# HSC Agriculture transcript

(Duration: 50 minutes and 27 seconds)

(upbeat music)

[Presenters: Dr Jaime Manning and Dr Amy Cosby, CQUniversity]

Amy: Hi everyone, welcome to the HSC on demand seminar, about analysing a research paper in Agriculture.

Firstly, "I would like to pay my respects and acknowledge the traditional custodians of the lands, that each of us are located on, and also pay respect to elders both past and present."

Just a quick note, is that there are images of sheep predation in this presentation, that some viewers might find uncomfortable or distressing. Please feel free to skip over these parts of the presentation.

Today, we're going to be speaking to you about how to analyse a research paper. And I'd like to go through the outline of our presentation first. Firstly, we're going to introduce ourselves. Secondly, we'll cover what is sheep predation, a little bit about new technologies. We'll look at a research paper and what the components of one is, and then analyse that research paper.

My name’s Amy Cosby, and I'm a Research Fellow at CQ University Australia. My qualifications are in Agriculture and Law, and I have a PhD in Precision Ag. So, my role entails now conducting research, like we’ll speak about today and writing journal articles.

Jaime: Hi everyone, my name’s Jaime Manning, and I'm a lecturer in Agriculture at CQ University. I lecture into our agriculture degree that CQ offers, mainly around livestock production and a lot of the research I do is with new and emerging technologies for a variety of livestock species. And the paper we're going to go through today is actually one of the projects that I worked on a couple of years ago.

So, to touch on, we're going to go through, well what is sheep predation and why is it a concern? And an article that was released by Allen and West back in 2013, had a really good quote around “over the next 30 years, wool and sheep production in rangeland Australia has been projected to disappear if livestock losses from predation are not reduced.” So, this is really just highlighting why it's an issue. When we talk about rangeland Australia, we're talking about those areas of Australia that have low rainfall. So, they're not really areas that are suitable for cropping, but very suitable to raising sheep. And so, when we look at sheep predation, we talked about, well, what is it? And it can vary, so it can vary from things like attacks, wounds or even death to sheep. And it's caused by domestic dogs, wild dogs and or dingoes. So, it's not always by wild dogs, it can be from domesticated dogs. And this is increasingly common when we think about urban encroachment. So, when we've got lots of people that are moving to these communities, and located next to farms, and some of these attacks can also be caused by those domestic dogs from those owners. And we look at some of the economic implications, sheep predations costs Australian sheep sector around $65 million annually. So, it's got a very big economic impact.

But most importantly, it's actually got a really big welfare impact and a large proportion of lamb losses. So nearly around 40% of animals are attributed to predation events. And this really highlights a key animal welfare issue in the sheep industry. And the reason why it is a big issue, is because these wounds inflicted really vary. I mean, a lot of the time the animal doesn't die from a predation event, so it can have things like superficial wounds or severe lacerations. So, things like cuts and abrasions, they can be mutilated, and you can see from some of those pictures there. And if they aren't lucky, they do die. But really, it's around these wounds and this mutilation that really raises the issue of why we needed to detect predation events when they're happening.

And so, we look at some of the control methods there're out there currently, we've got lots of different options available to producers. So, anything from baiting programs to trapping, guardian dogs and some of these deterrents. But what's important to note, is that lots of these fail to detect predation issues as they arise. So these control methods are really good in controlling and reducing the numbers of wild dogs that are out there, but none of them actually tell a producer, that they've got an issue on farm, something happening in the paddock and you need to go out there and do something about it. And this is really why we need research in this area, to help producers better identify when these predation events are happening.

Amy: So, there's a range of new technologies that I'm sure you're learning about throughout your schooling. The technology that we're focused on in this paper, is GPS technology. So, GPS technology can be found on lots of different things. In the livestock industry, we're looking at having GPS in collars like this one in the top right, and we're looking towards making GPS available on ear tag, but at the moment, there's a big difference between research and commercial devices. So, the research devices that we use at CQU, and a majority of research that happens in GPS in Australia and across the world is in a collar. And one of the reasons for that, is that ear tags don't have the battery life of a collar. So, GPS uses a lot of battery, which is if you've ever had your mobile phone, and you've used it for Google Maps, if your, you'll notice that your battery starts to drain. One of the other issues with a collar versus an ear tag, is that animals are quite rough on gear. So, we often will be told that ear tags are military grade, so that they could withstand war. But what we often forget is that when people go to war, they're aiming to look after their equipment, they're not wanting to ruin it. Whereas cows and sheep, that don't really care. They might whack their head on water troughs on trees and those sorts of things, which can damage and make that equipment not possible to use at all.

