Tethys Data Explorer Manual

Tethys, Antioch mosaic, 3rd century from Baltimore Museum of Art

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1   What is the Data Explorer?

The Data Explorer is a web application interface for taking a high-level look at the data available on Tethys. For a more detailed look at these data, users are directed to the Tethys Web Client. The Data Explorer provides maps of deployment locations and detection effort, plots of detections, and allows users to download figures and detections for further analysis. This document provides a tutorial for using the Tethys Data Explorer.

2   Start the Data Explorer

The Tethys server must be running to use the Data Explorer. Please reference the Tethys Manual for details if you need help starting the Tethys server.

To start the Data Explorer:

1. Navigate to the *DataExplorer* folder within your directory of Tethys files.
2. Locate the batch file named *data_explorer.bat*.
   Note: If you are running Tethys locally, proceed to step 5. Otherwise, proceed to Step 3.
3. Right-click on *data_explorer.bat* and select edit.
4. Update the --server argument to point to your server:

   `"..\Python39\python.exe" data_explorer.py `==`--server "http://server_name:port"`==

   Where `server_name` is the name of the server that Tethys is running on and `port` is the associated port number. By default, Tethys uses port 9779.

5. Double-click on *data_explorer.bat*.
   Note: If your administrator's security policy does not allow you to click on batch files, open a command window (Windows Key + R and type cmd.exe). You'll need to change the directory to your Data Explorer folder. For example, if Tethys was downloaded in C:\Users\UserName\Tethys you would type:

   `cd C:\Users\UserName\Tethys\DataExplorer`

   followed by:

   `data_explorer.bat`

A command line window will open and you will see several automatic queries to the server for information (this can take up to a minute to complete depending on machine speed and if this is the initial query to the server).

Once the initial queries have run, you should see a message indicating where the Data Explorer can be accessed. This will be http://127.0.0.1:8050/ (127.0.0.1 is the number used for the current machine; if you prefer, you can use http://localhost:8050).

If you paste the provided link into an internet browser, the Data Explorer interface will automatically open to the "Detection Effort" tab. The user can navigate between four tabs along the top of the Data Explorer page. From left to right these tabs are "Deployments", "Detection Effort", "Detections", and "Settings." The first three tabs show plots with detailed information presented below the plots as data tables. Data tables may be downloaded as either Microsoft Excel or comma separated value files (type is determined by a choice on the settings tab).

Future releases will add the ability to view localization information, but these are not currently included.

3   Deployments Tab

The Deployments tab provides a quick visualization of the amount of recording effort at different sites. The displayed map is automatically populated with colored circles that contain basic deployment information for all deployments in the database (both stationary and mobile; Figure 1). By navigating around the map and adjusting the sliding time scale along the bottom of the map, the user can view deployments in a specific region or during certain years.
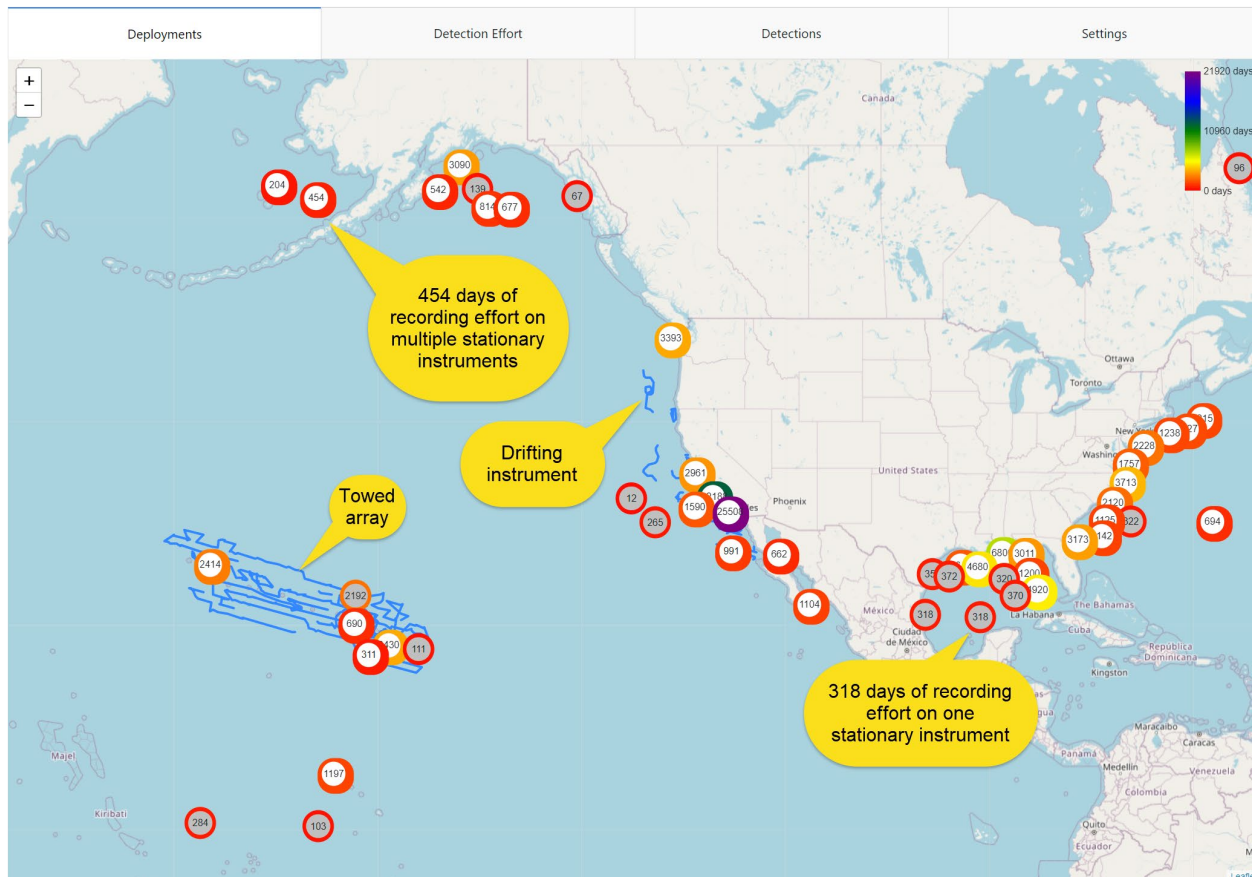

Figure 1 – Deployments tab showing overall deployment effort of stationary moorings (colored circles) and survey track lines (blue lines).

