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INQUIRY INTO KOALA POPULATIONS AND HABITAT IN NEW SOUTH WALES

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Statement for the inquiry into koala populations and habitat in New South Wales

My name is Kara Youngentob, and I am a Research Fellow at the Australian National University, Research School of Biology. My expertise include nutritional ecology and landscape ecology, with a particular focus on the factors that impact habitat quality for arboreal marsupials. I have served on expert advisory panels for koala conservation and management for NSW OEH and the Federal Government. I was an independent reviewer for the World Wildlife Fund's Koala Habitat Conservation Plan. Professor David Lindenmayer requested that I put together a statement in response to your request for information for your inquiry into koala populations and habitat in New South Wales. I have done my best to distil the information that I think might be useful to your inquiry into the paragraphs below. I am happy to answer any specific questions that you might have in the future.

Koalas and all eucalypt leaf eating animals survive on a diet that is very low in critical nutrients, like protein, but high in toxins that can be harmful to herbivores. As a result, small changes in the nutritional quality of koala's food can have big impacts on reproductive success and population densities. In the same way that cattle do better on more nutritious pasture, koalas also thrive in areas with better quality eucalypt browse. That said, the balance between koalas being able to eat eucalypts and eucalypts being able to protect themselves from predators like koalas is important too. If you upset that balance, which can happen from moving koalas to naive landscapes (i.e., Kangaroo Island) or changing the species composition of forests or the origin of seed stock for trees, then you can end up with over-browsing, defoliation and eventual population collapse, or entirely unpalatable landscapes that can't support populations. Despite its central role in habitat quality and animal fitness, foliage nutritional quality (the combination of nutrients and toxins) is often an overlooked element of habitat quality for wild herbivores.

The nutritional quality of eucalypt browse varies both within and between tree species and it is not always linked to soil types, soil nutrients, or other traditional measures of landscape productivity. There is a strong genetic component to the palatability of eucalypt leaves. That said, certain tree species are often preferred browse for the koala because they usually, but not always, have the nutritional quality that meets or exceeds the needs of koalas. For this reason, the presence and abundance of particular "preferred" tree species is generally used to assess habitat quality for the koala.

It is important to understand that across the large distribution of the koala from QLD to SA, there is also a lot of variability in browse quality, even within "preferred" tree species. The preferred food tree species in one area may differ to the preferred food species in another area due to foliar chemical variability. Therefore, the NSW Government's approach to identify "locally" preferred tree species across a number of Koala Management Areas, rather than a state-wide approach, is a step in the right direction. It recognises that the trees that are high quality browse in one area, may differ from another area, even if the same tree species are present. I hope that in the future, additional research can be conducted to ascertain whether some tree species that are considered to be "locally" preferred browse are truly that, rather than just trees in which koalas are sometimes seen or trees under which koala scat is found.

Landscape disturbance, such as logging and fire, can impact the composition of forest tree species. Changing the composition of forests can impact the nutritional quality of food by directly changing the suite of available browse species. This has been demonstrated in extensive

areas of forests on the South Coast of NSW, where a disturbance-adapted species, *Eucalyptus sieberi* (Silvertop Ash), is becoming more dominant due to logging and fire. However, *E. sieberi* is exceptionally poor quality food for koalas. As a result, as the proportion of *E. sieberi* increases, the occurrence of koalas decreases. Until this research was conducted and published, *E. sieberi* was often included in the list of secondary preferred browse species for the koala, owing primarily to observations of koala scat or koalas in *E. sieberi* trees. Koalas may be able to eat small amounts of *E. sieberi*, but based on the nutritional quality of the samples that we measured from areas across NSW and Vic, it could not make up a large portion of the koala's diet. This highlights the need to be cautious about assigning food status to a tree species based on associations with animal scats or even observations of an animal in a tree without detailed data on actual feeding and nutritional quality. This is particularly concerning given that policy often prescribes retaining some "food tree" species in logged areas (i.e., NSW Environment Protection Authority, 2018), but these are rarely, if ever, assessed from a nutritional quality perspective.

The biggest threats currently facing the koala are a combination of habitat loss and climate change. The koala has a huge distribution; however, increasing temperatures and drought have made vast areas of western NSW and QLD unsuitable habitat. Koala populations there have plummeted and it is unlikely they will be able to recover. I have not seen any evidence to suggest that conditions will improve to the point that those areas will be viable habitat for large populations again. Koalas along the east coast of Australia are rapidly losing habitat from development and land clearing. This situation is death by a thousand cuts for the koala. Populations are shrinking and becoming more isolated. This impacts gene flow and population fitness and resilience. When koalas are stressed, they are more susceptible to disease, and it is not surprising that many populations along the east coast are further dwindling due to chlamydia, which negatively impacts reproductive success and causes illness and death in individuals as well. Wild dogs and traffic are additional, serious threats to the koala that need to be managed in areas where koala conservation is a desired outcome.

