CruzPlot

A Mapping Program in R

v1.2

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Contents

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 both download bathymetric data from the ETOPO1 database hosted on the NOAA website, and shade and/or contour depth data from a local file.
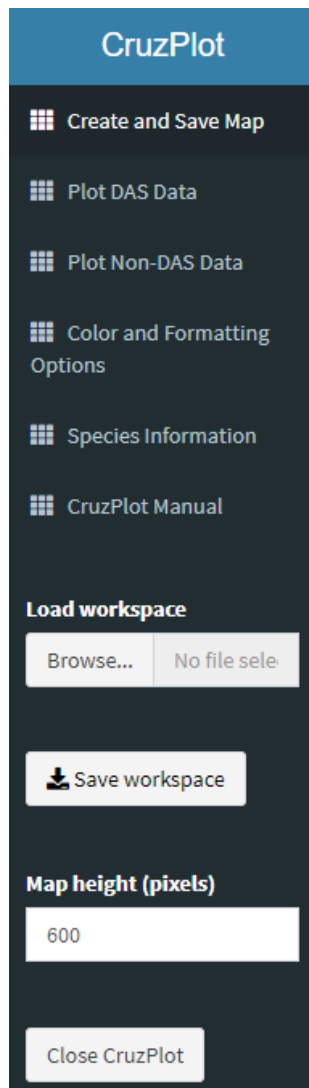
After a map has been created, marine mammal and turtle sightings and transect-line effort can be plotted directly from DAS files. Sightings and effort may be filtered by mode, effort type, Beaufort sea state, date, cruise number, and perpendicular distance from the trackline. After data have been plotted, 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 using the "shiny" and "shinydashboard" R packages. Each time a new value is entered through the interface, CruzPlot updates the plot using what Shiny calls 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 actions such as plotting and replotting detailed depth data will always take a long time.

The Shiny app is included in the R package CruzPlot, which is available for download from GitHub as described at https://smwoodman.github.io/CruzPlot/. In short, the user can run 'devtools::install_github("smwoodman/CruzPlot")' in R, once they have devtools installed, to install the package. This website also contains a link to this manual, a link to the GitHub issues page to report a bug, and a 'Changelog' that describes changes in CruzPlot functionality across versions. Also of note, CruzPlot comes with a default 'SpCodes.dat' file for matching species codes with species names. For shipboard use, the package and depth files of the area of interest should be downloaded locally prior to the cruise.

To open the CruzPlot application, download the CruzPlot package and run 'CruzPlot::cruzplot_gui()' in the RStudio window. CruzPlot may launch in an RStudio 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, e.g. Google Chrome.

CruzPlot Sidebar Menu

CruzPlot

- Create and Save Map
- Plot DAS Data
- Plot Non-DAS Data
- Color and Formatting Options
- Species Information
- CruzPlot Manual

Load workspace

Browse...   No file sele

Save workspace

Map height (pixels)

600

Close CruzPlot

When CruzPlot is opened, the Create and Save Map page will be selected, and you will see a map with default coordinates of -135º, -110º, 27º, and 52º (the CCE). You can easily update this value using the default map ranges. 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 described in detail in this manual. 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 return to the Create and Save Map page and make your changes while the data plotted on the map stay the same. If you wish to remove plotted DAS or non-DAS data, you can 1) unselect the plot sightings, plot effort, or plot non-DAS data selections, or 2) close CruzPlot and reopen the program.

Also on the sidebar menu are options to load or save a CruzPlot workspace, update the map height (in pixels), and a button to close the program. A saved workspace allows users to pick up where they left off, and includes but is not limited to: current map parameters, planned transects, coastline data, DAS data, non-DAS data, currently plotted species, and currently plotted effort. A saved workspace must have an '.RDATA' file extension, and has a specific internal format. Thus, this file should not be manually altered. You can load a saved workspace using the 'Load workspace' option.

Create and Save Map

Range

| Range | Planned Transects | Ticks & Labels | Map Labels | Color | Grid | Save | Map |

Map range   −

For longitude values, please use the range -180 to 180. For instance, use left and right longitudes of 130 and -110, respectively, for a map of the northern Pacific.

