REPORT ON PROCEEDINGS BEFORE

PORTFOLIO COMMITTEE NO. 7 - PLANNING AND ENVIRONMENT

INQUIRY INTO HEALTH AND WELLBEING OF KANGAROOS AND OTHER MACROPODS IN NEW SOUTH WALES

Virtual hearing via videoconference on Thursday 19 August 2021

The Committee met at 11:00.

PRESENT

The Hon. Cate Faehrmann (Chair)

The Hon. Catherine Cusack
The Hon. Ben Franklin
The Hon. Rose Jackson
The Hon. Shayne Mallard
The Hon. Mark Pearson (Deputy Chair)
The Hon. Penny Sharpe

The CHAIR: Welcome to this virtual hearing for the inquiry into the health and wellbeing of kangaroos and other macropods. This is the third hearing for this inquiry, which is examining a range of issues related to the health and wellbeing of kangaroos and other macropod populations, including the impact on kangaroo populations of commercial and non-commercial killing of kangaroos and government policies and programs related to kangaroo management. Before I commence I would like to acknowledge the Gadigal people of the Eora nation, who are the traditional custodians of the land from which I and many of us join this meeting today. I also acknowledge the traditional owners of the lands from which all meeting participants join us today. I pay my respect to the Elders past, present and emerging and extend that respect to all Aboriginal people watching.

Today's hearing will be the first ever fully virtual hearing by this Committee. Holding this hearing virtually enables the work of the Committee to continue during the COVID-19 pandemic without compromising the health and safety of members, witnesses and staff. As we break new ground with the technology, I would ask for everyone's patience through any technical difficulties we may encounter today. If participants lose their internet connection and are disconnected from the virtual hearing, they are asked to re-join the hearing by using the same link as provided by the Committee secretariat. Today we will hear from representatives from the Department of Planning, Industry and Environment, and from three scientists whose work has informed the department's kangaroo management program.

Before we commence I would like to make some brief comments about the procedures for today's hearing. There may be some questions that a witness could only answer if they had more time or with certain documents to hand. In these circumstances, witnesses are advised that they can take a question on notice. The Committee requests that answers to questions on notice from this hearing are provided within 14 days of receipt of the transcript. Today's proceedings are being recorded and a transcript will be placed on the Committee's website once it becomes available.

Finally, a few notes on virtual hearing etiquette to minimise disruptions and assist our Hansard reporters. Can I please ask Committee members to clearly identify who questions are directed to and could I ask everyone to please state their name when they begin speaking. Could everyone please mute their microphones when they are not speaking—that is a really important one. Please remember to turn your microphones back on when you are getting ready to speak. If you start speaking while muted, please start your question or answer again so it can be recorded in the transcript. Members and witnesses please avoid speaking over each other so we can all be heard clearly. Also to assist Hansard, may I remind members and witnesses to speak directly into the microphone and avoid making comment when your head is turned away.

SHARON MOLLOY, Executive Director, Biodiversity Conservation Division, Environment, Energy and Science Group, Department of Planning, Industry and Environment, on former affirmation

TERRY BRILL, Senior Team Leader, Kangaroo Management, Environment, Energy and Science Group, Department of Planning, Industry and Environment, on former affirmation

STEVE McLEOD, Senior Research Scientist, Department of Primary Industries, affirmed and examined

STUART CAIRNS, Consultant, affirmed and examined

The CHAIR: I now welcome our first witnesses. Ms Molloy, would you like to start by making a short opening statement? Please keep it to no more than a few minutes, if you can.

Ms MOLLOY: Thank you very much, Ms Faehrmann. I would just like to thank the Committee for inviting us to give further evidence today in addition to the evidence presented in the last hearing and also the substantial additional information provided to the Committee in the form of answers to supplementary questions and questions on notice. We understand today that the Committee is interested in collecting additional information on kangaroo populations, biology, harvest quotas and survey methodologies used by the department. We really appreciate being able to bring our scientific experts along today to assist the Committee and provide additional information. I would like to personally thank them for doing that to support us. In addition, I would like to reiterate some of the points—and I will do that as succinctly as possible—that I made previously about how we manage and regulate the commercial kangaroo management program in New South Wales.

I would also like to just remind the Committee that the original submission we made and provided to the Committee was a whole-of-government response that was supported by the Department of Regional NSW, including our colleagues in the Department of Primary Industries [DPI] and Local Land Services. I will not go into as much detail as I did in my opening statement at the previous hearing, but I previously mentioned we operate under an extensive legislative framework that is not only New South Wales legislation—the Biodiversity Conservation Act—but also the Commonwealth Environment Protection and Biodiversity Conservation Act in terms of the approval of our commercial kangaroo harvest management plan.

The Committee will also be acutely aware of the Prevention of Cruelty to Animals Act, which is the primary piece of legislation protecting animals from cruelty in New South Wales and that also applies to kangaroos. The NSW Police Force monitor and investigate breaches under the New South Wales Firearms Act. So there are quite a few pieces of legislation that we have to adhere to and respect as part of our management of the program. In addition to the legislation, we have also got quite a lot of codes, plans and guidelines, including the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes, which was updated in 2020. In addition to that, internally in the department there are annual quota reports, commercial harvest quotas—minimum quotas are set at 15 per cent. There are a lot of different codes, guidelines and rules that support us.

In addition, the kangaroo management program is managed with the assistance of some really good governance. The department convenes the Kangaroo Management Advisory Panel, which provides advice on the operation of the commercial end of the kangaroo management program. That includes nominated representatives from industry, animal welfare interest groups, Aboriginal communities, farmers, the scientific community and government. We also engage with the kangaroo industry by maintaining regular comms with the Kangaroo Industry Association of Australia. Our team are supported by the broader environment, energy and science leadership team in terms of decision-making around planning and policy settings. We also take part in the Kangaroo Management Taskforce, which is a collaborative group of industry, community and government bodies led by the New South Wales Local Land Services.

We have a very modern and up-to-date compliance program, which includes compliance policy and framework, prosecution guidelines. We have a very strong relationship with our regulatory partners, including NSW Food Authority, Department of Primary Industries' Game Licensing Unit, the New South Wales police and also interstate agencies where they come into play. We have a range of tools at our disposal: education, warning measures—which we use regularly—penalty infringement notices and, where necessary, prosecution. We also undertake opportunistic, random and targeted inspections of carcasses, harvesters, chiller premises and processing works. Most of you are aware that we have a number of macropod species that are actually listed as threatened and they are dealt with through our Saving our Species program. A good example of that would be brush-tailed rock wallabies.

Just a few comments in closing—we constantly, proactively seek and apply the best available science to improve our management approach and outcomes. We are committed to using adaptive management combined with monitoring, evaluation and reporting to support continuous improvement of the on-ground management

decisions and improve capacity for data management and reporting for ecological, social and economic outcomes. In conclusion, we operate a program that has been around for decades and base our decisions on robust science and data. The program focuses, as I said, on continuous improvement and the principles of ecologically sustainable development. Thank you very much for the opportunity to make that opening statement on behalf my colleagues.

The CHAIR: Thank you very much, Ms Molloy. I just want to thank all the witnesses again for agreeing to appear today at what was reasonably short notice. We will go to the Hon. Mark Pearson for first questions.

The Hon. MARK PEARSON: I will put this question to Ms Molloy and Mr Brill because they were here at the last hearings. On the last occasion you took various questions on notice and you have since provided further material and are answering further questions today. Have you provided all that you are able to provide in response to the issues that you took on notice?

Ms MOLLOY: Mr Pearson, to the best of my knowledge, I think we addressed the questions as well as we could. If you feel there are gaps or we could expand—obviously there were quite a few questions. I cannot remember the exact number, which is perfectly fine. We did our best to answer them in as much detail as possible without creating volumes of material. Where possible, we also added relevant scientific papers and citations. Obviously there is a lot of information contained in them that we could not draw out, so if you feel there are any gaps in that information we can expand. But we were trying to be succinct but also give you as much information as was required to answer the questions.

The Hon. MARK PEARSON: Okay, so you gave us as much information as required. So we can, can we not, therefore proceed and report on the basis that for any unanswered question or request for information you have no answer or information, or no additional answer or information? Is that correct?

Ms MOLLOY: There could be some additional answers or information that the other witnesses have potentially. I do not know. Mr Brill, did you want to add anything to that?

Mr BRILL: No. I agree with my executive director that we provided thorough answers to those questions. We believe we have provided thorough answers to those questions. But, of course, if you think there are bits that are not answered, then there is an opportunity now and following this to come back to us.

The Hon. MARK PEARSON: Thank you, Mr Brill. My next question is actually for you. On the last occasion, at page 56 in the transcript, you testified that you "disagree[d] with the premise" that kangaroo populations can only increase by a maximum reproduction rate of 10 per cent. You said that you "would like to see the calculations and figures". Since so testifying, have you examined the figures and calculations?

Mr BRILL: Yes.

The Hon. MARK PEARSON: So you have examined them, have you?

Mr BRILL: Yes.

The Hon. MARK PEARSON: And has that been of the contrary of the science that actually underpins that estimate of 10 per cent?

Mr BRILL: Yes. The calculations and assumptions that were provided that the 10 per cent is based on is contrary to the science.

