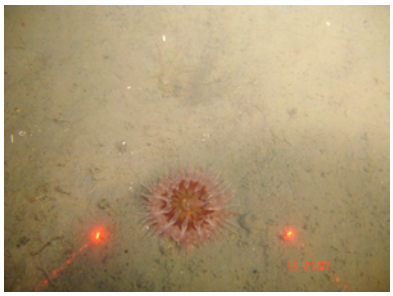

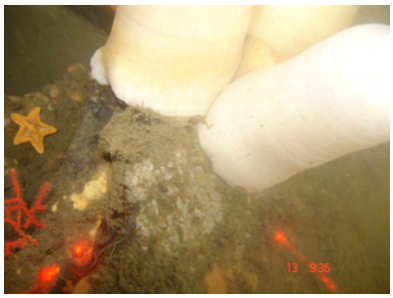

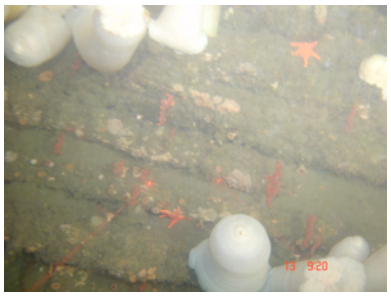

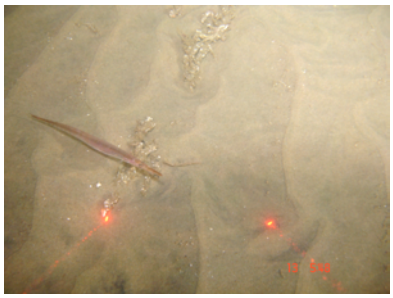

Survey Report:

Remotely Operated Vehicle (ROV) Biological Characterization Survey of the Asia America Gateway (AAG) S-5 Project Fiber Optic Cable Route Offshore Morro Bay, California

January 2008

Prepared for:

AT&T Corporation
3D151F, 1 AT&T Way
Bedminster, NJ 07921

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APPLIED marine SCIENCES

4749 Bennett Drive, Suite L
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1.0 Executive Summary

On October 11-13, 2007, scientists from Applied Marine Sciences, Inc. (AMS) conducted a remotely operated vehicle (ROV) survey of 14 kilometers (7.6 nautical miles) of the Asia America Gateway (AAG) S-5 cable route located between the offshore terminus of the Montana de Oro state park borepipe and approximately 150-meters water depth offshore of Morro Bay, California (Figure 1). Both color digital video and still images were collected of hard-bottom and soft-bottom habitat, as well as associated biota.

Multiple marine habitats were observed and assessed along the route including both low- (<1m) and high-relief (>1m) hard-bottom areas, mixed sand and cobble, coarse sand formed into large sand waves and troughs, heavily bioturbated silt and fine sand, and fine sand and silt soft-substrate areas. Of the 14km of cable route surveyed, the majority of the proposed route consisted of soft-sediment habitat (84.8%). The remainder of the route consisted of mixed sand and exposed cobble (9.1%), low-relief hard bottom (4.1%), and high-relief hard bottom (2.1%) habitat. The majority of high-relief hard-bottom habitat was encountered in Survey Segment C and most of the low-relief hard-bottom habitat was encountered in Survey Segment D. One small high-relief feature occurred in Survey Segment E, within the 100-m cable right-of-way but ended 25m from the centerline. The mapping of the seafloor habitats observed during the biological reconnaissance survey closely matched and corroborated the geophysical seafloor mapping previously performed along the cable route (Figure 3).

The epibenthic invertebrate, algae, and fish species observed along the proposed cable route are representative of hard-substrate and soft-substrate areas of central California and offshore Morro Bay. The epifauna observed in the soft substrate segments of the nearshore cable route right-of-way consisted of sea pens, including *Stylatula elongata*, *Acanthoptilum* sp., *Virgularia californica, Virgularia agassizii, Scytallum* sp., *Scytallopsis* sp., and *Ptilosarcus gurneyi,* brittle stars including *Amphiophodia urtica*, *Amphiopholis* sp., *Amphiodia* sp., *Ophionereis* sp., and *Ophiura* sp., the cerianthid anemone *Pachycerianthus* sp., the anemones *Urticina piscivorus, Urticina sp*., and *Stomphia coccinea*, tube worms, cancer crabs including the slender crab (*Cancer gracilis*), hermit crabs, (*Paguristhes sp*.), shrimp, (*Pandalus sp*.), occasional marine snails (Gastropoda), the California sea slug (*Pleurobranchaea californica*), octopus (*Octopus rubescens*), and several species of sea stars including *Pisaster brevispinus*, *Petalaster (Luidia) foliolata, Rathbunaster californica, Asterina miniata, Solaster dawsonii, and Astropecten sp., the* ornate tube worm (*Diopatra ornata),* sand dollars (*Dendraster ecentricus*), the sea cucumber *Parastichopus sp*., occasional orange gorgonians (*Adelogorgia phyllostera*) attached to shallow buried rocks, and a free living polychaete fire worm (Amphinomidae). Squid (*Loligo* sp.) were also frequently observed in the water column.

Fish species observed in soft-bottom areas included assorted flatfish, such as sanddabs (*Citharichtys sp*.), California halibut (*Paralichthys californicus),* Dover sole (*Microstomus pacificus*) and English sole *(Pleuronectes vetulas),* tonguefish (*Symphurus atricauda),* pink surfperch (*Zalembius rosaceus*), tubesnout (*Aulorhynchus flavidus*), hagfish (*Etatretus stouti*), longspine combfish (*Zaniolepis latipinnus*), anchovies (*E. Mordax*), swell shark (*Cephaloscyllium ventriosum*), banded guitarfish (*Zapteryx exasperata), Pacific electric ray (Torpedo californica*), big eye skate (*Raja binoculata),* longnose skate *(Raja binoculata,* Pacific angel shark (*Squatina californica)*, olive rockfish (*Sebastes serrinoides), j*uvenile and adult rockfish (Sebastes sp.), eelpouts (*Lycodes* sp.), lingcod (*Ophiodon elongatus*), cuskeels (*Chilara* sp), poachers (Algonidae), and sculpins (Cotidae)*).*

In water depths less than 30.5m (100ft), ornate tubeworms (*D. ornata),* cancer crabs, and the sea pens *S. elongata and P. gurneyii* were the most frequently observed soft-bottom epifuanal invertebrates. In water

depths greater than 30.5m (100ft) and less than 104m (340ft), sea pens, brittle stars, assorted sea stars including *P. foliolata, R. californica, Astropecten* sp., and *P. brevispinus,* the cerianthid anemone *Pachycerianthus* sp., the anemones *U. piscivorus, Urticina* sp., and *S. coccinea*, cancer crabs including the slender crab (*Cancer gracilis), and* octopus (*O. rubescens)* were the most abundant megafauna observed. Both the sea pen *P. gurneyi* and the seastar *P. brevispinus* were observed only at water depths of 48.8m (160ft) or less. In water depths greater than 104m (340ft) to the end of the ROV survey at 153m (500ft), the free-living fire worm (Amphinomidae) was the most abundant and dominant epifaunal organism, followed by sea pens and brittle stars.

Although sea pens were observed in all soft-bottom areas and at all water depths, the species composition shifted from *Stylatula elongata* and *Ptilosarcus gurneyi* in the shallowest water depths to *Virgularia californica, Virgularia agassizii, Scytallum* sp., and *Acanthoptilum* sp., at the deeper depths. A similar depth shift in brittle star species was also observed with *Ophionereis* sp. more abundant in the shallower coarse sand sediment depths and *Amphiodia urtica* in the deeper, silty-sand sediments.

The most frequently observed fish taxa in soft-sediment habitat areas were cuskeels (*Chilara* sp), eelpouts (*Lycodes* sp.), assorted flatfishes, including sanddabs (*Citharichtys* sp.), Dover sole (*M. pacificus*) and English sole *(P. vetulas),* tonguefish (*S. atricauda),* as well as pink surfperch (*Z. rosaceus*), hagfish (*E. stouti*), anchovies (*E. Mordax*), and the olive rockfish (*Sebastes serrinoides*) and numerous unidentifiable juvenile and adult rockfishes (*Sebastes* spp.), poachers (Algonidae), and sculpins (Cotidae).

Organisms observed in hard-bottom habitats along the nearshore cable route consisted mostly of sessile taxa that are restricted to solid substrata. Analysis of photographs using point-contact methods suggested the greatest percent of hard substrata was covered by the anemones *Metridium farcimen (=giganteum)*, *Corynactis californica* and *Urticina lofotensis*, followed by bryozoans (e.g., *Cellaria* sp., orange encrusting, orange branching and pink encrusting forms), followed by sponges, such as *Tethya aurantia*, and unknown tan globular and yellow lumpy forms, followed by the seastars *Asterina miniata*, *Dermasterias imbricata*, *Mediaster aequalis*, *Orthasterias koehleri* and *Pisaster giganteus*, followed by the cup corals *Balanophyllia elegans* and *Paracyathus stearnsi*. Also observed in video records from hard-bottom habitat were encrusting coralline algae, the red alga *Rhodymenia* sp., a saucer-shaped sponge, a white foliose sponge, a white encrusting sponge, a white erect sponge, a yellow puff ball sponge, a yellow encrusting sponge, an orange encrusting sponge, an orange puff ball sponge, an orange foliose sponge, a red encrusting sponge, the anemones *Urticina columbiana*, *U. piscivora*, *Stomphia coccinea*, and unidentified cerianthids, the hydrocoral *Stylaster californicus (=Allopora californica)*, the gorgonians *Lophogorgia chiliensis* and *Adelogorgia phyllostera*, the crab *Cancer* sp., the sea stars *Mediaster aequalis*, *Orthasterias koehleri*, *Ceramaster patagonicus*, *Henricia* sp., and *Pisaster brevispinus*, crinoids (probably *Florometra serratissima*), the ascidian *Ascidia paratropa*, the cabezon, *Scorpaenichthys marmoratus*, the olive rockfish, *Sebastes serranoides*, the rosy rockfish, *Sebastes rosaceus*, the brown rockfish, *Sebastes auriculatus* and juvenile rockfishes.

Quantitative data from analysis of photos revealed several differences in organism abundances associated with the relief of hard-bottom habitat and different survey segments, which correlated roughly with water depth. The Shannon-Weaver diversity index and the coverage of the compound ascidian *Cystodytes* sp. were greatest in photos from high-relief habitat. Encrusting coralline algae were found only in the shallower, more inshore regions of the survey area and coverage of the anemone *M. giganteum* and overall living cover were significantly greater in the deeper, more offshore regions of the survey area than in the shallower, more inshore areas.

No invertebrate or fish species of special significance or concern were observed. The California hydrocoral *Stylaster californicus (=Allopora californica)*, a federally protected species in Southern California, was observed but occurred infrequently in the high-relief areas in Survey Segments C and D, at water depths less then 80.5m (264ft). Several marine mammals were also observed on the sea surface or diving in the water column during ROV operations included a California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina*), and California sea otter (*Enhydra lutris*).

Comparing survey observations and data from the current survey with those previously collected in the area (SAIC, 1999) indicate that no substantial changes in either marine habitat or associated biota appear to have occurred over the past eight years within the nearshore Morro Bay region.

2.0 Project Overview

AT&T is proposing to install a new trans-Pacific fiber-optic cable between the United States and Southeast Asia, with the US landfall at Montana De Oro State Park, in Los Osos, California. The new cable, called the Asia America Gateway (AAG) project, will be the first direct terabit (one billion bits) submarine cable network to link Malaysia to the US via Singapore, Thailand, Brunei, Vietnam, Hong Kong the Philippines, Guam, Hawaii and the West coast of the U.S.

In 2000 and 2001, MCI directionally drilled a series of bore holes from the Montana de Oro State Park sand spit parking lot that transited under the adjacent beach and intertidal and near-shore sub-tidal regions of the coast. Two of these borepipes were subsequently assigned by MCI to AT&T, with approval from the California State Lands Commission. These bore pipes exited the seafloor in approximately 70–feet of water. All of the horizontally directionally drilled (HDD) boreholes, except one, drilled in 2000 were used for the fiber-optic cables installed in 2001. Within the coastal region of the cable installation, the installed fiber-optic cables were laid along the seafloor within a pre-determined cable route/path that avoided sensitive hard and soft-bottom habitat to the maximum extent feasible.

The proposed Asia America Gateway fiber-optic cable will utilize the previously bored, but unused bore pipe, at Montana De Oro State Park, to transit the intertidal and near shore habitats. In addition, it will follow a similar subsea route through the coastal area offshore of Morro Bay, as used by previous cables, in order to maximize avoidance of sensitive hard and soft-bottom habitat areas. Figure 1 provides an illustration of the location of the proposed cable route and the portion covered by the biological survey.

As part of its CEQA environmental review process, the California State Lands Commission requested that a new marine habitat and biota survey of the seafloor along the nearshore portions of the proposed cable route be conducted. The primary objective of the survey was to obtain sufficient visual data (color video and still images) to describe the existing epibenthic community structure inhabiting both soft and hard-bottom habitat located in the vicinity of the surveyed section of the cable route. This Survey Report presents the results and conclusions resulting from a remotely operated vehicle (ROV) based photographic survey of approximately 7.6 nautical miles of the nearshore portion of the cable route.

3.0 Survey Methodologies

AMS conducted a biological survey of the nearshore portion of the fiber optic cable right-of-way located offshore Morro Bay, California on October 11-13, 2007 using a remotely operated vehicle (ROV). Messrs. Jay A. Johnson and Dane D. Hardin with AMS were the onboard observers during the survey. To facilitate field operations, subsequent laboratory analysis, and data presentation, the cable route was divided into five segments (labeled A through F), which roughly corresponded to anticipated differences

in habitat types and water depths that might result in different biological communities or differences in dominant taxa as a result of habitat conditions. Figure 2 illustrates the location of these five survey segments. The following sections detail the equipment and methodologies employed during the survey.

3.1 Field Survey Protocols

3.1.1 Surface Support Vessel & ROV

The surveyed nearshore segment of the fiber-optic cable route for the AAG-S5 cable is presented in Figure 1. The ROV survey was conducted from the 175-ft support vessel M/V Pacific Star. A Hydrosub-10 ROV, owned and operated by DIVECON, Inc. (Oxnard, CA) was used to conduct the survey and was equipped with:

- Color digital video camera,
- Digital still camera (7.3 megapixels) and strobe,
- Mesotech-1000 Color scanning sonar to assist in locating hard-substrate features,
- BW video for low light conditions, and
- Lasers for providing photographic scales and ensuring consistent sized photoquadrats.

Both the color video camera and digital still camera used for photodocumenting seafloor habitat and associated biota were mounted on a pan/tilt unit located on the front bumper of the ROV to allow the tilting of the still camera into a near vertical position for the collection of photoquadrats. To aid in quantifying the area within a photograph, as well as for providing a means of measurement on photos and video, to two lasers were mounted under the cameras on the pan/tilt unit. Initially, the pan/tilt unit was mounted such that the point of convergence of the two lasers placed the ROV a set distance from the substrate and allowed the photographing of a 0.25-meter squared viewing area (photoquadrat). This offset distance and corresponding photoquadrat area was used in previous ROV surveys of the area (SAIC, 1999) and was determined by SAIC personnel to achieve optimum clarity in the photographs, since greater offsets resulted in reduced data quality due to near bottom turbidity.

