2025 SAFMC HEAP Meeting
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AECOM

Infrastructure Development in the Marine Environment – *Telecommunication Subsea Fiber Cables*

Rita Melo, Morgan Paris & Laura Cherney

Meet our AECOM Team

Rita Melo is the US East Subsea Permitting Lead in the NYC office with over 14 years of global experience in environmental management for coastal and marine projects.

Morgan Paris is a conservation-oriented Marine Biologist in the Raleigh, North Carolina office with over nine years of marine science experience, comprised of three fisheries positions, along with a Master of Marine Science degree in physical oceanography.

Kate Melanson, PhD is an Ecologist in the Greenville, South Carolina office with over ten years of marine ecology and science policy experience, with her Doctorate in Ecology and Evolutionary Biology.

Laura Cherney is a Senior Ecologist and Project Manager in the Miami, Florida office with 25+ years experience in ecology, environmental permitting, and NEPA compliance.

Agenda

- 01 Components of Infrastructure
- 02 Potential Impacts from Infrastructure
- 03 Policy Considerations

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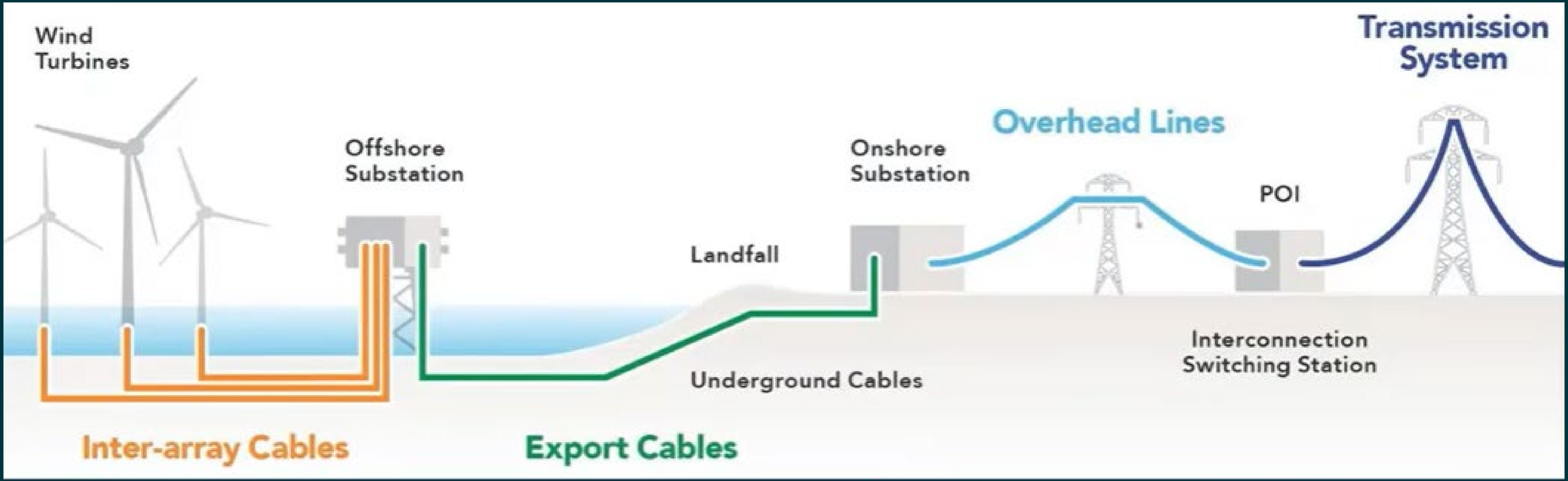
01

Components of Infrastructure

How does offshore wind work?

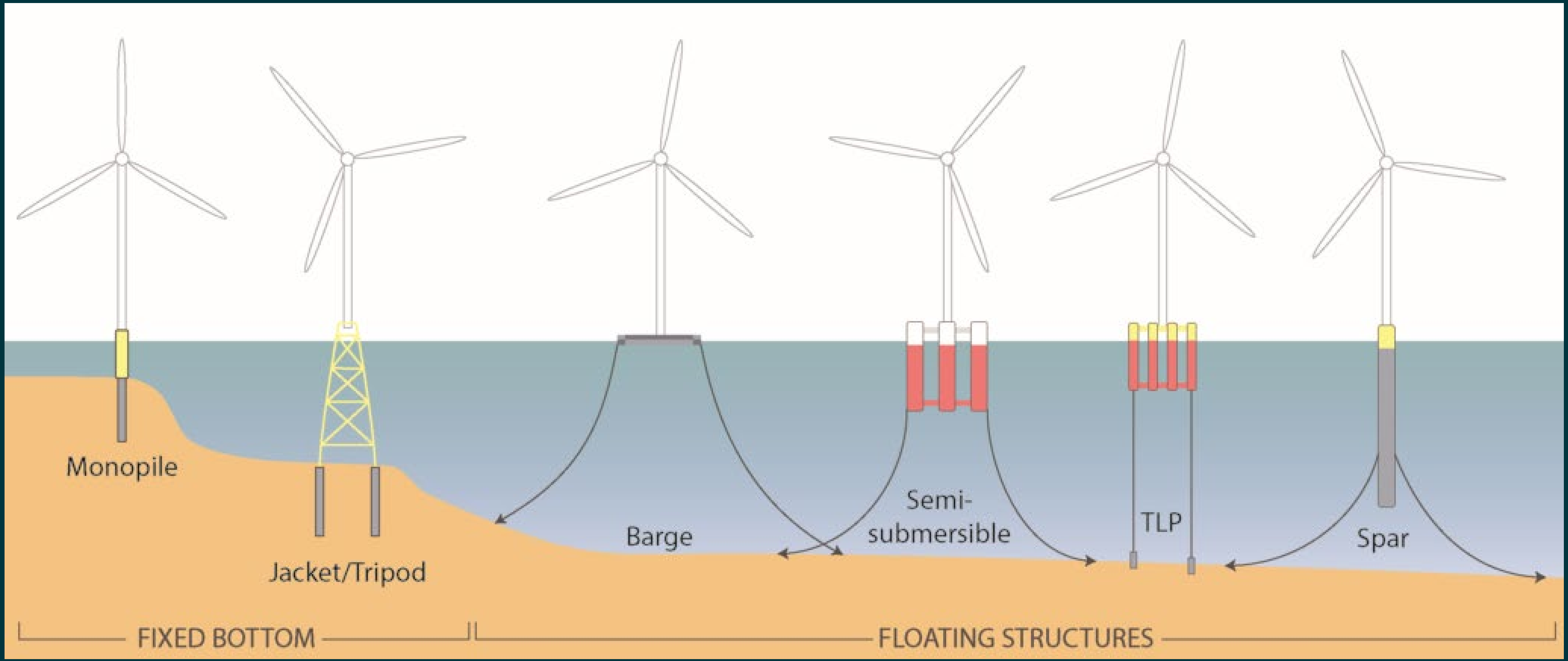


- Marine environment: sea waves, seabed mobility, corrosion, weather downtime
- Specific health and safety risks and requirements
- Huge scale of operations

