CruzPlot

A Mapping Program in R

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INTRODUCTION AND SET-UP

CruzPlot is a utility program to create maps and plot data on them. The main feature of the software is the ability to create publication-quality map graphics quickly and easily with a user-friendly interface. The program's features reflect its main use by the Marine Mammal and Turtle Division of the Southwest Fisheries Science Center, NOAA Fisheries (SWFSC) in La Jolla, California. In particular, CruzPlot is oriented to the ocean and to data files in the "DAS" format produced by WinCruz, the data-entry program used on line-transect surveys at the SWFSC. CruzPlot is specifically designed to plot marine mammal and turtle sightings directly from DAS files. CruzPlot is not meant to replace specialized map-oriented analytical software such as ArcView or Surfer.

CruzPlot can produce maps virtually anywhere in the world at any scale using the R "maps" and "mapdata" packages. Visual details such as color fill, tick marks and tick spacing, and tick and axis labels are controlled by the user. The main additional feature of interest for marine studies is water depth. Using the R package "marmap", CruzPlot can either download bathymetric data from the ETOPO1 database hosted on the NOAA website, or shade and/or contour depth data from a local file.

After a map has been created, marine mammal and turtle sightings and transect-line effort can be plotted directly from DAS files. Sightings and effort may be filtered by Beaufort sea state, date, cruise number, and perpendicular distance from the trackline. After data have been plotted, sightings or effort can be identified interactively with the cursor. CruzPlot can also plot points and/or lines from any file with latitude and longitude coordinates.

CruzPlot is written in R using the Shiny web application framework through the "shiny" and "shinydashboard" R packages. Shiny applications have two required files, a ui file and a server file, that handle interface and calculations, respectively. Each time a new value is entered through the interface, CruzPlot updates the plot. Shiny utilizes what are called reactive functions. The reactive functions are "smart", meaning that they cache their values and rerun only when input variables they depend on change. This allows CruzPlot to update quickly because the program does not have to do repetitive calculations. However, the CruzPlot map must be regenerated each time an input is changed, so something like plotting or replotting detailed depth data will always take a long time.

CruzPlot requires a recent version of R (available at https://www.r-project.org/) and the following R packages: shiny, shinydashboard, shinyjs, DT, maps, mapdata, marmap, stringr, geosphere, and dplyr. In the same folder as the interface file ui.R and the calculations file server.R, CruzPlot requires, at a minimum "SpCodes.dat" with SWFSC species names and codes and this document "CruzPlot Manual.pdf". The optional file "StarterVals.csv" is useful to specify the default map shown when CruzPlot is launched. For shipboard use, depth files of the area of interest should be downloaded/created to a local file prior to the cruise.

To run CruzPlot, open either the ui.R or server.R file in an R editor such as RStudio or Tinn-R. Enter "shiny::runApp()" on the command line or click "runApp" in the upper right corner of the ui.R or server.R scripts in RStudio. CruzPlot will launch in a browser window, but you can run CruzPlot in a separate browser window by clicking "Open in Browser" on the top bar of RStudio. This "Open in Browser" action does not require internet access; it simply runs the program through your default browser.

CRUZPLOT SIDEBAR MENU DETAILS
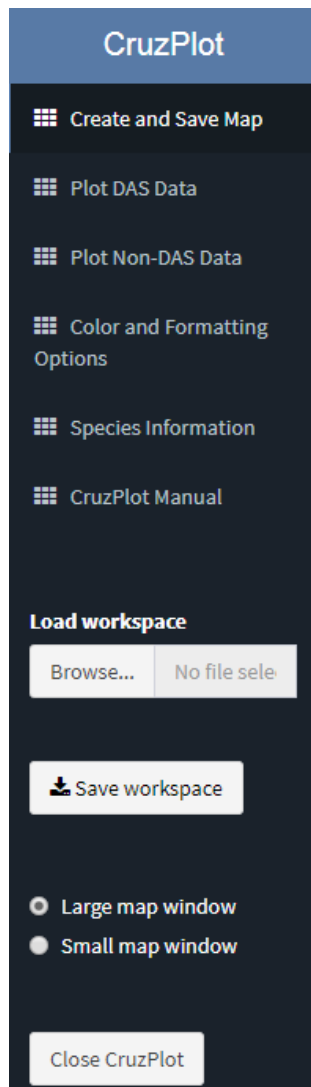
When CruzPlot is opened, the Create and Save Map page will be selected, and you will see a map with the latitude and longitude limits specified in StarterVals.csv. If StarterVals.csv is not found, then the map will have default coordinates of -160º, -75º, -20º, and 34º (the ETP). Geographic positions in CruzPlot are given as signed decimal numbers in degrees. South latitudes and west longitudes are negative; north latitudes and east longitudes are positive. Thus, 124° 30' W longitude is represented as -124.5.