The digital video feed from the ROV was recorded onto DVD's using a JVC DVD recorder. Superimposed on each video were the ROV heading, water depth, survey date, and time stamp in hours, minutes, and seconds. Digital images were recorded onto a one-gigabyte flash memory card inside the camera with a 700+ image capacity at maximum resolution (7.1 megapixels). Each image included a date and time stamp.

Scientific field crews maintained a dive observations and information log that tracked time, navigation fixes, water depth, when photos were taken, habitat type, and any noteworthy observations. Dive transects were conducted at ROV speeds ranging between 0.3-0.5 knots. In hard-bottom areas and when taking still photos, the ROV was operated at much slower speeds.

3.1.2 Surface Vessel and ROV Navigation

Navigation and positioning of the surface support ship and ROV along the proposed fiber optic cable route was performed by personnel from Fugro West, employing Differential Global Positioning Satellite (DGPS) navigation. The configuration of Fugro's Positioning System for acoustic tracking of an ROV along a pre-determined cable route is based on a powerful menu-driven navigation software system that

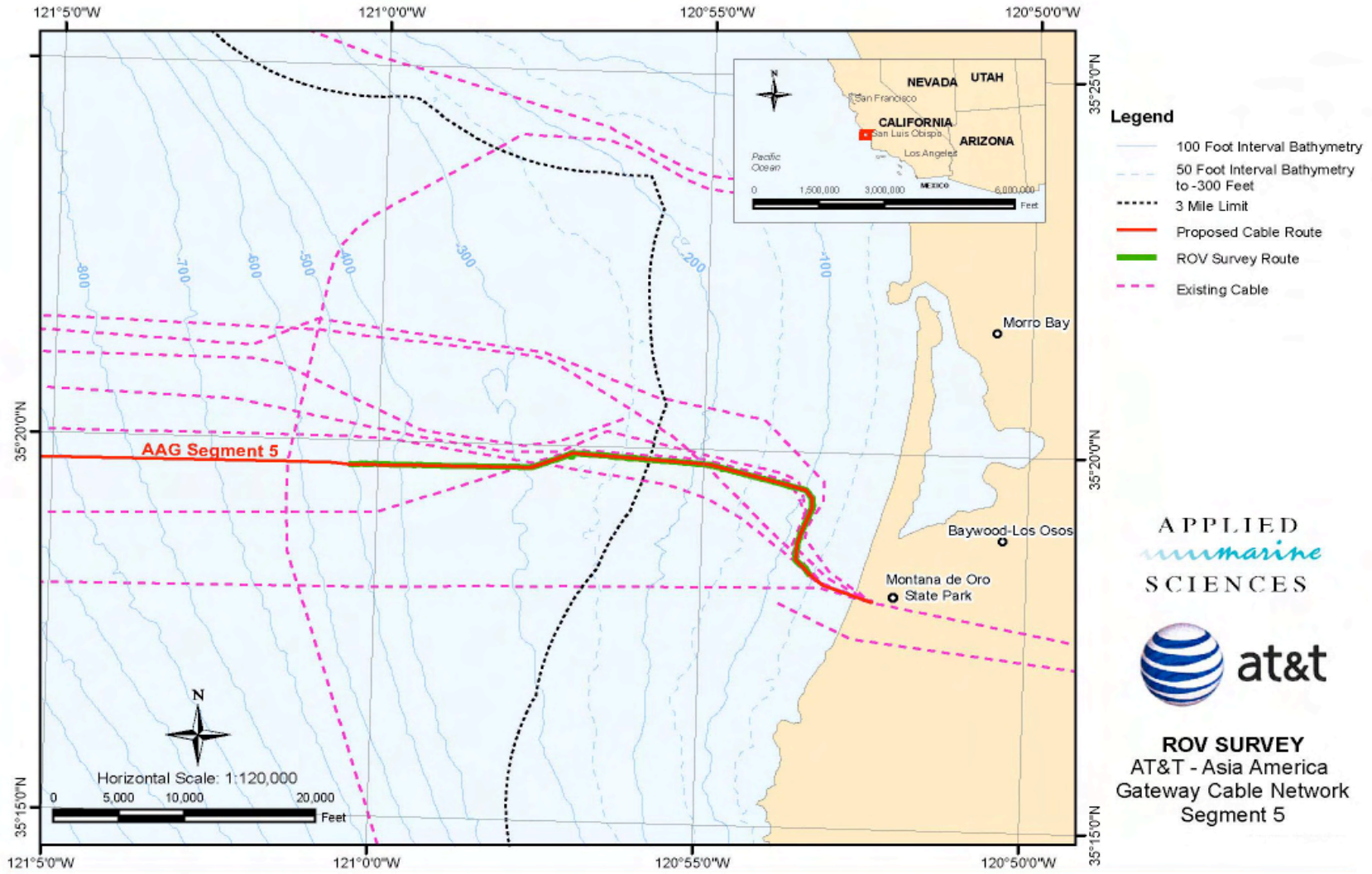

Figure 1: Location of ROV Biological Survey and Nearshore Route of the AT&T AAG S-5 Fiber Optic Cable.

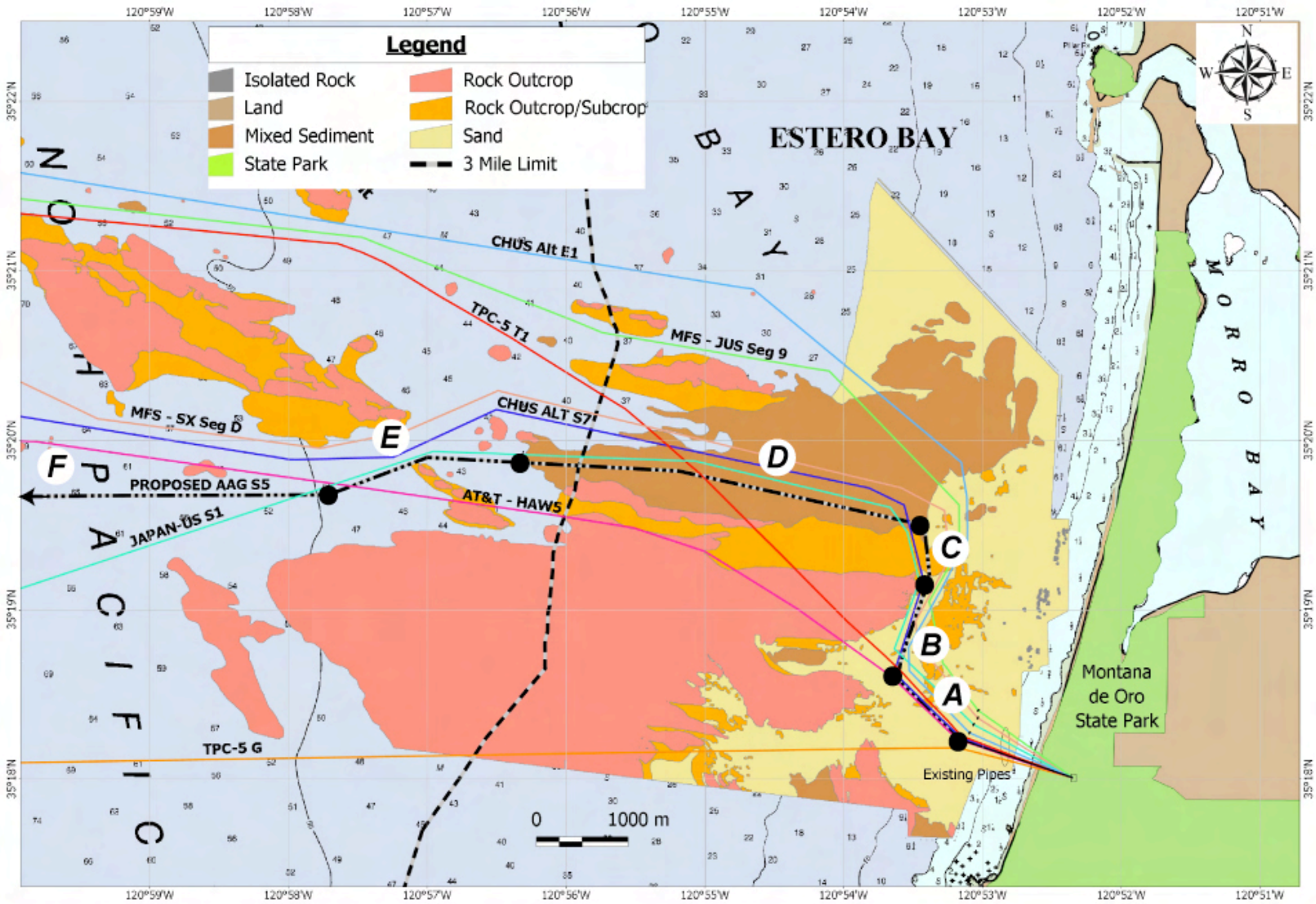

Figure 2: Biological Survey Segment Locations for the AAG S-5 Fiber Optic Cable Route.

allowed the integration of input data collected from a number of navigation sensors combined with pre-plotted data that allows for "real time tracking" of the support vessel and ROV as detailed below.

Vessel Positioning: Positioning of the vessel was accomplished through the utilization of a DGPS positioning system and integrated navigation software. Real-time corrections are transmitted via a dedicated communications satellite transponder to the vessel.

The corrections themselves are pseudo-range corrections and range-rate corrections for every satellite in view. The GPS base stations that collectively comprise the Fugro Wide Area Differential (WAD) network are located throughout the world. These base stations make real-time differential observations of the GPS satellite constellation in their view. The differential data were further enhanced by applying corrections for ionospheric and tropospheric distortions. The enhanced data were then uplinked to a dedicated communication satellite transponder where they were simultaneously transmitted to the vessel. This method of transmitting Wide Area Differential requires no local base station, has no radio range or line-of-sight considerations, and produces a position accuracy on the order $\pm$1 meter RMS, or better.

Additional input data including vessels heading information from the gyrocompass were logged at every fix mark. Computer logged position information was stored on disk and backed up by hard copy print out. Position fix marks were generated from the computer system at 100-meter intervals along the pre-plotted fiber-optic cable route, whenever a photo was taken, and whenever the surveying marine biologist requested a position fix be made, such as at the start of a hard-bottom habitat area along the route.

Vessel Heading: A survey grade digital Gyrocompass was used to provide vessel heading and allow for the accurate position of offsets for the acoustic tracking system hydrophone and bearings to the ROV.

Subsurface Bearing and Distance: Subsurface acoustic positioning of the ROV was accomplished using an Ocean Research Equipment (ORE) Trackpoint II Ultra Short Baseline system. The system determines relative range and bearing from the surface vessel to a mini transponder attached to the ROV and therein providing accurate subsurface positioning data. The system comprises a control and display unit (CDU), a hydrophone and an acoustic beacon mounted on the ROV.

Range and bearing information is output to the surface positioning system for further transformation to a real-time position. The Ultra short baseline system derives it name from three sensors located on the hydrophone w transmitting and receiving acoustic signals. The three sensors form an ultra short baseline between themselves that receive acoustic signals. The returning acoustic signal from the transponder arrives at each sensor at a different time. This time phase difference comparison is processed by the central processing unit to derive a direction and distance to the transmitting beacon on the ROV

System Software: The FUGRO positioning system utilizes a PC based navigation system that has the capability of interfacing DGPS positions of latitude and longitude and converting them to the appropriate coordinates as necessary. In addition to data acquisition of positioning data the software interfaces with external instruments such as echo sounders, Ultra Short Base Line acoustic systems, side scan sonar and geophysical equipment for annotation of records. One of the systems strengths is its ability to import Cad generated maps and digital charts and have them depicted on several graphics display monitors that can be stationed throughout the vessel.

The graphic monitor displays a scaled depiction of the vessel orientation to the survey lines and or subsurface targets, range and bearing from the vessel or ROV to the target. The surveyor can control the scaling of the graphics to assist the vessel helmsman in fine-tuning the vessel's position. The software is

configured to allow the operator to select operating coordinate system and zone, pre-plotted data file, output logging file, logging file interval, and vessel offsets from the GPS antenna to the Trackpoint hydrophone pole. Once these selections are input, the software interrogates data output from the differentially corrected GPS satellite positioning system, the vessel heading from a precision gyroscope, and the ROV bearing and distance (relative to the vessel) from the ORE Trackpoint II, to provide the visual and logging output displays.

3.2 Data Analysis

3.2.1 Video and Photographic Analysis

Laboratory evaluation of the video and photographic images were conducted in separate phases. Photographs were initially reviewed to compile a master species list of observed biota and to establish a photographic reference list for subsequent detailed digital still photograph and video analysis. Still photographs and video images were quantitatively analyzed using different protocols based on habitat type. All photographic and video images were analyzed using personal computers equipped with DVD video and still image viewing software.

Soft and mixed bottom habitat: Prior to the field survey, the proposed cable route was divided into five segments, designated A through E. These route segments were selected based on habitat type (soft, mixed and, hard bottom) and water depth. Figure 2 illustrates the location of these five segments along the proposed cable route. The laboratory analysis of soft-bottom habitat segments consisted of the first five 100-meter segments in each route segment (A-E) being quantitatively analyzed for the identification and enumeration of all observable biota to the lowest taxon practicable. If more than one 2.5-hour DVD disk of video was required to cover the segment, then the first five 100-meter segments of each disk were quantitatively analyzed. Remaining video coverage for that cable segment (A-E) on each DVD disk was then analyzed for the presence of organisms not previously observed and which could be characterized as present but not abundant. If within a cable segment the habitat changed, each different habitat type was analyzed separately with up to five 100-meter segments being semi-quantitatively analyzed and remaining video footage scanned for occasionally occurring organisms.

Digital still photographs of soft and mixed bottom habitat areas were individually characterized by water depth and substrate type and all observable biota on each photo identified to the lowest taxon practicable and enumerated. With the exception of the photos taken in water depths greater than 265 feet (Survey Segment F), all soft and mixed bottom photoquadrats were 0.25 m^2 in size. Digital images for Survey Segment F were taken with the camera positioned in an oblique, forward-looking angle. This resulted in an image significantly larger than 0.25 m^2 in size.

Hard-bottom habitat: Each of the approximately 140 digital photos of hard-bottom habitat were initially reviewed and assessed for suitability for further detailed analysis. Photos had to be clear and have a minimum of 75% of conspicuous individual organisms in the image identifiable in order to be suitable for further analysis. All suitable photos were imported into a Microsoft Windows based computer equipped with a software application called CPCe 3.4. This software, developed by the National Coral Reef Institute (NCRI), allows images to be analyzed using a random point contact (RPC) method of assessing percent cover of an individual organism. The application further allows data to be input into a Microsoft Excel spreadsheet for data storage and subsequent statistical analysis. Although initially developed for assessing organism coverage on coral reefs, AMS adapted the program for use with temperate water hard-bottom habitat and associated communities. A total of 30 random points were displayed over each photo by the program and every organism underlying one of the randomly projected

points was identified to the lowest practical taxon and recorded onto excel based data sheets. In addition, all large and conspicuous organisms were identified to the lowest practical taxa and enumerated.

The actual area coverage of each photo was calculated using the pre-set 6-inch distance between the two lasers mounted on the ROV (captured on each photo). Because the distance between the ROV cameras and the hard bottom fluctuates based on the proximity of the cameras from the substrate this will vary in each photo. Percent cover of all observed taxa was calculated.

3.2.2 Statistical Analysis

Several statistical procedures were used to explore the spatial patterns of hard-bottom organisms throughout the survey area. First, the mean and standard deviation of percent cover were calculated for taxa that were quantified in the point-contact analysis. These statistics were used to rank the abundances of all taxa within each survey segment, in order to better describe how organisms are distributed throughout the survey area. Next, the percent cover data for all taxa were tested for significant differences between locations (i.e., survey segments) and habitat relief by analysis of variance. To improve conformance of the data to the assumptions of parametric statistical tests, all percent cover data were transformed using the arcsine transformation (Sokal and Rohlf, 1995).

