CHAPTER SEVEN

THE RELATIONSHIP BETWEEN SUBMARINE CABLES AND THE MARINE ENVIRONMENT

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Introduction

There has been a perception that submarine cables and cable operations have a negative impact on the marine environment.[1] While there are inevitably interactions between the environment and cables, they are not necessarily detrimental. This Chapter examines those cable/environment interactions. It then discusses whether the trend of increasing coastal State environmental regulations on cable operations are consistent with international law and the 1982 UN Convention on the Law of the Sea (UNCLOS) and, equally as important, whether these regulations are necessary to protect the marine environment.

I. Interactions Between Submarine Cables and the Environment

The interactions of submarine power and telecommunications cables with the marine environment can be viewed in the context of water depth and cable size. In depths > ~2000 m, i.e. a nominal limit for bottom trawl fishing,[2] the diameter of a telecommunications fiber optic cable is between 17–22 mm, which is about the size of a garden hose (see Figure 1.4). These cables are laid directly on the seabed. Hence they have a small physical footprint, especially when viewed in a global context as depths > ~2000 m constitute 84 per cent of the world's ocean. Telecommunications cables in waters < ~2000 m depth can be up to 50 mm diameter due to the addition of protective wire armor. Submarine power cables,

1 See for example, A. Freiwald *et al.*, "Cold-water Coral Reefs: Out of Sight—No Longer out of Mind" (2004) UNEP–WCMC, United Nations Environment Programme (UNEP) Biodiversity Series, at 84, available at http://www.unep-wcmc.org/medialibrary/2010/09/10/29fefd54/CWC.pdf (last accessed 7 June 2013).

2 For example, P. Mole *et al.*, "Cable Protection—Solutions Through New Installation and Burial Approaches" Conference Proceedings of SubOptic, 11–16 May 1997, San Francisco at 750–757.

which at present are laid no deeper than ~1600 m, are larger than telecommunications cables, with diameters ranging between 70–150 mm although they can be up to 300 mm. The following sections will examine the different operations relating to these small, deep and larger, shallow cables and their interactions with benthic settings.

Cable Route Surveys

The main tools used for cable route surveys are acoustic instruments such as echo-sounders, multibeam or seabed mapping systems, commercial side-scan sonars and, in areas where cables are to be buried, acoustic sub-bottom profilers. These survey tools are guided by accurate navigation from satellite-based Global Positioning System (GPS) and Differential GPS. High frequency and low energy survey systems are generally used during the surveys. This is because surveys focus on the depth, topography and composition of the seabed surface and also gather information on sediments immediately below the seabed. Our knowledge of the effects of surveys and other human-made acoustics on marine animals is incomplete,[3] but available data suggest that the risk associated with cable route survey instruments is minor.[4] This contrasts with some high energy naval sonar systems that produce prolonged acoustic pulses in mid-range frequencies. Such systems have been implicated with the stranding of certain whale species[5] and are the focus of considerable and ongoing research.[6]

To verify the acoustic data and imagery, photographic or video records of the seabed may be collected by survey vessel or divers (where depths permit). These tools are non-invasive. Sediment samples from the seabed may also be required and these are collected by small grabs that typically recover samples of up to a few kilograms. To verify seismic records, physical testing of the substrate is becoming the norm. The prime instrument is the cone penetrometer, which measures the sediment strength by the resistance encountered as a rod is pushed

3 Refer National Research Council, "Ocean Noise and Marine Mammals" (2003) Committee on Potential Impacts of Ambient Noise in the Ocean on Marine Mammals, Ocean Studies Board, National Academies Press, Washington DC, www.nap.edu (last accessed 7 June 2013).

4 "Impacts of Marine Acoustic Technology on the Antarctic Environment" Version 1.2 July 2002, SCAR Ad Hoc Group of Marine Acoustic Technology and the Environment, available at http://www.geoscience.scar.org/geophysics/acoustics_1_2.pdf (last accessed 7 June 2013).

5 A. Fernández *et al.*, "'Gas and Fat Embolic Syndrome' Involving a Mass Stranding of Beaked Whales (Family Ziphiidae) Exposed to Anthropogenic Sonar Signals" (2005) 42 *Veterinary Pathology* at 446–457.

6 D.E. Claridge, "Providing Field Support for the Behavior Response Study (BRS-07)" (2007) available at http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA505862; see also Physorg.com "Sperm Whales in Gulf Seemingly Unaffected by Distant Seismic Sounds" (2008) Oregon State University, http://www.physorg.com/news138545651.html (last accessed 7 June 2013).

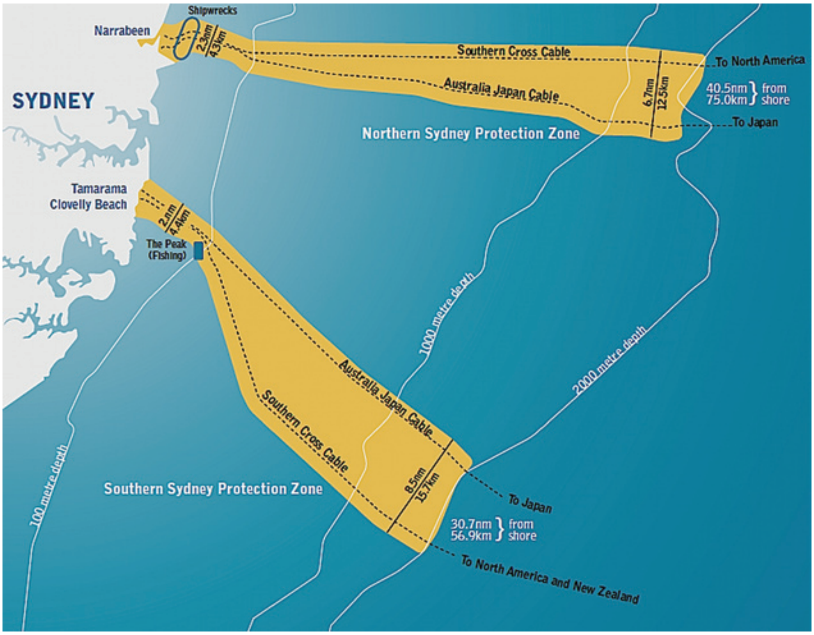

Figure 7.1 Established telecommunications cable protection zones (yellow) extending from shore to the 2000 m depth contour off New South Wales, Australia. Locations of zones are freely available on charts and brochures for all seabed users. (Image courtesy of the Australian Communications and Media Authority (ACMA))

~5 m into the seabed. If required, sub-seabed samples may be collected by coring, but this is usually kept to a minimum reflecting the high quality of modern acoustic and penetrometer information. Accordingly, the physical impact to the seabed and subsoil by cable route surveys is minimal.

Surface Laid Cables

Telecommunication and power cables are routinely laid on the seabed in water depths > ~2000 m, which is beyond the main zone of human activities. However, surface-laid telecommunications and power cables may also occur in depths shallower than ~2000 m where the seabed is unsuitable for burial, such as in areas of submarine rock outcrops and high ecological sensitivity. They may also be located in an effectively policed and legally designated *cable protection zone*[7]

[7] Australian Communications and Media Authority (ACMA), New South Wales Protection Zones, available at http://www.acma.gov.au/Industry/Telco/Infrastructure/Submarine-cabling-and-protection-zones/nsw-protection-zones-submarine-cable-zones-i-acma (last accessed 7 June 2013).

(such as those depicted in Figure 7.1). In particularly hazardous shallow areas, power and telecommunications cables may be afforded additional protection via coverings made from carefully emplaced rocks or concrete mats or by placement of the cable within articulated iron pipes (Figures 13.5 and 13.6).[8]

Interactions with Water and Sediment

Telecommunication and power cables crossing the continental shelf (this being the submarine plain that slopes gently seaward from the shore to an average depth of ~130 m) can be exposed to strong currents and wave action that are capable of instigating sediment transport on time scales of hours to months to years. During storms, the increased wind and wave forces greatly enhance sediment erosion and transport. Such processes can undermine, exhume and bury cables.[9] Undermining can create cable suspensions that sway and strum under strong currents thus inducing serving fatigue as well as abrasion where suspensions are supported by rocky promontories.[10] Where cable suspensions are stable and long-lived, as in the case of power cables laid in Cook Strait, New Zealand, they can become cemented to the rock by encrusting organisms—a stabilizing effect that may be offset by increased water drag on the suspension due to an enlarged profile caused by the biological growth.

In zones of moderate wave/current action, cables may self-bury into soft sediment under turbulence induced by passing currents. Burial also occurs as a migrating sand wave passes across a cable; a process that may be followed by exhumation under the next sand wave trough. The temporary nature of burial is apparent in water depths of < ~30 m where storm-forced waves and currents can temporarily remove the sand blanket to expose a cable; a process that may be followed by fair-weather burial as sediment naturally accumulates.[11] Finally, high discharge rivers produce zones of high sediment accumulation that enhances

8 Transpower and Ministry of Transport, Cook Strait Submarine Cable Protection booklet (2011) at 16 available at https://www.transpower.co.nz/resources/cook-strait-cable-booklet; see also International Cable Protection Committee (ICPC), 'About Submarine Power Cables', accessed through the "Information" button on the ICPC webpage at http://www.iscpc.org/ (last accessed 7 June 2013); and CEE, "Basslink Marine Biological Monitoring, McGauran's Beach" (2007) Report to Enesar Consulting at 43. Available on request from Senior author.

9 P. Allan, "Cable Security in Sandwaves" Paper presented at the International Cable Protection Committee Plenary, May 2000, Copenhagen; L. Carter and K. Lewis, "Variability of the Modern Sand Cover on a Tide and Storm Driven Inner Shelf, South Wellington, New Zealand" (1995) 38 *New Zealand Journal of Geology and Geophysics* 451–470; see also L. Carter *et al.*, "Seafloor Stability along the Cook Strait Power Cable Corridor" (1991) Proceedings of the 10th Australasian Conference on Coastal and Ocean Engineering 565–570.

10 I. Kogan *et al.*, "ATOC/Pioneer Seamount Cable After 8 Years on the Seafloor: Observations, Environmental Impact" (2006) 26 *Continental Shelf Research* 771–787.

