CONTRIBUTION 3.6

DIGIFISH: Data Driven Solutions to Inform Decision Making

Richéda Speede[1]*, Shelly-Ann Cox[2*], Vernel Nicholls[3], Veta Wade[4], Jen Cole[4], Ché Greenidge[5], Juan Carlos Marti[6], Kelvin Carter[7], Adriel Jackman[2;];
Corresponding author: richedaspeede@gmail.com*

Blue Shell Productions[1]; Fisheries Division[2], Bridgetown, Barbados; Barbados National Union of Fisherfolk Organisation (BARNUFO)[3]; Pelagic Data Systems[4]; Barbados Environmental Conservation Trust[5]; Remora Fishing Traceability[6]; Mr. Fish Inc[7]

Abstract

DigiFish aims to promote the use of digital technologies and innovative data analytical methods to support the application of the Ecosystem Approach to Fisheries (EAF) in Barbados. Phase 1 of DigiFish is being implemented by Barbados National Union of Fisherfolk Organisations (BARNUFO) and Blue Shell Productions in collaboration with the Barbados Environmental Conservation Trust and Pelagic Data Systems (PDS). This initiative piloted the installation of 30 PDS vessel tracking devices on small-scale vessels in Barbados to illustrate how fishing effort changes through space and time. The pilot demonstrates how vessel tracking systems can be used to make informed decisions about how fisheries can be best managed to balance diverse societal and environmental objectives while improving livelihoods. It also aims to foster productive partnerships between industry stakeholders, the Coastal Zone Management Unit (CZMU) and Barbados Coast Guard (BCG) in applying integrated data solutions to support fisheries management and MSP. This pilot is now being replicated in Saint Vincent and the Grenadines.

Phase 2 of DigiFish aims to address the fragmentation of seafood value chains and promote traceability by transforming landing sites into intelligent spaces. The project seeks to pilot the installation of 40 Remora Vessel Monitoring Devices (VMS) aboard longline vessels and station two Smart Scales in the Bridgetown Fisheries Complex. The data intelligence and visualization platform will compile the data collected to determine catch location, calculate fishing effort, analyze landings, and begin the traceability certification process. These same data are also relevant for eco-labels related to the premium growing market of responsibly-caught fish. This phase is being implemented by Blue Shell Productions in collaboration with Remora Fishing Traceability and Mr. Fish Inc. In this paper, we provide an overview of the initiative, present a data analytics summary, and offer recommendations for sustaining and scaling up this initiative across the Caribbean.

KEYWORDS: Digital technologies, vessel monitoring systems, marine spatial planning, EAF, traceability

CITATION: Speede, R., S-A. Cox, V. Nicholls, V. Wade, J. Cole, C. Greenidge, J. C. Marti, K. Carter, and A. Jackman, 2026. DIGIFISH: Data Driven Solutions to Inform Decision Making. Contribution 3.6, p159-171 *IN* CRFM, 2026. Volume I: Technical Papers. Presented at the CRFM 20th Anniversary Scientific Conference, 28-31 August 2023. CRFM Special Publication No. 37, CRFM Secretariat https://www.crfm.int/index.php?option=com_k2&view=item&id=911

1. INTRODUCTION

The Caribbean region, known for its pristine waters and abundant marine resources, has traditionally depended on its fishing industries as a vital source of livelihood and subsistence. However, the rapidly changing ocean conditions, owing to anthropogenic factors exacerbated by climate variability and change, have placed increased pressure on Caribbean fisheries resources and marine ecosystems. It is well understood that to effectively manage fisheries and maintain the sustainability of fish stocks in this evolving landscape, robust fisheries data are essential. Data scarcity is limiting effective fisheries management and the implementation of data-driven solutions to inform decision making (Gill et al. 2019). Conventional fisheries data collection systems are often time- and resource-intensive involving manual data recording using logbooks and vessel data reports, manual data entry, analysis, and interpretation. Furthermore, the process of moving and processing data from the point of collection into management decision-making is often slow or non-existent (Bradley et al. 2019). Issues of quality control and assurance can also arise owing to lack of standardization in data collection, transcription errors and misreporting (Lowell et al. 2015). In a recent forum more than 300 experts from over 50 countries were contributing to the Illuminating Hidden Harvests (IHH) study (FAO, Duke University & WorldFish 2023), a global small-scale fisheries initiative. When participants were asked "how can FAO best work with governments to support implementation of the Small-Scale Fisheries Guidelines?", the top response (31%) was "build capacity for collecting and analyzing data." According to Bradley et al. (2019), data collecting resources and ineffective data collection systems have resulted in a scarcity of basic indicator data for many small-scale fisheries, such as total catch, vessel count, and catch per unit effort (CPUE).

In response to the growing need to address many of the shortcomings of current approaches and improve fishing efficiency, developments and technologies have been gradually emerging within the fisheries sector, offering benefits to both fisheries managers and fisherfolk. Initiatives such as the use of state-of-the-art ICTs, Vessel Monitoring Systems (VMS), online marketplaces, mobile apps, cloud-based computing and artificial intelligence, have the potential to revolutionise Caribbean fisheries sectors. Technologically advanced fisheries data systems can also facilitate traceability of catch for fisheries certification programs, reduce cumbersome data collection, and provide a means to enhance communication and cooperation between fisherfolk and managers to achieve mutual goals (Bradley et al. 2019).

