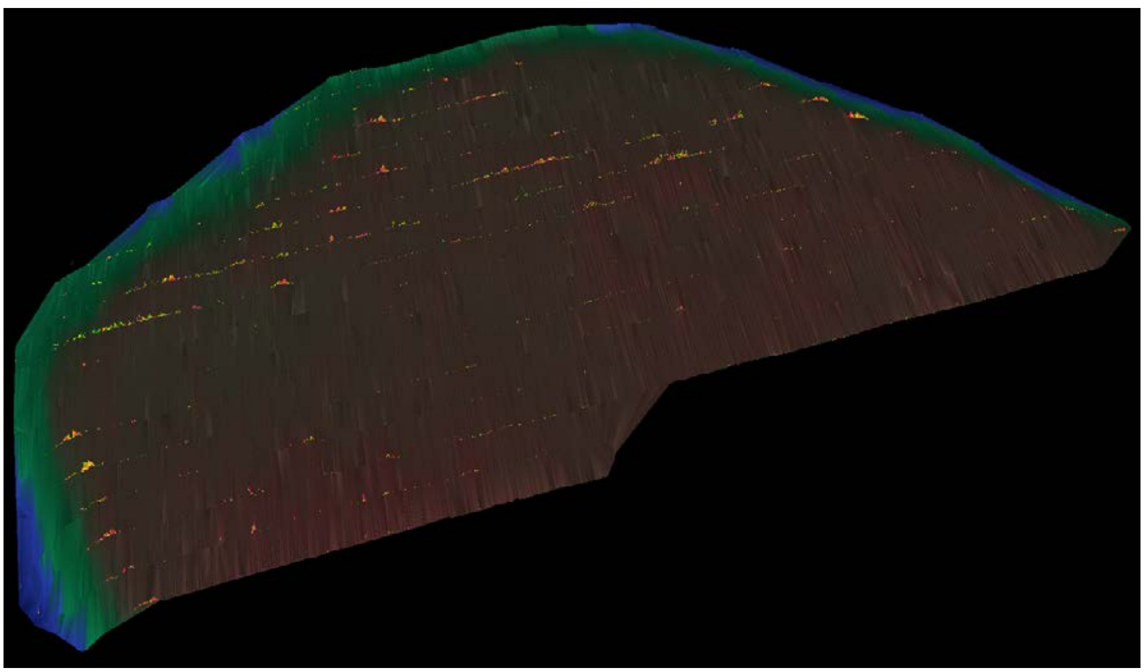


Figure 1.37. Northwest San Nicolas distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

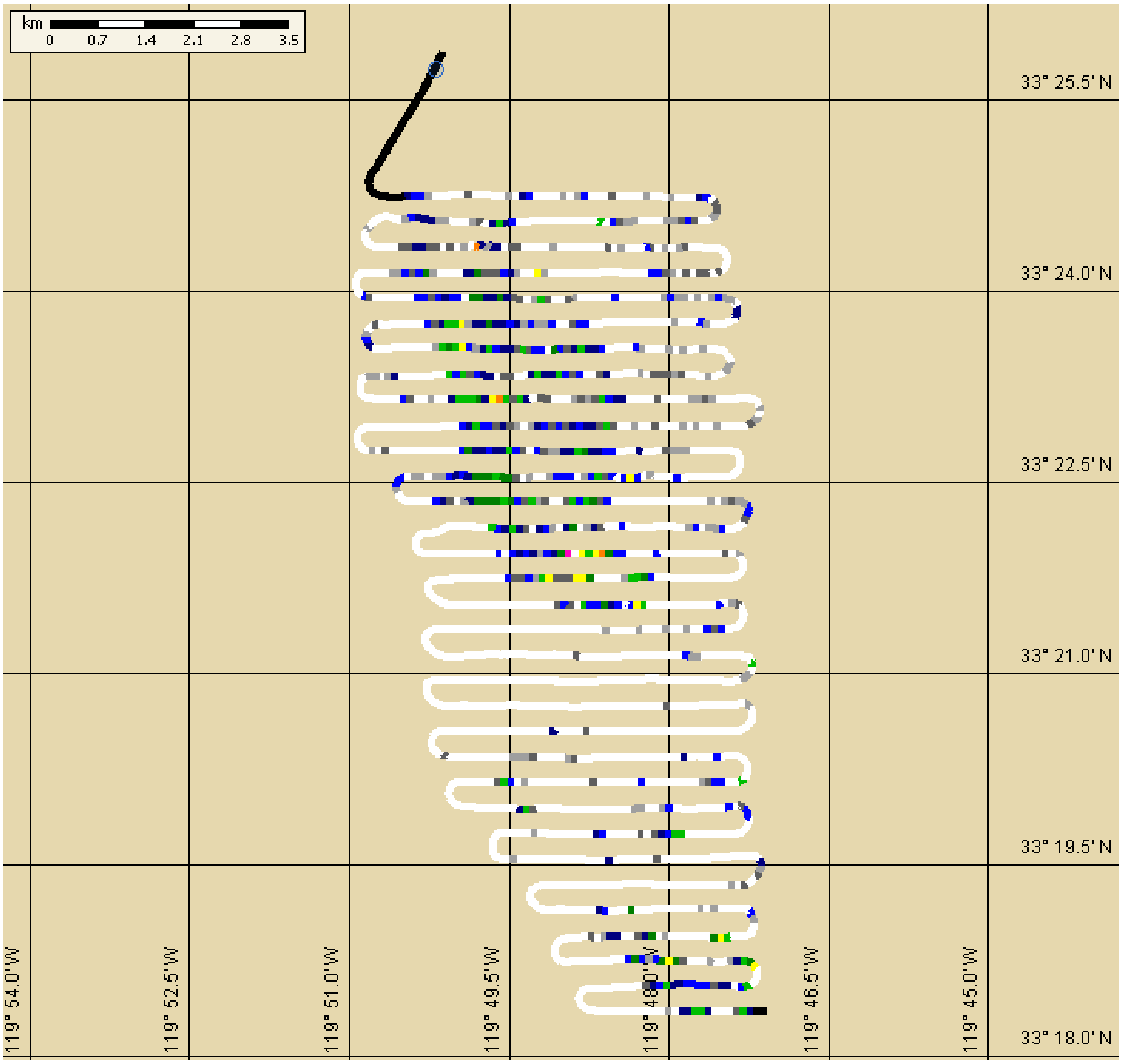


Figure 1.38. Northwest San Nicolas 3-D image of bathymetry (m) and S_v of rockfishes (dB).

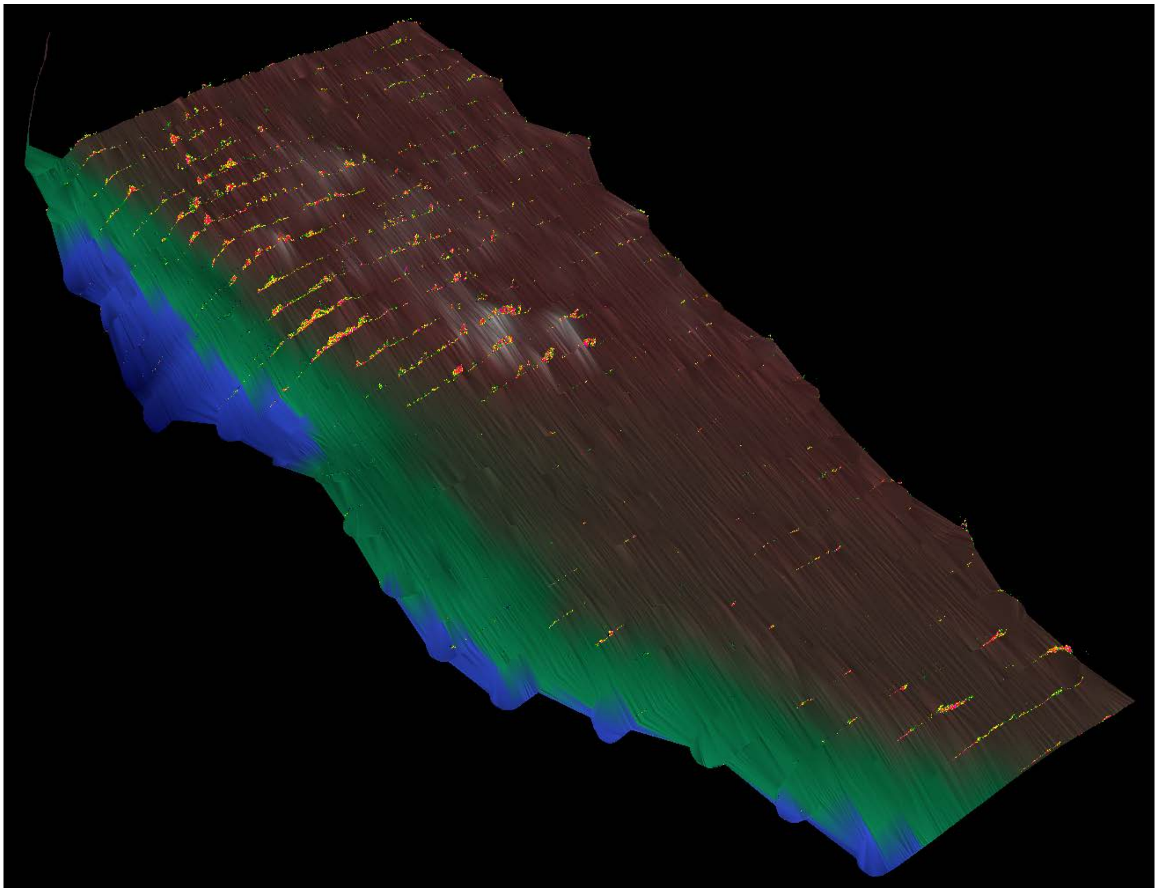


Figure 1.39. Potato Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

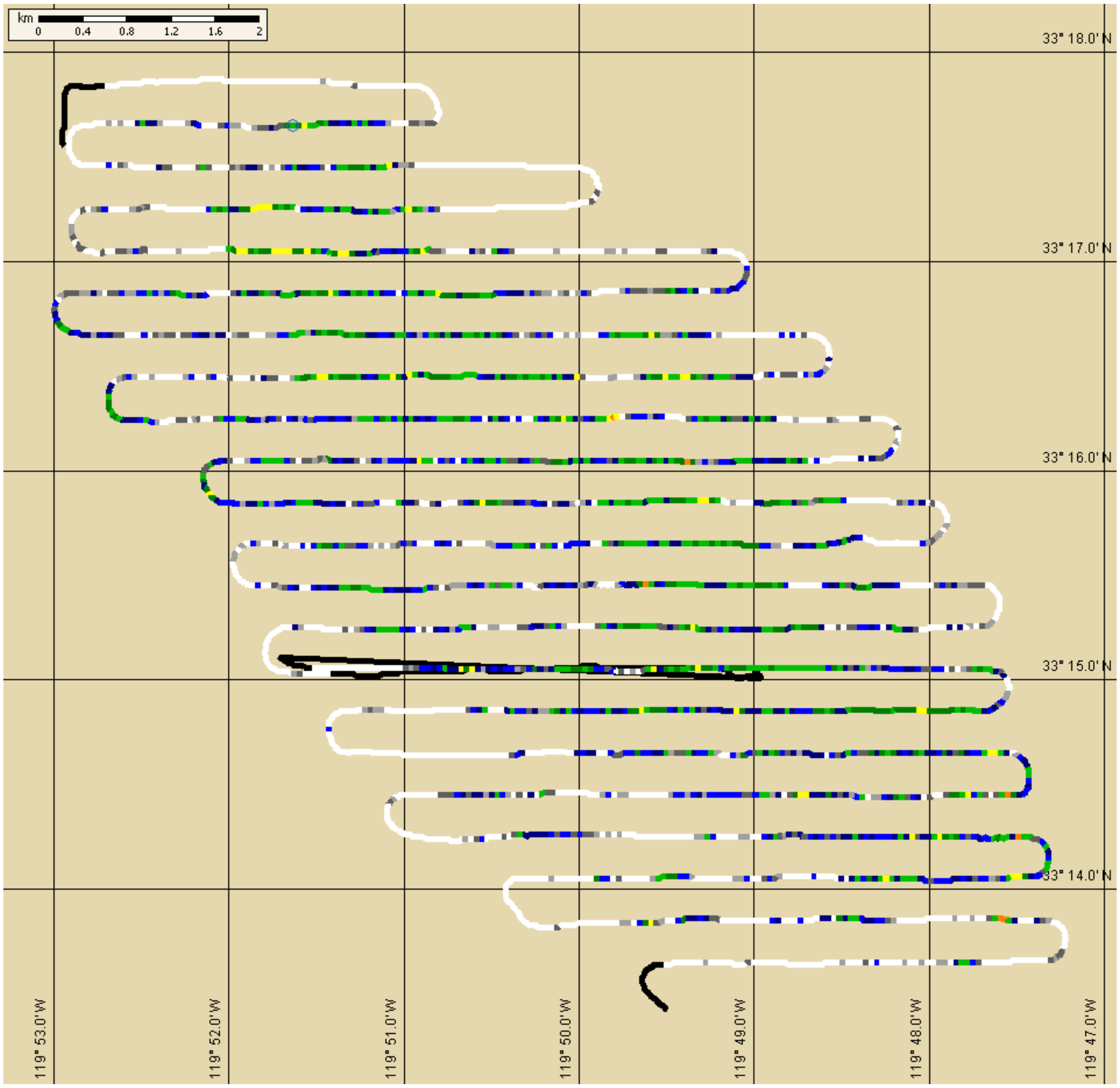


Figure 1.40. Potato Bank distribution 3-D image of bathymetry (m) and S_v of rockfishes (dB).

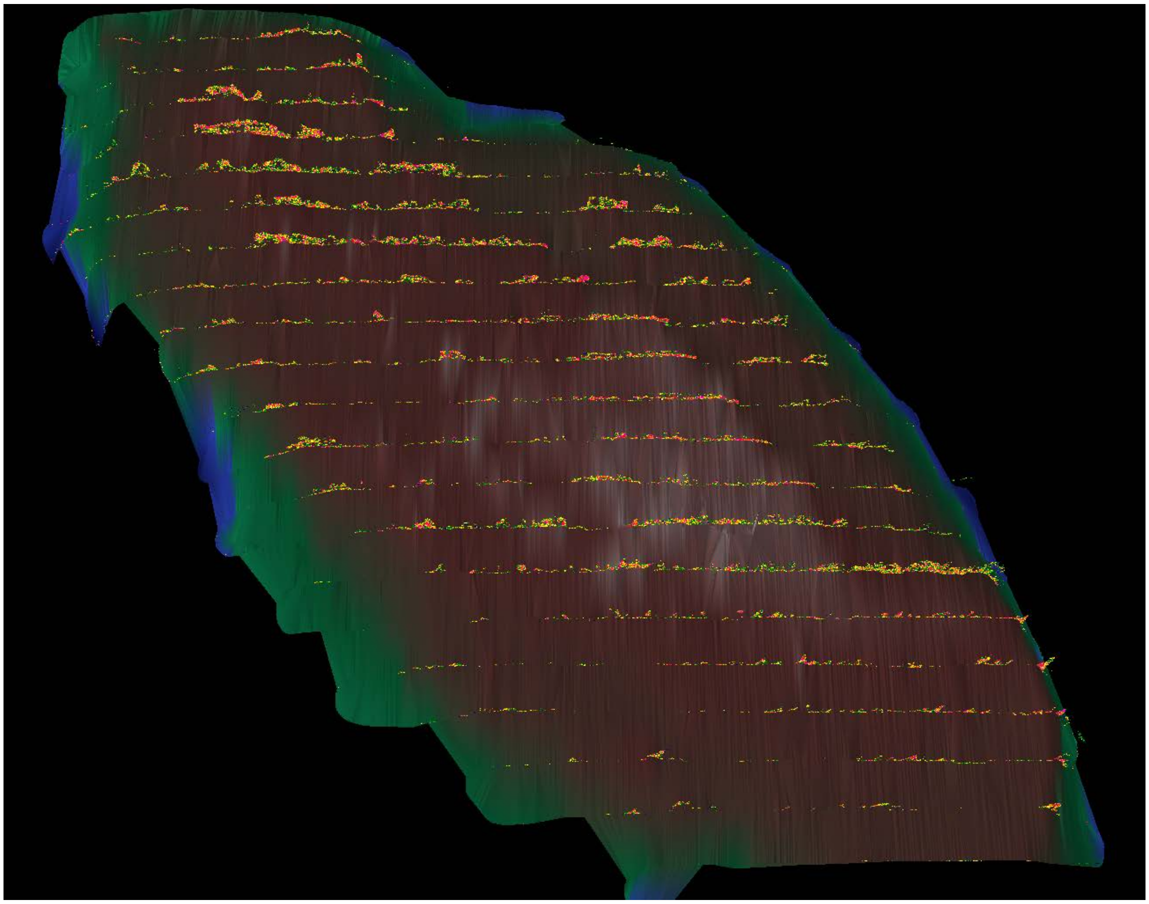


Figure 1.41. Cherry Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

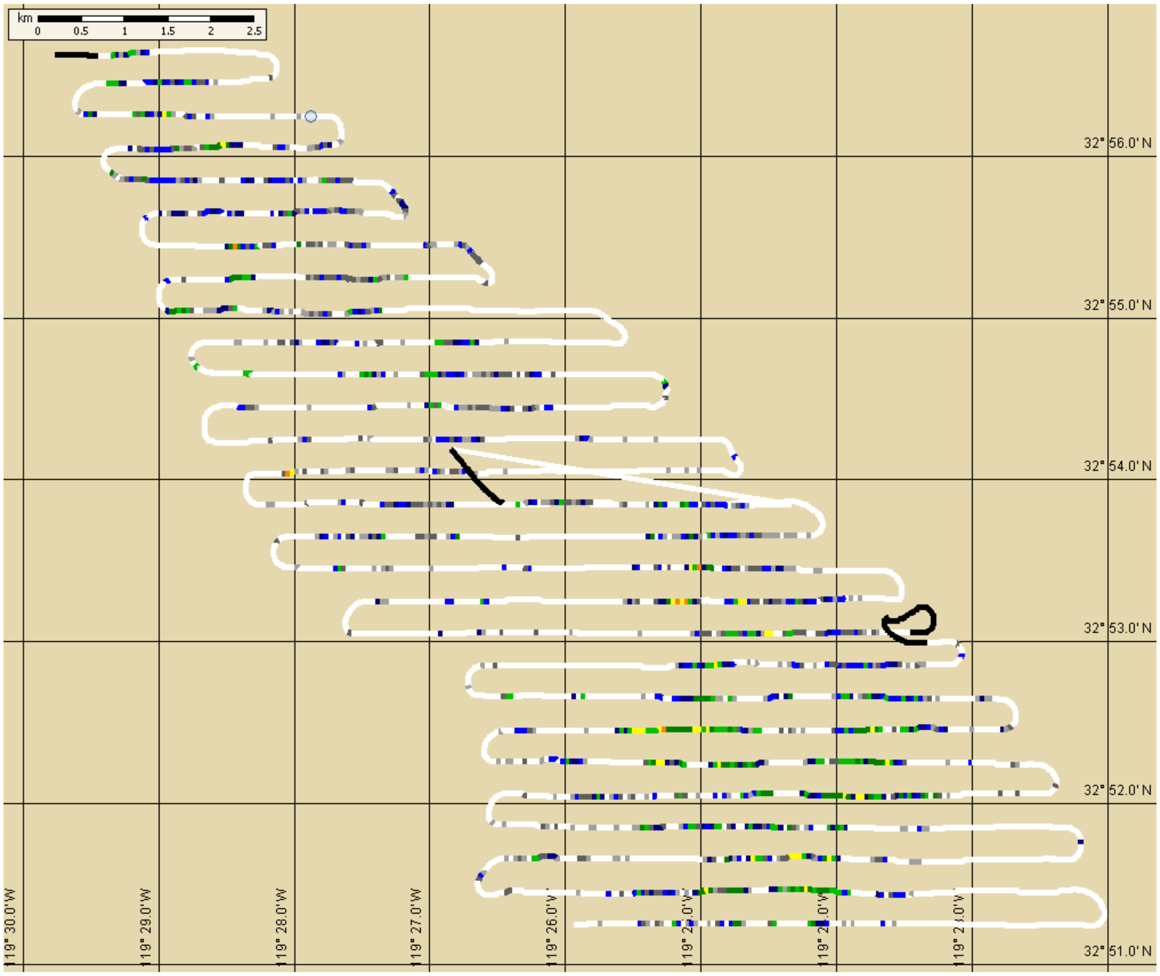


Figure 1.42. Cherry Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

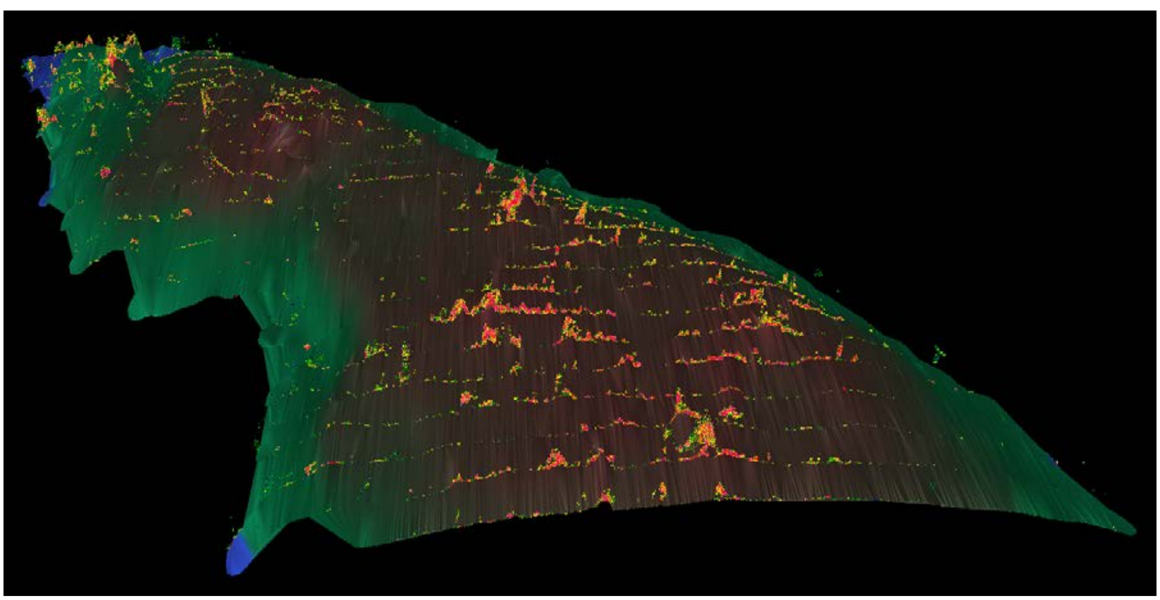


Figure 1.43. 107 Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

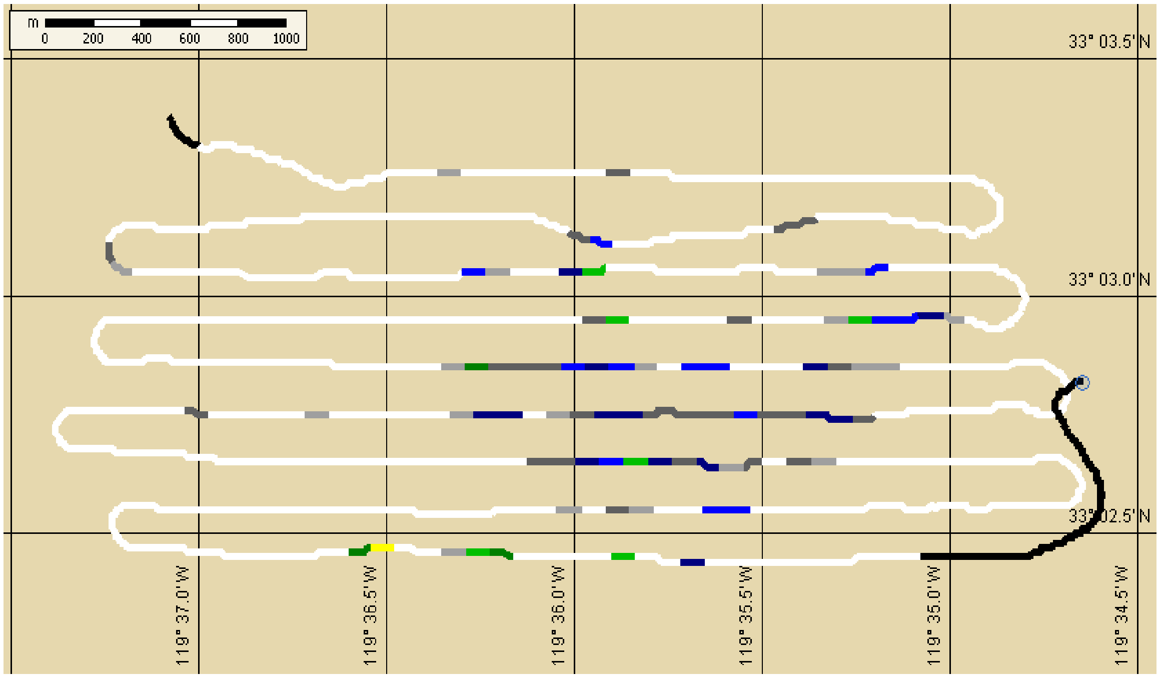


Figure 1. 44. 107 Bank distribution 3-D image of bathymetry (m) and S_v of rockfishes (dB).

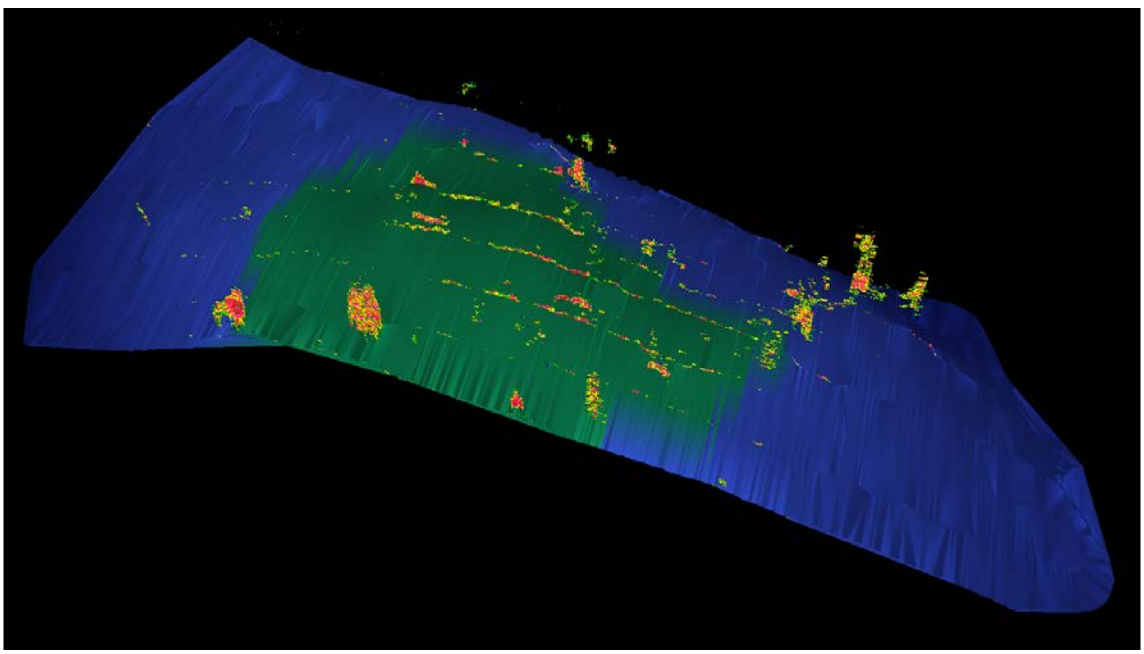


Figure 1.45. 118 Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

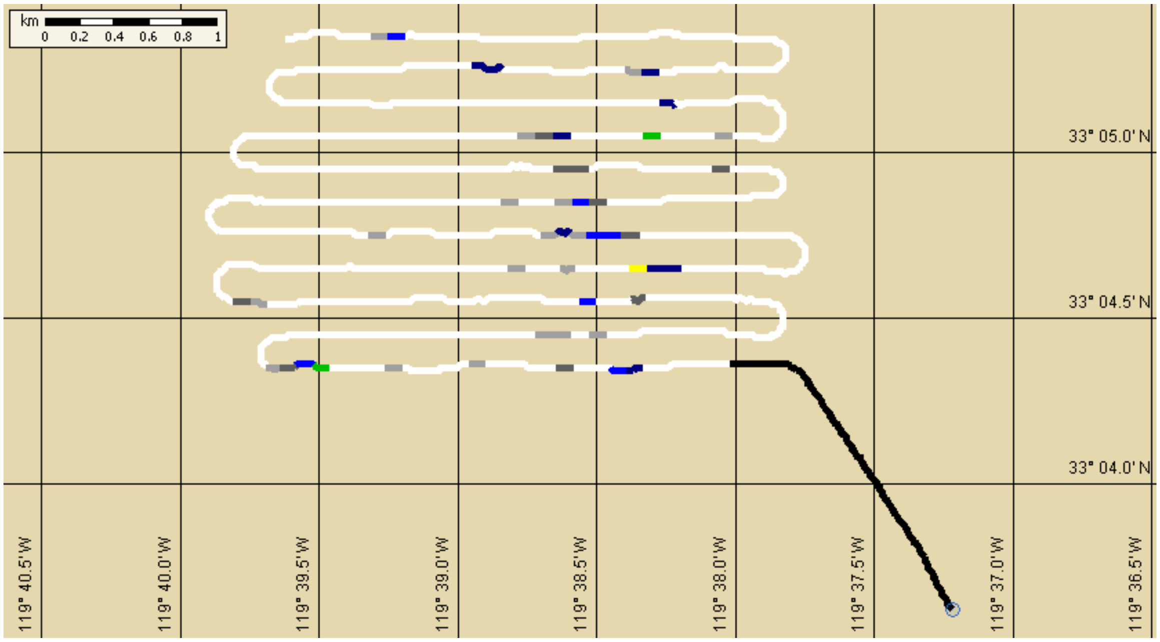


Figure 1.46. 118 Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

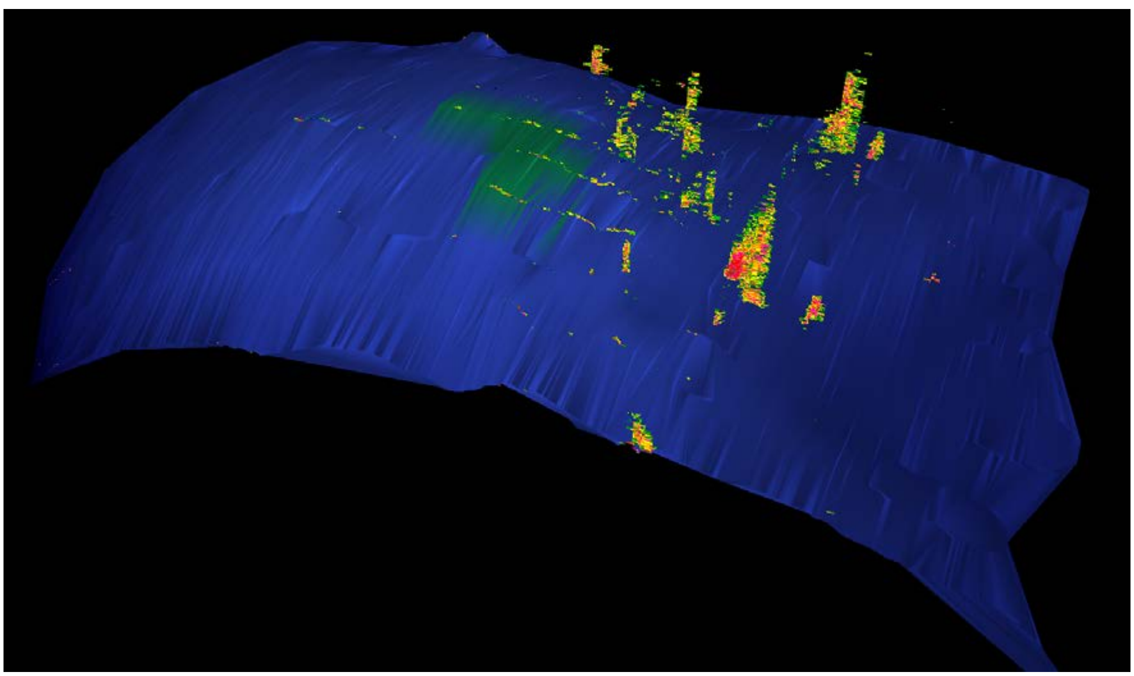


Figure 1.47. Mission Bay Reef distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

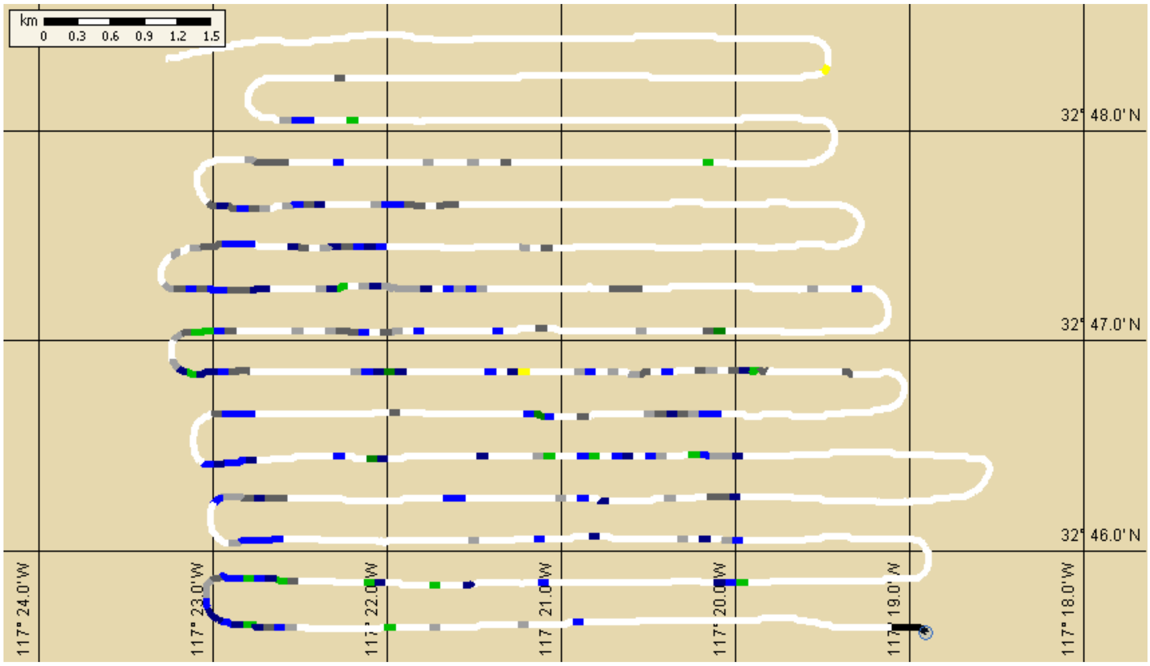
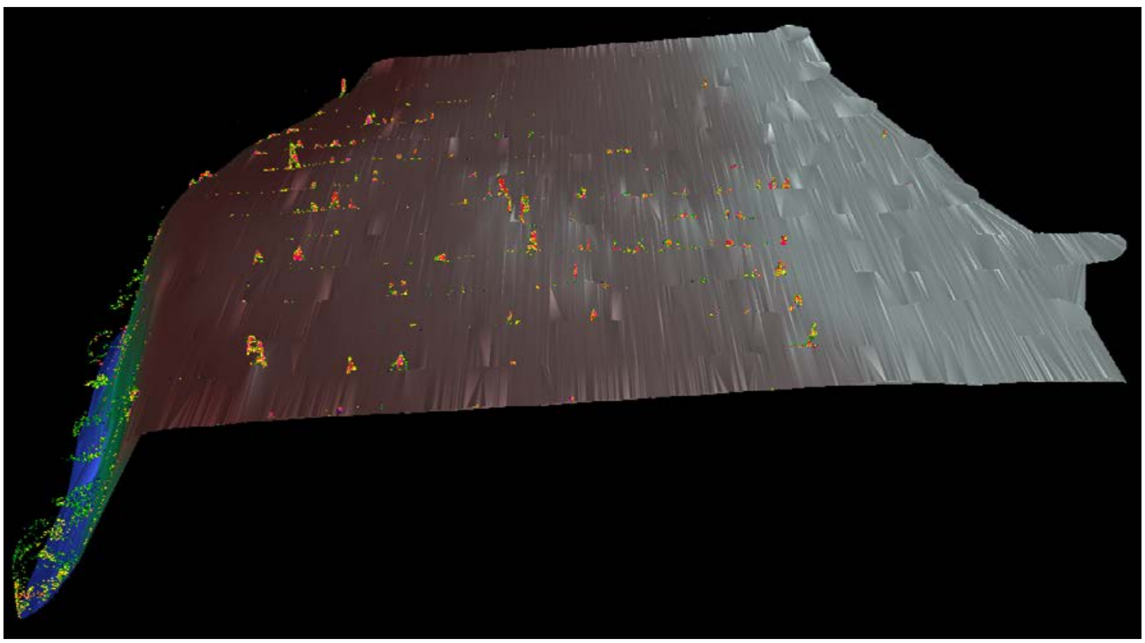


Figure 1.48. Mission Bay Reef 3-D image of bathymetry (m) and S_v of rockfishes (dB).



COAST07 Leg III

<u>1 October 2007:</u> The ship departed from the Scripps Institution of Oceanography's marine facility pier on 1 October 2007 at 1500 GMT and headed to 43 Fathom Bank. Logging of EK60 data began at 1630. The ship arrived at 43 Fathom Bank at 2322, then deployed the DropTS and mooring system (32 39.01 N, 117 58.32 W). A planned ROV transect was cancelled due to a lack of time.

<u>2 October 2007:</u> The DropTS and mooring equipment was recovered at 0118 on 2 October 2007. The ship then proceeded to Hidden Reef where the acoustic survey was conducted between 1300 and 1637 (**Figs. 1.49 and 1.50)**. A CTD (overall #28, Leg3 #1) was cast at Hidden Reef (33 47.77 N, 119 10.24 W) between 1709 and 1723. An ROV transect was conducted there at 1905. The ship then proceeded to South Anacapa Island and began the acoustic survey there at 2318.

<u>3 October 2007:</u> The acoustic survey of S Anacapa Island was completed at 0048 on 3 October 2007 (**Figs. 1.51 and 1.52**). A CTD (#29; Leg 3 #2) was cast there (33 57.71 N, 119 29.19 W) between 0056 and 0106. The ship then proceeded to an overnight anchorage. At 0201, logging from the EK60s was stopped and the ship anchored off Santa Cruz Island. Data logging resumed at 1257, en route to Anacapa Pass. The acoustic survey of Anacapa Pass began at 1325 and ended at 1616 (**Figs. 1.53 and 1.54**). At 1729, the 38 kHz echosounder was turned off to avoid interference with the ROV tracking system. Between 1753 and 1817, a CTD (#30; Leg 3 #3) was cast in conjunction with the DropTS deployment (34 00.91 N, 119 28.66 W). The 38 kHz echosounder was restarted at 1829. Between 1908 and 2104, an ROV transect was conducted at Anacapa Pass between 34 02.00 N, 119 28.99 W and 34 02.11 N, 119 28.20 W. The ship then proceeded to the PAL deployment location at Santa Rosa Flats.

<u>4 October 2007:</u> The AURAL+PAL mooring was deployed (33 40.49 N, 120 00.46 W) at 0111 on 4 October 2007. The ship then proceeded to N Santa Rosa Island. The acoustic survey was conducted there between 1329 and 1601 (**Figs. 1.55 and 1.56**). A CTD (#31; Leg 3 #4) was conducted there (34 03.89 N, 120 12.46 W) between 1623 and 1629. The ship then proceeded to NE San Miguel Island. The acoustic survey was conducted there between 1717 and 1848 (**Figs. 1.57 and 1.58**). A CTD (#32; Leg 3 #5) was cast there 34 04.51 N, 120 19.05 W) between 1902 and 1909. The ship then proceeded to SW San Miguel Island and began the acoustic survey at 2230.

<u>5 October 2007:</u> The acoustic survey at SW San Miguel was halted due to darkness at 0129 on 5 October 2007. The acoustic survey resumed there at 1402 and was completed at 2212 (**Figs. 1.59 and 1.60**). A CTD (#33; Leg 3 #6) was cast there (34 00.06 N, 120 24.80 W), in conjunction with the DropTS deployment, between 2249 and 2318. The 38 kHz EK60 was stopped between 2250 and 2320. The ship then proceeded to Santa Rosa Flats.

<u>6 October 2007:</u> The acoustic survey of Santa Rosa Flats was conducted between 0121 and 0224 on 6 October 2007. The survey there resumed at 1401.

7 October 2007: The survey at Santa Rosa Flats ended at 0059 on 7 October 2007 **(Figs. 1.61 and 1.62).** At 0143, the 38 kHz EK60 was set to passive mode. A CTD (#34; Leg 3 #7) was deployed in the area (33 45.88 N, 119 58.08 W), in conjunction with the DropTS, between 0143 and 0216. The 38 kHz EK60 was reset to active mode at 0216. The ship then proceeded to NW San Miguel. The acoustic survey was conducted there between 1402 and 1917. At 1942, the DropTS was cast for calibration (34 08.27 N, 120 24.90 W), and recovered at 2055. The DropTS was recast for calibration between 2116 and 2228.

