Dear Committee Member,

Please accept my apologies for contacting you so near to the meeting on Tuesday 20th April. I am aware that my Petition (1230) is to be considered once more at this meeting and I anticipate that it will, once more, be suspended due to the fact that the long-awaited report on tail injuries in dogs by the Royal Veterinary College and Bristol University has yet to be published.

That aside, I would like to bring to your attention that fact that the independent “Working Dog Injury Survey” has now been analysed by Biomathematics & Statistics Scotland (Bioss) and only today did I receive permission to forward this report to you. Please find this report attached.

While this report is of a technical nature it does validate the methods of data collection, covering 319 records of dogs in Scotland supplied by 156 owners. It also provides clear statistical evidence that working springer and cocker spaniels have a higher risk of injury that is associated with longer tail. This is clearly stated in the Conclusion section of this report on page 9.

Conclusions
The study has identified strong statistically significant evidence that working dogs belonging to the springer and cocker breeds have a higher risk of injury associated with longer tails. A similar effect was observed for HPR animals, but that effect was not formally statistically significant.

No other risk factors were found to be statistically significant in explaining injury, though of course this does not mean that other, unrecorded, factors were not operational. The results do suggest, however, that longer tails are an important predispositional risk, either alone or in interaction with other risk factors.

In addition, the report also states on page 9 that:

This effect can be quantified as saying that the odds of a cocker spaniel in this population having an injury increase by a factor of 2.4 for every extra inch of tail length; the odds of a springer spaniel in this population having an injury increase by a factor of 13 for every extra inch of tail length; and the odds of a HPR in this population having an injury increase by a factor of 1.3 for every extra inch of tail length.

In the likely and regrettable absence of the Royal Veterinary College report (now one year overdue) I would be grateful if consideration could be given to this detailed and robust analysis of the “Working Dog Injury Survey”.

With best wishes,

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Working Dog Injury Survey Analysis

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Biomathematics & Statistics Scotland
16/4/2010

Sponsor: Airlie Bruce-Jones

Executive Summary

Following detailed discussions on the design of this survey in order both to maximise power and to minimise bias, BioSS recommended that this study should

- focus on spaniels as being a relatively common group of dogs likely to be at relatively high risk, hence giving the highest power of detecting a hazard given the relatively sparse resources available;
- explicitly define 'tail injury' as having required medical treatment;
- utilise the collaborators' existing database of names and addresses, while attempting to sample further individuals at game fairs and such-like events;
- treat the sampled mean prevalences of injury as worst-case scenarios, which cannot be quoted as being relevant to the wider population of dogs;
- have a particular focus on collecting and completing datasets from owners with multiple dogs, some, but not all of which have a history of injury;
- also be analysed with the data restricted to the above sub-sample;
- be marketed and designed as a survey of risk factors in tail injury, even though tail length was the factor which was driving the exercise;
- explicitly try to encourage accurate reporting of all terms;
- collect information from a recent, short, well-defined period of time;
- try to collect information about the length of tail prior to injury, while noting that any bias arising from a failure to achieve this will be conservative in its effect.

Having reviewed the survey as conducted against the above recommendations, I have concluded that although the study probably will be subject to a number of biases and sources of excess variability, these are, with one exception, all likely to be conservative in their effect. The exception is recruitment bias, as it is impossible to be sure that the surveyed animals were drawn at random from the population about which inference is to be drawn. Recruitment bias could result from a number of different effects likely to be at work, operating in opposing directions. However, since these are all likely to be operational at the owner stratum of variability, it is believed that an analysis of data within owners, restricted to owners with multiple dogs, some but not all of which have been subject to injury, will provide relatively unbiased estimates of the risk factors. The latter analysis is also subjected to a stringent interpretation of the demand that data should be collected from a recent, short, well-defined period of time.

When analysed in this way, the study has identified strong statistical evidence that working dogs belonging to the springer and cocker breeds have a higher risk of injury associated with longer tails. A qualitatively similar effect was estimated for HPR (Hunt Point Retrieve) animals, but there was no statistical evidence that this was genuine.

No other risk factors were found to be statistically significant in explaining injury, though of course this does not mean that other, unrecorded, factors were not operational. The results do suggest, however, that longer tails are an important predispositional risk, either alone or in interaction with other risk factors.

