Measuring Seafloor Health

Rapid Environmental Assessment for Same Day Results

Seeing is believing, and since the earliest days of oceanography, marine scientists have sought to accurately represent and understand the complex ecology of the seafloor. Interpreting data from grab samples and cores, scientists have attempted to tell a complete story of the largest ecosystem on earth. However, removed from context, these samples can misinform seafloor monitoring programs and underrepresent the complex dynamics of the seafloor. At INSPIRE, we read through layers of seafloor history in situ, deriving both qualitative and quantitative observations and applying robust statistics for faster and more holistic information for effective seafloor management at a lower cost.

INSPIRE’s innovative approach with Sediment Profile Imaging (SPI) allows us to communicate the recent history of the seafloor from disturbance to recovery. We can mobilize our equipment anywhere in the world and deliver same-day results using cutting-edge technology developed and deployed by INSPIRE staff. Our integrated team of marine scientists deliver pioneering solutions and monitoring plans tailored to your site, bringing hard-earned expertise to design a path to avoid, minimize, or recover from habitat disturbance. The seafloor is the canary in the coal mine for ocean health, an indicator of change and resilience for marine and coastal environments, and INSPIRE Environmental is your partner for telling its story.

Measuring Seafloor Health

Innovative Data Collection Technology

We combine technologies to help our clients visualize the seafloor. SPI, situated in GIS and paired with high-resolution acoustic data, tells detailed stories of seafloor resilience.

Immediate Data Processing

Immediate data processing aboard research vessels and in real-time at our Newport office provides same-day preliminary results to support adaptive sampling and optimize field collection.

Quality Control & Interpretation

From survey design to our state-of-the-art image analysis process, our statistical analyses and quality control protocols ensure data integrity and usability.

Advanced Data Visualization

Our visualization techniques take full advantage of high-resolution remote sediment imaging by integrating data into “Popup” 3D visualizations easily interpretable by clients and stakeholders.
EXPERTS IN SEAFLOOR HEALTH

Our scientists are best known as the original developers of SPI and our staff have more collective experience than anyone in acquiring and interpreting benthic images. From this core focus, our team has expanded to include expertise in seafloor, water quality, hydrodynamics, and fisheries assessments: capabilities that provide support to a full range of coastal and ocean projects. We have developed a suite of standard processes from data collection through analysis and interpretation, backed by rigorous quality assurance to ensure data integrity and defensibility. Unique and interactive visualizations convey this information to key stakeholders and decision-makers, providing a “worm’s eye view.” Our company was formed to communicate complex seafloor, coastal, and water dynamics through assessments of a wide range of natural and human impacts.

SUCCESSFUL PROJECTS
Throughout North America, Europe, Asia, Australia, and Africa, SPI has been used to characterize the physical, chemical, and biological processes of the seafloor and fresh water systems.

NUMBER OF SPI PHOTOS
Members of INSPIRE’s team have used this unique tool since the development of the SPI camera four decades ago. SPI allows for quick reconnaissance with multiple frames per sampling station.

FULL TIME STAFF
INSPIRE is comprised of a tight core team of geologists, benthic ecologists, engineers, fisheries scientists, data analysts, and field and project managers. As a small business, we operate efficiently to provide rapid turnaround on our projects.
Measuring Seafloor Health

How SPI Works

The SPI system can complete 3-5 stations per hour in shallow waters, and one station per hour in deep-sea environments.

1. System is Lowered to Seabed
2. Plan View Camera is Triggered
3. Profile Camera is Triggered

The camera system is deployed from the vessel stern using an A-Frame or crane. When a lead weight hanging from the frame reaches the bottom, it triggers the plan view camera to capture a downward-looking image. When the frame reaches the bottom, hydraulic pistons allow the prism to lower slowly into the sediment and the SPI camera captures a cross-sectional image of the sediment-water interface. This process can be repeated by raising and lowering the system without bringing the camera on deck, allowing for rapid collection at multiple stations.