8 October 2007: An ROV transect was conducted at NW San Miguel between 0006 and 0136 on 8 October 2007. The acoustic survey of NW San Miguel resumed at 1405.

9 October 2007: The acoustic survey of NW San Miguel stopped at 0130 on 9 October 2007. A CTD (#37; Leg 3 #10) was cast there between 0130 and 0138. The acoustic survey resumed there at 1404 and ended at 1933 (**Figs. 1.63 and 1.64**). A CTD (#38; Leg 3 #11) was deployed in NW San Miguel area (34 04.97 N, 120 28.46 W), in conjunction with the DropTS between 2021 and 2048. The acoustic survey of N San Miguel began at 2135 and ended at 2345 (**Figs. 1.65 and 1.66**).

10 October 2007: A CTD (#39; Leg 3 #12) was deployed at N San Miguel area (34 07.69 N, 120 22.05 W), in conjunction with the DropTS, between 0008 and 0031 on 10 October 2007. The DropTS was deployed for calibration at N San Miguel (34 07.53 N, 120 21.50 W) between 0056 and 0223. The ship then proceeded to N Santa Rosa Island. An ROV transect was conducted there between 1400 and 1552. The ship then proceeded to NE San Miguel. An ROV transect was conducted there between 1723 and 1846. The ship then proceeded to N San Miguel. An ROV transect was conducted there between 1955 and 2100. The ship then proceeded to Santa Rosa Flats.

11 October 2007: The DropTS was case for calibration at Santa Rosa Flats (33 50.17 N, 119 58.06 W) between 0208 and 0312 on 11 October 2007. The acoustic survey of Santa Rosa Flats began at 1341 and stopped at 1845 (**Figs. 1.61 and 1.62**), when Navy Fleet Control demanded that the ship leave the area. The ship proceeded to Santa Cruz Canyon. The acoustic survey was conducted there between 2023 and 2149 (**Figs. 1.67 and 1.68**). A CTD (#41; Leg 3 #14) was cast in the Santa Cruz Canyon area (33 56.11 N, 119 50.93 W) in conjunction with the DropTS between 2204 and 2235. The ship then proceeded to Santa Rosa Flats.

12 October 2007: The acoustic survey of Santa Rosa Flats resumed at 0007 on 12 October 2007 and stopped at 0123. The DropTS was cast for calibration at Rosa Flats area (33 42.72 N, 120 02.51 W) between 0138 and 0214. The acoustic survey resumed there at 1358 and stopped at 1617. At 1644, the AURAL+PAL mooring was recovered there. The DropTS mooring system was deployed (33 42.55 N, 120 01.83 W) at 1736. An ROV transect was conducted at Santa Rosa Flats between 1935 and 2127. The acoustic survey of Santa Rosa Flats resumed at 2206.

13 October 2007: The acoustic survey of Santa Rosa Flats stopped at 0003 on 13 October 2007 (**Figs. 1.61 and 1.62**). At 0129, the DropTS mooring was recovered. The ship then proceeded to Santa Cruz Canyon. An ROV transect was conducted at Santa Cruz Canyon between 1429 and 1602. The acoustic survey of Santa Rosa Flats resumed

at 1831 and ended at 2023 (**Figs. 1.61 and 1.62**). A CTD (#42; Leg 3 #15) was cast at Santa Rosa Flats (33 37.95 N, 119 49.64 W) in conjunction with the DropTS between 2036 and 2055. The DropTS was cast (33 37.73 N, 119 49.39 W) for calibration between 2100 and 2305. The ship then proceeded to 43 Fathom Bank.

14 October 2007: The acoustic survey of 43 Fathom Bank was conducted between 1541 and 1620 on 14 October 2007. The DropTS mooring was deployed there (32 39.36 N, 117 58.43 W) between 1646 and 1701. The acoustic survey resumed there at 1701 and ended at 1848 (**Figs. 1.69 and 1.70**). A CTD (#43; Leg 3 #16) was cast at 43 Fathom Bank (32 39.39 N, 117 58.18 W) between 1904 and 1912. An ROV transect was conducted at 43 Fathom Bank between 1959 and 2120. The DropTS mooring was recovered at 2340. The ship returned to port in San Diego due to a crew member's injury.

15 October 2007: The EK60 was turned off at 0354 on 15 October 2007. The ship docked at the SIO marine facility pier at 0500.

Table 1.4. COAST07 Leg III survey sites, dates, and times (GMT).

Survey Location	Start Date	Start Time	End Date	End Time
Hidden Reef	10/2/07	1300	10/2/07	1637
Hidden Reef ROV	10/2/07	1905	10/2/07	2035
South Anacapa Island	10/2/07	2318	10/3/07	0047
Anacapa Pass	10/3/07	1325	10/3/07	1616
Anacapa Pass ROV	10/3/07	1908	10/3/07	2104
N Santa Rosa Island	10/4/07	1329	10/4/07	1601
NE San Miguel Island	10/4/07	1717	10/4/07	1848
SW San Miguel Island Day 1	10/4/07	2230	10/5/07	0124
SW San Miguel Island Day 2	10/5/07	1402	10/5/07	2212
Santa Rosa Flats Day 1	10/6/07	1401	10/7/07	0059
NW San Miguel Island Day 1	10/7/07	1402	10/7/07	1917
NW San Miguel Island ROV	10/8/07	0006	10/8/07	0136
NW San Miguel Island Day 2	10/8/07	1405	10/9/07	0130
NW San Miguel Island Day 3	10/9/07	1406	10/9/07	1933
N San Miguel Island	10/9/07	2135	10/9/07	2345
N Santa Rosa Island ROV	10/10/07	1400	10/10/07	1552
NE San Miguel Island ROV	10/10/07	1723	10/10/07	1846
N San Miguel Island ROV	10/10/07	1955	10/10/07	2100
Santa Rosa Flats Day 2	10/11/07	1341	10/11/07	1845
Santa Cruz Canyon	10/11/07	2023	10/11/07	2149
Santa Rosa Flats Day 3 Part 1	10/12/07	1358	10/12/07	1617
Santa Rosa Flats ROV	10/12/07	1935	10/12/07	2127
Santa Rosa Flats Day 3 Part 2	10/12/07	2206	10/13/07	0003
Santa Cruz Canyon ROV	10/13/07	1400	10/13/07	1443
Santa Rosa Flats Day 4	10/13/07	1831	10/13/07	2023
43 Fathom Bank Part 1	10/14/07	1541	10/14/07	1620
43 Fathom Bank Part 2	10/14/07	1701	10/14/07	1848
43 Fathom Bank ROV	10/14/07	1959	10/14/07	2129

Figure 1.49. Hidden Reef distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

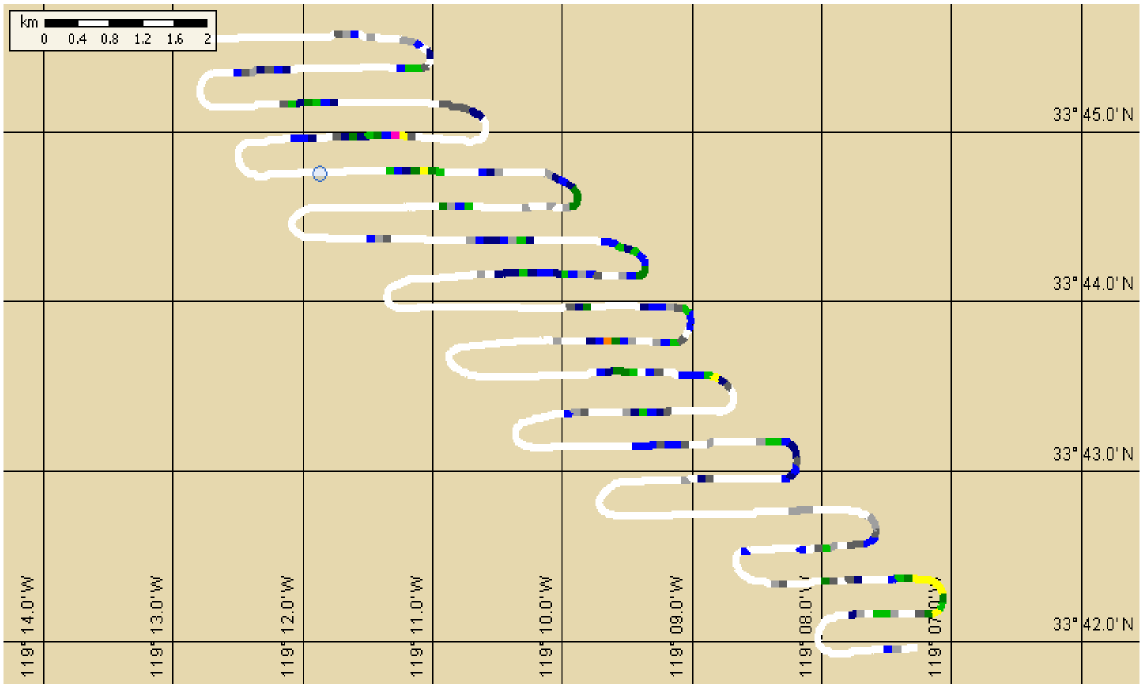


Figure 1. 50. Hidden Reef 3-D image of bathymetry (m) and S_v of rockfishes (dB).

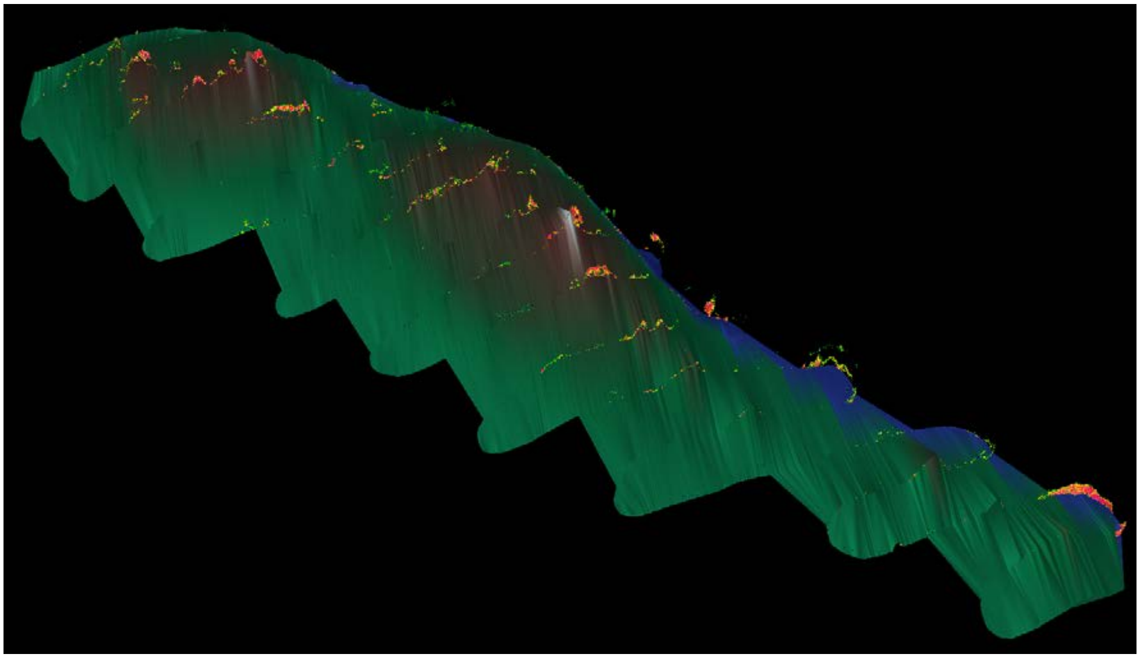


Figure 1.51. South Anacapa Island distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

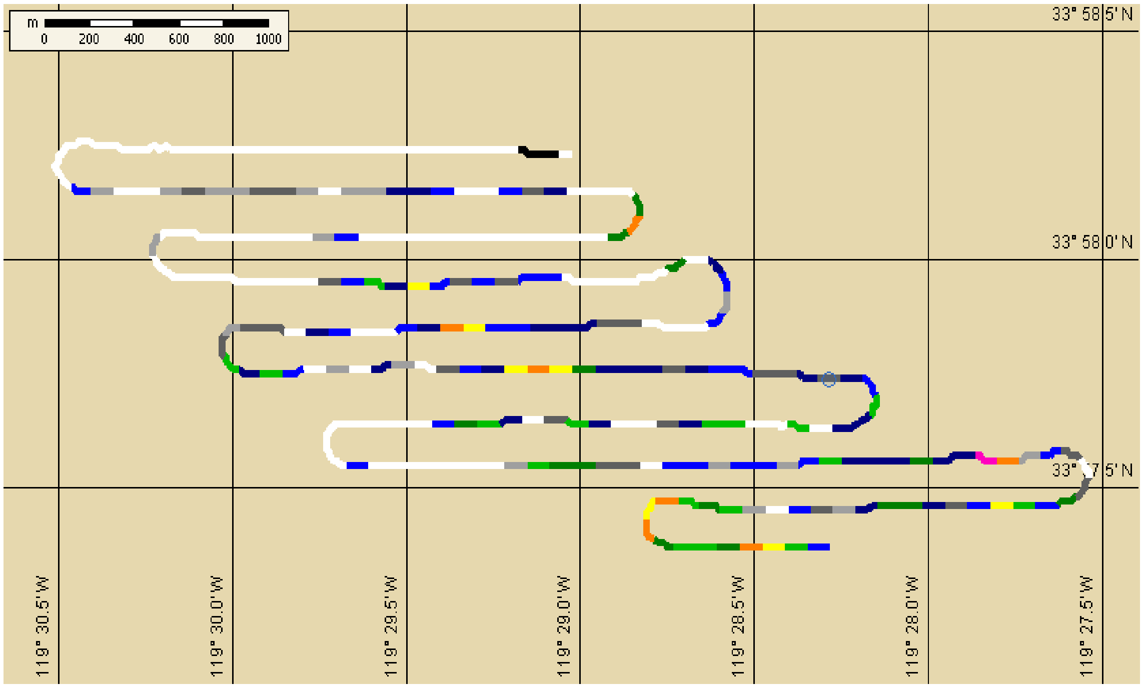


Figure 1.52. South Anacapa Island 3-D image of bathymetry (m) and S_v of rockfishes (dB).

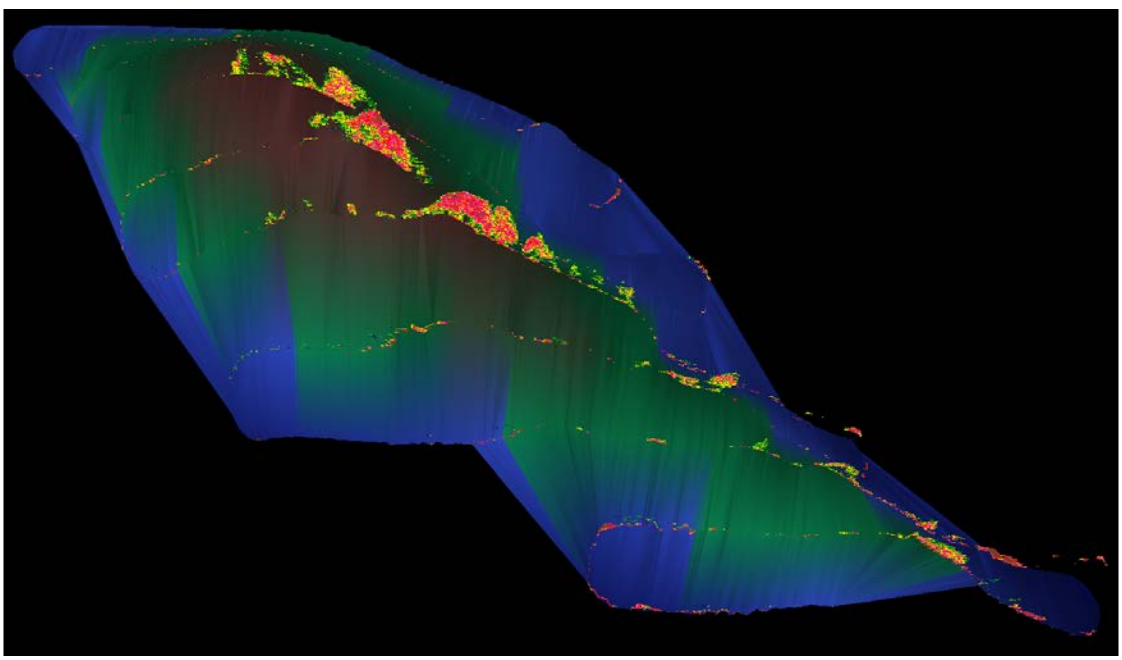


Figure 1.53. Anacapa Pass distribution of s_A ($m^2/n.mi.^2$) attributed to rockfishes.

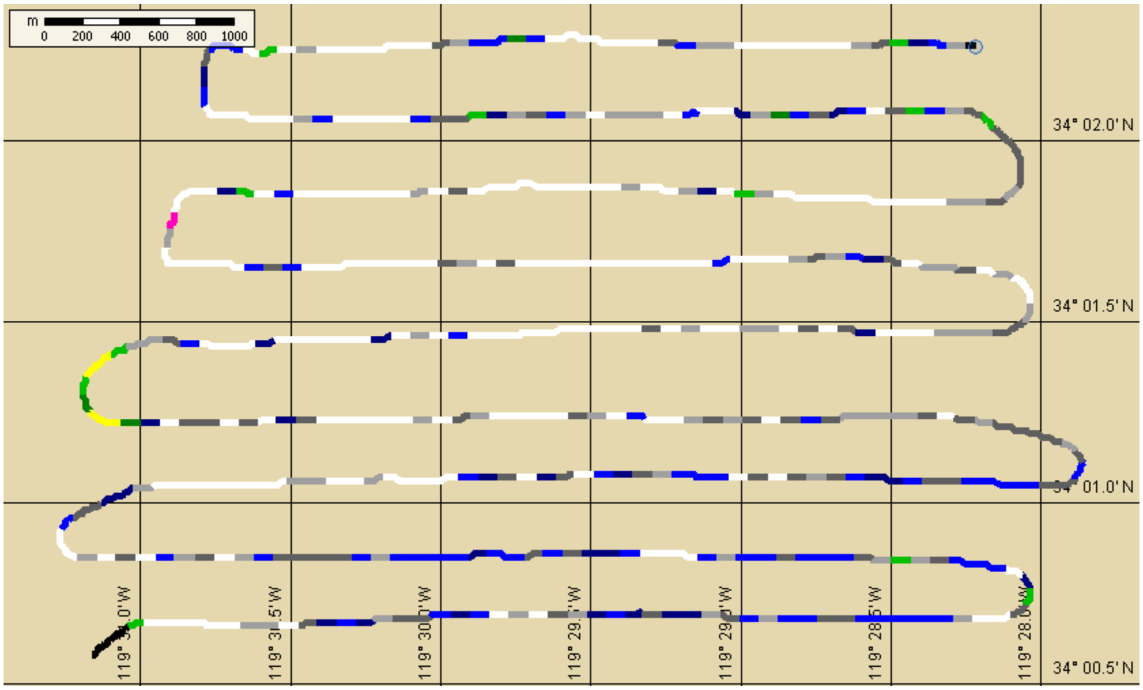


Figure 1.54. Anacapa Pass 3-D image of bathymetry (m) and S_v of rockfishes (dB).

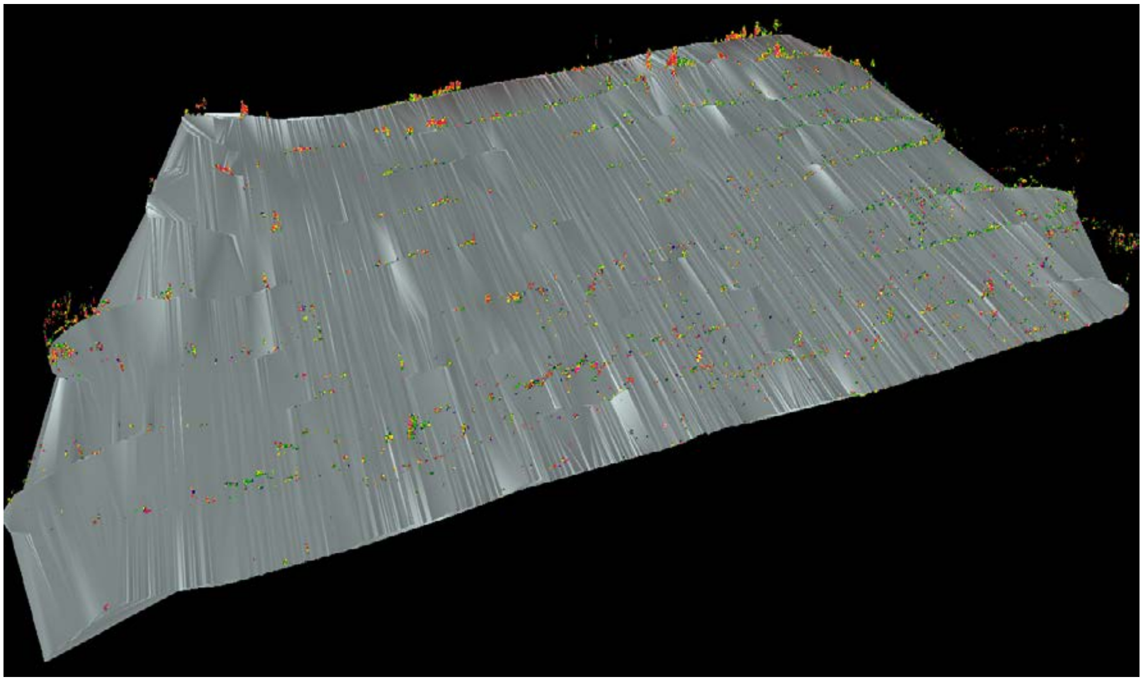


Figure 1.55. North Santa Rosa Island distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

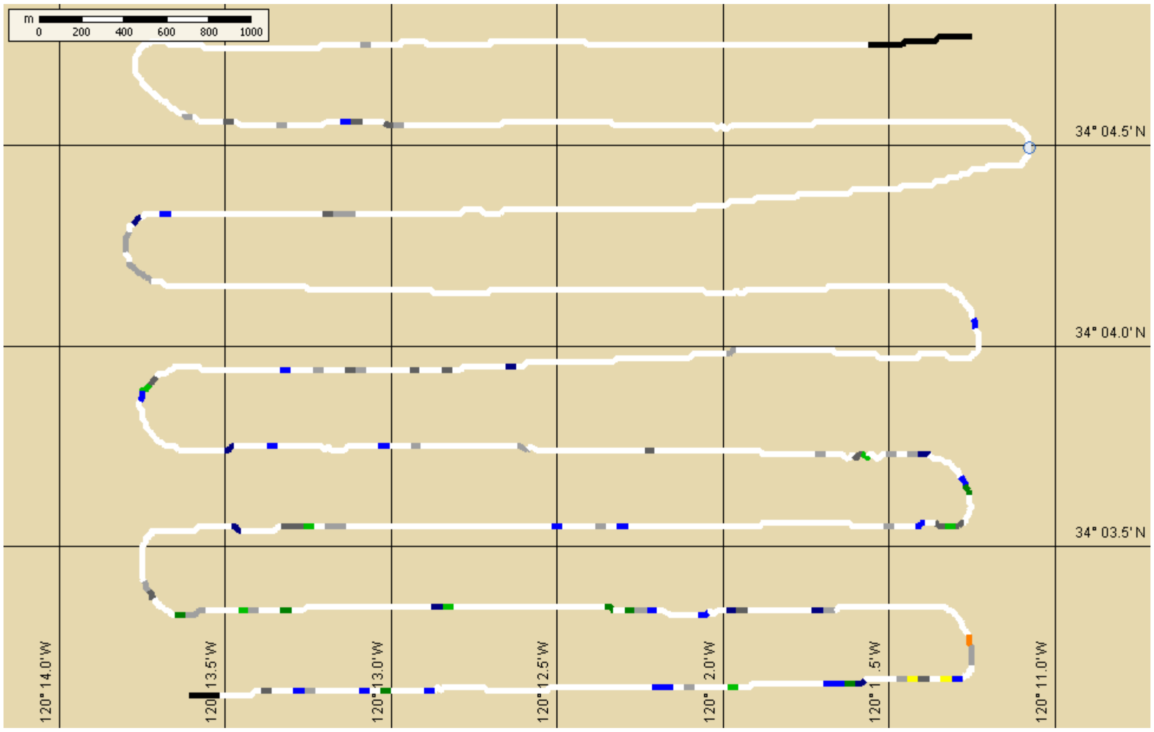


Figure 1.56. North Santa Rosa Island 3-D image of bathymetry (m) and S_v of rockfishes (dB).

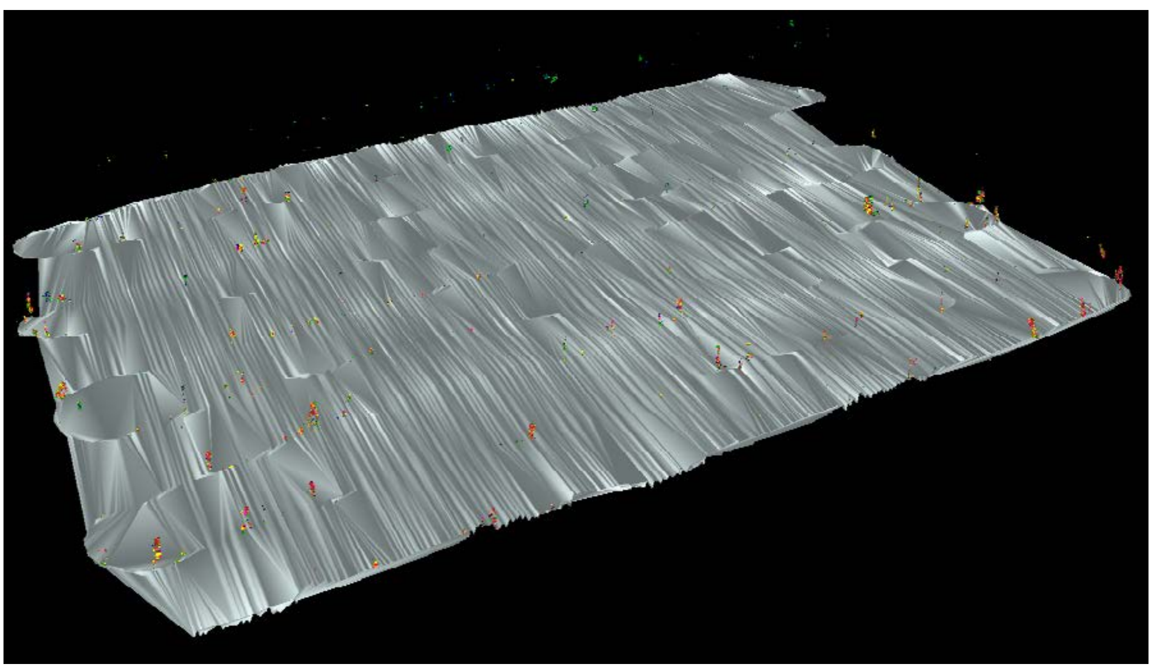


Figure 1.57. Northeast San Miguel distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

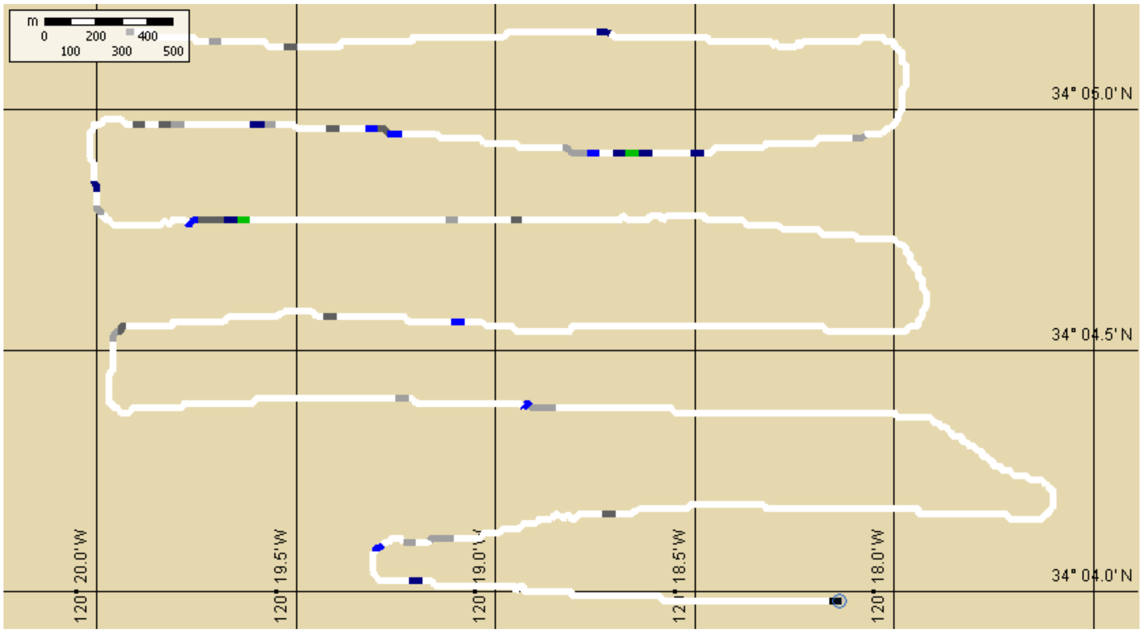


Figure 1.58. Northeast San Miguel 3-D image of bathymetry (m) and S_v of rockfishes (dB).

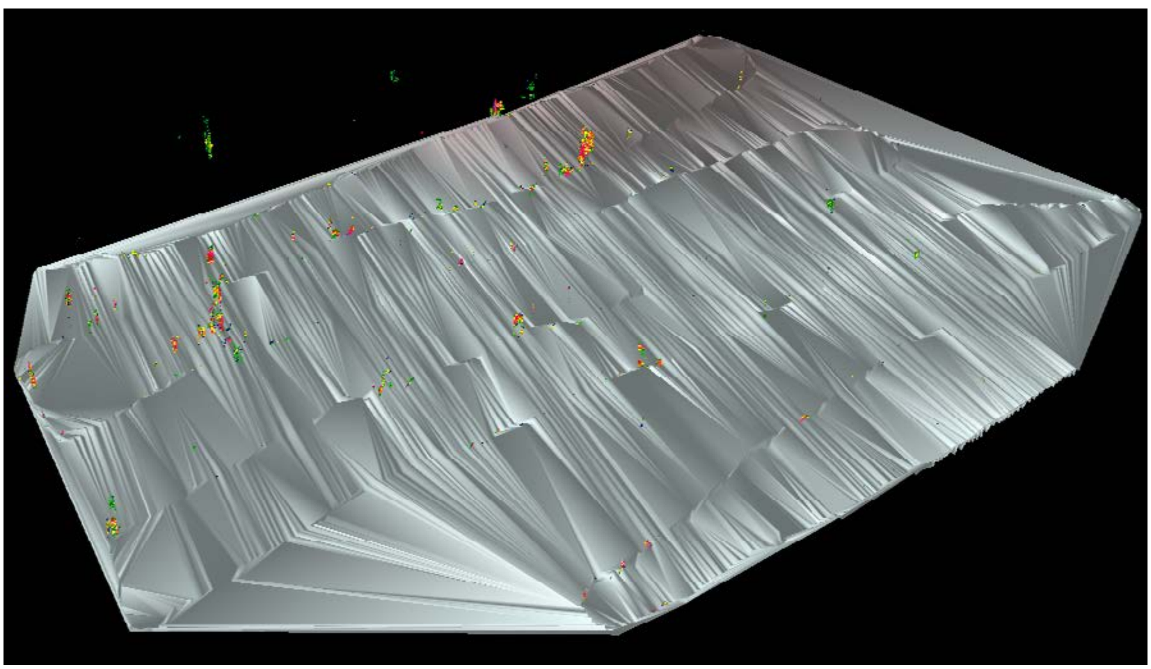


Figure 1.59. Southwest San Miguel distribution of s_A ($m^2/n.mi.^2$) attributed to rockfishes.

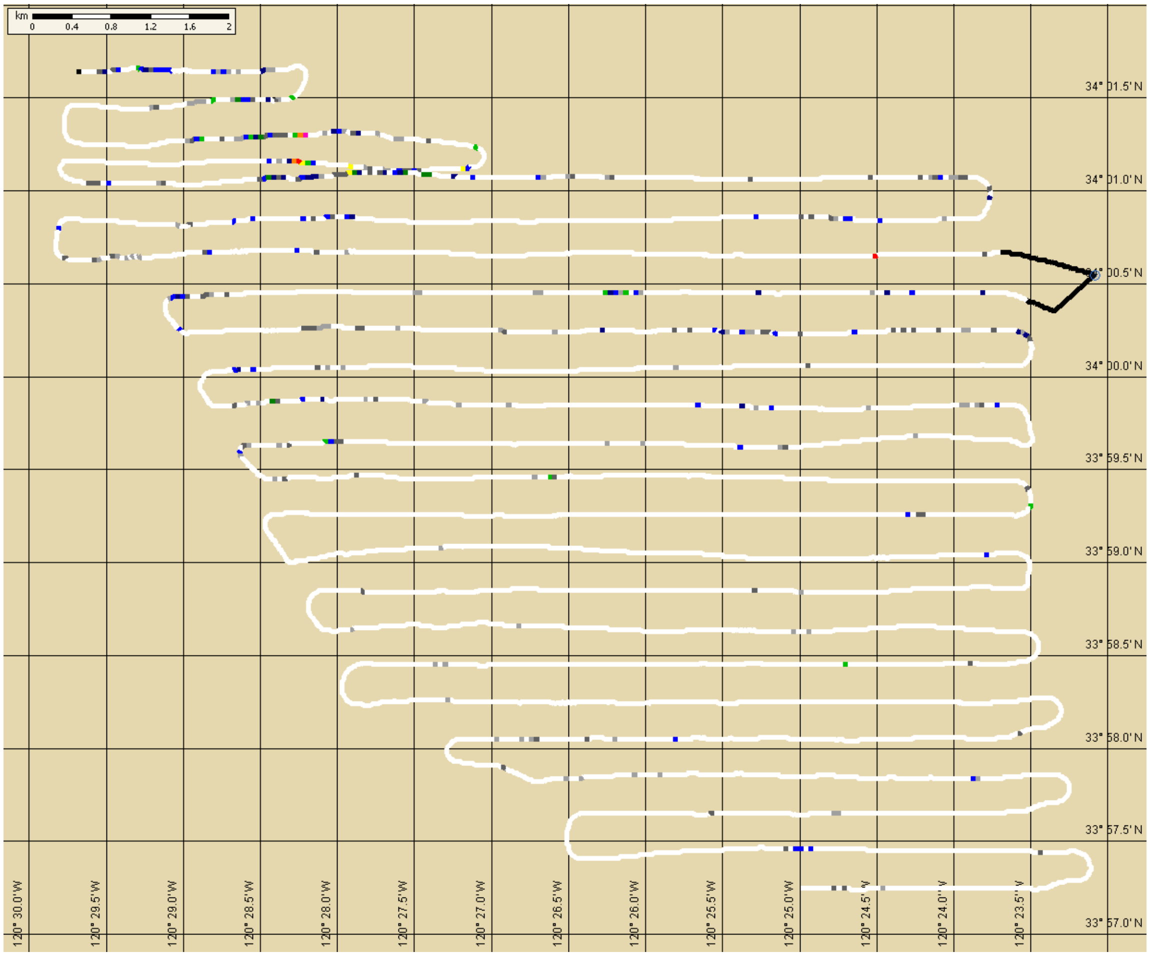


Figure 1.60. Southwest San Miguel 3-D image of bathymetry (m) and S_v of rockfishes (dB).

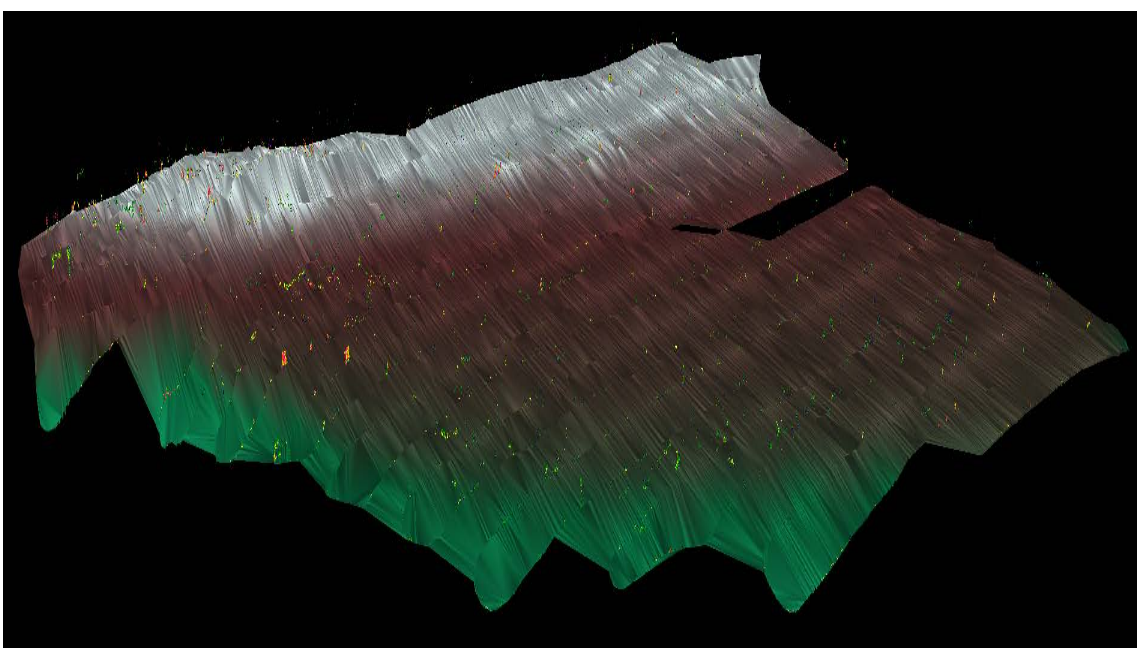


Figure 1.61. Santa Rosa Flats distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

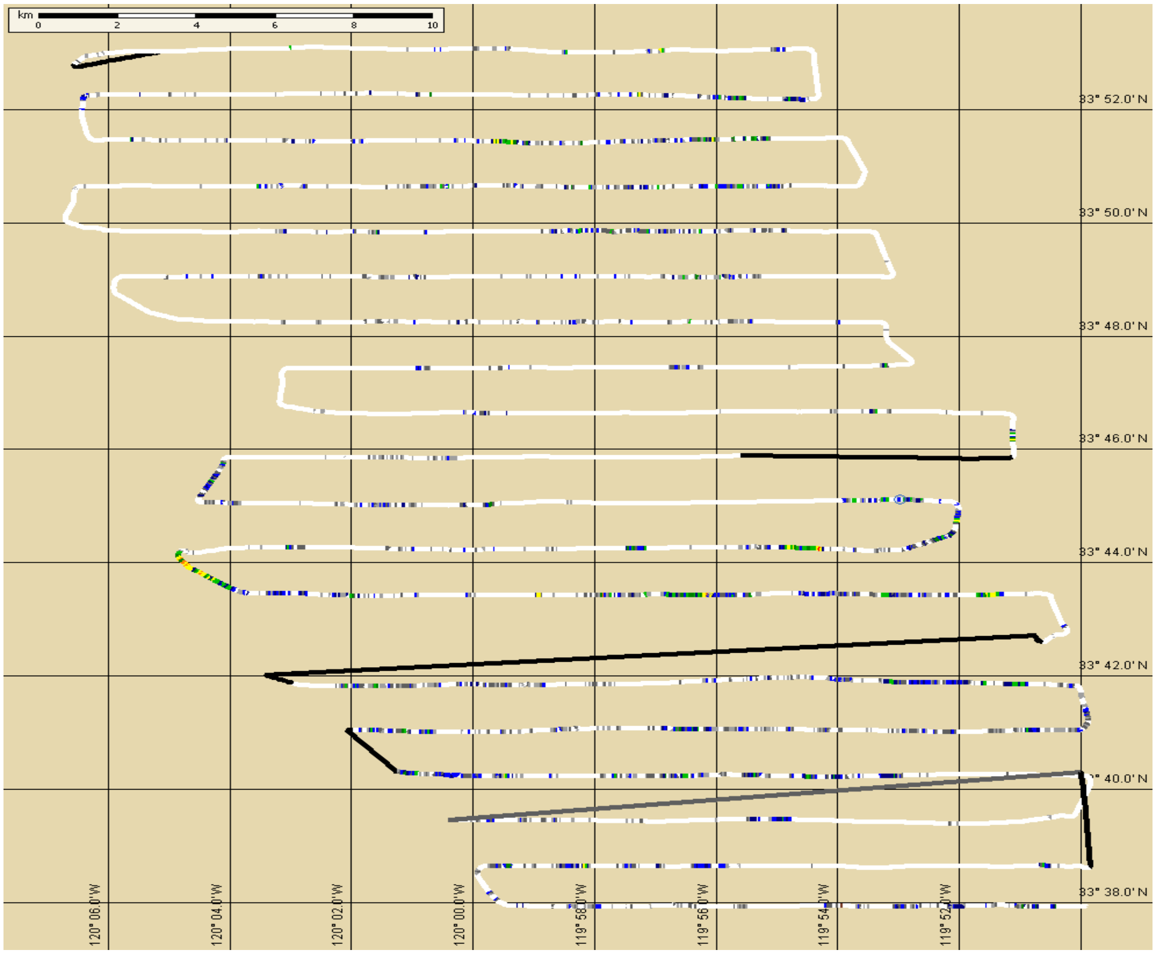


Figure 1.62. Santa Rosa Flats 3-D image of bathymetry (m) and S_v of rockfishes (dB).