In remaining koala habitat, even along the coast, temperatures have been reaching extremes that are hot enough to be fatal. Extreme heat can kill in two ways, either directly through heat transfer from the environment to the animal, resulting in lethal core body temperature, or through reduced food intake and resulting dehydration and starvation. Heat-stressed animals eat less to counteract diet induced thermogenesis, which is the production of heat as a by-product of digestion. Reduced food intake for the koala leads to dehydration because the koala obtains most of its water from leaves. Even when supplementary water is available, heat-stressed animals will not eat as much food and this causes a loss of energy. This loss of energy can be relatively rapid for species that survive in a fine nutrient balance with little fat reserves, like the koala, leading to death. When not directly fatal, high temperatures for prolonged periods can still impact lactation and reproductive fitness, causing more gradual declines in populations.

Koala habitat that remains in relatively good condition and/or recovers quickly after prolonged periods of heat and drought should have priority for protection. Vegetation condition can be assessed from a combination of field surveys and remote sensing data. We need more research into the impacts of disturbance, like logging and fire, on microclimates in forests. Burnt forests are likely to be hotter due to reduced albedo (they are darker and absorb more heat from the sun) and less transpiration because trees have been defoliated. Further reducing the canopy cover through salvage logging may compound this issue by allow more radiative energy from the sun to enter the forest and increase local temperatures. This would negatively impact the ability of koalas to survive in landscapes post-fire and may hinder the recovery of forest ecosystem and

native vegetation. In addition, more research is needed to determine whether koalas can survive on the leaves that sprout after fire (epicormic regrowth) and for how long, so that more informed management decisions can be made to assist wildlife populations impacted by fire. Lastly, in many areas, we do not have a good understanding of how forest tree species composition is impacted by fire, logging, or the combination of the two. We know that tree species composition has a big impact on landscape nutritional quality for koalas and therefore habitat quality, so this should be a research priority as well.

It is often assumed that animals will move up in elevation in response to climate change to escape extreme temperatures. This may be a possibility for some species, but recent research shows that many herbivores may struggle to find enough sodium at high elevation. Sodium is critical for the survival of all mammals and, in Australia and possibly globally, sodium in foliage tends to decreases with increasing elevation. Animals are often able to exploit resources that are not typical of their normal diet to obtain essential nutrients; however, this does not necessarily ameliorate nutritional deficiencies or their impacts on individuals and populations. Koalas in some high-elevation landscapes, like the Monaro, eat the bark of some trees to get salt that is not available in the leaves. However, koala densities in this region are very low, with an estimated 0.005 animals/ha and this may relate to nutrient limitations. We can not depend on upland areas to provide habitat in the face of climate change because nutrient deficiency could be a significant barrier to the success of upward migration in response to climate change.

Similarly, current offset legislation is not sufficient to ensure that koala habitat of like value is retained when another area is lost to development. This is primarily because nutritional quality and resilience to climate change are not considered in either the offset or the developed land. I am concerned that local councils are not properly resourced to manage offset legislation. From what I have seen, there is a lot of variability and too little oversight in the practice of identifying and classifying koala habitat, despite existing legislation and guidelines. Revegetation of landscapes to improve habitat for the koala should also consider the nutritional quality of the trees selected for replanting. Since there is a large genetic component to eucalypt palatability, seed should be sourced from nearby trees from which koalas are known to feed, or nutritional quality analyses should be conducted to ensure that revegetated areas are of sufficient nutritional quality to support populations of koalas in the future. Without doing this, it is possible to plant "preferred" tree species that are from a chemotype that koalas cannot eat or are too edible and will die from over-browsing. For example, although *E. viminalis* (Manna gum) is usually a favourite food of koalas, in some locations it contains cyanide, which is toxic to koalas, and/or has relatively low available protein, while other chemotypes have very high concentrations of available protein and no cyanide.

Lastly, we have a very poor understanding of the distribution and abundance of the koala across most of its range. The methods for assessing occupancy and abundance are highly variable and a more consistent approach would be very helpful. The use of koala detection dogs holds a lot of promise for improving our ability to detect and monitor this cryptic and shy animal that spends most of its life in eucalypt tree canopies.

Sincerely,

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