The Hon. MARK PEARSON: Okay, so you disagree with the 10 per cent. But you do accept that, in setting the cull quotas, a relevant factor would be the biological capacity of a kangaroo population to regenerate? Would that not need to be taken into account?

Mr BRILL: In setting the quota, we need to take account of what the populations are. That is correct. That is how the quotas are set. We survey populations. Based on the surveyed population, we set quotas.

The Hon. MARK PEARSON: Right. So are you saying you set quotas on surveying a population but you do not take into account the relevant factor, which is the biological capacity of a kangaroo to regenerate? You do not take that into account?

Mr BRILL: The population survey—because you are surveying the population itself, you have already taken into account the capacity for it to have regenerated in the previous period of time between the previous two surveys.

The Hon. MARK PEARSON: So you disagree that the maximum population growth is only 9 per cent or 10 per cent—

Mr BRILL: Absolutely.

The Hon. MARK PEARSON: —which is based on a great deal of science. Okay, so you disagree with that.

Mr BRILL: I absolutely disagree with that.

The Hon. MARK PEARSON: Okay, so if you disagree with that, which is accepted by a large majority of ecologists et cetera, you still have the aspirational harvest rate of 15 per cent to 17 per cent as being sustainable, so an extra, in your calculations, of quotas. It states—and I think you refer to this—that there is actually a 15 per cent or 17 per cent increase in regeneration in kangaroo mobs. That is your finding, is it?

Mr BRILL: The science has established that 15 per cent in eastern grey, western grey and wallaroo species is a sustainable harvest level and 17 per cent for red kangaroos is a sustainable harvest level. We can draw on scientists that we have with us that can give a much more thorough answer as to why and how those levels are set and why 10 per cent is not correct.

The CHAIR: Okay. Let us do that then if we can. Dr McLeod, I think you raised your hand to respond.

Dr McLEOD: Thank you, Madam Chair. I would just like to address the 10 per cent as being a maximum rate in terms of the rate of increase. That is incorrect. There is substantial empirical evidence from a large number of studies that has shown that the maximum rate of increase of many kangaroo populations and over a range of species is substantially higher than that.

The CHAIR: Can I jump in just to clarify something with this. When we did hear that at the previous hearing, that was in reference to greys, I understand. So the 10 per cent is because grey kangaroos—is that 12-month gestation period, if you like, whereas some, potentially others, are eight to nine months, which gets you to the potential 14 per cent, 15 per cent. I just clarify that the evidence that we did hear was greys, so continue.

Dr McLEOD: Yes, thank you. You are quite correct. There is a difference in the duration of pouch life between greys and red kangaroos. That is not the only thing that is affecting the rate of increase here. There are a number of assumptions in the calculations that were presented at the last inquiry, the testimony of—let us say, assuming that the maximum rate of survival of pouch young was quite low at 30 per cent is incorrect. It can be and it ranges dramatically depending on what the conditions are, but under good conditions pouch survival can approach 80 per cent or 90 per cent under some good conditions. That is why we see spectacular rates of increase under some conditions. That is not to say it is not variable. It is. It can be quite variable but, if we are looking at all the assumptions that were underpinning those calculations, a number of them can be disputed in terms of there being the maximum rates for the population.

If we go back to what Mr Pearson brought up before in terms of the maximum rates, the quota itself is based on a survey of the population size but that is not what determines the harvest strategy. The harvest strategy is based on the population dynamics and the population dynamics are related to the sustainability of the harvest, which is tested against—uses the rate of increase of the population, uses the tracking strategy, which takes into account changes in the population size, changes in the harvest rate, which tracks populations and the population size. This strategy is used around the world in variable environments and is shown to be quite a safe—in terms of reducing the risk of overharvest—harvesting strategy. On top of that, an additional level of safety is included in the threshold, which is now used around Australia, not just in New South Wales but in all commercial harvest of kangaroos around Australia.

The Hon. MARK PEARSON: My question goes directly to the evidence just given. Is there a reason why your department does not take into account the lower confidence level and the upper confidence level of 1.96 per cent when calculating the quotas? This is the methodology which is used all over the world. It is used at the Convention on International Trade in Endangered Species of Wild Fauna and Flora [CITES] to determine whale numbers and therefore bring about a ban. It is a factor which we cannot see in your data and methodology. Do you understand what I mean by this lower confidence level and upper confidence level that is adopted pretty much by about 50 countries, which I have in front of me, including CITES? But it is not adopted in your methodology.

The CHAIR: Just to be clear, who are you directing your question to?

The Hon. MARK PEARSON: I think I will direct that question to Mr Brill.

Mr BRILL: I think it is much better answered by Dr McLeod.

The Hon. MARK PEARSON: Okay. Dr McLeod?

Dr McLEOD: The harvest strategy itself is based on an estimate of the population size and that estimate includes a variance, which is the 95—well, in this case you are talking about a 95 per cent confidence interval. That does not affect the point estimate of what the estimated population size is. It is just an estimate of how much

variance they think or how much confidence we have in that estimate at that particular time. If you could be a bit clearer, I can give you more detail as to how that is used in other harvests around the world. That might help me answer the question.

The Hon. MARK PEARSON: Well, it is the methodology which has been adopted wherever there is an exploitation of wildlife in many areas of the world. If we look at the quotas, estimates, population estimates—for example, in 2018 there was a population estimate done at four million. If you had taken into account the lower confidence level measurement and the upper confidence level, the lower confidence level would have been extinction, according to this international practice of using the lower confidence level and upper confidence level. So because your department is not applying this internationally recognised methodology to err on the side of caution, to protect animals that would otherwise be harmed in breach of law—if that was applied to your own calculations, in 2018 the quota for kangaroos or for wallaroos would have been at the lower confidence level of extinction. The world practice—so if CITES was to be asked about this, they would say, "You cannot have a quota because if you do it could cause extinction." That is the importance of this methodology which you are not applying. Is that correct?

Dr McLEOD: I think I am getting a better understanding of your question. What I would ask you to do is—would you be able to provide those calculations? I have a very good knowledge of the harvesting literature and I am not aware of the calculations that you are citing. But what I think you are referring to is the confidence interval or the basing of the threshold and how that is calculated. In the answers to supplementary questions that I have read in response to the submission by the Department of Planning, Industry and Environment [DPIE], the calculation of the thresholds—there was a mistake made in the calculations in those. We did not make a mistake; in the response to our question there was a mistake. And it comes out because the application or calculating the 95 per cent confidence intervals or the z-scores we referred to for setting the thresholds is based upon a normal distribution. If the population is not normally distributed, then you cannot accurately calculate that. Kangaroo—

The CHAIR: Sorry. Can you just finish this one sentence—can you wrap up please, Dr McLeod? I am just really conscious that we have Dr Cairns here for just another 30 minutes.

Dr McLEOD: Yes, sorry. The data needs to be transformed before that calculation is made and that would calculate it correctly. What has happened is that there is a mistake in those calculations in response to our answers and that needs to be corrected. Thank you, Chair.

The CHAIR: I might just move to a few questions that I have. I think, Dr McLeod, you said potentially a 90 per cent—like some good years it could be a 90 per cent survival rate in joeys. I have seen a few different literatures on this now. I think I have seen something which is a maximum of, say, 73 per cent—maybe Arnold has said juvenile mortality is 73 per cent. But I think the supplementary questions that the department has responded to I believe quoted Banks, maybe, as the 50 per cent mortality as a result of foxes. I do understand that foxes are pretty rampant throughout most of regional New South Wales. I just wanted to maybe go to you, Dr Cairns. Firstly, with that figure where 90 per cent of joeys survive, is that an average year?

Dr CAIRNS: I think, Madam Chair, that would be a very good year. Pouch young survival is generally quite good in my opinion, certainly with red kangaroos. I have been working with red kangaroos in South Australia for a number of years where mortality is more likely to be high is in that first year of being independent—in the one- to two-year age class.

The CHAIR: [Audio malfunction]. Sorry. I was the first one to speak with the mute on. The 50 per cent figure that Banks quotes then in terms of juvenile mortality—yes, that is still what you used to determine the biological rate though. I think we are being a bit pedantic here, aren't we? That is what that figure is—the juvenile mortality. Fifty per cent of young will not survive to become adult kangaroos.

Dr CAIRNS: Again, that would depend upon conditions. I mean, most of these animals live in an energy-rich world but a protein-poor world. If conditions are good and they require protein to grow, they will grow and survive. The level of predation in a lot of these areas is fairly low now because of the heavy baiting that goes on for foxes and dingoes.

The CHAIR: Okay. Can we run with that then? Say 90 per cent of juveniles survive. That is still—what roughly would that be in terms of reproduction rate? We are probably getting—say it was 10 per cent, I mean, we might be getting up to, say, 25 per cent. If 90 per cent of joeys survive—can I just get your response, Dr Cairns, to the 426 per cent increase? I think you probably would have seen the transcripts of this if you did some research for today, which I am sure you did, that 426 per cent increase in eastern greys in the Tibooburra region. We asked a lot of questions last hearing, which was between—yes, the change from 2014 to 2015 was 426 per cent. What do you say to that level of increase for eastern greys?

