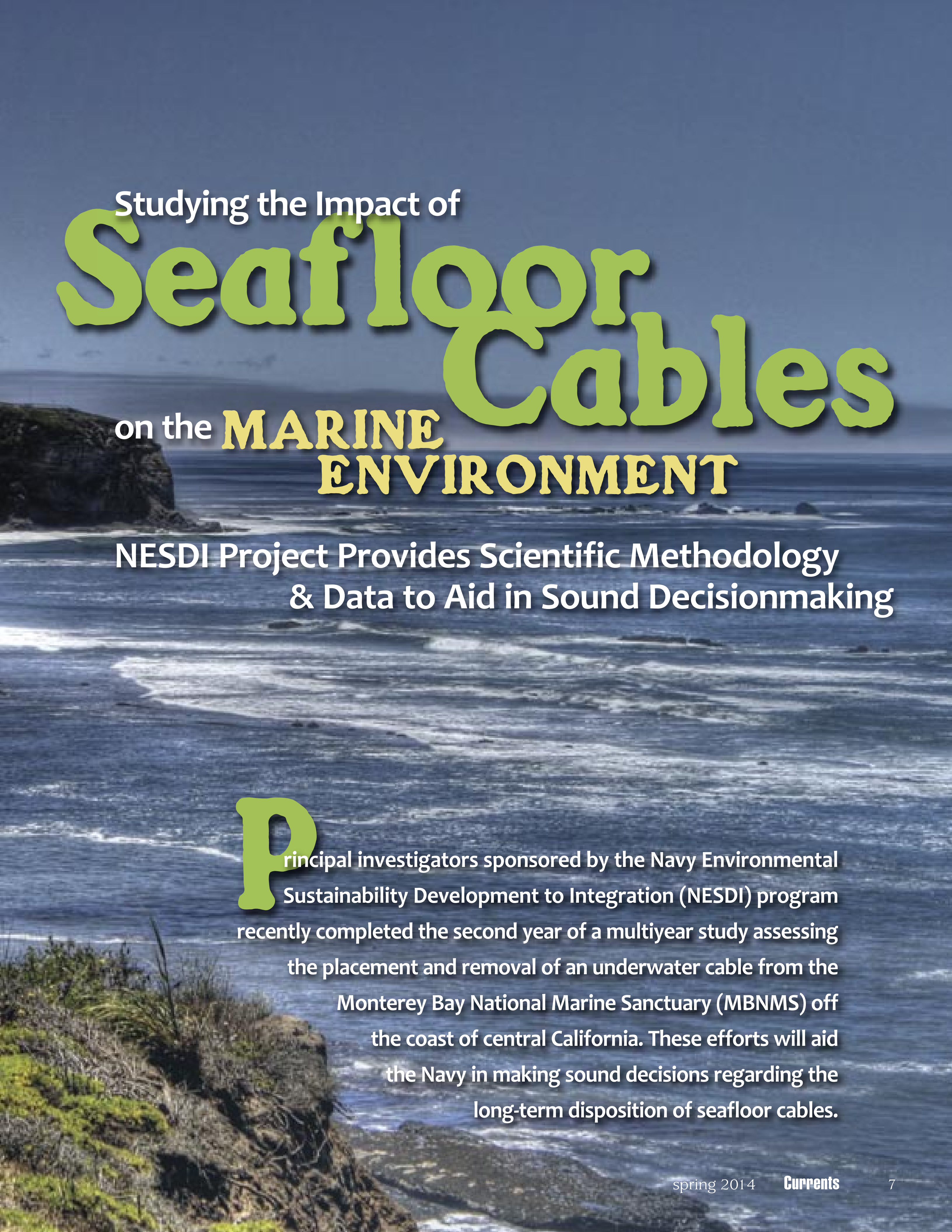
Jack Sutton, Wild Bay Area Photography



Studying the Impact of Seafloor Cables on the Marine Environment

NESDI Project Provides Scientific Methodology & Data to Aid in Sound Decisionmaking

Principal investigators sponsored by the Navy Environmental Sustainability Development to Integration (NESDI) program recently completed the second year of a multiyear study assessing the placement and removal of an underwater cable from the Monterey Bay National Marine Sanctuary (MBNMS) off the coast of central California. These efforts will aid the Navy in making sound decisions regarding the long-term disposition of seafloor cables.

TOP LEFT: One aquarium contained a length of shredded cable in order to represent a "worst-case" scenario where all internal components of the cable were freely exposed to seawater.

TOP RIGHT: Cable components.

LEFT: Cross-section of weathered cable showing copper tube core and armoring steel wires.

