Project Report

Improving Fisheries Sustainability in Belize by Linking Electronic Traceability to Fishery Visualization and Simulation Tools that Enable Data-Informed Adaptive Management

Traceability:

The Tally electronic traceability system developed by ThisFish captures specific product data collected at the National Fishermen Producers Cooperative Society Ltd ('National'). This is used to track product through the supply chain to; a) reduce operational costs by modernising administrative processes; and b) pave the way towards opening new markets.

However, Tally also provides an efficient and accurate means of gathering data capable of meeting a third objective; to create a data-rich fishery that supports effective co-management and preservation of stocks. The challenge was to develop a system capable of utilizing data from the Tally system to support effective fisheries management in Belize. Numerous consultations with multiple fishery stakeholders and experts resulted in consensus that an ability to visualize the current state of the fishery, for experts and non-experts alike, would be the most effective way to aid fishery managers, fishermen and fish processors in understanding the current state of the fishery. Likewise, a visual approach to simulating projected future outcomes for the fishery based on management decisions made today was needed to sensitize and generate consensus and support among stakeholders for complying with resultant harvest control recommendations.

Adaptive Management Framework (AMF):

Data collection and analysis of landings data is fundamental to good science-based fisheries management. Since 2011, a consortium of scientists and marine protected area (MPA) managers from the Belize Fisheries Department, academic institutions (UCSB, University of Miami) and non-governmental organizations (TNC, WCS, EDF, TIDE), collaborated over several years to develop a national-level multi-indicator Adaptive Management Framework (AMF) for commercial fisheries in Belize that collates and analyses data from multiple data streams, and prescribes management actions in response to changes in fishery Performance Indicators (PIs) in comparison to preselected Target Reference Points (TRPs) and Limit Reference Points (LRPs) over time. However, there were a number of social, technological, economic and legislative obstacles stalling national level implementation of the AMF in Belize.

After several years without significant further progress, TNC, after seeing the potential utility of Tally data for fisheries management, aimed to remobilise adoption of the AMF by pioneering a new approach that builds on TNC's existing partnerships with fishery stakeholders. TNC's strategy was therefore to gain consensus among decision-makers for national implementation of the AMF, by creating a cooperative-level demonstration of how data-informed adaptive management of Belize's lobster and conch fisheries can work.

Key Data Elements (KDEs):

The next step was therefore to create a digital reporting function within Tally that would satisfy the landings data collection requirements of the Belize Fisheries Department (BFD) and provide the best suite of indicators possible to feed into an AMF dashboard with visualization and simulation tools.

TNC drew from multiple sources, including the fisheries laws of Belize, scientific literature, and signed agreements Belize has made to national and international fishery management initiatives to determine the most important Key Data Elements (KDEs) to feed into a downloadable CSV/Excel report generated by Tally (known at the BFD Report function). The suite of KDEs selected (agreed upon between National, BFD and TNC as the most important to feed into the fishery visualisation and simulation tools) aim to enable BFD to meet its regional level stock assessment commitments under agreements made with OSPESCA, particularly the MARPLESCA Plan and Regulation OSP 02-10.

Data-informed Fisheries Management

The following step was therefore to find a suitable provider with the appropriate technological capabilities and background experience to develop the visualization and simulation tools. Through a competitive RfP bidding process, Vericatch Solutions Inc. were selected for this task, and were contracted to execute the deliverables detailed in the RfP. After multiple discussions with experts involved in the original consortium that developed the Belize fisheries AMF concept, it was apparent that different areas of expertise were required to develop the visualization and simulation tools respectively. MER Consultants therefore partnered with Vericatch to develop the simulation tools, as MER comprise fisheries modelling experts that were directly involved in the development of the AMF concept for Belize.

Data Sharing Agreement:

In order to populate the visualization and simulation tools with real landings data from National, a Data Sharing Agreement (DSA) was created and signed by National (the owner of the data), TNC and Vericatch to clearly define the liberties and limitations of the use the data by each Paryty. This DSA allows TNC and Vericatch to use any and all KDEs within the Tally BFD Report function strictly and solely for the development and subsequent operation of the visualization and simulations tools, as defined in the Description of Services from Contract No. [CBELIZE-060719] between Vericatch and TNC.

Vericatch Contract CBELIZ060719 implementation

Product A: Workplan

A workplan was agreed between TNC, Vericatch and MER Consultants for timeline and schedule of activities to execute to accomplish the deliverables of this project. This workplan was adhered to throughout the project duration, with any challenges being discussed in timely manner so as to ensure the smooth continuance of the project.

Products B-1 and B-2: Development of visualization tool as a module of FisheriesApp, integrate with Tally via API

Vericatch worked with ThisFish to develop an Application Program Interface (API) to enable landings data in Tally to integrate with Vericatch's FisheriesApp platform, which was used as the basis for development of the visualization tools. This API is located at https://fisheriesapp.com/docs/api/v1.

The following data fields are collected and available through the Tally platform:

- Date
- Fisherman Name
- Vessel Name
- Product Type
- Total Weight (in lbs)
- Zone Fished
- Gear Type
- Effort (in sea days)

The above data is sent through the API from Tally to FisheriesApp on a recurring basis under the control of National. Vericatch subsequently developed the following visualization tools in FisheriesApp:

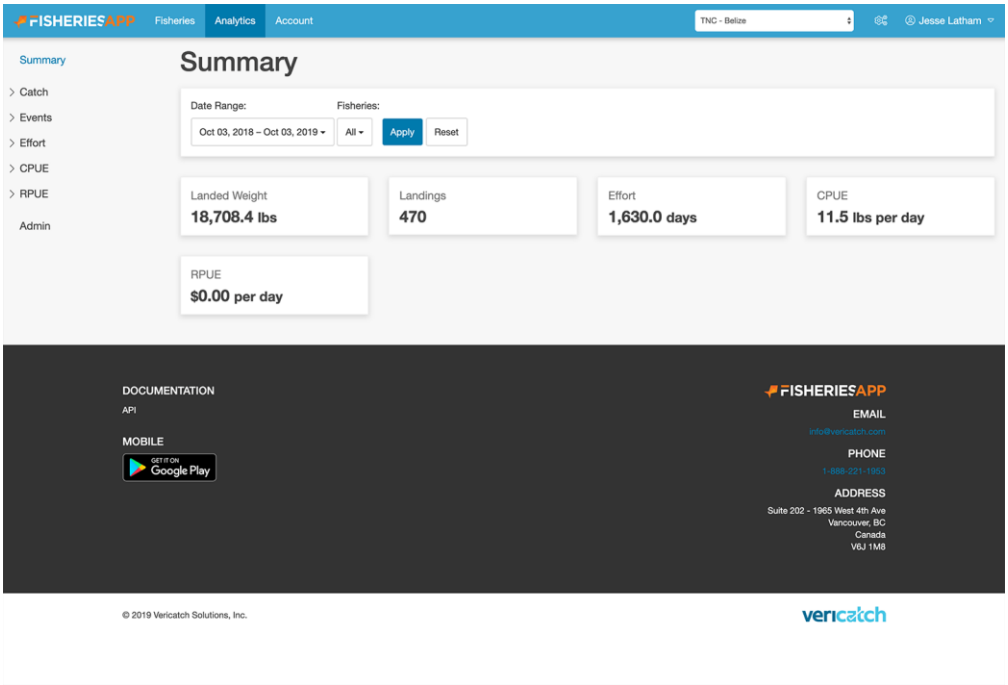
1) A map showing total catch (lbs/kgs) and CPUE across each of the designated fishing zones
2) Graphs and other visualization tools displaying the following:

    - *Total monthly biomass landed (lbs/kgs) per zone*
    - *Total biomass (lbs/kgs) per zone per season (individual zones + all zones combined)*
    - *Total number of landing events per month per zone*
    - *Total number of landing events per zone per season*
    - *Total monthly effort (days at sea) per zone*
    - *Mean monthly effort (days at sea) per trip per zone*
    - *Total effort (days at sea) per zone per season (individual zones + all zones combined)*
    - *Mean effort (days at sea) per trip per zone (individual zones + all zones combined)*
    - *Mean monthly CPUE (lbs/kgs per day at sea + lbs per trip) per zone*
    - *Mean CPUE (lbs/kgs per day) per season*
    - *Mean daily RPUE ($BZ/$US per day at sea) per zone*
    - *Total monthly value ($BZ/$US per month) per zone*
    - *Mean value per trip ($BZ/$US per trip) per zone*

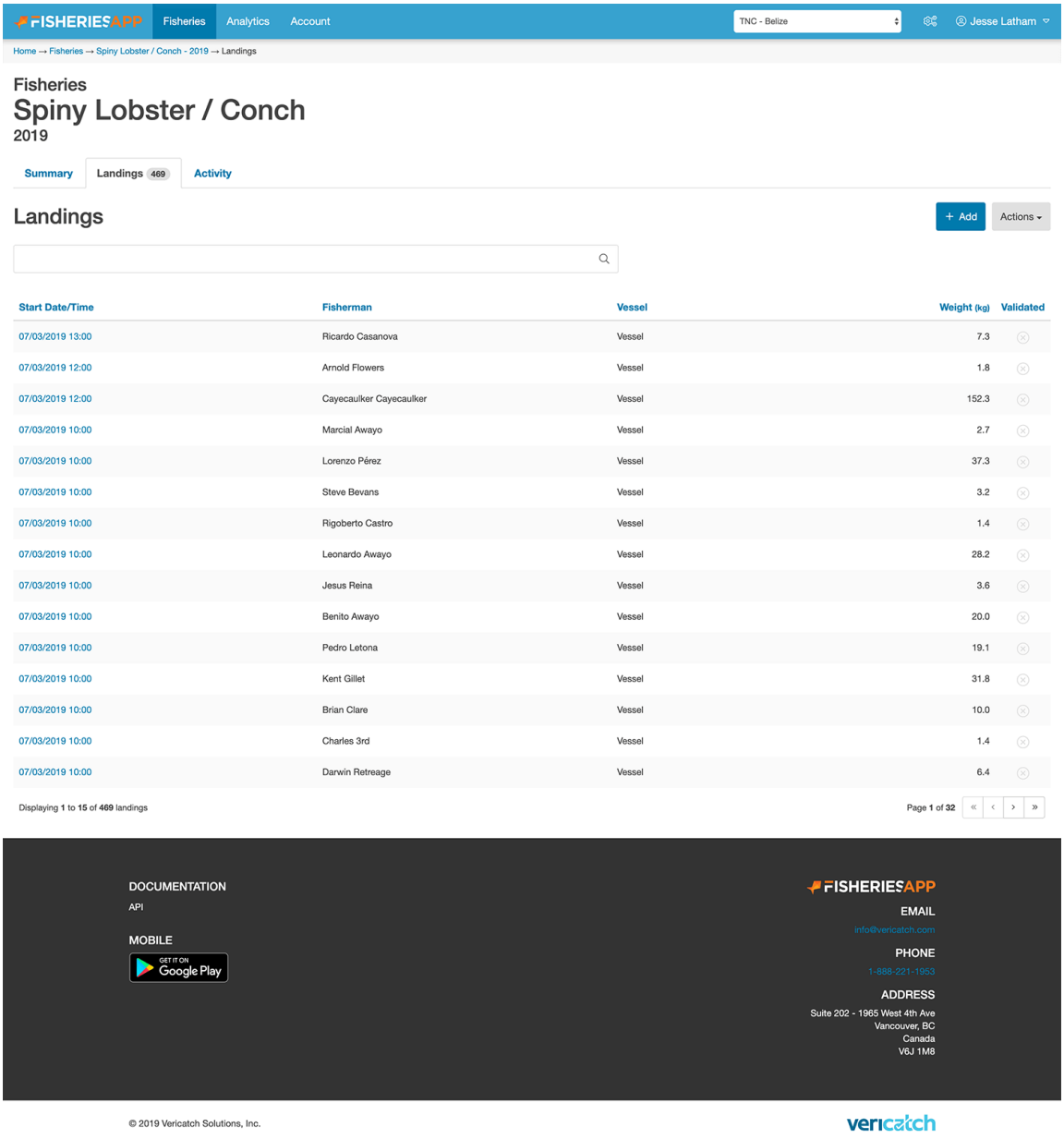
3) A table displaying the data used to generate the graphs and maps.