Dr CAIRNS: In the Tibooburra zone I would think a substantial amount of that has to do with movement. You have got to remember with eastern grey kangaroos that the first record of eastern grey kangaroos west of the Darling River was in 1972, so prior to that there were effectively no eastern grey kangaroos in that rangelands country west of the Darling River. But with changes in pastoral practices, particularly putting in lots of watering points, it has created an environment that suits eastern grey kangaroos. I have heard anecdotally that if you get dropped into the rangelands anywhere you would be no more than five kilometres from a watering point, which for a kangaroo is not far. Those eastern grey kangaroos in the Tibooburra zone move in and then a drought will correct the edge of their range and their distribution and they will be eliminated. Once conditions improve they will move back in again. I think I would have to defer to Steve on this one. He does the surveys in those areas. He might like to add something.

The CHAIR: Dr McLeod, if you could just come in here as well—although I have got lots of research that suggests that in fact eastern greys are sedentary really. Aren't they? They do not really roam far beyond five to 10 kilometres. That is the science, is it not, Dr McLeod?

Dr McLEOD: There is some evidence that they are sedentary, but it tends to be in a cohort that are adults. Most of the studies that we have done have not looked at large-scale movements. There are a couple reasons for that. One is that the technology has not been widely available or cheap enough to use on a broad scale. The other one is that most of the studies have been done by PhD or Masters students, who have a very short time to do their work. So, they have specifically selected animals that they thought would not leave the study site because they were using technology that they had to track down on the ground. So, they used VHF collars, which have a very short range. So our studies on the movement tend to be biased by—in terms of home range—those studies, our understanding of that.

However, if we look at large-scale aerial survey data—and this has been done in South Australia. There was one particular study that was led by Dr Pople, who will be talking later today, that actually tracked much greater movement and that included western grey kangaroos—mainly red kangaroos but also western grey kangaroos—which were again thought to be much more sedentary. Those movements were much greater than we had thought before. I think what you have identified is we really have a knowledge gap here. We really need to understand the movement of kangaroos through the environment a little bit more. We think we know what is going on in most cases, but there are still things that we need to learn and this is one of them. This is a good example.

The CHAIR: Okay. Well, it also sounds like if you do not have as much evidence that they are migratory, then maybe they are not migrating and you need have a look at the way you are surveying and the figures potentially because this 426 per cent figure just has not been able to be justified yet. I will throw to questions from the Opposition.

The Hon. PENNY SHARPE: Thank you very much for coming on here. I note that none of us are scientists but we are working through this very carefully. I suppose I wanted to ask the question, which is really where some of these issues are coming from, that there is concern within the community and from some scientific people who have given evidence to the Committee—and I am assuming that you have seen most of that—that the way that we are doing these calculations, whether it is the reproductive rate, whether it is the correction factors, whether it is the discussion around survival rates, the fundamental question to me seems to be: Are kangaroos in danger as a result of our actions because somehow the use of these figures is masking their decline? I do not know who is the right person to answer this. I am happy for anyone to jump in and I defer to your expertise. But we have got a lot of claims and counterclaims around the figures. Clearly, we have got a framework about how we manage commercial and non-commercial populations of kangaroos. I really just want to give you the opportunity to explain to us the concerns about masking decline and why you do not believe these are an issue.

The CHAIR: Who would like to handle that one? Dr Cairns, maybe because you are with us the—

Dr CAIRNS: I think with kangaroos in eastern Australia there have been three major climatic events which have done a lot to shape the populations. They were the 1982-83 drought, the millennium drought and this most recent drought in 2017 to 2019. In between those droughts kangaroo numbers have increased and increased quite substantially. I think the harvest in lots of ways has very little impact on kangaroo numbers.

The Hon. PENNY SHARPE: Right. In terms of the frameworks that you are operating around—calculating quotas and such—you believe that obviously the drought has the biggest impact. I think that is very clear and we have also heard a lot of evidence around the boom-and-bust populations as a result of that. But the concern from the community that we are endangering kangaroos is clearly not your view. Is that right?

Dr CAIRNS: Certainly.

The Hon. PENNY SHARPE: There has been a lot of backwards and forwards around correction factors. For people like me who are not across the maths of all of this, can someone take us through that and again explain the differences? Because, again, we have had a lot of to-ing and fro-ing on this issue.

Dr CAIRNS: Which differences are you seeking to get explained?

The Hon. PENNY SHARPE: Good question. Well, we have received evidence that the correction factors are adding in different areas that have not been included before. Can I just say, I do not pretend to understand all of that, which is why I am really asking you to explain how the correction factors are applied and why they have changed over time because there is significant concern about that issue.

Dr CAIRNS: Well, correction factors are to deal with the issues of sightability. If you are looking at a survey strip and you are travelling at—particularly with helicopter surveys—90 kilometres an hour, detectability of objects like kangaroos declines as you look further away from the survey platform. That is why they have been developed. This is why there has been a move to use distance sampling because with distance sampling you can actually model detectability. I think Steve might—

The Hon. PENNY SHARPE: Sorry, Dr Cairns, can you just explain to me distance surveys and how they work?

Dr CAIRNS: Essentially what you are doing is you are measuring the distance of the object you see from the aircraft and eventually, when collect enough data, you can then model that decaying, declining sightability. Once you have got that, you can work out a probability of detecting an animal in a nominal survey strip.

The Hon. PENNY SHARPE: And is there work being done—look, the counting methodology is argued. It does not matter what sort of animal it is. It is a significant issue. Sorry, this is actually off the correction factors but while we have got you—drones and the use of drones and the type of [disorder].

The CHAIR: Can I jump in just to delve a bit deeper on the survey methods that Dr Cairns was just referring to. You have increased those survey transects though. Is that right? I thought at one point you had 200 metres, then you went to 100 metres for more accuracy and I think at the last hearing we heard you are now up to 300 metres. Why the difference in the transects over time?

Dr CAIRNS: That is with the fixed-wing surveys in the inland parts of New South Wales. I think Steve, who is involved in those surveys, should respond to that, but I can comment on the helicopter surveys in the tablelands. We use a 150-metre-wide strip and I would be quite happy to go back to a 100-metre-wide strip because when you look through the results, the detections—you are picking up less than 10 per cent of the animals. Fewer than 10 per cent of the animals you see are in that last section of the strip, which is the 100- to 150-metre section of the strip. The great majority of detections are within 100 metres of the aircraft and if you parse it further, the overall majority or the substantial proportion of them are within the first 70 metres, 40 metres of the aircraft.

The Hon. MARK PEARSON: Can I just ask a question on that?

The CHAIR: Sorry, I am conscious that I have jumped into the Hon. Penny Sharpe's question time. Dr McLeod, did you have something to say on that transect as well? Why the change?

Dr McLEOD: As research has been done and we have improved the methods, we have been looking at improving the precision and accuracy of the counts themselves. That is the initial reason changing from a 200- metre strip to a 100-metre strip did not have such a great difference on the actual estimate but it had a big impact on the precision of the count. Moving again to using distance sampling, which is a change from 100 metres to 300 metres, gave a great gain again. Basically this comes about because as statistical methods have evolved and become available, and new methods of collecting data become available, we adopt them into the program. The idea there is that it produces more accurate accounts so the quotas can be set more accurately. That is the reason.

The Hon. CATHERINE CUSACK: It is Catherine. I just have one question—

The CHAIR: Sorry, everybody. The Hon. Mark Pearson has a specific question on this and so does the Hon. Catherine Cusack. The Hon Penny Sharpe will have time to ask several questions after this but just to pick this out if that is okay because it is a critical issue. We will go to the Hon. Mark Pearson very quickly and then to the Hon. Catherine Cusack.

The Hon. MARK PEARSON: Dr Cairns, you have obviously made it very clear that the methodologies that have been used to produce the population estimates have changed continuously. If that is the case, how is it possible to justify how long-term trends and quotas can be reliably set across time, given that different methodologies have been used? So we have had no period of time when the same methodology has been used to

calculate the quota over a period of two or three years. Surely that is much closer to an accurate assessment rather than having various methodologies?

Dr CAIRNS: I think that Dr McLeod is right; the methods have evolved and become better. But I could comment on the shift from a 200-metre to 100-metre strip. I was involved in the research that effected that. There are always available conversion ratios that you could either convert the 100-metre estimates to 200-metre strip estimates or vice versa. That would allow you to have continuity in your data estimates. I presume that Dr McLeod might be able to comment on the conversion between the distance sampling fixed-wing surveys and the 100-metre strips, which have dovetailed into one another.

The CHAIR: We will go to you, Dr McLeod, and then to the Hon. Catherine Cusack.

Dr McLEOD: Yes, in the same way that the research had been done looking at the calibration of a 200-metre strip to the 100-metre strip so that you can directly compare the results from a 200-metre strip to a 100-metre strip, we have done the same work with moving from a 100-metre strip to distance sampling. In the last evidence that Mr Brill presented, he said that they did not run concurrently with the survey and that is true. They did not run concurrently with the wide-scale survey, but we did research work at a recent station owned by the University of New South Wales. Over two weeks of testing the counters, we compared both the methods.

The analysis of that has been done to a preliminary stage and we are very confident that there is a substantial improvement in the accuracy and precision of going to using distance sampling, in particular micro-capture distance sampling as opposed to the 100-metre strips. But we also have the data to recalibrate what the 100-metre strips were, so we do have continuity in the time series. I would just like to point out that in over nearly 35 years there has been three changes in methods. It does not change rapidly. The last change occurred only relatively recently to micro-capture distance sampling but that is only because those methods have been developed to the stage where they are sophisticated and fine enough for us to use in an operational way, not just in research.

