Protection of the cable landing: new techniques for minimizing the environmental impact and costs

The biggest challenge to which are called companies that deal with the design and the installation of submarine cable systems, is surely to protect the cables that were laid on the seabed. The possible causes of damage and thus catastrophic disruption of services, which cause significant financial losses related to both repair costs on average over one million dollars, and the losses resulting from the suspension of services, are now known at the whole universe of companies of telecom industry, which are constantly looking for methods and technologies to limit the damages. In this discussion we do not deal with all the various issues related to damages, since it is easy to understand how many and different they are, but we will have a particular focus on the areas of landing of the cables and in particular, in those areas where protecting the cable is made difficult or limited by the presence of vulnerable species (for example, *Posidonia oceanica* in Mediterranean Sea).

In these areas it is usually impossible to carry out a burial of the cable that allows suitable protection, due to several factors which prevent the use of standard techniques, first of all the legislative intervention which protects areas inhabited by protected species, limiting the mechanical protection of the cables to the use of articulated pipes that "wrap around" the wire leaving it lying on the surface, even if anchored to the bottom. This technique is usually used for most of the landings, but it must be noted the limitations and contraindications of it, starting from exposure of the system to mechanical damage and drag due to human activities, finishing to the considerable cost of purchase and installation.

Globally, cables are broken by fishing or anchoring 100-150 times per year (around 70% of all cable faults are caused by fishing and anchoring in depths of less than 200 m). By far the highest percentage of breaking events is due to negligence. In fault database (status 2009) these incidents are the major cause (60%) of cable disruption.

In comparison to natural hazards, man-made causes for submarine cable disruption count for the highest number of events and are more likely to occur. In water depths of less than 1000 m human activity is the main hazard to submarine cables, natural impacts cause less than 10% of cable damage in this area.

The intentional damaging of submarine cables can be ordinary theft, aimed at the cable materials. Alternatively, it can be sabotage or even terrorism which aims at disrupting communications using the cable. This threat has to be taken very seriously. The imbalance between the vulnerability of submarine cables on the one hand and the possible impact of their disruption on the other hand makes them an especially interesting target for terrorists (1).

Each year the owner companies invest large amounts of money to make repairs in these areas, often being forced to replace hundreds of meters of cable (double armour which are the more expensive) because they are unable to do the repairs with the normal techniques used in deeper waters. It is undeniable that the repairs in very shallow water require the use of special vessels (barges), in addition to these costs, it must be added those of a Cable Repair Ship. If the cost of a typical repair is more than one million dollars, that in very shallow water can reach and exceed this amount. Therefore it becomes of strategic importance to find alternative solutions for installation and protection of the cables, which will drastically reduce the possibility of damages.

According to this perspective, it is thought to take advantage of the innovative techniques of seagrass transplanting, *Posidonia oceanica* in particular, in order to heal the wound caused by a possible excavation, caused by the burial of cable, necessary for its greater protection to the phenomena listed above.

To date, these techniques have not been made possible because of vulnerability of seagrass beds and, therefore, of their protection dictated by international law.

Seagrass meadows have an important role in coastal marine ecosystems, providing a number of ecosystem services and rank among the highest of all ecosystems on Earth (2).

Ecological services given by seagrasses ecosystems include: the increase of the biodiversity, the improvement of water quality, the enhancement of sediment deposition and retention, the reduction of ocean acidification, playing also a substantial role in nutrient and carbon cycling in the ocean (3, 4, 5).

Seagrass meadows have shown a considerable capacity to sequester and store great amount of carbon in their carbon-rich sediments, being responsible for 20% of the global carbon sequestration in marine sediments (6) and contribute to mitigate climate changes.

Today, seagrass meadows cover less than 0.2% of the world oceans (the current estimate of the total area of seagrasses is 177,000 km^2) and are the most threatened ecosystems due to anthropogenic stresses. The rate of their decline is estimated of 5% per year and 1/3 of the area covered by these habitats has been lost since World-War II (7).

In order to partially mitigate seagrass decline following natural and human pressures, transplanting techniques are an effective option to protect seagrass ecosystems (3). Seagrass transplantations for habitat restoration have been conducted for almost 60 years (8). Seagrass transplanting techniques include vegetative transplanting methods, where seedlings or mature plants are harvested from donor beds, and seed-based methods (9, 10, 11).

Vegetative shoot transplanting techniques include sediment associated and sediment-free methods. Sediment associated methods such as the plug/core or sod method can minimize disruption to root and rhizome tissues, resulting in successful transplant establishment. Sediment-free methods involve removing seagrass shoots along with bare roots and rhizomes from donor beds. The shoots are then anchored using devices such as staples, nails, rods, and frame systems because of the positive buoyancy of seagrass shoots (12).

The appropriate transplantation technique will depend on the seagrass species and the conditions at the planting sites such as current velocities, substrate types, and expected predators on the planted material (13, 14). Seagrass transplantation experiments have shown various results in relation to the rate of mortality and survival of cuttings. Survival rates after 3 years ranged from 40 to 85% for plagiotropic shoots and from 25 to 73% for orthotropic cuttings at depths from 3 to 11 m (15, 16).

In Mediterranean Sea transplantation experiments carried out on *Posidonia oceanica* use supports for the anchorage of cuttings different techniques and methods as cheesecloths, plastic and metal grid and concrete frame (17, 18).

Recently, a new innovative technique for the restoration of *Posidonia oceanica* meadows in the Mediterranean Sea has been developed using a biodegradable plastic support (bioplastic *Mater-Bi*). The support allows a rapid and efficient positioning of *Posidonia oceanica* cuttings, ensures their establishment and growth, supports the natural dynamic development of the meadow reducing the rate of mortality and the impact on marine environment.

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