It must be highlighted that fisheries management authorities typically have greater resources and institutional capacity to integrate digital technologies into their operations, while the uptake among fisherfolk can be slower. Lack of resources and insufficient digital literacy of Caribbean fisherfolk still remain critical issues and major barriers to the successful use of digital technologies. Overcoming these barriers will require support to acquire digital devices, get buy-in from fisherfolk and fisheries management officials, conduct awareness raising activities, and obtain support institutionalised training programmes that emphasise the importance of these technologies. Notwithstanding, there has been notable use of VMS (Russo et al. 2016, Hoenner et al. 2022, Tassetti et al. 2022), GPS, smart phones, and apps primarily those which provide weather forecasts and oceanographic data to help fishers plan their trips more effectively.

There have been advances in the installation of VMS and Automatic Identification Systems (AIS) in the Caribbean. Noteworthy initiatives include the Coastal Monitoring network in Antigua and Barbuda established in 2017. That system consists of three radar antennas with the capability to cover up to 90 nautical miles each and three AIS receivers. One hundred Weatherdock VMS Track Pro handheld AIS units were issued to fishers. In Belize the Asset link global satellite VMS has been installed on 85 fishing vessels. This user-friendly monitoring platform is managed by Comprehensive Security Solutions around the clock by qualified and

trained staff. Similar units are being used in Suriname and have been piloted in Barbados in 2015 but unfortunately the pilot was not sustained.

Project DigiFish seeks to enable efforts to overcome the identified barriers. DigiFish is a practical demonstration that fisherfolk are taking the initiative to use digital technologies to solve issues, promote sustainable fishing practices and support marine conservation. The ultimate goal is to promote the use of digital technologies and innovative data analytical methods to support the application of the Ecosystem Approach to Fisheries (EAF) in Barbados. This fisherfolk-led initiative aims to provide data-driven solutions and improve the digital literacy of fisherfolk and fisheries management officials. DigiFish was first piloted in 2022 in Barbados and implemented by Barbados National Union of Fisherfolk Organisations (BARNUFO) and Blue Shell Productions in collaboration with the Barbados Environmental Conservation Trust (BECT) and Pelagic Data Systems (PDS). The key aim was to demonstrate how VMS, installed on small-scale vessels, can be used to show how fishing effort changes through time and space. Incorporating these systems and data-driven approaches into fisheries management can help to create a more holistic, evidence-based, and sustainable approach to balancing the diverse societal and environmental objectives. Following the successful implementation of the Pilot, DigiFish Phase 2 was launched with the aim of addressing the fragmentation of seafood value chains and promote traceability by transforming landing sites into intelligent spaces. Specifically, it seeks to outfit 40 longline vessels in Barbados with VMS as well as to station two state-of-the-art Smart Scales in the Bridgetown Fisheries Complex for the tuna species. This phase is being implemented by Blue Shell Productions in collaboration with Remora Fishing Traceability and Mr. Fish Inc. In this paper, we provide an overview of the DigiFish initiative, present a data analytics summary, and offer recommendations for sustaining and scaling up this initiative across the Caribbean.

2. METHODS

A participatory action research approach was employed to support the successful implementation of DigiFish. This strategic initiative can be categorised into three pivotal phases: project initiation, pilot implementation and scaling up (phase 2) as shown in ***Figure 1***.

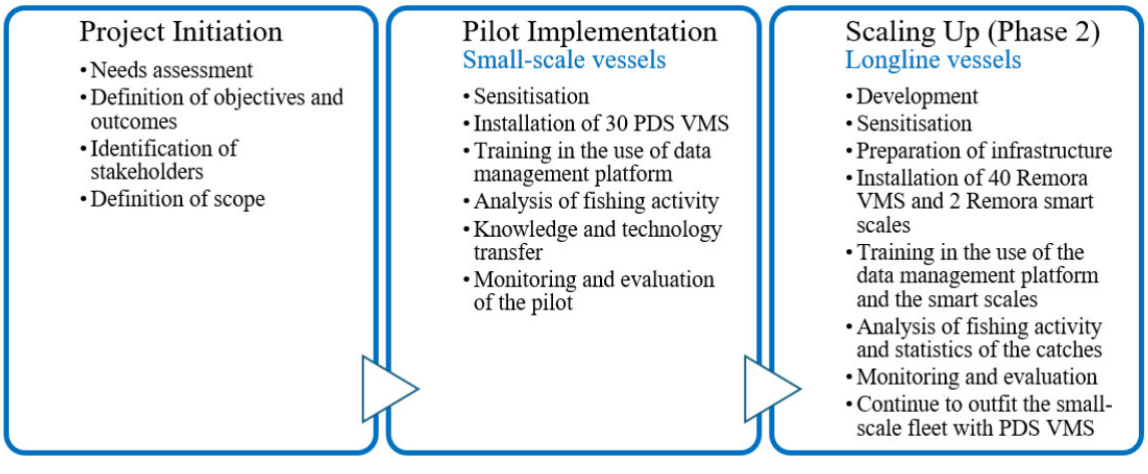

Figure 1. Methodological framework used for the development of Project DigiFish

2.1 Project Initiation

The Project Initiation phase began with a needs assessment to understand the current state of the Barbadian fishing industry, its challenges, and the technological readiness of the sector. This involved research and literature reviews and a series of strategic meetings with the Barbados National Union of Fisherfolk Organisation (BARNUFO), the Barbados Fisheries Division and Blue Shell Productions at different landing sites. After careful evaluation, endorsement of the project was given by these key stakeholders, and the project scope, objectives and outcomes were defined through collaborative efforts among stakeholders.