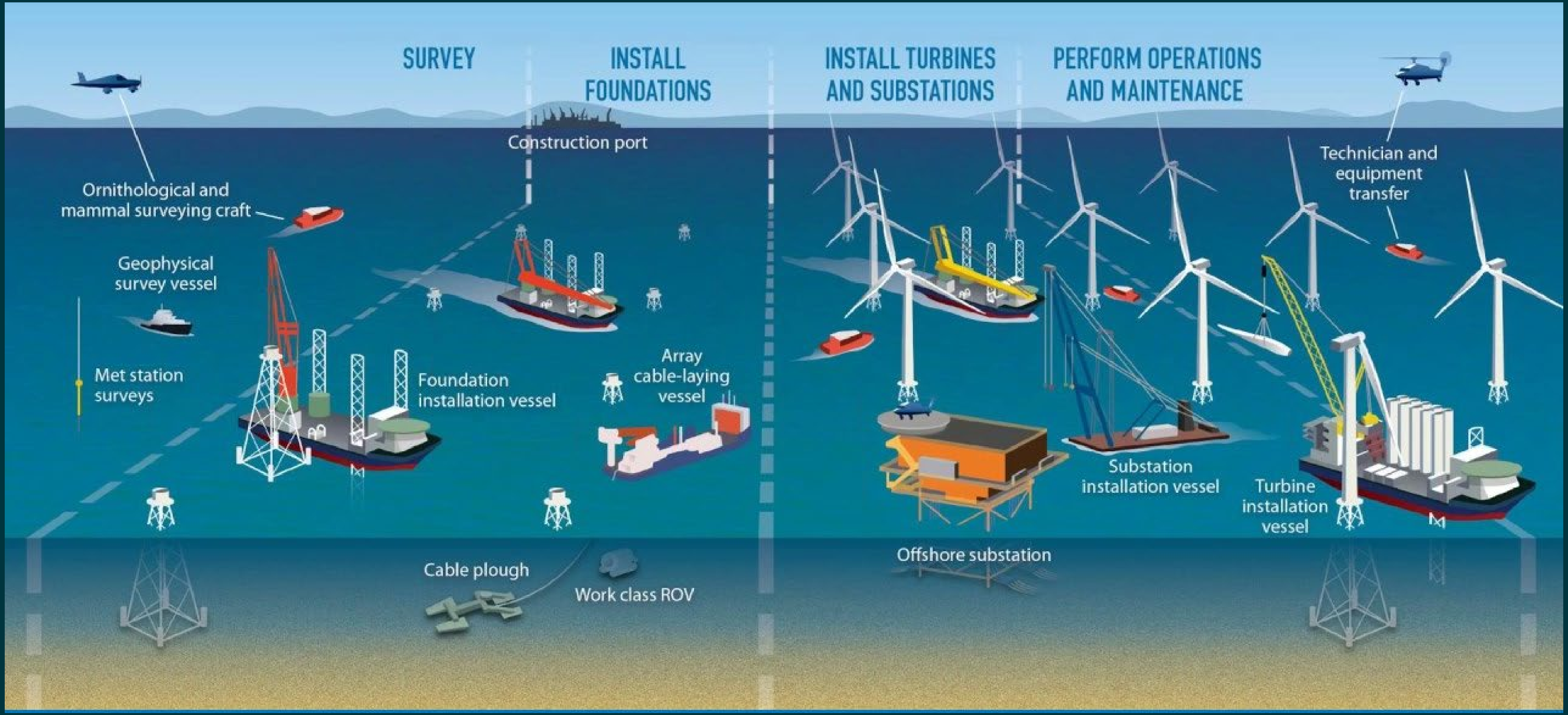
Export cables can be HVAC or HVDC, depending on distance of project from shore.

In case HDVC cable is used, a convertor station is required on both ends (offshore & onshore)

Which types of offshore wind turbines are there?



Offshore wind construction phases



Every phase of offshore wind

STUDIES & SURVEYS

- Sediment sampling & physical, chemical, & biological analysis
- Remotely Operated Vehicle (ROV) video survey & analysis
- Sediment Profile Imaging (SPI)
- Physical oceanography, hydrography, & geophysical surveys
- Water quality & conductivity, temperature, & depth (CTD)
- Marine ecology/biology
- Air & visual impact assessments
- Marine (metaocean, fisheries, benthic/ biological, chemistry)
- Submerged aquatic vegetation mapping
- Avian/bat studies
- Visual assessments/viewshed analysis
- Wetland delineations
- Threatened & Endangered (T&E) species surveys
- Cultural resources surveys
- Noise/acoustics studies
- Sediment sampling & transport

ENVIRONMENTAL PERMITTING & SOCIAL IMPACT ASSESSMENT

- Site Assessment Plans (SAP)
- Construction Operation Plans (COP)
- Offshore & coastal Environmental Impact Assessments (EIA)
- Social impact assessments (SIAs)
- Stakeholder engagement
- Oil Spill Response Plans (OSRPs)
- Coastal Zone Management (CZM) plans
- Federal Aviation Administration (FAA) Permit
- US Army Corps of Engineers (USACE) Section 10/404 Permitting
- US Fish & Wildlife Service (USFWS) Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA) & Marine Mammal Protection Act (MMPA) experience
- National Oceanic & Atmospheric Administration (NOAA) & National Marine Fisheries Service (NMFS) Fisheries Protected Species (ESA, MMPA) & Essential Fish Habitat (EFH), National Marine Sanctuary (MNS)
- State Section 401 Water Quality Certification (WQC)
- Federal Energy Regulatory Commission (FERC)
- US Coast Guard (USCG) permits
- US Environmental Protection Act (USEPA) Clean Water Act National Pollutant Discharge Elimination System (NPDES) permits
- Section Federal National Historic Preservation Act (NHPA) & State Historic Preservation Office (SHPO) (Section 106)

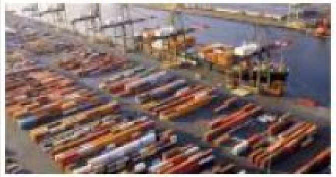
SUBMARINE & LAND CABLES AC & HVDC

- Engineering & due diligence services at land based points of interconnection
- Optimization & constraints analysis submarine cable routing
- Environmental permitting & assessment & engineering design
- Cable design - type & rating selection
- Subsea geological & constraints mapping/survey
- Cable technical specification development
- Undersea cable routing design support
- Cable onshore landing protection & design

ONSHORE INTERCONNECTIONS

- Direct applied experience in electric transmission, distribution, & substation projects (new construction & maintenance)
- Marine, overhead, & underground installations
- Refurbishment & reconductoring
- Substation construction & expansion
- Substation design, engineering, & automation
- Routing & feasibility studies
- Utility corridor siting & selection criteria
- Route reconnaissance & quantitative assessments
- Construction monitoring
- Horizontal directional drilling (HDD) design
- Power systems analysis
- Supervisory Control and Data Acquisition (SCADA) Systems
- Detailed third-party engineering reviews

PORTS & HARBORS – FULL SERVICE MARINE ENGINEERING



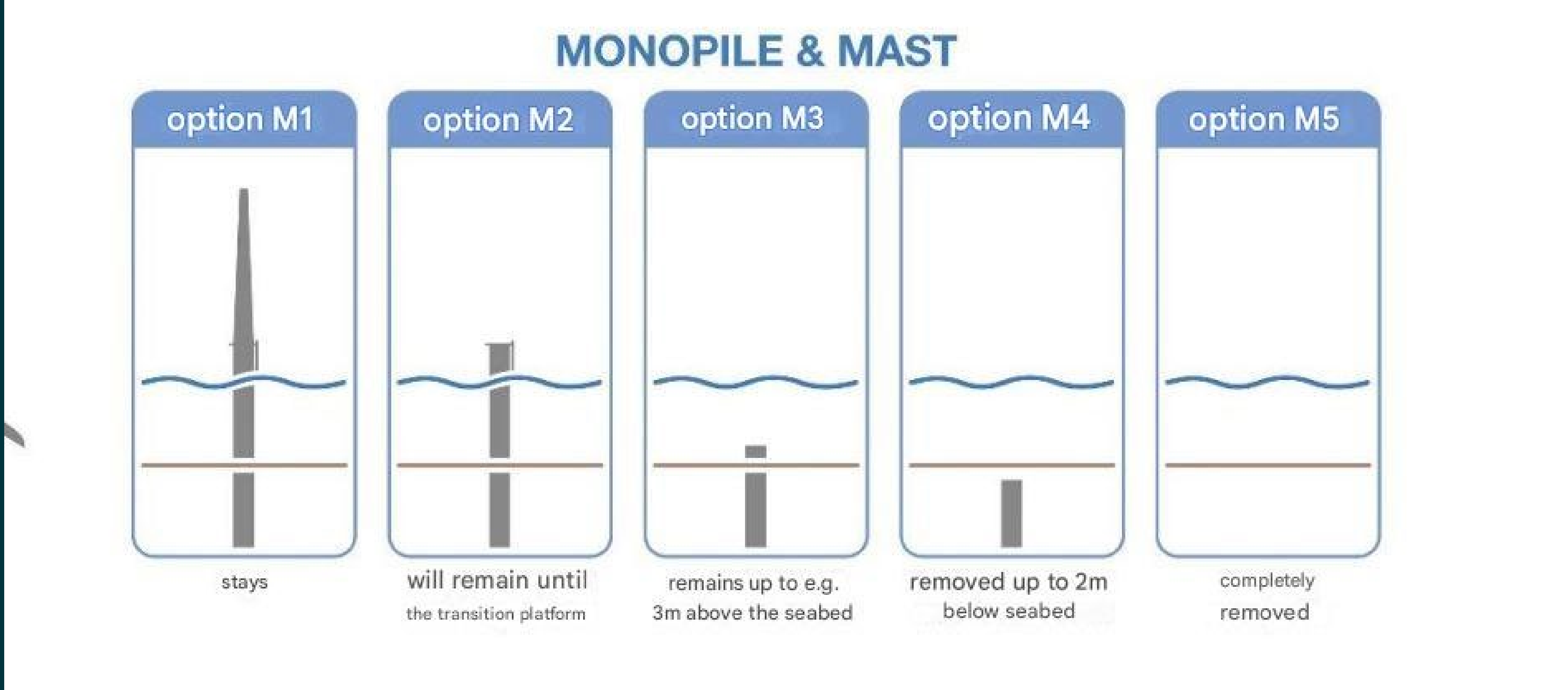
- Planning
- Economic evaluations
- Coastal & marine engineering
- Civil & structural design
- Modelling & dynamic simulation
- Maritime security
- Marine architecture
- Program & construction management
- Coordination with NOAA, USACE, USFWS, & various agencies
- State & regional environmental agencies & port authorities
- Cold ironing/shore power engineering

