Viewing Data

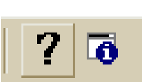
To Create a Project

To view data you must first Query the database in order to extract the data you want to View. When you have Queried the database, you can then view the data in a Table or a Map. You can then save the Query, Table and Map as a Project.

Start the **CyberTracker** application.

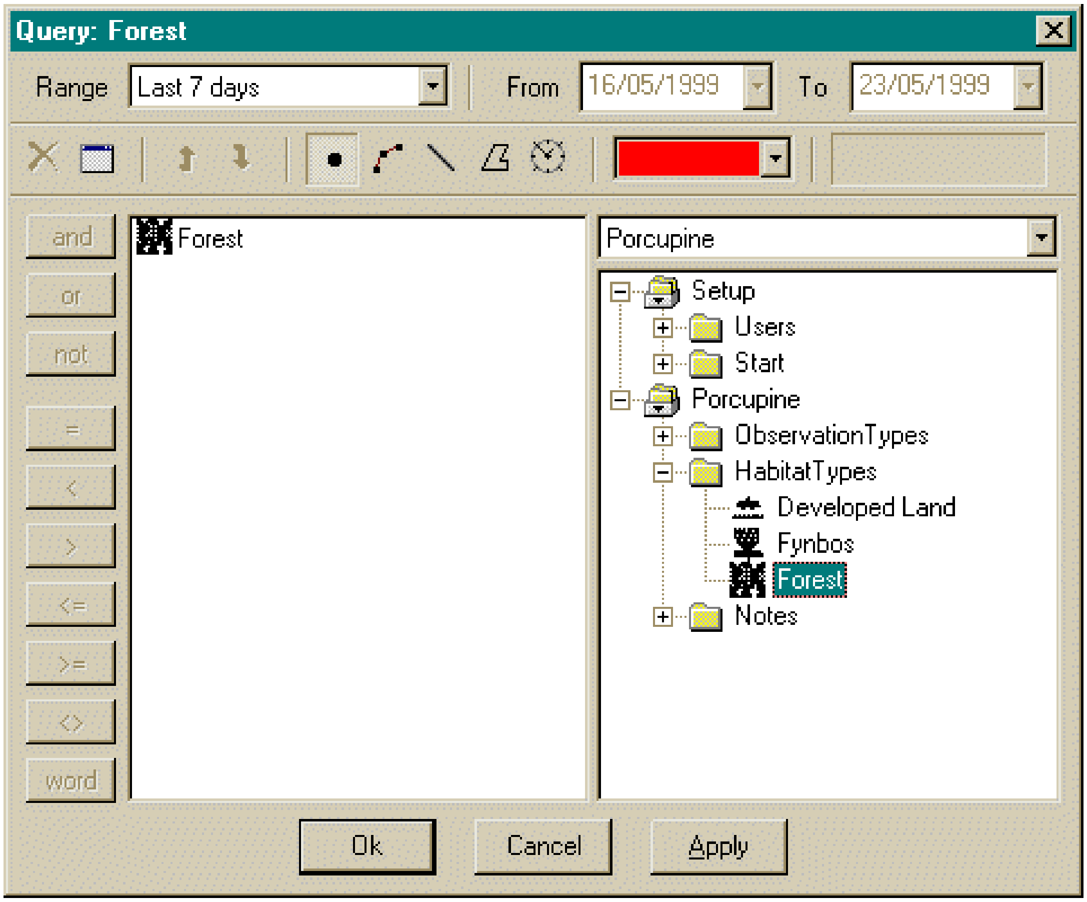
1. Select **File, New**
2. In the **New Project** window that appears, double click on the **database icon** .

To Query Data



1. *Click* on the **Query [?]** icon on the toolbar.
2. *Click* on the **New Query [+]** icon.
3. Type in the name of the Query.
4. *Click* on the **Properties** icon.

5. Select the Date **Range** from the drop-down menu, or if you select **Custom** date range, select the dates **From** and **To.**
6. *Drag-and-Drop* the database element you want to query from the right-hand pane to the left-hand pane.
7. You may *Drag-and-Drop* several database elements and use the Logical and Relational Operators on the left-hand side to create your query (see below).
8. To do a word search *Drag-and-Drop* the Notes database element and *click* on the **word** button. *Right-click* on the database element and select **Properties** to enter the word you want to search.
9. Select icons to query **Point data, Path data** or **Timed data.**
10. When you have completed your Query, click **Ok** to query the database.
11. *Click* on the **New Query [+]** icon if you want to add another query to your project.
12. Select **File, Save** or click on **Save project** icon to save your queries as a project.



Logical Operators

Logical Operators involve comparing or manipulating values at a TRUE or FALSE level. To create a Query you may combine database elements with logical operators:

- **AND:** A AND B includes all data with A AND B but not A without B or B without A.
- **OR:** A OR B includes all data with A OR B, including A without B and B without A.
- **NOT:** NOT A excludes all data with A.

For example, if you want to query all three the rhinos Chippenberry, Katrina and Ngara, you may query Chippenberry OR Katrina OR Ngara. If you want to query Chippenberry or Katrina, but not Ngara, you may query Chippenberry OR Katriena AND NOT Ngara.

Relational Operators

Relational Operators are used to compare the values of two variables. These include the operators =, <>, <,>,<=,>=.

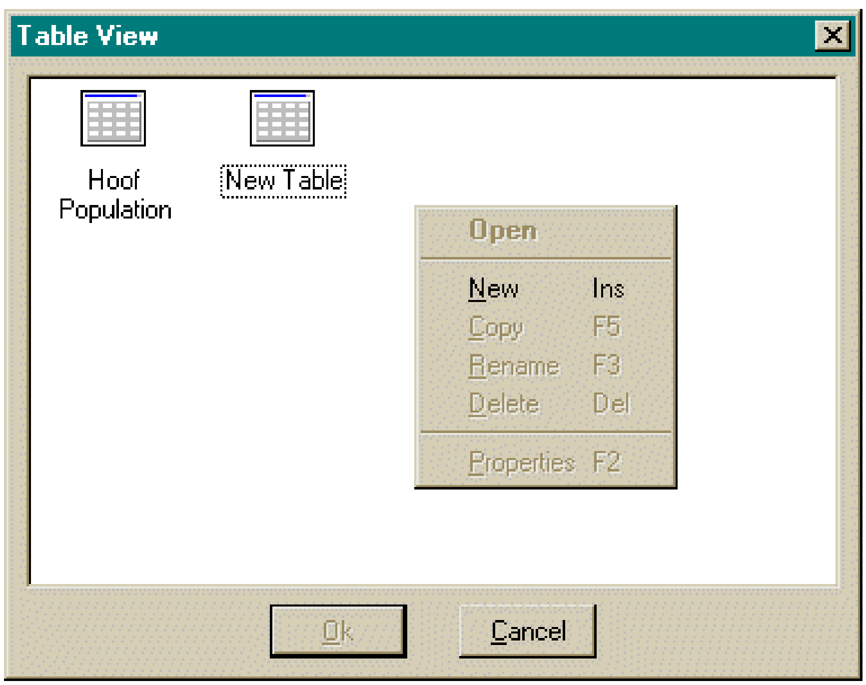
- = Equal
- <> Not Equal
- < Less than
- > Greater than
- <= Less than or equal to
- >= Greater than or equal to

To Create a Table

1. Select **View, Table** or *click* on **Table** icon.
2. *Right click* in window and select **New.**
3. Type in a name for the Table.
4. *Right click* on new icon that has been created and select **Properties.** A new dialog window will appear with the **COLUMNS** tab in the foreground.
5. *Right click* in left-hand pane and select **New** to create new column.
6. Type in name of column.
7. *Click* on name of column to define properties of column.

