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Executive Summary

What the report is about? This report is about research undertaken by the University of New England (UNE), South Australia Research and Development Institute (SARDI) and the Queensland Department of Primary Industries and Fisheries (QPIF) to examine alternatives to beak trimming. This was assessed by SARDI and QPIF in free range hens by examining if the provision of shade, shelterbelts and forage in the range improved the feather condition of birds. An on farm trial was conducted in New South Wales to determine if low light rearing prevented feather picking and cannibalism in cage reared pullets. The studies conducted at the University of New England investigated a range of deterrents that may avert the onset of cannibalism in caged hens.

Who is the report targeted at? This report is targeted at Australian and overseas egg farmers, scientists, students, welfare groups, policy makers and poultry industry leaders.

Background:

The welfare of beak trimmed birds and the potential negative long-term effects of the procedure are becoming increasingly recognised by consumers. UK law classes beak trimming as a mutilation. In the EU routine beak trimming is banned in organic and free-range poultry production systems. In conventional pullet and layer houses in the EU it is possible to minimise the light intensity within the house and reduce the risk of outbreaks of injurious feather pecking. In Australia there is an increasing trend toward poultry houses where light intensity can be controlled. It is likely that the need for beak trimming can be reduced in flocks where light control is possible throughout the life of the hen. However in older conventional layers sheds, barn and free-range systems the problem of feather pecking and cannibalism will persist. Alternative methods for controlling cannibalism and feather pecking in poultry are being developed in the EU and could become mandatory. In the EU preliminary work has suggested that feather pecking in free-range flocks was greatest when a low percentage of the flock used the outside range, increasing the stocking density within the house and increasing feather pecking. At Roseworthy, studies with free-range birds has shown that some forms of forage available in paddocks can encourage greater use of the range and reduce bullying and cannibalism. Other options include the use of shelterbelts and shaded areas as attractants. The use of plastic slats in the house, improving litter condition and changing type of drinkers has also reduced feather pecking. A range of predator scents from faeces; urine, scent glands and saliva are being increasingly used to act as repellents against predators of ruminant species. There has been little investigation of the use of such repellents in poultry but the potential application in suppressing feather pecking appears large. There is a need to evaluate the effectiveness of enrichment methods and repellents under Australian conditions as well as to continue development of new methods to reduce the need for beak trimming in our Industry.

Aims/Objectives:

Reduce the need for beak trimming and re-trimming by;

- Developing products that deter the onset of cannibalism and feather pecking in cage and free range systems.
- Developing the design of free-range system to minimise cannibalism.

Methods:

The project was based on examining if alternative methods could be used to avoid beak trimming or at least to eliminate the need for re-trimming.

Three trials were undertaken with free range layers under Australian conditions at a free range research facility at SARDI's Roseworthy Campus in South Australia and in Queensland on commercial free range farms. Each trial examined if the risk of feather pecking was reduced when layers were provided artificial cover and forage areas. The first trial examined the role of shaded areas; the second trial examined the role of forage and the third trial examined the influence of shelter belts in the range. Hens were allowed day time access to the range and measurements were made daily for egg production, weekly for egg weight and four weekly for feather score. Video records were made of hens at 4 weekly intervals in each of the trials. A low light rearing (10 lux) experiment was conducted on a commercial pullet rearing farm in New South Wales to determine if dim light prevented feather pecking and cannibalism.

SARDI trials

SARDI's free-range research facility comprised an eco shelter divided into 6 experimental units each holding 20 birds. The birds in each experimental unit had access to a 726m^2 paddock adjoining the shelter.

Experiment 1: Shade
There were 2 treatments; 1) control group, and 2) treatment group allowed access to shade in the range. There were 3 replicates of each treatment. The shade was provided by waterproof shade cloth suspended from 4 posts. The control hens were not provided outdoor shade while the treatment hens were provided a shaded area located 10m and 20m from the shed. Birds were examined over 32-44 weeks to determine if birds spend a greater % of time in the range and the subsequent influence on bird condition, feather pecking, cannibalism and production.

Experiment 2: Shelterbelts
There were 2 treatments; 1) control group, and 2) group allowed access to moveable shelterbelt (shrubs in pots). There were 3 replicates of each treatment. Birds were examined over 24-32 weeks to determine if birds spent a greater % of time in the range and subsequent influence on bird condition, feather pecking, cannibalism and production.

Experiment 3: Forage
There were 3 treatments provided in the range, no pasture (control); vetch pasture and wheat pasture. Over the period 58-70 weeks birds were allowed access to the range and measurements were made on production, feather score and percentage of birds foraging.

Low light intensity rearing trial on a commercial farm

The feather condition and mortality of 1000 layer chicks not trimmed were compared at 6 weekly intervals to 1000 infrared trimmed birds housed at a light intensity of 10 lux in a commercial cage rearing facility in Young, New South Wales

QPIF Trials

QPIF's trials were based on the work undertaken at SARDI and were run on commercial free range layer farms on the Darling Downs in Southeast Queensland.

Trial 1: Shadecloth
There were two treatments; 1) hens with access to shadecloth shelters in the range area, and 2) hens without access to shade with three replicates of each treatment. The size of the shade was dependant on the number of hens in the flock/shed and was positioned 30m and 60m out from the shed. Birds were examined for 12 weeks to determine if birds with access to shade used the range more and influence on feather score and bird weight.

Trial 2: Shelterbelt and Summer Shadecloth
There were two treatments; 1) hens with access to shelterbelts in the range area, and 2) hens without access to shelterbelts with two replicates of each treatment. The size of the shelterbelt was dependant on the number of hens in the flock/shed and was positioned 15m and 30m out from the shed. Birds were examined for 15 weeks to determine if birds with access to the shelterbelt used the range more and influence on feather score and bird weight.

At the same time two sheds (one with a shadecloth shelter and one without) continued to run through summer for comparison with the winter results of Trial 1.

Trial 3 – Forage
There were three treatments; 1) hens with access to forage in the range area, 2) hens without access to forage, and 3) hens with access to a hay bale in the range area with 2 replicates of each treatment. The size of the forage area was dependant on the number of hens in the flock/shed and was positioned 12m and 30m out from the shed. Birds were examined for 14 weeks to determine if birds with access to shade used the range more and influence on feather score and bird weight.

UNE Trials

Experiment 1: Screening Repellents
A suite of 10 potential bird repellent agents were screened for their effectiveness in reducing food intake of adult hens for a prolonged period. Two agents Thiram and LiCl were identified as being by far the most effective.

Experiment 2: Training
Thiram and LiCL were added to blood and a combination of blood and feathers and made available to groups (~50) chicks at 2 weeks of age, at 15 weeks of age or at both 2 and 15 weeks of age. The effectiveness of the repellent was monitored by recording the number of approaches of the chicks to bowls containing the blood and blood plus feathers. The effectiveness appeared much more pronounced at 2 weeks

Experiment 3: Cannibalism Trial
The mortality of caged birds was recorded between 19 and 31 weeks of age for the different treatment groups described earlier. Mortality was significantly reduced (~7%) for the birds exposed to both Thiram or LiCl at 2 weeks compared to controls. The effects seemed to be most effective when blood and feathers were used rather than just blood.

Results/Key findings:

i) Work conducted at SARDI

Enrichment study

Aggressive feather pecking was only observed on a few occasions in all of the trials. Enriching the free range environment attracted birds in the range. Shaded areas were more readily used by hens and encouraged more hens to use other areas in the range. Forage availability resulted in a more consistent use of the range during the day. A higher percentage of birds were observed in the range when birds were provided a shelter belt. In addition the shelter belt attracted greater numbers of birds in areas further away from the poultry house.

On-farm low light rearing trial

Feather pecking commenced in the non trimmed birds about 30 days of age with 7 birds removed from the trial due to pecking damage around the base of the tail. The farm manager continued with the trial but feather pecking persisted and the trial was abandoned when the birds reached 16 weeks of age.

ii) Work conducted by QPIF

The results from work undertake by QPIF were similar to SARDI's results with enrichment of the free range environment attracting more birds into the range. All enrichment treatments trialled showed some degree of success with the forage and hay bale being the most successful followed closely by the shelterbelt and shadecloth. Feather scores were not significantly affected by the addition of shade to the range area except to a minor extent in the forage trial. This result however is tempered by the fact that there were different breeds of hens used in this trial (Hyline Brown, Bond Black and Bond White) which could have influenced the results.

iii) Work conducted at UNE

The results of the trials conducted at UNE have shown that there are repellents that can be effective in reducing or preventing food intake in birds after only short exposures. The most effective of these repellents can also be used to train birds to associate aversive effects with blood and or a combination of blood and feathers. Once trained the birds exposed to the repellents at 2 weeks of age had reduced mortality in the first third of lay compared to the untreated birds or birds exposed to the repellents at 15 weeks. It appears that this methodology could be considered as additional option in a multiple strategy approach to reduce the onset of cannibalism.

Implications for relevant stakeholders:

SARDI trials
Enrichment of the free range attracted birds to use the range. However aggressive feather pecking was only observed on a few occasions in all of the trials conducted at SARDI. It is likely the small flock size contributed to the flock being docile. However in larger operations there is no guarantee that there would be an outbreak of feather pecking and cannibalism.

QPIF trials
Regardless of the type of enrichment used in the range areas, more hens were attracted out of the sheds to use the range compared to areas with no enrichment. Having the enrichment in steps out from the shed (eg. 10m, 20m, 30m etc) could attract even more birds out of the shed into the range area. When fresh forage is available birds are willing to travel greater distances from the shed.

UNE studies
The initial evaluation of repellents suggests that training methodologies in early life may be a useful option in a multiple strategy approach to achieve a reduction in cannibalism onset in layer birds.

Recommendations:

From SARDI trials

- Australian free range egg farmers are encouraged to provide pasture, shaded areas and shelter belts to attract birds into the free range.
- Caution needs to be exercised by commercial egg producers when using low light rearing as an alternative to beak trimming.
- Landscape architects should be utilised to design outdoor range areas which cater for the behavioural needs of birds and reduce feather pecking.

From QPIF trials

- Work on commercial free range egg farms has endorsed the SARDI results and the recommendation that farmers should be encouraged to provide pasture, shaded areas and shelter belts to attract birds into the free range.
- If unable to provide pasture, shelter belts or shade cloth shelters, the provision of hay bales in the range areas proved to be an excellent alternative to attract birds from their sheds.

From UNE trials

- Initial exposure of chicks to repellents associated with blood and feathers resulted in a reduced incidence of cannibalism and should be considered as another option in a multiple strategy approach to achieve a reduction in cannibalism onset in layer birds.

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Literature review

Introduction

Cannibalism in poultry involves severe pecking and tearing of the skin and usually leads to death of the pecked bird. It has been reported in a wide variety of birds of different genetic background. Once cannibalism has started, it can spread very rapidly causing large bird losses, economic loss and welfare concerns. Cannibalism can occur at any age or in any strain (Klemm *et al*., 1995, Elliot, 1996; Ambrosen and Petersen, 1997) and occurs in birds raised in barns and in cages (Appleby *et al*., 1989). After many years of research the causes of cannibalism are still not clear with numerous factors suggested. Housing factors such as high stocking density (Cain *et al*., 1984), flooring (Blokhuis and van der Haar, 1989), bright lighting (Scott *et al*., 1954), and inadequate feeding space (Robinson, 1979) have been attributed to a higher degree of feather pecking and/or cannibalism. Others research has identified nutritional factors such as protein deficiency, mineral imbalance (Cooke, 1992), and insufficient dietary fibre (Esmail, 1997) as important factors contributing to cannibalism.

The costs associated with cannibalism are also significant in barn and free-range systems. Mortality from cannibalism in some imported strains can be greater than 20% depending on the production system and management strategies. Because of the increasing community and market expectations for animal welfare standards there is a need to address the cannibalism problem in a cost-effective manner taking into account community concerns. The hot blade - method of beak-trimming has been used for many years as a standard method to prevent cannibalism (Glatz and Bourke, 2006) but the technique is coming under increasing scrutiny in Australia as well as overseas. Therefore the development of alternatives to beak trimming and re-trimming needs to be given high priority as critics of animal interventions become more vocal and antagonistic. These alternatives have not been fully evaluated but what is known is now examined.

Alternatives to beak trimming

Lighting

In Australia Parkinson (2005) reported complete control of cannibalism and feather pecking by rearing birds from 1-16 weeks at light intensities of 5 lux. The only light provided was through natural daylight passing into the shed through fan cowlings. The precise threshold of light intensity required to achieve the control of pecking and cannibalism is not clear but is believed to be about 5-10 lux. The effective control of feather pecking and cannibalism in young pullets appears to have produced persistent long-term control of cannibalistic behaviours.

Repellents

A range of predator scents (e.g. tiger, lion, fox, leopard and dingo) from faeces; urine, scent glands and saliva are being increasingly used to act as repellents against predators of ruminant species. There has been little investigation of the use of such repellents in poultry but the potential application in suppressing feather pecking appears large. In addition aversive chemicals, species-specific alarm pheromones and ultrasound could all be useful repellents of pecking and cannibalism. The probability of success of the repellent is considered to be high as literature indicates that a variety of repellents based on predator odours have deterred foraging by animals (Beecham, and Farnsworth, 1999; Elgar, 1989; Hoefs *et al*., 1986; Nolte, *et al*., 1993; Nolte, *et al*., 1994; Provenza, 1996; Speed, 2000 and Weldon *et al*., 1993). The unknown is how the repellents may effect other social interactions.

Aversion training appears not to have been previously attempted in hens but has been shown to be effective as a means to reducing consumption of foods normally consumed by birds. For example crows exposed to coloured eggs containing lithium chloride (induces nausea) have been shown to avoid these eggs when given a choice of coloured and white eggs (Nicolaus *et al*., 1983, Dimmick and Nicolaus, 1990). This approach can probably be taken a step further by aversion training for colour, taste and odour of blood although the concept does not appear to have been tried experimentally. Similar concepts were suggested by Jones and Roper (1997) in their review on olfaction in birds. It may be that a desired aversion can be established in chicks. Birds as young as 2-3 days have been made averse to citrus smell (Turro *et al*., 1994)

Environmental Enrichment

Claims are made that the provision of string enrichment devices will eradicate the propensity to feather peck and thereby eliminate the need for beak trimming (Jones and Ruschak, 2002). In Australia, Renz and Walkden-Brown (2007) found that a string enrichment device reduced pecking in chicks. This form of enrichment is likely to sustain the birds' interest, to promote desirable 'natural behaviours' like exploration and foraging, to potentially reduce boredom, and to significantly reduce the expression of feather pecking as well as the amount of pecking-related feather damage. String has the added advantages of low cost, durability and ready availability. Its beneficial effects are considered unlikely to be constrained by genotype or housing system. String enrichment devices are now being used routinely at a number of farms in Europe (Jones, 2005).

Surveys in Europe have shown that increases in pecking is related to poor litter condition. A number of authors have suggested that feather pecking and subsequently cannibalism in poultry may be considered as redirected ground pecking, based on strong similarities in the performance of both behaviours. Blokhuis and Wiepkema (1998) report the main strategy to prevent feather pecking is to provide an adequate substrate. Substrate conditions during the rearing period affect the development of feather pecking and the use of scratch grain is recommended. During the rearing period Gleaves (1999) recommended the location of semi sold milk or whey blocks around the house, hanging green leafy vegetables and spreading grass clippings to prevent feather pecking. An alternative approach is to use scratching trays in the shed and provide high fibre grain to encourage more forage related activities in birds.

There is potential to improve the ranging ability of birds in free-range systems and get the birds out of the shed (where they tend to feather peck) by using shelterbelts, crop rotations (Miao *et al*., 2006), shade and sand baths. Improving the attractiveness of the range for birds is therefore an important aspect to investigate. Currently many range areas are just fenced open fields with hardly any cover. This does not allow the hen the opportunity to seek shelter from weather or predators, or make the free range area stimulating for the birds to use (Hegelund *et al.*, 2002).

Studies have shown that there is a positive relationship between the availability of cover and the % of birds in the range (Zeltner and Hirt, 2003; Hegelund *et al.*, 2002). Trees provide an area where birds can dust bathe (Dawkins *et al.*, 2003), and seek shade and protection from predators. More birds use the range area when cloud cover is prevalent (Hegelund *et al*., 2002). The use of the range decreases as the flock size increases. A greater % of the birds use the range in small flocks compared to larger flocks (Hegelund *et al.*, 2002; Hirt *et al*., 2000). Hens in the range usually remain close to the poultry house (Fujrmetz *et al.*, (2005) and leave the area denuded of forage. However, when trees or shrubs or shaded areas are provided about 75% of hens in larger flocks will use the range (Bestman and Wagenaar, 2003). Nevertheless poor use of the range by hens remains a major issue in all free range systems. Birds are unable to hide from predators if there is no overhead protection provided by trees or other shaded areas.

Work from the EU therefore suggests that the free range area needs to enriched by providing trees and shaded areas (Zeltner and Hirt, 2003; Nicol *et al*., 2003; Bestman and Wagenaar, 2003). This enrichment with shade and shelter and providing a variety of these facilities enables birds to meet their behavioral needs. The risk of feather pecking is reduced, when the hens used the free range more frequently (Nicol *et al*., 2003; Bestman and Wagenaar, 2003) particularly when the range has trees and man made shade areas provided. Even though feather pecking is reduced when the hens use the free range frequently, feather pecking remains a serious problem on free range farms (Bestman and Wagenaar, 2003; Bestman and Wagenaar, 2006). Reduced feather pecking occurs when birds are reared in the same facility, stocking density is low, high quality litter is used and perches are provided (Bestman and Wagenaar, 2003; Bestman and Wagenaar, 2006; Knierim *et al*., 2008).

