GLOBAL FISHING PRACTICES AND ORGANIZATIONS AND THEIR IMPACT ON CABLE ROUTE PLANNING, MARINE OPERATIONS, AND CABLE PROTECTION

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Abstract: Global fishing practices and patterns continue to be one of the primary considerations in planning and executing an undersea cable project. This paper will examine the influence of the fishing industry, fishing committees and fishing unions in a sample of countries and how we address these dynamic requirements on new and existing cables through geospatial analyses, building country-specific institutional knowledge and directly liaising with fishing contacts. On the U.S. West Coast, for example, established fishing organizations require cable owners to enter formal fishing agreements for the lifetime of a system and require the fishing organization's approval to obtain regulatory permissions. Fishing liaisons in Asia follows a similar process. Although many steps are different, all benefit from early engagement. Furthermore, illegal, unreported and unregulated (IUU) fishing is a widespread issue. Approximately one in five fish is caught illegally. Until recently, IUU fishing was an unaccounted-for risk to the undersea cable industry. In some areas of the world, IUU poses a significant risk to cable projects. This paper will highlight innovative approaches to address fishing requirements and risks through specific case studies while also exploring new methods to improve fishing risk analyses. These efforts benefit customers in many ways by ultimately lowering risks to cable projects, from system design to installation and maintenance.

1. INTRODUCTION

Global statistics show that fish (and other types of seafood like crustaceans and mollusks) account for 15% of global protein consumption, and 10% of the world's population relies on fisheries for their livelihood [1]. Global Commercial Fishing production for fish catch (excluding inland waters catch and aquaculture) was 79.3 million tonnes in 2016. Capture represented US$130 billion in first sale revenue [2]. India, Indonesia, Japan, Thailand, and China have large footprints in the Asia-Pacific commercial fishing industry. Amongst those countries, China represented more than 19% of the 2016 global commercial capture fishing market, followed by Indonesia [2]. The Asia-Pacific region dominates world fisheries in terms of fish landed, value, production and employment. After China and Indonesia, the U.S. held the third largest share of the world fisheries capture [2].

Global fishing practices impact most submarine cable projects worldwide. Indeed, fishing practices and patterns continue to be one of the primary considerations in planning and executing an undersea cable project. Cable fault data indicates that >90% of faults (2010-2015) are caused by external aggression, and of this percentage, ~75% are attributed to fishing or anchoring [13]. Fishing practices influence routing selection, burial requirements, permitting durations and marine operations. In some cases, fishing agreements may be required. Capturing spatial and temporal variation in fishing intensity, as well as documenting fishing gear-types, is necessary to completing

fishing risk analyses and developing fishing liaison strategies for a cable project. This paper will examine the methodology for approaching this dynamic risk to cable systems. Specifically, the paper will focus on two case study regions: Asia-Pacific and the U.S., respectively. New, innovative methods to expand spatial fishing risk analyses will also be discussed. Understanding the scope and depth of fishing risks to cable systems ultimately lowers cable projects' risks, from system design to installation and maintenance.

2. CASE STUDIES

2.1. Case Study 1: Asia-Pacific Region

The Asia-Pacific region is home to some of the world's largest and busiest commercial fishing fleets. Mid-water and bottom trawling are prevalent in China, Japan, South Korea and Taiwan [3]. Add to this large-scale illegal, unregulated, and unreported (IUU) fishing, destructive fishing-gear types and dwindling fish stocks caused by over-exploitation and it is not surprising that the threat posed by fishing to submarine cables is greater in this region than in any other.

The importance of seafood to Asia-Pacific countries is reflected in the significant role fisheries stakeholders play in permitting requirements. Any impacts that submarine cable operations have on ocean-space areas that are important to fish stocks or the associated livelihood of fishermen are analyzed by both national and local authorities. Cables' impacts on such fishing grounds are weighted against potential compensation or mitigation measures.

Indeed, many cable routes in this region traverse relatively shallow areas where trawling and stow net fishing, gear types that can pose significant risks to a cable, occur. Routing to avoid these fishing gear methods is impractical, as are fishing prohibition corridors. Therefore, burial of the cable is the most effective risk mitigation method. The need for burial can be ascertained from cable fault histories, seabed scarring from trawl doors and fisheries stakeholders' advice. Burial can form part of fishing agreements, as exposed cable increases liability and can reduce open fishing grounds.

