A Technological Revolution in Montserrat's Fisheries Management and Governance: Integrating Vessel Movement and Fisheries Data for Marine Management, Spatial Planning, and Valuing Ecosystem Goods and Services

Una Revolución Tecnológica en Montserrat a la Gestión de la Pesca y Gobernabilidad: Integración de Movimiento de Losbarcos y la Pesca Marina, para la Gestión de Datos, Planificación Territorial y la Valoración de Losbienes y Servicios de Losecosistemas

Une Révolution Technologique dans la Gestion des Pêches et de la Gouvernance: Intégrer le Mouvement des Navires et de la Pêche Maritime, de Gestion des Données pour L'aménagement du Territoire et de Valorisation de Biens et Services des Écosystèmes

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ABSTRACT

Knowledge of spatial distribution and intensity of fishing related activities in waters under national jurisdiction for decades have been poorly understood by national fisheries authority. A Joint Nature Conservation Committee (JNCC) funded program in partnership with the Government of Montserrat makes way for the installation of SuccorfishM2M low-cost Inshore Vessel Monitoring System (I-VMS) utilizing mobile phone technology on seven (7) open deck fishing vessels < 12 meters in length. Data collected from this system is projected to provide managers and scientists with accurate and real-time information required to improve fisheries management and governance. The use of this state-of-the-art technology will also assist the fishers and policy makers manage human activities within the fishery in a sustainable and responsible way. IVMS is being adopted in Montserrat as a critical Monitoring Control and Surveillance (MCS) tool for the real-time monitor of fishing vessel activities and detecting any infringement with new and updated fisheries regulation. The project offers support to a Territory to Territory partnership between the Government of Montserrat and the Falkland Islands Government (SAERI), in developing the most appropriate data infrastructure to support marine spatial planning through the analysis of pre-existing and new accurate real time fisheries data. The outcomes delivered using this technology will inform sustainable access to fisheries policy areas, realize the development and implementation of new ocean related policies, a Marine Spatial Plan (MSP), MCS and ecosystems approach to fisheries management and governance. All these benefits will be achieved via a modest capital cost of fit for purpose technology and the engagement of the fishing communities who will buy into the objectives and benefit from the safety and security features that the IVMS technology brings.

KEYWORDS: Management, governance, data, fisheries, I-VMS

INTRODUCTION

Traditionally fisheries management and governance in Montserrat for commercially targeted species is based on catch and effort fishery dependant data which, when review have been deemed inadequate, unreliable and incomplete (Murray and Nicholas, 1998). Inaccurate fisheries and ocean resources data can result ambiguous decisions for policy makers in ocean related issues. The results can negatively impact the socio-economic benefits which can be obtained from the ocean invaluable resources.

In recent years, there are increasing concerns in Montserrat regarding the sustainability of the fish stock as there is the perception that the stock is been overfished (LST International 2007). The uncertainty of the stock can be linked to the limited knowledge and understanding of the ocean resources and its associated ecosystems services, as well as pressure been exerted on the resources directly or indirectly by natural and manmade activities (Berkes et al. 2001).

Amidst this background the UK Overseas Territory Government of Montserrat in collaboration with Joint Nature Conservation Committee (JNCC) have embarked on an ambitious self-sustaining Marine Spatial Planning (MSP) Project, aimed at improving ocean resources data management systems, knowledge and understand of the spatial distribution and characteristics of its commercial inshore fisheries activities in waters under national jurisdiction in the future (Figure 1).

The Fisheries Unit technical team have identified a robust system that can fill the gaps to support future management, governance and sustainable utilization of its ocean resources under national jurisdiction. (Hart et al. 2001).

The project partners have adopted SUCCORFISHM2M Inshore Vessel Monitoring Systems (IVSM) as the data gathering tool to develop an all-inclusive representation of the spatial relationship between commercial fisheries activities and the ocean ecosystems goods and services. In the initial phase, the project will fit seven (7) open deck fishing vessels < 12 meters in length with the solar powered I-VMS.