Map size, labels, tick marks and colors can be modified using the tabs at the top of the Map page. Details of the tab entries are described below. At any time, you can plot data on the map by selecting the Plot DAS Data or Plot Non-DAS Data pages on the left sidebar menu. The tabs associated with these plotting actions are also described below. As you explore different options for plotting your data, the base map will remain the same. If you wish to alter the map, you can reopen the Create and Save Map page and make your changes while the data plotted on the map stay the same. If you wish to return to the default base map and remove plotted DAS or non-DAS data, you can reload the program by reloading the web page if CruzPlot is open in a browser or by clicking the circular arrow if CruzPlot is open in an external window.

Also on the sidebar menu are 'Load workspace' and 'Save workspace' options, a selection for making the map display large or small, a button to close the program. A saved workspace includes but is not limited to: planned transects, coastline data, DAS data, non-DAS data, currently plotted species, and currently plotted effort. A saved workspace must have a '.RDATA' file extension, and you can load any of these saved files using the 'Load workspace' option. The 'Large map' setting is designed for desktop computers, while the 'Small map' setting is designed for laptops.

Create and Save Map
Range

Map range
- Left and Right longitude – left and right limits of map in decimal degrees, using negative for west. For a global map, set Left longitude to -180 and the Right longitude to 180.
- Bottom and Top latitude – bottom and top limits of map in decimal degrees, using negative for south.
- Resolution – choose the level of detail for the map appropriate for size of area. Options are Low and High, which correspond to the normal and HiRes map, respectively, from the R map package.
- Replot map – Click to replot map with updated map range. If you resize your browser window and the map is awkwardly sized, you can click this button to regenerate the map for the new browser window size

Coastline
- Load coastline file - Coastline .csv file must consist of a two columns with the headers 'lon' and 'lat' representing longitude and latitude points. Currently CruzPlot can only process coastline files with points are between -180° and 0°.

Scale bar
- Plot scale bar – check to show a simple scale bar on the map. Strictly speaking, the scale bar is accurate only at the latitude range at which it is located.
- Longitude, Latitude – coordinates of left end of the scale bar, using negative for south and west. The default values put the scale bar in the lower left corner of the map. The values are recalculated when map limits are changed, while an error message is produced if the entire scale bar is not in the map area.

- Scale bar units – Specifies whether the length of the scale bar is in kilometer (km) or nautical miles (nmi).
- Length – length of scale bar in km or nmi, printed as a label below the bar. The value is reset to the default when map limits are changed.
- Width of bar – relative thickness of scale bar; appearance may vary with monitor or printer.

Planned Transects

Range	Planned Transects	Ticks & Labels	Map Labels	Color	Grid	Save

Planned transects

Load planned transects

Longitudes must be in -180 to 180 range. See the manual for the required .csv file format

Load planned transects .csv file

Browse...	PlannedTransects_example.csv

Upload complete

Longitude column

lon ▼

Latitude column

lat ▼

Transect number column

transect_num ▼

Transect class column

transect_class ▼

Transect class 2 column

transect_class2 ▼

Add data to CruzPlot	Transect data added to CruzPlot

Plot loaded planned transects

☑ Plot planned transect lines

For the color(s) and (if a class 2 column is specified) the line type(s), select either one or the same number as transect classes or class 2s, respectively. When multiple colors or line types are selected, the order in which transect classes and class 2s are selected to be plotted corresponds to order of specified colors and line types, respectively.