HEAVY CIVIL CONSTRUCTION

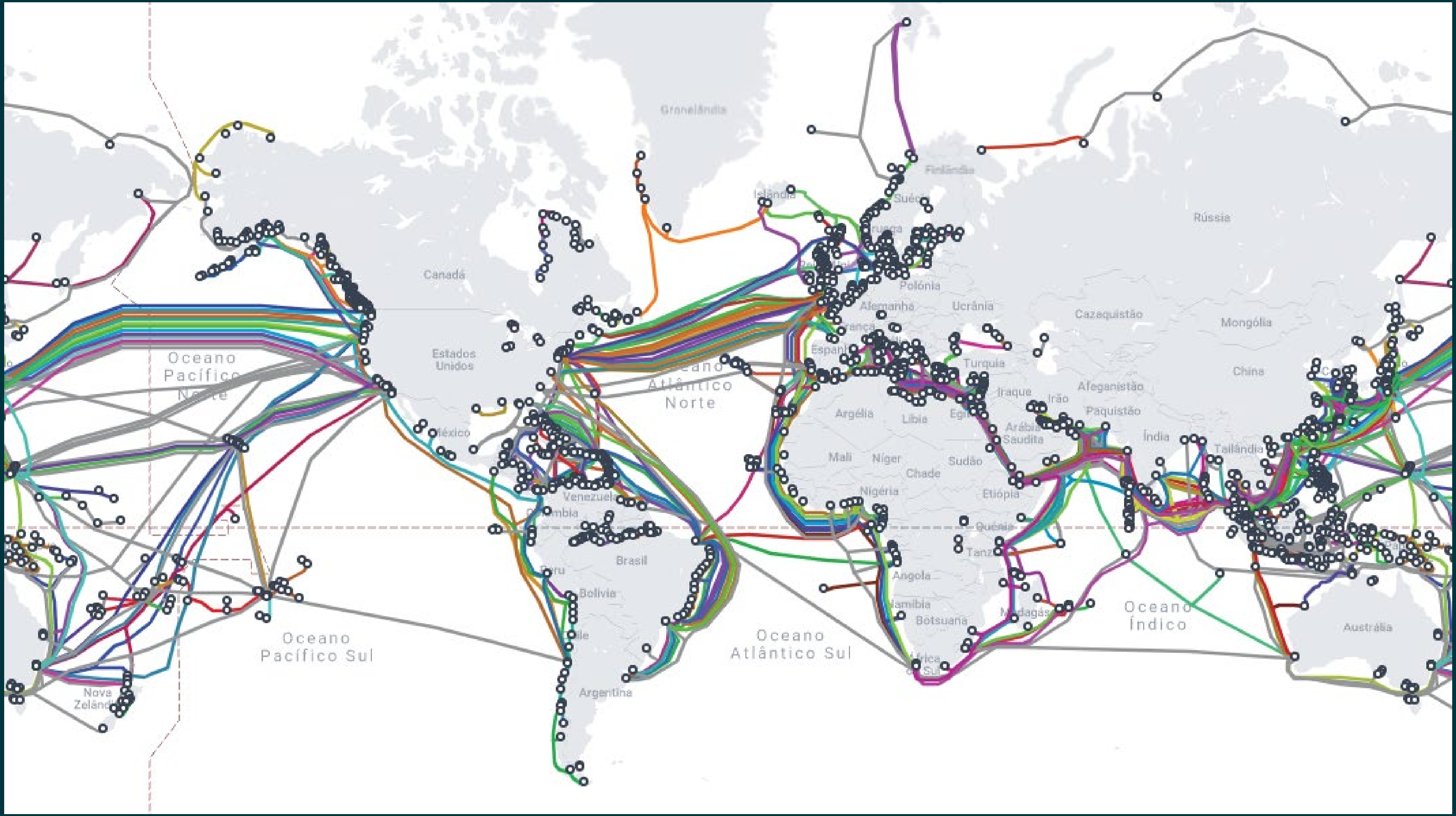
- Constructability reviews
- Marine construction
- Pier structures
- Port facilities
- Specialty foundations
- Earthwork
- Electrical & mechanical
- Structural steel & concrete

Offshore wind decommissioning

OSW decommissioning best practices are case by case

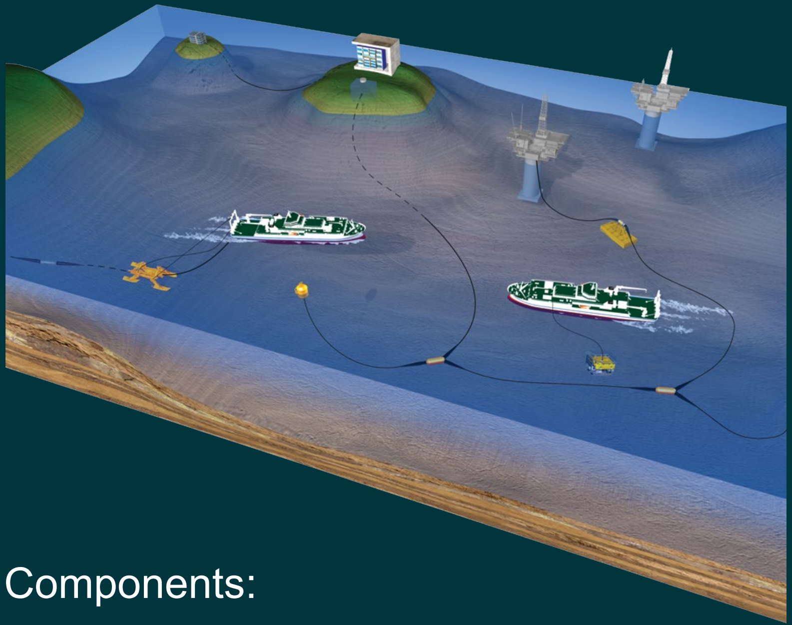


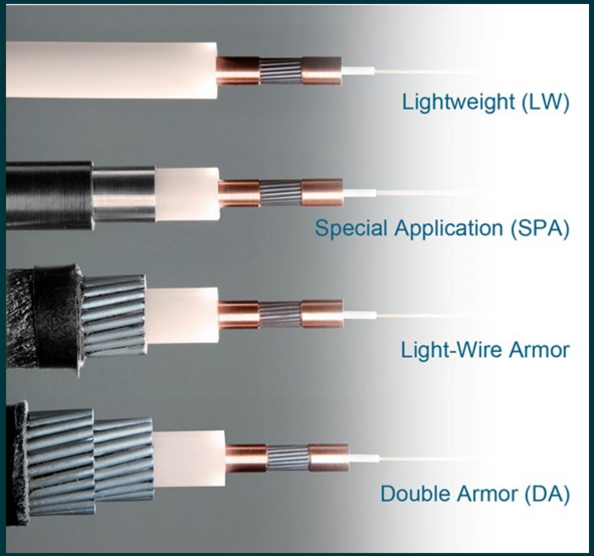
Telecommunication Subsea Cables Map



https://www.submarinecablemap.com/

Telecommunication Subsea Cable Systems – components and materials?