The objectives included:

- Demonstrate how VMS can be used to makes informed decisions
- Pilot the installation of VMS on small- scale vessels in Barbados
- Use data classification algorithms to illustrate how fishing effort changes through space and time
- Foster productive relationships with BARNUFO, Fisheries Division, the Coastal Zone Management Unit (CZMU) and the Barbados Coast Guard (BCG)

The outcomes included:

- Improved digital literacy of fisherfolk and fisheries management officials in Barbados to support fisheries management
- Improved collaboration among coastal and marine stakeholders in the practical application of EAF
- Database of location data and analytical tools to support marine spatial planning (MSP) and inform decision- making by fisherfolk and fisheries management officials

2.2 Pilot Implementation

The second phase, Pilot Implementation, witnessed the practical application of the VMS. The project implementation team was identified along with the respective roles and responsibilities. The team comprised: Blue Shell Productions (project coordinator), BECT (funder), BARNUFO (beneficiary) and PDS (technology manufacturers).

In the Pilot, BECT facilitated the procurement of 30 cutting-edge PDS VMS. Sensitisation activities were conducted at 12 landing sites and 1 port around the island of Barbados and included combination of one-on-one dialogues and focus group meetings with fisherfolk. The aim was to present the project, understand their perspectives, needs, and concerns. The size of the fleet (1,156 vessels) and the spread across landing sites were taken into consideration when nominations for beneficiary list were reviewed.

After finalisation of the beneficiary list for the pilot, 30 PDS VMS were distributed across the 12 landing sites and 1 port *(Figure 2*). The aim was to install at least 2 devices at each landing site where possible. The installation process was simple, requiring only a screwdriver and 4 screws. The fishers took charge of the installations on their respective vessels which included ‘moses’, day boats and ice boats. The devices were strategically placed in areas exposed to maximum sunlight.

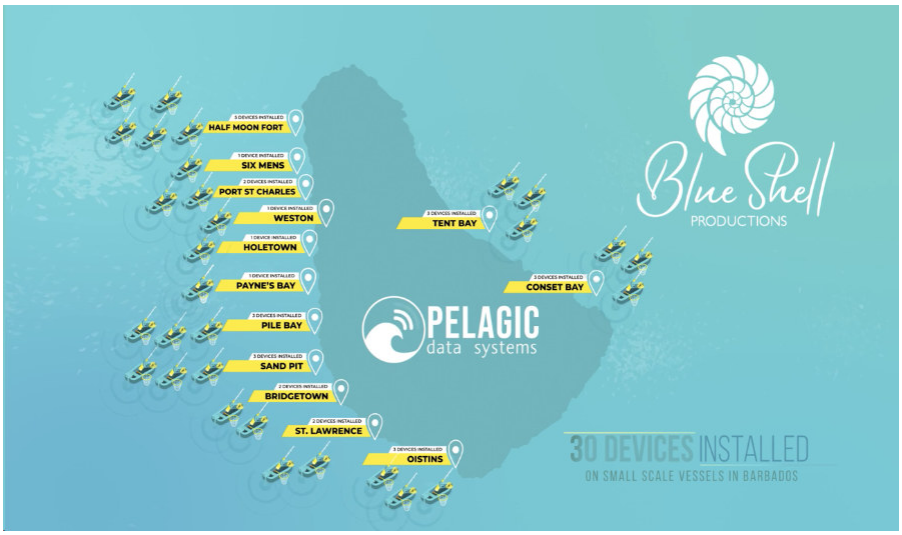

Figure 2. Distribution of vessels with PDS monitoring devices installed operating from 12 landing sites and 1 port

The PDS monitoring device is ultra-light, tamper resistant, waterproof and requires no maintenance (*Figure* 3). It is also solar-powered and self- charging with an eco-friendly LFP battery that connects to a cloud-based analytics platform. It requires neither vessel power nor any action by the fisher. The first device was installed on 21 Jan 2022.

Training and support to the pilot participants was provided by PDS personnel and Blue Shell to ensure they can effectively access and use the data visualisation platform. During the online portal demonstrations, they were shown how to interpret the location data to identify fishing patterns and optimal fishing locations. Training sessions were also conducted with fisheries management authorities on how to effectively analyse and utilize the data generated by the devices.