11 L. Carter and K. Lewis *supra* note 9.

natural cable burial. High sediment accumulation is frequently associated with mountainous regions near actively colliding tectonic plates.[12] Unfortunately, such areas tend to be earthquake prone thus raising the spectre of hazardous submarine landslides and turbidity currents[13] as well as cable-damaging floods.[14]

Interactions with Marine Biota

Any effect of cables on marine biota can be assessed (i) by biological census taken before and after a cable installation,[15] or in the case of an existing cable, (ii) by comparative analyses of the biota near to and distant from a cable.[16] These quantitative studies show that surface laid cables have little or no impact on the resident fauna and flora. On the basis of extensive video coverage and 138 sediment cores Kogan *et al.* in a 2006 study found no statistical difference in the distribution and abundance of animals dwelling within 1 m and 100 m of a coaxial telecommunications cable.[17] Grannis also recorded no significant change in fauna living in the soft sediment near to and away from a fiber optic cable.[18] Likewise, Andrulewicz *et al.* revealed no change in the composition, biomass and abundance of benthic animals preceding and following deployment of a power cable.[19]

By providing a firm substrate, cables can become sites of marine encrustation (see Figure 7.2), as observed (i) off California where anenomes, typical of rocky substrates, were found confined to a coaxial cable traversing a soft muddy substrate that is unsuitable for such animals, (ii) in Cook Strait, (iii) in Bass Strait where articulated pipe cable protection has a biological mantle similar to that of surrounding rocks,[20] and (iv) in many other areas.

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12 J.D. Milliman and J.P.M. Syvitski, "Geomorphic/Tectonic Control of Sediment Discharge to the Ocean: the Importance of Small, Mountainous Rivers" (1992) 100 *Journal of Geology* 525–544.

13 S.-K. Hsu *et al.*, "Turbidity Currents, Submarine Landslides and the 2006 Pingtung Earthquake off SW Taiwan" (2006) 19(6) *Terrestrial, Atmospheric & Oceanic Science* 767–772.

14 L. Carter *et al.*, "Near-synchronous and Delayed Initiation of Long Run-out Submarine Sediment Flows from a Record-breaking River Flood, Offshore Taiwan" (2012) 39 *Geophysical Research Letters* L12603.

15 E. Andrulewicz *et al.*, "The Environmental Effects of the Installation and Functioning of the Submarine *SwePol Link* HVDC Transmission Line: A Case Study of the Polish Marine Area of the Baltic Sea" (2003) 49(4) *Journal of Sea Research* 337–345.

16 Kogan *et al.*, *supra* note 10; see also B.M. Grannis "Impacts of Mobile Fishing Gear and a Buried Fiber-optic Cable on Soft-sediment Benthic Community Structure" (2001) M. Sc. Thesis, University of Maine, at 100.

17 See Kogan *et al.*, *supra* note 10.

18 See Grannis *supra* note 16.

19 See Andrulewicz *et al.*, *supra* note 15.

20 See ICPC *supra* note 8 'About Submarine Cables'.

Figure 7.2 Delicate encrustations of coral and coralline algae on a fiber optic telecommunications cable. (Photograph courtesy of G. Rivera and S. Drew)

Historically, organisms encrusted on recovered communications cables have contributed to our knowledge of the marine biota, especially that of the deep ocean (> ~2000 m depth), which occupies almost 60 per cent of the planet's surface and even today, is still largely unexplored.[21]

Surface laid cables are exposed to fish and marine mammals; a situation that came to the fore during the telegraphic cable era when 16 cable faults were attributed to whale entanglements recorded between 1877 and 1955. Thirteen faults resulted from sperm whales, which were identified by their entangled remains; the remaining faults were attributed to a humpback whale, killer whale and an unknown species.[22] Most faults occurred near the edge of the continental shelf and adjacent continental slope where telegraphic cables had been repaired. This led to speculation that the repairs produced coils or loops that subsequently ensnared the whales. However, with the replacement of submarine telegraphic cables by coaxial cables in the 1950s, whale entanglements ceased. This continued to be the case throughout the fiber optic cable era, which began in the mid

21 P.M. Ralph and D.F. Squires, "The Extant Scleractinian Corals of New Zealand" (1962) 29 Zoology Publications from Victoria University of Wellington 1–19; see also C.D. Levings and N.G. McDaniel, "A Unique Collection of Baseline Biological Data: Benthic Invertebrates from an Underwater Cable Across the Strait of Georgia" (1974) Fisheries Research Board of Canada, Technical Report 441 at 19.

22 B.C. Heezen, "Whales Entangled in Deep Sea Cables" (1957) 4 *Deep-Sea Research* 105–115; see also B.C. Heezen and G.L. Johnson, "Alaskan Submarine Cables: A Struggle with a Harsh Environment" (1969) 22(4) *Arctic* 413–424.

1980s.[23] The marked change reflects technological advances in cable design, surveying and laying: (i) cables are now torsionally balanced—an improvement that reduces the tendency to self coil on the seabed; (ii) cables are laid under tension over accurately charted seabed topography; (iii) repaired cables are relaid without slack and, in shallow water, the repaired sections are usually buried and (iv) cables on the continental shelf and upper continental slope are often buried below the seabed.

Exposed telecommunications cables can be damaged by sharks, barracuda and other fish as identified from teeth embedded in the cable serving.[24] Bites cut the serving and insulation allowing seawater to ground the cable's power conductor. The first deep-ocean fiber optic cable sustained a series of shark attacks in 1985–1987. The culprit was the deep dwelling crocodile shark, which caused cable faults in depths of 1060–1900 m. It was speculated that the sharks were attracted by electromagnetic fields or cable vibrations, but later experiments were inconclusive. Nevertheless, the episode instigated design improvements that have greatly reduced the bite problem.

Chemical Stability

The basic fiber optic telecommunications cable consists of: (i) one or more pairs of glass fibers; (ii) a sheath of steel strands for strength; (iii) a copper conductor for power transmission and (iv) an insulating sheath of high density polyethylene. In shallow water, one or more layers of galvanized steel wire may be added for protection. Anti-fouling agents are not used.[25] The behavior of some of these cable components in seawater has been investigated in the laboratory and coastal sea by Collins.[26] Sections of various cable types, some with their cut ends exposed and others sealed, were immersed in 5 liters of seawater and any leaching from the copper conductor and iron/zinc galvanized armor was analyzed at set time intervals. Only zinc was detected in the seawater where it registered

[23] M.P. Wood and L. Carter, "Whale Entanglements with Submarine Telecommunications Cables" (2008) 33 *IEEE Journal of Oceanic Engineering* at 445–450.

[24] International Cable Protection Committee, "Fish and Shark Bite Database" Report of the International Cable Protection Committee (October 1988) at 5; see also L.J. Marra, "Sharkbite on the S.L. Submarine Lightwave Cable System: History, Causes and Resolution" (1989) 14(3) *IEEE Journal of Oceanic Engineering* 230–237.

[25] See L. Carter *et al.*, "Submarine Cables and the Oceans—Connecting the World" Report of the United Nations Environment Program and the International Cable Protection Committee (2009) 'UNEP/ICPC Report' at 33. Available online at http://www.unep-wcmc.org/medialibrary/2010/09/10/352bd1d8/ICPC_UNEP_Cables.pdf (last accessed 7 June 2013); see also Emu Ltd, "Subsea Cable Decommissioning: a Limited Environmental Appraisal" Report No 04/J/01/06/0648/0415. Open file report is available at email@ukcpc.org.uk.

[26] K. Collins, "Isle of Man Cable Study—Preliminary Material Environmental Impact Studies" (2007) Preliminary Report, University of Southampton.

Figure 7.3 A power cable in the tide-swept Cook Strait, New Zealand, where currents move gravel (fragments > 2 mm diameter) on a daily basis. Cables are protected by steel armoring with an outermost serving of polypropylene yarn, which is intact and retains its yellow-black markings after more than a decade of exposure to frequent sediment abrasion. (Photograph courtesy of Transpower New Zealand)

concentrations < 6 parts per million (ppm) for cables with sealed ends and < 11 ppm for those with exposed ends. Leaching reduced after ~10 days. As the tests were carried out in closed containers, the concentrations of cable-sourced zinc in the open ocean can be expected to be much lower because of dilution by the oceanic circulation. Furthermore, zinc occurs naturally in the ocean where it is essential for biological processes such as the production of plant plankton.[27]

In contrast to everyday plastic debris such as polystyrene and polycarbonate fragments, which are known to degrade in the ocean,[28] cable grade, high density polyethylene sheathing is basically non-reactive with seawater. It would take centuries to fully convert this material to carbon dioxide and water via oxidation, hydrolysis and mineralization.[29] Plastic debris degrades in the presence of ultra-violet light, but cable polyethylene is light stabilized with further protection provided by steel armoring and burial on the continental shelf where light can penetrate to the seabed surface. The depth of light penetration depends on the presence of sediment and plankton in the seawater, but the so-called photic

27 F.M.M. Morel and N.M. Price, "The Biogeochemical Cycles of Trace Metals in the Oceans" (2003) 300(5621) *Science* 944–947.

28 K. Saido *et al.*, "New Contamination Derived from Marine Debris Plastics" 238th ACS National Meeting, 22–26 August 2009, Washington, DC.

29 A.L. Andrady, "Plastics and their Impacts in the Marine Environment" Proceedings of the International Marine Debris Conference on Derelict Fishing Gear and the Ocean Environment, 6–11 August 2000, Hawaii.

zone is typically < 150 m below the ocean surface. The abrasive effect of mobile sand and cable movement in strong waves and currents may abrade and release particles that may affect marine organisms.[30] However, physical breakdown is minimized by cable burial, steel armor and advanced polypropylene servings that are abrasion resistant (Figure 7.3). The limited information regarding power cables also suggest that modern coatings such as polypropylene yarn are abrasion resistant as demonstrated by observations of cables in the current swept Cook Strait (Figure 7.3).