Introduction

BioSS was approached for advice on collecting information relating to tail injuries in working dogs. Anecdotal evidence suggested that spaniels (and perhaps other working dogs) were proving more prone to tail injury subsequent to the ban on tail docking in Scotland. It was desired to collect information which would be submitted to the Scottish Government or the Scottish Parliament as a spur to further action. Any survey would be carried out on a voluntary basis, with relatively little resource. BioSS's view was that we would only undertake to work on this project if the collaborators accepted that the statistical robustness of the exercise was of the highest priority. As a safeguard against publication bias, we asked the collaborators to commit to publicising the conclusions from any statistical analysis, regardless of whether these conclusions confirmed or contradicted their hypotheses. We believe that, within the logistical constraints defined by their relative lack of resources and lack of official status, the collaborators have taken pains to live up to the high statistical standards set by BioSS, and have succeeded to an extent which has allowed a valid statistical analysis to proceed.

Other Sources of Data and Focus of Study

The Royal Veterinary College/University of Bristol is currently undertaking a general case-control survey based on cluster sampling through veterinary practices. Anecdotally, however, this study is apparently collecting data equally in a 2 by 3 structure across Urban/Rural and Scotland/England/Wales from all dogs, where only a subset of animals are likely to be at higher risk of tail injury. It is not clear whether the exercise will have sufficient power to find the type of effect indicated by anecdotal evidence from the Scottish field.

An English vet has recently published a paper reporting the results from his survey of gundog lameness and injuries in Great Britain (Houlton, 2008). The statistical analysis is no more than adequate, but the reported data do suggest that spaniels might be at a higher risk of tail injury than other breeds.

Accordingly, it was recommended that any study should

- focus on spaniels as being a relatively common group of dogs likely to be at relatively high risk, hence giving the highest power of detecting a hazard given the relatively sparse resources available.

Although the organisers of the study chose also to collect information about other breeds of dog, this should not have, in any way, invalidated their collection of spaniel data.

A study investigating issues relating to tail injury in animals requires a robust and defendable definition of injury. To avoid subjective assessments of injury, medical treatment was a useful criterion for this. It was decided not to specify that 'medical treatment' had to have been carried out by a veterinary surgeon, as such a constraint would have been overly restrictive and likely therefore to reduce the prevalence of injury to overly low levels.

Accordingly, it was recommended that any study should

- explicitly define 'tail injury' as having required medical treatment.

Possible Strategies

The ideal design for a study would be similar to that carried out by the RVC: a case-control study which matched injured animals (as they were recruited) with other animals matched on relevant properties except for docking status. This would only be possible through the involvement of veterinary practices. It would be both statistically wise and logistically necessary to utilise many veterinary practices in the study, to allow for between-practice variability and to collect sufficient numbers of animals. The focus of the study would, however, be different to that of the RVC study, since it would preferably focus on rural working dogs. A study of this size and complexity is, however, beyond the resources and logistical capacity of even the most enthusiastic volunteers.

The only alternative which is, potentially, within the capacity of a voluntary study is to survey the experiences of dog owners, collecting information about injuries accruing to their animals, while collecting data about possible risk factors. The advantage of this approach is that it might allow collection of information about a wider range of risk factors. The drawbacks are that the power to detect statistically significant effects per animal is less than in a case control study, since the focus of the study is more diffuse. There are also serious issues relating to the quality of the data collected. Retrospective data provided on a voluntary basis by owners (as opposed to veterinarians) may be subject to recruitment bias, deliberate bias, recollection bias and a higher level of variability. Nevertheless, since this is the only viable approach, it is necessary to consider how these effects can be minimised, and their likely effects assessed.