Click the 'Replot map' button after changing map range values, or if the map isn't properly sized in the window.

In addition, users can automatically change the map range input values by clicking and holding to draw a box on map, although users still must click 'Replot map'. To clear the box, click within the plot outside of the box.

Left longitude	Right longitude	Bottom latitude	Top latitude
-135	-117	29	52

Resolution

Low ▼   [Replot map]

Set the map range to a default study area and replot:

[CCE] [Extended CCE] [ETP] [Hawaii] [Marianas]

Scale bar   −

☑ Plot scale bar

Provide the coordinates for the left edge of the scale bar. The coordinates must have the same range as the map range coordinates.

Longitude	Latitude	Width of bar
-133.2	31.3	2

Scale bar units

○ Kilometers
● Nautical miles

Length in nmi

180

Coastline   −

☐ Use coastline file

Map range
- General: You can automatically select an area on the map to zoom in on by clicking and holding to draw a box on map. Drawing this box, which will appear blue on the map, will update the input values. Then you can click 'Reset map' to actually redraw the map. If you clear the box by clicking outside of it but still

within the map area, then the map range input values will reset to the current map range. This feature is only available when the 'Map range' tab is selected.

- *Left and Right longitude* – Left and right limits of map in decimal degrees, using negative for west. The range for both values is [-180, 180], and thus for a Pacific map you could enter 130 and -110 for the left and right longitude, respectively.
- *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 package 'map'.
- *Replot map* – Click to replot map with updated map range. This button keeps the map from attempting to update while you are typing new coordinates. If you resize your browser window and the map is awkwardly sized, you can also click this button to regenerate the map for the new browser window size.
- *Default map ranges* – Click the buttons to automatically set the map range values and plotted map range to a default study area.

Scale bar
- General: The scale bar follows the following behavior:
  - If the scale bar is not plotted ('Plot scale bar' is not checked) and the map range is changed, then the scale bar position and length are automatically updated to the defaults.
  - If the scale bar is plotted ('Plot scale bar' is checked) and the map range is changed, then a) the scale bar length is not changed and b) the scale bar coordinates are updated only if the point specified by the coordinates is not within the new map range - otherwise they stay the same.
- *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). Updating this only changes the length unit, nothing else.
- *Length* – length of scale bar in km or nmi, printed as a label below the bar on the map. The value is reset to the default (20% of the map width) when map limits are changed.
- *Width of bar* – relative thickness of scale bar; appearance may vary with monitor or printer.

Coastline
- *Load coastline file* – A coastline CSV file must consist of a two columns with the headers 'lon' and 'lat' representing longitude and latitude points, respectively. Currently CruzPlot can only process coastline files with points are between -180° and 0°.
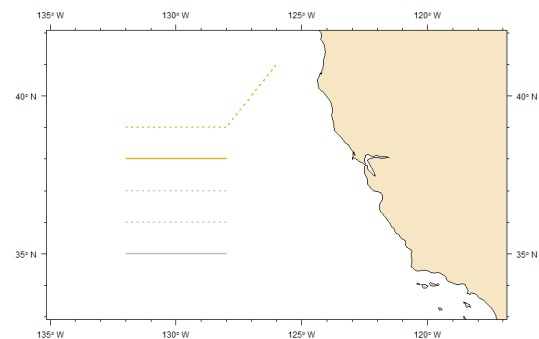
Planned Transects

Load planned transects
- *Load planned transects CSV file* – Load planned transect CSV file, which 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]. See screenshot of an example planned transect CSV below.
- *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 (if applicable). You can line type-code the planned transects by their class 2 values.
- *Add data to CruzPlot* – Click to add the planned transect data in the loaded file to CruzPlot. This will overwrite any previously loaded planned transect data. A blue message will be printed when data is loaded

Example CSV file and resulting map, given selections made in the screenshot above