Components:

- Subsea cable, repeaters, and branching units
- Terrestrial beach manholes, ducts, and cable landing station

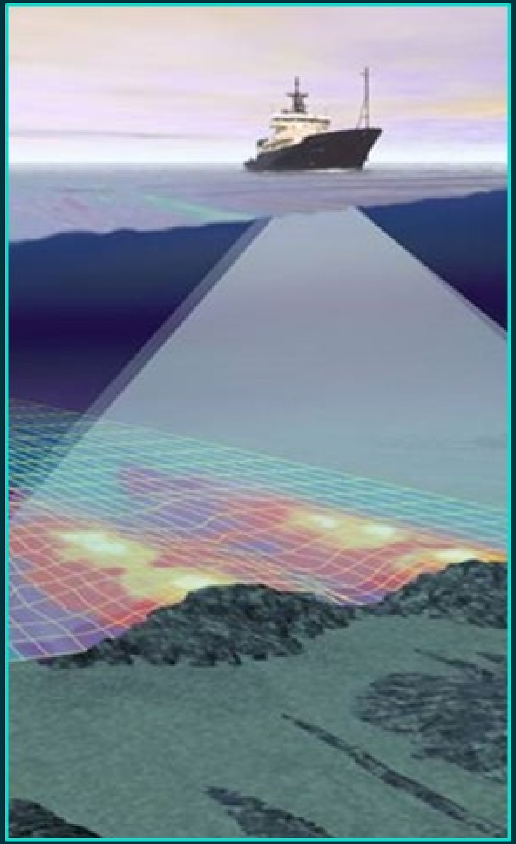
Modern fiber optic cables are composed of very similar raw materials as their predecessors:

ultra-high strength steel wires
copper sheathing
polyurethane insulation
galvanized wire armoring.

Innovation increased the fiber count in short- and long-haul cable systems, as well as increasing the speed of data transmission resulting from greatly enhanced terminal equipment, fiber performance and repeater technology

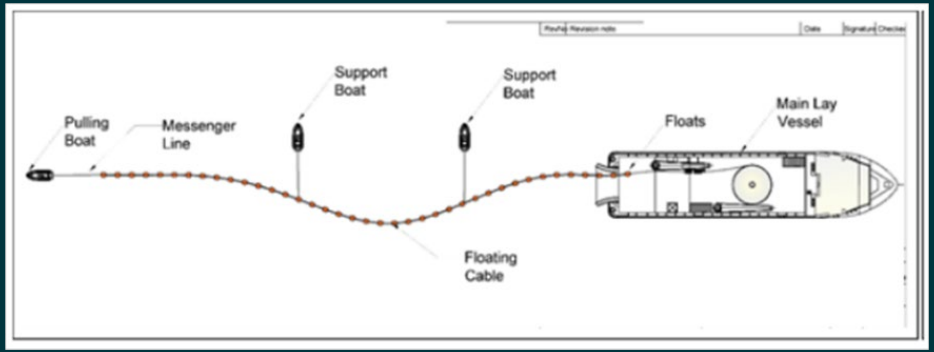
Step 1 of telecom subsea cable projects – Cable Route Survey

The goal is to use geotechnical and geophysical hydrographic survey methodologies to collect route specific data of the seabed.

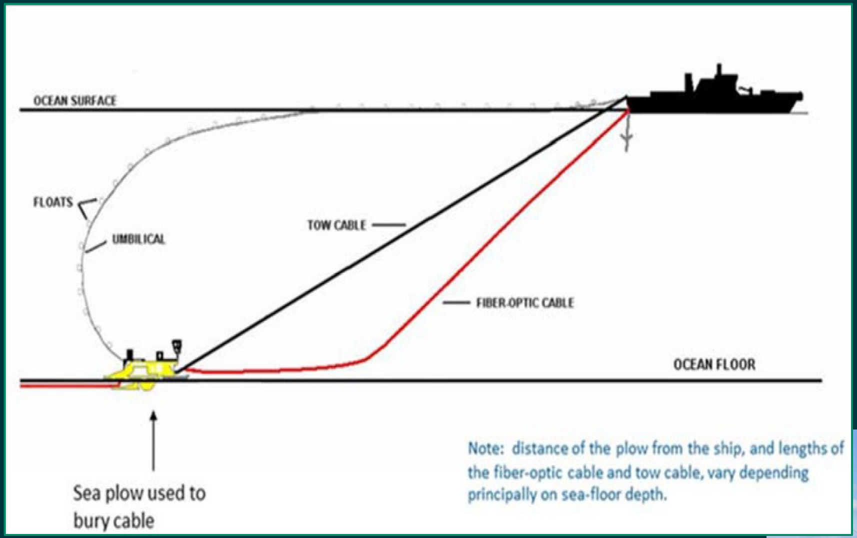


Step 2 – Cable installation

– Nearshore



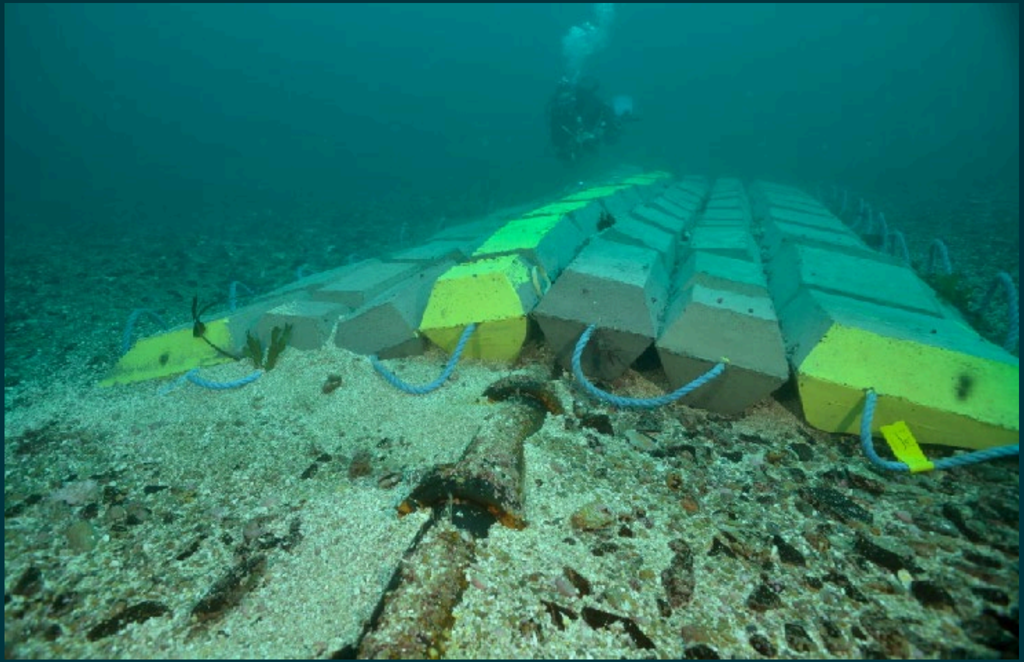
– Offshore



If not buried with ROV, cables became naturally buried along much of their lengths within a few days/weeks of installation

aecom.com

Step 3 of telecom subsea cable projects – post installation burial and inspection