Buried Cables

Because of hazards posed by shipping, bottom trawl fishing, dredging and other activities on the continental margin, power and telecommunications cables may be buried below the seabed for extra protection.[31] Such burial measures can disturb the bottom or benthic environment of the continental shelf and uppermost continental slope. However, compared to repetitive fishing, ships' anchoring, and dredging, cable burial is usually a one-off operation for the 20–25 year design life of the cable. Further disturbance can occur, however, (i) when a cable fails and requires repair (during which time disturbance will be localized to the fault location) and (ii) when a decommissioned cable is removed (which in the context of a cable's life time, is still an infrequent event).[32] Another consideration is the limited extent of burial, which is confined to a designated cable route. This contrasts with, for example, bottom trawl fishing, which is so widespread and repetitive that it has been described recently as the submarine equivalent of industrial-scale agricultural plowing on land.[33] The following section examines seabed disturbance under various aspects of burial followed by a brief review of seabed recovery.

Cable Route Clearance

Debris that may impede burial operations is removed by a grapnel towed by a ship along the proposed cable route.[34] Depending on the grapnel size, penetration is typically 0.5 to 1.0 m in soft muddy sediment. Accurate positioning of grapnel

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30 M. Allsop *et al*., "Plastic Debris in the World's Oceans" (2006) Greenpeace Publication at 10, available online at http://www.unep.org/regionalseas/marinelitter/publications/docs/plastic_ocean_report.pdf (last accessed 7 June 2013).

31 L. Carter *et al*., *supra* note 25 at 30.

32 For further information, refer to Chapter 8 on Out-of-Service Submarine Cables.

33 P. Puig *et al*., "Ploughing the Deep Sea Floor" (September 2012) 489 *Nature* 286–289.

34 National Oceanographic and Atmospheric Administration (NOAA), "Final Environmental Analysis of Remediation Alternatives for the Pacific Crossing-1 North and East Submarine Fiber-optic Cables in the Olympic Coast National Marine Sanctuary" (2005) at 77 and Appendix, see http://sanctuaries.noaa.gov/library/alldocs.html (last accessed 7 June 2013).

tows is essential to define the burial route and hence minimize unnecessary seabed disturbance. In addition, debris can also be identified by high resolution, side-scan sonar that may detect (i) objects as small as cables and wires with diameters of a few centimeters, depending upon equipment settings and (ii) seabed composition. In that case, debris removal is localized.

Cable Burial

Mechanical plowing is the more common burial process. During this process a plow is towed across the seabed, the plowshare opens a furrow into which the cable is placed, and the cable is covered as the furrow sides close.[35] Further covering comes from the natural rain of sediment, which, in regions of high river input, can locally exceed 1 cm/year.[36] This generalized picture of plowing varies in accordance with the nature of the substrate and the type of plow being used.[37] For ecologically sensitive coastal zones such as marshlands, tidal flats and eelgrass/seagrass meadows, specialist plows are available that have a minimal footprint.[38] Directional drilling beneath sensitive coastal areas will also reduce disturbance.[39] On the continental shelf, cables are buried to depths according to the seabed type and the nature of the hazard.[40] For soft to firm sediments, ships' anchors bite 2 to 3 m into the seabed and bottom trawl fishing gear penetrates ~0.5 m. Thus to address the latter hazard, cables are buried to 1 m, in which case the appropriate plowshare would leave a strip ~0.3 m wide (plowing to larger sub-seabed depths may leave a wider strip). For soft to firm substrates, the furrow will self-heal, but for harder materials only partial closure may result.[41] In addition to the plow furrow, the seabed is likely to be compacted and biota disturbed by the passage of the skids or wheels that support the plow. Again the nature of disturbance depends upon seabed type, associated organisms and plow size. Overall, the plowshare plus skid/wheel disturbance can range from ~2 to

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35 P.G. Allan, "Geotechnical Aspects of Submarine Cables", IBC Conference on Subsea Geotechnics, November 1998, Aberdeen.

36 C.A. Huh *et al.*, "Modern Accumulation Rates and a Budget of Sediment off the Gaoping (Kaoping) River, SW Taiwan: A Tidal and Flood Dominated Depositional Environment Around a Submarine Canyon" (2009) 76(4) *Journal of Marine Systems* 405–416.

37 R. Hoshina and J. Featherstone, "Improvements in Submarine Cable System Protection" Conference Paper presented at SubOptic, Kyoto 2001, Paper P6.7 at 4; R. Rapp *et al.*, "Marine Installation Operations: Expectations, Specifications, Value and Performance" Conference Poster presented at SubOptic, Monaco 2004, Poster We 12.5 at 3.

38 Ecoplan, Monitoring der salz-wiesen vegetation an der Bautrasse im Ostheller von Norderney 1997–2002, (2003) Ecoplan Report for Deutsche Telekom.

39 S. Austin *et al.*, "A Comparative Analysis of Submarine Cable Installation Methods in Northern Puget Sound, Washington" (2004) 7 *Journal of Marine Environmental Engineering* 173–183.

40 Hoshina and Featherstone *supra* note 37.

41 Refer to NOAA *supra* note 34.

Figure 7.4 SMD remotely operated vehicle with manipulating arms and other equipment for cable repairs and burial (right) and positioning propellers (left). (Photograph courtesy of TE SubCom)

8 m width. Following plowing, coastal State permit conditions may require that a post-burial survey be conducted, which may involve single or repeated surveys to monitor seabed recovery.

High pressure water injection or *jetting* is commonly used to bury cables that are already laid, although water jets may also be incorporated into plows to facilitate burial during the cable laying process. Jets are commonly incorporated onto remotely operated vehicles (ROVs) (see Figure 7.4) that can operate in water depths over 1000 m, in steep topography and in very soft sediments—essentially conditions that are unfavorable for plowing.[42] ROV-equipped jets liquefy sediment along a cable causing it to sink to a pre-determined depth below the seabed. This technique is ideal for burying repaired sections of cable as well as sectors where a cable is only partially buried by plowing. The width of jetting disturbance tends to be wider than plowing due to the formation of turbid plumes that may occur in sands but are more noticeable in soft muds. Jet-induced liquefaction may displace or damage the marine biota inhabiting the path for the trench, whereas turbid plumes may affect more distant sites.[43] Any impact of plumes is best assessed on a case-by-case basis because plume dispersal and settling depends upon local currents and waves, the nature and concentration of the sediment in plumes, the composition and resilience of the resident biota, seabed topography and the frequency of natural perturbations such as storms.

42 Hoshina and Featherstone *supra* note 37, see also M. Jonkergrouw, "Industry Developments in Burial Assessment Surveying" Paper Presented at SubOptic, Kyoto 2001, Paper P6.3.1 at 4.

43 Refer to NOAA *supra* note 34.

Even though burial has markedly reduced the numbers of fiber optic cable faults in water depths < 200 m,[44] failures still occur. Where possible, a damaged cable is recovered by grapnel (Figure 6.4) or ROV operated from a cable repair ship (Figure 7.4). The damaged section is removed and replaced by new cable (*splice*) onboard the repair ship. The repaired section is then relaid perpendicular to the original cable and where appropriate is buried by jetting using a ROV (Figures 6.5 and 6.6).[45]

Seabed disturbance may result from the recovery of a buried decommissioned cable. According to Emu Ltd,[46] recovery will dislodge the overlying sediment and benthic biota. Local seabed conditions dictate the nature of that disturbance. If soft, muddy sediment prevails, any disruption will be small, as these sediments are physically weak and cannot maintain any relief. In contrast, consolidated materials may form cohesive fragments that form a blocky surface whose longevity depends on the strength and frequency of wave/current action, rates of natural sedimentation and any biological activity.

Environmental Recovery

From the previous discussion it is apparent that benthic disturbance associated with cable burial, repair and recovery occurs primarily on the continental shelf and upper continental slope. This is confirmed by the occurrence of 50 to 70 per cent of all cable faults (and related repairs) in water depths < 200 m.[47] This depth range covers several environmental settings with distinct oceanographic, geological and biological features that dictate the rate of seabed recovery. Human activities, in particular bottom trawl fishing, also play a prominent role by influencing patterns of erosion and siltation.[48]

Substrate recovery in sheltered coastal areas may be facilitated by their accessibility. This permits the use of laying techniques that minimize disturbance and also allows better access for remedial measures. In the case of seagrass beds in Botany Bay, Australia, remedial actions have been proposed that involve the removal of plants from the cable route and their replanting after cable emplacement.[49]

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44 M.E. Kordahi and S. Shapiro, "Worldwide Trends in Submarine Cable System Faults" Conference Paper presented at SubOptic, Monaco 2004, Paper We A2.5 at 3.

45 Hoshina and Featherstone *supra* note 37.

46 Emu Ltd, "Subsea Cable Decommissioning: A Limited Environmental Appraisal" (2004) Report No 04/J/01/06/0648/0415. Open file report available from email@ukcpc.org.uk.

47 J. Featherstone *et al.*, "Recent Trends in Submarine Cable System Faults", Conference Proceedings SubOptic, Kyoto 2001 at 5; see also M.E. Kordahi *et al.*, "Trends in Submarine Cable System Faults" Conference Proceedings SubOptic, Baltimore 2007 at 4.

48 Puig *et al.*, *supra* note 33.

49 Molino-Stewart Pty, Botany Bay Cable Environmental Impact Assessment (2007) available at http://www.molinostewart.com.au/index.php?option=com_content&view=article&id=95:botany-bay-cable-environmental-impact-&catid=41:environmental-impact-assessment-and-approvals&Itemid=82 (last accessed 7 June 2013).

For other seagrass/eelgrass restorations, the sowing of grass seed can be effective. Cable burial in salt marshes along Germany's north coast was facilitated by a low impact, custom built vibrating plow.[50] Post-deployment monitoring of the salt marsh showed that vegetation in disturbed areas re-established within one to two years and fully recovered within five years. In soft sediment settings such as mangrove swamps, recovery from human-caused disruptions can range from two to seven months.[51]

Seaward of the coast, the continental shelf descends gradually to the shelf edge at an average depth of ~130 m. Accompanying this deepening is a decline in wave energy and its potential to move sediments. That, together with ocean currents and tides, weather events, seabed biology and geology, collectively influence the rate and nature of seabed restoration.[52] Restoration can be assessed in the context of three depth zones, each with their own hydrodynamic character. However, assessments are generalized and actual seabed recovery will be affected by local conditions. This is exemplified by tide-dominated continental shelves where tidal currents can force sediment movement at most shelf depths, for example, the Channel between the United Kingdom and France, Straits of Messina (Italy) and Cook Strait (New Zealand). Returning to the depth zone approach, the *inner shelf* (0 to ~30 m) is exposed to frequent wave and current action, especially during storms. As a result the seabed is typically mobile sand except in the vicinity of high discharge rivers where muddy deposits may prevail as off the Mississippi River delta in the United States. Both physical and biological recovery from cable burial in inner shelf sands commonly occurs within weeks to months.[53] Substrates of the *middle shelf* (~30 to 70 m) are less frequently disturbed by waves and swell with the main bouts of sediment erosion and transport associated with storms.