Screenshot examples of visualization tools:

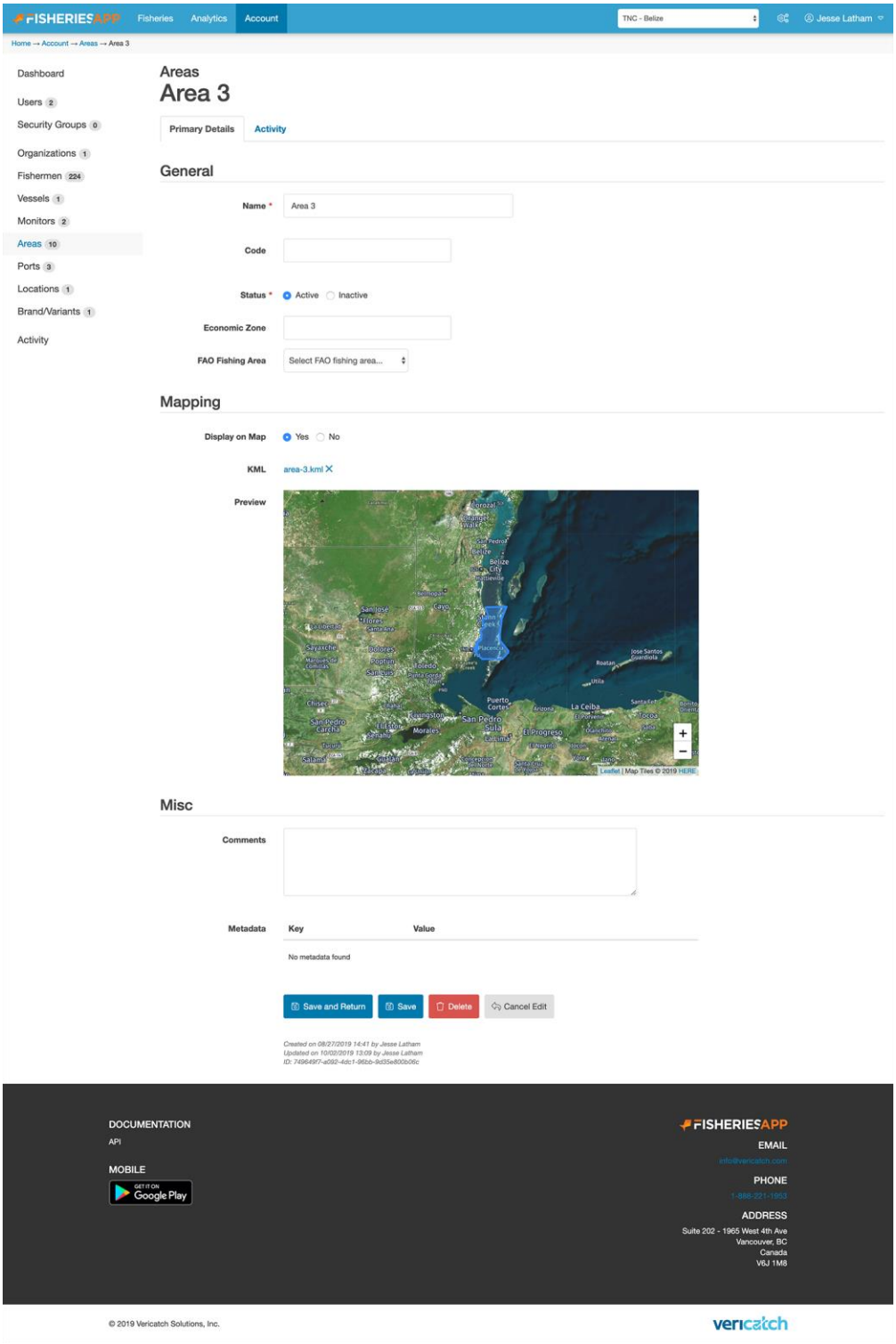
- Summary statistics:



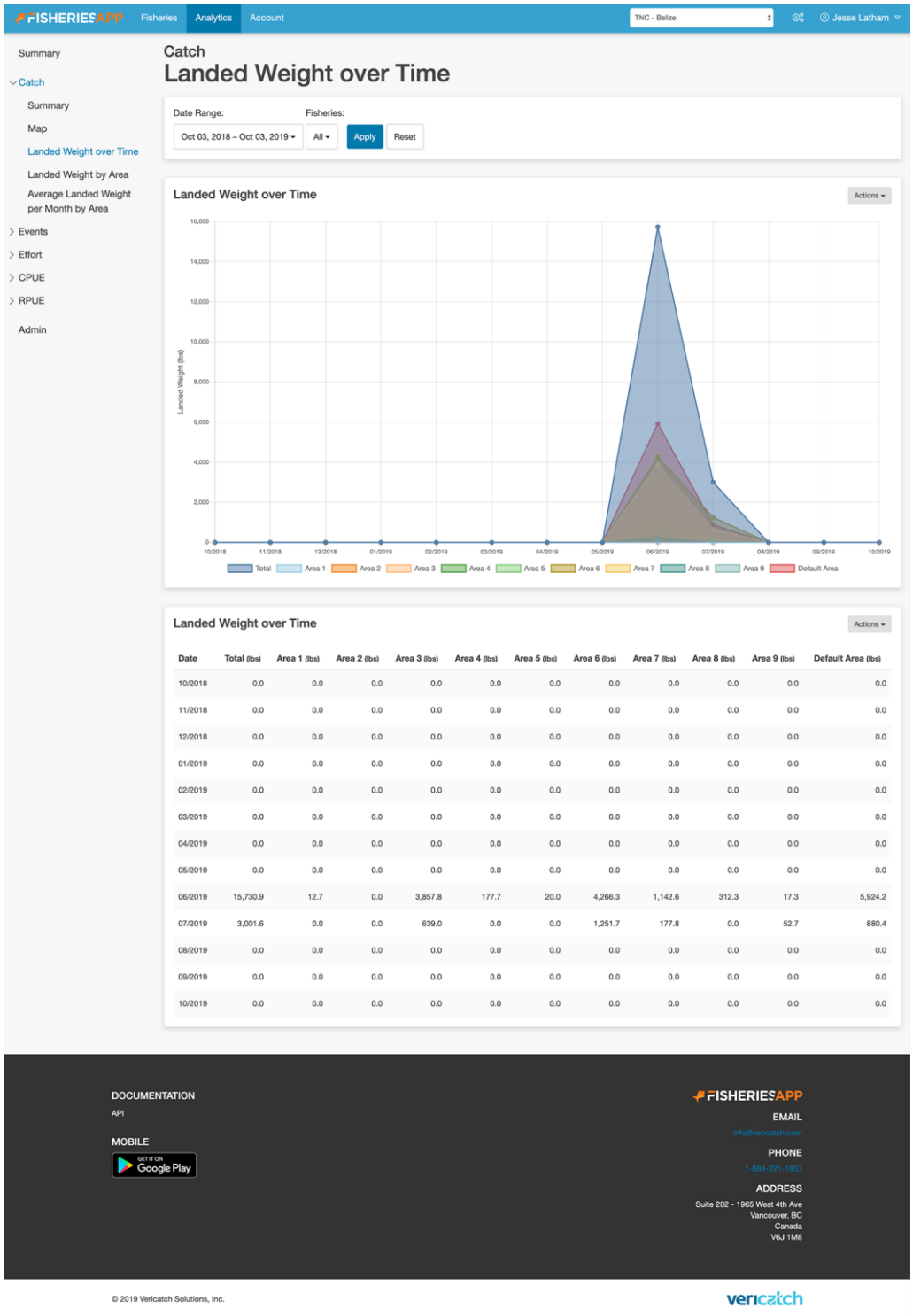
- List view of a single page of Landings as provided by the Tally platform:



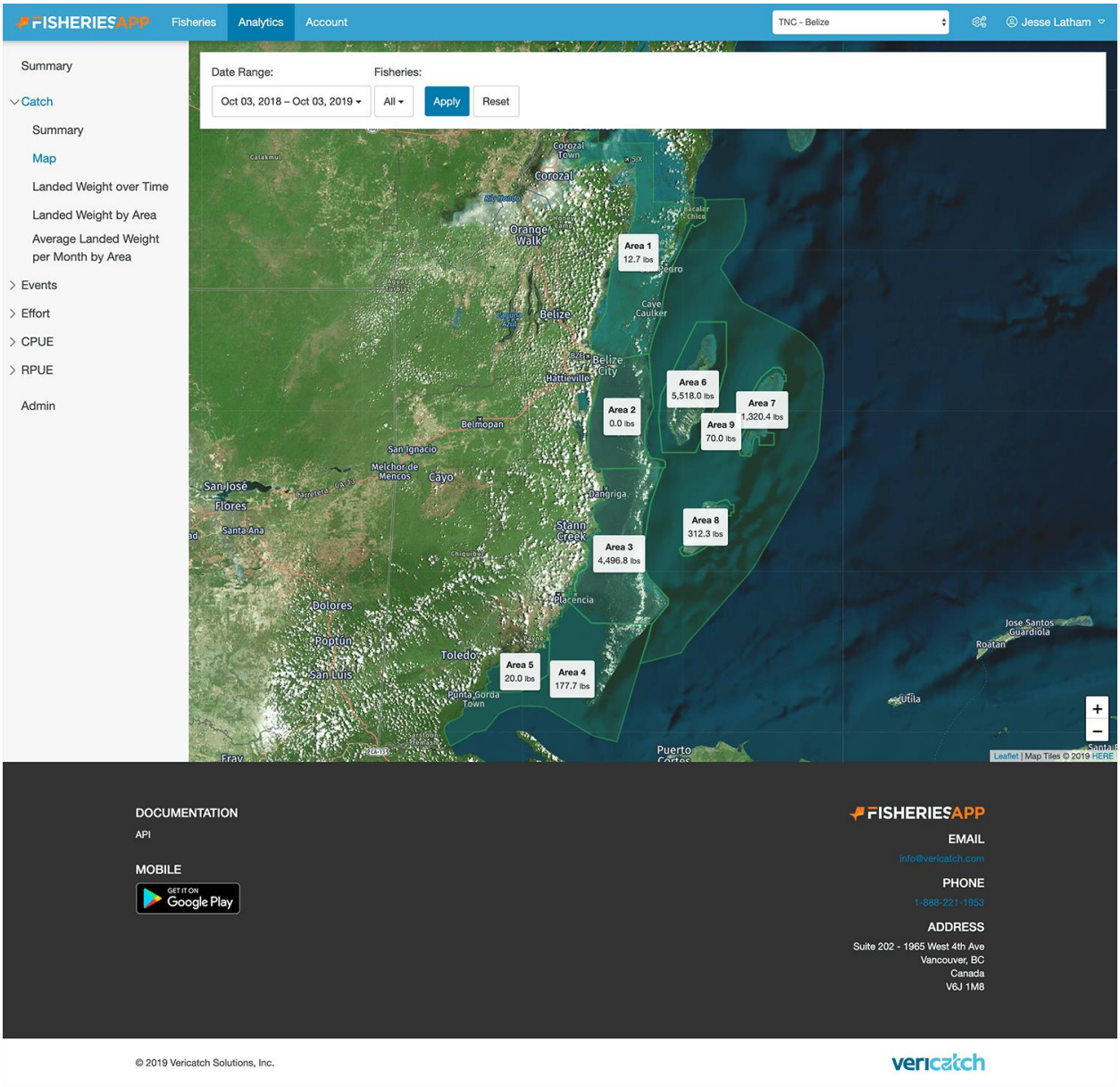
- Area configuration screen with a single shapefile overlay:



- Screen showing a time series by area of landed catch over time:



- Map of Belize region with accurate shapefile overlays and total landed catch displayed
- Area coloring, line weights, opacity are configurable at a global level or individual area level