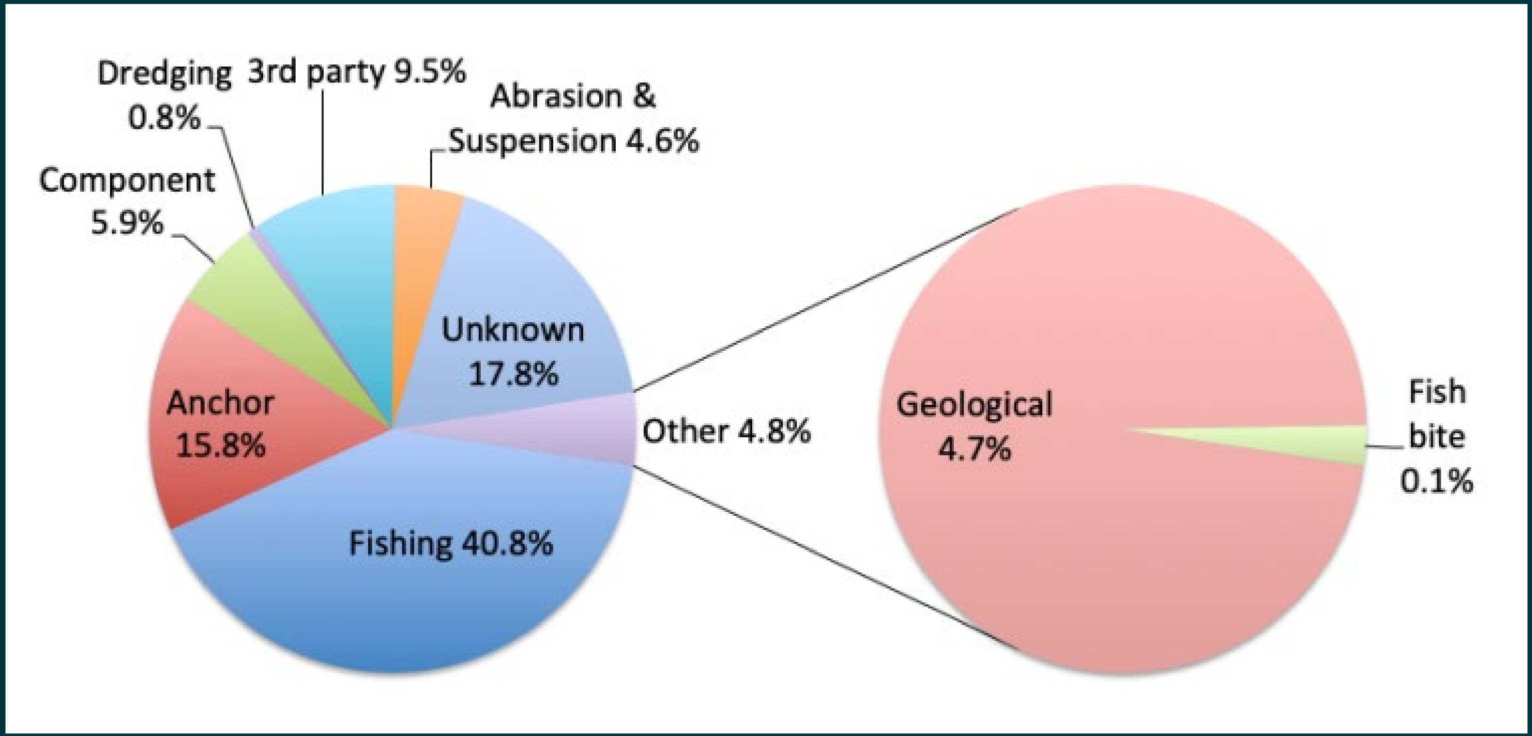


02

Potential Impacts from Infrastructure

Subsea Cables - Monitoring and Decommissioning

- Subsea cables largely remain untouched during their lifespan, which is usually about 25 years or longer.
- Cable damages, specially in the High Seas, are quite rare, averaging fewer than 4 instances per year worldwide.
- % cable faults related to different causes based on a global database kept since 1959.
- One of the biggest myths cited in the press is that sharks are known to bite telecom subsea cables – this happened in the past but not a major threat. Fish bites (including sharks) accounted for zero faults between 2007 and 2014.



ICPC Publication: Submarine Cable Protection and the Environment – March 2021

Subsea Cables Decommissioning

- In many cases, cables are left on the seafloor even after their lifespan (25 years)
- Recovered cables that laid on the seafloor between 38-44 years are almost pristine.
- The plastic outer sheath is intact, no degradation of inner conductors is observed, and the steel was free of corrosion.
- A laboratory study confirmed lightweight cables are chemically inert. Cables with protective metallic armor were found to release low concentrations of zinc (<11 ppm) which, when compared to naturally occurring concentrations added by the atmosphere or rivers is non-representative.

ICPC Publication: Submarine Cable Protection and the Environment – September 2020

Impacts from telecom subsea cables on habitats

- There is no statistically significant difference detectable in seafloor fauna near or far from telecom subsea cables.
- This is observed in hybrid systems of fiber-optic cables and power cables.

Beneficial Impacts

Artificial Reef Effect

Fish Aggregation

Disruptive Impacts

Noise – Pile Driving & Operational

Other Impact Producing Factors

Stepping Stone Effect

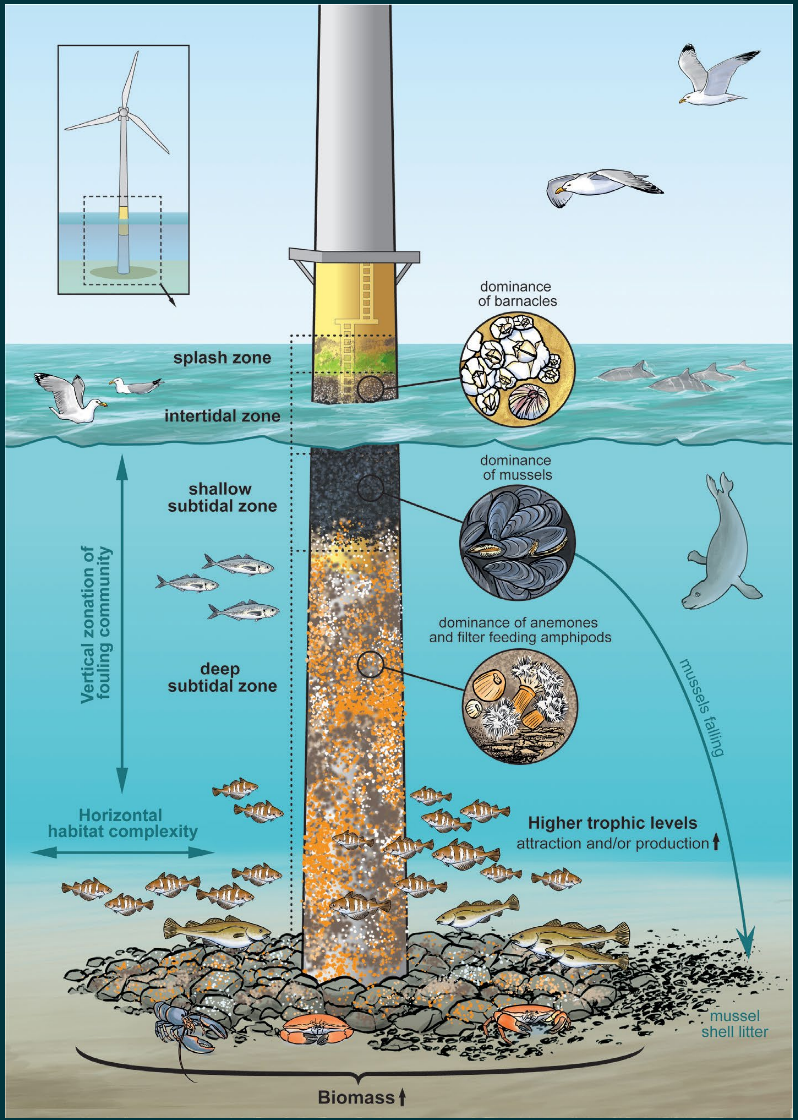
Fisheries Exclusion Effect

Impact Producing Factors

Stressors typically created by anthropogenic forces which result in specific changes to the environment during construction, operation, and decommissioning

Impact Production Factors	Potential Impacts Summary
Seabed Disturbance - Suspended Sediment and Turbidity	Temporary behavioural disturbance (avoidance behaviour, stress response, mortality, displacement Mortality of benthic species Temporary/localized habitat disturbance and varied recovery rates Sensitivity of EFH/complex habitat to temporary habitat disturbance
Introduced Sound – Pile Driving and Operation	Temporary behavioural disturbance (avoidance behaviours, stress response) Barotrauma (lethal/injury) Likely acclimate to operational sounds
Changes in Ambient Lighting	Potential attraction/avoidance behaviour Small scale displacement/harassment
Changes in Ambient Electromagnetic Field – Cables only	Little to no behavioral effects to elector/magneto sensitive species No adverse or beneficial species-level effects
Presence of Structures and Cables	Conversion of sand/gravel habitat to hard bottom habitat - artificial reef effect and fish aggregation Fisheries exclusion – reduced commercial fishing pressure
Planned Discharges – i.e. cooling water intake system to remove heat from the equipment	Insignificant
Accidental Releases	Potential harassment/mortality

Artificial Reef Effect



Vertical zonation

- Water surface - mussels, macroalgae, and barnacles
- Intermediate depths - filter-feeding arthropods
- Deeper waters - anemones
- Scour protection – microhabitats for variety of organisms

Attract higher trophic levels – increase in fish and large crustacean abundance around wind turbines