3.1 Map

The Deployments tab will display a map with colored circles that represent deployments in the database. The map will default to showing all the deployments in the database.

The numbers within the colored circles represent the total days of recorded data in the region or at an individual site. These numbers will adjust as the user zooms in or out on the map. When zoomed out, overlapping deployments will be clustered in regions where there are many sites, or at sites where there have been multiple deployments. As the user zooms in on a region, the circles will separate out to distinguish individual deployments (Figure 2). Circles with a white center represent more than one deployment while circles with a gray center represent a single deployment.

Figure 2 – Deployments tab showing groups of deployments (white circles) and individual deployments (gray circles).

If the user hovers their cursor over an individual deployment (gray circle), the deployment Id (a unique identifier that typically includes the project, site, and deployment number of the data), the start date of the deployment, and the number of days of recorded data will be displayed (Figure 3). For example, "CINMS_C_33: 2017-02-22, 105.4 days" indicates that the cursor is hovering over the 33rd deployment at site C in the Channel Islands National Marine Sanctuary, which started recording on February 22, 2017, and recorded for 105.4 days.

Figure 3 – Deployments tab showing information about a selected deployment.

The color bar in the top right of the map corresponds to the circle color for each deployment and indicates the number of days of recorded data, with warmer colors representing fewer days.

The map also includes the boundaries of the US National Marine Sanctuaries. The user can load their own shape files by adding them to the '...\DataExplorer\Assets\shape' folder. However, currently, this cannot handle shapes that cross the international date line.

3.2   Sliding time scale

Below the map is a sliding scale that spans the years over which there is recording effort for the deployments in the database. This scale will default to span the full range of years covered by the deployments. The user can adjust this scale by moving the sliders at each end so that the scale covers only the years of interest (Figure 4).
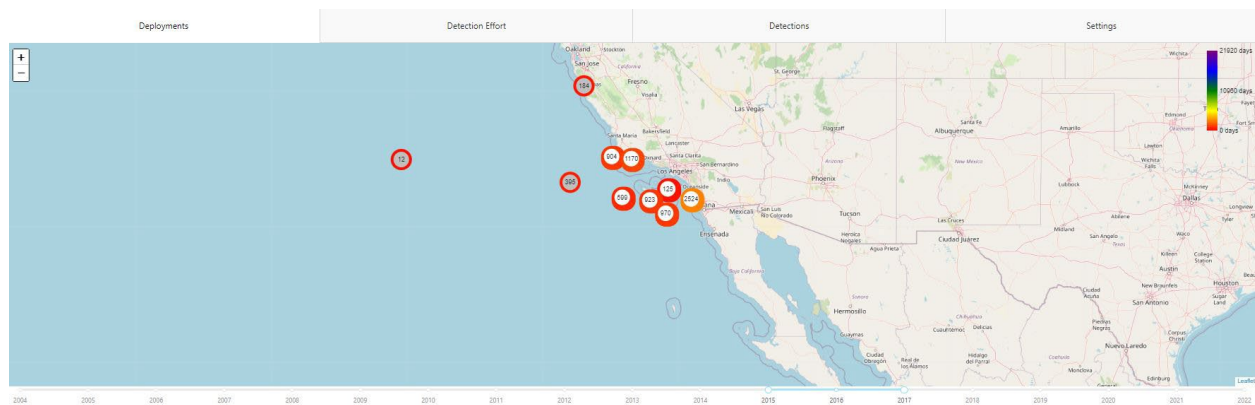

Figure 4 – Deployments tab shown with the sliding time scale restricted to deployments from 2015 to 2017.

4   Detection Effort Tab

The Data Explorer interface automatically opens to the Detection Effort tab; it may take a few seconds to load. The Detection Effort tab provides a visualization of the detection effort in the

database (Figure 5). Note that detection effort means that a species or call type was looked for in a dataset, not that it was necessarily found.
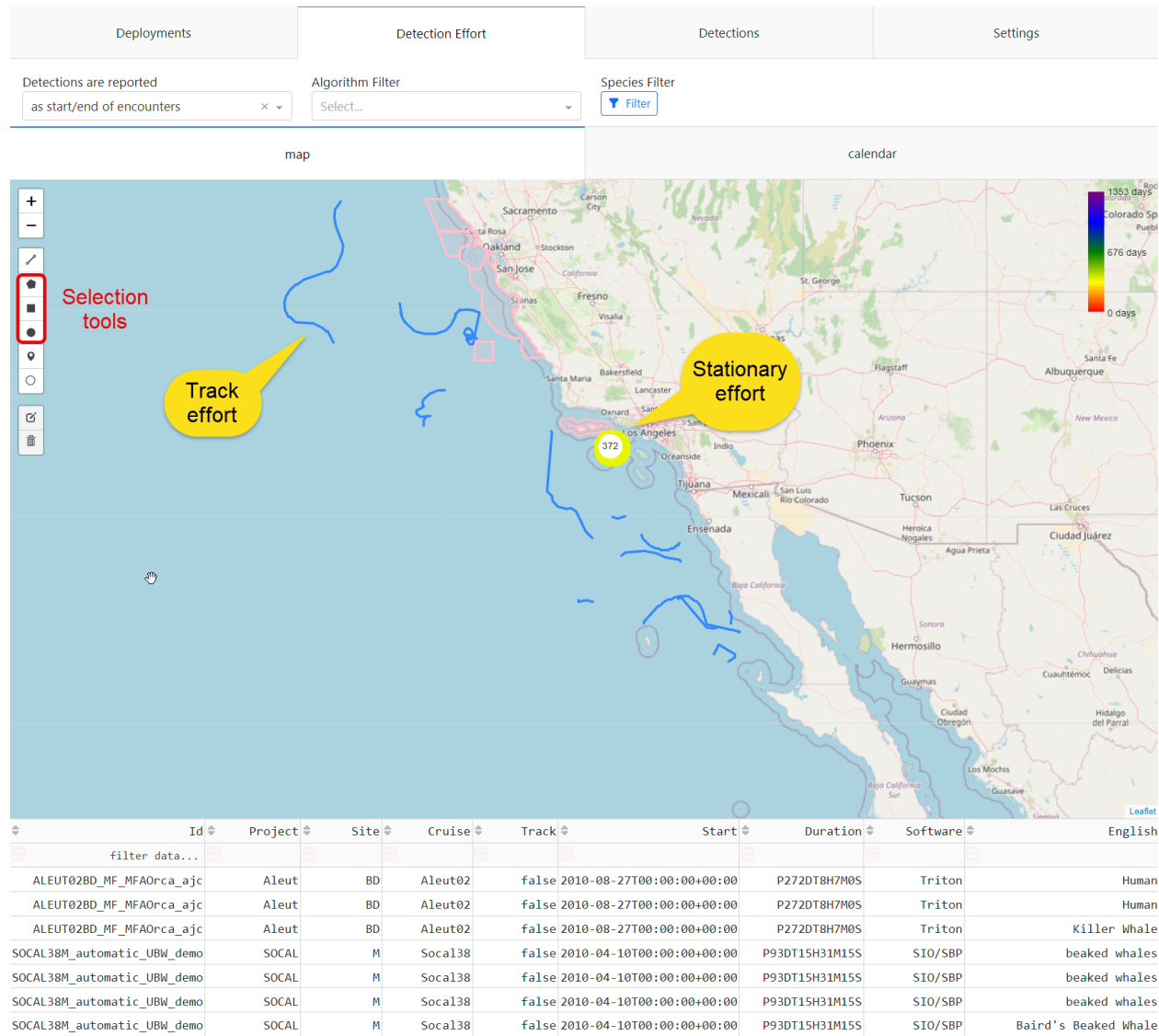