You probably heard of technology in other ways as well, I've already mentioned on your mobile phone, but what about for your pets? So, some people have got them on their animals so they can use a containment fence, or if they can know where their cat has travelled. If you're into sport, you might have noticed that your team is using GPS trackers to understand how far they've moved on the field. So, GPS is not just a technology for livestock or agriculture, it's in a range of different industries across the world.

So, what do you think of when you hear the term GPS? GPS stands for Global Positioning System. And what it does, is it uses the satellites that are orbiting around us in the world and admits to a device. It could be your mobile phone, or in our case, we're looking at livestock. So, these different satellites are orbiting and sending signals to our livestock. And what we're able to know from that, is exactly where our livestock is located, and then use that information to determine how fast that animal is traveling. So that can be important for a number of different things. And in your class, you should have a think about or brainstorm ideas of what types of information you would use GPS location of your animals to find out. Maybe it's how often they go to a water trough, maybe it's how far they travel in a day, you could look at social behaviours to see which animals are hanging out together more often. There's a raft of different things that you can think about with GPS, but today we'll be looking at sheep predation events.

So why do we need research in this area? Well, technology is changing all the time. So, in respect to GPS, it could be looking at how those commercial ear tags or collars, how they stand up? Are they true and accurate records? It can be looking at how we can use that information to predict or detect certain behaviour. So, looking at patterns in the data, how to analyse that information, and how accurate that is when looking and observing how an animal behaves.

So, we're going to be looking at a research paper that has been published in a journal. So, you might ask, "Why do people publish research papers?" There's lots and lots of different reasons, and we've listed a few here on the screen. There is hundreds of thousands of research projects underway at the moment, internationally, all across the world, each year. So publishing is one way for each researcher to share what they've been doing. Jaime and I wouldn't know every single person who's looking at GPS research. But if we are able to look at published articles, we can find out what people have done, both here in Australia, across the world. It's a way for us to connect with other researchers that are doing research in our area. It demonstrates how new protocols or applications of the technology are being used in other parts. We consider these quite a reputable source of information. As each journal article that's published in a peer review journal, so that means somebody else has reviewed or at least in this case, two people, has gone through a process to know that it's quite reputable, that the scientific method and the research that's been undertaken is of a very high quality. Another way that this is useful, is that it can be one way to formalise research between industry, researchers at universities and or tech companies. So, you can see who's been working together.

So, what are the key parts of a research article? There's lots of different ways that research articles are written and structured. However, the majority contain all of these different parts. We will go through each of these different sections in this presentation, but this diagram here gives you a bit of an overview. So firstly, you look at the titles and authors of the paper, then an abstract, which is a short section of the paper right at the start, an introduction, materials and methods, the results of the research, a discussion, so, the implications of what those results tell us, a conclusion, and then the other references that the authors have relied upon in reaching those conclusions, and or setting up that research paper.

Jaime: So today, we're going to go through a paper, and it's actually some of my research that I did several years ago, and a copy of this annotated research paper is available for you all. So you can either have a look at the version that doesn't have any notes on it, and have a read of that first and make your own notes, and then you can use this annotated version to really highlight which areas you should be picking out and getting information from. But what we're going to do now, is actually go through each of those sections, and hopefully make it a little bit more easy to understand.

So, the next part is analysing a research paper. So, the first part we're actually going to look at, is what is the name of the research article. And this is quite important, because we don't want to be spending a lot of time reading articles that aren't important to us. So here we can see that the title of the project or the research article is "A pilot study, into the use of global navigation satellite system technology, to quantify the behavioural responses of sheep during simulated dog predation events." And a lot of time we read research, there's lots of words. So, the first thing I would be doing, is trying to pick out some of those key words to try and make it, understand a bit more. So, for pilot study, that really is just telling us that's one of the first studies conducted. So, it's really just trying to see what happens in this situation. When we look at the word global navigation satellite system, is just another word for GPS. And you'll see that a lot in this area, that some people refer it to GPS, and some people refer it to GNSS. But for the rest of today, we're going to refer it as GPS. The word behavioural, really telling us that this paper is looking at a study of behaviour. Sheep, that's the species that we're interested in, so if I was interested in more, something to do with alpacas or cattle, this paper might not be as relevant. And then the final bit, is during simulated dog predation events. So, it's telling us that the paper that's on sheep, is really looking at the behaviour of those sheep during a dog attack or during a predation event. And in this one, it's simulated, so it's not during commercial conditions, everything is set up under a simulated trial.

