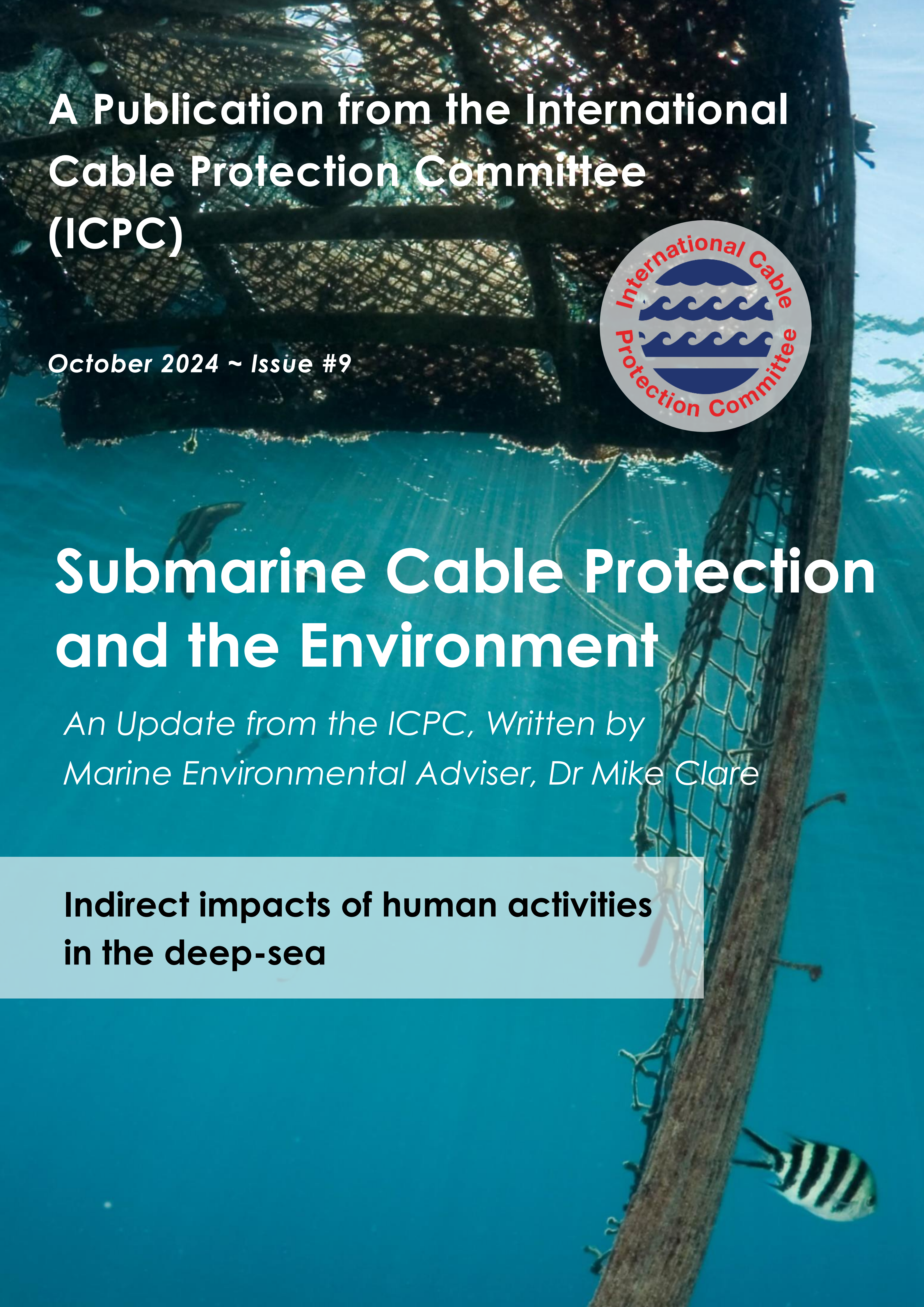

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Submarine Cable Protection and the Environment

An Update from the ICPC, Written by Marine Environmental Adviser, Dr Mike Clare

Indirect impacts of human activities in the deep-sea

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SUBMARINE CABLE PROTECTION AND THE ENVIRONMENT

An Update from the ICPC, Written by the Marine Environmental Adviser (MEA)

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EDITOR'S CORNER

Submarine cables, by their very nature, connect one place to another (and often times many more than that). From a global perspective, we are talking primarily about submarine fibre optic cables used for international communications. From a regional perspective, we are talking about submarine fibre optic cables, as well as power cables, which transmit power between countries or within a region, or bring power from offshore renewable energy sources to shore. Whether a fibre optic cable or a power cable, the scope of such a project or installed infrastructure asset is large from a geographic perspective. As a result, companies and the overall industry are charged to think holistically and globally about the environment this infrastructure is installed in—the ocean. There is an equally important charge to think locally in terms of the risks and threats to a cable in each country or environment where the cable is placed.

