COMPASS – A Survey Toolkit for Marine Species Data Collection: 2017 Annual Progress Report

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Cover Photo Credit:

COMPASS website screenshot.

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Acronyms and Abbreviations

MSM	Marine Species Monitoring
QC	quality control
U.S.	United States

1. Background

The United States (U.S.) Navy identified the need for development of a survey data-collection system that fully meets U.S. Navy Marine Species Monitoring (MSM) data standards. The objectives were to streamline data-collection procedures, minimize manual data-management requirements, and increase the standardization and repeatability of data-collection efforts. In response to this need, HDR developed a survey toolkit called *COMPASS (Cetacean Observation and Marine Protected Animal Survey Software)*. *COMPASS* is designed to be an integrated survey data-collection and data-management system to facilitate work conducted during MSM surveys. HDR's survey toolkit integrates current mobile and web technologies to allow efficient real-time collection, processing, reporting, and delivery of marine species data. The final product will include a mobile platform for data collection in the field; a web portal to design, plan, and execute surveys and access data products; and a server-hosted database-management system for quality control (QC), team collaboration, and preliminary data processing/reporting.

The surveys conducted within the MSM program include a variety of data-collection scenarios and technologies. The preliminary version of the *COMPASS* system addresses the needs for the most common survey types: shore-based (theodolite), vessel-based, and aerial-based. The data-collection routines for each survey type are designed to maintain consistency with the U.S. Navy's Data Standard (developed by Naval Facilities Engineering Command Atlantic and HDR, Inc.), which specifies field names, aliases, data types, measurement units, and descriptions for data that are collected in the field. Each data-collection scenario will use some subset of fields specified in the Data Standard.

2. *COMPASS* Overview

2.1 Mobile Application

The mobile application ("app") runs on the Apple® iPad platform and is the primary interface for the collection of field data (example data collection screenshot is seen in **Figure 1**). The mobile app includes mapping capabilities for navigation and data collection, and functions in areas without network or cellular connectivity. It has the ability to display the data stream (e.g., sightings and tracklines [**Figure 2**]), relevant auxiliary data (e.g., range complex boundaries, exclusion zones, passive acoustic monitoring stations, pinnacles, etc.), and customizable base-map layers (e.g., bathymetry, ortho-imagery). Users can pan and zoom on the map, and control the visibility of data layers on the map. Users are able to search the attributes of collected data and auxiliary data, and easily reference the search results.

Customizable data fields allow users to collect data relevant to each of the survey types, including ancillary tasks (e.g., focal-follow studies, biopsy collection, satellite tagging, etc.). All data collected are stored in relational databases adhering to the U.S. Navy Data Standard.