	A	B	C	D	E
1	lon	lat	transect_num	transect_class	transect_class2
2	-132	35	1	a	x
3	-128	35	1	a	x
4	-132	36	2	a	y
5	-128	36	2	a	y
6	-132	37	3	a	y
7	-128	37	3	a	y
8	-132	38	4	b	x
9	-128	38	4	b	x
10	-132	39	5	b	y
11	-128	39	5	b	y
12	-126	41	5	b	y

Plot loaded planned transects – section only displayed when planned transects are loaded
- *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. Only available if a class 2 column was specified when loading the data
- *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 positive number. You can only specify of line width for all plotted transects

Ticks & Labels

- *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 display or hide associated tick marks, respectively.
- *Degrees between each major tick* – The number of degrees between major (large and labeled) tick marks; default depends on map size.
- *Minor ticks between each major tick* – The number of tick marks between each major tick. Default is 4.
- *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 display or hide associated tick labels, respectively.
- *Start longitude tick labels at* – Left-most longitude on the map at which to start labels on major tick marks, using negative for west. The default is the first default 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. The default is the first default major tick north of 'Bottom latitude'.
- *Tick label font* – Font for tick and axis labels. See the Color and Formatting Options for 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. Delete all text to clear the title.
- *Title font* – Font for map title.
- *Title size* – Relative size of the map title.

Axis labels
- *Longitude axis label* – Enter text for optional label below the bottom axis. Delete all text to clear the label.
- *Latitude axis label* – Enter text for optional (vertical) label along the left axis. Delete all text to clear the label.
- *Axis label font* – Font for axis label(s).
- *Axis label size* – Relative size of text for axis label(s).

Color

Color style
- *Color style* – Select the color palette for the map: either color or grey scale. The color style choice applies to the map land and water, as well as to all symbols, lines and text (e.g. DAS sightings) plotted on it. See the Color and Formatting Options page for available colors for each color style.

Land
- *Color all land* – Check this box to color all land. If unchecked, all land is white.
- *Land color* – Select a color for land areas; only available if 'Color all land' is checked.

Water
- *Color lakes and rivers* – Check this box to include lakes and rivers on the map. They will have the color specified in 'Water (background) color'.

- *Water (background) color* – Color of water areas, including the water area not covered by the depth file (if applicable).
- *Ocean color style* – "Single color" allows you to select a uniform color, while "Depth shading" allows you to choose bathymetric data to plot.
- *Bathymetric CSV file* – Load a CSV file with 3 columns: longitude, latitude, and depth. This file should ideally be downloaded using the 'Download bathymetric data' section.

Download bathymetric data
- *Bathymetric data resolution* – The resolution (in minutes) of the bathymetric data to download. This value must be a whole number between 0 and 60.
- *Download bathymetric file* - CruzPlot will use the R package marmap to download a file for the given latitude and longitude coordinates and resolution (in minutes) from the ETOPO1 database hosted on the NOAA website. The user can save this CSV and then load it via 'Bathymetric CSV file'.

Grid

| Range | Planned Transects | Ticks & Labels | Map Labels | Color | Grid | Save | Map |

Grid —

☑ Include grid lines at major tick marks

Line color	Line width	Line type
Black ▼	1	Solid ▼

Grid

- *Include grid lines* – Check to show grid lines on the map at major tick intervals. Grid lines can be shown even if the tick marks or labels are not 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

Save map
- *File format* – File type (format) of the downloaded map (saved file).
- *File dimensions* – Specify whether you want the downloaded map to have the same dimensions (width and height) as the displayed map, or whether you want to specify them yourself. Note that the size of text and plotted values may be different if you specify the file dimensions yourself.
- *Resolution (ppi)* – Resolution of the downloaded file in pixels per inch (ppi). This must be a whole number greater than zero. A standard resolution is traditionally 72, while a high resolution value is traditionally 300. This argument is ignored when saving the map as a PDF.
- *File width (inches)* – Width of the saved file in inches; only available when "Specify dimensions" is selected.
- *File height (inches)* – Height of the saved file in inches; only available when "Specify dimensions" is selected.
- *Download map* – Open the download window where you can specify the name and location of where to save the map. Note: there have been issues downloading maps when CruzPlot is run through RStudio on a Windows computer. If you have these issues, try running CruzPlot in a browser and then saving the map. Also, be sure to specify the file extension if saving file through the RStudio 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 by the SWFSC to record searching effort and sightings of mammals, turtles, and boats. CruzPlot uses the R package swfscDAS.for primary DAS data processing.