4.0 Survey Results & Discussion

The proposed route of the AAG S5 fiber optic cable through the nearshore coastal waters offshore Morro Bay, California encounters marine communities that vary both by habitat type, water depth, and ecological conditions. Both low and high-relief hard-bottom habitat as well as fine-mud, fine-sand, and coarse-sand soft-substrate habitat were encountered in water depths ranging between 21.3-85.3m (70-500ft) water depths. To facilitate field operations and subsequent laboratory analysis, the surveyed portion of the cable route was divided into five segments, corresponding to anticipated differences in habitat types and water depths, that could be expected to result in different biological communities or differences in dominant taxa, as a result of habitat conditions (Figure 2).

Post plots of observed habitats (Figure 3, Table 1) revealed that soft substrate was the predominant type of habitat observed. Of the 14km (7.6 nautical miles) surveyed, approximately 11.9km (84.8%) were soft bottom. Hard bottom covered approximately 880km, or 6.3% of the survey area. This hard bottom consisted mostly of low-relief habitat (4.1%), with the remainder being high-relief habitat (2.1%). Mixed bottom, consisting of cobbles or scattered rocks with sandy or muddy bottom, covered approximately 9.1% of the seafloor in the survey area. A large area of sand waves along Survey Segment D covered approximately 18% of the survey area.

The following sections present detailed information on the seafloor habitat and associated biota encountered within each of the five cable segments. Figure 2 illustrates the location of each segment along the surveyed cable route. Tables 2 and 3 provide species lists of all plant, invertebrate and fish species observed during the entire survey.

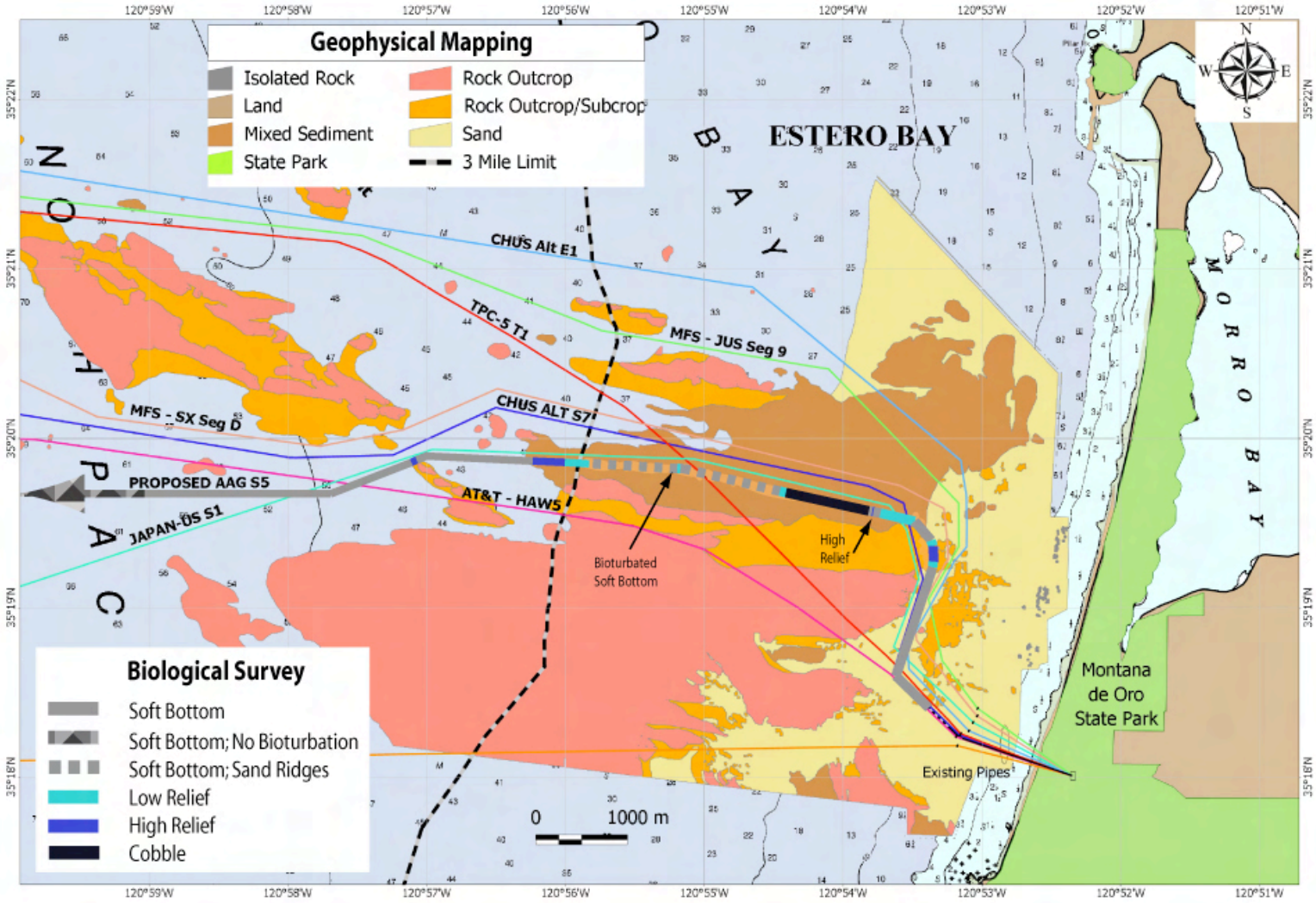

Figure 3: Delineation of seafloor habitat along nearshore segment of proposed AAG S-5 fiber optic cable route.

Table 1: Amount of seafloor in the survey area covered by each habitat type.

Habitat Type	Kilometers Covered	Percent of Survey Area
Soft Substrate	11.9	84.8
Coarse Sand Waves and Troughs along Survey Segment D	2.52	18.0
Mixed Bottom (Sand & Cobble)	1.28	9.1
Hard Bottom	8.8	6.2
Low-relief	5.8	4.1
High-relief	3.0	2.1

Table 2: Invertebrate and plant taxa observed along AT&T's proposed AAG S-5 fiber optic cable route offshore Morro Bay, California

Phylum	Scientific Name	Common Name	Habitat[1]		
			HB	MB	SB
Angiosperm		**Flowering Plant**			
	Phyllospadix sp.	Surf grass	x		
Chlorophyta		**Green Algae**			
	Ulva spp. drift	Sea lettuce, drift	x		
Phaeophyta		**Brown Algae**			
	Egregia meanzinii drift	Feather boa kelp drift	x	x	x
	Macrocystis pyrifera drift	Giant kelp, drift	x	x	x
	Nereocystis californica drift	Bull kelp, drift	x	x	x
Rhodophyta		**Red Algae**			
	Callophyllus sp.	Beautiful leaf algae	x		
	Corallincea Unident., drift	Coralline algae, drift	x	x	x
	Rhodymenia sp.	Red membrane algae	x		
Porifera		**Sponges**			
	Polymastia pachymastia	aggravated vase sponge	x		
	Spheciospongia confoederata	Grey moon sponge	x		
		Sponge, foliose white	x	x	
		Sponge, large white	x		
		Sponge, white	x	x	
		Sponge, white encrusting	x	x	
		Sponge, white/gray saucer	x	x	
		Sponge, grey	x	x	
		Sponge, orange	x		
		Sponge, salmon encrusting	x	x	
		Sponge, tan bulbous	x		
		Sponge, tan globose	x		
		Sponge, yellow	x	x	
	Tethya aurantia	Orange puff ball sponge	x	x	
	Toxadocia spp.	White finger sponge	x		

Phylum	Scientific Name	Common Name	Habitat[1]		
			HB	MB	SB
Cnidaria		**Hydroids, Sea Anemones, Sea Pens, Corals**			
	Acanthoptilum sp.	Sea Pen		x	x
	Adelogorgia phyllostera	Orange gorgonian	x		x
	Anthopleura artemsia?	Moonglow anemone			x
	Aurellia sp.	Moon jelly			
	Balanophyllia elegans	Orange cup coral	x		
	Caryophillia sp.?	White cup coral	x		
	Cerianthidae, unident.	Cerianthid anemone		x	x
	Corynactis californica	Strawberry or club-tipped anemone	x		
	Lophelia sp.	Branching white coral	x		
	Lophogorgia chiliensis	Red gorgonian (sea whip)	x		
	Metridium farcimen (=giganteum)	White-plumed anemone	x	x	x
	Paracyathus stearnsi	Brown cup coral	x	x	
	Pachycerianthus sp.	Tube anemone	x	x	
	Ptilosarcus gurneyi	Orange or fleshy sea pen			x
	Scytalium sp.	Sea pen		x	x
	Stomphia coccinea	Swimming anemone	x		x
	Stylaster californicus (formerly Allopora californica)	California hydrocoral	x		x
	Stylatula elongata	White sea pen		x	x
	Stylatula sp.	Sea pen		x	x
	Urticina piscivora	Rose anemone	x	x	
	Urticina sp.	Anemone, unident.			x
	Virgularia californica	Sea pen			x
	Virgularia sp	Sea pen		x	x
	Virgularidae unident.	Sea pen		x	x
	Urticina columbiana	Sand-rose anemone	x	x	
	Urticina piscivora	White-spotted rose anemone Fish-eating anemone	x		
	Urticina sp.	Sand dwelling anemone			x
		Plumed hydroid, unident.	x		x
		Branched hydroid, unident.	x		
Annelida		**Segmented Worms**			
	Amphinomidae	Polychaete worm			x
	Chloeia pinnata ?	Free living polycahete			x
	Diopatra ornata	Ornate tube worm			x
		Serpulid worm casing	x		
		Tube Worm, unident.			x

Phylum	Scientific Name	Common Name	Habitat[1]		
			HB	MB	SB
Mollusca		**Bivalves, Snails, Octopus, Squid, Sea Hares, Nudibranchs**			
	Anisodoris sp.	Yellow nudibranch	x		
	Astrea gibberosa	Red turban snail	x		
	Bivalve Mollusk	Clam like bivalve			
	Calliostoma annulatum	Purple-ring top snail	x		
	Chromadorid sp.	Chromid sea slug	x		
	Flabellinopsis iodinea	Spanish shawl nudibranch	x		
	Gastropoda	Marine snail			
	Loligo sp.	squid		Water	
	Nudibranch, dorid white	Sea slug	x		
	Octopus rubescens	Octopus			x
	Pleurobranchea californica	Sea slug			x
Arthropoda		**Shrimp, Crabs, Isopods**			
	Cancer gracilis	Slender crab		x	x
	Cancer sp	Crab	x	x	x
	Hinnites giganteus	Rock scallop	x		
	Loxorhynchus crispatus	Masking crab	x		
	Munida quadrispina	Squat lobster	x		
	Paguristes sp.	Hermit crab		x	x
	Pandalus danae	Coon stripe shrimp	x		
	Pandalis jordani ?	Pacific ocean shrimp	x	x	x
	Pandalid shrimp	Shrimp	x	x	x
Ectoprocta		**Bryozoans**			
		Bryozoa, tan Bryozoa, tan branching Bryozoa, white branching Bryozoa, white branching Bryozoa, pink encrusting Bryozoa, orange encrusting Bryozoa, orange branching	x		
	Membranipora sp.	White encrusting bryozoan on drift kelp		x	
		White ectoproct?			
	Cellaria sp	Stick-figure bryozoan	x		
Echinodermata		**Sea Stars, Brittle Stars**			
	Amphiodia sp.	Brittle star			x
	Amphipholis sp.	Brittle star			x
	Asterina miniata	Bat star			x
	Astropecten verrilli and/or A. *armatus*	Spiny sand star			x

Phylum	Scientific Name	Common Name	Habitat[1]		
			HB	MB	SB
	Ceramaster patagonicus	Cookie cutter sea star	x		
	Dedraster ecentricus	Sand dollar		x	
	Dermasterias imbricata	Leather star	x		
	Echinoderm, juvenile unident.	Juvenile sea star	x		
	Florometra serratissima	Crinoid	x		
	Henricia spp.	Sea star	x		
	Mediaster aequalis	Red sea star	x		
	Ophiocantha diplasia	Brittle star			x
	Ophionereis sp.	Brittle star			x
	Ophiura sp.	Brittle star		x	x
	Ophiuroids	Brittle star		x	x
	Orthasterias koehleri	Rainbow sea star	x		
	Parastichopus sp.	Sea cucumber			x
	Petalaster (luidia) foliolata	Leafy flat star			x
	Pisaster brevispinus	Pink sea star	x	x	x
	Pisaster sp.	Sea star	x	x	x
	Pisaster giganteus	Giant-spined sea star	x		
	Pteraster tesselatus arcuatus	Fat sea star			x
	Pycnopodia helianthoides	Sunflower star			x
	Rathbunaster californica	Multi-armed sea star			x
	Solaster dawsonii	Morning sun star			x
Urorchordata		**Tunicates**			
	Archidistoma psammion	Compound ascidian	x		
	Ascidia paratropa	Glassy tunicate	x		
	Boltenia villosa	Spiny-headed tunicate	x		
	Cystodytes sp.	Lobed tunicate	x		
	Polyclinum planum	Elephant ear tunicate	x		
	Styela montereyensis	Stalked tunicate	x		

[1] = HB – hard bottom, MB – mixed bottom, SB – soft bottom

Table 2: Fish taxa observed along AT&T's proposed AAG S-5 fiber optic cable route offshore Morro Bay, California

Scientific Name	Common Name	Habitat			
		Hard Bottom	Mixed Bottom	Soft Bottom	Water Column
Agonidae unident.	Poacher		x	x	
Aulorhynchus flavidus	Tubesnout			x	x
Cephaloscyllium ventriosum	Swell shark			x	
Chilara taylori	Spotted cusk-eel			x	
Chilara sp	Cusk-eel			x	

Scientific Name	Common Name	Habitat			
		Hard Bottom	Mixed Bottom	Soft Bottom	Water Column
Citharichthys sordidus	Pacific sanddab			x	
Citharichthys spp	Sanddab			x	
Cottidae unident.	Sculpin, cabezon	x	x	x	
Engraulis mordax	Anchovy	x	x	x	x
Enophrys taurina	Bull sculpin		x	x	
Eptatretus stouti	Pacific hagfish			x	
Genyonemus lineatus	White croaker			x	x
Hydrolagus colliei	Spotted ratfish			x	
Lycodes sp.	Eelpout			x	
Microstomus pacificus	Dover sole			x	
Heterostichus rostratus	Giant Kelpfish	x			
Oxylebius pictus	Painted Greenling	x			
Ophiodon elongatus	Lingcod			x	
Paralichthys californicus	California halibut			x	
Pleuronectes vetulas	English sole			x	
Pleuronectidae unident.	Sole			x	
Raja binoculata	Big skate			x	
Raja rhina	Longnose skate			x	
Raja sp.	Skate			x	
Sebastes serriceps	Tree fish	x			
Sebastes elongatus	Green stripped rockfish	x			
Sebastes semicinctus	Half banded rockfish	x			
Sebastes maliger	Quillback rockfish	x			
Sebastes rosaeeus	Rosy rockfish	x			
Sebastes serrinoides	Olive rockfish	x	x	x	
Sebastes spp. (juveniles)	Rockfish (juveniles)	x	x	x	
Sebastes spp. (adult)	Rockfish (adult)	x		x	
Paralabrax clathratus	Kelp bass	x			
Squatina californica	Pacific angel shark			x	
Symphurus atricauda	California tonguefish			x	
Torpedo californica	Pacific electric ray			x	
Zalembius rosaceus	Pink surfperch	x			
Zaniolepis latipinnus	Longspine combfish			x	
Zapteryx exasperata	Banded guitarfish			x	
	Unidentified fish	x	x	x	x
	Unidentified flattfish	x	x	x	x

4.1 Soft-bottom Habitat

4.1.1 Segments A & B (21.3-32.0m)

This segment of the cable and its associated marine habitat and epibenthic community transits from the borepipe to approximately 32.0m (100ft) water depth and predominantly parallels the coastline. The seafloor along this segment appears to be composed of fine to medium sand with some shell hatch. Although the geophysical mapping for this area of the proposed cable route indicated the possible presence of low-relief hard bottom, none was encountered. Strong surge and high turbidity was observed in this area and the coarse sediments and scoured appearance of the exposed rocks at the north end of the Survey Segment where Survey Segment C began, suggest the area is subject to heavy surge and sand movement.