Therefore, understanding national and local stakeholder administrative structures, fishing practices and seabed characteristics, as well as maintaining respectful and communicative relationships, is key to minimizing the impact of fishing risks on submarine cables in this diverse region.

Great variation exists within the Asia-Pacific region with respect to fishing fleet management, fishing methods and the type of engagement with submarine cable installers and operators. Understanding this variation is important when attempting to gain consent for vessel operations or to plan for long-term risk mitigation. Developing such institutional knowledge is also critical to creating effective fishing agreements that provide for the needs of governments, fishermen and the cable companies.

These sub-regional differences can be effectively demonstrated by examining Japan and China. While national and local governmental bodies play a part in both countries for submarine cable permitting and fishing liaison requirements, only in Japan does a submarine cable company directly liaise with individual fishing unions and their umbrella organizations. To support principle permit applications, the cable owner is required to establish an agreement with fishing unions through signed legally-binding documents if the cable transits through the fishing union's designated fishing grounds within Japan's Territorial Sea (TS). Agreements with fishing unions operating outside of the TS typically take the form of non-legally binding verbal consent. Such verbal agreement is achieved after in-person meetings that explain the scope, area and schedule of marine operations for the

project and may address safety measures, hiring of guard vessels, damage to gear and matters pertaining to regional fishing operations rather than specific fishing areas. Additional focus is placed on environmental impacts, cable burial and removal of fixed-gear. For deep-water operations, the focus area pivots to schedule management, shipboard contact with fishing vessels and disruption to traditional (and seasonal) fishing grounds. Once an agreement is reached, all effort should be made to avoid schedule changes to the installation. Direct costs incurred by the project for fishing agreements include use of local consultants, travel, meetings, guard vessels, fishery radio broadcasts and the hiring of local fishing representatives. Indirect costs typically comprise of vessel audits, additional management and reporting.

In China, fishing agreements are addressed as part of the principle permitting process and take the form of written conditions which are produced following the Ministry of Ecological Environment's approval of an Environmental Impact Assessment (EIA). Financial compensation is addressed in the EIA, which is determined in a meeting held only with the Chinese landing party. The agreement is designed to address all fishery-related matters from the beach to the EEZ boundary and includes requirements for state-supplied guard vessels, the names of fishery stakeholders and the agreement's duration. This centralized approach has its benefits, as it reduces the task of multi-union consultation, but it does not provide effective mitigation for the region's widespread IUU fishing or allow for minor schedule changes. Chinese waters include large areas of shallow seas that are heavily fished by trawlers and stow netters. Robust fishing agreements that prevent fishing over the cable during installation would reduce guard vessel costs and mitigate damage before burial is completed. Direct costs incurred by the project for Chinese fishing agreements include the use of local consultants, meetings, government-supplied guard vessels and the hire of local fishing representatives. Indirect costs typically comprise of vessel audits, additional management and reporting.

To manage submarine cables' fisheries risk(s), valid data on current fishing practices over cable routes is essential to improving resource use. Due to data sensitivity and the scale of fished areas in this region, accurate information on current practices can be hard to find. The need for this data has led to several atypical methodologies, such as VIIRS Boat Detection (VBD) data combined with Automatic Information System (AIS) data, local stakeholder input and route survey data, which can all improve risk assessment and mitigation. By accounting for these data points, burial location and depth requirements can be improved, and guard vessel planning becomes more strategic and economical. Other benefits include improved preparation for vessel-based fishing representatives and influence of vessel schedules to reduce delays from fishing.