Another part we'd look at is where is this journal or this article published? And we spoke about this peer review process. So, this article is published in a journal called Animal Production Science, from CSIRO Publishing, and this is a reputable peer review journal. And then the second part, we're going to look at, is those authors and their affiliations. And so underneath the title, we can see all of the authors there, and then we can see where they're all located or when they did the trial and the research, what university or institute they were all located at. And then there's always, going to be an email address. If you did need to contact the author, you could contact them.

Amy: So, after we've looked at the title, we would be looking at the first section of the paper, which is called an abstract. The abstract is a really good part to read, because as Jaime said, it can be quite frustrating to read through lots and lots of different articles and not find something that you're interested in, or that's relevant to your study. An abstract contains each of these four sections in about, normally about 200 words. So, there's a sentence about the background information and the importance of the research. One about the method that's been used. It discusses the findings or the most important finding, and then tells you what the outcome of the research is in the discussion and conclusions, and what the future implications might be for that research.

So, this is the abstract from the research article that we're looking at. And like I've mentioned, it gives you a summary of what the article is about. So, you can see here in this first blue section, that it's telling us the importance. So, it's looking at the “serious welfare issues inflicted to animals” in this study. The next section is the method. So, it tells you what was undertaken in this research, then the results. So, it tells you here that in this part, the velocity of the sheep was higher, during the predation event compared with before and after it was simulated. And then the future of this research, so, “while further research and mathematical modelling of predation events is clearly required”. And that's most likely in this case, because it was a pilot study, it was the first one of its kind, it tells you where this researcher might take this further. In conjunction with reading the abstract and the title, keywords is a really good spot to look. So, researchers will be required to nominate between four and five key words that they think summarises their article. This might be a way when you're searching journals or using search engines like Google Scholar or Web of Science, you could type in keywords, and that will find articles as well with keywords. So here, we've picked behaviour, dog attack, Global Positioning System, and remote monitoring. They're also in order of importance. So, the most important word here is behaviour, and the least is remote monitoring.

So, if we're going to summarise the abstract of this article, we would say “predation has serious welfare and economic implications for the Australian sheep industry”. It's important here as well, because this is a pilot study, that we're looking only at Australia. There are lots of different sheep industries across the world, by putting Australia in this abstract, it’s saying that this is for Australian conditions and that other researchers on reading this, might try and replicate this trial in another part of the world. The method here that was used was 15 Merino ewes. were all wearing GPS collars. And those GPS collars, collected behaviour information, speed and spatial distribution. So spatial distribution is looking at where the animals were in that paddock. The results tell us that speed, also known as velocity, was higher when sheep were under a simulated predation event. So that is the most important result from this research study. And looking at what in the discussion and conclusion, we have noted here that GPS could improve the future monitoring of livestock, however, more research is required.

So, the next section of the research paper is the introduction. So, the purpose of the introduction is to look at what is known. So that's where we know that predation is a serious issue in Australia and we know the economic implications, as well as the animal welfare. What else do we know about sheep behaviour and predation that we can include in there? This section is where we would refer to a lot of already published journal articles, where we would make references to those and incorporate which ones are important to our research. The next section of introduction, generally we'll look at what is unknown. So, what don't we know about sheep predation? What potentially is this trial going to look at? And then lastly, how and why should we fill this gap? So, the gap that is known across all of the different literature, and importantly, this is going to form one of our research questions.

So, in this paper, the issues facing the sheep industry is one of the most important parts, and that's why we use that as our introduction to look at the impact this research could potentially have, and the implication for the industry. We're also including the species studied. So, this is sheep, and then why this research is needed. So, we've been looking at the sheep numbers in Australia have been declining, and that's been through a number of issues, not just predation, but that's definitely an important one, but also the drought, low wool prices, and animal welfare concerns. So, there is other animal welfare concerns that have led to the decline in sheep numbers, things like mulesing, live export, and our inability to sort of monitor animals in remote locations. The blue box around the text here, is all about why predation is a concern, and what happens. What do we know that happens during a predation event? So as Jaime's already mentioned, there are lots of different predators for sheep. And there's also predators they could be the same or similar for lambs. There is lots of things that can happen to a sheep. So, it could be wounds in different areas, it could be the lacerations, or in really serious attacks sheep can be killed.

