

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, maps, mapdata, marmap, and stringr. In the same folder as the interface file ui.R and the calculations file server.R, CruzPlot requires, at a minimum, the files "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. **Starter lines ...?**

To run CruzPlot, open either the ui.R or server.R file in an R editor such as RStudio or Tinn-R. Enter “runApp()” on the command line or click “runApp” in the upper corner of RStudio. CruzPlot will launch in a browser window. If using RStudio, the browser window will be fixed in size and maps cannot be downloaded and saved. If you run CruzPlot in a separate browser window by clicking “Open in Browser” on the top bar of RStudio, this will allow the zoom and save functions to work. This “Open in Browser” action does not require internet access; it simply runs the program through your default browser.

CRUZPLOT SIDEBAR MENU DETAILS

Create and Save Map

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 -160°, -75°, -20°, and 34° (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.

Size

Size

Ticks & Labels

Map Labels

Coloring

Grid & Projection

Save

Map

Map Limits

—

Longitude range is -180 to 180. Thus, an example longitude for a Pacific-centered map would be Left longitude = 120 and Right longitude = -90

Left longitude	Bottom latitude
<input type="text" value="-160"/>	<input type="text" value="-20"/>
Right longitude	Top latitude
<input type="text" value="-75"/>	<input type="text" value="34"/>

Resolution

Low

▼

Scale Bar

—

☒ Include scale bar

Longitude	Latitude
<input type="text" value="-151.5"/>	<input type="text" value="-14.6"/>
Length in km	Width of bar
<input type="text" value="1000"/>	<input type="text" value="2"/>

- 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.
- Include scale bar – check to show a simple scale bar on the map. Strictly speaking, the scale bar is accurate only at the midpoint of the latitude range (i.e., across the middle of the map).
- 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.
- Length in km – length of scale bar in kilometers, 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.

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

15

Minor ticks between each major tick

2

Tick label style

120°W

Tick length

1

Tick Labels

☒ Left

☒ Right

☒ Bottom

☒ Top

Start longitude tick labels at

-150

Start latitude tick labels at

-15

Tick label font

Sans

Tick label size

1

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

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

Title

Map title

Title font

Sans

Title size

1.5

Axis Labels

Longitude axis label

Latitude axis label

Axis label font

Sans

Axis label size

1.2

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

Size

Ticks & Labels

Map Labels

Coloring

Grid & Projection

Save

Map

Projection

Map projection

☒ Cylindrical

Projection factor

0

Grid

☒ Include grid lines

Line color

Black

Line type

Solid

Line width

1

- Map projection – the only implemented projection is cylindrical, which is the default for the “maps” package.
- Projection factor – not currently implemented.
- 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

Size

Ticks & Labels

Map Labels

Coloring

Grid & Projection

Save

Map


Save map

Download map as

☐ jpeg

☐ pdf

☒ png

 Download map

- 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.

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 & Sightings

Sightings Filters

Sightings Legend

Effort

Plot Sightings/Effort

Data

DAS file input

Choose File no file selected

Sighting Type and Codes to Plot

Sighting type

Mammals

☐ Plot all mammal sightings

☒ Plot selected mammal sightings

☐ Include probable species sightings

Sighting codes and scientific names

Sightings

☒ Plot sightings

Symbol Properties

Symbol type(s)

1: Open Circle

Symbol color(s)

Black

Symbol size(s)

1

Symbol line width(s)

1

☐ Input symbol properties as text

Interactive Sighting Labels

☒ Non-interactive plot

☐ Label sightings interactively

Remove last sighting label

Remove all sighting labels

- DAS file input – click Choose File to select DAS data file.
- Plot sightings – check to plot sightings, uncheck to plot effort only.
- 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 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 – “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