DOCUMENTATION

API

MOBILE

GET IT ON Google Play

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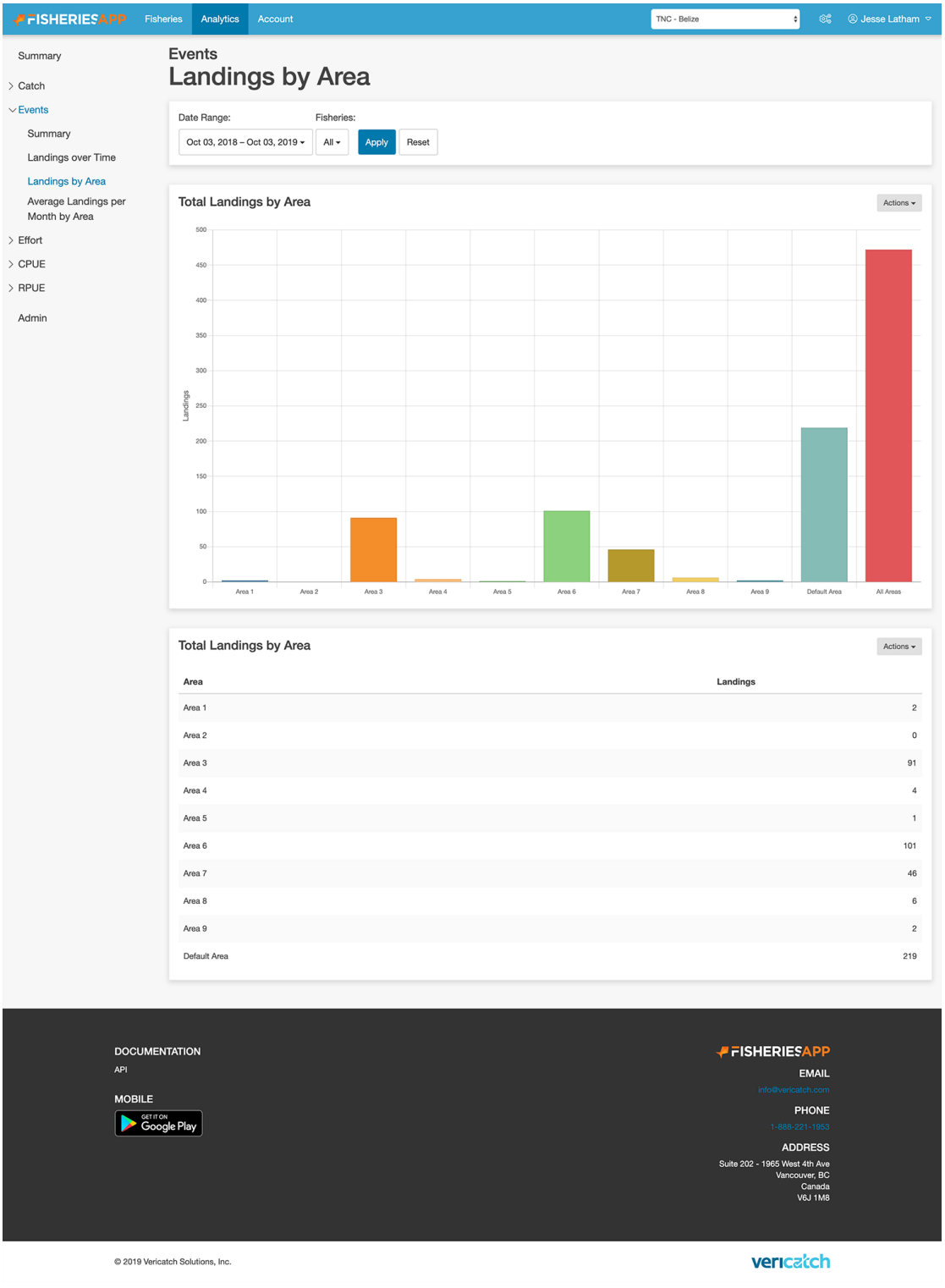
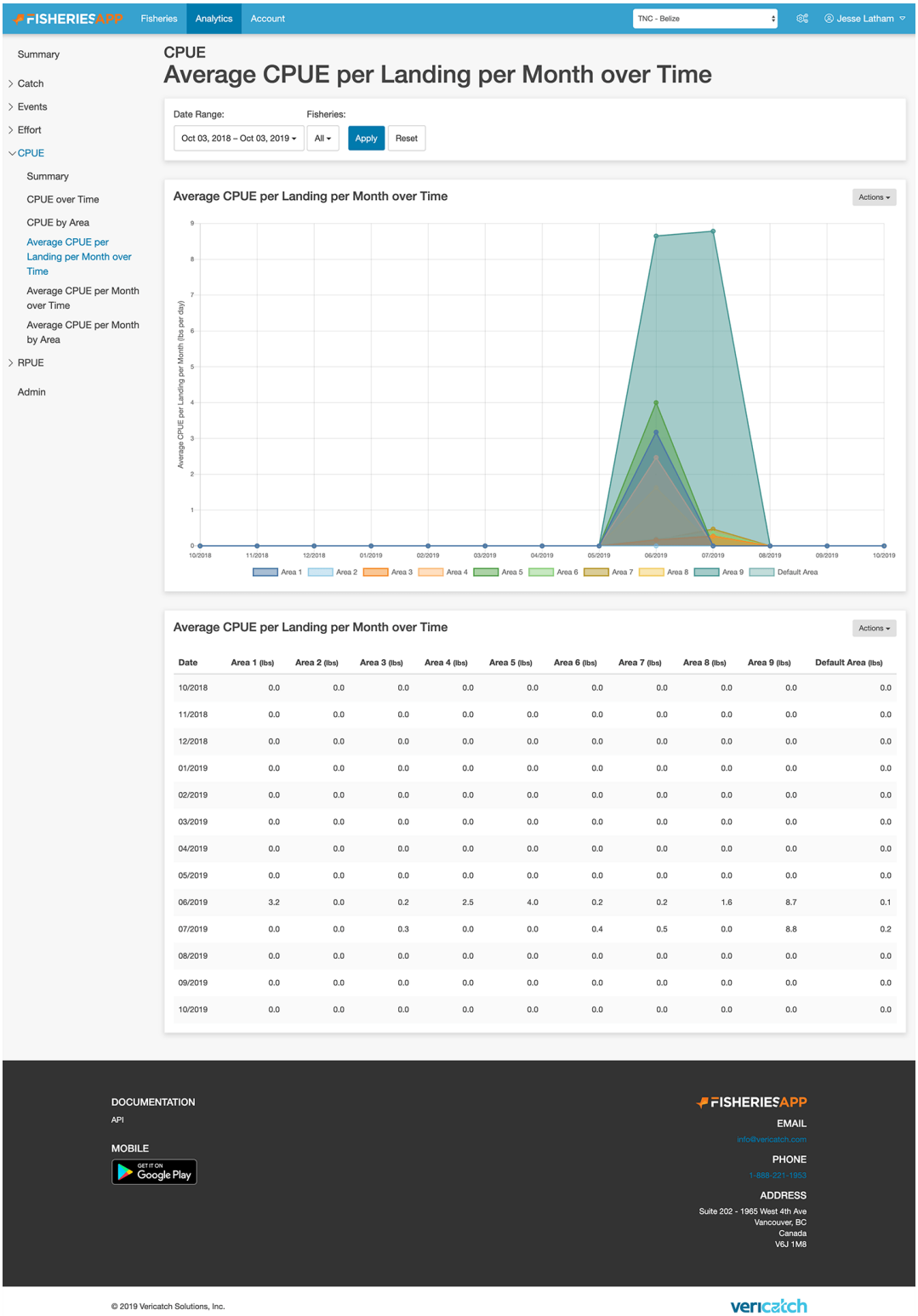
vericatch