Jaime: So, at the end of our introduction, we usually find the aims and the objectives of the study. You can see this highlighted down the bottom, which is telling us that the “objective of the study, was to identify if spatio-temporal data derived from GNSS technology, can identify a simulated dog predation event”. And there's lots and lots of jargon there. So more simply, what it's telling us, is this research, was investigating if data from those GPS collars that we're putting on those animals, could be used to identify simulated sheep predation events. And so, we're going to go through that paper a bit further now.

So, next section, we look at a paper, we'll look at the method. And I like to refer to the method as a recipe. So if I was going to give you a recipe to make a chocolate cake, these are all the different ingredients that you'd require, and I'd give you all the different steps, and hopefully, you'd have a beautiful chocolate cake that would turn out at the end. And then the same should happen for a research paper. I should be able to give you all the different things that these researchers use, and you should be able to get the same lot of ingredients and carry out the same trial, and hopefully, then get the same results.

 So, for this research trial or our recipe for our research, we had animals. And so, there was 15 ewes per group, so 30 in total. And they were aged between two and eight years of age. We had two replicates. And each of those individuals was fitted with a GPS collar, and we were getting information every five seconds on where that animal was located, and then we can also work out the speed of movement later on. And then each was fitted one of these identification bibs, which you can see in that top right picture there. So each of them has a colour and a number, and the reason for that it makes it easy for us to identify which animal is doing what behaviour response, especially when we're standing from afar, we're easily able to identify who is what.

We had information in the method about where the trial was located. So, it was run in New South Wales, and this is really important when we look at research, because we need to understand the context of the research. So even though all of this stuff was done in New South Wales, we need to ask the question is it applicable in other parts of Australia? Other parts of the world? Other environments or other species? So, it's really important to look at where the research was conducted. We had three trained dogs who were asked to undertake certain behaviours and they are simulated, obviously, our dogs are our predators, and each of those dogs was undertaking certain behaviours. So, things like round up the flock, run around the periphery or the outside of that flock, they were asked to stand still, or walk back towards the flock. And this is also behaviours that we would see, if those dogs are going out and mustering those animals.

Amy: So, for all research and teaching in Australia to do with animals, it needs to be approved by an Animal Ethics Committee. So, each state has an Animal Ethics Committee, and most universities and research organisations each have their individual research Animal Ethics Committee as well. This is required by the law. So, it's not an optional activity for researchers. And each animal welfare or ethics committee, follows the what we call the three R's. Replace, reduce and refine. So, replace means, that we try to not use animals wherever possible if we can. In lots of instances though, and especially in this trial, we really needed to use animals, because we were very interested in how sheep would behave under a predation event. It would-be no-good using humans because they would not act like a sheep would, even if we'd watch sheep hundreds and hundreds of times acting like that.

The next R is reduce. So, you want to reduce the number of animals that are subject to the trial as much as possible. But we still want to ensure that we have enough animals, that the result that we get is statistically significant or statistically relevant. So, for example, if we only used one animal in this trial, that wouldn't be enough to reach any conclusions about how sheep behave when they're under predation. So, we need to make sure that we use enough animals, but we don't want to use too many. And in an experiment like this one, there is not a lot of implications or health implications for these sheep. It's a very structured and controlled trial, but there are other trials, that is not the case. And that's why it's very important to reduce wherever possible, the numbers.

And then the last R is refine. So, we want to make sure that we're refining the treatments to avoid any unnecessary pain or stress that can be caused to the animals. In every research paper that's published using animals, you will see a line there that tells you about where this research was approved. So you can see here, that this research was approved and by the University of Sydney's Animal Ethics Committee, and it gives you a number that you can refer to, if you were concerned about anything and you wanted to contact that Animal Ethics Committee to raise concerns or ask questions, you would refer here to this protocol number.

So, when looking and designing research, there are a number of things that we need to consider to design a good research project. So firstly, we're going to look at control and treatment groups. So, treatment groups or sometimes referred to as experimental, they're the groups that receive the treatment and they're used to compare or any similarities or differences that occur. So, examples of treatments in animal research, they could be giving sheep in the treatment group, a specific drench, or a dietary supplement, and that's compared to the control group. So, the control group is a group of animals that does not receive the treatment. So, they're used to measure therefore, if there's any difference between the control group of animals, or the treatment group of animals. So, in the same sorts of examples here, animals in the control group, they wouldn't receive the drench, or the diet supplement.

In this research, this was a pilot trial. So, there was no treatment groups allocated. So, all of the animals, were in the simulated predation event. However, the data prior to the predation and after the predation, was the baseline behaviour data. So, we looked at how the animals behave prior to an event. So, we've got their baseline activity of what their regular and normal activities were, and then afterwards, well after the predation event, we also went back to see if that matched the data prior.