Data

DAS data
- General: CruzPlot uses the das_read and das_process functions of swfscDAS to read and process the loaded DAS file(s). CruzPlot contains a 'click here' link the will open local documentation. The official documentation for these functions, and their arguments, can be found here and in the swfscDAS package.
    - *Number of lines to skip before reading data* – The number of lines of each DAS file that will be ignored before reading data.
    - *days.gap* – The time gap (in days) used to identify a new cruise in concatenated DAS files.
    - *reset.event* – A logical indicating if state/condition information (weather, Bft, Mode, etc.) should be reset to NA if there is an applicable event with an NA for that state/condition

15

- o *reset.effort* - A logical indicating if state/condition information should be reset to NA when beginning a new continuous effort section (i.e. at each R event).
  - o *reset.day* – This argument is always set to TRUE, and means that all conditions will be reset to NA at the beginning of each day. Thus, condition information is not carried over from day to day.
- *DAS file input* – Click Choose File to select one or more DAS data files. A blue message is printed with the file names of the currently loaded DAS file(s)

Species codes
- General: A species codes file must be used to 'translate' the species codes recorded in the DAS data to scientific or common names. A blue message is printed when either the default or a personal file is loaded.
- *Load species codes file* – Load a personal species code file if desired
- *Load default species codes* – Load the default SpCodes.dat file included in CruzPlot. This file was last updated by Jim Caretta on 26 May 2020.

Species codes file format:
- General: White space is trimmed from both the left and right sides of the data extracted from the species codes file. It is assumed that every new line indicates a new species
- Data
  - o Species codes: columns 1 to 4
  - o Species abbreviation: columns 6 to 17
  - o Scientific name: columns 18 to 57
  - o Common name: columns 58 to the new line
- Note that the following species codes are hard-coded as turtle species within CruzPlot. If these turtle species are updated, these values will need to be changed within CruzPlot.
  - o Turtle species: CC, CM, DC, EI, HT, LK, LV, ND, UH, UT

Sightings

Data   **Sightings**   Sighting Filters   Effort   Legends   Tabular Output

Plot DAS Sightings and Effort

Sightings   −

☑ Plot sightings

Position to plot

◉ Plot ship position

○ Plot sighting position

Sighting position is calculated using the ship position, ship course, sighting bearing (angle), and radial distance to the sighting. If any of these values are NA, then the sighting position will be NA

Sighting type & species   −

Sighting type

Mammals ▼

○ Plot all mammal sightings

◉ Plot selected mammal sightings

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

Select mammal species

[   ]

☐ Use probable species code

Plot sightings from (click here for details)

☑ S events ☐ G events ☐ K events ☐ M events
☐ p events ☐ s events ☐ g events ☐ k events

Symbol properties   −

Not available when 'Plot all...sightings' is selected

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

The order in which species are selected to be plotted corresponds to the order of specified symbol properties

Symbol type(s)

1: Open Circle

Symbol color(s)

Black

Symbol size(s)   **Symbol line width(s)**

1   1

☐ Input symbol properties as text

Interactive sighting labels   −

◉ Non-interactive plot
○ View and label sightings interactively

[Remove last sighting label]   [Remove all sighting labels]

Sightings

- *Plot sightings* – Check to plot sightings, or uncheck to remove sightings.
- *Position to plot* – Specify whether the point plotted on the map should be the ship or sighting position. CruzPlot calculates the sighting position using the destPoint function from the geosphere package, with the provided arguments being the ship position, the ship course plus sighting bearing (angle) modulo 360, and the radial distance to the sighting, respectively. The defaults are used for the other

arguments. If any of these values are NA, then CruzPlot will print a message and not plot the sighting.

