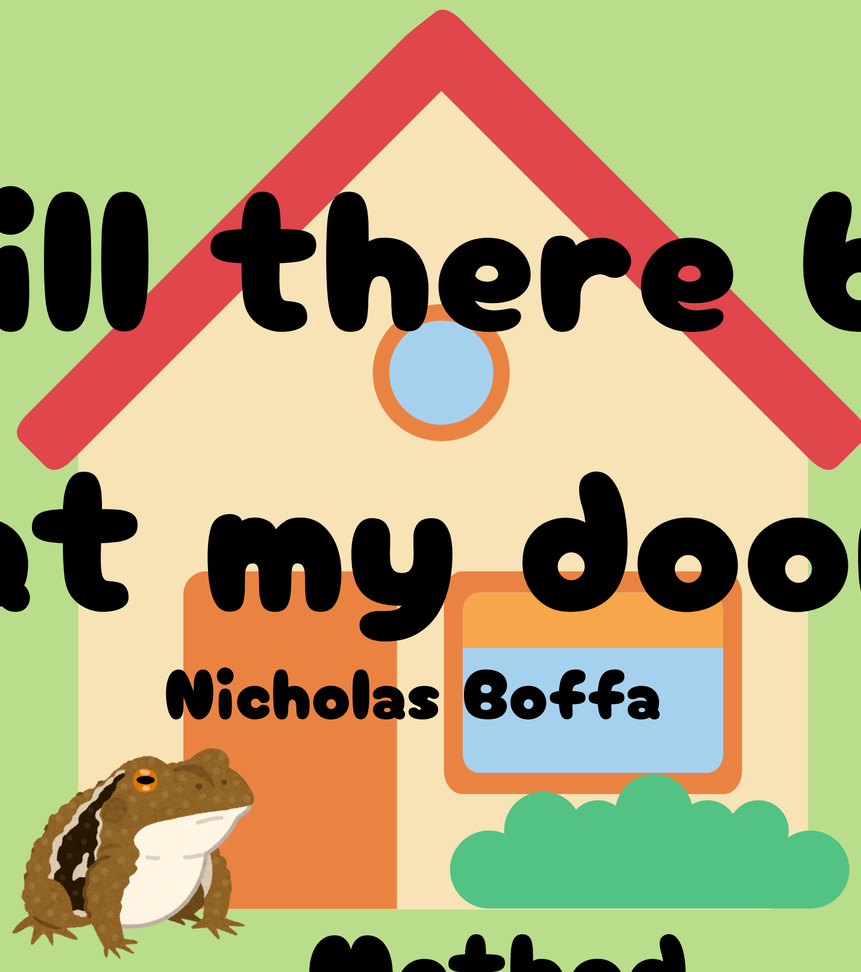
When will there be a cane toad at my doorstep?

Nicholas Boffa



Context

In case you haven't been to Darwin recently, cane toads are terrible, and there's only so many you can play golf with before you get bored. So that communities can prepare for the invasion, it's vital to know when exactly they will arrive.

Elith et. al (2010) determined that one of the best ways to predict where cane toads will end up, given that their range is still expanding, is to combine models that only consider the biology of cane toads with models that only consider the climates they live in. We follow this recommendation, and use the resulting prediction to determine, given the toads begin in Queensland, how long it will take them to finish invading new lands

Method

1. Use AI to figure out what environments toads like and don't like, by combining environmental data (like rainfall), records of cane toad observations, and the results of a previous model that only used the biology of cane toads to determine where they can survive.

2. Create an **A**gent **B**ased **M**odel, where the toads are the 'agents'. A toad gains energy when it moves to areas that are good for it, and loses energy when it moves to areas that are bad for it (as determined by the AI model in step 1). If its energy gets too low it dies, and if its energy is high enough it reproduces.