Nutrition

An adequate amount of insoluble fibre in the diet appears to be important for minimising the outbreak of cannibalism in chickens. Millrun, oat hulls, rice hulls and lucerne meal are effective sources of fibre. It has been suggested that the physical properties of the fibre, modulate the function of the gizzard, giving the birds a calm feeling. In addition it has been suggested that the increased rate of digesta passage, increases hunger and results in birds spending more time eating and less time pecking (Choct and Hartini, 2005).

Elwinger *et al*. (2008) selected a genotype over 25 generations on low protein diets based on home grown feedstuffs. This experimental genotype was compared with two commercial hybrids on different diets. Cannibalism and feather pecking occurred mostly in the low protein diet in commercial hybrids. These results indicate that the reliance on soya could be reduced and production could be based on diets with a higher proportion of home-grown protein crops (e.g. beans, peas, lupins and/or protein cake from oil crop) throughout Europe if another genotype or breed would be used.

Beak abrasives

Abrasive materials applied to the feed trough may enable the bird to blunt the hooked end of the beak while feeding and reduce the effectiveness of pecking. The beak blunting technique can be applied to growing pullets and during the laying period. Utilising the blunting procedure early in the rearing period may prevent the formation of the hooked end of the beak. The blunting technique may be continued throughout the laying period if required and consequently maybe effective in reducing the impact of pecking (Fiks-van Niekerk and Elson, 2005).

To our knowledge the alternatives to beak trimming mentioned above all have some potential to be effective in various management situations. The question of how a combination of these approaches may work is still to be evaluated.

Objectives

Reduce the need for beak trimming and retrimming by;

- Developed products that deter the onset of cannibalism and feather pecking in Australian production systems.
- Developed design principles of free-range systems that minimise cannibalism.

Results

Work conducted at SARDI

Shade trial

A total of 120 laying hens (Hyline Brown) were housed at 18 weeks in an eco-shelter (6m x 6m) located in the centre of a paddock with dimensions 66m x 66m. The eco-shelter had 6 internal pens of equal size (2m x 3m) with a free range area (726m^2) adjoining the shelter. Hens were provided feeders, drinkers, nest boxes and perches in each pen but no artificial light. Layers were randomly allocated into 6 groups of 20 birds. There were 2 treatments provided in the range, shade vs. no shade, with each treatment replicated 3 times. The control hens were not provided outdoor shade while the treatment hens were provided a shaded area (3m x 2m x 1m= l x b x h) fitted with shade cloth located 10 m and 20 m from the shed. Over the late summer period from 32-40 weeks hens were allowed access to the range and measurements were made daily for egg production, weekly for egg weight and four weekly for feather score. All birds were fed *ad libitum* daily with a commercial diet (Barastoc Golden Yolk) which contained 15.0% crude protein. Water was available *ad libitum*.

There was little forage available for birds due to prevailing drought conditions in South Australia. Video records were made of hens from each of the replicates using the shade or in the range for a 1h period in the morning and afternoon at 38 weeks when average maximum temperature was 27.5^{0}C. A total of 12h of video tape was assessed. Data were analysed using ANOVA in the Systat software.

There was no significant (P>0.05) difference in feather condition of birds provided shade or given no shade (Figure 1). Poor feather condition was observed at the base of the tail and vent of all birds irrespective of whether they were provided shade or no shade.

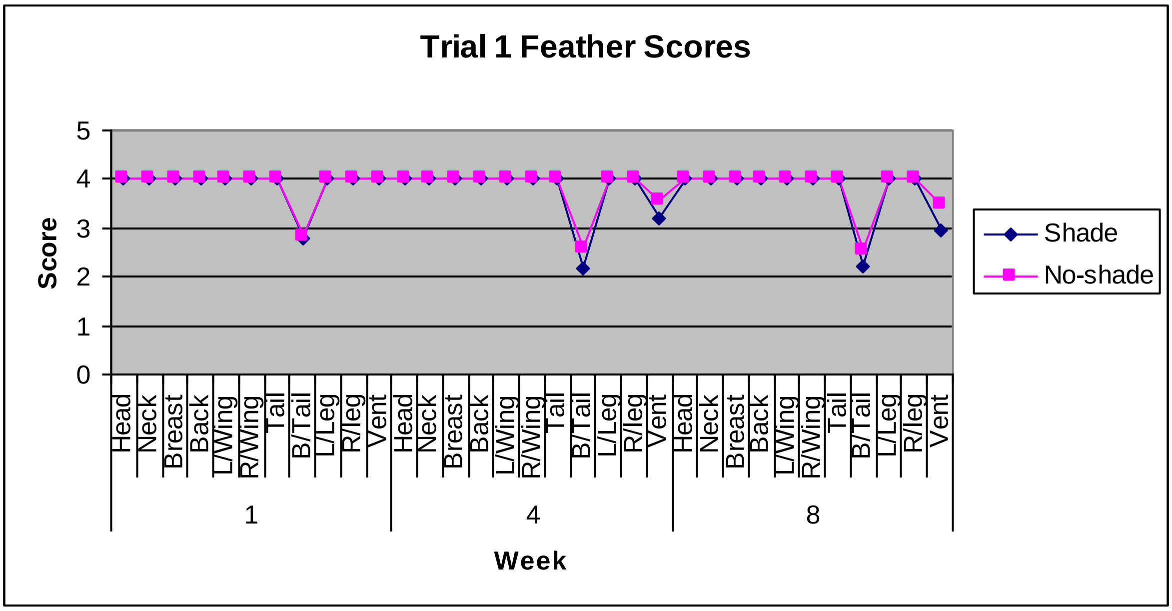


Figure 1: The feather scores of different body parts of birds provided shade or no shade in the range.

The weight of birds was similar whether they were provided shade or no shade (Table 1). Likewise there was no significant (P>0.05) difference in egg weight between the treatments (Table 2). However, there was a significantly higher (P<0.01) rate of lay for birds not provided shade in the first week but this was not observed for the remainder of the trial and is therefore considered to be of little importance in the outcomes of the trial (Table 2).

Table 1. Bird weight of birds provided shade or no shade

Week	Shade	No-shade	*P value*	*SEM*
1	1.78	1.80	*0.157*	*0.008*
4	1.81	1.90	*0.138*	*0.031*
8	1.87	1.86	*0.886*	*0.024*

Table 2. Egg weight and rate of lay of birds provided shade or no shade.

Week	Treatment	Rate of lay (%)	Egg wt (g)
1	Shade	85.2	60.0
	No-shade	96.3	59.3
	P	*0.007*	*0.178*
	SEM	*2.656*	*0.253*
2	Shade	86.3	59.7
	No-shade	95.3	58.9
	P	*0.155*	*0.326*
	SEM	*3.067*	*0.391*
3	Shade	87.2	60.1
	No-shade	86.6	59.5
	P	*0.920*	*0.483*
	SEM	*2.368*	*0.381*
4	Shade	84.2	61.9
	No-shade	87.7	60.4
	P	*0.671*	*0.064*
	SEM	*3.584*	*0.403*
5	Shade	87.5	62.2
	No-shade	88.0	62.5
	P	*0.923*	*0.713*
	SEM	*2.060*	*0.339*
6	Shade	86.4	63.3
	No-shade	93.0	61.6
	P	*0.072*	*0.136*
	SEM	*1.908*	*0.556*
7	Shade	89.1	63.3
	No-shade	90.5	62.9
	P	*0.709*	*0.625*
	SEM	*1.533*	*0.339*
8	Shade	88.3	62.8
	No-shade	86.6	62.6
	P	*0.802*	*0.839*
	SEM	*2.889*	*0.445*

In the morning shaded areas were visited by 18.6% of the hens (Table 3) with a tendency (P=0.07) for more hens to be in the paddock (Table 4); 43% for paddocks with shade compared to 25% for the paddocks with no shade provided. In the afternoon there were no difference between treatments for hens that used the range (30% for shade treatment vs. 40% no shade; P=0.49). Only 11% of hens used the shade in the afternoon (Table 3, Figure 5). There was no significant difference (P=0.22) for % of hens in the shade 10m from the shelter vs. those 20m from the shelter (Table 5). The provision of shaded areas in the free range attracted some additional hens into the range but other attractants are needed to encourage more hens into the paddocks, particularly during the summer season.

Table 3. The percentage of birds in the shelter, in the range, using the shade and not in the shade for the shade and no shade treatments.

Treatment	Time of day	Birds in range (%)	Birds in shade (%)	Birds not in shelter (%)	Birds in shelter (%)
Shade	Morning	43.2	18.6	61.8	38.2
	Afternoon	30.7	11.1	41.9	58.1
	P	*0.362*	*0.268*	*0.302*	*0.302*
	SEM	*6.509*	*3.247*	*9.244*	*9.244*
No-shade	Morning	24.7	-	-	75.3
	Afternoon	40.2	-	-	59.8
	P	*0.133*	-	-	*0.133*
	SEM	*5.078*	-	-	*5.078*

Table 4. The percentage of birds in range between treatments in the morning or afternoon.

Time	Treatment	Birds in range (%)
Morning	Shade	43.2
	No-shade	24.7
	P	*0.074*
	SEM	*8.380*
Afternoon	Shade	30.7
	No-shade	40.2
	P	*0.490*
	SEM	*6.449*

Table 5. The percentage of birds within 10-metres and 20-metres of the shelter in the morning or afternoon for birds provided shade.

Time	Distance from shelter (m)	Birds in shade (%)
Morning	10	12.3
	20	6.3
	P	*0.226*
	SEM	*2.39*
Afternoon	10	7.6
	20	3.6
	P	*0.380*
	SEM	*2.14*

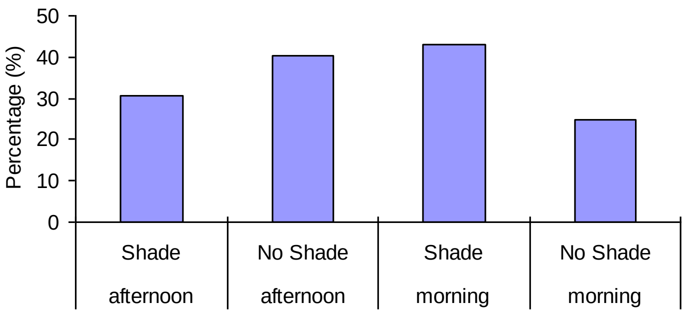


Figure 2: Percentage of birds in the range for birds in the shade or no shade treatments.

Forage Trial

The SARDI forage trial used a total of 120 laying hens (Hyline Brown) housed in an eco-shelter which had 6 internal pens of equal size (2m x 3m) with a free range area (726m^2) adjoining the shelter. Hens were provided feeders, drinkers, nest boxes and perches in each pen but no artificial light. There were 3 treatments provided in the range, no pasture (control); vetch pasture and wheat pasture. Over the period 58-70 weeks of age birds were allowed access to the range and measurements were made on production, feather score and percentage of birds foraging. No difference in feather cover of the treatment groups was observed (Figure 3). The first SARDI shade trial observed poor feather condition at the base of the tail and vent of all birds. This finding was also shown in the forage treatment. In addition the feather score for the left and right legs for all treatments was poor toward the end of the trial (Figure 3).

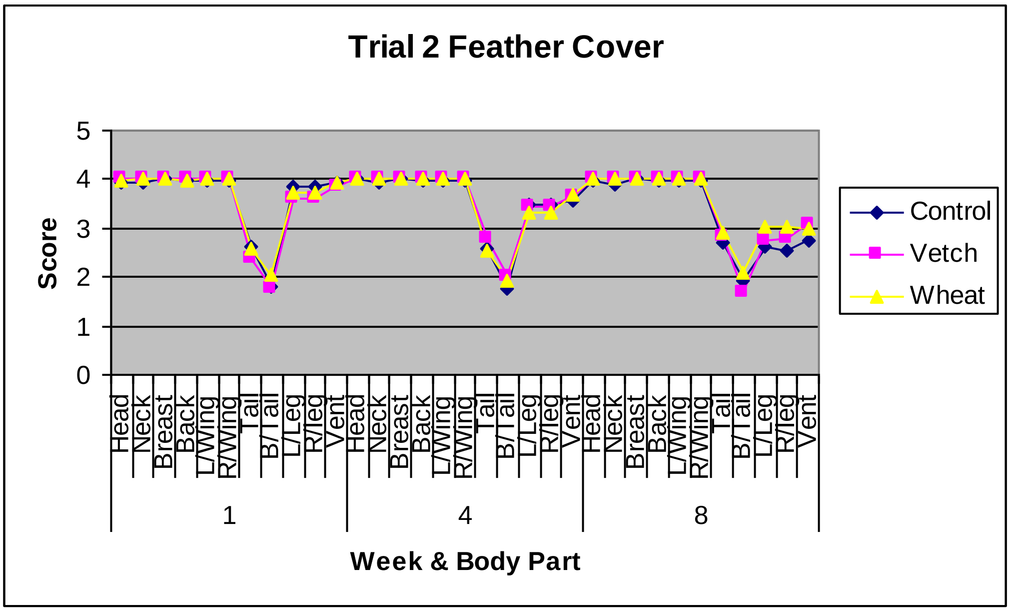


Figure 3: The feather scores of birds provided no pasture (control); vetch pasture and wheat pasture.

Live weight of birds was similar for all forage treatments during the experimental period (Table 6). There was a significant difference (P<0.05) in rate of lay for the control group (76.7%) compared to the vetch (83.9%) and wheat (84.3%) group. This finding was due to the presence of a few non layers in the control group. The difference in performance is not considered to be due to availability of forage (Table 7). Egg weight was heavier (P<0.05) from the hens feeding on vetch compared to control group and birds foraging on wheat (Table 7) presumably due to the additional protein consumed by birds from the vetch which is a legume.

Table 6. Live weight of birds provided no pasture (control); vetch pasture and wheat pasture.

Week	Control	Vetch	Wheat	*P value*	*SEM*
1	1.97	1.97	1.92	*0.654*	*0.020*
4	1.94	1.96	1.96	*0.802*	*0.013*
8	1.95	1.96	1.91	*0.605*	*0.016*

Table 7. Egg weight and rate of lay of birds provided no pasture (control); vetch pasture and wheat pasture.

Treatment	Rate of lay (%)	Egg wt (g)
Control	76.7a	64.6b
Vetch	83.9b	65.8a
Wheat	84.3b	64.4b
P	0.000	0.016
SEM	0.907	0.230

When weekly data (Table 8) was analysed for rate of lay and egg weight the differences in rate of lay in particular were only observed early in the trial and in the final week. As mentioned this is due to the presence of a few non layers in the control group. In this trial the variability in egg production over 58-70 weeks is largely due to the small numbers of birds and the low number of replicates used in the trial.

Table 8. Egg weight and rate of lay of birds provided no pasture (control); vetch pasture and wheat pasture.

Week	Treatment	Lay (%)	Egg wt (g)
1	Control	74.9a	63.6
	Vetch	84.2b	62.9
	Wheat	75.9a	64.1
	P	*0.045*	*0.529*
	SEM	*1.992*	*0.365*
2	Control	73.4	64.1
	Vetch	83.7	66.9
	Wheat	82.3	64.9
	P	*0.298*	*0.221*
	SEM	*2.748*	*0.659*
3	Control	75.9	64.2
	Vetch	82.4	66.6
	Wheat	85.7	64.7
	P	*0.373*	*0.405*
	SEM	*2.614*	*0.689*
4	Control	81.1	64.4
	Vetch	83.1	65.2
	Wheat	86.1	64.7
	P	*0.892*	*0.739*
	SEM	*3.402*	*0.329*
5	Control	72.2	63.4
	Vetch	83.6	66.4
	Wheat	81.2	66.8
	P	*0.135*	*0.439*
	SEM	*2.542*	*0.864*
6	Control	78.4	64.6
	Vetch	81.7	65.6
	Wheat	84.2	63.4
	P	*0.412*	*0.440*
	SEM	*1.598*	*0.623*
7	Control	80.3	66.3
	Vetch	90.4	66.7
	Wheat	89.1	65.0
	P	*0.275*	*0.593*
	SEM	*2.628*	*0.602*
8	Control	77.2a	65.9
	Vetch	82.3a	66.4
	Wheat	89.9b	63.5
	P	*0.019*	*0.323*
	SEM	*2.417*	*0.786*

There was a significant interaction (treatment x time of day) for percentage of birds in range (Table 9). The percentage of control birds in range was greater (54%) in morning than the afternoon (30%) while for the pasture treatments about 45% if the birds were in the range both during the morning and afternoon (Table 9, Figure 4 and 5). A higher percentage of birds ranged within 20m of the shelter in the morning compared to in the afternoon (Table 9).

Table 9. The percentage of birds in the range and 10m and 20 m from shelter for birds provided no pasture (control); vetch pasture and wheat pasture.