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50 Ecoplan Report *supra* note 38.

51 K.M. Dernie *et al.*, "Recovery of Soft Sediment Communities and Habitats Following Physical Disturbance" (2003) 285–286 *Journal of Experimental Marine Biology and Ecology* at 415–434.

52 For example, C.A. Nittrouer *et al.*, *Continental Margin Sedimentation—From Sediment Transport to Sequence Stratigraphy* (International Association of Sedimentologists, Special Publication 37 Blackwell Publishing, 2007) at 549 and references therein.

53 CEE, Basslink Project Marine Biology Monitoring, McGauran's Beach, (2006) Report to Enesar Consulting; see also J. DeAlteris *et al.*, "The Significance of Seabed Disturbance by Mobile Fishing Gear Relative to the Natural Processes: A Case Study in Narragansett Bay, Rhode Island" in L. Benaka, ed, *Fish Habitat: Essential Fish Habitat and Rehabilitation* (American Fisheries Society, 1999) at 400; see also S. Bolam and H. Rees, "Minimizing Impacts of Maintenance Dredged Material Disposal in the Coastal Environment: A Habitat Approach" (2003) 32(2) *Environmental Management* 171–188; see also National Oceanic and Atmospheric Administration (NOAA), Stellwagen Bank National Marine Sanctuary Report, 2007 at 41, available at http://sanctuaries.noaa.gov/science/condition/sbnms/welcome.html (last accessed 7 June 2013).

The nature of the substrate also reflects the amount of sediment supply with sediment-nourished shelves having muddy substrates whereas sediment-starved systems have middle shelves mantled by sand and gravel that are essentially current-modified deposits from the last ice age when sea level was 120 m lower than present.[54] In the case of muddy substrates off Massachusetts, United States, a cable trench had not completely in-filled one year after laying due to slow natural deposition, but the benthic fauna appeared to have recovered within that year.[55] In contrast, physical evidence of power cable burial in sandy deposits of the Baltic Sea was erased within one year of burial—a consequence of local waves and currents.[56] In addition, there were no significant changes in the benthic animal communities. Those examples and others[57] indicate that the rate of burial trench recovery reflects: (i) the amount of sediment supplied to the middle shelf; (ii) the physical nature of the sediment cover whereby loose mobile sand is unable to retain physical evidence of burial in contrast to well consolidated mud substrates; (iii) the frequency of natural disturbances such as storms, and (iv) the depth of the trench incision. On the *outer shelf* (~70 to ~130 m) and *upper continental slope* (> ~130 m), reduced sediment supply and infrequent wave/current action suggest that any trench scar may last longer than on the middle shelf. However, local conditions will ultimately dictate the recovery rate. If, for example, the seabed is composed of unconsolidated sand/gravel then recovery can be rapid, especially in the presence of tidal or ocean currents that are commonly intensified along the continental shelf edge. Alternatively, a consolidated substrate, low current action and weak sediment supply may bring about a slower recovery.[58]

Cable Recycling and Life Cycle

The robust nature of submarine cables and the commercial value of their materials make them attractive for recycling. However, it has only been in recent years that effective recycling schemes have been developed.[59] In the case of Mertech

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54 Nittrouer *et al.*, *supra* note 52.

55 Grannis *supra* note 16 at 100.

56 Andrulewicz *et al.*, *supra* note 15.

57 For example, California Coastal Commission, Coastal Development Permit Application and Consistency Certification, (2005), E-05-007 at 50, available at http://www.coastal.ca.gov/energy/Th6b-9-2005.pdf (last accessed 7 June 2013); see also California Coastal Commission, Coastal Development Permit Amendment and Modified Consistency Certification E-98-029-A2 and E-00-0004-A1, http://documents.coastal.ca.gov/reports/2007/11/Th8a-s-11-2007.pdf (last accessed 7 June 2013).

58 See NOAA *supra* note 34.

59 For example, see MTB, Cable Recycling, http://mtb-recycling.fr/en/index-2cables_EN.html (last accessed 8 April 2013) and Mertech Marine, SAT-1 "Proof of Out-of-Service Deep Sea Cable Recovery and Dismantling as a Viable Business Case" Presentation at the International Cable Protection Committee Plenary, 2011 Lisbon, Portugal.

Marine,[60] decommissioned coaxial and fiber optic telecommunications cables are recovered by cableships or other specially adapted vessels at a quoted rate of ~40 km/day. Onshore, mechanical processors break the cables down and separate out their main components; copper, polyethylene plastic and steel. Clearly, the metal components are valuable but so too is the high quality polyethylene, which is recycled through plastic conversion plants. Interestingly, the plastic retains its quality even though recovered coaxial cables have been on the seabed for over 30 years. Recycling offers several benefits that include clearing the seabed of non-operational infrastructure, recovery of valuable materials plus remuneration and employment for recyclers. As discussed in Chapter 8, management of out-of-service cables, including recycling and salvage, has been addressed by the industry in the form of an International Cable Protection Committee recommendation and adherence to UNCLOS.

Recycling is part of an analysis that identifies the net amounts of carbon produced during the cradle-to-grave life cycle of a submarine fiber optic cable. Such analyses help gauge a cable's overall environmental footprint. A study by Donovan[61] showed that the main potential environmental effects related to (i) electrical power used at land-based terminal stations—127 gigawatt hours, and (ii) fuel consumed during all ship operations including cable laying and maintenance—1515 tonnes of fuel. Fuel and power consumption were calculated for the lifetime of a cable. Donovan estimated that 7 grams of carbon dioxide equivalents would be released into the atmosphere for every 10,000 gigabit kilometers (note, (i) 10,000 Gb/km is a designated unit of reference of a cable's functionality and (ii) *carbon dioxide equivalent* is the warming potential of **all** greenhouse gases if expressed as CO_2). The significance of 7 grams is brought into perspective by comparing a cable-based teleconference between New York and Stockholm with the equivalent face-to-face meeting. For a two day teleconference of 8 hours/day, 5.7 kg of CO_{2eq} would be released compared to 1920 kg emitted for the face-to-face meeting, which involved 16,000 km of air travel. While such life-cycle analyses rely on some assumptions that may be debatable, Donovan's study nonetheless highlights the small carbon footprint of submarine telecommunications and their positive contribution to reducing greenhouse emissions by reducing the need for transoceanic air travel and other high carbon-use activities.

60 Refer http://www.mertechmarine.co.za/ (last accessed 7 June 2013).

61 C. Donovan, "Twenty Thousand Leagues Under the Sea: A Life Cycle Assessment of Fibre Optic Submarine Cable Systems" (2009) Degree Project, SoM EX2009-40 KTH Department of Urban Planning and Environment, Stockholm. See http://cesc.kth.se/submarine-cable-systems/ Thesis at 97.

Electromagnetic Fields (EMF) from Power Cables

Apart from the interactions described above, electromagnetic fields (EMF) generated by power cables may also have an impact on the environment.

The offshore expansion of submarine power grids associated with wind-turbine farms has raised the possibility that associated EMF fields may affect marine animals.[62] By way of background, it is well established that DC and AC submarine power cables produce a magnetic field, the intensity of which is directly related to the applied voltage. Model studies conducted by Normandeau *et al.*[63] in 2011 show that a DC field is more intense than its AC counterpart (see Chapter 13). Intensity is strongest directly above a cable but reduces rapidly in horizontal and vertical directions, for instance at 10 m horizontal distance, the field is about two per cent of the peak intensity above the cable. When several cables are present, the strength of their collective magnetic field appears to be influenced by (i) the separation distances of cables; (ii) the direction of current flow with opposing currents having a cancelling effect on the field, and (iii) cable voltage. As a water current or a swimming animal passes through a magnetic field, it induces an electric field whose strength depends upon (i) the direction of the water current/swimming organism (the maximum electrical field being induced when the path is perpendicular to the cable's magnetic field); (ii) the speed of the water current/organism, and (iii) the strength of the magnetic field.

The biological literature records a range of marine organisms that are sensitive or potentially sensitive to magnetic, electric or combined fields. The list includes some sharks and rays i.e. *Elasmobranchs*, other types of fish (e.g. mackerel, cod, salmon), sea turtles, some marine invertebrates (e.g. sea urchins, snails, lobsters) and possibly whales.[64] EMF may influence an animal's navigation, feeding, orientation, and/or detection of other animals. Such potential responses are based on studies of an animal's behavior, anatomy or functioning, as well as theoretical analyses. Experiments with sandbar sharks, whose shallow coastal habitat is also favored by offshore wind turbine farms, show that they respond to low intensity electric fields, suggesting they could also be affected by power cables. However, field trials with cables have not been undertaken. In the case of sockeye salmon, the young partly rely on Earth's geomagnetic field for navigation. However, because the fish are *pelagic* or free swimming and the EMF of cables

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[62] OSPAR Commission "Assessment of the Environmental Impacts of Cables" (2009) available online at http://qsr2010.ospar.org/media/assessments/p00437_Cables.pdf (last accessed 7 June 2013). The document merely raises the possibility, but contains no research to support this possibility.

[63] Normandeau Associates Inc *et al.*, "Effects of EMFs from Undersea Power Cables on Elasmobranchs and other Marine Species" US Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OSC Study BOEMRE 2011-09, May 2011.

[64] *Ibid.*

is limited in extent, juvenile salmon are unlikely to be adversely affected. Even if cables influence the local geomagnetic field, salmon can compensate by relying more on sight and smell, which are also used to aid their navigation.