Recruitment Bias

The target population is the population of working dogs whose activities put them at potential risk of tail injury. There was no viable mechanism to explicitly define a sampling frame for the study. The collaborators had proposed contacting possible respondents via various interest groups, but in discussion it was concluded that this approach would give rise to a sample with unacceptably non-random statistical properties. If it were possible to involve a large group of veterinary practices, one option would have been for the vet to pass the questionnaires on to owners who they knew owned working dogs. However such a two-stage process would have been likely to give rise to a very low response rate. The collaborators have made contact with a large number of people with working dogs while collecting signatures for a petition, which might reasonable be characterised as a representative sample of the population of working dog owners who are concerned about the causes of tail injuries. They have frequently been contacted via personal contact at game fairs and such-like events, and indeed the participants at such events are likely to include disproportionate numbers of owners of animals in the at-risk group. Individuals contacted or re-contacted via game shows may be likely to own animals in the at-risk population, but there may be issues relating to bias in the sample. This is clearly not a sample whose *past* experiences can be used to compare incidences of injury in animals with different lengths of tail, since recruitment may well have been influenced by these past events, but it is a sample which could credibly provide data to explore whether there is any relationship between an animal's tail length and risk of injury in the *current* and *future* seasons, provided that we are confident that other sources of bias which might be present in this sample can be controlled. In fact, if recruitment is positively correlated with past injury, which in turn is positively correlated with a high potential risk of injury, then this is a set of animals within the wider at-risk group which would provide a statistically more powerful sample to detect any relationship of injury with tail-length. The corollary is, however, that the actual observed mean prevalence of injuries is unlikely to be representative even of the wider at-risk group of animals, and these figures should be discounted.

Retrospectively reviewing the properties of the study, it appears that virtually all respondents were previously unknown to the organisers (reportedly, all but 5 respondents, approximately 97% of the sample). They were predominantly not people who had previously been surveyed or were on a list of contacts. The majority had heard about the survey from membership associations, their employers or by word-of-mouth. The concerns expressed in the previous paragraph, as identified at the survey design stage, have therefore turned out to be much less of an issue. However, there are other issues relating to the recruitment of this new group which do require further discussion.

After considering potential sources of bias in the sample, it was concluded that owners with injured animals were more likely to respond than those whose animals had no injuries; that some owners with animals with longer tails were potentially more likely to report a lack of injury (since if they were positively engaged with the policy, and hence had animals with longer tails, they might be thought likely to be pleased to report that no injury had ensued); and that some owners with animals with longer tails were potentially more likely to report injury (since if they were negatively engaged with the policy, and hence had animals with longer tails than they wished, they might be thought likely to be keen to report when injury had ensued). These subgroups of owners are unlikely to be balanced between the shorter tail and longer tailed groups of dogs, so the size of any bias effect will be different for shorter tailed and longer tailed animals. Summarising the effects in a table, we see the following pattern (italics: tail effects; bold: injury effects).

	Shorter Tail	*Longer Tail*
No injury	**0 baseline propensity to respond** *+ higher propensity to report amongst those positive about current policy, probably less marked in this group*	**0 baseline propensity to respond** *++ higher propensity to report amongst those positive about current policy, probably more marked in this group*
Injury	**+ more likely to respond** *++ higher propensity to report amongst those negative about*	**+ more likely to respond** *+ higher propensity to report amongst those negative about*

	current policy, probably more marked in this group	*current policy, probably less marked in this group*

What we do not know is the relative size of the injury and tail effects. However if we sum the effects on a qualitative basis, the following summary of effects would result.

	Shorter Tail	**Longer Tail**
No injury	+	++
Injury	+++	++

The biases in these data are likely to lead to an underestimation of risk associated with longer tails. Hence for the purposes discussed these biases are likely to have a conservative effect, when attempting to identify tail length as a risk factor.

There are uncontrolled sources of bias present in the data. However, it is reasonable to regard these as operating through the decision of the owner to contribute data about his or her dogs to the survey. If efforts are made to ensure that all contributing owners report information about all their dogs, and the analysis is restricted to data only from owners with multiple dogs, some of whom have reported injuries and some who do not, then, since much of the variability in the data will also occur at the owner stratum, it would be anticipated that most of any estimated tail length effect will be estimated at the within-owner stratum, and hence will not be subject to these biases. The organisers took great pains to chase up owners with incomplete information about multiple dogs, and it has therefore been possible to fit a mixed effects model to a restricted dataset, as indicated here. Although the sampled population is now a population of owners with multiple dogs, whose animals are prone to some level of injury, it does not seem likely that this will cause any additional problems in our interpretation of any results (although again it ensures that mean prevalence figures will be meaningless in this context).

Accordingly, it was recommended that any study should

- utilise the collaborators' existing database of names and addresses, while attempting to sample further individuals at game fairs and such-like events;
- treat the observed mean prevalences of injury as worst-case scenarios.

  However, it is impossible to quantify what biases may be present in the sample. General bias arising from the owners' propensity to volunteer information may be conservative in its effect, but the data could also exhibit a more severe bias caused by the recruitment of owners known to the organisers because of the existence of previous injuries. Retrospective assessment of the dataset suggests, however, that this latter effect will be negligible.

