

Feedback on Proposed amendment to the Priorities Action Statement for the koala.

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Introduction

The University of Sydney has a sustained record in research in koala disease and ecology. As a group we have a combined history in koala research and management that exceeds 60 years, and have substantial additional experience in wildlife disease and management beyond that. Areas of expertise include ecology, evaluation of koala management interventions, pathology and immunology (with particular expertise in *Chlamydia*, KoRV, *Cryptococcus*, and neoplasia and other non-infectious diseases), disease ecology and epidemiology, laboratory diagnostics, anaesthesia and field support, capture and translocation risk assessment, clinical and records-based research through koala rehabilitation facilities; with additional track record in genetics, stakeholder engagement and citizen science. We have active teaching and collaborative research programs across all of these areas.

Through our Masters of Wildlife Health and Population Management and our PhD students we supply a significant level of people power that supports ongoing research across a wide range of koala ecology and health related projects.

With sustained support, the Koala Health Hub (KHH), in the Faculty of Science at the University of Sydney, is in a position to assist in refining, achieving and disseminating outcomes of many of the proposed priority actions. The KHH engages with 200+ State and Federal Government, peak body, university, koala rehabilitation and community stakeholders to help guide or facilitate koala care, research, management and/or policy in NSW and interstate.

Current KHH activities include:

- Provision of free of charge expertise and diagnostic services to most koala rehabilitation groups and associated vets.
- Provision of diagnostic services, veterinary support, or disease expertise to several koala ecology projects across NSW and Qld, including two coordinated by NSW OEH:
 - *Chlamydia* testing, anaesthesia health assessment and sample collection, Southern Highlands Koala Project

- Scat-based *Chlamydia* and KoRV testing, sex determination and genetic diversity of low-density populations on the far South Coast.
- Individual and workshop-based training in sample collection and koala necropsy
- Fostering communication and collaboration through
 - An annual national conference comprising Local, State and Federal Government, peak body, university, koala rehabilitation and community stakeholders
 - A quarterly email bulletin
 - A website due to launch this month, comprising: fact sheets; other training resources, policies, management plans and guidelines; online discussion forums; and news.
- Provision of direct care to koalas from Blue Mtns and southwest Sydney, at the Faculty's purpose built wildlife clinic at Camden.

General Feedback

Though it will be challenging, we applaud the whole of government approach that underpins this strategy. In particular we support:

- Recognition of need for evidence base for planning and evaluating management
- Recognition that the role of rehabilitation groups goes beyond individual koala care, and the need to support rehabilitation groups in their work
- Recognition of the need for improved communication and coordination/ collaboration of efforts

The need for ongoing and inclusive consultation is highlighted by:

- The number of proposed activities that are already being conducted, to some extent, by our group and others
 - Duplication of effort is clearly not of benefit
 - There is significant opportunity to cost-effectively value-add to existing capacity
- The need for specialised input across a wider range of disciplines than has been achieved to date

We recommend: That a New South Wales Koala Management and Research Advisory Board or Steering Committee be established. It should be inclusive, which may mean that it would have a large membership (possibly with subcommittees), should meet at least once a year, and review all projects in NSW related to koalas and their effectiveness, review what research is being done and what needs to be done, and be used to facilitate collaboration. It would contain members of government, OEH, carers, councils and private and university researchers. There should be no compensation for being on the board and the recommendations might be nonbinding, but their report should go to all levels of the government and be made available to the public.

Specific Feedback and Recommendations

Loss, modification and fragmentation of habitat

“In areas where a koala population is present, undertake planting to restore and increase the area of koala habitat. Restoration and augmentation planting and/or direct seeding should use appropriate feed and shelter tree species in areas of degraded and/or potentially suitable habitat. Revegetation should focus on expanding existing smaller areas of known occupied habitat, including private land, and connecting areas of suitable habitat to create corridors for movement. Resources for long-term monitoring and management of revegetated areas should be included”.

Tree use is very poorly understood across the koala’s range and the distinction between day time (roosting) and night time (feeding) tree use has been understated and is inadequately understood.