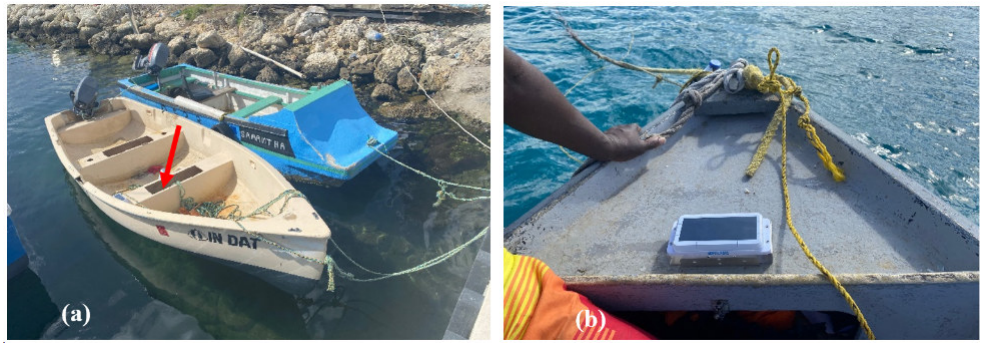

Figure 3a and 3b. A PDS vessel monitoring device installed on Class 1 vessels called 'Moses'

The Data Management Platform

The GPS receiver continuously collected the vessels' location data, including latitude and longitude coordinates. These data provided near real-time information about the vessels' location.

The collected location data and other relevant information (such as vessel identification and speed) were transmitted from the VMS to a cloud-based platform where it was stored and processed (*Figure 4*). Analytical tools were used to visualise vessel positions on maps, review

historical routes, and monitor vessel activities. Monthly reports were developed by Pelagic Data Systems and shared with the project team. The platform was continuously monitored to identify challenges, successes, and areas for improvement.

At the pilot's conclusion, the overall impact and effectiveness in promoting digital technology in the fishing industry was evaluated. Lessons learned and best practices were documented for future initiatives.

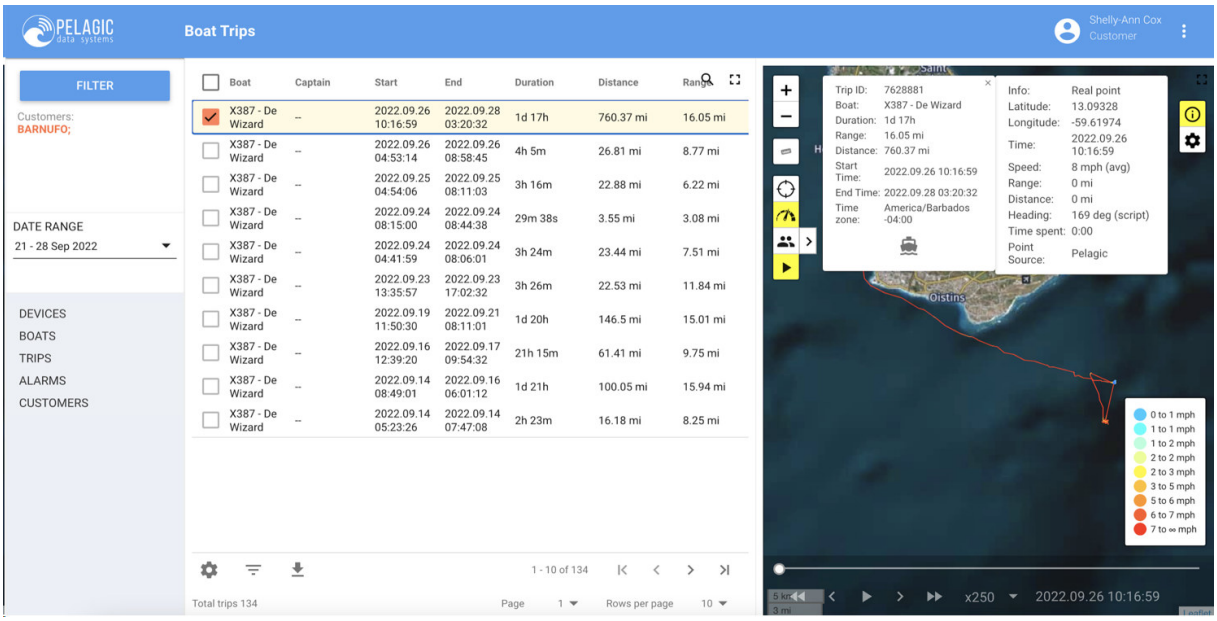

Figure 4. Some of the features of the PDS data management platform

2.3 Scaling Up (Phase 2)

The project is currently in the Scaling Up phase. This phase marks the transition from the pilot project to a broader initiative aimed at building out the traceability agenda. It features the installation of 40 Remora VMS on Barbadian longline vessels as well as stationing two Remora Smart Scales in the Bridgetown Fisheries Complex for the tuna species. Through commitment of the BECT, installation of more VMS on small-scale vessels also continues into this Phase. In June 2023, an additional 8 Pelagic VMS were installed on small-scale vessels, increasing the overall count to 38 vessels with these devices. The Phase 2 team comprises: Blue Shell Productions (project coordinator), Remora Fishing Traceability (technology manufacturer), Pelagic Data Systems (technology manufacturer) Mr. Fish Inc. (tuna exporter), BARNUFO (beneficiary), BECT (funder), Export Barbados (funder) and Compete Caribbean (funder).