Data & Sightings	Sightings Filters	Sightings Legend	Effort	Plot Sightings/Effort
<div><h3>Sightings to Plot</h3><p><input checked="" type="radio"/> On and off effort <input type="radio"/> On effort only <input type="radio"/> Off effort only</p><p>Note: Plotting effort lines is done under the Effort tab</p></div>		<div><h3>Filters for Sightings</h3><div><div>Minimum Beaufort</div><div>0</div></div><div><div>Maximum Beaufort</div><div>9</div></div><div><div>Range of dates from which to plot sightings</div><div><div>1960-01-01</div><div>to</div><div>2015-08-26</div></div></div><div><div>Only sightings from entered cruise(s) will be plotted. Enter cruise numbers: as 'number, number'</div><div>Cruise number(s)</div></div><div><div>Only sightings less than or equal to this perpendicular distance from the trackline will be plotted</div><div>Truncation (km)</div></div></div>		

- 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.
- 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.

Sightings Legend

Data & Sightings

Sightings Filters

Sightings Legend

Effort

Plot Sightings/Effort

Legend for Sightings

☒ Include legend

Legend Contents

Title (optional)

Legend sighting information

☐ Species code

☐ Species abbreviation

☒ Scientific name

☐ Common name

☐ Include the number of sightings

Legend Options

Position

Top Left

Box color

White with border

Font

Sans

Text size

1

- Include legend – if checked, a legend for the sightings will be plotted.
- 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.
- 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 color – choose a white legend box with black border (default), white legend box without border, or transparent background.
- Font – font for text in the legend.
- Text size – relative size of legend text.

Effort

Data & Sightings	Sightings Filters	Sightings Legend	Effort	Plot Sightings/Effort
<div>Effort to Plot</div> <div><input type="radio"/> No effort lines <input type="radio"/> Simplified effort <input checked="" type="radio"/> Detailed effort</div>		<div>Line Properties</div> <div>Line color: Black Line width: 2</div>		
<div>Effort Types</div> <div><input checked="" type="checkbox"/> Closing <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Passing <input type="checkbox"/> Non-standard <input type="checkbox"/> Fine</div>		<div>Effort Filters</div> <div><input type="checkbox"/> Use filters from Sightings Filters Minimum Beaufort: 0 Maximum Beaufort: 9 Range of dates from which to plot effort lines: 1960-01-01 to 2015-08-26 Only effort lines from this cruise number will be plotted Cruise number(s): <input type="text"/></div>		
<div>Interactive Effort Labels</div> <div><input checked="" type="radio"/> Non-interactive plot <input type="radio"/> Label effort lines interactively <div>Remove last effort label</div><div>Remove all effort labels</div></div>				

- Effort to plot – select one option:
 - No effort lines: effort is not plotted (default).
 - Simplified effort: lines are drawn between positions of B (begin) and the last (before next B) E (end) records in the DAS file. Normally this will produce a single, straight line segment for each day. This simple representation of effort will plot quickly and will generally be an adequate representation of effort for a map of a large area. However, it will not be accurate in some circumstances – for example, if effort for the day included a turn at a waypoint, or if there was an extended off-effort period in the middle of the day.
 - Detailed effort: lines are drawn between each pair of R (resume) and E (end) records in the DAS file. This representation of effort takes a bit longer, but gives a detailed plot of each segment covered on effort. It assumes straight lines between R and E positions in the DAS file.

- Effort Types: Closing/Passing – select to plot effort in closing mode (default), passing mode, or both, and/or sightings during such effort.
- Effort Types: 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.
- 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.
- Line color – color of effort lines. Open the **Color/Formatting Options** tab for color choices.
- Line width – relative thickness of effort lines.
- 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.