Another way to think about this is that the submarine cable industry is charged to think about the ocean environment (the ocean, water column, seabed and the natural events that take place) and the human activities that take place within it (fishing, shipping, deep seabed mining, renewable energy, dredging, oil and gas, etc). Based on this, the ICPC has been committed to understanding the ocean at a global and local level and investigating ways of minimising the impacts of the industry through an evidence-based approach. And the ICPC has been committed to managing interactions between the submarine cable industry and other seabed users, which is continually important with the growth and expansion of marine uses around the world.

Given that the majority of annual cable faults (specifically submarine fibre optic cables) are caused by bottom contact fishing and vessel anchorages, the primary risk to cables is from human activity. As cables push into new terrain, finding diverse routes and landing sites, new risks exist where submarine cables have not interacted with other marine uses before. A good example of this is the interaction between submarine cables and fish aggregating devices (FADs) in Indonesian waters, among other locations. An important component of venturing into new routes and landings is education and awareness of cable infrastructure, a mitigation measure that the ICPC supports through the charting of submarine cables, among other best practice awareness methods. This has driven the ICPC to continue efforts in cable education and awareness to governments and other entities and to contribute to the evidence-based literature about submarine cables and the environment by sponsoring research projects across a variety of topics. This publication is also another initiative to promote more education and research about submarine cables and the environment they exist in. In a simple summary, this edition is all about cables and their crossroads with the natural environment and human activities.

Sincerely,

Ryan Wopschall
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INTRODUCTION

The ocean is a dynamic and ever-changing place. Powerful seafloor currents can reach the deepest parts of the ocean and scientists continue to be surprised by the processes that operate across the largest habitable space on our planet. It is becoming increasingly apparent that variable impact of human activities are now being felt across the entirety of the ocean, and in some cases their influence exceeds that of natural processes. To enhance the resilience of the global network of subsea cables requires a wide understanding of how the ocean is changing. In this issue of *Submarine Cable Protection and the Environment* we discuss some of the ways in which human activities are modifying natural conditions and how that may relate to new or changing hazards for subsea cables.

- The global network of subsea cables continues to grow to enable digital communications and carrying energy supplies.
- These critical connections can be damaged, particularly by accidental human activities.
- Fishing and anchoring account for most instances of cable damage in shallow water, but these unintentional impacts can largely be avoided through careful cable protection and increased awareness.
- The impacts of fishing can sometimes extend into even deeper waters, which can have unforeseen implications for subsea cables.
- Fish Aggregating Devices that are deployed in very deep water can cause damage where their mooring lines or anchors snag on cables.
- Seafloor disturbances by trawling can create sediment flows that travel along submarine canyons.

- Other human activities are modifying natural environments that may pose new or previously-unrecognised hazard for subsea cables.
- It is therefore important to consider the indirect impacts of human activities, as well as direct ones, and natural hazards.

MOST DAMAGE TO SUBSEA CABLES IS CAUSED BY ACCIDENTAL HUMAN ACTIVITIES

Subsea telecommunications cables are fundamental to our daily lives, providing critical digital connections that enable the internet and financial trading, and transmitting electricity harnessed from offshore renewable energy sources. These networks of telecommunications and power cables are designed to be as resilient as possible, but from time-to-time damage occurs that requires repair. While often grabbing media headlines, natural hazards such as earthquakes and underwater landslides only account for around 10% of the approximately 150-200 faults that occur each year; although when they do happen such natural processes can damage multiple cable systems at the same time, sometimes across large areas. Instead, most instances of damage relate to accidental human activities, with the primary causes being due to unintentional snagging of fishing gear deployed from trawlers or the dragging of a ship's anchor. Anchor faults are mostly concentrated within busy harbours and ship traffic areas, which can be hard to patrol and protect, while fishing-related faults largely occur in areas of the continental shelf that are intensively trawled.