Leslie Karr

UNDERWATER CABLES & THE NAVY

In 1858, the U.S. Navy participated in the installation of the first successful transatlantic cable. The USS Niagara and the British naval vessel HMS Agamemnon installed the pioneering telecommunications cable, which stretched from Ireland to Newfoundland and set the stage for instant worldwide communication.

Today, the Navy is responsible for a vast number of installed seafloor cables—estimates exceed 40,000 miles—that provide numerous functions such as communications, at-sea training, and surveillance. These cables periodically need to be repaired, replaced, and upgraded, and new cables must sometimes be installed to meet the changing requirements of the Navy.

The Navy, along with other federal agencies, has regulatory compliance requirements when installing seafloor cables. In response to the increased installation of commercial communications cables in recent years, regulatory agencies and marine sanctuaries have increased their awareness of and permitting requirements for the installation and removal of undersea cables. In some cases, these requirements have effectively blocked planned cable installation routes, and required longer and/or additional routes, which can raise project costs significantly.

Current Navy practice is to leave out-of-service cables in place. While removing undersea cables has the potential to cause environmental, financial, and operational impact, until recently there has been a lack of scientific evidence regarding the impact of undersea cables on the environment. The goal of a NESDI-sponsored study near Half Moon Bay is to add to this body of knowledge by documenting the expected or observed impact of an undersea cable before and after its removal.

SCIENTIFICALLY DEFENSIBLE INFORMATION

The project consisted of two phases—laboratory studies to determine whether cables leach contaminants, and a field study to examine potential environmental impacts from the original placement and removal of one specific cable.

Laboratory results indicated that no metals, other than zinc, were significantly elevated in the test aquariums relative to controls.

PHASE I: THE LABORATORY STUDY

One long-time impetus for the removal of out-of-service cables has been the concern that these cables may leach contaminants of concern into ocean waters. To address this concern, the NESDI program initiated the first phase of its efforts—a laboratory study led by John Kornuc from the Naval Facilities Engineering and Expeditionary Warfare Center (EXWC).

Scientists set up 16 saltwater aquariums to test potential chemical leaching from cables when exposed to seawater under various conditions. Segments of a copper-conductor armored communication cable were used. Researchers added samples of this type of cable, at various ages and conditions, to each tank. Both new cables and cables retrieved from the seafloor after years of use were tested. Tanks contained a bottom substrate, aragonite sand, and some tanks also contained “live rock,” which is ancient coral skeletons colonized by bacteria. Certain tanks also housed test organisms—snails, crabs and other invertebrates—animals considered very sensitive to chemical leaching, particularly copper. Researchers buried some cables in the substrate, while other cables were laid on top of the substrate. One aquarium also contained a length of shredded cable in order to represent a “worst-case” scenario where all internal components of the cable were freely exposed to seawater.

The aquarium water, substrate, and organisms were periodically sampled and analyzed for the presence of metals and organic compounds which would be characteristic of leaching of the cables. Researchers compared these results to baseline values (analytical results prior to the introduction of the cables) and “control” aquariums which did not contain cables. Water samples were taken at three, six and 12 months.

Typical cables contain a copper conductor or optical fibers, steel, polyethylene, nylon, elastomers, and waterblock compounds. Cables which are subject to high-energy environments, such as cables that pass through the surf zone, are often armored with wound steel wire. Due to the corrosive nature of saltwater, this steel wire is typically galvanized—meaning it is coated with a layer of zinc.

Laboratory results indicated that no metals, other than zinc, were significantly elevated in the test aquariums relative to controls. In addition,

THE BASICS ABOUT THE NESDI PROGRAM

THE NESDI PROGRAM seeks to provide solutions by demonstrating, validating and integrating innovative technologies, processes, materials, and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness. The program accomplishes this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

The NESDI program is the Navy’s environmental shoreside (6.4) Research, Development, Test and Evaluation program. The program is sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities Engineering Command out of EXWC in Port Hueneme, California. The program is the Navy’s complement to the Department of Defense’s Environmental Security Technology Certification Program which conducts demonstration and validation of technologies important to the tri-Services, U.S. Environmental Protection Agency and Department of Energy.

For more information, visit the NESDI program web site at www.nesdi.navy.mil or contact Leslie Karr, the NESDI Program Manager at 805-982-1618, DSN: 551-1618 or leslie.karr@navy.mil.

pollutant organic compounds were not detected. Zinc levels were highest in those tanks where new cables were in direct contact with circulating seawater and sat on top of the substrate. The tank containing the new shredded cable had the highest levels of dissolved zinc. Cables which were embedded in the substrate also had significantly elevated levels of zinc, but lagged behind the cables which sat on top of the substrate likely due to decreased diffusion rates. Older cables retrieved from the ocean had lower levels of dissolved zinc, likely due to the decreased zinc content of the armoring from years of previous saltwater exposure.