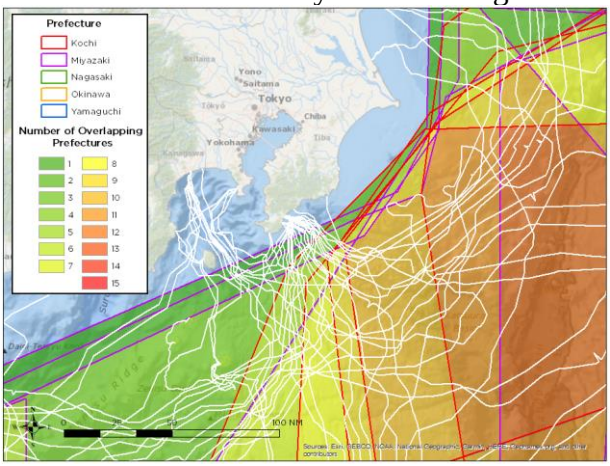

Figure 1: In-service cables off Tokyo, Japan in relation to Japanese Fishing Prefecture Areas and their overlapping fishing areas.

2.2. Case Study 2: United States

Within the U.S., different fishing union structures exist between the East and West coasts. Such disparity in localized organization leads to utilizing different

fishing liaising strategies for cable planning, permitting and marine operations.

On the U.S. West Coast, fishing/cable committees have formed to help facilitate the interests of the fishing community and cable company. In Oregon (OR) and California (CA), conducting outreach to fishing communities is required when a cable project is in the cable planning and permitting stages. For cable systems installed off of OR, it is now a commonplace milestone to receive a letter of support from the local fishing organization when a cable route has been agreed upon. Furthermore, the cable owners enter a Memorandum of Understanding (MOU) and later a formal fishing agreement with the local fishing organization for the cable's lifespan. This formal fishing agreement includes a "sacrificed gear" fund in the event that a fisherman becomes entangled on a cable and abandons their gear. The agreement also requires fishing liaison officers (FLOs) on board for survey and installation, supports cable awareness campaigns to inform fishermen of the cable's locations and requires periodic ROV inspections to ensure cable burial. [5]

During installation, FLOs monitor the real-time cable burial and liaise with local fishing vessels who may be in the area. If a guard vessel is used, the vessel must be nominated by the fishing committee. If expected burial cannot be achieved, this area is marked and charted on the cable awareness charts distributed to fishermen.

The main benefit of these organized fishing associations is that they serve as a "one-stop-shop" for fishing liaison efforts. A clear and defined process exists for submarine cable owners and installers, including FLOs, guard vessels, gear clearance and compensation for fixed-gear users. These fishing organizations also have their own in-house process for vetting snag calls and determining the value of gear lost. Thus, these fishing organizations offer a streamlined and straightforward process for fishing liaising needs between fishermen and a cable project, from system design to maintenance.

Negotiation and liaison with organizations like these, however, can prove costly and time consuming for the cable owner and installer. Fewer routing options exist due to the strict burial and crossing requirements put forth by these organizations, and the owner must pay a yearly fee.

Interestingly, these West Coast fishing organizations are vastly distinct from the loosely organized fishing groups on the U.S. East Coast. On the East Coast, there is a high density of cables in the New York Bight area. This is also a high-density fishing region, where many clam dredgers, scallopers, longliners, bottom trawlers and lobster and crab trap fishermen are active.

Although formal fishing agreements are not signed with these East Coast fishing communities, outreach is essential to protect a cable system throughout its lifespan and to limit fishing gear interaction during installation. The New York Bight area requires extensive groundwork (i.e., building relationships with fishermen, determining what gear is used and where and deciphering shifts in fishing patterns from local knowledge) and cable awareness campaigns to be carried out by the installer and/or maintenance provider. Independent research on the major fishing ports and gaining points of contact is vital. It can take years to establish relationships with fishermen cooperatives and private owners to effectively distribute cable awareness materials to reach the relevant fishing groups.

On the East Coast, the installer and/or owner is responsible for finding reliable contacts to serve as guard vessels and for establishing an internal contact list to notify fishermen during surveys and installations. Without proper outreach, significant interference

from fixed lobster and crab gear, longlines and mobile gear users can occur. A collection of cable awareness materials needs to be created and distributed, including paper and electronic charts and cable routes converted into local fishermen's plotter formats. Delivering these materials to relevant ports and contacts is imperative to the cable awareness campaign's success. The lack of formal fishing organizations on the eastern seaboard puts more pressure on the installer and owner to develop the cable awareness strategy. However, this loose organization allows for greater flexibility for the owner/installer in cable planning. Although consultation with fishermen is an important and sometimes required aspect to U.S. East Coast permitting applications, formal fishing agreements are not a built-in requirement. Therefore, owners may also save economically as no formal agreement must be negotiated.