- Landings By Area - Shows Landings by Area chart and associated data table

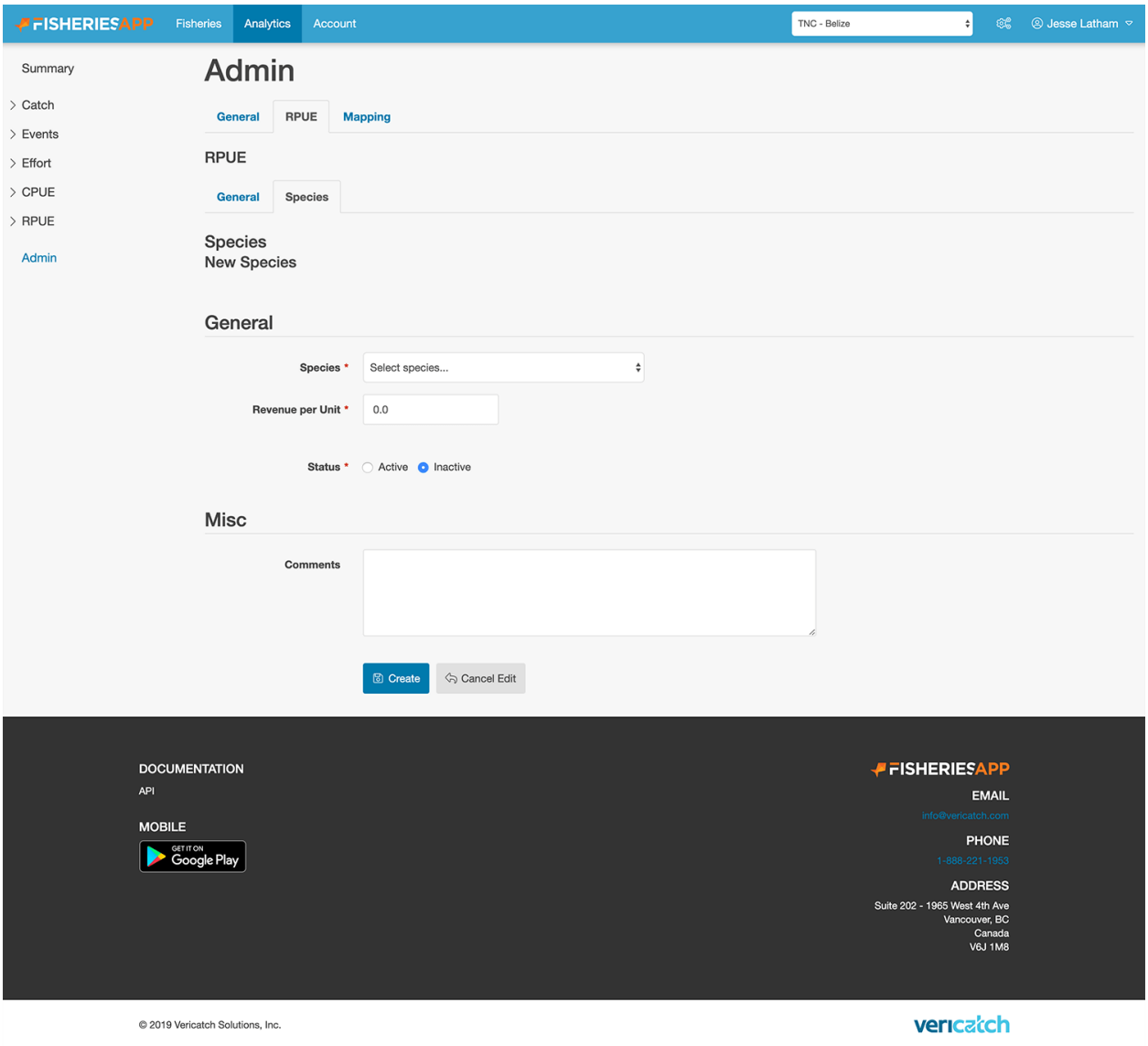


- CPUE - Average Per Landing Per Month Over Time

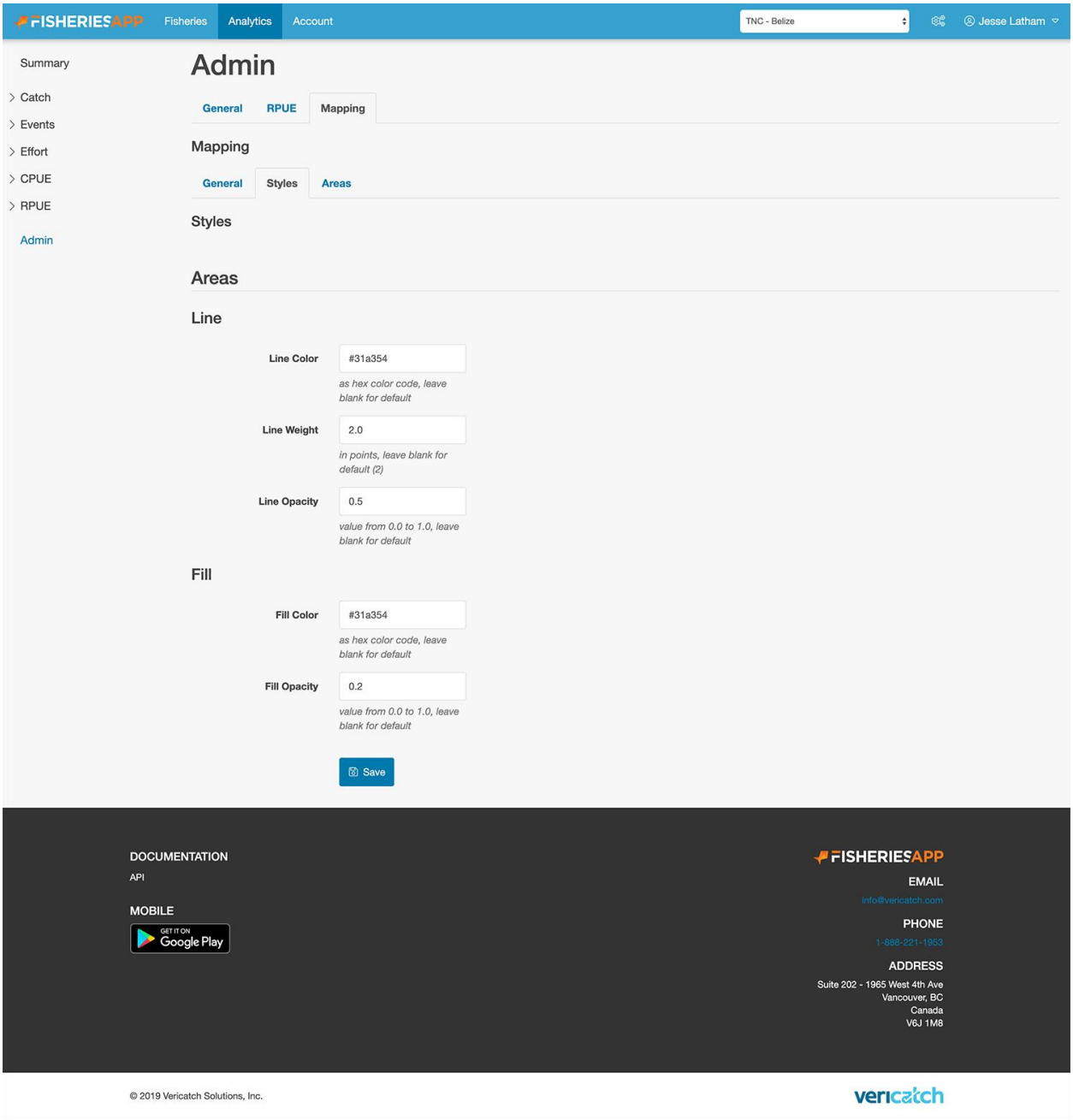


Date	Area 1 (lbs)	Area 2 (lbs)	Area 3 (lbs)	Area 4 (lbs)	Area 5 (lbs)	Area 6 (lbs)	Area 7 (lbs)	Area 8 (lbs)	Area 9 (lbs)	Default Area (lbs)
10/2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11/2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12/2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01/2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02/2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03/2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04/2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05/2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06/2019	3.2	0.0	0.2	2.5	4.0	0.2	0.2	1.6	8.7	0.1