Figure 5 – Detection Effort tab shown with the map view. Callouts draw attention to examples of effort associated with stationary and mobile deployments with an associated track line. The selection tools may be used to query for detections associated with effort.

The Detection Effort tab allows for a map view (default) or a calendar view. Users can select their desired view using the subtabs map & calendar.

Users can also select the type of detection effort they are interested in viewing using the "Detections are reported" drop-down menu, located on the top left. Detections can be reported as either the start/end of encounters (bouts of calls were detected by denoting the start and end time of the bout), in binned intervals (presence/absence of calls was noted during a defined interval), or per call (individual calls were detected).

To the right of the "Detections are reported" drop-down are filters based on the algorithm used for the detection effort and the species for which there was effort. When one or multiple algorithms are selected using the Algorithm Filter drop-down, the map will update to show only detection efforts where the selected algorithms were used. By clicking the Species Filter button, a window will open (Figure 6) where the user can select only the species they want to view detection effort for, whether individual species or entire families or suborders.

Figure 6 – The Detection Effort species filter with only suborder Odontoceti selected.

4.1   Map view

The map view is automatically populated with colored circles that represent detection effort. The numbers inside the circles indicate the number of days of detection effort. The color bar in the top right of the map corresponds to the circle colors and indicates the number of days of detection effort, with warmer colors representing fewer days.

The map displays all detection effort in the database that matches the currently specified set of filters that were previously described: reporting type (granularity of detection: start/end, binned, per call), specific species or algorithms.

White circles represent detection effort from multiple detection documents while gray circles represent an individual detection document. When clicked, a white circle will expand out to show the various detection efforts at that location. If the user hovers their cursor over an individual detection effort circle (gray circle), the Id (a unique identifier for the detection document), the effort start date, and the number of days of effort will be displayed.

Below the map of detection effort is a table that provides details on the detection efforts shown on the map. Details include the Id of the detection document, the Project, Site, and Cruise that the effort was a part of, whether or not the effort is a Track, the Start date and time and Duration of the effort, the Software used for the effort, and the name of the species for which there was

effort. Note that durations are reported in ISO 8601 duration format. They start with a P followed by numbers of day values which use abbreviations for year (Y), month (M), and day (D). When partial days are displayed, a time indicator (T) is present followed by hours (H), minutes (M) and seconds (S). Example: 93 days, 16 hours, 24 minutes and 25 seconds would be represented as: P93DT16H24M25S.

To determine whether a species/call was detected during a detection effort, the user must select the detection effort of interest using one of the map selection tools on the left side of the map (Figure 5). These allow the user to select an arbitrary polygonal, rectangular, or circular region.

The map toolbar also includes options to zoom in (+) and out (-) on the map, as well as to draw lines and place markers on the map, and to edit and delete layers that have been added.

When detection effort has been selected using one of these tools, if there are detections in the database, the view will automatically switch to the Detection tab where the user will find weekly detection plots.

4.2   Calendar view

The calendar view displays the timespan during which there was detection effort for a given species/call. Month and year are shown on the x-axis and species/call are labeled on the y-axis (Figure 7). The calendar defaults to displaying all detection effort in the database, but it is possible to only view effort for specific species or when specific algorithms were used by using the Algorithm and Species Filters, as described previously. It is also possible to zoom in (see 4.2.1) on specific species/calls or years if needed.

If the user hovers their cursor over a detection effort bar, details about the detection effort will be displayed including start and end date, species and call type, total days of detection effort, the method, software, and version used for analysis, the document Id, latitude, and longitude.

The toolbar (see 4.2.1) in the top right can be used to select detection effort. If there are detections in the database for a selection, the Detections tab will open to a weekly plot of those detections.
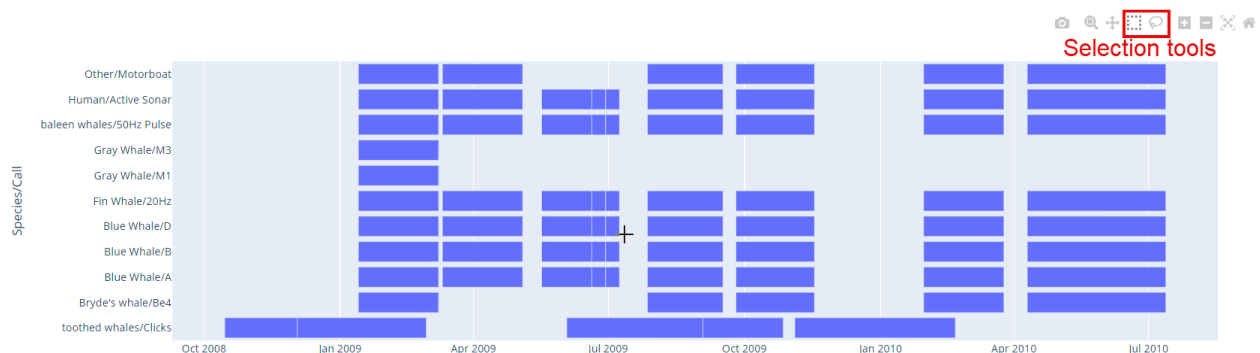

Figure 7 – Calendar view in the Detection Effort tab showing time periods with detection effort, broken down by species. Detections can be queries using the selection tools (see 4.2.1 for details).