Normandeau *et al.*[65] note substantial gaps in our knowledge of animal behavior in the presence of EMF, especially relating to actual field studies involving power cables. Thus the report notes that any conclusions about the effects of EMF on organisms must be regarded as speculative. Nevertheless, if mitigation is required on the basis of evidenced-based science, options are available to lower EMF. These include:

- Use of AC cables, which have magnetic fields lower than DC cables for the same voltage;
- Use of higher voltage cables that generate magnetic fields less intense than lower voltage systems for the same power output;
- Change the conductivity and permeability of the cable sheathing or serving;
- Place cables closer together so that opposing current flows cancel one another's EMF (however, this option could produce unacceptable constraints on cable maintenance);
- Cable burial;
- Align a cable to minimize the collective effect of the cable EMF and local geomagnetic field.

II. UNCLOS, Coastal State Environmental Regulations and Submarine Cables

The past forty years have seen an exponential growth in concern for the marine environment, coupled with a growing body of law known as international environmental law.[66] This concern for the marine environment is reflected in the increasing number of coastal State regulations aimed at protecting the marine environment from harm arising from activities in the oceans. In line with this development, there has been a growing trend by coastal States to subject cable operations to environmental regulations. However, such environmental regulations may be inconsistent with UNCLOS, can delay or impede laying/repair operations and most importantly, may be unnecessary. In this regard, the following sections will first examine the extent to which UNCLOS allows coastal States to impose environmental regulations on cable operations and then discuss specific examples of environmental regulations that have posed challenges to the industry.

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[65] *Ibid.*

[66] For a general overview of the growth of international environmental law, see P. Birnie *et al.*, *International Law and the Environment* (3rd ed, New York, 2009) at 1–43.

UNCLOS and the Protection of the Marine Environment

The protection of the marine environment received a significant boost with the adoption of UNCLOS. As noted by two scholars, UNCLOS establishes:

> a unifying framework for marine environmental protection that seeks to address all sources of marine pollution, incorporates by reference the latest international rules and standards, strengthens the enforcement capacity of port and flag States, and gives coastal States extensive jurisdiction with regard to the protection and preservation of the marine environment within their territorial seas and EEZs.[67]

While there are provisions on environmental protection scattered throughout UNCLOS, there is also a whole part devoted to the protection of the marine environment. Part XII of UNCLOS contains general obligations on States to protect and preserve the marine environment,[68] which are supplemented by specific articles addressing different sources of marine pollution from land-based sources, from seabed activities subject to national jurisdiction, pollution from activities in the deep seabed, ship-source pollution and pollution from the atmosphere.[69] Generally, these specific provisions place an obligation on States to establish global and regional rules, standards and practices to prevent, reduce and control pollution from a particular source, either through competent international organizations or through diplomatic conferences. These specific provisions then enjoin States to adopt national laws and regulations to prevent marine pollution from these particular sources. The laws and regulations should "take into account"[70] or "be no less effective"[71] or "at least have the same effect"[72] as global and regional rules, standards and practices. In this way, UNCLOS incorporates by reference the latest internationally agreed rules, standards and recommended practices and procedures. Part XII also extends coastal States' specific enforcement powers in respect of pollution from the various sources.[73]

The critical question for present purposes is to what extent does UNCLOS allow coastal States to impose environmental regulations on cable operations? The following sections will attempt to answer this.

67 D. Rothwell and T. Stephens, *The International Law of the Sea* (Oregon, 2010) at 338.
68 See UNCLOS Sections 1–4, Part XII.
69 UNCLOS Section 5, Part XII.
70 UNCLOS Art 207(1) and Art 212(1).
71 UNCLOS Arts 208(3), 209(2) and 210(6).
72 UNCLOS Art 211(2).
73 UNCLOS Section 6, Part XII.

Cable Deployment and Marine Pollution

The first point to note is that the laying or repair of cables does *not* fall within the definition of marine pollution provided in UNCLOS. Article 1(4) defines "pollution of the marine environment" as:

> the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.[74]

While the definition of marine pollution is deliberately wide so as to accommodate any type of pollution where it results in harmful effects, it is highly unlikely that the laying or repair of cables *per se* can be deemed to be "marine pollution". While arguably the deployment of cables is an "introduction by man, directly or indirectly, of substances or energy into the marine environment", as explained in Part I, cables cause minimal disturbance to the seabed and the surrounding marine environment. While power cables do generate EMF, there has been no conclusive evidence to show that they actually cause harm to "living resources and marine life". Fiber optic cables certainly do not cause any "harm to living resources and marine life". Neither power nor telecommunications cables result in "hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities".

Coastal State Authority to Impose Environmental Regulations on Cables/Cable Operations

Within territorial seas and archipelagic waters, coastal States have extensive authority to take measures to protect the marine environment pursuant to their sovereignty over these zones,[75] including measures *vis-à-vis* cable operations. In the EEZ and continental shelf, however, the situation is less clear. In the EEZ, the coastal State is given jurisdiction with regard to the protection and preservation of the marine environment "as provided for in the relevant provisions of this Convention".[76] There does not appear to be any express provision giving coastal States the jurisdiction to impose regulations on cable operations or cables in the EEZ/continental shelf in order to protect the marine environment, apart from coastal State measures to prevent ship-source pollution. The latter would apply

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74 UNCLOS Art 1(4).
75 UNCLOS Arts 2 and 49.
76 UNCLOS Art 56(b)(iii).

to cableships like any other vessel.[77] The only other arguably relevant provision is Article 208 on pollution from seabed activities which states the following:

> Coastal States shall adopt laws and regulations to prevent, reduce and control **pollution** of the marine environment arising from or in connection with **seabed activities subject to their jurisdiction** and from artificial islands, installations and structures under their jurisdiction, pursuant to articles 60 and 80.[78]

It is unlikely that coastal States could use this provision to impose environmental regulations on cables and/or cable operations. As argued above, submarine cables and cable operations do not constitute "pollution" under UNCLOS. Further, cables and cable operations in the EEZ/continental shelf are not "seabed activities" under the "jurisdiction" of the coastal State, but rather are one of the freedoms that other States are permitted in the EEZ and continental shelf of the coastal State.

Similarly, the provision on the freedom to lay cables on the continental shelf also seems to imply that coastal States may not subject cable operations to environmental regulations. Article 79(2) of UNCLOS states that:

> Subject to its right to take reasonable measures for the exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction and control of pollution from pipelines, the coastal State may not impede the laying or maintenance of such cables or pipelines.

This suggests that a coastal State may subject the laying and repair of cables on its continental shelf only to reasonable measures related to the exploration of the continental shelf and exploitation of its natural resources, and that only *pipelines* may be subject to measures for preventing, reducing and controlling pollution.

States or companies exercising the right to lay and repair cables must, of course, have due regard to the rights and duties of the coastal States, including those rights and duties related to the marine environment.[79] However, this is an obligation on other States undertaking activities in the EEZ to take into consideration the coastal State's rights and duties with regard to its jurisdiction over the protection and preservation of the marine environment (something which is arguably done during the Survey Phase of cable operations when efforts are made to avoid environmentally sensitive areas). This does not translate into coastal State authority to impose environmental measures on cable operations in the EEZ and continental shelf. This is reinforced by Article 194(4) which states that:

> In taking measures to prevent, reduce or control pollution of the marine environment, States shall refrain from unjustifiable interference with activities carried out by other States in the exercise of their rights and in pursuance of their duties in conformity with this Convention.

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77 UNCLOS Art 211.
78 UNCLOS Art 208(1). Emphasis added.
79 UNCLOS Art 58(3).

The next three sections will discuss three specific examples of environmental regulations imposed by coastal States on cable operations, namely environmental impact assessments (EIAs), regulations imposed pursuant to Marine Protected Areas (MPAs) or Marine Spatial Planning (MSP) policies and certain environmental practices in cable laying and operation adopted in the Northeast Atlantic Ocean.

Environmental Impact Assessments

Environmental Impact Assessments under International Law

As States seek to protect their coasts and oceans through various legislative measures there are increasing requirements to assess the actual and potential effects of offshore activities on the marine environment. Such requirements are well established in Australasia, Europe, North America and parts of Asia.[80]

Evaluation of an activity's effect on the marine environment is typically covered by an Environmental Impact Assessment (EIA) report. EIAs are important tools for coastal States in the protection of their marine environment. Indeed, under general international law, it has been held that an EIA has gained so much acceptance among States that it is now considered obligatory to carry out an EIA where there is a risk that a proposed activity may cause considerable trans-boundary environmental effects (i.e. effects extending across national boundaries).[81] For activities that do not cause trans-boundary effects (i.e. environmental effects confined within national boundaries), there is wide consensus that there is also an obligation to carry out an EIA if the activity is likely to have an impact on the environment and the impact is significant.[82] Article 206 of UNCLOS itself states that:

> When States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results of such assessments in the manner provided in article 205.

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80 For example, the Hong Kong Environmental Protection Department, "Environmental Impact Assessment Ordinance" (2002). See also C2C Cable Network Hong Kong Section at http://www.epd.gov.hk/eia/register/profile/latest/e_dir46.pdf (last accessed 7 June 2013).

81 See *Pulp Mills on the River Uruguay* (Argentina v Uruguay), International Court of Justice (ICJ) Judgment of 20 April 2010, available at http://www.icj-cij.org/docket/files/135/15877.pdf at para 203.

82 See generally, A. Epiney, "Environmental Impact Assessment" in R. Wolfrum (ed), *The Max Planck Encyclopedia of Public International Law* Volume III (Oxford University Press, 2012) at 587–589.

However, neither general international law nor UNCLOS specifies the precise scope and content of an EIA and there is no formulation under international law on the manner and procedure to be applied when requesting an EIA.[83] Further, both international law and UNCLOS lack clarity on who has the responsibility for conducting an EIA. Article 206 of UNCLOS, for example, appears to place the responsibility for undertaking an EIA on the State, but in practice the State usually leaves it to the company or enterprise that is undertaking the activity.