To remove selected input(s): click the input(s) to remove and then click backspace or delete

Class(es) to plot

a b

Color(s)

Gray Orange

Class 2(s) to plot
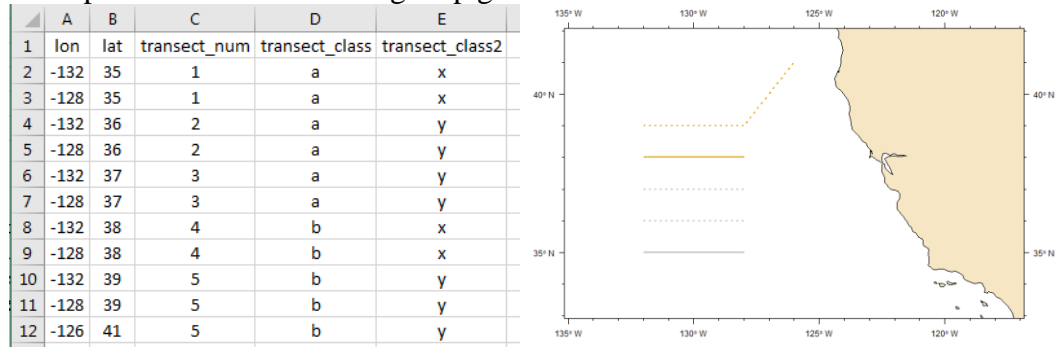
x y

Line type(s)

Solid Dot

Line width

2

Planned transects
- Example .csv file and resulting map given selections made in screenshot above

- Load planned transects .csv file – Planned transect .csv file; must have headers and consist of at least one column with longitudes, one with latitudes, one with the transect number, and one with the transect class. There may also be a fifth column with a second transect class (class 2). All longitude values must be in the range [-180, 180]. A screenshot of an example planned transect .csv file is above.
- Longitude column – Select the name of the column with longitude data
- Latitude column – Select the name of the column with latitude data
- Transect number column – Select the name of the column with the transect number information. The transect number indicates which points make up a planned transect and thus should be connected by CruzPlot; there must be at least two points per transect
- Transect class column - Select the name of the column with the transect class information. You can color-code plotted planned transects by their class
- Transect class 2 column - Select the name of the column with the transect class 2 information. You can line type-code the planned transects by their class 2 values.
- Add data to CruzPlot – Add the planned transect data in the loaded file to CruzPlot. This will overwrite any previously loaded planned transect data

- Plot planned transect lines – Check the box to plot loaded planned transects
- Class(es) to plot– Select transect class(es) to plot
- Color(s) – Select color(s) of plotted transect(s). When multiple colors are selected, the order in which transect classes are selected to be plotted corresponds to the order of selected colors
- Class 2(s) to plot– Select transect class 2(s) to plot
- Line type(s) – Specify line width(s) of plotted transect(s). If no class 2 column was specified, then you can only select one line type. When multiple line types are selected, the order in which transect class 2s are selected to be plotted corresponds to the order of selected line types
- Line width – Specify line width of plotted transect(s). Must be a number. You can only specify of line width for all plotted transects

Ticks & Labels

| Size | Ticks & Labels | Map Labels | Coloring | Grid & Projection | Save | Map |

☑ Plot tick marks and/or their labels

Tick Marks −

☑ Left ☑ Right
☑ Bottom ☑ Top

Degrees between each major tick | Minor ticks between each major tick
15 | 2

Tick label style | Tick length
120°W | 1

Tick Labels −

☑ Left ☑ Right
☑ Bottom ☑ Top

Start longitude tick labels at | Start latitude tick labels at
-150 | -15

Tick label font | Tick label size
Sans | 1

- Plot tick marks and/or their labels – uncheck to suppress all tick marks and labels

Tick Marks
- Tick Marks: Left, Right, Bottom, Top – check or uncheck these boxes to control display of tick marks.
- Degrees between each major tick – the number of degrees between major (labeled) tick marks; default depends on map size.
- Minor ticks between each major tick – the number of tick marks between each major (labeled) tick. Default is 2.
- Tick label style – options for tick label style are 120, 120W, 120°, and 120°W.
- Tick length – length of both major and minor tick marks relative to a standard of 1.0. Minor tick marks are 40% the length of major tick marks.

Tick Labels
- Tick Labels: Left, Right, Bottom, Top – check or uncheck these boxes to control display of tick labels
- Start longitude tick labels at – left-most longitude on the map at which to start labels on major tick marks, using negative for west. Default is the first major tick to the east of Left longitude.
- Start latitude tick labels at – bottom-most latitude on the map at which to start labels on major tick marks, using negative for south. Default is the first major tick north of Bottom latitude.
- Tick label font – font for tick and axis labels. Open the Color/Formatting Options page to display available fonts.
- Tick label size – relative size of text for tick and axis labels.