Another important factor to consider, is randomisation and replication. So, randomisation, is where animals are randomly assigned either to a control or a treatment group. So what that means is that you don't pick all your favourite animals and put them in the control group, or you pick all the animals that are fully wool or all shorn, there's no picking animals to assign to each group based on any characteristics. It's all very random so that the characteristics of each animal are distributed between each group. In this research, animals were selected based on the order they came through the race, and then placed into one or two mobs. So that was how we were randomising the animals that we utilised. They just ran through the race, and one was drafted into mob one, and another one was drafted into mob two. When we talk about replication, that's a repetition of the trial using different animals. So that means even though we had two mobs, that means one, the first mob was used in trial one, and mob two was used in trial two. So, in this research, it was replicated twice. In lots of different research trials, depending on your budget, your timeframe, the resources that you have, you might replicate your trial more than twice, but it depends on your research design. So, it's important to consider these items, before you start undertaking your research.

Then when we're talking about variables and things that we're going to examine, a standardised condition, also known as a control variable, is something that doesn't change throughout that trial period. So, in some instances, that could be the size of the paddock. So, throughout the entire trial, the animals are staying within a two-hectare paddock. The amount of feed available in that paddock, so we're not going to be giving them additional pellets or hay, we're just going to leave the amount of pasture that's in the paddock, and then perhaps, there's only one water trough. So, it's not something that we're changing. A variable is what we're trying to measure. We're trying to measure the response to something. So, in this research, sheep behaviour and speed, and that was collected from the GPS, when under attack from a predator, versus when it was not under attack from a predator, is what we were looking at. So, an independent variable is one that is stable and not affected by other variables, whereas a dependent variable, depends on the independent variable. Now that sounds quite confusing. So, in the next slide, I'm going to give you a few examples to try and illustrate that more clearly.

So, let's look at what we, the independent and dependent variable if we were looking at an animal nutrition experiment. So, the presence or the absence of a supplement, is the independent variable. So, the actual pellet or the nutritional supplement, that we're giving, that's the independent variable, the one that doesn't change. The weight of the animal, whether it increases or decreases or stays the same, that's the dependent variable. That's the one that we're looking at the response, of how that changes in relation to the independent variable. So, if we're giving them the group that is getting the 50 grams supplement, their weight might increase. Whereas the group that's not getting that supplement, the control group, it might stay the same. So that's how we would compare.

Another example is the effectiveness of a drench. So, the amount of drench administered is the independent variable. We'll be writing down exactly how much drench each animal's getting, the time and the date of when that occurs. And then the dependent variable, is looking at the absence or presence of worms. So, we want to know if the amount of drench that we're giving, is having an effect, on whether the animals have worms or don't have worms, or the amount of worms that are present.

Jaime: Okay, so we've looked at the method section. So, we now know exactly what goes into making this research trial. So, remember we had the analogy of baking a cake and that recipe. So, we now have that recipe for the research trial, we've made sure that all of the number of animals we're going to use is statistically relevant, and we've got the appropriate ethics. And so, the next part we're going to look at, is the results. And we really look results section and it's used, to help summarise. So, to help summarise all of the findings and the key areas, and those key research data points to the reader. And most of the time, there'll be a combination of tables, and also graphs or figures, really just to help summarise these important results. You won't really see papers where they throw all the data in, it's just columns and rows of data. It's really about summarising those key findings, presenting in a way that anyone could just pick up that table or pick up that figure, be able to read the axis, and you should be able to interpret what those results are, without having to read the entire paper.

So now we're going to go through some of those key results and sort of see what did we find when we put GPS collars on sheep, and we simulated a predation event, what actually happened, did the technology show us anything? So, the first one we're going to look at, is an example of a figure. And so, this figure here is looking at the speed that that animal travelled. So down the bottom we've got the two different flocks. Remember, we had two different replicates. So, our first replicate was known as flock one, and the second replicate was known as flock two, and then we've got the speed that those animals were traveling. And so, on that Y-axis, we can see the speed, and that speed's in metres per second, that the whole flock was traveling. And the key part here is to really look at how did that speed change before a simulated predation event. And while we want to know that, is we spoke about getting some baseline data. So, it's all well and good to say animals run really fast, when we put dogs in the paddock in a predation event. But we really need to understand, well, what do they do beforehand. If they're running fast all of the time, that's not going to be very useful to us.

