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### Project Summary: The Ecological Effects of Cane Toads

Since the introduction of cane toads in 1935, they have created countless ecological problems for Australia and its native species. The cane toad was brought to Australia from Hawaii in hopes that it would help control the cane beetles which were destroying the sugar cane crops in North Queensland. On June 22<sup>nd</sup>, 1935, 102 cane toads arrived at Gordonvale. The cane toads multiplied, spreading across Queensland and much of Australia. The cane beetles were not affected by the cane toads to the degree many had hoped, but the same cannot be said for many other native Australian Species. Because the cane toads were introduced over 80 years ago, many studies have been conducted on their devastating effects, including studies on the long term repercussions on their introduction on Australian Ecosystems. Because their effects have been thoroughly researched, I believe that they are a great cautionary example against transplanting certain species. This term project will serve as a call to action, displaying many of the negative long term effects on species brought on by the introduction of the cane toad. Through this project, I hope to show the viewer that just one invasive species can be detrimental to an entire ecosystem. (Lewis)

Richard Shine, Australian evolutionary biologist and ecologist (and expert on reptiles and amphibians) has extensively researched the cane toad and its effects on many native faunae. The data analyzed in Shine's article, "The Ecological Impact of Invasive Cane Toads in Australia" was one of the main focuses in the design of this project. In this article, Shine references dozens of studies on populations of species that have been affected by the cane toad; he compares populations of such species in areas affected by cane toads vs areas that were left unaffected. In doing so, Shine was able to show the sheer number of species affected by the introduction of the cane toads. Cane toads have affected a variety of species including everything from invertebrates to fish to crocodiles. What makes cane toads so devastating to native Australian fauna? According to Shine, "The paratoid (shoulder) glands of cane toads contain bufogenis, bufotoxins, and other substances but the constituents of cane toad toxins differ from those of Australian native frogs. The cane toad is toxic throughout all of its life stages (ie. Eggs, tadpoles, metamorphs, and adults)" (253). Cane toads are highly toxic, and Australian native fauna is not well adapted to deal with these toads. Because of this, many predators (including freshwater crocodiles) are found dead with their mouths still wrapped around a cane toad- the poison is so potent that they die before even swallowing the toads. there have been over 27 native terrestrial vertebrate species (as well as dogs, cats, and humans) in which individual predators have died as a direct result of mouthing cane toads. (Shine 263)

Because the cane toads were introduced over 80 years ago, it is possible to study not only the short term effects that the toads had on certain populations, but also the long term effects. In addition to decreasing many populations, the toads have also forced many species to adapt to their presence over many generations. For this reason, scientists have been able to study not only the effects on populations, but also the effects on species' behaviors and traits. This is especially the case in species such as freshwater crocodiles (Shine, Wiens 254) and red bellied black

snakes, (Phillips, Shine 1545) which have evolved traits and behaviors as a direct result of the cane toads influence.

Through this project, I created a piece which stresses the potential dangers of introducing a non-native species. Using cane toads as an example, this piece is a call to action, warning viewers that just one species (such as the cane toad) can potentially be detrimental to entire ecosystems, causing population changes in *many* native species. Some species strongly affected by cane toads include Goannas, Blue tongue skinks, Northern death addlers, King brown snakes, Northern Quolls, Freshwater Crocodiles, and native toad and frog species (Shine 258). Rather than focus on one specific species, this project will feature a plethora of species to create a more impactful illustration for the viewer. The sheer number of species affected, as well as the diversity of species affected (coming from all parts of the animal kingdom) will be of utmost importance.

The project uses a cutout of a cane toad as a “canvas” in order to show that each species illustrated relates back to the cane toad. On this canvas, I illustrated many different species that have been affected by the cane toad along with graphic elements of cane beetles and poison. The poison is illustrated in stark, graphic white to show contrast between the rendering of the native species and the invasive poison which they have no means of coping with. Through these illustrations, I have highlighted not just the sheer number of species, but also the variety of species affected. Even species that seem to be unrelated or separate from toads, like wallabies, have been negatively affected by the introduction of the toad. The inclusion of many species will convey to the viewer the widespread affects of introducing a non-native species.

Although this species focuses on cane toads, this piece is not *just* about cane toads specifically. The intended impact of this piece is not just to create a discussion about cane toads, but also to create a call to action to future generations. The intended audience of this piece is young adults and older, though I hope to particularly impact young people, as I believe that although they may not be able to make changes today, it is important that the politicians and CEOs of the future know that their choices can have a great impact. The intended message of this piece is that just one non-native species (be it cane toads or some other invasive species) can cause widespread detrimental effects that are impossible to predict and even more difficult to reverse. The scientific idea of this piece is that we should be extremely careful when transplanting species, as non-native species could have potentially detrimental effects across entire ecosystems.

Through this project, I hope to create a dialogue not just on cane toads, but about the potential detrimental effects of invasive species in general. Through the creation of this piece I plan to make every effort to make the piece both visually engaging and readable enough that it can be easily understood by someone with a limited knowledge of the subject matter. Most of all, I plan to create a work of art that serves as a call to action for conservation of biodiversity in Australian ecosystems and as well as the prevention of future invasive species.

## Annotated Works Cited

Brown, Gregory P., et al. "Invasion, Stress, and Spinal Arthritis in Cane Toads." *Proceedings of the National Academy of Sciences of the United States of America*, vol. 104, no. 45, 2007, pp. 17698–17700., [www.jstor.org/stable/25450305](http://www.jstor.org/stable/25450305).