As in the map view, below the calendar of detection effort is a table that provides details on the detection efforts shown on the calendar. Details include the Id of the detection document, the Project, Site, and Cruise that the effort was a part of, whether or not the effort is a Track, the Start date and time and Duration of the effort, the Software used for the effort, and the Latin name of the species for which there was effort.

4.2.1   Toolbar

A toolbar of calendar controls is located on the top right of the calendar view.

📷   **Download Plot** will take a snapshot of the calendar as currently displayed and download it as an SVG file (or PNG file if you've changed the default settings).

🔍   **Zoom** (default) allows the user to draw a box on the calendar and zoom in on the selected section of the plot.

✛   **Pan** allows the user to move around the calendar by clicking and dragging the cursor.

⬚   **Box Select** allows the user to draw a box around a section of the calendar. Note that if you draw a box around a species/call for which there are detections, the view will switch to the Detections tab where a weekly plot of the species/call selected will be displayed.

💬   **Lasso Select** allows for a more freeform selection than Box Select but will produce the same results.

➕   **Zoom in** and   ➖   **Zoom out** will zoom on the calendar as currently displayed.

⛶   **Autoscale** and   🏠   **Reset axes** will return the calendar to the default view.

5   Detections Tab

The Detections tab will show empty plots when the Data Explorer is first opened. Users must select species/call detection effort from the Detection Effort tab to generate plots in the detections tab. When the Detections tab is populated with data, there will be a figure on the top (either a weekly plot, diel plot, or a map of detections) and a data table on the bottom. Each plot type is presented as a separate tab under detections.

5.1   Plots

Plots are shown as the hours of detections per week by default. Below the plots is a drop-down menu where the plot type can be changed. Other options include a diel plot and a map display. For all plot displays, a toolbar of plot controls is in the top right of the Detections tab.

5.1.1   Hours of detections per week

The weekly plot display provides the number of hours with detections per week for individual species (Figure 8). Note that these plots are for a given species and may represent multiple call types across multiple sites. The Colored bars show the detections for each species while gray bars indicate a lack of analysis effort. Hovering the cursor over a bar will display the species, the start date for the weekly bin, and the number of hours with detections that week.
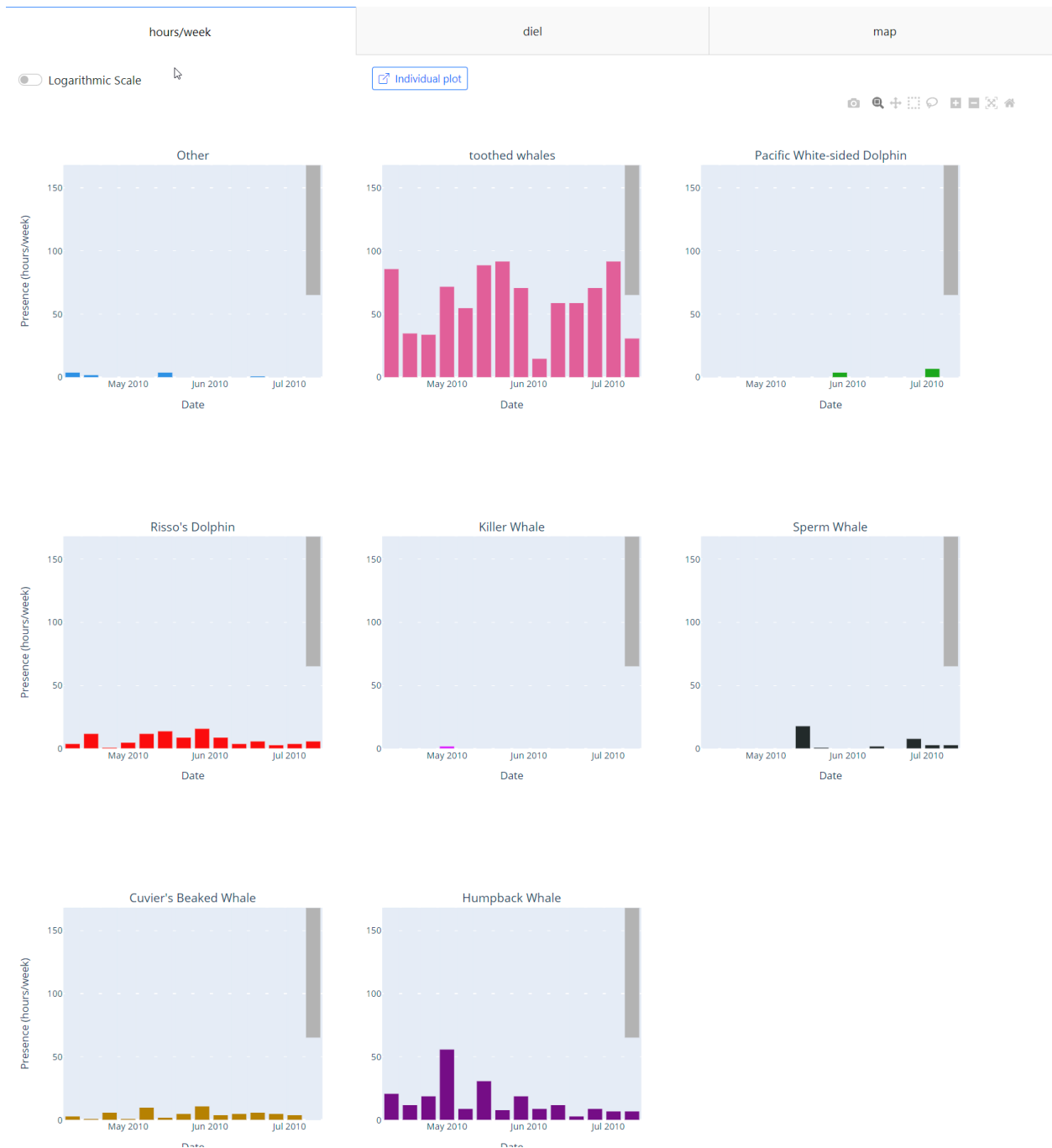
Figure 8 – Selected detections in weekly plots, broken down by species.