Nevertheless it was recommended that any study should

- have a particular focus on collecting and completing datasets from owners with multiple dogs, some, but not all of which have a history of injury;
- also be analysed with the data restricted to the above sub-sample.

Deliberate Bias

Given the emotive nature of the issues involved, it is possible that respondents might deliberately distort their responses or suppress relevant pieces of information in order to deliberately distort the conclusions of any study in line with their personal opinions. It was concluded that any study which **explicitly** aimed to study the effects of tail docking would be at highest risk of such biases, and in such a case it would be impossible even to infer in what direction such biases might be operating. It was felt that a stated focus on investigation of the risk of tail injury in working dogs, in which tail length was recorded as one amongst several covariates, would provide the best basis for collection of minimally biased data. In addition, the organisers ensured that the questionnaire began with the following rubric:
"PLEASE answer EVERY question in this document for ALL your dogs even if your dogs have experienced NO tail injury. Your accurate information about your working dogs is essential for establishing both the causes of tail injuries and how to avoid them to give to the Scottish Government."
which, by linking the (rational) need for accurate information to the uniformly desirable (emotive) outcome of avoiding tail injuries, will hopefully have encouraged respondents to report as accurately as they are able.

Accordingly, it was recommended that any study should
- be marketed and designed as a survey of risk factors in tail injury, even though tail length was the factor which was driving the exercise;
- explicitly try to encourage accurate reporting of all terms.

Recollection Bias

The only strategy which could reduce recollection bias would be to collect information from a recent, relatively short period of time. However, this would inevitably reduce the numbers of injuries reported in the survey, with a commensurate reduction in the power of the study. However, we might assume that an animal's injury is a sufficiently serious event that conscientious owners would correctly remember the details over a moderate period of time. That this is so may have been confirmed by the numbers of owners who have carefully provided different sets of information for different animals which they own. It was felt that an accurate count of numbers of injuries over a longer period of time would be unlikely to be accurate, and that an appropriate strategy was therefore to aim to collect information about recent injuries during the 2008/09 season; in order to validate these data, respondents reporting an animal as injured were asked to give a date for the **initial** injury occurrence. The following table summarises the responses to this request:

Type of Response	**Number**
2008/09 Season	46
Late 2007	6
First injury much earlier than 2008/09	6
Missing	5

Hence, from the 63 records of injury, 46 (73%) were clearly within the specified sampling frame, 6 (10%) fell just outside the frame, 6 (10%) were repeat injuries, occurring within the 2008/09 season, although possibly recurrences of earlier injuries, and 5 (8%) provided no information. Effectively, 17% of the sample cannot be validated as occurring in the specified season, since the associated data is either missing or details an earlier injury. The properties of the rest of the data suggest that compliance with the questionnaire has been good, with the bulk of the data arising from the 2008/09 season. Even the injuries from the 2007 period are relatively recent. Therefore it was proposed to analyse all the data, regardless of the status of the date field, in the initial analysis, but to restrict the analysis of the multiple dogs dataset (as specified earlier in this report) only to animals with date of injury restricted to the 2008/09 period. This is a very restrictive assumption, since it seems likely that the bulk of the data are probably well defined. As it happened, this latter restriction only led to the removal of 6 animals/2 owners from the latter analysis.

There is, however, a serious problem in formulating the study as retrospective in this way: once an injury has occurred, and docking has occurred, the owner will no longer be able to measure and report the original length of tail. This problem is inherent in any retrospective study.

Ideally, the survey would have operated on a two-stage basis, with owners being asked to complete an initial form detailing their animals, including information about the length of tail. Later, at the end of the season, they would have been asked to return a further questionnaire, detailing injuries and relevant between animal within year covariates (such as number of days worked). The advantages of this approach would have been to reduce the risk of bias (since the tail and injury information was being collected on different occasions) while giving better quality data, at the cost of greater expense and a potentially much lower response rate, and lower incidence of injury (since this data set would relate to only 1 year). This approach was, however, logistically unfeasible for what was a purely voluntary activity on the part of the organisers.

I suspect that it has proved impossible in a one-off survey of this type to collect tail length data which perfectly describes the length of tail before injury. However, the effect of such errors will have been to attenuate the relationship between injury and tail length, leading to reduced statistical power and a conservative bias in this study's attempt to establish length as a risk factor. This loss of power is purely a matter of concern to the organisers, and should not impact on our interpretation of any identified risk factors.

