**Amphibian populations stuff for 14.11.19**

**Rough intro/background stuff** *\*Written as a whole piece here, but can be split into 2*

It is widely accepted that anthropogenic climate change has been reducing global biodiversity for the last century, and that major action will be required to save our ecosystems. But, the vertebrate group most threatened by these activities (approx. 40% of all species – approx. 1,900 total) [1] is also one of the most overlooked and underrepresented in conservation research; the amphibians.

It has been estimated that their current extinction rates may be 25,000-40,000 times higher than the class’s entire background extinction rate[2] – far too extreme and over too short of a timespan to just be a natural phenomenon – and one other study observing over 900 amphibian populations, with a variety of spatial and temporal trends, further consolidated these predictions, confirming that even despite the variability their populations had been declining for decades[3].

Amphibians are uniquely vulnerable to environmental change, due largely to their unique physiologies and life histories; In fact, this sensitivity is why they are often regarded as “canaries in the coal mine” – good indicators of the overall health of ecosystems and the environment[4]. Most species have a two-staged life cycle, exposing them both to various aquatic and terrestrial environmental conditions at important developmental and reproductive periods of their lives, and their highly permeable skins make them extremely sensitive to any changes in these environments (such as disease and toxins [4]).

The major extinction factors affecting their decline range from habitat destruction, pollution, ozone depletion, invasive species etc. but disease is one of the most significant, with two major examples are the chytridiomycosis fungus in the Americas, Australia and East Africa (which has been linked to droughts caused by global warming[4]) and trematode parasites (exacerbated by eutrophication from the overuse of fertilisers[5]) – all these can be directly or indirectly linked to human activities.

Obviously, the ramifications of an entire class of organism continuing to rapidly go extinct would be catastrophic to the biosphere, making their protection a prime concern; However, the conservation of already endangered amphibian populations is also uniquely difficult (mainly due to the propensity of such efforts to only work temporarily and lead to inbreeding in protected areas [6]). So, we have set out to utilise population modelling on a diverse and globally distributed set of amphibian species to identify the major factors contributing to amphibian declines as a preventative measure that may be the best strategy to rescue their populations before their decline continues irrecoverably.

1. IUCN Red List (2008) “Threatened Amphibians of the World”, *IUCN Red List*, Retrieved November 11, 2019 from <https://www.iucnredlist.org/resources/stuart2008>

2. McCallum (2007) “Amphibian Decline or Extinction? Current Declines Dwarf Background Extinction Rate”, *Journal of Herpetology*, Vol. 41, No. 3, pp.483-491

3. Houlahan et al. (2000) “Quantitative evidence for global amphibian population declines”, *Nature*, Vol. 404, pp.752-755

4. Conservation International. (2004) “Amphibians In Dramatic Decline; Study Finds Nearly One-Third Of Species Threatened With Extinction”, ScienceDaily, Retrieved November 11, 2019 from [www.sciencedaily.com/releases/2004/10/041015103700.htm](http://www.sciencedaily.com/releases/2004/10/041015103700.htm)

5. Johnson et al. (2007) “Aquatic eutrophication promotes pathogenic infection in amphibians”, *PNAS*, Vol. 104, No. 40, pp.15781-15786

6. Crump (2002) “Amphibians, Reptiles, and their Conservation”, North Haven, Connecticut: Linnet Books

**Rough stuff for the discussion, confounding/unaccounted-for factors etc.** *\*Get the others to add to the list any difficulties they came across in their modelling etc.*

Only have a limited range of data from a single source (COMADRE Animal Matrix Database) for only 10 species to represent an entire class of organisms (approx. 8,000 species) globally, so these models are relatively very approximate

The population models for each species, apart from the White-bellied frog and the Orange-bellied frog, were only based off of a single set of data

Additionally, the species we have chosen live in different environments with varying selection and extinction pressures

There will be a vast number of different factors could be affecting the population growth and decline of an entire class globally, with many of them being only vaguely or indirectly related to human activities (e.g. virility or rate of infection of certain diseases etc.) and therefor almost impossible to measure and model or even control, and therefore were unable to be accounted for

Additionally, there are only a limited number of ways in which we can manipulate the population matrices in MATLAB to simulate different environmental factors

For 6 of the data sets it was unspecified as to how long the populations were studied for, 7 for how the data was treated

Axolotls, Eastern hellbenders, White- and Orange-bellied frogs all have very specific/niche and small habitat ranges, whereas the Western and Natterjack toad, American bullfrog and common frog all have much more diverse and wider home ranges

Most species’ data was only obtained from 1 study of 1 population (Axolotl, Pouched frog, Western toad, Red-legged frog, American bullfrog, Common frog), and there’s no information on how many Eastern Hellbender populations were studied

No information given on how large the areas where each population’s data were sampled from were