QuickTip:

Many of the menu functions have shortcut keys (indicated to the right of the menu choice). Use the INSERT key on your keyboard to insert a New Table in the table dialog.

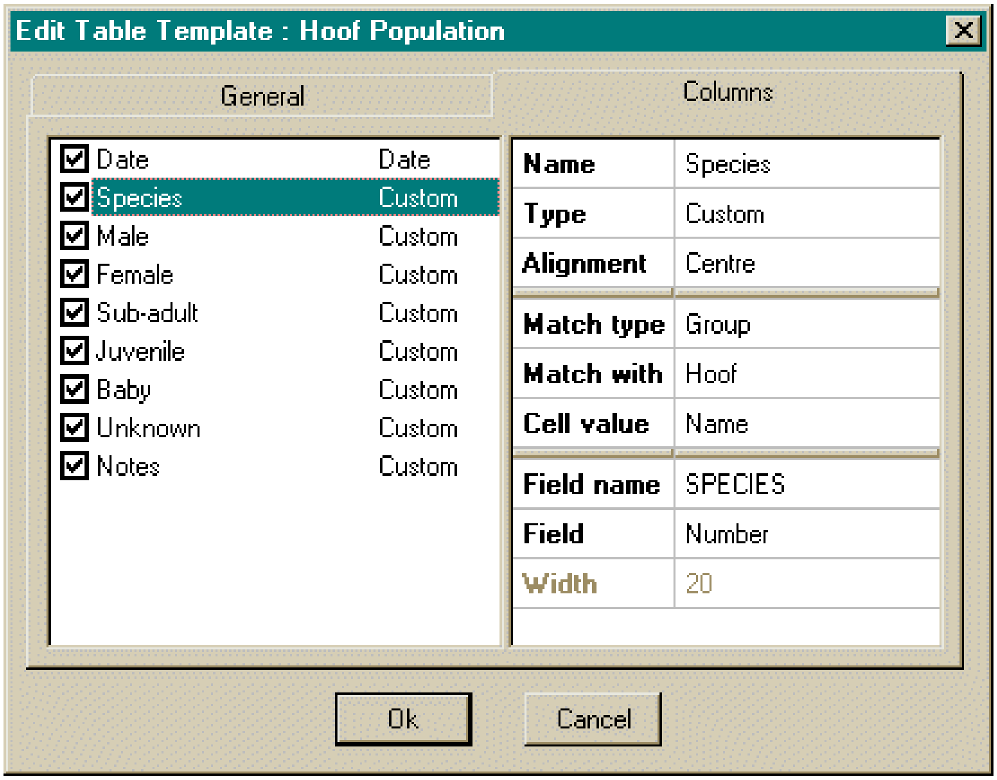


To Define the Properties of a Column

- **Name:** Type in name of column.
- **Type:** Select type of information from drop-down menu.
- **Alignment:** Select alignment of information in column from drop-down menu.
- **Match type:** If type custom selected, select match type from drop-down menu.
- **Match with:** Select item from database.
- **Cell value:** Select Name, Alias, Value or Note.
- **Field name:** Type in field name of the column in the exported table when exporting Table to Excel or ArcView.
- **Field:** Select Date, Number, Boolean (true/false) or String (words).

QuickTip:

When entering information into the Field Name box, you are defining the names of Fields (dBase) or Columns (MS Excel) that will will be used in the output file from this table. In order to maintain compatibility with these data formats, you should avoid using spaces in these names.