So, if we look here, we can see that speed prior, is a lot lower. So, it's sitting at around less than 0.3 metres per second or lower. So, before predation event, before there's any dogs present, for flock one, the average speed is sitting well and truly less than 0.3 metres per second. And if we look at flock two, it's even lower. It’s sitting pretty much at zero. So, when there's no dogs in the paddock, the animals aren't moving very fast. And this is what we'd expect. We'd expect them to sort of stand still, take a couple of steps, they might be doing some grazing behaviour, they might be standing still, or lying down ruminating and digesting their food. And then the second part we're going to look at, was how fast did animals, those sheep travel when they were exposed to dogs, during that simulated predation event? And because this trial was undertaken a couple of different times, we can see that it varied depending, on which trial number that those dogs were in the paddock. But all you really need to see, is the speed was higher during those prediction events than before. And this information can be quite useful, when we start talking about how we can use technology on farm to detect and tell a producer when something's happening. And if we think back to when we spoke about, well, what do we already know about sheep predation, what do we know about those control methods, and we said that the current control methods really control dogs, but there's none that to tell us, that there's a dog in the paddock. This is a first key indicator that tells us that we could use GPS, look at the speed an animal is traveling as an indicator that there's something in the paddock going wrong.

A second example is the results table. This is an example here. So, you can see here it's got a label at the top saying table one, and then what the tables of. And this tables of sheep and flock behaviour responses to dog presence during the simulated predation events. And it's really just a table showing you all the different behaviours that we would see from a sheep, when they're exposed to a dog. So that first one at the top, is going to be the one that we saw the most. So, if we look at the frequency, there was 55 times that this behaviour of flee occurred. And we've got a description there. And we really want those descriptions, so that when we other people read this research, and if they want to carry it out again, they can see, "Did I see the same behaviours? Were there new behaviours that happened? And was this flee behaviour, the most common in other occasions?" And so, flee is where an individual sheep breaks away, and isolated from the flock or group. We can see that image there, we've got that image of sheep number one in that left-hand corner, and then on the right-hand side, you can see the rest of the mob. The dog is pretty much splitting her off, and she's isolated and has to pretty much flee and go elsewhere.

So that was the most common behavioural response that we saw during these simulated predation events. Some other examples was the sheep was pursued by the dog, and you can see there, that one with the black and green striped bib, that that sheep is getting pursued by that dog. And if this was under commercial condition or real-life example, there's a high chance that that dog would be targeting that animal and would result in some wounds or even death.

Another one is the animal stands still, and that's pretty self-explanatory. It's just an individual animal that's just standing still, and you can see it pretty much has to stand still, because there's nowhere else to go. In this particular example, there's three dogs that are surrounding it, and it's pretty much standing still, it'd be evaluating its surroundings, working out where the rest of the mob is, before it decides to then undertake its next behaviour.

The next one, which is the most interesting, is known as centripetal rotation by flock. And I'll read the definition and it does sound a little bit jargony, but I'll show you an example in a video of what it actually looks like. So the description of it is “the flock appears to rotate, as the individual sheep perform a centre seeking behaviour, in which they move towards forwards in a curved, circular path of movement, pressing against each other, apparently attempting to move into the middle and away from the periphery of the flock”. And this sort of makes sense. So, we think about a mob of sheep, we've got a whole mob, and the safest part in the mob if were surrounded by dogs is going to be right in the middle. So, what the animals are really trying to do, is force their way into that middle of the flock, and if they do that, then they got a lower chance of getting predated upon. So, all the individuals on the outside of the flock, they're obviously going to be closest to the dog. And if the dog really wants to attack that animal, they're probably going to be first pick. And so, what we see is this centripetal rotation where the whole flock turns around, spins around one another, really trying to get towards the centre, and away from the predators or the dogs.

And so, I've got a video here to sort of show you what it looks like. So, we've got our mob of animals. You can see one dog in the background but is actually surrounded by three dogs. And so what the sheep will start to do, and they’re starting now, is they start spinning around one another, pushing towards the middle, and you see that spinning behaviour, that centripetal rotation, trying to get towards the middle, and then they'll change and pick their next behaviour. And so, if we look at it from this angle, we really see that spinning, that centripetal rotation, as they all spin around one another, trying to get towards the middle, and away from those dogs. And you can see there, you can see the other dog in that right-hand corner. They're really just trying to get away and reduce their risk of getting attacked. But what's really interesting, so we know that was a common behaviour that we saw, 'cause that was in that results table with the frequency. But what we could also see, is this behaviour with the GPS collars. So, remember, each of those individuals is fitted with a GPS collar, and we're getting information every five seconds from that individual. And so, we look during this centripetal rotation, and look at these three different examples and these three different animals. And we look at number A, because it's the most clear, those areas tell us what direction that animals going in. And you can see it has this spinning centripetal rotation behaviour before it tries to get towards the middle. And so why this is important, is it's got the potential later on if we develop this further, that when those animals do this spinning type behaviour, that could be a potential alert for a producer telling them that there's something going on.