We recommend: Develop specific local strategies for tree planting and also assessing the effectiveness of tree planting and other habitat recovery projects. We are helping to do this with our collaborative work with OEH in the Southern Highlands, with Citizens for Science and OEH in South East NSW, with input from our wildlife masters students (through our Masters of Wildlife Health and Population Management and our PhD students we supply a significant level of people power that support ongoing research across a wide range of koala ecology and health related projects).

Activities in this area obviously need to be guided by *“Lack of knowledge (poor understanding of animal movements and use of habitat)”*- see that section below.

Koala disease

“Improve understanding of the role of chlamydia in koala population dynamics and mortality, including baseline genetic information and links between habitat disturbance and disease-related morbidity, by conducting research in collaboration with universities, vets and ecologists”.

We support this action. Chlamydial infertility is widely considered to be the most important infectious disease of koalas (e.g. Polkinghorne et al 2013, Griffith et al 2013) and its control has been identified as the key component in long term survival of some threatened northern koala populations in New South Wales and Queensland (Rhodes et al 2011, Wilson et al 2015). Its significance in most others is unknown.

However, there are two ways in which this should be amended.

We recommend:

1. Disease investigation should not be restricted to chlamydial disease because:
 - a. Other infectious agents may be important drivers of chlamydial disease outcomes
 - b. Other infectious disease may have an additive effect on morbidity and mortality
 - c. Prevalence and loads of infectious agents or disease are commonly useful indicators of ecosystem/ population health (as a manifestation of changes to stress hormones or immune function)

- d. With population decline, increased fragmentation of populations, and climatic change, disease dynamics have a significant potential to change rapidly, therefore an understanding of multiple disease entities is wise.

Among 296 wild-caught koalas from south-east Queensland, 8% had lesions or syndromes considered consistent with retroviral disease in other species, including AIDS-like condition/immunodeficiency disorder, myelodysplasia, neoplasia, and severe chlamydiosis. From longitudinal data, the incidence (new occurrences each year) of these diseases in the population was 12.5% (Hanger and Loader, 2014). Among captive koalas, bone marrow conditions (14%) and AIDS-like syndromes (20%) contribute significantly to mortality (Gillett, 2014). Koalas in some areas of NSW, particularly in the north of the state, are also reported to suffer frequently from a spectrum of diseases that include a range of immunosuppression-like, opportunistic infectious diseases, blood and bone marrow disorders (myelodysplasia) and cancers (e.g. lymphoma and leukaemia, mesothelial and craniofacial tumours). These are widely assumed to be associated with koala retrovirus, but this is not proven and doing so will require more rigorous definition of many of these diseases, with concurrent immunological and virological assessment, to develop predictive indicators of disease risk in individuals or populations. Given recent research has indicated association of some common KoRV subtypes with disease and immune changes in free-ranging Victorian and captive koalas (Maher et al 2016, Maher et al unpublished, Legione et al 2017), investigation of KoRV and this group of diseases should be included in this research priority to evaluate their importance or otherwise.

Only limited work has been done on the significance of lesser known infectious agents of koalas. Cryptococcosis occurs sporadically across the koala's range, but associated drivers are poorly understood and, while the disease is unlikely to have a population impact, along with other diseases it may serve as an indicator of ecosystem health. The impact of recently discovered infectious agents such as Koala herpesvirus and multiple *Trypanosoma* species is even less understood, as Koala herpesvirus has only been identified in a few Victorian koalas and trypanosomes have only been studied in Queensland koalas (8,10). Similar agents play a synergistic role in exacerbating disease, or can be useful as indicators of population health, in other species.

Decision making for population management or rehabilitation requires better understanding of the distribution, interactions, drivers and impact of the multiple agents. Given the paucity of knowledge on disease in free-ranging koala populations, samples (scats, blood, and/ or swabs) should be collected at every opportunity during surveys and capture events, as has been proposed for genetic studies, and development of improved assays for use on the more easily collected samples, should be supported.

2. Disease assessment should be included as an intrinsic part of population surveys whenever access to samples (visual data, scats, blood and/or swabs) is feasibly possible.
 - a. The presence of infectious agents, and other factors with potential to affect fecundity or survival, potentially affect population viability and should therefore be considered a fundamental attribute of any population being assessed;

- b. Translocation or corridor construction should be accompanied by a disease risk assessment in line with IUCN guidelines due to risk of transfer of novel pathogens or strains; absence of information in this area therefore impedes management planning. For example, *Chlamydia* has caused significant mortality events in a small intensively monitored population of koalas in Canyonleigh and in koalas translocated to Tarlo National Park. Thus, an understanding of diseases in source and recipient populations is essential to balancing land management with conservation.
- c. Identification of pathogen-free populations. Aside from direct management implications, determining the impact of infectious diseases on koala populations would be assisted greatly by identification of baseline populations that are free of the disease of interest.

The Koala Health Hub is able to support both areas. We are currently engaged in these areas, through independent and collaborative research, analysis and archival of diagnostic samples from koala hospitals and field researchers, and commissioned research for the Office of Environment and Heritage, NSW. KHH currently supports collection and analysis of relevant samples (blood, swabs, scats) through provision of expertise, sampling equipment, training, and development and validation of techniques and, with appropriate support, could do so on a broader scale.

Heat stress through drought and heatwaves

“Research and trial adaptation management actions such as installation of artificial water sources and the establishment of refuge habitat and promote connectivity through habitat restoration.”

This type of mitigation measure has already been trialled in the same area proposed by OEH and almost in the same way (by our research team) and some results are already available.

Water stations are a potential practical solution that *might* be beneficial for koala populations. So far we (USyd) have proven that koalas use these stations extensively, even in cooler months, and that the intensity of their use by koalas is dependent on rainfall. We do not know yet if the drinkers will enhance koala survival.

Questions that need to be answered are:

- Would multiple koalas visit a single water station? This is central for the SOS koala project because if water stations benefit only a few individuals, then they are not a viable solution to enhance koala numbers.
- Will koalas move away from their home range to seek water? This is fundamental to understand how far apart water stations should be placed for the SOS water supplementation project.
- What is the effect of this intervention with regards habitat resilience, disease transmission and predation risk? For instance it is possible that the location of water sources may put extra pressure on habitat in a small radius around water and have unintended effects; there is a possibility of increased density and therefore increased risk of disease transmission events. Obviously it would also be wise to assess the effect of this intervention to determine whether it significantly influences population size / demographics / health. In addition, water stations

attract a variety of wildlife and may inadvertently act as a focal point of interest for predators. Therefore, more research is needed to determine the possible negative impacts of providing water stations for koalas.

- Do koalas always need free water or only in particular circumstances? If the moisture in the leaves that koalas eat is good, they might not need water supplementation. This is important for the SOS project so valuable resources are not wasted. A framework should be developed to determine when to deploy watering points e.g. leaf moisture, rainfall events, soil moisture etc.
- Can we relate use of water stations to koala survival?

Answering these questions is crucial for what the SOS koala project wants to achieve.

We recommend: We (USyd) could play an essential role in the SOS project by answering these questions because our koala water supplementation in Gunnedah is on-going and has already been running for a year.

Inadequate support for fauna rehabilitation

We support all actions in this area. Rehabilitation groups and associated vets, with the correct support, can play a key role in community and local government engagement, data and sample collection, passive disease surveillance, support of local koala populations, and guiding research and management actions.

The Koala Health Hub currently supports care groups and associated vets with research evidence-based expertise and laboratory diagnostics, as well as communication, education and training through fact sheets, bulletins, statewide and national conferences, and individual and group training in necropsy and sample collection for genetic and disease studies. A website comprising training and other resources, news, discussion forums and links to groups and projects, is to be launched within the month. With appropriate support, these activities can be maintained and expanded.

“Support koala rehabilitation groups and vets to rehabilitate sick and injured koalas through training, provision of materials, and promotion of state-wide protocols including for rehabilitation, genetic profiling, record-keeping and release to the wild”.

We recommend: Disease information is of equal importance to genetic information and protocols and training for collection of samples for disease studies should be included.

“Develop standardised method and reporting for monitoring change in koala populations and distribution through time and contribute survey data to centralised database. Include genetic information where possible.”

We recommend: Disease information is of equal importance to genetic information and should also be included.

“Lack of knowledge (poor understanding of sources of trauma and mortality): Engage with koala rehabilitation groups and other information sources to better understand the causes of koala trauma and mortality. Collate and map the results.”

A major impediment to this currently is a lack of standardization and compatibility of record systems used by the various koala care groups and associated vets, and incomplete entry of data. The result is that extremely valuable data, gained by significant investment, is being lost.

We recommend: Investment in liaison and coordination, database refinement in consultation with end-users, and resourcing of groups to support compliance, would comprise value for money. As a result of its long history of conducting research with koala care groups the Koala Health Hub has the understanding of these issues, and strong end-user relationships necessary to facilitate this activity, with appropriate funding support.

Lack of knowledge (poor understanding of animal movements and use of habitat)

“Improve understanding of koala movements and use of their habitat in the landscape by conducting targeted research on individuals using GPS collars and mark-recapture techniques.”

1. Our research has indicated that koalas need large trees, which ample canopy cover, to offload heat and take shelter. Other elements from the trees, such as moisture, available nitrogen and concentrations of toxins such as tannins, FPCs and terpenes are also needed the understanding of koala habitat.

We recommend: Studies also need to be combined with extensive tree surveys, to address not only tree species requirements of koalas, but physical attributes of the trees

2. Tracking and mark-recapture data is also essential for demographic profiles of populations. Ages, sex ratios, number of offspring, as well as sources of mortality, are needed for an understanding of current population trends.

We recommend: Demographic data be collected in these studies.

3. Any capture and handling of animals for collaring or tagging is also a rare opportunity to collect data on genetics and disease. Collection of samples for genetic studies has been identified as a priority, but not for disease (ie infectious agents).
 - Our existing knowledge of the distribution and prevalence of infectious agents in koalas in most of NSW is minimal.
 - Ability to interpret the relevance of proposed faecal stress hormone studies to koala health is very limited without validation against immunological, parasite/ pathogen load or disease data to determine what changes are biologically significant.

We recommend: that capture opportunities for placement of collars or tags should be used to collect samples for disease studies. Operational staff should be supported with protocols, training and

equipment, and/ or provided with veterinary support. The Koala Health Hub currently supports collection and analysis of such samples (blood, swabs, scats) through provision of expertise, sampling equipment, training, and development and validation of techniques and, with some additional support, could do so on a broader scale.

4. Capture and collar, sample or translocate projects have a range of ethical, welfare and technical issues associated. They also comprise a rare opportunity for disease survey work to be conducted. Both benefit greatly from (or, arguably, require) specialized wildlife veterinary and epidemiological input in design and execution.

We recommend: that wildlife veterinary and epidemiological input be obtained for design and execution of capture studies. The Koala Health Hub currently provides this support to OEH associated projects in the Southern Highlands and South Coast, as well as to other projects in the Sydney area, with significant benefit to those projects. With support, these activities could be expanded.

Getting the community engaged in koala conservation

“Use multiple channels to engage the community in koala conservation and recovery actions across the state. This includes communication strategies, citizen science, volunteers, on-ground conservation actions, awareness programs, and landholder engagement”.

Koala rehabilitation groups should be mentioned explicitly as an important channel for community engagement. They commonly have strong ties in the community and play the role of both representing community concerns and coordinating community activities.

With appropriate support, the Koala Health Hub has potential to play a role in facilitating communication between rehabilitation groups and the research, veterinary and government communities.

KHH can also play a significant role in engaging community in koala conservation by increasing awareness of disease and providing support to community groups, researchers and veterinary profession. The existing collaborative, community-engaged research projects at Gunnedah, Southern Highlands and South Coast provide the information to drive conservation/recovery actions and, with appropriate support, could include more citizen science and landholder engagement.