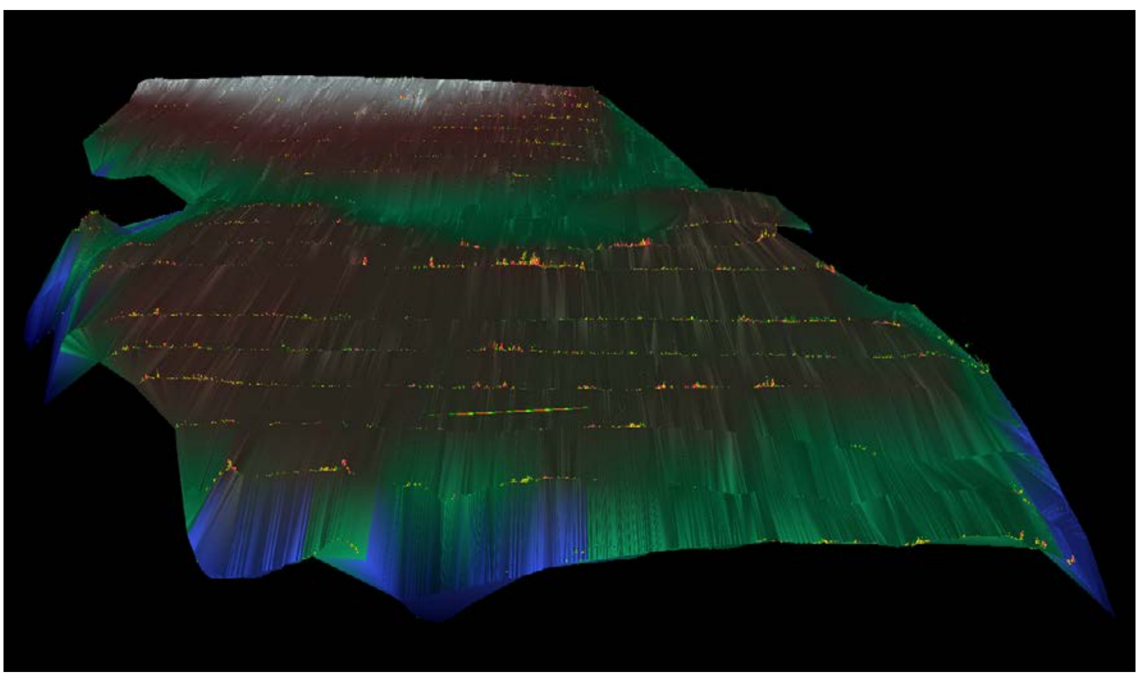


Figure 1.63. Northwest San Miguel distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

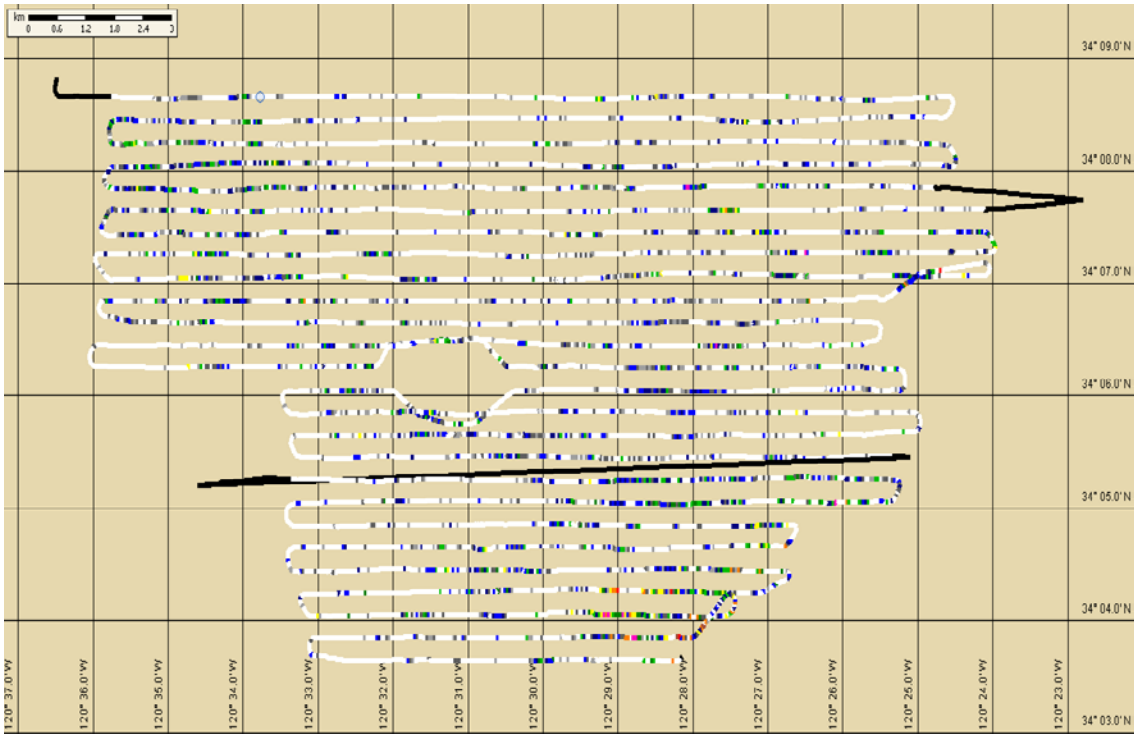


Figure 1.64. Northwest San Miguel 3-D image of bathymetry (m) and S_v of rockfishes (dB).

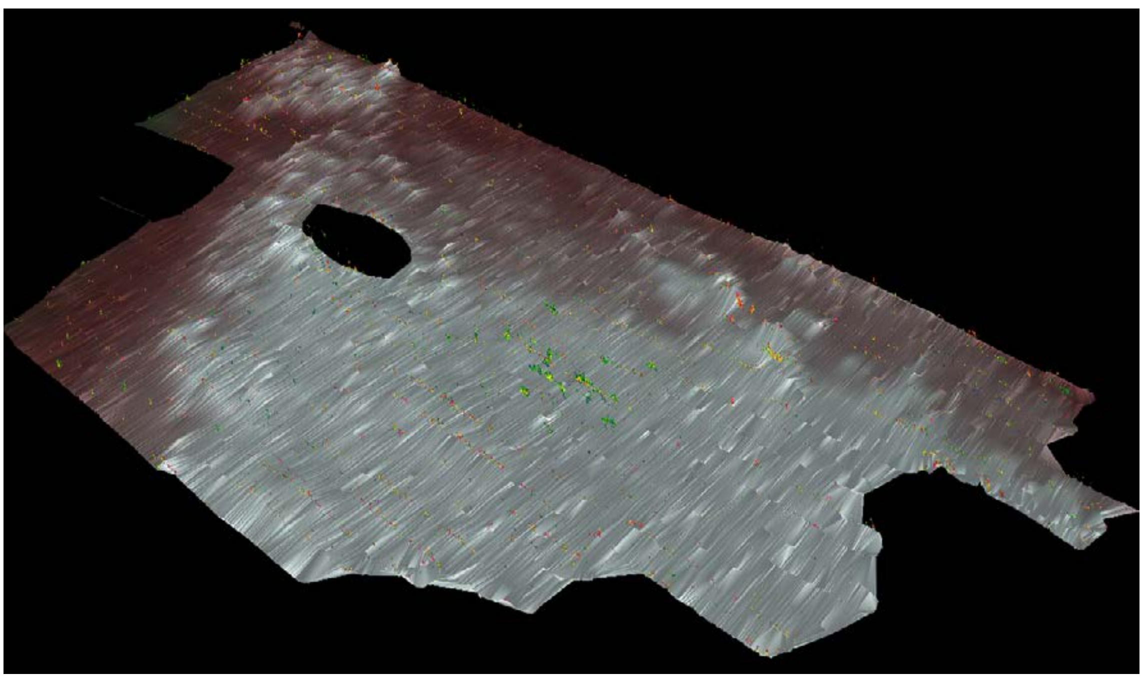


Figure 1. 65. North San Miguel distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

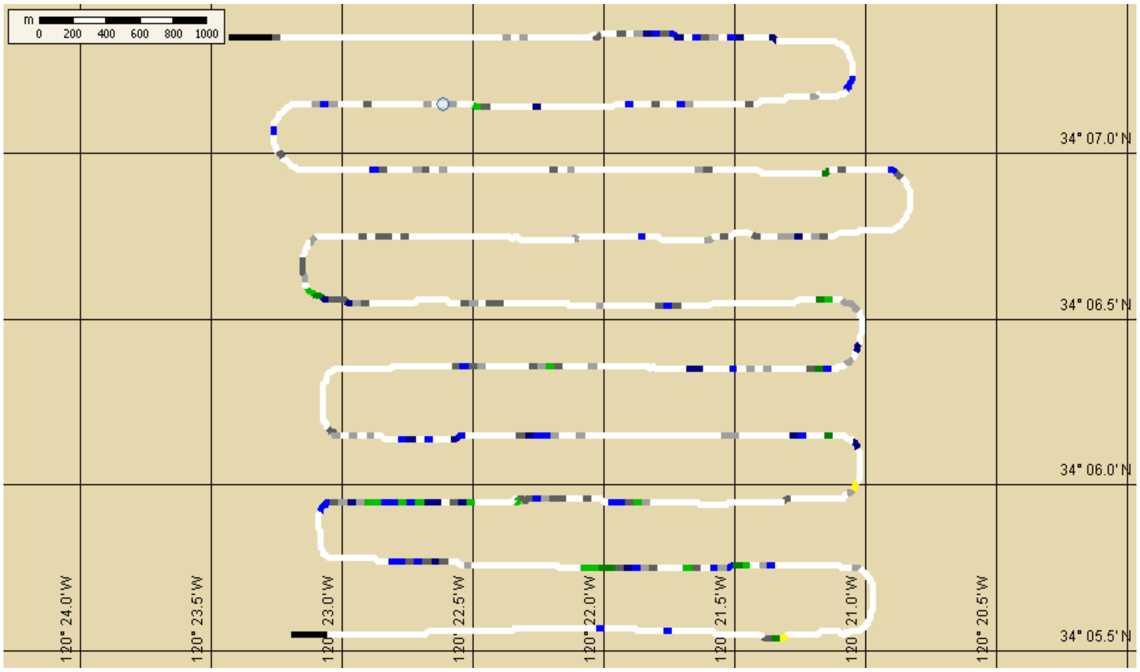


Figure 1.66. North San Miguel 3-D image of bathymetry (m) and S_v of rockfishes (dB).

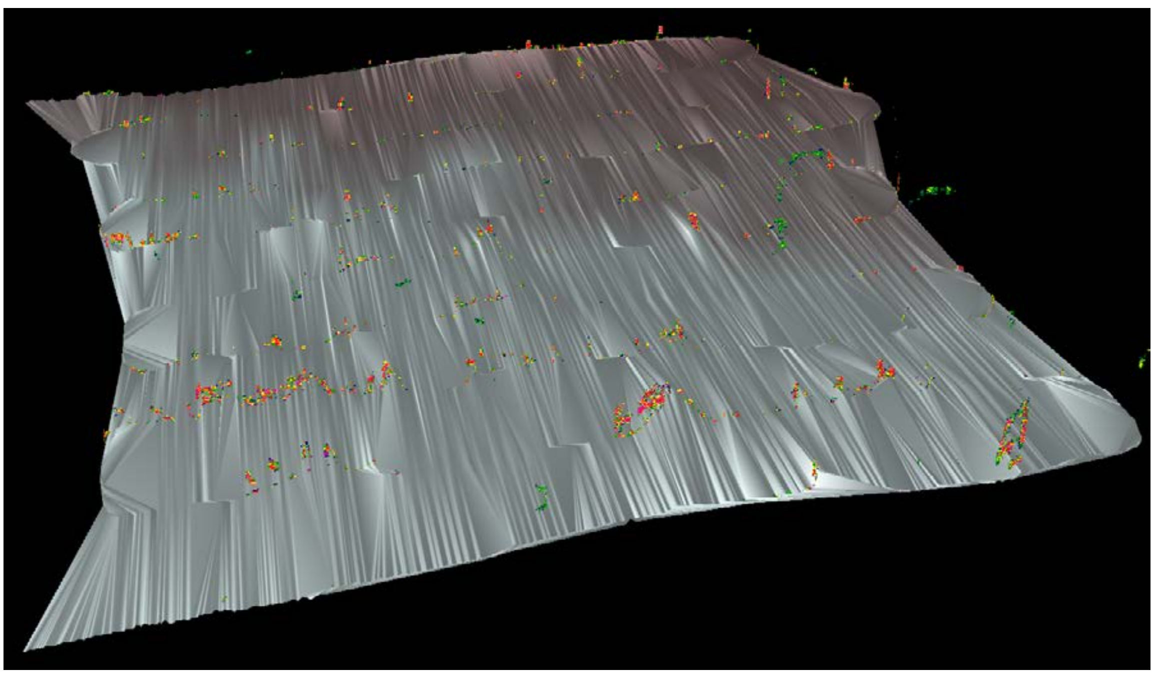


Figure 1.67. Santa Cruz Canyon distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

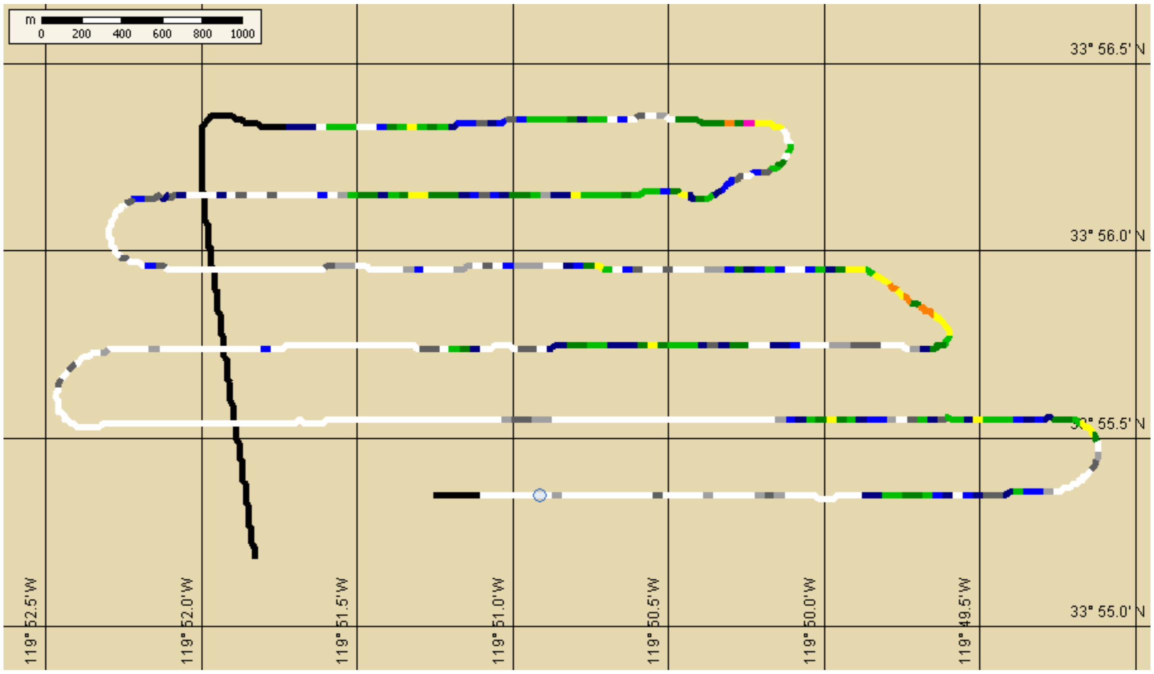


Figure 1.68. Santa Cruz Canyon 3-D image of bathymetry (m) and S_v of rockfishes (dB).

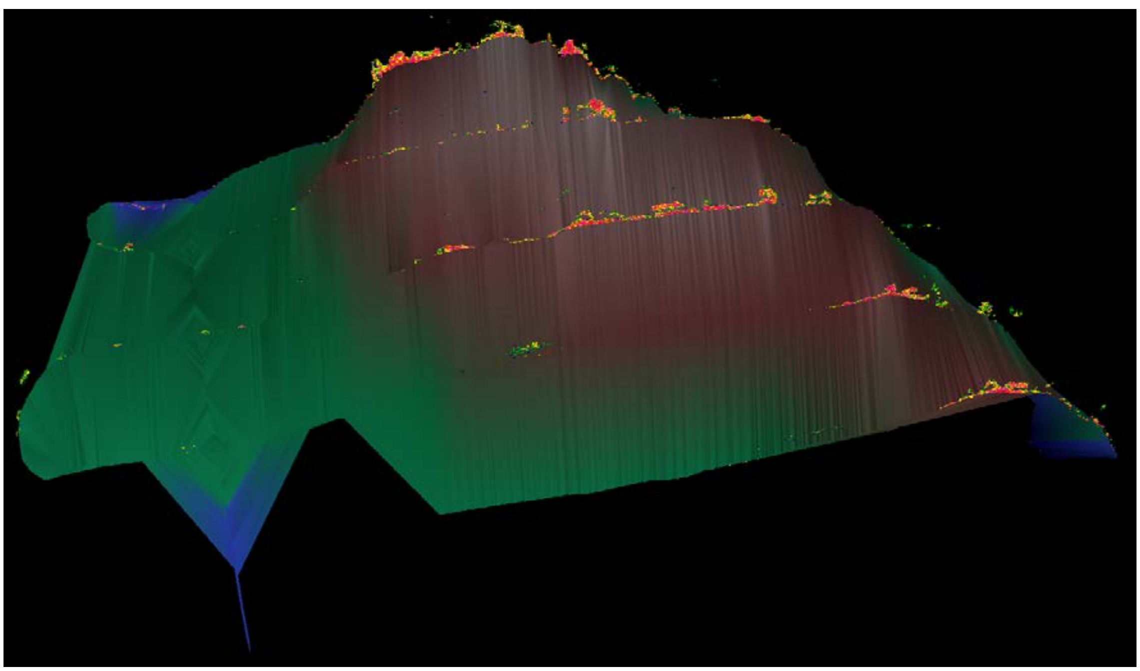


Figure 1.69. Forty-Three Fathom Bank #3 distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

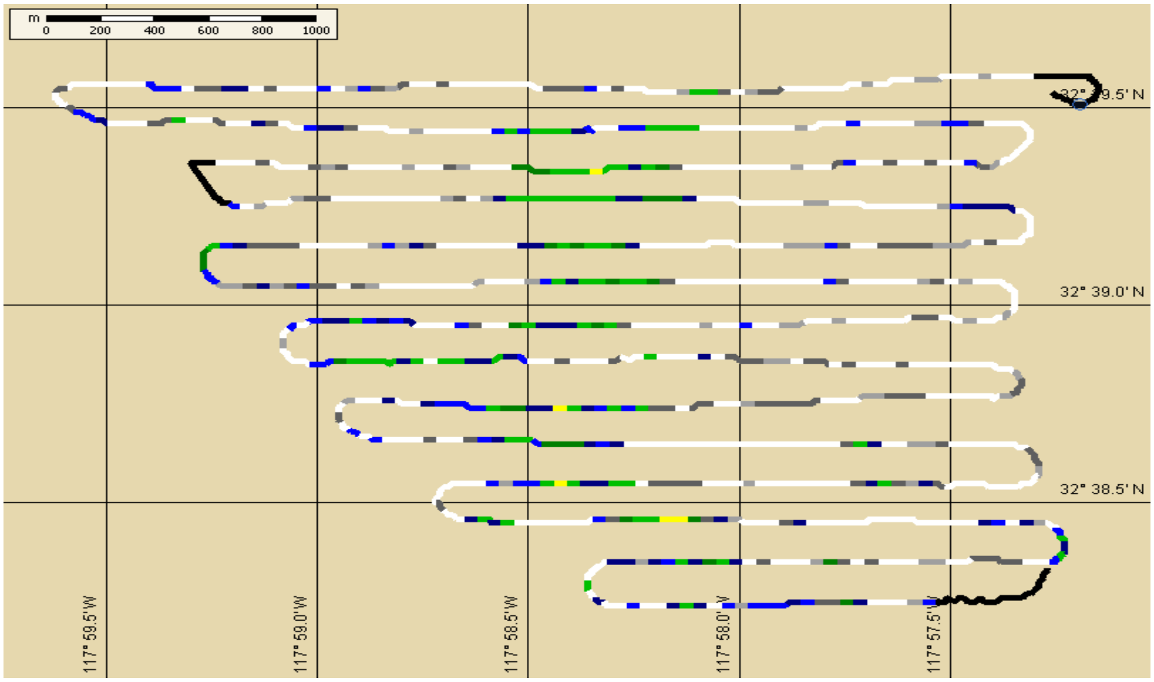
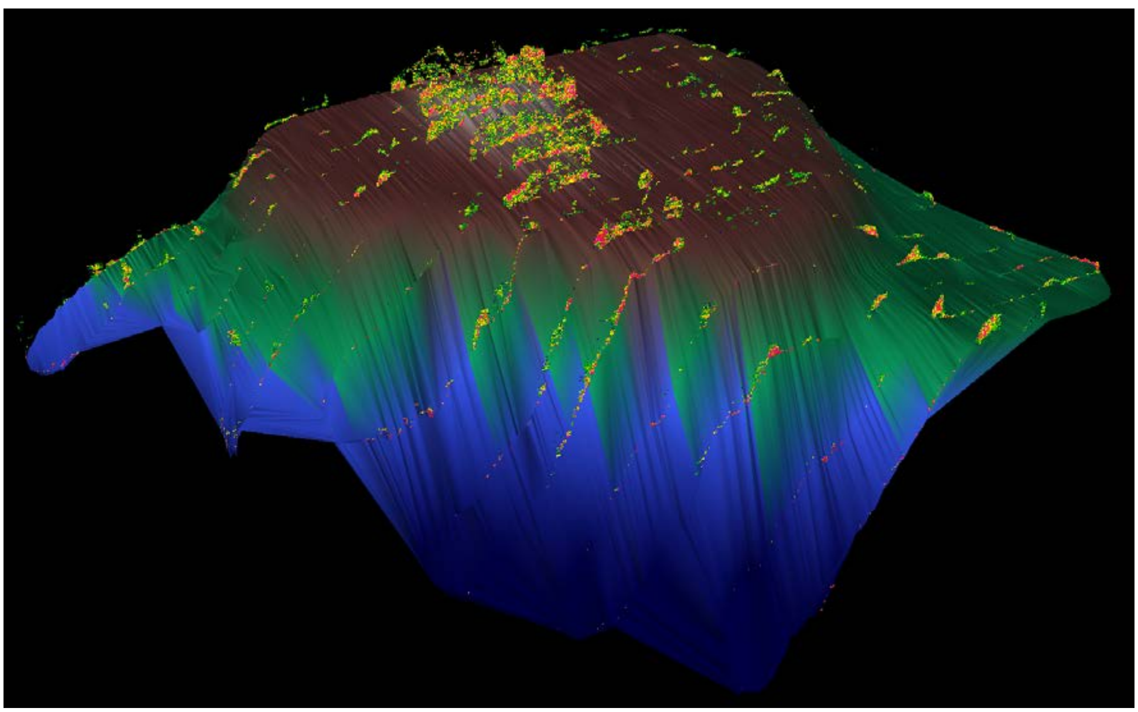


Figure 1.70. Forty-Three Fathom Bank #3 3-D image of bathymetry (m) and S_v of rockfishes (dB).

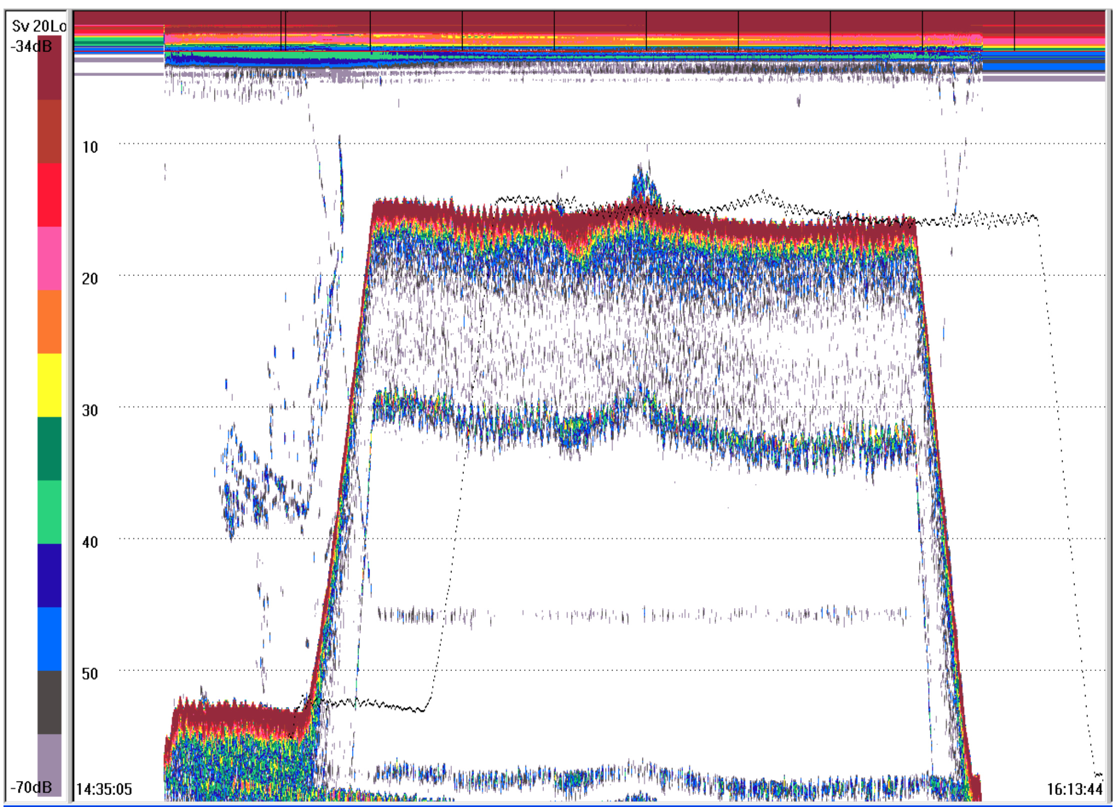


On 1 October 2007, the DropTS was assembled. Also, an imaging sonar (Didson) and a time-lapse camera were integrated into a separate deployment frame. The mooring apparatus was assembled and the DropTS battery packs were charged.

At 1600, the DropTS was deployed with four float buoys attached to the main lifting eye. While deploying, the crane-hook quick-release line snagged and the Didson+camera lander was dropped from deck to water level. The apparatus was retrieved, the locking sleeve on the camera battery pack was replaced and the both flash housings were reattached. At 1622, the Didson+camera lander was deployed in 75 m depth at 32 39.3099 N 117 58.3281 W.

On Wednesday 3 October 2007, the float buoys were removed and the Seabird SBE 19 CTD was attached to the DropTS frame. Between 1753 and 1814, The DropTS with CTD was deployed in 56 m of water (**Fig. 1.71**). The system was running, but the water switch was off so the EK60 was not transmitting. The DropTS was recovered. At 1859, the DropTS was charging and the EK60 files were downloaded. At 1926, it was noted that the DropTS PC clock was still set to GMT +2. The clocks were set to GMT.

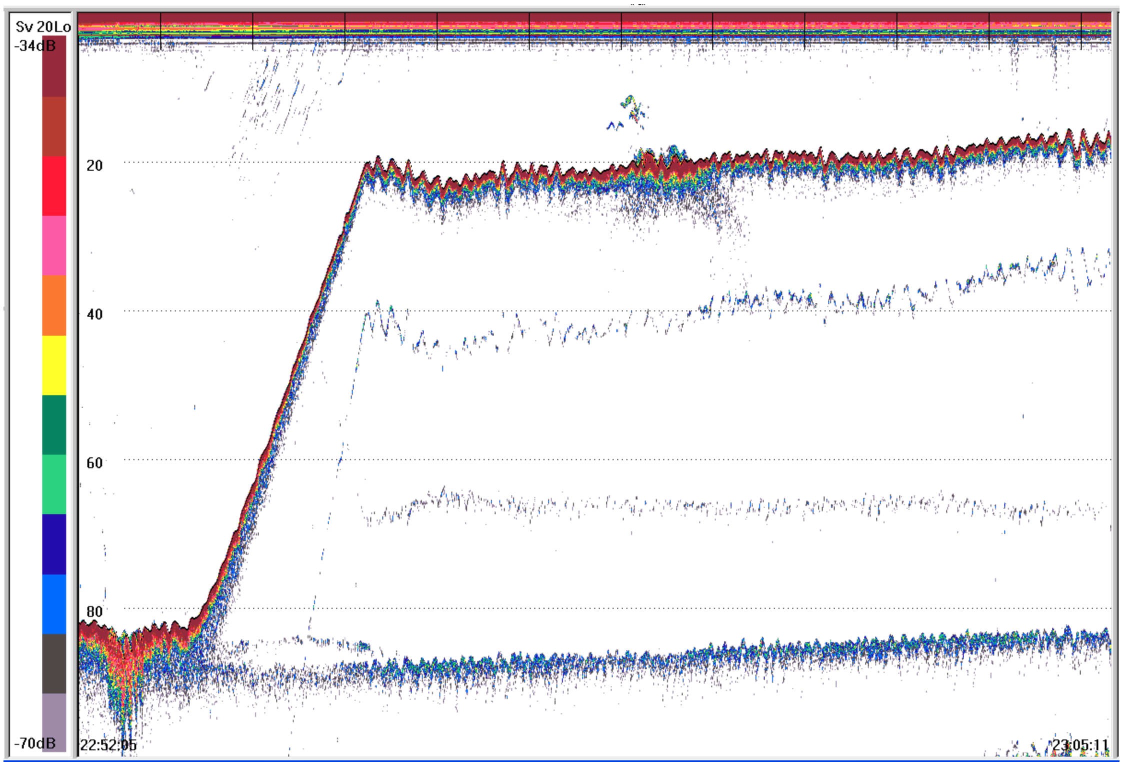
Figure 1.71. DropTS-EK60 echogram (38 kHz) during the deployment of the DropTS on 2 October 2007. During the descent of the DropTS, the range to the seabed decreases from approximately 53 to 15 m. Backscatter from fish near the seabed are apparent near the center of the echogram.



On 5 October 2007, in the DropTS EK60 the range and maximum depth were set to 30 m, the pulse length was set to 512 µs, and the ping rate was set to maximum. Between 2249 and 2320, the DropTS/CTD was deployed in a water depth of 82 to 84 m (**Fig.**

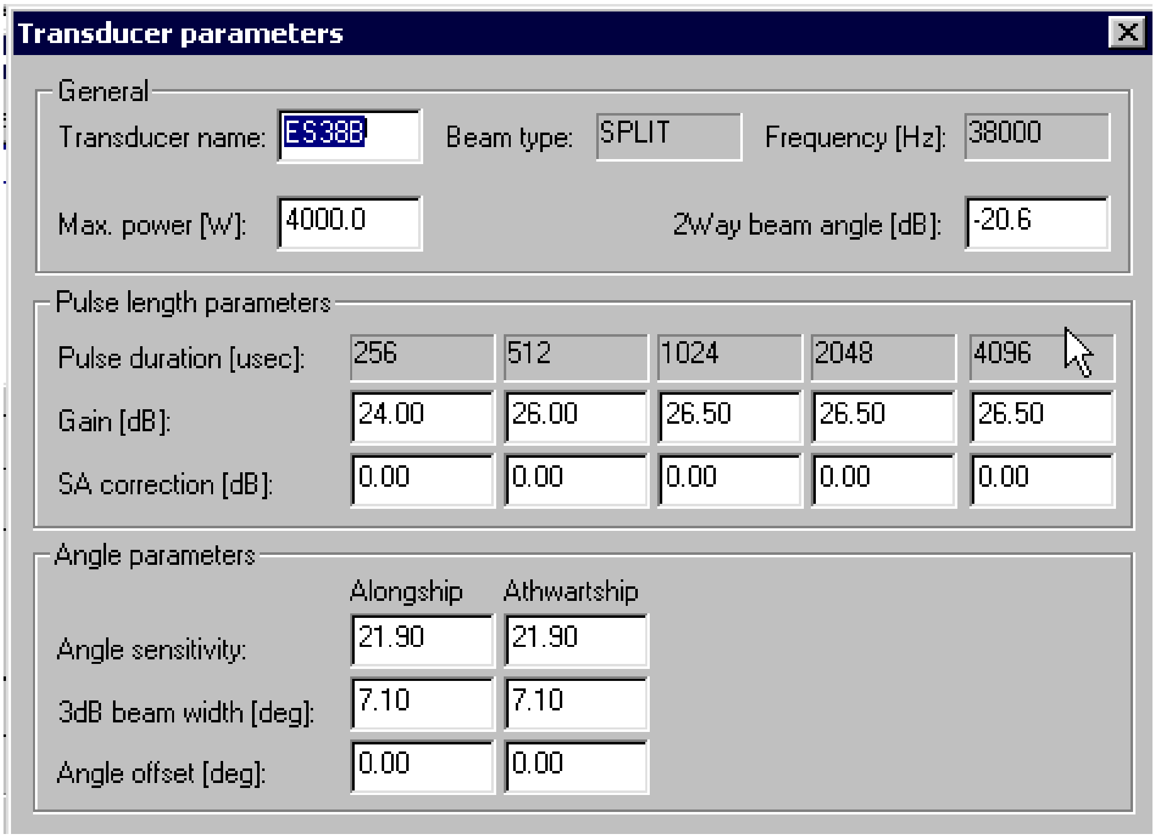
1.72). The wire out was 65 m. The wire angle changed frequently as the ship labored to hold position in 2 to 3 m swell.

Figure 1.72. DropTS-EK60 echogram (38 kHz) during the deployment of the DropTS on 5 October 2007. . During the descent of the DropTS, the range to the seabed decreases from approximately 81 to 20 m. Backscatter from fish near the seabed are apparent near the center of the echogram. The ship motion is evident in the oscillations of the seabed echo.



The DropTS+CTD was deployed on 7 October 2007 between 0142 and 0218 in 191 m of water. The water-switch magnet was repositioned farther away from the reed switch because the GPT was not switching off. At 1942, the DropTS+CTD was deployed in 80m depth. This time, the EK60 did not turn on so the DropTS+CTD was recovered. The DropTS.exe software had crashed. The water switch performed differently in the ocean compared to during tests on the deck. At 2122, the DropTS+CTD was deployed in 98 m depth, with a calibration sphere suspended beneath (**Fig. 1.73**). The system was lowered and stopped for 10 minutes each at 5, 10, 20, 40, 60 and 75 m depths.

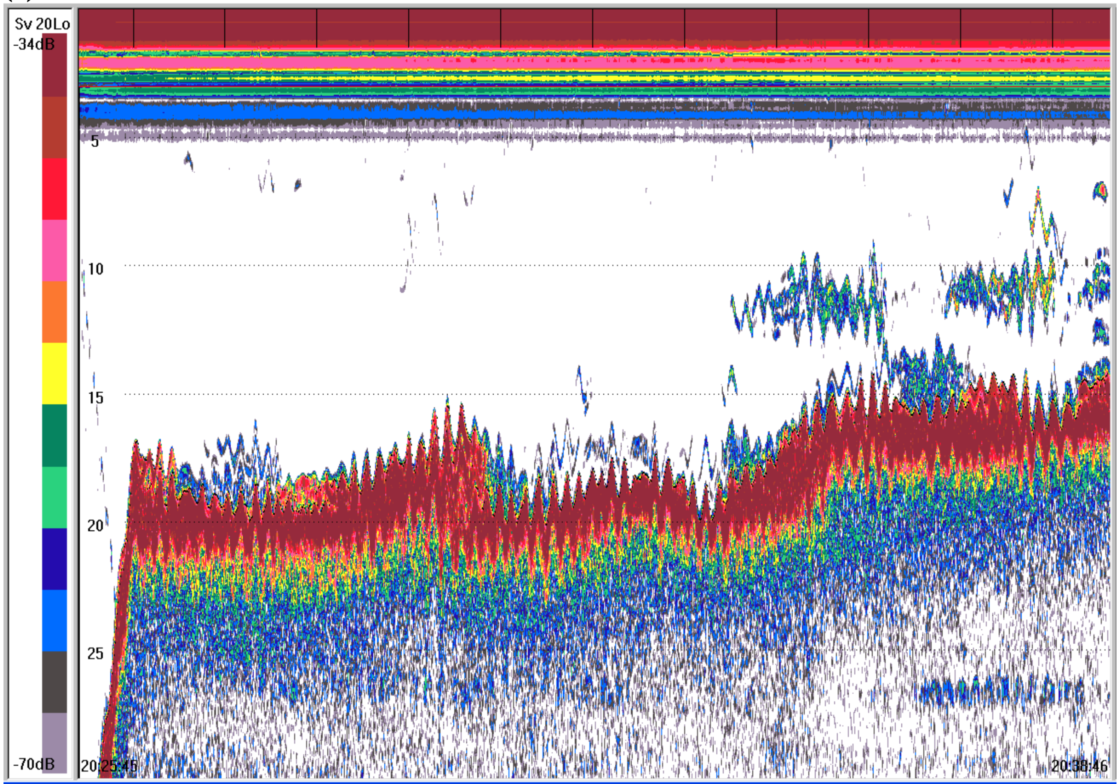
Figure 1.73. DropTS-EK60 (38 kHz) transceiver settings during the deployment of the DropTS on 7 October 2007 with a calibration sphere suspended beneath.



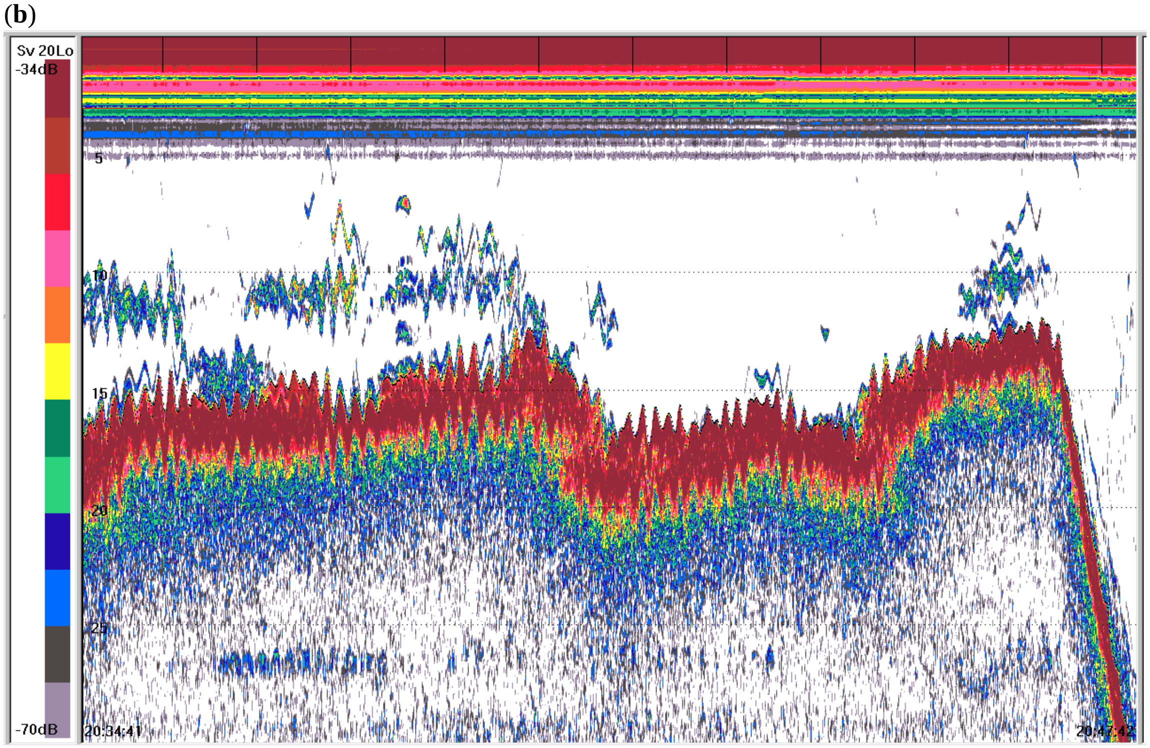
On 9 October 2007, it was noted that the water-switch float was waterlogged, so a new water-switch float was fabricated from syntactic foam. At 0100, the transducer selection was corrected from ES38B to ES38D. The DropTS+CTD was deployed from 0138 to 0205 in 47 m water depth. It was held 15 m above the seabed for 20 min (**Fig. 1.74a**). The DropTS+CTD was also deployed from 2021 to 2050 in 43 m of water for 20 min (**Fig. 1.74b**).

Figure 1.74. DropTS-EK60 echogram (38 kHz) during a deployment (**a**) and a recovery (**b**) of the DropTS on 9 October 2007. During the descent of the DropTS, the range to the seabed decreased to approximately 15 m. Backscatter from fish very near the seabed are apparent throughout most of the echogram. The ship motion caused undulations in the echo ranges.