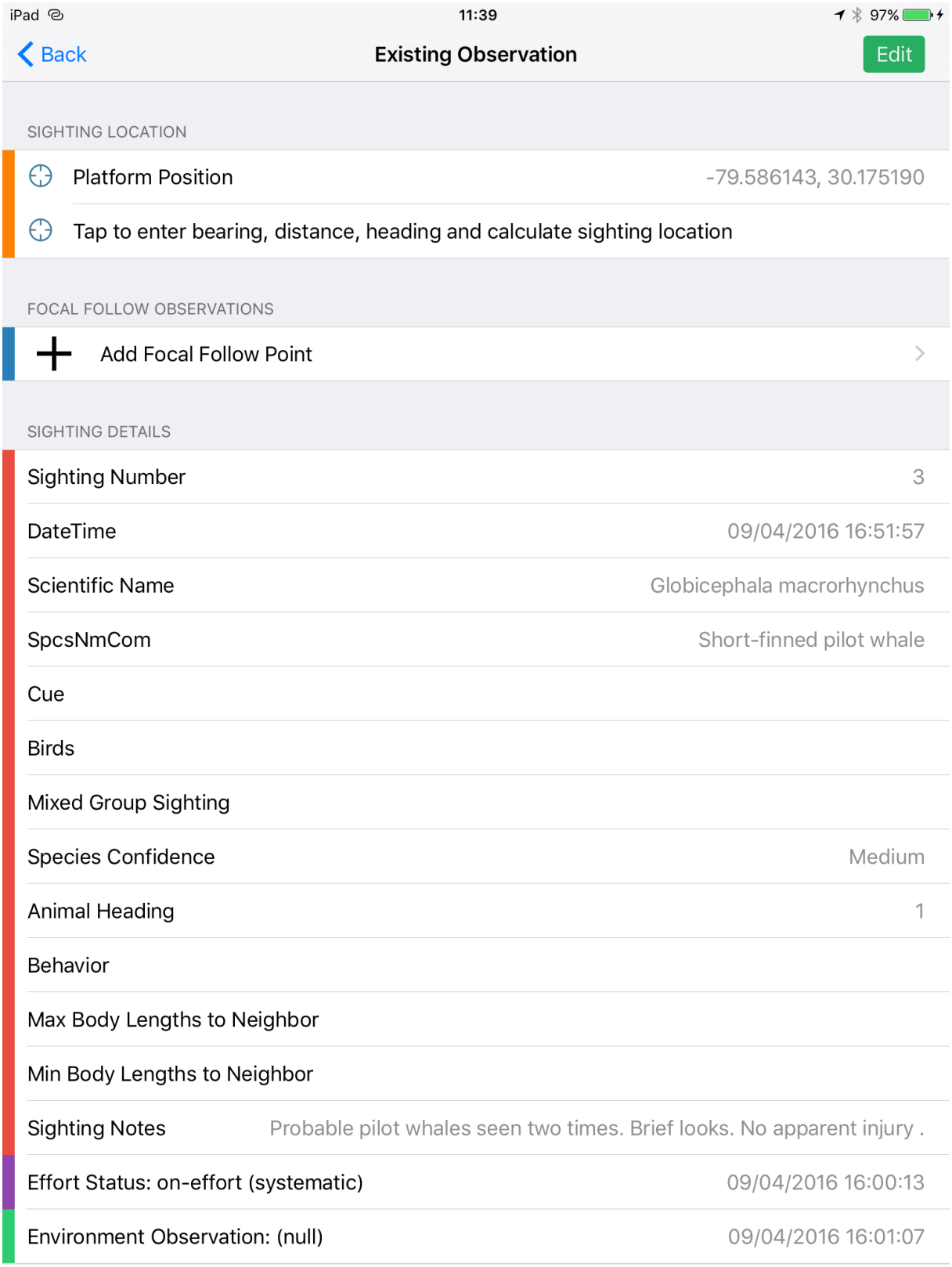

Figure1. Screenshot of the *COMPASS* field app showing data entry fields for an observation.

