Conference Proceedings – Speaker Transcript

More burning, more warts: frequent burning favours cane toads

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Link to Slides

Thank you. The results I am presenting came from my PhD that I completed at Griffith University with my three supervisors (Slide 1). Landscape disturbance processes can have synergistic effects with invasive species on native fauna (Slide 2). When disturbance processes create more open landscapes, this can favour habitat generalists including invasive species, improve dispersal pathways and also increase access to prey. This can cause further impacts after the original disturbance effect. For example, in large burnt landscapes in northern Australia, cats come in and utilise these to access small mammal prey.

Frequent burning is a common land management tool used across the country (Slide 3), however the relationships with this and invasive species is not well studied. Fire is a landscape disturbance process that alters habitat structure, and when applied frequently can reduce vegetation cover and homogenise the landscape. This can lead to favouring of invasive species.

The cane toad is one particular invasive that has had widespread impacts on native fauna across the country (Slide 4). Introduced from South America, this is the current distribution shown on the map from the Atlas of Living Australia data. As you can see, it is a big problem in Queensland and is coming into New South Wales. Fire is commonly used across this entire region where cane toads exist, however the relationships of fire with cane toads and native anurans has not been studied in detail. Understanding these relationships may assist land managers to determine ecologically appropriate and sustainable fire management regimes.

Native anurans (Slide 5) generally require habitat heterogeneity to maintain diversity and are often reliant on structural habitat features that are likely to be impacted by fire, such as coarse woody debris or leaf litter. As an example, the burrowing frog and wood frogs both require thick litter layers and these are affected by fuel reduction burning. Cane toads, on the other hand, prefer open habitats. The influence of disturbances that reduce key habitat features may have detrimental impacts on species that are reliant on these habitat structures, particularly if cane toads are already causing pressure on native communities.

Southeast Queensland has long been impacted by cane toads (Slide 6). This study was aiming to determine if differing fire regimes, including repeated fires, variable fire histories and

wildfire, influenced ground dwelling native anuran communities as well as cane toads. I was testing the hypothesis that more frequent burning would lead to a decrease in habitat heterogeneity which would negatively impact on native anurans and cause increases in cane toads.

The focus was on three study sites in southeast Queensland (Slide 7), including St Mary, Tiaro and Bauple State Forests, the last of which consists of a long term fire experiment. The focus was on dry sclerophyll forest communities. Each area previously had fire treatments and differing fire histories (Slide 8). There had been four treatments at the long term fire experiment and the other two forest sites incorporated more variable fire regimes. The experiment at Bauple includes annually burnt sites and triennially burnt sites. These have been running since the 1970s, so it is a quite long influence of fire. There are two wildfire sites, both burnt in 2006, and a long unburnt area at the fire experiment, which has been unburnt since the 1940s. Two of the sites were last burnt in 2001 and one area was last burnt in 2003.

Anuran data was collected over four survey periods (Slide 9), from 35 plots over winter and spring, between 2010 and 2013. This was done using pitfall traps over four trap nights. Each site included four pitfall traps, with three drift fences (3 metre long) that targeted ground dwelling anurans. Predictor variables included habitat structural features, including habitat heterogeneity. Fire histories were based on spatial data, including fire treatment, time since fire and total number of fires. Rainfall data was acquired from the Bureau of Meteorology.

For habitat heterogeneity (Slide 10) I looked at indices that measured changes in habitat structure or community along transects. I used three transects 40 metres in length at each study site, and looked at the three strata: ground, shrub and canopy, as shown in the image. This was done using the Shannon Weiner Diversity Index calculation as shown. I used the calculation for both species richness and patchiness. *ni* was equal to species richness per patch or the length of each patch. N was the total species per transect or the number of patches.

Four species were caught in high enough abundances to allow for statistical analyses (Slide 11). These are shown on the top of the table, including striped marsh frogs, northern banjo frogs, spotted grass frogs and the cane toad. Cane toads dominated the data set, with 100% total site occupancy. Preferences for these species were variable but triennially burnt sites seemed to be the most preferable. An additional six species were rarely caught in this study; two of these species preferred long unburnt sites, including the tusked frog, which is a vulnerable species. Two preferred triennially burnt sites and one preferred the annually burnt areas.

Some species were significantly different among different fire treatments (Slide 12). Native anuran abundance was highest in the triennially burnt sites. Native anuran species richness was highest in annually, triennially and wildfire burnt sites. The striped marsh frog was highest in the triennially burnt and long unburnt areas.