The Hon. CATHERINE CUSACK: My question is simply: How many kangaroos do you actually see versus what the methodology tells you is the kangaroo population? Can you just give us some indication from the raw data how many kangaroos are actually observed? I am trying to get a feeling for what is the size of the number of what is actually seen versus what that then extrapolates into the size of that number.

Dr CAIRNS: Well if you look at the probabilities of detections, you are only detecting probably 30 per cent of what is present as you pass them on a strip. So if you produce an estimate of 3,000 kangaroos you are probably only seeing a thousand or fewer. There is an example that has been kicked around with wallaroos in the Northern Tablelands where one of the protagonists, or antagonists, concerned about this has raised the point that 508 sightings of wallaroos was able to be converted into—I think it was 30,000—sorry.

Dr McLEOD: No, it was almost 300,000.

Dr CAIRNS: Almost 300,000 animals. That is easy to do because you could use that 508 observed animals to produce a density estimate, which takes into account the sightability, the area surveyed and the fact that we incorporate into wallaroo estimates the multiplier of 1.85 because it has been demonstrated that they still have an overall flat sightability problem. Once you multiply that by the 40,000-odd square kilometres of the survey blocks, you get your 300,000 animals. You are mute.

The Hon. CATHERINE CUSACK: Yes. The point is that if you have such large multipliers it requires only a small change in what is observed to lead to a radical change in the population estimate.

Dr CAIRNS: Well, proportionally the change is still the same.

The Hon. CATHERINE CUSACK: Thank you.

The CHAIR: Okay we might just go—

Dr CAIRNS: Dr McLeod might want to comment on this.

The CHAIR: Yes. Just quickly, Dr McLeod, if you have something to contribute to this?

Dr McLEOD: If I can just add: The difference of going from strip sampling, which was the older methods, to distance sampling has changed the method of analysis substantially. I think the question you were talking to before was really relevant to strip sampling. It is not so relevant to distance sampling because of the method that is used to estimate what the population size is. It does not depend on sampling large areas. It is really more dependent upon constructing a detection function and how much variability there is between the transect sort of survey. From there it can be done very accurately and this is actually measured within the analysis itself. The precision of the analysis or the estimate can be actually calculated. So we can be quite confident that the numbers, using the distance sampling methods, are very close to what we have seen.

The CHAIR: We will go to the Hon. Penny Sharpe now if you are ready to recommence. Sorry, you are mute.

The Hon. PENNY SHARPE: Sorry. I am happy for the Hon. Mark Pearson to jump in, if he wants to, at this point.

The CHAIR: Okay. We will go to the Hon. Mark Pearson. I also have a couple of questions as well.

The Hon. MARK PEARSON: Dr Cairns, just while you are here because I know you are leaving shortly, in your professional opinion, should the Department of Planning, Industry and Environment reports be subject to the rigour of the peer review process?

Dr CAIRNS: I would have thought not because they have been peer reviewed in the past. I did some work on horses for DPIE and those reports were peer reviewed. In fact, they were sent overseas to be peer reviewed and the methodologies are similar. They got—

The Hon. MARK PEARSON: But the methodologies are changing, and constantly changing.

Dr CAIRNS: The methodologies at the moment are similar. The method that I am involved in which is used to count kangaroos is the same one that is used to count horses in the alpine national parks.

The Hon. MARK PEARSON: But there has been no internal or external audit of your work since the horses?

Dr CAIRNS: No. Sorry, yes. Two reports were peer reviewed in probably 2009 or 2010 and were found to have no problems. I presume that DPIE, or the Office of Heritage and Environment as it was then, felt that if the methods were not changing and they considered I was an honest trader in this area, they would not bother with peer reviews again.

The Hon. MARK PEARSON: But the methodology has changed, Dr Cairns.

Dr CAIRNS: Not from what I do for the tableland surveys.

The Hon. MARK PEARSON: But you just explained that sometimes there is a 100-metre view and then a 200-metre view et cetera, et cetera. So these are changes in the department.

Dr CAIRNS: No. That is for the inland; that is for the pastoral division surveys; that is for the fixed-wing aircraft surveys. The helicopter surveys on the tablelands, which I am involved with, have not changed in terms of their execution since their inception, which is in 2003.

The Hon. MARK PEARSON: Is that not a concern?

Dr CAIRNS: In what way?

The Hon. MARK PEARSON: If there has been no audit, no peer review, considering the controversial nature of this.

Dr CAIRNS: It is not a concern of mine, but if people want to have my reports peer reviewed I am quite happy to have that done.

The CHAIR: Can I just jump in there with this as well.

Dr CAIRNS: The first audit that I did was peer-reviewed by five agencies.

The CHAIR: I am very sorry I spoke over you, but I might just jump in with a question on this as well. Some of the areas that you survey, if we go to the Northern Tablelands, you do that every year. Is that correct, Dr Cairns?

Dr CAIRNS: No, every three years. There is a survey of the tablelands every year but you start—the Northern Tablelands was done in 2019, for instance; Central Tablelands done in 2020 and there will be a survey starting in early September of the Southern Highlands or the Southern Tablelands. So it is in a three-year rotation through those tableland zones.

The CHAIR: Do the transects that you use, do they stay exactly the same in size—for example, the area that you survey each time?

Dr CAIRNS: No. I change it. I change it based on information from the previous survey. So we have got information on previous survey effort, which is transect length flown, the precision of the estimate we obtained, and the new surveys are reset to a target precision of 20 per cent.

The CHAIR: Does the area that you survey increase then?

Dr CAIRNS: Sometimes it increases, sometimes it decreases. It depends on how precise the previous estimates were, which gives us a bit of flexibility. The surveys are redesigned so the same survey transects are not flown, but they are redesigned and tested with simulations as to what sort of coverage they will give.

The CHAIR: I will go back to the Hon. Mark Pearson in a second. You were talking about the whole kind of boom and bust thing, if you like, for the whole industry but I just want to check. Why, therefore, in really significant periods of drought—so, let us say for populations—I think I actually got this from the quota report, which I think is May 2018 just before the aerial surveys had been conducted across the Western Plains, New South Wales was experiencing widespread agronomic drought conditions and that, as of 31 May 2018, 99 per cent of the State was covered by one of the three drought categories. Why then with this boom and bust do so many licences continue to be issued, or quotas set I should say, when it is clear that the whole State is in drought and the population is going to go through the floor? Dr Cairns?

Dr CAIRNS: I am not sure that I am the person to ask about setting quotas but I have never had a problem with harvesting kangaroos as the populations move into drought because generally I see the harvest mortality as being compensatory. It is often removing animals from the population that would perish anyway. I mean, the impact of drought in the inland areas is really quite savage compared to the tableland zones. I thought the last drought, which was now thought to be perhaps the worst drought than the Federation drought, had little impact on the Northern Tablelands of New South Wales, but as you moved further south the impact became greater. And certainly as you move west into the inland, it was really quite savage.

The Hon. MARK PEARSON: Dr Cairns, the harvesting of kangaroos would be taking out healthy kangaroos, would it not? They would not be wanting to take out emaciated, burnt or harmed kangaroos, would they?

Dr CAIRNS: They take out kangaroos. It depends on the strategy of the field processor.

The Hon. MARK PEARSON: But if it is a commercial harvest as opposed to a mitigation killing, then surely the shooter, the harvester, would only want to take a kangaroo for which he will be paid. [Inaudible].

Dr CAIRNS: Most shooters will shoot for body size, but it depends on the density of the population. I did some work years ago in the north-west of the South Australian pastoral zone where shooters would shoot anything that moved because the density of the populations were so low and, really, it was almost an uneconomical activity.

The Hon. MARK PEARSON: But the shooters are choosing animals they will be able to hang in the chiller and for which they will be paid. They are not going to be euthanising animals that are suffering. That would be correct, would it not?

Dr CAIRNS: Well, the conventional thinking on kangaroos and individual responses to drought is that the large animals succumb to drought fairly quickly and so do the very small animals. So often after a drought you have got a population with a biased sex ratio—biased towards females—and most of your survivors have been females of prime reproductive age. This is why you can get quite substantial increases following a drought.

The CHAIR: Can I just jump in as well. At the last hearing we asked questions around the overall population number of kangaroos but, within that population—I think every year the department issues a table which has how the various populations are going. But it did not seem to add in different areas, or zones if you like, or take into account the fact that different zones had been added to increase overall the areas that were—for example, the Northern Tablelands was added in 1991; south-east New South Wales was added in 2004; and the Central Tablelands was added in 2008. I just want to get to your sense, firstly, Dr Cairns. Is that correct?

Dr CAIRNS: As far as I know because the first surveys were done in the Southern Tablelands in 2004, I think, or 2003, the same as the first surveys done in the Northern Tablelands. In the Central Tablelands, the first surveys were not done until 2008. So prior to that I guess quotas in those areas were always set in relation to some ground surveys that had been done mainly in the Northern Tablelands.

The CHAIR: That artificially inflates the populations, though, does it not?

Dr CAIRNS: [Inaudible].

The CHAIR: For the fact that—yes?

Dr CAIRNS: I was just going to say—

The CHAIR: If you have new zones added. Sorry, you go.