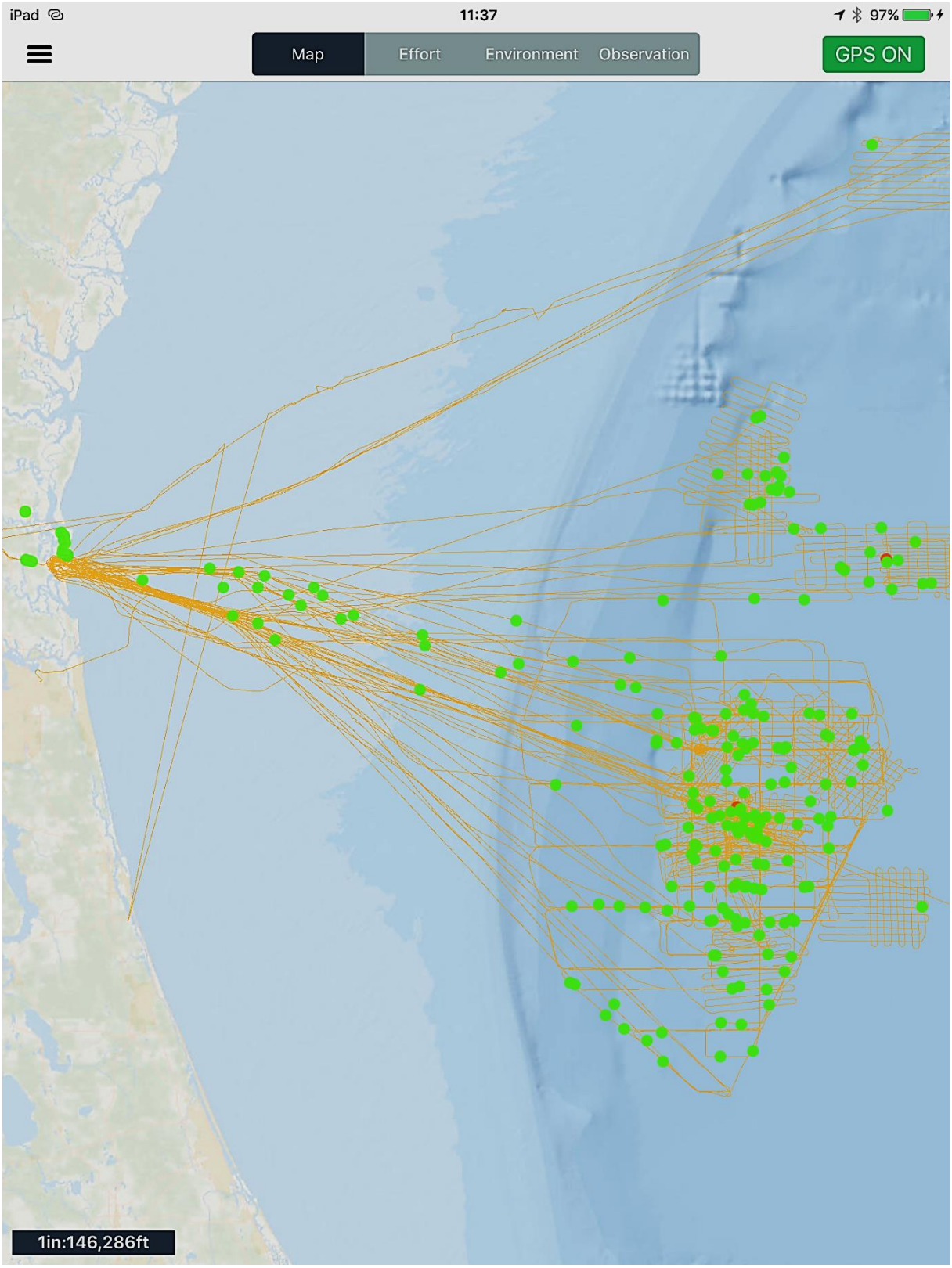

Figure 2. Screenshot from *COMPASS* field app showing the tracklines and sightings made during the Full Ship Shock Trial aerial survey efforts in summer 2016. Green dots indicate cetacean and sea turtle sightings, red dots indicate re-sightings, and orange lines are the survey tracklines flown.

Data collected with the mobile app are synchronized with a central database server via Wi-Fi, cellular data connection, or USB. Transmitting collected data as soon as possible after a survey ensures that information is archived and protected, while allowing for collaborative QC review and editing through a web-based user interface. Alternatively, data can be backed up, edited, and managed locally via direct connection with a laptop when web connectivity is unavailable.

2.2 Web-based Application

The web-based application is the central interface for the management of marine species surveys and data (**Figure 3**). It allows access from any Internet-connected computer, allowing field crews, biologists, and program managers from multiple locations to collaborate on active surveys. New users can be added easily, and authorization control will be implemented in order to designate specified users able to access different aspects of the surveys and data management.

Field crews can use the web application to perform QC checks on data uploaded from the mobile app. Accessing these data via the internet allows field crews to verify that collected data have been transmitted successfully to the server and also provides an opportunity to review as well as annotate field data from laptop computers. If Internet access is unavailable, QC checks in the field can be conducted in the mobile app.

