Stephen Palethorpe
Committee Secretary
Senate Standing Committee on Environment and Communications
PO Box 6100
Parliament House
Canberra
ACT 2600

re: Status, health and sustainability of Australia's koala population

Dear Stephen

Thank you for the opportunity to provide further information relevant to your Inquiry. Our responses to your questions are presented in the following pages. In some cases, we cite references in these responses. Please let us know whether you require copies of any of these references.

We would be pleased to provide any further information, or to meet with you again, to clarify or discuss any further issues of interest.

Threatened Species Scientific Committee
10 August 2011

Questions

Population estimates

1. Under criterion 1 in its advice to the minister, the TSSC states "The Committee considers that the national population may have declined by about 30% over three generations" (p. 27).

- What are your baseline figures to make this judgement?

As is evident in the wording of our advice, it is challenging to provide a robust or precise assessment of the current koala population, and also the koala population 20 years ago (that is, the 3-generation benchmark [18-24 years]). If koalas were distributed at equal abundance across their range, then their eligibility for the decline criterion (criterion 1) could be addressed without knowing the current or former total koala population, but rather through assessment of results from a series of monitoring sites sampling regularly or randomly across that range. However, koala numbers are not so equitably distributed, which means that any trend information from a single or small set of sites must be contextualised within a judgement of the proportion of total population that that site or set of sites comprises, and weighted by that proportion. So, for example, a set of 50% reported declines in several small NSW populations will have less impact on the total national trend than a 5% decline in a much larger population (say, Victoria).

Based on information presented at our commissioned workshop, and published and unpublished information, we estimated the koala abundance across all regions within their range, *at the time of assessment* and about 20 years previously. We concluded that the national koala population in 1990 was about 430,000, and in 2010 was about 300,000, a decline of about 31%. Based on more recent information made available since our assessment, we estimate that a *plausible lower bound* for the current national koala population is about 200,000 individuals. If regions in which the recent koala decline has been driven primarily by drought are excluded from consideration, we estimate that the decline over the rest of the range between 1990 and 2010 is about 16%.

- Under criteria 2, 3 and 4 the TSSC further states that the koala population is 'greater than 200 000 individuals'. How did the TSSC arrive at this figure?

See answer above.

- If 'greater than 200 000 individuals' is the lower population estimate, what is the upper population estimate?

Presenting upper bounds of koala population becomes speculative. We were more concerned with the plausible lowest estimate (200,000+), because the figure is relevant to other criteria (criteria 3 and 4) in the assessment. An upper bound is not so relevant.

- The TSSC 'reasonable baseline estimate' figure for Queensland is approximately 300 000 (p. 26). This implies that the nation baseline is greater than 300 000. Given this is the baseline figure for Queensland alone, and the current national population is greater than 200 000, why does this not represent a 33% decline in koala numbers over three generations?

As noted above, 200,000 is not our estimate of the current koala population – it is a plausible lower bound (the measure recommended for use by IUCN). So it is not logical nor reasonable to simply take that current lower bound estimate as a proportion of the former (i.e. the "baseline" of 1990) estimated population – the relevant comparison is of the current plausible lower bound is with the baseline plausible lower bound, which for Queensland in 1990 was 180,000 (p.26 of our advice).

Furthermore, the criteria used both by the IUCN and EPBC Act stipulate that the 30% threshold should be used only for declines owing to those causes that "may not have ceased OR may not be understood OR may not be reversible" (definition of criterion 1:A2,4). Conversely, if "the causes of reduction are clearly reversible AND understood AND ceased" the required decline to meet the eligibility threshold increases to 50% (definition of criterion 1:A1). That is, if drought-driven decline is to be included in the assessment then the total national koala population must have at least halved over the 20-year period.