Time of day	Treatment	Birds in range (%)	10m from shelter (%)	20m from shelter (%)
Morning	Control	53.6±0.006	16.7±2.184	36.9±2.190
	Vetch	47.4±2.957	24.2±3.522	22.9±6.176
	Wheat	45.2±2.328	23.4±3.340	22.1±0.810
Afternoon	Control	30.6±2.146	20.9±3.817	14.8±1.885
	Vetch	40.3±2.656	26.6±4.753	13.5±7.196
	Wheat	47.1±4.150	20.0±1.417	27.0±2.733
Source of variation		*P value*	*P value*	*P value*
Time		0.005	0.849	0.042
Treatment		0.377	0.091	0.233
Time x Treatment		0.010	0.705	0.049

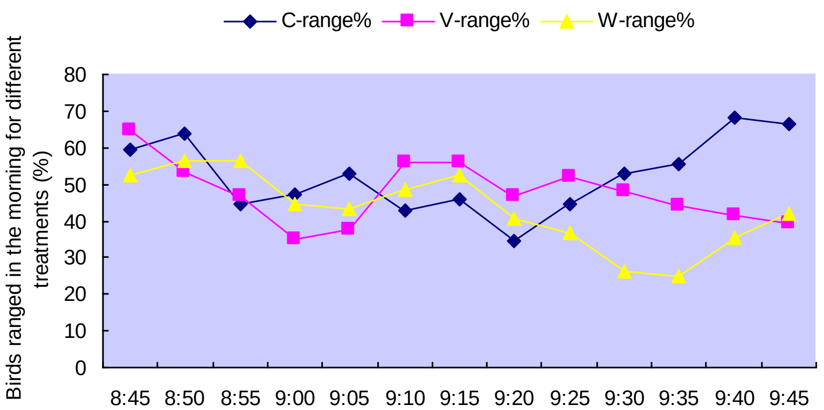


Figure 4: The % of birds in the range in the morning for birds provided no pasture (c), vetch (v) and wheat (w) pasture

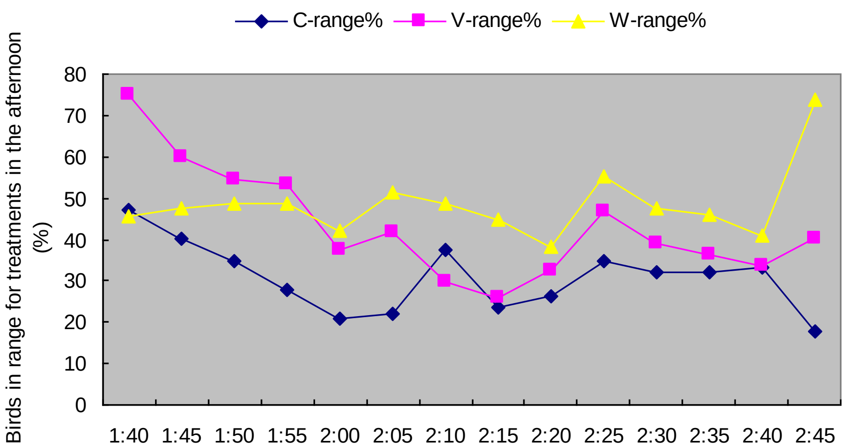


Figure 5: The % of birds in the range in the afternoon for birds provided no pasture (c), vetch (v) and wheat (w) pasture

Shelter Belt Trial

The third trial at SARDI was undertaken to examine the role of shelterbelts in reducing feather pecking behaviour by attracting hens into the range. A total of 120 Hyline Brown hens were housed at 17 weeks in an eco-shelter which had 6 internal pens (20 birds/pen) of equal size (2m x 3m) and a free range area (726m^2) adjoining each pen. There were feeders, drinkers, nest boxes and perches in each pen but no artificial light. Two treatments were examined; a shelterbelt vs. no shelterbelt replicated 3 times. The treatment hens were provided a shelterbelt 10m and 20m from the poultry house while the control hens only had access to a bare paddock. The shelterbelt consisted of a range of sizes of trees in pots [small (1m high), medium (2m high) and large (3m high)] as well as shrubs 1 m in height. Shelterbelts were established two weeks before the trial commenced. From 24 to 31 weeks the birds were allowed access to the range from 0800-1700 h. Measurements were made daily for egg production, fortnightly and monthly for feather score and body weight. Video recordings were made to assess the number of birds 10m and 20m from the house. There was no significant (P>0.05) effect on liveweight, feather score (Table 10), egg weight (Table 11) and rate of lay (Table 12) of hens whether they were provided shelterbelts or no shelterbelts in the range.

Table 10. Live weight and feather score of birds provided a shelter belt or no shelter belt in the range

Week	Treatment	Control	Tree	*P value*	*SEM*
1	Bird weight	1.456	1.457	*0.139*	*0.006*
	Head	4	4	-	-
	Neck	4	4	-	-
	Breast	4	4	-	-
	Back	4	4	-	-
	L/Wing	4	4	-	-
	R/Wing	4	4	-	-
	Tail	4	4	-	-
	B/Tail	4	4	-	-
	L/Leg	4	4	-	-
	R/leg	4	4	-	-
	Vent	4	4	-	-
4	Bird weight	1.704	1.729	*0.275*	*0.010*
	Head	4	4	-	-
	Neck	4	4	-	-
	Breast	4	4	-	-
	Back	4	4	-	-
	L/Wing	4	4	-	-
	R/Wing	4	4	-	-
	Tail	4	4	-	-
	B/Tail	4	4	-	-
	L/Leg	4	4	-	-
	R/leg	4	4	-	-
	Vent	4	4	-	-
8	Bird weight	1.880	1.887	*0.665*	*0.007*
	Head	4	4	-	-
	Neck	4	4	-	-
	Breast	4	4	-	-
	Back	4	4	-	-
	L/Wing	4	4	-	-
	R/Wing	4	4	-	-
	Tail	3.583	3.867	*0.331*	*0.131*
	B/Tail	4	4	-	-
	L/Leg	4	4	-	-
	R/leg	4	4	-	-
	Vent	4	4	-	-

Table 11. Egg weight of hens provided a shelter belt or no shelter belt in the range

Week	Treatment	Egg wt (g)
1	Control	56.175
	Shelter Belt	57.527
	P	*0.567*
	SEM	*0.611*
3	Control	61.400
	Shelter Belt	61.127
	P	*0.591*
	SEM	*0.127*
5	Control	60.994
	Shelter Belt	62.021
	P	*0.072*
	SEM	*0.297*
7	Control	62.801
	Shelter Belt	63.219
	P	*0.554*
	SEM	*0.304*

Table 12. Rate of lay of hens provided a shelter belt or no shelter belt in the range

Weeks	Treatment	Lay (%)
1	Control	9.286
	Shelter Belt	9.524
	P	*0.951*
	SEM	*1.644*
2	Control	31.667
	Shelter Belt	26.667
	P	*0.228*
	SEM	*1.929*
3	Control	52.143
	Shelter Belt	55.714
	P	*0.711*
	SEM	*4.086*
4	Control	67.857
	Shelter Belt	73.333
	P	*0.408*
	SEM	*2.918*
5-8	Control	80.238
	Shelter Belt	82.619
	P	*0.730*
	SEM	*2.922*

There was a significantly ($P<0.05$) higher percentage of birds in the range when provided a shelterbelt compared to no shelterbelt and this was consistent for the morning and the afternoon (Table 13). The number of birds 20m from the shelter was higher (although not significant, $P=0.12$) for birds provided a shelter belt compared to no shelter belt.

Table 13. The percentage of birds in range when provided a shelter belt or no shelter belt in the range

Time	Treatment	Birds in range (%)	10m from shelter (%)	20 m from shelter (%)
Morning	Control	22.115	46.020	20.530
	Shelter Belt	40.833	47.468	40.994
Afternoon	Control	27.628	45.999	29.184

	Shelter Belt	45.385	38.572	45.189
Source of variation		*P value*	*P value*	*P value*
Time		0.569	0.526	0.576
Treatment		0.049	0.670	0.122
Time x Treatment		0.956	0.528	0.846
Time of day				
Morning		31.474	46.744	30.762
Afternoon		36.506	42.285	37.186
P value		*0.588*	*0.512*	*0.581*
SEM		*4.502*	*3.302*	*5.645*
Treatment				
Control		24.872	46.010	24.857
Shelter Belt		43.109	43.020	43.091
P value		*0.040*	*0.661*	*0.108*
SEM		*4.502*	*3.302*	*5.645*

On-farm low light rearing trial

The feather condition and mortality of 1000 layer chicks not trimmed were compared at 6 weekly intervals to 1000 infrared trimmed birds housed at a light intensity of 10 lux in a commercial cage rearing facility in Young, New South Wales. Feather pecking commenced in the non trimmed birds at about 40 days of age with 7 birds removed from the trial rearing cages due to pecking damage around the base of the tail. The farm manager continued with the trial but feather pecking persisted and the trial was abandoned when the birds reached 16 weeks of age.

General Discussion- SARDI trials

Aggressive feather pecking was only observed on a few occasions in all of the SARDI trials. However it was clear that enriching the free range environment attracted birds into the range. For examples shaded areas were used by hens with a tendency for out door shade to attract more birds into other areas of the paddock. When forage was provided in paddocks, there was a significant interaction (treatment x time of day) for percentage of birds using the paddocks. More control birds were observed in the range in morning than the afternoon while for the pasture treatments a similar % of the birds were in the range both the morning and afternoon. Control birds explored the range in the morning to access a food source given no forage was provided near the house. Clearly forage availability has an impact on the percentage of birds using the range during the day.

When shelterbelts were provided there were a significantly higher percentage of birds in the range and greater numbers of birds were observed in areas further away from the poultry house. These findings support the work of Hegelund et al. (2002) who observed the number of birds visiting the outdoor range depends on the type of outdoor enrichment birds are provided. Zeltner and Hirt (2008) tried to determine the characteristics of enrichment facilities in the range which could encourage more hens into the range as well as improve the distribution of the hens. They found that hens not provided any overhead protection (trees, bushes, and artificial structures) are less likely to use the free range area. However, free range paddocks that are provided with a large variety of enrichment facilities appear to encourage more frequent use of these facilities. Hens prefer ranging in areas with trees and will either stay close to the house or seek tree cover. This supports the current findings where a greater number of birds ranged outside when provided shade or shelter belts. The lack of aggression of the birds in the SARDI trial is likely due to the small flock size. However in larger operations there is no guarantee that there would be an outbreak of feather pecking and cannibalism even when the environment is enriched.

Work conducted by QPIF

Shadecloth Trial

A total of 6800 hens (age range 22–52 weeks) were housed in 3 sheds and had access to shade in the range area with, 6700 hens (age range 22–54 weeks) housed in 3 sheds without access to shade. The shade areas were of differing sizes depending on the size of the flock in the shed and were 30m and 60m out from the shed (figures 6, 7 and 8).

Figure 6: Shadecloth 30 m out from shed (2800 birds – each shade size 35m^2).

Figure 7: Shadecloth 30m and 60m out from shed (2800 birds – each shade size 35m^2).

Figure 8: Shadecloth 30m and 60 m out from shed (1200 birds – each shade size 20m^2).

Areas of the same size were pegged out in the range areas of the sheds without shade (figures 4 and 5).

Figure 9: 35m^2 area pegged out 30m out from shed housing 2600 birds.

Figure 10: Area 30m out from shed housing 2900 birds, looking from area 60m out from shed.

Over a 12 week period through winter, feather scores and bird weights were measured in each of the sheds (0, 8 and 12 weeks – 2% of the flock total in each shed, figures 11 and 12). Feather scores were as per methodology by Tauson *et al.* (2005) which is a 4 point scale (1 = worst, 4 = best). Birds were weighed in a funnel attached to a digital scale (Nuweigh JAC101, e=0.01kg max=50kg).

Cameras were set up at each site (2 per shed giving 1 per shadecloth/non shadecloth area) recording daily the use of the shade and non-shade areas. The cameras recorded from 9am-10am and 2pm-3pm every day giving 16 photos per shed per day (figures 13, 14, 15 and 16).

Figure 11: Bird weighing.

Figure 12: Feather scoring.

Figure 13: Setting up cameras at each site.

Figure 14: Each shed had two cameras set on timers and one recorder recording onto a SD card.

Figure 15: The cameras were positioned approximately 5m out from the shadecloth area.

The temperature was recorded inside and outside of each group of 2 sheds (shadecloth vs no shadecloth) using a Tinyview Gemini Datalogger range -30°C to 50°C. Recordings were taken every hour the trial was in progress (figure 17).

Trends were looked at in the data using changes over time because of the different ages of the birds used.

Figure 16: One day of recording for one shed resulting in 16 photos.

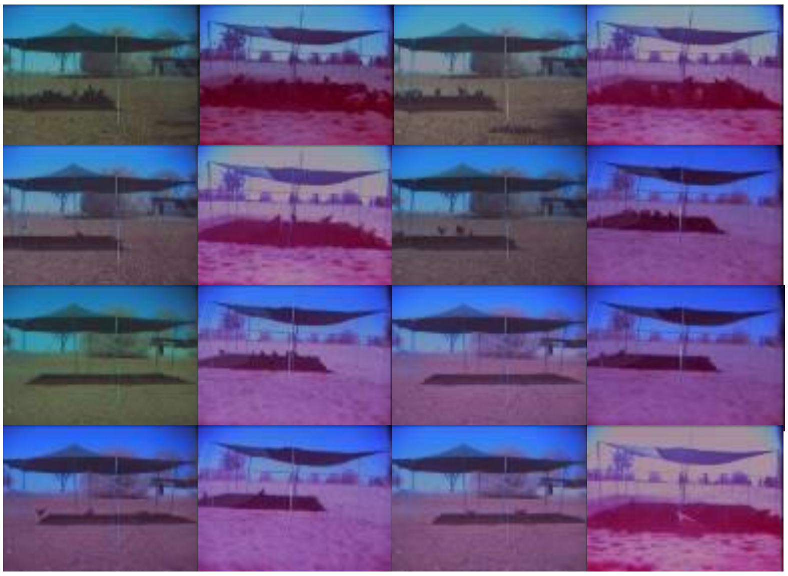


Figure 17: Tinyview temperature logger recording temperature outside of a shed with shadecloth in the range.

Results

Bird weight (figure 18), breast feather score, vent feather score and wing feather score was not affected over the trial period. Back, neck, tail and overall feather scores in both treatments showed a downward trend over the trial however again this was not significant (figures 19, 20 and 21). Regardless of the provision of shade in the range, birds showed reduced feather cover on the back and tail area.

The trend was for more birds to use the shaded areas in the range than the non shaded areas in the corresponding ranges (figure 22). Overall 3 times more hens used the shaded areas than the non shaded areas, with slightly more using the shade in the morning than the afternoon (figures 23 and 24).

Figure18: Effect of shade on change in bird weight over 12 weeks.

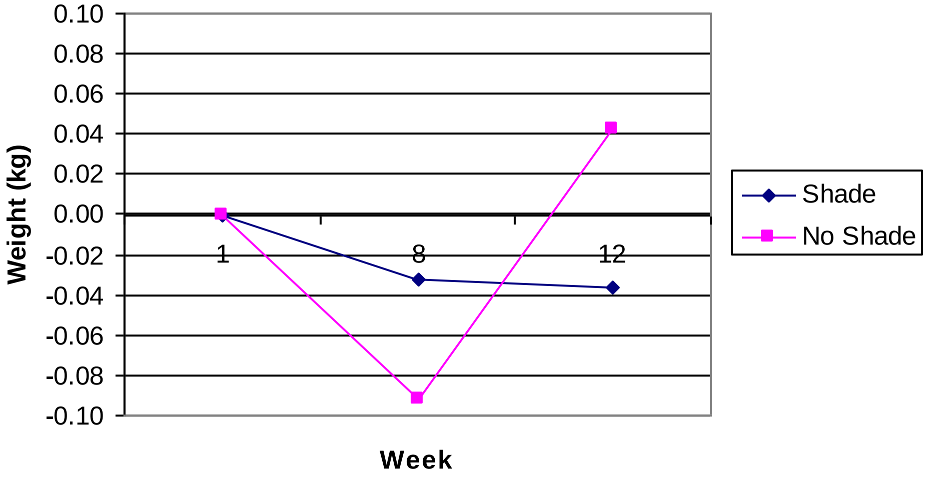


Figure 19: Effect of shade on change in (a) neck and (b) back feather score over 12 weeks.

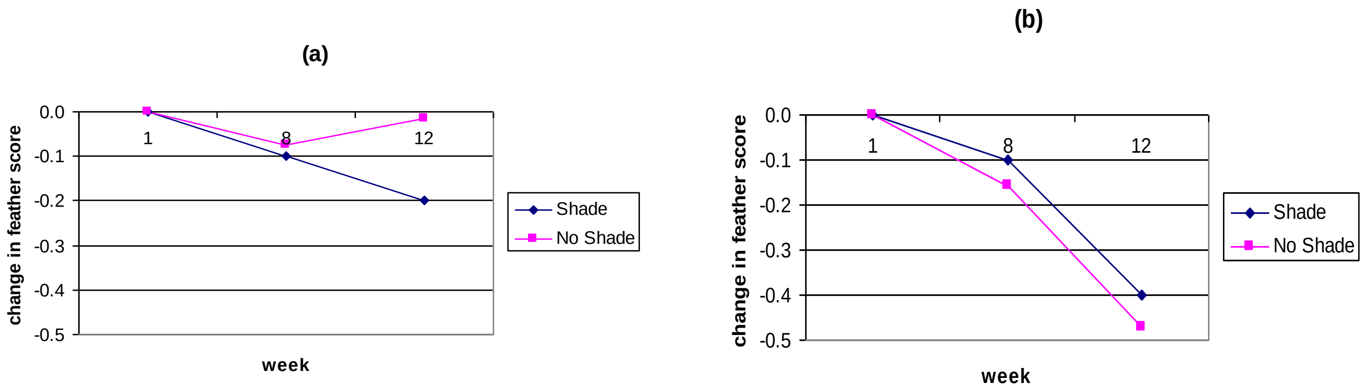


Figure 20: Effect of shade on change in tail feather score over 12 weeks.