For the weekly plot display, the toolbar options are the same as for the Detection Effort tab calendar view (see 4.2.1). When there are many weeks with few counts, the **Logarithmic Scale** toggle button at the top left may be clicked to show the number of hours/week on a logarithmic scale.

Selecting the Open Single Plot icon opens a new window that will contain one weekly plot that the user can examine, format, and download (Figure 9). The drop-down at the top of this window

allows the user to switch between the weekly plots for different species. The **Height Adjust** sliding scale allows the user to change the height of the plot (e.g., to match other figures or meet journal requirements).

Figure 9 – New window with an individual weekly plot of detections.

5.1.2   Diel plot

The diel plot display shows which hours of the day detections occurred for each day of recording effort (Figure 10). The x-axis denotes the hour in the day and the y-axis denotes the day. Gray bars indicate a lack of analysis effort.
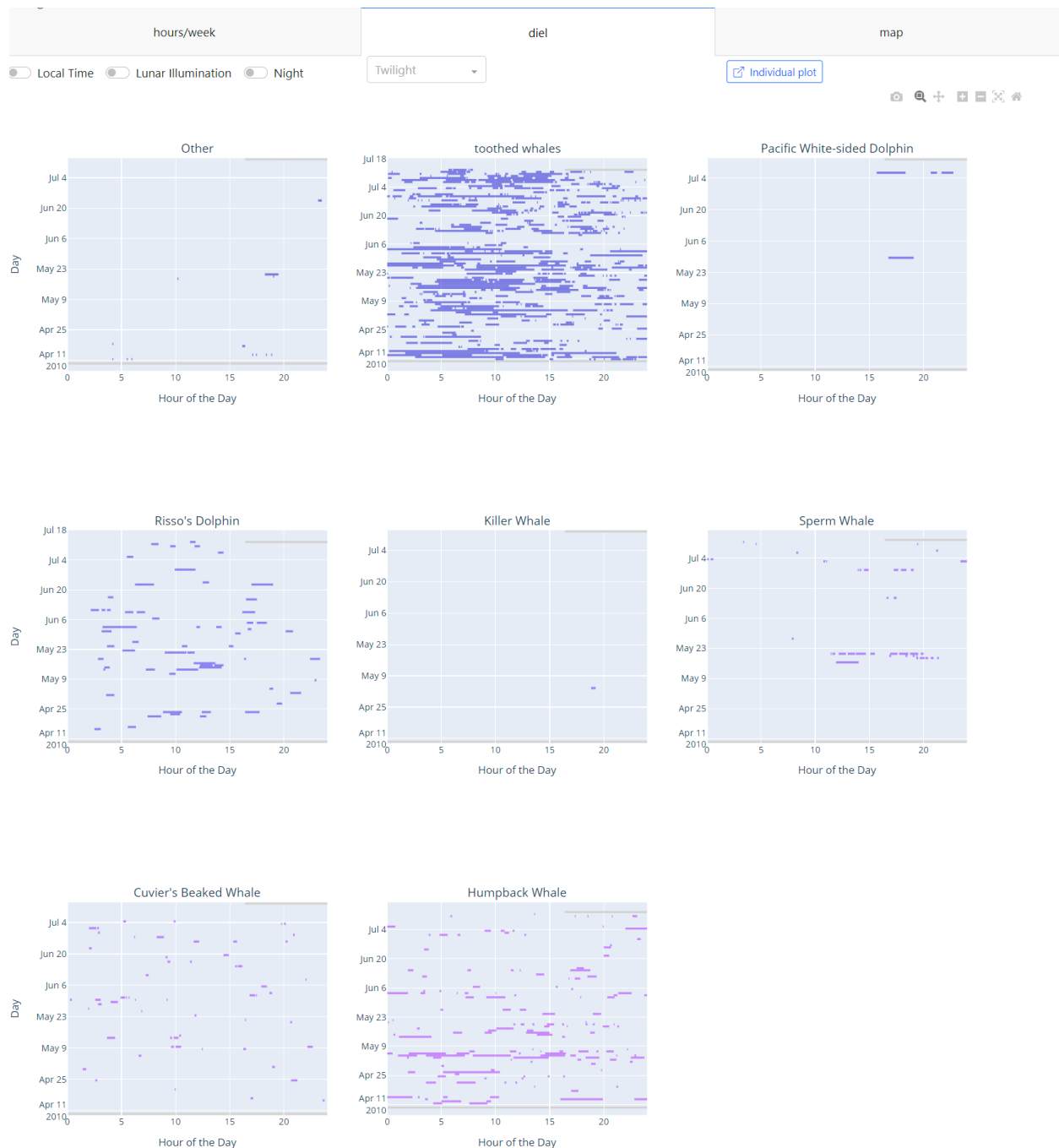
Figure 10 – Selected detections in diel plots, broken down by species.

For the diel plot display, the toolbar options, from left to right, are Download plot, Zoom (default), Pan, Zoom in, Zoom out, Autoscale, and reset axes. Controls at the top of the display enable modifications to these plots:

- **Local Time** toggle – By default, all detections are displayed in UTC. Enabling this toggle will convert to local time based on nautical time zones (geopolitical time zone boundaries are not considered).
- **Lunar illumination** toggle - Add shading to indicate periods of lunar illumination during the night (Figure 11).