A study was conducted on Cane Toads which are an invasive species in Australia; this study revealed that invasive cane toads in Australia have a much higher risk of spinal arthritis than native Cane Toads. While many studies are conducted on the environments which invasive species effect, not many studies are conducted on the effects of invading on a species. This study revealed that the process of rapidly invading Australia was also not beneficial for the Cane Toad species, since the rapid colonization selected for frogs which could move quickly with long legs, which is a trait which often accompanies spinal arthritis in frogs.

Phillips, Ben L., and Richard Shine. "An Invasive Species Induces Rapid Adaptive Change in a Native Predator: Cane Toads and Black Snakes in Australia." *Proceedings: Biological Sciences*, vol. 273, no. 1593, 2006, pp. 1545–1550., [www.jstor.org/stable/25223486](http://www.jstor.org/stable/25223486).

Invasive species have long been a threat to biodiversity, but in this article, scientists studied the possibility of species evolving to accommodate invasive species. In the case of this study, scientists studied populations of red-bellied black snakes in Australia which have been affected by cane toad populations. After generations of being exposed to the toxic toads, some snakes had evolved a resistance to the toxin or learned to not eat the toads. This evolution over many generations shows some hope for native species adapting to invasive species.

Shine, Richard, and JohnJ. Wiens. "The Ecological Impact of Invasive Cane Toads (*Bufo Marinus*) in Australia." *The Quarterly Review of Biology*, vol. 85, no. 3, 2010, pp. 253–291., [www.jstor.org/stable/10.1086/655116](http://www.jstor.org/stable/10.1086/655116).

Cane toads were introduced to Australia in 1935. Because there has been so much time since their introduction, Scientists have been able to study the long term effects of their introduction on Australian Ecosystems. Cane toads have impacted many species in Australian ecosystems including a decrease in abundance and diversity of many beetles, termites, and ants (Cane toads have been eating many of these species, thus causing a major effect on their populations). There are many charts and diagrams in this article which detail specific changes in populations, especially on pages 258-260. Cane toads also compete with many native species including native tadpoles and toads. This has caused a decrease in native toad populations. The toads have also affected many populations through lethal ingestion; since they are toxic, many predator species, including saltwater crocodiles, have been negatively impacted by the introduction of the cane toads.

Gurevitch, Jessica and Padilla, Dianna. "Are invasive species a major cause of extinctions?" *TRENDS in Ecology and Evolution*, vol. 19, no. 9, 2004, pp. 470-474, <http://www.des.ucdavis.edu/faculty/grosholz/InvasionReadings.pdf>.

This article analyzes data to determine whether or not invasive species are a major cause for extinction. This article recounts that, although invasive species are often blamed for decline of native species, there is not enough data to prove that every case of invasive species is the cause of extinction. Although invasive species *sometimes* cause extinction, in many cases, there are many other contributing factors to a loss of biodiversity, and the invasive species are blamed despite not being the sole cause. One example of this is the zebra mussels. Although the introduction of zebra mussels coincided with the decline of several native bivalve species, factors such as water diversion, erosion, and pesticides had a greater effect on native bivalves than the invasive zebra mussels.

Lewis, Mark. *Cane Toads: An Unnatural History*. Sydney: Film Australia, 1987.

This documentary discusses the history of cane toads within Australia and the effects that they have had not only on the native fauna but also on the native people. Many interviews are conducted with experts as well as natives who live alongside countless toad invaders. The history of the introduction of these toads is particularly detailed in this documentary.

Phillips, Ben L., and Richard Shine. "the Morphology, and hence impact, of an invasive species (The cane toad): Changes with time since colonization" *Animal Conservation*, vol. 8, 2005, pp. 407-413.,

[https://www.researchgate.net/profile/Richard\\_Shine/publication/227793632\\_The\\_morphology\\_and\\_hence\\_impact\\_of\\_an\\_invasive\\_species\\_the\\_cane\\_toad\\_Bufo\\_marinus\\_Changes\\_with\\_time\\_since\\_colonisation/links/0fcfd50502b173c82d000000.pdf](https://www.researchgate.net/profile/Richard_Shine/publication/227793632_The_morphology_and_hence_impact_of_an_invasive_species_the_cane_toad_Bufo_marinus_Changes_with_time_since_colonisation/links/0fcfd50502b173c82d000000.pdf)

Since colonizing Australia, cane toads have successfully evolved to suit their environment. Specifically, a study has found that over many generations, cane toads have evolved to be smaller and less poisonous. This also suggests that the toads will have the largest impact on an area when they first arrive, with a diminishing impact as generations pass. Scientists believe that it is possible that this selection is occurring because size and large poison glands are costly features, or it is possible that they are adapting to a new environment where the size of poison glands and the size of a toad gives no advantage or disadvantage. This is an interesting study because it shows that after generations of cane toads living in Australia, they are becoming less poisonous and may therefore become less of a threat to native predators.

Somaweera, Ruchira, et al. "Hatchling Australian Freshwater Crocodiles Rapidly Learn to Avoid Toxic Invasive Cane Toads." *Behaviour*, vol. 148, no. 4, 2011, pp. 501–517., [www.jstor.org/stable/23034331](http://www.jstor.org/stable/23034331).

This article discusses a study done on hatchling crocodiles. This study revealed that while adult freshwater crocodiles sometimes eat cane toads (and die as a result because of their low resistance) the populations are recovering due to the fact that the young hatchling crocodiles are learning to avoid the toads. This is because older crocodiles have likely already reproduced, therefore their deaths are not nearly as impactful as the deaths of hatchling crocodiles. As long as most hatchlings avoid the toads, enough fresh water crocodiles are able to survive and reproduce.