Sediment Profile Images provide data for the identification and measurement of physical and biological features using well-established interpretive paradigms. SPI is a proven tool for assessing disposal and discharge impacts (e.g., dredged material, drill cuttings), response to contaminants, and mapping benthic conditions. The technology is widely accepted as a baseline and impact assessment monitoring tool by regulators and agencies including U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the Bureau of Ocean and Energy Management (BOEM), and the EU Water Directive.

Plan View Images provide increased areal coverage and context to aid in the interpretation of SPI. The detailed, high resolution images from the plan view camera can also be used for a quantitative analysis of the seafloor. INSPIRE has pioneered the use of plan view images to classify dominant biotic groupings in support of benthic habitat classification, including the Coastal and Marine Ecological Classification Standard (CMECS). Plan View imaging is suitable for assessment of hard and soft bottom habitats.

Advantages of SPI

- Rapid and cost-effective data collection and analysis.
- Undisturbed, synoptic collection of sediment, geochemical and biological data.
- Results that are easily understandable by a non-scientific audience.
The INSPIRE team’s innovative approach integrates technology from SPI, acoustic, and direct sampling to deliver compelling, accurate, and accessible visualizations of the seafloor across the globe.

INSPIRE produces innovative interactive visualizations that combine data in the context of regional seafloor topography. We layer geological, sediment, and biological data over regional bathymetry to show users their data in context. Seismic, sidescan, and SPI images are easily accessible in our simple HTML interface, through which users can selectively display results online.

**Ground-Truthing and Reconnaissance**

SPI and PV images can be used to ground-truth geological and geophysical survey data. Assessments of sediment characteristics derived through analysis of acoustic data can be quickly confirmed in these images. The image data can also be used with high-frequency mapping technologies in a reconnaissance mode, to ground-truth desktop data and quickly identify favorable locations for offshore infrastructure.

**SPI Image Assessment**

INSPIRE’s rapid turnaround of quality-controlled data and robust quantitative analyses is made possible by our team of skilled scientists. Collaborating with field scientists in real-time, our analysts quantify substantial changes in benthic community composition associated with the study site. The robust results provide defensible baseline site characterizations for development or remediation projects.

**Stakeholder Engagement**

A picture is worth a thousand words, and the SPI camera’s lens into seafloor ecology tells a singularly compelling story to developers, stakeholders, and permitting agencies alike. We integrate SPI images into dynamic visualizations to support developers in agency consultations with groups like BOEM, NOAA Fisheries, USACE, local tribes, fishermen, and state and federal representatives.

**Health & Safety**

INSPIRE is committed to keeping our staff and clients safe. We strive for a healthy, secure, and safe workplace and work to protect the environment in accordance with applicable laws and our Quality, Health, Safety, Security, and Environmental (QHSSE) Policy. Our commitment is based on the conviction that incidents are preventable, and we promote a strong safety culture in the office and in the field.
The era of renewable offshore energy is now upon us. Through the painstaking progress of industry and governmental leaders in the U.S. and abroad, there is now a policy and regulatory landscape primed for offshore renewable development, increasingly advantageous pricing for reliable technology and construction services, and a need for specialized expertise necessary for successful project development. INSPIRE can provide this unique expertise and tools to expedite offshore renewable development.

We supported the development and implementation of the historic Block Island Wind Farm, the first offshore wind farm in the United States. Through the design and implementation of numerous technical studies including seafloor imaging, baseline surveys, site suitability consulting, finfish and lobster trawl surveys, export cable route optimization, stakeholder outreach, and data visualization and reporting that meet and exceed national and international requirements, INSPIRE has developed exclusive expertise in rapid and rigorous seafloor reconnaissance to support offshore renewable project development.

By rapidly generating accurate and compelling images of the seafloor before, during, and after drilling, SPI technology and our scientists’ expert knowledge go beyond due diligence in assessing the health of the seafloor. Through SPI and PV images we can quickly identify and quantify the extent and impacts of any drilling discharges on the bottom as well as document the recovery of the benthic community following the initial impact from discharge. We work globally to map the footprint of drilling muds and remnant oil deposits, identify gradients in benthic community structure, and identify any benthic “hot spots” of low diversity or high benthic productivity. Our imagery systems reduce financial cost and risk and can easily communicate results to depict operational impacts to the seafloor with defensible detail.
INSPIRE founders and staff have more than 30 years of experience monitoring and assessing dredged material disposal sites. Integrated SPI and bathymetric visualizations help us monitor the placement of dredged material, precisely measure the thickness of sediment caps, and trace the biological recovery of sites after placement. Our staff are experienced interpreters of the presence and condition of dredged material, using Sediment Profiling to document ecological baselines and conduct forensic exercises that trace sediments to confirm disposal events.