07/2019	0.0	0.0	0.3	0.0	0.0	0.4	0.5	0.0	8.8	0.2
08/2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09/2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10/2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

- TNC-Belize - FisheriesApp - Analytics - Admin - Species per Unit Revenue Config - 20191003
    - Configuration screen showing how to specify a value per unit (BZ$) to a particular species from a fishery
    - One or more need to be defined or order to display any relevant RPUE KPIs or charts/data tables



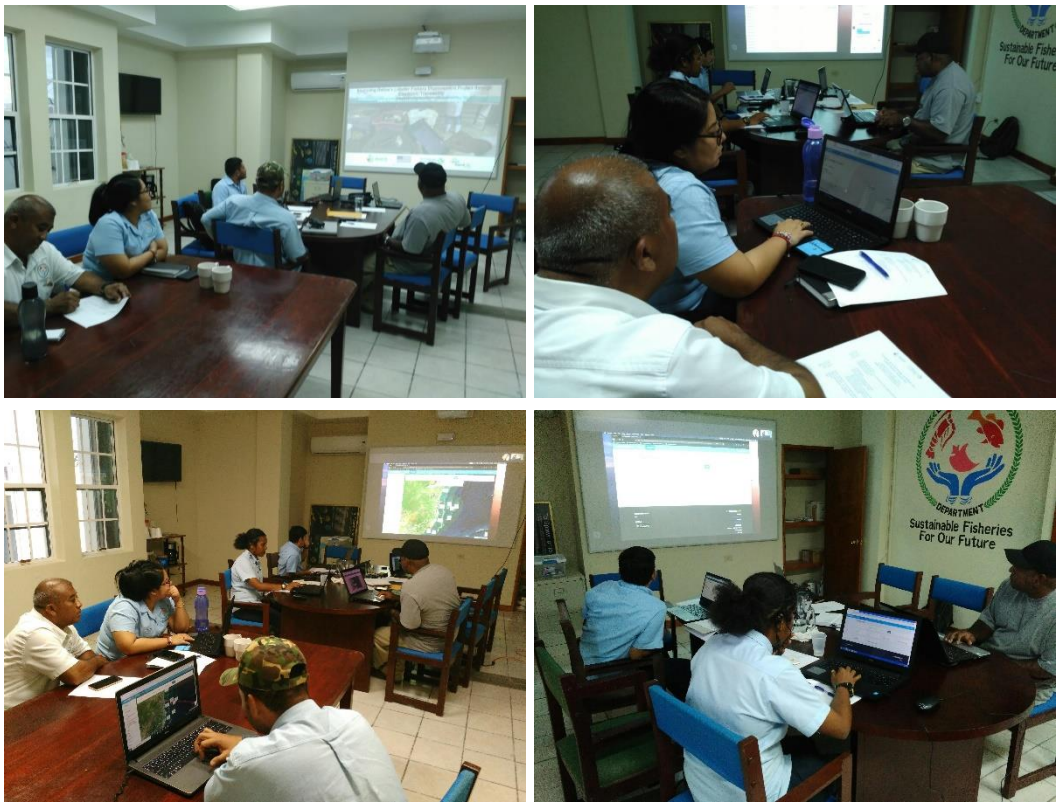
- Admin - Map Styling Configuration screen showing global styling configuration options for maps within the Analytics area
    - Individual area styling options found underneath the Areas tab