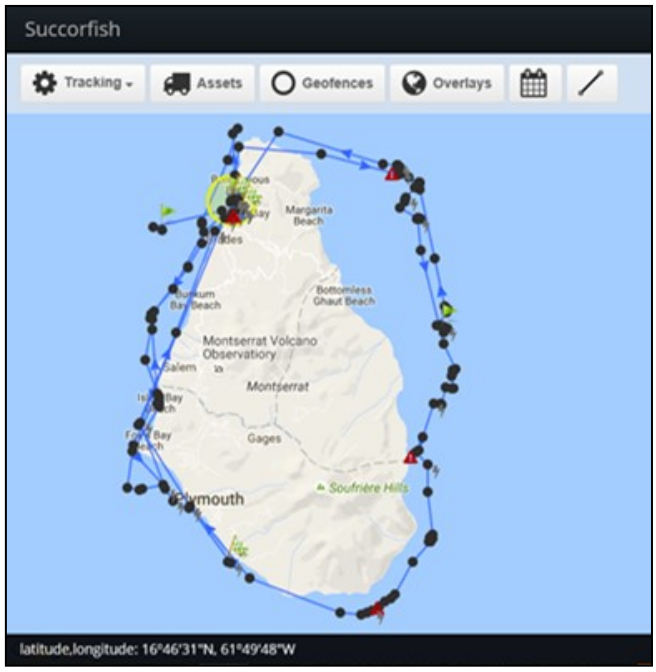

Figure 1. SUCCORFISHM2M Inshore Vessel Monitoring Systems (IVSM).

Objectives of Introducing IVMS as a Data Management Tool

i) To make available sound scientific information for the development and implementation of new policies to support MSP,
ii) To develop a fully documented fishery, while exploring the opportunity for new fishing grounds,
iii) To correlate and improve accuracy of fishing activities, including catch, effort and biological data to support policy decisions, and
iv) To obtain better understanding, knowledge and the opportunities of the key fishing grounds.

What is IVMS

I-VSM is a low-cost monitoring communication system utilizing mobile phone network, that will provide the Government with accurate and real-time information of local fishing vessel actives in waters under national jurisdiction (FAO 1998). The system is a fit and forget solution for fishermen on small open boats (Figure 2).

Figure 2. The I-VMS system.

Benefits of IVMS

i) It provides real-time remote vessel monitoring and accurate linkage of catch, effort and biological fisheries data will provide the foundation for Montserrat to meet its international obligation in ocean resources governance and management.
ii) Supporting the Territory to Territory (T2T) partnership between the Falkland Islands Government Institute (SAERI) and the Government of Montserrat (GoM) to transfer knowledge and skills from the South Atlantic to Montserrat. This project will focus on improved information management systems, data handling and Marine Spatial Planning (MSP).
iii) Catch entries that were previously recorded manually on paper can now be digitally logged and submitted online in real time, and
iv) Identify the key fishing ground that are most valuable to fishers.

METHODOLOGY

Data processing was carried out in R and ArcGIS. Vessel position, speed and heading were recorded by a succorfish IVMS unit every 15 minutes. Catch data was collected by independent shore based data collectors at the time of landing. Catch data had been compiled for a single vessel from September to October, and each day's fishing trip was allocated an individual unique trip ID number.

The IVMS data for this vessel during this time was then extracted, and individual fishing trips were identified. It was possible to identify the beginning of a trip by when the vessel left it's mooring, based on both the reported vessel speed and location (a speed > 5knots following successive reports of < 0.5 knots from the mooring location). All pings occurring between this event and the vessels subsequent return to its mooring were identified as a single daily fishing trip, and were allocated the appropriate trip ID number corresponding to that date within the catch data.

Reported vessel speed was then used to differentiate fishing activity from transit to, from and between grounds within each fishing trip. In this example, a speed threshold of 4 knots was used (although with a larger data set a higher confidence data driven speed threshold will be identifiable, based upon the frequency of different reported speeds-(Figure 3), with speeds more than this threshold assumed to be transit between grounds. Speeds below 4 knots were assumed to reflect a vessel actively involved in the fishing activity (hauling/shooting gear). Figure 3 provides data driven identification of fishing speed thresholds. (source http://archive.nafo.int/open/sc/2013/scr13-001.pdf.)

The catch data for each trip was then divided equally amongst those IVMS pings that were linked to the corresponding trip ID number and had reported speeds of less than 4 knots. These IVMS points were aggregated across a 0.0025 decimal degree grid and the catches in each grip cell were summed to show the total catch for each of the main target species within each grid cell. Four main commercial fish species (Queen triggerfish, Red Hind, Doctor Fish and Blue Tang) were selected for the correlation with the IVMS data (Figure 4).