Effective remediation of seafood processing waste – making actual, measured progress on ecological restoration – relies on comprehensive monitoring of seafloor ecology. INSPIRE combines SPI and PV imaging with high-resolution multibeam data, hydrodynamic studies, water quality testing, sediment cores, and towed video and video-probe imaging to assess the extent and impact of seafood processing waste on the environment. We use image data to assess both the depth of waste and the health of marine habitats in response to this intense nutrient input. We work with clients over time to develop and assess remediation solutions and evaluate the recovery and resilience of the seafloor at these locations. SPI is the optimal tool for seafood waste remediation because, unlike pneumatic or gravity coring that might alter material thickness in the process of taking the sample, the camera bisects rather than compresses materials. Accurate characterization of site conditions reduces cost and ensures successful site remediation. INSPIRE’s team has almost a decade of experience supporting clients in seafood waste remediation and providing them cost-effective measures to secure a healthy seafloor.
CONTAMINATED SEDIMENTS

There is no substitute for experience when it comes to interpreting the effects of contaminated sediments on the environment. While we can accurately measure the response of benthic biology to disturbance, biology and chemistry don’t always tell the whole story. At the individual image level, experienced analysts can discern sediment dynamics, such as erosion or frequent resuspension of surface sediments, that also influence the benthic biota. By contextualizing SPI images in physical processes our scientists can provide information on the likely fate and transport of contaminants at low cost and quantify the benthic response to contamination through statistical comparisons with reference locations. These data complement data on sediment composition, contaminant concentration, benthic community analysis, and toxicity testing in a weight-of-evidence approach to risk assessment. As with many of our projects, these data are enhanced when paired with high-resolution multibeam bathymetry and/or backscatter data.

CLIENT RECOMMENDATIONS

Proven in the Field

“ Their combination of the right tools and the right expertise facilitated our major shift in remedial strategy without any perception of consultant advocacy or overreach. They have been “partners” in the best sense of the word. ”

Helder Costa, Haley & Aldrich
Principal Consultant & Sediment Practice Leader

“ INSPIRE scientists proposed an innovative approach that gave us the information we needed much more cost effectively than we expected. ”

Clint Plummer, Ørsted U.S.
Head of Market Strategies and New Projects

“ INSPIRE reports have provided a remarkable level of detail to our studies, increasing the overall value and providing support to sound analyses and overall conclusions to our clients. ”

Jose Antonio Castillo, Environmental Resources Management, Mexico
Principal Consultant
GLOBAL EXPERIENCE
Providing seafloor ecology expertise in over 50 countries.

INSPIRE’s team uses a cutting-edge approach to deliver compelling, accurate, and accessible visualizations of the seafloor from across the globe. The following projects exemplify our commitment to innovative solutions.

**DEEPWATER HORIZON OIL SPILL**
Gulf of Mexico, USA

In the spring of 2010 the Macondo wellhead blowout resulted in the tragic loss of 11 lives and the catastrophic release of more than 5 million barrels of crude oil and natural gas into the Gulf of Mexico. The impacts on coastal ecosystems, fish, birds, and mammals is well-documented. Based on this, public and scientific press assumed little hope for recovery in the Gulf’s deep-sea ecosystem, anticipating severe impacts and a decades-long recovery. However, SPI technology enabled INSPIRE scientists to see beyond traditional sampling depths and preconceived notions of benthic response, discovering signs of benthic recovery in the deep-sea one year after the spill. SPI allowed for samples to be collected more rapidly, more precisely, and at a greater density than what was feasible with traditional sediment sampling techniques such as core and grab sampling. INSPIRE’s unique approach to documenting benthic recovery presents new standards for monitoring offshore energy development, including environmental baseline studies, pre- and post-drilling evaluations, and environmental impact assessments following the decommissioning of wellheads.