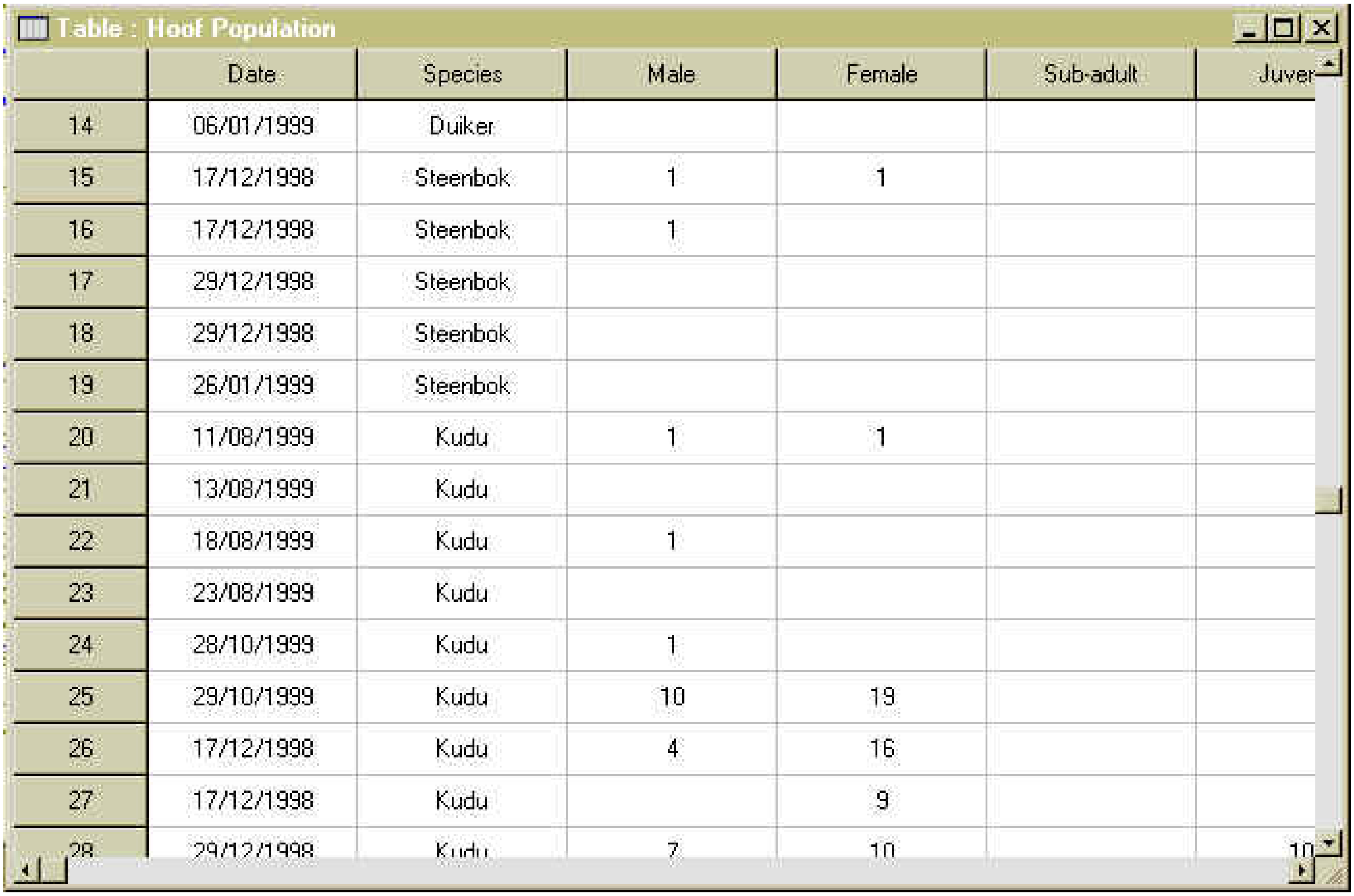


Table : Hoof Population

	Date	Species	Male	Female	Sub-adult	Juver
14	06/01/1999	Duiker				
15	17/12/1998	Steenbok	1	1		
16	17/12/1998	Steenbok	1			
17	29/12/1998	Steenbok				
18	29/12/1998	Steenbok				
19	26/01/1999	Steenbok				
20	11/08/1999	Kudu	1	1		
21	13/08/1999	Kudu				
22	18/08/1999	Kudu	1			
23	23/08/1999	Kudu				
24	28/10/1999	Kudu	1			
25	29/10/1999	Kudu	10	19		
26	17/12/1998	Kudu	4	16		
27	17/12/1998	Kudu		9		
28	29/12/1998	Kudu	7	10		10

To Show or Hide Columns in Table

Once the properties of a Table have been defined, *click* in tick box to show a column, or *click* on tick box to remove tick to hide column.

MAPS

Georeferenced data makes the most sense when displayed on a map of the appropriate area. In CyberTracker, maps are either defined with ***layers*** (which are defined by shapefiles), or by an ***image***. If you don't have an ArcView shapefile or other GIS source data to use for your map, then you have to use an Image.

How to use a Shapefile map in CyberTracker

To add a new map you need to copy the Shapefiles into CyberTracker.

- Create a Map folder in CyberTracker

    1. Open **Windows Explorer**
    2. Go to **C:\Program Files\CyberTracker\Map**
    3. Right click on blank right panel and select **New** to create a new folder in CyberTracker\Map for your maps example **Karoo Map**

- Copy Shapefiles into your new **Map folder**

1. Run CyberTracker.
2. Select **View, Map.**
3. *Right click* on map icon (or create new icon), select **Properties** to open **Edit Map Template** window.
4. Select **Layers** tab.
5. *Right click* in left pane, select **Scan.**
6. Select the Custom Map folder, *click* **Ok**.
7. Select **Position** tab.
8. For **Geoposition** (e.g. to locate GPS positions on map):

    - **Left** (edge of map)**:** 22.00000 (e.g. decimal degrees for Karoo National Park)
    - **Top** (edge of map)**:** -32.00000 (decimal degrees)
    - **Right** (edge of map)**:** 22.75000 (decimal degrees)
    - **Bottom** (edge of map)**:** -32.50000 (decimal degrees)

QuickTip:

Resolving problems with map geopositioning.

The geoposition parameters in CyberTracker should be based on the largest (in extents) digital map layer (shapefile). Currently, CyberTracker supports data only in the Geographic projection (unprojected). If you are having problems with getting your CyberTracker field data to appear in the correct position over your digital map layers, check that your map layers are unprojected, and that you have the correct extents entered.

How to use an Image file picture as a Map in CyberTracker

Image files can be created by, for example, scanning in a paper map, or by downloading a digital map from the Internet. CyberTracker can import either Windows Bitmap files (BMP) or TIF image files. If you have an image in another format, you will have to convert it to one of these formats first.

To add a new map you need to copy the Image files into CyberTracker.

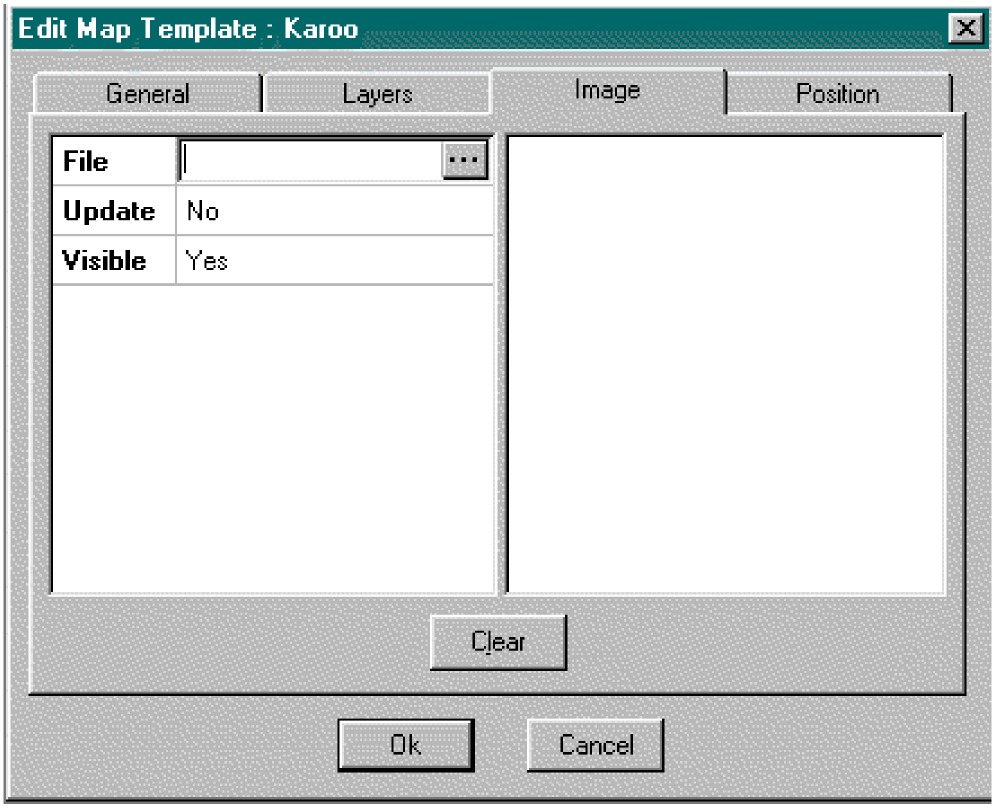
- Create a Map folder in CyberTracker

    1. Open **Windows Explorer**
    2. Go to **C:\Program Files\CyberTracker\Map**
    3. Right click on blank right panel and select **New** to create a new folder in CyberTracker\Map for your maps example **Karoo Map**

- Copy Image files into your new **Map folder**

1. Run CyberTracker.
2. Select **View, Map.**
3. *Right click* on map icon (or create new icon), select **Properties** to open **Edit Map Template** window.
4. Select **Image** tab.