We've picked up two main things from the results section, so far. And so, the discussion is really trying to summarise those results and put it into a bit of context. So, you should see lots of different references where it's drawing in anything that we previously know, so any previous knowledge or research, and we do that to support our arguments. So we're saying that animals, are doing this centripetal rotation behaviour, if I can justify it and show that actually happens in lots of different other species, or other people have actually seen it, it really just identifies and highlights that that behaviour is quite common and it's not just an abnormal result. So, in this first part of the discussion, it's really talking about that centripetal rotation behaviour. It's telling us well, what is it? So we’ve got a definition here, of that it occurs when that tightly packed flock is formed, and animals are on the periphery trying to get towards the middle, we then take it further and go, "Well, why wouldn't animal do this behaviour?" And so, there's some other references there, telling us that animals that are on the periphery of the flock, are the most vulnerable, and that's why that centre seeking behaviour occurs. So, we're using that discussion to highlight, that we saw the centripetal rotation and that's our result and we're going to use, other supporting research to identify what is already known, and how it can be applied.

Another purpose of the discussion is to highlight any limitations. And there's always going to be limitations in any research trial. And it's really important to highlight these limitations because we don't want other researchers to read a paper, do the exact same thing, if they're going to have the same issues. And so we have these limitations, or we have research articles where things might not go right or maybe there was no result, and they're just as important as research trials and articles where we do get findings, because we don't really want to spend time and effort repeating the same thing over again, if it's not going to work. And so, in this trial, one of the limitations was, that the highest speeds recorded, may not be representative of other breeds. So, we used Merino ewes, and we obviously didn't use any other breed, but if we repeated this with a different type or different breed of animal, we're not sure whether those animals would have the same response during a simulated predation event. The other thing is we spoke about false positives. And I'm going to show you some examples of some other data during this trial, and highlight why false positives might be an issue, when we talk about getting this technology on farm for producers.

So, this is an example during one of those simulated predation events. And so, on the X-axis, we can see we've got some data before. So, remember, that's when there's no dog. During the predation event, when obviously there was a dog in the paddock and then afterwards, when again the dog left. On the Y-axis, we’ve got the speed, and we can see speed in metres per second. And this one's quite an easy example in that we can see that the speed during a predation event, is definitely much higher than before or after. And so what this tells us is, that if we were going to develop an algorithm or an alert, so an alert where with a speed was above, say 0.8 metres per second, that producer would get an alert on their phone, telling them something's going wrong and they could go out in the paddock. And so, for this particular example, it looks perfect. Yep, we can send an alert to that producer, and it should work pretty much all of the time. Because the speed before and after, is a lot lower than during that predation event.

But this didn't happen for every single example. And I'm going to show you an example where we'd actually see what we call a false positive and show you what it is. So, we've got again this data during the simulated predation event. And so if I was going to develop an alert, I'd say, anything over 0.8 metres per second, send an alert to that producer and tell them something's going wrong in the paddock, go and check their sheep, go and do something about it. But for this particular example, if we look at the data afterwards, we can see there's this overlap. And so, any speed that was between 0.8 and 1.1 metres per second. So, if we had that alert at 0.8 metres per second, there's going to be a number of instances where that producer is getting an alert on their phone, when it's actually nothing happening. And so, we call this a false positive. And the reason why we don't want false positives, is because if a producer or a farmer is getting an alert on their phone telling them there's something going wrong out in the paddock, and they go and check, and there's nothing out there, they get another alert, and they go and check again, after they do that about 10 times, it's going to get to a point where they go, "You know what, I'm not even going to go and check, it's not going to be anything." And then there's going to be a time where it's actually is something which we call a true positive. And then they’re not going to actually be going out there to rectify the issue or to go and say that there's something wrong with their animals. So, we highlight this as a limitation because we can't just use speed, as an alert telling us that there's a predation event going on. Because if we do, we're going to get these false positives and it's not going to work very well. And so, this is one major limitation of using speed to detect predation events.