In this instance the Threatened Species Scientific Committee (TSSC) considered that the threat or impact of drought was reversible, understood and had ceased. Note that the TSSC , following IUCN guidelines, has not included primarily drought-driven declines in its assessments of other nominated species. To do otherwise would (a) require listing of an unworkably large proportion of species occurring in inland Australia; (b) open the process to interpretational and administrative problems, as species would need to be cyclically added to the list (during and immediately after drought) then removed from the list (during and after their recovery); and (c) be inconsistent with international practice.

There is no doubt that the 80% decline of koalas in the Mulga Lands of south-western Queensland is primarily due to the drought (e.g. the title of the paper reporting the trend is "Drought-driven decline …"[1]). The drought has ceased over most of the koala's range; its impact on koalas is well understood; and it is more or less reasonable that loss of vegetation (and hence koala numbers) in previously drought-affected areas will be at least partly reversible. As noted in the response to the first question (above) our judgement is that if we exclude all regions where population decline is mostly driven by drought, then we estimate that the koala decline over the 20-year period is about 16%.

- What is your assessment of the Australian Koala Foundations estimate of 43 000 to 84 000 individuals?

The Threatened Species Scientific Committee recognises and welcomes the attempt by the Australian Koala Foundation (AKF) to provide a national, systematic and integrated approach to koala distributional modelling, habitat preference and population assessment.

[1]Seabrook, L., McAlpine, C., Baxter, G., Rhodes, J., Bradley, A. and Lunney, D. (in review) Drought-driven change in wildlife distribution and numbers: a case study of koalas in south west Queensland. *Wildlife Research*.

However, there are some serious shortcomings in the methodology and its conclusions. The normal forum for testing scientific rigour and model applicability is the peer-reviewed literature, and it is unfortunate that the AKF koala population estimate has not been subject to such scrutiny. Instead, we base our assessment on an unpublished AKF report "Koala population estimates explanation and methodology" presented to the TSSC as part of the AKF's submission[2]. (To be consistent, we note that much of the other information available on koala population estimates has also not been formally published, regrettably. This lack of formal peer-reviewed information obliged us to apply our professional judgement in interpreting available information, and gaps in that information.)

One explicit concern with the AKF estimate of 43,000 to 84,000 koalas at national level is that it excludes all (ca. 20,000) koalas living in South Australia, on the basis that these are derived from introduced stock taken beyond their natural range. The rationale for the AKF's omission is erroneous. The IUCN guidelines for the listing of threatened species are very explicit about inclusion of "benign introductions" (even outside their natural range) in the assessment of population size: they should be included[3]. There are many precedents among other species for individuals from benign introductions providing a critical conservation reservoir for species which may otherwise have become extinct, and such translocation is an important mechanism for the conservation of many Australian species, particularly mammals. The koalas in South Australia are real, and they should be included in the species' current and future conservation management considerations.

With due respect to the AKF, their methodological explanation is difficult to interpret precisely, but our understanding is that (a) broad vegetation types (eucalypt formations and Callitris forests and woodlands of eastern Australia) likely to support koalas are mapped, with information based on the National Vegetation Information System (NVIS); all other habitats were excluded; (b) across part of this range, field studies sampled for koala faeces within these mapped vegetation units, and the frequency with which faeces were observed around particular tree species was used to rank tree species and habitats according to koala preference; (c) this habitat quality was then transformed to abundance information, based on a small set of sites and studies that assessed koala home range size and its overlap, or modelled from such information; (d) the proportion of active sites (i.e. with koalas shown to be present) was assessed from some field sampling: however, this sampling was non-random, and an attempt was made to address this deficiency by random sampling in six study areas; (e) to populate the modelling, koala density estimates were taken from ten sites previously documented in the literature; however, for the AKF analysis these reported densities were reduced in modelling on the claim that their collections were biased.

This is a complex approach, with many assumptions for each step, and where the consequences of inaccuracies or flawed assumptions may be magnified in subsequent steps of the calculations. Again, to be fair, any attempt at national population estimate for koalas may necessarily be complex and require a series of potentially flawed and compounding assumptions.

For the present purposes, we offer the following critique of the method.