    - Choose the image file you want to use by entering the full name (giving the full path, name and extension) of the image file in the **“File”** field (Or press the **[...]** icon and navigate to the file).
    - The **“Update”** property determines if the map image is to be reloaded each time the map is redrawn (e.g. when a query is redefined). Since the map does not change in most applications, it is safe (and faster) to leave this set to **NO**.
    - The **“Visible”** property determines if the map image will be shown in the map view.

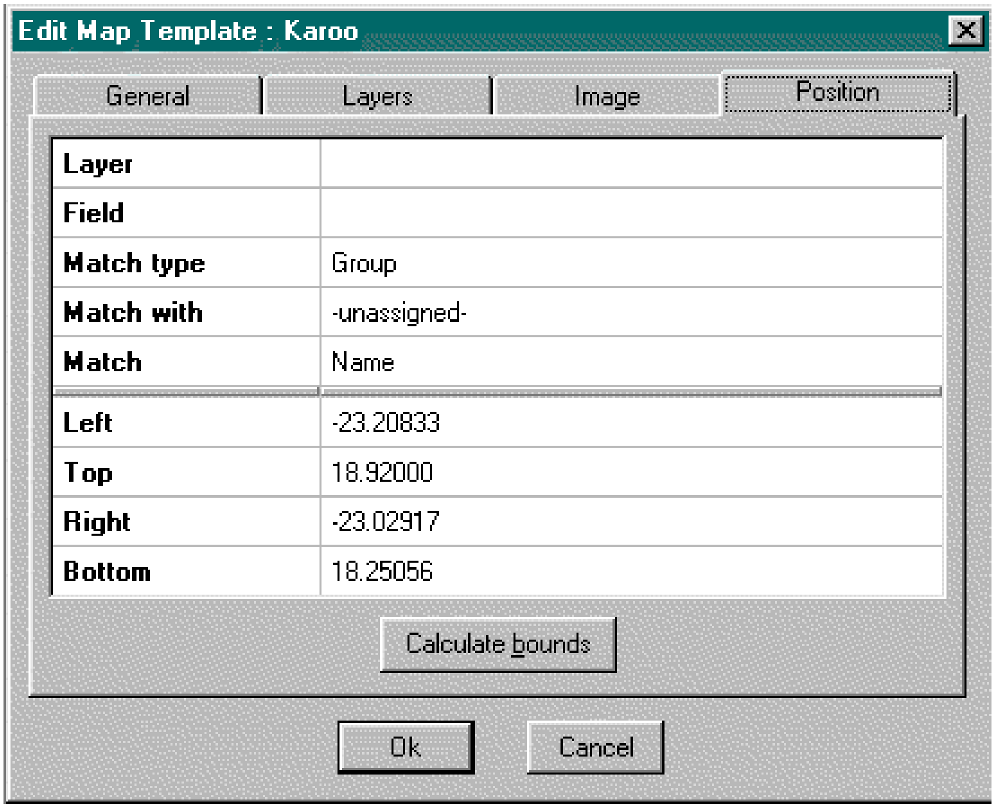


Select **Position** tab.

1. **Adding Georeferencing:**

- Before you can view Georeferenced information on your map, you have to define the GPS co-ordinates of the corners. In the “**Position**” tab, there are four fields: “**Left**”, “**Top**”, “**Right**” and “**Bottom**”. There are the decimal notation values of the longitude and latitude.

    - **For example**, if the top left and bottom right co-ordinates of a map are: Top left (18ºN 55’ 12’’, 23ºW 12’ 30’’) and bottom right (18ºN 15’ 02’’, 23ºW 01’ 45’’) respectively, then the values of the four CyberTracker fields become:



In decimal notation (remembering that lines of latitude (North/South) are positive for the northern hemisphere, while lines of longitude (East/West) are positive in the Eastern hemisphere).

2. **Converting from DDº MM’ SS.ss’’ to decimal notation:**

- To convert from Degrees, minutes and seconds into decimal notation, the following formula should be used:
- Degree notation is of the form: **DDº MM**’ **SS.ss**’’, so since there are 60 seconds in a minute and 60 minutes in a degree, in decimal notation we get: **DD** + **MM**/60 + **SS.ss**/(60 * 60).
- For example, 18ºN 55’ 12.00’’:

  18 degrees = 18 = 18.0

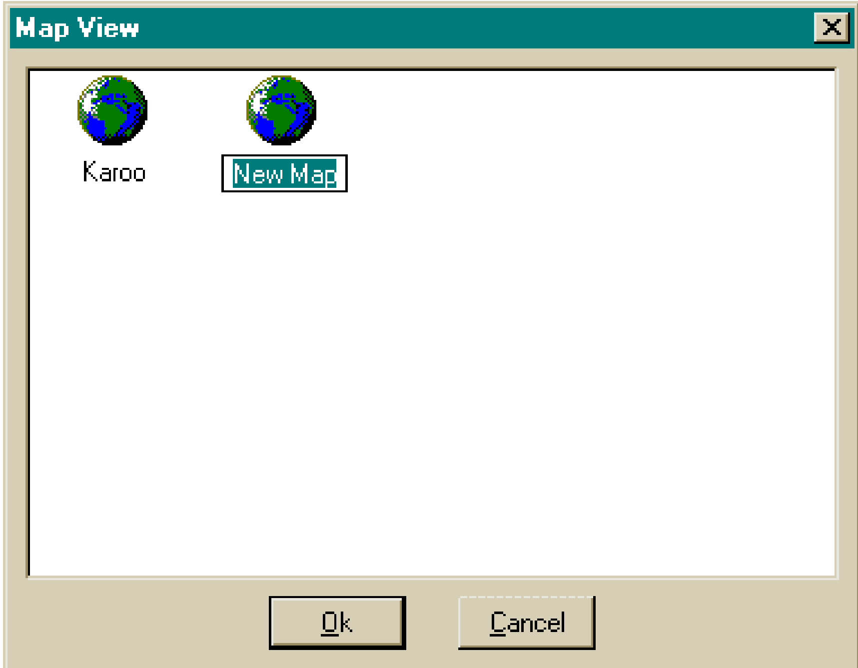
  55 minutes = 55/60 = .91666666...