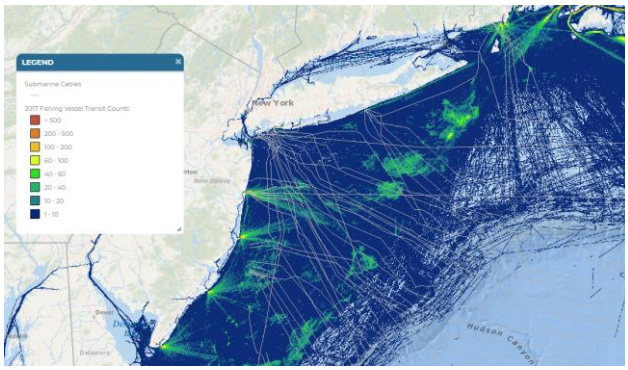

Figure 2: Submarine Cables off the NY Bight and 2017 Fishing Vessel Activity [11].

3. FISHING FRONTIER

A variety of open-source, global databases are offering fishing liaison teams a glimpse into maritime activities that were once unknown or undocumented. The Global Fishing Watch (GFW) Project is one such example. GFW's geospatial platform provides global and regional "apparent" fishing effort. Moreover, GFW offers two other data layers that provide a window into the IUU fishing industry. Illegal fishing accounts for a $23.5 billion-dollar annual industry [6]. One in five fish sold is caught illegally and, in the U.S. alone, 32% of imported seafood is caught illegally [6]. For the submarine cable industry, this is a sector of global fishing that has, until now, remained an elusive and unaccounted-for risk.

A NASA-NOAA satellite collects low light imaging data from a primary imager called the Visible Infrared Imaging Radiometer Suite (VIIRS). The technology was designed for atmospheric research. However, it was discovered that the VIIRS detects light at sea at night, when boats use light to attract catch and/or for fishing operations [7,8]. NASA/NOAA have created output data from this detection, called VIIRS Boat Detection (VBD) data. GFW has integrated this data into its geospatial platform. More than 85% of the VBD detections are from vessels that do not have AIS or Vessel Monitoring System (VMS) transponders enabled [9]. Therefore, the VBD data offers the first proxy dataset to capture the global IUU fishing effort.

To compliment VBD data, GFW has also developed an algorithm that produces a data layer called "Vessel Encounters." This data layer aims to capture the IUU "mothership," or transshipment aspect of IUU fishing. These motherships bring the catch to shore for processing [10]. Not all countries have strict fish landing requirements, which means transshipment is thought to be the "missing link" in deciphering where and how illegally caught fish is brought to market [10]. GFW's Vessel Encounters data layer attempts to capture where this offloading activity occurs between a fishing vessel and mothership. This data layer shows that often these vessel encounters are on the High Seas.

It is also important to note that countries are beginning to make public their VMS data. Indonesia and Peru are two such examples, where they have made their VMS derived data available for viewing on GFW. VMS

broadcasts data differently from AIS and could potentially give a more accurate and complete picture of regional fishing effort. If this trend of offering gridded VMS data for public use continues, we can better capture both reported and IUU proxy fishing efforts.

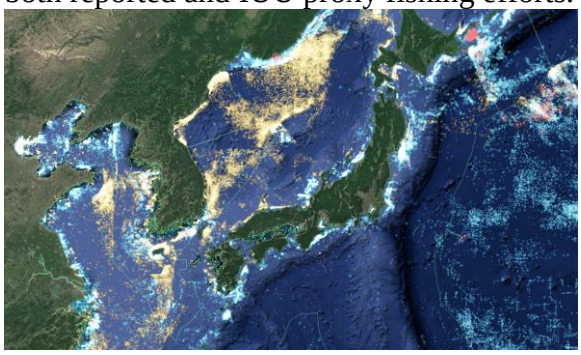

Figure 3: GFW Fishing Effort (blue), VBD (yellow), and Vessel Encounter (pink) data, Asia-Pacific, Sept-Dec. 2018 [9].