---

[2] The Australian Koala Foundation (AKF) (undated). Koala population estimates explanation of methodology. (AKF, Brisbane.)

[3] Standards and Petitions Working Group of the IUCN SSC Biodiversity Assessments Sub-Committee (2010). Guidelines for using the IUCN Red List Categories and Criteria. Version 8.1. http://www.iucnredlist.org/documents/RedListGuidelines.pdf [p. 7]

(a) (As recognised by AKF), the base vegetation mapping is of coarse resolution and is now long superseded. Most notably its coarse scale precludes the recognition and inclusion of riparian strips of habitat, and most habitats where eucalypts may be non-dominant. However, riparian strips are a particularly preferred koala habitat, especially in inland areas[4], so we suspect that the modelling is likely to significantly under-estimate the availability of key koala habitat, and hence population size.

(b) Several of the key linking functions in the modelling (notably koala densities, home range size and home range overlaps) are based on remarkably few sites, but are known to show very major variation. This reliance on few data points for pivotal linkages in the model seriously compromises its robustness. The value used for home range overlap (20%) seems particularly low – higher values would lead to concomitant prediction of higher population estimates.

(c) The calculations are not clearly explained in the AKF report provided to us, but we are concerned about the linking probability distribution modelling, which shows values well in excess of 1 (their Figure 4): this is a mathematical impossibility.

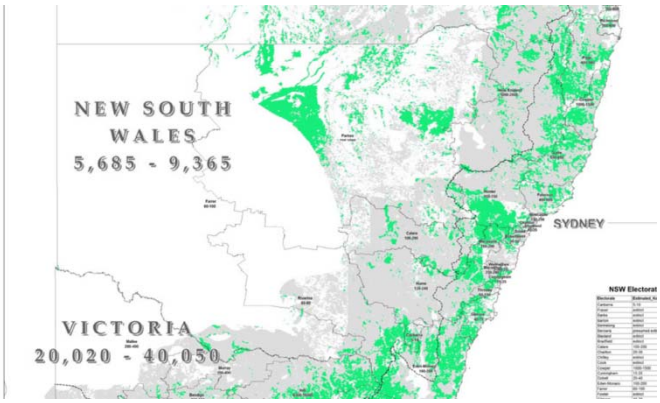
(d) To our knowledge, the model has never been tested against verified field estimates of abundance.

(e) Where it is possible to measure its output against other sources, it appears to be unreliable. For example, Lunney et al. (2009) provide maps of koala distribution (i.e. known koala occurrences) in New South Wales derived from sightings reported by the public in 2006[5]. This mapping of known koala occurrences (Lunney et al. Figures 9 and 10) shows very substantial disparities from that of the modelled distributions output by the AKF approach (see maps below). Furthermore, Lunney et al. (2009) reported 4904 separate locations at which the public involved in their sampling recorded koalas in the year 2006. This compares with AKF estimates of only 5,600 to 9,400 koalas in NSW. It is completely infeasible that the public records sent to Lunney et al. in 2006 would have included almost all (4904/5600) or about half (4904/9400) of all the koalas then living in NSW. The AKF estimates for Victoria (20,000 to 40,000) are also notably discordant with the estimates of long-term koala researchers in that State – notably Mr Peter Menkhorst reports a population of 73,500 koalas in Victoria from just those sites subject to recent assessment, and has indicated a likely population in Victoria of well in excess of 100,000 individuals.

[4] Sullivan, B.J., Baxter, G.S., and Lisle, A.T. (2003). Low-density koala (*Phascolarctos cinereus*) populations in the mulgalands of south-west Queensland. III. Broad-scale patterns of habitat use. *Wildlife Research* **30**, 583-591.

[5] Lunney, D., Crowther, M.S., Shannon, I., and Bryant, J.V. (2009). Combining a map-based public survey with an estimation of site occupancy to determine the recent and changing distribution of the koala in New South Wales. *Wildlife Research* **36**, 262-273.