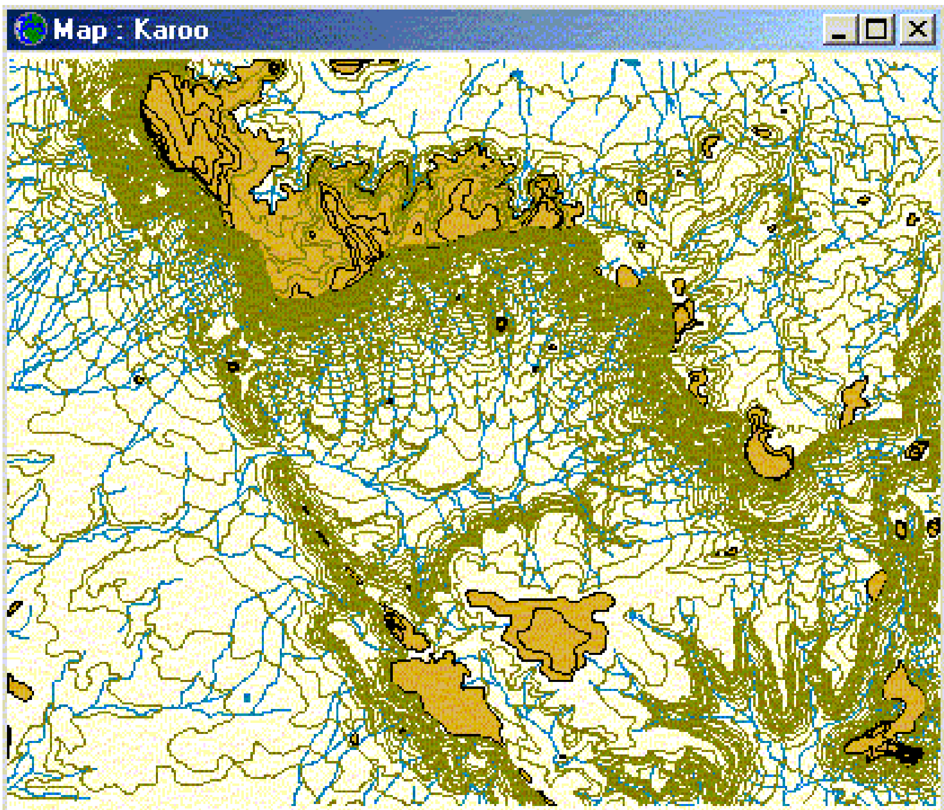
  12 seconds = 12.00/(60*60) = 12/3600 = 0.0033333...

- Add them all up to get 18.920000... = 18.92000 (5 significant digits)
- Once you’ve defined the four fields, press **OK** to complete the process.

To View Map

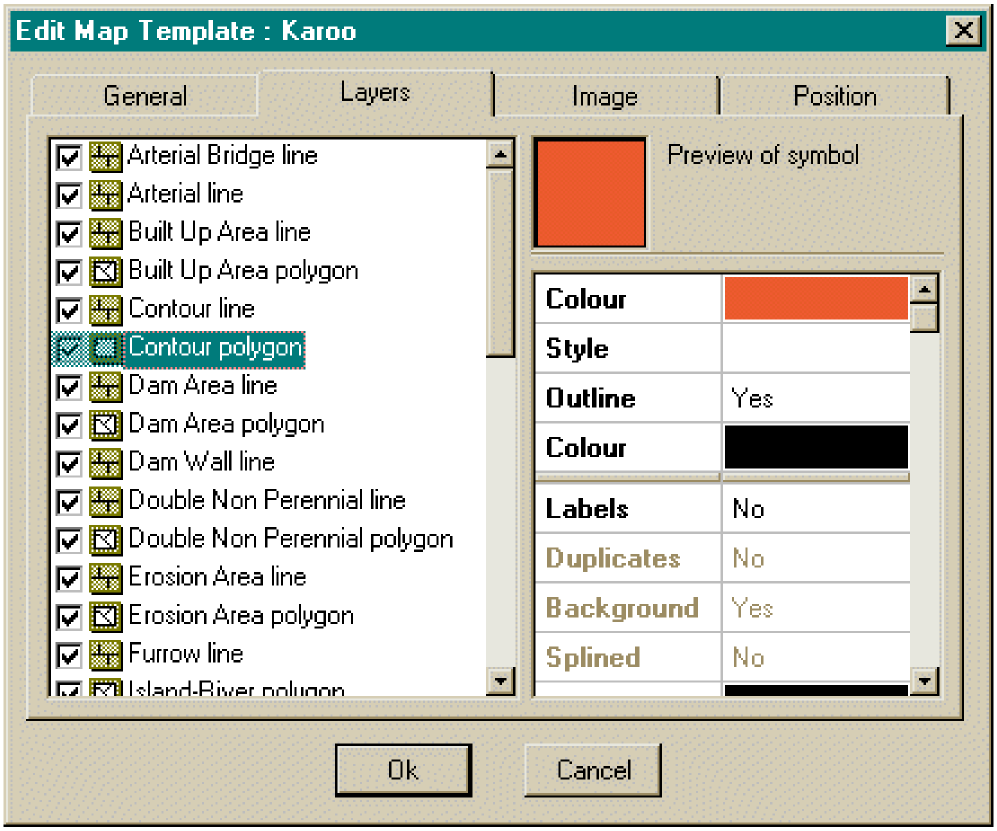
1. Select **File, Open** or *click* on **Open project** icon to open an existing project.
2. Or, Select **File, New** to create a new project.
3. Select **View, Map** or *click* on the **map** icon.
4. Select map, *click* **Ok**, or *double-click* on map to open map.