A significant fire treatment and season interaction occurred for total anuran abundance and cane toad abundance (Slide 13). Total anuran abundance was highest in annually burnt areas, particularly in the spring. Cane toad abundances showed a similar trend to total anuran

abundance due to cane toads dominating the dataset. Cane toad abundance was highest in annually burnt areas, and spring had consistently higher abundances than winter.

Time since fire had a negative relationship with the northern banjo frog, as shown here (Slide 14); i.e. with more recent fires there are more frogs of this species.

Total number of fires was significant for total anuran abundance and cane toad abundance (Slide 15), shown on the left with a positive relationship, as well as anuran richness and spotted marsh frogs, which showed a slightly weaker but still positive relationship on the right hand side.

I modelled the data using Generalised Linear Mixed Models (slide 16). These showed generally weak outcomes, except for the northern banjo frog, which had an r^2 of 0.52. This species' model included total number of fires and heterogeneity of the ground and canopy layers. I've shown the significant models in yellow, with positive relationships shown in green and negative in red. Total number of fires was also important for native species abundance, as well as heterogeneity of the ground cover. Rainfall was important for species richness and cane toads. Cane toads lastly had a negative relationship with litter cover, as shown in the red.

I believed the anuran data may also be related to distance to nearest creek line (Slide 17), as there are many small streams that run through these sites. I undertook my PhD on fire during the Queensland floods; this image is showing one of my main access tracks through Bauple State Forest. However, there were pretty weak correlations with anurans and distance to creek line. In the top left, native anuran abundance is showing a very slight negative relationship. Anuran richness was basically flat line, and cane toad abundance had a very slight increasing relationship with distance to creek line.

Despite fire-driven changes to habitat structure (Slide 18), anurans seem to persist in the landscape with frequent fire disturbances, including both wildfire and very frequent fires. This therefore refuted the hypothesis that frequent burning reduces habitat heterogeneity and negatively impacts on anurans. This may be due to the small scale and patchy nature of the burns that occur at the long term fire experiment, due to their frequency. The patchiness would allow for a higher number of refuges within the burn perimeter, as well as the small scale of the fires allowing source populations to repopulate after the fires. Therefore, these positive outcomes should be taken with caution when applied to other land management burns that may be of a larger scale. As an example, here is a photo of one of the annually burnt sites (Slide 18). There is a lot of unburnt grass remaining in the landscape. Further studies that look at the scale of the patchiness that is most preferable for anurans is important to determine whether fine scale patchiness or retaining large, unburnt areas is most beneficial for anuran communities.

In the past, anurans have often been found to be unaffected or positively affected by fire (Slide 19), due to their ability to avoid mortality by retreating underground or in moist environments. This was generally congruent with our results, likely due to the low intensity of the burns that allowed for effective retreating, which is particularly true for cane toads.

The cane toads preferred frequently burnt sites (Slide 20). This hasn't been described before for cane toads; however other species of toads in the USA have shown similar trends where they increase after fires. Cane toads were negatively associated with litter cover, which was lower in the frequently burnt areas. The species preferred these frequently disturbed areas, and likely favoured the structural composition of the sites, that comprised a dense grass layer with reduced leaf litter. They usually prefer open grassland and disturbed habitats, which explains their preference for these sites.

The importance of habitat heterogeneity for maintaining faunal communities is well-established (Slide 21). Habitat heterogeneity was a key predictor for native species abundance and two anuran species, highlighting its importance.

Fine-scale habitat heterogeneity is important to consider when applying management burns as repeated burning is likely to reduce this heterogeneity. It is therefore important to ensure the application of patchy fires when undertaking fire management, as recommended in the management guidelines dry sclerophyll forest suggesting that a patchy mosaic burn be applied with a 40-80% burn coverage. But again, the scale of fire heterogeneity that is most beneficial is unknown.

The persistence of native anuran species in burned landscapes is a positive outcome (Slide 22). A negative outcome of the frequent burning regimes revealed that these areas favoured cane toads. This may be detrimental to other species that may be excluded through competition or predation, or negatively affected by cane toad presence through ingestion of toxins. This is a result that land managers should consider when undertaking fire management with the goal of biodiversity conservation, as this may not be an intended or desirable outcome of the management interventions. Particularly in areas where cane toads may pose a significant risk, such as vulnerable wetland areas or where threatened anurans occur.

Questions from audience

Question: In northern New South Wales, there are local groups who do cane toad busting. They target the times after wildfires. When there's a fire it's open and we know they're going to increase. They target the dams and the waterholes and they can collect lots of tadpoles, it's a really opportune time to do work. Is there any sort of groups up in your study area doing any of that sort of work?

Diana: Not that I know of, no.