Environmental Impact Assessments for Cables/Cable Operations

EIAs, in the case of submarine cables, assess any environmental impacts of cable route surveys, cable laying and maintenance. This information is required before permission is granted to deploy a cable. Typically, an EIA covers the following aspects of a cable project: (i) the nature of the proposed project incorporating basic information on the route, type and length of cable, cable laying information including burial, timing and duration of the operation plus other factors; (ii) documentation on the environment that commonly encompasses relevant information on the oceanography, seafloor geology, biology, natural hazards, human activities and social aspects such as avoidance of sites of historical or cultural significance; (iii) potential effects of the project encompassing cable route survey and laying operations; (iv) measures required to reduce any negative impacts to an acceptable level (which may involve restrictions on timing and location of operations, requirements to restore any disturbed setting, installation of observers to prevent collisions with marine mammals, etc) and (v) monitoring to ensure that remedial measures are effective. Major EIAs are likely to be substantial technical documents. Accordingly, they often contain a non-technical summary that is accessible by the public for consultation.

However, the nature of the required information can vary between States and even within a single State. Requirements may involve (i) a brief review of environmental conditions and potential impacts; or (ii) an appropriate technical assessment accompanied by a statement of compliance with environmental accreditation or (iii) a comprehensive analysis that requires additional research, e.g. field measurements, computer modeling and formal consultation with government, other seabed users and the public.[84] In that context, completion of EIAs may take weeks or even years in extreme cases.[85] For example, California has some of the most onerous environmental permitting requirements of any state in the United States and obtaining an environmental impact report can take

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83 *Pulp Mills on the River Uruguay* (Argentina v Uruguay) *supra* note 81 at para 205.

84 Carter *et al.*, *supra* note 25.

85 See for example, Monterey Bay National Marine Sanctuary, EIR/EIS for MBARI MARS Cabled Observatory, refer http://www.mbari.org/staff/linda/MARS%20Cable%20Environmental%20Impact%20Report%20through%202010.pdf (last accessed 7 June 2013).

several years, causing considerable delay to the deployment and landing of a cable system.[86]

Permission to deploy a submarine cable is often conditional on cable operators submitting an EIA to the coastal State. But is this condition consistent with UNCLOS? Within territorial waters, coastal States certainly have the authority to request an EIA before cable laying operations commence. Whether it is an *obligation* is not as clear-cut. Both international law and UNCLOS require that there must be, at the very least, reasonable grounds for believing that activities may cause a substantial adverse impact to the marine environment.[87] Given the relatively benign nature of submarine cables and cable operations, including the fact that they do not cause significant harm to the marine environment, there are grounds for arguing that there is no obligation to require an EIA. In any event, regardless of whether it is a right or obligation under international law and/or UNCLOS, coastal States may wish to reconsider extensive EIA requirements that unduly interfere with cable operations or result in an impractical cost benefit analysis.

Within the EEZ/continental shelf, the coastal State does not appear to have authority to request an EIA for cable deployment in these zones. First, as noted above, the right of coastal States to impose environmental regulations on cable operations appears to be limited. Second, Article 206 provides that States shall conduct an EIA when they have "reasonable grounds for believing that planned activities **under their jurisdiction or control** may cause substantial pollution of or significant and harmful changes to the marine environment" (emphasis added). Cable operations in the EEZ/continental shelf are not "under the jurisdiction or control" of the coastal State but rather are one of the freedoms allocated to other States.[88]

Nonetheless, even if an EIA for cable operations in the EEZ is not recognized under UNCLOS, this does not mean to say that cable companies should not be cognizant of the potential environmental impacts of their operations. Indeed,

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86 See A. Lipman and Nguyen T. Vu, "Building a Submarine Cable: Navigating the Regulatory Waters of Licensing and Permitting" Submarine Telecoms Forum, Finance and Legal Edition (March 2011), available at http://www.bingham.com/Publications/Files/2011/04/Building-a-Submarine-Cable-Navigating-the-Regulatory-Waters-of-Licensing-and-Permitting (last accessed 7 June 2013).

87 See UNCLOS Art 206 and A. Epiney, "Environmental Impact Assessment" in R. Wolfrum (ed), *The Max Planck Encyclopedia of Public International Law* Volume III (Oxford University Press, 2012) at 587–589.

88 This raises an interesting question as to whether the State or company of the State which is conducting cable operations are obliged under UNCLOS Art 206 to conduct an EIA in the EEZ/continental shelf on the basis that these activities are under their jurisdiction or control. In any event, such States/companies can always argue that there are no reasonable grounds for believing that cable activities may cause substantial pollution or harm to the marine environment.

cable companies may themselves wish to avoid environmentally sensitive areas to avoid any potential damage and controversy. In practice cable companies normally take steps to avert this issue during the initial Survey Phase during which they ensure that fragile ecosystems are identified and bypassed as possible locations for cable laying.[89]

Marine Protected Areas and Marine Spatial Planning

Another recent trend, which has had an impact on the freedom to lay, repair and maintain submarine cables, is the tendency of coastal States to designate areas outside of territorial waters as marine protected areas (MPAs) or conservation areas. This section will give an overview of MPAs, and a related tool for the protection of the marine environment, Marine Spatial Planning (MSP). It will also discuss the basis under international law for these protective regimes and examine the ways in which they have impacted cable operations.

Overview of Marine Protected Areas and Marine Spatial Planning

The marine environment has come under pressure from an increased human presence offshore. Area-based management is recognized as one of the ways in which the marine environment can be protected from some uses. Area-based management encompasses a range of tools, which can have a wide variety of objectives, such as the conservation and management of species or protection of fragile habitats and are "designed to achieve these objectives by managing human activities within a spatially defined area".[90]

One of the most widely recognized area-based management tools is the concept of the MPA.[91] An MPA has been defined as "any area of intertidal or subtidal terrain together with their overlying waters and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect all or part of the enclosed environment".[92] In practice, there are many types of MPAs, which can either address protection of a single species or a fragile habitat. For instance, one of the more dramatic examples which prompted the need for an MPA was the indiscriminate fishing of deep-water corals. These corals form fragile communities that reside in water depths ranging from 40 m

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89 See Chapter 4 on the Planning and Surveying of Submarine Cable Routes.

90 J. Roberts *et al.*, "Area-based Management on the High Seas: Possible Application of the IMO's Particularly Sensitive Sea Area Concept" *International Journal of Marine and Coastal Law* 25 (2010) 483–522 at 484.

91 *Ibid.*

92 World Conservation Union, Resolution 17.38 of the 17th General Assembly of the International Union for Conservation of Nature and Natural Resources (IUCN), Proceedings of the 17th Session of the General Assembly of IUCN and 17th Technical Meeting, 1–10 February 1988, San Jose, Costa Rica 104–106.

to more than 1000 m and provide habitats for fish and other organisms.[93] One suite of deep-water coral communities—the Darwin Mounds off northeast Scotland—were found to be extensively damaged by bottom trawling.[94] This led the European Commission to close off the area to bottom trawl fishing and assign it protective status.

MPAs have grown in size and number. The majority of MPAs are designated within the 200 nm EEZ.[95] As of 2012, the total area assigned to MPAs was 11,254,389 km^2 or about 3.2 per cent of the world's ocean.[96]

Concomitant with the expansion of MPAs is the development of policies to regulate offshore activities in ocean spaces around the world, including Europe, the United Kingdom, Australia, New Zealand, Canada, the United States and other regions. Commonly referred to as *Marine Spatial Planning* (MSP), it is designed to provide frameworks to address various marine and coastal issues relating to environmental conservation and sustainability, commercial and recreational activities, and conflicts between offshore stakeholders. Such a need is perceived from an increased recreational, industrial, scientific and security presence offshore. In the case of the United States, a National Ocean Council is now in place to implement policy concerning stewardship of coasts and oceans (plus the Great Lakes).[97] Its aims include:

- Improving the resiliency of ecosystems, communities and economies;
- Protecting, maintaining and restoring the health and biological diversity of oceans;
- Advancing scientific knowledge and understanding to improve decisions relating to a changing global environment and other issues;
- Supporting sustainable, safe, secure and productive access to, and uses of the ocean;
- Exercising rights and jurisdiction in accordance with applicable international law that involve respect for and preservation of navigational rights and freedoms;

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93 Freiwald *et al.*, *supra* note 1; see also UNEP, Ecosystems and Biodiversity in Deep Waters and High Seas (2006) UNEP Regional Seas Report and Studies, No 178 at 58, available at http://www.unep.org/pdf/EcosystemBiodiversity_DeepWaters_20060616.pdf (last accessed 7 June 2013).

94 A.J. Wheeler *et al.*, "The Impact of Demersal Trawling on NE Atlantic Deepwater Coral Habitats: the Case of Darwin Mounds, United Kingdom" in P.W. Barnes and J.P. Thomas, eds, *Benthic Habitats and the Effects of Fishing* (American Fisheries Society, 2004) 807–817.

95 Roberts *et al.*, *supra* note 90 at 485.

96 Marine Reserves Coalition (2012), see 'Marine Protected Areas' http:///www.marinereservescoalition.org/ (last accessed 7 June 2013).

97 National Ocean Council (2013) available at http://www.whitehouse.gov/administration/eop/oceans (last accessed 7 June 2013).

- Increasing scientific understanding of ocean ecosystems including their relationships to humans and their activities; and
- Fostering public understanding of the oceans.

While the wording may differ between different national MSP policies, most strive to maintain a balance between sustainable offshore development and the maintenance of a healthy and sustainable marine environment.[98]

Basis of Marine Protected Areas under International Law

Within territorial waters, MPAs can be established by the coastal State pursuant to their sovereignty over this zone. Within the EEZ, UNCLOS has several specific provisions, which arguably provide the basis for the establishment of different types of MPAs. First, UNCLOS gives coastal States sovereign rights for the purpose of conserving and managing the natural resources, whether living or non-living[99] and also places an obligation on coastal States to "ensure through proper conservation and management measures that the maintenance of the living resources in the exclusive economic zone is not endangered by over-exploitation".[100]

Second, UNCLOS also provides some basis for coastal States to take measures to "protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life", and such measures would include MPAs.[101] Whilst this is a "separate and independent legal obligation" distinguishable from the obligation to prevent pollution, it has been said that it is not a jurisdictional rule which creates jurisdiction of the coastal State with regard to its EEZ.[102]

Third, there are three categories of MPAs, which specifically target ship-source pollution.[103] The first category are MPAs designated pursuant to Article 211(6) of UNCLOS where the adoption of special mandatory measures for the prevention of pollution is required in a certain area of the EEZ for "recognized technical reasons in relation to its oceanographical and ecological conditions, as well as its utilization or the protection of its resources and the particular character of its traffic". The second category is the designation of Particularly Sensitive Sea Areas

98 Department of Environment, Food and Rural Affairs (DEFRA) UK Marine Policy Statement (2011) available at https://www.gov.uk/government/publications/uk-marine-policy-statement (last accessed 7 June 2013).
99 UNCLOS Art 56(1)(a).
100 UNCLOS Art 61(2).
101 UNCLOS Art 194(5).
102 R. Lagoni, "Marine Protected Areas in the Exclusive Economic Zone" in A. Kirchner (ed), *International Marine Environmental Law: Institutions, Implementation and Innovations* (Kluwer Law, 2003) at 160.
103 *Ibid.*, at 160–161.