Comparison of predicted koala distributions by AKF in New South Wales (first map below) and known records of koalas in NSW in 2006 (two following maps),



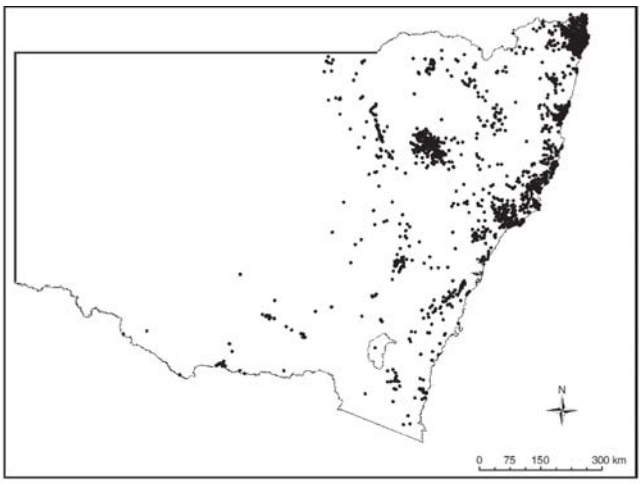


Fig. 9. Locations of koala records obtained from the 2006 NSW Wildlife Survey.

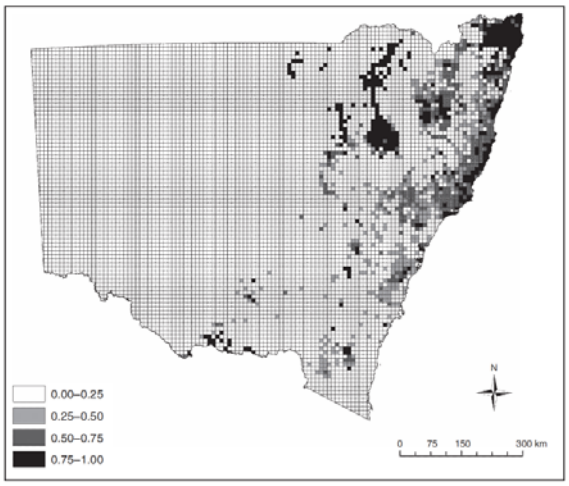


Fig. 10. The distribution of koalas in NSW in 2006. The map shows the average occupancy of koalas in each 10-km square within NSW.

- What do you make of observations made by various submitters to this inquiry (eg Dr Joanne Loader) that koala populations in much of Victoria and South Australia have limited genetic diversity and are therefore not viable populations in the long-term?

The extent to which low genetic diversity impacts a population's viability cannot be predicted or quantified, but the TSSC does recognise it as a potential threat. Some populations survive for thousands of years with very little genetic diversity, while others (e.g. those in zoos) can suffer from inbreeding depression due to the expression of a deleterious trait that by chance was retained in the gene pool when the population went through a major reduction in size, often referred to as a bottleneck. With respect to southern koala populations, other than isolated reports of individuals showing deformities that may or may not be due to inbreeding, there is no evidence at present that population growth is being impacted by low genetic diversity: indeed, these populations are mostly showing far greater levels of population increase than is the case for the more genetically variable

populations in parts of Queensland and New South Wales. This is despite the presence of disease agents in populations in southern Australia. While genetic diversity in neutral markers in southern koalas (other than in the Strzelecki Ranges) is lower than that seen in NSW/QLD, we do not know what impact there may have been on the functional variation that will determine how a population responds to new environmental challenges. To be able to quantitatively assess viability of southern koalas over a particular timeframe a population viability analysis (PVA) model would need to be developed, taking into account all threats including low genetic diversity.

While it is likely that the relatively low genetic variation in South Australian and many Victorian koala populations may render them more susceptible to some threats, it is not the case that these populations are "not viable". Furthermore, ongoing monitoring (of genetic diversity and of survival parameters) can be used to guide management responses: if decline due to limited variability is evident in the future, then it should be feasible to remedially manipulate that variation through translocation or management of breeding stocks.