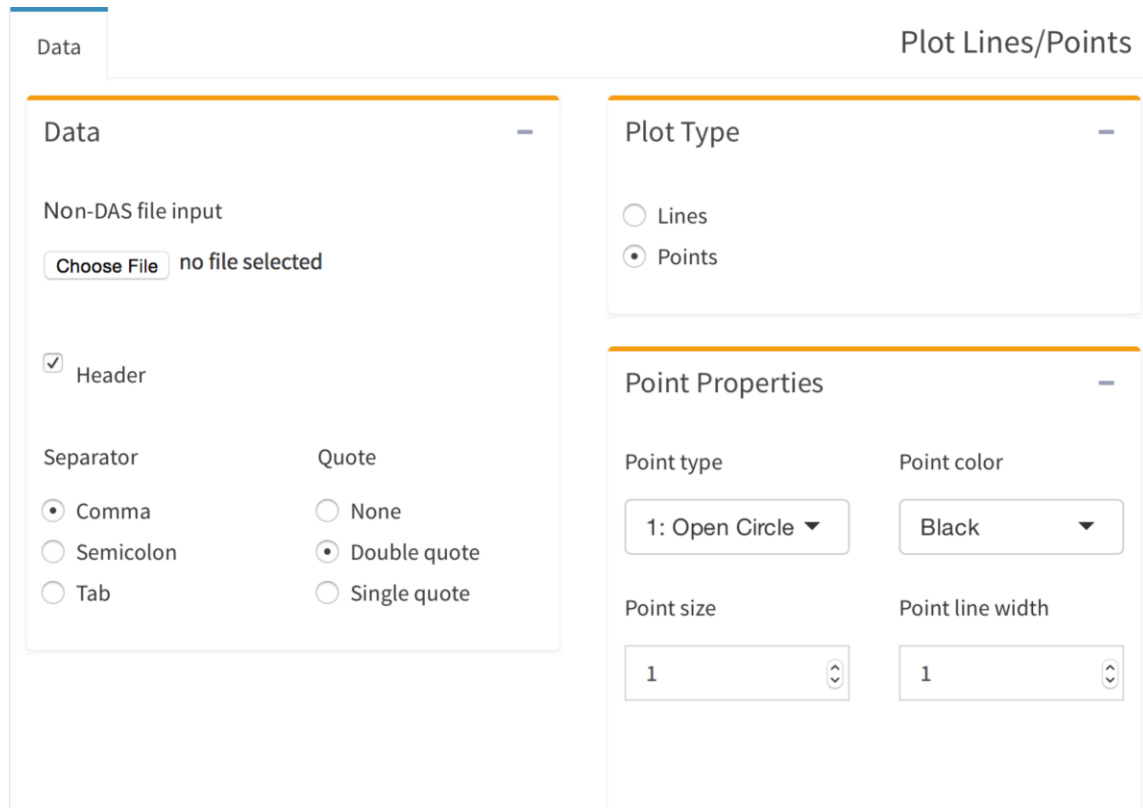
Notes:

- (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). If this is not the case, effort is not plotted and a warning is issued.
- (3) Warnings are issued if more symbol properties than species codes are selected/entered.

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



The interface is titled "Data" and "Plot Lines/Points".

Data Section:

- Non-DAS file input:** A button labeled "Choose File" and the text "no file selected".
- Header:** A checkbox labeled "Header" which is checked.
- Separator and Quote options:**

Separator	Quote
<input checked="" type="radio"/> Comma	<input type="radio"/> None
<input type="radio"/> Semicolon	<input checked="" type="radio"/> Double quote
<input type="radio"/> Tab	<input type="radio"/> Single quote

Plot Lines/Points Section:

- Plot Type:** Radio buttons for "Lines" and "Points". "Points" is selected.
- Point Properties:**
 - Point type:** A dropdown menu showing "1: Open Circle".
 - Point color:** A dropdown menu showing "Black".
 - Point size:** A spinner box showing "1".
 - Point line width:** A spinner box showing "1".

- Non-DAS file input – click Choose File to select a non-DAS data file to plot. You can specify properties of the data file. Quote specifies what is used as quotes in the file. The data file must have 2 columns: longitude values and latitude values, in that order, as signed decimal values in degrees.
- Plot type – 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 or a single comma) 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.

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. **Not Implemented**

Close CruzPlot

Clicking this button will cause the program to quit. The program can also be quit by simply closing the program window.