Phase 2 commenced with the conducting of literature reviews, research, and strategic meetings with fisherfolk and personnel at different landing sites. Discussions with collaborators under the themes of traceability, monitoring, MSP, and statistical analysis were also conducted. During this development stage compliance with national, regional, and international regulations to be included within the management and visualization platform were identified. Additionally, a module to identify compliance with the fish commercialization criteria within the management and visualization platform was also generated. The team also conducted a thorough analysis of the existing infrastructure at the Bridgetown Fisheries Complex where the smart scales are to be installed. This thorough evaluation aimed to ensure that the chosen locations were well-equipped and conducive for the implementation of the technology. Landing site visits also facilitated sensitization of fisherfolk and landing site personnel towards transparency, traceability, and commercialization.

Next, activities related to the implementation of electronic and digital information capture were carried out. The first device was installed on 07 July 2023. To date, the team installed 6 Remora VMS on longline vessels operating from the Bridgetown Fisheries Complex. Installation of 4 more is expected within the next month. The Remora device is a self-energy generating device that collects high resolution data (data points captured every 30 mins) to support the creation of data algorithms adapted to the local context (*Figure 5*). The Remora smart scales (still to be installed) will take pictures of every fish, and through image processing and artificial intelligence will analyze the weight and size (length) of the fish (*Figure 6*). The temperature and grade of the fish can also be manually inputted. Every tuna passed through the Smart Scale will generate the print of a traceability tag that will encompass the weight and dimensions of the fish, the fisherman, the boat, and the fishing path through a correlation with the VMS.

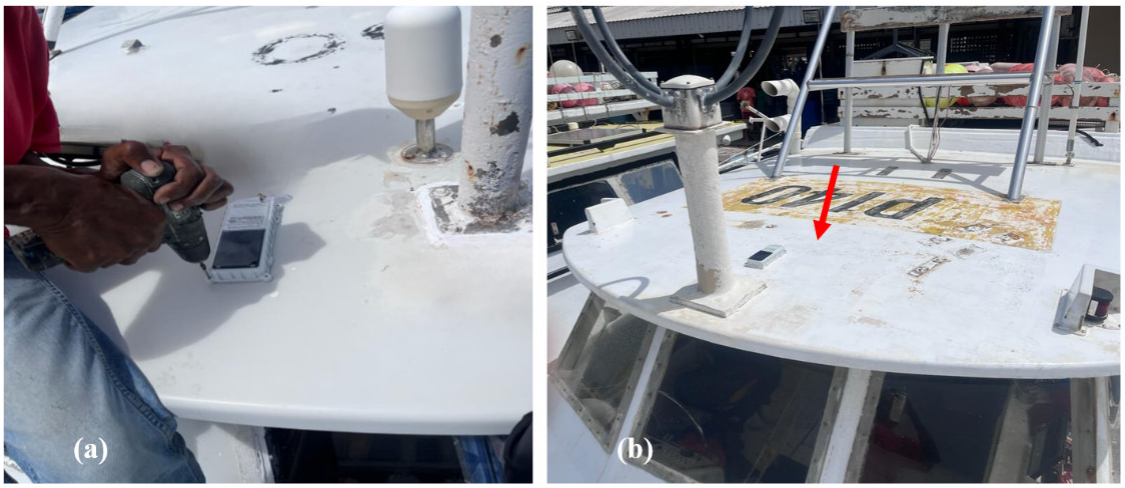

Figure 5a and 5b. A Remora VMS installed on a Barbados longliner

Figure 6. A custom designed Remora smart scale, dockside testing in Costa Rica

The Data Management Platform

The data intelligence and visualization platform will compile the data collected using the Remora hardware to determine catch location, calculate fishing effort, analyze landings, generate predictive models, and begin the traceability certification process. Staff in the tuna export facility at the Bridgetown Fisheries Complex and fisherfolk will be trained to use the smart scales and data management platform and will be provided with protocols and video manuals.

After installation of the smart scales, performance of the suite of technologies will be monitored, evaluated and necessary adjustments made over a 6-month period. Thereafter, official data will be collected, behaviours will be visualised and statistical analyses will be generated on a consistent basis.

3. RESULTS

3.1 Pilot Implementation- Small-scale Vessels

The efficiency of the automated data collection and visualisation platform has led to more comprehensive spatial and temporal datasets which have been helping the fisheries division in understanding when and where fishing efforts are concentrated. The data management platform has been effectively collecting, storing, processing, and analyzing data since the first trip on 24 Jan 2022. From 24 Jan 2022 to 25 August 2023, a total of 5,445 trips were recorded illustrating the length, distance, and range of trips from 12 landing sites and 1 port in Barbados. The longest trip logged up until 25 August 2023 was 16 days, 15 hrs. with a distance of 3.5 km and range of 1.3km. These data have been helping to assess the time fishers invest in fishing activities, which is a key indicator of fishing effort.

Figure 7a illustrates a summary of the trips from 12 landing sites and 1 port in Barbados. It shows that although fishers belong to a particular community, they fish all around the island at various times of the year. As it relates to community level data, Pile Bay (3 boats) and Half Moon Fort (3) are the most active sites based on the number of trips documented (*Figure 7b*). The data visualisations illustrate trips by community, demonstrating how far Barbadian fishers venture even in smaller vessels to contribute to food security.