Dr CAIRNS: The new zones were added as harvest zones. Prior to that there was no harvesting in those areas.

Dr McLEOD: I have a comment.

The CHAIR: Yes, Dr McLeod.

Dr McLEOD: If I could just add, the overall picture, that is not how quotas are allocated. Looking at the overall population, summing all those areas together is not how the quota is allocated. The quota is allocated on a zone-by-zone basis. So the population is calculated within each zone and each zone is managed separately from other zones. You are quite correct, that graph has included new figures so it is misleading in that sense. It should be calculated on density rather than abundance. That graph itself has no relationship to the setting of the quotas because they are managed on a much smaller scale on a zone-by-zone basis. I guess what you were talking about their does not apply to the management of zones itself. Does that make sense?

The CHAIR: Yes. Just as you were responding to that, I will pause there, thank you, and we will say thank you to Dr Stuart Cairns, unless there are any burning questions from Committee members. I am sure there are many but time has beaten us. Dr Cairns, thank you very much for appearing at today's hearing.

Dr CAIRNS: Thank you, Madam Chair.

The CHAIR: We will now swap witnesses.

Dr McLEOD: Thank you, Stuart.

Dr CAIRNS: Thanks, Terry. I will talk to you later.

Mr BRILL: No worries.

Ms MOLLOY: Thanks very much, Stuart.

The CHAIR: Thank you.

(Dr Cairns withdrew.)

ANTHONY POPLE, Senior Principal Scientist and Manager, Invasive Plants and Animals Research, Queensland Department of Agriculture and Fisheries, affirmed and examined

The CHAIR: Welcome, Dr Pople. There is no opportunity for an opening statement, if that is okay. You have not prepared one? I am just checking.

Dr POPLE: No, I have not prepared a statement. Sorry.

The CHAIR: No, that is good. That is perfect. That is how it should roll. We might just continue our questioning. I will go back to the Deputy Chair, the Hon. Mark Pearson, for further questions.

The Hon. MARK PEARSON: Thank you, Dr Pople. In 1997 you authored a paper entitled *Comparison of Helicopter Line Transects and Walk Line Transects for Estimating Densities of Kangaroos*, undertaking comparisons at five sites, all in Queensland, during winter, summer and autumn. That is correct, is it not?

Dr POPLE: Yes. It sounds correct.

The Hon. MARK PEARSON: You stated in that report a sample size of at least 60 to 80 single animal sightings per transect. You stated:

> … a sample size of at least 60–80 sightings for adequate estimation of density. Where sample sizes fall below this value, some caution is needed in interpreting the results.

Yet the wallaroo sightings are as low as 54 wallaroos across 37 transects. That is from the design and analysis of helicopter surveys et cetera. How then can you determine the population estimates are accurate when your own data contradicts your statement?

Dr POPLE: I am just trying to remember that study, which was some time ago.

The Hon. MARK PEARSON: Well it is what everybody relies on, including in an article in work that was done by both yourself, Dr Cairns and Dr McLeod. It always relies on this particular finding of yours, yet it does not seem to be being applied to prevent harm to the wallaroos.

Dr POPLE: The 60 to 80 number refers to a number of clusters of animals, not actually individual animals. It is a rule of thumb.

The Hon. MARK PEARSON: Sorry, what is a cluster of animals?

Dr POPLE: It is like a [disorder]. I am sorry, I missed that.

The Hon. MARK PEARSON: Is it a mob or is it a single animal? One would assume [disorder] a sighting is a single animal.

Dr POPLE: It is a sighting object and it does not matter whether it is kangaroos, duck nests or a pod of dolphins. It is a sighting object; it is what you see.

The Hon. MARK PEARSON: Obviously you are counting because you are saying 60 to 80 sightings. Surely for the purpose of robust science we need to know how many are in that sighting, whether it is four in a cluster, 100 in a cluster, or one.

Dr POPLE: Yes, of course, but the 60 to 80 refers to the number of clusters that you see when doing a survey. It is a rule of thumb because it is to enable good modelling of the detection probability. If you do not have 60 to 80, I mean, really, the more the merrier. If you could have 100, 200, that would be even better. It is likely to be better. But 50, 30, 40 you know, that could work. You would need to have a look at the data. It would depend.

The Hon. MARK PEARSON: It is all very grey and vague. You undertook a study where 922 female red kangaroos with joeys were shot at locations all across Australia as an experiment to see the extent to which reproductive success increases with age. However, prior to 2011 there was extensive literature clearly already demonstrating what the reproductive success increases with age were. Could you please statistically justify how killing 922 does with their joeys, which would mean probably up to 1,844 animals across the entire country, is a reflective sample?

Dr POPLE: Sorry, I just missed the start to that question. You were referring to a study published when? This was looking at the determinants of reproductive success in female red kangaroos?

The Hon. MARK PEARSON: Correct. It involved killing 922 does—female kangaroos—and their joeys. It might have one or two per—I am just wondering what is—statistically justify how this was done across an entire country as a reflective of examples? What proportion of the entire group or mob did each of the 922 make up to determine how reflective they were for the area?

Dr POPLE: Again, from memory of that study, the samples were taken from a number of sites in Queensland and New South Wales. We were interested in whether seasonal conditions affected reproductive output and there were other factors, such as maternal age. Sorry, I am just trying to remember or trying to think of your question. Exactly what are you asking again?

The Hon. MARK PEARSON: Dr Pople, you were involved in an experiment which killed probably 1,844 animals. Did you get an ethics approval for that, do you remember?

Mr BRILL: Tony, don't forget you can take it on notice.

Dr POPLE: If it would have been an ethical experience for the animals—

The Hon. PENNY SHARPE: Point of order: The inquiry is about how we do kangaroo management in New South Wales. I do not think asking about experiments undertaken by a witness that has nothing to do with this and asking about ethics approval is in order.

Mr BRILL: And, Tony, don't forget you can take it on notice.

Ms MOLLOY: Yes, take it on notice.

The CHAIR: Order! Can I also just remind all members that we do, and should, treat witnesses with respect at all times, although witnesses can expect robust questioning. I ask members to treat witnesses with respect and, yes, Dr Pople, questions can be taken on notice. That is also our witnesses' prerogative. Continue, please.

The Hon. MARK PEARSON: I will not press any questions.

The CHAIR: Thank you.

Dr POPLE: If you could please provide your question again? It was not clear to me just exactly what you were asking. You did ask me about ethics clearance. There was certainly ethics clearance for those.

The Hon. MARK PEARSON: [Disorder].

The CHAIR: Can I just interrupt and suggest that the Hon. Mark Pearson has said he is not going to pursue that line of questioning at this point. The Hon. Mark Pearson still has questions, so if you could ask a new question, please.

The Hon. MARK PEARSON: Basically I just wanted to understand how that experiment, involving that number of animals, across Australia has helped determine calculating population numbers in New South Wales, if at all? WE

Dr POPLE: I do not think it is relevant to estimating population numbers in New South Wales.

The Hon. MARK PEARSON: But it was related to understanding production rates. Correct?

Dr POPLE: It was addressing questions on reproductive output in kangaroos. Questions had been raised previously by others and we addressed those questions. It was to do with—I am trying to remember the exact questions. I mean, I can take it on notice but I am still not sure whether it is—

The Hon. MARK PEARSON: You can take it on notice.

Dr POPLE: I do not think it is terribly relevant to the questions at hand here.

The CHAIR: We might go to the Hon. Penny Sharpe for questions. We will come back to the Hon. Mark Pearson. We will go to other Committee members who have questions as well. We will have questions from the Opposition, Ms Sharpe.

The Hon. PENNY SHARPE: I think this question is to Ms Molloy. I will start with you, Ms Molloy. Obviously there is a lot of discussion about methodology and science, and I accept that that changes over time. My question to you really is: The department talks a lot about using the best science. Are there things that we could be doing, in your view, that we are not, and what are they? What would you like to do, and is it an issue of resourcing?

Ms MOLLOY: I will answer the last bit first. It is not an issue of resourcing. We do have a small team but they are an expert team with a lot of experience, led by Terry Brill and also the director. Sonya Errington is the substantive holder of that director role. Sonya has a lot of experience in managing the program, as do Terry Brill and his small team. You can also see that we have access to quite a considerable amount of expertise, not only the scientists here but also the broader breadth of ecological scientists and zoologists and botanists et cetera, within the Environment, Energy and Science [EES] portfolio. I think we operate really well from an adaptive

management point of view. We are cognisant of how things are changing out there on the ground, particularly during the drought. We are cognisant of climate change and the changes that will a have in terms of not only kangaroos but lots of other species that we look after, including those that are threatened. I think we already operate within, as I mentioned earlier, a tight legislative framework, really good compliance, good policy and good governance.

There are always things we can do better and more efficiently, but we are constantly on the lookout for that in terms of that continuous improvement. I apply that to all of the programs that I manage, be it environmental water, saving our species, the coast flood estuaries stuff. We are constantly striving for excellence in terms of how we deliver for the New South Wales Government and we are constantly doing that. Can we do more? Potentially, yes, but we are constantly [disorder].