A REDUCTION IN FISHING-RELATED CABLE FAULTS DUE TO GREATER AWARENESS AND PROTECTION

Despite the continued expansion of the global network of subsea cables, the number of such human-related faults has actually decreased over time relative to its total length. Fishing and anchor-related faults in shallow water (<1000 m) have reduced, from an average of around 0.2 faults/1000 km in 2010 to around 0.05 by 2018 (Kordahi et al., 2019). This decrease in cable damage has primarily arisen due to increased awareness of the location of subsea cables, monitoring of those activities, increased armouring and

systematic burial of cables in shallow water areas that are affected by fishing and vessel traffic. While subsea cables are laid directly on the seafloor in deep waters (away from the exposure to fishing gear and anchors), cable burial is now routine down to water depths of 1000-1500 m. Cable burial is typically to a depth of around 0.5-1.0 metres below the seafloor, but may be deeper in some specific locations, where anchors from commercial vessels penetrate much deeper (Clare et al., 2023). Environmental surveys performed after cables were installed have shown that, while such burial disturbs the seafloor, conditions recover relatively quickly; typically within weeks or months (OSPAR, 2024). The rate of recovery strongly depends on the background environmental conditions, seafloor currents, and the nature of the seafloor sediment (Kraus and Carter, 2018).

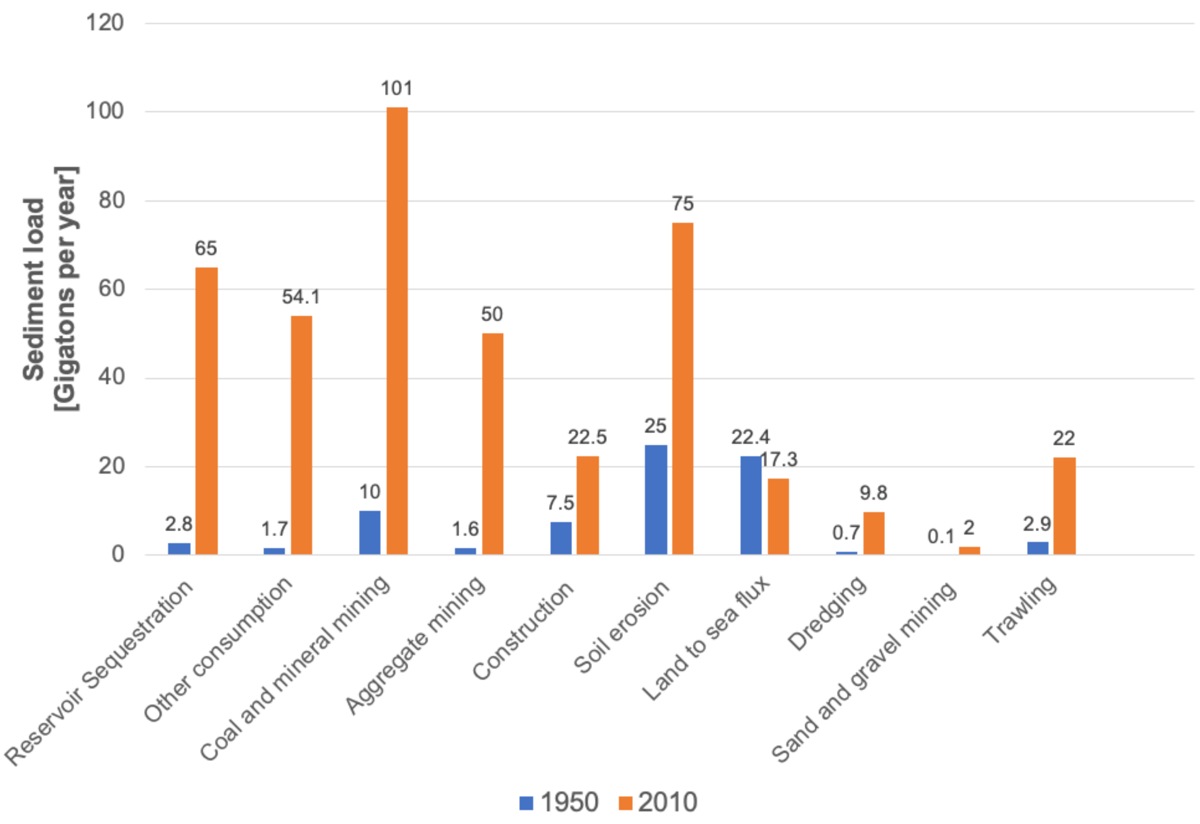
IMPACTS OF HUMAN ACTIVITIES SUCH AS FISHING ARE NOT ENTIRELY LIMITED TO SHALLOW WATER