(PSSAs) under the auspices of the International Maritime Organization (IMO).[104] The third category is Special Areas adopted under the International Convention for the Prevention of Pollution from Ships and its protocol (MARPOL 73/78).[105]

It is clear that coastal States do have some legal basis for adopting MPAs in their EEZs, however, the question is to what extent can coastal States restrict the rights of other States within these MPAs including the right to lay and repair submarine cables. This will be dealt with in the next section.

Cable Operations within Marine Protected Areas

It seems reasonably clear that within a MPA, coastal States can restrict activities over which they are given sovereign rights and jurisdiction under UNCLOS,[106] such as fishing and resource exploration and exploitation. However, it is also widely agreed that the ability of coastal States to restrict recognized freedoms such as navigation within MPAs is limited.[107] The IMO, as the competent international organization responsible for shipping, is the only body that can control navigation through MPAs.[108] While there is no equivalent body for submarine cables, by the same reasoning it can be argued that as with navigation, coastal States do not have the authority to impose blanket prohibitions on the laying or repairing of cables within MPAs.[109]

Despite this, there have been several instances of MPAs being adopted in the EEZ which restrict cable operations in these areas. For example, the United Kingdom sought to control the routing of a new cable system[110] initially planned to enter designated Special Areas of Conservation outside its territorial waters.[111] Another example is the designation by US authorities of additional areas in the

104 Information on the designation of PSSAs is available on the IMO website at http://www.imo.org/OurWork/Environment/pollutionprevention/pssas/Pages/Default.aspx (last accessed 7 June 2013).

105 1978 Protocol Relating to the 1973 International Convention for the Prevention of Pollution from Ships (including Annexes, Final Act and 1973 International Convention), adopted 17 February 1978, 1340 UNTS 61 (entered into force 2 October 1983) (MARPOL 73/78).

106 See generally UNCLOS Art 56.

107 E.J. Goodwin, *International Environmental Law and the Conservation of Coral Reefs* (Routledge, 2011) at 52.

108 *Ibid.*, at 53.

109 Also refer to the discussion above on the ability of coastal States to impose environmental regulations on cable/cable operations.

110 D. Toombs and R. Carryer, "Jurisdictional Creep and the Retreat of UNCLOS" Paper Presented at the 2010 SubOptic Conference, Yokohama, Japan 11–14 May 2010 (personal copy with authors).

111 See United Kingdom Marine Conservation (Natural Habitats) Regulation 2007 available at the UK Legislation Web site, available at http://www.legislation.gov.uk/uksi/2007/1842/contents/made (last accessed 7 June 2013).

US EEZ as a "critical habitat" for the protection of the leatherback sea turtle.[112] Given the already wide-ranging environmental permitting requirements imposed by the US for cable operations, the industry, represented in this case by the North American Submarine Cable Association (NASCA)[113] was concerned that the designation would add an additional requirement for cable operations in these designated areas.[114] In particular, NASCA was apprehensive that some agencies may interpret this regulation as imposing a requirement on Federal Agencies to initiate a consultation before taking any action (including permit requirements) that may affect an endangered species or its critical habitat.[115] In their view, this would "impose substantial additional permitting costs and delays on undersea cable operators without any corresponding increase in the protection of leatherback sea turtles"[116] and they requested that the US authorities confirm that such a consultation would not be required.[117] While the US authorities considered the comments by NASCA, it ultimately did not clarify this requirement as they stated that it was the responsibility of the relevant agency to determine if such a consultation was required.[118]

There have also been examples of MPAs, which protect the marine environment and permit cable deployment and related operations. For example, Australia has been particularly active in the protection of the marine environment, with the federal government announcing a proposal to increase the number of MPAs from 27 to 60 thus creating the world's largest network of MPAs, known locally as *reserves*.[119] The network covers 3.1 million km^2 and extends out to the

112 See generally Comments of the North American Submarine Cable Association (NASCA) Before the National Oceanic and Atmospheric Administration, US Department of State, In the Matter of *Endangered and Threatened Species: Proposed Rule to revise the Critical Habitat Designation for the Endangered Leatherback Sea Turtle,* Docket No 0808061067-91396-01 RIN 0648-AX06, dated 23 April 2010, available at http://www.n-a-s-c-a.org/app/download/2942651913/NASCA+Comments+re+Leatherback+Sea+Turtle+Habitat.pdf?t=1272296427.

113 The North American Submarine Cable Association (NASCA) is a regional cable protection committee which consists of an "organization of companies that own, install or maintain submarine telecommunications cables in the waters of North America". For more information, see the NASCA Website available at http://www.n-a-s-c-a.org/ (last accessed 7 June 2013).

114 *Ibid*., at page 3.

115 This is a requirement under Section 7 of the Endangered Species Act.

116 See NASCA Comments, supra note 112 at 1.

117 *Ibid.*

118 See Response to Comment 48 in Federal Register, Volume 77 Issue 17 dated 26 January 2012 available on line at http://www.nmfs.noaa.gov/pr/pdfs/fr/fr77-4170.pdf (last accessed 7 June 2013).

119 Australian Government, Announcement of the Final Commonwealth Marine Reserves Network Proposal (2012), available at http://environment.gov.au/coasts/mbp/reserves/index.html (last accessed 7 June 2013).

200 nm limit of the EEZ. Three levels of protection are designated: (i) *Marine National Parks*, which have the highest level of protection whereby commercial activities are prohibited apart from vessel passage and some aspects of tourism; (ii) *Multiple Purpose Zones* that allow activities such as recreational fishing, some types of commercial fishing and resource exploration while maintaining designated conservation values, and (iii) *Special Purpose Zones* that permit additional commercial activities, but still exclude those deemed damaging to an ecosystem.

Generally, the laying and maintenance of submarine telecommunications and power cables are generally permitted or allowable activities in multi-purpose protected areas such as those adopted by Australia, especially in light of their designation as *critical infrastructure*, their special status under UNCLOS and their low environmental impact.[120] Similarly, commercial and science cables reside in National Marine Sanctuaries in the United States.[121] It is clear that MPAs and cable operations are not mutually exclusive.

Cable Protection Zones as Marine Protected Areas?

For those States with designated cable protection zones,[122] there has been the suggestion that such areas may act as MPAs as they prohibit potentially hazardous and environmentally damaging activities such as bottom trawl fishing, ships' anchoring and seabed mining.[123] To assess the validity of that suggestion, a study was undertaken of a cable protection zone off Auckland, New Zealand.[124] No statistically valid difference was found in fish species inside or outside the zone—an observation attributed to the short four-year existence of the protection zone and illegal fishing within the protected zone. However, where the zone included reefs, there was a preferred concentration of fish within the zone, suggesting some protective effect. While the results are inconclusive, they demonstrate that for a cable protection zone to act as an MPA, it must have suitable fish habitats and effective policing to prevent poaching.

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120 See Carter *et al.*, *supra* note 25; see also OSPAR *supra* note 62.

121 See Grannis, *supra* note 16; see also NOAA (2005) *supra* note 34 and NOAA (2007) *supra* note 53; see also Kogan *et al.*, *supra* note 10; see also Monterey Bay National Marine Sanctuary *supra* note 85.

122 See Chapter 11 on Protecting Submarine Cables from Competing Uses.

123 See for example, ACMA, *supra* note 7; V.A. Froude and R. Smith, "Area-based Restrictions in the New Zealand Marine Environment" (2004) Department of Conservation MCU Report, available at http://www.marinenz.org.nz/nml/files/documents/7_minfish/minfish_froude_04.pdf (last accessed 7 June 2013); see also Cook Strait Submarine Cable Protection booklet *supra* note 8.

124 N.T. Shears and N.R. Usmar, "The Role of the Hauraki Gulf Cable Protection Zone in Protecting Exploited Fish Species: De Facto Marine Reserve?" (2005) Department of Conservation Research and Development Series 253 at 27.

OSPAR Commission Guidelines on Best Environmental Practice in Cable Laying and Operation

Perhaps one of the more striking examples of environmental regulations which encroach upon the freedom to lay and repair cables is the *Guidelines on Best Environmental Practice in Cable Laying and Operation* (BEP Guidelines) issued by the OSPAR Commission in 2012.[125] The OSPAR Commission was established to administer and implement the Convention for the Protection of the Marine Environment of the Northeast Atlantic (the OSPAR Convention).[126] The OSPAR Convention is a "mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Community, cooperate to protect the marine environment of the North-East Atlantic".[127] It covers a wide area that is divided into five regions comprising Arctic waters, the Greater North Sea, Celtic Sea, the Bay of Biscay and the Iberian Coast, and the Wider Atlantic.[128]

The BEP Guidelines are based on two reports issued by the OSPAR Commission on the environmental impact of submarine cables.[129] Its purpose is, *inter alia*, to set out possible measures to avoid and mitigate any ecological impacts of construction, operation and removal of underwater cables, differentiate between possible measures regarding various types of sea cables and identify remaining gaps in knowledge and the resulting specific research needs.[130] However, there are several issues with both the assumptions underlying the BEP Guidelines and the recommendations contained in it, some of which are highlighted in the following paragraphs.