**DYNAMIC SEDIMENT ASSESSMENT**
San Francisco, CA, USA

Residual contamination from a now-defunct manufactured gas operator at one of San Francisco’s busy urban harbors poses risks for the local tourism and fisheries industries. Navigating an active harbor front, INSPIRE designed and conducted a 100+ station SPI survey to assess remediation needs and options related to legacy polycyclic aromatic hydrocarbon (PAH) contamination. INSPIRE staff compared data from the SPI survey to previous sediment chemistry and biological community index results conducted in the harbor and integrated these data to inform both industry and government regulators.

SPI imagery revealed impacts to the benthic ecology from frequent physical disturbance like scour and dredging activity, providing robust, comprehensive analysis of benthic health which other methods would have struggled to fully capture. Through careful analysis of the SPI and existing sediment quality index results, INSPIRE scientists presented a new option for assessing impairment to the benthic community in the harbor, enhancing the decision-making ability of district managers as they plan for remediation.

**MAPPING DEEP-SEA DRILLING IMPACTS**
Ghana, Africa

Offshore oil/gas exploration and production platforms can produce drilling mud discharges that alter seafloor conditions. An oil and gas company commissioned studies around four wellheads to map the extent and thickness of drilling mud deposits on the seafloor and benthic invertebrate colonization in areas where deposits were detected. The project required a rapid turnaround time, making the application of SPI the ideal method for this deep-sea reconnaissance project (compared to traditional benthic sampling using grabs and coring).

Adapting quickly to new working conditions, INSPIRE designed and implemented a combined SPI and PV imaging survey in 1200 meters of water off the coast of Ghana from a Floating Production Storage and Offloading vessel. This project was part of a multidisciplinary monitoring program; rapid analysis of SPI results provided feedback to optimize direct sampling. Project design was driven by baseline surveys conducted by INSPIRE at the well-field five years prior.
GLOBAL EXPERIENCE

INNOVATING IN FISHERIES SURVEYS

RI & NY, USA

INSPIRE conducted extensive fish and shellfish surveys to measure potential ecological and economic effects of ongoing offshore wind farm development at the Block Island Wind Farm. Engaging local fishermen in the design and data collection has led to broad acceptance of results that represent the most comprehensive studies of offshore wind in the U.S. We continue to incorporate stakeholder input into biological resource studies to more effectively represent these communities and provide defensible results.

Deepwater Wind and BOEM solicited an Atlantic cod spawning survey to support a new commercial wind farm offshore of southern New England with export cables reaching as far as Long Island. Rocky hardbottom geomorphology precluded the use of bottom trawls for traditional large-scale surveys, and sparse data on Atlantic cod spawning in the work area necessitated coordination with multiple federal and state agencies. INSPIRE scientists developed a reconnaissance survey using novel sampling techniques and utilizing the knowledge of local fishermen—working with local for-hire vessel captains to develop a sampling protocol that successfully documented total catch, cod spawning condition, water quality, and physical/oceanographic conditions at all fishing stations.

MAPPING SEAFOOD WASTE IMPACTS

Alaska, USA

For more than a decade, scientists from INSPIRE have been delineating the footprint and studying the environmental impacts of seafood waste discharged from floating and land-based processing plants for both state and federal regulators as well industrial clients. Using a multidisciplinary approach to collect data on both water and sediment quality associated with these permitted discharges, INSPIRE scientists have worked at multiple locations in Alaska in a wide variety of bottom types and hydrodynamic settings. Our expertise in using video, SPI, and PV imaging as well as video probes, vibra-coring, and box coring have been invaluable in helping our industrial clients demonstrate to federal and state regulators compliance with both discharge permit requirements and consent decree cleanup orders.

Our reputation for data quality and integrity has allowed us to become trusted advocates and serve as effective advisors during complex consent decree negotiations; our data visualization tools have made complex scientific data and their interpretive results easily understandable in both public stakeholder meetings and regulatory workshops.