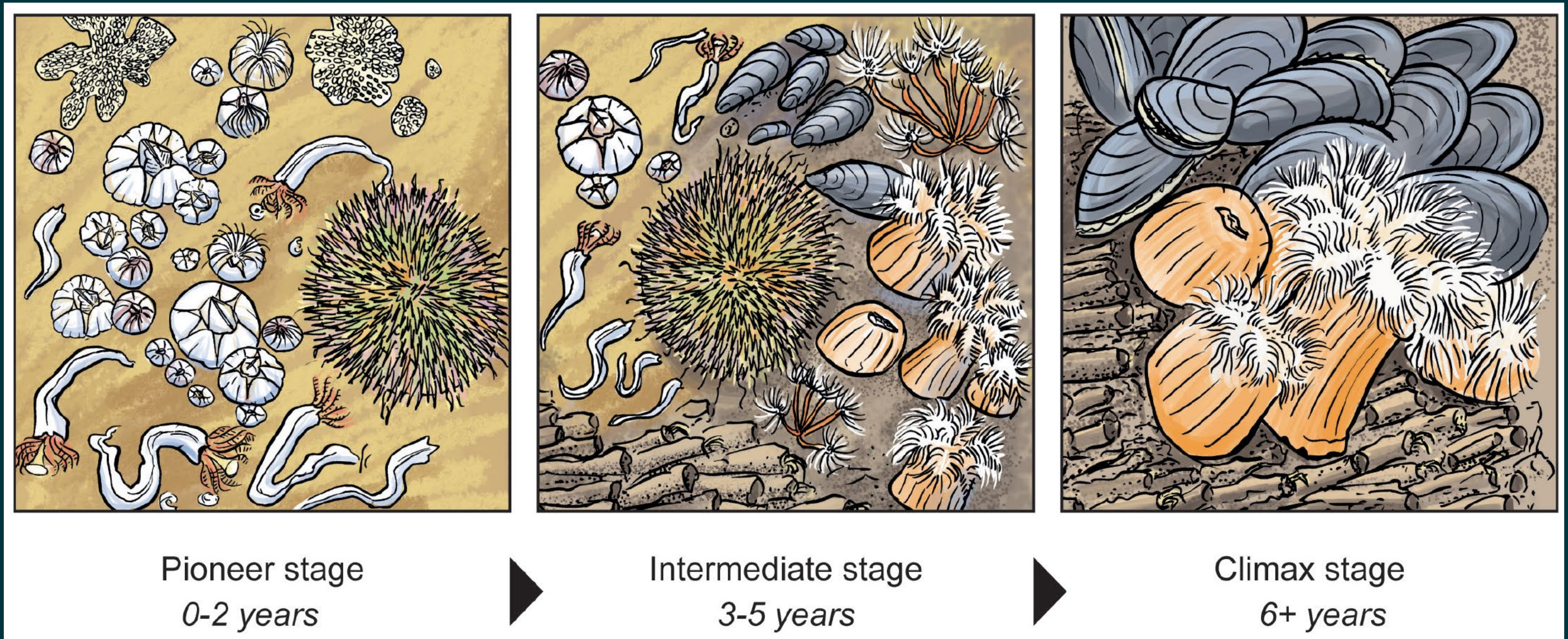
Potential biofilter effect – enriching surrounding seabed and decreasing turbidity

Provide habitat for different life stages

Policy consideration – offshore wind can create habitat opportunities for species that are rare or of conservation concern

Degraer, S., D.A. Carey, J.W.P. Coolen, Z.L. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. Offshore wind farm artificial reefs affect ecosystem structure and functioning: A synthesis. *Oceanography* 33(4):48–57, https://doi.org/10.5670/oceanog.2020.405.

Colonization and Succession



Initial set of species

Large numbers of suspension feeding invertebrates

Mussels mixed with hydrozoans and anemones

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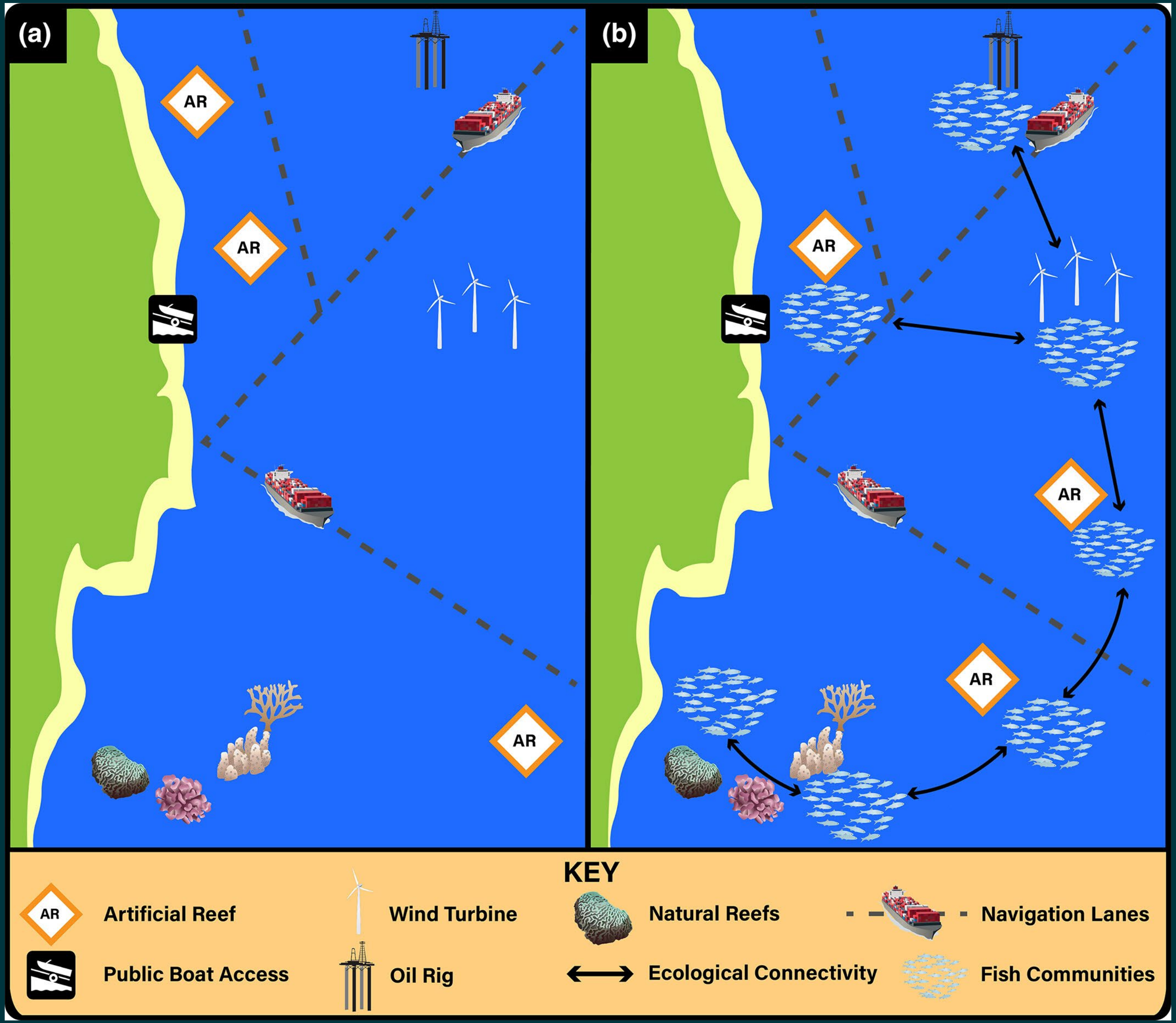
Stepping Stone Effect

The drastic increase of hard substrates in an environment consisting largely of soft substrates can impact spatial distribution and connectivity of speices by creating **new dispersal pathways** and **facilitating species migrations** but can also affect the **spread of non-native species**

Policy consideration – incorporating ecological principles into the siting and planning process



Adams, T.P., R.G. Miller, D. Aleynik, and M.T. Burrows. 2014. Offshore marine renewable energy devices as stepping stones across biogeographical boundaries. *Journal of Applied Ecology* 51:330–338, https://doi.org/10.1111/1365-2664.12207.

Paxton, A. B., Steward, D. A. N., Harrison, Z. H., & Taylor, J. C. (2022). Fitting ecological principles of artificial reefs into the ocean planning puzzle. Ecosphere, 13(2), e3924.

Fisheries Exclusion Effect

Offshore wind farms have potential to acts as no take zones, could provide resources enhancements or redistribution but displacement of fishing effort may have consequences to fisheries elsewhere.