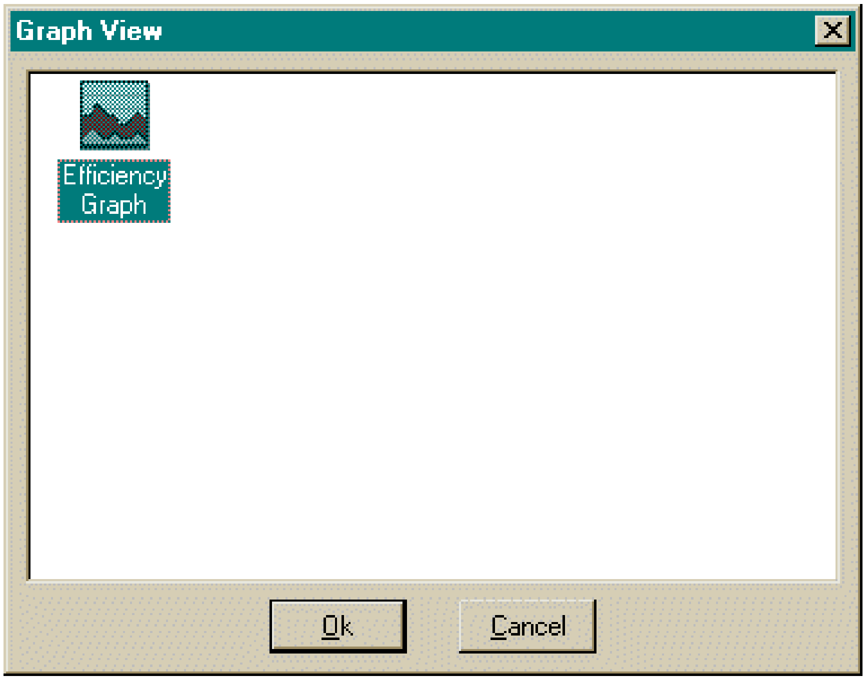


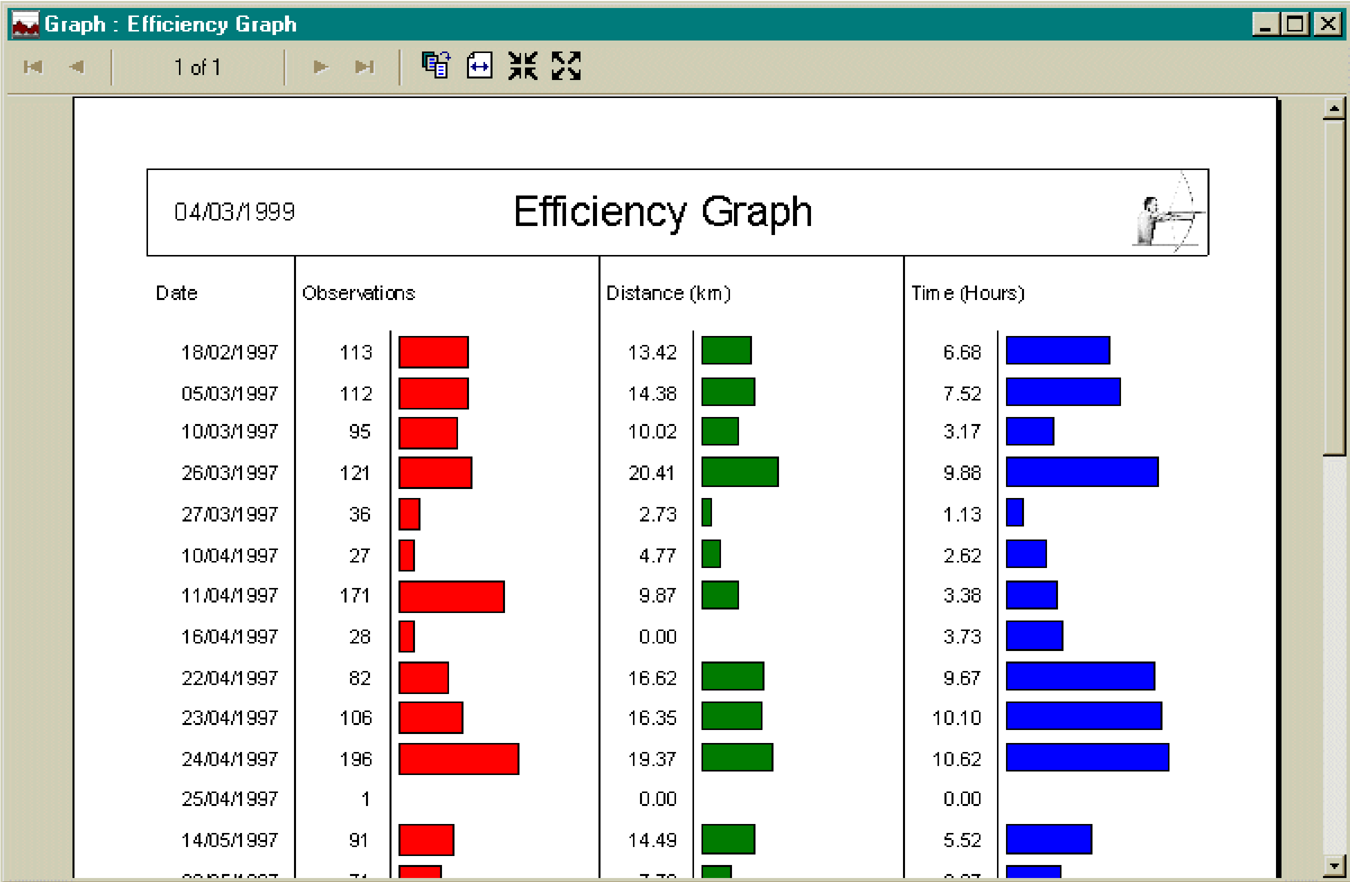
To Edit Map Template Rendering

Map rendering controls the symbology that is used to display maps on screen. Use the layers tab in the map template properties window to alter the appearance of individual map layers.



To Create Efficiency Graph





To Create Frequency Graph

Cybertracker can also generate frequency graphs. To change to a frequency graph type, right click a graph in the Graph View window and choose properties, Then change the graph type to Frequency from the Type picklist

To Create Other Graphs

The CyberTracker does not create graphs of data. To create graphs you need to export a Table to Excel and create a graph in Excel.

Effort of Patrol and Index of Abundance

TOP

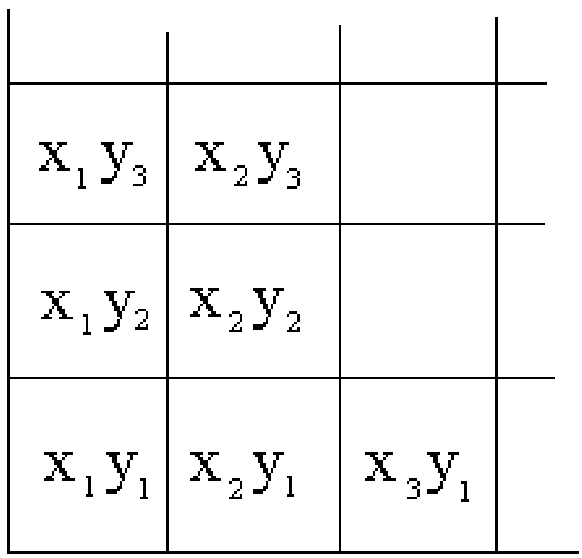
Effort of Patrol and Index of Abundance

Definitions of Effort of Patrol and Index of Abundance

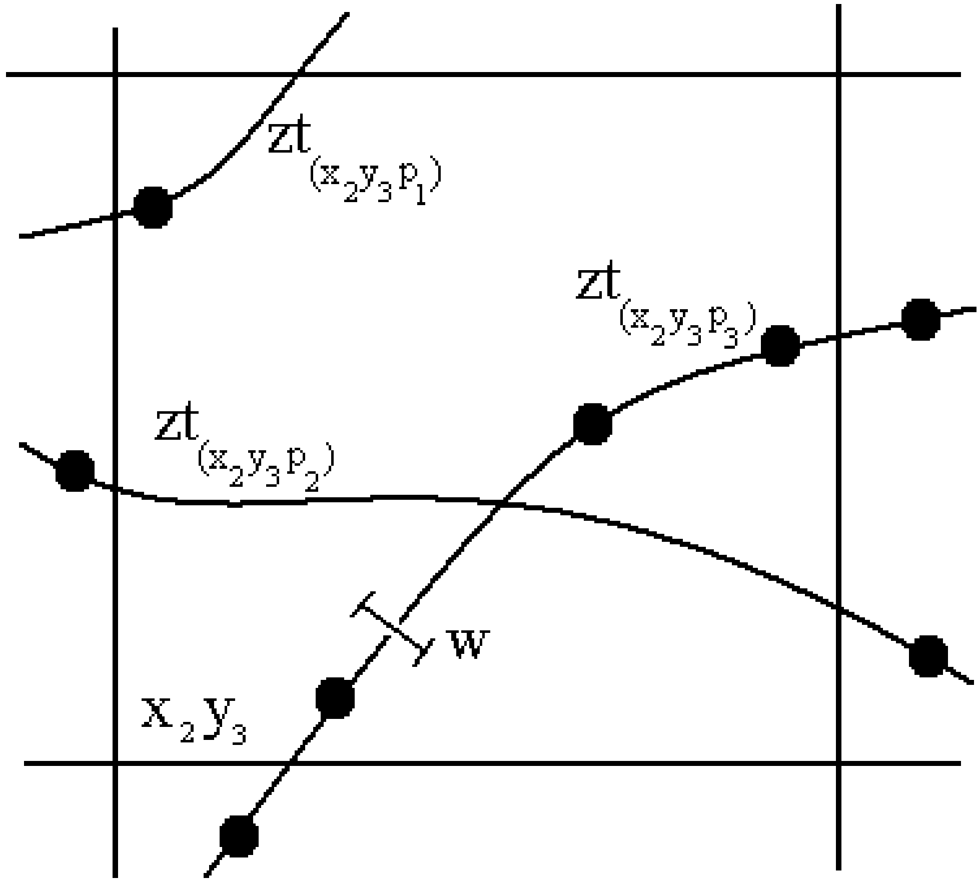
The user can produce a Map View of the following calculations:

- Effort of Patrol (EoP): A function of the time spent and distance covered in each grid cell.
- Cell Counts: Sum of all population figures for the IoA item in each grid cell.
- Index of Abundance (IoA): A function of Counts divided by Effort.
- Grid Paths: Shows how CyberTracker calculated the paths in each cell.

To measure the Effort of Patrol and calculate the Index of Abundance a grid with cells of variable sizes covers a given area:



For each cell the length and time of the path segments are calculated.



Define the Effort of Patrol (EoP) as:

$$E_{x_i y_j} = \left(\sum_{k=1}^{n} zt_{(x_i y_j p_k)} \right) . w \quad \text{km}^2 . \text{hours}$$

$E_{x_i y_j}$ is the Effort for the cell $(x_i y_j)$

$zt_{(x_i y_j p_k)}$ is the length and time of the segment of path p_k within cell $(x_i y_j)$

w is the width of the path

Define the Index of Abundance (IoA) as:

$$I_{x_i y_j} = \frac{C_{x_i y_j}}{E_{x_i y_j}} \text{ per km}^2 \text{ per hour}$$

$I_{x_i y_j}$ is the IoA for cell $(x_i y_j)$

$C_{x_i y_j}$ is the cell count for cell $(x_i y_j)$

$E_{x_i y_j}$ is the EoP for cell $(x_i y_j)$

User interface

The present **Index of Abundance** (IoA) engine uses the following CyberTracker entities:

- A Patrol Item
- A Patrol Group
- A Start Item
- A Stop Item
- A IoA Item
- A Population Group.

These entities must be included in the CyberTracker Database and Screen Sequence when it is customised and must be entered by the observer when collecting data.

The user must assign appropriate items/group to these entities before the engine can be used. For the purposes of demonstration/debugging, the Odzala data has been used (Database "A A Odzala IoA test"), and the IoA entities have been present to:

- Patrol Item = Pied
- Patrol Group = Patrouille Activite
- Start Item = Debut
- Stop Item = Fin
- IoA Item = Elephant
- Population Group. = Population.

To perform a Cell Count, Effort of Patrol (EoP), Index of Abundance (IoA), or Grid Paths calculation, the user must:

1. Clean up all outlier points
2. Define a query for the Path Item, IoA Item and date range
3. Define the Map View Properties

Outliers are points whose latitude and/or longitude values are incorrect, sometimes so much that the points appear on the map far out of the area patrolled. They are caused by GPS errors, either due to hardware defects or bugs in the software. If these points are not removed, the calculation of the EoP will be incorrect.

Future versions of CyberTracker will remove them automatically, but for the current version they must be removed manually.

To clean up the outlier points:

- Use the Map Rendering feature to join all points in a Map View. This will visually show outlier points.
- Using a Table, click on either the Latitude or Longitude heading bar to order values numerically (a small triangle will appear in the heading bar). The outliers will now appear at the top of the Table and/or at the bottom of the Table. Repeating this for both Latitude and Longitude values should sort all the outliers from good data.
- Having identified an outlier point, select it and use the Edit Sighting to change the "Use Position" from "Yes" to "No". This will remove the Latitude and Longitude values from the sighting. With no value for the Latitude and Longitude, the CyberTracker will Interpolate co-ordinates for sightings missing co-ordinates. However, if the sighting is the first or last sighting in a path, it will be ignored.

To define a query:

The query is used to define the Patrol Item, the IoA Item and the date range.

For example, for an IoA of elephants while doing a Foot Patrol, set a query to "Foot Patrol AND elephant" and select the date range. The points on the map now indicate where the EoP/IoA data will occur.

To define Map View Properties:

- Select the Mode: Point and Path; Cell Count; EoP; IoA; Grid Paths
- Specify grid cell size
- Assign the Start Item, Stop Item, Patrol Group and Population Group
- Specify the path width
- Define visualisation properties, such as scaling mode and colour values

The process is initiated by pressing the "Ok" button. At this moment, all data is added to the Patrol dataset. The patrol dataset is sorted. The EoP engine then scans through the dataset items, linking valid sub-patrol segments with each (and joining them graphically). Valid sub-patrols are added to the Grid data registers (the time, distance and effort spent in each grid square is calculated and stored for later representation). Once all sub-patrols have been processed, the accumulated grid data is presented (the grid square is coloured according to relative value of what has been calculated). If the data item is an IoA item, the grid square population register is incremented by the sum of the values of the population group items (if present) of the observation.

In order for the sequence to satisfy the IoA algorithm requirements, every sub-patrol (if a patrol lasts 10 days, sub-patrols are those sequential sets of measurements that use the "Patrol" item, e.g. Pied) must start with an observation containing (preferably both) the Start and Patrol item (e.g. Debut & Pied), and end with (preferably both) the Stop and patrol item (e.g. Fin & Pied). To calculate Index of Abundance, the animal to be counted is specified by the IoA item, and the entire contents of the "population group" group are added together to be used by the algorithm. Any change to another patrol type (e.g. Vehicule) or a change in patrol method (e.g. transect to poaching camp survey or *vice versa*) must also contain observations that stop and start the patrol. The GPS timer is used to provide improved time and distance resolution for observations.

Functional description of the IoA calculation:

The ***Patrol dataset*** is all observations (including timer points) within a date range (presently, the date range of the first defined query). All observations in the date range are added to the patrol set, thus the Patrol dataset contains a list of **items**. Each item records the ***Device ID, latitude, longitude, date, time, database ID, count*** and ***PatrolType*** of it's appropriate observation. The contents of the PatrolType set depends on the attributes of the original observation:

- If the observation had a "Patrol start item", ***ptStart*** is added..
- likewise for "Patrol stop", ***ptStop*** is added..
- "Patrol item", ***ptPatrol*** is added..
- for timer points ***ptTimer*** is added..
- for the IoA item, ***ptIoAItem*** is added..
- if any items from the population group are present, their value is added to the "***count***" attribute of the dataset item.
- [present implementation] if the observation has none of above (Start, Stop, IoAItem, Patrol, Timer), the PatrolType is set to "***ptOther***"..