(a)



(**b**)



On 10 October 2007 between 0008 and 0034, the DropTS was deployed in 94 m depth with a calibration sphere suspended 15 m beneath the transducer. The DropTS was held at 70 m depth for 20 min. The sound speed was estimated from the CTD data and the DropTS was redeployed between 0056 and 0224 with the calibration sphere. The DropTS was stopped for 10 min each at 5, 10, 20, 30, 40, 50, 60, and 70 m depths.

On 11 October 2007, the EK60 gain was changed from 26 to 24 dB (**Fig. 1.75**). The DropTS was then deployed between 0206 and 0312 in 101 m depth and stopped at 5, 20, 40, 60, and 80 m depths. From 2204 to 2237, the DropTS was deployed in 84 m of water to 20 m off the seabed.

Figure 1.75. DropTS-EK60 (38 kHz) transceiver settings during the deployment of the DropTS on 11 October 2007. A calibration sphere was suspended 15 m beneath the transducer.

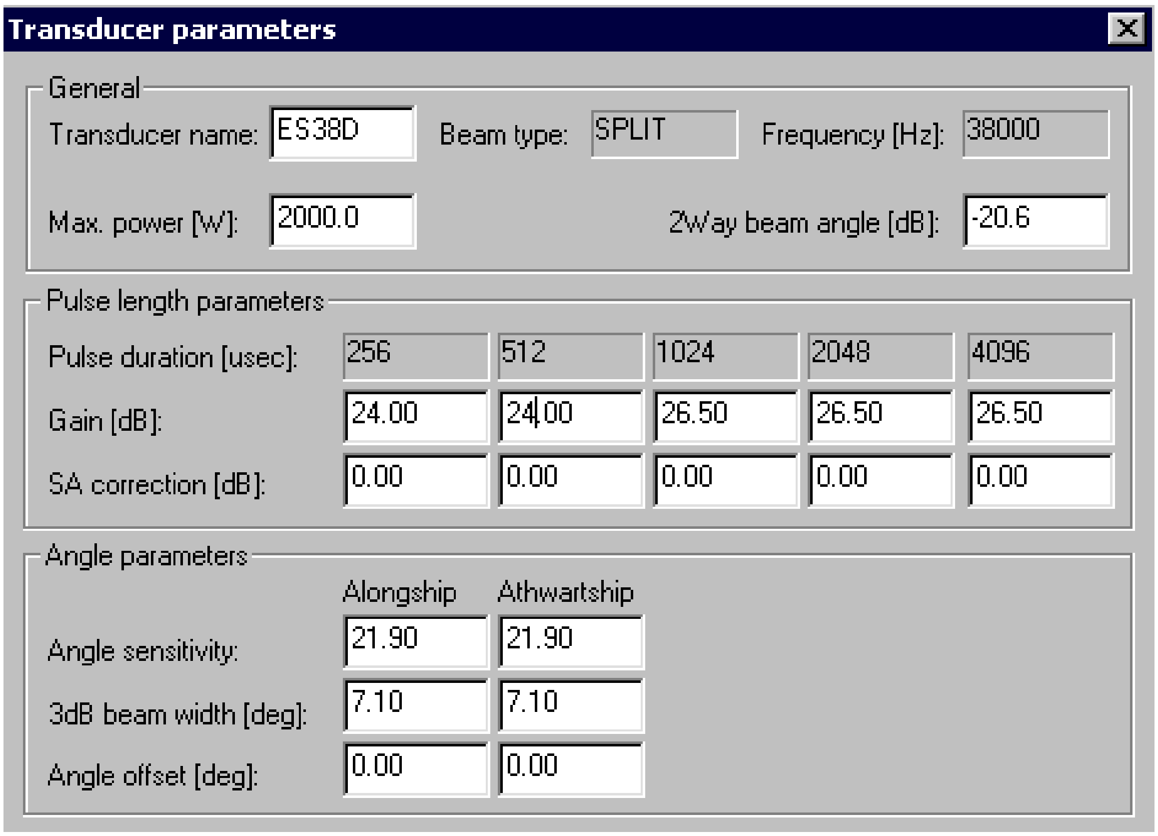
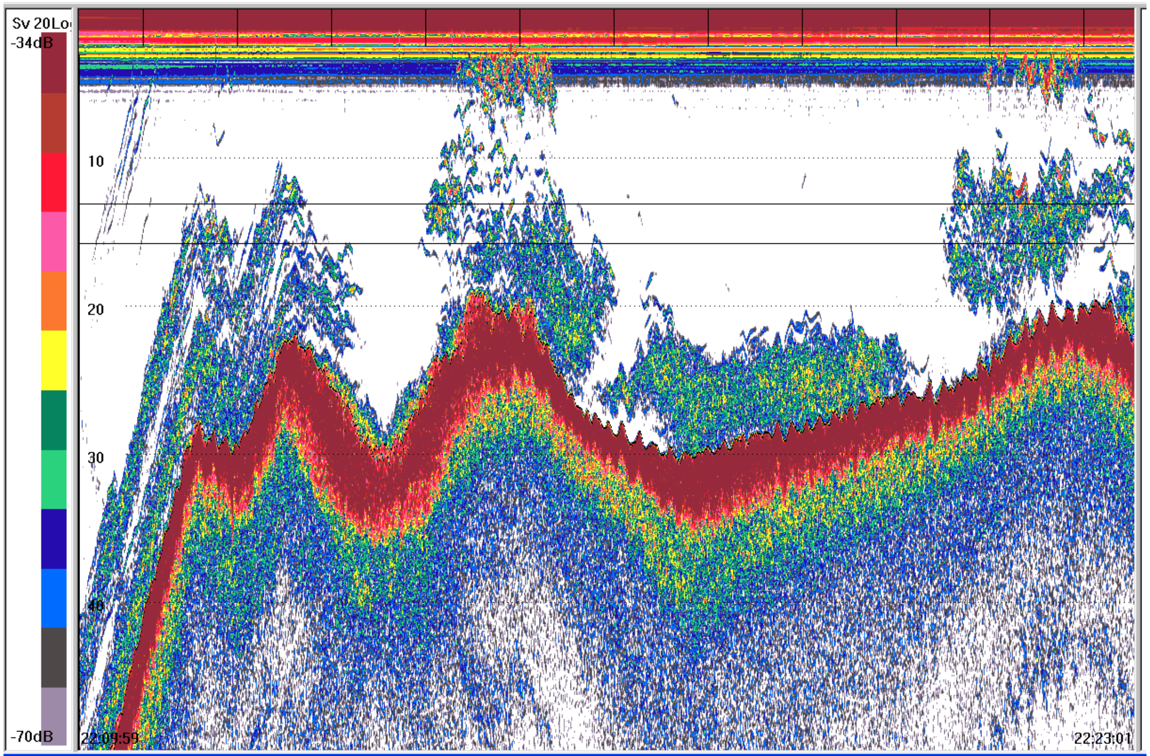


Figure 1.76. DropTS-EK60 echogram (38 kHz) during a deployment of the DropTS on 11 October 2007. The calibration sphere suspended beneath the transducer is not imaged, likely due to current moving it out of the beam. Backscatter from rockfishes near the seabed is evident throughout most of the echogram.



On 12 October 2007, between 0138 and 0022, a calibration sphere was suspended beneath the transducer by monofilament lines attached to the transducer mounting plate. The DropTS was then deployed in 112 m of water and stopped at 5 m depth for 5 min, and 20 and 80 m depths for 30 min each.

At 1756, the DropTS was deployed on a surface mooring in conjunction with the Didson and still camera system positioned at ~75 m depth, ~25 m above the ~100 m depth seabed. At 1849, the ship and then the ROV sailed past mooring.

On 13 October 2007 at 0120, the DropTS+CTD and Didson+camera were retrieved. Between 2036 and 2055, the DropTS+CTD was cast in 384 m depth. Between 2101 and 2308, the DropTS was calibrated at 20 m with three 15 m lines suspending the sphere beneath the transducer, and a fourth line to the ship to move the sphere through the acoustic beam.

On 14 October 2007 at 1646, the DropTS+CTD and the Didson+camera were deployed in 84 m of water. At 2055, the ROV was temporarily caught by a derelict fishing net about 30 m from the DropTS mooring. At 2340, the mooring was retrieved.

COAST07 Leg IV

<u>22 October 2007:</u> The ship departed from the SIO marine facility pier at 1715 GMT on 22 October 2007 and headed for 9 Mile Bank. At 1813, the EK60 was operational and recording data. The vessel began surveying the 9 Mile Bank at 1938.

<u>23 October 2007:</u> The acoustic survey of 9 Mile Bank ended at 0112 on 23 October2007 (**Figs. 1.77 and 1.78**) . At 0133, the AURAL mooring was deployed at 9 Mile Bank (32 36.20 N, 117 23.49 W). Between 0142 and 0158, a CTD was cast (#44, Leg 4 #1) at 9 Mile Bank (32 36.20 N, 117 23.58 W). The ship then proceeded to NW San Clemente Island. The acoustic survey of NW San Clemente Island began at 1358 and ended at 1528 (**Figs. 1.79 and 1.80**). The ship then headed back to San Diego to offload crew members whose families were being evacuated due to wildfires.

<u>24 October 2007:</u> At 0000 on 24 October 2007, the EK60s were turned off. At 0035, the ship returned to the SIO marine facility pier. At 2100, the ship departed the pier and headed for 9 Mile Bank. Data recording from the EK60s began again at 2144. At 2300, the AURAL mooring was recovered from 9 Mile Bank. At 2311, the acoustic survey of 9 Mile Bank began.

<u>25 October 2007:</u> The acoustic survey of 9 Mile Bank ended at 0113 on 25 October 2007 (**Figs. 1.77 and 1.78**). Between 0121 and 0137, a CTD was cast (#45, Leg 4 #2) at 9 Mile Bank (32 34.72 N, 117 21.00 W). The ship then proceeded to 60 Mile Bank. The survey of 60 Mile Bank began at 1400 and ended at 2237 (**Figs. 1.81 and 1.82**).

<u>26 October 2007:</u> An ROV transect was conducted at 60 Mile Bank between 0008 and 0142 on 26 October2007. Between 0156 and 0158, a CTD was cast (#46, Leg 4 #3) at 60 Mile Bank (32 00.72 N, 118 12.59 W). The ship then proceeded to China Point Reef. At 1315, an AURAL+PAL mooring was deployed at China Point Reef (32 44.67 N, 118 24.27 W). The acoustic survey of China Point Reef was conducted between 1405 and 1950 (**Figs. 1.83 and 1.84**). The acoustic survey of 81 Fathom Bank was conducted between 2002 and 2031; an ROV transect was conducted at China Point Reef between 2129 and 2318, and the acoustic survey of 81 Fathom Bank continued at 2352.

<u>27 October 2007:</u> The acoustic survey of 81 Fathom Bank was halted at 0058 on 27 October2007. A CTD (#47, Leg 4 #4) was cast at 81 Fathom Bank (32 42.88 N, 118 23.78 W) between 0109 and 0128. A CTD (#48, Leg 4 #5) was cast at China Point Reef (32 44.34 N, 118 24.68 W) between 0149 and 0158. The acoustic survey of 81 Fathom Bank continued at 1403 and ended at 1444 (**Figs. 1.85 and 1.86**). The ship then proceeded to 86 Fathom Bank. The acoustic survey of 86 Fathom Bank began at 1504 and ended at 1740 (**Figs. 1.87 and 1.88**). A CTD (#49, Leg 4 #6) was cast at 86 Fathom Bank (32 43.54 N, 118 27.47 W) between 1758 and 1812. The ship then proceeded to 81 Fathom Bank. An ROV transect was conducted at 81 Fathom Bank between 1900 and 2148. The ship then proceeded to China Point Reef where the AURAL+PAL mooring was recovered at 2220. The ship then proceeded to 86 Fathom Bank where an ROV transect was begun at 2327.

<u>28 October 2007:</u> The ROV transect at 86 Fathom Bank ended at 0105 on 28 October 2007. The ship then proceeded to W San Clemente where the acoustic survey was

conducted between 1404 and 2031 (**Figs. 1.89 and 1.90**). A CTD (#50, Leg 4 #7) was cast at W San Clemente (32 51.04 N, 118 32.04 W) between 2056 and 2109. The ship then proceeded to NW San Clemente where the acoustic survey began at 2153.

29 October 2007: The acoustic survey of NW San Clemente ended at 0112 on 29 October 2007. A CTD (#51, Leg 4 #8) was cast at NW San Clemente (32 57.98 N, 118 36.39 W) between 0127 and 0136. The acoustic survey of NW San Clemente was conducted between 1410 and 1604 (**Figs. 1.79 and 1.80**). A CTD (#52, Leg 4 #9) was cast at NW San Clemente (32 59.71 N, 118 37.91 W) between 1615 and 1626. An ROV transect was conducted at NW San Clemente between 1710 and 1727. The ROV required repairs. An ROV transect was conducted at NW San Clemente between 1743 and 1916. An ROV transect was conducted at NW San Clemente between 2026 and 2134. The ship then proceeded to W San Clemente where an ROV transect was begun at 2320.

30 October 2007: The ROV transect at W San Clemente ended at 0036 on 30 October07. The ship proceeded to Farnsworth Bank. At 1315, an AURAL+PAL mooring was deployed at Farnsworth Bank (33 20.75 N, 118 31.24 W). The acoustic survey of Farnsworth Bank began at 1409 and ended at 1738 (**Figs. 1.91 and 1.92**). A CTD (#53, Leg 4 #10) was cast at Farnsworth Bank (33 21.79 N, 118 32.60 W) between 1803 and 1818. An ROV transect was conducted at Farnsworth Bank between 1944 and 2053. The ship then proceeded to NW Catalina Island where an acoustic survey began at 2208 and ended at 2359 (**Figs. 1.93 and 1.94**).

31 October 2007: An ROV transect was conducted at NW Catalina between 0046 and 0124 on 31 October 2007. The clump weight was lost during the dive. The ship then proceeded to Lasuen Knoll. The acoustic survey of Lasuen Knoll began at 1409 and ended at 1600 (**Figs. 1.95 and 1.96**). A CTD (#54, Leg 4 #11) was cast at Lasuen Knoll (33 24.81 N, 118 00.56 W) between 1645 and 1701. An ROV transect at Lasuen Knoll was conducted between 1815 and 2048. The ship then proceeded to Farnsworth Bank.

1 November 2007: The AURAL+PAL mooring was recovered at Farnsworth Bank at 0043 on 1 November 2007. The ship then proceeded to 43 Fathom Bank. The AURAL mooring was recovered from 43 Fathom Bank at 1400. The acoustic survey of 43 Fathom Bank began at 1416 and ended at 1704 (**Figs. 1.97 and 1.98**). The ship then proceeded to Kidney Bank where the acoustic survey began at 1802 and ended at 2034 (**Figs. 1.99 and 1.100**). The ship then proceeded to Del Mar Steeples where the acoustic survey was begun at 2329.

2 November 2007: The acoustic survey of Del Mar Steeples ended at 0103 on 2 November 2007 (**Figs. 1.101 and 1.102**). The ship then proceeded to the SIO marine facility pier. The EK60 data logging was stopped at 0318 and the ship docked at 0415.

Table 1.5. COAST07 Leg IV survey sites, dates, and times (GMT).

Survey Location	Start Date	Start Time	End Date	End Time
9 Mile Bank Day 1	10/22/07	1938	10/23/07	0112
NW San Clemente Island Day 1	10/23/07	1358	10/23/07	1528
9 Mile Bank Day 2	10/24/07	2311	10/25/07	0113
60 Mile Bank	10/25/07	1400	10/25/07	2237
60 Mile Bank ROV	10/26/07	0008	10/26/07	0142
China Point Reef	10/26/07	1405	10/26/07	1950
81 Fathom Bank Part 1	10/26/07	2002	10/26/07	2031
China Point Reef ROV	10/26/07	2129	10/26/07	2318
81 Fathom Bank Part 2	10/26/07	2352	10/27/07	0058
81 Fathom Bank Part 3	10/27/07	1403	10/27/07	1444
86 Fathom Bank	10/27/07	1504	10/27/07	1740
81 Fathom Bank ROV	10/27/07	1900	10/27/07	2148
86 Fathom Bank ROV	10/27/07	2327	10/28/07	0105
W San Clemente	10/28/07	1404	10/28/07	2031
NW San Clemente Days 2 & 3, Part 1	10/28/07	2153	10/29/07	0112
NW San Clemente Days 2 & 3, Part 2	10/29/07	1410	10/29/07	1604
NW San Clemente ROV	10/29/07	1710	10/29/07	2134
W San Clemente ROV	10/29/07	2320	10/30/07	0036
Farnsworth Bank	10/30/07	1409	10/30/07	1738
Farnsworth Bank ROV	10/30/07	1944	10/30/07	2053
NW Catalina	10/30/07	2208	10/30/07	2359
NW Catalina ROV	10/31/07	0046	10/31/07	0124
Lasuen Knoll	10/31/07	1409	10/31/07	1600
Lasuen Knoll ROV	10/31/07	1815	10/31/07	2048
43 Fathom Bank	11/1/07	1416	11/1/07	1704
Kidney Bank	11/1/07	1802	11/1/07	2034
Del Mar Steeples	11/1/07	2329	11/2/07	0103

Figure 1.77. Nine Mile Bank distribution of s_A ($m^2/n.mi.^2$) attributed to rockfishes.

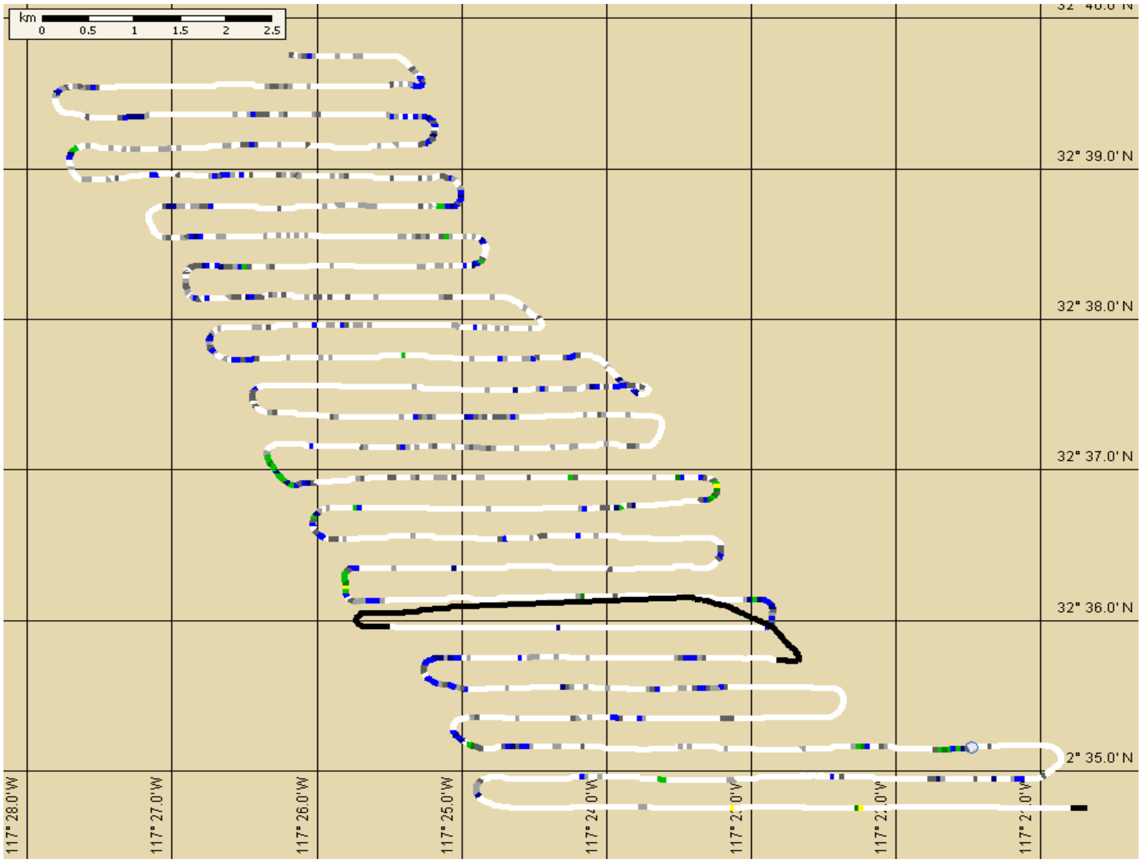


Figure 1.78. Nine Mile Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

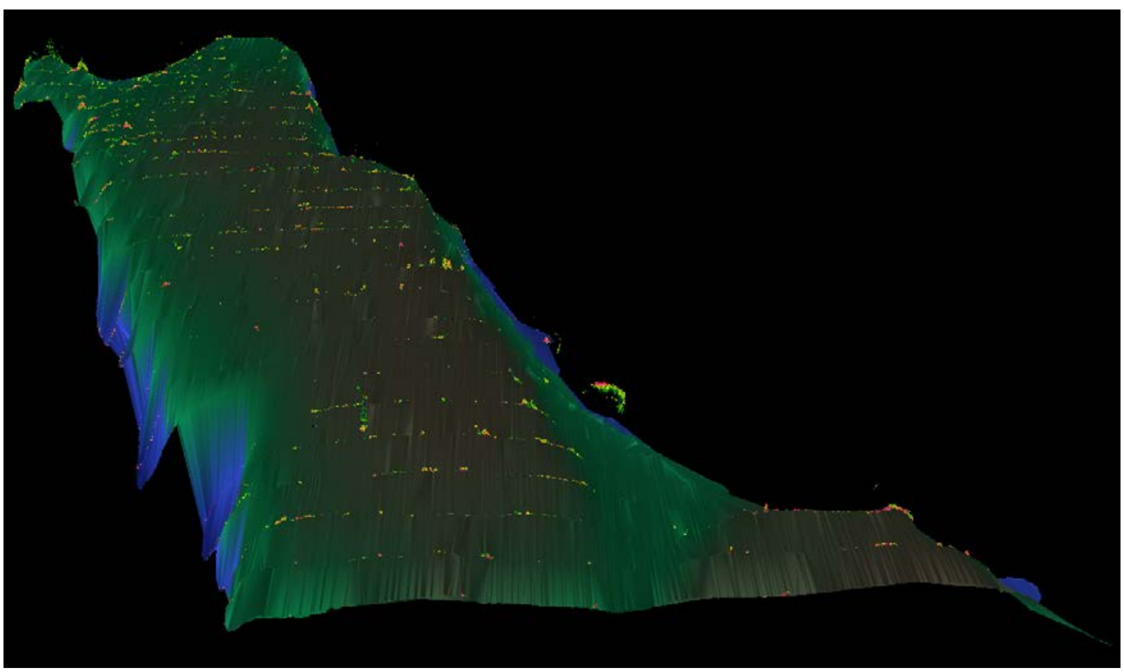


Figure 1.79. NW San Clemente distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

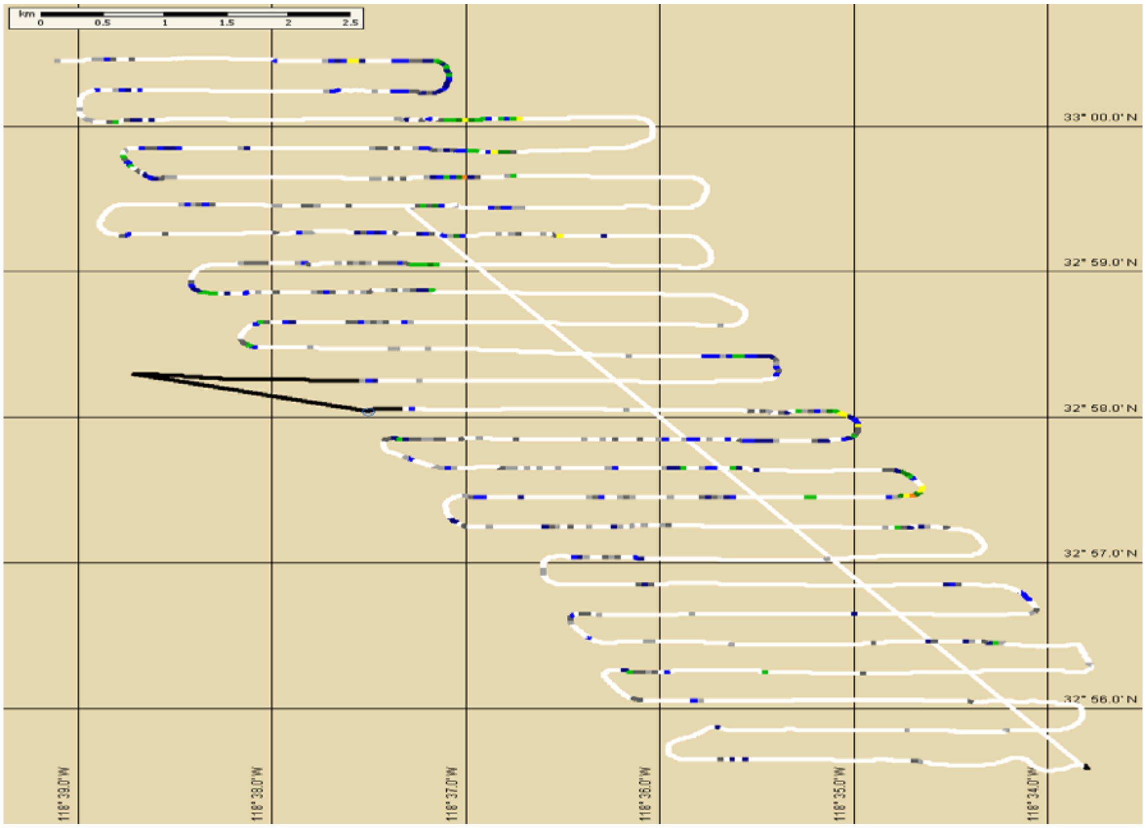


Figure 1.80. NW San Clemente 3-D image of bathymetry (m) and S_v of rockfishes (dB).

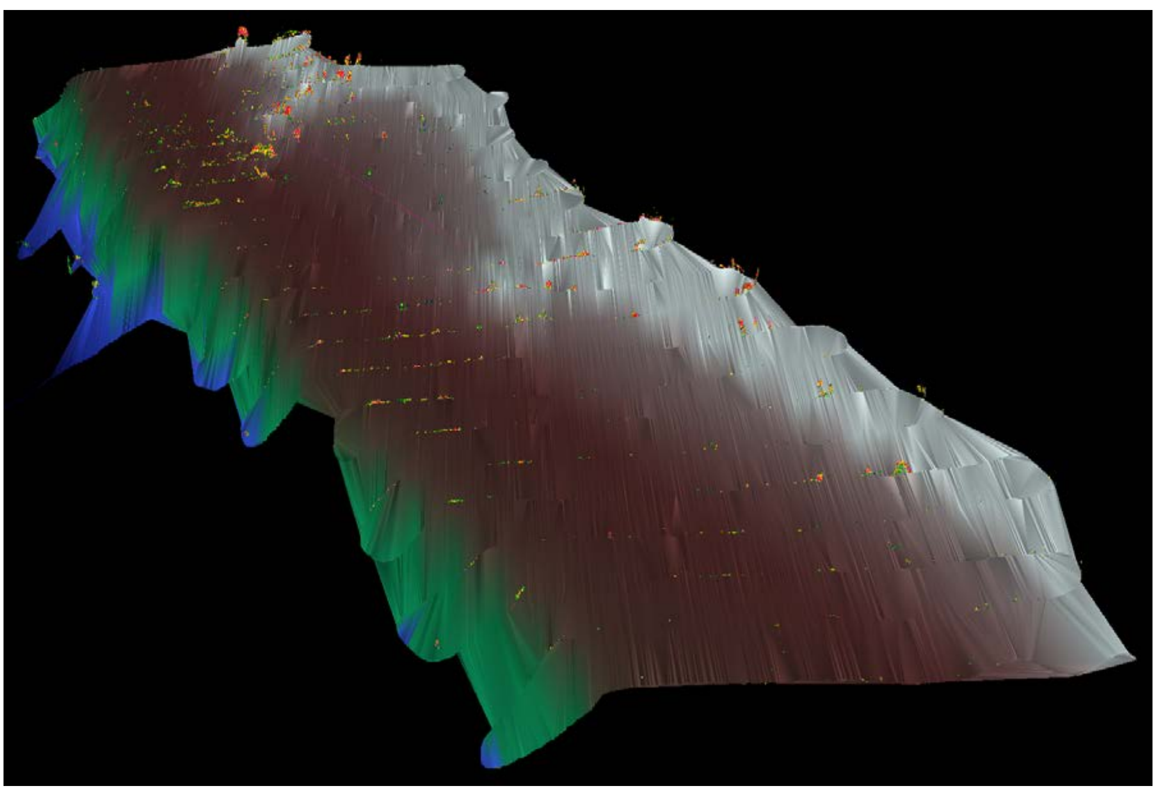


Figure 1.81. 60 Mile Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

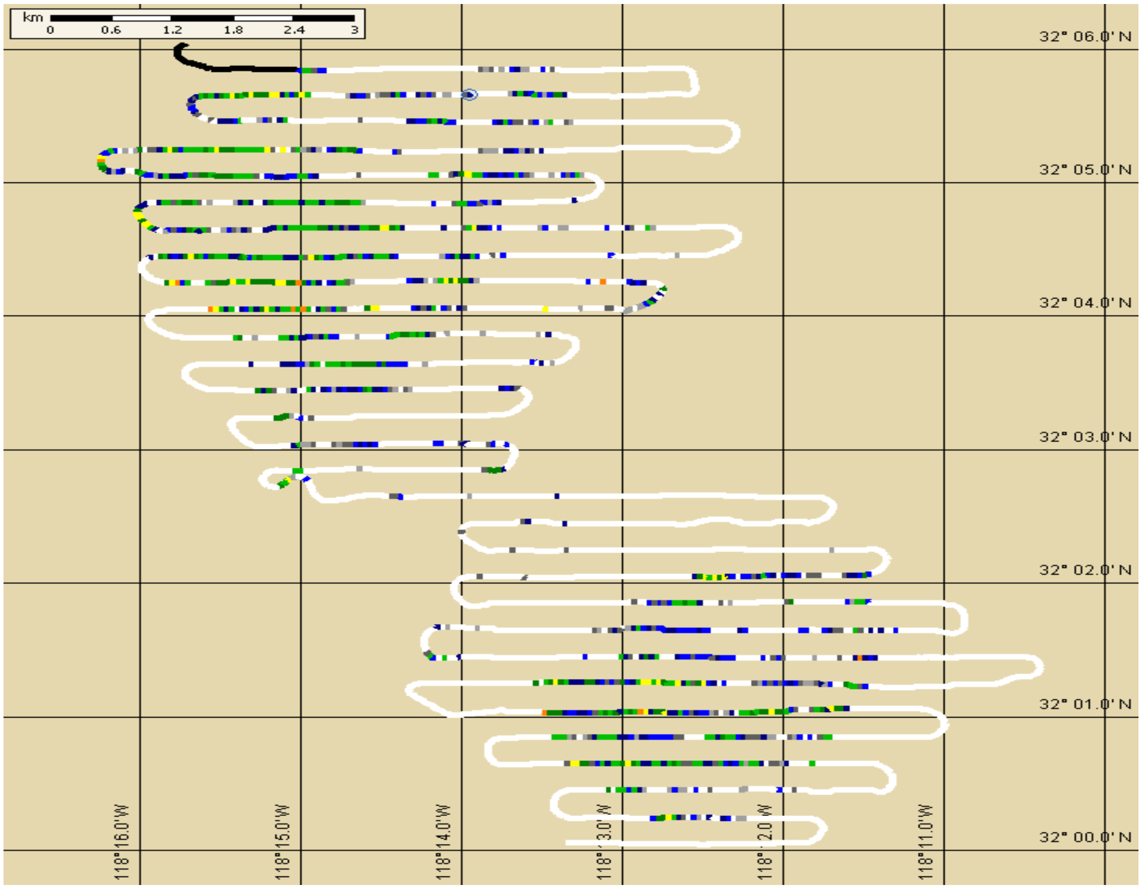


Figure 1.82. 60 Mile Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

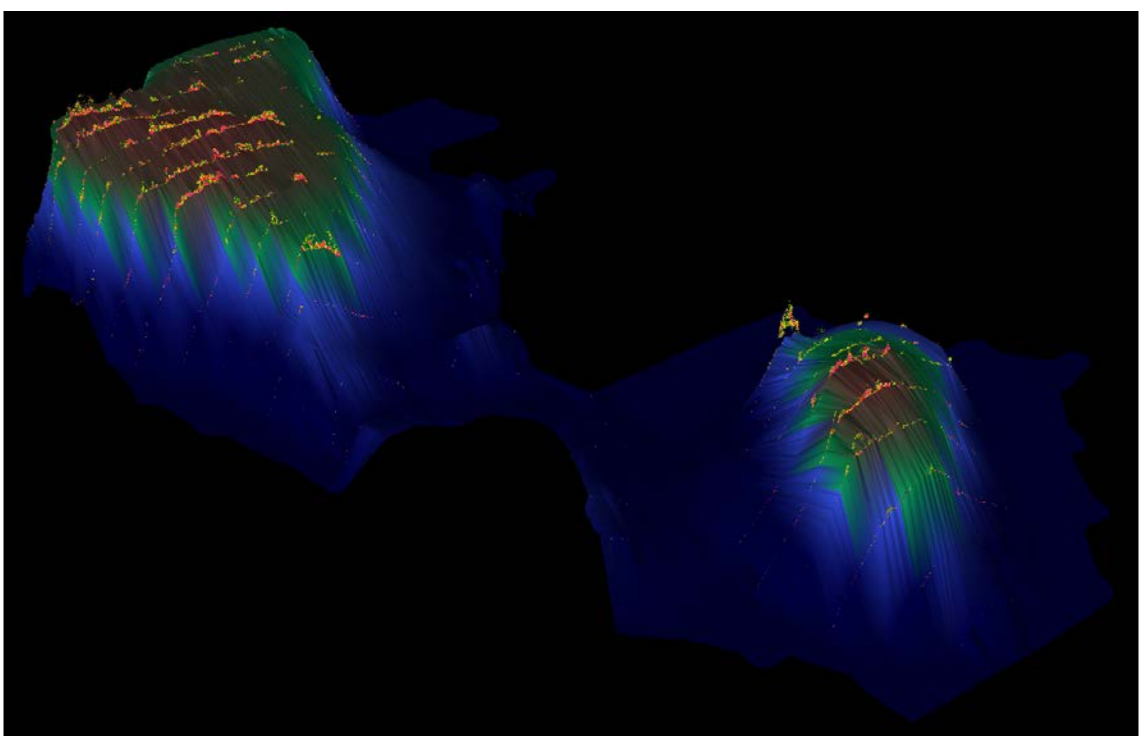


Figure 1.83. China Point Reef distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

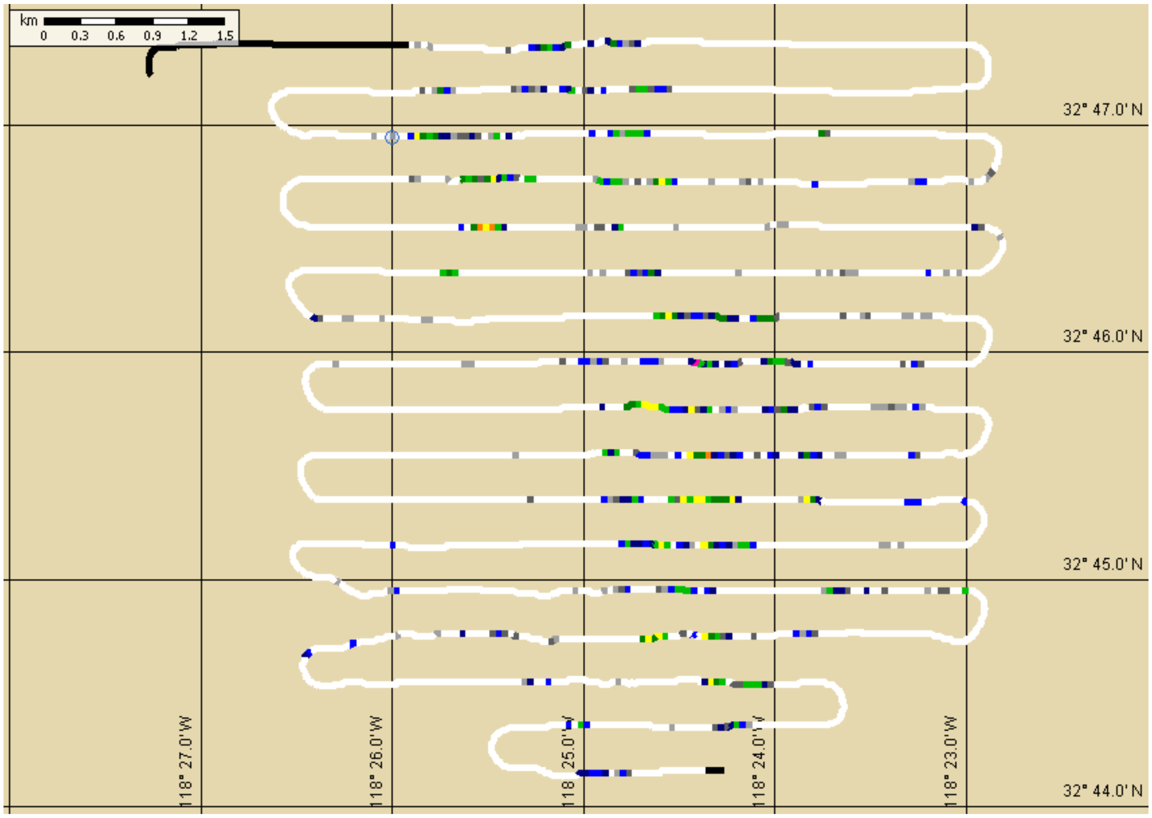


Figure 1.84. China Point Reef 3-D image of bathymetry (m) and S_v of rockfishes (dB).

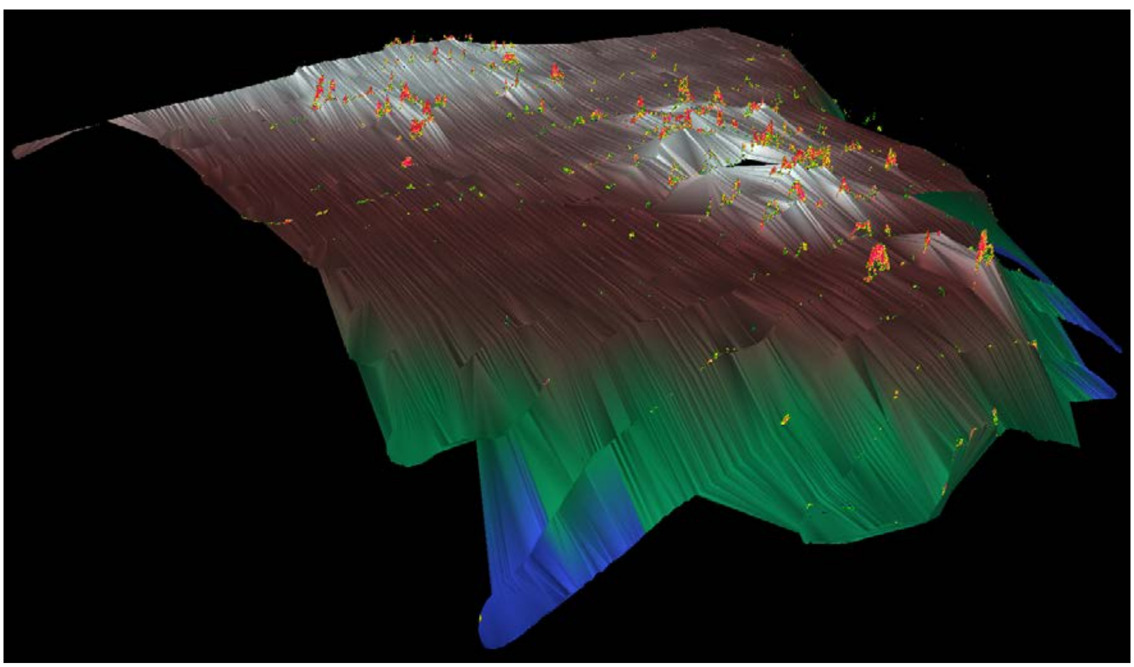


Figure 1.85. 81 Fathom Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

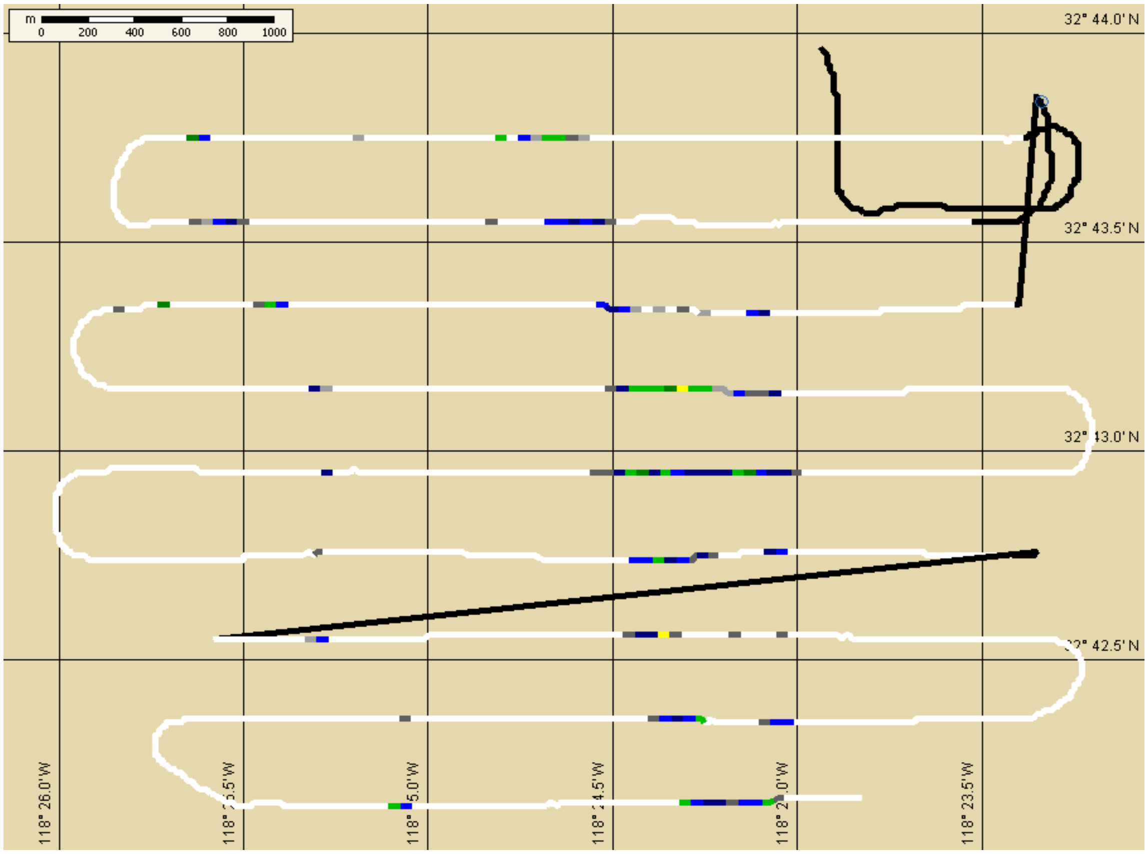


Figure 1.86. 81 Fathom Bank 3-D image, looking southward of bathymetry (m) and S_v of rockfishes (dB).

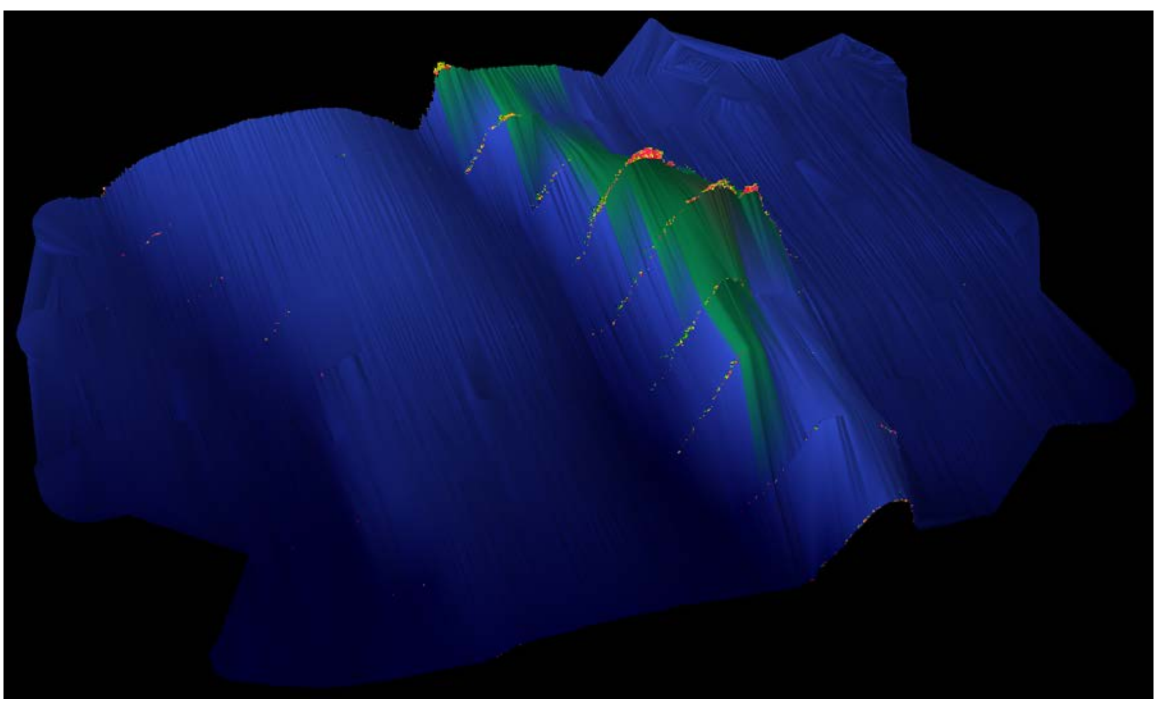


Figure 1.87. 86 Fathom Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

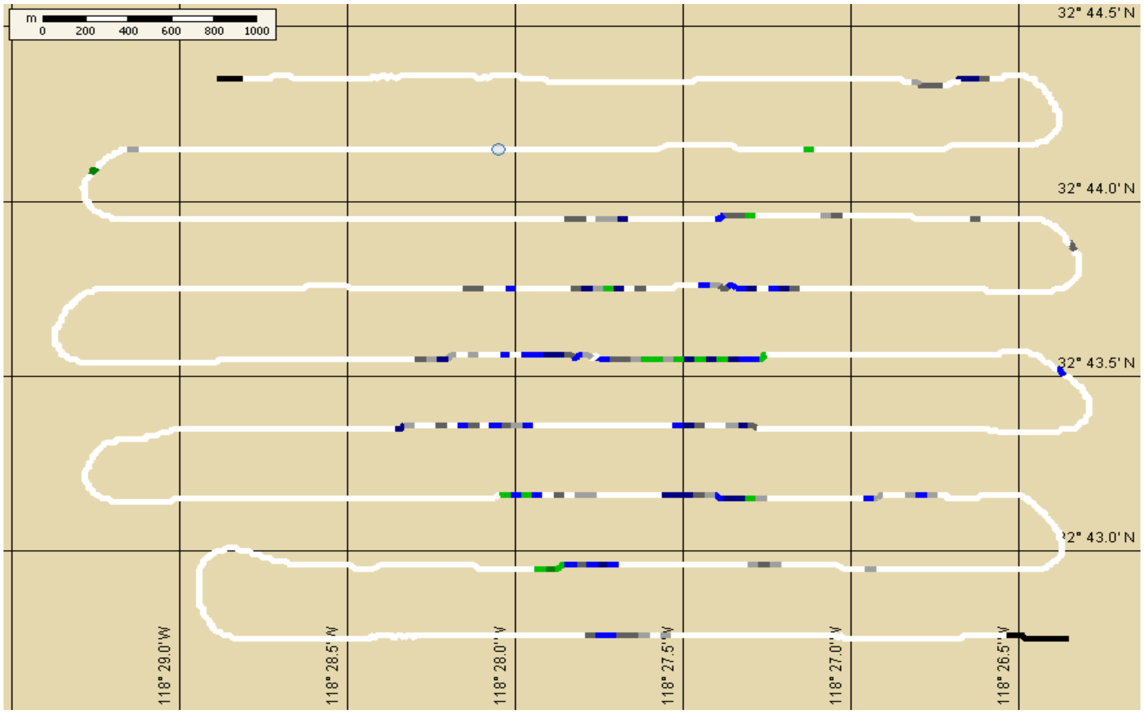


Figure 1.88. 86 Fathom Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

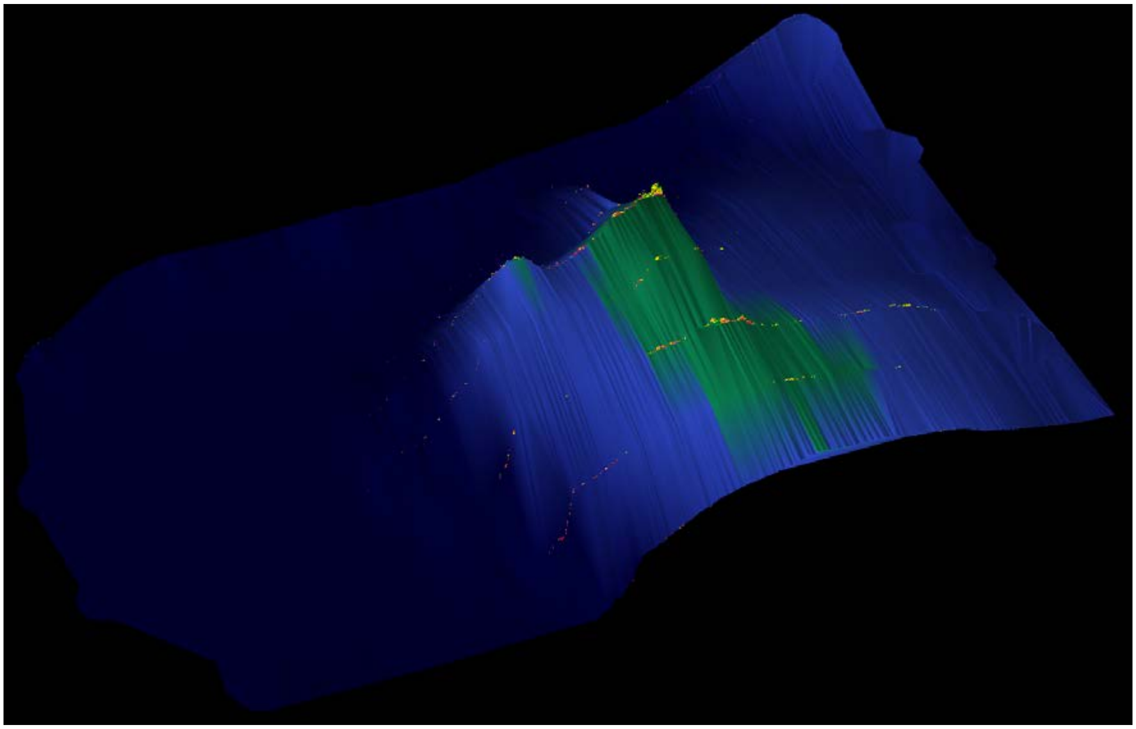


Figure 1.89. West San Clemente Island distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

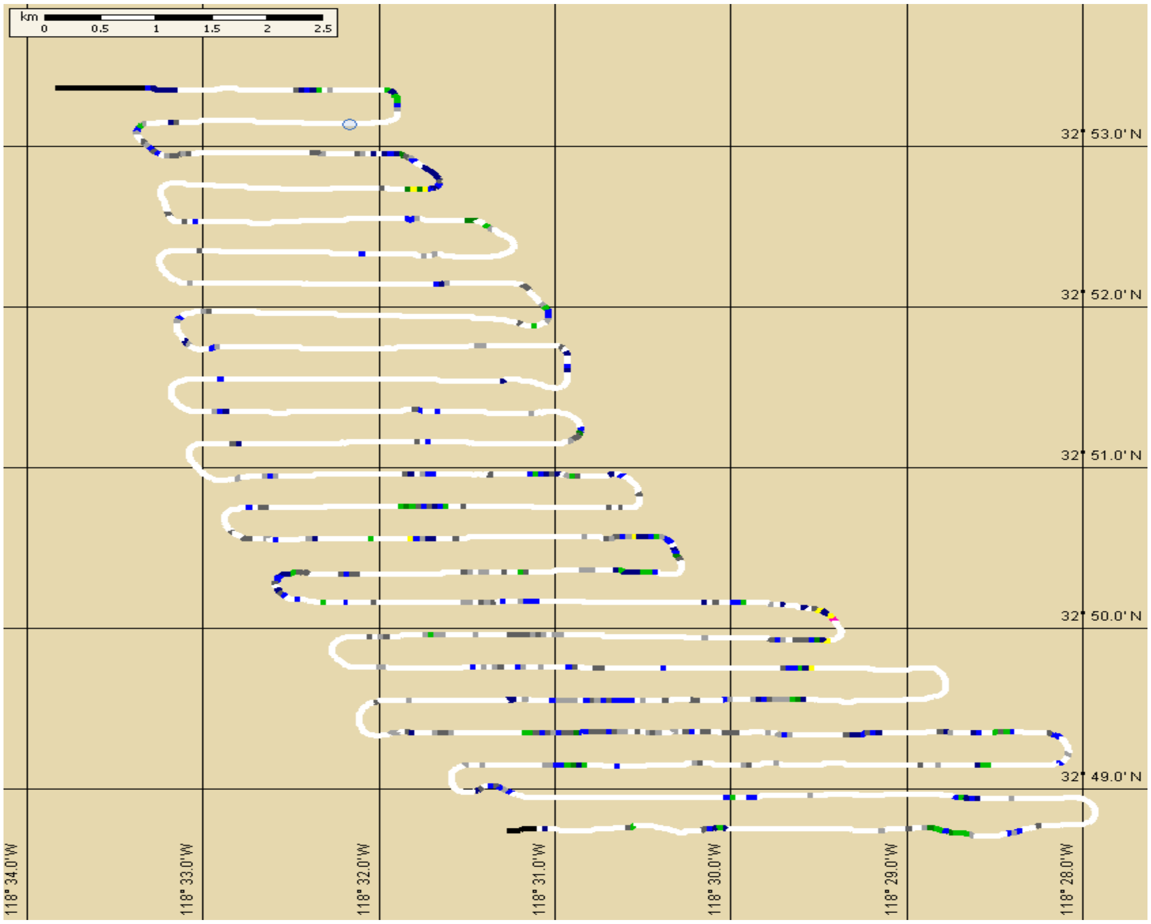


Figure 1.90. West San Clemente Island 3-D image of bathymetry (m) and S_v of rockfishes (dB).

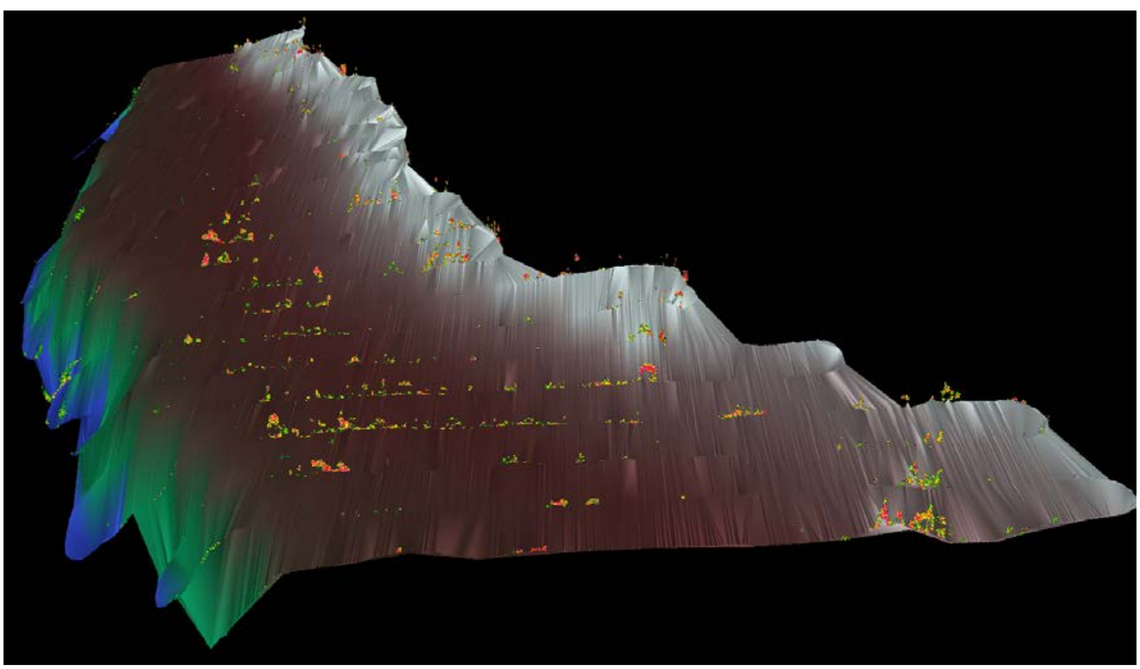


Figure 1.91. Farnsworth Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

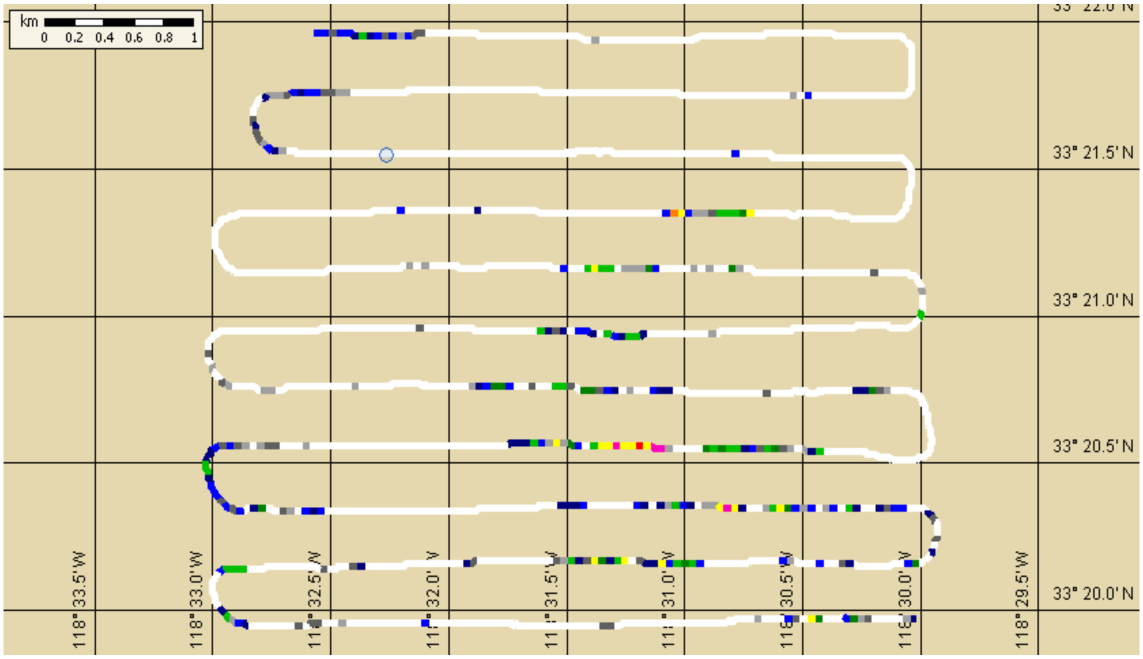


Figure 1.92. Farnsworth Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

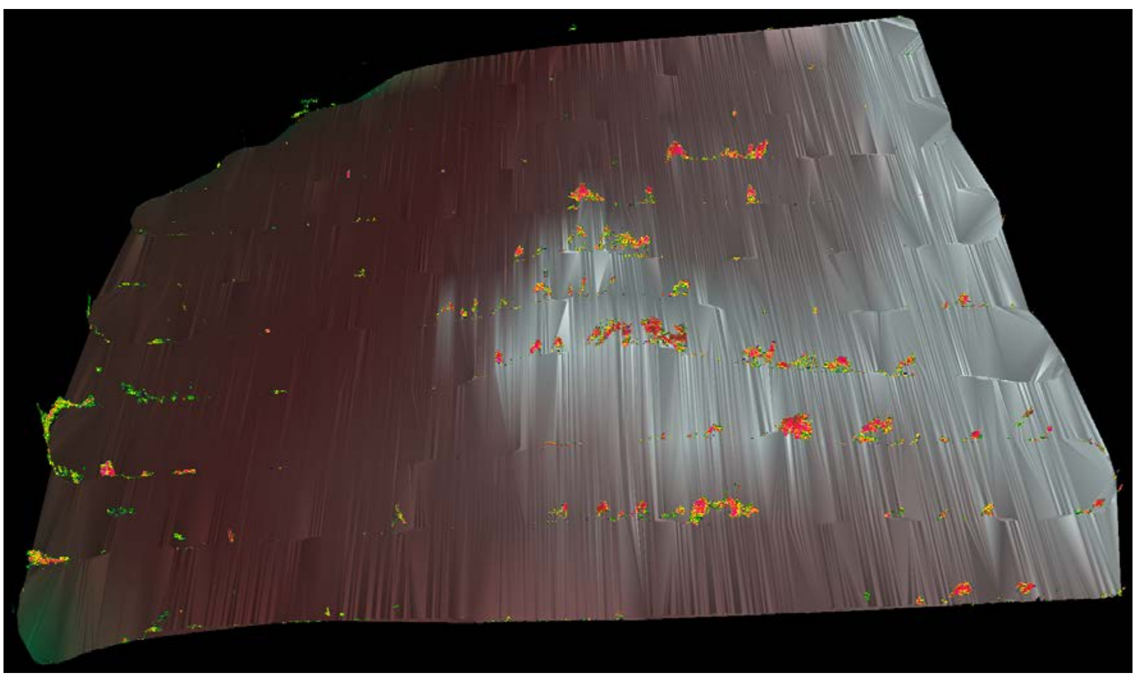


Figure 1.93. Northwest Catalina Island distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

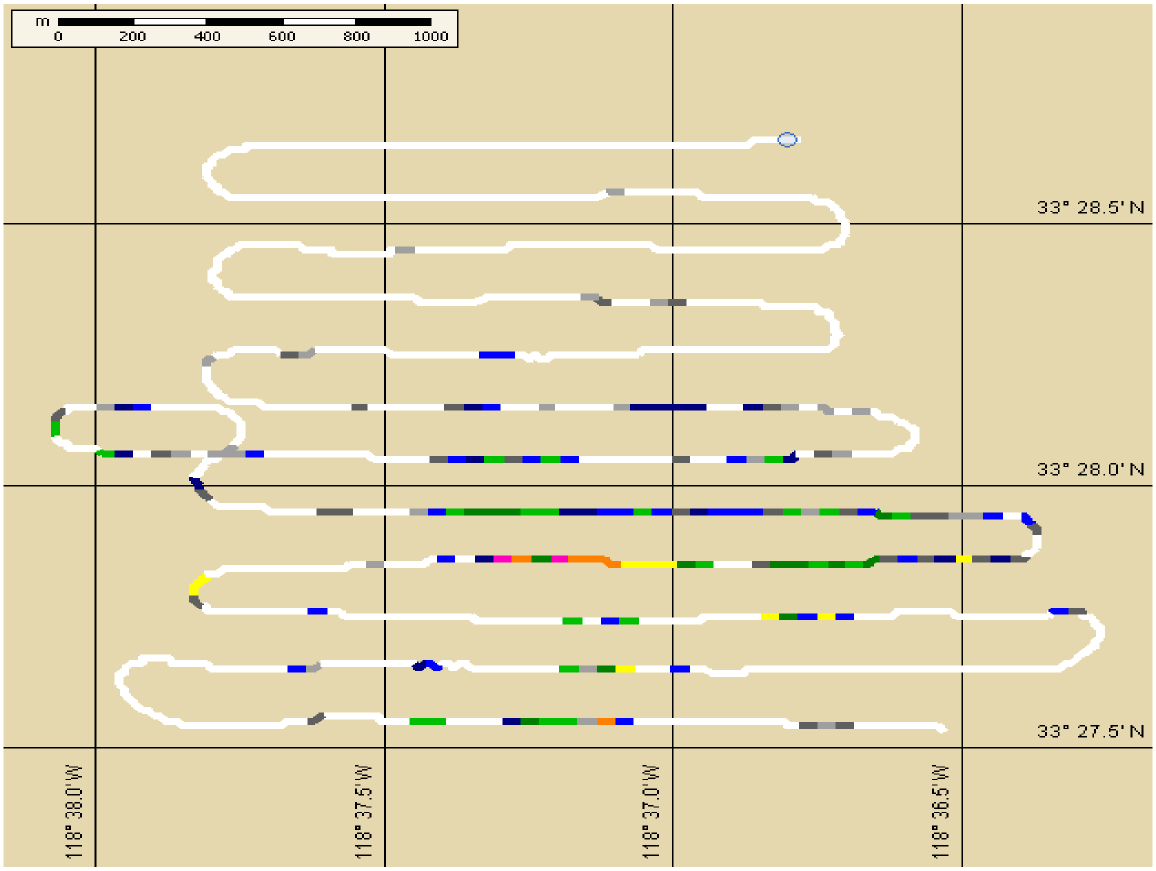


Figure 1.94. Northwest Catalina Island 3-D image of bathymetry (m) and S_v of rockfishes (dB).

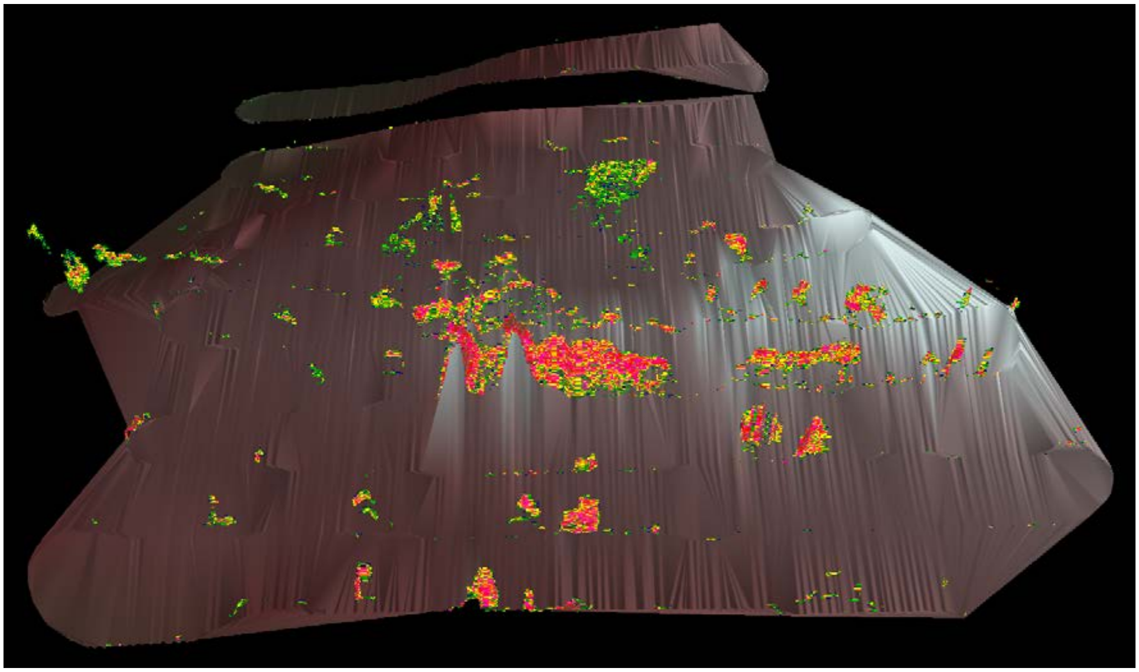


Figure 1.95. Lasuen Knoll distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

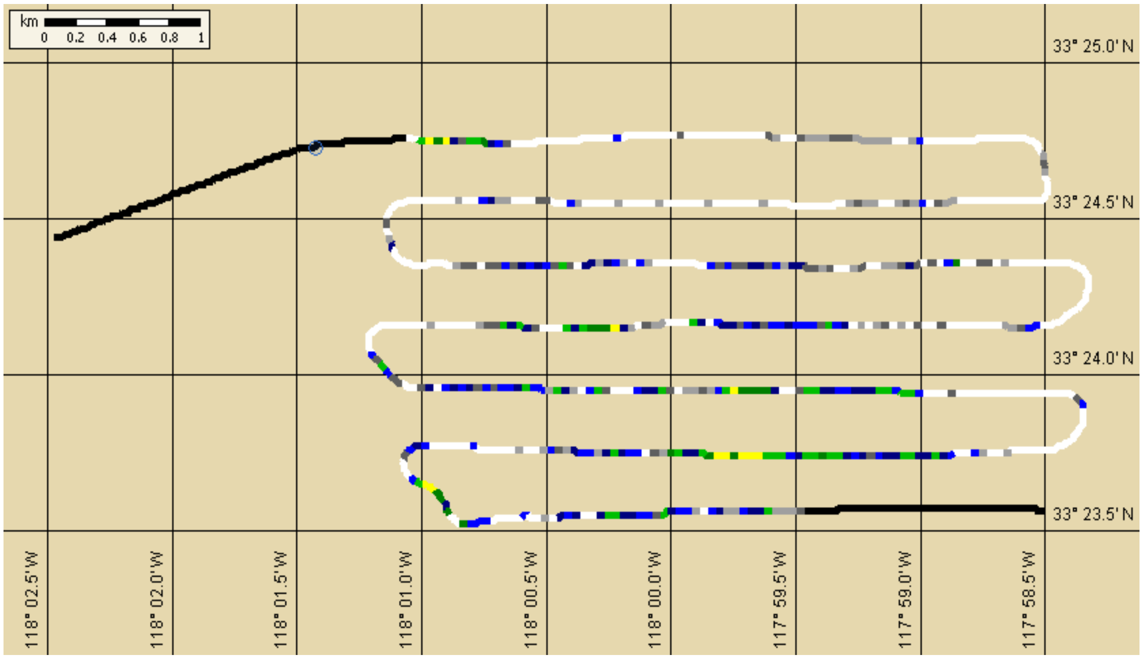


Figure 1.96. Lasuen Knoll 3-D image of bathymetry (m) and S_v of rockfishes (dB).

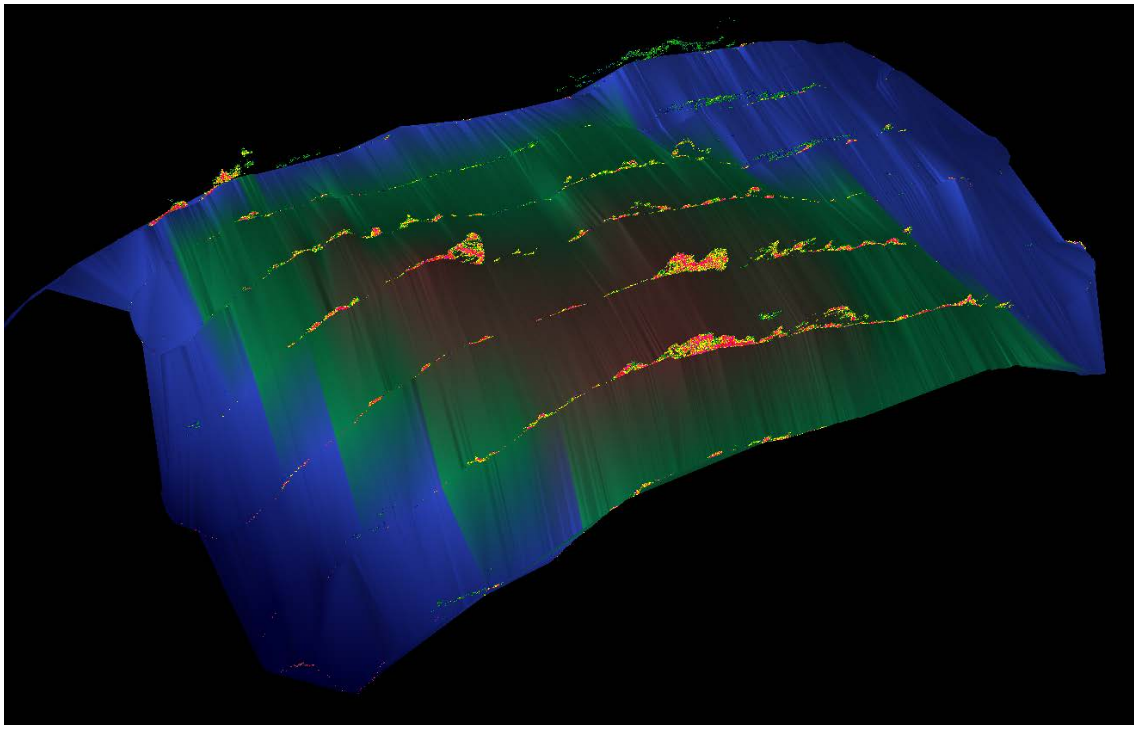


Figure 1.97. Forty-Three Fathom Bank #4 distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

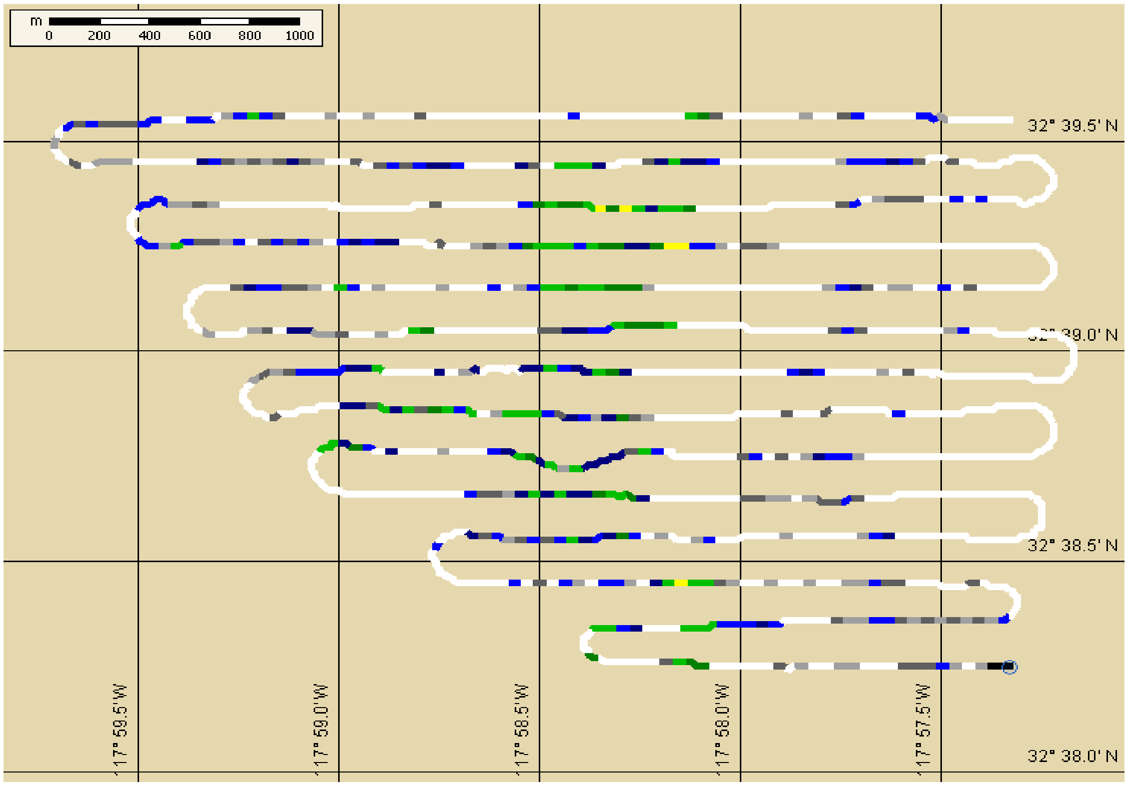


Figure 1.98. Forty-Three Fathom Bank #4 3-D image of bathymetry (m) and S_v of rockfishes (dB).

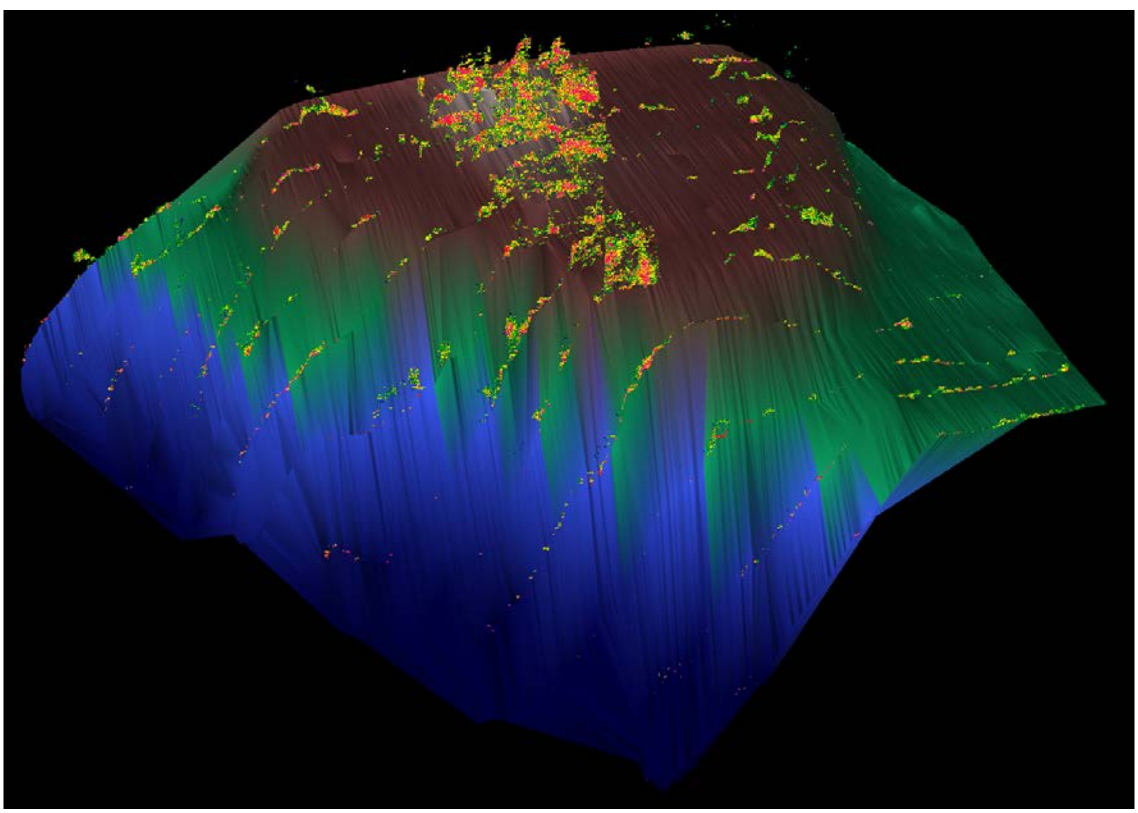


Figure 1.99. Kidney Bank distribution of s_A ($m^2/n.mi.^2$) attributed to rockfishes.

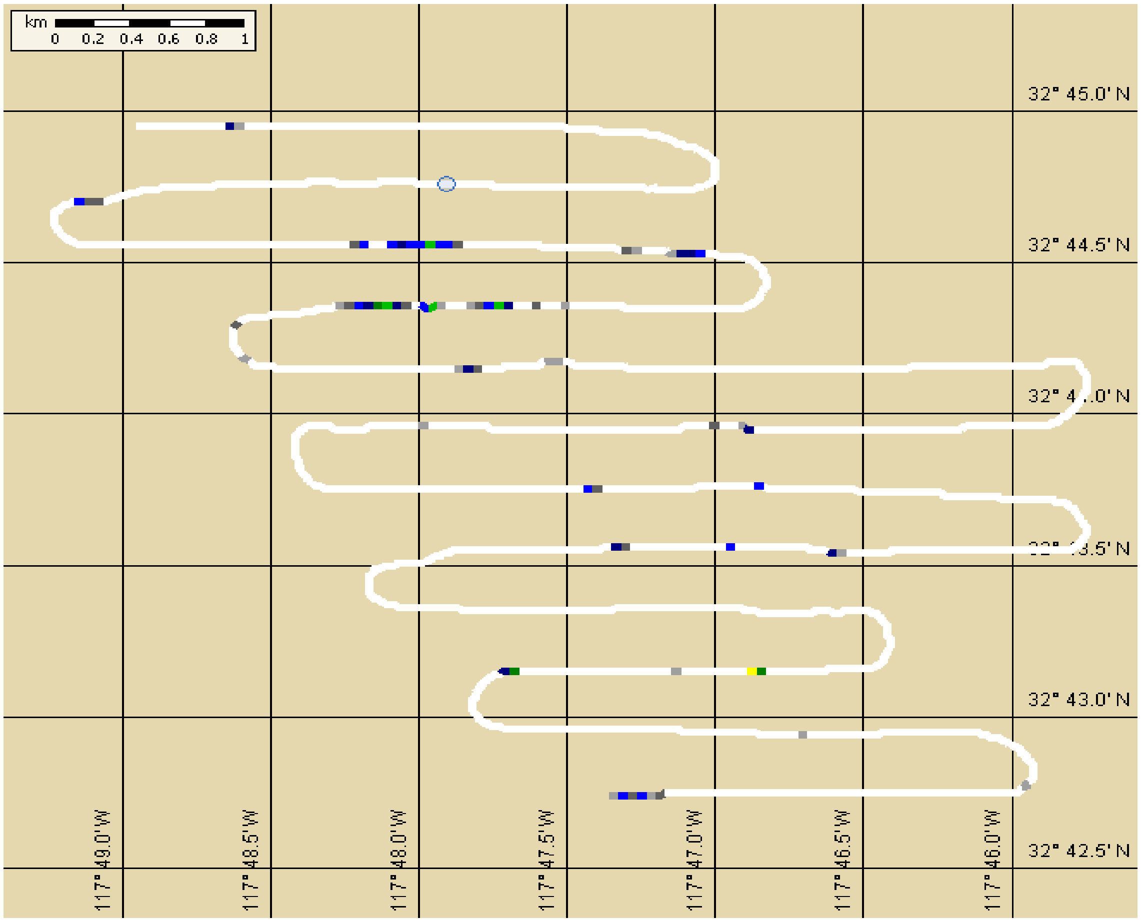


Figure 1.100. Kidney Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).

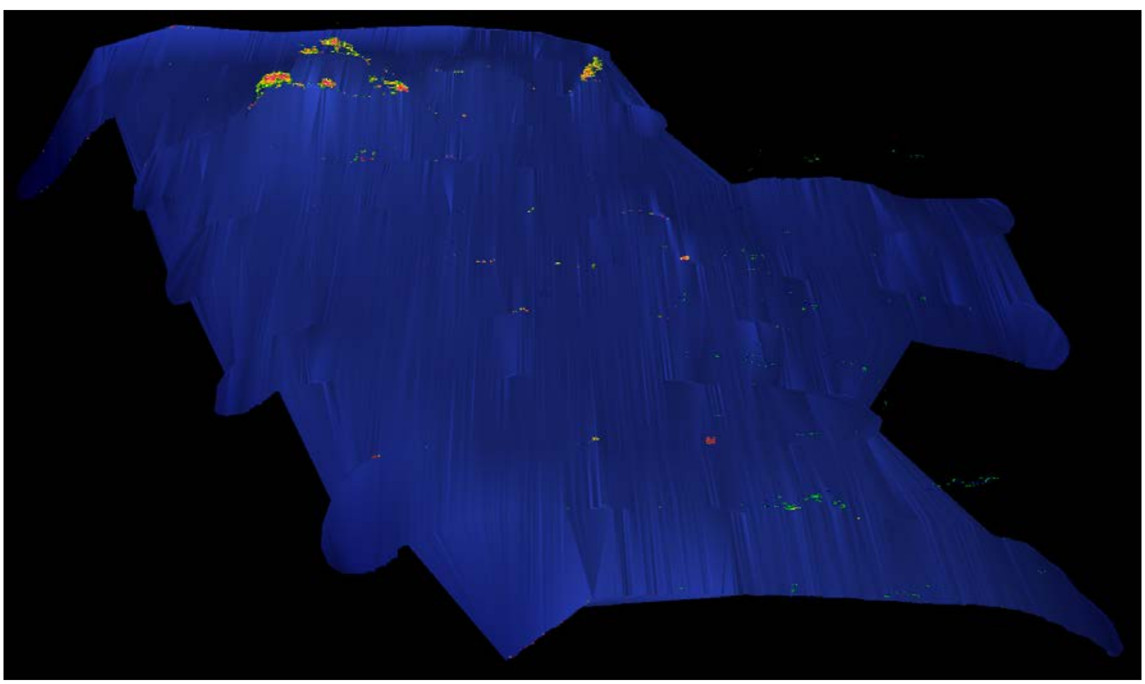


Figure 1.101. Del Mar Steeples distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

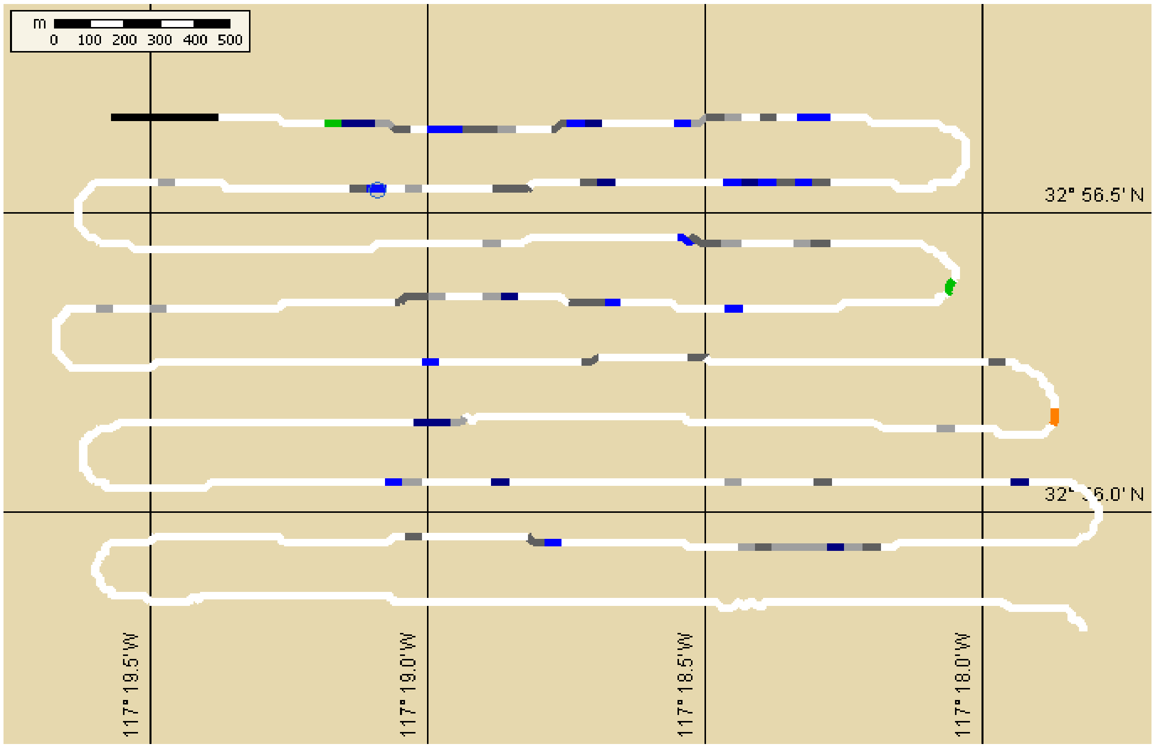
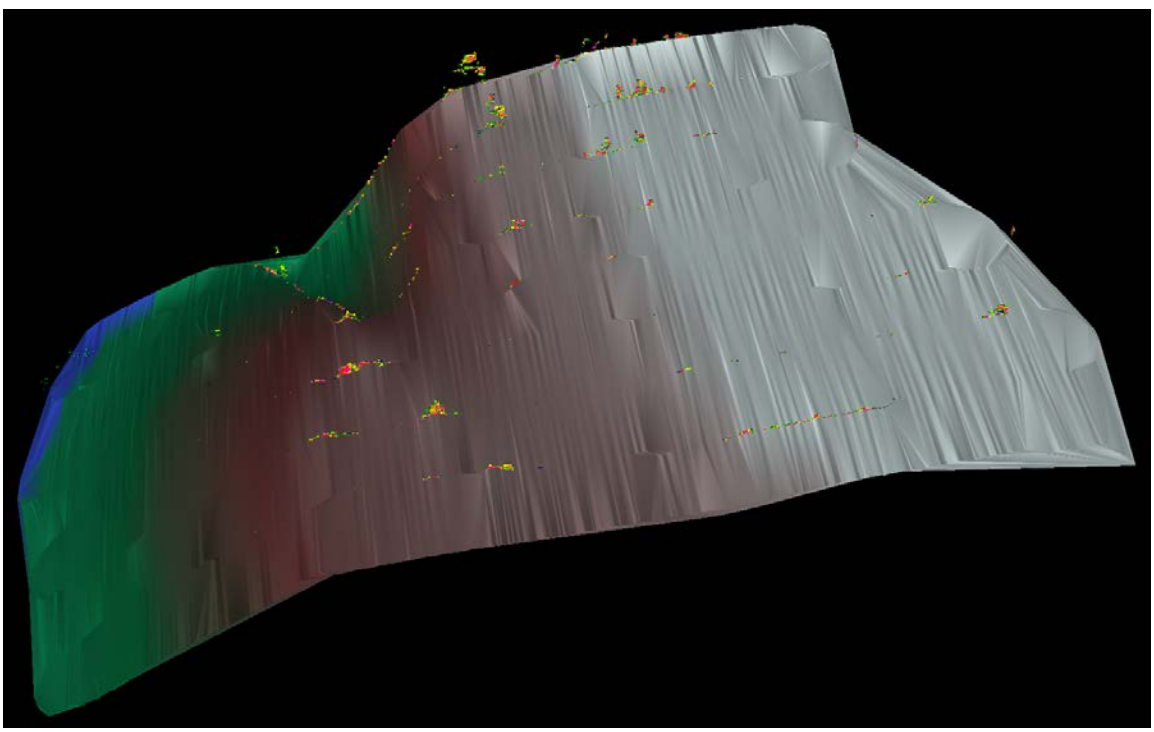


Figure 1.102. Del Mar Steeples 3-D image of bathymetry (m) and S_v of rockfishes (dB).



COAST07 Leg V

Table 1.6. COAST07 Leg V survey sites, dates, and times (GMT).

Survey Location	Start Date	Start Time	End Date	End Time
N San Clemente	11/29/07	1431	11/29/07	1903
NW San Clemente Island Day 1	11/29/07	1942	11/30/07	0045
NW San Clemente Island Day 2	11/30/07	1432	11/30/07	2024
57 Fathom Bank	11/30/07	2136	11/30/07	2242

Figure 1.103. N San Clemente distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

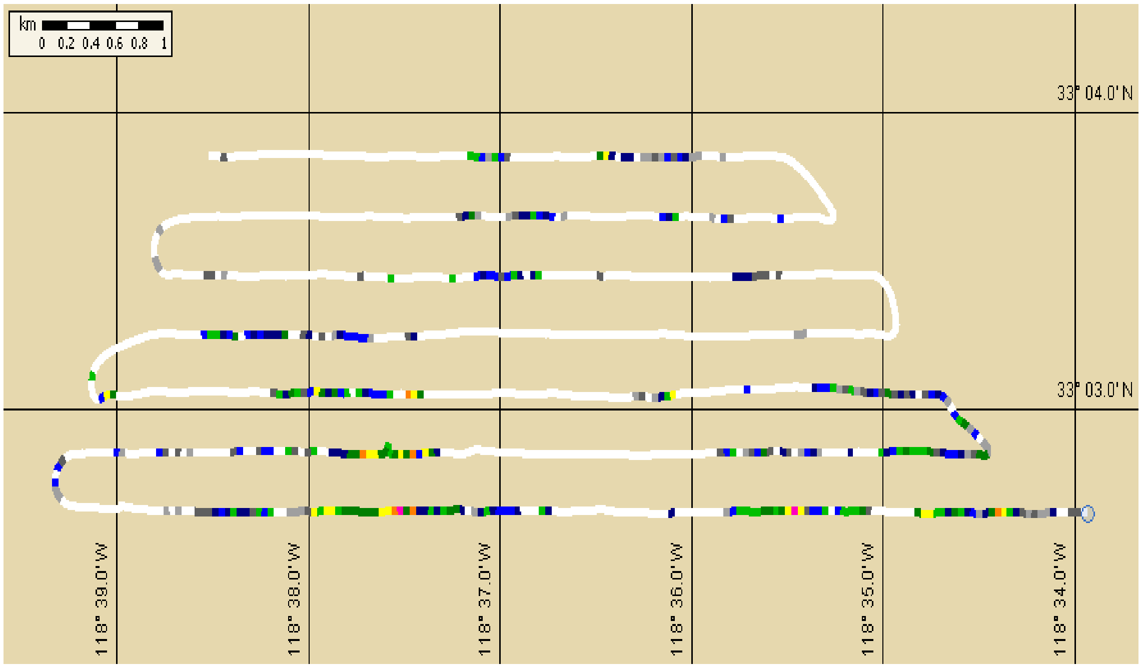


Figure 1.104. N San Clemente 3-D image of bathymetry (m) and S_v of rockfishes (dB).

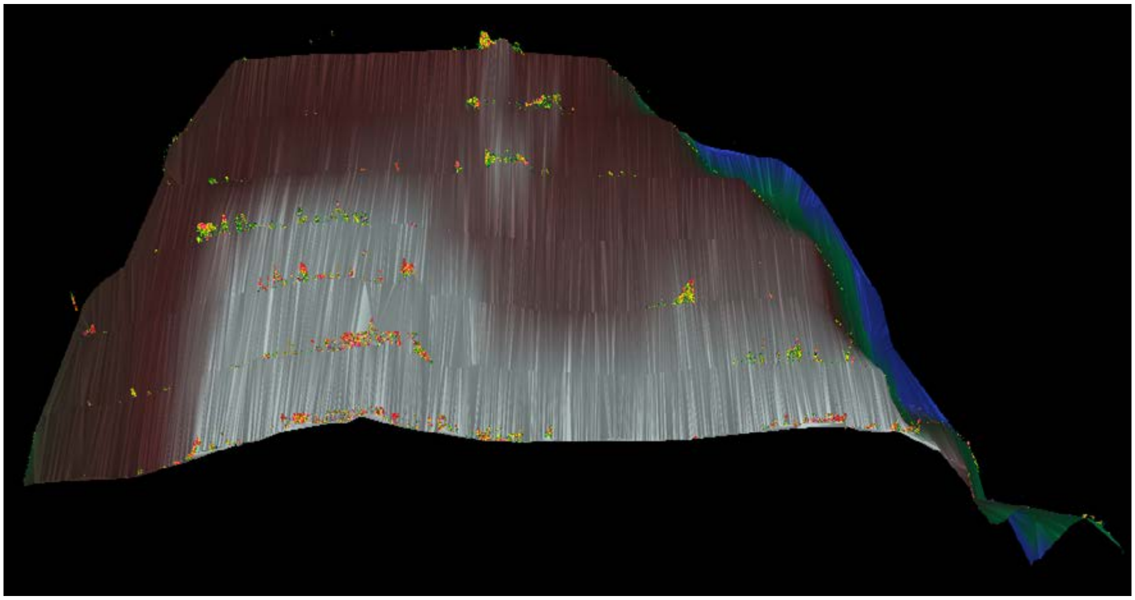


Figure 1.105. NW San Clemente distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

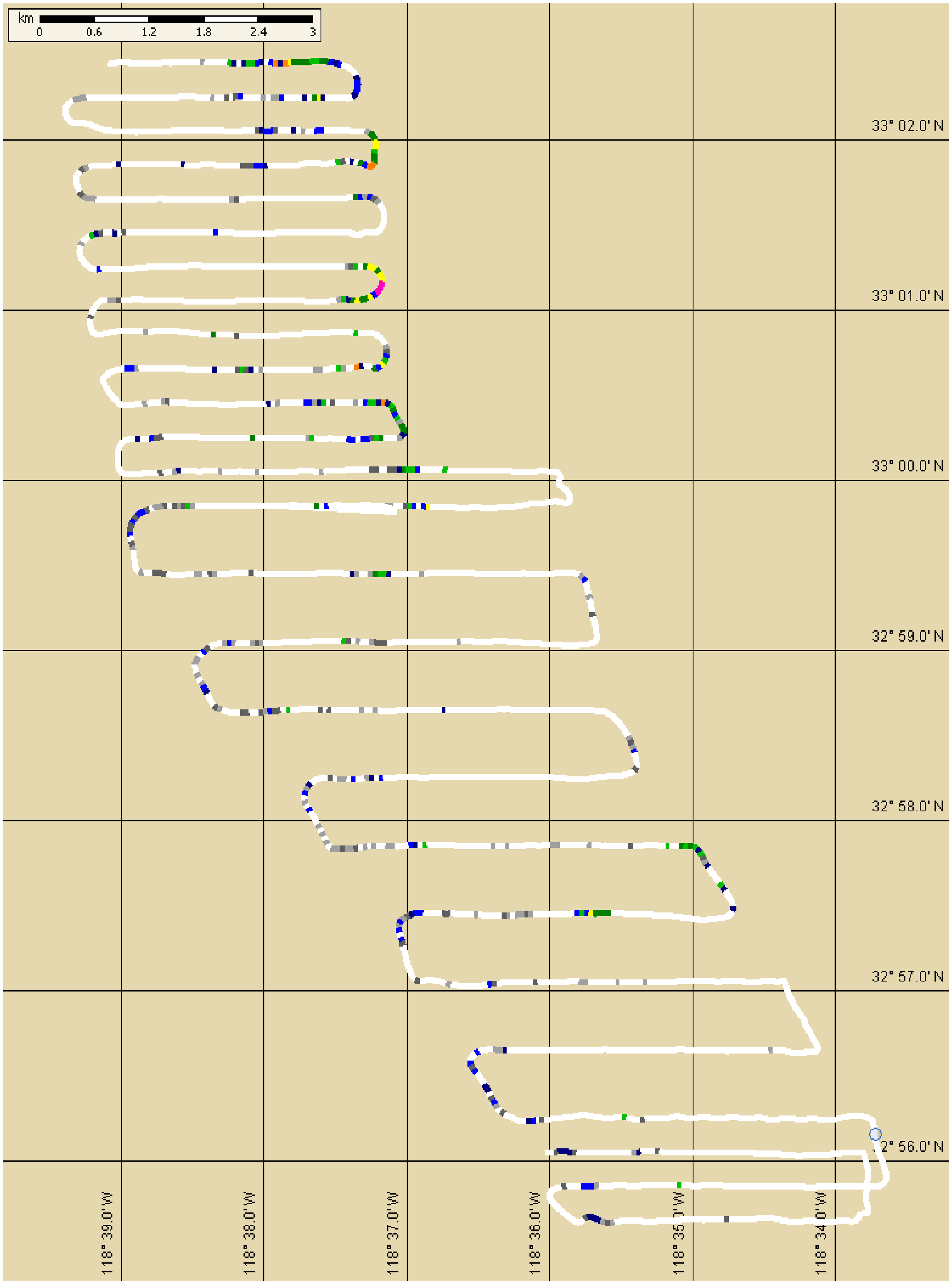


Figure 1.106. NW San Clemente 3-D image of bathymetry (m) and S_v of rockfishes (dB).

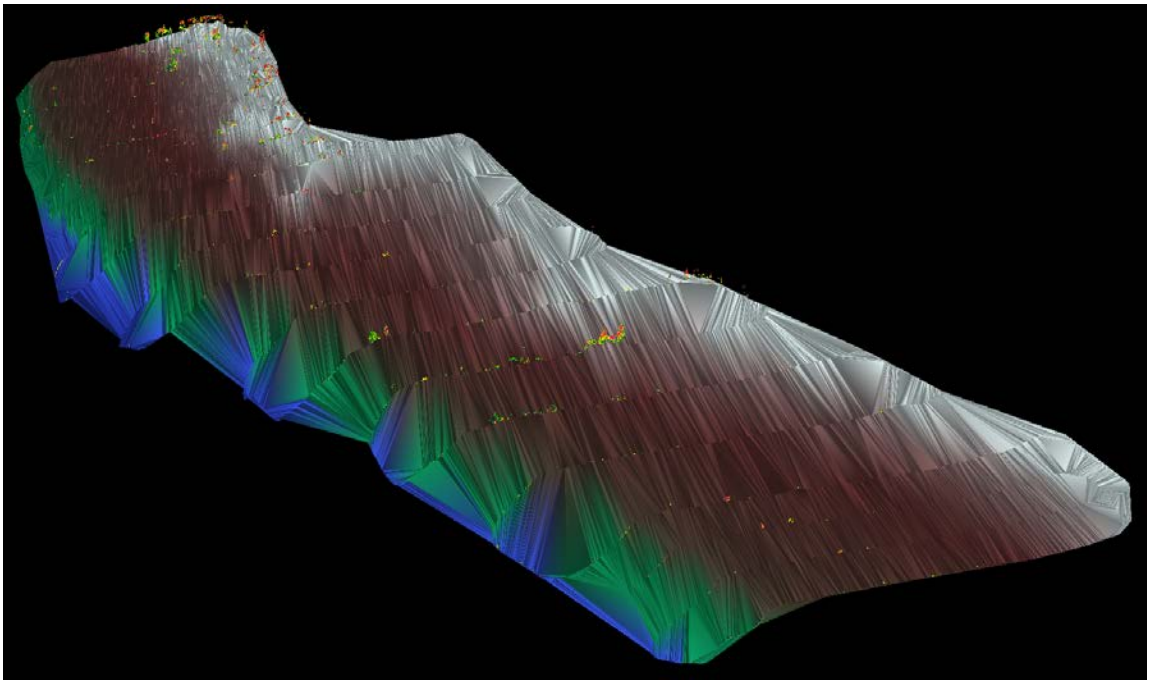


Figure 1.107. 57 Fathom Bank distribution of s_A (m^2/n.mi.^{2}) attributed to rockfishes.

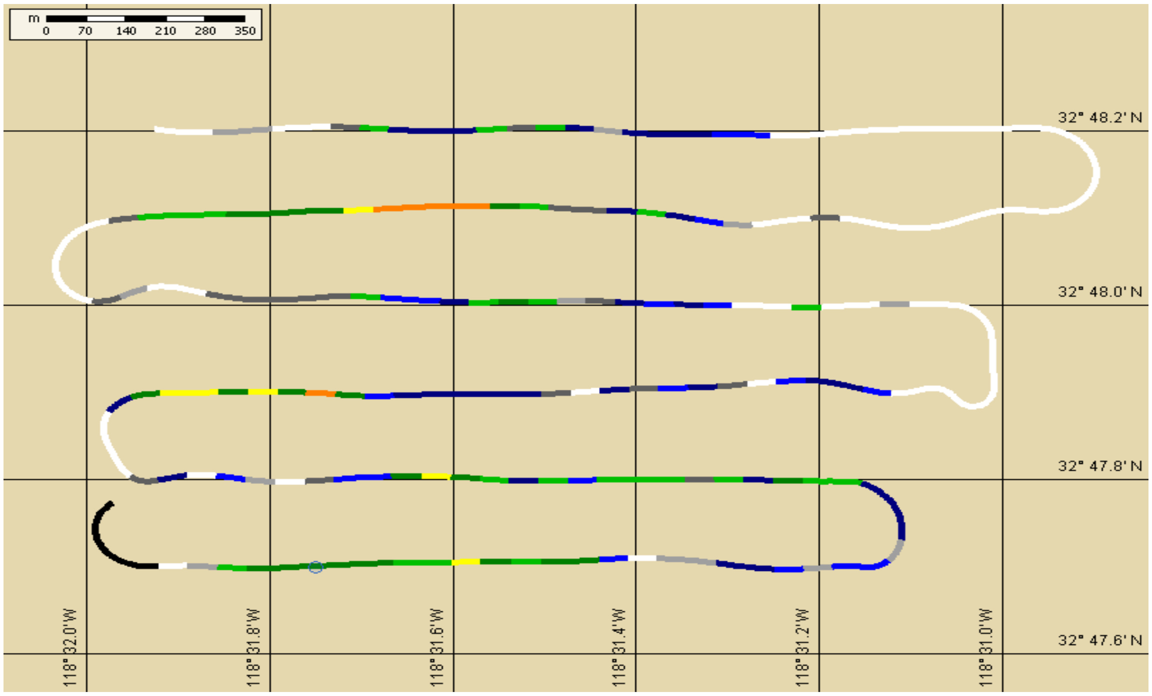
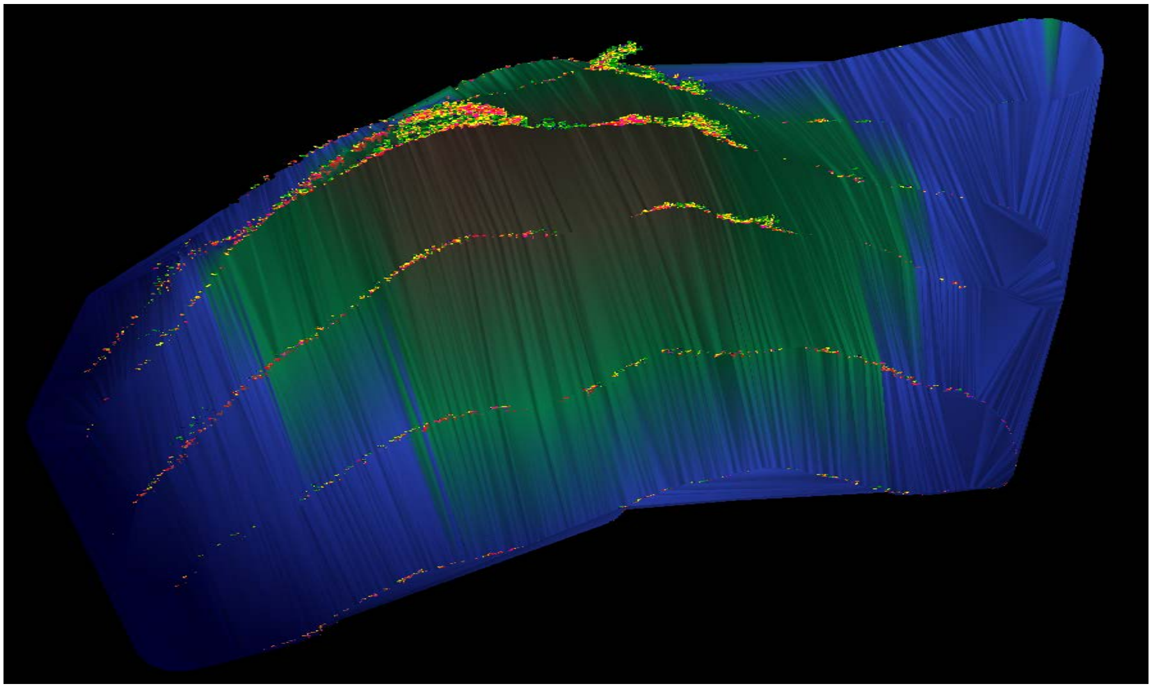


Figure 1.108. 57 Fathom Bank 3-D image of bathymetry (m) and S_v of rockfishes (dB).



1.5 Tentative conclusions

The rockfishes in each of 47 selected areas of the SCB (**Fig. 1.1**) were mapped using a combination of multiple-frequency echosounders (Simrad EK60s); high-resolution video and still cameras deployed from an ROV; a CTD (SBE 19+); a multi-beam sonar (Simrad SM2000); and passive-acoustic loggers (Multi-Electronique, AURALs). The rockfishes and seabed in each area were mapped using the backscatter data. The backscatter maps were used to navigate the ROV through the fish and the optical samples were used to identify fish species and their sizes. Ultimately, these data will be used to estimate rockfish biomass, by species, throughout the SCB.

The 43 Fathom Bank site was surveyed twice during Leg I and once each during Legs II, III and IV, for a total of five replicates. During each of these surveys, the rockfishes were found largely in the same areas and at comparable densities. This finding attests to the high site fidelity of rockfishes in the SCB.

1.6 Disposition of Data

Echosounder (~60 GB), CTD (~2 MB), thermosalinograph (~30 MB), and metadata (~10 MB) are archived by David Demer, NOAA/ NMFS, 8604 La Jolla Shores Drive, La Jolla, CA 92037, david.demer@noaa.gov.

1.7 Acknowledgements

We thank the Captains and crews of *David Starr Jordan* and *Outer Limits* for competently and enthusiastically facilitating the echosounder surveys. They provided vigilant attention to the repetitive tasks and were eager to assist. We are also appreciative of *Jordan*'s electronic technician for providing the project with thermosalinograph and GPS data, and both vessels for providing telephone and VHS radio communications.

1.8 References

Love MS, Yoklavich M, Thorsteinson L (2002) The Rockfishes of the Northeast Pacific University of California Press, Ltd., Berkeley and Los Angeles, CA

2. Multi-beam Survey, submitted by Randy Cutter (Leg I).

2.1 Objectives

The goals of the multi-beam sonar survey were to collect seabed backscatter data for seabed classification, and to provide high-resolution bathymetric maps for identifying the spatial extent of seabed morphological features.

2.2 Accomplishments

Four sites were surveyed with the SM20 multi-beam echosounder: 43 Fathom Bank (~4 km^2), Tanner Bank (~20 km^2), North Cortes Bank (~100 km^2), and 109 Seamount (~3 km^2).

2.3 Methods

<u>Survey preparation:</u> The SM2000 sonar head was mounted on a pole attached to the port side of *David Starr Jordan*. The pole had a pivot arm and socket mounted on the railing just forward of the J-frame where the CTD was deployed on the port side. During transit, the pole was retracted in horizontal position. For deployments, the pole was lowered into the water using the crane. The multi-beam pole was held in place by forward and aft steel rope stays, a bracket mounted on the side of the ship, and a bolted sleeve on the pivot arm. The SM2000 head was 3.2 m below the water surface.

Line plans for the multi-beam survey were developed to cover as substantial subset of the EK60 acoustic survey areas. Line plans were generated using Hypack, and then converted to a format compatible with Nobeltec, and conveyed to the ship's navigator.

<u>Position and orientation:</u> Position and orientation data were provided by a POSMV V4 Wavemaster. The POSMV IMU was used as the reference point (**Table 2.1**). The IMU was mounted on vessel centerline. POSMV Coordinate system is: +x forward, +y to starboard, +z downward.

The initial installation was altered twice in attempt to obtain the GPS Azimuth Measurement Subsystem (GAMS) solution for heading. With GAMS, heading accuracy was generally about 0.05°. Without the GAMS solution, heading accuracy was only ~ 0.6° to 1.1°. Despite adjustments to the POSMV installation, GAMS solution was never obtained during this survey.

Table 2.1. Summary of POSMV installations

20070827
- Offset, dx, dy, dz
- IMU to TDCR, 2.67, -5.81, 5.51
- IMU_to_ANT1, -3.86, 3.14, -2.08
- IMU_to_ANT2, -3.86, 1.53, -2.08
- ANT_sep=1.6130

20070901
- Offset, dx, dy, dz
- IMU to TDCR, 2.67, -5.81, 5.51
- IMU_to_ANT1, -3.71, 1.04, -2.08
- IMU_to_ANT2, -3.71, 3.16, -2.08
- ANT_sep =2.1150

20070902
- Offset, dx, dy, dz

IMU to TDCR, 2.67, -5.81, 5.51
IMU_to_ANT1, -3.71, 1.04, -2.03
IMU_to_ANT2, -2.30, 5.47, -2.03
ANT_sep= 4.6240

Tidal water levels: Predicted tide data were obtained for San Clemente Island, and were applied during HIPS processing of the XTF data.

Sound speed: Sound speed profiles were obtained from CTD casts and applied during HIPS processing. Sound speed was calculated by the Sea-Bird SBE19plus CTD using the Chen-Millero method, and applied during processing of the bathymetry data from North Cortes Bank (**Table 2.2**).

Table 2.2. Sound speed profile for North Cortes Bank from a CTD cast acquired 2007-244 000300 at 323533, N, 119:19:52, W; saved in file "N_Cortes_20070901.svp."

Depth (m)	Sound speed (m/s)
1.3	1512.8
8.2	1513.6
9.0	1513.5
12.5	1513.0
18.3	1506.2
25.6	1504.4
30.5	1500.6
42.1	1496.5
51.8	1494.9
61.4	1491.2
74.3	1498.80
86.1	1489.20
102.1	1488.6
120.6	1488.7

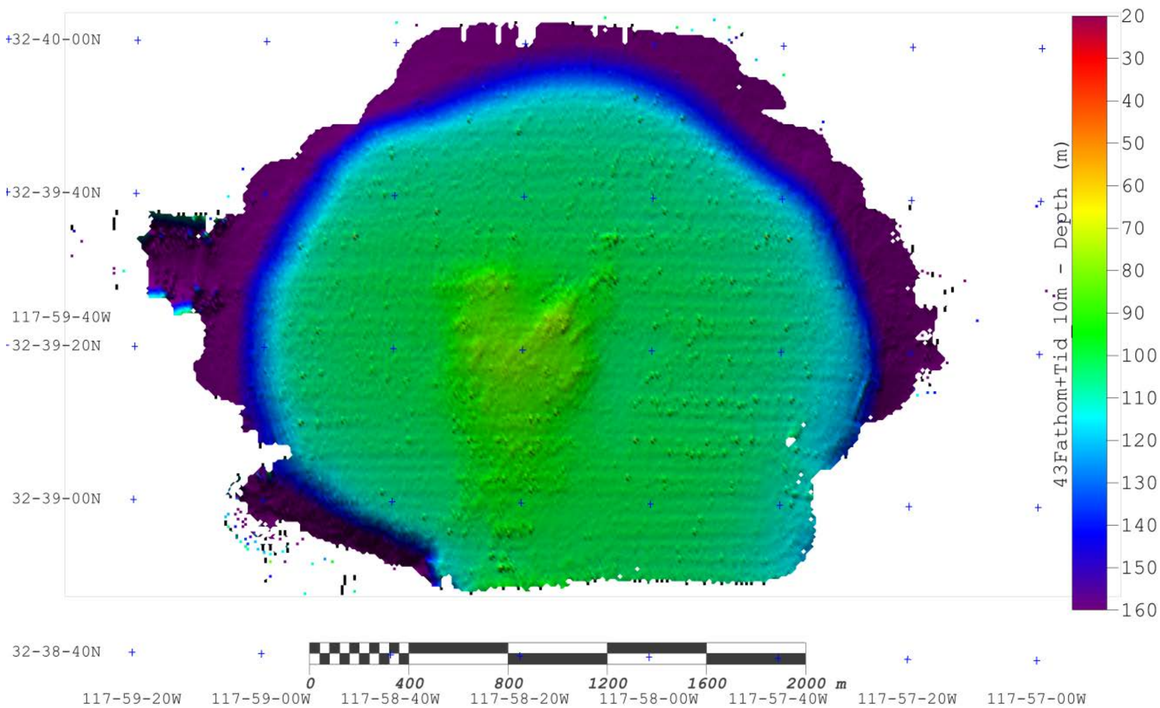
Surveying: The multi-beam survey was conducted during nighttime hours of Leg I from 27 August to 09 September 2007. The ship followed the planned lines at a survey speed of 7 to 9 kts, except when sea state required slower speeds.

Data collection: The SM20 was operated in echosounding mode, using separate transmit and receive transducers. The SM20 was operated using range settings from 150 to 400 m, dependent on the site, and at high power level. The swath angle was set to 120°, and the processor formed 100 beams for the exported data. Gain settings from 50 to 75% were used. Pulse duration was manually set to 1050 μs for 150-m and 200-m range settings. SM20 data were collected in raw form and stored in SMB file format (Kongsberg-Mesotech) on the SM20 processor computer. Positioning and attitude data were provided to the SM20 by an Ethernet serial device server (SDS). The raw SMB-format SM20 data files incorporate unbeamformed stave data and the positioning and attitude data. Seabed-detection solutions for each beam produced by the profiling option of the SM20 were exported by serial port to a laptop computer running Triton Isis multi-beam acquisition software. Isis also collected navigation and attitude data supplied by serial port and Ethernet from the POSMV V4 Wavemaster. Secondary positioning data were logged using Hypack Survey, with GPS data from the DSJ provided over a serial data connection. Raw NMEA sentences exported from the POSMV were logged on a separate PC using a serial communications program.

Onboard data processing: XTF data were post-processed onboard using CARIS HIPS. HIPS projects incorporate vessel and system installation data as well as patch test results to compensate the raw bathymetry data in the XTF files for positioning and vessel motion. Water level changes due to tides and refraction due to varying speed of sound with depth are compensated for during HIPS processing. Gridded bathymetry was generated using HIPS. Grid-cell sizes from 4 to 15 m were used, dependent on the depth of the site and the density and quality of the data. Preliminary bathymetric surfaces provided here still contain artifacts and require cleaning following hydrographic data processing conventions.

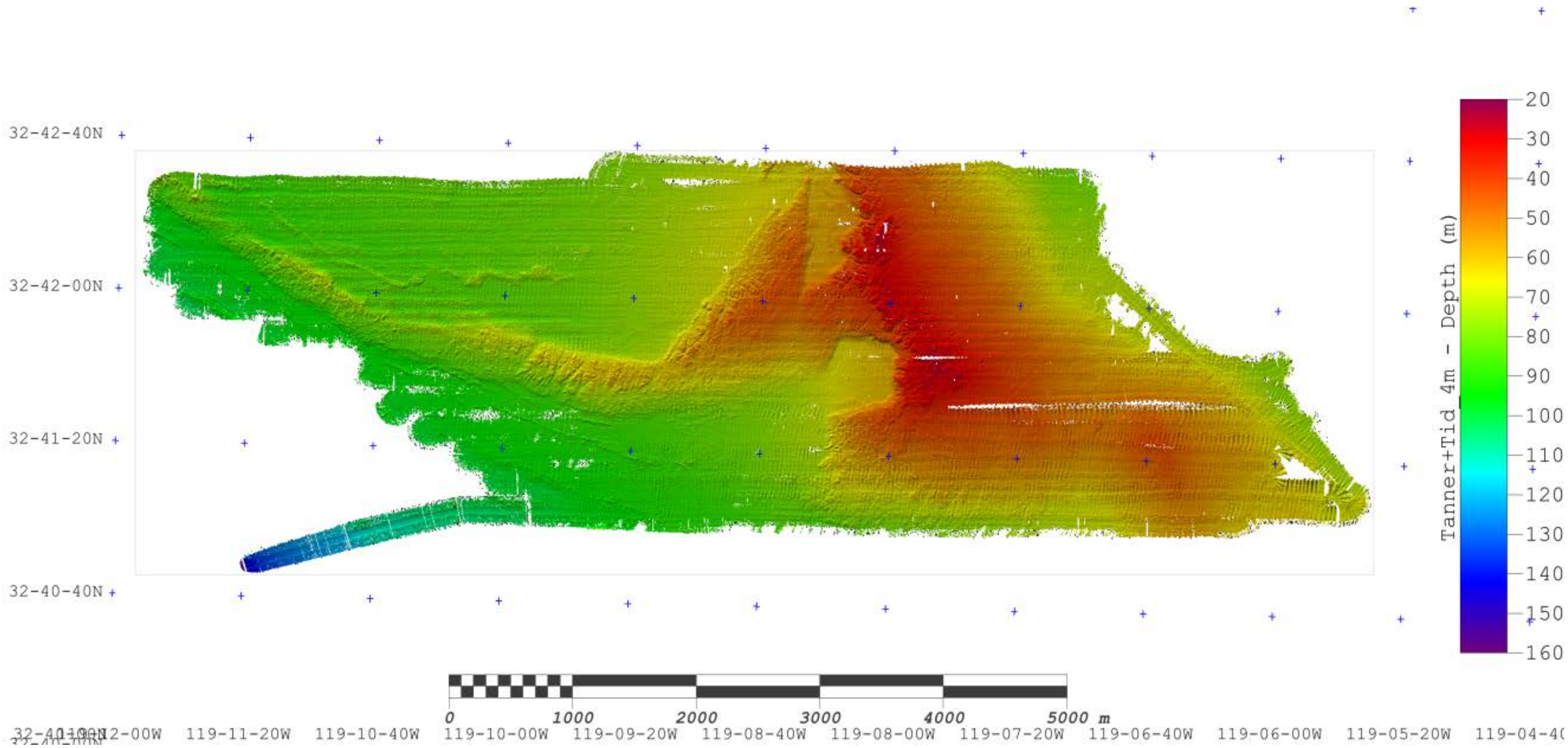
2.4 Preliminary results

Figure 2.1. Multi-beam bathymetry at Forty-Three Fathom Bank, survey on 27 August 2007. The grid has a 10 m cell size. Data are compensated for tides at San Clemente Island and results from a preliminary patch test. The small bumps are artifacts of bad automatic bottom-detection, and will be removed from final products.



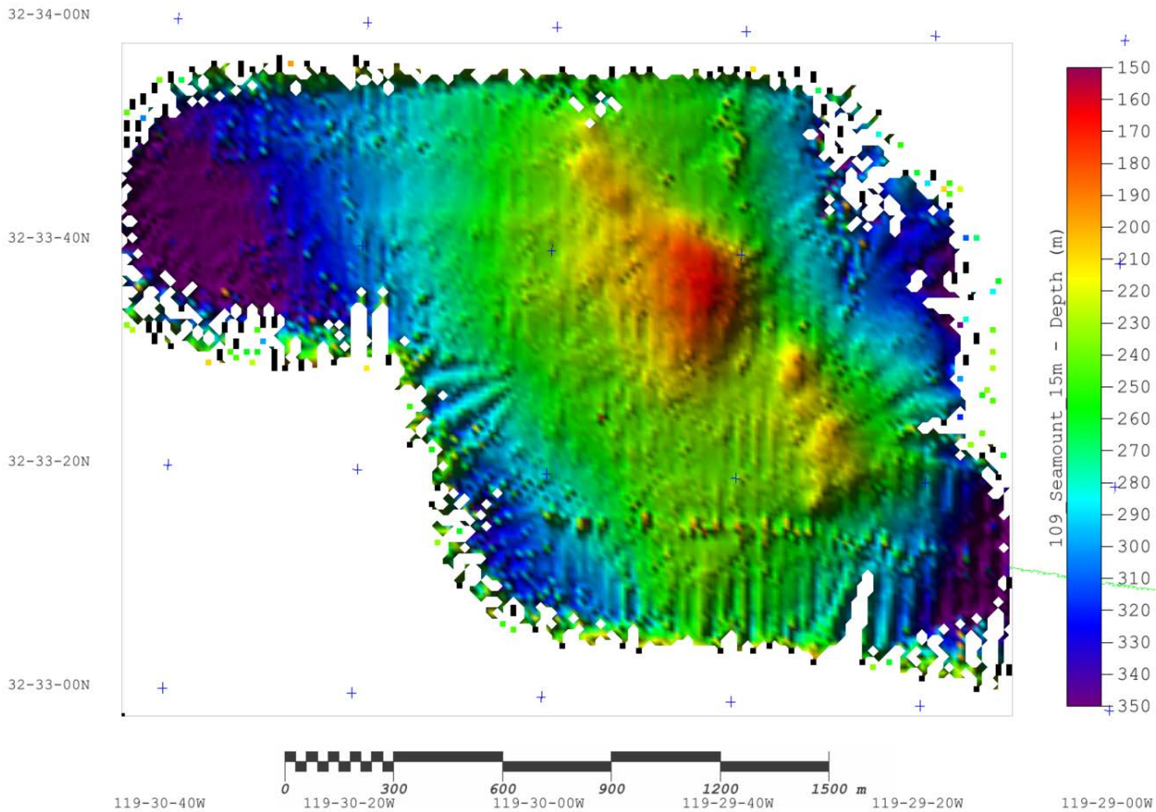
Last modified: 20070906
HIPS Project: Tanner_Test
Fieldsheet: Tanner_test
BASE: 43Fathom+Tid_10m
Session: Tanner_Test.hsf
Image: 43Fathom+Tid_10m.tif
Note: Compensated for predicted tide heights from San Clemente Island.
3-D shading illuminated from azimuth of 315°, and an elevation of 35°.

Figure 2.2. Multi-beam bathymetry at Tanner Bank, survey on 1 September 2007. The grid has a 4 m cell size. Data are compensated for tides at San Clemente Island and results from a preliminary patch test.



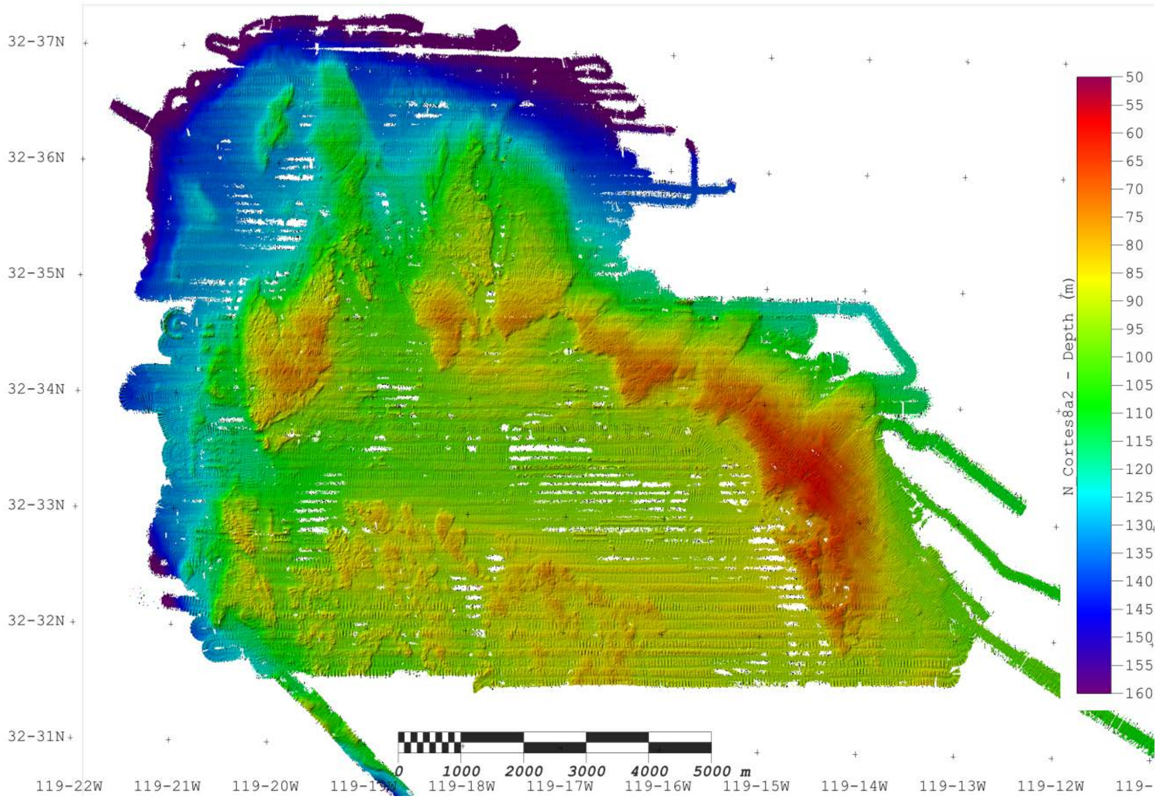
Last modified: 20070906
HIPS Project: Tanner_Test
Fieldsheet: Tanner_test
BASE: Tanner+Tid_4m
Session: Tanner_Test.hsf
Note: Compensated for predicted tide heights from San Clemente I.
3-D shading illuminated from azimuth of 315°, and an elevation of 35°.

Figure 2.3. Multi-beam bathymetry at 109 Seamount, survey on 8 September 2007. The grid has a 15 m cell size. Data are compensated for tides at San Clemente Island and results from a preliminary patch test.



Last modified: 20070908
HIPS Project: 109_Seamount
Fieldsheet: 109_Seamount
BASE: 109_Seamount
Session: 109_Seamount
Note: Compensated for predicted tide heights from San Clemente I.
3-D shading illuminated from azimuth of 315°, and an elevation of 35°.

Figure 2.4. Multi-beam bathymetry at North Cortes Bank, survey on 1-8 September 2007. The grid has a 8 m cell size. Data are compensated for tides at San Clemente Island and results from a preliminary patch test.



Last modified: 20070908
HIPS Project: N_Cortes5, N_Cortes6, N_Cortes7, N_Cortes8
Fieldsheet: N_Cortes1-8
BASE: N_Cortes1-8
Session: N_Cortes_all1
Note: Compensated for predicted tide heights from San Clemente I.
3-D shading illuminated from azimuth of 315°, and an elevation of 35°.

2.5 Tentative Conclusions

The goals of this multi-beam sonar survey were to collect backscatter data for seabed classification, and to provide high-resolution bathymetric maps for identifying the spatial extent of seabed morphological features. Four sites were surveyed with the SM20 multi-beam echosounder: 43 Fathom Bank (~4 km^2), Tanner Bank (~20 km^2), North Cortes Bank (~100 km^2), and 109 Seamount (~3 km^2).

2.6 Problems and Suggestions

During one night, the processor lost contact with the SM2000 head, and the sonar ceased to operate. Shining a spotlight into the water revealed the head to still be attached. When the pole was raised, the problem was found to be that the connectors to the sonar head had vibrated loose. There was no damage to the connector pins or the cable. The connectors were cleaned and dried and reconnected, and the sonar operated normally afterward.

During much of the survey, high latency between the SM20 and the Isis software seemed to cause problems in the post-processing. It appears that high latency values either are associated with errors in timing that get introduced into the XTF files, and subsequently cause HIPS to erroneously compensate for motion; or if the latency values are stored in the XTF files, perhaps they are not properly handled by HIPS. The result is that the vessel and sensor motions are not accurately compensated for, and motion artifacts appear in the bathymetric surface. Subsequent post-processing of the raw SMB files mitigates these problems.

On 08 September 2007, during daytime operations, the SM20 pole was in deployed mode and caught a large load of kelp around the pole and the aft stay. The weight caused so much drag that the forward come-along wire parted, and the pole bent slightly. Only the pole was damaged. The bend occurred below the inner sleeve joining the two pole sections, and the bend was approximately 2–5°. Since only a few more hours of multi-beam operation were scheduled during the final night of Leg 1, the operation was called off.

2.7 Disposition of Data

Multi-beam echosounder data archived by Randy Cutter, NOAA/ NMFS, 8604 La Jolla Shores Drive, La Jolla, CA 92037, George.Cutter@noaa.gov.

3 Physical Oceanography and Meteorology, submitted by David A. Demer (Leg I), Josiah Renfree (Legs I and IV), Thomas S. Sessions (Legs II and III), Randy Cutter (Legs I and II), Dave Griffith (Leg II), Derek Needham (Leg III), and Ana Širović (Legs III and IV).

3.1 Objectives

Sampling of physical oceanographic conditions at each site to the shallower of 300 m or 3 m above the seabed using a Seabird 19+ CTD augmented with a dissolved oxygen sensor. Additionally, current vectors will be profiled using the ship's ADCP.

Continuous underway sampling of surface waters and weather conditions were accomplished using the ship's thermosalinograph, weather station, and Scientific Computing System (SCS). Temperature and salinity data were automatically merged with the time and position data from the ship's GPS navigational unit and logged by computer each minute.

3.2 Accomplishments

CTD casts were successfully conducted at most survey sites throughout the duration of the cruise. The data from these casts were used to document depth profiles of temperature, salinity, and sound speed, and to see how they differ among varying survey sites. A list of the CTD deployment sites can be found in **Table 3.1**. While a majority of the survey sites were sampled by the CTD, casts at 118 Bank from Leg I and Mission Beach Reef, Del Mar Steeples, NW Catalina Island, N San Clemente Island, Kidney Bank, and 43 Fathom Bank from Leg IV were omitted, due to time constraints. In some cases, as in N San Clemente Island, access to the survey site was prohibited.

3.3 Methods

Upon completion of the acoustic survey at each site, the CTD was cast near the center of the site to the shallower of 300 m or 3 m above the seabed. Each cast was deployed at a rate of 30 m/min using the J-frame wench on the port side of the ship. Prior to deployment, the CTD soaked for three minutes at a depth of approximately 2 m before being lowered. The CTD was configured in profiling mode, which scans at a 4 Hz sampling rate. Pressure, temperature, conductivity, and oxygen saturation were recorded during each cast. During processing, these measurements were used to estimate depth, salinity, and sound speed.

The CTD data were processed with a series of steps including low-pass filtering, splitting the data into up and down-casts, deriving additional environmental data (e.g., salinity, depth, and sound speed), and averaging over one meter depth bins.

3.4 Preliminary results

The CTD was deployed at the sites and times recorded in **Table 3.1**.

Table 3.1. CTD cast details.

	Location	Date	Latitude	Longitude	Maximum Depth (m)
	Leg I				
1	43 Fathom Bank	270807	32° 39.670 N	117° 58.130 W	87
2	43 Fathom Bank	270807	32° 39.260 N	117° 58.200 W	77
3	S Tanner Bank	290807	32° 42.410 N	119° 10.190 W	73
4	S Tanner Bank	300807	32° 41.450 N	119° 08.870 W	68
5	S Tanner Bank	310807	32° 41.151 N	119° 09.765 W	78
6	N Cortes Bank	10907	32° 35.330 N	119° 19.860 W	121
7	S Cortes Spawning Grounds	10907	32° 36.440 N	119° 09.330 W	135
8	N Cortes Spawning Grounds	10907	32° 39.730 N	119° 14.980 W	119
9	N Cortes Bank	50907	32° 28.620 N	119° 07.300 W	80
10	S Cortes Bank	70907	32° 25.765 N	119° 02.307 W	85
11	109 Seamount	80907	32° 33.634 N	119° 29.861 W	179
	Leg II				
12	43 Fathom Bank	150907	32° 38.739 N	117° 58.833 W	259
13	117 Seamount	150907	32° 33.120 N	119° 12.840 W	215
14	N Santa Barbara Island	160907	33° 30.970 N	119° 02.210 W	65
15	N Santa Barbara Island	160907	33° 30.000 N	119° 05.700 W	88
16	SW Santa Barbara Island	180907	33° 28.170 N	119° 06.480 W	69
17	Osborne Bank	180907	33° 21.330 N	119° 01.540 W	49
18	SE San Nicolas Island	190907	33° 14.500 N	119° 17.500 W	92
19	E San Nicolas Island	200907	33° 16.990 N	119° 26.210 W	44
20	E San Nicolas Island	210907	33° 20.150 N	119° 31.150 W	79
21	N San Nicolas Island	220907	33° 28.560 N	119° 49.150 W	119
22	N San Nicolas Island	230907	33° 27.510 N	119° 51.160 W	119
23	NW San Nicolas Island	240907	33° 23.805 N	119° 49.540 W	89
24	Cherry Bank	250907	33° 53.870 N	119° 24.940 W	149
25	107 Bank	260907	33° 02.570 N	119° 36.640 W	193
26	107 Bank	260907	33° 02.600 N	119° 34.670 W	274
27	Mission Bay Reef	270907	32° 45.680 N	117° 18.910 W	60
	Leg III				
28	Hidden Reef	21007	33° 47.770 N	119° 10.24 W	139
29	S Anacapa Island	31007	33° 57.710 N	119° 29.190 W	110
30	Anacapa Pass	31007	34° 00.910 N	119° 28.660 W	44
31	N Santa Rosa Island	41007	34° 03.890 N	120° 12.460 W	40
32	NE San Miguel Island	41007	34° 04.510 N	120° 19.050 W	50
33	SW San Miguel Island	51007	34° 00.060 N	120° 24.800 W	66
34	Santa Rosa Flats	71007	33° 45.880 N	119° 58.080 W	180
35	NW San Miguel Island	71007	34° 08.270 N	120° 24.900 W	73

36	NW San Miguel Island	71007	34° 08.270 N	120° 24.900 W	-
	Location	**Date**	**Latitude**	**Longitude**	**Maximum Depth (m)**
37	NW San Miguel Island	91007	34° 05.480 N	120° 24.970 W	34
38	NW San Miguel Island	91007	34° 04.970 N	120° 28.460 W	28
39	N San Miguel Island	101007	34° 07.690 N	120° 22.050 W	69
40	Santa Rosa Flats	111007	33° 50.170 N	119° 58.060 W	-
41	Santa Cruz Canyon	111007	33° 56.110 N	119° 50.930 W	64
42	Santa Rosa Flats	131007	33° 37.950 N	119° 49.640 W	97
43	43 Fathom Bank	141007	32° 39.390 N	117° 58.180 W	77
	Leg IV				
44	9 Mile Bank	231007	32° 36.200 N	117° 23.580 W	132
45	9 Mile Bank	251007	32° 34.720 N	117° 21.000 W	158
46	60 Mile Bank	261007	32° 00.720 N	118° 12.590 W	187
47	81 Fathom Bank	271007	32° 42.880 N	118° 23.780 W	278
48	China Point Reef	271007	32° 44.340 N	118° 24.680 W	113
49	86 Fathom Bank	271007	32° 43.450 N	118° 27.470 W	172
50	W San Clemente	281007	32° 51.040 N	118° 32.040 W	97
51	NW San Clemente	291007	32° 57.980 N	118° 36.390 W	79
52	NW San Clemente	291007	32° 59.710 N	118° 37.910 W	99
53	Farnsworth Bank	301007	33° 21.790 N	118° 32.600 W	190
54	Lasuen Knoll	311007	33° 24.810 N	118° 00.560 W	227

Figure 3.1. Combined CTD data from casts 1-11, collected during Leg I.

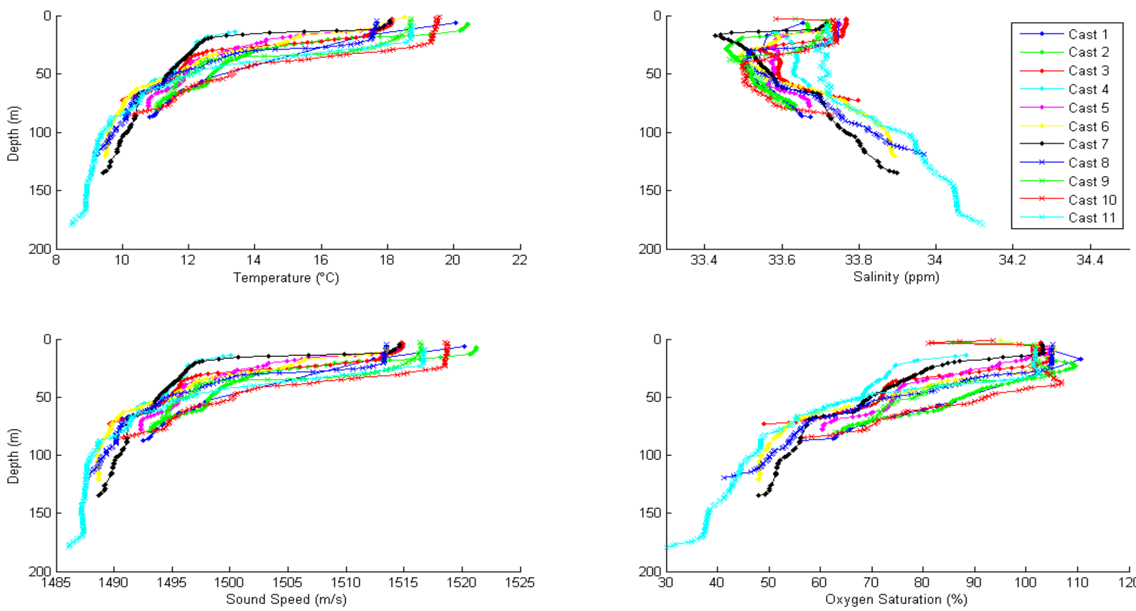


Figure 3.2. Combined CTD data from casts 12-27, collected during Leg II.

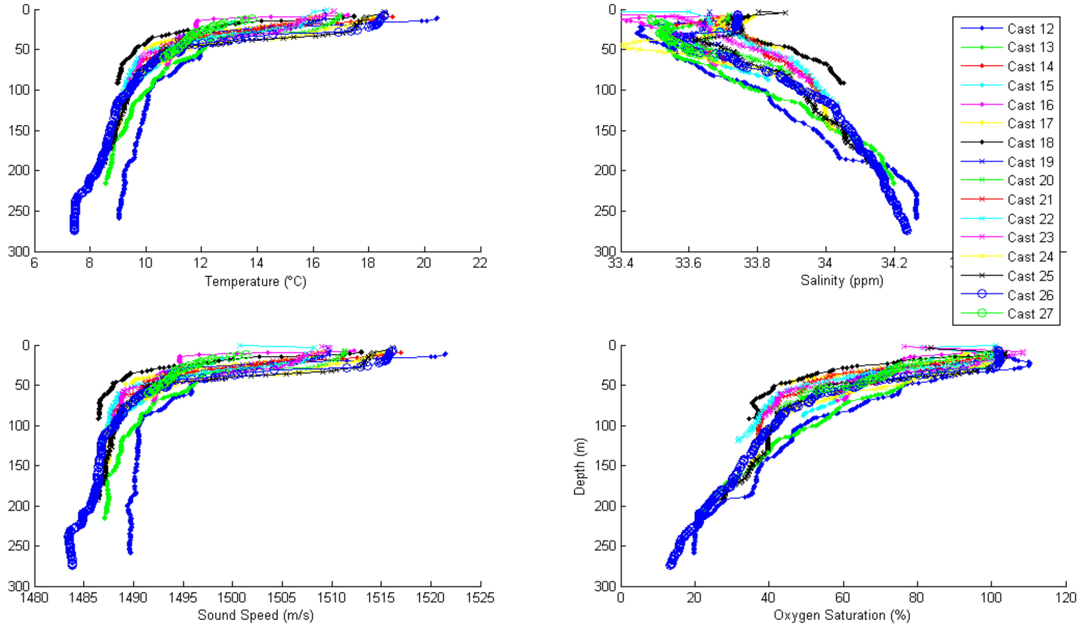


Figure 3.3. Combined CTD data from casts 28-43, collected during Leg III.

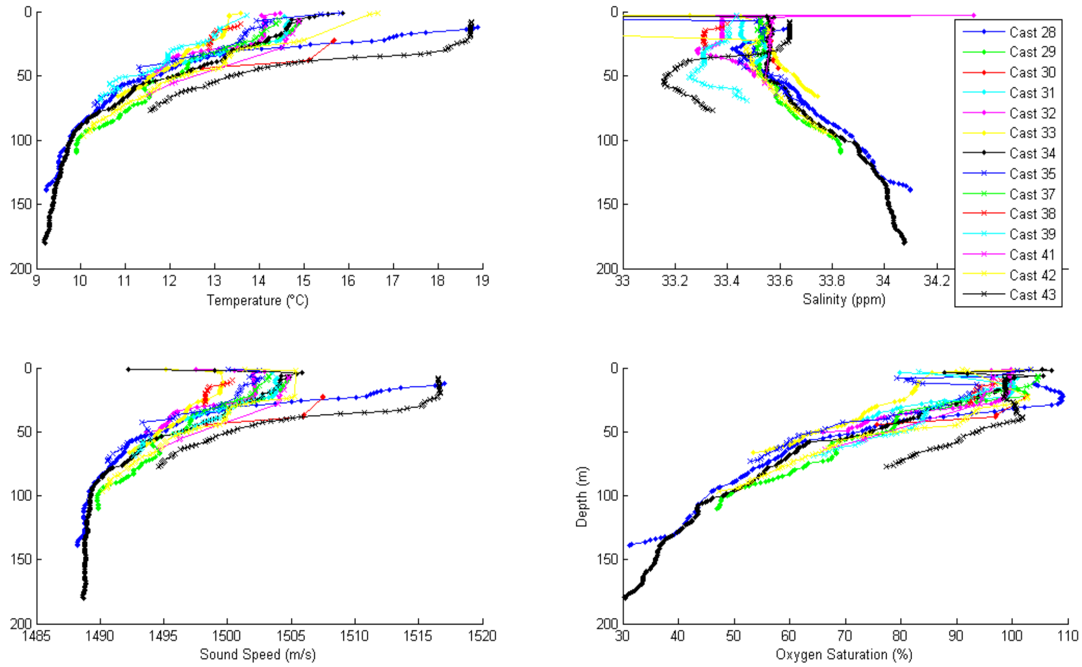
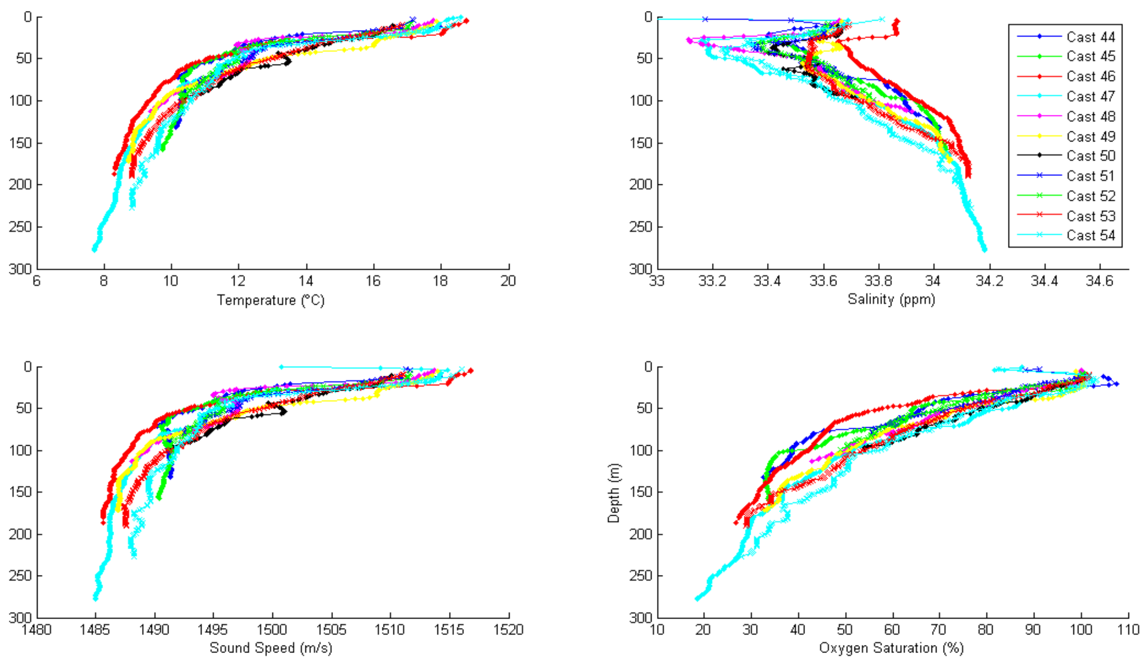


Figure 3.4. Combined CTD data from casts 24-54, collected during Leg IV.



Throughout the cruise, ADCP data were collected continuously by the ship's electronic technician. Also, throughout the cruise, thermosalinograph and weather station data, indexed by GPS time, position and vessel speed, were stored each minute by the SCS.

3.5 Tentative Conclusions

CTD casts were successfully conducted at most survey sites. The data from these casts were used to estimate depth profiles of temperature, salinity, and sound speed. Due to time constraints, CTD sampling was not conducted at 118 Bank (Leg I); and Mission Beach Reef, Del Mar Steeples, NW Catalina Island, N San Clemente Island, Kidney Bank, and 43 Fathom Bank (Leg IV). Access to N San Clemente Island was prohibited by the Navy.

3.6 Problems and Suggestions

Early CTD casts, which were deployed using a drop rate of 60 m/min, tended to have many empty data values, resulting in large gaps in the dataset. This was vastly improved when the drop rate was decreased to 30 m/min. Therefore, if there appears to be missing large chunks of data, the drop rate of the CTD should be decreased to increase the number of scans at each depth.

3.7 Disposition of Data

CTD and SCS data are archived by David Demer, NOAA/ NMFS, 8604 La Jolla Shores Drive, La Jolla, CA 92037, david.demer@noaa.gov.

3.8 Acknowledgements

Thanks to the ship's Chief ET, Kim Belveal, for providing ADCP and SCS data at the conclusion of legs I-III and ET Eric Thompson for providing these data at the end of leg IV. Also thanks to the crew of the *David Starr Jordan* for operating the crane when conducting the CTD casts.

4. Passive Acoustic Monitoring, submitted by Ana Širović (Legs III and IV), Thomas S. Sessions (Legs II and III), Derek Needham (Leg III), David A. Demer (Leg I), Randy Cutter (Legs I and II), and Josiah Renfree (Legs I and IV).

4.1 Objectives

Fish vocalizations recorded at 15 sites are to be compared with COAST estimates of rockfish abundances and species mixtures. This is a feasibility study for passive-acoustical monitoring of rockfish populations during periods between ship-based surveys.

4.2 Accomplishments

Passive acoustic recorders were deployed at 15 sites throughout the Southern California Bight during the cruise: 43 Fathom Bank, South Tanner Bank, twice at North Cortes Bank, North Cortes Spawning Grounds, South Cortes Bank, North Santa Barbara Island, East San Nicolas Island, North San Nicolas Island, Potato Bank, Cherry Bank, Santa Rosa Flats, Nine Mile Bank, China Point Reef, and Farnsworth Bank. A total of approximately 75.5 days of passive acoustic data were recorded and a number of sounds were identified that could be produced by rockfish.

4.3 Methods

Instrument specifications: The AURAL is a passive acoustic recorder available from Multi-Electronique capable of long-term deployments. Two units were available for the survey and they were set to record continuously at 8192 Hz, with 8 min 20 s gap in recording while recorded data are transferred from 512MB CF card to 160GB hard drive . The hydrophone on the AURAL was HTI-96-MIN.

Also available for legs 3 and 4 of the survey were three PAL units. The sampling frequency of the PAL was 4096 Hz and it was recording continuously on a 8GB SD card. The hydrophone used on the PALs was HTI-94-SSQ.

A long-duration passive acoustic logger (AURAL) was deployed at 43 Fathom Bank at the beginning of Leg 1 and recovered at the end of Leg 4 (deployment location: 32° 39.239 N; 117° 58.262 W).

A second AURAL was deployed for shorter durations at each of the following survey sites for periods of 1 to 4 days:
Leg I: S Tanner Bank, N Cortes Spawning Grounds, N Cortes Bank, and S Cortes Bank;
Leg II: N Santa Barbara Island, E San Nicolas Island, N San Nicolas Island, Potato Bank, and Cherry Bank;
Leg III: Santa Rosa Flats;
Leg IV: 9 Mile Bank, Farnsworth Bank, and China Point Reef.

During legs III and IV a secondary, short-duration passive acoustic logger (PAL) was deployed in conjunction with the AURAL at all sites, for comparison of the two recorders. Deployment locations are listed (**Table 4.1**).

Deployment procedures: Deployment efforts were conducted at nighttime, to maximize active-acoustic surveys during daylight. The recoveries, however, were conducted during daytime, to ensure the mooring was sighted.

The moorings were prepared for deployment before arriving at each location. At location, the ship pointed up swell; the floats, acoustic recorders, and acoustic releases were hand-deployed over the side as the expendable steel weight was lowered from the J-frame.

On recovery, the ship arrived at the deployment location and a release command was sent to the acoustic release. The ship moved 0.2 n.mi. down swell, and awaited visual confirmation that the instrument has surfaced. The ship then pointed into the swell, maneuvered alongside it, and a hook was used to grapple a line between two floats. The floats, data logger and acoustic releases were carefully pulled out of the water and placed on deck.

After recovery, the data were downloaded to an external hard disk; batteries replaced as necessary, and a new weight attached for the next deployment.

Table 4.1. AURAL deployment locations, dates and times.

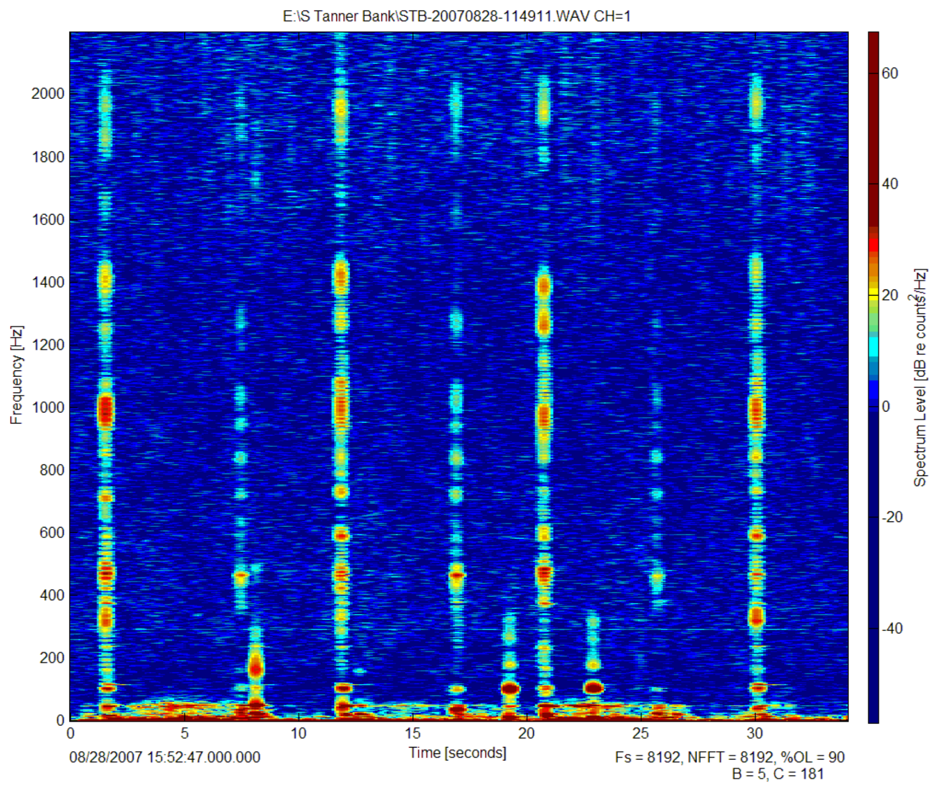
Location	Deploy date	Time (GMT)	Latitude (N)	Longitude (W)	Depth (m)	Recover date	Time (GMT)
43 Fathom Bank	08/27/07	1349	32.65398	117.97103	88	11/01/07	1400
S Tanner Bank	08/30/07	1242	32.69923	119.13998	44	08/31/07	0200
N Cortes Spawning Grounds	08/31/07	1240	32.66343	119.2486	123	09/01/07	2000
N Cortes Bank 1	09/02/07	1147	32.5599	119.24111	62	09/04/07	2330
N Cortes Bank 2	09/05/07	1240	32.47308	119.11721	75	09/6/07	2245
S Cortes Bank	09/07/07	1220	32.41813	119.05621	77	09/08/07	1635
N Santa Barbara	09/15/07	1230	33.52485	119.06733	105	09/17/07	0817
E San Nicolas	09/18/07	1210	33.30032	119.4252	75	09/20/07	2022
N San Nicolas	09/21/07	1155	33.49975	119.79195	128	09/23/07	2345
Potato Bank	09/24/07	1302	33.25035	119.8163	93	09/24/07	1900
Cherry Bank	09/25/07	1257	32.87528	119.42463	108	09/26/07	0038
Santa Rosa Flats	10/04/07	0111	33.67483	120.00766	107	10/12/07	1643
9 Mile Bank	10/23/07	0133	32.60333	117.3915	160	10/24/07	2300
China Point Reef	10/26/07	1315	32.7445	118.4045	86	10/27/07	2223
Farnsworth Bank	10/30/07	1315	33.34583	118.52066	57	01/11/07	0043

4.4 Preliminary results

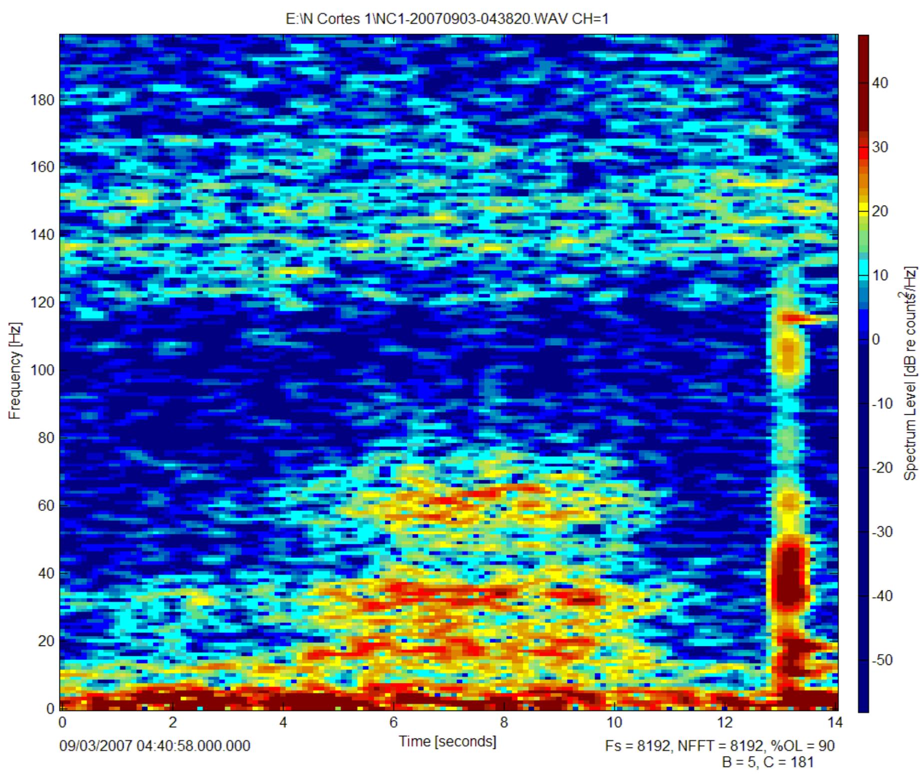
Several sounds were recorded during the survey that could be produced by rockfishes or some other species of fish (**Fig 4.1 a-e**).

Figure 4.1. Sample spectrograms of recorded sounds that could be produced by rockfishes.

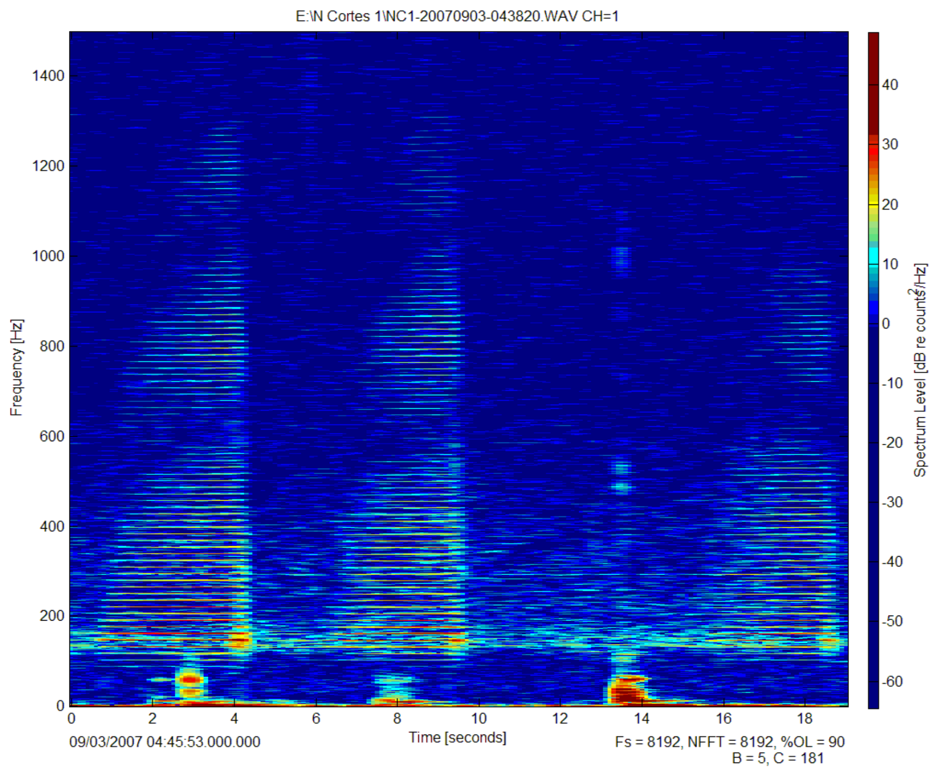
a)



b)

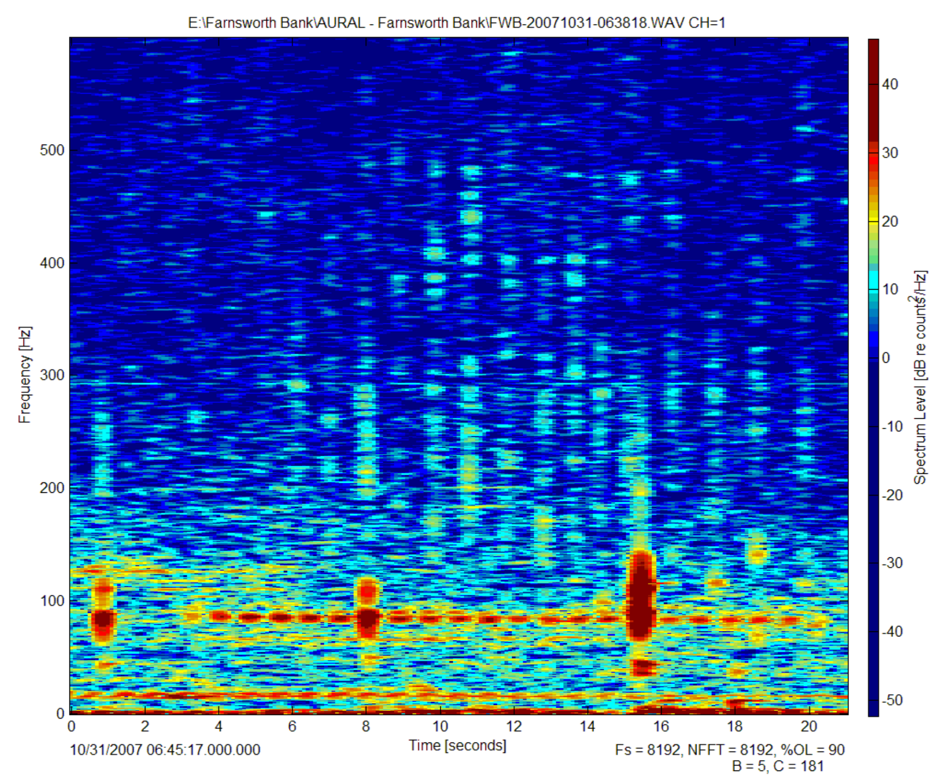


c)



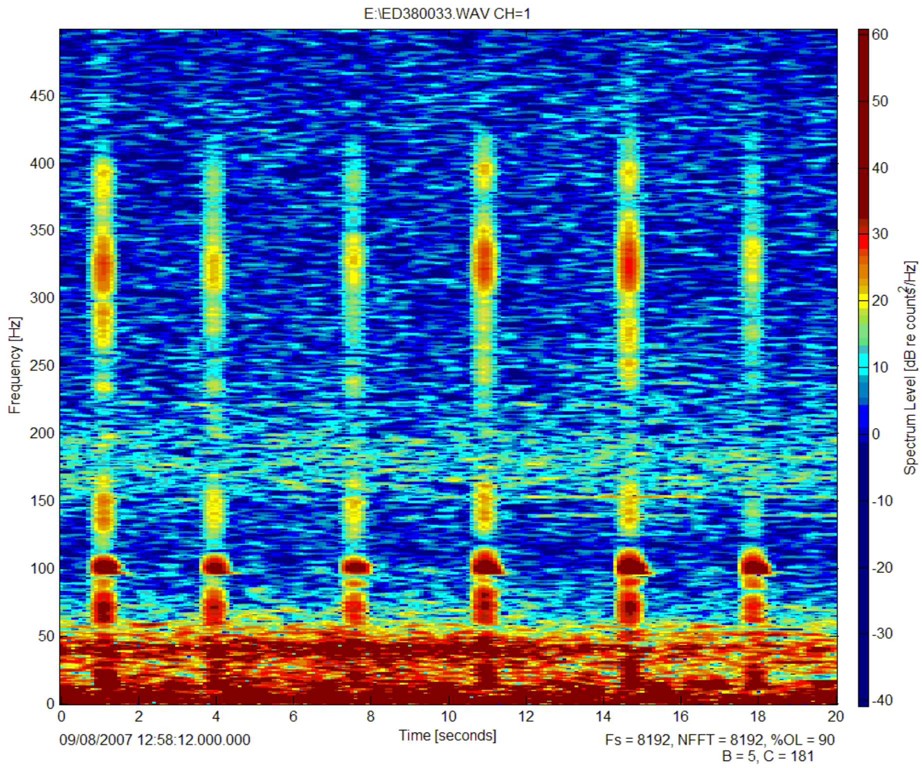
E:\N Cortes 1\NC1-20070903-043820.WAV CH=1
1400
1200
1000
800
600
400
200
0
Frequency [Hz]
0
2
4
6
8
10
12
14
16
18
Time [seconds]
09/03/2007 04:45:53.000.000
Fs = 8192, NFFT = 8192, %OL = 90
B = 5, C = 181
40
30
20
10
0
-10
-20
-30
-40
-50
-60
Spectrum Level [dB re counts^2/Hz]

d)