Map Labels

Title
- Map title – enter text for optional title above the map.
- Title font – font for map title.
- Title size – relative size of text for map title.

Axis labels
- Longitude axis label – enter text for optional label below the bottom axis.
- Latitude axis label – enter text for optional label along the left axis.
- Axis label font – font for axis label(s).
- Axis label size – relative size of text for axis label(s).

Coloring

| Size | Ticks & Labels | Map Labels | Coloring | Grid & Projection | Save | Map |

Color Style −

- ⦿ Color
- ◯ Gray scale

Land −

☑ Color all land

Land color

Tan ▼

Water −

☐ Color lakes and rivers

Ocean color style

- ⦿ Single color
- ◯ Depth shading

Water color

Light Blue ▼

Color style
- Color style – select either Color or Gray scale for the map. The color style choice applies to the map as well as to all symbols, lines and text plotted on it. Open the Color/Formatting Options tab to display available colors for each color style.

Land
- Color all land – check this box to fill all land with color; uncheck for white land.
- Land color – select a color for land areas.

Water
- Color lakes and rivers – check this box to include lakes and rivers on the map.
- Ocean color style – "Single color" allows you to select a uniform color while "Depth shading" allows you to choose bathymetric data to plot.
- Water color – if Ocean color style is "Single color", select the color for water areas
- Bathymetric data source – if Ocean color style is "Depth shading", either select "csv file" to load a csv file containing depth data for your map or select "NOAA server" to download a depth file or load a already-downloaded depth file. If you choose to load a csv file, it must contain three columns: longitude, latitude, and depth titled V1, V2, and V3, respectively. You can load a csv file that is larger than the given map area. You can also specify details about the csv file. If you select "NOAA server", CruzPlot will check if a csv file exists the CruzPlot folder for a map with the latitude and longitude limits of the map and the selected resolution. If this file exists, CruzPlot will load it. If not, CruzPlot will download a file for the given latitude and longitude coordinates and resolution from the NOAA server and automatically save the file in the CruzPlot directory. CruzPlot can then use this file the next time that specific map is used.

Grid & Projection

- Map projection - not currently implemented
- Projection factor – not currently implemented.

Grid
- Include grid lines – check to show grid lines on the map at major tick intervals, whether or not the tick labels for those major intervals are displayed.
- Line color – select a color for the grid lines.
- Line type – select a line type for the grid lines.
- Line width – specify a thickness for the grid lines.

Save

- Download map as –choose format for downloaded map
- Download map – opens window that allows you to specify name and location of saved map. The name specified for the saved map must include the proper format extension (.jpg, .pdf or .png). In order to download and save a map, you might have to run CruzPlot in a separate browser window by clicking "Open in Browser" on the top bar of RStudio. Note: there have been issues downloading maps when CruzPlot is run in an external window through RStudio on a Windows computer. If you have these issues, try running CruzPlot in a browser and then saving the map.

- Note: Be sure to specify file extension if saving file through RStudio external window

Plot DAS Data

DAS files are text files in a specific format produced by WinCruz, the data entry program used on line-transect cruises at the SWFSC to record searching effort and sightings of mammals, turtles, and boats.

Data & Sightings

Data
- DAS file input – click Choose File to select one or more DAS data files.

Sightings
- Plot sightings – check to plot sightings, uncheck to plot effort only.

Sighting type & species
- Sighting type – choose Mammals, Turtles or Boats. These sighting types are recorded in different formats in DAS files.
- Plot all sightings – plot all Mammal or Turtle sightings in the DAS file.
- Plot selected sightings – plot only selected Mammal or Turtle species codes.
- Include probable species sightings – if checked, plot will include "probable" identifications.
- Sighting codes and scientific names – if you select "Plot selected sightings" you will be able to select species to plot. Each species is assigned a species code used for identification in the DAS data; open the Species Information page to see the species code, abbreviation, scientific name, and common name for each species. The order of selection of the sighting codes in this box corresponds to the order of choices for symbols and colors, as well as to the order in which they are listed in the legend. If "Plot all species" is selected, sighting codes in the DAS file will automatically be assigned various combinations of symbols and colors, but these may not all be unique if the number of species is greater than 21. Use the legend to identify sightings on the map. If you select "Boats", there are no additional selection options.