Interestingly, in those tanks where live rock was present, dissolved zinc levels were substantially lower, by up to about 500-fold. Investigators theorize that bacteria in the rock, and the rock itself (through ion exchange processes) adsorbed the zinc. This is a situation more analogous to what would occur in the ocean. Additionally, algae in these aquariums showed elevated levels of zinc (as opposed to the control tanks), while snails in the tanks showed no increase in zinc levels.

Kornuc emphasized that each aquarium tank test was a closed system and therefore not subject to rapid contaminant dilution effects that exist in the ocean environment. As identified in this study, zinc will most likely be one of the primary drivers in submarine cable risk-based decision-making, but numerous other factors including dilution, cable type, cable condition, and benthic environment, will play major roles.

THE FIELD STUDY: BACKGROUND

The focus of Phase 2 of the project, the field study, was a 96-kilometer-long cable installed in October 1995 off California's central coast.

Although this cable was never directly used by the Navy, it was owned by the Office of Naval Research, and provided to the

ECHOING THE LAB STUDY RESULTS

A LABORATORY STUDY conducted concurrently in Great Britain returned results remarkably similar to the Phase 1 laboratory study. The purpose of this particular study, conducted by Southampton and Bangor Universities for the Isle of Man Department of Agricultural Fisheries and Forestry, was to determine whether abandoned cable was safe to use in the construction of artificial reefs. Tests on new cables indicated that there was some leaching of zinc in the initial stages of the trial, but that this dropped quickly after immersion. Researchers using old, reclaimed cable found that the risk for water pollution actually decreased with the age of the cable. For more insights into this study, visit www.gov.im/lib/docs/daff/Fisheries/cablereefconsultationjun2009.pdf

Diver on the surface above the cable location at Pillar Point.
Jessie Altstatt

Diver Mike Moss prepares to enter the water for the pre-removal survey in May 2011.
Jessie Altstatt

North Pacific Acoustic Laboratory for a project known as the Acoustic Thermometry of Ocean Climate (ATOC) project.

THE ATOC PROJECT

The ATOC project, conducted by a consortium of four academic institutions, set up underwater recording devices in order to monitor ocean temperature fluctuations. The ultimate goal of the project was to test and refine climate models to gain a better understanding of the link between climate change and sea level rise.

The project partners received a permit from the National Marine Sanctuary Program (NMSP) of the National Oceanic and Atmospheric Administration's (NOAA) National Ocean Service to conduct their work. This was necessary because regulations implementing the designation of MBNMS prohibit the disturbance of the seabed without a permit. The permit specified that the permittee (Scripps Oceanographic Institute) must remove the cable prior to 30 September 1997, the original expiration date of the permit. The permit was amended eight times, primarily for the purpose of extending the expiration date, until finally the expiration date was set as December 31, 2001.

On June 22, 2001, NOAA's Office of Oceanic and Atmospheric Research (OAR) filed an application with NMSP, requesting permission to use the cable for 25-30 years to support a passive acoustic monitoring project. In evaluating this request, NMSP learned that no data existed on the condition of the cable and concluded that it could not determine if the impacts of the cable's presence were truly short-term and negligible as is required by MBNMS regulations.

The NMSP determined that the impacts of leaving the cable in place for two additional years were considered short-term and negligible. However, the permit was issued on the condition that OAR agree to survey the cable and obtain data about the effect it was having on MBNMS resources and the environment. OAR partnered with the Monterey Bay Aquarium Research Institute (MBARI) to conduct this survey.

The cable location prior to cable removal showing sponges, hydroids and tunicates.
Jessie Altstatt

Rock Crab (*Cancer productus*) photographed during the two-year post-removal survey.
Jessie Altstatt

Nine stations, or segments of cable were chosen for quantitative comparison with "control" sites—similar areas five to ten meters away where the cable was absent. Survey locations were chosen in both nearshore and deep water locations to target substrate and habitat types, features of interest, and for logistical reasons. Divers collected a total of 42 hours of video footage and 138 sediment samples over 15.1 kilometers of seafloor. Approximately 13 percent of the cable was observed in this manner.

Video observations indicated that most of the nearshore cable had become buried over time in sediment substrates, whereas much of the cable remained exposed on the seafloor at deeper depths. Researchers observed quite a bit of abrasion and fraying in the shallower depths due to high wave energies. Some sharp kinks were observed at deeper depths in areas subject to heavy trawling. No entanglements with fishing gear or marine life were observed.

THE BASICS ABOUT THE MONTEREY BAY NATIONAL MARINE SANCTUARY

LOCATED ALONG THE central California coast between San Francisco and Cambria, the MBNMS is a federally protected marine area. It encompasses 4,600 nautical miles and extends an average of 30 miles from shore. The sanctuary contains the largest kelp forests in the nation, and one of North America's largest underwater canyons—reaching a depth of over two miles. The area harbors a wide variety of marine life, including 34 species of marine mammals, more than 180 species of birds, at least 525 species of fishes, and an abundance of invertebrates and algae.

Recreational activities and commercial fishing are allowed within the MBNMS, but activities such as oil drilling and seabed mining are not. For more about the sanctuary, visit http://montereybay.noaa.gov/intro/welcome.html.

One particular species of anemone was especially numerous, essentially utilizing the cable as a colonization surface similar to outcrops and isolated rocks.

MBARI researchers found abundant sea life attached to the cable at its deepest depths, including anemones, echinoderms (including sea stars and sea urchins) and sponges. One particular species of anemone (*Metridium farcimen*) was especially numerous, essentially utilizing the cable as a colonization surface similar to outcrops and isolated rocks.

The researchers determined that, if left alone, the cable would likely continue to cause abrasion of nearshore rock outcrops, and could snag fishing gear. However, removing the cable would not only cause organism mortality and disturbance, it would also remove an obstacle to trawling, possibly resulting in increased fishing in the area. It was postulated that the removal process would also likely cause rock breakage and beach impacts, effectively destabilizing the area.

However, the environmental assessment prepared as a result of the study also determined that the effects of removal were “expected to be minor and short term” with “few (if any) uncertainties.” However, “little is known about the long-term impacts of leaving the cable abandoned in the Monterey Bay National Marine Sanctuary.” For these reasons, the decision was made to remove the cable.

More about this effort can be found at www.mbari.org/news/publications/ATOC.pdf

MEANWHILE IN SOUTHERN CALIFORNIA

In 2010, EXWC initiated a NESDI-funded project to determine the effects of cable installation, presence and removal. This comprehensive project, “Environmental Analysis of Seafloor Cables,” provided background information on the composition, installation, maintenance, and repair of seafloor cables, and reviewed case studies to determine the environmental fate, effects, and final disposition of seafloor cables.

A literature review identified the main areas of concern among regulators in regard to seafloor cables:

1. Cable motion on the seafloor could produce long-term adverse modification of hard-bottom substrates and associated biological communities.
2. Unburied cables could pose potential entanglement issues with fishing gear and marine mammals.
3. There may be conflicts with the installation and operation of new submarine cables in the vicinity of an out-of-service cable.
4. There could be chemical leaching from cable constituents into the surrounding media.

To address concerns regarding the impacts of cable motion on hard-bottom substrates and associated biological communities, regulators now require installers to avoid high-relief outcrops and sensitive species (deep-water corals) whenever possible. If interaction with these sensitive species is unavoidable, monetary compensation may be required.

CONTINUED ON PAGE 16.

Frilled dogwelks (*Nucella lamellosa*) and a Leather Star (*Dermssterias imbricata*) found during the one-year post-removal survey.
Jessie Altstatt

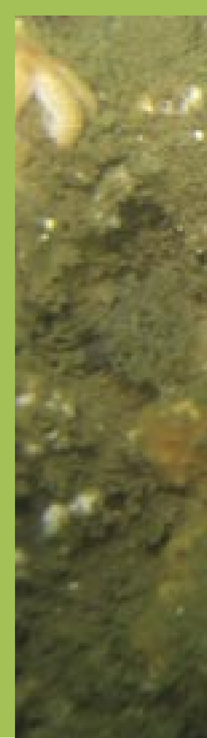
Typical sea life in the area included sea stars and sponges. This photo was taken before cable removal.

Sea star attached to the cable just prior to removal.

Frilled Dogwelk (*Nucella lamellosa*) aggregation with eggs photographed during the two-year post-removal survey.

The initial pre-survey performed by divers in May, 2011 was in near zero visibility.

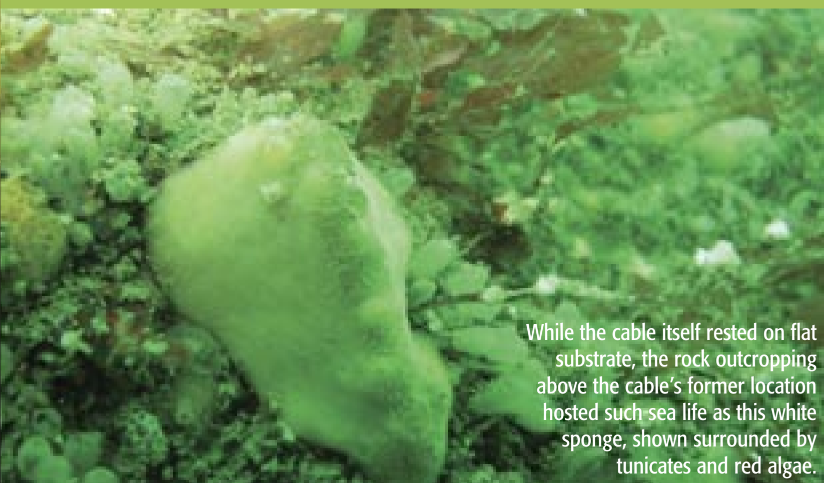
Nudibranch (snail without a shell) among tunicates and the miscellaneous invertebrate and plant matrix that colonized the rock outcropping above the cable location.



Stubby Rose Anemone (*Urticinna coriacea*) found during the one-year post-removal survey.

Juvenile sea star (*Pisaster spp.*) feeding on barnacles attached to the in-shore cable before it was removed in July 2011.

High relief rock substrate with orange sponge, red foliose algae and other invertebrates. This photo was taken one year post-removal.



While the cable itself rested on flat substrate, the rock outcropping above the cable's former location hosted such sea life as this white sponge, shown surrounded by tunicates and red algae.

A white sponge, algae, and miscellaneous invertebrate and plant life that colonized the area above the former cable location. This photo was taken one month after the cable's removal.

Nudibranch on a rock outcropping adjacent to the cable location. This photo was taken just prior to cable removal in July 2011.

Jessie Altstatt

The cable's former location as seen in September, 2013. Fragile, low-lying siltstone shows signs of side-to-side abrasion.
Jessie Altstatt

One year after the cable's removal, the former site shows signs of abrasion and regrowth.
Jessie Altstatt

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With regard to possible entanglement issues, a 2008 study found that modern cable installation techniques have virtually eliminated the entanglement risk to marine mammals. (Wood, Matthew Peter and Lionel Carter. 2008. "Whale Entanglements with Submarine Telecommunication Cables," Institute of Electrical and Electronics Engineers Journal of Oceanic Engineering, vol. 33, no. 4, 445-450.) There have been no whale entanglements since 1959.

Undersea cable does sometimes pose an impediment to fishing practices, particularly trawling. In some cases commercial or recreational fishermen have also lost gear due to entanglement issues. The resolution of these issues has typically been negotiated through agreements between cable stakeholders and the affected fisheries.

Potential conflicts with the installation and operation of new submarine cables in the vicinity of an out-of-service cable is still and will continue to be an issue.

The possible chemical leaching from cable constituents into the surrounding media was addressed in the NESDI project described above.

Like the MBARI study before it, "Environmental Analysis of Seafloor Cables" concluded that "The evidence is clear that submarine cables provide a substrate for the attachment of marine biota." It also pointed out that cable removal can have a variety of negative environmental impacts. The study reported that cables can often be repurposed without removal, saving significant amounts of money and impact to the environment. However, the team stressed the need for continued laboratory and field research, including efforts like the NESDI-sponsored ATOC cable study in MBNMS discussed below. This report will be available in mid-2014 for download from the NESDI web site at www.nesdi.navy.mil (username and password required) or by contacting John Kornuc.