- **Night Overlay** toggle – Add shading to indicate the difference between day and night.
- **Twilight** dropdown menu – Add shading to show twilight periods to better identify crepuscular activity. Three twilight types are provided:
  - Civil – Sun is 0.56 ° to 6° below the horizon. (0.56º accounts for the curvature of the earth and refraction).
  - Nautical – Sun is 0.56 ° to 12° below the horizon.
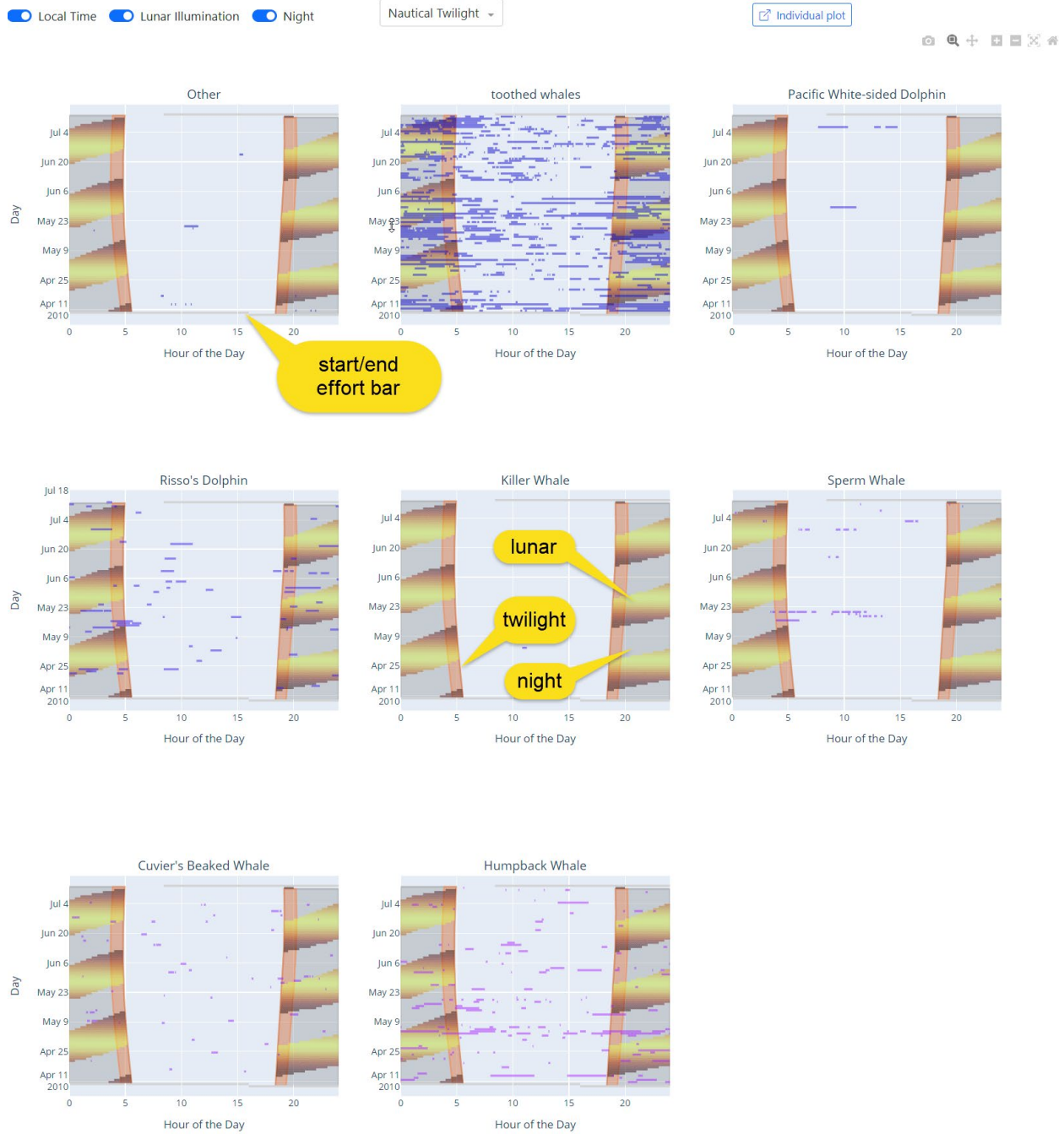 - Astronomical - 0.56 ° to 18° below the horizon.

Figure 11 – Diel plots in local time with night, lunar and twilight overlays. Light gray bars at the top and bottom show where effort begins and ends.

As with the weekly plots, selecting the [Open Single Plot] icon opens a new window that will contain one diel plot that the user can examine, format, and download.