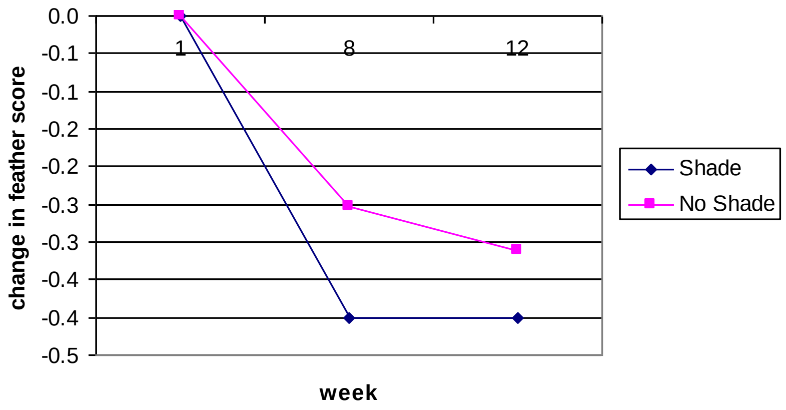


Figure 21: Effect of shade on change in average total feather score over 12 weeks.

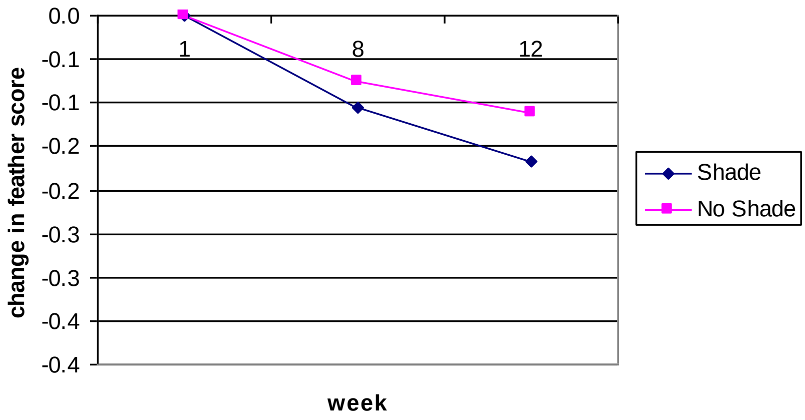


Figure 22: Average number of birds in shade and non shade areas over a day.

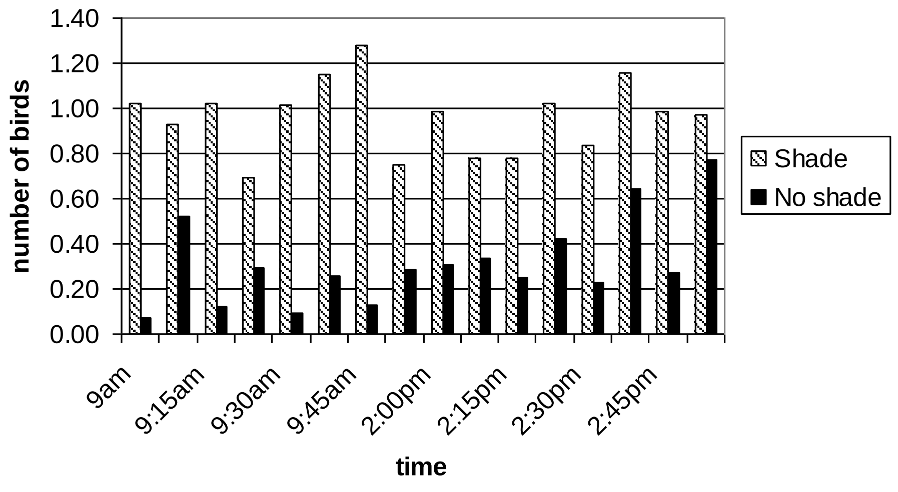


Figure 23: Average number of birds in shade and non shade areas between 9-10am.

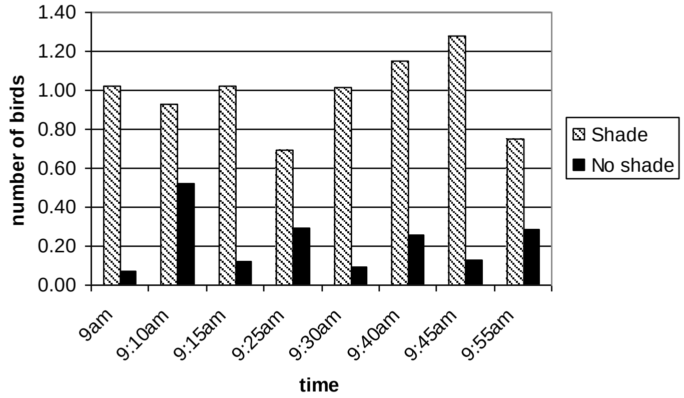
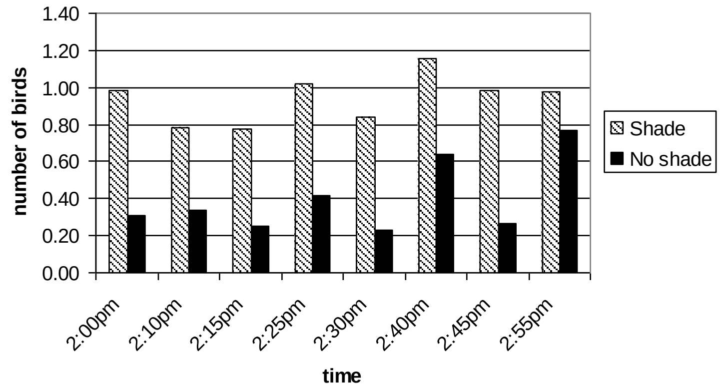


Figure 24: Average number of birds in shade and non shade areas between 2-3pm.



The temperature inside the sheds, and to a lesser extent in the range area, was positively correlated with the number of birds using the shaded area. As the temperature increased the number of birds using the shade also increased (figures 25 and 26).

Figure 25: Effect of temperature inside the shed on use of shaded and non shaded areas in the range.

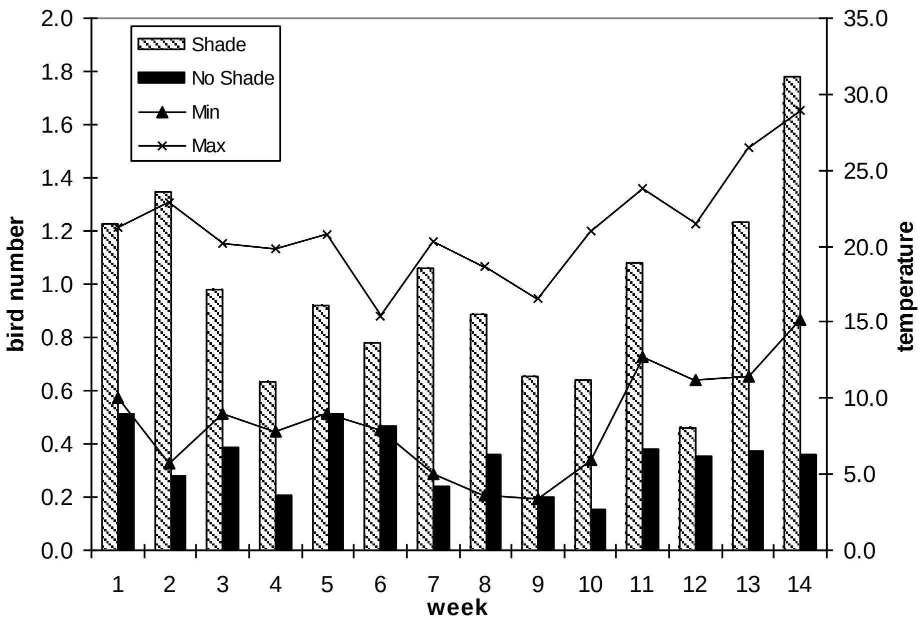
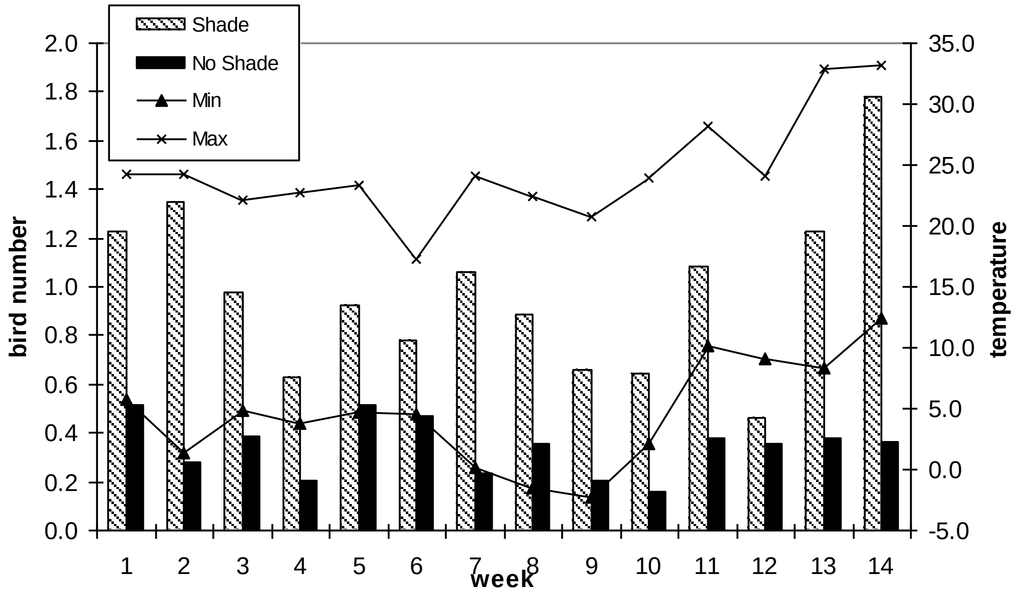


Figure 26: Effect of temperature in the range on use of the shaded and non shaded areas in the range.



Two sheds (one with outdoor shade and one without) continued to be monitored over the summer months to compare with the results received during the winter (above). The shed with an outdoor shadecloth shelter had 2300 hens (age 78.5 weeks), with 2500 hens (age 46.5 weeks) housed in a shed without access to shade. Shade and camera setup, feather score, bird weight and temperature recording were all the same as described previously, except for the time period being 15 weeks instead of 12.

Bird weight (figure 27) was not affected by access to shade over the trial period. Overall average feather score and individual bird part feather scores trended downwards over the summer period to a larger degree than in winter (figures 28 and 29). The trend over a summer day was for six times the number of birds to use the shaded area than the corresponding non shaded area (figure 30).

Figure 27: Effect of shade on change in bird weight over summer and winter.

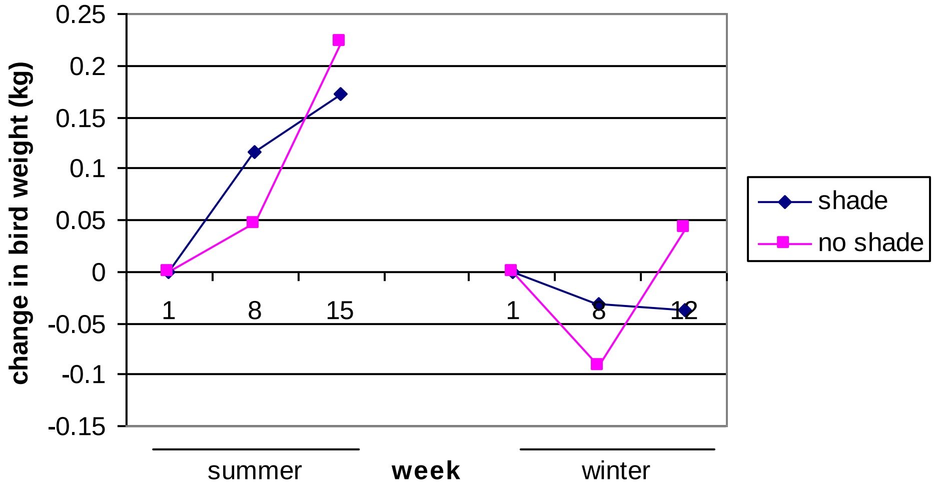


Figure 28: Effect of shade on change in average total feather score over summer and winter.

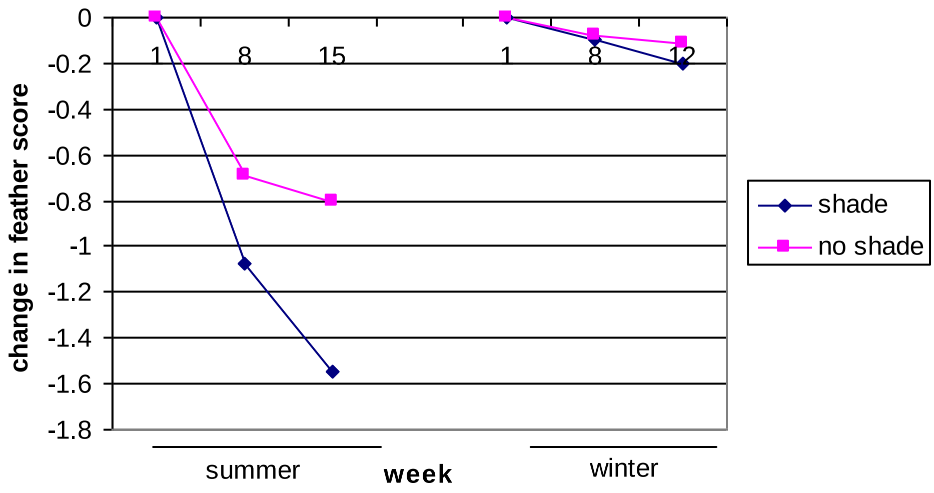


Figure 29: Effect of shade on change in feather score on neck, back, wing, breast, tail and breast over summer and winter (♦shade, ■ no shade).

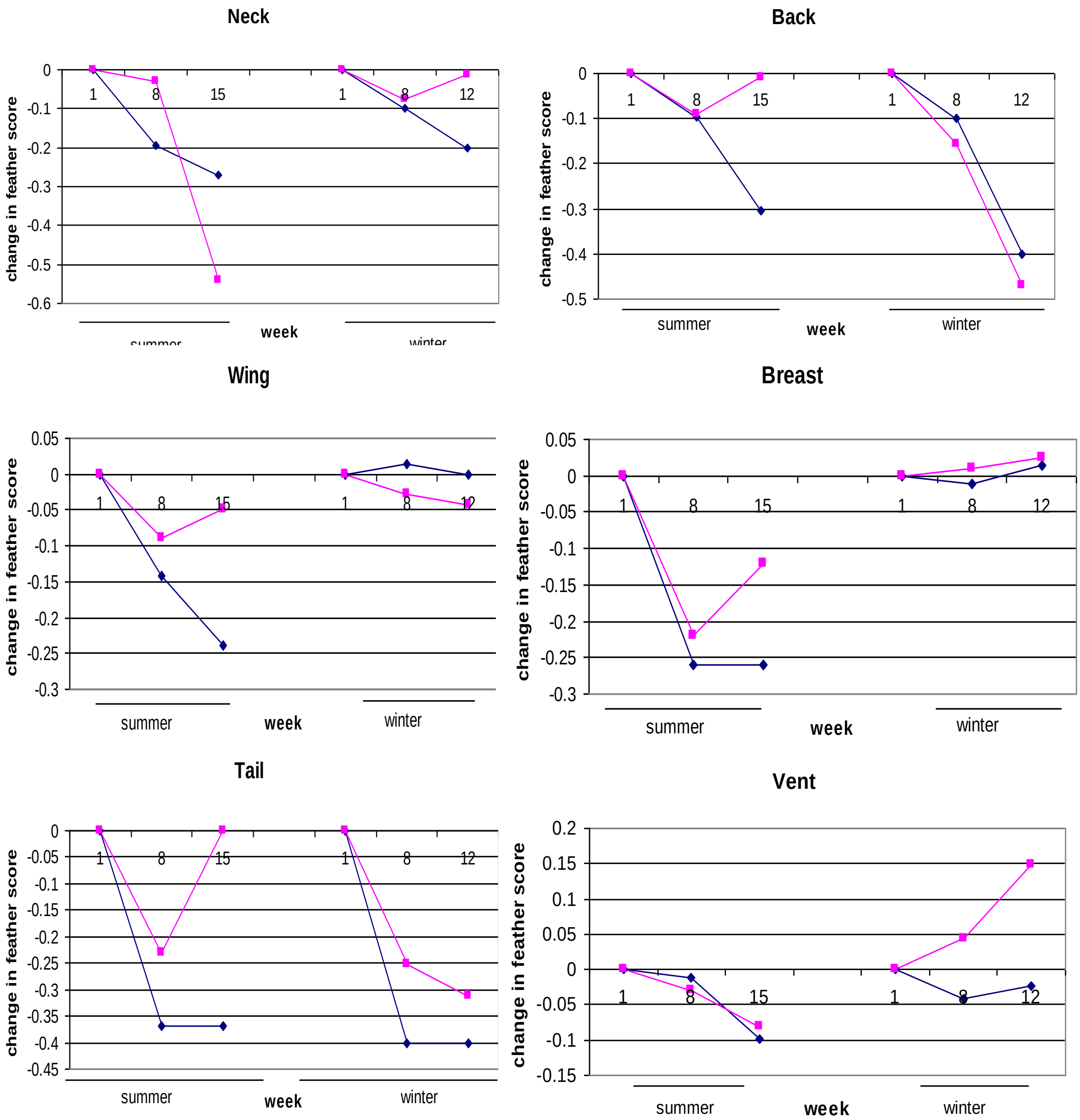
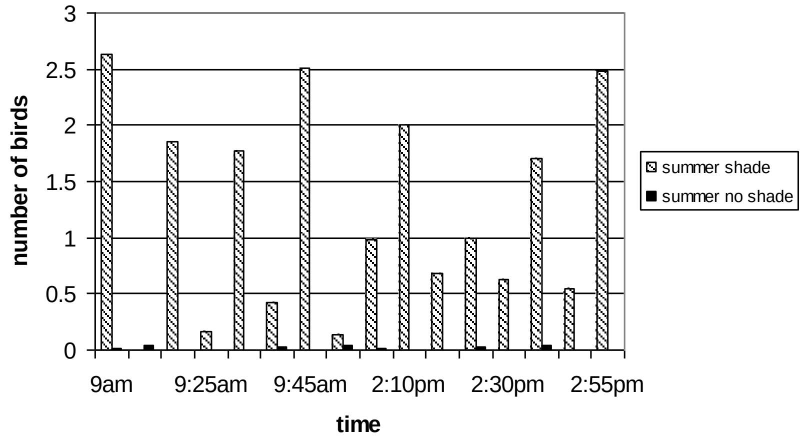
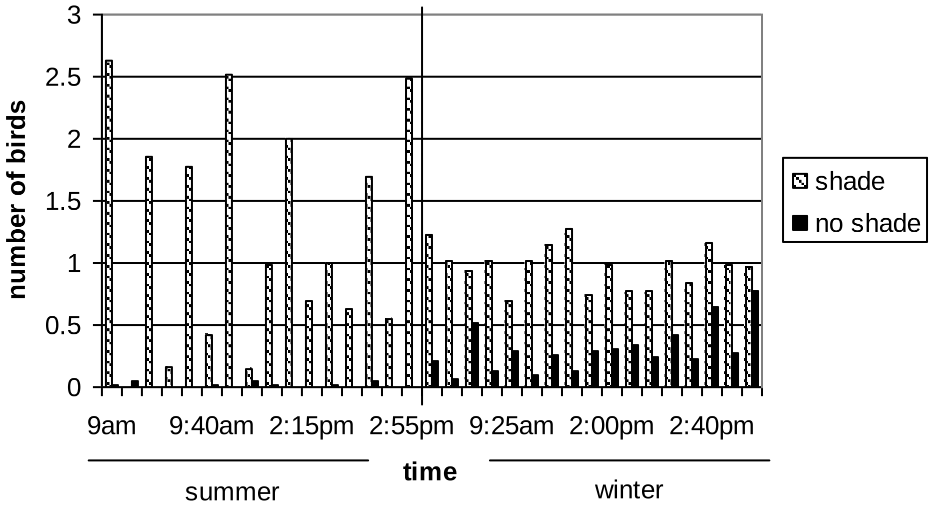