Prior to initiating a survey, the web portal is used by survey leads to “create” a new survey, assign authorized users to a survey, and configure survey-specific information including species lists, equipment descriptions, survey ranges and platform specifics. The web portal will provide instructions for the loading of pre-built base-maps, which will be created for the most common survey areas. Pre-built base-maps will cover the instrumented U.S. Navy training ranges and other areas of interest. The web portal will also provide instructions to load any additional feature data required for the survey, including tidal data, track lines, waypoints of interest, passive acoustic mooring positions, etc.

After the survey is completed (daily or at the end of a project) and the data are synchronized with a central database server, primary access to the survey data will occur through a web-based interface. This user interface allows access to the centralized database, and facilitates QC review and editing. It allows a broader set of specified users (e.g., field crews, biologists, program managers, external clients) access to the data, while controlling access through the use of user accounts and permissions. Project managers will use the web application interface to monitor data collection and QC activity, and to export data.

3. Progress to Date

3.1 Application Development

All of the initial development has been completed for each of the survey platform types. Additional functionality has been added beyond the scoped features including customized species lists, customized symbology for map production, and many specific user requests to help facilitate ease of use in the field (e.g., heads-up map orientation; user-selected units for distance, horizontal angle, and depth). Additional development has been completed for data

outputs into multiple formats (daily summary reports, ArcGIS Map Package files, and flat table database file). The basic functionality is complete and follow-on efforts will build off the existing structure and development efforts to further enhance the interface and outputs, and to add customized functionality to facilitate ease of use for data input and output.

3.2 Field Testing and Progress in 2017

In 2016, HDR completed four months of aerial surveys to monitor the U.S. Navy's Full Ship Shock Trials that were conducted off the Atlantic coast of Florida during the summer of 2016. *COMPASS* was used for the primary survey aircraft's field observations and data management. In 2017 *COMPASS* has been used on a number of other field projects for testing and validation purposes. HDR has been using *COMPASS* for multiple vessel surveys offshore of Virginia Beach, Virginia. These small-vessel surveys focus on photographic identification, biopsy sampling, and satellite tagging of large whales. In addition to overall software stability, these efforts have been particularly useful for testing the functionality of related data for the specific field activities beyond visual detection and counting of marine species. Each biopsy and tagging attempt includes logging of position and time stamp information and other ancillary information that is essential for permit reporting.

HDR was also able to trial *COMPASS* on the 2017 National Oceanic and Atmospheric Administration Pacific Islands Fisheries Science Center Hawaiian Islands Cetacean and Ecology Assessment Survey. This project is a large-scale ship survey to determine the abundance and density of cetaceans and seabirds around the Hawaii Exclusive Economic Zone. This opportunity was beneficial for validating the ability of *COMPASS* to plot big-eye sightings and collect sighting information alongside WinCruz, a proven survey software. *COMPASS* performed as expected and a number of suggested upgrades and updates were noted for future development and improved applicability for large-scale ship surveys.

Additionally, Naval Facilities Engineering Command Atlantic used *COMPASS* for a short monitoring project around a mine neutralization exercise in 2017. Two vessels conducted simultaneous focal-follow surveys of bottlenose dolphins (*Tursiops truncatus*) before, during, and after an underwater detonation off of Virginia Beach, Virginia.

The HDR MSM data-management leads and geographic information system personnel were able to verify that the data collected, and output, by *COMPASS* were aligned with the MSM Data Standard.

3.3 Future Development

While the primary development of both the data-collection app for field survey types and the web portal is complete, user functionality needs and upgrades are being documented for future modifications and updates. Future versions of *COMPASS* will aim to support a networked version that enables multiple platforms and survey types (shore station, vessel, and aerial) to collect simultaneous data to be synchronized with the same project database. This will be useful for ship-shock monitoring so sighting information can be sent real-time via a mesh network to other devices without needing push the data manually.

HDR will continue to host projects on its server and support project setup and troubleshooting until follow-on development needs are identified.