Improvements in data

2. In its letter and advice to the minister the TSSC made repeated mentions of the poor quality of data on koala populations and its variability (eg p. 2).

- What improvements need to be made to the data to bring it up to scratch?

We note that there has been some outstanding research on koala, and that such studies have provided very significant amounts of information on disease incidence, and many aspects of reproductive and foraging ecology. Indeed, there is more data available for the koala than for most other species that the TSSC considers. However, there are significant gaps in the available data, relating particularly to population size, population trends, and the relative impacts on demography of the range of threatening factors. With respect to considerations of the eligibility of any species to meet criteria for listing as a threatened species, the most important information relates to population size and trends.

In this context, the TSSC considered that the main areas for improvement are (1) broad-scale sampling/survey (to provide distributional and abundance information) in those regions for which koala occurrence is least known (particularly including Desert Uplands, Brigalow Belt, Einasleigh Uplands, and central coast of Queensland, as well as inland NSW). The public mail survey method (or an online equivalent) used by Lunney et al. (2009) may provide a useful initial mechanism for this inventory. (2) continue to monitor koalas (and their food trees) in the Mulga Lands region, to assess the extent of recovery (if any) following the cessation of the drought.

- Deficient population data is clearly an issue across many of Australia's unique species (p. 3). How can this situation be remedied?

This issue was addressed by us at the Melbourne hearing. We recommend a nationally coordinated integrated program for population monitoring of threatened plant and animal species (and other species of cultural, evolutionary and/or economic significance). Such monitoring should (i) provide timely warning of unacceptable declines that automatically triggers alerts that require immediate management actions to ameliorate or halt the decline to enable population recovery, (ii) measure the effectiveness of conservation management responses (and hence help continually refine and adapt that management), and (iii) provide a headline index of the nation's environmental progress that can be counterpointed with more traditional economic and human demographic indices.

3. Under criterion 1 in its advice to the minister the TSSC recommends that critical gaps in the data could be filled by 'giving urgent attention to koala population distribution and demographics in Queensland and New South Wales' (p. 27). Yet in its letter to the minister the TSSC states that 'there are some regions, such as south east Queensland and some areas of coastal New South Wales, for which there is high quality population data covering significant areas' (p. 2).

- Can the TSSC identify which areas of New South Wales and Queensland require better quality data?

The TSSC suggests that (a) it is particularly important to maintain the monitoring (at an increased frequency) of the Mulga Lands koala populations, to provide as early evidence as possible of the extent of recovery (or not) of the drought-affected population; and (b) population assessment be undertaken comparably for some other inland regions (including the Desert Uplands in Queensland, and mid-western NSW) to provide a more robust population estimate for these regions, and to develop and maintain a monitoring program that may provide early warning of climate change impacts. In addition, the TSSC would recommend renewed monitoring of populations that were previously monitored but which have not been monitored in recent years e.g. Northern Rivers region in northern NSW.

4. In its letter to the minister the TSSC recommends that a national koala monitoring and evaluation program be implemented (p. 3). Could you elaborate on why you think this is important?

A consistent, integrated national monitoring program for koalas is required because (1) the density of koalas varies extensively across its range, so it is difficult or impossible to extrapolate national trends from monitoring data obtained at only a small set of sites; (2) a coordinated national monitoring and evaluation program would provide much greater statistical power to evaluate the relative impacts of different threats, and the relative efficacy of different management interventions; and would help identify regions or threats requiring the most urgent management interventions; (3) it is important to report on national trends for important and threatened

components of Australia's biodiversity; and (4) such coordination would help provide more effective communication between all agencies involved in koala conservation and management leading to more effective management outcomes.

Listing assessment

5. In its letter to the minister the TSSC pointed out that whilst the koala's propensity to recover from severe drought is well established, its ability to recover from drought with continued land clearing and habitat fragmentation is unknown (p. 2).

- In the face of this uncertainty why didn't the TSSC use the precautionary principle and list the koala as threatened?