The Hon. PENNY SHARPE: I am sorry, can I just jump in there? Obviously I expect you to defend the amount of resourcing you have got. I would make an aside that Saving Our Species has just had $5 million at least a year cut from it, but that is not what we are talking about today. If I can just press you a little bit more with the research that is there. Obviously this Committee has seen a lot of evidence that basically presents alternative facts, I suppose I would call it, and I am just trying to get a sense of how comfortable you are that New South Wales is using the best science. Are there things that we are missing? One of the examples I would just use is drone technology, for example. Maybe some of the other scientists here can answer that question. What in your view is missing from the way in which we are trying to make what everyone accepts are quite difficult calculations?

Ms MOLLOY: From my perspective we are using the best available information we have got, and I know in the previous two hearings there was a lot of evidence provided that may offer a counter view on how we can do things. We have subsequently provided an incredible amount of evidence and advice that supports what we do and we are very grateful today to be able to sort of bring that to you in terms of the personnel that support us in that scientific information. But just in terms of the drone technology, given that we have got the scientists here with us, I might get either Mr Brill or perhaps Dr McLeod, or even Dr Pople, to comment on that aspect specifically, Ms Sharpe, if that is okay with you.

The CHAIR: Mr Brill.

Mr BRILL: If I comment first, then I will pass over to Dr McLeod, if that is okay, Madam Chair, for some more detail about autonomous drone technology. First of all, of course we are always looking for better ways to do things and of course that involves money. If there were more resources to do further research and things like that, things could be more refined. There is no question about that and that probably applies in every industry and every field of science. Drones certainly appear to a layperson to be a bit of a goose that lays—not the goose, but appears to be the golden egg, if you like, that we are all chasing, but conducting drone surveys on a statewide basis does not even fit within Australian aviation law at the moment. So there is a lot of policy and a lot of technology to be developed, and law change, before that can ever become a reality. Yes, we are very keen to pursue that and other improvements but it is a fair way down the track for us in the case of drones. Dr McLeod, do you want to add on the technical because I know you—

The Hon. PENNY SHARPE: Sorry, can I just say that I accept that. It is just that people keep raising it with us and I do think the explanation of why it is difficult, particularly in a large place like New South Wales, is important. I do not need to know the technical details. I suppose my questioning for Ms Molloy was about, well, you know, the science is ever evolving, the techniques are evolving, and I am fine with that. I just have a couple more questions, which is actually moving to the animal welfare aspect of this rather than the toing and froing on the reproductive rates and those kind of things. I think there is significant evidence of real problems with the way that either where the culling is done, and I think less so in the commercial harvesting field. Given the reports of the terrible animal welfare outcomes, particularly in the non-commercial field, what action is actually being undertaken to manage this? I am not quite sure who to direct that to, whether it is you, Mr Brill, or whether it is to Ms Molloy.

Mr BRILL: I am happy to speak to the commercial sector and the measures that take place in that sector. But anything in the non-commercial sector and the non-commercial cull I think, if you are agreeable, we will take on notice because we do not have the right people here.

The Hon. PENNY SHARPE: No. Just to be clear, who are the right people for that? That is National Parks, is it not?

Ms MOLLOY: Yes, National Parks and Wildlife Service—

Mr BRILL: Correct.

Ms MOLLOY: —look after non-commercial culling, which is essentially wrapped up in their wildlife licensing. So, yes, we will take those on notice.

The Hon. PENNY SHARPE: Yes, I think you will have to. The evidence that this Committee has, which is pretty compelling to me, is that I think there are real issues there and I would like to know what action is being undertaken. I previously asked questions about this. My general view is that there is not enough people on the ground in national parks to actually do monitoring and compliance. It is a tick-a-box exercise that I think is very problematic. That is a very long way of saying we do not have them here today, but if you could take on notice just exactly what actions they are taking, particularly if they have looked at the evidence that has been provided to this Committee off the back of that, that would be appreciated. Mr Brill, back to you. Thank you.

Mr BRILL: In terms of the commercial harvest, firstly, the National Code of Practice has developed and was reviewed in 2020 by a field of experts and that defines a benchmark, if you like, that professional harvesters can follow. It includes things like the firearm calibre, projectile weights—quite a lot of detail that assures humane harvesting, humane shooting. That is then enforced through rigorous licence conditions that all of the harvesters and in fact dealers are subject to. It is relevant to the dealers because there is a requirement for dealers to report any evidence they see or that comes through their processing works of non-head shot or, if you like, body-shot carcasses that are evidence of—it is not evidence of not complying with the code because an accidental body shot is possible, albeit rare, in the field, but the licence forbids them to possess or sell those. So the code requires them to quickly euthanase any animals that are not shot with a single clean head shot. Then the monitoring process and also our inspection process of chillers ensures that we have a really good handle on the incidence of that in the field.

The Hon. PENNY SHARPE: Thanks for that, Mr Brill. We have actually had evidence of that before so I do not need you to take me through all of that.

Mr BRILL: No.

The Hon. PENNY SHARPE: I suppose the one question arising from that, though, is that it seems to me that the commercial harvesting obviously has far clearer guidelines. And I know I am going back to my other question, but, Ms Molloy, is there a recognition within the department of the differences between the animal welfare outcomes that are occurring on the commercial versus non-commercial? Has there been any discussion/committees or work undertaken to try to improve that?

Ms MOLLOY: I can only comment from our perspective, managing the commercial end of the business. Whether there have been any committees set up between non-commercial and commercial, I am not aware. I know there are constantly conversations between ourselves as a leadership team within EES across parks and our directorate on many different issues. I will have to take the specifics of that on notice because I would like to collaborate with my parks colleagues on the response so I get it accurate.

The CHAIR: We will go to questions from the Hon. Mark Pearson again.

The Hon. MARK PEARSON: I will put my question to you, Mr Brill. When you say that compliance is being able to be adhered to in terms of animal welfare at the chiller, when the carcass arrives at the chiller it has no head. Is that correct?

Mr BRILL: Correct.

The Hon. MARK PEARSON: Is anybody on the field checking and inspecting as to what actually happens at the point of kill? Does anybody go out onto the field meeting shooters and having a look at what they are doing and the standard? Because it is clear we do not know whether there has been a clean head shot. There could be a jaw shot, a neck shot or an eye shot. Because the head is removed and it can be cut down low through the neck, if there are neck shots, is there anybody who goes out on the field and inspects at the point of kill?

Mr BRILL: We traditionally did that in the past, yes. But due to safety reasons—and you would probably be aware of events of the last several years or several years ago when one of my dear colleagues lost his life to a firearms incident. We do not go out with shooters at night and inspect those. We do inspect in the chillers and you can determine things regarding neck shots and things like that. But I guess you are right. I guess there is a little bit of scope for interpretation or a scope for error. But I will say that these shooters are highly professional. They don't miss. I have been out with shooters before that took—I said, "What's a load?" "Forty kangaroos." "How many bullets have you got?" "Forty." There was no more, no less. Every night they would come home with 40. These guys don't miss very often.

The Hon. MARK PEARSON: But it would be a shame though, wouldn't it, if the fortieth kangaroo was not shot cleanly and we needed a coup de grâce shot? That would be a bit of a problem, wouldn't it?

Mr BRILL: [Inaudible].

The Hon. MARK PEARSON: I just want to raise with you—we asked the Kangaroo Industry Association of Australia whether they calculate how many joeys are killed during commercial harvesting, and they said no and that your department should have that number. Do you have the number of joeys that have been killed in the last year, both joey in pouch and joey at foot, which may have fled? Do we have any figures for those animals?

Mr BRILL: No, we do not collect that information.

The Hon. MARK PEARSON: So we have these ghost animals. We do not know anything about them and they have been killed as a consequence of the commercial—

Mr BRILL: Mr Pearson, "ghost" is your term, not mine. I am not sure how that is useful, but no. The answer to your question is no, we do not collect that data.

The Hon. MARK PEARSON: Basically what ghost means is, we know—

The CHAIR: This is your last question. If you could just put the question please and then I have got questions too, thank you.

The Hon. BEN FRANKLIN: In a non-pejorative way, if you can do it.

The Hon. MARK PEARSON: We know about the carcass that has arrived in the chiller and obviously what has possibly happened to it in terms of animal welfare, but we do not know about any of the joeys that have been involved or impacted upon by the commercial kill. Is that correct?

Mr BRILL: Yes, we do. Absolutely we do. The harvesters abide by a code of practice. The code of practice sets out in very clear detail how that action is to be taken. So we know in the vast majority of cases that is exactly what happens. You are quite right. We do not know how many. We do not collect that data. But we do know what happens. We have a code of practice that is very, very comprehensive. It is best available science. It was reviewed in 2020 by experts in the animal welfare field. To make assumptions that this is all bad I think is completely wrong.

The Hon. MARK PEARSON: Mr Brill, can I be clear, we are not making assumptions [disorder].

The CHAIR: I will just jump in now. Order! I was just going to continue on that if I can. I have not asked questions this round but I just wanted to check with you, Mr Brill. You said there is a code of conduct but just to be clear you also said, did you—

Mr BRILL: A code of practice.

The CHAIR: A code of practice, thank you. We have a code of conduct as MPs. A code of practice is essentially there but the compliance officers, you have said, do not go out at night now to accompany shoots. Is that correct?

Mr BRILL: Correct. Due to personal safety for the compliance officers themselves, they no longer go with the shooters at night.

The CHAIR: When did that commence?

Mr BRILL: It stopped after the death of our dear colleague Mr Turner.