Accordingly, it was recommended that any study should

- collect information from a recent, short, well-defined period of time;
- try to collect information about the length of tail prior to injury, while noting that any bias arising from a failure to achieve this will be conservative in its effect.

In the event, it was found that compliance with date recording was good, but that as part of a conservative analysis strategy it was concluded that

- the 'multiple dogs' analysis should also be restricted to records reported as first occurring in the 2008/09 season.

Higher Level of Variability

Where the dependence of the data on owners' recollection of past facts causes a higher level of variability in the recorded data than was actually the case, it is difficult to imagine a realistic scenario when this would lead to a factor being incorrectly identified as a statistically significant risk factor. However, it might easily reduce the apparent effect of a (genuine) risk factor to a degree such that we record a false negative. In so far as these would then be conservative results, and the organisers are interested in collecting evidence for the **existence** of a risk factor, then this loss of power is purely a matter of concern to the organisers, and should not impact on our interpretation of any identified risk factors. As usual, in studies of this type, a failure to find any particular effect should not be taken as evidence of the non-existence of that effect.

Validity of Study

It is concluded that although the study as carried out is subject to a number of biases and sources of excess variability, these are, with one exception, all likely to be conservative in their effect. The exception is bias arising from recruitment bias, where there are a number of different effects likely to be at work, operating in opposing directions. However, since these are all operational at the owner stratum of variability, it is anticipated that an analysis of data restricted to owners with multiple dogs, some but not all of which have been subject to injury, will provide unbiased estimates of the risk factors. These results can then be compared with those arising from the complete dataset.

Statistical Analysis

Statistical analyses were carried out using Genstat 12th edition, using various linear regression, generalised linear modelling, linear mixed modelling and generalised linear mixed modelling approaches as appropriate to the data.

Results

Summary information about the data set and the evidence behind the following results are given in the Tables and Figures at the end of this report.

Analysis of the complete dataset indicated that, when examining each risk factor separately:

- Age of animal, number of days worked, whether the animal was less than 3 years old and tail length were all statistically significant risk factors.
- Breed, Height to Shoulder, Animal off lead, Rural environment, and Sex of animal all exhibited no statistically significant evidence of being a risk factor (although it should be noted that only 14 responses were from non-rural animals, giving a negligible power to detect differences between rural and non-rural animals).

- A detailed examination of the statistically significant variables and factors showed that the apparent associations of risk of injury with Age, Number of days worked and whether the animal was less than 3 years old were all also associated with tail length and that tail length was a better explanatory variable.
- For all three breeds, the statistical model identifies length of tail as a risk factor for injury. For HPR (Hunt Point Retrieve) animals, this effect is not statistically significant ($p=0.18$), but for both spaniel breeds the effect is highly statistically significant ($p<0.001$ in both cases).

Analysis of the dataset when restricted to only date validated responses from owners with multiple dogs, some but not all of which have exhibited injuries showed:

- For all three breeds, the statistical model identifies length of tail as a risk factor for injury. For HPR, this effect is not statistically significant ($p=0.50$), but for both spaniel breeds the effect is statistically significant ($p=0.004$ for cockers and $p=0.01$ for springers).
- This effect can be quantified as saying that the odds of a cocker spaniel in this population having an injury increase by a factor of 2.4 for every extra inch of tail length; the odds of a springer spaniel in this population having an injury increase by a factor of 13 for every extra inch of tail length; and the odds of a HPR in this population having an injury increase by a factor of 1.3 for every extra inch of tail length. Note that the size of these effects cannot be used to make statements about the risk of injury in the more general dog population.

The results from the full and restricted analyses are qualitatively identical, providing additional confidence in the robustness of the conclusions. On balance, however, the results from the restricted analysis are to be preferred, since these are potentially less subject to bias.

Conclusions

The study has identified strong statistically significant evidence that working dogs belonging to the springer and cocker breeds have a higher risk of injury associated with longer tails. A similar effect was observed for HPR animals, but that effect was not formally statistically significant.

No other risk factors were found to be statistically significant in explaining injury, though of course this does not mean that other, unrecorded, factors were not operational. The results do suggest, however, that longer tails are an important predispositional risk, either alone or in interaction with other risk factors.

Summary of Analysis

The full dataset consisted of 319 records from 156 owners.