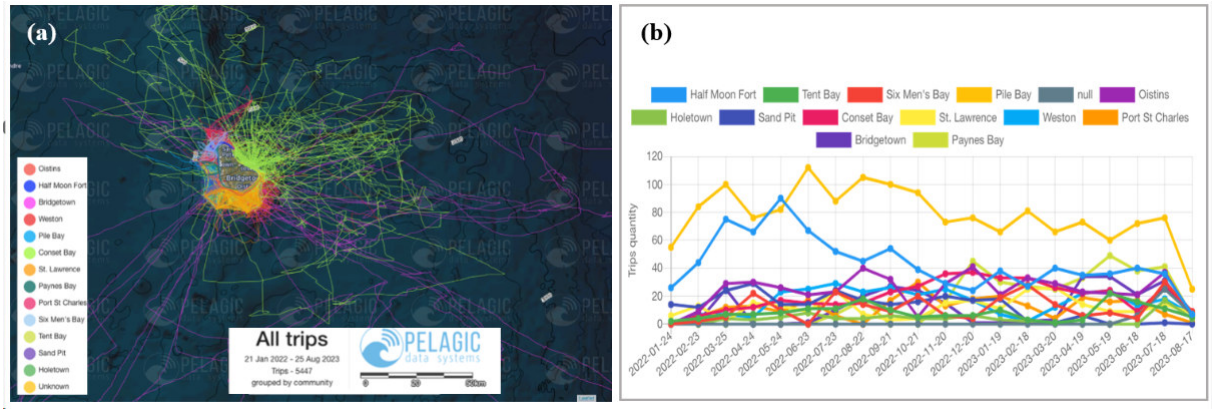

Figure 7a and 7b. Distribution of trips by community of the small-scale vessels

The data management platform also illustrates average total trip distance (km) by community. Over the 20-month period, one of the ice boats operating from Bridgetown has been going the furthest followed by an ice boat at Conset Bay. The ice boat at Bridgetown has primarily targeted pelagic species such as flyingfish, dolphinfish and almaco jacks further offshore, while the boat at Conset Bay has been targeting pelagic fish using drifting Fish Aggregating Devices (FADs). Taking a closer look at the distribution of total trip lengths for Bridgetown, most trips average around 36.38 km.

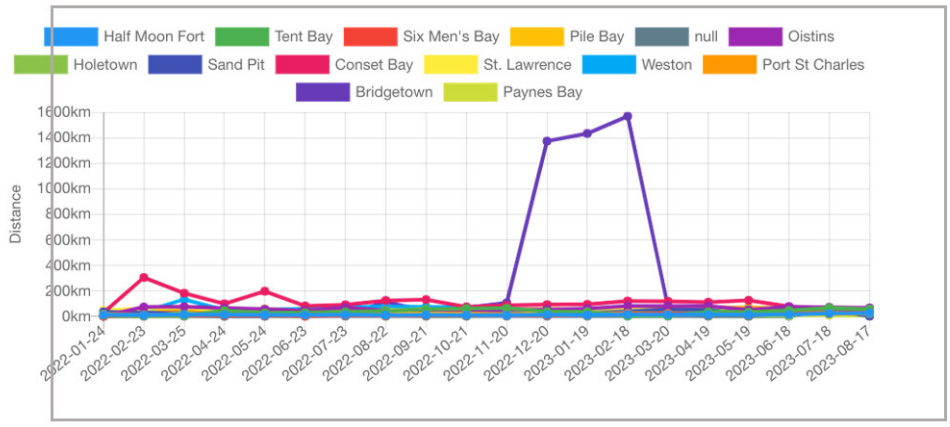

Figure 8. Average total trip distance (km) by community of the small-scale vessels

The data indicate that fishers have generally maintained consistent patterns of fishing. They also illustrate frequent visits to FADs which have been deployed to ease the pressure from nearshore reefs. This consistency suggests that there have been no significant disruptions or deviations in their fishing practices. Fishers seem to be adhering to relevant fishing regulations and guidelines as it relates to the two marine conservation areas: the Folkestone Park and Marine Reserve and Carlisle Bay. This is a positive indicator of responsible and sustainable fishing practices.

The pilot was successful in fostering productive relationships with stakeholders including BARNUFO, Fisheries Division, the CZMU and the BCG. The fishers have expressed satisfaction and contentment with the monitoring devices, especially the positive impact on maritime safety. According to one pleased fisher, “the tracker gives me peace of mind”. Fishers and boat owners have reportedly been using the data analytics platform to view the fishing activities of their boats, thereby gaining practical experience in handling digital information. Screenshots of fishing paths are frequently shared with fishers which form the basis of discussions on fishing practices and fishing grounds where species are targeted. Collaboration among other coastal and marine stakeholders has been strengthened. Already datasets to support the planning process and zonation of use areas for MSP have been shared with the CZMU. The data generated are being used to identify areas of high fishing activity and potential conflicts with other uses such as tourism/recreation, conservation zones, or boating lanes. Furthermore, efforts to map catch per unit effort (CPUE) are on the way to inform where fishing priority areas can be located and where closed areas can be demarcated to protect nursery areas or spawning aggregations. The project has also fostered a productive partnership with the BCG. The BCG has access to the platform to support monitoring and surveillance and search and rescue efforts. The partnership has also led to a collaboration in the delivery of a Fishing Vessel Operations Level 3 national vocational qualification which will include data analytics from DigiFish to illustrate technologies to support effective vessel operations.