Thus typical data set items would look like:

Date	time	Long Lat	Device ID	DB Id	PatrolType	Count
19/06/2000	10:19:17	0.48698 15.08680	20946	Id: 38950	[Patrol Start]	Count=0
19/06/2000	10:22:02	0.48687 15.08728	20946	Id: 38951	[Patrol]	Count=0
19/06/2000	10:22:33	0.48687 15.08730	20946	Id: 38952	[Patrol]	Count=0
19/06/2000	10:25:25	0.48662 15.08773	20946	Id: 38953	[Patrol]	Count=0
19/06/2000	10:26:23	0.48657 15.08768	20946	Id: 38954	[Patrol]	Count=0
19/06/2000	10:26:56	0.48662 15.08772	20946	Id: 38955	[Patrol]	Count=0
19/06/2000	10:29:40	0.48652 15.08810	20946	Id: 38956	[Patrol]	Count=0

19/06/2000	10:30:41	0.48665 15.08817	20946	Id: 38957	[Patrol]	Count=1

Method:

The patrol dataset is sorted by DeviceID (which is related to the HotSync user name of the PDA), then by Date, then by Time. Thus all observations from the same device occur sequentially in chronological order.

The patrol dataset is traversed two items at a time (to form a ***patrol fragment***), in a method whereby the second item of the first pass becomes the first item of the second pass: e.g. for three items (P1, P2, P3), first the fragment P1 to P2 is examined, then the fragment P2 to P3 (unless the attributes of P2 were such that P2 and P3 could be ignored).

If the attributes of P1 and P2 are acceptable, and the patrol fragment is to be used for EoP/IoA calculations, the time and distance between the two points is shared proportionally over all grid squares entered/crossed between them. If both points are contained within 1 grid square, the entire distance, time and effort between the points is added to that grid square. If either of the two points are in a different grid, the distance covered in each grid is added to that grid, and the time is shared between all grids touched in proportion to the distance covered in that grid (if half of the total distance between P1 and P2 is spent in a grid, half of the total time between P1 and P2 is added to the grid).

After the calculation has finished, the GridList variable (UnxIoACalc) contains a list of all grids that have been entered or crossed and for each grid: the time spent, the distance covered, the effort spent, a count of how many sightings occur in each grid (if any, since a grid that is only crossed has no sightings), and the total population count of the IoA item counted. This data structure (actually, the interface functions to this structure) can then be used to render the user interface.

Algorithm for EoP, IoA, Grid Paths, Cell count

The algorithm is divided into 3 parts:

1. **Building paths from raw observations**

The objective is to create paths from observations that match the current query. A path is defined as a sequence of observations that taken together yield a single unit of meaning. For example, an individual foot patrol on a specific day can be considered to have meaning outside the individual observations of which it is made up.

Although the source of data for the path is the current query, it is not enough to simply take data from the query alone. For example: "Foot Patrol and Elephant" yields all observations that contain the attributes "Foot Patrol" and "Elephant", but it does *not* include GPS timer readings or observations like "Foot Patrol + Start/Stop".

Therefore, the algorithm goes:

a. Read every observation in the database (including GPS timer readings)
b. Group observations by path (*)
c. Remove paths that do not contain any queried observations

(*) Observations are grouped in terms of the following rules (applied in order):

a. Observations are from different paths if:
    1. They are separated by 24 hours or more
    2. They come from different devices
    3. Their path item is different (e.g. Foot Patrol)
c. An observation is the beginning of a new path if:
    1. No previous observation exists
    2. It contains the "Start" item
    3. The previous observation contains the "Stop" item
e. An observation is the end of a path if:
    1. No subsequent observation exists
    2. It contains the "Stop" item
    3. The next observation contains the "Start" item
g. Observations are part of the same path if:
    1. They are both GPS timer readings

2. **Clipping paths to cells**

The map is divided up into grid cells. The cell size is specified in meters and need not be symmetrical, i.e. the width and height can be different.

The objective is to determine which paths cross which cells. Since we now have a list of all paths, the algorithm is as follows:

a. Go through every cell and determine which paths could possibly intersect with it
b. Calculate the intersection of the path segment with the cell and produce a segment which is entirely contained within the bounds of the cell. This is essentially a line clipping problem and is handled by means of the Cohen-Sutherland line clipping algorithm. However, in addition to the path line segment being clipped, time is also clipped to represent only the segment in question.
c. Add this segment to cells segment list
d. If an observation lies within the cell bounds, the total of the Population group's values is added to a running total for the cell. This observation must also match the current query, i.e. if we added a observation to make an accurate path, this observation will not be included in the cell count calculation.

What results is a structure that contains a list of path segments for every grid cell as well as a count. The line segments and count are used in the calculations performed in (3).

3. **Calculating cell values**

Cell coloring is done by means of simple linear or logarithmic interpolation based upon the value calculated for each cell. This value can also be scaled by means of a multiplier in order to improve the visualization.

The cell values are calculated in the following way:

a. Cell count: the running count of the sums of the items in the population group. This number is an integer.
b. Effort of Patrol (EoP): (sum of path segment lengths) * (sum of time segments) * (path width). This number is a real value with units: km^2.t.

c. Index of Abundance (IoA): (cell count) / (Effort of Patrol).

Statistical Significance

Empirical testing of the EoP and IoA, using variable cell sizes, indicate that more research needs to be done to establish the confidence of the IoA for a given EoP.

If the EoP is too small, the value of the IoA may not be statistically significant. For example if a particular cell has a very small EoP and coincidentally an unusually high cell count, then the IoA may not be a reliable reflection of the real abundance of animals.

Empirical field research will be required to establish the optimum EoP for a given area.

For a given EoP there may also be an optimum cell size. For this reason CyberTracker makes it possible to test varying cell sizes, from 10m x 10m and larger.

The confidence of the IoA will also be effected by terrain. Thick forest with limited visibility will have a much lower EoP for given distance.time covered than open areas with good visibility. For this reason the width of the path, which will be determined by the visibility, have been factored into the calculation of the EoP.

To determine the statistical significance of the IoA will therefore also require empirical field research in different types of habitat.

It should be noted that even where there is not enough data to produce IoA that is statistically significant, it is meaningful to be able to measure the EoP regardless of how small the effort is.

Conservation agencies work on limited budgets and must allocate available resources to protect biodiversity. Ideally managers should be able to demonstrate EoP that is sufficient to protect biodiversity and produce statistically significant data.

However, it is just as important to know when the EoP is too small to ensure the protection of an area, or when data is not statistically significant. Or where there is no data at all. This will provide a clear indication of where additional resources are needed to manage protected areas.

The automatic Cell Count, EoP and IoA in CyberTracker will provide a useful tool in field research, since it will allow field workers to test data in the field while gathering it, providing direct feedback.

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