Data layers like these offer new, innovative ways to spatially and temporally analyze fishing risks to cable operations, and can help with many aspects of a cable project such as cable engineering and determining the best time to conduct marine operations. Such data cannot replace consultation with fishermen and fishing associations, as vital on-the-ground information is gained from building these relationships. However, these data can augment fishing risk analyses to mitigate fishing's impact to all stages of a cable system's lifespan. In short, such data can identify a fishing risk before it becomes an on-the-ground risk during marine operations.

4. DISCUSSION

It is clear that the fishing liaison component of a cable project is not as straightforward as other project swim-lanes activities. As the Asia-Pacific and U.S. fishing liaison examples demonstrate, strong regional differences in how fishing groups are organized, as well as the type of fishing that occurs in a region, can guide a cable system's customized fishing liaison strategy. Indeed, it appears that a spectrum of different fishing organizations exists, even within this small set of examples. The type of regional organizations dictate how fishing liaison efforts must be adapted to conduct successful efforts for a cable project. On one end of the spectrum, there are strong fishermen organizations that require negotiation for both compensation and routing, which are built-in components of a cable project's permitting requirements. In the middle of the spectrum, there exists a hybrid approach where strong fishermen organizations require consultation and agreement to move a cable project forward, but consent from fishermen for permitting purposes is not mandatory. On the other end of the spectrum are loose fishermen organizations where permission is not required. However, consultation is still critical to ensure successful marine operations and security for the cable's lifespan. Highlighting these differences and the spectrum of fishing organization-cable project interactions shows that fishing liaison work must be tailored to individual regions' fishing profiles to achieve a mutually beneficial outcome. Fishermen must be informed of a cable project's marine operations and its route, and they must agree to not intentionally hinder marine operations during installation and/or harm the cable after installation.

To reach this objective, fishing liaising not only requires expertise in understanding fishermen organizations and their internal structures, but temporal and spatial fishing patterns, dominant gear-types and the prevalence of IUU fishing. In addition, fishing liaison teams must develop strong relationships with key points of contact in the local fishing industries to receive accurate information about local fishing knowledge and new trends. Moreover, fishing liaison teams must augment their knowledge-base with analyses of available global fishing data in the form of AIS, VMS and VBD, among other datasets, to gain a snapshot of what fishing activity looks like throughout a project's route. A fishing liaison team must

then correlate this information with the cable project's route, armoring-types and burial plan to ensure that fishing remains a low risk to a cable project. Integrating these disparate data points, from on-the-ground knowledge to satellite data, is critical to a fishing liaison strategy. Outlining these aspects of fishing liaison work demonstrates that although a clear goal for a cable system's fishing liaison strategy exists, the ways in which it is achieved are not clear-cut and must be adapted for not only each region but also each project.

5. CONCLUSION

The subsea cable community long ago recognized the importance of working with fishing industries and local communities in the protection of cables. [12] This is true now more than ever.

Engaging with fishing interests is necessary during all phases of the project: route planning, permitting, survey, installation, maintenance and operations focused on cable protection. Cable awareness for fishing requires in-region face-to-face visits and the distribution of charts and RPLS in navigation plotter compatible software. Strategies and approaches must be tailored to the region and fault history experienced there. Fishing unions often require direct communication with the cable owner. Use of available global fishing data, in the form of AIS, VMS and VBD among other datasets is crucial for success. Unsurprisingly, in regions where there is good cooperation with fishing interests, there are lower fault rates, but the seabed also plays a factor. Asia will continue to be the most challenging region, considering maritime disputes and heavy reliance on fishing in the regional economies as well as a high occurrence of cable faults. Industry level liaison with governments in the region such as in Indonesia, the Philippines, Vietnam, Taiwan, China, Korea and Japan may bring improvements.

Fishing liaison teams play a unique role in cable system projects to ensure an additional level of protection throughout the cable's lifespan and reduce the probability of faults caused by fishing activity.

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