- Regulations and/or physical barriers to trawling gears
- Increased opportunities for passive/fixed gears

Photo Credit: Shawn Wilkinson, Getty Images

Policy consideration – Interaction between commercial and recreational fisheries and offshore wind farms

Zone of Influence – Scaling Up

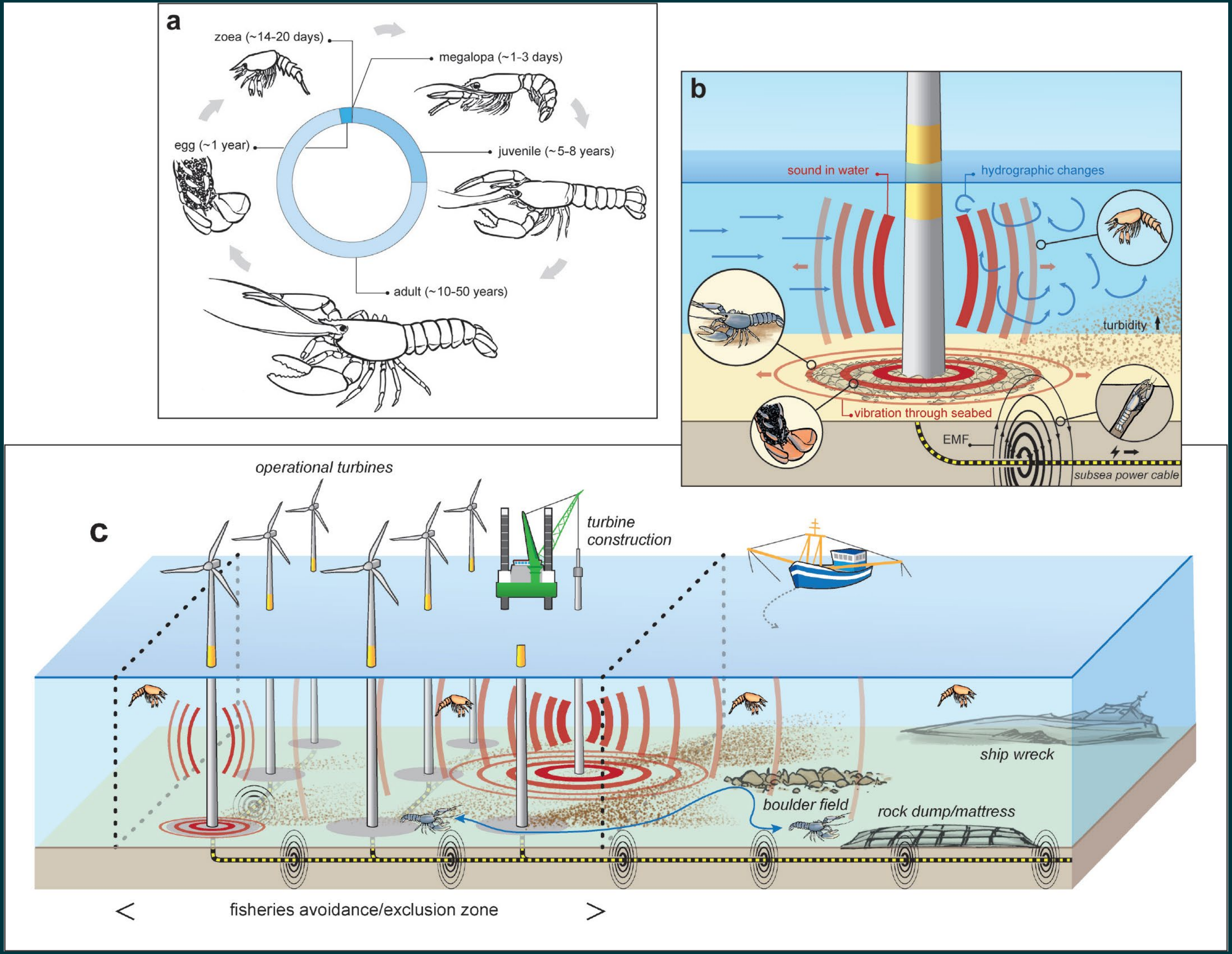
Numerous biotic and abiotic components within ecosystem exhibit multiple cause-effect pathways that operate over different spatial and temporal scales

Need to understand how biological, ecological, and socioeconomic changes due to offshore wind impact spatiotemporal population dynamics of commercial and recreational species

- Requires monitoring and survey data collection
- Integrate policy and regulations

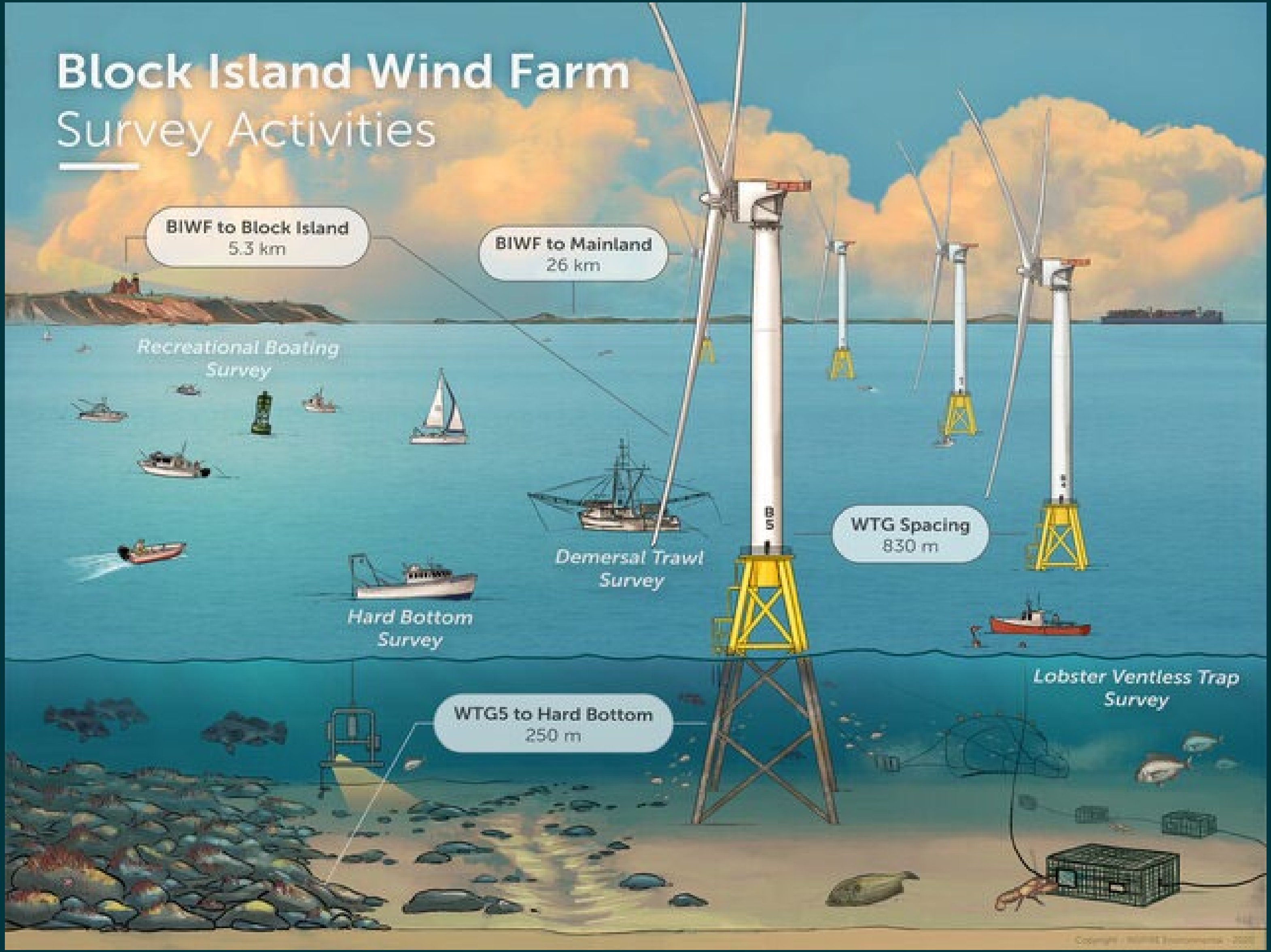
How does increased fish abundance alter local food webs i.e. carbon flow?

Case Study - Space- and Time-Based Interactions Between Offshore Wind Farms and the Life History of the Lobster Genus (Homarus)



Gill, A.B., S. Degraer, A. Lipsky, N. Mavraki, E. Methratta, and R. Brabant. 2020. Setting the context for offshore wind development effects on fish and fisheries. Oceanography 33(4):118–127, https://doi.org/10.5670/oceanog.2020.411.