Product B-3. Vericatch FisheriesApp visualisation tool training –

On Thursday 23rd January 2020, TNC Belize held a training in partnership with technical staff from Vericatch Solutions Inc. at the Belize Fisheries Department. The purpose of this training was to introduce staff from the Belize Fisheries Department and from National Fishermen Cooperative Society Ltd. ('National') to the fisheries visualisation tool developed by TNC and Vericatch, that links to data outputs from the Tally electronic traceability system installed at National. The training was attended by 6 members of the Belize Fisheries Department, and one member of National.

This system now provides managers and industry alike with user-friendly tools that enable real time analysis and reporting of national level landings data. Although currently only a single-coop-level demonstration, this approach was successful in sensitizing government and industry representatives to the potential of this data-linked management tool to provide transparent, data-informed fisheries management at a national level if traceability linked to FisheriesApp is replicated across all producers in the country. This resulted in strong endorsement from senior Fisheries Officer Mauro Gongora for expansion of the project, with plans for integrating the private seafood companies into the system in the near future. Mr Gongora stated that this represents a huge step for effective fisheries management in Belize.



Staff of the Belize Fisheries Department and National Fishermen Cooperative Society Ltd. receiving training in FisheriesApp fishery visualisation tool developed in partnership between TNC and Vericatch.

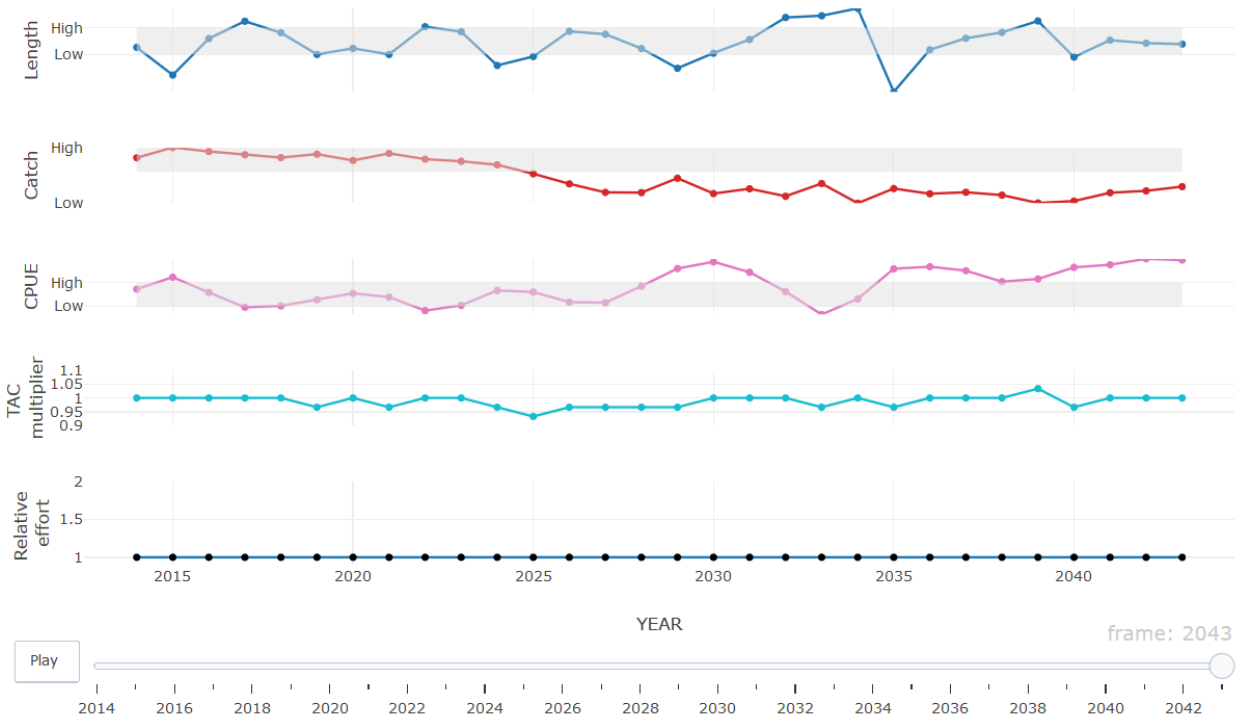
Phase 2: Development of simulation tool

MER Consultants met the revised 30th January 2020 deadline to complete development of the simulation tools that will enable users to project long term outcomes for the Belize lobster and conch fisheries based on landings data. This is a complex task involving advanced fishery modelling approaches.

The simulation tool is written as an R Shiny model which permits the easy, open source, cloud based, and free visualization of interactive tools. The underlying model that populates the input data of the Shiny app is the operating model underlying the 2016 Management Strategy Evaluation (MSE) of Belize's lobster and conch fisheries conducted by Harford et al. (2016).

This simulation software provides an essential training tool as we move into the next phase of data-informed fisheries management in Belize. While it will take time before a long enough time series has accrued in fisheries electronic traceability systems in Belize, this training tool paves the way for moving managers and the industry towards a fishery simulation approach, enabling projections on future stock status to be forecast based on management decisions made today.

The R Shiny simulation tool can be accessed online at https://harford.shinyapps.io/Belize_lobster/



Example Adaptive Management using historical time series data to project Incremental TAC adjustments in response to changes in indicators. As more data is collected over years in the Tally traceability system, projections will become increasingly more accurate, reliable and usable for management.