Symbol properties
- Symbol type(s) – select symbol(s) to be plotted, one symbol for each species code, or a single symbol for all species. If fewer symbol types than species codes are selected, the symbol types are recycled from the beginning. If more symbol types than species codes are selected, then a warning is printed and the extra symbol types are ignored. Each symbol type is represented by a number; open the Color/Formatting Options page to display the symbols. The order of the symbol codes corresponds to the order of the sighting codes. A single comma must separate multiple symbol types. For instance, "1, 3" would specify symbol types 1 (open circle) and 3 (plus sign). If "Boats" is selected, then you will only be able to choose one symbol type.
- Symbol color(s) – select color(s) for symbol(s), anywhere from one color for each symbol to a single color for all symbols. The order of the selected colors corresponds to the order of the sighting codes and thus the order of the symbols. A single comma must separate multiple symbol colors. If fewer symbol colors than species codes are selected, the symbol colors are recycled from the beginning. If more symbol colors than species codes are selected, then a warning is printed and the extra symbol colors are ignored. Open the Color/Formatting Options page to display available colors. If "Boats" is selected, then you will only be able to choose one symbol color.
- Symbol size(s) – size(s) for all symbols relative to standard 1.0. The order of the symbol sizes corresponds to the order of the sighting codes. If fewer symbol sizes than species codes are selected, the symbol colors are recycled from the beginning. If more symbol sizes than species codes are selected, then a warning is printed and the extra symbol sizes are ignored. A single comma must separate multiple symbol sizes. For instance, "1, 1.4" could be an entry for plotting two symbol sizes.

- Symbol line width(s) – line width(s) for all symbols relative to standard 1.0. The order of the line widths corresponds to the order of the sighting codes. If fewer symbol line widths than species codes are selected, the symbol line widths are recycled from the beginning. If more symbol line widths than species codes are selected, then a warning is printed and the extra symbol line widths are ignored. A single comma must separate multiple line widths. For instance, "1, 2" could be an entry for plotting two line widths.
- Input symbol properties as text – if this box is checked, you must enter the symbol types and colors as text; there is no dropdown menu. This allows you to enter the same symbol property multiple times, which the dropdown menus do not permit. Symbol properties must be entered as numbers separated by commas. Symbol colors must be entered exactly as the color names, with a capital letter, also separated by commas. The color names can be found in the drop down menu when "Input symbol properties as text" is not selected, or in the Color/Formatting Options page.

Interactive sighting labels

- Interactive Sighting Labels – "Label sightings interactively" allows for interactive identification and labeling of sightings. After sightings have been plotted, the cursor will change to a cross over the map. A left-click of the mouse near a point will identify the point by cruise number, sighting number and date. To exit interactive mode, select "Non-interactive plot". You can still change filter values, or species plotted, or map parameters in interactive mode. The labels will remain after "Non-interactive plot" is selected and can be removed using the "Remove" buttons. If the map limits or filters are changed so that a labeled point is not plotted anymore, then that label will be removed from the map.
- Remove last sighting label – if clicked, the last interactive sighting label added to the map will be removed.
- Remove all sighting labels – if clicked, all interactive sighting labels will be removed.

Sightings Filters

Sightings to plot
- Choose one option: all sightings, only on-effort sightings, or only off-effort sightings. To plot no sightings, uncheck the "Plot sightings" box on the Data & Sightings page.

Filters for sightings
- Minimum, Maximum Beaufort - only sightings with associated Beaufort sea state values greater than or equal to the minimum and less than or equal to the maximum will be plotted.
- Range of dates from which to plot sightings – only sightings recorded on or between the specified dates will be plotted.
- Cruise number(s) – only sightings with this cruise number will be plotted. Multiple cruise numbers can be specified if they are separated by a comma (i.e. "1630, 1631"). A blank box (default) plots sightings with all cruise numbers.
- Truncation (km) – only sightings less than or equal to this perpendicular distance from the trackline will be plotted. A blank box (default) plots sightings at all distances.

Legend

Legends
- Include legend for sightings – as it sounds
- Include legend for effort – as it sounds

Sighting legend contents
- Title – title for legend (optional).
- Legend sighting information – include the information to be included for each species code in the legend (default is Scientific name only).
- Include number of sightings – if checked, after the species name the legend will include the number of plotted points as "n = ". Note that this is the number of sightings within the plotted area, and does not include sightings in the DAS file outside the map limits.