Case Study: Block Island Wind Farm – Four Targeted Studies



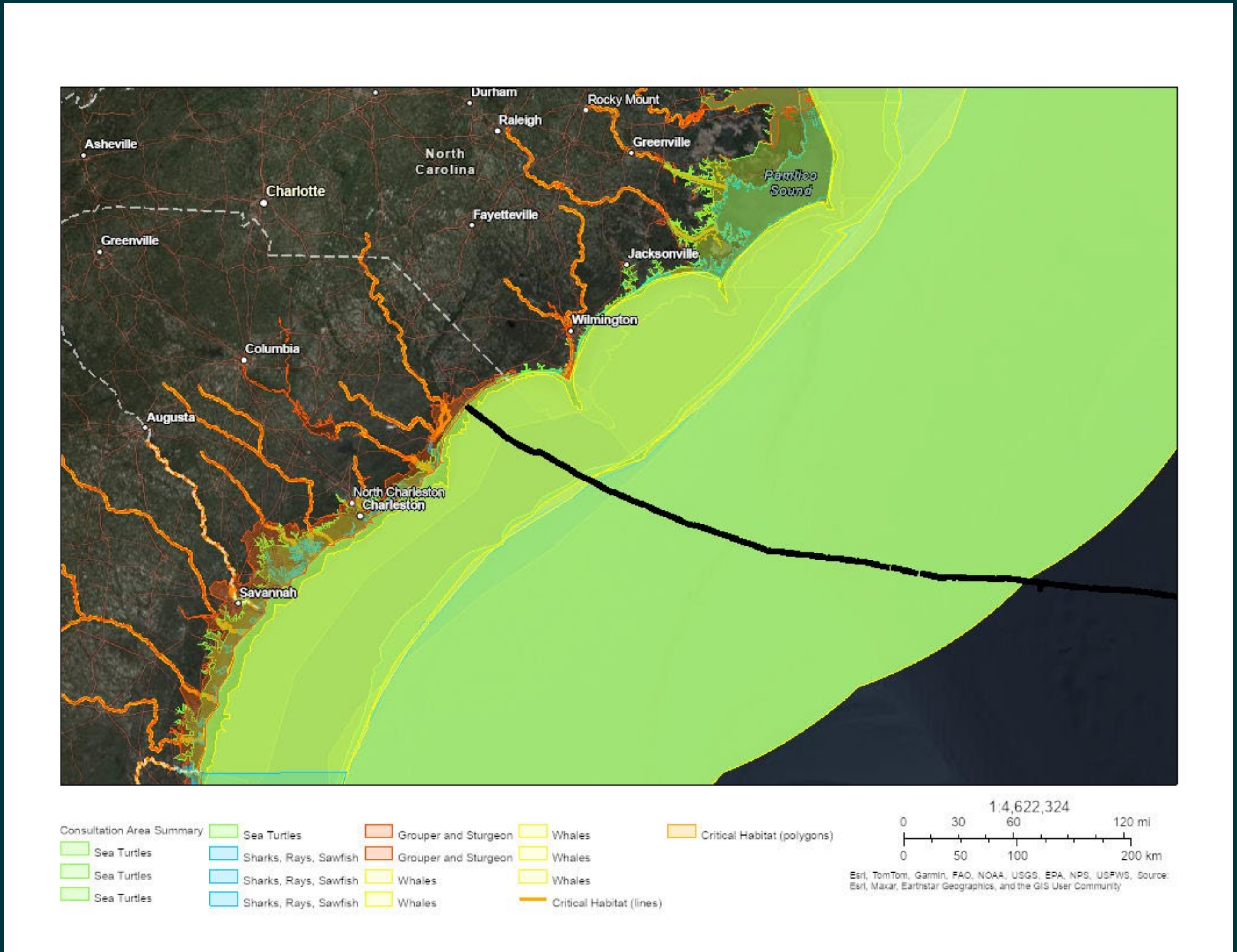
ENVIRONMENT Carey, Drew A., et al. "Effects of the block island wind farm on coastal resources." Oceanography 33.4 (2020): 70-81.

03

Policy Considerations

Species of Conservation Interest + Installation

- Identification via NOAA Section 7 Mappers or Essential Fish Habitat Mappers
- Practices to follow to avoid harm or harassment
- Permitting and feedback is usually the largest concern for timing
- Working with BOEM and/or USACE
- NOAA is always consulted (formally or informally)



Species of Conservation Interest + Decommissioning Concerns

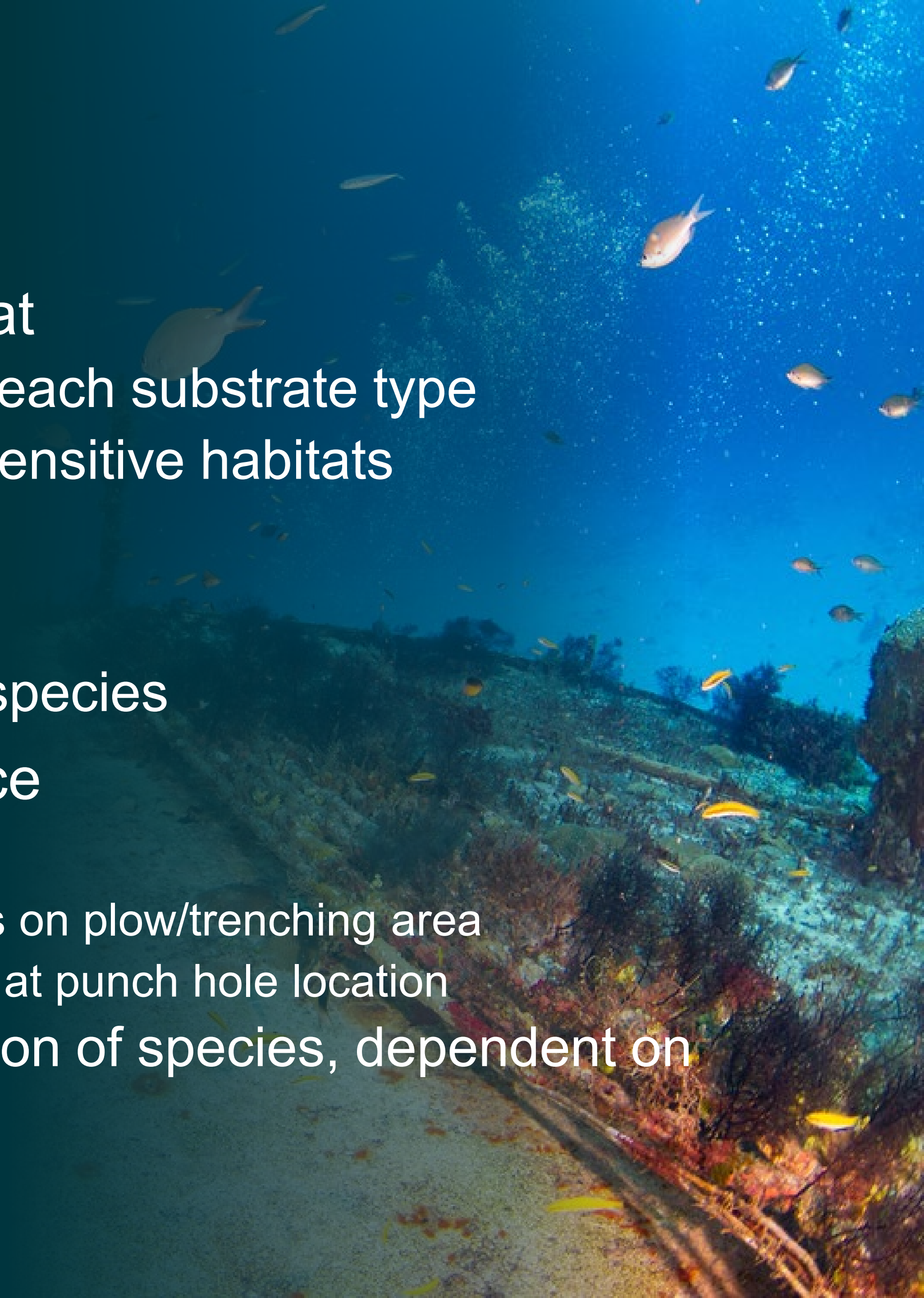
- Offshore wind infrastructures provide new habitat for species that are rare or of conservation concern
- Artificial habitat helps maintain local populations of these species; possible increases to ecosystem productivity or protection
- Decommissioning implications for species and possible food web impacts
- Use as possible permanent monitoring stations

Social considerations for fisheries

- Offshore wind structures or other cables in fishing waters
  - Different fisheries and equipment, different impacts
  - Increased occurrence vs loss of fishing grounds
- Inclusion of stakeholders in the decision-making process
  - Improve communication with fishing industry
  - Consider mitigation and minimization practices
- Data needed to support fisheries community
  - Baseline fisheries data; Ongoing research and monitoring
  - Study impact to fishery and communities

Subsea Cables + Essential Fish Habitat

- Necessary Information for Essential Fish Habitat
  - Area disturbed by the cable and cable laying for each substrate type
  - Avoidance of areas with SAV or corals or other sensitive habitats
- Surface-lay – Long-term, minimal disturbance
  - Area disturbed = length x width of cable
  - Possible sea floor resettling; habitat for pioneer species
- Cable Burial – Short-term, moderate disturbance
  - Dependent on method
    - Burial / Trenching– consider disturbance of habitats on plow/trenching area
    - Horizontal Directional Drilling – only area impacted at punch hole location
  - Return to baseline with possible removal/relocation of species, dependent on substrate



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THANK YOU!

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