Sighting type & species
- *Sighting type* – Choose "Mammals", "Turtles", or "Boats". Marine mammal sightings are recorded using S, G, K, M, and p events, while turtle and boat sightings are recorded using t and F events, respectively.
- *Plot all sightings* – Plot all sightings in the DAS file(s) of the specified sighting type.
  - If "Plot all species" is selected, sighting codes in the DAS file will automatically be assigned various combinations of symbols and colors. Use the legend to identify sightings on the map. If you select "Boats", there are no additional selection options.
- *Plot selected sightings* – Plot selected (can select multiple) mammal or turtle species codes. The codes in the dropdown menu are generated from the species codes file. Marine mammal codes are displayed with the abbreviation column from the species codes column, while turtle codes are displayed with the corresponding scientific name. See the Species Information page to see other associated names for the species codes.
- *Include probable species sightings* – If checked, mammal sightings will use the associated probable species code, if applicable. Note that this also means that species code "977" (used as probably vaquita sighting on some cruises) will be updated to "041" (vaquita).
- *Plot sightings from* – For marine mammal, filter the sightings by the selected species code(s). This filter is secondary to the species filter. Click the 'click here for details' link for local documentation about how these event codes are used. When plotting resights (s, k, and g events), specific rules apply:
  - Only one DAS file can be loaded, and you must be careful that you are not using a concatenated DAS file that has multiple primary sighting events with the same sighting number
  - Only one mammal species code can be selected
  - Exactly two event codes must be selected: S and s, K and k, or G and g.
  - The 'Symbol color…' input corresponds to the event code, meaning the first color corresponds to the S/K/G events and the second color (if any) corresponds to the s/k/g events

Symbol properties – not available when "Plot all…sightings" is selected
- General: The order of each value corresponds to the order of the sighting codes, although if the "Boats" sighting type is selected then you will only be able to make one selection for each symbol property. If fewer values than species codes are selected, the values are recycled in order for that symbol property. However, you cannot select more values than species codes. When 'Input symbol properties as text' is checked, a single comma must separate multiple values. See the Color and Formatting Options page for examples of all of the symbol properties, and their corresponding codes and names

- *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. The values must be separated by a single comma.
- *Symbol type(s)* – Select symbol(s) to be plotted, one symbol for each species code, or a single symbol for all species. When 'Input symbol properties as text' is checked, the entered symbol types must be the numeric codes of the different symbols (e.g. "1" for an open circle).
- *Symbol color(s)* – Select color(s) of the symbol(s), anywhere from one color for each symbol to a single color for all symbols. When 'Input symbol properties as text' is checked, the entered color values must be valid color names. See the Color and Formatting Options page for valid color names.
  - When a resight event is selected to be plotted, these colors corresponds to the event code, meaning the first color corresponds to the S/K/G events and the second color (if any) corresponds to the s/k/g events
- *Symbol size(s)* – Size(s) for all symbols relative to standard 1.0. Multiple values must be separated by a single comma, such as "1.2, 1"
- *Symbol line width(s)* – Line width(s) for all symbols relative to standard 1.0. Multiple values must be separated by a single comma, such as "1, 2"

Interactive sighting labels
- *View and label sightings interactively* – The interactive map allows users to view and label information about a sighting, specifically the sighting number and coordinates, date, and time of the sighting. Hovering the mouse over a sighting will display the information, while clicking will print the label on the map. The identified sighting is the sighting point closest to the cursor; a warning will be printed if there is no point close enough to the cursor. Note that while "Non-interactive plot" will be automatically selected when the user switches to a new page or tab, the printed labels will remain on the map. Labels will be removed if the selected species or sighting filters change, or they can be manually removed using the 'Remove…' buttons.
- *Remove last sighting label* – When clicked, the last interactive sighting label added to the map is removed.
- *Remove all sighting labels* – When clicked, all interactive sighting labels are removed.