Fourteen alga and invertebrate taxa were observed in video records from Survey Segments A and B (Table 4). The invertebrate epibenthic community included the ornate tube worm (*Diopatra ornata), cancer crabs (Cancer sp.),* the slender crabs *(Cancer gracilis), octopus (Octopus rubescens*), the white sea pen (*Stylatula elongata*), occasional polychaete tube worms, *Pachycerianthus* anemones, and the sea star *Petalster* (*Luidia) foliolata*, The sea stars *Asterina miniata* and *Mediaster aequalis*, were observed when in close proximity to exposed hard substrate at the north end of Survey Segment B. Figure 4 is a representative photograph of the habitat observed in Survey Segments A and B. The invertebrate community was dominated by ornate tubeworms (*D. ornata*) with hundreds of colonies per square meter and highly mobile organisms like octopus and cancer crabs.

Six fish taxa were observed in video records from Survey Segments A and B (Table 5). Observed fish species included cusk-eels (*Chilaria* sp), flatfish, sandabs (*Citharichtys* sp.), a tubesnout (*Aulorhynchus flavidus*), and anchovies (*Engraulis mordax*) in the water column. In addition, squid (*Loligo* sp.) were periodically observed in the water column as well.

4.1.2 Segment C (27.40-32.0m)

Survey Segment C consisted predominantly of low and high-relief hard-bottom habitat with brief segments of shallow depth, soft sediment, between exposed shelf rock and boulders. Similar oceanographic conditions to those observed in Survey Segments A & B were also observed. The soft sediment areas were inhabited by the same organisms described in Survey Segments A&B, except hard bottom species that can inhabit soft bottom areas were also observed, like the sea stars *A. miniata, M. Aequalis,* and *Pisaster brevispinus* along with some additional species of rockfish were observed more frequently. Twenty-eight invertebrate taxa and nine fish taxa were observed in video records from the soft sediment areas of Survey Segment C (Tables 4 and 5). Figure 5 is a photograph of some soft-sediment habitat in Survey Segment C adjacent to low-relief hard-bottom habitat.

4.1.3 Segment D (32.0-76.2m)

This segment was characterized as “mixed bottom” based on acoustic seafloor mapping (Figure 2). It trends in a westerly direction and contains a variety of sub-habitats including low and high-relief hard bottom, coarse sand and cobble/small rocks, coarse sand and shell hatch soft-substrate and one small stretch of heavily bioturbated finer sand and silt soft-substrate. The predominant habitat within this Survey Segment was soft sediment composed of coarse sand, pebbles and shell hatch occurring in long, steep sand waves running parallel to shore (north-south) along the seafloor (Figure 3). Figure 6 provides an image of the seafloor and these standing coarse-sand waves taken with the sonar attached to the ROV. Figures 7 and 8 provide photographic images of the sand wave crests and troughs, respectively.

Along a portion of Survey Segment D, within the region of sand waves, an area of flat, highly bioturbated fine sediment seafloor, was also observed. This stretch of habitat was located at a depth of approximately 200ft, with a clearly defined break between the sand waves and flat mud bottom and ran approximately east-west. This feature, shown in an image from the sonar on the ROV (Figure 9), suggests that some physical or mechanical action leveled the sand wave bedform in this location, and oceanographic conditions have not been suitable to permit their reformation. This area of flat mud seafloor was just west of an area of low-relief hard bottom and was similar to the highly bioturbated soft sediment areas described occurring in Survey Segments E and F.

Forty-three algal and invertebrate taxa were observed in video records from soft-bottom areas of Survey Segment D (Table 4). Observations of organisms in this region of sand waves suggest they exert a strong influence on the distribution of many taxa. Associated invertebrate biota included sea pens, mostly *Stylatula elongata*, *Acanthoptilum sp*., and *Ptilosarcus gurneyi,* brittle stars including *Ophioneries* sp., the cerianthid anemone *Pachycerianthus sp*., the anemones *Urticina piscivorus, Urticina sp*., and Stomphia coccinea, tube worms, cancer crabs including the slender crab (*Cancer gracilis*), shrimp, (*Pandalus sp*.), occasional marine snails (Gastropoda), the California sea slug (*Pleurobranchia californica*), hermit crabs, (*Paguristhes sp*.), and several species of sea stars including *Pisaster brevispinus*, *Petalaster (luidia) foliolata, Rathbunaster californica, Asterina miniata,* and *Solaster dawsonii*. Ornate tube-worms

Table 4: Invertebrate taxa and drift algae observed in association with soft-sediment habitat areas along the five survey segments of the AT&T AAG S-5 fiber optic cable route offshore Morro Bay, California.

Scientific Name	Common Name	Cable Route Segment					
		A&B	C	D	E	F (<340ft)	F (> 340ft)
Angiosperm	**Flowering Plant**						
Phyllospadix sp.	Surf grass, drift	P	P	P	P	P	
Phaeophyta	**Brown Algae**						
Egregia meanzinii	Feather boa kelp, drift	P	P	P	P	P	
Macrocystis pyrifera	Giant kelp, drift	P	P	P	P	P	P
Cnidaria	**Hydroids, Sea Anemones, Sea Pens, Corals,**						
Acanthoptilum sp.	Sea Pen			A	A	A	A
Adelogorgia phyllostera	Orange gorgonian						P
Anthopleura artemsia?	Moonglow anemone				P		
Cerianthidae, unident.	Cerianthid anemone			C	P	A	C
Metridium farcimen (=giganteum)	White-plumed anemone			P		P	P
Pachycerianthus sp.	Tube anemone			C	P	A	C
Ptilosarcus gurneyi	Orange or fleshy sea pen			A			
Scytalium sp.	Sea pen			P	P	P	P
Stomphia coccinea	Swimming anemone		C	A			
Stylatula elongata	White sea pen	A	C	A	A	A	A
Stylatula sp.	Sea pen	A	C	A	A	A	A
Urticina columbiana	Sand-rose anemone		C				
Urticina piscivora	White-spotted rose anemone Fish-eating		C				

Scientific Name	Common Name	Cable Route Segment					
		A&B	C	D	E	F (<340ft)	F (> 340ft)
	anemone						
Urticina sp.	Anemone, unident.		P	C	A	A	A
Virgularia californica	Sea pen		P	A	P	A	A
Virgularia sp	Sea pen		P	A	A	A	A
Virgularidae unident.	Sea pen		P	A	P	A	A
Annelida	**Segmented Worms**						
Amphinomidae	Free living Polychaete						A
Chloeia pinnata?	Free living polychaete						A
Diopatra ornata	Ornate tube worm	A	P	P			
	Tube Worm, unident.	P	P	C	A	A	A
Mollusca	**Bivalves, Snails, Octopus, Squid, Sea Hares, Nudibranchs**						
Bivalve Mollusk	Clam like bivalve			P			
Gastropoda	Marine snail		P	C	P		
Loligo sp.	squid	P	P	P	P	P	P
Octopus rubescens	Octopus	C		A	C	C	C
Pleurobranchea californica	Sea slug			P	P	C	C
Arthropoda	**Shrimp, Crabs, Isopods**						
Cancer gracilis	Slender crab	A		C	P	P	P
Cancer sp	Crab	A	P	C	C	C	C
Hinnites giganteus	Rock scallop			P			
Loxorhynchus crispatus	Masking crab		P				
Paguristes sp.	Hermit crab			P			
Pandalis jordani?	Pacific ocean shrimp			C	P	P	P
Pandalid shrimp	Shrimp			C	P	P	P
Echinodermata	**Sea Stars, Brittle Stars**						
Amphiodia urtica	Brittle star				A	A	A
Amphiodia sp.	Brittle star				A	A	A
Amphipholis sp.	Brittle star				A	A	A
Asterina miniata	Bat star	P	P	A	P	P	P
Astropecten verrilli and/or A. *armatus*	Spiny sand star			P			
Dedraster ecentricus	Sand dollar			P			
Dermasterias imbricata	Leather star			P			
Ecinoderm, juvenile unident.	Juvenile sea star		P	P			
Mediaster aequalis	Red sea star	C	C	P	P		
Ophionereis sp.	Brittle star			A			
Ophiura sp.	Brittle star		P	P	P	P	P
Ophiuroids	Brittle star		P	A	A	A	A
Parastichopus sp.	Sea cucumber					P	
Petalaster (luidia) foliolata	Leafy flat star	P	P	A	C	P	P
Pisaster brevispinus	Pink sea star		A	A	P		
Pisaster sp.	Sea star		C	A			

Scientific Name	Common Name	Cable Route Segment					
		A&B	C	D	E	F (<340ft)	F (> 340ft)
Pisaster giganteus	Giant-spined sea star		P				
Pycnopodia helianthoides	Sunflower star		P			P	
Rathbunaster californica	Multi-armed sea star			A	C	C	C
Solaster dawsonii	Morning sun star			P	P		
Total number of taxa observed		**14**	**28**	**43**	**34**	**32**	**31**

Table 5: Fish taxa observed in association with soft-sediment habitat areas along the five survey segments of the AT&T AAG S-5 fiber optic cable route offshore Morro Bay, California.

Scientific Name	Common Name	Cable Route Segment					
		A&B	C	D	E	F (<340ft)	F (>340ft)
Agonidae unident.	Poacher			C	C	P	
Aulorhynchus flavidus	Tubesnout	C					P
Cephaloscyllium ventriosum	Swell shark		P				
Chilara taylori	Spotted cusk-eel	P	C	A	A	A	C
Chilara sp	Cusk-eel	P	P	A	A	A	A
Citharichthys sordidus	Pacific sanddab			A	C	C	C
Citharichthys spp	Sanddab			A	C	C	C
Cottidae unident.	Sculpin, cabezon			A	C	P	P
Engraulis mordax	Anchovy	A			C	A	A
Enophrys taurina	Bull sculpin			P			
Eptatretus stouti	Pacific hagfish			P	P	C	C
Genyonemus lineatus	White croaker			P			
Hydrolagus colliei	Spotted ratfish				P		
Lycodes sp.	Eelpout			A	A	A	A
Microstomus pacificus	Dover sole			C	C	C	
Ophiodon elongatus	Lingcod			P			
Paralichthys californicus	California halibut			C	C	C	P
Pleuronectes vetulas	English sole			C	C	C	
Pleuronectidae unident.	Sole			C	C	C	P
Raja binoculata	Big skate			P			
Raja rhina	Longnose skate					P	
Raja sp.	Skate			P	P	P	
Sebastes rosaeeus	Rosy rockfish		P	P	P		
Sebastes serrinoides	Olive rockfish			P			
Sebastes spp. (juveniles)	Rockfish (juveniles)		C	C	C	A	P
Sebastes spp. (adult)	Rockfish (adult)		C	C	C	C	P
Paralabrax clathratus	Kelp bass		P	P			
Squatina californica	Pacific angel shark			P			
Symphurus atricauda	California tonguefish			A	C	C	
Torpedo californica	Pacific electric ray			P			
Zalembius rosaceus	Pink surfperch			C	C	C	
Zanioleis latipinnis	Longspine combfish					P	
Zapteryx exasperata	Banded guitarfish			P			
	Unidentified Fish	A	C	A	A	A	C
	Unidentified Flatfish	A	C	A	A	A	C
Total number of taxa observed		**6**	**9**	**29**	**22**	**22**	**15**

(*Diopatra ornata)* were occasionally observed in the troughs of the sand waves as well as occasional isolated sand dollars (*Dendraster ecentricus*) observed on the tops of sand waves. Squid (*Loligo* sp.) were also frequently observed in the water column. The sea pen *P. gurneyi* and the sea star *P. brevispinus* were observed only at water depths of 48.8 m (160 feet) or less. The most abundant invertebrate organisms were sea pens, including *Stylatula elongata*, *Acanthoptilum sp.*, and *Ptilosarcus gurneyi,* brittle stars (Ophiuroids), especially *Ophioneries* sp., tube worms, and the sea stars *P. brevispinus, A. miniata,* and *R. californica.*

Twenty-nine fish taxa were observed in video records from soft-bottom areas of Survey Segment D (Table 5). Observed fish species included assorted flatfish including sanddabs (*Citharichtys sp.*), California halibut (*Paralichthys californicus),* Dover sole (*Microstomus pacificus) and English sole (Pleuronectes vetulas),* tonguefish (*Symphurus atricauda)* a banded guitarfish (*Zapteryx exasperata), Pacific electric ray (Torpedo californica*), a Pacific angel shark (*Squatina californica),* (juvenile rockfish (Sebastes sp.), eelpouts (*Lycodes* sp.), cuskeels (*Chilara* sp), poachers (Algonidae), sculpins (Cotidae) and hagfish (*Eptatretus stouti).* The dominant and most frequently observed fish taxa were the assorted flatfish, especially pacific sanddabs (*C. sordidus*), cusk-eels, poachers and rockfish.

Associated invertebrate and vertebrate biota observed inhabiting the soft bottom areas of this study segment appeared to be the most diverse as a result of the increased diversity in bottom habitat and more stable oceanographic conditions.

4.1.4 Segment E (76.2-85.3m)

This segment of the cable route consisted predominantly of highly bioturbated fine sand and silt sediments (Figures 3, 10, and 11). One very small area of low relief hard-bottom habitat was observed within the 100 m wide cable right-of-way, but not at the centerline. This feature represents the northernmost extension of a much larger area of high-relief hard-bottom habitat located just south of the proposed cable route (Figures 2 and 3). Both hard-bottom areas are located in approximately 83.5m (274-ft.) of water.

Thirty-four algal and invertebrate taxa were observed in video records from soft-bottom areas of Survey Segment E (Table 4). The epibenthic biota associated with the soft-sediment habitat consisted of several species of sea pens including *Stylatula, sp, Virgularia californica, Virgularia agassizii, Scytallum* sp,, and *Scytallopsis* sp., brittle stars including *Amphiophodia urtica*, *Amphiopholis* sp,, *Amhiodia* sp., *Ophionereis sp, and Ophiura* sp., octopus (*Octopus rubescens*), the California sea slug (*Pleurobranchia californica*), several species of anemones including *Urticina sp.,* and *Pachycerianthus sp.*, the sea stars *Asterina (Luidia) foliolata, Rathbunaster californica*,, and *Astropecten sp.* The dominant invertebrate taxa were the sea pens Stylatula sp., V. californica, and V. agassizi, the brittle star *A. urtica*, the cerianthid anemone (*Pachycerianthus* sp.), cancer crabs, especially *C. gracilis*, and octopus.