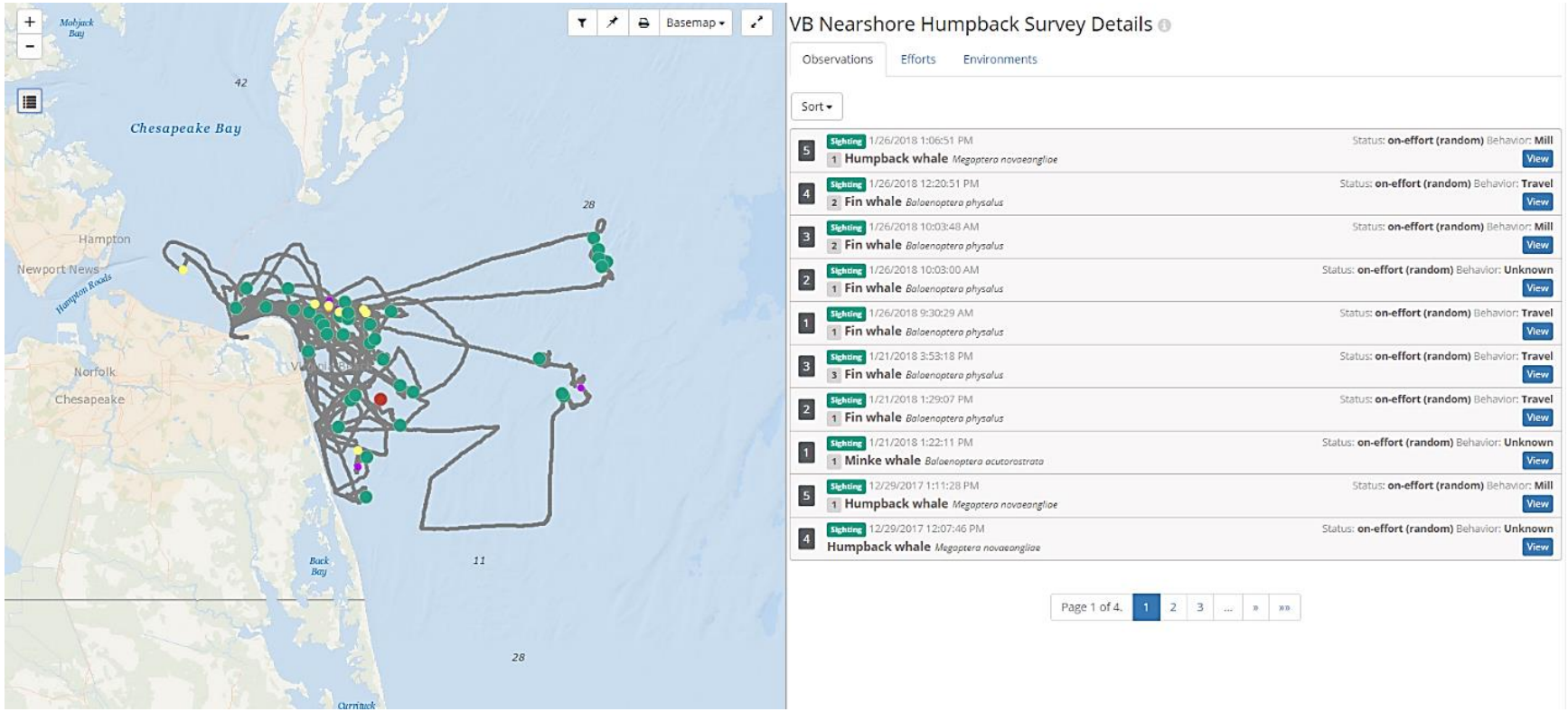

Figure 3. Screenshot from *COMPASS* web portal. The window on the left shows survey track and sighing data from a coastal vessel survey and the window on the left shows sighting details for QA and QC of data. Colored dots indicate protected species sightings and re-sighting information and the gray lines are the survey tracklines.