DEEP WATER REMOVAL

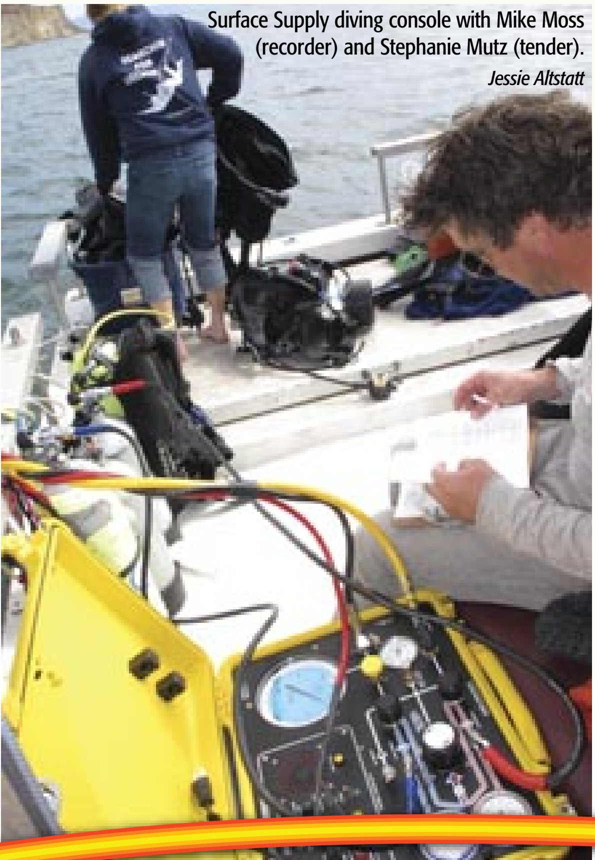
The ATOC cable removal operation was performed in accordance with a Memorandum of Understanding (MOU) established on June 25, 2010 between NOAA and Naval Facilities Engineering Command Engineering Service Center (now EXWC), and under the guidelines of NOAA permit MBNMS-2001- 031.

The removal process occurred in two phases. The offshore portion of the cable was removed first, in November 2010, utilizing the International Telecom (IT)

Modern cable installation techniques have virtually eliminated the entanglement risk to marine mammals.

cable ship Intrepid. The IT Intrepid recovered the cable over the bow using a cable drum. Standard procedure is for the cable to be stored in large circular tanks below deck until the ship visits a port of convenience, where the segments can be offloaded and recycled by the contractor. The offshore cable, with the exception of three pre-existing breaks, was recovered in good condition. There was abundant sea life attached to the entire length of this cable, including a large species of anemone.

The objective of this operation was to remove as much of the cable as possible. However, about one kilometer of nearshore cable remained in water too shallow for the Intrepid to navigate. This section of cable, scheduled for removal in June 2011, was the site of the NESDI-sponsored pre- and post-removal studies.



Surface Supply diving console with Mike Moss (recorder) and Stephanie Mutz (tender).
Jessie Altstatt

THE NEARSHORE FIELD STUDY

The second phase of the NESDI study evaluated the benthic (seafloor) environment in the nearshore portion of the cable before and after its scheduled removal. Scientific divers implemented various accepted marine ecology survey methods to examine the habitat and associated biological communities along the cable and adjacent areas. Methods included a comparative approach similar to those used by the MBARI team. The study consisted of a total of five dive survey events (of two to four days each) and are referred to below as the Pre-Survey, Pre/Post-Removal Surveys, One Year Post-Removal Survey, and Two Year Post-Removal Survey.

Pre-Survey

Scientific divers were mobilized on May 22, 2011 to locate the cable and perform an initial assessment of the benthic environment. The nearshore portion of the ATOC cable was in a high-energy location subject to high wave action and frequent storms. Consequently, the initial pre-survey performed by divers was in near zero visibility conditions and the four follow-on survey events had to be planned carefully to string together even a few days of acceptable dive conditions. The pre-survey concentrated on locating and mapping the cable location and evaluating locations for the establishment of memorialized survey locations. Once the cable was located and marked,

Research Vessel Susie II at anchor on a calm day. On deck are lead scientist Derek Lerma and scientific divers Mike Moss and Stephanie Mutz.
Jessie Altstatt

NAVFAC SW personnel aboard the NR-1 (22-foot Boston Whaler) outside of Ross's Cove above the ATOC location.
Jessie Altstatt

Abundant sea life was attached to the deep water cable.
Jessie Altstatt

single beam sonar soundings were conducted from a Boston Whaler along diver-positioned buoys to map the cable path (GPS coordinates), depth, and surrounding substrate.

Divers documented the cable lying along the bottom on rock and sand or intermittently suspended between substrate. Some rock deformation and sand burial was observed in relation to the cable. Divers noted that the cable's position tended to settle among the low points of the rock, and the rock-sand interface appeared frequently disturbed from wave action and sand movement. Biological communities on or adjacent to the cable were relatively low in density and diversity relative to nearby high-relief substrate. The physical movement of the cable was documented to cause noticeable impacts to the substrate and associated biota at less than a one-meter scale. Based on pre-survey observations, researchers determined that the habitat along the nearshore portion of the cable experienced significant scouring from persistent wave action and suspended sand/debris from the shoreward beach, to a degree that no perennial macroalgae communities occur or become established.

Pre/Post-Removal Surveys

As this portion of the cable was removed in July 2011, pre/post cable removal surveys were conducted in the July and August 2011 timeframe. Survey methods included a band transect method and point contact method, conducted by the divers. Both methods involved studying a specific length of the cable and comparing it to a reference site (where cable was absent) two to five meters away on a parallel trajectory.