Twenty-two fish taxa were observed in video records from soft-bottom areas of Survey Segment E (Table 5). The observed bottom dwelling fish species included assorted flatfish including sanddabs (*Citharichtys sp.*) and sole (Pleuronectidae), poachers (Cottidae), sculpin (Cottidae), skates (Raja sp), juvenile rockfish (Sebastes sp.). eelpouts (*Lycodes* sp.), cuskeels (*Chilara* sp), and sculpins. The dominant and most frequently observed fish taxa were cuskeels, flatfish, and juvenile rockfish.

4.1.5 Segment F (85.3-153m)

This Survey Segment of the cable route consisted of two slightly differing fine sediment habitats that varied physically based upon the extent of bioturbation. The shallower portion was heavily bioturbated,

like Survey Segment E, and the associated biological community was similar. The deeper portion lacked this heavy bioturbation. The biota observed in this deeper-water portion of the Survey Segment, although as similarly diverse in species as the shallower portion, the observed taxa were generally less abundant (Table 4 and 5). The one exception was a free-living polychaete.

The shallower portion of the two observed soft-sediment habitats observed in this survey segment transited between 85.3m and 103.7m (280-340ft) of water. Thirty-two algal and invertebrate taxa were observed in video records from this shallower section of Survey Segment F (Table 4). The biological community observed inhabiting this segment was similar to those observed and reported for Survey Segment E. Figures 11 and 12 illustrate the habitat and some of the associated biota observed in this Survey Segment. The deeper portion transited between depths of 103.7–153m (340-500ft) where the current survey ceased and contained 31 algal and invertebrate taxa observed in video records (Table 4). The biological community observed along this deeper portion of the cable route consisted of sea pens including *Stylatula, sp, Virgularia californica, Virgularia agassizii, and Scytallum* sp,, brittle stars including *Amphiophodia urtica*, *Amphiopholis* sp,, *Amhiodia* sp., *Ophionereis sp, and Ophiura* sp., squid (*Loligo* sp), octopus (*Octopus rubescens*) the California sea slug (*Pleurobranchia californica*), several species of anemones including *Urticina sp.,* and *Pachycerianthus sp*., the sea stars *Rathbunaster californica*, *P. foliolata,* the sea cucumber *Parastichopus sp*., occasional orange gorgonians (*Adelogogia phyllostera*), and a free living polychaete fire worm (Amphinomidae). The dominant invertebrate taxa were the fire worms, brittle stars, and sea pens. The fire worms were observed in abundances approaching thousands per square meter and the other species were observed in much lower abundances than observed in Survey Segment E and the shallower portion of Survey Segment F.

Twenty-two fish taxa were observed in video records from the shallower soft-bottom areas of Survey Segment F and 15 fish taxa were observed the deeper section of Survey Segment F (Table 5). Observed fish species included pink surfperch (*Zalembius rosaceus*), poachers (Algonidae), hagfish (*Eptatretus stouti*), rockfish (Sebastes spp.), both juveniles and adults, anchovies (*E. Mordax*), tonguefish (*Symphurus atricauda)*, skate including big eye skate (*Raja binoculata),* longnose skate *(Raja binoculata)* and several unidentified skates, flatfish including sanddabs (Citharichtys sp.), sole (Pleuronectidae), and unidentified flatfish, eelpouts (*Lycodes* sp.), and cuskeels (*Chilara* sp), The dominant fish taxa were cuskeels, eelpouts, tonguefish, hagfish and anchovies in the water column. All fish species were observed in lower abundance than in Survey Segment E and the shallower portion of F.

4.2 Hard-bottom habitat

4.2.1 Segment C (27.40-32.0m)

The hard-bottom habitat in this segment was a mix of low (< 1m) and high-relief (> 1m) continuous rock shelves (Figures 4, 13 and 14). Based upon quantitative analysis of photos, the predominant assemblage covering rock substratum in this area (43% cover) was a turf of Komokoiacea foraminiferans and hydroids. Substrata in photographs also included 15%, 8.5%, 8%, and 7% coverage by gravel, sediment on rock, sediment, and bare rock, respectively (Table 6). Based upon percent cover data from analysis of photographs, the five most abundant taxa in the hard-bottom habitat of this transect were the unknown orange encrusting bryozoan (5.3%), encrusting coralline algae over rock (3.3%), unknown tan globular sponge (2.0%), the brown cup coral *Paracyathus stearnsi* (1.7%), and the purple-ringed sea star *Pisaster giganteus* (1.2%). Eighteen taxa were identified in the photos of hard-bottom habitat in Survey Segment C.

Visual observations of video records from Survey Segment C revealed additional large taxa inhabiting the hard-bottom habitat than were contacted by points in the photo analysis. Also observed in Survey

Segment C were the red alga *Rhodymenia* sp., a saucer-shaped sponge, a foliose white sponge, the anemones *Urticina columbiana*, *U. piscivora*, *Metridium* sp., and *Stomphia coccinea* and the sea stars *Mediaster aequalis* and *Pisaster brevispinus*.

4.2.2 Segment D (32.0-76.2m)

The hard-bottom habitat in this segment consisted of exposed low-relief (<1m) shelf rock, small boulders and cobbles and some high relief (>1 m) near the eastern end of the segment (Figures 15, 16 and 17). The mean percent cover of primary substrates were 28% turf of Komokoiacea foraminiferans and hydroids, 21.4% sediment, 13.8% gravel, 12.7% sediment on rock, and 5% bare rock (Table 6). Based upon percent cover data from analysis of photographs, the five most abundant taxa in the hard-bottom habitat of this transect were *Cellaria sp*. (2.1%), unknown orange encrusting bryozoan (1.8%), *Dermasterias imbricata* (1.75%), *Paracyathus stearnsi* (1.5%), and unknown tan globular sponges (1.1%). Twenty-eight taxa were identified in the photos of hard-bottom habitat from Survey Segment D.

Visual observations of video records from Survey Segment D also revealed additional taxa in hard-bottom habitat than were contacted by points in the photo analysis. Also observed in Survey Segment C were a large erect saucer-shaped sponge, white encrusting, white foliose, and white erect sponges, a yellow puff ball sponge, a yellow encrusting sponge, an orange encrusting sponge, an orange puff ball sponge, an orange foliose sponge, the anemones *Metridium* sp., and *Stomphia* coccinea, unidentified cerianthid anemones, the soft coral *Stylaster californicus (=Allopora californica)*, the gorgonians *Lophogorgia chiliensis* and *Adelogorgia phyllostera*, the crab *Cancer* sp., the sea stars *Mediaster aequalis*, *Orthasterias koehleri*, the cookie cutter sea star, *Ceramaster patagonicus* and *Henricia* sp., crinoids (probably *Florometra serratissima*), the ascidian *Ascidia paratropa*, the cabezon, *Scorpaenichthys marmoratus*, the olive rockfish, *Sebastes serranoides*, and the rosy rockfish, *Sebastes rosaceus* and juvenile rockfishes.

4.2.3 Segment E (76.2-85.3m)

Survey Segment E is the deepest segment of the survey with any exposed hard bottom, which was composed predominantly of high-relief (>1 m) stepped shelf-rock ridges (Figures 16 and 17). This area of hard bottom substrate represents the northern tip of a larger area of exposed shelf rock that extends fingerlike to the southeast (Figure 3). The observed and surveyed feature does not occur along the fiber optic cable route centerline, but does occur within the 100m wide right-of-way corridor, beginning about 25m south of the centerline and continuing in a southeast direction.

The mean percent cover of primary substrates in this hard-bottom area were 32% turf of Komokoiacea foraminiferans and hydroids, 11% sediment on rock, 2% bare rock and 1.3% sediment (Table 6). Based upon percent cover data from analysis of photographs, the five most abundant taxa in the hard-bottom habitat of this transect were *Metridium farcimen (=giganteum)* (20.5%), *Lophogorgia chiliensis* (4.9%), unknown orange encrusting bryozoan (1.5%), unknown yellow lumpy sponge (1.17%), and *Pisaster giganteus* (1.14%). Sixteen taxa were identified in the photos of hard-bottom habitat from Survey Segment E.

Visual observations of video records from Survey Segment E also revealed additional taxa in hard-bottom habitat than were contacted by points in the photo analysis. Also observed in Survey Segment C were a red encrusting sponge, the orange gorgonian *Adelogorgia phyllostera*, the brown cup coral,

Table 6: Mean and standard deviation for percent cover of hard-bottom organisms, Shannon-Weaver diversity and substratum type based on point-contact analysis of photographs. The number of photographs analyzed for each segment is also indicated.

Phylum	Scientific Name	Common Name	Mean % Cover by segment			Standard Deviation % Cover by segment		
			C	D	E	C	D	E
Plantae		**Coralline algae**						
		Encrusting Coralline Algae	3.30	0.0	0.0	5.37	0.0	0.0
Porifera		**Sponges**						
		tan globose Sponge,	2.0	1.07	0.52	3.42	2.75	1.17
		Yellow lumpy Sponge,	0.0	0.0	1.17	0.0	0.0	3.05
	Tethya aurantia	Orange puff ball sponge	0.0	0.96	0.0	0.0	3.44	0.0
Cnidaria		**Hydroids, sea anemones, Sea Pens, Corals,**						
	Balanophyllia elegans	Orange cup coral	0.36	0.38	0.28	1.06	1.13	0.91
	Corynactis californica	Strawberry anemone	0.88	0.0	0.0	3.72	0.0	0.0
	Lophogorgia chiliensis	Red gorgonian (sea whip)	0.0	0.84	4.88	0.0	2.57	8.53
	Metridium farcimen (=giganteum)	White-plumed anemone	0.0	0.33	20.51	0.0	1.43	9.77
	Paracyathus stearnsi	Brown cup coral	1.70	1.51	0.0	3.69	2.99	0.0
	Urticina lofotensis	Beaded anemone	0.18	0.0	0.0	0.76	0.0	0.0
		Uknown plumed hydroid	0.19	0.57	0.28	0.79	1.80	0.94
		Uknown branched hydroid	0.0	0.18	0.0	0.0	0.76	0.0
Mollusca		**Gastropod**						
	Calliostoma annulatum	Purple-ring top snail	0.0	0.18	0.0	0.0	0.79	0.0
Polychaeta		**Segmented worm**						
		Unknown feathered tube worm	0.0	0.19	0.0	0.0	0.82	0.0
Ectoprocta		**Moss animals**						
		Bryozoa, orange branching	0.0	0.55	0.0	0.0	1.71	0.0
		Bryozoa, orange encrusting	5.27	1.80	1.46	6.48	2.10	3.44
		Bryozoa, pink encrusting	0.77	0.53	0.89	3.25	1.27	1.52
		Unknown Bryozoan	0.19	1.54	1.27	0.79	3.86	3.28
	Cellaria sp	Stick-figure bryozoan	0.0	2.12	0.0	0.0	4.52	0.0
Echinodermata		**Sea stars, brittle stars**						
	Asterina miniata	Bat star	0.19	0.19	0.0	0.81	0.82	0.0
	Dermasterias imbricata	Leather star	0.0	1.75	0.0	0.0	7.65	0.0

Phylum	Scientific Name	Common Name	Mean % Cover by segment			Standard Deviation % Cover by segment		
			C	D	E	C	D	E
	Mediaster aequalis	Red sea star	0.0	0.0	0.23	0.0	0.0	0.77
	Ophiocantha diplasia	Brittlestar	0.0	0.91	0.0	0.0	2.82	0.0
	Ophiocantha sp.	Brittlestar	0.0	0.35	0.0	0.0	1.05	0.0
	Ophiothrix spiculata	Brittlestar	0.0	0.36	0.0	0.0	1.07	0.0
	Orthasterias koehleri	Rainbow sea star	0.18	0.0	0.0	0.76	0.0	0.0
	Pisaster giganteus	Giant-spined star	1.17	0.0	1.14	4.96	0.0	3.77
Urochordata		**Tunicates**						
	Cystodytes sp.	Lobed tunicate	0.0	0.18	0.0	0.0	0.76	0.0
	Polyclinum planum	Elephant ear tunicate	0.0	0.19	0.0	0.0	0.82	0.0
Vertebrata		**Fishes**	0.0	0.0	0.23	0.0	0.0	0.77
	Paralabrax clathratus	Kelp Bass						
Substrata								
		Gravel	15.23	13.83	0.0	18.54	18.27	0.0
		Bare rock	7.12	5.21	2.35	14.10	11.42	7.78
		Sediment	8.03	21.36	1.35	12.54	18.37	2.66
		Sediment over rock	8.53	12.73	11.52	13.48	13.76	17.58
		Turf of Komokoiacea foraminiferans and hydroids	43.47	28.12	31.40	31.88	21.93	29.15
Other								
		Total algal and invertebrate cover	16.4	16.9	32.9	12.1	13.0	12.4
		Total number of taxa	5.17	6.26	4.73	1.76	1.97	1.27
		Shannon-Weaver Diversity Index	0.49	0.55	1.22	0.37	0.36	0.27
		Area of Photos (cm^2)	887	1273	3049	540	811	1622
		Number of Photos	18	19	11	-	-	-

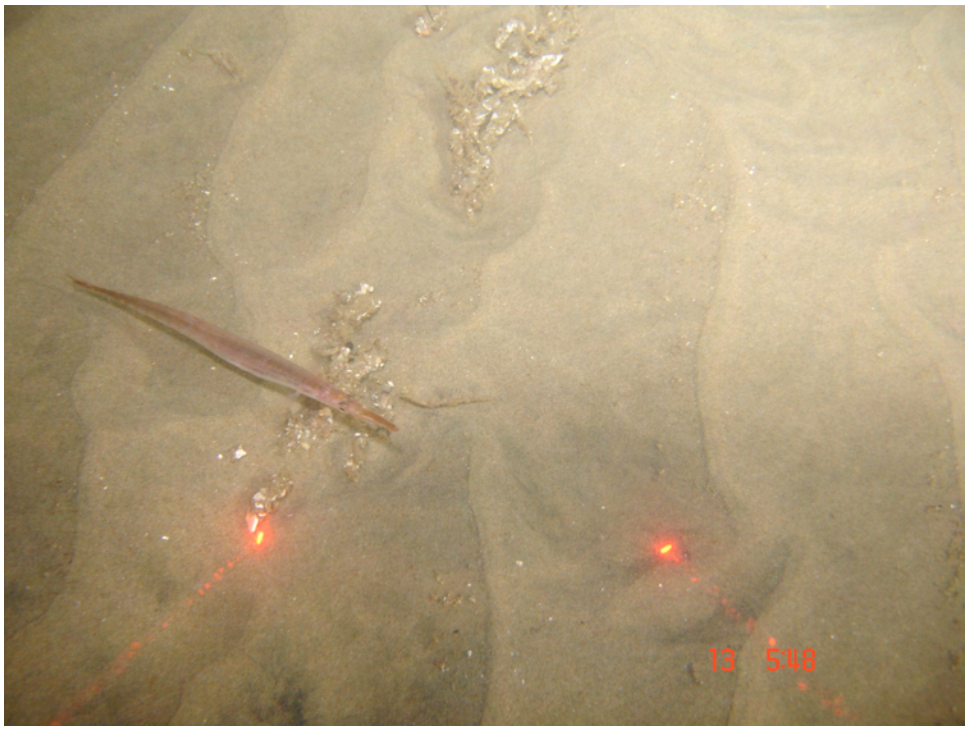

Figure 4: Soft sediment habitat in Survey Segment A & B. Ornate tube worms (*Diopatra ornata*) and a tubesnout (*Aulorhynchus flavidus).*