Figure 30: Average number of birds in the shade and non shade areas over a summer day.



More birds used the shaded areas in summer than winter, with very few birds using the non shaded areas in summer (figure 31).

Figure 31: Average number birds in shade and non shade areas over a summer and winter day.



Overall as the temperature inside the shed and on the range increased the number of birds in the shade areas increased through summer and winter (figures 32 and 33).

Figure 32: Effect of temperature inside the shed on use of shaded and non shaded areas in the range over summer and winter (nb. No data for shade weeks 4, 5, 6, 9, 10 and 11 in summer).

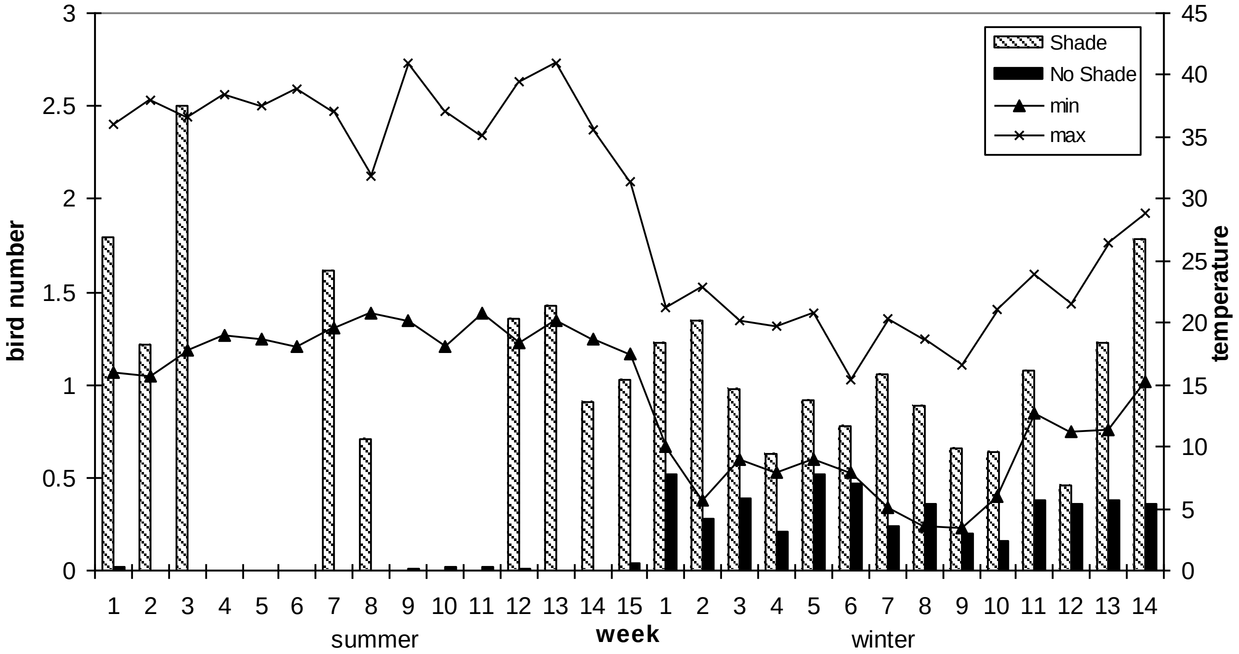
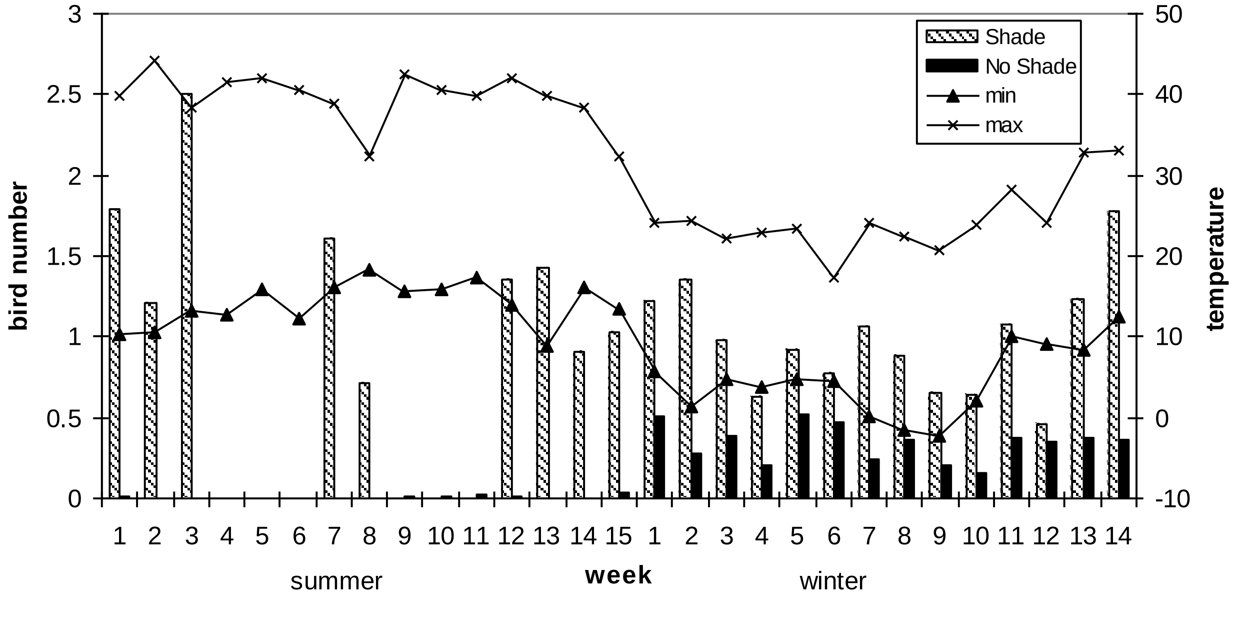


Figure 33: Effect of temperature in the range on use of shaded and non shaded areas in the range over summer and winter (nb. No data for shade weeks 4, 5, 6, 9, 10 and 11 in summer).



Shelterbelt trial

A total of 2000 hens (age range 43.5–73.5 weeks) were housed in 2 sheds and had access to shelterbelt shade in the range area with 3000 hens (age range 35.5 – 55 weeks) housed in 2 sheds without access to shelterbelt shade. The shade areas were of differing areas depending on the size of the flock in the shed and were 15m and 30m out from the shed (figures 34, 35 and 36).

Figure 34: Shelterbelt 15m out from shed.

Figure 35: 15 m² shelterbelt 30m out from shed.

Figure 36: Shelterbelt 15m and 30m out from shed.

Areas of the same size were pegged out in the range areas of the sheds without shelterbelts (figure 37 and 38).

Figure 37: 30 m^2 area pegged out 15m out from shed housing 2000 birds.

Figure 38: Area 15m and 30m out from shed housing 2000 birds.

Camera setup, feather score, bird weight and temperature recording were all the same as described previously for shadecloth trial, except for the time period being 15 weeks instead of 12. The trial was run over summer.

Results

Bird weight was not affected over the period of the trial, with overall feather score and individual bird part feather scores showing a downward trend over the 15 weeks (figure 38, 39 and 40). The trend was for more birds to use the shelterbelt areas in the range than the non shaded areas in the corresponding ranges. Overall 17 times more hens used the shelterbelt areas than the non shaded areas, with slightly more using the shelterbelts in the afternoon than the morning (figure 41).

Figure 39: Effect of shelterbelt shade on change in bird weight over 15 weeks.

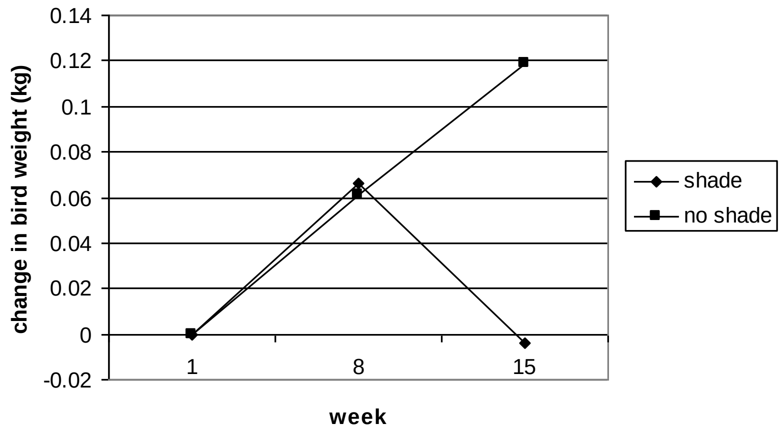


Figure 40: Effect of shelterbelt shade on change in average total feather score over 15 weeks.

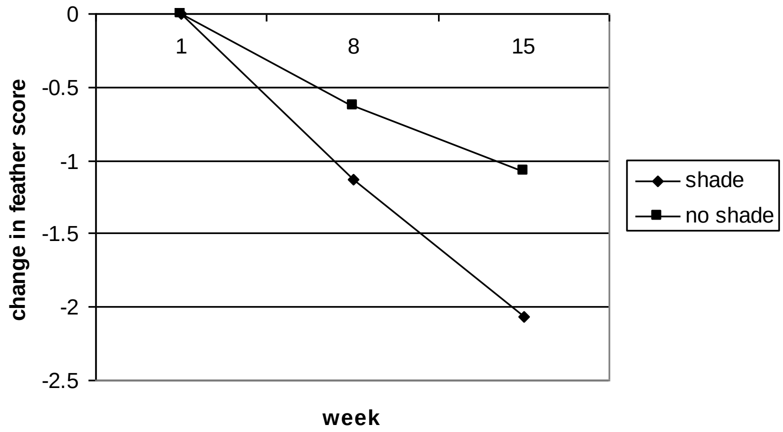


Figure 41: Effect of shelterbelt shade on change in feather score on neck, back, wing, breast, tail and breast over 15 weeks (♦shade, ■ no shade).

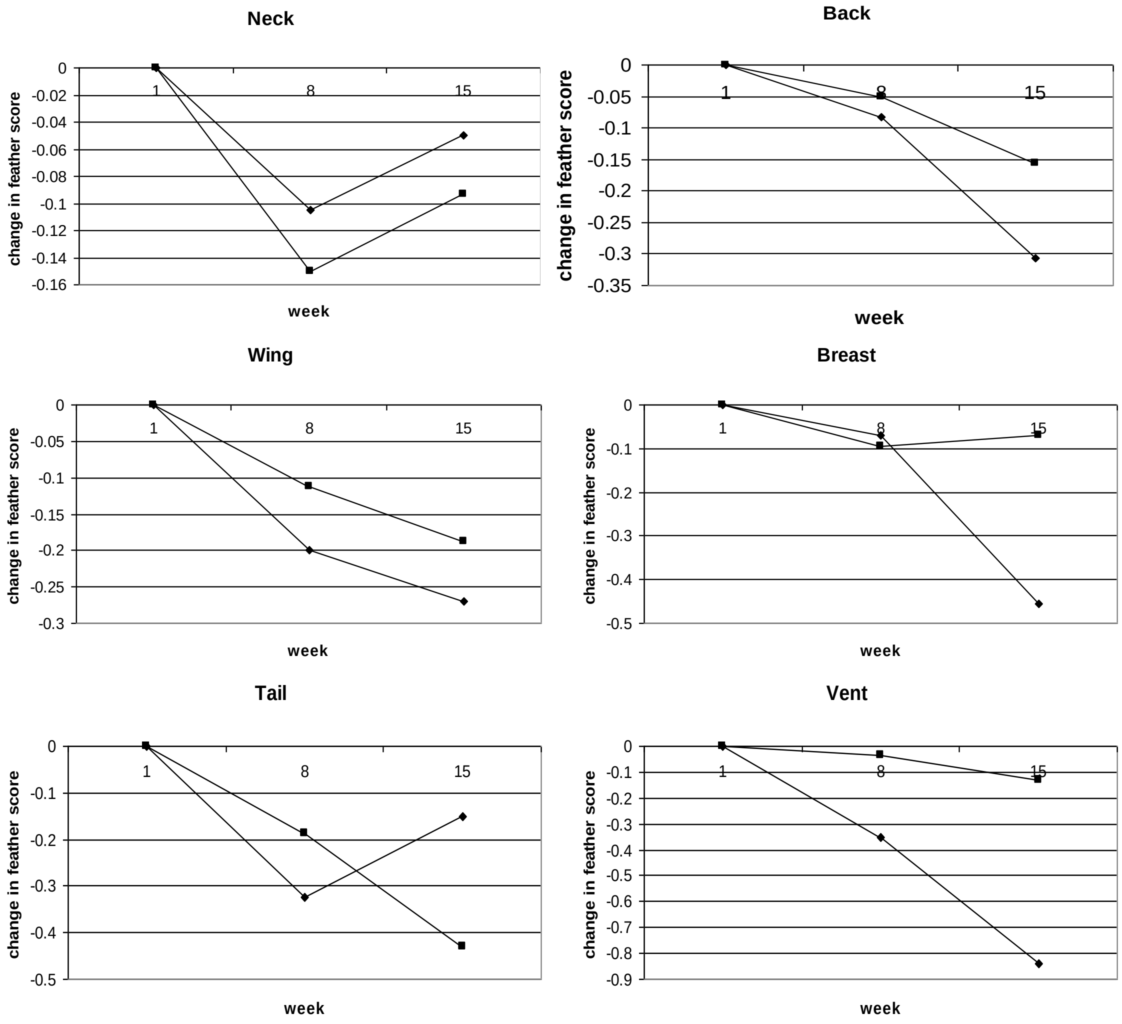
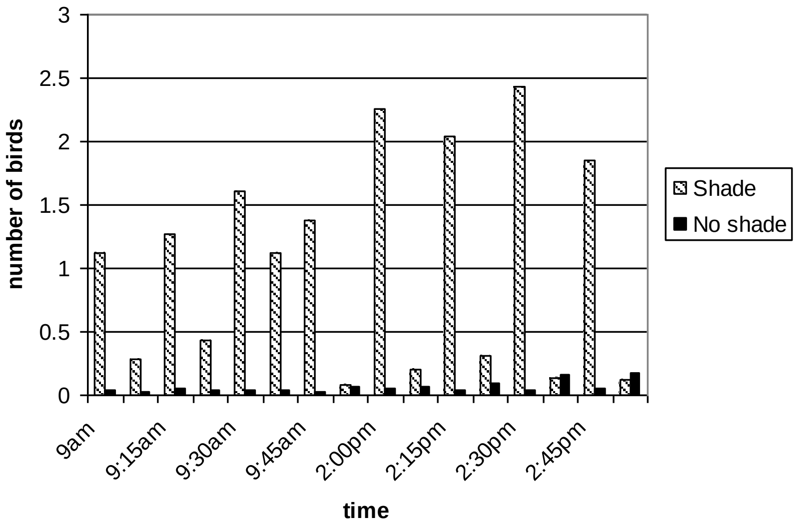


Figure 42: Average number of birds in shelterbelt shade and non shade areas over a day.