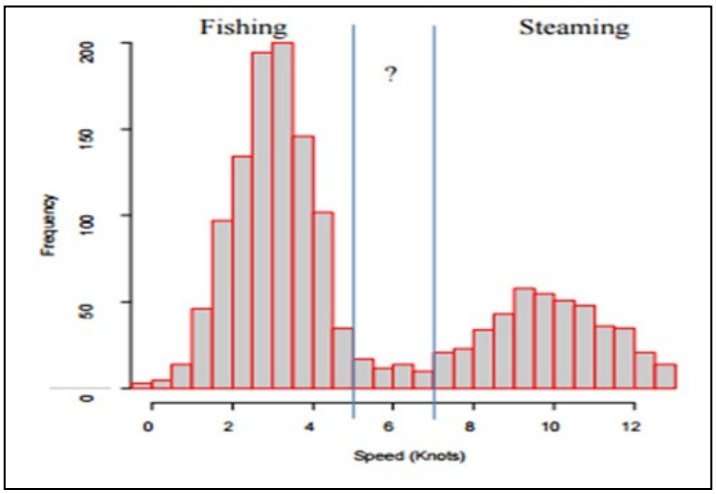

Figure 3. Hypothesized frequency histogram of speed distributions from VMS polling data.

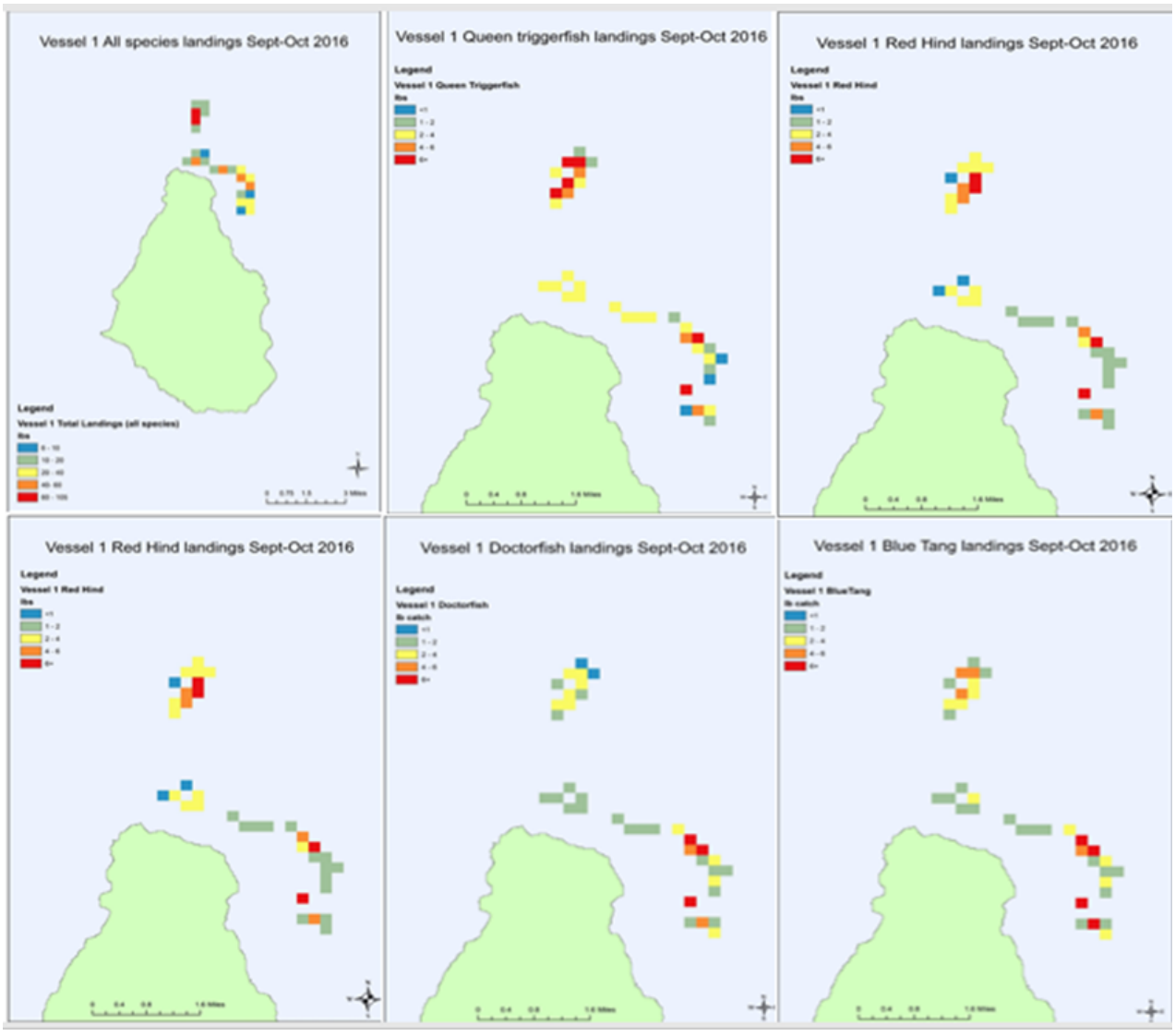

Figure 4: Correlation between selected fish species and IVMS data.