Sightings Filters

Sightings to plot
- Choose one of the following options: all sightings, only on-effort sightings, or only off-effort sightings. Uncheck the "Plot sightings" box in the Sightings tab to remove all plotted sightings.
- *Mode* – Filter the sightings by effort mode (closing or passing). This filter only applies when "On effort" is selected for 'Sightings to plot'
- *Effort type* – Filter the sightings by effort type (standard, non-standard or fine). This filter only applies when "On effort" is selected for 'Sightings to plot'

Filters for sightings
- General: A pop up window will be displayed if there are any sightings that were filtered out because they had an NA value for one of the filter values. This notice will be shown any time a sighting filter value is changed.
- *Minimum and Maximum Beaufort* – Only plot sightings with an associated Beaufort sea state value equal to or between the min and max Beaufort values. The minimum value must be less than or equal to the maximum value. If these values are zero and nine, respectively, then sightings with NA Beaufort values (e.g. some off effort sightings) will be plotted

- *Date range* – Only plot sightings recorded on or between the specified dates. The default is the complete date range in the provided DAS file(s).
- *Cruise number(s)* – Only plot sightings with the selected cruise number(s). This input is a dropdown menu with the cruise numbers identified in the loaded DAS file(s). If blank, all sightings are plotted, including those with NA cruise numbers.
- *Truncation (units)* – Only plot sightings with a perpendicular distance (from the trackline) less than or equal to the truncation value (note units). The perpendicular distance is calculated in kilometers by the das_sight function from swfscDAS, and converted to the unit specified in *Truncation distance units*. If blank, all sightings are plotted, including those with NA perpendicular distances.

Effort

Effort to plot
- Choose one of the following options:
  - "No effort lines": effort is not plotted (default).
  - "Simplified effort": lines are drawn between every R and E event. All effort segments have the same color and line width.
  - "Detailed effort": for each pair of R and E events, effort segments run 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 and filter effort by Beaufort. Of note: the R to V segments (the first segment of each effort section) is filtered out (i.e. not plotted or included in tabular effort) because it does not have a defined Beaufort value. The segment is usually of length zero, so this generally should affect any output.
- *Mode* – Filter the effort by effort mode (closing or passing).

- *Effort type* – Filter the effort by effort type (standard, non-standard or fine). 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 – simplified effort
- *Simplified effort line color and width* – The color and line width of the simplified effort lines; each effort line will have the same color and line width.

Line properties – detailed effort – by effort type
- *Standard effort line color and width* – The color and line width of the standard effort lines.
- *Non-standard effort line color and width* – The color and line width of the non-standard effort lines.
- *Fine scale effort line color and width* – The color and line width of the fine scale effort lines.

Line properties – detailed effort – by Beaufort
- General: Displayed when 'Show effort by Beaufort' is checked.
- *Beaufort colors* – Ten colors must be selected. These colors correspond to, in order, the ten possible Beaufort values from zero to nine. By selecting ten colors, the colors will stay the same even if the Beaufort filters are used.
- *Line width* – The line width of all of the detailed effort lines

Effort filters
- General: A pop up window will be displayed if there are any effort lines that were filtered out because they had an NA value for one of the filter values. This notice will be shown any time an effort filter value is changed.
- *Use filters from Sightings Filters* – If checked, effort lines will be filtered by filters from Sightings Filters. If unchecked, effort filter options will appear.
- *Minimum and Maximum Beaufort* – Only plot effort lines with an associated Beaufort sea state value equal to or between the min and max Beaufort values. The minimum value must be less than or equal to the maximum value. If these values are zero and nine, respectively, then effort lines with NA Beaufort values will be plotted
- *Date range* – Only plot effort lines recorded on or between the specified dates. The default is the date range in the provided DAS file(s).

- *Cruise number(s)* – Only plot effort lines with the selected cruise number(s). This input is a dropdown menu with the cruise numbers identified in the loaded DAS file(s). If blank, all effort lines are plotted, including those with NA cruise numbers.