The temperature inside the sheds and out on the range stayed relatively stable over the 15 weeks, with more birds using the shelterbelt areas in the last weeks of the trial than at the start (figures 43 and 44).

Figure 43: Effect of temperature inside the shed on use of the shelterbelt shaded areas and non shaded areas in the range (nb. No data for shade weeks 9, 10 and 11).

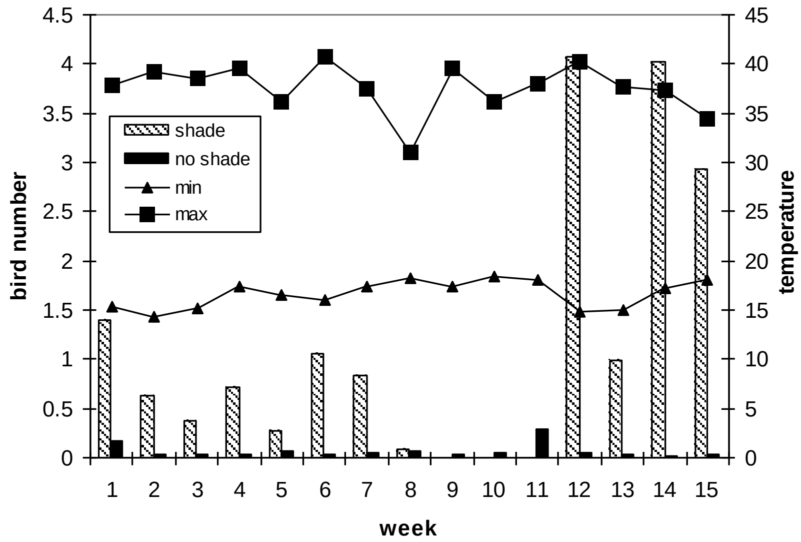
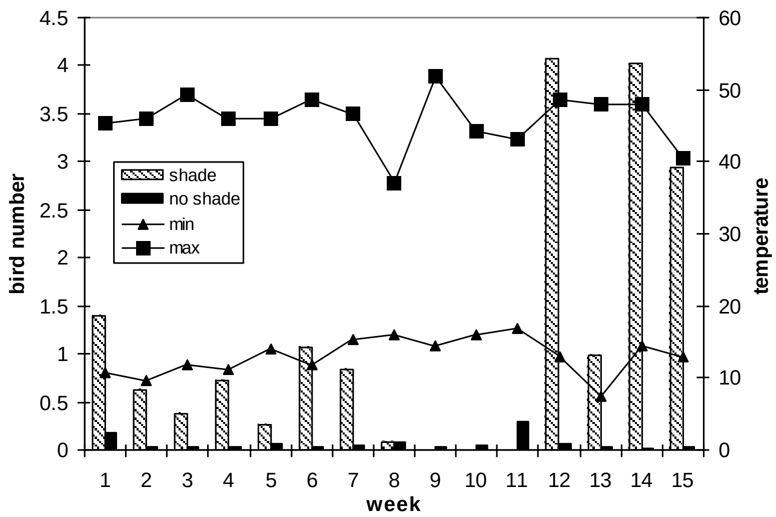


Figure 44: Effect of temperature on the range on use of the shelterbelt shaded areas and non shaded areas in the range (nb. No data for shade weeks 9, 10 and 11).



Forage Trial

A total of 4800 hens (age range 22–48 weeks) were housed in 2 sheds and had access to forage in the range area, with 4900 hens (age range 38–82 weeks) housed in 2 sheds without access to forage but with access to a hay bale in the range. The forage areas were approximately 35m^2, and were 12m and 30m out from the shed (figures 45 and 46). Areas of the same size were pegged out in the range of the sheds without shade with two of the four areas having access to a hay bale (figures 46, 47 and 48). Camera setup, feather score, bird weight and temperature recording were all the same as described previously for shadecloth trial, except for the time period being 14 weeks instead of 12 and feather scores and bird weight recorded at 5 and 14 weeks only. The trial was run through winter.

Figure 45: Forage area 30m out from shed (left image – start of trial, right image – during trial, 2400 birds – forage size 35m²).

Figure 46: Forage area 12m out from shed housing 2400 birds.

Figure 47: 35m² area pegged out 30m out from the shed housing 2000 birds.

Figure 48: Setting up area of no shade in range 30m out from shed housing 2900 hens.

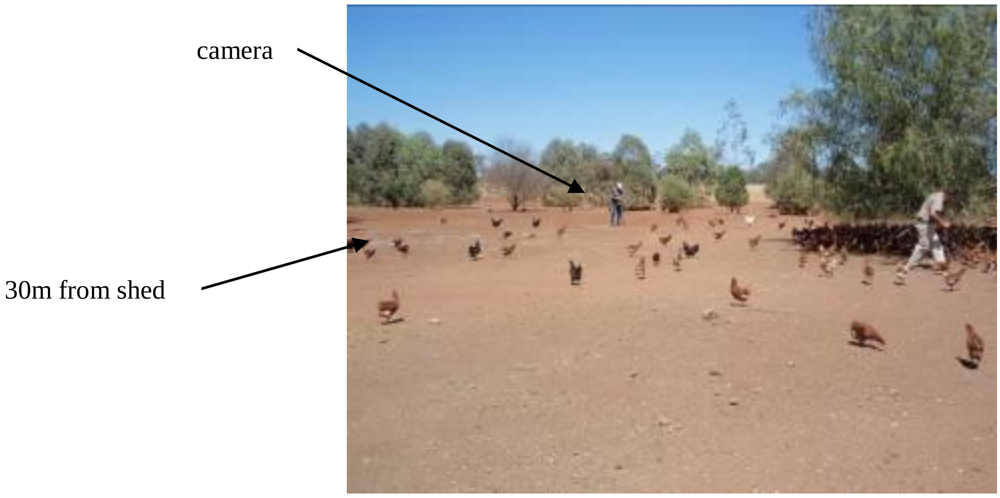


Figure 49: Hay bale in non forage area.

Results

Bird weight (figure 50), overall feather score (figure 51), and individual bird part feather score (except for vent feather score) all trended downwards over the 14 weeks (figure 51). The birds with access to forage had an overall lower average feather score of 1 compared to birds without access to forage at 14 weeks.

Figure 50: Effect of forage on change in bird weight over 14 weeks.

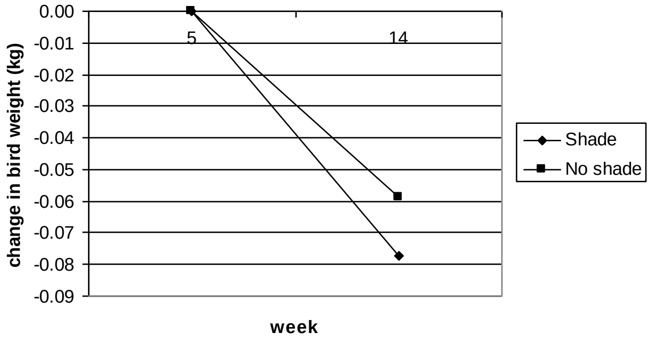


Figure 51: Effect of forage on change in average total feather score over 14 weeks.

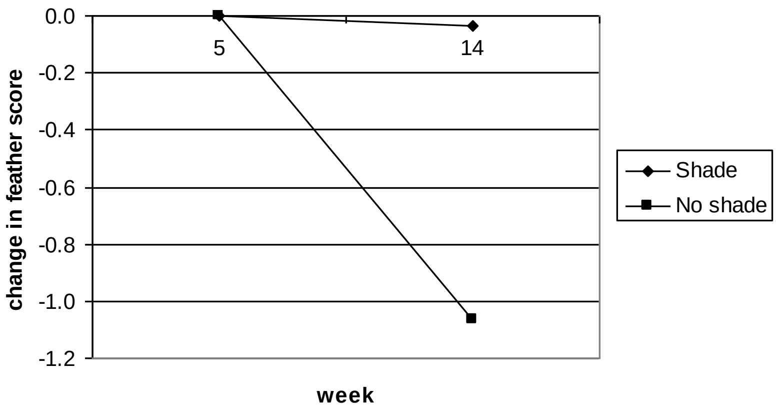
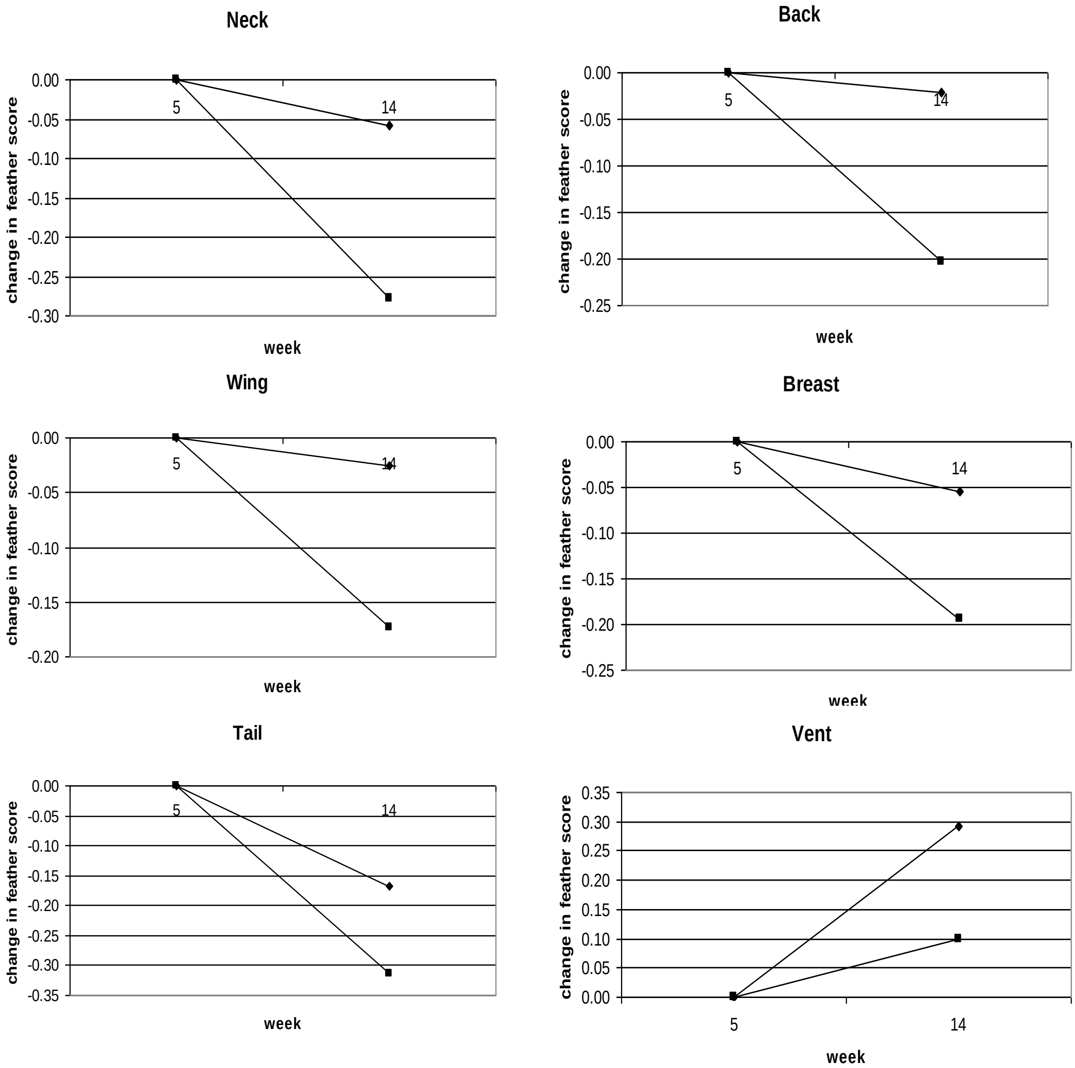


Figure 52: Effect of forage on change in feather score on neck, back, wing, breast, tail and breast over 15 weeks (♦shade, ■ no shade).



Approximately 17 times more birds used the forage areas compared to the same area of no shade in the corresponding range, with 8 times more birds using the hay bale enriched area compared to the area of no shade (figure 55). The birds tended to use the areas throughout the day with little difference between morning and afternoon. Over the 14 weeks of the trial the number of birds using the forage and hay bale areas decreased, possibly in line with the decrease in the availability of forage and hay (figure 54).

Figure 53: Average number of birds in forage, hay bale enriched and non shade areas over a day.

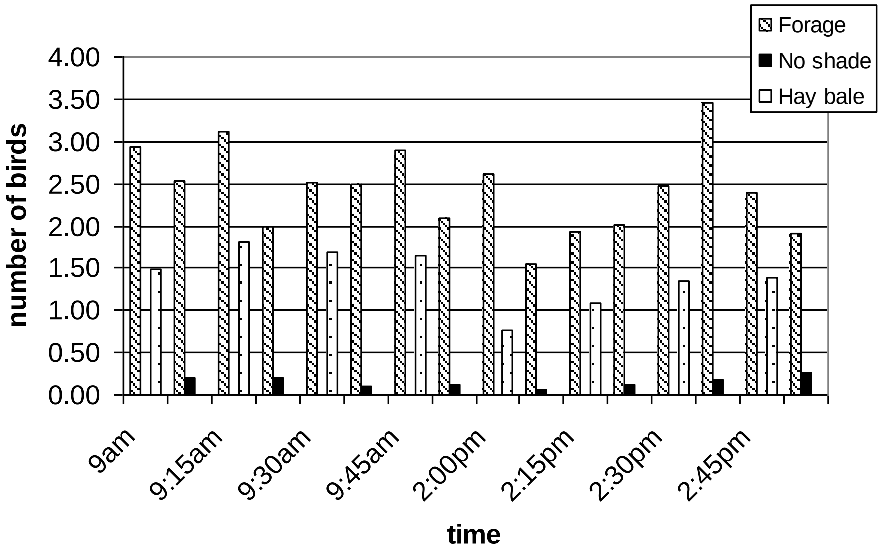
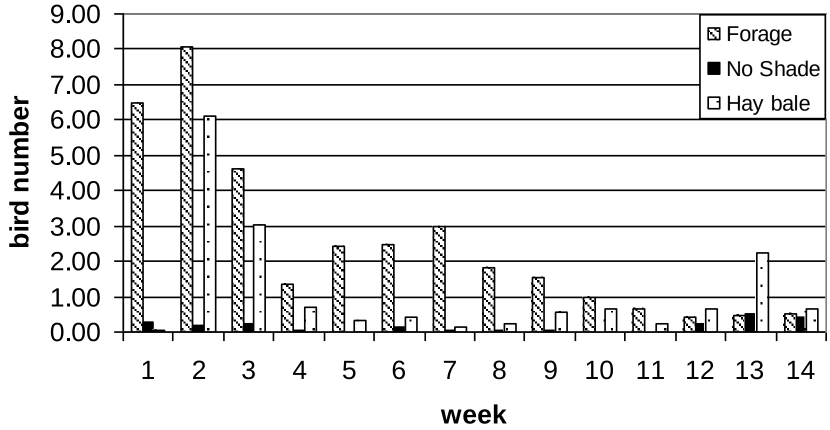


Figure 54: Weekly average number birds in forage, hay bale enriched and non shade areas over 14 weeks.



The temperature inside the shed and on the range did not vary considerably over the trial with the decrease in number of birds in the forage and hay bale enriched areas more likely affected by the decrease in the forage and hay (figures 55 and 56).

Figure 55: Effect of temperature inside the shed on use of forage, hay bale enriched and non shade areas in the range.