The CHAIR: That was a few years ago now, which was—

Ms MOLLOY: It was 2014.

The CHAIR: Yes, we understand what that was about, which was not on a kangaroo shoot at night, though. It was a different issue.

Mr BRILL: Correct.

The CHAIR: I just wanted to go to the issue of the new kangaroo management plan, which I think is the draft *NSW Commercial Kangaroo Harvest Management Plan 2022-26*. I have got the graph here that is in that draft plan, which we are very familiar with, that shows the fluctuation in kangaroo populations over certain times. That goes back to I think what you all talk about which is the 40 years of data and goes back to 1975 and right up here until 2021. It takes us through the classic boom-bust cycles that you have all referred to according to, largely, the weather patterns at the time. I just wanted to check you are familiar with what I am talking about in terms of that graph.

Mr BRILL: Yes, I am.

The CHAIR: I might start with you, Mr Brill. I have been looking at this graph just to verify and have a look at the increase in population numbers. Say if we go to what was really the last rainy period of 2010 to 2011—the wet years, if you like. This graph says that wet years continued I think into 2012 and 2013. It said that it was a wet year as well in 2013. I just wanted to query that because I have in front of me the Australian rainfall deciles from 1 January to 31 December for 2013, which actually suggest that the vast and overwhelming majority of New South Wales received very much below average or the lowest on record or below average or average rainfall. I just wanted to query this because we have had quite a few people raise this with us about the boom and bust cycle that fits in apparently with the wet years. But according to your very own graph that is contained within the plan that is before the Minister to sign off on, one of the years that you suggest is a wet year is actually a dry year. Were you aware of that contention?

Mr BRILL: I will point out that that is also marked as a dry year, indicating that some areas of the State were better than others. Some areas of the State were quite dry and some areas of the State were not so dry. So 2013 and 2014 are marked both wet and dry in that graph. I think that is quite plausible. It is exactly what Dr Cairns told us about regarding the last drought in the Northern Tablelands. Some areas are affected much more than other areas.

The CHAIR: In 2013 there certainly was some pretty severe, coming into 2014 particularly—I think the Government had started spending money on drought and there was no wet in 2013 and no wet in 2014 according to these, particularly west of the very east. There is no wet in 2014. I am sure you would be aware of this, Mr Brill. That is the Bureau of Meteorology for New South Wales the entire 2013 year. It was not a wet year. So why in the graph that has always been relied upon to justify and demonstrate the boom-bust cycle—why is there a year in here that says it was a wet year but it is actually a dry year according to the Bureau of Meteorology for New South Wales?

Mr BRILL: I am happy to take the data you have spoken about on notice and respond, but the comment I will make is that you can take the wet and dries out of that picture and the boom-bust cycle speaks for itself.

The CHAIR: How is that then, because—

Mr BRILL: You do not need the markings to say which ones were dry and which ones were wet to see the population responses up and down. It is quite clear. I will say right up-front that this graph was raised in the last hearing and we did agree in the last hearing that it does contain some small additions of zones and possibly it is going to be your next question given your nodding of your head. It does contain some small additions of zones that are not standardised for and the correct way to draw that graph, as Dr McLeod pointed out a little while ago, is to draw it on a density basis. I will undertake to do that before this is resubmitted to the Commonwealth for consideration.

The CHAIR: Thank you, because it just does go to the heart of this—because we have heard from the department that the justification for the increases in some ways of kangaroo populations is because of this boom-bust and because of wet years. Yes, we can see the increase in the graph in what appears to be a wet year and it is like yes, that's what happens. The wet and dry—that's what happens. But if you delve a little bit deeper, that is a year of drought. So actually how is the rate of the population of kangaroos increasing so much when we have heard from witnesses, including yourself, Mr Brill, that during the drought is when they plummet so much in terms of their numbers? We are asking about the numbers that have decreased potentially by shooting but you say, "No, that's because of drought." How is it increasing so much during a year of drought?

Mr BRILL: I will go to Dr McLeod in a moment, but kangaroos respond to feed availability. They do not respond to rainfall. If you had a kangaroo in a pen and you fed it lucerne hay, it will respond regardless of the rain. I am not trying to teach you to suck eggs. What I am saying is that it is the feed availability that grows in response to the rain and that can hang on after rain stops—and kangaroos can still continue reproduce or grow after the rain stops if the feed continues to be there. Dr McLeod, do you want to add a comment?

The CHAIR: Can I also just say in terms of that pasture, though, that in early 2014 farmers were shooting their stock because there was such little feed. Dr McLeod?

Dr McLEOD: Yes, if I could just add that, as Mr Brill is pointing out—he is quite right—a succession of good years can grow a base of food. Kangaroos can still have a positive rate of increase even though there might be a rainfall deficit. The difference between a wet year and a dry year, the measurement of drought and the definition of drought become important here. And there certainly will be situations where some areas would be in drought and others would not be, but that does not stop kangaroos from moving away from the dry areas to areas of more forage, which is something that was experienced by many graziers in western New South Wales during the last drought. There were pockets of very high densities of kangaroos and large areas with very few kangaroos

in them as well. We see that in the data. We see that in the aerial survey data. We also see that in the time series within a zone.

So just having a simple definition of drought or dry as opposed to wet does not really help us try to understand the population dynamics of kangaroos because, as Mr Brill said, they are not driven by rainfall itself—they are driven by a response in vegetation to rainfall. I would also like to point out—could I just be very quick. The boom and bust nature of kangaroo populations is beyond dispute. Every ecologist who has worked on kangaroo populations understands that they do go through this cycle and it is typical of animals, particularly herbivores, in variable environments.

The CHAIR: Just one more thing in relation to this graph then. Again this graph that you rely on and that is once again in the new draft kangaroo harvest management plan, why doesn't it seem to account for the fact that the correction factors and the whole methodology changed in 2000 and 2001? That graph does not seem to account for that. Is that correct as well? And it does not account for the additional harvest areas.

Mr BRILL: I agree with it not accounting for the additional harvest areas. It does account for the population in the additional harvest areas, but I agree it does not standardise for those and therefore from that perspective it could be misleading. Over the long period of time, however, they are quite small. But I have undertaken to create that graph on an average density basis and that will standardise for those additional areas. In terms of the change in survey methodology, the graph does document that change in survey methodology. Right down the bottom it has a dotted line and it has a grey line and a legend underneath that actually says what the survey methodology was in those times. Yes, it is true that we could apply some correction factors to adjust populations up and down, and Dr McLeod or Dr Pople could talk to that a lot more. I actually personally think it is better that the estimates are shown as they are calculated with a documentation of what the methodology is so that the reader can make their own interpretations of that issue. Perhaps you could show both; that is another alternative.

The CHAIR: Could I just jump in there because it does say between 2000 and 2001—in every single quota report, when you look at this and when you look at the estimates, it says, "Invalid comparison due to a change in correction factors and survey strip width." So the comparison is not valid but it appears in these graphs as though it is. The counts have continued and it is a natural rate of increase according to your boom and bust cycle, but back in 2000 and 2001 it is a complete—there are several factors here that I am just pointing out. The chart that you have been relying on for 40 years—that you once again submit to the department—once again just seems to be unreliable. This is after you were stressing the best methodology and the best science, but you are here admitting that these few things that I have pointed out are in fact—you have to look at it and possibly we could do better.

Mr BRILL: At the last hearing I agreed that that graph needed to be standardised for the increases in area—absolutely. I agreed with that at the time. Best available science does not ever mean that you cannot improve. Let's not be under any illusion. Best available science does not mean you can never improve. Dr McLeod, do you want to—

The CHAIR: Could it be potentially overestimating the numbers of kangaroos out there then, Mr Brill, if the additional zones have not been factored in, as you suggest, as well as the fact that between 2000 and 2001 there was a change in correction factors to the point that you cannot make comparisons between those two years, but this is exactly what the department has done?

Mr BRILL: Can I defer to Dr McLeod, please. I think he is going to give us a much more constructive contribution to this.

Dr McLEOD: I will unpack a few of the things that you have talked about. The first one is the best available science was at the time that the surveys were taken. So during 1983 up to 2000 the 200-metre strip width was considered to be the best way of estimating kangaroo populations. Subsequent research showed that shortening the strip width to 100 metres improved precision. It did not have a great impact on the estimate of the population size itself. It just improved the precision. The switch from going from that to MRDS, mark recapture distance sampling, did the same thing again. We are just improving the precision and accuracy of the counts themselves. To say that you cannot compare them from one time to another is not quite correct. They can be compared. I think what you stated in—if that is a quote from the plan itself, I don't think that that is quite correct. There was one more thing I wanted to talk about.

The CHAIR: Just to jump in on that one, though, I am getting that statement from every single quota report. The 2018 I have got in front of me. It is also in the 2021. I looked at this last night. It is underneath every single estimate of population you have got from 1997 right through to 2017 or 2020 or 2021. You have the asterisk between 2000, where it actually has minus 14 per cent, a decrease of 14 per cent trend in abundance percentage

change from the previous year—minus 14 per cent. Then in 2001, it goes to 13 per cent—so an increase. But it says, "Invalid comparison due to a change in correction factors and survey strip width." So it says it is an invalid comparison. An invalid comparison means what, Dr McLeod—that you cannot compare the two figures? And you should not suggest that it was a 13 per cent increase from 2000 to 2001?