Interactive effort labels
- *View and label effort lines interactively* – Note this feature can only be used with simplified effort. The interactive map allows users to view and label information about an effort line, specifically the date, time, and starting and ending coordinates. Hovering the mouse over an effort line will display the information, while clicking will print the label on the map. The identified effort line is the line with the starting or ending point closest to the cursor; a warning will be printed if there are no points close enough to the cursor. Note that while "Non-interactive plot" will be automatically selected when the user switches to a new page or tab, the printed labels will remain on the map. Labels will be removed if the selected 'Effort to plot' or effort filters change, or they can be manually removed using the 'Remove…' buttons.
- *Remove last effort label* – When clicked, the last interactive effort label added to the map is removed.
- *Remove all effort labels* – When clicked, all interactive effort labels are removed.

Legends

Sightings legend
- *Include legend for sightings* – As it sounds
- *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.
  - *Longitude, Latitude* – Position of the upper left corner of the legend using decimal degrees (negative values for south and west). Only available when "Specify" is selected for 'Position'.
- *Font* – Font for text in the legend.
- *Title* – Title for legend (optional). Delete all text to remove the title.
- *Box style* – Choose a white legend box with a black border (default), a white legend box without a border, or a transparent background with no border.
- *Legend size* – Relative size of legend.
- *Legend sighting information* – Include the information to be included for each species code in the legend. One of the four species identifiers must be selected. If 'Include number of sightings' is checked, then the end of each legend label will

include the number of plotted points for that species code as "n = #". Note that this is the number of sightings within the plotted area that satisfy the specified filters, not all of the sightings for that species in the DAS file. If a resight event is plotted, then there will be exactly two lines in the legend: the first for the primary sighting event and the second for the resight event.

Effort legend
- *Include legend for effort* – as it sounds
- General: All options are described in the 'Sighting legend' section. When plotting detailed effort by Beaufort, only the Beaufort codes specified via the effort Beaufort filters will be displayed. When plotting detailed effort by effort type, only the effort types specified in the effort type filter will be displayed.

Tabular Output

Data   Sightings   Sighting Filters   Effort   Legends   **Tabular Output**

Plot DAS Sightings and Effort

Effort

Reports the distance traveled while on effort, summarized by effort type. The effort that is summarized is the same as the effort that is plotted, i.e. it has been filtered using the same filters (mode, effort type, date, Beaufort, and cruise number) specified in the 'Effort' tab

◉ Distance unit: kilometers
◯ Distance unit: nautical miles

Beaufort	Standard	Non-standard	Fine	Total
All	112.41	7906.08	4650.67	12669.17

⤓ Save effort table

Sightings

Reports the number of sightings with the selected species, summarized by effort type. The sightings that are summarized are those that are plotted, i.e. they have been filtered using the same filters (species, on or off effort, mode, effort type, date, Beaufort, cruise number, and truncation distance) specified in the 'Filters' tab

Additional species information to include

☐ Species abbreviation   ☐ Scientific name   ☐ Common name

☐ Include an 'All' summary row

Species code	Standard	Non-standard	Fine	Off effort	Total
018	1	13	0	1	14
037	0	2	8	1	10
075	0	25	17	11	42
079	0	12	28	2	40
199	0	43	36	5	79

⤓ Save sightings table

Effort
- Distance calculation: The distance between points is calculated using the distVincentyEllipsoid function from the geosphere package, using the default function arguments.
- *Distance unit* – Specify whether the value displayed in the table should have units or kilometers or nautical miles, respectively.
- Table: Summarizes distance traveled while on effort, grouped by effort type and, if "Detailed effort" effort is selected, Beaufort sea state. If an effort type is not plotted, then the corresponding column contains all NAs. The effort is filtered as

specified in the 'Effort filters' section before being summarized, including filtering for effort lines with both the start and end points within the map range. In other words, only the lines drawn on the map are included in the distance sums.

- Save effort table – Download the displayed tabular effort summary.

Sightings
- *Additional species information to include* – Check to include addition species information in the tabular sighting output.
- *Include an 'All' summary row* – Check to include a row at the bottom of the table that contains the sum of the applicable columns of the tabular sighting output.
- Table: Summarizes the sightings by species code and the effort type when the sighting occurred. If an effort type is not plotted, then that column contains all NAs. The filters applied to the plotted sightings, including geographic extent, are also applied to the sightings summarized in the tabular output.
- *Save sightings table* – Download the displayed tabular sighting summary.