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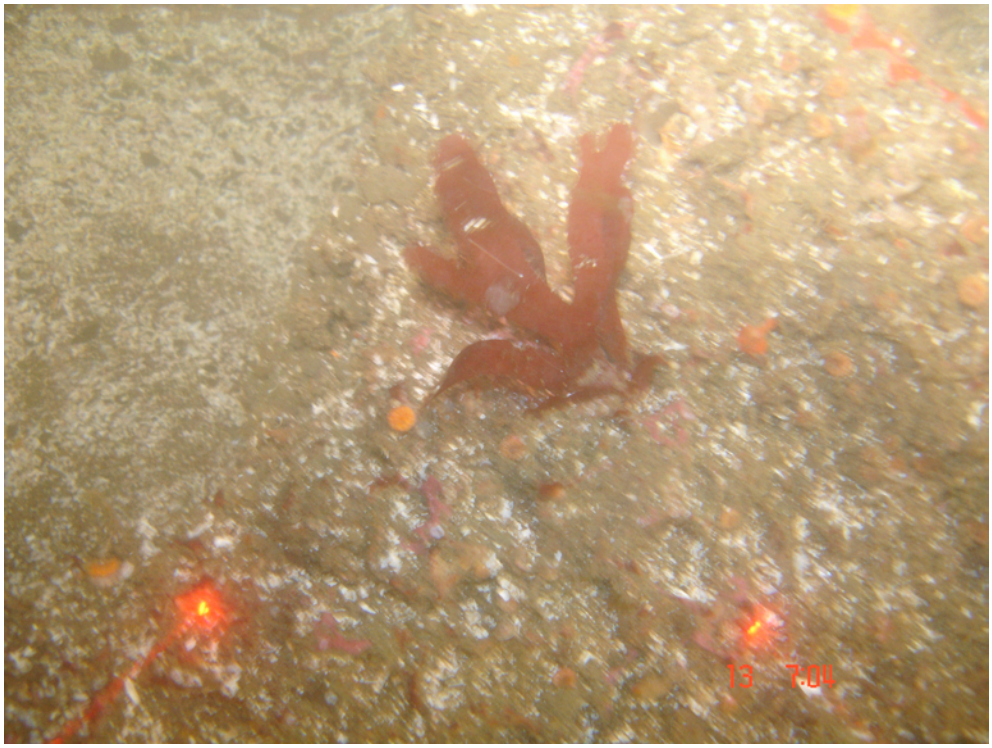

Figure 5: Low-relief hard-bottom habitat in Survey Segment C with orange cup corals (*Balanophyllia elegans),* purple encrusting bryozoan, yellow encrusting sponge, and the red alga *Rhodymenia* sp.

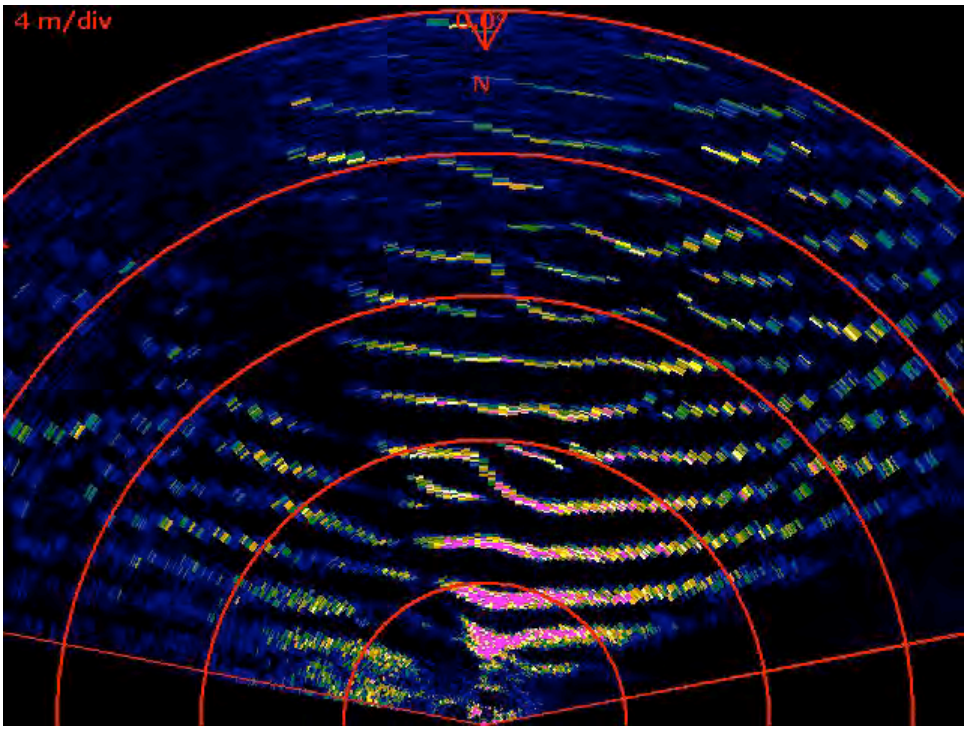

Figure 6: Sonar image of standing coarse sand waves in Survey Segment D.

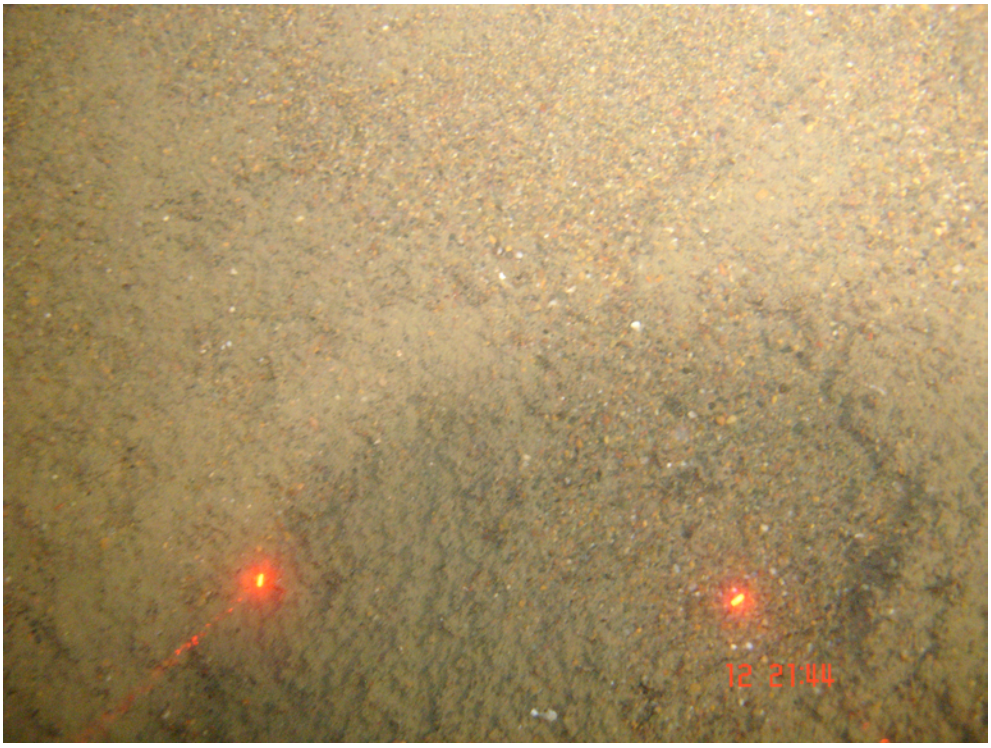

Figure 7: Soft sediment habitat along ridge top of sand ridge in Survey Segment D.

Figure 8: Soft sediment habitat in the trough of a sand wave in Survey Segment D with an anemone (*Urticina* sp.) and brittle stars (*Ophionereis* sp).

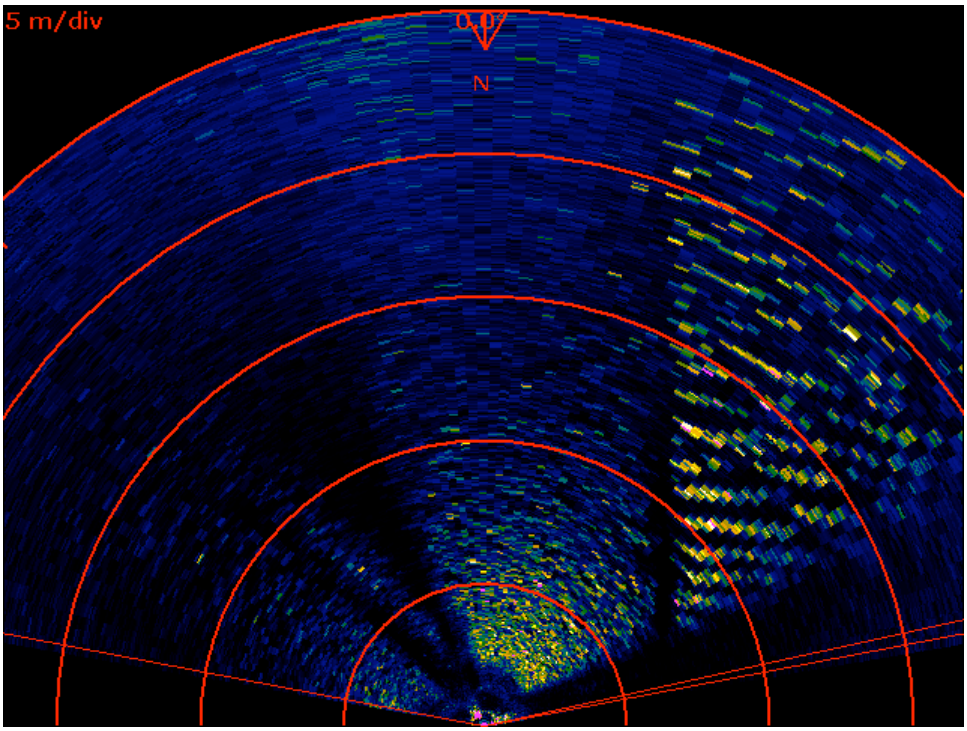

Figure 9: Sonar image of bioturbated sandy-silt seafloor (left portion of image) transiting through coarse sand ridge and furrow bedform (right side of image) in survey segment D. The image is looking easterly.

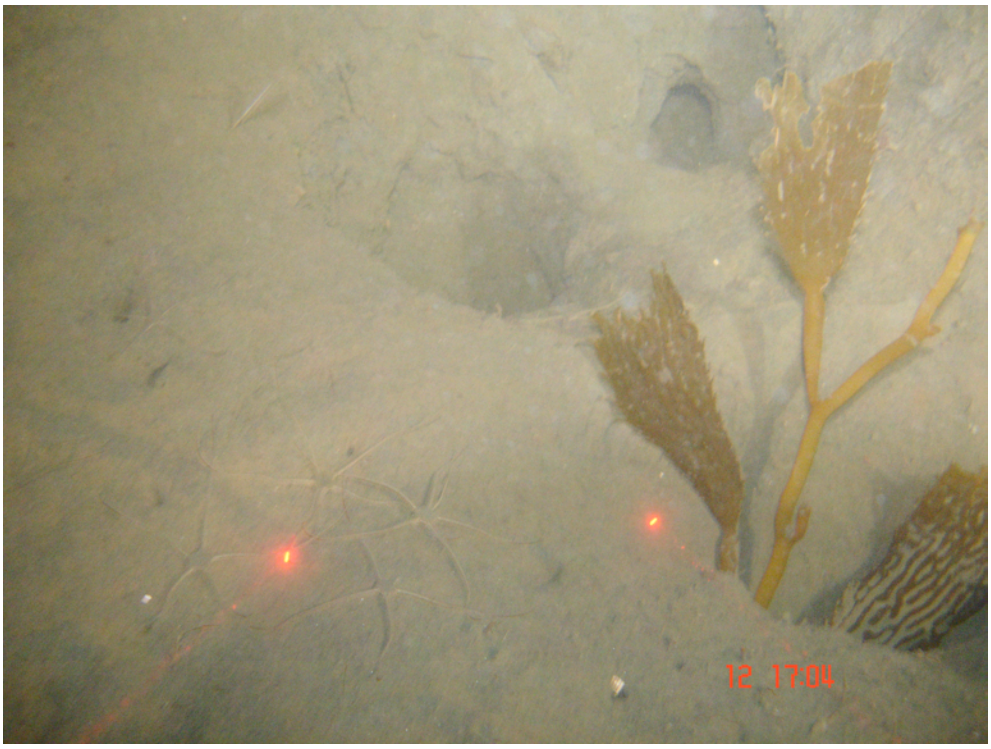

Figure 10: Highly bioturbated soft sediment habitat and associated biota (the brittle star *Amphiophodia urtica* and drift *Macrocystis* kelp) in Survey Segment E and F.

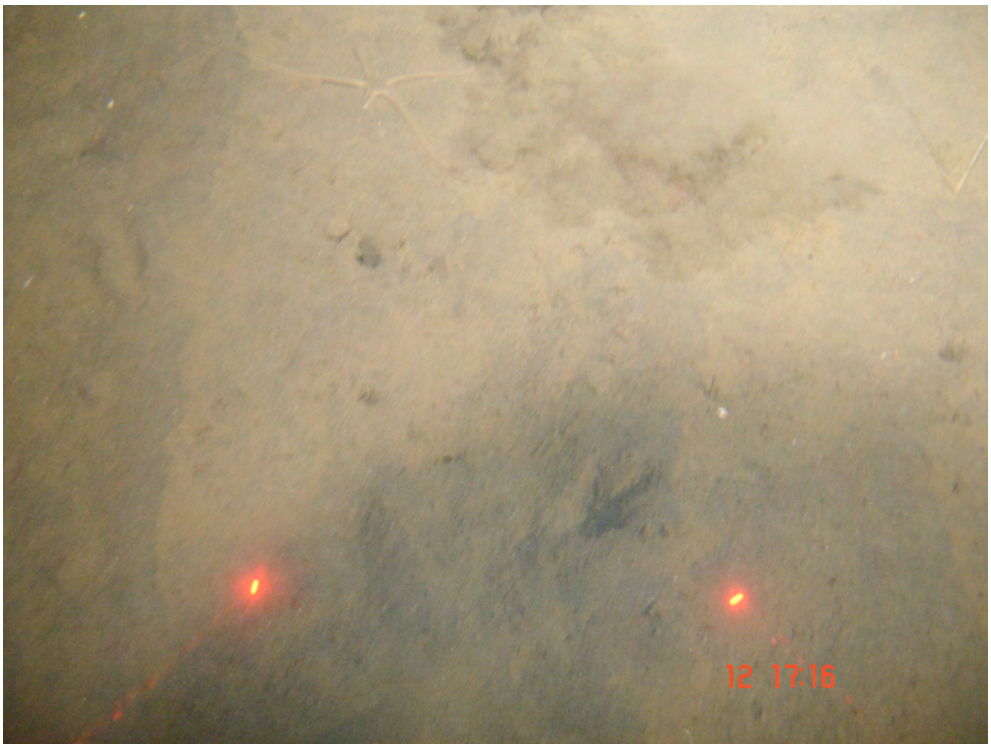

Figure 11: Soft sediment habitat and associated biota (brittle stars) in Survey Segment F (< 103.4 m).

Figure 12: Soft sediment habitat and associated biota including the brittle star (*Amphiodia urtica*) and free-living polychaetes (Amphinomidae) in Survey Segment F (> 103.4 m).