The point contact method involves laying down a weighted measuring tape across the cable and quantifying organisms and substrate type a set distance on either side of the cable. Divers made visual observations of the types of organisms found along these memorialized transects to document potential impacts and recolonizations after the cable was removed. This method provides a general measure of the density and diversity of various types of sessile (attached) marine life.

The band transect method is a broader mode of observation designed to quantify motile (mobile) invertebrates or species with clumped distributions. In this process, the area to be surveyed is divided into four meter by one meter sections or transects. Selected key species or target species representative of the surrounding habitat are individually counted and recorded. For more details, see the sidebar entitled "Survey Methods."

The findings from both of these surveys were subjected to statistical analyses to discern differences in the cable versus reference transect, and between the cable area both pre- and post-removal. Species composition and diversity between cable and control sites were similar and observations of adjacent areas confirmed that the documented habitat extended at least 200 meters north and south of the survey sites.

Differences in species composition between the cable and adjacent habitat were not significant and showed that the cable served as similar habitat and supported like biological communities.

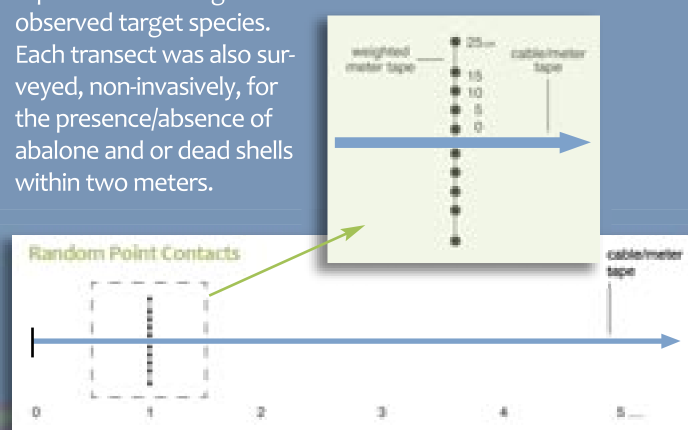
SURVEY METHODS

THE INITIAL STUDY design assumed a rocky reef macroalgae (kelp) environment supporting common central California coast marine invertebrates and fish. Because of the physically disturbed nature of the habitat and relatively low density of biological communities identified in the pre-survey, a modified fine scale comparative approach was adopted to document both the pre-removal and post-removal condition of the biological communities adjacent to the cable and at reference transects. This methodology was similar to that utilized in the MBARI study discussed above.

The band transect method utilizes 10 paired (1 x 4 meter) contiguous transects on opposite sides of the cable, totaling 80 square meters per transect study area. For each dive event of several days, the two cable and reference transects were enumerated for all occurrences of target macroalgae and macro invertebrate species.

The point contact methodology utilized a 50-centimeter (cm) piece of weighted marked lead line that is laid perpendicular to transects at each meter mark along a transect tape. Divers use this line as a guide to identify and record attached species, assemblages, and substrate immediately adjacent to the cable on either side at distances of 5, 10, 15, and 25 cm from the cable. Ten points are inspected at each meter mark, and each transect length was 40 meters, resulting in a total of 400 inspection points per transect. An additional three cable inspection points per meter were also added to capture species residing directly on the cable. The point contact methodology recorded the substrate at each point and incorporated a wide variety of sessile species (those that live exclusively on substrate) and assemblages (species groups). Due to the large volume of data collected by the point contact method, sampling was performed using surface supply diving equipment fitted with underwater communications that expedited data collection and improved safety.

Photo imagery from scientific divers was used to document all transects as well as the cable's path from its offshore terminus end shoreward to the extent practicable. Divers photographed each transect and captured representative images of observed target species. Each transect was also surveyed, non-invasively, for the presence/absence of abalone and or dead shells within two meters.



Data on macro invertebrate species diversity and density were similar for both treatment and reference transects. The primary motile macroinvertebrate species consisted of sea stars and a predatory dogwinkle (snail) capable of subsisting in a physically demanding environment. The low density and diversity of macro invertebrate species recorded during band transects was consistent with observations from general species list surveys.

North part of Ross's Cove as seen from the cliff just north of Pillar Point.
Jessie Altstatt

In most cases, the weight of the cable, in conjunction with the frequent changes to the bottom topography and self-burial within sand channels, greatly restricted the cable's movement and subsequent impacts to the surrounding biological communities. However, in some locations, damage to the cable and abrasion of rock due to cable strumming (vibration) had occurred.