3.2 Scaling up (Phase 2): Transforming landing sites into intelligent spaces

So far in phase two we have completed project development, sensitisation, and currently in the process of installing the monitoring devices. So far 6 Remora devices have been successfully installed and have been effectively gathering data. The data collected up to this point are considered experimental, and ongoing efforts are dedicated to refining and optimizing this valuable tool. There were 9 completed trips in 54 days of data collection (7 July 2023 to 23 August 2023). Note a trip occurs when the vessel leaves the landing site, engages in fishing activity and returns to the landing site. The distance travelled per boat ranged from 1500- 4000

km and the trip time per boat ranged from 300-790 km. The furthest range recorded was 481.1 km.

Figure 9 shows the distribution, range and areas of possible fishing activities of the longline vessels logged from 07 July, 2023 to August 23, 2023. Analyzing patterns in vessel speed over specific spatial and temporal intervals can reveal potential fishing activities. Longline vessels often slow down significantly when setting and retrieving their longlines. The devices have been capturing these distinct patterns of slowing down, coming to a halt, and then resuming movement (*Figure 9*). Cluster analysis was also generated which shows the densities of geolocation points associated with fishing activity. This can indicate specific areas or fishing grounds where longline vessels tend to operate.

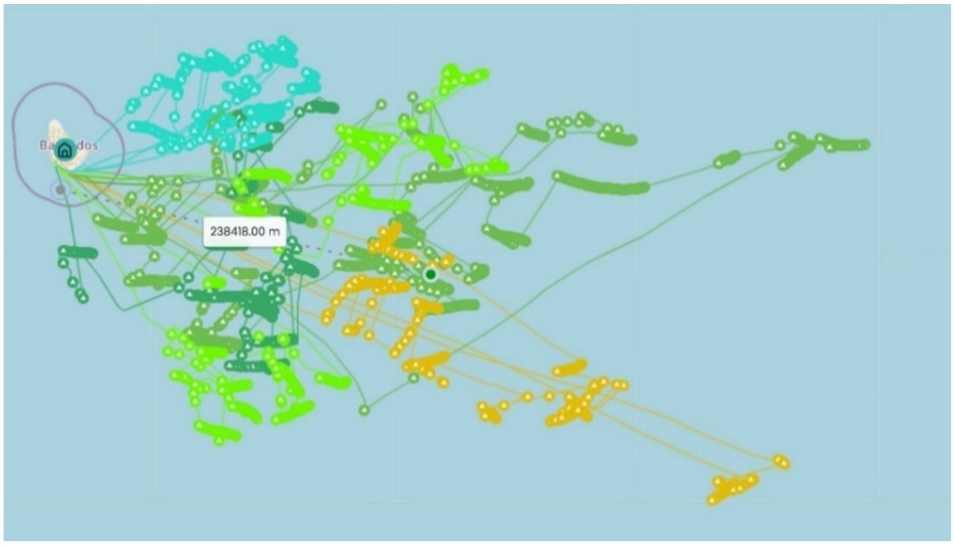

Figure 9. Visualisation of the distribution of trips of the longline vessels

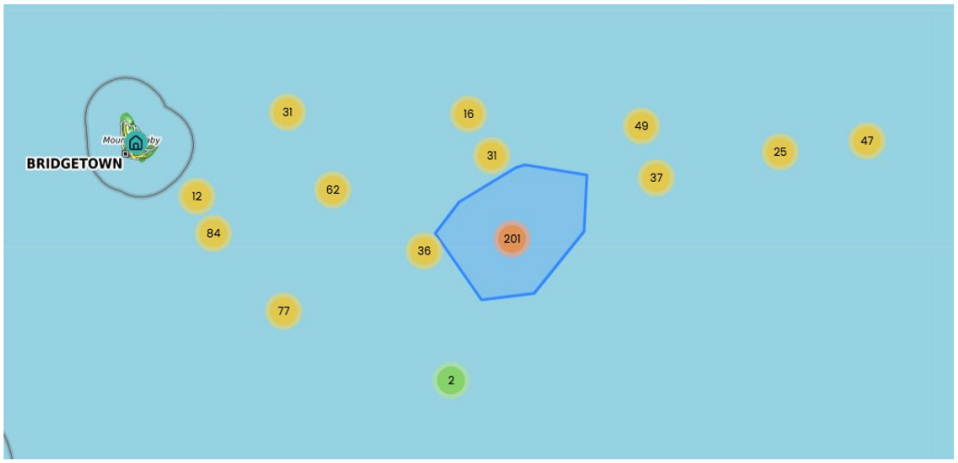

Figure 10. Visualisation of the cluster analysis indicating areas of potential fishing activity

4. DISCUSSION

The outcomes of the pilot phase of Project DigiFish have already yielded tangible benefits for the fishing industry. By leveraging cutting-edge digital technology, Barbadian fishers now have the tools to navigate the waters with greater efficiency and security. They have gained valuable insights into optimal fishing locations and techniques, targeting areas where maximum profits could be gained sustainably and possibly saving fuel. The Project underscores the importance of stakeholder engagement, actively involving fisherfolk in the development and implementation of digital solutions. Project DigiFish has also ushered in a new era of data collection and analysis for the Barbados Fisheries Division. The Division now has access to real-time data to monitor and analyse fleet behaviour, compliance monitoring and to support MSP.