CAVEAT: When displaying data over long time periods, the daily detection lines may be thinner than the resolution of the monitor on which they are displayed. In such cases (e.g., Figure 12) either filter the effort to show fewer species or use the open single plot button to look at a single plot at a time, possibly increasing the plot height.
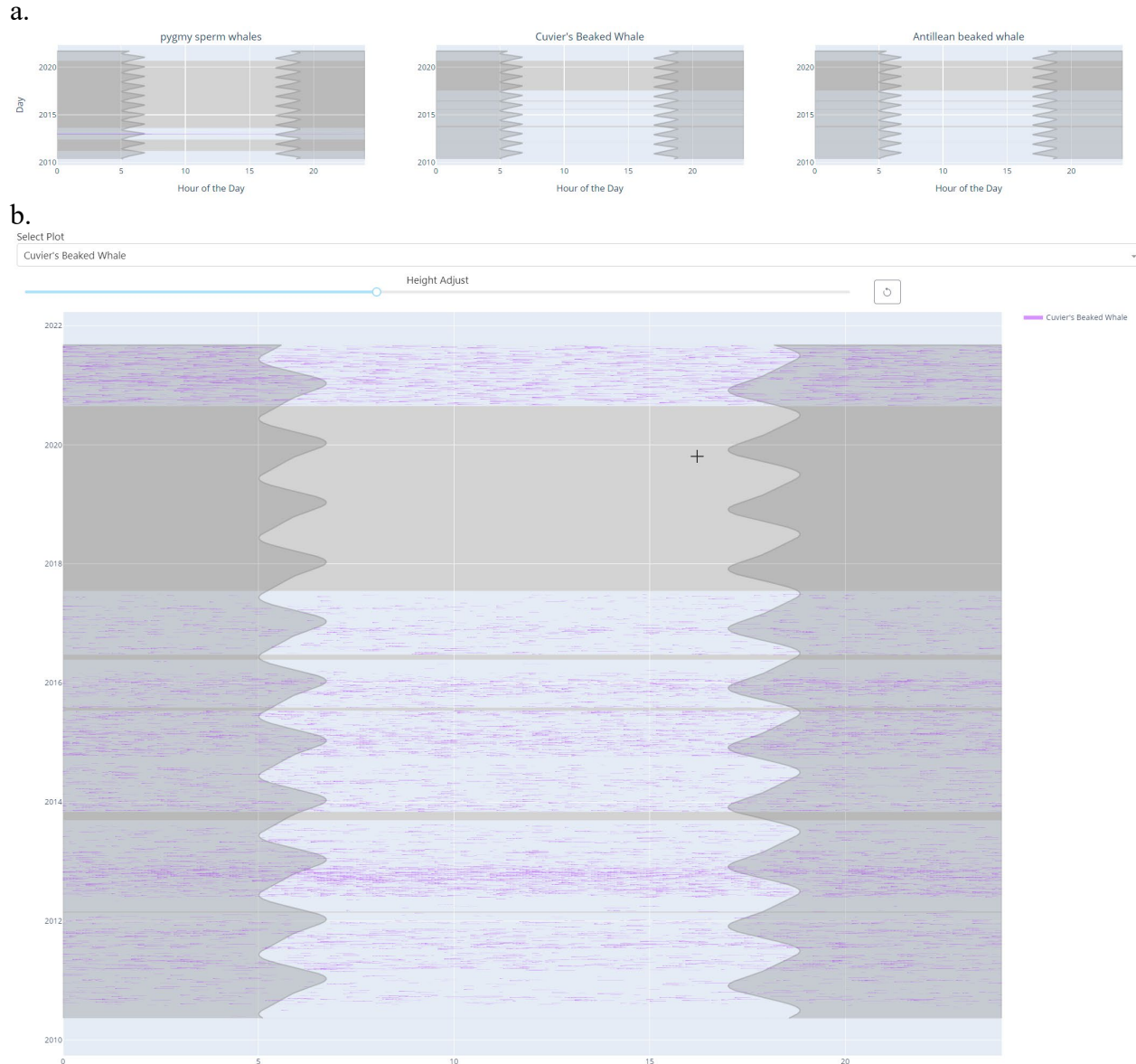
a.

b.

Figure 12 – Diel plot of detections from the Gulf of Mexico over a period of about one decade. a) One row of a four row plot is shown on the top. Ten years contains over 3,600 days, which is more lines than are available on the monitor on which the plot was generated (4K displays are typically 3,840 x 2,160). Consequently, the detections cannot be seen. b) The open single plot button shows detections for one of the species. While some lines are still hidden, the detection patterns are clearly visible, and the height adjust slider permits one to make the plot taller or shorter.

5.1.3 Map display

The map display shows where detections occurred. Detections for each species are plotted as a circle with color indicating the number of detections (warmer colors indicate a greater number of detections; Figure 12). Currently, detections for individual species are shown overlapping at the same site, so it may appear that there are detections for only one species when really there are many. This visualization will be improved in future releases. Hovering the cursor over a circle will display information about the detections (i.e., latitude, longitude, species, call type, the date and time of the first and last detection, and the total count of detections). Multiple species overlap in the plot can be avoided by using the species selection filter on the effort tab prior to querying for detections.
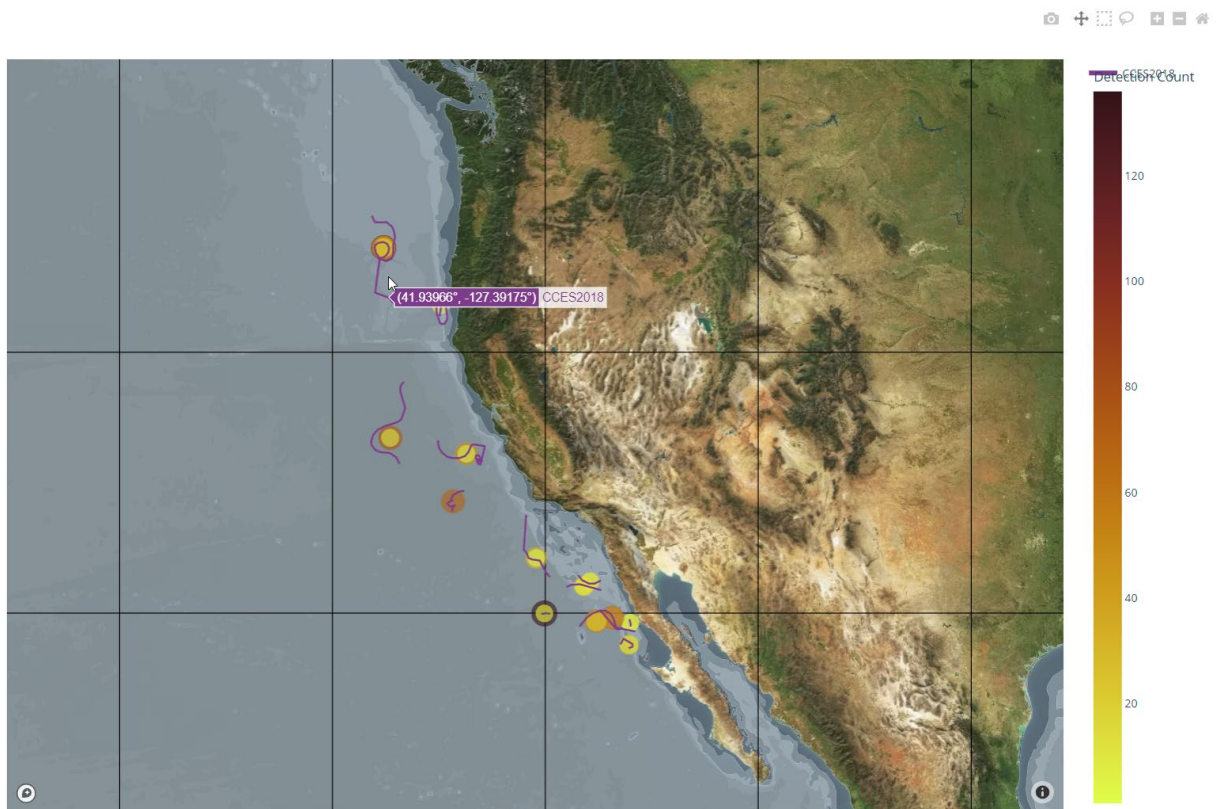

Figure 13 – Map display showing locations of selected detections.