Based on the observations of the cable's position along the seabed and an analysis of the data, differences between the cable and reference transect were a function of cable abrasion along rock surfaces. Divers found a significantly higher degree of plant life (filamentous diatoms) on the cable transects versus the reference transects. This is likely due to the fact that these life forms quickly colonize space made available from cable abrasion. The significant differences in percent cover of all sessile invertebrates calculated from the point contact method support the same conclusion.

The Removal Process

The nearshore cable removal planning and field operation was performed by EXWC's Ocean Facilities Department, the Navy's Underwater Construction Team 2 (UCT 2) with the added support of Pillar Point Harbor personnel and contractor work boat and hauling/disposal equipment and services. The cable was removed between July 18 and July 23, 2011. Work was performed in a manner calculated to have minimal impact on the seabed and beach. The first step was to cut the cable loose from its onshore anchor (four to six feet underground) and to dig out the rest of the underground section up to the waterline. The undersea portion of the cable was pulled aboard a fishing vessel utilizing a large winch device. The cable was cut into 22-foot sections, bundled, and delivered to Pillar Point Harbor for delivery to a salvage container.

One Year Post-Removal Survey

One year after the cable was removed, divers returned to survey the cable's former footprint and the previously established cable and reference transects. Their main goal was to monitor changes in the density and richness of the benthic environment. Percent cover of sessile species and assemblages remained low in density and species richness, similar to results from the 2011 surveys. Overall, changes in percent cover of species or assemblages were greatest for the miscellaneous plant, miscellaneous invertebrate, and bare substrate categories and were similar for both cable and reference transects. Similar to 2011, no canopy-forming macroalgae were found during the 2012 post removal surveys.

Changes in species or assemblage percent cover between pre- and post-removal surveys displayed mostly a redistribution of percent cover among lower level biological communities; miscellaneous plants, miscellaneous invertebrates and bare substrate categories or assemblages. Seasonal vari-

Differences in species composition between the cable and adjacent habitat were not significant.

ability of percent cover of these categories or assemblages within the project footprint are likely much greater than impacts associated with the cable's movement or removal. Changes in percent cover of sessile species occupying low relief or flat rock substrate documented from pre removal to one year post removal surveys were likely a result of covering by the dominant assemblages rather than disturbance from the cable or its removal. Similar trends in species composition and percent cover were observed for both cable and reference transects in most cases.

The two year post-removal survey, completed in September 2013, returned similar results. All three surveys are currently being incorporated into the project's final report.

CONCLUSIONS

Overall, the biological impacts of the presence or removal of the ATOC cable are minor, particularly in the context of high-energy environmental conditions within the nearshore region of this area. The likelihood of the presence of sensitive biological resources within the observed inshore portion of the ATOC cable both past and present are low based on collected data and biologist observations. Impacts from submarine cables on the subtidal marine environment are a function of the value and complexity of the surrounding biological assemblages.

The ATOC cable was placed within a high-energy environment that was detrimental to the cable's function and subsistence but also avoided valuable biological resources and communities. The consistency of the study results in terms of species diversity, density and distribution in the pre- and post-removal surveys provided evidence that the proper methodology is in place to document the differences in and/or recovery of these communities after cable removal. The methods utilized in this survey can potentially provide an effective blueprint for future efforts in this type of high-energy nearshore environment. ⚓

Note: Once the laboratory studies described in this article were completed, Bill Major, formerly with EXWC, was the driving force behind the execution, analysis and documentation of the cable removal efforts. Bill also made significant contributions to this article before his retirement at the end of 2013.

THE BASICS ON THE NAVAL SEAFLOOR CABLE PROTECTION OFFICE

THE NAVAL SEAFLOOR Cable Protection Office (NSCPO) is the primary initial point of contact within the Navy for cable concerns related to marine policy and encroachment, environmental planning, seafloor deconfliction, and technical issues. The NSCPO participates in national and international forums with the commercial undersea cable industry and other government agencies. In addition, NSCPO represents the interests of Navy cable owners in policy discussions with all levels of United States government.

The NSCPO was created in 2000 by the Naval Facilities Engineering Command to address the increasing number of cable breaks. During the late 1990's, the Navy was averaging 10 breaks per year.

Part of the office's success is due to the database that NSCPO developed to pinpoint the location of all Navy-controlled seafloor cable and to track inquiries. Through this database, the NSCPO is uniquely positioned to answer queries from commercial cable owners, planners, surveyors and installation contractors in order to minimize possible damage to Navy cable systems.

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