Sighting legend options
- Position – specify where to place the legend on the map. Choose a pre-set position at a corner of the map or choose "Specify" to enter coordinates.
- Latitude, Longitude – position of the upper left corner of the legend when "Specify" is selected for legend position, using decimal numbers, negative for south and west.
- Box style – choose a white legend box with black border (default), white legend box without border, or transparent background.
- Font – font for text in the legend.

- Legend size – relative size of legend text.

Effort legend options
- Same options as 'Sighting legend options'

Effort

Effort to plot
- No effort lines: effort is not plotted (default).
- Simplified effort: lines are drawn between every R and E event. Filtering by standard/non-standard/fine is not allowed, and all effort segments have the same color and line width.
- Detailed effort: for each pair of R and E events, lines are drawn from the R event to the next V event, then to the next V event, etc., until the E event is reached. This allows the user to color-code effort by Beaufort and filter pieces of R to E effort segments by Beaufort.

Effort types to plot
- Closing/Passing – select to plot effort in closing mode (default), passing mode, or both, and/or sightings during such effort.

- Standard/Non-standard/Fine. – for Detailed effort, select 1, 2, or all 3 of standard effort (default), non-standard effort, or fine effort. Non-standard effort is regular line-transect effort but, for any of several reasons, is not considered part of the designed survey. Fine scale effort is effort in a restricted area also not considered part of the designed survey.

Line properties
- Show effort by Beaufort – Effort is color-coded by Beaufort levels 0 to 6. The legend can be changed in 'Legends' tab
- Standard / non-standard / fine line color and width
- These options are displayed if the corresponding effort type is selected to plot
  - Line color – color of effort lines. Open the Color/Formatting Options tab for color choices.
  - Line width – relative thickness of effort lines. Numerical entries only

Effort filters
- Use filters from Sightings Filters – if checked, effort lines will be filtered by filters from Sightings Filters. Cannot be checked if "Plot sightings" is unchecked. If unchecked, effort filter options will appear.
- Minimum and Maximum Beaufort – only effort with associated Beaufort sea state values greater than or equal to the minimum and less than or equal to the maximum will be plotted.
- Range of dates from which to plot effort lines – only effort recorded on or between the specified dates will be plotted.
- Cruise number(s) – only effort from this cruise number will be plotted. Multiple cruise numbers can be specified if they are separated by a comma (i.e. "1630, 1631"). A blank box (default) plots effort from all cruise numbers.

Interactive effort labels
- "Label effort lines interactively" allows for interactive identification and labeling of effort lines. After lines have been plotted, the cursor will change to a cross over the map. A left-click of the mouse near a line will identify the transect by cruise number and date. To exit interactive mode, select "Non-interactive plot". You can still change filter values, effort lines plotted, or map parameters in interactive mode. The labels will remain after "Non-interactive plot" is selected. If the map limits or filters are changed so that a labeled line is not plotted anymore, then that label will be removed from the map. "View effort lines interactively" is not implemented.
- Remove last effort label – if clicked, the last interactive effort label added to the map will be removed.
- Remove all effort labels – if clicked, all interactive effort labels will be removed.

Notes:
(1) Because mammal, turtle and boat sightings are recorded in different formats in DAS files, only one type may be plotted at a time.

(2) If effort is plotted, the number of R (Resume effort) and E (End effort) records in the DAS file must be equal (they should occur in pairs).
(3) Warnings are issued if more symbol properties than species codes are selected/entered.

Tabular Output

Data & Sightings	Filters	Legends	Effort	Tabular Output	Plot Sightings and/or Effort

Effort −

Uses the same filters as those applied to plotted effort

Effort distance units

○ Kilometers
● Nautical miles

Effort file name

Effort_20170731_142736.csv

Save specified effort data

Beaufort	Standard	Non-standard	Fine	Total
0	0.00	NA	NA	0.00
1	0.00	NA	NA	0.00
2	0.00	NA	NA	0.00
3	8.07	NA	NA	8.07
4	63.70	NA	NA	63.70
5	71.46	NA	NA	71.46
6	8.42	NA	NA	8.42
All	151.65	NA	NA	151.65

Sightings −

Uses the same species, on or off effort, date, Beaufort, cruise number, and truncation filters as those applied to plotted sightings in the 'Filters' tab