So, in the summary section, we highlight pretty much well what did the research show? A summary of why they the research was done. And it's pretty much just going to say exactly what we were already reading in the abstract and in that introduction, that we know that there's welfare concerns, production losses and economic impacts. So, we really need to highlight a way and find a way to control wild dogs and these predation events of sheep. And the other second part in a summary, should really highlight the importance of this research. So, what's the future application? And we're going to go through some of that a little bit further.

So, the impact of it was, that even though we saw a high speed of movements, that high speed that animal was traveling during a predation event. Remember we can't just use that by itself because we will see some false positives. So, what we need to do, is actually combine that with something. And one example could be that centripetal rotation or that behaviour of that individual animal. And if we combine those two things, that could be a potential indicator or an alert to tell us that a predation event is occurring in the future. However, refinements required before this, will be commercially available, and to ensure there are limited false positives. So, remember, it was just a pilot trial. So, doing this one trial isn't going to create an alert, create an algorithm and solve all of our issues with sheep predation. It's really just showing us the potential, of using GPS technology, looking at speed, and looking at behaviour to detect that this event is occurring.

Amy: So why do we need research in the development of agricultural technologies? We went through this at the start of our presentation, but just to reiterate what we've learnt from Jaime going through the research that she conducted with her team. So again, GPS is still currently only a research tool. There's lots of commercial companies developing technology options, and you'll see lots of ads and flashy websites, but currently there’s nothing that's ready to purchase off the shelf. So, there's things that you might want to ask when you're talking to companies that are producing GPS technology and there are things that we mentioned at the start. Battery life, how long will they last? How durable is the hardware that's being developed whether it's a tag or a collar? And talk to people that are actually using that technology. Who are the farmers that have trialled the technology in a commercial setting? As we've been through this pilot trial, is a really important steppingstone to undertaking commercial activity. But it was still only a pilot, Jaime just said, it's not now that we've solved all of the problems of sheep predation in one trial, it's that starting block, to build the foundations of research using GPS technology in sheep. Its really important, GPS technology has a wide range of capabilities that can really improve animal production. It can improve efficiency and effectiveness of labour on farms. It could improve economic returns, but it can also have implications, really positive implications for animal welfare and environmental sustainability. So, at the moment, they're looking at how we can improve on farm monitoring, we're looking at the development of alert systems, so that trigger that you might get a text or an email to your phone. And in terms of predation detection, we can stop or limit the impact that is felt by predation on economic production and animal welfare.

So, like we've said, the next steps is that this is only a research tool. So, one of the things with this, is that the data was not live. It was contained on the collar, when the trial was over, Jaime got the collars off the animals, and downloaded the data. Now, that's obviously not going to be that useful to a farmer, if they're looking at a predation activity. They don't want to know that the predation occurred and then download the data. They want that real time system that gives you an alert straightaway. So that's something that this data can inform and can inform the algorithm development. So, looking at the trends in data and when we should know that predation attack's occurring, and to trigger that response, to develop that real time system.

Another thing is what we would refer to as the form factor. A size that is suitable for sheep. So, collars aren't really something that is commercially viable, because as the wool on a sheep grows, it could really impact how it grows and also how comfortable with collar is. So we really do need to move towards a tag, but that tag, that ear tag has to be light enough for a sheep to keep in its ear, what we refer to as tag retention, but still have a long battery life and be able to transmit that information that it's collecting. So, what we need now is research in commercial conditions. So, this was a pilot trial ran as part of an honours project at the University of Sydney. But what we need to do is run these sorts of activities, under real life predation events in different parts of Australia where sheep production is prevalent.

Jaime: So, the next step to obviously this pilot trial, is further research required to develop that algorithm or that alert that's capable of detecting predation events. So even though that was a pilot trial, the information gained from this particular article, was actually used to write up a proposal and submit an application to get additional funding. And that was submitted to the Australian Wool Innovation. So AWI. And it's actually a project I'm currently working on. So, through the CQ University and AWI, really looking at their smart ear tags, and that top right-hand corner, you can see the tag that they've developed. So, when we talked about form factor like Amy mentioned, this one is an ear tag that goes into its ear. And we're looking under commercial conditions, how do these sheep respond during predation events. And so it's really just a nice way to highlight how some pilot trials, and when you get some fundamental information, and then when we do find some those key indicators that could tell us that they could be incorporated into an alert and then take that further to commercial conditions to really test it out, and we'll see how that goes over the next couple of years and hopefully is a more viable solution for our wool growers across Australia.

So all of our acknowledgments you can read on this slide. And thank you so much for joining us today.

(upbeat music)