As highlighted in *Issue 2 of Submarine Cable Protection and the Environment,* moored Fish Aggregating Devices (FADs) are increasingly being used in locations such as the Indian Ocean and south-east Asia, in much deeper waters than exploited for trawling. These floating structures attract commercially-important fish such as tuna at the sea surface, and are tethered to a seafloor anchor weight by a long mooring line. Interaction or entanglement of cables with this mooring line or the anchor, such during deployment or during storm events, can lead to sudden or progressive abrasion of the outer protective sheath of a cable, sometimes resulting in a fault. Damage from interaction with FADs has been reported down to several thousand meters water depth, locations where repairs can be particularly challenging (ICPC, 2021).

It is now apparent that the influence of a wide range of human activities is being felt across the global ocean. The influence of human-driven climate change is a worldwide phenomenon, that has wide-reaching impacts for ocean biodiversity (Talukder et al., 2022). Microplastics and other pollutants have been found in the deepest hadal trenches in the ocean; transported far from the coast by seafloor currents that act like conveyor belts into the deep sea (e.g. Peng et al., 2020). A recent review showed that human activities dominate the transport of sediment on a global scale, outcompeting the effects of rivers (Syvitski et al., 2022). Over recent decades, the amount of sediment disturbed and transported by human activities has dramatically increased. For example, the amount of aggregate mining on land has been reported to increase from 1.6 gigatons (i.e. thousand million tons) in 1950 to 50 gigatons in 2010 (Syvitski et al., 2022). Dredging of ports and harbours has grown from less than one to more than ten gigatons per year, while trawling has increased the amount of suspended sediment offshore by an order of magnitude, from 2.9 to 22 gigatons per year, a number that is approximately the same as the total sediment mass supplied to submerged continental shelves by all the world's rivers annually (Oberle et al., 2016).

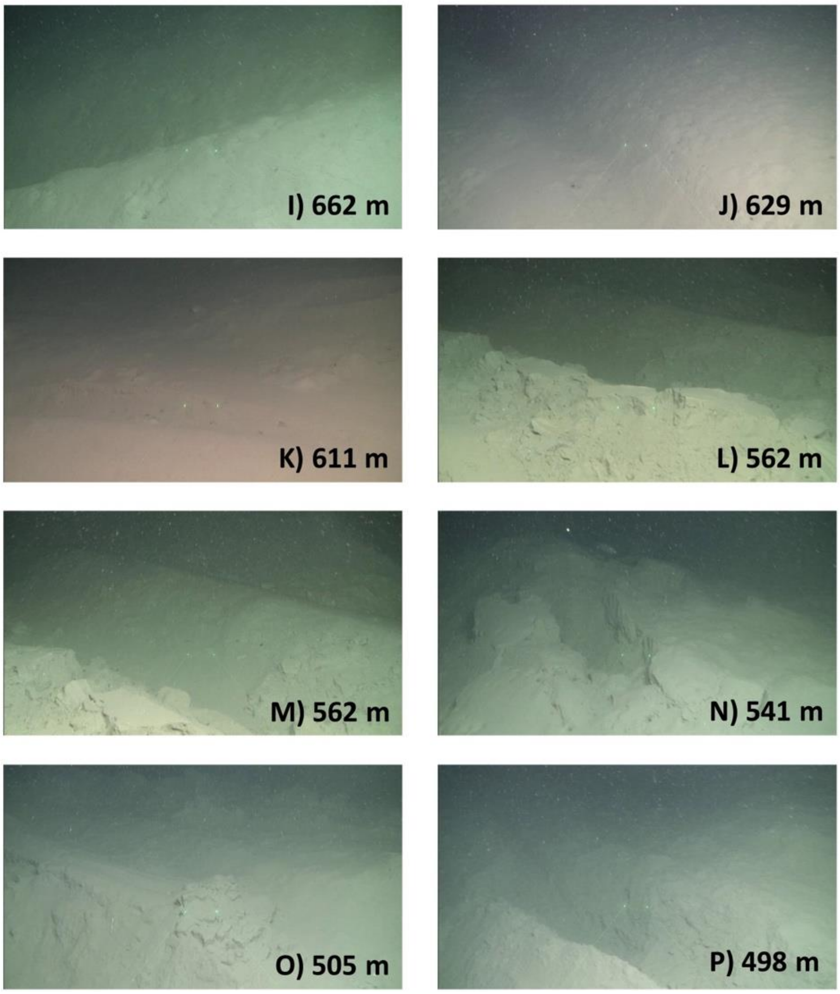
▼ **Figure 1:** Photograph of lightweight cable damage caused by entanglement with a moored Fish Aggregating Device near the Philippines in 4,000m water depth. Note that the polyethylene insulation has been stripped by the FAD mooring exposing the copper conductor (ICPC, 2024).