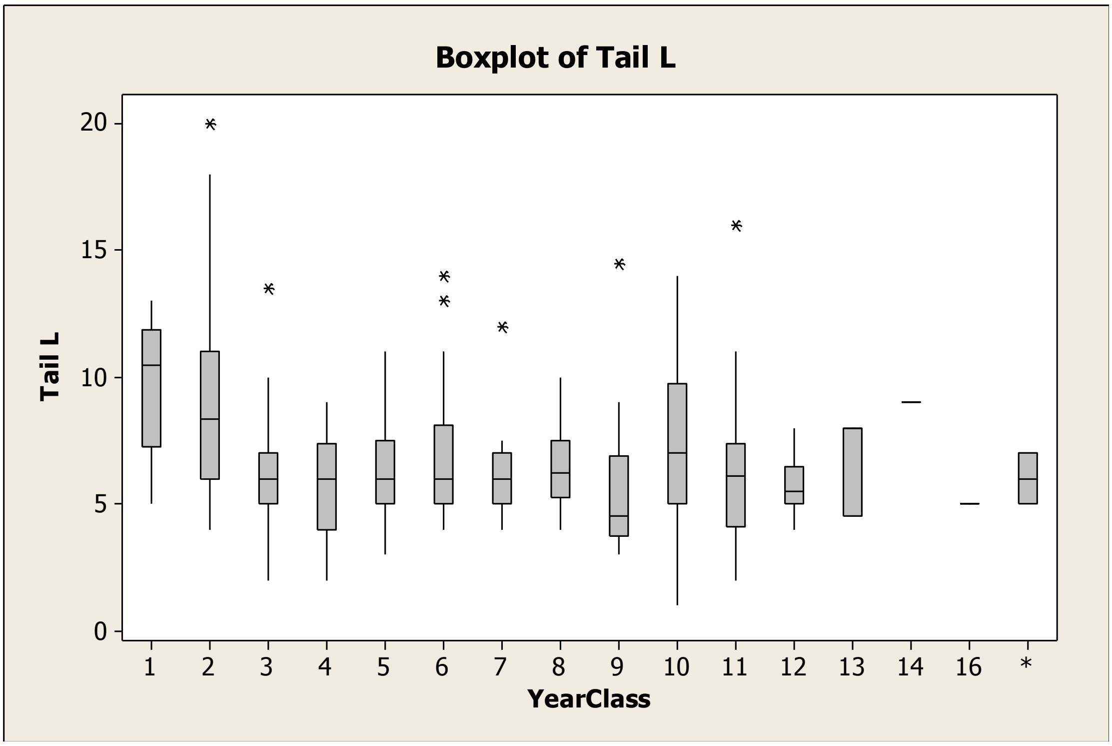
Fitting univariate models relating the different explanatory variables to the absence/present of injury response variable, fitting generalised linear mixed models, with a binomial response and a logit link function, with dispersion fixed at 1 (since the data are Bernoulli in form), the following results were seen.

Explanatory Variable	**Estimated Effect(s) (+ve= increased risk; -ve= reduced risk)**	**Standard Error(s) of Effect(s)**	**p-value Associated with Effect(s)**
Age	-0.17	0.049	<0.001
Breed	0.54 (Springers v Cockers) -0.12 (HPR v Cockers)	0.69 0.32	0.18
Days Worked	-0.0095	0.0044	0.03
Animal Aged Less Than 3	1.69	0.30	<0.001
Animal Off Lead	0.25	1.12	0.82
Rural Area	1.26	1.06	0.23
Sex	0.065 (Male v Female)	0.29	0.82
Tail Length	0.76	0.10	<0.001

The ‘Height to Shoulder’ variable could only be modelled appropriately when in interaction with Breed. With an overall p-value of 0.18, there was no evidence that Height to Shoulder was a statistically significant risk factor for any of the breeds of dog.