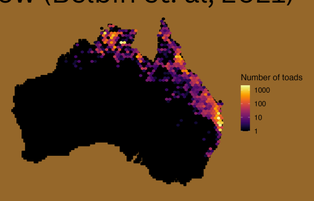
3.Run model with two starting cane toads - one in Cairns and one in Brisbane. Match up output to real life up to current day.

4. Observe what the predictions are for the future!

Results

Toad Observations

Where the toads are right now (Belbin et. al, 2021)



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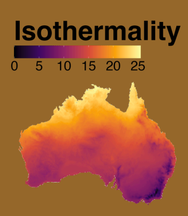
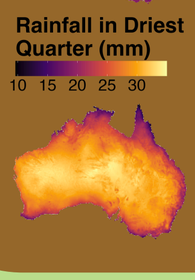
Climate Data

The climates the toads like to live in





Biological Model

Where the toads could theoretically live. 1 means habitable, 0 means not (Kearney et. al, 2008)

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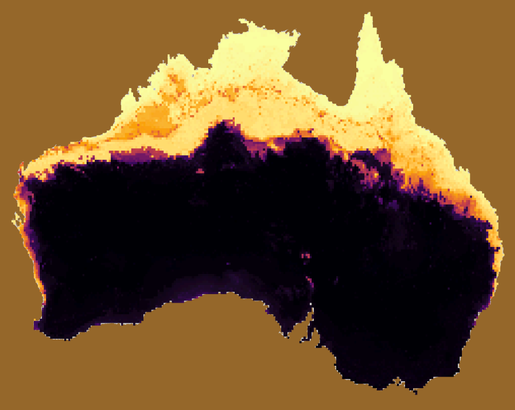
AI Model

Where the toads are likely to end up living



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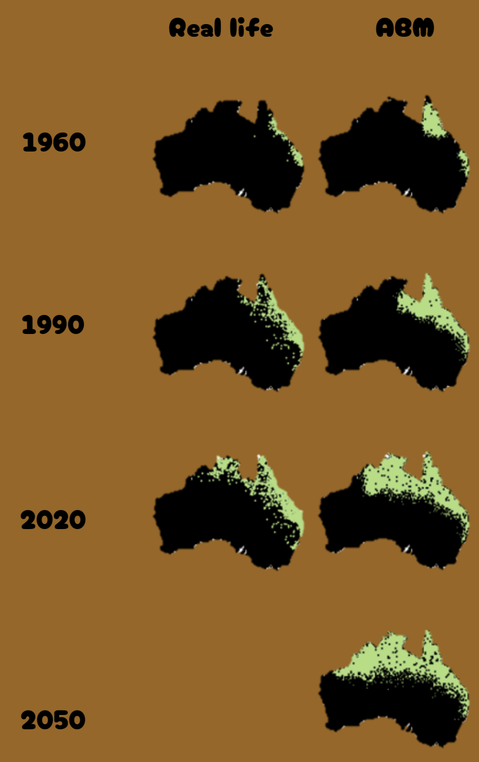
Agent-based Model

When the toads might get there



Conclusion

The likely eventual habitat of cane toads, disregarding the effects of global warming and human intervention, spans all of northern Australia. At current rates, toads should reach the the westernmost point of Australia by a bit after 2050.

Github Repo

https://github.com/nickboffa/DS48-final-report

References

1. Belbin, L., Wallis, E., Hobern, D., & Zerger, A. (2021). The Atlas of Living Australia: History, current state and future directions. Biodiversity Data Journal 9: e65023. https://doi.org/10.3897/BDJ.9.e65023

2. Elith, J., Kearney, M., & Phillips, S. (2010). The art of modelling range-shifting species. Methods in Ecology and Evolution, 1(4), 330-342. https://doi.org/10.1111/j.2041-210X.2010.00036.x

3. Kearney, M., Phillips, B. I., Tracy, C. R., Christian, K. A., Betts, G., & Porter, W. P. (2008). Modelling species distributions without using species distributions: the cane toad in Australia under current and future climates. – Ecography 31: 423–434.