▼ **Figure 2:** Sediment disturbed or transported by different human activities, illustrating dramatic increase from a total of 70 gigatons per year in 1950 (blue) to 300 gigatons/year in 2010 (orange), with more recent estimates likely to be much higher. Values from Syvitski et al. (2022) and references therein.



GLOBALLY-SIGNIFICANT EFFECTS OF BOTTOM TRAWLING

Bottom trawling is playing an increasingly significant role in sediment transport, in places overprinting the natural regime. This is perhaps unsurprising given that the footprint of seafloor trawled to date is estimated at 37 million km^2 – just over 10% of the total seafloor area worldwide. Bottom trawling accounts for 22% of the global fish production (Kelleher, 2005) and up to 80% when considering high seas fisheries focused on benthic resources (Martin et al., 2014). In the Gulf of Lions (Mediterranean



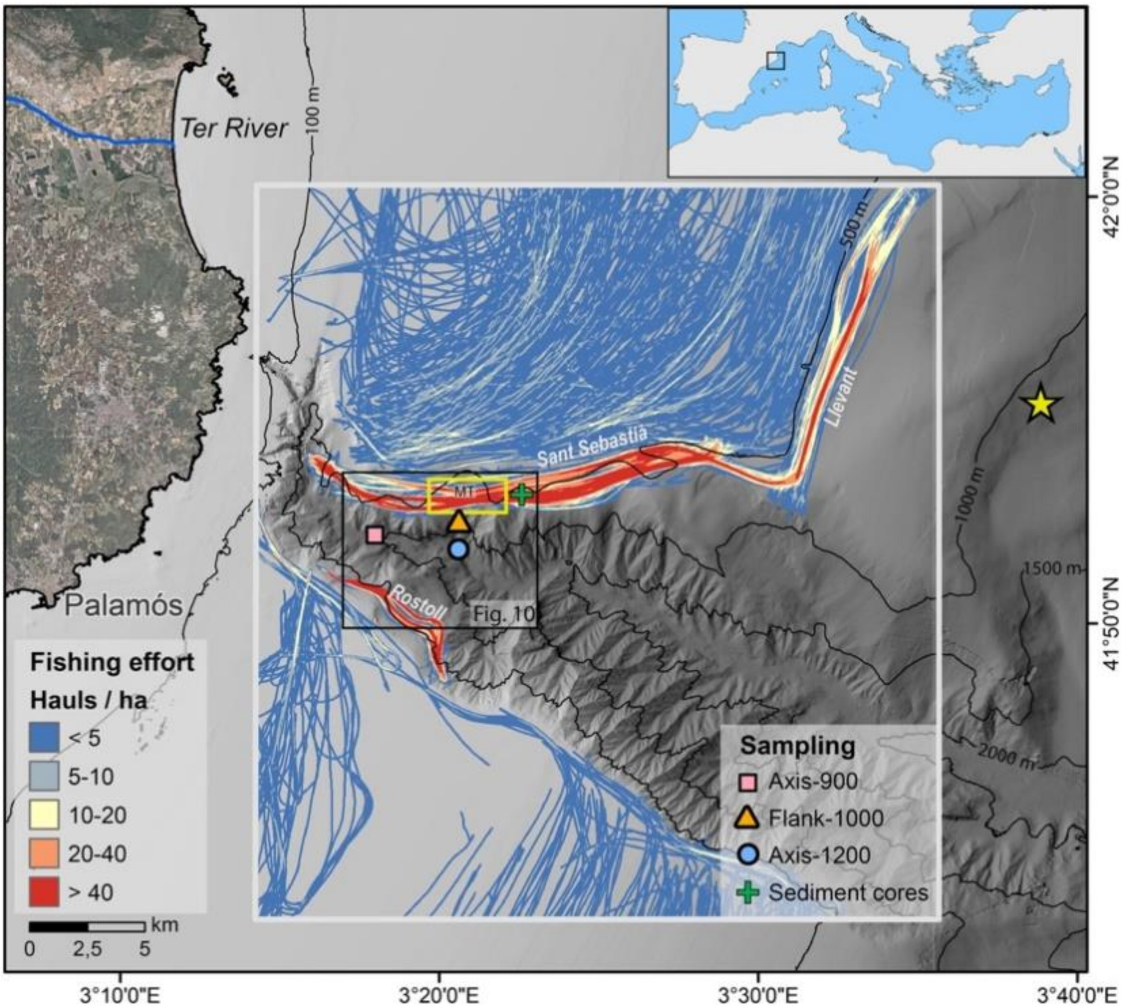
◀ **Figure 3:** Photographs of the seafloor taken by a Remotely Operated Vehicle showing piles of sediment created by trawling disturbance. Reproduced from Palnques et al. (2024) under a Creative Commons Licence.

Sea), bottom trawling has been estimated to account for one third of the total amount of sediment that is transported from the continental shelf to the slope (Ferré et al., 2008), while it is estimated that bottom trawling has created an increase in such sediment transport of six times above the natural regime offshore Portugal (Oberle et al., 2016). Other places show a similar story, including the Gulf of Maine (north-west Atlantic Ocean) and the Kattegat Sea (connection between the Baltic and North Sea) (Pilskaln et al., 1998; Floderus and Pihl, 1990; Palanques et al., 2014). Trawling-induced disturbance of the seafloor, can generate pronounced plumes of sediment, the scale of which can be seen from satellites that orbit the Earth (Oberle et al., 2018).

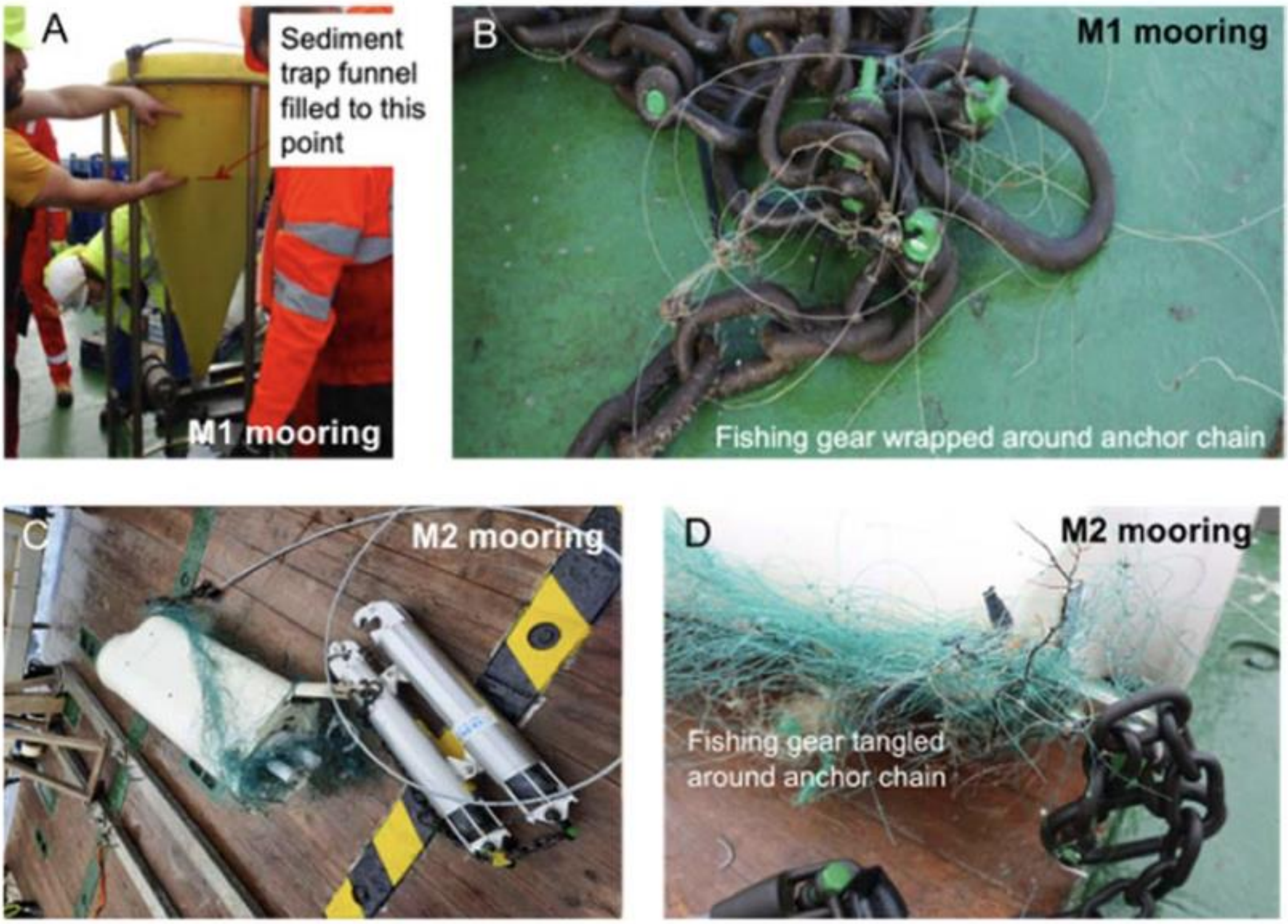
EFFECTS OF TRAWLING FELT FAR AWAY INTO THE DEEP-SEA