This issue was addressed by us at the Melbourne hearing.

The koala recovered from the "Federation" drought across central Queensland with sufficient speed and extent to be the subject of intensive hunting and harvesting programs within 20-30 years of the drought's cessation[6]. In that region, the Federation drought was at least comparable – if not more extreme – than the most recent drought. For example, eyewitness reports noted:

> "*the timber on miles and miles of forest and scrub land died, and one could ride all day without seeing a tree with a green leaf. The ground was quite bare, even the roots of the grass appeared to have gone. Birds died in hundreds, no in thousands. When the rain fell in December of 1902 hardly a bird remained.*"[7]

In addition, there was substantial land clearance (by extensive ring-barking), hunting and poisoning immediately prior to and following the Federation drought[8]. It is therefore reasonable to assume that the koala has evolved to cope with considerable climatic fluctuation, and should recover from this most recent drought. To list the koala on the assumption that it won't recover would set a precedent that would mean that all drought-affected species should also be listed, until their recovery is demonstrated.

6. In his submission to the inquiry Professor Carrick stated: "… if the question concerning the Koala was put the other way around (which I believe would be consistent with the Precautionary Principle) -i.e. "Is there compelling evidence that the Koala is NOT declining rapidly towards foreseeable extinction?", I believe the [TSSC] would be have to answer

[6] Gordon, G., and Hrdina, F. (2005). Koala and possum populations in Queensland during the harvest period, 1906-1936. *Australian Zoologist* **33**, 69-99.
[7] Barnard, H.G. (1934). Observations on the disappearance and probable cause of many of our native birds in central Queensland. *Queensland Naturalist* **9**, 3-7.
[8] Woinarski, J.C.Z., and Catterall, C.P. (2004). Historical changes in the bird fauna at Coomooboolaroo, northeastern Australia, from the early years of pastoral settlement (1873) to 1999. *Biological Conservation* **116**, 379-401.

"No" and agree that there are insufficient data to be confident the process isn't well & truly underway! (submission 86, p. 10). What is your response to this perspective?

The perspective is inconsistent with existing practice. The IUCN is explicit that:

> "It is recommended that 'worst case scenario' reasoning be avoided as this may lead to unrealistically precautionary listings."[9]

There are probably tens of thousands to hundreds of thousands of poorly-known species in Australia (including for example most invertebrates). The logic of Professor Carrick's reasoning would be that all such species should be listed. This would make the list unworkable and useless. Alternatively, if the reasoning were to apply to the koala only, then the objective underpinning of the list would be lost.

7. In its letter to the minister the TSSC notes that it considered listing the koala in distinguishable regional populations that are under threat (p. 3). The TSSC decided against this.

- Can you please elaborate on why you choose not to list particular threatened populations?

Our procedure for assessing whether local populations could be recommended to the Minister to be declared as 'species' under the EPBC Act involves examining evidence that they are distinct on an evolutionary timescale – that is, that they have been disjunct from other populations of the species over long periods of time due to natural processes. This assessment uses a range of information depending on its availability, including the species' habitat requirements and its specificity, geographic distribution of that habitat, biogeographical features in the landscape, likely natural distribution of the species, movement and dispersal characteristics of the species, and genetic data. In the case of the koala, the widespread and continuous nature of its habitat prior to anthropogenic disturbance, lack of obvious barriers to koala dispersal throughout its range, and lack of genetic evidence for long-term isolation of sampled populations led us to conclude that no population qualified for separate consideration. Using any other criteria for identifying separate populations in the case of the koala would be a contrivance that sets a potentially damaging precedent with regard to listings.