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125 Agreement 2012-2, OSPAR 12/22/1, Annex 14. Available for download from the OSPAR Commission website http://www.ospar.org/v_measures/browse.asp?menu=00750302260125_000002_000000 (last accessed 7 June 2013).

126 Convention for the Protection of the Marine Environment of the North-East Atlantic, adopted 22 September 1992, 2354 UNTS 67 (entered into force 25 March 1998) (OSPAR Convention).

127 See the OSPAR Commission Website available at http://www.ospar.org/content/content.asp?menu=00010100000000_000000_000000 (last accessed 7 June 2013).

128 For more information on the Regions that are covered by the OSPAR Convention, see http://www.ospar.org/content/content.asp?menu=00420211000000_000000_000000 (last accessed 7 June 2013).

129 OSPAR Commission, "Background Document on Potential Problems Associated with Power Cables other than those for Oil and Gas Activities" (2008) Publication Number 370/2008 available online at http://www.ospar.org/documents/dbase/publications/p00370_cables%20background%20doc.pdf (last accessed 7 June 2013); OSPAR Commission "Assessment of the Environmental Impacts of Cables" (2009) Publication Number 437/2009 available online at http://qsr2010.ospar.org/media/assessments/p00437_Cables.pdf (last accessed 7 June 2013).

130 BEP Guidelines, *supra* note 125 at para 1.

- The BEP Guidelines cite oil leaks from power cables as the basis for regulation.[131] The use of oil in ocean cables became obsolete in the 1990s.[132] Modern ocean power cables use mass impregnated paper or XPLE (cross-linked polyethylene) for insulation, and no oil at all is used.[133] The modern plastics used in HVDC cables for insulation are environmentally benign.
- The BEP Guidelines state that modern cable installation techniques like burial have a "lethal effect on some [unnamed] species".[134] However, no citations or studies are provided to support this claim.
- The BEP Guidelines require that existing cables and pipelines be bundled.[135] This requirement is problematic on several levels. First, submarine cables when repaired in the ocean are usually located by grapnel runs.[136] Cable owners will be very unwilling to drag grapnels over oil and gas pipelines where contact could result in an oil spill or pipe rupture. Second, cables are critical international infrastructure upon which the internet and international communications depend. Co-locating cables with pipelines increases the risk of damage to both the cables and pipelines, makes any repair more complicated and dangerous, and increases the risk of marine pollution from a damaged pipeline. In addition, the effects of a single event, such as a terrorist attack or natural weather phenomenon, may have wider repercussions if cables and pipelines are located in close proximity. If a number of telecommunication cables are damaged in a single event then there will be reduced re-routing options, and repairs will be hampered because multiple repair vessels will need to be sourced and will be required to operate simultaneously in the same area.
- The BEP Guidelines require that cables laid in any area be buried to a depth of 1–3 m to reduce speculative heat impacts.[137] Modern fiber optic cables, especially those laid beyond the continental shelf and upper continental slope (< ~1500 m water depth), are simply draped on the seabed with minimal impact. Cables are only buried on the continental shelf/upper in order to avoid bottom trawlers and ship anchors. Burial of cables in great ocean depths (nominally taken as > 2000 m) is not technically possible at the present time.
- The BEP Guidelines mandate that explosives not be used for burial.[138] Cable owners never use explosives to lay or maintain cables for the simple reason that to do so would damage or destroy the cable. The cable industry itself, represented by the International Cable Protection Committee (ICPC), recommends

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131 *Ibid.*, BEP at 2.0 and 3.6 (Insulation of power cables).
132 See Figure 13.1 in Chapter on Power Cables.
133 See "About Power Cables" www.iscpc.org, under 'Publications'.
134 BEP Guidelines, *supra* note 125 at para 3.2.
135 BEP Guidelines, *ibid.*, at para 5.2.1.
136 See Figure 6.4 in Chapter on Submarine Cable Repair and Maintenance.
137 BEP Guidelines, *supra* note 125, at para 5.3.1.
138 BEP Guidelines, *ibid.*, at para 5.2.2.

that air guns and other seismic techniques not be used near cables as their use will damage sensitive optical amplifiers.[139]

- The BEP Guidelines require removal of out-of-service cables.[140] However, any removal should be made with due regard to the impact of removal on the benthic environment. Removal may produce a disturbance that has a more negative impact than leaving the cable on the seabed, bearing in mind that the environmental impact of cables is so benign that they have been used by governments for artificial reefs for years.[141] (Figures 7.2 and 8.1.) However, where removal has little environmental impact, especially for surface laid cables in water depths > ~1500 m, cable recovery can be undertaken (see above, Cable Recycling and Life Cycles and Chapter 8).[142]
- The BEP Guidelines also require formal Environmental Impact Statements (EIS) be prepared for the high seas.[143] This is not consistent with UNCLOS, which provides that waters beyond of national jurisdiction, especially the high seas, are not subject to regulation by any single State or group of States such as OSPAR.
- The BEP Guidelines require cable companies to pay for mitigation for not complying with the above requirements,[144] presumably with the payments being made to OSPAR itself, but the specifics of who will receive the 'ecological compensation measures' funds and how amounts will be determined and divided by OSPAR are not provided.

One of the major reasons for the above problems with the BEP Guidelines is the fact that they were conceived and issued without input from stakeholders in the telecommunication and power cable industries. A survey of all of the major telecommunications companies and power cable companies by the ICPC in August 2012 revealed that none of these companies had been contacted nor were

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139 ICPC Recommendation No. 7A, Offshore Seismic Survey Work in the Vicinity of Active Submarine Cable Systems.

140 BEP Guidelines, *supra* note 125 at para 5.3.3.

141 See http://www.state.nj.us/dep/fgw/artreef.htm (last accessed 7 June 2013). The Division of Fisheries and Wildlife, New Jersey Department of Environmental Protection, New Jersey has an extensive artificial reef programme on the continental shelf. Fourteen sites are defined, each site containing clusters of artificial reefs. Since 1984, over 2100 artificial reefs have been built, covering about 2 per cent of the 65 square kilometers enclosed by the designated sites. The website also leads to the *New Jersey Reef News*, containing useful summaries of scientific investigations of artificial reefs, e.g. *NJ Reef News 2000.*

142 ICPC Recommendation No. 1 Recovery of Out-of-Service Submarine Cables; see also D. Burnett, "The Legal Status of Out-of-Service Submarine Cables" (July/August 2004) 137 *Journal of Maritime Studies* 22.

143 BEP Guidelines, *supra* note 125 at para 5.2.1.

144 BEP Guidelines, *ibid.*, at para 4.0 [Implementation of ecological compensation measures].

they even aware of BEP. These included major companies in the OSPAR region such as British Telecom, France Telecom, TDC (Denmark) and Deutsche Telecom. Similarly, there was no consultation with industry trade groups such as the ICPC, CIGRE, Subsea Cables UK, and the Danish Cable Protection Committee. As a result, the BEP recommendations inevitably contain misconceptions about cables and cable operations. Moreover, the OSPAR Commission itself consists of environmental ministries, but not ministries associated with telecommunications or power cable infrastructure, which meant that the latter's input was also omitted from the drafting of the BEP Guidelines. In an effort to open dialogue with OSPAR, Subsea Cables UK applied for observer status with OSPAR on 25 March 2013. OSPAR informed Subsea Cables UK on 4 July 2013 that the application had been vetoed by Germany.

Another possible explanation for the various issues in the BEP Guidelines is that it heavily relies on the precautionary principle, which has acquired special significance in international environmental law.[145] The precautionary principle is based on the concept that "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation".[146] While the legal status and content of the precautionary principle is still evolving and its status as a principle of customary international law has not been confirmed with any degree of certainty,[147] the OSPAR Convention obliges States Parties to apply the precautionary principle.[148] Accordingly, even though the BEP Guidelines acknowledge that there are gaps in the knowledge of noise impacts on fauna, heat impacts on benthic species and electromagnetic impacts on the orientation of fish and marine mammals,[149] it concludes "there is sufficient evidence that placement and operation of submarine cables *may* affect the marine environment" and hence, the precautionary principle should be applied.[150] The BEP Guidelines include no

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145 Birnie *et al.*, *supra* note 66 at 154.

146 Principle 15 of the Rio Declaration on Environment and Development available online at http://www.unep.org/documents.multilingual/default.asp?documentid=78&articleid=1163 (last accessed 7 June 2013).

147 For a description of the debate on the status of the precautionary principle, please refer to M. Schroder, "Precautionary Approach/Principle" in R. Wolfrum (ed), *The Max Planck Encyclopedia of Public International Law* (Oxford University Press, 2012) at 400–405.

148 See the OSPAR Convention, Art 2(2)(a) which states that the Contracting Parties shall apply "the precautionary principle, by virtue of which preventive measures are to be taken when there are reasonable grounds for concern that substances or energy introduced, directly or indirectly, into the marine environment may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship between the inputs and the effects".

149 BEP Guidelines, *supra* note 125 at 3.2–3.5 and 8.0.

150 BEP Guidelines *ibid.*, at 8.0.

cost versus benefit analysis of its controversial measures. For the cable industry and the international community, the application of the precautionary principle and its accompanying consequences for cable operations in such a wide expanse of ocean area has potentially far-reaching consequences.

Conclusions

Submarine cables are the arteries through which global commerce and human telecommunications pass. Cables also underpin the rapidly developing offshore renewable energy sector as well as scientific ocean observatories. In these critical roles, cables have nonetheless been recognized as having low to negligible impact on the marine environment. As has been made clear in this Chapter, the marine environment can be sufficiently protected without the need to unduly restrict the freedom to lay and repair submarine cables. The few environmental issues surrounding cables should be resolved by meaningful scientific research documented in quality peer-reviewed journals. When imposing environmental regulations on cables and cable operations, coastal States should carefully consider whether the regulations are consistent with international law and whether they achieve the purpose of protecting the marine environment. The coastal State should also consider the impact of such regulations on cable deployment. Perhaps most importantly, there should be a dialogue between industry, governments and environmental organizations. After all, companies and industry organizations such as the ICPC have shown themselves to be open to working with environmental organizations and independent scientists to better determine the interactions of submarine cables and the marine environment. Such fruitful cooperation between science and industry extends back over 150 years and will undoubtedly continue in the future.