REMEDIATION SITE MONITORING

New York, NY, USA

New York District’s Historic Area Remediation Site (HARS) is the historic disposal site for materials dredged from New York Harbor since the mid-1800s, resulting in a broad area of contaminated sediments. The site is currently under remediation using Category 1 dredged materials that isolate legacy sediments and require rigorous multi-method monitoring.

INSPIRE staff have supported these remediation efforts under contract to the U.S. Army Corps of Engineers since 2010, including annual, comprehensive acoustic site monitoring using multibeam echo sounder and acoustic backscatter, SPI, vibracoring, toxicity testing, and chemical and biological analyses to support objectives outlined in the Site Management and Monitoring Plan. Hallmarks of our performance have been consistency and comparability of data, including comparative analysis of current and historical data.
CREATING BASELINES FOR OIL & GAS

Gulf of Mexico, Mexico

New leases in the Gulf of Mexico have opened for oil and gas exploration since Mexico’s oil reform in 2013. National environmental regulation requires all companies to conduct a multidisciplinary environmental baseline survey, including characterizing surface sediments and water column properties, prior to any exploration drilling activities to establish an accurate baseline for Mexico’s deep seabed conditions. Supporting ERM, INSPIRE generated a cost-effective documented baseline to which successive surveys can be accurately compared.

Physical, biological, and geological conditions of surficial sediments within the study area were easily communicated with SPI imagery and INSPIRE’s visualization tools. They effectively informed stakeholders of baseline conditions in an accessible and intuitive format while comprehensively documenting all surface sediments and sedimentary horizons preserved in the seafloor. Our technology will also support assessment of post-exploration and post-production.

REFINED HARBOR SEDIMENT ASSESSMENT

Ontario, Canada

Located on a shallow natural harbor off Lake Ontario, Port Whitby Marina planned to remediate the harbor bed and requested refined sediment quality assessment to confirm or refute benthic health indicators from previous sediment toxicity tests. Port managers provided hotspot maps of chemical contamination for this legacy contamination site; INSPIRE was able to provide additional data and ecological analysis to refine conceptual remedial options.

INSPIRE scientists used SPI imagery to help explain how sediment transport processes for the harbor interact with chemical hotspots as part of site risk assessment. We provided these data as well as a decision-making framework to identify areas within Whitby Harbour that might present unacceptable risk to ecological receptors or human communities.

MONITORING MARINE DREDGED MATERIALS

New England, USA

The Disposal Area Monitoring System (DAMOS) Program is managed by the New England District of the U.S. Army Corps of Engineers. The DAMOS Program has collected and evaluated data on dredged material placement throughout New England since 1977. In partnership with the Corps, INSPIRE scientists have participated in DAMOS monitoring throughout that time, conducting assessments that have inspired the development of a nationally-recognized monitoring and management program for aquatic dredged material disposal. INSPIRE staff have made key advances in effective resource management techniques for dredged material disposal, including capping and confined aquatic disposal through the use of of SPI, tiered monitoring strategies, and integrating results from precision acoustic surveys with traditional sediment sampling and optical survey techniques.

INSPIRE scientists are recognized experts on assessing the effects of dredged material placement in coastal waters and specialize in dredged material management. Helping to define the next generation of management strategies for the Central Long Island Sound Disposal Site (CLDS), INSPIRE scientists recently leveraged this expertise in combination with a comprehensive and statistically sound sampling plan to support decision-making at the Corps and EPA. The results of this project will define management strategies at CLDS going forward.
INSPIRE scientists have worked side-by-side with Deepwater Wind (now Ørsted) to address the environmental challenges associated with permitting the nation’s first offshore wind farm since the project’s inception. With operation beginning on December 12, 2016, the Block Island Wind Farm (BIWF) is the first offshore wind farm in the United States.

INSPIRE scientists supported the development and implementation of Deepwater Wind’s Marine Work Plan and permitting strategy for BIWF, leading with innovative approaches for benthic assessment and fisheries monitoring. INSPIRE’s SPI and PV imaging were used to assess the benthic habitat and to ground-truth the geological and geophysical survey results at Block Island.