Submarine canyons and their surroundings are often hotspots for biodiversity, which attract commercially-important fish. Such canyons occur along all of the world's submerged slopes, and provide an important connection between continental shelves and the deep sea, acting as a focal

▼ **Figure 4:** Intensity of trawling revealed from satellite-tracking (AIS) of fishing vessels around the submerged Palamos Canyon in the western Mediterranean Sea. Red tracks indicate intense fishing effort (more than 40 hauls per hectare) which is focused along the northern flank of the canyon. Coloured shapes represent the locations of seafloor sensors that recorded sediment flows immediately after trawls occurred. Reproduced from Paradis et al. (2022) under a Creative Commons Licence.



point for the generation of nutrient-rich waters and the accumulation of organic-rich matter (De Leo et al., 2010). Fishing activity is therefore often concentrated around submarine canyons, with repeated trawling sometimes occurring more than one thousand metres water depth close to the rim and along canyon flanks (Pusceddu et al., 2014). While trawling typically does not extend



▼ **Figure 5:** Scientific moorings recovered from the deep-sea Whitttard Canyon (north-east Atlantic Ocean) from water depths of 1.5 km (M1) and 2.0 km (M2). When recovered, a trap was almost completely full of sediment (A) and mooring lines were entangled with fishing gear (C-D) that had been transported down the canyon. Reproduced from Heijnen et al. (2022) under a Creative Commons Licence.

into the canyon itself, resultant impacts have been recorded far from the location of the initial disturbance, into much greater water depths. Sensors deployed in the axis of the Palamos canyon (Mediterranean Sea) recorded episodic increases in suspended sediment and down-canyon flow speed that were uncharacteristic of the background conditions (Puig et al., 2012). Analysis revealed that these peculiar deep-sea sediment transport events only occurred on weekdays, and during specific times of day (after around 09:00am, stopping around 12:00 and resuming for a few hours in the afternoon). These were found to closely match the times when trawling activities occurred on the canyon flanks (Puig et al., 2012). Longer-term monitoring inside the canyon revealed that sediment transport was negligible during months when trawling had ceased, but switched on when trawling resumed (Paradis et al., 2022). In the Blanes canyon (also in the Meditarreanan Sea), down-canyon sediment flows occurred coincident with trawling activity, as well as afterwards, as a result of disturbed sediment piles collapsing into the canyon (Palanques et al., 2024). Sediment accumulation rates in other submarine canyons have been found to be significantly elevated above their natural background levels, such as in the Whittard Canyon in the north-east Atlantic (Amaro et al., 2016).

WHAT ARE THE IMPLICATIONS OF HUMAN-MODIFIED SEDIMENTARY REGIMES?

Similar, albeit larger magnitude, sediment flows have been shown to damage cables in several submarine canyons worldwide. Fast-moving sediment flows in the submerged Congo Canyon (west Africa) damaged multiple telecommunications cables as they flowed to the deep-sea, cutting internet connections during the first COVID-19 lockdown (Talling et al., 2022). Other examples include flows in the Gaoping Canyon offshore Taiwan that damaged nine cables in 2009 (Carter et al., 2012). These powerful flows were

triggered by the delivery of sediment to the heads of submarine canyons, by natural processes including river floods, or disturbances caused by earthquakes or tropical storms (Talling et al. 2024). Submarine canyons that lie away from naturally-occurring sediment supplies in the present day have been thought to be relatively inactive with regards to these sort of events (Covault and Graham, 2010). However, recent deep-sea measurements have revealed frequent and powerful flows in canyons that were otherwise thought to be inactive (Heijnen et al., 2022).