Project DigiFish has great potential beyond its applications in MSP both for fisherfolk and fisheries management authorities. Boat owners can stand to gain from a pay-per-use insurance scheme, where premiums can be tailored based on actual vessel usage. Information such as duration and frequency of trips, can allow insurers to calculate premiums that align with the specific usage patterns of vessels. As it relates to the fishers, synergizing fishing activity data with oceanic climate variables can promote smart fishing practices. Oceanic climate variables such as sea surface temperature, ocean currents, chlorophyll concentration, etc. can influence the distribution and behaviour of marine species, including the target species of the longline fishers. By overlaying Catch Per Unit Effort (CPUE) with satellite images of oceanic climate variables, fishers can identify areas of favourable sea conditions which may have higher fish abundance. They can also adjust their fishing patterns depending on seasonal distribution and behaviour.

As it relates to applications in fisheries management, data generated from the project can be used to assist in the monitoring and management of FADs. By analysing fishing behaviour, fisheries management authorities can gain insights into the trends of usage of FADs. This information can then be overlayed with catch data to determine whether higher catch rates are achieved when fishing occurs in FAD-associated areas. Analysis of fishing behaviour data can also reveal seasonal variations and shifts in FAD-related activities to aid in understanding the dynamics of FAD use over time. Sea turtle conservation is another application of data generated from the project. Vessel movement data can be used to map areas where vessels frequently travel and overlap with critical sea turtle habitats thus informing on areas where specific conservation measures are needed.

Exciting activities are on the horizon for Project DigiFish. We will continue to refine our hardware and software prototypes to ensure robust, reliable, and efficient solutions that have been rigorously tested. Following a successful pilot program, the St. Vincent and the Grenadines Environmental Fund (SVGEF), a sister agency to BECT located in St. Vincent and the Grenadines, has adopted our model, and acquired 30 VMS. This demonstrates the scalability and replicability of our approach in the Caribbean region. The project also aims to start commercialization under an improved value-chain due to the implementation of a new traceability scheme. We intend to create a roadmap to scale the suite of technologies to other landing sites in Barbados and the Caribbean region. According to the Caribbean Regional Fisheries Mechanism (CRFM) statistics report in 2020, there is a potential market of 32,000 vessels that can benefit from these digital technologies. Furthermore, through the adoption of this technology the Caribbean fishing industry can use traceability as a tool to open new market possibilities that will pay an added value for sustainably sourced fish. We will also be exploring the potential for monetizing data through the development of revenue-generation models that would allow for sustenance of the initiative. Recognizing the importance of youth engagement, Project DigiFish will also implement strategies to involve young individuals, designed to inspire and educate the next generation of marine conservationists and tech innovators.

By implementing cutting-edge technology and sustainable practices in fisheries management, the DigiFish project contributes to addressing broader sustainable development objectives that encompass the well-being of both marine ecosystems and local communities. For instance, it can support efforts in achieving several of the UN Sustainable Development Goals particularly the ones outlined in *Figure 11*.

Figure 11. UN Sustainable Development Goals linked to Project DigiFish

ACKNOWLEDGEMENTS

e wish to acknowledge the support of the BECT, Export Barbados and Compete Caribbean whose financial support has been instrumental in the success of our project. We would also like to extend our heartfelt appreciation to the Barbadian fisherfolk community and Mr. Fish Inc. for their dedication and cooperation throughout the duration of the project. We further acknowledge the unwavering commitment of teams working at Pelagic Data Systems and Remora Fishing Traceability who have been indispensable in bringing this initiative to fruition.

LITERATURE CITED

Bradley, D., M. Merrifield, K. Miller, S. Lomonico, J. Wilson, & M. Gleason. 2019. Opportunities to improve fisheries management through innovative technology and advanced data systems. *Fish and Fisheries* 20 (3): 564-583.

FAO, Duke University, & WorldFish. 2023. Illuminating Hidden Harvests – The contributions of small-scale fisheries to sustainable development. Rome. https://doi.org/10.4060/cc4576en.

Gill, D, H.A. Oxenford, R.A. Turner, & P. W. Schumann. 2019. Making the most of data-poor fisheries: Low-cost mapping of small island fisheries to inform policy. *Marine Policy* 101:198-207.

Hoenner, X., E. Barlian, T. Ernawati, B.D. Hardesty, D.D. Kembaren, P.J. Mous, L. Sadiyah, F. Satria, & C. Wilcox. 2022. Using anti-theft tracking devices to infer fishing vessel activity at sea. *Fisheries Research* 249: 106230. https://doi.org/10.1016/j.fishres.2022.106230.

Lowell, B., P. Mustain, K. Ortenzi, & K. Warner. 2015. One name, one fish: Why seafood names matter. Oceana Report. https://www.sciencedirect.com/science/article/abs/pii/S0308597X22004031.

Tassetti, A.N., A. Galdelli, J. Pulcinella, A. Mancini, L. Bolognini. 2022. Addressing Gaps in Small-Scale Fisheries: A Low-Cost Tracking System. *Sensors* 22(3): 839. https://doi.org/10.3390/s22030839.

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