Dr McLEOD: No, I would dispute that. I think the uncertainty around that would be greater because you have moved from a 200-metre strip to a 100-metre strip and you have moved from a less precise method to a more precise method. But I think in a general sense the trend in the populations will still be correct.

The CHAIR: It was a drought as well, I think, in 2000 and 2001. I will finish on this point, but that was a period of extreme drought—the millennium drought, if we remember, in the year 2000. You changed the correction factor, which it says is invalid, and magically in 2001 the kangaroo population had increased by 13 per cent when in 2000 it had decreased by 14 per cent. During the millennium drought you changed the correction factor. How can we rely on this chart—this graph that has been relied upon by the industry for 40 years—when that is an extraordinary error in what has been continued to be produced and is right now before the Minister?

Dr McLEOD: The calculation or the quotas are not based on this figure. It is not based on this graph. As I said before, each kangaroo management zone is assessed separately, and the trend in the population and the abundance of kangaroos within that zone itself is used to calculate the quota. Combining all the zones gives this nice graphic of the overall trend in the population, but that graph itself is not used in any form to calculate the quota. From what you are saying, I think that is a misinterpretation of how this is used, unless I am mishearing.

The CHAIR: My very last question on this and then I will go to the Hon. Mark Pearson because I am done—it is more than just the graph. It is every single table that I have looked at that says—I have got one in front of me now—"Population estimates and trends in abundance for western grey kangaroo on the Western Plains, 1997-2017." Again in the quota report—so the quota report I think is a pretty important document—and in all of these tables it has from 2000 to 2001 the asterisk that says that this is an invalid comparison between these two times. This is in every single table. So the graph is, you said, potentially misleading. It sounds like all of the tables in the quota reports are potentially misleading. Dr McLeod, would that be correct?

Dr McLEOD: I do not agree with how they have labelled that as an invalid comparison. I do not think that is correct. I think how we need to interpret this as well is the detections within, and using correction factors tries to account for this—doing aerial surveys we do not see everything from the air. There are animals that are missed and this is a consistent phenomenon for every aerial survey, particularly for kangaroos. The correction factors themselves are set at a conservative level. They are not set at a liberal level. So we tend to underestimate what the population sizes were at those times. But that is a limitation of the statistical methods and the methods we have to collect data at those particular times. As that has improved, we have adopted changes to try to address the issues which you are pointing out. At the moment, using mark recapture distance sampling—I am not aware, for broadscale survey, that there is any better method for surveying populations over 500,000 square kilometres. There isn't.

The CHAIR: I think we have covered that quite well in the first half of this hearing, actually. Sorry to cut in. We have got less than 10 minutes left. I will go to the Hon. Ben Franklin first from the Government and then the Hon. Mark Pearson for a couple more.

The Hon. BEN FRANKLIN: Can I start by thanking you all for being here today. You are all professional scientists and public servants and I, for one, deeply appreciate the very committed job that you do in this space. It is very clear how much work you do and how genuinely you are committed to trying to deal with this area. So I just wanted to thank you on that. The second point I wanted to make was that I agree with the Hon. Penny Sharpe that obviously scientific methods are changing and it is appropriate that you enact those changes in your research. That is absolutely clear. Obviously some issues have been raised today, and previously, that you have agreed to address and that is a good thing too. But hopefully we can all land in a place that is sensible and that we all agree.

The question I wanted to ask was back to the animal welfare issues. You can either answer this now or on notice or a bit of both if you wish. It is regarding the code of practice or indeed any protocols or procedures around the kangaroo culls that are focused on achieving the best possible outcomes for animal welfare. I would be very grateful if you could detail those in depth so that we know—there have obviously been some suggestions, implied and otherwise, that have been made today and in previous hearings. It would help me and I think this Committee to have a very deep understanding of what the processes, protocols and procedures are that are gone through in order to achieve the best animal welfare outcomes. I do not know who best to address that question to but whoever is the most appropriate person—possibly Mr Brill, but it is up to you.

Mr BRILL: I think, given that you have asked for a detailed account, we should take it on notice.

The CHAIR: Yes.

The Hon. BEN FRANKLIN: That is fine, Mr Brill.

Mr BRILL: I think that is the most sensible approach.

The CHAIR: It sounded like a bit of advice as opposed to more of a question, to be honest. I think taking it on notice is a good thing. Thank you.

The Hon. BEN FRANKLIN: I am very happy with that. Thank you.

Ms MOLLOY: Thanks, Mr Franklin. We would be very happy to outline that in a lot more detail for you and get back to you.

The CHAIR: Okay. We will go to questions from the Hon. Mark Pearson.

The Hon. MARK PEARSON: Just to ensure that that report will also include all aspects in relation to joeys—that is correct, isn't it?

Mr BRILL: Sure.

The Hon. MARK PEARSON: I just want to go to a question about Tibooburra, which has sort of been haunting this Committee since we started this inquiry. It is basically about this very confusing situation that happened. In the 2021 quota report on page 20, the data from Tibooburra shows that the population of greys was allowed to fall from an estimated 451,594 to 6,859. When questioned about this—I forget who answered the question; it might have been taken on notice—you said that red kangaroos in Tibooburra declined from around 1.5 million in 2016 to 344,000 in 2018 as a result of drought during the 2014, 2015 and 2016 period. Can you explain this answer, given that the Bureau of Meteorology data shows an average rainfall in Tibooburra in 2014 and above average rainfall in 2015 to 2016, with rainfall up 74 per cent to the annual average. Was there a disease or we just do not know?

The CHAIR: Who would like to take that one? Mr Brill.

Mr BRILL: Without seeing the detail of the data that you are referring to, I do not think I can respond directly to the question. I am not aware of a disease although there are diseases that exist. We are not aware of a widespread disease that has impacted populations to that extent. In fact that is one of the things about the commercial harvesting industry—we actually have 500 people out there with a very keen interest in the health of kangaroos that are looking at kangaroos every night. So we generally find out very quickly if there is such a thing. Beyond that comment I would really have to take it on notice if you could provide the data you are referring to.

The Hon. MARK PEARSON: Obviously the answer is that what we were given was incorrect, so it is important we find out. I would just like to go to the—

Mr BRILL: No, sorry. I am not accepting that the answer was incorrect. You have implied the answer is incorrect. Let us see the data for that and we can respond then.

The Hon. MARK PEARSON: I am just referring to the weather report. Just in relation to drones, Mr Quirk, when he was asked about that at the last hearing, said, "We have not been offered a technology that would work at that scale." And considering that—I think it was Mr Brill and Dr McLeod—you said that you are always wanting to improve the precision and accuracy of calculating these animals. And drones—something about we do not even know about the aviation requirements of drones.

Mr BRILL: That is absolutely not what I said. What I said is that it is not within the aviation laws in Australia to fly a broadscale out-of-sight survey—I didn't say "out of sight" at the time but that was the implication—to do 500,000 square kilometres of survey across most of New South Wales. It is just not permitted in the Australian aviation laws at the current time. There is lots and lots of both policy and technical development that needs to take place before that could happen.

The Hon. MARK PEARSON: But the question is, isn't it, that if a drone can lawfully fly between 10 metres and 30 metres over an area as opposed to a fixed-wing plane, which is only flying along transects as you call them, surely a drone getting at 10 metres above the ground with heat sensors—surely that would give a much more accurate count of the animals which we are interested in, wouldn't it, rather than flying two people at a great height looking out a window?

Mr BRILL: A couple of things and then I am going to go to Dr McLeod, who uses drones in his research to count kangaroos. Firstly, we do not fly at a great height. We fly at 170 metres above the ground which is—I will let Dr McLeod correct that too because I fear I have mixed up my units. And it is six people in the plane for

the fixed-wing surveys; it is not two people. So there are some facts that it is important that this Committee understands about how the program is conducted and the rigour which that brings and the science that we rely on to make sure that it is rigorous. Dr McLeod, would you like to comment on your experience with drones?

Dr McLEOD: Sure. I use drones as part of my research similar to the ones you have described using thermal imaging and high-resolution RGB cameras. On a small scale they are very good. They work excellently. There are a number of issues. The biggest one is the matter of scale. You cannot fly them on the scale to survey 70 per cent of New South Wales in a reasonable amount of time to use them effectively. Mr Brill mentioned the Civil Aviation Safety Authority approval. It cannot be flown out of line of sight. So they are very restricted in the range they can be used. There have also already been a number of tests of using drones, and they are not great for kangaroos at the moment.

Technology is developing very rapidly and we are watching this space because they have the capacity to be a game changer really but we are probably a long way from that—I would suspect more than 10 years away from that at the moment. As I said, we review the methods. I use drones where they are appropriate. At the moment the fixed-wing survey is the best way of doing the broadscale surveys and drones are not appropriate. I should add that they are not used anywhere in the world across a broadscale survey like that—anywhere.

The CHAIR: At that point, at one minute past one, I will thank all of the witnesses for appearing today. I really do appreciate you all being available for the Committee members to ask you some further questions, so thank you so much, all of you, for appearing. I do believe there were questions taken on notice. The secretariat will be in touch with you about those and you will have 14 days to respond to those after the Hansard transcript becomes available. Thank you very much. Thank you everybody for tuning in. Our live stream will finish now.

(The witnesses withdrew.)

The Committee adjourned at 13:01.