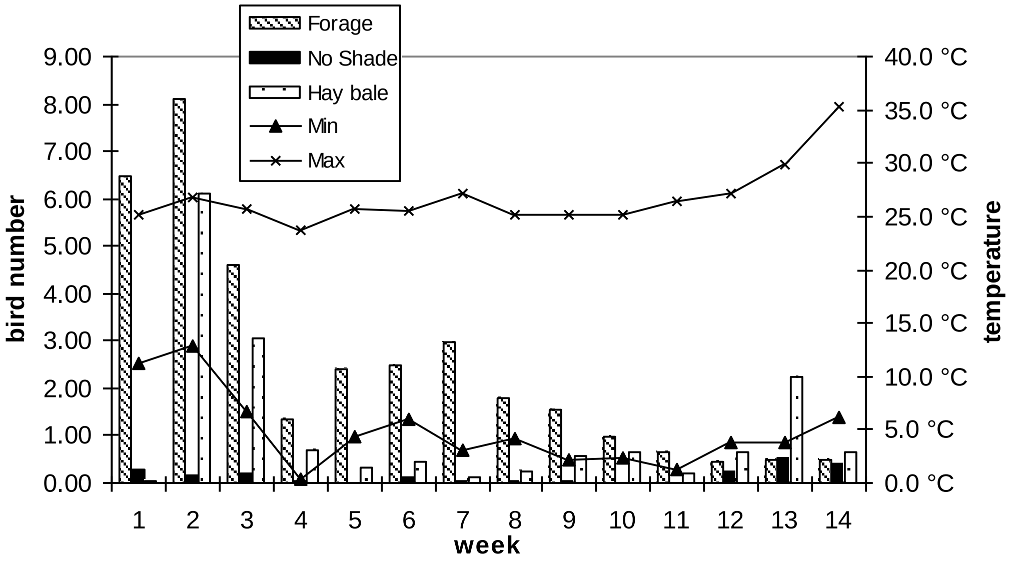
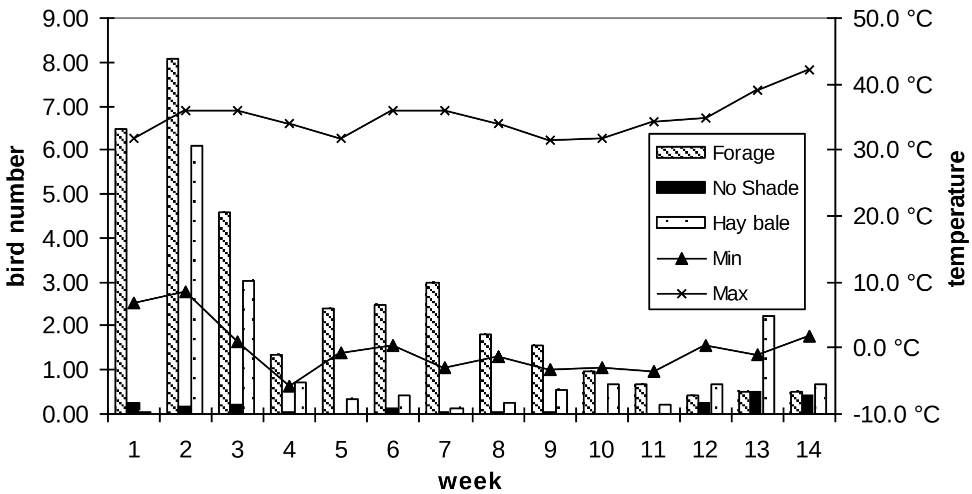


Figure 56: Effect of temperature on the range on use of forage, hay bale enriched and non shade areas in the range.



General Discussion – QPIF trials

The enrichment of the range areas with shadecloth shades, shelterbelts and forage attracted more birds to use these areas. The addition of hay bales to the range also proved to be a successful attractant for birds. Feather scores all showed a downward trend over the three trials regardless of the provision of shade with the back and tail areas most affected. The exception was the forage trial with birds having access to the forage having a feather score 1 point higher at the end of the 14 weeks. This result however has to tempered by the fact that there were different breeds of hens used in the sheds in this trial (Hyline Brown, Bond Black and Bond White) which could have influenced the results. Bird weight was not affected by enrichment of the range areas.

Forage and hay bales attracted the most number of birds into the range however as their availability decreased the number of birds using the range dropped to a level in line with the areas with no forage or hay. This suggests in order to keep more birds on the range forage would have to be managed in a way to keep it available year round. If this is not possible (and with the climate in Australia it is more than likely not) hay bales can be added to the range as the forage decreases or until new forage has been grown with the same affect.

Shelterbelts and shadecloth shelters also attracted birds to the range. Through the summer months (temperatures on the range were commonly over 40˚C) when few birds ventured onto the range in the non shade areas, the shelterbelts encouraged a large number of birds out of their sheds into the range.

This work undertaken on commercial free range egg farms supports the results from the SARDI trials with the recommendation that producers provide shade/enrichment in the range to attract more birds out of sheds and increase the use of these areas.

Work undertaken at UNE

Screening for Repellents

The aim of this trial was to screen a number of potentially repellent substances and identify two substances to be used for more extensive testing for their effectiveness in reducing cannibalism

Experimental methodology: This experiment was based on a choice feeding (2 trough choices) protocol using mature laying hens not previously exposed to any of the "repellent" substances used. A new group of 8 Hyline Brown birds was used for each substance test.

The objective was to create a clear link between food and consequences and this was done by using coloured food cues (normal, red and green- colours were tested and shown to create no bias and designated to a repellent treatment). To ensure no left or right bias the colours were used in random positions daily. The choice test ran each morning for 3 hours and in the afternoons all feed was normal

Repellent substances tested

The group of 10 substances tested in listed below in Tables 14 & 15 which also summarises dose levels and characteristics. Essentially they were chosen based on likely bird repellent effects based on smell or nausea post- ingestion.

Testing**:**
Stage 1: Initial screening: All 10 substances choice compared to control; 8 birds per combination. Daily intakes from both troughs recorded and the time taken for the birds to begin to reject the repellent feed was recorded. This continued for 1 week and was followed by a 3 day test to determine if birds would eat a repellent food if no other choice was available

Stage 2: Examine in greater detail the 4 most effective (2 olfactory, 2 post-ingestive). These feeds were coloured and the methodology used was as previously described. The birds were then tested to determine if the repellent action was extinguished if not reinforced by making coloured feed (previously containing the repellent) as the only choice.

Table 14. Repellent agents – irritant smell

Agent	Effects	Dose /comment
Cabbage extract /"sulphur" volatiles	Irritant/smell	Spray – without saturation (very volatile and requires renewal or carrier!
BHPM - D-Ter® Animal and Bird Repellent Aluminium (ammonium	Irritant/smell	0.05% in food- non toxic

sulphate +)		
Methyl anthrailate (MA) – grape flavor	Irritant /smell	1000ppm in food –non toxic
2 Ethyl- athraquinone - "Flight Control"	Known to cause nausea for about 20 minute	Registered as a goose repellent (USA) – low toxicity
Multicrop- Scat Aluminium ammonium sulphate	Irritant/smell	0.05% in food –non toxic

Table 15. Repellent agents – nausea

Agent	Effects	Dose/comments
Lithium Chloride	Known to cause nausea in birds	Max 40mg/kg in food - toxic ~ 400mg /kg
Monsensin sodium	Known to reduce food intake – possibly nausea	50ppm in food - toxic ~ 600ppm
Thiram (tetramethylthiuram disulphide) used as seed treatment fungicide	known to reduce food intake – irritant on mucus membrane	100mg/kg -Toxic ~ 800mg/kg
Azadirachtin - Neem extract - biopesticide	bitter compound known to reduce seed intake of birds	1000mg/kg – low toxicity
Strawberry food flavor (high conc)	Reduced intake – possibly nausea	>1000ppm- non toxic

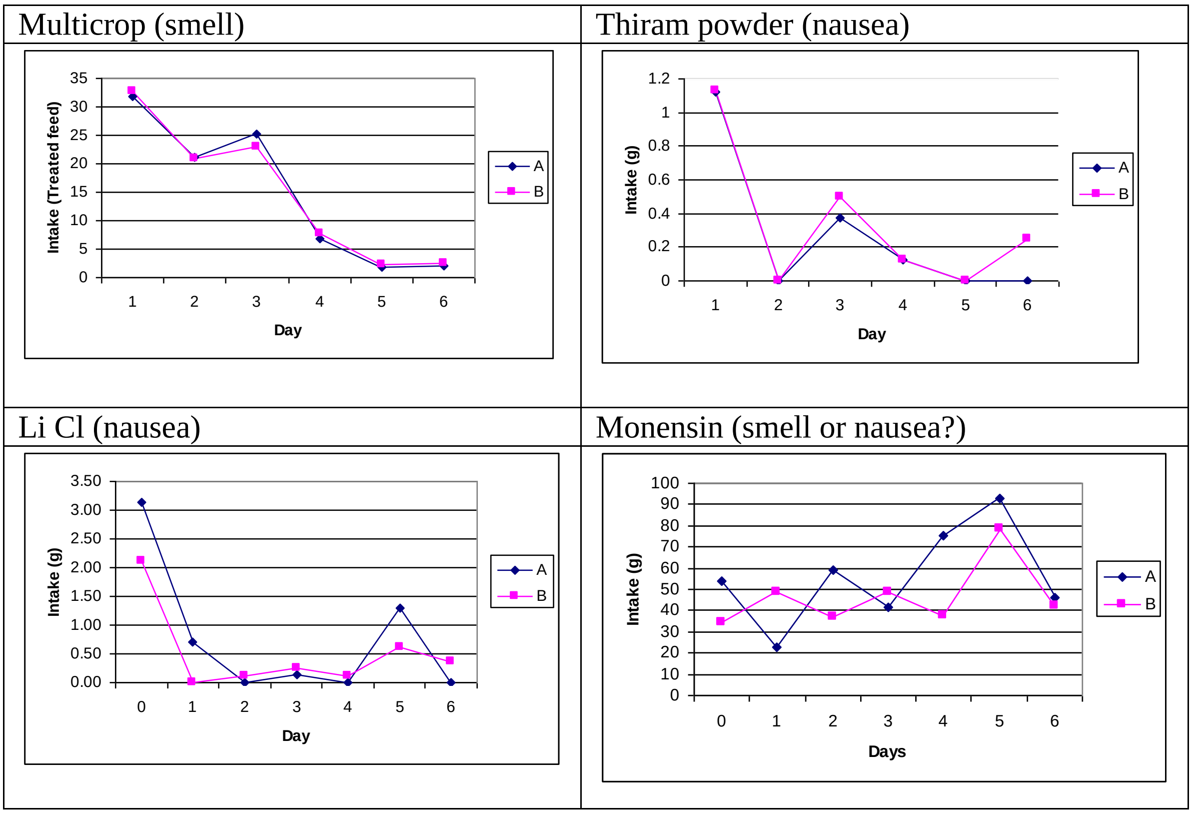
Results

Initial Screening provided profiles of feed intake over time and figure 57 illustrates the intakes of the "repellent feed" for either trough position for the 4 substances shown to be have potential in initial screening. Thiram powder and lithium chloride effects were rapid and lasting and Table 16 shows the proportion of the feed consumed that was the repellent food for each of the screened substances.

Table 16. Proportion of diet consumed that was the "repellent" food

	Agent	Rep 1	Rep 2	Mean
Smell	Sulphur	0.32	0.322	0.32
	D-Ter	0.46	0.475	0.47
	MethylA	0.133	0.129	0.13
	SCAT	0.069	0.119	0.09
	FlightC?	0.105	0.09	0.10
Nausea	LiCl	0.064	0.047	0.06
	Mon	0.4	0.42	0.41
	Strawb	0.33	0.25	0.29
	Thiram	0.0006	0.003	0.00
	AZ	0.12	0.13	0.13

Figure 57: Examples of intake pattern for four "repellent" substances



Conclusions

It appears from these results that nausea producing substances are more effective in reducing intake and that both LiCl and Thiram had lasting effects. Multicrop appeared to have potential as a repellent but the aversion took considerable time to develop.

Training using Thiram & LiCl Repellents

The aim was to create a link between the aversive substance and the intake of blood, or a combination of both feathers and blood. To achieve this, 600 chicks (Hyline Brown) were used and subdivided into smaller groups according to the following treatments. Chicks were exposed to treatments for 3 hours in the mornings for 5 days (figure 58).

- Two substances: LiCl or Thiram
- Two medium for addition of repellent: Blood or Blood + Feathers
- Timing of treatment: 2 weeks or 14 weeks or 2+14 weeks (ideally first exposure should have been in week 1 but logistic problems delayed establishment).

The blood and feathers from slaughter chickens were collected from a local abattoir and stored in a cool room (feathers) after cutting into short lengths of around 2cm. The blood was frozen into suitable portions and thawed the day before use.

For animal welfare reasons the concentrations of Thiram and LiCl were based on the assumption that repellent levels (Table 15) would be reached at normal daily intakes. In reality as the medium was not the major component of the feed, intake levels of the repellent would have been well below these "repellent concentrations".

Figure 58 confirms activities around the “feeders” for blood and feathers and illustrates the decline after initial activity on day 2 – typical of aversion response. No further exposures were carried out after the 14 week training when attendance at feeders was slower to decline.

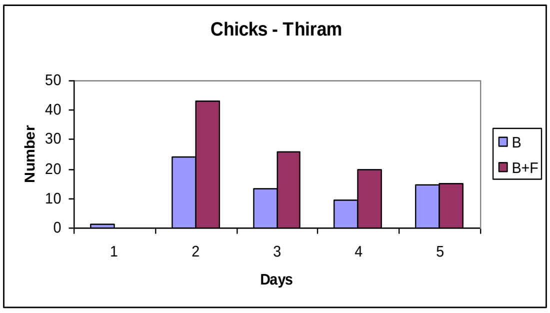
Figure 58: Exposure method for young chicks

Blood plus feathers

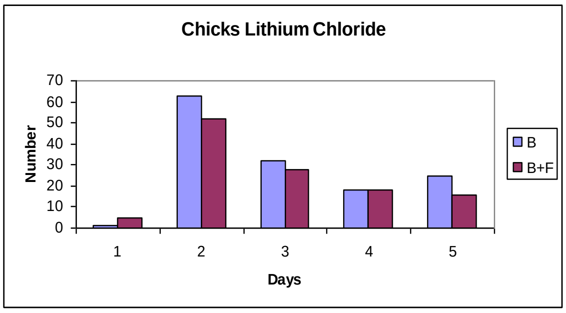
Blood only

Figure 59: Birds at feeders – 10 minute interval counts

Thiram - 2 weeks old - 56 birds



LiCl - 2 weeks old -56 birds



Cannibalism Trial

This trial involved the measurement of egg production, cannibalism and feather scores to evaluate differences in birds from different treatment groups described in the training section. Birds were placed in 4-bird cages at 15 weeks of age with two replicate groups for each treatment combination, each replicate consisting of around 14 cages located within a 3000 bird cage shed. The trial was terminated at 31 weeks of age.

Birds were fed ad-libitum on a commercial layer pellet ration. Birds that were identified as having skin lesions associated with pecking were removed on the basis of welfare and allocated to a “mortality” classification for evaluation of treatments. Feather scores were recorded at the commencement of the trial (week 19) and again at week 25.

Eggs

Hen housed egg production between weeks 17-31 averaged 64.5% for the control birds, reaching 80% production level by week 27 and overall was not significantly different between treatment groups. Hen day egg production was on average higher but again was not significantly different between treatments although the Thiram group tended ($P<0.10$) to be greater than the control group.

The medium for training (blood or blood & feathers) had no significant effects on average egg production (Table 18); while stage of treatment did ($P<0.001$, Table 19) with a significantly lower egg production from the late (L) treatment group. There were no significant interactions between main effects

Table 17. Average treatment effects on egg production (SE)

	Control	LiCl	Thiram
HHEP	64.5 (2.7)	65.7 (3.1)	68.5 (3.1)
HDEP	74.6 (2.9)	73.4 (3.2)	72.7 (2.4)

Table 18. Average effect of medium for training (SE)

	Blood	Blood + feathers	Control
HHEP	69.3 (3.8)	64.7 (3.2)	64.5 (2.9)
HDEP	73.6 (3.7)	72.3 (3.1)	74.6 (3.1)

Table 19. Average egg production for stage of training groups (SE)

	Early	Early & Late	Late
HHEP	70.0 (3.1)	67.9 (3.0)	60.3 (2.8)
HDEP	75.7 (2.3)	75.6 (3.0)	70.7 (3.3)

Mortality

Hen mortality increased slowly from week 17 (Table 20) reaching an average loss (including birds removed because of pecking damage) of 29% by week 31.

Table 20. Hen survival (%) over weeks 19-31 of lay

Week	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
Survival %	99	97	95	92	90	87	85	83	80	78	75	73	71

Analysis showed that the repellent treatments were not significantly different for hen losses (13% LiCl,14% Thiram) with both treatments have significantly less birds lost than the control group (20%, $P<0.01$). The medium of training differed significantly ($P<0.001$) with the blood & feathers treatment having lower losses (12%) than blood alone (16%). Stage of training also differed significantly (P<0.001) with the early (E) treated birds having lower mortality (9%) than early plus late (11%) and late (17%). There were significant two-way interactions (P<0.001, Table 5) showing that blood & feathers was the most effective medium particularly for LiCl and for early treated birds. The three way interaction (P<0.01) showed that that early treated-LiCl-B+F birds had the lowest losses of any treatment combination at 1%.

Table 21. Mortalities (%) to 31 weeks of various treatment groups and interactions

Repell/Medium	**Blood**	**B+F**		**E**	**E+L**	**L**
LiCl	17	10		8	8	19
Thiram	14	14		11	14	16
B				10	17	18
B+F				9	6	17
Medium	**LiCl-E**	**Thiram-E**	**LiCl-E&L**	**Thiram-E&L**	**LiCl – L**	**Thiram – L**
B	15	5	12	21	20	15
B+F	1	16	4	7	17	17

Feather Scores

There were no significant differences in treatment groups in mean feather scores at 19 weeks but differences at 26 weeks were apparent with both treatment groups having significantly better scores (P<0.05) than control birds (Controls- 1.80 vs. LiCl- 1.57 Thiram -1.55)

The medium of training had a significant effect in the treated groups with B&F having slightly poorer feathering than blood only (1.48 vs. 1.64, P<0.01) while the stage of training was also significantly different (P<0.01) with the early birds having better feather scores than E&L or Late (1.278 vs. 1.615 vs. 1.749). Interactions between treatments were not significant except Medium* Stage (P<0.01) where the early-blood-only treatment had significantly better scores than B&F.