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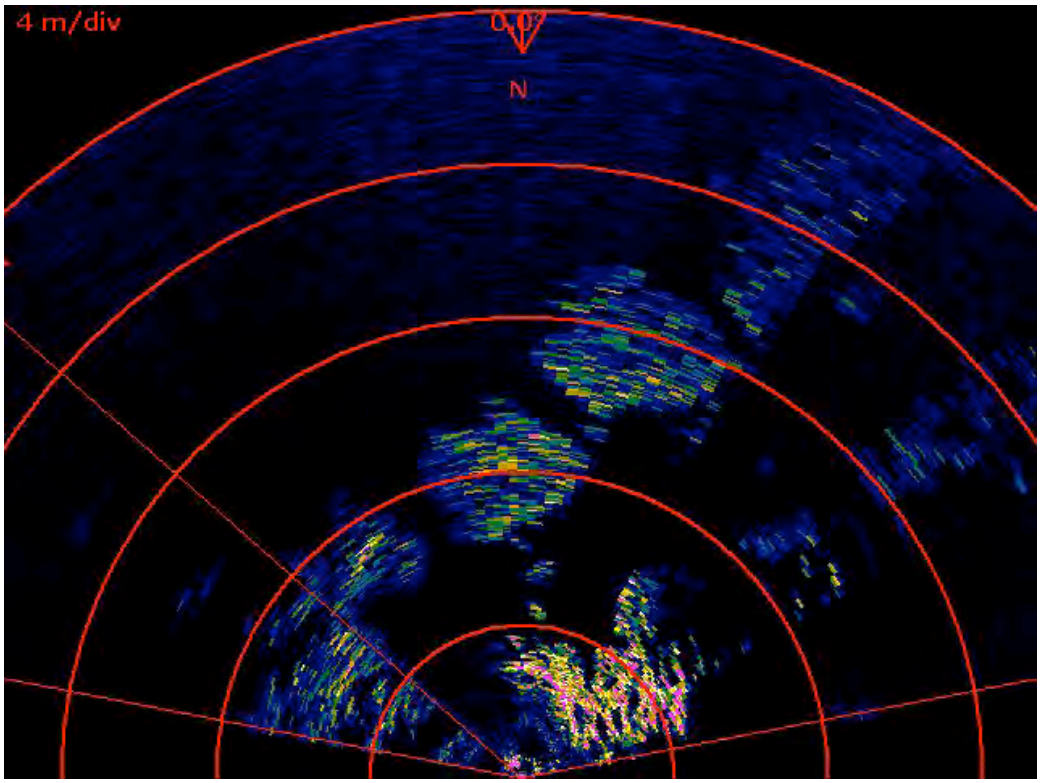

Figure 13: Sonar image of high relief habitat in Survey Segment C.

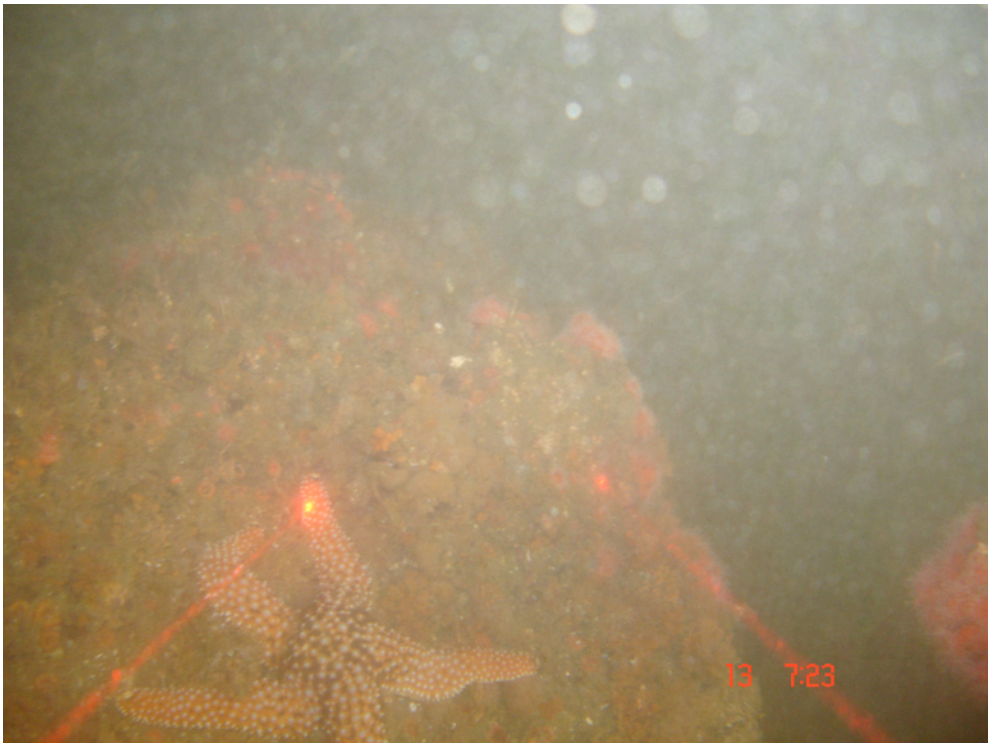

Figure 14: High-relief hard-bottom habitat with the orange cup coral *Balanophyllia elegans* and the seastar *Pisaster giganteus* in Survey Segment C

Figure 15: Low-relief hard-bottom habitat in Survey Segment D and associated biota (turf of Komokoiacea foraminiferans and hydroids, globular sponge, *Dermasterias imbricata*, *Balanophyllia elegans*, *Paracyathus stearnsi* and red stripe shrimp).

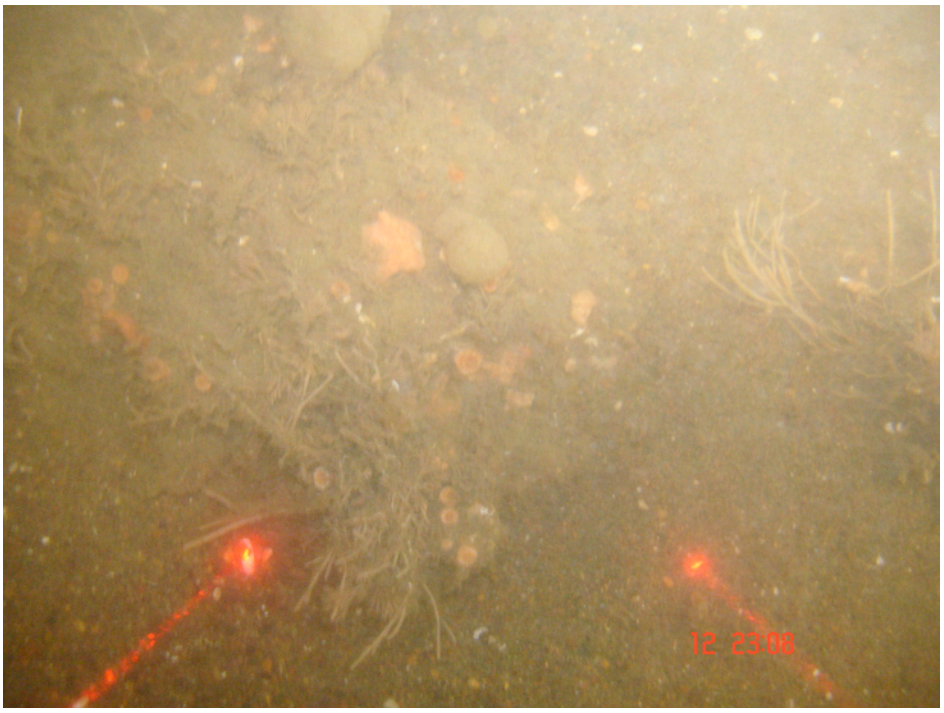

Figure 16: Low-relief habitat and associated biota (turf of Komokoiacea foraminiferans and hydroids, globular sponges, *Paracyathus stearnsi* and *Cellaria* sp.) in Survey Segment D.

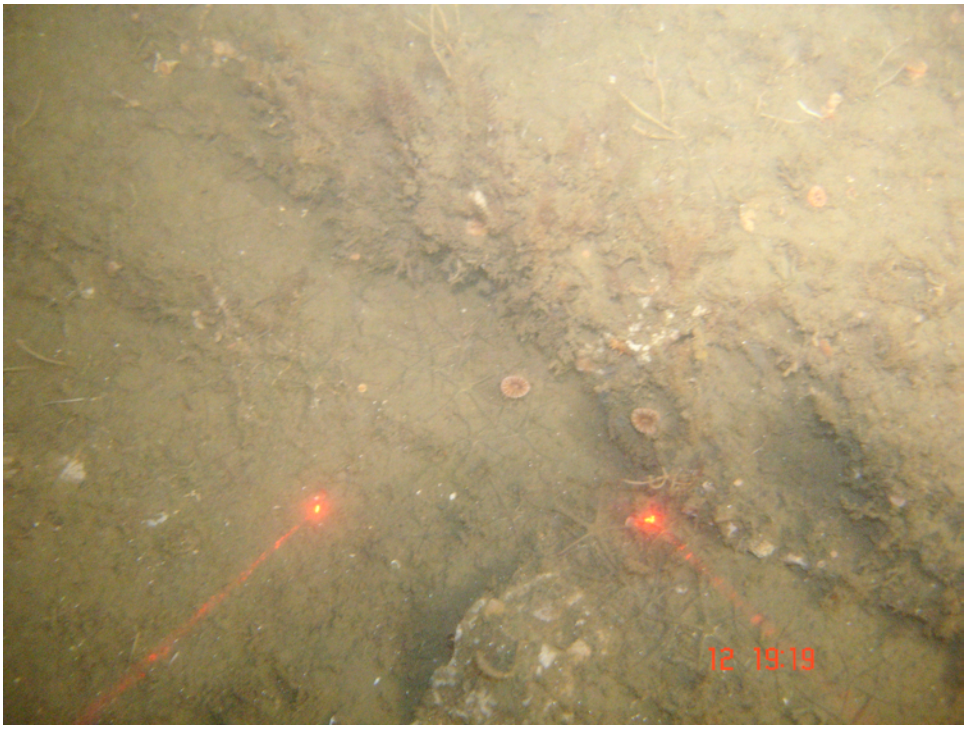

Figure 17: Low-relief hard-bottom habitat with turf of Komokoiacea foraminiferans and hydroids, and *Paracyathus stearnsi* in Survey Segment D.

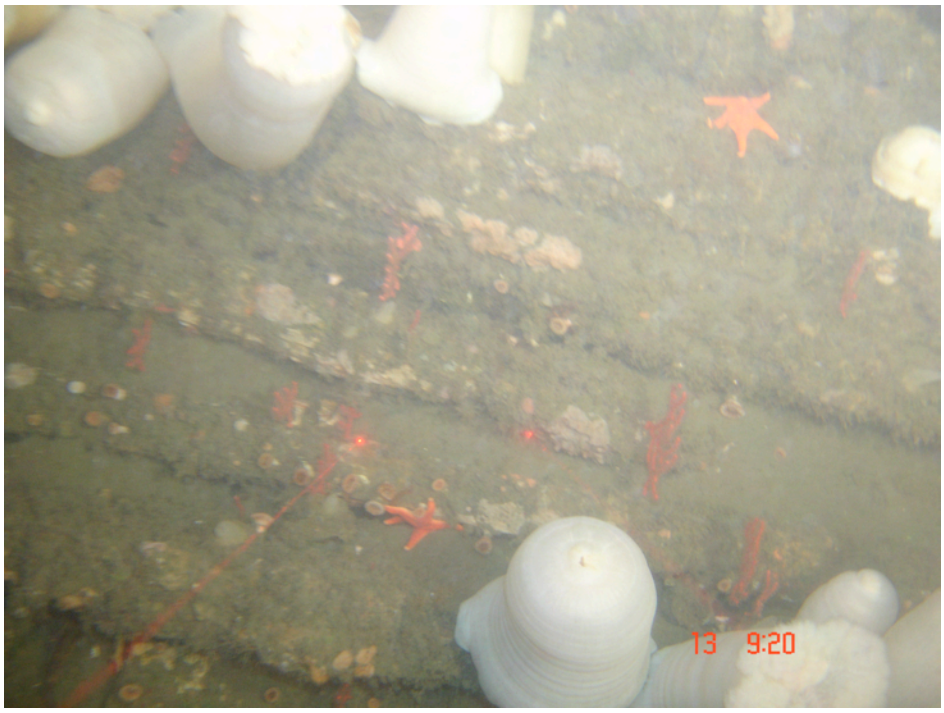

Figure 18: High-relief hard-bottom habitat with *Metrideum giganteum*, *Paracyathus stearnsi*, *Lophogorgia chiliensis* and *Mediaster aequalis* in Survey Segment E..

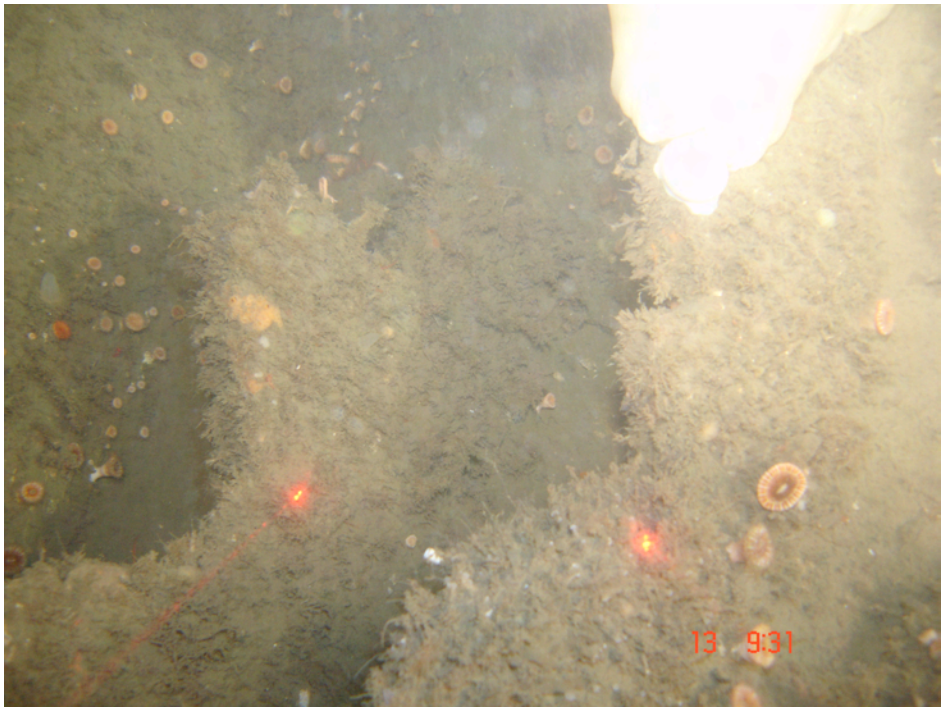

Figure 19: High-relief hard-bottom habitat with turf of Komokoiacea foraminiferans and hydroids, *Metrideum giganteum*, *Balonphyllia elegans* and *Paracyathus stearnsi*, in Survey Segment E.

Paracyathus stearnsi, the California hydrocoral *Stylaster californicus (=Allopora californica)*, the cookie cutter sea star, *Ceramaster patagonicus*, the olive rockfish, *Sebastes serranoides*, and the rosy rockfish, *Sebastes rosaceus*, and the brown rockfish, *Sebastes auriculatus* and juvenile rockfishes.