This cost effective and data intense approach is now widely accepted by BOEM and other regulatory agencies. We are now in our 7th year of fisheries monitoring at the site, having pioneered an approach that effectively connects the developer with the fishing community to produce defensible results that satisfy multiple stakeholders. We also designed and conducted technical studies to address concerns related to cable routing, sensitive eelgrass habitat, hardbottom habitat, lobsters, recreational boating, and NEPA documentation. With the current growth in offshore wind energy, INSPIRE is successfully applying this experience to projects along the U.S. eastern seaboard from Massachusetts to North Carolina for Ørsted U.S. Offshore Wind and other developers.

### Ongoing INSPIRE Projects Supporting Offshore Wind

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PROVIDING EXPERTISE ACROSS THE WORLD

Services Available:

› Sediment Profile and Plan View Imaging
› Statistical Analysis and Survey Design
› Environmental Baseline Surveys
› Siting Suitability Consulting
› Fish and Fisheries Impact Surveys
› Benthic Habitat Assessments
› Construction Impacts Monitoring
› Data Visualization and Reporting
› Community Stakeholder Outreach
› Dredged Material Mapping and Management
› Sediment Collection and Analysis
› Computer Modeling of Environmental Conditions
› Construction and Operation Plan Support
› Database Development and Management
› Water Resources Planning
› Support for Risk Assessment Studies

Our Clients Include:

› Deepwater Wind / Ørsted
› Fugro Marine GeoServices, Inc.
› International Seabed Authority
› New York State Energy Research & Development Authority (NYSERDA)
› Environmental Resources Management (ERM)
› Continental Shelf Associates (CSA)
› Trident Seafoods
› Golder Associates
› Haley and Aldrich
› Oceaneering
› U.S. Environmental Protection Agency (USEPA)
› U.S. Army Corps of Engineers (USACE)
› American Petroleum Institute (API)
› British Petroleum (BP)
› Imperial Oil Ltd.
› ExxonMobil
› Shell
› Petrobras
› Chevron-Texaco
› PEMEX
› Pacific Gas & Electric
› AECOM
› Battelle
› Stantec
› Jacobs
› RAMBOLL

“INSPIRE is unique among consulting firms due to their attention to detail and the thoughtful way they present the data they collect and analyze.”

Aileen Kenney, Ørsted U.S. Head of Development & Permitting
An environmental consultancy based in Rhode Island, INSPIRE represents the collective experience and expertise of two preceding small businesses: CoastalVision, LLC and Germano & Associates. The founders, Dr. Drew Carey and Dr. Joseph Germano, have over thirty years of experience in the application of Sediment Profile and Plan View Imaging (SPI/PV) to seafloor assessments in support of offshore energy development, benthic habitat mapping, dredged material disposal monitoring, fish processing, and sediment contamination issues.

An original developer of the SPI camera, Dr. Germano is a world leader in analysis and interpretation of the data. Through INSPIRE Environmental, Drs. Germano and Carey are enhancing this expertise with new and innovative data processing techniques that deliver scientifically defensible results in visual, intuitive formats. INSPIRE is the only company to include SPI/PV in a seamless view of seafloor topography to provide detailed information on the nature and health of the seafloor.

By leveraging their ‘best in class’ expertise and innovative presentation tools, the principals are now providing services to a wide range of commercial clients and governmental agencies in most U.S. coastal areas and other regions as diverse as Alaska, Scotland, Mexico, Brazil, New Zealand, Australia, Ghana, and Italy. With offices and facilities in Rhode Island, Idaho, and Washington, INSPIRE employs 18 full time scientific and technical staff and maintains 3 sets of Sediment Profile and Plan View camera systems, complete with full spares as back-up. No other provider of SPI services can field as many simultaneous surveys or demonstrate our sterling record of data return.

Mission Statement

INSPIRE Environmental’s mission is to illuminate and expand our understanding of the seafloor. We work creatively and collaboratively with clients worldwide to clarify their questions, choose appropriate tools to answer them, and present clear and compelling results to support the best decision-making possible.
Statement of Qualifications