General Discussion-UNE trials

These data suggest that early exposure of birds to a repellent substance that is linked to blood and/or feather consumption can have positive effects in reducing the mortality observed in caged layer hens. The treatments seem to be most effective when applied at an early age (2 compared to 14 weeks) and reinforcement at 14 weeks had no additional effect although, there were differences in patterns of mortalities for different treatment combinations for the two repellents which could justify further evaluation of the ages at which the optimal effects of a repellent are obtained. Presentation of the repellent in the blood + feathers medium appeared to have the greatest positive effect in reducing mortalities. The feathers only medium was not tested in this trial because of logistical complications of facilitating adequate intake of the repellents by very young chicks.

The differences observed for the feather scores were largely consistent with mortality figures suggesting that the treatment effects were possibly mediated through a reduction in feather pecking that may lead to cannibalistic behaviours. This implies that the development of an aversion to feathers could be an important contributor to the success of the aversion treatments. However, the majority of birds were still in good feather condition at the end of the trial and what would happen late in lay as feathering deteriorates needs to be evaluated as this may be associated with a breakdown in aversion.

Lack of a difference in the egg production of control and treated birds during the first 13 weeks of lay, suggest that the treatments had minimal differential effects on egg production although a closer examination of the impact in the late (L) treatments may be necessary as there appeared to be a delay in the commencement of lay for this group. However, differential effects were not seen in the most effective early-treatment (E) which suggests that feed intake in adult life has not been reduced and that the treatments can be applied with no negative effects on production.

Conclusion

Both the repellents used in this trial were effective in reducing cannibalistic behaviour relative to control birds. It would seem that LiCl was associated with the most successful treatment combination but differences between it and Thiram were small. The actions of the two repellents are most likely via aversion, Thiram possibly associated with olfaction and taste rather than the post-ingestive nausea linked to LiCl. There may well be more effective repellents yet to be identified. There is still much to be done in optimising dose levels and the timing of treatments, but these results do suggest that this approach could be a very useful addition to the array of methods already used to reduce cannibalism in layer hens.

Implications

Environmental enrichment of range areas using shade, forage and shelter attracted more birds into the range. However aggressive feather pecking was only observed on a few occasions in all of the trials conducted at SARDI. It is likely the small flock size contributed to the flock being docile. However in larger operations there is no guarantee that there would not be an outbreak of feather pecking and cannibalism even when the environment is enriched.

In the large scale trials conducted on commercial free range farms by QPIF it was observed that regardless of the type of shade/enrichment used in the range areas, more hens were attracted out of the sheds to use the range when compared to areas with no enrichment. Having the shade/enrichment in steps out from the shed (eg. 10m, 20m, 30m etc) could attract even more birds out of the shed into the range area. In particular, birds are willing to travel greater distances to forage on fresh pasture.

Repellents working through aversion linked with blood and or feathers can be used to reduce the incidence of cannibalism in caged birds. There is still much to be done in optimising dose levels and the timing of treatments, but these results do suggest that this approach could be a very useful addition to the array of methods already used to reduce cannibalism in layer hens.

Recommendations

From SARDI trials

- Australian free range egg farmers are encouraged to provide pasture, shaded areas and shelter belts to attract birds into the free range. Landscape designers should be utilised to develop the design of free range areas to cater for the behavioural needs of birds in the range.

- Caution needs to be exercised by commercial egg producers when using low light rearing as an alternative to beak trimming.

From QPIF trials

- Work on commercial free range egg farms has endorsed the SARDI results and the recommendation that farmers should be encouraged to provide pasture, shaded areas and shelter belts to attract birds into the free range.

- If unable to provide pasture, shelter belts or shade cloth shelters, the provision of hay bales in the range areas proved to be an excellent alternative to attract birds from their sheds.

From UNE Trials

- Initial exposure of chicks to repellents associated with blood and feathers is associated with a reduced incidence of cannibalism and may provide another option to a multiple strategy approach to reductions in cannibalism.

Further Research Required

- Determine the preference of birds for foraging areas (pasture, insects, worms, bales of hay, scratch grain); overhead shelters (shade, shelter belts, and enclosed passageways for exit to range); dust and sun bathing areas and how these influence social and pecking interactions between birds.

- Determine if breed of bird has an affect on use of range area and shade/enrichment influence on bird condition and production.

- Extend the identification of repellent possibilities and further examine age of birds at exposure, dose level combinations and media for presentation of repellent to maximise the effectiveness of the treatment throughout a lifetime; and also test whether repellents are effective in all systems of egg production.

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References

Ambrosen, T. and Petersen, V.E. (1997). The influence of protein level in the diet on cannibalism and quality of plumage of layers. Poultry Science 76: 559-563.

Appleby, M.C., Hughes, B.O., and Hogarth, G.S. (1989). Behaviour of laying hens in a deep litter house. British Poultry Science 30: 545-553.

Beecham, J.A. and Farnsworth, K.D. (1999). Animal Group Forces Resulting from Predator Avoidance and Competition Minimization. J. Theor. Biol. 198: 533-548.

Bestman, M.W. P. and Wagenaar, J.P. (2006). Feather pecking in organic rearing hens. Joint Organic Congress, Odense, 30-31 May 2006.

Bestman, M.W.P. and Wagenaar, J.P. (2003). Farm level factors associated with feather pecking in organic laying hens. Livestock Production Science 80: 133-140.

Blokhuis, H.J. and van der Haar, J.W. (1989). Effects of floor type during rearing and of beak trimming on ground pecking and feather pecking in laying hens. Applied Animal Behaviour Science, 22: 359-369.

Blokhuis, H.J. and Wiepkema, P.R. (1998). Studies of feather pecking in poultry. The Veterinary Record 20: 6-9.

Cain, J.R., Weber, J.M., Lockamy, T.A. and Creger, C.R. (1984). Grower diets and bird density effects on growth and cannibalism in ring-necked pheasants. Poultry Science 63: 450-457.

Choct, M. and Hartini, S. (2005). Interaction between nutrition and cannibalism in laying hens. In Poultry Welfare Issues, Beak Trimming (Ed. P.C. Glatz), Nottingham University Press, pp.111-115.

Cooke, B.C. (1992). Cannibalism in laying hens. The Veterinary Record, Nov. 21: 495.

Curtis, P.E. and Marsh, N.W.A. (1992). Cannibalism in laying hens. The Veterinary Record, Oct. 31: 424.

Dimmick, C.R. and Nicolaus, L.K. (1990). Efficiency of conditioned aversion in reducing depredation by crows. Journal of Applied Ecology 27: 200-209.

Elliot, M. (1996). Factors influencing feathering. Poultry International, Nov. 80-81.

Elgar, M.A. (1989). Predator vigilance and group size in mammals and birds: A critical review of empirical evidence. Biol. Rev. 64: 13-33.

Elwinger, K., Tufvesson, M., Lagerkvist, G. and Tauson, R. (2008). Feeding layers of different genotypes in organic feed environments. British Poultry Science 49: 654-665.

Esmail, H.M. (1997). Fiber nutrition. Poultry International, July: 31-34.

Fiks-van Niekerk, T.G.C.M. and Elson, A. (2005). Abrasive devices to blunt the beak. In Poultry Welfare Issues, Beak Trimming (Ed. P.C. Glatz), Nottingham University Press, pp.127-131.

Fujrmetz, A., Keppler, C., Knierim, U., Deerberg, F. and Hess, J. (2005). Laying hens in a mobile housing system- Use and condition of the free-range area. In: Hess, J., Rahmann, G. (Eds) Ende der Nische, Beitrage zur 8. Wissenschaftstagung Okologischer Landbau, Kassel, pp.3l3.

Glatz, P.C. and Bourke, M. (2006). Beak Trimming Handbook for Egg Producers. Best Practice for Minimising Cannibalism in Poultry. Landlinks Press, Melbourne, ISBN:0643092560; pp.88.

Gleaves, J.W. (1999). Cannibalism. Cause and prevention in poultry. WWW article published by Cooperative Extension Institute of Agriculture and Natural Resources. University of Nebraska. Lincoln.

Hauser, S., Zeltner, F. and Hirth H. (2003). Rearing of Laying Hens in Free Range Systems: Can the Use of the Hen Run be Improved by Scattering Grains Outside? In: Aktuelle Arbeiten zur artgemässen Tierhaltung 2002, KTBL-Schrift 418: 37-44.

Hegelund, L., Kjaer, S., Kristensen, I.S. and Sorensen, S.T. (2002). Use of the outdoor area by hens in commercial organic egg production systems. Effect of climate factors and cover In: 11th European Poultry Conference-Abstracts. Archiv für Geflugelkunde 66: 141-142.

Hirt, H., Hordegen, P. and Zeltner, E. (2000). Laying hen husbandry: group size and use of hen-runs. In: Alfoldi, T. Lockeretz, W. and Niggli, U. (Eds) Proceedings 13th International IFOAM Scientific Conference, Basel, 363.

Hoefs, M., Hoefs, H. and Burles, D. (1986). Observations on Dall Sheep, *Ovis dalli dalli* – Grey Wolf, *Canis lupus pambasileus*, Interactions in the Kluane Lake Area, Yukon. The Canadian Field-Naturalist 100: 78-84.

Jones, R.B. (2005). Environmental Enrichment can reduce feather pecking. In Poultry Welfare Issues, Beak Trimming (ed. PC Glatz), Nottingham University Press, pp. 97-100.

Jones, R.B. and Roper, T.J. (1997). Olfaction in the domestic fowl: a critical review. Physiology and Behaviour 62, 1009-1018
Jones, R.B. and Ruschak, C. (2002). Domestic chick's responses to PECKABLOCKS and string enrichment devices. Proceedings of the British Society of Animal Science, pp. 215.
Klemm, R., Reiter, K. and Pingel, H. (1995). Investigations on feather pecking in Muscovy ducks (Abstract). Archiv fuer Gefluegelkunde 59 (1): 99-102.
Knierim, U., Staack, M., Gruber, B., Keppler, C., Zaludik, K. and Niebuhr, K. (2008). Risk factors for feather pecking in organic laying hens-starting points for prevention in the housing environment. 16th IFOAM Organic World Congress, Modena, Italy, June 16-20, 2008. Archived at http;//orgprints.org/view/projects/conference.html.
Miao, Z.H., Glatz, P.C., Ru, Y.J., Wyatt, S.K. and Rodda, B.J. (2006). Integration of hens into a crop and pasture rotation system in Australia-production and agronomic aspects. Australian Poultry Science Symposium 18: 94-99.
Nicol, C.J., Potzsch, C., Lewis, K. and Green, L.E. (2003). Matched concurrent case-control study of risk factors for feather pecking in hens on free-range commercial farms in the UK. British Poultry Science 44: 515-523.
Nicolaus, K., Cassal, J.F., Carlson, R.B. and Gustavson, C.R. (1983). Taste-aversion conditioning of crows to control predation on eggs. Science 220: 4593-4595
Nolte, D.L., Farley, J.P., Campbell, D.L., Epple, G.M. and Mason, J.R. (1993). Potential repellents to prevent mountain beaver damage. Crop Protection 12: 624-626.
Nolte, D.L., Mason, J.R., Epple, G.M., Aronov, E. and Campbell, D.L. (1994). Why are predator urines aversive to prey? J. Chem. Ecol. 20: 1505-1516.
Parkinson, G.B. (2005). Alternatives to beak trimming. Light Intensity. In: Poultry Welfare Issues, Beak Trimming (Ed. PC Glatz), Nottingham University Press, pp. 117-121.
Provenza, F.D. (1996). Acquired Aversions as the Basis for Varied Diets of Ruminants Foraging on Rangelands. Journal of Animal Science 74: 2010-2020.
Renz, K.G. and Walkden-Brown, S.W. (2007). Environmental enrichment strategies. Australian Poultry Science Symposium 19: 94-99.
Robinson, D. (1979). Effects of cage shape, colony size, floor area and cannibalism preventatives on laying performance. British Poultry Science 20: 345-356.
Scott, M.L., Holm, E.R. and Reynolds, R.E. (1954). Studies on pheasant nutrition. 2. Protein and fiber levels in diets for young pheasants. Poultry Science 33: 1237-1244.
Speed, M.P. (2000). Warning Signals, receiver psychology and predator memory. Animal Behaviour 60: 269-278.
Turro, I., R. H. Porter, et al. (1994). Olfactory cues mediate food selection by young chicks. Physiology and Behaviour 55: 761-767.
Weldon, P.J. Graham, D.P. and Mears, L.P. (1993). Carnivore fecal chemicals suppress feeding by alpine goats (*Caprus hircus*). J. Chem. Ecol. 19: 1785-1794.
Zeltner, F. and Hirt, H. (2008). Factors involved in the improvement of the use of hen runs. Applied Animal Behaviour Science 114: 395-408.
Zeltner, E. and Hirt, H. (2003). Effect of artificial structuring on the use of laying hen runs in a free-range system. British Poultry Science 44: 53 3-537.

Plain English Compendium Summary

Project Title:	Alternatives to Beak Trimming
Project No.:	07-17
Researchers:	Phil Glatz, Assoc Prof Geoff Hinch and Ms Tanya Nagle
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Objectives	Reduce the need for beak trimming and re-trimming by; • Developed products that deter the onset of cannibalism and feather pecking in cage and free range systems. • Developed the design of free-range system to minimise cannibalism.
Background	The welfare of beak trimmed birds and the potential negative long-term effects of the procedure are becoming increasingly recognised by consumers. UK law classes beak trimming as a mutilation. In the EU routine beak trimming is banned in organic and free-range poultry production systems. In conventional pullet and layer houses in the EU it is possible to minimise the light intensity within the house and reduce the risk of outbreaks of injurious feather pecking. In Australia there is an increasing trend toward poultry houses where light intensity can be controlled. It is likely that the need for beak trimming can be reduced in flocks where light control is possible throughout the life of the hen. However in older conventional layers sheds, barn and free-range systems the problem of feather pecking and cannibalism persists. Alternative methods for controlling cannibalism and feather pecking in poultry are being developed in the EU and could become mandatory. In the EU preliminary work has suggested that feather pecking in free-range flocks was greatest when a low percentage of the flock used the outside range, increasing the stocking density within the house and increasing feather pecking. At Roseworthy, studies with free-range birds has shown that some forms of forage available in paddocks can encourage greater use of the range and reduce bullying and cannibalism. Other options include the use of shelterbelts and shaded areas as attractants. A range of predator scents from faeces; urine, scent glands and saliva are being increasingly used to act as repellents against predators of ruminant species. There has been little investigation of the use of such repellents in poultry but the potential application in suppressing feather pecking appears large. There was a need to evaluate the effectiveness of enrichment methods and repellents under Australian conditions as well as to continue development of new methods to reduce the need for beak trimming in our Industry.
Research	*i) Work conducted at SARDI* Aggressive feather pecking was only observed on a few occasions in all of the trials. Enriching the free range environment attracted birds in the range. Shaded areas were more readily used by hens and encouraged more hens to use the free range. Forage availability resulted in a more consistent use of the range during the day. A higher percentage of birds

	were observed in the range when birds were provided a shelter belt. In addition the shelter belt attracted greater numbers of birds in areas further away from the poultry house. Low light rearing trial on a commercial farm Feather pecking commenced in the non trimmed birds about 30 days of age with 7 birds removed from the trial cages due to pecking damage around the base of the tail. The farm manager continued with the trial but feather pecking persisted and the trial was abandoned when the birds reached 16 weeks of age. QPIF Trials All enrichment treatments showed some degree of success with the forage and hay bale being the most successful followed closely by the shelterbelt and shadecloth. Feather scores were not significantly affected by the addition of shade to the range area except to a minor extent in the forage trial. This result however is tempered by the fact that there were different breeds of hens used in this trial (Hyline Brown, Bond Black and Bond White) which could have influenced the results. UNE Trials Potential repellents that might be effective in reducing feather pecking and cannibalism if linked to blood and feathers during rearing were identified. Two of these (Thiram and LiCl) were effective in reducing hen mortality during the first 13 weeks of lay particularly when used at 2 weeks of age and in association with a combination of blood and feather.
Outcomes	SARDI trials Aggressive feather pecking was only observed on a few occasions in all of the trials conducted at SARDI. It is likely the small flock size contributed to the flock being docile. However in larger operations there is no guarantee that there would not be an outbreak of feather pecking and cannibalism. QPIF Trials Regardless of the type of enrichment used in the range areas, more hens were attracted out of the sheds to use the range compared to areas with no enrichment. Having the enrichment in steps out from the shed (eg. 10m, 20m, 30m etc) could attract even more birds out of the shed into the range area. When fresh forage is available birds are willing to travel greater distances from the shed. UNE Trials Initial exposure of chicks to repellents associated with blood and feathers maybe associated with a reduced incidence of cannibalism and could provide another option in a multiple strategy approach to reducing the onset of cannibalism
Implications	From SARDI trials • Australian free range egg farmers are encouraged to provide pasture, shaded areas and shelter belts to attract birds into the

	free range. • Caution needs to be exercised by commercial egg producers when using low light rearing as an alternative to beak trimming. QPIF Trials • If farmers are unable to provide pasture, shelter belts or shade cloth shelters, the provision of hay bales in the range areas is an excellent alternative to attract birds into the range. From UNE trails • An initial evaluation of repellents suggest that training methodologies in early life may be a useful option in a multiple strategy approach to reducing the onset in cannibalism in layer birds
Publications	