4.2.4 Effects of Location (Survey Segment) and Habitat Relief

Very few taxa or community parameters of the various hard-bottom substrate surveyed differed significantly between Survey Segments or due to habitat relief (Table 7). Only *Cellaria* sp., encrusting coralline algae, *Metridium farcimen (=giganteum)*, orange encrusting bryozoan, total algal and invertebrate cover and Shannon-Weaver diversity differed significantly among Survey Segments. Survey Segment C had the highest percent cover for encrusting coralline algae and the orange encrusting bryozoan, whereas Survey Segment D had the highest percent cover of *Cellaria* sp. and Survey Segment E had the highest percent cover of *M. giganteum*, total algal and invertebrate percent cover and Shannon-Weaver diversity. Only the ascidian *Cystodytes* sp. and Shannon-Weaver diversity differed significantly between habitat relief categories, with high-relief habitat having the highest mean for each.

In reviewing the video records of the had-bottom habitats within each Survey Segment, a few minor differences were observed. Crinoids were only observed attached to hard substrate in Survey Segment D and although present, few *Metridium* anemones were observed occupying the upper ridges of high-relied features in Segment C.

Due to differing amounts of hard-bottom habitat and varying conditions, different numbers of photographs were suitable for analysis from each hard-bottom area encountered (Table 7). Varying bottom conditions also resulted in different areas captured in each photograph, which resulted in slightly different mean photo areas from each segment. If a higher number of photographs had been suitable for analysis, probably more taxa would have exhibited significant differences between segments and categories of habitat relief.

4.3 Comparison of Biological Surveys

In May-June 1999, SAIC conducted an ROV survey of the seafloor habitat and associated biota offshore Morro Bay, California for the AT&T China-US S-7 and China-US E-1 fiber optic cables (SAIC, 1999). Both of these cables make landfall near the proposed AAG S-5 cable, but transit along slightly different routes through the nearshore region (Figures 1 and 3). The China-US S-7 cable follows a route closest and slightly northward of the AAG S-5 proposed route. Portions of Survey Segments A, B and C of the current survey were surveyed in the 1999 biological survey. The seafloor areas in Survey Segments D, E and F that were observed in the current survey were not surveyed in 1999, but comparable habitats at similar depths were.

Differences in survey goals and resulting analytical approaches between the two surveys make direct comparison of reported dominant taxa within the different habitat types difficult. For example, although both studies had the same goal to characterize seafloor habitat and associated marine biota, the SAIC study had as a primary focus of their endeavor "…to provide quantitative information on species of potential concern in high-relief areas". As a result, they only conducted quantitative analysis of epibenthic communities in high-relief hard-substrate areas. Low-relief hard bottom and soft-sediment areas were analyzed solely for species presence/absence. However, as requested by California State Lands Commission staff, the current study focused on identifying the various soft-substrate and hard-bottom habitats along the surveyed cable route and the characterization of marine biota within each varying substrate. This resulted in the delineation of the various encountered seafloor habitats into

Table 7. Analysis of variance results for effects of location and habitat relief on the percent cover of hard-bottom organisms. Tukeys results indicate the categories between which significant differences exist. The category with the highest mean is to the left and that with the lowest mean in to the right.

	Model	Segment		Habitat Relief	
Taxon	r^2	*p*	**Tukey results**	*p*	**Tukeys results**
Asterina miniata	0.05	0.9654	D = C = E[1]	0.2422	L = H[2]
Balanophyllia elegans	0.01	0.9985	D = C = E	0.6846	L = H
Bryozoan, orange branching	0.08	0.3757	D = C = E	0.4278	L = H
Bryozoan, orange encrusting	0.16	0.0225	C = D, C > E, D = E	0.3193	H = R
Bryozoan, pink encrusting	0.02	0.6442	E = D = C	0.6129	L = H
Calliostoma annulatum	0.04	0.6225	D = C = E	0.5826	L = H
Cellaria sp.	0.17	0.0253	D = E, D > C, E = C	0.8115	L = H
Coralline algae, encrusting	0.30	0.0004	C > D = E	0.3549	L = H
Corynactis californica	0.08	0.2742	C = D = E	0.1655	H = L
Cystodytes sp.	0.12	0.1033	D = C = E	0.0496	H > R
Dermasterias imbricata	0.04	0.6225	D = C = E	0.5826	L = H
Hydroid, branched	0.04	0.6225	D = C = E	0.5826	L = H
Hydroid, plumed	0.02	0.6489	D = E = C	0.6057	H = R
Lophogorgia chiliensis	0.19	0.0541	E = D = C	0.5418	H = L
Mediaster aequalis	0.06	0.3761	E = C = D	1.0000	H = L
Metridium farcimen (= giganteum)	0.79	<0.0001	E > D = C	0.4621	H = L
Ophiocantha diplasia	0.08	0.4400	E = D = C	0.1232	H = L
Ophiothrix spiculata	0.09	0.3668	D = C = E	0.4221	L = H
Orthasterias koehleri	0.08	0.2742	C = D = E	0.1655	H = L
Paracyathus stearnsi	0.07	0.3768	D = C = E	0.8964	L = H
Pisaster giganteus	0.05	0.7888	E = C = D	0.2684	H = L
Polyclinum planum	0.04	0.6225	D = C = E	0.5826	L = H
Tethya aurantia	0.08	0.4178	D = C = E	0.4544	L = H
Tube worm, plumed	0.04	0.6225	D = C = E	0.5826	L = H
Urticina lofotensis	0.08	0.2742	C = D = E	0.1655	H = L
Sponge, yellow lumpy	0.12	0.1510	E = C = D	1.0000	H = L
Total algal and invertebrate cover	0.19	0.0440	E = D, E > C, D = C	0.9275	H = L
Total number of taxa	0.08	0.1985	D = C = E	0.8420	L = H
Shannon-Weaver Diversity Index	0.42	0.0039	E = D, E > C, D = C	0.0472	H > R

[1] = C, D and E refer to survey segments. [2] = L and H refer to low-relief and high-relief habitat, respectively.

multiple subcategories as well as gathering species abundance data resulting in more discreet information.

Despite these differences, some comparisons between the two studies can be made as follows.

- No observable changes in either marine habitat or associated biota within the nearshore Morro Bay region appear to have occurred over the past eight years based on observable species and similarities in reported habitat occurrence within comparable depth and route segments of the surveyed cable routes.

- Similar epibenthic plants, invertebrates, and fishes were observed in both surveys for both soft-substrate and hard-bottom habitats. Slight differences in species lists, primarily for fishes, could be due to the different times of the year (May-June vs. October) in which the two surveys were conducted, different cable routes crossing slightly different terrain, and different conditions affecting underwater visibility when the surveys were conducted.

- The soft-substrate habitats in the survey region were largely dominated by the same species of sea pens, sea stars, anemones, brittle stars, polychaetes (tube dwelling and free-living), octopuses, crabs, and fish taxa (flatfish) in both surveys.

- Although the 1999 survey did not report results by seafloor habitat types (other than soft or hard bottom) or depth stratifications, as done in the current survey, some similar trends in soft-substrate taxa were reported. These include a gradual transition in sea pen species from *Stylatula elongata* and *Ptilosarchus gurneyi* in the shallower water depths of the cable route to *Virgularia* and *Acanthoptilum* species at the deeper depths.

- Both surveys observed the presence of free-living "fire-worm" polychaetes in the deeper segments of the project area. The previous survey reported their presence at water depths between 89.7-100m (294-328 ft) whereas the current survey observed them beginning slightly deeper at 104m (340 ft).

- Hard-bottom areas in both surveys were dominated by low-growing turf species, cup corals, seastars, encrusting sponges, and bryozoans. Both surveys reported similar occurrence of red algae in the shallower, photic depths, of each survey route and higher abundances of the large anemone, *Metridium farcimen (=giganteum)* in deeper waters.

- Both surveys observed the California hydrocoral, *Stylaster californicus (=Allopora californica),* infrequently in high-relief hard-bottom areas along the three surveyed cable routes.

- The current survey only observed the crinoid, *Florometra,* as part of the epibenthic community inhabiting hard-bottom areas in water depths between 32–76m (105–250ft) whereas the earlier survey reported it from all hard-bottom areas in deeper waters with higher numbers at depths greater than 100m (328 ft.). Since crinoids are a common component of all deeper water offshore hard-bottom habitats in central and southern California, this difference in observations is probably related to slightly different areas surveyed.

5.0 Observations and Conclusions

Based upon the analysis of the digital video and still images collected during the October 11-13, 2007 ROV survey of the nearshore portion of the AT&T AAG S-5 proposed fiber optic cable route offshore Morro Bay, California, the following conclusions and general observations can be made:

- The epibenthic invertebrate, algae, and fish species observed along the proposed cable route are representative of hard-substrate and soft-substrate areas of central California and offshore Morro Bay (SAIC, 1999; Hyland, *et al*, 1994; SAIC and MEC, 1989; Thompson, 1993).

- Of the 14 kilometers of proposed cable route surveyed during the biological reconnaissance survey, the predominant seafloor habitat is soft-substrate (84.8%). Approximately 9.1 % of the survey route encounters sand and exposed cobble, 4.1% contains low-relief hard bottom, and 2.1% contains high-relief hard bottom. Most of the high-relief hard-bottom habitat occurs in Survey Segment C and most of the low-relief hard-bottom habitat occurs in Survey Segment D. One small high-relief feature is present in Survey Segment E, within the 100-m cable right-of-way, but ends 25m south of the centerline.

- The mapping of seafloor habitats observed during the biological reconnaissance survey closely match and corroborate the geophysical seafloor mapping along the cable route.

- The most abundant marine invertebrate taxa observed associating with areas of soft-substrate habitat within the cable route included sea pens, brittle stars, anemones, tube worms, cancer crabs, octopus, sea stars, and a free living polychaete fire worm. Squid were also frequently observed in the water column. The most abundant fish species observed included cuskeels, eelpouts, flatfish, rockfish, poachers, sculpins, pink surfperch, hagfish, and anchovies in the water column.

- Marine taxa observed in hard-bottom habitats consisted mostly of sessile organisms that are restricted to solid substrata. Analysis of photographs using point-contact methods suggested the greatest percent of hard substrata was covered by anemones, bryozoans, sponges, seastars, and cup corals, in descending order of coverage. Also observed in video records from hard-bottom habitat were encrusting coralline algae, a red alga, assorted encrusting and erect sponges, the soft coral *Stylaster californicus (=Allopora californica)*, gorgonians, and several species of crabs. Observed dominant fish taxa included rockfish, cabezon, and greenling.

- Survey Segments A and B, which lie predominantly parallel to the coast in 21.3-30.5m (70-100ft) water depth, consist of soft-sediment habitat regularly exposed to high-energy waves and currents, as indicated by seafloor sediment composition and associated biota. The generally high turbidity noted during the survey and the scoured appearance of the exposed rocks at the southern end of Survey Segment C suggests this region of the fiber optic cable route undergoes frequent disturbance from wave energy. The epibenthic invertebrate community observed in this area was very low in diversity.

- Survey Segment C consists primarily of low-relief and high-relief exposed shelf rock dipping in a southerly direction with individual features trending along a northeast to southwest axis. Much of the exposed low-relief rock in this area appears subject to frequent burial and exposure as exhibited by lower diversity and occurrence of attached organisms dominated by cup corals, large sponges and some species of anemones, which, upon reaching a certain size, are able to extend up through the sediment and survive during substrate burial.

- Survey Segment D contains the greatest diversity of habitats along the cable route. It included low-relief and high-relief hard-bottom areas, mixed sand and cobble, coarse sand formed into large sand waves and troughs, and finer, more heavily bioturbated silt and fine sand. As a result, the associated biota observed along this segment of the proposed cable route was the most diverse, as indicated by the highest numbers of taxa observed in video records.

- Clusters of multiple individuals of the sea star *Pisaster brevispinus* were frequently observed along the sand waves in the shallower portion of Survey Segment D, suggesting the presence of clams.

- The large standing sand waves observed along much of Survey Segment D are a major physical feature in the area. Observations of invertebrate taxa associated with these sand waves suggest they exert substantial influence on organism distributions. Moreover, the sharp delineation between these sand waves and the area of flat bottom observed to the north suggests that these sand waves do not quickly reform after physical disturbance.

- Survey Segment F and all but one small area of E consist of soft sediment substrate composed of finer sands and silts. Between 32-104m (105-340ft) water depths these sediments were highly bioturbated.

- The presence of the free-living "fire worm" polychaete in Survey Segment F, in water depths greater than 104m (340ft), was associated with observable decreases in seafloor bioturbation, and reductions in the numbers of epibenthic invertebrate and fish taxa noted in video records.

- Quantitative data from analysis of photos revealed several differences in organism abundances associated with the relief of hard-bottom habitat and different survey segments, which correlated roughly with water depth. Most notably, encrusting coralline algae were found only in the shallower, more inshore regions of the survey area and coverage of the anemone *M. giganteum* and overall living cover were significantly greater in the deeper, more offshore regions of the survey area than in the shallower, more inshore areas. The Shannon-Weaver diversity index and the coverage of the compound ascidian *Cystodytes* sp. were greatest in photos from high-relief habitat.

- The high-relief hard-bottom feature observed in Survey Segment E is the northernmost extension of a much larger hard-bottom area to the south of the cable route. Although the feature is located within the cable right-of-way, it stops 25m (82 ft) south of the router centerline can be avoided if the cable is laid along the right-of-way centerline or slightly north of the centerline.

- The California coral *Stylaster californicus (=Allopora californica)* appeared infrequently in the high-relief areas in Survey Segments C and D, in water depths less then 80.5m (264ft). The individual specimens observed were small, non-branching, and attached to the sidewalls of the exposed rock features.

- Detrital specimens of surf grass (*Phyllospadix*), bull kelp (*Nereocystis*) and giant kelp (*Macrocystis*) were observed drifting along the seafloor throughout the survey route. However, no surf grass, bull kelp, or giant kelp beds were observed along the cable right-of-way.

- Comparing survey observations and data from the current survey with those previously collected in the area (SAIC, 1999) indicate that no substantial changes in either marine habitat or associated biota appear to have occurred over the past eight years within the nearshore Morro Bay region.

6.0 References & Citation

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7.0 Appendices

Appendix A: Digital Still & Video Files

Table A-1: AT&T Photo and Video Log Summary

Dive #	Survey Segment	Photo #'s	Habitat (HB/SB)	Date	Video Disk	Time	Navigation Fix's
1	E, F	1-49	SB	10/11/07	1,2,3	17:21-22:56	1-97
2	A	5665	SB	10/12/07	4	13:38-14:35	99-104
3	E	5666-5669	SB	"	4,5,6	16:03-16:22	105-109
	E	5670-5673	HB	"	6	16:29-16:44	110-112
	E, D	5674-5687	SB	"	7	16:53-18:48	113-139
	D	5688-5695	HB	"	7	18:59-19:35	140-148
	D	5696-5709	SB	"	7,8	19:37-21:09	149-170
	D	5710-5715	HB	"	8	21:17-21:24	171-175
	D	5716-5730	SB	"	8, 9	21:31-23;03	176-197
	D	5730-5732	HB	"	9	23:03-23:07	199-202
	D	5733-5751	SB	"	9	23:19-01:12	203-226
	D	5752-5773	HB	10/13/07	9	01:13-01:33	227-238
	D, C	5774-5784	SB	"	9,10	01:34-02:35	239-250
	C	5785-5807	HB	"	10	02:39-03:38	251-269
4	A, B	5808-5822	SB	10/13/07	11	05:19-07:01	270-291
	C	5823-5826	HB	"	11	07:04-07;09	292-294
	C	5827	SB	"	12	07:12	295
	C	5828-5860	HB	"	12	07:15-07:56	296-309
5	E	5861-5892	HB	10/13/07	13	09:12-09:36	310-323