Note that the most recent national taxonomic assessment of the koala (The Zoological Catalogue of Australia. Volume 5. Mammalia) states that:

> "Three subspecies of koala have been described, but as variation is latitudinal and apparently clinal these are treated in this work merely as synonyms."[10]

This recognition of continuous clinal variation is long-standing. For example, H.H. Finlayson noted in 1934:

---

[9] Standards and Petitions Working Group of the IUCN SSC Biodiversity Assessments Sub-Committee (2010). Guidelines for using the IUCN Red List Categories and Criteria. Version 8.1. http://www.iucnredlist.org/documents/RedListGuidelines.pdf [p. 18]

[10] McKay, G.M. (1988). Phascolarctidae. In *Zoological Catalogue of Australia. Volume 5. Mammalia*. (ed. D.W. Walton.) pp. 51-52. (Bureau of Flora and Fauna, Canberra.) [p. 51]

> "In view of the even distribution of the koala (until recently) throughout all of the East Coast lands from the 19° to 39° parallels, and the general similarity of the forest country which it selects, it does not seem probable that the mid-Queensland animals should constitute a distinct race, abruptly differing from its neighbours to the south. The few examples of the New South Wales representative which I have examined, seem to be quite intermediate between Victorian and Queensland ones, and I have no doubt that a series adequately representing the whole of its range would show a steady gradation of characters – the passage from south to north being accompanied by a decrease in average size, dulling of colouration and (at similar altitudes) shortening of the coat."[11]

Hence, there is no sound biological or evolutionary grounds for considering separate population/s – in essence, the koala is distributed continuously and varies continuously and only slightly across its vast range.

Furthermore, it is also not consistent with the TSSC practice to provide separate assessments of populations (with a very small number of markedly different exceptions – all involving populations that are clearly evolutionarily disjunct). The EPBC Act is self-consciously national in its ambit, as is proper. For threatened species, it is particularly about protecting the species from extinction. For the protection of local or regional populations of wide-ranging species, there is a range of state-based legislation and regional and local planning mechanisms. If this precedent was set, it could follow that threatened species status could be afforded to any "population" of a wide-ranging species, where that "population" may be subject to a particular local or regional threat, regardless of its likely impact on the national status of the species of which it is a part. This would make the Act unworkable, and divert it from its objective of maintaining the existence of species.

Furthermore, the IUCN guidelines suggest that such assessments are not desirable:

> "*Subpopulations:* If a subpopulation assessed under the criteria is not isolated (i.e., if it may be exchanging individuals with other subpopulations), its assessments must follow the regional guidelines (IUCN 2003). In addition, it must be a biological subpopulation (i.e., not defined by political or national boundaries). Although the regional guidelines can in principle be applied at any geographical scale, application within very small geographical areas is strongly discouraged. The smaller the subpopulation as a proportion of the global population of the species, the more often the subpopulation will exchange individuals with other subpopulations. Therefore the assessment of extinction risk based on the criteria would become more unreliable (IUCN 2003)."

8. The koala has been nominated for listing under the EPBC Act three times in the past 15 years. Have any other species been nominated this many times for listing under the Act?

No; although at least 16 species have been nominated twice.

[11] Finlayson, H.H. (1934). On mammals from the Dawson and Fitzroy valleys; central coastal Queensland. – Part II. *Transactions of the Royal Society of South Australia* **58**, 218-231. [p. 221]

National Koala Conservation and Management Strategy

9. Can the TSSC express a view on the effectiveness of the *National Koala Conservation and Management Strategy 2009–2014* and its implementation?

This issue was addressed by us at the Melbourne hearing. We refer you to Professor Harrison's presented evidence (page 51 of the draft Hansard).

10. Is it sufficient to prevent the further decline in the koala population?

This issue was addressed by us at the Melbourne hearing. We refer you to Professor Harrison's presented evidence (page 51 of the draft Hansard).

11. In its letter to the minister the TSSC states that the *National Koala Conservation and Management Strategy 2009–2014* does not meet the requirement for Conservation Dependent listing under the Act (p.2).

- What amendments need to be made to the Strategy if the koala were to be listed as Conservation Dependent?

This issue was addressed by us at the Melbourne hearing. We refer you to Professor Harrison's presented evidence (page 51 of the draft Hansard).