For the map display, the toolbar options are the same as for the Detection Effort tab map view (see 4.1.1).

5.2 Data table

The data table contains information about the selected detections. Information includes the species, call type, document Id (the filename), dates and times of the first and last detections, the total number of detections, and the detection method used during analysis (Figure 13).

SpeciesId	Call	Id	Start	End	Count	Method
filter data...						
Other phenomena	Other	SOCAL38M_MF_demo	2010-04-11T04:11:47.901000+00:00	2010-06-23T23:26:37.500000+00:00	15	Analyst detections
Odontoceti	Buzzes	SOCAL38M_hf_logs_demo	2010-04-29T13:40:12.500000+00:00	2010-07-11T18:49:37.499999+00:00	13	Analyst detections
Odontoceti	Whistles<5kHz	SOCAL38M_MF_demo	2010-04-11T05:32:39.097000+00:00	2010-06-24T15:29:56.604000+00:00	17	Analyst detections
Odontoceti	Whistles>10kHz	SOCAL38M_hf_logs_demo	2010-04-10T10:01:27.499999+00:00	2010-07-12T07:50:27.500000+00:00	551	Analyst detections
Lagenorhynchus obliquidens	Buzzes	SOCAL38M_hf_logs_demo	2010-07-06T15:44:37.500000+00:00	2010-07-06T18:18:47.499999+00:00	1	Analyst detections
Lagenorhynchus obliquidens	Whistles	SOCAL38M_hf_logs_demo	2010-05-29T16:46:27.499999+00:00	2010-07-06T22:41:32.500000+00:00	3	Analyst detections
Grampus griseus	Buzzes	SOCAL38M_hf_logs_demo	2010-05-08T22:52:12.500000+00:00	2010-07-05T06:03:57.500000+00:00	2	Analyst detections
Grampus griseus	Clicks	SOCAL38M_hf_logs_demo	2010-05-14T02:33:57.500000+00:00	2010-07-12T11:45:42.499999+00:00	58	Analyst detections
Grampus griseus	Whistles	SOCAL38M_hf_logs_demo	2010-05-14T03:27:47.499999+00:00	2010-06-23T13:00:12.500000+00:00	5	Analyst detections
Orcinus orca	Buzzes	SOCAL38M_hf_logs_demo	2010-05-03T18:51:07.500000+00:00	2010-05-03T19:13:27.500000+00:00	1	Analyst detections
Orcinus orca	Clicks	SOCAL38M_hf_logs_demo	2010-05-03T18:51:07.500000+00:00	2010-05-03T19:13:27.500000+00:00	1	Analyst detections
Physeter macrocephalus	Clicks	SOCAL38M_hf_logs_demo	2010-05-16T11:58:32.500000+00:00	2010-07-10T19:28:27.500000+00:00	20	Analyst detections
Physeter macrocephalus	Codas	SOCAL38M_hf_logs_demo	2010-05-19T16:51:47.499999+00:00	2010-07-07T21:18:12.499999+00:00	9	Analyst detections
Physeter macrocephalus	Creaks	SOCAL38M_hf_logs_demo	2010-05-18T19:24:12.500000+00:00	2010-07-11T03:21:02.500000+00:00	14	Analyst detections
Ziphius cavirostris	Clicks	SOCAL38M_automatic_UBW_demo	2010-04-15T23:40:00+00:00	2010-07-04T09:55:00+00:00	80	Analyst detections
Ziphius cavirostris	Clicks	SOCAL38M_hf_logs_demo	2010-04-15T23:40:22.499999+00:00	2010-07-04T05:22:42.500000+00:00	55	Analyst detections
Megaptera novaeangliae	Non-Song	SOCAL38M_Humpback_demo	2010-04-11T04:16:17.970000+00:00	2010-07-11T13:36:13.114000+00:00	142	Analyst detections

Figure 14 – Data table with details about selected detections.

Users can download the data in the data table by clicking the **Download Raw Data** button
located at the top left of the data table. Using the default settings will save the table as shown. If
the save setting has been changed to "complete", the downloaded data will contain all detection
records.

6   Settings Tab

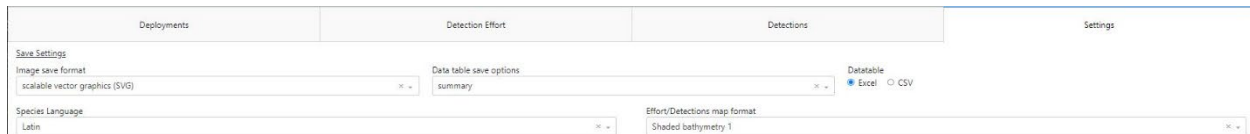The Settings tab provides user-adjustable settings for the Data Explorer (Figure 14).

Figure 15 – Settings tab showing user-adjustable settings.

The **Image save format** drop-down allows the user to select the file format that images will be
saved in (e.g., when taking a snapshot of the Detection Effort calendar or Detection plots). The
current options are scalable vector graphics (SVG; default) and portable network graphics
(PNG).

The **Data table save options** drop-down allows the user to select whether they want a summary
(default) of detection information (i.e., a list of species, call types, dates and times of first and
last detections, the total number of detections, and the detection method) or complete detection
information (i.e., document and deployment IDs, start and end times, species, and call type for
each detection).

The **Datatable** toggle allows the user to select whether they would like the data table saved as an
Excel (default) or comma-separated values (CSV) file.

The **Species Language** drop-down allows the user to select the format they want species names
displayed in while using the Data Explorer. The current options are Latin (default), English,
Spanish, and French.

The **Effort/Detections map format** drop-down allows the user to specify whether they would like maps to use a shaded bathymetry 1, shaded bathymetry 2, or nautical chart (isobar) style. Note that this currently only affects detection maps.