Based on the recent observations of trawling-induced sediment flows, it has been suggested that such human influence may play a role in increasing the likelihood of sediment avalanches or slope collapses, potentially explaining this surprising activity and posing previously-unrecognised threats to subsea cables (Arjona-Camas et al., 2024; Palanques et al., 2024). In addition to the sediment that they carry, flows have been shown to transport litter and plastics related to fishing to water depths of at least 2000 m (Zhong and Peng, 2021; Heijnen et al., 2022). Other human activities have also been suggested to enhance the likelihood of hazardous sediment flows, such as deforestation on land, which increases the rate of soil erosion, that washes off into rivers, and is ultimately flushed offshore where it can enter the heads of submarine canyons (Talling et al., 2022).

Given the amount of sediment that is redistributed by human activities, it is important that this is now considered in addition to natural processes, as well as the effect of climate change that is affecting the ocean (Syvitski et al., 2022). Further studies are required to better understand to what extent this is a widespread phenomenon, and the potential effects on the deep ocean.

Sharing seabed and oceans in harmony

The International Cable Protection Committee (ICPC) was formed in 1958 and its primary goal is to promote the safeguarding of international submarine cables against human made and natural hazards. The organisation provides a forum for the exchange of technical, legal and environmental information about submarine cables and, with more than **230 MEMBERS** from over **70 NATIONS,** including cable operators, owners, manufacturers, industry service providers, and governments, it is the world's premier submarine cable organisation. The ICPC comprises of an 18 Member Executive Committee (EC)-led organisation voted in by its Full Members. In addition to the Marine Environmental Adviser (MEA), General Manager (GM) and Secretariat team, the ICPC also has an appointed International Cable Law Adviser (ICLA) as well as a United Nations Observer Representative (UNOR).

Prime Activities of the ICPC:

- Promote awareness of submarine cables as critical infrastructure to governments and other users of the seabed.
- Establish internationally agreed recommendations for cable installation, protection, and maintenance.
- Monitor the evolution of international treaties and national legislation and help to ensure that submarine cable interests are fully protected.
- Liaison with UN Bodies.

Recommendations:

- Taking into account the marine environment, the ICPC authors Recommendations which provides guidance to all seabed users ensuring best practices are in place.
- Educating the undersea community as well as defining the minimum recommendations for cable route planning, installation, operation, maintenance and protection as well as survey operations.
- Facilitating access to new cable technologies.

Advancing Regulatory Guidance:

- Promoting United Nations Convention for the Law of the Sea (UNCLOS) compliance.
- Championing uniform and practical local legislation and permitting
- Protecting cable systems and ships.
- Aiding education of government regulators and diplomats.

Working with Science:

- Supporting independent research into cables.
- Publishing reviews for governments and policy makers.
- Working with environmental organisations.
- Effective public education via various media.

To learn how to become of Member organisation of the ICPC, please click on join here.

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As part of her Secretariat role, Christine coordinates marketing activities for ICPC. With a background in graphic design and publishing, Christine has been working in the telecommunications industry since 2000.

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1. **Cover Image**: iStock by Getty Images credit, RainervonBrandis; Fish aggregation devices are used by the fishing industry to attract fish which are then netted. They regularly wash up on reefs and damage / pollute the environment.

2. **Page 4:** pexels.com, credit Egor Kamelev; Blue Sea Anemone

3. **Page 6:** iStock by Getty Images credit, Vitalii Kalutskyi; Butterfly fish. Schooling kabouba - Scholing bannerfish - Heniochus diphreutes (family Chaetodontidae) - grows up to 18 cm. Representatives of this genus of the bristle-toothed family have an elongated fourth ray in the dorsal fin. Fish swim in large flocks in the water column high above the reef tops and feed on zooplankton.

4. **Page 8:** pexels.com, credit Quang Nguyen Vinh; Man on Boat Holding White Mesh Fishing Net.

5. **Page 15:** iStock by Getty Images credit, Damocean; Small canyon underwater carved by swell into the reef, Huahine island, Pacific ocean, French Polynesia.

6. **Page 17:** Credit, Schinella, Christine E.; Description: Humpback whale off the coast of Provincetown, Massachusetts, USA.

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