Limitations/Future Work/Benefits

A very small amount of data was analysed in this initial demonstrative example. In future, the analysis will take place with a much larger quantity of data over a longer period, and will include the variety of different fishing gears active in the Montserrat fleet. Further work will need to take place to identify the various speed thresholds for these different types of fishing activity to be able to separate the activity from vessel transit movements. This will need to use a combination of a data driven approach, along with expert knowledge from industry participants.

Data gathered over a longer period will enable the analysis of the spatial dynamics of the fishery; how the distribution of activity is changing, between seasons and over time. It will also allow investigation of the response of the local fishing fleet to short term environmental events, such as hurricanes.

FINDINGS

Catch

Analysis of the catch and effort data recorded confirmed that there was critical missing information when correlating it with the IVMS data, especially on the weekends.

Effort

The current data collection regime doesn't include a direct metric for fishing effort. In static gear fisheries, this is a function of quantity of gear deployed and its soak time. In future, the project will seek to establish effort levels within the fishery, which will enable the calculation of catch per unit effort (CPUE). CPUE is an indirect measure of the abundance of the target species, and trends in CPUE can be a useful indicator of changes in the abundance of target species.

Economic Data

Analysis of longer time series of data will allow for the identification of the core areas which support the economic activity of the Montserrat fleet. By incorporating economic data about the values of the different species present in the catch it will be possible to make detailed maps of fisheries value, which can then be used to inform marine spatial planning and ensure that the impacts of plans on fishing activity can be minimised.

Spatial Resolution

More work is still to be done on the appropriate resolution for aggregating and gridding the data for Montserrat's fisheries. 0.05 decimal degree cell resolutions have typically been used in satellite VMS analysis, however, this is based on a position polling frequency of 2 hours. With the Succorfish SC2 units we have much more frequent reporting (due to lower transmission costs), and the ability to map fisheries at a much finer scale.

However, value maps produced at too fine a spatial resolution may reveal too much commercial information, which could disadvantage certain industry participants, and so an appropriate balance needs to be struck through dialogue with the fishing community, balancing their needs as a competitive industry with those of marine spatial planners.

CONCLUSIONS

Management have recognized that the implementation of IVMS is a highly effective management, governance, and enforcement tool which will improve health and wealth of the ocean resources. The data collected and analysed will improved knowledge and understanding of the spatial distribution native and non-invasive (lionfish) fish species, the socio-economic benefits of the fisheries sector, core high valued fishing areas, and evidence based data to support future decision making process in Marine Spatial Planning.

Based on the findings of the analysis, the Government of Montserrat must improve capacity, accuracy and consistency in its fisheries data collection and management systems, to better support future ocean-related decisions.

In addition, adapting addition supporting IVMS technologically advanced equipment such as, Radio Frequency Identification (RFID) and specially adapted RFID tag to put an actual fix on fishing gears, Succorfish Catch App, will provide management authority and fishers with a complete and up-to-date digital diary of critical fisheries and environmental data.

It is envisioned that in the future evidence based data obtained from the new equipment will realize the benefits of:

i) A fully documented evidence based fisheries,
ii) Development and enactment new and updated oceans related legislation and policies,
iii) Improving the accuracy and reliability of fisheries data infrastructure governance systems,
iv) Ensure that GoM meet its international legal obligations in developing and implementing National Plan of Action to prevent, deter, and Eliminate Illegal, Unreported and Unregulated Fishing (NPOA−IUU),
v) Real-time monitoring of local fishing vessel activities and identifying,
vi) Monitoring Control and Surveillance (MCS)
vii) Improving the health and wealth of the oceans r sources to support livelihoods,
viii) Improve safety of life at sea,
ix) Identification of core value fishing areas,
x) A comprehensive socio-economic valuation of the fisheries sector in Montserrat, and
xi) Integrating vessel movement and evidence based fisheries data as a governance tool to support the MSP component of the T2T partnership project, http://jncc.defra.gov.uk/page-7338-theme=textonly.

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