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 (e.g. to show locations of samples) or lines (e.g. to show boundaries of a study area). After loading the data into CruzPlot, the data are saved and available for later plotting at any time.


Loaded data
- Table: These non-DAS data are loaded and saved when the user clicks 'Add non-DAS data to CruzPlot'. The user can click table rows to select them, and then remove the selected data by clicking 'Remove selected non-DAS data'

Example CSV file and resulting map, given selections made in the screenshot above

	A	B	C
1	Longitude	Latitude	ID
2	-130	41	1
3	-131	42	2
4	-132	43	3
5	NA	NA	4
6	-133	44	4
7	-133	45	5
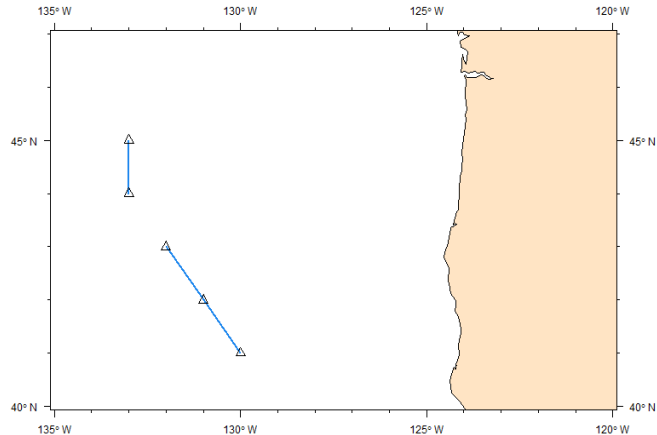
Load data
- *Load non-DAS CSV file* – Load a non-DAS data file to plot. The data file must have headers and two columns with longitude values and latitude values as signed decimal values in degrees. The longitude column must be named one of 'Longitude", "longitude", LONGITUDE", "Lon", "lon", or "LON", while the latitude column must be named one of "Latitude", "latitude", "LATITUDE", "Lat", "lat", or "LAT".
- *Type of data* – Choose whether the data should be plotted as point(s) or line(s).
  - o If you select "Point": each coordinate (longitude/latitude pair) will be plotted as a point using graphics::point(). Rows with an NA value for either coordinate will be ignored.
  - o If you select "Line": the longitude and latitude columns will be passed to the x and y arguments of the graphics::line() function. The coordinates can contain NA values. If a point contains NA in either its x or y value, it is omitted from the plot, and lines are not drawn to or from such points. Thus, missing values can be used to achieve breaks in lines.
- *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
- *Plot loaded non-DAS data* – Uncheck this box to remove plotted non-DAS data.
- *Select non-DAS data to be plotted* – Select loaded data to be plotted, or remove data that should not be plotted. The options are loaded data shown in the Loaded data table. If 'Plot loaded non-DAS data' is checked, then at least one piece of loaded data must be selected to plot

Color and Formatting Options

Symbols, colors, line types and fonts are specified by character and/or numerical codes. A display of available choices can be produced by clicking on the Color and Formatting Options page, 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 and 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.

If the CruzPlot window is resized and the options do not properly display, click 'Redraw display'.

Species Information

This page displays tables of all the mammal and turtle species and their corresponding codes. These codes and names are read from the species codes file loaded in the 'Plot DAS Data – Data' section. Users can display mammal and turtle information separately or together, and can also can search by code or name.

Species are identified in the DAS data by a species code consisting of a series of numbers or letters. 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 codes/species are changed, this information would also need to be updated in the CruzPlot code.

CruzPlot Manual

This page displays the manual. If CruzPlot is open in an external RStudio window, the manual may be opened in an external window. If the user closes this external manual, they cannot reopen the manual until they restart CruzPlot and the external window is generated again. The height of the manual display follow the 'Map height' entry in the sidebar. The manual can also be accessed at https://smwoodman.github.io/CruzPlot/.