Filter sightings by effort type

☑ Closing   ☑ Standard
☑ Passing   ☑ Non-standard
             ☑ Fine

Species code	Standard	Non-standard	Fine	Off effort	Total
002	0	1	0	0	1
031	1	1	0	0	2
All	1	2	0	0	3

Sightings file name

Sight_20170731_142747.csv

Save specified sighting data

Effort
- Distance traveled while on effort summarized by Beaufort level during the performed effort. The filters applied to the plotted effort are also applied to the displayed effort distances.
- The user can specify a file name and save the displayed table to the 'Outputs' folder in the CruzPlot folder

Sightings
- Sightings summarized by species code and the effort when the sighting occurred. The user can filter sightings counts by effort type. The filters applied to the plotted sightings, including geographical extent, are also applied to the sightings summarized in the displayed table.
- The user can specify a file name and save the displayed table to the 'Outputs' folder in the CruzPlot folder

Plot Non-DAS Data

Any data associated with geographic positions (latitude and longitude) can be plotted on the map. Positions may be plotted as points (to show locations of samples, for example) or lines (to show boundaries of a study area, for example). After import into CruzPlot, the data are saved and available for later plotting at any time.

Data

	File.name	Type	Count	Line or point type	Color	Size	Line width
1	exp_line_pt_1.csv	Line	4	Solid	Black		1

Non-DAS data

Loaded data

Remove selected non-DAS data

Load data

Longitudes must be in -180 to 180 range See manual for lon and lat column naming requirements

Load non-DAS .csv file

Browse...   exp_line_pt_1.csv
Upload complete

Type of data

⦿ Line
◯ Point

Line type

Solid ▼

Line color

Black ▼

Line width

1

Add non-DAS data to CruzPlot

Line data added

Plot data

☑ Plot loaded non-DAS data

Select non-DAS data to be plotted

1: exp_line_pt_1.csv || Line

Loaded data
- Table of loaded non-DAS data. These are what will be saves if user clicks 'Save current app data'. User can click on the table to select rows to remove loaded data.

Load data
- Non-DAS file input – click Choose File to select a non-DAS data file to plot. The data file must have headers and two columns with longitude values and latitude values as signed decimal values in degrees. The longitude column must be named one of 'Longitude", "longitude", LONGITUDE", "Lon", "lon", or "LON", while the latitude column must be named one of "Latitude", "latitude", "LATITUDE", "Lat", "lat", or "LAT".
- Type of data – choose whether you want to plot lines or points. If you select "Points", each longitude/latitude pair will be plotted as a point. If you select "Lines", a line will be drawn from the first longitude/latitude pair to the second longitude/latitude pair, from the third pair to the fourth pair, and so on. Lines can be separated with a missing record (NA,NA) in the data file.
- Line/Point type – line or symbol type of lines or points, respectively.
- Line/Point color – color of lines or points.
- Point size – relative size of points.
- Line/Point line width – relative line width of lines/points.

Plot data
- Select loaded data to plot

Color/Formatting Options

Symbols, colors, line types and fonts are specified by numerical codes. A display of available choices can be produced by clicking on the Color/Formatting Options tab, either color or gray scale. Additional symbols may be created by using different combinations of size and color.

The exact appearance of symbols, colors, line types and fonts will vary by monitor and printer. Print the Color/Formatting Options page to see exactly how they will look for your hardware. A larger range of gray scales can be produced by creating a color map but printing it in black-and-white.

Species Information

Opening this tab will allow you to see a list of all the mammal species and their codes, all of the turtle species and their codes, or both together. You also can search for certain species by name or species code.

Species are identified in the DAS data by a species code consisting of a series of numbers or letters. CruzPlot loads these codes and the species they correspond to from a file named "SpCodes.dat". This file can be updated with new species codes, but a file with the name "SpCodes.dat" in the same format must be present in the CruzPlot folder. In order to distinguish the mammal and turtle codes, the turtle codes were deemed less likely to be changed so they are hard coded in the program and used to identify turtle

species versus mammal species. If the turtle species are changed, this code would also need to be updated in the code.

CruzPlot Manual

Opening this tab will display this manual. If CruzPlot is open in an external RStudio window, the manual is opened in an external window. If the user closes this external manual, they cannot reopen the manual until they restart CruzPlot.