E:\Farnsworth Bank\AURAL - Farnsworth Bank\FWB-20071031-063818.WAV CH=1
500
400
300
200
100
0
Frequency [Hz]
0
2
4
6
8
10
12
14
16
18
20
Time [seconds]
10/31/2007 06:45:17.000.000
Fs = 8192, NFFT = 8192, %OL = 90
B = 5, C = 181
40
30
20
10
0
-10
-20
-30
-40
-50
Spectrum Level [dB re counts^2/Hz]

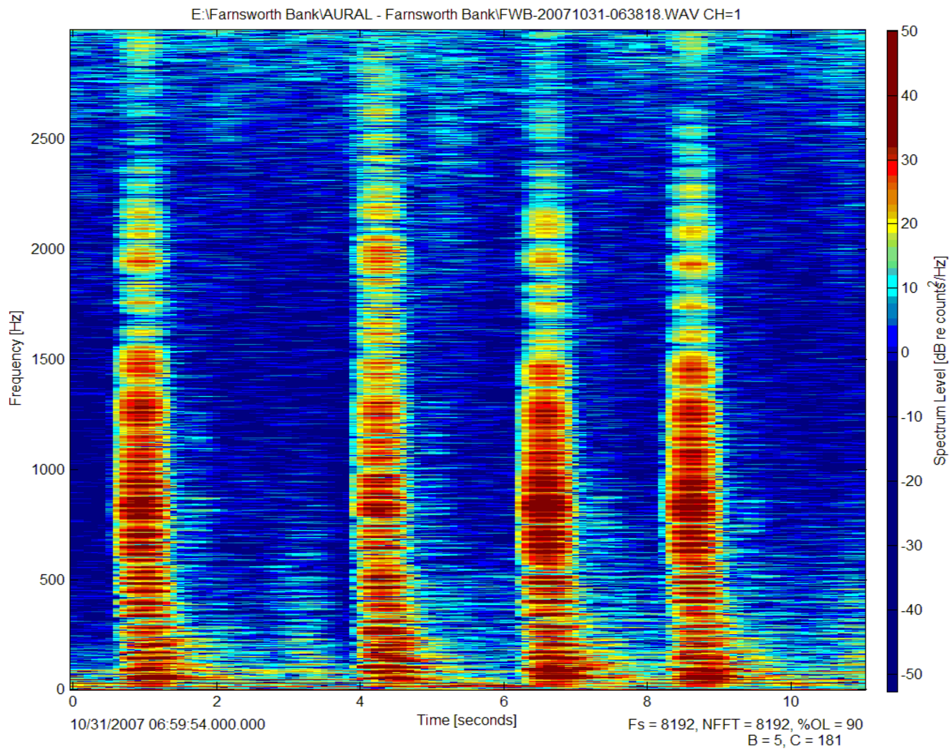
e)



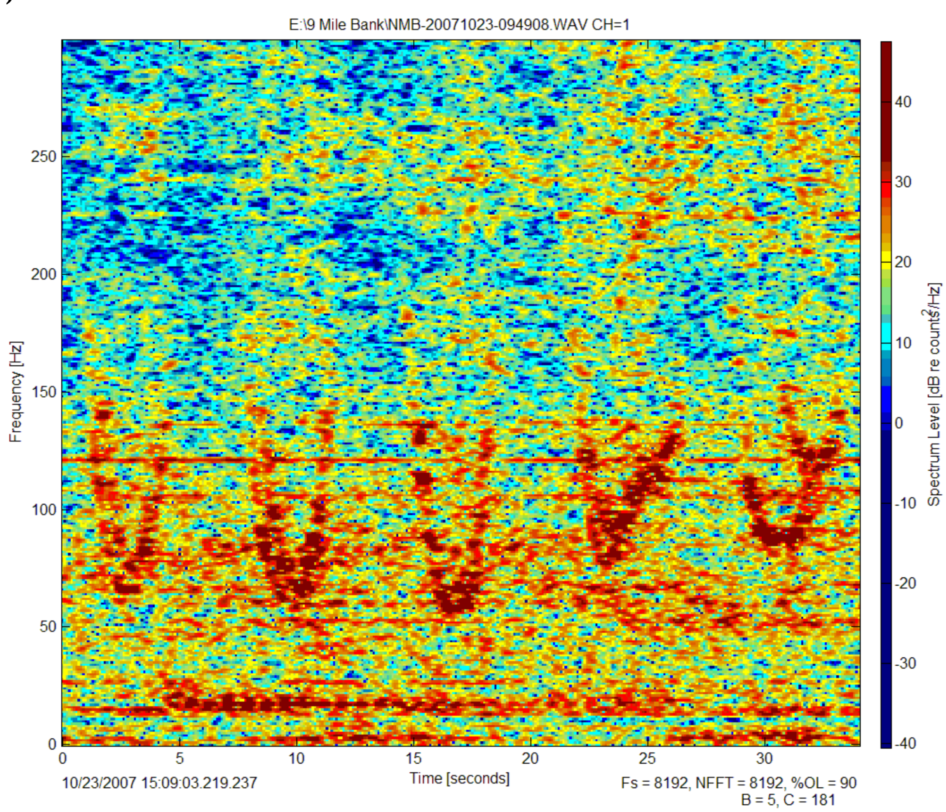
Preliminary analysis indicated that sounds in **Figs. 4.1a-c** were recorded intermittently on all sites. Characteristics of calls in **Figs. 4.1a and b** may be similar to calls recorded in tanks containing several rockfish species at Hubbs-Sea World Research Institute. Sounds in **Figs. 4.1d-e** were only seen on individual sites in preliminary screening of the data, but more detailed analyses are required before any spatial differences in the presence of different sounds can be established. Note that there are likely three different biological sounds in **Fig. 4.1e**. There are three pulses near 100 Hz of unknown origin, a series of pulses at approximately 90 Hz which is a blue whale A-type call, and a series of weaker pulses in the range from 200 to 500 Hz that could be produced by a fish species. Other biological sounds recorded by the passive acoustic recorders include snapping shrimp, blue whale (*Balaenoptera* musculus) B and D calls, fin whale (*B. physalus*) calls, and other cetacean whistles. Some recorded sounds could also be from man-made noise, such as bombings in the navy range (**Fig. 4.2a**) or ship-related noises (**Fig 4.2b**).

Figure 4.2. Sample spectrograms of recorded sounds that could be produced by non-biologics.

a)



b)



Further analysis of recorded sounds are needed to verify possible origins and establish diel patterns for sounds of interest, as well as determine the feasibility of using passive acoustics for rockfish monitoring.

4.5 Tentative Conclusions

This was a feasibility study for passive-acoustical monitoring of rockfish populations during periods between ship-based surveys. Fish vocalizations were recorded at 15 sites throughout the Southern California Bight: 43 Fathom Bank, South Tanner Bank, twice at North Cortes Bank, North Cortes Spawning Grounds, South Cortes Bank, North Santa Barbara Island, East San Nicolas Island, North San Nicolas Island, Potato Bank, Cherry Bank, Santa Rosa Flats, Nine Mile Bank, China Point Reef, and Farnsworth Bank. A total of 75.5 days of passive acoustic data were recorded and a number of sounds were identified that could be produced by rockfishes. These are to be compared with COAST estimates of rockfish abundances and species mixtures.

4.6 Problems and Suggestions

After the second short term deployment of the AURAL (N Cortes Spawning Grounds site), there was approximately 5 ml of water at the seabed of the unit. The traces of drips indicated that the problem was on the lid, and was subsequently pinpointed to the pressure sensor. For the rest of the deployments on leg 1, the AURAL was cleaned and dried after each deployment and desiccant packs were replaced. The deployments continued as the leak was deemed not to be bad enough to cause major problems during short deployments. The problem was fixed between legs 1 and 2 by replacing the faulty pressure sensor and subsequently there were no water intrusions into the unit.

The AURAL deployed at N Santa Barbara site returned with no data collected. After deployment, it was indicating that the hard drive was full, but there were no new files and over 150GB of space. The hard drive was reformatted and worked properly on subsequent deployments.

PAL maximum recording duration was 3 days and 10 hrs, as limited by the battery capacity. The maximum deployment could be prolonged potentially by adding extra batteries to the current pack (6 D-cell batteries). Likewise, the long-term AURAL deployed at 43 Fathom Bank appeared to have used up its 64-battery pack after only 46 days, as opposed to the 98 days advertised by the manufacturer. On recovery, the unit was off and attempts to turn it on resulted in a message “Going in power down for 1 month.” However, it was determined that the unit recorded normally from deployment until 1716 on 12 October, and 60GB of collected data were downloaded without problems. Voltage on the battery was 7.82V.

4.7 Disposition of Data

Passive acoustic data are archived by David Demer, NOAA/ NMFS, 8604 La Jolla Shores Drive, La Jolla, CA 92037, david.demer@noaa.gov.

4.8 Acknowledgements

Thanks to the officers and crew of NOAA Ship *David Starr Jordan* for their help deploying and recovering passive acoustic moorings. We would like to thank Jacques Saint-Pierre for promptly supplying a new pressure sensor.

5. Optical surveys using a remotely operated vehicle (ROV), submitted Kevin L. Stierhoff John L. Butler (Legs I and IV), Scott Mau (Legs I, II, III and IV), David Murfin (Legs I and II), Deanna Pinkard (Leg III), Noelle Bowlin (Leg II), Tony Cossio (Leg III), Dave Griffith (Leg II), and Dale Sweetnam (Leg IV)

5.1 Objectives

The research objective was to conduct visual transect surveys using a remotely operated vehicle (ROV) at offshore banks previously surveyed using multi-beam and multi-frequency split-beam acoustic sampling methods described in detail above. These surveys aimed to 1) provide general information on rockfish community structure (e.g., relative abundance, size distributions, seabed associations, and height above the bottom) to aid in the apportioning of acoustic backscatter from fish targets, and 2) provide visual data on seabed composition to ground-truth acoustic survey results.

5.2 Accomplishments

A total of 57 ROV transect surveys covering a distance of ~117 km were conducted at 39 nominal sites during daylight hours between 29 August 2007 and 12 April 2008 (**Fig. 5.1, Table 5.1**). Over 240,000 rockfishes and thornyheads (~42 species) were identified and quantified between 0 and 350 m depth. Each observation included the date, time, latitude, longitude, depth, temperature, size, seabed association, and height above the seabed.

Figure 5.1. Location of ROV (black lines) and acoustic (green lines) transect surveys throughout the Southern California Bight survey area.

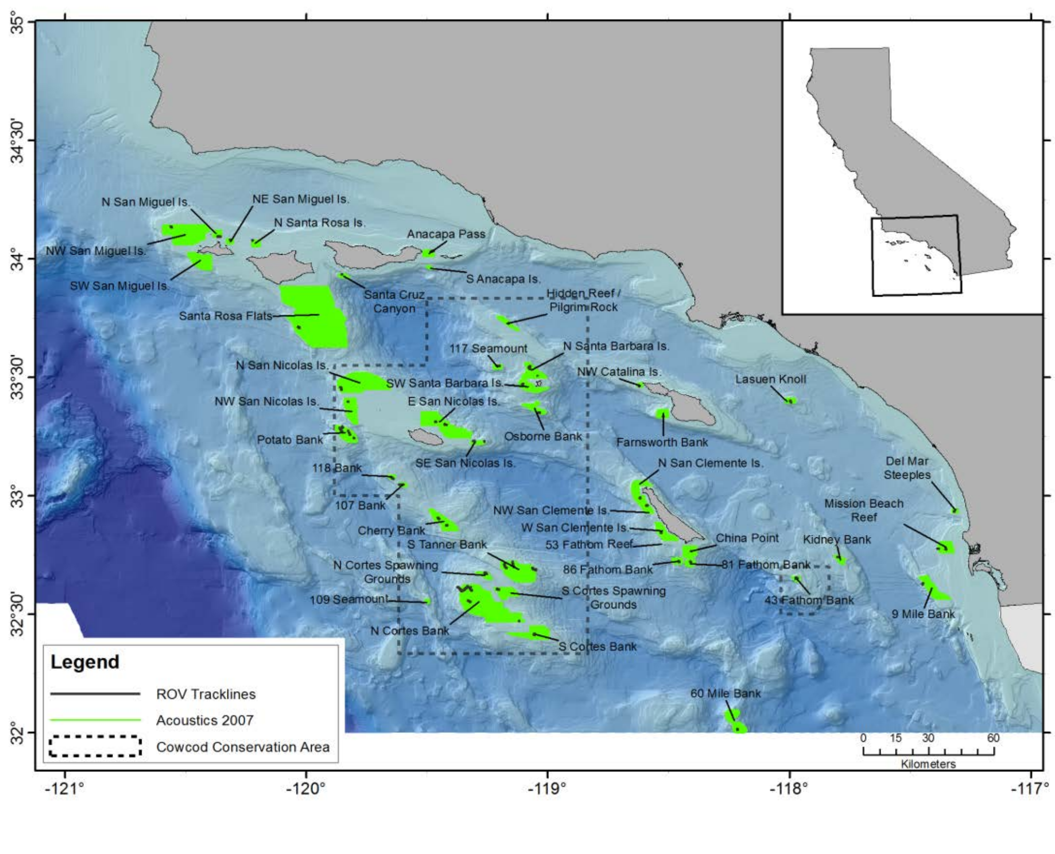


Table 5.1. Summary of visual surveys conducted within the acoustic survey areas using the SWFSC remotely operated vehicle (ROV) during the COAST 2007 surveys.

Site name	# of dives	Latitude	Longitude	Avg depth
107 Bank	1	33.050	-119.610	-219
117 Seamount	1	33.550	-119.210	-223
118 Bank	1	33.080	-119.640	-244
43 Fathom Bank	2	32.650	-117.970	-88
60 Mile Bank	1	32.020	-118.210	-130
81 Fathom Bank	1	32.720	-118.410	-231
86 Fathom Bank	1	32.720	-118.460	-175
9 Mile Bank	1	32.630	-117.450	-247
Anacapa Pass	1	34.030	-119.480	-65
Cherry Bank	2	32.890	-119.440	-115
China Point Reef	1	32.770	-118.410	-62
Del Mar Steeples Reef	2	32.940	-117.310	-79
E San Nicolas Island	2	33.310	-119.440	-68
Farnsworth Bank	1	33.340	-118.520	-87
Hidden Reef	1	33.730	-119.160	-105
Kidney Bank	1	32.740	-117.800	-258
Lasuen Knoll	1	33.400	-117.990	-128
Mission Beach Reef	2	32.780	-117.360	-132
N Cortes Bank	4	32.590	-119.320	-145
N Cortes Spawning Grounds	1	32.670	-119.260	-141
N San Miguel Island	1	34.100	-120.360	-53
N San Nicolas Island	1	33.450	-119.860	-124
N Santa Barbara Island	2	33.540	-119.070	-110
N Santa Rosa Island	1	34.080	-120.220	-69
NE San Miguel Island	1	34.080	-120.320	-73
NW Catalina Island	1	33.470	-118.620	-82
NW San Clemente Island	2	32.980	-118.600	-77
NW San Miguel Island	1	34.140	-120.560	-84
NW San Nicolas Island	1	33.400	-119.820	-108
Osborne Bank	1	33.350	-119.030	-74
Potato Bank	5	33.270	-119.840	-111
S Cortes Bank	1	32.420	-119.060	-79
S Cortes Spawning Grounds	1	32.610	-119.210	-150
S Tanner Bank	3	31.160	-120.450	-83
Santa Cruz Canyon	1	33.940	-119.850	-101
Santa Rosa Flats	1	33.710	-120.030	-118
SE San Nicolas Island	3	33.230	-119.290	-81
SW Santa Barbara Island	1	33.470	-119.110	-103
W San Clemente Island	1	32.850	-118.530	-104
All sites	57			

5.3 Methods

Visual transect surveys were conducted in areas of high acoustic backscatter, as identified by earlier split-beam acoustic surveys (e.g., see **Fig. 1.2**, above**)**, using an ROV (Deep Ocean Engineering, Inc. Phantom DS4) fitted with a forward-looking color-video camera (Sony FCB-IX47C) with 470 lines of horizontal resolution and an 18x optical zoom. For improved species identification, the ROV was also fitted with a high-resolution-still camera (Insite Pacific, Inc. Scorpio with Nikon Coolpix 995) with 4x zoom. The location of the ROV relative to the ship was estimated using an acoustic transponder. The position of the ROV above the seabed and speed-over-ground was estimated in real-time using an ultra-short baseline (USBL) acoustic tracking system (ORE Offshore TrackPoint II-Plus) and tracking software (Fugro Pelagos, Inc. WinFrog). All other navigational data (e.g., seawater depth and temperature; ROV heading and speed; and camera pitch, roll, and altitude) were synchronously logged at one-to-two second intervals using WinFrog. The ROV's speed-over-ground was used to calculate the length of each transect. This method was calibrated over a submerged structure of known distance (~1500 m) and was deemed accurate to 1–3% (data not shown).

The ROV sampling effort was allocated according to acoustically-sampled fish density and seabed depth. Because the surveys targeted areas with rocky seabed and reefs, extreme caution was used when operating the ROV. The ship and ROV operated together to run the transects from deep to shallow. A remote monitor on the bridge displayed the ship and ROV positions to facilitate coordination.

Due to intermittent inclement weather, the ROV was deployed only in areas where it was deemed safe to operate. Acceptable sea-conditions were: swell height <3m, wind <12 kts, and surface current <2 kts. During all ROV deployments, the ship maintained a constant course and steady speed of < 0.5 kts.

To optimize daylight operations and optimal weather conditions, the ROV was deployed between sunrise and sunset. The ROV was tracked using a directional hydrophone mounted on the starboard side of the ship. The hydrophone was deployed prior to each launching of the ROV. The ship was not operated at speeds >3 kts while the pole-mounted hydrophone was deployed. The ROV operations were conducted on the port side. First, the multi-beam pole was retracted and secured on the port-side; secondly, the pole-mounted ROV tracking transducer was deployed on the starboard side. During all launch and recovery, the Deck Officer maintained the wind on the port-side and the swell to the stern. The Deck Officer disengage the screws when the ROV was <30 m from the ship. The ROV was lifted by the articulated crane, lowered over the vessel side and driven directly away from the ship under its own propulsion as the tether was paid. After 30-40 m of tether was deployed, the ROV propulsion was idled and the tether was attached with a swivel to the clump weight, which was connected to the cable on the port CTD winch.

The ROV and clump weight were lowered in unison (via frequent communication between the ROV operator and winch operator in regards to vehicle depth) until the ROV and clump weight were ~10 m above the seabed. Once the ROV and clump weight were 10 m from the seabed, the cable to the clump weight was secured, monitored, and adjusted to maintain a clump-weight-elevation of >10 m (to avoid hitting the seabed), while the ROV more closely approached the seabed.

The ROV was recovered following the reverse of the launch procedure. The clump weight was raised at a rate that was less than or equal to the rate of the ROV ascent. At the conclusion of the ROV operations each day, the ROV tracking transducer was retracted and secured, and the multi-beam transducer was deployed.

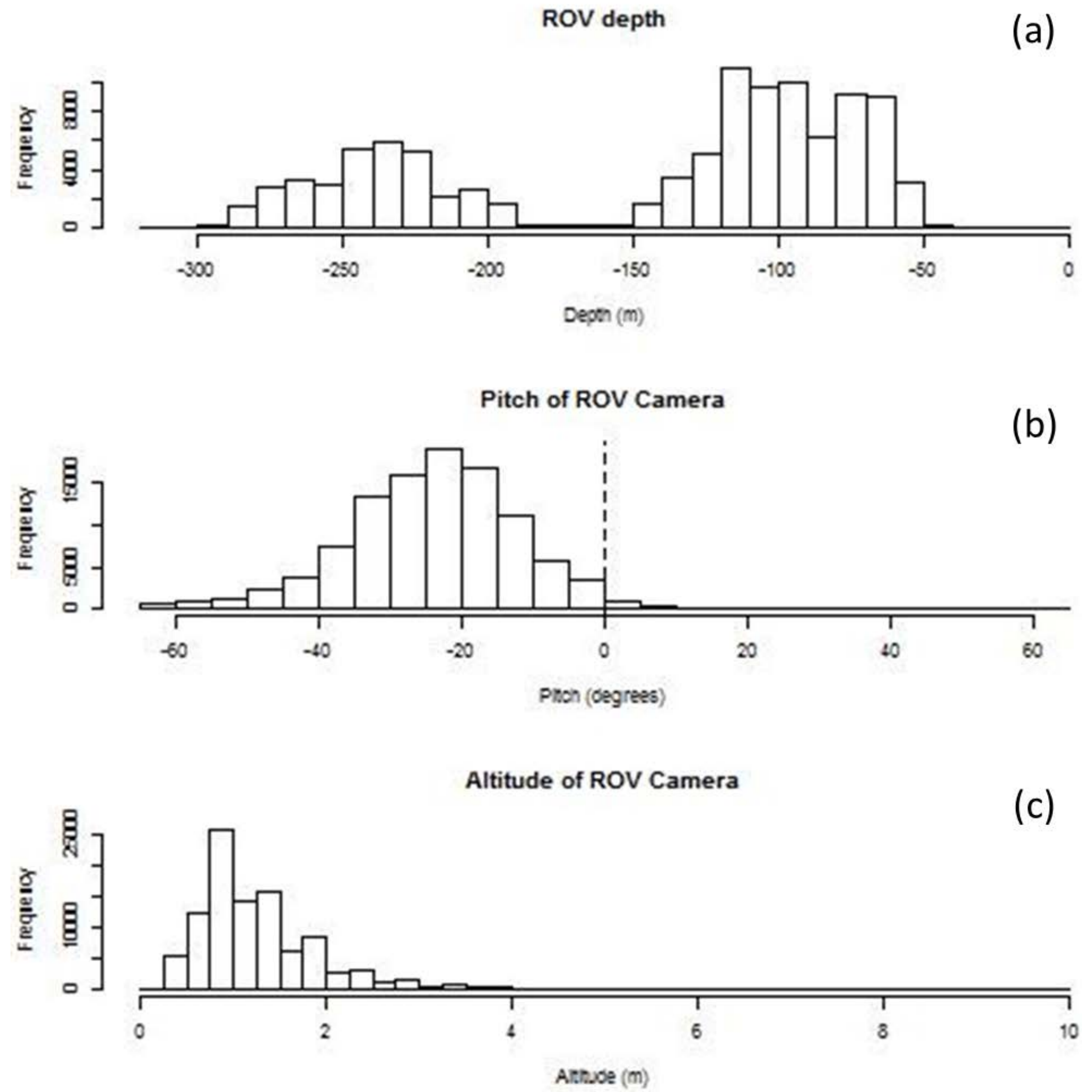
All adult rockfishes and thornyheads were identified to the lowest possible taxonomic level and counted (**Table 5.1**). Unidentifiable rockfishes (231 rosy-group rockfish, subgenus *Sebastomus*; and 21,201 other unidentified rockfishes, genus *Sebastes*), were also counted. Best efforts were made to distinguish between the newly described sunset rockfish (*S. crocotulus*, Hyde et al. 2008) and vermilion rockfish (*S. miniatus*) based on color differences and depth of occurrence. Although this survey focused on rockfishes and thornyheads, all other observed fishes were also identified and quantified to the lowest level possible taxonomic level (data not shown). Fish lengths were estimated using two pairs of parallel reference lasers (20 and 61cm spacing) mounted on the camera platform, and later grouped into four broad size classes: < 10 cm, 10 – 25 cm, 25 – 60 cm, and >60 cm total length (*TL*).

The survey sites were post-stratified into areas of similar species mixtures. The length measurements for bocaccio, cowcod, vermilion and bank rockfish were combined throughout the SCB. Ultimately, density means and variances were estimated within strata, by species.

5.4 Preliminary Results

A total of 57 ROV transect surveys from 30-350 m depths (**Fig. 5.2a**) covering a distance of ~117 km. Approximately 98 hrs of video and 4,900 high-resolution still images were collected. The ROV surveyed from 0-10 m above the seabed, but most commonly flew within 2 m of the seabed (**Fig. 5.2b**). The camera was typically oriented at ~30° below horizontal, but was rotated higher and lower to aid in the identification of species when necessary (**Fig. 5.2c**). Occasionally the ROV was flown up into the water column (as high as 10 m above the seabed) to survey at greater altitudes when schools of fishes were observed overhead or when data from the acoustic surveys indicated acoustic targets high above the seabed. Assuming an altitude of ~1 m, camera pitch of ~25° below horizontal, and the known vertical camera viewing angle (46°), the ROV typically surveyed fishes within 0.9 m of the seabed and out to ~4 m in front of the ROV.

Figure 5.2. Distributions of a) ROV depth, b) camera pitch, and c) camera altitude during the COAST 2007 survey.



A total of 241,640 individual fishes representing 42 rockfish and thornyhead species were identified and quantified (**Table 5.2**). Four species (*S. ensifer*, *S. hopkinsi*, *S. semicinctus*, and *S. wilsoni*) comprised ~83% of the fish community. These most abundant species were small, schooling or aggregating species. Unlike the COAST 2004 survey, *S. jordani* comprised a very small percentage of the overall fish community. Approximately 12% of the fish community comprised unidentified rockfishes (*Sebastes* sp.), which were likely among the four most abundant species that were identifiable to the species level. The greatest relative abundance (~95%) of rockfishes occurred shallower than 150 m, while the greatest species richness (total number of species) occurred between 50-150 m (**Table 5.2**). The distribution of individuals by size class was as follows: <10 cm (10%), 10-25 cm (78%), 25-60 cm (12%), and >60 cm (<1%).

Table 5.2. Relative abundances (number of individuals km^{-1}) by depth of rockfish and thornyhead species during the COAST 2007 surveys. Species are sorted from shallow to deep using the depth stratum where each species was most abundant. The color scale indicates the depth strata where each species is least (green) to most (red) abundant. The red bars and associated percentages in the rightmost column indicate the relative abundance of that species compared to all other species.

Scientific name	Common name	Depth (m)								
		0:49	50: 99	100: 149	150: 199	200: 249	250: 299	300: 349	Total	% total
Sebastes hopkinsi	Squarespot rockfish	2825.89	2151.18	622.31					131,102	54.3%
Sebastes sp.	Rockfish-unidentified	1725.98	340.13	176.35	31.43	11.58	10.07	15.69	28,092	11.6%
Sebastes mystinus	Blue rockfish	111.78	15.99						1,000	0.1%
Sebastes serranoides	Olive rockfish	3.82	2.60	0.13					131	0.1%
Sebastes serriceps	Treefish	0.76	0.07						5	0.1%
Sebastes paucispinis	Bocaccio	17.17	17.82	6.39	7.12	2.94		7.85	1,218	0.1%
Sebastes ovalis	Speckled rockfish		23.11	9.41	3.93				1,486	0.1%
Sebastes rosaceus	Rosy rockfish	14.50	19.45	0.57	0.12				925	0.1%
Sebastomus sp.	Rosy-group rockfish	0.76	8.59	2.94	0.25	1.25	2.24		543	0.1%
Sebastes miniatus	Vermilion rockfish	3.43	6.87	1.87	1.23	0.09			410	0.1%
Sebastes caurinus	Copper rockfish	0.76	3.30	0.04					150	0.1%
Sebastes rubrivinctus	Flag rockfish		2.24	1.74	0.61				184	0.1%
Sebastes umbrosus	Honeycomb rockfish		1.92						85	0.1%
Sebastes flavidus	Yellowtail rockfish		0.50	0.07					25	0.1%
Sebastes lentiginosus	Freckled rockfish		0.47						21	0.1%
Sebastes ruberrimus	Yelloweye rockfish		0.43	0.07					22	0.1%
Sebastes dalli	Calico rockfish		0.05						2	0.1%
Sebastes chrysomelas	Black-and-yellow rockfish		0.02						1	0.1%
Sebastes ensifer	Swordspine rockfish		16.30	694.25	301.13	99.16	28.20		36,269	15.0%
Sebastes wilsoni	Pygmy rockfish		25.10	339.93	7.86				16,772	6.9%
Sebastes semicinctus	Halfbanded rockfish		99.55	251.67	100.78	3.03			16,806	7.0%
Sebastes moseri	Whitespeckeled rockfish		0.47	37.05	4.05	2.32			1,780	0.1%
Sebastes chlorostictus	Greenspotted rockfish		3.12	13.58	8.10	0.09			828	0.1%
Sebastes constellatus	Starry rockfish	1.53	4.25	5.58	0.49				452	0.1%
Sebastes crocotulus	Sunset rockfish		0.16	2.16					106	0.1%
Sebastes entomelas	Widow rockfish		0.36	1.22					72	0.1%
Sebastes rufinanus	Dwarf-red rockfish		2.19	1.24	7.98	5.17	1.34		283	0.1%
Sebastes gilli	Bronzespotted rockfish			0.02	1.23	0.45			16	0.1%
Sebastes rufus	Bank rockfish		0.02	4.23	12.89	42.85	10.74		829	0.1%
Sebastes eos	Pink rockfish			0.04		2.49	1.57		37	0.1%
Sebastes saxicola	Stripetail rockfish				1.60	2.32	1.57		46	0.1%
Sebastes goodei	Chilipepper rockfish		0.05	0.02		1.16	0.90		20	0.1%
Sebastes levis	Cowcod		0.63	1.09	1.10	1.16			100	0.1%
Sebastes zacentrus	Sharpchin rockfish					0.09			1	0.1%
Sebastolobus alascanus	Shortspine thornyhead					0.09			1	0.1%
Sebastes jordani	Shortbelly rockfish		0.23	15.19	4.54	6.68	91.32	7.85	1,228	0.1%
Sebastes elongatus	Greenstripe rockfish		0.88	4.29	8.72	9.09	11.41		460	0.1%
Sebastes simulator	Pinkrose rockfish					3.39	7.39		71	0.1%
Sebastes melanostomus	Blackgill rockfish					0.09	1.79		9	0.1%
Sebastes helvomaculatus	Rosethorn rockfish					0.71	1.34		14	0.1%
Sebastes rosenblatti	Greenblotched rockfish		0.07	0.11	0.49	0.45	1.34		23	0.1%
Sebastes macdonaldi	Mexican rockfish						0.90		4	0.1%
Sebastes phillipsi	Chameleon rockfish						0.22		1	0.1%
Sebastes diploproa	Splitnose rockfish					0.36	1.34	15.69	12	0.1%
All species		4706.39	2748.12	2193.56	505.64	196.98	173.68	47.08		
Number of species		11	33	29	21	24	17	4		

Many of the rockfish and thornyhead species occurred over a wide range of seabed types (**Table 5.3**), from mud to high-relief reef. However, most species (~95% of individuals) were most commonly observed over hard seabeds with low- to high-relief (cobble or larger). The greatest species richness (total number of species) occurred in these same habitats, except for a great number of species that also occurred over sandy seabeds. Since the survey targeted rockfishes, the pattern in species richness is partly due to the greater search effort over hard, rocky seabed types where abundance is also generally greater.

Table 5.3. Relative abundances (% of total observations) by seabed type of rockfish species during the COAST 2007 surveys. Species are sorted by seabed type, from low- (mud) to high-relief (high-relief reef) seabeds, where each species was most abundant. The color scale indicates the seabed type where each species is least (green) to most (red) abundant. The red bars and associated percentages in the rightmost column indicate the relative abundance of that species compared to all other species.

Scientific name	Common namne	Mud	Sand	Pebble/Gravel	Cobble	Low-relief rock	Boulder	High-relief reef	Vertical-rock	% total
Sebastes diploproa	Splitnose rockfish		100							<1%
Sebastes elongatus	Greenstripe rockfish	1	41		22	5	12	19		<1%
Sebastes saxicola	Stripetail rockfish		94			6				<1%
Sebastes semicinctus	Halfbanded rockfish	1	67	1	8	10	14	1		4.4%
Sebastes serranoides	Olive rockfish	1	29		6	14	27	23		<1%
Sebastes melanostomus	Blackgill rockfish		50				50			<1%
Sebastes ensifer	Swordspine rockfish	1	10	1	56	20	14	1		12.7%
Sebastes eos	Pink rockfish		33		67					<1%
Sebastes phillipsi	Chameleon rockfish				100					<1%
Sebastes simulator	Pinkrose rockfish		37		26	5	32			<1%
Sebastes wilsoni	Pygmy rockfish	1	28		50	12	4	6		3.8%
Sebastes caurinus	Copper rockfish		35			47	17	1		<1%
Sebastes chrysomelas	Black-and-yellow rockfish					100				<1%
Sebastes dalli	Calico rockfish					100				<1%
Sebastes jordani	Shortbelly rockfish		1		6	83	8	2		<1%
Sebastes lentiginosus	Freckled rockfish				50		50			<1%
Sebastes macdonaldi	Mexican rockfish					100				<1%
Sebastes miniatus	Vermilion rockfish	1	13		3	44	33	7		<1%
Sebastes rosenblatti	Greenblotched rockfish		13		25	50	13			<1%
Sebastes rubrivinctus	Flag rockfish		9		14	35	35	8		<1%
Sebastes brevispinis	Silvergray rockfish						100			<1%
Sebastes chlorostictus	Greenspotted rockfish	1	30		28	5	33	3		<1%
Sebastes constellatus	Starry rockfish		9		19	11	43	17		<1%
Sebastes crocotulus	Sunset rockfish		21		9	5	65			<1%
Sebastes entomelas	Widow rockfish				3		67	31		<1%
Sebastes gilli	Bronzespotted rockfish						100			<1%
Sebastes goodei	Chilipepper rockfish		14		7		71	7		<1%
Sebastes hopkinsi	Squarespot rockfish	1	8	1	4	11	47	29		62.0%
Sebastes levis	Cowcod	2	3		21	10	52	10	2	<1%
Sebastes moseri	Whitespeckeled rockfish				18	3	41	39		<1%
Sebastes ovalis	Speckled rockfish		9		9	12	46	24		<1%
Sebastes paucispinis	Bocaccio		9		6	7	49	29		<1%
Sebastes rosaceus	Rosy rockfish	1	9		2	31	35	23		<1%
Sebastes rufinanus	Dwarf-red rockfish		6	1			61	32		<1%
Sebastes rufus	Bank rockfish		2		8	15	66	10		<1%
Sebastes serriceps	Treefish		20			40		40		<1%
Sebastes sp.	Rockfish-unidentified		17	1	4	14	40	24		12.9%
Sebastes umbrosus	Honeycomb rockfish		14			29	43	14		<1%
Sebastes ruberrimus	Yelloweye rockfish						50	50		<1%
Sebastes flavidus	Yellowtail rockfish		18			14	9	59		<1%
Sebastes helvomaculatus	Rosethorn rockfish							100		<1%
Sebastes mystinus	Blue rockfish		1		1	10	25	63		<1%
Sebastomus sp.	Rosy-group rockfish		21		3	16	24	35	1	<1%
Number of species (richness)		10	32	5	28	31	34	29	2	

Over 98% of the rockfishes identified during this survey were freely swimming above the seabed (**Table 5.4**). Small, schooling or aggregating species, which were also most numerous, were typically found >0.5 m above the seabed. It is important to note, however, that these most numerous species are also the ones that are most likely to alter their behavior in the presence of the ROV. The most typical behavior in the presence of the ROV (or other visual survey platforms) is for schools of rockfishes to swim toward, not away from, the seabed (pers. obs.). This behavior is corroborated by acoustic data that were collected during the deployment and operation of the ROV (D. A. Demer, unpublished). Therefore, the vertical distribution of these rockfishes in the absence of the ROV is likely higher than the data in **Table 5.4** might suggest. Species that were most commonly observed embedded in or resting on the seabed were typically solitary, benthic species that were rarely encountered.

Table 5.4. Relative abundances (% of total observations) by height above the seabed of rockfish species during the COAST 2007 surveys. Species are sorted by the height category where each species was most abundant. The color scale indicates the height above the seabed where each species is least (green) to most (red) abundant. The red bars and associated percentages in the rightmost column indicate the relative abundance of that species compared to all other species.

Scientific name	Common name	Embedded	On the seabed	0.1-0.5m	0.5-1m	1-2m	2-10m	>10m	% total
Sebastes helvomaculatus	Rosethorn rockfish	100							0.1%
Sebastes gilli	Bronzespotted rockfish	50	50						0.1%
Sebastes melanostomus	Blackgill rockfish	50	50						0.1%
Sebastes dalli	Calico rockfish		100						0.1%
Sebastes diploproa	Splitnose rockfish		100						0.1%
Sebastes macdonaldi	Mexican rockfish		100						0.1%
Sebastes phillipsi	Chameleon rockfish		100						0.1%
Sebastes saxicola	Stripetail rockfish	6	81	13					0.1%
Sebastes rosenblatti	Greenblotched rockfish		63	25	13				0.1%
Sebastes chrysomelas	Black-and-yellow rockfish			100					0.1%
Sebastes ruberrimus	Yelloweye rockfish			100					0.1%
Sebastes caurinus	Copper rockfish	1	3	93	4				0.1%
Sebastes ensifer	Swordspine rockfish	0	3	92	5	0			12.8%
Sebastes semicinctus	Halfbanded rockfish		4	89	7	0	0		4.5%
Sebastes moseri	Whitespeckeled rockfish	8	2	85	4			0	0.1%
Sebastomus sp.	Rosy-group rockfish	2	8	85	5	0	0		0.1%
Sebastes jordani	Shortbelly rockfish	0	14	84	1	0			0.1%
Sebastes rubrivinctus	Flag rockfish	1	14	83	1	1			0.1%
Sebastes chlorostictus	Greenspotted rockfish	1	8	83	7	1	1		0.1%
Sebastes rosaceus	Rosy rockfish	0	10	80	9	1			0.1%
Sebastes serriceps	Treefish		20	80					0.1%
Sebastes wilsoni	Pygmy rockfish		7	79	14	0			3.8%
Sebastes miniatus	Vermilion rockfish	3	2	77	15	2	0		0.1%
Sebastes entomelas	Widow rockfish	4		75	21				0.1%
Sebastes crocotulus	Sunset rockfish			72	28				0.1%
Sebastes serranoides	Olive rockfish	2	2	69	22	4	2		0.1%
Sebastes eos	Pink rockfish		33	67					0.1%
Sebastes levis	Cowcod	3	14	66	16			2	0.1%
Sebastes constellatus	Starry rockfish	6	33	58	2	1	0		0.1%
Sebastes umbrosus	Honeycomb rockfish		29	57	14				0.1%
Sebastes sp.	Rockfish-unidentified	0	3	53	30	6	4	3	13.0%
Sebastes paucispinis	Bocaccio	1	2	53	28	14	3		0.1%
Sebastes simulator	Pinkrose rockfish	26	26	47					0.1%
Sebastes elongatus	Greenstripe rockfish		36	45	19				0.1%
Sebastes rufus	Bank rockfish	17	12	44	24		3		0.1%
Sebastes ovalis	Speckled rockfish	0	2	39	20	24	15		0.1%
Sebastes flavidus	Yellowtail rockfish			55	41		5		0.1%
Sebastes lentiginosus	Freckled rockfish			50	50				0.1%
Sebastes hopkinsi	Squarespot rockfish	0	0	29	27	12	24	8	61.9%
Sebastes rufinanus	Dwarf-red rockfish			42	58				0.1%
Sebastes goodei	Chilipepper rockfish			36	50	14			0.1%
Sebastes mystinus	Blue rockfish	2		21	46	30	1		0.1%

5.5 Tentative Conclusions

The preliminary results from the ROV surveys provided information on the species composition, depth distribution, and seabed associations of rockfishes and thornyheads in the acoustic survey areas. The images collected with cameras on the ROV also provided information about the proportions of various rockfish species present in each survey area, and their length distributions throughout the SCB. These estimates of species proportions and lengths are used to convert the acoustic backscatter from rockfishes to estimates of their abundances, by species. The geolocated observations of seabed type are being used to ground-truth model results that predict seabed type from multiple-frequency echo amplitude and interferometric-phase information.

5.6 Problems and Suggestions

The use of high-definition (HD) video could greatly improve the ability of analysts to identify more fishes without the aid of still images, thereby improving the time efficiency of video analysis, and would likely allow for the identification of many species that were only able to be identified as *Sebastes* or *Sebastomus* sp. Methods that allowed for better and more length estimates of fishes (e.g., stereo images or video) are being developed, which could reduce any error associated with the calculation of species-specific biomass using the visual and acoustic data.

5.7 Disposition of Data

Video and still camera images, and ROV metadata are archived by John Butler (john.butler@noaa.gov), NOAA Fisheries, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037, USA.

5.8 Acknowledgements

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5.9 References

Hyde, J.R., Kimbrell, C.A., Budrick, J.E., Lynn, E.A., Vetter, R.D., 2008. Cryptic speciation in the vermilion rockfish (*Sebastes miniatus*) and the role of bathymetry in the speciation process. Molecular Ecology 17, 1122-1136.

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