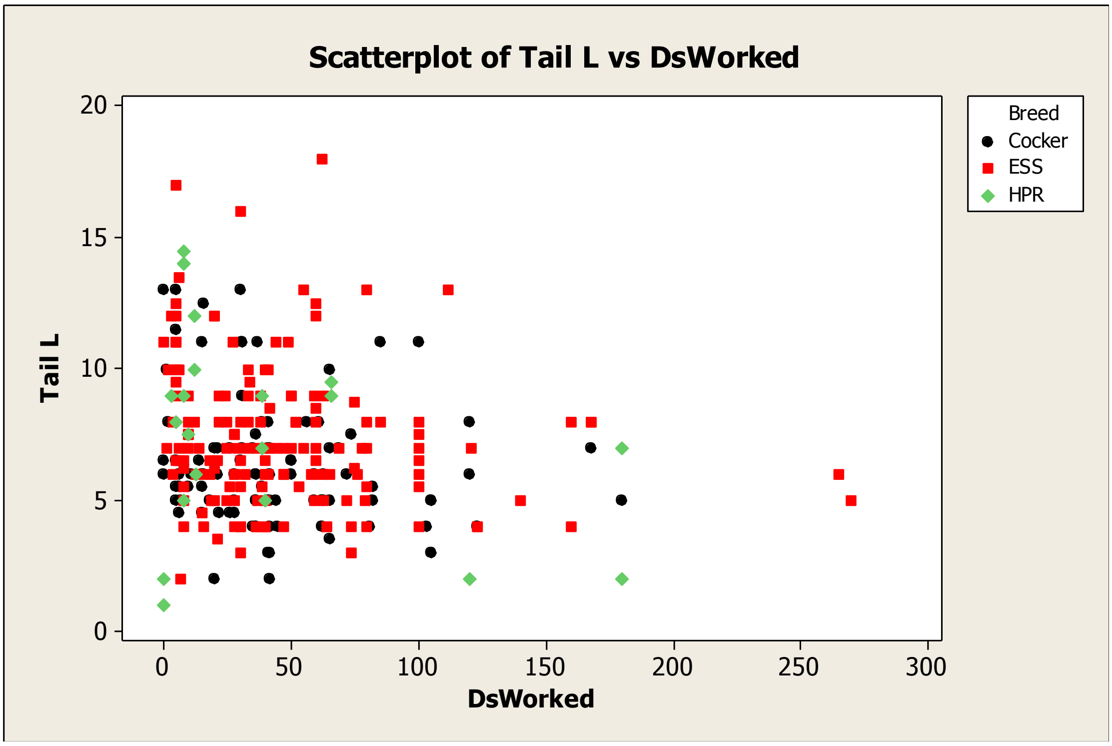
Of these variables, Age, Days Worked, Less3 and Tail Length were worthy of further investigation. The effect of Breed as an interacting factor was also explored.

There were relationships between each of these explanatory variables. For example, there were more springers and cockers with longer tails in the younger age groups, reflecting the change in legislation in recent years, as illustrated by the following boxplot:



Across older animals there was little difference in the tail length distributions in different years. However, animals in Year classes 2 and 1 had distributions which were steadily shifting towards higher median values in younger animals. Focusing only on younger animals, in which age classes there was a wide and relatively balanced range of tail length, fitting a model incorporating both age and tail length showed that little of the variability was explained by the age ($p=0.16$) but much was explained by tail length ($p<0.001$).

Examining the explanatory variables Days Worked and Length of Tail, it was found that animals with longer tails tended to have worked for fewer days than those with shorter tails.



The univariate 'Days Worked' model was refitted, restricting the model to animals with less than 100 days worked. This subset of the data exhibited a fairly constant range of tail lengths with respect to different days worked. In this model, number of days worked ceased to show any statistical significance as an explanatory variable (p=0.13).

Length of tail was the only explanatory variable identified by univariate analysis which appeared to have genuine explanatory value. It was investigated further by examining the behaviour in different breeds.

In cocker spaniels, Length of Tail was found to be the only statistically significant explanatory variable ($p<0.001$), where increased length equated to increased risk. In springer spaniels, Length of Tail was found to be the only statistically significant explanatory variable ($p<0.001$), where increased length equated to increased risk. In HPR animals, the dataset was too sparse to evaluate all options, Length of Tail was found to increase risk but was not statistically significant as an explanatory variable (p=0.18).

The analysis was repeated, applied only to the restricted dataset of owners reporting multiple dogs, some, but not all, of which have injuries, where the injuries were date validated. The restricted dataset consisted of 101 records from 29 owners. The estimated values were qualitatively similar in each case, though typically with larger standard errors and hence larger p-values. This change reflected the smaller sample sizes incorporated into this restricted analysis. These p-values are reported in the main text above, but the interpretation of the results is unchanged: length of tail is a risk factor, statistically significantly so for the spaniel breeds, not significantly so for the HPR animals.