SPREAD OF INVASIVE SPECIES LAB.

The Exercise.

The goal of this exercise is to use the time-range maps for the cane toad invasion of Australia to replicate Skellam’s plot of the muskrat range expansion in Europe.

Steps:

- Open the range maps in the program Image J, and calculate the area of toad range\(^1\) for each time step (see appendix 2 for specifics of using ImageJ)
- Using Excel, plot the square root of each range area against the date.
- Plot a linear regression line (“trend line”), and find the slope of the line. This is the rate of spread, and will be in units of kms per year.
- If we assume radial (circular) expansion, the rate of spread is a measure of the increase in the radius of that circle. Simple geometry tells us that for a circle, Area = \(\pi r^2\)
- Calculate the rate of change in km\(^2\) /year
- You are now ready to address the questions.

Questions.

- Assuming radial expansion from the original introduction site at Gordonvale, Queensland, in 1935, how long do you predict it took the toads to reach Edmund Kennedy National Park? Bulleringa National Park?

- As the toads spread down the Gold Coast, their range expansion becomes more linear. How long do you predict it took them to expand from Rockhampton to Brisbane?

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\(^1\) This will need some thought for the detailed range maps of Queensland. How will you handle disjunct distributions?
Appendix 1 – Range maps.

(For area calculations, use the jpg versions of the range maps downloadable from the course website.)

Map of northeastern Queensland, Australia, showing the location of the original cane toad release site at Gordonvale, and surrounding National Parks.
Expanded map of Queensland, Australia.
Composite range map of Australia, showing approximate limits of cane toad distribution in various time intervals following the initial release in 1935.
Detailed cane toad range maps in various time intervals (Queensland only).
Appendix 2 – using Image J to calculate area.

*ImageJ* is a freeware image processing package developed by the National Institutes of Health for biomedical imaging, but in wide use by scientists of many disciplines. You can download it for PC or Mac, at: [http://rsb.info.nih.gov/ij/](http://rsb.info.nih.gov/ij/)

There is also full, online documentation available at the same site if you need it.

Run *ImageJ*; you will see a toolbar like this:

![ImageJ toolbar](imagej_toolbar.png)

Select the “File” menu, and “Open”. Open the appropriate range map jpeg image.

Run your cursor over the map – notice the X and Y pixel coordinates are shown beneath the *ImageJ* toolbar. Put the cursor on one end of the map scale bar – note the X coordinate. Move the cursor to the other end of the scale bar – note the x coordinate. The absolute difference between these values is the horizontal length of the scale bar in pixels.

- Now you need to calibrate the image.

Select the “Analyze” menu, and “Set Scale”. You should see:

![Set Scale image](set_scale.png)

Plug in the scale bar “Distance in Pixels” and the “Known Distance” in kilometers. Click OK.

*ImageJ* will now report linear measurements in kilometers and areas in square kilometers.

- Select the “Analyze” menu, and “Set measurements”. Check “area”.
Now select “Edit” menus and “Draw”. Select the freehand tool, and outline the area to be measured:

In the “Analyse” menu, select “Measure”. A new window will appear with your result: